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PHOTOMETRIC AND SPECTROSCOPIC STUDY OF THE W-TYPE, W UMa BINARY, TYC 2853-18-1

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TYC 2853-18-1 (GSC 2853 0018, $\alpha(2000){=}02^{\rm h}47^{\rm m}07^{\rm s}\!.996$, $\delta(2000){=}{+}41^\circ22'32''\!.80$) was recently discovered by TYCHO-2 as an eclipsing binary (Nicholson, Varley, 2006). The V magnitude range is $10.8 - 11.5$ and the variable was identified as an EW-Type with the following ephemeris:

$$\text{HJD Tmin I} = 2451370.87525 + 0.2949\text{d} \times \text{E}. \quad (1)$$

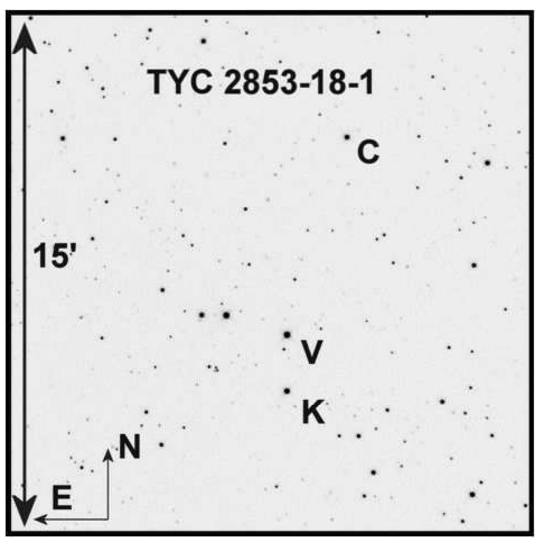

Figure 1. Finding Chart, TYC 2853-18-1 Variable (V), Comparison (C) and Check (K).

The LSPM North Catalog (Lépine and Shara, 2005) gives a Vmag of 11.05 and a $V - J$ of 1.61 for the variable, and TYCHO-2 gives an estimated $B - V$ of 0.799. These color indices all confirm that the variable is of spectral type ∼K0V. Finally, the spectra of TYC 2853-18-1 and 54 Piscium were observed with the Dominion Astrophysical Observatory's (DAO) 1.8m telescope at 60Å/mm and are shown in Figure 2. The midtime of observation was 09:00 22 November 08, 2008 UT, which corresponds to a phase of approximately zero. The strength of the G band, Calcium H&K lines and the Calcium I 4227Å line and the H γ to Fe I 4384Å line all indicate a K0V±1 spectral class or $T = 5150 \pm 150$ for the effective temperature at phase zero where the primary, more massive component is eclipsing the hotter less massive secondary.

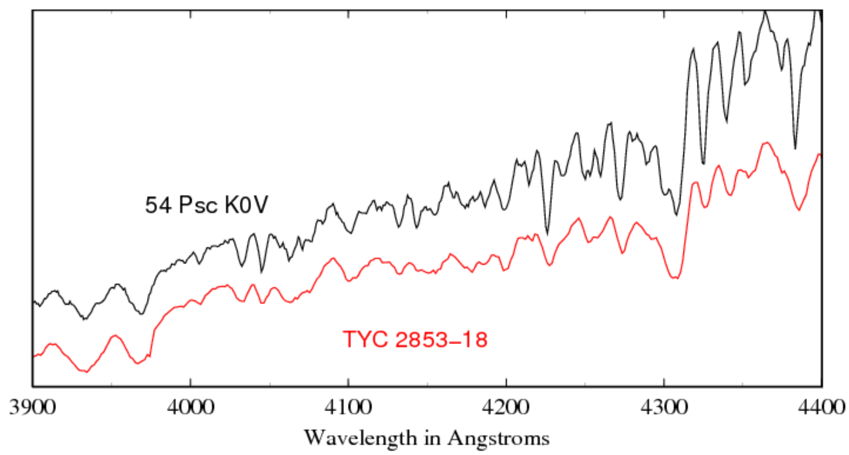

Figure 2. Optical Spectra of TYC 2853-18-1 at phase zero.

Our U, B, V, R_C, I_C light curves were taken at Lowell Observatory with the 0.81-m reflector with NURO time on 20 and 27 December, 2007 and via remote observing to Kitt Peak from South Carolina with the SARA 25 November, 3 December, 2007 and 19 February, 2008. NURO observations were take with the thermoelectrically cooled (< -100°C) 2K×2K CCD NASACAM. Ninety-five observations were taken in U, 217 observations were taken in B, 207 in V, 194 in R and 214 in I. Photometric precision was better than 1% in all filters. Our observations are given in Table 1, in delta magnitudes, variable minus comparison star. (The table is available through the IBVS website as `5901-t1.tex`.)

Our comparison star (marked C on the finder chart given as Figure 1) was GSC 2853 0765 [$\alpha(2000) = 02^h46^m58\overset{s}{.}481$, $\delta(2000) = +41°28'26\overset{''}{.}69$, TYCHO $B-V = 0.741$, ~G8V]. The check star was GSC 2853 0312 (K) [$\alpha(2000) = 02^h47^m08\overset{s}{.}413$, $\delta(2000) = +41°20'49\overset{''}{.}71$ TYCHO $B-V = 0.591$, ~G0V]. The variable is given as V.

We determined five times of minimum light from our present observations using parabola fits, which are given in Table 2.

We calculated the following ephemeris from all the available times of minimum light including the epoch given in Table 3.

$$\text{HJD Tmin I} = 2451370.875 \pm 0.001 + 0.2949039 \pm 0.0000001\text{d} \times \text{E} \qquad (2)$$

Our $O-C$ residuals calculated from Equation 2 are given in Table 2.

Table 2. $O-C$ Linear Residuals, Eq. 2

	Epochs	Errors	Cycles	Linear residuals	Reference
1	2451370.8753		0.0	0.0000	IBVS 5700 (2006)
2	2454455.7199	0.0006	10460.5	0.0028	This paper
3	2454516.6131	0.0005	10667.0	−0.0016	This paper
4	2454438.7605	0.0001	10403.0	0.0004	This paper
5	2454440.5298	0.0005	10409.0	0.0002	This paper
6	2454462.6464	0.0003	10484.0	−0.0009	This paper
7	2454462.7943	0.0002	10484.5	−0.0005	This paper

Our $UBVRI$ phased light curves, Phase versus Delta Magnitudes, in the sense of $V-K$, are given as Figures 6–8. (Available through the IBVS website as `5901-f6.eps -- 5901-f8.eps`.)

The $V-C$ curves in V showed scatter whose source is unknown, so we switched to the $V-K$ for modeling purposes. The light curves show some intrinsic effects of variability possibly due to magnetic spots. A brief total eclipse occurred in the primary eclipse

(~8.5 m) shows this is a W-Type W UMa. The angularity in the shoulder at ~phase 0.12 reveals that this is a very shallow fill-out contact binary.

Table 3. Synthetic Curve Parameters for TYC 2853-180-1

Parameters	*BVRI* Solution	*U* Solution
$\delta B, \delta V, \delta R, \delta I$ (nm)	440, 550, 640, 790	360
$x\mathrm{bol}_{1,2}, y\mathrm{bol}_{1,2}$	0.645, 0.645 0.17, 0.17	0.647, 0.647 0.176, 0.176
$x_{1I,2I}, y_{1I,2I}$	0.637, 0.637 0.208, 0.208	–
$x_{1R,2R}, y_{1R,2R}$	0.724, 0.724 0.200, 0.200	–
$x_{1V,2V}, y_{1V,2V}$	0.790, 0.790 0.159, 0.159	–
$x_{1B,2B}, y_{1B,2B}$	0.851, 0.851 0.044, 0.044	–
$x_{1B,2B}, y_{1B,2B}$	0.870, 0.870, −0.117, −0.117	–
$g_1 = g_2$	0.32	0.32
$A_1 = A_2$	0.50	0.50
Inclination (°)	81.63±0.09	85 ±2
T_1, T_2 (K)	5150±150*, 5023±5	5250±150*, 5219±14
Potentials, ω_1, ω_2	6.057±0.025	6.16±0.04
$q(m2/m1)$	2.62±0.02	2.69±0.03
fill-out	5.5±4%	6±6%
$L_1/(L_1+L_2)_I$	0.31±0.06	–
$L_1/(L_1+L_2)_R$	0.32±0.04	–
$L_1/(L_1+L_2)_V$	0.32±0.02	–
$L_1/(L_1+L_2)_B$	0.32±0.04	–
$L_1/(L_1+L_2)_U$	–	0.30±0.03
JD_0 (days)	2454440.5298±0.0005	
Period (days)	0.29489998±0.0000005	
r_1, r_2 (pole)	0.282±0.001, 0.440±0.001	0.280±0.004, 0.441±0.003
r_1, r_2 (side)	0.295±0.002, 0.471±0.001	0.292±0.004, 0.472±0.004
r_1, r_2 (back)	0.326±0.007, 0.499±0.005	0.326±0.007, 0.499±0.005
Sum of square res	3.7554	

*Estimated from the spectroscopy. The Wilson code period shows formal errors that are calculated from the variability of differentially corrected parameters as listed in the table. These have little to do with observational scatter. For example, while the Wilson code assigns an error to T2 of only 5K. However, the observational scatter would suggest about 150K from the spectral observations. All the other uncertainties, including the phasing period should be regarded the same way. Actual observational errors can be 10 times or more greater than those found from numerical calculations in such a synthetic code. I have exaggerated the errors by listing errors from the full set of corrections and not from the subsets in order to minimize this effect.

Binary Maker 3.0 (Bradstreet, 2002) was used to find initial fits for modeling. Representative values were then entered into the 2004 version of the Wilson Code (Wilson and Devinney, 1971 (WD); Wilson, 1990, 1994; Van Hamme and Wilson, 1998; Wilson, and Van Hamme 2003). We ran a full *UBVRI* simultaneous solution. However, the *U* solution did not fit the data well so a *BVRI* synthetic simultaneous solution was calculated. The T2 is an estimate from our spectroscopic observations. Following our first solution, we ran 23 additional solutions with q fixed and spanning the mass ratio range of 0.3 to 3.25. This "q-search" was used to determine the best q value for our *BVRI* light curves. See Figure 3. Our best synthetic light curve solution is seen overlaying the normalized flux curves are shown as Figure 4 and 5. The complete solution table is given as Table 3. A Roche-lobe model for the binary is shown as Figure 9 (Available through the IBVS website as `5901-f9.eps`.) We decided to run a *U* curve solution separately just to see how different it was. The *U* solution is found to be very similar (See Table 3.) to the *BVRI* with a 3 degree increase in inclination, while other values are overlapping or nearly overlapping the earlier ones. So we see no major differences to further comment on.

TYC 2853-18-1 is found to be among the W-type W UMa contact binaries. (Our solution reveals that the less massive, slightly hotter component is eclipsed at phase zero.) The mass ratio has reached 2.6 (m_1/m_2) and is likely tending toward larger mass ratios as the secondary component is consumed by the primary. Thus, TYC 2853-18-1 may be a prototype of an AW UMa-type system. The driving mechanism for this supposed process is the torque supplied by out flowing winds along 'stiff' field lines originating from the solar-type stars.

Acknowledgements: We wish to thank NURO and DAO for their allocation of observing time, and the American Astronomical Society for a small research grant for student travel expenses for this observing run.

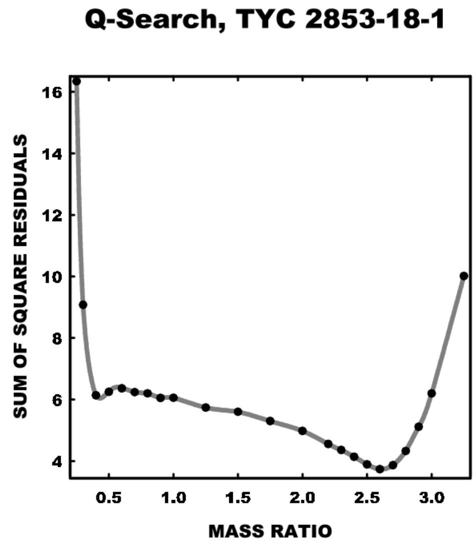

Figure 3. Plot of the results of our q-search for the best fiting mass ratio.

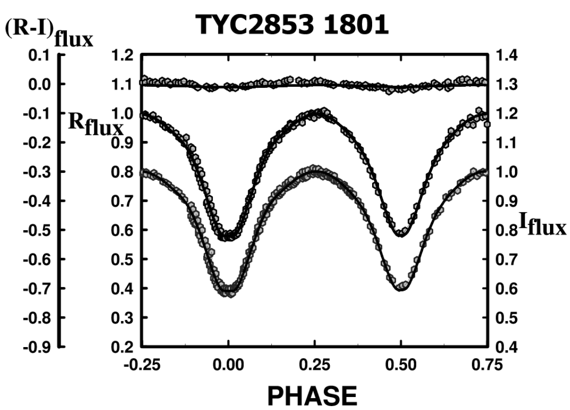

Figure 4. B,V,R,I synthetic light curve solutions overlaying the normalized flux curves.

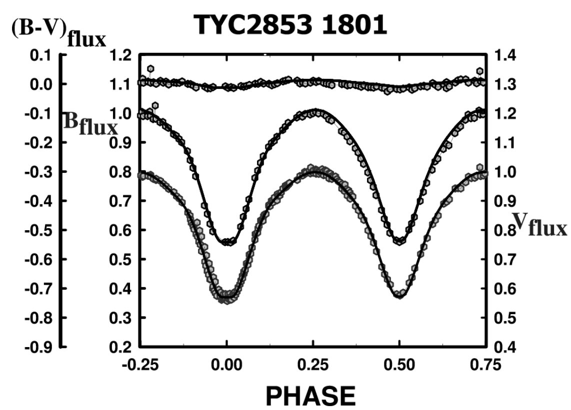

Figure 5. B,V,R,I synthetic light curve solutions overlaying the normalized flux curves.

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DISCOVERY OF δ SCUTI TYPE OSCILLATIONS IN TWO ALGOL-TYPE BINARIES: DY Aqr and BG Peg

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Algol type binaries with one of the components indicating δ Scuti type pulsations have been found attractive to observe, since both pulsational and eclipsing behaviours in their light and radial velocity curves provide reliable stellar and pulsational parameters. However, it is difficult to measure the pulsations in these systems, because their variations are of such low amplitude. So Algols with δ Scuti components have been studied extensively for only about ten years, although they were known since the 1970s (Tempesti, 1971). Pulsational variability may be expected in Algol type light curves, since their hotter components are mostly located in the δ Scuti region of the instability strip (Soydugan et al., 2006) and sometimes even both components. In recent photometric surveys to detect pulsational variations in Algols several systems with δ Scuti type pulsators were discovered (e.g. Sumter & Beaky, 2007; Turcu et al., 2008; Liakos & Niarchos, 2009). In this work, we report δ Scuti type variability in the primaries of the two Algol type binaries DY Aqr and BG Peg for the first time.

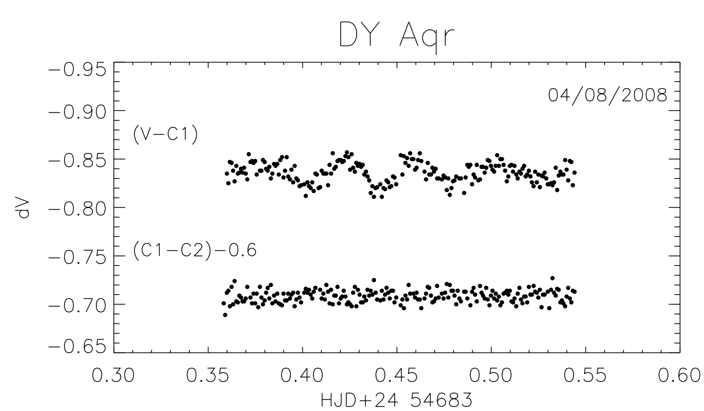

Figure 1. Differential light variation of DY Aqr ($V-C1$) and also differential magnitudes between comparison and check stars ($C1-C2$) in the V filter.

Table 1. Basic information of the variable, comparison, and check stars used for the CCD photometry

ID	Name	RA (J2000)	DEC (J2000)	V_T^*	$(B-V)_T^*$
Var	DY Aqr	$22^h19^m04\overset{s}{.}3$	$-02°38'30\overset{''}{.}0$	10.51	0.16
C1	GSC 5228-137	$22^h18^m51\overset{s}{.}2$	$-02°47'35\overset{''}{.}6$	11.06	0.50
C2	GSC 5228-188	$22^h18^m27\overset{s}{.}7$	$-02°43'15\overset{''}{.}7$	10.89	1.01
C3	GSC 5228-263	$22^h19^m32\overset{s}{.}4$	$-02°49'08\overset{''}{.}2$	10.09	1.89
Var	BG Peg	$22^h52^m47\overset{s}{.}3$	$+15°39'34\overset{''}{.}0$	11.39	0.32
C1	TYC 1698-1052	$22^h53^m23\overset{s}{.}9$	$+15°33'14\overset{''}{.}0$	10.98	0.19
C2	TYC 1698-1142	$22^h52^m58\overset{s}{.}4$	$+15°32'53\overset{''}{.}1$	12.18	0.52

*: The V_T and $(B-V)_T$ values denote Tycho data.

Photometric observations of DY Aqr and BG Peg were carried out at the Çanakkale Onsekiz Mart University Observatory using the 40 cm Schmidt-Cassegrain telescope equipped with a CCD camera SBIG STL-1001E (1024×1024 pixels, 24 μm pixel size). All observations were made with the Johnson B and V filters. While DY Aqr was observed during 14 nights in July-September 2008, the observing run of BG Peg was covered between September and December 2008. The basic information on the variable, comparison and check stars are given in Table 1. All parameters in this table were taken from Hog et al. (2000). Reduction of the CCD frames was carried out using the MUNIPACK (`http://integral.sci.muni.cz/cmunipack`) software. The comparison and check stars selected for each system did not show any significant light variations between themselves during the observations. The atmospheric extinction coefficients in B and V filters for each observational night were calculated from the observations of the comparison star using common methods (cf. e.g. Budding & Demircan, 2007). Then, all the differential B and V magnitudes (in the sense variable minus comparison) were corrected for atmospheric extinction.

DY Aqr (HD 211705) is an Algol type binary system with orbital period of about 2.1597 d (Kreiner, 2004). The depth of the primary minimum in V is about 0.6 mag in our data. We found no previously published spectroscopic and photometric studies of the system. Pulsational light variability of the primary component of DY Aqr is here noted for the first time and shown in Fig 1. To determine the pulsational period, primary eclipses were excluded from the V data. Period analysis was carried out using the `PERIOD04` program (Lenz & Breger, 2005) on data obtained over 11 nights. As a result, it was found that the primary of DY Aqr has a frequency of about 23.39 c/d (1.03 hour period) and a pulsational amplitude of about 0.013 mag. The spectral window and power spectrum for the system can be seen in Fig 2.

The Algol type binary system BG Peg was listed as a candidate Algol having a pulsating component in the Catalogue of Close Binaries in the δ Scuti region of the Cepheid Instability Strip (Soydugan et al., 2006). BG Peg has an orbital period of 1.952443 d (Kreiner, 2004), and we measured the depth of the primary minimum as 0.96 mag. In the Algols catalogue of Budding et al. (2004), the spectral type of BG Peg is given as A2. We couldn't find any previous detailed study for the system in relevant literature. The system was observed during 13 nights in 2008. The pulsational behaviour of the hotter component of BG Peg is indicated in Fig 3. A frequency search was made using the V data from 10 nights. We found the primary component of BG Peg to show a pulsational frequency of about 25.54 c/d (1.34 hour period), with an amplitude of about 0.03 mag. The spectral window and power spectrum of this star is shown in Fig 4.

Candidate oscillating Algol systems selected from the Catalogue of Soydugan et al. (2006) will be searched and any further new discoveries should be announced in due course.

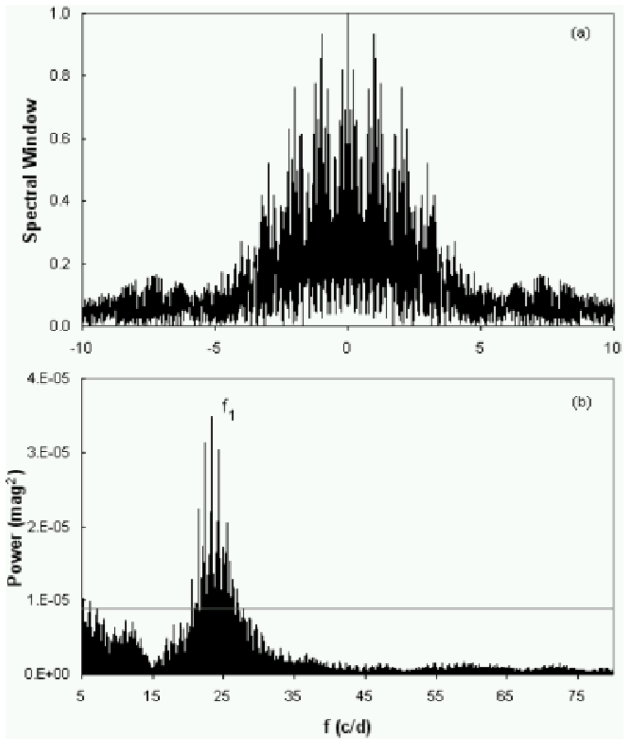

Figure 2. a) The spectral window, (b)Power spectrum and the significance limit (horizontal line) for the data of DY Aqr.

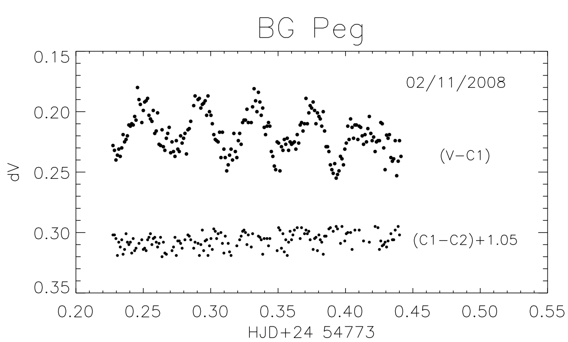

Figure 3. As per Fig.1 but for BG Peg

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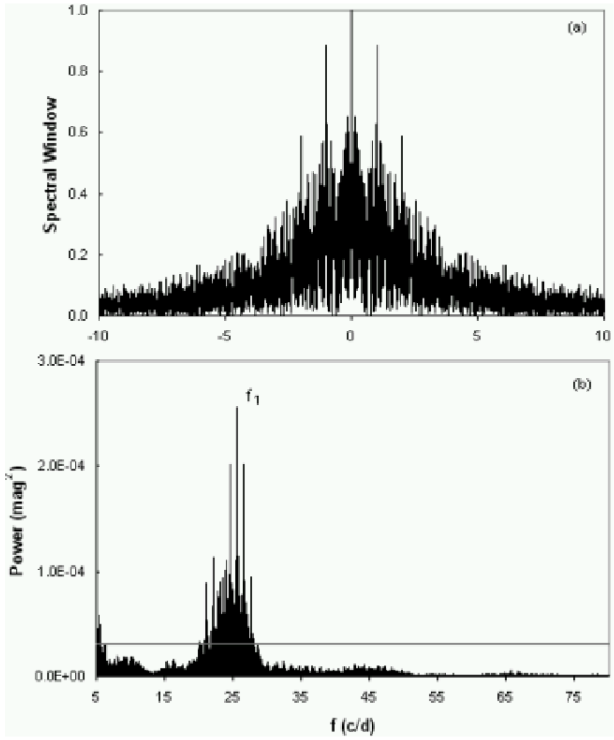

Figure 4. a) The spectral window, (b)Power spectrum and the significance limit (the horizontal line) for the data of BG Peg.

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ELEMENTS FOR 6 PULSATING STARS

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These stars were discovered and reported to be variable by Boyce & Huruhata (1942), Hoffmeister (1967, 1968) and Morgenroth (1933).

Except some remarks concerning the supposed type of variability no further observations or ephemeris have been published until today.

Photographic plates of a field centered at α Oph, taken with the Sonneberg Observatory 40-cm Astrographs during three intervals spread over the years from 1964 to 1994, were used to investigate the behaviour of these objects (see Table 1).

The given elements were obtained by means of least-squares solutions. Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 2. An extensive list holding the times of maxima derived can be retrieved as `5903-t3.txt`, using the link in the HTML version of this paper. Individual data are available upon request.

Remarks:

V553 Her

A paper of Patterson (1979) dealing with the Nova Her 1963 = V533 Her has been erroneously cited a few times. The publications of Warner & Wickramasinghe (1991), Idan & Shavin (1996) and Mobberley (1999) refer to V553 Her spuriously.

V553 Her was discovered by Hoffmeister (1967) as RR Lyrae type variable. According to the observations presented in this paper it is of SR type.

V621 Her, V1068 Oph, NSV 9827

Brightness in minimum light below the plate limit.

NSV 9125

Suspected to be of RR Lyrae type by Boyce & Huruhata (1942).

This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

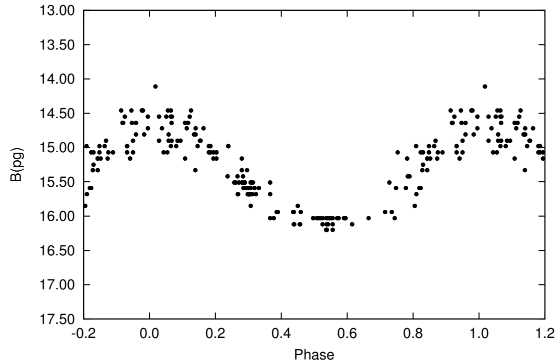

Figure 1. Light curve of V553 Her

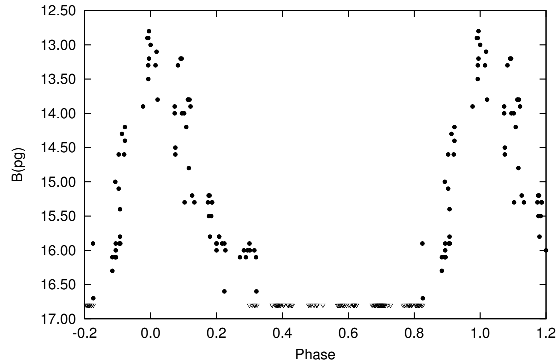

Figure 2. Light curve of V621 Her

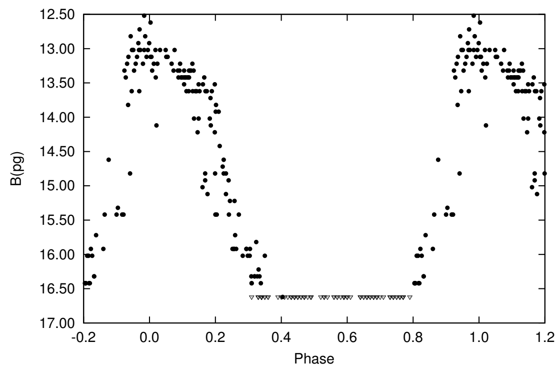

Figure 3. Light curve of V1068 Oph

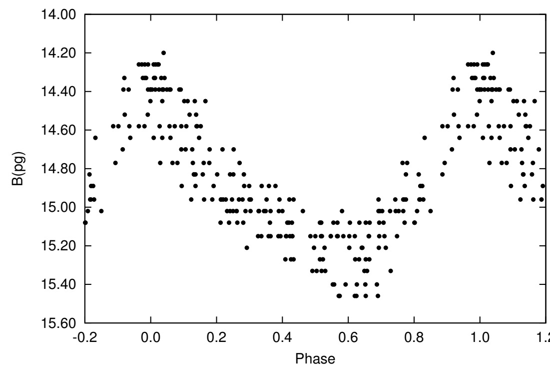

Figure 4. Light curve of NSV 8861

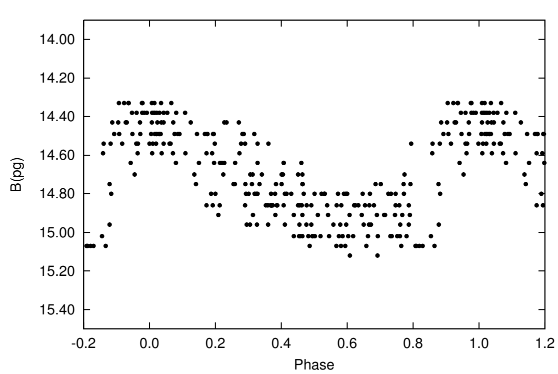

Figure 5. Light curve of NSV 9125

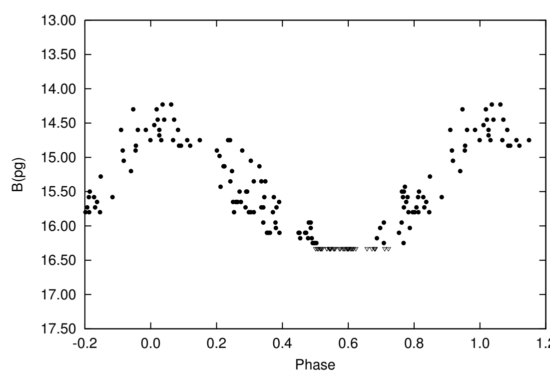

Figure 6. Light curve of NSV 9827

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	$M-m$	No. of Plates	Former classification
V553 Her	SR	49231.2	220.7	$14^m.5$	$16^m.1$		178	RR:
		±9.9	±0.4					
V621 Her	M	49100.2	295.5	$13^m.0$	[$16^m.8$	$0^p.25$:	201	M
		±2.3	±.3					
V1068 Oph	M	46659.4	246.2	$12^m.8$	[$16^m.6$	$0^p.30$:	245	M
		±4.2	±.3					
NSV 8861	CWB	46704.325	1.573369	$14^m.3$	$15^m.3$	$0^p.40$	235	
		±14	±5					
NSV 9125	CWB	49488.233	3.532940	$14^m.2$	$15^m.0$	$0^p.30$	253	RR:
		±83	±37					
NSV 9827	SR	49207.3	346.1	$14^m.3$	[$16^m.4$	$0^p.40$:	150	M
		±21.2	±2.1					

Table 2. Comparison stars and cross references

	V553 Her S 9808 USNO 1050-0881332		V621 Her S 10332 USNO 1050-08539397	
Comp. No.	USNO	m^*	USNO	m^*
1	1050-08816021	$14^m.1$	1050-08540184	$12^m.7$
2	1050-08817448	$14^m.4$	1050-08538893	$13^m.2$
3	1050-08812489	$15^m.2$	1050-08537841	$14^m.5$
4	1050-08815816	$15^m.7$	1050-08537958	$15^m.2$
5	1050-08812817	$16^m.6$	1050-08539865	$16^m.2$
6			1050-08540191	$17^m.5$

	V1068 Oph S 9817		NSV 8861 HV 10947 USNO 0975-09260404	
Comp. No.	USNO	m^*	USNO	m^*
1	0975-09553402	$12^m.7$	0975-09257894	$14^m.4$
2	0975-09550091	$13^m.0$	0975-09260358	$15^m.1$
3	0975-09562065	$13^m.7$	0975-09258828	$15^m.5$
4	0975-09558584	$14^m.2$		
5	0975-09555861	$14^m.7$		
6	0975-09552696	$16^m.0$		

	NSV 9125 HV 10968 USNO 0975-09346163		NSV 9827 358.1933 USNO 1050-09322332	
Comp. No.	USNO	m^*	USNO 1050-09322332	m^*
1	0975-09346685	$14^m.2$	1050-09328723	$14^m.1$
2	0975-09344458	$14^m.6$	1050-09323681	$14^m.4$
3	0975-09342260	$14^m.8$	1050-09332256	$14^m.9$
4	0975-09346609	$15^m.2$	1050-09327165	$15^m.2$
5			1050-09326294	$15^m.7$
6			1050-09323255	$16^m.4$

* Magnitudes refer to the B values of the USNO−A2.0 catalogue

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PHOTOELECTRIC MINIMA OF SOME ECLIPSING BINARY STARS

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Observatory and telescope:
30-cm, 35-cm, 40-cm MEADE LX200 telescopes and 48-cm Cassegrain telescope of the Ege University Observatory

Detector:	SSP-5 photoelectric photometer, high-speed three channel photometer and Alta U47 CCD

Method of data reduction:
Reduction of the observations were made in the usual way (Hardie, 1962). Reduction of the CCD frames was done with CMunipack programme.

Method of minimum determination:
The minima times were calculated using Kwee & van Woerden's (1956) method.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
BD And	54702.4229	0.0001	I	BVR	
	54703.3488	0.0002	I	BVR	
	54707.5158	0.0002	I	BVR	
	54709.3668	0.0001	I	BVR	
	54714.4586	0.0002	I	BVR	
	54752.4148	0.0002	I	BVR	
	54753.3401	0.0003	I	BVR	
ET Boo	54177.4445	0.0002	I	UBVR	
	54178.4119	0.0003	II	UBVR	
	54197.4411	0.0002	I	UBVR	
	54198.4076	0.0002	II	UBVR	
	54615.4295	0.0004	I	UBVR	
DK CVn	54168.4007	0.0010	I	BVR	
	54217.4049	0.0005	I	VR	
	54220.3725	0.0003	I	VR	
	54564.3733	0.0008	I	BVR	
	54619.3154	0.0010	I	VR	

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
EG Cep	54643.3409	0.0005	II	BVRI	
	54676.5637	0.0006	II	BVRI	
	54699.4367	0.0005	II	BVRI	
	54714.4119	0.0001	I	BVRI	
	54752.2627	0.0004	II	BVRI	
	54760.4327	0.0003	II	BVRI	
	54776.2253	0.0003	II	BVRI	
	54776.4962	0.0002	I	BVRI	
	54786.2995	0.0002	I	BVRI	
	54787.3890	0.0001	I	BVRI	
	54804.2721	0.0002	I	BVRI	
KR Cyg	53195.3598	0.0006	II	UBVR	
	53585.3955	0.0005	I	UBVR	
	53593.4249	0.0008	II	UBVR	
	53891.3416	0.0007	I	uvby	
	53937.4060	0.0010	II	uvby	
	54682.4095	0.0001	I	BVR	
	54762.2706	0.0005	II	BVR	
	55036.5296	0.0001	I	BVR	
V346 Cyg	54681.3689	0.0002	I	BVR	
XX Leo	54587.3608	0.0009	I	BVR	
	54622.3209	0.0011	I	BVR	
GSC 2038 293	54213.4434	0.0014	I	BVR	
	54219.3903	0.0032	I	BVR	
	54226.3264	0.0014	I	BVR	
	54526.5460	0.0008	I	BVR	
	54587.4837	0.0007	I	BVR	
	54621.4215	0.0019	II	I	
	54651.3956	0.0067	I	BVRI	
	54659.3202	0.0038	I	BVRI	
	54671.4488	0.0097	II	BVRI	
GSC 4589 2999	54752.2629	0.0003	I	BVRI	
	54833.3082	0.0073	I	BVRI	
	55055.3703	0.0007	II	I	
SAO 67556	54652.3522	0.0004	I	UBVR	
	54667.4148	0.0005	II	UBVR	
	55052.4561	0.0002	I	UBVR	
	55078.2683	0.0004	I	UBVR	

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NEW EXTREME OUTBURST OF Z CMa

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Z CMa is an 0.1 arcsec pre-main sequence binary system (Koresko et al., 1991). It is a young stellar system consisting of a $16M_{\odot}$ B0 IIIe primary and a $\sim 3M_{\odot}$ secondary companion at an age of ~0.3 Myr (Hartmann et al., 1989; Whitney et al., 1993; van den Ancker et al., 2004). The high resolution spectroscopy showed that Z CMa has the double-peaked emission line profiles whose shapes and widths are characteristic of FU Ori objects (Hartmann et al., 1989). The currently accepted interpretation for the FU Ori objects is that they are T Tau stars undergoing episodes of very rapid disk accretion. Indeed, under this interpretation, Z CMa has one of the highest accretion rates, $M_{acc} \simeq 10^{-4} M_{\odot}\ yr^{-1}$, observed in FU Ori systems (Hartmann and Kenyon, 1996).

On large scales, this system displays a collimated outflow (Cohen and Bieging, 1986; Poetzel et al., 1989) and has a roughly 400 AU disk-like structure (Malbet et al., 1993). The major axis of this disk-like structure is perpendicular to the large-scale bipolar jet. Recently, interferometric observations of both components have been obtained, probing their environment on AU scales (Millan-Gabet et al., 2006). Both components have been spatially resolved by these observations, but detailed analysis has revealed that both components are more complex than previously thought.

The photometric variations of the system have been monitored for 21 years (1983-2004) at Mt. Maidanak (Uzbekistan). The mean magnitude of the system has been continuously decreasing from 1983 to 1997 (from V $9\overset{m}{.}3$ to V $10\overset{m}{.}4$) and then remained nearly constant till a short duration (6 month) outburst in 1999/2000 when it has increased up to V $9\overset{m}{.}5$ (see Figure 1 in van den Ancker et al., 2004). Based on high resolution spectroscopy, this outburst was identified as resulting from a large scale accretion instability in the circumstellar disk of the massive primary. Our last Mt. Maidanak observations of Z CMa in 2004 have shown that the average brightness of this system was $9\overset{m}{.}94$ in V band.

We have decided to continue some patrol $UBVR$ observations of this star at Crimean Astrophysical Observatory (CrAO) in Ukraine since 2008. In September-November 2008 we have discovered that the Z CMa is again exhibiting an extreme outburst with an amplitude more than $1\overset{m}{.}7$–$1\overset{m}{.}9$, i.e., larger than any photometric variations recorded in the last 25 years. The statistical and photometric properties of the long-term light curve taken at Mt. Maidanak and at CrAO are presented in Table 1.

On November, 19th 2008 we have spread the information about this extreme outburst to all interested researchers and have suggested to make some simultaneous photometric, spectroscopic and interferometric observations of this star. Such coordinated observations took place within December 2008 - January 2009. We report here multi-color photometric observations of Z CMa taken during this unprecedented outburst state (see Table 2).

Table 1. Statistical properties of Z CMa light curve. Columns are: Year - observation season, N_{obs} - number of observations, $\overline{V}$ - mean magnitude in V, σ_V - standard deviation in V, V_{max} - maximum brightness in V, ΔV - photometric amplitude in V, $\overline{U-B}$, $\overline{B-V}$, $\overline{V-R}$ - mean color index in $U-B$, $B-V$, and $V-R$ accordingly.

Year	N_{obs}	$\overline{V}$	σ_V	V_{max}	ΔV	$\overline{U-B}$	$\overline{B-V}$	$\overline{V-R}$
1983	11	9.301	0.043	9.237	0.124	0.678	1.233	1.200
1984	10	9.337	0.046	9.243	0.140	0.672	1.236	1.218
1985	22	9.110	0.115	8.920	0.330	0.374	1.177	1.228
1986	9	9.027	0.209	8.745	0.533	0.403	1.136	1.182
1987	17	9.540	0.023	9.504	0.087	0.538	1.270	1.242
1988	35	9.551	0.040	9.492	0.148	0.752	1.295	1.197
1989	40	9.631	0.054	9.492	0.275	0.749	1.330	1.206
1990	32	9.592	0.024	9.542	0.102	0.692	1.321	1.221
1991	24	9.556	0.081	9.447	0.304	0.496	1.258	1.257
1992	21	10.055	0.018	10.023	0.063	0.797	1.391	1.232
1994	10	9.979	0.011	9.964	0.033	0.495	1.317	1.318
1995	23	10.169	0.039	10.031	0.190	0.608	1.348	1.300
1996	21	10.231	0.020	10.204	0.069	0.370	1.264	1.288
1997	19	10.412	0.028	10.309	0.127	0.421	1.277	1.337
1998	17	10.337	0.014	10.305	0.049	0.258	1.130	1.322
1999	23	9.491	0.182	9.224	0.676	0.468	1.044	1.207
2000	10	9.655	0.393	9.299	0.943	0.233	0.969	0.957
2001	15	10.081	0.075	9.961	0.224	0.319	1.088	1.251
2002	7	10.100	0.030	10.060	0.087	−0.055	0.913	1.291
2003	5	10.333	0.029	10.307	0.076	0.190	1.054	1.333
2004	11	9.940	0.023	9.906	0.073	−0.045	0.959	1.357
2008	10	8.662	0.215	8.408	0.633	0.034	0.804	0.896
2009	8	8.432	0.043	8.397	0.098	0.005	0.750	0.821

Table 2. Multi-color photometric observations of Z CMa at CrAO

Date	JDH2400000+	V_{mag}	$U-B$	$B-V$	$V-R$
30-Sep-2008	54740.6353	8.806	0.104	0.866	0.939
01-Oct-2008	54741.6449	8.786	0.139	0.833	0.924
23-Oct-2008	54763.6639	8.849	0.060	0.821	0.907
30-Oct-2008	54770.5778	8.888	0.077	0.834	0.898
07-Nov-2008	54778.6044	8.930	0.042	0.862	0.927
01-Dec-2008	54802.6248	9.041	0.051	0.868	0.982
12-Dec-2008	54813.5285	8.581	−0.080	0.761	0.879
12-Dec-2008	54813.5385	8.583	−0.038	0.772	0.873
12-Dec-2008	54813.5480	8.587		0.778	0.874
30-Dec-2008	54831.4622	8.434		0.816	0.853
21-Jan-2009	54853.3282	8.408	0.000	0.774	0.896
21-Jan-2009	54853.3414	8.425	0.004	0.766	0.882
05-Feb-2009	54868.2754	8.468	0.025	0.752	0.854
05-Feb-2009	54868.2809	8.476	0.028	0.751	0.861
04-Mar-2009	54895.2343	8.425	0.005	0.747	0.843
04-Mar-2009	54895.2463	8.412	0.006	0.743	0.840
21-Mar-2009	54912.2527	8.397		0.746	0.790
24-Mar-2009	54915.2456	8.495		0.763	0.812

It is visible from Table 1 that in the end of 2008 the mean magnitude of the system was V $8^{\rm m}\!.7$, and in the beginning of 2009 it has achieved a value of V $8^{\rm m}\!.4$. As the number of our multi-color data points are not numerous enough for the analysis of photometric behaviour of this star, we used all V-band data from the All Sky Automated Survey (ASAS) catalogue (see for example Pojmanski, 2002). The optical V light curve of Z CMa spanning the period 1998-2009 is shown in the top panel of Figure 1. We conclude from this Figure 1 that the new outburst (2008/2009) is really the brightest and longest lived within the last ten years. The duration of the new outburst exceeds 430 days (see bottom panel of Figure 1). It should be noted that the current outburst (2008/2009) and an optical light curve for the last seven years was published first by Stelzer et al. (2009). They used the visual photometry from the American Association of Variable Star Observers (AAVSO) and a few photoelectric CCD observations obtained by Czech observers. We tried to use the AAVSO data in our analysis too. But we have ascertained that these visual data have low precision and are suitable to check variations of an average level of light. However, the overall structure of the long-term light curve is well visible in Figure 1 of Stelzer et al. (2009) and in good conformity with our light curve.

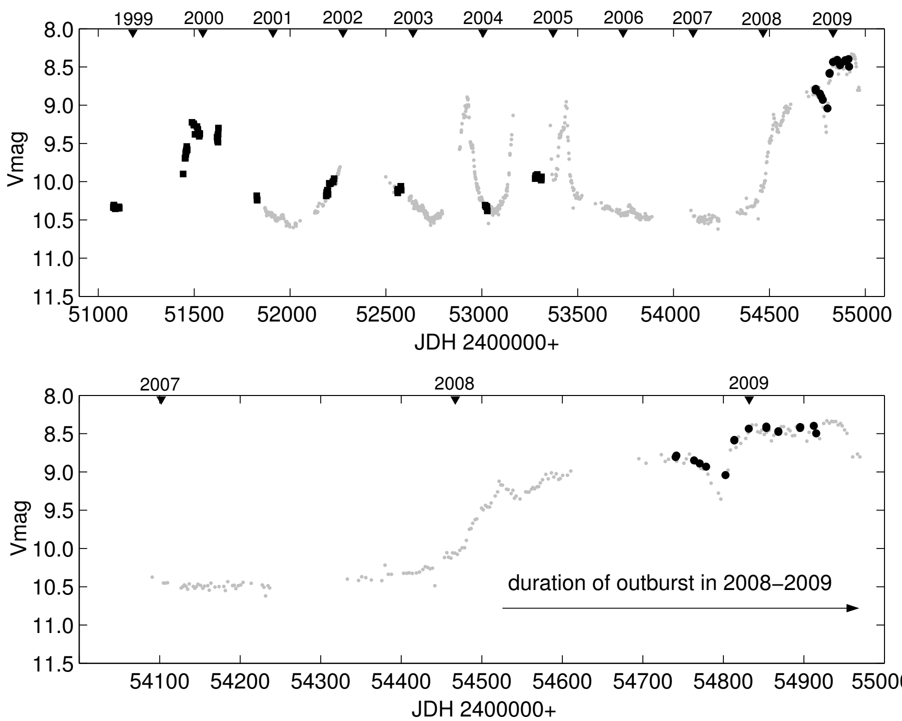

Figure 1. Optical V light curve of Z CMa spanning the period 1998-2009 (top panel) and new outburst (bottom panel). Data from the All Sky Automated Survey (ASAS) are indicated by the grey circles, data from Maidanak Observatory by black squares, and our new data points obtained at CrAO are indicated by the black circles.

Besides, the ASAS data show at least three more short-term outbursts during 2003-2006. The amplitudes of these outbursts are comparable or exceed the amplitude of the well studied 1999/2000 outburst. Unfortunately, we cannot tell anything about the color changes during these short-term outbursts because the ASAS data comprise only the V-band. Nevertheless, we can compare the color behaviour of two outbursts (1999/2000 and 2008/2009) on our multi-color observations at Maidanak and CrAO (see Figure 2).

Multi-color photometry indicates that the system is currently brighter and bluer (2008/2009 outburst) than it has ever been in the past (1999/2000 outburst). Besides, both outbursts show an uniform dependence on the color-magnitude and the color-color diagrams. It specifies the same mechanism of the photometric variability during these two outbursts. At the same time we see that the photometric variability during a quiet state (outside of outbursts) shows another dependence. It is visible especially clearly on the V, $U-B$ and V, $B-V$ diagrams. This may not be surprising, since we are probably observing the result of two independently varying sources, a FUor secondary component which usually dominates the visual continuum and a Be-type primary star in a large dust cocoon, which is dominating the near- and far-infrared part of the spectrum.

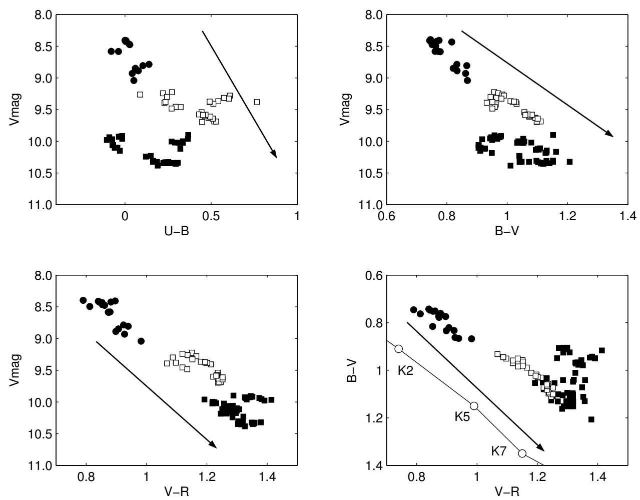

Figure 2. Optical color-magnitude and color-color diagrams of Z CMa using photometric data from the period 1998-2009. Data from the 1999/2000 outburst are indicated by the open squares, data from the 2008/2009 outburst by black circles, and other data outside of outbursts are indicated by the black squares. The arrows indicate the direction of interstellar reddening.

We expect that the recent IR photometric, high resolution spectroscopic and VLTI interferometric observations taken during the integrated observational campaign in 2008-2009 will allow us to understand the physics of this phenomenon more deeply.

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BRIGHTNESS VARIATIONS OF SAO 53210

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With the aim to test the physical nature of some of the stellar serendipitous X-ray sources detected by EXOSAT (Giommi et al., 1991), our group collected, during the years 1990-1992, several photometric and spectroscopic observations at the Observatorio Astronomico National, UNAM (San Pedro Martir, BC, Mexico). For each star of our sample only few observations were obtained, but in many cases they were sufficient to point out the presence of some photoelectric variability (Cutispoto et al., 2000). So we decided to plan, during the following years, further observations to determine more precisely the variation characteristics and possibly the nature of the stars.

The X-ray source SAO 53210 (EXO 233530.1+4555.4) is classified as BY Dra type variable, with the name V454 And, in the 78th Name List of Variable Stars (Kazarovets et al., 2006), on the basis of our Mexican observations. These observations were very limited: in total five data points on August 1990 and six on October 1991, distributed in seven days for both observing runs. As a consequence, the period suggested in Cutispoto et al. (2000) was inevitably very tentative. The new data discussed here completely superseed this earlier attempt.

Following the ADS Abstract Service (Centre de Données Astronomiques de Strasbourg), no other report about the photometric variability of this star has been published after Cutispoto et al. (2000), except an analysis by Percy (1993), which suggests a variability of SAO 53210 up to $0^{\mathrm{m}}.05$ in V and B on a timescale of months.

The colours derived by the Hipparcos Catalogue are consistent with the spectral type G3/4V.

SAO 53210 was observed during 30 nights in September-October 1992 at the Brera Astronomical Observatory in Merate, using a digital photon-counting photometer at the 50 cm. reflector and a Stromgren y filter. The comparison and check stars were SAO 53147 and SAO 53149, respectively. For details on the observing technique and data handling, see Cereda et al., 1988. As a rule, about ten observations of the variable were performed in alternation with the comparison star: these Δm magnitudes have been averaged to give one or two y-normal points for every night.

Table 1 shows these y-normal points (y-np) with the observational times and the standard errors σ. Also the Mexican observations: J.D.... 126-... 133 and J.D.... 556-... 563, related to August 1990 and October 1991 respectively, are reported in this Table.

Figure 1 presents the light curves derived from our 1992 observations: the magnitude differences *variable minus comparison* (top) is compared, in the same scale, with the difference *check minus comparison* (bottom).

Table 1. y-normal points (y-np) with observational times and standard errors σ

J.D.(8000+)	y-np	σ	J.D.(8000+)	y-np	σ
126.8610	0.352	0.003	892.4853	0.336	0.001
127.8660	0.356	0.001	893.4015	0.339	0.003
130.7910	0.356	0.003	893.5812	0.339	0.001
132.8370	0.351	0.001	894.4886	0.344	0.002
133.7990	0.345	0.001	896.4068	0.347	0.003
556.7710	0.338	0.001	896.5714	0.349	0.001
558.7450	0.340	0.004	898.4044	0.323	0.001
559.7390	0.345	0.002	898.4634	0.323	0.004
560.8400	0.327	0.003	899.6105	0.325	0.002
562.8360	0.329	0.002	901.3950	0.344	0.001
563.7190	0.334	0.001	901.5980	0.348	0.003
870.5428	0.341	0.003	909.4569	0.331	0.002
871.5931	0.347	0.002	911.3985	0.320	0.002
872.6163	0.349	0.002	911.5500	0.325	0.001
873.5012	0.337	0.001	914.3890	0.345	0.002
882.5884	0.342	0.004	914.5420	0.364	0.003
883.4500	0.350	0.002	915.4653	0.339	0.004
883.5963	0.351	0.003	917.4243	0.332	0.002
884.4430	0.345	0.002	918.4039	0.340	0.001
884.6137	0.347	0.001	918.5315	0.338	0.003
885.5330	0.331	0.003	919.4419	0.348	0.005
887.4850	0.325	0.001	920.3918	0.346	0.001
887.5830	0.326	0.002	920.5290	0.343	0.002
888.5705	0.333	0.004	922.3873	0.322	0.002
889.5380	0.349	0.002	923.3940	0.322	0.002
890.4740	0.347	0.002	923.5355	0.325	0.003
890.6200	0.346	0.002	925.4335	0.340	0.001

Table 2. The two solutions for the light curve of SAO 53210

Epoch	Period	Amplitude	Phase
1992 only	P_1=11.8d ±0.1	$0^{\text{m}}_{.}0060$ ±0.0005	−3.125 ±0.085
1992 only	P_2=5.9d ±0.2	$0^{\text{m}}_{.}0100$ ±0.0004	−2.596 ±0.056
1990+1991+1992	P_1=12.1d ±0.01	$0^{\text{m}}_{.}0069$ ±0.0009	−2.993 ±0.130
1990+1991+1992	P_2=6.1d ±0.02	$0^{\text{m}}_{.}0009$ ±0.0008	−2.592 ±0.100

Table 3. Details of the frequency analysis for the two different epochs of observation

Epoch	T_o	Initial $r.m.s.$ res.	Final $r.m.s.$ res.	Total variance
1992 only	JD2448899.5450	$0^{\text{m}}_{.}0096$	$0^{\text{m}}_{.}0031$	89%
1990+1991+1992	JD2448899.5450	$0^{\text{m}}_{.}0099$	$0^{\text{m}}_{.}0041$	83%

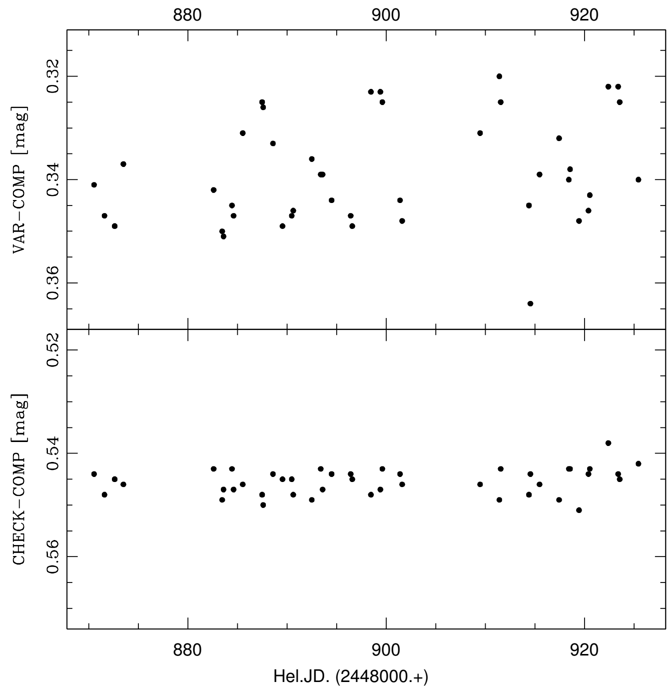

Figure 1. The light curves derived from our 1992 observations: the magnitude differences *variable minus comparison* (top) is compared with the difference *check minus comparison* (bottom).

The data of Table 1 were analysed in two steps: at first considering only the more meaningful group of 1992 observations and then all the data together (1990+1991+1992). The analysis was performed by means of the "Multifre code" (Bossi et al., 2009), which searches for the least squares best fit of a time series using a finite number of sinusoids.

In Figure 2 the periodogram related to the complete data set is presented, while Tables 2 and 3 show the results of the two separate analyses.

Finally, Figure 3 shows the synthetized light curve and the phased y-normal points, computed according to the data of Tables 2 and 3, and related to the whole set of observations reported in Table 1. Here open and filled circles represent the 1990 and 1992 measures, while crosses describe the 1991 data. A similar plot using only the 1992 observations does not show significant differences.

As a preliminary conclusion, Table 2 and 3 show that the light curve parameters based on the 1992 observations represent quite well also the 1990 and 1991 light variations. This could indicate that the same periodic physical phenomenon acted continuously over at least three years.

As a second important point, the light variations of SAO 53210 are satisfactorily explained by means of a double wave in which the two frequencies are not independent, but represent the fundamental frequency and its first harmonic.

The deviations of the 1990 observations (open circles in Figure 2) from the fit could be explained by a modulation of the light variation amplitude.

This picture seems to agree with the classification of SAO 53210 as a BY Dra type variable (Kazarovets et al., 2006), or as some other type of rotating variable stars. Further observations would clearly be important in order to improve the model of the star.

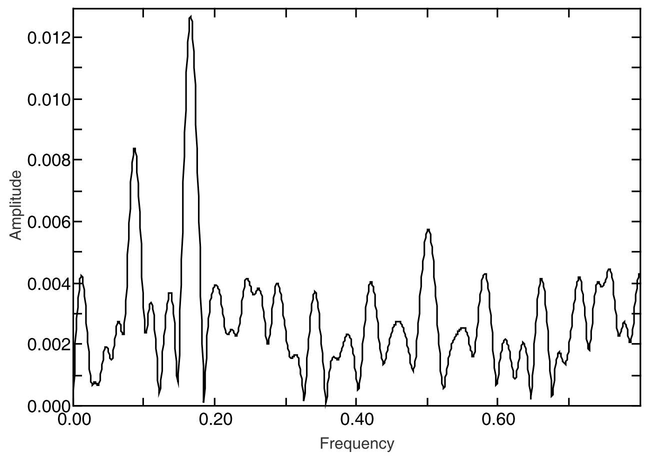

Figure 2. The periodogram of the complete set of observations

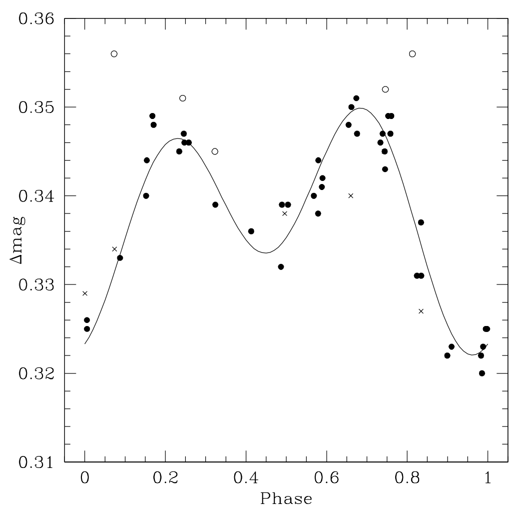

Figure 3. The light curve of SAO53210. The solid line is the synthetized light curve obtained according to to the data of Tables 2 and 3, and related to the whole set of observations. The open and filled circles represent the 1990 and 1992 observations, while the crosses correspond to 1991 data.

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DRASTIC CHANGES IN PHOTOMETRIC VARIABILITY OF V410 Tau

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V410 Tau is a weak emission-line T Tauri star with a spectral type K4, lithium in absorption and a weak H_α emission (Herbig and Kameswara Rao, 1972; Cohen and Kuhi, 1979; Holtzman, Herbst, and Booth, 1986), it is also a source of highly variable, nonthermal, radio emission (Cohen, Bieging, and Schwartz, 1982; Becker and White, 1985), but exhibits no infrared excess (Rucinski, 1985). V410 Tau is a fast rotating star ($v \sin i \sim 70$ km/s; Hartmann et al., 1986) with a 1.872 day rotational period derived from its photometric variability (Rydgren and Vrba, 1983; Vrba et al., 1988; Bouvier and Bertout, 1989). The periodic light variations have an amplitude of 0.2-0.6 mag in the V-band, which is attributed to cold stellar spots that cover at least 29% of the stellar surface (Grankin, 1999). This young rapidly-rotating star thus exhibits intense surface magnetic activity, also witnessed by its large X-ray luminosity (3×10^{30} erg/s, Stelzer et al., 2003) and strong flares in the U-band (Fernandez et al., 2004). V410 Tau is indeed an ideal candidate for an in-depth study of magnetic activity in cool stars: it is relatively bright, well situated for observation from the northern hemisphere and has exhibited the largest amplitude of variability among all known spotted variables (including RS CVn and BY Dra stars).

The photometric variations of this star have been monitored for 20 years (1986-2006) at Maidanak Observatory (Uzbekistan) and continued at Crimean Astrophysical Observatory (CrAO) in Ukraine since 2007. Over nearly 18 years (1986-2004), V410 Tau has exhibited smooth periodic light variations resulting from cool spotted regions on its surface (see Grankin et al., 2008). Model calculations (Grankin, 1999) show that, (1) the spot temperature is lower than the photospheric temperature by at least 1450 K, and (2) spotted regions cover from 29% to 67% of the visible stellar hemisphere. Small variations in the mean brightness level and in the shape of the light curve over the period 1986-2004 suggest limited spot evolution over the years.

However, drastic changes started to occur in the light curve of V410 Tau from 2005 on. While the photometric variations were quite smooth, sinusoidal and repeatable over the time period 1986-2004 (see Fig. 3 in Grankin et al., 2008), the amplitude suddenly started to decrease quite significantly in 2005, reaching a minimum in 2007-2008. The optical V light curve based on photoelectric observations of 1981-2008 is shown in Figure 1. The statistical properties of long-term photometric behaviour of V410 Tau are presented in Table 1. Individual data are available upon request. It is visible from Figure 1 and Table 1 that the amplitude of variability has reached a record minimum in 2007/2008 ($0\overset{m}{.}08$-$0\overset{m}{.}06$) while the maximal amplitude was observed in 1998/1999 ($0\overset{m}{.}63$-$0\overset{m}{.}62$). The mean brightness level has been changed very little during this time interval.

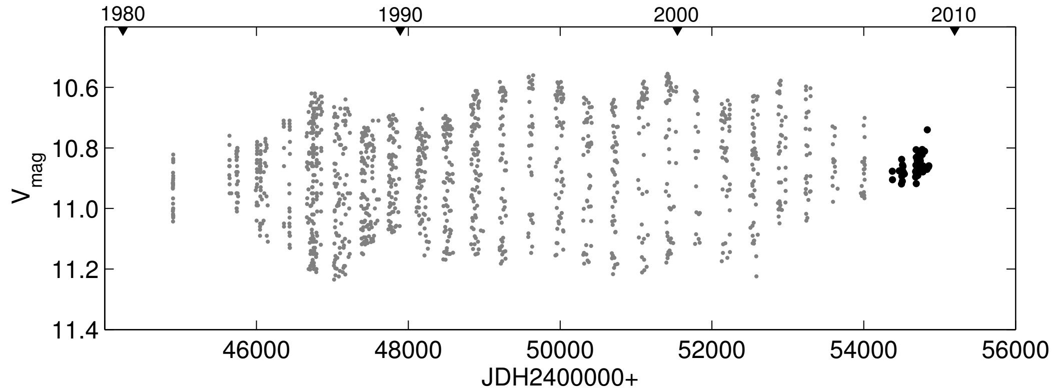

Figure 1. Optical V light curve of V410 Tau based on photoelectric observations of 1981-2008. Data are from Rydgren and Vrba (1983), Vrba, Herbst, and Booth (1988), Bouvier, Bertout, and Bouchet (1988), Herbst (1989), Grankin (1999), Grankin et al. (2008), and this paper. Observations corresponding of the minimal amplitude are indicated by the black filled circles, and other observations by the grey filled circles.

Table 1. The long-term photometric behaviour of V410 Tau. Columns are: Year - observation season, N_{obs} - number of observations, $\overline{V}$ - mean magnitude in V, σ_V - standard deviation in V, V_{max} - maximum brightness in V, ΔV - photometric amplitude in V, $\overline{U-B}$, $\overline{B-V}$, $\overline{V-R}$ - mean color index in $U-B$, $B-V$, and $V-R$ accordingly.

Year	N_{obs}	$\overline{V}$	σ_V	V_{max}	ΔV	$\overline{U-B}$	$\overline{B-V}$	$\overline{V-R}$
1981	26	10.939	0.066	10.822	0.221	0.935	1.221	1.054
1983	38	10.886	0.067	10.760	0.250	0.940	1.213	1.046
1984	59	10.895	0.086	10.770	0.320	0.918	1.211	1.041
1985	35	10.925	0.151	10.710	0.420	0.850	1.211	1.052
1986	150	10.897	0.176	10.620	0.590	0.917	1.193	1.047
1987	86	10.936	0.191	10.630	0.605	0.894	1.157	1.044
1988	104	10.934	0.135	10.690	0.461	0.929	1.165	1.039
1989	75	10.884	0.127	10.691	0.388	0.942	1.161	1.033
1990	78	10.886	0.121	10.672	0.483	0.927	1.152	1.043
1991	68	10.904	0.158	10.694	0.475	0.930	1.157	1.040
1992	77	10.853	0.169	10.612	0.540	0.912	1.151	1.036
1993	56	10.864	0.211	10.582	0.600	9.999	1.141	1.033
1994	32	10.796	0.199	10.519	0.628	0.915	1.140	1.016
1995	52	10.820	0.192	10.582	0.573	0.886	1.140	1.028
1996	42	10.872	0.180	10.634	0.548	0.917	1.147	1.039
1997	48	10.896	0.175	10.641	0.576	0.928	1.152	1.036
1998	37	10.816	0.223	10.581	0.630	9.999	1.148	1.017
1999	49	10.832	0.227	10.555	0.624	0.923	1.154	1.020
2000	21	10.830	0.191	10.613	0.504	0.884	1.149	1.025
2001	44	10.833	0.163	10.643	0.531	0.842	1.166	1.024
2002	49	10.872	0.158	10.628	0.596	0.960	1.166	1.066
2003	39	10.821	0.153	10.578	0.471	0.951	1.184	1.035
2004	27	10.823	0.144	10.597	0.443	0.971	1.180	1.049
2005	14	10.847	0.075	10.729	0.249	9.999	1.203	1.054
2006	20	10.879	0.079	10.701	0.265	9.999	1.206	1.058
2007	14	10.880	0.022	10.838	0.081	0.910	1.189	1.032
2008	42	10.852	0.031	10.805	0.055	0.922	1.172	1.046

These drastic changes in the amplitude of variability during 2005-2008 were accompanied by significant evolution of the shape of the phase light curve (see Figure 2). During the 2005/2006 and 2006/2007 seasons the phase light curve had a complex shape in the sense that two maxima and two minima were observed per cycle. Such shapes of the light curves can be a result of the existence of two extended spotted regions on opposite sides of the star. Similar light curves were observed during 1981-1985 (see Herbst, 1989). This $\sim$ 23yr evolution (from 1983 till 2006) possibly reflects a long term activity cycle similar to the 11-yr cycle occurring in the Sun. Recently some publications informs on the detection of shorter cycles of activity for this star within the range of 4-13 years (Stelzer et al., 2003; Sokoloff et al., 2008; Oláh et al., 2009). In any case, to check if V410 Tau indeed has a cycle with a quasi period of $\sim$ 23yr it is necessary to use photographic and photometric data from other observatories.

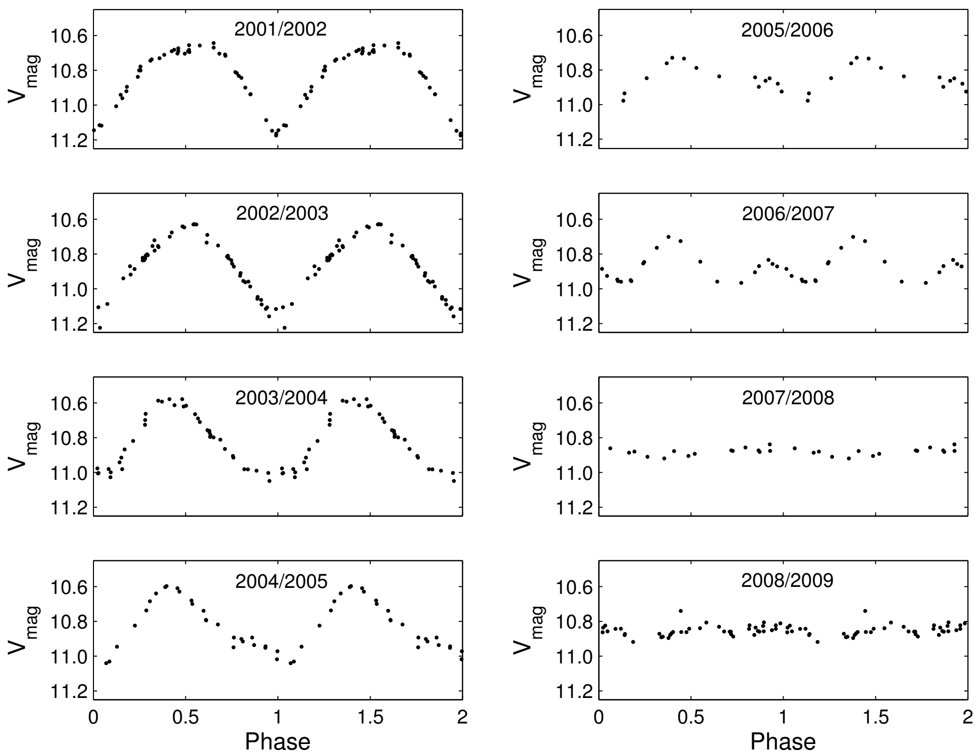

Figure 2. Phased light curves of V410 Tau for the last eight seasons, with JD (Hel.) min = 2452234.28597 + 1.87197 × E.

What happens to the spot configuration and to the underlying magnetic field distribution during the last 4 years (2005-2008) of perturbations should therefore give us hints on how dynamo processes are operating in young active stars, something on which very few constraints have been obtained so far. At least 2 possible interpretations can be put forward to explain the sudden decrease in amplitude of variability: either large monolithic spots have drifted exactly to the stellar poles, or many small spots are now nearly evenly distributed over the stellar surface. These two possible, nearly axisymmetric configurations would produce little modulation of the light curve, as observed in 2007-2008.

Preliminary simple modeling of the light curve of V410 Tau (cf. Grankin et al. 2008) showed that:

(i) The amplitude of the phased light curve depends on the degree of non-uniformity in the spot distribution more strongly than on the star's total spot area. An increase in amplitude was accompanied by an increase in the degree of non-uniformity in the spot distribution over the stellar surface from 4 to 37%.

(ii) The decrease in average magnitude is attributable to the increase in total spot area from 44 to 53% and that it is essentially independent of the degree of non-uniformity in the spot distribution over the surface (see Figure 3).

These two results shows, that the second interpretation is more likely, than the first one.

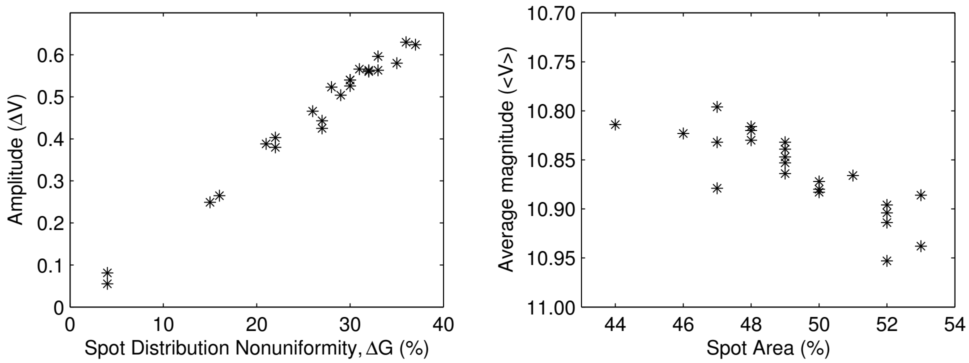

Figure 3. Plots of the amplitude of V410 Tau against the non-uniformity in the spot distribution (left) and the average level of brightness against the total spot area (right), see Grankin et al. (2008) Fig. 10. for comparison.

In order to decide between these alternatives, we need to obtain Doppler maps of the stellar surface, or even better, a Doppler-Zeeman map during several seasons. We will then be able to understand how the cool polar spots or equatorial regions develop and extend with time, how much toroidal and poloidal fields of the magnetic topology contains at each stage of the evolution process, and how much the surface of V410 Tau is sheared by differential rotation, a crucial ingredient for the dynamo process.

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PHOTOMETRIC ANALYSIS OF USNO-B1.0 1323-0548678

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In the last years we have repetitively observed the variability of USNO-B1.0 1323-0548678 (J2000.0 $\alpha = 22^h02^m27^s.8$; $\delta = +42°18'03''$) during a program to study the well known extragalactic object BL Lac. The source has been already identified by Sokolovsky & Amirkhanyan (2006) as an EW eclipsing variable, and now we are able to give the first results about the physical parameters of components in this close binary system.

The data have been obtained at the Armenzano Astronomical Observatory with the 0.40 m Ritchey-Chrétien telescope equipped with an Apogee AP47p (Marconi 47-10 of 1024×1024 pixels), and at the Porziano Astronomical Observatory with the 0.35 m Schmidt-Cassegrain telescope equipped with a QSI532WS CCD camera (Kodak Kaf 3002me of 2184×1472 pixels). Both the instruments are provided with standard BVR_CI_C Johnson–Cousins broad-band filters, and the simultaneous results show small differences within the corresponding standard deviations. The CCD frames were first corrected for standard de–biasing and flat–fielding, then processed for aperture photometry and differential photometry using the comparison stars already calibrated for BL Lac (Fiorucci & Tosti, 1996). The typical standard deviation is of the order of 0.02 magnitudes. The 698 photometric points are reported in Table 4 (available in electronic form only through the IBVS website as `5908-t4.txt`), and briefly resumed in Table 1. Time has been converted to Heliocentric Julian Days.

The first important step in our analysis was to estimate the intrinsic colors of the system. Table 2 shows optical color indices and the JHK_s colors reported by 2MASS (Cutri et al., 2003). Optical photometry suggests a spectral classification ∼ K2 V, while the near-infrared colors are consistent with an higher average temperature: a spectral

Table 1 Photometric observations of USNO-B1.0 1323-0548678

filter	N. of data			max	min
	Armenzano	Porziano	TOT		
B	29	51	80	16.64±0.03	16.93±0.04
V	147	35	182	15.67±0.02	15.98±0.02
R_C	258	59	317	15.20±0.01	15.51±0.01
I_C	75	44	119	14.72±0.02	15.03±0.02

Table 2 Observed and dereddened colors of USNO-B1.0 1323-0548678

$E(B-V)$	$B-V$	$V-R_C$	$V-I_C$	$J-H$	$J-K_s$
0.00	0.95	0.45	0.95	0.39	0.45
0.10	0.85	0.38	0.81	0.35	0.41

classification $\sim$ G8 V. It is extremely probable that the variable is reddened by the interstellar matter in the Lacerta region (Schlegel et al., 1998, report a Galactic extinction $A_V \simeq 1.1$), so we computed the dereddened colors (Fiorucci & Munari, 2003) changing the $E(B-V)$ parameter from 0 to 0.40, step 0.01. Comparing the dereddened colors with the expected ones for the various MK spectral types we verified that the best fit is achieved for $E(B-V) = 0.10$, corresponding to the spectral type G6 V, a value that now allows a good agreement between optical and near-infrared dereddened color indices (see Table 2).

W UMa stars are close contact binary systems, with components that generally belong to main–sequence stars of spectral type from late A to middle K. They are among the most numerous variable stars in the sky, $\sim$ 95% of all variable stars in the solar neighborhood (Hoffman et al., 2009). They can be easily identified by spectroscopic observations, while the photometric classification is usually performed by visual inspection of the light curve profile and by the identification of the spectral type. With our estimation of the spectral type, and taking into account of the typical patterns in the light curve, we can confirm that USNO-B1.0 1323-0548678 is a close binary system. The minima in the light curve have almost exactly the same depth indicating very similar temperatures of the components. The minima are not flat-bottomed, and the overall variations are less than 0.3 mag in all the bands, indicating a moderate orbital inclination. Since much information is obtained from observations of the eclipses, we expect that the quality of determination of the geometrical and physical parameters of the system will not be as good as for systems with higher inclination. The beginning and end of eclipses are barely visible in the light curve, which may suggest a small overfilling configuration for this system. With our observations, together with the historical data reported by Sokolovsky & Amirkhanyan (2006), we are able to considerably improve the period by means of the Fourier periodogram:

$$\mathrm{P} = 0.354632 \pm 0.000001 \text{ days } (8^{\mathrm{h}}30^{\mathrm{m}}40\overset{\mathrm{s}}{.}2)$$

$$\Phi_0 = \mathrm{HJD}\ 2453999.06601 \pm 0.00001$$

We analyzed our observations with the 2003 version of the Wilson-Devinney program (Wilson & Devinney, 1971; Wilson, 1990). We used mode 3, appropriate for over–contact binaries of this type, and adjusted the parameters shown in Table 3. As explained before, we have estimated the system as a G6 V MK spectral type, so we can set the mean effective temperature of star 1 equal to 5600 K. Unadjusted parameters such as the gravity darkening exponents and bolometric albedos were set to their theoretically expected values for this type of star. Limb darkening coefficients were taken from the tables presented by Van Hamme (1993). Only the principal parameters were iterated: phase of the primary conjunction ϕ_0, inclination i, average temperature of the secondary star T_2, surface potential $\Omega_1 = \Omega_2$, mass ratio q, and relative monochromatic luminosity of the primary star L_1 in the B, V, R_C and I_C bands. Figure 1 shows the best fit to the BVR_CI_C normalized flux versus phase. The geometrical representation is given in Figure 2. This is our best fit, obtained after a deep sampling of a large range of parameters. However, further photometric and spectroscopic observations could be useful since acceptable fits can be

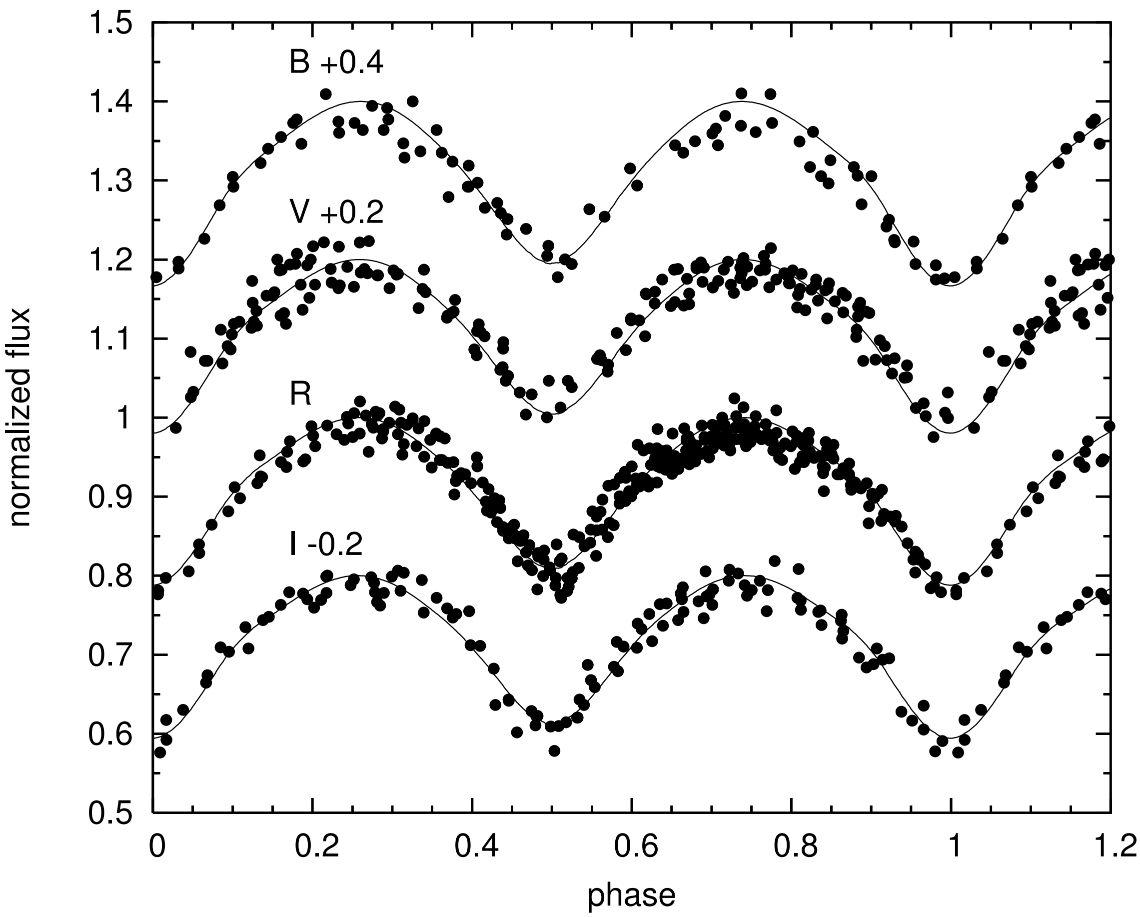

Figure 1. Comparison between theoretical (lines) and observed (circles) BVR_CI_C phase diagrams

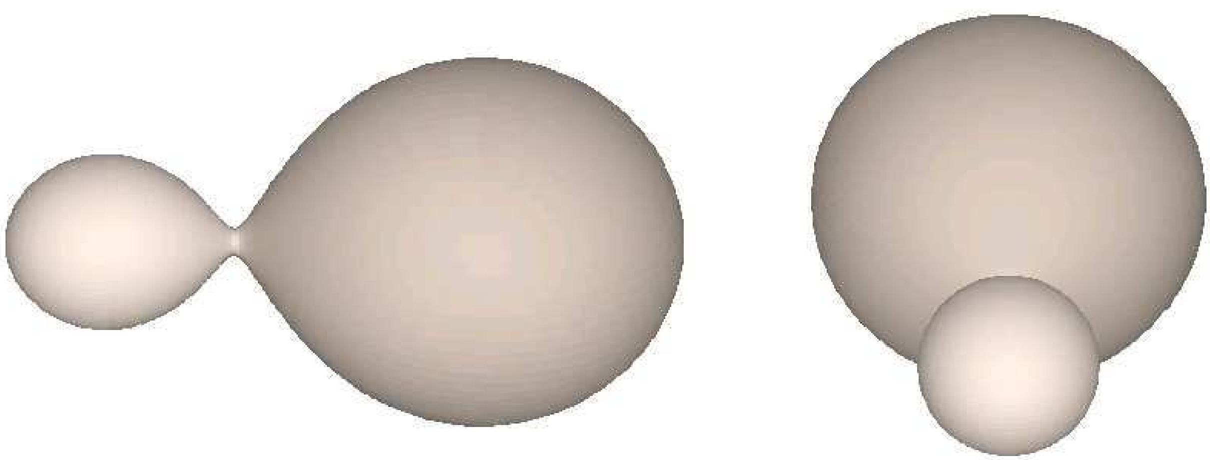

Figure 2. Geometrical representation of USNO-B1.0 1323-0548678 during the maximum (left) and the secondary minimum (right). It is worth to note the small filling factor ($\simeq$ 1.1%).

Table 3 Adjusted Parameters from the Wilson-Devinney code

Parameter	Value	Std. Error*
i	63°.7	0°.6
T_1	5600 K	(assumed)
T_2	5428 K	32 K
$q = M_2/M_1$	5.009	0.031
$\Omega_1 = \Omega_2$	9.157	0.013
$L_1(B)$	2.607	0.046
$L_1(V)$	2.535	0.033
$L_1(R_C)$	2.494	0.027
$L_1(I_C)$	2.463	0.027
$L_2(B)$	9.317	0.085
$L_2(V)$	9.452	0.076
$L_2(R_C)$	9.531	0.062
$L_2(I_C)$	9.593	0.065
r_1^{pole}	0.2337	0.0002
r_2^{pole}	0.4881	0.0002
r_1^{side}	0.2432	0.0002
r_2^{side}	0.5312	0.0002
r_1^{back}	0.2764	0.0002
r_2^{back}	0.5540	0.0002

* Formal errors from the differential corrections solution.

achieved for a large range of mass ratio values, thus resulting in significantly differences in the other parameters.

Our solution indicates that USNO-B1.0 1323-0548678 is a W-type W UMa contact binary: the primary minimum corresponds to an occultation eclipse of the larger secondary in front of the smaller primary component (using the definition of components required by the W–D code). These variables usually have surface temperatures equal or less than 6200 K, in agreement with the estimate obtained considering the interstellar extinction. The temperature difference between the two components is relatively small (≃170 K) and this is in agreement with a good thermal contact. Like many W-type systems, also this system shows rapid changes within the two observed light curve maxima.

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THE NEW ECCENTRIC ECLIPSING BINARY GSC 3152 1202

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The recently discovered binary system (GSC 3152 1202, $\alpha_{2000} = 20^h27^m17\overset{s}{.}3$, $\delta_{2000} = +37°56'27''$, $P = 2.094$) belongs to the list of "50 new eccentric eclipsing binaries found in the ASAS, Hipparcos and NSVS databases" published by Otero et al. (2006). The star is a rather faint eclipsing binary. The only photometric measurement available is the original ROTSE1 magnitude ($12\overset{m}{.}69$).

We performed measurements in the V band at the Crimea Station of the Sternberg Astronomical Institute using the Zeiss-600 + an Ap47 CCD array in June 2009 and at the Tien Shan Astronomical Observatory using a Ritchey-Chretien-350 + an ST-402 CCD array in August 2009. The nearest neighbors GSC 3152 1174 ("c1") and GSC 3152 0488 ("c2") were used as comparison stars initially. We found the rms deviation of $\Delta m(var-c2)$ outside minima to reach $0\overset{m}{.}008$. The rms-scatter $\Delta m(var - c1)$ reached $0\overset{m}{.}011$. However, on June 22 the $\Delta m(var - c2)$ values had a trend of about $0\overset{m}{.}1$ in 2.5 hours in contrast to the $\Delta m(var - c1)$ values. This behavior must be due to the variability of the star "c2". In any case in this study we used only "c1" (GSC 3152 1174) as the comparison star. The joint light curve is shown in Fig. 1. The data of individual measurements are accessible at the IBVS website as `5909-t2.txt` .

Only one star in the CCD-images has a known spectral type (BD +37°3937, Sp G0). The information is obtained from the SIMBAD Astronomical Database (operated at Strasburg, France). Some of our observations outside minima were made in U, B and R bands. Our study has limited a range of a spectral type of the star under investigation from G0 to K2 with high probability.

We see from Fig. 1 that the depths of minima are close to each other. Thus we are dealing with a binary system composed of two stars with similar masses and spectra.

The photometric elements of the system have been derived by minimizing a functional depending on the measured and theoretical magnitude differences (Kozyreva, Zakharov, 2001).

The coefficients of limb-darkening u_1 and u_2 of the component stars (spectral types from $G0$ until $K2$) were chosen according to Grygar et al. (1972) and were fixed during calculations. We found the correlation between the derived photometric elements and the adopted limb-darkening parameters to be rather weak.

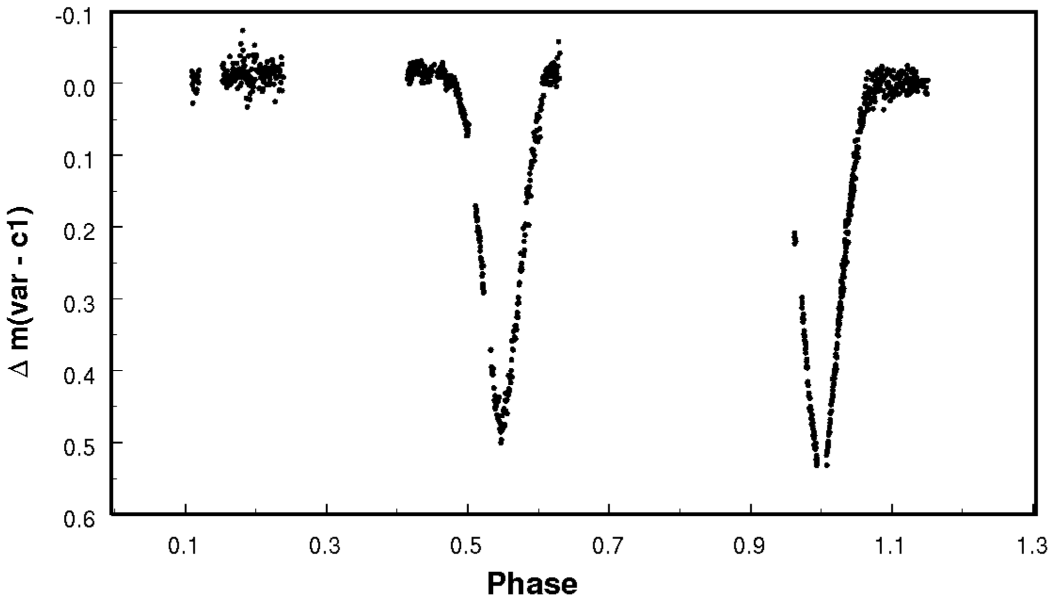

Figure 1. The summary V-light curve of GSC 3152 1202 obtained at the Tian-Shan observatory and at the Crimea observatory in summer 2009

The elements of the system are presented in Tab. 1: the radii (r_1,r_2), inclination (i), the eccentricity (e), longitude of periastron of the orbit (ω), luminosities of the components (L_1,L_2 and the "third light", L_3). In addition the table includes the interval of the fixed limb-darkening parameters (u_1, u_2, according to adopted spectral types of the components), the shift of the secondary minimum ϕ_{II} and the standard deviation (σ_{o-c}) of the solution. The solution corresponds to the average time of our observations (July 2009). Since the light curve is based on a compilation of measurements obtained on different instruments during several months, we expect some systematic errors to be present in the derived photometric elements.

Table 1: The photometric elements of the star GSC 3152 1202.

Element	Value	Element	Value
r_1	0.241 ± 0.003	L_1	0.560 ± 0.020
r_2	0.216 ± 0.005	L_2	0.410 ± 0.020
i	$85^\circ\!.3 \pm 0^\circ\!.3$	L_3	0.030 ± 0.030
e	0.084 ± 0.001	u_1	$0.61 \div 0.72$(fixed)
ω	$332^\circ\!.7 \pm 0^\circ\!.2$	u_2	$0.61 \div 0.72$(fixed)
ϕ_{II}	$0.^{p}5475 \pm 0.0005$	σ_{o-c}	0.0107

The only available data besides our observations of this star are the time of the primary minimum (JDH 51478.596) and the shift of the secondary minimum ($\phi_{II} = 0.489$) published by Otero et al. (2006).

The change in the phase of the secondary minimum for the two epochs of observations is significant, indicating the existence of apsidal motion of the orbit.

Given the calculated eccentricity $e = 0.084$, the shift of the secondary minimum ($\phi_{II} = 0.489$) agrees with two values of the longitude of periastron located in quadrants II and III. The apsidal period is equal to either 15 or 50 years correspondingly. Thus we can give only the upper limit for the apsidal period: $U \leq 50$ years.

We derived, along with other photometric elements, the time of conjunction of the components at primary eclipse (T_1). The time of secondary conjunction of the components (T_2) was inferred via well-known relation from Kopal (1978) with the derived values of orbital elements (Tab.1):

$$\mathrm{T}_2 = \mathrm{T}_1 + \frac{P}{2} + \frac{2Pe\cos\omega}{\pi} - \frac{2Pe^3(1+3\sqrt{1-e^2})}{3\pi(1+\sqrt{1-e^2})^3}\cos 3\omega + ... \qquad (1)$$

The period P_1 was calculated using two moments of primary minima.

$$\mathrm{Min\,I} = \mathrm{JD}_\odot\, 2455004.4386(2)$$

$$\mathrm{Min\,II} = \mathrm{JD}_\odot\, 2455066.3026(3)$$

$$P_I = 2\overset{\mathrm{d}}{.}093731(1)$$

In conclusion we note that this eclipsing binary system (GSC 3152 1202) is a very good object for rapid detection of apsidal motion.

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NEW TIMES OF MINIMA OF SOME ECLIPSING VARIABLES

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Observatory and telescope:
URSA: URSA Observatory at the University of Arkansas (ursa.uark.edu); 10-inch Schmidt-Cassegrain reflector. NFO: NFO WebScope near Silver City, NM, USA (`www.nfo.edu`); 24-inch classical Cassegrain.

Detector:	URSA: 1020×1530 pixels SBIG ST8EN CCD cooled to (typ.) −20°C; 1.15 arcsec square pixels; 20′(N-S)×30′(E-W) field of view. NFO: 2102×2092 pixels Kodak KAF 4300E CCD cooled to (typ.) −20 C; 0.78 arcsec square pixels; 27′ square field of view.

Method of data reduction:
Virtual measuring engine (Measure 2.0) written by C.H.S. Lacy (2005).

Method of minimum determination:
Kwee & van Woerden (1956)

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
AP And	54285.9143	0.0002	1	*V*	NFO
	54289.8826	0.0003	2	*V*	URSA
	54317.6601	0.0004	1	*V*	URSA
	54327.9778	0.0002	2	*V*	NFO
	54328.7708	0.0002	1	*V*	URSA
	54328.7713	0.0002	1	*V*	NFO
	54331.9456	0.0002	1	*V*	NFO
	54339.8823	0.0002	1	*V*	URSA
	54339.8830	0.0004	1	*V*	NFO
	54343.8510	0.0002	2	*V*	NFO
	54347.8194	0.0005	1	*V*	NFO
	54367.6601	0.0001	2	*V*	NFO
	54371.6281	0.0002	1	*V*	NFO
	54386.7074	0.0002	2	*V*	NFO
	54389.8824	0.0002	2	*V*	NFO
	54393.8503	0.0002	1	*V*	NFO
	54394.6440	0.0002	2	*V*	NFO
	54398.6122	0.0002	1	*V*	URSA
	54401.7867	0.0002	1	*V*	URSA

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
	54401.7865	0.0002	1	*V*	NFO
	54405.7550	0.0001	2	*V*	NFO
	54409.7229	0.0002	1	*V*	NFO
	54413.6914	0.0004	2	*V*	URSA
	54413.6911	0.0002	2	*V*	NFO
	54421.6278	0.0002	2	*V*	URSA
	54459.7226	0.0002	2	*V*	NFO
	54463.6909	0.0001	1	*V*	NFO
	54475.5954	0.0002	1	*V*	NFO
	54498.6113	0.0002	1	*V*	NFO
	55097.8142	0.0002	2	*V*	NFO
CO And	54321.8820	0.0003	2	*V*	URSA
	54332.8474	0.0003	2	*V*	NFO
	54343.8131	0.0003	2	*V*	URSA
	54365.7456	0.0003	2	*V*	URSA
	54365.7456	0.0002	2	*V*	NFO
	54387.6785	0.0002	2	*V*	NFO
	54409.6103	0.0003	2	*V*	URSA
	54418.7474	0.0004	1	*V*	NFO
	54420.5760	0.0005	2	*V*	URSA
	54734.9352	0.0003	2	*V*	NFO
	54736.7608	0.0003	1	*V*	URSA
	54745.9002	0.0003	2	*V*	NFO
	54747.7290	0.0002	1	*V*	NFO
	54756.8668	0.0002	2	*V*	NFO
	54758.6957	0.0002	1	*V*	NFO
	54767.8323	0.0002	2	*V*	NFO
	54778.8003	0.0005	2	*V*	URSA
	54778.7987	0.0002	2	*V*	NFO
	54789.7646	0.0003	2	*V*	NFO
	54800.7295	0.0003	2	*V*	NFO
	54811.6962	0.0003	2	*V*	NFO
	54822.6622	0.0005	2	*V*	URSA
CG Aur	54386.9152	0.0004	2	*V*	NFO
	54406.7684	0.0005	2	*V*	URSA
	54413.9894	0.0006	2	*V*	NFO
	54423.8644	0.0003	1	*V*	NFO
	54453.6973	0.0007	2	*V*	URSA
	54480.7714	0.0005	2	*V*	NFO
	54489.7942	0.0006	2	*V*	URSA
	54526.7436	0.0005	1	*V*	NFO
	54536.7228	0.0009	2	*V*	NFO
	54746.9401	0.0003	1	*V*	NFO
	54755.9590	0.0006	1	*V*	NFO
	54765.9411	0.0006	2	*V*	URSA
	54767.7473	0.0011	2	*V*	URSA
	54793.8649	0.0002	1	*V*	URSA
	54811.9147	0.0005	1	*V*	NFO
	54820.9374	0.0006	1	*V*	NFO
	54821.8891	0.0006	2	*V*	NFO
	54832.7197	0.0004	2	*V*	URSA
	54842.5937	0.0004	1	*V*	URSA
	54869.6646	0.0005	1	*V*	NFO
	54907.5671	0.0007	1	*V*	URSA

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
HP Aur	54387.8986	0.0003	1	*V*	NFO
	54397.8588	0.0002	1	*V*	URSA
	54404.9722	0.0002	1	*V*	URSA
	54404.9720	0.0002	1	*V*	NFO
	54432.7178	0.0002	2	*V*	URSA
	54469.7110	0.0004	2	*V*	URSA
	54486.7847	0.0007	2	*V*	URSA
	54489.6304	0.0003	2	*V*	URSA
	54521.6429	0.0002	1	*V*	NFO
	54536.5843	0.0004	2	*V*	URSA
	54737.9104	0.0001	1	*V*	URSA
	54769.9220	0.0002	2	*V*	URSA
	54777.7496	0.0002	1	*V*	URSA
	54779.8821	0.0003	2	*V*	URSA
	54787.7094	0.0001	1	*V*	URSA
	54789.8428	0.0003	2	*V*	URSA
	54849.6013	0.0002	2	*V*	URSA
	54866.6736	0.0003	2	*V*	URSA
	54881.6145	0.0002	1	*V*	URSA
	54908.6470	0.0002	1	*V*	URSA
UW Boo	54906.8298	0.0010	2	*V*	NFO
V381 Cas	54334.9247	0.0003	2	*V*	URSA
V651 Cas	54360.9342	0.0001	1	*V*	URSA
	54393.8289	0.0001	1	*V*	URSA
	54402.8002	0.0002	1	*V*	URSA
	54408.7811	0.0001	1	*V*	URSA
	54439.6816	0.0001	1	*V*	URSA
	54466.5955	0.0001	1	*V*	URSA
	54467.5924	0.0002	1	*V*	URSA
	54469.5857	0.0001	1	*V*	URSA
	54727.7602	0.0001	1	*V*	URSA
	54732.7434	0.0001	1	*V*	URSA
	54735.7344	0.0001	1	*V*	URSA
	54750.6865	0.0001	1	*V*	URSA
	54766.6355	0.0002	1	*V*	URSA
	54767.6325	0.0001	1	*V*	URSA
	54769.6261	0.0002	1	*V*	URSA
	54779.5931	0.0002	1	*V*	URSA
	54786.5713	0.0001	1	*V*	URSA
	54792.5522	0.0001	1	*V*	URSA
	54793.5490	0.0001	1	*V*	URSA
	54795.5425	0.0001	1	*V*	URSA
WW Cep	54304.6991	0.0003	1	*V*	URSA
	54320.8009	0.0005	2	*V*	URSA
	54334.6067	0.0006	2	*V*	URSA
	54403.6196	0.0007	2	*V*	URSA
	54419.7208	0.0002	1	*V*	URSA
	54479.5287	0.0003	1	*V*	URSA
	54649.7619	0.0001	1	*V*	URSA
	54732.5776	0.0001	1	*V*	URSA
	54741.7794	0.0001	1	*V*	URSA
WY Cep	54324.7841	0.0001	1	*V*	URSA
	54327.9077	0.0003	2	*V*	URSA

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V456 Cyg	54227.9184	0.0001	1	*V*	NFO
	54320.6032	0.0003	1	*V*	URSA
	54373.6286	0.0002	2	*V*	NFO
V974 Cyg	54636.8342	0.0005	1	*V*	NFO
V1136 Cyg	54612.7989	0.0006	1	*V*	NFO
BF Dra	54260.8543	0.0005	1	*V*	URSA
	54305.6982	0.0003	1	*V*	URSA
	54344.7510	0.0006	2	*V*	URSA
	54361.7525	0.0004	1	*V*	NFO
	54406.5972	0.0003	1	*V*	URSA
	54406.5976	0.0002	1	*V*	NFO
	54613.8163	0.0004	2	*V*	NFO
	54731.7160	0.0002	1	*V*	NFO
	54938.9325	0.0012	2	*V*	NFO
AC Gem	54466.6994	0.0004	1	*V*	NFO
	54735.9134	0.0006	1	*V*	URSA
LV Her	54331.7839	0.0003	2	*V*	NFO
	54368.6548	0.0002	2	*V*	NFO
	54589.8873	0.0002	2	*V*	NFO
	54647.7332	0.0002	1	*V*	URSA
	54647.7328	0.0006	1	*V*	NFO
	54868.9645	0.0007	1	*V*	URSA
WZ Leo	54483.9779	0.0013	2	*V*	NFO
	54495.9464	0.0003	1	*V*	NFO
	54502.9877	0.0007	1	*V*	NFO
	54507.9173	0.0006	2	*V*	NFO
	54567.7639	0.0003	1	*V*	NFO
	54584.6621	0.0003	1	*V*	URSA
	54584.6630	0.0003	1	*V*	NFO
	54591.7031	0.0003	1	*V*	NFO
V501 Mon	54422.8674	0.0005	2	*V*	NFO
	54450.9531	0.0007	2	*V*	NFO
	54454.8302	0.0004	1	*V*	NFO
	54475.8934	0.0008	1	*V*	NFO
	54787.9741	0.0006	2	*V*	NFO
	54791.8490	0.0010	1	*V*	NFO
V506 Oph	54179.9684	0.0001	1	*V*	NFO
	54195.8747	0.0002	1	*V*	URSA
	54222.9155	0.0002	2	*V*	NFO
	54237.7616	0.0002	2	*V*	URSA
	54238.8222	0.0002	2	*V*	URSA
	54240.9431	0.0002	2	*V*	NFO
	54256.8503	0.0002	2	*V*	NFO
	54275.9374	0.0002	2	*V*	NFO
	54289.7228	0.0002	2	*V*	URSA
	54290.7834	0.0002	2	*V*	URSA
	54306.6892	0.0002	2	*V*	URSA
	54323.6566	0.0002	2	*V*	URSA
	54556.9504	0.0002	2	*V*	NFO
	54564.9038	0.0004	1	*V*	NFO
	54572.8568	0.0003	2	*V*	NFO
	54582.9305	0.0002	1	*V*	NFO
	54590.8842	0.0001	2	*V*	URSA
	54600.9580	0.0002	1	*V*	NFO

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
	54605.7299	0.0002	2	*V*	URSA
	54607.8509	0.0003	2	*V*	URSA
	54625.8780	0.0002	2	*V*	URSA
	54625.8782	0.0002	2	*V*	NFO
	54631.7105	0.0003	1	*V*	NFO
	54632.7710	0.0002	1	*V*	NFO
	54648.6772	0.0002	1	*V*	URSA
	54648.6765	0.0003	1	*V*	NFO
	54726.6186	0.0002	2	*V*	URSA
	54727.6783	0.0003	2	*V*	NFO
	54752.5992	0.0001	1	*V*	NFO
	54865.0047	0.0003	1	*V*	URSA
	54881.9711	0.0002	1	*V*	URSA
	54915.9048	0.0002	1	*V*	URSA
	54916.9655	0.0002	1	*V*	NFO
	54924.9187	0.0002	2	*V*	NFO
	54974.7598	0.0006	2	*V*	NFO
	54984.8325	0.0003	1	*V*	NFO
	54999.6791	0.0003	1	*V*	NFO
IM Per	54364.7974	0.0004	2	*V*	URSA
	54373.8136	0.0002	2	*V*	NFO
	54392.9735	0.0002	1	*V*	NFO
	54400.8664	0.0003	2	*V*	NFO
	54408.7535	0.0002	1	*V*	NFO
	54409.8810	0.0005	2	*V*	URSA
	54409.8827	0.0004	2	*V*	NFO
	54416.6436	0.0004	2	*V*	NFO
	54487.6514	0.0003	1	*V*	NFO
	54505.6866	0.0003	1	*V*	NFO
	55109.8221	0.0007	1	*V*	NFO
V482 Per	54193.6316	0.0006	2	*V*	NFO
	54402.8237	0.0003	1	*V*	NFO
	54408.9423	0.0004	2	*V*	URSA
	54764.9399	0.0005	1	*V*	URSA
	54764.9392	0.0004	1	*V*	NFO
	54774.7265	0.0006	1	*V*	URSA
	54786.9621	0.0005	1	*V*	NFO
	54801.6414	0.0008	1	*V*	NFO
	54812.6523	0.0006	2	*V*	URSA
	54840.7884	0.0005	1	*V*	URSA
	54840.7874	0.0005	1	*V*	NFO
	54845.6802	0.0004	1	*V*	NFO
	54867.7018	0.0004	1	*V*	URSA
	54867.7024	0.0004	1	*V*	NFO
V514 Per	54370.8736	0.0004	2	*V*	NFO
	54411.8034	0.0005	1	*V*	NFO
	54412.7129	0.0007	2	*V*	NFO
	54422.7193	0.0006	1	*V*	URSA
	54422.7215	0.0010	1	*V*	NFO
	54503.6717	0.0005	2	*V*	NFO
	54733.7953	0.0005	1	*V*	URSA
	54742.8921	0.0004	1	*V*	URSA
	54742.8907	0.0010	1	*V*	NFO
	54753.8085	0.0006	1	*V*	NFO

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
	54762.9037	0.0005	1	*V*	NFO
	54794.7391	0.0009	2	*V*	NFO
	54795.6452	0.0005	1	*V*	NFO
	54803.8337	0.0012	2	*V*	NFO
	54865.6842	0.0005	2	*V*	NFO
	55094.8967	0.0005	2	*V*	NFO
	55104.9025	0.0009	1	*V*	NFO
	55105.8154	0.0006	2	*V*	NFO
AQ Ser	54210.7929	0.0003	2	*V*	URSA
	54221.7613	0.0004	1	*V*	NFO
	54242.8536	0.0002	2	*V*	NFO
	54259.7283	0.0003	2	*V*	NFO
V335 Ser	54616.7031	0.0002	1	*V*	URSA
	54616.7032	0.0002	1	*V*	NFO
TY Tau	54403.7429	0.0005	2	*V*	URSA
	54404.9722	0.0002	2	*V*	URSA
	54410.7442	0.0003	1	*V*	URSA
	54411.8215	0.0003	1	*V*	URSA
	54412.8990	0.0002	1	*V*	URSA
	54413.9757	0.0006	1	*V*	URSA
	54419.9011	0.0004	2	*V*	URSA
	54437.6785	0.0002	1	*V*	URSA
	54451.6849	0.0002	1	*V*	URSA
	54453.8400	0.0003	1	*V*	URSA
	54465.6896	0.0003	1	*V*	URSA
	54466.7673	0.0002	1	*V*	URSA
	54477.5404	0.0004	1	*V*	URSA
	54479.6950	0.0003	1	*V*	URSA
	54486.6969	0.0006	2	*V*	URSA
	54499.6275	0.0005	2	*V*	URSA
	54506.6298	0.0002	1	*V*	URSA
	54526.5625	0.0007	2	*V*	URSA
	54732.8767	0.0004	1	*V*	URSA
	54733.9552	0.0003	1	*V*	URSA
	54740.9554	0.0006	2	*V*	URSA
	54766.8121	0.0005	2	*V*	URSA
	54767.8898	0.0004	2	*V*	URSA
	54768.9673	0.0010	2	*V*	URSA
	54774.8930	0.0003	1	*V*	URSA
	54779.7399	0.0005	2	*V*	URSA
	54786.7446	0.0002	1	*V*	URSA
	54787.8229	0.0003	1	*V*	URSA
	54792.6688	0.0004	2	*V*	URSA
	54795.9019	0.0008	2	*V*	URSA
	54822.8342	0.0009	2	*V*	URSA
	54842.7657	0.0004	1	*V*	URSA
	54848.6930	0.0005	2	*V*	URSA
	54849.7702	0.0006	2	*V*	URSA
	54853.5409	0.0004	1	*V*	URSA
	54882.6298	0.0002	1	*V*	URSA
CF Tau	54384.8710	0.0004	1	*V*	NFO
	54406.9206	0.0003	1	*V*	NFO
	54734.8615	0.0004	1	*V*	URSA

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V1094 Tau	54438.6645	0.0002	1	*V*	URSA
	54447.6544	0.0003	1	*V*	NFO
BP Vul	54346.7370	0.0002	1	*V*	NFO
	54347.6682	0.0002	2	*V*	NFO
	54380.6558	0.0006	2	*V*	NFO
	54381.6640	0.0001	1	*V*	NFO
	54632.9003	0.0002	2	*V*	NFO
	54740.6289	0.0001	1	*V*	URSA
	55097.6520	0.0003	1	*V*	NFO
BT Vul	54206.8771	0.0004	1	*V*	URSA
	54234.8349	0.0003	2	*V*	URSA
	54314.7229	0.0007	2	*V*	URSA
	54319.8561	0.0002	1	*V*	URSA
	54326.7036	0.0002	1	*V*	URSA
	54327.8448	0.0001	1	*V*	NFO
	54346.6742	0.0006	2	*V*	URSA
	54346.6746	0.0002	2	*V*	NFO
	54358.6558	0.0002	1	*V*	NFO
	54362.6500	0.0002	2	*V*	NFO
	54370.6370	0.0002	2	*V*	NFO
	54379.7680	0.0004	2	*V*	NFO
	54382.6213	0.0002	1	*V*	NFO
	54398.5972	0.0003	1	*V*	NFO
	54402.5932	0.0004	2	*V*	URSA
	54402.5930	0.0004	2	*V*	NFO
	54410.5817	0.0004	2	*V*	NFO
	54458.5123	0.0007	2	*V*	URSA
	54586.8975	0.0004	1	*V*	NFO
	54594.8854	0.0002	1	*V*	NFO
	54614.8562	0.0004	2	*V*	NFO
	54618.8507	0.0002	1	*V*	NFO
	54642.8155	0.0003	2	*V*	NFO
	54722.6994	0.0003	1	*V*	NFO
	54726.6930	0.0007	2	*V*	URSA
	54734.6810	0.0005	2	*V*	URSA
	54739.8167	0.0005	1	*V*	NFO
	54746.6643	0.0003	1	*V*	NFO
	54754.6533	0.0002	1	*V*	NFO
	54762.6415	0.0002	1	*V*	NFO
	54774.6239	0.0004	2	*V*	URSA
	54778.6189	0.0001	1	*V*	NFO
	54794.5946	0.0002	1	*V*	NFO
	54986.8895	0.0005	2	*V*	NFO
	54998.8704	0.0002	1	*V*	NFO
	55106.7132	0.0004	2	*V*	NFO

Remarks:

A sample of the observations has been published by Lacy, Hood & Straughn (2001). Mean deviations between independently timed eclipses by the two telescopes (URSA & NFO) are not significantly larger than expected based on the error estimates, implying that the estimated timing errors are realistic.

Acknowledgements:

Construction and operation of the URSA telescope were partially funded by the National Science Foundation and the University of Arkansas, Fayetteville. Construction and operation of the NFO telescope were partially funded by the National Science Foundation, the Arkansas Center for Space and Planetary Sciences, the NASA Arkansas Space Grant Consortium, the University of Arkansas, Fayetteville, the University of Arkansas at Little Rock, and the Harvard-Smithsonian Center for Astrophysics. We are grateful to Bill Neely for initial processing of the images and maintenance of the NFO equipment and software.

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OPTICAL LIGHT CURVES OF THE HIGH MASS X-RAY BINARY 4U 2206+54

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The high-mass X-ray binary system (HMXB) 4U 2206+54 (BD 53°2790) was first seen as an X-ray source in *Uhuru* observations examined in Giacconi et al. (1972). The system has been examined for periodicity a number of times using X-ray data. Corbet & Peele (2001) reported a period of 9.568 ± 0.004 days from *Rossi X-ray Timing Explorer* (*RXTE*) All-Sky Monitor (ASM) data. Corbet et al. (2007) found that data from the *Swift* Burst Alert Telescope (BAT) along with recent ASM data indicate a period of 19.25 ± 0.08 days and note that this is almost exactly double the previous period. They conclude that the lengthening is likely a recent secular change. In Negueruela & Reig (2001) they report published optical photometry of this system and report all observations at that time were consistent with no optical variability. However, Blay et al. (2006) report seven optical measurements over an eleven year time line that show a long term change, but with insufficient coverage to estimate any periodicity. They also report that their IR data, when folded with the 9.6 days period, showed no clear pattern. As part of an undergraduate summer research program, we examined the HMXB system 4U 2206+54 with time-series observations in the V filter to check for possible correlations in variability with the X-ray data.

The observation and data reduction details for the 22 nights secured for this study have been previously given in Hintz et al. (2009). Although it should be noted here that reductions were done using IRAF aperture photometry packages. The only differences between the two data sets are that there are two additional nights of 0.41-m data and the data for three of the 0.31-m nights were saturated for the bright star 4U 2206+54 in the current study. The finder chart for 4U 2206+54 can be found in Hintz et al. (2009). As noted by Hintz et al. (2009), all observations were done using a standard V filter (Bessell, 1990). Since 4U 2206+54 shows variations during a single night it is hard to get an estimate of the error per observation from this object. However, for star #6, a star about two magnitudes fainter, we find single night error per observation values on the order of 0.003 to 0.004 mag, with the majority nearer 0.003 mag. From the one relatively flat night for 4U 2206+54 on HJD2454658 we find an error per observation of 0.0038 mag, or a value consistent with those seen for star #6. The standard deviation in the nightly zeropoint correction values ranged from 0.003 to 0.005 mag, except for one poor night of data with a zeropoint error of 0.012 (HJD2454651). The observational data are available on the IBVS website as `5911-t1.txt`.

The light curves for each of the 22 nights are presented in Fig. 1. It should be noted that it is not possible to distinguish differences in the dense portions of the curves when simultaneous data were obtained with different combinations of three different telescopes. Each of the graph panels is scaled to cover 6 hours of time. There is variation within each night as well as night to night variation for 4U 2206+54. In Fig. 2, we show the long term run of data for 4U 2206+54 and comparison star #6 over the 55 days covered by this study. Even though star #6 is almost two magnitudes fainter than 4U 2206+54, it is clear from the internal scatter within each night that the variation for the comparison star is smaller than for the HMXB. Further, the night to night variation is present in the data for 4U 2206+54, while the fainter comparison star is flat within the size of the errors. We do note one night, HJD2454651, for star #6 which is systematically higher. This is the previously reported night with an exceptionally high zeropoint error. Finally, from our analysis of the δ Scuti variable star, GSC 3973-1698 (Hintz et al., 2009), we see no zero point drift from night to night. Based on these three evidences, we judge the variations seen for 4U 2206+54 to be actual variability and not an observational artifact due to photometric error.

Using the `Period04` package (Lenz & Breger, 2005), we looked for the most likely period of 4U 2206+54 and found 25.1 ± 0.1 days to be the best fit for the visual data. It is possible that the visual and X-ray data are not well correlated. In Fig. 3 we show a phased light curve for the visual data using our period of 25.1 days along with published periods of 9.568 days and 19.25 days. We selected a starting epoch for phasing of HJD2454679.0 since this was near a maximum brightness point in our data curve. It is worth noting that both of the X-ray periods connect some of the data in an interesting manner but in general produce an irregular phase curve.

An examination of the individual curves shown in Fig. 1 reveals that many nights show short term variation. This could be an indication of more complex variability. After removing the long 25.1 day curve, we examined the remaining variations using `Period04`. We found a frequency of 2.5726 ± 0.0005 cycles/day, or a period of 9.33 hours. The signal-to-noise ratio for this frequency was found to be 5.5, which puts it near the cut-off point for significance detailed by Breger et al. (1993, 2007). A much larger data set would be needed to confirm this underlying oscillation.

Although we do find a period of 25.1 days in the visual data for 4U 2206+54, we must note this is a preliminary result covering just over two of the proposed cycles. A longer data run covering more cycles, over a number of years, would help in the determination of a period of the optical light variation. The larger data set might also help clarify the short period variation suspected in our data set. In addition, it would be useful to examine this system in different wavelengths in order to search for better correlations with the X-ray observations.

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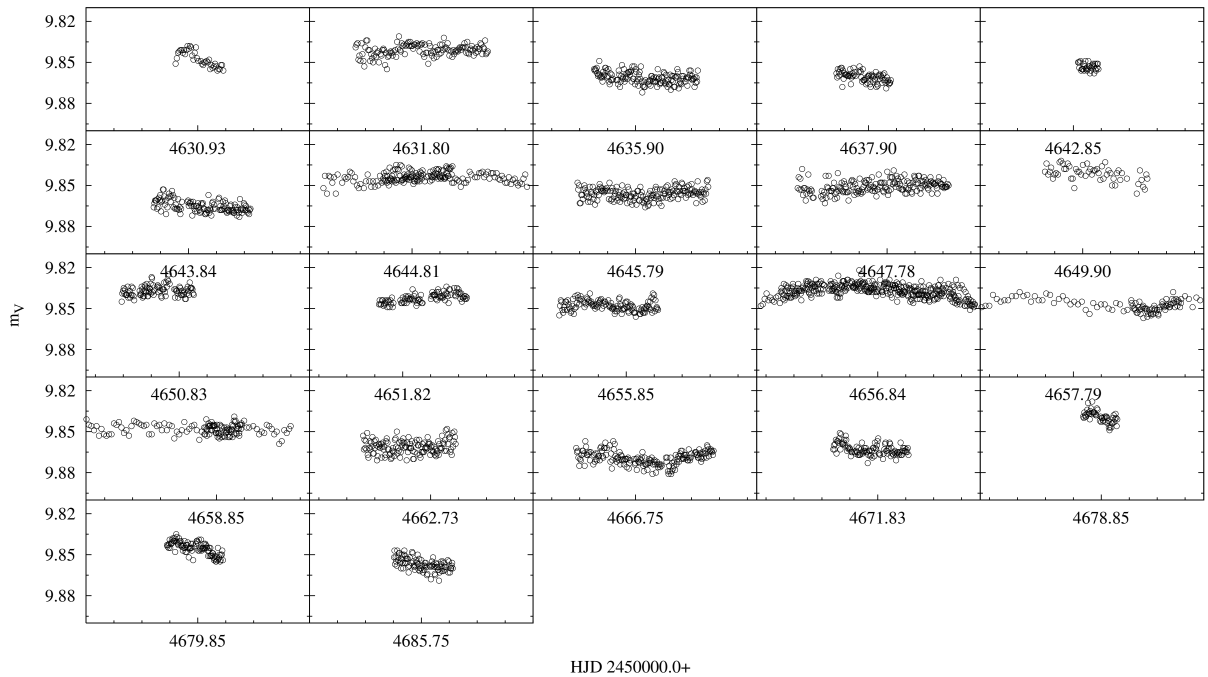

Figure 1. The 22 reported nights of V filter photometry for 4U 2206+54 plotted on the same scale in both time and magnitude. Each tick mark on the time axis is 0.03 days and each panel covers 6 hours.

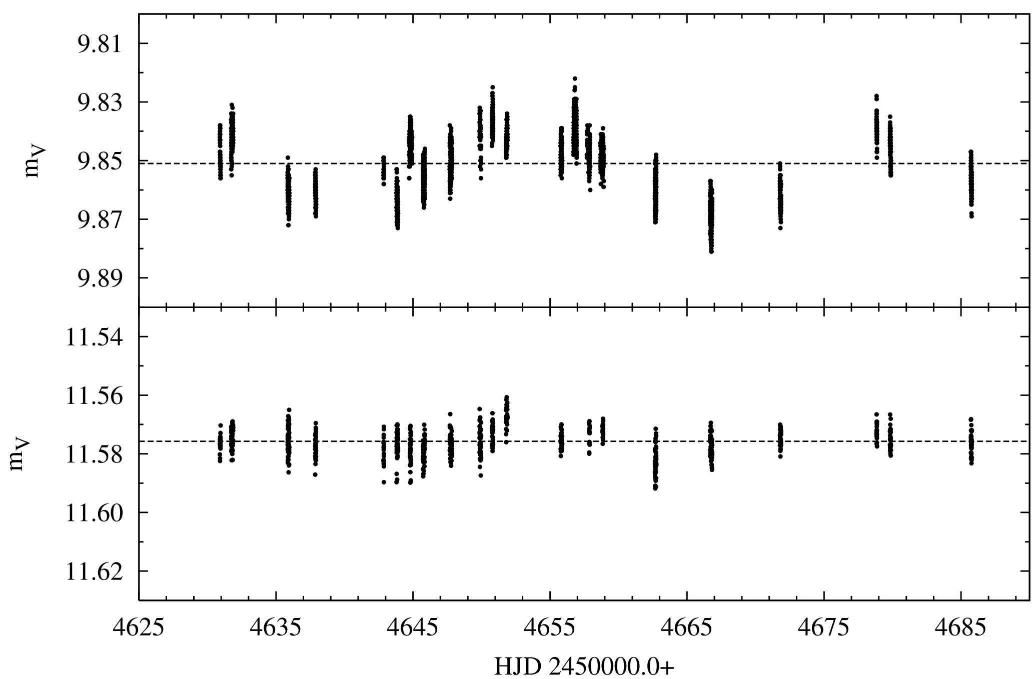

Figure 2. Magnitudes of 4U 2206+54 and the fainter comparison star #6 over 55 days.

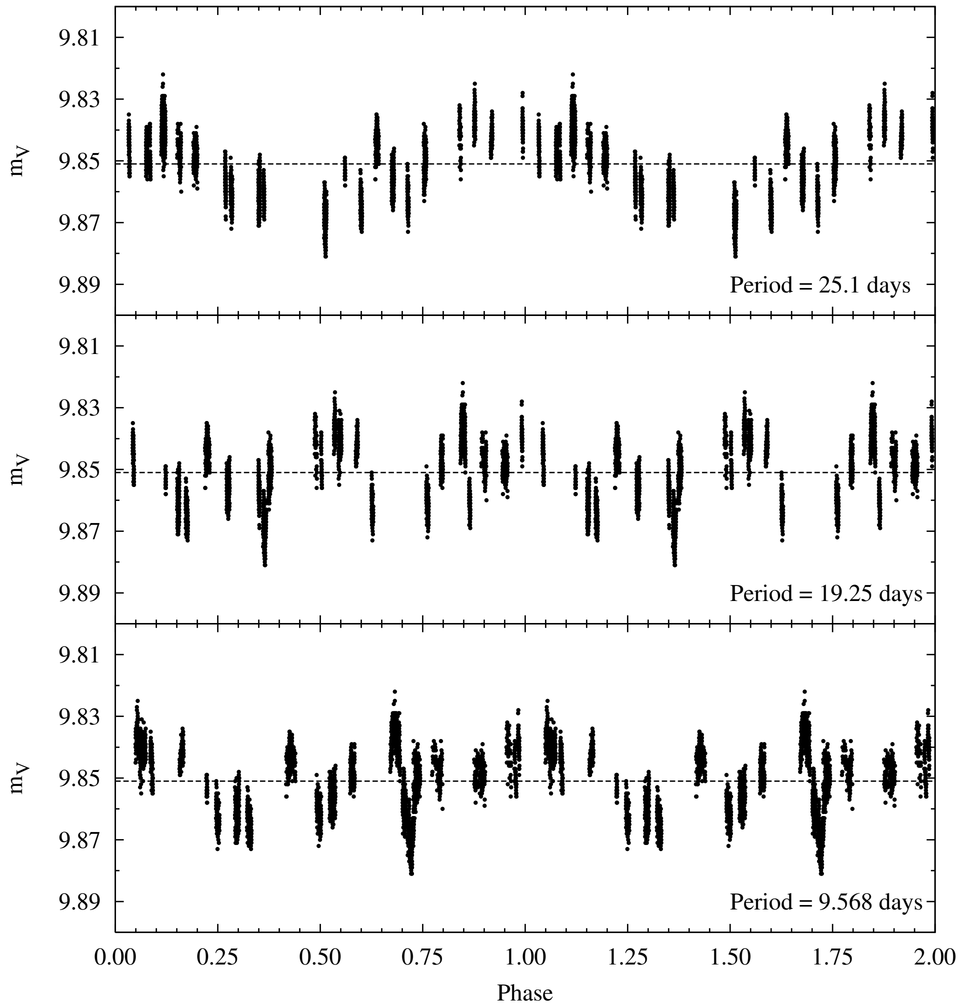

Figure 3. Phased light curves for 4U 2206+54 calculated with different periods as noted. The starting epoch in all cases is 2454679.0.

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2007 PHOTOMETRY OF UV LEONIS

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UV Leo is a member of the short period eclipsing group of RS CVn systems. McCluskey (1966) performed an early photometric study and summarized earlier work on UV Leo. Frederik and Etzel (1996) performed a complete optical photometric study of this system.

Kjurkchieva et al. (2007) performed an optical photometric and spectroscopic study of this system. Their photometry was on the nights of April 4, 14, and 15, 2007. For this work, I collected new optical photometry of UV Leo in 2007. This new photometry, collected about a month later, can tell us something about how rapidly the spots on UV Leo evolve.

I observed UV Leo with the San Diego State University 61-cm telescope on Mt. Laguna. The light curves were obtained on the nights of May 8, 9, 11, 13, 16, 23, & 28, 2007. I used SAO 99225 as the comparison star and SAO 99223 as the check. Using standards of Landolt (1983), I calibrated the comparison star magnitudes: $B = 9.26, V = 8.20$, R=7.61, and $I = 7.11$. The calibrated check star magnitudes are: $B = 8.77, V = 8.33, R = 8.04$, and $I = 7.77$. The complete four filter light curves, with 120 data points per filter, are plotted in Figure 1. The data are differential magnitudes (var-comp) in the standard Johnson-Cousins system. I used the ephemeris of McClusky (1966):

$$\phi_0 = 2438440.7275 + 0.6000855E.$$

Figure 1 shows considerable variations in the out of eclipse portion of the light curve between phases 0.6 and 0.9. To check if these variations are scatter in the data or changes in the light curve, Figure 2 shows the V band data divided into three groups. Group 1 includes the data from the first four nights, May 8, 9, 11, and 13. Group 2 includes the data from May 16, and Group 3 includes the data from May 23 and 28. It is apparent that the out of eclipse portions of the light curve changed during the nearly three weeks between the beginning and end of the observations.

Because the period is so close to 0.6 days the same phases are available to observe in a three night repeating cycle. It was therefore not possible to fill in the small gaps in the light curves that occurred when the phase at the start of a night was a little after the phase at the end of a previous night. Hence removing the later nights in Group 3 only slightly affects the phases covered, however the photometry is less dense. To completely cover the light curve, it was also necessary to observe at a higher than optimal air mass at the ends of the nights. Therefore the last few data points for each night have more scatter than most of the data for the night. These data are at phases are 0.80, 0.47, 0.57, 0.97, and 0.11. The data deviating most from the models in the clean fits (See Figure 4.) were at these phases. However removing these data would have made the light curves to be modeled even more sparse.

I modeled the 90 data points from Groups 1 and 2 using Budding and Zeilik's (1987) Information Limit Optimization Technique (ILOT). Initial values for stellar parameters were in most cases taken from Kjurkchieva et al. (2007). I used $k(= r_2/r_1) = 0.9668$, $r_1 = 0.30$, $i = 84\overset{\circ}{.}2$, $q(= m_2/m_1) = 0.954$, $T_1 = 6000$, and $T_2 = 5970$. I adopted the limb darkening coefficients for each wavelength from Frederik and Etzel (1996). After the initial fit, the ILOT extracts a distortion wave which I then, in an iterative procedure, fit for two circular 3400K spots. The fits for each color are performed independently. The reported longitude, latitude, and radius of each spot are in degrees. The latitude is the most difficult spot parameter to fit. Attempts to fit the spot latitudes produced errors that were in some cases larger than the possible range of latitudes. The preliminary fits however yielded mid range latitude values, so I fixed the spot latitudes at 45° for the final spot models. Figure 3 shows the V band spot fit. For the spot fits I get:

Spot Fits

2007	B band	V band	R band	I band
Longitude_1	260.9±3.3	260.0±4.1	258.4±4.2	255.9±4.6
Radius_1	17.4±0.9	16.6±1.0	17.7±1.0	17.3±1.1
Longitude_2	47.8±7.6	47.4±9.4	41.2±7.7	40.7±8.4
Radius_2	9.8±1.5	9.4±1.7	12.1±1.5	12.4±1.6
χ^2	234.4	105.6	189.9	192.8

Kjurkchieva et al. (2007) find two spots near the equator at longitudes of 0° and 110° and radii of 27° and 24°. Because my data were taken only about a month after the Kjurkchieva et al. (2007) data, comparing the spot models tells us that the spots on UV Leo can changed considerably in this short time.

It should be noted that they used Binarymaker 3.0 to model their data, and this code uses a different convention for latitude and longitude than the ILOT code. The ILOT code measures latitude north and south from the equator and longitude from phase 0.0 increasing with phase. The Binarymaker code uses the Wilson-Devinney code convention. Latitude is measured south from the north pole, and longitude on the primary star is measured from the primary eclipse increasing in the direction of orbital motion. So longitude(Binmaker) = 360°- longitude(ILOT) and latitude(Binmaker) = 90°- latitude(ILOT).

The latitude comparison is not definitive because I used a fixed latitude.

To definitively compare the spot longitudes, one should note that I used the original McClusky (1966) ephemeris, while Kjurkchieva et al. (2007) cite an updated ephemeris. The ILOT clean fits, after correcting for the spots, compute the best fit for the phase correction correction needed so that the primary and secondary eclipses occur at phases 0.0 and 0.5. For these light curves, this correction is $-7\overset{\circ}{.}1$. Therefore the longitudes in the above table should be reduced by $7\overset{\circ}{.}1$ for direct comparison to the longitudes reported by Kjurkchieva et al. (2007). Hence the Kjurkchieva et al. (2007) spot at 110° longitude is at 250° longitude in the ILOT convention and is very nearly the same longitude as the 253° longitude of my spot corrected as above. The other spot however migrated nearly 40° from the primary eclipse in about a month. Hence one of the spot longitudes changed significantly.

The spots also became smaller in size, and at the same time cooler, during the month between the two sets of light curves.

The ILOT can estimate spot temperatures by comparing infrared models to visual models. Using the initial values of 0K spot parameters at a visual wavelength, I fit infrared data for the unit of light and flux ratio. The value of the spot temperature can be found from the flux ratio of the star's photospheric temperature and the spot temperature.

Comparing the R to V data did not give a valid fit. I compared the R to B, I to V, and I to B fits. The reported spot temperature is the average of these three comparisons. Doing so I find an average value of the spot temperature of $T_s = 3400 \pm 300$K. In an iterative procedure, I then fit the other spot parameters to 3400K spots. In this second iteration the spot longitudes and sizes differed from the values found in the first iteration by less than the reported errors. Hence, I made no further iterations. The spot parameters in the table above are for 3400K spots.

After the spot fits, I performed clean fits to the light curves removing the effects of the distortion wave from the spot as modeled in that filter. I fit each wavelength independently and averaged the color independent parameters. The mass ratio, q, is difficult to determine photometrically, so I fixed this parameter at q=0.954, the value found spectroscopically by Kjurkchieva et al. (2007). For the other color independent parameters, I get: $k(= r_2/r_1) = 0.920 \pm 0.007$, $r_1 = 0.291 \pm 0.002$, and $i = 83.^\circ4 \pm 0.^\circ2$. Figure 4 shows the V band clean fits.

My value for the inclination, $i = 83.^\circ4 \pm 0.^\circ2$, is between the values found by Kjurkchieva et al. (2007), $84.^\circ2$, and Frederik and Etzel (1996), $82.^\circ6$.

The ratio of the radii, $k(= r_2/r_1)$, provides the most astrophysically interesting comparison with previous results. In this work, I get $k = 0.920$. Frederik and Etzel (1996) find $k = 1.097$, so that the secondary star is larger, even though less massive, than the primary. Kjurkchieva et al. (2007), on the other hand, find that $k = 0.967 \pm 0.064$ ($r_1 = 0.30 \pm 0.01$ and $r_2 = 0.29 \pm 0.01$), which agrees to within the errors with my result. In any case the two components of this system are close to the same radius and mass.

This work shows that the spot structure on UV Leo can evolve on time scales of a few weeks. The modeled stellar parameters are consistent with previous work.

I thank Paul Etzel for scheduling generous amounts of observing time at Mt. Laguna. I also acknowledge support from Western Carolina University and the American Astronomical Society Small Research Grant Program.

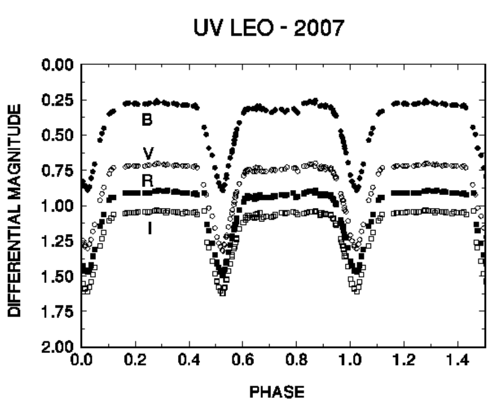

Figure 1. BVRI light curves of UV Leo

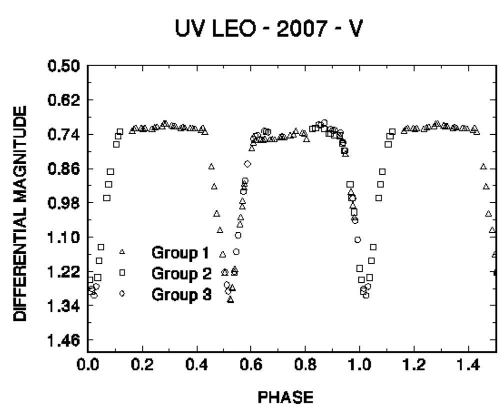

Figure 2. UV Leo V data grouped by date

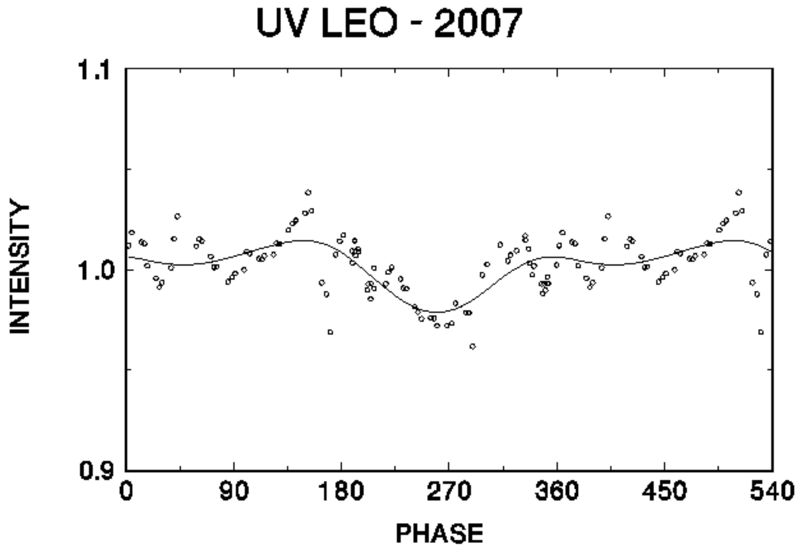

Figure 3. UV Leo V spot fit

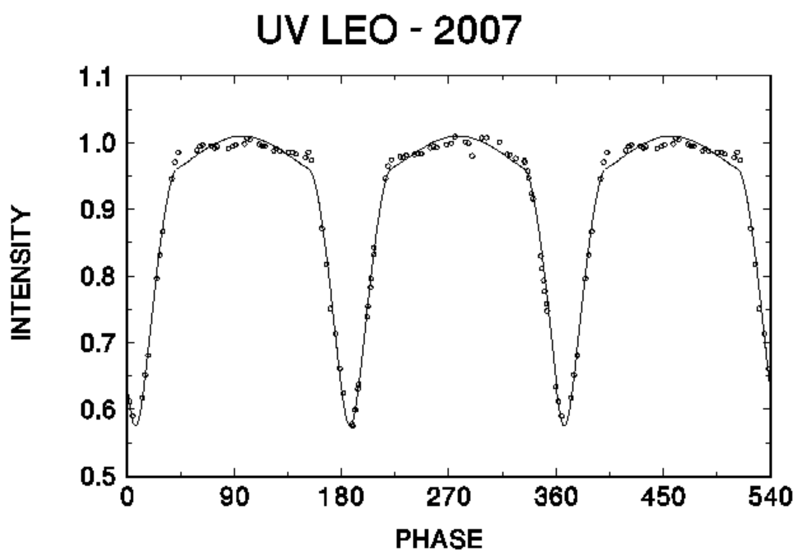

Figure 4. UV Leo V clean fit

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PERIOD CHANGES IN THE ECLIPSING BINARY SYSTEM V861 Her

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The variability of eclipsing binary V861 Her (GSC 3079-00201; $\alpha = 16^{\rm h}51^{\rm m}12\overset{\rm s}{.}80$, $\delta = +41^\circ17'58\overset{''}{.}2$; J2000.0) was discovered and initially investigated on the photographic plates of Moscow collection by Antipin (1996). Later, Csizmadia et al. (2004) analyzed CCD observations and times of minima published by Csizmadia et al. (2002) and Borkovits et al. (2003). The authors gave following light elements:

$$MinI = HJD2451690.5276 + 0\overset{\rm d}{.}344824 \times E \quad (1),$$

that differ considerably from the ephemeris published by Antipin (1996):

$$MinI = HJD2443684.325 + 0\overset{\rm d}{.}3446322 \times E \quad (2).$$

Assuming probable strong variations of the period, we undertook additional CCD observations.

Our CCD photometry was carried out using a Pictor 416XTE camera at the 50-cm Maksutov telescope of the Crimean Laboratory (Sternberg Astronomical Institute). The observations in the Johnson V band continued for three years. 475 brightness measurements were obtained on five nights in 2004 (JD2453195–212), 257 ones – on four nights in 2005 (JD2453561–570), and 166 more – on two nights in 2006 (JD2453552 and 53945). The images were dark subtracted, flat-fielded and analyzed with the aperture photometry package developed by V.P. Goranskij. GSC 3079-00194 was used as a comparison star, the same star was selected for comparison by Csizmadia et al. (2002) and Borkovits et al. (2003). We observed seven primary and two secondary minima, the times of minima determined from our observations (with Gaussian fitting) are marked *tp* (this paper) in the last column of Table 1.

Phased light curves for each season and for all our observations are shown in Figure 1. The curve was plotted for the elements:

$$MinI = HJD2453212.336 + 0\overset{\rm d}{.}3446322 \times E \quad (3).$$

The O'Connell effect mentioned by Csizmadia et al. (2004) is presented in our data too. The period (but not the epoch) is in agreement with that from Antipin (1996) and contradicts the ephemeris published by Csizmadia et al. (2004).

To study period changes of V861 Her in detail, we re-analyzed the photographic data (Antipin, 1996). The observations were divided in parts (seasonal in most cases), then the time of minimum for each of the parts was determined using Hertzsprung's method in conjunction with a computer algorithm developed and described by Berdnikov (1992). The same technique was used by us to determine the time of minimum from NSVS/ROTSE-I online data (Wozniak et al., 2004). Furthermore, we collected all published times of minima of the variable. The results are summarized in Table 1. The last columns of the table contains a reference to the source of information: (pg) photographic observations; (NSVS) NSVS/ROTSE-I data (Woźniak et al., 2004); (C&) Csizmadia et al. (2002); (D1) Diethelm (2002); (B&) Borkovits et al. (2003); (tp) this paper, our CCD observations; (HSW) Hübscher et al. (2009); (D2) Diethelm (2009).

The $O-C$ residuals were calculated for the linear light elements (3). The corresponding $O-C$ diagram is shown in Fig. 2. Variations of the orbital period in the binary system are clearly seen. The remarkable changes occurred between JD2445869 and JD2452344. The diagram corresponds to abrupt period changes not periodic ones. The linear ephemeris (3) can be accepted as current light elements.

Note that neither primary nor secondary minima from Csizmadia et al. (2002) and Borkovits et al. (2003) are in agreement with all other available observations. Apparently, these times of minima are erroneous.

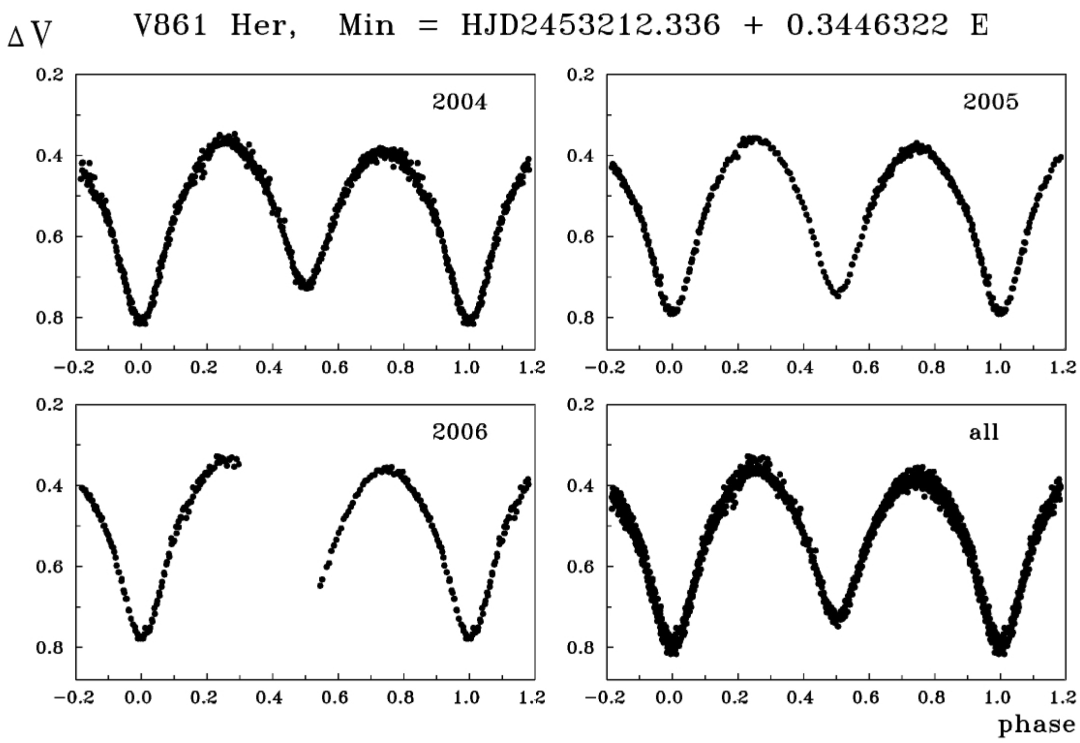

Figure 1. Phased light curves for each season and for all our CCD observations.

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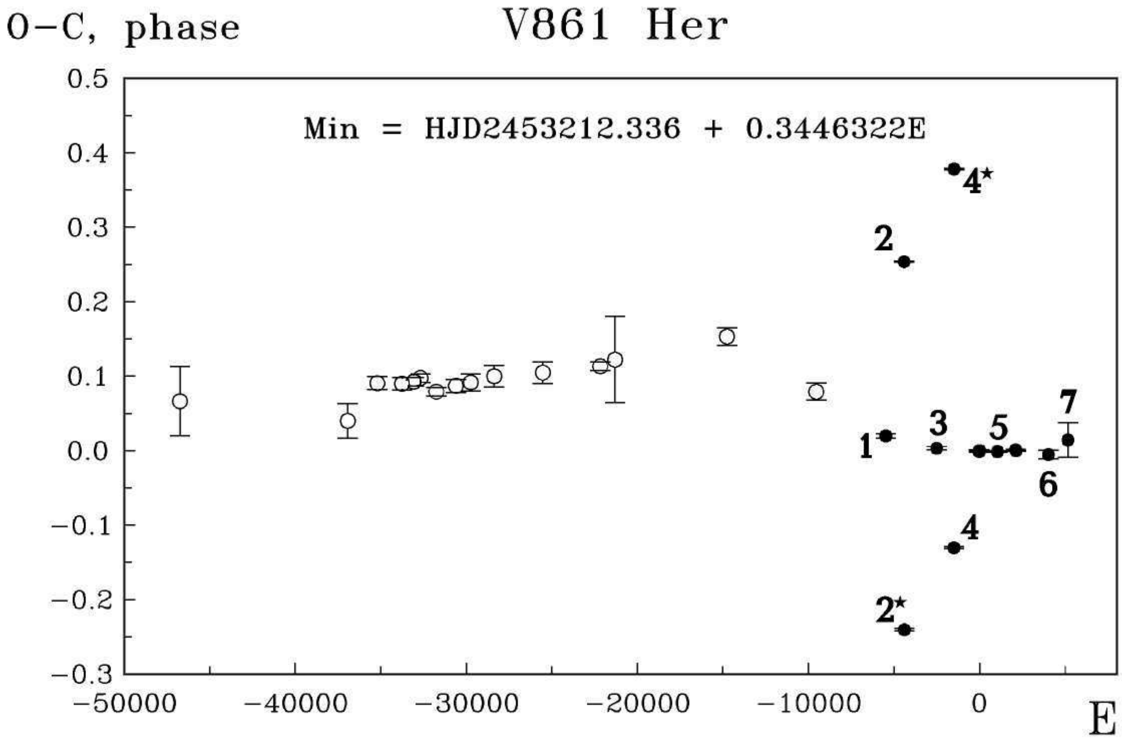

Figure 2. The $O-C$ diagram. Open circles: the photographic times of minima; filled circles: CCD times of minima: (1) NSVS data (Woźniak et al., 2004), (2) and (2*) primary and secondary minima from Csizmadia et al. (2002), (3) Diethelm (2002), (4) and (4*) primary and secondary minima from Borkovits et al. (2003), (5) this paper, (6) Hübscher, Steinbach & Walter (2009), (7) Diethelm (2009).

Table 1. Times of minima and $O-C$ residuals.

HJD(UT)24...	Err, d	Min	E	O–C, d	O–C, p	Err, p	Source
37105.9730	0.016	I	-46735	0.0229	0.0663	0.0464	pg
40484.0487	0.008	I	-36933	0.0137	0.0399	0.0232	pg
41080.2799	0.003	I	-35203	0.0312	0.0906	0.0087	pg
41578.9624	0.003	I	-33756	0.0309	0.0898	0.0087	pg
41813.3132	0.002	I	-33076	0.0319	0.0924	0.0058	pg
41950.1339	0.002	I	-32679	0.0336	0.0974	0.0058	pg
42272.0141	0.002	I	-31745	0.0273	0.0792	0.0058	pg
42665.9314	0.003	I	-30602	0.0300	0.0870	0.0087	pg
42961.9720	0.004	I	-29743	0.0315	0.0915	0.0116	pg
43431.7086	0.005	I	-28380	0.0344	0.0999	0.0145	pg
44414.6013	0.005	I	-25528	0.0361	0.1047	0.0145	pg
45571.8791	0.002	I	-22170	0.0390	0.1131	0.0058	pg
45868.9552	0.020	I	-21308	0.0421	0.1222	0.0580	pg
48124.5836	0.004	I	-14763	0.0528	0.1531	0.0116	pg
49923.1935	0.004	I	-9544	0.0272	0.0790	0.0116	pg
51322.3798	0.001	I	-5484	0.0068	0.0197	0.0029	NSVS
51690.5276	0.0002	I	-4416	0.0874	0.2536	0.0006	C&
51695.5268	0.0006	II	-4401	-0.0829	-0.2405	0.0017	C&
52344.5532	0.0008	I	-2518	0.0011	0.0031	0.0023	D1
52693.6196	0.0004	I	-1505	-0.0449	-0.1304	0.0012	B&
52696.5519	0.0004	II	-1497	0.1303	0.3781	0.0012	B&
53195.4489	0.0004	I	-49	-0.0001	-0.0003	0.0012	tp
53203.3751	0.0003	I	-26	-0.0005	-0.0013	0.0009	tp
53208.3742	0.0002	II	-11	-0.1708	-0.4957	0.0006	tp
53212.3360	0.0002	I	0	0.0000	0.0000	0.0006	tp
53564.3795	0.0003	II	1022	-0.1706	-0.4950	0.0009	tp
53569.3744	0.0002	I	1036	-0.0006	-0.0016	0.0006	tp
53570.4085	0.0002	I	1039	-0.0004	-0.0010	0.0006	tp
53937.4425	0.0003	I	2104	0.0004	0.0010	0.0009	tp
53945.3686	0.0002	I	2127	-0.0001	-0.0003	0.0006	tp
54596.3771	0.0019	I	4016	-0.0018	-0.0053	0.0055	HSW
54596.5511	0.0024	II	4017	-0.1724	-0.5004	0.0070	HSW
54990.6430	0.008	I	5160	0.0049	0.0141	0.0232	D2
54990.8089	0.0005	II	5161	-0.1739	-0.5045	0.0014	D2

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V1032 OPH IS A DWARF NOVA

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V1032 Oph was discovered by Kinman et al. (1965, their star number 40) as a possible RR Lyrae type variable. It had however an unusually large photographic amplitude of about two magnitudes and Kinman et al. could not find a suitable period. GALEX (Martin et al., 2005) visited the object three times, with near UV magnitudes $nuv = 18.9$ and 17.8 on two occasions in 2005 (and no far UV magnitude fuv determined), and with $fuv = 20.4 \pm 0.4$ and $nuv = 20.2 \pm 0.2$ in 2007. The Catalina Real-time Transient Survey (CRTS; Drake et al., 2009) rediscovered V1032 Oph recently (as CSS080426:162610-035325). The CRTS light curve was not characteristic for RR Lyrae type stars.

V1032 Oph was therefore selected for follow-up observations using the robotic mode of the C14 telescope at the Sonoita Research Observatory (SRO). Photometry was performed using a SBIG STL-1001E CCD camera equipped with B and V filters. The stars USNO-B1.0 0861-0298934 ($V = 14.98 \pm 0.02$, $B - V = 0.97 \pm 0.05$, star "a" of Kinman et al.) and USNO-B1.0 0860-0285298 ($V = 15.88 \pm 0.13$, $B - V = 0.81 \pm 0.05$) were used as comparison stars for the SRO observations. Their B and V magnitudes were determined from absolute photometry at SRO. In general two B and two V images with exposures of 300 seconds were made each available night. These observations, taken in the first half of 2009, are available from the IBVS website.

The light curve of V1032 Oph presented in Fig. 1 is similar to that of SU UMa, with frequent short outbursts and a generally fairly small amplitude for a dwarf nova (V varies between 15.1 and 19.0, but maxima are generally around mag. 16 and minima around mag. 18.5). Also the data of Kinman et al. (1965) and early CRTS observations are compatible with this interpretation. The outburst that started at the end of March 2009 and lasted into April, was brighter and lasted longer than any of the other outbursts. This could therefore have been a superoutburst. The CRTS light curve shows a period of about four months in the first half of 2007 when the object was always near minimum without any outbursts (unfiltered mag. 17-17.5; note that the unfiltered CRTS observations have the object in general about one magnitude brighter than in V). Also SU UMa has experienced such extended spells in quiescence in the past. During maximum V1032 Oph has $B-V = 0.26 \pm 0.10$ on average, within the range of cataclysmic variables. This value may need to be corrected for interstellar extinction ($E(B-V) = 0.282$ in the direction of V1032 Oph, according to Schlegel et al., 1998).

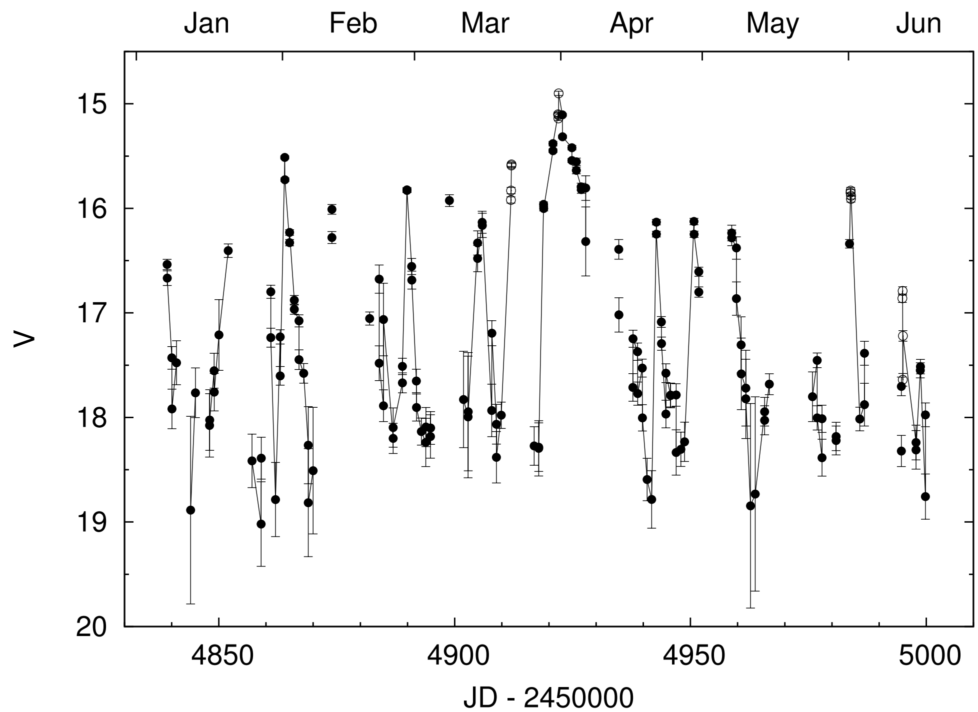

Figure 1. Light curve of V1032 Oph in the first half of 2009 from CRTS (open circles; unfiltered) and SRO data (filled circles) using nightly averages. To guide the eye, some points have been connected by lines.

Acknowledgements: This study made use of the Simbad and VizieR database (Ochsenbein et al., 2000), and of data provided by the Catalina Real-time Transient Survey and the NASA GALEX mission.

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THE RECOVERY PHASE AFTER THE 2009.0-EVENT OF η CARINÆ

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It is currently accepted that the massive and luminous star η Carinæ is comprised of at least a binary system, with a 5.5 years orbital period (e.g. Damineli et al., 2000). This assertion was firstly based on the evidence of many optical spectroscopic events registered since 1948 (Gaviola, 1953) up to the present (see Damineli et al., 2008 and references therein). Observations performed in other wavelengths from X-rays to mm-wavelengths confirmed that related events occurred with the same period and almost at the same orbital phase. Particularly, we reported the occurrence of a photometric event at the time of an expected spectroscopic event for 2003.5 (Fernández-Lajús et al., 2003).

At the beginning of 2009, η Car experienced a new "event", which was detected in different spectral regions (Corcoran, 2009; Fernández-Lajús et al., 2010, hereafter Paper II; Abraham, Breaklini and Miceli, 2009). This event indicates the starting of "cycle 12", enumerating the cycles since 1948 (Groh and Damineli, 2004). In Paper II, we presented the CCD optical ground-based photometry of the complete event, showing an "eclipse-like" feature similar to that we recorded in 2003.5. After the 2009.0 event, we continued the observations to register the light curves behaviour during the recovery phase after the "eclipse-like" event and to compare the evolution at the same orbital phases of the previous cycle reported by Fernández-Lajús et al. (2009, hereafter Paper I).

In this paper, we present the $BVRI$ and Hα CCD photometry of the recovery phase after the 2009.0 event, up to the end of our η Car 2009 observing season. The CCD images were acquired using the "Virpi S. Niemela" telescope at La Plata Observatory, with the same instrumental configuration already described in detail in Papers I and II. More than 8500 images were obtained during 79 nights between March 31 and August 25, 2009. As stated in Paper I, bias, dark and 'twilight' flat-field frames were meant to be acquired every night. However, on several occasions bad weather conditions prevented us from obtaining good quality flat-fields images. Even though we attempted to process images with Master calibrations frames, the resulting light curves presented a large number of points out of scale as a consequence of many bad quality flat-fields. For this reason, we decided to present only the data obtained from the uncalibrated images, considering that the light curves were practically the same as those obtained with the calibrated images. However, the calibration images were used to check the overall behaviour of the telescope and detector.

The resulting $BVRI$ and Hα light curves are depicted in Fig. 1. The η Car differential magnitudes, their mean values and its rms errors were determined as explained in Paper I. The typical rms errors of our data (also represented in Fig. 1) are: $\epsilon_B = 0.015$, $\epsilon_V = 0.006$, $\epsilon_R = 0.010$, $\epsilon_I = 0.015$ and $\epsilon_{H\alpha} = 0.015$ mag. The light curves are smoothed using natural cubic splines. These splines were extended backward using the data published in Paper II, in order to display the 2009.0 "eclipse-like" event observed during our 2009 observing season. The orbital phases are marked in the top axis. They are determined using the ephemeris given in Paper II and adding '11', which is the number of cycles from the first event registered in 1948 up to the date of the event (JD 2452819.8 or $\phi = 0$) related with that ephemeris (see Damineli et al., 2008).

The light curves of Fig. 1 show that the system keeps a brightening trend in the five photometric bands. It is remarkable that the brightening rate during this phase is higher than 0.4 mag year^{-1} in the BVR bands, 0.3 mag year^{-1} in I, and almost 0.9 mag year^{-1} in Hα. Thus, η Car has reached the magnitude $V \sim 4.6$, the maximum brightness achieved in the last one and a half century.

The differential photometry data of η Car and the two other nearby stars in the field, namely CPD -59 2627 and CPD -59 2628, are available online as an electronic table (`5915-t1.txt`) at the IBVS website. An example of the table is shown in Table 2 in Paper I.

The new time-series presented in this paper together with those already published in Papers I and II constitute the longest based-time of self-consistent photometric data of η Car currently available, which are useful for a better understanding of the present state of this object.

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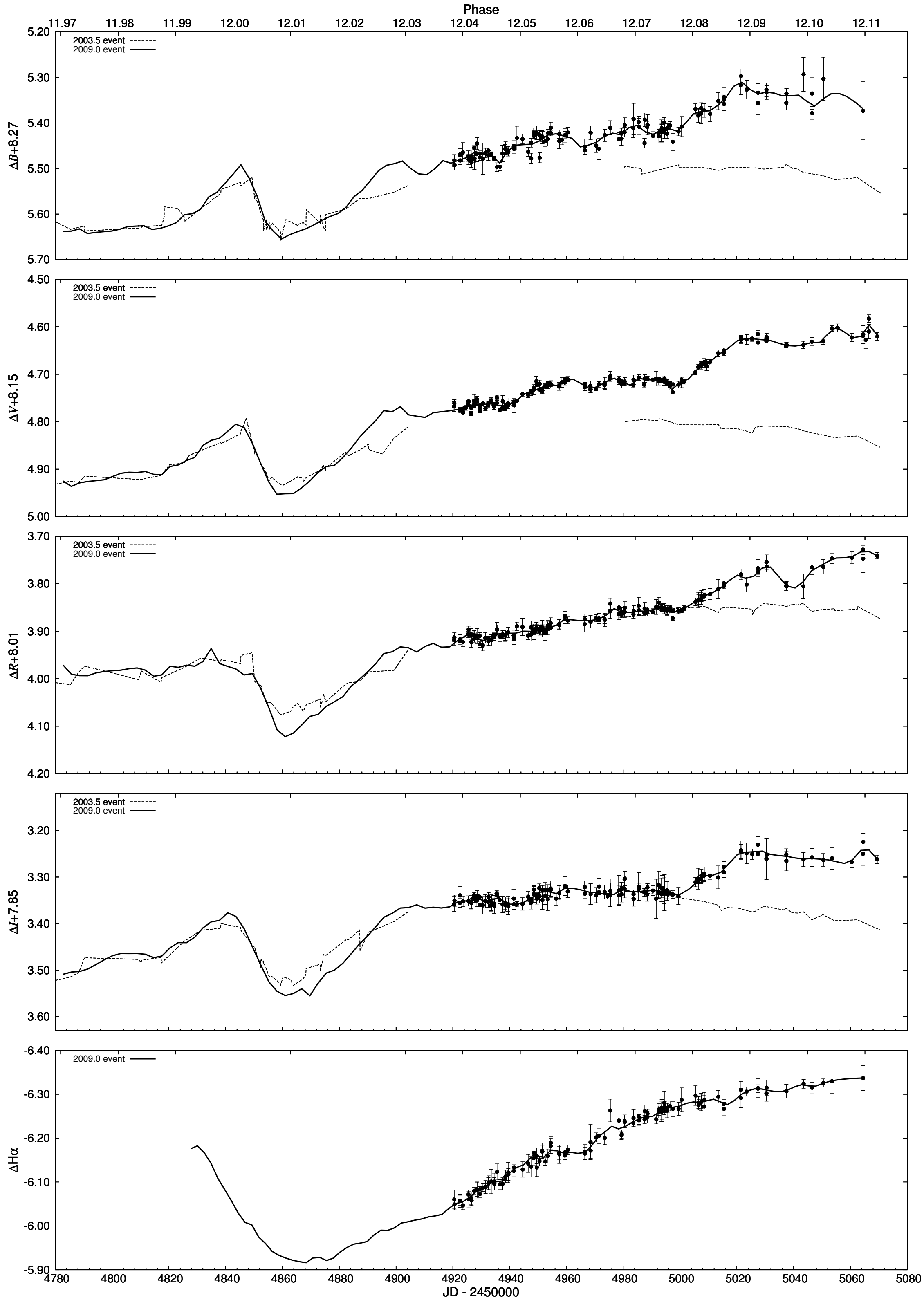

Figure 1. *BVRI* and Hα light curves of η Car observed between March 31 and August 25, 2009. Bars represent the standard deviations of the mean values. The data were smoothed using splines. Along the top axis, orbital phases are indicated according to Paper II. The previous cycle light curves (dashed lines) were y-shifted to display them together for comparison.

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ERRATUM FOR IBVS 5838

In IBVS 5838, first page, third paragraph, the comparison star of V841 Cen is mentioned with two different HD numbers. The correct name of the star is HD 128227.

The Editors

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NEW CATACLYSMIC VARIABLES FROM 6dFGS SPECTROSCOPY

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To understand the distribution and evolution of close binaries and cataclysmic variables (CVs) in particular, it is important to have as complete a sample of these stars as possible. Through the Sloan Digital Sky Survey (SDSS) a large number of CVs have been discovered spectroscopically (see e.g. Szkody et al., 2009), revealing quite a different population from the objects discovered before (Gänsicke et al., 2009). As a by-product, the 6dF Galaxy Survey (6dFGS; Jones et al., 2004 and 2009) revealed seven hitherto unknown CVs spectroscopically. In addition the survey contains spectra for another 28 known CVs. Recently a dwarf nova was found by Wils et al. (2009), for which also a 6dFGS spectrum was available, suggesting that not all CVs in that survey have been identified. To look for further CVs, all the 6dFGS spectra originating from Galactic sources (those with Quality = 6) were examined. This turned up another five new CVs, so that a total of 13 previously unknown CVs have been found in the 6dFGS spectra. The five new CVs are listed in Table 1. The ultraviolet magnitudes given in the table have been extracted from GALEX data (Martin et al., 2005).

The spectra for the five systems are given in Figs. 1 and 2, and except for 6dFGS g1915227-263015, all are fairly typical for dwarf novae in quiescence. The object 6dFGS g0242429-114646, which is identical to PHL 1445 (Haro & Luyten, 1962) = PB 9151 (Berger & Fringant, 1984), has double-peaked emission lines, indicating a high inclination system. 6dFGS g1013459-275758 coincides with the X-ray source 1RXS J101345.7-275750. For 6dFGS g1915227-263015 three spectra are available, shown in Fig. 2. Only one of those three is a typical CV spectrum. The He II emission is an indication that it is possibly a magnetic CV, but because it is not particularly strong, it might be an intermediate polar or an SW Sextantis type star. There are four objects within a radius of less than 10 arc seconds around the 6dFGS position, among them is a galaxy. The fibres used to measure the spectra have a diameter of 7 arc seconds. It is suggested that the CV spectrum originated from the object USNO-B1.0 0634-0894139 at the position given in Table 1, and the two other spectra correspond to the brighter K-type star USNO-B1.0 0634-0894149 five arc seconds to the East. Further observations are needed to confirm this.

All objects were examined on images of the United States Naval Observatory, Flagstaff Station and the Near Earth Asteroid Tracking (NEAT) for possible outbursts. A.J. Drake kindly provided observations of 6dFGS g0242429-114646 from the Catalina Real-time Transient Survey (CRTS; Drake et al., 2009) from 2004 to 2009. Data for the other objects were not available from CRTS. Approximate magnitude ranges in Table 1 are

Table 1: New cataclysmic variables identified from 6dFGS spectra.

6dFGS	Position (2000)		*fuv*	*nuv*	Mag. range
g0002074-374917	00 02 07.39	−37 49 16.7	18.10	17.94	16.8-17.3
g0242429-114646	02 42 42.86	−11 46 45.5	19.15	18.72	15.7-18.9
g0431396-301514	04 31 39.55	−30 15 14.0	20.76	20.12	17.2-18.6
g1013459-275758	10 13 45.91	−27 57 58.0	20.61	20.35	17.8-18.2
g1915227-263015	19 15 22.18	−26 30 13.9	–	–	16.4-16.9

taken from the CRTS data for 6dFGS g0242429-114646, and from the USNO-B1.0 catalogue values for the other objects. Only 6dFGS g0242429-114646 has been observed in outburst, on only one occasion by CRTS. Some of the data points are anomalously faint, so it may be a deeply eclipsing dwarf nova, in agreement with the broad double-peaked emission lines in the spectrum. The light curve is shown in Fig. 3.

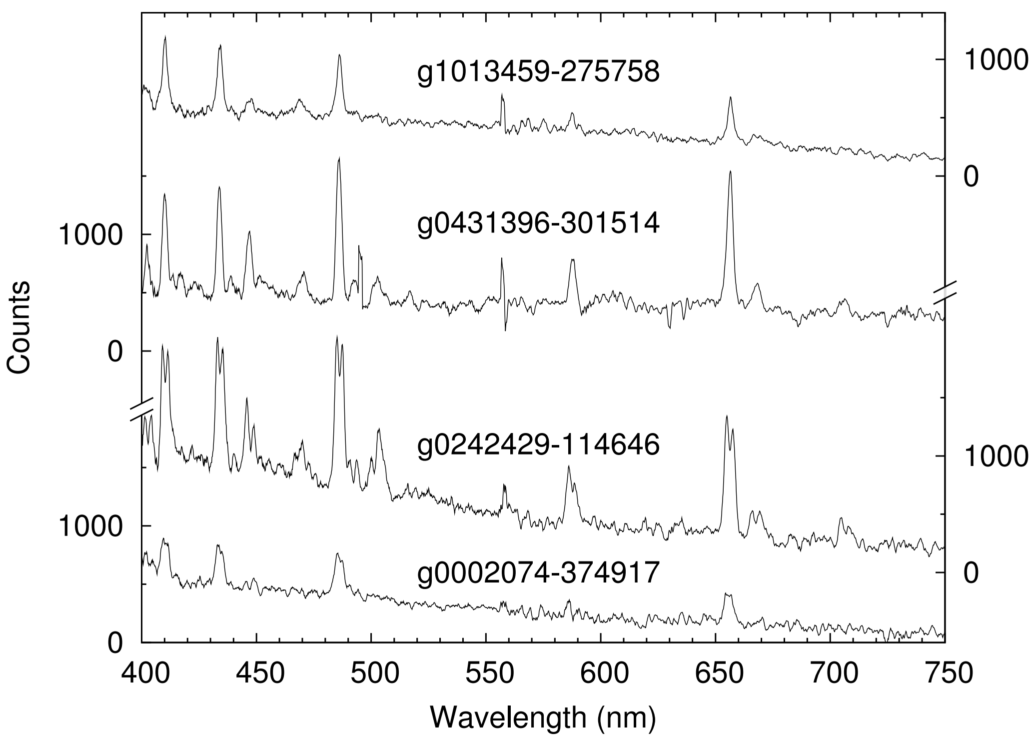

Figure 1. 6dFGS spectra for four cataclysmic variables identified in this paper. For clarity the vertical axis scales are plotted on alternate sides.

Acknowledgements: Boris Gänsicke is gratefully acknowledged for helpful remarks, Heath Jones for commenting on the spectra of 6dFGS g1915227-263015 and Andrew Drake for extracting the CRTS data. Funding for the CRTS survey is provided by the U.S. National Science Foundation under grant AST-0909182.

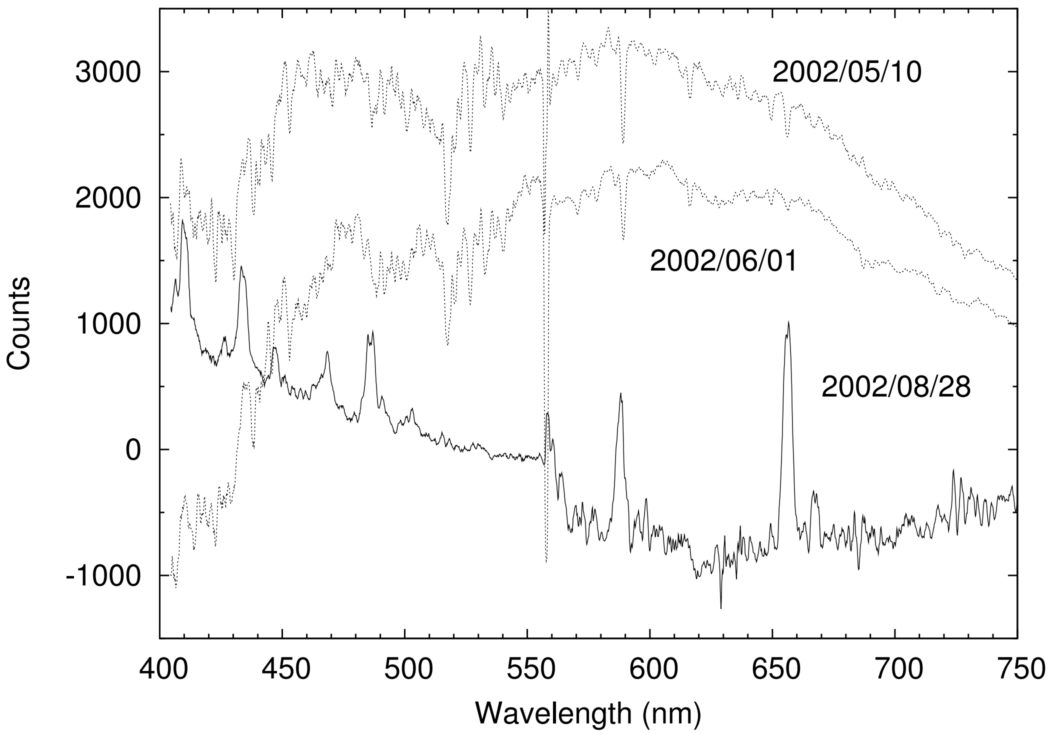

Figure 2. 6dFGS spectra for 6dFGS g1915227-263015 on three different dates in 2002. The line near 560 nm is an artefact of stitching two independent spectra together.

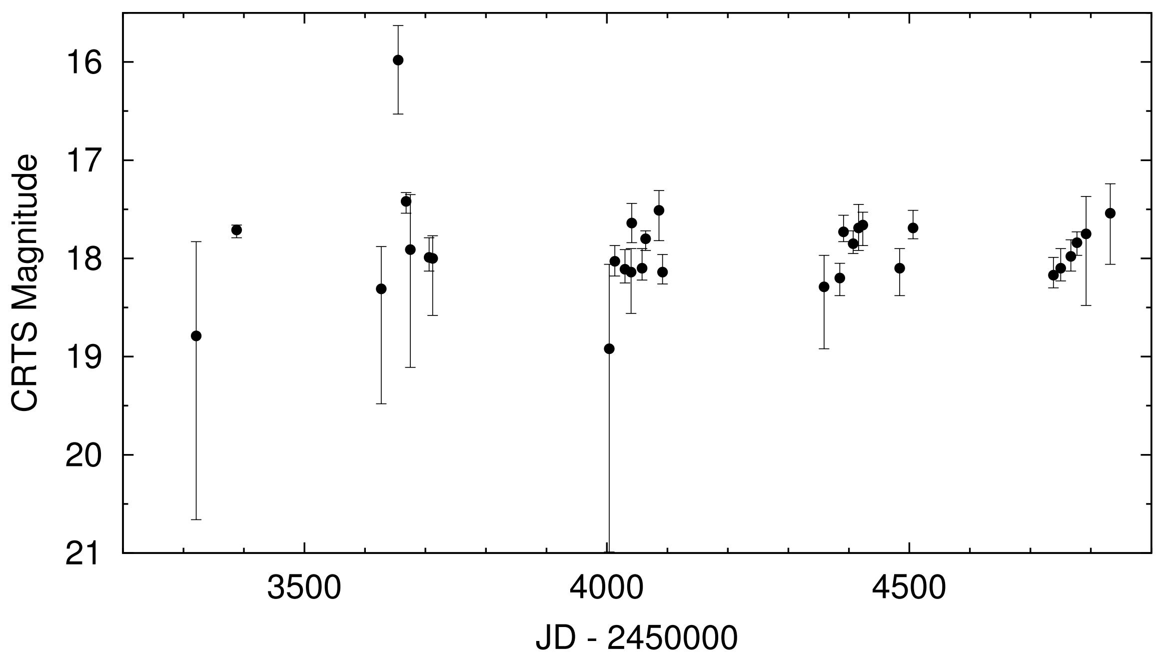

Figure 3. Light curve of PHL 1445 = 6dFGS g0242429-114646 from CRTS data. Each point is the average of four observations from the same night, the error bars indicate the brightest and faintest points.

This study made use of the Simbad and VizieR database (Ochsenbein et al., 2000), the Image and Catalogue Archive operated by the United States Naval Observatory, Flagstaff Station (`http://www.nofs.navy.mil/data/fchpix/`), optical images generated by the Near Earth Asteroid Tracking (NEAT) through the Skymorph website (`http://skyview.gsfc.nasa.gov/skymorph/skymorph.html`) and of data provided by the GALEX mission and the Sloan Digital Sky Survey (SDSS). GALEX (Galaxy Evolution Explorer) is a NASA Small Explorer, launched in April 2003.

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CCD MINIMA OF ECLIPSING BINARY STARS

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We present 76 CCD minimum times of eclipsing binaries collected during a campaign of Unione Astrofili Italiani (UAI). The data cover time span from May 2003 to October 2009.

All the observations were made by private observatories. 25 light curves were remotely obtained (via Internet) by using the Italian and Australian telescopes of the Skylive-UAI Project, that are publicly available on the web site www.skylive.it.

All moments of minimum presented in Table are heliocentric.

Both geocentric and heliocentric photometric data can be requested via e-mail to Giuseppe Marino (giumar69@gmail.com).

Observatory and telescope:
40-cm Ritchey–Chrétien telescope (RC40) of Lumezzane Observatory (Italy)
30-cm Schmidt–Cassegrain, 20-cm Newton–Cassegrain and 9-cm apochromatic refractor telescopes (SC30, NC20, Rfr9, respectively) of the Skylive-UAI Project (Italy)
13-cm and 9-cm apochromatic refractor telescopes (AP13 and AP9, respectively)
25-cm and 23-cm Schmidt–Cassegrain telescopes (SC25 and SC23, respectively)
20-cm Newton telescope (NW20)
8-cm semi-apochromatic refractor telescope (ED8)

Detector:	Kaf400e CCD camera (Kaf) SBIG ST-10XME CCD camera (ST10) Starlight XPress HX916 CCD camera (HX916) HiSis23 CCD camera (HiS23) SBIG ST-7XME CCD Camera (ST7) Meade DSI Pro II Monochromatic CCD camera (DSI)

Method of data reduction:

Data reduction, consisting in differential photometry on each CCD image, was made by means of the softwares Maxim DL, Iris (occasionally) and, in one case, AIP. When dark and flat field corrections were not been performed, the flatness of the interested detector's area and/or the stability of the comparison–check stars were accurately checked. No reduction to photometric standard system was performed.

Method of minimum determination:

The minimum times (in days) reported in Table were computed by KvW method (Kwee & van Woerden, 1956) and, occasionally, by Avalon neuronal networks fitting program (Gaspani, 1995). For the KvW method we used a DOS program available at AAVSO, whose results were found to be consistent with those produced by the AVE (Barberá, 1996) and Peranso (`www.peranso.com`) softwares.
The error in the timing of each minimum was determined following Arlot's method (Arlot *et al.*, 2009): we calculated the noise on magnitudes from their standard deviation σ_m within a stable range of the light curve (at the deepest part of the minimum or at the maximum) and transformed it into an error time, through the value of the speed of decrease in magnitude $\frac{\Delta m}{\Delta t}$, by adopting the formula $\sigma_{ToM} = \frac{\sigma_m}{\Delta m}\Delta t$.
The effects of different data sampling/selection and of asymmetry of some minima were evaluated in a sample of light curves and found within the reported errors.
We note that the errors in Table do *not* include systematic errors, depending on the time synchronization accuracy (estimated within ±0.5 s), the shutter latency time (measured between −0.2 to −0.5 s) and the difference between the heliocentric and the barycentric light time (up to ∼ 5 s).
The type of each minimum is assumed according to the updated elements of Kreiner (2004).

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
AB And	55111.3770	0.0007	I		Sal-Los/SC23/ST7
OO Aql	52784.5735	0.0005	I	*V*	Fog-Cre/RC40/Kaf
	53184.4335	0.0006	I	*V*	Pap/SC25/HX916
	53218.3895	0.0008	I	*V*	Pap/SC25/HX916
	53220.4148	0.0005	I		Ben *et al.*/AP13/ST10
	53258.4244	0.0006	I	*V*	Pap/SC25/HX916
	53591.387	0.001	I	*V*	Pap/SC25/HX916
	53966.4152	0.0006	I	*RG*9	Mil/NW20/HiS23
	53967.429	0.001	I	-*IR*	Bel/AP9/ST7
	53968.4424	0.0005	I	-*IR*	Bel/AP9/ST7
	54000.3692	0.0002	I	*V*	Pap/SC25/HX916
	54978.4790	0.0004	I		Sal/SC23/ST7
ZZ Aur	:54529.3864	0.0003	I		Sal/SC30/ST10
TY Boo	54639.3687	0.0001	I	*R*	Mar/SC30/ST10
TZ Boo	:54642.422	0.001	I	*R*	Mar/SC30/ST10
VW Boo	54610.3792	0.0007	I	-*IR*	Sal/AP9/ST7
AC Boo	54938.3649	0.0005	II	*R*	Sal-Los/SC23/ST7
CW Cas	55023.4699	0.0007	I		Are/NW20/DSI
V523 Cas	55022.5079	0.0003	II		Are/NW20/DSI
BE Cep	55009.4351	0.0009	I		Are/NW20/DSI
CW Cep	53972.542	0.003	I		Mar-Los/SC25/ST7
GK Cep	53971.513	0.004	II		Mar-Los/SC25/ST7
	54001.470	0.004	II		Mar-Sal/SC23/ST7

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
RW CrB	54572.431	0.001	I		Sal/SC30/ST10
VZ CVn	54191.4775	0.0009	I		Mar/NC20/ST10
GM Cyg	54974.579	0.001	I		Mar/NW20/ST7
GO Cyg	54715.475	0.001	I		Are/NW20/ST7
V548 Cyg	54318.498	0.001	I		Mar/SC23/ST7
	54652.4695	0.0007	I	*R*	Are/SC30/ST10
V836 Cyg	54319.4897	0.0008	I		Mar/SC23/ST7
	55006.554	0.002	II		Are/NW20/DSI
RZ Dra	54641.4491	0.0003	I	*R*	Mar/SC30/ST10
UX Eri	54791.2726	0.0009	II		Sal/SC23/ST7
QW Gem	54544.3746	0.0009	I		Sal-Mar/SC30/ST10
SZ Her	54905.5884	0.0004	I		Are/NW20/DSI
AK Her	54198.5863	0.0009	I	-*IR*	Mar/AP9/ST7
V829 Her	54938.476	0.002	I	*R*	Sal-Los-Mar/SC23/ST7
SW Lac	54327.4341	0.0004	II		Mar/SC23/ST7
	54327.5955	0.0003	I		Mar/SC23/ST7
	54718.3917	0.0008	II		Are/NW20/ST7
XY Leo	54954.429	0.001	I		Are/NW20/DSI
DU Leo	54157.3373	0.0009	I		Mar/NC20/ST10
	54201.3100	0.0007	I		Mar/NC20/ST10
VZ Lib	54667.3531	0.0007	II		Sal/SC23/ST7
VW LMi	54192.352	0.001	II		Mar/NC20/ST10
UV Lyn	54164.293	0.003	I	-*IR*	Mar/AP9/ST7
V400 Lyr	55014.433	0.001	II		Are/NW20/DSI
	55014.559	0.001	I		Are/NW20/DSI
	55015.446	0.001	II		Are/NW20/DSI
	55015.573	0.002	I		Are/NW20/DSI
V576 Lyr	54978.4373	0.002	I		Sal-Los/SC23/ST7
V508 Oph	54721.3643	0.0007	II	*R*	Sal-Are/NW20/ST7
V839 Oph	54938.536	0.001	I	*R*	Sal-Los-Mar/SC/ST7
ER Ori	54791.4350	0.0002	II		Sal/SC23/ST7
AQ Peg	54001.365	0.001	I	*V*	Pap/SC25/HX916
AT Peg	54379.3224	0.001	I		Zar/NC20/ST10
IP Peg	54413.4150	0.0001	I		Sal-Mar/SC23/ST7
V357 Peg	54373.326	0.003	I		Sal/SC23/ST7
	54375.353	0.002	II		Sal/SC23/ST7
AZ Pup	54542.026	0.004	I		Sal/SC30/ST10
AU Ser	54978.3680	0.0006	II		Sal-Los/SC23/ST7
AH Tau	54513.3391	0.0004	I		Sal/SC30/ST10
AN Tau	54447.403	0.001	I		Sal/SC30/ST10
RV Tri	53746.3086	0.0002	I	*V*	Pap/SC25/HX916
	54018.3813	0.0005	I	*V*	Pap/SC25/HX916
W UMa	54200.3725	0.0005	I	-*IR*	Mar/AP9/ST7
	54952.3869	0.001	I		Mar *et al.*/ED8/HX916
XZ UMa	54174.5341	0.0009	I		Bel/NC20/ST10
RU UMi	54173.5540	0.0007	I	*R*	Bel/NC20/ST10
AG Vir	54620.386	0.004	I		Sal-Mar-Los/SC23/ST7
AH Vir	54161.6242	0.0006	II	-*IR*	Mar/AP9/ST7
AX Vir	54571.3490	0.0009	I		Sal/SC30/ST10
HT Vir	54974.418	0.002	I		Mar/NW20/ST7
NN Vir[a]	54159.636	0.003	I		Mar/NC20/ST10
Z Vul	53945.5753	0.0004	I		Mar/SC25/ST7
	54662.4148	0.0007	I	*R*	Are/SC30/ST10

Explanation of the remarks in the table:
Observer[s] (as the first letters of authors' surname)/Telescope/Detector
[a] + TYC 323.830.1
: uncertain

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BAV-RESULTS OF OBSERVATIONS - PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

(BAV MITTEILUNGEN NO. 209)

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In this 65th compilation of BAV results, photoelectric observations obtained in the year 2009 are presented on 521 variable stars giving 871 minima on eclipsing binaries and maxima on pulsating stars. All moments of minima and maxima are heliocentric. The errors are tabulated in column '±'. The values in column '$O-C$' are determined without incorporation of nonlinear terms. The references are given in the section 'Remarks'. All information about photometers and filters are specified in the column 'Rem'. The observations were made at private observatories. The photoelectric measurements and all the light curves with evaluations can be obtained from the office of the BAV for inspection.

Table 1: Times of minima of eclipsing binaries

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
AB And	54844.3698	.0003	AG	−0.0235	s	GCVS 1985	V	62	21)
BD And	54676.4992	.0001	RAT RCR	+0.0160		GCVS 1985	-U-I	115	4)
	54728.3450	.0002	RAT RCR	+0.0168		GCVS 1985	-U-I	66	4)
	54834.3488	.0007	AG	+0.0160		GCVS 1985	-Ir	70	21)
CO And	54718.4853	.0002	RAT RCR	+0.0169		GCVS 1985	-U-I	105	4)
GZ And	54829.2290	.0001	RAT RCR	−0.0095		GCVS 1985	-U-I	38	4)
LO And	54784.4251	.0003	RAT RCR	−0.0262	s	GCVS 1985	-U-I	42	4)
EX Aqr	54671.4649	.0002	RAT RCR	+0.0397		GCVS 2007	-U-I	102	4)
OO Aql	54976.4513	.0007	PGL	+0.0426		GCVS 1985	o	277	13)
V343 Aql	54627.5052	.0001	RAT RCR	−0.0514		GCVS 1985	-U-I	119	4)
V417 Aql	55041.3924	.0001	WTR	−0.0547	s	BAVR 33,152	-Ir	66	19)
V1353 Aql	55016.4794	.0042	PGL	+0.0204	s	BAVR 44,62	o	559	13)
AH Aur	54831.3225	.0007	AG	−0.0187		BAVR 35,41	V	29	21)
	54832.3117	.0006	AG	−0.0178		BAVR 35,41	-Ir	79	21)
	54832.5543	.0011	AG	−0.0223	s	BAVR 35,41	-Ir	79	21)
	54857.5068	.0004	AG	−0.0250		BAVR 35,41	-Ir	55	21)
AP Aur	54881.4687	.0021	SCI	+0.0879	s	IBVS 3942	o	133	5)
CI Aur	54857.2833	.0009	AG	+0.1255		GCVS 2007	-Ir	66	21)
EM Aur	54858.3509	.0011	MS FR	−0.1923		GCVS 1985	o	561	11)
EP Aur	54829.3847	.0056	FR	+0.0251	s	GCVS 1985	-Ir	51	21)
	54829.6608	.0012	FR	+0.0057		GCVS 1985	-Ir	51	18)
	54831.4398	.0063	AG	+0.0117		GCVS 1985	V	28	21)
	54832.3266	.0006	AG	+0.0120	s	GCVS 1985	-Ir	77	21)
	54832.6226	.0017	AG	+0.0125		GCVS 1985	-Ir	77	21)
	54840.3049	.0011	FR	+0.0117		GCVS 1985	-Ir	43	18)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
EP Aur	54857.4451	.0002	AG	+0.0127		GCVS 1985	-Ir	58	21)
GI Aur	54857.3096	.0008	AG	+0.0238		GCVS 2007	-Ir	58	21)
	54857.3102	.0010	JU	+0.0244		GCVS 2007	o	132	5)
GX Aur	54507.3594	.0005	RAT RCR	+0.0691		BAVM 69	-Ir	110	7)
	54531.3656	.0001	RAT RCR	+0.0670		BAVM 69	-Ir	160	7)
HL Aur	54507.5479	.0004	RAT RCR	−0.0085		GCVS 1985	-Ir	172	7)
HP Aur	54857.4262	.0001	WN	+0.0525		GCVS 1985	V	100	16)
IY Aur	54865.2908	.0030	JU	−0.1256		GCVS 1985	o	80	5)
	54865.2948	.0020	SCI	−0.1216		GCVS 1985	o	69	5)
IZ Aur	54529.3802	.0004	RAT RCR				-Ir	94	7)
KO Aur	54842.4047	.0003	FR	+0.0493		GCVS 1985	-Ir	96	21)
KU Aur	54832.4321	.0022	AG	+0.0218	s	GCVS 1985	-Ir	80	21)
	54857.5033	.0016	AG	+0.0210	s	GCVS 1985	-Ir	51	21)
LY Aur	54847.2920	.0015	FR	−0.0095		GCVS 1985	-Ir	169	18)
MU Aur	54866.5114	.0005	AG	+0.0400		GCVS 2007	-Ir	53	21)
NN Aur	54840.6224	.0008	FR				-Ir	65	21)
V379 Aur	54840.3321	.0005	MS FR				o	660	11)
V410 Aur	54829.3130	.0001	RAT RCR				-U-I	67	4)
V432 Aur	54844.2306	.0007	FR	−0.0002		IBVS 5319	-Ir	105	18) 1)
V534 Aur	54866.5277	.0006	AG				-Ir	53	21)
SU Boo	54861.5077	.0003	MS FR	+0.0202		GCVS 1985	o	396	11)
TU Boo	54941.3650	.0010	AG	+0.0328	s	GCVS 1985	-Ir	40	21)
	54941.5280	.0008	AG	+0.0336		GCVS 1985	-Ir	40	21)
TY Boo	54943.3541	.0002	MS FR	−0.0303	s	BAVM 68	o	560	11)
TZ Boo	54512.5565	.0003	MS FR	−0.0486	s	BAVM 68	o	392	11)
UW Boo	54514.4850	.0001	MS FR	−0.0073		GCVS 1985	o	336	11)
	54843.5088	.0014	MS FR	−0.0263	s	GCVS 1985	o	560	11)
	54912.3498	.0003	AG	−0.0079		GCVS 1985	-Ir	64	21)
VW Boo	54555.4383	.0001	RAT RCR	−0.0590	s	BAVR 32,122	-Ir	75	7)
	54597.3715	.0001	RAT RCR	−0.0600		BAVR 32,122	-Ir	106	7)
XY Boo	54509.5416	.0004	RAT RCR	−0.0479	s	GCVS 1985	-Ir	189	7)
AC Boo	54843.7305	.0001	MS FR	−0.0226		GCVS 1985	o	495	11)
	54931.4908	.0019	SCI	−0.0172		GCVS 1985	o	106	5)
	54932.3711	.0012	SCI	−0.0180	s	GCVS 1985	o	76	5)
	54932.5485	.0017	SCI	−0.0168		GCVS 1985	o	99	5)
	54936.4253	.0001	FR	−0.0167		GCVS 1985	-Ir	222	21)
	54936.6015	.0001	FR	−0.0168	s	GCVS 1985	-Ir	222	21)
	54941.3584	.0014	PGL	−0.0176		GCVS 1985	o	467	13)
	54947.3504	.0021	PGL	−0.0169		GCVS 1985	o	199	13)
	54950.3467	.0014	PGL	−0.0163	s	GCVS 1985	o	328	13)
AD Boo	54933.4210:	.0100	AG	+0.0347		GCVS 1985	-Ir	41	21)
AR Boo	54924.3468	.0012	AG	+0.1013		GCVS 2007	-Ir	38	21)
	54924.5222	.0012	AG	+0.0684	s	GCVS 2007	-Ir	38	21)
BW Boo	54937.3127	.0009	FR	−0.0161		GCVS 1985	-Ir	179	18)
CV Boo	54931.4325	.0004	QU	−0.0103		BAVR 49,117	V	66	6)
	54939.4791	.0007	PGL	−0.0102	s	BAVR 49,117	o	413	13)
	54940.3252	.0021	PGL	−0.0111	s	BAVR 49,117	o	220	13)
	54948.3723	.0014	PGL	−0.0104		BAVR 49,117	o	417	13)
	54956.4184	.0007	PGL	−0.0107	s	BAVR 49,117	o	519	13)
ET Boo	54936.3367	.0005	FR				-Ir	135	21)
	54982.4556	.0019	JU				o	55	5)
GK Boo	54937.3112	.0020	FR				-Ir	202	18)
	54937.5462	.0005	FR				-Ir	202	18)
GM Boo	54933.5024	.0004	AG				-Ir	41	21)
	54968.5305	.0004	AG				-Ir	37	21)
GN Boo	54829.6623	.0001	MS FR				o	540	11)
	54968.3999	.0003	AG				-Ir	38	21)
	54968.5494	.0009	AG				-Ir	38	21)
GP Boo	54933.4981	.0009	AG				-Ir	41	21)
GQ Boo	54908.4847	.0002	MS FR				o	405	11)
	54933.4866	.0008	AG				-Ir	41	21)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
GQ Boo	54945.4105	.0002	MS FR				o	522	11)
	54968.4890	.0005	AG				-Ir	38	21)
GR Boo	54516.5074	.0002	MS FR				o	385	11)
	54933.4813	.0005	AG				-Ir	41	21)
	54968.5119	.0010	AG				-Ir	38	21)
GS Boo	54591.3852	.0001	RAT RCR				-Ir	79	7)
GV Boo	54924.3933	.0009	AG	−0.0510		GCVS 2007	-Ir	38	21)
	54924.5841	.0006	AG	−0.0441	s	GCVS 2007	-Ir	38	21)
	54941.5038	.0021	AG	−0.0468	s	GCVS 2007	-Ir	41	21)
GX Boo	54924.4414	.0025	AG	−0.0366		GCVS 2007	-Ir	38	21)
HH Boo	54513.5136	.0004	RAT RCR	−0.0496	s	GCVS 2007	-Ir	132	7)
	54912.3233	.0008	AG	+0.0097		GCVS 2007	-Ir	64	21)
	54912.4835	.0003	AG	+0.0106	s	GCVS 2007	-Ir	64	21)
	54937.3392	.0002	FR	+0.0141	s	GCVS 2007	-Ir	112	21)
HR Boo	54933.4227	.0006	AG				-Ir	40	21)
	54933.5801	.0011	AG				-Ir	40	21)
	54968.4959	.0007	AG				-Ir	38	21)
Y Cam	54844.3441	.0004	AG	+0.3496	s	GCVS 1985	-Ir	140	21)
SV Cam	54902.3547	.0003	WN	+0.0553	s	GCVS 1985	V	144	16)
AK Cam	54947.4553	.0007	AG	+0.0328		BAVM 69	-Ir	99	21)
AL Cam	54589.4255	.0001	RAT RCR	−0.0329		GCVS 1985	-Ir	84	7)
AO Cam	54843.2395	.0004	AG	−0.0688	s	GCVS 1985	-Ir	141	21)
	54843.4048	.0002	AG	−0.0685		GCVS 1985	-Ir	141	21)
	54843.5689	.0003	AG	−0.0693	s	GCVS 1985	-Ir	141	21)
AQ Cam	54843.4644	.0004	AG	+0.0275		GCVS 2007	-Ir	135	21)
AY Cam	54947.4771	.0011	AG	+0.0133		GCVS 1985	-Ir	99	21)
CD Cam	54844.3403	.0014	AG				-Ir	140	21)
DN Cam	54881.3423	.0014	JU				o	80	5)
NR Cam	54947.3562	.0006	AG				-Ir	99	21)
	54947.4823	.0004	AG				-Ir	99	21)
TX Cnc	54831.4140	.0002	RAT RCR	+0.0372		GCVS 1985	-U-I	62	4)
WW Cnc	54830.5542	.0001	RAT RCR	−0.0766		BAVR 32,36	-U-I	102	4)
WX Cnc	54514.5614	.0004	RAT RCR	+0.0117		GCVS 1985	-Ir	172	7)
WY Cnc	54923.3667	.0001	WN	−0.0320		GCVS 1985	V	180	16)
AH Cnc	54513.3642	.0004	RAT RCR				-Ir	150	7)
EV Cnc	54513.3950	.0044	RAT RCR				-Ir	150	7)
GW Cnc	54506.3336	.0006	RAT RCR				-Ir	61	7)
IL Cnc	54500.4124	.0004	RAT RCR	+0.0400		GCVS 2007	-Ir	103	7)
VZ CVn	54924.4181	.0009	AG	−0.0016		GCVS 1985	-Ir	38	21)
YZ CVn	54924.3921	.0005	AG	−0.0127		GCVS 2007	-Ir	38	21)
	54941.4403	.0047	AG	−0.0101	s	GCVS 2007	-Ir	40	21)
BI CVn	54971.5196	.0028	FR	−0.0035		GCVS 1985	-Ir	45	18)
DX CVn	54589.5241	.0004	RAT RCR	+0.0054	s	GCVS 2007	-Ir	140	7)
EE CVn	54924.4239	.0005	AG	−0.0050		GCVS 2007	-Ir	38	21)
	54924.5636	.0012	AG	−0.0055	s	GCVS 2007	-Ir	38	21)
EF CVn	54505.5544	.0005	RAT RCR	−0.0039		GCVS 2007	-Ir	149	7)
	54594.3781	.0002	RAT RCR	−0.0043	s	GCVS 2007	-Ir	79	7)
	54924.3727	.0014	AG	−0.0056	s	GCVS 2007	-Ir	38	21)
	54924.5085	.0005	AG	−0.0058		GCVS 2007	-Ir	38	21)
	54941.3746	.0015	AG	−0.0068		GCVS 2007	-Ir	41	21)
	54941.5118	.0013	AG	−0.0056	s	GCVS 2007	-Ir	41	21)
EH CVn	54924.4239	.0017	AG	−0.0453	s	GCVS 2007	-Ir	38	21)
	54924.5582	.0026	AG	−0.0428		GCVS 2007	-Ir	38	21)
UZ CMi	54829.4492	.0002	RAT RCR	+0.0026		GCVS 2007	-U-I	74	4)
CZ CMi	54510.3661	.0006	RAT RCR	+0.0392	s	IBVS 5366	-Ir	96	7)
ZZ Cas	54840.4491	.0014	AG	−0.0109	s	GCVS 1985	-Ir	43	21)
	54847.2898	.0008	AG	−0.0096		GCVS 1985	-Ir	58	21)
AT Cas	54847.3859	.0035	AG	−0.0840		GCVS 2007	-Ir	58	21)
AX Cas	54847.4669	.0011	AG	−0.0967	s	GCVS 1985	-Ir	57	21)
BG Cas	54841.4926	.0023	AG	+0.4174		GCVS 2007	-Ir	74	21)
BH Cas	54830.3532	.0008	AG				-Ir	130	21)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
BH Cas	54830.5598	.0018	AG				-Ir	130	21)
	54841.3161	.0017	AG				-Ir	49	21)
	54841.5154	.0023	AG				-Ir	49	21)
BI Cas	54847.5146	.0019	AG	−1.0713	s	GCVS 2007	-Ir	58	21)
CW Cas	54847.3004	.0005	AG	−0.0498		GCVS 1985	-Ir	58	21)
	54847.4608	.0005	AG	−0.0488	s	GCVS 1985	-Ir	58	21)
EG Cas	54832.4031	.0004	AG	+0.1095	s	GCVS 1985	-Ir	66	21)
EP Cas	54788.3770	.0006	RAT RCR	−0.0347		GCVS 1985	-U-I	51	4)
	54832.3020	.0005	AG	−0.0354		GCVS 1985	-Ir	28	21)
IR Cas	54685.4927	.0002	RAT RCR	+0.0119	s	GCVS 1985	-U-I	100	4)
LR Cas	54847.6183	.0028	AG	+0.0143	s	GCVS 1985	-Ir	89	21)
MS Cas	54830.3011	.0003	AG	+0.0391		GCVS 2007	-Ir	130	21)
	54840.2726	.0019	AG	+0.0424	s	GCVS 2007	-Ir	43	21)
	54841.4452	.0015	AG	+0.0422	s	GCVS 2007	-Ir	48	21)
MU Cas	54830.3894	.0010	AG	+0.1029	s	GCVS 2007	-Ir	130	21)
MV Cas	54840.4539	.0005	AG	−0.0897		GCVS 2007	-Ir	51	21)
OR Cas	54841.2705	.0002	AG	−0.0213		GCVS 1985	-Ir	50	21)
	54847.4985	.0005	AG	−0.0219		GCVS 1985	-Ir	58	21)
OX Cas	54835.3558	.0007	AG	+0.0473	s	GCVS 1985	-Ir	48	21)
QQ Cas	54840.4305	.0010	AG	+0.1078		BAVR 35,1	-Ir	62	21)
	54841.5121	.0042	AG	+0.1183	s	BAVR 35,1	-Ir	60	21)
V336 Cas	54830.4277	.0002	AG	−0.0145		GCVS 2008	-Ir	130	21)
	54841.4809	.0055	AG	−0.0111	s	GCVS 2008	-Ir	60	21)
V360 Cas	54737.5172	.0002	RAT RCR	−0.1037		GCVS 2007	-U-I	159	4)
V375 Cas	54840.2822	.0012	AG	+0.2112	s	BAVR 32,36	-Ir	66	21)
V381 Cas	54861.3087	.0009	JU	−0.0039		BAVR 32,36	o	56	5)
V473 Cas	54829.2928	.0002	AG	−0.0168		IBVS 4669	-Ir	48	21)
	54829.5019	.0017	AG	−0.0155	s	IBVS 4669	-Ir	48	21)
V520 Cas	54832.3569	.0009	AG	−0.1094	s	GCVS 1985	-Ir	28	21)
SY Cep	54925.4103	.0003	AG	−2.0332		GCVS 2007	-Ir	27	21)
BR Cep	54925.4980	.0010	AG	+0.0117		GCVS 2007	-Ir	50	21)
DK Cep	54925.6107	.0001	AG	+0.0332		GCVS 1985	-Ir	53	21)
EF Cep	54925.4148	.0003	AG	−0.1103	s	GCVS 1985	-Ir	58	21)
	54934.5063	.0008	AG	−0.1098	s	GCVS 1985	-Ir	37	21)
EY Cep	54925.5242	.0012	AG	+1.3320	s	GCVS 2007	-Ir	51	21)
V489 Cep	54925.3998	.0014	AG	+0.1169		IBVS 4406	-Ir	48	21)
TV Cet	54835.2549	.0014	FR	−0.0006	s	GCVS 1985	-Ir	107	18)
RW Com	54933.4180	.0012	AG	−0.0171		GCVS 1985	-Ir	45	21)
	54933.5372	.0009	AG	−0.0166	s	GCVS 1985	-Ir	45	21)
	54937.4535	.0001	AG	−0.0165		GCVS 1985	-Ir	33	21)
	54937.5707	.0014	AG	−0.0180	s	GCVS 1985	-Ir	33	21)
	54964.3908	.0001	WN	−0.0180	s	GCVS 1985	V	129	16)
UX Com	54857.5449	.0005	MS FR	−0.1008		BAVM 69	o	795	11)
	54908.5382	.0016	AG	−0.1014		BAVM 69	-Ir	40	21)
	54910.3751	.0024	MS FR	+1.7355		BAVM 69	o	330	11)
AQ Com	54831.6443	.0005	MS FR	+0.0602	s	GCVS 2007	o	354	11)
CC Com	54934.3808	.0006	DIE	−0.0149		GCVS 1985	o	22	14)
CI Com	54941.5726	.0021	AG				-Ir	50	21)
CN Com	54941.4910	.0025	AG	+0.0594	s	GCVS 2007	-Ir	50	21)
	54976.4239	.0010	JU	+0.0589		GCVS 2007	o	51	5)
DD Com	54505.5301	.0002	MS FR	−0.0587	s	GCVS 2008	o	324	11)
DG Com	54847.6088	.0006	MS FR	−0.0516	s	GCVS 2007	o	348	11)
EK Com	54500.5529	.0004	RAT RCR				-Ir	135	7)
	54908.4430	.0008	AG				-Ir	39	21)
	54908.5757	.0004	AG				-Ir	39	21)
	54933.3769	.0008	AG				-Ir	45	21)
	54933.5111	.0012	AG				-Ir	45	21)
	54937.3770	.0062	AG				-Ir	34	21)
	54937.5115	.0014	AG				-Ir	34	21)
EQ Com	54830.5685	.0005	MS FR	−0.0094		GCVS 2007	o	650	11)
LL Com	54908.4487	.0007	AG	+0.0064		IBVS 4386	-Ir	39	21)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
LL Com	54908.6508	.0017	AG	+0.0050	s	IBVS 4386=BAVM 88	-Ir	39	21)
LO Com	54933.4783	.0007	AG				-Ir	45	21)
	54933.6215	.0003	AG				-Ir	45	21)
	54937.4867	.0009	AG				-Ir	34	21)
LP Com	54933.3659	.0012	AG				-Ir	45	21)
	54933.5335	.0015	AG				-Ir	45	21)
	54937.4205	.0024	AG				-Ir	33	21)
	54937.5879	.0021	AG				-Ir	33	21)
LQ Com	54933.4060	.0006	AG				-Ir	46	21)
	54933.5853	.0011	AG				-Ir	46	21)
	54937.5099	.0009	AG				-Ir	35	21)
LT Com	54933.4407	.0020	AG				-Ir	40	21)
	54937.5337	.0025	AG				-Ir	34	21)
MM Com	54908.5121	.0007	AG	−0.0118	s	GCVS 2007	-Ir	39	21)
	54908.6596	.0042	AG	−0.0153		GCVS 2007	-Ir	39	21)
MR Com	54512.5209	.0004	RAT RCR	−0.0276		GCVS 2007	-Ir	153	7)
	54908.5487	.0004	AG	−0.0324	s	GCVS 2007	-Ir	39	21)
U CrB	54936.3422	.0006	FR	+0.1193		GCVS 1985	-Ir	200	18)
RT CrB	54974.5574	.0012	FR	−0.0213		GCVS 1985	-Ir	54	21)
RW CrB	54596.4007	.0001	RAT RCR	−0.0044		GCVS 1985	-Ir	100	7)
	54974.5022	.0005	FR	+0.0000	s	GCVS 1985	-Ir	41	21)
TU CrB	54932.5806	.0002	AG	+0.1172	s	GCVS 2007	-Ir	53	21)
TW CrB	54924.5009	.0001	FR	+0.0399		GCVS 2007	-Ir	94	18)
YY CrB	54931.4002	.0001	FR				-Ir	109	21)
	54931.5875	.0001	FR				-Ir	109	21)
	54958.5128	.0020	SCI				o	123	5)
AR CrB	54924.4480	.0004	FR	−0.0033		GCVS 2007	-Ir	80	18)
	54924.6413	.0001	FR	−0.0087	s	GCVS 2007	-Ir	88	18)
	54943.5195	.0002	AG	−0.0047		GCVS 2007	-Ir	46	21)
AS CrB	54932.4535	.0005	AG	+0.0056		GCVS 2007	-Ir	53	21)
AV CrB	54943.4272	.0004	AG	−0.0132		GCVS 2007	-Ir	46	21)
	54943.5789	.0003	AG	−0.0156	s	GCVS 2007	-Ir	46	21)
	54968.3894	.0007	AG	−0.0147		GCVS 2007	-Ir	50	21)
	54968.5421	.0005	AG	−0.0161	s	GCVS 2007	-Ir	50	21)
Y Cyg	54705.6035	.0004	FR	+0.0682	s	GCVS 1985	-Ir	78	21)
UW Cyg	54784.3197	.0001	RAT RCR	+0.0249		GCVS 1985	-U-I	84	4)
AE Cyg	54736.5224	.0002	RAT RCR	−0.0039		GCVS 1985	-U-I	105	4)
CG Cyg	54709.5243	.0001	RAT RCR	+0.0606		GCVS 1985	-U-I	118	4)
V370 Cyg	54765.2554	.0003	RAT RCR	−0.0238		GCVS 1985	-U-I	47	4)
V387 Cyg	54662.4759	.0001	RAT RCR	+0.0184		GCVS 1985	-U-I	120	4)
V456 Cyg	54706.4907	.0002	RAT RCR	+0.0442		GCVS 1985	-U-I	36	4)
V477 Cyg	54788.2515	.0001	RAT RCR	−0.0219		GCVS 1985	-U-I	112	4)
V484 Cyg	54984.4677	.0003	MS FR	+0.1144		GCVS 2007	o	750	11)
V488 Cyg	54983.5541	.0006	MS FR	+0.0610		GCVS 1985	o	675	11)
V496 Cyg	54976.5061	.0001	MS FR	+0.0073		GCVS 2008	o	798	11)
V500 Cyg	54942.5629	.0002	MS FR	+0.1061		GCVS 1985	o	480	11)
V693 Cyg	54974.4677	.0006	MS FR	+0.0067		GCVS 2007	o	644	11)
V906 Cyg	54908.6273	.0002	MS FR	+0.0607		GCVS 2007	o	348	11)
V931 Cyg	54512.6809	.0011	MS FR	+0.0155		GCVS 1985	o	196	11)
V934 Cyg	50369.2750	.0007	FR	−0.0663	s	GCVS 1985	-Ir	42	18) 1)
	50370.3391	.0005	FR	−0.0532		GCVS 1985	-Ir	38	17)
	50371.3791	.0009	FR	−0.0643	s	GCVS 1985	-Ir	25	17)
	50390.2962	.0012	FR	−0.0661	s	GCVS 1985	-Ir	32	17)
	50391.3522	.0005	FR	−0.0611		GCVS 1985	-Ir	58	17)
V1004 Cyg	54941.503 :	.000	MS FR	−0.167		GCVS 1985	o	486	11)
	54985.388 :	.000	MS FR	−0.167		GCVS 1985	o	618	11)
V1141 Cyg	54801.2337	.0006	RAT RCR	+0.0246	s	GCVS 2007	-U-I	65	4)
V1305 Cyg	54981.4718	.0006	MS FR	−0.0128		GCVS 2007	o	765	11)
V1877 Cyg	54705.5069	.0009	FR				-Ir	78	21)
V1918 Cyg	54776.2503	.0002	RAT RCR				-U-I	66	4)
V2021 Cyg	54663.4498	.0002	RAT RCR				-U-I	48	4)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V2422 Cyg	53258.5458	.0027	AG	−0.0567	s	GCVS 2007	o	21	4)
	53258.5458	.0027	AG	−0.0567	s	GCVS 2007	o	21	4)
	54707.4439	.0010	AG	−0.1274		GCVS 2007	-Ir	20	21)
TT Del	54652.4715	.0003	RAT RCR	−0.0889		GCVS 1985	o	82	7)
RZ Dra	54936.4440	.0031	AG	+0.0477	s	GCVS 1985	-Ir	71	21)
TW Dra	54959.5258	.0015	AG	+0.0288		GCVS 1985	-Ir	131	21)
AR Dra	54924.5195	.0001	AG	+0.0188		GCVS 2007	-Ir	77	21)
AU Dra	54943.4491	.0003	AG	+0.0898		GCVS 2007	-Ir	75	21)
AX Dra	54924.4244	.0005	AG	−0.0033	s	BAVR 32,36	-Ir	77	21)
BE Dra	54943.5380	.0013	AG	−0.1152		GCVS 1985	-Ir	75	21)
BF Dra	55034.4126	.0001	WTR	+0.2360		GCVS 1985	-Ir	82	19)
CV Dra	54936.4911	.0006	AG	+0.0019		BAVM 69	-Ir	71	21)
EF Dra	54943.5757	.0010	AG	+0.0641		IBVS 3811	-Ir	75	21)
FU Dra	54540.6021	.0001	RAT RCR				-Ir	163	7)
	54959.4243	.0004	AG				-Ir	131	21)
GM Dra	54936.4621	.0011	AG				-Ir	71	21)
NN Dra	54924.3581	.0003	AG				-Ir	77	21)
	54924.5491	.0001	AG				-Ir	77	21)
RW Gem	54866.4016	.0002	AG	+0.0023		GCVS 1985	-Ir	53	21)
SX Gem	54830.4167	.0024	AG	−0.0454	s	GCVS 1985	-Ir	64	21)
WW Gem	54829.6196	.0016	AG	+0.0340	s	GCVS 1985	V	90	21)
	54857.4671	.0003	AG	+0.0307		GCVS 1985	-Ir	55	21)
AF Gem	54861.2804	.0013	MS FR	−0.0691		GCVS 1985	o	468	11)
AH Gem	54830.4442	.0010	AG	+0.0394	s	GCVS 2008	-Ir	64	21)
	54830.6150	.0012	AG	+0.0418		GCVS 2008	-Ir	64	21)
AI Gem	54830.3638	.0004	AG	−0.0337	s	GCVS 2008	-Ir	64	21)
	54843.4000	.0014	AG	−0.0475	s	GCVS 2008	-Ir	57	21)
	54856.4361	.0008	AG	−0.0614	s	GCVS 2008	-Ir	55	21)
AL Gem	54830.2578	.0017	AG	+0.0679		GCVS 1985	-Ir	65	21)
AV Gem	54843.3693	.0012	AG	−0.0282		GCVS 2007	-Ir	54	21)
BT Gem	54831.2886	.0017	AG	−0.0073		GCVS 2007	V	28	21)
	54857.2633	.0033	AG	−0.0083		GCVS 2007	-Ir	55	21)
CP Gem	54830.5269	.0005	AG	−0.0112		GCVS 2007	-Ir	64	21)
CX Gem	54830.4322	.0032	AG	−0.0167	s	GCVS 1985	-Ir	65	21)
DG Gem	54830.3333	.0007	AG	−0.7778		GCVS 2007	-Ir	65	21)
	54858.5147	.0005	FR	−0.7801		GCVS 2007	-Ir	159	21)
EG Gem	54856.5469	.0011	AG	+0.2777		GCVS 1985	-Ir	59	21)
EL Gem	54830.3667	.0007	AG	−0.2217		GCVS 1985	-Ir	64	21)
EN Gem	54830.3649	.0007	AG	−0.0434		GCVS 1985	-Ir	63	21)
FG Gem	54827.4310	.0001	MS FR	−0.0283		GCVS 1985	o	504	11)
	54843.4104	.0037	AG	−0.0219	s	GCVS 1985	-Ir	57	21)
	54856.5122	.0010	AG	−0.0261	s	GCVS 1985	-Ir	59	21)
HI Gem	54845.4545	.0009	AG				-Ir	86	21)
HR Gem	54829.4202	.0005	AG	+0.0141	s	GCVS 2007	V	93	21)
	54835.2975	.0006	AG	+0.0121		GCVS 2007	-Ir	44	21)
	54866.2980	.0006	AG	+0.0126		GCVS 2007	-Ir	54	21)
KQ Gem	54830.3160	.0015	AG	−0.0764	s	GCVS 2007	-Ir	63	21)
	54830.5157	.0007	AG	−0.0807		GCVS 2007	-Ir	63	21)
KV Gem	54843.3029	.0014	AG	−0.0152		BAVR 52,95	-Ir	56	21)
	54843.4809	.0005	AG	−0.0165	s	BAVR 52,95	-Ir	56	21)
	54856.3877	.0005	AG	−0.0166	s	BAVR 52,95	-Ir	57	21)
LO Gem	54829.3347	.0005	AG				V	92	21)
	54857.3058	.0004	AG				-Ir	55	21)
SZ Her	54933.4040	.0001	FR	−0.0212		GCVS 1985	-Ir	164	21)
TT Her	55011.4431	.0020	SIR	+0.0368		GCVS 1985	-Ir	322	12)
TU Her	54931.5389	.0002	AG	−0.1905		GCVS 1985	-Ir	43	21)
	54947.4076	.0004	AG	−0.1908		GCVS 1985	-Ir	36	21)
UX Her	54987.4616	.0020	SIR	+0.0750		GCVS 1985	-Ir	420	12)
AK Her	54971.4510	.0016	AG	+0.0177	s	GCVS 1985	-Ir	29	21)
BO Her	54959.4743	.0004	AG	−0.0377		GCVS 1985	-Ir	86	21)
EF Her	54971.4620	.0010	AG	+0.4317		GCVS 2007	-Ir	29	21)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
GU Her	54931.5040	.0009	AG	+0.8158		GCVS 1985	-Ir	43	21)
IK Her	54947.5676	.0008	AG	+0.2420		GCVS 2007	-Ir	36	21)
LT Her	54555.5385	.0003	RAT RCR	−0.0297		BAVM 69	-Ir	136	7)
MS Her	54619.4732	.0004	RAT RCR	−0.1172	s	GCVS 1985	-U-I	115	4)
MT Her	54595.5143	.0001	RAT RCR	+0.0162		GCVS 1985	-Ir	158	7)
MX Her	54506.5931	.0001	MS FR	−0.5304		GCVS 1985	o	650	11)
	54971.4072	.0005	AG	−0.5517		GCVS 1985	-Ir	37	21)
V338 Her	54591.5169	.0001	RAT RCR	+0.0822		GCVS 1985	-Ir	159	7)
	54744.2907	.0001	RAT RCR	+0.0845		GCVS 1985	-U-I	58	4)
	54937.5431	.0002	AG	+0.0875		GCVS 1985	-Ir	38	21)
	55039.3908	.0001	WTR	+0.0875		GCVS 1985	-Ir	74	19)
V359 Her	54908.5697	.0010	AG	+0.1894		GCVS 1985	-Ir	38	21)
V387 Her	54910.5727	.0001	MS FR	+0.0698	s	GCVS 1985	o	558	11)
V412 Her	54513.5982	.0001	MS FR	+0.0808		GCVS 2007	o	658	11)
V502 Her	54947.4145	.0006	AG	+0.0211		GCVS 2007	-Ir	36	21)
	54947.6009	.0006	AG	+0.0228	s	GCVS 2007	-Ir	36	21)
V643 Her	54924.5189	.0017	SCI	+0.2807	s	GCVS 2007	o	46	5)
V719 Her	54908.4961	.0011	AG	+0.0259		GCVS 2007	-Ir	38	21)
	54937.3581	.0010	AG	+0.0030		GCVS 2007	-Ir	37	21)
	54937.5646	.0005	AG	+0.0416	s	GCVS 2007	-Ir	37	21)
V728 Her	54718.3524	.0002	RAT RCR	+0.0594	s	IBVS 3234	-U-I	84	4)
	54908.5187	.0008	AG	+0.0615		IBVS 3234	-Ir	38	21)
	54942.4519	.0004	MS FR	+0.0621		IBVS 3234	o	468	11)
V731 Her	54937.5272	.0008	AG	−0.0468		GCVS 2007	-Ir	38	21)
V829 Her	54934.3612	.0018	AG	+0.0333	s	IBVS 5496	-Ir	53	21)
	54947.4281	.0009	AG	+0.0277		IBVS 5496	-Ir	36	21)
V842 Her	54709.3615	.0001	RAT RCR	−0.0464		BAVR 49,180	-U-I	94	4)
	54940.4614	.0007	PGL	−0.0474	s	BAVR 49,180	o	247	13)
V856 Her	54908.5203	.0005	AG				-Ir	37	21)
V857 Her	54908.5260	.0007	AG				-Ir	38	21)
	54932.4135	.0008	AG				-Ir	52	21)
	54932.6095	.0016	AG				-Ir	52	21)
V878 Her	54928.3621	.0015	SCI				o	153	5)
	54932.5981	.0002	FR				-Ir	95	21)
	54933.3945	.0010	FR				-Ir	89	18)
	54971.5224	.0018	AG				-Ir	37	21)
V899 Her	54931.3946	.0005	FR				-Ir	177	18)
	54931.6258	.0007	FR				-Ir	177	18)
V1024 Her	54935.3908	.0004	FR				-Ir	51	21)
V1032 Her	54934.5507	.0025	AG				-Ir	53	21)
V1033 Her	54931.4127	.0006	AG				-Ir	43	21)
	54931.5596	.0010	AG				-Ir	43	21)
V1038 Her	54931.4510	.0012	AG				-Ir	43	21)
	54931.5878	.0008	AG				-Ir	43	21)
	54934.4019	.0009	AG				-Ir	52	21)
	54934.5380	.0006	AG				-Ir	52	21)
	54947.4100	.0007	AG				-Ir	36	21)
	54947.5424	.0014	AG				-Ir	36	21)
V1039 Her	54971.4130	.0005	AG				-Ir	29	21)
V1044 Her	54908.5497	.0003	AG				-Ir	38	21)
V1045 Her	54706.3830	.0004	RAT RCR				-U-I	87	4)
V1047 Her	54931.4448	.0014	AG				-Ir	43	21)
	54931.6048	.0009	AG				-Ir	43	21)
	54947.4789	.0004	AG				-Ir	35	21)
V1054 Her	54971.4425	.0003	AG				-Ir	27	21)
V1055 Her	54737.3523	.0002	RAT RCR				-U-I	95	4)
	54908.4623	.0010	AG				-Ir	38	21)
	54908.6173	.0004	AG				-Ir	38	21)
	54937.4804	.0006	AG				-Ir	37	21)
V1062 Her	54937.4422	.0008	AG				-Ir	40	21)
V1067 Her	54937.4208	.0005	AG				-Ir	39	21)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V1067 Her	54937.5507	.0009	AG				-Ir	39	21)
V1068 Her	54971.4666	.0009	AG				-Ir	37	21)
V1088 Her	54931.5029	.0011	AG	+0.0170		GCVS 2007	-Ir	43	21)
	54934.3763	.0022	AG	+0.0165		GCVS 2007	-Ir	52	21)
	54934.5546	.0011	AG	+0.0152	s	GCVS 2007	-Ir	52	21)
	54947.4864	.0009	AG	+0.0147	s	GCVS 2007	-Ir	36	21)
V1091 Her	54908.5612	.0015	AG	−0.0154		GCVS 2007	-Ir	33	21)
	54934.5371	.0006	AG	−0.0125		GCVS 2007	-Ir	53	21)
	54947.5256	.0016	AG	−0.0105		GCVS 2007	-Ir	36	21)
V1092 Her	54947.4747	.0004	AG	−0.0090	s	GCVS 2007	-Ir	35	21)
V1094 Her	54947.5200	.0005	AG	−0.0013		GCVS 2007	-Ir	36	21)
V1095 Her	54908.4639	.0008	AG	−0.0178	s	GCVS 2007	-Ir	34	21)
	54937.5409	.0004	AG	−0.0175	s	GCVS 2007	-Ir	37	21)
V1096 Her	54908.4999	.0009	AG	+0.0188		GCVS 2007	-Ir	34	21)
	54908.6159	.0064	AG	+0.0141	s	GCVS 2007	-Ir	34	21)
	54937.4700	.0008	AG	+0.0191		GCVS 2007	-Ir	37	21)
	54937.5854	.0010	AG	+0.0138	s	GCVS 2007	-Ir	37	21)
V1100 Her	54937.4637	.0011	AG	+0.0400		GCVS 2007	-Ir	36	21)
V1102 Her	54971.5024	.0007	AG	+0.0066	s	GCVS 2007	-Ir	37	21)
V1103 Her	54593.5145	.0001	RAT RCR	−0.0054		GCVS 2007	-Ir	156	7)
V1104 Her	54971.4262	.0008	AG	−0.0033	s	GCVS 2007	-Ir	37	21)
	54971.5377	.0011	AG	−0.0057		GCVS 2007	-Ir	37	21)
UW Hya	54866.4380	.0004	FR	+0.0060		GCVS 2007	-Ir	74	21)
VZ Hya	54866.3976	.0003	FR	+0.0046		GCVS 1985	-Ir	61	21)
CQ Hya	54866.4545	.0047	FR	+0.1743	s	GCVS 2007	-Ir	34	21)
DF Hya	54815.5121	.0002	RAT RCR	+0.0320	s	GCVS 1985	-U-I	114	4)
SW Lac	54844.2761	.0003	AG	+0.0600	s	GCVS 1985	V	62	21)
VX Lac	54763.5076	.0001	RAT RCR	+0.0659		GCVS 1985	-U-I	142	4)
AW Lac	54801.3575	.0003	RAT RCR	+0.0429		BAVR 35,1	-U-I	82	4)
FL Lac	54834.3510:	.0020	AG	−0.0584		GCVS 1985	-Ir	70	21)
NR Lac	54834.3920	.0006	AG	+0.0687		GCVS 2008	-Ir	70	21)
OX Lac	54834.4434	.0006	AG	+0.1442		GCVS 2007	-Ir	80	21)
PP Lac	54834.3719	.0002	AG	−0.0506	s	GCVS 1985	-Ir	70	21)
	54834.5722	.0006	AG	−0.0509		GCVS 1985	-Ir	70	21)
UV Leo	54880.3801	.0014	PGL	+0.0023	s	IBVS 5338	o	618	13)
UZ Leo	54829.5157	.0003	RAT RCR	−0.1131	s	GCVS 1985	-U-I	142	4)
	54907.3924	.0030	SIR	−0.1098	s	GCVS 1985	-Ir	152	12)
	54912.3368	.0001	MS FR	−0.1097	s	GCVS 1985	o	432	11)
XZ Leo	54509.4123	.0004	RAT RCR	+0.0453		GCVS 1985	-Ir	93	7)
	54831.5634	.0001	RAT RCR	+0.0473	s	GCVS 1985	-U-I	129	4)
	54908.3830	.0001	MS FR	+0.0487		GCVS 1985	o	420	11)
AM Leo	54876.3709	.0021	PGL	+0.0083		GCVS 1985	o	820	13)
	54911.3048	.0035	PGL	+0.0086	s	GCVS 1985	o	157	13)
BW Leo	54891.4349	.0028	SCI	+0.0576	s	GCVS 2007	o	32	5)
	54891.6111	.0014	SCI	+0.0651		GCVS 2007	o	23	5)
	54910.4967	.0017	SCI	+0.0664		GCVS 2007	o	48	5)
CE Leo	54832.5546	.0002	RAT RCR	−0.0080	s	GCVS 2007	-U-I	51	4)
GV Leo	54506.4949	.0004	RAT RCR	+0.0384	s	GCVS 2007	-Ir	135	7)
HI Leo	54555.3732	.0001	RAT RCR	+0.0007		GCVS 2007	-Ir	78	7)
RT LMi	54512.3908	.0004	RAT RCR	−0.0064	s	GCVS 1985	-Ir	100	7)
VW LMi	54931.3618	.0002	WTR				-Ir	58	19)
WZ LMi	54912.4115	.0006	AG	+0.0509	s	GCVS 2007	-Ir	68	21)
	54942.3750	.0013	AG	+0.0513	s	GCVS 2007	-Ir	58	21)
	54942.5704	.0026	AG	+0.0521		GCVS 2007	-Ir	58	21)
XX LMi	54942.4133	.0011	AG	+0.0046		GCVS 2007	-Ir	58	21)
XY LMi	54505.4479	.0004	RAT RCR	−0.0112		GCVS 2007	-Ir	96	7)
	54912.4083	.0005	AG	−0.0135	s	GCVS 2007	-Ir	68	21)
	54942.5519	.0008	AG	−0.0153	s	GCVS 2007	-Ir	60	21)
RY Lyn	54516.5374	.0004	RAT RCR	−0.0484		GCVS 1985	-Ir	219	7)
RZ Lyn	54942.3647	.0014	AG	−0.1125		GCVS 1985	-Ir	78	21)
UU Lyn	54924.4137	.0022	SCI	−0.0112		GCVS 1985	o	44	5)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
UU Lyn	54942.4533	.0016	AG	−0.0073	s	GCVS 1985	-Ir	78	21)
UV Lyn	54865.4123	.0013	SCI	+0.0690	s	GCVS 1985	o	63	5)
	54865.6194	.0021	SCI	+0.0686		GCVS 1985	o	84	5)
AH Lyn	54509.2891	.0001	MS FR				o	322	11)
CC Lyn	54936.4409	.0038	SCI				o	70	5)
DE Lyn	54927.3657	.0031	SCI				o	88	5)
UZ Lyr	54744.4041	.0002	RAT RCR	−0.0263		GCVS 1985	-U-I	73	4)
	54763.3171	.0013	RAT RCR	−0.0261		GCVS 1985	-U-I	112	4)
BV Lyr	54628.4534	.0004	RAT RCR	+0.0258		GCVS 2007	-U-I	100	4)
EW Lyr	54598.5705	.0001	RAT RCR	+0.2366		GCVS 1985	-Ir	140	7)
	54760.3153	.0001	RAT RCR	+0.2374		GCVS 1985	-U-I	97	4)
	54943.4964	.0001	FR	+0.2385		GCVS 1985	-Ir	64	18)
MZ Lyr	54959.5119	.0004	AG	−0.0071		GCVS 2007	-Ir	86	21)
V401 Lyr	54509.6397	.0007	MS FR	+0.1576	s	GCVS 2007	o	333	11)
V431 Lyr	54911.5912	.0005	MS FR	+0.0017		GCVS 2007	o	360	11)
	54945.5149	.0012	MS FR	+0.0015		GCVS 2007	o	522	11)
V563 Lyr	54738.3467	.0003	RAT RCR				-U-I	85	4)
V592 Lyr	54596.5001	.0001	RAT RCR	+0.0088		GCVS 2007	-Ir	151	7)
RW Mon	54830.4014	.0004	RAT RCR	−0.0671		GCVS 1985	-U-I	87	4)
	54891.3959	.0001	WTR	−0.0676		GCVS 1985	-Ir	106	19)
AO Mon	54847.4992	.0005	AG	−0.0136	s	BAVR 51,38	-Ir	40	21)
AY Mon	54843.5360:	.0030	AG	+0.0532	s	GCVS 2007	-Ir	54	21)
BM Mon	54479.4111	.0001	RAT RCR	+0.0441		GCVS 1985	-Ir	72	7)
CP Mon	54841.4560	.0009	AG	+0.0182		GCVS 2007	-Ir	45	21)
	54841.4582	.0005	MS FR	+0.0204		GCVS 2007	o	510	11)
DD Mon	54840.3953	.0009	AG	+0.1393		GCVS 1985	-Ir	63	21)
	54841.5474	.0006	AG	−0.1286	s	GCVS 1985	-Ir	46	21)
GH Mon	54847.4440	.0017	AG	−0.0809	s	GCVS 2007	-Ir	45	21)
GU Mon	54840.3975	.0009	AG	−0.0461	s	GCVS 1985	-Ir	63	21)
	54841.3011	.0019	AG	−0.0392	s	GCVS 1985	-Ir	46	21)
	54866.4012	.0006	AG	−0.0462	s	GCVS 1985	-Ir	59	21)
HM Mon	54866.3406	.0003	AG	+0.0017		GCVS 1985	-Ir	59	21)
	54866.5462	.0012	AG	+0.0034	s	GCVS 1985	-Ir	59	21)
IL Mon	54506.3224	.0006	MS FR	−0.0495		GCVS 1985	o	600	11)
IX Mon	54882.3766	.0027	AG	−0.0350	s	GCVS 2007	-Ir	26	21)
NN Mon	54847.5962	.0016	AG	+0.1674		GCVS 2007	-Ir	44	21)
V384 Mon	54847.3769	.0013	AG	−0.0373		GCVS 1985	-Ir	44	21)
	54866.3896	.0009	AG	−0.0388		GCVS 1985	-Ir	59	21)
V395 Mon	54841.5381	.0014	AG	+0.0439		GCVS 2007	-Ir	46	21)
V396 Mon	54505.3422	.0004	RAT RCR	−0.0736		GCVS 1985	-Ir	58	7)
	54840.4509	.0016	AG	−0.0746	s	GCVS 1985	-Ir	63	21)
	54841.4409	.0014	AG	−0.0754		GCVS 1985	-Ir	45	21)
V404 Mon	54866.3051	.0010	AG	+0.0138		GCVS 2007	-Ir	59	21)
V442 Mon	54840.3422	.0028	AG	+0.0433	s	GCVS 1985	-Ir	63	21)
V448 Mon	54847.4316	.0009	AG	+0.0598		GCVS 1985	-Ir	42	21)
V450 Mon	54841.5516	.0029	AG	+0.0073	s	GCVS 1985	-Ir	45	21)
V453 Mon	54832.4175	.0001	RAT RCR	+0.1586		GCVS 1985	-U-I	83	4)
V496 Mon	54840.5507	.0020	AG	−0.0353	s	GCVS 1985	-Ir	62	21)
	54841.5455	.0007	AG	−0.0317		GCVS 1985	-Ir	45	21)
V507 Mon	54841.4107	.0019	AG	−0.0407		GCVS 2007	-Ir	46	21)
V514 Mon	54840.5593	.0022	AG	+0.0434		GCVS 1985	-Ir	63	21)
	54841.4016	.0015	AG	+0.0497	s	GCVS 1985	-Ir	46	21)
V521 Mon	54866.4432	.0012	AG	−0.1084		GCVS 1985	-Ir	59	21)
V528 Mon	54841.4233	.0011	AG	−0.2197		GCVS 2007	-Ir	45	21)
V532 Mon	54847.3512	.0012	AG	−0.0027		GCVS 1985	-Ir	43	21)
	54847.5790	.0017	AG	−0.0084	s	GCVS 1985	-Ir	43	21)
	54862.2925	.0002	MS FR	−0.0049		GCVS 1985	o	455	11)
	54866.4956	.0007	AG	−0.0046		GCVS 1985	-Ir	57	21)
V634 Mon	54847.3986	.0014	AG	+0.0772		GCVS 1985	-Ir	44	21)
V714 Mon	54509.3321	.0001	RAT RCR				-Ir	92	7)
	54840.4036	.0005	AG				-Ir	63	21)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V714 Mon	54840.5757	.0016	AG				-Ir	63	21)
V843 Mon	54843.5561	.0029	AG	−0.0508		BAVM 147	-Ir	54	21)
V449 Oph	55042.3804	.0001	WTR	+0.0874		GCVS 1985	-Ir	53	19)
V2553 Oph	54971.4790	.0015	AG				-Ir	27	21)
UW Ori	54829.5604	.0009	AG	+0.0522		GCVS 1985	V	88	21)
DN Ori	54845.2800:	.0100	AG	−0.0053		GCVS 1985	-Ir	65	21)
EG Ori	54829.2893	.0003	MS FR	−0.0847		GCVS 1985	o	530	11)
EY Ori	54842.4255	.0024	AG	−0.0393		GCVS 2007	-Ir	61	21)
FF Ori	54843.4298	.0022	FR	−0.8662		GCVS 1985	-Ir	42	21)
FR Ori	54815.4130	.0002	RAT RCR	+0.0277		GCVS 1985	-U-I	70	4)
	54845.4408	.0006	AG	+0.0280		GCVS 1985	-Ir	63	21)
FT Ori	54829.3235	.0004	AG	+0.0144		GCVS 1985	V	90	21)
FZ Ori	54842.4372	.0012	AG	−0.0587		GCVS 1985	-Ir	61	21)
GU Ori	54845.3560	.0005	AG				-Ir	65	21)
V392 Ori	54829.5977	.0006	AG	+0.0032		GCVS 1985	V	89	21)
V645 Ori	54828.4343	.0001	MS FR	+0.0559		GCVS 2007	o	413	11)
V647 Ori	54500.3022	.0004	RAT RCR	−0.2458		GCVS 1985	-Ir	96	7)
	54840.4916	.0005	AG	−0.2493		GCVS 1985	-Ir	53	21)
V1353 Ori	54842.3667	.0017	AG				-Ir	61	21)
UX Peg	54719.3559	.0002	RAT RCR	−0.0088		GCVS 1987	-U-I	73	4)
VW Peg	54844.3466	.0008	AG	−4.8170	s	BAVM 129	V	63	21)
GP Peg	54844.2506	.0002	AG	−0.0446		GCVS 1987	V	63	21)
WY Per	54842.4669	.0003	AG	−0.1612		GCVS 2007	-Ir	63	21)
BB Per	54516.4071	.0004	RAT RCR				-Ir	170	7)
BP Per	54815.2873	.0002	RAT RCR	−0.0287		GCVS 1987	-U-I	85	4)
BY Per	54829.3971	.0001	AG	+0.0243		GCVS 2008	-Ir	48	21)
CC Per	54829.2837	.0014	AG	−0.3408		GCVS 2007	-Ir	48	21)
HS Per	54829.4851	.0002	AG				-Ir	48	21)
HV Per	53989.5311	.0015	MS FR	−0.2590		GCVS 2007	o	484	11)
	54828.2829	.0002	MS FR	−0.2813		GCVS 2007	o	576	11)
IM Per	54830.2946	.0004	RAT RCR	+0.0909		GCVS 1987	-U-I	96	4)
IQ Per	54841.4993	.0008	FR	+0.8105		GCVS 1987	-Ir	62	21)
IT Per	54784.5079	.0005	RAT RCR	−0.0041		GCVS 1987	-U-I	99	4)
IU Per	54831.3228	.0002	RAT RCR	+0.0108		GCVS 1987	-U-I	111	4)
	54831.3236	.0002	AG	+0.0116		GCVS 1987	-Ir	88	21)
	54842.4640	.0005	AG	+0.0106		GCVS 1987	-Ir	64	21)
IZ Per	54829.3209	.0013	AG	+0.0026		GCVS 1987	-Ir	48	21)
KN Per	54521.3093	.0004	RAT RCR	+0.0101	s	BAVR 52,93	-Ir	174	7)
	54817.6387	.0006	AG	+0.0085	s	BAVR 52,93	-Ir	99	4) 21)
	54831.5097	.0010	AG	+0.0161	s	BAVR 52,93	-Ir	94	21)
	54842.3322	.0012	AG	+0.0078		BAVR 52,93	-Ir	68	21)
	54845.3671	.0004	WTR	+0.0100	s	BAVR 52,93	-Ir	131	19)
KR Per	54827.2473	.0001	MS FR	−0.0172		GCVS 1987	o	462	11)
QT Per	54842.2536	.0006	MS FR	−0.1234	s	GCVS 2007	o	390	11)
QU Per	54831.4892	.0002	AG	−0.0020		GCVS 2007	-Ir	98	21)
	54842.3006	.0040	AG	+0.0052	s	GCVS 2007	-Ir	64	21)
V432 Per	54514.3379	.0004	RAT RCR	−0.0128		IBVS 3797	-Ir	93	7)
	54827.3088	.0002	RAT RCR	−0.0164	s	IBVS 3797	-U-I	88	4)
	54831.3352	.0004	AG	−0.0148		IBVS 3797	-Ir	99	21)
	54831.5255	.0004	AG	−0.0161	s	IBVS 3797	-Ir	99	21)
	54842.2597	.0006	AG	−0.0147	s	IBVS 3797	-Ir	63	21)
	54842.4516	.0006	AG	−0.0144		IBVS 3797	-Ir	63	21)
V450 Per	54831.3219	.0014	AG	+0.0958	s	GCVS 1987	-Ir	98	21)
	54842.2314	.0002	AG	+0.0956		GCVS 1987	-Ir	64	21)
V570 Per	54845.4945	.0009	FR				-Ir	60	21)
AO Ser	54599.3865	.0001	RAT RCR	−0.0101		GCVS 1987	-Ir	58	7)
AS Ser	54595.3892	.0001	RAT RCR	−0.0099		GCVS 1987	-Ir	80	7)
V384 Ser	54934.3748	.0003	FR	+0.0024	s	GCVS 2007	-Ir	134	21)
	54934.5081	.0001	FR	+0.0014		GCVS 2007	-Ir	134	21)
	54943.3768	.0008	AG	+0.0020		GCVS 2007	-Ir	46	21)
	54943.5111	.0006	AG	+0.0019	s	GCVS 2007	-Ir	46	21)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V384 Ser	54959.4998	.0003	FR	+0.0013		GCVS 2007	-Ir	103	21)
	54996.4497	.0003	FR	+0.0009	s	GCVS 2007	-Ir	49	21)
	55029.3681	.0003	FR	+0.0000		GCVS 2007	-Ir	135	21)
	55029.5003	.0003	FR	−0.0021	s	GCVS 2007	-Ir	135	21)
SV Tau	54866.3135	.0007	AG	−0.0183		GCVS 1987	-Ir	52	21)
WY Tau	54857.4015	.0004	AG	+0.0565	s	GCVS 1987	-Ir	56	21)
	54866.4074	.0003	AG	+0.0565	s	GCVS 1987	-Ir	54	21)
AL Tau	54847.3682	.0005	MS FR	+0.0460		GCVS 2007	o	413	11)
AM Tau	54835.2900	.0003	AG	−0.0521		GCVS 1987	-Ir	47	21)
	54845.5092	.0021	AG	−0.0525		GCVS 1987	-Ir	65	21)
AQ Tau	54857.3714	.0004	AG	−0.0925		GCVS 1987	-Ir	66	21)
AS Tau	54857.3675	.0004	AG	+0.5007		GCVS 2007	-Ir	65	21)
CF Tau	54842.3397	.0019	FR	−0.0099		BAVR 35,1	-Ir	50	18)
CR Tau	54479.2836	.0002	RAT RCR	−0.0022		IBVS 4778	-Ir	107	7)
	54835.3164	.0018	AG	+0.0007	s	IBVS 4778	-Ir	44	21)
	54857.5004	.0003	AG	−0.0031		IBVS 4778	-Ir	53	21)
	54866.3753	.0003	AG	−0.0034		IBVS 4778	-Ir	54	21)
CT Tau	54857.2945	.0004	AG	−0.0508		GCVS 1987	-Ir	55	21)
	54866.2974	.0012	AG	−0.0501	s	GCVS 1987	-Ir	49	21)
CU Tau	54832.2743	.0003	RAT RCR	+0.0829		GCVS 1987	-U-I	59	7)
EN Tau	54829.4404	.0003	AG	+0.0012		BAVR 52,49	V	91	21)
EO Tau	54866.4649	.0010	AG				-Ir	55	21)
V1112 Tau	54860.3314	.0003	MS FR				o	315	11)
V Tri	54857.3034	.0011	FR	−0.0037	s	GCVS 1987	-Ir	39	18)
RS Tri	54857.3361	.0001	WN	−0.0331		GCVS 1987	V	102	16)
	54857.3372	.0002	FR	−0.0320		GCVS 1987	-Ir	48	18)
RU Tri	54830.4173	.0036	FR	−0.8263		GCVS 2007	-Ir	29	18)
W UMa	54844.4545	.0004	AG	−0.0088	s	BAVR 44,156	V	44	21)
TY UMa	54947.3936	.0001	WTR	−0.0871		GCVS 1987	-Ir	88	19)
UY UMa	54956.4040	.0010	JU	−0.0786	s	GCVS 1987	o	61	5)
XY UMa	54922.3724	.0013	SCI	+0.0340		GCVS 1987	o	166	5)
	54922.6131	.0017	SCI	+0.0352	s	GCVS 1987	o	157	5)
ZZ UMa	54844.5010	.0003	AG	−0.0024		GCVS 1987	V	43	21)
AA UMa	54941.3544	.0008	SCI	+0.0375		GCVS 1987	o	100	5)
	54941.5893	.0017	SCI	+0.0383	s	GCVS 1987	o	97	5)
AW UMa	54866.5150	.0015	SCI	−0.0707		GCVS 1987	o	107	5)
BQ UMa	54931.4364	.0007	AG	−0.1154		GCVS 2007	-Ir	66	21)
BS UMa	54931.3651	.0006	AG	+0.0653		GCVS 2007	-Ir	65	21)
	54931.5403	.0003	AG	+0.0220	s	GCVS 2007	-Ir	65	21)
ES UMa	54586.4317	.0001	RAT RCR				-Ir	177	7)
	54925.4245	.0013	SCI				o	166	5)
IY UMa	54942.3580	.0002	SHT				-Ir	102	8)
KM UMa	54847.4663	.0003	MS FR				o	336	11)
LO UMa	54942.4844	.0004	AG				-Ir	39	21)
LP UMa	54844.4609	.0015	AG				V	41	21)
	54866.3138	.0031	JU				o	60	5)
MQ UMa	54931.4375	.0007	AG	+0.0693		GCVS 2007	-Ir	67	21)
MS UMa	54932.4150	.0002	AG	+0.0329		GCVS 2007	-Ir	101	21)
	54932.6207	.0010	AG	+0.0334	s	GCVS 2007	-Ir	101	21)
W UMi	54936.4233	.0008	AG	−0.1628		GCVS 1987	B	25	21)
	54936.4248	.0011	AG	−0.1613		GCVS 1987	V	25	21)
RT UMi	54977.4614	.0018	JU	+0.1292		GCVS 1987	o	51	5)
RZ UMi	54936.4228	.0010	AG	+0.0466	s	GCVS 2007	B	23	21)
	54936.4234	.0006	AG	+0.0472	s	GCVS 2007	V	24	21)
AH Vir	54912.5044	.0003	MS FR	+0.0093	s	GCVS 1987	o	424	11)
	54924.3233	.0014	PGL	+0.0101	s	GCVS 1987	o	366	13)
	54941.4401	.0002	AG	+0.0110	s	GCVS 1987	-Ir	51	21)
PT Vir	54941.3804	.0017	AG	−0.0791		GCVS 2007	-Ir	49	21)
	54941.5366	.0022	AG	+0.0771		GCVS 2007	-Ir	49	21)
QX Vir	54590.4080	.0001	RAT RCR	+0.0050		GCVS 2007	-Ir	67	7)
AY Vul	54624.5027	.0003	RAT RCR	−0.0735		GCVS 1987	-U-I	75	4)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
BO Vul	55041.4016	.0020	SIR	−0.0328		GCVS 1987	-Ir	58	12)
CD Vul	54639.5102	.0002	RAT RCR	−0.0001		GCVS 1987	-U-I	110	4)
GP Vul	54648.4861	.0001	RAT RCR	−0.0601		GCVS 1987	o	117	7)
GSC 0005900024	54835.2618	.0012	FR				-Ir	95	18)
GSC 0021501230	54866.4106	.0007	FR				-Ir	58	21)
	54866.5453	.0005	FR				-Ir	58	21)
GSC 0064600946	54800.2853	.0007	FR				-Ir	38	18)
GSC 0080801106	54513.4518	.0003	FR				-Ir	77	21)
GSC 0087500978	54971.4980	.0020	FR				-Ir	49	21)
	54972.4422	.0012	FR				-Ir	46	21)
GSC 0133000287	54809.5916	.0003	AG	−0.0025		BAVR 54.105	-Ir	51	21)
	54843.4176	.0013	AG	−0.0009		BAVR 54.105	-Ir	56	21)
	54843.5947	.0006	AG	+0.0019	s	BAVR 54.105	-Ir	56	21)
	54856.4965	.0003	AG	+0.0016	s	BAVR 54.105	-Ir	57	21)
GSC 0138300181	54544.4356	.0002	FR				-Ir	41	21)
GSC 0139500877	54531.4411	.0004	FR				-Ir	90	21)
	54531.6121	.0017	FR				-Ir	90	21)
GSC 0186401065	54509.3620	.0002	FR				V	89	10)
	54509.5439	.0004	FR				V	89	10)
GSC 0203800293	54610.517	.001	FR	+0.004	s	BAVM 177	-Ir	56	21)
	54636.5298	.0009	FR	+0.0083		BAVM 177	-Ir	50	21)
	54703.4093	.0008	FR	+0.0074		BAVM 177	-Ir	22	21)
	54959.5359	.0003	FR	+0.0071		BAVM 177	-Ir	63	21)
	55029.3875	.0009	FR	+0.0058		BAVM 177	-Ir	55	21)
GSC 0203800800	54935.4010	.0001	FR				-Ir	51	21)
GSC 0214001485	54658.4718	.0004	AG	+0.0610		BAV unpb.	-Ir	42	21)
GSC 0215700014	54709.4601	.0003	FR				-Ir	97	21)
GSC 0267700988	54763.3777	.0005	FR				-Ir	137	21)
GSC 0310100683	54591.5278	.0001	RAT RCR				-Ir	159	7)
	54744.2977	.0004	RAT RCR				-U-I	48	4)
GSC 0367501186	54815.3403	.0010	AG	+0.0139	s	BAV unpb.	-Ir	60	21)
	54815.4902	.0011	AG	+0.0152		BAV unpb.	-Ir	60	21)
	54829.3050	.0011	AG	+0.0149	s	BAV unpb.	-Ir	48	21)
	54829.4536	.0007	AG	+0.0149		BAV unpb.	-Ir	48	21)
GSC 0367901920	54815.5807	.0027	AG				-Ir	60	21)
GSC 0403002020	54673.5509	.0004	AG	−0.0289		BAV unpb.	-Ir	30	21)
	54776.3525	.0004	AG	−0.0173		BAV unpb.	-Ir	48	21)
	54776.4901	.0007	AG	−0.0149	s	BAV unpb.	-Ir	48	21)
	54835.2734	.0007	AG	−0.0654		BAV unpb.	-Ir	49	21)
	54847.3039	.0004	AG	+0.0631		BAV unpb.	-Ir	57	21)
	54847.4412	.0001	AG	−0.0701		BAV unpb.	-Ir	57	21)
	54847.5771	.0004	AG	+0.0658		BAV unpb.	-Ir	57	21)
GSC 0453001042	54192.3835	.0001	RAT RCR				-Ir	73	4)
GSC 0455200118	54583.4549	.0001	RAT RCR				-Ir	179	7)
GSC 0492200116	54514.4252	.0013	FR				-Ir	38	21)
NSV 26190	54337.3854	.0040	MZ				V	32	15)
	54338.4406	.0030	MZ				V	23	15)
	54342.3324	.0030	MZ				V	29	15)
	54342.5072	.0030	MZ				V	29	15)
U-A2 1200-07442402	54943.4044	.0007	MS FR				o	560	11)
U-A2 1200-13084491	54365.5196	.0017	FR				-Ir	48	10) 1)
U-A2 1275-15124020	54648.4741	.0006	AG	−0.3914	s	BAV unpb.	-Ir	46	21)
U-A2 1275-15134722	54648.4638	.0013	AG	−0.0711		BAV unpb.	-Ir	36	21)
U-A2 1500-0005759	54718.5144	.0015	AG	−0.0594		BAV unpb.	-Ir	63	21)
	54830.4028	.0012	AG	−0.1598		BAV unpb.	-Ir	130	21)
	54840.3694	.0002	AG	+0.1411	s	BAV unpb.	-Ir	43	21)
	54841.3271	.0024	AG	+0.0989		BAV unpb.	-Ir	48	21)
U-A2 1500-01208912	54776.3946	.0008	AG	+0.0367	s	BAV unpb.	-Ir	48	21)
	54835.3360	.0008	AG	−0.0027	s	BAV unpb.	-Ir	44	21)
	54847.4263	.0011	AG	+0.0164		BAV unpb.	-Ir	58	21)
U-A2 1508-0029126	54776.3341	.0013	AG	−0.0663		BAV unpb.	-Ir	48	21)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
U-A2 1508-0029126	54776.4952	.0017	AG	+0.0948		BAV unpb.	-Ir	46	21)
	54841.3669	.0013	AG	−0.0537	s	BAV unpb.	-Ir	50	21)
	54841.5225	.0019	AG	−0.0563		BAV unpb.	-Ir	50	21)
	54847.4093	.0011	AG	−0.0229	s	BAV unpb.	-Ir	58	21)

