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GSC 5728_92: A NEW W UMa VARIABLE

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Name of the object:
GSC 5728_92

Equatorial coordinates:	**Equinox:**
R.A.= $19^{\mathrm{h}}40^{\mathrm{m}}08^{\mathrm{s}}$ **DEC.=** $-10^{\circ}22'26''$	J2000

Observatory and telescope:
Regent Lane Observatory, 0.35-m Schmidt–Cassegrain telescope; Wharemaru Observatory, 0.25-m Schmidt–Cassegrain telescope

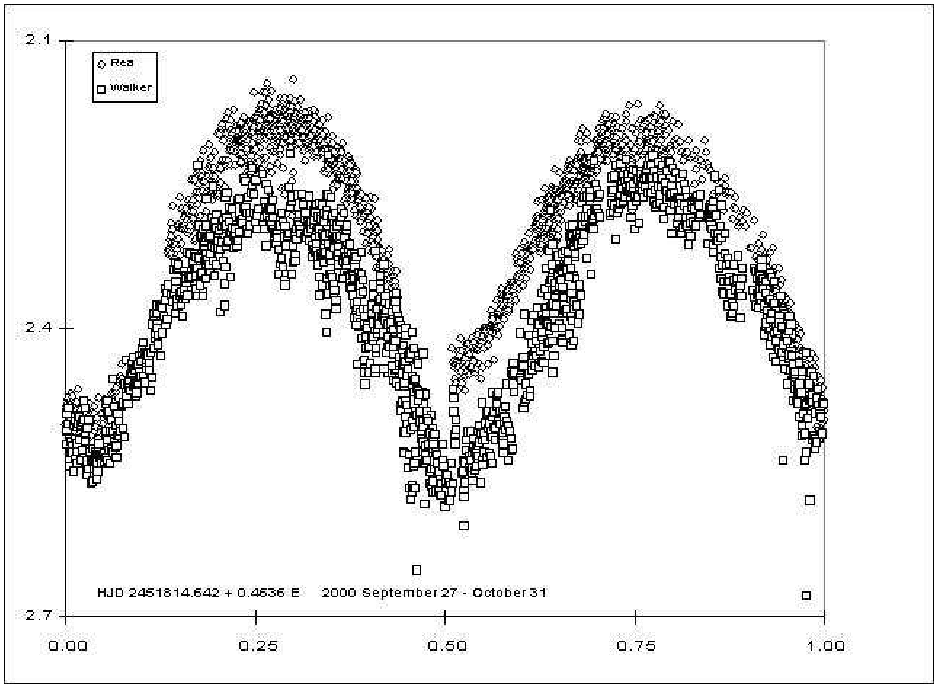

Figure 1. Phase diagram of GSC 05728_00092

Detector:	Santa Barbara Instruments Group ST6B

Filter(s):	None, roughly *R*

Comparison star(s):	GSC 5728_410; GSC 5728_248 (for observations on Oct. 9 and Oct. 16, 2000, with 0.35-m Schmidt–Cassegrain)

Transformed to a standard system:	No

Availability of the data:
Upon request

Remarks:

The variability of GSC 5728_92 was initially noticed while reducing data obtained on October 9th, 2000 while monitoring V1432 Aquilae as part of the Center for Backyard Astrophysics program of investigating CV stars. GSC 5728-92 was being investigated as a possible check star for CCD photometry, but the measured standard deviations indicated it was unsuitable, and further investigation showed it declined in brightness by about 0.3 magnitudes over a time period of approximately two hours. Data acquired previously (September 27) at Wharemaru Observatory confirmed the variability.

Further data was gathered on when weather permitted until October 31.

Analysis of the data yields an ephemeris:

$$\mathrm{Minimum} = \mathrm{HJD}\ 2451814.642 + 0\overset{\mathrm{d}}{.}4636 \times E.$$

The fit is reasonable and the star is certainly a W Ursae Majoris binary.

The amplitude measured at Regent Lane Observatory is similar but offset from than that obtained at Wharemaru Observatory. The data are in the natural telescope/CCD systems, hence the offset. No extinction corrections have been applied hence the slopes on the different nights do not match.

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BVR PHOTOMETRY OF THE W UMa STAR V2388 OPHIUCHI IN 2000

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Name of the object:
V2388 Oph = HD 163151

Equatorial coordinates:	**Equinox:**
R.A.= $17^{\rm h}54^{\rm m}14\overset{\rm s}{.}21$ **DEC.=** $11^\circ07\overset{\prime}{.}9$	2000

Observatory and telescope:
Ege University Observatory, 48-cm Cassegrain Telescope

Detector:	Hamamatsu, R4457 (PMT)

Filter(s):	B, V and R filters of Johnson UBV system

Comparison star(s):	HD 166095 = HIP 88862

Availability of the data:
Upon request

Type of variability:	W UMa

Remarks:

In this paper we present BVR light curves of V2388 Oph, which was discovered to be a W UMa type system by Rodriguez et al. (1998). This system was observed photoelectrically with the 48-cm Cassegrain telescope from 7 May 2000 to 23 August, 2000. The phases of the observations were calculated using the light elements given by Rodriguez et al. (1998):

$$\mathrm{HJD}_{\mathrm{min\,I}} = 2449890.5045 + 0\overset{\rm d}{.}80230 \times E.$$

Table 1 lists the dates of observations and the corresponding phases covered. The derived light curves for B, V and R colours are illustrated in Figure 1.

Acknowledgements:

This work was supported by Ege University Research Fund (Project No. 99/FEN/016).

Table 1

Date	Phase	Date	Phase
07 May	0.99–0.55	02 Aug.	0.31–0.45
04 Jun.	0.85–0.06	03 Aug.	0.53–0.66
10 Jun.	0.43–0.54	08 Aug.	0.77–0.99
27 Jun.	0.51–0.68	09 Aug.	0.01–0.22
08 Jul.	0.19–0.41	12 Aug.	0.81–0.92
18 Jul.	0.64–0.87	23 Aug.	0.44–0.64
23 Jul.	0.87–0.31		

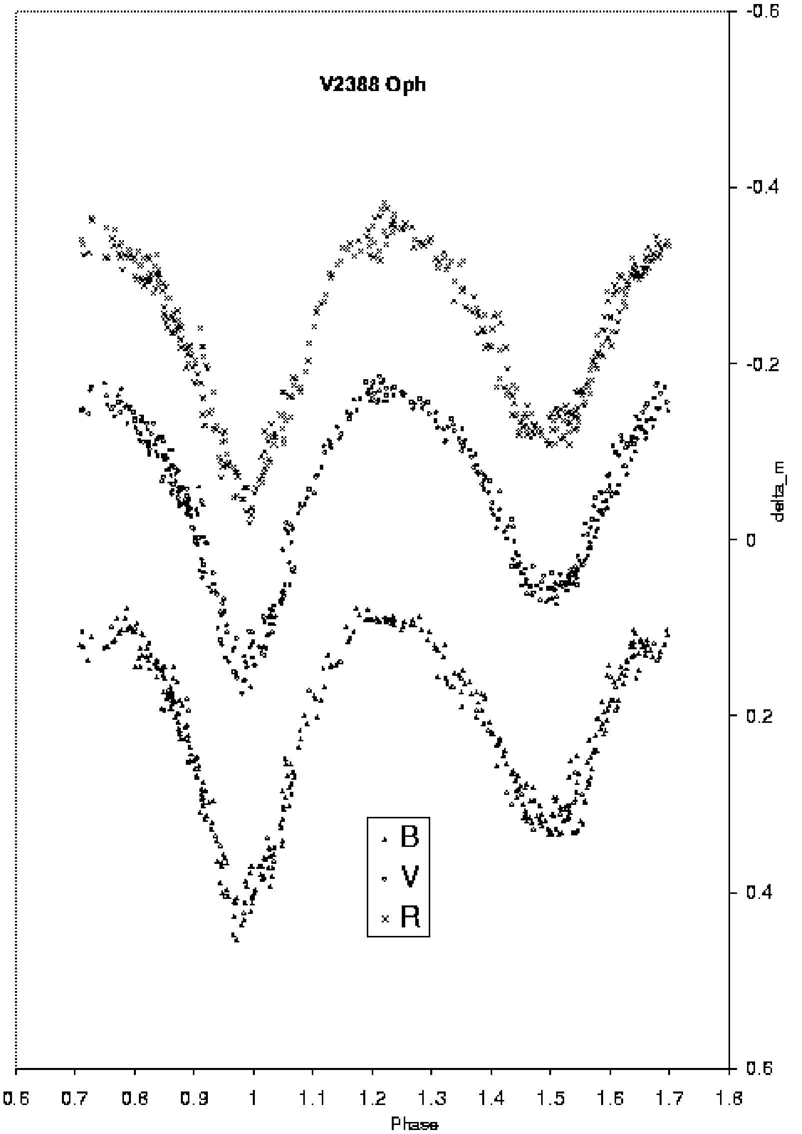

Figure 1. The light curves of V2388 Oph

Reference:

Rodriguez, E., et al., 1998, *A&A*, **336**, 920

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ON THE VARIABILITY OF F1–F9 LUMINOSITY CLASS III–V STARS

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This paper considers Hipparcos photometry (ESA 1997) of luminosity class III–V F1–F9 stars from the Bright Star Catalogue, 5th edition (Hoffleit & Warren 1991) and the Supplement, 4th edition (Hoffleit et al. 1983). These stars include α^2 CVn stars, δ Sct pulsators, eclipsing binaries, irregular variables, microvariables, RS CVn stars, SX Phe stars, periodic variables of unspecified types, unresolved variables, and constant stars. Table 1 lists the mean amplitudes, which indicate the mean variability, of spectral types with at least 3 class members. We omit stars with spurious variability due to duplicity. The Hipparcos photometry does not confirm the reported variability of some stars which might indicate a change in their stellar behavior or reflect the quality of the previous photometry.

Table 2 (available electronically from the IBVS site as 5003-t2.tex and 5003-t2.txt) contains the individual star information including those of stars not used in compiling the means. For each star it lists the HR number (if any), names (Bayer, Flamsteed, and/or variable star designation), the V magnitude from the Bright Star Catalog or its Supplement, the spectral type, the Hipparcos number, the standard error (mag), the amplitude (mag), and comments (type of variable and the NSV number if there was not space in the Names column). The F stars are not particularly variable with their means being similar to those of B6–B9 III stars (Adelman, Gentry, & Sudiana 2000), A0–A2 III–V stars (Adelman, Flores, & Patel 2000), A3–A7 III and A3–F0 IV stars (Adelman 2000a), G0–G9 stars (Adelman, Davis & Lee 2000), and K0–K4 III stars (Adelman 2000b). The luminosity III star variability is consistent with the trends seen in the F supergiants (Adelman, Cay, Cay, & Kocer 2000).

Table 3 lists stars with amplitudes of 0.04–0.08 mag. Some are well-known variables while others are in need of additional observations. As a $0^{\rm m}_{\cdot}07$ amplitude found for Procyon is questionable, this star was omitted. Those with amplitudes greater than $0^{\rm m}_{\cdot}08$ are usually well-known variables: the irregular variable V1401 Aql (F1III, 0.21); the δ Sct stars γ^2 Cae (F1III, 0.09), δ Sct (F2IIIp, 0.17), 1 V474 Mon (F2IV, 0.31), and 44 IM Tau (F2IV–V, 0.10); the Algol systems MX Hya (F2IV, 0.49), R CMa (F1V, 0.40), and V1143 Cyg (F6Va, 0.11); the W UMa stars ε CrA (F2V, 0.26), CN Hyi (F6V, 0.26), and 44 Boo (F9–G1Vn, 0.15); the SX Phe star AI Vel (F2V, 0.57); the β Lyr type stars κ^1 BG Ind (F3V,0.21) and V2388 Oph (F5Vn, 0.30); and the α^2 CVn star DW Eri (F4IIIpSr, 0.09). HD 134646 (F4III, 0.09) and HD 81734 (F7V, 0.17) are unresolved variables while ι TrA (F4IV, 0.09) and HR 6844 (F2V, 0.11) are periodic variables.

Acknowledgements. SJA wishes to thank the Citadel Development Foundation for their support. Cadets Coursey and Harris are US Navy ROTC scholarship recipients.

Table 1: The mean amplitudes of various types of F1 through F9 stars

Spectral class	Number	Mean ampl. (mag)	Comment
F1III	16	0.041 ± 0.049	0.023 ± 0.008 without 3 stars
F2III	26	0.030 ± 0.031	0.021 ± 0.005 without 4 stars
F3III	13	0.022 ± 0.006	
F4III	15	0.039 ± 0.024	0.028 ± 0.008 without 3 stars
F5III	23	0.024 ± 0.014	0.021 ± 0.008 without V784 Cas
F6III	11	0.025 ± 0.007	
F7III	3	0.040 ± 0.017	HR 8269's amplitude 0.06
F8III	4	0.022 ± 0.005	
F1III–IV	10	0.024 ± 0.014	0.020 ± 0.007 without BZ Gru
F2III–IV	9	0.027 ± 0.013	
F3III–IV	9	0.027 ± 0.017	0.021 ± 0.006 without AL CVn
F5III–IV	3	0.020 ± 0.000	
F6III–IV	4	0.025 ± 0.010	
F7III–IV	3	0.023 ± 0.006	
F1IV	17	0.028 ± 0.011	
F2IV	20	0.055 ± 0.110	0.023 ± 0.013 without 1 Mon & MX Hya
F3IV	20	0.024 ± 0.008	
F4IV	15	0.029 ± 0.022	0.022 ± 0.07 without ι Leo & ι TrA
F5IV	31	0.025 ± 0.008	
F6IV	20	0.022 ± 0.005	
F7IV	12	0.026 ± 0.009	
F8IV	8	0.025 ± 0.005	
F9IV	3	0.020 ± 0.000	
F2IV–V	7	0.044 ± 0.025	0.035 ± 0.005 without IM Tau
F3IV–V	9	0.029 ± 0.008	
F4IV–V	5	0.026 ± 0.005	
F5IV–V	9	0.028 ± 0.018	
F6IV–V	8	0.022 ± 0.007	
F7IV–V	5	0.026 ± 0.005	
F8IV–V	3	0.023 ± 0.006	
F1V	21	0.043 ± 0.082	0.026 ± 0.010 without R CMa
F2V	54	0.042 ± 0.081	0.026 ± 0.010 without AI Vel, HR 6844, & ε CrA
F2.5V	4	0.025 ± 0.010	
F3V	39	0.030 ± 0.031	0.024 ± 0.006 without HR 3936 & BG Ind
F4V	40	0.023 ± 0.006	
F5V	85	0.026 ± 0.031	0.022 ± 0.007 without AR Dor & V2388 Oph
F5–6V	3	0.023 ± 0.006	
F6V	80	0.021 ± 0.029	0.007 ± 0.031 without CN Hyi & V1143 Cyg
F6–7V	4	0.028 ± 0.005	
F7V	80	0.027 ± 0.018	0.025 ± 0.008 without HD 81734
F8V	75	0.026 ± 0.008	
F9V	31	0.025 ± 0.013	

Table 3: F stars with amplitudes of 0.04–0.08 magnitudes

Name	HD number	Spectral type	HIP number	SE (mag)	Amp. (mag)	Comments
CG Gru	214441	F1III	111833	0.0017	0.06	DSCT
BB Phe	2724	F2III	2388	0.0015	0.05	DSCT
ρ Phe	4919	F2III	3949	0.0024	0.07	DSCT
LT Vul	177392	F2III	93603	0.0010	0.04	DSCT
γ Dor	27290	F4III	19893	0.0020	0.07	EW
HR 3325	71433	F4III	41452	0.0010	0.04	
V947 Cen	113537	F4III	63849	0.0028	0.04	P
HR 5817	139478	F4IIIp	76384	0.0016	0.04	
V784 Cas	13122	F5III	10141	0.0041	0.08	DSCT
	33924	F5III	24658	0.0012	0.04	
HR 8269	205877	F7III	106978	0.0009	0.06	U
BZ Gru	208435	F1III–IV	108347	0.0018	0.06	DSCT
11 β Cas	432	F2III–IV	746	0.0017	0.04	DSCT
54 Hya	129926	F2III–IV	72197	0.0013	0.05	U
4 AL CVn	107904	F3III–IV	60467	0.0017	0.07	DSCT
HR 6890	169268	F6III–IV	90174	0.0010	0.04	
NSV 488	8391	F0/2IV	6418	0.0013	0.05	U
HR 4803	109799	F1IV	61621	0.0021	0.04	U
DK Vir	115308	F1IV	64769	0.0015	0.04	DSCT
HR 5079	117281	F1IV	65698	0.0014	0.04	
	159340	F0/2IV	86119	0.0012	0.04	
	189307	F2IV	98577	0.0013	0.04	
QQ Tel	185139	F2IV	96721	0.0035	0.07	DSCT
	87638	F3IV	49434	0.0010	0.04	
	207826	F3IV	107710	0.0045	0.04	
78 ι Leo	99028	F4IV	55642	0.0007	0.07	SV
	85821	F5IV	48483	0.0011	0.04	
HR 5537	131040	F5IV	72508	0.0052	0.04	MV
HR 6375	155078	F5IV	83962	0.0005	0.04	
HR 8363	208177	F5IV	108144	0.0064	0.04	
HR 2072	39937	F7IV	27737	0.0014	0.05	
ZZ Boo	121648	F2IV/V+F2Iv/V	68064	0.0011	0.04	EA/DM
	140130	F2IV/V	77067	0.0016	0.04	
HR 8945	221740	F2IV–V	116399	0.0009	0.04	
	135208	F3IV/V	74593	0.0010	0.04	
HR 5766	138498	F3IV–V	76407	0.0007	0.04	
26 Cet	6288	F1V	4979	0.0022	0.04	MV
HR 6849	168092	F1V	89401	0.0014	0.04	
39 Peg	213617	F1V	111278	0.0018	0.05	U
HR 1470	29364	F2V:	21619	0.0016	0.04	NSV 1676
HR 2384	46273	F2V	30953	0.0009	0.04	U
HR 4686	107192	F2V	59767	0.0017	0.05	P
KQ Lup	137785	F2V	75818	0.0020	0.05	E
V949 Sco	158741	F2V	85839	0.0022	0.04	DSCT

Table 3 (cont.)