Table 2: Times of maxima of pulsating stars

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
GP And	54853.2793	.0011	WN	+0.0051	GCVS 1985	V	51	16)
	54862.2498	.0008	WN	+0.0058	GCVS 1985	V	88	16)
OV And	54857.2696	.0024	WN	−0.0238	MVS 11,133	V	106	16)
TU Ari	54861.346	.004	SB	+0.219	GCVS 2007	-Ir	154	20)
	54862.282	.004	SB	+0.212	GCVS 2007	-Ir	144	20)
TZ Aur	54852.3507	.0014	PGL	+0.0091	GCVS 1985	o	244	13)
	54865.2791	.0014	PGL	+0.0122	GCVS 1985	o	376	13)
	54866.4031	.0022	ALH	−0.0388	GCVS 1985	o	203	9)
RS Boo	54934.3308	.0021	PGL	+0.0085	BAVR 36,157	o	141	13)
	54946.4035	.0014	PGL	+0.0063	BAVR 36,157	o	192	13)
	54981.4977	.0022	WN	+0.0080	BAVR 36,157	V	93	16)
SV Boo	54942.3771	.0010	MZ	+0.0038	GCVS 2007	-Ir	91	5)
SZ Boo	54933.525	.002	AG	+0.009	GCVS 2007	-Ir	41	21)
UU Boo	54956.3552	.0014	PGL	+0.2147	GCVS 1985	o	324	13)
VY Boo	54996.4416	.0010	MZ			-Ir	71	5)
WW Boo	54933.587	.002	AG	+0.146	GCVS 2007	-Ir	41	21)
YZ Boo	54982.4079	.0050	SIR	+0.0025	GCVS 1985	-Ir	218	12)
CG Boo	54505.6630	.0013	MS FR			o	500	11)
CM Boo	54964.4149	.0021	PGL	−0.1110	GCVS 1985	o	258	13)
CQ Boo	54981.4007	.0007	MZ	−0.0565	BAVR 48,189	-Ir	151	5)
	54981.4022	.0030	ALH	−0.0550	BAVR 48,189	B	190	9)
	54981.4368	.0007	MZ	−0.0204	BAVR 48,189	-Ir	121	5)
	54981.4382	.0030	ALH	−0.0190	BAVR 48,189	B	190	9)
	54981.4382	.0030	ALH	−0.0190	BAVR 48,189	B	190	9)
	55005.3995	.0010	MZ	−0.0178	BAVR 48,189	-Ir	103	5)
CS Boo	54947.3941	.0021	PGL	−0.0012	IBVS 2855	o	146	13)
CU Boo	54968.5394	.0035	ALH			o	209	9)
	54971.4997	.0030	ALH			o	253	9)
DD Boo	54933.410	.003	AG			-Ir	41	21)
UY Cam	54844.272	.002	AG	+0.065	BAVR 49,41	-Ir	140	21)
	54844.543	.002	AG	+0.069	BAVR 49,41	-Ir	140	21)
AH Cam	54843.467	.002	AG	−0.062	GCVS 1985	-Ir	137	21)
EW Cam	54844.324	.002	AG			-Ir	140	21)
RW Cnc	54876.4510	.0007	PGL	+0.2066	GCVS 1985	o	246	13)
	54910.3755	.0011	WN	+0.2048	GCVS 1985	V	73	16)
	54922.4218	.0026	WN	+0.2127	GCVS 1985	V	124	16)
TT Cnc	54907.4320	.0023	ALH	−0.0066	A&A 476.307 2007	V	191	9)
	54911.3762	.0018	WN	−0.0066	A&A 476.307 2007	V	67	16)
CQ Cnc	54924.340	.003	SB	−0.023	BAVR 49,41	V	129	20)
W CVn	54946.4975	.0022	WN	−0.0209	SAC Vol.70	V	100	16)
ST CVn	54941.538	.003	AG	−0.063	BAVR 49,105	-Ir	41	21)
VW CVn	54924.594	.010	AG	+0.132	BAVR 49,105	-Ir	38	21)
XY CVn	54941.533	.004	AG	+0.008	GCVS 1985	-Ir	41	21)
XZ CVn	54941.442	.003	AG	+0.080	GCVS 1985	-Ir	41	21)
PS Cas	54829.496	.002	AG	−0.200	GCVS 2008	-Ir	48	21)
V363 Cas	54830.309	.002	AG	+0.019	BAVR 49,41	-Ir	130	21)
V470 Cas	54829.402	.003	AG	+0.218	IBVS 4332	-Ir	49	21)
V871 Cas	54737.4674	.0020	RAT RCR			-U-I	159	4)
	54737.5931	.0008	RAT RCR			-U-I	159	4)

Table 2: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
RZ Cep	54997.4922	.0021	PGL	−0.1107	GCVS 1985	o	732	13)
EZ Cep	54934.342	.002	AG	+0.085	GCVS 2007	-Ir	37	21)
S Com	54937.441	.002	AG	+0.011	SAC Vol.73	-Ir	33	21)
S Com	54964.4196	.0017	WN	+0.0070	SAC Vol.73	V	129	16)
	54981.4294	.0026	WN	+0.0058	SAC Vol.73	V	87	16)
U Com	54933.464	.002	AG	+0.004	BAVR 49,41	-Ir	46	21)
	54937.557	.003	AG	−0.001	BAVR 49,41	-Ir	35	21)
UW Com	54908.546	.002	AG	+0.067	GCVS 2007	-Ir	39	21)
CZ Com	54937.496	.005	AG	−0.021	GCVS 2007	-Ir	34	21)
HY Com	54941.517	.003	AG			-Ir	50	21)
IS Com	54908.613	.002	AG			-Ir	39	21)
RV CrB	54943.569	.003	AG	−0.007	GCVS 1985	-Ir	46	21)
SU CrB	54932.460	.002	AG	+0.025	GCVS 2007	-Ir	50	21)
SZ CrB	54943.395	.002	AG	+0.012	BAVR 49,41	-Ir	46	21)
UY CrB	54943.484	.002	AG			-Ir	46	21)
	54996.436	.003	SB			V	206	20)
AQ CrB	54924.484	.003	FR	+0.001	GCVS 2007	-Ir	67	18)
RR Gem	54845.497	.002	AG	−0.009	BAVR 47,67	-Ir	60	21)
SZ Gem	54910.3239	.0010	WN	+0.0092	BAVR 48,65	V	87	16)
	54911.3255	.0001	WN	+0.0085	BAVR 48,65	V	90	16)
	54912.3279	.0015	WN	+0.0086	BAVR 48,65	V	118	16)
	54921.3487	.0015	WN	+0.0091	BAVR 48,65	V	142	16)
	54922.3546	.0017	WN	+0.0127	BAVR 48,65	V	120	16)
DT Gem	54831.434	.004	AG	−0.275	GCVS 2007	V	28	21)
TW Her	54945.3974	.0035	PGL	−0.0117	GCVS 1985	o	259	13)
VX Her	54954.4717	.0021	PGL	+0.0245	GCVS 1985	o	407	13)
AR Her	54925.4928	.0021	PGL	+0.0473	BAVR 52,3	o	403	13)
	54934.4233	.0021	PGL	+0.0481	BAVR 52,3	o	529	13)
	54935.3607	.0021	PGL	+0.0455	BAVR 52,3	o	422	13)
	54939.5772	.0021	PGL	+0.0322	BAVR 52,3	o	465	13)
	54941.4561	.0021	PGL	+0.0312	BAVR 52,3	o	343	13)
	54942.3910	.0014	PGL	+0.0261	BAVR 52,3	o	405	13)
	54965.4354	.0021	PGL	+0.0412	BAVR 52,3	o	419	13)
	54988.4676	.0021	PGL	+0.0442	BAVR 52,3	o	494	13)
	55004.4410	.0069	PGL	+0.0381	BAVR 52,3	o	319	13)
DY Her	54983.4269	.0050	SIR	−0.0045	BAVR 48,189	-Ir	176	12)
GZ Her	54968.498	.003	AG	−0.115	GCVS 2007	-Ir	50	21)
HN Her	54934.548	.002	AG	−0.148	GCVS 2008	-Ir	52	21)
	54947.447	.002	AG	−0.147	GCVS 2008	-Ir	36	21)
LS Her	54974.579 :	.007	FR	−0.018	GCVS 1985	-Ir	55	18)
V394 Her	54971.533	.001	AG	−0.142	GCVS 2007	-Ir	27	21)
WZ Hya	54912.4481	.0060	SIR	−0.0015	GCVS 1985	-Ir	191	12)
CR Hya	54866.387	.002	FR	−0.188	GCVS 2007	-Ir	61	21)
RR Leo	54908.4344	.0014	PGL	+0.0053	A&A 476.307 2007	o	551	13)
	54932.4117	.0007	QU	+0.0053	A&A 476.307 2007	V	62	6)
SS Leo	54911.3953	.0035	PGL	−0.0651	GCVS 1985	o	524	13)
	54921.4177	.0014	PGL	−0.0641	GCVS 1985	o	348	13)
	54921.4196	.0026	WN	−0.0623	GCVS 1985	V	75	16)
ST Leo	54880.4564	.0028	PGL	−0.0202	GCVS 1985	o	388	13)
	54937.3362	.0021	PGL	−0.0205	GCVS 1985	o	277	13)
	54946.4176	.0015	WN	−0.0208	GCVS 1985	V	81	16)
AS Leo	54943.4208	.0004	MZ	+0.0350	GCVS 2007	-Ir	111	5)
CM Leo	54894.4348	.0050	MZ	+0.0512	GCVS 2007	-Ir	95	5)
	54915.4229	.0010	MZ	+0.0588	GCVS 2007	-Ir	106	5)
DM Leo	54910.3868	.0020	MZ			-Ir	135	5)
Y LMi	54912.401	.002	AG	−0.017	BAVR 49,41	-Ir	67	21)
	54944.3940	.0010	MZ	−0.0141	BAVR 49,41	-Ir	172	5)
VY LMi	54911.3454	.0001	MZ			-Ir	148	5)
SZ Lyn	54869.3692	.0021	PGL	+0.0188	GCVS 1985	o	696	13)
	54871.4191	.0014	PGL	+0.0196	GCVS 1985	o	461	13)
	54910.4749	.0013	WN	+0.0221	GCVS 1985	V	62	16)

Table 2: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
SZ Lyn	54911.4396	.0020	WN	+0.0225	GCVS 1985	V	66	16)
	54912.4054	.0009	WN	+0.0241	GCVS 1985	V	84	16)
	54924.3380	.0008	WN	+0.0237	GCVS 1985	V	71	16)
	54943.3822	.0007	WN	+0.0234	GCVS 1985	V	115	16)
TT Lyn	54942.382	.005	AG	−0.024	GCVS 2007	-Ir	73	21)
BE Lyn	54871.3883	.0014	PGL			o	590	13)
	54946.3594	.0009	WN			V	75	16)
RZ Lyr	54962.4133	.0014	PGL	−0.0160	BAVR 48,189	o	183	13)
	54963.4356	.0021	PGL	−0.0162	BAVR 48,189	o	246	13)
WW Lyr	54945.5170	.0025	MS FR	+0.1032	GCVS 2007	o	513	11)
CN Lyr	55007.456	.010	PGL	+0.000	A&A 476.307 2007	o	126	13)
EZ Lyr	54946.4541	.0035	PGL	+0.0293	BAVR 34,145	o	371	13)
KR Lyr	54943.531	.002	FR	−0.090	GCVS 1985	-Ir	64	21)
V462 Lyr	54943.557	.004	FR	+0.082	GCVS 1985	-Ir	63	21)
V1640 Ori	54828.4738	.0020	MZ	−0.0855	BAVM 149	-Ir	79	5)
CV Peg	54779.3535	.0010	MZ	−0.0604	GCVS 2007	-Ir	70	5)
AR Per	54857.2260	.0021	PGL	+0.0555	GCVS 1987	o	122	13)
	54862.3325	.0015	WN	+0.0554	GCVS 1987	V	99	16)
	54908.2930	.0013	WN	+0.0565	GCVS 1987	V	73	16)
AN Ser	54954.4099	.0028	PGL	+0.0029	GCVS 1987	o	217	13)
	54968.5043	.0014	PGL	+0.0013	GCVS 1987	o	476	13)
BH Ser	54968.4348	.0014	PGL	+0.0993	GCVS 1987	o	149	13)
T Sex	54891.4066	.0020	ALH	−0.0968	BAVR 51,247	V	612	9)
	54898.5496	.0030	ALH	−0.0974	BAVR 51,247	B	437	9)
AI Tau	54829.2499	.0008	MZ	−0.1144	GCVS 2007	-Ir	207	5)
	54842.3248	.0008	MZ	−0.1162	GCVS 2007	-Ir	79	5)
	54843.4716	.0020	MZ	−0.1065	GCVS 2007	-Ir	56	5)
BR Tau	54830.4320	.0040	MZ	+0.0119	GCVS 2008	-Ir	96	5)
CV Tau	54861.4601	.0008	MZ			-Ir	151	5)
IY Tau	54862.2870	.0005	MZ	+0.1130	GCVS 2007	-Ir	283	5)
	54912.3606	.0010	MZ	+0.1134	GCVS 2007	-Ir	71	5)
U Tri	54830.333 :	.010	FR	−0.011	BAVR 49,105	-Ir	77	21)
TU UMa	54925.4104	.0021	PGL	−0.0285	GCVS 1987	o	584	13)
AE UMa	54894.4412	.0005	SCI	+0.0069	BAVR 48,189	o	53	5)
	54894.5227	.0005	SCI	+0.0023	BAVR 48,189	o	42	5)
	54894.6071	.0006	SCI	+0.0007	BAVR 48,189	o	43	5)
	54898.3084	.0004	SCI	+0.0033	BAVR 48,189	o	40	5)
	54904.4199	.0007	SCI	+0.0076	BAVR 48,189	o	44	5)
	54904.5006	.0004	SCI	+0.0023	BAVR 48,189	o	48	5)
	54909.3147	.0004	SCI	−0.0006	BAVR 48,189	o	25	5)
	54909.4087	.0006	SCI	+0.0074	BAVR 48,189	o	39	5)
	54909.4895	.0006	SCI	+0.0022	BAVR 48,189	o	64	5)
	54910.4335	.0008	WN	+0.0000	BAVR 48,189	V	48	16)
	54912.3323	.0012	SCI	+0.0064	BAVR 48,189	o	48	5)
	54912.4146	.0004	SCI	+0.0027	BAVR 48,189	o	30	5)
	54924.3742	.0010	WN	+0.0059	BAVR 48,189	V	59	16)
XZ Vir	54912.4356:	.0040	MZ			-Ir	49	5)
	54922.4714	.0010	MZ			-Ir	114	5)
AT Vir	54924.3969	.0014	PGL	+0.2382	GCVS 1987	o	283	13)
FU Vir	54941.475	.003	AG	−0.153	BAVR 49,105	-Ir	49	21)
GSC 0256601398	54954.3988	.0008	SCI			o	58	5)
	54954.4910	.0010	SCI			o	33	5)
	54954.5789	.0008	SCI			o	38	5)
GSC 0297700238	54953.4272	.0005	SCI			o	66	5)
GSC 0307400114	54946.3740	.0006	SCI			o	19	5)
	54946.4241	.0004	SCI			o	17	5)
	54946.4768	.0002	SCI			o	34	5)
	54946.5302	.0010	SCI			o	32	5)
	54946.5790	.0004	SCI			o	32	5)
GSC 0383200152	54956.4272	.0006	SCI			o	50	5)
	54956.5183	.0004	SCI			o	53	5)

Remarks:

AG:	Agerer, F., Tiefenbach	RAT:	Rätz, M., Herges-Hallenberg
ALH:	Alich, K., Schaffhausen (CH)	RCR:	Rätz, K., Herges-Hallenberg
DIE:	Dietrich, M., Radebeul	SB:	Steinbach, Dr. H., Neu-Anspach
FR:	Frank, P., Velden	SCI:	Schmidt, U., Karlsruhe
JU:	Jungbluth, Dr. H., Karlsruhe	SHT:	Scharnhorst, D., Erfurt
MS:	Moschner, W., Lennestadt	SIR:	Schirmer, J., Willisau (CH)
MZ:	Maintz, Dr. G., Bonn	WN:	Wischnewski, M., Wennigsen
PGL:	Pagel, Dr. L., Klockenhagen	WTR:	Walter, F., München
QU:	Quester, W., Esslingen		
:	uncertain		Filter
s	secondary minimum	o	without filter
C	CCD-camera	B	B-filter
1)	normal minimum	V	V-filter
2)	normal maximum	-Ir	-Ir-filter
3)	double maxima	-U-I	-U and -Ir-filter
	CCD-Cameras		
4)	ST-6 chip 375×242	13)	Artemis 4021
5)	ST-7	14)	Canon EOS D60
6)	ST-7E	15)	holicam
7)	ST-8E	16)	Meade DSI Pro2
8)	ST-8E chip KAF1602E	17)	OES-LcCCD11
9)	ST-8XMEI chip KAF1603ME	18)	OES-LcCCD12
10)	ST-9	19)	Pictor 416XT
11)	ST-9XE chip 512×512	20)	Sigma 402ME
12)	AlphaMaxi	21)	Sigma 1603

References:

A&A	Astronomy & Astrophysics
BAVM nnn	BAV Mitteilungen No. nnn
BAVR vv,ppp	BAV Rundbrief volume, pages
BAV unpb.	BAV unpublished
GCVS yyyy	General Catalogue of Variable Stars, yyyy
GSC	The HST Guide star Catalogue 1.2
IBVS nnnn	Information Bulletin on Variable Stars No. nnnn
MVS vv,ppp	Mitteilungen ueber Veraenderliche Sterne, volume,page
SAC vv	Rocznik Astronomiczny No. vv, Krakow (SAC)
U-A2	USNO A2.0 catalogue

ERRATA FOR IBVS 5889 (BAVM 203)

SV Cam	54760.3081 SG	correct value:	54760.3068
AI Dra	54758.3120 SG	correct value:	54758.3134

ERRATUM FOR IBVS 5918 (BAVM 209)

RR Lyr 54866.4031 ALH has to be deleted

ERRATUM FOR IBVS 5918 (BAVM 209)

DD Mon 54840.3953 AG has to be deleted

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LIMITS ON TRANSIT TIMING VARIATIONS IN HAT-P-6 AND WASP-1

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The study of Transit Timing Variations (TTV, e.g. Díaz et al., 2008; Sozzetti et al., 2009) is important because it may reveal the effect of other perturbing planets in the exoplanetary systems (Steffen and Agol, 2005), or moons of the transiting exoplanet (e.g. Szabó et al., 2006; Simon et al., 2007; Kipping et al., 2009ab). We present new transit times and Transit Timing Variation analysis of two exoplanets, HAT-P-6b and WASP-1b.

Time series were taken at two different sites. On 19/20 August, 2008, HAT-P-6 was observed with the 0.6 m Schmidt telescope of the Konkoly Observatory, Piszkéstető mountain station. The integration time was 15 s through Johnson R filter. On 3/4 November, 2008, we observed WASP-1 with the 0.4 m telescope of the Szeged Observatory, equipped with an ST-7E CCD camera. The integration time was 30 s through Johnson I filter.

The data were analysed with aperture photometry in IRAF, with an ensemble of comparison stars. Stellar magnitudes were obtained with multiple apertures. The optimal aperture size was determined with minimizing the *rms* scatter of the residuals. In both cases, the aperture radius was 4 pixels, corresponding to 4 arc seconds with the 0.6 m Schmidt and 5.3 arc seconds with the 0.4 m Newtonian. The scatter of the raw light curves is $\approx \pm 0.005$ mag for HAT-P-6 and $\approx \pm 0.008$ mag for WASP-1. After calculating 3-minute averages, these values are reduced to $\approx \pm 0.0025$ mag (HAT-P-6) and $\approx \pm 0.004$ (WASP-1).

Times of minima were determined by fitting a model light curve. To reduce the degree of freedom of fitting, the shape of the model was not adjusted; we used previously published parameters. The model was shifted in time, minimising the *rms* scatter of the measurements.

The log of observations is summarised in Table 1, light curves and TTV diagrams are shown in Fig 1.

Notes on individual exoplanets:

HAT-P-6b is a hot Jupiter known for its very low density. One time of mid-transit at HJD 2454035.67575 $\pm$ 0.00028 was published by Noyes et al (2008), who determined a period of 3.852985 $\pm$ 0.000005 days. They also published a second light curve starting from 2454347.7. We have re-fitted the publicly available photometry simultaneously with our new data by assuming the same transit geometry parameters (duration,

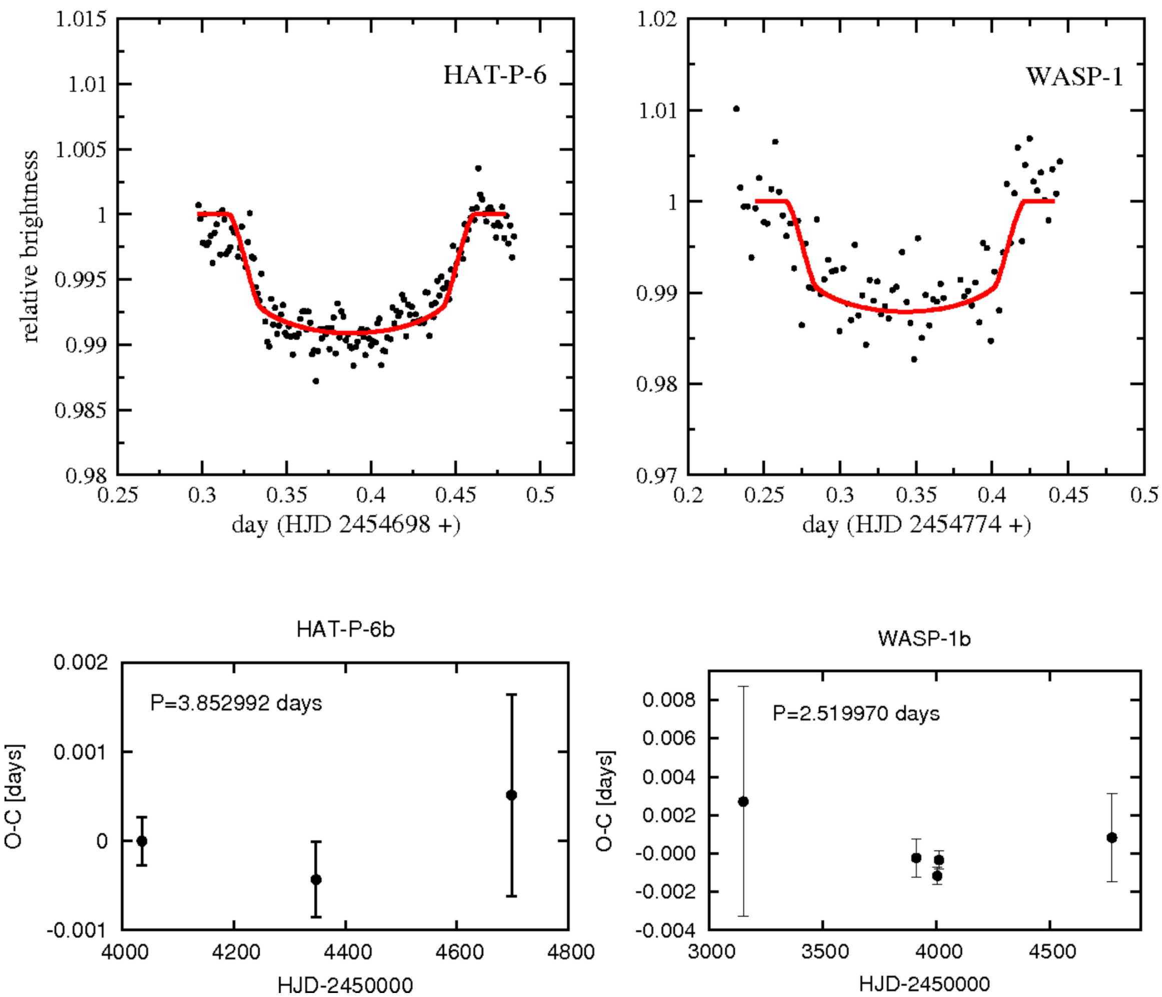

Figure 1. Light curves of the observed transits and fitted models (top panels) and $O - C$ diagrams of the exoplanet systems (bottom panels).

Planet	Date	HJD (first point)	duration (hour)	number of points	transit time HJD−2450000
HAT-P-6b	2008.08.19	2454698.30	4.5	647	4698.3908±0.0011
WASP-1b	2008.11.04	2454774.22	5.2	351	4774.3448±0.0023

Table 1: The log of observations

depth, impact parameter) but independent transit times. The resulted transit times are 2454035.67571±0.00027, 2454347.76763±0.00042 and 2454698.3908±0.0011. The data do not indicate any departure from constant orbital period.

WASP-1b: is supposed to be a hot Jupiter with metal-rich atmosphere, little or no core, and its age is less than 1.5 Gyr. (Cameron et al., 2007; Stempels et al., 2007). Two transits at 2453912.514 ± 0.001 and 2454005.75196 ± 0.00045 were published by Charbonneau et al. (2007), who adopted a period of 2.51997 days. Shporer et al. (2007) published a transit time at 2454013.31269 ± 0.00047 and determined a period of 2.519961±0.000018. Cameron et al. (2007) have also published measurements from 2004 with a pre-discovery transit at 2453151.486 ± 0.006 (the numerical value is available at exoplanet.eu); the resulting period was 2.51995 ± 0.00001 days.

We measured a transit at HJD 2454774.3448±0.0023 and determined a new period of 2.519970±0.000003 days. All transit times are compatible with the updated ephemeris. The pre-discovery transit time is well off a linear fit, but the large error bar preclude any conclusion on TTV. By neglecting this first point, the best-fitting period is 2.519973±0.000003 days and the earliest point is a significant outlier. At this moment it is unclear whether there is period change in the system, hence further monitoring is necessary.

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TIMINGS OF MINIMA OF ECLIPSING BINARIES

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The following Table lists timings of minima of eclipsing binaries secured by CCD photometry, obtained in the second half of 2009. The given $O-C$ values generally refer to the linear elements of the 2008 electronic version of the GCVS (Samus et al., 2009), except for the cases stated in the remarks, where the determination of current elements made use of the up-to-date ASAS data (`http://www.astrouw.edu.pl/asas/`) and the Lafler-Kinman algorithm of the PERANSO software (`http://www.peranso.com/`). All times given are heliocentric UTC.

Table 1: Minima of eclipsing binaries

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
AA And	p	55137.6993	0.0002	−0.0039	45	RD	V
AP And	p	55144.6406	0.0003	+0.0018	34	RD	V
BD And	p	55135.6958	0.0002	−0.0137	12	RD	V
DS And	p	55114.8953	0.0004	−0.0002	26	RD	V
EP And	p	55102.8861	0.0002	−0.0065	37	RD	V; el.: IBVS 5184; d=0.02d
FL And	p	55158.6960	0.0003	+0.0097	27	RD	V
GZ And	s	55114.8785	0.0004	0.0000	14	RD	V
LM And	p	55102.9086	0.0002	−0.0089	41	RD	V
GSC 3627-1727	p	55135.5821	0.0009	+0.0031	15	RD	V; el.: 2451400.783+0.396770*E
GSC 3638-2422	s	55144.6505	0.0003	−0.0081	32	RD	V; el.: 2451453.635+0.3380213*E
GSC 3641-587	p	55144.7207	0.0003	−0.0098	30	RD	V; el.: 2451443.74+0.6945*E
UU Aqr	p	55114.687:	0.003	−0.002	4	RD	V
GH Aqr	s	55121.7061	0.0005	+0.0003	22	RD	V
GM Aqr	s	55119.6768	0.0009	−0.0269	8	RD	V
HV Aqr	p	55102.6932	0.0005	−0.0083	27	RD	V; d=0.03d
NN Aqr	s	55119.6416	0.0003	−0.0045	22	RD	V; el.: 2451487.689+0.306792*E
NQ Aqr	p	55102.6687	0.0005	−0.0035	25	RD	V
NW Aqr	s	55137.5768	0.0006	+0.0245	15	RD	V
	p	55137.7247	0.0005	+0.0216	26	RD	V
GSC 568-1328	p	55137.6597	0.0005	0.0000	29	RD	V; el.: 2454365.632+0.284671*E
GSC 5804-102	p	55121.6580	0.0004	−0.0258	33	RD	V; el.: 2453660.670+2.554220*E
V346 Aql	p	55100.6909	0.0003	−0.0083	23	RD	V
V765 Aql	p	55100.7001	0.0005	+0.0082	35	RD	V: el.: 2453166.803+0.878242*E
GSC 1083-2003	p	55100.7107	0.0003	−0.0047	31	RD	V; el.: 2454338.656+0.670237*E
GSC 5725-698	s	55100.7901	0.0006	−0.0032	21	RD	V; el.: 2454675.780+1.281847*E
GSC 1209-1201	p	55114.9059	0.0003	+0.0268	26	RD	V; el.: 2453329.629+0.351086*E
GSC 1216-409	p	55181.7073	0.0003	+0.0117	27	RD	V; el.: 2454436.722+0.528725*E; d=0.03d
GSC 1217-696	s	55181.6474	0.0004	−0.0074	39	RD	V; el.: 2454683.903+0.395198*E; d=0.03d
GSC 1221-1118	s	55181.7103	0.0004	−0.0073	27	RD	V; el.: 2454392.681+0.380167*E; d=0.025d
RY Aur	p	55137.9515	0.0003	+0.0213	34	RD	V
CI Aur	p	55135.9202	0.0002	+0.1301	39	RD	V
CP Aur	p	55158.995:	0.010:	+0.072	40	RD	V; el.: IBVS 5652; d=0.095d

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
EP Aur	p	55158.8584	0.0002	+0.0224	23	RD	V; el.: IBVS 4099
FO Aur	p	55140.0051	0.0002	+0.1867	12	RD	V
FP Aur	p	55144.9515	0.0001	−0.0718	34	RD	V
HP Aur	s	55139.8572	0.0003	+0.0550	23	RD	V
HU Aur	p	55137.8799	0.0004	−0.0127	34	RD	V; el.: IBVS 3666
HW Aur	s	55137.9601	0.0005	+0.0246	31	RD	V; el.: IBVS 5016
V576 Aur	s	55158.0064	0.0007	−0.1334	15	RD	V; el.: ASAS
GSC 2393-680	s	55137.9229	0.0006	+0.0103	21	RD	V; el.: IBVS 5699
GSC 3751-178	s	55158.9510	0.0003	+0.0017	29	RD	V; el.: 2453285.2664+0.327997*E
GM Boo	s	55015.4787	0.0004	+0.0542	12	EBl	C; el.: IBVS 5125
GN Boo	p	55015.4454	0.0005	+0.0055	15	EBl	C; el.: IBVS 5125
GQ Boo	p	55015.408	0.004	−0.011	8	EBl	C; el.: IBVS 5125
GR Boo	s	55015.4062	0.0005	+0.0005	9	EBl	C; el.: IBVS 5125
GSC 2013-288	s	55015.3713	0.0010	−0.0056	10	EBl	C; el.: IBVS 5699
	p	55015.5221	0.0008	−0.0064	12	EBl	C
UU Cam	s	55121.9640	0.0006	−0.0545	22	RD	V; el.: CoSka 33, 38
AO Cam	s	55135.8636	0.0006	−0.0415	22	RD	V; el.: PASP 97, 648
NO Cam	s	55127.8930	0.0002	+0.0041	38	RD	V; el.: IBVS 5894
GSC 3715-1039	p	55121.9522	0.0003	+0.0656	27	RD	V; el.: 2451453.283+0.4255427*E
NSV 3715	p	55181.9031	0.0002	+0.0047	16	RD	V; el.: IBVS 5894
GSC 2544-1090	p	55015.4736	0.0011	+0.0194	11	EBl	C; el.: IBVS 5699
GSC 2545-970	s	55015.4361	0.0003	−0.0114	13	EBl	C; el.: IBVS 5699
GSC 3034-299	s	55015.4601	0.0004	−0.0057	11	EBl	C; el.: IBVS 5699
AK CMi	p	55181.8645	0.0009	−0.0214	18	RD	V
AM CMi	s	55181.9082	0.0010	+0.1953	38	RD	V
CW CMi	p	55181.9020	0.0006	+0.0054	18	RD	V; el.: IBVS 5871
AL Cas	s	55100.9053	0.0006	+0.0071	30	RD	V
BH Cas	p	55158.7231	0.0003	+0.0255	27	RD	V; el.: IBVS 4482
CW Cas	p	55158.6693	0.0005	−0.0497	27	RD	V; el.: JAAVSO 21, 34
DZ Cas	s	55144.6460	0.0006	−0.1636	46	RD	V; d=0.06d
EY Cas	p	55153.7046	0.0003	+0.0330	37	RD	V
IL Cas	p	55100.8869	0.0009	−0.0059	27	RD	V; el.: BAV Rdb. 2002-1, 1
LX Cas	p	55119.8650	0.0009	+0.0504	20	RD	V
LY Cas	p	55100.8695	0.0008	+0.1248	21	RD	V
MN Cas	p	55100.8881	0.0009	+0.0163	28	RD	V
MS Cas	p	55158.6657	0.0003	+0.0375	25	RD	V
NN Cas	p	55158.6342	0.0005	+0.1228	33	RD	V
PV Cas	p	55139.6207	0.0005	−0.0365	31	RD	V; non-circ.
V345 Cas	p	55139.6771	0.0003	−0.0210	35	RD	V
V471 Cas	s	55106.9030	0.0002	+0.1025	34	RD	V
V520 Cas	s	55153.6841	0.0003	+0.0575	43	RD	V; el.: BBB 117, 9
V541 Cas	p	55119.9340	0.0004	+0.0200	26	RD	V; el.: IBVS 2652
V608 Cas	s	55100.8897	0.0006	+0.0038	19	RD	V; el.: IBVS 5151
V821 Cas	s	55153.6590	0.0002	−0.1939	12	RD	V; el.: IBVS 5386; non-circ.
V961 Cas	s	55158.6349	0.0007	−0.1619	34	RD	V; el.: IBVS 5437
TV Cep	p	55127.737	0.010	+0.075	42	RD	V
WZ Cep	p	55144.6758	0.0001	−0.0819	45	RD	V; el.: AAS 131, 17
BE Cep	s	55135.6906	0.0003	−0.1024	17	RD	V
DY Cep	p	55153.549	0.002	−0.196	9	RD	V
GI Cep	s	55102.7080	0.0005	−0.1053	26	RD	V
GS Cep	s	55139.7283	0.0005	−0.0021	25	RD	V; el.: IBVS 3596
GW Cep	s	55106.8831	0.0002	−0.0037	26	RD	V; el.: IBVS 4293
IP Cep	s	55121.7019	0.0010	−0.0222	32	RD	V; el.: IBVS 5016
MT Cep	p	55106.7109	0.0005	−0.0019	23	RD	V; el.: 2434240.4258+1.2064227*E
V744 Cep	p	55127.7447	0.0005	+0.0194	18	RD	V; el.: 2451426.642+0.62455*E
V746 Cep	p	55137.7185	0.0003	+0.0571	36	RD	V; el.: IBVS 5644
GSC 4286-49	s	55137.6896	0.0003	−0.0591	42	RD	V; el.: IBVS 5570; non-circ.
GSC 4502-138	s	55102.9565	0.0001	+0.0849	23	RD	V; el.: IBVS 5700
TT Cet	p	55102.8983	0.0001	−0.0606	40	RD	V
XY Cet	s	55197.6567	0.0005	+0.0097	42	RD	V
GSC 44-1052	s	55106.8638	0.0002	−0.0267	18	RD	V; el.: 2453389.554+0.818754*E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
AR CrB	p	55038.4884	0.0004	−0.0029	29	EBl	C; el.: IBVS 5295
AS CrB	s	55038.4675	0.0007	+0.0063	26	EBl	C; el.: IBVS 5295
AV CrB	s	55038.5036	0.0002	−0.0144	24	EBl	C; el.: IBVS 5295
DK Cyg	s	55114.6800	0.0004	+0.0817	40	RD	V
PW Cyg	p	55100.7184	0.0007	−0.0286	28	RD	V
V680 Cyg	p	55106.7021	0.0005	+0.0646	27	RD	V
V706 Cyg	s	55114.6896	0.0005	−0.0267	18	RD	V
V1416 Cyg	p	55119.7376	0.0003	+0.1787	18	RD	V
V1616 Cyg	p	55102.7318	0.0006	+0.0099	19	RD	V
V1815 Cyg	s	55119.7015	0.0005	+0.0006	27	RD	V; el.: BAVSR 55, 1
V2280 Cyg	p	55154.2636	0.0005	+0.0629	22	EBl	C; el.: IBVS 4996
V2284 Cyg	p	55109.2829	0.0007	−0.0015	14	EBl	C; el.: IBVS 4985
	s	55154.2612	0.0004	+0.0024	30	EBl	C
	p	55154.4183	0.0005	+0.0060	11	EBl	C
MU Dra	p	55104.3112	0.0011	−0.0356	10	EBl	C; el.: IBVS 5232
GSC 3523-505	s	55083.425	0.002	+0.007	11	EBl	C; el.: IBVS 5699
GSC 3552-321	s	55083.461	0.002	−0.004	10	EBl	C; el.: IBVS 5699
GSC 3888-464	s	55074.3322	0.0006	+0.0122	19	EBl	C; el.: IBVS 5505
	p	55074.4914	0.0006	+0.0130	15	EBl	C
GSC 3905-60	s	55083.3878	0.0007	−0.0026	28	EBl	C; el.: IBVS 5699
RU Eri	p	55127.8520	0.0003	−0.0271	23	RD	V
UX Eri	s	55119.8942	0.0005	+0.1606	31	RD	V
WW Eri	p	55144.8608	0.0004	+0.0643	26	RD	V; d=0.065d
AM Eri	s	55127.8636	0.0006	−0.0949	16	RD	V
BC Eri	s	55139.9219	0.0001	+0.0483	40	RD	V
BZ Eri	p	55137.9278	0.0002	+0.0032	25	RD	V; el.: IBVS 4937
CD Eri	p	55128.013	0.003	+0.048	8	RD	V
GSC 5297-974	p	55119.9109	0.0005	+0.0033	27	RD	V; el.: IBVS 5894
NSV 1864	p	55135.9103	0.0003	+0.0108	44	RD	V; el.: 2455125.794+0.594444*E; d=0.04d
EL Gem	p	55158.8795	0.0002	+0.0342	36	RD	V
NSV 3744	p	55181.9101	0.0003	+0.0323	37	RD	V; el.: ASAS
V1033 Her	p	55049.4384	0.0013	−0.0145	9	EBl	C; el.: IBVS 5146
V1036 Her	s	55049.529	0.002	+0.003	11	EBl	C; el.: IBVS 5146
V1038 Her	s	55049.4529	0.0006	+0.0079	13	EBl	C; el.: IBVS 5146
V1039 Her	s	55049.3515	0.0004	+0.0025	12	EBl	C; el.: BBSAG Bull. 128, 10
V1044 Her	p	55049.4431	0.0016	−0.0058	8	EBl	C; el.: IBVS 5192
	s	55049.561	0.004	−0.009	8	EBl	C;
V1047 Her	p	55049.4770	0.0009	−0.0057	9	EBl	C; el.: IBVS 5192
V1053 Her	p	55049.4727	0.0009	+0.0040	11	EBl	C; el.: BBSAG Bull. 128, 10
V1055 Her	s	55049.4493	0.0018	+0.0076	12	EBl	C; el.: IBVS 5192
V1062 Her	p	55067.4384	0.0015	−0.0029	10	EBl	C; el.: IBVS 4965
V1067 Her	s	55067.3817	0.0004	+0.0032	10	EBl	C; el.: IBVS 4966
	p	55067.5087	0.0010	+0.0012	17	EBl	C
V1073 Her	p	55067.4803	0.0003	+0.0168	12	EBl	C; el.: IBVS 4975
V1094 Her	s	55059.4657	0.0013	−0.0070	21	EBl	C; el.: IBVS 5306
V1095 Her	p	55059.4512	0.0007	−0.0215	29	EBl	C; el.: IBVS 5306
V1096 Her	p	55059.3874	0.0011	+0.0219	15	EBl	C; el.: IBVS 5306
	s	55059.5012	0.0008	+0.0150	12	EBl	C
V1097 Her	p	55059.3463	0.0002	+0.0062	19	EBl	C; el.: IBVS 5306
	s	55059.5273	0.0008	+0.0067	20	EBl	C
V1101 Her	s	55067.5124	0.0008	+0.0143	16	EBl	C; el.: IBVS 5333
V1102 Her	p	55067.4443	0.0012	+0.0025	13	EBl	C; el.: IBVS 5333
V1103 Her	s	55067.4051	0.0010	−0.0005	16	EBl	C; el.: IBVS 5333
	p	55067.5437	0.0008	−0.0076	11	EBl	C
V1104 Her	s	55067.3635	0.0018	−0.0020	11	EBl	C; el.: IBVS 5333
	p	55067.4729	0.0005	−0.0066	13	EBl	C
GSC 963-246	s	55074.3618	0.0006	+0.0228	21	EBl	C; el.: IBVS 5799
GSC 1518-913	p	55049.4517	0.0009	−0.0214	16	EBl	C; el.: 2453900.5264+0.321204*E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC 1537-1557	p	55074.4589	0.0008	+0.0051	22	EBl	C; el.: IBVS 5505
GSC 1549-121	s	55074.4374	0.0006	−0.0061	33	EBl	C; el.: IBVS 5505
GSC 2587-289	p	55049.3992	0.0003	−0.0024	13	EBl	C; el.: IBVS 5799
GSC 2587-1888	p	55049.3702	0.0016	+0.0097	14	EBl	C; el.: 2453877.4694+0.310764*E
	s	55049.5223	0.0009	+0.0065	11	EBl	C
GSC 2614-1369	s	55059.3788	0.0004	+0.0028	14	EBl	C; el.: IBVS 5516
	p	55059.5399	0.0011	−0.0034	14	EBl	C
GSC 2615-1821	p	55059.5026	0.0003	+0.0006	18	EBl	C; el.: IBVS 5516
GSC 2618-1385	p	55059.4478	0.0007	−0.0057	15	EBl	C; el.: IBVS 5516
GSC 3097-1297	p	55067.4500	0.0011	+0.0024	22	EBl	C; el.: IBVS 5564
GSC 3101-547	p	55067.4980	0.0008	+0.0071	15	EBl	C; el.: IBVS 5564
GSC 3106-1368	s	55067.3976	0.0011	−0.0012	17	EBl	C; el.: 2453229.5392+0.358362*E
GSC 3510-5	s	55067.3895	0.0008	+0.0316	14	EBl	C; el.: IBVS 5564
GSC 3510-1283	s	55059.344	0.002	−0.008	12	EBl	C; el.: IBVS 5516
	p	55059.4790	0.0007	−0.0121	16	EBl	C
GSC 3532-553	p	55083.3376	0.0005	+0.0035	14	EBl	C; el.: IBVS 5699
		55083.4951	0.0013	+0.0022	13	EBl	C
GSC 196-894	p	55181.8166	0.0009	+0.0097	8	RD	V; el.: 2455131.642+0.414586*E
	s	55182.0272	0.0009	+0.0130	11	RD	V
VY Lac	p	55137.6890	0.0001	+0.0001	52	RD	V; el.: MVS 10, 54
AG Lac	s	55106.7072	0.0008	−0.3847	23	RD	V
BS Lac	p	55106.757	0.002	−0.174	13	RD	V; d=0.06d
CG Lac	p	55135.6488	0.0005	−0.1546	35	RD	V
CO Lac	s	55135.7336	0.0008	+0.0010	10	RD	V; non-circ.
HR Lac	p	55106.6705	0.0012	+0.1092	20	RD	V
HX Lac	p	55127.7587	0.0010	+0.0082	11	RD	V
IP Lac	s	55119.6894	0.0006	+0.0764	23	RD	V
IU Lac	p	55114.6896	0.0004	+0.0145	25	RD	V
LU Lac	s	55121.564	0.003	+0.030	5	RD	V
	p	55121.7134	0.0001	+0.0301	20	RD	V
LZ Lac	p	55127.7550	0.0010	+0.3180	14	RD	V
NR Lac	p	55121.6725	0.0004	+0.0674	30	RD	V
V364 Lac	p	55137.5933	0.0010	+0.0542	28	RD	V; non-circ.
Z Lep	p	55135.8681	0.0005	+0.0572	37	RD	V; el.: JAAVSO 21, 111
RR Lep	p	55144.9477	0.0003	−0.0342	33	RD	V
GSC 5337-1744	s	55153.8559	0.0002	−0.0062	20	RD	V; el.: IBVS 5871
GSC 5361-545	s	55153.8689	0.0006	+0.0066	25	RD	V; el.: IBVS 5871
V400 Lyr	s	55104.3987	0.0008	−0.0541	13	EBl	C; el.: IBVS 4995
V574 Lyr	s	55104.3183	0.0012	−0.0076	14	EBl	C; el.: IBVS 4976
	p	55104.4565	0.0009	−0.0060	10	EBl	C
V579 Lyr	s	55104.4012	0.0013	−0.0226	22	EBl	C; el.: IBVS 4982
V580 Lyr	p	55104.2982	0.0013	−0.0296	13	EBl	C; el.: IBVS 4982
	s	55104.4509	0.0012	−0.0214	16	EBl	C
V582 Lyr	p	55104.3537	0.0012	+0.0566	17	EBl	C; el.: IBVS 4985
	s	55104.482	0.002	+0.057	10	EBl	C
V591 Lyr	p	55104.3046	0.0014	+0.0059	11	EBl	C; el.: IBVS 5232
	s	55104.4454	0.0006	−0.0034	12	EBl	C
V592 Lyr	p	55104.4195	0.0010	+0.0144	18	EBl	C; el.: IBVS 5232
V596 Lyr	s	55104.3355	0.0008	+0.0077	14	EBl	C; el.: IBVS 5232
GSC 3108-57	p	55083.4085	0.0004	−0.0061	21	EBl	C; el.: IBVS 5525
GSC 3109-859	s	55083.4443	0.0007	−0.0087	26	EBl	C; el.: IBVS 5525
GSC 3526-1995	p	55083.3954	0.0013	−0.0152	13	EBl	C; el.: IBVS 5525
GSC 3526-2369	s	55083.4454	0.0003	+0.0339	19	EBl	C; el.: IBVS 5525
V498 Mon	p	55158.8996	0.0003	−0.1355	44	RD	V
GSC 145-685	p	55158.9059	0.0001	+0.0160	43	RD	V; el.: 2454459.712+1.159499*E
GSC 4839-280	p	55181.9467	0.0007	+0.0104	21	RD	V; el.: IBVS 5894
ER Ori	s	55139.9017	0.0003	+0.0821	35	RD	V
FF Ori	p	55144.8754	0.0006	+0.0325	28	RD	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
V343 Ori	p	55153.9044	0.0002	+0.0033	44	RD	V; el.: 2453704.726+0.809143*E
V392 Ori	s	55158.9118	0.0004	+0.0330	50	RD	V; el.: PASJ 54, 139
V517 Ori	p	55137.8570	0.0003	−0.0081	25	RD	V; el.: IBVS 5871
V641 Ori	p	55153.8776	0.0004	−0.0090	28	RD	V; el.: 2454750.858+0.450815*E
V1799 Ori	s	55135.7727	0.0004		9	RD	V
	p	55135.9187	0.0005		17	RD	V
GSC 104-1999	p	55137.8535	0.0006	−0.0044	23	RD	V; el.: IBVS 5871
GSC 107-596	p	55139.8154	0.0005	−0.0037	9	RD	V; el.: IBVS 5799
	s	55139.9516	0.0006	−0.0007	14	RD	V
GSC 702-1892	s	55144.9085	0.0002	+0.0009	26	RD	V; IBVS 5493
GSC 706-845	p	55135.9090	0.0006	−0.0035	30	RD	V; el.: IBVS 5799
GSC 1283-53	s	55144.9170	0.0004	−0.0086	32	RD	V; el.: IBVS 5799
BN Peg	p	55102.7190	0.0004	+0.0035	24	RD	V
BX Peg	p	55121.6025	0.0007	−0.0006	20	RD	V; el.: IBVS 5668
	s	55121.7390	0.0004	−0.0044	18	RD	V
CF Peg	s	55102.6650	0.0007	−0.1090	26	RD	V
DV Peg	p	55114.6664	0.0003	+0.0495	36	RD	V
FL Peg	s	55114.6242	0.0005	+0.0014	15	RD	V
KW Peg	p	55121.6584	0.0003	+0.1518	17	RD	V; el.: IBVS 3579
GSC 563-861	p	55127.6711	0.0004	−0.0016	22	RD	V; el.: 2454597.915+0.368399*E
GSC 573-1241	p	55119.6655	0.0011	+0.0021	14	RD	V; el.: 2454815.539+0.309384*E
GSC 1141-480	p	55114.7029	0.0002	−0.0009	31	RD	V; el.: 2454403.614+0.386672*E
GSC 1170-123	p	55144.6565	0.0002	+0.0078	35	RD	V; el.: 2454329.832+0.368362*E
GSC 1174-344	s	55153.6294	0.0002	+0.0039	35	RD	V; el.: 2454299.824+0.388710*E; d=0.03d
GSC 1178-1208	p	55153.6568	0.0005	−0.0054	21	RD	V; el.: 2454438.559+0.277710*E
GSC 1686-1001	s	55127.6644	0.0006	+0.0013	13	RD	V; el.: 2454427.554+0.282359*E
GSC 1694-992	p	55106.6839	0.0005	+0.0038	27	RD	V; el.: 2453912.803+0.346453*E
GSC 1715-1370	s	55139.6420	0.0008	+0.0047	16	RD	V; el.: 2454305.775+0.357344*E
GSC 1716-1457	s	55144.6998	0.0001	+0.0114	39	RD	V; el.: 2454681.775+0.408393*E; d=0.03d
GSC 1718-1664	p	55139.6312	0.0003	−0.0027	13	RD	V; el.: 2454372.596+0.258175*E
	s	55139.7653	0.0007	+0.0023	13	RD	V
GSC 2223-87	p	55127.6815	0.0002	−0.0104	39	RD	V; el.: 2454985.901+0.564904*E
GSC 2225-1482	p	55139.6622	0.0003	−0.0074	43	RD	V; el.: 2454761.568+0.748716*E
GSC 2226-2148	s	55121.6857	0.0004	+0.0163	21	RD	V; el.: 2452860.717+0.311791*E
GSC 2244-1064	p	55139.6523	0.0003	+0.0071	43	RD	V; el.: 2453596.695+0.425994*E; d=0.03d
GSC 2258-1489	s	55158.6320	0.0002	−0.0342	27	RD	V; el.: 2452645.587+0.273741*E
GSC 2766-775	p?	55135.5792	0.0012	+0.0568	13	RD	V; el.: 2453254.588+0.375736*E
GSC 2766*1184	p	55144.6644	0.0004	−0.0304	48	RD	V; el.: 2453255.588+0.801828*E; d=0.05:d
BE Per	p	55121.8690	0.00004	+0.0157	26	RD	V; MVS 11, 38
EX Per	p	55106.817:	0.005	−0.662	8	RD	V
HK Per	p	55135.8551	0.0003	+0.0913	37	RD	V
IU Per	s	55197.7015	0.0018	+0.0113	34	RD	V
PS Per	p	55114.8667	0.0006	+0.0627	12	RD	V
QT Per	p	55119.8568	0.0006	−0.0460	18	RD	V; el: MVS 11, 65
QW Per	p	55192.6677	0.0006	+0.0165	17	RD	V
V427 Per	p	55197.6373	0.0005	+0.0149	35	RD	V
V432 Per	p	55181.6748	0.0001	−0.0077	42	RD	V; el.: BAV Rb. 43, 104
V434 Per	p	55197.6269	0.0008	−0.0762	30	RD	V
V680 Per	p	55114.9429	0.0002	+0.0488	20	RD	V; el.: IBVS 5610
	p	55119.809	0.002	+0.053	6	RD	V
	s	55119.9950	0.0002	+0.0522	8	RD	V
	s	55121.8660	0.0003	+0.0533	24	RD	V
V737 Per	s	55127.9249	0.0002	+0.0449	32	RD	V; el.: IBVS 5894
GSC 2853-18	s	55197.6874	0.0001	−0.0081	17	RD	V; el.: IBVS 5901
GSC 3708-1325	s	55102.9297	0.0004	−0.4983	31	RD	V; el.: 2451421.708+3.02356*E; non-circ.
GSC 8-448	s	55153.6777	0.0005	+0.0018	31	RD	V; el.: 2454727.799+0.401203*E; d=0.035d
GSC 14-479	p	55153.7375	0.0005	+0.0182	21	RD	V; el.: 2454684.826+0.394090*E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC 575-429	p	55137.6044	0.0003	+0.0008	18	RD	V; el.: 2455014.843+0.234276*E
	s	55137.7179	0.0004	−0.0029	19	RD	V
GSC 621-834	p	55106.8948	0.0005	+0.0072	28	RD	V; el.: 2453651.723+0.282666*E
GN Sge	p	55100.6849	0.0004	−0.0003	37	RD	V
V384 Ser	p	55029.3688	0.0004	+0.0007	13	EBl	C; el.: IBVS 5295
	s	55038.3694	0.0006	−0.0011	9	EBl	C
	p	55038.5057	0.0004	+0.0008	21	EBl	C
RZ Tau	p	55127.8954	0.0002	+0.0575	35	RD	V
WY Tau	s	55153.9012	0.0002	+0.0556	41	RD	V
AH Tau	p	55192.6539	0.0004	+0.0115	20	RD	V; el.: IBVS 5554
AP Tau	p	55144.8719	0.0003	+0.0261	32	RD	V
BV Tau	p	55139.8956	0.0005	−0.0003	42	RD	V; el.: 2452622.09+0.930453*E; d=0.05d
CC Tau	p	55144.8755	0.0001	−0.0044	33	RD	V; d=0.03d
CU Tau	p	55121.8645	0.0008	−0.0005	20	RD	V; el.: AJ 130, 224
EQ Tau	p	55192.695	0.003	−0.026	5	RD	V
GR Tau	s	55127.8923	0.0006	−0.0280	34	RD	V; d=0.05d
V1222 Tau	s	55121.9539	0.0008	−0.0563	20	RD	V; el.: IBVS 5871; d=0.03d
V1223 Tau	p	55100.9035	0.0002	+0.0032	30	RD	V; el.: 2454377.787+0.446918*E
V1241 Tau	s	55181.6530	0.0007	+0.0186	37	RD	V; formerly WX Eri
V1260 Tau	p	55139.9050	0.0003	+0.0269	47	RD	V; el.: 2453347.724+5.43077*E; non-circ.
GSC 67-348	p	55192.5590	0.0003	+0.0043	11	RD	V; el.: 2454388.813+0.282709*E
GSC 658-185	s	55192.6464	0.0004	+0.0028	27	RD	V; el.: 2454305.915+0.443032*E
GSC 659-262	s	55197.6383	0.0008	−0.0129	21	RD	V; el.: 2454167.516+0.386760*E
GSC 663-23	p	55197.6661	0.0004	−0.0050	44	RD	V; el.: 2453751.610+0.619829*E
GSC 1256-188	s	55192.6434	0.0002	+0.0061	29	RD	V; el.: 2454758.781+0.373531*E
GSC 1841-879	p	55127.9213	0.0001	−0.1113	37	RD	V; el.: 2452623.651+0.935518*E
GSC 1848-1264	s	55153.9349	0.0004	+0.0024	25	RD	V; el.: IBVS 5699
V Tri	p	55106.8932	0.0003	−0.0041	30	RD	V
RV Tri	p	55102.8993	0.0002	−0.0311	35	RD	V
RW Tri	p	55181.7186	0.0002	−0.0050	10	RD	V
ST Tri	p	55114.9106	0.0003	+0.0015	20	RD	V
	s	55119.9430	0.0007	+0.0039	25	RD	V
	s	55121.8550	0.0003	−0.0003	22	RD	V
VW Tri	p	55102.8981	0.0003	−0.0302	27	RD	V; el.: MVS 11, 1
VZ Tri	p	55102.8667	0.0004	−0.0087	23	RD	V; el.: OEJV 107
GSC 1774-845	p	55181.6550	0.0003	−0.0055	39	RD	V; el.: 2454823.626+0.468019*E

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CSS091215:060708-060335 : AN OPTICALLY EMERGENT ERUPTIVE NEAR THE HEAD OF HERBIG HARO 866 WEST

GREAVES, J.

Northants, UK

CSS091215:060708-060335 ($\alpha_{2000} = 06^{\rm h}07^{\rm m}08^{\rm s}.1$; δ_{2000} =-06°03′35″ good to one arcsecond).

Public Catalina RealTime Transient Survey optical data (Drake *et al.*, 2009) reveal a faint and slowly brightening object which was first detected in Autumn 2006 whilst not having been detected previously in unfiltered optical data from the Catalina Sky Survey 0.7 meter telescope (albeit with gaps) back to January 2005, as illustrated in Figure 1 and provided in Table 1 (available through the IBVS website as `5921-t1.txt`).

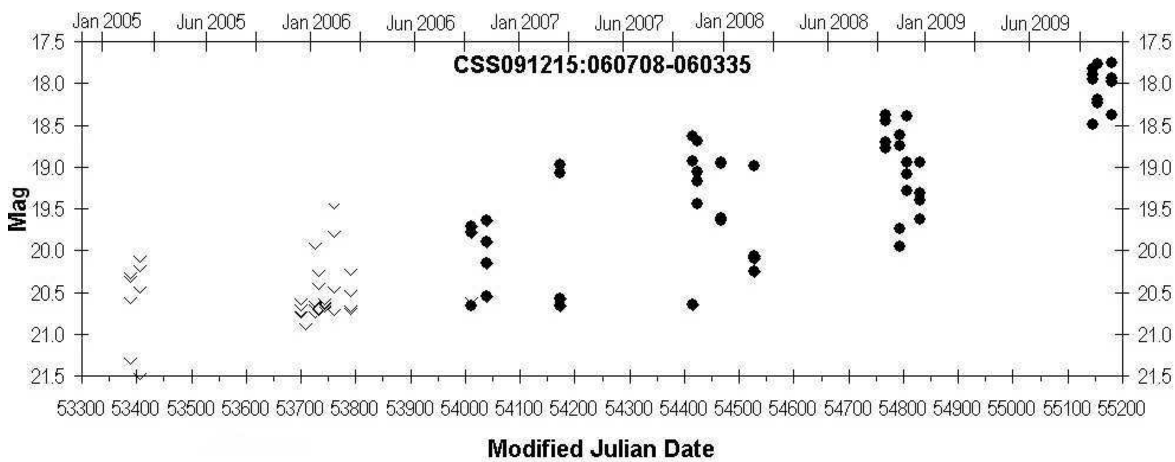

Figure 1. CRTS observations of CSS091215:060708-060335, filled circles are measurements, 'V' symbols are upper limits. Errors on each measure range from nearly a quarter up to at most half a magnitude

Investigation of archival POSS I and SERC/AAO Schmidt red and blue plates showed nothing in the region down to limiting magnitudes of 20 to 21. Images from the 2MASS All Sky Survey (Skrutskie *et al.*, 2006) show an object just visible in the J band, however it begins to appear more firmly in the H band and is most evident in the K_s band all from images taken in November 1998, lying very adjacent to the 2MASS Extended Catalog object 2MASX J06070812-0603352. SPITZER IRAC 3.6, 4.5, 5.8 and 8.0 micron March 2005 images (Werner *et al.*, 2004) also show the object well, but it is not evident on the same date MIPS 24 micron image, although apparently appearing on the 70 micron image, however this image does not cover the whole field (Figure 2). The extended object is always most evident around the two to four micron passbands, being faint to invisible at longer and shorter wavelengths, with public April 2007 AKARI mission images

(Murakami, H. *et al.*, 2007), for example, showing it best at 3.2 and 4.1 microns and barely present at 7.0 microns, whilst HH 866 becomes increasingly much brighter towards the longer passbands (Figure 3).

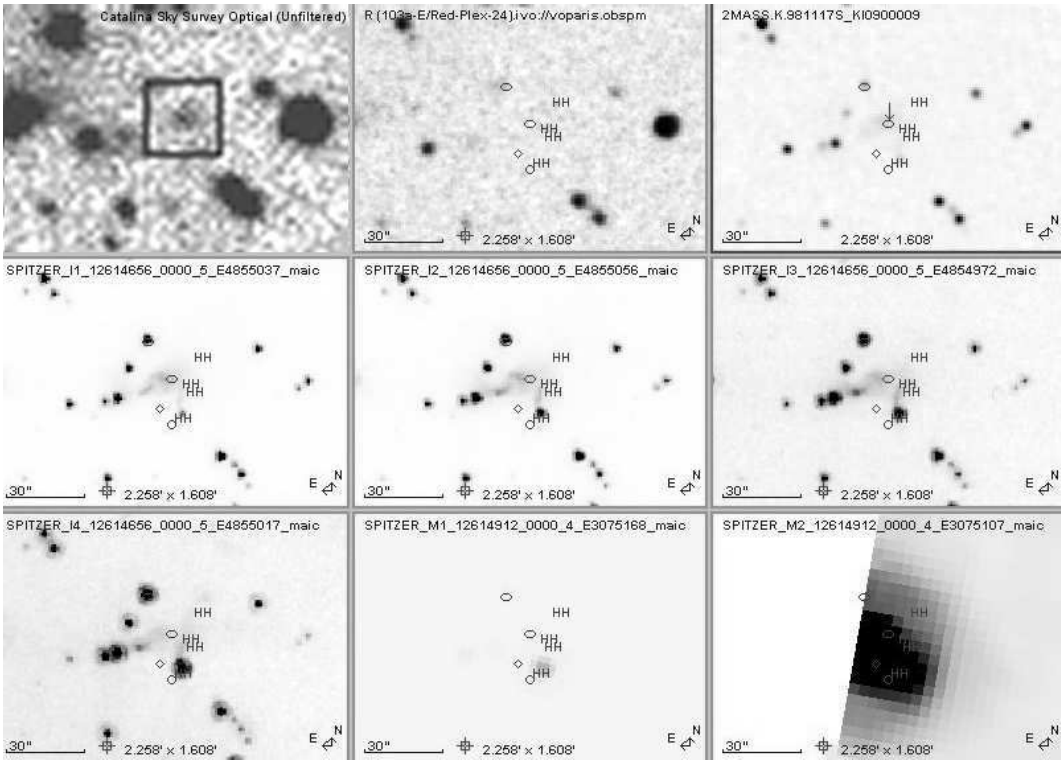

Figure 2. Optical and SPITZER IRAC and MIPS images of the region surrounding CSS091215:060708-060335. From left to right, in top to bottom rows, CSS 0.7m Telescope unfiltered optical image, POSS I E (red) plate image, 2MASS K_s image, SPITZER IRAC 3.6, 4.5, 5.8 and 8.0 micron images, SPITZER MIPS 24 and 70 micron images. The arrow in the 2MASS image points to the CRTS object position, HH denotes Herbig Haro objects with HH 866 southmost. The ellipses are 2MASX objects shown at centre and Northeast of centre respectively, the diamond denotes the SIMBAD position for IRAS 06046-0603, the circle the SIMBAD position for [C2001b] 11, with all images orientated and scaled via Aladin, except for the CRTS image which was done by hand

Wang et al. (2005) imaged the region of this suspected embedded infrared cluster, [C2000b] 11 (Carpenter, 2000), as part of a search for Herbig Haro Objects in the more general Monoceros R2 region, finding in particular one just South of this position detected in [SII] and Hα images which they denoted HH 866. Hodapp (2007) examined this object and the area immediately around [C2000b] 11 (amongst others) in more detail using UKIRT WFCAM K band images in October 2005. Hodapp (2007) classifies the main HH 866 as HH 866 West to differentiate it from a newly detected East object, and as can be seen in Figure 17 of that paper, and the image also reveals an extended region extending slightly East from the tip of the North-South aligned HH 866 jet. Hodapp (2007) further notes :

"To the east of this position is a large, rather poorly defined bow shock at $6^h7^m08\overset{s}{.}1$, $-6°03'36''$ that appears to be associated with more shock emission knots further east of it."

which lies within $1''$ of the CRTS position for CSS091215:060708-060335.

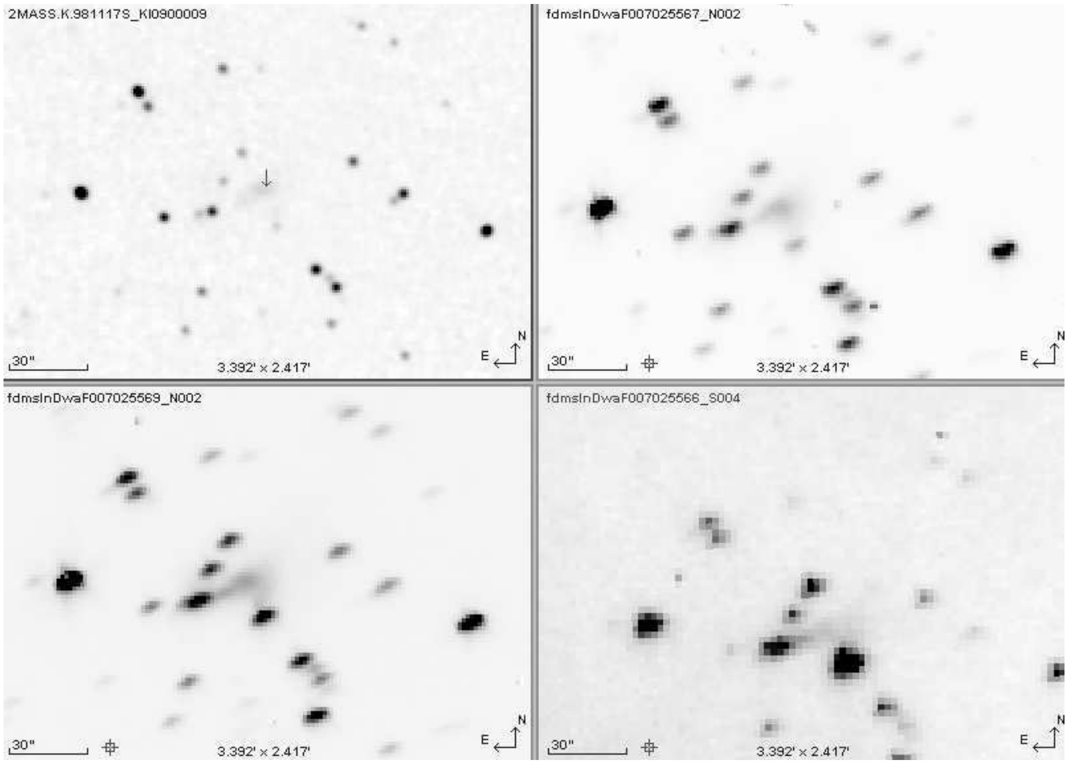

Figure 3. JAXA AKARI IRC images of the region surrounding CSS091215:060708-060335 in various passbands. From left to right, in top to bottom rows, 2MASS Ks positional reference image, AKARI IRC N3 3.2 micron image, N4 4.1 micron image and S7 7.0 micron image.

Given the general and immediate environments to CSS091215:060708-060335, its passband specific visibility, and its recent optical expression, it is possible that CSS091215:060708-060335 is an active pre-main sequence star currently emerging from the circumstellar material it is embedded within. In recent Catalina Sky Survey optical images the object appears stellar enough at core, albeit somewhat similar to a very compact nebulosity. Given the extent of the brightening so far, an increasingly illuminated knot of nebulosity is a possibility, but not a certain one given an absence of any evident illuminating star. Further, although the literature states both implicitly and at times explicitly that the various denoted Herbig Haro objects associated with HH 866 are being energised by the same object or region, said Herbig Haro objects appearing quite plainly and distinctly in emission line images, whilst there being no distinct object at the CRTS transient position in the same images, yet none of these various Herbig Haro objects can be seen in the CRTS image, which would mean this was a case of the energising object causing a new knot to brighten more than the other objects it impinges upon, with these somehow remaining unaffected.

An uninformative and very red optical spectrum having no sign of emission lines taken with the Palomar 5m telescope (Drake, A.J., pers. comm.) suggests that near infrared spectroscopy would be more suitable for discerning the character of this new transient.

Acknowledgements:

This research utilised data and images from the Catalina RealTime Transient Survey. The Aladin utility and SIMBAD data via the IAU funded CDS at Strasbourg were also utilised. 2MASS all sky data is courtesy of a NASA/NSF funded project of the University of Massachusetts and IPAC/CalTech. NASA SPITZER IRAC and MIPS post-BCD images were also used and accessed via the NASA IRSA IPAC interface. The research also further made use of observations made with AKARI, a JAXA project with the participation of ESA with the images served via the Data ARchives and Transmission System (DARTS), provided by Center for Science-satellite Operation and Data Archives (C-SODA) at ISAS/JAXA. Andrew J. Drake of CRTS kindly provided the CRTS photometry for the object upon request.

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Drake, A. J., Djorgovski, S. G., Mahabal, A., Beshore, E., Larson, S., Graham, M. J., Williams, R., Christensen, E., Catelan, M., Boattini, A., Gibbs, A., Hill, R., Kowalski, R., 2009, *ApJ*, **696**, 870

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Skrutskie, M. F., Cutri, R. M., Stiening, R., Weinberg, M. D. et al., 2006, *AJ*, **131**, 1163

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Werner, M. W., Roellig, T. L., Low, F. J., Rieke, G. H. et al., 2004, *ApJS*, **154**, 1

COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

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29 January 2010

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MINIMA TIMES OF SOME ECLIPSING BINARY STARS

GÖKAY, G.; DEMİRCAN, Y.; TERZİOĞLU, Z.; GÜRSOYTRAK, H.; OKAN, A.; ÇOKER, D.; SARAL, G.; GÜROL, B.; DERMAN, E.

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Observatory and telescope:
AUG: 16″ Schmidt/Cassegrain telescope at Ankara University Observatory
TUG: 16″ Meade LX200-GPS Telescope of the TÜBİTAK National Observatory

Detector:	AUG: Apogee ALTA U47+ back illuminated CCD camera, Peltier cooling, E2V CCD47-10 chip, 1024 × 1024 pixels.TUG: ST8-E CCD Camera

Method of data reduction:
Reduction of the CCD frames was made with IRAF[1] CCDRED and DAOPHOT packages.

Method of minimum determination:
The minima times were computed with several methods in Minima25b (Nelson, 2006) (parabolic fit, tracing paper, bisectors of chords, Kwee and van Woerden method (Kwee & van Woerden, 1956), Fourier fit and sliding integrations technique). Then weighted mean minimum-time value calculated for all filters used.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
QX And	55114.4307	0.0001	II	BVRI-AUG	YD
V1073 Cyg	55089.4572	0.0008	II	BVRI-AUG	DÇ-GG
V1191 Cyg	54353.4729	0.0002	II	BVR-TUG	ED-GG
	54356.4476	0.0003	I	BVR-TUG	ED-GG
V566 Oph	55032.3375	0.0002	I	BVRI-AUG	GG-ZT
	55033.3618	0.0001	II	BVRI-AUG	GG-GS
TV UMi	55064.3009	0.0008	II	BVRI-AUG	YD
	55064.5059	0.0002	I	BVRI-AUG	YD
	55075.3133	0.0010	I	BVRI-AUG	GG-GS
	55075.5133	0.0004	II	BVRI-AUG	GG-GS

[1]IRAF is distributed by the National Optical Astronomical Observatories, operated by the Association of the Universities for Research in Astronomy, inc., under cooperative agreement with the National Science Foundation

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
ASAS 013630+0150.3	54354.5494	0.0001	I	BVR-TUG	ED-GG
	54355.3508	0.0004	I	BVR-TUG	ED-GG
	54355.4833	0.0001	II	BVR-TUG	ED-GG
	54355.6183	0.0005	I	BVR-TUG	ED-GG
ASAS 061245+1134.0	54422.3961	0.0003	II	VRI-TUG	ED-GG
	54426.5140	0.0050	I	VRI-TUG	ED-GG
ASAS 225832+0552.4	54354.3047	0.0001	II	BVR-TUG	ED-GG
	54354.4223	0.0001	I	BVR-TUG	ED-GG
	55092.2714	0.0001	II	BVRI-AUG	ZT-DÇ
	55092.5051	0.0004	II	BVRI-AUG	ZT-DÇ
	55098.3619	0.0003	II	BVRI-AUG	AO-YD
	55098.4792	0.0003	I	BVRI-AUG	AO-YD
	55099.2988	0.0001	II	BVRI-AUG	ZT-HG
	55099.4161	0.0002	I	BVRI-AUG	ZT-HG
	55099.5334	0.0002	II	BVRI-AUG	ZT-HG
	55110.4266	0.0004	I	BVRI-AUG	GS
ASAS 225956+1418.2	55112.3540	0.0002	II	BVRI-AUG	ZT-UD
BD+42 2782	54356.3481	0.0002	I	BVR-AUG	ED-GG
GSC 2331-0731	55108.4808	0.0025	I	BVRI-AUG	HG
GSC 2587-1888	55015.3399	0.0003	I	BVRI-AUG	BG-YD-AO-HG-ZT
	55015.4937	0.0009	II	BVRI-AUG	BG-YD-AO-HG-ZT
	55021.3987	0.0004	II	BVRI-AUG	YD-AO-HG-ZT
GSC 2750-0854	55106.3084	0.0007	I	BVRI-AUG	GG-AMÖ
GSC 3526-2369	55014.4217	0.0002	II	BVRI-AUG	BG-YD-AO-DÇ-HG-ZT
	55022.3478	0.0001	II	BVRI-AUG	BG-YD-AO-DÇ-HG-ZT
GSC 3996-0574	55122.2975	0.0019	I	BVRI-AUG	GG
	55122.5093	0.0002	II	BVRI-AUG	GG
TYC 1761-1246-1	55080.5182	0.0001	I	BVRI-AUG	AO-GS
	55103.4279	0.0003	I	BVRI-AUG	GG
	55103.5887	0.0004	II	BVRI-AUG	GG
	55144.3189	0.0008	II	BVRI-AUG	HG

Explanation of the remarks in the table:

Observers: AMÖ: A.Mithat ÖZ, AO: Abdullah OKAN, BG: Birol GÜROL, DÇ: Deniz ÇOKER, ED: Ethem DERMAN, GG: Gökhan GÖKAY, GS: Gözde SARAL, HG: Hande GÜRSOYTRAK, UD: Utku DEMİRHAN, YD: Yahya DEMİRCAN, ZT: Zahide TERZİOĞLU

Remarks:

The times of minima are weighted averages from all filters observed.

Acknowledgements:

We are grateful to TÜBİTAK National Observatory and Ankara University Observatory for use of the telescope time allocation and other facilities.

References:

Kwee, K. K., van Woerden, H., 1956, *Bull. Astron. Inst. Neth.*, **12**, 327.

Nelson, B., 2006, Software, `http://members.shaw.ca/bob.nelson/software1.htm`

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THE POLAR CSS 081231:071126+440405 AT A LOW ACCRETION RATE

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CSS 081231:071126+440405 (AAVSO Alert Notice #142) is a suspected polar that went into bright outburst in early 2009. A polar is an accreting white dwarf with a strong magnetic field that disrupts the accretion disk, funneling material directly on to the magnetic poles. CSS 081231:071126+440405 shows deep eclipses with a period of about 1.94 hours and reached a peak brightness of $V \sim 14\overset{\text{m}}{.}8$ in March, 2009 (AAVSO Special Notice #149).

We imaged CSS 081231:071126+440405 with the Vatican Advanced Technology Telescope (VATT) over four consecutive nights 2009 October 22-25 (UT) using the VATT4K CCD. The CCD was binned by two pixels and only the first 512 pixels were read out, reducing the overhead to 10 sec. We continuously took 30 sec exposures in the V band spanning 3.5 hours on the first two nights, then switched to 20 sec exposures in the B-band for the final two nights. Using images of the Landolt (1992) standard region SA113, we estimated a zeropoint for the VATT photometry. For the star at the USNO-B.1 coordinates $\alpha = 7^{\text{h}}11^{\text{m}}22\overset{\text{s}}{.}839$, $\delta = +44^\circ04'12\overset{''}{.}45$ (30 arcsec west of the variable) we find $V = 16.57 \pm 0.05$ mag and $B - V = 0.36$ mag.

The V-band light curve is shown Figure 1. Two short, deep eclipses are clearly seen each night and the heliocentric corrected times of mid-eclipse are given in Table 1. We derived a period of 117.181±0.004 minutes and used it to phase the photometric data. The eclipse times in Table 1 provide an ephemeris in heliocentric Julian days of

$$\text{HJD} = 2455126.8960(1) + \text{E} \times 0.081376(3)$$

where the numbers in parentheses are the uncertainties on the final decimal place. We find the full eclipse length is 0.058±0.001 in phase or 6.80±0.12 minutes.

The light curve from Oct. 22-23 shows a bright plateau between phases −0.25 and +0.25 surrounding the eclipse. During the plateau, the star is strongly variable but shows a dip in brightness near phase +0.1 which is likely to be self-absorption by the accretion column. Between phases +0.25 and +0.75 the star displays a slow, steady rise of 0.1 mag and a brightness that is extremely consistent from orbit to orbit.

The light curve is similar to the eclipsing polar HU Aqr in its low accretion state (Schwope et al., 2001). We expect CSS 081231:071126+440405 has a single hotspot on the accreting white dwarf which is in synchronous rotation with the secondary star. The hotspot is occulted by the white dwarf for half the spin period, opposite the phase of the eclipse, suggesting that the accreting magnetic pole is nearly facing the secondary star.

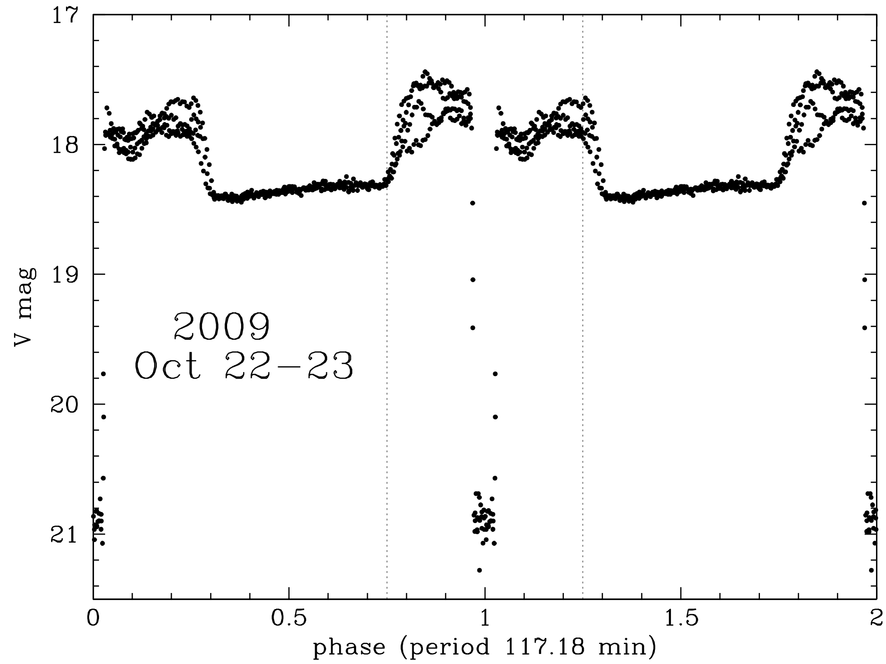

Figure 1. The phased V-band light curve from the first two nights of VATT observations. The accreting hotspot is visible on each side of the eclipse but is occulted by the white dwarf for half the orbit. The dotted lines marks phases ±90° to show that the hotspot lags the companion by 10°.

A careful look at the light curve shows that the occultation of the hotspot is shifted by 10.5 degrees (0.03 in phase) relative to the eclipse. This implies that the hotspot trails the line between the primary and secondary stars by about 10°. In HU Aqr, the accretion spot leads the secondary by 30° to 50°.

The time it takes for the plateau phase to rise to full brightness or disappear depends on the size of the hotspot as it is revealed or blocked by the white dwarf limb. The hotspot latitude and vertical displacement also affect the timing of the hotspot occultation (Schwope et al., 2003). We estimate the ingress/egress of the hotspot takes about 0.05±0.01 in phase. While the hotspot is occulted there is a 10% rise in brightness suggesting that temperature varies with longitude on the white dwarf. The color of the system while the hotspot is occulted is $B - V = 0.17 \pm 0.02$ mag.

Figure 2 shows that the B-band phased light curve from Oct. 24-25 differs significantly from the previous two nights. While the plateau from the hotspot is present during the first orbit each night, it is essentially gone on the second cycle. This suggests the mass transfer is “sputtering” as it ends an active accretion phase. The star is three magnitudes fainter than its peak in 2009 March, and the accretion may be becoming sporadic at this low rate.

Assuming the eclipse is total, we estimated the brightness and color of the secondary star. At minimum the star is very faint, so the eight to ten individual short exposures during each eclipse were added together to improve the signal-to-noise ratio. The secondary star's brightness is $V = 20^{\rm m}_{.}86 \pm 0^{\rm m}_{.}05$ and $B = 22^{\rm m}_{.}6 \pm 0^{\rm m}_{.}2$, consistent with a late M-type dwarf star (note that reddening in this direction is as much as E($B - V$)=0.075 mag (Schlegel et al., 1998)). Correcting for the contribution of the secondary star, the color of the white dwarf plus accretion stream is $B-V$=0.09 mag, but at this low accretion rate the light is likely dominated by the white dwarf.

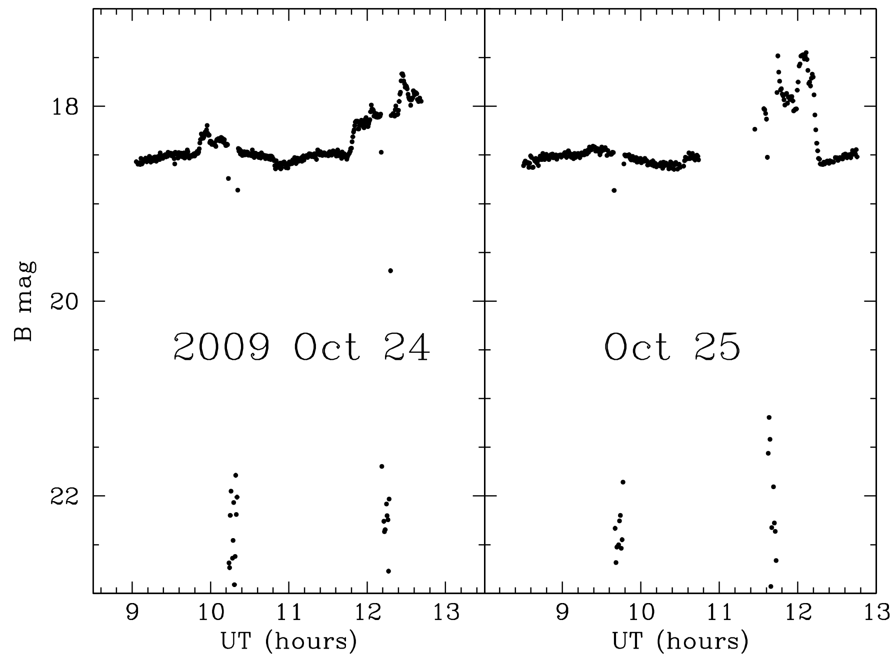

Figure 2. The *B*-band light curves from the last two nights of VATT observations. A gap in the Oct. 25 light curve around 11 UT was caused by clouds. On both nights the hotspot is very weak during the first orbit but has recovered on the second orbit suggesting the mass transfer is becoming sporadic.

Table 1. Observed Times of Mid-Eclipse

Date (UT)	Bandpass	Epoch	HJD	error (days)
2009 Oct. 22	*V*	0	2455126.8960	0.0001
2009 Oct. 22	*V*	1	2455126.9773	0.0001
2009 Oct. 23	*V*	12	2455127.8724	0.0001
2009 Oct. 23	*V*	13	2455127.9539	0.0001
2009 Oct. 24	*B*	25	2455128.9303	0.0001
2009 Oct. 24	*B*	26	2455129.0117	0.0001
2009 Oct. 25	*B*	37	2455129.9069	0.0001
2009 Oct. 25	*B*	38	2455129.9883	0.0002

References:

Landolt, A., 1992, *AJ*, **104**, 340
Schlegel, D. et al., 1998, *ApJ*, **500**, 525
Schwope, A. D., Schwarz, R., Sirk, M. and Howell, S. B., 2001, *A&A*, **375**, 419
Schwope, A. D. et al., 2003, *A&A*, **402**, 201

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NEW TIMES OF MINIMA OF SOME ECLIPSING BINARY STARS

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Observatory and telescope:
30-cm Cassegrain-Schmidt (T30), 40-cm Cassegrain-Schmidt (T40) and 122-cm Cassegrain-Nasmyth (T122) telescopes of the Çanakkale University Observatory.

Detector:	-ST237 camera, Peltier cooling, TC237 chip, $11' \times 8'$ FOV, 640×480 pixels, (ST). -ALTA U47 camera, Peltier cooling, E2V CCD47-10 chip, $15' \times 15'$ FOV, 1024×1024 pixels, (ALTA). -STL1001E camera, Peltier cooling, KAF-1001E chip, $28' \times 28'$ FOV, 1024×1024 pixels, (STL).

Method of data reduction:
Reduction of the CCD frames was made with C-MUNIPACK[1] software.

Method of minimum determination:
Kwee – van Woerden method (Kwee & van Woerden, 1956).

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
XZ And	55140.4666	0.0002	I	C	T40-ST
	55187.2939	0.0003	II	C	T40-ST
KO Aql	55079.3683	0.0004	I	C	T40-ST
OO Aql	55018.5154	0.0004	I	C	T40-ST
CL Aur	55154.4182	0.0001	I	C	T40-ST
SX Aur	55173.3918	0.0002	I	C	T40-ST
DO Cas	55104.5485	0.0002	I	C	T40-ST
IV Cas	55070.5110	0.0001	I	C	T40-ST
	55161.3769	0.0001	I	C	T40-ST
RZ Cas	55157.6186	0.0001	I	C	T40-ST
TV Cas	55133.6118	0.0001	I	C	T40-ST
ZZ Cas	55159.4127	0.0002	I	C	T40-ST
RY Cnc	55157.5175	0.0001	I	C	T40-ST
V909 Cyg	55077.3184	0.0002	I	C	T40-ST
BR Cyg	55074.3206	0.0001	I	C	T40-ST
CG Cyg	55105.2521	0.0001	I	C	T40-ST
DK Cyg	55075.3783	0.0003	I	C	T40-ST
GO Cyg	55071.4840	0.0004	I	C	T40-ST

[1]Motl, D., 2004, C-MUNIPACK, `http://integral.sci.muni.cz/munipack/`

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
UW Cyg	55091.4404	0.0001	I	C	T40-ST
WW Cyg	55042.5055	0.0002	I	R	T30-ALTA
	55042.5055	0.0002	I	V	T30-ALTA
	55062.4132	0.0002	I	C	T40-ST
WZ Cyg	55079.4924	0.0003	I	C	T40-ST
ZZ Cyg	55071.3670	0.0002	I	C	T40-ST
	55127.3118	0.0002	I	C	T40-ST
TY Del	55105.4205	0.0001	I	C	T40-ST
RR Dra	55160.3391	0.0002	I	C	T40-ST
TZ Eri	55163.4249	0.0002	I	C	T40-ST
AK Her	55018.4482	0.0015	I	C	T40-ST
SZ Her	55091.2964	0.0001	I	C	T40-ST
DG Lac	55088.4013	0.0002	II	R	T122-STL
RW Mon	55133.4676	0.0001	I	C	T40-ST
V501 Oph	55042.3905	0.0003	I	R	T30-ALTA
	55042.3904	0.0003	I	V	T30-ALTA
FH Ori	55123.5334	0.0002	I	C	T40-ST
FL Ori	55157.3903	0.0001	I	C	T40-ST
AT Peg	55070.4057	0.0001	I	C	T40-ST
BG Peg	55077.4601	0.0001	I	C	T40-ST
DI Peg	55044.4620	0.0001	I	R	T30-ALTA
	55044.4620	0.0001	I	V	T30-ALTA
	55116.3557	0.0001	I	C	T40-ST
TY Peg	55133.3197	0.0001	I	C	T40-ST
RT Per	55116.5253	0.0001	I	C	T40-ST
	55163.2421	0.0001	I	C	T40-ST
XZ Per	55105.5329	0.0001	I	C	T40-ST
Z Per	55173.2947	0.0002	I	C	T40-ST
ZX Per	55127.4097	0.0002	I	C	T40-ST
UZ Sge	55114.3830	0.0001	I	C	T40-ST
AC Tau	55154.6017	0.0001	I	C	T40-ST
X Tri	55104.4290	0.0000	I	C	T40-ST
AX Vul	55044.3720	0.0003	I	R	T30-ALTA
	55044.3725	0.0004	I	V	T30-ALTA
BO Vul	55154.2614	0.0000	I	C	T40-ST
AY Vul	55138.3466	0.0001	I	C	T40-ST

Remarks:

We present 54 minima times of 44 eclipsing binaries. In the Remarks column of Times of Minima table, telescopes and detectors used in the observations are given.

Acknowledgements:

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Reference:

Kwee, K. K., & van Woerden, H., 1956, *Bull. Astron. Inst. Neth.*, **12**, 327.

ERRATUM FOR IBVS 5924

ZX Per should be changed as XZ Per.

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INFORMATION BULLETIN ON VARIABLE STARS

Number 5925

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SHORT-PERIOD OSCILLATIONS IN THE ALGOL-TYPE SYSTEMS V: SX DRACONIS

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e-mail: dinko@astro.bas.bg; zk@astro.bas.bg; vpopov@astro.bas.bg; vgenkov@astro.bas.bg

In the course of a programme for search of short-period oscillations in newly discovered Algols based on NSVS data (Wozniak et al., 2004) we selected as candidates four already known Algols: SX Dra, RT UMi, V548 Cyg, and V728 Cyg. Only RT UMi was included in the catalogue of Soydugan et al. (2006) as candidate for a system with pulsations. The NSVS light curves of the stars are shown on Fig. 2. For SX Draconis, known to have very rapid period increase of 94.2 sec/century (Shengbang, 2002), an ephemeris, based on NSVS data is computed:

$$HJD(\mathrm{MinI}) = 2451275.9851(\pm 0.0013) + 5.169196(\pm 0.000062)E \qquad (1)$$

Time-series CCD observations of the selected stars were obtained at NAO Rozhen and AO Belogradchik. The astrometric and photometric data† for the variables and comparison stars (Table 1) are taken from NOMAD catalogue (Zacharias et al., 2005). The CCD photometry (in V and B bands) was carried out with the 60cm Cassegrain telescopes, equipped with the CCD cameras FLI PL09000 (3056×3056, 12μ pixel), and Bessell (1990) standard $UBVRI$ filters. Standard IDL procedures were used for the reduction of the photometric data. Several stars from the fields around the variables with $\sigma < 0.01$ mag were selected to create ensemble standard stars (Everett & Howell, 2001).

During the campaign short-period oscillations with a peak-to-peak amplitude up to 0.040 mag in V were detected in the time-series of SX Dra only (Table 2). Six of the V patrols of SX Dra are shown on Fig. 3. The frequency-analysis of the residual light curves of the variables, performed with the PERIOD-04 software (Lenz & Breger, 2005), revealed significant peaks in the power spectrum of SX Dra (Fig. 4). The frequency interval is $22 \div 24$ c/d or about 63 min.

Acknowledgements This study made use of the SIMBAD, ADS, and VSX databases, and GCVS catalogue. V.G. acknowledges N. Kacharov for the assistance in the Belogradchik observations.

†Photometric data for SX Dra are available through the IBVS website as `5925-t3.txt`

Table 1. Data for the variables and comparison stars used in the CCD photometry

ID	Name	RA (J2000)	DEC (J2000)	V	$B-V$	$V-R$	Sp. type
Var	SX Dra	$18^h04^m33\overset{s}{.}87$	$+58°23'54\overset{''}{.}2$	10.411	0.313	0.201	A9V
Std1	TYC 3915-588-1	$18^h05^m01\overset{s}{.}78$	$+58°27'01\overset{''}{.}6$	11.007	1.343	0.827	
Std2	TYC 3915-696-1	$18^h04^m34\overset{s}{.}20$	$+58°27'19\overset{''}{.}7$	11.707	0.669	0.447	
Std3	TYC 3915-966-1	$18^h03^m59\overset{s}{.}08$	$+58°23'05\overset{''}{.}4$	11.976	0.135	0.076	
Std4	TYC 3915-1572-1	$18^h04^m42\overset{s}{.}51$	$+58°23'26\overset{''}{.}2$	12.606	0.526	0.346	
Std5	GSC 3915-1086	$18^h04^m44\overset{s}{.}42$	$+58°23'14\overset{''}{.}9$	13.110	0.200	0.350	
Var	RT UMi	$17^h04^m05\overset{s}{.}51$	$+80°19'45\overset{''}{.}2$	10.893	0.238	0.153	F0
Std1	GSC 4576-0151	$17^h05^m14\overset{s}{.}62$	$+80°17'12\overset{''}{.}9$	13.040	0.520	0.130	
Std2	GSC 4576-0121	$17^h07^m03\overset{s}{.}47$	$+80°21'26\overset{''}{.}5$	12.770	0.570	0.330	
Std3	TYC 4576-137-1	$17^h08^m06\overset{s}{.}75$	$+80°20'16\overset{''}{.}3$	12.922	0.821	0.532	
Std4	TYC 4576-118-1	$17^h09^m17\overset{s}{.}25$	$+80°13'00\overset{''}{.}1$	11.310	0.414	0.270	
Var	V548 Cyg	$19^h56^m58\overset{s}{.}31$	$+54°47'58\overset{''}{.}3$	8.617	0.092	0.047	A1V
Std1	TYC 3939-442-1	$19^h57^m15\overset{s}{.}31$	$+54°48'55\overset{''}{.}7$	10.315	0.632	0.415	
Std2	TYC 3939-1332-1	$19^h56^m44\overset{s}{.}87$	$+54°52'35\overset{''}{.}4$	10.749	1.003	0.619	
std3	GSC 3939-1357	$19^h56^m54\overset{s}{.}08$	$+54°52'05\overset{''}{.}5$	12.680	0.190	0.680	
Var	V728 Cyg	$20^h26^m40\overset{s}{.}13$	$+58°46'47\overset{''}{.}9$	10.514	0.207	0.134	A0
Std1	GSC 3949-0782	$20^h26^m22\overset{s}{.}72$	$+58°48'25\overset{''}{.}4$	12.330	0.540	-0.580	
Std2	GSC 3962-1280	$20^h27^m01\overset{s}{.}49$	$+58°47'58\overset{''}{.}6$	11.790	0.610	0.480	

Table 2. Observational runs of SX Dra, RT UMi, V548 Cyg, and V728 Cyg

Variable	Date	HJD(start)	Length	Filter	Exp.[s]	N	A_{osc}(max)	Telescope
SX Dra	25.08.2009	2455069.28986	03^h24^m	V	45	240	0.040	60cm Bel
SX Dra	22.09.2009	2455097.42745	01^h38^m	V	50	108	0.025	60cm Bel
SX Dra	23.09.2009	2455098.24907	03^h03^m	V	50	198	0.040	60cm Bel
SX Dra	24.10.2009	2455129.30177	01^h21^m	V	60	73	-	60cm NAO
SX Dra	22.11.2009	2455158.15639	03^h16^m	V	120	93	-	60cm NAO
SX Dra	23.11.2009	2455159.16581	03^h52^m	V	30	400	0.030	60cm NAO
SX Dra	25.11.2009	2455161.15522	02^h59^m	V	60	170	0.020	60cm NAO
SX Dra	26.11.2009	2455162.17403	02^h36^m	V	60	147	0.035	60cm NAO
RT UMi	23.06.2009	2455006.31125	03^h01^m	V	60	150	-	60cm NAO
RT UMi	22.08.2009	2455066.32643	03^h05^m	V	60	146	-	60cm Bel
RT UMi	27.08.2009	2455071.28892	03^h12^m	V	60	175	-	60cm Bel
RT UMi	29.08.2009	2455073.24592	08^h53^m	B	120	239	-	60cm NAO
RT UMi	22.09.2009	2455097.29443	02^h59^m	V	60	159	-	60cm Bel
RT UMi	26.09.2009	2455101.48473	01^h45^m	V	60	100	-	60cm Bel
V548 Cyg	22.08.2009	2455066.47921	02^h57^m	V	30	230	-	60cm Bel
V548 Cyg	27.08.2009	2455071.43507	03^h10^m	V	30	325	-	60cm Bel
V548 Cyg	24.09.2009	2455099.25112	03^h01^m	V	30	309	-	60cm Bel
V548 Cyg	26.09.2009	2455101.34676	02^h21^m	V	30	251	-	60cm Bel
V728 Cyg	25.08.2009	2455069.43906	03^h34^m	V	60	233	-	60cm Bel
V728 Cyg	24.09.2009	2455099.39883	03^h54^m	V	60	215	-	60cm Bel
V728 Cyg	25.09.2009	2455100.41488	03^h34^m	V	60	165	-	60cm Bel

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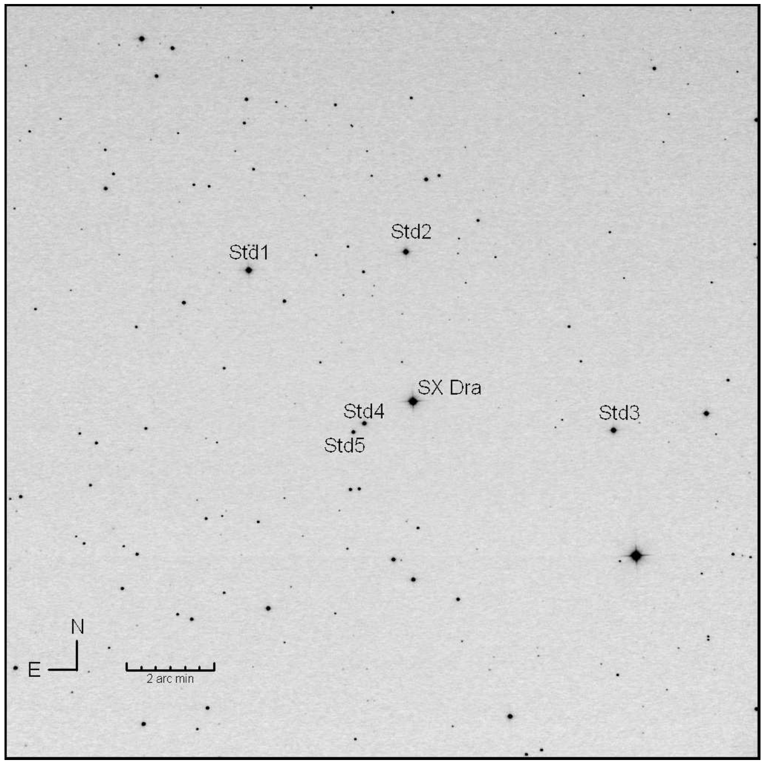

Figure 1. Field around the eclipsing binary SX Dra.

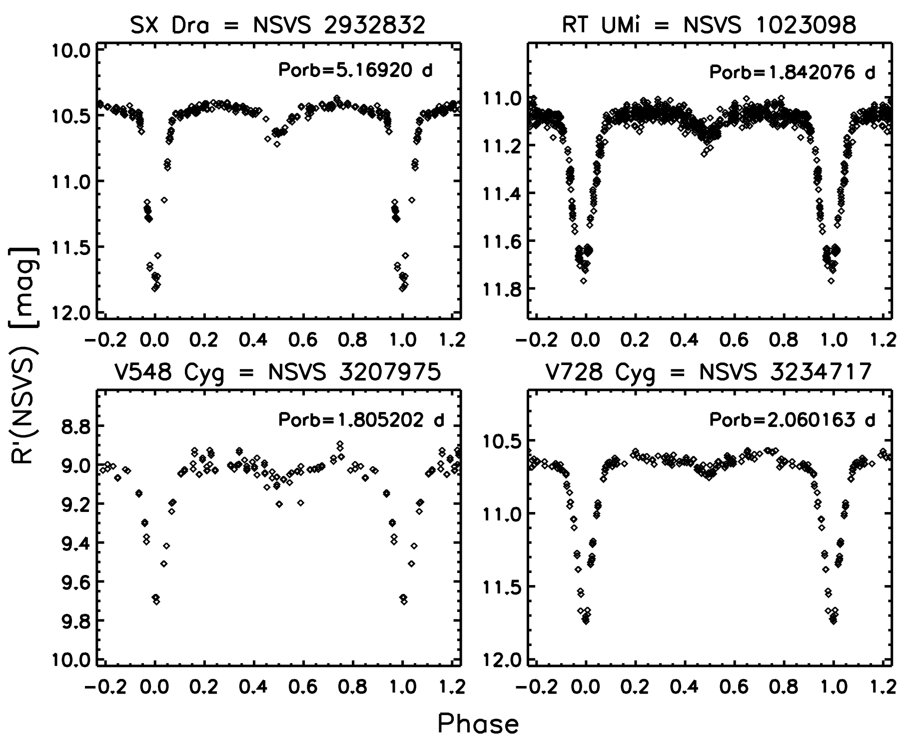

Figure 2. Light curves of SX Dra, RT UMi, V548 Cyg and V728 Cyg in the NSVS instrumental system R'.

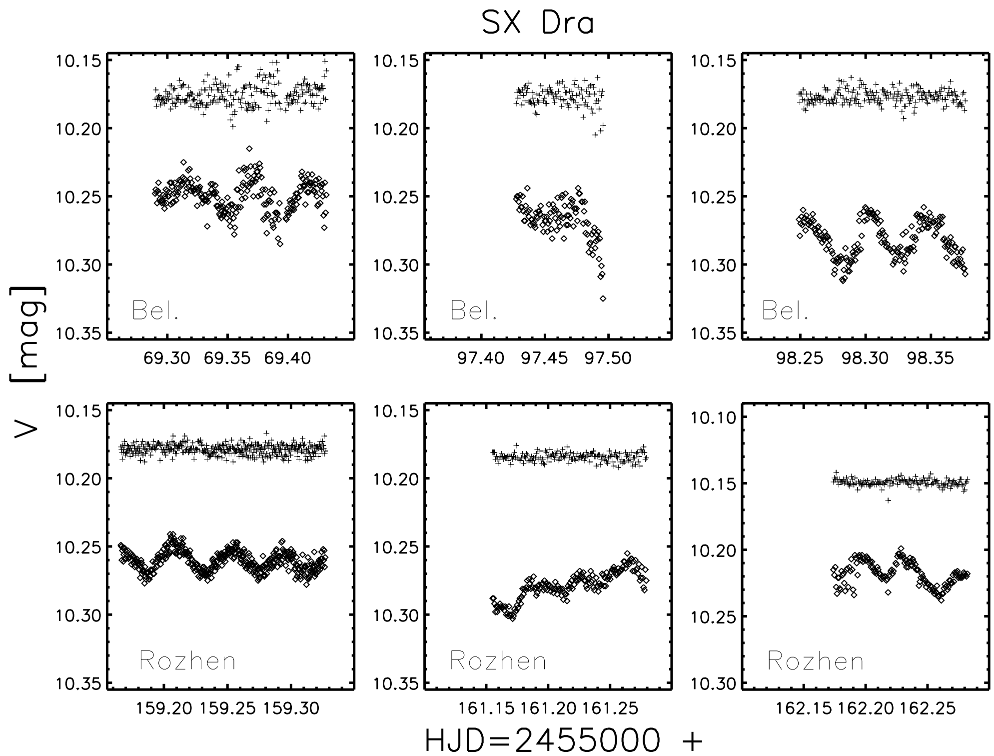

Figure 3. Sample V light curves of SX Dra (diamonds), and properly shifted Std4 for the Belogradchik data and Std2 for Rozhen data (crosses).

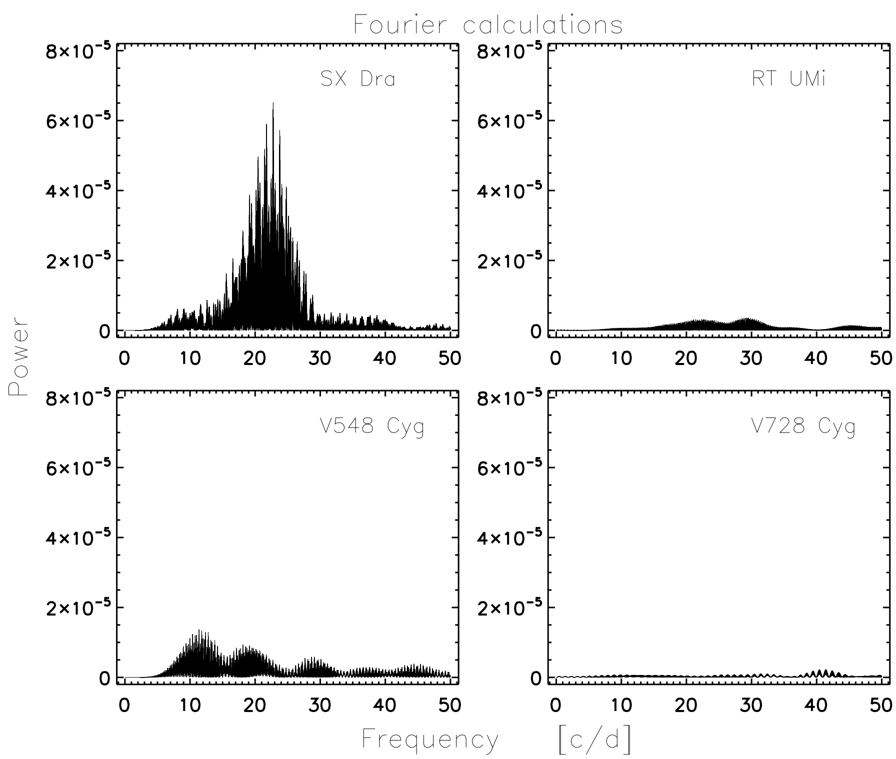

Figure 4. Power spectra of SX Dra, RT UMi, V548 Cyg, and V728 Cyg Rozhen data after subtracting the corresponding trends.

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8 RR LYRAE STARS WITH VARIABLE PERIODS

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No ephemerides were published for the stars analysed in this paper except for V870 Oph, V878 Oph and V964 Oph. Elements of these three stars, published and included in the General Catalogue of Variable Stars (Samus et al., 2009) were found to be erroneous. Indications of more or less intense period variations were detected in all cases.

Photographic plates of fields centered around α Oph, κ Oph and 67 Oph, taken with the Sonneberg Observatory 40cm Astrograph during several intervals spread over the years from 1938−1994, were used to check the behaviour of these objects (see Table 1). The elements listed below were obtained by means of least-squares solutions.

Straight lines in the (O−C) diagrams mark the scopes of the linear subsets according to Table 1.

Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 2. An extensive list holding the times of the new found maxima can be retrieved as `5926-t3.txt`, using the link in the HTML version of this paper. Individual data are available upon request.

Remarks:

V558 Her

Discovered by Hoffmeister (1967). The data in the (O−C)-diagram were calculated using mean linear elements

$$\text{Max. J.D. hel} = 2438524.597 + 0\overset{d}{.}473106 \times \text{E}$$

A sinusoidal fit is also possible for the whole range of observations.

$$\text{Max. J.D. hel} = 2438524.525 + 0\overset{d}{.}473106 - 0\overset{d}{.}074 \times \sin(0.000306 \times E - 2.12)$$

Elements listed in Table 1 are valid for J.D. 2438500−2441200, J.D. 2441200−2446700 and 2446700−2449500 resp.

V762 Oph

Discovered by Boyce and Huruhata (1942). Although a precise time of the period change can not be deduced from the (O−C)-diagram, the composite light curve drawn with these period values gives some hints to assume a period change took place around J.D. 2440000. Elements are at least valid for J.D. 2438500−2440000 and J.D. 2440000−2449500, resp.

V771 Oph
Discovered by Luyten (1937). Subtle to observe due to a close and bright neighboring star. Elements are at least valid for J.D. 2438000−2442000 and J.D. 2442000−2449500, resp.

V870 Oph
Independently from Boyce and Huruhata (1942) discovered by Hoffmeister (1949). Elements derived by Götz et al. (1957) have turned out to be inaccurate. Götz's observations made on Astrograph plates have been reexamined; those made with the 170mm Triplet (Designation "A" in the paper of Götz et al.) have been included in our analysis to enlarge the time base to derive the first subset of elements.
Elements listed in Table 1 are valid for J.D. 2425000−2429000, J.D. 2429000−2438000 and 2438000−2449500 resp.

V878 Oph
Type of variability and first elements derived by Götz et al. (1957) have turned out to be wrong. The elements given below are at least valid for J.D. 2429000−2432000 and J.D. 2438500−2449500, resp. Unfortunately there were no plates available in between these times. So, the (O–C)-diagram represents only one reasonable version of the star's period history.

V964 Oph
Elements derived by Götz et al. (1957) are not accurate and the period has to be halved. The elements given below are at least valid for J.D. 2429000−2444100 and J.D. 2443000−2449500, resp.

NSV 8590
Discovered by Boyce and Huruhata (1942). Subtle to observe due to a close neighboring star. Coordinates published in the General Catalogue of Variable Stars (Samus et al., 2009) are improper; right position is 17:23:55 +09:46:39 (2000.0). The elements given below are at least valid for J.D. 2438500−2440000 and J.D. 2440500−2449500, resp.

NSV 9613
ASAS measurements were included in this analysis. The preliminary ID refers to the paper of Grubissich (1958). The elements given below are at least valid for the intervals of JD 2429000−2447000 and J.D. 2447000−2453600.

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	M−m	No. of Plates
V558 Her (1)	RRab	39299.513 ±6	0.473134 ±3	$14^{m}.3$	$15^{m}.8$	$0^{p}.22$	87
V558 Her (2)		45871.424 ±7	0.473093 ±2				119
V558 Her (3)		49214.409 ±4	0.473117 ±1				38
V762 Oph (1)	RRab	38503.558 ±5	0.499951 ±7	$14^{m}.6$	$16^{m}.0$	$0^{p}.30$	80
V762 Oph (2)		48357.608 ±27	0.500021 ±6				130
V771 Oph (1)	RRab	38524.550 ±13	0.460735 ±3	$13^{m}.2$	$14^{m}.4$	$0^{p}.25$	103
V771 Oph (2)		49484.449 ±18	0.460822 ±3				188
V870 Oph (1)	RRab	29786.507 ±16	0.320631 ±2	$15^{m}.1$	$16^{m}.2$	$0^{p}.25$	
V870 Oph (2)		38258.409 ±8	0.320735 ±1				42
V870 Oph (3)		48356.584 ±13	0.320729 ±1				120
V878 Oph (1)	RRab	29785.521 ±2	0.633563 ±1	$14^{m}.9$	$16^{m}.0$	$0^{p}.22$	42
V878 Oph (2)		49124.465 ±8	0.633573 ±1				112
V964 Oph (1)	RRc	29790.439 ±6	0.254484 ±1	$15^{m}.0$	$16^{m}.1$	$0^{p}.30$	112
V964 Oph (2)		44022.482 ±13	0.254488 ±1				64
NSV 8590 (1)	RRab	38553.533 ±11	0.493591 ±14	$14^{m}.1$	$14^{m}.7$	$0^{p}.19$	81
NSV 8590 (2)		42988.453 ±24	0.493515 ±4				180
NSV 9613 (1)	RRab	29813.509 ±34	0.574765 ±2	$15^{m}.0$	$15^{m}.5$	$0^{p}.25$	160
NSV 9613 (2)		49475.521 ±9	0.574744 ±2				32

Table 2. Comparison stars and cross references

	V558 Her S 9827 USNO 0975-09760289		V762 Oph HV 10940 USNO 0975-09206057	
Comp. No.	USNO	m*	USNO	m*
1	0975-09754037	$14^{\mathrm{m}}.4$	0975-09206984	$14^{\mathrm{m}}.8$
2	0975-09754926	$14^{\mathrm{m}}.8$	0975-09205488	$15^{\mathrm{m}}.4$
3	0975-09756549	$15^{\mathrm{m}}.5$	0975-09205008	$16^{\mathrm{m}}.3$
4	0975-09758451	$16^{\mathrm{m}}.4$		

	V771 Oph 183.1937 USNO 0975-09337118		V870 Oph HV 11042 / S 4181 USNO 0900-10501915	
Comp. No.	USNO	m*	USNO	m*
1	0975-09338753	$12^{\mathrm{m}}.9$	0900-10502097	$14^{\mathrm{m}}.8$
2	0975-09338860	$13^{\mathrm{m}}.7$	0900-10503177	$15^{\mathrm{m}}.3$
3	0975-09333498	$14^{\mathrm{m}}.8$	0900-10504815	$16^{\mathrm{m}}.7$

	V878 Oph S 4221 USNO 0900-12249555		V964 Oph S 4219 USNO 0900-12201787	
Comp. No.	USNO	m*	USNO	m*
1	0900-12233849	$14^{\mathrm{m}}.4$	0900-12191210	$14^{\mathrm{m}}.5$
2	0900-12249979	$15^{\mathrm{m}}.1$	0900-12198837	$15^{\mathrm{m}}.2$
3	0900-12242643	$15^{\mathrm{m}}.9$	0900-12203760	$15^{\mathrm{m}}.8$
4	0900-12243574	$16^{\mathrm{m}}.4$	0900-12199688	$15^{\mathrm{m}}.9$

	NSV 8590 HV 10935 USNO 0975-09152532		NSV 9613 3(SA 109) USNO 0900-10436490	
Comp. No.	USNO	m*	USNO	m*
1	0975-09147252	$13^{\mathrm{m}}.8$	0900-10431734	$14^{\mathrm{m}}.9$
2	0975-09149633	$14^{\mathrm{m}}.4$	0900-10436319	$15^{\mathrm{m}}.1$
3	0975-09151256	$14^{\mathrm{m}}.6$	0900-10440956	$15^{\mathrm{m}}.5$
4	0975-09154060	$14^{\mathrm{m}}.8$		

* Magnitudes refer to the B values of the USNO−A2.0 catalogue

This research made use of Aladin and the SIMBAD data base, operated at CDS, Strasbourg, France.

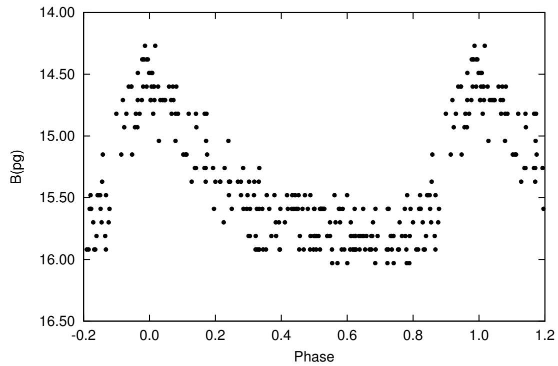

Figure 1. Composite light curve of V558 Her

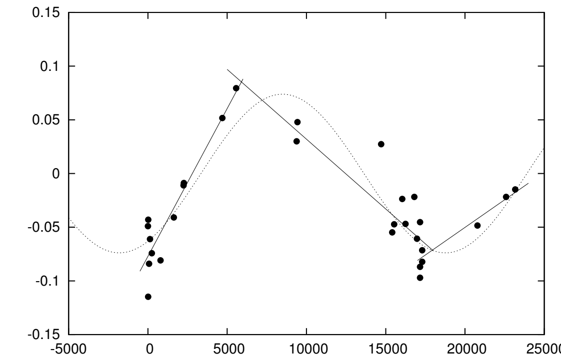

Figure 2. (O−C) diagram for V558 Her

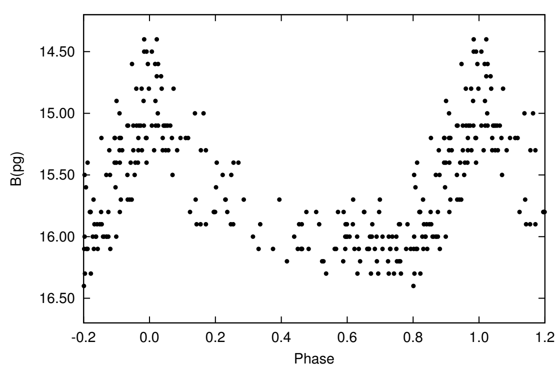

Figure 3. Composite light curve of V762 Oph

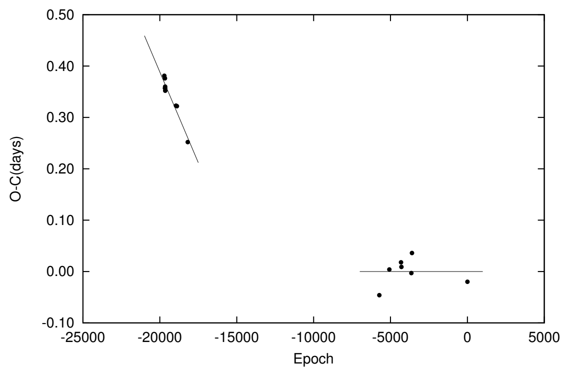

Figure 4. (O−C) diagram for V762 Oph

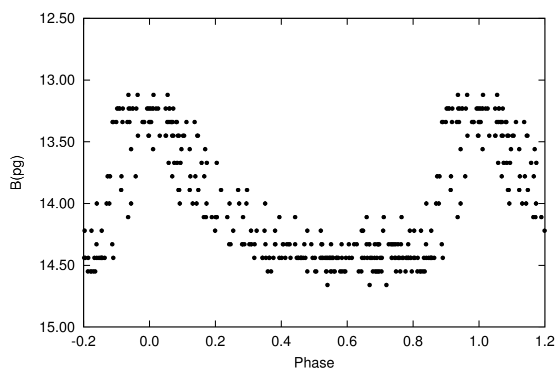

Figure 5. Composite light curve of V771 Oph

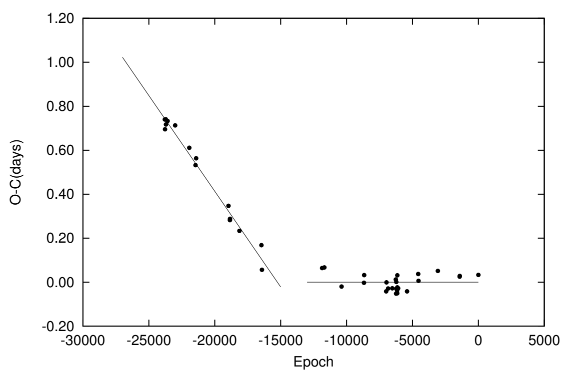

Figure 6. (O−C) diagram for V771 Oph

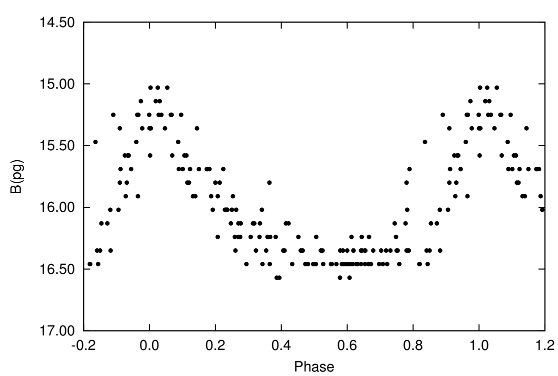

Figure 7. Composite light curve of V870 Oph

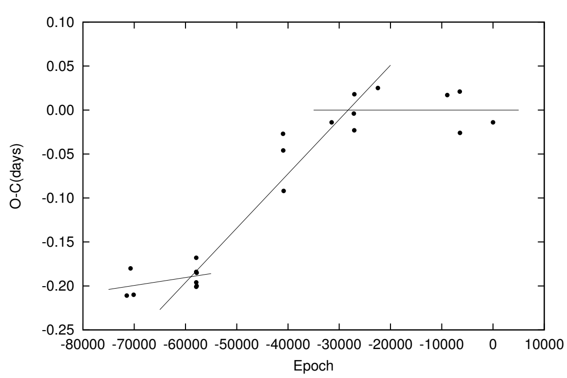

Figure 8. (O−C) diagram for V870 Oph

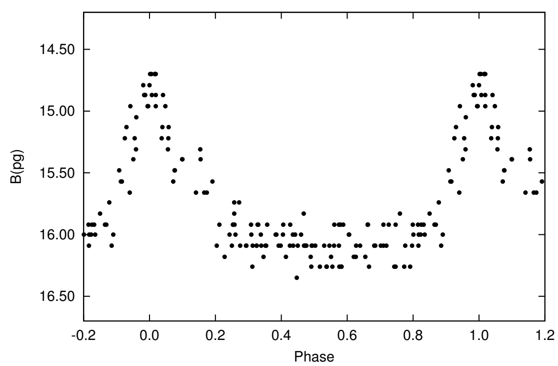

Figure 9. Composite light curve of V878 Oph

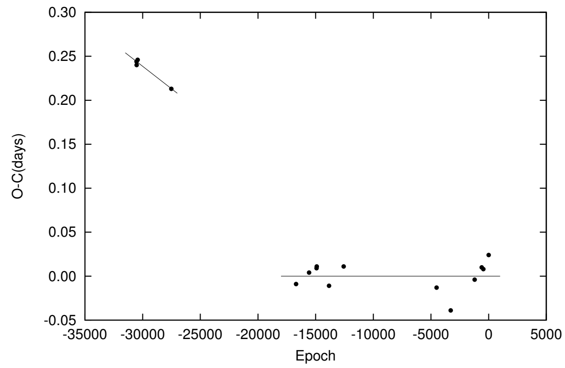

Figure 10. (O−C) diagram for V878 Oph

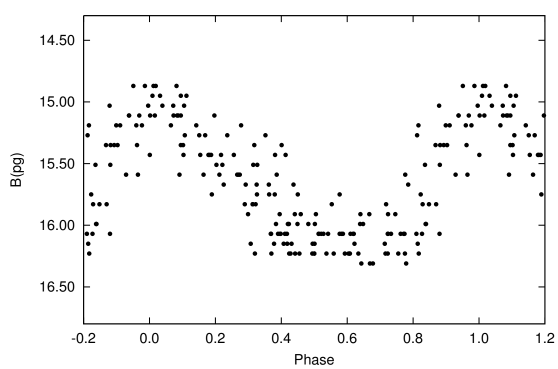

Figure 11. Composite light curve of V964 Oph

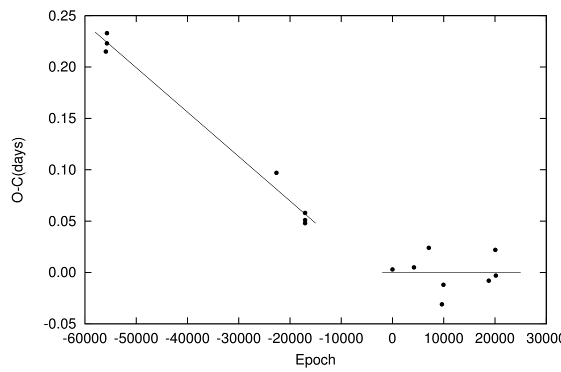

Figure 12. (O−C) diagram for V964 Oph

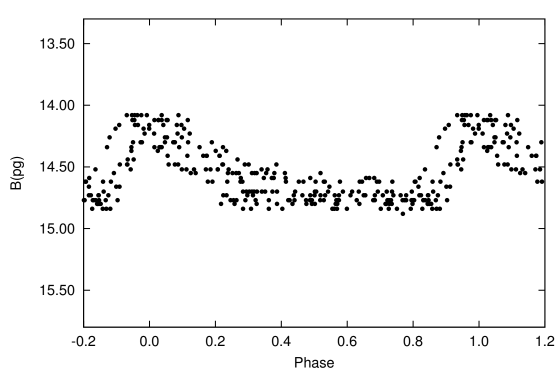

Figure 13. Composite light curve of NSV 8590

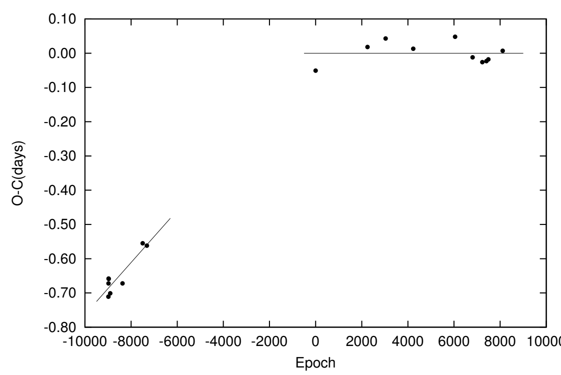

Figure 14. (O−C) diagram for NSV 8590

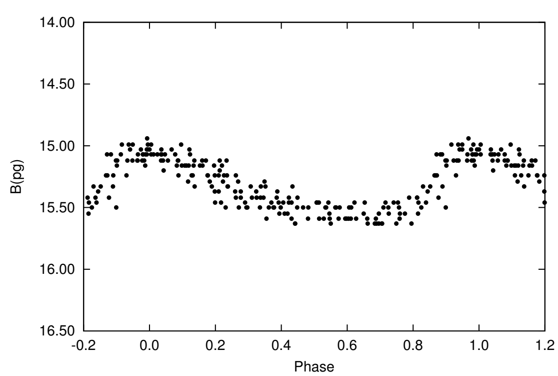

Figure 15. Composite light curve of NSV 9613

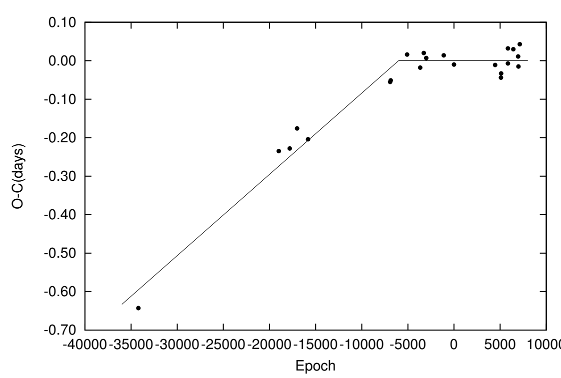

Figure 16. (O−C) diagram for NSV 9613

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Samus, N.N., Durlevich O.V. et al., 2009, `http://www.sai.msu.su/gcvs/gcvs/`
The All Sky Automated Survey, `http://www.astrouw.edu.pl/~gp/asas/asas.html`

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A PROPOSED UNIFORM NOMENCLATURE FOR PULSATING HOT SUBDWARF STARS

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The first rapidly-pulsating sdB stars were found accidentally in the mid-1990s (Kilkenny et al., 1997 and following papers). At the same time – and independently – the Montreal group was showing that these stars should pulsate (see the review by Charpinet et al., 2001). Over 40 such stars are now known; they are p-mode pulsators with periods $\sim 2-5$ minutes, though periods as long as 9 minutes are known. They can exhibit anywhere from one to over 40 pulsation modes and occur amongst the hotter sdB stars with $28000 < T_{\rm eff} < 35000$ and $5.2 < \log g < 6.1$.

The slowly-pulsating sdB stars were also discovered serendipitously during a search for sdB binaries by looking for eclipses, ellipsoidal and reflection effects (Green et al., 2003). Over 30 slow pulsators are now known, though it is possible that a large fraction of the cooler sdB stars might pulsate. They are g-mode pulsators and typically have periods $\sim 1-2$ hours. Like the rapid pulsators, they are multi-periodic but occur amongst sdB stars with $T_{\rm eff} < 27000$ and $\log g \sim 5.4$, and there appears to be a good separation between the rapidly- and slowly-pulsating sdBs in a $T_{\rm eff}/\log g$ diagram (see Fig. 3 in Schuh et al., 2006, for example).

An exciting discovery was that some sdB stars exhibit *both* p- and g-mode pulsations (Schuh et al., 2005; Oreiro et al., 2005). The oddly-named Balloon 090100001 exhibits many modes; Baran et al. (2009) recently listed 73 p-modes in the range $2800-5500\mu$Hz, 24 g-modes in the range $100-400\mu$Hz, and 17 combination frequencies. A handful of these stars are now known and all lie on the temperature boundary between rapidly- and slowly- pulsating stars.

The first (and only known) variable helium-rich sdB star, LSIV$-14^\circ116$, was found by Ahmad & Jeffery (2005). From the discovery observations, these authors find two periods – 1950s and 2900s (amplitudes ~ 0.004 mag) – and suggest that these are g-modes. This is in accord with the long periods, but the star has $T_{\rm eff} = 32500$ K which puts it in the rapidly-pulsating zone (for normal sdB stars). However, recent sdB models indicate that g-modes should be stable at this temperature (Fontaine et al., 2003).

Most recently, the discovery was announced of the first (and only known) pulsating sdO star, SDSS J160043.6+074802.9 (Woudt et al., 2006). Variability was discovered (again serendipitously) during a search for new AM CVn stars amongst Sloan Digital Sky Survey stars of appropriate colour. This star shows a strong 2 minute oscillation (of large amplitude ~ 0.04 mag) with a clear first harmonic near 1 minute. Woudt et al. (2006) find at least another 8 frequencies between the main oscillation and its harmonic and show that, spectroscopically, the star is a classical sdO star.

The relatively rapid discovery of a new genus – the pulsating hot subdwarfs – comprising several species, sdB (slow, fast and "hybrid"), He-sdB and sdO – has resulted in a confusion over nomenclature. The rapidly-pulsating sdB stars have been widely referred to as "EC14026 stars" after the prototype, and "sdBV stars"; the compilers of the General Catalogue of Variable Stars tentatively labeled them "RPHS" (very rapidly pulsating hot (subdwarf B) stars) but that name was never used – and the GCVS had already asked for suggestions for a better designation (Kazarovets, Samus & Durlevich, 2000). The slowly-pulsating stars have been called "PG1716 stars" after the prototype, or "Betsy stars" after the discoverer, Dr. Elizabeth M. Green, and also "lpsdBV" stars – where the "long-period" (lp) serves to separate these objects from the (rapidly-pulsating) sdBV stars. The sdB stars which show both rapid and slow pulsations – all fairly recent discoveries –have been widely referred to as "hybrid" pulsators. There is no clearly standardised nomenclature and this lack was raised for discussion at the Vienna pulsation meeting (Kilkenny, 2007) and the third and fourth meetings on pulsating hot subdwarfs (Fontaine et al., 2008; Kilkenny, 2009).

Table 1 summarises the problem and suggests a solution. It is common usage in variable star research to use "prototype" names – Cepheids, Miras, δ Scuti stars, and so on. In some cases, these are also the prototype *variable* star name – RR Lyrae stars, for example. Using prototype names for the hot subdwarf variables would, in some cases, be terribly unwieldy (e.g. "SDSS J160043.6+074802.6 stars") and prototype variable star names are less easy to remember in the cases of these late arrivals on the variable star stage (e.g "V1093 Her stars"). The informal names ("EC14026" and "Betsy" stars) have been a pleasant way of linking the stars to their discoverers but perhaps should now be replaced by a more systematic nomenclature.

By analogy with the white dwarf stars (DAV, DBV, etc.), we suggest that the simplest expedient is to add "V" to the spectral designation to indicate a *photometric* variability. One problem is that we have effectively three different types of pulsators within the sdB class. It is here suggested that we add the subscripts "r","s" or "rs" – for rapid, slow and hybrid pulsators. The subscripts need not be added to the He-sdBV or sdOV designations unless new discoveries make this useful. (We suggest subscripts, rather than straightforward letters because these qualify the "V" designation, rather than the spectral type).

The use of "r" and "s" is, perhaps, not optimum; "fast" is a more direct antonym of "slow" than "rapid" – and "s" could be misinterpreted as short (period) rather than slow (pulsation). But the usage suggested in Table 1 already exists in variable star nomenclature in the form of the rapidly-oscillating Ap stars (roAp) and the slowly-pulsating B stars (spB) and is therefore more appropriate.

Table 1. Photometrically variable Subdwarf Types.

Pulsator Type	Prototype Name		Variable Star Name	Informal Usage	Proposed Nomenclature
sdB (rapid) (*p*-mode)	EC 14026-2647	=	V361 Hya	EC14026 sdBV	$sdBV_r$
sdB (slow) (*g*-mode)	PG 1716+426	=	V1093 Her	PG1716 "Betsy" lpsdBV	$sdBV_s$
sdB (both) (*p* and *g*)	HS 0702+6043	=	DW Lyn	"Hybrid"	$sdBV_{rs}$
He-sdB (*g*-mode ?)	LSIV −14°116				He-sdBV
sdO (*p*-mode)	SDSS J160043.6+074802.9				sdOV

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MAXIMA OF HIGH-AMPLITUDE DELTA SCUTI STARS

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We report further times of maximum for a number of High-Amplitude Delta Scuti Stars (HADS), following the report of Wils et al. (2009). For the first time, time series photometry was obtained for GSC 2815-790 (Khruslov, 2008), and for the following objects found to be variable in ASAS-3 data (Pojmanski, 2002): GSC 2108-1564 (= HD 343024 = ASAS 184744+2313.2), GSC 4923-693 (= ASAS 112518-0047.3), GSC 6678-0579 (= ASAS 115336-2905.9) and GSC 7027-0700 (= ASAS 033219-3539.3), confirming these stars to be δ Scuti stars. Three stars known to be multi-periodic are included as well in this paper. For these stars a second frequency was not detected in our data (AN Lyn, see Zhou, 2002 and V1162 Ori, see Arentoft, 2001), or, in the case of BL Cam, the amplitude of the secondary frequency is so low compared to the main frequency, that it does not significantly alter the time of maximum. Although we have only one night of data, GSC 6678-0579 is likely to be multiperiodic as well.

The method used to calculate the times of maximum is described in Wils et al. (2009). The templates used to fit the light curves for those stars not included in that paper are available electronically through the IBVS website as `5928-t3.txt` These have been calculated using Period04 (Lenz & Breger, 2005).

The observers and their instruments are given in Table 1. The 218 times of maximum obtained for 25 HADS are listed in Table 2. When the same maximum was observed in more than one filter, the table shows the average value of the times obtained in each filter individually. The suggestion of a companion in a 22-year orbit around AN Lyn (Hintz et al., 2005) does not seem to be confirmed by our data. A linear ephemeris which better fits the available data since 2000 (Zhou, 2002; Agerer & Hübscher, 2003; Hintz et al., 2005; Hübscher, 2005; Hübscher et al., 2005, 2006; Klingenberg et al., 2006 and from this paper) is given by:

$$\text{HJD Max} = 2451583.0767(3) + 0.098274972(13) \times E \quad (1)$$

Fig. 1 shows an $O-C$ plot using this ephemeris of these data, and also including older data discussed by Hintz et al. (2005). The period is slightly longer (0.18 seconds) than the one derived by these authors. The $O-C$ plot also assumes that they miscounted the number of cycles in the ten year gap between the observations in the 1980s and 1990s (one cycle too many).

Table 1: List of instruments used for the observations.

Code	Observers	Telescope type	Aperture	Observatory	CCD
AO1	SO+EB	Refractor	9 cm	Astropilar Observatory	SBIG ST-10XME
AO2	SO+EB	Catadioptric	25 cm	Astropilar Observatory	SBIG ST-10XME
BHO1	PL+PVC	Refractor	18 cm	Beersel Hills Observatory	SBIG ST-10XME
BHO2	PL+PVC	Newton	40 cm	Beersel Hills Observatory	SBIG ST-10XME
ET	ET	Newton	25 cm	Pegasus Observatory Brakel	SBIG ST402-ME
HMB	FJH	Cassegrain	28, 35, 40 cm	Mol, Belgium	SBIG ST-8
HMB2	FJH	Ritchey-Chrétien	50 cm	New Mexico, USA	STL11000XM
HO18	PL+PVC	Refractor	18 cm	R.O.B.-Humain	SBIG ST-10XME
HO40	PL+PVC	Newton	40 cm	R.O.B.-Humain	SBIG ST-10XME
JVW	JVW	Refractor	8 cm	Hooglede, Belgium	SBIG ST-7XME
MVL	MVL	Catadioptric	26 cm	Willebroek Observatory	SBIG ST-10XME
RP	RDP	Catadioptric	30 cm	Shobdon, UK	Starlight XPress SXV-H9
SBL	BS	Cassegrain	28, 23.5 cm	Patrick Mergan Observatory	Starlight XPress MX-716
SK	SK	Catadioptric	30 cm	Zagori Observatory	SBIG ST-7XMEI

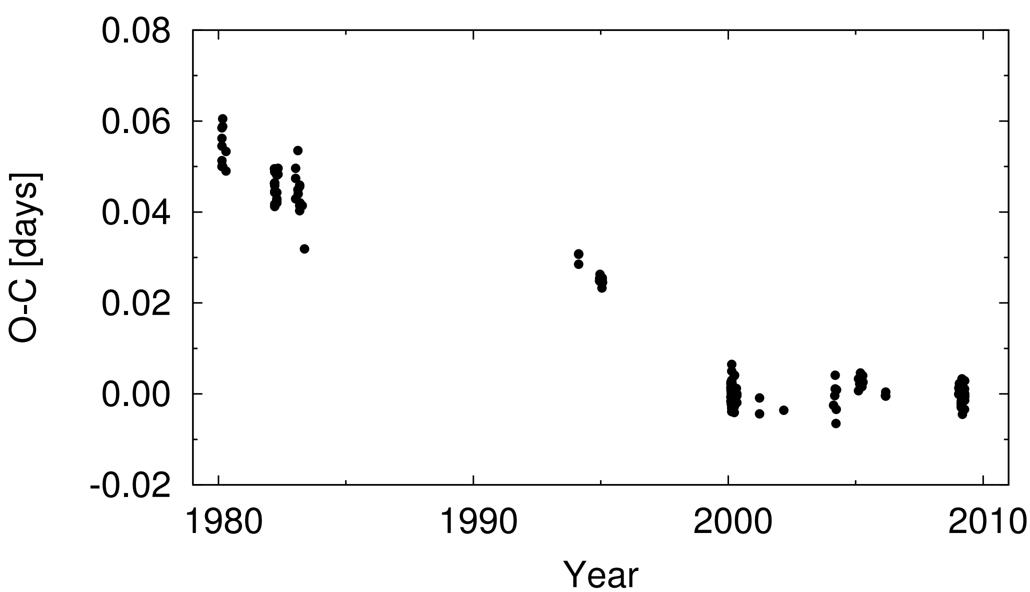

Figure 1. $O-C$ curve of AN Lyn with respect to the elements given in Eq. 1.

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Table 2: Observed times of maximum (Epoch = HJD - 2400000).

Star	Epoch	Unc.	Obs.	Filter	Star	Epoch	Unc.	Obs.	Filter
GP And	55155.3448	0.0007	HMB	V	AN Lyn	54890.6197	0.0006	HMB2	BV
	55155.5017	0.0009	HMB	V		54890.7170	0.0012	HMB2	BV
	55172.3392	0.0009	HMB	V		54891.7006	0.0016	HMB2	BV
	55172.4183	0.0013	HMB	V		54892.6821	0.0018	HMB2	BV
	55204.3636	0.0013	HMB	V		54893.6677	0.0019	HMB2	BV
V460 And	55192.3112	0.0005	HMB	V		54901.6265	0.0026	HMB2	V
	55192.3863	0.0012	HMB	V		54901.7236	0.0023	HMB2	V
YZ Boo	54891.5364	0.0008	HMB	V		54901.8180	0.0020	HMB2	V
	54891.6405	0.0006	HMB	V		54901.9206	0.0036	HMB2	V
	54906.5261	0.0007	SBL	V		54928.6517	0.0013	HMB2	BV
	54906.6292	0.0007	SBL	V		54928.7482	0.0025	HMB2	BV
	54931.4034	0.0008	SBL	V		54934.6456	0.0009	HMB2	BV
	54931.5075	0.0009	SBL	V		54934.7457	0.0025	HMB2	BV
	54974.4971	0.0008	ET	V	V593 Lyr	54941.5634	0.0007	HMB	V
BL Cam	54896.3796	0.0008	RP	C		54942.5858	0.0011	HMB	V
	54896.4187	0.0008	RP	C	V337 Ori	54837.4619	0.0016	ET	V
	54896.4585	0.0008	RP	C		54873.4822	0.0020	RP	V
	54896.4965	0.0012	RP	C		54892.4001	0.0047	RP	C
	54896.5360	0.0011	RP	C		54893.4088	0.0009	HMB	V
	54896.5753	0.0009	RP	C	V1162 Ori	51553.3517	0.0006	BHO2	V
	55200.3658	0.0015	RP	C		51553.4297	0.0008	BHO2	V
	55200.4054	0.0009	RP	C		51568.3020	0.0008	BHO2	V
	55200.4446	0.0006	RP	C		51568.3803	0.0008	BHO2	V
	55200.4840	0.0007	RP	C		52223.5414	0.0007	BHO2	V
	55200.5232	0.0012	RP	C		52228.4989	0.0008	BHO2	V
	55200.5616	0.0006	RP	C		52228.5780	0.0008	BHO2	V
	55200.6017	0.0008	RP	C		52254.3889	0.0008	BHO2	V
AD CMi	54891.3291	0.0007	HMB	V		52254.4652	0.0008	BHO2	V
	54893.4197	0.0009	HMB	V		52254.5444	0.0007	BHO2	V
	55180.6865	0.0007	HMB	V		52254.6220	0.0005	BHO2	V
XX Cyg	55044.4658	0.0007	HMB	V		52257.4561	0.0007	BHO2	V
LW Dra	54922.3613	0.0008	HMB	V		52257.5342	0.0007	BHO2	V
	54922.4799	0.0007	HMB	V		52257.6124	0.0011	BHO2	V
	54922.5975	0.0010	HMB	V		52258.4006	0.0009	BHO2	V
	54946.4652	0.0007	JVW	V		52258.4786	0.0007	BHO2	V
	54953.4358	0.0009	JVW	V		52258.5582	0.0010	BHO2	V
	54960.4069	0.0008	JVW	V		52270.3625	0.0009	BHO2	V
	54960.5249	0.0008	JVW	V		52270.4388	0.0009	BHO2	V
SZ Lyn	54912.5263	0.0009	HMB	V		52270.5174	0.0009	BHO2	V
	55189.5234	0.0008	HMB	V		52277.3647	0.0008	BHO2	V
	55191.4519	0.0004	HMB	V		52277.4445	0.0008	BHO2	V
	55191.5722	0.0006	HMB	V		52279.3314	0.0009	BHO2	V
	55191.6931	0.0005	HMB	V		52279.4101	0.0009	BHO2	V
AN Lyn	54848.4592	0.0009	SK	V		52279.4896	0.0007	BHO2	V
	54848.5573	0.0008	SK	V		54829.4874	0.0008	BHO2	V
	54848.6570	0.0010	SK	V		54829.5674	0.0008	BHO2	V
	54858.3862	0.0009	SK	V		54833.4990	0.0009	BHO2	V
	54858.4834	0.0008	SK	V		54838.3803	0.0007	BHO2	V
	54858.5838	0.0009	SK	V		54838.4570	0.0008	BHO2	V
	54882.6568	0.0019	HMB2	V		54838.5365	0.0007	BHO2	V
	54882.7551	0.0016	HMB2	V		54841.3694	0.0007	BHO2	V
	54882.8526	0.0025	HMB2	V		54841.4495	0.0008	BHO2	V
	54883.6408	0.0018	HMB2	BV	DY Peg	55069.3734	0.0004	SBL	V
	54883.7388	0.0013	HMB2	BV		55069.4458	0.0003	SBL	V
	54887.6704	0.0014	HMB2	BV		55069.5190	0.0002	SBL	V
	54887.7674	0.0017	HMB2	BV		55069.5923	0.0002	SBL	V
	54889.6375	0.0007	HMB2	BV		55113.4203	0.0009	SBL	V
	54889.7342	0.0021	HMB2	BV		55113.4933	0.0006	SBL	V

Table 2: Observed times of maximum (continued).

Star	Epoch	Unc.	Obs.	Filter	Star	Epoch	Unc.	Obs.	Filter
DY Peg	55130.2666	0.0003	SBL	V	GSC 2977-0238	55244.5580	0.0000	HMB	VR
	55132.3811	0.0006	SBL	V		55244.6337	0.0000	HMB	VR
	55143.3929	0.0007	JVW	V	GSC 3074-0114	54921.4442	0.0006	HO40	C
	55155.3534	0.0004	HMB	VR		54921.4953	0.0005	HO40	C
	55155.4266	0.0001	HMB	VR		54944.5786	0.0007	HMB	V
	55177.3767	0.0007	JVW	V		54944.6299	0.0002	HMB	V
	55180.2940	0.0008	HMB	VR		54945.5532	0.0006	HMB	V
	55180.3671	0.0006	HMB	VR		54945.6044	0.0005	HMB	V
	55192.2535	0.0002	HMB	VR	GSC 3755-0845	54841.2752	0.0009	BHO1	V
	55192.3270	0.0006	HMB	VR		54862.2796	0.0008	SBL	V
GW UMa	54838.5450	0.0009	MVL	V		54862.3559	0.0010	SBL	V
	54877.3546	0.0013	HMB	V		54862.4318	0.0007	SBL	V
	54891.3755	0.0016	HMB	V		55132.5017	0.0014	SBL	V
	54891.5794	0.0019	HMB	V		55132.5772	0.0013	SBL	V
	55198.6049	0.0050	HMB	V		55153.3524	0.0012	SBL	V
	55223.3947	0.0015	HMB	V		55153.4283	0.0010	SBL	V
	55233.3504	0.0017	HMB	V		55153.5046	0.0016	SBL	V
GSC 2108-1564	55047.4141	0.0021	HMB	V		55153.5801	0.0015	SBL	V
	55047.5122	0.0017	HMB	V	GSC 3832-0152	54881.3444	0.0007	HMB	V
GSC 2566-1398	54891.5362	0.0005	HMB	V		54910.3909	0.0008	SBL	V
	54911.4928	0.0008	SBL	V		54910.4823	0.0008	SBL	V
	54911.5831	0.0008	SBL	V		54910.5736	0.0007	SBL	V
	54911.6740	0.0007	SBL	V		55233.4679	0.0005	HMB	V
	54912.4904	0.0007	SBL	V		55233.5592	0.0004	HMB	V
	54941.4279	0.0011	SBL	V	GSC 4556-1113	54842.2812	0.0006	HMB	V
	54944.4213	0.0006	SBL	V		54843.3171	0.0006	HMB	V
	54944.5120	0.0005	SBL	V		54843.4034	0.0008	HMB	V
	54945.4191	0.0008	SBL	V		54850.3111	0.0009	HMB	V
	54945.5098	0.0007	SBL	V		54850.3971	0.0009	HMB	V
	54946.4169	0.0008	SBL	V		54856.3553	0.0010	HMB	V
	54946.5077	0.0006	SBL	V		54856.4415	0.0008	HMB	V
GSC 2815-0790	55117.3778	0.0024	RP	V		54856.5272	0.0008	HMB	V
	55117.4844	0.0018	RP	V		54856.6129	0.0008	HMB	V
	55117.5916	0.0015	RP	V		54858.4273	0.0007	HMB	V
	55121.3342	0.0018	RP	V		54858.5135	0.0008	HMB	V
	55227.3099	0.0012	RP	V		54858.5998	0.0009	HMB	V
	55227.4170	0.0013	RP	V		54858.6862	0.0008	HMB	V
GSC 2977-0238	54922.3720	0.0002	HO40	V		54860.3263	0.0009	HMB	V
	54922.4481	0.0003	HO40	V		54860.4133	0.0007	HMB	V
	54922.5240	0.0003	HO40	V		54860.4995	0.0008	HMB	V
	54930.2691	0.0007	SK	V		54860.5855	0.0010	HMB	V
	54930.3447	0.0010	SK	V		54861.2763	0.0007	HMB	V
	54930.4209	0.0008	SK	V		54861.3627	0.0007	HMB	V
	54963.3004	0.0008	SK	V		54861.4489	0.0009	HMB	V
	55223.2964	0.0008	HO18	V		54861.5354	0.0008	HMB	V
	55223.3725	0.0008	HO18	V		54861.6217	0.0006	HMB	V
	55233.3197	0.0005	HMB	V	GSC 4923-0693	54138.8439	0.0003	HMB2	C
	55233.6236	0.0004	HMB	V	GSC 6678-0579	54953.5297	0.0011	AO2	C
	55244.3300	0.0001	HMB	VR		54953.5991	0.0012	AO2	C
	55244.4060	0.0001	HMB	VR	GSC 7027-0700	55151.7081	0.0004	AO1	C
	55244.4819	0.0001	HMB	VR		55151.7624	0.0004	AO1	C

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COMMISSIONS 27 AND 42 OF THE IAU
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Number 5929

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CCD MINIMA FOR SELECTED ECLIPSING BINARIES IN 2009

NELSON, ROBERT H.

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Observatory and telescope:
Sylvester Robotic Observatory (SRO): 33 cm f/4.5 Newtonian on Paramount ME mount

Detector:	SRO: SBIG ST-7XME, 1″.25 pixels, 15′.8 × 10′.5 FOV, cooled $-10 < T < -30°$ C

Method of data reduction:
Aperture photometry using MIRA, by Mirametrics.

Method of minimum determination:
Digital tracing paper method, bisection of chords, curve fitting, and (occasionally) Kwee and van Woerden (1956)

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
QR And	55109.745	0.001	II	c	
ZZ Aur	54880.7941	0.0005	II	c	
DN Aur	55109.9052	0.0003	I	c	
HP Aur	54888.7294	0.0002	I	c	
V0560 Aur	54889.6840	0.0004	I	R	
V0567 Aur	54890.648	0.001	I	R	
TU Boo	54895.8029	0.0002	II	R	
TZ Boo	54877.9187	0.0003	II	R	
XY Boo	54872.8873	0.0003	I	c	
DN Boo	54899.8538	0.0004	I	R	
FY Boo	54901.8492	0.0004	II	R	
FY Boo	54912.8242	0.0003	I	R	
GM Boo	54888.9036	0.0003	I	c	
GN Boo	54889.8313	0.0002	II	R	
GN Boo	54858.0134	0.0002	I	c	
GR Boo	54937.8123	0.0001	I	R	
HR Boo	54900.8755	0.0005	I	R	
AO Cam	55149.7175	0.0001	II	R	
CD Cam	55166.825	0.002	I	c	
MP Cam	55108.7950	0.0003	I	c	
NO Cam	55108.9387	0.0001	II	c	
ZZ Cas	55114.6494	0.0003	I	R	
DN Cas	55087.890	0.001	I	R	

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V0520 Cas	55046.9002	0.0003	II	R	
V0608 Cas	55170.6927	0.0002	I	c	
V1009 Cas	55113.7607	0.0002	II	c	
V1011 Cas	55171.588	0.001	I	c	
GSC2.2 N311332336840	55050.8578	0.0003	II	R	
SU Cep	54986.8694	0.0002	II	R	
V0738 Cep	55000.839	0.002	II	R	
XZ CMi	54862.7529	0.0002	I	c	
CZ CMi	55159.977	0.001	I	R	
AH Cnc	54883.7412	0.0003	I	c	
EH Cnc	54882.8580	0.0002	II	c	
G1927-0862	54884.9130	0.0002	II	c	
IR Cnc	54879.6708	0.0003	II	c	
AS CrB	54945.7762	0.0002	I	R	
AV CrB	54948.8171	0.0002	II	R	
VW CVn	54916.7284	0.0004	II	R	
BO CVn	54950.7803	0.0003	I	R	
CX CVn	54913.8222	0.0004	I	R	
DE CVn	54937.709	0.001	I	R	
DF CVn	54879.8491	0.0002	II	c	
EE CVn	54883.8805	0.0003	II	c	
G2544-1007	54913.7168	0.0004	I	R	
G2544-1090	54918.7859	0.0003	II	R	
G2545-0970	54857.0824	0.0004	I	R	
G2545-0970	54936.7183	0.0003	I	R	
G2545-0970	54856.9018	0.0004	II	R	
G3034-0299	54879.9715	0.0001	II	c	
ZZ Cyg	54990.9041	0.0001	I	R	
CV Cyg	54911.9944	0.0004	I	R	
DO Cyg	55087.7001	0.0003	I	R	
V0841 Cyg	54984.8749	0.0004	II	R	
V1171 Cyg	54979.8017	0.0002	I	R	
V1191 Cyg	55086.8059	0.0002	II	R	
V1305 Cyg	55115.7064	0.0003	I	c	
V1763 Cyg	54950.8897	0.0003	I	R	
V1823 Cyg	54978.8404	0.0002	II	R	
V2197 Cyg	54951.9013	0.0001	I	R	
G3550-1770	54937.9371	0.0003	I	R	
G3575-3593	54992.821	0.001	I	R	
G3576-0170	54990.796	0.001	II	R	
BV Dra	54943.7793	0.0001	I	R	
CV Dra	54896.0395	0.0002	II	R	
FU Dra	54949.7633	0.0003	II	R	
G3552-0321	54998.8293	0.0003	I	R	
G3905-0060	54982.8120	0.0001	I	R	
AF Gem	54888.6372	0.0005	I	c	
V0345 Gem	54862.638	0.001	II	c	
V0367 Gem	55159.8243	0.0003	I	R	
V0373 Gem	54876.8499	0.0005	II	R	
V0390 Gem	55172.8410	0.0003	I	c	
G1330-0287	55159.8652	0.0005	II	c	
G1356-2826	54857.7415	0.0004	II	R	
IT Her	54953.9334	0.0003	II	R	
V0829 Her	54901.9444	0.0001	I	R	

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V0842 Her	54872.9947	0.0001	II	c	
V0856 Her	54953.7837	0.0002	I	R	
V0857 Her	54916.9348	0.0001	II	R	
V1033 Her	54882.9794	0.0003	II	c	
V1036 Her	54951.8058	0.0003	I	R	
V1052 Her	54948.9056	0.0002	II	R	
V1094 Her	54952.8124	0.0003	II	R	
V1094 Her	54949.8726	0.0002	II	R	
V1103 Her	54985.8244	0.0003	II	R	
G1518-0913	54916.8018	0.0005	II	R	
G2587-1888	54945.8825	0.0005	II	R	
G2614-1369	54889.0091	0.0005	II	c	
G2618-1385	54895.9315	0.0002	I	R	
G3101-0547	54919.9164	0.0003	I	R	
G3532-0553	54912.9464	0.0002	II	R	
IZ Lac	55062.815	0.001	II	R	
XY Leo	54908.6876	0.0003	I	R	
GV Leo	54900.7214	0.0002	II	R	
RY Lyn	54919.7707	0.0001	I	R	
EL Lyn	55184.876	0.002	II	c	
IW Lyr	55065.781	0.001	I	R	
V0563 Lyr	54952.9401	0.0002	I	R	
V0592 Lyr	55049.8215	0.0002	II	R	
G3109-0859	54918.8899	0.0003	II	R	
IX Mon	55149.9177	0.0001	I	c	
V0448 Mon	54882.6631	0.0003	II	c	
V0530 Mon	54875.6770	0.0003	II	c	
V0392 Ori	55163.853	0.001	I	R	
V1799 Ori	55113.8532	0.0005	II?	c	
PU Peg	55108.70	0.01	II	V	
G2765-0348	55046.7953	0.0002	I	R	
V0427 Per	55166.7236	0.0002	I	c	
V0432 Per	55065.9185	0.0002	I	R	
V0680 Per	55171.8248	0.0003	II	c	
V0740 Per	55159.7533	0.0001	I	R	
RV Psc	55185.5696	0.0002	I	R	
CP Psc	55188.7005	0.0002	I	R	
DS Psc	55170.6345	0.0003	I	c	
DZ Psc	55171.7433	0.0002	I	c	
AS Tau	54881.7521	0.0004	I	c	
EN Tau	54856.6968	0.0002	I	R	
EQ Tau	55171.8725	0.0002	I	c	
HY Tau	55170.7832	0.0003	I	c	
IL Tau	55114.9225	0.0002	I	c	
G1874-0399	55184.7375	0.0003	II	c	
UY UMa	54857.8866	0.0002	I	c	
XY UMa	55166.903	0.001	II	V	
ZZ UMa	54876.6902	0.0003	I	R	
ES UMa	55188.7928	0.0002	II	R	
HH UMa	54872.7367	0.0004	II	c	
LP UMa	54884.7505	0.0003	II	c	
OQ UMa	54896.7607	0.0002	II	R	
BO Vul	54988.8636	0.0001	I	R	
G2140-1485	55166.6001	0.0002	II	c	
G2144-1499	54983.8089	0.0005	I	R	

Explanation of the remarks in the table:
All elements can be found in Nelson, R.H., 2010.

Acknowledgements:

Thanks are due to Environment Canada for the website satellite views (see reference below) that were essential in predicting clear times for observing runs in this cloudy locale. Thanks are also due to Atilla Danko for his 'Clear Sky Clocks', (see below). This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France.

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BVR_CI_C PHOTOMETRIC EVOLUTION AND FLICKERING DURING THE 2010 OUTBURST OF THE RECURRENT NOVA U SCORPII

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The 2010 outburst of the recurrent nova U Scorpii was discovered by B.G. Harris (New Smyrna Beach, FL, USA) on Jan. 28.4385 UT, when the star was measured at $V = 8.05$ (cf Schaefer, 2010). On Jan 27.63 UT, i.e. 0.80 days earlier, the nova was still at quiescence brightness ($V \geq 16.5$ mag, Linnolt, 2010).

This is the 10th recorded outburst of U Scorpii. Previous ones occurred on 1863, 1906, 1917, 1936, 1945, 1969, 1979, 1987 and 1999 according to the recent summary by Schaefer (2009). The last outburst has been the best observed one, with detailed reports being provided by Munari U. et al. (1999), Kiyota (1999), Lépine et al. (1999), Anupama and Dewangan (2000), Hachisu et al. (2000), Evans et al. (2001) and Iijima (2002).

We obtained accurate BVR_CI_C of U Sco with a 0.30-m Meade RCX-400 f/8 Schmidt-Cassegrain telescope equipped with a SBIG ST-9 CCD camera. The photometry was accurately corrected for color equations using nightly calibration on Landolt (1992) standard stars. The data are presented in Table 1, and plotted in Figure 1. The external errors (always less than 0.02 mag) do not exceed the dimension of the symbols in Figure 1.

In Figure 1 the time is counted from the discovery of U Sco in outburst on Jan. 28.4385 UT (t=0.00 days), that we assume as the time of actual maximum, there being no earlier observations of U Sco or reporting it brighter than V=8.05. The light curve in Figure 1 is characterized by a smooth decline, similar to that of previous outbursts (cf Munari et al. 1999; Kiyota 1999). The decline times ($\pm$0.1 days) are:

$$t_2^V = 1.8 \qquad t_3^V = 4.1 \text{ days} \tag{1}$$

that are significantly slower than t_2=1.2, t_3=2.6 days reported by Schaefer (2009) as typical values for previous outbursts, and instead much closer to the t_2=2.2, t_3=4.3 days derived by Munari et al. (1999) for the 1999 outburst. The light-curve in Figure 1 exhibits a plateau phase extending from day +12 to day +20, during which the mean colors are

$$< V >= 14.25 \quad < B - V >= +0.16 \quad < V - R_C >= +0.35 \quad < V - I_C >= +0.41 \tag{2}$$

This phase corresponds to the white dwarf still burning hydrogen in the envelope and the ejecta being transparent to soft X-rays. In fact, on day +12, Schlegel et al. (2010) found U Sco to have become a super-soft X-ray source with a brightness 100 time larger

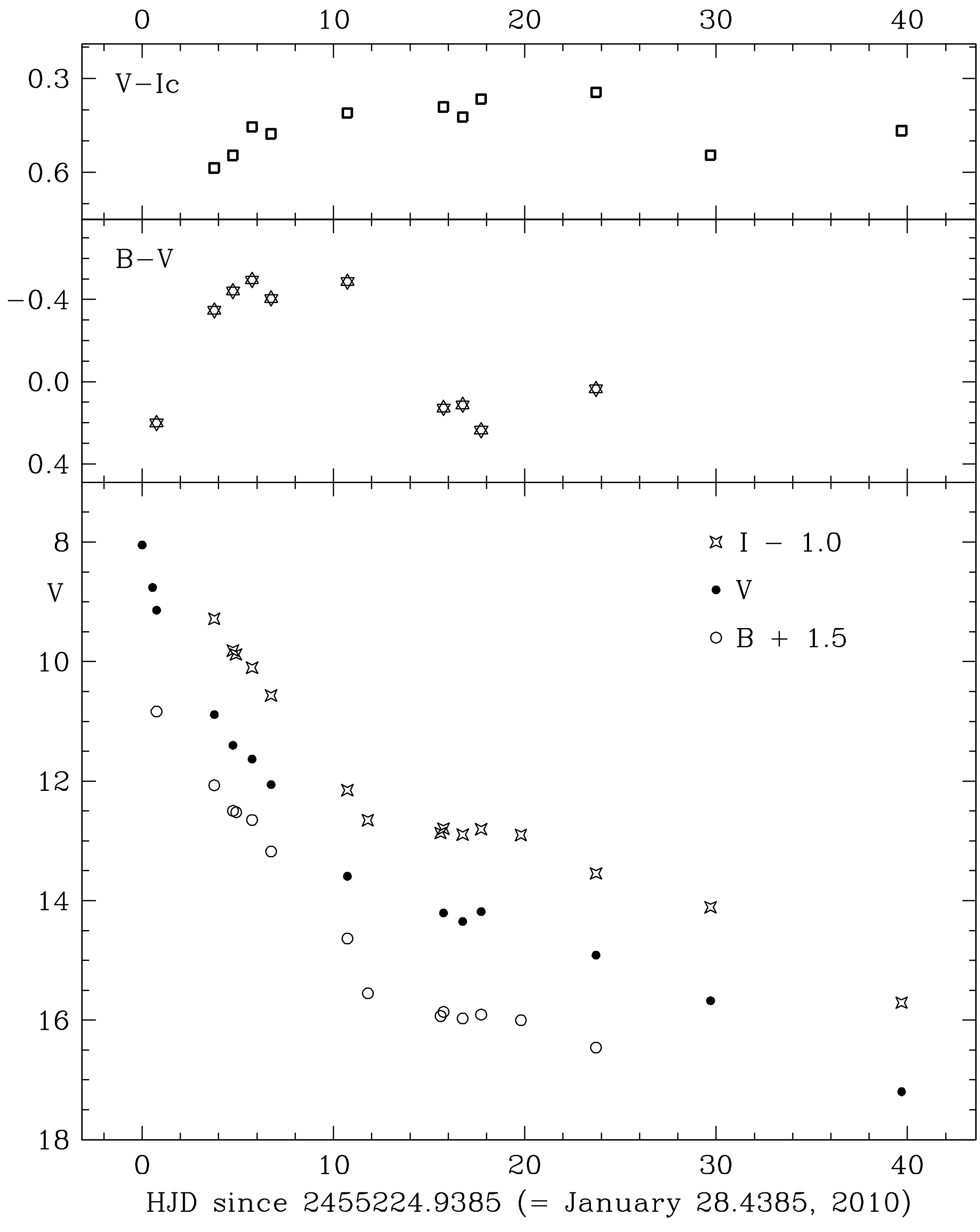

Figure 1. BVR_CI_C photometric evolution of the 2010 outburst of the recurrent nova U Scorpii according to our observations listed in Table 1. The point at t=0.0 days, V=8.05 is taken from IAUC 9111, that at t=0.54 days, V=8.76 from ATel 2412.

than a previous observation on day +8. Osborne et al. (2010) found U Sco still in super-soft conditions at day +17.5. A plateau was observed also during the 1999 outburst (Kiyota 1999, and Hachisu et al. 2000), but at a fainter mean magnitude ($<V>= 14.75$), lasting slightly longer (11 days) and starting appreciably later, on day +17.

With a 0.40-m f/8 Ritchey-Chrétien telescope located on Monte Baldo (Verona, Italy), and equipped with a Finger Lake Instruments ML1001E CCD camera, we carried out three runs in B and I_C filters looking for short time variations in U Sco. The results are presented in Figure 2.

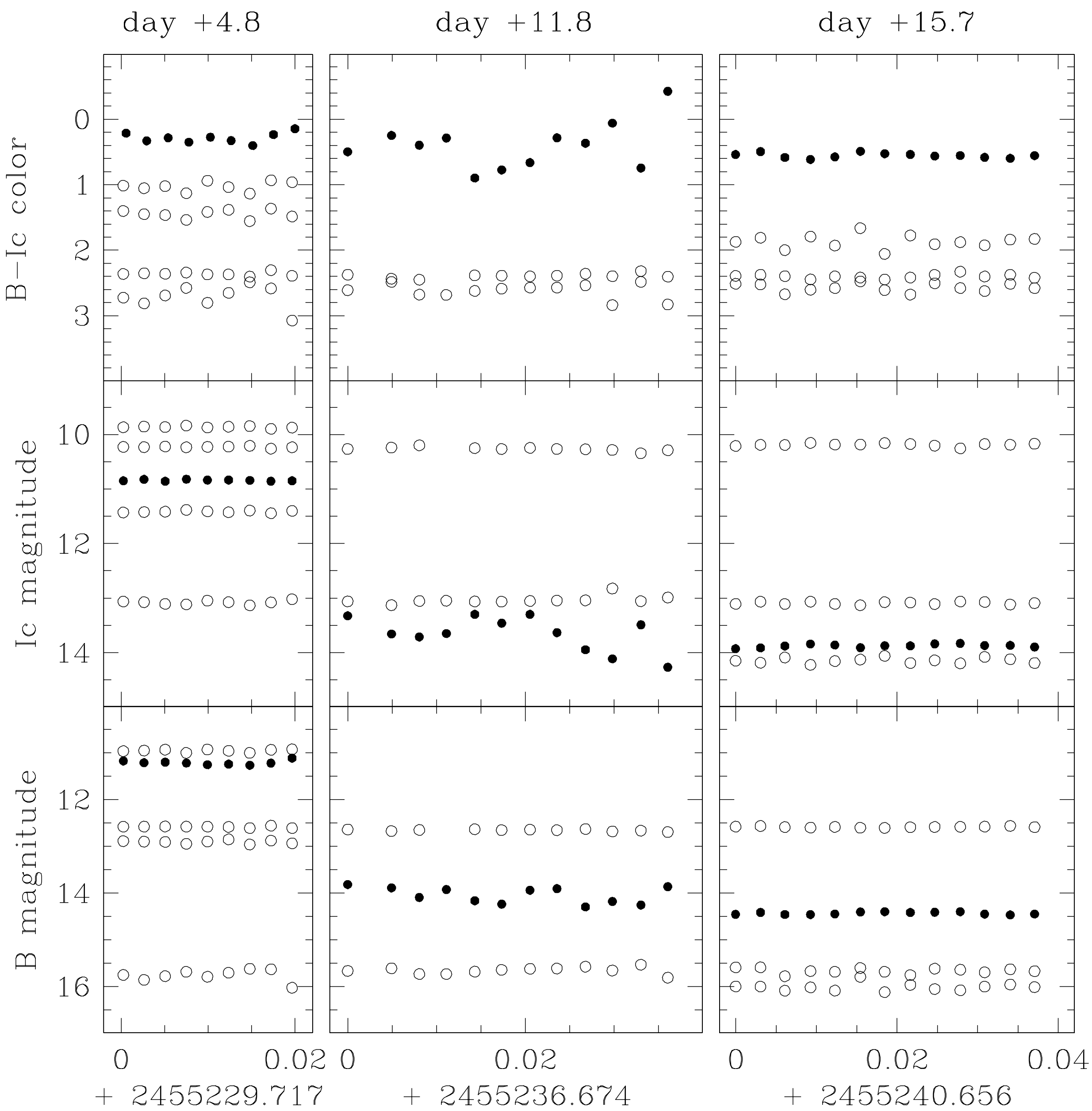

Figure 2. Results of searches for flickering carried out on days +4.8, +11.8 and +15.7 in the B and I_C bands. The dots represents measurements of U Sco, the circles those of nearby field stars to monitor photometric stability.

Table 1. Our BVR_CI_C of U Scorpii

HJD	date HUT	V	$B-V$	$V-R_C$	$V-I_C$	R_C-I_C
225.6933	2010 01 29.19	9.140	0.201			
228.7090	2010 02 01.21	10.888	−0.347	0.831	0.586	−0.300
229.6861	2010 02 02.19	11.401	−0.441	0.751	0.546	−0.217
230.6817	2010 02 03.18	11.632	−0.495	0.582	0.455	−0.239
231.6799	2010 02 04.18	12.059	−0.405	0.572	0.477	−0.146
235.6682	2010 02 08.17	13.592	−0.487	0.365	0.410	0.022
240.6921	2010 02 13.19	14.207	0.128	0.347	0.391	0.038
241.6912	2010 02 14.19	14.349	0.113		0.423	
242.6575	2010 02 15.16	14.184	0.236	0.286	0.366	0.078
248.6599	2010 02 21.16	14.912	0.035	0.275	0.344	0.062
254.6492	2010 02 27.15	15.674		0.227	0.545	0.317
264.6344	2010 03 09.13	17.197			0.467	

No flickering was detected on day +4.8, while the short term variability was clearly present on day +11.8 (at the beginning of the plateau phase). Worters et al. (2010) reported that the flickering became visible on day +8, and they attributed it to an accretion disk that had already been re-established and was visible through optically thin ejecta. Our last observing run on day +15.7 (and additional three scattered points around day +19.8), at the center of the plateau phase, did not however show any short term variability, which cast doubts on the Worters et al. interpretation in terms of re-established accretion. The flickering we observed had a characteristic time scale of ~half an hour, and a larger amplitude in I_C (Δm=1.0 mag) than in B band (Δm=0.5 mag).

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101 MINIMA TIMES OF ECLIPSING BINARIES OBSERVED BY INTEGRAL/OMC

ZASCHE, P.

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Observatory and telescope:
ESA INTEGRAL Satellite, 50mm Optical Monitoring Camera (OMC)

Method of data reduction:
Data processing was done by Off-line Scientific Analysis package (OSA 6.0) on Laboratory for Space Astrophysics and Theoretical Physics (LAEFF), Spain.

Method of minimum determination:
The minima times were computed with the Kwee – van Woerden method (Kwee & van Woerden, 1956).

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
FZ CMa	54583.4293	0.0008	Prim	V	
FZ CMa	54584.0635	0.0007	Sec	V	
SW Car	53159.6271	0.0023	Prim	V	
HP Car	52816.2368	0.0024	Prim	V	New
HP Car	53150.7342	0.0019	Prim	V	New
HP Car	53157.9383	0.0061	Sec	V	New
HP Car	54183.0304	0.0020	Prim	V	New
ZZ Cas	53047.2980	0.0035	Sec	V	
ZZ Cas	53711.9445	0.0018	Prim	V	
ZZ Cas	53722.5179	0.0031	Sec	V	
ZZ Cas	53729.9650	0.0028	Sec	V	
ZZ Cas	53740.5445	0.0011	Prim	V	
AQ Cas	53920.9538	0.0145	Prim	V	
BM Cas	54575.783	0.132	Prim	V	
MN Cen	52793.2792	0.0007	Prim	V	
MN Cen	53541.7131	0.0014	Sec	V	
MN Cen	53850.4754	0.0023	Prim	V	
DE Cep	54504.4557	0.0014	Prim	V	
BN Cir	53433.2098	0.0018	Prim	V	
CE Cir	54683.7038	0.0029	Prim	V	
RW Cra	54161.7400	0.0012	Prim	V	
AE Cru	53546.1185	0.0058	Prim	V	

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
PV Cyg	52608.4109	0.0013	Prim	V	
PV Cyg	52609.7044	0.0017	Prim	V	
PV Cyg	52614.9786	0.0025	Prim	V	
PV Cyg	52616.3005	0.0013	Prim	V	
V367 Cyg	53040.9777	0.0456	Sec	V	
V367 Cyg	53133.8367	0.0272	Sec	V	
V367 Cyg	53198.9077	0.0315	Prim	V	
V367 Cyg	54445.0398	0.0277	Prim	V	
V478 Cyg	53969.0142	0.0219	Sec	V	
V536 Cyg	54098.7977	0.0013	Prim	V	
V536 Cyg	54261.0784	0.0016	Prim	V	
V537 Cyg	54104.4789	0.0043	Prim	V	
V616 Cyg	54093.3891	0.0046	Prim	V	
V616 Cyg	54247.2789	0.0010	Prim	V	
V703 Cyg	54087.6494	0.0036	Prim	V	New
V909 Cyg	54004.2649	0.0045	Sec	V	
V1061 Cyg	54087.9706	0.0007	Prim	V	
RR Dra	54613.9033	0.0012	Prim	V	
CV Gem	53300.8039	0.0022	Prim	V	
HZ Her	54347.7557	0.0020	Prim	V	
HZ Her	54351.1664	0.0054	Prim	V	
HZ Her	54350.3407	0.0045	Sec	V	
V359 Her	54346.7169	0.0019	Prim	V	
V359 Her	54348.4681	0.0014	Prim	V	
V359 Her	54350.2285	0.0023	Prim	V	
V359 Her	54351.9894	0.0021	Prim	V	
CY Lac	54086.9743	0.0046	Prim	V	
CY Lac	54229.0927	0.0055	Prim	V	
DG Lac	54248.8118	0.0011	Prim	V	
HZ Lac	54234.6889	0.0077	Prim	V	
TY Lib	54486.3026	0.0015	Prim	V	
TY Lib	54489.4971	0.0023	Prim	V	
FU Lib	53964.9418	0.0022	Prim	V	
FV Lup	53222.845	0.012	Sec	V	
UZ Lyr	52628.0745	0.0012	Prim	V	
AT Mon	54417.2529	0.0018	Prim	V	
Z Nor	53414.4988	0.0018	Sec	V	
Z Nor	53423.4596	0.0011	Prim	V	
Z Nor	53962.9722	0.0010	Prim	V	
UU Oph	53260.4096	0.0025	Prim	V	
V456 Oph	54742.8314	0.0009	Prim	V	
V456 Oph	54766.7134	0.0012	Sec	V	
V456 Oph	54769.7640	0.0011	Sec	V	
V2383 Oph	54334.0179	0.0004	Prim	V	
V2383 Oph	54363.3928	0.0007	Sec	V	
V2383 Oph	54366.4077	0.0006	Sec	V	
V2383 Oph	54402.8144	0.0004	Prim	V	
V2383 Oph	54535.9003	0.0012	Prim	V	

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
EQ Ori	54153.1670	0.0005	Prim	V	
FF Ori	54154.5213	0.0010	Prim	V	
FF Ori	54330.1376	0.0005	Prim	V	
FF Ori	54507.5728	0.0005	Prim	V	
V640 Ori	54710.1407	0.0037	Prim	V	
AG Per	54493.9598	0.0028	Sec	V	
QW Per	52717.2704	0.0022	Prim	V	
MX Pav	54406.9713	0.0055	Prim	V	
SU Pic	53922.3609	0.0017	Prim	V	
RS Sgr	53782.7242	0.0028	Prim	V	
WY Sgr	52893.6725	0.0021	Prim	V	
XZ Sgr	54180.5234	0.0004	Prim	V	
EG Sgr	54423.0396	0.0014	Prim	V	
V524 Sgr	54596.0211	0.0009	Prim	V	
V1133 Sgr	54420.5870	0.0016	Prim	V	
V1133 Sgr	54421.3895	0.0006	Prim	V	
V1133 Sgr	54423.0026	0.0006	Prim	V	
V1133 Sgr	54595.3458	0.0009	Prim	V	
V1647 Sgr	53809.5808	0.0004	Sec	V	
RW Tau	54494.4145	0.0100	Prim	V	
CR Tau	54179.5731	0.0015	Prim	V	
GN Tra	54291.5804	0.0018	Prim	V	
MN Tra	53397.7452	0.0010	Sec	V	
BY Vel	53859.9681	0.0014	Prim	V	
BY Vel	53870.3350	0.0012	Prim	V	
ET Vel	53687.4309	0.0032	Sec	V	
ET Vel	53688.9301	0.0117	Prim	V	
ET Vel	53691.9958	0.0019	Prim	V	
ET Vel	53693.5956	0.0095	Sec	V	
ET Vel	53704.3077	0.0013	Prim	V	
GT Vel	53693.9383	0.0004	Sec	V	

Remarks:

Ephemerides: Paschke & Brát, 2006

New ephemerides for the stars: V703 Cyg: $2433214.191 + 4.14566 \cdot E$

HP Car: $2453150.7342 + 1.60046 \cdot E$.

Acknowledgements:

Based on data from the OMC Archive at LAEFF, pre-processed by ISDC. This work was supported by the Czech Science Foundation (grant no. P209/10/0715).

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BVR_CI_C PHOTOMETRIC EVOLUTION OF THE VERY FAST NOVA OPHIUCHI 2010 N.1 = V2673 Oph

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Nova Ophiuchi 2010 N.1 (= V2673 Oph) was discovered by H. Nishimura on Jan. 15.9 UT (cf. Nakano, 2010) and confirmed spectroscopically by H. Maehara (2010) as a "Fe II" class nova.

We obtained BVR_CI_C photometry of Nova Ophiuchi 2010 N.1 with a 0.30-m Meade RCX-400 f/8 Schmidt-Cassegrain telescope equipped with a SBIG ST-9 CCD camera. The photometry was accurately corrected for color equations using nightly calibrations on Landolt (1992, 2009) standard stars. The data are presented in Table 1, and plotted in Figure 1. The combined (Poissonian + transformation) errors (always less than 0.03 mag) do not exceed the dimension of the symbols in Figure 1. The zero points of the photometry are scaled on the nearby star TYC 6260-1846-1, for which we adopted: $B = 11\overset{m}{.}550$, $V = 10\overset{m}{.}963$, $R_C = 10\overset{m}{.}574$ and $I_C = 10\overset{m}{.}222$. The B and V are the values recommended by AAVSO for this star, the R_C and I_C are derived combining B, V with J, H, K from 2MASS following the recipes by Caldwell et al. (1993).

We started our observations immediately past maximum, and thus to reconstruct the whole light curve as presented in Figure 1, we had to integrate them with the published data.

Various estimates, based on unfiltered CCD observations secured around the time of discovery with digital cameras by Japanese amateurs, were published in CBET 2128. These observations are generally calibrated against the R_C band values of field stars as listed by the USNO catalog. We have measured the field stars around Nova Ophiuchi 2010 N.1 and found a mean $< V - R_C >= +0.57$ for them. We thus applied this shift to the unfiltered photometry of CBET 2128 and inserted it as open circles in Figure 1.

Four approximately V-band observations were obtained by Vollmann (2010) from the green channel of color CCD images obtained with a DSLR camera. Comparison with our simultaneous photometry indicates that Vollmann values need to be corrected by +0.1 mag to be placed onto the V photometric scale. We applied such a correction and plotted the data as star symbols in Figure 1.

The VSNET organization collected some BVR_CI_C CCD photometric data of Nova Ophiuchi 2010 N.1, with observers S. Kiyota and H. Maehara (cf. March 1, 2010 summary in `[vsnet-recent-nova 35402]` at `http://www.kusastro.kyoto-u.ac.jp/vsnet/`). The data obtained by observer S. Kiyota were corrected for instrumental color equations, and are inserted in Figure 1 as asterisks. They did not require adjustments, as it also was for V band data by VSNET observer H. Maehara. The B, R_C and I_C data of the latter, however, need the application of a shift to be brought in agreement with the rest of the data. The shift we applied amounts to +0.32 mag in B, +0.34 in R_C, and +0.45 mag in I_C.

In Figure 1 the time is counted from maximum brightness that was reached on Jan. 18.3, 2010 at V=8.5. At that time the colors were $B-V=+0.95$, $V-R_C=+0.75$, and $V-I_C=+1.50$.

Table 1. Our BVR_CI_C of Nova Oph 2010 N.1

HJD	V	$B-V$	$V-R_C$	$V-I_C$
2455216.7306	9.15	+0.86		+1.61
2455218.7244	9.51	+0.74		+1.68
2455223.7142	10.28	+0.69	+1.01	+1.65
2455225.7166	10.60	+0.70		+1.64
2455229.7095	10.85	+0.72	+1.00	+1.60
2455231.7104	10.90	+0.66	+1.04	+1.57
2455235.6959	11.31	+0.67	+1.13	+1.71
2455242.6834	11.79	+0.61	+1.29	+1.91
2455248.6852	12.19	+0.56	+1.49	+2.13
2455261.6320	12.91	+0.53	+1.96	+2.11
2455264.6625	12.93	+0.49	+1.89	+2.01

van den Bergh and Younger (1987) derived a mean intrinsic color $(B-V)_\circ=+0.23\pm0.06$ for novae at the time of maximum, and $(B-V)_\circ=-0.02\pm0.04$ at t_2. Comparing with $B-V=+0.95$ at maximum and $B-V=+0.68$ at t_2 from Figure 1, the reddening affecting Nova Oph 2010 N.1 is $E_{B-V}=0.71$, and the extinction (assuming a standard $R_V=3.1$ interstellar law) is therefore $A_V=2.2$ mag.

The light curve in Figure 1 is characterized by a rapid rise (the last 2.2 mag in V band were covered in 3.4 days) and by a smooth decline, regulated by the decline times

$$t_2^V=10.0 \qquad t_3^V=23.5 \text{ days}$$

which are the time taken by the nova to decline, in the V band, by two and three magnitudes, respectively, from maximum brightness. These t_2^V and t_3^V values for Nova Oph 2010 are in the normal proportion found for typical novae. Given t_2^V, the Warner (1995) relation would predict $t_3^V=20.8$, while Munari et al. (2008) relation would give $t_3^V=23.1$. According to the classification of Warner (1995, his Table 5.4), a $t_2^V=10$ days qualifies Nova Oph 2010 N.1 to be classed among the very fast novae.

Published relations between the absolute magnitude and the rate of decline generally take the form $M_{\rm max}=\alpha_n\log t_n+\beta_n$. Using the Cohen (1988) $V-t_2$ relation, the distance to the nova is 8.3 kpc, and 7.5 kpc according to the Schmidt (1957) $V-t_3$ relation.

Buscombe and de Vaucouleurs (1955) suggested that all novae have the same absolute magnitude 15 days after maximum light. The mean value of the calibrations presented by Buscombe and de Vaucouleurs (1955), Cohen (1985), van den Bergh and Younger (1987), van den Bergh (1988), and Capaccioli et al. (1989) is $M_{15}^V=-5.42\pm0.09$, which provides a distance of 6.5 kpc to Nova Oph 2010 N.1 when compared to $V_{15}=10.85$ from Figure 1. Taking the mean of these three determinations, the distance to Nova Oph 2010 N.1 is $d=7.4$ kpc. At a galactic latitude $b=4.92$ deg, it corresponds to an height over the

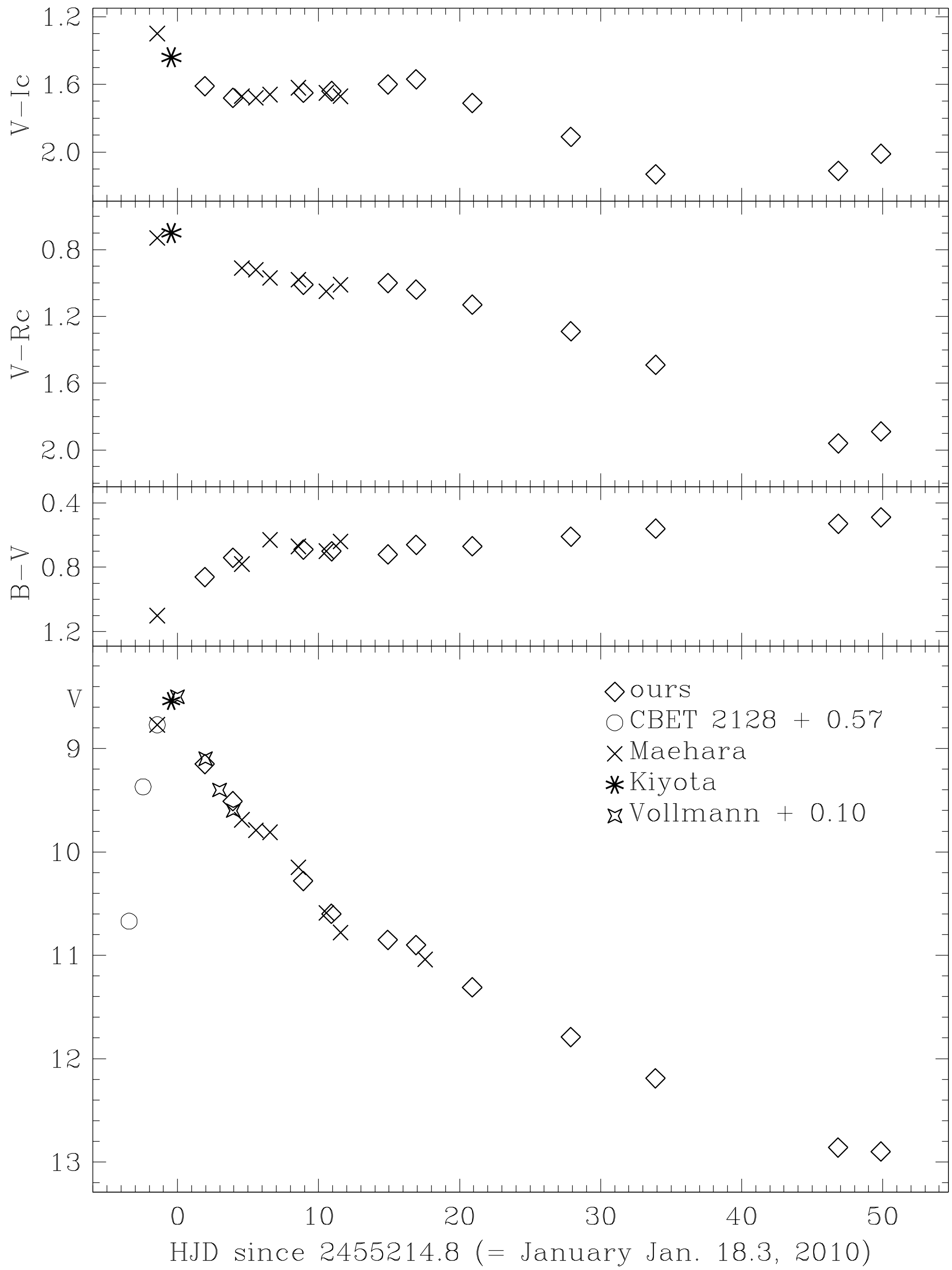

Figure 1. $BVR_{\mathrm{C}}I_{\mathrm{C}}$ photometric evolution of the outburst of Nova Ophiuchi 2010 N.1. For the literature data, see text for details.