Name	HD number	Spectral type	HIP number	SE (mag)	Amp. (mag)	Comments
HR 6786	166114	F2V	89099	0.0011	0.04	U
NZ Peg	206043	F2V	106897	0.0018	0.06	DSCT
HR 9106	225233	F2V	357	0.0010	0.04	
HR 3874	84447	F2–3V	47762	0.0012	0.04	
HR 3936	86358	F3V	48895	0.0022	0.07	I
HR 8507	211575	F3V	110091	0.0014	0.04	
HR 673	14221	F4V	10830	0.0013	0.04	
AR Dor	34349	F5V	24221	0.0010	0.08	E:
	172416	F5V	91732	0.0021	0.04	U
	184151	F5V	96081	0.0007	0.04	
NSV 1614	28406	F6V	20948	0.0016	0.04	
	152923AB	F6V	83174	0.0012	0.05	
	102357	F7V	57488	0.0019	0.05	MV
HR 4533	102634	F7V	57629	0.0013	0.05	U
HR 5779	138763	F7V	76233	0.0020	0.04	U
ρ Tel	177171	F7V	93815	0.0014	0.04	U
HR 8843	219482	F7V	114948	0.0010	0.04	MV
HR 1179	23856	F8V	17689	0.0008	0.04	
111 V1119 Tau	35296	F8V	25278	0.0014	0.04	P
	63008	F8V	37718	0.0011	0.04	
17 Vir	107705	F8V	60353	0.0186	0.04	
	116156	F8V	65159	0.0009	0.04	
HR 5148	119124	F7–9V	66704	0.0012	0.04	U
	128563	F8V	71510	0.0018	0.04	
HR 5583	132375	F8V	73309	0.0013	0.04	
	157466	F8V	85007	0.0007	0.04	
	108147	F9V	60644	0.0010	0.04	
	112196	F9V	63008	0.0022	0.04	U
V819 Her	157482	F9Vn:	84949	0.0009	0.08	EA
DL Eri	24832	F1V	18455	0.0021	0.04	DSCT

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NOVA VELORUM 1999: LIGHT CURVES AND SPECTROPHOTOMETRY

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In May 1999 Peter Williams and Alan C. Gilmore independently discovered a bright nova in Vela (Green 1999), now designated as V382 Velorum. As we have done in the past, the authors carried out photometric observations, Jones visually and Liller with a CCD and a "minus-IR" filter. As noted elsewhere (Liller & Jones 1996), this combination of CCD and filter results in a broad band V system which extends from a wavelength of about 420 nm to 730 nm and thus includes the Hα line. Additionally, Liller recorded low-resolution CCD spectra of the nova using a 10-degree objective prism with a 20-cm $f/1.5$ Schmidt camera. The spectrograms covered the range from Hα to the higher members of the Balmer series, at times reaching beyond Hδ at 410 nm. At the wavelength of Hα, the resolution is 27 Å/pixel and improves to 6.6 Å/pixel at Hδ.

The light curves are shown in Figure 1 and include some pre-discovery magnitudes on various systems taken from IAUC 7176. Our own observations, depicted as filled circles (Jones) and crosses (Liller), are in general agreement showing a rapid decline in brightness for the first 50 or 60 days after maximum, and a slow, smooth fall-off afterwards. Assuming that peak brightness came at JD 2451320.8, we measure the quantity t_3, the time it takes a nova to decline by three magnitudes from peak brightness, to be 12.3 days in the visual and 17.5 days with the CCD. As we have explained before (Liller & Jones 1999), this difference can be understood by remembering that the strong Hα emission makes the nova appear relatively brighter with the CCD than visually since the eye has low sensitivity at this wavelength. In either case, the nova can be classed as "fast" and quite similar to Nova Sco 1998 (Liller & Jones 1999a) but not so fast as Nova Oph 1998 or Nova Mus 1998 (Liller & Jones 1999b).

Perhaps the most interesting feature of Fig. 1 is the cross-over of the two light curves that occurred at about JD 2451490. The reason for this change can be readily explained by considering the spectrograms. Figure 2 shows scans of the nova spectrum taken just when the cross-over was beginning at JD 2451468 (Oct. 16), and then at JD 2451526 (Dec. 13) when the cross-over was complete. Hα, at pixel number 128, continues strong, but in the later scan the blended [O III] lines (496 and 501 nm) are beginning to dominate the spectrum and overpower neighboring Hβ. Since the dark-adapted eye is at peak sensitivity near 500 nm with the CCD peaking in the red, it is apparent that the eye will see the nova fading less rapidly as the [O III] lines strengthen relative to the hydrogen lines. Another conspicuous change is the blend of lines appearing at wavelengths around 464 nm. This

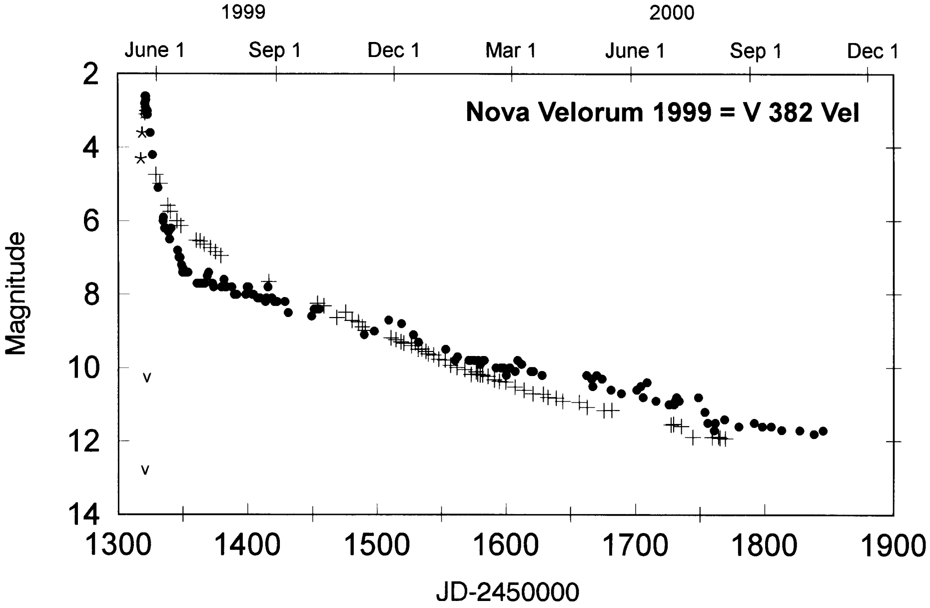

Figure 1. Light curves of Nova Velorum. The filled circles depict Jones's visual observations while crosses indicate Liller's broad band V measurements. Some pre-discovery observations taken from the IAUC are also included, and shown by different symbols

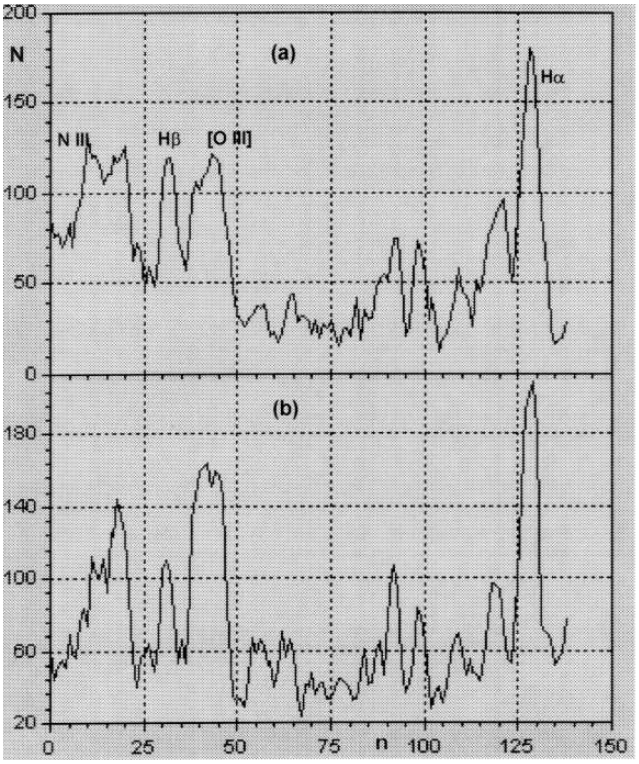

Figure 2. Low-resolution scans of the spectrum of Nova Velorum taken at (a) JD 2451465 and (b) JD 2451526. The wavelengths range from approximately 450 nm at the left to just beyond the wavelength of Hα at the right. Lines of interest are labelled. The scale along the horizontal axis gives the CCD relative pixel numbers, n; the vertical scale shows the relative number of counts per pixel, N

blend is made up primarily of permitted lines of N III around 460 nm which weaken as the nova enters the "nebular stage". However, at this wavelength both the eye and the CCD have loss considerable sensitivity. Finally, note that the continuum, best seen in the vicinity of pixel 75 and just shortward of Hβ, has faded relative to the stronger emission lines.

As always, it is a pleasure to thank Dr. Nikolai Samus for his interest and his encouragement to publish light curves of novae.

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UBV PHOTOMETRY OF THE SYMBIOTIC STAR Z And DURING ITS 2000 OUTBURST

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Z Andromedae is considered as a prototype symbiotic star. This system consists of an M4.5 giant and a hot compact star of $T_\star \sim 10^5$ K (Nussbaumer & Vogel 1989, Mürset et al. 1991). The orbital period of the binary is 758.8(±2) days (Mikolajewska & Kenyon 1996). The inclination of the orbital plane was determined by Schmid & Schild (1997) to $47 \pm 12°$. Photometric activity of Z And has been recorded since 1887 (Mattei 1978). The top panel of Fig. 1 shows its historical 1895–2001 photographic/B-band/visual light curve (LC). The LC is characterized by phases of activity with up to 2-3 mag increase of the star's brightness, alternating with periods of quiescence. Sharp brightness oscillations of even larger amplitude are also often present during outburst phases (also Formiggini & Leibowitz 1994). The mid panel of Fig. 1 shows the Z And LC in the last 20 years. This portion of the LC is dominated by the 1984 active phase, which lasted about 2 years and consisted of two consecutive outbursts. The second one peaked around 9 mag in U and V. During this outburst an optically thick shell was ejected at moderately high velocities of the order of 200–300 $\mathrm{km\,s^{-1}}$ (Fernández-Castro et al. 1995). The quiescent phase of Z And is characterized by a complex wave-like brightness variation as a function of the orbital phase, well pronounced in the U band. The nature of this type of variability was recently discussed by Skopal (1998) and Skopal (in press). The bottom panel of Fig. 1 shows the most recent evolution of the LC, which indicates that Z And has entered a new bright outburst at the end of August 2000. During the current active phase, Z And reached its maximum around 8.4 mag in U, and is thus brighter than in the 1984-85 main outburst.

Our U, B, V measurements of Z And were performed in the standard Johnson system using single-channel photoelectric photometers mounted in the Cassegrain foci of 0.6-m reflectors at the Skalnaté Pleso (hereafter SP in Table 1) and Stará Lesná observatories (SL). The results of our photometric measurements of Z And (HD 221650, BD +48°4093) are in Table 1. Stars SAO 53150 ($V = 8.99$, $B-V = 0.41$, $U-B = 0.14$) and SAO 63189 ($V = 9.17$, $B-V = 1.36$, $U-B = 1.11$), were used as a comparison and a check star, respectively. We obtained the magnitudes of both standards by their long-term measuring (1997–1999) with respect to the previous comparison star (SAO 35642, $V = 5.30$, $B-V = -0.06$, $U-B = -0.15$). The measurements were conducted in short cycles 'comparison–check–Z And–comparison–Z And–. . . ' in U, B, V filters for each star individually and in total duration approximately of 60 minutes. The data in Table 1 represent means of such measurements and are shown in Fig. 2. Their inner uncertainty is $\leq 0\overset{m}{.}01$ and $\leq 0\overset{m}{.}02$

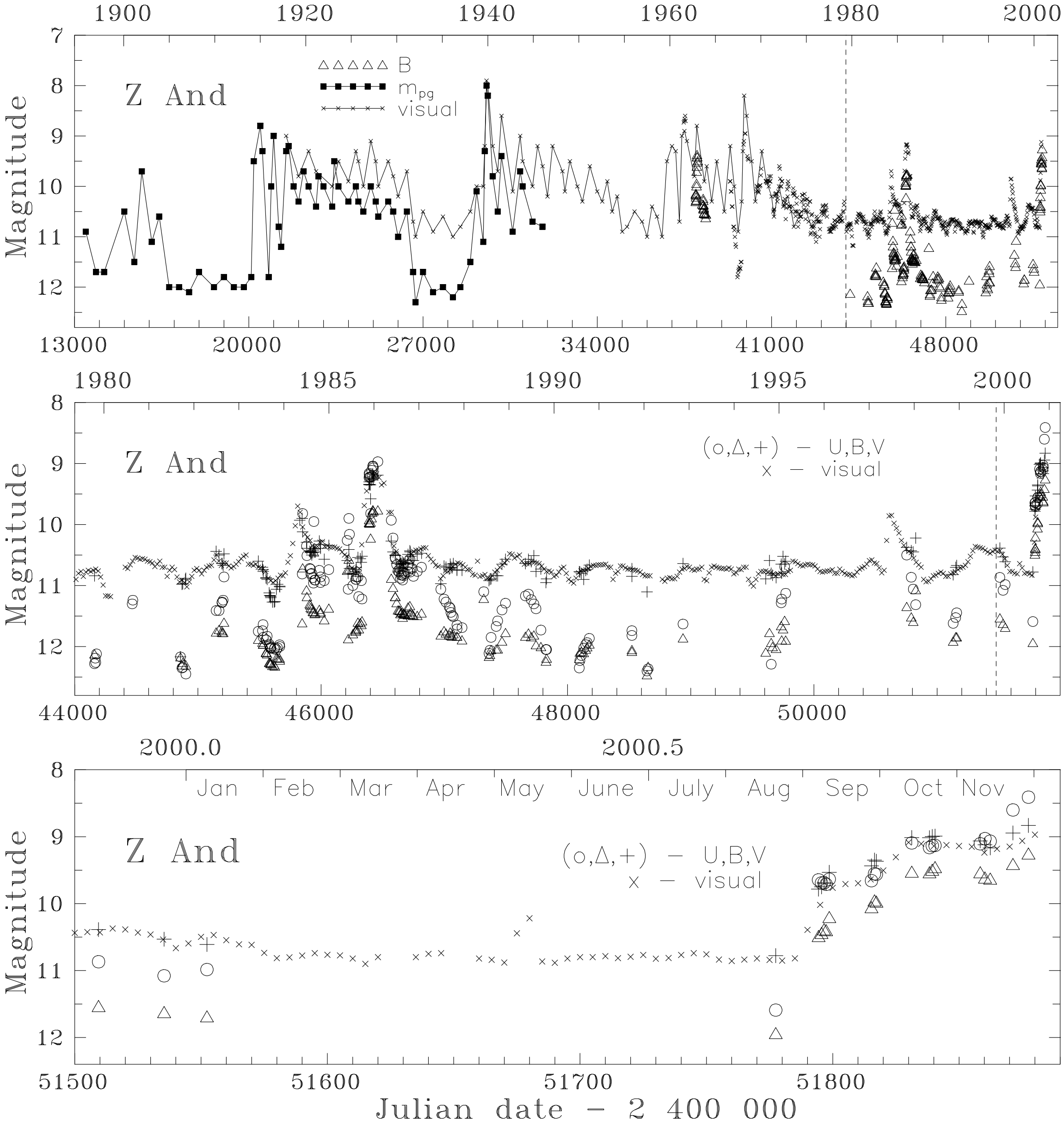

Figure 1. **Top:** The historical 1894.5–2000.9 photographic/B-band/visual LC of Z And. It is compiled from photographic data (Payne-Gaposchkin 1946), visual AAVSO estimates (Mattei 1978), smoothed visual data gathered by the VSNET and AFOEV observers, and B-band photoelectric measurements as published by Belyakina (1965, 1992), Hric et al. (1991, 1993, 1996), Skopal et al. (1992) and Mikolajewska & Kenyon (1996). **Middle:** A part of the LC from 1980. In addition to the data referred above, there are U-band measurements of Belyakina (1985), and between 30/07/97 and 26/11/99 there are some our unpublished UBV data. Visual LC in these panels represents smoothed data (VSNET + AFOEV) by the filter with the resolution of 40 days and the step of 20 days (40/20). **Bottom:** A detail of the LC from 2000 covering the current outburst. Here the visual data were smoothed by the 10/5 filter. Note a very good agreement between the photoelectric V and the smoothed visual LC. Parts of the LC from the broken vertical line to the end of the panel are shown in the following panel in detail.

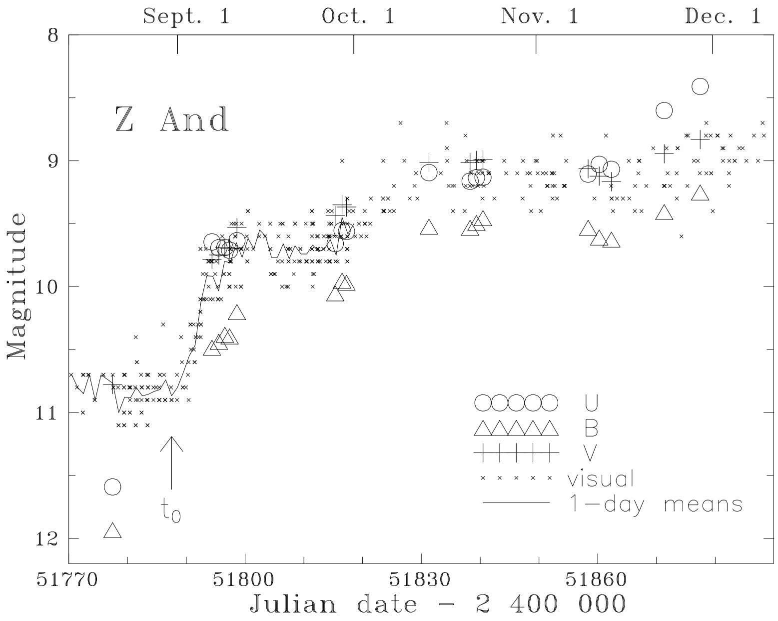

Figure 2. A detail of the LC covering the current outburst, which began on 2000 August 31.0 ± 1.5 UT. The solid line connects the means of visual estimates in 1-day bins, in order to see better the beginning of the outburst, t_0. From JD 2451818, only the VSNET data were available. The latest brightening, at the end of November 2000, indicates a strong outburst of Z And, which reached over that observed in 1984-85.

in V, B and U band, respectively. For a comparison, we used also the visual magnitude estimates gathered by the VSNET observers and the members of Association Francaise des Observateurs d'Etoiles Variables (AFOEV).