Galactic equatorial plane of $z = 0.6$ kpc, well within the range of heights reported by della Valle and Livio (1998) for novae of the Fe II type.

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NEW TIMES OF MINIMA OF 36 ECLIPSING BINARY SYSTEMS

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Observatory and telescope:
0.3-m Schmidt-Cassegrain (Kle30) equipped with SBIG-ST7 camera 0.13-m refractor (BHO13) 0.18-m refractor (BHO18) 0.40-m Newtonian (BHO40) 0.13-m refractor (Hum13) 0.40-m Newtonian (Hum40) with SBIG-ST10XME and STL6303e cameras 0.14-m refractor (HMB14) 0.20-m refractor (HMB20) 0.28-m Schmidt-Cassegrain (HMB28) with SBIG-ST10XME, STL6303e and STL11000 cameras 0.26-m Maksutov-Cassegrain (Vlh26) 0.28-m Schmidt-Cassegrain (Vlh28) with SBIG-ST10XME camera 0.08-m refractor (Duf08) 0.20-m Newtonian (Duf20) with SBIG-ST10XME camera

Detector:	SBIG-ST7 camera, Peltier cooling, KAF-400 chip, 765×510 pixels^2 SBIG-ST10XME camera, Peltier cooling, KAF-3200ME chip, 2184×1472 pixels^2 SBIG-STL6303E camera, Peltier cooling, KAF-6303E chip, 3060×2040 pixels^2 SBIG-STL11000 camera, Peltier cooling, KAI-11000 chip, 4008×2672 pixels^2

Method of data reduction:
Reduction of the CCD frames was made with the following packages: AIP4WIN for Kle30; Mira-AP7[1] software for BHO13/BHO18/BHO40 and Hum13/Hum40; MaximDL4 for HMB14/HMB20/HMB28, Vlh26/Vlh28 and Duf08/Duf20.

Method of minimum determination:
The times of minima were computed with a parabolic fitting, in some cases (Kle30) also complemented with a few other methods available in the software *Minima* (cf. `http://members.shaw.ca/bob.nelson/software1.htm`).

[1]Mira-AP7 is distributed by Axiom Research Inc.

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
CL Aur	54512.3138	0.0002	1	V	Vlh28
CL Aur	54522.2690	0.0001	1	V	Kle30
CL Aur	54858.2534	0.0001	1	V	Kle30
CL Aur	55104.6421	0.0004	1	V	Kle30
HP Aur	54522.3559	0.0001	2	V	Kle30
HP Aur	55155.5075	0.0006	2	V	Kle30
IU Aur	54495.3575	0.0002	2	B	Kle30
IU Aur	54496.2615	0.0001	1	B	Kle30
IU Aur	54505.3240	0.0002	1	V	Vlh28
IU Aur	54513.4762	0.0003	2	V	Vlh28
IU Aur	54514.3778	0.0006	1	V	Vlh28
IU Aur	54777.9493	0.0048	2	V	HMB20
IU Aur	54778.8542	0.0027	1	V	HMB20
IU Aur	54782.4751	0.0029	1	V	HMB28
IU Aur	54787.9143	0.0036	1	V	HMB20
IU Aur	54788.8166	0.0033	2	V	HMB20
IU Aur	54817.8060	0.0080	2	V	HMB20
IU Aur	54828.6684	0.0003	2	V	Vlh26
IU Aur	54831.3847	0.0002	1	V	Vlh26
IU Aur	54835.9180	0.0082	2	V	HMB20
IU Aur	54847.6863	0.0043	1	V	HMB20
IU Aur	54851.3094	0.0001	1	V	Kle30
IU Aur	54861.2703	0.0013	2	V	BHO18
IU Aur	55079.5586	0.0001	1	V	Kle30
AS Cam	54897.4283	0.0010	2	V	Duf20
AB Cas	54506.5768	0.0004	1	V	Vlh28
AE Cas	54843.3705	0.0037	1	V	HMB28
AE Cas	54843.3719	0.0022	1	R	HMB28
DN Cas	54838.3062	0.0007	1	V	BHO13
IT Cas	54669.4909	0.0001	2	V	Kle30
IT Cas	55041.4219	0.0006	1	V	Kle30
IV Cas	54506.3577	0.0001	1	V	Vlh28
IV Cas	54508.3542	0.0003	1	V	Vlh28
IV Cas	54509.3526	0.0002	1	V	Vlh28
IV Cas	54828.3764	0.0006	2	V	Vlh26
MU Cas	54749.4874	0.0001	2	V	Kle30
OX Cas	54499.3016	0.0001	2	V	Vlh28
OX Cas	55074.3340	0.0003	2	V	Kle30
PV Cas	54649.4909	0.0001	1	V	Kle30
PV Cas	54762.4303	0.0001	2	V	Vlh26
PV Cas	55077.5149	0.0004	2	V	Kle30
V821 Cas	54663.4449	0.0002	2	B	Kle30
V442 Cyg	55106.3494	0.0007	2	V	Kle30
V961 Cyg	54994.4216	0.0006	1	V	Kle30
V961 Cyg	54995.4417	0.0001	2	V	Kle30
V974 Cyg	54670.3887	0.0005	2	V	Kle30
V974 Cyg	54702.4295	0.0007	2	C	Duf08
V974 Cyg	55077.3493	0.0008	2	V	Kle30

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V1136 Cyg	54978.4275	0.0006	2	V	Kle30
CT Her	54643.4882	0.0001	1	V	Vlh26
RX Her	55026.3856	0.0006	2	V	Kle30
AU Lac	54746.4515	0.0001	1	V	Kle30
CO Lac	54614.4697	0.0001	2	V	Kle30
CO Lac	54644.5300	0.0001	1	V	Kle30
CO Lac	54746.3164	0.0001	1	V	Kle30
CO Lac	55015.4415	0.0006	2	V	Kle30
CO Lac	55022.3730	0.0005	1	V	Kle30
UU Lyn	54848.5266	0.0001	1	V	Kle30
UU Lyn	54858.3645	0.0001	1	V	Kle30
FL Lyr	54201.5793	0.0020	2	V	BHO13
FL Lyr	54359.4960	0.0005	1	B	BHO40
FL Lyr	54381.2785	0.0003	1	B	BHO40
IU Per	54502.22271	0.00023	1	BVR_CI_C	Kle30
IU Per	54751.6224	0.0003	1	B	Hum40
IU Per	54755.4849	0.0002	2	V	Kle30
IU Per	54759.3359	0.0002	1	V	BHO18
IU Per	54775.61885	0.00015	1	BVR_CI_C	Kle30
IU Per	54827.4647	0.0005	2	V	Hum40
IU Per	54830.4665	0.0005	1	V	Hum40
IU Per	54843.3216	0.0003	1	V	BHO18
IU Per	54861.3177	0.0010	1	V	HMB28
AO Ser	54612.5770	0.0001	1	V	Kle30
AO Ser	54614.3375	0.0001	1	V	Kle30
AO Ser	54628.4051	0.0003	1	V	Kle30
AO Ser	54974.4272	0.0008	2	V	Hum40
SV Tau	54491.4415	0.0004	1	V	Kle30
RS Tri	55041.5456	0.0020	2	V	Kle30
BS UMa	54923.5014	0.0004	1	V	Hum40
BS UMa	54942.3756	0.0007	1	V	Hum40
BS UMa	54942.5480	0.0005	2	V	Hum40
BS UMa	54943.4230	0.0007	1	V	Hum40
BS UMa	54943.5971	0.0009	2	V	Hum40
BS UMa	54944.4722	0.0007	1	V	Hum40
DN UMa	54508.4886	0.0005	2	BV	BHO13
DN UMa	54514.5462	0.0014	1	BV	BHO13
DN UMa	54515.4132	0.0013	2	V	BHO13
DN UMa	54944.5637	0.0014	2	V	Hum13
VV UMa	54592.4439	0.0031	1	V	Duf08
VV UMa	54605.5044	0.0004	1	V	Duf08
VV UMa	54862.5833	0.0009	1	V	HMB14
VV UMa	54893.5156	0.0037	1	V	HMB14
VV UMa	54897.6402	0.0020	1	V	HMB14
VV UMa	54910.3563	0.0013	2	V	HMB14
VV UMa	54911.3875	0.0022	1	V	HMB14
VV UMa	54927.5435	0.0030	2	V	Duf08
XZ UMa	54911.5821	0.0016	1	V	HMB14

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
XZ UMa	54927.4703	0.0008	1	*V*	Duf08
GSC 143 226	55126.5304	0.0001	1	*V*	Kle30
GSC 3612 1565	55078.4828	0.0009	2	*V*	Kle30
GSC 4487 347	54743.4548	0.0001	2	*V*	Kle30
GSC 4550 1408	54861.4032	0.0027	1	*V*	HMB28
NSV 26199	55104.4202	0.0002	1	*V*	Kle30

Explanation of the remarks in the table:

Observers: Kle = Kleidis, S.; BHO/Hum = Lampens, P. & Van Cauteren, P.; HMB = Hambsch, J.; Vlh = Vanleenhove, M.; Duf = Dufoer, S.

Remarks:

We use filters B, V, R_C and I_C according to the specifications given by Bessell (1995). The monitoring of IU Aur is part of an international campaign organised by Hegedüs et al. (Baja Observatory, Hungary) and is still on-going. AB Cas, IV Cas, CT Her, AO Ser, IU Per, VV UMa and GSC 4550 1408 are members of the class of oEA stars (Mkrtichian et al., 2004). In the majority of cases, we used ephemerides based on Nelson's *Eclipsing Binary O-C Files*. In the case of BS UMa, the eclipse type does not follow the convention of the *O-C Gateway* (Paschke & Brát), but our determination is based on the clear distinction between primary and secondary eclipse from light curves obtained during several consecutive hours.

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Paschke, A. & Brát, L., $O-C$ Gateway: database of times of minima (E) and maxima (RR) (`http://astro.sci.muni.cz/variables/ocgate/`)

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THE GEOS RR Lyr SURVEY

Twelfth list of maxima of RR Lyr stars observed by the automated telescopes TAROT

(GEOS Circular RR 43)

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We present here the twelfth list of light maxima of RR Lyrae stars from the GEOS RR Lyr Survey (Le Borgne et al. 2007), a GEOS program (`http://geos.webs.upv.es/`, Boninsegna et al., 2002) of observations of RR Lyr stars using the automatic telescopes TAROT (`http://tarot.obs-hp.fr`, Klotz et al., 2009). The present list contains 364 maxima observed mainly between July and December 2009 (Table 1).
A description of the present list may be found in the former lists (for example Le Borgne et al. 2008). The data are also available in the GEOS RR Lyr web database (`http://rr-lyr.ast.obs-mip.fr/dbrr/dbrr-V1.0_0.php`). The $O-C$'s are computed with the GCVS elements (Kholopov et al., 1985) when available. Otherwise, the reference of the elements, if exists, is given as a footnote of Table 1.

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Table 1: maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
SW And	55045.523±0.002	-0.796	83462.	C
SW And	55088.426±0.002	-0.794	83559.	C
SW And	55156.532±0.002	-0.800	83713.	C
SW And	55158.299±0.002	-0.802	83717.	C
XX And	55044.489±0.003	0.241	22078.	C
XX And	55078.461±0.003	0.243	22125.	C
XX And	55180.370±0.004	0.245	22266.	C
AT And	55078.390±0.004	-0.002	20643.	C
AT And	55086.411±0.004	-0.001	20656.	C
AT And	55160.436±0.005	-0.005	20776.	C
AT And	55170.309±0.004	-0.003	20792.	C
CI And	55051.562±0.004	0.117	39885.	C
CI And	55052.530±0.002	0.115	39887.	C
CI And	55087.427±0.002	0.112	39959.	C
CI And	55155.287±0.002	0.112	40099.	C
CI And	55170.313±0.003	0.112	40130.	C
NX And [1]	55180.339±0.004	0.002	25521.	C
SW Aqr	55037.515±0.002	0.000	65186.	C
SW Aqr	55055.427±0.002	-0.000	65225.	C
SW Aqr	55082.523±0.002	-0.003	65284.	C
SW Aqr	55088.497±0.002	0.000	65297.	C
SX Aqr	55033.526±0.003	-0.119	28443.	C
SX Aqr	55061.384±0.002	-0.118	28495.	C
SX Aqr	55085.489±0.002	-0.121	28540.	C
SX Aqr	55095.670±0.005	-0.118	28559.	LS
TZ Aqr	55043.453±0.003	0.014	30628.	C
TZ Aqr	55056.585±0.003	0.009	30651.	C
TZ Aqr	55083.430±0.002	0.007	30698.	C
YZ Aqr	55096.603±0.003	0.057	35751.	LS
AA Aqr	55096.559±0.005	-0.125	56411.	LS
AA Aqr	55127.612±0.003	-0.126	56462.	LS
BN Aqr	55056.447±0.003	0.598	36588.	C
BN Aqr	55086.505±0.002	0.599	36652.	C
BN Aqr	55098.719±0.003	0.602	36678.	LS
BO Aqr	55098.561±0.005	0.162	19419.	LS
BR Aqr	55090.657±0.004	-0.165	36222.	LS
CP Aqr	55029.445±0.002	-0.116	36998.	C
CP Aqr	55035.469±0.002	-0.116	37011.	C
CP Aqr	55081.345±0.002	-0.118	37110.	C
CP Aqr	55097.561±0.003	-0.121	37145.	LS
GP Aqr	55045.520±0.004			C
GP Aqr	55056.461±0.005			C
GP Aqr	55086.432±0.005			C
GP Aqr	55094.543±0.004			LS
GP Aqr	55098.598±0.005			LS
OX Aqr	55095.872±0.009			LS
OX Aqr	55129.716±0.006			LS
AA Aql	55083.398±0.002	0.035	84956.	C
AA Aql	55088.463±0.002	0.035	84970.	C
V341 Aql	55029.474±0.002	0.035	23932.	C
V341 Aql	55055.484±0.003	0.035	23977.	C
X Ari	55088.599±0.003	0.362	26883.	C
X Ari	55159.575±0.003	0.364	26992.	C
TZ Aur	55157.472±0.002	0.016	90011.	C
TZ Aur	55159.430±0.002	0.015	90016.	C
AH Cam	55162.406±0.001	-0.447	44567.	C
TT Cnc	55156.488±0.004	0.114	26998.	C
TT Cnc	55191.405±0.003	0.097	27060.	C
AA CMi	55175.489±0.002	0.066	39047.	C
AA CMi	55184.538±0.003	0.065	39066.	C
IU Car	55131.641±0.005	0.285	18227.	LS
IU Car	55139.748±0.004	0.284	18238.	LS
IU Car	55148.586±0.003	0.276	18250.	LS
V363 Cas	55044.568±0.005	0.599	34584.	C
V363 Cas	55078.458±0.004	0.604	34646.	C
V363 Cas	55080.644±0.003	0.604	34650.	C
V363 Cas	55159.351±0.006	0.610	34794.	C
RR Cet	55088.514±0.002	0.006	39613.	C
RR Cet	55157.644±0.004	0.008	39738.	LS
RR Cet	55159.299±0.005	0.004	39741.	C
RR Cet	55185.295±0.003	0.007	39788.	C
RU Cet	55093.822±0.003	0.094	26041.	LS
RU Cet	55096.761±0.008	0.101	26046.	LS
RU Cet	55140.732±0.004	0.101	26121.	LS
RU Cet	55150.706±0.004	0.108	26138.	LS
RU Cet	55153.629±0.002	0.100	26143.	LS
RV Cet	55095.765±0.009	0.219	25637.	LS
RV Cet	55155.623±0.010	0.231	25733.	LS
RV Cet	55168.721±0.005	0.237	25754.	LS
RX Cet	55093.733±0.005	-0.259	26091.	LS
RX Cet	55139.613±0.005	-0.274	26171.	LS
RX Cet	55151.652±0.003	-0.283	26192.	LS
RZ Cet	55101.672±0.005	-0.161	41509.	LS
RZ Cet	55156.300±0.003	-0.169	41616.	C
RZ Cet	55157.323±0.002	-0.167	41618.	C
RZ Cet	55158.351±0.003	-0.160	41620.	C
RZ Cet	55170.599±0.003	-0.167	41644.	LS
UU Cet	55093.750±0.004	-0.142	22910.	LS
UU Cet	55098.597±0.005	-0.143	22918.	LS
UU Cet	55101.624±0.005	-0.147	22923.	LS
UU Cet	55127.690±0.003	-0.142	22966.	LS
RW Col	55154.654±0.004	0.089	51671.	LS
RW Col	55155.743±0.005	0.120	51673.	LS
RX Col	55162.699±0.003	0.167	44357.	LS
RX Col	55187.620±0.002	0.138	44399.	LS
RY Col	55149.770±0.003	-0.177	43519.	LS
RY Col	55151.680±0.002	-0.183	43523.	LS
RY Col	55164.602±0.003	-0.190	43550.	LS
RY Col	55175.607±0.002	-0.198	43573.	LS
AV Col	55153.754±0.003			LS
AV Col	55162.662±0.002			LS
AV Col	55168.753±0.002			LS
AV Col	55169.691±0.003			LS
AV Col	55178.597±0.002			LS
AV Col	55185.630±0.002			LS
UY Cyg	55017.466±0.003	0.063	58112.	C
UY Cyg	55026.437±0.003	0.063	58128.	C
UY Cyg	55035.403±0.004	0.057	58144.	C
UY Cyg	55081.385±0.003	0.061	58226.	C
UY Cyg	55086.430±0.002	0.060	58235.	C
XZ Cyg [2]	55025.521±0.003	0.006	13834.	C
XZ Cyg [2]	55033.443±0.003	-0.004	13851.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
XZ Cyg [2]	55047.434±0.002	-0.011	13881.	C	BB Eri	55149.663±0.002	0.242	27356.	LS
XZ Cyg [2]	55080.576±0.003	0.002	13952.	C	BB Eri	55165.626±0.005	0.248	27384.	LS
XZ Cyg [2]	55082.444±0.004	0.004	13956.	C	BB Eri	55169.610±0.002	0.243	27391.	LS
DM Cyg	55017.470±0.002	0.070	29617.	C	RX For	55095.747±0.009	0.001	25555.	LS
DM Cyg	55043.494±0.002	0.063	29679.	C	RX For	55129.776±0.003	-0.017	25612.	LS
DM Cyg	55048.535±0.002	0.066	29691.	C	RX For	55153.644±0.004	-0.042	25652.	LS
DM Cyg	55054.412±0.002	0.065	29705.	C	SS For	55122.601±0.004	-0.142	33211.	LS
DM Cyg	55085.483±0.002	0.066	29779.	C	SS For	55166.699±0.003	-0.138	33300.	LS
DM Cyg	55087.581±0.003	0.065	29784.	C	SS For	55167.692±0.005	-0.135	33302.	LS
V939 Cyg [3]	55033.465±0.009	0.013	13534.	C	SS For	55168.683±0.004	-0.135	33304.	LS
V939 Cyg [3]	55047.439±0.003	0.036	13570.	C	SW For	55132.752±0.006	0.427	25865.	LS
DX Del	55037.481±0.002	0.061	33156.	C	SW For	55140.791±0.009	0.429	25875.	LS
DX Del	55038.426±0.002	0.060	33158.	C	SW For	55149.629±0.003	0.425	25886.	LS
DX Del	55044.568±0.003	0.058	33171.	C	SW For	55169.722±0.006	0.425	25911.	LS
DX Del	55046.460±0.004	0.060	33175.	C	SX For	55101.711±0.005	0.043	26338.	LS
DX Del	55056.389±0.002	0.064	33196.	C	SX For	55158.618±0.003	0.048	26432.	LS
DX Del	55081.433±0.002	0.059	33249.	C	SX For	55164.669±0.003	0.046	26442.	LS
RT Dor	55129.707±0.002	-0.072	50457.	LS	SX For	55170.729±0.003	0.052	26452.	LS
RT Dor	55140.810±0.004	-0.074	50480.	LS	SX For	55184.647±0.005	0.047	26475.	LS
RT Dor	55153.848±0.004	-0.072	50507.	LS	RR Gem	55180.413±0.004	-0.420	34793.	C
VW Dor	55106.767±0.002	-0.118	29315.	LS	SZ Gem	55177.429±0.003	-0.060	55840.	C
VW Dor	55138.717±0.002	-0.122	29371.	LS	SZ Gem	55191.459±0.002	-0.062	55868.	C
VW Dor	55158.692±0.003	-0.119	29406.	LS	SZ Gem	55192.463±0.002	-0.060	55870.	C
VW Dor	55182.652±0.003	-0.124	29448.	LS	GI Gem	55157.645±0.002	0.069	57265.	C
VW Dor	55187.794±0.003	-0.118	29457.	LS	GI Gem	55158.511±0.001	0.069	57267.	C
RW Dra	55024.526±0.002	0.206	35327.	C	GI Gem	55160.678±0.004	0.070	57272.	C
XZ Dra	55021.433±0.003	-0.126	27478.	C	RW Gru	55093.569±0.003	-0.148	37676.	LS
XZ Dra	55042.392±0.002	-0.132	27522.	C	RW Gru	55099.627±0.005	-0.143	37687.	LS
XZ Dra	55050.488±0.002	-0.137	27539.	C	TW Her	55022.521±0.003	-0.011	83777.	C
BC Dra	55016.468±0.007	0.091	17702.	C	TW Her	55024.518±0.002	-0.012	83782.	C
BC Dra	55047.415±0.005	0.096	17745.	C	TW Her	55034.511±0.002	-0.009	83807.	C
BC Dra	55054.603±0.005	0.088	17755.	C	TW Her	55046.495±0.002	-0.013	83837.	C
BC Dra	55057.477±0.006	0.084	17759.	C	TW Her	55050.490±0.002	-0.014	83847.	C
BC Dra	55085.549±0.006	0.092	17798.	C	VX Her	55020.501±0.002	-0.431	73062.	C
BC Dra	55155.348±0.006	0.092	17895.	C	VX Her	55021.412±0.002	-0.431	73064.	C
BC Dra	55159.660±0.007	0.087	17901.	C	VZ Her	55022.505±0.002	0.069	41409.	C
BC Dra	55160.386±0.007	0.093	17902.	C	DL Her	55038.507±0.002	0.041	28447.	C
BC Dra	55168.299±0.003	0.091	17913.	C	V650 Her	55021.397±0.002	0.029	30021.	C
BC Dra	55170.457±0.008	0.090	17916.	C	UU Hor	55127.659±0.002	0.163	47236.	LS
BD Dra	55023.498±0.002	0.688	22491.	C	UU Hor	55165.637±0.003	0.164	47295.	LS
BD Dra	55026.444±0.002	0.689	22496.	C	DD Hya	55160.500±0.002	-0.163	26835.	C
BD Dra	55043.482±0.005	0.645	22525.	C	DD Hya	55162.508±0.003	-0.162	26839.	C
BD Dra	55079.454±0.003	0.685	22586.	C	DD Hya	55167.528±0.002	-0.160	26849.	C
BD Dra	55080.629±0.002	0.681	22588.	C	RR Leo	55167.661±0.002	0.102	26243.	C
BD Dra	55155.433±0.004	0.676	22715.	C	V LMi	55157.598±0.004	0.038	65501.	C
BD Dra	55159.525±0.004	0.644	22722.	C	U Lep	55132.798±0.005	0.048	23699.	LS
BK Dra	55016.506±0.002	-0.155	49813.	C	U Lep	55149.657±0.002	0.044	23728.	LS
BK Dra	55038.410±0.002	-0.158	49850.	C	U Lep	55181.641±0.004	0.047	23783.	LS
BK Dra	55048.476±0.002	-0.157	49867.	C	TT Lyn	55155.653±0.008	-0.037	30973.	C
RX Eri	55149.648±0.004	-0.010	56973.	LS	TT Lyn	55167.596±0.002	-0.043	30993.	C
RX Eri	55159.629±0.004	-0.012	56990.	LS	TT Lyn	55192.692±0.005	-0.039	31035.	C
RX Eri	55180.775±0.003	-0.007	57026.	LS	TW Lyn	55155.558±0.005	0.066	21029.	C
SV Eri	55098.812±0.005	0.816	27383.	LS	TW Lyn	55157.475±0.003	0.056	21033.	C
SV Eri	55151.625±0.004	0.808	27457.	LS	TW Lyn	55158.441±0.003	0.058	21035.	C
SV Eri	55158.777±0.007	0.822	27467.	LS	TW Lyn	55183.497±0.003	0.057	21087.	C
BB Eri	55129.719±0.005	0.245	27321.	LS	RZ Lyr	55035.520±0.004	-0.016	27095.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
RZ Lyr	55036.547±0.002	-0.012	27097.	C	VV Peg	55034.443±0.003	-0.023	32034.	C
RZ Lyr	55051.362±0.002	-0.023	27126.	C	VV Peg	55057.398±0.002	-0.023	32081.	C
AW Lyr	55079.443±0.003	-0.021	59801.	C	VV Peg	55167.287±0.002	-0.021	32306.	C
AW Lyr	55080.438±0.002	-0.021	59803.	C	AV Peg	55059.386±0.002	0.124	28867.	C
AW Lyr	55081.432±0.002	-0.022	59805.	C	AV Peg	55082.419±0.002	0.124	28926.	C
CN Lyr	55014.454±0.004	0.024	25592.	C	AV Peg	55083.590±0.002	0.124	28929.	C
CN Lyr	55021.442±0.005	0.018	25609.	C	AV Peg	55087.494±0.002	0.125	28939.	C
CN Lyr	55023.502±0.002	0.021	25614.	C	AV Peg	55166.351±0.002	0.126	29141.	C
CN Lyr	55025.561±0.003	0.024	25619.	C	BH Peg	55060.522±0.005	-0.113	24486.	C
CN Lyr	55037.487±0.003	0.019	25648.	C	BH Peg	55085.522±0.004	-0.111	24525.	C
CN Lyr	55047.362±0.003	0.021	25672.	C	BH Peg	55155.384±0.005	-0.118	24634.	C
CN Lyr	55049.422±0.003	0.024	25677.	C	CG Peg	55014.476±0.002	-0.049	34063.	C
CN Lyr	55053.528±0.003	0.017	25687.	C	CG Peg	55034.561±0.002	-0.050	34106.	C
CN Lyr	55054.353±0.003	0.019	25689.	C	CG Peg	55048.576±0.003	-0.050	34136.	C
CN Lyr	55056.411±0.004	0.020	25694.	C	CG Peg	55083.610±0.003	-0.051	34211.	C
CN Lyr	55079.454±0.005	0.025	25750.	C	CG Peg	55084.544±0.002	-0.051	34213.	C
CR Lyr	55034.579±0.004	-0.026	51224.	C	CG Peg	55157.416±0.004	-0.053	34369.	C
CR Lyr	55035.559±0.003	-0.033	51226.	C	CV Peg	55057.420±0.005	-0.057	53853.	C
CR Lyr	55036.543±0.002	-0.035	51228.	C	DZ Peg	55046.479±0.002	0.161	34832.	C
CR Lyr	55037.526±0.003	-0.039	51230.	C	DZ Peg	55060.447±0.002	0.160	34855.	C
CR Lyr	55038.515±0.002	-0.037	51232.	C	DZ Peg	55085.349±0.002	0.161	34896.	C
CR Lyr	55045.415±0.005	-0.045	51246.	C	DZ Peg	55156.409±0.002	0.162	35013.	C
CR Lyr	55047.391±0.003	-0.043	51250.	C	DZ Peg	55170.375±0.003	0.159	35036.	C
CR Lyr	55048.380±0.004	-0.041	51252.	C	AR Per	55156.389±0.002	0.057	65608.	C
CR Lyr	55049.366±0.004	-0.041	51254.	C	AR Per	55159.369±0.004	0.059	65615.	C
CR Lyr	55079.471±0.005	-0.035	51315.	C	AR Per	55162.348±0.001	0.059	65622.	C
IO Lyr	55027.501±0.003	-0.032	26699.	C	RV Phe	55099.756±0.003	-0.190	22106.	LS
IO Lyr	55049.431±0.002	-0.032	26737.	C	RV Phe	55151.642±0.003	-0.192	22193.	LS
IO Lyr	55060.393±0.002	-0.036	26756.	C	TZ Phe	55092.781±0.006			LS
V340 Lyr	55035.551±0.003	-0.044	42996.	C	TZ Phe	55097.712±0.005			LS
Z Mic	55092.624±0.003	-0.125	22993.	LS	TZ Phe	55158.649±0.005			LS
Z Mic	55099.665±0.005	-0.128	23005.	LS	TZ Phe	55166.648±0.004			LS
RY Oct	55132.653±0.005	0.081	48175.	LS	U Pic	55127.777±0.003	0.067	30568.	LS
RY Oct	55150.696±0.005	0.093	48207.	LS	U Pic	55131.739±0.002	0.066	30577.	LS
RY Oct	55154.630±0.002	0.083	48214.	LS	U Pic	55139.667±0.003	0.067	30595.	LS
SS Oct	55094.833±0.003	-0.034	43540.	LS	U Pic	55154.638±0.002	0.066	30629.	LS
SS Oct	55106.649±0.004	-0.033	43559.	LS	U Pic	55157.725±0.003	0.070	30636.	LS
SS Oct	55129.660±0.003	-0.030	43596.	LS	U Pic	55169.610±0.002	0.065	30663.	LS
SS Oct	55149.566±0.003	-0.022	43628.	LS	U Pic	55180.622±0.004	0.068	30688.	LS
SS Oct	55162.621±0.002	-0.025	43649.	LS	U Pic	55187.667±0.003	0.067	30704.	LS
SS Oct	55167.599±0.003	-0.022	43657.	LS	HH Pup	55157.772±0.003	0.009	42630.	LS
UW Oct	55097.749±0.005	-0.010	46706.	LS	HH Pup	55195.676±0.003	0.011	42727.	LS
UW Oct	55122.637±0.003	-0.013	46762.	LS	HK Pup	55180.657±0.004	-0.281	25295.	LS
UW Oct	55138.636±0.003	-0.016	46798.	LS	X Ret	55094.783±0.005	0.225	31822.	LS
UW Oct	55162.642±0.003	-0.012	46852.	LS	X Ret	55132.682±0.003	0.241	31899.	LS
V455 Oph	55022.391±0.004	-0.278	29057.	C	V1646 Sgr	55107.587±0.003	0.173	38173.	LS
V455 Oph	55027.392±0.003	-0.270	29068.	C	UZ Scl	55094.721±0.005	0.037	35586.	LS
TY Pav	55122.523±0.005	0.228	19130.	LS	VW Scl	55092.732±0.004	-0.005	53401.	LS
BN Pav	55090.525±0.004	-0.106	47171.	LS	VW Scl	55139.727±0.005	-0.014	53493.	LS
BP Pav	55121.579±0.002	-0.141	49846.	LS	VW Scl	55157.612±0.002	-0.011	53528.	LS
BP Pav	55131.595±0.002	0.201	49864.	LS	VW Scl	55158.636±0.002	-0.009	53530.	LS
BP Pav	55132.649±0.002	0.181	49866.	LS	VX Scl	55151.705±0.002	-0.898	21242.	LS
BP Pav	55140.558±0.004	0.029	49881.	LS	VX Scl	55167.629±0.004	-0.907	21267.	LS
BP Pav	55150.572±0.003	-0.168	49900.	LS	AE Scl	55128.658±0.010	0.252	25288.	LS
DN Pav	55097.652±0.002	0.104	29703.	LS	AE Scl	55155.610±0.003	0.250	25337.	LS
DN Pav	55150.588±0.002	0.106	29816.	LS	AE Scl	55166.605±0.002	0.243	25357.	LS

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
HY Tel	55093.659±0.002	0.053	65518.	LS	AE Tuc	55164.676±0.002	0.090	50418.	LS
W Tuc	55093.529±0.002	0.174	28362.	LS	AE Tuc	55166.748±0.003	0.090	50423.	LS
W Tuc	55127.564±0.002	0.171	28415.	LS	AE Tuc	55167.579±0.002	0.093	50425.	LS
W Tuc	55139.764±0.003	0.169	28434.	LS	AE Tuc	55169.647±0.001	0.089	50430.	LS
W Tuc	55148.754±0.003	0.167	28448.	LS	AE Tuc	55191.616±0.001	0.097	50483.	LS
W Tuc	55157.751±0.004	0.173	28462.	LS	EX UMa	55160.589±0.006	0.032	11325.	C
W Tuc	55159.681±0.005	0.176	28465.	LS	EX UMa	55167.644±0.005	0.030	11338.	C
W Tuc	55168.663±0.005	0.167	28479.	LS	SV Vol	55182.648±0.003	0.064	35509.	LS
YY Tuc	55094.791±0.003	0.112	20787.	LS	BN Vul	55029.406±0.002	0.068	15988.	C
AE Tuc	55100.837±0.001	0.063	50264.	LS	BN Vul	55036.535±0.002	0.068	16000.	C
AE Tuc	55121.563±0.002	0.071	50314.	LS	BN Vul	55042.477±0.003	0.069	16010.	C
AE Tuc	55128.610±0.005	0.074	50331.	LS	BN Vul	55045.448±0.004	0.069	16015.	C
AE Tuc	55138.559±0.003	0.078	50355.	LS	BN Vul	55080.498±0.003	0.065	16074.	C
AE Tuc	55159.699±0.001	0.085	50406.	LS	BN Vul	55086.440±0.002	0.066	16084.	C

* C = Calern, LS = La Silla
1 Meinunger, 1984
2 Baldwin and Samolyk, 2003
3 Agerer and Moschner, 1996

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RADIAL VELOCITIES FOR TWELVE PULSATING VARIABLES IN THE ANTICENTER

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The kinematics of the *outer* halo can be studied by using the radial velocities of tracers such as RR Lyrae stars in the direction of the Anticenter. Radial velocities of distant Anticenter RR Lyraes have been given by Pier et al. (2003). In this paper we give radial velocities for twelve more pulsating variables in the Anticenter ($171° < l < 186°$). Eleven are RR Lyrae variables and one (NSVS 48209670) is a δ-Scuti (DSCT) star. Five have been previously identified as RR Lyrae stars: DQ Lyn (Kinman, 1998), NSV 17902 and EN Lyn (Kinemuchi et al., 2006), BN UMa (McClusky, 2008) and CK UMa (Hoffleit, 1972).

Table 1. Identifications and positions for the variables

No.	Identification	R.A. (J 2000)	Dec. (J 2000)	Other ID
01	NSVS 4732626[a]	$08^h01^m56^s.2$	+41°01′18″	···
02	DQ Lyn	$08^h23^m41^s.0$	+37°28′11″	···
03	NSV 17902[b]	$08^h30^m41^s.7$	+40°24′25″	NSVS 4812548[a]
04	Case A-F 232[c]	$08^h31^m52^s.2$	+38°32′14″	NSVS 4812987[a]
05	NSVS 4814234[a]	$08^h32^m49^s.6$	+43°16′02″	···
06	NSVS 4819931[a]	$08^h43^m56^s.7$	+43°22′13″	···
07	NSVS 4820967[a]	$08^h46^m10^s.2$	+43°04′31″	···
08	EN Lyn	$08^h46^m07^s.0$	+38°02′53″	···
09	NSVS 4822969[a]	$08^h50^m39^s.5$	+43°40′03″	···
10	NSVS 4894895[a]	$09^h44^m36^s.3$	+41°08′35″	BPS 16927-123 [d]
11	BN UMa	$11^h16^m22^s.9$	+41°14′02″	···
12	CK UMa	$12^h01^m36^s.4$	+31°54′12″	···

[a] Northern Sky Variability Survey, (Wozniak et al., 2004).
[b] New Catalogue of Suspected Variables, (Kholopov, 1982).
[c] Case A-F star.(Pesch and Sanduleak, 1989).
[d] HB-star candidate. (Beers et al., 1996).

[1]The National Optical Astronomy Observatories are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation

The remainder are A-F stars identified in the Case low-dispersion Northern Sky Survey (Pesch & Sanduleak, 1989) or unpublished stars from this survey that were kindly made available by P. Pesch (private communication, 1997). Identifications and coordinates of these stars are given in Table 1.

Most of the spectra from which the radial velocities were obtained were taken in the interval 2009 November 15 to 18 UT with the MMT blue-channel spectrograph. This gave flux-calibrated spectra that cover $\lambda\lambda$ 3600 – 4500 with a spectral resolution of 1.0Å. The spectra had a S/N in the range 50 to 100 which give radial velocities with a precision of 2 to 3 km s^{-1}. The spectra of NSVS 4822969 and CK UMa were taken on 2009 December 19 UT with the FAST spectrograph on the Whipple Observatory 1.5-m telescope. These spectra cover $\lambda\lambda$ 3600 – 5500, and have a spectral resolution of 2.3 Å and a S/N of 30. The radial velocities from these spectra have a precision of 5 km s^{-1}. The heliocentric radial velocities are presented in Table 2.

Table 2. Spectroscopic Observations

No.	JDH[a] +2400000.	Exp.[b] (sec)	RV[c] km s^{-1}	ϕ^d	No.	JDH[a] +2400000.	Exp.[b] (sec)	RV[c] km s^{-1}	ϕ^d
01	55154.046	210	+67	0.366	07	55152.040	150	−37	0.268
02	55151.049	30	+56	0.408	08	55154.048	90	−43	0.941
03	55151.046	150	+38	0.320	09	55185.058	570	+46	0.245
04	55151.038	300	+316	0.875	10	55154.035	60	+61	0.181
05	55151.042	130	+10	0.472	11	55154.038	90	+7	0.936
06	55152.043	120	−203	0.530	12	55185.049	180	−10	0.018

[a] Heliocentric Julian Date of mid-exposure;
[b] Exposure time;
[c] Heliocentric radial velocity;
[d] Phase of mid-exposure

The variability type of the new RR Lyrae stars was established by photometry in the 1990's but the ephemerides derived from these observations are now out of date. New photometric data were therefore needed to establish the phases of the spectroscopic observations. The JD(hel.), phases and V magnitudes of these new data are given in Table 3 (available electronically through the IBVS website as `5935-t3.txt`) and were obtained with the commercial robotic f/7 0.8-m telescope of the Tenagra Observatory in Arizona which has a 1024 × 1024 SITe CCD. Details of similar photometry with this telescope are given by Kinman & Brown (2010). Periods were determined using the periodogram program of Horne & Baliunas (1986); in the case of previously known variables, these were in satisfactory agreement with those found earlier. The JDH of the maxima of var. 6 and 9 take into account NSVS photometry and the 1990's photometry referred to above.

Phases for the times of observation of these spectra were derived from new ephemerides and are shown by vertical lines in the light curves (Fig. 1). The velocities of the type *ab* variables were then corrected to γ- velocities by the method given by Liu (1991) which scales the velocity amplitude against the V-mag. amplitude. In the case of the type *c* and type *d* variables, we took the known γ velocity and radial velocity curve of the type *c* variable T Sex (Liu & Janes, 1989, 1990) and scaled the correction to the γ-velocity by the ratio of the V- mag. amplitudes. As the referee has pointed out, these corrections can only be approximate — particularly for stars showing Blazhko effect (Jurcsik et al., 2002). These heliocentric γ-velocities are given with the new ephemerides and V_{max} and V_{min} in Table 4.

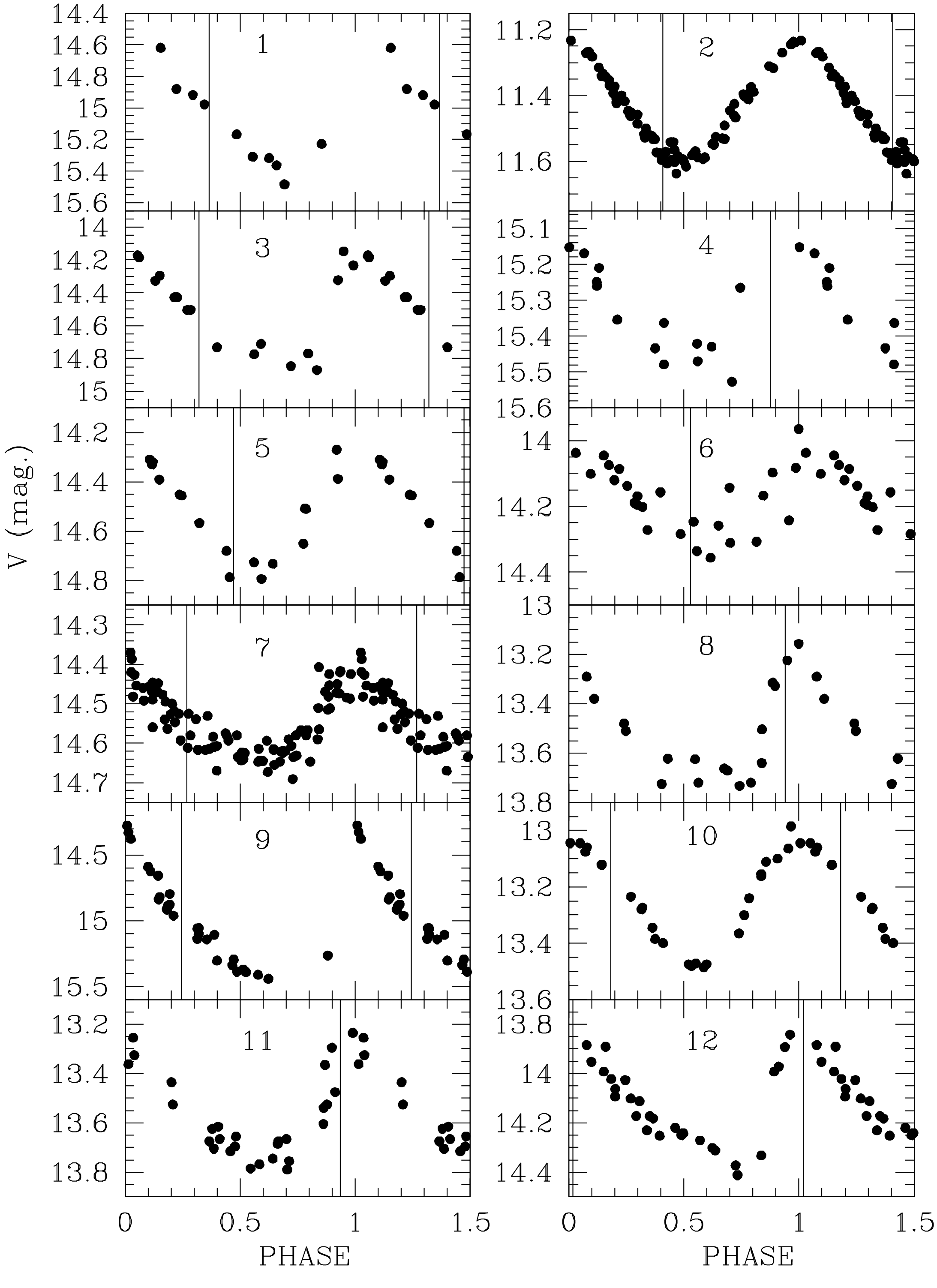

Figure 1. Light curves of variables (ordinate V magnitude).

Table 4. Radial Velocities and Ephemerides for the Variables

No.	ID	Period (days)	JDH Max +2400000.	V_{max} (mag)	V_{min} (mag)	RV† km s^{-1}	RR type	Notes
01	NSVS 4732626	0.5945	55149.667	14.6	15.5	+69	RR*ab*	
02	DQ Lyn	0.4948041	55153.816	11.23	11.60	+53	RR*c*	(1)
03	NSV 17902	0.6292137	52999.563	14.15	14.8	+42	RR*ab*	(2)
04	Case A-F 232	0.2887838	53000.790	15.18	15.47	+316	RR*c*	
05	NSVS 4814234	0.3091869	53000.192	14.20	14.72	+3	RR*c*	
06	NSVS 4819931	0.2831657	51274.504	14.0	14.3	−211	RR*c*	(3)
07	NSVS 4820967	0.087382	55153.939	14.44	14.62	−33	DSCT	
08	EN Lyn	0.6251465	55153.460	13.18	13.70	−32	RR*ab*	(4)
09	NSVS 4822969	0.497256	49338.200	14.30	15.46	+60	RR*ab*	
10	NSVS 4894895	0.35881	55208.509	13.02	13.48	+70	RR*c*	
11	BN UMa	0.39966	55208.817	13.25	13.75	+19	RR*d*	(5)
12	CK UMa	0.61031	55208.840	13.82	14.35	+16	RR*ab*	(6)

† Heliocentric γ radial velocity.

Notes:

(1) Period = 0.49489 days (Wils et al., 2006).

(2) Period = 0.62941 days (Kinemuchi et al., 2006).

(3) The considerable scatter appears to be caused by a Blazhko effect with a period of a few days.

(4) Period = 0.62532 days (Kinemuchi et al., 2006).

(5) McCluskey (2008) gives a fundamental period of 0.535786 days and a first overtone period of 0.39966 days. The first overtone has an amplitude of 2.48 times that of the fundamental.

(6) The adopted period is that given by Hoffleit (1972).

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*This version of the paper contains corrections, and differs from the one appeared on-line originally.

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DISCOVERY AND PHOTOMETRIC ORBITAL SOLUTION OF A NEW DOUBLE-LINED AND HIGHLY ECCENTRIC B5V ECLIPSING BINARY

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ANS (Asiago Novae and Symbiotic stars) Collaboration is monitoring in $UBVR_CI_C$ bands the photometric evolution of the 80 symbiotic stars for which Henden and Munari (2000, 2001, 2006) provided calibration photometric sequences. While observing the symbiotic star AX Per, it was noted that the star *b* of the photometric sequence by Henden and Munari (2006), located at RA=$01^h36^m42^s.4$ and DEC=$+54^\circ15'21''.0$ (J2000.0) and coincident with GSC 3671.0099 (= 3UC 289-030898 in the UCAC3 catalog), was indeed variable. Henden and Munari sequences, while accurately placed on the Landolt (1992) equatorial photometric standards, have been built from only three separate epoch observations. Unknown eclipsing binaries could easily pass undetected when only few observations are available, and Henden and Munari warned against the risk.

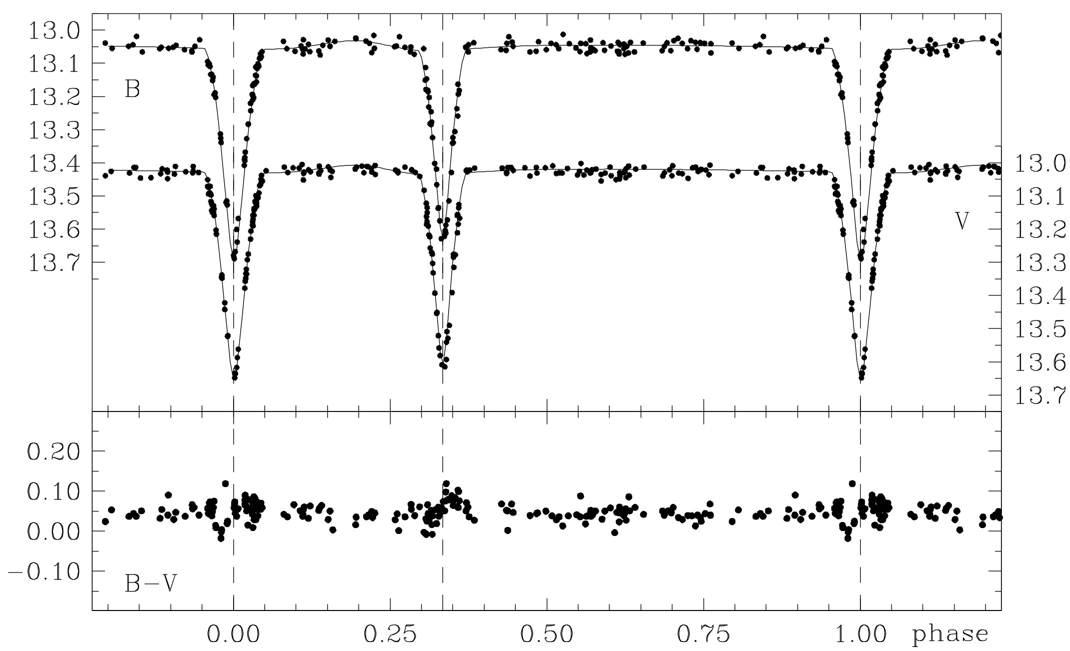

Figure 1. The photometric observations from Table 1 are plotted together with the light-curves corresponding to the photometric orbital solution from Table 2.

Table 2. Photometric orbital solution for the eccentric eclipsing binary GSC 3671.0099.

T_0(HJD)	2454158.301	±	0.275	$T_2(K)$	14480	±	60
P(d)	4.30885	±	0.00001	Ω_1	9.07	±	0.08
Phase shift	0.911	±	0.064	Ω_2	8.34	±	0.10
e	0.284	±	0.002	$R_1(R_\odot)$	3.08	±	0.03
ω(deg)	201.67	±	0.95	$R_2(R_\odot)$	3.41	±	0.05

After the serendipitous discovery of its variability (to which contributed the ANS Collaboration members G. Cherini, G.L. Righetti, S. Tomaselli, S. Moretti, A. Vagnozzi and S. Bacci), we started an intensive monitoring of GSC 3671.0099. During 135 different nights, we obtained 201 observations in B and 212 in V band with a 30cm telescope located in Cembra (Trento, Italy) and equipped with a SBIG ST-9 CCD camera, 512×512 array, 20 μm pixels ≡ 1″.72/pix, with a field of view of 13′×13′. The B filter was from Omega and the V filter from Custom Scientific. The data are given in Table 1 (available in electronic form through the IBVS website as `5936-t1.txt`). A Deeming-Fourier analysis promptly revealed the variability to be periodic with a period P=4.30885 days. Figure 1 plots the data in phase with the ephemeris for the primary minima $t_{minI} = 2454158.30072 + 4.30885 \times$ E. The light-curve shows GSC 3671.0099 to be a highly eccentric eclipsing binary, with secondary eclipse occurring photometric phase 0.33. The mean brightness values away from eclipses are $V = 13.046$ and $B - V = +0.047$, and the depth of the primary eclipse is $\Delta m = 0.65$. The star does not change color during both eclipses, or away from them.

To classify the variable, a low resolution, wide wavelength range spectrum of GSC 3671.0099 was obtained with the AFOSC imager+spectrograph mounted on the Asiago 1.82m telescope. The spectrum is presented in Figure 2. Comparison with the MK spectral atlas by Yamashita et al. (1977) shows the spectrum to be that of a normal B5V star. The intrinsic color of a B5V star is $(B - V)_\circ = -0.16$ (Fitzgerald, 1970), and therefore the reddening affecting GSC 3671.0099 is $E_{B-V} = +0.21$. This is close to $E_{B-V} = +0.27$ generally accepted for the nearby symbiotic star AX Per (Skopal et al., 2001; Mikołajewska & Kenyon, 1992).

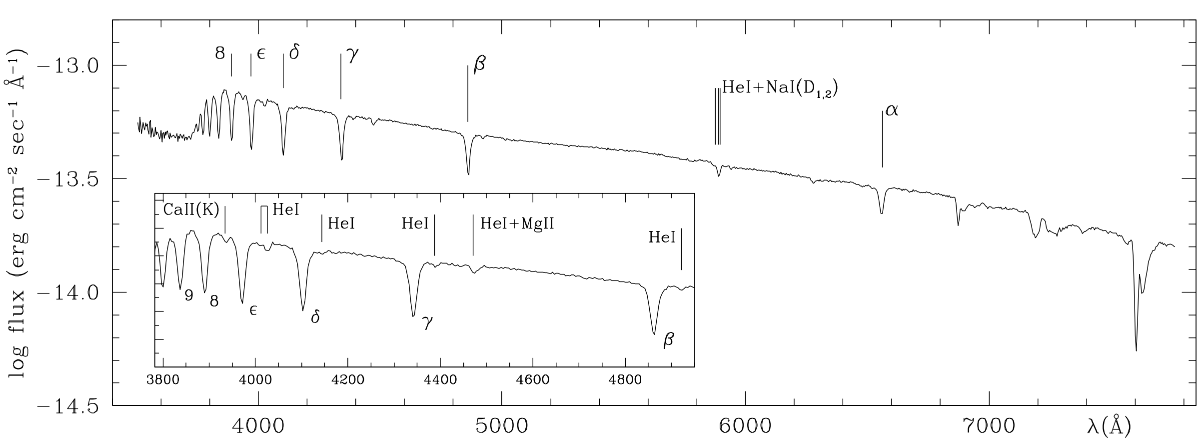

Figure 2. Low-resolution spectrum of the discovered new eclipsing star GSC 3671.0099. The insert highlights the wavelength range adopted by Yamashita et al. (1977) for spectral classification.

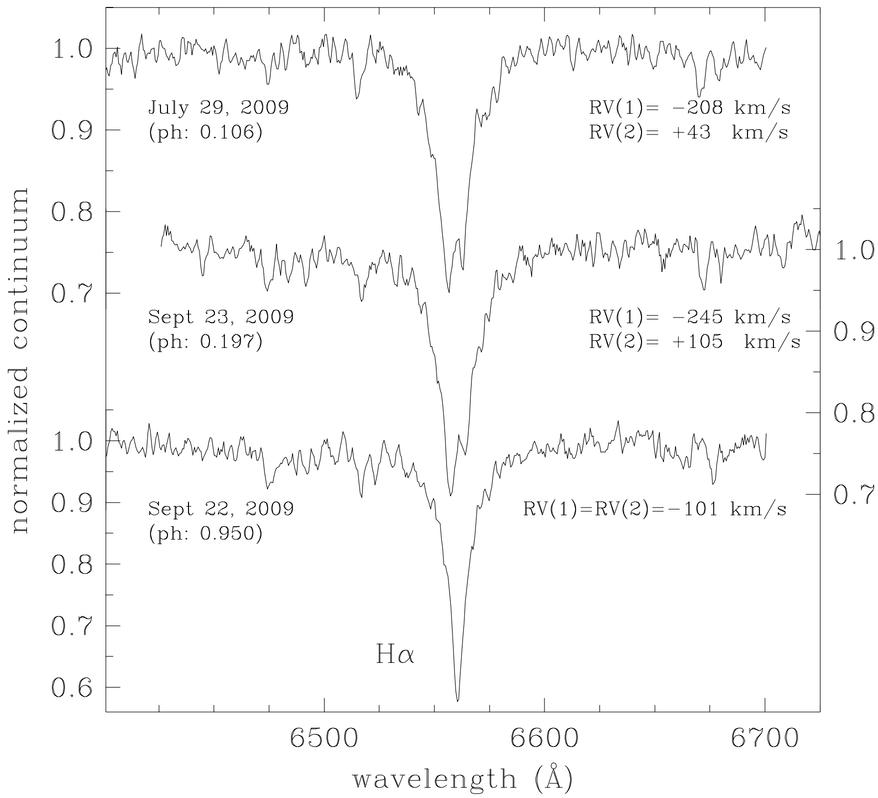

Figure 3. Observed H_α profiles and heliocentric radial velocities for GSC 3671.0099.

The presence of equally deep primary and secondary eclipses led to expect a double-lined nature for the newly discovered eclipsing binary. To verify this, three medium resolution spectra were obtained with the B&C spectrograph mounted on 1.22m Asiago telescope, and equipped with an ANDOR iDus 440A CCD camera, housing a EEV 42-10BU back-illuminated chip, 2048×512 pixels of 13.5 μm size. A 1200 ln/mm grating provided a dispersion of 0.61 Å/pix and a covered wavelength range of 5640-6860 Å. On these spectra, only Hα turned out to be strong enough to allow a meaningful profile to be recorded. The Hα profiles for the three spectra are presented in Figure 3, were heliocentric radial velocities and orbital phases are also provided. Figure 3 gives three strong indications: the system is double-lined as expected, the velocity separation of the two components support a mass ratio very close to 1.0, the luminosities of the two components are similar. However, given the low signal-to-noise ratio of the three spectra we avoid to use them to improve the orbital solution.

The WD98k93d code (Wilson and Devinney, 1971) was used to obtain only a photometric solution of the new eclipsing binary. From the B5V spectral classification and the calibrations of Straižys and Kuriliene (1981), we adopted as starting values for the primary a temperature $T_{\rm eff}$=15400 K and a mass M=4.79 $M_\odot$. The linear limb darkening coefficients were taken from Van Hamme (1993). The best fit to the light-curves was found for a mass ratio $q = 0.7$ and individual masses of M_1=5.62 $M_\odot$ and M_2=3.93 $M_\odot$. These nicely bracket the M=4.79 $M_\odot$ corresponding to B5V the spectral classification and are in visual good agreement with the radial velocity curves showed in Figure. 4. The semi-major axis is $a = a_1 + a_2$=23.62 $R_\odot$. The orbital inclination is not a critical parameter for deeply eclipsing binary stars. We obtained a set of different solutions for different values of the inclination and we found that $i = 87.5$ was the one best fitting the observed data. Finally, we assumed a periastron-syncronized rotation, with gravity brightening and albedo values equal to 1. The photometric orbital solution is given in Tab. 2. The radii of the stars are similar and close to the R=3.16 $R_\odot$ radius listed by Straižys and Kuriliene (1981) as typical for B5V stars. They are far smaller than their Roche lobe radii, and both component stars are not deformed by binary interaction. The light-curves corresponding to the orbital solution are overplotted to the B and V data in Figure 1 and show an excellent match.

The radial velocity curves corresponding to the photometric orbital solution of Table 2 are presented in Figure 4, where the measured radial velocities from Figure 3 are overplotted. The spectrum for Sept 22, 2009, secured at photometric orbital phase 0.950, corresponds to passage at stellar conjunction, and thus fixed to −101 km/sec the barycentric velocity of GSC 3671.0099. The model radial velocity curves were scaled to this value. The radial velocities at the other two observing dates well match the computed radial velocity curves. Given the limited resolution and S/N of the spectroscopic observations, and the fact that we were able to measure just one line (Hα), we do not attach more significance to this match than that of a welcome support to the photometric orbital solution. More accurate and far more numerous radial velocities, well distributed in orbital phase, are necessary to justify a combined photometric/orbital solution for this binary. The acquisition of the necessary spectroscopic observations are encouraged.

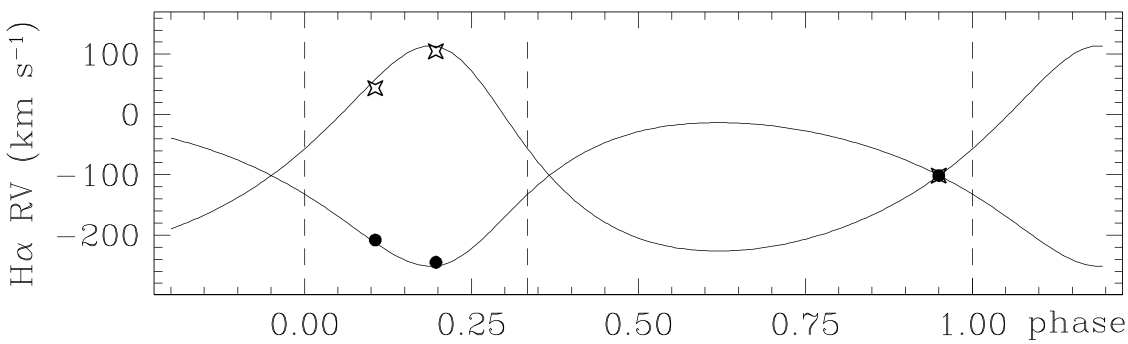

Figure 4. Radial velocity curves predicted from the orbital solution compared to observations of GSC 3671.0099 from Figure 3 (filled circles: primary component, stars: secondary component). The dashed lines marked the phases of eclipses from Figure 1.

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A NEW EPHEMERIS AND AN ORBITAL SOLUTION OF ϵ AURIGAE

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The bright star ϵ Aur (7 Aur, HD 31964, HR 1605; $V_{\rm max} = 3\overset{\rm m}{.}0$; F0Ia+?) is an unusual eclipsing binary with a very long orbital period of 27.1 years (see Guinan & Dewarf 2002 for a recent review). Its primary eclipse started in the summer 2009 and has naturally attracted the interest of many astronomers all over the world. The aim of this paper is to present our analysis of an extensive collection of archival and new photometry, and radial velocities (RVs), and provide a new, more precise ephemeris and orbital solution for the prediction of the current and future primary eclipses and a (not yet observed) secondary eclipse. Just prior to submission of this paper, Stefanik et al. (2010; hereafter ST) published their analysis of a comparable dataset for this same star. ST presented a new orbital solution and improved ephemeris for the binary but because the data analysis approach presented here is significantly different and may provide a more accurate ephemeris, we have proceeded to publish our results also.

We compiled and digitized a large collection of RVs from the literature, including ST's dataset of 515 RVs obtained at the Harvard-Smithsonian Center for Astrophysics (CfA). These data were augmented by our new series of electronic spectra from the Dominion Astrophysical Observatory (DAO) and the Ondřejov Observatory. Altogether, these RVs span an interval of 110 years. These RV observations are summarized in Table 1 and are plotted vs. time in Figure 1[1]. We also collected and digitized light curves from all six previously observed eclipses. Additionally, for the 2010 eclipse, we used standard photoelectric V photometry obtained by PC, HB, DR, DS and MW at Hvar Observatory, CCD V-band photometry obtained by ML at the Hradec Králové Observatory, and visual observations by PD reduced to Johnson V magnitude. These observations are listed in Table 2 and the individual eclipses are plotted in Figure 2[2].

[1] RVs obtained during primary eclipse were not used in our solution because they are known to deviate from purely orbital motion. These eclipse RVs are not included in Table 1 or Figure 1.

[2] Some observations were not included because of their large scatter and/or unsufficient coverage of a particular eclipse. We have also omitted extended datasets outside eclipse. These omitted data do not appear in either Table 2 or Figure 2.

Table 1. Journal of available RVs.

from years	observatory	No.	reference
1899–1932	Yerkes	298	Frost et al. (1929)
1901–1913	Postdam	173	Ludendorff (1924)
1928–1958	Mt.Wilson	53	Struve et al. (1958)*
1970–1971	Haute Provence	18	Castelli (1977)
1989–2009	CfA	515	Stefanik et al. (2010)
1994–2009	DAO	99	this paper**
2006–2009	Ondřejov	109	this paper**

* RVs computed from the mean of 6 lines — Fe II 4123, Mg II 4481, Fe II 4508, Fe II 4515, Fe II 4576 and Fe II 4629 Å.

** RVs computed from the mean of 5 lines — Si II 6347, Si II 6371, Fe II 6417, Fe II 6433 and Fe II 6456 Å.

Table 2. Journal of photometric observations during primary eclipses.

mid-eclipse	observer	passband*	No.	reference
1848	J.F.J.Schmidt	pv	39	Ludendorff (1912)
1875	J.F.J.Schmidt	pv	69	Ludendorff (1912)
1902	J.Plassmann	pv	29	Ludendorff (1903)
1902	F.Schwab	pv	38	Ludendorff (1903)
1929	C.M.Huffer & J.Stebbins	pe	98	Huffer (1932)
1956	K.Gyldenkerne	V	131	Gyldenkerne (1970)
1956	G.Larsson-Leander	V	106	Larsson-Leander (1959)
1983	J.L.Hopkins	V	130	Schmidtke (1985)
1983	S.Ingvarsson	V	119	Schmidtke (1985)
2010	Hvar Obs.	V	100	this paper
2010	M.Lehký	V	21	this paper
2010	P.Dubovský	pv(V)	28	this paper

* Abbreviations 'pv' and 'pe' stand for photovisual and photoelectric, respectively.

Here we provide more details of the new datasets. The DAO CCD spectra were obtained by SY and PDB and have a linear dispersion of 10 Å mm^{-1} . The Ondřejov CCD spectra were obtained by PH, PŠ, MŠ, MW and a few other observers and have a dispersion of 17 Å mm^{-1} . Both the DAO and Ondřejov datasets cover the spectral region around 6300–6700 Å. Their initial reductions were carried by SY and MŠ in IRAF. Rectification and RV measurements of the spectra were carried out by PC using the SPEFO (Horn et al. 1996, Škoda 1996) program's capability to compare direct and inverted line profiles. The zero point of the RV scale was determined by measurement of selected telluric lines (Horn et al. 1996). The Hvar dataset is actually UBV photometry carefully reduced to the standard system (Harmanec, Horn and Juza 1994). The Hradec Králové CCD $BVRI$ photometry was obtained with a 2.8/29 Pentacon auto lens and SBIG ST-5C CCD camera. The visual estimates by PD, reduced to Johnson V-band magnitude scale, were carried out using a modified version of Argelander's method developed by S. Otero (Štefl et al. 2003). It is based on a cone vision and calibration technique used to minimize the effects of extinction and colour differences. We are making all new RVs and photometric datasets available with the electronic version of this paper[3]; the remaining RV and photometric data are already accessible from the electronic version of ST.

[3]5937-t1.txt – t5.txt

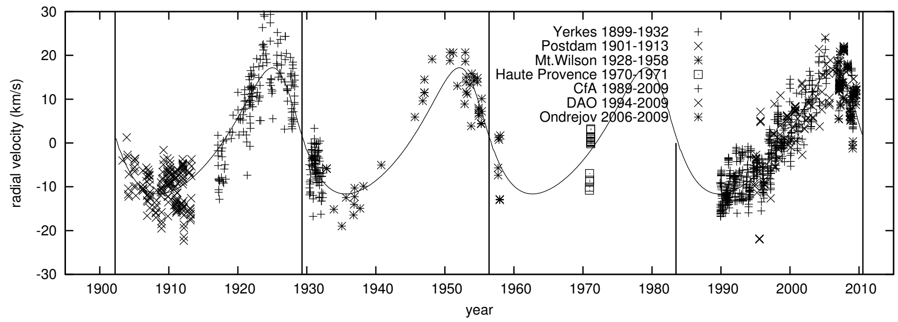

Figure 1. RVs used in the orbital solution and the derived PHOEBE fit (curve). The vertical lines denote individual eclipses (during which RVs were not used in the solution). Plotted RVs are corrected for their individual γ velocities.

We used two independent programs, PHOEBE 0.31 (Prša & Zwitter 2005) and FOTEL (Hadrava 2004), to derive new orbital solutions and formal light-curve solutions. All data sets were assigned weights inversely proportional to the squares of their rms errors derived from preliminary solutions. In FOTEL, we allowed calculations of individual systemic (γ) velocities for individual spectrographs. Since PHOEBE can treat only a single RV set, we used RVs with individual γ velocities subtracted. It turned out that the rms errors per observation for the RV sets in Table 1 were between 4 and 6 $\mathrm{km\,s^{-1}}$. This indicates that the scatter is dominated by the intrinsic variations of the F star because the actual measurement errors are typically less than 1 $\mathrm{km\,s^{-1}}$. The RV solutions were used to derive the orbital eccentricity (e), longitude of periastron (ω) and RV semiamplitude of a primary K_1, and the resulting values were then held fixed in the light-curve (LC) solutions. This is because the photometric data used only covers orbital phases near primary eclipse and, therefore, these data do not constrain the eccentric orbit. LC solutions were used to derive an improved ephemeris, assuming a mass ratio fixed at unity, and inclination fixed at 87°. The derived photometric period was held fixed again for the final iteration of the orbital solution, evaluated using the *unconstrained system* option in PHOEBE.

The final photometric ephemerides (based exclusively on the LC solutions) are:

$T_{\rm prim.min.}$ = HJD (2455402.8 ± 1.0) + ($9890\overset{\rm d}{.}26 \pm 0\overset{\rm d}{.}62$) × E (PHOEBE),

$T_{\rm prim.min.}$ = HJD (2455403.7 ± 1.1) + ($9890\overset{\rm d}{.}98 \pm 0\overset{\rm d}{.}50$) × E (FOTEL).

The epoch of primary minimum was allowed to vary independently for both the RV and LC solutions. We strongly prefer the more accurate value from photometry. For instance, the epoch of the primary minimum from the final RV solution in FOTEL at HJD 2455347 differs significantly from the above ephemerides. ST arrived at the same conclusions from their orbital solution; they obtained the epoch of the primary minimum at JD 2455136 (compared to their photometric minimum at JD 2455413). ST suggested that the gravitating companion responsible for the orbital motion need not be the same as the extended gaseous structure responsible for the eclipses. However, they also noted that intrinsic radial velocity variations in the F supergiant's atmosphere might bias the orbital solution, thereby accounting for the discrepancy between the photometric and RV solutions. We carried out an orbital solution in which the epoch of photometric mid-eclipse was held fixed and found that the resulting rms error was virtually identical to that of a solution converged with the epoch free to vary. This result strongly suggests that the discrepancy is due to intrinsic RV variations of the F supergiant and not due to asymmetry in the companion's structure.

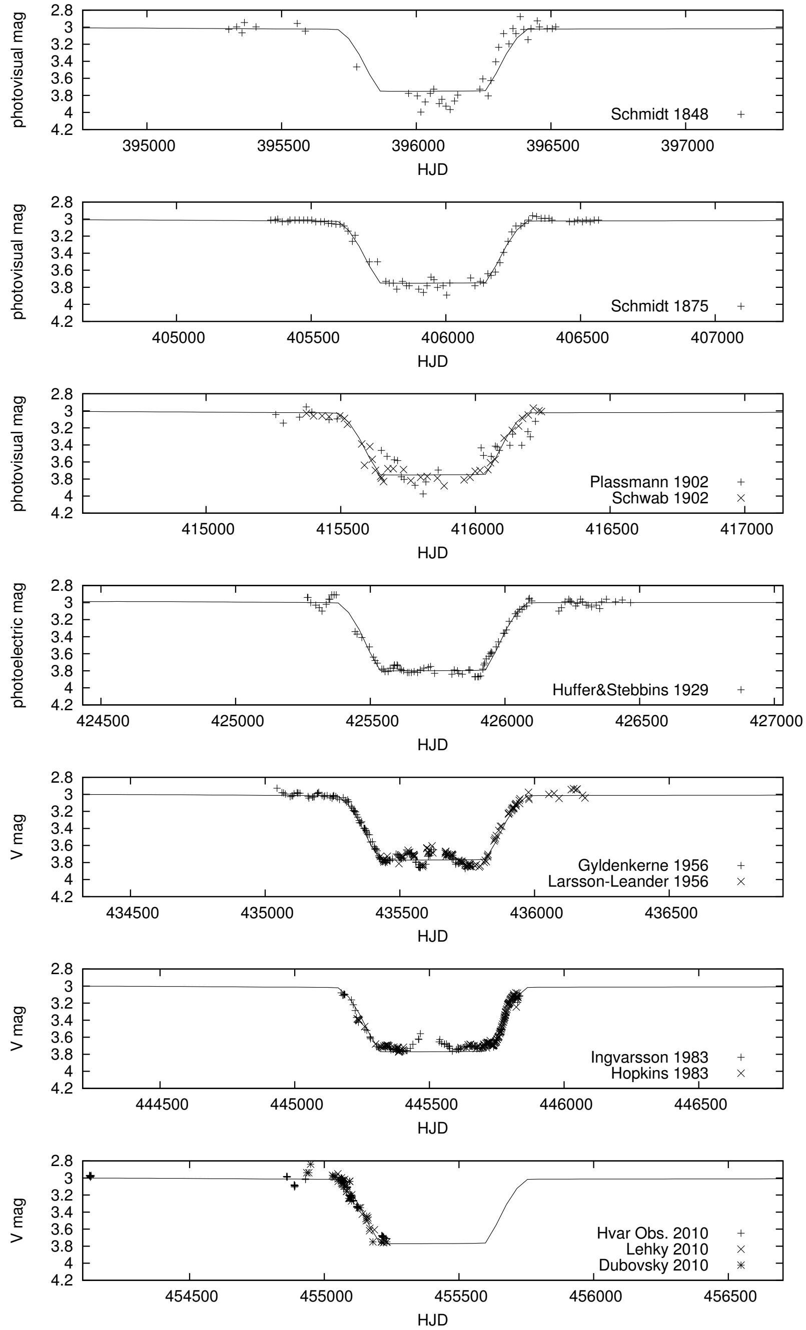

Figure 2. Light curves from the last 6 eclipses, the current 2010 eclipse, and the PHOEBE fit (solid curve) are shown. Each measurement set is corrected to its individual 'zero level' magnitude. Mid-eclipse epochs have been centered using the new ephemeris and have been plotted on the same magnitude scale to facilitate visual comparison.

Table 3. New RV and LC solutions compared to those of Wright and Stefanik.

element	PHOEBE	FOTEL	Wright	Stefanik
$T_{\rm periastron}$	2454596 ± 23*	2454622 ± 97*	2453130 ± 280$^{*}_{\#}$	2454515 ± 80$^{*}_{\#}$
$T_{\rm prim.min.}$	2455402.8 ± 1.0	2455403.7 ± 1.1	2455323$_{\#}$	2455413.8 ± 4.8
$T_{\rm sec.min.}$	2451681 ± 120$^{*}_{+}$	2451610 ± 180$^{*}_{+}$	–	–
P (d)	9890.26 ± 0.62	9890.98 ± 0.50	9890 (assumed)	9896.0 ± 1.6
e	0.256 ± 0.012	0.249 ± 0.015	0.200 ± 0.034	0.227 ± 0.011
ω (°)	41.2 ± 3.1	43.3 ± 4.0	346±11	39.2 ± 3.4
K_1 (km s^{-1})	14.40 ± 0.38	14.30 ± 0.25	15.00 ± 0.58	13.84 ± 0.23

* Errors from RV solutions. + Errors are semianalytical estimates. # Epochs recalculated for the authors' original periods.

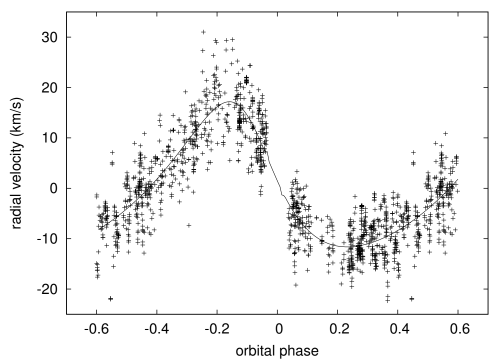

Figure 3. A phase plot of all RVs used in the orbital solution, and the derived PHOEBE fit (solid curve). Plotted RVs have been corrected for their individual γ velocities. Note that PHOEBE also accounts for rotational effect during eclipse.

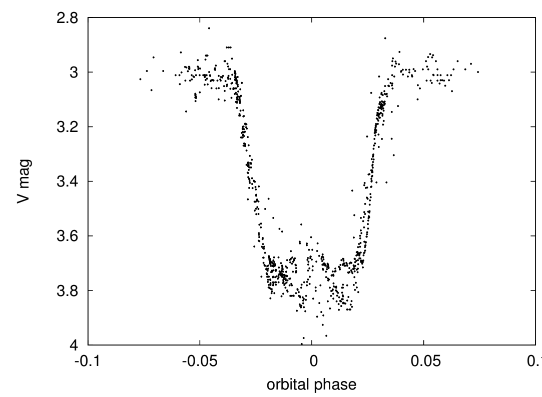

Figure 4. A phase plot of all photometric observations used in the ephemeris calculation. Each measurement set has been corrected for individual 'zero level' magnitude.

We present our orbital solutions in Table 3, along with those of Wright (1970) and ST. A phase plot, using our new ephemeris from PHOEBE, of all RVs and photometry is shown in Figure 3. Note that our new solutions, obtained with two independent programs, agree within their respective errors. Our ephemerides predict the next primary mid-eclipse will occur on July 25-26, 2010, and the next secondary mid-eclipse in 2027. The previous secondary eclipse should have occurred in 2000. When compared to Wright, we obtain a significantly different orientation of the orbit in space (longitude of periastron ω), a higher eccentricity (e), and a different epoch of the primary minimum. Our results are much closer to the ST solution, but we still disagree with ST by more than the estimated errors. At the request of the referee, we mention that the resulting relative photometric radii from the LC solutions were 0.045 and 0.216 from PHOEBE, and 0.058 and 0.218 from FOTEL. We caution the reader, however, not to give these values much weight since neither program can treat disks; both assume two stellar bodies.

Two important conclusions about ϵ Aur, which disagree with the generally accepted model, follow from our study:

1. Inspection of Figs. 2 and 3 shows that the idea of a central brightening inside the eclipse, interpreted as evidence of a hole in the disk (see, e.g., Carroll et al. 1991), should be reconsidered. Note that the 'flat' part of each recorded eclipse is different and what is seen are most probably the physical light variations, similar to the out-of-eclipse

variability. Of course, the final conclusion will come from a detailed analysis of colour changes and other types of observations and from the photometry secured this summer.

2. The right panel of Figure 3 shows that claims of variability in the width and duration of individual observed eclipses, which have been used to infer a decline in the primary's radius over time (Saito 1986), are not supported by the data. It is apparent that the cyclic but irregular physical light variations affected the different eclipses differently. It will be difficult to obtain a 'pure' eclipsing light curve without a better understanding and quantitative description of these light changes.

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*This version of the paper contains corrections, and differs from the one appeared on-line originally. Date of last modification: Sat May 1 22:27:41 MEST 2010

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TIMES OF MINIMA FOR ECLIPSING BINARIES 2009

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Observatory and telescope:
25cm catadioptric telescope at Rolling Hills Observatory (RHO)

Detector:	SBIG ST-9XE, Peltier cooling, Kodak KAF-0261 chip, $18'.5 \times 18'.5$ FOV, 512×512 pixels.

Method of data reduction:
Reduction of the CCD frames was done with sextractor and custom-written applications [1].

Method of minimum determination:
The heliocentric times of minima and the error estimates were computed using the Kwee and van Woerden method as implemented in a custom-written C application. A floor of 0.0001d (~8 seconds) was applied to the error estimates to allow for the error contribution due to barycentric variation, and as somewhat arbitrary allowance for timing errors and the overly optimistic error estimates of the Kwee and van Woerden method.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
BX And	54842.5615	0.0001	I	*V*	
	54860.5621	0.0001	II	*V*	
CN And	54848.5527	0.0001	II	*V*	
V0376 And	54846.6108	0.0001	II	*V*	
V0417 Aur	54866.6169	0.0001	II	*B*	
HL Aur	54901.5814	0.0001	I	*V*	
HW Aur	54893.6411	0.0001	I	*V*	
IU Aur	54876.6797	0.0001	I	*V*	
ZZ Aur	54869.6709	0.0001	I	*V*	
AC Boo	54862.9405	0.0001	II	*V*	
UW Boo	54898.7873	0.0002	II	*V*	
AY Cam	54899.6132	0.0002	II	*V*	
AZ Cam	54888.6301	0.0001	I	*V*	
CD Cam	54883.6928	0.0001	II	*V*	
	54896.6875	0.0001	II	*V*	

[1] sextractor is written by Emmanuel Bertin and is available from `http://terapix.iap.fr/`

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
DN Cam	54867.6387	0.0001	II	*V*	
	54886.5728	0.0001	II	*V*	
FN Cam	54895.6165	0.0001	II	*V*	
EG Cep	54915.9218	0.0001	I	*V*	
AK CMi	54853.6479	0.0001	I	*V*	
BF CMi	54868.8339	0.0003	I	*V*	
UZ CMi	54925.6602	0.0001	II	*V*	
XZ CMi	54894.5864	0.0001	I	*V*	
AH Cnc	54946.6421	0.0001	I?	*V*	
W Crv	54934.690	0.001	I	*V*	
BI CVn	54871.8029	0.0001	I	*V*	
DF CVn	54950.6199	0.0001	I	*V*	
V0836 Cyg	55010.8009	0.0001	I	*V*	
AR Dra	54886.6715	0.0001	I	*V*	
BH Dra	54944.7758	0.0001	I	*V*	
BV Dra	54898.7971	0.0001	II	*V*	
BW Dra	54897.8187	0.0001	I	*V*	
FU Dra	54901.7606	0.0001	I	*V*	
	54937.8016	0.0001	II	*V*	
UZ Dra	54962.8256	0.0001	II	*V*	
AF Gem	54857.5498	0.0001	I	*V*	
FG Gem	54876.5787	0.0001	I	*V*	
GX Gem	54872.5817	0.0001	II	*V*	
HR Gem	54854.5394	0.0001	I	*V*	
QW Gem	54870.620	0.002	I	*V*	
LT Her	54945.7946	0.0001	I	*V*	
SZ Her	54926.8595	0.0001	I	*V*	
UX Her	54937.8978	0.0001	I	*V*	
V0728 Her	54897.9138	0.0001	II	*V*	
	54915.8265	0.0001	II	*B*	
	54981.8063	0.0002	II	*V*	
	54982.7488	0.0001	II	*V*	
V0842 Her	55010.6476	0.0001	I	*V*	
V0899 Her	54899.8229	0.0002	I	*V*	
Z Lep	54868.5639	0.0001	I	*V*	
VW LMi	54871.6723	0.0001	I	*V*	
RY Lyn	54945.6002	0.0001	I	*V*	
SW Lyn	54902.6246	0.0001	I	*V*	
UV Lyn	54887.6127	0.0001	I	*V*	
V0714 Mon	54841.6094	0.0003	II	*V*	
ER Ori	54842.6693	0.0001	II	*V*	
V0647 Ori	54854.6654	0.0001	II	*V*	
V1363 Ori	54872.6159	0.0001	I	*V*	
IK Per	54879.5353	0.0001	I	*V*	
IQ Per	54868.5899	0.0001	I	*B*	
NZ Per	54849.5927	0.0001	I	*V*	

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
RV Per	54870.6687	0.0001	I	*V*	
V0432 Per	54841.6843	0.0001	I	*V*	
	54871.5814	0.0001	I	*V*	
UZ Pup	54863.6964	0.0001	II	*V*	
AC Tau	54834.7884	0.001	II	*V*	
AH Tau	54848.6737	0.0001	I	*V*	
CT Tau	54880.6329	0.0001	I	*V*	
WY Tau	54898.5490	0.0002	I	*V*	
V Tri	54867.5444	0.0001	I	*V*	
AA UMa	54854.7488	0.0001	I	*V*	
AW UMa	54921.7947	0.0002	I	*V*	
II UMa	54949.6403	0.0001	II	*V*	
KM UMa	54901.6523	0.0001	I	*V*	
UY UMa	54880.8244	0.0001	I	*V*	
	54886.8404	0.0001	I	*V*	
VV UMa	54870.8314	0.0002	I	*V*	
HW Vir	54841.8577	0.0001	II	*V*	
	54841.9159	0.0001	I	*V*	
	54841.9743	0.0001	II	*V*	
HT Vir	54909.8015	0.0001	I	*V*	
NN Vir	54926.821	0.001	I	*V*	
VV Vir	54920.8037	0.0001	I	*V*	

Reference:

Kwee, K. K. & van Woerden, H., 1956, *BAN*, **12**, 327

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OPTICAL PHOTOMETRY OF PARSAMIAN 21

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One of the most impressive events during the early stages of stellar evolution is the FU Orionis (FUors) outbursts (Herbig, 1977). The main characteristics of FUors are an increase in optical brightness of about 4-5 mag, a F-G supergiant spectrum with broad blueshifted Balmer lines, strong infrared excess, and connection with reflection nebulae. The light curves of FUors are characterized by a rapid rise in brightness to the maximal light (outburst) followed by a relatively slow decrease in brightness after the outburst (Clarke et al., 2005). According to Hartmann & Kenyon (1985) the FUor outburst is a result of a major increase of accretion from a circumstellar disk on the stellar surface.

Parsamian 21 is a young stellar object surrounded by an extended reflection nebula, located in a small dark cloud in Aquila. The object was discovered on the plates from the Palomar Observatory Sky Survey and included in the catalog of cometary nebulae (Parsamian, 1965). On the basis of optical spectroscopic and far-infrared properties Parsamian 21 was classified as a FUor object (Staude & Neckel, 1992). Results supporting the FUor nature of Parsamian 21 were published in Kóspál et al. (2008). Parsamian 21 was a subject of many studies, but very few optical photometric data have been published to the present (Parsamian & Petrosian, 1978, Neckel & Staude, 1984). Since no outburst was observed at optical wavelengths in most of the studies Parsamian 21 is classified as FUor-like object (Greene et al., 2008).

In this paper we present $BVRI$ photometric data of Parsamian 21 obtained in the period Feb. 2003 - Jul. 2009. Our observations were performed with two telescopes: the 2-m RCC telescope of the National Astronomical Observatory Rozhen (Bulgaria) and the 1.3-m RC telescope of the Skinakas Observatory[1] of the Institute of Astronomy, University of Crete (Greece). Three different CCD cameras were used during the period of our photometric observations. The technical parameters and chip specifications for the CCD cameras used are summarized in Table 1. All frames were taken through a standard Johnson-Cousins set of filters. Aperture photometry was performed using IDL DAOPHOT routines. The procedure used calculate the centroid of stellar object and the mean value of the background around it. The digitized plates from the Palomar Schmidt telescope, available via the website of the Space Telescope Science Institute, are used, too.

In order to facilitate transformation from instrumental measurements to the standard system a sequence of sixteen comparison stars in the field of Parsamian 21 was calibrated in $BVRI$ bands. Calibrations were made with the 1.3 m RC telescope during nine clear

[1] Skinakas Observatory is a collaborative project of the University of Crete, the Foundation for Research and Technology - Hellas, and the Max-Planck-Institut für Extraterrestrische Physik.

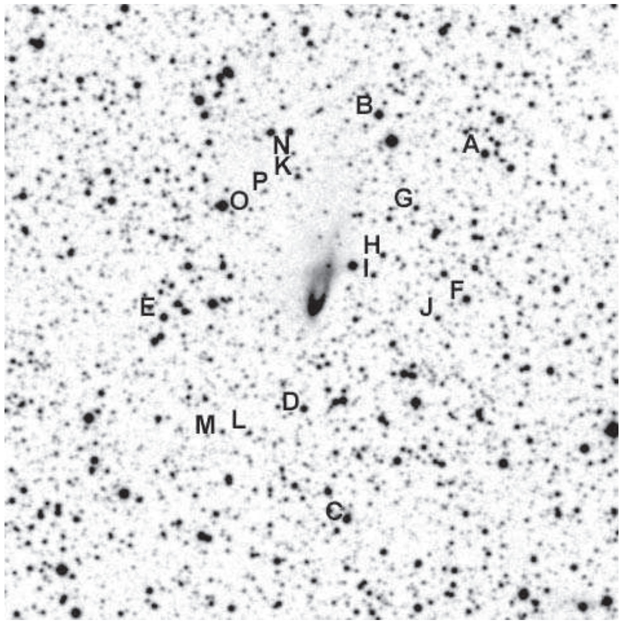

Figure 1. A finding chart of the comparison sequence in the field of Parsamian 21

Table 1. CCD cameras and chip specifications

Telescope	CCD type	Size	Pixel size	Field	RON
2-m RCC	Photometrics AT200	1024×1024	24μm	$5'.6 \times 5'.6$	3.9ADU/rms
1.3-m RC	Photometrics CH360	1024×1024	24μm	$8'.5 \times 8'.5$	2.6ADU/rms
1.3-m RC	ANDOR DZ436-BV	2048×2048	13.5μm	$9'.6 \times 9'.6$	5.3ADU/rms

nights in 2007, 2008 and 2009. Standard stars from Landolt (1992) were used as a reference. The finding chart of the comparison sequence is presented in Fig. 1. The chart is retrieved from the STScI Digitized Sky Survey Second Generation Red. The field is $8'.0 \times 8'.0$, centered on Parsamian 21. North is at the top and east to the left. Table 2 contains the coordinates and the photometric data for the $BVRI$ comparison sequence. The corresponding mean errors of the mean are listed, too. The comparison sequence contains stars both redder and bluer than Parsamian 21, labeled from A to P in order of their V-band magnitude.

The results from our CCD photometric observations are given in Table 3. The table contains Date, the Julian Date, the Ic, Rc, V and B magnitudes. In order to minimize the light from the surrounding nebula we used a $2''.5$ radius aperture. The background is taken between radii $10''$ and $12''.5$. The typical seeing during our observations vary between $1''.5$ and $2''$. The typical instrumental errors from CCD photometry are in the range $0^{m}.01$- $0^{m}.02$ for I and R, $0^{m}.03$-$0^{m}.05$ for V and $0^{m}.05$-$0^{m}.09$ for B filter. Aperture photometry of the digitized plates from POSS-I, POSS-II and Quick-V sky surveys was performed with the same parameters as for the CCD observations. The $BVRI$ comparison sequence reported in the present paper was used as a reference. The results of estimating magnitudes of the Palomar photographic plates are summarized in Table 4. The light curves of Parsamian 21 from all observations are plotted on Fig. 2. The photometric data published by Parsamian & Petrosian (1978) and Neckel & Staude (1984) are not consistent with our observations due to the different parameters of measurements (aperture radius and background position).

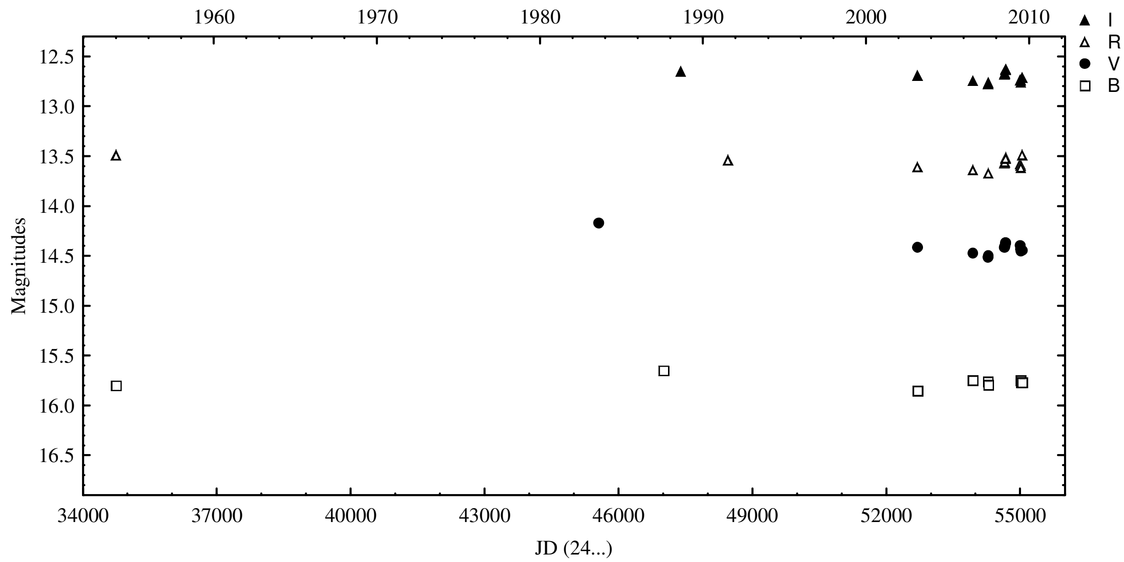

Figure 2. B/pg, V, R and I light curves of Parsamian 21.

Our CCD photometric observations of Parsamian 21 in the period 2003 - 2009 show that the brightness of the star is almost steady. We observed only low amplitude fluctuations of about $0\overset{\rm m}{.}07$ (I) around the middle values. Comparing our CCD photometric observations with the data from Palomar plates showed no significant change in the brightness of the star for a very long period (57 years). Due to the small number of objects known as FUors their classification is very difficult. The shape of observed light curves of FUors may vary considerably from object to object. The results from our study suggest that the photometric behaviour of Parsamian 21 appears different from the well studied FUors (FU Ori, V1515 Cyg and V1057 Cyg). Another object with a similar photometric behaviour is the classical FUor star V1735 Cyg (Peneva et al., 2009). We conclude that Parsamian 21 is probably a member of the group of long-lived FUors and that the time-scale of the FUor phenomenon in some cases is much longer than that predicted in

Table 2. $VIcRcB$ photometric data for the comparison sequence

Star	R.A.(2000)	DEC.(2000)	V	σ_V	Ic	σ_I	Rc	σ_R	B	σ_B
A	19:28:51.92	09:40:45.3	14.418	0.020	13.210	0.023	13.838	0.027	15.411	0.047
B	19:28:57.51	09:41:15.3	14.474	0.028	12.569	0.026	13.500	0.037	16.229	0.064
C	19:28:59.17	09:36:00.8	14.969	0.039	12.422	0.040	13.676	0.044	17.160	0.021
D	19:29:01.43	09:37:26.4	15.138	0.015	14.071	0.016	14.606	0.025	16.049	0.035
E	19:29:08.80	09:38:37.7	15.402	0.043	12.514	0.043	14.008	0.045	17.730	0.044
F	19:28:52.86	09:38:51.3	15.450	0.036	13.172	0.035	14.270	0.042	17.449	0.053
G	19:28:55.53	09:40:02.8	16.325	0.028	14.826	0.040	15.596	0.033	17.546	0.040
H	19:28:57.29	09:39:25.5	16.536	0.035	14.560	0.044	15.519	0.045	18.239	0.080
I	19:28:57.77	09:39:10.3	16.698	0.051	15.158	0.033	15.920	0.035	18.044	0.175
J	19:28:54.35	09:38:37.2	16.934	0.041	14.821	0.023	15.843	0.049	18.700	0.207
K	19:29:01.73	09:40:26.8	16.943	0.028	14.680	0.039	15.778	0.042	18.911	0.114
L	19:29:04.29	09:37:07.1	17.429	0.026	15.300	0.043	16.366	0.045	19.247	0.074
M	19:29:05.72	09:37:08.1	17.560	0.056	15.386	0.037	16.461	0.048	19.472	0.300
N	19:29:02.01	09:40:44.9	17.746	0.042	16.270	0.062	17.045	0.055	18.891	0.094
O	19:29:04.25	09:40:01.5	17.937	0.063	16.535	0.058	17.157	0.073	19.346	0.149
P	19:29:03.50	09:40:15.6	18.311	0.038	16.225	0.099	17.246	0.039	20.069	0.217

previous studies.

Table 3. CCD photometric observations of Parsamian 21

Date	J.D.(245...)	*Ic*	*Rc*	*V*	*B*	CCD	Tel.
2003 Feb 27	2698.614	12.69	13.61	14.41	15.85	Photometrics	2m RCC
2006 Jul 21	3938.353	12.74	13.64	14.47	15.75	Photometrics	2m RCC
2007 Jun 26	4278.322	12.78	–	14.51	15.76	Photometrics	1.3m RC
2007 Jul 03	4285.313	12.76	13.67	14.50	15.79	Photometrics	1.3m RC
2008 Jun 28	4646.310	12.68	13.57	14.42	–	ANDOR	1.3m RC
2008 Jul 05	4653.313	12.68	13.56	14.40	–	ANDOR	1.3m RC
2008 Jul 06	4654.325	12.67	13.56	14.41	–	ANDOR	1.3m RC
2008 Jul 24	4672.316	12.63	13.51	14.37	–	ANDOR	1.3m RC
2008 Jul 25	4673.310	12.63	13.52	14.37	–	ANDOR	1.3m RC
2009 Jun 14	4997.515	12.74	13.58	14.40	–	ANDOR	1.3m RC
2009 Jun 26	5009.503	12.74	13.59	14.43	15.75	ANDOR	1.3m RC
2009 Jul 01	5014.502	12.76	13.62	14.45	15.77	ANDOR	1.3m RC
2009 Jul 31	5044.309	12.71	13.49	14.45	15.77	ANDOR	1.3m RC

Table 4. Photographic observations of Parsamian 21 from the Palomar Schmidt plates

Plate No.	Band	Date	J.D. (24...)	Magnitude
506E	R	1952 May 25	34742.016	13.49±0.09
506O	pg	1952 May 25	34742.032	15.80±0.10
573V	V	1983 Aug 11	45557.972	14.17±0.09
1333	B	1987 Jul 30	47006.938	15.65±0.10
3991	I	1988 Aug 19	47393.032	12.65±0.08
4712	R	1991 Jul 17	48455.032	13.53±0.08

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THE HIGHLY ACTIVE LOW-MASS ECLIPSING BINARY BS UMa

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BS UMa was found to be a short-period eclipsing binary by Meinunger and Wenzel (1968). They gave a period of 0.437016 days, but later on this turned out to be a spurious period. The correct period of 0.34951 days was given by Diethelm (2009). Lampens et al. (2010) noted that the given ephemeris is in fact that for the secondary minimum.

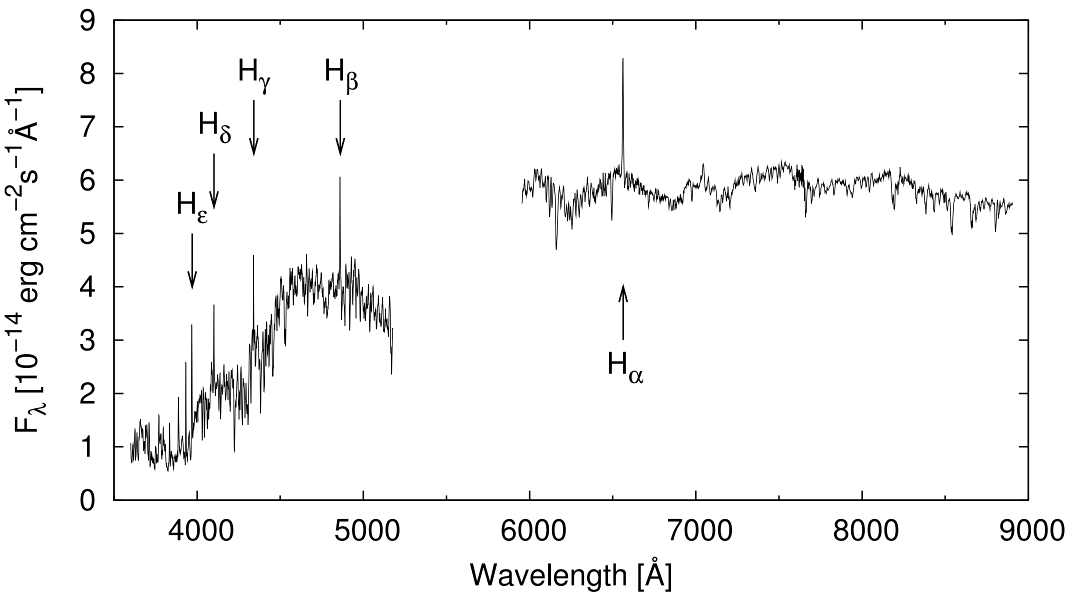

Figure 1. Spectrum of BS UMa taken on JD 2454512.5 with WHT/ISIS, total exposure time 1500 seconds. The spectrum was flux-calibrated with SP0946+139 and telluric lines were removed. For details of the data reduction method see Southworth et al. (2007a & 2007b).

From a simple black body fit to the available photometry in the literature (2MASS, SDSS, CMC, GALEX) and the low-resolution spectrum discussed below, a temperature of $T_1 = 3800 \pm 100K$ can be estimated for the brightest star in the BS UMa system, making it of late K to early M spectral type. Interstellar extinction has been neglected in this, as $E(B-V) = 0.018$ in the direction of the object (Schlegel et al., 1998). BS UMa is also known as the X-ray source 1RXS J112540.3+423449, indicating chromospheric activity.

Low-mass eclipsing binaries are of interest because they can provide the necessary physical parameters to test the evolutionary models for the low-mass main-sequence stars.

Until recently very few were known (see e.g. Dimitrov & Kjurkchieva, 2010). Therefore BS UMa was chosen as a target for further study.

A low-resolution spectrum was taken with the ISIS double-beam spectrograph on the William Herschel Telescope (WHT) at La Palma in February 2008 (see Fig. 1). It shows the Balmer lines in emission, another indication of chromospheric activity.

BS UMa was observed photometrically on 5 nights in April 2009 and on 4 nights in April 2010 at the Humain site of the Royal Observatory in Belgium. A 40-cm Newtonian was used, equipped with an SBIG ST-10XME CCD camera and B and V filters. GSC 3059-1349, with $V = 11.50 \pm 0.11$ and $B - V = 0.62 \pm 0.18$ (derived from Tycho photometry, Høg et al., 2000), was used as comparison star and GSC 3059-1419 as check star. Image processing and photometric analysis were done using Mira AP Pro from Mirametrics Inc. All the photometric data obtained for this study are available as electronic tables (`5940-t3.txt` and `5940-t4.txt`) from the IBVS website.

The light curve obtained during 2009 already showed small changes after three weeks. But as shown in Fig. 2, the light curve obtained in 2010 differs dramatically from the one obtained the year before. Consequently, BS UMa is a highly active system with rapidly changing spots significantly altering the shape of the light curve.

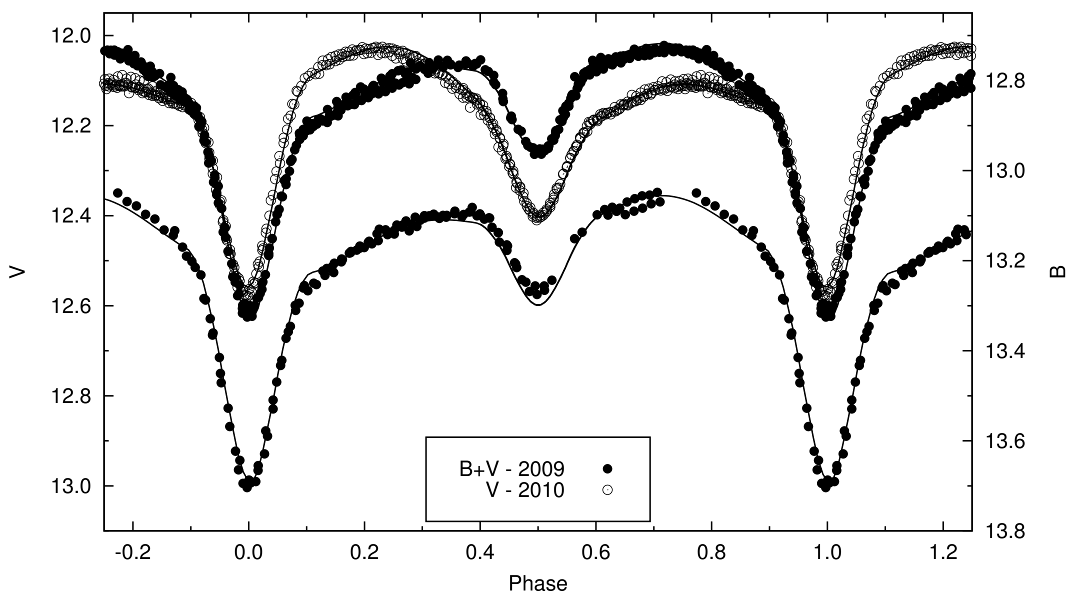

Figure 2. Light curve of BS UMa. B (bottom) and V (top) data from April 2009 are given as filled circles, whereas V data obtained in April 2010 are shown as open circles. The full lines show the model light curves discussed in the text.

Because of this changing aspect of the light curve, several models involving dark spots can explain the light curve equally well. Radial velocity data will be needed, but also more photometry to establish a "quiescent" light curve. Because of the symmetric non-distorted shape of the light curve obtained by SuperWASP (Norton et al., 2007) in 2004 (see Fig. 3), it may be considered to be close to such a quiescent state. Calculations done using Phoebe (Prša & Zwitter, 2005) resulted in the following model parameters (with formal uncertainties): $i = 72.5 \pm 0.2°$, $T_2 = 3550 \pm 10K$, $\Omega_1 = 4.50 \pm 0.03$, $\Omega_2 = 3.85 \pm 0.02$. Lacking radial velocity data, a mass ratio of 1 was assumed. Building further on this configuration, one spot on each star was introduced to separately model the distorted light curves seen in 2009 and 2010. Because of the uncertainty already present in the quiescent model, on which the models with spots are heavily dependent, only a rough fit was aimed for, and no attempt was made to fit the observations exactly. This would

Table 1: Spot parameters. Coordinates and radii are expressed in degrees.

Year	Star	Colatitude	Longitude	Radius	Temperature factor
2009	Primary	80	285	25	0.80
	Secondary	40	205	60	0.95
2010	Primary	30	160	25	0.65
	Secondary	60	235	20	0.75

probably require a larger number of spots and would likely not lead to a unique solution. Such a detailed model would also fairly soon be made oblivious by the rapid evolution of the spots. The spot parameters from the simple model are listed in Table 1. As can be expected, these spots differ wildly between 2009 and 2010. Unfortunately nothing can be said about the intermediate evolution between the two snapshots.

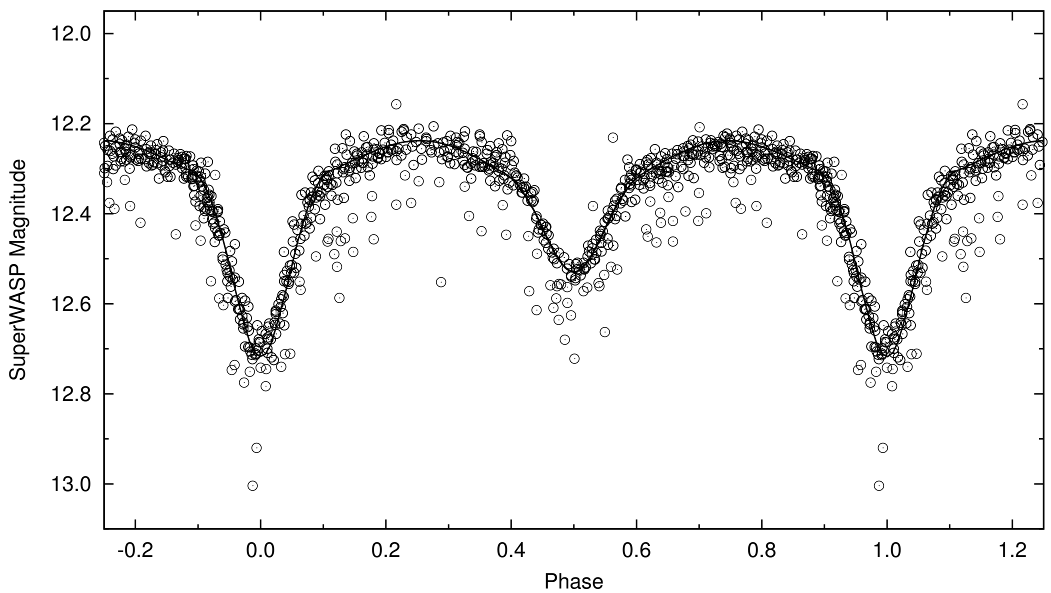

Figure 3. Phase plot of BS UMa from SuperWASP data obtained during May-July 2004.

The secondary in this model is fairly close to filling its Roche lobe (fill-out factor = −0.2). With the fairly limited data set at hand, and depending on the mass ratio, it cannot be entirely excluded that the system is semi-detached, or that this is the case at least part of the time, depending on the activity. Some of the distortions in the light curve could then be explained by gas streams from the secondary impacting on the primary and thereby creating a hot spot, such as in V361 Lyr (Andronov & Richter, 1987) and DK CVn (Terrell et al., 2005).

The times of minimum obtained during 2009 were published by Lampens et al. (2010). Those obtained this year are given in Table 2 (all were obtained from V data only). Together with the times of minimum listed in the $O-C$ *Gateway* since 1999, a new ephemeris for the primary minimum could be calculated as follows:

$$\text{HJD Min} = 24553134.7088(5) + 0\overset{\text{d}}{.}34950987(9) \times E \quad (1)$$

Except for one point, all available times deviate less than 0.004 days from this ephemeris. This is well within the accuracy of the observed times, taking into account the varying shape of the light curve. From the available data, there is therefore no indication of a changing period at present. The $O-C$ values in Table 2 correspond to the ephemeris above.

Table 2: New times of minimum of BS UMa.

HJD - 2400000	Uncertainty	Type	$O-C$
55292.4086	0.0004	II	0.0006
55292.5810	0.0003	I	−0.0017
55293.4569	0.0004	II	0.0004
55303.4158	0.0002	I	−0.0017
55305.3399	0.0005	II	0.0001
55305.5130	0.0002	I	−0.0016

BS UMa is a highly interesting object worthy of further study.

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This study is based in part on observations made with the William Herschel Telescope, which is operated on the island of La Palma by the Isaac Newton Group in the Spanish Observatorio del Roque de los Muchachos (ORM) of the Instituto de Astrofýsica de Canarias (IAC).

This work has made use of the SIMBAD and VizieR databases operated at CDS, Strasbourg, France and of the *O-C Gateway*, created by A. Paschke and L. Brát. We have used data from the WASP public archive in this research. The WASP consortium comprises of the University of Cambridge, Keele University, University of Leicester, The Open University, The Queen's University Belfast, St. Andrews University and the Isaac Newton Group. Funding for WASP comes from the consortium universities and from the UK's Science and Technology Facilities Council.

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BAV-RESULTS OF OBSERVATIONS - PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

(BAV MITTEILUNGEN NO. 212)

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In this 66th compilation of BAV results, photoelectric observations obtained in the years 2009 and 2010 are presented on 452 variable stars giving 838 minima on eclipsing binaries and maxima on pulsating stars. All moments of minima and maxima are heliocentric. The errors are tabulated in column '±'. The values in column '$O-C$' are determined without incorporation of nonlinear terms.The references are given in the section 'Remarks'. All information about photometers and filters are specified in the column 'Rem'. The observations were made at private observatories. The photoelectric measurements and all the light curves with evaluations can be obtained from the office of the BAV for inspection.

Table 1: Times of minima of eclipsing binaries

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
RT And	55066.3799	.0021	PGL	+0.0422		GCVS 2009	V	735	16)
	55097.5110	.0008	AG	+0.0417	s	GCVS 2009	-Ir	55	17)
TT And	55039.4804	.0003	MS FR	+0.0037		GCVS 2009	o	480	9)
WZ And	55154.5407	.0008	AG	+0.0032	s	GCVS 2009	-Ir	77	17)
AA And	55039.5145	.0004	AG	−0.0036		GCVS 2009	-Ir	31	17)
	55141.4409	.0004	AG	−0.0027		GCVS 2009	-Ir	46	17)
AB And	55057.4429	.0035	PGL	−0.0046	s	GCVS 2009	V	125	16)
	55114.3656	.0035	PGL	−0.0012		GCVS 2009	V	122	16)
AD And	55141.4827	.0003	AG	−0.0517		GCVS 2009	-Ir	50	17)
	55154.3025	.0010	JU	−0.0525		GCVS 2009	o	81	7)
BD And	55039.4130	.0007	AG	−0.0121		GCVS 2009	-Ir	31	17)
	55071.3532	.0001	MS FR	−0.0124		GCVS 2009	o	205	9)
BL And	55039.5310	.0005	AG	−0.0016		GCVS 2009	-Ir	31	17)
	55141.3862	.0003	AG	−0.0014		GCVS 2009	-Ir	52	17)
BO And	55141.4982	.0018	AG	+0.0951		GCVS 2009	-Ir	50	17)
CN And	55154.4593	.0011	AG	−0.0050	s	GCVS 2009	-Ir	71	17)
HS And	55154.4308	.0009	AG	+0.0041		GCVS 2009	-Ir	80	17)
KN And	55067.5685	.0001	MS FR	+0.0911		BAVR 39,19	o	513	9)
KP And	55082.4143	.0011	FR	+0.0430		GCVS 2009	-Ir	54	17)
LM And	55059.5203	.0004	MS FR	−0.0097		GCVS 2009	o	564	9)
MO And	55045.5863	.0017	MS FR	+0.0004		GCVS 2009	o	345	9)
V404 And	55154.4264	.0006	AG	+0.0060		GCVS 2009	-Ir	80	17)
V422 And	55141.5550	.0049	AG	+0.0058	s	GCVS 2009	-Ir	52	17)
V440 And	55154.4819	.0001	AG	−0.0337	s	GCVS 2009	-Ir	73	17)
V441 And	55154.3104	.0005	AG	+0.0290	s	GCVS 2009	-Ir	80	17)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V441 And	55154.5444	.0005	AG	+0.0282		GCVS 2009	-Ir	80	17)
HS Aqr	55041.3878	.0012	FR	−0.0028	s	GCVS 2009	-Ir	47	12)
LL Aqr	54735.339 :	.003	BKN	−0.019		IBVS 5557	V	240	14)
V1075 Aql	55067.4082	.0003	AG	−0.0352		GCVS 2009	-Ir	23	17)
V1097 Aql	55067.3592	.0014	AG	−0.0654		GCVS 2009	-Ir	23	17)
V1353 Aql	55067.3984	.0003	BRL	+0.0065	s	BAVR 44,62	o	31	20)
	55067.4090	.0030	WTR	+0.0171	s	BAVR 44,62	-Ir	75	13)
	55072.3650	.0024	BRL	+0.0213		BAVR 44,62	o	48	20)
BC Aur	54829.6857	.0007	FR	−0.6804	s	GCVS 2009	-Ir	37	17)
EM Aur	55164.4382	.0035	PGL	−0.1983		GCVS 2009	V	387	16)
IU Aur	54908.3706	.0042	ATB	−0.0066	s	GCVS 2009	o	88	6)
KO Aur	55083.5852	.0002	MS FR	+0.0486		GCVS 2009	o	363	9)
TZ Boo	54648.5095	.0002	GB	−0.0448		BAVM 68	V	0	6)
	54658.4660	.0002	GB	−0.0430	s	BAVM 68	o	0	6)
	54866.6247	.0003	GB	−0.0425		BAVM 68	B+V	0	6)
	54921.4526	.0002	GB	−0.0400	s	BAVM 68	B+V	0	6)
	54921.6020	.0007	GB	−0.0392		BAVM 68	B+V	0	6)
	54924.4240	.0003	GB	−0.0402	s	BAVM 68	B+V	0	6)
	54924.5734	.0002	GB	−0.0394		BAVM 68	B+V	0	6)
	54928.4367	.0003	GB	−0.0391		BAVM 68	B+V	0	6)
	54928.5855	.0007	GB	−0.0389	s	BAVM 68	B+V	0	6)
AC Boo	54928.4989	.0001	GB	−0.0135	s	GCVS 2009	B+V	0	6)
	54931.4908	.0001	MS FR	−0.0172		GCVS 2009	o	495	9)
	54933.4300	.0002	GB	−0.0164	s	GCVS 2009	B+V	0	6)
BG Boo	55012.4328	.0070	JU	−0.0178	s	GCVS 2009	o	46	7)
UU Cam	55125.3768	.0016	AG	+0.0069		GCVS 2009	-Ir	33	17)
VZ CVn	54972.4395	.0004	AG	−0.0005		GCVS 2009	-Ir	38	17)
EE CVn	54972.3989	.0001	AG	−0.0062		GCVS 2009	-Ir	38	17)
	54972.5392	.0007	AG	−0.0062	s	GCVS 2009	-Ir	38	17)
EF CVn	54972.3898	.0008	AG	−0.0052		GCVS 2009	-Ir	38	17)
	54972.5251	.0005	AG	−0.0059	s	GCVS 2009	-Ir	38	17)
EH CVn	54972.3979	.0006	AG	−0.0441	s	GCVS 2009	-Ir	38	17)
	54972.5292	.0007	AG	−0.0446		GCVS 2009	-Ir	38	17)
EI CVn	54972.4345	.0005	AG	−0.0143		GCVS 2009	-Ir	38	17)
	54972.5640	.0004	AG	−0.0152	s	GCVS 2009	-Ir	38	17)
TW Cas	55070.3996	.0002	FLG	−0.0107		GCVS 2009	V	218	15)
XX Cas	55154.6029	.0014	AG	+0.0162		GCVS 2009	-Ir	45	17)
ZZ Cas	55108.4344	.0014	AG	−0.0056		GCVS 2009	-Ir	48	17)
AE Cas	55060.4764	.0003	AG	+0.0656		GCVS 2009	-Ir	57	17)
	55073.3818	.0003	JU	+0.0660		GCVS 2009	o	46	7)
AQ Cas	55081.3180	.0080	AG	−0.0476		GCVS 2009	-Ir	119	17)
AX Cas	55154.5556	.0010	AG	−0.1003		GCVS 2009	-Ir	45	17)
BH Cas	55029.4444	.0014	AG				-Ir	44	17)
	55096.4225	.0014	AG				-Ir	48	17)
	55096.6184	.0020	AG				-Ir	48	17)
BS Cas	55049.4897	.0002	MS FR	−0.0153	s	IBVS 4778	o	540	9)
	55124.3673	.0014	JU	−0.0176	s	IBVS 4778	o	85	7)
BU Cas	55154.4159	.0023	AG	−0.0231		GCVS 2009	-Ir	45	17)
BW Cas	55059.5049	.0003	AG	+0.4199		GCVS 2009	-Ir	68	17)
	55155.4815	.0028	SCI	−0.2485		GCVS 2009	o	60	7)
BZ Cas	55059.4279	.0004	AG	+0.2764		GCVS 2009	-Ir	68	17)
CR Cas	55082.3348	.0010	JU	+0.1369		GCVS 2009	o	70	7)
CW Cas	55029.5291	.0001	AG	−0.0409	s	GCVS 2009	-Ir	44	17)
DZ Cas	55063.3971	.0016	AG	−0.1762		GCVS 2009	-Ir	30	17)
EG Cas	55049.4661	.0007	AG	+0.1060	s	GCVS 2009	-Ir	43	17)
	55063.5305	.0010	AG	+0.1069	s	GCVS 2009	-Ir	30	17)
	55067.5070	.0010	AG	+0.1089		GCVS 2009	-Ir	32	17)
	55074.5358	.0006	AG	+0.1060	s	GCVS 2009	-Ir	41	17)
EK Cas	55067.1444	.0100	AG	−0.2562		GCVS 2009	-Ir	75	17)
EN Cas	55155.4759	.0017	AG	+0.2721		GCVS 2009	-Ir	48	17)
EP Cas	55049.4897	.0005	AG	−0.0360		GCVS 2009	-Ir	43	17)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
EP Cas	55067.3854	.0009	AG	−0.0360		GCVS 2009	-Ir	33	17)
ES Cas	55049.5616	.0025	AG	−0.4487		GCVS 2009	-Ir	43	17)
EY Cas	55063.5764	.0013	AG	+0.0344		GCVS 2009	-Ir	30	17)
	55067.4309	.0011	AG	+0.0331		GCVS 2009	-Ir	33	17)
GH Cas	55141.4236	.0007	AG	−0.5770		GCVS 2009	-Ir	65	17)
GK Cas	55075.4062	.0002	MS FR	−0.3265		GCVS 2009	o	660	9)
GU Cas	55067.3473	.0035	AG	−0.3429		GCVS 2009	-Ir	33	17)
IQ Cas	55154.6432	.0028	AG	−0.2418		GCVS 2009	-Ir	64	17)
IR Cas	55039.4456	.0006	AG	+0.0084	s	GCVS 2009	-Ir	31	17)
	55141.5477	.0007	AG	+0.0077	s	GCVS 2009	-Ir	50	17)
IS Cas	55058.3938	.0006	AG	+0.0658		GCVS 2009	-Ir	50	17)
IT Cas	55125.3986	.0035	PGL	+0.2602	s	GCVS 2009	V	171	19)
	55154.4254	.0002	FR	+0.0622		GCVS 2009	-Ir	71	17)
IV Cas	55060.5282	.0001	MS FR	−0.0769		GCVS 2009	o	482	9)
	55157.3840	.0001	WTR	−0.0779		GCVS 2009	-Ir	119	13)
KL Cas	55154.5653	.0038	AG	−0.0188	s	GCVS 2009	-Ir	44	17)
LR Cas	55081.5291	.0023	AG	−0.0031		GCVS 2009	-Ir	46	17)
MS Cas	55058.3987	.0015	AG	+0.0395	s	GCVS 2009	-Ir	54	17)
	55096.5121	.0016	AG	+0.0390		GCVS 2009	-Ir	48	17)
MT Cas	55067.4622	.0014	AG	+0.0188	s	GCVS 2009	-Ir	33	17)
	55074.3675	.0006	AG	+0.0188	s	GCVS 2009	-Ir	41	17)
	55074.5247	.0004	AG	+0.0191		GCVS 2009	-Ir	41	17)
MU Cas	55029.4201	.0017	AG	+0.2846		GCVS 2009	-Ir	44	17)
	55058.3791	.0036	AG	+0.2851	s	GCVS 2009	-Ir	51	17)
MV Cas	55029.5362	.0005	AG	−0.0910		GCVS 2009	-Ir	44	17)
	55108.5087	.0014	AG	−0.0887		GCVS 2009	-Ir	48	17)
NN Cas	55063.4971	.0052	AG	+0.1253		GCVS 2009	-Ir	30	17)
NT Cas	55155.6232	.0020	SCI	+0.0248		GCVS 2009	o	23	7)
NU Cas	55074.5812	.0009	AG	−0.1423	s	GCVS 2009	-Ir	40	17)
	55147.4185	.0031	SCI	−0.1398	s	GCVS 2009	o	35	7)
OR Cas	55029.3718	.0013	AG	−0.0224		GCVS 2009	-Ir	43	17)
	55108.4699	.0014	AG	−0.0270	s	GCVS 2009	-Ir	48	17)
OX Cas	55125.3390	.0035	PGL	+0.0220		GCVS 2009	V	398	19)
PV Cas	55098.5216	.0013	AG	+0.0005	s	GCVS 2009	-Ir	41	17)
	55134.3712	.0007	SIR	−0.0345		GCVS 2009	-Ir	323	11)
	55135.2801	.0010	JU	−0.0009	s	GCVS 2009	o	70	7)
QQ Cas	55096.4094	.0019	AG	+0.1121	s	BAVR 35,1	-Ir	48	17)
V336 Cas	55096.5187	.0025	AG	−0.0152	s	GCVS 2009	-Ir	48	17)
	55108.4691	.0014	AG	−0.0105	s	GCVS 2009	-Ir	48	17)
V337 Cas	55063.4174	.0012	AG	−0.0646		GCVS 2009	-Ir	30	17)
V345 Cas	55039.4661	.0005	AG	−0.0176	s	GCVS 2009	-Ir	31	17)
	55097.3199	.0011	AG	−0.0196	s	GCVS 2009	-Ir	55	17)
	55141.4011	.0021	AG	−0.0189	s	GCVS 2009	-Ir	50	17)
V350 Cas	55097.5041	.0002	AG	−0.0443		GCVS 2009	-Ir	55	17)
V355 Cas	55067.3733	.0008	AG	−0.1304		GCVS 2009	-Ir	32	17)
	55076.4035	.0026	AG	−0.1382		GCVS 2009	-Ir	19	17)
	55155.4922	.0005	AG	−0.1316		GCVS 2009	-Ir	45	17)
V357 Cas	55067.5507	.0033	AG	−0.2698		GCVS 2009	-Ir	32	17)
V359 Cas	55072.4352	.0001	MS FR	+0.0005		IBVS 5016	o	414	9)
	55074.3880	.0026	AG	−0.0025	s	IBVS 5016	-Ir	41	17)
	55076.3472	.0019	AG	+0.0009		IBVS 5016	-Ir	19	17)
	55098.5146	.0009	AG	+0.0024		IBVS 5016	-Ir	41	17)
V361 Cas	55047.5512	.0001	MS FR	−0.2000		GCVS 2009	o	405	9)
	55063.5278	.0010	AG	−0.2002		GCVS 2009	-Ir	30	17)
V374 Cas	55049.4637	.0004	AG	+0.0175		GCVS 2009	-Ir	43	17)
	55063.5679	.0027	AG	+0.0167	s	GCVS 2009	-Ir	30	17)
	55074.5402	.0005	AG	+0.0185		GCVS 2009	-Ir	41	17)
	55155.5159	.0042	AG	+0.0215	s	GCVS 2009	-Ir	49	17)
V375 Cas	55108.4494	.0013	AG	+0.2234	s	BAVR 32,36	-Ir	48	17)
V384 Cas	55124.5807	.0014	SCI	−0.1482		GCVS 2009	o	61	7)
V396 Cas	55098.6057	.0019	AG	−1.4901		GCVS 2009	-Ir	44	17)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V423 Cas	55059.4823	.0010	AG	−0.0874	s	GCVS 2009	-Ir	68	17)
V449 Cas	55154.4709	.0022	AG				-Ir	44	17)
V471 Cas	55141.3835	.0007	AG	−0.0248	s	GCVS 2009	-Ir	63	17)
	55141.5843	.0012	AG	+0.0080		GCVS 2009	-Ir	63	17)
V473 Cas	55141.3018	.0008	AG	−0.0188		IBVS 4669	-Ir	65	17)
	55141.5099	.0018	AG	−0.0185	s	IBVS 4669	-Ir	65	17)
V520 Cas	55063.5544	.0017	AG	+0.0016	s	GCVS 2009	-Ir	29	17)
	55067.4756	.0009	AG	+0.0061	s	GCVS 2009	-Ir	31	17)
V546 Cas	55096.5573	.0025	AG	−0.0033		GCVS 2009	-Ir	48	17)
V651 Cas	55098.5733	.0008	AG	+0.0027		IBVS 3554	-Ir	42	17)
	55155.3914	.0003	AG	+0.0027		IBVS 3554	-Ir	48	17)
V654 Cas	55058.3900	.0016	AG				-Ir	52	17)
V776 Cas	55154.3451	.0028	SCI				o	99	7)
U Cep	55067.4176	.0024	FLG	+0.1680		GCVS 2009	V	277	15)
SU Cep	55058.5355	.0022	AG	+0.0090		GCVS 2009	-Ir	50	17)
VW Cep	55053.3838	.0021	PGL	−0.0458		GCVS 2009	V	378	16)
	55068.4114	.0003	FLG	−0.0472		GCVS 2009	V	156	15)
AI Cep	55058.5260	.0020	AG	+0.1669		GCVS 2009	-Ir	52	17)
BE Cep	55097.4971	.0004	AG	−0.1003	s	GCVS 2009	-Ir	55	17)
	55098.5584	.0002	AG	−0.1000		GCVS 2009	-Ir	41	17)
CO Cep	55064.5721	.0005	AG	−0.1884		GCVS 2009	-Ir	51	17)
	55083.3994	.0004	AG	−0.1954	s	GCVS 2009	-Ir	79	17)
DV Cep	55028.4772	.0004	AG	+0.0066		BAVR 50,159	-Ir	44	17)
GS Cep	55051.4333	.0002	AG	−0.0461	s	GCVS 2009	-Ir	39	17)
	55098.5267	.0011	AG	−0.0448	s	GCVS 2009	-Ir	41	17)
GW Cep	55064.4796	.0006	AG	−0.0122	s	BAVR 33,160	-Ir	51	17)
	55083.4513	.0004	AG	−0.0109		BAVR 33,160	-Ir	79	17)
	55103.3781	.0009	AG	−0.0111	s	BAVR 33,160	-Ir	64	17)
LM Cep	55045.4643	.0002	AG	+0.1060		GCVS 2009	-Ir	61	17)
NR Cep	55060.5145	.0005	AG	−0.0489		GCVS 2009	-Ir	57	17)
ZZ Cyg	55075.4530	.0015	AG	−0.0540	s	GCVS 2009	-Ir	38	17)
BO Cyg	54749.383	.010	BKN	−0.781		GCVS 2009	V	147	14)
	54815.2342	.0002	BKN	+0.0890		GCVS 2009	V	79	14)
	55051.4496	.0012	AG	−0.7862		GCVS 2009	-Ir	52	17)
CG Cyg	55068.3322	.0011	FR	+0.0648	s	GCVS 2009	-Ir	25	17)
CV Cyg	55062.4548	.0003	FR	−0.2614		GCVS 2009	-Ir	55	17)
DK Cyg	55050.4319	.0008	JU	+0.0552		BAVR 35,1	o	50	7)
	55058.4350	.0019	SCI	+0.0565		BAVR 35,1	o	160	7)
	55083.3824	.0003	FR	+0.0573		BAVR 35,1	-Ir	69	12)
	55083.6205	.0004	FR	+0.0601	s	BAVR 35,1	-Ir	69	12)
DL Cyg	55081.5687	.0016	AG	+0.1046		GCVS 2009	-Ir	59	17)
	55098.4811	.0073	AG	+0.1106	s	GCVS 2009	-Ir	27	17)
DO Cyg	55125.3208	.0001	AG	−0.0228		GCVS 2009	-Ir	50	17)
DP Cyg	55071.3618	.0017	AG		s		-Ir	42	17)
	55125.3400	.0008	AG		s		-Ir	50	17)
DX Cyg	55073.3759	.0011	SCI	−0.0744		GCVS 2009	o	77	7)
EN Cyg	55068.5177	.0002	AG	+0.4390		GCVS 2009	-Ir	37	17)
GG Cyg	55096.4211	.0005	AG	+0.1373		GCVS 2009	-Ir	54	17)
GM Cyg	55050.5134	.0012	AG	−0.2299		GCVS 2009	-Ir	41	17)
GT Cyg	55083.4792	.0026	AG	−0.0253	s	GCVS 2009	-Ir	41	17)
GV Cyg	55050.5301	.0004	AG	+0.1604	s	GCVS 2009	-Ir	31	17)
	55059.4457	.0004	AG	+0.1599	s	GCVS 2009	-Ir	33	17)
	55062.4175	.0007	AG	+0.1597	s	GCVS 2009	-Ir	32	17)
	55064.3989	.0011	AG	+0.1597	s	GCVS 2009	-Ir	32	17)
	55102.5397	.0017	AG	+0.1594		GCVS 2009	-Ir	58	17)
KR Cyg	55075.4040	.0001	FR	+0.0147		GCVS 2009	-Ir	58	17)
	55096.5329	.0003	AG	+0.0148		GCVS 2009	-Ir	53	17)
LO Cyg	55027.4156	.0002	AG	+0.0066	s	GCVS 2009	-Ir	35	17)
	55032.4491	.0010	AG	+0.0063	s	GCVS 2009	-Ir	49	17)
	55042.5176	.0002	AG	+0.0071	s	GCVS 2009	-Ir	35	17)
	55083.4166	.0005	AG	+0.0060	s	GCVS 2009	-Ir	41	17)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
MR Cyg	55059.4878	.0009	AG	−0.0009	s	GCVS 2009	-Ir	33	17)
PQ Cyg	55071.4698	.0031	SCI	+0.0291		GCVS 2009	o	32	7)
QS Cyg	55101.4886	.0020	SCI	−0.0254		GCVS 2009	o	77	7)
QU Cyg	54922.6161	.0002	MS FR	−0.0711		GCVS 2009	o	570	9)
QW Cyg	55062.4673	.0008	FR	−0.0726	s	GCVS 2009	-Ir	52	17)
V345 Cyg	55096.5230	.0012	AG	+0.0444		IBVS 5016	-Ir	53	17)
V366 Cyg	55075.5517	.0053	AG	−0.0050	s	GCVS 2009	-Ir	39	17)
	55124.3251	.0014	SCI	−0.0044		GCVS 2009	o	110	7)
V370 Cyg	54996.4592	.0021	AG	−0.0214	s	GCVS 2009	-Ir	56	17)
V388 Cyg	55048.4145	.0010	JU	−0.0859		GCVS 2009	o	50	7)
	55063.4496	.0013	FR	−0.0839	s	GCVS 2009	-Ir	40	12)
V401 Cyg	55103.4137	.0013	AG	+0.0594		GCVS 2009	-Ir	24	17)
V435 Cyg	54995.5385	.0035	SCI	+0.2128		GCVS 2009	o	39	7)
V442 Cyg	55063.4046	.0006	FR	−0.0394	s	GCVS 2009	-Ir	73	17)
V444 Cyg	55084.5104	.0034	FR	+0.2233	s	GCVS 2009	-Ir	52	17)
V454 Cyg	55082.4439	.0013	SCI	−0.0078		GCVS 2009	o	126	7)
V456 Cyg	55050.4922	.0007	AG	+0.0455		GCVS 2009	-Ir	40	17)
V463 Cyg	55048.4178	.0019	SCI	+0.0562		GCVS 2009	o	218	7)
	55084.4140	.0003	FR	+0.0538		GCVS 2009	-Ir	39	17)
V466 Cyg	55076.3902	.0001	AG	+0.0068		GCVS 2009	-Ir	17	17)
V477 Cyg	55096.4061	.0016	AG	+0.6769		GCVS 2009	-Ir	50	17)
V483 Cyg	55060.4777	.0017	SCI	+0.0054		GCVS 2009	o	105	7)
V488 Cyg	55096.4975	.0004	AG	+0.0610	s	GCVS 2009	-Ir	50	17)
V490 Cyg	55096.4362	.0004	AG	+0.1683		GCVS 2009	-Ir	50	17)
V508 Cyg	55075.5525	.0004	AG	−0.0173		GCVS 2009	-Ir	39	17)
V509 Cyg	55075.4765	.0025	AG	+0.1984	s	GCVS 2009	-Ir	35	17)
V512 Cyg	55075.5807	.0005	AG	+0.1134		GCVS 2009	-Ir	38	17)
	55075.5885	.0027	SCI	+0.1212		GCVS 2009	o	157	7)
V519 Cyg	55075.4786	.0009	AG	−0.2254	s	GCVS 2009	-Ir	39	17)
	55102.4484	.0024	SCI	−0.2242		GCVS 2009	o	115	7)
V526 Cyg	55059.3864	.0025	SCI	+0.0469		GCVS 2009	o	53	7)
	55102.5528	.0006	AG	+0.0421		GCVS 2009	-Ir	58	17)
V534 Cyg	55059.5413	.0002	FR	+0.1807		GCVS 2009	-Ir	62	17)
V536 Cyg	55084.5057	.0024	SCI	+0.4191		GCVS 2009	o	159	7)
	55102.5335	.0004	AG	+0.4163		GCVS 2009	-Ir	58	17)
	55108.5449	.0009	AG	+0.4175		GCVS 2009	-Ir	44	17)
V537 Cyg	55108.5259	.0025	AG	+0.5373		GCVS 2009	-Ir	44	17)
V541 Cyg	55066.5740	.0024	AG	+0.0594		GCVS 2009	-Ir	49	17)
V587 Cyg	55074.5098	.0011	AG	+0.2173		GCVS 2009	-Ir	36	17)
V616 Cyg	55064.4998	.0005	AG	−0.3182		GCVS 2009	-Ir	31	17)
	55074.4553	.0012	AG	−0.3126	s	GCVS 2009	-Ir	36	17)
	55102.3088	.0018	AG	+0.3445		GCVS 2009	-Ir	58	17)
V628 Cyg	54931.5818	.0013	MS FR	+0.0018		IBVS 4381	o	300	9)
	55050.4679	.0009	AG	−0.0028		IBVS 4381	-Ir	31	17)
V635 Cyg	55042.4851	.0004	AG	−0.0495		GCVS 2009	-Ir	35	17)
	55059.5900	.0026	AG	−0.0527	s	GCVS 2009	-Ir	33	17)
	55064.5350	.0008	AG	−0.0501		GCVS 2009	-Ir	32	17)
	55074.4198	.0005	AG	−0.0500		GCVS 2009	-Ir	36	17)
	55083.5444	.0004	AG	−0.0497		GCVS 2009	-Ir	41	17)
	55102.5535	.0005	AG	−0.0496		GCVS 2009	-Ir	58	17)
	55108.6340	.0017	AG	−0.0520		GCVS 2009	-Ir	44	17)
V661 Cyg	55083.5388	.0020	AG	+0.0284		GCVS 2009	-Ir	40	17)
V675 Cyg	55059.5185	.0012	AG	+0.6075		GCVS 2009	-Ir	33	17)
V680 Cyg	55063.5310	.0005	AG	+0.0192		BAVR 32,36	-Ir	45	17)
V699 Cyg	55050.4695	.0056	SCI	−0.0825		GCVS 2009	o	66	7)
	55067.5843	.0031	SCI	−0.0344		GCVS 2009	o	66	7)
V700 Cyg	55050.4457	.0009	AG	−0.0609	s	GCVS 2009	-Ir	41	17)
	55050.5908	.0009	AG	−0.0858		GCVS 2009	-Ir	41	17)
	55073.4063	.0004	AG	−0.0534		GCVS 2009	-Ir	48	17)
	55073.5506	.0007	AG	−0.0791	s	GCVS 2009	-Ir	48	17)
V704 Cyg	54995.4990	.0002	MS FR	+0.0303		GCVS 2009	o	522	9)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V704 Cyg	55074.5432	.0008	AG	+0.0320	s	GCVS 2009	-Ir	36	17)
V705 Cyg	55051.4630	.0008	AG	−0.3000	s	GCVS 2009	-Ir	52	17)
V706 Cyg	55051.4876	.0006	AG	−0.0510		GCVS 2009	-Ir	52	17)
	55062.4443	.0004	AG	−0.0513	s	GCVS 2009	-Ir	88	17)
	55074.3327	.0001	MS FR	−0.0525		GCVS 2009	o	420	9)
V711 Cyg	55050.4503	.0068	AG	−0.0276		GCVS 2009	-Ir	28	17)
	55062.4368	.0003	AG	−0.0290	s	GCVS 2009	-Ir	32	17)
	55064.5082	.0014	AG	−0.0245		GCVS 2009	-Ir	32	17)
	55074.4330	.0050	AG	−0.0208		GCVS 2009	-Ir	34	17)
V726 Cyg	55073.4674	.0002	AG	+0.0418		GCVS 2009	-Ir	49	17)
V728 Cyg	55045.3985	.0002	AG	+0.0539		GCVS 2009	-Ir	61	17)
V749 Cyg	55073.5737	.0013	AG	−0.0394	s	GCVS 2009	-Ir	58	17)
V787 Cyg	55075.3598	.0011	AG	+0.0018		GCVS 2009	-Ir	39	17)
V828 Cyg	55059.4263	.0011	JU	+0.1216	s	GCVS 2009	o	86	7)
V842 Cyg	54937.5723	.0004	MS FR	+0.0299		GCVS 2009	o	540	9)
	55060.4318	.0003	AG	+0.0327		GCVS 2009	-Ir	35	17)
V850 Cyg	55066.5153	.0012	AG	+0.6453		GCVS 2009	-Ir	45	17)
V856 Cyg	55068.4650	.0009	AG	+0.0864		GCVS 2009	-Ir	37	17)
V859 Cyg	55097.3786	.0043	FR	+0.0078		GCVS 2009	-Ir	42	12)
V869 Cyg	55063.4184	.0024	SCI	+0.1229		GCVS 2009	o	34	7)
V873 Cyg	54996.5357	.0023	SCI	+0.0264		GCVS 2009	o	44	7)
V877 Cyg	55068.4991	.0022	AG	+0.0245	s	GCVS 2009	-Ir	36	17)
V880 Cyg	54943.5499	.0001	MS FR	−0.0027		GCVS 2009	o	504	9)
V891 Cyg	55097.2948	.0014	FR	+0.0458		GCVS 2009	-Ir	26	12)
V906 Cyg	55074.4128	.0008	SCI	+0.0605		GCVS 2009	o	56	7)
	55074.5957	.0011	SCI	+0.0608	s	GCVS 2009	o	56	7)
V909 Cyg	55060.4863	.0011	AG	−0.0194	s	BAVR 47,2	-Ir	35	17)
V912 Cyg	55061.4172	.0021	SCI	−0.1107		GCVS 2009	o	70	7)
	55066.4690	.0004	AG	−0.1153		GCVS 2009	-Ir	51	17)
V940 Cyg	55125.3967	.0014	SCI	+0.0509	s	GCVS 2009	o	38	7)
V941 Cyg	55060.3824	.0019	AG	−0.0700		GCVS 2009	-Ir	35	17)
	55103.3897	.0005	AG	−0.0700		GCVS 2009	-Ir	22	17)
V961 Cyg	54996.4601	.0003	AG	−0.0788		GCVS 2009	-Ir	57	17)
V962 Cyg	55060.5454	.0022	AG	−0.1984		GCVS 2009	-Ir	34	17)
V965 Cyg	55084.598 :	.001	FR	−0.128	s	GCVS 2009	-Ir	60	17)
V1004 Cyg	55096.4691	.0004	AG	−0.1691		GCVS 2009	-Ir	54	17)
V1011 Cyg	55049.5452	.0049	SCI	+0.0371		GCVS 2009	o	123	7)
	55075.4612	.0008	FR	+0.0382		GCVS 2009	-Ir	43	17)
V1013 Cyg	55075.3545	.0002	FR	+0.1541		GCVS 2009	-Ir	87	17)
	55096.4268	.0015	AG	+0.1678	s	GCVS 2009	-Ir	54	17)
V1034 Cyg	55075.3711	.0016	FR	+0.0098	s	GCVS 2009	-Ir	35	17)
	55096.3645	.0005	AG	−0.0008		GCVS 2009	-Ir	53	17)
V1048 Cyg	55073.5378	.0045	AG	+0.0073	s	GCVS 2009	-Ir	58	17)
	55075.3902	.0010	AG	+0.0042		GCVS 2009	-Ir	39	17)
V1061 Cyg	54395.386	.004	BKN	−0.039		GCVS 2009	V	67	14)
V1066 Cyg	55059.5537	.0006	FR	+0.0773		GCVS 2009	-Ir	39	17)
V1073 Cyg	55083.5635	.0005	FR	−0.1262		GCVS 2009	-Ir	68	12)
V1083 Cyg	55041.4207	.0019	AG	−0.0594	s	GCVS 2009	-Ir	41	17)
	55063.3659	.0010	AG	−0.0632		GCVS 2009	-Ir	44	17)
V1136 Cyg	55066.4248	.0003	AG	+0.0832		GCVS 2009	-Ir	50	17)
	55068.4650	.0014	AG	+0.3920	s	GCVS 2009	-Ir	37	17)
V1171 Cyg	55062.4181	.0014	FR	−0.0482	s	GCVS 2009	-Ir	39	12)
	55067.5288	.0006	FR	−0.0550		GCVS 2009	-Ir	48	17)
	55075.5724	.0004	FR	−0.0531	s	GCVS 2009	-Ir	47	17)
	55103.3536	.0020	AG	−0.0522	s	GCVS 2009	-Ir	21	17)
V1188 Cyg	55075.3371	.0014	AG	−0.0178		GCVS 2009	-Ir	39	17)
V1189 Cyg	55073.4151	.0008	AG	−0.0509		GCVS 2009	-Ir	55	17)
V1193 Cyg	55045.4725	.0001	AG	−0.1605	s	GCVS 2009	-Ir	61	17)
V1321 Cyg	55073.4045	.0008	AG	+0.0825		GCVS 2009	-Ir	37	17)
V1326 Cyg	55073.5038	.0020	AG	−0.0012		GCVS 2009	-Ir	58	17)
V1401 Cyg	55050.5331	.0030	AG	+0.2432		GCVS 2009	-Ir	30	17)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V1401 Cyg	55062.3636	.0033	AG	+0.2438		GCVS 2009	-Ir	32	17)
	55063.5442	.0008	AG	+0.2414		GCVS 2009	-Ir	46	17)
	55075.3732	.0020	AG	+0.2405		GCVS 2009	-Ir	56	17)
	55102.5767	.0029	AG	+0.2352		GCVS 2009	-Ir	58	17)
	55108.4995	.0023	AG	+0.2430		GCVS 2009	-Ir	44	17)
V1411 Cyg	55064.4099	.0004	AG	−0.1650	s	GCVS 2009	-Ir	32	17)
V1414 Cyg	55032.4628	.0011	AG	+0.0459		GCVS 2009	-Ir	51	17)
V1417 Cyg	55049.5022	.0015	AG	+0.1600		GCVS 2009	-Ir	28	17)
	55064.3996	.0002	AG	+0.1585	s	GCVS 2009	-Ir	32	17)
V1787 Cyg	55073.5221	.0005	AG				-Ir	55	17)
V2031 Cyg	55084.4838	.0014	FR				-Ir	78	12)
V2181 Cyg	54313.3797	.0020	FR	+0.0067	s	BAVR 50,45	-Ir	13	12)
	55096.4729	.0006	AG	+0.0110		BAVR 50,45	-Ir	53	17)
V2239 Cyg	55082.4363	.0029	SCI				o	139	7)
	55098.3113	.0011	SCI				o	157	7)
V2240 Cyg	55050.4386	.0023	AG				-Ir	41	17)
	55082.3769	.0030	SCI				o	66	7)
	55082.5648	.0028	SCI				o	64	7)
	55097.3338	.0014	SCI				o	66	7)
	55097.5243	.0031	SCI				o	61	7)
	55098.3289	.0035	SCI				o	83	7)
	55098.5325	.0038	SCI				o	75	7)
V2247 Cyg	55050.3899	.0011	FR				-Ir	60	17)
V2280 Cyg	55066.4552	.0005	AG				-Ir	44	17)
V2284 Cyg	55066.4613	.0005	AG				-Ir	45	17)
V2364 Cyg	55066.4561	.0006	AG	−0.0105		GCVS 2009	-Ir	44	17)
V2422 Cyg	55067.5873	.0029	SCI	−0.1382	s	GCVS 2009	o	95	7)
	55073.4007	.0011	AG	−0.1460		GCVS 2009	-Ir	48	17)
V2456 Cyg	55083.3673	.0004	FR	+0.0811		GCVS 2009	-Ir	42	12)
LS Del	55050.5164	.0007	FR	+0.0830		GCVS 2009	-Ir	63	17)
	55059.4202	.0006	FR	+0.0737	s	GCVS 2009	-Ir	125	17)
	55059.6131	.0007	FR	+0.0847		GCVS 2009	-Ir	125	17)
RZ Dra	54972.5267	.0003	AG	+0.0482		GCVS 2009	-Ir	53	17)
BE Dra	55034.4507	.0007	AG	−0.1160		GCVS 2009	-Ir	123	17)
BF Dra	55034.4138	.0004	AG	+0.2373		GCVS 2009	-Ir	123	17)
BS Dra	55028.4844	.0057	AG	−0.0002		GCVS 2009	-Ir	42	17)
GQ Dra	54995.4150	.0010	JU				o	46	7)
KK Dra	54972.5063	.0002	AG				-Ir	53	17)
LZ Dra	55028.5066	.0007	AG				-Ir	42	17)
BT Gem	55192.4721	.0008	MS FR	−0.0091		GCVS 2009	o	500	9)
KV Gem	54910.3465	.0007	ATB	−0.0156		BAVR 52,95	o	104	6)
	54910.3597	.0042	ATB	−0.0024		BAVR 52,95	o	102	6)
	54910.3696	.0014	ATB	+0.0075		BAVR 52,95	o	101	6)
TX Her	55058.360 :	.000	FR	−0.002	s	GCVS 2009	-Ir	279	17)
	55125.3017	.0007	FR	−0.0041		GCVS 2009	-Ir	56	17)
AD Her	55096.3967	.0002	FR	−0.0455		GCVS 2009	-Ir	20	52)
DD Her	54999.4611	.0027	SCI	+0.3723		SAC Vol.63	o	92	7)
MM Her	54976.4415	.0010	AG	−0.0011		GCVS 2009	-Ir	38	17)
V342 Her	54516.6832	.0011	MS FR	+0.0102		GCVS 2009	o	396	9)
V643 Her	54976.4996	.0025	AG	−0.3323	s	GCVS 2009	-Ir	40	17)
V719 Her	54932.3537	.0003	MS FR	+0.0367		GCVS 2009	o	300	9)
V728 Her	55058.3907	.0003	FR	+0.0643		IBVS 3234	-Ir	65	17)
	55125.3152	.0004	FR	+0.0661		IBVS 3234	-Ir	44	17)
V829 Her	55049.4928	.0014	FR	+0.0196		IBVS 5496	-Ir	42	17)
V842 Her	54937.313 :	.000	MS FR	−0.053		BAVR 49,180	o	556	9)
V1032 Her	55033.5533	.0017	AG				-Ir	27	17)
V1038 Her	55033.4959	.0007	AG				-Ir	31	17)
V1049 Her	55033.414 :	.005	FR				-Ir	28	12)
V1055 Her	55125.3043	.0004	FR				-Ir	50	17)
V1091 Her	55033.5120	.0036	AG	−0.0104	s	GCVS 2009	-Ir	29	17)
V1106 Her	54976.5253	.0004	AG	+0.0072		GCVS 2009	-Ir	38	17)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
RT Lac	55051.4892	.0026	AG	−0.2185		GCVS 2009	-Ir	52	17)
RW Lac	55141.4447	.0007	AG	−0.0959	s	GCVS 2009	-Ir	50	17)
SW Lac	55059.4779	.0009	BRL	+0.0581	s	GCVS 2009	o	60	20)
	55071.5035	.0002	FR	+0.0566		GCVS 2009	-Ir	53	17)
	55072.4656	.0035	PGL	+0.0566		GCVS 2009	V	349	16)
	55082.4087	.0001	FR	+0.0573		GCVS 2009	-Ir	80	17)
	55082.5693	.0002	FR	+0.0576	s	GCVS 2009	-Ir	80	17)
TW Lac	55175.3214	.0015	JU	+0.3361		GCVS 2009	o	43	7)
UW Lac	55042.5219	.0011	AG	+0.0696		OEJV 0007	-Ir	35	17)
	55095.4238	.0009	AG	+0.0707		OEJV 0007	-Ir	44	17)
VX Lac	55135.2913	.0003	DIE	+0.0747		GCVS 2009	o	22	21)
AR Lac	55051.5824	.0025	FR	−0.0711		GCVS 2009	-Ir	116	17)
AU Lac	55062.5361	.0001	AG	−0.0257		GCVS 2009	-Ir	32	17)
	55071.5882	.0035	AG	−0.0245	s	GCVS 2009	-Ir	41	17)
	55108.4856	.0006	AG	−0.0268		GCVS 2009	-Ir	44	17)
AW Lac	55034.5017	.0002	AG	+0.0447		BAVR 35,1	-Ir	76	17)
	55058.5012	.0011	AG	+0.0443		BAVR 35,1	-Ir	51	17)
BB Lac	55049.5467	.0032	AG	−0.5658		GCVS 2009	-Ir	27	17)
BS Lac	55050.4697	.0008	AG	−0.1767		GCVS 2009	-Ir	31	17)
	55050.4704	.0003	MS FR	−0.1760		GCVS 2009	o	585	9)
	55095.4978	.0005	AG	−0.1758		GCVS 2009	-Ir	44	17)
CG Lac	55073.3785	.0002	MS FR	−0.1510		GCVS 2009	o	423	9)
	55141.3876	.0001	AG	−0.1515		GCVS 2009	-Ir	51	17)
CM Lac	55051.4490	.0005	FR	−0.0034	s	GCVS 2009	-Ir	51	17)
CN Lac	55042.5444	.0018	AG	−0.0519	s	GCVS 2009	-Ir	35	17)
	55045.4115	.0002	MS FR	−0.0530		GCVS 2009	o	265	9)
	55050.5103	.0004	AG	−0.0532		GCVS 2009	-Ir	31	17)
	55059.4340	.0007	AG	−0.0528		GCVS 2009	-Ir	33	17)
	55071.5441	.0009	AG	−0.0528		GCVS 2009	-Ir	42	17)
	55081.4196	.0015	AG	−0.0566	s	GCVS 2009	-Ir	54	17)
	55083.3342	.0018	AG	−0.0541	s	GCVS 2009	-Ir	41	17)
	55095.4499	.0013	AG	−0.0485	s	GCVS 2009	-Ir	44	17)
	55108.5128	.0010	AG	−0.0518		GCVS 2009	-Ir	44	17)
CO Lac	55147.2919	.0007	SIR	−0.0062		GCVS 2009	-Ir	162	11)
DG Lac	55067.4328	.0003	JU	−0.2194		GCVS 2009	o	75	7)
EK Lac	55041.5406	.0003	AG	−0.0032		GCVS 2009	-Ir	41	17)
	55075.3616	.0004	AG	−0.0032		GCVS 2009	-Ir	56	17)
EL Lac	55041.3850	.0013	AG	+0.1280		GCVS 2009	-Ir	41	17)
EM Lac	55051.5063	.0002	AG	+0.0766		GCVS 2009	-Ir	39	17)
	55068.4329	.0009	AG	+0.0759	s	GCVS 2009	-Ir	45	17)
EP Lac	55034.4696	.0003	AG	−0.3741		GCVS 2009	-Ir	76	17)
	55071.4749	.0005	AG	−0.3737		GCVS 2009	-Ir	41	17)
EQ Lac	55095.5696	.0008	AG	+0.0183		GCVS 2009	-Ir	44	17)
	55108.5864	.0003	AG	+0.0169		GCVS 2009	-Ir	44	17)
ER Lac	55033.4942	.0006	AG	−0.5128		GCVS 2009	-Ir	29	17)
ES Lac	55034.4866	.0005	AG	+0.1262		GCVS 2009	-Ir	76	17)
	55068.4649	.0024	AG	+0.6594	s	GCVS 2009	-Ir	45	17)
EX Lac	55039.4548	.0016	AG	+0.2285	s	GCVS 2009	-Ir	31	17)
EY Lac	55033.5400	.0006	AG	−0.4109	s	GCVS 2009	-Ir	32	17)
FL Lac	55051.3887	.0011	AG	−0.0560		GCVS 2009	-Ir	39	17)
GX Lac	55097.3028	.0011	AG	−0.0385		GCVS 2009	-Ir	68	17)
HX Lac	55041.5187	.0003	MS FR	+0.0089	s	GCVS 2009	o	846	9)
IL Lac	55071.3655	.0019	AG				-Ir	40	17)
	55075.5408	.0013	AG				-Ir	56	17)
	55108.3479	.0021	AG				-Ir	44	17)
IM Lac	55075.4351	.0003	AG	−0.1825		GCVS 2009	-Ir	56	17)
	55108.4117	.0008	AG	−0.1830		GCVS 2009	-Ir	44	17)
IP Lac	55071.5537	.0006	AG	+0.0793		GCVS 2009	-Ir	42	17)
IU Lac	55058.4830	.0004	AG	+0.0133		GCVS 2009	-Ir	57	17)
	55062.3594	.0029	AG	+0.0134		GCVS 2009	-Ir	32	17)
IZ Lac	55050.4316	.0008	AG	+0.0109	s	GCVS 2009	-Ir	30	17)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
IZ Lac	55058.4206	.0005	AG	+0.0111	s	GCVS 2009	-Ir	54	17)
	55062.4149	.0011	AG	+0.0110	s	GCVS 2009	-Ir	32	17)
	55141.5086	.0007	FR	+0.0158	s	GCVS 2009	-Ir	67	17)
KS Lac	55033.4633	.0011	AG	+0.1781		GCVS 2009	-Ir	30	17)
	55049.4859	.0023	AG	+0.1755		GCVS 2009	-Ir	28	17)
	55051.4876	.0030	AG	+0.1740	s	GCVS 2009	-Ir	39	17)
LU Lac	55049.4047	.0002	MS FR	+0.0313		GCVS 2009	o	378	9)
LY Lac	55049.4457	.0008	AG	+0.2307		GCVS 2009	-Ir	28	17)
	55097.3457	.0013	AG	+0.2309		GCVS 2009	-Ir	55	17)
LZ Lac	55051.4639	.0012	AG	+0.3196		GCVS 2009	-Ir	39	17)
MZ Lac	55034.5202	.0001	AG	+0.1585		GCVS 2009	-Ir	76	17)
NR Lac	55041.5382	.0022	AG	+0.0696	s	GCVS 2009	-Ir	40	17)
	55042.4432	.0007	AG	+0.0674		GCVS 2009	-Ir	35	17)
	55049.4007	.0027	AG	+0.0697	s	GCVS 2009	-Ir	28	17)
NS Lac	55067.4115	.0002	MS FR	−0.2240		GCVS 2009	o	513	9)
OO Lac	55051.5297	.0011	AG	+0.1500		GCVS 2009	-Ir	39	17)
OS Lac	55033.5039	.0010	AG	+0.3229	s	GCVS 2009	-Ir	33	17)
	55049.3905	.0030	AG	+0.3215	s	GCVS 2009	-Ir	28	17)
	55075.3886	.0010	AG	+0.3211	s	GCVS 2009	-Ir	56	17)
PP Lac	55068.4485	.0008	AG	−0.0526		GCVS 2009	-Ir	45	17)
V342 Lac	55050.3793	.0012	AG	−0.0947		GCVS 2009	-Ir	30	17)
	55051.4265	.0007	FR	−0.0984	s	GCVS 2009	-Ir	49	17)
	55058.4317	.0004	AG	−0.0989	s	GCVS 2009	-Ir	54	17)
	55125.3425	.0006	AG	−0.0933		GCVS 2009	-Ir	50	17)
	55141.4546	.0003	FR	−0.0945		GCVS 2009	-Ir	72	17)
V344 Lac	55033.4456	.0026	AG	+0.0911		GCVS 2009	-Ir	32	17)
	55051.4876	.0003	FR	+0.0907		GCVS 2009	-Ir	56	17)
	55062.4707	.0005	AG	+0.0914		GCVS 2009	-Ir	32	17)
	55141.3114	.0009	FR	−0.1018	s	GCVS 2009	-Ir	72	17)
	55141.5065	.0003	FR	+0.0933	s	GCVS 2009	-Ir	72	17)
V345 Lac	55051.3743	.0008	AG	+0.1687	s	GCVS 2009	-Ir	39	17)
V364 Lac	55071.4412	.0004	FR	−0.0109		BAVR 47,33	-Ir	50	17)
	55082.5585	.0006	FR	+0.0790	s	BAVR 47,33	-Ir	47	17)
V401 Lac	55041.5060	.0041	AG				-Ir	41	17)
	55042.4909	.0012	AG				-Ir	34	17)
V402 Lac	55051.5025	.0004	FR				-Ir	71	17)
V441 Lac	55058.5237	.0012	AG	+0.0584		IBVS 5024	-Ir	57	17)
	55062.3821	.0011	AG	+0.0556	s	IBVS 5024	-Ir	32	17)
	55062.5379	.0010	AG	+0.0569		IBVS 5024	-Ir	32	17)
UZ Lyr	55075.3757	.0003	JU	−0.0275		GCVS 2009	o	60	7)
AA Lyr	55074.4975	.0010	FR	+0.1535	s	GCVS 2009	-Ir	54	17)
BV Lyr	55068.4881	.0028	AG	+0.0303	s	GCVS 2009	-Ir	36	17)
FH Lyr	54932.5299	.0003	MS FR	+0.0247		GCVS 2009	o	765	9)
PS Lyr	55060.4250	.0010	JU	+0.0118		GCVS 2009	o	50	7)
	55076.3420	.0026	AG	+0.0120		GCVS 2009	-Ir	17	17)
	55097.3207	.0003	FR	+0.0095	s	GCVS 2009	-Ir	100	17)
QU Lyr	55092.3996	.0007	MZ	−0.0021	s	GCVS 2009	-Ir	114	7)
	55130.3186	.0010	MZ	+0.0028	s	GCVS 2009	-Ir	98	7)
V412 Lyr	55074.5381	.0005	FR	+0.1982		GCVS 2009	-Ir	53	17)
V579 Lyr	54996.4256	.0004	JU				o	62	7)
V580 Lyr	55063.3997	.0004	JU				o	51	7)
	55087.3935	.0008	JU				o	54	7)
V423 Oph	55029.5126	.0006	AG	+0.0424		GCVS 2009	-Ir	51	17)
V509 Oph	55045.4768	.0005	AG	+0.0562		GCVS 2009	-Ir	42	17)
V577 Oph	55041.5209	.0010	AG	−0.0087		GCVS 2009	-Ir	55	17)
V969 Oph	55045.4115	.0004	AG	+0.0179	s	GCVS 2009	-Ir	45	17)
V2612 Oph	55041.5208	.0008	AG	+0.0824	s	GCVS 2009	-Ir	55	17)
VV Ori	55175.3728	.0011	FR	−0.0271		GCVS 2009	-Ir	121	12)
GG Ori	52655.4238	.0005	FR	+0.0830		GCVS 2009	-Ir	62	12) 1)
	55175.3830	.0005	FR	+0.0836		GCVS 2009	-Ir	53	17)
V1353 Ori	55175.4493	.0006	FR				-Ir	70	17)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
U Peg	54839.2897	.0035	ATB	−0.0162	s	BAVR 45,3	o	42	6)
	55059.4707	.0021	PGL	−0.0170		BAVR 45,3	V	371	16)
	55063.4060	.0007	FLG	−0.0169	s	BAVR 45,3	V	106	15)
AT Peg	55093.3274	.0035	PGL	+0.0231		GCVS 2009	V	482	16)
	55141.4661	.0004	FR	+0.0265		GCVS 2009	-Ir	79	12)
BK Peg	54829.3925	.0007	BKN	+0.0073		GCVS 2009	V	233	14)
BY Peg	55060.4037	.0002	MS FR	−0.0265		GCVS 2009	o	385	9)
CE Peg	55048.4709	.0003	MS FR	+0.1473	s	GCVS 2009	o	720	9) 1)
CU Peg	55155.2625	.0031	SCI	+0.0152		GCVS 2009	o	41	7)
	55155.2625	.0031	SCI	+0.0152		GCVS 2009	o	41	7)
DF Peg	55083.4191	.0007	FR	+0.1075		GCVS 2009	-Ir	32	17)
DI Peg	55064.3920	.0014	PGL	−0.0123		GCVS 2009	V	553	16)
	55064.3929	.0001	FLG	−0.0114		GCVS 2009	V	89	15)
DM Peg	55154.4139	.0012	FR	+0.0383	s	GCVS 2009	-Ir	27	12)
GH Peg	55084.3655	.0007	SIR	+0.0061		GCVS 2009	-Ir	268	11)
LS Peg	55068.4350	.0005	FR				-Ir	353	17)
	55068.6083	.0005	FR				-Ir	353	17)
AG Per	55155.3272	.0011	FR	+0.1557	s	GCVS 2009	-Ir	23	12)
BP Per	55073.5374	.0004	MS FR	−0.0269	s	GCVS 2009	o	252	9)
	55074.5233	.0002	MS FR	−0.0305		GCVS 2009	o	675	9)
FW Per	55066.5850	.0003	MS FR	−0.0530		GCVS 2009	o	476	9)
HS Per	55141.5318	.0004	AG				-Ir	65	17)
IK Per	55155.4131	.0002	MS FR	−0.1760		GCVS 2009	o	590	9)
KN Per	55048.5498	.0004	MS FR	+0.0067		BAVR 52,93	o	486	9)
	55155.5636	.0011	AG	+0.0121	s	BAVR 52,93	-Ir	54	17)
QT Per	55058.5473	.0004	MS FR	+0.1883		GCVS 2009	o	500	9)
QU Per	55155.6128	.0010	AG	−0.0048		GCVS 2009	-Ir	54	17)
V337 Per	55155.4929	.0004	AG	−0.0404		GCVS 2009	-Ir	54	17)
V427 Per	55155.4856	.0005	AG	+0.0140		GCVS 2009	-Ir	54	17)
V432 Per	55155.4190	.0005	AG	−0.0215	s	IBVS 3797	-Ir	54	17)
	55155.6122	.0011	AG	−0.0200		IBVS 3797	-Ir	54	17)
V449 Per	55155.4906	.0026	AG	+0.0483	s	GCVS 2009	-Ir	50	17)
V450 Per	55075.6073	.0002	MS FR	+0.0997		GCVS 2009	o	477	9)
	55155.2975	.0007	AG	+0.1019		GCVS 2009	-Ir	54	17)
U Sge	54697.5417	.0012	FR	−0.0020	s	GCVS 2009	-Ir	43	12) 1)
	55042.3649	.0012	FR	−0.0020	s	GCVS 2009	-Ir	43	12) 1)
V Sge	55028.4893	.0009	AG	−0.0596		GCVS 2009	-Ir	34	17)
	55097.3965	.0019	AG	−0.0546		GCVS 2009	-Ir	67	17)
UZ Sge	55032.4024	.0001	AG	+0.0716		GCVS 2009	-Ir	44	17)
BR Sge	55097.4465	.0008	AG	−0.5564		GCVS 2009	-Ir	67	17)
CK Sge	55032.4838	.0054	AG	−0.0386		GCVS 2009	-Ir	36	17)
CW Sge	55028.4412	.0011	AG	+0.0285		GCVS 2009	-Ir	33	17)
DE Sge	55042.4051	.0011	AG	−0.4060		GCVS 2009	-Ir	42	17)
DK Sge	55028.5049	.0004	AG	−0.1544		GCVS 2009	-Ir	35	17)
	55042.4928	.0005	AG	+0.1535		GCVS 2009	-Ir	42	17)
	55067.3653	.0015	AG	+0.1532		GCVS 2009	-Ir	24	17)
DM Sge	55045.4258	.0005	JU	+0.0110		GCVS 2009	o	60	7)
FF Sge	55042.4384	.0011	AG	+0.0358	s	GCVS 2009	-Ir	42	17)
FL Sge	55067.5008	.0182	AG	+0.1159		GCVS 2009	-Ir	23	17)
GN Sge	55042.4657	.0011	AG	+0.0033	s	GCVS 2009	-Ir	42	17)
GO Sge	55028.5327	.0009	AG	−0.0705	s	GCVS 2009	-Ir	35	17)
V365 Sge	55028.4226	.0004	AG	−0.0435		GCVS 2009	-Ir	32	17)
	55067.3656	.0014	AG	−0.0439	s	GCVS 2009	-Ir	23	17)
X Tri	55071.3962	.0001	FLG	−0.0756		GCVS 2009	V	148	15)
RS UMi	55095.4970	.0015	AG	+0.1516		GCVS 2009	-Ir	152	17)
TV UMi	55095.4628	.0047	AG				-Ir	38	17)
RS Vul	55064.5034	.0003	FR	−0.0158	s	GCVS 2009	-Ir	25	17)
AB Vul	55060.4105	.0006	AG	−0.0310		GCVS 2009	-Ir	34	17)
AW Vul	55039.4813	.0001	FR	−0.0138		GCVS 2009	-Ir	73	17)
	55041.5014	.0012	FR	−0.0098	s	GCVS 2009	-Ir	37	17)
BE Vul	55096.4375	.0002	AG	+0.0717		GCVS 2009	-Ir	50	17)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
BG Vul	55071.3537	.0006	AG	+0.0724		GCVS 2009	-Ir	52	17)
	55071.5551	.0004	AG	+0.0722	s	GCVS 2009	-Ir	52	17)
BS Vul	55071.3633	.0010	JU	−0.0234		GCVS 2009	o	30	7)
DR Vul	55039.4559	.0003	FR	+0.1272		GCVS 2009	-Ir	48	17)
	55083.4373	.0010	JU	+0.2167	s	GCVS 2009	o	68	7)
FM Vul	55060.5407	.0009	AG	+0.0285		GCVS 2009	-Ir	35	17)
	55068.3873	.0006	AG	+0.0287		GCVS 2009	-Ir	36	17)
FO Vul	55060.4985	.0032	AG	−0.1275		GCVS 2009	-Ir	35	17)
FR Vul	55066.5274	.0004	AG	−0.0065		GCVS 2009	-Ir	48	17)
	55068.4100	.0012	AG	−0.0076		GCVS 2009	-Ir	36	17)
GP Vul	54996.4388	.0004	AG	−0.0609		GCVS 2009	-Ir	42	17)
GR Vul	55068.4968	.0011	AG	−0.0345		GCVS 2009	-Ir	37	17)
GV Vul	54996.4857	.0003	MS FR	+0.0685		GCVS 2009	o	630	9)
V403 Vul	55059.5176	.0011	FR				-Ir	83	17)
V467 Vul	55071.3523	.0013	AG	−0.0248	s	GCVS 2009	-Ir	53	17)
	55071.5622	.0007	AG	−0.0286		GCVS 2009	-Ir	53	17)
GSC 00238-00793	52338.3977	.0012	AG	+0.0015		PZP 10.4	o	24	6)
	52338.5566	.0007	AG	−0.0005	s	PZP 10.4	o	24	6)
	52344.3450	.0008	AG	−0.0020	s	PZP 10.4	o	31	6)
	52344.5069	.0009	AG	−0.0009		PZP 10.4	o	31	6)
	52345.3179	.0018	AG	+0.0059	s	PZP 10.4	V	31	6)
	52345.4718	.0015	AG	−0.0010		PZP 10.4	B+V	65	6)
	52347.4022	.0012	AG	−0.0006		PZP 10.4	o	61	6)
	52371.3733	.0010	AG	+0.0067	s	PZP 10.4	o	74	6)
	52696.4064	.0005	AG	+0.0004		PZP 10.4	o	183	6)
	54136.4845	.0009	AG	−0.0023		PZP 10.4	-Ir	55	6)
	54171.3920	.0019	AG	+0.0049	s	PZP 10.4	-Ir	59	6)
	54171.5437	.0036	AG	−0.0043		PZP 10.4	-Ir	59	6)
	54173.3208	.0020	AG	+0.0037	s	PZP 10.4	-Ir	29	6)
	54173.4805	.0026	AG	+0.0026		PZP 10.4	-Ir	29	6)
	54506.3938	.0010	AG	−0.0043		PZP 10.4	-Ir	70	6)
	54506.5609	.0022	AG	+0.0020	s	PZP 10.4	-Ir	70	6)
GSC 00434-03766	55029.5113	.0017	AG				-Ir	51	17)
	55045.4855	.0012	AG				-Ir	42	17)
GSC 0113-400160	55068.3614	.0007	FR				-Ir	73	17)
	55068.5360	.0007	FR				-Ir	73	17)
	55083.3827	.0003	FR				-Ir	66	17)
	55083.5560	.0006	FR				-Ir	66	17)
GSC 01134-00352	55068.4426	.0003	FR				-Ir	40	17)
	55083.3845	.0004	FR				-Ir	45	17)
GSC 01330-00293	52690.3790	.0013	AG	+0.0004		BAVR 57.232	-Ir	39	6)
	52691.3015	.0021	AG	−0.0013		BAVR 57.232	-Ir	34	6)
	52692.4621	.0033	AG	+0.0040	s	BAVR 57.232	-Ir	43	6)
	52721.3403	.0015	AG	+0.0002		BAVR 57.232	o	19	6)
	53028.4182	.0016	AG	+0.0051	s	BAVR 57.232	-Ir	29	6)
	53055.4549	.0009	AG	+0.0083		BAVR 57.232	-Ir	40	6)
	53410.3457	.0013	AG	−0.0025		BAVR 57.232	-Ir	57	6)
	54505.3276	.0040	QU	+0.0064	s	BAVR 57.232	V	76	8)
	54507.3974	.0010	QU	−0.0033		BAVR 57.232	V	84	8)
	54509.4793	.0020	QU	−0.0009	s	BAVR 57.232	V	96	8)
	54515.4886	.0020	QU	+0.0010	s	BAVR 57.232	V	75	8)
	54516.4142	.0020	QU	+0.0023	s	BAVR 57.232	V	90	8)
	54520.3369	.0015	QU	−0.0029		BAVR 57.232	V	75	8)
	54531.4262	.0010	QU	−0.0043		BAVR 57.232	B	70	8)
	54809.6201	.0020	AG	−0.0015		BAVR 57.232	-Ir	52	17)
	54843.3513	.0008	AG	−0.0044		BAVR 57.232	-Ir	56	17)
	54843.5860	.0029	AG	−0.0008	s	BAVR 57.232	-Ir	56	17)
	54856.5263	.0014	AG	+0.0004	s	BAVR 57.232	-Ir	57	17)
GSC 01643-01880	54682.5753	.0005	AG				-Ir	46	17)
	55067.3648	.0019	AG				-Ir	24	17)
GSC 02149-00720	54697.4274	.0008	AG				-Ir	38	17)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
GSC 02161-01310	55039.5590	.0010	FR				-Ir	113	17)
	55041.4276	.0014	FR				-Ir	56	17)
	55063.4519	.0005	FR				-Ir	61	17)
GSC 02537-00520	54924.5164	.0016	AG				-Ir	38	17)
GSC 02569-00553	52721.5577	.0015	AG	−0.0021	s	PZP 10.4	o	29	6)
	52722.4429	.0025	AG	−0.0036	s	PZP 10.4	o	42	6)
	52722.5925	.0018	AG	−0.0018		PZP 10.4	o	42	6)
	52723.4834	.0017	AG	+0.0024		PZP 10.4	o	41	6)
	52724.3594:	.0100	AG	−0.0083		PZP 10.4	o	16	6)
	52725.3976	.0017	AG	−0.0046	s	PZP 10.4	o	37	6)
	52725.5564	.0042	AG	+0.0064		PZP 10.4	o	37	6)
	52726.4395	.0044	AG	+0.0028		PZP 10.4	o	29	6)
	52726.5862	.0021	AG	+0.0017	s	PZP 10.4	o	29	6)
	52730.4248	.0018	AG	−0.0021	s	PZP 10.4	o	36	6)
	52730.5744	.0040	AG	−0.0003		PZP 10.4	o	36	6)
	52743.4312	.0027	AG	−0.0008	s	PZP 10.4	o	54	6)
	52747.4302	.0016	AG	+0.0080		PZP 10.4	o	48	6)
	52764.4143	.0010	AG	−0.0033	s	PZP 10.4	o	37	6)
	52784.5163	.0023	AG	−0.0001	s	PZP 10.4	o	38	6)
	52827.5248	.0020	AG	+0.0028		PZP 10.4	o	33	6)
	52834.4706	.0072	AG	+0.0027	s	PZP 10.4	o	26	6)
	53097.3810	.0016	AG	+0.0027		PZP 10.4	o	43	6)
	53097.5256	.0030	AG	−0.0005	s	PZP 10.4	o	43	6)
	53110.3840	.0030	AG	+0.0006		PZP 10.4	o	22	6)
	53145.4166	.0034	AG	+0.0080	s	PZP 10.4	o	24	6)
	53151.4671	.0019	AG	−0.0007		PZP 10.4	o	39	6)
	53475.4126	.0034	AG	−0.0010		PZP 10.4	-Ir	32	6)
	53475.5592	.0018	AG	−0.0022	s	PZP 10.4	-Ir	32	6)
GSC 02656-04286	55084.5602	.0009	FR	−0.0037	s	IBVS 5900 No.4	-Ir	30	17)
GSC 02673-02495	53659.3408	.0030	AG	+0.0000		PZP 10.4	-Ir	30	6)
GSC 02677-00988	55067.3630	.0010	FR				-Ir	48	17)
	55075.4953	.0018	FR				-Ir	30	17)
GSC 02712-02018	55083.4194	.0010	FR				-Ir	66	12)
GSC 02712-02166	55083.2952	.0068	FR				-Ir	60	52)
	55083.5097	.0015	FR				-Ir	60	12)
GSC 03137-00126	55062.5665	.0005	FR				-Ir	96	17)
GSC 03575-03593	55075.3760	.0028	AG	+0.0022	s	IBVS 5700 No.74	-Ir	39	17)
GSC 03575-06239	52859.4347	.0002	AG	−0.0003		PZP 10.4	-Ir	30	6)
	52886.4693	.0001	AG	+0.0011		PZP 10.4	o	26	6)
	55074.4202	.0024	AG	−0.0076	s	PZP 10.4	-Ir	36	17)
GSC 03576-00170	55075.4466	.0008	AG	−0.0444	s	IBVS 5724	-Ir	38	17)
GSC 03612-00014	54031.3224	.0046	AG	−0.0030		PZP 10.4	-Ir	12	6)
	55063.3704	.0014	AG	+0.0034		PZP 10.4	-Ir	46	17)
GSC 03618-00162	52617.3227	.0050	AG	+0.0019		PZP 10.4	-Ir	12	6)
	52855.4901	.0001	AG	−0.0073	s	PZP 10.4	-Ir	19	6)
	53226.4132	.0001	AG	−0.0090	s	PZP 10.4	-Ir	18	6)
	53226.5372	.0009	AG	−0.0054		PZP 10.4	-Ir	18	6)
	53233.5207	.0014	AG	−0.0023		PZP 10.4	-Ir	18	6)
	53242.4353	.0058	AG	+0.0062		PZP 10.4	-Ir	15	6)
	55062.3945	.0007	AG	+0.0025		PZP 10.4	-Ir	32	17)
	55062.5134	.0013	AG	+0.0010	s	PZP 10.4	-Ir	32	17)
GSC 03618-00448	52621.2669	.0010	AG	+0.0136	s	PZP 10.4	-Ir	20	6)
	52855.5415	.0003	AG	−0.0115		PZP 10.4	-Ir	19	6)
	53233.5060	.0009	AG	+0.0035	s	PZP 10.4	-Ir	18	6)
	53242.4638	.0057	AG	−0.0168		PZP 10.4	-Ir	15	6)
	53284.4781	.0004	AG	+0.0031	s	PZP 10.4	-Ir	22	6)
	53653.4550	.0036	AG	+0.0085	s	PZP 10.4	-Ir	30	6)
	54712.5701	.0030	AG	−0.0039		PZP 10.4	-Ir	22	17)
	54738.3559	.0034	AG	+0.0060	s	PZP 10.4	-Ir	67	17)
	54798.2931	.0011	AG	−0.0074		PZP 10.4	-Ir	75	17)
	55062.4201	.0013	AG	−0.0106		PZP 10.4	-Ir	32	17)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
GSC 03618-00448	55098.6275	.0018	AG	−0.0053	s	PZP 10.4	-Ir	29	17)
	55125.2893	.0032	AG	+0.0118	s	PZP 10.4	-Ir	50	17)
	55141.5031	.0016	FR	+0.0071	s	PZP 10.4	-Ir	50	17)
GSC 03619-00047	53256.5804	.0010	AG	−0.0106		PZP 10.4	-Ir	21	6)
	54035.3425	.0016	AG	+0.0053		PZP 10.4	-Ir	35	6)
	54035.5994	.0046	AG	+0.0198	s	PZP 10.4	-Ir	35	6)
	54080.4337	.0020	AG	+0.0010		PZP 10.4	-Ir	46	6)
	55033.4988	.0032	AG	−0.0009	s	PZP 10.4	-Ir	29	17)
	55051.4442	.0008	FR	+0.0033	s	PZP 10.4	-Ir	56	17)
	55098.4750	.0064	AG	−0.0011	s	PZP 10.4	-Ir	27	17)
	55108.4148	.0021	AG	−0.0017		PZP 10.4	-Ir	44	17)
	55141.3861	.0012	FR	−0.0034		PZP 10.4	-Ir	79	17)
GSC 03675-01186	55141.4089	.0013	AG	+0.0189		IBVS 5700 No.67	-Ir	65	17)
	55141.5589	.0010	AG	+0.0203	s	IBVS 5700 No.67	-Ir	65	17)
GSC 03679-02129	54815.3248	.0024	AG				-Ir	60	17)
	54815.5227	.0023	AG				-Ir	60	17)
	54829.3199	.0024	AG				-Ir	49	17)
	54829.3199	.0024	AG				-Ir	49	17)
	54829.5127	.0028	AG				-Ir	49	17)
	54829.5127	.0028	AG				-Ir	49	17)
GSC 03688-01184	53636.4490	.0004	AG	+0.0054	s	PZP 10.4	-Ir	24	6)
	53654.4093	.0022	AG	−0.0013	s	PZP 10.4	-Ir	50	6)
	53654.5956	.0009	AG	+0.0053		PZP 10.4	-Ir	50	6)
	53659.4416	.0020	AG	+0.0002	s	PZP 10.4	-Ir	37	6)
	54026.3262	.0038	AG	−0.0024	s	PZP 10.4	-Ir	23	6)
	54056.3335	.0029	AG	+0.0000		PZP 10.4	-Ir	21	6)
	54115.4343	.0022	AG	−0.0108	s	PZP 10.4	-Ir	49	6)
	54815.4372	.0012	AG	−0.0042	s	PZP 10.4	-Ir	59	17)
	54829.2774	.0020	AG	+0.0014		PZP 10.4	-Ir	48	17)
	54829.4567	.0012	AG	+0.0010	s	PZP 10.4	-Ir	48	17)
	55141.3685	.0030	AG	+0.0048	s	PZP 10.4	-Ir	63	17)
	55141.5462	.0025	AG	+0.0028		PZP 10.4	-Ir	63	17)
GSC 04009-00670	53349.2934	.0042	AG	−0.0045	s	PZP 10.4	-Ir	23	6)
	53656.4158	.0049	AG	+0.0051		PZP 10.4	-Ir	30	6)
GSC 04030-02020	55081.3444	.0010	AG				-Ir	46	17)
	55081.4805	.0010	AG				-Ir	46	17)
	55081.6183	.0028	AG				-Ir	46	17)
	55154.3459	.0021	AG				-Ir	45	17)
	55154.4840	.0006	AG				-Ir	45	17)
	55154.6182	.0022	AG				-Ir	45	17)
GSC 04285-00122	53768.3875	.0002	AG	+0.0029		PZP 10.4	-Ir	22	6)
	54003.4629	.0017	AG	−0.0008	s	PZP 10.4	-Ir	63	6)
	54035.3089	.0031	AG	+0.0018	s	PZP 10.4	-Ir	45	6)
	54035.4900	.0018	AG	−0.0044		PZP 10.4	-Ir	45	6)
	54085.5048	.0023	AG	−0.0024	s	PZP 10.4	-Ir	30	6)
	54218.5056	.0012	AG	+0.0055	s	PZP 10.4	-Ir	41	6)
	54718.4394	.0013	AG	−0.0018		PZP 10.4	-Ir	63	17)
	54840.3874	.0026	AG	+0.0048	s	PZP 10.4	-Ir	66	17)
	54840.5703	.0050	AG	+0.0004		PZP 10.4	-Ir	66	17)
GSC 04497-00283	55064.5253	.0014	AG				-Ir	51	17)
	55083.4777	.0004	AG				-Ir	79	17)
	55103.3541	.0015	AG				-Ir	67	17)
GSC 04502-00138	54080.2646	.0005	AG	−0.0848		IBVS 5700 No.8	-Ir	45	6)
	54080.4572	.0009	AG	−0.0887	s	IBVS 5700 No.8	-Ir	45	6)
	54080.6555	.0012	AG	−0.0868		IBVS 5700 No.8	-Ir	45	6)
	55064.4471	.0008	AG	−0.1168		IBVS 5700 No.8	-Ir	51	17)
	55103.3507	.0010	AG	−0.1103		IBVS 5700 No.8	-Ir	64	17)
GSC 04502-01040	54080.3860	.0028	AG	+0.0496	s	IBVS 5700 No.60	-Ir	45	6)
	54080.5158	.0007	AG	+0.0442		IBVS 5700 No.60	-Ir	45	6)
	54080.6565	.0008	AG	+0.0497	s	IBVS 5700 No.60	-Ir	45	6)
	55064.4131	.0007	AG	+0.0329	s	IBVS 5700 No.60	-Ir	51	17)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
GSC 04502-01040	55064.5544	.0017	AG	+0.0390	IBVS 5700 No.60	-Ir	51	17)
GSC 04816-02749	54507.4583	.0015	AG			-Ir	24	6)
TYC 4015-0998	55096.6179	.0182	AG			-Ir	48	17)

Table 2: Times of maxima of pulsating stars

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
OV And	55063.3839	.0035	PGL	−0.0240	MVS 11,133	V	242	16)
AA Aql	55071.4592	.0030	ALH	+0.0042	BAVM 78	V	190	10)
V341 Aql	55041.6020:	.0100	FR	+0.0055	BAVR 45,74	-Ir	56	12)
	55062.4116	.0011	FLG	+0.0064	BAVR 45,74	V	227	15)
V525 Aql	55066.4590	.0060	SB	+0.1361	GCVS 2009	V	76	15) 1)
V672 Aql	55067.3939	.0006	MZ	−0.2628	GCVS 2009	-Ir	102	7)
TZ Aur	55123.3915	.0021	PGL	+0.0110	GCVS 2009	V	233	19)
YZ Boo	54952.4272	.0016	FLG	+0.0002	GCVS 2009	V	52	15)
CM Boo	54953.4486	.0022	FLG	−0.1138	GCVS 2009	V	183	15)
CQ Boo	54981.4007	.0007	MZ	−0.0565	BAVR 48,189	-Ir	151	7) 1)
	54981.4368	.0007	MZ	−0.0204	BAVR 48,189	-Ir	121	7) 1)
ST CVn	54972.468	.002	AG	−0.065	BAVR 49,105	-Ir	38	17)
PS Cas	55141.389	.005	AG	−0.192	GCVS 2009	-Ir	65	17)
V363 Cas	55108.525	.003	AG	+0.037	BAVR 49,41	-Ir	48	17)
RZ Cep	55068.4860	.0035	PGL	−0.1145	GCVS 2009	V	844	16) 3)
	55070.3691	.0035	PGL	−0.0835	GCVS 2009	V	479	16) 4)
	55083.3100	.0035	PGL	−0.1074	GCVS 2009	V	477	16) 5)
	55091.3321	.0042	PGL	−0.1111	GCVS 2009	V	613	16) 5)
	55094.4275	.0056	PGL	−0.1026	GCVS 2009	V	545	16) 5)
	55099.360 :	.006	PGL	−0.109	GCVS 2009	o	135	16) 5)
RV CrB	54972.4318	.0030	ALH	+0.0098	GCVS 2009	V	171	10) 4)
UY Cyg	55063.4239	.0030	ALH	+0.0429	GCVS 2009	V	332	10)
XZ Cyg	55119.3035	.0005	MOO	+0.0402	BAVR 48,189	o	60	15)
DM Cyg	55059.4525	.0030	ALH	−0.0015	A&A 476.307 2007	V	128	10)
V833 Cyg	55082.3600	.0010	MZ	−0.1580	GCVS 2009	-Ir	251	7) 1)
	55083.4372	.0015	MZ	−0.1571	GCVS 2009	-Ir	61	7)
V838 Cyg	55101.4494	.0007	MZ	+0.0288	GCVS 2009	-Ir	80	7)
	55102.4128	.0007	MZ	+0.0317	GCVS 2009	-Ir	75	7)
V1949 Cyg	55119.4790	.0010	MZ			-Ir	72	7)
	55119.4790	.0010	MZ			-Ir	72	7)
	55130.4645	.0026	MZ			-Ir	47	7)
	55130.4645	.0026	MZ			-Ir	47	7)
DD Dra	54972.453	.003	AG	+0.064	BAVR 49,6	-Ir	53	17)
RR Gem	55164.5212	.0021	PGL	−0.0107	BAVR 47,67	V	379	19)
SZ Gem	54922.3515	.0032	MOO	+0.0096	BAVR 48,65	o	33	18)
TW Her	55066.4339	.0020	MOO	−0.0541	GCVS 2009	o	76	18)
VZ Her	54709.4292	.0014	ATB	+0.0667	GCVS 2009	o	75	6)
AR Her	55051.4351	.0035	PGL	+0.0337	BAVR 52,3	o	676	16)
	55060.3762	.0021	PGL	+0.0452	BAVR 52,3	o	441	16)
	55066.4812	.0035	PGL	+0.0403	BAVR 52,3	o	419	16)
	55067.4170	.0035	PGL	+0.0362	BAVR 52,3	o	264	16)
	55068.3528	.0035	PGL	+0.0320	BAVR 52,3	o	235	16)
DY Her	55028.4606	.0011	BRL	−0.0061	BAVR 48,189	o	50	20)
V392 Her	55066.3618	.0008	MZ	−0.1313	GCVS 2009	-Ir	104	7)
	55101.3251	.0006	MZ	−0.1311	GCVS 2009	-Ir	86	7)
V862 Her	55100.3747	.0070	MZ			-Ir	67	7) 2)
	55100.3925	.0007	MZ			-Ir	67	7) 2)
CQ Lac	54834.4017	.0028	ATB	+0.1385	GCVS 2009	o	137	6)
CZ Lac	55141.556	.003	FR	−0.162	BAVR 53,12	-Ir	79	17)
GP Leo	54922.327	.003	MS FR	+0.301	IBVS 5114	o	628	9)
CG Lyr	55074.3750	.0002	MZ	+0.1108	GCVS 2009	-Ir	79	7)
CX Lyr	55062.3950	.0010	MZ	+0.2607	BAVR 49,41	-Ir	113	7)
EZ Lyr	55059.3820	.0014	FLG	+0.0255	BAVR 34,145	V	122	15)

Table 2: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
FN Lyr	54735.4498	.0021	ATB	+0.0244	GCVS 2009	o	41	6)
IO Lyr	54709.5058	.0024	ATB	−0.0322	GCVS 2009	o	52	6)
	55083.4786	.0030	ALH	−0.0349	GCVS 2009	V	255	10)
QV Lyr	55092.3998	.0009	MZ	+0.1047	GCVS 2009	-Ir	132	7)
	55130.3561	.0009	MZ	+0.1035	GCVS 2009	-Ir	110	7)
VZ Peg	54831.2817	.0056	ATB	−0.0114	BAVR 49,41	o	81	6)
CG Peg	55050.4419	.0035	PGL	−0.0314	SAC Vol.72	V	648	16)
DH Peg	55097.4007	.0030	ALH	−0.0021	GCVS 2009	V	398	10) 2)
	55097.4288	.0030	ALH	+0.0260	GCVS 2009	V	398	10) 2)
	55141.378	.003	FR	+0.027	GCVS 2009	-Ir	47	12)
DY Peg	55068.4982	.0010	BRL	−0.0093	GCVS 2009	o	41	20)
	55091.3980	.0009	BRL	−0.0083	GCVS 2009	o	64	20)
	55091.4707	.0007	BRL	−0.0085	GCVS 2009	o	36	20)
	55091.5436	.0007	BRL	−0.0086	GCVS 2009	o	65	20)
	55093.3656	.0035	PGL	−0.0097	GCVS 2009	V	79	16)
	55097.3769	.0021	PGL	−0.0094	GCVS 2009	m	218	16)
AR Per	55155.538	.002	FR	+0.058	GCVS 2009	-Ir	101	17)
	55168.3042	.0035	PGL	+0.0574	GCVS 2009	V	464	16)
V375 Per	55155.265	.001	AG	−0.258	GCVS 2009	-Ir	54	17)
EV Psc	55082.4053	.0030	MZ	−0.0105	GCVS 2009	-Ir	121	7)
	55097.4178	.0030	MZ	−0.0046	GCVS 2009	-Ir	127	7)
V1025 Sgr	55042.530	.006	FR	−0.027	GCVS 2009	-Ir	90	17)
GSC 01666-00929	55083.617	.005	FR			-Ir	208	17)
GSC 02681-00859	55062.426	.002	FR			-Ir	52	17)
	55062.558	.002	FR			-Ir	52	17)

Observers:

AG: Agerer, F., Tiefenbach
ALH: Alich, K., Schaffhausen (CH)
ATB: Achterberg, H., Norderstedt
BKN: Bakan, S., Wedel
BRL: Brettel, Dr. G., Schwarzenbek
DIE: Dietrich, M., Radebeul
FLG: Flechsig, Dr. G., Teterow
FR: Frank, P., Velden
GB: Gröbel,R., Eckental
JU: Jungbluth, Dr. H., Karlsruhe
MOO: Moos, C., Netphen
MS: Moschner, W., Lennestadt
MZ: Maintz, Dr. G., Bonn
PGL: Pagel, Dr. L., Klockenhagen
QU: Quester, W., Esslingen
SB: Steinbach, Dr. H., Neu-Anspach
SCI: Schmidt, U., Karlsruhe
SIR: Schirmer, J., Willisau (CH)
WTR: Walter, F., München

Remarks:

:	uncertain
s	secondary minimum
1)	normal maximum or minimum
2)	double maxima: time of the first and the second maximum
3)	double maxima: time of the first maximum
4)	double maxima: time of the second maximum
5)	double maxima: time of the middle of both maxima
	CCD-Cameras
6)	ccd-camera ST-6: chip 375*242 uncoated
7)	ccd-camera ST-7
8)	ccd-camera ST-7E
9)	ccd-camera ST-9E
10)	ccd-camera ST-8XMEI: chip KAF1603ME
11)	ccd-camera Alpha Maxi: chip KAF401e
12)	ccd-camera OES-LcCCD12
13)	ccd-camera Pictor 416XT
14)	ccd-camera Meade DSI Pro 2
15)	ccd-camera SIGMA 402
16)	ccd-camera Artemis 4021
17)	ccd-camera Sigma 1603
18)	ccd-camera Canon EOS 350D
19)	ccd-camera AlCCD6c
20)	ccd-camera Canon EOS 450D
21)	ccd-camera Meade 1616XTE
	Filter
o	without filter
B	B-filter
V	V-filter
-Ir	-Ir-filter
m	multiple filter

References:

A&A	Astronomy & Astrophysics
AJ vvv,ppp	Astronomical Journal volume, pages
BAVM nnn	BAV Mitteilungen No. nnn
BAVR vv,ppp	BAV Rundbrief volume, pages
GCVS 2009	General Catalogue of Variable Stars, version: iii.dat 20.11.2009
IBVS nnnn	Information Bulletin on Variable Stars No. nnnn
MVS vv,ppp	Mitteilungen ueber Veraenderliche Sterne, volume,page
SAC vv	Rocznik Astronomiczny No. vv, Krakow (SAC)
	Star catalogues
GSC	The HST Guide star Catalogue 1.2
TYC	Tycho ctalogue

ERRATUM FOR IBVS 5918 (BAVM 209)

RR Lyr 54866.4031 ALH has to be deleted

ERRATUM FOR IBVS 5941 (BAVM 212)

TW Her 55066.4339 MOO has to be deleted

ERRATUM FOR IBVS 5941 (BAVM 212)

KV Gem 54910.3597 ATB has to be deleted
KV Gem 54910.3696 ATB has to be deleted

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MOST OBSERVATIONS OF THE λ BOOTIS STAR HD 142703

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For the first time, we present photometric data of a space mission (MOST satellite) for a member, HD 142703 (HR Lib, V = 6.12), of the λ Bootis group. The latter comprises late B- to early F-type, Population I stars which are generally metal weak and show underbundances as particularly the iron group elements, but not in C, N, O and S. Only a maximum of about 2% of all objects in the relevant spectral domain are believed to be λ Bootis type stars (Paunzen 2001).

At least 70% of all λ Bootis type stars inside the classical instability strip pulsate with rather typical δ Scuti type characteristics (Paunzen et al., 2002).

In the past, three different IBVS notes reported ground-based observations for this object. A summary is given in Paunzen & Handler (1996) who list detected frequencies of 16.5, 18 and 31.5 d^{-1}. The highest of these published frequencies, however, was probable due to a misidentification or alias in the periodogram and is two times the "true" one. The amplitudes were found to be between 8 and 10 mmag for Strömgren v and b, respectively.

The MOST observations were carried out from May 18 to 28, 2007. HD 142703 was observed as a switch target, this means: MOST switches between two targets every orbit (101.4 min). One target benefits from the low stray light phase, while the light curve of the other target suffers from high stray light. In our case HD 142703 was observed in the latter phase. As for the published ground-based observations, HD 142640, was used as a comparison star. The reduction and all instrumental corrections were done in the standard way for this instrument and the given settings (Rowe et al., 2006). The final light curve is shown in Fig. 1.

The time series analysis was performed within the CINDERELLA (Comparison of INDEpendent RELative Least-squares Amplitudes) programme package (Reegen et al., 2008) which is optimized for these data sets. In addition, a Fourier technique and the Phase-Dispersion-Minimization was applied.

All methods yield comparable results. Two frequencies of 16.99 and 18.35 d^{-1} are detected, with a high significance (12 and 8σ), in the light curve. Both compare well, within the errors, to the previously reported ones. The phase diagram of the observations folded with the main frequency is shown in Fig. 2. Furthermore, no significant frequencies, which do not correspond to known artefacts due to the experimental design, can be detected. The limited of the detectable amplitude for the data set is about 0.8 mmag.

The amplitudes of the MOST data are a factor two smaller than the previously reported ones. This result can be understand due to the fact that MOST measures the integrated light from 350 to 700 nm, only.

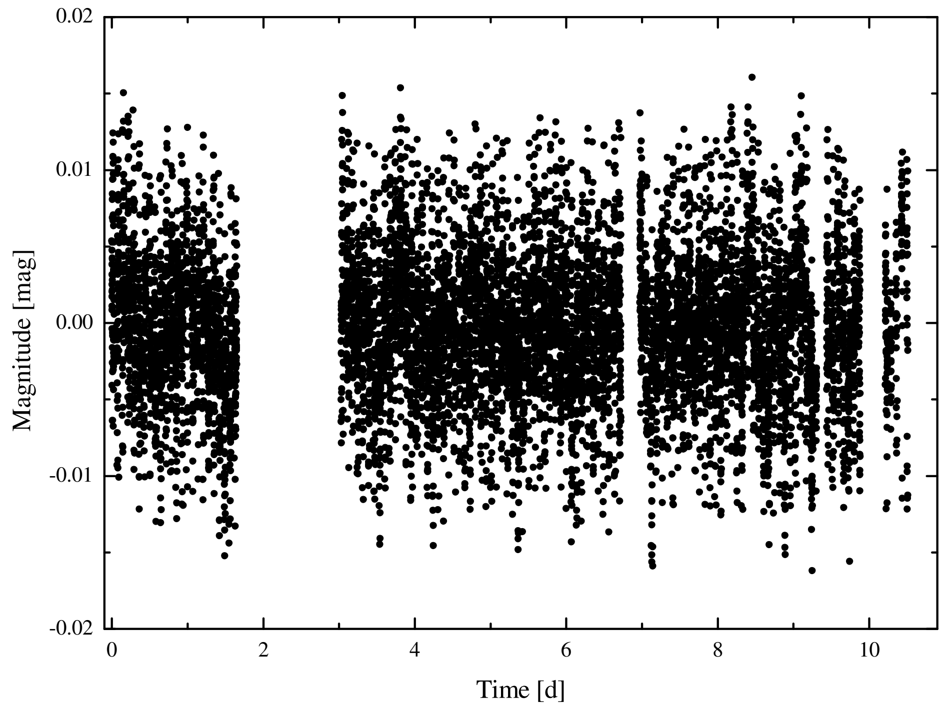

Figure 1. The MOST observations of HD 142703.

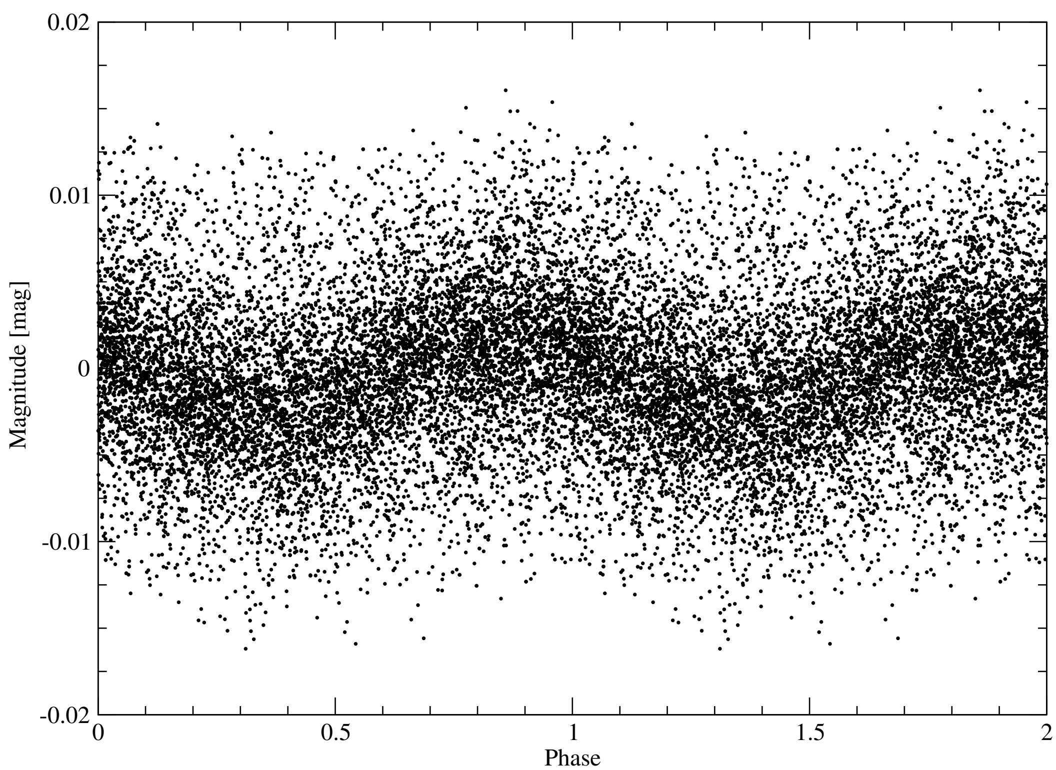

Figure 2. The MOST observations of HD 142703 folded with the main frequency.

Taking the basic astrophysical parameters of HD 142703 from Paunzen et al. (2002), we get Q values of 0.024 and 0.022, as well as $\log \rho/\rho_{\odot} = -0.80$, respectively. These values correspond to the second to fourth overtone for classical δ Scuti type pulsation (Fitch, 1981).

We conclude that for HD 142702, two frequencies are well established. The pulsation characteristics seems very similar to another member of the λ Bootis group, HD 210111 (Breger et al., 2006). In both cases, there is one domination frequency, but all others only have very small amplitudes.

Acknowledgements This work was supported by the financial contributions of the Austrian Agency for International Cooperation in Education and Research (WTZ CZ-10/2010 and HR-14/2010). Based on data from the MOST satellite, a Canadian Space Agency mission, jointly operated by Dynacon Inc., the University of Toronto Institute for Aerospace Studies and the University of British Columbia with the assistance of the University of Vienna.

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CCD TIMES OF MINIMA OF SEVERAL ECLIPSING BINARIES

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Observatory and telescope:
T1: 40 cm Cassegrain telescope, and **T2**: 20 cm Newtonian reflector telescope, both at the University of Athens Observatory

Detector:	**C1**: ST-10XME CCD camera, Peltier cooling, KAF-3200ME chip, $16' \times 11'$ and $25' \times 17'$ (using a focal reducer) FoV, 2184 × 1472 pixels, Bessell UBVRI filters, and **C2**: ST-8XMEI CCD camera, Peltier cooling, KAF-1603ME chip, $46' \times 32'$ and $23' \times 15'$ FoV, 1530 × 1020 pixels, Bessell UBVRI filters

Method of data reduction:
The reduction of the CCD frames was made using the software Muniwin v.1.1.23 (Hroch, 1998).

Method of minimum determination:
The minima times were computed using the Kwee & van Woerden (1956) method.

Table 1: Times of minima

System	HJD	Error	Type	Filters	Remark
2MASS J00511854+5022580	2455109.3990	0.0006	II	B	T1 + C1
	2455138.2859	0.0007	II	VI	T1 + C1
	2455140.2623	0.0004	I	VI	T1 + C1
	2455140.4152	0.0004	II	VI	T1 + C1
	2455156.2276	0.0004	I	R	T1 + C1
	2455156.3797	0.0002	II	R	T1 + C1
	2455158.2029	0.0006	I	B	T1 + C1
	2455158.3572	0.0004	II	B	T1 + C1
2MASS J07083972+1214429	2454115.5301	0.0005	I	R	T1 + C1
	2454468.5781	0.0011	II	V	T1 + C1
	2454477.4864	0.0017	II	VR	T1 + C1
	2454492.5078	0.0018	I	VRI	T1 + C1
	2454522.3797	0.0016	II	VRI	T1 + C1
	2454773.5715	0.0007	II	I	T1 + C1
	2454783.5875	0.0008	II	I	T1 + C1
	2455149.6162	0.0005	I	I	T1 + C1
	2455155.5516	0.0009	I	I	T1 + C1

Table 1: cont.

System	HJD	Error	Type	Filters	Remark
	2455158.5221	0.0007	I	I	T1 + C1
V0417 Aur	2455118.4598	0.0002	II	B	T1 + C1
	2455147.3744	0.0004	I	BVRI	T1 + C1
	2455148.3154	0.0006	II	RI	T1 + C1
	2455157.6332	0.0004	II	BVRI	T1 + C1
44i Boo	2455272.3703	0.0007	I	UBVRI	T2 + C2
	2455272.5030	0.0005	II	UBVRI	T2 + C2
TX Cnc	2455289.3403	0.0003	I	BVRI	T1 + C1
YY CMi	2455231.4317	0.0002	I	BVRI	T2 + C2
	2455232.5252	0.0004	I	BVRI	T2 + C2
	2455254.4055	0.0003	I	BVRI	T2 + C2
	2455258.2379	0.0009	II	B	T2 + C2
	2455271.3642	0.0003	II	BVRI	T2 + C2
AB Cas	2455148.3371	0.0012	II	RI	T2 + C2
	2455157.2167	0.0002	I	BVRI	T2 + C2
V0523 Cas	2455126.2678	0.0001	II	BVI	T2 + C2
	2455126.3843	0.0001	I	BVI	T2 + C2
V0405 Cep	2455124.4902	0.0007	II	BVRI	T1 + C1
	2455126.5541	0.0003	I	BVRI	T1 + C1
HZ Dra	2455343.5529	0.0003	I	B	T2 + C2
	2455360.5596	0.0006	I	BVRI	T2 + C2
AL Gem	2455246.2693	0.0001	I	BVRI	T1 + C1
	2455273.3935	0.0009	II	BVRI	T1 + C1
GSC 0199−2035	2455231.2721	0.0007	I	BVRI	T2 + C2
	2455232.2829	0.0005	I	BVRI	T2 + C2
	2455245.4475	0.0006	I	BVRI	T2 + C2
	2455246.4603	0.0027	I	BVRI	T2 + C2
	2455271.2688	0.0006	II	BVRI	T2 + C2
	2455272.2836	0.0005	II	BVRI	T2 + C2
GSC 0770−0523	2454107.3902	0.0004	II	R	T1 + C1
	2454107.6002	0.0005	I	R	T1 + C1
	2454115.4502	0.0005	I	R	T1 + C1
	2454477.4636	0.0009	II	VR	T1 + C1
	2454485.5262	0.0009	I	VI	T1 + C1
	2454486.4023	0.0009	I	VRI	T1 + C1
	2454492.5014	0.0011	I	VI	T1 + C1
	2454522.3624	0.0010	II	VRI	T1 + C1
	2455149.6158	0.0008	II	I	T1 + C1
	2455155.5060	0.0010	I	I	T1 + C1
	2455158.5562	0.0005	I	I	T1 + C1
	2455296.2998	0.0011	I	I	T1 + C1
GSC 1025−1841	2455013.4801	0.0012	I	BI	T1 + C1
	2455014.5168	0.0015	II	BI	T1 + C1
GSC 4516−2121	2455123.4148	0.0012	II	BVRI	T1 + C1
	2455124.3793	0.0011	II	BVRI	T1 + C1
	2455126.5573	0.0008	I	BVRI	T1 + C1
	2455149.3063	0.0007	I	R	T1 + C1

Table 1: cont.

System	HJD	Error	Type	Filters	Remark
	2455149.5512	0.0005	II	R	T1 + C1
	2455155.3601	0.0007	II	I	T1 + C1
AK Her	2455343.4415	0.0002	I	BVRI	T1 + C1
	2455344.4973	0.0002	II	BVRI	T1 + C1
V0948 Her	2455360.4494	0.0005	I	BVRI	T1 + C1
	2455365.5491	0.0002	I	B	T1 + C1
V0972 Her	2455344.4602	0.0011	I	UBVRI	T2 + C2
CM Lac	2455063.4844	0.0001	I	BVRI	T1 + C1
	2455068.2982	0.0001	I	BVRI	T1 + C1
	2455072.3081	0.0002	II	BVRI	T1 + C1
SW Lac	2455124.2633	0.0001	I	BVRI	T2 + C2
UU Leo	2455249.3034	0.0004	I	BVRI	T1 + C1
	2455285.4185	0.0012	II	VRI	T1 + C1
SX Lyn	2455158.4123	0.0012	II	I	T2 + C2
ER Ori	2455198.3340	0.0001	II	BVRI	T1 + C1
	2455199.3924	0.0001	I	BVRI	T1 + C1
	2455232.2062	0.0003	II	BVRI	T1 + C1
	2455232.3864	0.0001	I	BVRI	T1 + C1
V1128 Tau	2454426.4313	0.0001	I	BVRI	T1 + C1
	2454426.5844	0.0002	II	BVRI	T1 + C1
	2454438.3409	0.0002	I	BVRI	T1 + C1
	2454438.4937	0.0003	II	BVRI	T1 + C1
	2455127.4110	0.0002	II	VRI	T2 + C2
IO UMa	2455298.3910	0.0013	II	I	T1 + C1
	2455309.4246	0.0010	II	RI	T1 + C1
	2455320.4844	0.0007	II	I	T1 + C1
	2455334.2764	0.0005	I	BVRI	T1 + C1
	2455345.3144	0.0016	I	BVRI	T1 + C1
	2455356.3482	0.0018	I	BVRI	T1 + C1
VV UMa	2455276.3859	0.0001	I	B	T1 + C1
	2455277.4173	0.0003	II	B	T1 + C1
	2455284.2907	0.0004	II	B	T1 + C1
TU UMi	2455276.4687	0.0009	I	BVRI	T2 + C2
	2455277.4066	0.0010	II	BVRI	T2 + C2
	2455285.5216	0.0009	I	BVRI	T2 + C2
	2455289.4796	0.0012	II	BVRI	T2 + C2

Explanation of the remarks in the table:

T1, T2, C1 and C2 refer to the instrumentation (telescope and CCD camera) used for each case.

Remarks:

The systems: 2MASS J00511854+5022580, 2MASS J07083972+1214429, GSC 0770-0523, GSC 1025-1841, GSC 4516-2121 are newly discovered eclipsing binaries (Liakos & Niarchos, 2010).

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ABSOLUTE SPECTROPHOTOMETRY AND BVR$_C$I$_C$ PHOTOMETRIC EVOLUTION OF THE FAST NOVA OPHIUCHI 2010 N.2 (V2674 Oph)

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Nova Ophiuchi 2010 N.2 (= V2674 Oph) was discovered by H. Nishimura on UT 18.85 Feb 2010 (cf. Nakano, 2010) and confirmed spectroscopically on UT 19.85 Feb 2010 by Imamura, Tanabe and Fujii (2010) as a Fe II class nova.

We obtained BVR_CI_C photometry of Nova Ophiuchi 2010 N.2 with a 0.30-m Meade RCX-400 f/8 Schmidt-Cassegrain telescope equipped with a SBIG ST-9 CCD camera. The photometry was accurately corrected for color equations using nightly calibrations on Landolt (1992, 2009) standard stars. The data are presented in Table 1, and plotted in Figure 1. The combined Poissonian + transformation errors were always less than 0.025 mag. The zero points of the photometry were scaled on the nearby star HD 157866, for which we adopted: $V = 9.849$, $B - V$=+0.004, $V - R_C$=+0.158 and $V - I_C$=+0.327. The B and V were obtained from Tycho-2 photometry transformed to Johnson system following Bessell (2000), and the R_C and I_C were derived combining B, V with J, H, K from 2MASS following the recipes of Caldwell et al. (1993).

Our light-curve in Figure 1 indicates a very smooth evolution for Nova Oph 2010 N.2. The time of maximum brightness seems coincident with that of our first observation. This is supported by the zoomed view in the V-band panel of Figure 1 where our early observations are compared to those collected by VSNET (`http://www.kusastro.kyoto-u.ac.jp/vsnet/`). In spite to their much larger dispersion, interpolations of VSNET observations following different statistical criteria consistently indicate that our Feb 21.2 UT observation (HJD 2455248.7) marks the actual maximum V band brightness, from which time is counted in Figure 1 and in the rest of this paper.

The decline times are

$$t_2^V = 18 \qquad t_3^V = 31 \text{ days} \tag{1}$$

which are the times taken by the nova to decline, in the V band, by two and three magnitudes, respectively, from maximum brightness. The t_3^V/t_2^V ratio for Nova Oph 2010 N.2 is somewhat smaller than observed in other novae. In fact, given t_2^V, the Warner (1995) relation would predict t_3^V=35, while Munari et al. (2008) relation would give t_3^V=38. According to the classification of Warner (1995, his Table 5.4), t_2^V = 10 days qualifies Nova Oph 2010 N.2 to be classed among the *fast* novae.

Van den Bergh and Younger (1987) derived a mean intrinsic color $(B-V)_\circ$=+0.23±0.06 for novae at the time of maximum, and $(B - V)_\circ$=−0.02 ± 0.04 at t_2. Comparing with $B-V$=+1.07 at maximum and $B-V$=+0.57 at t_2 from Figure 1, the reddening affecting Nova Oph 2010 N.2 is $E_{B-V} = 0.7 \pm 0.1$, and the extinction (assuming a standard R_V=3.1 interstellar law) is therefore A_V=2.2 mag.

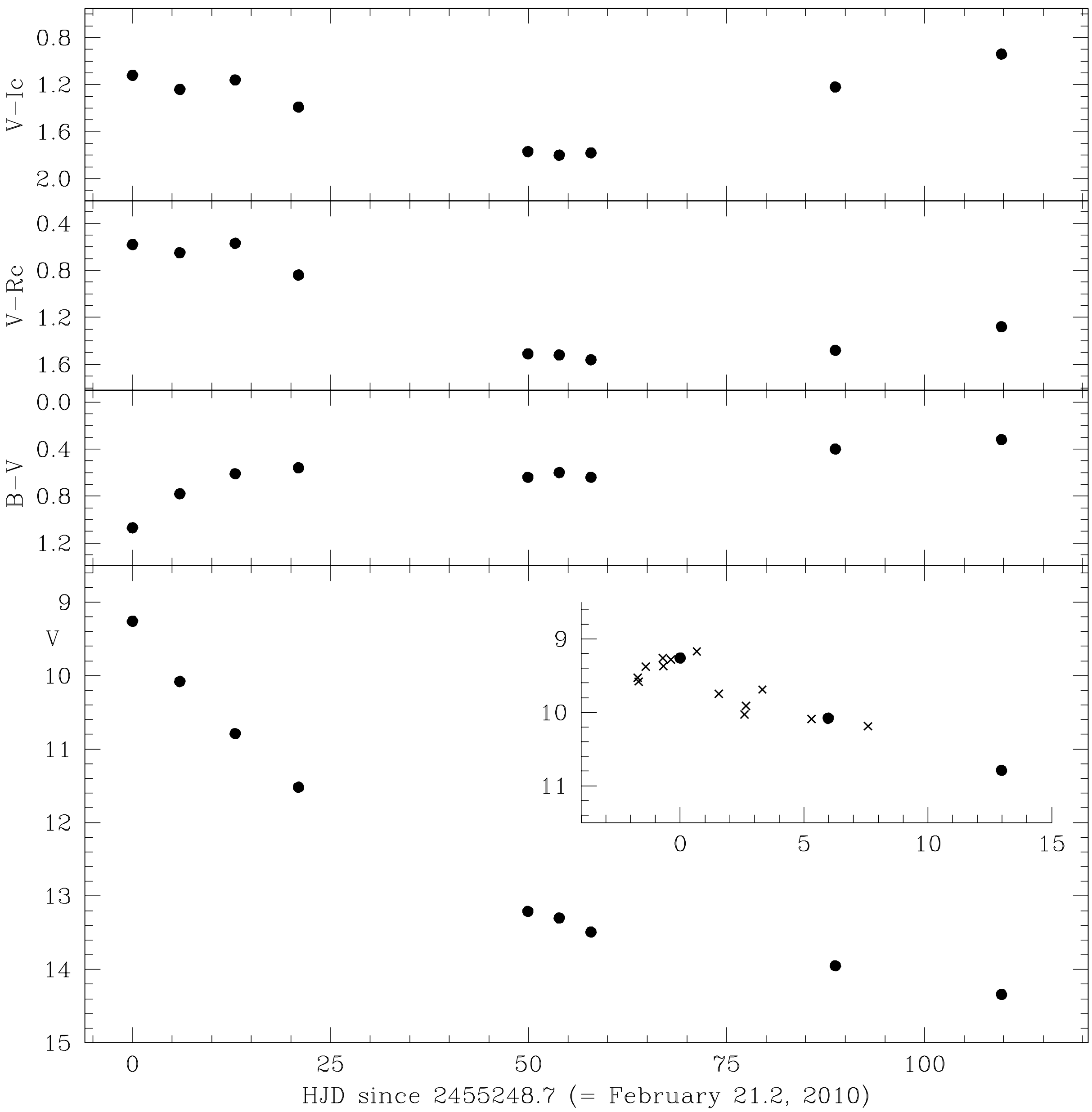

Figure 1. BVR_CI_C photometric evolution of the outburst of Nova Ophiuchi 2010 N.2. The dots represent the data in Table 1. The insert zooms on the earliest evolution of the outburst in the V band, where the crosses are VSNET V estimates.