Timing of the last U, B, V observation prior to the brightening (made on 20/8/00) and the first one during it (6/9/00) define the beginning of the outburst, t_0, to JD $2451786 \pm 8^{\mathrm{d}}$ (cf. Table 1). However, a very good agreement between the photoelectric V and the visual magnitude estimates (cf. Figs. 1 and 2) enable us to determine the t_0 time more precisely. Combining the visual data available on CDS (AFOEV data), on the VSNET web site and those of Mattei (2000), we determined the beginning of the current outburst of Z And as

$$t_0 = \mathrm{JD}\ 2451787.5 \pm 1\overset{\mathrm{d}}{.}5$$

i.e. on 2000 August 31.0 ± 1.5 UT (see Fig. 2). An interesting feature of the current outburst is a *cascade* profile of the LC observed in the period from the beginning of the outburst to its maximum. The cascade nature can be clearly seen in the visual and U data, but it is less definite in V and it is marginal in B (cf. Fig. 2). Between October 13 and November 13 brightening has stopped and Z And stood at the plateau of $U \sim 9.05$, $B \sim 9.54$ and $V \sim 9.10$, which was comparable with the brightness maximum of Z And during its last major outburst in 1984-85 (Fig. 1). However, our observations made at the end of November indicate a further increase in the star's brightness up to $U \sim 8.4$, $B \sim 9.3$ and $V \sim 8.8$. These values reached over those of the 1984-85 outburst. Therefore it is possible that the duration of the current outburst will be comparable with the previous one, and thus we can expect its continuation in 2001/2002.

Z And is currently included in the observing programme of the Skalnaté Pleso Observatory. The further data will be published in *Contrib. Astron. Obs. Skalnaté Pleso.*

Table 1: U, B, V observations of Z And during the current outburst.

Date	JD 24...	U	B	V	Obs.
Nov 26, 1999	51509.430	10.867	11.530	10.388	SP
Dec 22	51535.364	11.078	11.620	10.532	SP
Jan 8, 2000	51552.321	10.984	11.684	10.610	SP
Aug 20	51777.449	11.590	11.933	10.777	SP
Sep 6	51794.368	9.645	10.485	9.783	SL
Sep 7	51795.531	9.691	10.438	9.748	SP
Sep 8	51796.555	9.689	10.383	9.691	SP
Sep 9	51797.363	9.711	10.396	9.695	SL
Sep 10	51798.612	9.635	10.202	9.532	SP
Sep 27	51815.331	9.658	10.054	9.436	SP
Sep 28	51816.510	9.555	9.952	9.350	SP
Sep 29	51817.263	9.562	9.970	9.367	SP
Oct 13	51831.276	9.094	9.524	9.013	SL
Oct 20	51838.286	9.163	9.533	9.015	SL
Oct 21	51839.369	9.135	9.495	8.998	SL
Oct 22	51840.475	9.131	9.455	8.991	SP
Nov 9	51858.360	9.106	9.533	9.064	SP
Nov 11	51860.249	9.029	9.610	9.122	SL
Nov 13	51862.372	9.068	9.627	9.167	SP
Nov 22	51871.313	8.601	9.408	8.944	SL
Nov 28	51877.428	8.410	9.252	8.832	SP

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UBV PHOTOMETRY OF BX And

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The short period eclipsing binary BX And (BD +40°442) is the brighter component of visual binary ADS 1671 and was discovered as an Algol type eclipsing binary by Soloviev (1945). Photographic studies by Ashbrook (1951) using 200 Harvard patrol plates confirmed the binary nature of BX And with a β Lyrae type light variation. Since then, the system has been observed frequently by many observers (see Rovithis et al. 1984, and Bell et al. 1990). Gülmen et al. (1988) published a period analysis, summarising the time of minima observed by many authors. Their analysis confirmed the occurrence of a period change about $0\overset{s}{.}25$ already reported by Ahnert (1975) and suggested another change around 1981.

The system consists of a primary with spectral type F2V and a K type secondary. It has been classified as a near contact binary by Bell et al. (1990). To study the light curve variation, it has been included in our observing program. UBV photoelectric observations of BX And were made in October 1996, 1997, 1998 and 2000, at Khajheh Nassir Addin Observatory of Tabriz University (Iran). The observations were carried out using a 40-cm Cassegrain telescope. A single channel photometer equipped with an unrefrigerated photomultiplier tube RCA 1P21 and Johnson's standard UBV filters were employed during the observations. The output of the photometer was fed to a microcomputer enabling rapid data access. Two stars BD +39°476 and BD +39°480 were used as comparison and check stars, respectively. The data were corrected for differential extinction and light time effect.

The phases were calculated using the elements given by Derman et al. (1993):

$$\text{Hel. JD(Min I)} = 2447538.2967 + 0\overset{d}{.}61011355 \times E.$$

During the observations three primary and three secondary minimum times were obtained in each color. These minima are given in Table 1 where $O - C$ residuals have been computed with the elements given above. Figures 1 and 2 show the light curves of BX And in U, B and V bands where $\Delta m =$ Var. − Comp. have been plotted versus phase. There is no asymmetry in the profiles of the minima and no displacement in the secondary minimum, and the maxima are equal.

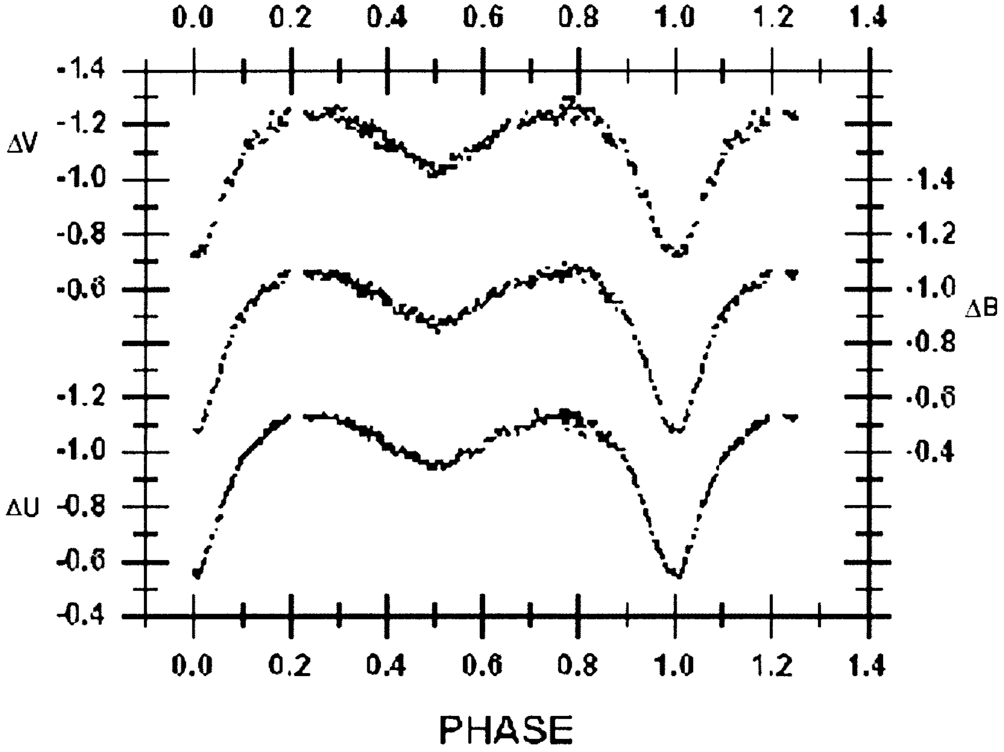

Figure 1. 1998 light curves of BX And

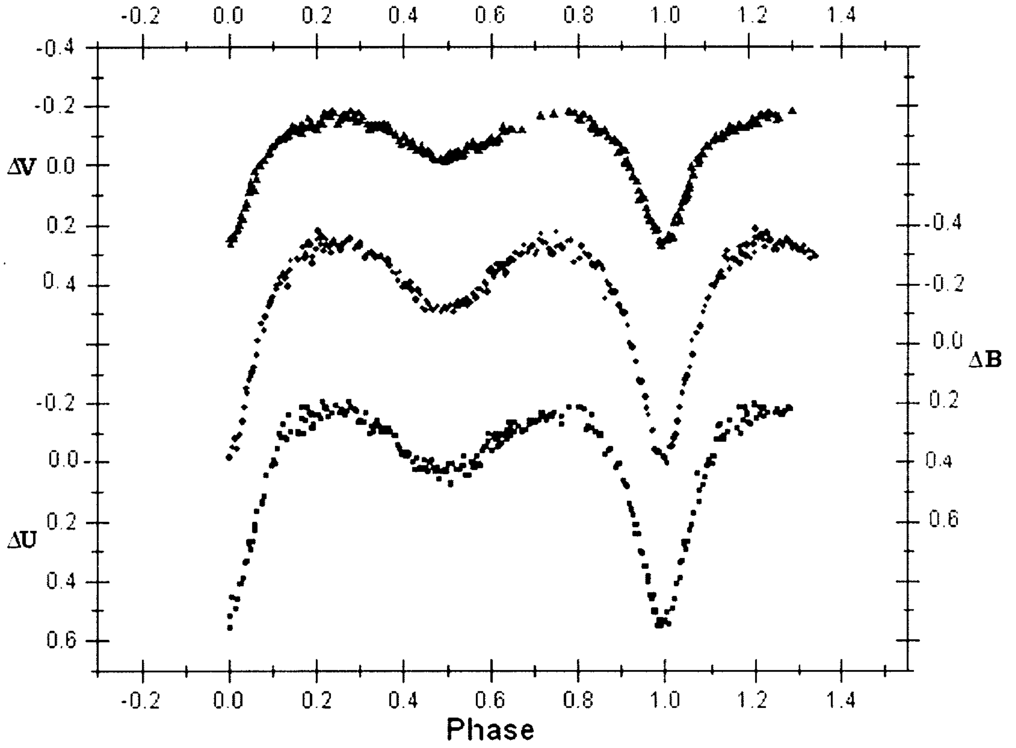

Figure 2. 2000 light curves of BX And

Table 1: Time of minima of BX And

Hel. JD 2450000 +	Filter	$O-C$	Remark	$O-C$ (average of three filters)
0392.4069	U	−0.0007	Min I	
0392.4045	B	−0.0033	Min I	−0.0019
0392.4030	V	−0.0048	Min I	
0731.3224	U	−0.0034	Min II	
0731.3220	B	−0.0039	Min II	−0.0028
0731.3258	V	−0.0001	Min II	
1105.3228	U	−0.0027	Min II	
1105.3214	B	−0.0039	Min II	−0.0033
1105.3221	V	−0.0034	Min II	
1109.2954	U	−0.0012	Min I	
1109.2950	B	−0.0037	Min I	−0.0025
1109.2940	V	−0.0027	Min I	
1823.7294	U	−0.0047	Min II	
1823.7251	B	−0.0090	Min II	−0.0046
1823.7338	V	−0.0003	Min II	
1824.9516	U	−0.0028	Min I	
1824.9516	B	−0.0028	Min I	−0.0027
1824.9518	V	−0.0026	Min I	

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COMMENT ON THE RADIUS OF THE COOLER COMPONENT OF THE ECLIPSING RS CVn BINARY CF Tuc (HD 5303)

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There appears to be a discrepancy between values of the rotational $v \sin i$ for the cooler component of the RS CVn system CF Tuc, as measured by Donati *et al.* (1997) from a high signal-to-noise ratio line profile using Least Squares Deconvolution (LSD), and as derived by fitting the photometric light curves, by for example Budding & McLaughlin (1987) and Anders *et al.* (1999). The stellar radius implied by the LSD technique does not appear to give a satisfactory fit to the light-curve of this well observed system.

CF Tuc is an eclipsing RS CVn binary, of period of $2\overset{d}{.}7978$. Many light curves have been obtained of this system by various workers, and basic stellar parameters have been deduced from these data (see for example Budding & McLaughlin 1987; Anders *et al.* 1999). The only published radial-velocity data for CF Tuc are those of Balona (1987) and Collier Cameron (1987), from which we calculate the result $a \sin i = 10.06\ R_\odot$. Assuming that the stars are in synchronous rotation with the orbital period and have rotation axes parallel to the orbital axis, we have used the stellar parameters deduced by Budding & McLaughlin (1987) and Anders *et al.* (1999), together with the result for $a \sin i$, to derive the data in the first two rows of Table 1. (Other recent measured values for $v_c \sin i$ for CF Tuc, based on the same observed spectrum, are 35 $\mathrm{km\,s^{-1}}$ by Pallavicini *et al.* 1992, and 65 $\mathrm{km\,s^{-1}}$ by Randich *et al.* 1993.)

Table 1: Parameters of CF Tuc derived from various sources

i [°]	a [$R_\odot$]	R_c [$R_\odot$]	$v_c \sin i$ [$\mathrm{km\,s^{-1}}$]	R_h [$R_\odot$]	$v_h \sin i$ [$\mathrm{km\,s^{-1}}$]	Source
69.3	10.8	3.26	55	1.80	30	Anders *et al.* (1999)
71.4	10.6	3.05	52	1.58	27	Budding & McLaughlin (1987)
64.5	11.2	4.29	70 ± 2	1.53	25 ± 1	Donati *et al.* (1997)

We derived the results in the third row of the table from measurements of rotational $(v \sin i)_{\mathrm{LSD}}$ by Donati *et al.* (1997). The value for i was estimated from the phases of contact at primary eclipse, as described later. The three values of R_h agree reasonably well, but for the cooler star the $(v \sin i)_{\mathrm{LSD}}$ datum leads to a much larger radius.

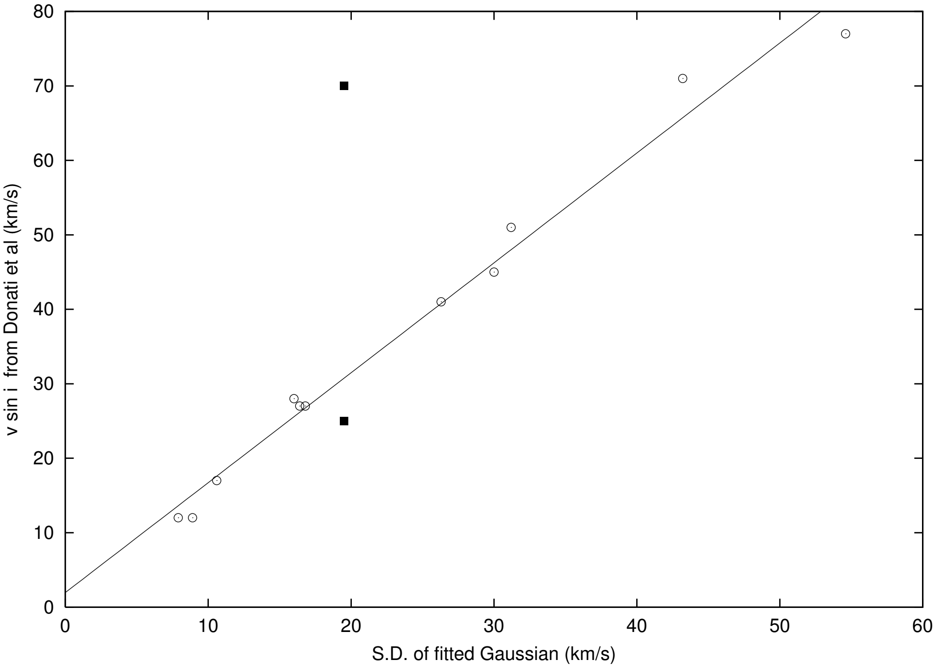

Figure 1. $v \sin i$ from Donati *et al.* (1997) versus σ for the fitted Gaussians. The points marked as filled-in squares are for the components of CF Tuc, the circles are for the other stars. The line is the fit given in the text

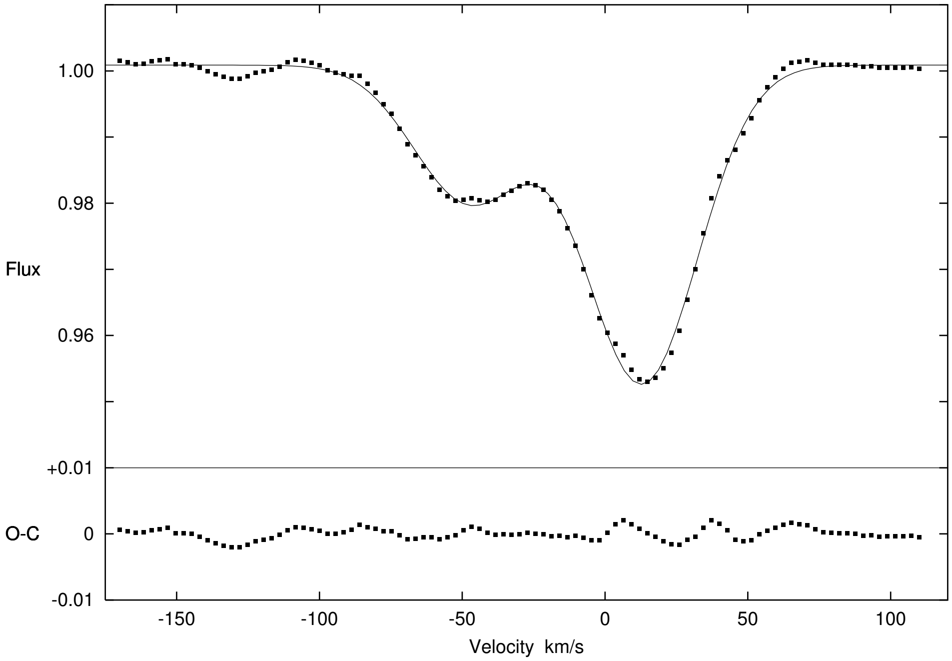

Figure 2. Gaussian fits to the overlapping profiles of Fig. 16 of Donati *et al.* (1997). Each Gaussian has about the same width, approximately equivalent to a $v \sin i$ of 30 $\mathrm{km\,s^{-1}}$

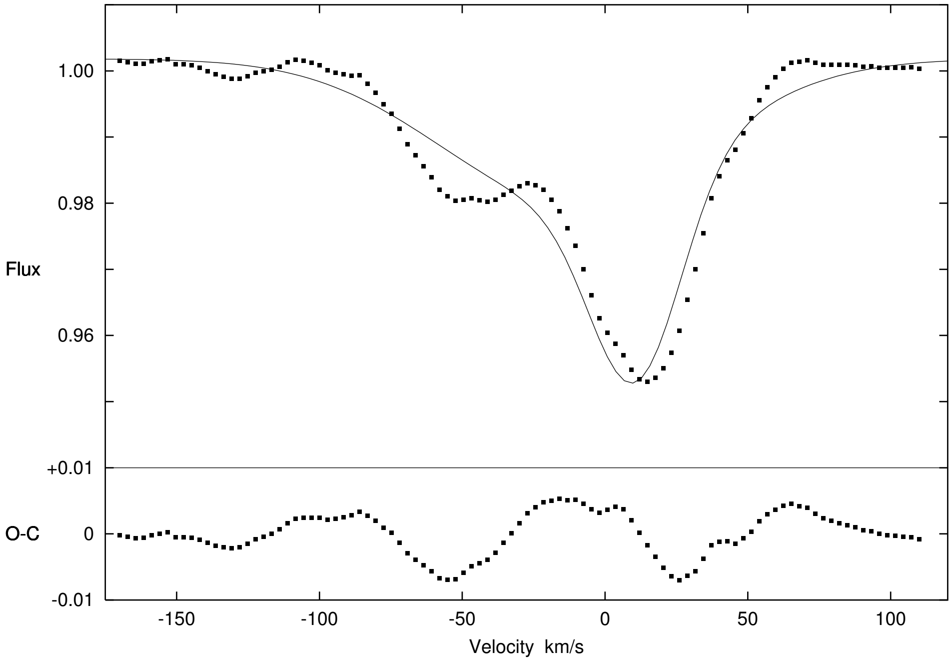

Figure 3. As for Fig. 2, but with Gaussians of widths implied by $(v \sin i)_{\rm LSD}$ values of 70 and 25 $\rm km\,s^{-1}$ from Donati *et al.* (1997), and radial velocities of 10.9, -12.9 $\rm km\,s^{-1}$