Table 1. Our $BVR_{\rm C}I_{\rm C}$ of Nova Oph 2010 N.2

HJD	V	B-V	V-R_C	V-I_C	HJD	V	B-V	V-R_C	V-I_C
2455248.7012	9.26	1.07	0.58	1.12	2455302.5948	13.30	0.60	1.52	1.80
2455254.6787	10.08	0.78	0.65	1.24	2455306.5942	13.49	0.64	1.56	1.78
2455261.6759	10.79	0.61	0.57	1.16	2455337.4588	13.95	0.40	1.48	1.22
2455269.6603	11.52	0.56	0.84	1.39	2455358.4332	14.34	0.32	1.28	0.94
2455298.6337	13.21	0.64	1.51	1.77					

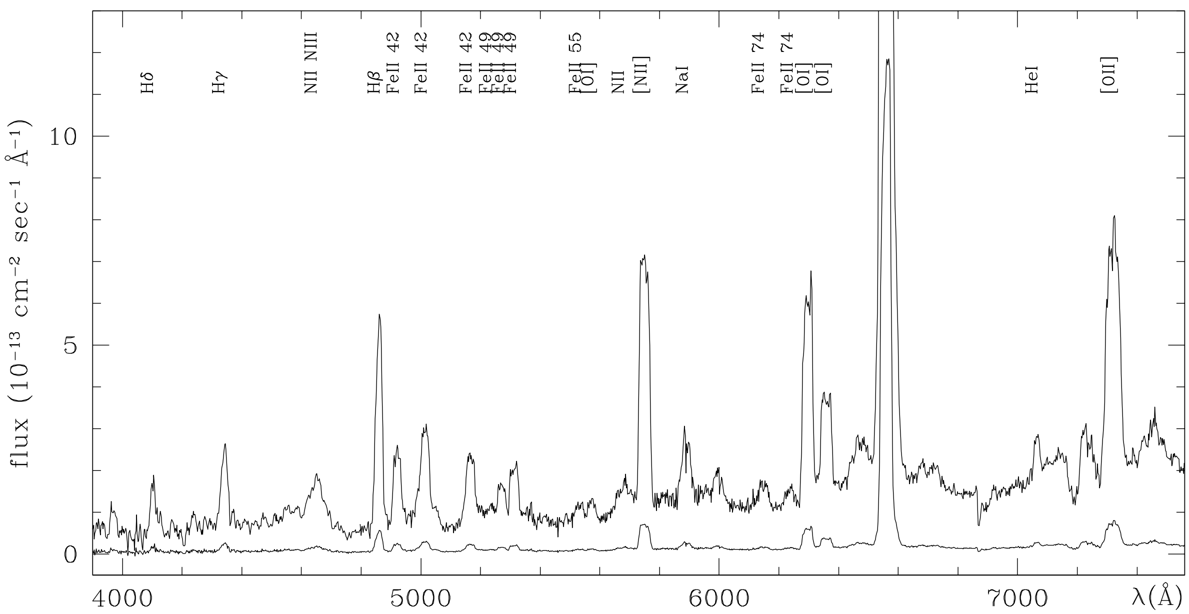

Figure 2. Absolute spectrophotometry of Nova Ophiuchi 2010 N.2 for 16.128 April 2010 UT. The spectrum is also plotted at 10× expanded scale to emphasize the visibility of weaker features.

Table 2. Integrated fluxes of the emission line (in erg $\rm cm^{-2}\ sec^{-1}$) of Nova Oph 2010 N.2 on the spectrum of Figure 2 for 16.128 April 2010 UT

$\lambda_\circ$	ion	flux	$\lambda_\circ$	ion	flux	$\lambda_\circ$	ion	flux
4101	Hδ	3.21E-13	5276	FeII 49	2.29E-13	6148	FeII 74	2.57E-13
4340	Hγ	4.45E-13	5317	FeII 49	4.88E-13	6245	FeII 74	1.95E-13
4650	NII, NIII	5.69E-13	5535	FeII 55	1.80E-13	6300	[OI]	1.85E-12
4861	Hβ	1.53E-12	5577	[OI]	1.65E-13	6364	[OI]	9.73E-13
4924	FeII 42	6.01E-13	5679	NII	2.77E-13	6563	Hα	4.22E-11
5018	FeII 42	1.06E-12	5755	[NII]	2.31E-12	7065	HeI	1.89E-13
5169	FeII 42	6.00E-13	5893	NaI	6.17E-13	7323	[OII]	2.77E-12
5235	FeII 49	2.79E-13						

Published relations between the absolute magnitude and the rate of decline generally take the form $M_{\rm max} = \alpha_n \log t_n + \beta_n$. Using the Cohen (1988) V-t_2 relation, the distance to the nova is 8.8 kpc, and 9.2 kpc according to the Schmidt (1957) V-t_3 relation. Buscombe and de Vaucouleurs (1955) suggested that all novae have the same absolute magnitude 15 days after maximum light. The most recent calibrations for it are those of Capaccioli et al. (1989, on M31 novae) and Duerbeck and Downes (2000, on galactic novae), that give $M^V_{\rm max}$=5.69±0.14 and 6.05±0.44, respectively. The brightness of Nova Oph 2010 N.2 15 days after V maximum light was V_{15}=10.98, which corresponds the respective distances of 7.8 and 9.2 kpc. Taking the mean of these four determinations, the distance to Nova Oph 2010 N.1 is d=9 kpc. At a galactic latitude b=3.6 deg, it corresponds to an height over the Galactic equatorial plane of z=0.55 kpc, well within the range of heights reported by della Valle and Livio (1998) for novae of the Fe II type.

An absolutely fluxed, low resolution spectrum of Nova Oph 2010 N.2 was obtained on UT 16.128 April 2010 (day +53.9) with the B&C+CCD spectrograph attached to the Asiago 1.22m telescope. The spectrum is presented in Figure 1. At that time the nova was well past t^V_3, being 4.1 mag fainter than at maximum brightness, but the spectrum was still that of optically thick ejecta and consistent with a FeII classification. The integrated absolute flux of the strongest emission lines is given in Table 2.

The brightness decline in Figure 1 is well represented by a

$$F_\lambda \propto t^{-1.55} \quad (2)$$

power-law, which is significantly less steep than the dilution t^{-3} power-law that represents the continuum emission from optically thin gas in the advanced decline stages. This is nicely consistent with the optically thick characteristics of the spectrum in Figure 2. The stable $t^{-1.55}$ power-law could be used to speculate that the spectrum of Nova Oph 2010 N.2 was not yet optically thin at the time of the last photometric observations in Table 1.

The FWHM of Hα in the spectrum of Figure 2 is 1650 km/s, and 1570 for Hβ. [OI] and [NII] lines present a distinctive rectangular profile with a FWHM of 1800 and 1950 km/s, respectively. The expansion velocities they indicate nicely agree with the ~850 km/s reported for the bulk velocity of P-Cyg absorption in the early spectra described by Imamura, Tanabe and Fujii (2010).

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TIMINGS OF MINIMA OF ECLIPSING BINARIES

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The following Table lists timings of minima of eclipsing binaries secured by CCD photometry, obtained in the first half of 2010. The given $O-C$ values generally refer to the linear elements of the 2008 electronic version of the GCVS (Samus et al., 2009), except for the cases stated in the remarks, where the determination of current elements made use of the up-to-date ASAS data (`http://www.astrouw.edu.pl/asas/`) and the Lafler-Kinman algorithm of the PERANSO software (`http://www.peranso.com/`). All times given are heliocentric UTC.

Table 1: Minima of eclipsing binaries

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
MU Aqr	p	55366.7925	0.0002	−0.0037	20	RD	V
V476 Aql	p	55341.8217	0.0005	−0.0113	26	RD	V; el.: 2454338.576+0.624693*E; d=0.043d
V688 Aql	s	55358.7799	0.0014	+0.0061	50	RD	V; non-circular
V724 Aql	s	55358.8183	0.0004	−0.0370	29	RD	V; el.: IBVS 3555
V770 Aql	p	55360.7828	0.0004	+0.3686	30	RD	V
V802 Aql	p	55341.7791	0.0006	−0.0172	18	RD	V; el.: IBVS 5527
V871 Aqr	s	55341.8256	0.0004	−0.2529	29	RD	V; non-circular
V873 Aql	s	55340.8097	0.0004	+0.0577	22	RD	V
V1075 Aql	p	55360.7714	0.0003	−0.0387	29	RD	V
V1184 Aql	p	55342.8369	0.0004	+0.0246	25	RD	V
V1341 Aql	s	55342.8461	0.0002	+0.0035	18	RD	V; d=0.018d
V1665 Aql	p	55341.8114	0.0010	+0.0013	33	RD	V; el.: 2452810.87+3.88181*E
GSC 496-696	p	55362.7816	0.0003	+0.0044	31	RD	V; el.: 2454609.835+0.819306*E; d=0.054d
GSC 499-1563	p	55362.8549	0.0001	+0.0087	21	RD	V; el.: 2453866.859+0.467204*E
GSC 1071-1838	p	55360.7855	0.0004	+0.0041	22	RD	V; el.: 2453585.729+0.535784*E
GSC 1083-2003	p	55360.7620	0.0002	−0.0055	26	RD	V; el.: IBVS 5920; d=0.02d
GSC 5115-246	s	55340.7736	0.0003	−0.0049	24	RD	V; el.: 2454386.525+1.161599*E
NSV 11636	p	55342.8226	0.0002	+0.0084	31	RD	V; el.: 2452384.140+0.357933*E; d=0.02d
TX Ari	p	55201.6072	0.0005	−0.0099	26	RD	V
GSC 1240-657	p	55201.6964	0.0002	+0.0003	36	RD	V; el.: 2453338.636+0.453520*E
AP Aur	p	55273.776	0.003	+0.140	10	RD	V
EU Aur	p	55240.6299	0.0006	+0.5966	18	RD	V
V364 Aur	p	55245.6773	0.0004	−0.0186	21	RD	V; el.: IBVS 5894
TY Boo	s	55364.8441	0.0002	−0.0337	21	RD	V; el.: BAV Mitt. 68
UW Boo	p	55243.9016	0.0010	−0.0107	9	RD	V
XY Boo	p	55352.7810	0.0005	−0.0079	31	RD	V; el.: 2453903.474+0.370574*E; d=0.02d
AC Boo	p	55364.8277	0.0003	+0.1839	36	RD	V; d=0.022d
AD Boo	p	55364.7629	0.0004	−0.0197	33	RD	V; el.: Chin. AA 6, 366
AR Boo	p	55352.8514	0.0005	+0.0309	20	RD	V; el.: IBVS 4601
EF Boo	p	55243.8792	0.0008	+0.1743	21	RD	V; el.: IBVS 4811
GH Boo	s	55352.7824	0.0003	−0.0425	32	RD	V; el.: IBVS 5060
GR Boo	p	55364.7682	0.0004	+0.0011	25	RD	V; el.: IBVS 5125

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GW Boo	s	55352.864	0.005	+0.002	13	RD	V; el.: 2454555.809+0.531546*E
HH Boo	s	55243.8920	0.0002	+0.0563	19	RD	V
GSC 921-412	p	55364.7996	0.0002	+0.0264	17	RD	V: el.: IBVS 5894
GSC 1467-1309	s	55352.7602	0.0003	+0.0040	21	RD	V; el.: 2454543.813+0.397808*E; d=0.038d
GSC 1470-582	p	55352.7842	0.0002	+0.0082	20	RD	V; el.: 2453762.875+0.299360*E; d=0.015d
AZ Cam	s	55205.9031	0.0002	+0.0207	40	RD	V
NR Cam	s	55277.7032	0.0003	+0.0036	15	RD	V; el.: IBVS 5894
NSV 4638	s	55298.7044	0.0018	−0.0001	31	RD	V; el.: 2454849.619+0.390005*E
TY Cnc	p	55201.8866	0.0003	−0.2141	32	RD	V; d=0.043d
GQ Cnc	s	55245.8432	0.0003	+0.0041	16	RD	V; el.: Acta Astr. 54, 207
IL Cnc	p	55245.8286	0.0009	+0.0509	11	RD	V; el.: IBVS 5428
IM Cnc	p	55290.7298	0.0004	−0.0119	26	RD	V
IO Cnc	p	55205.9378	0.0002	+0.0427	24	RD	V; el.: IBVS 5428
IU Cnc	p	55245.8507	0.0003	−0.0119	20	RD	V; d=0.024d
GSC 224-44	s	55290.7127	0.0006	−0.0168	22	RD	V; el.: 2453855.549+0.286092*E
GSC 819-595	p	55205.8960	0.0005	+0.0162	30	RD	V; el.: 2453442.665+1.194590*E
GSC 1397-1030	s	55290.7349	0.0003	−0.0176	19	RD	V; el.: 2453526.468+0.291016*E
GSC 1407-222	p	55201.9105	0.0005	−0.0176	24	RD	V; el.: ASAS
NSV 4158	s	55201.9069	0.0006	+0.0223	15	RD	V; el.: IBVS 5871
BI CVn	p	55283.6760	0.0002	+0.0473	20	RD	V; el.: IBVS 4554
CI CVn	p	55283.6958	0.0004	−0.0236	26	RD	V
DF CVn	p	55283.7282	0.0001	−0.0007	34	RD	V; el.: IBVS 5894
DH CVn	p	55290.8569	0.0007	−0.0181	22	RD	V; el.: IBVS 5149
DI CVn	s	55276.6782	0.0005	−0.0034	17	RD	V; el.: IBVS 5224
DQ CVn	s	55280.7095	0.0004	+0.0063	20	RD	V; el.: IBVS 5541
DR CVn	s	55290.8408	0.0004	+0.0441	15	RD	V
EI CVn	p	55243.8837	0.0010	−0.0246	9	RD	V; el.: IBVS 5403
UZ CMi	p	55277.7076	0.0001	+0.0161	31	RD	V; el.: IBVS 5894
AV CMi	p	55273.7081	0.0002	+0.0145	41	RD	V; el.: 2454437.759+2.277751*E; e≠0
CZ CMi	p	55268.7142	0.0001	+0.0563	29	RD	V; el.: IBVS 5366
GSC 167-251	s	55268.7385	0.0008	−0.0045	17	RD	V; el.: 2453818.541+0.289606*E
GSC 176-801	s	55268.6794	0.0004	−0.0027	19	RD	V; el.: 2453743.688+0.274650*E
GSC 181-1939	s	55277.7382	0.0004	+0.0037	23	RD	V; el.: 2454200.601+0.746713*E
GSC 762-958	p	55268.7337	0.0003	+0.0044	22	RD	V; el.: 2453759.560+0.443859*E
GSC 772-425	p	55273.7218	0.0001	+0.0455	17	RD	V; el.: 2454810.765+0.286810*E; d=0.024d
RW Com	p	55283.7442	0.0008	−0.0135	13	RD	V
RZ Com	s	55280.6907	0.0004	+0.0449	18	RD	V; d=0.017d
UX Com	p	55283.6922	0.0008	−0.1168	31	RD	V; el.: BAV Mitt. 69
AQ Com	p	55276.7070	0.0005	−0.0094	15	RD	V; el.: IBVS 5684
CC Com	p	55276.6670	0.0001	−0.0132	12	RD	V
	s	55276.7750	0.0006	−0.0155	9	RD	V
CM Com	p	55329.8255	0.0005	−0.0113	23	RD	V; el.: IBVS 5894
DD Com	s	55269.6738	0.0003	+0.0781	15	RD	V
EK Com	p	55280.7291	0.0003	−0.0606	26	RD	V; el.: IBVS 4167; d=0.021d
LO Com	s	55276.6807	0.0013	+0.0123	10	RD	V; el.: IBVS 5052
LP Com	s	55276.7103	0.0006	−0.0154	18	RD	V; el.: IBVS 5052
MM Com	p	55280.7124	0.0005	−0.0141	17	RD	V; el.: IBVS 5224; d=0.024d
GSC 871-248	s	55267.7087	0.0003	+0.0233	16	RD	V; el.: 2453438.689+0.252746*E; d=0.023d
GSC 881-218	s	55283.6985	0.0002	−0.0087	23	RD	V; el.: IBVS 5894
GSC 1445-866	s	55276.6494	0.0004	+0.0034	8	RD	V; el.: IBVS 5894
GSC 1446-1499	s	55280.7154	0.0003	+0.0087	23	RD	V; el.: IBVS 5894
GSC 1446-2377	p	55269.6994	0.0006	−0.0031	15	RD	V; el.: IBVS 5894
TU CrB	p	55269.8241	0.0007	−0.7079	13	RD	V
TW CrB	s	55269.8772	0.0003	+0.0421	19	RD	V
YY CrB	p	55267.8569	0.0005	−0.1018	17	RD	V; el.: IBVS 5152
AR CrB	p	55296.7665	0.0004	−0.0036	19	RD	V; el.: IBVS 5295
AS CrB	p	55296.7443	0.0002	+0.0067	34	RD	V; el.: IBVS 5295
AV CrB	p	55276.8849	0.0007	−0.0203	14	RD	V; el.: IBVS 5295
GSC 880-55	p	55329.8293	0.0004	+0.0003	23	RD	V; el.: IBVS 5894
W Crv	p	55320.8182	0.0006	+0.0198	16	RD	V
AC Crt	p	55268.8889	0.0004	+0.0011	22	RD	V; el.: 2453762.771+0.617261*E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GO Cyg	s	55366.8495	0.0006	+0.0686	28	RD	V
KR Cyg	p	55362.7581	0.0004	−0.0133	28	RD	V; el.: IBVS 4961; d=0.03d
NZ Cyg	s	55358.7366	0.0003	+0.0038	24	RD	V; el.: 2450681.384+0.405967*E
PY Cyg	p	55358.8579	0.0004	−0.0566	19	RD	V; d=0.05d
QU Cyg	p	55360.7638	0.0009	−0.0712	15	RD	V
V454 Cyg	p	55362.7891	0.0003	−0.0068	43	RD	V
V508 Cyg	p	55366.7537	0.0005	−0.0227	29	RD	V; el.: AJ 110, 346; d=0.018d
V726 Cyg	p	55362.7865	0.0001	+0.0398	29	RD	V
V1023 Cyg	p	55360.7740	0.0006	−0.0473	30	RD	V
V2181 Cyg	s	55362.8529	0.0009	+0.0090	17	RD	V; el.: BAV Mitt. 105
V2239 Cyg	s	55362.6996	0.0012	+0.2511	8	RD	V; el.: IBVS 4819
EX Del	p	55362.7759	0.0003	+0.0058	28	RD	V; el.: BBSAG Bull. 114, 11
GSC 1633-1579	p	55366.8508	0.0006	+0.0001	20	RD	V; el.: 2454411.538+0.310368*E; d=0.024d
NSV 13339	s	55366.7833	0.0002	+0.0007	25	RD	V; el.: 2454389.579+0.357361*E; GSC 1647-488
Z Dra	p	55329.7709	0.0003	−0.1942	36	RD	V
XY Dra	p	55333.7978	0.0002	+0.0116	45	RD	V; d=0.051d
AX Dra	p	55329.8113	0.0003	−0.0562	29	RD	V
EF Dra	p	55327.7494	0.0006	+0.0138	28	RD	V; el.: IBVS 5668
IV Dra	s	55267.8540	0.0002	+0.0032	22	RD	V; el.: IBVS 5894
ZZ Eri	p	55240.6724	0.0010	−0.0144	14	RD	V
BL Eri	p	55209.6550	0.0002	+0.0611	32	RD	V; el.. IBVS 4104
KQ Gem	p	55259.7207	0.0004	−0.0838	31	RD	V; d=0.03d
KV Gem	s	55259.7210	0.0004	+0.0224	31	RD	V; el.: IBVS 5894
MM Dra	s	55360.7610	0.0005	−0.0128	15	RD	V; el.: IBVS 4848
V383 Gem	s	55259.7346	0.0005	−0.0013	24	RD	V; el.: IBVS 5630
GSC 774-58		55268.7458	0.0003	+0.0305	18	RD	V; el.: 2454798.805+0.381266*E
GSC 777-1088	p	55273.7263	0.0003	−0.0015	32	RD	V; el.: 2453744.682+0.569265*E
GSC 1368-1825	s	55273.6867	0.0004	+0.0046	29	RD	V; el.: 2454864.621+0.352791*E
GSC 1888-1148	p	55259.7125	0.0008	+0.0130	18	RD	V; el.: 2452624.731+0.338337*E
GSC 1894-2977	s	55259.7448	0.0005	+0.0177	18	RD	V; el.: 2454535.579+0.270659*E
FN Her	p	55283.8840	0.0001	+0.0910	36	RD	V
HS Her	s	55342.8187	0.0013	−0.0048	39	RD	V; non-circular orbit
HZ Her	p	55311.730	0.002	−0.086	35	RD	V
IT Her	p	55339.8224	0.0003	+0.0013	30	RD	V; el.: 2451362.4511+0.339395*E: d=0.04d
V357 Her	s	55340.8183	0.0003	−0.0193	20	RD	V; el.: IBVS 5280
V366 Her	p	55311.8069	0.0003	−0.1327	39	RD	V
V687 Her	p	55276.8424	0.0004	−0.1574	16	RD	V
V719 Her	s	55311.8299	0.0005	−0.0220	29	RD	V
V731 Her	p	55312.7610	0.0002	−0.0114	23	RD	V; el.: IBVS 5592
V732 Her	p	55321.714	0.002	+0.001	20	RD	V; el.: 2451040.421+0.356834*E
V789 Her	s	55311.7586	0.0004	+0.0182	21	RD	V; el.: IBVS 5741
V857 Her	s	55283.8781	0.0004	+0.0303	31	RD	V; el.: IBVS 4364; d=0.044d
V861 Her	s	55276.8522	0.0003	−0.0385	17	RD	V; el.: IBVS 4360
V878 Her	p	55321.7629	0.0005	−0.0341	31	RD	V; el.: IBVS 4284
V1005 Her	p	55280.8955	0.0003	+0.0633	15	RD	V; el.: IBVS 4611
V1024 Her	p	55269.8116	0.0001	+0.0434	8	RD	V; el.: IBVS 5894
V1033 Her	s	55283.8597	0.0003	−0.0111	19	RD	V; el.: IBVS 5146
V1036 Her	p	55311.7572	0.0005	+0.0039	30	RD	V; el.: IBVS 5146
V1038 Her	s	55283.8413	0.0002	+0.0079	25	RD	V; el.: IBVS 5146
V1042 Her	s	55311.7732	0.0003	−0.0220	31	RD	V; el.: IBVS 4998
V1044 Her	s	55312.8277	0.0002	−0.0027	27	RD	V; el.: IBVS 5192
V1047 Her	p	55312.7988	0.0003	−0.0090	37	RD	V; el.: IBVS 5192; d=0.024d
V1053 Her	p	55312.8083	0.0001	+0.0067	27	RD	V; el.: BBSAG Bull. 128, 10
V1055 Her	p	55321.8000	0.0004	+0.0034	29	RD	V; el.: IBVS 5192
V1094 Her	s	55321.7976	0.0005	−0.0061	29	RD	V; el.: IBVS 5306; d=0.04d
V1095 Her	s	55321.7605	0.0004	−0.0253	28	RD	V; el.: IBVS 5306
V1096 Her	p	55321.8037	0.0005	+0.0201	15	RD	V; el.: IBVS 5306
V1102 Her	s	55327.7830	0.0003	+0.0045	22	RD	V; el.: IBVS 5333
V1119 Her	s	55283.8934	0.0006	+0.0004	30	RD	V; ,el.: 2453185.651+0.723407*E
V1134 Her	p	55336.8169	0.0002	−0.0056	38	RD	V; el.: IBVS 5630; d=0.026d

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC 960-163	p	55280.8684	0.0001	+0.0013	23	RD	V; el.: 2453490.787+0.327015*E
GSC 960-1531	s	55280.8416	0.0005	+0.0050	19	RD	V; el.: 2454671.622+0.381833*E
GSC 967-1277	s	55296.7807	0.0002	+0.0091	26	RD	V; el.: 2454602.718+0.433648*E
GSC 968-876	s	55280.8729	0.0002	+0.0051	28	RD	V; el.: 2454564.806+0.404669*E; d=0.025d
GSC 985-533	p	55312.7949	0.0004	+0.0090	42	RD	V; el.: IBVS 5894
GSC 990-480	p	55312.7761	0.0001	+0.0050	21	RD	V; el.: IBVS 5894
GSC 987-1582	p	55311.8236	0.0004	+0.0024	35	RD	V; el.: 2454158.898+0.501489*E
GSC 1505-565	p	55296.7916	0.0002	+0.0158	16	RD	V; el.: 2453832.789+0.236165*E
GSC 1540-1433	p	55283.8654	0.0002	−0.0016	27	RD	V; el.: 2454563.836+0.587301*E
GSC 1550-2362	s	55321.8009	0.0005	+0.0049	16	RD	V; el.: 2454197.827+0.309676*E
GSC 1552-862	s	55327.7537	0.0003	+0.0020	23	RD	V; el.: 2453896.708+0.300671*E
GSC 1556-1186	p	55327.8293	0.0002	−0.0066	31	RD	V; el.: 2452867.526+0.409915*E
GSC 1568-694	p	55333.7830	0.0003	−0.0048	27	RD	V; el.: 2454679.672+0.377012*E
GSC 1578-2373	p	55336.7852	0.0001	+0.0095	23	RD	V; el.: 2454229.785+0.418522*E
GSC 1588-632	s	55340.8259	0.0003	−0.0038	25	RD	V; el.: 2453832.884+1.419243*E
GSC 2043-227	p	55276.8862	0.0009	+0.0038	14	RD	V; el.: IBVS 5894
GSC 3080-1410	p	55312.8179	0.0002	−0.0085	33	RD	V; el.: AJ 133, 255
UW Hya	p	55290.7230	0.0002	+0.0278	31	RD	V; el.: MVS 12, 48
AV Hya	s	55205.8899	0.0009	+0.2487	18	RD	V; el: ApSS 76, 173
V404 Hya	s	55240.837	0.002	+0.131	12	RD	V
	p	55240.975	0.003	+0.114	8	RD	V
GSC 217-849	p	55290.7029	0.0005	+0.0036	17	RD	V; el.: 2453799.597+0.275416*E
GSC 235-461	p	55245.9206	0.0007	+0.0340	16	RD	V; el.: IBVS 5894
GSC 4872-764	p	55201.8548	0.0004	+0.0058	24	RD	V; el.: 2451964.63+3.712407*E
GSC 4881-888	s	55240.9035	0.0009	+0.0105	11	RD	V; el.: 2453028.761+0.265578*E
GSC 4882-488	p	55201.9634	0.0001	+0.0127	29	RD	V; el.: 2453714.818+0.374404*E
GSC 4887-1149	p	55240.8855	0.0004	−0.0070	22	RD	V: el.: 2454856.744+0.336088*E
GSC 5457-59	p	55240.8971	0.0005	+0.0096	12	RD	V; el.: 2453699.803+0.311645*E
GSC 5458-351	s	55290.7480	0.0003	−0.0055	18	RD	V; el.: 2453875.561+0.343285*E
GSC 5463-45	p	55209.8364	0.0004	−0.0131	18	RD	V; el.: 2453412.804+0.433023*E
GSC 5468-1340	p	55205.9029	0.0008	+0.0045	20	RD	V; el.: 2453411.731+0.501865*E
GSC 5472-966	p	55245.9153	0.0010	+0.0022	10	RD	V; el.: 2453750.766+0.731481*E
GSC 6027-134	s	55240.8667	0.0012	−0.0098	17	RD	V; el.: 2452813.48+1.613424*E
GSC 6029-311	s	55205.8883	0.0004	+0.0000	29	RD	V; el.: 2453465.610+0.480143*E
UZ Leo	p	55273.9002	0.0006	+0.2076	23	RD	V
WZ Leo	p	55240.8761	0.0005	+0.0016	19	RD	V; el.: Acta Astr. 54, 207
XX Leo	s	55259.8887	0.0006	+0.0069	29	RD	V; el.: 2454470.837+0.971132; d=0.07d
XZ Leo	s	55243.7032	0.0001	+0.0510	37	RD	V
XY Leo	p	55298.7640	0.0001	+0.0154	18	RD	V; el.: 2454646.455+0.284100*E
AG Leo	p	55243.7350	0.0006	+0.0208	27	RD	V; el.: 2454205.596+3.392543*E
AL Leo	p	55243.7065	0.0003	+0.0103	37	RD	V; el.: IBVS 3401
AM Leo	p	55268.8716	0.0008	+0.0084	14	RD	V
AP Leo	p	55243.7034	0.0003	−0.0303	28	RD	V
BL Leo	s	55290.9056	0.0008	−0.0257	14	RD	V
BW Leo	s	55277.8974	0.0008	+0.0648	16	RD	V
CE Leo	s	55267.6741	0.0007	−0.0057	17	RD	V
GU Leo	p	55245.9143	0.0003	+0.0722	16	RD	V; el.: IBVS 5329
GV Leo	p	55243.7354	0.0004	−0.0795	29	RD	V; el.: IBVS 5697
HI Leo	p	55268.9122	0.0001	+0.0009	17	RD	V; el.: IBVS 5455
HS Leo	s	55273.8430	0.0001	+0.0562	19	RD	V; el.: Per. Zv. 25, 2
GSC 262-948	p	55320.7995	0.0002	+0.0495	26	RD	V; el.: IBVS 5894
GSC 263-585	p	55277.8580	0.0003	−0.0076	25	RD	V; el.: IBVS 5894
GSC 265-617	s	55273.8941	0.0002	−0.0017	19	RD	V; el.: 2454505.748+0.290910*E
GSC 267-162	p	55273.9463	0.0007	+0.0292	15	RD	V; el.: 2452755.600+1.402181*E
GSC 270-9	s	55209.8298	0.0007	+0.1223	15	RD	V; el.: IBVS 5894; d=0.04d
	s	55277.8371	0.0005	+0.0674	18	RD	V; d=0.042d
GSC 270-593	s	55273.8669	0.0006	+0.0011	12	RD	V; el.: 2453800.731+0.276671*E
GSC 270-777	p	55209.8542	0.0002	+0.0041	12	RD	V; el.: 2453859.664+0.487784*E
GSC 828-1721	p	55245.9192	0.0004	+0.0051	15	RD	V; el.: 2454892.634+0.694067*E
GSC 835-652	p	55298.7559	0.0002	+0.0229	15	RD	V; el.: 2454228.534+0.257507*E
GSC 840-216	p	55268.9114	0.0005	+0.0041	17	RD	V; el.: 2454566.575+0.349593*E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC 847-367	s	55268.8770	0.0002	+0.0125	20	RD	V; el.: 2454531.734+0.312145*E
GSC 851-768	p	55273.8863	0.0002	+0.0037	22	RD	V; el.: 2454642.474+0.512507*E
GSC 859-1106	s	55320.8225	0.0001	+0.0086	33	RD	V; el.: 2454551.668+0.339954*E
GSC 870-349	s	55269.7002	0.0004	−0.0110	27	RD	V; el.: IBVS 5894
GSC 1410-439	p	55240.8484	0.0015	−0.0071	10	RD	V; el.: 2454176.557+0.653746*E
GSC 1417-401	s	55259.8832	0.0002	+0.0030	21	RD	V; el.: 2454918.653+0.235248*E
GSC 1419-666	p	55259.8393	0.0006	+0.0042	18	RD	V; el.: 2453853.592+0.317007*E
GSC 1422-142	p	55273.9047	0.0001	+0.0018	13	RD	V; el.: 2454177.681+0.300006*E
GSC 1429-137	p	55290.8989	0.0005	+0.0079	16	RD	V; el.: 2453329.861+0.380487*E
GSC 1434-1034	p	55290.8316	0.0003	−0.0048	14	RD	V; el.: 2454538.694+0.867523*E
GSC 1437-805	p	55329.796	0.008	+0.031	25	RD	V; el.: 2454850.805+2.004016*E
GSC 1441-914	p	55267.7363	0.0006	−0.0015	21	RD	V; el.: 2453438.689+0.268307*E
GSC 1443-87	p	55269.7211	0.0005	−0.0189	24	RD	V; el.: 2453175.509+0.325545*E
GSC 1969-579	p	55290.8837	0.0004	+0.0207	14	RD	V; el.: 2454885.718+0.388442*E
GSC 1971-916	s	55243.642	0.004	+0.018	8	RD	V; el.: 2454573.558+0.639688*E
GSC 1978-1818	s	55273.9337	0.0005	−0.0176	9	RD	V; el.: 2454939.591+0.341707*E
GSC 1981-237	s	55277.9018	0.0008	+0.0350	14	RD	V; el.: 2454907.676+0.260606*E
T LMi	p	55205.8531	0.0008	−0.1014	18	RD	V
RT LMi	p	55245.9178	0.0004	−0.0065	18	RD	V; d=0.02d
XY LMi	s	55268.9036	0.0011	−0.0203	25	RD	V; el.: IBVS 5411
NSV 7481		55296.759	0.003	+0.019	6	RD	V; el.: IBVS 5894
DF Lyr	s	55339.8235	0.0006	+0.0324	25	RD	V
EX Lyr	p	55339.7882	0.0004	−0.0201	34	RD	V; el.: IBVS 5713
HT Lyr	p	55333.8381	0.0004	−0.0221	26	RD	V
KT Lyr	p	55338.7671	0.0006	−0.0682	27	RD	V
MN Lyr	p	55341.8172	0.0006	+0.0438	26	RD	V
V406 Lyr	p	55338.7672	0.0004	−0.0151	28	RD	V; el.: IBVS 4132
V412 Lyr	p	55342.8078	0.0003	+0.2049	38	RD	V; non-circular orbit
V477 Lyr	p	55338.8087	0.0001	+0.0010	7	RD	V; el.: IBVS 4962; D=0.032d
V507 Lyr	p	55339.7835	0.0006	+0.0167	23	RD	V; el.: IBVS 5547
V563 Lyr	s	55340.8273	0.0003	+0.0200	28	RD	V
V574 Lyr	s	55336.7496	0.0003	−0.0073	25	RD	V; el.: IBVS 4976
	p	55336.888	0.003	−0.006	8	RD	V
V579 Lyr	s	55339.7746	0.0006	−0.0289	21	RD	V; el.: IBVS 4982
V580 Lyr	p	55342.7674	0.0006	−0.0308	13	RD	V; el.: IBVS 4982
V582 Lyr	p	55341.8320	0.0005	+0.0590	9	RD	V; el.: IBVS 4985
V591 Lyr	p	55336.8077	0.0004	+0.0033	19	RD	V; el.: IBVS 5232
V592 Lyr	p	55338.8124	0.0001	+0.0128	25	RD	V; el.: IBVS 5232
V596 Lyr	p	55341.7907	0.0002	+0.0045	20	RD	V; el.: IBVS 5232
GSC 2115-1000	s	55340.8366	0.0004	+0.0015	22	RD	V; el.: 2452853.598+0.328717*E; DS
GSC 3104-1085		55336.8087	0.0006		39	RD	V; comp. of V591 Lyr
BM Mon	p	55268.7068	0.0002	+0.0462	28	RD	V
FW Mon	p	55277.7471	0.0005	−0.0115	19	RD	V
V464 Mon	p	55273.6634	0.0007	−0.1150	16	RD	V
V514 Mon	p	55259.7195	0.0002	+0.0597	30	RD	V
V532 Mon	p	55273.6923	0.0008	−0.0186	30	RD	V
GSC 4840-528	p	55277.6888	0.0005	−0.0115	24	RD	V; el.: 2454204.554+0.567502*E
V456 Oph	s	55342.7859	0.0002	+0.0232	26	RD	V
V508 Oph	s	55327.8487	0.0003	−0.0200	20	RD	V
V1022 Oph	p	55276.8814	0.0008	−0.0042	10	RD	V; el.: IBVS 5690
V1125 Oph	p	55283.933	0.005	−0.001	20	RD	V; el.: GEOS EB 28
V2332 Oph	p	55327.7702	0.0002	−0.0799	26	RD	V; el.: IBVS 4345
V2553 Oph	p	55321.7816	0.0004	+0.0048	34	RD	V; el.: ASAS
GSC 398-1236	p	55283.8461	0.0004	+0.0065	25	RD	V; el.: IBVS 5894
GSC 403-1109	s	55312.8418	0.0004	−0.0056	21	RD	V; el.: IBVS 5894
GSC 429-1488	s	55327.7789	0.0005	+0.0068	20	RD	V; el.: 2454532.894+0.251186*E
GSC 436-1066	p	55333.8095	0.0004	+0.0049	21	RD	V; el.: 2454740.524+0.549843*E
GSC 979-1273	s	55311.8275	0.0004	+0.0103	31	RD	V; el.: IBVS 5894
GSC 998-2391	s	55327.7957	0.0005	+0.0179	29	RD	V; el.: 2454568.844+0.490109*E; d=0.056d
GSC 1010-1632	p	55333.8172	0.0004	+0.0043	15	RD	V; el.: 2453523.779+0.254540*E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC 1010-2098	p	55336.7929	0.0002	−0.0081	39	RD	V; el.: 2454943.855+0.982365*E
GSC 1031-1526	s	55338.8124	0.0001	+0.0051	25	RD	V; el.: 2453877.758+0.547312*E; d=0.02d
NSV 7727	p	55276.8767	0.0004	+0.0165	14	RD	V; el.: 2451938.070+0.348808*E; d=0.025d
NSV 7838	p	55280.8591	0.0004	−0.0059	21	RD	V; el.: 2454156.867+0.692117*E
NSV 8733	p	55321.8094	0.0004	−0.0071	21	RD	V; el.: 2454364.558+0.357186*E; d=0.014d
V1353 Ori	p	55245.6939	0.0004	−0.0062	26	RD	V; el.: IBVS 5313
GSC 122-419	s	55245.6689	0.0007	−0.0001	16	RD	V; el.: 2453763.617+0.398991*E
GSC 4753-984	p	55245.7008	0.0006	+0.0059	28	RD	V; el.: IBVS 5871
ST Per	p	55201.6836	0.0001	+0.2173	38	RD	V; d=0.041d
XZ Per	p	55205.7253	0.0001	−0.0515	29	RD	V
BO Per	p	55240.6576	0.0005	−0.0797	28	RD	V
FQ Per	p	55201.7136	0.0005	+0.7151	36	RD	V; d=0.12d
FW Per	p	55240.6584	0.0005	−0.0484	21	RD	V
II Per	p	55209.6478	0.0003	+0.0015	32	RD	V; IBVS 5741
NP Per	s	55209.6845	0.0002	−0.0539	31	RD	V
NZ Per	p	55240.7018	0.0003	+0.0407	27	RD	V
V462 Per	p	55205.7320	0.0002	−0.3505	26	RD	V; d=0.05d
NSV 3765	p	55277.7185	0.0004	−0.0203	31	RD	V; el.: 2451874.00+3.396945*E
GSC 1621-2192	p	55362.8485	0.0002	+0.0233	23	RD	V; el.: 2454933.908+0.452922*E; d=0.021d
XY Sct	s	55339.7765	0.0006	−0.1257	23	RD	V
CW Sct	p	55342.8556	0.0011	−0.1230	34	RD	V
EY Sct	p	55341.8435	0.0002	+0.0787	22	RD	V; d=0.020d
FG Sct	s	55340.8212	0.0003	+0.0049	15	RD	V; el.: 2453823.860+0.270571*E
AS Ser	s	55267.9365	0.0009	+0.0082	11	RD	V; el.: 2453634.481+0.466233*E
AU Ser	s	55267.8523	0.0008	−0.1049	14	RD	V
V384 Ser	p	55269.8770	0.0001	−0.0036	15	RD	V; el.: IBVS 5295
V413 Ser	p	55336.8462	0.0016	+0.0253	35	RD	V; non-circ. orbit
GSC 355-983	p	55267.8150	0.0008	+0.0154	9	RD	V; el.: 2454312.553+0.248116*E
	s	55267.9385	0.0008	+0.0149	10	RD	V
GSC 357-162	s	55269.8836	0.0003	+0.0071	18	RD	V; el.: IBVS 5894
GSC 366-196	s	55296.8308	0.0007	+0.0010	13	RD	V; el.: 2454151.872+0.275462*E
GSC 368-118	p	55276.8738	0.0006	−0.0030	12	RD	V; el.: 2453560.570+0.278757*E
GSC 370-468	s	55296.8029	0.0003	+0.0116	34	RD	V; el.: 2454703.561+0.388876*E
GSC 433-512	s	55336.8285	0.0003	+0.0008	23	RD	V; el.: 2453883.787+0.290521*E
GSC 949-1089	p	55296.7688	0.0002	+0.0077	18	RD	V; el.: IBVS 5894
GSC 1499-834	p	55267.8727	0.0003	+0.0062	21	RD	V; el.: IBVS 5894
GSC 2034-1670	p	55269.8840	0.0006	−0.0004	14	RD	V; el.: IBVS 5894
GSC 5017-129	p	55267.8512	0.0004	−0.0094	24	RD	V; el.: IBVS 5894; d=0.027d
Y Sex	s	55298.848	0.005	−0.004	10	RD	V; el.: 2454589.566+0.419820*E
WW Sex	p	55209.8309	0.0006	−0.0325	15	RD	V
WX Sex	p	55298.858	0.005	−0.006	7	RD	V; el.: IBVS 5455
GSC 244-434	p	55298.855	0.006	−0.018	12	RD	V; el.: 2454580.571+0..603615*E
GSC 246-90	s	55259.8858	0.0005	−0.0038	18	RD	V; el.: 2454886.711+0.295587*E
GSC 250-668	p	55298.8326	0.0006	+0.0025	18	RD	V; el.: 2454227.561+0.304165*E; d=0.016d
GSC 253-870	p	55259.9227	0.0001	+0.0033	17	RD	V; el.: 2454139.807+0.268870*E
GSC 256-41	p	55259.8417	0.0003	−0.0000	17	RD	V; el.: 2454837.816+0.321666 3 E
GSC 4911-1235	p	55268.8976	0.0010	+0.0017	17	RD	V; el.: IBVS 5894
AC Tau	p	55205.6846	0.0003	+0.0585	35	RD	V
AL Tau	p	55245.6911	0.0003	+0.0473	26	RD	V
GW Tau	p	55240.7311	0.0004	−0.0765	22	RD	V; d=0.045d
V1022 Tau	p	55205.7162	0.0004	−0.0669	17	RD	V; el.: PASP 101, 177
V1123 Tau	s	55201.7135	0.0004	−0.0000	33	RD	V; el.: IBVS 5688
V1220 Tau	p	55201.6466	0.0003	−0.0451	47	RD	V; el.: IBVS 5455; d=0.08d
V1237 Tau	p	55245.7046	0.0005	−0.0110	23	RD	V; el.: IBVS 5271
V1250 Tau	s	55209.7012	0.0003	+0.0111	33	RD	V; el.: 2452661.589+2.04093*E
ASAS J054432+1305.7	s	55245.7084	0.0003	−0.0002	24	RD	V; el.: 2453660.814+0.300141*E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC 72-521	s	55205.7032	0.0005	+0.0063	31	RD	V; el.: 2455122.864+0.375659*E
GSC 74-465	s	55240.6654	0.0010	+0.0227	16	RD	V; el.: 2454146.555+0.230942*E
GSC 76-527	p	55205.6339	0.0003	−0.0033	22	RD	V; el.: 2454720.879+0.309157*E
GSC 650-1226	s	55205.6296	0.0006	+0.0119	16	RD	V; el.: 2453740.638+0.390193*E
GSC 661-580	s	55201.6540	0.0005	+0.0015	25	RD	V; el.: 2454817.639+0.404864*E
GSC 663-23	p	55205.7248	0.0002	−0.0041	29	RD	V; el.: IBVS 5920
GSC 664-423	p	55240.6343	0.0009	+0.0020	10	RD	V; el.: 2454502.533+0.350641*E
GSC 681-692	p	55209.6716	0.0004	+0.0014	11	RD	V; el.: 2454473.688+0.247389*E
TY UMa	p	55267.7336	0.0004	+0.1341	19	RD	V; el.: MNRAS 317, 111
XY UMa	s	55201.8690	0.0007	+0.0373	12	RD	V
AA UMa	s	55201.8680	0.0003	+0.0393	18	RD	V
BM UMa	p	55243.7073	0.0003	+0.0075	23	RD	V
	s	55329.8208	0.0004	+0.0085	13	RD	V
BS UMa	p	55277.9023	0.0004	−0.0013	12	RD	V; el.: IBVS 5894
ES UMa	p	55298.7926	0.0002	−0.0902	64	RD	V; el.: IBVS 3914
IW UMa	p	55240.8300	0.0004	+0.0139	9	RD	V; el.: IBVS 4402
KM UMa	p	55269.6948	0.0003	−0.0200	15	RD	V; el.: IBVS 4810
LO UMa	p	55259.8273	0.0010	+0.0014	12	RD	V
MS UMa	s	55243.6924	0.0005	+0.0341	29	RD	V
MT UMa	s	55320.8284	0.0005	+0.1374	69	RD	V
RU UMi	s	55352.8011	0.0008	−0.0133	38	RD	V
AH Vir	p	55269.7070	0.0002	+0.0197	20	RD	V; d=0.022d
IR Vir	p	55280.7006	0.0002	+0.0094	21	RD	V; el.: IBVS 5894
PS Vir	s	55267.7136	0.0003	−0.0078	20	RD	V
QX Vir	p	55364.8025	0.0006	+0.0047	14	RD	V; el.: IBVS 5894
GSC 272-94	p	55267.6803	0.0003	+0.0025	20	RD	V; el.: 2453499.648+0.339875*E
GSC 272-630	s	55267.6998	0.0001	+0.0103	22	RD	V; el.: 2453442.690+0.370220*E
GSC 274-437	p	55277.8920	0.0005	+0.0136	29	RD	V; el.: 2453899.549+0.544579*E; d=0.037d
GSC 279-35	p	55320.8401	0.0002	−0.0002	41	RD	V; el.: 2454852.850+2.239188*E
GSC 279-822	s	55269.7011	0.0006	−0.0006	23	RD	V; el.. 2453432.751+0.370465*E
GSC 291-860	p	55280.6899	0.0001	−0.0050	17	RD	V; el.: 2453912.622+0.247257*E
GSC 296-9	s	55276.7013	0.0005	+0.0028	20	RD	V; el.: IBVS 5894; d=0.02d
GSC 304-73	p	55283.6781	0.0006	+0.0029	19	RD	V; el.: 2454611.579+0.408073*E
GSC 317-1142	p	55243.8410	0.0004	+0.0166	20	RD	V; el.: 2454914.788+0.301133*E
GSC 318-1169	p	55243.8925	0.0008	−0.0006	14	RD	V; el.: IBVS 5894
GSC 322-760	p	55352.8379	0.0002	+0.0080	21	RD	V; el.: 2453093.752+0.341302*E; d=0.015d
GSC 323-602	s	55243.9150	0.0005	+0.0033	15	RD	V; el.: 2453896.597+0.333535*E
GSC 329-256	p	55364.8249	0.0004	+0.0379	25	RD	V; el.: IBVS 5894
GSC 873-411	p	55269.6927	0.0005	−0.0012	17	RD	V; el.: 2452764.597+0.336933*E
GSC 881-920	s	55280.7190	0.0005	−0.0068	30	RD	V; el.: 2454623.595+0.387345*E
GV Vul	p	55358.7784	0.0004	+0.0705	43	RD	V; d=0.036d
IM Vul	p	55366.7613	0.0003	+0.0072	32	RD	V
GSC 1624-493	s	55358.7342	0.0007	+0.0780	22	RD	V; el.: IBVS 5860; non-circular
GSC 1646-52	p	55366.7985	0.0001	+0.0074	33	RD	V; el.: 2453880.830+0.833405*E
GSC 2140-1485	s	55358.7665	0.0002	+0.0090	26	RD	V; el.: 2453593.569+0.301201*E
GSC 2171-397	p	55366.8093	0.0005	+0.0014	28	RD	V; el.: 2454602.892+0.411371*E

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SIMULTANEOUS PHOTOMETRIC AND SPECTROSCOPIC SOLUTION FOR AW CAM

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The eclipsing binary system AW Cam (HD 48049) was discovered by Strohmeier et al. (1963). It was observed with yellow and blue filters by Harris (1968) who used the Russell Model to analyze his data. Mammano et al. (1967) obtained a spectroscopic orbit solution. Russo and Milano (1983) analyzed the Harris data with the W-D model (Wilson & Devinney, 1971) finding a semi-detached system with a mass ratio of 0.22. The next study of the system was done by Oprescu & Suran (1992) using U,B,V filters and the Wood Model finding a mass ratio of 0.5. Djurasevic et al. (2006) reanalyzed the Harris data using a variation of the W-D model, and a q-search method, they found a mass ratio of 0.36 and a detached configuration.

AW Cam was observed photoelectrically by one of us (JRF) on four nights from March 13 through April 17, 2004. The Mount Laguna Observatory 0.6-m Smith reflector was used with a thermoelectrically cooled Hammamatsu R943-02 tube and Stromgren *uvby* filters. 115 individual observations per filter were made. All photometry was carried out in pulse-counting mode. HD 48586 was used as the comparison star and HD 46046 as the check star. These stars were found to be constant in brightness. The observations were not transformed, and mean extinction coefficients were used.

Using the method of Kwee & Van Woerden (1956) we determined a time of primary minimum $HJD = 2453077.7837 \pm 0.0005$. Batten, et al. (1978) reported an eccentricity of 0.12. Again using the method of Kwee & Van Woerden (1956) the time of secondary minimum was $HJD = 2453079.7122 \pm 0.0004$, which corresponds to a phase of 0.5002 ± 0.0003. Therefore, we found no evidence of the reported eccentricity.

O-C data has been collected by Kreiner (2004) and shows no evidence of period change. We used the period given by Oprescu et. al. (1992). The epoch was chosen from our observed time of minimum and the phases were calculated using the ephemeris:

Min I(HJD) = 2453077.7837 + 0.7713468E.

We used the ELC code (Orosz and Hauschildt, 2000) to model the system. This code does not use limb darkening laws, but rather calculates it directly from the model atmospheres. We did a simultaneous solution using all four light curves and the velocity curve with a genetic optimizer algorithm. The radial velocity data and weights were taken from Mammano et al. (1967). The starting value of temperature $T_1 = 9750K$ was adopted for the primary from Cox (2000) based on the reported spectral type of A0V from Mammano et al. (1967). Hilditch and Hill (1975) reported an average $b - y = 0.022$, which corresponds to a system temperature of 9200K (Cox, 2000). Since this $b - y$ neglects reddening and includes the cooler star, this temperature is consistent with our adopted value. The starting value of $T_2 = 6500K$ was based on previous published W-D solutions.

Bolometric albedo $A_1 = 1.0$ was set to the value for a radiative atmosphere (Kallrath and Milone, 1999) and $A_2 = 0.5$ was set to the value for a convective atmosphere (Rucinski, 1969). The gravity-darkening coefficients, $g_1 = 1.0$ and $g_2 = 0.32$ were set to the usual values for a radiative primary (von Zeipel, 1924) and convective secondary (Lucy, 1967) respectively. Synchronous rotation was assumed for both stars. The free parameters were orbital inclination i, T_1, T_2, velocity semi-amplitude K_1, primary mass, and the ELC fill factors. The results are given in Table 1 in which the fill factors have been converted to potentials. Contrary to some previous work, the ELC simultaneous light and velocity solution gave a detached configuration with a mass ratio $q = 0.45$ and $K_1 = 110 \pm 5$ km/s. Representative light curves and solutions for the y and v filters are shown in Figure 1 and Figure 2, and the radial velocity curve is shown in Figure 3. Figure 4 presents the system at phase 0.25.

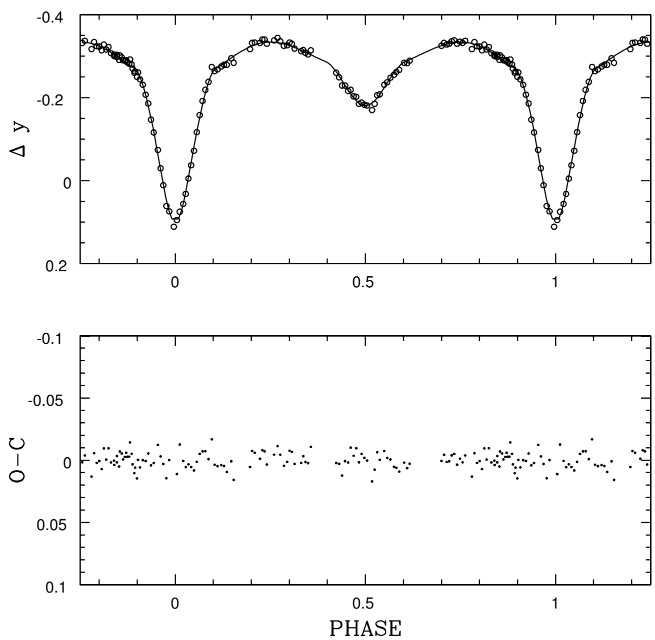

Figure 1. Light curve and ELC solution for AW Cam in the y filter. The circles represent the data points and the solid line the model fit. The lower plot presents the O-C residuals. All y-axis values are in magnitudes.

As a check, the light curves were also modeled using the W-D program (Wilson & Devinney 1971, Wilson 1992). Simultaneous solutions were performed using all four *uvby* light curves. E. C. Olson (see Etzel & Olson 1995) provided the version of W-D program used in this study. This version added stellar atmosphere parameters based on the Kurucz (1979) models. An integration grid size of 30x30 was used. The input parameters were the same as for the ELC code. Limb darkening coefficients were taken from Van Hamme (1993). Using the results from ELC, W-D solutions were made for a detached system,

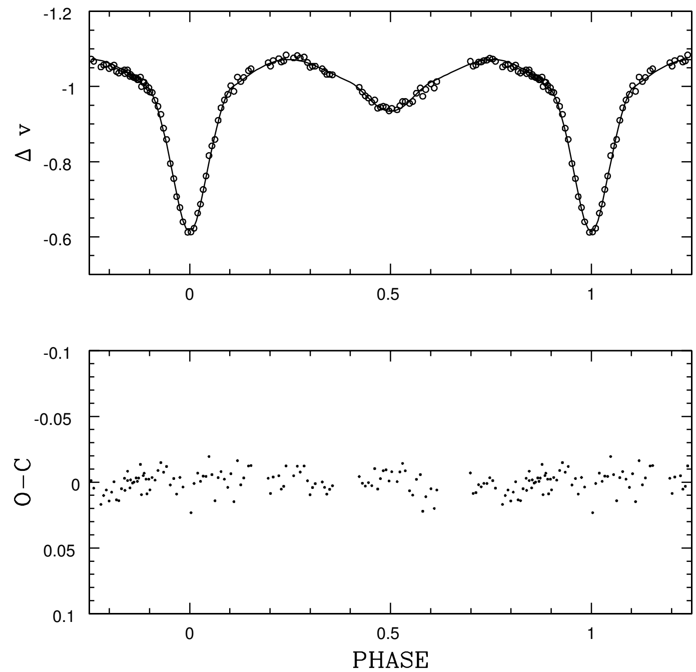

Figure 2. Light curve and ELC solution for AW Cam in the *v* filter. The circles represent the data points and the solid line the model fit. The lower plot presents the O-C residuals. All y-axis values are in magnitudes.

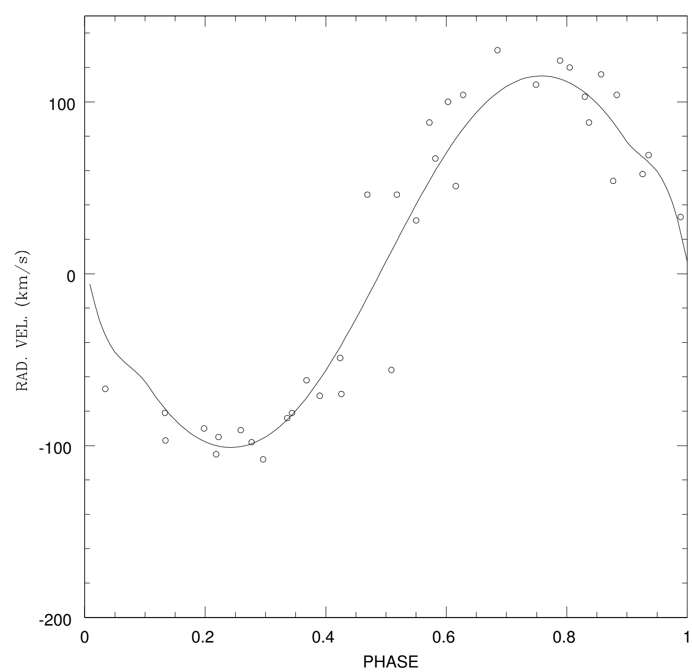

Figure 3. Radial velocity solution using the data from Mammano et al. (1967).

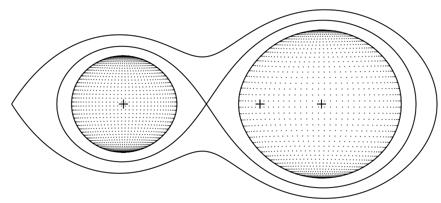

Figure 4. Roche surfaces of AW Cam using Binary Maker 3.0 (Bradstreet, 2004).

Mode 2. The free parameters were i, T_2, potentials Ω_1, Ω_2, and primary star luminosity L_1. A grid approach was used to determine the mass ratio, which yielded q = 0.45, this value was the same as found with the ELC code. The W-D results are given in Tables 1 and 2. We also attempted a Mode 5 solution because some previously published studies using the W-D code (see Introduction) found this system to be semi-detached (Mode 5) for the mass ratios they used. A grid approach in Mode 5 yielded a mass ratio q = 0.5. However, the Mode 5 solution ($\Sigma W(O-C)^2 = 0.027$) was not as good as the Mode 2 solution ($\Sigma W(O-C)^2 = 0.021$). Therefore the W-D solutions also indicate a detached system.

Previously published results have indicated both semi-detached and detached systems with mass ratios ranging from 0.22 to 0.5. Our simultaneous photometric and spectroscopic solution gave a detached system with a q = 0.45. This was also consistent with our W-D, Mode 2 (detached) grid approach. Our value for $K_1 = 110$ km/s, is essentially the same as the 112 km/s found by Mammano et al. (1967). However, inspection of Figure 3 shows that there is large uncertainty in the original data. Our analysis also determined new temperatures indicating spectral types A1 and F8 for the primary and secondary stars rather than the previously reported A0 and F2. Using our $K_1 = 110$ km/s and q = 0.45 values, the masses for the primary and secondary are 2.76 and 1.24 and the radii are 2.18 and 1.41 in solar units respectively. The value of K_1, along with the temperature, radius, and bolometric magnitude from the ELC solution, place both the primary and secondary in the main sequence band (e.g. Hilditch et al., 1988).

We thank the editor of the IBVS for supplying us with the radial velocity data. Use was made of the SIMBAD database and the NASA Astrophysics Data System Abstract Service.

Table 1 Wavelength-Independent Parameters

Parameter	W-D	Error	ELC	Error*
i	75.37	±0.1	74.68	±0.02
q	0.45	±0.01	0.45	±0.01
T_1	9550	Fixed	9550	±1
T_2	6162	±20	6109	±1
Ω_1	3.094	±0.005	3.101	±0.006
Ω_2	3.169	±0.007	3.095	±0.003
g_1	1.00	Fixed	1.00	Fixed
g_2	0.32	Fixed	0.32	Fixed
A_1	1.0	Fixed	1.0	Fixed
A_2	0.5	Fixed	0.5	Fixed
F_1	1.0	Fixed	1.0	Fixed
F_2	1.0	Fixed	1.0	Fixed
r_1(pole)	0.374	±0.001	0.373	±0.001
r_1(pnt)	0.420	±0.001	0.418	±0.001
r_1(side)	0.390	±0.001	NA	
r_1(back)	0.404	±0.001	0.403	±0.001
r_2(pole)	0.234	±0.001	0.242	±0.001
r_2(pnt)	0.256	±0.001	0.268	±0.001
r_2(side)	0.239	±0.001	NA	
r_2(back)	0.250	±0.001	0.261	±0.001
$\Sigma W(O-C)^2$	0.021		NA	

* Formal errors from solutions.

Table 2 Mode 2 Wavelength-Dependent Parameters

Parameter	y	b	v	u
x_1	0.430	0.494	0.514	0.470
x_2	0.574	0.669	0.756	0.775
L_1^a	0.930	0.947	0.957	0.954
L_2^a	0.070	0.053	0.043	0.046
l_1^b	0.923	0.941	0.952	0.949
l_2^b	0.077	0.059	0.048	0.051

a Normalized monochromatic luminosities over 4π steradians

b Normalized fractional light at phase 0.25

Probable errors for luminosities are ±0.01.

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OBSERVATIONS OF MIRA VARIABLE V407 CYG

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V407 Cyg is a symbiotic binary system consisting of a white dwarf and a red giant which transfers material to the hot component either by Roche lobe overflow or by stellar wind. The red giant is a Mira variable with a pulsation period of about 745 d (Meinunger 1966). The system was detected and discovered by Hoffmeister (Ahnert et al., 1949) in 1936. In August 1994, Munari et al. (1994) reported the bright and active phase of V407 Cyg. The next active phase of the system occurred in 1998 (Kolotilov et al. 2003; Tatarnikova et al. 2003). During this phase (1998-2002) emission lines, superimposed on the M6-M7 red giant continuum (Kolotilov et al. 1998), were observed. The binary is inside a nebula which is formed by the red giant wind. Munari et al. (1990) suggested an orbital period of 43 years considering the time between two minima of the mean system brightness.

V407 Cyg has been recently detected in bright optical outburst (Nishiyama et al., 2010) on March 10, 2010 (JD 2455266). In the present study, we report observations of V407 Cyg obtained in the period 2004-2010. The observations were carried out by the 45 cm robotic ROTSEIIId telescope (located at Bakırlıtepe, Turkey[1]) which operates without filters (Akerlof et al. 2003). After the report of the outburst of V407 Cyg, we analyzed the observations of V407 Cyg which is found in the same CCD frames with our target, the Be-X ray binary system SAX J2103.5+4545 (Kızıloğlu et al. 2009). ROTSEIIId magnitudes were calibrated by comparing all the field stars against USNO A2.0 R-band catalog, after obtaining the instrumental magnitudes by aperture photometry. Details on the reduction of data were given previously in several studies (Kızıloğlu et al. 2005; Baykal et al. 2005).

The behavior of the binary system V407 Cyg in the period 2004-2010 is presented in Fig.1. As apparent from the figure the pulsations are seen superimposed on an increased mean brightness of the system. The bottom panel in Fig.1. shows high time variability in the minimum state of its brightness. There is an inflection during the rise to the maximum of pulsation. When we fit a parabola to each of these three inflection minima, we find minima times as JD 2453520.6, 2454310.2, and JD 2455077.3. The average time interval between the two inflection minima is found as 778 days. These inflection features can be due to the newly formed dust layers or are caused by shock waves in the stellar atmosphere (Feuchtinger et al. 1993; Smith et al. 2002).

[1] `http://www.tug.tubitak.gov.tr`

The parabolic fit is also applied to the two pulsation minima and the times of the two minima are found as JD 2453275.9 and JD 2454815.4 giving an average time interval of 769.8 d between the two pulsation minima. We give an ephemeris for the minima of pulsations as T= 2453275.9 + 769.8 E d. However, the other ephemerides given for the pulsation maxima T= 2429710 + 745 E d in R and B band (Munari and Jurdana-Sepic 2002; Munari et al. 1990) and T= 2445326 + 762.9 E d in K band (Kolotilov et al. 2003) differ from our findings. Munari and Jurdana-Sepic (2002) gives a pulsation period in R band similar to the value given from blue photographic observations (Meinunger 1966). The discrepancy in R band between the pulsation periods in two different studies could be due to the dust envelope, beating phenomena and difficulty in determining the minima (or maxima) positions of the pulsations.

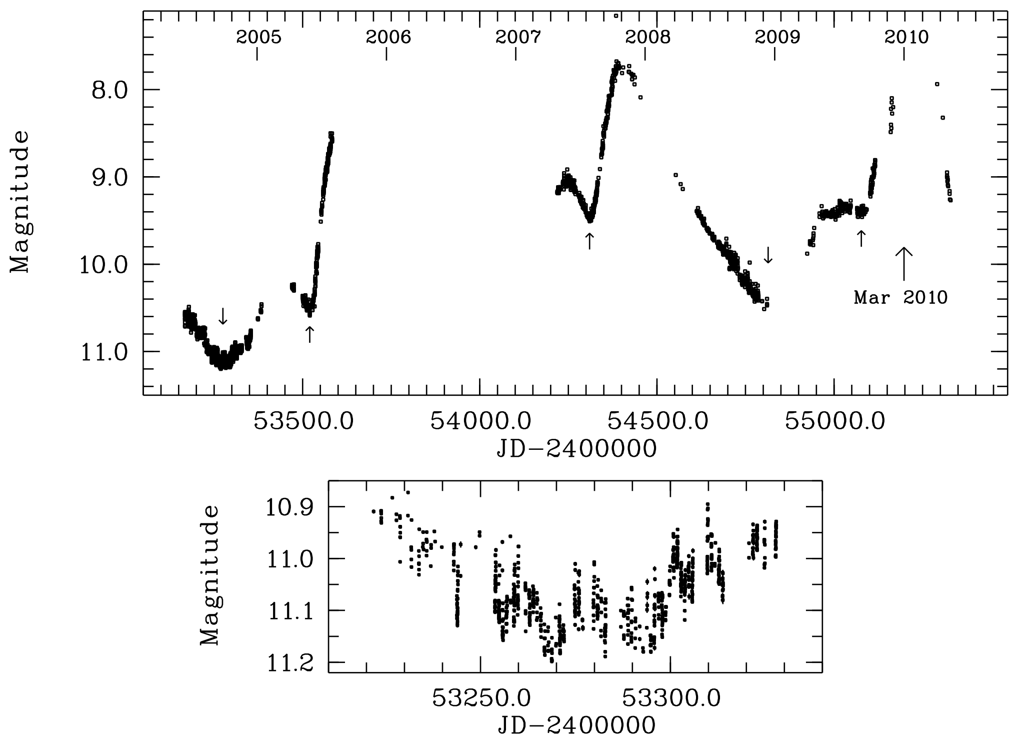

Figure 1. ROTSEIIId light curve of the binary system V407 Cyg. Downward and upward arrows show the pulsation minimum and inflection minimum, respectively.

Kolotilov et al (2003), making a Fourier analysis of the light curve of V407 Cyg, found periods of 18 and 33 minutes. Gromadzki et al (2006) determined periods of 2h, 72 and 45 minutes. We searched for any time variability using Period04 [2], Scargle (Scargle 1982) and Clean (Roberts et al. 1987) algorithms. We used differential magnitudes for the time series analysis. No short term variability was found in our light curve. We also searched for a possible variability during the first brightness minimum between JD 2453220 and JD 2453330 which is shown in the bottom panel of Fig.1. Two periodic variations at 5.261 d and 21.497 d were detected. These variations can be due to the Mira. In Fig.2 the power spectrum by clean algorithm is shown together with the light curves folded with the given periods.

[2]http://www.univie.ac.at/tops/period04

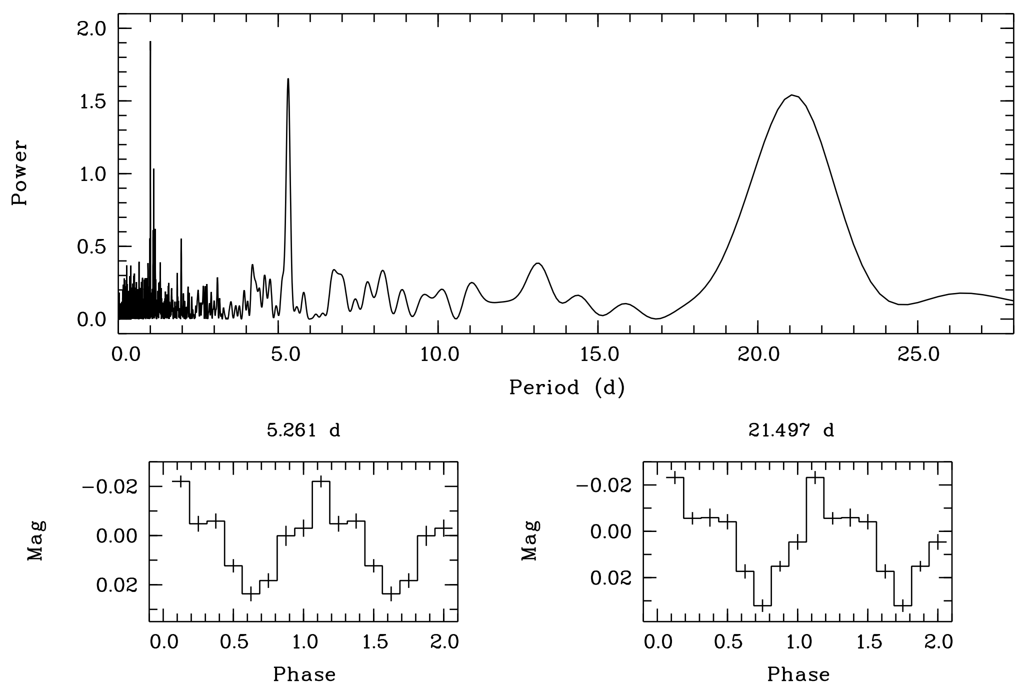

Figure 2. Upper panel: Power spectra of V407 Cyg obtained in the period between JD 2453220 and JD 2453330. Lower panel: Light curves with the given periods. Ephemerides for the minimum brightness are, T=JD 2453175.0 + 5.261 E d and T=JD 2453182.6 + 21.497 E d, respectively.

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EVIDENCE FOR A VARIABLE COMPONENT IN THE ECLIPSING BINARY SYSTEM V417 AURIGAE

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The bright eclipsing binary star V417 Aurigae (HD 33671; RA=$05^h13^m31^s.80$, Dec=$+35°39'11''.0$; $V = 7.9 - 8.2$; period 1.86553 days; spectral type A0) was identified by E. Soydugan et al. (2006a) as a likely candidate to contain a pulsating δ Scuti component. This system appears in Soydugan's Table 5, which uses $B - V$ colors and spectral type information from the Hipparcos mission to identify those Hipparcos eclipsing binary systems where one or both of the components lies in the δ Scuti region of the Cepheid instability strip.

Recently, Dvorak (2009) published the results of a search for pulsations in 35 eclipsing binary systems from the Soydugan catalog, including several from the Hipparcos list. Dvorak observed V417 Aur for five nights, but reported finding no statistically significant evidence of pulsations with frequencies between 6 and 50 cycles/day.

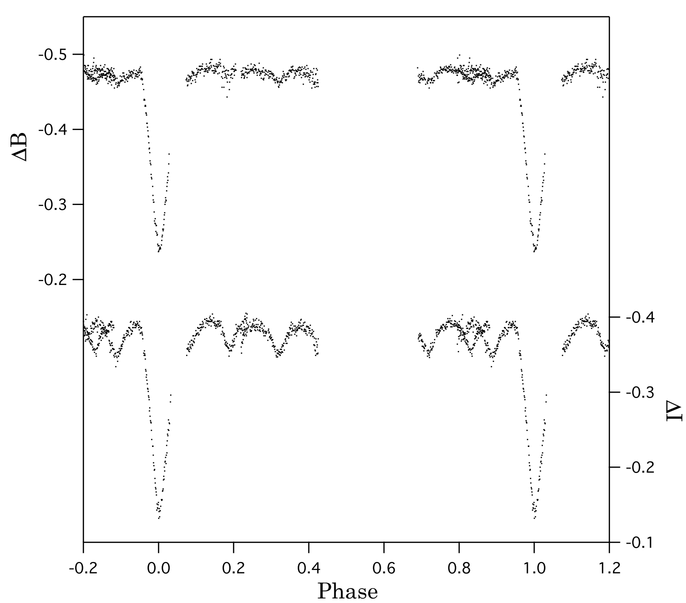

Figure 1. *B* and *I* light curves of V417 Aur, phased according to the eclipsing binary period.

Independent of Dvorak's investigations, a study of V417 Aurigae was undertaken at the Truman State University Observatory. V417 Aur was observed on four nights between November 2009 and February 2010, for no less than seven hours each night. All data were acquired with a 20-cm Meade LX200GPS Schmidt-Cassegrain telescope with an SBIG-ST9 CCD using Bessell standard *B* and *I* filters. The star HD 33688 was used as a comparison, and HD 280704 was used as a check star. All images were processed using normal dark and flat frame processing; differential magnitudes for the target and check stars were produced with MaximDL.[1]

Figure 1 shows all of the data acquired for V417 Aur (which is available through the IBVS website as `5948-t1.txt`), phased according to the eclipsing binary period of 1.86553 days. Significant out-of-eclipse variations are evident in both B and I filter data, indicating that one of the stars in the binary system is a short period, low amplitude variable star. Analysis of the out-of-eclipse variations with the period search software Peranso[2] using the Lomb-Scargle method generated the power spectrum shown in Figure 2, resulting in a most probably frequency of $f = 4.7808 \pm 0.0192$ cycles/day, with a peak-to-peak amplitude of approximately 0.02 in B and 0.05 in I. The phased light curves for the oscillating component are presented in Figure 3.

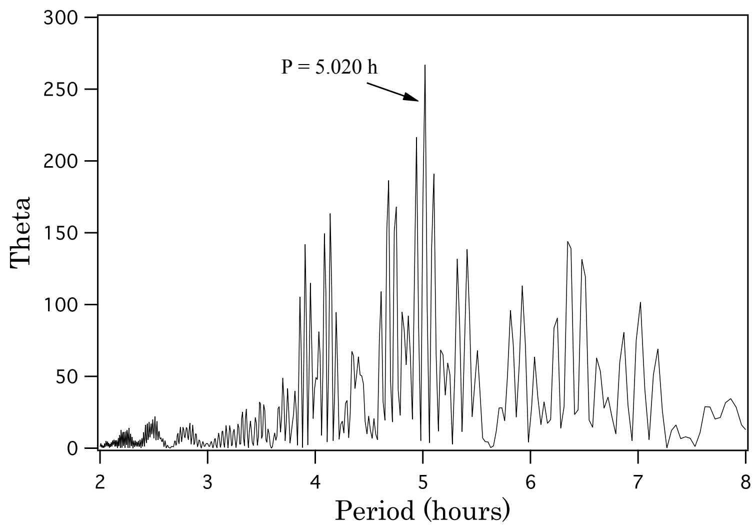

Figure 2. Lomb-Scargle power spectrum of small-amplitude oscillations of V417 Aur (I filter).

Despite the fact that V417 Aur appears in Soydugan's catalog of candidate eclipsing binary systems with δ Scuti components, it is not possible to definitively classify the variable component as a δ Scuti star based upon the photometric data alone. The apparent pulsation period (5.020±0.020 hours) is at the generally accepted upper limit of δ Scuti variable periods; in fact, it seems likely that Dvorak failed to recognize the oscillating nature of one of the stars in the V417 Aur system because he only searched his data for periods up to 4 hours. The $B - V$ color of 0.100 and A0 spectral type derived by Hipparcos place V417 Aur just outside the δ Scuti region of the Cepheid instability strip (Rodríguez & Breger, 2001). Furthermore, the amplitude of pulsation for δ Scuti variables is generally larger at shorter wavelengths, while for V417 Aur the amplitude is larger in infrared than in blue.

V417 Aurigae merits follow-up observation for several reasons. First, of course, it is important to accurately classify the putative pulsating star in this eclipsing binary system. Second, although the smoothness and symmetry of the light curve near primary eclipse suggest that the primary star in the system is the oscillating component, this cannot be confirmed without photometric observations at secondary eclipse. Finally, it has been noted that there exists an approximately linear relationship between the orbital

[1]Diffraction Limited, Ottawa, Ontario, Canada, `http://www.cyanogen.com`
[2]T. Vanmunster, Landen, Belgium, `http://www.peranso.com`

period and the pulsation period for those eclipsing binary systems that contain a δ Scuti component (Soydugan et al., 2006b; Hoffman & Harrison, 2009). If it happens that the variable component of V417 Aur is indeed a δ Scuti star, it would stand well apart from similar systems on a plot of the pulsation period versus the orbital period.

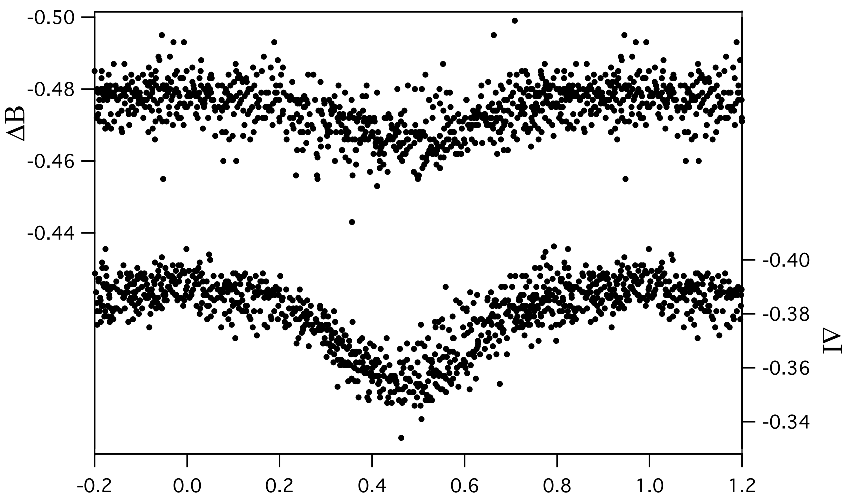

Figure 3. *B* and *I* light curves for the oscillating component of V417 Aur. Data has been folded with a period of 5.020 hours.

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DETECTION OF A RAPIDLY PULSATING COMPONENT IN THE ALGOL-TYPE ECLIPSING BINARY YY Boo

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YY Boo is an Algol-type eclipsing binary which was discovered by Hoffmeister (1949). Götz and Wenzel (1969) determined the spectral type to be A4. Halbedel (1984) lists four radial velocity measurements (ranging from −59.5 km/s to +29.9 km/s) and a spectral type A7 (III), while also possibly detecting an F or G type companion. The spectral type F9IV given by Simbad refers to the earliest possible spectral type of the companion (Halbedel, 1984). Because of the spectral type of the primary component, it is a potential oscillating Algol-type eclipsing binary (oEA star, see Mkrtichian et al., 2004). However it is neither listed in the recent catalogue of pulsating components in binary systems (Zhou, 2010), nor as a candidate for pulsation in the catalogue of close eclipsing binary systems with at least one component located in the lower Cepheid instability strip (Soydugan et al., 2006), probably due to its Simbad classification as of spectral type F9IV.

YY Boo was observed unfiltered out-of-eclipse on February 5/6, 2010. Rapid variations were detected with an amplitude of $\approx$ 0.1 mag and a period of around 88 minutes. Following this detection, a follow-up campaign was initiated using B and V filters. The contributing observatories and the instruments used are listed in Table 1, as well as the number of nights and hours the target was observed. The rapid variability was confirmed during the following nights. Standard aperture photometry was applied to all the frames to obtain differential instrumental magnitudes with respect to the comparison stars GSC 3059-614 and GSC 3059-615. A light curve acquired in the B passband, after removal of a synthetic binary light curve (see below), is shown for illustration in Fig. 1. It is a typical light curve of a δ Scuti star with a fairly high amplitude.

After three months of intensive photometric observations, an almost complete eclipsing binary light curve has been obtained in both filters (see Fig. 2). Even during the descending and ascending branches of the primary eclipse, the pulsations could be clearly

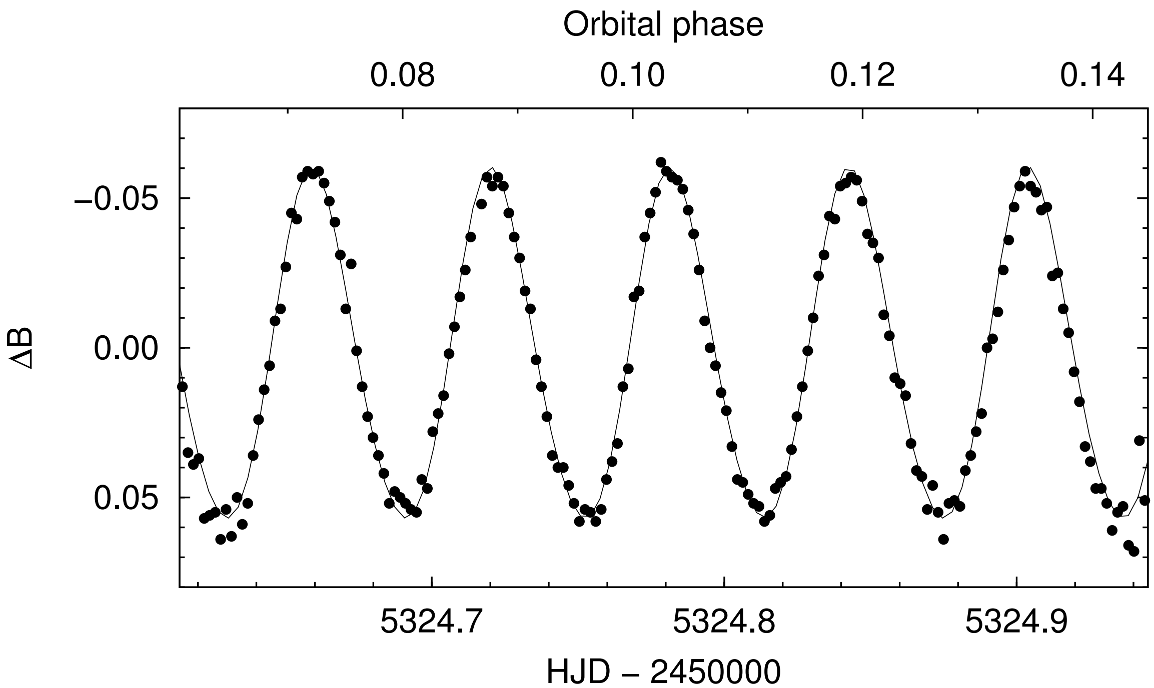

Figure 1. Light curve of YY Boo in B with a synthetic binary light curve subtracted. The full line shows the light curve based on the elements listed in Table 2.

detected (see Fig. 3). Without detailed radial velocity data it is difficult to determine an accurate value of the mass ratio, and it is therefore not the purpose of this paper to present a reliable binary solution. However the photometry is still useful to calculate a rough binary model, which can then be used to disentangle the pulsations and the variations due to the binary motion. To calculate these binary model parameters the following iterative method was used. In the first step, all data were used uncorrected in Phoebe (Prša & Zwitter, 2005), to find initial parameters. The second step was then to subtract the synthetic light curve thus obtained from the data and use the points outside of the primary and secondary eclipses to calculate the pulsation parameters with Period04 (Lenz & Breger, 2005). In step three, those pulsations were then subtracted from the original data. For observations during primary eclipse, a reduced amplitude was taken into account, as the primary is partly hidden by the companion. This reduced amplitude can be computed approximately by using the previously obtained synthetic light curve and the average radius of the primary (illustrated in Fig. 4; note that YY Boo is rather faint during primary minimum for the instruments used). This is strictly correct only if the light variations are caused solely by temperature changes and if the disc has a uniform temperature (disregarding limb darkening effects). In reality of course the star expands and contracts, and therefore the correction is only an approximation. In principle this would allow to measure the relative change in radius of the primary during the pulsation cycle and the phase of maximum radius (if the change in temperature is known). This is however beyond the scope of this paper, as more precise photometry is needed and detailed spectroscopic observations are required as well. The slightly enhanced amplitude during the secondary eclipse (because the main star dominates the total light even more, as part of the light of the companion is blocked) has been neglected as the change in brightness is at most 3 mmag in both B and V, less than the precision of the photome-

Table 1: List of the instruments used for the observations.

Observer Initials	Telescope type	Aperture (cm)	Observatory	CCD (SBIG)	Filter	Nights	Hours
HMB	Catadioptric	28	Mol, Belgium	ST-10XME	B	17	86.8
PL & PVC	Newtonian	40	R.O.B.-Humain	ST-10XME	V	6	35.3
PL & PVC	Refractor	18	R.O.B.-Humain	ST-10XME	V	2	7.4
PL & PVC	Newtonian	25	Beersel Hills	ST-10XME	V	5	14.0
SK	Catadioptric	30	Zagori	ST-7XMEI	B	8	38.0
SK	Catadioptric	30	Zagori	ST-7XMEI	V	11	57.9
CWR	Catadioptric	40	SETEC	ST-8XME	B	4	28.8
CWR	Catadioptric	30	SETEC	ST-8XMEI	V	3	20.6
TK	Catadioptric	30	Astrokolkhoz	ST-9XME	B	5	13.9
TK	Catadioptric	30	Astrokolkhoz	ST-9XME	V	5	14.0

try. With the light curve corrected for the pulsations, a new eclipsing binary model was then calculated. Step two and further above were then repeated until convergence was obtained.

The resulting pulsation parameters are presented in Table 2. An ephemeris for the pulsation maxima was derived from our data, supplemented with SuperWASP data from 2004 and 2007 (Norton et al., 2007), as follows:

$$HJD\ Max\ Pulsation = 2455244.5033(1) + 0\overset{d}{.}06128095(2) \times E \qquad (1)$$

Because of the fairly large amplitude, the pulsation mode is most likely a radial one. For the calculation of the binary parameters, a semi-detached configuration was assumed, with the secondary filling its Roche lobe. The following ephemeris (derived from our data) was used:

$$HJD\ Min\ I = 2455265.3796(2) + 3\overset{d}{.}933049(12) \times E \qquad (2)$$

The temperature T_1 of the main component was taken to be $8000K$ in accordance with its mid A spectral type. Calculations done using the Wilson-Devinney method as implemented in PHOEBE (Prša & Zwitter, 2005), resulted in the following model parameters (with formal uncertainties): $q = M_2/M_1 = 0.29 \pm 0.01$, $i = 81.7 \pm 0.1°$, $T_2 = 4650 \pm 10K$, $\Omega_1 = 7.03 \pm 0.01$. The uncertainty on T_1 is on the order of a few $100K$ and this will make the real uncertainties larger than the given values. The eclipses are partial, with 92% of the pulsator's disc eclipsed by the companion at minimum light. The limited radial velocity data from Halbedel (1984), only four points, were not used for the modeling. After subtracting the synthetic binary model and the fit to the pulsations the residual standard deviations (RMS) in both B and V are 7 millimag.

YY Boo is a new member of the group of mass-accreting pulsating components in Algol-type eclipsing binary systems (Mkrtichian et al., 2004). As such, it has the second largest pulsation amplitude among the known oEA stars after BO Her (Sumter & Beaky, 2007). It is therefore an ideal target to study the physical pulsation characteristics, taking advantage of the changing geometric aspects. A further campaign for spectroscopic follow-up has been started at the National Astrophysical Observatory (NAO) in Rozhen, in cooperation with Dr. Z. Kraicheva et al. of the Institute of Astronomy (Sofia, Bulgaria).

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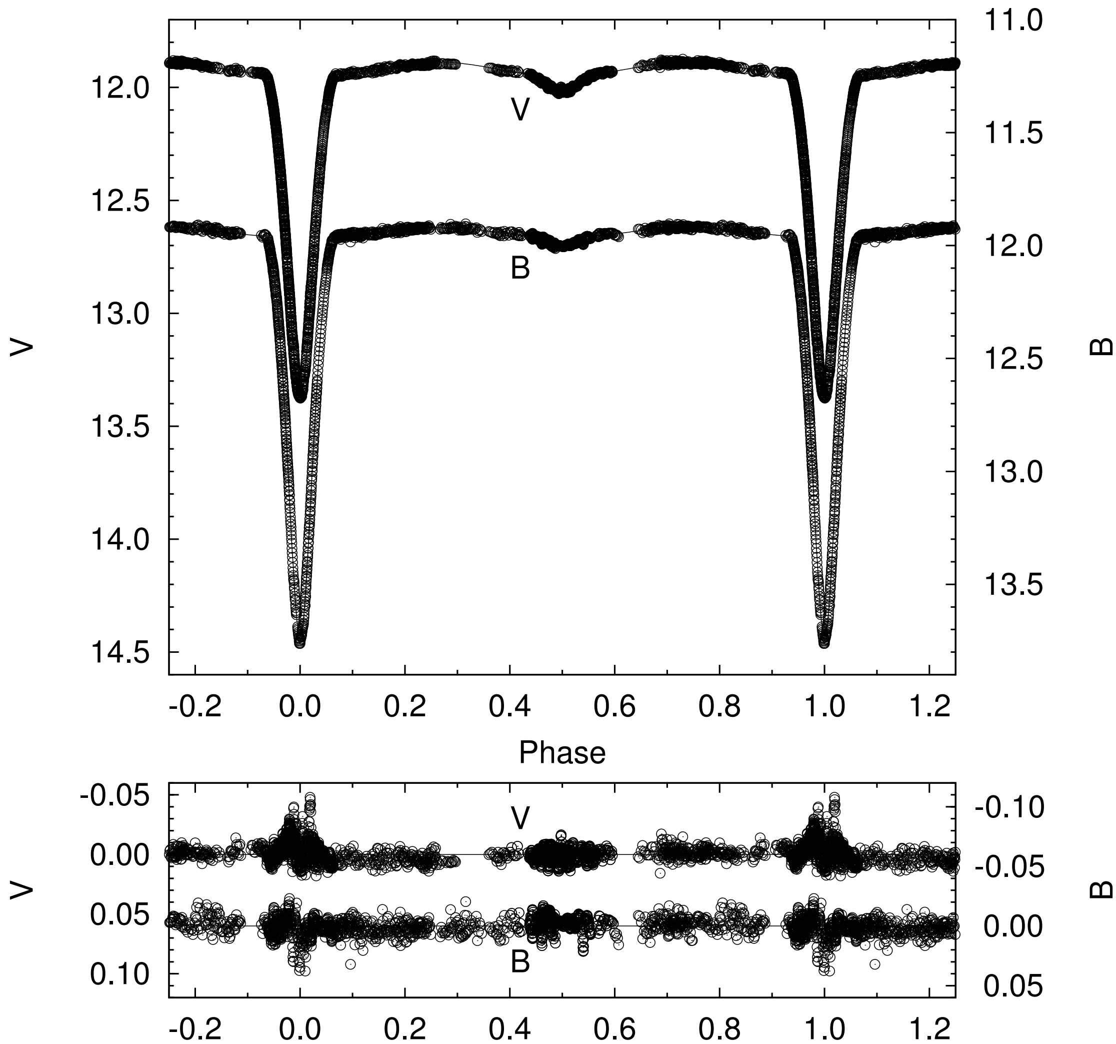

Figure 2. Phased light curve (upper panel) of YY Boo in B (lower curve) and V (upper curve) with the pulsations as described by Table 2 subtracted. The full line shows the model binary light curve. The bottom panel shows the residuals with both the pulsations and the binary model subtracted.

Table 2: Pulsation frequencies and associated parameters (details following the convention of Period04 (Lenz & Breger, 2005). Uncertainties between brackets (in units of the last displayed decimal) are derived from Monte-Carlo simulations in Period04.

Identification	Frequency (c/d)	Filter	Semi-amplitude (mmag)	Phase ($HJD_0 = 0$)
f	16.31828(2)	B	58.4(2)	0.7830(6)
		V	39.6(2)	0.7829(10)
$2f$	32.63656	B	4.2(3)	0.923(8)
		V	3.1(2)	0.924(13)

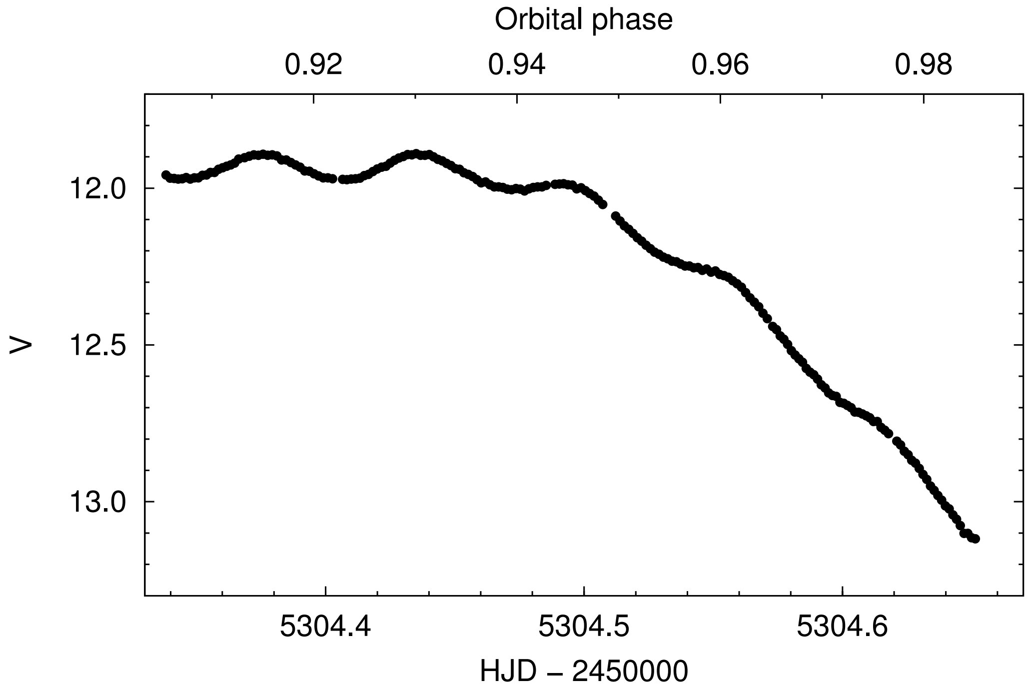

Figure 3. Light curve of YY Boo in V during the descending branch of an eclipse. The pulsations are still clearly seen during the fading.

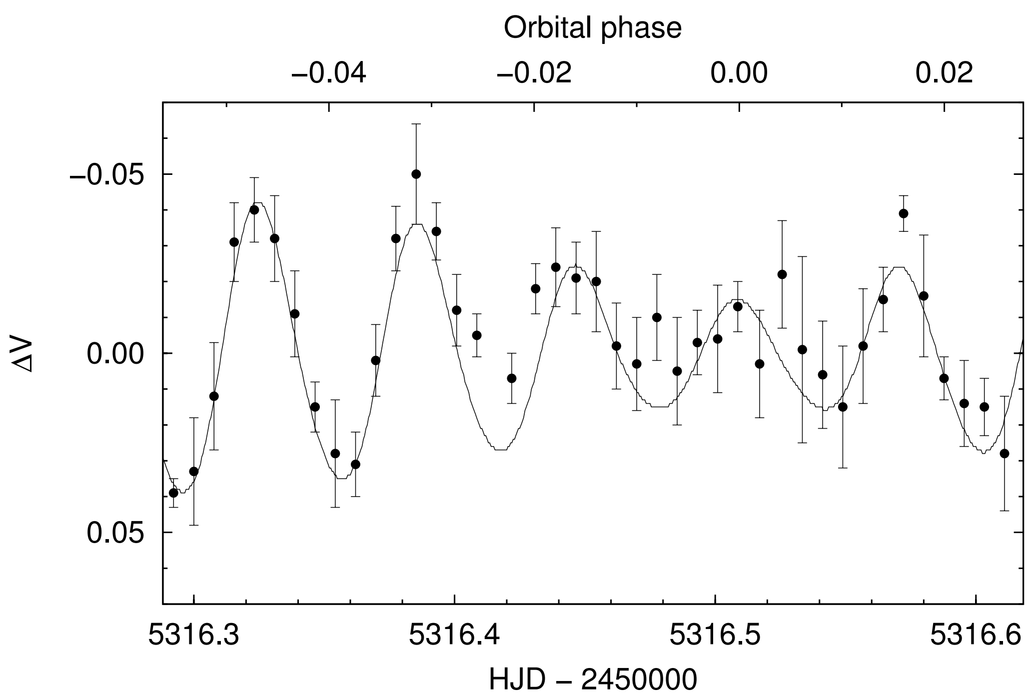

Figure 4. Light curve of YY Boo in V during primary eclipse with a synthetic binary light curve subtracted, based on 5-point averages (the uncertainties shown are the standard deviation on these averages). The full line shows the theoretical pulsation light curve taking into account that the primary is partly hidden by the companion (see text for details). Note the larger error bars at the phase of primary minimum.

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Part of the data used in this study were obtained through AAVSONet, the Robotic Telescope Network of the American Association of Variable Star Observers.

We have also used data from the WASP public archive in this research. The WASP consortium comprises of the University of Cambridge, Keele University, University of Leicester, The Open University, The Queen's University Belfast, St. Andrews University and the Isaac Newton Group. Funding for WASP comes from the consortium universities and from the UK's Science and Technology Facilities Council.

This work has further made use of the SIMBAD and VizieR databases operated at CDS, Strasbourg, France.

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THE FIRST DISCOVERY OF A VARIABLE MAGNETIC FIELD IN X-RAY BINARY Cyg X-1=V1357 Cyg

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The X-ray binary Cyg X-1=V1357 Cyg=HDE 226868 is a microquasar containing the historically first black-hole candidate. Theoretical models describing processes in objects with black holes, like microquasars or active galactic nuclei, are dominated with the magnetic-disk-accretion paradigm. Nevertheless, no reliable measurements of magnetic fields in these systems were available so far. Shvartsman (1971) was the first to predict the existence of a magnetic field for Cyg X-1. He wrote that flickering X-ray emission from Cyg X-1 evidenced for the presence of a black hole and indicated the role of the magnetic field in accretion onto a black hole (Pustilnik & Shvartsman, 1974; Kaplan & Shvartsman, 1976). Since then, there were many attempts to search for the magnetic field of the optical component of the Cyg X-1 binary (the O9.7Iab supergiant), but all these efforts resulted in upper limits only.

Our spectropolarimetric observations were performed with the 8.2-m Very Large Telescope (VLT) of the European Southern Observatory (Cerro Paranal, Chile) in its service mode with the FORS 1 spectrograph in June/July, 2007 and in July, 2008 (Table 1). The spectra were obtained in the 3680–5129 Å spectral range with the spectral resolution of $R = 4000$ and the signal-to-noise ratio $S/N = 1500{-}3500$ for spectra of intensity (Stokes parameter I). Cyg X-1 was in its X-ray "hard state" at that time. 13 spectropolarimetric spectra with exposure times of ~ 1 hour were obtained during 13 nights.

The details on the observing technique with FORS 1 and data reduction can be found, for example, in Hubrig (2004); see also references therein. Using the method described there, we obtained the mean longitudinal magnetic field $\langle B_z \rangle$; it is the magnetic field component along the line of sight, averaged over the visible stellar hemisphere and weighted by the local emergent spectral line intensity. It is diagnosed from the slope of the linear regression of V/I versus $-\frac{g_{\rm eff} e}{4\pi m_e c^2}\lambda^2 \frac{1}{I}\frac{{\rm d}I}{{\rm d}\lambda}\langle B_z\rangle + V_0/I_0$, where V is the Stokes parameter measuring the circular polarization; I, the intensity observed in unpolarized light; $g_{\rm eff}$, the effective Landé factor; e, the electron charge; λ, the wavelength; m_e, the electron mass; c, the speed of light; ${\rm d}I/{\rm d}\lambda$, the derivative of the Stokes I parameter; V_0/I_0, a constant; and $\langle B_z\rangle$ is the mean longitudinal field. The method is statistical: to increase the sensitivity, we used all observed spectral lines simultaneously.

Cyg X-1 possesses a strong interstellar/circumstellar linear polarization that can produce a cross-talk with circular polarization within the FORS 1 analyzing equipment. Moreover, the derived $\langle B_z \rangle$ is relatively low. For this reasons, we had to take certain precautions in our magnetic field measurements of the binary and to adjust the method to such conditions. We removed all spectral features not belonging to the photosphere of the Cyg X-1 optical component (O9.7 Iab): interstellar lines, CCD flaws, the He II λ4686 Å emission line, lines with strong P Cyg components. Telluric lines being rather weak in the considered spectral range, we find no pollution from these lines in our low-resolution spectra.

Before applying the procedures for the magnetic field measurements, we removed linear trends, mainly caused by the cross-talk between linear and circular polarization within the FORS 1, from our V/I-spectra. This seems to be an appropriate step since, as follows from Nagae *et al.* (2009), the optical-range linear polarization of Cyg X-1 has no significant spectral line features. Therefore, according to our estimates, the cross-talk can produce only a false V continuum slope and does not significantly distort the S-shaped V profiles of spectral lines caused by Zeeman effect (hereafter, Zeeman S-waves). The Stokes I spectra were normalized to the pseudo-continuum I_c, which is produced by the source energy distribution, interstellar reddening, broad diffuse interstellar bands (DIBs), as well as atmospheric extinction and detector sensitivity. After these reductions, the residual deviations of the least-squares linear regression follow the Gauss function up to $\pm 3.6\sigma(V/I)$, where $\sigma(V/I)$ is the standard deviation of V/I, i.e. the level of significance corresponds to the Gauss statistics now.

Table 1. Magnetic field from VLT spectropolarimetric observations of the X-ray binary Cyg X-1.

Date	JD*	Orbital phase	$\langle B_z \rangle$, G	σ, G	significance $\vert\langle B_z \rangle/\sigma\vert$
18-19 June 2007	2454270.768	0.650	-6	28	0.2
19-20 June 2007	2454271.778	0.830	37	22	1.7
20-21 June 2007	2454272.760	0.006	58	21	2.8
25-26 June 2007	2454277.808	0.907	22	28	0.8
29-30 June 2007	2454281.707	0.603	48	20	2.4
9-10 July 2007	2454291.766	0.400	101	18	5.5
14-15 July 2008	2454662.711	0.641	49	23	2.1
15-16 July 2008	2454663.684	0.816	22	22	1.0
16-17 July 2008	2454664.692	0.995	80	23	3.5
17-18 July 2008	2454665.692	0.174	24	19	1.3
23-24 July 2008	2454671.704	0.247	-16	20	0.8
24-25 July 2008	2454672.728	0.430	27	19	1.4
30-31 July 2008	2454678.676	0.500	128	21	6.2

*JD is the Julian date of the middle of observation; orbital phases φ are according to the ephemeris from Brocksopp *et al.* (1999): φ=0 corresponds to the optical component in front; σ is the standard deviation.

To verify our results (see Table 1), we used several tests: (1) each spectrum was subdivided in two halves at mid-wavelength to check that $\langle B_z \rangle$ values determined over each half separately were in agreement within error bars. (2) We repeated $\langle B_z \rangle$ calculations using fragments of spectra that include strong absorption lines (deeper than 4%) only: ~1/3 spectral points were used and $\langle B_z \rangle$ values were found in agreement with our earlier measurements using the whole spectral range within 1.5 $\sigma(\langle B_z \rangle)$. (3) Zeeman S-waves were found for the strongest lines.

Our measurements of $\langle B_z \rangle$ at different orbital phases, φ, are presented in Table 1 and Fig.1 a. It follows from Fig.1 a that $\langle B_z \rangle$ varies periodically with the orbital phase (two waves for period), reaching 130 G ($\sigma = 20$ G) at phase 0.5. Figure 1 b, presenting moving-average points (calculated as the mean of each consecutive 3 points of Fig.1 a), shows the regular variability component clearer. The dependence of $\langle B_z \rangle$ on φ is more complicated than for a magnetic dipole and has probably changed from 2007 to 2008.

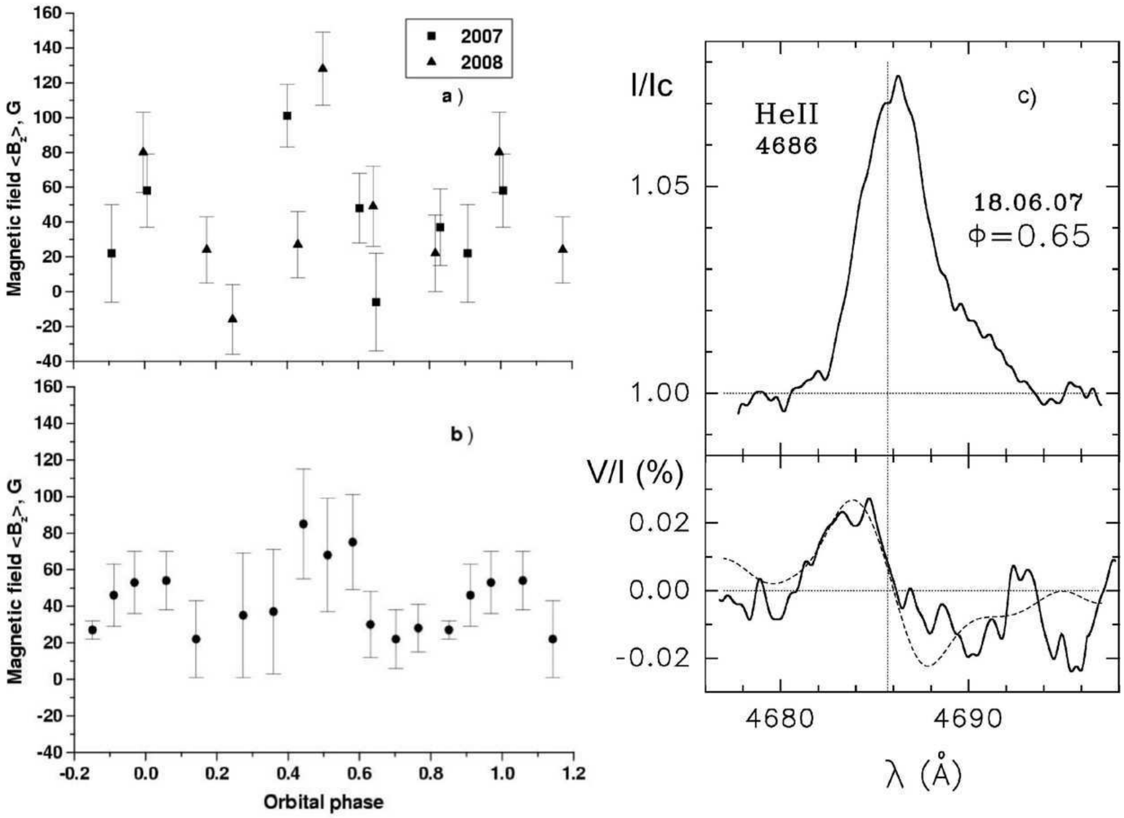

Figure 1. **a**, The mean longitudinal magnetic field of the Cyg X-1 optical component $\langle B_z \rangle$ (in Gauss) *vs.* the orbital phase φ for 2007 and 2008. **b**, The moving average points calculated as the mean of each consecutive 3 points of the panel **a**. **c**: The He II λ4686 Å spectral line profile I/I_c for June 18, 2007 (top); the solid curve in the bottom panel shows the observed V/I spectrum smoothed over 3 Å. The dashed curve displays the expected Zeeman S-wave shape $(dI/d\lambda)/I \propto V/I$, where I is smoothed over 3 Å. The good agreement between these curves demonstrates the possible existence of a rather large magnetic field in the region of forming He II λ4686 Å emission.

At the next step of our study, we investigated the He II λ4686 Å spectral line separately. Due to the presence of a strong emission component in the line profile, it was omitted from the earlier analysis. In fact, this line has a compound profile consisting of absorption (originating in the stellar photosphere) and emission (originating in the accretion structure) components. Certainly, the accuracy of the magnetic-field measurements using just a single line is considerably worse compared to those using the whole spectrum. Nevertheless, our analysis shows the results for the two spectra at the 4σ level: $\langle B_z \rangle = -730 \pm 170$ G for the orbital phase $\varphi = 0.65$ in 2007 and $\langle B_z \rangle = -420 \pm 106$ G for $\varphi = 0.43$ in 2008. The Zeeman S-wave in the V-spectrum smoothed over 3 Å and its correspondence to the $dI/d\lambda$ wave is presented in Fig.1 c for June 18, 2007.

To exclude the influence of the stellar-photosphere absorption component of

He II λ4686 Å, we subtracted the model-atmosphere line profile for each φ. We calculated it by the method described, for example, in Karitskaya *et al.* (2005). The subtraction changes numerical values of $\langle B_z \rangle$ but does not distort the qualitative result: the presence of a magnetic field of the order of $(300 - 1000)\ G$, on a significance level about $(2.5-3.5)\sigma$ in the region of formation of the λ4686 Å emission. The emission component of He II λ4686 Å originates in the outer part of the accretion structure. This is demonstrated with the Doppler tomogram (the binary system image in velocity space) constructed by us on the base of He II λ4686 Å profiles for Cyg X-1 from our VLT observations (Karitskaya *et al.*, 2009) and Terskol observations (Karitskaya *et al.*, 2005).

Consequently, $\langle B_z \rangle$ derived from the He II emission line is located in outer parts of the accretion structure. Its value, ~ 600 G, is in agreement with Shvartsman's ideas (Kaplan & Shvartsman, 1976) that the gas stream carries the magnetic field to the accretion structure and the gas is compressed by a factor of $\sim$ 10 due to interaction with the structure of the outer rim. Along with the increase of gas density, the magnetic field is increased to $B \sim 600$ G. It takes place at a distance 6×10^{11} cm $= 2 \times 10^5 R_g$ from the black hole (Bochkarev, Karitskaya & Shakura, 1975), where R_g is the gravitation radius. According to Shakura & Sunyaev (1973), we get $B \sim 10^9$ G at $3R_g$ for the magnetized accretion disc standard model. Taking into account the radiative pressure predominance inside $\sim 10 - 20R_g$, we get $B(3R_g) \sim (2 - 3) \times 10^8$ G. Then the magnetic energy flux is 10^{37} erg/s, equal to or exceeding the luminosity of the X-ray flickering component. Actually, the region of main energy release for X-ray binaries extends from $5R_g$ to $27R_g$, and there should be a maximal frequency $F \sim 100$ Hz for Cyg X-1 (e.g., Sunyaev & Revnivtsev 2000). Thus, magnetic energy dissipation permits to account for the X-ray flickering.

Our results demonstrate that the VLT FORS1 observations of 2007–2008 permit to detect the presence of a magnetic field in Cyg X-1. These are the pioneer measurements in a black hole system. The field can be responsible for X-ray flickering. Our results point to necessity of taking into account the impact of the magnetic field on the matter-flow structure in Cyg X-1.

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AC BOOTIS – AN UNEVOLVED W-TYPE OVERCONTACT ECLIPSING BINARY WITH A HIGH MASS TRANSFER RATE

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The variability of AC Boo (= BD +46°2004 = TYC 3474-905-1 = HIP 73103, Sp. F8V) was discovered by Geyer (1955, as reported in Mauder, 1964). Zessewitsch (1956) first identified the system as a W-UMa-type and attempted to determine its period, getting values of 0.38514 and 0.4278192 days. Mauder (1964) secured light curves in B and V photoelectrically and determined the correct period of 0.352429 days. He went on to do an analysis of the light curves using the rectification method. Lacking radial velocities, he was forced to estimate the mass ratio by indirect methods. Binnendijk (1965) used the 28-inch reflector at the Flower and Cook Observatory to secure a photoelectric light curves in two colours and derived orbital elements from the rectification method. Mancuso et al. (1974, 1977, 1978) determined times of minima and full light curves photoelectrically. They classified the system as W-type and went on to use the methods of Wood (1971) and Wilson-Devinney (1971, 1990, hereafter WD) to analyze their light curves, taken in 1972 and 1973, and also those of Binnendijk (1965). Assuming a spectral type of F0 (attributed to Mauder, 1964), they used fixed parameters $i = 85.^\circ47$, $\Omega_1 = 7.330$, $T_1 = 6100$ K, and mass ratio $q = M_2/M_1 = 3.57$. (The temperature was estimated from the colour index, and the others indirectly from Russell-Merrill (1952) analysis.) Noting the variation in the light curves over time, they obtained temperatures of the secondary varying from $T_2 = 5735$ to 6055 K. Schieven et al. (1983) secured further light curves photoelectrically, analyzed some period changes, and performed a light curve synthesis using the methods of Rucinski (1976a, b, and c). They also noted the variability of the light curves (on a time scale of days) and also the presence of an asymmetry in the portion of the light curve following the primary (flat-bottomed) minimum. They attributed the latter to the presence of starspots. They obtained two values of the mass ratio: 0.31 and 0.28. (Note that these values <1 imply an A-type system.) Linnell, et al. (1990) report modelling with their (unpublished) photometric data and the mass ratio of 0.41 (A-type) = 2.44 (W-type) of Hrivnak (1993) requiring a complex set of dark spots and third light. No error estimate was provided. Finally, Hrivnak (1993), using cross-correlation techniques, derived RV values which fit a double sine curve somewhat poorly, resulting in an rms deviation of 16.7 km/s and the above reported mass ratio.

With improved versions of the WD code that support star spots, and the opportunity to obtain new radial velocities (RVs) using analysis by the modern broadening functions due to Rucinski (1976a, 1976b, 1976c, 1992, 2004), an updated study was deemed important.

Table 1. New times of minima for AC Boo

Minima	Error (days)	Cycle	Type
55300.8561	0.0002	28893	I (occultation - flat bottom)
55301.7380	0.0005	28895.5	II (transit)
55312.8395	0.0002	28927	I (occultation - flat bottom)

This system has shown significant period change since 1929 when the first visual observations were recorded. Altogether 246 times of minimum have been entered into the Excel worksheet that is part of the "Eclipsing Binary $O - C$ Files" (observed minus calculated) database at the AAVSO site that is maintained by the author (Nelson, 2010 – updated annually). These include three new times of minimum determined during light curve acquisition and reported here – see Table 1.

Throughout the years, a total of 10 elements (epoch, period) have been used by various authors; some give the (incorrect) phase 0.5 of the deeper, or flat-bottomed minima (and of course, 0.0 for the shallower minima). The elements of Schieven et al. (1983) seem to give the best results (but note that there seems to have been a typo in HJD_0 – the correct value, as determined from his data, is given in Equation 1). As corrected, the elements give correct phases for the minima of Mauder (1964) and Binnendijk (1965), (subject to the requirement to adjust the cycle counts by + or − 0.5 for various ranges to obtain a contiguous relationship):

$$\text{J.D. Hel. min I} = 2445117.781(1) + 0.3524321(2)E \tag{1}$$

The results are plotted in Figure 1. The reader will note, as mentioned by various authors, that the period seems to have been constant from 1929 to 1982 (cycle counts from −54880 to 0); the best-fit period in this interval was 0.3524294 (1) days. Close to cycle 0 there was a sudden rise in the period; after that, the period displayed a slow, steady increase over time. The abrupt change of period can be explained by an episodal mass interchange, possibly as the two stars established contact (but see below). The portion of the curve after cycle 200 (and especially after cycle 1400) can be fitted closely by a parabola – denoting a constant rate of change. (Assuming no other cause, this implies a constant mass transfer rate; this is calculated later.) The elements best describing the curved section are given in Equation 2. (Then $\mathrm{d}P/\mathrm{d}E = 2\times$ the quadratic coefficient $= 8.13 \times 10^{-10}$ days/cycle.)

$$\text{J.D. Hel. min I} = 2445117.8019(1) + 0.3524305(1)E + 4.1(3) \times 10^{-10}E^2 \tag{2}$$

During September of 2008 and 2009, the author took six spectra (10 Å/mm reciprocal dispersion, resolving power 10,000) at the Dominion Astrophysical Observatory (DAO) in Victoria, British Columbia, Canada; he then used the Rucinski broadening functions (Rucinski, 2004) to obtain radial velocity (RV) curves (see Nelson et al., 2006 for details). The spectral range was 5014-5261 Å. A log of DAO observations and RV results is presented in Table 2. An anonymous referee has pointed out that – due to the short period of the system – the one hour exposures represent a significant fraction of a period (0.118) and that excessive "phase smearing" of RVs might occur. A simple analysis reveals that, for circular orbits and assuming that neither star is undergoing an eclipse during any part of the exposure, the derived (averaged) RV values are reduced by a factor $f = \sin X/X$ from the instantaneous values (where $X = \pi t/P$, with $t =$ exposure time and $P =$ period).

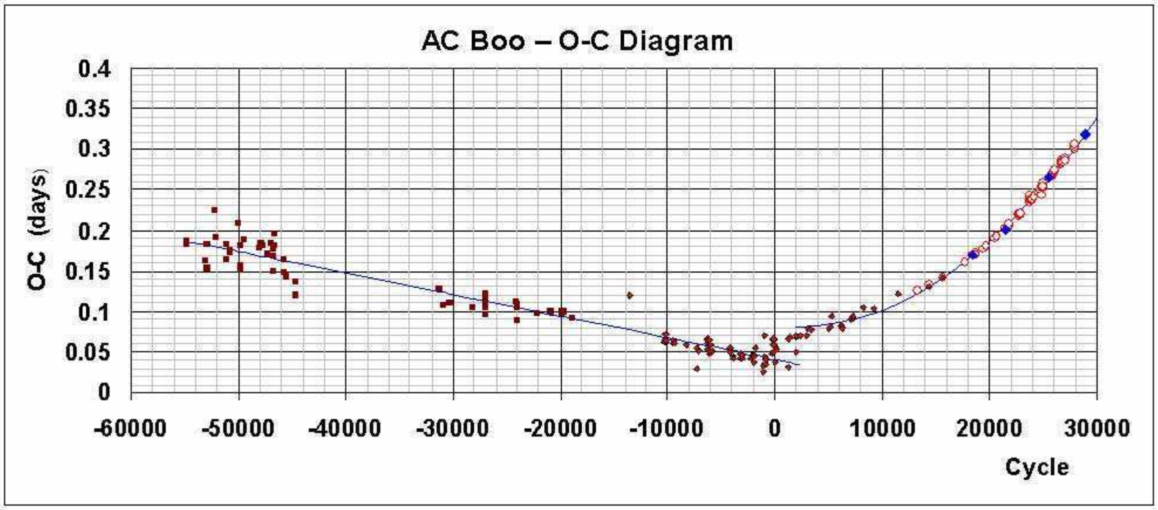

Figure 1. Observed - Computed $(O - C)$ plot for AC Boo

Table 2.

DAO Image #	Mid Time (HJD-2400000)	Exposure (sec)	Phase at Mid-exp	V_1 (km/s)	V_2 (km/s)
4786*	54568.8890	3600	0.192	−275.7	50.2
4854*	54571.9030	3600	0.743	232.1	−109.9
5369	54927.8462	3600	0.655	200.6	−96.9
5381	54928.0313	1693	0.180	−266.4	32.5
5402	54928.9480	1800	0.781	221.2	−95.6
5420	54929.8189	3600	0.252	−278.2	56.6

*Taken in 2008

Note that factor f is independent of phase (subject to the above conditions). Therefore, corrected RVs were obtained by simply dividing all the derived RVs by f. (Note that, for $t = 3600$ seconds, $f = 0.977$. Note also that neglecting this correction factor cannot affect the derived value for the mass ratio but does affect the derived values of mass, etc.; therefore this correction is needed.)

On seven nights April of 2010, the author took a total of 241 CCD images of the field in V, 266 in R_C and 238 in I_C (both Cousins) at his private observatory in Prince George, British Columbia, Canada. The telescope was a 33 cm f/4.5 Newtonian on a Paramount ME mount; the detector was a SBIG ST-7XME CCD cooled to −20°C. Reduction software was MIRA by Mirametrics, Inc., and light-box flats were used. A list of the Variable, Comparison and Check stars appears in Table 3.

The following elements were used for phasing the light curves (see Nelson, 2010 for the $O - C$ relation):

$$\text{JD Hel Min I} = 2455312.8409(1) + 0.3524320(1)E \quad (3)$$

The author used the 2004 version of the Wilson-Devinney (WD) light curve and radial velocity analysis program with the Kurucz atmospheres (Wilson and Devinney, 1971, Wilson, 1990, Kallrath, et al., 1998) as implemented in the Windows software WDwint (Nelson, 2009) to analyze the data. To get started, a spectral type F8 V (SIMBAD

Table 3.

Type	TYC 3474−	R.A. J2000	Dec. J2000	V Mags	$B-V$ Mags
Variable	905	$14^h56^m28.341s$	$46°21'44''.1$	10.0−10.62	0.592
Comparison	835	$14^h56^m07.846s$	$46°21'26''.2$	11.18	0.549
Check	966	$14^h56^m26.300s$	$46°26'50''.7$	9.39	0.358

Table 4.

Quantity	Value	
—	Star 1	Star 2
g	0.500	0.500
A	1.000	1.000
$x_{\rm bol}$	0.137	0.137
$y_{\rm bol}$	0.581	0.581
$x_{\rm V}$	0.148	0.148
$y_{\rm V}$	0.665	0.665
$x_{\rm Rc}$	0.049	0.049
$y_{\rm Rc}$	0.696	0.596
$x_{\rm Ic}$	−0.018	−0.018
$y_{\rm Ic}$	0.678	0.678

- no reference given) and a temperature $\mathbf{T_1 = 6250 \pm 240}$ K were used; interpolated tables from Cox (2000) which gave $\log g = 4.368$ were used; an interpolation program by Terrell (1994) gave the (van Hamme, 1993) limb darkening values; and finally, a square root (LD=3) law for the limb darkening coefficients was selected, appropriate for hotter stars (Bessell, 1979). (The logarithmic LD=2 coefficients were tried but gave identical results.) Radiative envelopes were chosen for both stars, again appropriate for hotter stars (convective envelopes were tried but gave much poorer results.) The parameters are listed in Table 4.

Mode 3 (for overcontact binaries) was chosen, based on the general appearance of the light curves.

Because of the asymmetry of the light curves (unequal maxima and distorted light curve from about phase 0.25 to 0.50), noted by other authors, it was necessary to add a bright spot (a plage) on the more massive star (star 2). After a number of adjustments, the computed curved fit the observed values very closely indeed. The fit for the same spot put on star 1 was poorer, and a dark spot anywhere on the system did not give any kind of fit at all. It was also necessary to add third light; the values of l_3 are well above the 3 sigma values – see Table 4.

Convergence by the method of multiple subsets was reached in a large number of iterations (owing to the many parameters to adjust – 17). It was noted that identical values (to 3 figures) for the mass ratio were obtained from the photometric only WD solution, RV curve-fitting (alone), and the combined solution. This agreement reinforces the validity of the solution.

A plot of the VR_CI_C light curves and WD fit are shown in Figure 2; the RVs are shown in Figure 3 (the rms deviation from the fitted curve was 3.7 km/s). A three dimensional representation from Binary Maker 3 (Bradstreet, 1993) is shown in Figure 4.

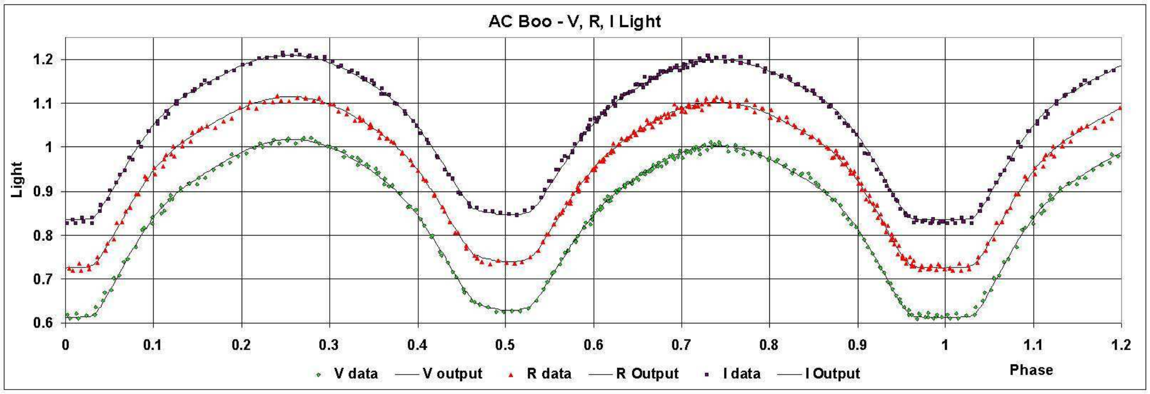

Figure 2. AC Boo: V, R, I Light Curves – Data and WD Fit

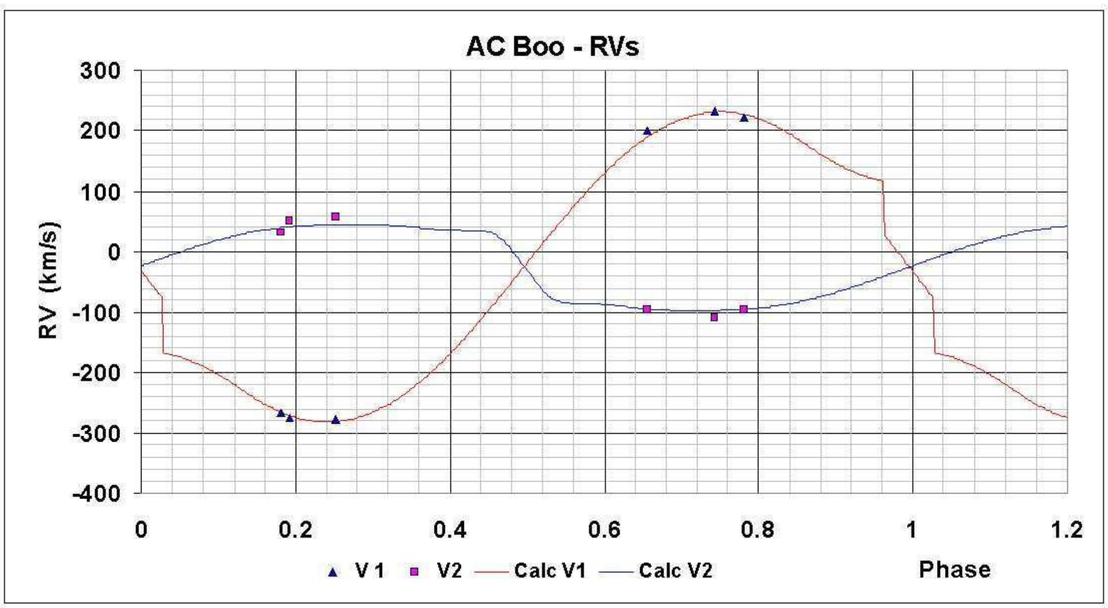

Figure 3. AC Boo: Radial Velocity Curves – Data and WD Fit.

Table 5.

Quantity.	Value	Error	Quantity	Value	Error
T_1 (K)	6250	—	a (solar radii)	2.43	0.04
T_2 (K)	6241	6	V_γ (km/s)	−25.8	0.1
$\Omega_1 = \Omega_2$	7.034	0.004	Spot Co-latitude	75	40
$q = M_2/M_1$	3.340	0.004	Spot Longitude	31	4
i (deg)	86.3	0.5	Spot Radius	40	2
$L_1/(L_1 + L_2)(V)$	0.251	0.0006	Spot Temp. Factor	1.019	.007
$L_1/(L_1 + L_2)(R)$	0.250	0.0005	R_1 (pole)	0.263	0.001
$L_1/(L_1 + L_2)(I)$	0.250	0.0004	R_1 (side)	0.274	0.001
$l_3/(L_1 + L_2)(V)$	0.0013	0.0001	R_1 (back)	0.308	0.001
$l_3/(L_1 + L_2)(R)$	0.0012	0.0001	R_2 (pole)	0.458	0.001
$l_3/(L_1 + L_2)(I)$	0.0009	0.0001	R_2 (side)	0.493	0.001
$\Sigma\omega^2_{\rm res}$	0.00665	—	R_2 (back)	0.518	0.001

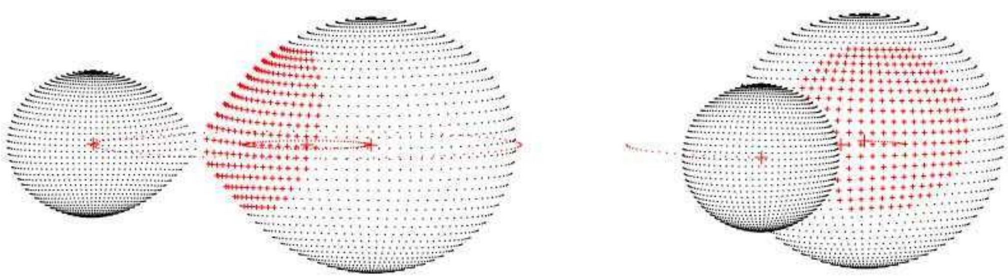

Figure 4. Binary Maker 3 representation of the system – at phases 0.24 and 0.44.

Final WD output parameters are listed in Table 5 with formal errors; the real error of the temperatures are around $\pm 250K$ as noted above.

The WD output fundamental parameters are listed in Table 6 along with those from the properties of zero age main sequence stars (ZAMS; Cox, 2000). The more massive star's mass and radius correspond closely to the tabular values (confirming its spectral type and its unevolved status), but it's overluminous by 3%. This may be due to the hot spot, or just to random error. In estimating the distance, galactic extinction was ignored, owing to the high galactic latitude (58°).

In an effort to understand the period behaviour of this system, the author scanned the data of Binnendijk (1965) [early data only – later data required a spot] and Schieven (1983), and ran the same WD package, starting at the above solution set of parameters. The results were (somewhat gratifyingly) almost identical with the above. The system in 1965 and 1983 was overcontact then as well. However, that does nothing to explain why the period could be constant for so long, suffer some kind of jump around cycle 0 (1982) and then display a constant rate of increase after that.

The calculation of the mass transfer rate for the curved part of the $O - C$ curve (i.e. after cycle 0) proceeded as follows:

It is not difficult to show that, under the assumptions of mass and angular momentum conservation of the system as a whole, and using basic physics:

Table 6.

Fundamental Quantity	Star 1 Tabular	Star 1 WD	Star 1 error	Star 2 Tabular	Star 2 WD	Star 2 Error
Sp. Type	F8 V	—	—	F8 V	—	—
Mass ($M_\odot$)	—	0.36	0.03	1.18	1.20	0.05
Radius ($R_\odot$)	—	0.69	0.01	1.18	1.19	0.01
M_{bol}	—	5.26	0.17	3.84	4.07	0.17
Log g (cgs)	—	4.32	0.004	4.388	4.36	0.004
Luminosity ($L_\odot$)	—	0.65	0.09	1.89	1.94	0.28
Distance (pc)	—	182	13	—	—	—

$$(M_1 M_2)^3 P = \text{constant} \tag{4}$$

where M_1 and M_2 = masses (any units), and P= period. Taking the natural logarithm of both sides of the equation and differentiating by time, and using the fact that $\mathrm{d}M_2 = -\mathrm{d}M_1$, one gets:

$$\frac{\mathrm{d}M_1}{\mathrm{d}t} = \frac{1}{3P}\left(\frac{1}{M_2} - \frac{1}{M_1}\right)^{-1} \frac{\mathrm{d}P}{\mathrm{d}t} \tag{5}$$

Substituting the values from Table 5, and using the derived value of $\mathrm{d}P/\mathrm{d}t = +8.16(6) \times 10^{-7}$ days/year (taken from fitting the $O-C$ curve with a parabola), one gets a value of $-3.9(3) \times 10^{-7}$ solar masses/year for the mass transfer rate of the primary (less massive) star (i.e., mass is transferred from the less to the more massive star). This value is consistent with those of a number of other overcontact binaries (Schieven et al., 1983; Pribulla and Vanko, 2002).

In conclusion, AC Bootis is a subtype W overcontact binary comprised of unevolved stars. A full solution for its fundamental parameters has been obtained. It has been shown that it is undergoing mass transfer from the less massive to the more massive star at a rate of 3.9×10^{-7} solar masses per year.

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THE NEW ECLIPSING VARIABLE STAR USNO-A2.0 0825-18396733, A PROBABLE POLAR

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During observation of a field in Aquila, we found a new eclipsing variable star with an extremely short period, $0\overset{d}{.}0840$. Its USNO-A2.0 coordinates are: $\alpha = 20^{h}31^{m}37\overset{s}{.}59$, $\delta = -0^{\circ}05'11\overset{''}{.}2$ (J2000). Our observations were carried out at the Astrotel–Caucasus observatory using an 0.3-m Ritchey–Chretien telescope, equipped with an unfiltered Apogee Alta U9000 CCD camera. A total of 98 images with 5-minute exposures were obtained on JD 2455384–2455397. For basic reductions for dark current, flat fields, bias and for removing cosmic rays hits, we use IRAF routines. For photometry of the new variable star, we applied VaST software by Sokolovsky and Lebedev (2005). The comparison star was USNO-A2.0 0900-18617527 = USNO-B1.0 0904-0528702 ($\alpha = 20^{h}30^{m}53\overset{s}{.}81$, $\delta = +0^{\circ}25'33\overset{''}{.}7$ (J2000, 2MASS); $R_1 = 14\overset{m}{.}24$, $R_2 = 14\overset{m}{.}44$ (USNO-B1.0)). Unfiltered magnitudes were calibrated using the comparison star, assuming $R_{comp} = 14\overset{m}{.}34$. To search for period and derive epochs of minima, we use Peranso software (`www.peranso.com`). During our observing campaign, we detected three primary minima, listed in Table 1.

Table 1. CCD minima of USNO-A2.0 0825-18396733

HJD(TT)	±
2455387.3976	0.0004
2455388.4050	0.0006
2455397.398	0.002

All moments in the Table 1 are expressed in terrestrial time in accordance with IAU recommendations (resolution B1 XXIII IAU GA). The light curve of the star is presented in Fig. 1; Fig. 2 is the finding chart. The light elements are:

$$\mathrm{Min\,HJD(TT)} = 2455387.3976 + 0\overset{d}{.}0840 \times E.$$

Borisov and Shimansky (2010) have kindly made available to us their spectroscopy of the star performed on JD 2455412 with the 6-m telescope. They observed the one-peak Hβ and HeII (4686Å) emission lines approximately of equal intensity, weaker HeI emission lines (4471,4921,5015 Å), and the CNO blend (4640-4650 Å). The general appearance of the spectra is characteristic of polars. Thus, the star is probably a magnetic cataclysmic variable. The spectra of the star are presented in Fig. 3.

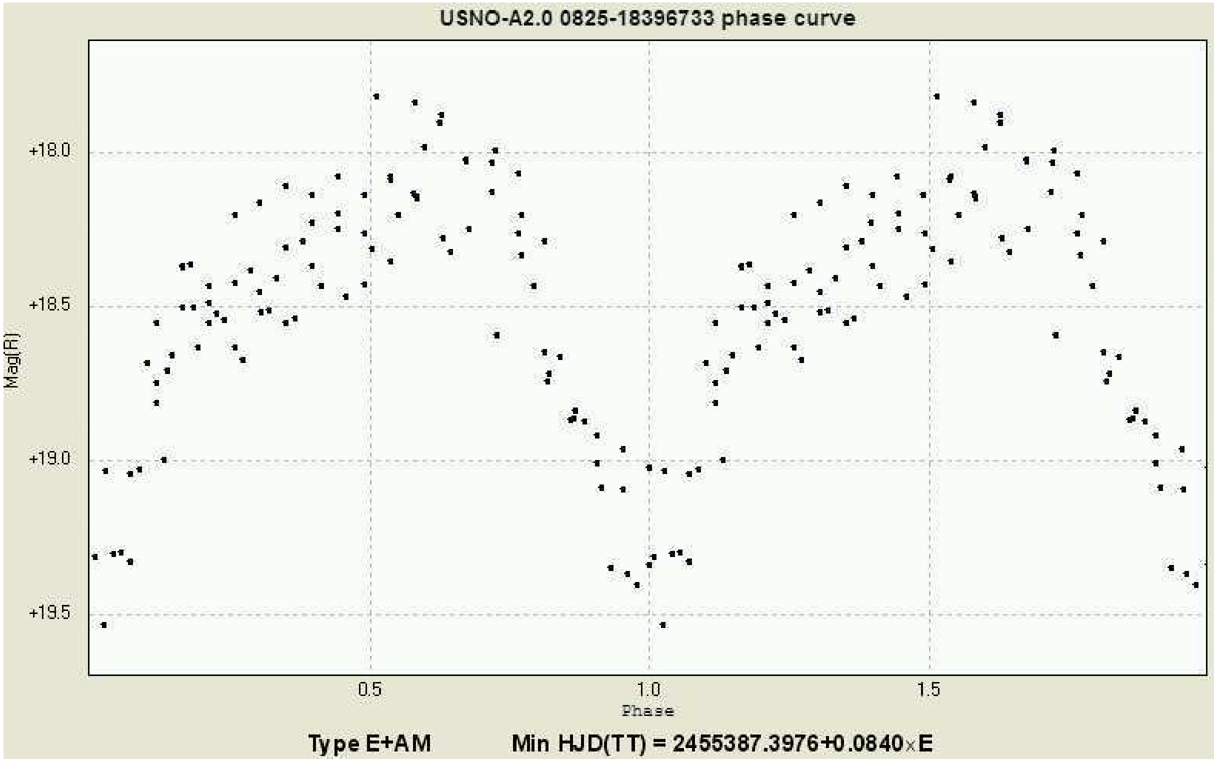

Figure 1.

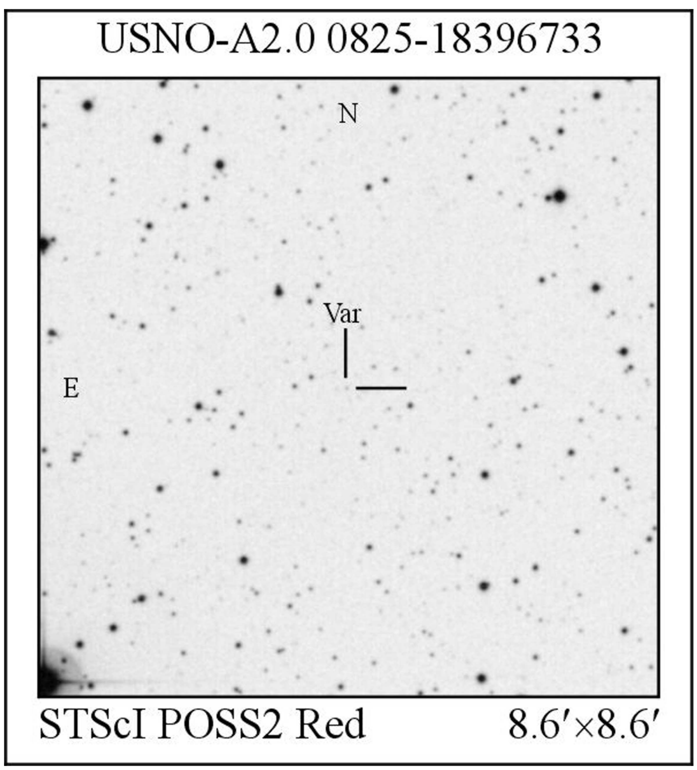

Figure 2.

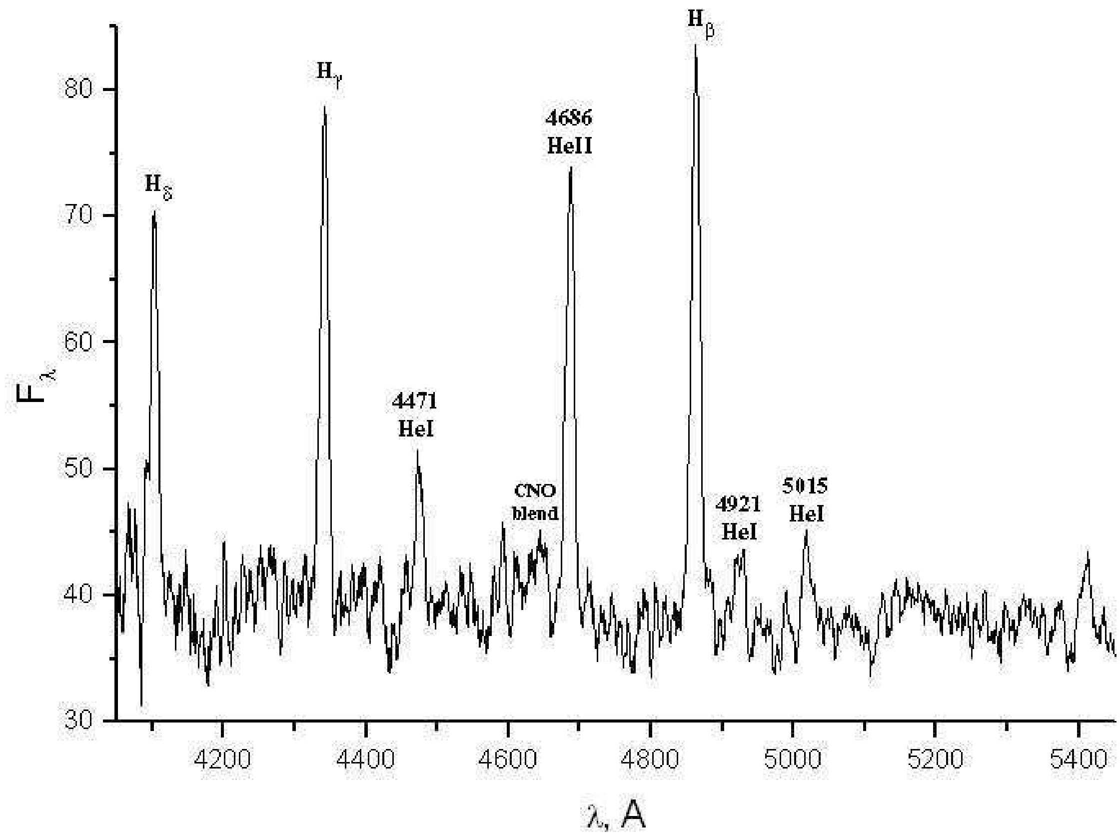

Figure 3.

Acknowledgements We would like to thank V. Chavushyan and S. Zharikov (Observatorio Astronomico Nacional, San Pedro Martir, B.C., Mexico) for heplful discussion, V. Shimansky and N. Borisov (Special Astrophysical Observatory, Russian Academy of Sciences) for obtained spectra and commenting it, and N. Samus (Institute of Astronomy, Russian Academy of Sciences) for assistance in the preparation of this article.

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THE LONG-TERM MULTI-COLOUR VARIATION OF THREE BRIGHT RS CVn TYPE SYSTEMS

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Name of the object:
HR 1099, σ Gem, λ And

Observatory and telescope:
Ege University Observatory, 48-cm Cassegrain telescope and 35-cm Schmidt-Cassegrain telescope

Detector:	SSP-5 photomultiplier, high-speed three-channel photometer

Filter(s):	BVR,U (from 2000)

Date(s) of the observation(s):
1996-2005

Availability of the data:
Available at the IBVS website (`5953-t1.txt` – `5953-t6.txt`)

Type of variability:	RS CVn

Table 1. The information log of the observations. The first three columns list the target, comparison and check stars, while the last four columns in Table show the averages of yearly errors for observations in each filter.

Variable stars	Comparison stars	Check stars	err_U (mag)	err_B (mag)	err_V (mag)	err_R (mag)
HR 1099	10 Tau	11 Tau	0.019	0.017	0.013	0.014
λ And	ψ And	κ And	0.018	0.015	0.012	0.012
σ Gem	HD 60318	HD 60522	0.020	0.018	0.013	0.012

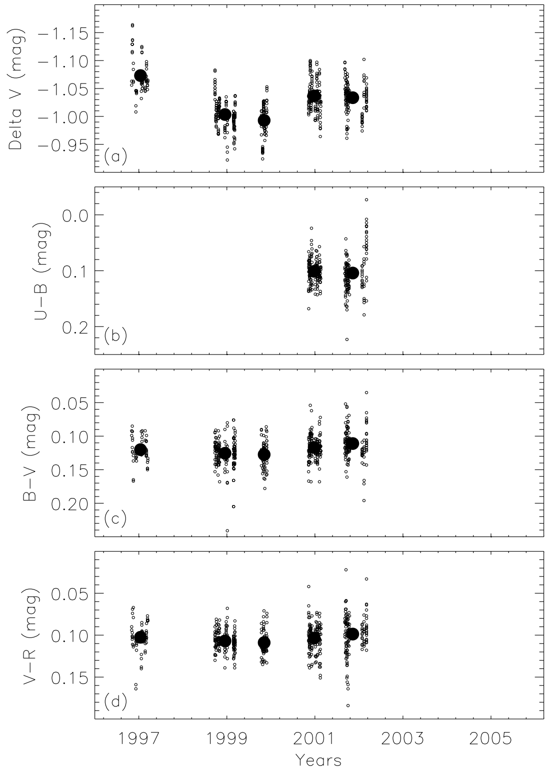

Figure 1. (a) The V brightness variation and (b) the $(U-B)$, (c) $(B-V)$, (d) $(V-R)$ colour variations of the σ Gem between the years 1996 and 2005. The larger filled circles denote the seasonal averages of observations.

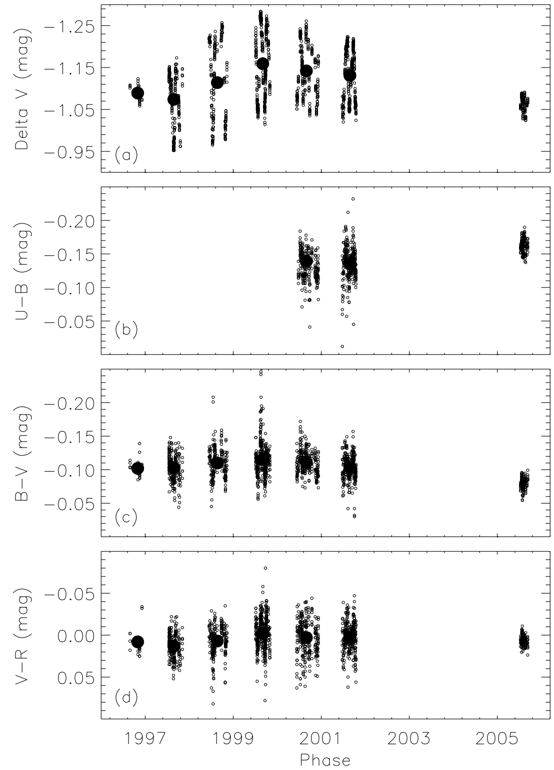

Figure 2. Definitions of the panels in the figure are the same as in Figure 1, but it is for λ And.

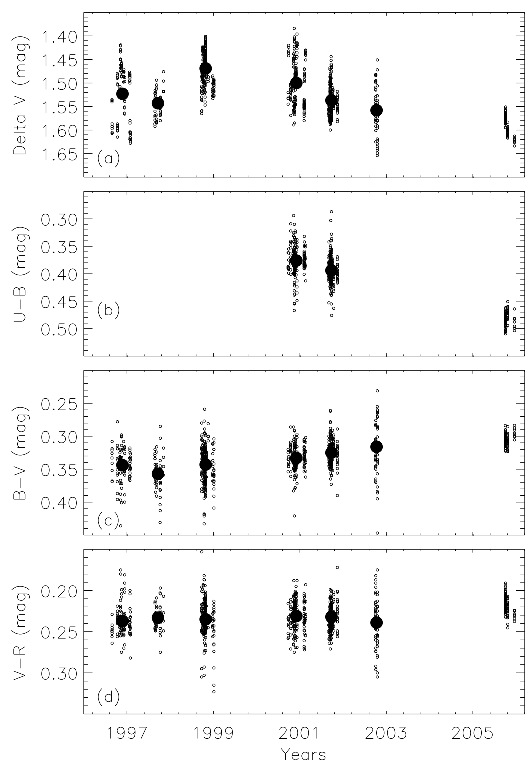

Figure 3. Definitions of the panels in the figure are the same as in Figure 1, but it is for HR 1099.

Remarks:

The short- and long-term light and colour variation of active stars is a very important subject, because they yield valuable information about their evolution in time and the distribution of different temperature structures on the stellar surface. Observations spanning for decades help to find the activity cycles. Since stars with longer periods have generally longer cycles, we think all data are important. Our stars is also difficult to observe because of their brightness, like λ And.

σ Gem. The results of our observations show no evident correlation between the long-term V light and colour variations for σ Gem (see Figure 1).

λ And. For this star also, no color index variations is seen which exceeds the limit (see Figure 2 and the error values in Table 1).

HR 1099 = V711 Tau. HR 1099 was observed with its visual component, which is a K3 V single star located 6 arcseconds away in the sky. Our observations show that when V brightness of the system decreases, than the $U-B$ colour index becomes redder, in accordance with the observations of Messina obtained between 1997-2005 (2008, Fig. 3. upper panel) which shows continuous decrease (reddening) during this time interval. In the same time our $B-V$ colour indices show marginal or no variations, while that of Messina's values are also constant except the last two years when the star seem to be slightly bluer. Our data in 2005 show a slight reddening, but this change is within 3σ of the measurements. The $V-R$ colour does not show a clear variation.

Acknowledgements:

The authors would like to thank the staff of the Ege University Observatory for their contributions and supports, and Dr. K. Oláh for valuable advices and comments.

Reference:

Messina, S., 2008, *A&A*, **480**, 495

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SPECTROSCOPY OF ECLIPSING BINARY DY LYNCIS THIRD COMPONENT DETECTED

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The following paper[1] presents the results of spectroscopic observations of DY Lyncis (HD 65498). The object is listed in SIMBAD database as an eclipsing binary of Algol type with V magnitude of $9.^{m}67$, color index $(B-V) = 0.^{m}56$ and with equatorial coordinates $\mathrm{RA} = 08^{\mathrm{h}}00^{\mathrm{m}}46^{\mathrm{s}}, Dec = +42°10'33''$. Eclipsing nature of HD 65498 was detected by SAVS (Semi-Automatic Variability Search described by Maciejewski et al., 2003). The light curve is typical of detached binaries and suggests similar components and partial eclipses with amplitude of 0.4 mag. According to Maciejewski et al. (2003) the orbital period of HD 65498 is 31.5 hours and the ephemeris is:

$$\begin{array}{rl} \text{Min. I} = \text{HJD } 2452704.48836 + 1.^{d}31324 \times E. \\ \pm 0.00054 \pm 0.00006 \end{array} \qquad (1)$$

To determine the spectral type of the star spectroscopic observations were made. The obtained spectrum corresponds to F5V star (Maciejewski et al., 2003). There are also seven measurements of the times of minima (Gurol et al., 2007; Brat et al., 2008; Brat et al., 2009)

Our spectroscopic observations were made during 13 nights (between March 21 and April 13 in 2009). All data were collected at Borowiec station of the Poznań University Observatory. HD 65948 was observed spectroscopically with PST (Poznań Spectroscopic Telescope; Baranowski et al., 2009) equipped with 0.5m mirror and fiber-fed echelle spectrograph. The exposure time was 1800s and the spectra cover range from 4500 to 8250 Å. The thorium argon lamp provides calibration of the spectra with sigma RV of 100m/s. The spectrograph box is thermally stabilized on the level of 0.5 deg. Data reduction was performed with IRAF echelle package based script. For the RV measurement we have used IRAF FXCOR task. Cross correlation functions reveal three peaks (Figure 4). Two of them (low and broad) are connected with the eclipsing pair and the central one - with

[1]Based on PST spectroscopic and SAVS photometric data.
`http://www.astro.amu.edu.pl/PST/`
`http://www.astri.uni.torun.pl/~gm/SAVS`
Correspondence to: `dimitrov@amu.edu.pl`

the detected third component (the peak is high and narrow). Due to faster rotation (tidal effects) and possible higher $\sin i$ value, the eclipsing stars have wider peaks. The shape of the H_α (Figure 3) and H_β profile is also triple.

The light curve and radial velocities enable us to obtain Wilson-Devinney model of the system (Wilson & Devinney, 1971). We treat the third body as a third light. The third component can be dynamically connected with the eclipsing pair or be just in the same line of sight. Radial velocities of the third component are decreasing with time. This phenomenon can be explained by the mutual orbital motion. The time span of our spectra is about twenty days, they can be affected by the light-time effect.

Our spectroscopic data is shifted with respect to the ephemeris. In order to make a simultaneous solution we calculated a new ephemeris based on both photometric and spectroscopic observations:

$$\begin{array}{c} \text{Min. I} = \text{HJD } 2452704.489 + 1^{\mathrm{d}}\!.313187 \times E. \\ \pm 0.001 \quad \pm 0.000003 \end{array} \qquad (2)$$

Time span between spectroscopic and photometric data is about 6 years and the ephemeris has been probably affected by the light-time effect.

The eclipsing pair consists of two similar components with masses $1.02 M_\odot, 1.05 M_\odot$ and radii $1.28 R_\odot, 1.26 R_\odot$, respectively (Table 2). The components are slightly evolved. We have no direct information on the color index of the eclipsing pair. The temperature of the first component was obtained from evolutionary tracks, which were computed for the derived masses and radii. The temperature of the second component was fitted during the modelling. We found the third light to be 0.364 ± 0.016 (normalization $l_1 + l_2 + l_3 = 1$). The color index of the system ($B - V = 0.47 \pm 0.05$, Tycho) suggests that the third component is hotter than the eclipsing pair. The temperature must be higher than 6500 K due to the mixing of light of the three components (the eclipsing pair is cooler). We think that the mass of the third body must be higher than one solar mass. Further spectroscopic and photometric observations will enable us to measure the mutual orbit and the light-time effect, respectively.

The mass and radii of the eclipsing pair suggest that the system is quite old. Luminosities of the three stars are comparable but the temperature of the third component is significantly higher and inconsistent with stellar evolution theory. The existence of additional white dwarf component is a possible explanation of high $B - V$ index. The white dwarf is a source of a blue continuum light but it is not adding its lines to the triple lined spectrum of the object.

Table 1. Absolute radial velocity measurements from PST (template: *o* Aquilae).

HJD (+2454900)	RV1 (km/s)	RV2 (km/s)	RV3 (km/s)
12.319274	−103.9	145.7	58.0
12.474967	−54.6	91.6	58.3
12.504987	−37.2	95.7	59.3
16.330385	−81.7	121.4	56.6
16.356517	−70.6	111.0	57.2
16.383448	−61.0	120.0	58.4
24.527291	91.8	−14.4	55.4
24.569706	93.1	−45.8	55.6
25.413819	−110.1	155.3	55.6
25.440946	−114.6	157.3	55.5
35.327167	133.0	−100.7	52.3
35.353276	128.1	−93.4	51.9
35.379281	117.5	−79.4	52.5

Table 2. Preliminary solution for the eclipsing pair and formal errors outputted by the WD code.

parameter	component 1	component 2
i	$89\overset{\circ}{.}2 \pm 1\overset{\circ}{.}5$	
q	1.03 ± 0.13	
$a(R_\odot)$	6.42 ± 0.09	
$V_\gamma\ (km/s)$	23.2 ± 1.4	
Ω	6.07 ± 0.22	6.27 ± 0.62
l_V	0.330 ± 0.016	0.306 ± 0.016
$T(K)$	5400(fixed)	5340 ± 10
$M(M_\odot)$	1.017 ± 0.050	1.048 ± 0.050
$R(R_\odot)$	1.280 ± 0.054	1.260 ± 0.123

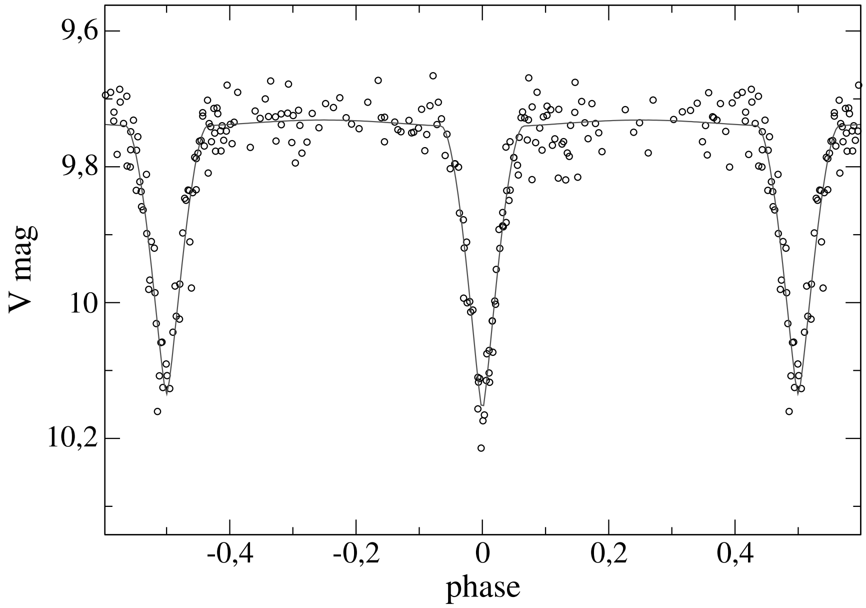

Figure 1. Light curve of HD 65498 from SAVS compared with the synthetic curve based on the derived model.

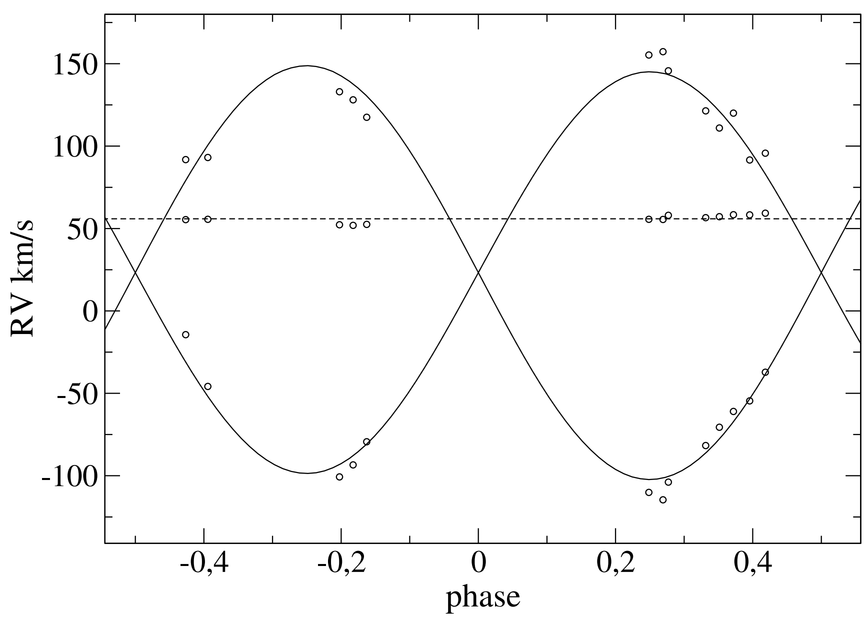

Figure 2. Absolute radial velocity curve for the three components of HD 65498. The solid line presents RV measurements for the eclipsing pair and the dashed line corresponds to the third component.

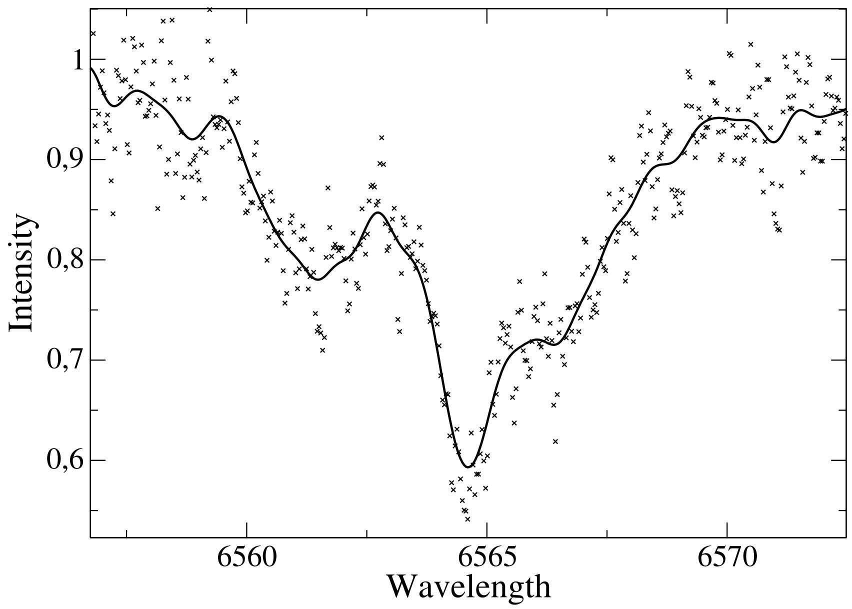

Figure 3. The H_α line profile (smoothed) is triple, we can see two shallow lines caused by the eclipsing pair and deep central line by the third component (x signs present the original not smoothed spectrum).

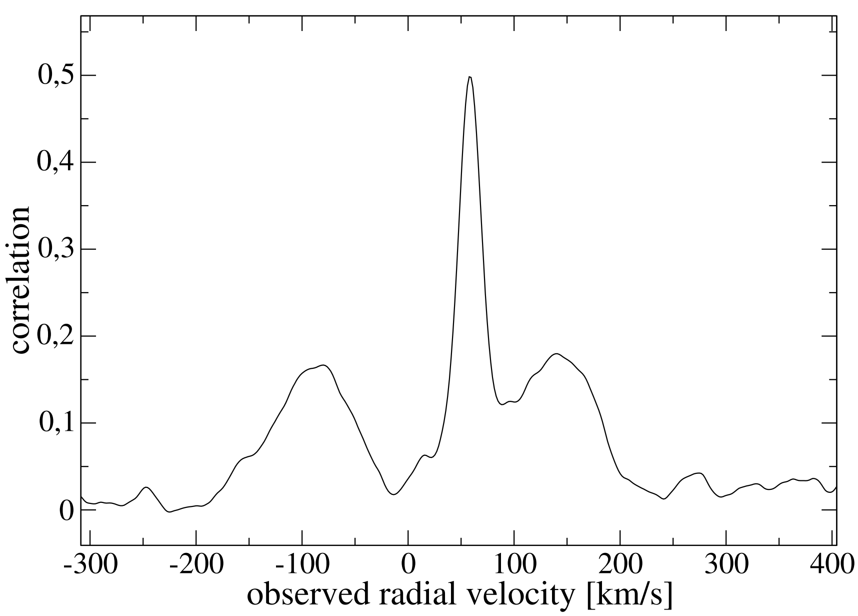

Figure 4. The cross correlation function for the same spectrum as in figure 3. We have the low and broad peaks of the eclipsing pair and the high and thin peak of the third component.

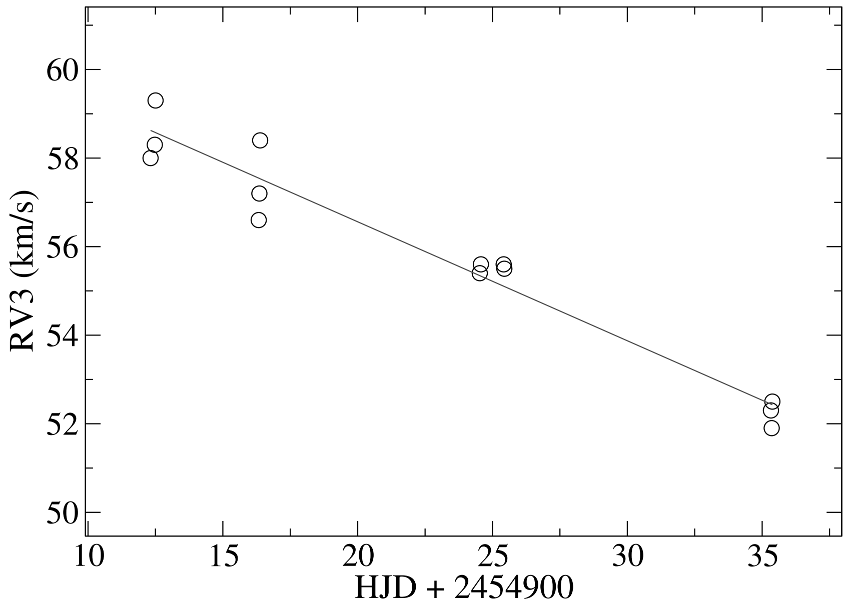

Figure 5. Radial velocity of the third component is decreasing with time (mutual orbit motion).

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NEW DOUBLE-MODE AND OTHER RR LYRAE STARS FROM WASP DATA

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The data from the first public data release of the exoplanet transit survey WASP (Wide Angle Search for Planets; Butters et al., 2010) were studied for a number of known and suspected RR Lyrae stars (types RR, RRab and RRc), and for a number of Horizontal Branch stars (Beers et al., 1988, 1996; Christlieb et al., 2005), in order to find previously unrecognized double-mode RR Lyrae (RRd) stars. In the analysis only TAMUZ (Collier Cameron et al., 2006) corrected data were used for which the uncertainty on the magnitude was less than 0.1. The period analysis was done using Period04 (Lenz & Breger, 2005).

Seven previously unidentified RRd stars were found in this way: four among previously known RR Lyrae stars, and three more among the Horizontal Branch stars. Details of these seven stars are all listed in Table 1. After the name the WASP identification is given, followed by the full magnitude range (unfiltered WASP magnitude) and the periods of the fundamental and first overtone modes. The last column contains a sequence number used in Tables 2 and 3. These tables contain respectively the amplitudes and phases of the detected frequencies. Uncertainties are given between parentheses in units of the last decimal. These were calculated using the Monte Carlo simulations provided by Period04. As is usual for RRd stars, the first overtone mode has a larger amplitude than the fundamental mode, except in the case of HE 0414-2958 = BPS CS 22182-17, in which both frequencies have similar amplitudes. As an illustration, phased light curves of V797 Her are provided in Fig. 1. Note also that BPS BS 16478-18 = BPS BS 16553-34 has a double identifier in Beers et al. (1996).

Among the 3670 Horizontal Branch stars from Beers et al. (1988, 1996) and Christlieb et al. (2005) for which there were enough WASP observations, 108 RRab, 77 RRc and 5 RRd stars were identified. Not all of these RR Lyrae stars are however new discoveries. Besides the three RRd stars from those catalogues mentioned in Table 1, also the RRd stars BS Com = BPS BS 15626-36 (Dékány, 2007) and GSC 7509-299 = BPS CS 22888-11 (Bernhard & Wils, 2006) were recovered. The relatively high number of RRc stars compared to the number of RRab stars may be a selection effect, as the objective prism and interference filter technique with which these stars were identified may favour the hotter RRc stars. For comparison, the Large Magellanic Cloud contains 17693 RRab, 4958 RRc and 986 RRd stars (Soszyński et al., 2009), while the Small Magellanic Cloud contains 1933 RRab, 175 RRc and 258 RRd stars (Soszyński et al., 2010).

Table 1: New double-mode RR Lyrae stars identified in WASP data.

Star	1SWASP	Range	P_0	P_1	N
UV Phe	J011210.74 − 411326.1	14.3-14.8	0.534254(5)	0.398668(1)	1
HE 0414-2958	J041649.58 − 295129.1	14.4-15.0	0.477467(6)	0.354824(4)	2
BPS BS 16478-18	J105743.63 + 384648.3	13.6-14.4	0.494909(14)	0.368498(5)	3
BPS BS 16466-19	J124322.85 + 345717.0	13.9-14.6	0.486651(2)	0.362228(1)	4
V633 Cen	J141302.53 − 434817.7	13.2-13.8	0.480517(3)	0.357379(1)	5
V797 Her	J171608.40 + 481752.7	14.2-14.9	0.532299(5)	0.397058(1)	6
NSV 12753	J200447.74 − 371503.4	14.7-15.1	0.474658(11)	0.353082(4)	7

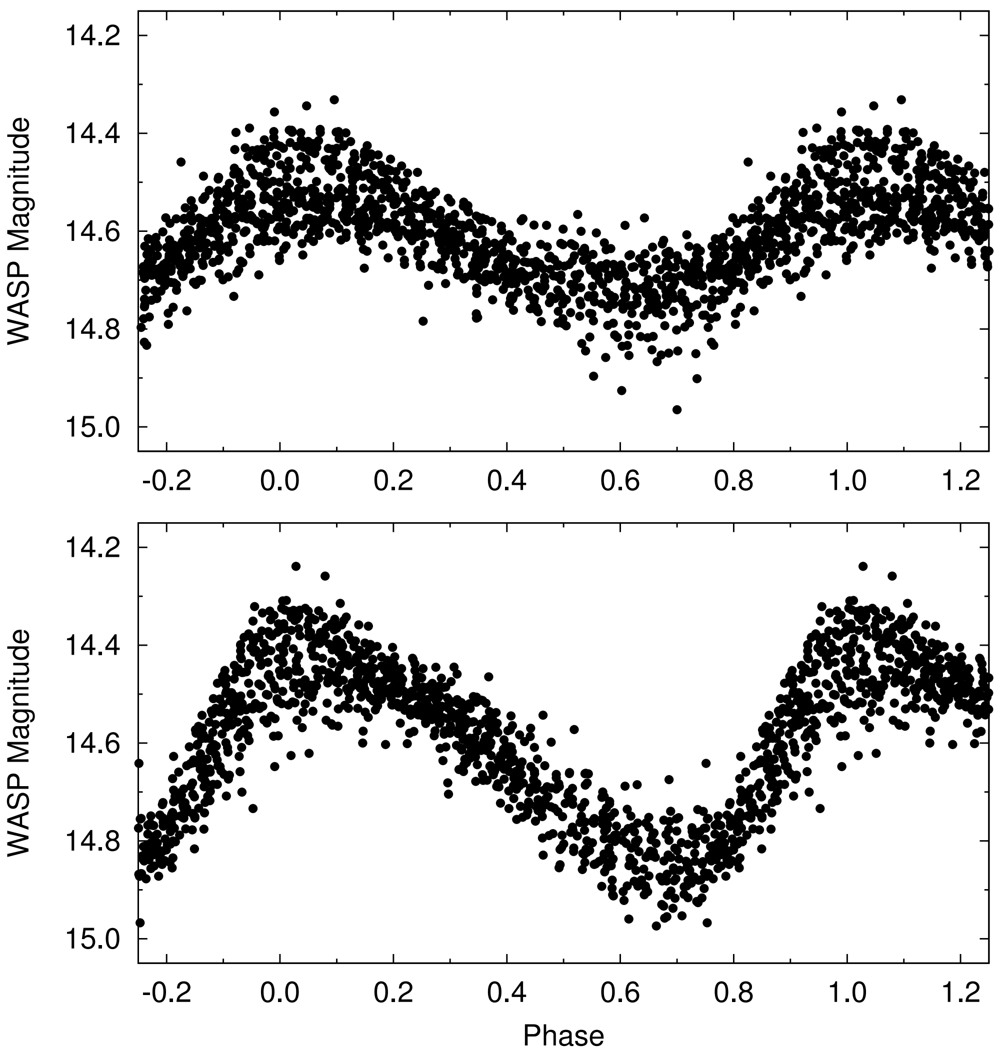

Figure 1. Light curve of V797 Her. Top: phased with the fundamental period and prewhitened with the first overtone mode and its harmonics. Bottom: as above, but now phased with the first overtone period and prewhitened with the fundamental mode and its harmonics. Each point is the average of 10 consecutive WASP observations.

Table 2: Semi-amplitudes of the frequencies detected in the WASP data of the new RRd stars. The number above each column refers to the stars in Table 1.

Freq.	1	2	3	4	5	6	7
f_0	0.074(2)	0.164(5)	0.164(3)	0.132(5)	0.118(2)	0.103(2)	0.053(4)
f_1	0.140(2)	0.158(5)	0.209(3)	0.188(4)	0.156(2)	0.200(2)	0.088(4)
$f_0 + f_1$	0.032(2)	0.071(4)	0.061(3)	0.057(4)	0.045(2)	0.041(2)	0.022(4)
$f_1 - f_0$	0.028(2)	0.048(5)	0.046(3)	0.041(5)	0.030(2)	0.035(2)	–
$2f_0$	0.010(2)	0.047(5)	0.027(3)	0.026(4)	0.023(2)	0.016(2)	–
$2f_1$	0.027(2)	0.034(4)	0.044(3)	0.028(5)	0.025(2)	0.044(2)	0.013(3)
$3f_1$	0.009(2)	–	–	–	0.009(2)	0.014(2)	–
$f_0 + 2f_1$	0.015(2)	0.025(5)	0.028(3)	–	0.018(2)	0.015(2)	–
$2f_0 + f_1$	–	0.025(5)	0.016(3)	0.020(4)	0.010(2)	–	–
$2f_0 + 2f_1$	–	–	0.018(3)	–	0.010(2)	–	–
$3f_0 + f_1$	–	–	–	–	0.006(2)	–	–

Table 3: Phases of the detected frequencies of the new RRd stars. These are given following the convention used by Period04 and with T_0= HJD 2450000.

Freq.	1	2	3	4	5	6	7
f_0	0.077(4)	0.944(4)	0.032(3)	0.358(5)	0.393(3)	0.059(4)	0.916(9)
f_1	0.111(2)	0.678(4)	0.030(2)	0.346(4)	0.836(2)	0.767(2)	0.181(6)
$f_0 + f_1$	0.570(8)	0.002(12)	0.443(8)	0.106(12)	0.615(6)	0.229(9)	0.464(27)
$f_1 - f_0$	0.890(9)	0.624(17)	0.864(9)	0.896(16)	0.322(10)	0.558(10)	–
$2f_0$	0.491(28)	0.242(16)	0.443(16)	0.114(26)	0.156(13)	0.539(21)	–
$2f_1$	0.737(11)	0.869(22)	0.577(10)	0.265(22)	0.222(10)	0.076(7)	0.760(38)
$3f_1$	0.297(32)	–	–	–	0.519(27)	0.331(23)	–
$f_0 + 2f_1$	0.126(19)	0.139(32)	0.913(15)	–	0.910(17)	0.477(22)	–
$2f_0 + f_1$	–	0.360(28)	0.904(27)	0.929(33)	0.393(27)	–	–
$2f_0 + 2f_1$	–	–	0.440(22)	–	0.772(31)	–	–
$3f_0 + f_1$	–	–	–	–	0.379(48)	–	–

For completeness, the other RR Lyrae stars found among the Horizontal Branch stars that were not included in the AAVSO Variable Star Index at the time of writing, are listed in Tables 4 (42 RRab) and 5 (46 RRc). When stars appear in two of the Horizontal Branch star lists, the designation of Christlieb et al. (2005) is given in the tables. Due to the fairly low resolution of the WASP instruments, in some cases the magnitude range and the WASP coordinates may be affected by nearby stars.

A Petersen diagram of all known Galactic RRd stars is plotted in Fig. 2. Apart from the stars from Table 1 and those listed in the references cited by Dékány (2009), the RRd stars given by Wu et al. (2005), Gruberbauer et al. (2007), Pilecki & Szczygieł (2007), Szczygieł & Fabrycky (2007), McClusky (2008), Sokolovsky et al. (2009) and Khruslov (2010) are included, 75 in total. In addition the brightest RRd stars with respectively $I < 18.0$ and $I < 18.5$ in the LMC and SMC catalogues (Soszyński et al., 2009 and 2010) were considered to be Galactic foreground objects. This gives 14 additional stars (7 from each of the LMC and SMC lists).

Table 4: New RR Lyrae stars pulsating in the fundamental mode (RRab) identified in WASP data among Field Horizontal Branch Stars (Beers et al., 1988, 1996, Christlieb et al., 2005). The epoch of maximum is given as HJD - 2450000. The letter B at the end of the line denotes stars that show the Blazhko effect.

Star	1SWASP	Range	Period	Epoch	
BPS CS 22876-029	J000157.75 − 364042.4	13.5-14.0	0.63752	4001.56	B
HE 0001-4300	J000400.87 − 424356.7	14.3-14.8	0.51895	3880.61	
HE 0007-3416	J000944.08 − 335920.1	13.9-15.0	0.60493	4270.57	
HE 0147-3030	J014926.72 − 301600.0	14.0-15.2	0.57693	3981.48	
HE 0155-2108	J015744.41 − 205346.5	14.7-15.0	0.35943	4379.60	
HE 0200-4322	J020236.92 − 430755.8	14.6-15.0	0.67014	3999.57	
HE 0210-3735	J021237.64 − 372112.7	13.6-13.8	0.50770	4050.38	
HE 0314-2836	J031616.36 − 282534.8	14.2-14.5	0.59432	4090.31	
HE 0332-2129	J033419.05 − 211959.8	14.4-15.2	0.54191	4353.56	B
HE 0333-4650	J033452.98 − 464023.5	13.9-14.8	0.48951	4484.32	B
HE 0441-3136	J044255.90 − 313118.3	14.8-16.3	0.34337	4412.44	
HE 0443-2513	J044505.91 − 250823.0	15.0-15.3	0.32996	4110.35	
HE 0504-3113	J050606.02 − 310953.5	14.2-14.7	0.56835	4136.41	
HE 0510-4101	J051207.76 − 405759.8	14.5-15.1	0.68467	4029.44	
HE 0549-3927	J055104.65 − 392620.9	14.8-15.4	0.56970	4522.28	
HE 1015-2201	J101812.69 − 221619.7	14.2-15.0	0.56692	4522.48	
HE 1104-3222	J110703.96 − 323902.0	14.0-14.4	0.56947	3862.05	
BPS BS 16545-047	J111329.97 + 353434.7	13.1-13.3	0.45695	4140.71	
HE 1111-2927	J111352.38 − 294334.3	14.8-14.9	0.47236	4155.51	
HE 1112-1950	J111451.40 − 200704.1	15.0-15.4	0.30855	4564.38	
HE 1157-2813	J115953.34 − 282929.3	13.6-13.9	0.52957	3898.24	
HE 1157-2519	J115958.37 − 253547.3	14.5-14.7	0.51239	3890.22	
HE 1233-2316	J123636.50 − 233238.7	14.9-15.4	0.60441	4586.24	
HE 1239-2151	J124201.81 − 220748.5	12.4-12.5	0.55074	4495.54	
HE 1338-2727	J134100.84 − 274233.2	14.2-15.1	0.62896	4562.38	
HE 1351-2348	J135421.23 − 240323.4	14.0-14.8	0.46064	4588.43	
HE 1354-2320	J135702.57 − 233448.1	14.6-15.1	0.60405	4562.50	
HE 1358-2125	J140049.44 − 214009.5	13.9-15.1	0.47163	4572.53	
BPS BS 16554-067	J140655.96 + 205658.6	13.6-13.7	0.33906	4261.54	
BPS CS 22936-279	J190129.86 − 354511.2	13.8-14.2	0.64767	4250.67	
BPS CS 22885-084	J202501.21 − 422417.9	14.4-14.6	0.49462	4387.26	
BPS CS 22955-119	J203041.85 − 235720.2	14.1-14.7	0.60865	3960.46	B
BPS CS 22955-139	J203637.65 − 240537.0	13.7-15.1	0.46782	4301.35	
BPS CS 22880-004	J203911.98 − 212449.7	13.6-14.4	0.61036	3891.58	
BPS CS 29501-046	J211204.06 − 370008.1	14.0-14.8	0.54534	4271.70	
BPS CS 22948-023	J213530.97 − 390630.5	14.5-15.0	0.57652	4300.53	B
BPS CS 22948-084	J214600.39 − 401553.4	14.0-15.0	0.66984	4300.39	
HE 2150-3053	J215320.37 − 303914.1	14.1-14.7	0.64148	3960.32	
HE 2217-3717	J222042.00 − 370204.2	15.1-15.2	0.55321	3999.29	
HE 2317-4517	J231959.89 − 450045.8	14.1-14.3	0.62527	3954.56	
HE 2325-4624	J232746.99 − 460800.7	14.4-15.0	0.29106	3909.61	B
BPS CS 22876-023	J235742.03 − 340111.2	14.4-15.2	0.27802	3953.60	

Table 5: New RR Lyrae stars pulsating in the first overtone mode (RRc). For details, see Table 4.

Star	1SWASP	Range	Period	Epoch	
BPS CS 29509-039	J005441.47 − 281354.6	14.0-14.2	0.27286	4083.31	
HE 0055-3951	J005749.63 − 393531.4	14.0-14.4	0.36111	4041.51	
HE 0145-2946	J014754.61 − 293131.2	14.5-14.9	0.34140	4000.45	
HE 0222-2507	J022440.34 − 245403.6	14.7-15.1	0.29095	3996.58	
HE 0250-3150	J025212.05 − 313827.5	14.8-15.2	0.29625	4007.53	
HE 0311-2333	J031347.95 − 232239.6	14.4-14.8	0.33963	4353.55	
HE 0351-3512	J035256.91 − 350327.9	14.7-15.2	0.30276	4421.28	
HE 0428-3926	J042952.36 − 392004.6	13.7-13.8	0.27715	4488.35	
HE 0442-3801	J044357.89 − 375609.2	14.2-14.5	0.27606	4444.55	
HE 0505-3833b	J050712.81 − 382956.0	14.0-14.2	0.27391	4454.30	
BPS BS 16473-027	J084337.67 + 465824.3	14.6-14.9	0.28122	4501.39	
BPS BS 16468-023	J090600.07 + 392758.6	14.0-14.4	0.35638	4092.66	
BPS BS 16468-121	J092321.37 + 383836.6	14.6-15.0	0.29065	4157.65	
BPS BS 16927-028	J093240.67 + 422108.4	12.2-12.6	0.25399	4533.39	
HE 1046-2228	J104833.88 − 224414.8	14.5-14.9	0.33384	4110.55	B
BPS BS 16478-017	J105520.01 + 383039.0	14.3-14.8	0.27416	4203.42	
BPS BS 16545-066	J112042.66 + 344712.6	12.7-13.0	0.33970	4168.41	
HE 1122-2844	J112439.10 − 290048.2	13.9-14.2	0.37957	4572.13	
BPS BS 16077-009	J113525.85 + 304318.1	13.3-13.7	0.31215	4167.42	
HE 1222-2649	J122535.83 − 270549.7	14.3-14.8	0.33595	4572.50	
HE 1228-2341	J123046.18 − 235743.6	14.7-14.9	0.30872	4558.58	
BPS BS 16032-029	J124643.41 + 282809.8	14.1-14.6	0.35752	4216.63	
HE 1302-2257	J130442.80 − 231336.6	13.8-14.2	0.27356	4554.32	
BPS BS 16938-029	J130508.41 + 391533.1	14.5-14.9	0.31621	3153.38	
BPS BS 16076-087	J130753.93 + 221007.1	14.0-14.5	0.40112	4218.38	
BPS BS 15623-004	J141022.29 + 254433.1	14.3-14.6	0.34471	4216.42	
BPS BS 16084-087	J161635.47 + 542258.4	12.0-12.3	0.30627	4626.60	
BPS CS 22936-325	J190329.08 − 332433.8	14.1-14.4	0.31945	3919.59	
BPS CS 22955-036	J202146.61 − 234129.5	14.3-14.5	0.38810	4002.28	
BPS CS 22943-115	J202210.82 − 451849.2	13.4-13.5	0.32715	3897.43	
BPS CS 22885-200	J202301.74 − 415448.5	14.8-15.0	0.31697	4272.51	
BPS CS 22955-094	J203037.02 − 271349.3	14.9-15.1	0.26593	4592.52	
BPS CS 22880-076	J204825.07 − 204635.4	14.5-14.9	0.27237	4361.27	
BPS CS 29501-083	J211730.39 − 351757.9	14.9-15.2	0.36968	4292.43	
HE 2115-4535	J211910.34 − 452233.7	14.5-14.9	0.30140	3999.35	
HE 2126-4428	J213012.04 − 441520.4	13.9-14.5	0.30029	4238.60	
BPS CS 29495-050	J214006.88 − 265319.3	14.3-14.7	0.32103	4296.67	
BPS CS 29495-090	J214935.24 − 233018.7	13.9-14.2	0.26758	3925.49	
BPS CS 22951-097	J215736.58 − 453236.0	13.9-14.2	0.31660	4364.42	
HE 2201-2717	J220442.48 − 270233.3	14.3-14.9	0.29918	3965.34	
HE 2309-3753	J231214.23 − 373719.5	14.6-15.1	0.29260	4273.54	
HE 2316-3757	J231917.06 − 374047.9	13.7-14.1	0.34475	4338.42	
BPS CS 29496-026	J234648.67 − 300028.7	14.5-15.0	0.29756	3943.60	
HE 2344-2511	J234735.06 − 245507.8	14.1-14.4	0.37096	4352.52	
HE 2349-4236	J235223.86 − 422000.8	14.7-15.0	0.26362	3919.53	
HE 2356-4456	J235856.59 − 444014.6	14.4-14.8	0.33155	3953.54	

Three Galactic RRd stars have a higher period ratio than what can be expected from the other stars. The one with the highest ratio, [C2001c] vd05f715 (Cseresnjes, 2001), has noisy data, so that one of the frequencies may well turn out to be spurious. The limited number of data points for [IGF2000] 91 (Wu et al., 2005) may have resulted in inaccurate frequencies as well. The most interesting of the outlier objects is likely OGLE BUL-SC39 V1568 (Mizerski, 2003), as the OGLE II data (Udalski et al., 1997 and Szymański, 2005) for this object show additional frequencies very close to the main ones, an indication of a rapidly changing period. In that case, the period ratio may not be reliable. More observations of this object are highly recommended.

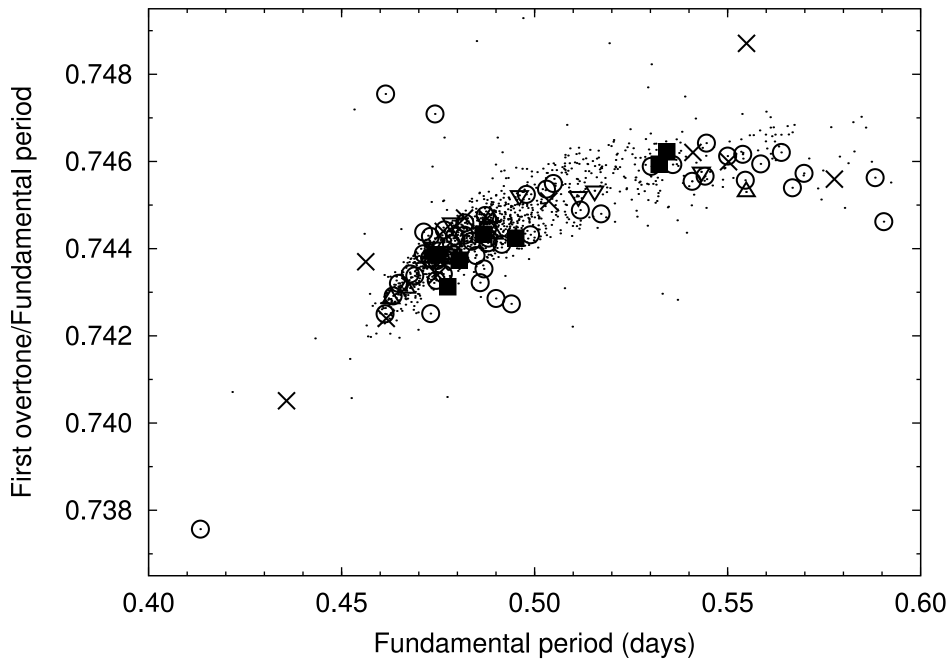

Figure 2. Petersen diagram of 89 Galactic RRd stars. The stars from Table 1 are shown as black squares, foreground stars to the LMC and SMC as up- and downward pointing triangles resp., the Sgr foreground stars (Cseresnjes, 2001) as crosses, and other previously known RRd stars as open circles. For comparison, the RRd stars of the LMC and SMC (Soszyński et al., 2009, 2010) are plotted as small dots.

The distribution of the periods of the Galactic RRd stars in Fig. 2 appears to be bimodal, with the majority of stars having a fundamental period around 0.48 days, a lack of stars with periods around 0.52-0.53 days and a substantial number of stars with periods around 0.55 days. This is clearly evident as well when comparing the cumulative distribution of the Galactic RRd stars with those from the Large and Small Magellanic Clouds (Soszyński et al., 2009, 2010) in Fig. 3. Although there is a small increase of SMC RRd stars with a period near 0.56 days, this increase is less pronounced than in the Galactic case. The LMC does not show this bimodality.

Because many of the Galactic RRd stars have been found in data from surveys that make at most a few observations per night, the apparent lack of RRd stars with a fundamental period near 0.52 days (or a first overtone period near 0.39 days) could be attributed to a selection effect. However it is more likely that variable stars with a period very close to an integer fraction of a day (e.g. 0.50 or 0.33 days) would go undetected. Also the

RRab stars found in data from the Northern Sky Variability Survey (Wils et al., 2006 and Kinemuchi et al., 2006) do not show fewer stars with periods near 0.39 or 0.52 days. But the sample of Galactic RRd stars is certainly not a homogeneous sample as is the case for those found in the Magellanic Clouds, so this will need to be explored further. In addition, the relative number of known RRd stars with respect to RRab or RRc stars is still relatively small in the Galaxy compared to those in the Magellanic Clouds.

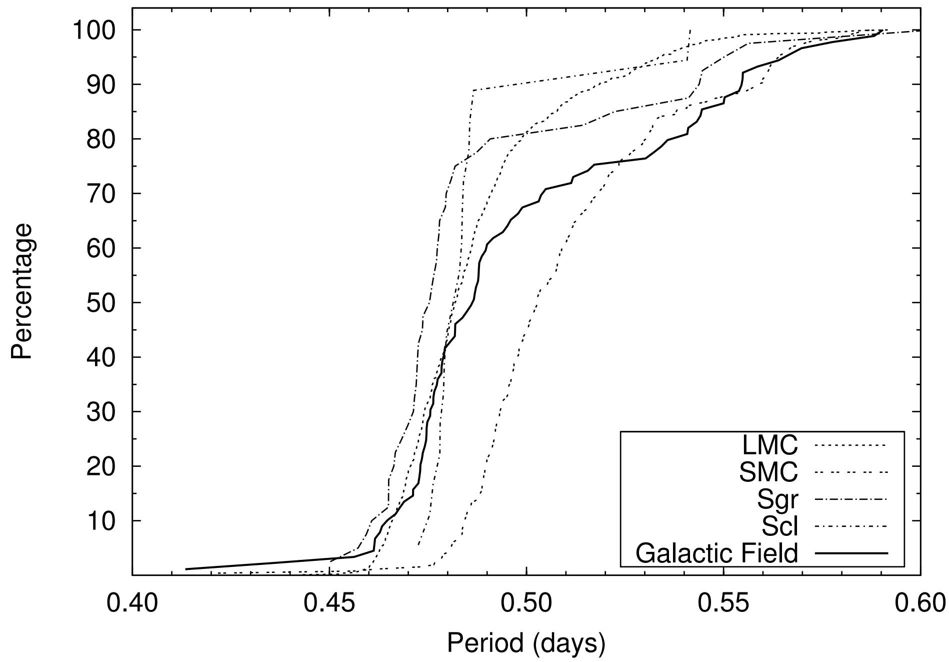

Figure 3. Cumulative distribution of the periods of the fundamental mode of the double-mode RR Lyrae stars in the Magellanic Clouds (Soszyński et al., 2009, 2010), in the Sagittarius (Cseresnjes, 2001) and the Sculptor dwarf galaxies (Kovács, 2001) and in the Galactic Field.

The RRd stars in the Sagittarius dwarf galaxy (Cseresnjes, 2001) show a similar bimodal distribution (Fig. 3). In this case the gap is symmetrically located around a fundamental period of 0.50 days, so that this could really be a selection effect as described above. But again, the distribution of periods of RRab stars in the same field does not show a lack of stars with periods around 0.50 days (Cseresnjes, 2000). Also the double-mode RR Lyrae stars in the Sculptor dwarf galaxy (Kovács, 2001) show a bimodal distribution, but with only 18 objects (including only two stars with a longer period) this sample is too small for definite conclusions.

The globular cluster IC 4449 contains only 13 short period RRd stars, while the 9 in M68 and the 8 in M15 have long periods (Clement et al., 1993). This could be explained in terms of the Oosterhoff dichotomy for those globular clusters (Oosterhoff, 1939), with longer period stars in metal-poor Oosterhoff type II clusters, and shorter period stars in relatively metal-rich Oosterhoff type I clusters. The RRab population in the solar neighbourhood has been described as a mixture of metal-rich (Thick Disc), Oosterhoff I, and Oosterhoff II stars (Kinemuchi et al., 2006). The bimodality in the period distribution of Galactic Field RRd stars may also be a consequence of this.

In Fig. 3 also an obvious shift of about 0.02 days can be seen between the average periods of the RRd stars in the SMC and the other galaxies (the LMC in particular). The difference of the mean RRd period between the LMC and SMC is significant to better than the 99% confidence level. It may be due to the different metallicities of stars in the Magellanic Clouds. Dékány (2009) derived tight relations for the radius and density of double-mode RR Lyrae stars as a function of their fundamental period. Based on the longer period of the SMC stars, these relations indicate a higher mass, and from Dékány's (2009) mass-metallicity graphs also a lower metallicity on average for the SMC, as is generally accepted.

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PHOTOMETRIC STUDY OF A NOVA-LIKE CATACLYSMIC VARIABLE STAR NSV 25181

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Cyg1 ($\alpha = 20^{\rm h}34^{\rm m}14\overset{\rm s}{.}51$, $\delta = +50°48'06\overset{''}{.}2$; J2000.0) is mentioned in the Archival edition of the Catalog and Atlas of Cataclysmic Variables (Downes et al., 2006) as a cataclysmic variable without subtype specification. This information is based on the study by Downes (1986), who found out that spectra of Cyg1 were typical for cataclysmic binaries, the Balmer lines were in emission, their intensity was variable. Downes referred to a private communication by J. Patterson who observed the star flickering. Cyg1 resembles a dwarf nova in minimum light, although an examination of almost 300 plates from Harvard plate collection did not reveal any outburst of the star during the time interval from 1890 to 1962. The orbital period of the system is still unknown. The star was designated as NSV 25181 (Kazarovets et al., 1998).

To investigate the star more carefully, we have started our CCD photometry. NSV 25181 was observed at the 60-cm telescope of the Crimean Laboratory (Sternberg Astronomical Institute) equipped with an Apogee AP-47p CCD camera. Our observations cover eight nights on August 4–20, 2010 (JD 2455413–429). 1112 frames were taken with 120-second exposures in Johnson R filter. The images were debiased, dark-subtracted, flat-fielded and than analyzed in MaxIm DL4 package. USNO-A2.0 1350-12565617 ($\alpha = 20^{\rm h}34^{\rm m}10\overset{\rm s}{.}56$, $\delta = +50°47'27\overset{''}{.}0$; J2000.0; photographic R magnitudes: $15\overset{\rm m}{.}3$ in the USNO-A2.0 and $15\overset{\rm m}{.}03$ and $15\overset{\rm m}{.}17$ in the USNO-B1.0 catalog) was used for comparison. The accuracy of photometry is between $0\overset{\rm m}{.}01$ and $0\overset{\rm m}{.}07$ depending on weather conditions. The summary light curve is given in Fig. 1. The full amplitude of light variation is $0\overset{\rm m}{.}34$.

On the basis of our analysis, we consider NSV 25181 as a nova-like cataclysmic variable. Three kinds of variations were detected. Firstly, brightness slowly changes from night to night. Nightly average brightness varies within $0\overset{\rm m}{.}115$ for our interval of observations. Secondly, strong flickering takes place on time scale of minutes. Several individual night light curves are shown in Fig. 2. On some nights, the amplitude of variability reaches $0\overset{\rm m}{.}27$, mostly because of flickering. There is no evidence of the orbital variability in our photometry.

After whitening the light curve for night-to-night changes, we have analyzed our observational run for periodicity using the method by Deeming (1975). The third kind of variability of NSV 25181 was found. Most significant peaks in the power spectrum (Fig. 3) correspond to periods of 28.32 min (amplitude $0\overset{\rm m}{.}032$) and 24.58 min (amplitude $0\overset{\rm m}{.}026$).

The corresponding phased light curves are shown in Fig. 4. The nature of these oscillations remains unknown. One of possible reasons for them are non-radial pulsations of the white dwarf in the cataclysmic system (Arras et al., 2006; Gänsicke et al., 2006 and references therein). The double periodicity, values of the periods and their amplitudes are consistent with ZZ Cet type.

The periodic variability of NSV 25181 needs to be confirmed. We plan to continue our observations of this interesting variable.

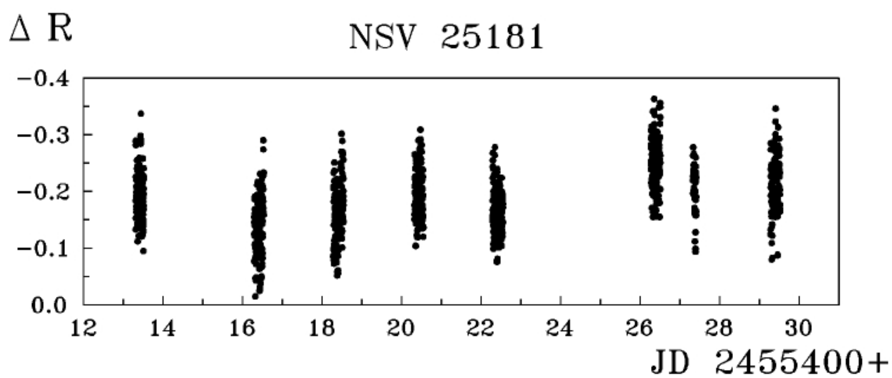

Figure 1. The summary light curve.

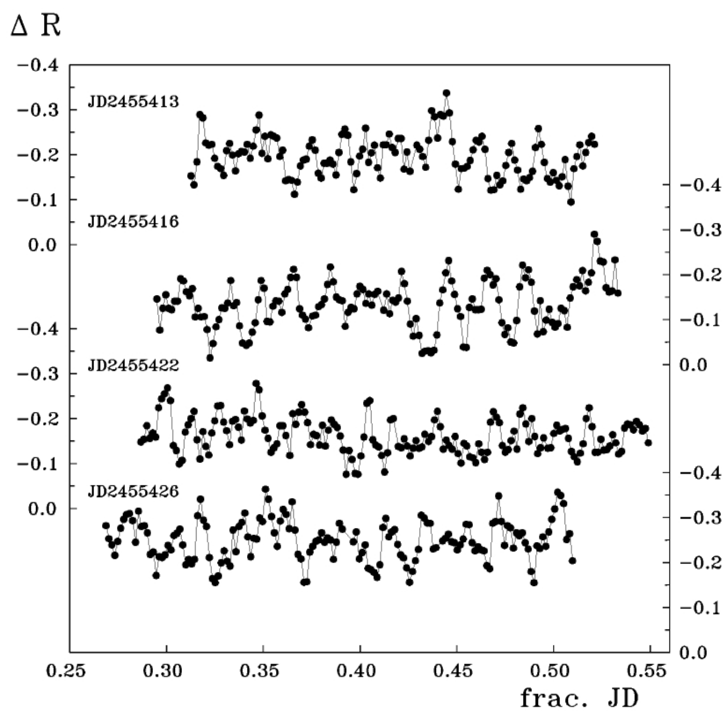

Figure 2. Individual light curves for four nights of observations.

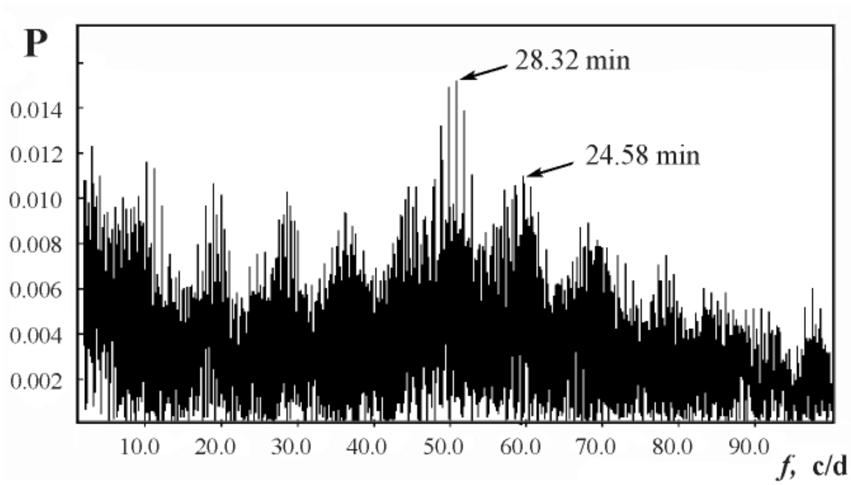

Figure 3. The power spectrum.

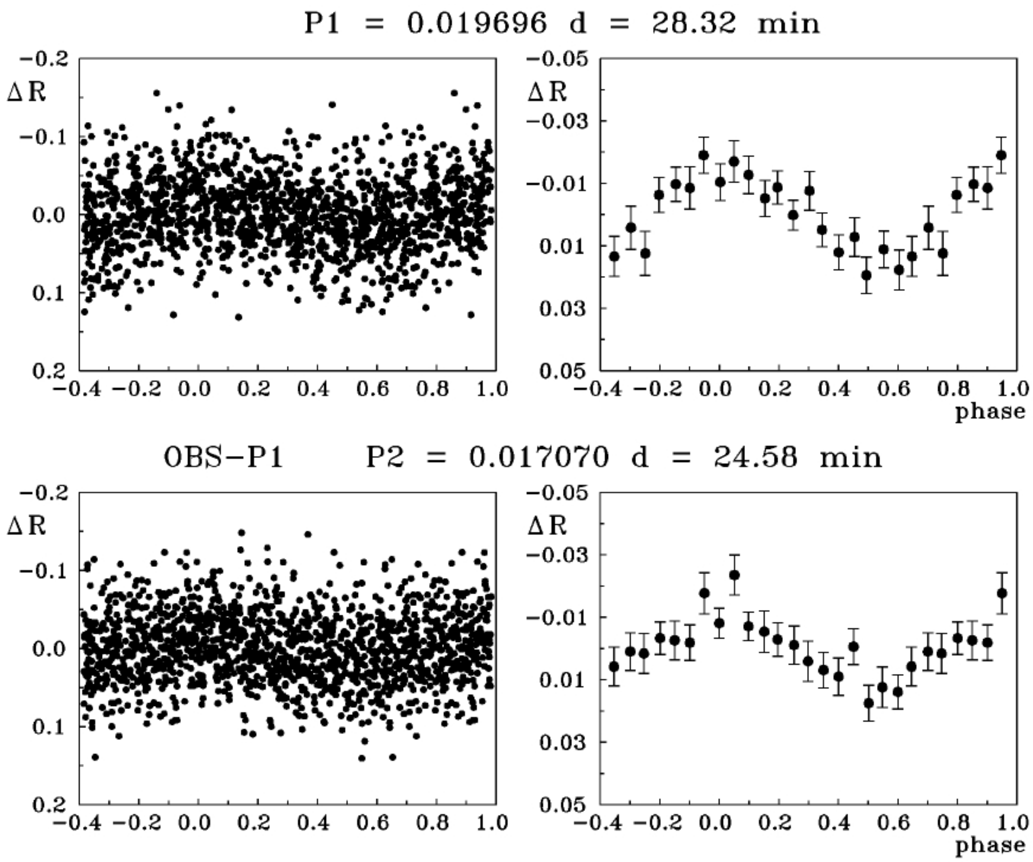

Figure 4. The phased light curves for two found periodicities. Bottom panels are constructed for the data whitened for the 28.32-minute variability.

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TIME-RESOLVED SPECTROSCOPY OF THE POLAR RBS 0324(=1RXS J023052.9–684203)†

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AM Herculis stars or polars are the cataclysmic variables whose white dwarf presents the strongest superficial magnetic field. The intensity of this field varies from ∼10 to 200 MG and is enough to prevent the formation of an accretion disc (with the material coming from the secondary star through L_1) around the white dwarf and to lead the flux through the magnetic lines. A shock occurs near the white dwarf, resulting in an increase of density and temperature of the gas. This region emits strong X-rays as well as polarised radiation in the visible region, consequently, such characteristics are used to identify objects of this class. In fact, several variables of this type have been firstly discovered by their X-ray emission. This is the case of RBS 0324, which was identified as a polar candidate in the course of the ROSAT Bright Survey (RBS) (Schwope et al., 2000). For reviews on polars and cataclysmic variables, see Cropper (1990), Hellier (2001) and Warner (2005).

The confirmation that RBS 0324 is really a polar was done by Schwope et al. (2002). The object shows broad, asymmetric emission lines of the Balmer series, HeI and HeII. They are typical of polars in the state of high accretion rate. Photometric and polarimetric observations revealed variations of brightness with timescales of minutes to hours and amplitude of 2 magnitudes, as well circular polarisation reaching 20% in certain phases, all modulated with a period of 181.8 min, which was considered as the orbital period of the binary.

The fact that RBS 0324 is a poorly known polar motivated us to include it in our photometric, polarimetric and spectroscopic observational programs whose objective is better characterize magnetic cataclysmic variables and/or candidates to this class. In this letter, we present spectroscopic observations of this object.

Spectra of RBS 0324 were collected on 2009, September 26 (UT) using the Goodman spectrograph at the 4.1-m SOAR telescope, Chile. We used the 1200 l/mm transmission VPH grating and a 0.84 arcsec long slit. The detector was a Fairchild 4096×4096 CCD, with 15 micron/pixel (0.15 arcsec/pixel). This instrumental setup provided a spectral coverage from 4280 to 5580 Å with a reciprocal dispersion of 0.31 Å/pixel and a spectral resolution of 1.5 Å. A total of 12 spectra was collected using an integration time of 15 minutes. The data cover more than one cycle of the 181.8 min orbital period.

†Based on observations collected at the Southern Astrophysical Research Telescope (SOAR), Cerro Pachón, Chile.

The reduction was done in the usual manner using the IRAF package[1] and consisted of zero and flat corrections, extraction to unidimensional spectrum, and finally wavelength and flux calibrations.

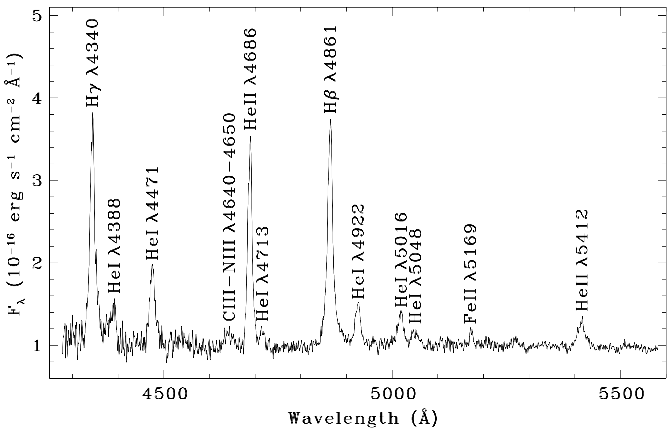

Figure 1. Average spectrum of RBS 0324.

The average spectrum of RBS 0324 is shown in Figure 1. Emission lines of Balmer series, HeI and HeII are very prominent, with HeII λ4686 so intense as Hβ. This is usually seen in others magnetic cataclysmic variables and is used as one of the criteria for select candidates to this class. The individual spectra around the Hγ, HeII λ4686 and Hβ spectral regions are shown in Figure 2. They are ordinated in phase using the ephemeris given by Schwope et al. (2002): HJD = 2452262.0 + 0.126245 $\times$ E. The profiles are complex, presenting broad and narrow components, and are highly variable with the orbital phase. The profiles for the three lines are similar, this is particularly evident for HeII λ4686 and Hβ lines whose signal-to-noise ratios are better.

We have determined the radial velocity of the Hβ and HeII λ4686 lines. Initially, each spectrum was continuum subtracted and smoothed due to the oversampling of the spectral PSF. To have an estimate of the radial velocity of each line, we calculated the flux weighted centroid as well as the line peak velocity. The resulting centroid radial velocity curves are shown in Figure 3 (top panel), where we used the same ephemeris as above. The two curves have the same pattern, with a semi-amplitude of about 250 km/s. An estimate of the uncertainty in the velocities was done by checking the dispersion of the sky line in λ5577. This provides an error of $\sim$20$-$30 km/s for the individual velocities. A sinusoid fit to the Hβ narrow peak velocities suggests that the inferior conjunction of the secondary star occurs around phase 0.92$\pm$0.10. However, better S/N data is required to confirm the absolute phasing for this system.

Figure 3 (bottom panel) shows the continuum variation along the orbital cycle. The continuum magnitude was estimated using a square band of 660 Å width centred at 5230 Å. We performed flux calibration using spectrophotometric standard stars (Hamuy et al., 1994). However, we do not consider the absolute calibration trustful due to significant slit losses. Even so, there is a clear modulation with orbital period with an amplitude of about 1.5 mag. This amplitude is compatible with that presented by Schwope et al. (2002) and shows its maximum around phase 0.55. The light and polarization curves of

[1]IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

RBS 0324 (Schwope et al., 2002) are typical of cyclotron emission in polars. Therefore the origin of the modulation shown in Figure 3 should be cyclotron. However, around phase 0.55 the observer sees the illuminated surface of the secondary, which can also contribute to the flux modulation.

These data represent the first approach on time-resolved spectroscopy of RBS 0324. The very complex line emission profiles put this object as a potential target for future and more detailed spectroscopic studies, such as Doppler tomography. These studies are important to understand the accretion structure in magnetic compact binaries.

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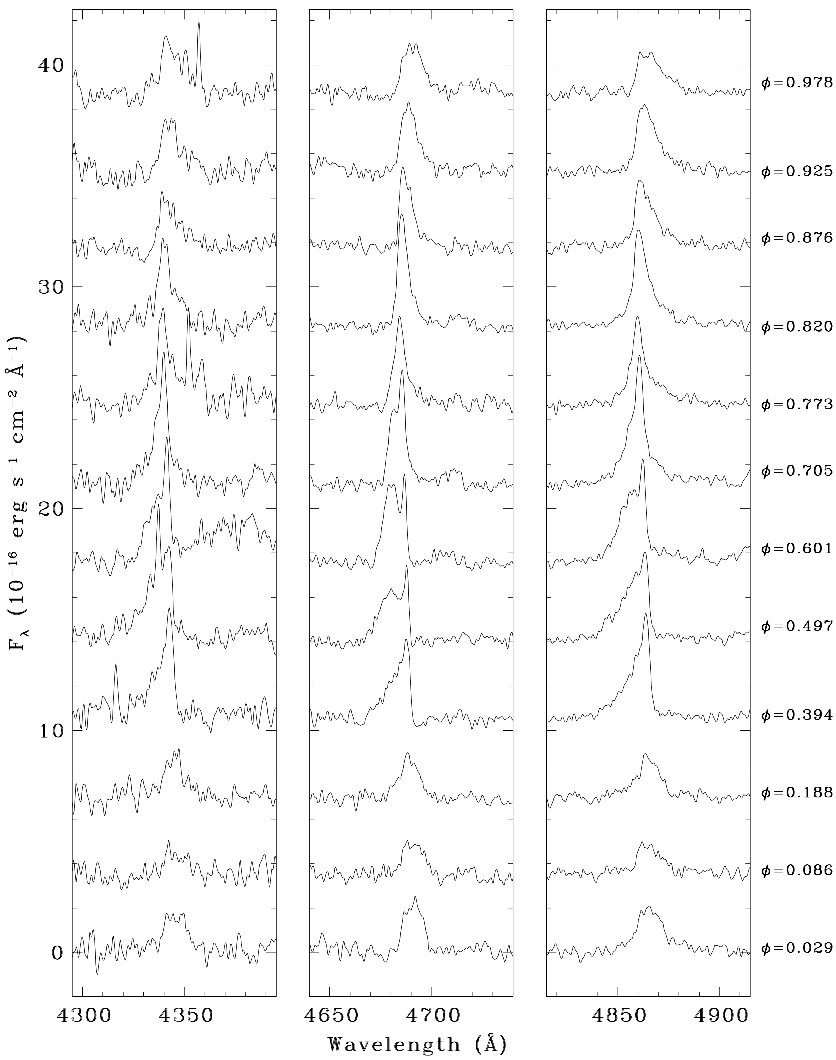

Figure 2. Hγ (left), HeII λ4686 (middle) and Hβ (right) profiles as a function of the orbital phase of RBS 0324. The phases, ϕ, were calculated using the ephemeris HJD = 2452262.0 + 0.126245 × E (Schwope et al., 2002). The individual spectra were continuum subtracted and are arbitrarily shifted for better visualisation.

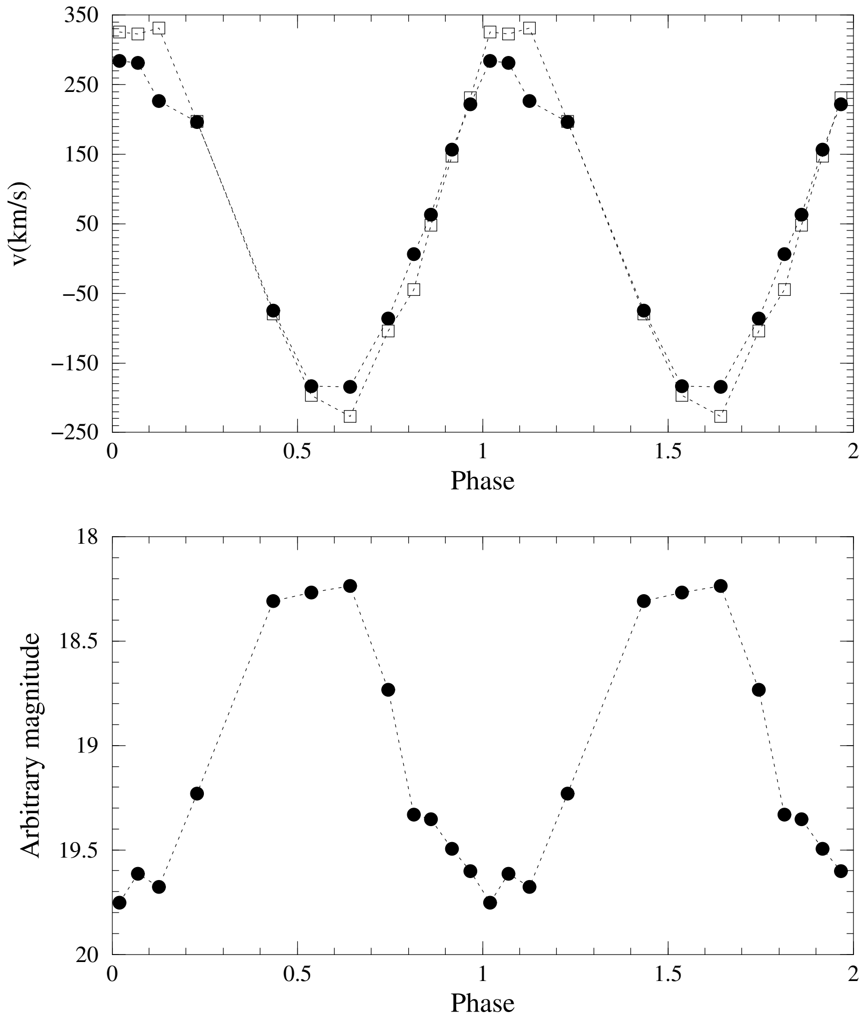

Figure 3. The top panel shows the phase diagram of the radial velocities of RBS 0324 using Hβ (filled circle) and HeII λ4686 (open square). The bottom panel shows the phase diagram of the continuum in the interval from 4900 to 5560 Å. The phases were calculated using the ephemeris provided by Schwope et al. (2002).

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CCD TIMES OF MINIMA OF ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

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Observatory and telescope:
T1: 40cm Cassegrain telescope (f/8.1), **T2**: 25cm Newtonian reflector telescope (f/4.7), **T3**: 20cm Newtonian reflector telescope (f/5) at the University of Athens Observatory, and **T4**: 1.2m Cassegrain telescope (f/13) at the Kryonerion observatory, Mt. Killini, Corinthia, Hellas, of the Astronomical Institute of the National Observatory of Athens.

Detector:	**C1**: ST-10XME CCD camera, Peltier cooling, KAF-3200ME chip, $16' \times 11'$ and $25' \times 17'$ (using a focal reducer) FoV with T1, 2184 × 1472 pixels, **C2**: ST-8XMEI CCD camera, Peltier cooling, KAF-1603ME chip, $40' \times 26'$ FoV with T2, $46' \times 32'$ FoV with T3, 1530 × 1020 pixels and **C3**: AP47p CCD camera, Peltier cooling, Marconi 47-10 chip, $3' \times 3'$ FoV with T4. All CCDs are equipped with the Bessell UBVRI filters.

Method of data reduction:
Differential photometry with the software Muniwin v.1.1.26 (Hroch, 1998).

Method of minimum determination:
Kwee & van Woerden (1956).

Table 1: Times of maxima of pulsating stars

System	HJD	Error	Filters	Remark
BH Peg	2455446.3910	0.0009	BRI	C2+T2
	2455449.5890	0.0014	BVRI	C2+T2
	2455457.2877	0.0012	BVRI	C1+T1
	2455460.4890	0.0011	BVRI	C2+T2
	2455467.5438	0.0021	BVRI	C2+T2
	2455503.4367	0.0009	BV	C2+T2
	2455505.3686	0.0012	BVRI	C1+T1

Table 2: Times of minima of eclipsing binaries

System	HJD	Error	Type	Filters	Remark
2MASS J20275736+2453029	2455380.5448	0.0015	I	B	C2+T3
	2455384.5349	0.0027	I	BI	C2+T3
	2455392.5100	0.0013	I	BVRI	C2+T3
	2455396.4925	0.0007	I	R	C2+T3
V0395 And	2455460.3447	0.0016	I	UB	C2+T2
CZ Aqr	2455504.3318	0.0002	I	B	C1+T1
	2455505.1932	0.0003	I	B	C1+T1
	2455536.2532	0.0000	I	B	C1+T1
	2455539.2757	0.0004	II	B	C1+T1
GK Cep	2455395.4022	0.0005	II	UBVRI	C2+T3
	2455403.3591	0.0006	I	UBVRI	C2+T3
	2455408.5084	0.0005	II	UBVRI	C2+T3
UW Cyg	2455393.3837	0.0011	II	BVI	C1+T1
	2455398.5593	0.0002	I	BVI	C1+T1
	2455412.3625	0.0001	I	B	C1+T1
HL Dra	2455402.3768	0.0007	II	BVRI	C1+T1
	2455408.5157	0.0003	I	BVRI	C1+T1
	2455437.3170	0.0003	II	BV	C1+T1
	2455454.3142	0.0005	II	BVRI	C1+T1
	2455461.3952	0.0003	I	BVRI	C1+T1
HZ Dra	2455367.5164	0.0004	I	B	C2+T3
	2455376.4063	0.0007	II	BVRI	C2+T3
GSC 0198-2061	2455228.3940	0.0006	I	BVRI	C2+T3
	2455231.3374	0.0005	I	BVRI	C2+T3
	2455232.3812	0.0007	II	BVRI	C2+T3
	2455246.4542	0.0015	I	I	C2+T3
	2455254.4114	0.0010	I	BVRI	C2+T3
	2455258.3992	0.0013	II	BVRI	C2+T3
	2455271.4020	0.0006	II	I	C2+T3
GSC 0770-0523	2455522.5382	0.0003	I	I	C1+T1
	2455537.5631	0.0003	II	I	C1+T1
	2455538.4351	0.0008	II	I	C1+T1
GSC 3164-1558	2455383.5280	0.0005	I	BI	C1+T1
	2455392.4036	0.0002	II	B	C1+T1
	2455403.4968	0.0005	II	BVI	C1+T1
	2455412.3732	0.0004	II	B	C1+T1
GSC 3208-1986	2455399.5143	0.0017	II	B	C2+T3
	2455400.3400	0.0011	II	BVR	C2+T3
	2455400.5362	0.0007	I	BVRI	C2+T3
	2455401.5482	0.0010	II	BRI	C2+T3
	2455402.3560	0.0007	II	BVRI	C2+T3
	2455402.5593	0.0003	I	BVRI	C2+T3
	2455410.4484	0.0004	II	BVRI	C2+T3
	2455411.4593	0.0003	I	BVRI	C2+T3
GSC 3208-2644	2455399.4813	0.0005	I	BVRI	C2+T3
	2455402.3817	0.0013	II	BVRI	C2+T3
GSC 3913-0160	2455448.4226	0.0007	II	B	C1+T1
	2455454.4395	0.0009	II	BR	C1+T1

Table 2: cont.

System	HJD	Error	Type	Filters	Remark
	2455459.3952	0.0004	I	BVRI	C1+T1
	2455461.3330	0.0004	II	BVRI	C1+T1
	2455466.2811	0.0004	I	BVRI	C1+T1
	2455467.3551	0.0013	II	BVRI	C1+T1
GSC 4465-1210	2455401.3630	0.0009	II	VRI	C2+T3
	2455403.3954	0.0009	II	UBVRI	C2+T3
	2455408.4700	0.0007	I	UBVRI	C2+T3
	2455410.4986	0.0005	II	UBVRI	C2+T3
V0948 Her	2455376.3885	0.0013	II	BVRI	C1+T1
V0973 Her	2455368.3877	0.0002	I	BV	C2+T3
	2455374.3660	0.0009	II	UBVRI	C2+T3
AU Lac	2455404.3869	0.0003	II	B	C3+T4
	2455406.4674	0.0001	I	B	C3+T4
	2455436.4096	0.0013	II	BVRI	C1+T1
	2455438.4932	0.0002	I	BVRI	C1+T1
	2455441.2780	0.0006	I	BVRI	C1+T1
	2455450.3232	0.0018	II	BVRI	C1+T1
	2455457.2910	0.0010	II	BVRI	C1+T1
	2455507.4374	0.0003	II	B	C3+T4
V0407 Lac	2455400.4772	0.0020	II	BVRI	C2+T3
	2455402.5188	0.0018	I	BVRI	C2+T3
	2455411.4614	0.0010	I	BVRI	C2+T3
AT Peg	2455436.5775	0.0005	II	BR	C2+T3
	2455439.4392	0.0004	I	BR	C2+T3
	2455442.2968	0.0008	II	BR	C2+T3
	2455447.4616	0.0001	I	BR	C2+T2
BG Peg	2455443.5417	0.0015	II	VRI	C1+T1
	2455446.4710	0.0003	I	BVRI	C1+T1
	2455449.3997	0.0011	II	VRI	C2+T2
	2455450.3762	0.0005	I	BVRI	C2+T2
	2455494.3133	0.0013	II	RI	C2+T2
RZ Tau	2455505.5412	0.0002	II	B	C2+T2
	2455536.2999	0.0002	II	B	C2+T2
	2455536.5080	0.0001	I	B	C2+T2
	2455537.3392	0.0001	I	BVI	C2+T2
	2455537.5471	0.0002	II	BVI	C2+T2
IO UMa	2455367.3954	0.0010	I	BVRI	C1+T1
USNO-A2.0 1350-16144088	2455439.5919	0.0014	I	BV	C1+T1
	2455441.3565	0.0010	I	BVRI	C1+T1
	2455448.4193	0.0018	I	BVRI	C1+T1
	2455450.4064	0.0018	II	BVRI	C1+T1
	2455457.2512	0.0020	I	B	C1+T1
	2455457.4717	0.0012	II	BVRI	C1+T1
AW Vul	2455381.4155	0.0002	I	BVRI	C2+T3
	2455383.4316	0.0011	II	BVRI	C2+T3
	2455391.4986	0.0012	II	BVRI	C2+T3
	2455393.5121	0.0011	I	BVRI	C2+T3
	2455394.3186	0.0010	I	BVRI	C2+T3

Explanation of the remarks in the table:
T1, T2, T3, T4, C1, C2 and C3 refer to the instrumentation (telescope and CCD camera) used for each case.

Remarks:
The system GSC 0770-0523 was discovered by Liakos & Niarchos (2010a), the systems 2MASS J20275736+2453029, GSC 0198-2061, GSC 3164-1558, GSC 3208-2644 and USNO-A2.0 1350-16144088 by Liakos & Niarchos (2010b), the systems GSC 3208-1986 and GSC 3913-0160 by Gettel et al. (2006), and the system GSC 4465-1210 by Khruslov (2007).

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BAV-RESULTS OF OBSERVATIONS - PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

(BAV MITTEILUNGEN NO. 214)

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In this 68th compilation of BAV results, photoelectric observations obtained in the year 2010 are presented on 436 variable stars giving 784 minima on eclipsing binaries and maxima on pulsating stars. All moments of minima and maxima are heliocentric. The errors are tabulated in column '±'. The values in column '$O-C$' are determined without incorporation of nonlinear terms.The references are given in the section 'Remarks'. All information about photometers and filters are specified in the column 'Rem'. The observations were made at private observatories. The photoelectric measurements and all the lightcurves with evaluations can be obtained from the office of the BAV for inspection.

Table 1: Times of minima of eclipsing binaries

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
RT And	55381.4694	.0049	PGL	+0.0421		GCVS 2009	V	212	15)
AA And	54841.2736	.0002	RAT RCR	−0.0039		GCVS 2009	-U-I	82	4)
AS And	55102.3361	.0001	MS FR				o	488	9)
V452 And	55071.5098	.0004	FR	+0.0832		GCVS 2009	-Ir	29	16)
V463 And	55124.4122	.0019	RAT RCR	−0.0731		GCVS 2009	-U-I	173	4)
	55124.6061	.0004	RAT RCR	−0.0823	s	GCVS 2009	-U-I	173	4)
	55125.4198	.0002	RAT RCR	−0.0808	s	GCVS 2009	-U-I	197	4)
UU Ant	54968.3130	.0020	HND	−0.0281		GCVS 2009	o	52	7)
	54983.3170	.0020	HND	−0.0294		GCVS 2009	o	76	7)
MU Aqr	55029.5140	.0005	RAT RCR	−0.0016		GCVS 2009	-U-I	109	4)
KP Aql	55410.3796	.0030	WTR	−0.0194	s	GCVS 2009	-Ir	46	12)
QY Aql	55353.4883	.0005	AG	−0.1815		GCVS 2009	-Ir	31	16)
V340 Aql	55352.4696	.0005	AG	+0.0153		GCVS 2009	-Ir	43	16)
V346 Aql	55430.3848	.0010	WTR	−0.0105		GCVS 2009	-Ir	77	12)
V724 Aql	55017.4646	.0004	RAT RCR	−0.0333		IBVS 3555	-U-I	90	4)
V805 Aql	55409.4168	.0040	WTR	+0.0109	s	GCVS 2009	-Ir	81	12)
V962 Aql	55374.4966	.0014	AG	−0.1204		GCVS 2009	-Ir	33	16)
V1045 Aql	55353.4470	.0038	AG	−0.0131	s	GCVS 2009	-Ir	31	16)
V1097 Aql	55353.4483	.0121	AG	−0.0698	s	GCVS 2009	-Ir	31	16)
V1184 Aql	55359.5221	.0003	AG	+0.1240		GCVS 2009	-Ir	31	16)
	55374.5108	.0097	AG	+0.1065		GCVS 2009	-Ir	33	16)
V1299 Aql	55352.4665	.0009	AG	−0.0470		GCVS 2009	-Ir	27	16)
TT Aur	54840.4918	.0001	RAT RCR	−0.0139		GCVS 2009	m	190	4)
ZZ Aur	54843.5204	.0007	RAT RCR	+0.0185	s	GCVS 2009	-U-I	111	4)
AP Aur	54841.6138	.0003	RAT RCR	+0.0888	s	IBVS 3942	-U-I	158	4)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
AP Aur	54911.3657	.0002	RAT RCR	+0.0931		IBVS 3942	-U-I	87	4)
EM Aur	54909.3642	.0010	RAT RCR	−0.1946		GCVS 2009	-U-I	80	4)
HL Aur	54910.3029	.0002	RAT RCR	−0.0148		GCVS 2009	-U-I	44	4)
KU Aur	54838.3742	.0002	RAT RCR	+0.0258		GCVS 2009	-U-I	77	4)
NN Aur	55295.4256	.0004	FR				-Ir	40	16)
SU Boo	54947.3748	.0005	RAT RCR	+0.0187		GCVS 2009	-U-I	85	4)
TY Boo	55281.4350	.0022	AG	−0.0321	s	BAVM 68	-Ir	58	16)
	55281.5912	.0010	AG	−0.0345		BAVM 68	-Ir	58	16)
TZ Boo	55311.4755	.0002	GB	−0.0352		BAVM 68	V	100	5)
	55313.4059	.0002	GB	−0.0364	s	BAVM 68	V	121	5)
	55314.4476	.0046	AG	−0.0347		BAVM 68	-Ir	99	16)
	55314.4476	.0002	GB	−0.0347		BAVM 68	V	131	5)
	55314.5953	.0010	AG	−0.0356	s	BAVM 68	-Ir	99	16)
	55315.4863	.0001	GB	−0.0361	s	BAVM 68	V	85	5)
	55316.3772	.0001	GB	−0.0366	s	BAVM 68	V	83	5)
	55316.5284	.0021	AG	−0.0340		BAVM 68	-Ir	56	16)
	55352.4844	.0002	GB	−0.0340		BAVM 68	V	85	5)
	55358.4273	.0001	GB	−0.0342		BAVM 68	V	81	5)
	55362.4378	.0001	GB	−0.0353	s	BAVM 68	V	95	5)
VW Boo	54953.3787	.0003	RAT RCR	−0.0655		BAVR 32,122	-U-I	61	4)
XY Boo	55294.4146	.0014	AG	+0.0073	s	GCVS 2009	V	63	16)
	55294.5997	.0023	AG	+0.0071		GCVS 2009	V	63	16)
	55310.5361	.0035	AG	+0.0100		GCVS 2009	-Ir	35	16)
YY Boo	55316.5096	.0038	AG	−0.1053		GCVS 2009	-Ir	56	16)
AC Boo	55301.3887	.0021	PGL	+0.0060	s	GCVS 2009	V	213	18)
AQ Boo	55294.4080	.0032	AG				-Ir	63	16)
	55294.5743	.0022	AG				-Ir	63	16)
	55310.3964	.0044	AG				-Ir	35	16)
	55310.5638	.0012	AG				-Ir	35	16)
AR Boo	55310.4363	.0042	AG	+0.0970	s	GCVS 2009	-Ir	36	16)
	55310.6074	.0001	AG	+0.0597		GCVS 2009	-Ir	36	16)
DU Boo	55341.4260	.0018	JU				o	40	5)
EW Boo	55073.3606	.0002	RAT RCR				-U-I	104	20)
	55314.4498	.0075	AG				-Ir	99	16)
FY Boo	55310.3770	.0004	AG				-Ir	36	16)
	55310.4990	.0009	AG				-Ir	36	16)
GM Boo	55315.3853	.0031	AG				-Ir	50	16)
	55315.5660	.0060	AG				-Ir	50	16)
GN Boo	55315.3905	.0010	AG				-Ir	50	16)
	55315.5408	.0007	AG				-Ir	50	16)
GP Boo	55315.4505	.0130	AG				-Ir	50	16)
GQ Boo	55315.4348	.0039	AG				-Ir	50	16)
GT Boo	55314.4104	.0085	AG				-Ir	99	16)
	55316.4070	.0060	AG				-Ir	55	16)
GW Boo	55294.3962	.0058	AG	+0.1044		GCVS 2009	V	63	16)
	55310.4066	.0036	AG	+0.1674		GCVS 07	-Ir	40	16)
	55310.5829	.0011	AG	+0.0779	s	GCVS 2009	-Ir	40	16)
GX Boo	55310.5412	.0042	AG	−0.0017	s	GCVS 2009	-Ir	36	16)
HR Boo	55315.4281	.0047	AG	−0.0398		GCVS 2009	-Ir	50	16)
SV Cam	55227.3471	.0035	PGL	+0.0454	s	GCVS 09	V	63	18)
AO Cam	54844.2284	.0002	RAT RCR	−0.0697	s	GCVS 2009	-U-I	42	4)
	55194.4182	.0001	WN	−0.0868		GCVS 09	V	103	13)
	55263.3661	.0012	JU	−0.0915		GCVS 09	o	52	5)
AV Cam	54908.3802	.0002	RAT RCR	−0.0687		GCVS 2009	-U-I	102	4)
CD Cam	55263.4969	.0146	AG				-Ir	62	16)
NQ Cam	55263.3772	.0015	AG	+0.0901		GCVS 2009	-Ir	61	16)
	55263.5585	.0013	AG	+0.0904	s	GCVS 07	-Ir	61	16)
	55316.4251	.0035	AG	+0.0918	s	GCVS 07	-Ir	51	16)
NR Cam	54910.3790	.0002	RAT RCR	+0.0024		GCVS 2009	-U-I	245	4)
	54910.5077	.0002	RAT RCR	+0.0031	s	GCVS 2009	-U-I	245	4)
	54910.6361	.0003	RAT RCR	+0.0036		GCVS 2009	-U-I	245	4)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
NS Cam	55263.3587	.0056	AG	−0.0487		GCVS 2009	-Ir	66	16)
NU Cam	54911.5670	.0005	RAT RCR	+0.0358		GCVS 2009	-U-I	184	4)
TX Cnc	55192.4713	.0001	RAT RCR	+0.0372		GCVS 2009	-U-I	95	20)
WX Cnc	54881.3266	.0003	RAT RCR	+0.0125	s	GCVS 2009	-U-I	115	4)
AH Cnc	54173.4445	.0017	SCI	+0.0372		GCVS 2009	o	77	5)
EH Cnc	54857.3580	.0003	RAT RCR				-U-I	86	4)
FF Cnc	55279.4636	.0002	FR	−0.1897		IBVS 3859	-Ir	62	16)
GQ Cnc	55275.3979	.0015	AG				-Ir	23	16)
HN Cnc	54861.3853	.0003	RAT RCR	−0.0166		IBVS 5260	-U-I	96	4)
IL Cnc	54866.4299	.0003	RAT RCR	+0.0461	s	GCVS 2009	-U-I	84	4)
	55275.4110	.0013	AG	+0.0580	s	GCVS 2009	-Ir	25	16)
	55295.3479	.0010	AG	+0.0550		GCVS 2009	-Ir	45	16)
	55295.4840	.0009	AG	+0.0573	s	GCVS 2009	-Ir	45	16)
IM Cnc	55275.4354	.0001	AG	−0.0028	s	GCVS 2009	-Ir	24	16)
IO Cnc	55295.4652	.0022	AG	+0.0091	s	GCVS 2009	-Ir	43	16)
IT Cnc	55275.4235	.0019	AG	−0.0488	s	GCVS 2009	-Ir	27	16)
	55295.4284	.0023	AG	−0.0460	s	GCVS 2009	-Ir	43	16)
VZ CVn	54943.3740	.0002	RAT RCR	−0.0011	s	GCVS 2009	m	65	4)
BI CVn	55309.4183	.0039	AG	+0.0264	s	GCVS 2009	-Ir	59	16)
BO CVn	55294.3759	.0091	AG				-Ir	154	16)
DF CVn	55309.3901	.0012	AG				-Ir	59	16)
	55309.5525	.0010	AG				-Ir	59	16)
DR CVn	55309.4294	.0044	AG	+0.0412		GCVS 2009	-Ir	59	16)
	55309.5967	.0017	AG	+0.0440	s	GCVS 2009	-Ir	59	16)
DX CVn	54941.3625	.0004	RAT RCR	+0.0013		GCVS 2009	-U-I	77	4)
	55309.4697	.0018	AG	+0.0050		GCVS 2009	-Ir	59	16)
DY CVn	55309.4431	.0012	AG	−0.0037	s	GCVS 2009	-Ir	59	16)
	55309.5657	.0008	AG	−0.0041		GCVS 2009	-Ir	59	16)
EE CVn	55315.3876	.0029	AG	−0.0058	s	GCVS 2009	-Ir	61	16)
EH CVn	55315.4511	.0023	AG	−0.0494		GCVS 2009	-Ir	59	16)
	55315.5953	.0040	AG	−0.0370	s	GCVS 2009	-Ir	59	16)
EI CVn	55315.4722	.0012	AG	−0.0170	s	GCVS 2009	-Ir	60	16)
	55315.6041	.0002	AG	−0.0154		GCVS 2009	-Ir	60	16)
BZ Cas	54840.4030	.0003	RAT RCR	+0.2740		GCVS 2009	-U-I	66	4)
IR Cas	55192.2594	.0001	RAT RCR	+0.0084		GCVS 2009	-U-I	121	20)
MR Cas	55063.5061	.0024	AG	+0.0220		GCVS 2009	-Ir	30	16)
OR Cas	55374.4332	.0007	AG	−0.0232		GCVS 2009	-Ir	38	16)
PV Cas	54840.2923	.0003	RAT RCR	−0.0345		GCVS 2009	-U-I	69	4)
QQ Cas	54155.3169	.0004	RAT RCR	+0.4489		BAVR 35,1	-U-I	165	20)
V366 Cas	55374.4334	.0018	AG	−0.0356	s	IBVS 4798	-Ir	38	16)
V387 Cas	55374.4561	.0035	AG	+0.1023		GCVS 2009	-Ir	38	16)
V440 Cas	55154.3420	.0005	FR				-Ir	67	16)
	55154.5027	.0008	FR				-Ir	67	16)
V952 Cas	54843.2532	.0007	RAT RCR	−0.0072		BAVM148	-U-I	82	4)
VW Cep	55394.4511	.0035	PGL	−0.0532	s	GCVS 2009	V	363	15)
XX Cep	55376.4583	.0010	JU	−0.0122		GCVS 2009	o	50	5)
CW Cep	55353.5002	.0069	PGL	+0.0167		GCVS 2009	V	251	18)
	55398.4932	.0050	JU	−0.0212	s	GCVS 09	o	88	5)
EF Cep	54841.4654	.0005	RAT RCR	+0.1843	s	GCVS 09	-U-I	70	4)
GI Cep	55082.4741	.0001	RAT RCR	−0.1044		GCVS 2009	-U-I	289	20)
	55097.5205	.0007	RAT RCR	−0.1044	s	GCVS 2009	-U-I	182	20)
GW Cep	54843.3694	.0002	RAT RCR	−0.0130		BAVR 33,160	-U-I	78	4)
RW Com	54933.4181	.0001	RAT RCR	−0.0170		GCVS 2009	-U-I	101	4)
	55310.4456	.0017	AG	−0.0135	s	GCVS 2009	-Ir	40	16)
	55310.5646	.0008	AG	−0.0132		GCVS 2009	-Ir	40	16)
RZ Com	54866.5259	.0001	RAT RCR	+0.0422		GCVS 2009	-U-I	136	4)
	54932.3656	.0001	RAT RCR	+0.0425	s	GCVS 2009	-U-I	78	4)
SS Com	54935.3529	.0004	RAT RCR	−0.0461	s	BAVR 33,152	-U-I	57	4)
CN Com	55293.3996	.0001	MS FR	+0.0600		GCVS 2009	o	558	9)
DG Com	55306.3851	.0004	MS FR	−0.0512	s	GCVS 2009	o	324	9)
EK Com	55310.4659	.0016	AG				-Ir	40	16)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
EK Com	55310.5989	.0022	AG				-Ir	40	16)
EQ Com	55305.3627	.0004	MS FR	+0.0153		GCVS 2009	o	497	9)
LO Com	55310.4708	.0025	AG				-Ir	38	16)
LP Com	55310.5025	.0018	AG				-Ir	40	16)
LQ Com	55310.4057	.0048	AG				-Ir	40	16)
	55310.5815	.0011	AG				-Ir	40	16)
U CrB	55281.5594	.0055	AG	+0.1164		GCVS 2009	R	55	16)
	55281.5598	.0065	AG	+0.1168		GCVS 2009	V	53	16)
RT CrB	55281.5761	.0094	AG	−0.0321		GCVS 2009	V	57	16)
	55294.3963	.0078	FR	−0.0048	s	GCVS 2009	-Ir	35	10)
RW CrB	54922.5623	.0002	RAT RCR	−0.0015		GCVS 2009	-U-I	132	4)
	55281.4117	.0064	AG	+0.0007		GCVS 2009	V	59	16)
	55294.4872	.0004	FR	+0.0008		GCVS 2009	-Ir	53	10)
TW CrB	55293.4322	.0002	FR	+0.0421	s	GCVS 2009	-Ir	45	10)
AR CrB	55293.3883	.0006	FR	−0.0043	s	GCVS 2009	-Ir	79	16)
	55293.5857	.0003	FR	−0.0056		GCVS 2009	-Ir	79	16)
AS CrB	54968.4261	.0003	RAT RCR	+0.0060	s	GCVS 2009	-U-I	64	4)
	55067.3977	.0002	RAT RCR	+0.0065	s	GCVS 2009	-U-I	116	20)
AV CrB	54934.4885	.0002	RAT RCR	−0.0143		GCVS 2009	-U-I	123	4)
	54974.3975	.0002	RAT RCR	−0.0163	s	GCVS 2009	-U-I	57	4)
	55340.5298	.0020	AG	−0.0173	s	GCVS 2009	-Ir	25	16)
VV Cyg	55372.4826	.0004	AG	+0.0110		GCVS 2009	-Ir	33	16)
WZ Cyg	55072.4786	.0001	RAT RCR	+0.0628		GCVS 2009	-U-I	194	20)
DP Cyg	55309.5734	.0024	AG	+0.1784	s	GCVS 2009	-Ir	46	16)
EN Cyg	55376.3863	.0008	AG	+0.4489		GCVS 2009	-Ir	36	16)
	55398.5363	.0012	SCI	+0.4508		GCVS 2009	o	33	5)
GG Cyg	55359.5168	.0003	AG	+0.1372		GCVS 2009	-Ir	28	16)
LO Cyg	55357.4415	.0016	AG	+0.0003		GCVS 2009	-Ir	17	16)
MY Cyg	55359.4654	.0179	AG	−0.0026		GCVS 2009	V	30	16)
	55359.4669	.0117	AG	−0.0011		GCVS 2009	B	30	16)
NZ Cyg	55377.4130	.0012	AG	+0.0794	s	GCVS 2009	-Ir	24	16)
QW Cyg	55377.4435	.0046	AG	−0.0754	s	GCVS 2009	-Ir	24	16)
	55379.4930	.0021	SCI	−0.0826		GCVS 2009	o	55	5)
V346 Cyg	55375.4342	.0010	AG	+0.1493		GCVS 2009	-Ir	30	16)
V370 Cyg	55101.4070	.0005	RAT RCR	−0.0243		GCVS 2009	-U-I	56	4)
	55376.3694	.0010	AG	−0.0250		GCVS 2009	-Ir	62	16)
V401 Cyg	54968.5132	.0003	RAT RCR	+0.0590	s	GCVS 2009	-U-I	94	4)
	55376.4289	.0123	AG	+0.0693	s	GCVS 2009	-Ir	32	16)
V442 Cyg	55391.4693	.0027	SCI	−0.0425		GCVS 2009	o	98	5)
V443 Cyg	55371.4949	.0017	SCI	+0.0327		GCVS 2009	o	95	5)
V454 Cyg	55075.4922	.0001	RAT RCR	−0.0089		GCVS 2009	-U-I	262	20)
V478 Cyg	55092.5586	.0020	RAT RCR	+0.0232	s	GCVS 2009	-U-I	208	20)
V483 Cyg	55073.5275	.0030	RAT RCR	+0.0338		GCVS 2009	-U-I	152	20)
V499 Cyg	55359.4007	.0017	AG	+0.0383		GCVS 2009	-Ir	27	16)
V500 Cyg	55083.5077	.0007	RAT RCR	+0.1083	s	GCVS 09	-U-I	231	20)
	55370.4700	.0017	SCI	+0.1022		GCVS 2009	o	63	5)
V502 Cyg	55294.5662	.0007	MS FR	+0.1242		GCVS 2009	o	29	9)
V509 Cyg	55396.5066	.0028	SCI	+0.2039		GCVS 2009	o	73	5)
V704 Cyg	55372.4499	.0018	AG	+0.0312	s	GCVS 2009	-Ir	33	16)
V706 Cyg	55306.5260	.0002	MS FR	−0.0546		GCVS 2009	o	390	9)
	55372.5018	.0018	AG	−0.0540	s	GCVS 2009	-Ir	33	16)
V726 Cyg	55293.5696	.0001	MS FR	+0.0408		GCVS 2009	o	585	9)
V753 Cyg	55279.6187	.0002	MS FR	+0.0033		BAVM 69	o	306	9)
V787 Cyg	55084.5333	.0001	RAT RCR	+0.0042		GCVS 2009	-U-I	206	20)
V796 Cyg	55074.4847	.0001	RAT RCR	−0.0161		GCVS 2009	-U-I	228	20)
V824 Cyg	55377.4176	.0041	AG	+0.0149		GCVS 2009	-Ir	25	16)
V859 Cyg	55376.4325	.0023	SCI	+0.0158		GCVS 2009	o	113	5)
V909 Cyg	55429.3919	.0020	WTR	−0.0221		BAVR 47,2	-Ir	81	12)
V941 Cyg	55085.4615	.0029	SCI	−0.0785		GCVS 2009	o	65	5)
	55386.5169	.0023	SCI	−0.0736		GCVS 2009	o	105	5)
V957 Cyg	55305.5538	.0005	MS FR	+0.1387		GCVS 2009	o	572	9)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V959 Cyg	55126.2884	.0002	RAT RCR	−0.0514		GCVS 2009	-U-I	169	20)
	55376.5040	.0015	AG	−0.0514		GCVS 2009	-Ir	32	16)
V961 Cyg	55375.4909	.0005	AG	−0.0800		GCVS 2009	-Ir	30	16)
	55376.5093	.0023	AG	−0.0805	s	GCVS 2009	-Ir	32	16)
V963 Cyg	55065.4652	.0002	RAT RCR	−0.0011		GCVS 2009	-U-I	151	20)
	55376.4762	.0012	AG	−0.0011		GCVS 2009	-Ir	32	16)
V970 Cyg	55385.5250	.0029	SCI	−0.0006		GCVS 2009	o	32	5)
V995 Cyg	55062.5472	.0001	RAT RCR	+0.4891		GCVS 2009	-U-I	268	20)
V1004 Cyg	55375.5435	.0004	AG	−0.1746		GCVS 2009	-Ir	30	16)
V1013 Cyg	55358.4732	.0031	FR	+0.1512	s	GCVS 2009	-Ir	19	16)
V1018 Cyg	55125.2817	.0004	RAT RCR	−0.0885		GCVS 2009	-U-I	120	4)
V1036 Cyg	55304.5632	.0002	MS FR	+0.0005		BAVM 141	o	605	9)
V1141 Cyg	55044.5112	.0003	RAT RCR	+0.0358		GCVS 2009	-U-I	140	4)
	55124.3133	.0003	RAT RCR	+0.0228		GCVS 2009	-U-I	131	4)
	55377.4176	.0050	AG	+0.0963		GCVS 2009	-Ir	23	16)
V1171 Cyg	55358.4905	.0002	FR	−0.0559		GCVS 2009	-Ir	32	16)
V1193 Cyg	55264.6100	.0005	MS FR	+0.2640		GCVS 09	o	513	9)
	55393.5768	.0025	SCI	+0.1598	s	GCVS 2009	o	28	5)
V1196 Cyg	55265.6146	.0008	MS FR	+0.0769		GCVS 2009	o	513	9)
V1305 Cyg	55382.3907	.0033	SCI	+0.0049		GCVS 2009	o	60	5)
V1356 Cyg	55375.4983	.0010	AG	+0.1744		GCVS 2009	V	30	16)
V1425 Cyg	55374.4909	.0026	SCI	+0.0079		GCVS 2009	o	166	5)
V2080 Cyg	55375.5245	.0019	SCI				o	105	5)
V2240 Cyg	55075.4963	.0003	RAT RCR				-U-I	244	20)
V2287 Cyg	55063.5258	.0001	RAT RCR				-U-I	269	20)
W Del	55377.4703	.0058	AG	+0.0281		GCVS 2009	-Ir	26	16)
EX Del	55352.5175	.0013	AG	−0.0658	s	GCVS 2009	-Ir	27	16)
RZ Dra	55353.4603	.0098	AG	+0.0526	s	GCVS 2009	-Ir	120	16)
TW Dra	55296.3431	.0030	JU	+0.0244		GCVS 2009	o	55	5)
	55338.4462	.0010	JU	+0.0248		GCVS 2009	o	66	5)
TZ Dra	55391.4509	.0010	JU	−0.0309		GCVS 2009	o	62	5)
XY Dra	55375.4714	.0030	AG	+0.1631		GCVS 2009	-Ir	46	16)
AX Dra	54881.5272	.0004	RAT RCR	−0.0042		BAVR 32,36	-U-I	80	4)
BE Dra	54937.5211	.0002	RAT RCR	−0.1235	s	GCVS 2009	-U-I	188	4)
GV Dra	55340.4121	.0024	SCI	−0.0027		IBVS 4990	o	149	5)
LZ Dra	54942.4969	.0002	RAT RCR				-U-I	167	4)
NN Dra	54847.5901	.0002	RAT RCR	+0.0629		GCVS 2009	-U-I	199	4)
AF Gem	54861.2801	.0001	RAT RCR	−0.0694		GCVS 2009	-U-I	68	4)
AV Gem	55201.3127	.0018	AG	−0.0297		GCVS 2009	-Ir	15	16)
AZ Gem	55244.3529	.0003	AG	+0.0862		GCVS 2009	-Ir	13	16)
BO Gem	55263.4520	.0004	FR	+0.7178		GCVS 2009	-Ir	50	16)
DV Gem	55263.469 :	.001	FR	−0.380		GCVS 2009	-Ir	64	16)
EG Gem	55263.4003	.0173	AG	+0.2824	s	GCVS 2009	-Ir	23	16)
EN Gem	55263.3056	.0063	AG	−0.0372	s	GCVS 2009	-Ir	26	16)
FG Gem	55244.3702	.0004	AG	−0.0257		GCVS 2009	-Ir	15	16)
FT Gem	55263.4233	.0042	AG	−0.0273		GCVS 2009	-Ir	24	16)
HR Gem	54866.2978	.0003	RAT RCR	+0.0124		GCVS 2009	-U-I	57	4)
KM Gem	55263.4324	.0047	AG	−0.0587		GCVS 2009	-Ir	22	16)
KQ Gem	55263.3926	.0020	AG	−0.0839		GCVS 2009	-Ir	18	16)
KV Gem	55201.2838	.0010	AG	−0.0205	s	BAVR 52,95	-Ir	15	16)
	55244.3074	.0019	AG	−0.0198	s	BAVR 52,95	-Ir	15	16)
KY Gem	55201.7210	.0050	AG	−0.4233		GCVS 2009	-Ir	77	16)
SZ Her	55059.3907	.0001	RAT RCR	−0.0216		GCVS 2009	-U-I	94	20)
	55068.3901	.0001	RAT RCR	−0.0213		GCVS 2009	-U-I	94	20)
	55086.3881	.0001	RAT RCR	−0.0215		GCVS 2009	-U-I	133	20)
TT Her	54943.4897	.0005	RAT RCR	+0.0330	s	GCVS 2009	-U-I	147	4)
TX Her	55304.5043	.0004	QU	−0.0049		GCVS 2009	V	64	6)
BC Her	55374.5003	.0009	AG	−0.4184		GCVS 2009	-Ir	35	16)
CC Her	55340.4861	.0006	AG	+0.1997		GCVS 2009	-Ir	53	16)
DK Her	55352.3872	.0007	AG	−0.1371		GCVS 2009	-Ir	39	16)
FN Her	55340.4008	.0035	AG	+0.0914		GCVS 2009	-Ir	53	16)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
FW Her	53612.3589	.0018	SCI	+0.0596		GCVS 2009	o	28	5)
	55352.5326	.0022	SCI	+0.0701		GCVS 2009	o	37	5)
IK Her	55372.5098	.0096	AG	+0.2595	s	GCVS 2009	-Ir	32	16)
LT Her	54941.4588	.0009	RAT RCR	−0.0267		BAVM 69	-U-I	138	4)
V338 Her	55385.4167	.0006	JU	+0.0925		GCVS 2009	o	52	5)
V357 Her	55359.4356	.0024	AG	+0.0239	s	GCVS 2009	-Ir	29	16)
	55374.5253	.0026	AG	+0.0233	s	GCVS 2009	-Ir	35	16)
V359 Her	55075.3645	.0003	RAT RCR	+0.1894		GCVS 2009	-U-I	150	20)
	55340.4762	.0080	AG	+0.1851		GCVS 2009	-Ir	25	16)
V381 Her	55341.4971	.0028	AG	+0.1873		GCVS 2009	-Ir	33	16)
V387 Her	55341.4754	.0014	AG	+0.0685	s	GCVS 2009	-Ir	32	16)
V450 Her	55314.4030	.0028	AG	+0.1110	s	GCVS 2009	-Ir	30	16)
V719 Her	55084.3007	.0002	RAT RCR	+0.0025	s	GCVS 2009	-U-I	192	20)
	55092.3198	.0002	RAT RCR	+0.1287		GCVS 09	-U-I	156	20)
	55341.4961	.0022	AG	+0.0894		GCVS 09	-Ir	30	16)
	55358.5328	.0013	AG	+0.1647	s	GCVS 09	-Ir	29	16)
V728 Her	55083.3697	.0003	RAT RCR	+0.0651		IBVS 3234	-U-I	146	20)
	55376.5161	.0031	AG	+0.0711		IBVS 3234	-Ir	44	16)
V829 Her	55314.5377	.0041	AG	+0.0333		IBVS 5496	-Ir	30	16)
	55375.4291	.0015	JU	+0.0392		IBVS 5496	o	48	5)
V842 Her	54932.4983	.0001	RAT RCR	−0.0488	s	BAVR 49,180	-U-I	136	4)
	55340.4271	.0007	JU	−0.0561		BAVR 49,180	o	52	5)
	55388.4070	.0024	WTR	−0.0564	s	BAVR 49,180	-Ir	53	12)
	55393.4366	.0011	JU	−0.0553	s	BAVR 49,180	o	43	5)
V857 Her	55341.4004	.0037	AG				-Ir	31	16)
	55352.4867	.0010	JU				o	85	5)
V861 Her	55308.3846	.0005	AG				-Ir	8	16)
	55341.4700	.0020	AG				-Ir	29	16)
V878 Her	55045.3760	.0004	RAT RCR				-U-I	63	4)
	55396.4184	.0006	JU				o	40	5)
V1032 Her	55314.4878	.0087	AG				-Ir	30	16)
	55340.5243	.0025	AG				-Ir	25	16)
V1033 Her	55314.4077	.0021	AG				-Ir	30	16)
	55314.5593	.0020	AG				-Ir	30	16)
V1034 Her	55352.4994	.0005	AG				-Ir	39	16)
V1035 Her	54946.5353	.0002	RAT RCR				-U-I	132	4)
V1038 Her	55314.4140	.0005	AG				-Ir	30	16)
	55314.5499	.0006	AG				-Ir	30	16)
	55340.4275	.0008	AG				-Ir	25	16)
	55372.4765	.0013	AG				-Ir	32	16)
V1039 Her	55352.4844	.0011	AG				-Ir	39	16)
V1042 Her	55341.4190	.0020	AG				-Ir	27	16)
V1044 Her	55070.3809	.0003	RAT RCR				-U-I	91	20)
V1045 Her	55101.3606	.0004	RAT RCR				-U-I	124	4)
V1047 Her	55314.4049	.0022	AG				-Ir	30	16)
	55314.5625	.0027	AG				-Ir	30	16)
V1052 Her	55341.4259	.0018	AG				-Ir	29	16)
V1053 Her	55314.3904	.0004	AG				-Ir	30	16)
	55314.5351	.0013	AG				-Ir	30	16)
V1055 Her	54933.5352	.0002	RAT RCR				-U-I	130	4)
	55082.4090	.0002	RAT RCR				-U-I	100	20)
	55341.5174	.0045	AG				-Ir	30	16)
	55374.4755	.0010	JU				o	58	5)
	55376.5280	.0026	AG				-Ir	44	16)
V1062 Her	55358.4718	.0014	AG				-Ir	30	16)
V1067 Her	55358.3912	.0010	AG				-Ir	30	16)
	55358.5215	.0009	AG				-Ir	30	16)
	55376.4583	.0009	AG				-Ir	44	16)
V1073 Her	55097.3499	.0001	RAT RCR				-U-I	151	20)
V1088 Her	55314.4428	.0072	AG	+0.0177		GCVS 2009	-Ir	31	16)
	55372.4579	.0061	AG	+0.0172	s	GCVS 2009	-Ir	32	16)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V1091 Her	55314.5163	.0038	AG	+0.0135	s	GCVS 2009	-Ir	30	16)
V1095 Her	55049.4847	.0003	RAT RCR	−0.0189		GCVS 2009	-U-I	140	4)
	55050.5216	.0004	RAT RCR	−0.0204	s	GCVS 2009	-U-I	138	4)
	55341.4955	.0009	AG	−0.0209		GCVS 2009	-Ir	32	16)
	55358.5240	.0016	AG	−0.0230		GCVS 2009	-Ir	30	16)
V1096 Her	55049.4850	.0007	RAT RCR	+0.0175		GCVS 2009	-U-I	140	4)
	55050.4525	.0006	RAT RCR	+0.0194		GCVS 2009	-U-I	139	4)
	55341.4797	.0018	AG	+0.0208	s	GCVS 2009	-Ir	32	16)
	55358.5004	.0016	AG	+0.0217		GCVS 2009	-Ir	30	16)
	55376.4848	.0021	AG	+0.0207	s	GCVS 2009	-Ir	44	16)
V1102 Her	55357.4478	.0028	AG	+0.0048	s	GCVS 2009	-Ir	33	16)
WY Hya	54842.4442	.0002	RAT RCR	+0.0271		GCVS 2009	-U-I	77	4)
AV Hya	55294.3942	.0030	WTR	−0.0922	s	GCVS 2009	-Ir	84	12)
	55295.4178	.0147	AG	−0.0937		GCVS 2009	-Ir	61	16)
SW Lac	55352.4551	.0021	PGL	+0.0567		GCVS 2009	V	389	15)
EK Lac	55155.3016	.0012	JU	−0.0036		GCVS 2009	o	97	5)
IU Lac	55309.4688	.0036	AG	+0.0131		GCVS 2009	-Ir	46	16)
LY Lac	55358.4766	.0058	AG	+0.2308		GCVS 2009	-Ir	49	16)
LZ Lac	55358.5161	.0034	AG	+0.3248	s	GCVS 09	-Ir	49	16)
MZ Lac	55358.4188	.0050	AG	+0.2806	s	GCVS 2009	-Ir	49	16)
OS Lac	55358.4804	.0045	AG	+0.3179	s	GCVS 2009	-Ir	49	16)
PP Lac	55358.4873	.0017	AG	−0.0546		GCVS 2009	-Ir	49	16)
V345 Lac	55358.5430	.0018	AG	−1.0276	s	GCVS 2009	-Ir	49	16)
V441 Lac	55309.5174	.0046	AG	−0.0788		IBVS 5024	-Ir	46	16)
Y Leo	55293.3871	.0001	WTR	−0.0162		GCVS 2009	-Ir	76	12)
UV Leo	55258.4357	.0035	PGL	+0.0035	s	IBVS 5338	V	231	18)
	55259.3360	.0014	PGL	+0.0036		IBVS 5338	V	225	18)
	55304.3427	.0003	DIE	+0.0038		IBVS 5338	o	31	11)
	55310.3443	.0008	DIE	+0.0046		IBVS 5338	o	22	11)
UZ Leo	55305.4238	.0008	JU	−0.0979	s	GCVS 2009	o	80	5)
XX Leo	55289.4971	.0016	AG	−0.0124		GCVS 2009	-Ir	51	16)
XY Leo	55289.3881	.0009	AG	+0.0514	s	GCVS 2009	-Ir	51	16)
AL Leo	55289.4659	.0019	AG	+0.0126	s	IBVS 3401	-Ir	51	16)
AM Leo	54842.5359	.0001	RAT RCR	+0.0096	s	GCVS 2009	-U-I	110	4)
	55280.3959	.0005	ALH	+0.0101	s	GCVS 2009	V	406	8)
	55280.3964	.0030	AG	+0.0106	s	GCVS 2009	-Ir	105	16)
	55280.5787	.0027	AG	+0.0100		GCVS 2009	-Ir	105	16)
AP Leo	54924.3738	.0001	RAT RCR	−0.0345		GCVS 2009	-U-I	89	4)
GU Leo	55289.4694	.0009	AG	+0.0759		GCVS 2009	-Ir	51	16)
GV Leo	55289.3487	.0008	AG	+0.0485	s	GCVS 2009	-Ir	51	16)
	55289.4810	.0010	AG	+0.0474		GCVS 2009	-Ir	51	16)
HI Leo	54923.3602	.0001	RAT RCR	+0.0011		GCVS 2009	-U-I	80	4)
T LMi	55275.3070	.0025	AG	−0.1048		GCVS 2009	-Ir	69	16)
RT LMi	55275.3480	.0041	AG	−0.0074	s	GCVS 2009	-Ir	65	16)
RZ Lyn	55309.3715	.0043	JU	−0.1195		GCVS 2009	o	53	5)
SW Lyn	55280.3770	.0063	AG	+0.0642	s	GCVS 2009	V	45	16)
TY Lyn	55280.3812	.0039	AG	+0.0583		GCVS 2009	V	50	16)
	55306.3755	.0057	JU	+0.0627		GCVS 2009	o	38	5)
UU Lyn	55311.3646	.0021	PGL	−0.0083		GCVS 2009	o	589	15)
UV Lyn	54931.3959	.0002	RAT RCR	+0.0706	s	GCVS 2009	-U-I	47	4)
BG Lyn	55280.4776	.0024	AG				V	44	16)
DZ Lyn	55280.5114	.0031	AG	−0.0098		GCVS 2009	V	48	16)
DT Lyr	55263.6462	.0002	MS FR	+0.1265		GCVS 2009	o	234	9)
EW Lyr	54980.5222	.0001	RAT RCR	+0.2386		GCVS 2009	-U-I	148	4)
	55062.3691	.0001	RAT RCR	+0.2391		GCVS 2009	-U-I	100	20)
	55101.3436	.0001	RAT RCR	+0.2391		GCVS 2009	-U-I	71	4)
FL Lyr	55068.4855	.0001	RAT RCR	−0.0022	s	GCVS 09	-U-I	214	20)
V380 Mon	55263.372	.001	MS FR	−0.092		GCVS 2009	o	256	9)
V449 Oph	54976.4979	.0001	RAT RCR	+0.0879		GCVS 2009	-U-I	135	4)
V506 Oph	54953.5501	.0002	RAT RCR	+0.0299		GCVS 2009	-U-I	124	4)
	54970.5167	.0003	RAT RCR	+0.0297		GCVS 2009	-U-I	133	4)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
CQ Ori	55263.3486	.0023	AG	−0.0028		GCVS 2009	-Ir	19	16)
FH Ori	55192.3715	.0002	RAT RCR	−0.3612		GCVS 2009	-U-I	137	20)
FK Ori	54857.2647	.0002	RAT RCR	−0.0039		GCVS 2009	-U-I	62	4)
V392 Ori	55244.2859	.0016	AG	+0.0018		GCVS 2009	-Ir	21	16)
V647 Ori	54847.3334	.0002	RAT RCR	−0.2505		GCVS 2009	-U-I	99	4)
VW Peg	55386.4945	.0001	FR	+0.0013		BAVM 129	-Ir	49	16)
V404 Peg	55386.4555	.0004	FR	−0.0767	s	GCVS 2009	-Ir	53	16)
KW Per	55192.3904	.0001	WN	+0.0120		GCVS 2009	V	175	13)
UZ Sge	55012.4607	.0002	RAT RCR	+0.0715		GCVS 2009	-U-I	113	4)
V365 Sge	55352.5146	.0009	AG	−0.0494		GCVS 2009	-Ir	27	16)
AU Ser	54959.4289	.0002	RAT RCR	+0.0926		GCVS 2009	-U-I	56	4)
	55309.4045	.0005	FR	+0.0917	s	GCVS 2009	-Ir	42	10)
	55309.5937:	.0024	FR	+0.0876		GCVS 2009	-Ir	42	10)
V384 Ser	55049.3857	.0005	FR	−0.0027	s	GCVS 2009	-Ir	47	16)
	55293.3921	.0081	FR	−0.0022	s	GCVS 2009	-Ir	86	16)
	55293.5257	.0002	FR	−0.0030		GCVS 2009	-Ir	86	16)
	55304.4085	.0002	FR	−0.0037	s	GCVS 2009	-Ir	97	16)
	55304.5437	.0003	FR	−0.0029		GCVS 2009	-Ir	97	16)
	55309.5149	.0002	FR	−0.0032	s	GCVS 2009	-Ir	77	16)
	55376.4290	.0005	FR	−0.0026	s	GCVS 2009	-Ir	45	16)
	55397.5233	.0004	FR	−0.0035		GCVS 2009	-Ir	57	16)
Y Sex	54838.5180	.0002	RAT RCR	−0.0024	s	BAVR 32,36	-U-I	117	4)
SV Tau	55295.3594	.0014	FR	−0.0196		GCVS 2009	-Ir	35	10)
CT Tau	55295.3993	.0006	FR	−0.0535		GCVS 2009	-Ir	41	10)
EQ Tau	55175.4577	.0017	AG	−0.0245	s	GCVS 2009	-Ir	29	16)
	55175.4584	.0006	AG	−0.0238	s	GCVS 2009	B	24	16)
	55175.4594	.0004	AG	−0.0228	s	GCVS 2009	V	25	16)
	55175.4594	.0006	AG	−0.0228	s	GCVS 2009	R	27	16)
	55175.6270	.0001	AG	−0.0259		GCVS 2009	R	27	16)
	55175.6286	.0010	AG	−0.0243		GCVS 2009	-Ir	29	16)
GR Tau	55175.3803	.0007	AG	−0.0387		BAVR 35,1	B	25	16)
	55175.3806	.0010	AG	−0.0384		BAVR 35,1	V	26	16)
	55175.3809	.0014	AG	−0.0381		BAVR 35,1	R	28	16)
	55175.6103	.0047	AG	−0.0236	s	BAVR 35,1	R	28	16)
V781 Tau	55295.3980	.0015	FR	−0.0435	s	GCVS 2009	-Ir	53	10)
V1123 Tau	55175.3162	.0003	AG				R	23	16)
	55175.3181	.0002	AG				B	23	16)
	55175.5120	.0035	AG				V	21	16)
	55175.5154	.0015	AG				B	23	16)
	55175.5169	.0024	AG				R	23	16)
V1128 Tau	54847.2324	.0001	RAT RCR				-U-I	50	4)
V1239 Tau	54866.2421	.0004	AG	−0.0411		GCVS 2009	-Ir	56	16)
RV Tri	54841.3784	.0001	RAT RCR	−0.0298		GCVS 2009	-U-I	50	4)
W UMa	55289.3574	.0014	PGL	−0.0089		BAVR 44,156	V	321	18)
TY UMa	55304.4310	.0010	JU	−0.0701		GCVS 2009	o	76	5)
	55311.3434	.0010	AG	−0.0712	s	GCVS 2009	-Ir	140	16)
	55311.5221	.0010	AG	−0.0697		GCVS 2009	-Ir	140	16)
VV UMa	55311.4425	.0008	JU	−0.0487		GCVS 2009	o	65	5)
XY UMa	55314.4367	.0010	JU	+0.0412	s	GCVS 2009	o	57	5)
AA UMa	55279.3419	.0008	JU	+0.0384		GCVS 2009	o	56	5)
BM UMa	55311.3789	.0022	AG	+0.0095	s	GCVS 2009	-Ir	35	16)
	55311.5149	.0017	AG	+0.0099		GCVS 2009	-Ir	35	16)
BS UMa	55311.4543	.0015	AG	−0.0494		GCVS 2009	-Ir	35	16)
DW UMa	55260.3360	.0004	JU				o	60	5)
KM UMa	54921.3559	.0001	RAT RCR				-U-I	100	4)
	54931.5603	.0001	RAT RCR				-U-I	145	4)
LP UMa	55260.3514	.0011	JU				o	60	5)
MQ UMa	55311.5753	.0025	AG	+0.0748	s	GCVS 2009	-Ir	35	16)
MS UMa	54922.3604	.0002	RAT RCR	+0.0327	s	GCVS 2009	-U-I	97	4)
W UMi	54924.5153	.0002	RAT RCR	−0.1627		GCVS 2009	-U-I	170	4)
	55397.4324	.0010	JU	−0.1674		GCVS 2009	o	48	5)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
RU UMi	54857.5335	.0001	RAT RCR	−0.0131		GCVS 2009	-U-I	196	4)
	55307.3947	.0003	JU	−0.0136		GCVS 2009	o	64	5)
VY UMi	54921.5234	.0001	RAT RCR				-U-I	165	4)
AW Vir	54942.3692	.0001	RAT RCR	+0.0217		GCVS 2009	-U-I	59	4)
CG Vir	54923.5075	.0001	RAT RCR	+0.1498	s	GCVS 2009	-U-I	127	4)
AW Vul	55393.5121	.0003	FR	−0.0151		GCVS 2009	-Ir	59	16)
BB Vul	55340.5546	.0007	SIR				o	105	7)
	55379.5190	.0007	SIR				-Ir	90	7)
	55380.4580	.0007	SIR				-Ir	68	7)
IW Vul	55352.5175	.0006	FR	−0.0525	s	GCVS 2009	-Ir	28	16)
GSC 00238-00793	53446.3610	.0008	AG	−0.0003	s	PZP 10.4	-Ir	45	4)
	53446.5200	.0017	AG	−0.0021		PZP 10.4	-Ir	45	4)
	55295.4350	.0122	AG	+0.0003		PZP 10.4	-Ir	79	16)
GSC 00434-03766	54655.3865	.0006	AG				-Ir	65	16)
GSC 02016-00444	54933.3687	.0015	AG				-Ir	41	16)
	54933.5258	.0019	AG				-Ir	41	16)
	54968.5109	.0020	AG				-Ir	37	16)
	55315.4968	.0186	AG				-Ir	50	16)
GSC 02038-00293	55293.4393	.0019	FR	+0.0041		BAVM 177	-Ir	49	16)
	55304.3375	.0031	FR	+0.0033		BAVM 177	-Ir	57	16)
	55309.5682	.0038	FR	+0.0322	s	BAVM 177	-Ir	45	16)
	55311.5690	.0040	FR	+0.0514	s	BAVM 177	-Ir	49	16)
	55376.4469	.0028	FR	+0.0305	s	BAVM 177	-Ir	27	16)
	55397.4739	.0021	FR	+0.0026		BAVM 177	-Ir	35	16)
GSC 02135-02603	55074.3446	.0003	FR				-Ir	90	16)
	55074.5255	.0006	FR				-Ir	90	16)
	55380.3878	.0006	FR				-Ir	131	16)
	55380.5666	.0002	FR				-Ir	131	16)
	55385.4559	.0007	FR				-Ir	35	16)
	55387.4459	.0003	FR				-Ir	46	16)
GSC 02161-01310	55393.4581	.0008	FR				-Ir	36	16)
GSC 02177-00626	55393.4387	.0003	FR				-Ir	49	16)
GSC 02484-00139	54175.3569	.0004	AG				-Ir	45	4)
	54175.4935	.0001	AG				-Ir	45	4)
	54535.4245	.0008	AG				-Ir	27	4)
GSC 02537-00520	55315.4017	.0027	AG				-Ir	59	16)
GSC 02569-00553	55281.6266	.0050	AG	−0.0240		PZP 10.4	-Ir	60	16)
	55316.5059	.0072	AG	−0.0221		PZP 10.4	-Ir	56	16)
GSC 02610-00088	54947.4063	.0028	AG				-Ir	36	16)
GSC 02673-02495	52901.4353	.0243	AG	−0.0091	s	PZP 10.4	-Ir	33	4)
	53637.4018	.0038	AG	−0.0044		PZP 10.4	-Ir	18	4)
	55375.4771	.0123	AG	+0.0464	s	PZP 10.4	-Ir	30	16)
GSC 03187-01564	53259.4349	.0033	AG				o	26	4)
GSC 03210-01456	55041.4122	.0005	AG				-Ir	41	16)
	55051.4680	.0022	AG				-Ir	52	16)
	55062.4498	.0007	AG				-Ir	88	16)
	55095.3968	.0004	AG				-Ir	44	16)
	55095.5825	.0008	AG				-Ir	44	16)
	55357.4920	.0009	AG				-Ir	17	16)
GSC 03575-06239	55372.5183	.0036	AG	+0.0317	s	PZP 10.4	-Ir	33	16)
GSC 03618-00162	52505.3983	.0013	AG	+0.0049		PZP 10.4	-Ir	22	4)
	52505.5185	.0007	AG	+0.0047	s	PZP 10.4	-Ir	22	4)
	52506.4727	.0171	AG	−0.0039	s	PZP 10.4	-Ir	19	4)
GSC 03618-00448	52505.4122	.0010	AG	+0.0063	s	PZP 10.4	-Ir	22	4)
	53222.4903	.0026	AG	−0.0063	s	PZP 10.4	-Ir	22	4)
GSC 03619-00047	54712.4962	.0021	AG	−0.0013	s	PZP 10.4	-Ir	38	16)
	54738.4341	.0061	AG	−0.0055		PZP 10.4	-Ir	67	16)
GSC 03619-00715	53233.4371	.0080	AG				-Ir	18	4)
	53259.3909	.0023	AG				-Ir	19	4)
GSC 03688-01184	53651.3558	.0109	AG	−0.0004		PZP 10.4	-Ir	44	4)
	53651.5369	.0073	AG	+0.0010	s	PZP 10.4	-Ir	44	4)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
GSC 04009-00670	55049.4826	.0265	AG	+0.0046		PZP 10.4	-Ir	37	16)
	55067.3938	.0060	AG	−0.0014		PZP 10.4	-Ir	33	16)
	55074.3908	.0160	AG	−0.0034	s	PZP 10.4	-Ir	40	16)
GSC 04339-01166	54834.5872	.0014	AG				-Ir	169	16)
	55102.4011	.0021	AG				-Ir	119	16)
GSC 04502-01040	55083.3455	.0019	AG	+0.0362	s	IBVS 5700 No.60	-Ir	79	16)
	55083.4846	.0015	AG	+0.0401		IBVS 5700 No.60	-Ir	79	16)
U-A2 1125-18642389	50671.5185	.0047	AG				-Ir	32	4)
	51035.4617	.0060	AG				-Ir	33	4)
	51390.4017	.0044	AG				-Ir	28	4)
	51413.5036	.0039	AG				-Ir	21	4)
U-A2 1200-11760524	53992.3220	.0022	AG				-Ir	29	4)
	55376.5450	.0008	AG				-Ir	31	16)
U-A2 1200-12680286	55060.4684	.0014	AG	−0.0137	s	IBVS 5700 No.73	-Ir	35	16)
	55076.3403	.0013	AG	−0.0141	s	IBVS 5700 No.73	-Ir	18	16)
	55084.4735	.0006	FR	−0.0154		IBVS 5700 No.73	-Ir	60	16)
	55103.3221	.0006	AG	−0.0152	s	IBVS 5700 No.73	-Ir	22	16)
U-A2 1275-15124020	55074.5424	.0004	AG	−0.0017		IBVS 5700 No.72	-Ir	36	16)
	55372.4619	.0032	AG	−0.0005		IBVS 5700 No.72	-Ir	33	16)
U-A2 1275-15134722	55074.3953	.0024	AG	+0.0049		IBVS 5700 No.71	-Ir	36	16)
U-A2 1425-02081650	52135.4627	.0012	AG	+0.0041	s	IBVS 5700 No.65	o	25	4)
	53382.3901	.0005	AG	+0.0020	s	IBVS 5700 No.65	-Ir	47	4)
	53388.3683	.0017	AG	−0.0007		IBVS 5700 No.65	-Ir	44	4)
	53388.5297	.0018	AG	−0.0009	s	IBVS 5700 No.65	-Ir	44	4)
	53409.3823	.0013	AG	−0.0005		IBVS 5700 No.65	-Ir	32	4)
	53716.3454	.0005	AG	−0.0013	s	IBVS 5700 No.65	-Ir	114	4)
	53716.5052	.0003	AG	−0.0032		IBVS 5700 No.65	-Ir	114	4)
	53716.6642	.0003	AG	−0.0058	s	IBVS 5700 No.65	-Ir	114	4)
	55141.3818	.0010	AG	−0.0272	s	IBVS 5700 No.65	-Ir	63	16)
	55141.5407	.0014	AG	−0.0300		IBVS 5700 No.65	-Ir	63	16)
U-A2 1500-01208912	55081.3660	.0015	AG	+0.0106	s	IBVS 5900 No.6	-Ir	46	16)
	55081.5111	.0020	AG	+0.0046		IBVS 5900 No.6	-Ir	46	16)
	55154.3535	.0035	AG	+0.0071		IBVS 5900 No.6	-Ir	45	16)
	55154.5073	.0023	AG	+0.0098	s	IBVS 5900 No.6	-Ir	45	16)
U-B1 0903-0102370	54840.3678	.0008	AG				-Ir	63	16)
	54840.5116	.0006	AG				-Ir	63	16)
	54866.3356	.0012	AG				-Ir	59	16)
	54866.4803	.0012	AG				-Ir	59	16)
U-B1 1031-0151441	54856.5126	.0006	AG				-Ir	59	16)
	55244.2802	.0003	AG				-Ir	14	16)
	55263.4448	.0035	AG				-Ir	23	16)
U-B1 1041-0581206	53966.5033	.0039	AG	−0.0020		PZP 10.4	-Ir	21	4)
	54001.3848	.0013	AG	+0.0008		PZP 10.4	-Ir	25	4)
	54003.3218	.0005	AG	+0.0001	s	PZP 10.4	-Ir	38	4)
	54327.4722	.0019	AG	+0.0001		PZP 10.4	-Ir	40	4)
	54663.5244	.0007	AG	−0.0011		PZP 10.4	-Ir	43	16)
U-B1 1092-0472807	53566.4031	.0038	AG				-Ir	23	4)
	53900.4360	.0037	AG				-Ir	19	4)
	54023.3528	.0055	AG				-Ir	18	4)
U-B1 1135-0102876	54508.3948	.0008	AG				-Ir	68	4)
	54857.2597	.0007	AG				-Ir	55	16)
	54857.4229	.0004	AG				-Ir	55	16)
	54857.5847	.0021	AG				-Ir	55	16)
U-B1 1179-0155111	54148.3648	.0033	AG				-Ir	30	4)
U-B1 1183-0597128	52929.4712	.0090	AG	+0.0010		PZP 10.4	-Ir	23	4)
	53217.5065	.0024	AG	+0.0040	s	PZP 10.4	o	18	4)
	53251.4815	.0004	AG	+0.0060		PZP 10.4	o	29	4)
	53254.4306	.0037	AG	+0.0009		PZP 10.4	o	20	4)
	53257.3853	.0023	AG	+0.0014		PZP 10.4	o	24	4)
	53282.4961	.0024	AG	+0.0017	s	PZP 10.4	-Ir	22	4)
	53601.5458	.0018	AG	+0.0003	s	PZP 10.4	-Ir	30	4)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
U-B1 1183-0597128	53607.4546	.0011	AG	+0.0008	s	PZP 10.4	-Ir	26	4)
	53613.3642	.0012	AG	+0.0020	s	PZP 10.4	-Ir	31	4)
	53966.3856	.0026	AG	−0.0007		PZP 10.4	-Ir	23	4)
U-B1 1206-0055028	54034.5913	.0144	AG	+0.0078		PZP 10.4	-Ir	30	4)
	54055.4660	.0143	AG	+0.0080		PZP 10.4	-Ir	49	4)
U-B1 1257-0092393	53386.3968	.0021	AG	+0.0012		PZP 10.4	-Ir	38	4)
	53387.4385	.0018	AG	+0.0007		PZP 10.4	-Ir	61	4)
	53388.4796	.0006	AG	−0.0004		PZP 10.4	V	38	4)
	53410.3650	.0038	AG	−0.0015		PZP 10.4	V	27	4)
	54085.4535	.0001	AG	−0.0058	s	PZP 10.4	-Ir	36	4)
	54085.7200	.0009	AG	+0.0001		PZP 10.4	-Ir	36	4)
	54115.4229	.0012	AG	+0.0000		PZP 10.4	-Ir	45	4)
U-B1 1316-0383362	54697.4063	.0009	AG				-Ir	62	16)
	54697.5716	.0015	AG				-Ir	62	16)
	54707.3635	.0011	AG				-Ir	22	16)
	5073.4607	.0008	AG				-Ir	49	16)
U-B1 1332-0399848	54697.4374	.0005	AG				-Ir	59	16)
	54697.5617	.0007	AG				-Ir	59	16)
U-B1 1362-0458803	55071.3623	.0019	AG				-Ir	42	16)
	55081.4520	.0029	AG				-Ir	54	16)
U-B1 1383-0445772	55042.4188	.0024	AG				-Ir	35	16)
	55042.5528	.0005	AG				-Ir	35	16)
U-B1 1398-0469064	54024.2965	.0053	AG	−0.0010	s	PZP 10.4	-Ir	34	4)
	54024.4616	.0061	AG	+0.0015		PZP 10.4	-Ir	34	4)
	54663.4997	.0073	AG	+0.0000		PZP 10.4	-Ir	23	16)
U-B1 1400-0455467	55098.5329	.0020	AG				-Ir	22	16)
U-B1 1416-0454010	53932.4514	.0016	AG				-Ir	24	4)
	54035.4035	.0042	AG				-Ir	35	4)
	54035.5588	.0026	AG				-Ir	35	4)
	54080.3789	.0025	AG				-Ir	46	4)
	54712.3648	.0013	AG				-Ir	38	16)
	54712.5224	.0015	AG				-Ir	38	16)
	54738.3812	.0010	AG				-Ir	67	16)
	54738.5365	.0013	AG				-Ir	67	16)
	55108.5163	.0023	AG				-Ir	44	16)
	55141.4228	.0006	FR				-Ir	98	16)
U-B1 1440-0411990	55068.4477	.0032	AG	−0.0513	s	IBVS 5700 No.54	-Ir	45	16)
U-B1 1441-0441871	54798.3702	.0017	AG				-Ir	33	16)
	55039.4762	.0008	AG				-Ir	31	16)
	55141.4018	.0019	AG				-Ir	50	16)
	55141.5731	.0010	AG				-Ir	50	16)
U-B1 1447-0060874	53651.5124	.0042	AG	−0.0006		PZP 10.4	-Ir	45	4)
	53654.6208	.0018	AG	−0.0092		PZP 10.4	-Ir	50	4)
	54056.4053	.0011	AG	−0.0021	s	PZP 10.4	-Ir	21	4)
	54115.3204	.0034	AG	+0.0023		PZP 10.4	-Ir	49	4)
	54815.3947	.0017	AG	+0.0051		PZP 10.4	-Ir	59	16)
	54829.4141	.0030	AG	−0.0019	s	PZP 10.4	-Ir	48	16)
	55141.4220	.0027	AG	−0.0027		PZP 10.4	-Ir	63	16)
U-B1 1492-0009970	54830.3796	.0012	AG				-Ir	130	16)
	54830.5307	.0015	AG				-Ir	129	16)
	55029.4963	.0009	AG				-Ir	44	16)
U-B1 1500-0005759	55058.3653	.0018	AG	+0.1020		AJ 133.1470	-Ir	54	16)
	55096.6090	.0032	AG	+0.1176	s	AJ 133.1470	-Ir	48	16)
U-B1 1503-0282065	55045.4938	.0004	AG				-Ir	61	16)
U-B1 1505-0372164	54684.4375	.0008	AG				-Ir	60	16)
	54718.3715	.0009	AG				-Ir	63	16)
	54718.5284	.0003	AG				-Ir	62	16)
	55058.5097	.0010	AG				-Ir	50	16)
U-B1 1508-0029126	55029.4660	.0004	AG	+0.0001		IBVS 5900 No.5	-Ir	43	16)
	55096.4069	.0011	AG	+0.0011	s	IBVS 5900 No.5	-Ir	48	16)
	55096.5655	.0009	AG	+0.0007		IBVS 5900 No.5	-Ir	48	16)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
U-B1 1508-0029126	55108.3303	.0013	AG	−0.0006		IBVS 5900 No.5	-Ir	46	16)
	55108.4895	.0014	AG	−0.0004	s	IBVS 5900 No.5	-Ir	46	16)
	55374.5020	.0022	AG	+0.0017		IBVS 5900 No.5	-Ir	38	16)
U-B1 1514-0040346	53671.4614	.0189	AG				-Ir	25	4)
	54388.3730	.0020	AG				-Ir	40	4)
	54388.6077	.0021	AG				-Ir	40	4)
	55081.4766	.0026	AG				-Ir	46	16)
	55081.4766	.0026	AG				-Ir	46	16)
	55154.3110	.0030	AG				-Ir	45	16)
	55154.3110	.0030	AG				-Ir	45	16)
	55154.5402	.0025	AG				-Ir	45	16)
	55154.5402	.0025	AG				-Ir	45	16)

Table 2: Times of maxima of pulsating stars

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
GP And	55101.288	.000	DIE	+0.004	GCVS 2009	o	36	19)
	55102.312	.001	DIE	+0.005	GCVS 2009	o	93	19)
	55102.391	.001	DIE	+0.005	GCVS 2009	o	93	19)
	55185.3214	.0004	WN	+0.0043	GCVS 2009	V	202	13)
	55185.4002	.0007	WN	+0.0044	GCVS 2009	V	202	13)
	55194.3704	.0014	WN	+0.0048	GCVS 2009	V	65	13)
	55244.2546	.0060	WN	+0.0041	GCVS 2009	V	58	13)
WY Ant	54973.3600	.0020	HND	+0.0030	GCVS 2009	o	44	7)
	54992.3150	.0030	HND	+0.0048	GCVS 2009	o	46	7)
CY Aqr	55063.4284	.0003	RDL	−0.0023	GCVS 2009	o	111	14)
	55063.4918	.0001	RDL	+0.0000	GCVS 2009	o	111	14)
V378 Aur	55307.3543	.0030	MZ			-Ir	140	5) 1)
	55308.3619	.0050	MZ			-Ir	73	5)
	55311.3761	.0030	MZ			-Ir	234	5) 1)
SV Boo	55378.4597	.0010	MZ	+0.0049	GCVS 2009	-Ir	92	5)
TV Boo	55294.486	.001	AG	+0.081	GCVS 2009	-Ir	152	16)
UU Boo	55316.422	.001	AG	+0.228	GCVS 2009	-Ir	56	16)
	55353.4305	.0035	PGL	+0.2261	GCVS 2009	V	147	15)
UY Boo	55311.5195	.0028	PGL	+0.0049	BAVR 48,121	o	304	15)
	55311.5200	.0035	PGL	+0.0054	BAVR 48,121	o	306	15)
VY Boo	55309.4440	.0020	MZ			-Ir	134	5)
WW Boo	55315.560	.001	AG	+0.144	GCVS 2009	-Ir	50	16)
	55353.4187	.0009	MZ	+0.1403	GCVS 2009	-Ir	100	5)
AE Boo	55311.3750	.0040	FR	+0.0921	GCVS 2009	-Ir	97	10)
AY Boo	55294.336	.001	AG	+0.099	GCVS 2009	-Ir	63	16)
CM Boo	55310.369	.001	AG	−0.114	GCVS 2009	-Ir	36	16)
CQ Boo	55311.4878	.0035	PGL	−0.0550	BAVR 48,189	V	291	18)
	55339.3934	.0020	MZ	−0.0559	BAVR 48,189	-Ir	107	5)
	55339.4188	.0020	MZ	−0.0305	BAVR 48,189	-Ir	107	5)
CS Boo	55352.4728	.0028	PGL	−0.0010	IBVS 2855	V	225	18)
UY Cam	55263.531	.001	AG	+0.072	BAVR 49,41	-Ir	62	16)
SX Cnc	55263.322	.002	SB	+0.184	GCVS 2009	V	145	17)
	55265.360	.003	SB	+0.181	GCVS 2009	V	109	17)
EF Cnc	55275.351	.001	AG			-Ir	18	16)
EZ Cnc	55275.486	.001	AG			-Ir	27	16)
RU CVn	55315.410	.001	AG	+0.003	BAVR 52.89	-Ir	61	16)
RZ CVn	55315.403	.001	AG	+0.146	BAVR 48,189	-Ir	61	16)
SS CVn	55294.424	.001	AG	+0.156	GCVS 2009	-Ir	154	16)
RZ Cep	53620.3343	.0005	SG	+0.0852	GCVS 2009	-IrV	68	6) 2)
	53620.3641	.0003	SG	+0.1150	GCVS 2009	-IrV	68	6) 2)
	55382.4473	.0030	MZ	−0.0862	GCVS 2009	-Ir	109	5) 3)
S Com	55310.510	.001	AG	+0.012	SAC Vol.73	-Ir	40	16)

Table 2: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
U Com	55310.513	.001	AG	+0.007	BAVR 49,41	-Ir	40	16)
AG Com	55310.403	.002	AG	−0.007	GCVS 2009	-Ir	40	16)
SU CrB	55340.433	.001	AG	+0.016	GCVS 2009	-Ir	25	16)
TV CrB	55281.424	.001	AG	+0.002	BAVR 49,105	-Ir	58	16)
VX CrB	55067.3666	.0003	RAT RCR			-U-I	106	20)
XX Cyg	55125.2500	.0015	WN	+0.0021	GCVS 2009	V	102	13)
	55130.2419	.0008	WN	+0.0040	GCVS 2009	V	71	13)
CD Del	55377.534	.005	AG	−0.014	GCVS 2009	-Ir	25	16)
CH Del	55377.468	.005	AG	+0.067	GCVS 2009	-Ir	28	16)
AV Dra	55357.439	.003	AG	+0.052	GCVS 2009	-Ir	34	16)
BK Dra	55350.4329	.0021	PGL	+0.0700	BAVR 46,1	V	122	18)
DD Dra	55353.421	.001	AG	−0.009	BAVR 49,6	-Ir	120	16)
RR Gem	55223.3195	.0021	PGL	−0.0117	BAVR 47,67	V	316	18)
GU Gem	54858.428	.004	FR	−0.116	GCVS 2009	-Ir	44	16)
AR Her	55294.4135	.0021	PGL	+0.0301	BAVR 52,3	V	235	18)
	55311.3766	.0028	PGL	+0.0738	BAVR 52,3	V	311	18)
	55387.4901	.0035	PGL	+0.0498	BAVR 52,3	V	303	15)
	55388.4214	.0021	PGL	+0.0411	BAVR 52,3	V	228	15)
	55394.5183	.0035	PGL	+0.0283	BAVR 52,3	V	371	15)
GS Her	55372.513	.002	AG	−0.054	GCVS 2009	-Ir	32	16)
GZ Her	55340.461	.001	AG	−0.100	GCVS 2009	-Ir	26	16)
HN Her	55372.525	.001	AG	−0.158	GCVS 2009	-Ir	32	16)
HP Her	55372.409	.001	AG	−0.027	GCVS 2009	-Ir	32	16)
LN Her	55374.414	.003	AG			-Ir	35	16)
V633 Her	55337.4305	.0010	MZ	−0.0544	GCVS 2009	-Ir	92	5)
CZ Lac	55130.3324	.0010	WN	−0.1491	BAVR 53,12	V	114	13)
	55155.3811	.0019	WN	−0.1671	BAVR 53,12	V	170	13)
	55185.2065	.0040	WN	−0.1624	BAVR 53,12	V	75	13)
	55194.2819	.0023	WN	−0.1629	BAVR 53,12	V	197	13)
RR Leo	55294.3323	.0014	PGL	+0.0049	A&A 476.307 2007	V	108	18)
SZ Leo	55280.555	.002	AG	−0.171	BAVR 49,105	-Ir	105	16)
WW Leo	55295.376	.001	AG	+0.038	GCVS 2009	-Ir	68	16)
AQ Leo	55280.553	.001	AG	+0.099	GCVS 2009	-Ir	100	16)
BS Leo	55265.4598	.0030	MZ	−0.0037	GCVS 2009	-Ir	83	5)
CM Leo	55293.3718	.0030	MZ	−0.0022	GCVS 2009	-Ir	135	5)
	55310.3679	.0020	MZ	−0.0075	GCVS 2009	-Ir	108	5)
DM Leo	55288.4021	.0040	MZ			-Ir	151	5)
	55297.3883	.0040	MZ			-Ir	92	5)
	55306.3746	.0040	MZ			-Ir	70	5)
SZ Lyn	55303.4269	.0023	WN	+0.0303	GCVS 2009	V	92	13)
TW Lyn	55280.352	.001	AG	+0.058	GCVS 2009	-Ir	51	16)
AN Lyn	55311.4327	.0021	PGL			o	290	15)
BE Lyn	55304.3341	.0015	WN			V	70	13)
	55306.3510	.0014	PGL			o	707	15)
	55310.3759	.0009	WN			V	110	13)
CN Lyr	55353.4226	.0069	PGL	−0.0067	A&A 476.307 2007	V	432	15)
DD Lyr	55375.4231	.0010	MZ	−0.1603	GCVS 2009	-Ir	98	5)
EX Lyr	55384.4592	.0040	MZ	−0.0794	GCVS 2009	-Ir	94	5)
DY Peg	55185.2524	.0006	WN	−0.0101	GCVS 2009	V	55	13)
	55189.1908	.0027	WN	−0.0097	GCVS 2009	V	41	13)
	55192.1799	.0008	WN	−0.0106	GCVS 2009	V	172	13)
	55192.2538	.0013	WN	−0.0096	GCVS 2009	V	172	13)
	55378.5066	.0021	PGL	−0.0105	GCVS 2009	V	106	15)
AR Per	55225.3287	.0021	PGL	+0.0584	GCVS 2009	V	229	18)
	55265.3305	.0008	WN	+0.0585	GCVS 2009	V	58	13)
V378 Per	55265.3369	.0010	MZ	+0.0922	GCVS 2009	-Ir	90	5)
BH Ser	55340.4154	.0010	MZ	+0.1028	GCVS 2009	-Ir	100	5)
TU UMa	55258.3266	.0035	PGL	−0.0346	GCVS 2009	V	299	18)
	55293.4597	.0005	QU	−0.0340	GCVS 2009	V	112	6)
	55341.4179	.0017	SCI	−0.0344	GCVS 2009	o	86	5)

Table 2: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
UU UMa	55311.528	.001	AG	+0.013	GCVS 2009	-Ir	140	16)
UZ UMa	55263.423	.003	AG	+0.003	GCVS 2009	-Ir	60	16)
AE UMa	55259.4108	.0014	PGL	+0.0061	BAVR 48,189	V	306	18)
AE UMa	55293.3826	.0010	ALH	+0.0012	BAVR 48,189	V	94	8)
	55293.4752	.0007	ALH	+0.0078	BAVR 48,189	V	94	8)
	55302.3318	.0009	WN	+0.0046	BAVR 48,189	V	49	13)
	55303.3591	.0014	WN	−0.0003	BAVR 48,189	V	53	13)
	55304.3959	.0007	WN	+0.0043	BAVR 48,189	V	180	13)
	55304.4775	.0010	WN	−0.0001	BAVR 48,189	V	180	13)
	55305.3388	.0007	WN	+0.0010	BAVR 48,189	V	163	13)
	55305.4238	.0014	WN	+0.0000	BAVR 48,189	V	163	13)
	55309.3848	.0008	WN	+0.0042	BAVR 48,189	V	60	13)
	55310.4124	.0019	WN	−0.0004	BAVR 48,189	V	63	13)
	55311.3662	.0007	ALH	+0.0073	BAVR 48,189	V	75	8)
	55311.4488	.0005	ALH	+0.0038	BAVR 48,189	V	75	8)
AX UMa	55311.367	.001	AG	−0.191	GCVS 2009	-Ir	35	16)
MO UMa	55311.443	.001	AG	−0.085	GCVS 2009	-Ir	35	16)
GSC 02671-02149	54697.433	.001	AG			-Ir	38	16)
	54697.551	.001	AG			-Ir	38	16)
GSC 02977-00238	55265.3638	.0009	WN			V	235	13)
	55265.4401	.0010	WN			V	235	13)
	55265.5150	.0022	WN			V	235	13)
	55293.3068	.0010	WN			V	143	13)
	55293.3822	.0011	WN			V	143	13)
	55303.3300	.0008	WN			V	47	13)
	55309.3292	.0010	WN			V	54	13)
GSC 03197-00817	54312.502	.003	AG			-Ir	26	4)
	55032.441	.005	AG			-Ir	44	16)
GSC 03755-00845	55265.2903	.0008	WN			V	53	13)
	55266.2808	.0011	WN			V	166	13)
	55266.3577	.0005	WN			V	166	13)
	55279.2934	.0004	WN			V	111	13)
U-A2 1200-07442272	55281.488	.002	AG			-Ir	55	16)
U-A2 1425-00752967	55074.494	.002	AG	−0.037	IBVS 5700 No.59	-Ir	37	16)
U-B1 1646-0035146	54834.466	.005	AG			-Ir	169	16)

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HND.	Hund, F., Hakos Farm (Namibia)
JU:	Jungbluth, Dr. H., Karlsruhe
MS:	Moschner, W., Lennestadt
MZ:	Maintz, Dr. G., Bonn
PGL:	Pagel, Dr. L., Klockenhagen
QU:	Quester, W., Esslingen
RAT:	Rätz, M., Herges-Hallenberg
RCR:	Rätz, K., Herges-Hallenberg
RDL:	Rudolph, E., Jena
SB:	Steinbach, Dr. H., Neu-Anspach
SCI:	Schmidt, U., Karlsruhe
SG:	Sterzinger, P., Wien (A)
SIR:	Schirmer, J., Willisau (CH)
WN:	Wischnewski, M., Wennigsen
WTR:	Walter, F., München

Remarks:

:	uncertain
s	secondary minimum
1)	assembled from the observations of two nights
2)	double maximum
3)	double maxima: time of the second maximum
	CCD-Cameras
4)	ccd-camera ST-6: chip 375×242 uncoated
5)	ccd-camera ST-7
6)	ccd-camera ST-7E
7)	ccd-camera ST-8XME
8)	ccd-camera ST-8XMEI: chip KAF1603ME
9)	ccd-camera ST-9XE: chip 512×512
10)	ccd-camera OES-LcCCD12
11)	ccd-camera Pictor 1616XT
12)	ccd-camera Pictor 416XT
13)	ccd-camera Meade DSI Pro 2
14)	ccd-camera Meade 1616XTE
15)	ccd-camera Artemis 4021
16)	ccd-camera Sigma 1603
17)	ccd-camera Sigma 402ME
18)	ccd-camera AlCCD6c
19)	ccd-camera Canon EOS 450D
20)	ccd-camera Moravian G2-1600
	Filter
o	without filter
B	B-filter
V	V-filter
R	R-filter
-Ir	-Ir-filter
-U-I	-U-Ir-filter
m	multiple filter

References:

A&A	Astronomy & Astrophysics
AJ vvv,ppp	Astronomical Journal volume, pages
BAVM nnn	BAV Mitteilungen No. nnn
BAVR vv,ppp	BAV Rundbrief volume, pages
GCVS 2009	General Catalogue of Variable Stars, version: iii.dat 20.11.2009
IBVS nnnn	Information Bulletin on Variable Stars No. nnnn
PZP vol.n	Peremennye Zvezdy Prilozhenie Vol, No.
SAC vv	Rocznik Astronomiczny No. vv, Krakow (SAC)
	Star catalogues
GSC	The HST Guide star Catalogue 1.2
U-A2	USNO A2.0 catalogue
U-B1	USNO B1.0 catalogue

ERRATUM FOR IBVS 5959 (BAVM 214)

UY Boo	55311.5195 PGL	has to be deleted

ERRATUM FOR IBVS 5959 (BAVM 214)

GW Boo	55310.4066 AG	has to be deleted
	55310.5829 AG	has to be deleted

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TIMINGS OF MINIMA OF ECLIPSING BINARIES

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The following Table lists timings of minima of eclipsing binaries secured by CCD photometry, obtained in the second half of 2010. The given O-C values generally refer to the linear elements of the 2009 electronic version of the GCVS (Samus et al., 2009), except for the cases stated in the remarks, where the determination of current elements made use of the up-to-date ASAS data (`http://www.astrouw.edu.pl/asas/`) and the Lafler-Kinman algorithm of the PERANSO software (`http://www.peranso.com/`). All times given are heliocentric UTC.

Table 1: Minima of eclipsing binaries

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
WZ And	p	55518.7191	0.0003	+0.0016	32	RD	V
AA And	p	55497.7094	0.0004	−0.0062	41	RD	V; d=0.045d
AP And	s	55513.6845	0.0002	+0.0005	31	RD	V
BD And	p	55497.6850	0.0005	−0.0167	41	RD	V
BX And	p	55478.9054	0.0007	−0.0063	14	RD	V
CN And	s	55518.6751	0.0006	−0.0056	28	RD	V
CP And	p	55543.7247	0.0009	−0.0151	25	RD	V
DK And	s	55498.6807	0.0010	+0.0088	24	RD	V
EP And	p	55477.8946	0.0001	−0.0126	30	RD	V
GK And	p	55501.7107	0.0007	+0.0569	25	RD	V
GZ And	s	55533.6651	0.0003	−0.0016	20	RD	V
HS And	p	55527.7247	0.0002	+0.0031	30	RD	V; d=0.024d
LO And	p	55502.6997	0.0004	−0.0046	28	RD	V; d=0.020d
LY And	s	55533.6506	0.0003	+0.0137	36	RD	V
MO And	p	55543.6483	0.0005	+0.0037	23	RD	V
QW And	p	55469.9016	0.0007	+0.0144	12	RD	V
QX And	p	55542.6796	0.0005	+0.0238	32	RD	V
V412 And	p	55523.7051	0.0003	−0.0059	33	RD	V; el: 2451507.720 + 1.908741 * E
V422 And	p	55506.6502	0.0007	−0.0018	30	RD	V
V449 And	p	55532.5959	0.0015	−0.1689	7	RD	V
	s	55532.7638	0.0013	−0.1703	12	RD	V
V463 And	p	55503.7086	0.0005	−0.0694	31	RD	V; el: IBVS 5699; d=0.023d
GSC 1731-551	p	55511.7327	0.0004	+0.0032	14	RD	V; el: 2454273.900 + 0.422756 * E
GSC 1734-408	s	55511.6846	0.0003	+0.0005	18	RD	V; el: 2454408.538 + 0.268177 * E
GSC 1739-1463	p	55526.6616	0.0002	−0.0032	20	RD	V; el: 2454678.875 + 0.359233 * E; d=0.026d
GSC 2805-766	s	55527.5822	0.0007	+0.0841	9	RD	V; el: PZ 28,2
GSC 2822-1558	p	55469.8406	0.0003	−0.0185	23	RD	V; el: OEJV 104
GSC 3243-336	p	55506.7059	0.0009	+0.0607	24	RD	V; el: PZ 28, 2
GSC 3303-1583	s	55478.8982	0.0001	+0.0377	40	RD	V; el: OEJV 104
GSC 3638-2422	s	55506.6741	0.0005	−0.0053	28	RD	V; el: IBVS 5920
GSC 3641-587	p	55501.6967	0.0005	−0.0068	28	RD	V; el: IBVS 5920
GSC 3644-1562	p	55500.6834	0.0012	+0.0171	20	RD	V; el: 2451483.589 + 0.412558 * E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
CZ Aqr	p	55508.6457	0.0002	−0.0151	27	RD	V
EK Aqr	s	55503.6954	0.0006	+0.0128	41	RD	V
EL Aqr	p	55506.6662	0.0005	+0.1467	31	RD	V
GK Aqr	s	55480.6083	0.0024	+0.0191	11	RD	V
GM Aqr	p	55478.6886	0.0003	−0.0373	19	RD	V
GS Aqr	p	55480.7208	0.0009	+0.0231	24	RD	V
GSC 562-111	p	55478.6888	0.0001	0.0047	36	RD	V; el: 2452787.908 + 1.551774 * E
GSC 5210-437	p	55476.7022	0.0005	−0.0017	19	RD	V; el: 2454661.739 + 1.073755 * E
GSC 5802-335	p	55480.6945	0.0005	+0.0287	25	RD	V; el: 2452876.679 + 1.080941 * E
RX Ari	p	55532.6411	0.0002	+0.0651	28	RD	V
SS Ari	p	55538.6538	0.0003	−0.0076	17	RD	V
AW Ari	p	55538.7258	0.0005	−0.0142	18	RD	V; el: IBVS 5219
GSC 636-555	p	55542.7304	0.0005	+0.0025	21	RD	V; el: 2454805.578 + 0.484967 * E
GSC 645-85	p	55544.6560	0.0004	+0.0075	22	RD	V; el: 2454387.697 + 0.355220 * E
GSC 1209-1201	p	55469.8556	0.0002	+0.0285	27	RD	V; el: IBVS 5920
GSC 1210-442	s	55469.8716	0.0007	−0.0007	25	RD	V; el: 2455063.860 + 0.337915 * E
GSC 1213-1483	s	55477.8521	0.0005	+0.0328	20	RD	V; el: 2453654.676 + 0.346282 * E
GSC 1217-696	p	55538.7115	0.0004	−0.0048	27	RD	V; el: IBVS 5920; d=0.033d
GSC 1221-1118	p	55545.7239	0.0004	−0.0036	18	RD	V; el: IBVS 5920; d=0.025d
GSC 1240-657	s	55545.6914	0.0005	+0.0003	34	RD	V; el: IBVS 5945
GSC 1761-1934	s	55477.8592	0.0002	+0.0014	22	RD	V; el: 2452872.855 + 0.299374 * E
	p	55478.9091	0.0008	+0.0034	23	RD	V
GSC 1774-845 Ari	p	55532.6622	0.0004	−0.0126	21	RD	V; el: 2454823.626 + 0.468019 * E
AH Aur	s	55538.8843	0.0005	+0.1244	35	RD	V
EP Aur	p	55538.8781	0.0003	+0.0243	31	RD	V; el: IBVS 4099
HP Aur	s	55526.8674	0.0001	+0.0601	22	RD	V
HU Aur	s	55508.8874	0.0003	−0.0159	35	RD	V; el: IBVS 3666
MT Aur	p	55528.8704	0.0008	+0.0135	24	RD	V
V404 Aur	p	55528.8645	0.0003	+0.0309	23	RD	V; el: IBVS 4245; d=0.026d
V410 Aur	s	55508.9206	0.0005	+0.0038	22	RD	V; el: IBVS 5668, d=0.030d
V555 Aur	p	55518.9287	0.0009	+0.0158	21	RD	V; formerly ES Tau
GSC 2393-680	s	55508.9000	0.0004	+0.0083	25	RD	V; el: IBVS 5699
GSC 2898-2213	p	55506.8566	0.0004	+0.0028	29	RD	V; el: OEJV 91; d=0.06d
GSC 3751-178	s	55528.9341	0.0003	+0.0043	20	RD	V; el.: IBVS 5920
GM Boo	p	55398.4414	0.0008	+0.0576	25	EBl	C; el: IBVS 5125
GN Boo	p	55398.4813	0.0004	+0.0081	19	EBl	C; el: IBVS 5125
GQ Boo	p	55398.5129	0.0010	−0.0084	17	EBl	C; el: IBVS 5125
GR Boo	s	55398.4769	0.0003	−0.0022	18	EBl	C; el: IBVS 5125
WW Cam	p	55544.7137	0.0003	−0.0251	27	RD	V
AO Cam	p	55476.8130	0.0009	−0.0495	8	RD	V; el: PASP 97, 648
AQ Cam	p	55511.9223	0.0003	+0.0268	23	RD	V; d=0.031d
CP Cam	p	55559.6858	0.0003	−0.0194	38	RD	V; el: Hipparcos
LR Cam	p	55539.8908	0.0005	−0.0634	23	RD	V; el: IBVS 5132
MT Cam	p	55503.8891	0.0004	+0.0024	25	RD	V; el: IBVS 5871
MX Cam	p	55497.8500	0.0003	−0.1345	37	RD	V; el: IBVS 5557
	p	55511.8350	0.0005	−0.1351	17	RD	V
NO Cam	p	55480.8973	0.0002	+0.0063	30	RD	V; el: IBVS 5894
NR Cam	p	55559.8184	0.0008	+0.0056	8	RD	V; el: IBVS 5894
	s	55559.9459	0.0004	+0.0052	21	RD	V
GSC 3715-1039	s?	55497.9437	0.0008	+0.0910	24	RD	V; el: IBVS 5920; pulsator?
GSC 3722-650	s	55545.6214	0.0020	+0.0087	44	RD	V; el: 2451420.645 + 2.90593 * E
GSC 4346-929	p	55526.8711	0.0003	−0.0081	21	RD	V; el: OEJV 83
GSC 4362-272	p	55539.8729	0.0003	+0.0099	25	RD	V; el. OEJV 83; d=0.033d
GSC 4533-110	s	55540.0054	0.0002	+0.0863	8	RD	V; el: OEJV 83
NSV 3715	p	55559.9372	0.0006	0.0085	21	RD	V; el: IBVS 5894

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
EF CVn	p	55398.4168	0.0003	−0.0075	16	EBl	C; el: IBVS 5269
EG CVn	s	55398.4390	0.0006	+0.0471	24	EBl	C; el: IBVS 5269
GSC 5383-1971	p	55543.8813	0.0003	+0.0047	29	RD	V; el: 2454463.794 + 0.374249 * E
GSC 5391-1821	p	55544.9308	0.0019	−0.0044	16	RD	V; el: 2454842.741 + 1.823881 * E; non-circ.
	s	55545.8950	0.0007	+0.0478	28	RD	V
GSC 5948-2942	s	55533.8637	0.0001	−0.0111	26	RD	V; el: 2454213.496 + 0.320597 * E
GSC 5950-993	s	55542.9148	0.0007	−0.0218	20	RD	V; el. 2454157.669 + 1.161650 * E
CW CMi	p	55559.9216	0.0002	+0.0024	19	RD	V; el: IBVS 5871
GSC 4833-1925	p		0.0006	−0.0105	26	RD	V; el: 2454461.780 + 0.660754 * E; d=0.057d
TX Cas	p	55503.7706	0.0007	−0.1582	78	RD	V
AL Cas	p	55532.6322	0.0004	+0.0046	25	RD	V
BH Cas	s	55526.6654	0.0006	+0.0285	20	RD	V; el: IBVS 4482
BW Cas	p	55478.7628	0.0003	+0.0138	33	RD	V; el: 2450710.303 + 1.26283 * E
CR Cas	p	55502.6830	0.0004	+0.1380	43	RD	V
CW Cas	p	55518.6578	0.0001	−0.0588	15	RD	V; el: JAAVSO 21, 34
EG Cas	p	55508.6614	0.0006	−0.2073	26	RD	V
ES Cas	p	55513.6482	0.0005	−0.4653	18	RD	V
GG Cas	p	55480.8348	0.0011	−0.0622	63	RD	V
GK Cas	s	55532.6868	0.0011	−0.3333	45	RD	V
GR Cas	p	55484.9126	0.0002	−0.0425	39	RD	V
HQ Cas	p	55528.7252	0.0005	−0.5530	28	RD	V
IR Cas	p	55502.6530	0.0008	+0.0094	37	RD	V
LQ Cas	p	55523.6121	0.0006	−0.2754	12	RD	V
MM Cas	p	55527.6779	0.0005	+0.0955	39	RD	V
MN Cas	s	55469.8852	0.0006	+0.0050	19	RD	V
MR Cas	p	55513.7423	0.0004	−0.0486	19	RD	V
MS Cas	p	55511.6627	0.0004	+0.0410	29	RD	V; el: IBVS 5690, d=0.017d
MT Cas	p	55517.7157	0.0003	+0.0148	29	RD	V
MV Cas	p	55506.6922	0.0002	−0.0930	26	RD	V; d=0.027d
NN Cas	p	55511.7094	0.0028	+0.1025	24	RD	V
NV Cas	p	55526.6890	0.0003	−0.1134	18	RD	V
NZ Cas	p	55523.7647	0.0006	−0.1860	11	RD	V
OR Cas	p	55527.6549	0.0001	−0.0240	36	RD	V
OX Cas	p	55518.6605	0.0005	+0.0274	41	RD	V; non-circ.
V336 Cas	p	55513.7242	0.0001	−0.0152	27	RD	V
V345 Cas	p	55502.6590	0.0006	−0.0151	26	RD	V
V350 Cas	p	55498.6630	0.0006	−0.0518	15	RD	V
V357 Cas	p	55511.5831	0.0008	+0.2471	10	RD	V
V359 Cas	p	55502.7235	0.0009	+0.0098	21	RD	V; el: IBVS 5016
V362 Cas	p	55517.7285	0.0004	−0.0020	30	RD	V; el: OEJV 72
V366 Cas	s	55528.6798	0.0001	+0.0729	45	RD	V; el: 4798; d=0.026d
V380 Cas	p	55517.6612	0.0005	−0.0652	44	RD	V
V381 Cas	s	55511.6786	0.0006	−0.0291	35	RD	V
V399 Cas	p?	55497.658	0.003	−0.065	42	RD	V
V419 Cas	p	55469.8640	0.0012	+0.0389	28	RD	V
V448 Cas	p	55518.7584	0.0010	+0.2384	17	RD	V
V471 Cas	p	55542.7217	0.0003	−0.0362	21	RD	V
V520 Cas	s	55503.6641	0.0009	−0.1909	43	RD	V; el: BBSAG Bull. 117, 9
V523 Cas	p	55517.5877	0.0003	+0.0372	10	RD	V; el: MNRAS 317, 111
	s	55517.7045	0.0001	+0.0371	23	RD	V
V541 Cas	s	55478.8709	0.0002	+0.0219	37	RD	V; el: IBVS 2652
V608 Cas	p	55542.7275	0.0002	+0.0059	26	RD	V; el: IBVS 5151; d=0.016d
V651 Cas	s	55513.7449	0.0006	+0.0032	19	RD	V; el: IBVS 3554
V959 Cas	p	55517.6659	0.0005	+0.0141	43	RD	V; el: 2451335.8533 + 1.065155 * E
V961 Cas	s	55517.6429	0.0002	+0.0011	34	RD	V; el: 2452668.3556 + 0.759911 * E
V1009 Cas	p	55523.7562	0.0007	+0.1852	14	RD	V; d=0.03d
V1018 Cas	p	55543.6722	0.0011	−0.0152	30	RD	V; el: IBVS 5894, non-circ.
GSC 4017-1018	s	55517.6338	0.0017	−0.0133	32	RD	V; el: OEJV 91
NSV 18	p	55518.6451	0.0003	+0.0029	34	RD	V; el: 2451478.49 + 1.940515 * E
NSV 49	s	55506.6682	0.0013	+0.0016	17	RD	V; el: IBVS 5871

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
WZ Cep	p	55503.6700	0.0002	−0.0919	49	RD	V; el: A&AS 131, 17; d=0.022d
CO Cep	s	55513.7043	0.0003	+0.0153	35	RD	V; non-circ.
DK Cep	p	55476.7328	0.0008	+0.0336	27	RD	V
DP Cep	p	55498.6613	0.0003	−0.0566	24	RD	V
EF Cep	s	55500.9186	0.0009	+0.0362	27	RD	V; el: 2431860.546 + 0.606077 * E; d=0.05d
	p	55513.9523	0.0003	+0.0392	27	RD	V; d=0.03d
EK Cep	p	55469.6966	0.0016	+0.0119	19	RD	V; non-circ.
GW Cep	p	55469.8737	0.0006	−0.0025	15	RD	V; el: IBVS 4293
KP Cep	p	55469.7138	0.0008	+0.0423	20	RD	V
LL Cep	p	55498.6838	0.0005	+0.0005	25	RD	V
MT Cep	s	55477.6877	0.0002	−0.0001	36	RD	V; el: IBVS 5920
NN Cep	s	55497.725	0.003	+0.002	34	RD	V
NR Cep	s	55517.7204	0.0003	−0.0523	35	RD	V
V338 Cep	p	55383.7636	0.0007	+0.0333	21	RD	V
V358 Cep	s	55543.7255	0.0007	+0.0220	25	RD	V; el: BBSAG Bull. 96, 10; d=0.044d
V489 Cep	s	55383.7851	0.0005	+0.1150	27	RD	V; el: IBVS 4406
V743 Cep	p	55476.7280	0.0015	+0.0516	27	RD	V; el: IBVS 5586; non-circ.
V744 Cep	s	55484.6798	0.0019	+0.0242	24	RD	V; el: IBVS 5920
GSC 4286-49	s	55500.6767	0.0026	−0.0582	20	RD	V; el: IBVS 5570; non-circ.
GSC 4477-706	p	55502.6818	0.0004	+0.0015	41	RD	V; el: OEJV 83
GSC 4482-981	p	55500.7226	0.0011	−0.0044	15	RD	V; el: OEJV 83
GSC 4482-1238	p	55502.7168	0.0001	+0.0178	29	RD	V; el: OEJV 91
GSC 4490-777	s	55508.6382	0.0005	−0.0519	25	RD	V; el: OEJV 83; d=0.04d
GSC 4502-138	s	55518.7155	0.0003	+0.0495	34	RD	V; el: 2453433.636 + 0.39292 * E; d=0.02d
GSC 4614-887	s	55508.6900	0.0013	+0.0166	23	RD	V; el: OEJV 83
GSC 4620-1830	p	55480.9135	0.0008	+0.0007	25	RD	V; el: OEJV 83
SS Cet	p	55545.767	0.005	+0.021	30	RD	V
TT Cet	s	55533.6967	0.0002	−0.0625	36	RD	V; d=0.03d
VX Cet	p	55477.9083	0.0003	−0.0006	39	RD	V; el: 2454348.806 + 2.720730 * E; d=0.04d
DY Cet	p	55543.6546	0.0006	−0.0100	20	RD	V; el: IBVS 5806
GSC 28-697	p	55528.5909	0.0005	+0.0032	9	RD	V; el: 2454729.866 + 0.267131 * E
	s	55528.7238	0.0004	+0.0026	16	RD	V
GSC 43-686	s	55477.8599	0.0003	−0.0035	33	RD	V; el: 2454376.762 + 0.444620 * E
GSC 44-1314	s	55478.9047	0.0015	−0.0296	16	RD	V; el: 2454707.828 + 0.358644 * E
GSC 54-373	s	55538.6634	0.0007	+0.0047	31	RD	V; el: 2453015.629 + 0.880485 * E; d=0.08d
GSC 4687-79	p	55533.6280	0.0008	−0.0113	23	RD	V; el: 2453716.543 + 0.349173 * E; d=0.03d
GSC 4688-485	p	55538.6664	0.0007	+0.0120	28	RD	V; el: 2454697.848 + 0.387647 * E
GSC 4689-252	s	55532.6851	0.0005	+0.0066	44	RD	V; el: 2453561.918 + 0.573479 * E
GSC 4691-773	s	55533.6542	0.0003	+0.0089	44	RD	V; el: 2454707.847 + 0.584636 * E
GSC 4708-841	s	55484.9202	0.0002	−0.0081	31	RD	V; el: 2454430.781 + 0.361939 * E
GSC 5268-1013	p	55523.6312	0.0003	−0.0081	22	RD	V: el: 2453670.575 + 0.402665 * E; d=0.026d
GSC 5270-645	s	55527.7092	0.0005	0.0024	36	RD	V; el: OEJV 116
V679 Cyg	p	55477.730	0.003	−0.200	19	RD	V
RU Eri	p	55500.8497	0.0008	−0.0271	18	RD	V
UX Eri	p	55544.7025	0.0004	+0.0136	33	RD	V; el: 2454828.669 + 0.445286 * E
YY Eri	s	55476.9003	0.0009	0	24	RD	V; el: 2454197.495 + 0.321499 * E
ZZ Eri	p	55502.8724	0.0005	−0.0094	18	RD	V
AA Eri	s	55476.8857	0.0009	−0.0239	22	RD	V; el: Krakau catalogue
AM Eri	p	55508.8599	0.0006	−0.0979	14	RD	V
BC Eri	s	55506.8897	0.0004	+0.0018	21	RD	V; el: 2453012.727 + 0.527251 * E
BL Eri	p	55476.9055	0.0022	+0.0686	27	RD	V; el: IBVS 4104
BV Eri	p	55545.6781	0.0007	−0.0079	23	RD	V; el: 2454508.551 + 0.507653 * E
BZ Eri	p	55511.8554	0.0004	+0.0031	22	RD	V
GSC 4700-802	p	55544.6641	0.0004	−0.0010	29	RD	V; el: 2454740.773 + 0.792793 * E; d=0.036d
GSC 4725-661	s	55503.8993	0.0009	−0.0271	39	RD	V; el: 2453707.673 + 0.748907 * R; d=0.04d
GSC 4732-1231	p	55500.9166	0.0006	−0.0006	16	RD	V; el: 2453719.742 + 0.353829 * E
GSC 4734-713	p	55503.9240	0.0004	−0.0117	24	RD	V; el: 2454725.883 + 0.465621 * E
GSC 5294-1116	p	55484.8774	0.0002	+0.0020	35	RD	V; el: 2455093.796 + 0.360110 * E
GSC 5303-939	s	55497.8809	0.0007	−0.0046	36	RD	V; el: 2455057.899 + 0.568091 * E
GSC 5305-396	p	55559.6320	0.0004	−0.0238	23	RD	V; el: IBVS 5871

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC 5314-2102	p	55508.9031	0.0006	+0.0073	26	RD	V; el: 2455154.741 + 0.464770 * E
GSC 5314-2225	p	55511.9319	0.0006	+0.0003	15	RD	V; el: 2454610.533 + 0.468259 * E
GSC 5321-819	s	55500.8517	0.0005	−0.0034	24	RD	V; el: 2454838.739 + 0.353789 * E; d=0.027d
GSC 5322-2251	p	55513.8963	0.0004	+0.0109	22	RD	V; el: 2453478.481 + 0.489633 * E
GSC 5325-728	s	55506.9373	0.0006	+0.0067	18	RD	V; el: 2454519.622 + 0.431045 * E; d=0.04d
GSC5863-584	p	55543.6879	0.0005	+0.0058	27	RD	V; el: 2453651.711 + 0.366590 * E
TZ Gem	p	55538.8603	0.0010	−0.0007	24	RD	V; el: 2450047.6324 + 1.6777356 * E
WW Gem	s	55538.8724	0.0005	+0.0211	34	RD	V
AI Gem	s	55545.8804	0.0005	−0.0058	23	RD	V; el: 2451879.5741 + 0.7242098 * E
BT Gem	p	55528.9195	0.0004	−0.0082	42	RD	V
CV Gem	p	55542.887	0.003	+0.162	15	RD	V
DP Gem	p	55527.9162	0.0006	+0.1021	21	RD	V; d=0.04d
EN Gem	p	55542.8649	0.0008	−0.0436	19	RD	V; d=0.06d
FO Gem	p	55545.8693	0.0005	+0.2465	26	RD	V
GX Gem	s	55542.8837	0.0005	−0.0374	31	RD	V; el: OEJV 83
IN Gem	p	55542.813	0.005	−0.109	7	RD	V
KQ Gem	p	55533.8903	0.0006	−0.0852	19	RD	V
KV Gem	p	55544.9242	0.0004	+0.0238	21	RD	V; el: IBVS 5894; d=0.025d
V372 Gem	p	55545.8715	0.0010	−0.0402	18	RD	V; el: IBVS 5277
V380 Gem	p	55532.9093	0.0002	−0.0045	22	RD	V
V383 Gem	p	55544.8514	0.0002	−0.0023	18	RD	V; el: IBVS 5630
GSC 754-384	p	55539.8542	0.0005	+0.0057	18	RD	V; el: 2454886.605 + 0.317571 * E
	s	55540.0124	0.0015	+0.0051	6	RD	V
GSC 1328-1420	p	55538.8704	0.0004	+0.0005	22	RD	V; el: 2453765.648 + 0.302856 * E
GSC 1338-1529	p	55542.9199	0.0004	+0.0194	41	RD	V; el: 2453338.753 + 0.888053 * E; d=0.03d
GSC 1338-1984	s	55533.9534	0.0004	+0.0362	25	RD	V; el: OEJV 91
	p	55538.9432	0.0003	+0.0354	32	RD	V
GSC 1343-2440	s	55543.9518	0.0009	+0.0109	29	RD	V; el: 2453716.713 + 0.644184 * E
GSC 1352-763	p	55543.9395	0.0006	+0.0093	30	RD	V; el: 2454480.649 + 1.506064 * E
GSC 1369-98	s	55559.9295	0.0003	−0.0170	32	RD	V; el: 2453327.814 + 0.956970 * E
GSC 1864-1065	p	55523.9287	0.0004	−0.0064	25	RD	V; el: 2454089.641 + 0.361830 * E
GSC 1888-1148	s	55533.9404	0.0002	+0.0187	25	RD	V; el: IBVS 5945
GSC 1894-2977	p	55544.8876	0.0006	+0.0212	19	RD	V; el: IBVS 5945
NSV 3014	p	55532.9298	0.0004	+0.0350	37	RD	V; el: 2451565.855 + 2.44879 * E
TZ Lac	p	55484.7461	0.0012	+0.3615	26	RD	V
BP Lac	p	55484.6704	0.0009	−0.0402	27	RD	V
HR Lac	s	55469.6614	0.0005	−0.1094	19	RD	V
HW Lac	p	55480.6282	0.0016	−0.0444	32	RD	V
HX Lac	s	55477.745	0.003	+0.021	9	RD	V
HZ Lac	p	55476.7322	0.0015	+0.0356	27	RD	V
LY Lac	p	55469.7260	0.0002	+0.2292	22	RD	V
V344 Lac	p	55484.7156	0.0005	+0.0215	26	RD	V; el: BBSAG Bull. 127, 10
V441 Lac	p	55477.7211	0.0010	+0.0866	19	RD	V
RR Lep		55513.8586	0.0002	−0.0408	25	RD	V
GSC 5330-664	p	55526.9025	0.0003	−0.0352	21	RD	V; el: 2453806.568 + 0.298106 * E; d=0.014d
GSC 5345-815	s	55517.8821	0.0006	+0.0071	22	RD	V; el: 2454474.724 + 0.308853 * E; d=0.02d
GSC 5352-540	s	55523.9349	0.0004	+0.0038	19	RD	V; el: 2453666.814 + 0.515651 * E
GSC 5358-917	p	55518.9443	0.0001	+0.0006	25	RD	V; el: IBVS 5871; d=0.024d
NSV 2698	p	55528.9207	0.0004	+0.0080	21	RD	V; el: IBVS 5894; d=0.13:d
SX Lyn	p	55559.8814	0.0003	+0.0100	27	RD	V
RU Mon	s	55527.799:	0.008	−0.548	32	RD	V; non-circ.
XZ Mon	p	55543.8516	0.0002	+0.0214	20	RD	V
CC Mon	p	55538.8876	0.0003	+0.0362	33	RD	V; el: 2454832.752 + 1.619494 * E
CK Mon	p	55543.9125	0.0002	+0.2000	40	RD	V
CP Mon	p	55545.9528	0.0008	+0.0186	26	RD	V
EI Mon	p	55544.9255	0.0010	−0.0158	34	RD	V
GU Mon	p	55542.9187	0.0003	−0.0749	42	RD	V
V396 Mon	p	55533.8470	0.0002	−0.0840	17	RD	V; d=0.029d
V451 Mon	p	55533.8614	0.0017	+0.0737	26	RD	V
V507 Mon	p	55544.9351	0.0006	−0.0395	21	RD	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
V527 Mon	p	55543.9261	0.0003	−0.0273	36	RD	V
V560 Mon	p	55543.8592	0.0016	−0.1521	23	RD	V; close double
V714 Mon	p	55533.8936	0.0002	−0.0327	30	RD	V; el: IBVS 4468; d=0.016d
V843 Mon	p	55545.9230	0.0005	+0.0064	41	RD	V; el: IBVS 5168; d=0.027d
GSC 4781-1094	p	55532.9541	0.0008	+0.0269	28	RD	V; el: 2454412.826 + 5.803633 * E
GSC 4796-1108	p	55532.9237	0.0005	−0.0058	20	RD	V; el: 2454517.621 + 0.391105 * E
GSC 4833-115	p	55559.9058	0.0016	−0.0028	11	RD	V; el: 2454233.536 + 0.252258 * E
GSC 5382-452	p	55539.8651	0.0003	−0.0020	19	RD	V; el: 2454950.513 + 0.375624 * E
GSC 5383-58	s	55544.8974	0.0005	+0.0231	33	RD	V; el: 2454595.475 + 0.424123 * E; d=0.037d
GSC 5384-975	s	55545.9037	0.0002	+0.0076	31	RD	V; el: 2454727.887 + 0.472428 * E
NSV 3180	s	55539.8981	0.0004	+0.0039	31	RD	V; el: 2454418.846 + 2.946250 * E
UW Ori	s	55539.8512	0.0006	+0.0437	18	RD	V; el: Chin. AA 14, 298; d=0.075d
DW Ori	p	55523.9565	0.0006	+0.0106	27	RD	V; el: 2451177.303 + 0.9166265 * E
EF Ori	s	55523.8966	0.0013	−0.0026	44	RD	V; el: IBVS 5699
FF Ori	p	55517.8463	0.0013	+0.0354	17	RD	V
GG Ori	p	55526.8533	0.0005	+0.0860	21	RD	V; non-circ.
PQ Ori	p	55517.8582	0.0003	−0.0107	27	RD	V; el: 2454469.658 + 0.663005 * E; d=0.039d
V519 Ori	p	55528.8576	0.0007	+0.0110	17	RD	V; el: 2451460.83 + 1.395546 * E
V536 Ori	p	55539.9244	0.0005	+0.0125	27	RD	V; el: 2452722.529 + 6.317002 * E
V641 Ori	p	55528.9581	0.0001	−0.0066	26	RD	V; el: IBVS 5920
V648 Ori	s	55503.9434	0.0006	+0.0641	18	RD	V
V1353 Ori	s	55518.9032	0.0005	−0.0039	38	RD	V; el: IBVS 5313
V1626 Ori	p	55528.8671	0.0008	−0.0040	24	RD	V; el: IBVS 5339
V1633 Ori	p	55523.8906	0.0003	−0.0019	27	RD	V; el: BAV Mitt. 125
V1799 Ori	s	55506.9248	0.0003	+0.0048	14	RD	V; el: 2454437.734 + 0.290303 * E
V1824 Ori	p	55538.8461	0.0005	+0.0164	19	RD	V; el: IBVS 5871
GSC 85-1357	s	55508.8129	0.0004	+0.0251	13	RD	V; el: 2454441.763 + 0.283972 * E
	p	55508.9526	0.0005	+0.0232	13	RD	V
GSC 89-1424	p	55513.8806	0.0008	+0.0197	20	RD	V; el: 2453443.560 + 0.518223 * E
GSC 93-668	s	55513.8524	0.0002	−0.0051	15	RD	V; el: 2454143.580 + 0.314392 * E
GSC 103-738	p	55526.9343	0.0004	−0.0031	24	RD	V; el: 2454349.879 + 0.338527 * E
GSC 103-894	s	55526.8793	0.0002	+0.0001	21	RD	V; el: 2454423.748 + 0.295706 * E
GSC 111-1902	p	55526.8816	0.0004	+0.0018	14	RD	V; el: 2455082.903 + 0.314654 * E
GSC 128-980	p	55517.9358	0.0005	−0.0011	42	RD	V; el: 2454556.538 + 0.490760 * E; d=0.03d
GSC 709-1047	p	55518.8906	0.0003	−0.0033	18	RD	V; el: 2454412.777 + 0.266727 * E
GSC 730-243	p	55532.9228	0.0005	+0.0186	34	RD	V; el: 2454133.659 + 0.377664 * E
GSC 730-2307	p	55523.8843	0.0011	−0.0226	26	RD	V; el: 2453831.483 + 0.479712 * E
GSC 1315-1104	p	55538.8989	0.0004	+0.0041	36	RD	V; el: 2453779.645 + 0.763232 * E
GSC 1322-294	p	55532.9103	0.0004	+0.0044	17	RD	V; el: 2453327.756 + 0.287841 * E
GSC 4754-17	p	55513.8845	0.0009	+0.0012	23	RD	V; el: 2454371.873 + 0.548516 * E
GSC 4766-69	s	55517.9070	0.0003	+0.0067	16	RD	V; el: 2455122.848 + 0.274628 * E
GSC 4772-934	s	55527.9138	0.0002	+0.0112	31	RD	V; el: 2453744.662 + 1.295489 * E
GSC 4780-344	s	55527.9255	0.0003	−0.0034	18	RD	V; el: 2454532.562 + 0.322595 * E
GSC 4783-266	p	55527.9392	0.0008	+0.0143	33	RD	V; el: 2454334.921 + 0.611170 * E; d=0.037d
GSC 4783-467	p	55532.9297	0.0002	+0.0109	22	RD	V; el: 2454519.566 + 0.346327 * E
GSC 4783-2332	s	55523.9326	0.0002	+0.0004	15	RD	V; el: 2454702.918 + 0.248078 * E
GSC 5346-275	p	55527.9418	0.0004	+0.0087	16	RD	V; el: 2454461.732 + 0.344269 * E
U Peg	p	55501.7043	0.0003	−0.1395	24	RD	V
BO Peg	p	55383.8329	0.0005	−0.0309	24	RD	V
BW Peg	p	55383.8496	0.0005	+0.0233	15	RD	V; el: 2454656.807 + 1.58392 * E
BX Peg	p	55383.7904	0.0007	−0.0036	17	RD	V; el: IBVS 5668
CC Peg	p	55383.7557	0.0006	−0.0068	16	RD	V; el: 2449999.364 + 0.605601 * E
CW Peg	p	55476.7546	0.0015	+0.0442	16	RD	V
EU Peg	p	55500.7279	0.0004	+0.0401	19	RD	V
GH Peg	s	55476.734	0.003	+0.008	24	RD	V
GP Peg	p	55506.6930	0.0003	−0.0468	26	RD	V
V396 Peg	p	55501.6666	0.0011	−0.0079	23	RD	V; el: IBVS 5186
GSC 566-150	s	55484.7209	0.0008	+0.0055	25	RD	V; el: 2455088.664 + 0.397044 * E; d=0.02d
GSC 1141-480	p	55469.6662	0.0003	−0.0025	18	RD	V; el: IBVS 5920
GSC 1145-1104	p	55476.687	0.003	−0.010	15	RD	V; el: 2453704.537 + 1.06500 * E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC 1166-399	s	55500.6692	0.0004	+0.0040	18	RD	V; el: 2454386.694 + 0.316604 * E
GSC 1169-1244	p	55508.6967	0.0004	+0.0098	12	RD	V: el: 2454373.677 + 0.273233 * E
GSC 1173-844	p	55501.6907	0.0004	−0.0006	26	RD	V; el: 2453671.567 + 0.758458 * E
GSC 1174-344	p	55501.7209	0.0002	+0.0055	27	RD	V; el: IBVS 5920; d=0.03d
GSC 1178-1208	p	55513.7145	0.0003	+0.0013	20	RD	V; el: IBVS 5920
GSC 1670-251	p	55469.6874	0.0002	+0.0027	23	RD	V; el: 2453336.523 + 0.330569 * E
GSC 1685-588	p	55477.7274	0.0008	−0.0086	30	RD	V; el: 2453338.560 + 0.960564 * E
	p	55478.6857	0.0007	−0.0109	37	RD	V; d=0.06d
GSC 1686-1001	p	55484.7082	0.0018	+0.0021	23	RD	V; el: IBVS 5920
GSC 1694-992	s	55480.6783	0.0001	+0.0023	15	RD	V; el: IBVS 5920; d=0.01d
GSC 1715-1370	s	55497.6997	0.0002	+0.0038	37	RD	V; el: IBVS 5920
GSC 1716-1457	s	55503.6827	0.0003	+0.0168	39	RD	V; el: IBVS 5920; D=0.031d
GSC 1718-1664	p	55497.7251	0.0006	+0.0025	23	RD	V; el: IBVS 5920
GSC 1719-1034	p	55503.6908	0.0001	+0.0045	27	RD	V; el: 2454647.875 + 0.673337 * E
GSC 2188-568	s	55383.7525	0.0004	−0.0148	17	RD	V; el: 2454993.873 + 0.352049 * E
GSC 2189-1101	s	55383.7800	0.0008	−0.0023	12	RD	V; el: 2452937.585 + 0.239788 * E
GSC 2203-1663	s	55476.7215	0.0004	−0.0001	24	RD	V; el: 2453866.911 + 0.422024 * E; d=0.043d
GSC 2226-2148	s	55478.6907	0.0004	+0.0205	24	RD	V; el: IBVS 5920
	p	55480.7192	0.0007	+0.0225	21	RD	V
GSC 2244-1064	s	55497.6946	0.0003	+0.0013	42	RD	V; el: IBVS 5920; d=0.023d
GSC 2258-1489	p	55503.6511	0.0002	−0.0657	34	RD	V; el: IBVS 5920; d=0.017d
GSC 2755-2136	p	55500.6970	0.0010	+0.0258	15	RD	V; el: OEJV 83
GSC 2766-775	p	55508.6927	0.0004	+0.0644	18	RD	V; el: IBVS 5920
GSC 2766-1184	p	55500.6750	0.0007	−0.0314	24	RD	V; el: IBVS 5920
	p	55508.6888	0.0006	−0.0359	29	RD	V; d=0.04d
WY Per	p	55497.8928	0.0002	−0.1861	35	RD	V; d=0.03d
XZ Per	p	55502.8443	0.0002	−0.0541	32	RD	V
BR Per	p	55502.8029	0.0027	−0.2072	10	RD	V; el: PZ 24, 80
BY Per	p	55533.6567	0.0004	+0.0239	39	RD	V
CH Per	p	55538.6312	0.0012	−0.0788	19	RD	V; d=0.04d
DK Per	p	55538.6720	0.0008	−0.0405	32	RD	V; el: IBVS 3875
DZ Per	p	55478.8929	0.0015	+0.0301	38	RD	V
EQ Per	p	55484.9357	0.0020	+0.5685	33	RD	V
FQ Per	p	55511.927	0.003	+0.727	25	RD	V; d=0.12d
HW Per	p	55498.9097	0.0001	+0.0041	34	RD	V; el: IBVS 4516; d=0.020d
II Per	p	55500.9141	0.0002	−0.0017	21	RD	V; el: IBVS 5741
IK Per	p	55500.8595	0.0003	−0.1845	27	RD	V
IM Per	p	55508.8225	0.0021	+0.0986	51	RD	V
IT Per	p	55543.6945	0.0003	−0.0118	37	RD	V
KL Per	p	55543.6278	0.0009	+0.1327	16	RD	V
KN Per	p	55559.770	0.002	+0.009	28	RD	V; el: Krakau Cat.
LS Per	p	55480.8696	0.0009	−0.5287	34	RD	V; d=0.056d
MS Per	p	55513.8925	0.0007	+0.0034	39	RD	V; el: 2451511.615 + 2.779357 * E
NP Per	s	55503.8555	0.0003	−0.0557	31	RD	V
PS Per	p	55484.9164	0.0001	+0.0648	39	RD	V
QT Per	p	55480.9170	0.0004	−0.0456	34	RD	V; el: MVS 11, 65
QV Per	p	55559.6999	0.0007	−0.0514	24	RD	V
V365 Per	p	55500.8995	0.0020	−0.0098	27	RD	V
V432 Per	p	55484.8719	0.0001	−0.0100	36	RD	V; el: BAV Mitt. 61
V434 Per	s	55497.8428	0.0024	+0.1928	37	RD	V
V457 Per	p	55480.9093	0.0004	+0.0208	21	RD	V
V482 Per	p	55476.9168	0.0012	+0.2252	16	RD	V; el: BAV Mitt. 68, 21
V514 Per	p	55497.8417	0.0008	+0.1065	36	RD	V; el: IBVS 5357
V680 Per	s	55543.6134	0.0003	−0.0028	11	RD	V; el: 2452996.6731 + 0.373973 * E
V732 Per	s	55513.8307	0.0003	−0.0136	14	RD	V; el: 2451455.805 + 4.506429 * E
V737 Per	p	55500.9403	0.0004	+0.1078	16	RD	V; el: IBVS 5894
GSC 2853-18	s	55484.9228	0.0003	−0.0090	30	RD	V; el: IBVS 5901
GSC 2859-900	p	55484.8942	0.0006	−0.0559	26	RD	V; el: OEJV 91; d=0.04d
GSC 3708-1325	s	55480.9263	0.0009	+0.0890	35	RD	V; el: IBVS 5920; non-circ.

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
SX Psc	p	55528.7334	0.0002	−0.0012	25	RD	V; d=0.025d
UW Psc	s	55527.6808	0.0019	+0.2747	48	RD	V
VZ Psc	s	55498.7169	0.0008	+0.0114	22	RD	V; el: ApJS 58, 413
CP Psc	p	55528.6505	0.0002	−0.0590	20	RD	V; el: Hipparcos
DS Psc	s	55527.6821	0.0005	+0.0714	20	RD	V; el: IBVS 4424
DZ Psc	s	55511.7019	0.0004	+0.0298	22	RD	V; el: IBVS 4910; d=0.031d
GSC8-448	s	55506.7470	0.0006	+0.0123	11	RD	V; el: IBVS 5920
GSC14-479	s	55523.6671	0.0004	+0.0205	34	RD	V; el: IBVS 5920; d=0.026d
GSC18-1214	p	55528.7377	0.0004	+0.0075	24	RD	V; el: 2453705.635 + 0.401386 * E; d=0.025d
GSC575-429	p	55497.6837	0.0001	−0.0021	42	RD	V; el: IBVS 5920
GSC577-364	p	55500.7149	0.0003	+0.0019	20	RD	V; el: 2454644.918 + 0.948775 * E
GSC611-249	p	55528.6680	0.0002	+0.0085	25	RD	V; el: 2453617.755 + 0.316742 * E
GSC611-829	p	55527.5785	0.0008	−0.0038	5	RD	V; el: 2453603.775 + 0.287952 * E
	s	55527.7241	0.0003	−0.0021	30	RD	V
GSC1179-501	p	55526.7396	0.0006	+0.0208	18	RD	V; el: 2453699.584 + 0.376962 * E
GSC1183-1110	p	55526.7289	0.0007	+0.0365	23	RD	V; el: 2453620.697 + 0.649181; d=0.06d
GSC1194-613	p	55526.7091	0.0007	+0.0005	17	RD	V; el: 2453344.599 + 0.375837 * E
GSC1747-967	p	55528.6603	0.0001	−0.0019	35	RD	V; el: 2454291.871 + 0.494321 * E
GSC1762-103	p	55477.8265	0.0003	−0.0180	25	RD	V; el: 2452872.842 + 0.289284 * E
GSC5260-80	p	55511.6603	0.0004	+0.0041	32	RD	V; el: 2454352.754 + 0.386172 * E
GSC5420-2341	s	55559.9353	0.0021	+0.0067	22	RD	V; el: 2454534.557 + 0.685638 * E
RZ Tau	s	55503.8777	0.0002	+0.0620	38	RD	V
TY Tau	s	55544.6673	0.0009	+0.2535	18	RD	V
AH Tau	s	55498.8825	0.0002	+0.0158	39	RD	V; el: IBVS 5554; d=0.015d
AN Tau	p	55559.7167	0.0010	+0.0020	33	RD	V; el: Krakau Cat.
AP Tau	s	55506.9316	0.0006	+0.0260	18	RD	V
BV Tau	p	55527.8925	0.0005	−0.0027	37	RD	V; el: IBVS 5920; d=0.078d
CR Tau	p	55527.9158	0.0003	−0.0026	31	RD	V; el: IBVS 4778; d=0.021d
CU Tau	p	55498.9060	0.0020	+0.0063	25	RD	V; el: AJ 130, 224
EQ Tau	p	55498.8846	0.0005	−0.0253	50	RD	V
GR Tau	s	55545.7058	0.0010	−0.0311	34	RD	V
GW Tau	p	55506.8761	0.0008	−0.0830	21	RD	V
IV Tau	p	55545.6719	0.0003	−0.0201	31	RD	V
V781 Tau	s	55527.8628	0.0004	−0.0019	15	RD	V; el: 2454501.588 + 0.344909 * E
V1022 Tau	p	55476.8579	0.0013	−0.0690	24	RD	V; el: PASP 101, 177
V1112 Tau	s	55502.8711	0.0014	−0.0021	20	RD	V; el: IBVS 5871
V1123 Tau	p	55497.8738	0.0003	−0.0010	37	RD	V; el: IBVS 5688
V1220 Tau	s	55559.7543	0.0015	−0.0575	20	RD	V; el: IBVS 5455
V1222 Tau	p	55544.6299	0.0007	+0.0011	14	RD	V; el: 2454829.555 + 0.295363 * E
	s	55544.7776	0.0018	+0.0011	8	RD	V
V1223 Tau	p	55544.6925	0.0008	+0.0026	27	RD	V; el: IBVS 5920
V1249 Tau	s	55508.9353	0.0003	−0.0076	17	RD	V; el: IBVS 5894
	p	55511.9058	0.0004	−0.0077	26	RD	V
A054432+1305.7	s	55517.9353	0.0003	−0.0011	18	RD	V; el: IBVS 5945
GSC 67-348	s	55544.6742	0.0005	+0.0055	11	RD	V; el. IBVS 5920
GSC 72-521	p	55498.9062	0.0002	+0.0076	51	RD	V; el: IBVS 5945; d=0.01d
GSC 74-465	p	55511.7952	0.0006	−0.0049	7	RD	V; el: 2454146.555 + 0.300417 * E
	s	55511.9460	0.0008	−0.0043	11	RD	V
GSC 76-527	s	55498.8733	0.0005	+0.0007	32	RD	V; el: IBVS 5945
GSC 650-1226	s	55497.8850	0.0002	+0.0128	34	RD	V; el: IBVS 5945
GSC 658-185	p	55559.7006	0.0002	+0.0050	29	RD	V; el: IBVS 5920
GSC 659-262	s	55476.8800	0.0003	−0.0120	28	RD	V; el: IBVS 5290; d=0.026d
GSC 661-580	s	55502.8721	0.0004	+0.0008	31	RD	V; el: IBVS 5945; d=0.02d
GSC 663-23	s	55545.6999	0.0004	−0.0051	37	RD	V; el: IBVS 5920; d=0.034d
GSC 664-423	p	55502.9092	0.0008	−0.0026	27	RD	V; el: IBVS 5945
GSC 681-692	p	55506.7835	0.0008	−0.0010	5	RD	V; el: IBVS 5945
	s	55506.9092	0.0004	+0.0010	17	RD	V
GSC 1256-188	p	55559.6403	0.0003	+0.0089	28	RD	V; el: IBVS 5920; d=0.025d
GSC 1274-564	s	55511.8924	0.0005	+0.0095	26	RD	V; el: 2453327.726 + 0.357151 * E; d=0.02d
GSC 1293-1162	p	55506.9345	0.0004	+0.0278	18	RD	V; el: 2454506.559 + 0.488451 * E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Obs	Remarks
GSC 1304-227	s	55517.8420	0.0008	+0.0027	21	RD	V; el: 2454522.569 + 0.365438 * E
GSC 1822-314	p	55498.8765	0.0009	+0.0205	44	RD	V; el: OEJV 91
GSC 1831-687	p	55502.9003	0.0006	+0.0056	32	RD	V; el: 2453601.922 + 0.316249 * E
GSC 1841-879	p	55476.8614	0.0018	−0.1195	17	RD	V; el: IBVS 5920
GSC 1848-1264	s	55517.9585	0.0004	+0.0062	30	RD	V; el: IBVS 5699
GSC 1852-1665	s	55518.8590	0.0001	+0.0066	22	RD	V; el: 2453348.716 + 0.307363 * E
RW Tri	p	55533.7179	0.0005	−0.0045	9	RD	V
ST Tri	p	55543.6587	0.0003	−0.0014	24	RD	V; el: IBVS 5609; d=0.026d
VW Tri	s	55532.6606	0.0005	−0.0594	19	RD	V; el: MVS 11, 1
VZ Tri	s	55532.6630	0.0003	−0.0107	32	RD	V; el: OEJV 107
AK Tri	s	55478.9344	0.0005	+0.1034	40	RD	V; el: IBVS 4427
BK Vul	p	55469.6674	0.0009	−0.0077	22	RD	V; el: ASAS
DZ Vul	p	55478.6470	0.0004	−0.0043	37	RD	V; el: 2454716.661 + 1.594122 * E

Observers:

RD :	R. Diethelm	Rodersdorf, Switzerland; R. Szafraniec Obs. operated at Astrokolkhoz Obs., Cloudcroft, N.M., USA
EBl :	E. Blättler	Wald, Switzerland

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ERRATA FOR IBVS 5960

The TOM of GSC 4833-1925 is missing: 55559.9426.
The GSC 1338-1529 label is erroneous, instead it should read GSC 1338-1539.
Dr. Roger Diethelm

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USNO-A2.0 1425-04279615 AND USNO-A2.0 1425-04280420: TWO NEW SHORT-PERIOD ECLIPSING RS CVn VARIABLES

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During our observations of a field in Perseus, we found two new eclipsing variable stars with RS CVn variability. Their coordinates and magnitude ranges are presented in Table 1.

Table 1. New EA+RS variables

Star	α_{J2000}	δ_{J2000}	R_{max}	R_{min}
USNO-A2.0 1425-04279615	$03^{h}19^{m}59\overset{s}{.}75$	$+57°19'09\overset{''}{.}7$	$12\overset{m}{.}31$	$12\overset{m}{.}75$
USNO-A2.0 1425-04280420	$03^{h}20^{m}05\overset{s}{.}03$	$+57°07'32\overset{''}{.}1$	$13\overset{m}{.}70$	$13\overset{m}{.}97$

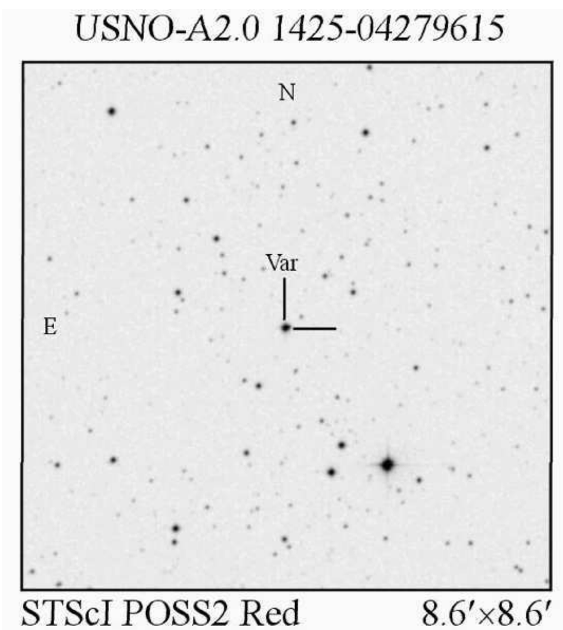

Figure 1. Finding chart of USNO-A2.0 1425-04279615

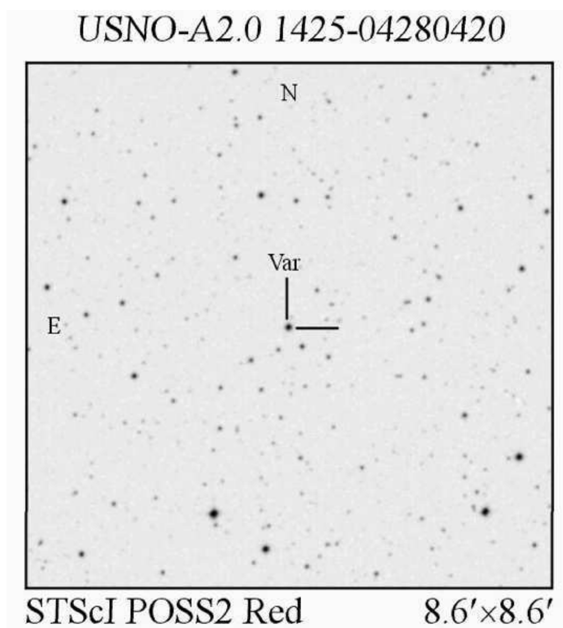

Figure 2. Finding chart of USNO-A2.0 1425-04280420

The coordinates were drawn from the 2MASS catalogue (Skrutskie et al., 2006). The finding charts for the two variables are presented in Figs. 1 and 2. Our observations were carried out at the Astrotel–Caucasus observatory using an 0.3-m Ritchey–Chretien telescope, equipped with an unfiltered Apogee Alta U9000 CCD camera. A total of 2316 images with 5-minute exposures were obtained on JD 2455080–2455519. For basic reductions for dark current, flat fields, bias and for removing cosmic-ray hits, we use IRAF routines. For search and photometry of the new variable stars, we applied VaST software by Sokolovsky and Lebedev (2005). The comparison star was USNO-A2.0 1425-04237176 = USNO-B1.0 1473-0129296 ($\alpha = 03^{h}15^{m}37\overset{s}{.}41$, $\delta = +57°19'36\overset{''}{.}5$ (J2000, 2MASS); $R_1 = 14\overset{m}{.}33$, $R_2 = 14\overset{m}{.}60$ (USNO-B1.0)). Unfiltered magnitudes were calibrated using the comparison star, assuming $R_{\rm comp} = 14\overset{m}{.}465$. To search for period and derive epochs of extrema, we use Peranso software (`www.peranso.com`).

During our observing campaign, we detected the primary minima of USNO-A2.0 1425-04279615 and USNO-A2.0 1425-04280420 listed in Table 2.

Table 2. CCD minima of USNO-A2.0 1425-04279615 and USNO-A2.0 1425-04280420

USNO-A2.0 1425-04279615		**USNO-A2.0 1425-04280420**	
HJD(TT)	±	**HJD(TT)**	±
2455116.2503	0.0002	2455116.5291	0.0002
2455117.2513	0.0002	2455122.5191	0.0003
2455122.2556	0.0005	2455123.4414	0.0009
2455123.2571	0.0007	2455142.339	0.001
2455142.2751	0.0003	2455145.5642	0.0006
2455144.2778	0.0009	2455163.5409	0.0001
2455145.2806	0.0005	2455168.606	0.001
2455163.2930	0.0004	2455169.5295	0.0006
2455202.3290	0.0002	2455230.3701	0.0007
2455230.3549	0.0002	2455260.330	0.001
		2455466.3555	0.0008
		2455495.400	0.001
		2455517.5178	0.0008
		2455518.4398	0.0005
		2455519.3633	0.0009

The light curves plotted with the detected periods (Figs. 3 and 4) reveal variations of the light curve shape characteristic of chromospherically active stars. As an example of such variations, Fig. 5 exhibits three light curves of USNO-A2.0 1425-04280420, plotted with the orbital period for three time intervals. For the analysis of additional variations to the eclipses we use observations between orbital phases 0.07–0.42 and 0.58–0.93 for USNO-A2.0 1425-04279615 and 0.2–0.8 for USNO-A2.0 1425-04280420.

For both stars, we remove the signals with P=3DPorb and find sine-wave periods presented in the corresponding columns of Table 3. The long series of observations and the high precision photometry of the stars reveal small but real differences between orbital and sine-wave periods. Light curves with the sine-wave periods are plotted in Fig. 6 and 7.

All times in Table 2 and further on are expressed in the Terrestrial Time in accordance with IAU recommendations (resolution B1 XXIII IAU GA). The light elements for eclipses of the two stars are given in corresponding columns of Table 3.

Table 3. Light elements

	Eclipsing variability		**Sine wave variability**	
Star	$\rm Min_0$ HJD(TT)	P, d	$\rm Max_0$ HJD(TT)	P, d
USNO-A2.0 1425-04279615	2455116.2503	0.500458	2455081.7051	0.499464
		±0.000006		±0.000080
USNO-A2.0 1425-04280420	2455116.5291	0.460909	2455080.5479	0.461208
		±0.000026		±0.000124

These stars are the shortest-period RS CVn stars when compared to chromospherically active binary stars in the third version of the catalog of chromospherically active binaries (Eker et al., 2008)

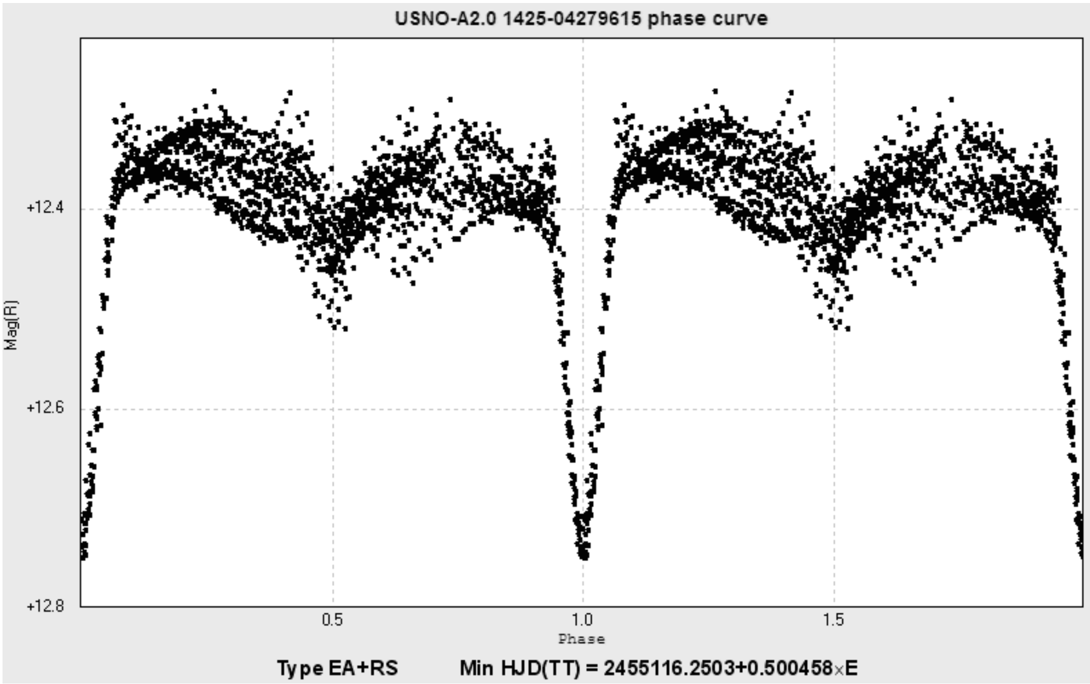

Figure 3. USNO-A2.0 1425-04279615 light curve

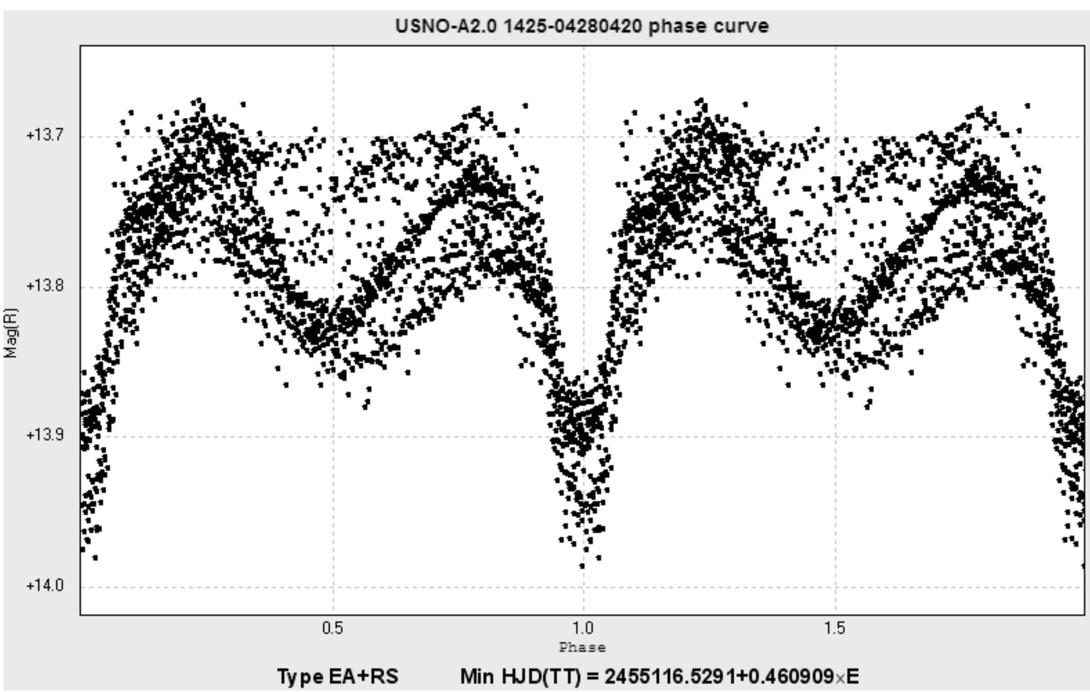

Figure 4. USNO-A2.0 1425-04280420 light curve

We conclude that USNO-A2.0 1425-04279615 and USNO-A2.0 1425-04280420 are new eclipsing RS CVn variables with periods among the shortest known and with dramatically changing light curves. Studying active stars in eclipsing binaries is very important since it makes possible to derive absolute dimensions of the components. The effect of the binarity on stellar activity is an interesting problem and such close binaries like these newly found objects can help to understand that. We hope that the present study will stimulate new observations of these interesting, very active stars.

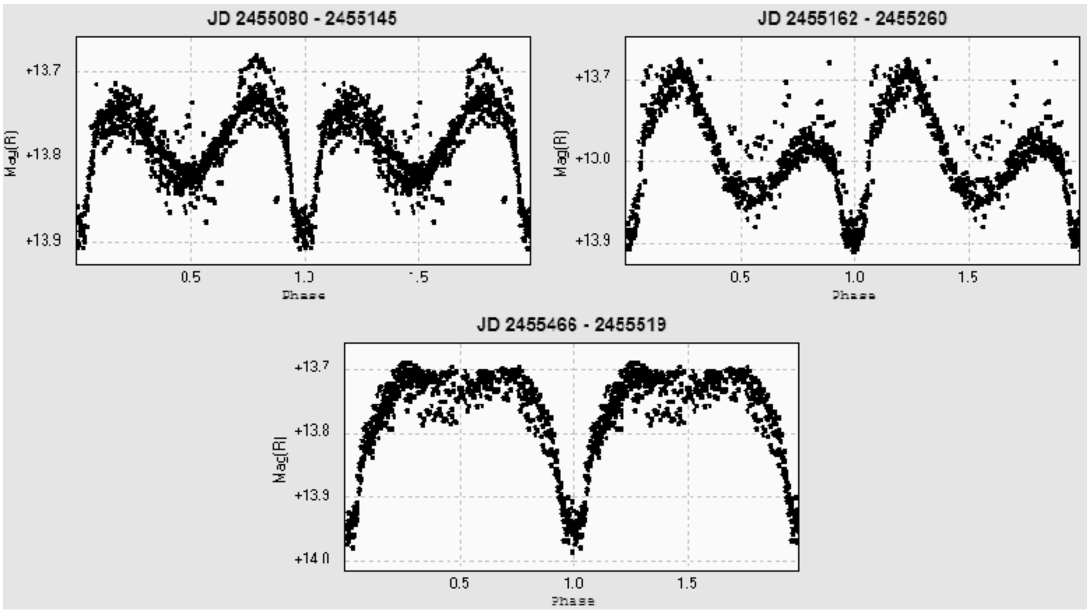

Figure 5. USNO-A2.0 1425-04280420 light curve variability

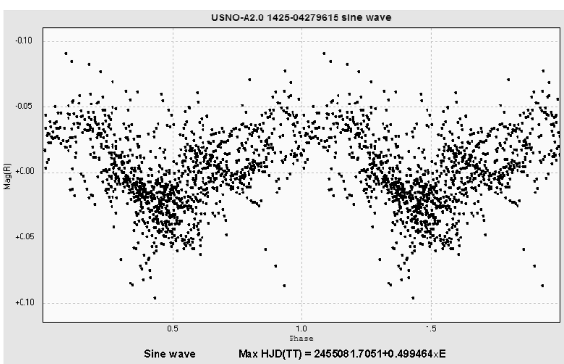

Figure 6. USNO-A2.0 1425-04279615 sine wave

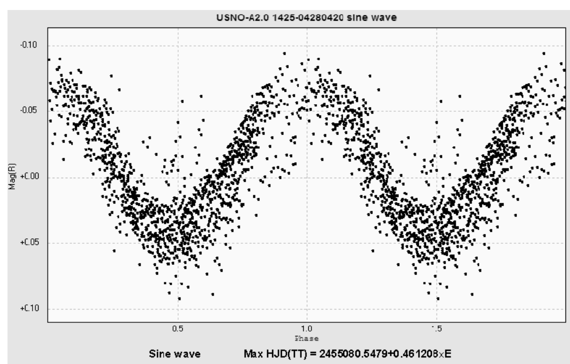

Figure 7. USNO-A2.0 1425-04280420 sine wave

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STUDY OF THE ECCENTRIC-ORBIT BINARY GSC 03152-01202

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Name of the object:
GSC 03152-01202=UCAC3 84806478

Equatorial coordinates:	**Equinox:**
R.A.= $20^{h}27^{m}17^{s}.27$ **DEC.=** $+37°56'26''.9$	2000

Observatory and telescope:
U.S. Air Force Academy Observatory, 41 cm and 61 cm Cassegrains

Detector:	CCD SBIG ST-2000XM and CCD SBIG STL-11000M

Filter(s):	Green

Date(s) of the observation(s):
UT 30 May, 31 May, 20 June, 27 August 2010

Comparison star(s):	GSC 3151-1174 = UCAC3 84806456, $20^{h}27^{m}11^{s}.2$, $+37°56'51''.1$

Check star(s):	UCAC3 84806530, $20^{h}27^{m}31^{s}.2$, $+37°55'14''.4$

Transformed to a standard system:	No

Availability of the data:
At the IBVS website (5962-t2.txt)

Type of variability:	EA

Remarks:

Bulut et al. (2007) listed GSC 3152-1202 as a candidate for eccentric orbits. Otero et al. (2006) gave light elements stating possible confusion of the primary and secondary eclipses and the phase of the secondary eclipse to be 0.489. Kozyreva et al. (2009) provided new times of minimum light for the primary and the secondary eclipses and found the phase of the secondary to be 0.5475(5). They proposed a period of apsidal motion of 15 or 50 years. We were unable to find any other photometric timings of minimum light in the literature. Due to this possible rapid motion we measured two additional times of primary and two additional times of secondary minimum, and we studied a comparison and a check star that proved stable (Figure 1). We extracted magnitudes from the flat-fielded images with AIP4Win. Our new times of minima are given in Table 1 along with those of Kozyreva et al. We show our typical light curves for the two minima in Figure 2 indicating that Otero's identification of the primary and secondary to be correct: the depth of the primary in green light is $0.^{m}075$ deeper than the secondary eclipse. Figure 3 shows the O-Cs of the primary and secondary eclipses using the current mean elements of the two minima. One year after Kozyreva's results, we found the phase of the secondary to be 0.5506(3) based on our new elements. This is significantly different from Kozyreva et al. Rapid rotation of the line of apsides seems likely and this star is worthy of additional observations. We have computed new light elements for the system using primary eclipse times from Kozyreva and this paper: Min I = HJD 2455004.4386(1) + 2.093745(1)×E. The light elements for the secondary are: Min II = HJD 245505.5824(1)+2.093799(2)×E.

Table 1. New Times of Minimum Light for GSC 3152-1202

Type Minimum	HJD Time of Minimum	Uncertainty	Source
I	2455004.4386	0.0002	1
II	2455066.3026	0.0003	1
II	2455346.8715	0.0005	2
I	2455347.8127	0.0006	2
II	2455367.8097	0.0003	2
I	2455435.7502	0.0002	2

1 Kozyreva et al.
2 This paper

Acknowledgements:

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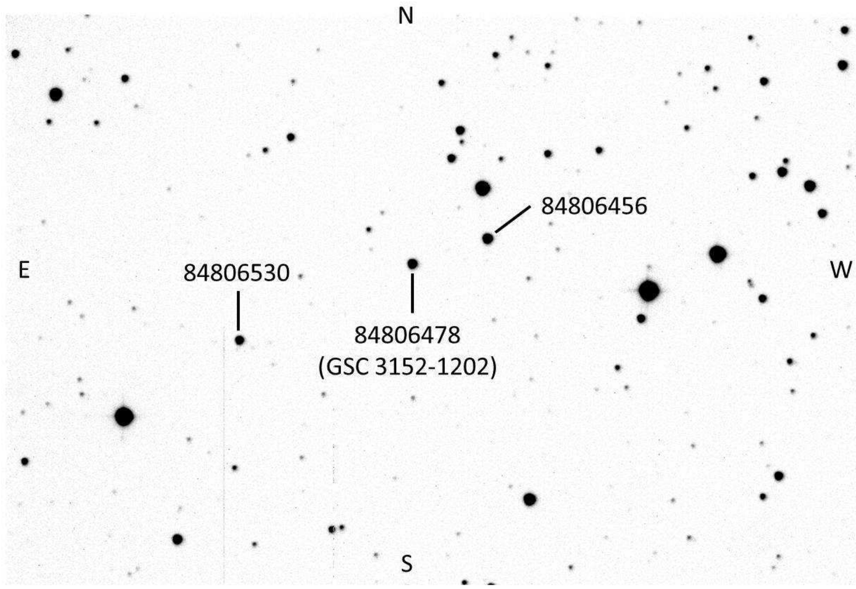

Figure 1. The comparison, check and variable stars for this study. The average standard deviation of the differences between the comparison and check stars for the four nights of this work was $0^{\mathrm{m}}_{\cdot}015$ indicating their good stability for photometry.

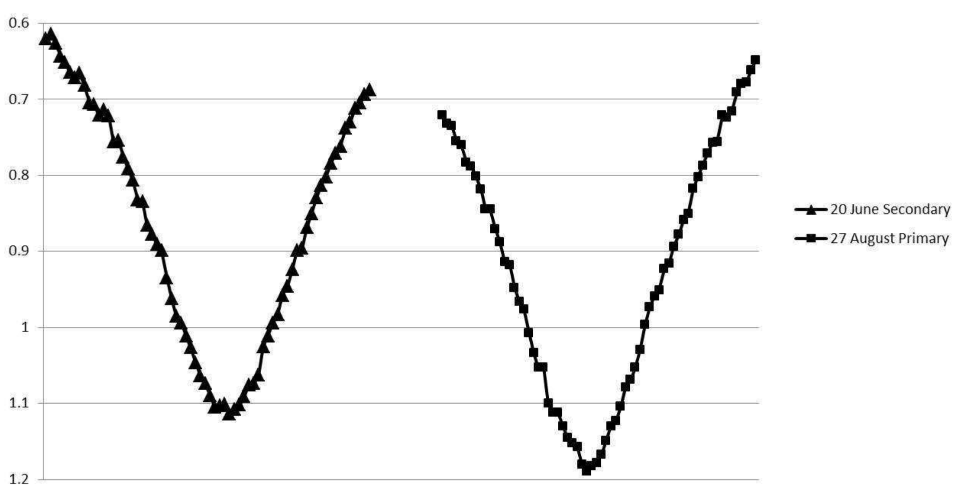

Figure 2. Light curves for 20 Jun 10 (secondary) and 27 Aug 10 (primary). The magnitude and times scales are identical for both curves, and the data points were about five minutes apart. This shows that the elements of Otero, Kozyreva and this paper correctly identify the eclipses. All images were checked to be sure no pixels were above 50% percent saturation.

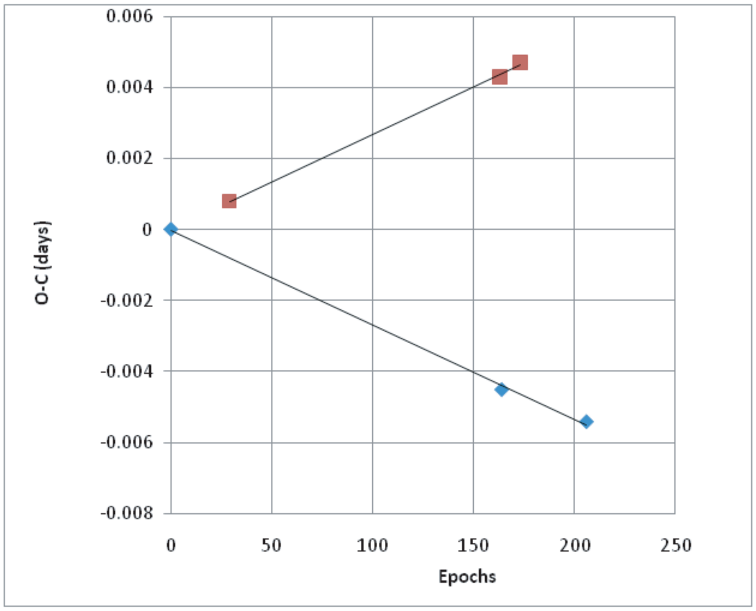

Figure 3. The O-Cs of the primary times (squares) and the secondary times (diamonds) including the times reported by Kozyreva et al. These are based on the mean elements from this study.

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Otero, S.A., Wils, P., Hoogeveen, G, Dubovsky, P.A., 2006, *IBVS*, 5681

*This version of the paper contains corrections, and differs from the one appeared on-line originally. Date of last modification: Jan 11 2011

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PHOTOMETRIC ANALYSIS AND EVIDENCE FOR A THIRD, DWARF COMPONENT IN THE FY Boo SYSTEM

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FY Boo [GSC 01999-00518, 2MASSJ13465180+2257140, ROTSE1 J134651.80+225714.7, $\alpha(2000) = 13^{\rm h}46^{\rm m}51\overset{\rm s}{.}81$, $\delta(2000) = +22^\circ57'13\overset{''}{.}0$] was recently discovered by ROTSE I (Diethelm, 2001), and identified as an EW type variable with a period of 0.241168 d. This makes it one of the shortest period W UMa binaries known and an object of our continuing study of very short period binaries (e.g., Samec, Faulkner and Williams, 2004).

We took B, V, R, I light curves of the binary with the Lowell 31 inch reflector in Flagstaff with a CRYOTYGER cooled (−100°C) NASACAM and a 2K×2K chip and standard BVR_cI_c filters. The dates of the observations were 11-15, March, 2009. We undertook the observing run under the auspices of the National Undergraduate Observatory (NURO) and were granted observing time by the Lowell TAC. We used the Lowell program LOIS to take our observations. Our modeled light curves included 107 B, 109 V, 95 R and 98 I individual CCD observations. These observations were taken by Oliver, Samec and Faulkner. The photometric precision was ±0.008 in B, ±0.006 in V, and ±0.005 in R and I. They are given in Table I (IBVS^{e1} `5963-t1.txt`), in delta magnitudes, variable minus comparison star.

Our comparison star (C) was GSC 1999 0750 [$\alpha(2000) = 13^{\rm h}46^{\rm m}58\overset{\rm s}{.}583$, $\delta(2000) = +22^\circ56'47\overset{''}{.}5$, TYCHO I $B-V = 0.666$]. The check star (K) was GSC 1999 0854 [$\alpha(2000) = 13^{\rm h}46^{\rm m}46\overset{\rm s}{.}152$, $\delta(2000) = +22^\circ54'41\overset{''}{.}61$ TYCHO $B-V = 0.684$]. We include a finding chart of these stars including the variable (V) in Figure 7 (IBVS^e).

We determined six times of minimum light from our present observations. The minima were calculated using parabola fits. With their standard errors in parentheses, they include: HJDMin I = 2454901.9711(±0.0022) d, 2454902.9350(±0.0024) d, 2454904.8587(±0.0002) d, 2454905.8304(±0.0002) d and HJDMin II = 2454904.9774(±0.0007) d, 2454905.9491(±0.0002) d. From our timings and 43 others which are referenced in Table 2 (IBVS^e `5963-t2.txt`), we calculated the following precision linear ephemeris:

$$\text{HJD Min I} = 2454904.8660 \pm 0.0003 + 0.24115955 \pm 0.00000005\,\text{d} \times \text{E} \qquad (1)$$

[1]Available electronically through the IBVS website

Interestingly, our fit revealed the presence of a low amplitude sinusoid. The sinusoidal ephemeris is:

$$\text{HJD Min I} = 2454904.8691(\pm 0.0002) + 0.2411596(\pm 0.0000005) \times \text{E} \\ +0.00265(\pm 0.00020) \cdot \sin[4.2(\pm 0.1) \times 10^{-4} \times \text{E} - 6.07(\pm 0.08)] \quad (2)$$

We believe this sinusoid is due to the light time effect of a third, orbiting component. The ephemeris gives an orbital period of 9.9±0.2 years for the third component. From the amplitude, we calculate an orbital radius of 0.61±0.05 AU in light travel time, assuming the orbital inclination of the third component is identical to that of the main binary. The third body has a mass ratio of 0.16±0.03 as compared to the FY Boo system. If the total mass of the eclipsing binary pair is 1 solar mass (K1V star; Cox, 2000) then the additional component has an estimated mass of 0.16 solar masses. This mass is that of an ∼M6 dwarf which is small, but comparable to the masses of the other two components (in the range of 0.2 to 0.8 solar masses).

The sinusoidal $O-C$ diagram is given in Figure 1. We also include the linear residuals from Equation 1 in the table.

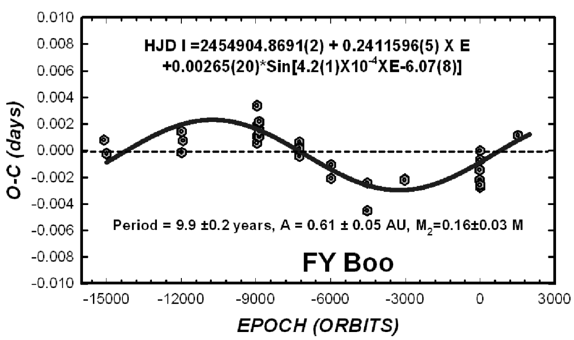

Figure 1. Sinusoidal $O-C$ residuals from Equation 2 revealing a third star orbiting the system.

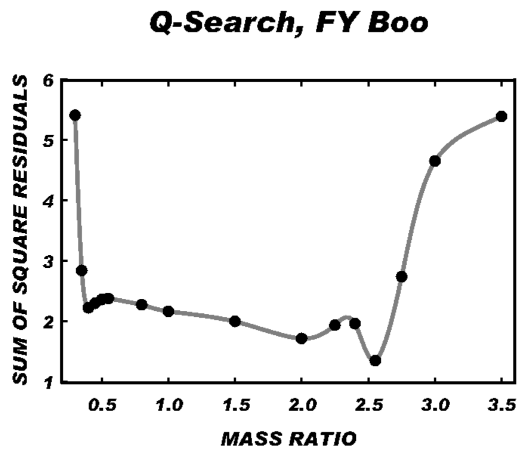

Figure 2. Chart of solution residuals of mass ratios extending from 0.3 to 3.5 minimizes near 2.5.

Our $UBVRI$ phased light curves, Phase versus Delta Magnitudes, in the sense of $V-C$, are given as Figures 8 and 9 (IBVS^e). The $BVRI$ curves are typical of a classic short period, solar-type contact system. The light curves show effects of night to night variability which forced us to use data for modeling from only two nights. Also, the maximum at phase 0.75 is about 0.1 mags higher than the one at phase 0.25. Thus, magnetic activity is strong in the system with either dark spots or hot spots predominating. Dips in the color curves at phase 0.0 and 0.5 indicate the system has achieved contact (as we view the cooler back parts of the contact Roche lobes). Broad eclipses at phase 0.0 indicate a brief total eclipse. This suggests that FY Boo is probably a W-Type W UMa binary (the hotter component is the less massive one).

Our B, V, R, I light curves were hand modeled with Binary Maker 3.0 (Bradstreet et al., 2002). Averaged values of parameters were then entered into the 2004 version of the Wilson Code (Wilson and Devinney, 1971 (WD); Wilson, 1990, 1994; Van Hamme and Wilson, 1998). From these we ran a full $BVRI$ simultaneous solution. Intermediate modeling iterations were done with PHOEBE (Prša and Zwitter 2005) which runs the same Wilson code in the background and makes it possible to view the light curve fit as the iterations progress. A mass ratio search covering regions from 0.3 to 3.5 was performed which indicated the value minimizes near ∼2.5. See Figure 2. Full synthetic light curve solutions follow. The temperature of the main component (4750K, K3V spectral type) which we used to model our light curves, was taken from a period-color relation from Battan, 1973 using the W UMa period. Recent 2MASS $B-V$, $V-R$, $J-H$ and $H-K$ average to K1±4 and affirms our choice. We computed both a Hot Spot and a Dark spot model. The Dark spot model has a slightly better sum of square residuals. Thus the choice of models is not conclusive. Either model is acceptable within the errors. The dark spot light curve solution is seen overlaying the normalized flux curves shown in Figures 3 and 4. The complete solutions are given as Table 3. Two phases of the Roche-lobe model of the binary for the dark spot solution are shown as Figures 5 and 6. Phase zero shows the total eclipse.

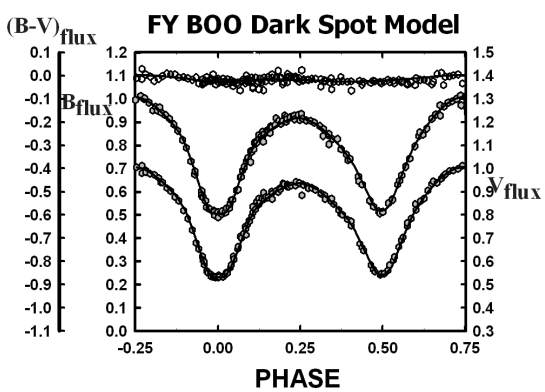

Figure 3. B, V synthetic light curve solutions overlaying the normalized flux curves.

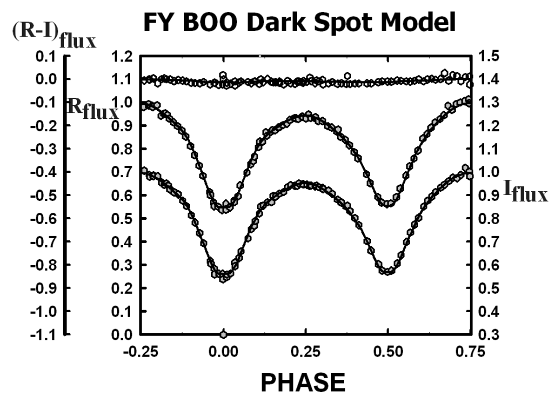

Figure 4. R, I synthetic light curve solutions overlaying the normalized flux curves.

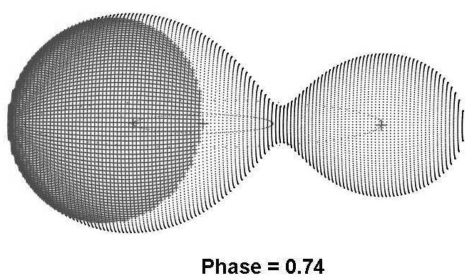

Figure 5. Roche Lobe surfaces from our $BVRI$ solution, phase 0.74.

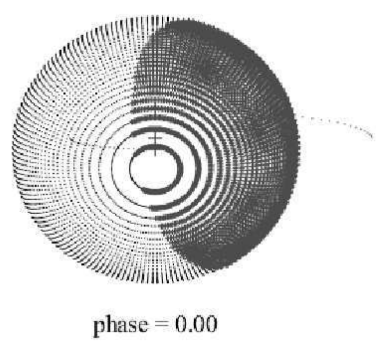

Figure 6. Roche Lobe surfaces from our $BVRI$ solution, phase 0.0 (the primary eclipse).

Our models show FY Boo is a W-type (the less massive component is the hotter) W UMa binary with a mass ratio of ~ 2.5. The system parameters from our model include a fill-out of 11%, a slight temperature difference of 200 K and an inclination of 82°. One large 68° radius magnetic region was modeled on the hotter companion with an average temperature of 0.96 times that of the photosphere. The T-Factors and spot radii indicate that this is a major *region* of spot activity rather than that of a single spot.

The solution gives a eclipse duration of ~7 minutes. The shallow fill-out is quite normal for a W-type system. We believe that this results due to an early stage of contact. The fairly extreme mass ratio probably indicates that the components had nearly this value when they came in contact. We suspect that the mass ratio should progress to

TABLE 3. SYNTHETIC CURVE PARAMETERS FOR FY Boo

Parameters	Dark Spot Solution (Mode 3)	Hot Spot Solution (Mode 3)
l_B, l_V, l_R, l_I (nm)	440, 550, 640, 790	440, 550, 640, 790
$xbol_{1,2}$, $ybol_{1,2}$	0.619, 0.649, 0.190, 0.190	0.619, 0.649 0.190 0.190
$x_{1I,2I}$, $y_{1I,2I}$	0.626, 0.626, 0.226, 0.226	0.626, 0.626, 0.226, 0.226
$x_{1R,2R}$, $y_{1R,2R}$	0.711, 0.711, 0.223, 0.223	0.711, 0.711, 0.223, 0.223
$x_{1V,2V}$, $y_{1V,2V}$	0.780, 0.780, 0.192, 0.192	0.780, 0.780, 0.192, 0.192
$x_{1B,2B}$, $y_{1B,2B}$	0.848, 0.848, 0.087, 0.087	0.848, 0.848, 0.087, 0.087
g_1, g_2	0.32	0.32
A_1, A_2	0.5	0.5
Inclination (°)	82.4±0.3	82.2±0.4
T_1, T_2 (K)	4750(fixed), 4555 ±44*	4750(fixed), 4700.2 ±75*
$\Omega_1 = \Omega_2$	5.947±0.015	5.917±0.023
q (m2/m1)	2.55±0.01	2.517±0.022
Fill-outs: $F_1 = F_2$	11.0±2%	11.0±2%
$L1/(L1 + L2)_I$	0.339±0.015	0.311±0.021
$L1/(L1 + L2)_R$	0.346±0.018	0.312±0.025
$L1/(L1 + L2)_V$	0.360±0.024	0.316±0.032
$L1/(L1 + L2)_B$	0.376±0.032	0.319±0.041
JDo (days)	2454904.8652±0.0001	2454904.8647±0.0001
Period (days)	0.241141±0.000007	0.241141±0.00001
r_1, r_2 (pole)	0.286±0.001, 0.440±0.001	0.286±0.001, 0.437±0.002
r_1, r_2 (side)	0.299±0.001, 0.470±0.002	0.299±0.001, 0.467±0.002
r_1, r_2 (back)	0.336±0.003, 0.499±0.002	0.334±0.003, 0.496±0.003
Sum of square res	1.352	1.461

SPOT Parameters

Latitude (°)	78±26	78±38
Longitude (°)	241±5	67±7
Spot radius (°)	68±39	86±42
T-Factor	0.9562±0.0004	1.0368±0.0006

*All Errors are formal, here the error in T_2 is in relation to T_1. We expect errors to T_1 to be on the order of ~250 K.

more extreme values in the future due to magnetic breaking. Breaking is due to the torque supplied by out flowing winds along "stiff" magnetic field lines originating from this solar-type binary.

Should we be looking for eclipses of the third component? Our calculations show that the proposed dwarf orbiting at $\sim$ 3.6 AU will never show any eclipses from an earth based observer.

We wish to thank Lowell Observatory for their allocation of observing time, and the AAS and the Arizona Space Grant for travel support for this observing run.

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PHOTOMETRIC VARIABILITY OF THE CHEMICALLY PECULIAR HOT SUBDWARF LS IV-14°116

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LS IV$-14°$116 was first catalogued as a luminous star by Nassau & Stephenson (1963). Kilkenny & Pauls (1990) classified it as an O-type subdwarf (sdO), while Viton et al. (1991) described it as an He-rich sdO star. Ahmad & Jeffery (2005) found the star to be photometrically variable with periods in the 30 – 90 minute range, and amplitudes of ≈ 0.003 mag. The star currently constitutes the sole member of the class of He-sdBVs (Kilkenny et al., 2010). Its variability is not reconciled with any theory of pulsational instability; g-modes would be indicated by the period, but are inconsistent with theoretical models of g-mode excitation in hot subdwarfs (Jeffery & Saio, 2006).

Although showing significantly more helium ($n_{\rm He} = 0.21$, Ahmad & Jeffery, 2003) than the majority of sdB stars, LS IV$-14°$116 is not as extremely helium-rich as a few. Analysis of the spectrum at high-resolution has revealed a super-abundance (≈ 4 dex) of zirconium, strontium, yttrium and germanium (Naslim et al., 2011), suggesting a heavily stratified atmosphere in which these particular elements have accumulated in the line-forming region. The question arises as to whether the photometric variability is in any way connected to the extreme chemical peculiarity of this star.

Table 1: Photometric observations of LS IV$-14°$116.

Night	Date	UT Start	$t_{\rm exp}$	$N_{\rm obs}$
N1	2005 06 15	23:00:43	10	1505
N2	2005 06 16	22:21:49	10	2093
N3	2005 06 17	22:19:18	15	336
N4	2005 06 19	22:42:46	15	1459

The very low-amplitude variations detected in the discovery data demanded confirmation. Additional observations were obtained with the South African Astronomical Observatory 1.0m telescope in 2005 June, using the University of Cape Town (UCT) high-speed CCD camera operated in 'frame-transfer' mode. Although the weather was not perfect, approximately 12.5 hours of data, and 5393 images were obtained (Table 1). The field size was the same as reported by Ahmad & Jeffery (2005), so that only one star was available as a useful comparison (GS2.2: S331330313746, R=14.1). A third star was too faint to provide a satisfactory check of the photometry. Regrettably, an unmarked improvement in seeing led to approximately 1300 frames obtained on the night of 2005 June 16 being saturated. These frames were easy to identify and discard during analysis of the light curve. The observer was duly chastened.

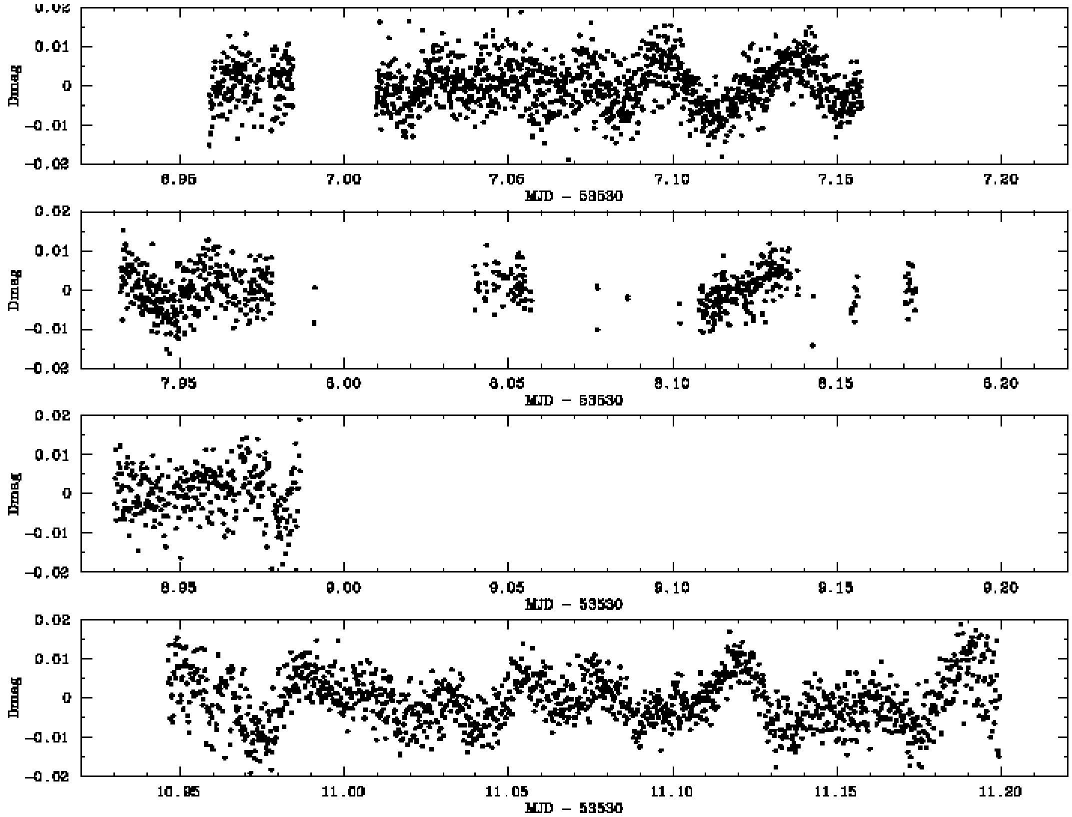

Figure 1. Differential photometry of LS IV−14°116 from June 2005.

The data were reduced using the ULTRACAM data reduction pipeline software (Dhillon & Marsh, 2001), extracted to differential magnitudes, and normalised (*i.e.* corrected such that $\langle V - C \rangle = 0$). Because the comparison star is substantially redder then LS IV−14°116, differential extinction is significant (> 0.04 mag/airmass), so data for each night were detrended by subtracting a third order polynomial fit. The final differential light curve is shown in Fig. 1, where variations of up to ±0.01mag. are clearly visible.

Table 2: Frequencies

f/mHz	a/mag	(f_{2004})	(a_{2004})
0.2908	0.0027		
0.2011	0.0018		
0.3368	0.0019	0.3484	0.0019
0.5203	0.0018	0.5119	0.0021

The Scargle power spectrum and window function for the entire dataset are shown in Fig. 2. The power spectrum resembles that obtained in 2004 (Ahmad & Jeffery, 2005) in so far as there is power at around 0.34 mHz and at 0.52 mHz in both cases. Any power at $f < 0.05$mHz has been removed by the detrending procedure. Best-fit frequencies and semi-amplitudes obtained using the period analysis software PERIOD04 (Lenz & Breger, 2005) are shown in Table 2. Errors are ±0.0116 mHz in frequency (*i.e.* at least one cycle per day) and ±0.0005 mag. in semi-amplitude. Allowing for such errors, we note that three frequencies might be construed as an harmonic series of 0.17, 0.34 and 0.51 mHz.

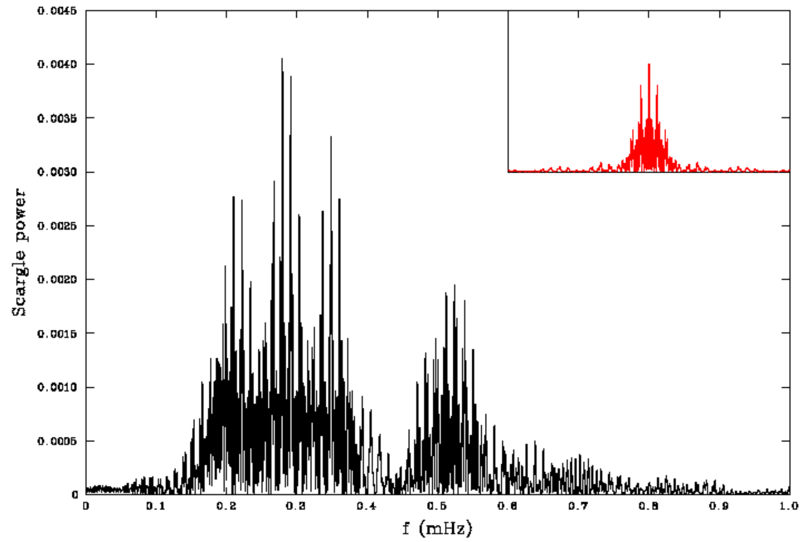

Figure 2. Scargle periodogram and window function (inset) for LS IV−14°116 from June 2005.

Ahmad & Jeffery (2005) suggested that the periodic variability in LS IV−14°116 could be due to pulsation. This view has been difficult to reconcile with the effective temperature and surface gravity of LS IV−14°116, and the known instability mechanisms for subdwarf B stars (Jeffery & Saio, 2007). The discovery of extreme chemical peculiarity (Naslim et al., 2011) suggests at least one alternative; namely that the stellar surface could be chemically inhomogeneous and that the surface flux might be modulated by rotation as in the strongly-magnetic Bp(He) stars. Arguing against such a proposition is the projected rotation velocity which is less than 2 km s^{-1}.

Given the quantity and quality of the 2005 photometric data, there is substantially little new information to be extracted from the light curve. The persistence of power at 0.34 and 0.52 mHz from 2004 to 2005 suggests that the underlying mechanism is physically robust, and not due to some stochastic process. Substantially better data are needed to establish the power spectrum more securely.

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MINIMA TIMES OF SOME ECLIPSING BINARY STARS

DEMİRCAN, Y.; GÜROL, B.; GÖKAY, G.; TERZİOĞLU, Z.; SARAL, G.; GÜRSOYTRAK, H.; OKAN, A.; DEMİRHAN, U.; ÇOKER, D.; DERMAN, E.

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Observatory and telescope:
16″Schmidt/Cassegrain telescope at Ankara University Observatory

Detector:	Apogee ALTA U47+ back illuminated CCD camera, Peltier cooling, E2V CCD47-10 chip, 1024 × 1024 pixels.

Method of data reduction:
Reduction of the CCD frames: IRAF[1] CCDRED and APPHOT packages.

Method of minimum determination:
The minima times were computed with several methods in Minima25b (Nelson, 2006) (parabolic fit, tracing paper, bisectors of chords, Kwee and van Woerden method (Kwee & van Woerden, 1956), Fourier fit and sliding integrations technique). Then weighted mean minimum-time value calculated for all filters used.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
ASAS 211538+2454.2	55435.2699	0.0001	II	BVRI	YD
	55435.5304	0.0001	I	BVRI	YD
	55439.4411	0.0001	II	BVRI	UD
ASAS 205847+2731.9	55405.3647	0.0002	II	BVRI	GG
	55405.4988	0.0001	I	BVRI	GG
	55406.4372	0.0001	II	BVRI	HG-ZT
	55406.5703	0.0002	I	BVRI	HG-ZT
ASAS 212915+1604.9	55407.5576	0.0001	II	BVRI	AO-YK-MSH
ASAS 231700+1944.9	55395.4988	0.0001	II	BVRI	GG
	55422.2993	0.0001	II	BVRI	AO
	55422.4785	0.0001	I	BVRI	AO
CP Cam	55409.5085	0.0005	II	BVRI	YD
	55412.2942	0.0002	I	BVRI	GG
DY CVn	55297.2885	0.0001	I	BVRI	YD
DZ Lyn	55208.3112	0.0002	I	BVRI	GG
	55218.5168	0.0001	I	BVRI	GS
	55222.2970	0.0002	I	BVRI	GG
	55222.4860	0.0002	II	BVRI	GG
EF Cep	55309.3863	0.0002	II	BVRI	GS
	55320.2955	0.0001	II	BVRI	AO

[1]IRAF is distributed by the National Optical Astronomical Observatories, operated by the Association of the Universities for Research in Astronomy, inc., under cooperative agreement with the National Science Foundation

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
EI CVn	55316.3851	0.0001	I	BVRI	GS
	55316.5147	0.0001	II	BVRI	GS
	55333.3349	0.0001	I	BVRI	ZT
	55333.4639	0.0001	II	BVRI	ZT
GH Boo	55323.4320	0.0002	I	BVRI	GG
	55324.4234	0.0002	II	BVRI	AO
GK Boo	55364.4367	0.0001	II	BVRI	HG
GSC 1127 1808	55417.5265	0.0010	I	BVRI	DC
GSC 2331 0731	55425.4799	0.0010	I	BVRI	UD
GSC 2140 1485	55383.3148	0.0001	I	BVRI	GG
	55437.3791	0.0001	II	BVRI	YD
	55437.5302	0.0001	I	BVRI	YD
GSC 2534 1121	55319.3945	0.0002	II	BVRI	DC-EA
	55319.5642	0.0002	I	BVRI	DC-EA
GSC 2544 1007	55317.3859	0.0001	I	BVRI	GG
	55317.5440	0.0001	II	BVRI	GG
GSC 3526 2369	55384.4777	0.0002	I	BVRI	UD
HH Boo	55322.4428	0.0001	I	BVRI	HG
LO And	55160.3026	0.0001	II	BVRI	UD-EA
PS Vir	55318.2827	0.0001	I	BVRI	YD
	55318.4291	0.0001	II	BVRI	YD
TV UMi	55392.3785	0.0010	I	BVRI	HG
	55423.3350	0.0009	II	BVRI	YD
	55423.5470	0.0013	I	BVRI	YD
	55424.3765	0.0013	I	BVRI	DC-EA
TYC 1761-1246-1	55392.5071	0.0001	I	BVRI	HG
	55080.3625	0.0003	I	BVRI	GG
V1191 Cyg	55381.3930	0.0001	I	BVRI	YD
	55381.5499	0.0002	II	BVRI	YD
	55388.4436	0.0001	II	BVRI	GS
V1918 Cyg	55380.3132	0.0001	II	BVRI	AO
	55380.5193	0.0001	I	BVRI	AO
	55390.4368	0.0001	I	BVRI	UD
XY LMi	55259.5120	0.0001	II	BVRI	HG

Explanation of the remarks in the table:

Observers: AO: Abdullah OKAN, DÇ: Deniz ÇOKER, EA:Emre AYDIN, GG: Gökhan GÖKAY, GS: Gözde SARAL, HG: Hande GÜRSOYTRAK, MSH: Muhammed SHEMUNI, UD: Utku DEMİRHAN, YD: Yahya DEMİRCAN, YK: Yücel KILIÇ, ZT: Zahide TERZİOĞLU

Remarks:

The times of minima are weighted averages from all filters observed.

Acknowledgements:

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COMMISSIONS 27 AND 42 OF THE IAU
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Konkoly Observatory
Budapest
25 January 2011

HU ISSN 0374 – 0676

CCD MINIMA FOR SELECTED ECLIPSING BINARIES IN 2010

NELSON, ROBERT H.

1393 Garvin Street, Prince George, BC, Canada, V2M 3Z1 e-mail: bob . nelson @ shaw . ca

Observatory and telescope:
Sylvester Robotic Observatory (SRO): 33 cm f/4.5 Newtonian on a Paramount ME mount

Detector:	SRO: SBIG ST-7XME, 1″.25 pixels, 15′.8 × 10′.5 FOV, cooled to $-10 < T < -30°$ C

Method of data reduction:
Aperture photometry using MIRA, by Mirametrics.

Method of minimum determination:
Digital tracing paper method, bisection of chords, curve fitting, and (occasionally) Kwee and van Woerden (1956)

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
QX And	55520.6267	0.0002	II	R	
GSC 1761-1934 Ari	55448.821	0.0002	I	R	
AP Aur	55522.8858	0.0003	I	R	
EP Aur	55561.6318	0.0005	II	c	
GSC 2374-0055 Aur	55522.7443	0.0003	I	R	
GSC 2407-0767 Aur	55546.629	0.001	I	R	
GSC 2933-1972 Aur	55485.8789	0.0002	I	c	
TY Boo	55274.9307	0.0003	I	c	
XY Boo	55274.0328	0.0002	II	R	
AC Boo	55300.8561	0.0002	II	VRI	
AC Boo	55312.8395	0.0002	II	VRI	
HH Boo	55259.9848	0.0002	I	c	
HR Boo	55264.8712	0.0003	I	c	
NR Cam	55259.664	0.0002	II	c	
GSC 4358-0151 Cam	55486.913	0.001	II	c	
GSC 4524-1856 Cam	55523.8033	0.0002	I	R	
GSC 4544-1144 Cam	55548.8678	0.0002	I	R	

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
BS Cas	55521.6727	0.0001	II	R	
V0776 Cas	55202.5705	0.0005	II	R	
V0952 Cas	55497.7659	0.0002	I	R	
V0959 Cas	55486.7753	0.0002	II	c	
V1004 Cas	55485.779	0.001	I	c	
GSC 4295-0927 Cas	55455.8407	0.0003	I	R	
GSC 4318-0519 Cas	55522.6020	0.0003	I	R	
V0497 Cep	55458.6986	0.0003	I	R	
GSC 4267-0682 Cep	55321.9166	0.0003	I	R	
GSC 4479-0888 Cep	55523.5982	0.0003	II	R	
IL Cnc	55523.9260	0.0002	I	R	
IN Cnc	55264.7131	0.0002	I	c	
IT Cnc	55242.694	0.001	II	c	
RZ Com	55262.7483	0.0003	II	c	
DL CVn	55308.7485	0.0005	I	c	
DL CVn	55325.779	0.002	I	c	
EN CVn	55259.8609	0.0003	I	c	
GSC 2545-0970 CVn	55560.9579	0.0002	I	R	
V1815 Cyg	55363.8692	0.0003	I	R	
V2477 Cyg	55312.9610	0.0001	II	R	
GSC 3581-1856 Cyg	55366.8012	0.0002	I	R	
EX Del	55345.8961	0.0003	I	c	
BL Dra	55322.9207	0.0002	I	R	
GSC 3900-0615 Dra	55326.8972	0.0001	I	R	
GSC 3900-0615 Dra	55328.7644	0.0003	II	VRI	
GSC 3900-0615 Dra	55356.7740	0.0001	I	VRI	
GSC 4436-1300 Dra	55273.9014	0.0005	I	R	
GSC 4449-1278 Dra	55325.9378	0.0004	II	c	
GSC 4541-1805 Dra	55560.824	0.001	I	c	
V0383 Gem	55553.9379	0.0005	I	c	
GSC 1913-1513 Gem	55560.7710	0.0001	I	c	
V0921 Her	55298.9376	0.0003	II	R	
V1064 Her	55324.7579	0.0003	II	R	
V1071 Her	55264.9678	0.0002	II	R	
V1091 Her	55321.7980	0.0004	I	c	
V1094 Her	55322.7765	0.0003	I	c	
V1103 Her	55303.9829	0.0004	II	c	
V1105 Her	55345.795	0.001	II	c	
GSC 3101-0547 Her	55309.9582	0.0002	II	c	
GSC 3510-1283 Her	55309.8558	0.0002	II	c	
GSC 1965-0735 Leo	55520.9310	0.0002	II	R	
XY LMi	55522.958	0.001	I	R	
V0563 Lyr	55261.9795	0.0002	I	c	
V0582 Lyr	55339.9114	0.0001	II	c	
V2357 Oph	55323.8774	0.0004	I	c	
GSC 0107-0596 Ori	55522.8275	0.0002	I	R	
GSC 1322-0294 Ori	55520.8205	0.0002	II	R	

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V0404 Peg	55411.8144	0.0005	I	VRI	
V0404 Peg	55412.8636	0.0005	II	VRI	
V0404 Peg	55424.8096	0.0005	II	VRI	
IM Per	55560.6675	0.0005	I	c	
KW Per	55521.5913	0.0005	II	R	
GSC 2846-0404 Per	55408.9483	0.0002	I	VRI	
GSC 2846-0404 Per	55456.7935	0.0007	II	VRI	
GSC 2846-0404 Per	55457.759	0.001	I	VRI	
GSC 2846-0404 Per	55457.956	0.002	II	VRI	
EN Tau	55448.9532	0.0002	I	R	
EQ Tau	55520.7310	0.0002	I	R	
GW Tau	55519.7038	0.0003	II	R	
V1112 Tau	55553.7278	0.0002	I	c	
GSC 1822-0314 Tau	55519.7933	0.0003	I	R	
GSC 1830-1432 Tau	55521.7684	0.0003	I	R	
XY UMa	55520.8786	0.0003	II	R	
KM UMa	55267.7730	0.001	II	R	
OQ UMa	55262.8603	0.0001	I	c	
GSC 2167-0490 Vul	55308.9146	0.0005	I	c	

Acknowledgements:

Thanks are due to Environment Canada for the website satellite views (see reference below) that were essential in predicting clear times for observing runs in this cloudy locale. Thanks are also due to Attilla Danko for his 'Clear Sky Clocks', (see below). This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France.

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NEW MULTICOLOUR CCD PHOTOMETRIC ANALYSIS OF BI CMi

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BI CMi (=HD 56167) was discovered as a δ Sct type pulsator by Kurpinska-Winiarska et al. (1988), with a period of ∼0.1194660 days, a V_{mag} of 9.279, and a $B-V$ index of 0.359. Mantegazza & Poretti (1994) performed a frequency analysis on their photoelectric data and resulted in 10 pulsation modes. The most complete study of the star was made by Breger et al. (2002) who included the star into a multisite photometric and spectroscopic campaign. They found 29 pulsation frequencies in the data of two observing seasons, calculated its rotational velocity and proposed a spectral type of F2.

The observations of the star were made at the Gerostathopoulion Observatory of the University of Athens, from January to March 2010 for 9 nights in a time span of 45 days, with a 20-cm Newtonian reflector telescope (f/5) and the ST-8XMEI CCD equipped with the Bessel B, V, R, I photometric filters. The differential photometry method was applied to the data using the software *MuniWin* v.1.1.26 (Hroch, 1998). TYC 194-498-1 ($V_{mag} = 10.293$ and $B-V = 0.379$ mag) and TYC 194-292-1 ($V_{mag} = 10.604$ and $B-V = 0.503$) were used as comparison and check stars, respectively. In this study, although the amount of data is less than the ones in the studies of Mantegazza & Poretti (1994) and Breger et al. (2002), we present for the first time 4-band photometry of the star based completely on CCD observations. In Fig. 1 the data of all nights in B-filter are illustrated.

The frequency analysis was made with the software *PERIOD04* v.1.2 which is based on the classical Fourier analysis (Lenz & Breger, 2005). Since our data cover less time span than the ones of Mantegazza & Poretti (1994) and Breger et al. (2002) we tried to find a solution based on their results. Initially, we performed frequency-search of all the available observational points in the interval from 8 to 9 c/d in order to detect the frequency f_1 ∼8.25 c/d reported as the dominant one by the previous authors. The latter, after the removal of this frequency, we continued to search for another ones in the interval 5-80 c/d (typical range for δ *Scuti* stars; Breger, 2000). In addition, we searched for frequencies in the range 0-1 c/d, which potentially could be caused from atmospheric reasons or observational drifts. These frequencies are indicated as f* in Table 1. After the first frequency computation, the residuals were subsequently prewhitened for the next one. The calculations stopped when the detected frequency had a signal-to-noise ratio ∼4 and its amplitude reached our magnitude error limit (∼4.5 mmag in B and V and ∼5 mmag in R and I filters). The results of the frequency search for all filters are given in Table 1, where we list: the identification number of the frequency (No), the frequency (F) value,

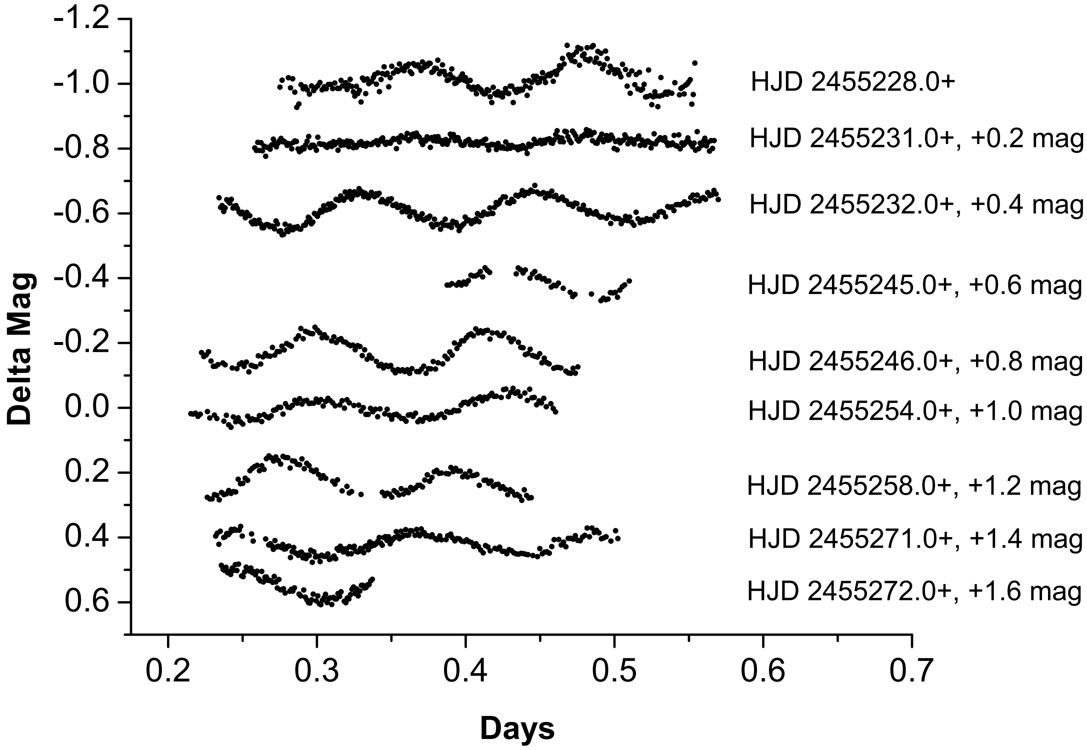

Figure 1. The observed light curves of BI CMi in B-filter.

its corresponding amplitude (A) and phase (Φ) and the signal-to-noise ratio (S/N) after prewhitening for the previous frequency(ies). The sum of the squared residuals (χ^2) derived from a multi-parameter least-squares fit of sinusoidal functions, is also given for each case. The Fourier fits on the observational points for the longest (data) sets of observations are presented in Figs 2 and 3, respectively, and the frequency spectra for B-filter is plotted in Fig. 4.

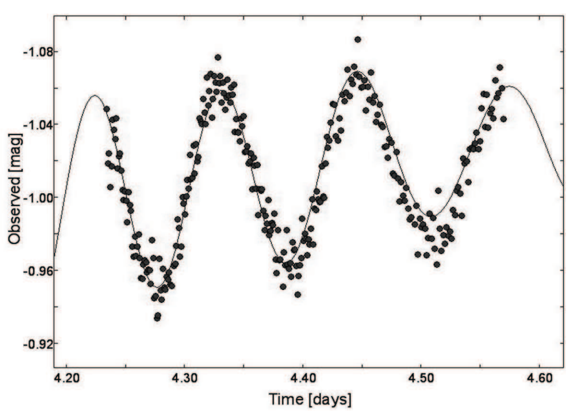

Figure 2. The Fourier fit on the B data.

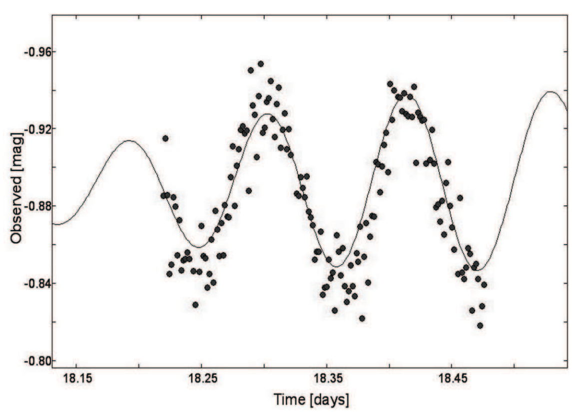

Figure 3. The Fourier fit on the V data.

The multifilter photometry helps us to verify which of the detected frequencies are physically originated, since they should be present in all filter observations. By this method, frequencies having a S/N>4 but not detected in all filter data, can be easily distinguished and characterized as observational errors (the lower ones) or residuals from

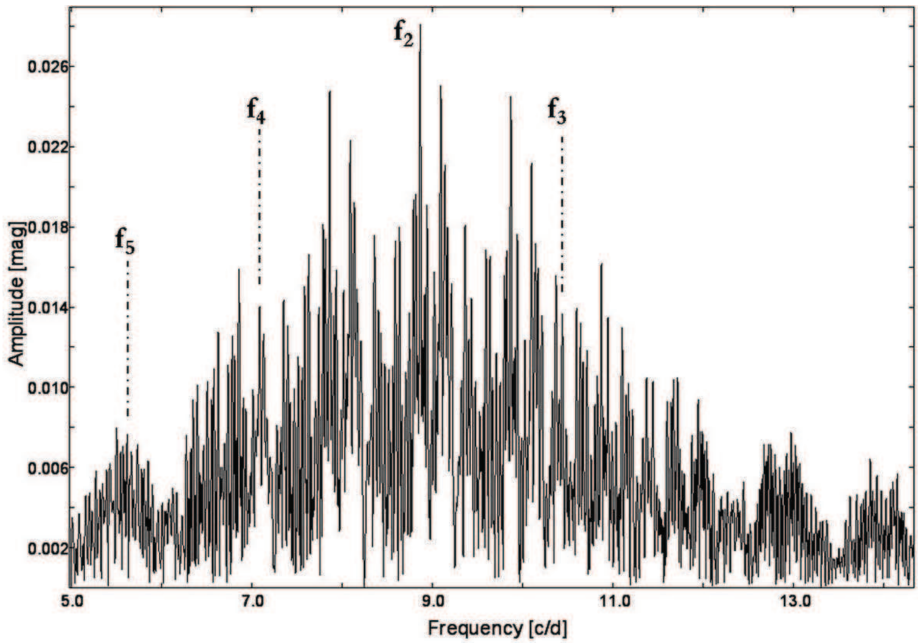

Figure 4. The periodogram in B-filter after the removal of f_1, where the detected frequencies are indicated.

Table 1. The pulsational frequencies of BI CMi for all filters

	B-filter				**V-filter**			
No	**F** [c/d]	**A** [mmag]	**Φ** [deg]	**S/N**	**F** [c/d]	**A** [mmag]	**Φ** [deg]	**S/N**
f_1	8.2476(3)	33.5(6)	335(1)	29.0	8.2464(4)	23.3(7)	336(2)	12.0
f_2	8.8675(3)	26.2(6)	130(1)	20.5	8.8654(4)	22.3(7)	147(2)	12.3
f_3	10.4391(7)	11.3(6)	230(3)	5.7	10.4358(11)	7.3(7)	238(2)	4.8
f_4	7.3966(7)	10.0(6)	54(3)	7.6	7.4452(14)	6.0(7)	345(5)	3.8
f_5	5.6487(9)	7.9(6)	220(4)	4.2				
f^*	0.7579(3)	27.5(6)	92(1)	5.8	0.2468(4)	22.3(7)	285(6)	4.0
χ^2	0.017				0.018			
	R-filter				**I-filter**			
f_1	8.2463(6)	15.7(8)	324(3)	12.0	8.2481(6)	15.7(7)	317(3)	13.8
f_2	8.8663(6)	16.6(8)	136(3)	12.3	8.8669(7)	16.6(7)	147(3)	12.5
f_3	10.4343(18)	5.4(8)	254(8)	3.8	10.4380(12)	8.7(7)	227(6)	5.2
f_4	7.3728(11)	8.7(8)	34(5)	4.8	7.3989(15)	5.4(7)	11(7)	4.4
f^*	0.6358(4)	22.9(8)	249(2)	3.8	0.0581(6)	22.9(7)	84(3)	3.9
χ^2	0.021				0.019			

a previous detected frequency after prewhitening (values close to the already detected ones). In the present work five pulsation frequencies in B-filter were found for BI CMi. The first four of them were also detected in V, R and I filter data. The Amplitude of the frequencies, as it is expected from the spectral type of the star, is decreasing from B to I filter. The current frequencies f_1, f_2 and f_4 were also detected by Mantegazza & Poretti (1994) and Breger et al. (2002). Our f_3 value is the almost the same with the f_5 (and f_6

as a close component) found by Breger et al. (2002). The frequency f_5 in the B-data was not detected by the other authors, while its signature was not traced also in the other filter data, a fact that creates uncertainty for its real existence.

Another solution could be achieved if one does not confine the initial search between 8-9 c/d, and search directly in the interval 5-80 c/d. The dominant frequency then is found to be ~9.09 c/d and the f_3=8.51 c/d of Breger et al. (2002) (=f_4 of Mantegazza & Poretti 1994) is also detected. A different value for the dominant frequency was also found by Kurpinska-Winiarska et al. (1988) as f_1=8.37 c/d.

Concluding, we preferred to present the current solution (Table 1) as the most possible one, since the amount of data of the other authors is larger, and their solution describes more or less very well our data in all filters.

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PERIODICITIES OF A NOVA-LIKE CATACLYSMIC VARIABLE STAR RX J1951.7+3716

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Motch et al. (1998) classified RX J1951.7+3716 ($\alpha = 19^h51^m47\overset{s}{.}50$, $\delta = +37^\circ16'47\overset{''}{.}8$; J2000.0) as a cataclysmic variable based on the X-ray and optical characteristics of the object. Peters and Thorstensen (2005) obtained optical spectra of the star and analyzed radial velocity changes using both absorption and emission lines. The authors found an orbital period of the system, $P_{orb} = 0\overset{d}{.}492(1)$. There were no studies on brightness variations of RX J1951.7+3716 published to date.

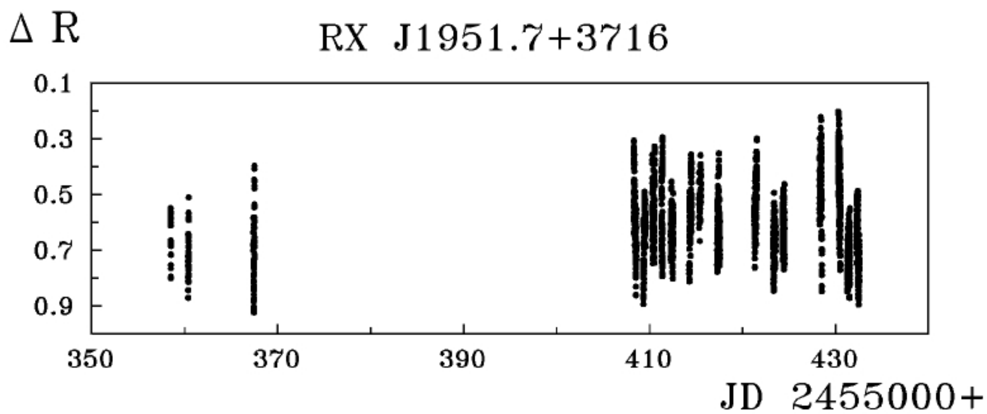

Figure 1. The summary light curve.

To confirm or disclaim present classification we have investigated RX J1951.7+3716 photometrically. Our observations were carried out at the 60-cm telescopes of the Terskol Branch of the Institute of Astronomy and the Crimean Laboratory of Sternberg Astronomical Institute equipped with a PixelVision SpectraVideoTM and an Apogee AP-47p CCD cameras respectively. We monitored RX J1951.7+3716 for eighteen nights on June 10–August 23, 2010 (JD 2455358–2455432). The frames were taken with 180 s (Terskol) and 120 s (Crimea) exposure times in the Johnson R filter. 2347 images were debiased, dark-subtracted, flat-fielded and then analyzed in MaxIm DL 4 package. USNO-A2.0 1200-13535122 ($\alpha = 19^h51^m50^s.37$, $\delta = +37°15'56''.0$; J2000.0; photographic R magnitudes: $13^m.8$ in the USNO-A2.0 and $13^m.98$, $13^m.83$ in the USNO-B1.0 catalog) was used for comparison. Stability of the comparison star was verified by brightness measurements with respect of several check stars. The uncertainty of our photometry is about $0^m.03$. The summary light curve is shown in Fig. 1.

The amplitude of light variations of RX J1951.7+3716 during different nights of our set changes from $0^m.4$ to $0^m.8$. The shape of the light curves is composite. The most stable feature of brightness variations is a flickering on timescales of 15–25 minutes. Some of light curves contain steep brightness rises and declines (Fig. 2). This photometric behavior is typical of nova-like cataclysmic variables (Warner, 1995).

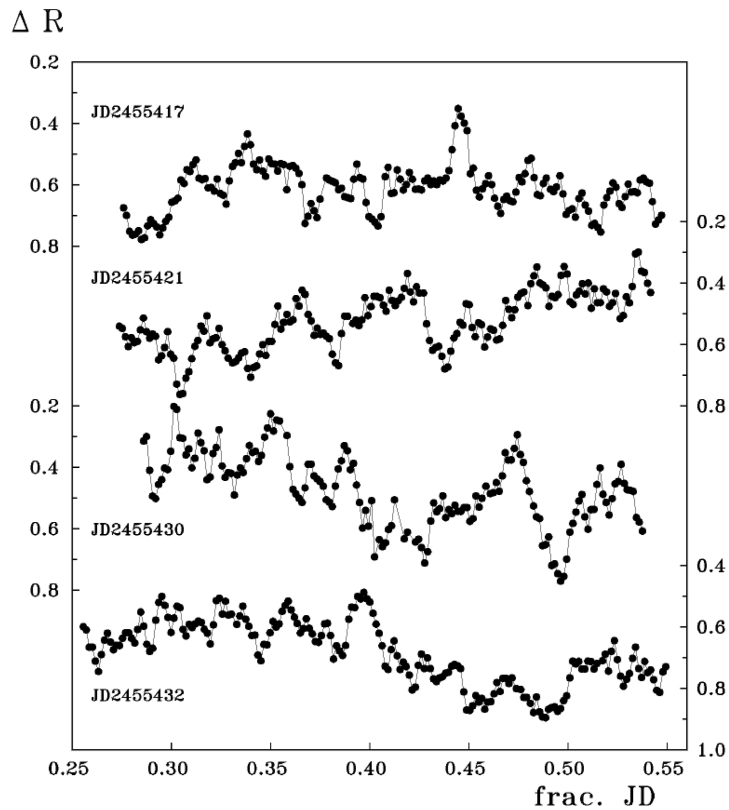

Figure 2. Individual light curves for several nights of observations.

We have analyzed our data (available through the IBVS website as `5968-t1.txt`) for periodicity using the Lafler and Kinman method (Lafler and Kinman, 1965) implemented in Pelt's (Pelt, 1980) and V.P. Goranskij's packages. The spectral orbital period (Peters and Thorstensen, 2005) is not present in our observations explicitly. Looking for periodicity in a very narrow interval in the vicinity of this period, we find only a low peak at 0.4928 days. We hope that the corresponding phased light curve (Fig. 3) can be considered as photometric reflection of the orbital motion. Two features are present in the figure. First, the wide minimum close to the phase 0.0 is better seen in the averaged light curve. Second, the flickering at the phases 0.2–0.35 is less prominent than at other intervals. We suppose that the latter finding can be explained by an eclipse of the interaction region of the disk with the accretion stream. Notice that, statistically, cataclysmic variables with orbital periods longer than ten hours are quite rare (e.g. Warner, 1995).

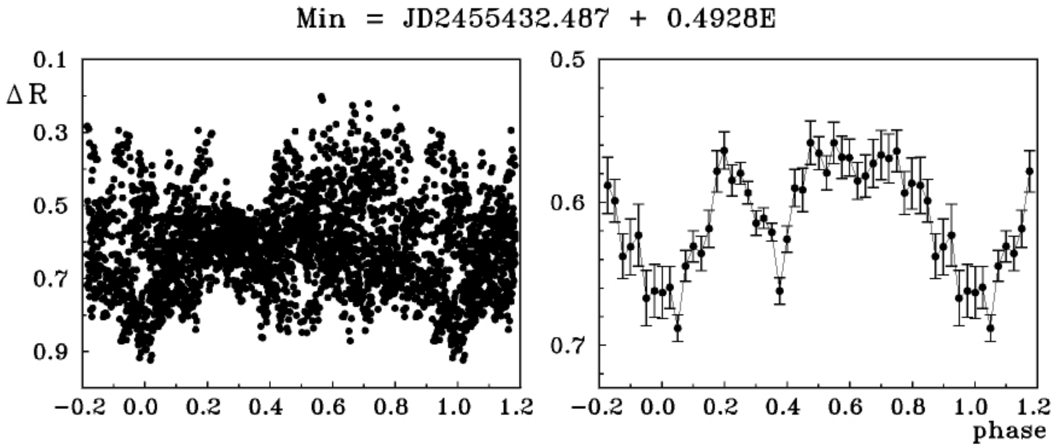

Figure 3. The phased light curve for the orbital period.

In absence of an evident orbital period, the strongest peaks on the periodogram correspond to $0^{d}.628$ and its daily alias $0^{d}.3879$ (Fig. 4, Fig. 5). We emphasize that these periods are not coupled with the orbital one. Nature of these periodicities remains unknown. The flickering being the most prominent feature of the variable's light curve, a whitening of the mentioned phased curves for the orbital variability and, vice versa, a whitening of the orbital curve for 0.628 or 0.3879 day periodicities does not improve the phased curves.

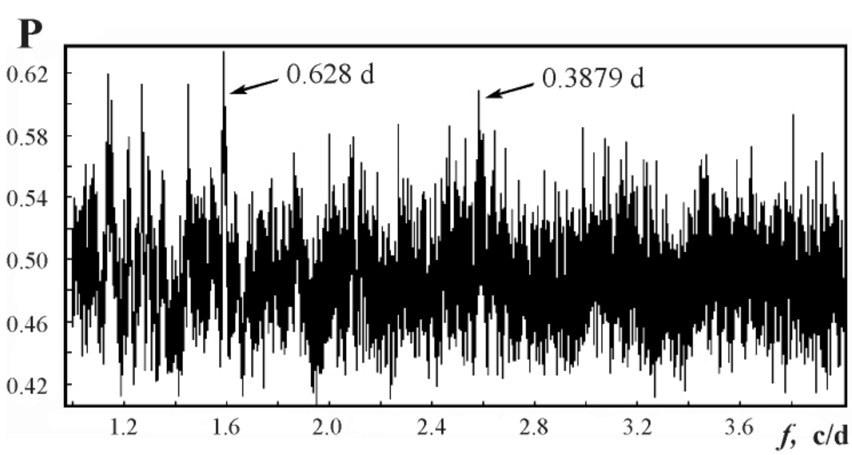

Figure 4. The power spectrum constructed using the Crimean set of observations (2232 images, July 30–August 23, 2010).

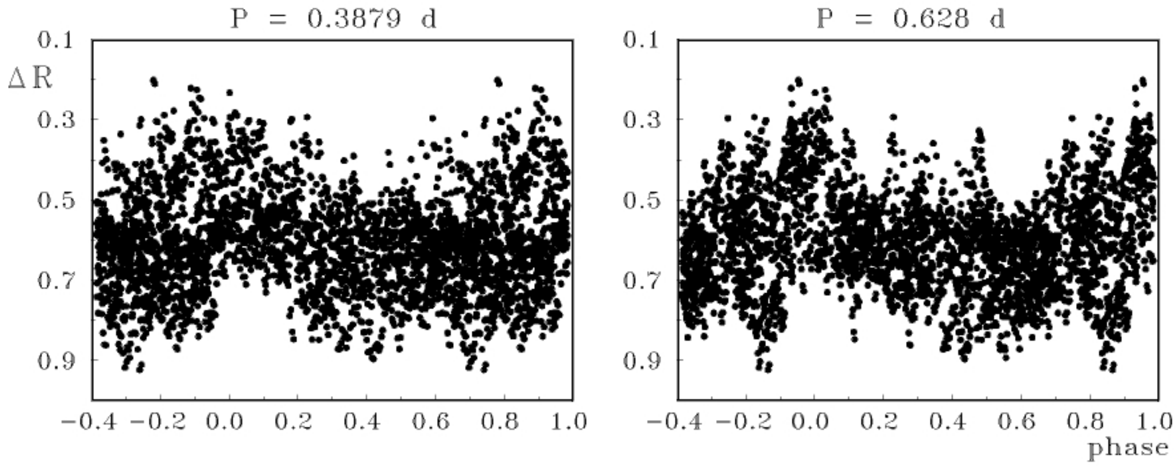

Figure 5. The phased light curve for possible periodicities.

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THE 80TH NAME-LIST OF VARIABLE STARS. PART I — RA $0^{\rm h}$ TO $6^{\rm h}$

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After the publication of the special 79th Name-List of Variable Stars (Kazarovets et al., 2008), we commenced preparation of the regular 80th Name-List. It turns out that the current flow of new discoveries is unprecedentedly high, so that it becomes reasonable to subdivide the Name-List into several parts by right ascension. The present Part I of the 80th Name-List of Variable Stars contains data necessary for identifications of new variables finally designated in 2010. Most stars in the Name-List are confined to right ascensions (J2000.0) between $0^{\rm h}$ and $6^{\rm h}$. Exceptions are several Novae and unusual variables named upon requests of the IAU Central Bureau of Astronomical Telegrams, which are included no matter the right ascension. With the 2036 stars of the current Name-List, the total number of named variable stars, not counting designated non-existing stars or stars subsequently identified with earlier-named variables, is now 43 519.

As it had been done in the 79th Name-List, we separate the catalogue of newly designated variables (to be published elsewhere in the nearest future) from the Name-List proper. Table 1 of the current Name-List contains the new GCVS name, equatorial coordinates (rounded to an accuracy sufficient for identification), and variability type for each star. The order of stars in Table 1 corresponds to the order of stars in the GCVS. The remarks concerning the two unusual variables (type *), BF Ari and GO Cet, follow Table 1. The electronic version of the Name-List at `http://www.sai.msu.su/gcvs/gcvs/nl80` additionally presents variability ranges, light elements, spectral types, identifications with astronomical catalogues, detailed remarks, bibliographic references for the newly named variable stars.

As usual, we continued naming Novae and other variables of astrophysical importance upon requests from the IAU Bureau of Astronomical Telegrams. These stars are also included in Table 1. They are also listed in Table 2 that contains, besides GCVS names, preliminary "constellation+year" designations for Novae.

We use this opportunity to announce two corrections.

In the 75th Name-List of Variable Stars (Kazarovets et al., 2000), because of a blunder in right ascension, the star Tmz V124 was erroneously named FS Boo. Now we announce FS Boo a non-existing variable and give Tmz V124 the new GCVS name V581 Aur. The correct J2000.0 coordinates of V581 Aur are $05^{\rm h}12^{\rm m}06\overset{\rm s}{.}9$, $+45^\circ46'43''$.

The 78th Name-List of Variable Stars (Kazarovets et al., 2006) changed the name of the eclipsing variable V577 Cen into V423 Hya because of the star's improved coordinates corresponding to a different constellation. Our identification was based on the chart by Tsesevich & Kazanasmas (1971). Christiansen et al. (2008) recovered the variable beyond doubt, their identification shows that the chart in Tsesevich & Kazanasmas is wrong, and the star is actually in Centaurus. Thus, we return the name V577 Cen to the variable and announce V423 Hya to be an alias name of V577 Cen. The accurate J2000.0 position of V577 Cen is $11^{\rm h}56^{\rm m}40\overset{\rm s}{.}5$, $-35°43'45''$.

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Table 1.