The high precision of the result $(v_c \sin i)_{\rm LSD} = 70 \pm 2$ $\rm km\,s^{-1}$ obtained by Donati *et al.* (1997) led us to examine its consequences. The implied absolute radius for the cooler star is significantly higher than that to which the light-curve fitting procedures converged (Budding & McLaughlin 1987, Anders *et al.* 1999). It is difficult to see how such a radius could yield a good fit to the light curves. As a possible solution to this problem, Collier Cameron (private communication) suggested that the cooler star may have a large number of small, dark spots, which reduces its surface brightness significantly below the value implied by the photometric colours. Hilditch & Collier Cameron (1995) found evidence for similar behaviour in the RS Cvn system XY UMa, in which the depth of primary eclipse varies with overall mean light level over many years, in just the way expected if the long term variation is caused by uniformly distributed spots.

So we assumed uniform maculation of the cooler star, as suggested by Collier Cameron, and attempted to fit the light curve of CF Tuc using the relative stellar radii implied by the rotational speeds obtained by Donati *et al.* (1997). We selected the light curve of Budding & McLaughlin (1987), which was measured at an epoch when there were almost certainly no large starspots on the cooler star, and thus no significant maculation wave on the light curve. Firstly we used the $v \sin i$ measurements of Donati *et al.* (1997) to derive $R \sin i$ for both stars. Then, using the program Binary Maker 2.0 (Bradstreet 1993), we adjusted the inclination i to give the correct times of contact at primary eclipse. This yielded $i \sim 64\overset{\circ}{.}5$, as in the third row of Table 1 above. However we found it impossible to adjust the surface brightness of the cooler star to obtain a fit to the light curve within primary eclipse. The fitted curve was always too shallow, even when the surface brightness of the cooler star was reduced to unrealistically low levels, at which also the light curve outside the eclipses was clearly too flat. Similarly we were unable to obtain a fit by adjusting the surface brightness of the hotter star.

We are left with two possibilities. Firstly, the value of $(v_c \sin i)_{\rm LSD}$ for the cooler star is correct, and phenomena at present not understood explain the form of the light curve. Secondly, the value of $(v_c \sin i)_{\rm LSD}$ for the cooler star may be in some way anomalous.

To investigate the second possibility, we scanned most of the line profiles published in Donati *et al.* (1997), digitised them and fitted Gaussians to the lines. A plot of the $(v \sin i)_{\rm LSD}$ values from Donati *et al.* (1997) versus the standard deviations, σ, of the corresponding Gaussians gives a reasonably tight linear relationship which, without the data for CF Tuc, is fitted by $(v \sin i)_{\rm LSD} = 1.477\sigma + 1.85$ km s^{-1}. However the point for the cooler component of CF Tuc falls far from this line: hence the anomaly. See Fig. 1.

Our fit to the profiles of Fig. 16 of Donati *et al.* (1997) is shown in Fig. 2. The residuals are small, as can be seen in the lower part of Fig. 2 which is at the same scale as the fit. σ for each of the Gaussians corresponds to $(v \sin i)_{\rm LSD}$ values of approximately 30 km s^{-1}. The radial velocities of the hotter and cooler stars at the time of the observations were 10.9 and -12.9 km s^{-1} according to the radial velocity data of Balona (1987) and Collier Cameron (1987), together with the ephemeris $2444219.270 + 2.797715 \times E$ of Anders *et al.* (1999). The Gaussian fits of Fig. 2 indicate radial velocities of 12.9 and -47.4 km s^{-1} for the hotter and cooler stars, the latter value again being anomalous. A possible explanation of the anomalies is that the lineshape for the cooler star is strongly distorted by the presence of starspots. However the fit using Gaussians has small residuals, so this explanation does seem unlikely. We examined this a little further by constraining the radial velocities to be 10.9 and -12.9 km s^{-1} and the values of $(v \sin i)_{\rm LSD}$ to be 25 and 70 km s^{-1}, as in Donati *et al.* (1997), and then fitting two Gaussians to the profile. The result, shown in Fig. 3, is not a good fit. While our method is admittedly rather crude, the results show that the value of $(v_c \sin i)_{\rm LSD}$ of 70 km s^{-1} is almost certainly not consistent with the overlapping line profiles for CF Tuc in Fig. 16 of Donati *et al.* 1997.

We conclude that there are still problems to be solved in the case of CF Tuc. Perhaps a subtle maculation process is confounding the fitting of the light curves. On the other hand, the value of $v \sin i$ for the cooler star of CF Tuc as found by Donati *et al.* (1997) is open to some question. The method of Least Squares Deconvolution is so powerful that this particular case where it may fail is well worth further study.

We are grateful to A. Collier Cameron for his suggestions and B. Carter for advice.

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ON THE VARIABILITY OF O4–B5 LUMINOSITY CLASS III–V STARS

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This paper considers the Hipparcos photometry (ESA 1997) of luminosity class III–V O4–B5 stars in the Bright Star Catalogue, 5th edition (Hoffleit & Warren 1991) and the Supplement of the 4th edition (Hoffleit et al. 1983). These stars include α^2 CVn variables, β Cep stars, eclipsing binaries including Algol and β Lyr types, rotating ellipsoidal variables, γ Cas variables, irregular and slow irregular variables, microvariables, slowly pulsating B stars, semi-regular variables, SX Ari stars, spurious variables due to duplicity, unresolved variables, and constant stars. Table 1 lists the mean amplitudes, which indicate the mean variability of those spectral types with at least 3 class members. We excluded stars with spurious variability due to duplicity. The Hipparcos photometry does not confirm the reported variability of some stars which might indicate a change in the stellar behavior or reflect the quality of the previous photometry. The mean amplitudes of the luminosity class III stars excluding the larger amplitude variables are equal to or greater than those of the corresponding supergiants (Adelman, Yüce & Engin 2000). The values in Table 1 are generally greater than those of cooler stars (see, e.g. Adelman, Gentry & Sudiana 2000) indicating that variability is greater among these stars than among cooler stars.

Table 2 (available electronically from the IBVS site as 5008-t2.tex and 5008-t2.txt) contains individual stars values including those which were not used in compiling the means. It gives for each star the HR number (if any), names (Bayer, Flamsteed, or variable star designation), the V magnitude from the Bright Star Catalog or its Supplement, the spectral type, the Hipparcos number, the standard error (mag), the amplitude (mag), and comments (type of variable and the NSV number if there was not space in the Names column). Table 3 presents selected stars with amplitudes of variability which are $\geq 0\overset{\mathrm{m}}{.}10$, which is significantly greater than the mean amplitude values. The majority of the well-known variables are γ Cas variables. A few others and many stars with amplitudes between $0\overset{\mathrm{m}}{.}05$ and $0\overset{\mathrm{m}}{.}09$ listed in Table 2 need further observations.

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Table 1: The mean amplitudes of various types of B6 through B9 stars

Sp. class	No.	Mean ampl.	Comment
07.5III	3	0.027 ± 0.006	
B0III	7	0.101 ± 0.198	0.027 ± 0.008 without HR 1260
B0.5III	15	0.034 ± 0.011	0.031 ± 0.005 without V1012 Sco
B1III	10	0.042 ± 0.013	
B1.5III	11	0.055 ± 0.064	0.030 ± 0.013 without MX Pup & LS Mus
B2III	19	0.096 ± 0.092	0.055 ± 0.034 without AX Mon, HP CMa, V767 Cen, & BW Vul
B3III	29	0.054 ± 0.082	0.036 ± 0.019 without NSV 4879 & V3792 Sgr
B4III	9	0.058 ± 0.054	0.033 ± 0.022 without ζ Tau & EW Lac
B5III	31	0.034 ± 0.015	0.032 ± 0.012 without V757 Mon
B2III/IV	3	0.020 ± 0.010	
B3III/IV	4	0.045 ± 0.017	0.037 ± 0.006 without MX CMa
B0IV	6	0.075 ± 0.088	0.025 ± 0.010 without V750 Mon and FY CMa
B0.5IV	8	0.079 ± 0.098	0.030 ± 0.013 without V1294 Aql & AH Cep
B1IV	6	0.033 ± 0.020	
B1.5IV	12	0.043 ± 0.046	0.024 ± 0.008 without κ CMa & NSV 6943
B2IV	44	0.049 ± 0.049	0.032 ± 0.020 without 6 G Cas stars & KP Per
B2.5IV	25	0.042 ± 0.056	0.027 ± 0.010 without FW CMa & NT Peg
B3IV	44	0.035 ± 0.033	0.028 ± 0.014 without V817 Cen, κ^1 Aps, & 6 V382 Cep
B4IV	15	0.043 ± 0.039	0.030 ± 0.018 without V3894 Sgr & V2148 Cyg
B5IV	29	0.032 ± 0.019	0.030 ± 0.014 without HR 1772
B2IV–V	52	0.040 ± 0.051	0.028 ± 0.016 without V960 Tau, 28 o CMa, V955 Cen, & IN Peg
B2.5IV–V	3	0.027 ± 0.006	
O6.5V	4	0.030 ± 0.014	
O9V	5	0.042 ± 0.029	0.030 ± 0.014 without LZ Cep
O9.5V	4	0.060 ± 0.045	two stars constant, two variable
B0V	9	0.091 ± 0.170	0.035 ± 0.022 without SZ Cam
B0.5V	8	0.038 ± 0.030	0.027 ± 0.010 without EM Cep
B1V	30	0.063 ± 0.065	0.035 ± 0.020 without 6 stars with amplitudes of 0.10 or more
B1.5V	21	0.038 ± 0.046	0.029 ± 0.015 without V436 Per
B2V	77	0.050 ± 0.050	0.032 ± 0.016 without 11 stars with amplitudes of 0.10 or more
B2.5V	49	0.046 ± 0.040	0.030 ± 0.015 without 8 stars with amplitudes of 0.10 or more
B3V	107	0.039 ± 0.029	0.033 ± 0.016 without 6 stars with amplitudes of 0.10 or more
B4V	33	0.066 ± 0.063	0.038 ± 0.020 without 7 stars with amplitudes of 0.10 or more
B5V	110	0.043 ± 0.050	0.032 ± 0.016 without 8 stars with amplitudes of 0.10 or more