Name	R.A. (2000.0) h	m	s	Decl. (2000.0) °	'	"	Type
V0467 And	00	00	06.5	+35	22	01	EW
V0468 And	00	09	46.5	+40	11	35	EA
V0469 And	00	11	22.0	+42	05	39	EW
V0470 And	00	12	50.2	+37	41	37	LPB
V0471 And	00	13	57.6	+35	02	43	RS
V0472 And	00	15	50.1	+41	28	03	EW
V0473 And	00	16	05.4	+41	51	24	EW
V0474 And	00	16	50.1	+43	44	56	EW
V0475 And	00	17	36.9	+30	51	20	RS
V0476 And	00	18	25.0	+23	24	34	RS
V0477 And	00	18	31.3	+30	25	58	EW
V0478 And	00	18	55.9	+22	39	40	DSCT
V0479 And	00	18	56.9	+34	54	44	NL
V0480 And	00	19	12.7	+33	01	12	EW
V0481 And	00	20	01.1	+27	59	54	RS
V0482 And	00	20	34.6	+40	25	06	E/RS
V0483 And	00	20	35.3	+40	04	17	EW
V0484 And	00	21	05.4	+32	29	17	EW
V0485 And	00	21	19.2	+35	24	15	EW
V0486 And	00	21	23.0	+33	42	37	RS
V0487 And	00	21	27.0	+30	13	23	EB
V0488 And	00	22	06.0	+40	31	24	EB
V0489 And	00	24	39.1	+24	55	23	EB
V0490 And	00	26	48.8	+41	50	04	EW
V0491 And	00	30	19.9	+41	10	40	BY
V0492 And	00	32	51.8	+26	18	15	RRAB
V0493 And	00	34	08.5	+25	23	50	RS
V0494 And	00	36	33.2	+43	05	54	RS
V0495 And	00	37	11.9	+44	12	59	RS
V0496 And	00	39	33.0	+27	30	29	EA
V0497 And	00	39	55.9	+34	14	53	EW
V0498 And	00	40	20.9	+43	43	25	RS
V0499 And	00	40	46.1	+43	23	59	RRC
V0500 And	00	42	26.5	+42	15	37	UG:
V0501 And	00	43	06.4	+41	30	13	UG:
V0502 And	00	43	38.3	+30	12	45	EW
V0503 And	00	43	59.5	+22	09	09	RRAB
V0504 And	00	45	00.4	+38	43	56	EW
V0505 And	00	45	38.6	+37	28	29	EW
V0506 And	00	46	37.7	+31	51	17	EW
V0507 And	00	47	05.4	+30	18	24	RS
V0508 And	00	47	44.2	+36	02	23	EW
V0509 And	00	48	36.9	+32	08	59	EW:
V0510 And	00	49	23.1	+32	00	37	EA
V0511 And	00	52	14.3	+45	41	26	RS:
V0512 And	00	52	17.3	+35	16	04	EA
V0513 And	00	54	17.8	+39	45	10	EA
V0514 And	00	54	53.2	+35	28	03	EW
V0515 And	00	55	19.9	+46	12	57	NL
V0516 And	00	56	03.4	+35	33	58	RRC
V0517 And	00	56	11.7	+35	49	10	EW
V0518 And	00	57	28.9	+40	01	44	EW
V0519 And	00	58	39.2	+36	38	50	CWA
V0520 And	00	59	04.5	+45	52	22	SR
V0521 And	01	01	26.5	+38	03	13	DSCTC
V0522 And	01	03	28.9	+43	01	28	EA
V0523 And	01	05	38.0	+36	49	06	EA
V0524 And	01	05	47.2	+44	35	04	SXPHE
V0525 And	01	16	48.1	+34	18	10	EA/RS
V0526 And	01	21	23.3	+35	50	12	EB
V0527 And	01	22	35.7	+34	19	36	EW
V0528 And	01	22	59.8	+36	28	17	SXPHE
V0529 And	01	27	26.7	+41	06	04	GDOR+DSCT
V0530 And	01	27	41.1	+33	51	55	EB
V0531 And	01	30	15.9	+33	39	19	EW
V0532 And	01	30	25.3	+39	18	30	EW
V0533 And	01	31	30.5	+38	09	52	EB
V0534 And	01	31	30.5	+34	55	52	EW
V0535 And	01	31	47.2	+38	48	03	RS
V0536 And	01	34	28.6	+39	50	26	EW:
V0537 And	01	35	19.3	+37	46	38	EA
V0538 And	01	36	14.7	+38	04	34	EW
V0539 And	01	36	26.2	+40	43	44	RS
V0540 And	01	37	27.1	+39	00	08	RS
V0541 And	01	37	36.1	+38	03	57	EA
V0542 And	01	40	28.8	+42	12	01	RS
V0543 And	01	42	25.3	+37	55	25	EA
V0544 And	01	44	28.0	+37	58	54	SXPHE
V0545 And	01	47	30.0	+48	06	48	LB
V0546 And	01	51	12.6	+43	49	08	EW
V0547 And	01	52	03.0	+37	48	09	EA/RS
V0548 And	01	54	55.8	+42	12	57	RRAB
V0549 And	01	55	18.3	+40	55	33	EW
V0550 And	01	56	08.2	+43	17	30	RRAB
V0551 And	01	56	21.3	+40	35	17	SR
V0552 And	01	57	39.9	+43	55	04	EW
V0553 And	01	57	51.1	+44	02	15	EW
V0554 And	01	57	57.2	+44	27	51	EW
V0555 And	01	58	18.2	+43	59	27	EB
V0556 And	01	58	47.8	+44	33	05	EW
V0557 And	01	59	10.8	+38	12	33	EW
V0558 And	01	59	17.9	+44	07	58	EW
V0559 And	02	00	24.7	+44	22	56	EW
V0560 And	02	01	30.0	+44	29	15	EA
V0561 And	02	02	03.6	+43	54	35	EW
V0562 And	02	02	11.3	+44	19	50	DSCT
V0563 And	02	02	40.1	+36	42	41	EW
V0564 And	02	03	08.4	+44	10	23	EW
V0565 And	02	03	27.8	+44	14	51	EW
V0566 And	02	07	20.0	+35	38	55	EW
V0567 And	02	07	59.5	+40	17	56	EA
V0568 And	02	13	05.4	+40	49	31	EW
V0569 And	02	14	40.6	+49	53	19	RRAB
V0570 And	02	15	45.9	+40	14	21	LB
V0571 And	02	19	13.8	+37	54	05	EW
V0572 And	02	22	16.5	+41	23	00	UGSU
V0573 And	02	24	52.5	+42	26	54	RS:
V0574 And	02	27	22.4	+39	11	29	LB

Table 1. (continued)

Name	R.A. 2000.0 h m s	Decl. 2000.0 ° ' "	Type	Name	R.A. 2000.0 h m s	Decl. 2000.0 ° ' "	Type
V0575 And	02 28 44.3	+37 28 59	EW	V0602 Aur	05 10 43.9	+46 14 39	BY
V0576 And	02 32 53.2	+46 30 34	SRB	V0603 Aur	05 10 57.2	+52 14 57	EW
V0577 And	02 38 57.3	+44 44 23	RS	V0604 Aur	05 19 08.5	+34 05 38	IB
V1722 Aql	19 14 09.7	+15 16 34	N	V0605 Aur	05 22 46.8	+35 35 36	LB
BE Ari	01 47 10.2	+23 45 32	RS:	V0606 Aur	05 23 36.6	+29 34 28	EA
BF Ari	01 51 41.6	+12 44 30	*	V0607 Aur	05 24 24.6	+54 39 22	EA/RS
BG Ari	01 51 51.9	+14 00 47	NL	V0608 Aur	05 27 37.9	+39 55 33	EA
BH Ari	01 55 48.0	+24 26 06	RS	V0609 Aur	05 27 48.6	+39 54 11	EB
BI Ari	01 57 27.9	+18 27 40	RPHS	V0610 Aur	05 30 01.9	+33 24 06	EA
BK Ari	01 59 35.6	+23 48 53	RS	V0611 Aur	05 30 20.9	+41 49 14	RS
BL Ari	02 03 19.4	+22 05 21	RRAB	V0612 Aur	05 32 40.0	+49 34 19	EA
BM Ari	02 06 38.3	+14 15 28	EW	V0613 Aur	05 35 05.6	+39 46 32	IB:
BN Ari	02 09 07.8	+26 29 07	EW	V0614 Aur	05 38 07.2	+42 20 29	BY
BO Ari	02 12 08.8	+27 08 18	EW	V0615 Aur	05 38 44.4	+53 56 31	SRB
BP Ari	02 20 32.4	+20 07 29	RS	V0616 Aur	05 39 29.4	+35 41 09	INB
BQ Ari	02 48 40.7	+13 44 48	EW	V0617 Aur	05 39 56.6	+30 05 11	EB
BR Ari	02 53 51.6	+15 21 07	RS	V0618 Aur	05 43 38.2	+31 58 54	EA
BS Ari	02 55 25.8	+20 04 52	IT	V0619 Aur	05 43 56.0	+52 57 31	SRB:
BT Ari	02 55 57.8	+20 05 45	BY:	V0620 Aur	05 45 40.2	+41 06 24	EA
BU Ari	02 56 08.0	+20 03 24	INT	V0621 Aur	05 46 04.5	+34 45 28	DCEP
BV Ari	02 56 08.4	+20 03 39	INT	V0622 Aur	05 47 53.6	+39 01 41	EW
BW Ari	02 57 46.7	+29 39 41	BY	V0623 Aur	05 48 15.4	+39 02 10	EB
BX Ari	02 58 11.2	+20 30 03	INT	V0624 Aur	05 48 18.1	+38 57 09	EA
BY Ari	02 58 16.1	+19 47 19	INT	V0625 Aur	05 48 24.5	+39 05 38	EW
BZ Ari	02 58 28.8	+29 47 54	IT:	V0626 Aur	05 48 37.6	+39 10 28	EW
CC Ari	03 02 39.9	+30 32 18	BY	V0627 Aur	05 49 00.7	+39 14 34	EW
CD Ari	03 03 15.5	+27 16 42	RRC	V0628 Aur	05 49 08.4	+39 12 36	EA
CE Ari	03 03 49.9	+25 02 34	RS	V0629 Aur	05 49 17.2	+39 20 12	EB
CF Ari	03 04 05.1	+30 03 10	RS:	V0630 Aur	05 50 11.4	+39 10 26	EB
CG Ari	03 15 31.9	+26 04 50	RS	V0631 Aur	05 50 14.3	+39 19 36	EW
CH Ari	03 22 31.6	+28 53 20	RS	V0632 Aur	05 50 17.9	+39 07 12	EB
CI Ari	03 23 05.5	+18 34 45	RRAB	V0633 Aur	05 50 27.0	+39 13 15	EA
CK Ari	03 27 14.3	+27 23 09	RS	V0634 Aur	05 50 45.2	+39 21 22	EW
CL Ari	03 29 06.6	+27 24 49	EB	V0635 Aur	05 51 02.1	+39 15 16	BY:
V0582 Aur	05 25 52.0	+34 52 30	FU:	V0636 Aur	05 52 54.7	+35 16 10	EW
V0583 Aur	04 39 25.5	+33 32 45	IB	V0637 Aur	05 52 58.8	+36 23 37	DCEPS
V0584 Aur	04 39 31.0	+34 07 45	RS	V0638 Aur	05 53 13.5	+38 24 07	RS:
V0585 Aur	04 47 29.2	+31 51 43	EB	V0639 Aur	05 54 43.4	+52 43 38	EW
V0586 Aur	04 51 04.9	+43 46 47	DSCTC:	SY Cae	04 51 00.9	−34 02 15	BY:
V0587 Aur	04 51 17.7	+43 37 14	DSCTC:	NV Cam	03 18 04.7	+61 34 06	SR:
V0588 Aur	04 52 22.0	+40 06 35	RS	NW Cam	03 25 04.5	+58 40 49	EA:
V0589 Aur	04 52 24.2	+43 19 55	EA	NX Cam	03 26 10.6	+59 34 42	EW:
V0590 Aur	04 53 08.7	+33 12 02	IB	NY Cam	03 27 52.2	+56 14 18	LB
V0591 Aur	04 54 00.2	+39 33 44	EB	NZ Cam	03 30 19.2	+65 54 03	EW:
V0592 Aur	04 54 50.6	+32 04 12	RS	OO Cam	03 32 18.4	+61 16 41	EA
V0593 Aur	04 56 39.2	+43 48 46	RS:	OP Cam	03 33 01.0	+58 31 55	EW
V0594 Aur	04 57 51.4	+39 30 02	EA	OQ Cam	03 33 34.3	+64 16 46	EW
V0595 Aur	04 58 09.0	+43 33 01	RS	OR Cam	03 34 23.7	+58 24 50	DCEPS
V0596 Aur	05 02 02.3	+42 37 55	EW	OS Cam	03 34 47.3	+62 14 53	EW
V0597 Aur	05 02 06.2	+31 11 02	RS	OT Cam	03 40 22.3	+64 06 11	EA/RS:
V0598 Aur	05 03 29.6	+31 09 42	RS:	OU Cam	03 42 35.5	+66 22 21	CEP
V0599 Aur	05 08 46.8	+32 02 09	EW	OV Cam	03 46 55.4	+76 58 39	LB
V0600 Aur	05 10 22.3	+31 26 40	IB	OW Cam	03 47 10.6	+53 23 15	M:
V0601 Aur	05 10 43.4	+30 20 43	RS	OX Cam	03 48 25.7	+59 26 32	DCEP

Table 1. (continued)

Name	R.A. (2000.0) h m s	Decl. (2000.0) ° ' "	Type	Name	R.A. (2000.0) h m s	Decl. (2000.0) ° ' "	Type
OY Cam	03 48 32.5	+63 30 40	EA	V0366 Cam	04 37 39.6	+71 58 46	EW
OZ Cam	03 48 44.8	+67 16 13	SR	V0367 Cam	04 40 55.2	+53 38 07	DSCT
PP Cam	03 49 03.5	+74 27 34	EA	V0368 Cam	04 43 24.3	+72 20 01	EW
PQ Cam	03 50 41.8	+67 34 46	EA	V0369 Cam	04 43 30.2	+63 59 12	EW
PR Cam	03 51 53.5	+54 09 53	EW	V0370 Cam	04 43 36.9	+69 32 21	SR
PS Cam	03 54 03.4	+59 54 12	EB	V0371 Cam	04 44 24.1	+78 54 12	SRD
PT Cam	03 54 52.5	+67 38 07	EA	V0372 Cam	04 45 29.3	+63 57 17	EB
PU Cam	03 54 56.1	+67 24 12	SRB	V0373 Cam	04 46 44.0	+59 27 51	EW
PV Cam	03 56 22.4	+57 15 26	DCEPS:	V0374 Cam	04 48 18.9	+64 01 16	EA
PW Cam	03 56 24.6	+65 16 14	SR	V0375 Cam	04 55 35.5	+78 37 56	EW
PX Cam	03 57 48.1	+57 31 27	EA	V0376 Cam	04 57 21.0	+79 20 59	SXPHE
PY Cam	03 58 37.7	+55 14 27	SRB	V0377 Cam	04 58 51.3	+57 00 53	RRAB
PZ Cam	03 59 47.7	+63 49 50	EW	V0378 Cam	05 00 09.2	+73 41 08	EA
QQ Cam	04 02 36.5	+64 26 53	CWA	V0379 Cam	05 04 42.9	+61 33 53	EA
QR Cam	04 02 53.8	+54 10 33	DCEP	V0380 Cam	05 07 18.8	+71 45 22	RS:
QS Cam	04 03 46.5	+57 14 52	DCEP	V0381 Cam	05 08 42.1	+70 40 44	EB
QT Cam	04 04 00.1	+62 31 55	EA	V0382 Cam	05 10 18.5	+63 19 51	EA
QU Cam	04 07 55.1	+77 31 22	EA	V0383 Cam	05 10 39.4	+75 10 34	EW
QV Cam	04 08 11.3	+55 50 12	EB	V0384 Cam	05 18 53.8	+65 42 33	EA
QW Cam	04 08 13.9	+54 12 34	EW	V0385 Cam	05 19 47.1	+77 36 14	EB
QX Cam	04 10 05.4	+61 46 38	CWB	V0386 Cam	05 21 33.9	+71 45 46	EW
QY Cam	04 11 48.1	+56 46 27	EA	V0387 Cam	05 21 46.3	+65 44 55	EB
QZ Cam	04 13 35.9	+60 23 11	EA	V0388 Cam	05 22 02.3	+77 27 44	SRD
V0335 Cam	04 14 41.8	+67 50 13	EA	V0389 Cam	05 22 54.8	+70 00 15	EW
V0336 Cam	04 16 09.0	+56 26 52	LB	V0390 Cam	05 29 23.4	+78 57 41	DSCT
V0337 Cam	04 16 20.0	+68 58 21	EB	V0391 Cam	05 32 33.9	+62 47 52	UGSU
V0338 Cam	04 19 20.8	+55 58 55	LB	V0392 Cam	05 33 44.9	+71 37 29	EW
V0339 Cam	04 19 45.1	+55 57 36	DSCTC	V0393 Cam	05 34 48.3	+70 14 29	EW
V0340 Cam	04 19 52.5	+56 00 52	EW	V0394 Cam	05 34 50.3	+72 26 45	EW
V0341 Cam	04 22 43.6	+62 33 37	SR:	V0395 Cam	05 35 36.0	+71 03 35	EA
V0342 Cam	04 23 32.8	+74 52 50	UGSU	V0396 Cam	05 36 41.4	+72 19 47	EW
V0343 Cam	04 23 59.2	+58 35 34	EA	V0397 Cam	05 36 49.7	+73 41 40	EA
V0344 Cam	04 24 15.2	+71 39 14	RRC:	V0398 Cam	05 37 14.5	+67 42 22	EA
V0345 Cam	04 25 55.3	+69 15 46	EW	V0399 Cam	05 38 23.5	+61 17 25	EA
V0346 Cam	04 25 59.7	+68 32 59	EW	V0400 Cam	05 39 41.8	+71 05 31	EA
V0347 Cam	04 26 23.1	+79 13 52	EA	V0401 Cam	05 39 55.3	+69 45 21	EW
V0348 Cam	04 26 41.6	+68 44 28	EB	V0402 Cam	05 39 57.8	+64 51 16	RRAB
V0349 Cam	04 27 26.0	+68 33 24	EB	V0403 Cam	05 39 58.5	+67 20 17	EW
V0350 Cam	04 27 32.9	+59 49 04	RRAB	V0404 Cam	05 40 15.7	+66 14 30	EA
V0351 Cam	04 27 34.9	+68 17 42	EW	V0405 Cam	05 42 50.7	+64 25 15	EW
V0352 Cam	04 28 18.8	+68 47 18	EW	V0406 Cam	05 43 35.0	+62 46 41	EW
V0353 Cam	04 28 31.3	+68 20 53	EA	V0407 Cam	05 43 53.5	+72 54 51	SR
V0354 Cam	04 28 41.0	+68 33 27	RRAB	V0408 Cam	05 44 49.1	+71 08 10	EB:
V0355 Cam	04 28 46.2	+55 17 01	RRC	V0409 Cam	05 46 43.9	+75 20 57	EA
V0356 Cam	04 29 09.9	+68 34 01	EW	V0410 Cam	05 47 51.5	+62 11 33	EW
V0357 Cam	04 29 25.4	+68 43 02	CEP:	V0411 Cam	05 49 19.8	+67 44 03	RS
V0358 Cam	04 30 06.0	+56 03 17	LB	V0412 Cam	05 50 55.1	+62 51 46	EA
V0359 Cam	04 30 18.7	+53 56 25	DCEP	V0413 Cam	05 52 46.5	+72 51 16	RRAB
V0360 Cam	04 30 23.2	+55 04 09	SRS	V0414 Cam	05 53 25.0	+79 45 01	RRC
V0361 Cam	04 32 51.2	+78 42 54	EA	V0415 Cam	05 57 38.2	+80 38 18	EW
V0362 Cam	04 33 36.2	+64 05 38	EW	V0416 Cam	05 59 03.8	+71 02 36	EW
V0363 Cam	04 34 42.0	+55 42 32	SR	V0417 Cam	05 59 28.0	+62 39 10	EW
V0364 Cam	04 34 48.5	+68 35 48	EA	V0679 Car	11 13 53.8	−61 13 48	NA
V0365 Cam	04 36 33.6	+57 24 05	SRA:	V1023 Cas	00 00 06.7	+56 39 12	RRAB

Table 1. (continued)

Name	R.A. 2000.0 h m s	Decl. 2000.0 ° ' "	Type
V1024 Cas	00 00 39.4	+56 45 29	EW
V1025 Cas	00 01 38.5	+52 54 14	EA
V1026 Cas	00 07 01.8	+64 44 05	DSCTC
V1027 Cas	00 10 45.6	+61 27 56	EA
V1028 Cas	00 12 01.9	+60 37 51	LB
V1029 Cas	00 18 42.8	+54 02 21	CWA
V1030 Cas	00 19 36.6	+48 39 55	EW
V1031 Cas	00 21 14.4	+66 05 09	EW
V1032 Cas	00 22 17.2	+46 49 37	EA
V1033 Cas	00 22 57.6	+61 41 08	NL
V1034 Cas	00 25 11.0	+51 35 31	RRAB
V1035 Cas	00 27 59.0	+49 09 45	RRC
V1036 Cas	00 28 17.1	+63 44 06	INT:
V1037 Cas	00 29 03.0	+59 34 19	XP
V1038 Cas	00 29 53.0	+47 50 34	EB
V1039 Cas	00 30 26.4	+68 42 59	SRB
V1040 Cas	00 31 48.1	+57 01 34	DSCT:
V1041 Cas	00 32 54.2	+47 08 49	RRAB
V1042 Cas	00 34 32.3	+51 29 00	SRA:
V1043 Cas	00 37 12.0	+53 01 32	EA
V1044 Cas	00 39 56.3	+67 42 55	EA:
V1045 Cas	00 40 43.6	+76 58 49	RRAB
V1046 Cas	00 40 44.2	+58 50 54	EA
V1047 Cas	00 42 01.5	+54 15 05	RRC
V1048 Cas	00 44 30.6	+56 45 51	SR
V1049 Cas	00 45 25.0	+58 05 52	EA
V1050 Cas	00 45 34.3	+56 16 27	LB
V1051 Cas	00 46 11.8	+57 13 06	LB
V1052 Cas	00 46 23.7	+63 19 37	DSCTC
V1053 Cas	00 47 12.7	+61 02 04	EW
V1054 Cas	00 48 20.8	+59 16 47	LB
V1055 Cas	00 48 21.0	+71 16 11	BY
V1056 Cas	00 51 00.2	+58 48 36	EB
V1057 Cas	00 51 53.0	+65 10 50	RRC:
V1058 Cas	00 51 58.2	+53 51 41	DSCTC
V1059 Cas	00 54 36.0	+74 31 41	RRAB:
V1060 Cas	00 55 14.2	+61 23 49	EA
V1061 Cas	00 56 13.7	+65 07 16	EA
V1062 Cas	01 02 09.2	+59 55 43	EB
V1063 Cas	01 04 47.3	+76 06 14	EW
V1064 Cas	01 07 59.9	+63 37 43	EW
V1065 Cas	01 09 28.9	+68 39 15	EA/RS
V1066 Cas	01 10 55.2	+58 05 56	EA
V1067 Cas	01 13 01.2	+74 43 54	EB
V1068 Cas	01 14 14.2	+52 54 39	EA
V1069 Cas	01 15 08.5	+54 39 34	EW
V1070 Cas	01 15 59.0	+52 46 40	EA
V1071 Cas	01 16 16.4	+74 13 41	RV:
V1072 Cas	01 16 16.6	+63 31 53	BE
V1073 Cas	01 17 02.5	+57 56 32	DCEPS:
V1074 Cas	01 17 08.7	+58 28 28	DSCT:
V1075 Cas	01 17 12.9	+58 50 00	LB:
V1076 Cas	01 17 34.0	+58 09 23	EW
V1077 Cas	01 17 49.8	+58 24 31	EW
V1078 Cas	01 17 51.4	+58 15 24	DSCTC
V1079 Cas	01 17 57.5	+58 27 50	EB
V1080 Cas	01 18 05.4	+57 57 52	EA
V1081 Cas	01 18 11.0	+58 32 01	EW
V1082 Cas	01 18 41.3	+58 07 57	LB
V1083 Cas	01 18 48.2	+58 31 39	DCEPS
V1084 Cas	01 18 49.2	+58 23 53	EA
V1085 Cas	01 19 02.0	+58 10 10	LB
V1086 Cas	01 19 02.4	+58 19 20	LPB:
V1087 Cas	01 19 08.3	+58 04 19	DCEPS
V1088 Cas	01 19 17.2	+57 45 59	DSCT
V1089 Cas	01 19 22.8	+71 02 55	LB
V1090 Cas	01 19 29.5	+58 13 41	EW
V1091 Cas	01 19 39.9	+67 09 05	LB
V1092 Cas	01 19 52.2	+58 44 58	RR:
V1093 Cas	01 20 14.9	+58 14 36	EW
V1094 Cas	01 20 23.1	+59 17 16	EW
V1095 Cas	01 20 23.9	+57 57 27	RRAB
V1096 Cas	01 20 37.9	+58 34 39	EB
V1097 Cas	01 20 38.1	+57 49 11	LB
V1098 Cas	01 20 43.5	+58 28 22	EA
V1099 Cas	01 20 48.8	+58 31 13	DCEP:
V1100 Cas	01 21 21.1	+64 06 03	DCEP
V1101 Cas	01 21 45.8	+58 01 22	EW
V1102 Cas	01 21 55.6	+58 06 11	CWB:
V1103 Cas	01 21 59.2	+58 33 14	EA
V1104 Cas	01 22 04.5	+58 38 11	EA
V1105 Cas	01 22 23.0	+58 24 08	DSCTC
V1106 Cas	01 22 31.9	+73 45 09	EA
V1107 Cas	01 23 14.6	+61 34 53	EW
V1108 Cas	01 23 46.4	+58 40 54	SRB
V1109 Cas	01 26 22.2	+73 13 11	RRAB
V1110 Cas	01 30 05.4	+73 45 32	EA
V1111 Cas	01 32 06.5	+60 45 27	DSCTC
V1112 Cas	01 32 10.7	+66 34 59	EA
V1113 Cas	01 32 11.1	+60 35 47	DSCTC
V1114 Cas	01 32 13.2	+60 34 56	EW
V1115 Cas	01 32 20.8	+55 13 57	EW
V1116 Cas	01 32 37.0	+61 58 12	BCEP
V1117 Cas	01 32 51.2	+60 45 33	DSCTC
V1118 Cas	01 32 54.8	+60 42 45	DSCTC
V1119 Cas	01 32 59.6	+60 49 38	DSCTC
V1120 Cas	01 33 07.1	+60 47 51	EA
V1121 Cas	01 33 11.9	+60 51 31	EW
V1122 Cas	01 33 15.1	+60 41 00	BE
V1123 Cas	01 33 16.3	+60 38 01	EA
V1124 Cas	01 33 16.9	+60 50 18	DSCTC
V1125 Cas	01 33 29.8	+60 47 11	EW
V1126 Cas	01 33 31.9	+60 36 24	GDOR:
V1127 Cas	01 33 32.3	+60 39 30	GDOR
V1128 Cas	01 33 33.2	+61 33 30	SRC
V1129 Cas	01 33 35.6	+60 40 39	SRS
V1130 Cas	01 33 36.8	+60 37 56	EA
V1131 Cas	01 33 41.5	+74 45 45	EA

Table 1. (continued)

Name	R.A. 2000.0 h	m	s	Decl. 2000.0 °	’	”	Type
V1132 Cas	01	33	45.5	+60	37	23	GDOR
V1133 Cas	01	33	54.0	+60	40	26	EA
V1134 Cas	01	33	58.4	+60	31	02	EB
V1135 Cas	01	34	15.4	+60	42	19	EW
V1136 Cas	01	34	26.8	+60	35	11	EW
V1137 Cas	01	34	53.9	+67	38	15	EA
V1138 Cas	01	35	16.7	+56	44	39	EA
V1139 Cas	01	35	44.5	+55	41	13	EW
V1140 Cas	01	36	21.5	+68	52	28	EA
V1141 Cas	01	38	18.0	+61	08	35	EA
V1142 Cas	01	43	32.2	+64	02	15	ELL:
V1143 Cas	01	43	35.6	+64	02	07	BCEP
V1144 Cas	01	44	08.1	+60	39	20	EA
V1145 Cas	01	44	19.7	+60	39	29	GDOR
V1146 Cas	01	44	22.7	+60	40	43	BE
V1147 Cas	01	44	28.1	+60	40	03	BE
V1148 Cas	01	44	29.9	+60	40	27	GDOR
V1149 Cas	01	44	33.2	+60	40	56	BE
V1150 Cas	01	44	42.6	+60	40	17	GDOR
V1151 Cas	01	45	44.0	+61	06	46	RRAB
V1152 Cas	01	46	26.6	+61	17	06	ELL
V1153 Cas	01	46	29.0	+61	16	13	LPB
V1154 Cas	01	46	31.5	+65	01	35	DCEP
V1155 Cas	01	46	39.0	+61	14	06	BCEP
V1156 Cas	01	46	39.8	+61	09	52	BCEP
V1157 Cas	01	46	40.8	+61	18	45	ELL
V1158 Cas	01	49	14.5	+76	55	12	SRA
V1159 Cas	01	51	08.2	+74	48	32	EA
V1160 Cas	01	56	39.2	+72	19	47	EA
V1161 Cas	01	58	12.8	+73	32	39	LB
V1162 Cas	02	08	31.9	+68	06	15	EA
V1163 Cas	02	14	26.6	+59	45	12	GCAS
V1164 Cas	02	17	57.8	+70	58	12	EA
V1165 Cas	02	27	22.4	+64	35	29	LB
V1166 Cas	02	32	09.6	+61	38	24	EA
V1167 Cas	02	35	24.5	+64	45	04	SR
V1168 Cas	02	40	12.9	+64	23	19	RV:
V1169 Cas	02	40	14.4	+61	09	17	RS:
V1170 Cas	02	47	31.2	+58	20	06	EW
V1171 Cas	02	50	57.7	+75	34	00	LB
V1172 Cas	02	55	23.2	+63	16	53	EA
V1173 Cas	02	58	26.1	+72	00	19	SR
V1174 Cas	03	16	22.5	+76	17	19	EA
V1175 Cas	03	21	26.5	+73	26	08	EA
V1176 Cas	03	24	49.2	+77	20	12	EA
V1177 Cas	03	24	50.7	+70	33	22	EA
V1178 Cas	03	33	16.9	+69	35	34	EA
V1179 Cas	03	35	57.4	+69	25	59	EA
V1213 Cen	13	31	15.8	−63	57	39	NA
V0747 Cep	00	01	46.9	+67	30	25	EA
V0748 Cep	00	06	31.1	+79	11	42	EA
V0749 Cep	00	07	48.6	+70	40	22	EA
V0750 Cep	00	14	50.9	+71	49	45	EA
V0751 Cep	00	14	52.5	+75	39	18	EB
V0752 Cep	00	14	56.1	+72	18	31	EW
V0753 Cep	00	15	42.4	+78	00	29	EA
V0754 Cep	00	15	42.6	+75	11	55	EW
V0755 Cep	00	18	24.2	+73	07	24	EW
V0756 Cep	00	20	02.6	+80	50	44	EA
V0757 Cep	00	20	24.9	+78	14	28	EW
V0758 Cep	00	23	41.9	+83	21	58	EA
V0759 Cep	00	29	20.7	+84	45	45	RRC:
V0760 Cep	00	33	48.9	+85	29	22	EW
V0761 Cep	00	34	05.3	+84	51	59	RRC
V0762 Cep	00	36	40.0	+85	03	18	BY
V0763 Cep	00	39	06.0	+85	18	39	BY
V0764 Cep	00	44	10.2	+84	54	13	EW
V0765 Cep	00	44	14.2	+85	16	34	BY
V0766 Cep	00	44	30.7	+85	01	29	BY
V0767 Cep	00	44	36.6	+85	14	23	EA
V0768 Cep	00	44	40.6	+85	15	21	BY
V0769 Cep	00	44	52.2	+85	15	54	BY
V0770 Cep	00	45	18.7	+85	18	37	BY
V0771 Cep	00	46	53.9	+85	14	37	BY
V0772 Cep	00	47	04.3	+85	15	01	BY
V0773 Cep	00	47	11.8	+85	13	31	BY
V0774 Cep	00	48	25.9	+85	12	23	BY
V0775 Cep	00	48	46.5	+85	17	27	EB
V0776 Cep	00	48	55.0	+85	17	13	BY
V0777 Cep	00	49	22.3	+84	52	58	EW
V0778 Cep	00	49	25.3	+85	01	18	BY
V0779 Cep	00	49	36.5	+85	06	26	BY
V0780 Cep	00	50	02.8	+85	21	23	BY
V0781 Cep	00	50	44.7	+85	11	39	BY
V0782 Cep	00	51	15.0	+85	24	51	EW
V0783 Cep	00	51	15.9	+85	09	48	BY
V0784 Cep	00	52	08.8	+85	19	06	EB
V0785 Cep	00	52	37.7	+85	10	35	EA
V0786 Cep	00	52	46.0	+85	12	15	BY
V0787 Cep	00	54	20.2	+85	24	01	BY
V0788 Cep	00	55	43.6	+85	24	01	BY
V0789 Cep	00	59	32.2	+84	51	40	EW
V0790 Cep	01	01	50.7	+85	24	00	EW
V0791 Cep	01	07	39.7	+85	24	00	EW
V0792 Cep	01	08	01.0	+84	47	25	DSCT:
V0793 Cep	01	08	31.8	+85	12	54	EW
V0794 Cep	01	13	59.0	+84	45	26	DSCTC:
V0795 Cep	01	24	31.0	+85	01	07	RRC
V0796 Cep	01	41	36.4	+80	04	19	EW
V0797 Cep	01	42	47.6	+80	07	52	EW
V0798 Cep	01	54	34.8	+79	28	09	EA
V0799 Cep	01	55	38.0	+81	07	09	LB
V0800 Cep	02	17	59.9	+81	10	05	EA
V0801 Cep	02	21	26.6	+78	10	21	EA
V0802 Cep	02	34	25.0	+79	37	39	EW
V0803 Cep	02	56	18.2	+82	18	24	EW
V0804 Cep	02	58	41.3	+84	49	04	EW
V0805 Cep	03	31	11.5	+79	00	16	EA

Table 1. (continued)

Name	R.A. 2000.0 h m s	Decl. ° ' "	Type	Name	R.A. 2000.0 h m s	Decl. ° ' "	Type
V0806 Cep	04 19 37.6	+80 35 46	EA	LS Eri	04 06 44.1	−00 22 29	RRAB
V0807 Cep	04 56 53.3	+85 28 23	CWA	LT Eri	04 07 14.8	−06 44 25	E+UGSU:
V0808 Cep	05 20 45.9	+85 11 56	EB	LU Eri	04 27 06.6	−00 07 55	EW:
GK Cet	00 03 47.5	−11 28 35	RRAB	LV Eri	04 29 40.4	−00 38 10	RRAB
GL Cet	00 11 59.8	−24 33 58	SRB	LW Eri	04 31 27.7	−00 43 52	EB
GM Cet	00 12 44.9	−11 01 18	SRB	LX Eri	04 33 11.4	−01 50 11	RRAB
GN Cet	00 24 31.5	−09 54 04	LB	LY Eri	04 36 46.7	−02 12 14	RRAB
GO Cet	00 30 30.1	−14 50 33	*	LZ Eri	04 40 00.7	−00 19 39	RRAB
GP Cet	00 36 55.1	−05 52 27	EA	MM Eri	04 40 59.8	−08 40 02	RS
GQ Cet	00 45 20.6	−04 19 25	RRAB	MN Eri	04 42 04.6	+00 02 28	RRAB
GR Cet	00 47 16.0	−19 41 44	EW	MO Eri	04 43 39.2	−00 58 41	RRAB
GS Cet	00 50 50.9	+00 09 13	NL	MP Eri	04 44 45.0	−00 36 33	RRC
GT Cet	01 05 15.9	+01 59 14	RS	MQ Eri	04 53 31.5	−06 41 45	EA
GU Cet	01 13 40.4	+02 09 40	RRAB	MR Eri	05 00 40.9	−04 56 16	RS:
GV Cet	01 18 25.3	−17 24 56	RRAB	MS Eri	05 07 48.3	−09 31 43	RS:
GW Cet	01 28 48.3	−11 27 13	RRAB	μ Eri	04 45 30.1	−03 15 17	EA+LPB:
GX Cet	01 30 16.7	−02 42 40	RRAB	AX For	02 19 28.0	−30 45 46	UGSU
GY Cet	01 31 32.4	−09 01 22	ZZ	AY For	02 42 34.8	−28 02 44	EA+NL
GZ Cet	01 37 01.1	−09 12 34	UGSU	AZ For	03 05 27.6	−30 58 39	RR(B)
HH Cet	01 40 18.0	+01 39 54	RRAB	AI Hor	03 07 47.8	−62 34 07	RRAB
HI Cet	01 44 16.9	−02 18 45	EA	AK Hor	03 15 08.7	−51 44 10	E/RS
HK Cet	01 47 21.8	−21 56 51	ZZA	DM Hyi	04 23 41.1	−70 34 47	CWB:
HL Cet	01 57 52.3	−05 32 03	RRC	AX Lep	05 03 49.6	−11 31 01	IB
HM Cet	02 07 31.4	+05 41 06	RRC	AY Lep	05 22 59.4	−20 32 53	SRB
HN Cet	02 19 52.3	+09 16 48	RRAB	AZ Lep	05 32 12.4	−13 05 29	RRAB
HO Cet	02 33 21.4	−10 47 05	UGSU	BB Lep	05 42 30.2	−16 22 54	RRAB
HP Cet	02 33 22.6	+00 51 00	NL	BC Lep	05 45 30.6	−17 46 33	EA
HQ Cet	02 35 55.9	+02 46 29	RRAB	BD Lep	05 45 56.7	−14 41 30	RRAB
HR Cet	02 42 36.2	+07 17 26	RS	BE Lep	05 48 38.0	−19 29 30	RRAB
HS Cet	02 46 44.5	+01 07 55	EA	BF Lep	05 51 36.9	−14 32 13	RRAB
HT Cet	03 03 28.2	+06 13 36	GDOR	BG Lep	05 52 08.7	−22 08 10	SRB
HU Cet	03 05 56.8	−00 36 16	DSCT:	AZ Men	03 57 01.2	−76 09 30	RRC
HV Cet	03 05 58.6	+05 47 14	NL	EV Oct	00 02 31.1	−78 53 12	EA
HW Cet	03 12 34.3	+09 44 57	RS	V2672 Oph	17 38 19.7	−26 44 14	NA
AY Col	05 19 08.4	−37 40 31	EA/RS	V2673 Oph	17 39 41.0	−21 39 48	NA
AZ Col	05 28 50.6	−30 10 13	EW	V2674 Oph	17 26 32.1	−28 49 39	NA
BB Col	05 43 43.1	−32 23 29	M	V1825 Ori	04 44 45.4	+08 13 47	BY
BC Col	05 57 07.9	−27 38 31	EW	V1826 Ori	04 45 33.6	+12 09 18	BY
BD Col	05 57 34.8	−35 17 11	BY:	V1827 Ori	04 45 36.5	+12 07 51	IB
BE Dor	05 09 18.9	−69 50 14	RRC	V1828 Ori	04 48 59.4	−01 49 08	SXPHE:
KT Eri	04 47 54.2	−10 10 43	NA	V1829 Ori	04 49 28.1	−01 27 14	RRAB
KU Eri	02 46 34.0	−06 42 07	GDOR	V1830 Ori	04 49 35.0	−01 42 20	RRC
KV Eri	02 50 15.9	−46 49 08	EW	V1831 Ori	04 50 04.7	+01 50 43	IB
KW Eri	02 54 13.5	−47 06 50	EW	V1832 Ori	04 50 36.9	−00 56 56	RRAB
KX Eri	02 58 10.4	−06 11 50	EB	V1833 Ori	04 51 10.2	+07 42 56	EW
KY Eri	03 10 51.7	−07 55 00	UGSU	V1834 Ori	04 54 56.4	+08 36 00	EA
KZ Eri	03 31 54.3	−01 38 21	EA	V1835 Ori	04 55 15.2	+13 05 30	RPHS
LL Eri	03 32 43.5	−08 55 39	ELL	V1836 Ori	04 55 16.4	+12 54 10	SXPHE
LM Eri	03 43 07.0	−19 26 24	RRAB	V1837 Ori	04 56 07.0	+12 54 15	UV
LN Eri	03 48 36.3	−05 20 30	BY	V1838 Ori	04 56 37.5	−00 18 19	RRAB
LO Eri	03 50 30.8	−13 55 30	RS	V1839 Ori	04 59 19.4	−01 55 33	RRAB
LP Eri	03 50 39.6	−03 53 55	BY	V1840 Ori	04 59 46.2	+14 30 55	IB
LQ Eri	03 56 37.4	−13 27 20	BY	V1841 Ori	05 00 49.3	+15 27 01	RS
LR Eri	04 00 10.8	−19 49 37	RRAB	V1842 Ori	05 01 04.2	+06 42 20	BY:

Table 1. (continued)

Name	R.A. 2000.0 h	m	s	Decl. °	’	”	Type
V1843 Ori	05	03	05.9	+05	48	40	RS:
V1844 Ori	05	03	36.8	−00	59	57	RRAB
V1845 Ori	05	05	27.0	−01	54	40	RRC:
V1846 Ori	05	07	26.4	−00	12	07	RRAB
V1847 Ori	05	08	30.1	+11	31	45	EW
V1848 Ori	05	08	36.4	+05	12	22	EW
V1849 Ori	05	09	00.7	−03	15	07	IB
V1850 Ori	05	11	38.9	−03	48	47	IB
V1851 Ori	05	12	44.9	+10	15	10	EW
V1852 Ori	05	13	05.8	+08	51	31	IB
V1853 Ori	05	13	06.1	+15	58	12	EW
V1854 Ori	05	13	19.0	+01	34	47	RS
V1855 Ori	05	17	54.4	−07	08	19	IB
V1856 Ori	05	18	02.2	+07	12	40	RS:
V1857 Ori	05	18	38.3	+09	59	16	IB
V1858 Ori	05	22	34.2	−00	22	24	RRAB
V1859 Ori	05	22	54.8	+08	58	05	RS
V1860 Ori	05	23	36.3	−00	11	44	RRC
V1861 Ori	05	23	44.3	−07	53	38	IB
V1862 Ori	05	24	22.1	−06	39	16	IB
V1863 Ori	05	25	05.1	−00	37	58	RRAB
V1864 Ori	05	26	16.0	+03	05	02	RS:
V1865 Ori	05	26	20.2	+15	37	00	EW
V1866 Ori	05	27	04.1	−00	57	33	RRAB
V1867 Ori	05	27	18.8	−00	20	57	RRC:
V1868 Ori	05	27	27.0	−01	27	23	RRC
V1869 Ori	05	27	59.0	−00	53	15	RS:
V1870 Ori	05	28	46.8	+00	48	41	RS:
V1871 Ori	05	28	52.6	+06	34	04	EA:
V1872 Ori	05	28	58.5	+10	45	38	INB
V1873 Ori	05	29	17.5	−01	20	41	RRAB
V1874 Ori	05	29	19.0	+12	09	29	INB
V1875 Ori	05	29	22.2	+06	06	54	LB
V1876 Ori	05	30	05.2	+00	41	20	RS:
V1877 Ori	05	30	29.7	−00	50	18	RRAB
V1878 Ori	05	30	42.6	−04	35	02	INB
V1879 Ori	05	30	56.2	+10	15	00	IB
V1880 Ori	05	31	04.7	+00	17	24	BY
V1881 Ori	05	31	18.1	−00	19	49	RR
V1882 Ori	05	32	02.3	−07	31	56	IB:
V1883 Ori	05	32	21.9	+01	31	41	IB
V1884 Ori	05	32	22.6	+01	31	42	IB
V1885 Ori	05	32	30.8	−04	21	36	INB
V1886 Ori	05	33	04.9	−07	58	49	IB
V1887 Ori	05	33	08.9	+02	24	44	IB
V1888 Ori	05	33	38.5	−06	00	00	INB
V1889 Ori	05	33	38.9	−07	30	08	IB:
V1890 Ori	05	33	40.4	−03	03	24	INB
V1891 Ori	05	33	41.1	−03	13	28	IS
V1892 Ori	05	33	41.6	−06	06	07	INSB
V1893 Ori	05	33	41.9	−06	15	49	INSB
V1894 Ori	05	33	43.7	−06	24	29	IN
V1895 Ori	05	33	45.4	−04	35	28	INSB
V1896 Ori	05	33	45.9	−05	32	58	INB
V1897 Ori	05	33	46.7	−05	23	26	INSB
V1898 Ori	05	33	47.7	−05	25	49	INB
V1899 Ori	05	33	48.2	−00	55	28	INB
V1900 Ori	05	33	48.2	−05	13	26	INT
V1901 Ori	05	33	50.3	−06	21	49	INB
V1902 Ori	05	33	50.7	−05	00	39	INB
V1903 Ori	05	33	51.3	−05	23	16	INSB
V1904 Ori	05	33	51.3	−04	48	22	INT
V1905 Ori	05	33	51.8	−05	33	04	INSB
V1906 Ori	05	33	52.2	−06	59	04	INB
V1907 Ori	05	33	52.2	−07	55	28	INSA
V1908 Ori	05	33	52.2	−08	28	10	INSA
V1909 Ori	05	33	54.4	−05	45	13	INSB
V1910 Ori	05	33	55.0	−00	56	44	INB
V1911 Ori	05	33	55.5	−05	25	58	INSB
V1912 Ori	05	33	57.3	−04	59	16	INSB
V1913 Ori	05	33	59.2	−05	46	23	INSB
V1914 Ori	05	33	59.6	−07	54	10	INSA
V1915 Ori	05	34	00.8	−00	57	57	INB
V1916 Ori	05	34	02.1	−05	17	26	INSB
V1917 Ori	05	34	03.8	−06	16	04	IN
V1918 Ori	05	34	04.1	−08	43	24	INSA
V1919 Ori	05	34	04.5	−06	31	38	INB
V1920 Ori	05	34	05.0	−06	23	47	INS
V1921 Ori	05	34	05.7	−00	57	04	INB
V1922 Ori	05	34	06.0	−05	22	44	INB
V1923 Ori	05	34	06.0	−06	06	12	INSB
V1924 Ori	05	34	06.7	−06	24	12	INB
V1925 Ori	05	34	07.0	−06	32	08	INSB
V1926 Ori	05	34	07.1	−05	15	59	INSB
V1927 Ori	05	34	07.4	−00	33	11	INB
V1928 Ori	05	34	09.2	−08	02	13	INB
V1929 Ori	05	34	09.8	−00	42	07	INB
V1930 Ori	05	34	10.1	−00	46	10	INB
V1931 Ori	05	34	10.5	−04	50	35	INSB
V1932 Ori	05	34	11.8	−08	09	42	INB
V1933 Ori	05	34	12.7	−06	29	00	INSB
V1934 Ori	05	34	13.1	−05	33	48	INSB
V1935 Ori	05	34	13.5	−05	35	39	INSB
V1936 Ori	05	34	14.9	−02	52	54	INA:
V1937 Ori	05	34	16.6	−03	57	22	INSB
V1938 Ori	05	34	16.9	−06	32	50	INS
V1939 Ori	05	34	17.1	−04	48	04	INB
V1940 Ori	05	34	17.8	−04	18	10	INB
V1941 Ori	05	34	18.1	−05	28	34	INSB
V1942 Ori	05	34	18.3	−05	31	16	INB
V1943 Ori	05	34	18.7	−03	41	32	INB
V1944 Ori	05	34	18.7	−05	37	08	INSB
V1945 Ori	05	34	20.4	−02	57	47	INB
V1946 Ori	05	34	20.5	−01	00	00	INB
V1947 Ori	05	34	20.5	−05	18	45	INSB
V1948 Ori	05	34	20.8	−06	48	48	INSB
V1949 Ori	05	34	20.9	−05	06	50	INSB
V1950 Ori	05	34	20.9	−03	18	27	INSB

Table 1. (continued)

Name	R.A. 2000.0 h m s	Decl. 2000.0 ° ' "	Type	Name	R.A. 2000.0 h m s	Decl. 2000.0 ° ' "	Type
V1951 Ori	05 34 21.9	−05 15 31	INSB	V2005 Ori	05 34 40.8	−05 26 39	INSB
V1952 Ori	05 34 23.6	−00 43 09	INB	V2006 Ori	05 34 40.9	−05 26 00	INB
V1953 Ori	05 34 23.9	−00 56 53	UVN+BY	V2007 Ori	05 34 41.4	−04 39 14	INSB
V1954 Ori	05 34 24.4	−04 52 52	INB	V2008 Ori	05 34 41.9	−04 53 38	INB
V1955 Ori	05 34 25.5	−06 53 47	INA:	V2009 Ori	05 34 42.0	−05 45 22	INSB
V1956 Ori	05 34 26.2	−05 26 30	INT	V2010 Ori	05 34 42.0	−05 04 32	INB
V1957 Ori	05 34 26.5	−05 37 41	INB	V2011 Ori	05 34 42.2	−05 33 04	INB:
V1958 Ori	05 34 27.0	−05 18 03	INSB	V2012 Ori	05 34 42.7	−05 28 38	INSB
V1959 Ori	05 34 27.0	−00 54 23	E:	V2013 Ori	05 34 42.9	−07 03 50	INB
V1960 Ori	05 34 27.1	−08 11 10	IS	V2014 Ori	05 34 43.2	−04 23 32	INA
V1961 Ori	05 34 27.3	−05 24 22	INB	V2015 Ori	05 34 44.4	−03 59 41	INSB
V1962 Ori	05 34 27.7	−05 37 19	INB	V2016 Ori	05 34 44.7	−04 46 57	INB
V1963 Ori	05 34 27.7	−05 31 55	INSB	V2017 Ori	05 34 44.8	−04 56 41	INB
V1964 Ori	05 34 28.8	−07 15 16	INB	V2018 Ori	05 34 44.9	−01 04 25	INB:
V1965 Ori	05 34 29.1	−02 52 56	INSA	V2019 Ori	05 34 45.0	−05 06 50	INT
V1966 Ori	05 34 29.3	−06 08 58	INB	V2020 Ori	05 34 45.1	−05 06 20	INSB
V1967 Ori	05 34 29.5	−05 13 55	INSB	V2021 Ori	05 34 45.2	−05 39 57	INSB
V1968 Ori	05 34 29.5	−03 39 30	INSB	V2022 Ori	05 34 45.7	−00 52 24	INB
V1969 Ori	05 34 29.6	−05 03 07	INT	V2023 Ori	05 34 46.4	−05 24 32	INB
V1970 Ori	05 34 29.8	−04 51 48	INSB	V2024 Ori	05 34 46.4	−04 26 16	INB
V1971 Ori	05 34 30.1	−04 49 51	INT	V2025 Ori	05 34 46.7	−08 11 29	IB:
V1972 Ori	05 34 30.6	−04 35 53	INT	V2026 Ori	05 34 46.8	−05 26 05	INSB
V1973 Ori	05 34 30.9	−04 25 07	INB:+E:	V2027 Ori	05 34 46.8	−05 21 29	INSB
V1974 Ori	05 34 31.1	−02 58 02	INB	V2028 Ori	05 34 47.6	−04 50 01	INB
V1975 Ori	05 34 31.7	−05 28 27	INSB	V2029 Ori	05 34 47.7	−06 19 40	INB
V1976 Ori	05 34 31.8	−05 35 20	INT	V2030 Ori	05 34 47.7	−05 26 32	INSB
V1977 Ori	05 34 31.9	−00 35 24	INB	V2031 Ori	05 34 47.8	−07 16 10	IN
V1978 Ori	05 34 32.0	−05 27 43	INB	V2032 Ori	05 34 47.8	−00 44 01	INB:
V1979 Ori	05 34 32.7	−05 21 07	INSB	V2033 Ori	05 34 47.9	−05 30 47	INB
V1980 Ori	05 34 33.0	−05 44 40	INSB	V2034 Ori	05 34 47.9	−05 35 44	INT
V1981 Ori	05 34 34.0	−05 34 51	INT	V2035 Ori	05 34 47.9	−06 21 42	INB
V1982 Ori	05 34 34.0	−05 48 25	INSB	V2036 Ori	05 34 48.0	−04 53 20	INSB
V1983 Ori	05 34 34.0	−06 32 10	INSB	V2037 Ori	05 34 48.2	−05 30 10	INSB
V1984 Ori	05 34 34.2	−02 58 17	INB	V2038 Ori	05 34 48.5	−05 42 28	INSB
V1985 Ori	05 34 34.9	−04 42 43	INB	V2039 Ori	05 34 48.5	−03 35 48	INB
V1986 Ori	05 34 35.1	−08 10 34	INSB	V2040 Ori	05 34 48.5	−04 49 57	INB
V1987 Ori	05 34 35.2	−04 52 18	INB	V2041 Ori	05 34 48.9	−03 07 05	INSB
V1988 Ori	05 34 35.2	−05 34 32	INSB	V2042 Ori	05 34 49.0	−05 28 17	INSB
V1989 Ori	05 34 35.7	−00 51 57	INB	V2043 Ori	05 34 49.1	−07 26 07	INSB
V1990 Ori	05 34 35.8	−05 40 09	INSB	V2044 Ori	05 34 49.1	−05 26 27	INT
V1991 Ori	05 34 36.0	−04 52 18	INSB	V2045 Ori	05 34 49.6	−05 29 03	INT
V1992 Ori	05 34 37.1	−05 31 09	INT	V2046 Ori	05 34 49.6	−05 05 00	INSB
V1993 Ori	05 34 37.2	−07 57 40	ISB	V2047 Ori	05 34 49.6	−04 51 57	INSB
V1994 Ori	05 34 37.6	−05 43 11	INSB	V2048 Ori	05 34 49.6	−03 25 21	INSB
V1995 Ori	05 34 37.8	−00 52 40	INB	V2049 Ori	05 34 49.6	−04 36 42	INSB
V1996 Ori	05 34 38.2	−05 05 17	INB	V2050 Ori	05 34 49.7	−08 02 36	INSB
V1997 Ori	05 34 38.2	−05 24 24	INSB	V2051 Ori	05 34 49.7	−04 51 34	INSB
V1998 Ori	05 34 38.8	−04 39 37	INB	V2052 Ori	05 34 49.7	−08 38 07	ISB
V1999 Ori	05 34 39.5	−00 54 32	EA:	V2053 Ori	05 34 49.7	−05 54 27	INSB
V2000 Ori	05 34 39.8	−05 00 34	INB	V2054 Ori	05 34 49.8	−06 15 29	INSB
V2001 Ori	05 34 39.9	−06 25 14	INSB	V2055 Ori	05 34 50.0	−06 28 12	INB
V2002 Ori	05 34 40.3	−05 45 09	INSB	V2056 Ori	05 34 50.0	−05 18 45	INA
V2003 Ori	05 34 40.5	−04 57 40	INT	V2057 Ori	05 34 50.4	−05 20 20	INT
V2004 Ori	05 34 40.6	−05 06 59	INSB	V2058 Ori	05 34 50.6	−04 48 37	INSB

Table 1. (continued)

Name	R.A. 2000.0 h	m	s	Decl. 2000.0 °	’	”	Type
V2167 Ori	05	35	06.5	−05	25	01	INB
V2168 Ori	05	35	06.6	−05	32	52	INB
V2169 Ori	05	35	06.7	−05	11	45	INB
V2170 Ori	05	35	06.9	−05	26	01	INB
V2171 Ori	05	35	07.2	−06	18	16	INSB
V2172 Ori	05	35	07.3	−05	38	41	INSB
V2173 Ori	05	35	07.5	−05	19	50	INB
V2174 Ori	05	35	07.5	−05	11	15	INSB
V2175 Ori	05	35	07.6	−05	24	01	INSB
V2176 Ori	05	35	07.7	−05	21	01	INB
V2177 Ori	05	35	07.8	−05	48	56	INSB
V2178 Ori	05	35	07.9	−05	21	17	INB
V2179 Ori	05	35	08.1	−05	48	54	INSB
V2180 Ori	05	35	08.3	−05	50	00	INSB
V2181 Ori	05	35	08.3	−05	24	35	INSB
V2182 Ori	05	35	08.3	−05	27	57	INSB
V2183 Ori	05	35	08.4	−05	21	20	INSB
V2184 Ori	05	35	08.5	−05	25	18	INB:
V2185 Ori	05	35	08.5	−05	24	41	INSB
V2186 Ori	05	35	08.6	−05	26	19	INSB
V2187 Ori	05	35	08.7	−05	31	27	INB
V2188 Ori	05	35	08.9	−05	19	33	INSB
V2189 Ori	05	35	09.3	−04	06	17	INSB
V2190 Ori	05	35	09.3	+09	52	44	INB
V2191 Ori	05	35	09.7	−05	26	23	INT
V2192 Ori	05	35	09.8	−05	18	58	INSB
V2193 Ori	05	35	09.9	−07	11	32	INSB
V2194 Ori	05	35	09.9	−05	14	50	INSB
V2195 Ori	05	35	10.1	−06	05	36	INSB
V2196 Ori	05	35	10.1	−05	17	07	INSB
V2197 Ori	05	35	10.1	−05	19	03	INSB
V2198 Ori	05	35	10.2	−05	19	32	INSB
V2199 Ori	05	35	10.2	−05	20	21	INSB
V2200 Ori	05	35	10.2	−05	18	34	INSB
V2201 Ori	05	35	10.3	−05	21	13	INB
V2202 Ori	05	35	10.5	−05	24	16	INSB
V2203 Ori	05	35	10.7	−04	42	08	INB
V2204 Ori	05	35	10.7	−06	34	16	INSB
V2205 Ori	05	35	10.8	−06	06	46	INB
V2206 Ori	05	35	10.9	−04	39	58	INSB
V2207 Ori	05	35	10.9	−05	24	49	INT
V2208 Ori	05	35	11.0	−04	56	40	INSB
V2209 Ori	05	35	11.0	−05	15	22	INSB
V2210 Ori	05	35	11.1	−07	35	30	INB:
V2211 Ori	05	35	11.1	−07	19	06	INB:
V2212 Ori	05	35	11.1	−05	36	51	EA
V2213 Ori	05	35	11.2	−05	22	38	INSB
V2214 Ori	05	35	11.2	−05	17	21	INSB
V2215 Ori	05	35	11.3	−05	21	03	INB
V2216 Ori	05	35	11.5	−05	17	57	INSB
V2217 Ori	05	35	11.5	−05	25	53	INSB
V2218 Ori	05	35	11.7	−05	26	09	INB
V2219 Ori	05	35	11.8	−04	49	30	INSB
V2220 Ori	05	35	11.9	−05	21	03	INSB
V2221 Ori	05	35	12.0	−05	20	33	INB
V2222 Ori	05	35	12.0	−05	18	41	INB
V2223 Ori	05	35	12.1	−05	28	08	INSB
V2224 Ori	05	35	12.1	−05	24	34	INSB
V2225 Ori	05	35	12.7	−05	19	35	INB
V2226 Ori	05	35	12.7	−04	54	03	INSB
V2227 Ori	05	35	12.8	−00	36	49	INSB
V2228 Ori	05	35	12.8	−05	20	44	INT
V2229 Ori	05	35	12.9	−05	45	38	INSB
V2230 Ori	05	35	13.0	−05	19	04	INSB
V2231 Ori	05	35	13.0	−05	34	04	INSB
V2232 Ori	05	35	13.1	−05	21	13	INT
V2233 Ori	05	35	13.2	−05	17	31	INSB
V2234 Ori	05	35	13.2	−05	36	18	INSB
V2235 Ori	05	35	13.2	−05	24	55	INT
V2236 Ori	05	35	13.2	−05	20	53	INSB
V2237 Ori	05	35	13.2	−05	27	54	INSB
V2238 Ori	05	35	13.3	−05	20	19	INSB
V2239 Ori	05	35	13.3	−04	51	45	INA
V2240 Ori	05	35	13.4	−05	28	18	INSB
V2241 Ori	05	35	13.4	−05	21	07	INB
V2242 Ori	05	35	13.5	−05	35	03	INSB
V2243 Ori	05	35	13.5	−05	17	31	INSB
V2244 Ori	05	35	13.6	−05	17	46	INB
V2245 Ori	05	35	13.6	−05	35	08	INB
V2246 Ori	05	35	13.7	−04	42	59	INT
V2247 Ori	05	35	13.8	−05	34	55	INB
V2248 Ori	05	35	13.8	−05	22	00	INB
V2249 Ori	05	35	13.9	−04	35	03	INB
V2250 Ori	05	35	13.9	−05	27	01	INSB
V2251 Ori	05	35	14.0	−05	18	49	INB
V2252 Ori	05	35	14.1	−05	19	52	INSB
V2253 Ori	05	35	14.1	−04	53	11	INB
V2254 Ori	05	35	14.1	−05	22	23	INA
V2255 Ori	05	35	14.2	−05	20	24	INSB
V2256 Ori	05	35	14.2	−05	28	43	INSB
V2257 Ori	05	35	14.2	−05	20	04	INB
V2258 Ori	05	35	14.3	−05	19	36	INB
V2259 Ori	05	35	14.4	−05	18	25	INSB
V2260 Ori	05	35	14.4	−05	33	19	INSB
V2261 Ori	05	35	14.6	−06	15	13	INSB
V2262 Ori	05	35	14.7	−07	55	52	IA:
V2263 Ori	05	35	14.7	−06	15	07	INSB
V2264 Ori	05	35	14.7	−05	51	04	INB
V2265 Ori	05	35	14.8	−05	34	17	INT
V2266 Ori	05	35	14.8	−05	20	29	INSB
V2267 Ori	05	35	14.9	−05	07	48	INB
V2268 Ori	05	35	15.3	−07	40	16	ISB:
V2269 Ori	05	35	15.4	−05	27	47	INSB
V2270 Ori	05	35	15.4	−05	21	14	INT
V2271 Ori	05	35	15.5	−05	17	38	INSB
V2272 Ori	05	35	15.5	−05	53	16	INSB
V2273 Ori	05	35	15.6	−04	59	28	INSB
V2274 Ori	05	35	15.7	−05	25	33	INSB

Table 1. (continued)

Name	R.A. 2000.0 h	m	s	Decl. °	'	"	Type	Name	R.A. 2000.0 h	m	s	Decl. °	'	"	Type
V2275 Ori	05	35	15.8	−05	30	06	INB	V2329 Ori	05	35	18.4	−04	53	23	INB
V2276 Ori	05	35	15.8	−06	09	47	INB	V2330 Ori	05	35	18.5	−05	42	31	INSB
V2277 Ori	05	35	15.9	−05	28	53	INSB	V2331 Ori	05	35	18.5	−05	13	38	INT
V2278 Ori	05	35	15.9	−05	41	12	INSB	V2332 Ori	05	35	18.6	−05	26	25	INB
V2279 Ori	05	35	16.0	−05	23	50	INT	V2333 Ori	05	35	18.6	−05	13	27	INB
V2280 Ori	05	35	16.1	−05	20	36	INSB	V2334 Ori	05	35	18.6	−04	53	46	INSB
V2281 Ori	05	35	16.1	−04	29	30	INSB	V2335 Ori	05	35	18.7	−05	41	10	INSB
V2282 Ori	05	35	16.2	−05	00	03	INB	V2336 Ori	05	35	18.7	−05	22	57	INB
V2283 Ori	05	35	16.2	−05	19	03	INB	V2337 Ori	05	35	18.7	−04	03	26	INB
V2284 Ori	05	35	16.2	−05	21	32	INT	V2338 Ori	05	35	18.8	−05	17	29	INA
V2285 Ori	05	35	16.2	−05	24	56	INB	V2339 Ori	05	35	18.9	−05	19	03	INSB
V2286 Ori	05	35	16.3	−05	32	02	INB	V2340 Ori	05	35	18.9	−04	44	28	INB
V2287 Ori	05	35	16.3	−05	29	33	INB	V2341 Ori	05	35	18.9	−06	27	26	INT
V2288 Ori	05	35	16.4	−05	25	10	INB	V2342 Ori	05	35	18.9	−05	20	52	INB
V2289 Ori	05	35	16.6	−05	25	18	INSB	V2343 Ori	05	35	19.0	−05	21	08	INB
V2290 Ori	05	35	16.6	−05	19	36	INT	V2344 Ori	05	35	19.0	−05	28	22	INSB
V2291 Ori	05	35	16.6	−05	17	23	INSB	V2345 Ori	05	35	19.1	+09	54	42	INB
V2292 Ori	05	35	16.7	−05	20	20	INSB	V2346 Ori	05	35	19.2	−05	31	03	INSB
V2293 Ori	05	35	16.8	−05	19	01	INSB	V2347 Ori	05	35	19.3	−05	16	45	INT
V2294 Ori	05	35	16.8	−05	30	56	INSB	V2348 Ori	05	35	19.3	−04	55	45	INSB
V2295 Ori	05	35	16.9	−07	19	02	INB	V2349 Ori	05	35	19.3	−06	24	15	INB
V2296 Ori	05	35	16.9	−05	27	09	INB	V2350 Ori	05	35	19.4	−05	25	42	INSB
V2297 Ori	05	35	16.9	−05	25	47	INSB	V2351 Ori	05	35	19.6	−05	27	05	INB
V2298 Ori	05	35	17.0	−05	28	58	INSB	V2352 Ori	05	35	19.6	−05	27	36	INSB
V2299 Ori	05	35	17.1	−05	23	34	INB	V2353 Ori	05	35	19.6	−05	20	02	INB
V2300 Ori	05	35	17.1	−05	58	31	INB	V2354 Ori	05	35	19.6	−05	23	57	INB
V2301 Ori	05	35	17.2	−04	41	14	INB	V2355 Ori	05	35	19.7	−05	13	26	INB
V2302 Ori	05	35	17.2	−05	20	28	INB	V2356 Ori	05	35	19.7	−05	24	27	INT
V2303 Ori	05	35	17.2	−04	39	48	INSB	V2357 Ori	05	35	19.7	−04	48	18	INB
V2304 Ori	05	35	17.4	−05	20	15	INB	V2358 Ori	05	35	19.8	−05	15	35	INB
V2305 Ori	05	35	17.4	−04	59	57	INB	V2359 Ori	05	35	19.8	−05	15	09	INSB
V2306 Ori	05	35	17.5	−05	18	23	INSB	V2360 Ori	05	35	19.9	−05	31	04	INB:
V2307 Ori	05	35	17.5	−05	19	29	INB	V2361 Ori	05	35	20.0	−05	12	50	INSB
V2308 Ori	05	35	17.5	−01	02	26	BY:	V2362 Ori	05	35	20.0	−05	29	12	INSB
V2309 Ori	05	35	17.6	−05	18	33	INSB	V2363 Ori	05	35	20.1	−05	20	44	INSB
V2310 Ori	05	35	17.7	−04	51	43	INSB	V2364 Ori	05	35	20.1	−05	13	16	INT
V2311 Ori	05	35	17.7	−05	32	02	INB	V2365 Ori	05	35	20.2	−04	41	34	INSB
V2312 Ori	05	35	17.7	−04	29	23	INSB	V2366 Ori	05	35	20.3	−05	46	40	INB
V2313 Ori	05	35	17.7	−07	20	15	INT	V2367 Ori	05	35	20.4	−05	17	14	INB
V2314 Ori	05	35	17.9	−05	20	54	INB	V2368 Ori	05	35	20.6	−06	17	50	INB
V2315 Ori	05	35	17.9	−04	53	36	INB	V2369 Ori	05	35	20.6	−05	03	01	INB
V2316 Ori	05	35	17.9	−05	30	41	INT	V2370 Ori	05	35	20.6	−05	22	56	INB
V2317 Ori	05	35	17.9	−05	18	35	INSB	V2371 Ori	05	35	20.8	−06	55	06	INB
V2318 Ori	05	35	17.9	−05	42	34	INT	V2372 Ori	05	35	20.8	−05	21	22	INB
V2319 Ori	05	35	18.0	−04	20	41	INB:	V2373 Ori	05	35	21.0	−05	20	43	INB
V2320 Ori	05	35	18.0	−05	26	51	INSB	V2374 Ori	05	35	21.2	−05	22	00	INB
V2321 Ori	05	35	18.0	−05	24	03	INB	V2375 Ori	05	35	21.2	−05	23	00	INSB
V2322 Ori	05	35	18.1	−04	31	19	INSB	V2376 Ori	05	35	21.6	−05	21	06	INT
V2323 Ori	05	35	18.1	−05	28	25	INT	V2377 Ori	05	35	21.6	−05	09	39	INSB
V2324 Ori	05	35	18.1	−03	21	38	INSB	V2378 Ori	05	35	21.6	−05	34	58	INT
V2325 Ori	05	35	18.2	−05	23	36	INB	V2379 Ori	05	35	21.6	−05	27	15	INB
V2326 Ori	05	35	18.2	−05	17	45	INB	V2380 Ori	05	35	21.7	−05	21	47	INSB
V2327 Ori	05	35	18.2	−05	13	07	INSB	V2381 Ori	05	35	21.7	−05	19	46	INB
V2328 Ori	05	35	18.4	−04	50	31	INSB	V2382 Ori	05	35	21.8	−06	18	51	INSB

Table 1. (continued)

Name	R.A.			Decl.			Type
	2000.0						
	h	m	s	°	'	"	
V2383 Ori	05	35	21.8	−05	23	39	INB
V2384 Ori	05	35	21.8	−05	46	09	EA
V2385 Ori	05	35	22.1	−05	52	37	INSB
V2386 Ori	05	35	22.3	−05	31	17	INSB
V2387 Ori	05	35	22.3	−04	41	33	INSB
V2388 Ori	05	35	22.4	−05	22	01	INSB
V2389 Ori	05	35	22.5	−05	25	45	INSB
V2390 Ori	05	35	22.5	−04	52	37	INB
V2391 Ori	05	35	22.6	−05	44	29	INB
V2392 Ori	05	35	22.7	−05	16	14	INSB
V2393 Ori	05	35	22.7	−05	18	38	INSB
V2394 Ori	05	35	22.8	−04	48	30	INB
V2395 Ori	05	35	22.8	−05	23	13	INSB
V2396 Ori	05	35	22.8	−06	12	05	INSB
V2397 Ori	05	35	22.8	−04	46	41	INB
V2398 Ori	05	35	22.9	+09	55	07	IB
V2399 Ori	05	35	22.9	−04	37	41	INSB
V2400 Ori	05	35	22.9	−05	32	29	INB
V2401 Ori	05	35	22.9	−05	13	40	INB
V2402 Ori	05	35	23.0	−05	25	36	INB
V2403 Ori	05	35	23.0	−05	29	41	INSB
V2404 Ori	05	35	23.1	−04	17	17	INB
V2405 Ori	05	35	23.2	−05	22	28	INB
V2406 Ori	05	35	23.3	−04	49	05	INB
V2407 Ori	05	35	23.3	−05	21	25	INT
V2408 Ori	05	35	23.3	−04	40	10	INB
V2409 Ori	05	35	23.5	−05	15	23	INSB
V2410 Ori	05	35	23.5	−05	18	57	INB
V2411 Ori	05	35	23.7	−05	26	27	INSB
V2412 Ori	05	35	23.7	−04	48	17	INB
V2413 Ori	05	35	23.8	−05	18	40	INT
V2414 Ori	05	35	24.0	−05	19	08	INSB
V2415 Ori	05	35	24.0	−05	23	14	INSB
V2416 Ori	05	35	24.1	−05	09	07	INSB
V2417 Ori	05	35	24.1	−05	21	33	INSB
V2418 Ori	05	35	24.1	−04	49	30	INB
V2419 Ori	05	35	24.2	−04	31	03	INB
V2420 Ori	05	35	24.2	−05	29	57	INB
V2421 Ori	05	35	24.3	−05	25	19	INT
V2422 Ori	05	35	24.3	−05	22	32	INSB
V2423 Ori	05	35	24.4	−05	24	40	INT
V2424 Ori	05	35	24.5	−05	17	00	INT
V2425 Ori	05	35	24.5	−05	25	02	INT
V2426 Ori	05	35	24.6	−05	55	34	INSB
V2427 Ori	05	35	24.6	−05	11	30	INT
V2428 Ori	05	35	24.6	−05	21	04	INSB
V2429 Ori	05	35	24.7	−05	16	41	INSB
V2430 Ori	05	35	24.9	−05	25	10	INB
V2431 Ori	05	35	25.1	−05	57	39	INB
V2432 Ori	05	35	25.2	−05	55	55	INB
V2433 Ori	05	35	25.2	−00	43	24	IB:
V2434 Ori	05	35	25.2	−05	15	36	INT
V2435 Ori	05	35	25.3	−08	31	03	IB:
V2436 Ori	05	35	25.3	−05	25	30	INSB
V2437 Ori	05	35	25.4	−05	24	11	INSB
V2438 Ori	05	35	25.5	−04	51	21	INT
V2439 Ori	05	35	25.6	−04	55	27	INB
V2440 Ori	05	35	25.6	−06	13	04	INB
V2441 Ori	05	35	25.7	−05	23	09	INT
V2442 Ori	05	35	25.7	−05	07	46	INSB
V2443 Ori	05	35	26.0	−03	08	33	INSB
V2444 Ori	05	35	26.2	−05	22	57	INB
V2445 Ori	05	35	26.2	−05	20	06	INB
V2446 Ori	05	35	26.2	−05	45	08	INB
V2447 Ori	05	35	26.4	−05	44	34	INB
V2448 Ori	05	35	26.4	−05	23	02	INB
V2449 Ori	05	35	26.4	−05	25	32	INS
V2450 Ori	05	35	26.5	−04	59	52	INSB
V2451 Ori	05	35	26.5	−05	54	45	INA:
V2452 Ori	05	35	26.5	−05	19	19	INB
V2453 Ori	05	35	26.6	−06	19	09	INB
V2454 Ori	05	35	26.7	−05	16	45	INB
V2455 Ori	05	35	26.8	−05	09	24	INB
V2456 Ori	05	35	27.0	−05	24	01	INB
V2457 Ori	05	35	27.0	−05	09	54	INB
V2458 Ori	05	35	27.0	−05	48	46	INB
V2459 Ori	05	35	27.1	−05	15	45	INB
V2460 Ori	05	35	27.1	−05	48	52	INB
V2461 Ori	05	35	27.1	−06	45	48	INB
V2462 Ori	05	35	27.2	−04	55	19	INB
V2463 Ori	05	35	27.3	−05	23	37	INB
V2464 Ori	05	35	27.4	−06	19	31	INSB
V2465 Ori	05	35	27.4	−05	02	42	INB
V2466 Ori	05	35	27.6	−04	49	08	INB
V2467 Ori	05	35	27.6	−05	09	37	INB
V2468 Ori	05	35	27.7	−05	42	55	INT
V2469 Ori	05	35	27.8	−05	21	19	INB
V2470 Ori	05	35	28.1	−05	01	35	INB
V2471 Ori	05	35	28.1	−05	23	06	INT
V2472 Ori	05	35	28.2	−05	21	35	INB
V2473 Ori	05	35	28.2	−05	15	51	INB
V2474 Ori	05	35	28.2	−04	43	52	INB
V2475 Ori	05	35	28.2	−04	58	38	INSB
V2476 Ori	05	35	28.4	−05	56	28	INSB
V2477 Ori	05	35	28.6	−05	33	04	INB
V2478 Ori	05	35	28.8	−04	45	30	INB
V2479 Ori	05	35	29.4	−05	49	51	INB
V2480 Ori	05	35	29.4	−05	17	55	INB
V2481 Ori	05	35	29.5	−05	18	46	INB
V2482 Ori	05	35	29.7	−05	30	25	INB
V2483 Ori	05	35	29.8	−05	32	54	INB
V2484 Ori	05	35	29.9	−05	23	56	INSB
V2485 Ori	05	35	30.0	−05	12	27	INT
V2486 Ori	05	35	30.1	−05	14	19	INB
V2487 Ori	05	35	30.3	−05	13	53	INB
V2488 Ori	05	35	30.5	−05	28	11	INSB
V2489 Ori	05	35	30.5	−05	19	34	INB
V2490 Ori	05	35	30.5	−05	49	04	INB

Table 1. (continued)

Name	R.A. h	m	s	Decl. °	'	"	Type	Name	R.A. h	m	s	Decl. °	'	"	Type
	2000.0								2000.0						
V2491 Ori	05	35	30.6	−05	51	55	INB	V2545 Ori	05	35	35.4	−05	08	47	INSB
V2492 Ori	05	35	30.6	−05	21	39	INSB	V2546 Ori	05	35	35.5	−05	58	19	INSB
V2493 Ori	05	35	30.6	−04	59	36	INSB	V2547 Ori	05	35	35.6	−05	39	08	INSB
V2494 Ori	05	35	30.7	−05	21	47	INB	V2548 Ori	05	35	36.0	−05	38	43	INB
V2495 Ori	05	35	31.0	−05	18	45	INT	V2549 Ori	05	35	36.2	−05	04	56	INSB
V2496 Ori	05	35	31.1	−05	13	44	INB	V2550 Ori	05	35	36.2	−05	20	20	INSB
V2497 Ori	05	35	31.2	−04	57	27	INB	V2551 Ori	05	35	36.4	−05	31	38	INB
V2498 Ori	05	35	31.2	−05	23	40	INSB	V2552 Ori	05	35	36.4	−04	16	20	INT
V2499 Ori	05	35	31.3	−05	18	56	INT	V2553 Ori	05	35	36.7	−05	23	28	INB
V2500 Ori	05	35	31.4	−05	20	17	INSB	V2554 Ori	05	35	36.7	−05	10	00	INSB
V2501 Ori	05	35	31.5	−05	21	37	INB	V2555 Ori	05	35	37.3	−05	02	36	INB
V2502 Ori	05	35	31.5	−05	05	47	INB	V2556 Ori	05	35	37.6	−01	02	51	BY
V2503 Ori	05	35	31.6	−05	16	58	INB:	V2557 Ori	05	35	37.9	−04	26	09	INB
V2504 Ori	05	35	31.6	−05	00	14	INB	V2558 Ori	05	35	38.5	−04	38	32	INSB
V2505 Ori	05	35	31.8	−05	21	21	INB	V2559 Ori	05	35	38.5	−00	51	11	E
V2506 Ori	05	35	31.9	−06	36	25	INSB	V2560 Ori	05	35	38.7	−05	16	59	INSB
V2507 Ori	05	35	31.9	−05	35	11	INSB	V2561 Ori	05	35	39.1	−04	17	44	INB
V2508 Ori	05	35	31.9	−05	31	48	INSB	V2562 Ori	05	35	39.4	−07	20	38	INT
V2509 Ori	05	35	32.0	−05	16	20	INB	V2563 Ori	05	35	40.0	−05	22	27	INB
V2510 Ori	05	35	32.0	−04	38	34	INB	V2564 Ori	05	35	40.2	−03	14	32	INB
V2511 Ori	05	35	32.2	−05	44	27	INSB	V2565 Ori	05	35	40.3	−07	05	34	INB
V2512 Ori	05	35	32.2	−00	56	37	BY:	V2566 Ori	05	35	40.4	−04	55	44	INB
V2513 Ori	05	35	32.3	−05	29	40	INSB	V2567 Ori	05	35	40.6	−04	35	19	INT
V2514 Ori	05	35	32.3	−04	46	48	INB	V2568 Ori	05	35	40.7	−04	33	27	INB
V2515 Ori	05	35	32.3	−05	11	44	INB	V2569 Ori	05	35	40.8	−05	12	48	INB
V2516 Ori	05	35	32.4	−05	15	07	INB	V2570 Ori	05	35	40.8	−05	21	42	INB
V2517 Ori	05	35	32.5	−04	48	08	INSB	V2571 Ori	05	35	40.9	−05	22	02	INT
V2518 Ori	05	35	32.6	−05	05	38	INSB	V2572 Ori	05	35	40.9	−04	34	38	INB
V2519 Ori	05	35	32.7	−05	45	28	INSB	V2573 Ori	05	35	42.0	−05	10	12	INSB
V2520 Ori	05	35	32.7	−05	21	18	INSB	V2574 Ori	05	35	42.3	−05	15	08	INT
V2521 Ori	05	35	32.7	−04	50	12	INSB	V2575 Ori	05	35	42.4	−04	42	57	INSB
V2522 Ori	05	35	33.0	−05	12	05	INB	V2576 Ori	05	35	42.6	−00	42	01	BY
V2523 Ori	05	35	33.2	−05	14	11	INB	V2577 Ori	05	35	42.6	−05	26	34	INSB
V2524 Ori	05	35	33.2	−05	19	58	INSB	V2578 Ori	05	35	42.8	−05	19	45	INSB
V2525 Ori	05	35	33.3	−04	51	11	INB	V2579 Ori	05	35	42.8	−05	11	55	INB
V2526 Ori	05	35	33.4	−01	52	36	RS:	V2580 Ori	05	35	42.8	−06	21	45	INB+E:
V2527 Ori	05	35	33.6	−05	15	23	INB	V2581 Ori	05	35	43.0	−05	23	02	INT
V2528 Ori	05	35	33.7	−04	46	24	INT	V2582 Ori	05	35	43.1	−05	03	08	INSB
V2529 Ori	05	35	33.8	−05	04	28	INSB	V2583 Ori	05	35	43.5	−05	08	50	INSB
V2530 Ori	05	35	34.1	−01	03	56	BY:	V2584 Ori	05	35	43.6	−00	46	46	BY
V2531 Ori	05	35	34.1	−07	14	58	INB	V2585 Ori	05	35	43.7	−08	55	57	E:
V2532 Ori	05	35	34.3	−05	33	22	INB	V2586 Ori	05	35	44.8	−05	24	34	INSB
V2533 Ori	05	35	34.4	−05	18	39	INB	V2587 Ori	05	35	45.3	−00	53	32	BY
V2534 Ori	05	35	34.5	−04	40	21	INT	V2588 Ori	05	35	45.3	−07	04	22	INB
V2535 Ori	05	35	34.5	−05	00	52	INSB	V2589 Ori	05	35	45.9	−04	20	36	INB
V2536 Ori	05	35	34.7	−06	02	47	INB	V2590 Ori	05	35	46.2	−05	18	08	INB+E:
V2537 Ori	05	35	34.7	−04	48	58	INB	V2591 Ori	05	35	46.2	−05	15	40	INT
V2538 Ori	05	35	34.7	−08	34	50	BY:	V2592 Ori	05	35	46.5	−02	22	27	EA
V2539 Ori	05	35	34.7	−05	34	38	INB	V2593 Ori	05	35	46.8	−08	48	31	IB:
V2540 Ori	05	35	34.8	−04	23	25	IN	V2594 Ori	05	35	46.9	−05	26	27	INB
V2541 Ori	05	35	34.9	−06	08	36	INB	V2595 Ori	05	35	47.0	−08	41	14	ISB
V2542 Ori	05	35	35.1	−05	33	49	INT	V2596 Ori	05	35	47.1	−03	32	03	INB
V2543 Ori	05	35	35.2	−05	21	24	INB	V2597 Ori	05	35	47.1	−07	19	43	INB
V2544 Ori	05	35	35.2	−04	47	40	INSB	V2598 Ori	05	35	47.6	−05	37	39	INT

Table 1. (continued)

Name	R.A.			Decl.			Type	Name	R.A.			Decl.			Type
	2000.0								2000.0						
	h	m	s	°	'	"			h	m	s	°	'	"	
V2599 Ori	05	35	47.7	−05	58	06	INB	V2653 Ori	05	36	14.8	−06	13	17	INT
V2600 Ori	05	35	48.0	−06	01	35	INB	V2654 Ori	05	36	15.3	−03	08	44	INSB
V2601 Ori	05	35	48.0	−03	57	45	INB	V2655 Ori	05	36	15.4	−07	36	59	INB
V2602 Ori	05	35	48.5	−05	56	23	INSB	V2656 Ori	05	36	15.8	−05	21	27	INB
V2603 Ori	05	35	49.0	−04	53	50	INSB	V2657 Ori	05	36	17.2	−06	17	25	INSB
V2604 Ori	05	35	49.5	−03	32	52	INB	V2658 Ori	05	36	18.2	−05	49	53	INSB
V2605 Ori	05	35	49.9	−05	18	31	INB	V2659 Ori	05	36	18.3	−06	14	00	INSB
V2606 Ori	05	35	50.0	−05	17	18	INB	V2660 Ori	05	36	19.4	−06	25	51	INB
V2607 Ori	05	35	50.7	−04	40	37	INB	V2661 Ori	05	36	19.5	−06	24	38	INB
V2608 Ori	05	35	50.7	−05	27	54	INSB	V2662 Ori	05	36	19.6	−07	59	45	INB
V2609 Ori	05	35	50.9	−04	43	23	INB	V2663 Ori	05	36	19.7	−05	48	24	INT
V2610 Ori	05	35	51.2	−04	56	28	INB	V2664 Ori	05	36	19.8	−04	44	55	INB
V2611 Ori	05	35	51.3	−06	13	53	INSB	V2665 Ori	05	36	19.8	−06	46	01	INB
V2612 Ori	05	35	51.7	−04	08	31	INB	V2666 Ori	05	36	20.0	−03	03	39	INSB
V2613 Ori	05	35	52.1	−04	49	15	INSB	V2667 Ori	05	36	20.5	−06	23	22	INSB
V2614 Ori	05	35	52.3	−04	43	05	INT	V2668 Ori	05	36	21.2	−06	26	57	INSB
V2615 Ori	05	35	52.3	−05	12	57	INB	V2669 Ori	05	36	21.4	−06	45	37	INT
V2616 Ori	05	35	52.8	−05	22	31	INSB	V2670 Ori	05	36	21.6	−06	22	52	INB
V2617 Ori	05	35	52.9	−05	25	44	INB	V2671 Ori	05	36	22.1	−06	26	45	INB
V2618 Ori	05	35	53.5	−05	20	27	INSB	V2672 Ori	05	36	22.5	−06	23	45	INSB
V2619 Ori	05	35	54.2	−05	17	10	INSB	V2673 Ori	05	36	23.6	−05	22	46	INB
V2620 Ori	05	35	54.8	−04	58	20	INSB	V2674 Ori	05	36	23.8	−06	23	11	INT
V2621 Ori	05	35	55.0	−04	40	28	INB	V2675 Ori	05	36	24.0	−06	25	27	INB
V2622 Ori	05	35	55.7	−05	49	29	INT	V2676 Ori	05	36	24.5	−06	22	23	INB
V2623 Ori	05	35	56.1	−08	32	30	IA:	V2677 Ori	05	36	24.5	−06	52	34	INSB
V2624 Ori	05	35	56.6	−05	35	11	INB	V2678 Ori	05	36	26.1	−03	13	54	INSB
V2625 Ori	05	35	57.0	−06	29	38	INT	V2679 Ori	05	36	26.1	−06	08	04	INT
V2626 Ori	05	35	57.0	−04	51	09	INSB	V2680 Ori	05	36	26.3	−05	18	30	INB
V2627 Ori	05	35	57.1	−06	47	05	INB	V2681 Ori	05	36	27.7	−06	23	12	INT
V2628 Ori	05	35	58.3	−06	14	05	INB	V2682 Ori	05	36	28.9	−05	39	16	INSB
V2629 Ori	05	35	58.3	−06	22	12	INB	V2683 Ori	05	36	29.1	−06	38	41	INSB
V2630 Ori	05	35	58.9	−05	32	54	INSB	V2684 Ori	05	36	29.3	−02	58	03	INB
V2631 Ori	05	35	59.0	−03	25	09	INB	V2685 Ori	05	36	29.3	−03	03	03	EW:
V2632 Ori	05	35	59.2	−06	49	52	INB	V2686 Ori	05	36	29.9	−06	38	22	INB
V2633 Ori	05	35	59.7	−05	55	03	INSB	V2687 Ori	05	36	30.2	−06	42	46	INSB
V2634 Ori	05	36	01.1	−06	25	08	INB	V2688 Ori	05	36	30.3	−04	32	17	INB
V2635 Ori	05	36	01.7	−06	42	36	INSB	V2689 Ori	05	36	31.0	+11	19	40	RS
V2636 Ori	05	36	03.9	−05	30	19	INSB	V2690 Ori	05	36	31.4	−05	52	16	INSB
V2637 Ori	05	36	05.0	−06	46	41	INT	V2691 Ori	05	36	31.5	−04	15	46	INSB
V2638 Ori	05	36	05.0	−06	42	44	INSB	V2692 Ori	05	36	32.5	−06	01	16	INB
V2639 Ori	05	36	05.1	−05	11	14	INSB	V2693 Ori	05	36	33.2	−06	08	55	INSB
V2640 Ori	05	36	05.3	−07	39	13	INB	V2694 Ori	05	36	33.3	−04	55	19	INSB
V2641 Ori	05	36	05.3	−03	07	17	INB	V2695 Ori	05	36	33.7	−05	57	54	INT
V2642 Ori	05	36	07.0	−05	13	34	INSB	V2696 Ori	05	36	35.8	−06	42	50	INB
V2643 Ori	05	36	07.0	−06	01	50	INSB	V2697 Ori	05	36	36.2	−05	55	29	INSB
V2644 Ori	05	36	07.4	−03	27	56	INB	V2698 Ori	05	36	37.5	−06	27	17	INSB
V2645 Ori	05	36	08.3	−06	24	38	INB	V2699 Ori	05	36	38.5	−04	28	21	INSB
V2646 Ori	05	36	09.3	−05	31	10	INT	V2700 Ori	05	36	38.9	−04	55	29	INSB
V2647 Ori	05	36	11.0	−05	39	49	INT	V2701 Ori	05	36	39.8	+09	07	16	IB
V2648 Ori	05	36	12.0	−06	09	45	INB	V2702 Ori	05	36	40.6	−06	10	33	INSB
V2649 Ori	05	36	12.2	−08	11	42	ISB	V2703 Ori	05	36	40.8	−06	11	08	INSB
V2650 Ori	05	36	12.5	−05	40	45	INSB	V2704 Ori	05	36	42.1	−06	07	06	INSB
V2651 Ori	05	36	12.6	−06	23	40	INB	V2705 Ori	05	36	45.5	−03	14	12	INB:
V2652 Ori	05	36	13.2	−06	49	42	INSB	V2706 Ori	05	36	47.2	−05	22	50	INSB

Table 1. (continued)

Name	R.A. 2000.0 h m s	Decl. 2000.0 ° ' "	Type	Name	R.A. 2000.0 h m s	Decl. 2000.0 ° ' "	Type
V2707 Ori	05 36 47.6	−03 04 29	INB:	V2761 Ori	05 43 52.8	−02 50 44	RS
V2708 Ori	05 36 48.6	−05 47 48	INB	V2762 Ori	05 45 39.1	+11 19 36	EA
V2709 Ori	05 36 49.3	−05 33 21	INSB	V2763 Ori	05 46 11.8	+09 03 55	LB
V2710 Ori	05 36 50.1	−06 41 29	INT	V2764 Ori	05 46 18.9	−00 05 38	INT
V2711 Ori	05 36 50.3	−06 41 55	INB	V2765 Ori	05 52 38.6	−05 51 34	RRC
V2712 Ori	05 36 52.3	−08 24 52	EW	V2766 Ori	05 54 27.7	+05 01 59	EW
V2713 Ori	05 36 52.7	−06 43 08	INB	V2767 Ori	05 54 50.5	+07 04 43	EA
V2714 Ori	05 36 52.9	−06 37 13	INB	V2768 Ori	05 54 56.6	+04 53 54	EW
V2715 Ori	05 36 54.1	−02 53 16	INB:	V2769 Ori	05 54 59.1	+05 04 19	EW
V2716 Ori	05 36 55.0	−04 58 20	INB	V2770 Ori	05 56 45.8	+04 51 26	LB
V2717 Ori	05 36 56.2	−06 27 53	INB	V2771 Ori	05 56 47.8	−03 36 54	SRB
V2718 Ori	05 36 57.2	−05 06 05	INSB	V2772 Ori	05 56 52.5	+12 27 44	EA
V2719 Ori	05 36 58.7	−04 04 07	INA:	V2773 Ori	05 57 30.9	−01 55 05	RRAB
V2720 Ori	05 36 59.0	−06 29 05	INB	V2774 Ori	05 58 10.7	−02 55 18	SRB
V2721 Ori	05 38 12.8	−02 12 27	INB	V0420 Peg	00 00 18.2	+19 32 55	RRAB
V2722 Ori	05 38 17.0	−02 14 46	INB	V0421 Peg	00 07 02.0	+22 50 40	EA
V2723 Ori	05 38 17.2	−02 22 26	INB	V0422 Peg	00 14 29.6	+13 31 09	RV:
V2724 Ori	05 38 23.2	−02 12 49	INB	V0751 Per	01 30 53.1	+53 25 38	EA
V2725 Ori	05 38 23.3	−02 25 35	INB	V0752 Per	01 36 15.7	+54 14 07	DSCTC
V2726 Ori	05 38 23.6	−02 20 48	INB	V0753 Per	01 51 15.7	+57 50 11	EA
V2727 Ori	05 38 23.8	−02 22 40	INB	V0754 Per	02 03 28.3	+58 54 13	EA
V2728 Ori	05 38 25.4	−02 42 41	INB	V0755 Per	02 10 13.4	+57 11 25	DSCTC:
V2729 Ori	05 38 25.6	−02 48 37	INT	V0756 Per	02 17 07.0	+56 09 17	EA
V2730 Ori	05 38 26.6	−02 12 18	INB	V0757 Per	02 18 23.0	+57 00 37	BCEP
V2731 Ori	05 38 29.2	−02 16 16	INT	V0758 Per	02 22 06.9	+56 07 54	EA
V2732 Ori	05 38 29.6	−02 25 14	INB	V0759 Per	02 22 56.4	+51 34 13	LB
V2733 Ori	05 38 30.0	−02 15 41	INB	V0760 Per	02 24 52.2	+58 00 24	LB
V2734 Ori	05 38 37.9	−02 20 40	INB	V0761 Per	02 24 53.9	+58 09 15	EA/RS:
V2735 Ori	05 38 38.1	+09 01 11	EA	V0762 Per	02 40 06.0	+42 38 57	BY
V2736 Ori	05 38 46.6	−02 19 40	INB	V0763 Per	02 40 09.6	+42 48 37	BY
V2737 Ori	05 38 49.3	−02 23 58	INB	V0764 Per	02 40 15.1	+42 47 14	BY
V2738 Ori	05 39 06.0	−02 07 31	INB	V0765 Per	02 40 19.3	+42 36 13	BY
V2739 Ori	05 39 07.6	−02 12 15	INB	V0766 Per	02 40 24.3	+42 46 57	BY
V2740 Ori	05 39 08.9	−02 39 58	INT	V0767 Per	02 40 26.6	+42 45 40	BY
V2741 Ori	05 39 09.1	−02 00 27	INB	V0768 Per	02 40 26.7	+42 40 16	BY
V2742 Ori	05 39 13.2	−00 20 44	DSCT:	V0769 Per	02 40 30.4	+42 41 52	BY
V2743 Ori	05 39 14.9	+00 31 13	E/RS	V0770 Per	02 40 30.6	+42 51 02	BY
V2744 Ori	05 39 15.1	−02 18 44	INB	V0771 Per	02 40 30.8	+42 36 25	BY
V2745 Ori	05 39 21.1	+09 18 10	RS	V0772 Per	02 40 33.3	+42 32 54	BY
V2746 Ori	05 39 26.6	−02 04 21	INB	V0773 Per	02 40 38.2	+42 43 07	BY
V2747 Ori	05 39 27.1	−03 47 04	INB:	V0774 Per	02 40 42.8	+42 38 59	BY
V2748 Ori	05 39 32.9	−02 11 31	INT	V0775 Per	02 40 48.5	+42 39 26	BY
V2749 Ori	05 39 45.2	−02 04 54	INB	V0776 Per	02 40 48.9	+42 30 34	BY
V2750 Ori	05 39 46.6	−02 26 31	INB	V0777 Per	02 40 49.1	+42 48 21	BY
V2751 Ori	05 39 56.5	+09 56 32	RS	V0778 Per	02 40 49.7	+42 46 55	BY
V2752 Ori	05 39 58.8	+07 08 31	RS	V0779 Per	02 40 53.9	+42 33 17	BY
V2753 Ori	05 40 07.2	−02 04 04	INB	V0780 Per	02 40 57.9	+42 34 39	BY
V2754 Ori	05 40 14.0	−02 31 27	INB	V0781 Per	02 41 05.0	+55 00 19	SRB
V2755 Ori	05 40 14.0	−07 08 35	RS:	V0782 Per	02 41 05.1	+42 56 43	BY
V2756 Ori	05 40 34.2	−01 21 54	INB	V0783 Per	02 41 11.6	+42 46 22	BY
V2757 Ori	05 40 34.7	+11 46 32	EA	V0784 Per	02 41 16.5	+42 49 35	BY
V2758 Ori	05 41 23.9	−03 24 46	INB	V0785 Per	02 41 18.4	+42 58 21	BY
V2759 Ori	05 42 59.9	+09 21 05	EB	V0786 Per	02 41 20.0	+42 39 24	BY
V2760 Ori	05 43 27.0	−09 59 38	INB	V0787 Per	02 41 20.5	+42 58 52	BY

Table 1. (continued)

Name	R.A. 2000.0 h m s	Decl. ° ' "	Type	Name	R.A. 2000.0 h m s	Decl. ° ' "	Type
V0788 Per	02 41 21.4	+42 35 44	BY	V0842 Per	02 42 24.9	+42 53 26	BY
V0789 Per	02 41 25.2	+39 47 28	EA	V0843 Per	02 42 24.9	+41 08 50	LB
V0790 Per	02 41 26.3	+42 30 15	BY	V0844 Per	02 42 26.3	+42 43 16	BY
V0791 Per	02 41 26.7	+42 51 34	BY	V0845 Per	02 42 28.9	+42 42 11	BY
V0792 Per	02 41 27.7	+42 35 42	BY	V0846 Per	02 42 31.5	+42 37 11	BY
V0793 Per	02 41 32.7	+43 02 16	BY	V0847 Per	02 42 32.3	+42 49 06	BY
V0794 Per	02 41 33.4	+42 42 12	BY	V0848 Per	02 42 33.1	+42 30 02	BY
V0795 Per	02 41 34.9	+42 48 53	BY	V0849 Per	02 42 33.6	+42 49 12	BY
V0796 Per	02 41 35.1	+42 33 31	BY	V0850 Per	02 42 34.0	+42 43 26	BY
V0797 Per	02 41 35.3	+42 41 02	BY	V0851 Per	02 42 34.3	+42 31 00	BY
V0798 Per	02 41 36.2	+42 54 56	BY	V0852 Per	02 42 35.0	+42 39 29	BY
V0799 Per	02 41 36.6	+42 40 04	BY	V0853 Per	02 42 36.3	+42 54 31	BY
V0800 Per	02 41 38.1	+42 44 04	BY	V0854 Per	02 42 39.4	+42 55 28	BY
V0801 Per	02 41 39.7	+42 38 07	BY	V0855 Per	02 42 40.6	+42 48 56	BY
V0802 Per	02 41 43.9	+42 45 08	BY	V0856 Per	02 42 41.1	+42 44 22	BY
V0803 Per	02 41 44.0	+42 40 32	BY	V0857 Per	02 42 41.8	+42 46 02	BY
V0804 Per	02 41 44.2	+42 46 08	BY	V0858 Per	02 42 43.7	+42 45 42	BY
V0805 Per	02 41 44.2	+42 35 36	BY	V0859 Per	02 42 44.9	+35 04 02	LB
V0806 Per	02 41 46.4	+42 32 32	BY	V0860 Per	02 42 46.4	+42 39 11	BY
V0807 Per	02 41 48.5	+42 49 34	BY	V0861 Per	02 42 47.5	+42 45 47	BY
V0808 Per	02 41 49.0	+42 40 00	BY	V0862 Per	02 42 47.7	+42 47 43	BY
V0809 Per	02 41 50.3	+42 44 38	BY	V0863 Per	02 42 49.8	+43 00 35	BY
V0810 Per	02 41 51.3	+42 34 25	BY	V0864 Per	02 42 50.8	+42 58 08	BY
V0811 Per	02 41 51.7	+42 38 23	BY	V0865 Per	02 42 51.7	+42 33 49	BY
V0812 Per	02 41 52.6	+42 36 02	BY	V0866 Per	02 42 55.2	+42 50 41	BY
V0813 Per	02 41 53.2	+42 35 26	BY	V0867 Per	02 42 56.9	+42 35 22	BY
V0814 Per	02 41 53.3	+42 32 10	BY	V0868 Per	02 42 57.8	+42 58 04	BY
V0815 Per	02 41 54.3	+42 59 36	BY	V0869 Per	02 42 57.9	+42 41 47	BY
V0816 Per	02 41 54.7	+42 35 30	BY	V0870 Per	02 42 59.9	+42 58 01	BY
V0817 Per	02 41 55.2	+42 50 32	BY	V0871 Per	02 44 15.9	+56 40 56	EA
V0818 Per	02 41 55.8	+42 33 33	BY	V0872 Per	02 46 02.3	+34 55 08	UG
V0819 Per	02 41 55.9	+42 58 31	BY	V0873 Per	02 47 08.2	+41 22 32	EW
V0820 Per	02 41 57.9	+42 53 22	BY	V0874 Per	02 50 20.7	+37 29 03	RS:
V0821 Per	02 42 01.8	+42 41 59	BY	V0875 Per	02 52 17.6	+36 16 48	RS:
V0822 Per	02 42 02.3	+43 01 13	BY	V0876 Per	02 55 48.2	+39 32 10	EW
V0823 Per	02 42 02.5	+42 51 52	BY	V0877 Per	02 57 10.0	+53 18 02	EA
V0824 Per	02 42 04.9	+42 37 47	BY	V0878 Per	02 57 52.7	+41 51 35	RS:
V0825 Per	02 42 07.5	+42 47 27	BY	V0879 Per	02 58 46.0	+53 37 12	LB
V0826 Per	02 42 07.8	+42 37 45	BY	V0880 Per	02 59 08.8	+40 36 20	EW:
V0827 Per	02 42 10.3	+42 34 50	BY	V0881 Per	02 59 53.1	+38 01 48	EW
V0828 Per	02 42 10.3	+42 59 36	BY	V0882 Per	03 03 53.4	+57 03 34	EA
V0829 Per	02 42 10.6	+42 34 09	BY	V0883 Per	03 04 08.8	+57 17 54	DCEPS
V0830 Per	02 42 11.0	+42 43 16	BY	V0884 Per	03 06 20.5	+48 33 12	EA
V0831 Per	02 42 11.7	+42 31 18	BY	V0885 Per	03 06 21.7	+54 47 02	EW
V0832 Per	02 42 11.7	+42 43 48	BY	V0886 Per	03 07 51.8	+55 04 38	EB
V0833 Per	02 42 12.5	+42 49 29	BY	V0887 Per	03 09 18.8	+43 44 54	EA
V0834 Per	02 42 16.1	+42 34 01	BY	V0888 Per	03 09 37.6	+50 53 31	EA
V0835 Per	02 42 16.2	+42 43 11	BY	V0889 Per	03 11 58.9	+46 07 43	GDOR
V0836 Per	02 42 17.0	+42 38 12	BY	V0890 Per	03 12 54.7	+50 29 35	EA
V0837 Per	02 42 17.2	+42 48 19	BY	V0891 Per	03 14 54.5	+55 52 49	DCEP
V0838 Per	02 42 17.3	+42 51 30	BY	V0892 Per	03 15 05.8	+56 12 45	DCEP
V0839 Per	02 42 20.3	+42 49 06	BY	V0893 Per	03 16 10.4	+41 19 32	LB
V0840 Per	02 42 21.9	+42 32 13	BY	V0894 Per	03 18 48.0	+55 40 12	RV:
V0841 Per	02 42 23.3	+42 38 21	BY	V0895 Per	03 20 14.3	+55 06 57	DCEP

Table 1. (continued)

Name	R.A. 2000.0 h m s	Decl. 2000.0 ° ' "	Type	Name	R.A. 2000.0 h m s	Decl. 2000.0 ° ' "	Type
V0896 Per	03 23 55.2	+43 43 14	SR	V0950 Per	04 07 54.3	+35 27 49	RS
V0897 Per	03 30 40.8	+31 36 58	RS	V0951 Per	04 10 36.3	+34 02 58	EW
V0898 Per	03 35 29.9	+31 13 37	IT:	V0952 Per	04 15 51.4	+31 00 36	IB
V0899 Per	03 38 45.0	+40 14 13	EA	V0953 Per	04 16 34.7	+49 07 29	SR
V0900 Per	03 40 57.8	+31 18 06	RS	V0954 Per	04 19 11.6	+47 16 40	RS
V0901 Per	03 41 57.1	+39 07 30	EA	V0955 Per	04 24 37.3	+48 00 01	LB
V0902 Per	03 44 18.6	+32 12 53	INB	V0956 Per	04 26 37.4	+38 45 02	IB
V0903 Per	03 44 20.0	+32 06 46	INB	V0957 Per	04 30 33.5	+48 04 43	DCEP
V0904 Per	03 44 21.7	+32 06 25	INB	V0958 Per	04 31 28.4	+32 52 13	EA
V0905 Per	03 44 22.3	+32 12 01	INB	V0959 Per	04 35 04.8	+37 28 21	EA
V0906 Per	03 44 24.6	+32 03 57	INB	V0960 Per	04 37 15.3	+33 48 49	EA
V0907 Per	03 44 25.3	+32 10 13	INB	V0961 Per	04 37 16.9	+31 08 20	IB
V0908 Per	03 44 25.6	+32 11 31	INB	V0962 Per	04 43 56.9	+37 23 03	BY
V0909 Per	03 44 26.0	+32 04 30	INT	V0963 Per	04 45 35.6	+52 22 35	EB
V0910 Per	03 44 29.7	+32 10 40	INT	V0964 Per	04 49 31.1	+51 31 11	EW
V0911 Per	03 44 30.5	+32 06 30	INB	DF Phe	00 01 56.9	−52 50 07	LB
V0912 Per	03 44 32.2	+39 59 35	EA/RS	DG Phe	01 09 01.5	−51 00 49	UV+BY
V0913 Per	03 44 32.6	+32 08 42	INB	AR Pic	05 49 45.4	−49 21 56	UGSU
V0914 Per	03 44 32.7	+32 08 37	INB	EW Psc	00 01 11.5	+09 04 41	EW
V0915 Per	03 44 33.3	+32 09 40	INB	EX Psc	00 13 22.7	+05 40 09	EW
V0916 Per	03 44 34.9	+32 09 54	INB	EY Psc	00 15 38.8	+18 54 05	EA
V0917 Per	03 44 34.9	+32 06 34	INB	EZ Psc	00 16 14.6	+19 51 38	BY
V0918 Per	03 44 36.9	+32 06 45	INB	FF Psc	00 17 48.5	+09 53 22	RRAB
V0919 Per	03 44 37.4	+32 12 24	INB	FG Psc	00 21 08.9	−02 21 25	LB
V0920 Per	03 44 37.9	+32 08 04	INB	FH Psc	00 22 03.5	+13 03 35	RS
V0921 Per	03 44 39.2	+32 09 18	INB	FI Psc	00 23 22.8	+13 45 41	RRAB
V0922 Per	03 44 39.2	+32 09 45	INB	FK Psc	00 23 34.7	+20 14 29	RS
V0923 Per	03 44 40.1	+32 11 34	INB	FL Psc	00 25 11.1	+12 17 12	UGSU
V0924 Per	03 44 42.6	+32 06 19	INB	FM Psc	00 31 49.8	+04 50 46	GDOR
V0925 Per	03 44 44.6	+32 08 13	INB	FN Psc	00 40 58.8	+09 58 03	RS
V0926 Per	03 44 44.7	+32 04 02	INB	FO Psc	00 41 34.5	+21 18 03	RS
V0927 Per	03 44 50.6	+32 19 06	IN	FP Psc	00 43 48.9	+18 46 53	RS
V0928 Per	03 46 30.4	+33 02 35	RS	FQ Psc	00 45 40.9	+18 57 03	RRAB
V0929 Per	03 56 52.6	+51 48 51	LB	FR Psc	00 47 57.1	+11 42 24	RRAB
V0930 Per	03 56 52.6	+51 51 56	EA	FS Psc	00 49 57.8	+32 56 08	BY
V0931 Per	03 57 00.8	+51 44 09	DCEPS:	FT Psc	00 50 33.2	+24 49 00	BY
V0932 Per	03 57 51.7	+52 05 50	LB:	FU Psc	00 51 01.8	+20 08 23	EA/RS
V0933 Per	03 58 48.1	+51 42 59	DCEPS	FV Psc	00 54 14.2	+30 15 50	RRAB
V0934 Per	03 58 57.5	+51 35 40	EB	FW Psc	00 55 08.3	+29 57 17	RS
V0935 Per	03 59 11.7	+52 04 33	LB:	FX Psc	00 55 15.0	+30 15 16	RS
V0936 Per	03 59 20.7	+51 14 25	EB	FY Psc	00 55 33.0	+31 32 58	EW
V0937 Per	03 59 31.6	+51 54 47	EA	FZ Psc	00 56 01.3	+30 38 26	RS
V0938 Per	03 59 38.2	+52 47 27	DCEP	GG Psc	00 56 43.7	+32 53 36	EB
V0939 Per	03 59 39.1	+51 33 38	LB:	GH Psc	00 57 07.7	+10 25 57	RS
V0940 Per	03 59 57.1	+51 57 01	LB:	GI Psc	00 57 34.2	+07 46 53	RRAB
V0941 Per	04 00 05.8	+39 41 37	RS	GK Psc	00 57 41.2	+31 09 16	EW
V0942 Per	04 00 06.2	+51 39 02	RR:	GL Psc	00 58 11.6	+27 34 37	RS:
V0943 Per	04 00 41.4	+51 56 59	LB:	GM Psc	01 01 54.5	+15 54 22	RRAB
V0944 Per	04 00 48.9	+51 11 45	EW	GN Psc	01 05 06.4	+09 35 08	RS
V0945 Per	04 01 05.1	+51 21 41	EW	GO Psc	01 07 05.0	+32 12 09	EW
V0946 Per	04 01 05.2	+34 39 03	RS	GP Psc	01 07 05.5	+19 09 08	RS
V0947 Per	04 03 41.0	+32 27 06	EW	GQ Psc	01 08 42.9	+24 56 10	RRAB
V0948 Per	04 04 15.4	+49 43 57	RS	GR Psc	01 09 31.9	+22 39 19	EW
V0949 Per	04 07 53.3	+33 56 05	RS	GS Psc	01 10 21.2	+28 33 00	RRAB

Table 1. (continued)

Name	R.A. 2000.0 h m s	Decl. 2000.0 ° ' "	Type	Name	R.A. 2000.0 h m s	Decl. 2000.0 ° ' "	Type
GT Psc	01 10 45.8	+33 10 55	EB	V1278 Tau	03 47 07.9	+24 23 38	BY
GU Psc	01 12 35.0	+17 03 56	RS	V1279 Tau	03 47 18.1	+24 13 51	BY
GV Psc	01 13 06.7	+21 52 50	UGSU	V1280 Tau	03 47 37.7	+24 24 23	BY
GW Psc	01 17 32.4	+07 53 30	EW	V1281 Tau	03 47 59.4	+24 35 37	BY
GX Psc	01 19 15.0	+31 35 27	EW	V1282 Tau	03 49 06.1	+23 46 53	RS
GY Psc	01 19 15.8	+30 13 39	EW	V1283 Tau	03 49 42.3	+24 27 47	RS
GZ Psc	01 21 39.3	+25 17 48	RS	V1284 Tau	03 51 26.2	+17 15 35	EW
HH Psc	01 21 39.8	+25 36 42	RS	V1285 Tau	03 51 26.3	+09 53 37	IB:
HI Psc	01 22 15.4	+20 21 30	RS	V1286 Tau	03 52 08.3	+24 13 49	RS:
HK Psc	01 24 58.0	+25 57 02	RS	V1287 Tau	03 53 07.4	+25 32 07	EA
HL Psc	01 27 28.9	+29 06 19	EB/RS	V1288 Tau	03 53 31.4	+26 31 41	BY
HM Psc	01 27 57.4	+18 59 25	RS	V1289 Tau	03 54 25.2	+24 21 36	RS
HN Psc	01 29 47.9	+33 03 36	EW	V1290 Tau	03 54 30.2	+01 24 19	SRB
HO Psc	01 30 16.5	+13 33 25	EW	V1291 Tau	03 57 54.7	+09 08 23	RRAB
HP Psc	01 32 55.6	+20 46 49	RRAB	V1292 Tau	04 00 13.5	+28 58 47	RRAB
HQ Psc	01 35 14.3	+21 16 22	RS	V1293 Tau	04 00 31.1	+19 35 21	IB
HR Psc	01 36 27.8	+25 08 36	RS	V1294 Tau	04 00 37.2	+06 22 46	NL
HS Psc	01 37 23.2	+26 57 12	RS	V1295 Tau	04 02 59.3	+27 18 55	EA
HT Psc	01 37 41.6	+07 03 20	RRAB	V1296 Tau	04 03 06.6	+04 44 15	NL
HU Psc	01 42 35.8	+10 14 40	DSCTC	V1297 Tau	04 05 12.3	+26 32 44	IB
HV Psc	01 44 53.6	+28 24 58	RS	V1298 Tau	04 05 19.6	+20 09 26	IB
WY Ret	03 32 19.2	−63 32 34	EA	V1299 Tau	04 05 40.6	+22 48 12	IB
V5580 Sgr	18 22 01.5	−28 02 40	N	V1300 Tau	04 06 38.8	+20 18 11	IB
V5581 Sgr	17 44 08.4	−26 05 49	N:	V1301 Tau	04 07 13.8	+22 09 31	DSCT
V5582 Sgr	17 45 05.4	−20 03 22	N	V1302 Tau	04 07 54.0	+17 50 26	RS
V5583 Sgr	18 07 07.7	−33 46 35	NA	V1303 Tau	04 08 43.3	+27 08 48	SRB
V5584 Sgr	18 31 32.8	−16 19 08	NA	V1304 Tau	04 09 17.0	+17 16 08	IB
V5585 Sgr	18 07 26.9	−29 00 44	NA	V1305 Tau	04 09 17.2	+17 15 47	EB
V5586 Sgr	17 53 03.0	−28 12 19	N	V1306 Tau	04 09 51.1	+24 46 21	IB
V1310 Sco	17 06 07.5	−37 14 27	NA	V1307 Tau	04 12 50.6	+19 36 58	IB
V1311 Sco	16 55 13.2	−38 03 47	NA	V1308 Tau	04 12 59.9	+16 11 48	IB
CO Scl	00 12 17.1	−35 11 14	LB	V1309 Tau	04 14 27.3	+12 26 07	BY
CP Scl	00 24 49.4	−27 44 19	EW	V1310 Tau	04 14 32.3	+23 34 30	BY
CQ Scl	00 28 21.3	−29 04 05	EW	V1311 Tau	04 17 03.5	+18 52 32	EW
CR Scl	00 44 30.2	−36 06 29	EW	V1312 Tau	04 17 38.9	+28 33 00	IT
CS Scl	00 59 23.5	−26 32 52	RRAB	V1313 Tau	04 18 10.8	+23 17 05	RS
CT Scl	01 16 00.6	−25 42 33	EW	V1314 Tau	04 19 46.6	+23 17 48	RS
CU Scl	01 42 26.4	−30 27 37	RRC	V1315 Tau	04 19 53.7	+30 09 54	RS
V0496 Sct	18 43 45.6	−07 36 42	NA	V1316 Tau	04 21 27.3	+01 29 13	M
V1263 Tau	03 24 05.6	+07 29 27	E:/RS	V1317 Tau	04 23 47.6	+29 40 38	BY
V1264 Tau	03 24 25.2	+02 31 01	IT:	V1318 Tau	04 25 21.1	+25 42 56	IB
V1265 Tau	03 29 12.2	+12 50 18	UGSU	V1319 Tau	04 30 49.2	+21 14 11	IB
V1266 Tau	03 30 26.0	+31 02 18	RS	V1320 Tau	04 31 14.4	+27 10 18	IB
V1267 Tau	03 33 11.6	+10 35 56	IT:	V1321 Tau	04 32 53.2	+17 35 34	IB
V1268 Tau	03 40 38.8	+28 46 24	EA	V1322 Tau	04 33 34.7	+19 16 49	IB
V1269 Tau	03 41 45.6	+27 18 57	IT:	V1323 Tau	04 33 42.0	+18 24 27	IB
V1270 Tau	03 42 20.9	+29 14 41	RS	V1324 Tau	04 35 56.8	+23 52 05	IB
V1271 Tau	03 43 48.3	+25 00 16	RS	V1325 Tau	04 38 13.0	+20 22 47	IB
V1272 Tau	03 44 03.6	+24 30 15	BY	V1326 Tau	04 38 27.7	+15 43 38	IB
V1273 Tau	03 44 53.2	+03 59 31	IB:	V1327 Tau	04 40 09.9	+11 43 17	RRC
V1274 Tau	03 45 57.9	+27 33 35	RS	V1328 Tau	04 41 24.0	+27 15 12	IB
V1275 Tau	03 46 24.6	+24 28 47	BY	V1329 Tau	04 41 55.2	+26 58 49	IB
V1276 Tau	03 46 32.0	+24 28 34	BY	V1330 Tau	04 42 18.6	+01 17 40	RS
V1277 Tau	03 46 54.9	+24 28 00	BY	V1331 Tau	04 43 26.0	+15 46 04	IB

Table 1. (continued)

Name	R.A. h	m	s	Decl. °	'	"	Type	Name	R.A. h	m	s	Decl. °	'	"	Type
	2000.0								2000.0						
V1332 Tau	04	43	41.3	+22	53	38	EW:	AZ Tri	01	34	21.9	+32	52	30	EA/RS:
V1333 Tau	04	44	26.9	+19	52	17	IB	BB Tri	01	34	30.9	+33	15	42	EW
V1334 Tau	04	44	54.5	+27	17	45	IB	BC Tri	01	35	51.2	+30	19	29	EW:
V1335 Tau	04	46	53.3	+22	55	13	IB	BD Tri	01	36	12.3	+30	49	02	RS
V1336 Tau	04	47	21.0	+28	08	53	RS	BE Tri	01	43	29.6	+29	52	40	EW
V1337 Tau	04	48	00.4	+27	56	20	RS	BF Tri	01	44	05.4	+30	51	23	EW
V1338 Tau	04	48	17.6	+27	55	18	SRB	BG Tri	01	44	47.6	+32	33	00	NL
V1339 Tau	04	48	58.0	+19	14	56	RS	BH Tri	01	46	33.5	+33	17	12	BY
V1340 Tau	04	49	52.3	+17	56	39	SXPHE	BI Tri	01	53	08.1	+31	16	01	EW
V1341 Tau	04	50	00.2	+22	29	57	IB	BK Tri	01	53	37.5	+33	25	08	SR
V1342 Tau	04	50	15.6	+18	23	46	ELL:	BL Tri	01	53	39.2	+29	57	57	EA/RS
V1343 Tau	04	51	54.2	+17	58	28	IB	BM Tri	01	53	58.7	+34	15	03	EW
V1344 Tau	04	51	56.5	+28	49	26	IB	BN Tri	01	54	58.0	+29	47	37	DSCT
V1345 Tau	04	51	56.9	+28	49	43	IB	BO Tri	01	56	31.9	+31	08	05	EA
V1346 Tau	04	52	30.8	+17	30	26	IB	BP Tri	02	03	12.7	+34	30	01	EW
V1347 Tau	04	52	50.2	+16	22	09	RS	BQ Tri	02	06	47.3	+33	49	42	EW
V1348 Tau	04	52	57.1	+19	19	50	IB	BR Tri	02	07	21.2	+32	02	02	EW:
V1349 Tau	04	55	09.6	+18	26	31	IB	BS Tri	02	09	29.8	+28	32	29	E+XM:
V1350 Tau	04	55	47.7	+17	42	02	RS	BT Tri	02	10	15.5	+30	26	46	EW
V1351 Tau	04	56	13.6	+15	54	22	IB	BU Tri	02	13	01.5	+37	03	26	EW
V1352 Tau	04	56	31.3	+24	26	48	EA	BV Tri	02	13	32.0	+37	02	37	EA
V1353 Tau	04	56	56.5	+16	00	25	IB	BW Tri	02	16	06.2	+34	37	49	RRC
V1354 Tau	04	57	30.7	+20	14	29	IB	BX Tri	02	20	50.8	+33	20	48	EW:
V1355 Tau	05	02	06.8	+24	27	40	EW	BY Tri	02	21	33.3	+34	04	45	RS
V1356 Tau	05	04	44.2	+22	17	08	EA	BZ Tri	02	22	26.7	+29	29	11	EA
V1357 Tau	05	05	59.7	+28	07	17	IB	CC Tri	02	23	54.1	+32	49	45	EW
V1358 Tau	05	12	39.4	+19	28	35	BY	CD Tri	02	24	30.2	+35	08	10	EB
V1359 Tau	05	13	19.2	+18	08	25	SR	CE Tri	02	25	29.1	+30	41	51	RS
V1360 Tau	05	20	37.1	+24	47	14	RS	CF Tri	02	25	32.1	+32	38	28	SR
V1361 Tau	05	21	46.8	+24	00	44	IB	CG Tri	02	27	08.4	+34	23	21	RS
V1362 Tau	05	22	10.3	+24	32	09	RS	CH Tri	02	27	34.8	+28	58	30	RS
V1363 Tau	05	22	47.2	+24	37	31	RS	CI Tri	02	28	42.4	+34	29	49	LB
V1364 Tau	05	23	54.6	+25	30	48	IB	CK Tri	02	29	36.4	+34	23	43	RS
V1365 Tau	05	27	05.9	+21	35	26	IB	CL Tri	02	29	41.0	+31	59	40	EA
V1366 Tau	05	29	42.5	+23	34	11	RS	CM Tri	02	31	45.3	+34	20	53	EW
V1367 Tau	05	30	19.1	+23	51	27	EW	CN Tri	02	32	15.2	+30	16	52	EW
V1368 Tau	05	31	04.4	+23	12	35	IB	CO Tri	02	32	28.2	+32	11	36	CWA:
V1369 Tau	05	32	24.0	+21	41	11	EA	CP Tri	02	34	28.7	+34	42	55	EA
V1370 Tau	05	32	48.8	+19	02	04	EW	CQ Tri	02	35	03.8	+31	39	22	RS
V1371 Tau	05	34	39.1	+28	03	04	BE	CR Tri	02	37	05.7	+33	08	45	EW
V1372 Tau	05	38	58.1	+24	42	57	BY	CS Tri	02	38	24.8	+32	07	42	EW
V1373 Tau	05	45	40.8	+15	43	49	SRB	CT Tri	02	38	39.1	+35	56	49	UGSU
V1374 Tau	05	48	03.9	+28	30	47	EB/RS	CU Tri	02	40	00.4	+35	18	17	EA
AW Tri	01	31	41.3	+29	41	52	EW	EL Tuc	00	01	04.3	−66	57	43	EW
AX Tri	01	31	49.2	+35	13	24	SXPHE	EM Tuc	00	02	08.2	−66	50	39	EW
AY Tri	01	32	30.8	+33	41	31	EW	EN Tuc	00	34	53.4	−68	35	48	EB

Remarks for unusual variable stars (type *).
BF Ari. Periodically variable brown dwarf.
GO Cet. Periodically variable brown dwarf.

Table 2

GCVS	Nova name	GCVS	Nova name
V1722 Aql	Nova Aql 2009	V5581 Sgr	Nova Sgr 2009 No. 1
V0582 Aur		V5582 Sgr	Nova Sgr 2009 No. 2
V0679 Car	Nova Car 2008	V5583 Sgr	Nova Sgr 2009 No. 3
V1213 Cen	Nova Cen 2009	V5584 Sgr	Nova Sgr 2009 No. 4
KT Eri	Nova Eri 2009	V5585 Sgr	Nova Sgr 2010 No. 1
V2672 Oph	Nova Oph 2009	V5586 Sgr	Nova Sgr 2010 No. 2
V2673 Oph	Nova Oph 2010 No. 1	V1310 Sco	Nova Sco 2010 No. 1
V2674 Oph	Nova Oph 2010 No. 2	V1311 Sco	Nova Sco 2010 No. 2
V5580 Sgr	Nova Sgr 2008 No. 2	V0496 Sct	Nova Sct 2009

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THE ABSOLUTE DIMENSIONS OF CU Sge

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CU Sge (= 2MASS J19242969+1629592), RA = $19^h24^m29\overset{s}{.}69$, Dec = $+16°29'59\overset{''}{.}3$ (2000.0) was discovered to be variable by Hoffmeister (1935) who supplied a finder chart and magnitude range but no period. Kurochkin (1949) seems to have determined a period but no other details are available. Numerous authors have determined times of minima (Nelson, 2010a) but no light curve is available and no analysis has been published.

During September of 2005 RHN took 11 spectra (10 Å/mm reciprocal dispersion, resolving power 10,000) at the Dominion Astrophysical Observatory (DAO) in Victoria, British Columbia, Canada; he then used the Rucinski broadening functions (Rucinski, 2004) to obtain radial velocity (RV) curves (see Nelson et al., 2006 for details). The spectral range was 5000-5263 Angstroms and the reciprocal dispersion, 10 Angstroms/mm. A log of DAO observations and RV results are presented in Table 1.

Table 1. Radial velocity observations of CU Sge.

DAO Image #	Mid Time (HJD-2400000)	Exposure (sec)	Phase at Mid-exp	V1 (km/s)	V2 (km/s)
9718	53634.7178	1736	0.143	−123.82	76.79
9722	53634.7616	3600	0.198	−131.61	117.00
9756	53635.6816	1492	0.360	−132.40	69.72
9759	53635.7161	3600	0.404	−122.11	30.88
9818	53636.6919	3600	0.636	−79.46	−295.36
9855	53637.6939	3600	0.902	−79.73	−224.73
9889	53638.7776	3600	0.271	−133.70	124.47
9891	53638.8463	3600	0.358	−131.06	72.66
9918	53639.8418	3600	0.615	−91.93	−278.26
9942	53640.7241	1812	0.730	−72.47	−332.59
9948	53640.8389	3600	0.875	−78.54	−275.80

Photometric data were obtained at the Sonoita Research Observatory (SRO) in September and October of 2006 with the 0.35m robotic telescope and SBIG STL-1001E CCD camera. The differential observations with respect to TYC 1600-439 to were made with

BVI_C filters and no variability in the comparison star greater than 0.01m was detected with respect to the check star TYC 1600-451. Table 2 gives the details of the variable, comparison and check stars.

VR_CI_C data were also obtained at the Sylvester Robotic Observatory (SyRO) in Prince George, BC, Canada. (See Nelson, 2010b for more details.)

Table 2. Details of the variable, comparison and check stars.

Star	Tycho ID	R.A. (2000)	Dec. (2000)	V	$B-V$
Variable	1600-1581	19:24:29.691	+16:29:59.293	11.2-11.9	0.51
Comparison	1600-0439	19:24:43.560	+16:30:01.169	11.10	0.35
Check	1600-0451	19:25:08.603	+16:44:28.145	10.03	0.34

The simultaneous light and radial velocity curve analysis was done by PHOEBE (Prsa and Zwitter, 2005), based on the Wilson-Devinney (WD) program (Wilson and Devinney, 1971; Wilson, 1979; Wilson, 1990) with weights for the individual curves determined by their scatter. The mean surface temperature of the primary star was fixed at a value of $T1 = 6650$ K based on the F5 spectral type (SIMBAD, no reference given), using the tables from Cox (2000).

Since the primary is in the transition region between stars that have convective envelopes and those that have radiative envelopes, we investigated solutions for both cases. The fits were noticeably better, especially in the shoulders of the eclipses for the convective case, and theoretical values for the bolometric albedo and gravity darkening appropriate for convective envelopes were assumed for both stars in our final solution. Similar results were found by Nelson et al. (1995) for V728 Her.

The initial solution attempts were made assuming a detached configuration (WD mode 2) but the corrections for the secondary star's surface potential consistently pushed it past the Roche lobe, so a semi-detached configuration (WD mode 5) was used. The parameters adjusted were the orbital semi-major axis (a), gamma velocity (V_γ), inclination (i), secondary mean surface temperature (T2), primary modified surface potential (Ω1), mass ratio (q) and primary wavelength-dependent luminosities (L1). We also used heliocentric Julian day as the independent variable and solved for the linear ephemeris parameters:

$$\text{JD Hel Min I} = 2452500.1332(7) + 0.7916754(4)\text{E}$$

Our initial attempts to fit the light curves were unsatisfactory due to a poor fit in the secondary eclipse. The theoretical curve, using the Van Hamme (1993) limb darkening coefficients and either the square root or logarithmic law, was insufficiently deep, so we decided to try adjusting the limb darkening coefficients. Since WD cannot adjust both coefficients of a non-linear limb darkening law, we used the linear law for these tests. The fit was noticeably improved, as shown in Figure 1. The final values for the limb darkening coefficients were substantially smaller than the theoretical values. For instance, the adjusted value for the B light curve was 0.14±0.06 whereas the theoretical value from the Van Hamme (1993) tables is 0.79. An interesting difference was found in the adjusted values for the V curve obtained at SRO and the one obtained at Prince George. The SRO value is 0.16±0.05 and the Prince George value was 0.26±0.05. The other passband in common between the two observatories, I_C, did not show a significant difference, both being 0.11±0.04. The V-band luminosity ratios in Table 3 also show differences. The two photometric datasets were obtained about a year apart, so it is unclear whether these differences are instrumental or a result of some time-dependent phenomenon of the

Table 3. Parameters from the final simultaneous light-velocity curve solution. The luminosity ratios marked with an asterisk, the values are from the 2005 SRO data while the others are for the 2006 SyRO data.

Quantity	Value	Error	Quantity	Value	Error
T1 (K)	6650	fixed	a ($R_\odot$)	4.14	0.09
T2 (K)	5483	18	V_γ (km sec^{-1})	−103	2
Ω1	3.089	0.005	r1 (pole)	0.3369	0.0006
q = M2/M1	0.127	0.001	r1 (point)	0.3485	0.0007
i (deg)	88.4	0.4	r1 (side)	0.3446	0.0007
L1/(L1+L2) (B)	0.858	0.001	r1 (back)	0.3469	0.0007
L1/(L1+L2) (V)	0.828*	0.001	r2 (pole)	0.2042	0.0006
continued	0.833	0.002	—	—	—
L1/(L1+L2) (R_C)	0.817	0.002	r2 (side)	0.2123	0.0006
L1/(L1+L2) (I_C)	0.798*	0.001	r2 (back)	0.2438	0.0006
continued	0.799	0.002	—	—	—
HJD0	52500.1332	0.0007	P (days)	0.7916754	0.0000004

system. The primary eclipse showed no fitting problems, so we used the theoretical limb darkening coefficients for the primary star.

A plot of the light curves and computed fits are shown in Figure 2 and the radial velocities and fits are shown in Figure 3. A three dimensional representation from Binary Maker 3 (Bradstreet, 1993) is shown in Figure 4. The absolute dimensions are listed in Table 4. The primary has a mass consistent with an F5 main sequence star, and a radius that indicates moderate evolution. The secondary is clearly an evolved object and the semidetached configuration is a clue that large-scale mass transfer has taken place.

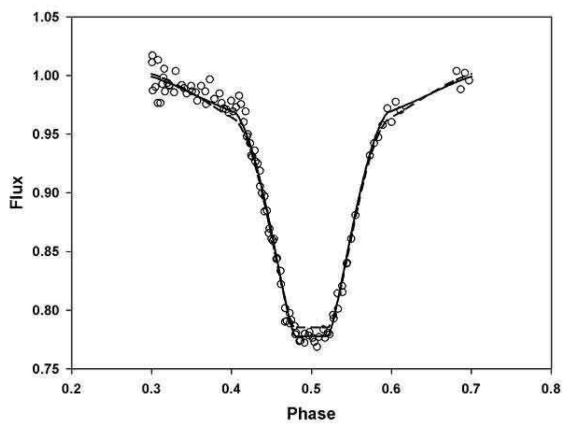

Figure 1. The secondary eclipse in I_C showing the poor fit with a logarithmic limb darkening law and theoretical limb darkening coefficients (dashed curve) for the secondary star, and the improved fit using a linear cosine law with an adjusted limb darkening coefficient (solid curve).

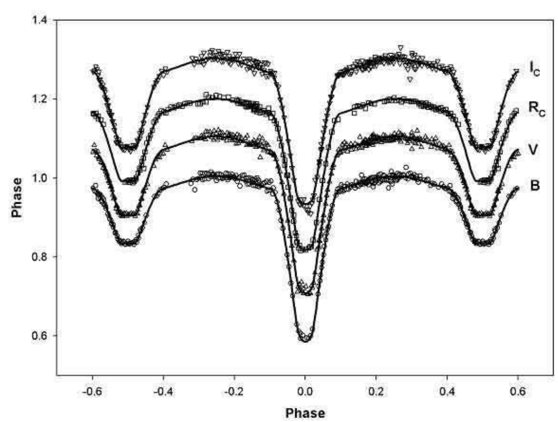

Figure 2. The observed light curves and fit using the linear limb darkening law with adjusted coefficients for the secondary star.

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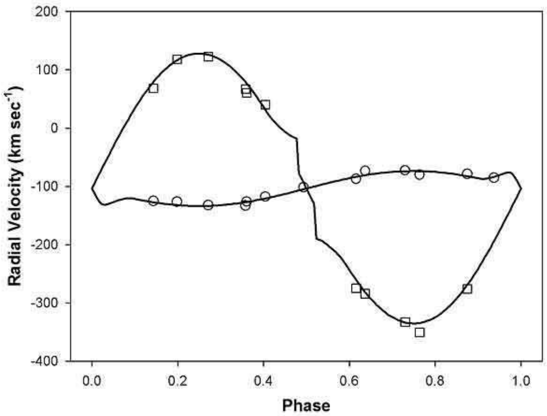

Figure 3. The radial velocity curves and the computed fit.

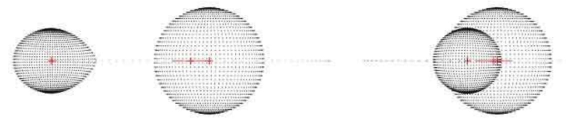

Figure 4. Binary Maker 3 representation of the system – at phases 0.75 and 0.97.

Table 4. Absolute dimensions for CU Sge.

Parameter	Star 1	Star 2
Mass ($M_\odot$)	1.36±0.09	0.17±0.01
Radius ($R_\odot$)	1.42±0.03	0.92±0.02
M bol	3.4±0.1	5.2±0.1
Log g (cgs)	4.26±0.03	3.75±0.03

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*This version of the paper contains corrections, and differs from the one appeared on-line originally. Date of last modification: Tue Feb 8 14:19:48 CET 2011

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DIFFERENTIAL PHOTOMETRY OF 2MASS J09440940-5617117[†]

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Cataclysmic variables (CVs) are binary stars consisting of a white dwarf accreting matter from a low mass companion via Roche-lobe overflow. 2MASS J09440940-5617117 was identified as a cataclysmic variable by Pretorius & Knigge (2008) using the Super-COSMOS Hα survey (Parker et al., 2005). They performed time-resolved spectroscopy from which a probable orbital period of 0.1877(2) d was estimated. The spectrum shows emission lines of the Balmer series and Helium with strong HeIIλ 4686. They have also presented photometry, which does not cover the entire orbital period. Both photometry and spectroscopy indicate an eclipsing system. By the observational characteristics of this system, Pretorius & Knigge (2008) tentatively suggest a SW Sex classification.

We obtained optical photometry of 2MASS J09440940-5617117 in 2008 at Observatório do Pico dos Dias (OPD) operated by the Laboratório Nacional de Astrofísica in Brazil. The data were obtained with the 0.6-m Boller & Chivens telescope at OPD in three nights. The CCD arrays used are 1024 × 1024 pixels back-illuminated SITe devices. Table 1 presents a log of the observations. Figure 1 shows the observed field-of-view around 2MASS J09440940-5617117.

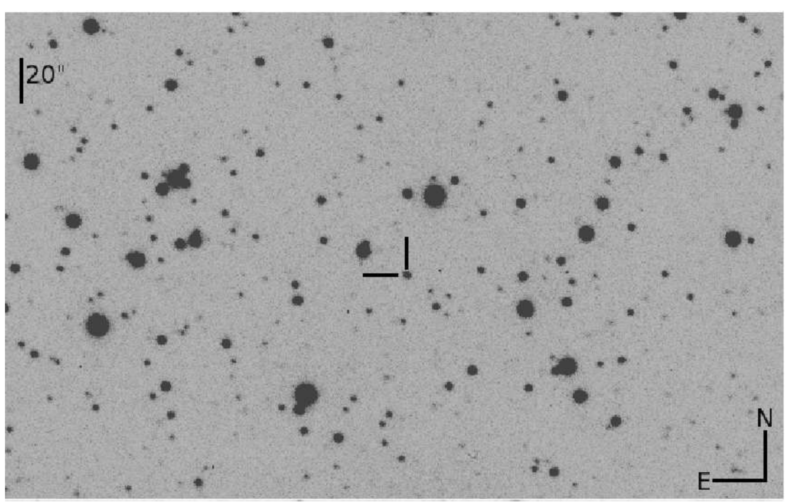

Figure 1. Finding chart for 2MASS J09440940-5617117 in the R_c band.

[†]Based on observations made at the Observatório do Pico dos Dias, Brazil, operated by the Laboratório Nacional de Astrofísica.

Table 1 Log of observations

Date	Telescope	Filter	Exposure time (s)	Number of images
2008 Feb 18	OPD/0.6m	R_C	120	19
2008 Feb 19	OPD/0.6m	R_C	120	74
2008 Mar 03	OPD/0.6m	R_C	120	140

We have used IRAF to correct for bias and flat-field and to perform differential photometry. To illustrate the photometric quality, we present in Figure 2 the light curve obtained on March 03, 2008 for 2MASS J09440940-5617117 and for a comparison star. In this light curve we see differences in the egress of eclipses. The reference star used is USNOB 8593-02515-1, for which the R_C magnitude was estimated in 11.55 ± 0.15, based on the USNO magnitudes of 593 stars in the same field-of-view.

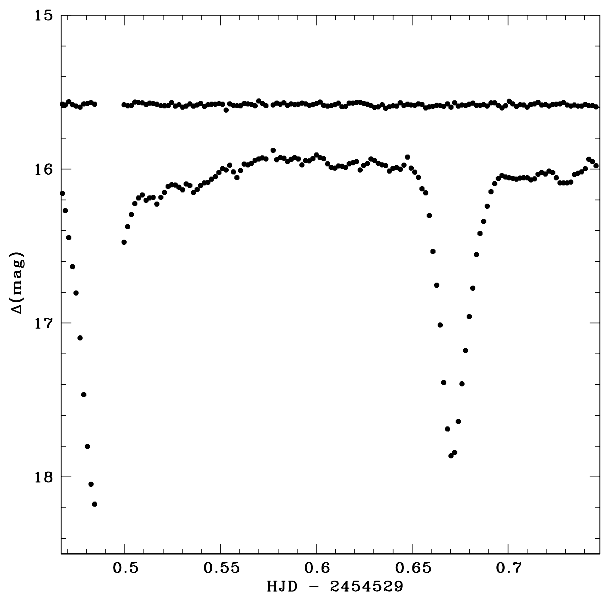

Figure 2. Optical light curve in the R_c band of 2MASS J09440940-5617117 on March 03, 2008. The light curve of a comparison star is also presented.

The data set contains four eclipses, allowing us to determine an ephemeris for the eclipses in the system. We have included the data from Pretorius & Knigge (2008) to improve the orbital period estimate. Three different methods were used to estimate the period: Phase Dispersion Minimization, String-Length and Discrete Fourier Transform. The best ephemeris for the times of mid-eclipse is:

$$T_{\mathrm{mid-eclipse}}\ (\mathrm{HJD}) = 2\,454\,516.703\,9\ (3) + 0.187\,934\,0\ (5)\ \mathrm{E}\ . \tag{1}$$

The uncertainty in the period was obtained from the spread of the values given by the three different methods. It is a conservative value since this error is twice as large as the one estimated using the expression of Gilliland & Fisher (1985) considering the noise. Our period estimate is consistent with the previous suggestion of Pretorius & Knigge (2008). Figure 3 shows the photometric data plotted in phase with our ephemeris.

The eclipse width ($\Delta\phi$) of 2MASS J09440940-5617117 is 0.112 ± 0.003 orbital cycles. It was calculated considering the phases of minimum and maximum derivative of the mean light curve, indicated by the dotted lines in Figure 4.

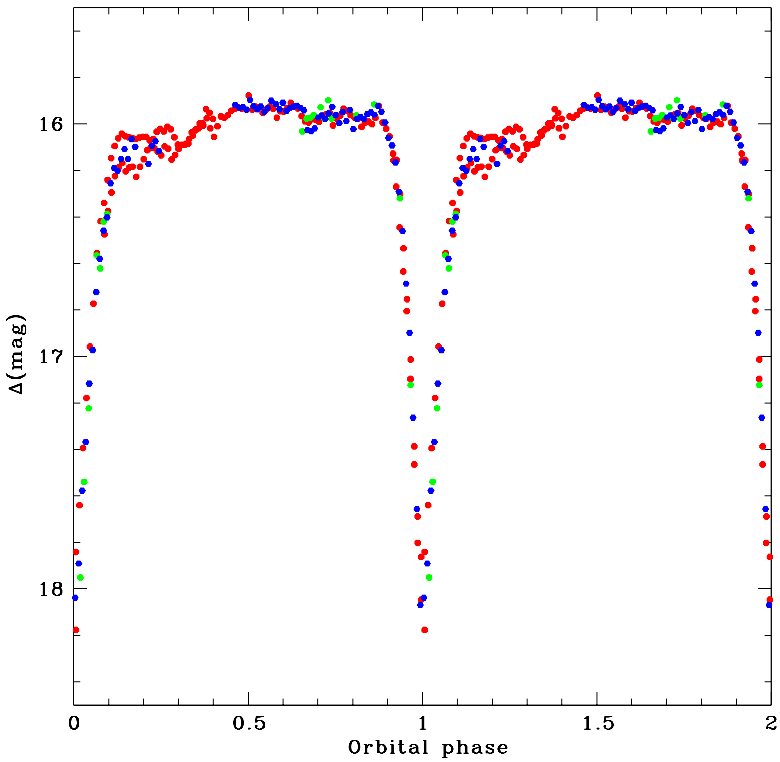

Figure 3. Phase diagram of 2MASS J09440940-5617117 in the R_c band on March 03, 2008 (red), on February 19, 2008 (blue) and on February 18, 2008 (green).

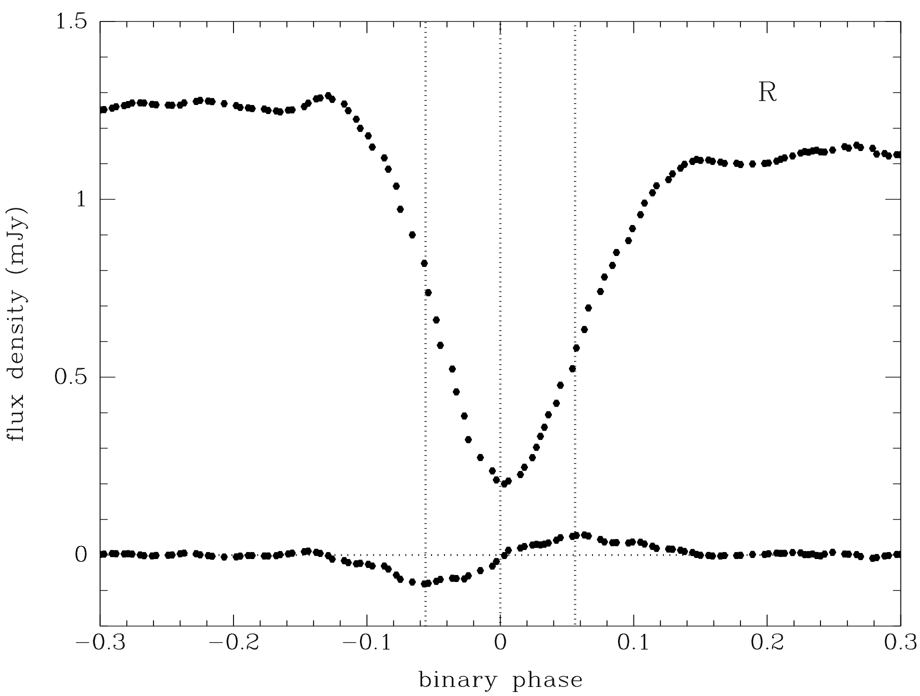

Figure 4. Mean eclipse profile and its derivative. The dotted lines indicate the center of the eclipse and the phases of minimum and maximum of the derivative.

Table 2 Parameters of 2MASS J09440940-5617117

Parameter		Comments
P_{orb}	0.1879340(5) d	this work
$\Delta\phi$	0.112 ± 0.003	this work
q	0.66-0.83	this work
i	84-90°	this work
M_2	0.4 $M_\odot$	donor sequence - Knigge (2006)

In a CV with a geometrically thin disk, the eclipse width and the mass ratio (q=M_2/M_1) can be used to estimate the inclination (i) of the system, as shown by Horne (1985). From the orbital period, we have obtained an estimate of the mass of the secondary star (see Table 2) using the table presented by Knigge (2006). Considering a wide range of white dwarf masses, 0.35-0.77 $M_\odot$, we have constructed a diagram of orbital inclination versus mass ratio, which is shown in Figure 5. For the estimated eclipse width, the lower limit to the mass ratio of the system is 0.66, while the upper limit can be found considering the limit of stable mass transfer (q $< 5/6$) and corresponds to 0.83. Considering these limits, the orbital inclination range is 84-90°. We remark that these results rely on the assumption that the disk is geometrically thin and that its center of light coincides with the white dwarf. This assumption fails if the accretion disk of 2MASS J09440940-5617117 is geometrically thick and suffers self-occultation – as it seems to occur in some SW Sex stars (Knigge et al., 2000).

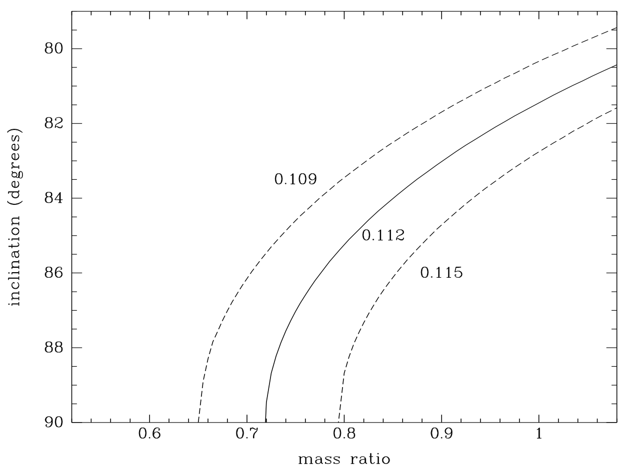

Figure 5. Orbital inclination versus mass ratio for an eclipse width of 0.112 ± 0.003 orbital cycles.

Acknowledgements. We acknowledge the referee, C. Knigge, for his comments. C.V. Rodrigues and K. M. G. Silva acknowledge CNPq and FAPESP grants, Procs. 308005/2009-0 and 2008/09619-5, respectively.

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*This version of the paper contains corrections, and differs from the one appeared on-line originally. Date of last modification: Tue Feb 8 14:16:41 CET 2011

COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5972

Konkoly Observatory
Budapest
4 February 2011

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NEW TIMES OF MINIMA OF SOME ECLIPSING VARIABLES

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Observatory and telescope:
URSA Observatory at the University of Arkansas; 10” Schmidt-Cassegrain reflector. NFO WebScope near Silver City, NM, USA (www.nfo.edu); 24” classical Cassegrain.

Detector:	URSA: 1020×1530 pixels SBIG ST8EN CCD cooled to (typ.) −20 °C; 1″.15 square pixels; 20′(N-S)×30′(E-W) field of view. NFO: 2102×2092 pixels Kodak KAF 4300E CCD cooled to (typ.) −20 °C; 0″.78 square pixels; 27′ square field of view.

Method of data reduction:
Virtual measuring engine (Measure 2.0) written by C.H.S. Lacy.

Method of minimum determination:
Kwee & van Woerden (1956)

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
AP And	55121.6229	0.0001	2	*V*	NFO
	55139.8769	0.0005	1	*V*	NFO
	55144.6391	0.0001	1	*V*	NFO
	55152.5755	0.0001	1	*V*	NFO
	55159.7179	0.0002	2	*V*	NFO
	55358.9230	0.0002	1	*V*	NFO
	55412.8911	0.0001	1	*V*	URSA
	55432.7316	0.0002	2	*V*	URSA
	55451.7796	0.0001	2	*V*	URSA
	55466.8587	0.0002	1	*V*	NFO
	55467.6531	0.0002	2	*V*	URSA
	55478.7642	0.0003	2	*V*	NFO
	55486.7003	0.0001	2	*V*	NFO
	55494.6360	0.0002	2	*V*	NFO
	55497.8112	0.0002	2	*V*	NFO
	55509.7156	0.0002	1	*V*	NFO
	55528.7633	0.0002	1	*V*	NFO
	55555.7470	0.0002	1	*V*	NFO
	55563.6837	0.0001	1	*V*	NFO
	55575.5884	0.0002	2	*V*	NFO
	55575.5885	0.0002	2	*V*	URSA

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
CG Aur	55116.9308	0.0004	1	*V*	NFO
	55126.9113	0.0004	2	*V*	NFO
	55137.7425	0.0008	2	*V*	NFO
	55183.7123	0.0004	1	*V*	NFO
	55193.6903	0.0011	2	*V*	NFO
	55554.6634	0.0005	2	*V*	NFO
HP Aur	55181.8290	0.0002	1	*V*	URSA
	55251.5488	0.0007	1	*V*	URSA
	55258.6627	0.0002	1	*V*	URSA
	55462.8389	0.0003	2	*V*	URSA
V361 Cas	55435.9071	0.0010	1	*V*	URSA
	55445.7402	0.0003	1	*V*	URSA
	55478.9212	0.0003	1	*V*	NFO
	55498.5865	0.0004	1	*V*	URSA
	55499.8127	0.0004	1	*V*	NFO
	55509.6477	0.0005	1	*V*	URSA
	55514.5622	0.0009	1	*V*	URSA
	55515.7912	0.0010	1	*V*	NFO
	55520.7069	0.0007	1	*V*	URSA
	55536.6835	0.0006	2	*V*	NFO
	55568.6355	0.0010	2	*V*	URSA
	55568.6366	0.0012	2	*V*	NFO
V381 Cas	55435.7317	0.0002	1	*V*	URSA
	55468.9034	0.0002	1	*V*	NFO
	55468.9044	0.0002	1	*V*	URSA
	55470.6509	0.0002	1	*V*	URSA
	55539.6137	0.0002	2	*V*	URSA
	55566.6796	0.0002	1	*V*	NFO
	55574.5311	0.0005	2	*V*	URSA
V651 Cas	55458.9197	0.0003	2	*V*	URSA
	55460.9133	0.0002	2	*V*	URSA
	55467.8926	0.0003	2	*V*	URSA
	55485.8329	0.0002	2	*V*	URSA
	55498.7920	0.0002	2	*V*	URSA
	55499.7889	0.0001	2	*V*	URSA
	55500.7856	0.0002	2	*V*	URSA
	55504.7729	0.0002	2	*V*	URSA
	55506.7666	0.0001	2	*V*	URSA
	55528.6964	0.0002	2	*V*	URSA
	55533.6805	0.0003	2	*V*	URSA
	55537.6673	0.0002	2	*V*	URSA
	55563.5838	0.0002	2	*V*	URSA
	55564.5808	0.0002	2	*V*	URSA
WW Cep	55176.5598	0.0006	2	*V*	URSA
	55431.9055	0.0002	1	*V*	URSA
	55468.7131	0.0002	1	*V*	URSA
	55469.8846	0.0003	2	*V*	URSA
	55528.5230	0.0003	1	*V*	URSA
V456 Cyg	55283.9844	0.0002	1	*V*	NFO
	55300.9172	0.0002	1	*V*	URSA
	55329.8805	0.0002	2	*V*	NFO
	55337.9033	0.0007	2	*V*	NFO
	55345.9214	0.0002	2	*V*	NFO
	55354.8351	0.0002	2	*V*	URSA
	55366.8658	0.0002	1	*V*	NFO

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
	55366.8660	0.0003	1	*V*	URSA
	55378.8965	0.0003	2	*V*	URSA
	55379.7882	0.0003	2	*V*	URSA
	55392.7107	0.0002	1	*V*	URSA
	55395.8291	0.0002	2	*V*	URSA
	55396.7202	0.0003	2	*V*	URSA
	55399.8398	0.0002	1	*V*	URSA
	55400.7314	0.0001	1	*V*	URSA
	55411.8723	0.0003	2	*V*	URSA
	55421.6745	0.0002	2	*V*	URSA
	55425.6845	0.0002	1	*V*	URSA
	55434.5962	0.0003	1	*V*	URSA
V974 Cyg	55296.9396	0.0003	1	*V*	NFO
	55320.8793	0.0005	2	*V*	URSA
	55365.7471	0.0007	2	*V*	URSA
V1136 Cyg	55301.8923	0.0005	1	*V*	URSA
	55301.8943	0.0004	1	*V*	NFO
	55360.7606	0.0004	1	*V*	NFO
	55362.7981	0.0014	2	*V*	NFO
	55457.7170	0.0007	1	*V*	NFO
	55466.6732	0.0013	2	*V*	NFO
BF Dra	55370.7426	0.0002	1	*V*	URSA
	55370.7433	0.0003	1	*V*	NFO
	55471.6415	0.0002	1	*V*	URSA
	55471.6422	0.0002	1	*V*	NFO
V501 Her	55278.8917	0.0009	1	*V*	NFO
	55321.8833	0.0005	1	*V*	URSA
	55351.7943	0.0007	2	*V*	NFO
	55364.8705	0.0005	1	*V*	NFO
WZ Leo	55192.9954	0.0004	1	*V*	NFO
	55209.8941	0.0004	1	*V*	URSA
AL Leo	55251.7365	0.0002	1	*V*	NFO
	55259.7643	0.0002	1	*V*	URSA
	55259.7653	0.0006	1	*V*	NFO
	55260.5666	0.0004	2	*V*	URSA
	55267.7921	0.0003	1	*V*	NFO
	55280.6366	0.0003	1	*V*	NFO
	55284.6497	0.0002	2	*V*	NFO
	55296.6915	0.0002	1	*V*	URSA
	55300.7051	0.0002	2	*V*	URSA
	55300.7055	0.0002	2	*V*	NFO
	55349.6723	0.0004	1	*V*	NFO
	55490.9584	0.0004	1	*V*	URSA
	55519.8576	0.0004	1	*V*	URSA
	55531.9001	0.0004	2	*V*	NFO
	55539.9273	0.0001	2	*V*	NFO
	55543.9408	0.0002	1	*V*	URSA
	55543.9411	0.0001	1	*V*	NFO
	55564.0097	0.0002	2	*V*	NFO
	55564.0099	0.0003	2	*V*	URSA
	55564.8123	0.0001	1	*V*	URSA
	55568.8256	0.0002	2	*V*	URSA
	55568.8262	0.0002	2	*V*	NFO
	55580.8670	0.0002	1	*V*	NFO
	55588.8953	0.0001	1	*V*	URSA

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V501 Mon	55135.8866	0.0019	1	*V*	NFO
	55170.9960	0.0013	1	*V*	NFO
	55493.9715	0.0009	1	*V*	NFO
	55500.9939	0.0011	1	*V*	NFO
V506 Oph	55293.9475	0.0002	2	*V*	NFO
	55369.7682	0.0002	1	*V*	URSA
	55378.7803	0.0003	2	*V*	URSA
	55412.7157	0.0002	2	*V*	URSA
	55462.5558	0.0002	2	*V*	URSA
	55472.6288	0.0002	1	*V*	NFO
FO Ori	55170.8995	0.0007	1	*V*	NFO
	55505.9168	0.0005	2	*V*	URSA
V530 Ori	55152.9342	0.0007	1	*V*	NFO
	55482.9157	0.0001	1	*V*	NFO
	55531.8024	0.0001	1	*V*	URSA
	55531.8024	0.0002	1	*V*	NFO
	55537.9129	0.0002	1	*V*	NFO
	55580.6883	0.0002	1	*V*	NFO
NP Per	55484.9086	0.0007	2	*V*	NFO
	55484.9116	0.0014	2	*V*	URSA
	55533.9424	0.0006	2	*V*	NFO
IM Per	55241.6872	0.0006	2	*V*	NFO
	55473.8723	0.0003	2	*V*	URSA
	55490.7857	0.0003	1	*V*	NFO
	55490.7865	0.0003	1	*V*	URSA
	55500.9194	0.0004	2	*V*	URSA
	55507.6854	0.0004	2	*V*	URSA
	55507.6862	0.0005	2	*V*	NFO
	55525.7190	0.0007	2	*V*	NFO
	55533.6170	0.0004	1	*V*	NFO
	55544.8885	0.0004	1	*V*	NFO
	55568.5474	0.0007	2	*V*	URSA
	55569.6845	0.0003	1	*V*	URSA
	55587.7179	0.0009	1	*V*	URSA
V482 Per	55158.8543	0.0011	1	*V*	NFO
	55169.8635	0.0006	2	*V*	NFO
	55185.7682	0.0004	1	*V*	NFO
	55201.6755	0.0005	2	*V*	NFO
	55245.7097	0.0004	2	*V*	NFO
	55432.8751	0.0005	1	*V*	URSA
	55443.8859	0.0004	2	*V*	URSA
	55459.7893	0.0009	1	*V*	URSA
	55465.9052	0.0005	2	*V*	NFO
	55476.9162	0.0004	1	*V*	NFO
	55481.8093	0.0004	1	*V*	NFO
	55497.7146	0.0006	2	*V*	URSA
	55498.9346	0.0004	1	*V*	NFO
	55498.9364	0.0007	1	*V*	URSA
	55503.8308	0.0003	1	*V*	NFO
	55508.7236	0.0002	1	*V*	NFO
	55509.9476	0.0010	2	*V*	URSA
	55514.8421	0.0003	2	*V*	URSA
	55519.7355	0.0005	2	*V*	URSA
	55536.8653	0.0006	2	*V*	NFO
	55557.6609	0.0005	1	*V*	NFO

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
	55563.7761	0.0006	2	*V*	NFO
	55563.7765	0.0004	2	*V*	URSA
	55573.5628	0.0004	2	*V*	URSA
	55590.6906	0.0003	2	*V*	URSA
V514 Per	55144.9267	0.0005	1	*V*	NFO
	55145.8344	0.0006	2	*V*	NFO
	55154.9320	0.0005	2	*V*	NFO
	55155.8410	0.0006	1	*V*	NFO
	55156.7505	0.0008	2	*V*	NFO
	55167.6673	0.0010	2	*V*	NFO
V335 Ser	55299.7795	0.0003	1	*V*	URSA
	55337.7290	0.0002	1	*V*	NFO
	55368.7776	0.0004	1	*V*	URSA
	55401.6790	0.0003	2	*V*	URSA
	55451.5751	0.0006	1	*V*	URSA
TY Tau	55175.6721	0.0003	1	*V*	URSA
	55209.6089	0.0004	2	*V*	URSA
	55245.7000	0.0005	1	*V*	URSA
	55485.9534	0.0003	1	*V*	URSA
	55499.9587	0.0002	1	*V*	URSA
	55533.8951	0.0004	2	*V*	URSA
	55544.6664	0.0003	2	*V*	URSA
	55557.5960	0.0008	2	*V*	URSA
CF Tau	55153.7515	0.0003	1	*V*	NFO
V1094 Tau	55157.7494	0.0003	1	*V*	NFO
	55175.7281	0.0003	1	*V*	NFO
	55181.5904	0.0003	2	*V*	URSA
	55202.6903	0.0006	1	*V*	NFO
	55208.5573	0.0002	2	*V*	URSA
	55247.6367	0.0003	1	*V*	NFO
	55274.6011	0.0003	1	*V*	URSA
HY Vir	55280.8670	0.0003	2	*V*	NFO
	55295.8986	0.0006	1	*V*	NFO
	55306.8257	0.0003	1	*V*	URSA
	55317.7536	0.0004	1	*V*	NFO
	55332.7877	0.0005	2	*V*	NFO
	55369.6662	0.0003	1	*V*	URSA
	55590.9881	0.0003	1	*V*	URSA
BP Vul	55350.8269	0.0004	2	*V*	NFO
BT Vul	55122.6912	0.0002	2	*V*	NFO
	55134.6733	0.0002	1	*V*	NFO
	55138.6677	0.0004	2	*V*	NFO
	55154.6456	0.0005	2	*V*	NFO
	55418.8327	0.0002	1	*V*	URSA
	55434.8089	0.0002	1	*V*	URSA
	55462.7666	0.0008	2	*V*	URSA
	55473.6084	0.0002	1	*V*	URSA
	55485.5918	0.0005	2	*V*	URSA
	55497.5738	0.0002	1	*V*	URSA

Remarks:

A sample of the observations has been published by Lacy, Hood & Straughn (2001). Mean deviations between independently timed eclipses by the two telescopes (URSA & NFO) are not significantly larger than expected based on the error estimates, implying that the estimated timing errors are realistic.

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Lacy, C. H. S., Hood, B. & Straughn, A., 2001, *IBVS*, No. 5067

ERRATUM FOR IBVS 5972

In IBVS 5972 the time of minimum for WW Cep - 55469.8846 +- 0.0003 type 2 eclipse from the URSA telescope - should have been from the star V651 Cas instead of WW Cep.

Lacy, C. H. S.

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NEW RADIAL VELOCITIES OF SOME SEMI-REGULAR VARIABLE STARS

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New radial velocities of 11 Semi-Regular variable stars measured in conjunction with the radial velocity program of the Vilnius University Observatory (Sperauskas et al. 2002) are reported here. The radial velocities were measured with the CORrelation RAdial VELocities (CORAVEL) spectrometer of the Vilnius University Observatory (Upgren, Sperauskas, and Boyle, 2002) attached to the 1.5 m Russian Turkish Telescope (RTT150) at the TÜBİTAK National Observatory (TUG), Turkey. Observations are described in Sperauskas et al. (2002). These stars were observed on two or more nights to check for possible variability. The results are tabulated in Table 1.

Table 1. Observed Radial Velocities

Variable	HJD 24...	Vr (km/s)	±
V0347 And	51887.297	−47.4	0.8
	51888.218	−47.1	0.9
	51892.312	−45.8	0.9
	51893.271	−44.9	0.8
AH Ari	51887.368	−3.5	0.7
	51888.200	−3.1	0.8
	51890.419	−5.0	0.7
	51892.349	−2.9	0.7
	51893.310	−2.5	0.8
	51894.380	−4.0	0.7
AU Ari	51887.356	44.9	0.7
	51888.208	45.0	0.8
	51892.337	45.9	0.8
	51893.301	45.8	0.8
	51894.370	44.6	0.7
V0453 Aur	51887.569	0.4	0.9
	51888.411	1.0	0.8
	51889.374	0.7	0.7
	51890.483	1.4	0.8
	51894.521	−0.2	0.8

Table 1. Observed Radial Velocities (continued)

Variable	HJD 24...	Vr (km/s)	±
RY Cam	51887.336	−19.6	0.9
	51888.395	−19.8	0.8
	51890.476	−20.3	0.9
	51890.477	−20.5	0.9
	51892.432	−19.8	0.8
	51892.434	−20.2	0.7
	51893.367	−17.6	0.8
	51893.369	−16.7	0.9
	51969.249	−26.3	0.7
	51893.367	−17.6	0.8
	51893.369	−16.7	0.9
	51969.249	−26.3	0.7
	51974.266	−26.1	0.7
	51976.296	−26.5	0.7
	52142.432	−25.2	0.8
	52199.623	−18.0	0.7
	52205.634	−17.3	0.7
	52350.275	−23.1	0.6
	52356.278	−23.6	0.7
V0401 Cep	51887.312	−2.6	0.8
	51887.319	−1.4	0.8
	51888.228	−1.1	0.8
	51892.325	−1.9	0.8
	51893.288	−1.8	0.8
BX Lyn	51887.583	−40.3	0.8
	51888.515	−39.5	0.8
	51889.400	−40.3	0.7
	51894.528	−40.3	0.7
X Mon	51887.483	167.6	1.5
	51888.493	166.6	1.2
V0719 Mon	51894.459	13.0	0.8
	51894.467	13.2	0.7
V1151 Tau	51887.457	32.9	0.8
	51888.371	33.1	0.8
	51888.455	33.3	0.8
	51890.469	32.0	0.7
	51893.423	33.5	0.8
AG Tri	51887.378	6.3	0.9
	51888.480	6.8	0.9
	51890.427	5.6	0.8
	51892.372	8.3	1.0
	51893.325	6.6	0.8
	51894.385	6.0	0.9

RY Cam is a SRb type (M3IIIvar) variable with a photometric period of about 135 days. It is seen from Table 1 that its radial velocity is variable, but it is not possible to determine if the variation is periodic as the number of observations is too few. A search in *SIMBAD* gave us five more observations (between -14 to -23 km/s with much less weight) more than 60 years earlier (Joy, 1942). It suffices here to note that the radial velocity variation is not compatible with the photometric period of 135 days.

Hipparcos discovered an astrometric companion to RY Cam at an angular distance of $0\farcs16$ with a position angle of 87 degrees. Prieur et al. (2002) give these as $0\farcs062 \pm 0\farcs008$ and 325 degrees, respectively. However, a preliminary calculation indicated that the radial velocity variation is not likely to be due to an orbital motion but is compatible with radial pulsation with a variation of about 8% in the radius (Aslan & Yeşilyaprak, 2002). More observations are needed to determine the real cause. The star is on an observing program at TUG.

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Upgren, A., Sperauskas, J., Boyle, R. P., 2002, *Baltic Astronomy*, **11**, 91

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TIMES OF MINIMA FOR ECLIPSING BINARIES 2010

DVORAK, S. W.

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Observatory and telescope:
25cm catadioptric telescope at Rolling Hills Observatory (RHO)

Detector:	SBIG ST-9XE, Peltier cooling, Kodak KAF-0261 chip, $18'.5 \times 18'.5$ FOV, 512×512 pixels.

Method of data reduction:
Reduction of the CCD frames was done with sextractor and custom-written applications[1] .

Method of minimum determination:
The heliocentric times of minima and the error estimates were computed using the Kwee and van Woerden method as implemented in a custom-written C application. A floor of 0.0001d (∼8 seconds) was applied to the error estimates to allow for the error contribution due to barycentric variation, and as an allowance for the overly optimistic error estimates of the Kwee and van Woerden method.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
HL Aur	55257.6638	0.0001	I	*V*	
AC Boo	55327.6421	0.0001	I	*V*	
AK Cam	55263.6608	0.0001	I	*V*	
AZ Cam	55260.6516	0.0001	I	*V*	
FN Cam	55287.6797	0.0001	II	*V*	
V0821 Cas	55491.6850	0.0001	II	*B*	
BH CMi	55259.6951	0.0001	I	*V*	
ES Cnc	55235.781	0.002	I	*V*	
EV Cnc	55235.802	0.002	II	*V*	
RW Com	55279.8279	0.0001	II	*V*	
	55279.8280	0.0002	II	*V*	
YY CrB	55261.8271	0.0001	I	*V*	
BI CVn	55251.7874	0.0001	I	*V*	
DF CVn	55209.8490	0.0001	I	*V*	
KR Cyg	55461.6389	0.0001	I	*V*	
V0488 Cyg	55461.6660	0.0007	I	*V*	

[1]sextractor is written by Emmanuel Bertin and is available from `http://terapix.iap.fr/`

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
BV Dra	55238.8856	0.0001	I	*V*	
BW Dra	55238.7694	0.0001	I	*V*	
	55238.917	0.001	II	*V*	
AX Dra	55261.6291	0.0001	I	*V*	
	55275.8333	0.0001	I	*V*	
BU Dra	55282.7920	0.0001	I	*V*	
FU Dra	55261.8473	0.0001	I	*V*	
	55296.6588	0.0001	II	*V*	
GM Dra	55285.8711	0.0001	I	*V*	
EL Gem	55261.7186	0.0001	I	*V*	
GW Gem	55472.9178	0.0001	I	*V*	
SX Gem	55261.6594	0.0001	I	*V*	
WW Gem	55269.6481	0.0001	I	*V*	
V0921 Her	55270.8510	0.0002	I	*V*	
CE Leo	55262.6640	0.0002	I	*V*	
VW LMi	55260.8762	0.0001	I	*V*	
UU Lyn	55222.8255	0.0001	I	*V*	
	55499.9207	0.0001	II	*V*	
BP Per	55254.6057	0.0002	I	*V*	
DZ Psc	55455.8647	0.0001	I	*V*	
V0781 Tau	55199.6806	0.0001	I	*V*	
AA UMa	55236.7415	0.0001	II	*V*	
AW UMa	55248.6453	0.0002	I	*V*	
II UMa	55231.8365	0.0001	II	*V*	
KM UMa	55202.8418	0.0001	I	*V*	
TY UMa	55216.8560	0.0001	I	*V*	
UY UMa	55262.8617	0.0003	I	*V*	
VV UMa	55253.7030	0.0001	I	*V*	
RU UMi	55270.6490	0.0001	I	*V*	
Q1997/11	55279.5864	0.0001	I	*V*	= GSC 3752-0986
ROTSE1 J140551.53+374652.5	55342.6907	0.0001	?	*V*	= GSC 3034-0870
TSVSC1 TN-N130110312-13-67-2	55342.7114	0.0001	?	*V*	= GSC 3034-1022
VSX J213808.7+261704	55343.8388	0.0005	?	*V*	= GSC 2197-0872

Reference:

Kwee, K. K. & van Woerden, H., 1956, *BAN*, **12**, 327

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A 116 YEAR RECORD OF MASS TRANSFER IN R ARAE

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R Arae (HD 149730) is a bright interacting southern binary star consisting of a B9 primary and a yet unseen secondary, undergoing rapid mass transfer just past the reversal of mass ratio stage of its evolution. With an orbital period of 4.4 days, its components are close enough to experience a direct impact of mass transferring from the secondary to the primary, but distant enough that an accretion structure has formed around the primary. The intense variations seen both photometrically and spectroscopically indicate that the accretion structure is unstable and quite variable (Reed et al., 2010). Because of this, R Ara is of great interest to the study of the evolution of interacting binary stars, but it has unfortunately been neglected.

New observations are combined with those found in the available literature (Hertzsprung, 1942; Payne-Gaposchkin, 1945; Nield, 1991; Reed, 2008 and Reed et al., 2010) and in the database of the American Association of Variable Star Observers (AAVSO) to construct R Ara's first ephemeris curve, which plots observed-minus-calculated ($O - C$) times of primary eclipses and spans the 116 years since its discovery by Roberts (1894). The best-fit to the $O - C$ curve is a quadratic function with parameters that yield period change and mass transfer rates consistent with those of an active Algol-type interacting binary.

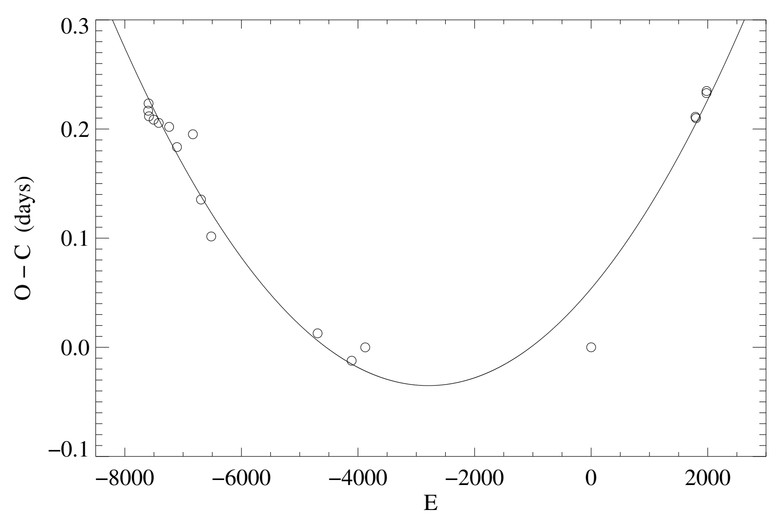

Figure 1. This is the first ephemeris ($O - C$) curve for R Ara, which spans 116 years. The line is the quadratic function that is the best fit to the data points.

The new observations presented here were collected at the Tzec Maun Observatory, located near Moorook, South Australia. The telescope is a 15.2-cm, f/7.3 refractor equipped

Table 1 Observed times of primary minimum of R Ara.

HJD (Pr.Min.)	Date	Observer / Reference
2412954.373	05 May 1894	AAVSO*
2412985.356	05 June 1894	AAVSO*
2413016.320	06 July 1894	AAVSO*
2413370.327	25 June 1895	AAVSO*
2413755.311	14 July 1896	AAVSO*
2414547.406	14 September 1898	AAVSO*
2415140.355	30 April 1900	AAVSO*
2416348.428	21 August 1903	AAVSO*
2416963.461	27 April 1905	AAVSO*
2417742.251	15 June 1907	AAVSO*
2425818.028	25 July 1929	Hertzsprung (1942)
2428402.28	21 August 1936	Hertzsprung (1942)
2429433.348	18 June 1939	Payne-Gaposchkin (1945)
2446585.1597	03 June 1986	Nield (1991)
2454501.932	05 February 2008	Reed (2008)
2454541.757	16 March 2008	Reed, *et al.* (2010)
2455338.3037	21 May 2010	Reed (this paper)*
2455347.1559	30 May 2010	Reed (this paper)*

with a research-grade CCD camera (3072×2048, 9-μ pixels). Each image was exposed for 10 seconds through a Bessel-V filter. The observations of 21 May 2010 consist of 51 consecutive images taken over eight hours, and those of 30 May 2010 consist of 50 consecutive images taken over five hours. The comparison stars were HD 150185 (HIP 81611), HD 149715 (HIP 81581), and HD 149784 (HIP 81611). The comparisons were chosen due to their proximity to R Ara and the fact that they are known to not be variable themselves ($\sigma_V < 0.01$ mag). The comparison stars' magnitudes are listed in the Hipparcos/Tycho archive.

All observed times of primary minimum are compiled in Table 1 and are plotted in Figure 1. The plot is somewhat sparsely populated, as evidence of R Ara's neglectedness, but it clearly indicates true period change. The observations marked with * in Table 1 refer to times of minimum light that were determined for this study, using the method of Kwee and VanWoerden (1956). The ephemeris found by Nield (1991) of $\mathrm{HJD_{Pr.Min.}} = 2446585.1597 + 4.425132E$ was used to compute the calculated eclipse times. The AAVSO data are plotted in Figure 2.

The best-fit $O-C$ curve is given by:

$$O - C = (0.0538) + (6.371 \times 10^{-5})E + (1.141 \times 10^{-8})E^2$$

The average rate of period change over the past 116 years is calculated to be:

$$\dot{P} = \frac{2C_2}{P} = \frac{2(1.141 \times 10^{-8})}{4.425132} = 5.16 \times 10^{-9} \frac{days}{day}$$

Then, using Sahade's values for the masses of the stars of $M_1 = 4M_\odot$ and $M_2 = 1.4M_\odot$ (Sahade, 1952), and assuming conservative mass exchange, the rate of mass transfer averaged over the past 116 years is:

$$\dot{M} = \frac{\dot{P}M_1M_2}{3P(M_1 - M_2)} = \frac{(5.16 \times 10^{-9})(4)(1.4)}{3(4.425132)(4-1.4)} = 8.37 \times 10^{-10} \frac{M_\odot}{day}$$

or:

$$\dot{M} = 3.06 \times 10^{-7} \frac{M_\odot}{year}$$

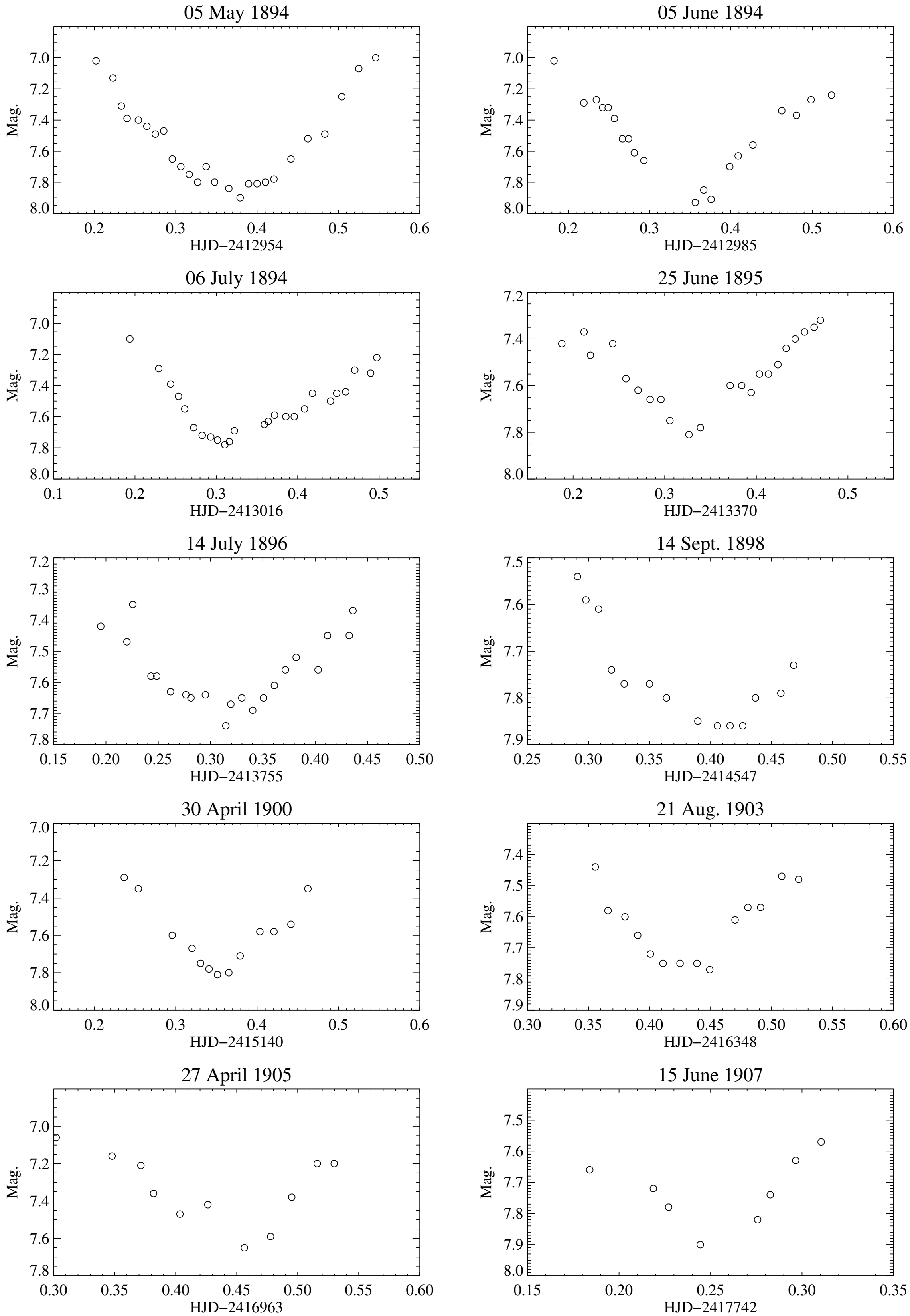

Figure 2. The archival AAVSO light curves.

which is consistent with an actively interacting Algol-type system undergoing rapid mass transfer. Albright and Richards (1996) have stated that Algols transfer mass at rates ranging from $\sim 10^{-11} M_\odot$ yr^{-1} to $\sim 10^{-7} M_\odot$ yr^{-1}. A system very similar to R Ara is U Sge, which was reported to exhibit a mass transfer rate of $\dot{M} \leq 2 \times 10^{-7} M_\odot$ yr^{-1} by Olson (1987) and $\dot{M} = 6.15 \times 10^{-7} M_\odot$ yr^{-1} by Manzoori (2008). The timescale for this stage of R Ara's evolution is very short, on the order of 10,000 years.

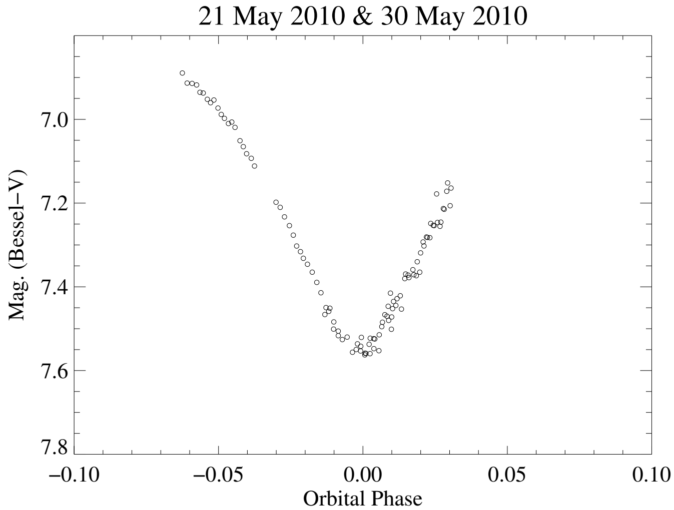

Figure 3. The 2010 light curve near primary minimum. The orbital phase values were determined using the newly calculated ephemeris.

The new times of primary minimum, which were determined to be at HJD 2455338.303704 $\pm$ 0.000591 and HJD 2455347.155868 $\pm$ 0.000378, provide an instantaneous orbital period of 4.426082 $\pm$ 0.000485 days. A new ephemeris of $\mathrm{HJD}_{\mathrm{Pr.Min.}} = 2455338.303704 + 4.426082E$ will provide more accurate calculated eclipse times, and other phase values, for future observations. Figure 3 shows the May 2010 light curve of R Ara near primary minimum.

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V974 Cyg - A TRIPLE SYSTEM WITH APSIDAL MOTION

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The detached eclipsing binary V974 Cyg (GSC 2660.3690, P = 3.20 days) was selected as a target for a detailed study of apsidal motion due to its displaced secondary minimum, $\phi_{II} = 0.47$. We observed the star during 9 nights in 2007-10 at the Russian Academy of Sciences observatory near Moscow (Zvenigorod, UBV photometer, EMI 9789 photomultiplier), the Crimean observatory of Moscow University, Ukraine (Nauchny, CCD Ap-47p), the Crimean Astrophysical Observatory, Ukraine (Simeiz, CCD VersArray 512UV) and at Stará Lesná Observatory of the Astronomical Institute of the Slovak Academy of Sciences (UBVR photometer, R 2949S photomultiplier). Everywhere we used the same type telescopes - 60cm reflectors "Zeiss-600" and the standard Johnson UBV filters. The nearby star GSC 2660.3950 on the same frame as variable served as a comparison star both for CCD and photoelectric observations. GSC 2660.3723 ($V = 10\overset{m}{.}6$) and HD187072 served as a check stars for CCD and photoelectric observations respectively. Using the UBV magnitudes of HD186377 from SIMBAD data base, we derived the absolute magnitudes of the stars under investigation in Stará Lesná observatory, see Table 1. All observations were corrected for atmospheric extinction and transformed to standard Johnson UBV system.

Table 1. The photoelectric magnitudes of the stars

Star	V	$U-B$	$B-V$	remarks
HD186377	5.936(2)	0.191(8)	0.123(7)	HR 7502
HD187072	8.790(5)	0.109(22)	0.113(16)	check
GSC 2660.3950	10.249(7)	0.047(15)	0.384(8)	comparison
V974 Cyg	12.117(7)	0.194(11)	0.227(5)	variable, plato

The CCD-observations in V filter were the most suitable for the analysis of the light curve because of their largest number and highest precision. So we used them to derive the geometrical parameters of the system. As there are no effects of proximity in the light of the system between minima, we used a simple model of two spherical stars revolving in the elliptic orbit. The results are presented in Table 2 and in Fig. 1. B and U observations were used to determine the colours of the components only. We have found that the secondary component is a little bit bluer than the primary, $\Delta(B-V) = 0\overset{m}{.}012$. So the

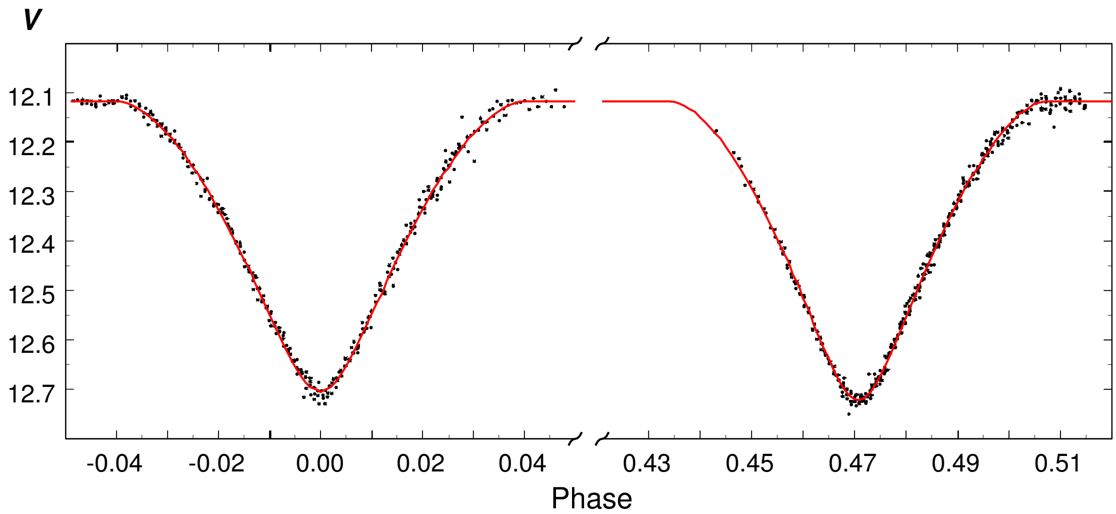

Figure 1. Part of the light curve of V974 Cyg in V filter near both minima. Points denote the individual CCD-observations, the line stands for the theoretical fit, according to parameters from Table. 2.

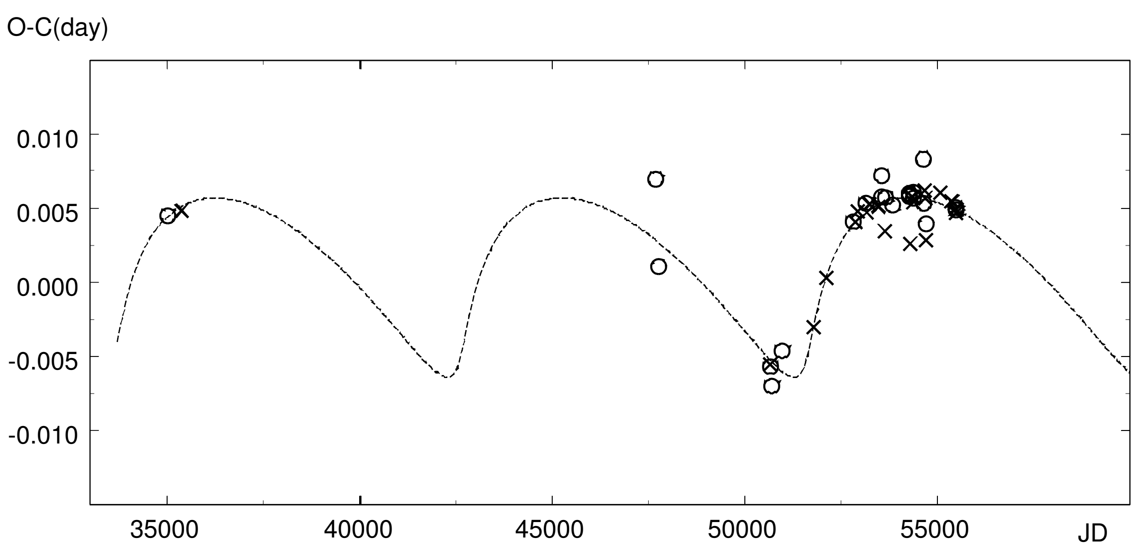

Figure 2. The deviations of minima times from the linear formulae given in this paper (O-C). Circles - primary minima, crosses - secondary ones

Table 2. Light curve solution of V974 Cyg

r_1	0.118 ± 0.002	L_{1V}	0.492 ± 0.020
r_2	0.120 ± 0.003	L_{2V}	0.508 ± 0.020
i	88.03 ± 0.02	$u_{1,2}$	0.49 *
e	0.061 ± 0.003	σ	$0\overset{m}{.}0121$
ω	220.8 ± 0.4		

* linear limb darkening coefficients, fixed from Wade and Rucinski (1985)

secondary component is almost 100K hotter than the primary one, Popper (1980). Our geometrical solution supports this conclusion as the radius of the secondary component was found to be a little bit larger, see Table 2. Therefore, the secondary component should be considered as a primary one. But to avoid confusion, we, in this article, leave all the same. The unreddened index $(B-V)_0$ of the star is enclosed in the interval from 0.02 to 0.16. We can not obtain this value more accurately until we get the spectra of the components. For our estimations we take the middle of this interval. Using Popper's (1980) calibration for $B-V$ we obtained the effective temperatures of the components. Then using empirical mass-luminosity relation and Kepler third law we estimated the absolute parameters of the components. The results are presented in Table 3.

Table 3. The absolute parameters of V974 Cyg

Parameter	Primary component	Secondary component
$M/M_\odot$	1.91 ± 0.11	1.95 ± 0.14
$R/R_\odot$	1.70 ± 0.05	1.72 ± 0.05
$\log L/L_\odot$	1.12 ± 0.09	1.16 ± 0.12
T_{eff}	8500 ± 300 K	8600 ± 300 K

Superimposing the synthetic light curve over the individual night observations by means of the least squares method we obtained nine new individual times of minima, see Table 4.

Table 4. Times of minima for V974 Cyg

HJD − 2,400,000	Eclipse Type	Cycle	Residual, (days)
54340.3335(9)	II	1145	+0.0001
54372.3773(3)	II	1155	−0.0003
54646.4445(2)	I	1241	−0.0003
54686.4103(13)	II	1253	+0.0001
54710.5313(14)	I	1261	−0.0016
55359.3373(2)	II	1463	+0.0004
55468.2868(1)	II	1497	−0.0000
55476.3869(3)	I	1500	+0.0002
55484.3087(3)	II	1502	−0.0002

Using our timings and all available data from literature - Wachmann (1961), Frank (1993), Caton and Smith (2005), Smith and Caton (2007), Lacy (2004, 2006, 2007, 2009), Hübscher et al. (2006), Diethelm (2008), Lampens et al. (2010), Brát et al. (2007, 2008) we have found that the $O-C$ diagram of V974 Cyg indicates the presence of the third body together with the rotation of the line of apsides. Because the photographic times of minima given by Wachmann are not so precise, we have averaged his data into one primary and one secondary minima. By the least squares method we found the elements of the third body orbit together with the velocity of the apsidal line rotation. We used formulae from Martynov (1973). Due to the apsidal line rotation the periods of primary and secondary minima differ:

$$\begin{aligned} \text{HJD Min I} &= 2{,}450{,}669.764(2) + 3.2044121(5) \cdot E, \\ \text{HJD Min II} &= 2{,}450{,}671.272(2) + 3.2044153(5) \cdot E\ . \end{aligned}$$

The parameters of the third body orbit are:

$$\begin{aligned} &P_3 \text{ (period)} = 9000 \pm 100 \text{ days, i.e. } 24.6 \text{ years} \\ &T_0 \text{ (time of periastron)} = \text{J.D. } 2442660 \pm 80 \\ &A \text{ (semiamplitude)} = 0.0077 \pm 0.0002 \text{ day} \\ &e = 0.74 \pm 0.12 \\ &\omega = 327^\circ \pm 5^\circ \end{aligned}$$

Assuming a coplanar orbit ($i_3 = 90^\circ$) we can obtain an estimation about a lower limit of mass of the third component $M_{3,\rm min} = 0.4 M_\odot$. The observed rate of the apsidal motion: $\dot\omega_{obs} = 0^\circ.26(5)$ year^{-1}. Theoretical rate can be estimated from Levi-Civita (1937) equation for relativistic and Kopal (1978) for classical parts of the apsidal motion. Claret and Gimenez (1992) models for solar abundance and for the age $\simeq 500$ million years, give the constants of internal structure as $k_{21} = k_{22} = 0.0042$. So we have: $\dot\omega_{theor} = \dot\omega_{rel} + \dot\omega_{class} = 0.07(3) + 0.15(2) = 0^\circ.22(4)$ year^{-1}. The two values are consistent within their respective errors.

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MAXIMA OF HIGH-AMPLITUDE DELTA SCUTI STARS

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In this paper we report 337 further times of maximum for 60 High-Amplitude Delta Scuti Stars (HADS), following the reports of Wils et al. (2009, 2010). The majority of the data were obtained during 2010. Time series photometry was obtained for the first time for a number of recently discovered HADS, mainly by the ASAS-3 survey (Pojmański, 2002).

The observers and their instruments are given in Table 1. The times of maximum obtained are listed in Table 3. When the same maximum was observed in more than one filter, the table shows the average value of the times obtained in each filter individually. The method used to calculate the times of maximum is described in Wils et al. (2009).

The pulsation frequency of KZ Lac turned out to be 9.577 cycles per day instead of 8.577 as given by the GCVS (Samus et al., 2007). A new ephemeris is given in Table 2, together with elements for a number of other stars that have been observed in detail the past year, or for which the existing ephemeris deviates substantially from our recent observations. To get a better precision, use was made of data from the ASAS (Pojmański, 2002), NSVS (Woźniak et al., 2004) and SuperWASP surveys (Butters et al., 2010). Table 2 also contains the elements of the previously unknown HADS GSC 4464-0924 (J2000 position: 20 52 31.06 +70 54 40.3) that was observed in the course of this study. Its magnitude range is 12.2-12.6V.

The period of DW Psc was found to be highly variable over the last decade. A linear ephemeris obtained from all available timings given by Krugly (1999), Van Cauteren et al. (2002) and this paper, results in the following ephemeris:

$$\text{HJD Max} = 2452219.3647(5) + 0\overset{\text{d}}{.}059648094(13) \times E \qquad (1)$$

Since 2009 however the data are better represented by a period of 0.059647300(34) days, shorter by 69 ± 3 milliseconds. An $O-C$ graph with respect to the above ephemeris is given in Fig. 1. A cyclical change in period is not excluded, but this has to be confirmed with more data.

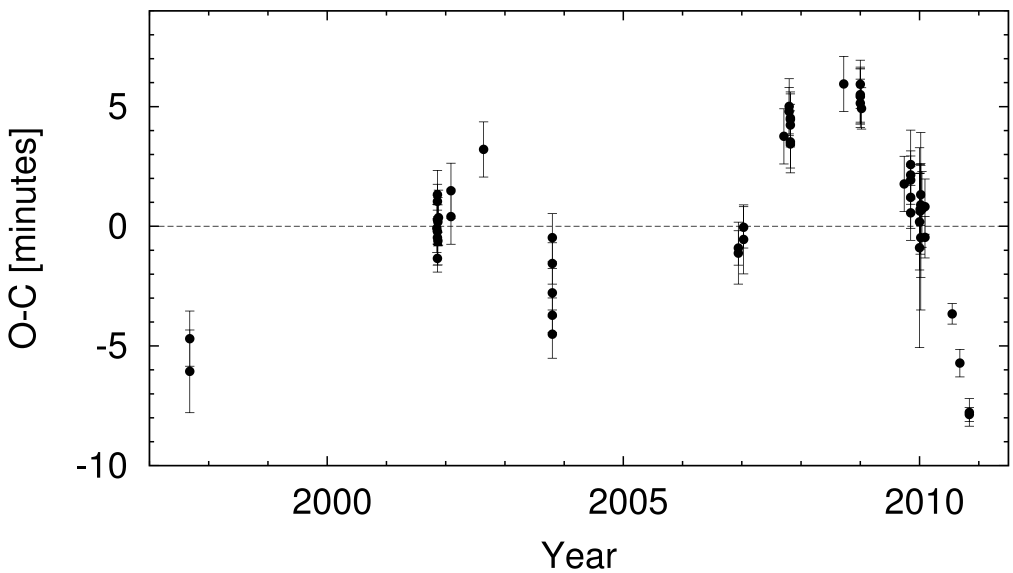

Figure 1. $O-C$ graph of DW Psc with respect to the elements given in Eq. 1.

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Table 1: List of instruments used for the observations.

Code	Observer(s)	Telescope	Observatory	CCD
AA	AA	Refractor 16 cm	Perseus Observatory, Athens	SBIG ST-10XME
AS	AS	Modified Ritchey-Chrétien 129 cm	Skinakas Observatory, Crete	CH360
BHO1	PL+PVC	Refractor 18 cm	Beersel Hills Observatory	SBIG ST-10XME
BHO2	PL+PVC	Newton 40 cm	Beersel Hills Observatory	SBIG ST-10XME
BHO4	PL+PVC	Newton 25 cm	Beersel Hills Observatory	SBIG ST-10XME
FN	FN	Catadioptric 40 cm	Alkmaar, Nederland	SBIG ST-7ME
HHSX	HH	Catadioptric 20 cm	Roosbeek Lake Observatory	Starlight XPress MX-716
HHU	HH	Catadioptric 20 cm	Roosbeek Lake Observatory	SBIG ST-7XME
HMB4	FJH	Ritchey-Chrétien 35 cm	Mol, Belgium	SBIG ST-8
HMB8	FJH	Ritchey-Chrétien 20 cm	Mol, Belgium	SBIG ST-8XME
HMBC	FJH	Ritchey-Chrétien 28 cm	Mol, Belgium	SBIG ST-10XME
HMBH	FJH	Hypergraph 40 cm	Mol, Belgium	SBIG STL-11000XM
HMBN	FJH	Catadioptric 28 cm	Farm Hakos, Namibia	SBIG ST-8XME
HMBT	FJH	Refractor 14 cm	Mol, Belgium	SBIG STL11000XM
HMBW	FJH	Catadioptric 30 cm	Astrokolkhoz, New Mexico	SBIG ST-9XE
HMBX	FJH	Ritchey-Chrétien 50 cm	New Mexico, USA	SBIG STL11000XM
HO18	PL+PVC	Refractor 18 cm	R.O.B.-Humain	SBIG ST-10XME, STL6303
HO40	PL+PVC	Newton 40 cm	R.O.B.-Humain	SBIG ST-10XME
KP	KP	Modified Cassegrain 26 cm	Pouda Observatory	SBIG ST-10XME
MAV	MV	Newton 25 cm	Leest Observatory ?	SBIG ST-10XME
RP	RDP	Catadioptric 36 cm	Shobdon, UK	Starlight XPress SXV-H9
RP30	RDP	Catadioptric 30 cm	Shobdon, UK	Starlight XPress SXV-H9
SBL	BS	Cassegrain 28 + 23.5 cm	Alan Guth Observatory	Starlight XPress MX-716
SH	SH	Catadioptric 25 cm	Merelbeke, Belgium	Meade DSI II pro
SK	SK	Catadioptric 30 cm	Zagori Observatory	SBIG ST-7XMEI
SO	CWR	Catadioptric 40 cm	SETEC Observatory	Apogee AP7B
SO30	CWR	Catadioptric 30 cm	SETEC Observatory	SBIG ST-8XME
SO40	CWR	Catadioptric 40 cm	SETEC Observatory	SBIG ST-8XME
VWS	JVW	Refractor 15.2 cm	Hooglede, Belgium	SBIG ST-7XME

Table 2: Updated elements of known HADS. Uncertainties are given in units of the last decimal.

Star	Max (HJD)	Period (d)
V524 And	2451505.703(1)	0.094491797(11)
V2455 Cyg	2452885.399(1)	0.094206008(7)
KZ Lac	2454075.578(1)	0.10441604(11)
GSC 1594-2234	2452713.245(1)	0.13668374(5)
GSC 2043-1201	2452701.105(2)	0.07793425(5)
GSC 2696-1396	2455378.441(1)	0.10307595(4)
GSC 2861-0970	2453987.695(1)	0.11010541(3)
GSC 3074-0114	2454138.969(1)	0.051296398(6)
GSC 3489-0868	2451311.722(2)	0.08664929(4)
GSC 4417-0394	2454835.182(1)	0.13224446(8)
GSC 4464-0924	2451342.906(3)	0.08063046(5)
GSC 4556-1113	2453813.331(1)	0.086343043(11)
GSC 4638-0455	2451511.601(1)	0.09661133(2)
NSVS 11672463	2451323.913(2)	0.10772127(4)

Table 3: Observed times of maximum (Epoch = HJD - 2400000).

Star	Epoch	Unc.	Obs.	Filter
GP And	55473.6155	0.0007	SO30	V
	55473.6942	0.0004	SO30	V
	55473.7731	0.0007	SO30	V
	55473.8518	0.0006	SO30	V
	55473.9309	0.0010	SO30	V
	55479.5955	0.0005	SO30	V
	55479.6740	0.0003	SO30	V
	55479.7526	0.0005	SO30	V
	55479.8313	0.0016	SO30	V
	55479.9102	0.0004	SO30	V
	55493.3654	0.0008	KP	V
	55493.4440	0.0009	KP	V
	55493.5230	0.0014	KP	V
	55493.6017	0.0014	KP	V
	55525.3098	0.0006	RP	V
	55525.3895	0.0009	RP	V
V460 And	55452.3457	0.0019	HMB8	V
	55452.4202	0.0011	HMB8	V
	55452.4947	0.0008	HMB8	V
	55452.5701	0.0007	HMB8	V
V524 And	55430.4199	0.0003	HHU	C
	55433.4441	0.0009	MAV	V
	55481.4454	0.0004	HHU	C
V544 And	55452.4119	0.0007	HMBC	V
	55452.5192	0.0006	HMBC	V
	55452.6263	0.0005	HMBC	V
	55531.4399	0.0005	KP	V
CY Aqr	55434.3598	0.0006	AA	C
	55434.4205	0.0006	AA	C
	55434.4816	0.0007	AA	C
	55481.3582	0.0003	HHU	C
YZ Boo	55262.5192	0.0007	SBL	V
	55262.6226	0.0007	SBL	V
	55311.4414	0.0004	VWS	V
	55321.4349	0.0002	HHU	C
	55321.5391	0.0002	HHU	C
	55367.6512	0.0011	SO30	V
	55367.7549	0.0008	SO30	V
V376 Cam	55263.3286	0.0006	HMBT	V
	55263.6093	0.0013	HMBT	V
	55486.4433	0.0004	VWS	V
	55487.4255	0.0004	VWS	V
	55520.5422	0.0004	KP	C
	55520.6826	0.0003	KP	C
V792 Cep	55462.4542	0.0028	HMBC	V
XX Cyg	55341.4404	0.0003	HO18	C
	55352.4979	0.0003	HMBH	V
	55437.3291	0.0005	AA	C
	55437.4641	0.0004	AA	C
	55437.5989	0.0004	AA	C
	55494.2412	0.0004	KP	V
	55494.3760	0.0004	KP	V
	55495.3212	0.0007	HHU	C
V2455 Cyg	55365.4676	0.0005	SBL	V
	55365.5619	0.0011	SBL	V
	55373.4747	0.0013	SBL	V
	55417.5631	0.0004	SH	V
LW Dra	55291.4726	0.0007	VWS	V

Star	Epoch	Unc.	Obs.	Filter
LW Dra	55295.3705	0.0014	VWS	V
	55340.5057	0.0005	VWS	V
	55352.4392	0.0008	VWS	V
	55373.7057	0.0016	SO30	V
	55451.6896	0.0010	SO30	V
	55479.3358	0.0010	VWS	V
	55480.3989	0.0010	VWS	V
DY Her	55322.4551	0.0009	BHO4	V
	55335.5343	0.0007	HHU	C
	55395.4324	0.0005	MAV	V
	55395.5805	0.0005	MAV	V
V1086 Her	55338.4849	0.0005	HO40	C
V1116 Her	55303.5268	0.0006	HMBH	V
	55303.6220	0.0007	HMBH	V
	55340.4535	0.0005	HHU	C
	55440.3423	0.0021	SH	V
KZ Lac	54075.5753	0.0008	HMBX	C
	54075.6795	0.0010	HMBX	C
	54076.6189	0.0009	HMBX	C
	54077.6627	0.0014	HMBX	C
	54084.5556	0.0022	HMBX	C
	55427.5661	0.0025	SH	V
	55443.4380	0.0015	SH	V
EH Lib	55334.4172	0.0004	HHU	C
	55334.5055	0.0003	HHU	C
	55367.6609	0.0004	SO40	V
	55367.7496	0.0007	SO40	V
SZ Lyn	55304.5137	0.0004	VWS	V
	55310.4195	0.0004	VWS	V
	55310.5398	0.0004	VWS	V
	55507.4890	0.0005	KP	V
	55507.6095	0.0005	KP	V
V593 Lyr	55309.5118	0.0004	HO40	C
	55309.6136	0.0003	HO40	C
	55371.4152	0.0008	HHU	C
	55371.5176	0.0006	HHU	C
	55420.4485	0.0010	SH	V
V337 Ori	55528.5845	0.0013	RP	V
V1162 Ori	55244.3083	0.0013	BHO4	V
	55254.2226	0.0020	SK	V
	55254.3020	0.0031	SK	V
	55254.3793	0.0014	SK	V
	55257.2910	0.0026	BHO4	V
	55258.2358	0.0023	SK	V
	55293.3302	0.0039	HO18	V
DY Peg	55409.7914	0.0007	SO30	V
	55409.8670	0.0013	SO30	V
	55445.3798	0.0007	MAV	V
	55445.4527	0.0003	MAV	V
	55445.5260	0.0003	MAV	V
	55459.6009	0.0010	SO30	V
	55459.6738	0.0004	SO30	V
	55459.7464	0.0002	SO30	V
	55459.8196	0.0003	SO30	V
	55459.8924	0.0006	SO30	V
	55464.6327	0.0002	SO30	V
	55464.7053	0.0003	SO30	V
	55464.7784	0.0002	SO30	V

Table 3: Observed times of maximum (continued).

Star	Epoch	Unc.	Obs.	Filter	Star	Epoch	Unc.	Obs.	Filter
DY Peg	55464.8514	0.0003	SO30	V	DW Psc	55396.5775	0.0003	HO40	C
	55464.9245	0.0005	SO30	V		55445.4875	0.0004	HHU	C
	55466.4561	0.0005	RP	C		55505.4920	0.0002	KP	C
	55466.6018	0.0002	SO30	V		55505.5517	0.0004	KP	C
	55466.6747	0.0002	SO30	V	CW Ser	55365.3304	0.0007	HMBN	V
	55466.7476	0.0006	SO30	V	GW UMa	55264.4392	0.0009	HMB4	V
	55466.8201	0.0004	SO30	V		55264.6425	0.0008	HMB4	V
	55466.8937	0.0004	SO30	V		55521.6828	0.0013	KP	V
	55468.6439	0.0003	SO30	V	GSC 0321-0314	55352.4908	0.0002	HHU	C
	55468.7165	0.0003	SO30	V		55362.2711	0.0004	HMBN	V
	55468.7893	0.0002	SO30	V		55362.3496	0.0003	HMBN	V
	55468.8627	0.0002	SO30	V		55362.4276	0.0004	HMBN	V
	55468.9354	0.0007	SO30	V	GSC 0429-2098	55338.4200	0.0019	HO18	C
	55470.6126	0.0002	SO30	V		55350.7098	0.0013	HMBW	V
	55470.6856	0.0002	SO30	V		55350.8555	0.0019	HMBW	V
	55470.7583	0.0004	SO30	V		55353.7820	0.0011	HMBW	V
	55470.8312	0.0003	SO30	V		55358.7564	0.0019	HMBW	V
DW Psc	52508.4812	0.0008	AS	V		55358.9031	0.0011	HMBW	V
	52931.6386	0.0007	SO	C	GSC 0612-0771	55443.4199	0.0006	HMBC	V
	52931.6991	0.0006	SO	C		55443.4830	0.0005	HMBC	V
	52931.7595	0.0007	SO	C		55443.5453	0.0005	HMBC	V
	52931.8169	0.0005	SO	C		55443.6084	0.0005	HMBC	V
	52931.8760	0.0007	SO	C		55444.4241	0.0005	HMBC	V
	54077.7599	0.0009	HMBX	C		55444.4874	0.0004	HMBC	V
	54077.8197	0.0005	HMBX	C		55444.5504	0.0007	HMBC	V
	54110.5671	0.0006	HMBX	C		55445.4920	0.0007	HMB8	V
	54110.6264	0.0010	HMBX	C		55445.5546	0.0006	HMB8	V
	54360.5549	0.0008	BHO2	C		55445.6175	0.0006	HMB8	V
	54392.4675	0.0008	SK	C	GSC 0628-0348	55461.4997	0.0007	HMB4	V
	54392.5270	0.0007	SK	C	GSC 0933-0651	55338.4924	0.0005	HMBH	C
	54400.6984	0.0006	SO30	C	GSC 1061-1651	55393.4367	0.0011	HMB8	V
	54400.7575	0.0007	SO30	C	GSC 1076-0158	55365.4317	0.0007	HMBN	V
	54400.8179	0.0007	SO30	C		55365.5186	0.0009	HMBN	V
	54400.8775	0.0008	SO30	C		55365.6058	0.0009	HMBN	V
	54400.9365	0.0009	SO30	C		55478.3546	0.0008	HHU	C
	54730.4939	0.0008	BHO1	C	GSC 1158-0921	55439.4442	0.0004	HHU	C
	54830.2252	0.0008	SBL	C		55445.3856	0.0004	HHU	C
	54830.2848	0.0008	MAV	C		55445.4515	0.0006	SH	V
	54830.2846	0.0007	SBL	C		55445.5160	0.0006	SH	V
	54830.3448	0.0007	MAV	C	GSC 1220-1131	55443.4758	0.0008	HMB8	V
	54830.4041	0.0008	MAV	C		55443.5574	0.0008	HMB8	V
	54838.2773	0.0006	HO40	C		55443.6390	0.0007	HMB8	V
	55101.4425	0.0008	HO40	C		55444.4524	0.0010	HMB8	V
	55140.6912	0.0007	SO30	C		55444.5334	0.0008	HMB8	V
	55140.7502	0.0009	SO30	C		55444.6146	0.0006	HMB8	V
	55140.8094	0.0008	SO30	C	GSC 1594-2234	55340.4431	0.0006	HO18	V
	55140.8700	0.0007	SO30	C		55340.5796	0.0002	HO18	V
	55140.9301	0.0010	SO30	C		55374.4790	0.0005	HHU	C
	55198.3099	0.0014	HMBH	V		55462.3647	0.0010	MAV	V
	55198.3688	0.0029	HMBH	V	GSC 1621-1643	55365.5201	0.0049	HMBN	V
	55200.2190	0.0013	HMBH	C		55365.6329	0.0033	HMBN	V
	55200.2786	0.0011	HMBH	C	GSC 1750-1237	55445.3591	0.0006	HMBC	V
	55204.2752	0.0021	HMBH	C		55445.4476	0.0006	HMBC	V
	55204.3339	0.0021	HMBH	C		55445.5345	0.0007	HMBC	V
	55204.3948	0.0009	HMBH	C		55445.6211	0.0006	HMBC	V
	55211.2539	0.0011	HO40	C	GSC 2043-1201	55363.3402	0.0010	HMBN	V
	55229.2677	0.0008	SK	C		55363.4172	0.0006	HMBN	V
	55231.2352	0.0006	SK	C	GSC 2080-0986	55350.5293	0.0004	HHU	C

Table 3: Observed times of maximum (continued).

Star	Epoch	Unc.	Obs.	Filter	Star	Epoch	Unc.	Obs.	Filter
GSC 2108-1564	55337.5449	0.0009	HO18	C	GSC 3832-0152	55301.5178	0.0005	HHSX	C
GSC 2566-1398	55304.5360	0.0010	HMBH	V		55308.3683	0.0005	HO18	V
	55308.3457	0.0020	HMBT	V	GSC 3863-0740	55264.3671	0.0024	HMBC	V
	55308.4366	0.0010	HMBT	V		55267.9247	0.0016	HMBW	V
	55308.5273	0.0007	HMBT	V	GSC 3934-1904	55339.5393	0.0003	HMBH	V
	55351.4324	0.0004	HHU	C		55364.4524	0.0008	SBL	V
	55351.5228	0.0003	HHU	C		55364.5617	0.0008	SBL	V
GSC 2696-1396	55378.4410	0.0011	HHU	C		55417.4471	0.0010	HHU	C
	55452.3469	0.0012	SH	V	GSC 4417-0394	55258.3647	0.0013	BHO4	V
GSC 2861-0970	55465.6402	0.0006	RP	C		55263.5219	0.0008	RP30	V
	55508.4706	0.0004	FN	V		55264.4476	0.0016	HMBT	V
	55508.5808	0.0003	FN	V		55264.5804	0.0026	HMBT	V
	55516.3976	0.0016	HMB4	V		55310.4680	0.0012	HHSX	C
GSC 2977-0238	55262.3263	0.0001	HMB4	VR		55552.4762	0.0008	KP	C
	55263.3896	0.0001	HMB4	VR		55552.6082	0.0008	KP	C
	55263.4654	0.0001	HMB4	VR	GSC 4464-0924	55304.5238	0.0007	HO18	C
	55263.5413	0.0001	HMB4	VR		55375.4772	0.0006	HHU	C
	55263.6181	0.0001	HMB4	VR		55452.3173	0.0004	HHU	C
	55309.3295	0.0005	HO40	V		55452.4000	0.0007	HHU	C
	55309.4051	0.0003	HO40	V	GSC 4500-0083	55365.4573	0.0013	HHU	C
	55536.4462	0.0002	KP	V		55479.2772	0.0016	HHU	C
	55536.5222	0.0002	KP	V		55479.3609	0.0009	HHU	C
	55536.5981	0.0003	KP	V	GSC 4552-1498	55257.3948	0.0015	BHO4	C
GSC 3074-0114	55310.3739	0.0006	HO18	C		55262.4737	0.0003	RP30	V
	55310.4252	0.0004	HO18	C		55262.5288	0.0003	RP30	V
	55310.4764	0.0005	HO18	C		55301.4297	0.0004	RP30	V
	55310.5275	0.0004	HO18	C		55301.4852	0.0003	RP30	V
	55386.4465	0.0004	HMB8	V		55480.3589	0.0003	HHU	C
	55386.4972	0.0006	HMB8	V		55480.4146	0.0003	HHU	C
	55386.5486	0.0010	HMB8	V		55537.4533	0.0005	KP	C
	55417.3779	0.0008	SH	V		55537.5094	0.0002	KP	C
	55433.3829	0.0007	SH	V		55537.5650	0.0002	KP	C
GSC 3483-0746	55266.5628	0.0008	HMBH	V	GSC 4556-1113	55262.3407	0.0009	BHO4	V
	55266.6748	0.0018	HMBH	V		55461.3606	0.0004	VWS	V
	55311.3810	0.0015	HO18	V		55478.3694	0.0007	VWS	V
	55311.4946	0.0008	HO18	V		55478.4564	0.0005	VWS	V
GSC 3489-0868	55334.4160	0.0015	BHO4	C		55478.5426	0.0006	VWS	V
	55334.5016	0.0010	BHO4	C		55521.3686	0.0004	VWS	V
GSC 3490-0814	55260.5677	0.0013	HO40	V		55521.4550	0.0003	VWS	V
	55308.5073	0.0016	HO18	C		55543.3012	0.0003	VWS	V
	55309.4001	0.0020	HO18	C		55543.3876	0.0003	VWS	V
	55396.4434	0.0008	MAV	V	GSC 4638-0455	55337.4089	0.0003	HMBH	C
	55396.5126	0.0009	MAV	V		55337.5059	0.0008	HMBH	C
GSC 3832-0152	55258.4054	0.0011	SBL	V	GSC 4923-0693	55297.3319	0.0008	HMBH	V
	55258.4960	0.0011	SBL	V		55297.3980	0.0009	HMBH	V
	55258.5861	0.0013	SBL	V		55303.3880	0.0006	HMBH	V
	55260.4138	0.0004	HO40	V		55303.4546	0.0006	HMBH	V
	55260.5051	0.0003	HO40	V	GSC 5018-1085	55337.4338	0.0003	HO18	C
	55260.5054	0.0005	SBL	V	NSVS 11672463	55445.4360	0.0005	SH	V
	55298.4128	0.0008	HHSX	C	NSVS 14243430	55365.4340	0.0008	HMBN	V
	55298.5030	0.0009	HHSX	C		55365.5199	0.0003	HMBN	V
	55301.4261	0.0009	HHSX	C		55365.6061	0.0003	HMBN	V

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PHOTOELECTRIC MINIMA OF SOME ECCENTRIC ECLIPSING BINARY SYSTEMS

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Observatory and telescope:
30-cm, 35-cm and 40-cm Meade and 48-cm Cassegrain telescopes at Ege University Observatory Research and Application Center.

Detector:	SSP-5 photoelectric photometer attached to 30 and 35-cm telescopes, high-speed three-channel Vilnius photometer attached to 48-cm telescope and Apogee 2048x2048 CCD camera attached to 40-cm telescope.

Method of data reduction:
Reduced differential magnitudes, in the sense of variable minus comparison, were obtained using the procedures outlined in Hardie (1962).

Method of minimum determination:
The minima times were calculated using the method of Kwee & van Woerden (1956).

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V889 Aql	53993.2951	0.0005	II	*BV*	SSP5
HP Aur	54172.3407	0.0005	II	*BV*	SSP5
V775 Cas	54048.3879	0.0003	I	*BV*	SSP5
	55471.3924	0.0005	I	*BV*	Vilnius
	55480.3192	0.0008	II	*BV*	Vilnius
DP Cet	53612.5175	0.0006	I	*UBV*	Vilnius
	53631.4600	0.0003	I	*UBV*	Vilnius
	53765.2544	0.0007	II	*UBV*	Vilnius
	55502.3173	0.0002	I	*BV*	Vilnius
TV Cet	54093.3940	0.0004	I	*BV*	SSP5
	55504.4072	0.0001	I	*BV*	Vilnius
KL CMa	53651.5780	0.0006	II	*U*	Vilnius
	53688.5861	0.0004	II	*UBV*	Vilnius
	53781.2641	0.0005	I	*UBV*	Vilnius
	55579.4189	0.0005	II	*BV*	Vilnius
LT CMa	54111.3730	0.0006	II	*BV*	Vilnius
	55604.3653	0.0003	I	*BV*	CCD
V335 Ser	53885.3276	0.0003	I	*BV*	Vilnius
	53911.3391	0.0006	II	*BV*	Vilnius
	53942.3875	0.0005	II	*BV*	Vilnius
	54287.3750	0.0004	II	*BV*	Vilnius
	54292.4138	0.0001	I	*BV*	Vilnius
	54670.3155	0.0006	II	*UBV*	Vilnius
	54675.3517	0.0003	I	*UBV*	Vilnius
	55384.4370	0.0004	II	*BV*	Vilnius
	55396.3780	0.0003	I	*BV*	Vilnius
DR Vul	54285.4500	0.0003	I	*BV*	SSP5
	54365.4033	0.0001	II	*BV*	SSP5
HD 171055	53947.4181	0.0005	I	*BV*	Vilnius
HD 350731	53957.4278	0.0006	I	*BV*	SSP5
	53966.3408	0.0002	II	*BV*	Vilnius

Remarks:

Detectors which were used to observe the related minima times.

Acknowledgements:

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References:

Hardie, R.H., 1962, in Astronomical Techniques, ed. W.A. Hiltner (Chicago: Univ. Chicago Press), 178

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NEW AND UNPUBLISHED TIMES OF MINIMA OF ECLIPSING BINARY SYSTEMS

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[7] On summer training at Baja Astronomical Observatory

Observatory and telescope:
50-cm $f/8.4$ Ritchey–Chrétien telescope (Ba50) of the Baja Astronomical Observatory (Hungary) 50-cm $f/6$ modified Cassegrain telescope (Baja Astronomical Robotic Telescope – BART1) of the Baja Astronomical Observatory (Hungary) 50-cm $f/15$ Cassegrain telescope (Pi50) of the Konkoly Observatory at Piszkéstető Mountain Station (Hungary) 1-m $f/13.3$ RCC telescope (Pi100) of the Konkoly Observatory at Piszkéstető Mountain Station (Hungary)

Detector:	512 × 512 Apogee AP-7 CCD camera (Ba50) 4096 × 4096 Apogee Alta U16 CCD camera (BART1) cooled UBVRI Photometer (Pi50) uncooled UBV Photometer (Pi50u) 1340 × 1300 Princeton Instr. CCD camera (Pi100)

Method of data reduction:
Reduction of CCD frames was made with customly developed IRAF[1] packages.

Method of minimum determination:
The minima times were computed with parabolic fitting, and in some cases with linearized Pogson-method or Kwee-van Woerden method (Kwee & van Woerden, 1956).

[1]IRAF is distributed by the National Optical Astronomical Observatories, operated by the Association of the Universities for Research in Astronomy, inc., under cooperative agreement with the National Science Foundation

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
RT And	53592.4863	6	II	V	Bor+Kla/Pi100
	54738.3933	6	II	V, R	Bor/Pi50
	55432.4158	2	I	R	Bor/Ba50
AB And	54353.5058	1	II	V	Bor/BART1
	55400.4531	2	I	R	Bor/Ba50
OO Aql	55101.3767	1	II	–	Bor/BART1
SS Ari	55479.3805	2	I	R	Bor/Ba50
IM Aur	54375.4016	1	I	V	Bor/BART1
	54751.452	1	II	V	Bor/Ba50
	54794.4802	2	I	V	Bor/Ba50
IU Aur	54081.4270	5	I	R	Heg/Ba50
	54752.5836	4	II	V	Kis/Ba50
	54781.575	1	II	V	Kis/Ba50
	54802.4045	5	I	V	Bír/Ba50
	54809.6489	7	I	V	Bor/Ba50
	54810.5544	7	II	V	Bor/Ba50
	54822.328	1	I	V	Bor/Ba50
	54840.4413	6	I	V	Bor/Ba50
	55463.5918	3	I	R	Bor/Ba50
	55590.3876	1	I	–	Heg/BART1
	55599.4428	1	I	–	Bír/BART1
	55600.3484	2	II	–	Szak/BART1
SV Cam	44833.4584	2	I	V, B	Pat/Pi50u
	48904.3157	2	I	B	Pat/Pi50u
	49702.5888	6	I	V, B	Pat/Pi50u
	50096.3916	2	I	V, B	Pat/Pi50u
AS Cam	54868.4524	3	I	V, R	Bor/Ba50
RZ Cas	54697.4451	1	I	V, R	Bor+Reg/Pi50
PV Cas	55491.4665	7	I	R	Bor/Ba50
VW Cep	54693.3926	5	I	B, V	Bor+Reg/Pi50
	54955.5607	5	I	V, R	Bor/Pi50
	54956.5317	1	II	V, R	Bor/Pi50
	54956.5324	2	II	B	Bor/Pi50
	55029.4481	9	II	B, V, R	Bor+Sim/Ba50
	55030.4260	6	I	B, V, R	Sim+Bor/Ba50
	55030.5613	3	II	B, R	Sim+Bor/Ba50
	55033.4864	5	I	B, V, R	Bír/Ba50
	55034.4580	10	II	B, V, R	Szak/Ba50
	55035.4344	6	I	B, V, R	Bír/Ba50
	55035.5718	5	II	B, V, R	Bír/Ba50
	55036.4070	12	II	B, V, R	Szak/Ba50
	55036.5480	8	I	B, V, R	Szak/Ba50
	55037.3833	7	I	B, V, R	Szak/Ba50
	55037.5192	8	II	B, V, R	Szak/Ba50
	55039.4676	12	II	B, V, R	Bor/Ba50
EK Cep	54597.4199	3	I	B, V, R	Bor/Ba50
	54628.4142	4	I	B, V, R	Bor/Ba50
GSC 4274-1702	54754.383	1	I	R	Bor/Ba50
	54761.4543	10	I	V, R	Bor/Ba50
	54767.334	1	I	V	Bor/Ba50
	54774.395	1	I	V, R	Bír+Kis/Ba50
	54798.5428	7	II	R	Bír/Ba50
GU Her	54640.501	1	I	R	Bor/Ba50
	54931.4978	6	I	R	Bor/Ba50
	55411.443	1	II	R	Bor/Ba50
HS Her	55362.4683	7	II	R	Bor/Ba50
	55430.402	1	I	R	Bor/Ba50

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V994 Her A[a]	54290.517	1	I	V	Kis/BART1
	54314.5204	8	II	V	Heg/BART1
	54315.522	1	I	V	Bor/BART1
	54360.3524	4	II	V	Kis/BART1
	54361.3570	2	I	V	Bor/BART1
	54383.2729	3	II	V	Bor/BART1
	54610.3494	8	II	R, V, B	Bír+Gre/Ba50
	54713.4349	14	I	R, V, B	Heg/Ba50
V994 Her B[a]	54283.4131	1	I	V	Kis/BART1
	54290.515	3	I	V	Kis/BART1
	54298.3787	2	II	V	Bír/BART1
	54300.4457	4	I	V	Bor/BART1
	54307.5424	5	I	V	Ger+Luk/BART1
	54332.457	1	II	V	Kis/BART1
	54334.523	:	I	V	Kis/BART1
	54347.3084	3	I	V	Bor/BART1
	54364.3439	3	I	V	Bír/BART1
	54374.2829	7	I	V	Kis/BART1
	54618.5160	13	I	R, V, B	Bír+Gre/Ba50
	54650.5498	30	II	R, V, B	Gre/Ba50
	54653.3886	13	II	R, V, B	Gre/Ba50
	54699.4777	14	I	R, V, B	Gre/Ba50
SW Lac	53589.4576	4	II	V	Bor+Kla/Pi100
	55442.4180	1	I	R	Bor/Ba50
UV Leo	54927.4883	5	I	V	Bor/Ba50
V404 Lyr	55358.4775	3	I	–	Bor/Ba50
FT Ori	54809.4344	1	II	V	Bor/Ba50
β Per[b]	54696.5458	4	I	$V + N$	Bor+Reg/Pi50
	54828.4502	7	I	$(V, R) + N$	Reg/Pi50
	54831.3157	2	I	$(V, R) + N$	Reg+Bor/Pi50
V1123 Tau	54366.6209	1	II	V	Bor/BART1
DW UMa	54910.3522	1	I	V, R	Bor/Ba50
	54910.4889	1	I	V, R	Bor/Ba50
	54910.6254	1	I	V, R	Bor/Ba50
LP UMa	54910.3169	13	I	V, R	Bor/Ba50
	54910.4685	11	II	V, R	Bor/Ba50
	54910.6286	15	I	V, R	Bor/Ba50

Explanation of the remarks in the table:

[Observer(s)]/Instrument

[a]: V994 Her A,B: This is an (at least) quadruple system, composed of two eclipsing pairs in a hierarchical configuration. In labeling the two eclipsing subsystems (both of them revolve on slightly eccentric orbits) we follow the notation of Lee et al., 2008.

Note also, that the minimum at HJD 2453206.365 published as an unidentified type in one of our previous compilation (Bíró et al., 2007) is found to be a secondary minimum of V994 Her B.

[b]:β Per: Due to the brightness of the system we had to use an additional neutral filter (denoted by N)

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References:

Bíró et al., 2007, *IBVS*, No. 5753
Kwee, K. K. & van Woerden, H., 1956, *Bull. Astron. Inst. Neth.*, **12**, 327
Lee, C.-U. et al., 2008, *MNRAS*, **389**, 1630

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MINIMA TIMES OF SELECTED ECLIPSING BINARIES

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Observatory and telescope:
Kolonica Observatory: K1 - 2.8/180 mm photo lens, K2 - 265/1360 mm Newton, K3 - 280/1500 mm Newton, K4 - 5.6/400 mm photo lens Astronomical Institute of the SAS: G2 - 600/7500 mm Cassegrain

Detector:	K1, K2, K4 - Meade DSI Pro, K3, K4 - Starlight Express SXVF-H9, G2 - back-illuminated SITe TK1024

Method of data reduction:
All observations were reduced and photometry were performed using C-Munipack package (`http://c-munipack.sourceforge.net/`)

Method of minimum determination:
The minima times were computed by Kwee & van Woerden (1956) method.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
RT And	55353.4866	0.0003	II	R	K4
	55376.4406	0.0002	I	R	K4
AB And	55221.2325	0.0002	I	R	K1
	55398.4621	0.0001	I	R	K4
	55461.3544	0.0002	I	R	K4
BX And	55212.2881	0.0001	I		K1
	55216.2585	0.0002	II	R	K1
	55429.4867	0.0002	I	R	K4
	55475.5505	0.0007	II	R	K4
CN And	55429.3556	0.0006	II	R	K4
	55431.4353	0.0004	I	R	K4
EP And	55065.5078	0.0001	II	V	K2
	55090.5616	0.0001	II	V	K2
	55219.2667	0.0003	I	R	K1
	55478.2984	0.0004	I	R	K4

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
GZ And	55213.2455	0.0001	I	V	K2
LO And	55065.3801	0.0001	II	V	K2
V376 And	55460.3745	0.0005	I	R	K4
	55488.3321	0.0004	I	R	K4
SS Ari	55075.4302	0.0002	I	V	K2
	55096.5400	0.0002	I	V	K2
	55097.5563	0.0002	II	V	K2
	55477.5543	0.0002	II	R	K4
AR Aur	55263.3464	0.0002	I	R	K1
	55484.5520	0.0001	II	R	K4
TY Boo	55221.6497	0.0001	I	V	K2
	55249.5593	0.0002	I	V	K2
	55264.4652	0.0001	I	V	K2
	55278.5794	0.0002	II	V	K2
TZ Boo	55219.6526	0.0001	I	V	K2
AC Boo	55220.6741	0.0002	I	R	K1
	55295.5692	0.0002	II	R	K4
	55606.6062	0.0002	I	R	K4
FI Boo	55211.6029	0.0009	I	R	K1
	55272.4494	0.0002	I	R	K1
	55381.4537	0.0003	II	R	K4
SV Cam	55265.6075	0.0002	I	R	K1
	55281.3241	0.0004	II	R	K1
	55478.5205	0.0001	I	R	K4
	55497.4977	0.0001	I	R	K4
AO Cam	55059.4886	0.0001	I	V	K2
	55068.5613	0.0002	II	V	K2
	55100.5613	0.0003	II	V	K2
	55212.4000	0.0002	II	R	K1
	55213.3888	0.0001	II	V	K2
CD Cam	55211.5301	0.0001	II	V	K2
	55263.4925	0.0002	II	V	K2
	55265.4027	0.0002	I	V	K2
	55501.5353	0.0004	I	R	K4
DN Cam	55416.5280	0.0002	I	R	K4
	55462.3723	0.0002	II	R	K4
	55462.6213	0.0002	I	R	K4
FN Cam	55264.3190	0.0003	I	R	K1
	55294.4514	0.0002	II	R	K4
	55474.5673	0.0003	II	R	K4
NR Cam	55591.4227	0.0002	II	RI	G2
	55593.4677	0.0001	II	RI	G2
TX Cnc	55221.3812	0.0002	II	R	K1
	55263.3049	0.0002	I	V	K2
WY Cnc	55219.4511	0.0002	I	R	K1
	55500.6065	0.0002	I	R	K4

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
EH Cnc	55232.3334	0.0002	II	V	K2
	55264.3139	0.0002	I	V	K2
	55278.3175	0.0002	II	V	K2
	55620.2688	0.0004	II	V	K4
GSC 1387-475	55219.4481	0.0003	I	V	K2
	55221.4079	0.0001	II	V	K2
	55221.5214	0.0002	I	V	K2
BI CVn	55249.4816	0.0003	I	R	K1
	55311.3397	0.0001	I		K3
	55606.4136	0.0005	I	R	K4
BS Cas	55052.3522	0.0001	I	R	K3
	55052.5731	0.0002	II	R	K3
	55054.5543	0.0001	I	R	K3
	55059.3999	0.0002	I	R	K3
	55061.3812	0.0002	II	R	K3
	55062.4820	0.0002	I	R	K3
CW Cas	55051.5298	0.0001	I	V	K2
	55094.4165	0.0002	II	V	K2
	55100.3155	0.0001	I	V	K2
	55164.4062	0.0002	I	V	K2
	55180.3497	0.0001	I	V	K2
	55482.4667	0.0003	II	R	K4
	55497.2935	0.0003	I	R	K4
V523 Cas	55054.4066	0.0001	I	V	K2
	55076.6077	0.0001	I	V	K2
	55221.2646	0.0001	I	V	K2
	55481.4825	0.0005	II	R	K4
	55500.2942	0.0002	I	R	K4
V362 Cas	55069.4397	0.0001	I	V	K2
	55082.5020	0.0002	II	R	K3
V651 Cas	55093.5889	0.0001	I	V	K2
	55480.3498	0.0001	I	R	K4
V776 Cas	55223.2688	0.0003	II	R	K1
	55397.4509	0.0008	I	R	K4
	55421.4527	0.0006	II	R	K4
	55475.4078	0.0006	I	R	K4
VW Cep	55358.4112	0.0002	II	R	K4
	55461.2444	0.0002	I	R	K4
	55484.3452	0.0001	I	R	K4
WZ Cep	55051.3781	0.0001	II	V	K2
	55480.5036	0.0003	II	R	K4
GW Cep	55095.5652	0.0001	I	V	K2
	55430.3390	0.0003	I	R	K4
	55430.4987	0.0004	II	R	K4

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
RW Com	55219.5412	0.0003	II	V	K2
	55586.7219	0.0003	II	RI	G2
RZ Com	55213.6651	0.0001	II	V	K2
SS Com	55212.5645	0.0001	II	V	K2
	55265.6129	0.0002	I	V	K2
CC Com	55180.6676	0.0001	I	V	K2
	55211.6738	0.0002	II		K3
	55213.5501	0.0001	I	V	K2
	55249.6319	0.0002	II	R	K1
YY CrB	55213.6289	0.0002	I	R	K1
	55219.6525	0.0001	I	R	K1
	55264.4622	0.0003	I	R	K1
	55311.3436	0.0002	II	R	K4
	55311.5309	0.0002	I	R	K4
	55354.4579	0.0002	I	R	K4
	55420.3565	0.0003	I	R	K4
CG Cyg	55380.4305	0.0002	I	R	K4
	55420.5079	0.0003	II	R	K4
V401 Cyg	55090.3037	0.0001	II	V	K2
V1191 Cyg	55063.4577	0.0006	I	V	K2
	55093.3878	0.0001	II	V	K2
V1918 Cyg	55065.4738	0.0002	II	V	K3
	55481.3356	0.0003	I	R	K4
LS Del	55401.4395	0.0008	I	R	K4
	55463.2943	0.0008	I	R	K4
	55476.3937	0.0006	I	R	K4
CM Dra	55051.4502	0.0001	I	V	K2
	55093.3070	0.0001	I	V	K2
	55100.2822	0.0001	II	R	K3
	55264.5398	0.0001	I	V	K2
CM Dra	55311.4703	0.0001	I		K3
FU Dra	55264.6074	0.0002	I	V	K2
	55304.3275	0.0001	II		K3
	55360.4566	0.0004	II	R	K4
AK Her	55359.4608	0.0003	I	R	K4
V728 Her	55076.3007	0.0001	I	V	K2
	55097.2728	0.0003	II	V	K2
V829 Her	55064.3678	0.0001	II	V	K2
V857 Her	55307.3835	0.0004	I	R	K4
	55392.4310	0.0005	II	R	K4
SW Lac	55390.4611	0.0002	I	R	K4
	55453.3228	0.0002	I	R	K4
	55498.3820	0.0002	II	R	K4
PP Lac	55090.3118	0.0002	II	V	K2
	55095.3262	0.0001	I	V	K2
	55482.2461	0.0004	II	R	K4

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
CE Leo	55211.5360	0.0002	II	V	K2
	55278.4426	0.0001	I	V	K2
RT LMi	55180.4928	0.0002	II	V	K2
	55212.5474	0.0003	I	R	K1
VW LMi	55180.6518	0.0001	I		K1
	55220.5257	0.0002	II	R	K1
	55263.5024	0.0002	II	R	K1
	55272.3358	0.0002	I	R	K1
	55274.4844	0.0005	II	R	K4
	55278.3068	0.0003	II	R	K4
	55294.3026	0.0003	I	R	K4
	55607.3413	0.0003	II	R	K4
WZ LMi	55594.5740	0.0005	II	RI	G2
UV Lyn	55284.3362	0.0004	I	R	K4
V714 Mon	55483.5951	0.0009	I	R	K4
V508 Oph	55052.3627	0.0001	II	V	K2
	55307.5067	0.0003	II	R	K4
	55355.4325	0.0002	II	R	K4
V2610 Oph	55304.5690	0.0006	II	R	K4
	55357.4613	0.0006	II	R	K4
V2612 Oph	55309.4940	0.0008	II	R	K4
	55356.4053	0.0004	II	R	K4
U Peg	55474.3455	0.0002	I	R	K4
AT Peg	55454.3390	0.0003	I	R	K4
	55477.2592	0.0003	I	R	K4
BB Peg	55060.3678	0.0002	II	V	K2
	55096.3369	0.0001	I	V	K2
	55476.2742	0.0003	I	R	K4
	55499.2302	0.0003	II	R	K4
BX Peg	55057.3837	0.0001	II	V	K2
	55482.3561	0.0002	I	R	K4
DI Peg	55498.2485	0.0006	II	R	K4
V351 Peg	55452.4462	0.0004	II	R	K4
	55475.2883	0.0003	I	R	K4
V357 Peg	55213.2378	0.0001	I	R	K1
V357 Per	55419.4560	0.0002	II	R	K4
V432 Per	55076.4580	0.0001	II	V	K2
	55477.3971	0.0002	II	R	K4
	55052.5010	0.0001	I	V	K2
	55095.4324	0.0002	I	V	K2
	55212.3414	0.0001	I	V	K2
DV Psc	55060.5125	0.0003	II	V	K2
	55064.5248	0.0002	II	V	K2
	55090.4418	0.0002	II	V	K2
	55097.3813	0.0002	I	V	K2
	55501.2574	0.0002	I	R	K4

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
GSC 8-901	55060.5095	0.0003	I	V	K2
	55097.4163	0.0006	II	V	K2
AU Ser	55059.3420	0.0001	I	V	K2
OU Ser	55294.5792	0.0003	II	R	K4
	55607.6748	0.0005	II	R	K4
Y Sex	55265.4744	0.0004	I	R	K1
CW Sge	55074.3314	0.0004	I	V	K2
	55075.3245	0.0002	II	V	K2
AH Tau	55063.5793	0.0002	I	V	K2
	55216.2765	0.0002	I	V	K2
	55482.5810	0.0004	II	R	K4
	55501.3768	0.0004	I	R	K4
EQ Tau	55094.5543	0.0001	II	V	K2
	55101.5552	0.0001	I	V	K2
	55186.3807	0.0001	II	V	K2
	55219.3202	0.0001	I	V	K2
	55453.4850	0.0003	I	R	K4
	55499.3979	0.0006	II	R	K4
V781 Tau	55213.4773	0.0004	I	R	K1
	55220.3756	0.0002	I	R	K1
	55463.5387	0.0005	I	R	K4
	55500.4428	0.0004	I	R	K4
XY UMa	55213.3687	0.0003	II	R	K1
	55232.2838	0.0002	I	R	K1
	55278.5124	0.0008	II	R	K4
	55476.5731	0.0001	I	R	K4
	55481.5991	0.0008	II	R	K4
AA UMa	55272.3197	0.0002	I	V	K2
	55603.2842	0.0002	I	R	K4
HH UMa	55272.4526	0.0005	I	V	K2
HV UMa	55232.4597	0.0003	I	R	K1
	55257.3387	0.0003	I	R	K1
TV UMi	55221.5881	0.0002	II	R	K1
	55257.5295	0.0003	I	R	K1
	55264.5999	0.0003	I	R	K1
	55284.5398	0.0004	I	R	K4
	55312.3834	0.0007	I	R	K4
	55400.4736	0.0009	I	R	K4
PY Vir	55304.3913	0.0003	II	R	K4
AG Vir	55607.4953	0.0007	I	R	K4
AH Vir	55280.5057	0.0002	I	R	K4

Explanation of the remarks in the table:

Remarks give an observatory.

Remarks:
Times of minima are weighted averages from all filters used. The minimum types are calculated according $O - C$ gateway of Czech Astronomical Society (`http://var.astro.cz/ocgate`). The elements for for GSC 8-901 are taken from Parimucha et al. (2008) and for GSC 1387-475 from Rucinski & Pribulla (2008)

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A SEARCH FOR PERIOD CHANGES IN LONG PERIOD VARIABLES

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Asymptotic Giant Branch (AGB) stars are objects of low or intermediate mass in their final stage of stellar evolution. This is a short but decisive phase, where the star is producing a variety of heavy elements and loses mass at a high rate. Most AGB-stars are showing long period variability on time scales of a few ten to a few hundred days and visual amplitudes up to several magnitudes. This class of pulsating stars is called the Long Period Variables (LPVs).

The evolution and internal structure of AGB stars is dominated by a hydrogen and a helium burning shell which alternate in providing the major part of the stellar luminosity. This cycle, named thermal pulse, has a typical timescale of 10^5 yr. During a cycle, luminosity, temperature, radius, and surface composition can change as a reaction to the processes in the stellar interior (e.g. Vassiliadis & Wood, 1993). The most easily accessible way to study such a cycle is the change in period (due to a radius change) as long time series exist for a large number of galactic LPVs. Indeed, candidates for period changes have been detected by various authors (Wood & Zarro, 1981; Lloyd, 1991; Percy & Au, 1999; Templeton et al., 2005).

Such studies are typically based on long, more or less continuous time series of visual observations provided by observatory publications or by amateur astronomers. These long light curves are then analysed for possible period changes e.g. by using an $O-C$-diagram, wavelet analysis (e.g. Hawkins et al., 2001) or other methods (e.g. Merchan Benitez & Jurado Vargas, 2000). Systematic period changes can be noticed on timescales of a few ten years.

In this paper we want to explore a somewhat different approach. Many LPVs have been detected and characterized in the first decades of the 20$^{\text{th}}$ century. The beginning of the 21$^{\text{st}}$ century sees a number of automatic surveys during which sets of typically several light cycles of photometric data of the same variables are obtained and automatically analyzed. This means that we have two sets of monitoring data separated by 60 to 100 years. By comparing the old periods with the newer ones should allow to detect candidates for a period change. We note that small irregular changes of the period length of a few percent are well known to occur in long period variables (cf. Wood & Zarro, 1981 and references therein). A relation to the thermal pulse cycle is less likely in these cases. Some stars show a switching of the pulsation mode from time to time of which the origin is not understood

Table 1. Candidates for period-changing Miras.

Name	GCVS period	rev. ACVS period	ΔP [%]	ΔT	Remark
BF Mon	283 d	151 d	−47	25000 d	
BG Hya	262 d	305 d	+16	24000 d	
V433 Cen	367 d	179 d	−51	24000 d	
ES Cen	174 d	352 d	+103	28000 d	
AX Mus	99 d	115 d	+16	27000 d	*
AX Lib	115 d	221 d	+92	24000 d	
CO Sco	176 d	149 d	−15	36000 d?	
V2121 Oph	158 d	296 d	+87	10000 d	*
ZZ Oph	205 d	303 d	+47	27000 d	
BD Ser	134 d	209 d	+56	29000 d	
WY Ser	399 d	195 d	−51	26000 d	*
V3190 Sgr	194 d	226 d	+16	38000 d	*
V2030 Sgr	283 d	159 d	−44	27000 d	
V3343 Sgr	134 d	122 d	−9	16000 d	*
UX Aql	375 d	188 d	−50	29000 d	
CX Sgr	211 d	179 d	−15	35000 d	
AM Sgr	95 d	126 d	+33	36000 d	
BM Sgr	403 d	201 d	−50	37000 d	*
V540 Aql	309 d	165 d	−47	24000 d	
EK Aql	152 d	259 d	+70	37000 d	
TX Cap	129 d	199 d	+54	25000 d	
UV Tuc	310 d	160 d	−48	28000 d	
RX PsA	366 d	151 d	−59	24000 d	

yet (Kiss et al., 1999). These aspects have to be considered when interpreting observed period changes.

For our study we selected the ASAS catalogue of variable stars (ACVS, Pojmanski, 2000) which is based on a monitoring of the whole Southern sky up to δ =+28° over a time span of about 3000 days between 1997 and 2005. Light curves of most variables brighter than V=15 mag as well as automatically determined periods and variability classes are available. We cross-correlated this catalogue with the General Catalogue of Variable Stars (GCVS, Samus et al., 2009) using stellar coordinates with a search radius of 0.1 arcminutes. Within this sample we identified 109 stars classified as miras in the ACVS where the ASAS period deviates by more than 9% from the GCVS value (stars with no GCVS period were not considered). For these stars we re-determined the period from the ASAS data and rejected 59 stars where either the corrected period was close to the GCVS value or the ASAS data were of low quality.

This left us with 50 stars to which we added 11 stars selected in the same way from the list of stars that were classified as 'MISC' in the ACVS, but as Miras in the GCVS. For this sample, we looked up the reference used for the period value given in the GCVS. 18 of these literature sources were not accessible for us and we also did not find any further usable reference. In 16 cases, we found that the published light curve data could be equally or even better fitted using the period derived from the ASAS data. Sometimes the authors noted already that the derived period is uncertain and could for instance be doubled or halved as well, which would bring it into agreement with the ACVS value.

This left us with 27 stars for which the difference between the independently determined periods from the GCVS and the ACVS makes them candidates for a period change.

Among these 27 targets we detected 4 stars that have been known before to be Miras with a variable period: RU Tau (Percy & Au, 1999; Templeton et al., 2005), BH Cru (Templeton et al., 2005; Walker, 2009), ES Del (Watanabe, 2001; Templeton et al., 2005), and RT Vel (Lysaght, 1989). This is a nice confirmation that our method is capable of detecting Miras with period changes. The remaining 24 candidates are listed in Tab. 1. The variable star name, the period from GCVS as well as the revised ACVS period (rounded to full days) and the difference in percent of the GCVS period are given. We also list the approximate time span elapsed between the observations leading to the GCVS period (typically the time of the first reported maximum) and the start of the ASAS monitoring. The candidates can be divided into two groups, one showing period changes of 10 to 20%, and one where the period is roughly halved or doubled. The latter group may indicate a change of the dominant pulsation mode in the past decades. Period changes in both directions are observed. The most promising candidates, based on the literature data, are marked with an asterisk in the table and are discussed in the following.

AX Mus: Swope (1931) analysed two long time series of observations of this star, separated by $4700^{\rm d}$ and noted, that the best fit for the first dataset is $99^{\rm d}$, while the second dataset gives $97\overset{\rm d}{.}3$. The ACVS value of $115^{\rm d}$ may suggest a continuous period variation. Interestingly, the time of the first maximum in the ASAS light curve can be predicted to within 1 day accuracy using the $97\overset{\rm d}{.}3$ period and a corresponding maximum (JD 2425330). Thus, $97\overset{\rm d}{.}3$ seems to represent the average period of the light change of AX Mus pretty well.

V2121 Oph: This Mira has been studied by Clement et al. (1980) in the course of a search for variables in the globular cluster NGC 6284. It is likely a non-member. Clement et al. listed the individual photometric measurements they had used, so we could test the ACVS period of $296^{\rm d}$, which, however, gave a considerably worse fit than the value mentioned in that paper. The ratio between GCVS period and ACVS period is close to 2, therefore, we may witness a switch from first overtone to fundamental mode here.

WY Ser: The GCVS value is based on a study by Hoppe (1938). While the individual measurements are not given, Hoppe explicitly excluded the possibility of a halving of the period. On the other hand, there is no doubt from the ASAS data that WY Ser is currently pulsating with a period around $195^{\rm d}$.

V3190 Sgr: Payne (1928b) noted that earlier papers gave either $222\overset{\rm d}{.}3$ or $227\overset{\rm d}{.}3$ for this star, which interestingly would be very close to the ACVS value, but she found that $194^{\rm d}$ clearly provided the best fit to the data analyzed by her.

V3343 Sgr: Plaut (1971) derived a period of this star of $134.2^{\rm d}$ based on 18 measurements from four light cycles between JD 2435600 and JD 2436800. The ACVS period is $121\overset{\rm d}{.}9$ which gives a very good fit of the ASAS data, but can be excluded for the Plaut data. On the other hand, the $134\overset{\rm d}{.}2$ period is not representing the light change described by the ASAS data. The typical short time scatter in period length derived from the ASAS data is about 3%, i.e. clearly less than the difference observed. As a further check we divided the time difference between one maximum derived from the Plaut data and the first maximum of the ASAS data by the two period values. The Plaut value gives a ratio of 123.96, i.e. the maximum is deviating only 4% from the expected time, while the ACVS period is almost half a period off. We suggest that the rather small deviation found when using the Plaut period indicates that the star has changed its period to the current (ACVS) value quite recently.

BM Sgr: For this object another period determination besides the GCVS and ACVS value exists. Shawl & Bord (1990) give a period of 199 d, i.e. very close to the ACVS value, with a reference maximum at JD 2446501. The older period of 403^{d} from Payne (1928a) was based on 167 observations covering 35 epochs of the light change of BM Sgr. She noted that the "period is more than usually variable".

With the list of stars presented in Tab. 1 we would like to draw further attention to these objects as they seem to be good candidates for Miras with a previously unknown and probably evolutionary caused period change. This study is also a test case for a future comparison of data from forthcoming surveys with archive material.

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THE ECLIPSING CATACLYSMIC VARIABLES PHL 1445 AND GALEX J003535.7+462353

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Eclipsing cataclysmic variables (CVs) are important because through detailed modeling of the eclipses it is possible to deduce the physical properties of the system. This paper reports the discovery of two new eclipsing CVs: PHL 1445 and GALEX J003535.7+462353.

PHL 1445 (= PB 9151) is listed in the Palomar-Haro-Luyten catalogue as a faint blue object (Haro & Luyten, 1962). A spectrum (6dFGS g0242429-114646) taken by the 6dF Galaxy Survey (Jones et al., 2004 and 2009) showed it to be a cataclysmic variable (Wils, 2009). Because of the split emission lines and a number of anomalously faint points in the light curve of the Catalina Real-time Transient Survey (CRTS; Drake et al., 2009), it was suspected to be an eclipsing variable as well. Follow-up observations at the Astrokolkhoz Observatory with a C14 Schmidt-Cassegrain and an unfiltered CCD camera, showed this indeed to be the case. As shown in Fig. 1, the light curve shows deep eclipses lasting about 6 minutes, with an amplitude of more than two magnitudes. In addition the period is very short, 76.3 minutes, near the minimum orbital period for CVs (Gänsicke et al., 2009). Such a short orbital period is usually observed in WZ Sagittae type dwarf novae like GW Lib (orbital period 76.8 minutes) and SDSS J074531.91+453829.5 (76.0 minutes), with rare large amplitude outbursts. Only SDSS J150722.30+523039.8 has a shorter orbital period among the eclipsing CVs (Savoury et al., 2011).

Table 1 lists the observed times of eclipses. From these, the following eclipse ephemeris was derived:

$$HJD Min = 2455202.5579(1) + 0\overset{d}{.}05298466(8) \times E \quad (1)$$

Since not many deeply eclipsing CVs are known at this orbital period, high speed photometry of the eclipses, such as done by Southworth and Copperwheat (2011) and Savoury et al. (2011) would certainly be of value for this object.

GALEX J003535.7+462353 was discovered as a variable source by the GALEX satellite (Martin et al., 2005) on 30 August 2008. Although the object is too faint itself, both the Northern Sky Variability Survey (NSVS; Woźniak et al., 2004) and SuperWASP (Butters et al., 2010) observed the combined magnitude of GALEX J003535.7+462353 and GSC 3249-1603, which lies some 18″ to the West. Both surveys show a number of brightenings in the combined light curve, lasting several days, with an amplitude of up to 0.2 magnitudes from the normal combined magnitude of 12.9, indicating the possible

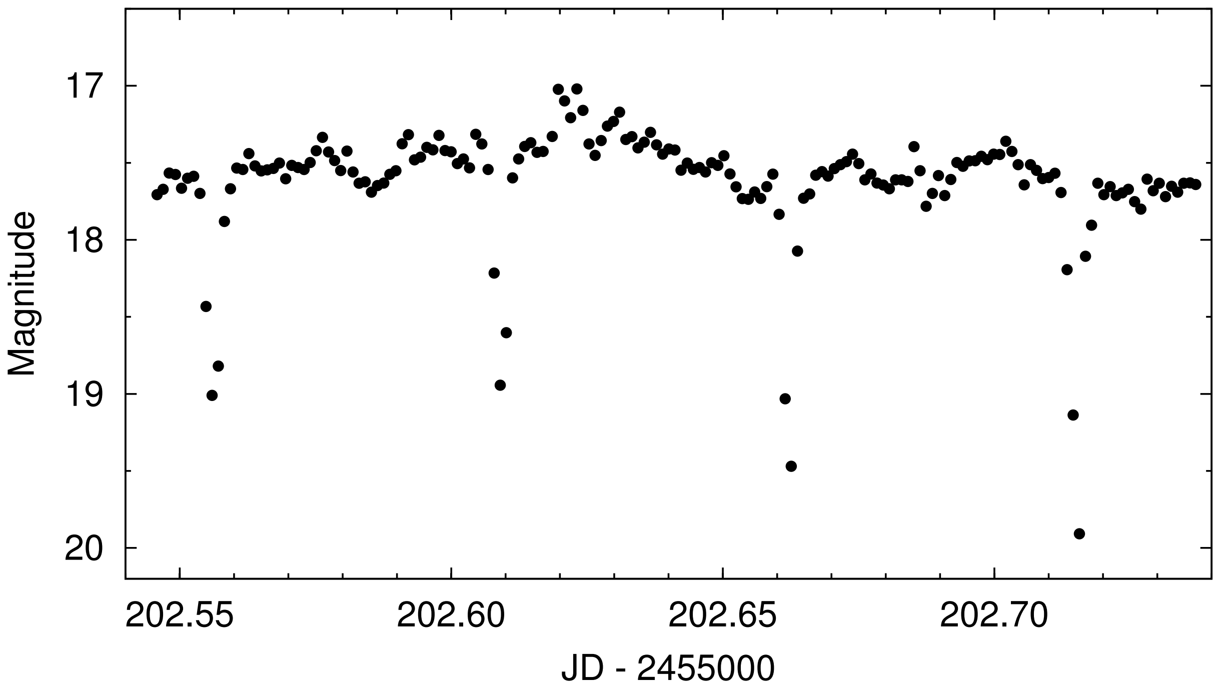

Figure 1. Light curve of PHL 1445 showing four eclipses.

Table 1: Observed times of eclipse for PHL 1445 and GALEX J003535.7+462353. The times are given as HJD - 2450000 (UTC based). The uncertainty on the times is about 0.0001 days for PHL 1445 and 0.0005 days for GALEX J003535.7+462353 for the minima obtained from our data, and 0.001 days for the minima obtained from SuperWASP data.

PHL 1445	GALEX J003535.7+462353	
	SuperWASP	This paper
5202.5579	4330.553	5477.5621
5202.6108	4331.589	5478.4228
5202.6640	4332.622	5478.5954
5202.7169	4333.655	5479.4560
5241.6075	4334.688	5479.6284
5242.6144	4335.551	5480.6625
	4360.703	5481.3519
	4407.388	5481.5239
	4408.424	5482.3856
		5483.4192
		5486.6920
		5495.3052
		5495.6516
		5576.6190
		5577.6526
		5579.7207

variability of GALEX J003535.7+462353 rising to about magnitude 14.5, from its normal magnitude of around 16.5. These may be an indication of a dwarf nova outburst with a fairly small amplitude. In addition, during these bright phases SuperWASP showed short periodic dimmings back to the normal combined magnitude with a period of around 0.1723 days. The likely cause of these periodic fadings are eclipses of the variable.

GALEX J003535.7+462353 was therefore followed extensively by the authors. The eclipses with a duration of about 30 minutes, could be easily confirmed. At quiescence the eclipse depth is about 2 magnitudes in V, but varying slightly. In a timespan of three months one definite outburst was observed, lasting about a week (see Fig. 2), and possibly a few shorter outbursts. At the end of the observing season, the object was entering another outburst. The rise to outburst seems to be more gradual, like in some other dwarf novae with a short outburst cycle and relatively small amplitude (often classified as Z Cam type variables). During the long outburst, the eclipses could also be observed with a similar amplitude as during quiescence. Fig. 3 shows eclipses observed during quiescence, during a rise to outburst and one during outburst.

From the list of observed times of eclipse in Table 1, together with the times of minimum that could be derived from the SuperWASP data, the following eclipse ephemeris was deduced:

$$\text{HJD Min} = 2455477.5615(4) + 0\overset{\text{d}}{.}17227503(11) \times E \qquad (2)$$

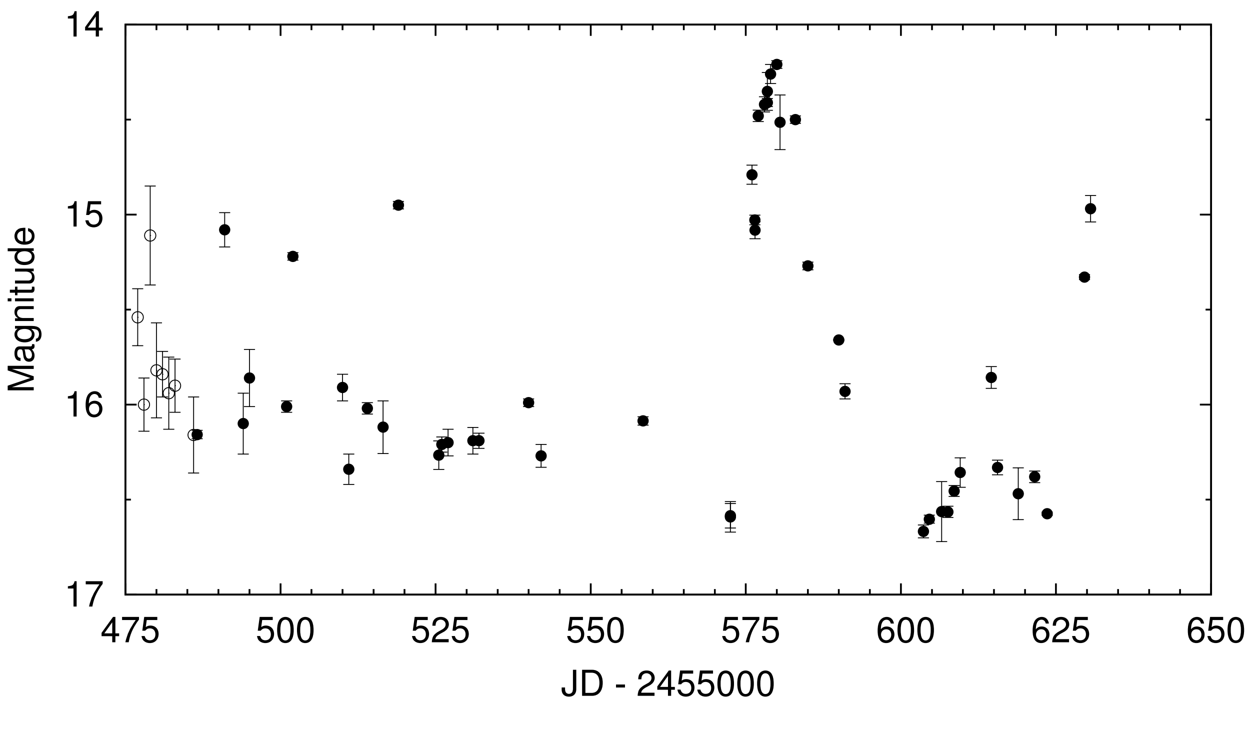

Figure 2. Light curve of GALEX J003535.7+462353 composed of daily means of observations outside of eclipse. Open circles represent V magnitudes, filled circles unfiltered magnitudes.

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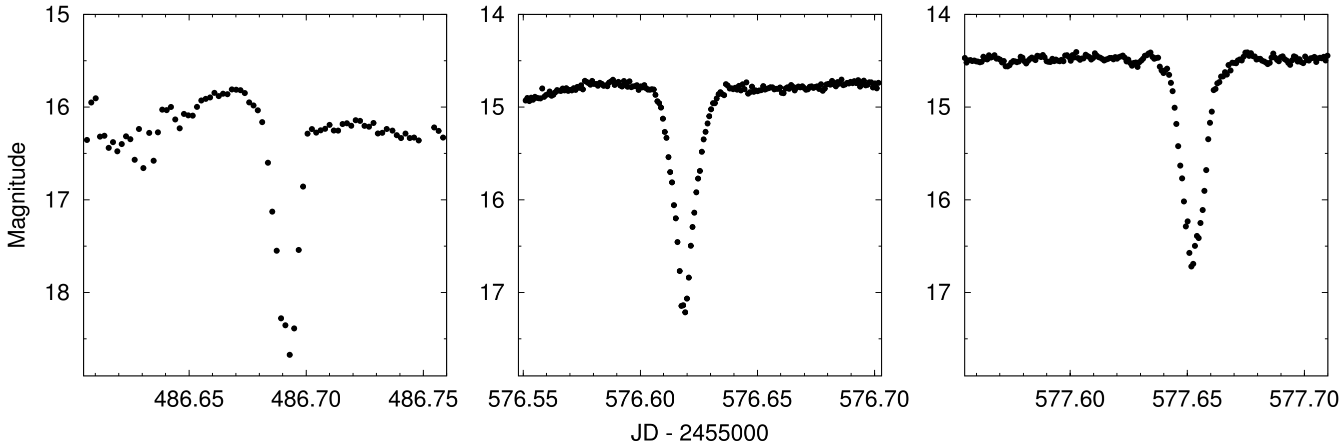

Figure 3. Eclipses of GALEX J003535.7+462353 observed in quiescence (left), rising to outburst (middle) and in outburst (right).

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In the context of a long-term variability study of a sample of dwarf novae, we have been monitoring AH Her since 1994 (Spogli et al., 2001, 2002) and we have obtained photometric data during many outbursts and standstills with the aim to constrain theoretical models. AH Her is one of the intrinsically brightest dwarf novae in quiescence, with the optical emission dominated by the accretion disk and the secondary (probably a K2 V star, Bruch, 1987). The system has an inclination angle $i \simeq 41^\circ$. Moreover, the FUV flux of AH Her is completely dominated by the accretion disk, with only a marginal fraction of the total light generated by the White Dwarf: $\simeq 3\%$ in quiescence (Urban & Sion, 2006) and $\leq 0.5\%$ during the outburst (Hamilton et al., 2007). For all these reasons, AH Her is a perfect candidate to study the accretion disk emission, thanks to the marginal contribution of the primary star and of the boundary layer region. The principal aim of this work is to test the steady state model making use of multicolour observations of AH Her on different parts of the outburst light curve. Since the secondary star is the same for the different observations, a set of disk spectra should exist which reproduces the different shapes of the simultaneous optical observations and the brightness differences.

All the observations have been obtained with a 0.30-m f/6.5 Schmidt-Cassegrain reflector, equipped with an AP-32ME CCD camera (Kodak 3200-ME, 2184×1470 pixels) and Schuler $UBVR_CI_C$ Johnson-Cousins filters. The exposure time was 120–600 s depending on the brightness of the object and the filter used. The CCD frames were first corrected for de-biasing and flat-fielding, then processed for aperture photometry. All the BVR_CI_C data were obtained in differential photometry using the photometric comparison sequence reported by Spogli et al. (2001). The U magnitudes have been measured only during good photometric nights with respect to a selected sample of standard stars (Landolt, 1992). Color transformation equations were characterized by slopes always within the margins 0.9–1.1.

AH Her has been monitored more intensively in the years 2007-2009, for a total of 121 different nights and 393 photometric points (see Table 1 in the electronic version). During the 2007 campaign many fast outbursts are evident in the light curve (Fig. 1), while during the 2008 campaign AH Her showed longer outbursts and standstill phases (Fig. 2).

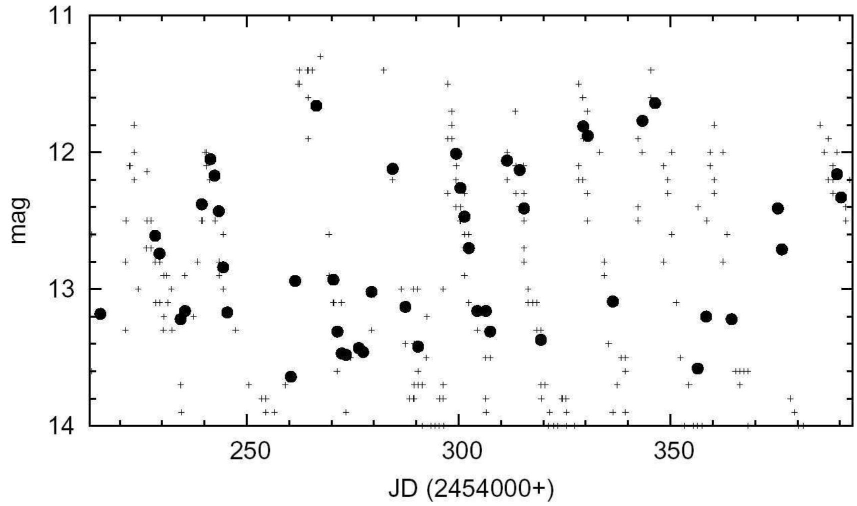

Figure 1. R_c data of AH Her from April 24th to October 16th 2007 from Table 1 (filled circles). Small crosses represent visual estimates available from AFOEV (`http://cdsweb.u-strasbg.fr/afoev/`).

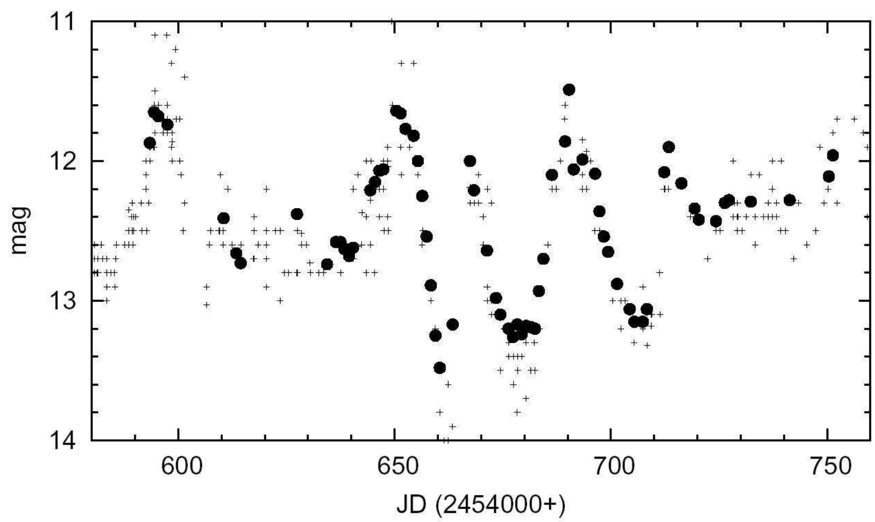

Figure 2. R_c data of AH Her from May 6th to October 11th 2008 from Table 1 (filled circles). Small crosses represent visual estimates available from AFOEV (`http://cdsweb.u-strasbg.fr/afoev/`).

To study the behaviour of the optical continuum of AH Her we corrected our observations by the interstellar extinction $E_{(B-V)} = 0.03$, then we converted the $UBVR_CI_C$ magnitudes in fluxes $f(\lambda)$ using the conversion factors reported by Bessell (1979). With this raw fluxes the spectral flux distribution is sensibly different from that expected by a standard accretion disk with the canonical power-law spectrum $f(\lambda) \propto \lambda^{7/3}$ (Lin & Papaloizou, 1996). For many times this behaviour has been considered an evidence that a steady and optically thick model disk cannot account for the continuum distribution of dwarf novae during the outburst (see, for example, Spogli et al., 1998). However, for AH Her the model is consistent with the observations if we take into consideration the secondary emission.

Fig. 3 shows the spectral flux distribution of AH Her at different stages of the outbursts cycle. The spectral slope is flatter in quiescence and steeper during the maximum, and in general is different from the spectral slope expected by a steady-state accretion disk. The same behaviour has been observed by many authors, for example by Hamilton et al. (2007) in the IUE spectra. Now we have considered the optically thick and geometrically thin disk model described by la Dous (1989) with angle of inclination $i = 45°$, and Fig. 3 shows that our observations are consistent with the superposition of this disk emission with a K5 V secondary star (Kurucz 1992, $T = 4250K$, $\log g = 4.5$, $\log Z = 0.0$). The disk emission during the maximum is $\simeq 13$ times brighter than at quiescence.

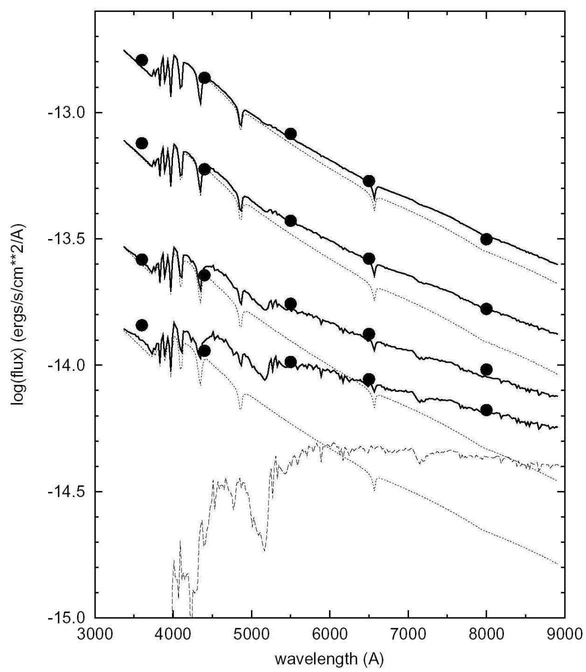

Figure 3. Examples of $UBVR_CI_C$ fluxes of AH Her from quiescence to the outburst (points). The solid lines represent the superposition of a K2 V secondary (dashed line) with an accretion disk with different levels of brightness (dotted lines). The dwarf nova and hot spot emissions have been omitted because they give a marginal contribution in the UV only.

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BAV-RESULTS OF OBSERVATIONS - PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

(BAV MITTEILUNGEN NO. 215)

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In this 69th compilation of BAV results, photoelectric observations obtained in the year 2010 and 2011 are presented on 503 variable stars giving 767 minima on eclipsing binaries and maxima on pulsating stars. All moments of minima and maxima are heliocentric. The errors are tabulated in column '±'. The values in column '$O-C$' are determined without incorporation of nonlinear terms. The references are given in the section 'Remarks'. All information about photometers and filters are specified in the column 'Rem'. The observations were made at private observatories. The photoelectric measurements and all the light curves with evaluations can be obtained from the office of the BAV for inspection.

Table 1: Times of minima of eclipsing binaries

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
RT And	55386.5021	.0028	AG	+0.0433		GCVS 2009	-Ir	28	11)
WX And	55461.5404	.0030	AG	+0.0614		GCVS 2009	-Ir	63	11)
AB And	52981.3033	.0001	BO	+0.0012		GCVS 2009	o	172	14)
AD And	55473.3341	.0003	JU	−0.0572	s	GCVS 2009	o	60	2)
	55491.5800	.0026	AG	−0.0561		GCVS 2009	-Ir	69	11)
AN And	55461.4038	.0024	SCI	+0.0696		GCVS 2009	o	159	2)
AP And	55491.4625	.0006	AG	+0.0006	s	GCVS 2009	-Ir	69	11)
BD And	55481.4814	.0017	AG	−0.0186		GCVS 2009	-Ir	49	11)
	55483.3337	.0005	JU	−0.0179		GCVS 2009	o	61	2)
BL And	55380.4924	.0017	AG	−0.0016		GCVS 2009	-Ir	35	11)
	55398.5525	.0013	AG	−0.0009		GCVS 2009	-Ir	33	11)
	55481.6220	.0045	AG	−0.0046		GCVS 2009	-Ir	50	11)
DK And	55386.4041	.0019	AG	+0.0010		BAVR 55,106	-Ir	28	11)
	55481.3147	.0016	AG	+0.0022		BAVR 55,106	-Ir	49	11)
	55481.5612	.0031	AG	+0.0041	s	BAVR 55,106	-Ir	49	11)
EX And	55386.5240	.0004	AG	−0.0005		GCVS 2009	-Ir	28	11)
GK And	55473.5831	.0029	SCI	+0.0597		GCVS 2009	o	58	2)
	55491.6681	.0016	AG	+0.0609		GCVS 2009	-Ir	69	11)
LO And	55491.2860	.0006	AG	−0.0050		GCVS 2009	-Ir	69	11)
	55491.4774	.0007	AG	−0.0038	s	GCVS 2009	-Ir	69	11)
	55491.6672	.0011	AG	−0.0043		GCVS 2009	-Ir	69	11)
QW And	55478.5025	.0041	AG	+0.0076	s	GCVS 2009	-Ir	90	11)
QX And	53657.4043	.0002	PRK	+0.0422		GCVS 2009	o	400	6)
V404 And	55484.3355	.0003	JU	+0.0109		GCVS 2009	o	70	2)
V412 And	55491.2562	.0031	AG	+0.0584		GCVS 2009	-Ir	69	11)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V422 And	55398.4857	.0071	AG	−0.0065	s	GCVS 2009	-Ir	33	11)
V425 And	55481.4887	.0009	AG	−0.0342		GCVS 2009	-Ir	49	11)
	55491.4340	.0005	AG	−0.0341		GCVS 2009	-Ir	69	11)
V490 And	55154.4234	.0164	AG				-Ir	73	11)
CK Aqr	55445.4036	.0001	FLG	+0.0115		GCVS 2009	V	92	9)
	55461.4144	.0001	FLG	+0.0118	s	GCVS 2009	V	195	9)
OO Aql	55385.4342	.0004	AG	+0.0473		GCVS 2009	-Ir	36	11)
	55487.2998	.0035	PGL	+0.0484		GCVS 2009	V	460	12)
V346 Aql	55389.4498	.0016	AG	−0.0101		GCVS 2009	-Ir	29	11)
V415 Aql	55418.4148	.0066	AG	+0.0006		BAVM 69	-Ir	44	11)
V417 Aql	55385.4141	.0008	AG	−0.0553	s	BAVR 33,152	-Ir	36	11)
	55418.3713	.0024	AG	−0.0561	s	BAVR 33,152	-Ir	43	11)
	55418.5566	.0007	AG	−0.0560		BAVR 33,152	-Ir	43	11)
V609 Aql	55389.4543	.0061	AG	−0.0492		GCVS 2009	-Ir	30	11)
V640 Aql	55418.4422	.0040	AG	+0.0344		GCVS 2009	-Ir	44	11)
V699 Aql	50279.4473	.0008	FR	+0.0211	s	GCVS 2009	o	30	2)
	50283.3884	.0025	FR	+0.0161		GCVS 2009	o	41	2)
	50286.4574	.0008	FR	+0.0160	s	GCVS 2009	o	36	2)
V770 Aql	55385.4717	.0039	AG	+0.3678	s	GCVS 2007	-Ir	36	11)
	55389.4534	.0012	AG	+0.3673		GCVS 2009	-Ir	29	11)
V879 Aql	53095.6264	.0001	MS FR	+0.0233		GCVS 2009	o	221	5)
V1075 Aql	55396.4544	.0035	AG	−0.0354	s	GCVS 2009	-Ir	25	11)
V1096 Aql	55396.4980	.0047	AG	+0.2935	s	GCVS 2009	-Ir	25	11)
V1168 Aql	55385.4642	.0115	AG	−0.0008	s	GCVS 2009	-Ir	36	11)
V1243 Aql	55418.4153	.0022	AG	+0.0318		GCVS 2009	-Ir	44	11)
V1430 Aql	55444.4111	.0035	PGL	−0.0108	s	AJ 119,2391	V	212	13)
V1692 Aql	55418.4209	.0089	AG	−0.0533	s	IBVS 5260=BAVM 150	-Ir	44	11)
V1712 Aql	55418.4995	.0018	AG	−0.0056	s	GCVS 2009	-Ir	45	11)
DN Aur	53764.4548	.0021	FR	+0.0658		GCVS 2009	o	34	11)
EP Aur	55590.2940	.0015	AG	+0.0116		GCVS 2009	-Ir	49	11)
	55590.5897	.0041	AG	+0.0118	s	GCVS 2009	-Ir	49	11)
FW Aur	55590.2863	.0027	AG	−0.0400		GCVS 2009	-Ir	49	11)
GI Aur	55590.4835	.0074	AG	+0.0285		GCVS 2009	-Ir	49	11)
	55601.3631	.0014	SCI	+0.0374		GCVS 2009	o	39	2)
MO Aur	55590.4580	.0320	AG	+0.0910	s	BAVM 68	-Ir	49	11)
V523 Aur	55591.4652	.0011	AG				-Ir	68	11)
	55591.6291	.0014	AG				-Ir	68	11)
V555 Aur	55481.6260	.0012	SCI	+0.0146		GCVS 2009	o	57	2)
EL Boo	54261.4409	.0035	JU				o	64	2)
	54639.4151	.0016	JU				o	54	2)
SV Cam	55563.3280	.0014	PGL	+0.0522		GCVS 2009	V	334	12)
XZ Cam	55599.2785	.0020	AG	+0.1155		GCVS 2009	-Ir	101	11)
AN Cam	55590.2891	.0079	AG	−0.2083		GCVS 2009	-Ir	125	11)
AZ Cam	55578.5840	.0073	AG	+0.0203		GCVS 2009	-Ir	107	11)
HW Cam	55578.4732	.0057	AG				-Ir	107	11)
NO Cam	55590.3107	.0020	AG	+0.0369		GCVS 2009	-Ir	125	11)
	55590.5256	.0016	AG	+0.0365	s	GCVS 2009	-Ir	125	11)
	55592.2489	.0010	AG	+0.0368	s	GCVS 2009	-Ir	15	11)
	55599.3562	.0008	AG	+0.0367		GCVS 2009	-Ir	76	11)
	55599.5705	.0014	AG	+0.0356	s	GCVS 2009	-Ir	76	11)
NQ Cam	55591.4405	.0037	AG	−0.0812	s	GCVS 2009	-Ir	63	11)
	55591.6191	.0012	AG	−0.0836		GCVS 2009	-Ir	63	11)
NS Cam	55591.3528	.0063	AG	−0.0544	s	GCVS 2009	-Ir	63	11)
NU Cam	55578.5179	.0092	AG	+0.0573	s	GCVS 2009	-Ir	107	11)
RT CMi	53768.4756	.0090	AG	−0.0720	s	GCVS 2009	-Ir	30	11)
TZ CMi	55599.2774	.0007	AG	+2.2374		GCVS 2009	-Ir	39	11)
AC CMi	55599.3817	.0011	AG	+0.1737	s	GCVS 2009	-Ir	39	11)
AG CMi	55599.3828	.0002	AG	−0.1384	s	GCVS 2009	V	37	11)
CZ CMi	55599.3872	.0012	AG	+0.0653	s	IBVS 5366=BAVM 156	V	38	11)
TX Cas	55480.3550	.0100	JU	−0.0143		BAVR 32,36	o	93	2)
ZZ Cas	55491.4433	.0046	AG	−0.0030		GCVS 2009	-Ir	61	11)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
AB Cas	55463.4821	.0035	PGL	+0.1875		GCVS 2009	V	150	13)
AE Cas	55473.4374	.0023	AG	+0.0659		GCVS 2009	-Ir	44	11)
AL Cas	55473.3184	.0019	AG	+0.0067	s	GCVS 2009	-Ir	44	11)
	55473.5682	.0025	AG	+0.0062		GCVS 2009	-Ir	44	11)
AX Cas	55479.3600	.0005	AG	−0.0994		GCVS 2009	-Ir	58	11)
	55491.3678	.0014	AG	−0.0991		GCVS 2009	-Ir	61	11)
	55491.6605	.0029	AG	−0.1066	s	GCVS 2009	-Ir	61	11)
	55514.4853	.0062	AG	−0.0960	s	GCVS 2009	-Ir	40	11)
BH Cas	55409.5640	.0038	AG				-Ir	28	11)
	55462.5355	.0064	AG				-Ir	46	11)
BN Cas	55514.4478	.0139	AG	+0.5144		GCVS 2009	-Ir	40	11)
BS Cas	55499.4272	.0028	AG	−0.0178		IBVS 4778=BAVM 123	-Ir	48	11)
	55499.6483	.0019	AG	−0.0170	s	IBVS 4778=BAVM 123	-Ir	48	11)
BU Cas	55499.4610	.0020	AG	−0.0234		GCVS 2009	-Ir	48	11)
BW Cas	55491.3916	.0043	AG	+0.2466		GCVS 2009	-Ir	61	11)
BZ Cas	55514.4964	.0035	AG	+0.2886		GCVS 2009	-Ir	40	11)
CC Cas	55462.3426	.0028	JU	+0.0819	s	GCVS 2009	o	72	2)
CV Cas	55473.5225	.0011	AG	+0.6499		GCVS 2009	-Ir	44	11)
CW Cas	55479.4382	.0017	AG	−0.0220	s	GCVS 2009	-Ir	58	11)
	55479.5977	.0009	AG	−0.0219		GCVS 2009	-Ir	58	11)
DP Cas	55460.5517	.0062	AG	+0.0144		GCVS 2009	-Ir	47	11)
DZ Cas	55460.5499	.0026	AG	−0.1786		GCVS 2009	-Ir	48	11)
EG Cas	55514.4724	.0050	AG	+0.1006		GCVS 2009	-Ir	39	11)
EI Cas	55462.6294	.0023	AG	+0.1019		GCVS 2009	-Ir	46	11)
EP Cas	55409.4342	.0025	AG	−0.0384	s	GCVS 2009	-Ir	28	11)
EY Cas	55409.3990	.0010	AG	+0.0389	s	GCVS 2009	-Ir	28	11)
	55460.4891	.0021	AG	+0.0395	s	GCVS 2009	-Ir	47	11)
	55462.4179	.0026	AG	+0.0404	s	GCVS 2009	-Ir	46	11)
	55473.5026	.0034	AG	+0.0397	s	GCVS 2009	-Ir	56	11)
	55514.4718	.0011	AG	+0.0409	s	GCVS 2009	-Ir	39	11)
GT Cas	55514.5425	.0030	AG	+0.1944		GCVS 2009	-Ir	39	11)
IR Cas	55380.4697	.0033	AG	+0.0091	s	GCVS 2009	-Ir	35	11)
	55398.5073	.0010	AG	+0.0086		GCVS 2009	-Ir	33	11)
IS Cas	55462.5998	.0118	AG	+0.0599	s	GCVS 2009	-Ir	46	11)
IT Cas	55386.4752	.0010	AG	+0.2621	s	GCVS 2009	-Ir	28	11)
KR Cas	55498.3724	.0027	JU	−0.1501		GCVS 2009	o	44	2)
LR Cas	55491.4504	.0252	AG	−0.0131		GCVS 2009	-Ir	61	11)
LU Cas	55483.3179	.0013	SCI	+0.1926		GCVS 2009	o	27	2)
MM Cas	55499.2961	.0019	AG	+0.0363	s	BAVR 32,36	-Ir	48	11)
MN Cas	55499.6024	.0020	AG	+0.0098		GCVS 2009	V	48	11)
MS Cas	55462.4079	.0034	AG	+0.0411		GCVS 2009	-Ir	46	11)
	55473.5496	.0028	AG	+0.0418	s	GCVS 2009	-Ir	56	11)
	55514.5943	.0031	AG	+0.0407	s	GCVS 2009	-Ir	39	11)
MT Cas	55473.3027	.0009	AG	+0.0155	s	GCVS 2009	-Ir	56	11)
	55473.4600	.0056	AG	+0.0158		GCVS 2009	-Ir	56	11)
	55473.6167	.0008	AG	+0.0156	s	GCVS 2009	-Ir	56	11)
MU Cas	55473.4548	.0082	AG	+0.2877		GCVS 2009	V	56	11)
MV Cas	55473.3262	.0027	AG	−0.0914		GCVS 2009	-Ir	56	11)
MY Cas	55483.5854	.0018	SCI	+0.0242		GCVS 2009	o	31	2)
NN Cas	55514.6531	.0066	AG	+0.1038		GCVS 2009	-Ir	39	11)
NU Cas	55514.6589	.0018	AG	−0.1400	s	GCVS 2009	-Ir	39	11)
NZ Cas	55479.4295	.0082	AG	−0.1853		GCVS 2009	-Ir	58	11)
OR Cas	55491.5305	.0027	AG	−0.0227		GCVS 2009	-Ir	61	11)
	55514.5757	.0018	AG	−0.0232	s	GCVS 2009	-Ir	40	11)
OX Cas	55491.2761	.0030	AG	+0.0258		GCVS 2009	-Ir	61	11)
PV Cas	55428.4507	.0035	PGL	−0.0339		GCVS 2009	V	169	13)
	55478.3732	.0014	JU	+0.0352	s	GCVS 2009	o	68	2)
QQ Cas	55460.5593	.0028	AG	+0.1142	s	BAVR 35,1	V	46	11)
V336 Cas	55409.4987	.0030	AG	−0.0139	s	GCVS 2009	-Ir	28	11)
V337 Cas	55514.3980	.0014	AG	−0.0654		GCVS 2009	-Ir	39	11)
V345 Cas	55380.4025	.0028	AG	−0.0169	s	GCVS 2009	-Ir	35	11)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V355 Cas	55460.5219	.0021	AG	−0.1331		GCVS 2009	-Ir	48	11)
V359 Cas	55409.4955	.0050	AG	+0.0090	s	IBVS 5016=BAVM 132	-Ir	28	11)
V361 Cas	55460.4885	.0016	AG	−0.2016		GCVS 2009	-Ir	48	11)
	55514.5647	.0032	AG	−0.2008		GCVS 2009	-Ir	39	11)
V374 Cas	55514.4049	.0032	AG	+0.0184		GCVS 2009	-Ir	39	11)
V375 Cas	55461.3312	.0017	JU	+0.2309		BAVR 32,36	o	60	2)
	55480.4945	.0087	AG	+0.2403		BAVR 32,36	-Ir	55	11)
	55492.2809	.0013	SCI	+0.2397		BAVR 32,36	o	115	2)
V381 Cas	55478.5088	.0074	AG	+0.0052	s	BAVR 32,36	-Ir	91	11)
	55479.3807	.0015	JU	+0.0042		BAVR 32,36	o	63	2)
V389 Cas	55478.5947	.0049	AG	+0.2608		GCVS 2009	-Ir	92	11)
V399 Cas	55480.5117	.0251	AG	−0.0412		GCVS 2009	-Ir	55	11)
V459 Cas	55479.4780	.0032	AG	−0.0822	s	IBVS 4737	-Ir	58	11)
V471 Cas	55499.4206	.0029	AG	+0.0064		GCVS 2009	-Ir	48	11)
	55499.6211	.0016	AG	+0.0389	s	GCVS 2009	-Ir	48	11)
V473 Cas	55499.4280	.0004	AG	−0.0198		IBVS 4669=BAVM 115	-Ir	48	11)
	55499.6363	.0009	AG	−0.0192	s	IBVS 4669=BAVM 115	-Ir	48	11)
V520 Cas	55460.5642	.0027	AG	−0.0460	s	GCVS 2009	-Ir	48	11)
	55482.3617	.0016	JU	−0.0353		GCVS 2009	o	70	2)
V523 Cas	55478.3278	.0007	AG	−0.0284	s	GCVS 2009	-Ir	92	11)
	55478.4453	.0023	AG	−0.0278		GCVS 2009	-Ir	92	11)
	55478.5615	.0021	AG	−0.0284	s	GCVS 2009	-Ir	92	11)
V527 Cas	55473.3246	.0017	AG	−0.3038		GCVS 2009	-Ir	44	11)
V608 Cas	55473.3031	.0016	AG				-Ir	44	11)
	55473.4952	.0021	AG				-Ir	44	11)
V651 Cas	55460.4144	.0017	AG	+0.0019		IBVS 3554=BAVM 55	V	48	11)
V654 Cas	55473.5356	.0031	AG				-Ir	56	11)
V860 Cas	55478.4726	.0030	AG				-Ir	90	11)
V959 Cas	55473.4649	.0073	AG	−0.1578	s	GCVS 2009	-Ir	56	11)
V961 Cas	55473.5740	.0027	AG	−0.1847		GCVS 2009	-Ir	56	11)
V1001 Cas	55491.2736	.0006	AG	+0.0409	s	GCVS 2009	-Ir	69	11)
	55491.4881	.0011	AG	+0.0410		GCVS 2009	-Ir	69	11)
V1011 Cas	55514.5653	.0026	AG	+0.0475	s	GCVS 2009	-Ir	40	11)
VZ Cep	55482.4673	.0121	AG	−0.0071	s	GCVS 2009	-Ir	103	11)
WW Cep	55482.5145	.0032	AG	+0.0013		IBVS 4131=BAVM 71	-Ir	90	11)
WX Cep	55386.5142	.0087	AG	+0.0062		GCVS 2009	-Ir	57	11)
XX Cep	55480.4860	.0284	AG	+0.0045	s	GCVS 2009	-Ir	55	11)
CM Cep	55409.5390	.0009	AG	−0.0350		GCVS 2009	-Ir	28	11)
CW Cep	55480.3673	.0090	AG	+0.2130	s	GCVS 2009	-Ir	55	11)
DK Cep	55386.5250	.0051	AG	+0.0363	s	GCVS 2009	-Ir	57	11)
EF Cep	55499.4068	.0063	AG	−0.0685	s	GCVS 2009	-Ir	93	11)
EY Cep	55499.4642	.0109	AG	+1.5332	s	GCVS 2009	-Ir	93	11)
GW Cep	55391.4419	.0003	AG	−0.0112		BAVR 33,160	-Ir	34	11)
IM Cep	55480.3167	.0011	AG	−0.1601		GCVS 2009	-Ir	55	11)
IP Cep	55482.5999	.0107	AG	−0.0340		IBVS 5016=BAVM 132	-Ir	103	11)
IW Cep	55480.4630	.0011	AG	+0.0387		GCVS 2009	-Ir	48	11)
KP Cep	55388.4408	.0027	AG	+0.0438		GCVS 2009	-Ir	31	11)
	55479.3892	.0027	AG	+0.0422		GCVS 2009	-Ir	42	11)
V358 Cep	55391.4747	.0040	AG				-Ir	34	11)
XY Cet	55563.3180	.0035	PGL	+0.0074		GCVS 2009	V	114	13)
SS Com	55584.7203	.0018	SCI	−0.0278	s	BAVR 33,152	o	48	2)
VV Cyg	55462.5839	.0024	AG	+0.0125		GCVS 2009	-Ir	34	11)
VW Cyg	54706.7558	.0028	FR	+0.2280		GCVS 2009	o	101	8) 17)
	55482.3777	.0005	FR	+0.2613		GCVS 2009	o	69	8) 17)
BR Cyg	55479.4205	.0028	PGL	+0.0015		GCVS 2009	V	369	12)
	55487.4156	.0035	PGL	+0.0012		GCVS 2009	V	360	12)
DO Cyg	55479.2926	.0002	AG	−0.0229		GCVS 2009	-Ir	42	11)
	55491.2620	.0023	SCI	−0.0236		GCVS 2009	o	41	2)
EN Cyg	55387.4623	.0009	AG	+0.4509		GCVS 2009	-Ir	31	11)
	55429.5445	.0010	AG	+0.4516		GCVS 2009	-Ir	34	11)
GM Cyg	55387.4717	.0028	AG	−0.2236		GCVS 2009	-Ir	34	11)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
GV Cyg	55479.4902	.0021	AG	+0.1573	s	GCVS 2009	-Ir	42	11)
	55482.4625	.0015	AG	+0.1575	s	GCVS 2009	-Ir	37	11)
KR Cyg	55397.4081	.0020	AG	+0.0160		GCVS 2009	-Ir	40	11)
LO Cyg	55391.4164	.0027	AG	−0.0033		GCVS 2009	-Ir	26	11)
	55397.3926	.0032	AG	−0.0049	s	GCVS 2009	-Ir	31	11)
MY Cyg	55397.5298	.0028	AG	+0.0041	s	GCVS 2009	-Ir	38	11)
V345 Cyg	55397.4789	.0035	AG	+0.0468		IBVS 5016=BAVM 132	-Ir	40	11)
V370 Cyg	55429.4269	.0062	AG	−0.0237	s	GCVS 2009	-Ir	34	11)
	55430.5871	.0012	AG	−0.0253		GCVS 2009	-Ir	41	11)
	55451.5006	.0013	AG	−0.0245		GCVS 2009	-Ir	36	11)
V382 Cyg	55430.5686	.0019	SCI	+0.1124		GCVS 2009	o	163	2)
V401 Cyg	55387.4992	.0114	AG	+0.0679	s	GCVS 2009	-Ir	31	11)
	55429.4546	.0042	AG	+0.0673	s	GCVS 2009	-Ir	33	11)
	55461.5092	.0028	AG	+0.0722	s	GCVS 2009	-Ir	30	11)
V442 Cyg	55397.4341	.0049	AG	−0.0426	s	GCVS 2009	-Ir	40	11)
V445 Cyg	55398.4908	.0012	AG	+0.2883		GCVS 2009	-Ir	32	11)
V453 Cyg	55428.3725	.0027	SCI	+0.0080		GCVS 2009	o	56	2)
V456 Cyg	55398.5035	.0006	AG	+0.0302	s	GCVS 2009	-Ir	32	11)
V463 Cyg	55429.5777	.0023	AG	+0.0549		GCVS 2009	-Ir	34	11)
	55481.4499	.0003	FR	+0.9563	s	GCVS 2009	o	87	11)
V469 Cyg	55387.4704	.0016	AG	−0.1245		GCVS 2009	-Ir	34	11)
V477 Cyg	55492.3459	.0003	JU	−0.0247		GCVS 2009	o	37	2)
V484 Cyg	55387.4976	.0154	AG	+0.1178	s	GCVS 2009	-Ir	32	11)
V488 Cyg	55397.4890	.0022	AG	+0.0570	s	GCVS 2009	-Ir	40	11)
V490 Cyg	55393.5007	.0020	AG	+0.1972	s	GCVS 2009	-Ir	33	11)
	55397.4590	.0017	AG	+0.1646		GCVS 2009	-Ir	40	11)
V498 Cyg	55398.5062	.0075	AG	+0.1478		GCVS 2009	-Ir	32	11)
V513 Cyg	55398.4536	.0062	AG	+0.1868		GCVS 2009	-Ir	32	11)
V519 Cyg	55462.4512	.0043	AG	−0.1941	s	GCVS 2009	-Ir	34	11)
V525 Cyg	55429.4098	.0026	AG	−0.0265		GCVS 2009	-Ir	31	11)
V526 Cyg	55429.4189	.0023	AG	+0.0413		GCVS 2009	-Ir	31	11)
V537 Cyg	55460.6384	.0016	AG	+0.5267		GCVS 2009	-Ir	100	11)
V616 Cyg	55397.4878	.0009	AG	+0.3427	s	GCVS 2009	-Ir	31	11)
	55460.5087	.0068	AG	−0.3158	s	GCVS 2009	-Ir	44	11)
V628 Cyg	55397.4759	.0008	AG	−0.0011		IBVS 4381=BAVM 89	-Ir	32	11)
	55429.3711	.0040	AG	−0.0034		IBVS 4381=BAVM 89	-Ir	30	11)
V635 Cyg	55391.4888	.0014	AG	−0.0512		GCVS 2009	-Ir	26	11)
	55429.5063	.0021	AG	−0.0517		GCVS 2009	-Ir	30	11)
	55462.5744	.0101	AG	−0.0592	s	GCVS 2009	-Ir	34	11)
V675 Cyg	55397.4617	.0127	AG	+0.6342		GCVS 2009	-Ir	31	11)
V680 Cyg	55388.5108	.0063	AG	+0.0318		BAVR 32,36	-Ir	29	11)
V687 Cyg	55461.3954	.0040	AG	−0.0087	s	GCVS 2009	V	29	11)
V700 Cyg	55398.4750	.0029	AG	−0.0687		GCVS 2009	-Ir	32	11)
V706 Cyg	55462.4894	.0017	AG	−0.0538	s	GCVS 2009	-Ir	34	11)
V711 Cyg	55391.4706	.0009	AG	−0.0445	s	GCVS 2009	-Ir	26	11)
	55460.5034	.0142	AG	−0.0459		GCVS 2009	-Ir	43	11)
V809 Cyg	55461.3940	.0027	AG	+0.0380	s	GCVS 2009	-Ir	29	11)
V822 Cyg	55387.5346	.0019	AG	−0.1491		GCVS 2009	-Ir	34	11)
V841 Cyg	55430.5199	.0018	AG	+0.0045		GCVS 2009	-Ir	41	11)
V842 Cyg	55451.3370	.0029	AG	+0.0305		GCVS 2009	-Ir	36	11)
V859 Cyg	55430.5028	.0044	AG	+0.0184	s	GCVS 2009	-Ir	42	11)
	55451.3587	.0030	AG	+0.0167		GCVS 2009	-Ir	36	11)
	55451.5591	.0047	AG	+0.0146	s	GCVS 2009	-Ir	36	11)
V870 Cyg	55429.4884	.0055	AG	+0.0527	s	GCVS 2009	-Ir	33	11)
V874 Cyg	55451.4064	.0020	AG	+0.0257		GCVS 2009	-Ir	36	11)
V877 Cyg	55393.4882	.0143	AG	+0.0248	s	GCVS 2009	-Ir	32	11)
	55451.4383	.0251	AG	+0.0312	s	GCVS 2009	-Ir	36	11)
V880 Cyg	55478.3359	.0030	AG	−0.0026	s	GCVS 2009	-Ir	34	11)
V884 Cyg	55393.5185	.0057	AG	+0.0146	s	GCVS 2009	-Ir	32	11)
V912 Cyg	55430.5282	.0040	AG	−0.1174		GCVS 2009	-Ir	38	11)
V921 Cyg	55461.4911	.0084	AG	+0.3635		GCVS 2009	-Ir	31	11)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V931 Cyg	55478.3105	.0017	AG	+0.0776	s	GCVS 2009	-Ir	33	11)
	55478.4809	.0020	AG	+0.0773		GCVS 2009	-Ir	33	11)
V934 Cyg	55429.3483	.0011	SCI	−0.0922		GCVS 2009	o	37	2)
	55429.3664	.0071	AG	−0.0741		GCVS 2009	-Ir	34	11)
	55451.4367	.0020	AG	−0.0759	s	GCVS 2009	-Ir	34	11)
V941 Cyg	55429.5263	.0024	AG	−0.0714		GCVS 2009	-Ir	34	11)
V947 Cyg	55481.4472	.0005	FR	−0.0089	s	GCVS 2009	o	49	11)
V957 Cyg	55429.3940	.0020	AG	+0.1380		GCVS 2009	-Ir	33	11)
V961 Cyg	55429.4942	.0016	AG	−0.0786	s	GCVS 2009	-Ir	34	11)
	55430.5101	.0029	AG	−0.0888	s	GCVS 2009	-Ir	41	11)
V962 Cyg	55393.4970	.0064	AG	−0.2049		GCVS 2009	-Ir	32	11)
V963 Cyg	55408.5538	.0014	SCI	−0.0008		GCVS 2009	o	59	2)
	55429.4735	.0026	AG	−0.0012		GCVS 2009	-Ir	34	11)
V965 Cyg	55408.4166	.0042	SCI	−0.1188		GCVS 2009	o	59	2)
	55429.5577	.0049	AG	−0.1166		GCVS 2009	-Ir	34	11)
	55481.4425	.0004	FR	−0.1182		GCVS 2009	o	43	11)
V1004 Cyg	55397.4849	.0025	AG	−0.1756		GCVS 2009	-Ir	40	11)
V1009 Cyg	55393.4551	.0032	AG	−0.0075		GCVS 2009	-Ir	32	11)
V1013 Cyg	55461.4398	.0132	AG	+0.1645	s	GCVS 2009	-Ir	29	11)
V1018 Cyg	55461.3830	.0012	AG	−0.0879		GCVS 2009	V	29	11)
V1083 Cyg	55397.4759	.0110	AG	−0.0653	s	GCVS 2009	-Ir	31	11)
	55462.5134	.0210	AG	−0.0618	s	GCVS 2009	-Ir	34	11)
V1187 Cyg	55398.4129	.0018	AG	−0.0198		IBVS 4133=BAVM 73	-Ir	32	11)
V1191 Cyg	55398.4717	.0016	AG	−0.0213	s	GCVS 2009	-Ir	32	11)
V1256 Cyg	55387.4662	.0023	AG	−0.0258		GCVS 2009	-Ir	31	11)
V1321 Cyg	55398.5383	.0021	AG	+0.0839		GCVS 2009	-Ir	32	11)
V1401 Cyg	55460.4648	.0187	AG	+0.2685	s	GCVS 2009	-Ir	44	11)
	55479.3919	.0077	AG	+0.2678	s	GCVS 2009	-Ir	42	11)
V1411 Cyg	55460.5520	.0003	AG	−0.1598	s	GCVS 2009	-Ir	44	11)
V1414 Cyg	55482.4656	.0073	AG	+0.0481		GCVS 2009	-Ir	37	11)
V1417 Cyg	55388.5366	.0029	AG	+0.1544	s	GCVS 2009	-Ir	31	11)
	55460.4876	.0023	AG	+0.1548	s	GCVS 2009	-Ir	44	11)
V1823 Cyg	55073.6228	.0014	FR				-Ir	109	11)
	55482.3634	.0004	FR				o	52	11)
V1877 Cyg	55480.3234	.0004	FR				o	41	11)
V2021 Cyg	55068.6002	.0007	FR				o	55	8)
V2181 Cyg	55393.5368	.0020	AG	+0.0115		BAVR 50,45	-Ir	33	11)
	55397.5507	.0012	AG	+0.0111		BAVR 50,45	-Ir	40	11)
V2240 Cyg	55387.5150	.0051	AG				-Ir	34	11)
V2284 Cyg	55418.4286	.0007	AG				-Ir	40	11)
	55418.5811	.0006	AG				-Ir	40	11)
V2294 Cyg	55418.5491	.0011	AG				-Ir	40	11)
V2363 Cyg	55418.4080	.0023	AG	+0.0518	s	GCVS 2009	-Ir	40	11)
V2364 Cyg	55418.4816	.0044	AG	−0.0108	s	GCVS 2009	-Ir	40	11)
BG Del	55389.4176	.0030	AG	+0.0842	s	GCVS 2009	-Ir	30	11)
	55396.4632	.0022	AG	+0.0846		GCVS 2009	-Ir	25	11)
BH Del	55396.4994	.0068	AG	+0.1286	s	GCVS 2009	-Ir	25	11)
BN Del	55396.4332	.0023	AG	−0.4058		GCVS 2009	-Ir	25	11)
BW Del	55396.5233	.0030	AG	+0.3727		GCVS 2009	-Ir	25	11)
RX Dra	55381.4984	.0046	AG	+0.0558		GCVS 2009	-Ir	84	11)
RZ Dra	55380.4531	.0033	AG	+0.0526	s	GCVS 2009	-Ir	65	11)
SX Dra	55380.6141	.0010	AG	+0.0963		GCVS 2009	-Ir	106	11)
CV Dra	55380.5480	.0008	AG	+0.0053		BAVM 69	-Ir	65	11)
MU Dra	55418.4813	.0028	AG	−0.0422	s	GCVS 2009	-Ir	40	11)
YY Gem	55552.3895	.0035	PGL	−0.0070		GCVS 2009	V	423	13)
AC Gem	55578.4678	.0013	SCI	−0.2786		GCVS 2009	o	54	2)
AI Gem	55578.4700	.0012	AG	−0.1275	s	GCVS 2009	-Ir	46	11)
AZ Gem	55578.4075	.0003	AG	+0.0880		GCVS 2009	-Ir	47	11)
DP Gem	55590.4610	.0027	AG	+0.0654	s	GCVS 2009	-Ir	49	11)
EG Gem	55578.5726	.0003	AG	+0.2902		GCVS 2009	-Ir	45	11)
EN Gem	55578.4903	.0184	AG	−0.0432	s	GCVS 2009	-Ir	47	11)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
FG Gem	55578.5757	.0021	AG	−0.0249		GCVS 2009	-Ir	47	11)
FQ Gem	55578.2928	.0011	AG	+0.3208		GCVS 2009	-Ir	47	11)
FT Gem	55578.3857	.0049	AG	−0.0249		GCVS 2009	-Ir	47	11)
GQ Gem	54513.3827	.0030	SB	+0.0081	s	GCVS 2009	-Ir	117	10)
HR Gem	55598.5377	.0036	AG	+0.0127		GCVS 2009	-Ir	54	11)
IV Gem	54845.3781	.0018	AG				-Ir	60	11)
KV Gem	55578.2676	.0009	AG	−0.0247		BAVR 52,95	-Ir	46	11)
	55578.4478	.0003	AG	−0.0238	s	BAVR 52,95	-Ir	46	11)
	55578.6254	.0030	AG	−0.0254		BAVR 52,95	-Ir	46	11)
V345 Gem	53446.3120	.0028	SCI				o	140	2)
AK Her	55386.438	.003	MOO	+0.016		GCVS 2009	V	60	13)
	55405.4042	.0035	PGL	+0.0139		GCVS 2009	V	337	13)
DH Her	55379.4648	.0028	AG	+0.0055		GCVS 2009	-Ir	35	11)
GL Her	55389.3890	.0003	AG	+0.0775		GCVS 2009	-Ir	51	11)
	55396.4238	.0017	AG	+0.0773		GCVS 2009	-Ir	32	11)
IT Her	54219.4827	.0027	SCI	−0.0507		GCVS 2009	o	65	2)
	54222.5376	.0010	AG	−0.0473	s	GCVS 2009	-Ir	19	1)
	54239.5012	.0029	SCI	−0.0366	s	GCVS 2009	o	88	2)
	54597.3983	.0035	SCI	+0.0424	s	GCVS 2009	o	58	2)
	54597.5701	.0046	SCI	−0.0119	s	GCVS 2009	o	50	2)
	54598.5769	.0023	SCI	−0.0223		GCVS 2009	o	73	2)
	54600.4542	.0004	AG	+0.0467		GCVS 2009	-Ir	52	11)
	54959.5326	.0003	AG	−0.0492		GCVS 2009	-Ir	86	11)
	54996.5268	.0018	AG	−0.0123	s	GCVS 2009	-Ir	49	11)
	55379.5308	.0010	AG	−0.0296		GCVS 2009	-Ir	35	11)
	55396.5005	.0023	AG	−0.0128		GCVS 2009	-Ir	32	11)
	55422.4648	.0001	MZ	−0.0429		GCVS 2009	-Ir	198	2)
	55498.3220	.0004	MZ	−0.0214	s	GCVS 2009	-Ir	98	2)
V342 Her	55379.4936	.0036	AG	+0.0181		GCVS 2009	-Ir	35	11)
	55396.5291	.0043	AG	+0.0190		GCVS 2009	-Ir	32	11)
V643 Her	55379.5132	.0030	AG	−0.3335		GCVS 2009	-Ir	35	11)
V719 Her	55388.4044	.0010	AG	−0.0241		GCVS 2009	-Ir	32	11)
V722 Her	55388.4969	.0120	AG	+0.0826	s	GCVS 2009	-Ir	32	11)
V728 Her	55388.5373	.0023	AG	+0.0745	s	IBVS 3234=BAVM 51	-Ir	34	11)
V731 Her	55388.4487	.0023	AG	−0.0693		GCVS 2009	-Ir	34	11)
V865 Her	55388.5064	.0146	AG				-Ir	34	11)
V899 Her	55600.6435	.0019	SCI				o	58	2)
V1055 Her	55388.5124	.0028	AG				-Ir	34	11)
V1095 Her	55388.4338	.0028	AG	−0.0207		GCVS 2009	-Ir	34	11)
V1096 Her	55388.4370	.0021	AG	+0.0229		GCVS 2009	-Ir	34	11)
	55388.5542	.0010	AG	+0.0194	s	GCVS 2009	-Ir	34	11)
RT Lac	55391.4286	.0029	AG	−0.2337		GCVS 2009	V	25	11)
TW Lac	55430.4781	.0040	AG	+0.3497		GCVS 2009	-Ir	50	11)
VV Lac	55480.2600	.0013	AG	−0.7690		GCVS 2009	-Ir	48	11)
AG Lac	55380.4981	.0052	AG	−0.0112		GCVS 2009	-Ir	35	11)
	55430.5171	.0025	AG	−0.0122	s	GCVS 2009	-Ir	47	11)
AU Lac	54718.6028	.0002	AG	−0.0261		GCVS 2009	-Ir	56	11)
	55463.5586	.0025	AG	−0.0262		GCVS 2009	-Ir	37	11)
AW Lac	55482.5030	.0075	AG	+0.0469		BAVR 35,1	-Ir	37	11)
BB Lac	55482.5164	.0015	AG	−0.5836		GCVS 2009	-Ir	37	11)
CF Lac	55388.4843	.0035	AG	−0.0091		GCVS 2009	-Ir	31	11)
CG Lac	55463.4017	.0041	AG	−0.1592		GCVS 2009	-Ir	55	11)
CN Lac	54718.4490	.0003	AG	−0.0425		GCVS 2009	-Ir	55	11)
	55391.4965	.0011	AG	−0.0623		GCVS 2009	-Ir	26	11)
	55397.5549	.0032	AG	−0.0590	s	GCVS 2009	-Ir	32	11)
	55479.4536	.0044	AG	−0.0629		GCVS 2009	-Ir	42	11)
DG Lac	55451.3671	.0024	AG	−0.2220		GCVS 2009	-Ir	59	11)
EP Lac	55480.5914	.0041	AG	−0.3665		GCVS 2009	-Ir	48	11)
ER Lac	55451.7300	.0050	AG	−0.5310		GCVS 2009	-Ir	72	11)
	55463.5082	.0056	AG	−0.5346		GCVS 2009	-Ir	32	11)
ES Lac	55398.4581	.0055	AG	+0.6608	s	GCVS 2009	-Ir	33	11)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
ES Lac	55480.4225	.0055	AG	+0.1272		GCVS 2009	-Ir	48	11)
EU Lac	55482.4913	.0034	AG	+0.2024		GCVS 2009	-Ir	37	11)
EX Lac	55480.3653	.0014	AG	+0.2282		GCVS 2009	-Ir	48	11)
FL Lac	55398.5288	.0136	AG	−0.0617	s	GCVS 2009	-Ir	33	11)
	55480.4765	.0492	AG	−0.0559	s	GCVS 2009	-Ir	48	11)
	55481.5933	.0171	AG	−0.0464	s	GCVS 2009	-Ir	52	11)
FP Lac	55463.5893	.0223	AG	+0.1319		GCVS 2009	-Ir	37	11)
	55481.5262	.0081	AG	+0.1485		GCVS 2009	-Ir	52	11)
GH Lac	55479.5566	.0084	AG	−0.0415		GCVS 2009	-Ir	42	11)
HR Lac	55460.4361	.0058	AG	+0.1049	s	GCVS 2009	-Ir	44	11)
IL Lac	55430.5340	.0068	AG				-Ir	49	11)
	55463.3395	.0029	AG				-Ir	37	11)
	55482.3052	.0004	AG				-Ir	62	11)
IM Lac	55430.5705	.0016	AG	−0.1846		GCVS 2009	-Ir	49	11)
	55463.5460	.0031	AG	−0.1861		GCVS 2009	-Ir	37	11)
	55482.5733	.0012	AG	−0.1840		GCVS 2009	-Ir	37	11)
IP Lac	55388.5033	.0009	AG	+0.0810		GCVS 2009	-Ir	31	11)
	55451.5516	.0012	AG	+0.0805		GCVS 2009	-Ir	59	11)
	55463.4811	.0029	AG	+0.0819		GCVS 2009	-Ir	36	11)
IU Lac	54718.3399	.0009	AG	+0.0094		GCVS 2009	-Ir	65	11)
	55463.5477	.0038	AG	+0.0119		GCVS 2009	-Ir	37	11)
IZ Lac	55451.4918	.0078	AG	+0.0343	s	GCVS 2009	-Ir	59	11)
	55463.4758	.0091	AG	+0.0351	s	GCVS 2009	-Ir	36	11)
LZ Lac	55480.4654	.0049	AG	+0.3308		GCVS 2009	-Ir	48	11)
MZ Lac	55451.4848	.0024	AG	+0.1622		GCVS 2009	-Ir	59	11)
NR Lac	55479.4077	.0088	AG	+0.0612	s	GCVS 2009	-Ir	42	11)
	55482.4366	.0059	AG	+0.0660	s	GCVS 2009	-Ir	37	11)
NW Lac	55398.4108	.0014	AG	−0.1439		GCVS 2009	-Ir	33	11)
PP Lac	55451.3569	.0021	AG	−0.0543	s	GCVS 2009	-Ir	59	11)
	55451.5576	.0016	AG	−0.0541		GCVS 2009	-Ir	59	11)
V342 Lac	55463.3771	.0024	AG	−0.0876	s	GCVS 2009	-Ir	36	11)
V344 Lac	55479.4217	.0007	AG	−0.0917	s	GCVS 2009	-Ir	42	11)
	55479.6192	.0012	AG	−0.0904		GCVS 2009	-Ir	42	11)
V345 Lac	55388.5084	.0047	AG	−1.0297	s	GCVS 2009	-Ir	31	11)
	55463.4265	.0055	AG	−1.0302	s	GCVS 2009	-Ir	37	11)
V441 Lac	54718.4054	.0005	AG	+0.0323		IBVS 5024=BAVM 135	-Ir	56	11)
	54718.5595	.0005	AG	+0.0320	s	IBVS 5024=BAVM 135	-Ir	56	11)
	55463.3571	.0008	AG	+0.0862	s	IBVS 5024=BAVM 135	-Ir	37	11)
	55463.5131	.0035	AG	+0.0877		IBVS 5024=BAVM 135	-Ir	37	11)
V459 Lac	55463.3802	.0034	AG	+0.2174		GCVS 2009	-Ir	55	11)
SW Lyn	55591.4731	.0152	AG	+0.0776	s	GCVS 2009	V	68	11)
UU Lyn	55600.4045	.0023	AG	−0.0084		GCVS 2009	-Ir	160	11)
	55600.6394	.0062	AG	−0.0077	s	GCVS 2009	-Ir	160	11)
WW Lyn	55591.5488	.0301	AG				-Ir	68	11)
DY Lyn	55591.4958	.0030	AG	−0.1507	s	GCVS 2009	V	68	11)
DZ Lyn	55591.4234	.0083	AG	−0.0176	s	GCVS 2009	V	68	11)
	55591.6207	.0075	AG	−0.0093		GCVS 2009	V	68	11)
AA Lyr	55380.4858	.0003	FR	+0.2430	s	GCVS 2009	o	41	11)
	55387.4713	.0008	FR	+0.2519		GCVS 2009	o	41	11)
	55409.4556	.0001	FR	+0.2329	s	GCVS 2009	o	44	11)
	55418.5116	.0007	FR	+0.1656		GCVS 2009	o	55	11)
	55429.3732	.0018	FR	+0.2939		GCVS 2009	o	64	11)
EX Lyr	52415.3879	.0044	AG	−0.0330		GCVS 2009	-Ir	16	1)
	55396.4568	.0036	AG	−0.0960	s	GCVS 2009	-Ir	32	11)
FG Lyr	55381.4409	.0032	AG	−0.0744		GCVS 2009	-Ir	29	11)
NY Lyr	55461.5511	.0002	AG	−0.0893		GCVS 2009	-Ir	29	11)
PV Lyr	55381.5073	.0075	AG	−0.0049		GCVS 2009	-Ir	29	11)
	55387.4982	.0093	AG	−0.0071		GCVS 2009	-Ir	31	11)
PY Lyr	55381.4196	.0016	AG	+0.0620		GCVS 2009	-Ir	29	11)
V400 Lyr	55379.4911	.0006	AG	−0.0702	s	GCVS 2009	-Ir	32	11)
V412 Lyr	55387.5213	.0020	AG	+0.2078		GCVS 2009	-Ir	31	11)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
V412 Lyr	55429.4385	.0005	FR	+0.2089		GCVS 2009	o	45	11)
	55430.3696	.0019	AG	+0.2085		GCVS 2009	-Ir	41	11)
V563 Lyr	55379.5312	.0033	AG				-Ir	31	11)
V579 Lyr	55379.4885	.0012	AG				-Ir	32	11)
UV Mon	54164.3682	.0003	AG	−0.0422	s	GCVS 2009	-Ir	15	1)
	55600.5185	.0016	AG	−0.0659	s	GCVS 2009	-Ir	40	11)
AE Mon	54164.4031	.0011	AG	+0.0368		GCVS 2009	-Ir	14	1)
AO Mon	55600.4591	.0030	AG	−0.0169		BAVR 51,38	V	39	11)
AY Mon	55599.4016	.0016	AG	+0.0759		GCVS 2009	-Ir	39	11)
BM Mon	54164.4389	.0001	AG	+0.0424		GCVS 2009	-Ir	17	1)
CK Mon	55599.4528	.0009	AG	+0.2008		GCVS 2009	-Ir	36	11)
DD Mon	54840.4115	.0018	AG	−0.1285	s	GCVS 2009	-Ir	63	11)
	55600.4191	.0017	AG	−0.1208	s	GCVS 2009	-Ir	40	11)
EZ Mon	54509.4147	.0008	MZ	+0.0227	s	GCVS 2009	-Ir	191	2) 16)
	54831.4146	.0008	MZ	+0.0254	s	GCVS 2009	-Ir	92	2)
	54852.4785	.0010	MZ	+0.0241	s	GCVS 2009	-Ir	115	2)
	54857.3714	.0005	MZ	+0.0268	s	GCVS 2009	-Ir	191	2) 16)
	55595.4086	.0020	MZ	+0.0283	s	GCVS 2009	-Ir	73	2)
IU Mon	55599.3189	.0019	AG	−0.0318		GCVS 2009	-Ir	39	11)
IX Mon	55599.5000	.0066	AG	−0.0373	s	GCVS 2009	-Ir	39	11)
IZ Mon	55599.2970	.0030	AG	−0.1399		GCVS 2009	-Ir	39	11)
V397 Mon	55600.4423	.0077	AG	+0.0231		GCVS 2009	-Ir	38	11)
V460 Mon	54164.3819	.0032	AG	+0.2035		GCVS 2009	-Ir	16	1)
V464 Mon	55600.3158	.0006	AG	−0.1213		GCVS 2009	-Ir	40	11)
V498 Mon	55600.3481	.0022	AG	−0.0786		GCVS 2009	-Ir	40	11)
V515 Mon	55600.3355	.0018	AG	−0.0392		GCVS 2009	-Ir	40	11)
V527 Mon	54164.4184	.0025	AG	−0.0222		GCVS 2009	-Ir	15	1)
V528 Mon	54164.4049	.0019	AG	−0.2378	s	GCVS 2009	-Ir	16	1)
V532 Mon	55600.3437	.0016	AG	−0.0230	s	GCVS 2009	-Ir	40	11)
V680 Mon	51256.3472	.0007	FR	+0.0898		GCVS 2009	o	16	7)
V843 Mon	55599.3227	.0027	AG	−0.0510		BAVM 147	-Ir	39	11)
V577 Oph	55385.4590	.0217	AG	+0.4604	s	GCVS 2009	-Ir	37	11)
V2203 Oph	55451.4266	.0015	FR				o	104	11)
V2612 Oph	55385.4942	.0086	AG	+0.0970		GCVS 2009	-Ir	37	11)
FF Ori	55472.5706	.0022	SCI	+0.0228		GCVS 2009	o	41	2)
U Peg	55473.4094	.0014	PGL	−0.0201	s	BAVR 45,3	V	229	12)
AW Peg	55479.3704	.0018	SCI	+0.0084		GCVS 2009	o	113	2)
BX Peg	55481.3719	.0015	AG	+0.0391	s	GCVS 2009	-Ir	40	11)
	55481.5166	.0025	AG	+0.0436		GCVS 2009	-Ir	40	11)
CE Peg	55428.5524	.0022	SCI	+0.1530	s	GCVS 2009	o	50	2)
CW Peg	55481.4950	.0003	AG	+0.0396		GCVS 2009	-Ir	40	11)
DV Peg	55481.3446	.0045	AG	−0.1168	s	GCVS 2009	-Ir	39	11)
HI Peg	55498.3309	.0019	SCI				o	26	2)
IP Peg	55419.4472	.0004	FLG				V	45	9)
	55420.3963	.0006	FLG				V	75	9)
	55478.3004	.0008	SCI				o	24	2)
	55478.3782	.0028	SCI				o	37	2)
	55478.4568	.0028	SCI				o	49	2)
	55480.5171	.0021	SCI				o	44	2)
	55481.3072	.0007	SCI				o	38	2)
	55481.4668	.0010	SCI				o	55	2)
	55484.3129	.0023	SCI				o	34	2)
	55499.3415	.0018	SCI				o	29	2)
	55502.3482	.0005	JU				o	33	2)
	55502.3502	.0013	SCI				o	35	2)
	55503.3062	.0007	SCI				o	22	2)
KW Peg	55481.2842	.0018	AG				-Ir	40	11)
V357 Peg	55459.3642	.0022	SCI				o	137	2)
V411 Peg	55481.2983	.0020	AG	−0.0012		GCVS 2009	-Ir	41	11)
	55481.4852	.0011	AG	−0.0028	s	GCVS 2009	-Ir	41	11)
XZ Per	55579.4331	.0247	AG	−0.0490	s	GCVS 2009	-Ir	82	11)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
AG Per	55514.3958	.0011	JU	+0.1428	s	GCVS 2009	o	56	2)
	55578.3122	.0010	JU	+0.1549		GCVS 2009	o	107	2)
AY Per	55498.5248	.0028	SCI	−0.0977		GCVS 2009	o	159	2)
BO Per	54164.3698	.0008	AG	−0.0318		GCVS 2009	-Ir	89	1)
BY Per	55499.6510	.0003	AG	+0.0209	s	GCVS 2009	-Ir	48	11)
V740 Per	55598.4524	.0013	AG	+0.0045		GCVS 2009	-Ir	54	11)
beta Per	55499.412	.001	VLM	+0.106		GCVS 2009	o	81	15) 16)
RV Psc	55461.4571	.0014	AG	−0.0512		GCVS 2009	-Ir	63	11)
UZ Sge	55393.5686	.0008	AG	+0.0734		GCVS 2009	-Ir	37	11)
DK Sge	55393.5154	.0011	AG	+0.1594	s	GCVS 2009	-Ir	30	11)
V365 Sge	55389.4280	.0011	AG	−0.0492		GCVS 2009	-Ir	31	11)
SV Tau	55479.5512	.0030	SCI	−0.0148		GCVS 2009	o	115	2)
WY Tau	55590.3414	.0012	AG	+0.0580	s	GCVS 2009	-Ir	46	11)
CT Tau	55590.4706	.0022	AG	−0.0546	s	GCVS 2009	-Ir	49	11)
	55598.4732	.0024	AG	−0.0540	s	GCVS 2009	-Ir	54	11)
V781 Tau	55590.2927	.0025	AG	−0.0468	s	GCVS 2009	V	49	11)
	55590.2929	.0030	AG	−0.0466	s	GCVS 2009	B	46	11)
	55590.4639	.0040	AG	−0.0481		GCVS 2009	B	46	11)
	55590.4641	.0029	AG	−0.0479		GCVS 2009	V	49	11)
V1239 Tau	55590.3286	.0145	AG	−0.0720	s	GCVS 2009	V	49	11)
	55590.3379	.0145	AG	−0.0627	s	GCVS 2009	B	46	11)
V1241 Tau	55491.6118	.0001	FR	+0.0162		GCVS 2009	o	66	11)
V Tri	55461.5283	.0028	AG	−0.0037		GCVS 2009	-Ir	63	11)
RS Tri	55461.4990	.0140	AG	−0.0444	s	GCVS 2009	-Ir	63	11)
AL Tri	55461.5281	.0094	AG				-Ir	63	11)
TW UMa	55592.2823	.0017	SCI	−0.3255		GCVS 2009	o	32	2)
TX UMa	55563.4506	.0035	PGL	+0.1945		GCVS 2009	V	372	12)
VV UMa	55599.4532	.0006	SCI	−0.0502		GCVS 2009	o	86	2)
AA UMa	55600.4760	.0046	AG	+0.0383		GCVS 2009	-Ir	160	11)
	55600.7127	.0015	AG	+0.0410	s	GCVS 2009	-Ir	160	11)
BM UMa	54935.3325	.0003	AG	+0.0106		GCVS 2009	-Ir	70	11)
	54935.6029	.0019	AG	+0.0098		GCVS 2009	-Ir	70	11)
IW UMa	55600.6947	.0002	AG				-Ir	160	11)
AG Vir	55578.5769	.0015	SCI	−0.0077		GCVS 2009	o	101	2)
AH Vir	55309.437	.001	MOO	+0.016	s	GCVS 2009	V	32	13)
HT Vir	55599.5831	.0009	SCI				o	36	2)
XZ Vul	55430.4124	.0017	AG	+0.3367		GCVS 2009	-Ir	41	11)
AW Vul	55393.5127	.0010	AG	−0.0145		GCVS 2009	-Ir	30	11)
	55473.3508	.0030	FR	−0.0151		GCVS 2009	o	62	11)
BB Vul	55443.3657	.0007	SIR				o	38	3)
BG Vul	55481.4461	.0021	AG	+0.0575		GCVS 2009	-Ir	39	11)
BP Vul	55393.5177	.0039	AG	−0.0498	s	GCVS 2009	-Ir	30	11)
BQ Vul	55478.4138	.0004	FR	+0.7036		GCVS 2009	o	40	11)
FF Vul	55393.4710	.0025	AG	−0.0740		GCVS 2009	-Ir	30	11)
FM Vul	55478.3620	.0045	AG	+0.0286	s	GCVS 2009	-Ir	34	11)
GO Vul	55430.3734	.0025	AG	−0.0384		GCVS 2009	-Ir	41	11)
IW Vul	55430.5477	.0040	AG	−0.0538		GCVS 2009	-Ir	39	11)
GSC 01330-00287	55578.3157	.0025	AG	+0.0014	s	BAVR 54.105	-Ir	46	11)
	55578.4866	.0015	AG	−0.0020		BAVR 54.105	-Ir	46	11)
GSC 01330-00293	55578.5662	.0045	AG	−0.0088		BAVR 57.232	-Ir	46	11)
GSC 02135-02603	53672.2694	.0006	FR				o	34	8)
	55409.5253	.0003	FR				o	49	8)
	55418.3953	.0004	FR				o	52	8)
	55418.5743	.0006	FR				o	52	8)
	55429.4324	.0005	FR				o	44	8)
GSC 02161-01310	55473.3473	.0006	FR				o	46	11)
GSC 02192-01283	55481.3944	.0044	AG	−0.0458		IBVS 5500 No.22	-Ir	41	11)
GSC 02361-02410	55598.3934	.0006	AG				-Ir	59	11)
GSC 02673-02495	55397.4183	.0180	AG	+0.0530	s	PZP 10.4	-Ir	38	11)
GSC 03187-01564	55391.5230	.0031	AG				-Ir	26	11)
	55462.4567	.0040	AG				-Ir	34	11)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
GSC 03187-01564	55462.6090	.0025	AG				-Ir	33	11)
GSC 03210-01456	55391.5530	.0003	AG	−0.1493		PZP 10.13	V	25	11)
GSC 03575-03593	55429.4383	.0019	AG	+0.0045		IBVS 5700 No.74	-Ir	30	11)
	55462.4575	.0031	AG	+0.0026		IBVS 5700 No.74	-Ir	34	11)
GSC 03575-06239	55429.3666	.0036	AG	+0.0409	s	PZP 10.4	-Ir	31	11)
GSC 03576-00170	52862.5033	.0008	AG	+0.0595	s	IBVS 5724	-Ir	51	2)
GSC 03618-00162	55451.3968	.0083	AG	+0.0271		PZP 10.4	-Ir	59	11)
	55451.5182	.0092	AG	+0.0282	s	PZP 10.4	-Ir	59	11)
GSC 03618-00448	55451.3944	.0114	AG	+0.0085	s	PZP 10.4	-Ir	59	11)
	55463.5554	.0151	AG	+0.0056	s	PZP 10.4	-Ir	36	11)
GSC 03619-00047	55430.3854	.0065	AG	−0.0038		PZP 10.4	-Ir	47	11)
	55451.4887	.0070	AG	+0.0065	s	PZP 10.4	-Ir	59	11)
	55463.3599	.0077	AG	−0.0024		PZP 10.4	-Ir	32	11)
GSC 03675-01186	55499.2637	.0004	AG	+0.0168	s	IBVS 5700 No.67	-Ir	48	11)
	55499.4124	.0010	AG	+0.0169		IBVS 5700 No.67	-Ir	48	11)
	55499.5616	.0025	AG	+0.0176	s	IBVS 5700 No.67	-Ir	48	11)
GSC 03679-01920	55499.2991	.0003	AG	+0.0045		IBVS 5700 No.76	-Ir	48	11)
GSC 03688-01184	55499.4488	.0026	AG	+0.0013		PZP 10.4	-Ir	48	11)
	55499.6316	.0030	AG	+0.0044	s	PZP 10.4	-Ir	48	11)
GSC 04009-00670	55409.5001	.0073	AG	−0.0029		PZP 10.4	-Ir	28	11)
	55514.4790	.0062	AG	−0.0080	s	PZP 10.4	-Ir	39	11)
GSC 04030-02020	55374.4429	.0031	AG				-Ir	38	11)
	55409.4380	.0012	AG				-Ir	15	11)
	55479.2941	.0013	AG				-Ir	58	11)
	55479.4324	.0018	AG				-Ir	58	11)
	55479.5689	.0005	AG				-Ir	58	11)
	55491.3259	.0037	AG				-Ir	61	11)
	55491.4624	.0016	AG				-Ir	61	11)
	55491.5976	.0018	AG				-Ir	61	11)
	55514.4290	.0007	AG				-Ir	40	11)
	55514.5662	.0009	AG				-Ir	40	11)
GSC 04285-00122	55480.4356	.0054	AG	−0.0008		PZP 10.4	-Ir	55	11)
	55480.6234	.0146	AG	−0.0003	s	PZP 10.4	-Ir	55	11)
GSC 04339-01166	55590.3714	.0090	AG	−0.1425		PZP 10.13	-Ir	98	11)
	55599.3729	.0171	AG	−0.1906		PZP 10.13	-Ir	76	11)
GSC 04497-00283	55391.5513	.0015	AG				-Ir	34	11)
GSC 04502-01040	55391.3894	.0013	AG	−0.0590		IBVS 5700 No.60	-Ir	34	11)
	55391.5271	.0031	AG	−0.0565	s	IBVS 5700 No.60	-Ir	34	11)
NSVS 10123419	55275.3594	.0018	AG				-Ir	25	11)
TYC 4034-0836	55479.5438	.0143	AG				-Ir	58	11)
TYC 4502-0138	55391.3933	.0010	AG	−0.0634		IBVS 5700 No.8	-Ir	34	11)
U-A2 1125-18642389	55481.3970	.0040	AG	+0.0260		IBVS 5700 No.64	-Ir	40	11)
U-A2 1200-11760524	55387.5419	.0017	AG				-Ir	31	11)
U-A2 1200-12680286	55429.4975	.0023	AG	−0.0160	s	IBVS 5700 No.73	-Ir	34	11)
U-A2 1275-15124020	55462.5273	.0026	AG	−0.0035		IBVS 5700 No.72	-Ir	34	11)
U-A2 1275-15134722	55462.3902	.0023	AG	+0.0082		IBVS 5700 No.71	-Ir	34	11)
U-A2 1425-02081650	55499.4139	.0006	AG	−0.0388		IBVS 5700 No.65	-Ir	48	11)
	55499.5748	.0014	AG	−0.0395	s	IBVS 5700 No.65	-Ir	48	11)
U-A2 1500-01208912	55514.4820	.0022	AG	+0.0167	s	IBVS 5900 No.6	-Ir	40	11)
	55514.6310	.0022	AG	+0.0146		IBVS 5900 No.6	-Ir	40	11)
U-B1 0903-0102370	55600.3809	.0025	AG				-Ir	40	11)
	55600.5234	.0006	AG				-Ir	40	11)
U-B1 1031-0151441	55578.3557	.0009	AG				-Ir	45	11)
	55578.5185	.0017	AG				-Ir	45	11)
U-B1 1041-0581206	55396.5280	.0028	AG	−0.0036		PZP 10.4	-Ir	25	11)
U-B1 1135-0102876	55598.4255	.0021	AG				-Ir	53	11)
	55598.5863	.0018	AG				-Ir	53	11)
U-B1 1362-0458803	55479.4769	.0451	AG	+0.6220		PZP 10.13	-Ir	42	11)
U-B1 1398-0469064	55380.5528	.0003	AG	−0.0372		PZP 10.4	-Ir	35	11)
U-B1 1400-0455467	55479.4978	.0209	AG	+0.1738		PZP 10.13	-Ir	42	11)
	55482.4190	.0119	AG	+0.0241		PZP 10.13	-Ir	36	11)

Table 1: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$		Bibliography	Fil	n	Rem
U-B1 1416-0454010	55430.3865	.0040	AG				-Ir	47	11)
	55451.3855	.0032	AG				-Ir	59	11)
	55451.5485	.0042	AG				-Ir	59	11)
U-B1 1440-0411990	55451.3934	.0033	AG	−0.0636	s	IBVS 5700 No.54	-Ir	59	11)
	55451.5986	.0048	AG	−0.0623		IBVS 5700 No.54	-Ir	59	11)
	55480.3501	.0035	AG	−0.0632	s	IBVS 5700 No.54	-Ir	48	11)
	55480.5513	.0049	AG	−0.0660		IBVS 5700 No.54	-Ir	48	11)
U-B1 1441-0441871	55380.4906	.0023	AG	+0.0062		PZP 10.13	-Ir	35	11)
U-B1 1447-0060874	55499.5607	.0091	AG	−0.0038	s	PZP 10.4	-Ir	48	11)
U-B1 1492-0009970	55409.5064	.0031	AG	+0.1258		PZP 10.13	-Ir	28	11)
	55462.5528	.0120	AG	−0.1411		PZP 10.13	-Ir	45	11)
U-B1 1500-0005759	55462.4932	.0324	AG	+0.1037		AJ 133.1470	-Ir	46	11)
	55473.4307	.0043	AG	+0.1189		AJ 133.1470	-Ir	56	11)
	55514.5786	.0095	AG	+0.1474		AJ 133.1470	-Ir	39	11)
U-B1 1505-0372164	55409.4328	.0008	AG	−0.0667		PZP 10.13	-Ir	28	11)
	55462.3989	.0036	AG	+0.1104		PZP 10.13	-Ir	46	11)
	55462.5526	.0035	AG	−0.0501		PZP 10.13	-Ir	46	11)
U-B1 1508-0029126	55491.3684	.0016	AG	+0.0017	s	IBVS 5900 No.5	-Ir	61	11)
	55491.5299	.0030	AG	+0.0042		IBVS 5900 No.5	-Ir	61	11)
	55514.4241	.0027	AG	+0.0021		IBVS 5900 No.5	-Ir	40	11)
	55514.5826	.0024	AG	+0.0016	s	IBVS 5900 No.5	-Ir	40	11)
U-B1 1514-0040346	55479.3280	.0062	AG	−0.1676		PZP 10.13	-Ir	56	11)
	55479.5545	.0046	AG	+0.0589		PZP 10.13	-Ir	56	11)
	55514.5973	.0122	AG	+0.0849		PZP 10.13	-Ir	40	11)

Table 2: Times of maxima of pulsating stars

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
XY And	55591.2691	.0009	MZ	+0.0261	GCVS 2009	-Ir	64	2)
CC And	55462.4633	.0035	PGL	+0.0261	GCVS 2009	V	345	12)
FI And	55578.3486	.0010	MZ	+0.0795	GCVS 2009	-Ir	143	2)
GP And	55462.4420	.0035	PGL	+0.0042	GCVS 2009	V	238	13)
SW Aqr	55083.4434	.0009	FLG	+0.0161	GCVS 2009	V	186	9)
CY Aqr	55446.3830	.0003	FLG	−0.0027	GCVS 2009	V	143	9)
eta Aql	55447.41	.00	VLM	+0.18	GCVS 2009	o	70	15) 16)
CQ Boo	55351.5333	.0010	TMG	−0.0370	BAVR 48,189	o	286	6) 19)
UY Cam	55591.451	.001	AG	+0.067	BAVR 49,41	-Ir	63	11)
EW Cam	55591.492	.001	AG			-Ir	63	11)
RW Cnc	53381.4839	.0015	JU	+0.1872	GCVS 2009	o	30	2)
W CVn	55340.453	.005	MOO	−0.020	SAC Vol.70	V	37	13)
BR Cas	55546.2382	.0030	MZ	+0.2960	GCVS 2009	-Ir	138	2)
PS Cas	55499.422	.001	AG	−0.184	GCVS 2009	-Ir	48	11)
QY Cas	55548.2725	.0030	MZ	−0.1815	GCVS 2009	-Ir	73	2)
V363 Cas	55473.643	.001	AG	+0.054	BAVR 49,41	V	56	11)
RZ Cep	55445.3782	.0010	MZ	−0.1271	GCVS 2009	-Ir	114	2) 18)
	55445.4102	.0010	MZ	−0.0951	GCVS 2009	-Ir	114	2) 19)
	55491.3701	.0020	ALH	−0.1292	GCVS 2009	V	621	4) 18)
	55491.3987	.0020	ALH	−0.1006	GCVS 2009	V	621	4) 19)
EL Cep	55482.642	.001	AG	+0.118	GCVS 2009	-Ir	103	11)
EZ Cep	55499.433	.001	AG	+0.088	GCVS 2009	-Ir	92	11)
delta Cep	55200.875	.001	VLM	−0.209	GCVS 2009	o	24	15) 16)
XX Cyg	55396.4642	.0050	ALH	+0.0026	GCVS 2009	V	128	4)
	55430.4517	.0006	ALH	+0.0041	GCVS 2009	V	287	4)
	55430.5857	.0010	ALH	+0.0032	GCVS 2009	V	287	4)
	55463.3596	.0035	PGL	+0.0049	GCVS 2009	V	121	12)
	55478.328	.001	MOO	+0.004	GCVS 2009	V	109	13)
	55483.3200	.0035	PGL	+0.0052	GCVS 2009	V	226	12)
DM Cyg	55508.2816	.0035	PGL	−0.0067	A&A 476.307 2007	V	124	12)
V798 Cyg	55478.337	.001	AG	−0.061	GCVS 2009	-Ir	34	11)
V838 Cyg	55481.3421	.0010	MZ	+0.0204	GCVS 2009	-Ir	96	2)

Table 2: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
V939 Cyg	55381.528	.001	AG	+0.070	BAVM 92	-Ir	87	11)
V944 Cyg	55481.368	.005	FR	+0.104	GCVS 2009	o	22	11)
V1962 Cyg	55479.3512	.0010	MZ			-Ir	108	2)
	55480.3684	.0010	MZ			-Ir	94	2)
BK Del	55430.5727	.0020	SB	+0.1509	GCVS 2009	V	243	10)
	55480.3103	.0020	SB	+0.1527	GCVS 2009	V	152	10)
CD Del	55396.520	.001	AG	−0.010	GCVS 2009	-Ir	25	11)
AR Her	55442.5022	.0035	PGL	+0.0737	BAVR 52,3	V	225	12)
	55444.3771	.0035	PGL	+0.0687	BAVR 52,3	V	337	12)
	55451.4097	.0035	PGL	+0.0515	BAVR 52,3	V	133	12)
CK Her	55379.399	.002	AG	−0.041	GCVS 2009	-Ir	35	11)
	55396.531	.001	AG	−0.042	GCVS 2009	-Ir	32	11)
CM Her	55396.502	.001	AG	+0.105	GCVS 2009	-Ir	32	11)
V347 Her	55389.396	.001	AG	−0.134	GCVS 2009	-Ir	50	11)
V862 Her	55352.4620	.0020	MZ			-Ir	108	2)
	55374.4560	.0050	MZ			-Ir	114	2)
	55429.4525	.0080	MZ			-Ir	117	2)
CH Lac	55380.508	.001	AG	+0.012	GCVS 2009	-Ir	35	11)
SZ Lyn	55591.381	.001	AG	+0.026	GCVS 2009	V	68	11)
	55591.500	.001	AG	+0.025	GCVS 2009	V	68	11)
	55591.621	.001	AG	+0.025	GCVS 2009	V	68	11)
TW Lyn	55591.637	.001	AG	+0.062	GCVS 2009	-Ir	68	11)
WZ Lyn	55591.444	.001	AG			-Ir	68	11)
AN Lyn	55600.367	.002	AG			-Ir	160	11)
	55600.466	.002	AG			-Ir	160	11)
	55600.564	.001	AG			-Ir	160	11)
	55600.661	.003	AG			-Ir	160	11)
RZ Lyr	55480.3068	.0035	PGL	−0.0110	BAVR 48,189	V	253	12)
CN Lyr	55397.4471	.0049	PGL	−0.0001	A&A 476.307 2007	V	140	12)
	55479.3134	.0035	PGL	+0.0010	A&A 476.307 2007	V	369	12)
	55486.307 :	.004	PGL	+0.001	A&A 476.307 2007	V	89	12)
IO Lyr	55397.4339	.0056	PGL	−0.0344	GCVS 2009	V	261	13)
	55445.3339	.0035	PGL	−0.0356	GCVS 2009	V	195	12)
NR Lyr	55379.415	.001	AG	−0.024	GCVS 2009	-Ir	32	11)
GM Mon	55591.3287	.0020	SB			o	78	10)
	55592.3284	.0020	MZ			-Ir	135	2) 18)
	55599.315	.003	SB			o	68	10)
ST Oph	55428.4243	.0017	FLG	+0.0029	BAVR 48,189	V	128	9)
AX Oph	55385.450	.001	AG	−0.018	GCVS 2009	-Ir	37	11)
V337 Ori	55598.430	.001	AG	+0.015	GCVS 2009	-Ir	54	11)
VV Peg	55481.3208	.0035	PGL	−0.0197	GCVS 2009	V	241	12)
BH Peg	55460.4933	.0019	SCI	−0.0071	BAVR 47,67	o	199	2)
	55473.313	.002	SCI	−0.007	BAVR 47,67	o	127	2)
	55482.2849	.0025	SCI	−0.0090	BAVR 47,67	o	126	2)
BP Peg	55481.317	.001	AG	−0.026	BAVR 48,189	-Ir	39	11)
	55481.431	.001	AG	−0.022	BAVR 48,189	-Ir	39	11)
	55481.536	.001	AG	−0.026	BAVR 48,189	-Ir	39	11)
CD Peg	55479.3883	.0020	SB	−0.2219	GCVS 2009	V	159	10)
DY Peg	55439.4733	.0035	PGL	−0.0102	GCVS 2009	V	157	12)
	55444.5053	.0014	PGL	−0.0102	GCVS 2009	V	320	12)
	55446.4011	.0028	PGL	−0.0104	GCVS 2009	V	145	12)
	55451.5064	.0028	PGL	−0.0100	GCVS 2009	V	96	12)
	55453.3285	.0035	PGL	−0.0110	GCVS 2009	V	114	12)
AR Per	55579.388	.001	AG	+0.061	GCVS 2009	-Ir	82	11)
ET Per	55462.4385	.0002	MZ	−0.0304	BAVR 49,41	-Ir	119	2)
KV Per	55483.4090	.0010	MZ	+0.0257	GCVS 2009	-Ir	86	2)
	55491.3780	.0010	MZ	+0.0228	GCVS 2009	-Ir	108	2)
	55494.3731	.0015	MZ	+0.0285	GCVS 2009	-Ir	148	2)
SS Psc	55481.2839	.0030	ALH	+0.0030	BAVR 47,67	V	190	8)
SY Psc	55495.4070	.0010	MZ	+0.1268	GCVS 2009	-Ir	122	2)
AI Tau	55572.3690	.0025	MZ	−0.0937	GCVS 2009	-Ir	41	2)

Table 2: (cont.)

Variable	HJD 24.....	±	Obs	$O-C$	Bibliography	Fil	n	Rem
UV Tri	55461.516	.001	AG			-Ir	63	11)
	55461.620	.001	AG			-Ir	63	11)
UZ UMa	55591.637	.001	AG	+0.001	GCVS 2009	-Ir	63	11)
GSC 03197-00817	54312.502	.003	AG			-Ir	26	1)
GSC 03755-00845	55600.2739	.0003	SCI			o	57	2)
U-A2 1200-07442272	53151.419	.001	AG	+0.004	IBVS 5700 No.69	o	39	1)
U-A2 1425-00752967	55473.332	.001	AG	−0.024	IBVS 5700 No.59	-Ir	56	11)
	55514.454	.001	AG	−0.023	IBVS 5700 No.59	-Ir	38	11)
U-B1 1118-0137672	54830.450	.002	AG			-Ir	61	11)
U-B1 1383-0445772	55391.431	.001	AG	+0.009	PZP 10.13	-Ir	26	11)
	55462.368	.001	AG	+0.034	PZP 10.13	-Ir	34	11)
	55462.495	.001	AG	+0.033	PZP 10.13	-Ir	34	11)
U-B1 1424-0504416	55380.498	.010	AG	−0.069	PZP 10.13	-Ir	35	11)
	55430.430	.005	AG	−0.027	PZP 10.13	-Ir	47	11)
U-B1 1646-0035146	55590.374	.001	AG	+0.064	PZP 10.13	-Ir	98	11)

Observers:

AG: Agerer, F., Tiefenbach
ALH: Alich, K., Schaffhausen (CH)
BO: Bode, H.-J., Hannover
FLG Flechsig, Dr. G.-U., Teterow
FR: Frank, P., Velden
JU: Jungbluth, Dr. H., Karlsruhe
MOO: Moos, C., Netphen
MS: Moschner, W., Lennestadt
MZ: Maintz, Dr. G., Bonn
PGL: Pagel, Dr. L., Klockenhagen
PRK: Proksch, W., Winhöring
SB: Steinbach, Dr. H., Neu-Anspach
SCI: Schmidt, U., Karlsruhe
SIR: Schirmer, J., Willisau (CH)
TMG: Team Martinus Gymnasium, Linz (A)
VLM: Vollmann, W., Wien (A)

Remarks:

:	uncertain
s	secondary minimum
16)	normal maximum
17)	normal minimum
18)	double maxima: time of the first maximum
19)	double maxima: time of the second maximum
20)	not much descend
	CCD-Cameras
1)	ccd-camera ST-6: chip 375*242 uncoated
2)	ccd-camera ST-7
3)	ccd-camera ST-8XME
4)	ccd-camera ST-8XMEI: chip KAF1603ME
5)	ccd-camera ST-9: chip 512*512
6)	ccd-camera ST-9E
7)	ccd-camera OES-LcCCD11
8)	ccd-camera OES-LcCCD12
9)	ccd-camera Sigma 402: chip KAF0402ME
10)	ccd-camera Sigma 402ME
11)	ccd-camera Sigma 1603
12)	ccd-camera Artemis 4021
13)	ccd-camera QHY8
14)	ccd-camera IOS (TI245)
15)	ccd-camera Canon powershot g3
	Filter
o	without filter
B	B-filter
V	V-filter
-Ir	-Ir-filter

References:

A&A	Astronomy & Astrophysics
AJ vvv,ppp	Astronomical Journal volume, pages
BAVM nnn	BAV Mitteilungen No. nnn
BAVR vv,ppp	BAV Rundbrief volume, pages
GCVS 2009	General Catalogue of Variable Stars, version: iii.dat 20.11.2009
IBVS nnnn	Information Bulletin on Variable Stars No. nnnn
PZP vol.n	Peremennye Zvezdy Prilozhenie Vol, No.
SAC vv	Rocznik Astronomiczny No. vv, Krakow (SAC)
	Star catalogues
GSC	The HST Guide star Catalogue 1.2
NSVS	Northern Sky Variability Survey
TYC	Tycho Catalogue
U-A2	USNO A2.0 catalogue
U-B1	USNO B1.0 catalogue

ERRATUM FOR IBVS 5802 (BAVM 186)

GSC 03776.00170 52862.5033 AG has to be deleted

ERRATUM FOR IBVS 5918 (BAVM 209)

DD Mon 54840.3953 AG has to be deleted

ERRATUM FOR IBVS 5941 (BAVM 212)

TW Her 55066.4339 MOO has to be deleted

ERRATUM FOR IBVS 5959 (BAVM 214)

UY Boo 55311.5195 PGL has to be deleted

COMMISSIONS 27 AND 42 OF THE IAU
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PQ Ser UNVEILED - NOT A CATACLYSMIC VARIABLE

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PQ Ser first appeared in the HIPPARCOS catalog as HIP 76538 (Perryman et al., 1997) and then it was listed as a nova-like cataclysmic variable (CV) by Kazarovets et al. (1999). It appears in many places under the classification of a nova-like (NL) cataclysmic variable (CV). Examples include the HIPPARCOS catalog, SIMBAD, and the AAVSO databases, and the Downes et al. CV catalog. Many of these sources also list the spectral class as F0, which is an apparent contradiction with NL: . Because PQ Ser is among the brightest stars listed as a CV, it is a tempting target for high resolution spectroscopy or high time resolution studies, for which the bright apparent magnitude of 8.1 is an obvious advantage.

Despite the fact that it is one of the brightest CVs known in the northern hemisphere, there is very little literature data on PQ Ser, including a lack of published spectra that might clarify its nature. NL CVs are semi-detached binary systems in which a white dwarf accrets material from a low-mass, low main sequence star (K/M dwarf) with mass transfer rates of $\sim 10^{-9}$-$10^{-8} M_{\odot} yr^{-1}$. Typical orbital periods of those systems are less than 8 hours, therefore orbitally-induced variations are commonly present in their light curves. Due to their relatively high mass transfer rate, their spectra are dominated by accretion-induced lines, the most prominent of which are Balmer emission lines, HeI and HeII emission. Here we present time-resolved photometry and high-resolution spectra of the star, discussing its nature, arguing that it is an F0 star, and not a CV.

Spectra were obtained with the Echelle Spectrograph on du Pont 2.5-m telescope of the Las Campanas Observatories during 2010-Feb-16 (UT). The Echelle Spectrograph provides wavelength coverage from 3700-9000Å at a typical resolution of ∼40,000. For our observations, we used the 1 arcsecond slit and no CCD binning. Spectrum of a ThAr lamp was obtained for wavelength calibration at the position of the telescope, before object observations. Through the night, the sky was clear and the moon 90 degrees away from the target, however scattered sunlight from the full moon is still present in the blue side of the spectra despite our careful sky subtraction. With this setup, we obtained three spectra of PQ Ser using exposure times of 900 sec, which were in turn median-coadded to produce the final spectrum presented and discussed in this communication. For data processing and reductions we used IRAF's[1] echelle package.

[1]IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

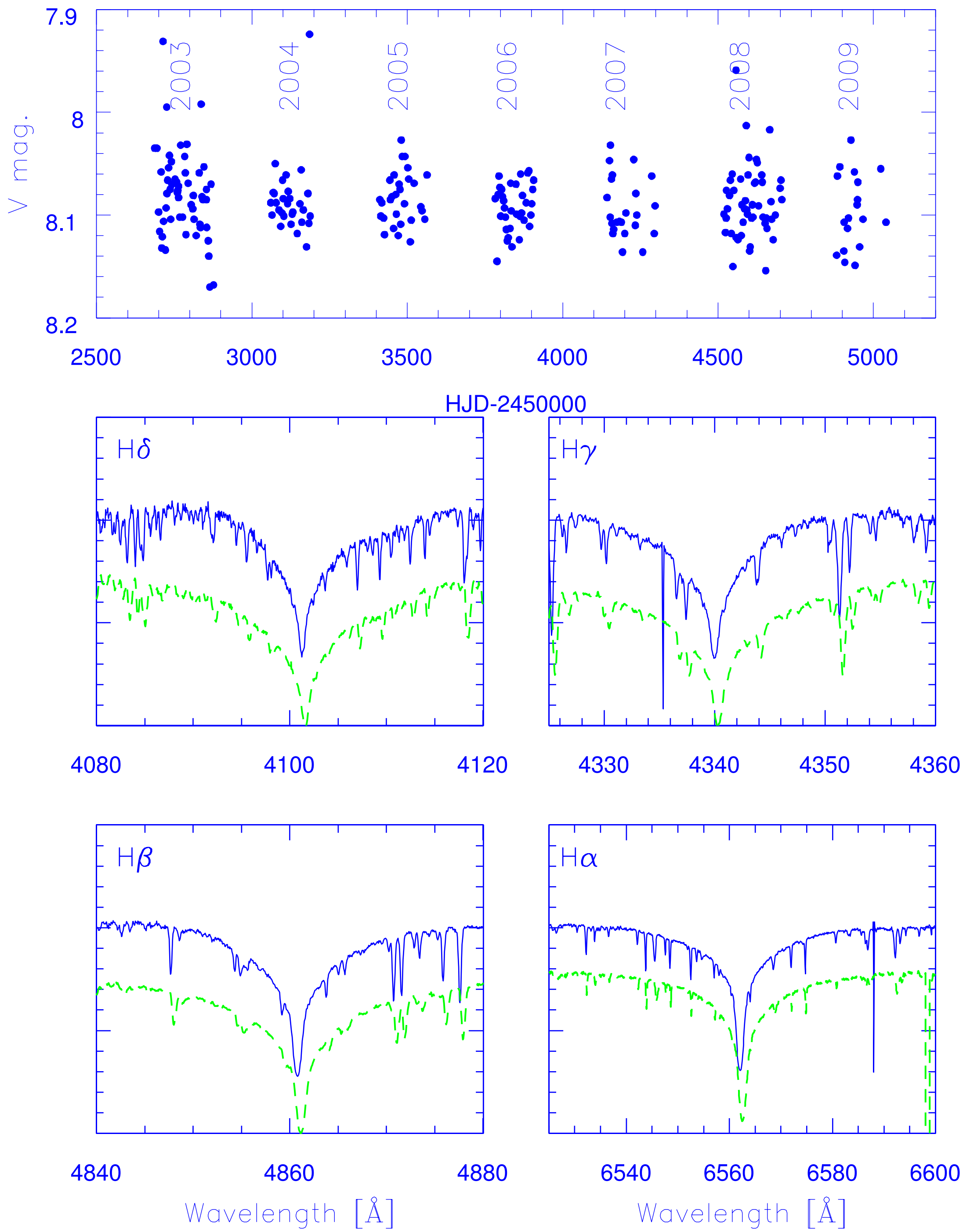

Figure 1. Top panel: ASAS light curve of PQ Ser. Typical error bars are 0.04 mag, which are omitted for clarity. Middle and bottom panels: Balmer lines from the median combined echelle spectra of PQ Ser are presented in blue continuous lines (HJD=2455608.860313). The F0V star HD 32537 is also plotted with green dashed lines for comparison. The striking similarities of the spectrum of HD 32537 with the spectrum of PQ Ser confirms its classification as an F0V star.

PQ Ser is also included in the All Sky Automated Survey (ASAS; Pojmanski, 2002) target list, and was observed with a V filter since 2003-February-15. Data reductions were conducted with the ASAS pipeline and the final output of the photometry is provided in the ASAS database, along with photometry errors. The data are flagged based on the photometric quality of the frame; we retained only data of grades A and B (best quality). The final light curve consists of 238 points spread over 6.4 years.

The full ASAS light curve (all seven years of photometric monitoring) is presented in the top panel of Figure 1. Overall, the long-term light curve is smooth, having an amplitude of 0.15 mag and no long-term trend nor any features (such as low states or small outbursts) which sometimes appear in nova-like CVs. We used the Peranso period analysis software to obtain Lomb-Scarle periodograms. A possible peak at 0.1019d has low significance and the data folded on this period showed no significant pattern. There is good overall evidence that PQ Ser is indeed variable, from the original HIPPARCOS detection of variability, to the Nichols et al. (2010) variability study of Chandra guide stars (0.02 mag change over 8 hrs). However, we see no indication of periodicities in the ASAS photometry.

The middle and bottom panels show the Balmer line regions of the averaged echelle spectrum of PQ Ser. In general, CaII H and K, all Balmer lines, NaD and the CaII IR triplet lines are in absorption, with complete lack of any emission component or any HeI or HeII emission lines, which are usual indications of an accretion disk. According to the Simbad database, this object is classified as F0. We used the ELODIE[2] database to retrieve a number of similar-resolution F0 stars, and compare them with the spectrum of PQ Ser. A good match is HD 32537 (F0V), which is also shown in Figure 1 (green dashed lines). The two stars exhibit strong Balmer absorption, with traces of low excitation metal lines of Fe I, Ca I and Mn I absorption, characteristic of the class.

We also checked the individual spectra for short-term secular variations in the line profiles that could indicate RV variations and the presence of a companion; we could not find any.

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Pojmanski, G. 2002, Acta Astronomica, 52, 397

[2]http://atlas.obs-hp.fr/elodie/

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THE GEOS RR Lyr SURVEY

Thirteenth List of Maxima of RR Lyr Stars Observed by the Automated Telescopes TAROT

(GEOS Circular RR 46)

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[4] Observatoire de Haute-Provence, Saint Michel l'Observatoire, France

We present here the thirteenth list of light maxima of RR Lyrae stars from the GEOS RR Lyr Survey (Le Borgne et al., 2007), a GEOS program (`http://geos.webs.upv.es/`, Boninsegna et al., 2002) of observations of RR Lyr stars using the automatic telescopes TAROT (`http://tarot.obs-hp.fr`, Klotz et al., 2009). The present list contains 656 maxima observed between January and December 2010 (Table 1).
A description of the present list may be found in the former lists (for example Le Borgne et al., 2008). The data are also available in the GEOS RR Lyr web database (`http://rr-lyr.ast.obs-mip.fr/dbrr/dbrr-V1.0_0.php`). The $O-C$'s are computed with the GCVS elements (Kholopov et al., 1985) when available. Otherwise, the reference of the elements, if exists, is given as a footnote of Table 1.

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Table 1: maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
SW And	55481.591±0.004	−0.816	84448.	C	TY Aps	55294.870±0.003	0.042	31032.	LS
SW And	55497.512±0.001	−0.817	84484.	C	VX Aps	55327.891±0.002	0.180	43519.	LS
SW And	55510.341±0.002	−0.814	84513.	C	VX Aps	55346.797±0.004	0.187	43558.	LS
SW And	55524.492±0.002	−0.816	84545.	C	VX Aps	55447.618±0.002	0.216	43766.	LS
SW And	55540.412±0.004	−0.818	84581.	C	XZ Aps	55285.644±0.003	0.087	45231.	LS
XX And	55198.434±0.002	0.240	22291.	C	XZ Aps	55342.614±0.004	0.076	45328.	LS
XX And	55414.542±0.003	0.247	22590.	C	XZ Aps	55403.685±0.005	0.054	45432.	LS
XX And	55432.608±0.002	0.244	22615.	C	BS Aps	55312.567±0.003	0.010	30714.	LS
XX And	55451.401±0.002	0.246	22641.	C	BS Aps	55414.526±0.006	0.022	30889.	LS
XX And	55461.521±0.004	0.247	22655.	C	BS Aps	55418.603±0.005	0.021	30896.	LS
XX And	55471.637±0.002	0.245	22669.	C	BS Aps	55432.593±0.005	0.030	30920.	LS
XX And	55497.655±0.004	0.244	22705.	C	EX Aps	55354.532±0.002	0.015	58120.	LS
XX And	55505.608±0.002	0.247	22716.	C	EX Aps	55396.522±0.004	0.015	58209.	LS
XX And	55511.389±0.003	0.246	22724.	C	EX Aps	55402.651±0.003	0.010	58222.	LS
XX And	55513.556±0.002	0.245	22727.	C	EX Aps	55404.542±0.002	0.014	58226.	LS
XX And	55524.397±0.003	0.244	22742.	C	EX Aps	55411.622±0.002	0.017	58241.	LS
XX And	55526.565±0.002	0.244	22745.	C	EX Aps	55446.528±0.002	0.010	58315.	LS
XX And	55527.288±0.002	0.244	22746.	C	SW Aqr	55388.879±0.003	−0.002	65951.	LS
XX And	55542.468±0.002	0.247	22767.	C	SW Aqr	55409.548±0.002	−0.001	65996.	C
AT And	55403.503±0.005	−0.003	21170.	C	SW Aqr	55420.571±0.003	−0.002	66020.	C
AT And	55416.459±0.003	−0.002	21191.	C	SW Aqr	55423.787±0.004	−0.001	66027.	LS
AT And	55429.416±0.004	−0.000	21212.	C	SW Aqr	55445.374±0.002	−0.001	66074.	C
AT And	55442.373±0.005	0.002	21233.	C	SW Aqr	55453.642±0.002	−0.001	66092.	LS
AT And	55450.389±0.003	−0.002	21246.	C	SX Aqr	55401.557±0.003	−0.124	29130.	C
AT And	55458.414±0.007	0.003	21259.	C	SX Aqr	55423.521±0.002	−0.124	29171.	C
AT And	55469.513±0.003	−0.003	21277.	C	SX Aqr	55426.736±0.002	−0.123	29177.	LS
AT And	55511.463±0.004	−0.003	21345.	C	SX Aqr	55444.416±0.002	−0.122	29210.	C
AT And	55513.317±0.004	0.000	21348.	C	TZ Aqr	55424.440±0.003	0.014	31295.	C
AT And	55527.501±0.003	−0.005	21371.	C	TZ Aqr	55425.584±0.003	0.016	31297.	C
AT And	55532.443±0.005	0.002	21379.	C	TZ Aqr	55440.433±0.003	0.014	31323.	C
AT And	55534.288±0.003	−0.004	21382.	C	TZ Aqr	55452.427±0.002	0.013	31344.	C
AT And	55542.308±0.002	−0.004	21395.	C	YZ Aqr	55395.754±0.003	0.061	36293.	LS
CI And	55199.402±0.002	0.117	40190.	C	YZ Aqr	55396.854±0.003	0.057	36295.	LS
CI And	55415.590±0.002	0.121	40636.	C	YZ Aqr	55426.659±0.003	0.057	36349.	LS
CI And	55417.528±0.002	0.120	40640.	C	YZ Aqr	55448.739±0.002	0.060	36389.	LS
CI And	55431.586±0.002	0.121	40669.	C	YZ Aqr	55453.706±0.002	0.060	36398.	LS
CI And	55449.516±0.002	0.117	40706.	C	AA Aqr	55388.822±0.005	−0.130	56891.	LS
CI And	55453.392±0.002	0.115	40714.	C	AA Aqr	55391.870±0.003	−0.126	56896.	LS
CI And	55455.341±0.006	0.125	40718.	C	AA Aqr	55416.835±0.004	−0.126	56937.	LS
CI And	55462.603±0.003	0.116	40733.	C	AA Aqr	55427.792±0.003	−0.129	56955.	LS
CI And	55488.291±0.002	0.114	40786.	C	AA Aqr	55482.594±0.003	−0.127	57045.	LS
CI And	55525.621±0.002	0.121	40863.	C	BN Aqr	55422.791±0.002	0.618	37368.	LS
CI And	55526.588±0.002	0.118	40865.	C	BN Aqr	55424.669±0.002	0.617	37372.	LS
CI And	55527.557±0.002	0.118	40867.	C	BO Aqr	55424.748±0.002	0.160	19889.	LS
CI And	55533.378±0.002	0.123	40879.	C	BO Aqr	55426.836±0.004	0.166	19892.	LS
CI And	55534.349±0.002	0.124	40881.	C	BO Aqr	55449.737±0.004	0.164	19925.	LS
NX And [1]	55198.485±0.003	0.002	25549.	C	BR Aqr	55417.848±0.003	−0.170	36901.	LS
NX And [1]	55430.491±0.005	0.007	25907.	C	BR Aqr	55426.521±0.002	−0.170	36919.	C
NX And [1]	55505.663±0.003	0.006	26023.	C	BR Aqr	55454.468±0.002	−0.172	36977.	C
NX And [1]	55511.491±0.003	0.001	26032.	C	BR Aqr	55495.425±0.002	−0.175	37062.	C
NX And [1]	55524.454±0.003	0.004	26052.	C	BR Aqr	55523.374±0.003	−0.175	37120.	C
WY Ant	55211.712±0.002	0.227	25362.	LS	CP Aqr	55415.457±0.001	−0.122	37831.	C
WY Ant	55238.703±0.002	0.225	25409.	LS	CP Aqr	55416.385±0.003	−0.121	37833.	C
WY Ant	55299.589±0.003	0.232	25515.	LS	CP Aqr	55437.699±0.002	−0.124	37879.	LS
BN Ant	55239.682±0.002			LS	CP Aqr	55451.603±0.003	−0.122	37909.	LS
TY Aps	55248.712±0.003	0.040	30940.	LS	CP Aqr	55454.384±0.002	−0.121	37915.	C

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
CP Aqr	55464.579±0.002	−0.121	37937.	LS	RV Cap	55445.693±0.004	−0.025	48158.	LS
CP Aqr	55473.382±0.002	−0.123	37956.	C	RV Cap	55454.656±0.005	−0.017	48178.	LS
DN Aqr	55427.682±0.005	0.045	42607.	LS	RV Cap	55463.592±0.004	−0.036	48198.	LS
DN Aqr	55444.781±0.005	0.033	42634.	LS	IU Car	55478.769±0.005	0.217	18698.	LS
DN Aqr	55455.561±0.005	0.039	42651.	LS	IU Car	55501.621±0.003	0.217	18729.	LS
DN Aqr	55505.623±0.003	0.035	42730.	LS	IU Car	55506.778±0.004	0.214	18736.	LS
OX Aqr	55484.616±0.003			LS	IU Car	55509.734±0.006	0.221	18740.	LS
OX Aqr	55494.667±0.004			LS	IU Car	55526.711±0.005	0.244	18763.	LS
AA Aql	55409.734±0.002	0.039	85858.	LS	IU Car	55540.694±0.006	0.221	18782.	LS
AA Aql	55414.434±0.002	0.036	85871.	C	IU Car	55557.624±0.005	0.197	18805.	LS
AA Aql	55437.590±0.002	0.038	85935.	LS	V363 Cas	55408.603±0.003	0.642	35250.	C
V341 Aql	55437.562±0.005	0.041	24638.	LS	V363 Cas	55426.640±0.003	0.643	35283.	C
IN Ara	55414.682±0.005	0.117	44604.	LS	V363 Cas	55430.479±0.005	0.656	35290.	C
MS Ara	55338.760±0.005	0.413	52101.	LS	V363 Cas	55431.553±0.005	0.637	35292.	C
MS Ara	55418.554±0.004	0.414	52253.	LS	V363 Cas	55453.420±0.004	0.643	35332.	C
MS Ara	55439.549±0.003	0.410	52293.	LS	V363 Cas	55454.522±0.005	0.652	35334.	C
X Ari	55454.558±0.005	0.379	27445.	C	V363 Cas	55455.608±0.003	0.645	35336.	C
X Ari	55514.464±0.002	0.380	27537.	C	V363 Cas	55488.411±0.004	0.656	35396.	C
X Ari	55525.533±0.002	0.380	27554.	C	V363 Cas	55489.504±0.005	0.655	35398.	C
X Ari	55527.486±0.002	0.379	27557.	C	V363 Cas	55490.594±0.005	0.652	35400.	C
X Ari	55529.443±0.002	0.383	27560.	C	V363 Cas	55496.615±0.004	0.661	35411.	C
X Ari	55557.442±0.002	0.383	27603.	C	V363 Cas	55495.508±0.006	0.648	35409.	C
TZ Aur	55240.505±0.002	0.014	90223.	C	V363 Cas	55523.404±0.005	0.670	35460.	C
TZ Aur	55284.371±0.003	0.012	90335.	C	V363 Cas	55525.585±0.005	0.665	35464.	C
TZ Aur	55489.609±0.002	0.013	90859.	C	BI Cen	55202.807±0.002	0.057	40850.	LS
TZ Aur	55505.670±0.002	0.015	90900.	C	BI Cen	55359.612±0.002	0.061	41196.	LS
TZ Aur	55506.452±0.002	0.014	90902.	C	V499 Cen	55300.586±0.004	0.032	27195.	LS
TZ Aur	55507.626±0.002	0.013	90905.	C	RR Cet	55453.518±0.002	0.012	40273.	C
TZ Aur	55534.652±0.001	0.014	90974.	C	RR Cet	55454.621±0.002	0.009	40275.	C
TZ Aur	55542.487±0.004	0.015	90994.	C	RR Cet	55474.530±0.004	0.009	40311.	C
TZ Aur	55545.619±0.001	0.013	91002.	C	RR Cet	55504.392±0.002	0.007	40365.	C
TZ Aur	55547.577±0.002	0.013	91007.	C	RR Cet	55505.497±0.002	0.006	40367.	C
TZ Aur	55548.360±0.002	0.013	91009.	C	RR Cet	55524.300±0.004	0.006	40401.	C
TW Boo	55270.416±0.003	−0.060	53317.	C	RU Cet	55443.843±0.003	0.105	26638.	LS
V Cae	55543.830±0.004	−0.184	37179.	LS	RU Cet	55486.642±0.005	0.106	26711.	LS
AH Cam	55454.440±0.002	−0.451	45359.	C	RU Cet	55503.648±0.006	0.110	26740.	LS
AH Cam	55461.438±0.002	−0.459	45378.	C	RU Cet	55513.622±0.005	0.117	26757.	LS
AH Cam	55462.547±0.002	−0.456	45381.	C	RV Cet	55499.750±0.005	0.239	26285.	LS
AH Cam	55488.350±0.003	−0.464	45451.	C	RX Cet	55451.698±0.007	0.296	26714.	LS
AH Cam	55489.448±0.002	−0.473	45454.	C	RX Cet	55455.716±0.005	0.298	26721.	LS
AH Cam	55490.548±0.002	−0.479	45457.	C	RX Cet	55478.660±0.005	0.295	26761.	LS
AH Cam	55507.526±0.003	−0.463	45503.	C	RZ Cet	55445.817±0.004	−0.168	42183.	LS
AH Cam	55529.654±0.002	−0.458	45563.	C	RZ Cet	55446.833±0.003	−0.173	42185.	LS
AH Cam	55534.418±0.002	−0.488	45576.	C	RZ Cet	55455.519±0.004	−0.167	42202.	C
AH Cam	55541.439±0.002	−0.473	45595.	C	RZ Cet	55477.468±0.005	−0.175	42245.	C
TT Cnc	55547.504±0.003	0.096	27692.	C	RZ Cet	55485.641±0.004	−0.171	42261.	LS
W CVn	55230.651±0.002	−0.138	61310.	C	RZ Cet	55486.660±0.004	−0.174	42263.	LS
RU CVn	55343.501±0.002	0.225	36389.	C	RZ Cet	55504.531±0.005	−0.174	42298.	C
RZ CVn	55269.442±0.002	−0.155	26305.	C	RZ Cet	55507.599±0.003	−0.170	42304.	LS
UZ CVn	55231.416±0.003	0.255	41279.	C	RZ Cet	55524.444±0.005	−0.175	42337.	C
AA CMi	55242.651±0.002	0.066	39188.	LS	RZ Cet	55525.469±0.004	−0.171	42339.	C
AA CMi	55504.631±0.002	0.069	39738.	C	RZ Cet	55541.302±0.005	−0.167	42370.	C
AA CMi	55506.538±0.002	0.070	39742.	C	UU Cet	55413.768±0.005	−0.134	23438.	LS
AA CMi	55533.690±0.002	0.072	39799.	C	UU Cet	55453.758±0.005	−0.146	23504.	LS
AL CMi	55519.612±0.002	0.470	34372.	C	UU Cet	55481.648±0.005	−0.136	23550.	LS
RV Cap	55423.753±0.003	−0.026	48109.	LS	RT Col	55535.647±0.003	−0.280	51727.	LS

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
RT Col	55544.767±0.005	−0.282	51744.	LS
RW Col	55243.583±0.003	0.107	51839.	LS
RW Col	55519.667±0.005	−0.069	52361.	LS
RW Col	55544.768±0.005	0.158	52408.	LS
RW Col	55562.771±0.005	0.167	52442.	LS
RX Col	55216.707±0.003	0.117	44448.	LS
RX Col	55526.684±0.005	0.003	44970.	LS
RX Col	55533.798±0.005	−0.011	44982.	LS
RX Col	55552.789±0.005	−0.030	45014.	LS
RY Col	55525.641±0.006	−0.209	44304.	LS
RY Col	55546.714±0.005	−0.206	44348.	LS
AV Col	55505.784±0.002			LS
AV Col	55528.751±0.002			LS
S Com	55199.641±0.003	−0.103	24796.	C
S Com	55225.453±0.003	−0.101	24840.	C
S Com	55235.426±0.002	−0.100	24857.	C
S Com	55548.665±0.004	−0.100	25391.	C
ST Com	55272.523±0.003	−0.032	20116.	C
WW CrA	55367.567±0.002	−0.020	43041.	LS
V413 CrA	55365.800±0.003	0.052	23527.	LS
W Crt	55301.644±0.003	−0.023	38002.	LS
UY Cyg	55414.441±0.002	0.059	58820.	C
UY Cyg	55429.581±0.003	0.060	58847.	C
UY Cyg	55438.551±0.002	0.059	58863.	C
UY Cyg	55474.444±0.003	0.066	58927.	C
UY Cyg	55496.304±0.003	0.059	58966.	C
UY Cyg	55497.425±0.002	0.059	58968.	C
UY Cyg	55506.395±0.002	0.057	58984.	C
XZ Cyg [2]	55374.533±0.001	0.001	14582.	C
XZ Cyg [2]	55403.460±0.003	−0.001	14644.	C
XZ Cyg [2]	55429.590±0.001	−0.001	14700.	C
XZ Cyg [2]	55430.526±0.002	0.002	14702.	C
XZ Cyg [2]	55431.452±0.002	−0.005	14704.	C
XZ Cyg [2]	55443.585±0.002	−0.003	14730.	C
XZ Cyg [2]	55458.508±0.002	−0.011	14762.	C
DM Cyg	55438.586±0.002	0.067	30620.	C
DM Cyg	55451.604±0.002	0.069	30651.	C
DM Cyg	55471.342±0.003	0.074	30698.	C
DM Cyg	55510.384±0.002	0.069	30791.	C
V939 Cyg [3]	55374.543±0.002	0.061	14414.	C
V939 Cyg [3]	55429.594±0.004	0.082	14556.	C
V939 Cyg [3]	55443.542±0.005	0.079	14592.	C
DX Del	55398.561±0.002	0.062	33920.	C
DX Del	55416.520±0.003	0.061	33958.	C
DX Del	55442.513±0.002	0.060	34013.	C
DX Del	55453.388±0.002	0.065	34036.	C
DX Del	55479.380±0.004	0.063	34091.	C
RT Dor	55494.744±0.004	−0.059	51213.	LS
RT Dor	55525.655±0.006	−0.050	51277.	LS
RT Dor	55527.578±0.005	−0.058	51281.	LS
VW Dor	55198.624±0.002	−0.129	29476.	LS
VW Dor	55199.765±0.003	−0.130	29478.	LS
VW Dor	55490.767±0.003	−0.139	29988.	LS
VW Dor	55494.764±0.003	−0.136	29995.	LS
VW Dor	55502.752±0.003	−0.136	30009.	LS
VW Dor	55505.597±0.002	−0.145	30014.	LS
VW Dor	55517.585±0.002	−0.139	30035.	LS
RW Dra	55404.545±0.005	0.202	36185.	C
RW Dra	55408.520±0.002	0.191	36194.	C
SW Dra	55225.405±0.003	0.061	50908.	C
SW Dra	55229.392±0.003	0.060	50915.	C
SW Dra	55231.669±0.003	0.058	50919.	C
SW Dra	55282.372±0.002	0.061	51008.	C
XZ Dra	55404.528±0.004	−0.134	28282.	C
XZ Dra	55414.528±0.002	−0.141	28303.	C
XZ Dra	55424.537±0.002	−0.138	28324.	C
XZ Dra	55427.397±0.002	−0.137	28330.	C
XZ Dra	55443.610±0.002	−0.125	28364.	C
BC Dra	55224.426±0.006	0.091	17991.	C
BC Dra	55398.565±0.005	0.093	18233.	C
BC Dra	55455.406±0.006	0.087	18312.	C
BC Dra	55462.611±0.010	0.097	18322.	C
BC Dra	55473.403±0.004	0.095	18337.	C
BC Dra	55488.515±0.005	0.096	18358.	C
BC Dra	55506.500±0.004	0.091	18383.	C
BC Dra	55511.550±0.005	0.104	18390.	C
BC Dra	55514.423±0.005	0.099	18394.	C
BC Dra	55519.456±0.006	0.095	18401.	C
BC Dra	55532.404±0.006	0.091	18419.	C
BC Dra	55557.598±0.005	0.099	18454.	C
BD Dra	55251.441±0.002	0.668	22878.	C
BD Dra	55287.358±0.003	0.653	22939.	C
BD Dra	55404.548±0.005	0.622	23138.	C
BD Dra	55414.595±0.002	0.655	23155.	C
BD Dra	55424.590±0.005	0.636	23172.	C
BD Dra	55430.474±0.004	0.630	23182.	C
BD Dra	55463.487±0.002	0.656	23238.	C
BD Dra	55473.473±0.004	0.628	23255.	C
BD Dra	55490.588±0.002	0.660	23284.	C
BD Dra	55506.475±0.004	0.643	23311.	C
BD Dra	55513.554±0.002	0.653	23323.	C
BD Dra	55519.438±0.003	0.647	23333.	C
BD Dra	55523.526±0.006	0.611	23340.	C
BD Dra	55532.394±0.003	0.644	23355.	C
BD Dra	55542.408±0.002	0.644	23372.	C
BD Dra	55557.709±0.002	0.629	23398.	C
BK Dra	55402.538±0.004	−0.160	50465.	C
BK Dra	55408.459±0.001	−0.160	50475.	C
BK Dra	55415.560±0.002	−0.163	50487.	C
BK Dra	55418.522±0.002	−0.162	50492.	C
BK Dra	55431.549±0.003	−0.161	50514.	C
BK Dra	55444.578±0.003	−0.158	50536.	C
RX Eri	55486.728±0.005	−0.009	57547.	LS
RX Eri	55506.694±0.003	−0.010	57581.	LS
RX Eri	55526.659±0.004	−0.011	57615.	LS
RX Eri	55540.753±0.004	−0.011	57639.	LS
SV Eri	55480.720±0.007	0.843	27918.	LS
SV Eri	55485.726±0.005	0.853	27925.	LS
SV Eri	55500.715±0.006	0.852	27946.	LS
BB Eri	55544.622±0.005	0.262	28049.	LS
BK Eri	55535.553±0.006	−0.022	32152.	LS
RX For	55497.691±0.004	−0.048	26228.	LS

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
RX For	55503.670±0.002	−0.042	26238.	LS	RR Leo	55524.606±0.002	0.108	27032.	C
SS For	55430.761±0.002	−0.141	33833.	LS	RR Leo	55533.654±0.001	0.108	27052.	C
SW For	55517.759±0.006	0.442	26344.	LS	ST Leo	55216.481±0.003	−0.019	57101.	C
SX For	55446.759±0.005	0.047	26908.	LS	ST Leo	55261.411±0.002	−0.019	57195.	C
SX For	55500.637±0.003	0.050	26997.	LS	ST Leo	55548.679±0.002	−0.020	57796.	C
SX For	55543.621±0.005	0.055	27068.	LS	TV Leo	55294.649±0.003	0.114	27128.	LS
RR Gem	55228.481±0.002	−0.426	34914.	C	V LMi	55235.372±0.002	0.032	65644.	C
RR Gem	55504.598±0.002	−0.440	35609.	C	V LMi	55517.667±0.002	0.033	66163.	C
RR Gem	55533.597±0.002	−0.445	35682.	C	V LMi	55523.650±0.002	0.033	66174.	C
RR Gem	55541.544±0.001	−0.444	35702.	C	V LMi	55534.531±0.002	0.036	66194.	C
SZ Gem	55203.488±0.002	−0.060	55892.	C	V LMi	55535.612±0.003	0.029	66196.	C
SZ Gem	55495.648±0.003	−0.063	56475.	C	V LMi	55542.687±0.001	0.032	66209.	C
GI Gem	55220.468±0.002	0.069	57410.	C	U Lep	55506.687±0.002	0.047	24342.	LS
GI Gem	55233.465±0.001	0.068	57440.	C	U Lep	55531.686±0.003	0.043	24385.	LS
GI Gem	55545.416±0.002	0.068	58160.	C	U Lep	55556.696±0.005	0.049	24428.	LS
RW Gru	55411.665±0.002	−0.129	38254.	LS	AO Lep	55529.728±0.005			LS
RW Gru	55449.623±0.005	−0.142	38323.	LS	AO Lep	55533.645±0.005			LS
TW Her	55398.544±0.004	−0.012	84718.	C	TV Lib	55376.602±0.002	−0.004	131143.	LS
TW Her	55404.536±0.004	−0.014	84733.	C	VY Lib	55377.604±0.002	−0.037	26657.	LS
TW Her	55420.521±0.003	−0.013	84773.	C	AZ Lib	55292.847±0.004	0.188	41924.	LS
VZ Her	55429.368±0.002	0.069	42333.	C	AZ Lib	55390.551±0.005	0.185	42074.	LS
VZ Her	55432.451±0.002	0.070	42340.	C	TT Lyn	55519.488±0.003	−0.040	31582.	C
AR Her	55292.545±0.001	−1.307	29444.	C	TW Lyn	55488.518±0.003	0.061	21720.	C
AR Her	55403.473±0.004	−1.305	29680.	C	TW Lyn	55517.430±0.002	0.061	21780.	C
DL Her	55348.527±0.003	0.048	28971.	C	TW Lyn	55541.521±0.004	0.059	21830.	C
V593 Her	55377.562±0.005	−0.121	31366.	C	TW Lyn	55546.336±0.003	0.056	21840.	C
UU Hor	55490.701±0.003	0.169	47800.	LS	RZ Lyr	55399.525±0.003	−0.016	27807.	C
UU Hor	55497.785±0.002	0.172	47811.	LS	RZ Lyr	55417.405±0.002	−0.029	27842.	C
SZ Hya	55224.453±0.002	−0.201	27074.	C	RZ Lyr	55462.405±0.002	−0.018	27930.	C
SZ Hya	55248.624±0.003	−0.206	27119.	LS	RZ Lyr	55463.427±0.002	−0.019	27932.	C
SZ Hya	55291.591±0.003	−0.218	27199.	LS	AW Lyr	55462.461±0.002	−0.037	60571.	C
SZ Hya	55545.705±0.001	−0.219	27672.	C	AW Lyr	55474.400±0.002	−0.037	60595.	C
UU Hya	55233.775±0.003	0.023	30074.	LS	CN Lyr	55418.428±0.003	0.020	26574.	C
UV Hya	54813.557±0.004	−0.013	28408.	C	CN Lyr	55427.479±0.003	0.021	26596.	C
WZ Hya	55243.671±0.002	−0.011	29042.	LS	CN Lyr	55432.414±0.004	0.019	26608.	C
WZ Hya	55249.591±0.004	−0.006	29053.	LS	CN Lyr	55441.461±0.005	0.016	26630.	C
XX Hya	55294.581±0.003	0.044	30452.	LS	CN Lyr	55462.444±0.003	0.019	26681.	C
BI Hya	55239.720±0.002	0.237	51928.	LS	CN Lyr	55474.374±0.004	0.018	26710.	C
BI Hya	55327.639±0.002	0.237	52095.	LS	CR Lyr	55418.456±0.003	−0.032	52002.	C
DG Hya	55237.677±0.005	−0.047	42378.	LS	IK Lyr	55405.498±0.005	−0.134	63134.	C
DH Hya	55249.698±0.003	0.073	49230.	LS	IO Lyr	55405.511±0.002	−0.037	27354.	C
ET Hya	55215.467±0.002	0.149	28145.	C	IO Lyr	55423.403±0.002	−0.036	27385.	C
ET Hya	55245.630±0.003	0.149	28189.	LS	IO Lyr	55449.372±0.002	−0.037	27430.	C
ET Hya	55247.689±0.004	0.151	28192.	LS	MM Lyr	54688.397±0.008	−0.034	52340.	C
ET Hya	55248.373±0.003	0.150	28193.	C	MM Lyr	54711.366±0.010	0.205	52387.	C
ET Hya	55533.553±0.002	0.154	28609.	C	MM Lyr	55395.382±0.006	−0.107	53802.	C
ET Hya	55548.634±0.002	0.154	28631.	C	Z Mic	55436.575±0.005	−0.118	23579.	LS
FX Hya	55309.566±0.002	−0.022	50478.	LS	Z Mic	55443.605±0.005	−0.131	23591.	LS
FX Hya	55362.571±0.002	−0.021	50605.	LS	Z Mic	55453.586±0.005	−0.128	23608.	LS
GO Hya	55216.391±0.004	−0.070	46457.	C	EM Mus	55242.814±0.002	−0.176	35752.	LS
GO Hya	55513.593±0.005	−0.084	46924.	C	EM Mus	55281.597±0.002	−0.179	35835.	LS
GO Hya	55543.522±0.005	−0.067	46971.	C	Y Oct	55292.882±0.004	−0.282	41623.	LS
TW Hyi	55541.579±0.004	0.003	23803.	LS	Y Oct	55313.579±0.004	−0.277	41655.	LS
V Ind	55439.774±0.003	0.367	31946.	LS	RV Oct	55231.826±0.003	0.134	70234.	LS
RR Leo	55297.499±0.002	0.103	26530.	C	RV Oct	55402.604±0.002	0.134	70533.	LS
RR Leo	55519.627±0.002	0.106	27021.	C	RY Oct	55346.771±0.006	0.081	48555.	LS

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
RY Oct	55399.734±0.003	0.078	48649.	LS	BH Peg	55426.515±0.003	−0.127	25057.	C
RY Oct	55411.558±0.003	0.069	48670.	LS	BH Peg	55449.588±0.003	−0.129	25093.	C
RY Oct	55435.776±0.002	0.058	48713.	LS	BH Peg	55469.466±0.006	−0.122	25124.	C
RY Oct	55436.903±0.002	0.058	48715.	LS	BH Peg	55471.386±0.003	−0.125	25127.	C
RY Oct	55457.749±0.004	0.055	48752.	LS	BH Peg	55496.390±0.005	−0.120	25166.	C
RY Oct	55479.721±0.005	0.052	48791.	LS	BH Peg	55498.315±0.005	−0.118	25169.	C
RY Oct	55501.709±0.006	0.065	48830.	LS	BH Peg	55507.291±0.005	−0.116	25183.	C
RY Oct	55531.571±0.005	0.063	48883.	LS	BH Peg	55523.331±0.006	−0.101	25208.	C
SS Oct	55486.604±0.004	−0.013	44170.	LS	BT Peg	55401.367±0.003	0.097	34025.	C
SS Oct	55494.688±0.004	−0.013	44183.	LS	BT Peg	55427.529±0.004	0.091	34072.	C
SS Oct	55509.607±0.003	−0.018	44207.	LS	BT Peg	55519.396±0.003	0.090	34237.	C
UV Oct	55312.592±0.002	−0.198	38672.	LS	CG Peg	55418.548±0.003	−0.051	34928.	C
UV Oct	55426.541±0.002	−0.200	38882.	LS	CG Peg	55439.565±0.002	−0.055	34973.	C
UV Oct	55427.629±0.002	−0.198	38884.	LS	CG Peg	55441.437±0.002	−0.052	34977.	C
UV Oct	55428.713±0.003	−0.199	38886.	LS	CG Peg	55453.579±0.002	−0.055	35003.	C
UV Oct	55446.610±0.002	−0.208	38919.	LS	CG Peg	55469.463±0.002	−0.054	35037.	C
UW Oct	55430.659±0.003	−0.023	47455.	LS	CG Peg	55505.434±0.002	−0.053	35114.	C
UW Oct	55437.795±0.002	0.001	47471.	LS	CG Peg	55527.388±0.002	−0.054	35161.	C
UW Oct	55455.552±0.005	−0.021	47511.	LS	DZ Peg	55417.571±0.002	0.166	35443.	C
UW Oct	55458.675±0.004	−0.010	47518.	LS	DZ Peg	55439.429±0.003	0.160	35479.	C
UW Oct	55490.677±0.003	−0.011	47590.	LS	DZ Peg	55451.578±0.002	0.162	35499.	C
UW Oct	55502.679±0.005	−0.010	47617.	LS	DZ Peg	55468.583±0.002	0.161	35527.	C
UW Oct	55511.563±0.004	−0.016	47637.	LS	DZ Peg	55473.447±0.004	0.166	35535.	C
AR Oct	55536.659±0.002	0.076	47498.	LS	DZ Peg	55496.517±0.002	0.157	35573.	C
DY Oct	55533.686±0.003			LS	DZ Peg	55498.346±0.003	0.164	35576.	C
DY Oct	55542.619±0.003			LS	DZ Peg	55504.419±0.003	0.164	35586.	C
DZ Oct	55548.599±0.005			LS	DZ Peg	55535.397±0.005	0.167	35637.	C
V445 Oph	55391.552±0.005	0.039	70142.	LS	AR Per	55198.520±0.002	0.059	65707.	C
V445 Oph	55404.649±0.005	0.034	70175.	LS	AR Per	55199.370±0.002	0.058	65709.	C
V455 Oph	55381.418±0.003	−0.295	29848.	C	AR Per	55233.412±0.002	0.056	65789.	C
CM Ori	55541.698±0.005	−0.007	46108.	LS	AR Per	55432.573±0.003	0.060	66257.	C
CM Ori	55543.658±0.005	−0.015	46111.	LS	AR Per	55449.594±0.002	0.059	66297.	C
V964 Ori	55505.693±0.002	−0.431	47569.	LS	AR Per	55464.489±0.002	0.060	66332.	C
WY Pav	55438.649±0.005	0.067	48541.	LS	AR Per	55483.639±0.002	0.060	66377.	C
BN Pav	55416.621±0.002	−0.134	47746.	LS	AR Per	55489.596±0.002	0.060	66391.	C
BP Pav	55416.774±0.002	0.021	50395.	LS	AR Per	55490.447±0.002	0.060	66393.	C
BP Pav	55423.627±0.002	−0.112	50408.	LS	AR Per	55506.617±0.002	0.059	66431.	C
BP Pav	55490.575±0.003	0.198	50532.	LS	AR Per	55509.598±0.002	0.061	66438.	C
DN Pav	55353.896±0.003	0.110	30250.	LS	AR Per	55510.449±0.002	0.061	66440.	C
DN Pav	55436.805±0.002	0.105	30427.	LS	AR Per	55511.301±0.004	0.062	66442.	C
DN Pav	55438.683±0.003	0.109	30431.	LS	AR Per	55533.427±0.001	0.059	66494.	C
DN Pav	55439.617±0.003	0.106	30433.	LS	AR Per	55535.556±0.002	0.060	66499.	C
DN Pav	55444.773±0.002	0.109	30444.	LS	AR Per	55540.662±0.002	0.060	66511.	C
DN Pav	55462.581±0.002	0.117	30482.	LS	U Pic	55482.721±0.003	0.072	31374.	LS
DN Pav	55499.579±0.002	0.108	30561.	LS	U Pic	55489.762±0.003	0.067	31390.	LS
DN Pav	55506.608±0.002	0.110	30576.	LS	U Pic	55516.626±0.004	0.069	31451.	LS
VV Peg	55427.598±0.001	−0.020	32839.	C	U Pic	55519.711±0.002	0.071	31458.	LS
VV Peg	55451.529±0.001	−0.020	32888.	C	RY Psc	55446.704±0.005	0.591	24098.	LS
VV Peg	55471.553±0.002	−0.020	32929.	C	RY Psc	55455.708±0.005	0.590	24115.	LS
VV Peg	55495.483±0.004	−0.021	32978.	C	XX Pup	55210.629±0.002	0.494	25981.	LS
VV Peg	55496.458±0.003	−0.023	32980.	C	XX Pup	55560.774±0.003	0.508	26658.	LS
AV Peg	55439.617±0.002	0.130	29841.	C	BB Pup	55560.749±0.003	0.131	34856.	LS
AV Peg	55440.399±0.002	0.131	29843.	C	HH Pup	55240.611±0.003	0.010	42842.	LS
AV Peg	55441.569±0.002	0.130	29846.	C	HH Pup	55522.729±0.003	0.009	43564.	LS
AV Peg	55450.548±0.002	0.130	29869.	C	HH Pup	55531.718±0.003	0.011	43587.	LS
AV Peg	55495.444±0.002	0.133	29984.	C	HH Pup	55547.737±0.003	0.010	43628.	LS

Table 1 (cont.): maxima of RR Lyrae stars

Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.	Variable star	Maximum HJD 24...	$O-C$ (days)	E	Obs.
HH Pup	55556.724±0.005	0.010	43651.	LS	YY Tuc	55447.802±0.003	0.052	21343.	LS
HH Pup	55560.635±0.003	0.013	43661.	LS	YY Tuc	55449.702±0.003	0.047	21346.	LS
V440 Sgr	55425.672±0.003	0.106	29145.	LS	YY Tuc	55496.690±0.003	0.043	21420.	LS
V440 Sgr	55435.705±0.004	0.112	29166.	LS	AE Tuc	55203.639±0.002	0.103	50512.	LS
V675 Sgr	55353.835±0.005	0.075	41985.	LS	AE Tuc	55432.874±0.002	0.195	51065.	LS
V1130 Sgr	55410.547±0.002	0.042	49379.	LS	AE Tuc	55437.849±0.002	0.198	51077.	LS
V1130 Sgr	55436.679±0.002	0.043	49425.	LS	AE Tuc	55462.724±0.003	−0.203	51138.	LS
V1130 Sgr	55448.606±0.002	0.041	49446.	LS	AE Tuc	55484.689±0.002	−0.199	51191.	LS
V1646 Sgr	55342.782±0.003	0.169	38605.	LS	AE Tuc	55489.663±0.003	−0.198	51203.	LS
V1646 Sgr	55392.871±0.002	0.169	38697.	LS	AE Tuc	55525.730±0.002	−0.180	51290.	LS
V1646 Sgr	55438.601±0.002	0.166	38781.	LS	AG Tuc	55559.629±0.003	0.057	26166.	LS
V1646 Sgr	55439.695±0.002	0.171	38783.	LS	TU UMa	55240.483±0.003	−0.033	22252.	C
V1646 Sgr	55444.593±0.004	0.169	38792.	LS	TU UMa	55545.511±0.003	−0.044	22799.	C
V494 Sco	55416.555±0.002	−0.262	33441.	LS	TU UMa	55546.626±0.003	−0.045	22801.	C
V494 Sco	55436.641±0.002	−0.261	33488.	LS	AB UMa	55319.485±0.007	0.114	31842.	C
RU Scl	55494.703±0.002	0.435	49401.	LS	AB UMa	55557.532±0.007	0.129	32239.	C
RU Scl	55503.587±0.005	0.439	49419.	LS	EX UMa	55203.467±0.004	0.026	11404.	C
UZ Scl	55505.662±0.002	0.034	36501.	LS	EX UMa	55228.440±0.003	0.029	11450.	C
VW Scl	55424.822±0.003	−0.009	54051.	LS	EX UMa	55297.378±0.005	0.027	11577.	C
VW Scl	55483.573±0.002	−0.014	54166.	LS	EX UMa	55513.435±0.005	0.037	11975.	C
VW Scl	55485.616±0.002	−0.014	54170.	LS	EX UMa	55534.601±0.004	0.033	12014.	C
VX Scl	55428.831±0.005	−1.649	21678.	LS	EX UMa	55540.567±0.004	0.027	12025.	C
VX Scl	55444.755±0.005	−1.659	21703.	LS	EX UMa	55541.661±0.004	0.036	12027.	C
AE Scl	55447.715±0.005	0.257	25868.	LS	EX UMa	55545.447±0.003	0.022	12034.	C
AE Scl	55485.678±0.002	0.264	25937.	LS	EX UMa	55547.634±0.005	0.038	12038.	C
VY Ser	55364.606±0.004	0.037	33804.	LS	KT UMa	55252.389±0.007	0.046	9862.	C
HY Tel	55410.603±0.003	−0.175	66306.	LS	KT UMa	55289.399±0.005	0.046	9921.	C
HY Tel	55435.572±0.002	−0.161	66368.	LS	KT UMa	55541.585±0.006	0.057	10323.	C
HY Tel	55449.672±0.003	−0.149	66403.	LS	KT UMa	55543.453±0.005	0.043	10326.	C
RW TrA	55366.889±0.004	−0.176	37102.	LS	KT UMa	55548.481±0.006	0.053	10334.	C
RW TrA	55367.638±0.005	−0.175	37104.	LS	AF Vel	55226.691±0.005	−0.209	26156.	LS
RW TrA	55403.546±0.004	−0.175	37200.	LS	AF Vel	55235.659±0.002	−0.206	26173.	LS
RW TrA	55410.651±0.002	−0.177	37219.	LS	AF Vel	55237.768±0.005	−0.207	26177.	LS
RW TrA	55449.548±0.003	−0.181	37323.	LS	AF Vel	55244.621±0.002	−0.210	26190.	LS
W Tuc	55213.624±0.003	0.172	28549.	LS	AF Vel	55311.598±0.005	−0.213	26317.	LS
W Tuc	55390.878±0.004	0.171	28825.	LS	ST Vir	55365.532±0.004	−0.016	35609.	LS
W Tuc	55430.704±0.003	0.178	28887.	LS	UV Vir	55267.452±0.003	0.022	26018.	C
W Tuc	55435.845±0.004	0.182	28895.	LS	AS Vir	55280.696±0.002	0.114	29138.	LS
W Tuc	55457.673±0.004	0.174	28929.	LS	AT Vir	55282.451±0.002	−0.299	29678.	C
W Tuc	55489.791±0.005	0.180	28979.	LS	BB Vir	55270.474±0.002	0.277	33234.	C
W Tuc	55504.557±0.005	0.175	29002.	LS	BB Vir	55290.734±0.003	0.280	33277.	LS
W Tuc	55525.759±0.006	0.183	29035.	LS	DO Vir	55301.657±0.003	0.216	53899.	LS
W Tuc	55534.739±0.005	0.172	29049.	LS	SV Vol	55199.716±0.002	0.099	35554.	LS
W Tuc	55545.664±0.004	0.179	29066.	LS	SV Vol	55524.792±0.005	0.044	36413.	LS
YY Tuc	55416.690±0.003	0.056	21294.	LS	BN Vul	55408.462±0.002	0.070	16626.	C
YY Tuc	55426.845±0.002	0.050	21310.	LS	BN Vul	55443.515±0.002	0.069	16685.	C
YY Tuc	55428.756±0.004	0.056	21313.	LS	BN Vul	55449.455±0.002	0.068	16695.	C
YY Tuc	55437.641±0.003	0.051	21327.	LS	BN Vul	55474.415±0.003	0.075	16737.	C

* C = Calern, LS = La Silla
1 Meinunger, 1984
2 Baldwin and Samolyk, 2003
3 Agerer and Moschner, 1996

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Regulus (α Leo) is a rapidly rotating, nearby B7V star which has been suspected of small-scale variability and binarity for a long time, this in addition to the known binary K2V + M4V companion $3'$ away. But only recently Gies et al. (2008) have discovered that it is indeed a moderately close binary with the orbital period $P = 40.11 \pm 0.02$ d. The discovery of radial velocity variations with the semi-amplitude of $K_1 = 7.7 \pm 0.3$ km s^{-1} was made in spite of the very strong broadening of the lines with $V \sin i \simeq 320$ km s^{-1}. The visible component moves radially by a distance only about twice its dimensions, $a_1 \sin i = 6.1 \pm 0.3\, R_\odot$. From the small value of the mass function and the assumed value for the mass of the primary $M_1 = 3.4 \pm 0.2\, M_\odot$, the authors derived $M_2 \geq 0.30 \pm 0.01\, M_\odot$. Using various theoretical arguments on the evolution of the Regulus binary system, Rappaport et al. (2009) argue that indeed $M_2 = 0.30 \pm 0.02\, M_\odot$, hence $q = M_2/M_1 \simeq 0.09$. The observed large value of $V \sin i$ suggests that the axis of rotation and the orbital momentum may be positioned not far from the plane of the sky implying a possibility of eclipses.

Chance and depth of eclipses depend on the size of the mutual orbit which – in turn – depends on the mass ratio $q = M_2/M_1$. Thus, for the case of Regulus' orbit, $(a_1 + a_2) \sin i = 6.1\,(1 + 1/q)\, R_\odot$. The secondary star cannot be large since it is spectrally undetectable; it can be an M-type dwarf, a low-mass white dwarf or a low-mass helium star. For $i = 90$ degrees and $q = 0.09 - 0.1$, the orbital dimensions would be $60 - 75\, R_\odot$. For such a large orbit eclipses would take place only within a small range of inclinations around $i = 90$ deg of about ± 3 degrees away from the edge-on orbital position. These limits are for an infinitesimally small secondary component and would increase for a physically larger secondary. The maximum duration of a central transit would be about 0.65 days.

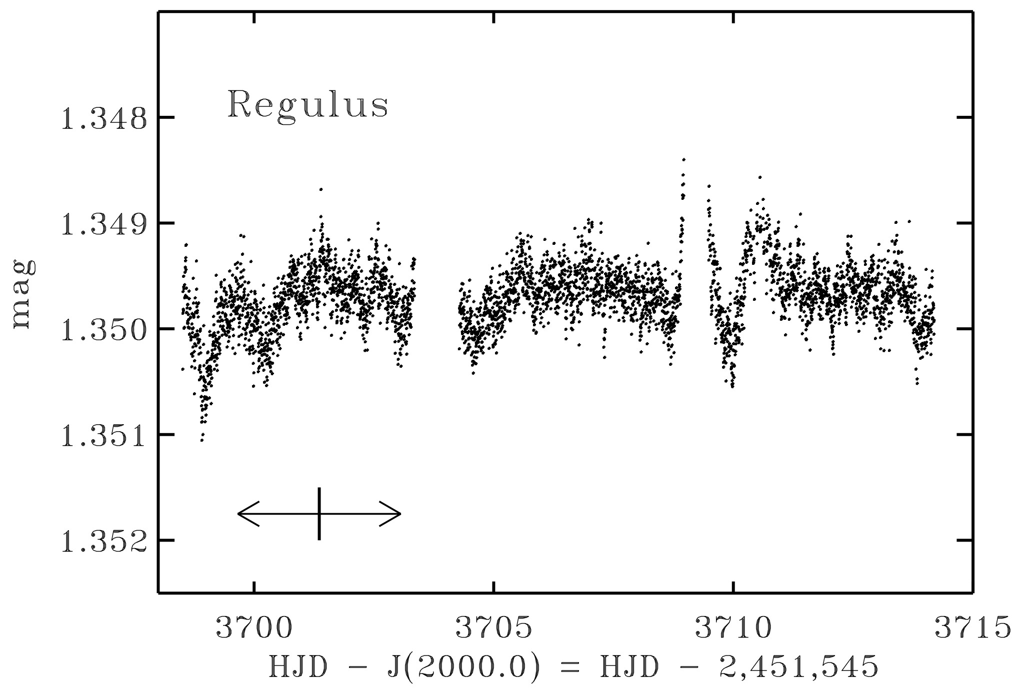

Figure 1. MOST observations of Regulus binned at 5 minute intervals. The vertical line and the arrows mark the expected time and its uncertainty of the transit of the invisible companion of Regulus.

We attempted to discover eclipse transits of Regulus by the invisible companion using the MOST satellite†. The optical system of the satellite consists of a 15 cm reflecting telescope with a custom broad-band filter covering the spectral range of 380 – 700 nm with the effective wavelength close to the Johnson V band. The pre-launch characteristics of the mission are described by Walker et al. (2003) and the initial post-launch performance by Matthews et al. (2004). Since the failure of the attitude control CCD in 2006, photometric observations are formed by adding short, typically one second exposures which are needed for stabilization of the satellite. For Regulus, we used the Fabry-lens mode with the star image spread within 30×30 pixels. The temporal sampling after the on-board addition was 30 sec. Because of the addition of the read-out noise, the final mean standard error per single observation is a complex function of the star brightness; it is expected to be at the level of 0.25 mmag (milli-magnitude) for the brightness of Regulus (Kuschnig 2010, unpublished). It should be stressed that the satellite was designed to be used for detection of *periodic signals* with time scales of minutes to hours and that long-term trends may happen and are sometimes hard to characterize. Some of them can be removed by using stars simultaneously observed with the target or by following satellite thermal and ambient magnetic field variations.

The MOST observations of Regulus were done over 15 days, February 10 to March 4, 2010. The predicted time of the spectral inferior conjunction (transit) using the Gies et al. spectroscopic elements for $E = 267$ elapsed epochs is: $T_0 + P/4 + E * P =$ HJD 2,455,246.36 ± 1.7 or MOST time = 3701.36, counted from J2000.0. Dr. Gies (private communication)

†The MOST satellite is a Canadian Space Agency mission, jointly operated by Dynacon Inc., the University of Toronto Institute of Aerospace Studies, and the University of British Columbia, with the assistance of the University of Vienna.

estimated that this time is uncertain by ±1.7 days.

The observations of Regulus are shown in Figure 1 after binning in 5 minute intervals, with the mean level adjusted to $V = +1.35$ which is the normally observed magnitude of the star; note that – as common for brightest stars – the scatter in the literature values of V is large reaching ±0.02 mag. We show the whole data well beyond the predicted moment of the eclipse to illustrate that the small depressions observed at the predicted conjunction time may be spurious or intrinsic to the star and cannot be interpreted as an eclipse. Similar fluctuations which reach 0.5 mmag of the mean signal and are present throughout the duration of the whole run could not be eliminated using any known instrumental effects. This is best visible around occurrences of two breaks of the sequence for 0.9 and 0.4 days which were caused by the telescope solar-door problem and an interruption to monitor a super-Earth transit. Note also that a depression of about 0.5 mmag at the MOST time $\simeq 3700$ appeared to last too long to be a grazing eclipse.

The residual variability seen in Regulus cannot be unambiguously interpreted as coming from the star, since the background measurements and telemetry show variability on similar time scales. Frequency analysis of the data and the telemetry did not reveal significant, periodic, coherent variations that would be clearly unique to Regulus at the amplitude level larger than 0.07 mmag (7×10^{-5} mean signal). Although the frequency range 0.3 to 3 cycles per day may require further investigation, at this point we have no convincing evidence for variations related to the rotation of Regulus at a frequency of about 1.7 cycles per day.

Summarizing: MOST observations did not lead to detection of any obvious eclipse deeper than about 0.5 mmag at the predicted moment of the spectroscopic inferior conjunction. For an orbit inclined by $i > 87$ degrees this excludes a red dwarf with $M_2 \simeq 0.3\,M_\odot$ as a companion because such a star would produce an eclipse up to 8 mmag deep. However, a low-mass white dwarf or a helium star – which according to Rapport et al. are more likely candidates for a companion of Regulus – would be undetectable by MOST. With their expected radius $R \simeq 0.02 - 0.06\,R_\odot$, the eclipse would be only 0.04 to 0.3 mmag deep.

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CCD TIMES OF MINIMA OF SOME ECLIPSING VARIABLES

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Observatory and telescope:
30-cm Cassegrain-Schmidt (T30), 40-cm Cassegrain-Schmidt (T40) and 122-cm Cassegrain-Nasmyth (T122) telescopes of the Çanakkale University Observatory.

Detector:	-STL1001E camera, Peltier cooling, KAF-1001E chip, $28' \times 28'$ FOV, 1024×1024 pixels, (STL). -Alta U47 camera, Peltier cooling, E2V CCD47-10 chip, $11'.5 \times 11'.5$ FOV, 1024×1024 pixels, (U47). -Alta U42 camera, Peltier cooling, E2V CCD42-40 chip, $7'.8 \times 7'.8$ FOV, 2048×2048 pixels, (U42).

Method of data reduction:
Reduction of the CCD frames was made with C-MUNIPACK[1] software.

Method of minimum determination:
Kwee – van Woerden method (Kwee & van Woerden, 1956).

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
XZ And	55423.4600	0.0002	II	VR_c	T40-U47
XZ Aql	55425.3846	0.0001	I	VR_c	T40-U47
FK Aql	55406.4212	0.0001	I	VR_c	T30-STL
KO Aql	55351.4724	0.0003	I	BVR_c	T30-STL
	55417.3468	0.0002	I	VR_c	T40-U47
V342 Aql	55333.5445	0.0009	I	BVR_c	T30-STL
RY Aqr	55418.4068	0.0001	I	VR_c	T30-STL
AC Boo	55352.4902	0.0006	II	R_cI_c	T30-STL
Y Cam	55424.5094	0.0001	I	VR_c	T40-U47
	55573.2684	0.0002	I	BV	T30-STL
ZZ Cas	55159.4166	0.0003	I	V	T30-STL
RY Cnc	55290.3103	0.0002	II	V	T30-STL
	55522.5645	0.0001	I	VR_c	T122-U42
WW Cnc	55580.4715	0.0001	I	BV	T30-STL
RW CrB	55337.3467	0.0009	I	VR_c	T30-STL
WW Cyg	55324.5222	0.0008	I	R_cI_c	T30-STL
ZZ Cyg	55350.4707	0.0001	I	R	T30-STL
DK Cyg	55346.4988	0.0007	I	R_cI_c	T30-STL
V401 Cyg	55346.4145	0.0002	I	R	T30-STL
V548 Cyg	55432.3217	0.0002	I	VR_c	T40-U47
V753 Cyg	55321.5236	0.0004	I	VR_c	T30-STL
V959 Cyg	55400.4192	0.0002	I	VR_c	T30-STL

[1] Motl, D., 2007, C-MUNIPACK, `http://c-munipack.sourceforge.net/`

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
TT Del	55410.4457	0.0002	I	VR_c	T30-STL
FZ Del	55406.5121	0.0001	I	R_c	T30-STL
TW Dra	55310.3782	0.0001	I	VR_c	T30-STL
	55568.6043	0.0001	I	BV	T30-STL
TZ Dra	55327.3619	0.0010	I	VR_c	T30-STL
AF Gem	55595.5667	0.0008	II	R_cI_c	T30-STL
SZ Her	55342.4524	0.0002	I	VR_c	T30-STL
CT Her	55329.4581	0.0003	I	VR_c	T30-STL
V338 Her	55432.4244	0.0001	I	VR_c	T40-U47
DG Lac	55162.3125	0.0003	I	V	T30-STL
	55409.4433	0.0002	I	VR_c	T30-STL
	55568.3133	0.0005	I	BV	T30-STL
UU Leo	55568.4594	0.0001	I	V	T30-STL
UX Leo	55321.3862	0.0020	II	R_cI_c	T30-STL
UZ Leo	55340.3432	0.0015	II	VR_cI_c	T30-STL
SX Lyn	55329.3167	0.0004	I	VR_c	T30-STL
V913 Oph	55400.3617	0.0003	I	BVR_c	T30-STL
	55423.3714	0.0001	I	VR_c	T40-U47
BN Peg	55455.4545	0.0001	II	R_c	T40-U47
DI Peg	55429.5569	0.0000	I	V	T40-U47
Z Per	55454.4698	0.0001	I	V	T40-U47
RT Per	55432.5053	0.0000	I	VR_c	T40-U47
XZ Per	55500.5411	0.0001	I	VR_c	T40-U47
AO Ser	55316.4953	0.0018	II	BVR_c	T30-STL
	55327.4831	0.0002	I	VR_c	T30-STL
VV UMa	55342.3744	0.0002	I	VR_c	T30-STL
RU UMi	55316.3180	0.0004	I	BVR_c	T30-STL
	55522.6142	0.0001	I	BV	T40-U47
	55580.3566	0.0001	I	BV	T30-STL
UW Vir	55311.4153	0.0002	I	VR_c	T30-STL
VV Vir	55324.3324	0.0005	II	VR_cI_c	T30-STL
AH Vir	55346.3230	0.0006	II	VR_cI_c	T30-STL
BE Vul	55425.4798	0.0002	I	VR_c	T40-U47
BO Vul	55398.4621	0.0004	II	R_c	T30-STL

Remarks:

We present 56 minima times of 46 eclipsing binaries. In the Remarks column of Times of Minima table, telescopes and detectors used in the observations are given.

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ERRATUM FOR IBVS 5924

ZX Per should be changed as XZ Per.

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ROTATIONAL VARIABILITY IN PRE-MAIN-SEQUENCE STARS: TWA 6 IN 2008

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TWA 6 (= 2MASS J10182870–3150029) is a K7 spectral-type member of the TW Hydrae association (TWA), one of the nearest pre-main sequence (PMS) stellar populations to Earth (Webb et al., 1999; Reid, 2003; Zuckerman & Song, 2004). Located at a distance of ≈ 50 pc (Mamajek, 2005), TWA 6 has a mass of $\approx 0.7\ M_\odot$ and a luminosity of $\approx 0.25\ L_\odot$ (Skelly et al., 2008). The association has an estimated age of ≈ 10 Myr, and this is consistent with the age inferred for TWA 6 (~ 12 Myr) following Hertzsprung-Russell diagram placement of the star and comparison with PMS evolutionary tracks (Skelly et al., 2009). TWA 6 is an example of a weak-lined T Tauri (WTT) star, with weak Balmer emission lines (the Hα equivalent width is ≈ 5 Å), and no near-infrared excess that would indicate the presence of an inner circumstellar disk.

The most-remarkable feature of TWA 6 is its large photometric amplitude that is a consequence of the rotational modulation of cool starspots that cover a few tens of percent of the photosphere. Lawson & Crause (2005) found the star to have a V-band amplitude of 0.49 mag modulated on a rotation period of 0.54 d, in $BVI_{\rm C}$ CCD differential photometry of the star obtained with the 1-m telescope at the South African Astronomical Observatory (SAAO) in 2001. (In this paper, the light curve amplitude is given as the peak-to-peak amplitude.) A trial series of previously-unpublished V-band observations of TWA 6 obtained at SAAO in 2000 returned the same period, although the star had a slightly-lower $V_{\rm ampl}$ of 0.40 mag. In Table 1, we present these data for the first time. Compared to other WTT stars, the photometric amplitude of TWA 6 is large; most WTT stars have rotational amplitudes of ~ 0.1 mag, and few have rotational amplitudes > 0.2 mag (Lawson et al., 2001; Lawson & Crause, 2005). Lawson et al. (2001) summarise the observing procedure at SAAO, and the production of the differential light curves.

The combination of a short rotation period for the star's spectral type, with a $v \sin i = 72$ km s^{-1} placing TWA 6 firmly in the 'fast rotator' regime ($v \sin i > 50$ km s^{-1}) for T Tauri stars, and a large photometric amplitude makes TWA 6 an ideal target for Doppler mapping studies, where spectral line profile variations allow for reconstruction of stellar surface features such as starspots, and other structures such as solar-type 'plages' and prominences. Skelly et al. (2008) observed TWA 6 using the UCLES echelle spectrograph at the 3.9-m Anglo-Australian Telescope in 2006, with the resulting Doppler map showing a large polar spot, and other starspot groups extending to the equator. The outcome was a starspot distribution similar to that seen in other young, fast-rotating stars. However, the inferred luminosity variation resulting from the Doppler study was only 0.1 mag, a factor of $4-5$ lower than that observed at SAAO in 2000 and 2001. While Doppler-reconstructed light curves are suspected of under-estimating the level of photometric variability, it is unlikely that the light amplitude is under-estimated by more than a factor of 2. Skelly et al. (2009) discussed this aspect for the Doppler studies of TWA 6 and TWA 17 and concluded that, in 2006, TWA 6 probably did have lower photometric variability than was observed during the 2000 and 2001 observing seasons.

With this background of variability information in mind, we observed TWA 6 again at SAAO in 2008, obtaining 15 epochs of data over 7 nights, or a time baseline of nearly 12 rotational periods. Our differential BVR_CI_C observations are presented in Table 2, where the phase of each observation is calculated assuming $JD_0 = 2454499.1050$, and where we adopt the Skelly et al. (2008) spectroscopic period of 0.5409 d. We have not merged the 2008 photometry with our earlier datasets in an attempt to further improve the rotation period, as the interval between the datasets is long, and there is very little information available on the timescale at which spot patterns evolve in WTT stars, i.e. the appearance or disappearance of major starspot groups could have the effect of introducing a significant phase shift in the light curve.

Table 1. 2000 SAAO V-band differential photometry of TWA 6.

JD–2450000	Phase	ΔV	JD–2450000	Phase	ΔV
1584.3945	0.0000	0.156	1619.2773	0.4903	–0.268
1585.0000	0.0438	0.160	1619.3906	0.6997	–0.141
1586.3945	0.6975	–0.106	1622.2656	0.0150	0.124
1587.3867	0.5319	–0.256	1622.3828	0.2316	0.009
1588.3047	0.2290	0.010	1623.3359	0.9937	0.126
1590.3086	0.9337	0.117	1623.4688	0.2393	0.126
1590.4922	0.2732	–0.050	1624.2852	0.7486	–0.108
1591.5664	0.2592	–0.030	1624.4453	0.0447	0.144
1596.2852	0.9830	0.137	1624.5625	0.2614	–0.017
1596.4414	0.2719	–0.028			

Table 2. 2008 SAAO BVR_CI_C differential photometry of TWA 6.

JD–2450000	Phase	ΔB	ΔV	ΔR_C	ΔI_C
4522.2950	0.1250	0.084	0.068	0.056	0.026
4522.3172	0.0838	0.113	0.090	0.070	0.052
4522.4952	0.7546	–0.017	–0.022	–0.018	–0.011
4522.5040	0.7385	–0.037	–0.031	–0.027	–0.022
4523.3652	0.1468	0.074	0.061	0.054	0.042
4523.3701	0.1376	0.082	0.066	0.045	0.031
4524.3934	0.2455	–0.002	0.004	–0.006	–0.004
4525.3110	0.5491	–0.099	–0.085	–0.082	–0.049
4525.5570	0.0943	0.108	0.093	0.089	0.079
4526.3160	0.6910	–0.044	–0.042	–0.032	–0.026
4526.4752	0.3966	–0.094	–0.082	–0.083	–0.053
4527.4125	0.6637	–0.048	–0.046	—	—
4527.6224	0.2757	–0.039	–0.026	–0.016	–0.025
4528.3740	0.8866	0.042	0.039	0.032	0.026
4528.6040	0.4616	–0.123	–0.086	–0.084	–0.067

Phase-folded BVR_CI_C light and colour curves of TWA 6 in 2008 are shown in Fig. 1. The overall trend of the light curve amplitudes follows that seen in the BVI_C observations obtained in 2001 by Lawson & Crause (2005), where there is a general decrease in amplitude towards longer wavelengths, but in 2008 the light amplitude was distinctly lower than in 2000 and 2001, with $V_{ampl} = 0.19$ mag. We note that if the 2006 Doppler-inferred amplitude was under-estimated by a factor of ~ 2, then the 2006 and 2008 light amplitudes are similar.

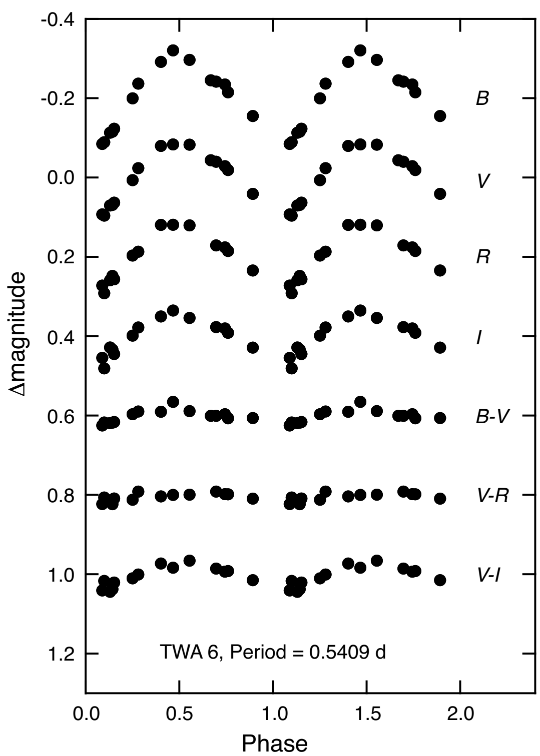

Figure 1. Phase-folded BVR_CI_C differential photometry of TWA 6, obtained at SAAO during 2008.

Table 3 summarises light curve amplitudes for TWA 6 measured in 2000, 2001, and 2008, along with the mean V-band magnitude. Clearly a more-complete dataset of amplitudes would be interesting to obtain, to allow investigation of temporal changes in the light curve amplitude, as would the production of Doppler maps at different epochs to investigate the evolution of the starspot distribution. We keep in mind that photometry measures the contrast of spot coverage during a rotation cycle, i.e. the photometric amplitude is determined from the brightness difference between the most-spotted, and least-spotted, hemispheres of the star. If the large polar spot indicated in the Doppler maps of Skelly et al. (2008) is always present and is roughly constant in extent, then it might contribute little to the luminosity variations, given that the inclination angle of the star is $\approx 50°$ and the polar cap is always exposed. This suggests that the presence of lower latitude spots may be principally responsible for driving the light curve amplitude.

Table 3. Summary of SAAO CCD photometric light amplitudes for TWA 6.

Year	V_{mean}	B_{ampl}	V_{ampl}	$R_{C,ampl}$	$I_{C,ampl}$
2000	11.68	—	0.40	—	—
2001	11.74	0.54	0.49	—	0.27
2008	11.43	0.25	0.19	0.18	0.14

Since we obtained multi-color observations in 2001 and 2008, we can estimate the starspot temperature and compare that to the spot temperature of 3300 K derived in the Doppler imaging study of Skelly et al. (2008). Assuming a $T_{\rm eff}$ for TWA 6 of 4000 ± 200 K (Skelly et al., 2008), we obtain a spot temperature of ≈ 3400 K with a spot filling factor of ≈ 50 % in 2001, and a spot temperature of ≈ 3700 K and a filling factor of ≈ 40 % in 2008. The mean V-band magnitude of the star changes from $2000-2001$ to 2008 both as a consequence of the reduced photometric amplitude, but also from an increase in the maximum V-band magnitude from 11.5 in $2000-2001$ to 11.3 in 2008. TWA 6 may have a younger, higher mass analogue in the few Myr-old, early K-type star V410 Tau which also displays significant variations in its long-term light curve behaviour. After a recent Zeeman-Doppler imaging study to reconstruct the surface spot pattern, the photometric variations of V410 Tau have been interpreted as being due to long-term changes in the spot distribution (Skelly et al., 2010, and references therein).

In summary, TWA 6 is a T Tauri star worthy of on-going monitoring for photometric variability. Its brightness ($V_{max} \approx 11.5$), combined with its short period (0.54 d) and stable (on timescales of at least a few weeks), large amplitude ($0.2-0.5$ mag) visual light curve makes TWA 6 an accessible target for observation even for small telescopes equipped with a CCD camera or photoelectric photometer.

The observations reported in this paper were obtained using facilities at the South African Astronomical Observatory. We thank the SAAO for the allocation of telescope time for this and other observing proposals. We also thank the reviewer of this paper for their constructive remarks.

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CCD TIMES OF MINIMA OF ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

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Observatory and telescope:
T1: 40cm Cassegrain telescope (f/8.1), **T2**: 25cm Newtonian reflector telescope (f/4.7), **T3**: 20cm Newtonian reflector telescope (f/5) at the University of Athens Observatory.

Detector:	**C1**: ST-10XME CCD camera, Peltier cooling, KAF-3200ME chip, $16' \times 11'$ and $25' \times 17'$ (using a focal reducer) FoV with T1, 2184×1472 pixels, **C2**: ST-8XMEI CCD camera, Peltier cooling, KAF-1603ME chip, $40' \times 26'$ FoV with T2, and $46' \times 32'$ FoV with T3, 1530×1020 pixels. Both CCDs are equipped with the Bessell UBVRI filters.

Method of data reduction:
Differential photometry with the software Muniwin v.1.1.26 (Hroch, 1998).

Method of minimum determination:
Kwee & van Woerden (1956).

Times of maxima of pulsating stars:

Star name	Time of min. HJD	Error	Filter	Rem.
TU UMa	2455632.5084	0.0008	UBVRI	C2+T2
	2455633.6232	0.0023	UBVRI	C2+T2
	2455664.2930	0.0006	UBVRI	C2+T2

Times of minima:					
Star name	Time of min. HJD	Error	Type	Filter	Rem.
DN Boo	2455666.3079	0.0005	II	BVRI	C1+T1
	2455685.3286	0.0006	I	BVRI	C1+T1
	2455685.5532	0.0014	II	BVRI	C1+T1
	2455688.4609	0.0007	I	BVRI	C1+T1
	2455691.3714	0.0003	II	BVRI	C1+T1
	2455693.3848	0.0005	I	BVRI	C1+T1
AV CMi	2455599.4273	0.0002	I	VI	C1+T1
RW Com	2455643.3269	0.0002	I	BR	C1+T1
	2455656.2618	0.0002	II	BR	C1+T1
	2455656.3811	0.0001	I	BR	C1+T1
	2455656.4988	0.0001	II	BR	C1+T1
	2455659.3471	0.0001	II	VI	C1+T1
	2455659.4665	0.0001	I	VI	C1+T1
	2455659.5845	0.0001	II	VI	C1+T1
	2455661.3650	0.0002	I	BR	C1+T1
	2455661.4832	0.0001	II	BR	C1+T1
	2455662.3145	0.0001	I	VI	C1+T1
	2455663.3821	0.0001	II	BR	C1+T1
	2455663.5014	0.0001	I	VI	C1+T1
DF Hya	2455579.3760	0.0001	I	BVRI	C1+T1
	2455579.5419	0.0001	II	BVRI	C1+T1
XY Leo	2455664.2666	0.0003	II	BVRI	C1+T1
	2455664.4105	0.0002	I	BVRI	C1+T1
	2455686.2868	0.0004	I	BVRI	C1+T1
	2455688.2750	0.0002	I	BVRI	C1+T1
	2455688.4164	0.0003	II	BVRI	C1+T1
	2455689.2685	0.0003	II	BVRI	C1+T1
CL Lyn	2455576.3657	0.0008	II	I	C2+T2
	2455588.2580	0.0007	I	BVI	C2+T2
	2455598.5568	0.0012	II	VI	C2+T2
ER Ori	2455580.2486	0.0003	II	BVRI	C1+T1
	2455580.4600	0.0003	I	BVRI	C1+T1
	2455581.3063	0.0001	I	BVRI	C1+T1
AC Tau	2455567.3731	0.0002	I	BV	C1+T1
AW UMa	2455632.3045	0.0010	II	UBVRI	C2+T2
	2455632.5286	0.0011	I	UBVRI	C2+T2
	2455633.4050	0.0006	I	UBVRI	C2+T2
	2455661.4833	0.0012	I	BVRI	C2+T2
	2455664.3362	0.0005	II	UBVRI	C2+T2
KZ Vir	2455326.3775	0.0006	I	BV	C1+T1
PY Vir	2455690.3317	0.0002	II	BVRI	C1+T1
2MASS J22514830+1532034	2455415.5027	0.0003	I	B	C1+T1
	2455443.3424	0.0011	II	BVRI	C1+T1
	2455443.5315	0.0015	I	BVRI	C1+T1
	2455446.3653	0.0012	I	BV	C1+T1
	2455446.5509	0.0013	II	BV	C1+T1
	2455457.3707	0.0012	I	BVRI	C2+T2

Times of minima:					
Star name	Time of min. HJD	Error	Type	Filter	Rem.
2MASS J22514830+1532034	2455457.5416	0.0013	II	I	C2+T2
	2455466.4338	0.0010	II	BVRI	C2+T2
	2455467.3184	0.0017	I	BVRI	C2+T2
	2455502.2785	0.0023	II	VRI	C2+T2
	2455505.3022	0.0020	I	BVRI	C2+T2
GSC 0770-0523	2455588.3515	0.0003	I	I	C1+T1
	2455594.2338	0.0009	II	VI	C1+T1
	2455594.4523	0.0006	I	VI	C1+T1
	2455599.2493	0.0007	I	VI	C1+T1
	2455599.4583	0.0007	II	VI	C1+T1
	2455600.3303	0.0006	II	VI	C1+T1
	2455601.4278	0.0006	I	VI	C1+T1
GSC 1137-0293	2455436.5809	0.0008	I	BR	C2+T3
	2455437.3442	0.0005	I	BR	C2+T3
	2455437.5266	0.0009	II	BR	C2+T3
	2455440.3694	0.0005	I	BR	C2+T3
	2455442.4410	0.0006	II	BR	C2+T3
	2455447.3567	0.0004	II	BR	C2+T2
GSC 3281-1359	2455490.4174	0.0006	II	B	C1+T1
	2455493.2672	0.0009	I	BVI	C1+T1
	2455493.4887	0.0011	II	BVI	C1+T1
GSC 3610-0124	2455436.3573	0.0011	I	BVR	C1+T1
	2455436.5247	0.0012	II	BVR	C1+T1
	2455437.5703	0.0008	II	BVR	C1+T1
	2455438.4306	0.0008	I	BVR	C1+T1
	2455444.3290	0.0016	I	BVR	C1+T1
	2455448.3209	0.0009	II	BVR	C1+T1
	2455450.3960	0.0016	II	BV	C1+T1
	2455457.3278	0.0009	II	BVR	C1+T1
	2455457.4986	0.0009	I	BVRI	C1+T1
GSC 3802-1986	2455157.6268	0.0006	I	BVI	C2+T3
	2455158.3955	0.0012	II	BVI	C2+T3
	2455538.4643	0.0004	I	BVI	C2+T2
	2455568.2873	0.0004	II	BVI	C1+T1
GSC 4372-0831	2455466.5356	0.0003	I	B	C1+T1
	2455469.5312	0.0011	II	VI	C1+T1
	2455502.5237	0.0010	I	BVI	C1+T1
	2455505.5377	0.0017	II	VI	C1+T1
USNO-A2.0 0975-04721840	2455587.3472	0.0002	I	I	C1+T1
	2455594.4133	0.0004	I	VI	C1+T1
	2455599.4591	0.0003	I	VI	C1+T1
	2455600.4676	0.0004	I	VI	C1+T1
	2455601.2241	0.0004	II	VI	C1+T1
	2455601.4771	0.0003	I	VI	C1+T1
	2455602.2334	0.0004	II	VI	C1+T1
	2455603.2420	0.0004	II	VI	C1+T1

Times of minima:					
Star name	Time of min. HJD	Error	Type	Filter	Rem.
USNO-A2.0 1350-16136263	2455438.3775	0.0019	I	BVRI	C1+T1
	2455441.3060	0.0009	II	B	C1+T1
	2455457.3195	0.0012	I	BVRI	C1+T1
	2455537.3322	0.0012	II	VRI	C1+T1
	2455538.3158	0.0005	I	R	C1+T1

Explanation of the remarks in the table:

T1, T2, T3, C1, C2 and C3 refer to the instrumentation (telescope and CCD camera) used for each case.

Remarks:

The following systems are recently discovered: GSC 0770-0523 (Liakos & Niarchos, 2010), 2MASS J22514830+1532034, GSC 3281-1359, GSC 3610-0124 and GSC 1137-0293 (Liakos & Niarchos, 2011a), GSC 4372-0831 (Liakos & Niarchos, 2011b), GSC 3802-1986 (ASAS J080731+0159.7; Pojmanski et al., 2005), USNO-A2.0 1350-16136263 (Liakos & Niarchos, 2011c), and USNO-A2.0 0975-04721840 (Liakos & Niarchos, 2011d).

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Liakos, A., Niarchos, P., 2011c, *IBVS*, 5998, 12

Liakos, A., Niarchos, P., 2011d, *IBVS*, 5998, 13

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ERRATUM FOR IBVS 5674

The epoch for GSC 7194 0239 should be 2452943.87 instead of 2452043.87 .

S. Otero

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V407 Peg AND LU Vir: TWO CONTACT BINARIES WITH DISPLACED SECONDARY MINIMA

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The role of eccentric eclipsing binaries in modern stellar astrophysics is undisputed. There are a few binaries, however, which are not eccentric, but show displaced secondary minima nevertheless. If one has no information about their light curve, one can consider the eccentricity only on the basis of the $O - C$ diagram of all available minima of a particular system. Due to the increasing number of CCD observations of minima, some systems were discovered with short period but displaced secondary minima.

The process of circularization is rather rapid in those binaries, which are close. Eccentric orbits are common in well-detached binaries with longer periods, or in systems which are very young. When the system is semi-detached or even contact, the nonzero eccentricity is extremely improbable. Therefore any discovery of a short period binary with displaced secondary minima (i.e. $\phi_2 \neq 0.5$ with respect to the primary) has to be considered very carefully.

The system **V407 Peg** (= GSC 01720-00658, V = 9.28 mag, sp F1) is a typical W UMa-type eclipsing binary. It was discovered by Maciejewski et al. (2002), showing two minima of almost equal depths. However even in the discovery paper it was noted that the secondary minimum is located in phase 0.52. The secondary minima occurred about 0.015 days later than phase 0.5. This is rather unusual for a W UMa type binary.

A detailed analysis was done by Maciejewski et al. (2003) and Rucinski et al. (2008). These complete analyses show that the inclination is about 73 deg and the masses are 1.53 and 0.39 for the primary and secondary, respectively. The observed asymmetry of the LC was explained by a photospheric hot spot. This spot also distorts both minima and also the maxima of the LC (O'Connell effect).

We collected all available (published) times of minima of V407 Peg. For a prospective analysis we need as many minima times as possible. Therefore, we also used the data for this target obtained by the automatic photometric monitoring system ASAS (Pojmanski, 2002). The star was also observed by the Pi of the Sky (Burd et al., 2005). Thanks to these observations, many new minima times were derived. A collection of all available times of minima is given in Table 1. These minima follow a linear ephemeris with the orbital period of 0.636883915 day.

Thanks to these minima one is able to study a potential long-term variation of the LC. The changing position of the spot on the surface is able to modulate the shape of the minima, and therefore also the position of primaries versus secondaries in the

$O-C$ diagram (plotted in Fig. 1). As one can see, the difference between primary and secondary minima is still visible and is not changing significantly. Some of the points have rather large errors, but still one can speculate about some year-to-year differences. For example the first data point from 2003 and the following ones from 2004 show a non-negligible difference. For a detailed evolution of the spot or other processes in the system a more detailed year-by year LC analysis would be desirable.

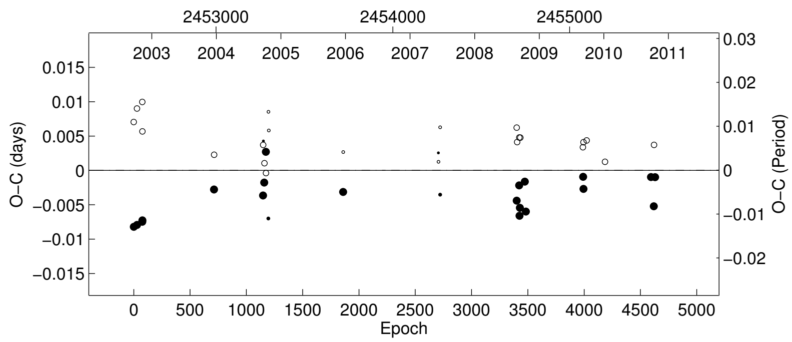

Figure 1. $O-C$ diagram of V407 Peg dots stand for primary and open circles for the secondary minima.

The shape of the LC taken from ASAS data is plotted in Fig. 2. As one can see, both minima are distorted and asymmetric. The bottom parts of minima (probably total eclipses) are not flat either, but rather inclined. As a result it is complicated to derive a precise time of minimum from the observed data. Most of the often used methods for minima computation are based on symmetric minima (e.g. Kwee-van Woerden, bisector chord method or polynomial fitting). Thus, using the data points with different slope of ascending and descending branch makes the application of these methods rather questionable and affects the result.

Table 1: Collected times of minima. The full table is available electronically. Sources: Brát et al. (2008, 2011); Nagai, K. (2003, 2004, 2005, 2008, 2009, 2011); Yilmaz et al. (2009), Perryman et al. (1997).

Star	HJD-2400000	Error	Type	Filter	Source
V407 Peg	52534.2999	0.0014	II	V	IBVS 5343
V407 Peg	52534.6031	0.0008	I	V	IBVS 5343
V407 Peg	52552.7715	0.0013	II	V	IBVS 5343
...					
LU Vir	48085.9734	0.0023	I	Hp	Hipparcos
LU Vir	48085.7456	0.0021	II	Hp	Hipparcos
LU Vir	48727.8604	0.0025	I	Hp	Hipparcos
...					

The second system is **LU Vir** (= HD 116914 = HIP 65590, V = 7.78 mag, sp A0). It is also a W UMa or β Lyrae star, but lacking a detailed analysis. Unlike the case of V407 Peg neither the LC nor the radial velocity curve were studied and a period analysis is missing too. The orbital period of the system is 0.492240615 day.

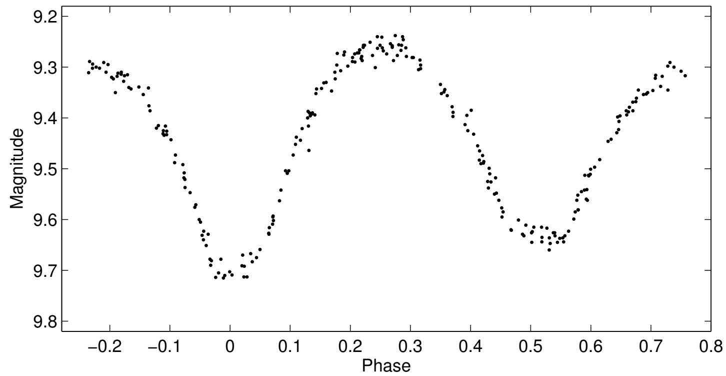

Figure 2. *V* light curve of V407 Peg from ASAS.

We collected all available published times of minima, these are given in Table 1. Some of the published minima are not included because we used the original data and recalculated the minima (these apply for the Hipparcos and "Pi of the Sky" data). The $O-C$ diagram of these minima is plotted in Fig. 3, where one can clearly see the difference between primary and secondary minima over a time span of almost two decades. The precision of individual observations is questionable, therefore a possible variation of displacement of secondary minima with time is still problematic to detect. New and more precise observations are needed to confirm some possible variation of the LC.

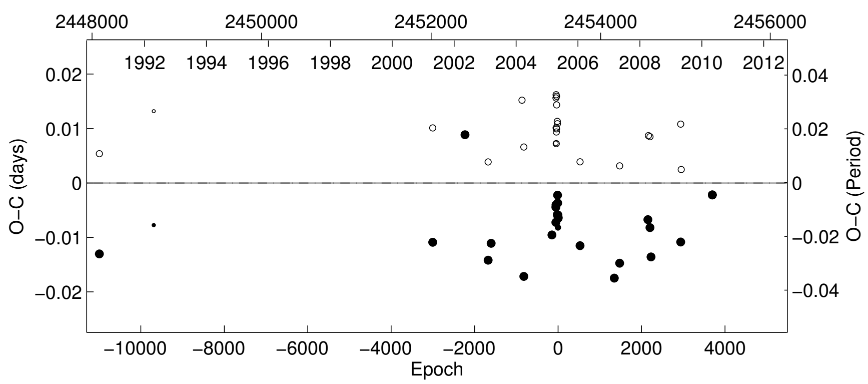

Figure 3. $O-C$ diagram of LU Vir.

The light curve of LU Vir is asymmetric in the same way as that of V407 Peg. We can see the curve in Fig. 4, where the primary minimum with its total eclipse is clearly distorted and the flat part is inclined. Thus the derivation of minima times is affected by asymmetry and the use of standard routines for minimum computation is problematic.

To conclude, in both systems the displaced secondary minima are very probably caused by asymmetry of the light curve, which is not changing significantly over a time span of more than a decade. It could be produced by an accreting hot spot from a stream of material flowing from one component to another, which is a rather common phenomenon in such semidetached or contact binaries.

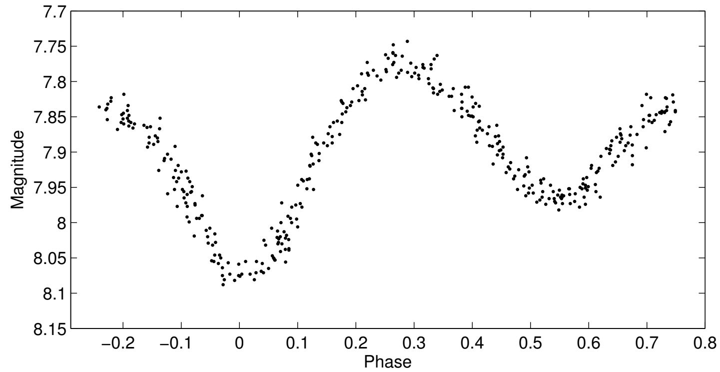

Figure 4. *V* light curve of LU Vir from ASAS.

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TIMINGS OF MINIMA OF ECLIPSING BINARIES

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The following Table lists timings of minima of eclipsing binaries secured by CCD photometry, obtained in the first half of 2011. The given $O-C$ values generally refer to the linear elements of the newest electronic version of the GCVS (Samus et al., 2011), except for the cases stated in the remarks, where the determination of current elements made use of the up-to-date ASAS data (http://www.astrouw.edu.pl/asas/) and the Lafler-Kinman algorithm of the PERANSO software (http://www.peranso.com/). All times given are heliocentric UTC. All data was obtained at the R. Szafraniec Observatory operated at Astrokolkhoz Obs., Cloudcroft, N.M., USA. The tireless support by T. Krajci at the site is acknowledged gratefully.

Table 1: Minima of eclipsing binaries

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
KP Aql	p	55711.7659	0.0009	−0.0225	39	V
SZ Ari	p	55579.6533	0.0004	−0.0155	33	V; d=0.025d
ZZ Aur	p	55585.7194	0.0001	−0.0042	32	V
AP Aur	s	55617.6880	0.0004	+0.0744	38	V
CL Aur	p	55583.7313	0.0001	+0.0105	44	V
DO Aur	p	55564.6720	0.0005	−0.0006	41	V; d=0.03d
EM Aur	s	55571.6523	0.0004	−0.0059	35	V
EU Aur	p	55585.6980	0.0004	+0.0539	47	V
FO Aur	s	55589.683	0.003	+0.118	39	V
GI Aur	p	55591.6879	0.0004	−0.0006	44	V
GY Aur	p	55565.7130	0.0018	+0.0820	43	V
HL Aur	p	55600.6631	0.0002	−0.0009	27	V
HW Aur	p	55577.7238	0.0005	−0.0011	30	V
II Aur	p	55564.6940	0.0004	−0.0098	30	V
IZ Aur	p	55579.6970	0.0005	−0.0000	25	V
KO Aur	p	55585.7183	0.0002	−0.0013	41	V; d=0.043d
KU Aur	p	55603.7356	0.0005	+0.0124	27	V
MU Aur	p	55575.6480	0.0009	+0.0037	29	V; d=0.04d
V364 Aur	p	55577.7127	0.0003	−0.0001	32	V
V379 Aur	p	55603.6527	0.0013	−0.0087	21	V
V495 Aur	p	55638.7615	0.0009	−0.0174	21	V
V523 Aur	p	55621.6977	0.0004	+0.0011	32	V
V576 Aur	p	55583.7365	0.0005	−0.0465	29	V
V585 Aur	p	55574.6686	0.0003	+0.0282	22	V
V612 Aur	p	55577.7343	0.0009	+0.0388	24	V; el: OEJV 83
SU Boo	p	55649.9350	0.0005	−0.0174	24	V
	p	55660.8633	0.0003	−0.0179	33	V
SY Boo	p	55644.8313	0.0013	+0.0041	22	V
	p	55694.8394	0.0004	−0.0015	49	V; d=0.050d
TU Boo	p	55637.9264	0.0002	+0.0037	24	V
	p	55690.7841	0.0002	+0.0034	19	V
TX Boo	p	55643.9115	0.0005	+0.0395	40	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
TY Boo	p	55647.8981	0.0003	−0.0018	17	V
	s	55698.8015	0.0003	−0.0007	35	V
TZ Boo	p	55647.8616	0.0011	−0.0040	24	V
	p	55697.7870	0.0007	−0.0017	18	V
UW Boo	p	55652.8222	0.0005	+0.0045	19	V
VW Boo	s	55638.8634	0.0006	+0.0003	25	V; el: 2453907.605 + 0.342315 * E
	p	55680.7967	0.0005	0	32	V
XY Boo	p	55632.9330	0.0003	−0.0098	29	V; el: IBVS 5945
	p	55687.7757	0.0002	−0.0121	31	V
AC Boo	s	55654.8918	0.0005	−0.0005	24	V
AD Boo	s	55638.8792	0.0004	+0.0021	34	V
	p	55695.7723	0.0003	+0.0030	34	V; d=0.016d
AQ Boo	s	55631.8750	0.0004	−0.0038	30	V
	s	55694.8381	0.0005	−0.0041	32	V
AR Boo	p	55632.8889	0.0009	−0.0074	21	V
	s	55694.7929	0.0006	−0.0088	18	V
CK Boo	p	55644.8962	0.0004	−0.0055	28	V
	p	55680.7700	0.0011	−0.0021	25	V
CV Boo	p	55653.9186	0.0001	−0.0001	17	V
	p	55698.8108	0.0003	+0.0014	32	V
EF Boo	p	55694.8850	0.0004	+0.0026	23	V; el: 2451589.815 + 0.420515 * E
EW Boo	p	55648.8958	0.0005	+0.0097	38	V
	p	55697.8392	0.0005	+0.0102	31	V
FY Boo	s	55631.8437	0.0002	+0.0055	14	V
	p	55631.9648	0.0008	+0.0060	10	V
	s	55687.7932	0.0004	+0.0060	18	V
GH Boo	p	55644.948	0.002	+0.001	33	V
	s	55690.7849	0.0010	+0.0022	30	V
GI Boo	p	55696.7997	0.0002	+0.0923	51	V; el: 2451567.835 + 1.033510 * E; d=0.036d
GK Boo	s	55644.8898	0.0005	+0.0001	17	V
	p	55695.7717	0.0005	−0.0007	14	V
GM Boo	s	55644.9063	0.0004	+0.0004	28	V
	s	55695.8251	0.0003	+0.0014	32	V
GN Boo	s	55643.8419	0.0004	+0.0137	28	V
	s	55685.7641	0.0003	+0.0136	15	V
GO Boo	p	55680.7375	0.0009	+0.0054	48	V; el: 2451352.9 + 3.075929 * E
GQ Boo	p	55643.9183	0.0007	−0.0027	33	V
	p	55697.7608	0.0008	−0.0044	40	V
GR Boo	p	55643.8793	0.0007	−0.0044	40	V
GS Boo	p	55674.7518	0.0004	+0.0336	30	V; el: 2451338.741 + 1.256805 * E
GU Boo	p	55654.8947	0.0009	−0.0004	11	V
GW Boo	s	55631.9288	0.0005	+0.0049	39	V; el: IBVS 5945
HH Boo	p	55644.9336	0.0003	−0.0037	20	V
	s	55680.7853	0.0002	−0.0020	26	V
HR Boo	p	55643.8751	0.0005	+0.0067	25	V; d=0.026d
	p	55687.7944	0.0009	+0.0070	14	V
GSC 900-421	p	55667.8586	0.0007	+0.0138	33	V; el: 2453833.742 + 1.886937 * E
GSC 902-318	p	55637.8400	0.0006	+0.0001	15	V; el: 2453396.874 + 0.326862 * E
	s	55680.8226	0.0006	+0.0004	32	V
GSC 912-792	s	55639.8916	0.0004	+0.0006	16	V; el: IBVS 5894
	s	55695.7576	0.0003	+0.0026	24	V
	p	55695.8979	0.0004	−0.0003	18	V
GSC 921-412	s	55647.8658	0.0004	+0.0297	16	V; el: IBVS 5894
	s	55696.8106	0.0007	+0.0328	26	V
GSC 1467-1309	p	55648.9255	0.0003	+0.0019	18	V; el: IBVS 5945; d=0.036d
GSC 1470-582	s	55634.9325	0.0003	+0.0097	20	V; el: IBVS 5945
	s	55694.8046	0.0003	+0.0098	28	V
GSC 1477-516	p	55643.8575	0.0002	+0.0047	30	V; el: 2453462.717 + 0.444676 * E
	p	55696.7704	0.0004	+0.0012	46	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
GSC 1478-669	p	55648.8496	0.0002	+0.0028	23	V; el: 2454204.822 + 0.427986 * E; d=0.031d
	p	55696.7858	0.0006	+0.0046	40	V
GSC 1484-525	p	55643.8494	0.0006	−0.0083	33	V; el: IBVS 5894
	s	55696.8267	0.0003	−0.0089	33	V; d=0.024d
GSC 1999-404	p	55637.8115	0.0022	+0.0005	13	V; el: 2454907.770 + 0.655333 * E
	s	55680.7384	0.0008	+0.0031	36	V
GSC 2006-128	p	55639.9087	0.0008	+0.0259	16	V; el: 2454256.516 + 0.397405 * E; d=0.04d
GSC 3039-709	p	55685.8080	0.0008	−0.0253	14	V; el: Per. Zv. Pril. 11, 1
GSC 3475-348	s	55685.7915	0.0007	+0.0061	26	V; el: Per. Zv. Pril. 11, 1
UU Cam	p	55566.6466	0.0005	−0.0383	34	V; el: CoSka 33, 38
AL Cam	p	55614.9005	0.0004	−0.0312	47	V
	p	55666.7072	0.0001	−0.0295	31	V
AS Cam	s	55583.6275	0.0007	−0.2155	33	V; d=0.037d; non-circ.
	p	55602.6779	0.0007	−0.0354	44	V; d=0.031d
AT Cam	s	55575.7568	0.0014	−0.0014	23	V; el: 2451455.783 + 1.395892 * E; d=0.042d
AV Cam	p	55607.7198	0.0005	−0.0689	35	V
AZ Cam	s	55577.9233	0.0005	+0.0192	39	V; d=0.032d
HW Cam	p	55640.7042	0.0005	+0.0888	28	V; el: IBVS 4526
MP Cam	p	55583.6514	0.0006	−0.0974	43	V
V343 Cam	p	55574.5988	0.0015	−0.0013	29	V; el: 2453321.995 + 5.26309 * E
V378 Cam	s	55565.7569	0.0006	+0.0442	36	V; el: OEJV 83
V397 Cam	p	55574.7410	0.0004	−0.0105	21	V; el: OEJV 83
V398 Cam	p	55589.6102	0.0009	−0.0516	13	V; el: OEJV 83
V400 Cam	p	55585.6511	0.0003	+0.0257	49	V; el: OEJV 83
GSC 4358-151	p	55602.7084	0.0003	−0.0037	40	V; el: OEJV 83
GSC 4365-444	p	55623.6512	0.0004	−0.0364	16	V; el: OEJV 83
GSC 4370-206	s	55591.6773	0.0007	−0.0551	40	V; el: IBVS 5894
GSC 4533-110	p	55608.7244	0.0003	+0.0879	27	V; el: OEJV 83
GSC 4544-120	p	55575.8991	0.0002	−0.0522	46	V; el: OEJV 83
GSC 4544-1144	p	55648.6795	0.0005	+0.0133	24	V; el: OEJV 83
GSC 4546-1600	s?	55634.6541	0.0006	−0.0824	31	V; el: OEJV 83
GSC 4550-183	p	55621.8537	0.0003	−0.0054	24	V; el: OEJV 91; d=0.046d
GSC 4631-2151	s	55566.8657	0.0008	−0.0081	25	V; el: OEJV 83
	p	55653.6717	0.0011	−0.0042	22	V
GSC 4633-796	p	55614.9588	0.0009	+0.0398	46	V; el: OEJV 83
GSC 4634-1925	p	55663.8649	0.0003	−0.0032	27	V; el: OEJV 83; d=0.024d
NSV 3715	p	55648.6523	0.0003	+0.0095	23	V; el: IBVS 5894
NSV 4638	s	55588.8722	0.0013	−0.0013	35	V; el: IBVS 5945; d=0.06d
	s	55663.7409	0.0015	−0.0135	27	V
RY Cnc	p	55653.7191	0.0002	+0.0712	30	V
TX Cnc	p	55566.9297	0.0007	+0.0374	24	V
	s	55656.7173	0.0003	+0.0393	23	V
WW Cnc	p	55640.7333	0.0002	−0.5447	26	V
WX Cnc	p	55649.7562	0.0004	+0.0126	26	V; d=0.024d
WY Cnc	p	55660.6748	0.0003	−0.0349	19	V
XZ Cnc	p	55648.7113	0.0005	+0.0634	33	V; el: IBVS 5592
YY Cnc	p	55643.7250	0.0008	−0.0055	33	V; el: IBVS 5591; d=0.073d
AB Cnc	p	55564.9178	0.0002	+0.0655	36	V; el: IBVS 5337
AC Cnc	s	55571.8851	0.0021	−0.0086	23	V
AD Cnc	s	55566.8745	0.0004	−0.0187	17	V
	p	55567.0150	0.0010	−0.0196	10	V
	s	55660.7438	0.0007	−0.0185	20	V
AE Cnc	p	55632.6588	0.0006	−0.1086	32	V
AH Cnc	p	55567.0004	0.0012	+0.1282	11	V
	p	55660.7209	0.0004	+0.1341	29	V; d=0.038d
AO Cnc	p	55648.6700	0.0008	−0.0718	11	V
EH Cnc	p	55656.6356	0.0016	−0.0052	16	V; el: 2453795.549 + 0.418035 * E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
FF Cnc	p	55563.9312	0.0003	+0.0004	25	V; el: 2454465.752 + 1.323107 * E; d=0.022d
	p	55632.7306	0.0003	−0.0017	25	V
GQ Cnc	p	55577.9104	0.0005	+0.0048	18	V; el: AcAst 54, 207
	p	55652.6406	0.0010	+0.0042	8	V
GW Cnc	s	55571.8950	0.0002	−0.0027	21	V; el: 2454474.813 + 0.281412 * E
	p	55656.7408	0.0002	−0.0026	19	V
IL Cnc	p	55571.8365	0.0003	+0.0612	17	V; el: IBVS 5428
	s	55571.9700	0.0003	+0.0608	15	V; d=0.021d
	p	55667.6576	0.0004	+0.0635	16	V
IO Cnc	s	55577.9670	0.0007	−0.0005	18	V; el: 2455663.6733 + 0.347691 * E
	p	55663.6733	0.0006	0	21	V
IR Cnc	s	55638.7129	0.0014	+0.0048	38	V; el: IBVS 5871
IU Cnc	s	55580.8454	0.0005	−0.0162	25	V; d=0.032d
	s	55667.7032	0.0003	−0.0178	31	V; d=0.029d
GSC 224-44	s	55571.9450	0.0007	−0.0129	14	V; el: IBVS 5945
GSC 794-1208	p	55563.9401	0.0004	−0.0067	17	V; el: 2453835.521 + 0.286258 * E; d=0.014d
GSC 795-590	s	55629.6954	0.0002	+0.0029	20	V; el: 2454818.788 + 0.319191 * E
GSC 800-1379	p	55634.6724	0.0003	+0.0140	36	V; el: 2454566.599 + 0.378208 * E
GSC 808-1106	p	55565.9259	0.0008	−0.0037	29	V; el: 2454499.784 + 0.506242 * E; d=0.036d
GSC 809-569	p	55565.8931	0.0007	+0.0087	28	V; el: 2454795.831 + 0.386573 * E
GSC 815-1932	s	55566.9136	0.0005	+0.0080	39	V; el: 2454599.491 + 0.741598 * E
GSC 817-322	p	55640.7027	0.0003	−0.0109	31	V; el: 2453791.596 + 0.269826 * E
GSC 817-411	p	55634.7309	0.0001	+0.0007	26	V; el: 2454123.712 + 0.353620 * E
GSC 819-48	p	55574.8883	0.0002	+0.0041	32	V; el: 2454469.779 + 0.325318 * E
	p	55663.7003	0.0002	+0.0043	14	V
GSC 819-595	p	55640.7314	0.0007	+0.0208	34	V; el: IBVS 5945
GSC 1383-181	p	55630.7202	0.0002	+0.0027	18	V; el: 2453414.607 + 0.267130 * E
GSC 1388-132	p	55629.6950	0.0002	+0.0014	42	V; el: 2453336.786 + 0.454221 * E; d=0.013d
GSC 1395-877	p	55565.9427	0.0005	+0.0131	25	V; el: 2453330.842 + 0.295139 * E
	p	55660.6849	0.0005	+0.0156	28	V
GSC 1397-1030	p	55572.8704	0.0003	−0.0221	17	V; el: IBVS 5945
	p	55667.7409	0.0002	−0.0229	28	V; d=0.015d
GSC 1407-222	s	55647.6714	0.0011	−0.0244	18	V; el: ASAS
GSC 1927-862	s	55564.8432	0.0007	+0.0001	32	V; el: IBVS 5871
GSC 1928-943	s	55563.9085	0.0004	−0.0007	38	V; el: 2454794.845 + 0.407020 * E
GSC 1936-40	p	55629.6923	0.0002	+0.0018	20	V; el: 2453792.557 + 0.467464 * E; d=0.031d
GSC 1950-1942	s	55572.8978	0.0002	+0.0195	21	V; el: 2454425.846 + 0.257847 * E; d=0.014d
	s	55656.7058	0.0006	+0.0271	36	V
NSV 4158	s	55565.9397	0.0005	+0.0004	16	V; el: 2454152.578 + 0.378410 * E
NSV 4188	s	55565.9165	0.0002	−0.0030	22	V; el: 2454523.683 + 0.308035 * E; d=0.025d
NSV 4269	p	55566.8721	0.0005	+0.0058	21	V; el: 2454443.826 + 1.324340 * E
RV CVn	p	55629.8931	0.0003	+0.0237	27	V
VV CVn	p	55634.8968	0.0008	+0.0424	40	V; el: IBVS 5894; d=0.028d
VZ CVn	s	55684.7404	0.0003	−0.0009	32	V
YZ CVn	p	55637.9522	0.0010	−0.0163	21	V
BI CVn	p	55622.9344	0.0002	+0.0519	26	V; el: IBVS 4554
	s	55685.7485	0.0007	+0.0483	20	V
BO CVn	p	55634.8679	0.0004	+0.0361	43	V; el: IBVS 3288; d=0.033d
	p	55690.7650	0.0011	+0.0475	40	V
CI CVn	p	55623.9168	0.0003	−0.0233	26	V; el: Hipparcos
DF CVn	p	55614.8718	0.0004	−0.0025	32	V; el: IBVS 5894
	p	55684.8291	0.0003	−0.0009	17	V
DH CVn	p	55617.8831	0.0003	−0.0242	35	V; el: IBVS 5149
DI CVn	s	55609.8730	0.0002	−0.0066	19	V; el: IBVS 5224
	p	55679.7891	0.0005	−0.0040	27	V
DK CVn	p	55637.9426	0.0007	−0.0009	12	V; el: IBVS 5642; d=0.019d
DQ CVn	s	55614.8824	0.0009	+0.0130	18	V; el: IBVS 5541
	s	55679.7520	0.0004	+0.0151	17	V
DR CVn	s	55617.9279	0.0005	+0.0526	21	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
DX CVn	p	55617.8901	0.0005	+0.0047	35	V
	p	55685.7908	0.0004	+0.0029	25	V
DY CVn	p	55622.9055	0.0002	−0.0039	17	V; el: IBVS 5403
	s	55684.7634	0.0003	−0.0024	25	V
	p	55684.8839	0.0004	−0.0048	15	V
EE CVn	s	55629.8987	0.0006	−0.0058	14	V; el: IBVS 5403
	s	55688.8152	0.0003	−0.0076	21	V
EF CVn	p	55629.9294	0.0006	−0.0090	23	V; el: IBVS 5269
EI CVn	s	55637.9112	0.0004	−0.0175	18	V; el: IBVS 5403
	s	55694.7555	0.0007	−0.0207	19	V
	p	55694.8898	0.0007	−0.0168	13	V
EN CVn	s	55586.010	0.002	+0.016	25	V; el: 2451338.725 + 6.33448 * E; non-circ.
RR CMa	p	55616.6791	0.0002	−0.0005	27	V; el: 2454867.814 + 1.196271 * E; d=0.021d
SX CMa	p	55608.7488	0.0004	+0.0037	36	V; el: 2454734.897 + 1.624253 * E
GSC 5375-811	p	55580.6762	0.0006	−0.0044	41	V; el: 2454588.460 + 0.472486 * E
GSC 5375-1015	s	55575.6987	0.0004	+0.0121	19	V; el: 2453497.598 + 0.282637 * E; d=0.021d
GSC 5404-2421	p	55589.6741	0.0006	+0.0112	40	V; el: 2454759.824 + 4.509994 * E; non-circ.
GSC 5406-2659	p	55614.6937	0.0005	+0.0032	35	V; el: 2454432.774 + 0.394235 * E
GSC 5407-2794	p	55617.6456	0.0003	−0.0053	16	V; el: 2454426.804 + 0.369484 * E
GSC 5934-2133	p	55580.7179	0.0002	+0.0049	21	V; el: 2454353.912 + 0.355904 * E
TU CMi	s	55615.6122	0.0003	+0.0566	15	V; el: IBVS 5524
TX CMi	p	55638.7378	0.0004	+0.0057	21	V; el: BBSAG Bull. 106, 7
UZ CMi	p	55615.6930	0.0002	+0.0173	39	V; el: IBVS 5894
XZ CMi	p	55629.6788	0.0002	−0.0034	37	V
AC CMi	p	55616.7287	0.0018	+0.0358	16	V; el: PASP 98, 690
AM CMi	p	55621.6867	0.0008	+0.1949	33	V
AV CMi	s	55575.6535	0.0006	+0.1579	33	V; el: IBVS 5945; non-circ.
	p	55617.6494	0.0005	+0.0154	27	V
BF CMi	p	55638.616	0.004	−0.145	26	V
BX CMi	p	55622.7218	0.0005	−0.0768	18	V; el: IBVS 4410
BZ CMi	s	55607.6334	0.0008	−0.0087	39	V; el: 2452706.548 + 2.545936 * E
CZ CMi	s	55617.7226	0.0002	+0.0660	25	V; el: IBVS 5366; d=0.030d
DG CMi	p	55614.7162	0.0001	+0.0285	35	V; el: IBVS 5630
GSC 167-251	s	55617.7154	0.0003	−0.0029	24	V; el: IBVS 5945
GSC 174-700	p	55614.6316	0.0005	−0.0068	35	V; el: 2453101.522 + 0.825868 * E
GSC 179-696	p	55638.7114	0.0009	−0.0262	37	V; el: 2453428.629 + 0.559238 * E
GSC 180-2135	p	55608.6577	0.0021	−0.0026	37	V; el: OEJV 83; d=0.047d
GSC 181-1576	p	55564.8648	0.0003	−0.0124	24	V; el: 2453478.471 + 0.362538 * E; d=0.024d
GSC 189-821	p	55623.7112	0.0004	+0.0084	27	V; el: 2454548.577 + 0.475509 * E
GSC 191-41	s	55616.6941	0.0008	+0.0068	18	V; el: 2454439.766 + 0.301736 * E
GSC 762-958	s	55614.7220	0.0004	+0.0046	30	V; el: IBVS 5945
GSC 763-1042	p	55621.6708	0.0003	−0.0146	33	V; el: 2453714.811 + 0.582074 * E
GSC 764-235	p	55616.7188	0.0020	+0.0043	19	V; el: 2454828.716 + 0.306853 * E
DO Cas	p	55563.6200	0.0014	−0.0135	16	V; el: 2451421.738 + 0.684724 * E
OX Cas	s	55574.6867	0.0005	+0.0434	42	V; non-circ.
V775 Cas	s	55582.7335	0.0012	+0.8365	36	V; el: IBVS 5557; non-circ.
V952 Cas	p	55563.6733	0.0004	−0.0069	42	V; el: IBVS 5171; d=0.047d
V1137 Cas	s	55580.6032	0.0006	−0.0464	37	V; el: OEJV 107; d=0.06d; non-circ.
CO Cep	p	55577.6273	0.0002	−0.1944	28	V; non-circ.
EK Cep	s	55737.7602	0.0027	+0.1941	25	V; non-circ.
V743 Cep	p	55602.6154	0.0006	+0.0738	18	V; el: IBVS 5630; non-circ.
TV Cet	s	55572.6216	0.0010	−0.0548	29	V; non-circ.
XY Cet	s	55564.7094	0.0006	+0.0084	20	V
RW Com	p	55609.8612	0.0002	−0.0097	12	V
	s	55609.9795	0.0004	−0.0101	15	V
	s	55679.7565	0.0006	−0.0128	21	V
	p	55679.8802	0.0006	−0.0078	17	V
RZ Com	s	55621.9038	0.0002	+0.0051	27	V; el: 2454610.612 + 0.338506 * E
SS Com	s	55616.9243	0.0004	+0.0089	26	V; el: 2453899.580 + 0.412821 * E; d=0.028d
	p	55660.6853	0.0006	+0.0109	19	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
UX Com	p	55647.9219	0.0008	−0.1291	31	V; el: BAV Mitt. 69, 9
AQ Com	s	55615.8518	0.0009	−0.0094	18	V; el: IBVS 5684
CC Com	p	55607.9171	0.0002	−0.0132	11	V
	p	55660.6609	0.0002	−0.0134	13	V
	s	55660.7712	0.0011	−0.0134	10	V
CM Com	p	55609.8467	0.0008	−0.0201	17	V; el: IBVS 5894
	p	55679.7172	0.0003	−0.0185	21	V
CN Com	p	55622.8757	0.0007	+0.0590	15	V
DD Com	s	55614.9352	0.0009	−0.0592	31	V
	s	55679.8144	0.0004	−0.0514	15	V
EK Com	p	55614.8897	0.0001	−0.0591	40	V; el: IBVS 4167; d=0.025d
EQ Com	p	55622.9157	0.0012	+0.2109	25	V
LL Com	p	55629.9122	0.0005	+0.0408	37	V; el: IBVS 4386
	s	55630.9313	0.0005	+0.0426	48	V
LO Com	p	55609.8564	0.0005	+0.0080	11	V; el: IBVS 5052
LP Com	p	55616.8337	0.0009	−0.0237	11	V; el: IBVS 5052
LR Com	p	55654.8337	0.0005	−0.0211	17	V; el: IBVS 5894
MM Com	s	55614.8630	0.0004	−0.0153	18	V; el: IBVS 5224
	p	55684.7678	0.0003	−0.0211	31	V; d=0.024d
GSC 871-248	s	55607.9070	0.0009	+0.0254	15	V; el: IBVS 5945; d=0.024d
	p	55674.7571	0.0002	+0.0242	13	V
GSC 880-55	s	55609.8870	0.0007	+0.0006	21	V; el: IBVS 5894
	p	55677.7880	0.0004	0	25	V
GSC 881-218	s	55616.9038	0.0003	−0.0012	25	V; el: IBVS 5894
GSC 1445-866	p	55608.8232	0.0010	+0.0084	16	V; el: 2454493.861 + 0.373019 * E
	p	55674.841	0.003	+0.002	6	V
GSC 1446-1499	s	55616.8765	0.0006	+0.0072	12	V; el: IBVS 5894
GSC 1446-2377	p	55609.8990	0.0003	−0.0042	26	V; el: IBVS 5894
	s	55679.7585	0.0010	−0.0020	19	V
GSC 1994-465	s	55623.9327	0.0003	+0.0066	21	V; el: 2454163.751 + 0.384915 * E; d=0.028d
	s	55684.7514	0.0003	+0.0088	33	V; d=0.023d
GSC 1994-935	p	55629.9163	0.0003	+0.0128	32	V; el: IBVS 5894
	p	55684.7935	0.0004	+0.0152	36	V
RT CrB	p	55685.8404	0.0007	−0.0234	49	V
RW CrB	p	55667.8619	0.0002	0	24	V
TU CrB	p	55695.8100	0.0004	−0.7370	47	V
TW CrB	s	55660.8908	0.0002	+0.0438	39	V
YY CrB	s	55652.882	0.003	−0.119	6	V; el: IBVS 5152
AR CrB	p	55663.9172	0.0002	−0.0061	29	V; el: IBVS 5295
AS CrB	s	55660.8457	0.0007	+0.0086	26	V; el: IBVS 5295
AV CrB	s	55666.9021	0.0005	−0.0213	15	V; el: IBVS 5295
W Crv	p	55604.8908	0.0003	+0.0172	36	V
A115645-1420.8	s	55604.8750	0.0015	+0.0019	12	V; el: 2453476.605 + 0.296313 * E
GSC 5532-1333	p	55615.9549	0.0006	+0.0080	17	V; el: 2454435.858 + 0.474503 * E; d=0.039d
GSC 6085-670	p	55623.8949	0.0013	+0.0178	29	V; el: 2454561.784 + 3.060787 * E
GSC 6094-1317	p	55623.9424	0.0003	+0.0087	20	V; el: 2454524.811 + 0.651525 * E
GSC 6095-294	s	55607.8746	0.0004	−0.0011	15	V; el: 2453144.615 + 0.277990 * E
V Crt	p	55600.9226	0.0004	−0.0009	22	V; el: 2453030.766 + 0.702037 * E
AC Crt	p	55589.8669	0.0005	+0.0034	25	V; el: IBVS 5945
	p	55654.6808	0.0008	+0.0048	31	V
GSC 5500-260	s	55602.865	0.003	−0.006	19	V; el: 2453538.534 + 0.374959 * E
	p	55665.6704	0.0010	−0.0060	12	V
GSC 5507-705	s	55583.8879	0.0010	+0.0115	19	V; el: 2454798.854 + 0.263563 * E
	s	55666.643	0.003	+0.012	13	V
	p	55666.7830	0.0023	+0.0160	11	V
GSC 5509-447	p	55604.8591	0.0004	−0.0039	25	V; el: 2454207.702 + 0.528827 * E
	p	55666.447	0.0006	−0.0047	31	V
GSC 5509-1073	p	55602.851	0.003	+0.007	11	V; el: 2453478.621 + 0.415374 * E
GSC 5509-1347	p	55608.8413	0.0004	+0.0031	16	V; el: 2454497.795 + 0.682040 * E
GSC 5516-355	s	55602.9769	0.0006	+0.0010	10	V; el: 2454866.795 + 0.267459 * E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
GSC 6077-1825	p	55589.9220	0.0007	−0.0083	34	V; el: 2454250.488 + 1.809284 * E
GSC 6085-670	p	55666.7466	0.0013	+0.0185	31	V; el: 2454561.784 + 3.060787 * E
EN Cyg	p	55730.7725	0.0007	+0.4654	38	V
V477 Cyg	s	55727.7443	0.0009	−0.4988	26	V; non-circ.
	p	55738.7806	0.0005	−0.0240	31	V
V498 Cyg	s	55741.8133	0.0035	+0.1986	38	V; non-circ. ?
V962 Cyg	p	55730.731	0.004	−0.198	36	V
V974 Cyg	s	55711.8205	0.0002	−0.2504	36	V; non-circ.
V1004 Cyg	p	55730.7260	0.0007	−0.0772	40	V
V1136 Cyg	p	55727.8154	0.0002	+0.0855	45	V; non-circ.
	s	55736.7660	0.0007	+0.3792	43	V
V1355 Cyg	p	55728.7909	0.0022	+0.0393	50	V
GSC 3152-1202	s	55725.8454	0.0010	+0.1164	39	V; el: IBVS 5909; non-circ.
	p	55726.7857	0.0009	+0.0099	48	V
Z Dra	p	55644.7013	0.0001	−0.1935	34	V
RX Dra	s	55712.8093	0.0004	+0.0578	49	V; non-circ.?
AR Dra	p	55615.9028	0.0001	+0.0203	33	V
	p	55684.8380	0.0002	+0.0201	30	V
AX Dra	p	55617.8672	0.0002	−0.0597	27	V
	p	55663.8898	0.0002	−0.0584	28	V
BF Dra	p	55695.8615	0.0003	−0.0536	43	V; el: IBVS 3867; non-circ.
BL Dra	p	55730.8256	0.0008	+0.0025	26	V; el: Cracow Cat.
BX Dra	p	55666.8861	0.0003	+0.0296	28	V; el: IBVS 4266
CM Dra	p	55695.7935	0.0003	+0.0042	11	V
FU Dra	s	55647.8534	0.0005	−0.0125	15	V; el: Hipparcos
IV Dra	p	55647.8926	0.0003	+0.0030	17	V; el: IBVS 5894
GSC 3883-926	s	55685.8483	0.0007		28	V; el: Per. Zv. Pril. 11, 1
GSC 4190-894	p	55688.8704	0.0004	+0.0472	16	V; el: Per. Zv. Pril. 11, 1
GSC 4193-44	p	55720.7638	0.0009	+0.1288	29	V; el: Per. Zv. Pril. 11, 1
GSC 4194-2180	p	55697.7292	0.0008	−0.0384	26	V; el: Per. Zv. Pril. 11, 1
	s	55697.8663	0.0006	−0.0354	21	V
GSC 4207-158	p	55736.7823	0.0010	−0.0384	20	V; el: Per. Zv. Pril. 11, 1
GSC 4391-1203	s	55665.6792	0.0009	+0.0502	19	V; el: OEJV 83
GSC 4392-717	s	55605.8588	0.0005	+0.0044	20	V; el: OEJV 83
GSC 4401-1126	p	55638.8321	0.0005	−0.0120	29	V; el: OEJV 91
	p	55685.8092	0.0002	−0.0160	50	V
GSC 4412-1734	p	55677.7229	0.0013	+0.0060	22	V; el: OEJV 91
GSC 4421-50	s	55721.7832	0.0005	+0.0020	32	V; el: OEJV 104
GSC 4424-1787	p	55736.8224	0.0004	+0.0247	44	V; el: OEJV 104; d=0.034d
GSC 4424-1958	p	55727.8427	0.0006	+0.0356	16	V; el: Per. Zv. Pril. 11, 1
GSC 4424-2294	p	55722.7791	0.0005	+0.0397	25	V; el: Per. Zv. 11, 1
GSC 4429-655	p	55738.7616	0.0005	−0.0009	29	V; el: OEJV 91
WW Eri	p	55575.6789	0.0006	+0.0612	45	V; d=0.066d
GSC 5323-652	p	55565.6824	0.0004	+0.0052	13	V; el: 2454132.659 + 0.313365 * E
GSC 5323-1798	p	55564.6659	0.0005	+0.0103	40	V; el: 2454475.603 + 1.119273 * E
SX Gem	p	55600.6379	0.0004	−0.0594	30	V
TZ Gem	p	55602.6133	0.0002	−0.0016	17	V; el: IBVS 5960
AF Gem	p	55603.6241	0.0003	−0.0970	26	V
AV Gem	p	55605.6807	0.0006	−0.0294	32	V
AY Gem	p	55609.7056	0.0002	−0.0539	37	V
CW Gem	p	55604.7141	0.0005	+0.0094	44	V; el: BAV Mitt. 69
DD Gem	p	55604.7033	0.0016	+0.0031	45	V; el: 2453338.732 + 3.80196 * E
FG Gem	p	55600.6911	0.0001	−0.0260	29	V
FT Gem	s	55605.7006	0.0011	−0.0340	35	V
HR Gem	p	55600.6744	0.0002	+0.0115	30	V
LO Gem	p	55575.6348	0.0003	+0.0154	30	V; el: IBVS 5020
V388 Gem	p	55617.6407	0.0004	−0.0117	15	V
GSC 1330-287	p	55604.6377	0.0003	−0.0023	17	V; el: 2454494.712 + 0.348705 * E
GSC 1335-1907	s	55572.6863	0.0011	+0.0159	47	V; el: 2451548.73 + 3.47041 * E; non-circ.
	p	55591.7394	0.0002	−0.0183	40	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
GSC 1336-717	p	55588.7329	0.0008	+0.0019	30	V; el: 2454520.581 + 0.350673 * E
GSC 1337-1137	s	55603.7294	0.0005	+0.0065	27	V; el: 2454482.701 + 0.475513 * E
GSC 1351-225	p	55616.7281	0.0013	+0.0132	18	V; el: 2454560.513 + 0.742758 * E
GSC 1360-49	p	55622.7345	0.0015	+0.0086	19	V; el: 2454905.576 + 0.448499 * E
GSC 1368-1411	s	55616.6656	0.0013	+0.0020	28	V; el: IBVS 5871
GSC 1368-1825	p	55615.7197	0.0005	+0.0066	31	V; el: IBVS 5945
GSC 1370-156	p	55615.7177	0.0011	+0.0025	22	V; el: 2454561.549 + 0.366539 * E
GSC 1883-1299	p	55600.7428	0.0011	+0.0068	21	V; el: OEJV 91
GSC 1886-1869	s	55583.6588	0.0004	+0.0743	14	V; el: 2453052.588 + 0.340852 * E
GSC 1909-2392	s	55617.6364	0.0006	−0.0008	15	V; el: 2454136.581 + 0.868400 * E
GSC 1914-933	p	55616.6883	0.0005	−0.0085	28	V; el: 2453673.835 + 0.658151 * E; d=0.024d
TT Her	p	55712.8331	0.0004	+0.0407	55	V
BC Her	p	55738.7946	0.0001	−0.4313	46	V
CC Her	p	55690.7694	0.0006	+0.2138	27	V
CT Her	p	55668.8692	0.0003	+0.0050	25	V
DD Her	p	55738.7384	0.0009	+0.0002	44	V; el: 2454271.462 + 5.64337 * E
FN Her	p	55711.7925	0.0003	+0.0892	52	V
GL Her	p	55738.7893	0.0002	+0.0770	48	V
HS Her	p	55726.7759	0.0004	−0.0261	33	V; d=0.053d; non-circ.
IK Her	p	55712.7809	0.0005	+0.2610	47	V
MS Her	p	55741.8631	0.0013	+0.0115	28	V; el: Cracow Cat.
V338 Her	p	55728.8322	0.0002	+0.0986	42	V
V359 Her	p	55726.7651	0.0010	+0.2214	40	V
V366 Her	p	55722.7964	0.0002	−0.1336	44	V
V381 Her	p	55723.8401	0.0004	+0.1936	38	V
V387 Her	s	55725.8053	0.0002	+0.0628	49	V
V477 Her	s	55725.7858	0.0008	−0.1480	23	V
V681 Her	p	55671.8692	0.0005	+0.0010	19	V; el: 2453565.497 + 0.579310 * E
V687 Her	s	55667.8903	0.0018	−0.1656	27	V
V718 Her	p	55723.7782	0.0012	+0.2844	50	V
V719 Her	p	55721.7693	0.0005	−0.0310	36	V
V728 Her	s	55737.7638	0.0004	+0.1073	35	V; el: IBVS 3234
V731 Her	p	55726.7976	0.0007	−0.0169	32	V; el: IBVS 5592
V733 Her	s	55727.7728	0.0005	+0.0127	35	V
V789 Her	s	55720.7787	0.0006	+0.0247	24	V; el: IBVS 5741
V811 Her	p	55737.8723	0.0003	+0.1529	24	V; el: 2442452.654 + 0.941936 * E
V842 Her	p	55653.8642	0.0002	+0.0776	20	V; el: IBVS 3946
V856 Her	p	55671.8718	0.0006	−0.0542	32	V; el: IBVS 4342
V857 Her	s	55698.7861	0.0007	+0.0022	37	V; el: IBVS 4364
V861 Her	s	55672.8322	0.0013	−0.0408	16	V; el: IBVS 4360
V878 Her	p	55725.7476	0.0003	−0.0413	43	V; el: IBVS 4284
V1005 Her	p	55668.9289	0.0002	+0.0661	13	V; el: IBVS 4611; d=0.017d
V1024 Her	p	55665.8084	0.0019	+0.0380	12	V
V1025 Her	p	55696.8180	0.0003	−0.0256	17	V; el: IBVS 5894
V1026 Her	p	55723.8339	0.0003	+0.0005	48	V; el: 2454571.819 + 0.829384 * E
V1031 Her	p	55698.8445	0.0004	+0.0030	40	V; el: IBVS 5894
V1033 Her	s	55712.7570	0.0003	−0.0106	22	V; el: IBVS 5146
	p	55712.9038	0.0013	−0.0128	19	V; d=0.02d
V1034 Her	p	55672.9082	0.0008	+0.0060	15	V; el: IBVS 5231
V1035 Her	p	55711.8438	0.0002	+0.0248	29	V; el: IBVS 5060
V1036 Her	p	55672.8823	0.0011	+0.0038	33	V; el: IBVS 5146
V1038 Her	p	55712.7953	0.0004	+0.0095	30	V; el: IBVS 5146
V1039 Her	s	55672.8779	0.0011	−0.0017	18	V; el: BBSAG Bull. 128, 10
V1040 Her	s	55672.8709	0.0007	+0.0059	28	V; el: 2453588.626 + 1.113673 * E
V1041 Her	p	55726.7817	0.0007	+0.0340	45	V; el: IBVS 5894
V1042 Her	p	55672.9009	0.0003	−0.0258	24	V; el: IBVS 4998
V1044 Her	p	55721.7654	0.0003	−0.0044	24	V; el: IBVS 5192
V1045 Her	p	55721.8466	0.0013	+0.0010	42	V; el: 2454238.450 + 0.510284 * E
V1046 Her	p	55727.7087	0.0014	−0.0673	51	V; el: 2454627.686 + 4.151283 * E
V1047 Her	s	55723.8219	0.0007	−0.0103	26	V; el: IBVS 5192

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
V1049 Her	p	55737.7992	0.0006	−0.0036	45	V; el: IBVS 5894; d=0.078d
V1053 Her	s	55722.7746	0.0004	+0.0085	29	V; el: BBSAG Bull. 128, 10
V1054 Her	p	55722.713	0.003	−0.003	17	V; el: 2455020.708 + 0.648207 * E
V1057 Her	s	55727.8982	0.0010	−0.1874	50	V; el: OEJV 107
V1061 Her	s	55736.7355	0.0008	−0.0126	31	V; el: 2453481.786 + 2.596387 * E
V1095 Her	p	55727.7941	0.0002	−0.0267	40	V
	s	55736.7252	0.0003	−0.0263	26	V
V1096 Her	p	55736.8020	0.0004	+0.0260	25	V
V1097 Her	s	55727.8163	0.0007	+0.0071	27	V
V1104 Her	p	55741.7615	0.0004	−0.0045	19	V
	s	55741.8735	0.0005	−0.0064	18	V
V1119 Her	p	55698.7671	0.0005	+0.0002	51	V; el: IBVS 5945
V1133 Her	p	55721.7730	0.0002	−0.0554	45	V; non-circ.
	s	55737.8249	0.0012	−0.0426	41	V
GSC 381-743	s	55668.9196	0.0003	−0.0115	23	V; el: 2453819.849 + 0.388912 * E; d=0.027d
GSC 394-1770	p	55710.8035	0.0006	+0.0069	30	V; el: 2453128.760 + 0.410956 * E
GSC 950-560	p	55667.8530	0.0004	−0.0059	32	V; el: IBVS 5894
GSC 954-418	p	55671.8874	0.0003	−0.0102	27	V; el: 2453171.737 + 0.323855 * E
GSC 960-163	p	55697.8163	0.0005	+0.0050	32	V; el: IBVS 5945
GSC 960-1531	s	55673.7483	0.0009	+0.0056	31	V; el: IBVS 5945; d=0.034d
GSC 965-581	s	55711.8107	0.0003	+0.0032	35	V; el: IBVS 5894
GSC 967-1277	s	55668.8519	0.0009	+0.0103	27	V; el: IBVS 5945
GSC 968-876	s	55673.8064	0.0003	+0.0050	54	V; el: IBVS 5945; d=0.023d
GSC 971-933	p	55671.8793	0.0005	+0.0043	32	V; el: 2454186.838 + 0.413429 * E
GSC 973-1212	p	55698.7668	0.0004	−0.0027	29	V; el: IBVS 5894; d=0.027d
	s	55698.9015	0.0015	−0.0018	16	V
GSC 985-533	s	55725.8066	0.0005	+0.0079	29	V; el: IBVS 5894
GSC 987-1570	p	55730.7231	0.0011	−0.0435	25	V; el: 2454357.529 + 3.238768 * E
GSC 987-1582	p	55672.8901	0.0008	−0.0032	29	V; el: IBVS 5945
GSC 990-480	s	55722.7892	0.0003	−0.0000	33	V; el: IBVS 5894
GSC 1505-565	s	55668.8723	0.0007	+0.0186	24	V; el: IBVS 5945
GSC 1537-1557	s	55725.8108	0.0005	+0.0072	24	V; el: IBVS 5505
GSC 1538-2200	p	55728.7706	0.0006	−0.0138	26	V; el: 2454616.844 + 0.260774 * E
	s	55728.909	0.005	−0.006	16	V
GSC 1539-326	p	55720.8041	0.0003	+0.0101	37	V; el: IBVS 5894
GSC 1540-1433	p	55737.8485	0.0004	−0.0022	25	V; el: IBVS 5945; d=0.036d
GSC 1546-1276	p	55736.7766	0.0003	−0.0010	28	V; el: 2454617.697 + 0.333755 * E; d=0.023d
GSC 1550-2362	s	55736.7673	0.0004	+0.0054	25	V; el: IBVS 5945
GSC 1577-974	s	55712.8138	0.0004	+0.3047	49	V; el: 2453500.775 + 7.146152 * E; non-circ.
GSC 2043-227	p	55668.8903	0.0004	+0.0105	16	V; el: IBVS 5894; d=0.023d
GSC 2074-1021	p	55726.7833	0.0015	+0.0050	34	V; el: 2453881.705 + 0.394837 * E
GSC 2094-2056	s	55728.7666	0.0009	−0.0010	22	V; el: 2454175.904 + 0.311601 * e
GSC 3080-1410	s	55712.7690	0.0002	−0.0062	42	V; el: AJ 133, 255
SY Hya	p	55648.7450	0.0020	−0.0079	33	V; el: 2454491.772 + 3.402885 * E; d=0.078d
TY Hya	p	55653.648	0.003	−0.009	32	V; el: 2454539.682 + 4.660985 * E; d=0.09d
UW Hya	p	55632.6818	0.0003	+0.0247	26	V; el: MVS 12, 48
VW Hya	p	55634.7241	0.0001	+0.0254	34	V; el: 2454771.834 + 2.696452 * E
WY Hya	p	55564.8973	0.0002	+0.0297	23	V
AL Hya	p	55577.9830	0.0008	+0.5048	16	V
AV Hya	p	55572.8789	0.0006	−0.0931	29	V; el: ApSS 76, 173
CQ Hya	p	55634.6584	0.0002	+0.1926	28	V
CU Hya	p	55640.7189	0.0002	−0.2202	30	V; d=0.036d
DF Hya	s	55571.9381	0.0002	+0.0013	14	V; el: 2454126.697 + 0.330605 * E
DI Hya	p	55643.7061	0.0005	−0.0277	19	V; d=0.019d
EU Hya	p	55640.6550	0.0008	−0.0322	19	V
EZ Hya	s	55575.8698	0.0004	+0.0120	24	V; el: 2454596.525 + 0.449751 * E; d=0.029d
	s	55653.6781	0.0007	+0.0134	18	V
FG Hya	s	55632.7353	0.0005	+0.0092	28	V; el: 2453779.667 + 0.327830 * E; d=0.041d
GK Hya	p	55638.685	0.005	−0.174	38	V; d=0.131d
GN Hya	s	55631.7125	0.0003	−0.1066	18	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
V409 Hya	p	55575.8500	0.0008	+0.0345	18	V
V410 Hya	p	55580.9173	0.0004	−0.0231	39	V; el: 2454824.772 + 3.150702 * E; d=0.062d
	p	55637.6345	0.0002	−0.0186	32	V; additional pulsation?
V412 Hya	p	55575.8601	0.0002	−0.0136	21	V
GSC 196-894	p	55564.8967	0.0004	+0.0123	33	V; el: IBVS 5920
GSC 201-1119	p	55632.6842	0.0004	+0.0023	28	V; el: 2453872.524 + 0.416113 * E
GSC 203-352	s	55629.6729	0.0003	+0.0032	24	V; el: 2454140.715 + 0.414462 * E
	p	55630.7095	0.0003	+0.0036	49	V
	s	55631.7442	0.0004	+0.0022	22	V
GSC 213-980	p	55640.7305	0.0003	−0.0078	33	V; el: 2453904.461 + 0.415278 * E
GSC 217-849	s	55572.8693	0.0005	+0.0064	18	V; el: IBVS 5945
	p	55573.0066	0.0009	+0.0060	10	V
	p	55653.7034	0.0005	+0.0059	29	V
GSC 220-70	s	55566.9266	0.0003	+0.0079	21	V; el: 2454498.714 + 0.361185 * E
	s	55667.6951	0.0001	+0.0058	39	V
GSC 221-871	s	55643.7492	0.0007	+0.0018	26	V; el: 2454167.619 + 0.446973 * E
GSC 230-1627	p	55668.7000	0.0007	+0.0280	31	V; el: IBVS 5894; d=0.060d
GSC 235-461	p	55643.6924	0.0003	+0.0395	28	V; el: IBVS 5894
GSC 238-2372	p	55579.8854	0.0005	+0.0082	27	V; el: 2454235.576 + 0.385297 * E
	p	55652.7046	0.0003	+0.0062	30	V
GSC 4848-461	p	55630.6935	0.0015	+0.0058	45	V; el: 2454906.594 + 0.472646 * E; d=0.024d
GSC 4853-30	p	55647.6942	0.0004	−0.0074	33	V; el: 2453819.689 + 2.084393 * E; d=0.017d
GSC 4860-1651	s	55563.9638	0.0013	+0.0182	18	V; el: 2453708.843 + 0.990709 * E
GSC 4861-1380	p	55630.6640	0.0002	−0.0102	28	V; el: 2454780.816 + 0.383510 * E
GSC 4867-982	s	55571.8447	0.0002	−0.0030	20	V; el: 2453755.681 + 0.348559 * E; d=0.018d
GSC 4870-779	p	55631.7231	0.0007	+0.0102	20	V; el: 2454591.499 + 0.374987 * E; d=0.033d
GSC 4875-1418	p	55565.8863	0.0003	−0.0084	17	V; el: IBVS 5894
GSC 4878-113	p	55565.9013	0.0003	−0.0035	31	V; el: 2454587.579 + 1.270553 * E; d=0.027d
GSC 4879-1416	p	55639.6727	0.0006	+0.0060	17	V; el: 2454960.529 + 0.559421 * E
GSC 4881-888	s	55575.9390	0.0004	+0.0192	14	V; el: 2453028.894 + 0.265578 * E
	p	55663.7161	0.0005	+0.0227	19	V
GSC 4882-117	p	55572.8859	0.0001	−0.0014	25	V; el: 2453114.511 + 2.031716 * E
GSC 4882-488	p	55580.8594	0.0011	+0.0118	26	V; el: IBVS 5945
GSC 4884-1351	p	55574.8930	0.0003	+0.0008	34	V; el: 2454797.844 + 0.574315 * E; d=0.047d
	p	55654.7224	0.0008	+0.0005	31	V; d=0.05d
GSC 4887-1149	s	55643.6847	0.0003	−0.0093	13	V; el: IBVS 5945
GSC 4893-1294	p	55663.642	0.003	−0.004	14	V; el: 2453794.696 + 1.011884 * E
GSC 4894-2310	p	55571.8917	0.0002	−0.0072	19	V; el: 2454541.655 + 0.897425 * E
	s	55647.7240	0.0003	−0.0073	17	V
GSC 4897-1114	p	55580.8805	0.0005	+0.0044	36	V; el: 2454180.632 + 0.564387 * E; d=0.045d
	p	55671.7462	0.0008	+0.0038	33	V
GSC 4897-1250	s	55577.9189	0.0004	+0.0120	25	V; el: 2454229.549 + 0.354691 * E
	p	55654.7105	0.0004	+0.0130	26	V
GSC 5426-1920	p	55621.6835	0.0003	−0.0092	35	V; el: 2453403.702 + 0.524844 * E
GSC 5427-2330	s	55563.9312	0.0003	+0.0041	13	V; el: 2454798.797 + 0.307590 * E
GSC 5428-75	s	55632.7463	0.0004	+0.0107	20	V; el: 2454520.734 + 0.385643 * E; d=0.024d
GSC 5429-1473	s	55632.6947	0.0005	−0.0049	27	V; el: 2454365.898 + 0.318572 * E
GSC 5441-60	p	55634.6401	0.0007	−0.0319	23	V; el: 2454534.577 + 0.610147 * E
GSC 5447-940	p	55630.6957	0.0003	+0.0129	46	V; el: IBVS 5894
GSC 5449-1194	p	55572.8764	0.0007	+0.0252	27	V; el: 2453420.668 + 0.755152 * E
	p	55656.6969	0.0007	+0.0239	40	V
GSC 5454-1746	p	55566.9052	0.0007	+0.0038	33	V; el: 2454917.673 + 0.403749 * E; d=0.035d
GSC 5457-59	p	55580.9034	0.0005	+0.0111	20	V; el: IBVS 5945; d=0.017d
GSC 5458-351	p	55577.9072	0.0003	−0.0042	12	V; el: IBVS 5945
GSC 5463-45	p	55574.8694	0.0004	−0.0185	27	V; el: IBVS 5945; d=0.028d
GSC 5463-753	p	55637.7005	0.0008	−0.0105	43	V; el: IBVS 5894; d=0.05d
GSC 5467-1483	p	55667.6744	0.0003	−0.0056	29	V; el: IBVS 5894
GSC 5472-602	s	55580.8800	0.0004	−0.0149	26	V; el: 2453650.879 + 0.305842 * E
GSC 5472-966	p	55580.9331	0.0002	+0.0016	26	V; el: IBVS 5945
	p	55649.6914	0.0005	+0.0007	34	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
GSC 5472-1583	s	55574.9376	0.0004	+0.0062	23	V; el: 2453871.500 + 0.332604 * E; d=0.022d
GSC 5487-197	p	55644.7524	0.0003	+0.0004	33	V; el: 2454297.474 + 0.577735 * E; d=0.034d
GSC 5487-801	p	55585.8734	0.0002	−0.0147	38	V; el: 2454295.472 + 0.636928 * E
	p	55654.6620	0.0008	−0.0144	23	V
GSC 5488-3	s	55588.8280	0.0006	−0.0081	23	V; el: 2453419.707 + 2.400807 * E
	p	55647.6452	0.0002	−0.0107	16	V
GSC 5489-963	s	55589.9009	0.0004	−0.0042	21	V; el: 2453526.549 + 0.418743 * E; d=0.033d
	s	55665.6919	0.0004	−0.0057	19	V
GSC 5489-511	s	55575.8625	0.0004	+0.0049	24	V; el: 2453887.574 + 0.441671 * E
	s	55652.7142	0.0005	+0.0061	23	V; d=0.036d
GSC 5495-765	p	55579.9005	0.0004	+0.0082	18	V; el: 2453801.690 + 0.352189 * E
	s	55582.8923	0.0007	+0.0064	15	V
	s	55660.7288	0.0003	+0.0092	14	V
GSC 5497-221	s	55582.8756	0.0009	+0.0054	20	V; el: 2454629.453 + 0.276473 * E
	p	55665.6783	0.0004	+0.0045	15	V
GSC 6011-1986	p	55629.6948	0.0002	−0.0017	49	V; el: 2453715.789 + 1.127154 * E
GSC 6013-1086	s	55571.9079	0.0006	+0.0161	18	V; el: 2454147.629 + 0.314789 * E
GSC 6014-855	p	55634.7354	0.0009	+0.0011	33	V; el: 2454232.557 + 0.501494 * E
GSC 6027-1009	p	55572.8800	0.0006	−0.0032	29	V; el: 2454865.709 + 0.361541 * E
GSC 6029-311	p	55574.8794	0.0005	+0.0012	28	V; el: IBVS 5945; d=0.036d
GSC 6046-312	s	55582.8903	0.0008	−0.0028	17	V; el: 2454502.851 + 0.299471 * E
Y leo	p	55640.7222	0.0001	−0.0181	34	V
RW Leo	p	55603.9048	0.0005	−0.1234	28	V
UX Leo	p	55600.8816	0.0003	−0.0047	20	V; el: 2453869.580 + 1.007159 * E
UZ Leo	s	55591.8920	0.0003	−0.0004	41	V; el: 2454131.728 + 0.618059 * E
VZ Leo	p	55574.8775	0.0002	−0.0632	27	V
WZ Leo	p	55585.8787	0.0002	0	35	V; el: Acta Astr. 54, 207
XX Leo	s	55637.633	0.003	−0.019	43	V; el: IBVS 5945
XY Leo	p	55637.7055	0.0018	+0.0256	18	V; el: IBVS 5945
XZ Leo	p	55649.7451	0.0003	+0.0534	34	V; d=0.023d
AL Leo	p	55588.8908	0.0009	+0.0091	31	V; el: IBVS 3401
	p	55654.7201	0.0006	+0.0123	26	V
AM Leo	p	55591.8739	0.0014	+0.0116	16	V
	p	55668.6920	0.0003	+0.0122	19	V; d=0.022d
AP Leo	p	55591.8622	0.0004	−0.0308	24	V
	s	55671.6946	0.0006	−0.0297	29	V
BL Leo	p	55600.8850	0.0004	−0.0290	14	V
	s	55673.7660	0.0005	−0.0271	30	V; d=0.016d
BW Leo	p	55603.9666	0.0003	−0.1273	25	V
	p	55666.7163	0.0023	−0.1007	31	V
CE Leo	s	55603.8722	0.0004	−0.0069	23	V
	s	55666.6799	0.0004	−0.0090	18	V
DU Leo	p	55649.7018	0.0005	+0.0013	18	V; el: IBVS 3999
GV Leo	p	55589.8205	0.0008	−0.0103	16	V; el: 2454531.701 + 0.266733 * E; d=0.027d
	s	55589.9539	0.0003	−0.0103	21	V
	p	55671.7056	0.0006	−0.0122	17	V; d=0.026d
HI Leo	s	55591.8746	0.0003	+0.0013	29	V; el: IBVS 5455
	p	55672.7336	0.0003	+0.0030	17	V
HS Leo	p	55600.9103	0.0003	+0.0591	15	V; el: Per. Zv. 25, 2
	s	55672.6730	0.0003	+0.0601	12	V
GSC 234-960	p	55574.8903	0.0004	−0.0045	28	V; el: 2454917.615 + 0.391471 * E; d=0.026d
	s	55668.6530	0.0005	+0.0009	12	V
GSC 262-948	p	55652.6780	0.0011	+0.0526	20	V; el: IBVS 5894
GSC 263-585	p	55617.9055	0.0001	−0.0136	35	V; el: IBVS 5894
GSC 265-617	s	55591.8581	0.0003	−0.0024	24	V; el: IBVS 5945
	s	55672.7316	0.0005	−0.0019	22	V
GSC 267-162	p	55604.8553	0.0007	+0.0235	37	V; el: IBVS 5945
	p	55649.7228	0.0003	+0.0212	33	V; d=0.080d
GSC 270-9	p	55615.8447	0.0005	+0.0006	18	V; el: 2453461.709 + 0.581727 * E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
GSC 270-593	s	55600.8940	0.0008	+0.0032	11	V; el: IBVS 5945
	p	55672.6899	0.0002	+0.0029	15	V
GSC 270-777	p	55605.9005	0.0002	−0.0302	28	V; el: IBVS 5945
	p	55672.7242	0.0008	−0.0329	24	V
GSC 824-1304	p	55575.9475	0.0001	+0.0118	30	V; el: IBVS 5894
	p	55647.6968	0.0002	+0.0121	27	V
GSC 827-1011	s	55585.8860	0.0005	+0.0009	40	V; el: 2454176.557 + 2.249526 * E
GSC 828-1721	p	55652.6544	0.0010	+0.0171	14	V; el: IBVS 5945
GSC 829-1040	p	55579.8585	0.0004	+0.0036	22	V; el: 2454493.814 + 0.776298 * E; d=0.042d
	p	55656.7150	0.0006	+0.0066	41	V
GSC 832-1401	p	55585.8967	0.0002	−0.0052	15	V; el: 2453907.482 + 0.379733 * E
	p	55668.6776	0.0004	−0.0061	15	V
GSC 835-652	p	55585.8646	0.0006	+0.0112	14	V; el: IBVS 5945
	s	55668.6534	0.0013	+0.0115	18	V
GSC 840-216	p	55644.7239	0.0003	+0.0041	23	V; el: IBVS 5945
GSC 847-367	s	55602.8745	0.0011	+0.0149	16	V; el: IBVS 5945
GSC 851-768	p	55600.8657	0.0007	+0.0036	20	V; el: IBVS 5945
GSC 859-1106	p	55603.8346	0.0004	+0.0089	28	V; el: IBVS 5945
	p	55666.7245	0.0006	+0.0074	23	V
GSC 870-349	p	55604.9050	0.0005	−0.0161	34	V; el: IBVS 5894
	p	55666.6950	0.0002	−0.0160	22	V
GSC 1410-439	p	55652.7087	0.0003	−0.0067	25	V; el: IBVS 5945; d=0.034d
GSC 1417-401	s	55579.8221	0.0004	+0.0046	10	V; el: IBVS 5945
	p	55579.9390	0.0003	+0.0039	11	V
	s	55649.6904	0.0003	+0.0043	13	V
GSC 1419-666	p	55589.8473	0.0003	+0.0080	25	V; el: IBVS 5945; d=0.026d
	s	55654.6763	0.0005	+0.0090	14	V
GSC 1422-142	s	55637.6660	0.0003	+0.0058	23	V; el: IBVS 5945
GSC 1429-137	p	55591.8629	0.0004	+0.0066	19	V; el: IBVS 5945
	p	55668.7204	0.0004	+0.0058	32	V
GSC 1434-1034	p	55591.8629	0.0002	−0.0041	27	V; el: IBVS 5945; d=0.021d
	p	55671.6751	0.0005	−0.0040	21	V; d=0.021d
GSC 1441-914	s	55604.8653	0.0003	−0.0003	15	V; el: IBVS 5945
	p	55674.7584	0.0005	−0.0011	26	V
GSC 1443-87	s	55604.8643	0.0006	−0.0242	24	V; el: IBVS 5945
GSC 1963-488	p	55574.8993	0.0001	−0.0007	30	V; el: 2453809.558 + 0.427030 * E
	s	55644.7200	0.0006	+0.0006	32	V; d=0.034d
GSC 1969-579	p	55591.9299	0.0003	+0.0243	12	V; el: IBVS 5945
	p	55665.7358	0.0005	+0.0263	14	V
GSC 1971-916	p	55652.7207	0.0002	+0.0171	21	V; el: IBVS 5945
GSC 1981-237	s	55602.8525	0.0009	+0.0100	12	V; el: IBVS 5945
GSC 4920-943	p	55600.9400	0.0005	+0.0083	20	V; el: 2453523.504 + 0.396986 * E; d=0.02d
GSC 4921-819	p	55605.8849	0.0005	−0.0081	33	V; el: 2454937.689 + 0.576038 * E
	p	55672.7067	0.0011	−0.0068	27	V
GSC 4936-907	s	55602.878	0.003	+0.005	14	V; el: 2454540.808 + 0.277193 * E
T LMi	p	55634.6744	0.0002	−0.1038	45	V
RT LMi	s	55583.9049	0.0005	−0.0079	29	V
XY LMi	s	55583.9019	0.0003	−0.0194	38	V; el: IBVS 5411; d=0.043d
	s	55654.6774	0.0004	−0.0200	23	V; d=0.044d
GSC 2515-839	p	55603.9216	0.0003	+0.0046	29	V; el: OEJV 83
GSC 5337-1744	s	55566.6559	0.0004	−0.0117	20	V; el: IBVS 5894
GSC 5354-334	p	55588.6629	0.0012	−0.0424	46	V; el: 2454815.668 + 8.312229 * E
GSC 5361-545	p	55580.6700	0.0002	+0.0062	18	V; el: IBVS 5894
GSC 5916-1668	p	55571.6472	0.0003	+0.0063	20	V; el: 2454729.878 + 0.361582 * E
	s	55574.7196	0.0003	+0.0052	26	V
NSV 1864	p	55565.6967	0.0007	+0.0141	18	V; el: IBVS 5920; d=0.05d
SS Lib	p	55660.8829	0.0003	−0.0040	40	V; el: 2453828.838 + 1.438029 * E
TY Lib	p	55654.9085	0.0002	−0.0296	27	V; d=0.047d
VZ Lib	s	55652.9091	0.0006	−0.0022	26	V; el: 2453883.669 + 0.358255 * E
FU Lib	p	55656.8359	0.0004	−0.0036	17	V; el: 2453858.814 + 0.780393 * E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
GK Lib	p	55653.8517	0.0002	−0.0130	32	V; el: 2454650.684 + 2.116415 * E
GSC 4987-740	p	55660.8425	0.0007	+0.0018	30	V; el: 2453794.858 + 0.580399 * E; d=0.044d
GSC 5028-828	p	55649.8628	0.0014	+0.0038	34	V; el: 2454934.790 + 0.917932 * E; d=0.072d
GSC 5569-173	p	55663.8550	0.0005	+0.0093	32	V; el: 2454492.852 + 1.910267 * E
GSC 5572-705	p	55649.8942	0.0003	−0.0187	35	V; el: 2454552.814 + 0.368525 * E; d=0.027d
	s	55695.7848	0.0003	−0.0094	33	V
GSC 5600-923	p	55654.8973	0.0004	+0.0022	21	V; el: 2454539.822 + 0.385705 * E; d=0.016d
GSC 5605-700	s	55673.8178	0.0007	+0.0016	45	V; el: 2453836.831 + 0.417734 * E
GSC 6155-352	p	55649.8525	0.0011	−0.0112	35	V; el: 2453755.848 + 2.422015 * E
GSC 6171-209	p	55710.7314	0.0006	−0.0042	33	V; el: 2453521.658 + 1.255205 * E
NSV 7292	p	55654.8299	0.0006	−0.0159	11	V; el: ASAS; d=0.019d
RY Lyn	p	55648.7566	0.0001	−0.0347	14	V
RZ Lyn	p	55639.6787	0.0004	−0.1247	21	V
SW Lyn	s	55623.6637	0.0015	+0.0650	28	V
UU Lyn	p	55577.9183	0.0002	−0.0085	21	V; d=0.027d
UV Lyn	s	55637.6985	0.0003	+0.0758	43	V
AH Lyn	p	55648.6848	0.0004	−0.0101	18	V; el: AJ 87, 314
BG Lyn	p	55564.8391	0.0003	−0.0059	31	V; el: AJ 87, 314; d=0.048d
CD Lyn	p	55623.682	0.005	−0.022	5	V; el: IBVS 4911
CL Lyn	p	55643.785	0.005	−0.009	29	V; el: Hipparcos
DE Lyn	s	55630.7346	0.0002	+0.0114	27	V; el: IBVS 5871; d=0.021d
DY Lyn	p	55640.7432	0.0004	+0.0003	35	V; el: IBVS 5894
DZ Lyn	p	55648.7006	0.0009	−0.0102	31	V; IBVS 5431
GSC 3421-1871	s	55563.9352	0.0007	+0.0128	31	V; el: OEJV 83
	p	55653.7064	0.0005	+0.0150	22	V
EV Lyr	p	55730.8725	0.0015	+0.1310	16	V; el: JAAVSO 36, 68
V412 Lyr	p	55710.7507	0.0009	+0.2174	26	V
V571 Lyr	s	55741.7660	0.0003	+0.0185	39	V; el: JAAVSO 39, 102
RU Mon	s	55588.7289	0.0004	−0.5588	45	V; non-circ.
UV Mon	s	55609.6636	0.0014	−0.0658	18	V
AY Mon	p	55603.6877	0.0005	+0.0735	31	V; d=0.062d
BB Mon	s	55602.6461	0.0002	+0.0031	25	V; el: 2454757.841 + 1.465398 * E
DD Mon	p	55602.6916	0.0001	−0.0030	31	V; el: 2454149.702 + 0.568019 * E
FH Mon	p	55614.6711	0.0005	−0.1002	33	V; d=0.033d
FS Mon	p	55621.7271	0.0002	−0.0128	24	V
HM Mon	s	55607.6665	0.0015	+0.0107	27	V; el: IBVS 5506
KR Mon	p	55623.6907	0.0005	+0.0099	34	V; el: IBVS 5894
NS Mon	s	55603.6400	0.0008	+0.0122	17	V; el: IBVS 4143
V384 Mon	p	55614.6630	0.0020	−0.0302	35	V
V404 Mon	p	55609.6528	0.0007	+0.0190	28	V
V442 Mon	p	55604.6601	0.0003	+0.0358	38	V
V453 Mon	s	55609.6517	0.0003	+0.0237	29	V
V454 Mon	p	55609.6711	0.0010	+0.0895	33	V
V455 Mon	s	55605.6381	0.0004	+0.0596	16	V
V457 Mon	s	55609.6837	0.0005	−0.0132	23	V
V458 Mon	p	55605.7416	0.0002	+0.1329	28	V
V494 Mon	s	55600.6582	0.0002	+0.0044	33	V; el: 2454856.620 + 1.677641 * E
V496 Mon	p	55604.7268	0.0002	−0.0338	21	V
V515 Mon	p	55604.7051	0.0003	−0.0395	31	V
V524 Mon	s	55603.6973	0.0010	+0.1257	14	V
V530 Mon	p	55607.7412	0.0003	+0.0110	22	V; el: 2453482.499 + 0.525527 * E; d=0.035d
V753 Mon	p	55617.646	0.003	+0.001	12	V; el: 2454548.593 + 0.677044 * E
V864 Mon	s	55621.7187	0.0004	−0.0372	27	V; el: IBVS 5425
A072609-0947.3	p	55608.6908	0.0004	−0.0021	26	V; el: 2454821.724 + 0.303030 * E
GSC 133-1076	p	55600.7485	0.0005	+0.0127	16	V; el: 2453457.567 + 0.485759 * E
GSC 140-964	s	55588.6470	0.0003	+0.0066	19	V; el: 2454935.506 + 0.298303 * E
GSC 145-685	p	55600.6811	0.0005	+0.0221	38	V; el: IBVS 5920
GSC 163-1374	p	55617.6990	0.0003	−0.0077	33	V; el: 2454586.484 + 0.335357 * E
GSC 174-675	s	55605.7214	0.0003	+0.0019	23	V; el: 2453818.583 + 0.262409 * E
GSC 4785-147	s	55579.6710	0.0004	+0.0231	29	V; el: 2454764.832 + 1.300584 * E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
GSC 4800-1651	p	55602.7078	0.0006	+0.0007	45	V; el: 2454194.591 + 1.223385 * E
GSC 4808-2578	p	55605.6621	0.0009	+0.0085	34	V; el: 2454159.648 + 0.540159 * E
GSC 4811-667	p	55608.7106	0.0005	+0.0308	35	V; el: 2454499.659 + 2.691798 * E
GSC 4815-1407	s	55621.7245	0.0007	+0.0189	30	V; el: 2454090.723 + 1.043259 * E
GSC 4822-2853	p	55585.7262	0.0009	−0.0816	37	V; el: 2452625.8 + 5.95575 * E; non-circ.
GSC 4826-411	p	55614.6822	0.0001	+0.0047	14	V; el: IBVS 5871
GSC 4827-2862	s	55607.6820	0.0004	−0.0001	17	V; el: 2454949.501 + 0.259484 * E
GSC 4831-2108	s	55616.6966	0.0002	+0.0033	19	V; el: 2454908.672 + 0.355879 * E
GSC 4831-2282	p	55615.7150	0.0004	−0.0183	19	V; el: 2454468.709 + 0.369412 * E; d=0.04d
GSC 4839-2026	p	55638.7549	0.0004	−0.0009	33	V; el: 2454392.861 + 0.945292 * E
GSC 4834-3265	p	55615.7314	0.0002	+0.0056	25	V; el: 2454572.536 + 0.529538 * E
GSC 4836-1009	p	55623.6798	0.0015	+0.0146	35	V; el: 2453776.569 + 1.310927 * E; d=0.032d
GSC 4841-1397	p	55623.6676	0.0003	−0.0020	16	V; el: 2454783.845 + 0.313017 * E
GSC 4846-809	p	55564.8728	0.0002	−0.0058	28	V; el: 2455164.768 + 0.377107 * E; d=0.030d
GSC 4850-1736	s	55564.8595	0.0008	−0.0001	11	V; el: IBVS 5871
GSC 4854-2084	s	55629.6934	0.0003	−0.0095	30	V; el: 2454436.799 + 0.318235 * E
GSC 4858-2028	s	55563.8870	0.0015	−0.0066	15	V; el: 2453834.625 + 0.303088 * E
GSC 5364-356	p	55588.6363	0.0002	−0.0003	21	V; el: 2454509.608 + 0.354012 * E
GSC 5397-1223	p	55615.6678	0.0007	+0.0035	22	V; el: 2454482.680 + 0.469339 * E
GSC 5398-2032	s	55607.6655	0.0006	+0.0091	28	V; el: 2453877.481 + 0.382486 * E
SW Oph	p	55673.8374	0.0007	−.0108	44	V; el: 2453550.616 + 2.446120 * E; d=0.048d
SX Oph	p	55672.9167	0.0007	−0.0048	33	V
AL Oph	p	55726.7695	0.0016	−0.0389	10	V; el: IBVS 4452
V496 Oph	p	55739.8123	0.0014	+0.0289	22	V; el: BAVSR 54, 8
V1016 Oph	p	55667.8256	0.0010	−0.0028	15	V; el: 2446907.546 + 0.407152 * E; d=0.028d
V1022 Oph	s	55677.8047	0.0004	−0.1187	19	V; el: IBVS 5690
V1120 Oph	p	55667.8624	0.0012	−0.0032	19	V
V2553 Oph	p	55726.7723	0.0012	+0.0080	31	V; el: ASAS
V2563 Oph	s	55739.8293	0.0003	+0.0109	34	V; el: 2454316.694 + 0.372302 * E
V2635 Oph	s	55712.7791	0.0003	−0.0117	45	V; el: 2454250.759 + 0.430960 * E
V2637 Oph	s	55725.689	0.005	−0.008	14	V; el: 2454683.609 + 0.386173 * E; pulsator?
	p	55725.8769	0.0005	−0.0130	20	V
GSC 388-1265	p	55698.7369	0.0007	−0.0075	45	V; el: OEJV 83
GSC 398-1236	s	55720.7989	0.0003	+0.0018	23	V; el: IBVS 5894
GSC 403-1109	s	55721.8300	0.0005	−0.0011	31	V; el: IBVS 5894
GSC 410-1013	s	55711.7412	0.0004	+0.1340	27	V; el: Per. Zv. Pril. 11, 1
GSC 413-506	p	55726.8469	0.0007	+0.0130	19	V; el: 2454575.834 + 1.609790 * E
GSC 436-1066	p	55741.7920	0.0006	+0.0039	41	V; el: IBVS 5945
GSC 978-768	s	55722.7984	0.0007	+0.0034	16	V; el: 2454293.657 + 0.282076 * E
GSC 979-1273	p	55721.8469	0.0004	+0.0088	34	V; el: IBVS 5894
GSC 1020-735	p	55738.7670	0.0003	−0.0060	28	V; el: 2453904.601 + 0.460269 * E
GSC 5044-460	p	55688.7858	0.0002	−0.0032	46	V; el: 2453098.823 + 0.493139 * E; d=0.035d
GSC 5049-7544	p	55722.7544	0.0002	−0.0056	22	V; el: 2454144.876 + 1.153424 * E; d=0.012d
GSC 5054-1417	p	55723.7679	0.0008	+0.0197	46	V; el: 2452770.764 + 3.351855 * E
GSC 5059-1258	s	55711.6782	0.0015	+0.0084	16	V; el: 2454559.838 + 0.349835 * E
	p	55711.8469	0.0004	+0.0023	21	V; d=0.024d
GSC 5065-829	s	55720.8055	0.0003	−0.0056	28	V; el: 2454685.578 + 0.309348 * E
GSC 5076-483	p	55723.8404	0.0006	+0.0076	50	V; el: 2454380.514 + 0.903983 * E
GSC 5080-2021	p	55736.8568	0.0004	−0.0010	43	V; el: 2453852.831 + 2.043413 * E
GSC 5611-173	p	55696.8328	0.0003	−0.0048	44	V; el: 2452520.481 + 2.426552 * E
GSC 5629-912	p	55698.7849	0.0004	−0.0066	38	V; el: 2453906.740 + 0.295523 * E
GSC 5636-400	p	55711.7880	0.0003	+0.0073	42	V; el: 2453872.745 + 0.524390 * E
GSC 5640-366	p	55720.7869	0.0004	+0.0097	42	V; el: 2454191.787 + 0.653694 * E
GSC 6218-197	s	55666.8407	0.0009	−0.0118	28	V; el: 2453522.712 + 3.612705 * E
NSV 7727	s	55671.9037	0.0008	+0.0184	25	V; el: IBVS 5945
NSV 7838	p	55712.7383	0.0004	−0.0077	55	V; el: IBVS 5945
NSV 8733	s	55737.7535	0.0004	−0.0061	19	V; el: IBVS 5945
DZ Ori	p	55585.775	0.003	+0.007	50	V; el: Cracow Cat.
EQ Ori	p	55565.7188	0.0001	−0.0399	27	V
ER Ori	s	55566.6996	0.0003	+0.0941	14	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
ET Ori	p	55574.6544	0.0006	−0.0031	34	V
FH Ori	p	55566.6622	0.0003	−0.3723	37	V
FK Ori	p	55583.6766	0.0002	−0.0203	43	V
FR Ori	p	55591.7138	0.0003	+0.0290	35	V
FT Ori	p	55591.7274	0.0004	+0.0179	33	V; non-circ.
	s	55609.6235	0.0004	+0.5867	33	V
FZ Ori	s	55582.6184	0.0010	+0.0304	23	V; el: IBVS 5554
GG Ori	p	55566.6411	0.0005	+0.0850	29	V; non-circ.
	s	55582.6985	0.0003	−0.4363	49	V
GU Ori	s	55575.6091	0.0005	−0.0007	18	V; el: ASAS
OS Ori	p	55580.6731	0.0002	−0.0124	39	V
QT Ori	p	55574.5958	0.0009	−0.8989	20	V
V343 Ori	p	55591.6528	0.0004	+0.0054	44	V; el: IBVS 5920
V392 Ori	p	55591.7289	0.0002	+0.0317	29	V; el: PASJ 54, 139
V517 Ori	p	55575.6758	0.0005	−0.0124	37	V; el: IBVS 5871; d=0.050d
V530 Ori	s	55589.6376	0.0013	−0.2059	40	V
V1027 Ori	s	55604.6746	0.0003	+0.5509	39	V; el: IBVS 5652; non-circ.
V1848 Ori	p	55564.6447	0.0004	−0.0020	12	V; el: IBVS 5799
	s	55564.7774	0.0008	−0.0025	9	V
V1853 Ori	s	55564.6861	0.0003	−0.0118	34	V; el: IBVS 5799; d=0.036d
V1865 Ori	p	55574.6720	0.0007	+0.0434	37	V; el: IBVS 5871
GSC 104-1999	p	55579.7126	0.0004	−0.0103	30	V; el: IBVS 5871
GSC 108-1146	p	55563.7157	0.0005	+0.0081	26	V; el: 2454527.536 + 0.369007 * E; d=0.026d
GSC 122-419	s	55571.6458	0.0003	+0.0011	23	V; el: IBVS 5945
GSC 127-719	p	55582.7753	0.0015	+0.0214	40	V; el: IBVS 5894
GSC 143-226	s	55571.5958	0.0029	+0.2414	10	V; el: 2454523.628 + 4.216203 * E; non-circ.
	p	55577.6601	0.0004	−0.0186	28	V
GSC 702-1892	s	55566.6972	0.0004	+0.0024	20	V; el: IBVS 5493
GSC 706-845	p	55563.6764	0.0007	−0.0143	30	V; el: IBVS 5799
GSC 711-49	p	55566.7110	0.0006	−0.0136	38	V; el: 2454881.549 + 0.629757 * E
GSC 711-1701	s	55572.6542	0.0004	+0.0065	20	V; el: 2454463.736 + 0.344436 * E; d=0.022d
GSC 722-457	p	55582.7591	0.0004	+0.0814	30	V; el: OEJV 83
GSC 740-8	p	55591.6745	0.0002	+0.0038	35	V; el: 2453108.521 + 1.342969 * E
GSC 4753-984	p	55565.6705	0.0003	+0.0065	36	V; el: IBVS 5871
GSC 4754-44	p	55563.7233	0.0002	+0.0068	27	V; el: 2454746.838 + 0.321989 * E
GSC 4754-339	s	55563.6956	0.0002	+0.0016	29	V; el: 2454522.602 + 1.330469 * E
GSC 4784-830	s	55579.7055	0.0005	−0.0019	28	V; el: 2454543.554 + 0.331410 * E
GSC 5337-337	p	55589.6924	0.0004	+0.0012	25	V; el: 2454761.806 + 0.724309 * E
NSV 2727	p	55571.7472	0.0009	+0.0257	43	V; el: OEJV 91
BE Per	p	55579.6344	0.0006	+0.0208	25	V; el: MVS 11, 38
DV Per	p	55564.7464	0.0011	+0.0877	17	V; d=0.035d
FW Per	p	55577.7215	0.0005	−0.0456	22	V
HV Per	p	55563.6631	0.0009	−0.3051	41	V; d=0.04d
MS Per	s	55566.6987	0.0003	−0.3663	49	V
NZ Per	p	55572.7234	0.0003	+0.0391	30	V; d=0.023d
OX Per	p	55571.7625	0.0015	−0.1074	15	V
V449 Per	p	55564.7249	0.0004	+0.0493	18	V
V482 Per	p	55579.6804	0.0004	+0.2294	42	V; el: BAV Mitt. 68, 21
V871 Per	s	55565.5985	0.0025	+0.1015	13	V; el: IBVS 5920; non-circ.
V884 Per	p	55577.7194	0.0003	+0.0124	26	V; el: 2451466.66 + 12.807 * E; non-circ.
AV Pup	s	55630.7481	0.0002	+0.0035	25	V; el: 2454623.479 + 0.435010 * E
V595 Pup	p	55632.6547	0.0004	+0.0197	36	V; el: IBVS 5586
GSC 5404-4206	p	55608.6646	0.0013	−0.0067	27	V; el: IBVS 5894
GSC 5421-76	p	55563.8556	0.0004	−0.0023	21	V; el: 2454929.534 + 0.270040 * E
GSC 5422-1430	s	55608.7004	0.0009	+0.0113	39	V; el: 2454179.655 + 1.505043 * E; d=0.035d
GSC 5424-55	p	55621.7097	0.0005	+0.0044	34	V; el: 2454410.848 + 0.808316 * E; d=0.058d
GSC 5435-225	p	55623.7016	0.0011	+0.0117	29	V; el: 2454482.751 + 2.347611 * E; d=0.08d
GSC 5439-620	p	55630.7373	0.0004	−0.0022	29	V; el: 2454524.653 + 0.340125 * E; d=0.025d

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
GSC 5998-968	p	55631.7221	0.0006	+0.0086	21	V; el: 2454869.680 + 0.358604 * E
GSC 5998-1918	s	55637.6891	0.0001	+0.0007	22	V; el: 2454800.839 + 1.528492 * E
NSV 3765	p	55615.7155	0.0002	+0.0221	39	V; el: 2453762.679 + 1.698455 * E
DE Sge	p	55728.8204	0.0007	+0.0121	41	V; el: 2453554.702 + 2.872003 * E
GSC 6264-2407	p	55741.8375	0.0009	+0.0059	30	V; el: 2454655.655 + 1.279360 * E
GSC 6268-928	s	55741.7909	0.0006	−0.0033	35	V; el: 2455089.631 + 1.267567 * E; d=0.030d
V784 Sco	p	55710.7651	0.0003	+0.0125	31	V; el: 2453425.862 + 1.526313 * E
GSC 5623-1173	p	55665.8702	0.0002	−0.0004	22	V; el: 2454246.677 + 0.636981 * E; d=0.020d
NSV 7481	s	55665.8612	0.0002	+0.0146	28	V; el: IBVS 5894; d=0.015d
GSC 5691-334	p	55738.723	0.008	0	26	V; el: 2453508.829 + 4.616758 * E
AO Ser	p	55666.9103	0.0001	−0.0140	29	V
AQ Ser	s	55656.9207	0.0006	−0.0016	34	V; el: 2455070.540 + 1.687431 * E
AS Ser	p	55665.8632	0.0004	+0.0050	26	V; el: IBVS 5945
AU Ser	p	55656.8658	0.0003	+0.0047	35	V; el: 2454699.508 + 0.386497 * E
BI Ser	p	55698.6999	0.0009	+0.0599	34	V
CC Ser	s	55652.9206	0.0003	+0.0073	38	V; el: BBSAG Bull. 128, 10
CX Ser	p	55723.8523	0.0003	−0.0782	28	V; d=0.017d
V384 Ser	p	55653.8944	0.0001	+0.0001	14	V; el: IBVS 5295
V385 Ser	p	55665.8279	0.0006	+0.0524	18	V; el: IBVS 5455; d=0.031d
V413 Ser	p	55727.7423	0.0014	−0.0197	41	V; non-circ.
	s	55728.8122	0.0014	−0.0797	47	V
A182117-1415.5	p	55739.8550	0.0013	+0.0762	46	V; el: 2454649.654 + 2.978483 * E
GSC 355-983	p	55653.8849	0.0003	+0.0168	15	V; el: IBVS 5945
GSC 357-162	p	55653.8684	0.0005	+0.0065	20	V; el: IBVS 5894; d=0.024d
GSC 361-795	p	55665.8350	0.0003	+0.0020	16	V; el: 2453877.740 + 0.940112 * E
GSC 362-302	p	55656.9023	0.0010	−0.0041	34	V; el: 2452755.885 + 1.774325 * E
GSC 366-196	p	55666.9156	0.0004	+0.0026	19	V; el: IBVS 5945
GSC 368-118	p	55671.8698	0.0004	−0.0057	26	V; el: IBVS 5945; d=0.018d
GSC 370-468	s	55663.9037	0.0002	+0.0134	25	V; el: IBVS 5945
GSC 371-1326	s	55667.9152	0.0007	−0.0043	32	V; el: 2454682.630 + 4.748383 * E
GSC 378-1212	p	55665.9144	0.0004	−0.0019	15	V; el: IBVS 5894
GSC 930-267	p	55656.9162	0.0004	+0.0171	35	V; el: IBVS 5894
GSC 945-626	s	55665.8389	0.0003	−0.0125	17	V; el: 2453079.846 + 0.579497 * E
GSC 949-1089	p	55666.8244	0.0005	+0.0045	10	V; el: IBVS 5894
GSC 1499-834	s	55653.8311	0.0004	+0.0116	13	V; el: IBVS 5894
GSC 2034-1670	p	55653.8894	0.0001	+0.0004	28	V; el: IBVS 5894
GSC 2038-293	p	55671.9330	0.0012	+0.0046	12	V; el: IBVS 5719
GSC 5017-129	p	55660.8609	0.0004	−0.0074	30	V; el: IBVS 5894
GSC 5037-866	p	55666.8731	0.0003	−0.0016	28	V; el: IBVS 5894
GSC 5097-641	p	55741.8001	0.0015	−0.0075	27	V; el: 2451980.846 + 0.353341 * E
GSC 5108-617	p	55739.7838	0.0003	−0.0051	43	V; el: 2454163.885 + 0.635958 * E; d=0.042d
GSC 5681-848	p	55741.7993	0.0013	−0.0026	32	V; el: 2453804.891 + 1.225893 * E
GSC 5683-122	s	55738.8242	0.0003	+0.0014	24	V; el: 2454640.661 + 0.702374 * E
GSC 5685-3278	p	55738.7532	0.0006	−0.0010	41	V; el: 2453539.793 + 1.674761 * E
Y Sex	p	55579.9212	0.0009	−0.0002	27	V; el: IBVS 5945
	s	55668.7127	0.0006	−0.0006	22	V; d=0.05d
WX Sex	p	55647.7494	0.0006	+0.0128	32	V; el: 2452948.864 + 0.428869 * E
WZ Sex	p	55588.8903	0.0011	−0.0035	39	V; el: IBVS 5894; l.c. not symmetric
	p	55656.672	0.005	−0.009	41	V
GSC 242-2191	p	55585.9402	0.0003	+0.0174	24	V; el: 2454575.579 + 0.381118 * E
	p	55663.6887	0.0004	+0.0178	27	V; d=0.024d
GSC 243-397	p	55585.9418	0.0003	+0.0007	24	V; el: 2454932.579 + 0.316092 * E; d=0.021d
GSC 246-90	p	55589.9139	0.0003	+0.0014	19	V; el: IBVS 5945
	s	55663.6625	0.0003	+0.011	16	V
GSC 250-668	s	55588.8566	0.0010	+0.0051	22	V; el: IBVS 5945
	p	55654.7089	0.0002	+0.0057	17	V
GSC 253-870	s	55591.8422	0.0002	+0.0027	13	V; el: IBVS 5945
	p	55591.9765	0.0001	+0.0026	13	V; d=0.013d
	s	55671.6958	0.0008	+0.0020	13	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
GSC 256-41	p	55589.8670	0.0005	−0.0041	16	V; el: IBVS 5945
	s	55671.7361	0.0009	+0.0010	13	V
GSC 4895-1885	s	55579.9616	0.0004	+0.0154	24	V; el: 2454247.499 + 0.406792 * E
	p	55671.6926	0.0007	+0.0148	25	V
GSC 4896-33	s	55637.7232	0.0004	+0.0149	34	V; el: 2454610.498 + 0.372380 * E
GSC 4896-135	s	55647.6609	0.0031	+0.0229	19	V; el: 2454172.703 + 0.808405 * E
GSC 4906-447	p	55643.6712	0.0001	−0.0010	17	V; el: 2454532.785 + 0.339617 * E
GSC 4907-992	p	55637.6746	0.0004	+0.0049	43	V; el: 2453439.654 + 0.482021 * E
GSC 4907-1262	s	55582.8576	0.0009	+0.0080	22	V; el: 2454089.978 + 0.299623 * E; d=0.02d
	p	55583.0064	0.0018	+0.0064	11	V
	p	55653.7174	0.0002	+0.0070	29	V
GSC 4909-1434	s	55588.9078	0.0002	−0.0013	27	V; el: 2454797.849 + 0.311625 * E; d=0.018d
GSC 4911-1235	p	55582.8849	0.0016	+0.0056	13	V; el: IBVS 5894
GSC 4913-1090	p	55600.9271	0.0002	+0.0004	19	V; el: 2453445.659 + 0.330867 * E
	p	55672.7247	0.0003	−0.0001	24	V
GSC 4916-292	p	55575.9058	0.0002	−0.0005	40	V; el: IBVS 5894
	p	55652.6771	0.0005	+0.0005	20	V
GSC 4916-492	s	55582.8972	0.0009	−0.0004	17	V; el: 2452749.696 + 0.368307 * E
GSC 4918-1155	p	55582.9446	0.0003	−0.0115	24	V; el: IBVS 5894
GSC 5477-108	s	55589.9003	0.0003	0	30	V; el: 2454849.750 + 0.429945 * E
GSC 5478-562	p	55579.8092	0.0025	+0.0030	7	V; el: 2454809.809 + 0.356976 * E
	s	55579.9873	0.0003	+0.0026	12	V; dII=0.021d
GSC 5481-1160	p	55643.7346	0.0004	−0.0071	24	V; el: 2454813.845 + 0.735724 * E; d=0.05d
GSC 5499-1020	p	55583.9630	0.0011	+0.0323	12	V; el: 2452749.657 + 0.334625 * E
	s	55665.789	0.008	+0.043	9	V
SV Tau	p	55585.7233	0.0002	−0.0210	50	V; d=0.038d
WY Tau	s	55589.6485	0.0002	+0.0579	31	V
AC Tau	p	55583.7208	0.0002	+0.0738	41	V
AQ Tau	p	55585.6921	0.0002	−0.0984	50	V; d=0.026d
CC Tau	p	55563.6263	0.0003	−0.0046	22	V; el: ASAS
CF Tau	p	55572.6417	0.0011	−0.0076	30	V; el: 2454420.691 + 2.755881 * E; d=0.063d
GQ Tau	p	55582.5958	0.0005	+0.1957	21	V
V407 Tau	p	55571.7366	0.0005	−0.0472	23	V; el: 2453725.585 + 2.051332 * E
V1239 Tau	p	55600.6371	0.0003	−0.0693	33	V; d=0.06d
V1249 Tau	s	55589.7358	0.0004	−0.0078	24	V; el: IBVS 5894
V1356 Tau	p	55565.6229	0.0008	−0.0451	43	V; el: 2452645.558 + 12.8075 * E; non-circ.
V1369 Tau	p	55572.7712	0.0008	+0.0566	12	V; el: OEJV 91
GSC 727-47	p	55588.6808	0.0012	−0.0113	46	V; el: 2453630.884 + 1.281288 * E
GSC 1235-663	p	55563.6789	0.0002	+0.0018	38	V; el: 2453675.804 + 1.302880 * E; d=0.023d
GSC 1273-661	s	55563.7222	0.0007	+0.0077	21	V; el: 2453433.516 + 0.851909 * E
GSC 1291-1139	p	55583.6789	0.0003	−0.0103	43	V; el: 2454133.618 + 0.717147 * E
GSC 1841-879	p	55566.6630	0.0002	−0.1277	32	V; el: IBVS 5920
NSV 1955	p	55565.6860	0.0009	+0.0103	29	V; el: IBVS 5871
TY UMa	s	55607.9271	0.0002	+0.1478	27	V; el: MNRAS 317, 111
	s	55677.7715	0.0007	+0.1481	26	V
UX UMa	p	55634.9452	0.0004	+0.0012	9	V
UY UMa	s	55631.9258	0.0011	+0.1184	22	V; d=0.03d
	p	55684.7568	0.0006	+0.1192	33	V
VV UMa	p	55580.8947	0.0002	−0.0494	36	V
XY UMa	p	55583.8697	0.0004	+0.0398	13	V
	p	55656.6768	0.0008	+0.0397	24	V
XZ UMa	p	55572.8501	0.0001	−0.1060	27	V
ZZ UMa	p	55644.645	0.003	−0.001	14	V
AA UMa	p	55579.8776	0.0005	+0.0374	16	V
	p	55663.6731	0.0004	+0.0385	27	V
AC UMa	p	55648.6926	0.0010	−0.1232	32	V; d=0.052d
BE UMa	p	55617.8478	0.0002	+0.0101	10	V; d=0.019d
BH UMa	p	55602.874	0.003	−0.001	21	V; el: 2453866.4736 + 0.698753 * E

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
BM UMa	p	55583.8208	0.0012	+0.0102	8	V
	s	55583.9551	0.0003	+0.0090	16	V
	p	55665.7296	0.0008	+0.0104	13	V
BQ UMa	p	55634.8513	0.0012	−0.1293	42	V; d=0.074d
BS UMa	p	55615.8821	0.0005	+0.0023	30	V; el: IBVS 5894
ES UMa	s	55579.8774	0.0008	−0.1179	25	V; el: IBVS 3914
	p	55644.6626	0.0004	−0.1235	20	V
IW UMa	p	55577.8312	0.0008	+0.0137	15	V; el: IBVS 4402
KM UMa	p	55583.9101	0.0005	−0.0175	24	V; el: IBVS 4810
	p	55652.8739	0.0005	−0.0187	19	V; d=0.03d
LO UMa	p	55660.6883	0.0003	−0.0122	34	V; el: IBVS 5084; d=0.052d
MS UMa	p	55605.8587	0.0004	+0.0365	25	V; d=0.038d
	p	55674.8050	0.0009	+0.0383	14	V
MT UMa	p	55583.8397	0.0006	+0.1410	16	V; d=0.032d
	p	55644.6879	0.0005	+0.1412	26	V
OQ UMa	p	55632.9230	0.0004	−0.0027	27	V; d=0.025d
GSC 3011-1150	s	55603.8610	0.0023	+0.0238	20	V; el: OEJV 104
GSC 4134-141	p	55653.7092	0.0003	−0.0030	31	V; el: OEJV 83
GSC 4375-620	p	55649.6496	0.0008	+0.0634	34	V; el: OEJV 83
RT UMi	p	55730.8331	0.0007	+0.1385	31	V
RU UMi	p	55622.8756	0.0004	−0.0133	33	V
	p	55694.7927	0.0004	−0.0112	50	V
RZ UMi	p	55647.8911	0.0004	−0.0079	15	V; el: BBSAG B. 111, 8
	p	55695.7944	0.0002	−0.0082	34	V
GSC 4407-351	p	55687.7296	0.0003	+0.0307	18	V; el: Per. Zv. Pril., 10, 18
GSC 4412-1967	p	55649.8830	0.0003	+0.0034	35	V; el: OEJV 91
GSC 4418-800	p	55694.8175	0.0004	+0.0070	38	V; el: Per. Zv. Pril. 11, 1
GSC 4541-1805	p	55647.7485	0.0007	+0.0106	33	V; el: OEJV 83
GSC 4577-707	p	55737.7162	0.0002	−0.0242	35	V; el: OEJV 91; D=0.045d
GSC 4579-1005	s	55668.9161	0.0015	+0.1554	15	V; el: OEJV 83
VV Vir	s	55638.8599	0.0004	−0.0380	21	V
AG Vir	s	55607.826	0.005	+0.001	28	V
AH Vir	p	55603.8845	0.0005	+0.0301	24	V
	s	55673.7709	0.0008	+0.0265	33	V
AW Vir	p	55630.8955	0.0001	+0.0239	27	V
	s	55688.7779	0.0010	+0.0278	14	V
AX Vir	p	55632.8720	0.0005	+0.0189	35	V
AZ Vir	p	55631.9055	0.0002	−0.0216	33	V
BD Vir	p	55632.9572	0.0006	+0.0072	38	V; el: 2454669.587 + 2.548578 * E
	p	55673.7315	0.0002	+0.0048	49	V
BF Vir	p	55631.9285	0.0002	−0.0058	24	V; el: 2453851.768 + 0.640578 * E; d=0.033d
BH Vir	p	55629.8951	0.0005	−0.0081	38	V
	s	55694.8351	0.0003	−0.0094	21	V
CG Vir	p	55654.8953	0.0004	+0.0056	27	V; el: 2453578.588 + 0.935271 * E
CM Vir	p	55687.7673	0.0006	−0.0489	45	V; el: 2452700.854 + 6.804014 * E
CX Vir	p	55634.8760	0.0005	+0.0033	42	V; el: 2454633.636 + 0.746078 * E; d=0.032d
	p	55687.8479	0.0003	+0.0037	45	V
DM Vir	s	55677.7111	0.0007	+0.0027	42	V; el: 2453452.735 + 4.669409 * E
DY Vir	p	55638.8993	0.0005	−0.1379	27	V
FQ Vir	p	55639.9250	0.0004	+0.0059	22	V; el: 2453855.864 + 0.749603 * E
	p	55663.9126	0.0002	+0.0062	27	V
HW Vir	p	55616.9328	0.0015	+0.0035	5	V; el: AA 364, 199
IR Vir	s	55615.9116	0.0005	+0.0107	29	V; el: IBVS 5894
	s	55679.8149	0.0003	+0.0017	36	V
PS Vir	s	55605.9142	0.0015	−0.0119	25	V
	s	55677.7865	0.0003	−0.0118	12	V
PY Vir	p	55623.8825	0.0005	−0.0313	25	V
QX Vir	s	55640.8909	0.0004	+0.0077	13	V; el: IBVS 5894
	p	55680.7123	0.0002	+0.0080	19	V
	s	55680.8333	0.0003	+0.0079	21	V

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
V337 Vir	p	55621.8536	0.0002	−0.0463	28	V; el: IBVS 5630
V340 Vir	s	55623.8864	0.0007	+0.0070	22	V; el: 2453542.672 + 0.454859 * E
V342 Vir	p	55639.8843	0.0010	−0.0026	21	V; el: 2454315.524 + 0.754193 * E; d=0.05d
GSC 272-94	p	55605.8568	0.0007	+0.0034	18	V; el: IBVS 5945
GSC 272-630	s	55603.8498	0.0002	+0.0005	16	V; el: IBVS 5945
GSC 274-437	p	55607.9091	0.0007	+0.0158	25	V; el: IBVS 5945; d=0.038d
	p	55673.7985	0.0002	+0.0111	33	V; d=0.028d
GSC 279-35	s	55648.8830	0.0002	+0.0017	34	V; el: IBVS 5945
GSC 279-822	p	55605.9041	0.0005	+0.0054	31	V; el: IBVS 5945
	p	55674.807	0.005	+0.002	19	V
GSC 286-631	p	55607.8223	0.0003	+0.0027	13	V; el: IBVS 5894
	s	55607.9808	0.0006	+0.0034	14	V
GSC 291-860	p	55621.9041	0.0003	−0.0056	14	V; el: IBVS 5945
GSC 296-9	s	55615.8770	0.0005	+0.0028	25	V; el: IBVS 5894
GSC 303-36	p	55630.9111	0.0002	−0.0057	45	V; el: IBVS 5894
GSC 303-65	s	55630.9314	0.0002	+0.0087	29	V; el: IBVS 5894
	p	55688.8286	0.0001	+0.0088	21	V
GSC 303-735	p	55623.8558	0.0006	+0.0016	20	V; el: IBVS 5894
	p	55688.7481	0.0002	+0.0012	13	V
	s	55688.8914	0.0007	+0.0003	13	V
GSC 304-73	p	55617.8854	0.0003	−0.0016	34	V; el: IBVS 5945
	s	55685.8273	0.0006	−0.0039	28	V
GSC 314-388	s	55634.9009	0.0001	+0.0011	23	V; el: IBVS 5894
	s	55687.7813	0.0002	+0.0013	31	V; d=0.024d
GSC 314-1184	p	55648.9172	0.0003	+0.0065	24	V; el: 2454677.535 + 0.489358 * E
GSC 316-99	s	55637.9373	0.0008	+0.0005	16	V; el: IBVS 5894
	s	55680.7889	0.0005	−0.0012	49	V
GSC 317-161	p	55656.8976	0.0002	+0.0042	36	V; el: 2453803.809 + 1.864270 * E
GSC 317-1142	p	55638.8913	0.0017	−0.0196	17	V; el: IBVS 5945
	p	55680.7773	0.0004	+0.0089	27	V
GSC 318-1169	s	55640.8581	0.0006	−0.0045	16	V; el: IBVS 5894
	p	55690.7926	0.0008	−0.0056	17	V
GSC 322-760	p	55637.8280	0.0003	+0.0109	25	V; el: IBVS 5945
	s	55687.8307	0.0004	+0.0129	18	V; d=0.02d
GSC 323-602	s	55649.8287	0.0004	+0.0050	22	V; el: IBVS 5945
	s	55696.8606	0.0007	+0.0085	26	V
GSC 329-256	s	55644.816	0.002	−0.006	12	V; el: 2455364.825 + 0.27171 * E
	p	55644.952	0.003	−0.006	11	V
	p	55648.8509	0.0007	+0.0117	26	V
	p	55654.8307	0.0012	+0.0142	10	V
GSC 329-639	s	55649.8557	0.0005	−0.0469	31	V; el: IBVS 5894
GSC 330-1394	s	55648.8814	0.0003	+0.0143	36	V; el: IBVS 5894; d=0.033d
GSC 332-302	p	55663.8954	0.0004	+0.0108	32	V; el: 2453563.577 + 1.442519 * E
GSC 873-411	s	55615.8904	0.0002	−0.0021	28	V; el: IBVS 5945
	p	55679.7393	0.0009	−0.0020	30	V
GSC 873-420	p	55649.6787	0.0003	+0.0067	33	V; el: 2454869.800 + 1.902127 * E
GSC 878-260	p	55621.9410	0.0003	+0.0096	22	V; el: IBVS 5894
GSC 881-920	s	55616.9380	0.0001	−0.0033	29	V; el: IBVS 5945
GSC 883-1116	p	55622.9116	0.0003	−0.0015	23	V; el: IBVS 5894; d=0.024d
GSC 886-340	p	55621.8509	0.0001	+0.0099	21	V; el: 2453064.764 + 0.425280 * E
GSC 887-564	p	55629.8346	0.0015	−0.0056	19	V; el: 2454505.835 + 0.401861 * E
	s	55630.8444	0.0004	−0.0004	44	V; d=0.038d
GSC 891-117	p	55640.8190	0.0002	+0.0104	17	V; el: 2454567.832 + 2.794210 * E
GSC 892-892	s	55630.8749	0.0002	−0.0026	40	V; el: IBVS 5894
GSC 897-470	p	55640.8568	0.0006	+0.0104	31	V; el: IBVS 5894
GSC 898-3	p	55629.9301	0.0002	−0.0041	18	V; el: IBVS 5894
	p	55688.8263	0.0002	−0.0052	15	V
GSC 4955-767	s	55616.8817	0.0004	+0.0020	17	V; el: IBVS 5894
GSC 4956-1196	p	55621.8734	0.0003	+0.0034	23	V; el: 2454151.758 + 0.279968 * E
GSC 4958-415	p	55648.8545	0.0004	−0.0014	24	V; el: IBVS 5894

Table 1: Minima of eclipsing binaries (continued)

Variable	Type	HJD 24...	±	$O-C$	n	Remarks
GSC 4958-697	s	55622.8780	0.0008	+0.0173	16	V; el: 2453867.619 + 0.398511 * E; d=0.024d
GSC 4965-293	s	55623.8814	0.0006	−0.0035	30	V; el: 2454597.624 + 0.604572 * E; d=0.054d
GSC 4968-751	s	55632.9177	0.0003	−0.0036	17	V; el: 2454664.508 + 0.320826 * E
GSC 4969-725	p	55630.9321	0.0004	+0.0078	33	V; el: 2454155.834 + 0.596237 * E
	p	55667.9024	0.0005	+0.0014	22	V
GSC 4977-1397	p	55639.8941	0.0006	+0.0138	14	V; el: 2454315.574 + 0.372834 * E
	s	55687.7996	0.0007	+0.0101	19	V
GSC 4980-656	p	55640.8842	0.0008	+0.0100	29	V; el: 2453528.719 + 0.564144 * E
GSC 5519-1371	p	55602.9047	0.0003	+0.0048	14	V; el: 2453490.704 + 0.281814 * E
GSC 5529-1490	s	55609.8992	0.0004	+0.0006	20	V; el: 2454151.818 + 0.328878 * E; d=0.022d
GSC 5539-45	p	55644.9378	0.0008	+0.0212	32	V; el: 2453586.504 + 1.580962 * E
GSC 5542-599	s	55621.9282	0.0004	−0.0050	12	V; el: 2453906.632 + 0.316272 * E
GSC 5543-1042	s	55622.9310	0.0006	+0.0171	18	V; el: 2454851.840 + 0.326657 * E
GSC 5548-1080	p	55656.9081	0.0002	+0.0139	36	V; el: 2454641.586 + 2.312775 * E
GSC 5553-1474	p	55632.8580	0.0003	+0.0015	15	V; el: 2454940.714 + 0.273358 * E
GSC 6136-609	s	55634.8400	0.0003	+0.0029	24	V; el: 2454517.837 + 0.345553 * E
GSC 1624-493	p	55720.8353	0.0005	−0.0033	31	V; el: IBVS 5860; non-circ.

Remark: Variable star designation A = ASAS

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ERRATA FOR IBVS 5992

The author has reported the following errors:

- GSC 5509-447 : 55666.7310 instead of 55666.447

- GSC 6077-1825 : 55583.9220 instead of 55589.9220

- GSC 4839-2026 should read GSC 4834-2026

- GSC 5049-7544 should read GSC 5049-458

*This version of the paper contains corrections, and differs from the one appeared on-line originally. Date of last modification: Thu Jul 21 09:24:20 CEST 2011

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Hen2-446 – A B[E] STAR WITH A VARIABLE V/R RATIO

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Hen2-446 = IRAS 19419+2319, with coordinates: α=19^{h}44^{m}05^s δ =+23°26′.8, was discovered by Henize (1967). Some low-excitation emission lines ([OI], FeII, HI) were discovered in the spectrum, and the object entered the Catalog of galactic planetary nebula (Perek & Kohoutek, 1967). Then the object was included in the list of emission-line objects with infrared excess (Allen & Swings, 1972, 1976). According to the modern classification this object is identified as a B[e] star (Lamers et al., 1998). Individual photometric measurements of Hen2-446 were provided by Allen & Swings (1972), Coyne et al. (1974) and Zacharias (2004). Our observations of Hen2-446 were begun in 1971 and were continued until 2010.

Observations were performed with the 0.7-m Cassegrain reflector AZT-8, located at the Observatory of Fessenkov Astrophysical Institute (AFIF) near Almaty. The earlier (1971 – 1995) estimations of the V magnitude were derived using the three-cascade image tube UM-92 plus a special film. The color system had a maximal sensitivity near 5460Å and a pass band about 800 Å, in accordance with Johnson's V band. Four nearby field stars were chosen as the secondary standards. (Their B and V-magnitudes were derived during photoelectric observations with the 1-meter telescope). A treatment procedure for the images, obtained with the image tube has been described in the paper Kondratyeva (2001). The intrinsic errors of differential photometry were equal to $0^m.03$–$0^m.07$ in dependence on the star's magnitudes.

Since 2000 our telescope has been equipped with a CCD ST-8 (1530 x 1020, 9μ) and B V Rc filters. All obtained frames were dark subtracted and flat fielded. The stars HD184740, HD184942 and HD185858 were adopted as standards. Expressions for transformation to the international system was made by measuring about 80 standard stars. The results of photometry are compiled in Table 1. Fig.1a displays variations of V mag versus HJD. Cyclic variations of V magnitude within $0^m.5$ – $0^m.8$ were accompanied by the gradual decrease of brightness (a line of trend in Fig.1a). The Discrete Fourier Transform of our normalized V magnitudes (the trend was excluded) showed a peak at frequency about 0.002521 d^{-1} (P=396.668d). The phase diagram for V according to the ephemeris: JDmin=2441577.480+396.668xE is presented in Fig.1c.

Spectral observations have been carried out with the original slit spectrograph, constructed in AFIF for faint emission objects (Denissyuk, 2003). The slit width equals to 3″ and 10″. A sample of gratings and objective lenses provided a spectral range from 3700 to 8200 Å. Spectrograms, obtained with the spectral resolution R=36000 were measured for the study of line profiles, and those with the R=9000–13000 were used for emission flux and EW determination.

All spectrograms were corrected for atmospheric extinction. There are emission lines of HI, HeI, [OI], [FeII] and possibly [NII], 6583Å in the spectrum of Hen2-446. The object is observed on a background of an extended HII region, and an appropriate long emission line of Hα is present on the spectrograms. This line together with the sky spectrum was measured on both sides of the stellar continuum and was subtracted from the observable spectrum of the object.

The absolute fluxes and equivalent widths for the Hα and Hβ are listed in Table 2. This is the case when the profiles of HI emission lines consist of two peaks with variable V/R ratio. The heliocentric radial velocities of all components are given in Table 3. (We estimate the errors in the V_r to be about $\pm$4km s^{-1}).

It turned out, that the radial velocities of the peaks were practically unchanged (within the limits of errors) during about 40 years. Position of an absorption line seems also to be persistent. Its negative velocity can specify an expansion of the outer absorbing layers of the disk or may be attributed to a proper motion of the star. No correlations were revealed between variations of EW(Hα) and V mag. Thus changes of EW depend mainly on the emission fluxes and may reflect variations of a size and gas density of the disk.

A period of V/R variations was not yet determined because our data points are distributed rather randomly. If the V/R ratios vary cyclically, they may arise from rotation of a circumstellar disk with a non-axisymmetric density distribution. In other case changes of V/R ratio may be caused by incidental density perturbations of the disk.

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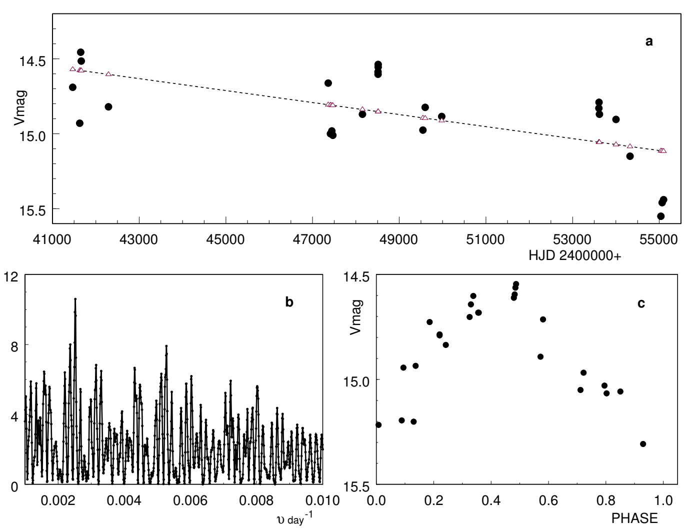

Figure 1. The results of photometry of Hen2-446. a – Vmag. versus HJD. b – DFT of the V magnitude measurements. c – the light curve.

*This version of the paper contains corrections, and differs from the one appeared on-line originally. Date of last modification: Mon Aug 1 09:46:18 CEST 2011

Table 1: Photometric results

Date	HJD	B	V	R
28.05.1972	41467.381		14.59±0.101	
07.11.1972	41629.173		14.93±0.13	
29.11.1972	41651.254		14.46±0.10	
13.12.1972	41665.038		14.52±0.11	
01.09.1974	42292.471		14.82±0.09	
18.07.1988	47361.313		14.56±0.10	
08.09.1988	47413.171		14.99±0.11	
11.10.1988	47446.288		14.98±0.09	
02.11.1988	47468.269		15.01±0.09	
16.09.1990	48151.235		14.87±0.08	
11.09.1991	48511.021		14.60±0.09	
12.09.1991	48512.146		14.59±0.08	
13.09.1991	48513.129		14.56±0.08	
14.09.1991	48514.123		14.56±0.07	
14.07.1994	49548.348		14.98±0.08	
02.09.1994	49598.256		14.82±0.09	
20.09.1995	49981.218		14.89±0.09	
25.08.2005	53608.217	15.92±0.06	14.83±0.03	
28.08.2005	53611.494	16.00±0.06	14.79±0.02	13.46±0.04
04.09.2005	53618.347		14.87±0.05	
05.09.2005	53619.196		14.86±0.05	
14.06.2006	54003.108		14.90±0.05	
12.08.2007	54325.254	16.34±0.06	15.15±0.03	13.93±0.04
23.07.2009	55036.350	16.55±0.06	15.55±0.04	14.20±0.04
23.08.2009	55067.215	16.68±0.06	15.46±0.03	
23.09.2009	55098.214	16.56±0.06	15.44±0.03	14.08±0.04

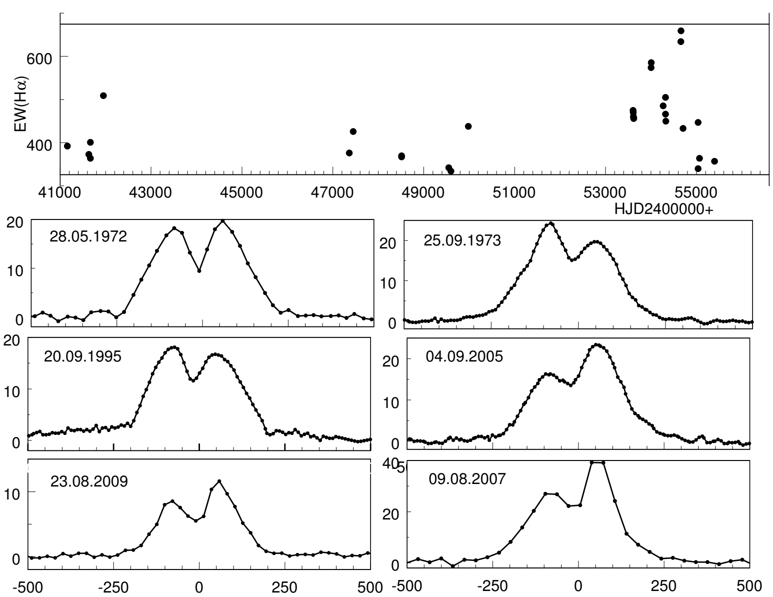

Figure 2. EW(Hα) vs HJD (the upper panel) and profiles of Hα for some dates. X-axis shows a heliocentric radial velocity, an Y-axis gives a ratio (I_λ-I_{cont})/I_{cont}

Table 2: Spectral results

Date	HJD 2400000+	EW(Hα) Å	σ Å	Fabs(Hα) erg cm^{-2}sec^{-1}	EW(Hβ) Å	σ Å	Fabs(Hβ) erg cm^{-2}sec^{-1}
24.07.1971	41157.300	392	28				
28.05.1972	41467.381	410	22				
07.11.1972	41629.173	373	33				
13.12.1972	41665.029	364	31				
26.09.1973	41952.158	509	45				
18.07.1988	47361.313	376	9				
08.09.1988	47413.163				30.8	2.2	
11.10.1988	47446.290	426	22				
02.11.1988	47468.271				31.3	2.5	
16.09.1990	48151.234				33	2.5	
11.09.1991	48511.038	367	25		29.6	2.3	
14.09.1991	48514.143	370	10		28.4	2.1	
14.07.1994	49548.350	342	18		28.1	1.8	
02.09.1994	49598.254	334	15				
20.09.1995	49981.217	438	21				
24.08.2005	53607.213	475	15				
25.08.2005	53608.217	470	19				
28.08.2005	53611.217	461	11	1.20E-12	27.0	1.9	8.49E-14
04.09.2005	53618.300	457	34	2.48E-12			
05.09.2005	53619.192	456	22	2.36E-12	36.7	2.2	9.27E-14
24.09.2006	54003.097	574	37				
26.09.2006	54005.333	585	29				
15.06.2007	54267.403	486	33				
05.08.2007	54318.250	466	22	1.52E-12			
06.08.2007	54319.229	505	27		30.6	1.1	5.28E-14
13.08.2007	54326.246	450	32	1.73E-12			
10.07.2008	54658.292	634	36	1.54E-12			
11.07.2008	54659.311	659	33	1.50E-12			
27.08.2008	54706.205	433	23				
22.07.2009	55035.181	347	29				
24.07.2009	55037.292	340	14				
23.08.2009	55067.236	364	17	1.27E-12			
19.07.2010	55397.299	357	14				

Table 3: Characteristics of the Hα profiles

Date	HJD 2400000+	V$_r$(red) km sec^{-1}	V$_r$(blue) km sec^{-1}	V$_r$(absorp) km sec^{-1}	FWHM Å	V/R
24.07.1971	41157.300	42.0	-81.0	-17.0	6.9	0.92
28.05.1972	41666.417	59.1	-82.6	-25.1	6.4	0.92
25.09.1973	41951.154	45.8	-79.0	-19.4	6.4	1.25
20.09.1995	49981.217	46.4	-72.3	-17.4	6.4	1.02
04.09.1995	53618.300	50.0	-73.4	-18.6	6.1	0.69
24.09.2006	54003.097	56.5	-84.6	-18.3	6.1	0.79
15.06.2007	54267.381	54.9	-92.3	-25.9	6.1	0.66
05.08.2007	54318.250	55.0	-79.4	-16.9	6.5	0.74
11.07.2008	54659.311	48.5	-81.9	-22.4	5.9	0.71
27.08.2008	54706.250	53.1	-84.1	-21.3	6.2	0.70
24.07.2009	55037.292	51.7	-72.3	-21.1	5.9	0.87
23.08.2009	55067.236	58.5	-78.3	-21.2	6.1	0.80
23.09.2009	55098.117	48.0	-88.6	-20.6	6.3	0.74
the mean	values	50.98±5.29	-81.77±5.62	-19.54±2.64	6.25±0.30	

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V456 CYG – A DETACHED ECLIPSING BINARY

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V0456 Cyg [=TYC 3152-323-1 = AN 172.1935 = BD+38°4107, RA = $20^h28^m50\overset{s}{.}845$, Dec = $39°09'13\overset{''}{.}69$ (J2000)] was first reported to be variable by Morgenroth (1935) who classified it as an Algol-type and supplied a finder chart plus magnitude range, but no period. The first available reference to a period is due to Savedoff (1951) who listed a period of 0.89 days for this system (amongst many others). Whitney (1959) reported a much improved period of 0.8911906 days, not far off the modern value of 0.8911956 days. Wood and Forbes (1963) reported quadratic and even cubic parameters for the ephemerides for these and 332 other systems, but modern period studies with photoelectric and CCD times of minima indicate a constant period for this system (Nelson 2011). Zakirov and Eshankulova (2006) took UBVR photoelectric observations and apparently solved by Lavrov's Direct Method (no reference was given; paper is not available).

In September of the years 2006 and 2007 the author took eight medium resolution (10 Å/mm reciprocal dispersion) spectra at the Dominion Astrophysical Observatory (DAO) in Victoria, British Columbia, Canada; he then used the Rucinski broadening functions (Rucinski, 2004) to obtain radial velocity (RV) curves (see Nelson et al., 2006 and Nelson 2010 for details). The spectral range was approximately 5005-5260 Å. A log of DAO observations and RV results is presented in Table 1.

Table 1: Observation log

DAO Image #	Mid Time (HJD-2400000)	Exposure (sec)	Phase at mid-exp	V1 (km/s)	V2 (km/s)
13043	53988.8632	3600	0.758	148.8	-174.4
13045	53988.9063	3600	0.807	136.1	-164.5
13076	53989.8656	3600	0.883	95.6	-120.7
13151	53994.7636	3600	0.379	-101.2	116.6
13222	54000.8693	3600	0.230	-146.9	172.2
13224	54000.9114	3600	0.277	-146.6	172.5
11195	54366.7578	2718	0.789	147.9	-167.2
11254	54369.7784	3326	0.179	-129.3	153.9

On three nights in May of 2008, one night in August of 2008, and nine nights in July of 2010, the author took a total of 151 CCD images of the field in B, 152 in V and 148 in Rc (Cousins) at his private observatory in Prince George, British Columbia, Canada. The telescope was a 33cm f/4.5 Newtonian on a Paramount ME mount; the detector was a SBIG ST-7XME CCD cooled to -20°C. Reduction software was MIRA by Mirametrics, Inc., and either sky or box flats were used. A list of the Variable (GSC 3152-323), Comparison (GSC 3152-491) and Check (GSC 3152-365) stars appears in Table 5 (available only electronically).

The following elements were used for phasing throughout (see Nelson, 2011 for the O-C relation):

$$JD_{Hel}MinI = 54637.8691(19) + 0.89119559(17)d \times E$$

The author used the 2004 version of the Wilson-Devinney (WD) light curve and radial velocity analysis program with the Kurucz atmospheres (Wilson and Devinney, 1971, Wilson, 1990, Kallrath, et al., 1998) as implemented in the Windows software WDwint (Nelson, 2009) to analyze the data. To get started, a spectral type A2 (SIMBAD, no reference given) and a temperature T1 = 9000 ± 150 K were used; interpolated tables from Cox (2000) which gave log g = 4.195 were used; an interpolation program by Terrell (1994) gave the (van Hamme, 1993) limb darkening values; and finally, a square root (LD=3) law for the extinction coefficients was selected, appropriate for hotter stars (Bessell, 1979). (The stated error in T1 corresponds to one half spectral sub-class.) At first, radiative envelopes were chosen for both stars, appropriate for hotter stars, but shifting to convective envelopes for star 2 gave a much better fit ($\Sigma\omega^2_{res}$ = 0.00559 for rad-conv versus $\Sigma\omega^2_{res}$ = 0.00808 for rad-rad). The parameters are listed in electronic Table 6 (the last three columns are explained below).

Mode 2 (for detached stars) was chosen, based on the general appearance of the light curves. Convergence by the method of multiple subsets was reached in a small number of iterations. In particular, the mass ratio q = M2/M1 was held fixed because this value (0.8487 ± 0.0036) was well determined from the RV curves; in contrast, it is not well constrained from the photometric data.

A plot of the B,V and R light curves, and WD fit is shown later. It is important at this stage to raise the issue that there was a problem in that the derived values for absolute parameters such as mass and stellar radius. They were simply too low to fit with the primary spectral type A2, and more closely fit those of a primary spectral type A8. As indicated above, the spectral type of A2 given in SIMBAD is without reference. However, the quoted infrared magnitudes J = 10.244 and H = 10.17 (from the 2MASS survey) yield J-H = 0.074 implying the spectral type of A2 (Covey, et al., 2007). As there is no indication of a classification spectrum in the references, the spectral type must be regarded as uncertain.

Next, the lower primary temperature T1 = 7640 K (equivalent to A8 V spectral type) was adopted and new extinction coefficients produced (also listed in Table 6). The usual runs in differential corrections mode were repeated and a new solution found. In view of the uncertainty as to primary spectral type it seemed advisable to present both solutions.

A plot of the B,V and V light curves, and WD fit are shown in Figures 1 and 2; careful comparisons reveal only very slight differences in the fits. The RVs are shown in Fig. 3. (the plots from the two models are almost identical) and a three dimensional representation from Binary Maker 3 (Bradstreet, 1993) is shown in Fig. 4 (electronic only).

Third light was tested for and found to be insignificant. Next, non-zero eccentricity was tested for; a value of 0.0016 +/- 0.0006 resulted. This is a very low value and is worth ignoring.

Final WD output parameters for each model are listed in Table 2 for both models.

Table 2: Final WD output parameters

WD Quantity	Mod. 1 Value	Mod. 1 Error	Mod. 2 Value	Mod. 2 Error	WD Quantity	Mod. 1 Value	Mod. 1 Error	Mod. 2 Value	Mod. 2 Error
T1 (K)	9000	170	7640	90	V_γ (km/s)	-0.50	0.19	-0.50	0.19
T2 (K)	7696	170	6667	90	r1 (pole)	0.279	0.001	0.258	0.001
Ω_1	4.398	0.01	4.696	0.01	r1 (point)	0.298	0.001	0.271	0.001
Ω_2	4.644	0.01	4.305	0.01	r1 (side)	0.285	0.001	0.262	0.001
q = M2/M1	0.8487	0.0036	0.8487	0.0036	r1 (back)	0.293	0.001	0.268	0.001
i (deg)	84.29	0.09	82.78	0.06	r2 (pole)	0.236	0.001	0.260	0.001
L1/(L1+L2) (B)	0.739	0.001	0.666	0.001	r2 (point)	0.247	0.001	0.278	0.001
L1/(L1+L2) (V)	0.704	0.001	0.634	0.001	r2 (side)	0.240	0.001	0.265	0.001
L1/(L1+L2) (R)	0.681	0.001	0.608	0.001	r2 (back)	0.245	0.001	0.274	0.001
a (solar radii)	5.712	0.007	5.730	0.008	$\Sigma\omega_{res}^2$	0.00556		0.00653	—

Table 3: Models 1 & 2

	Model 1						Model 2					
Fund. Quantity	Star 1 Tabular	Star 1 WD	Star 1 Error	Star 2 Tabular	Star 2 WD	Star 2 Error	Star 1 Tabular	Star 1 WD	Star 1 Error	Star 2 Tabular	Star 2 WD	Star 2 Error
Sp. Type	A2 V	—	—	A8 V	—	—	A8 V	—	—	F4 V	—	—
Temp. (K)	9000	9000	167	7640	7696	87	7640	7640	87	6765	6664	58
Mass ($M_\odot$)	2.50	1.71	0.09	1.75	1.45	0.09	1.75	1.73	0.04	1.44	1.46	0.03
Rad. ($R_\odot$)	2.09	1.63	0.008	1.58	1.37	0.008	1.58	1.51	0.008	1.34	1.53	0.008
M bol	1.10	1.80	0.18	2.29	2.85	0.07	2.29	2.68	0.08	3.40	3.25	0.08
Log g (cgs)	4.195	4.24	0.014	4.284	4.32	0.012	4.284	4.32	0.002	4.342	4.23	0.002
Lum. ($L_\odot$)	25.7	15.7	1.6	7.60	5.97	0.42	7.60	6.98	0.50	3.36	4.13	0.29
Dist. (pc)	—	496	57	—	—	—	—	483	56	—	—	—

The WD output fundamental parameters and errors are listed in Table 3 along with those from the properties of zero age main sequence stars (ZAMS; Cox, 2000). Most of the errors are output or derived estimates from the WD routines. The error in q was derived from the rms deviations of points from the best-fit double sine curves. In estimating the distance, galactic extinction was allowed for using the formula
$A_V = 3E(B-V) = R \times [(B-V)_{data} - (B-V)_{tables}]$.

This last method is relatively crude in that the colour index, B-V was taken from Tycho data; the stated error in each is 0.052 and 0.056 magnitudes, translating to ± 0.076 in the difference (but this may be a worst-case scenario). The tabular values are uncertain to around 0.015 magnitudes (corresponding to one half a spectral sub-class), and lastly, the value R=3 is an approximation – it varies from place to place and many authors favour the value 3.1. This last uncertainty accounts for an error of only a few pc and is therefore well within the error estimate of 56 or 57 pc for the distance.

In conclusion, it seems clear that spectral type A8 on the ZAMS better fits the derived mass for the primary star. Other quantities including the luminosity L are well within bounds for a main-sequence star. On the other hand, star 2 seems to be somewhat evolved, as its radius and luminosity are too high for a ZAMS star. Reference to triply-interpolated evolutionary tracks from the Geneva group reveal no fit at all for solar metallicity Z = 0.02 (Schaller et al., 1992)) but a possible fit for Z = 0.04 (Schaerer et al., 1993). Taking into account the estimated errors for L and T, an age between 0.5 and 1.00 Gy is feasible. There is no easy explanation as to how the stars could be at such disparate ages, however.

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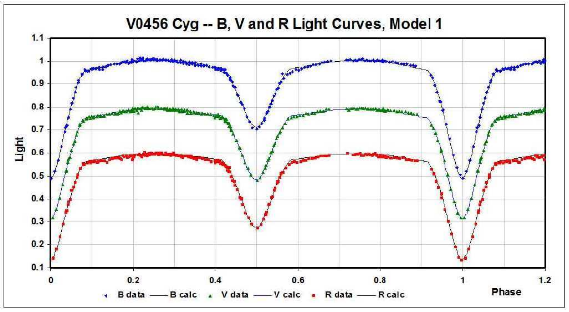

Figure 1. V456 Cyg: B,V and R Light Curves – Data and WD Fit (Model 1)

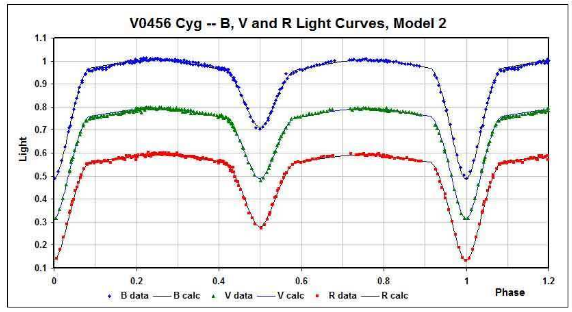

Figure 2. V456 Cyg: B,V and R Light Curves – Data and WD Fit (Model 2)

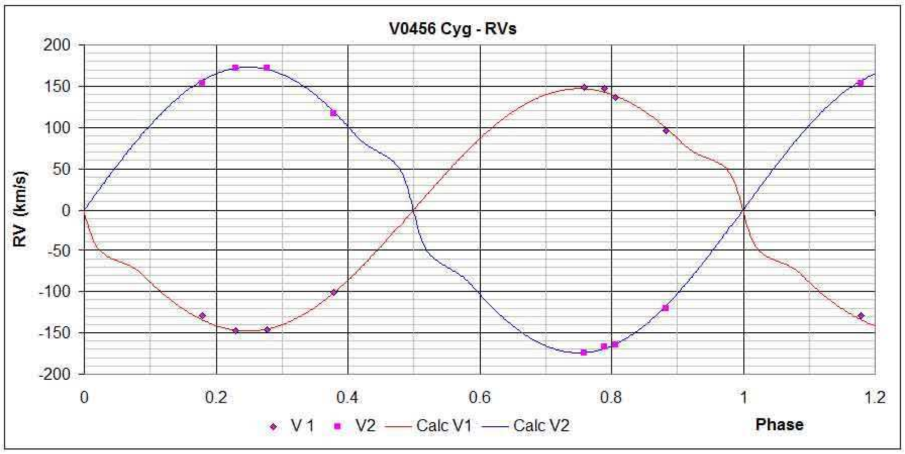

Figure 3. V465 Cyg: Radial Velocity Curves – Data and WD Fit

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UBVRI OBSERVATIONS OF THE FLICKERING OF THE SYMBIOTIC STAR MWC 560

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MWC 560 (V694 Mon) was discovered as an object with bright hydrogen lines (Merrill & Burwell 1943). It is a symbiotic binary system, which consists of a red giant and a white dwarf. The long term light curves (Luthardt 1991, Doroshenko et al. 1993) show that during the last century the star brightness varied in the range $m_{\rm B} = 11.0 - 12.5$, with one outburst in 1990, when it achieved $m_{\rm B} \approx 9.5$. The orbital period is estimated to be $P_{\rm orb} = 1931 \pm 162$ day (Gromadzki et al. 2007).

The flickering of MWC 560 in optical bands was first detected by Bond et al. (1984) and later reported also by Michalitsianos et al. (1993) and Tomov et al.(1996). Recently, Stute & Sahai (2009) discovered emission and quasi-periodic flickering in X-rays on timescales of minutes and hours using XMM-Newton.

On the night of 2010 December 29, we observed MWC 560 simultaneously with four telescopes equipped with CCD cameras. The 2m RCC telescope of the National Astronomical Observatory Rozhen observed in the U and V band with a dual channel focal reducer FoReRo2, equipped with CCD cameras Photometrics(1024x1024) and VersArray(512x512 px) and field of view 7.5'x7.5'. The 50/70 cm Schmidt telescope observed in the U band (CCD FLI PL 16803, 4096x4096 px, used 1024x1024 px, 18' x 18'). The 60 cm Rozhen telescope observed in the B, V and I bands (FLI PL 9000 CCD with 3056 x 3056 pixels and 18'x18'); the 60 cm telescope of the Belogradchik Astronomical Observatory in the V, R and I bands (FLI PL 9000 CCD, 3056 x 3056 px, 18'x18'). All the CCD images have been bias subtracted, flat fielded, and standard aperture photometry has been performed. The data reduction and aperture photometry were done with IRAF and have been checked with alternative software packages. The comparison stars of Henden and Munari (2006) have been used.

The results of our observations are summarized in Table 1 and plotted in Fig.1. For each run we measure the minimum, maximum, and average brightness in the corresponding band, plus the standard deviation of the run. The amplitude of variability is highest in U band, $\Delta U \approx 0.29$ mag. It decreases to longer wavelengths and in I-band is ≈ 0.07 mag. Our observations are obtained during the recent outburst, which reached the peak brightness in the end of December 2010 (Goranskij et al. 2011).

Table 1: CCD observations of MWC 560. In the table are given as follows: the band, UT-start and UT-end of the run, exposure time, number of CCD images obtained, average magnitude in the corresponding band, minimum – maximum magnitudes in each band, standard deviation of the mean, observational error.

band	UT start–end	exp [sec]	N_{pts}	average [mag]	min-max [mag]-[mag]	stdev [mag]	err [mag]
U	22:24–01:28	60	120	9.457	9.309 - 9.596	0.069	≤0.012
B	21:53–01:31	20	485	10.147	10.040 - 10.245	0.047	≤0.007
V	22:46–01:31	5	917	9.675	9.572 - 9.778	0.046	≤0.005
R	22:10–01:30	5	399	9.517	9.432 - 9.582	0.033	≤0.009
I	21:53–01:31	3,5	404	8.399	8.364 - 8.435	0.014	≤0.005

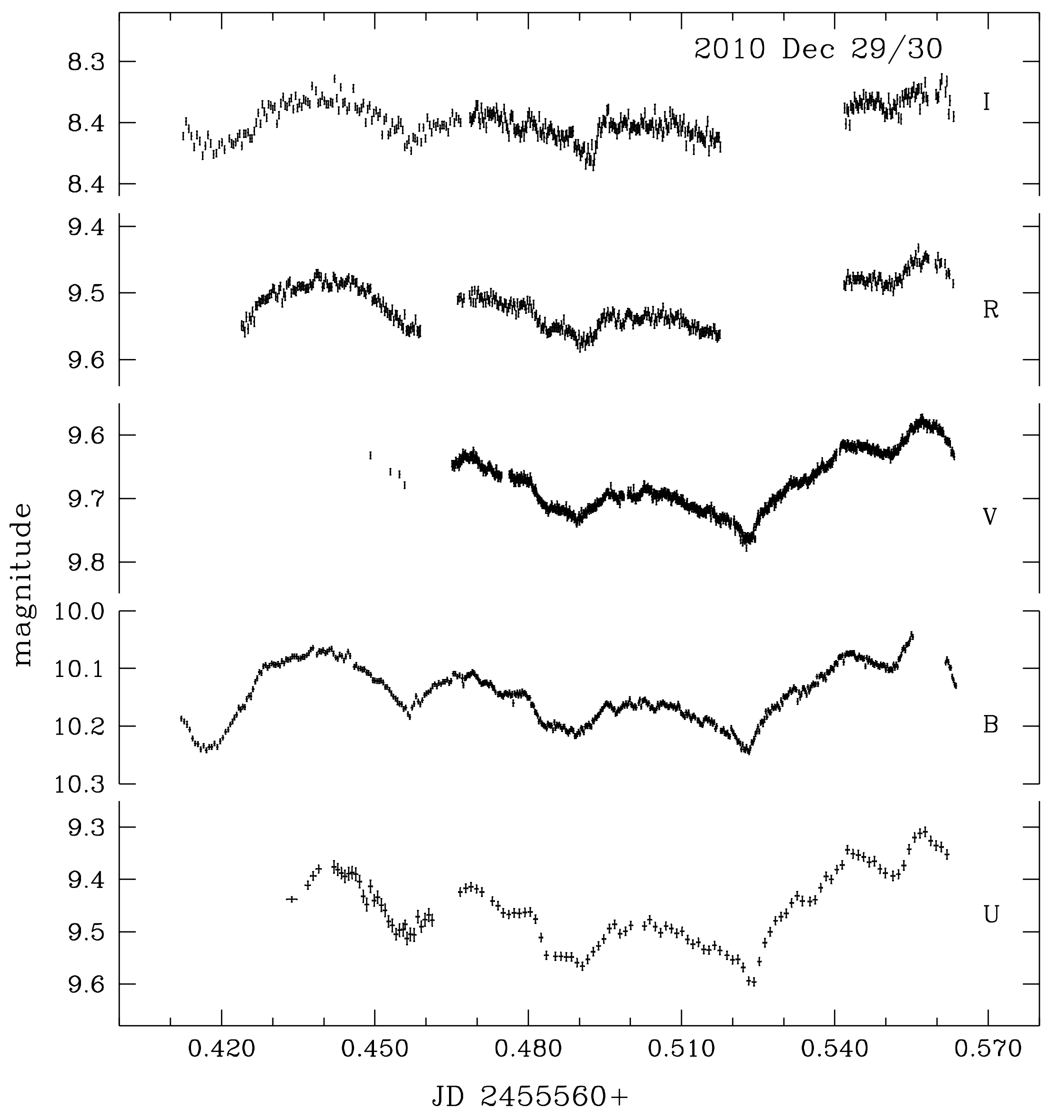

Figure 1. Variability of MWC 560 in the *UBVRI* bands on 29/30 December 2010.

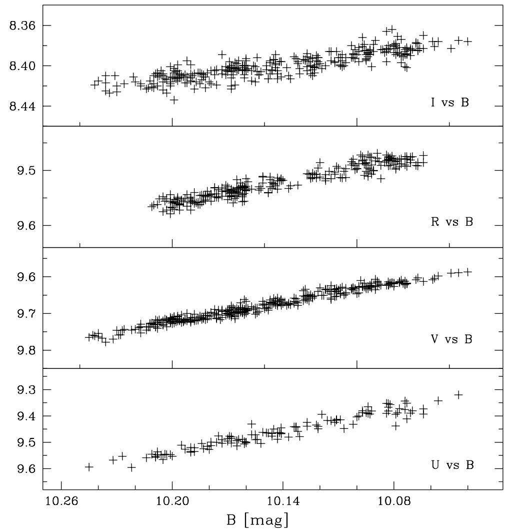

Figure 2. I, R, V, U band magnitudes versus B band magnitude

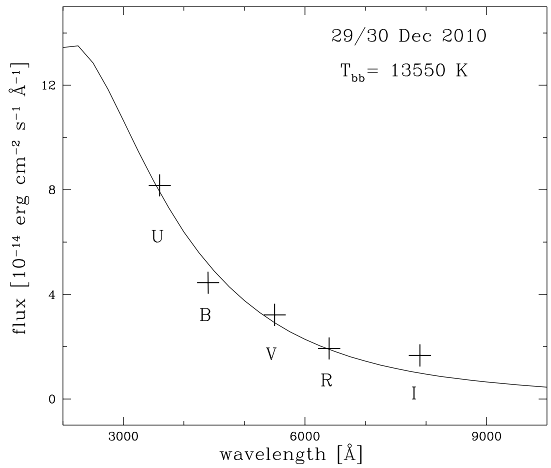

Figure 3. Dereddened fluxes of the flickering light source of MWC 560. The solid line represents a black body fit with $T_{bb} = 13550$ K, radius $R = 1.68$ $R_\odot$, located at distance $d = 2.5$ kpc.

In Fig.2, I, R, V, U band magnitudes are plotted versus the B magnitude. Linear fits (of type y = a + bx) to the data points in Fig.2 give:

$$U = -4.64(\pm 0.17) + 1.39(\pm 0.02)B \quad (1)$$
$$V = 0.43(\pm 0.08) + 0.91(\pm 0.01)B \quad (2)$$
$$R = 2.83(\pm 0.09) + 0.65(\pm 0.01)B \quad (3)$$
$$I = 6.04(\pm 0.06) + 0.23(\pm 0.01)B \quad (4)$$

The errors of the coefficients are given in brackets. These relations are obtained on the basis of our observations from 2010 Dec 29. They are valid over the range $10.05 \leq B \leq 10.25$ mag.

The Spearman's (rho) rank correlation gives $\rho = 0.96$ for Eq.1, $\rho = 0.98$ for Eq.2, $\rho = 0.93$ for Eq.3, $\rho = 0.94$ for Eq.4. The significance in Eq.1-Eq.4 is $< 10^{-10}$ indicating that all these correlations are highly significant.

The distance to MWC 560 is estimated to be $d = 2.5 \pm 0.3$ kpc (Meier et al. 1996). Schmid et al. (2001) give $d = 2.5 \pm 0.7$ kpc and $E_{B-V} = 0.15 \pm 0.05$ mag. We assume $d = 2.5$ kpc, $E_{B-V} = 0.15$ mag, and an extinction law as given in Zombeck (1990). This gives the interstellar absorption to MWC 560: $A_U = 0.754$ mag, $A_B = 0.628$ mag, $A_V = 0.477$ mag, $A_R = 0.400$ mag, $A_I = 0.304$ mag.

As a quantitative way to investigate the flickering properties Bruch (1992) proposed that the light curve of CVs can be separated into two parts – constant light and variable (flickering) source. In these suppositions the flickering light source is considered 100% modulated and it is assumed to be the modulated part of the emission from the boundary layer or the bright spot (see also Warner & Cropper 1983; Nelson et al. 2011). In a statistically representative light curve the difference between the radiation flux at a given moment and the minimum flux is then equal to the flux of the flickering light source at that moment.

Following these assumptions, we calculate the flux of the flickering light source as $F_{\rm fl} = F_{\rm av} - F_{\rm min}$, where $F_{\rm av}$ is the average flux during the run and $F_{\rm min}$ is the minimum flux during the run (corrected for the typical error of the observations). $F_{\rm fl}$ has been calculated for each band, using Eq.1-Eq.4 (in the interval $10.22 > B > 10.147$) and Bessel (1979) calibration for the fluxes of a zero magnitude star. The calculated magnitudes and colours of the flickering light source are:

$U = 12.08 \pm 0.07$, $B = 13.11 \pm 0.07$, $V = 12.75 \pm 0.06$, $R = 12.94 \pm 0.09$, $I = 12.92 \pm 0.20$,

$(U-B)_0 = -1.16 \pm 0.08$, $(B-V)_0 = 0.21 \pm 0.09$, $(V-R)_0 = -0.26 \pm 0.10$, $(V-I)_0 = -0.35 \pm 0.20$. The colours are corrected for interstellar extinction.

In Fig.2 (right panel) we plot these magnitudes transformed to fluxes and dereddened. Adopting $d = 2.5$ kpc and using a black body fit, we calculate for the flickering light source: $T_{\rm fl} = 13550 \pm 500$ K, $R_{\rm fl} = 1.68 \pm 0.16$ $R_\odot$ and $L_{\rm fl} \approx 88$ $L_\odot$.

Conclusion: We report simultaneous observations in 5 bands ($UBVRI$) of the flickering of the jet ejecting symbiotic star MWC 560.

The colours of the optical flickering source we have obtained are $(U-B)_0 = -1.16 \pm 0.08$ and $(B-V)_0 = 0.21 \pm 0.09$. The temperature of the flickering source derived is $T_{\rm fl} = 13550 \pm 500$ K, and the luminosity is $L_{\rm fl} \sim 88$ $L_\odot$.

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REFERENCE FRAME AND TIME STANDARD USED IN INTEGRAL/OMC DATASETS

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The INTEGRAL satellite (Winkler et al. 2003) started its operations in October 2002 and is dedicated to search and study of all kinds of high-energy sources using gamma-ray and X-ray instruments. In addition, there is an Optical Monitoring Camera (Mas-Hesse et al. 2003, hereafter OMC) consisting of a passively cooled CCD (1056×2061 pixels, imaging area: 1024×1024 pixels) working in frame transfer mode. The CCD is located in the focal plane of a 50 mm (diameter) lens including a Johnson V-filter to cover the 500–600 nm wavelength range. The OMC obtains very good long-term series of photometric observations. The public OMC Archive at `http://sdc.cab.inta-csic.es/omc/` (Gutiérrez et al. 2004) contains not only optical measurements of the original high-energy targets, but also many "common" variable stars observed with OMC. However, some OMC data used in the past were unfortunately interpreted in the incorrect time standard. For this reason we decided to write the following short description to help people working in the variable star community.

The data in the public archive are given as binary tables in fits format. The time information is given in two columns in terms of INTEGRAL Julian Date (IJD), which is defined as JD-2 451 544.5 or MJD-51 544.0. The time standard adopted by the INTEGRAL Project, as recommended by IAU Division I, is Terrestrial Time (TT). So, IJD starts on 1 January 2000, but expressed in TT and not in UTC. Since TT differs from UTC by 32.184 sec + 32 leap seconds at the start of year 2000, the UTC origin of the IJD is actually 1999-12-31 T23:58:55.816 (=JD 2 451 544.49925713 UTC).

The first time column is "TFIRST", where no barycentric or heliocentric correction is applied. So, "TFIRST" is the INTEGRAL Julian Date measured in the satellite reference frame and expressed in TT. The second time column "BARYTIME" includes the time after applying the barycentric correction to transform from the accelerated coordinate system of the INTEGRAL satellite into the coordinate system of the solar system barycenter. Following the IAU recommendations for barycentric ephemerides (IAU 2006 NFA glossary, prepared by the IAU Division I Working Group), "BARYTIME" is the Barycentric INTEGRAL Julian Date expressed in the Barycentric Dynamical Time standard (TDB). The difference TDB–TT has a maximum amplitude of 3.4 ms (Eastman et al. 2010), which is orders of magnitude lower than the OMC timing accuracy.

We notice that authors use heliocentric instead of barycentric correction in most papers devoted to variable stars. Heliocentric correction is only accurate to 8 seconds (see Eastman et al. 2010 for details). This difference is negligible for the majority of periodic variable stars with periods of days and longer, but it brings redundant and senseless noise to the data.

In addition to the above considerations, the OMC data user must take into account that times in both columns "TFIRST" and "BARYTIME" are the "starting" time of the integration. Thus, for the commonly used "middle" time of the integration, one must add "TELAPSE"/2 and be aware that TELAPSE is in seconds. An OMC integration consists of one or several individual exposures. Information in the TELAPSE column gives the length of the entire integration in seconds (which can include several exposures), while the EXPOSURE column gives the effective exposure in seconds. The number of exposures co-added to form a given OMC integration is controlled by the "Sampling Time" query parameter shown on the OMC Archive Web page. This parameter must be understood as a code to designate the type of light curve is obtained. There are three different sampling times used for data in the OMC Archive: 1, 630 and 9000 seconds. With 1 second sampling we get a light curve with one photometric point per exposure. With 630 second sampling individual exposures are co-added to obtain roughly one photometric point each 10 minutes, but images with exposures less than 20 seconds are rejected to increase the signal-to-noise ratio. For the 9000 seconds sampling all exposures in a given INTEGRAL pointing are co-added, and exposures shorter than 60 seconds are rejected to increase the signal-to-noise ratio. It should be borne in mind that longer exposures lead to saturation effects for bright sources. Consequently only the shortest possible exposure times should be used for such bright sources.

The OMC Archive is a rich source of photometric information on many variable stars. However, before using the information for a long term study of astronomical events, substantial attention should be devoted to the time scales and reference frames of data used in the analysis. As Bastian (2000), Eastman et al. (2010) and others showed, researchers should take into account the difference between JD based on UTC and TT (or TDB), which can introduce systematic errors of over 1 minute.

More information can be found at the ISDC[1] FAQ list:
`http://www.isdc.unige.ch/integral/support/faq`.

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[1]The INTEGRAL Science Data Centre

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MINIMA OF ECLIPSING BINARIES, VARIABILITY OF V840 HER AND NSV5740, NEW EPHEMERIDES FOR V997 CYG, V1037, V1098, V1100 HER

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The accompanying list contains 97 times of minima for 49 eclipsing binary stars (including the cataclysmic DO Leo) calculated from CCD observations made by participants in the SSV-UAI Eclipsing Binaries Program. All the observatories are located in Italy; one is managed by the Physics Department of the University of Siena, while the others are privately operated.

The observations were reduced following standard procedures (see next section) and the light curves were analyzed using the Kwee−van Woerden algorithm (Kwee & van Woerden, 1956) to determine the times of minimum. All the times of minimum listed in this paper are heliocentric.

We note most of the observed stars are neglected objects.

Observatory and telescope:
University of Siena Astron. Observatory: 32-cm Maksutov–Cassegrain (MC32)
Skylive Remote Telescopes: 30-cm Schmidt–Cassegrain (S30)
Other private astronomical stations:
30-cm Schmidt–Cassegrain (SC30)
25-cm Newton (NW25)
25-cm Schmidt–Cassegrain (SC25)
20-cm Newton (NW20)
20-cm Schmidt–Cassegrain (SC20)
11-cm Newton (NW11)

Detector:	Meade DSI Pro II Monochromatic CCD camera (DSI)
	QSI 516wsg
	SBIG ST-7 CCD Camera (ST7)
	SBIG ST-8XME CCD Camera (ST8)
	SBIG ST-9 CCD Camera (ST9)
	SBIG ST-10XME CCD camera (ST10)
	Sony ICX429ALL based CCD camera (CCD-UAI)

Method of data reduction:

Frame calibration (dark subtraction and flat field correction) and photometric analysis (differential photometry on each image) were performed using MaxImDL or Mira Pro software packages.

Method of minimum determination:

The times of minima, expressed as heliocentric Julian days (see the attached Table), were computed adopting the KW method (Kwee & van Woerden, 1956) using AVE (Barberá, 1996). This algorithm also provides an error estimate, that is the formal internal error of the KW method, so which can be considered as a lower limit of the actual uncertainty on times of minimum. Together with that error, we provide an alternative estimate error according to the Arlot's (modified) method (Arlot *et al.*, 2009) by adopting the formula $\sigma_{ToM} = \frac{1}{\sqrt{2}}\frac{\sigma_m}{\Delta m}\Delta t$, where σ_m is the error in magnitude and Δm is the magnitude drop during a time range Δt delimiting the part of the light curve where the speed of decrease in magnitude is the highest. The $\frac{1}{\sqrt{2}}$ factor takes into account that 2 branches (descending and ascending) contribute to the time of minimum estimation.

The types of minimum quoted in the Table were deduced according the ephemerides provided by Kreiner's (2004) web site (`http://www.as.up.krakow.pl/ephem`), by B.R.N.O. – *O–C Gateway* web site (`http://var.astro.cz/ocgate`) or by our updated elements (see below). Only in the latter case we are sure that the primary minimum (conventionally at zero phase) is the deeper.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V1490 Aql	55755.3731	0.0015[a] 0.0001[b]	I	R	Marino/NW25/ST7
EM Boo	55662.4656	0.0010 0.0009	II	V	Martinengo/SC20/QSI-516wsg
GG Boo	55694.3652	0.0009 0.0004	I	r	Ruocco/SC25/ST7
GI Boo	55671.4805	0.0021 0.0011	II	V	Banfi/SC25/ST7
EG Cep	55751.3698	0.0002 0.0001	I	c	Arena/NW20/DSI
V338 Cep	55436.3741	0.0005 0.0002	I	I	Marino/NW20/ST7
V383 Cep	55434.3814	0.0014 0.0002	II	I	Marino/NW20/ST7
AM CrB	55693.4176	0.0004 0.0003	I	r	Ruocco/SC25/ST7
CX CVn	55655.4633	0.0012 0.0003	I	V	Banfi/SC25/ST7
DU CVn	55658.3619	0.0011 0.0007	I	r	Ruocco/SC25/ST7
DU CVn	55658.5164	0.0005 0.0004	II	r	Ruocco/SC25/ST7
DU CVn	55661.4319	0.0007 0.0008	I	r	Ruocco/SC25/ST7
WZ Cyg	55412.3457	0.0005 0.0001	II	R	Romeo, Marino/SC20/ST7
V997 Cyg	55459.3667	0.0014 0.0003	II	R610	Corfini/NW20/CCD-UAI
V997 Cyg	55460.5135	0.0006 0.0017	I	R610	Corfini/NW20/CCD-UAI
V997 Cyg	55462.3445	0.0007 0.0003	I	R610	Corfini/NW20/CCD-UAI
V997 Cyg	55463.4917	0.0012 0.0010	II	R610	Corfini/NW20/CCD-UAI
V997 Cyg	55469.4474	0.0004 0.0002	II	c	Zambelli/SC25/ST8
V997 Cyg	55469.4481	0.0017 0.0006	II	R610	Corfini/NW20/CCD-UAI
V997 Cyg	55472.4243:	0.0020 0.0015	I	R610	Corfini/NW20/CCD-UAI
V997 Cyg	55476.3207	0.0022 0.0006	II	R610	Corfini/NW20/CCD-UAI
V997 Cyg	55478.3836	0.0011 0.0002	I	R610	Corfini/NW20/CCD-UAI
V997 Cyg	55479.2994	0.0004 0.0002	I	R610	Corfini/NW20/CCD-UAI
V1905 Cyg	55739.4298	0.0002 0.0001	I	V	Martinengo/SC20/QSI 516wsg
V2197 Cyg	55754.3883	0.0001 0.0001	I	V	Banfi, Aceti, Pesenti/SC25/ST7
V2278 Cyg	55710.4459	0.0009 0.0004	I	V	Marino/NW20/ST7
V2478 Cyg	55740.4118	0.0006 0.0002	II	V	Martinengo/SC20/QSI 516wsg
V2480 Cyg	55754.5378	0.0010 0.0001	I	V	Banfi/SC25/ST7
EF Dra	55754.5431	0.0009 0.0003	II	c	Arena/NW20/DSI
GM Dra	55755.3665	0.0009 0.0001	I	c	Arena/NW20/DSI
GM Dra	55755.5379	0.0009 0.0001	II	c	Arena/NW20/DSI
HL Dra	55644.5838	0.0019 0.0003	I	V	Banfi/SC25/ST7
HL Dra	55645.5304	0.0026 0.0002	I	V	Banfi/SC25/ST7
HL Dra	55706.4376	0.0064 0.0010	II	V	Martinengo/SC20/QSI 516wsg
MY Dra	55655.4064	0.0004 0.0002	I	V	Papini/SC25/ST9
BC Her	55726.4459	0.0007 0.0003	I	V	Banfi/SC25/ST7
V923 Her	55661.5027	0.0060 0.0002	I	V	Marino/NW20/ST7
V1037 Her	55696.5741	0.0003 0.0002	I	r	Ruocco/SC25/ST7
V1037 Her	55700.5123	0.0004 0.0003	I	r	Ruocco/SC25/ST7
V1037 Her	55700.5120	0.0004 0.0001	I	V	Marchini/MC32/ST7
V1037 Her	55702.4821	0.0014 0.0004	II	V	Banfi/SC25/ST7
V1037 Her	55719.4146	0.0012 0.0002	I	V	Banfi/SC25/ST7
V1037 Her	55750.5258	0.0020 0.0025	II	V	Banfi/SC25/ST7
V1072 Her	55670.4421	0.0012 0.0007	I	V	Banfi/SC25/ST7
V1072 Her	55698.3723	0.0011 0.0011	II	c	Zambelli/SC25/ST8
V1072 Her	55710.4276	0.0003 0.0001	I	V	Martinengo/SC20/QSI 516wsg
V1072 Her	55738.3594	0.0013 0.0007	II	c	Ruocco/SC25/ST7
V1098 Her	55417.3951	0.0007 0.0003	II	V	Corfini/NW20/CCD-UAI
V1098 Her	55454.3815	0.0007 0.0002	II	R610	Corfini/NW20/CCD-UAI
V1098 Her	55641.6130	0.0004 0.0001	I	V	Papini/SC25/ST9
V1098 Her	55644.6084	0.0004 0.0002	II	V	Papini/SC25/ST9
V1098 Her	55645.4866	0.0010 0.0006	I	V	Papini/SC25/ST9

Times of minima:					
Star name	Time of min. HJD 2400000+	Error	Type	Filter	Rem.
V1098 Her	55654.4722	0.0009 0.0003	II	*V*	Banfi/SC25/ST7
V1098 Her	55654.6468	0.0006 0.0002	I	*V*	Banfi/SC25/ST7
V1098 Her	55669.4424	0.0007 0.0002	I	*V*	Zambelli/SC25/ST8
V1098 Her	55733.3808	0.0004 0.0002	II	*c*	Ruocco/SC25/ST7
V1100 Her	55641.5702	0.0005 0.0002	II	*V*	Zambelli/SC25/ST8
V1100 Her	55646.6008	0.0008 0.0002	I	*V*	Banfi/SC25/ST7
V1100 Her	55658.5684	0.0016 0.0004	II	*V*	Banfi/SC25/ST7
V1100 Her	55731.4261	0.0003 0.0003	II	*c*	Ruocco/SC25/ST7
V1100 Her	55734.3741	0.0003 0.0002	I	*c*	Ruocco/SC25/ST7
V409 Hya	55652.3572	0.0003 0.0001	I	*V*	Corfini/NW20/CCD-UAI
XZ Leo	55601.4597	0.0003 0.0001	I	*R*	Bellia, Bianciardi/S30/ST10
DO Leo	55305.5006	0.0004 0.0001	I	*C.Booster*	Corfini/NW20/CCD-UAI
DO Leo	55308.3147	0.0006 0.0006	I	*R*610	Corfini/NW20/CCD-UAI
HS Leo	55698.3388	0.0002 0.0003	II	*c*	Corfini/NW20/CCD-UAI
G1965-735	55657.3612	0.0003 0.0003	I	*V*	Corfini/NW20/CCD-UAI
G1965-735	55660.3982	0.0005 0.0002	I	*V*	Banfi/SC25/ST7
WZ LMi	55658.3913	0.0008 0.0005	II	*V*	Corfini/NW20/CCD-UAI
CF Lyn	55632.3946	0.0012 0.0005	I	*r*	Ruocco/SC25/ST7
CL Lyn	55664.3905	0.0017 0.0020	I	*r*	Ruocco/SC25/ST7
EH Lyn	55689.4082	0.0014 0.0008	I	*V*	Corfini/NW20/CCD-UAI
V400 Lyr	55021.4022	0.0004 0.0001	I	*c*	Corfini/NW11/CCD-UAI
V400 Lyr	55021.5286	0.0009 0.0005	II	*c*	Corfini/NW11/CCD-UAI
V400 Lyr	55394.5691	0.0003 0.0004	II	*BVRI*	Marino/NW20/ST7
V400 Lyr	55395.4557	0.0005 0.0020	I	*BVRI*	Marino/NW20/ST7
V400 Lyr	55395.5831	0.0062 0.0004	II	*BVRI*	Marino/NW20/ST7
V400 Lyr	55418.3905	0.0004 0.0004	II	*BVRI*	Marino/NW20/ST7
V400 Lyr	55418.5175	0.0002 0.0002	I	*BVRI*	Marino/NW20/ST7
V400 Lyr	55433.4697	0.0008 0.0003	I	*BVRI*	Marino/NW20/ST7
V563 Lyr	55737.3801	0.0005 0.0003	I	*V*	Marino/NW25/ST7
V2394 Oph	55690.2155:	0.0007 0.0010	I	*r*	Marino/S30/ST10
V2640 Oph	55710.5011	0.0006 0.0002	I	*V*	Marino/NW20/ST7
BO Peg	55135.4101	0.0013 0.0003	I	*c*	Corfini/NW20/CCD-UAI
BO Peg	55147.3105	0.0022 0.0009	II	*c*	Corfini/NW20/CCD-UAI
WY Sex	55644.5001	0.0007 0.0004	II	*V*	Corfini/NW20/CCD-UAI
WY Sex	55645.4181	0.0006 0.0002	I	*V*	Corfini/NW20/CCD-UAI
WY Sex	55651.4923	0.0002 0.0004	II	*V*	Zambelli/SC25/ST8
XX Sex	55662.4122	0.0008 0.0003	I	*V*	Corfini/NW20/CCD-UAI
GQ Tau	55305.3461	0.0005 0.0004	I	*V*	Corfini/NW20/CCD-UAI
HV UMa	55654.2986	0.0043 0.0010	II	*r*	Ruocco/SC25/ST7
HV UMa	55665.3127	0.0013 0.0012	I	*r*	Ruocco/SC25/ST7
OQ UMa	55643.4067	0.0004 0.0001	I	*V*	Corfini/NW20/CCD-UAI
IK Vir	55657.5013	0.0019 0.0003	I	*V*	Banfi/SC25/ST7
IR Vir	55687.3854	0.0005 0.0001	II	*V*	Corfini/NW20/CCD-UAI
V384 Vul	55706.5493	0.0011 0.0003	II	*V*	Banfi/SC25/ST7
V384 Vul	55750.4349	0.0021 0.0004	II	*V*	Banfi/SC25/ST7
V384 Vul	55759.4315	0.0015 0.0002	I	*V*	Vincenzi/SC30/ST9

Explanation of the remarks in the table:

Rem.: Observer[s]/Telescope/Detector
[a] Arlot's modified method
[b] as given by KW method
: uncertain

Remarks:

V997 Cyg – This variable star was catalogued as RR Lyr type in the catalogues of Sonneberg Obs. (Gessner, 1966), GCVS (Samus *et al.*, 2007-2011) and VSX (`http://www.aavso.org/vsx`), as well as in the Kemper's (1982) spectroscopic program. More recently, the star was recognized to be an eclipsing binary (Akerlof *et al.*, 2000; Devor *et al.*, 2008).
In order to improve the ephemeris of this star, we firstly analyzed our light curves (covering all phases) by using the period searching utilities provided by PERANSO software (Vanmunster, 2007), which lead to the period value $p = 0^d.458219$, consistent with the values given by Akerlof *et al.* (2000) and Devor *et al.* (2008). Subsequently, including also the ROTSE1 time of minima given by Diethelm (2001a), the linear best fit of the O−C vs. the epoch, leaving the initial epoch and period free to vary, led to the following updated ephemeris:

$$T_{min}\text{ (HJD)} = 2455460.5124(\pm 0.0010) + 0^d.4582260(\pm 0.0000003) \times E$$

Figure 1 shows the O−C diagram computed using our new ephemeris. No change of period is evident in the O−C diagram.

V840 Her – The first report we found about a possible short term variability of NSV7814 (=V840 Her) was given in oral communication at a meeting by DeMartino & Predom (1991); nevertheless, Baldwin & Dahm (1993) did not find any variability. Kazarovets & Samus (1995) included the star in the 72^{nd} name-list of variable stars. We observed the star during 24 nights for 52 hours. Only during one nights we found a possible, never confirmed, variation of 0.04 mag.; in the other nights we found the star to be constant within 0.02 mag, allowing us to exclude all possible variability's period $\leq 0^d.9752$ and many greater values.

V1037 Her – For this very neglected star, ROTSE1 (Akerlof *et al.*, 2000) and VSX catalogues report a period of $\sim 1^d.30$ and $\sim 0^d.65$ respectively. Those values are not consistent with our light curves, which lead to the correct value of $\sim 0^d.79$, which also agree with the only two minima found in literature (ROTSE1−Diethelm, 2001b). The linear best fit of the O−C including all available data leads to the following correct ephemeris:

$$T_{min}\text{ (HJD)} = 2455696.57493(\pm 0.00097) + 0^d.7875767(\pm 0.0000003) \times E$$

The O−C diagram obtained with the new ephemeris is shown in Figure 2.

V1098 Her – ROTSE1 catalogue classified the stars as a δ Scuti. In their reclassification, Jin *et al.* (2003) recognized V1098 Her as an eclipsing binary.
Our minima allow us to significantly improve the ephemeris by performing a linear best fit of O−C including, together our data, the only time of minimum publicly available. Figure 3 shows the O−C diagram obtained with our following updated elements:

$$T_{min}\text{ (HJD)} = 2455417.21830(\pm 0.00034) + 0^d.352268564(\pm 0.000000098) \times E$$

V1100 Her – The star is included in the Kreiner's (2004) database. Relevant discrepancies between observed and predicted times of minima led us to examine the O−C diagram, which shows evident period's variation. The following new ephemeris is obtained by computing the linear best fit of all the available data:

$$T_{min}\text{ (HJD)} = 2452500.2778(\pm 0.0036) + 0^d.34693098(\pm 0.00000049) \times E$$

The O−C diagram obtained with the new ephemeris is shown in Figure 4.

NSV5740 – Hübscher, Paschke & Walter (2006), Paschke (2007) and Paschke (2009) report three minima. However, a recent revision of the original images has clarified those were minimum's times of GSC1991-1676 (Paschke, 2011). Actually, Faulkner (1986) had found the star to be constant within 0.02 mag. Our monitoring, performed during 14 hours in 5 nights, confirms the star is constant, within 0.01 mag.

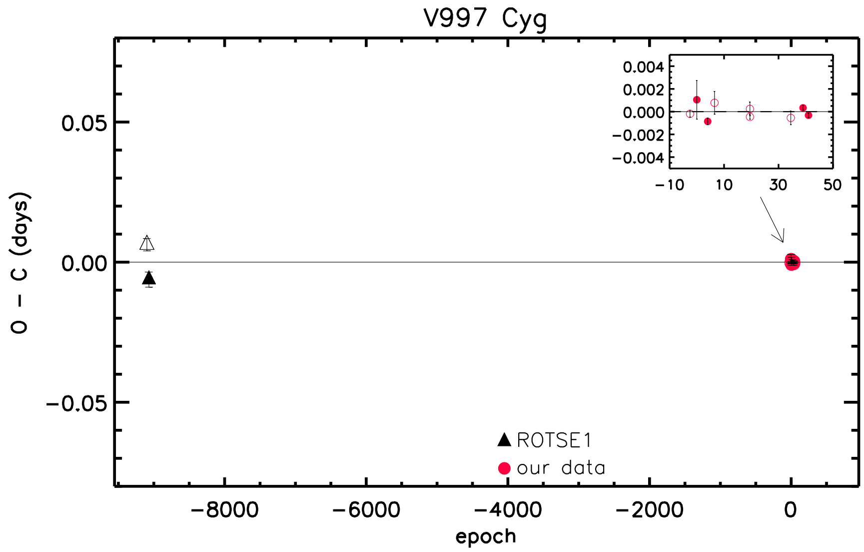

Figure 1. O−C diagram for V997 Cyg. Empty symbols for secondary minima.

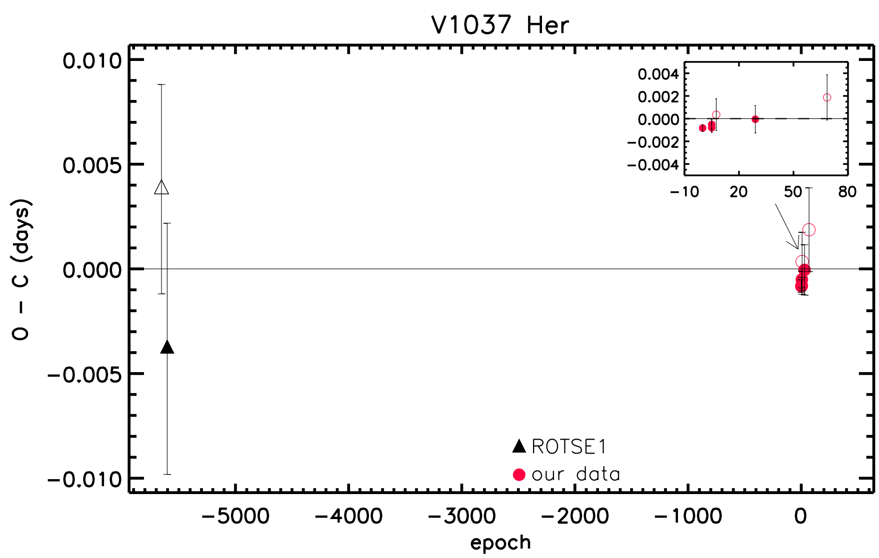

Figure 2. O−C diagram for V1037 Her. Empty symbols for secondary minima.

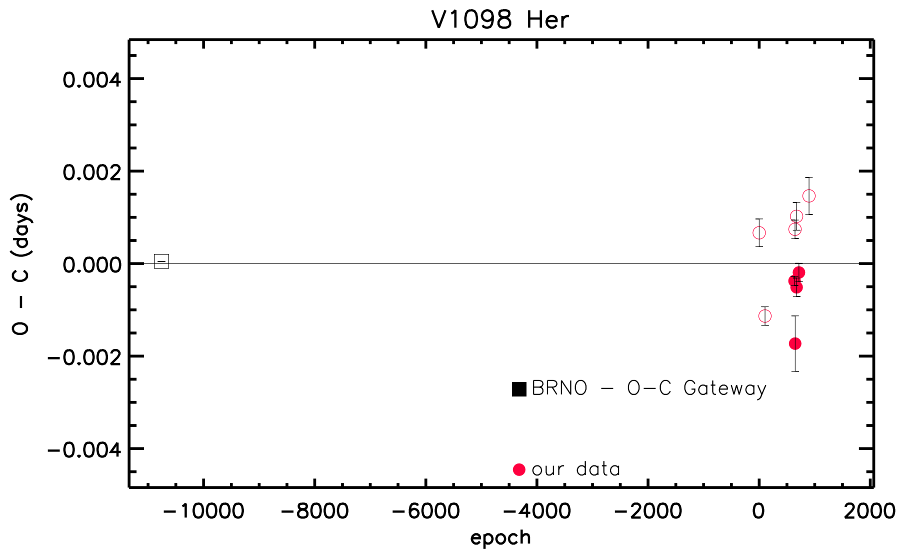

Figure 3. O−C diagram for V1098 Her. Empty symbols for secondary minima.

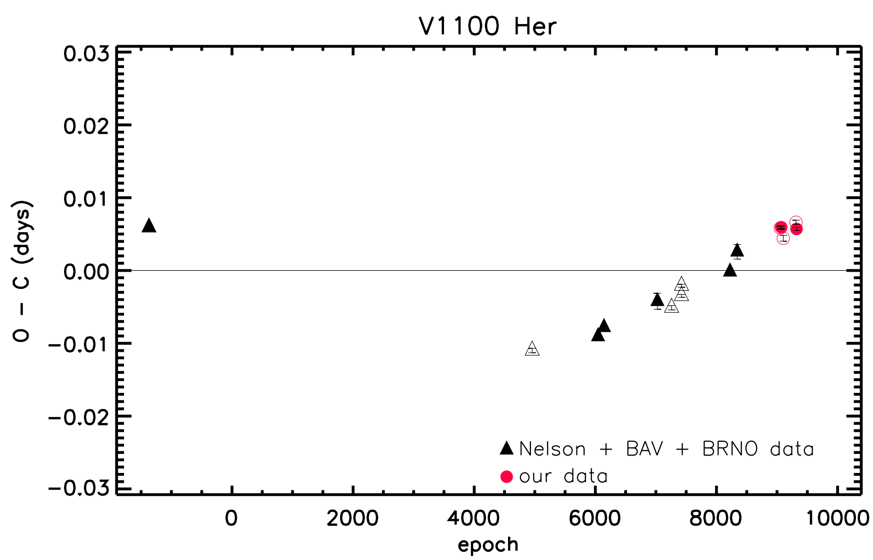

Figure 4. O−C diagram for V1100 Her. Empty symbols for secondary minima.

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COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5998

Konkoly Observatory
Budapest
7 September 2011

HU ISSN 0374 – 0676

REPORTS ON NEW DISCOVERIES

Date: 17 September 2009

Observer(s) and affiliation(s):
Liakos, A. - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, alliakos@phys.uoa.gr
Niarchos, P. - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, pniarcho@phys.uoa.gr

RA(J2000)	Dec(J2000)	type	Mag.
20 12 12	19 20 45	DSCT	11.9 (V) (GSC)

Period	Epoch
0.0310772d	-

Cross-identification(s):
GSC 1626-1303

Date: 28 April 2010

Observer(s) and affiliation(s):
Liakos, A. - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, alliakos@phys.uoa.gr
Niarchos, P. - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, pniarcho@phys.uoa.gr

Remark: In the field of TU UMi.

RA(J2000)	Dec(J2000)	type	Mag.
14 49 43	76 15 29	DSCT	12.1 (V)

Period	Epoch
0.06055(1) d	-

Cross-identification(s):
GSC 4559-2536

Date: 23 August 2010

Observer(s) and affiliation(s):
Liakos, A . - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, alliakos@phys.uoa.gr
Niarchos, P . - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, pniarcho@phys.uoa.gr

Remark: Detected in the FoV of AW Vul.

RA(J2000)	Dec(J2000)	type	Mag.
20 27 57.36	24 53 02.9	EB	V=12.940 mag (NOMAD-1 catalogue)

Period	Epoch
0.7974(1) d	2455396.495(2)

Cross-identification(s):
2MASS J20275736+2453029

Date: 28 October 2010
Observer(s) and affiliation(s): Liakos, A . - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, alliakos@phys.uoa.gr Niarchos, P . - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, pniarcho@phys.uoa.gr

Remark: Detected in the FoV of V407 Lac.

RA(J2000)	Dec(J2000)	type	Mag.
22 23 48	+41 19 56	EA	B=12.7 mag (USNO-A2.0 Catalogue)

Period	Epoch
1.1597(1) d	2455399.4818(7)

Cross-identification(s):
GSC 03208-02644

Remark: Detected in the FoV of UW Cyg.

RA(J2000)	Dec(J2000)	type	Mag.
20 23 24	+43 24 22	EA	B=12.8 mag (USNO-A2.0 Catalogue)

Period	Epoch
4.4377(1) d	2455392.4033(3)

Cross-identification(s):
GSC 03164-01558

Remark: Detected in the FoV of UW Cyg.

RA(J2000)	Dec(J2000)	type	Mag.
20 23 46	+43 30 14	DSCT	B=10.85 mag (Tycho Reference Catalogue)

Period	Epoch
0.13844(4) d	

Cross-identification(s):
GSC 03164-01517

Date: 1 December 2010
Observer(s) and affiliation(s): Marrero Corujo, A.L. - AAGC Observatory (MPC J56), Apdo. de correos 6015, CP 35007, Las Palmas de Gran Canaria, Spain, anlumaco@hotmail.com

Discovered by Wachmann (1940). O'Connel effect.

RA(J2000)	Dec(J2000)	type	Mag.
20 10 58.8	+35 27 05.0	EB	14.13 - 13.29 mag

Period	Epoch
0.796461 d	2455401.49048

Cross-identification(s):
NSV 12875

Date: 2 December 2010

Observer(s) and affiliation(s):
Liakos, A . - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, alliakos@phys.uoa.gr Niarchos, P . - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, pniarcho@phys.uoa.gr

Remark: Detected in the FoV of AU Lac.

RA(J2000)	Dec(J2000)	type	Mag.
22 14 15.12	+48 30 51.84	EB	R=14.5 mag (The USNO-A2.0 Catalogue)

Period	Epoch
0.44149(3) d	2455441.3567(7)

Cross-identification(s):
USNO-A2.0 1350-16144088

Remark: Detected in the FoV of YY CMi.

RA(J2000)	Dec(J2000)	type	Mag.
08 05 45.53	+02 03 01.6	EB	R=14.9 mag (The USNO-A2.0 Catalogue)

Period	Epoch
0.41958(7) d	2455231.336(4)

Cross-identification(s):
GSC 00198-02061

Date: 19 January 2011

Observer(s) and affiliation(s):
Liakos, A . - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, alliakos@phys.uoa.gr Niarchos, P . - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, pniarcho@phys.uoa.gr

Remark: Detected in the FoV of V1149 Tau, RZ Tau, NSV 1664 .

RA(J2000)	Dec(J2000)	type	Mag.
04 38 50	+18 40 19	DSCT	B=12.0 mag (The USNO-A2.0 Catalogue)

Period	Epoch
0.08744(1) d	-

Cross-identification(s):
GSC 01270-00926

Remark: Detected in the FoV of SS Cam .

RA(J2000)	Dec(J2000)	type	Mag.
07 14 55.9	+73 15 40.26	EA	R=12.4 mag (The USNO-A2.0 Catalogue)

Period	Epoch
1.19992(2) d	2455466.533(5)

Cross-identification(s):
GSC 04372-00831

Remark: Detected in the FoV of AU Lac .

RA(J2000)	Dec(J2000)	type	Mag.
22 14 03.6	+48 35 18.9	EB	R=13.9 mag (The USNO-A2.0 Catalogue)

Period	Epoch
0.65321(3) d	2455538.316(3)

Cross-identification(s):
USNO-A2.0 1350-16136263

Date: 15 February 2011

Observer(s) and affiliation(s):
Liakos, A . - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, alliakos@phys.uoa.gr
Niarchos, P . - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, pniarcho@phys.uoa.gr

Remark: Detected in the FoV of AV CMi and GSC 00770-00523 (newly discovered variable)

RA(J2000)	Dec(J2000)	type	Mag.
07 09 56.3	12 06 08.9	EB	R=14.6 mag (The USNO-A2.0 Catalogue)

Period	Epoch
0.50460(3) d	2455594.4123(6)

Cross-identification(s):
USNO-A2.0 0975-04721840

Date: 30 March 2011

Observer(s) and affiliation(s):
Vaccaro, T. - Francis Marion University, P.O. Box 100547, Florence, SC, USA, tvaccaro@fmarion.edu
Stone, K. - Francis Marion University, P.O. Box 100547, Florence, SC, USA, tvaccaro@fmarion.edu

Remark: HD 185587 has been used as a comparison/check for the eclipsing binary V1379 Aql (HD185510). HD1887 appears to have multiple frequencies. The muliple periodic nature of this star and its A0 classification indicate a low-amplitude delta Scuti variable. The constancy of the comparison (HD185567) was determined by comparing it to V1379 Aql, which was at phase ≈ 0.46 (Frasca et al., 1998). Data outside eclipse are expected to be constant for a given night due to its 20d orbit.

RA(J2000)	Dec(J2000)	type	Mag.
19 40 02.866	-06 06 12.48	DSCT	V=9.1 mag (Loyd Evans et al., 1983)

Period	Epoch
0.0313 d	-

Cross-identification(s):
HD 185587 = GSC 05157-03060

Date: 6 April 2011

Observer(s) and affiliation(s):
Monninger, G. - Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V. (BAV), Munsterdamm 90, DE-12169 Berlin, Germany, gerold.monninger@online.de

Remark: In the field of view of CW Ser, a delta scuti variable. USNO-B1.0 0961-0254829 is a high amplitude DSCT.

RA(J2000)	Dec(J2000)	type	Mag.
15 52 51.41	+06 06 07.0	DSCT	16.04 (R1mag - USNO B1.0)

Period	Epoch
0.054927 d	2455625.6301

Cross-identification(s):
USNO-B1.0 0961-0254829 = USNO-A2.0 0900-08288718 = SDSS J155251.38+060606.0 = GSC2.3 N3QU004103

Date: 6 July 2011

Observer(s) and affiliation(s):
Yang Y.-G. - School of Physics and Electronic Information, Huaibei Normal University, Huaibei 235000, Anhui Province, China, yygcn@163.com Zhou, A.-Y. - National Astronomical Observatories, Chinese Academy of Sciences, Beijing 100012, China, aiying@nao.ac.cn Dai, H.-F. - School of Physics and Electronic Information, Huaibei Normal University, Huaibei 235000, Anhui Province, China Yang, Y.-J. - School of Physics and Electronic Information, Huaibei Normal University, Huaibei 235000, Anhui Province, China

Remark: In the field of view of EF Dra. GSC 4433-0827 is a multiperiodic δ Scuti star.

RA(J2000)	Dec(J2000)	type	Mag.
18 04 58.8	+69 42 53.4	DSCT	10.8 (TYC V)

Period	Epoch
0.05875 d	-

Cross-identification(s):
GSC 4433-0827 = TYC 4433-827-1

Date: 27 July 2011

Observer(s) and affiliation(s):
Martignoni, Massimiliano - Stazione Astronomica Betelgeuse, Magnago, Milano, Italy, massimiliano.martignoni@alice.it

Remark: in the field of view of V373 Sge. UCAC3 214-271232 is a small amplitude Beta Lyrae star.

RA(J2000)	Dec(J2000)	type	Mag.
20 16 50.8	16 53 19.7	EB	12.0-12.3 (V)

Period	Epoch
1.97783d	2452724.64

Cross-identification(s):
UCAC3 214-271232

References:

Frasca, A., Marilli, E., Catalano, S., 1998, A&A, 333, 205
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Wachmann, A. A., 1940, BZ, 22, 10

COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5999

Konkoly Observatory
Budapest
7 September 2011

HU ISSN 0374 – 0676

OBSERVATIONS OF VARIABLES

Date: 19 October 2009

Reported by:
Sipahi, E. - Ege University Observatory, Bornova, Izmir - Turkey, esin.sipahi@mail.ege.edu.tr

Name of the object:
KR Cyg

Remarks:
Complete stromgren light curves of the eclipsing binary KR Cyg are presented. Light elements were published in Sipahi, 2005. The magnitude and colour differences inside-eclipse minus outside-eclipse are

$$\Delta b = 0\overset{m}{.}911$$
$$\Delta(b-y) = 0\overset{m}{.}044$$
$$\Delta m_1 = 0\overset{m}{.}05$$
$$\Delta c_1 = -0\overset{m}{.}232$$

The system is not bright. Thus, scatter in the u light is much more than expected.

Date: 28 April 2010

Reported by:
Liakos, A. - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, alliakos@phys.uoa.gr
Niarchos, P. - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, pniarcho@phys.uoa.gr

Name of the object:
GSC 0199-2035

Remarks:
The variability was discovered by ASAS (ASAS J080731+0159.7). In the field of YY CMi and BI CMi. Ephemeris: Min. I = HJD 2455232.2837(6) + 1.01263(3)*E

Date: 28 October 2010

Reported by:
Liakos, A. - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, alliakos@phys.uoa.gr
Niarchos, P. - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, pniarcho@phys.uoa.gr

Name of the object:
GSC 03208-01986

Remarks:
GSC 03208-01986 = NSVS 6099331 is an Eclipsing Binary of W UMa Type, in the FoV of V407 Lac.

Date: 7 December 2010

Reported by:
Rosario, M. J. - Vainu Bappu Observatory, Indian Institute of Astrophysics, Kavalur 635701, India, mjr@iiap.res.in
Muneer, S. - Indian Institute of Astrophysics, Bangalore 560034, India, muneers@iiap.res.in
Raveendran, A. V. - Indian Institute of Astrophysics, Bangalore 560034, India, avr@iiap.res.in
Mekkaden, M. V. - Indian Institute of Astrophysics, Bangalore 560034, India, mvm@iiap.res.in

Name of the object:
UX Ari

Remarks:
UX Ari was observed on a total of 33 nights during December 2008–February 2010 in standard Johnson BV bands with the 34–cm tel escope of Vainu Bappu Observatory, Kavalur. All the measurements were made with respect to 62 Ari. Each value given in the data file is a mean of 3–4 independent measurements and the typical uncertainty in each value is around 0.01 mag.

Name of the object:
V711 Tau

Remarks:
V711 Tau was observed on a total of 11 nights during January–February 2010 in standard Johnson BV bands with the 34–cm telescope of Vainu Bappu Observatory, Kavalur. All the measurements were made with respect to 10 Tau. Each value given in the data file is a mean of 3–4 independent measurements; the typical uncertainty in each value is around 0.01 mag.

Name of the object:
DM UMa

Remarks:
DM UMa was observed on a total of 17 nights during December 2008–March 2009 in standard Johnson BV bands with the 34–cm telescope of Vainu Bappu Observatory, Kavalur. All the measurements were made with respect to BD+60° 1301. Each value given in the data file is a mean of 3–4 independent measurements; the typical uncertainty in each value is around 0.01 mag.

Date: 17 January 2011

Reported by:
Liakos, A. - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, alliakos@phys.uoa.gr
Niarchos, P. - Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University, Athens, Greece, pniarcho@phys.uoa.gr

Name of the object:
GSC 03802-01986

Remarks:
GSC 03802-01986 = TYC 3802-1986-1 = RX J0811.9+5730 = NSVS 2432473 is an Algol type binary in the FoV of SX Lyn.

Date: 19 March 2011
Reported by: Osborn, Wayne H. - Central Michigan University, osbor1wh@cmich.edu

Name of the object:
WW Aur
Remarks:
A time of minimum has been determined from photolectric observations made with the Morgan 60-cm reflector at Lowell Observatory in 1983 and using a DDO "48" filter (see McClure, 1979): HJD 2445402.7218 +/- 0.0015.

Date: 20 May 2011
Reported by: Hoffman, D.I. - Infrared Processing and Analysis Center (IPAC), California Institute of Technology, Pasadena, CA 91125, USA, dhoffman@ipac.caltech.edu Monninger, G. - Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V. (BAV), Munsterdamm 90, DE-12169 Berlin, Germany, gerold.monninger@online.de

Name of the object:
GSC 03851-00240
Remarks:
GSC 03851-00240 was identified as a variable object and classified into the variable star class 'Short Period Delta Scuti Candidates' (Hoffman et al., 2009). Our observation confirmed the classification for the first time. GSC 03851-00240 is a high amplitude delta scuti variable (HADS), with a modulation in its light curve. The period is 0.067946 d.

References:

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McClure, R.D., 1979, Dudley Obs. Report, 14, 83
Sipahi, E., 2005, *IBVS* No. 5635.

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JUST ONE NEW MEASUREMENT OF THE B[e] SUPERGIANT HEN-S22

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This paper reports one new photometric measurement of the most peculiar B[e] supergiant Henize-S 22 (HD 34664, hereafter S 22), and accentuates the problems of transformability of magnitudes and colour indices from one photometric system to another for stars with very peculiar spectra.

S 22 is a luminous star of the LMC that was for the first time studied by Henize (1956), who listed it as an $11\overset{m}{.}4$ object. The star is located in `Association 38` (NGC 1871), as defined by Lucke & Hodge (1970). The object exhibits the B[e] phenomenon, and thus belongs to one of the most peculiar classes of stars known (according to Zickgraf 2006, only 15 such stars are known in the Magellanic Clouds). Zickgraf (2000) gives a definition of B[e] stars by naming physical conditions in the circumstellar environment, rather than by identifying intrinsic stellar properties. He points out that in this widely inhomogeneous group of stars, **it is the similarity of the circumstellar conditions that prevails over the dissimilarity of the stellar properties**.

The spectrum of S 22 is dominated by a curtain of narrow emission lines – allowed and forbidden – of singly-ionised iron, with almost no other absorption lines than the Balmer series (Muratorio 1978). Allen & Glass (1976) found a large infrared excess, which they attributed to circumstellar dust clouds.

Bensammar et al. (1983) investigated the complex gaseous environment of the star, and speculated that the stellar energy distribution comes from radiation formed in an accretion disk, rather than from an optically thin free-free emission region. These authors also found spectroscopic similarities with LBVs, in particular with η Car.

Shore (1990) reported that the star underwent massive shell ejection, and that it displayed one of the most extreme optical Fe II and [Fe II] emission spectra of any of the massive LMC supergiants. This author concludes that S 22 likely is in the luminous blue variable (LBV) shell-ejection phase, having been stable during 1980–1983, and he alerts for possibly dramatic changes to come. Shore (1992) consequently shows evidence that the optical brightness of S 22 has increased by more than one magnitude since 1983.

Two questions on the light constancy of B[e] stars remained unanswered for long:

1. do these stars exhibit light variations on short time scales, and
2. what is their behaviour in the long run, i.e., on time scales of decades.

Van Genderen & Sterken (1999) showed that S 22 undergoes microvariations up to $0\overset{m}{.}1$ in the Walraven V band, accompanied by colour variations of similar amplitudes. These authors recognise a low-amplitude S Doradus cycle (large-amplitude long-term variability in light and colour on time scales of years) on a time scale of about 7 years, and classify

S 22 as a weak-active LBV. These findings were recently confirmed by Szczygieł et al. (2010), who find evidence for a similar S Dor-like oscillation of the order of six years.

Table 1 gives a synoptic overview of all available photometric data on S 22, and their characteristics, and Fig. 1 shows the resulting light and colour curves. The data are described chronologically, hence the new data are discussed under items 11 and 12 below.

Table 1. The photometric data on S 22: photometric system, detector (with photocathode specification), full width at half maximum (FWHM), symbol (S) in Fig. 1, standardised or not (+ sign means that standard stars are listed, – sign means that standard stars are not specified), aperture size (in arcsec), type of photometry: all-sky or differential (comparison star given). The last column indicates whether photometric transformations were made within one photometric system (intra), or from one system to another (inter).

#	Photometric system	Detector (photocathode)	FWHM	S	Std	Ap.	Type	Transf.
1	photographic $m_{\rm ph}$	Kodak photographic plate	–	△	no	–	all-sky	–
2	Johnson V	PMT RCA-1P21 (S-4)	90	∗	yes+	?	all-sky	intra
3	Walraven $VBLUW$	PMT RCA-1P21 (S-4)	72	×	yes–	16.5	all-sky	inter
4	Johnson UBV	PMT EMI6256 (S-13)	90	□	yes+	15	all-sky	intra
5	Johnson UBV	PMT EMI 9502 and 9558	90	▲	yes–	18	all-sky	intra
6	Johnson UBV	PMT RCA-1P21	90	∘	yes+	?	all-sky	intra
7	Johnson UBV	PMT EMI6256 (S-13)	90	⋆	yes–	15	all-sky	intra
	Bessell $UBVRI$	PMT RCA31034A	85	⊛	yes–	15	all-sky	intra
8	Walraven $VBLUW$	PMT Hamamatsu R928 (S-20)	72	×	yes–	16.5	HD 33486	inter
9	IUE FES no filter	PMT (S-20)	250†	■	no	8	all-sky	–
10	ASAS-3 V	CCD THX7899M	80	−	no	45	all-sky	–
	ASAS-3 V	CCD THX7899M	80	+	no	45	all-sky	–
11	Strömgren $uvby$	PMT EMI 9789	24	♦	no	17	HD 34144	inter
12	Bessell V	CCD KAF6303E	85	•	no	18	HD 269209	inter

References. 1: Cannon & Pickering (1918); 2: Smith (1957); 3: van Genderen (1970, 2011); 4: Ardeberg et al. (1972); 5: Dachs (1972); 6: Lucke (1972, 1974); 7: Zickgraf et al. (1986); 8: van Genderen & Sterken (1999); 9: Shore (1990); 10: – Szczygieł et al. (2010), + Szczygieł et al. (2010), adjusted; 11: this paper; 12: this paper.

Note †: FWHM of item 9 was derived from the width at half maximum of the photocathode spectral response curve, as shown in Fig. 3 of Morrison (1967). The S-20 photocathode picks up radiation from 250 to 800 nm.

1. Photographic magnitude: Henize (1956) lists $m_{\rm ph}$ taken from the Henry Draper Catalogue. Observing date is uncertain, but most probably around 1917. This photographic magnitude is not directly comparable with V.

2. Vintage $m_{\rm v}$ magnitude: measurement made in January 1954, with a Corning 3384 filter glass, the same type as described in Johnson & Morgan (1951), though it is not clear whether this measurement is on the Johnson–Morgan system that was developed in 1953. No photometer aperture size is given.

3. Early Walraven $VBLUW$: measurement obtained by van Genderen with the Walraven 90-cm light collector in South Africa ($f/14$ optics). V and $B-V$ were derived from the Walraven $\log I$ indices with the transformation formula of Pel (1987).

4. Johnson UBV photometry: ESO 1-m telescope at La Silla, Chile, $f/15$ optical system.

5. Johnson UBV photometry: Bochum 61-cm telescope at La Silla, Chile. The V filter consisted of one Schott GG 495 glass only.

6. Johnson UBV photometry: Cerro Tololo 36″, Chile. No aperture size is given.

7. UBV and $UBVRI$: ESO 50-cm telescope at La Silla, Chile. Partly Bessell $UBVRI$ (these three magnitudes and color indices are encircled in Fig. 1).

8. Walraven $VBLUW$: Walraven differential photometry (intensity scale, relative to the comparison HD 33486) from Figs. 4–6 of van Genderen & Sterken (1999). The magnitudes and $B-V$ indices were transformed to their Johnson V, $B-V$ equivalents using a transformation formula from Pel (1987). Note that the PMT is different from the one used in item 3. Quasi-simultaneous observations with Zickgraf et al. (1986) yields $V = 11.837 \pm 0.006$, $B-V = 0.240 \pm 0.003$ for van Genderen & Sterken (1999), and $V = 11.765 \pm 0.010$, $B-V = 0.27 \pm 0.01$ for Zickgraf et al. (1986).

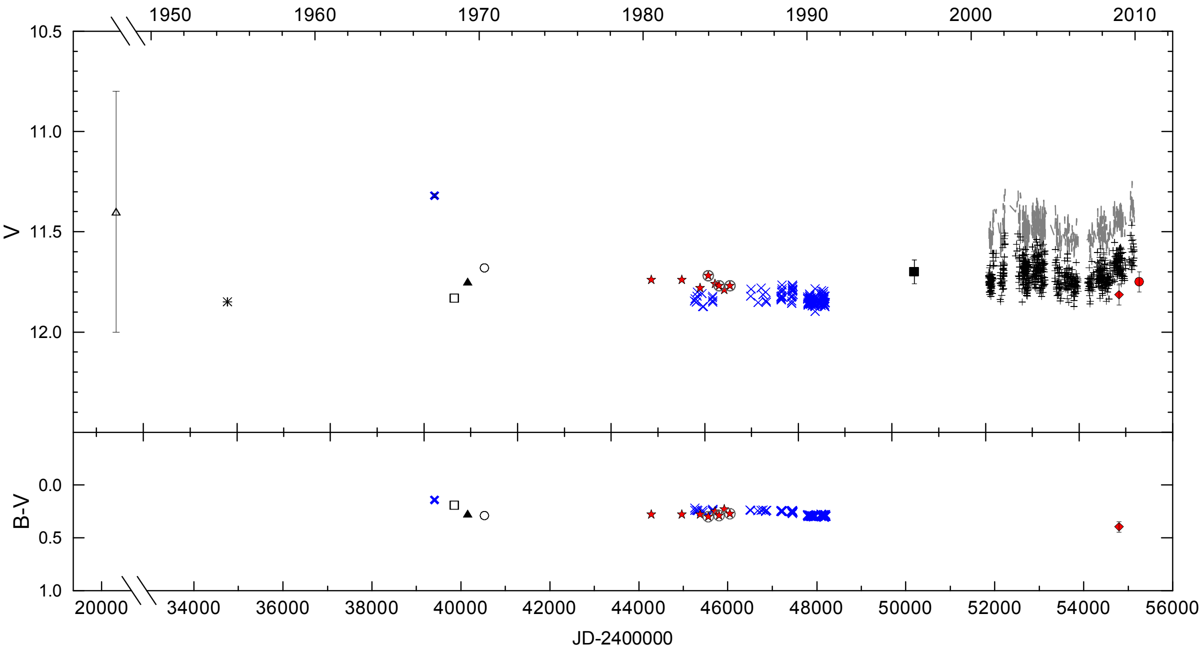

Figure 1. V, $B-V$ light and colour curve of S 22. Symbols are explained in Table 1.

9. IUE quasi-*V*: this data point was obtained with the IUE Fine Error Sensor (FES). The FES was an image dissector with a photocathode response that extended from 250 to 800 nm, with a resulting effective wavelength of about 520 nm. FES measured unfiltered light, and had potential for providing an estimate of V with a precision of about $0.^{m}06$ – that is, for stars that have normal spectra. The large FWHM listed in Table 1 is entirely due to the response of the S-20 photocathode that embraces many more emission lines than any of the other V-like passbands in Table 1.

10. ASAS-3 *V*: S 22 is identified as 0513536726.9 in the All Sky Automated Survey catalog (Pojmánski 2002, `http://www.astrouw.edu.pl/asas/?page=acvs`). The V data were obtained with an XBSSL/V filter (from Omega Optical) consisting of a 2.0-mm GG 495, and a 3.0-mm S-8612 Schott glass, with an incident beam of $f/2.8$. 846 V magnitudes yielding an average $V = 11.489$ with a standard deviation of $0.^{m}064$ were discussed in Szczygieł et al. (2010). These data are plotted in Fig. 1 with greyish lines appearing above the + symbols that were obtained from the same dataset, after applying a correction of $0.^{m}22$, as explained below.

11. Strömgren *uvby*: this new measurement is the average of two measurements obtained on 24 and 25 November 2008 with the Strömgren Automatic Telescope (SAT) at ESO La Silla, Chile. A diaphragm of 17″ was used, linear extinction coefficients were determined from the observations of comparison stars, and generic transformation equations to the standard $uvby$ system, were applied. The measurements were made differentially with respect to HD 34144, and resulted in $y = 11.82 \pm 0.05, b-y = 0.36 \pm 0.05$. $b-y$ was transformed to $B-V$ using formula (1) of Sterken et al. (2008).[1] Attempts to observe S 22 on Christmas eve of 2008, and on 24 January and 20 February 2009 failed, because the star could not be visualised in the photometer diaphragm viewer.

[1]Note that Sterken et al. (2008) underline that this equation **"should not be considered as a photometric transformation in the true sense, but as a statistical relationship between the observables $b-y$ and $B-V$"** (*i.e.*, for this sample of 18 LBVs). These data support a linear relationship between both variables, and adding a nonlinear term does not significantly improve the goodness of fit. Fig. 4 of Sterken et al. (2008) shows such a nonlinear inter-system transformation relation derived for more normal stars.

12. CCD V measurement on two consecutive nights in February 2009: to establish without doubt that S 22 had not faded beyond the limiting centering magnitude of the SAT, several exposures were obtained with a piggyback-mounted 20-cm refractor, equipped with an SBIG STL6303E CCD camera. The $f/9$ optical system incorporated a focal extender rendering an $f/20$ beam. The V magnitude was obtained differentially with respect to nearby HD 269209 – the brightest star in association NGC 1871 – with spectral type K2, and $V = 10.58$, $B-V = 0.97$ (Dachs 1972). Since no extinction nor colour correction was applied, the colour difference would lead to errors[2] of $\sim 0\overset{\text{m}}{.}015$ in V, hence this datum is to be considered only as a control measurement to check on the visual disappearance of S 22, and not as an exact magnitude.

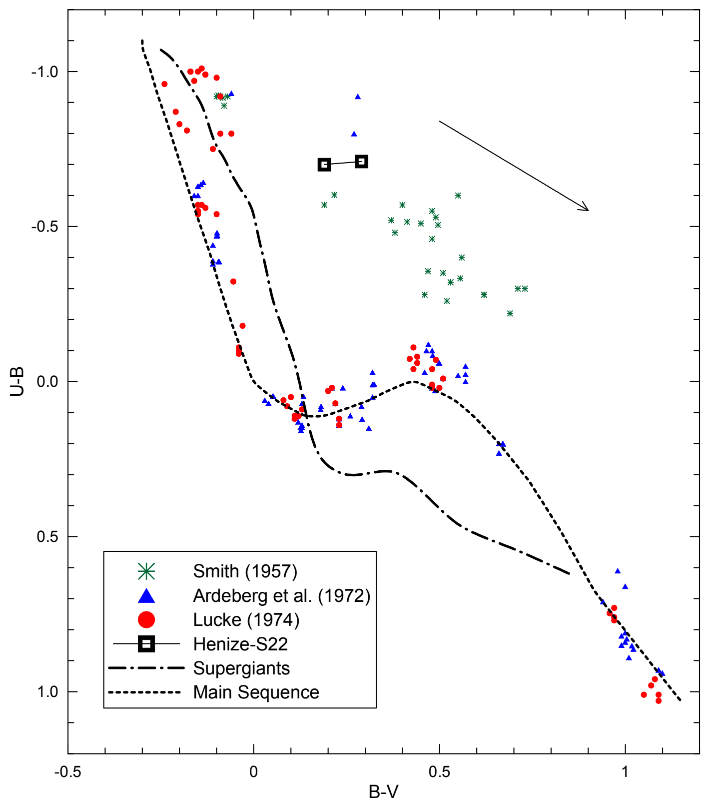

Figure 2. $B-V$, $U-B$ diagram of B0–K5 standard stars used for observations listed in Table 1. The dashed lines represent the intrinsic colors of main-sequence stars and supergiants as determined by Johnson (1966). The arrow gives the slope of the reddening line.

The basic principles of photometric standardisation. Sterken (2003) summarised the basic requisites for bringing long-term photometric data to a common standard. The following discussion centralises on two basic assumptions in astronomical photometry: *i*) that the data were obtained in a well-defined photometric system – thus **the problem of standardisation**, and *ii*) that the data can be transposed from one such system into another – thus **the problem of transformability**. This discussion bears on elements of hardware, as well as on the selection and the spectral nature of the observed targets and the standards.

1. A photometric system is defined by the set of filters, by the detector, by the set of standard stars that were used to define the system, and by the data reduction procedure.

[2] The multiplicative colour term in V is of the order of -0.03 (Landolt 2011).

2. All transformations from instrumental system to their parent standard system (labeled *intra* in Table 1) that use matrix manipulations (involving magnitudes and color indices) require compatible (and partly overlapping) passbands (see Young 1994 for a discussion), and spectral energy distributions that have continuous derivatives in the interval covered by the passbands. Note that extinction corrections (atmospheric as well as interstellar) also participate in the transformations.
3. All transformations from one standard system into another (labeled *inter* in Table 1), involve even more stringent requirements (as hinted at in the footnote on item 11).

The above points illustrate that two thirds of the datasets in Table 1 are on a standard system, but that only 25% of them explicitly list the standard stars. Fig. 2 shows the $B-V$, $U-B$ diagram for all published photometry of the B0–K5 stars of these 3 sets, and reveals that two datasets are most probably commensurable, but also uncovers that the set of standards does not really cover the location where S 22 is placed. The publication by Smith (1957) lists 8 bright standards that are closer to S 22 in the two-colour diagram (these stars have declination between $-30°$ and $-40°$, and their standard values were defineded at Mount Wilson).

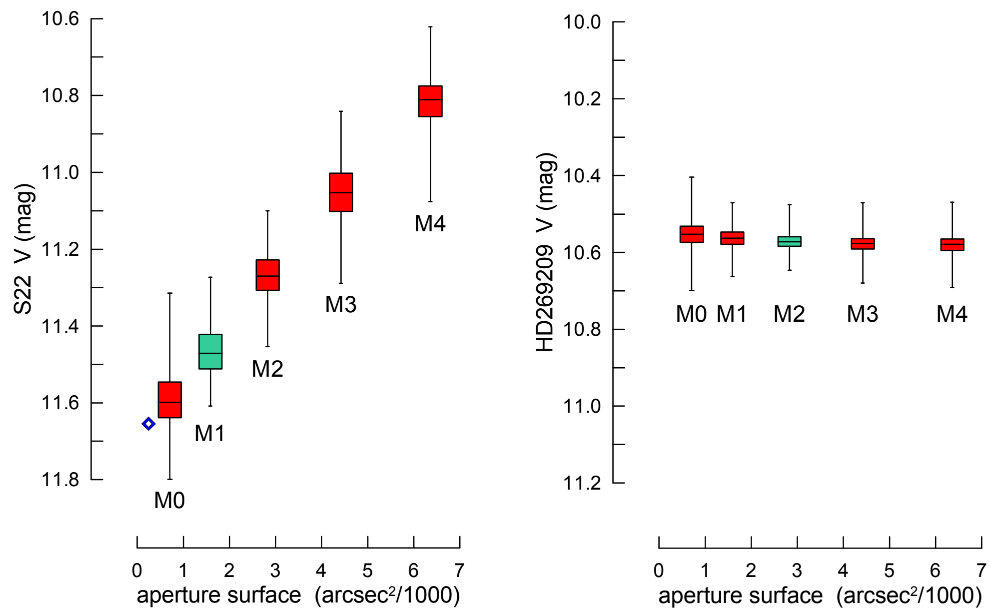

Figure 3. Box-whisker plots of S 22 (left) and HD 269209 for ASAS magnitude columns MAG_0–MAG_4 as a function of aperture surface. The most extreme outliers were clipped in order to keep the whiskers within the lower axis limits. The aperture automatically suggested by the ASAS software (MAG_1 for S 22, MAG_2 for HD 269209) is indicated. ⋄ is the extrapolated ASAS V for a diaphragm of 18″ diameter.

Adjustments. None of the data discussed in Table 1 were adjusted or corrected with any of the other datasets, simply because almost none of these datasets is on a same photometric standard system, or on one that can be rigorously transformed into another – although some of the data (for example, the sets discussed under items 7 and 8) can be brought to a common scale. This point is corroborated by the simultaneous photometry (in the same system) described in item 8, revealing a systematic difference $\Delta V = 0.08$.

The large discrepancy between the ASAS data and the SAT data, however, needs more explanation.

Fig. 3 shows box-whisker plots for the V magnitudes of S 22 and nearby HD 269209 (ASAS 051429-6728.4) for ASAS-3 magnitude columns MAG_0 to MAG_4, as a function of aperture surface. Box-whisker plots display data by showing the minimum of a sample, the lower quartile (which cuts off the lowest 25% of the data), the median, the upper quartile, and the highest data point, *without any assumption of the underlying statistical distribution of the data*. The Figure shows that, whereas the standard deviation of the average V magnitudes in the four apertures is $0\overset{m}{.}01$ for HD 269209 (see also Fig. 4), it amounts to $\sigma = 0\overset{m}{.}24$ for S 22. Moreover, **an unmistakable strong trend of brightening with aperture surface is present**. The $\diamond$ is the extrapolated ASAS V (linear fit M_3 to M_0) for a diaphragm of 18″ diameter. The ASAS-3 data were thus first corrected for this aperture effect, and then adjusted differentially with respect to the V value of HD 269209 as measured by Dachs (1972). The + symbols in Fig. 1 show the result of this adjustment.

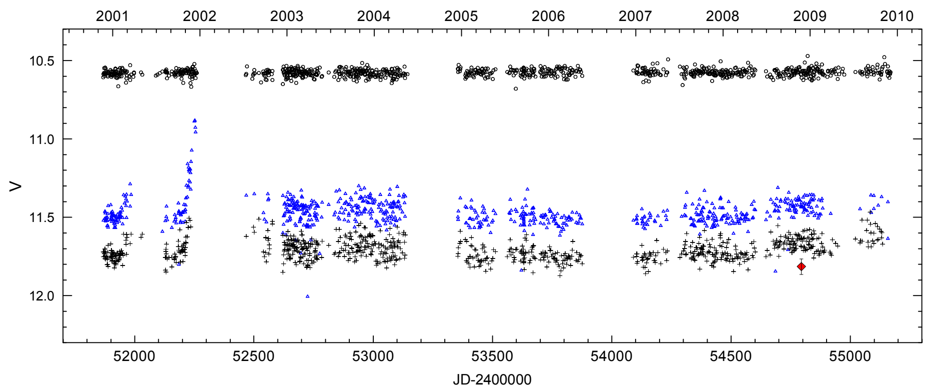

Figure 4. V light curve of S 22 for 2000–2010. Top to bottom: HD 269209 (○); ASAS grade A data from the ASAS-3 catalog (△); adjusted V magnitudes from Szczygieł et al. 2010 (+, the difference between this dataset and the original is that the latter was cleaned by removing points that lie more than 3σ from a local linear model, Szczygieł 2011); ⧫: this paper.

Conclusions. This procedure-oriented paper discusses data collected since the 1950s that lead to the following conclusions:

1. the star seems to have brightened by about $0\overset{m}{.}1$ since the 1990s, with an indication that this brightening is accompanied by a slight reddening – a typical signature of a possible long-term S Dor phenomenon;
2. the detected strong aperture-dependent trend in the ASAS-3 data can be entirely ascribed to the star's environment, as evidenced by the infrared excess, and the nebular emission lines;
3. systematic differences between datasets are evident, and can be ascribed to the different combinations of detectors, filters and diaphragms/apertures (8″–45″), and incident beam widths (off axis rays cause an increase in effective glass thickness);
4. the remaining magnitude residual ASAS/SAT can be ascribed to the lack of colour corrections, and to the causes mentioned in the previous point, as also explained for Wray 751 in Sterken et al. (2008), and for η Car in Sterken et al. (1999).

These conclusions sustain the statement made for η Car (Sterken 2000): **"the unavoidable differences between photometric systems may result in very severe discrepancies, rendering the morphological shape of the light curve piecewise dependent on the instrumental setup."** This is exactly what the case of S 22 proves.

EPILOG

This postscript addresses three questions.

1. **What are the lessons learned from these data?** Besides the arguments listed in the conclusions, there is one most important lesson to be drawn: when discussing the most exotic objects over time scales of half a century or longer, datasets should be calibrated in such a way that data from one epoch are directly comparable to data from another. That principle forcibly excludes two types of photometric data, viz.,

    1. filterless photometry, such as IUE-FES magnitudes described under item 9, and
    2. visual estimates, as mentioned under item 11: the CCD measurements, and the independent ASAS data reveal that the impression that S 22 suddenly dropped below the visual threshold, was unfounded. That the star could not be visually detected may have been the consequence of bad seeing, or of observer fatigue.

    That visual observations – and those made without filter – are unacceptable, was one of the very wise decisions taken by the IBVS Editors (Editorial Note, 4 May 2004).

2. **What is the value of the new measurements?** Experimentalists know that one single observation or measurement never can confirm nor refute an independent set of data. The new magnitude measurements reported under items 11 and 12, though taken with different instruments, not only confirm each other, but also allow to bring another set of valuable data closer to a standard value.

3. **What is the value of publishing such data?** The value of publishing these data refers to two aspects: the intrinsic value of the data, and the value of publishing these result in an information bulletin like IBVS.

    1. Fig. 1 shows two datablocks covering nearly a decade (items 8 and 10), and these data, evidently, are valuable, because they describe light and colour variability, together with the time scale of the associated cyclicity. The other datasets cover only a few points, sometimes even only one single measurement. But each of these datapoints is an element of valuable information, the more so because most of them have been obtained by experienced observers.
    2. Where else can such single isolated datapoint be published? The dataset shown in Fig. 1 covers, approximately, the full life time (6000 bulletins) of this journal. The pressure these days to only count (and value) papers in impact-factor indexed journals makes it almost impossible to publish such results in any of the classical ISI-counted journals – although they are of a very labor-intensive character. That IBVS is in full Open Access, i.e., involving reading rights, but also writing rights (no page charges) for the entire world, is a factual bonus and an example of really open scientific communication. That is the true value of this journal, and means much more than the seemingly accurate counts provided by any other bibliometric indicator.

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DEDICATION. I dedicate this paper to Katalin Oláh and Johanna Jurcsik, Editors of IBVS since the year 2000.

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