Table 3: O4–B5 III–V stars with amplitudes $\geq 0\overset{\rm m}{.}10$

Name	HD	Sp. type	HIP	SE	Amp.	Comment
AO Cas	1337	O9IIInn	1415	0.0101	0.18	ELL
HR 1260	25638	B0III	19272	0.0420	0.55	U
MX Pup	68980	B1.5IIIe	40274	0.0079	0.23	GCAS
LS Mus	113120	B1.5IIIne	63688	0.0040	0.11	GCAS
48 ν Eri	29248	B2III	21444	0.0064	0.12	BCEP
AX Mon	45910	B2IIIpeShell	31019	0.0077	0.16	I
10 FT CMa	48917	B2IIIe	32292	0.0043	0.11	GCAS
HP CMa	49131	B2III	32385	0.0140	0.35	GCAS
V767 Cen	120991	B2IIIe	67861	0.0085	0.26	GCAS
BW Vul	199140	B2IIIe	103191	0.0091	0.22	BCEP
DD Lac	214993	B2III	112031	0.0049	0.11	BCEP
NSV 4879	91188	B3IIIe	51444	0.0066	0.12	EB
V3792 Sgr	165814	B3III	88905	0.0241	0.46	EB
123 ζ Tau	37202	B4IIIpe	26451	0.0118	0.13	E:

Table 3 (cont.)

Name	HD	Sp. type	HIP	SE	Amp.	Comment
EW Lac	217050	B4IIIep	113327	0.0023	0.16	GCAS
CC Cas	19820	O9IV	15063	0.0033	0.12	EB/DM
V750 Mon	53367	B0IVe	34116	0.0094	0.24	GCAS
FY CMa	58978	B0IV:pe	36168	0.0034	0.11	GCAS
V1294 Aql	184279	B0.5IVe	96196	0.0106	0.25	GCAS
AH Cep	216014	B0.5IV*	112562	0.0082	0.25	EW
13 κ CMa	50013	B1.5IVne	32759	0.0037	0.15	GCAS
NSV 6943	133738	B1.5IV*	74147	0.0046	0.13	GCAS
KP Per	21803	B2IV	16516	0.0029	0.11	BCEP
FV CMa	54309	B2IVe	34360	0.0035	0.27	GCAS
V374 Car	66194	B2IVpne	38994	0.0042	0.11	GCAS
V345 Car	78764	B2IVe	44626	0.0041	0.10	GCAS
QY Car	88661	B2IVpne	49934	0.0042	0.11	GCAS
δ Cen	105435	B2IVne	59196	0.0067	0.13	GCAS
7 χ Oph	148184	B2IV:pe	80569	0.0033	0.15	GCAS
FW CMa	58343	B2.5IVe	35951	0.0079	0.28	GCAS
NT Peg	203699	B2.5IVne	105623	0.0071	0.15	GCAS
V817 Cen	105521	B3IV	59232	0.0097	0.15	GCAS
κ^1 Aps	137387	B3IVe	76013	0.0031	0.10	GCAS
6 V382 Cep	203467	B3IVe	105268	0.0016	0.17	GCAS
V3894 Sgr	161756	B4IVe	87163	0.0072	0.15	EB
V2148 Cyg	201733	B4IVpe	104483	0.0015	0.10	EA
HR 1772	35165	B5IVnpe	25007	0.0031	0.10	EW:
120 V960 Tau	36576	B2IV–Ve	26064	0.0052	0.10	GCAS
28 o CMa	56139	B2IV–Ve	35037	0.0011	0.25	GCAS
V955 Cen	114800	B2IV–Vnep	64578	0.0036	0.11	U
31 IN Peg	212076	B2IV–Ve	110386	0.0094	0.29	GCAS
δ Cir	135240	O8.5V	74778	0.0016	0.15	EA
V1081 Sco	158186	O9.5V	85569	0.0012	0.12	EA
SZ Cam	25639	B0V	19270	0.0393	0.54	EA/DM
EM Cep	208392	B0.5V*	108073	0.0055	0.11	EW
V801 Cas	19243	B1Ve	14626	0.0036	0.10	I
25 ψ^1 Ori	35439	B1Vpe	25302	0.0048	0.15	GCAS
W Ori	36695	B1V	26063	0.0086	0.27	EB
FR CMa	44458	B1Vpe	30214	0.0020	0.13	GCAS
NN CMa	58011	B1Ve	35769	0.0143	0.25	GCAS
V357 Lac	212044	B1Vpnne	110287	0.0043	0.13	GCAS
1 V436 Per	11241	B1.5V	8704	0.0008	0.23	EA/D
ϕ Per	10516	B2Vep	8068	0.0031	0.11	GCAS
V777 Cas	11606	B2Vne	8980	0.0066	0.17	SR
56 DX Eri	30076	B2Ve	22024	0.0041	0.10	GCAS
105 V1155 Tau	32991	B2Ve	23883	0.0074	0.14	U
V434 Aur	37657	B2Vne	26872	0.0051	0.14	I
GU CMa	52721	B2Vne	33868	0.0064	0.22	EB
OT Gem	58050	B2Ve	35933	0.0022	0.19	GCAS
V387 Pup	62753	B2Vne	37675	0.0055	0.12	GCAS

Table 3 (cont.)

Name	HD	Sp. type	HIP	SE	Amp.	Comment
66 V2048 Oph	164284	B2Ve	88149	0.0067	0.17	GCAS
V2119 Cyg	194335	B2Ven	100574	0.0025	0.10	GCAS
66 υ Cyg	202904	B2Vne	105138	0.0037	0.27	GCAS
11 BV Cam	32343	B2.5Ve	23734	0.0033	0.12	GCAS
V695 Mon	65875	B2.5Ve	39172	0.0029	0.12	GCAS
V375 Car	67536	B2.5Vn	39530	0.0042	0.11	BCEP
CO Cir	129954	B2.5Ve	72438	0.0021	0.13	GCAS
CX Dra	174237	B2.5Ve	92133	0.0086	0.17	GCAS
12 V395 Vul	187811	B2.5Ve	97679	0.0043	0.11	GCAS
28 V1624 Cyg	191610	B2.5Ve	99303	0.0021	0.10	SXARI
39 ε Cap	205637	B2.5Vpe	106723	0.0086	0.16	GCAS
OW Pup	60606	B3Vne	36778	0.0073	0.15	GCAS
V462 Car	66768	B3Vn:	39310	0.0067	0.17	EB
V438 Pup	71302	B3V	41250	0.0010	0.17	EA
HR 6274	152478	B3Vnep	82868	0.0031	0.10	I
V543 Lyr	176502	B3V	93177	0.0043	0.10	BCEP
V378 And	217543	B3Vpe	113640	0.0030	0.10	L
LQ CMa	52356	B4Vn	33673	0.0044	0.14	GCAS
PQ Pup	67888	B4V	39866	0.0016	0.16	GCAS
AI Pyx	75112	B4V	43114	0.0069	0.13	GCAS
PP Car	91465	B4Vne	51576	0.0076	0.23	GCAS
V518 Car	92938	B4V	52370	0.0113	0.16	GCAS
θ Cir	131492	B4Vnpe	73129	0.0126	0.27	GCAS
V532 Lyr	171406	B4Ve	90970	0.0013	0.10	GCAS
37 ψ Per	22192	B5Ve	16826	0.0058	0.11	GCAS
15 DV Cam	34233	B5V	24836	0.0013	0.12	EA
V1369 Ori	34959	B5Vp	25011	0.0020	0.21	I
V420 Pup	67698	B5Ve	39834	0.0073	0.27	GCAS
	78190	B5V	44545	0.0022	0.10	SV
V716 Cen	124195	B5Ve	69491	0.0091	0.41	EB/KE
QS Aql	185936	B5V	96840	0.0014	0.11	EA
V379 Vul	187640	B5V	97572	0.0008	0.11	GCAS
V2163 Cyg	204860	B5.5Ve	106145	0.0046	0.13	SR

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V807 Cas IS AN ECLIPSING BINARY STAR

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Name of the object:
V807 Cas = HIP 114552 = GSC 4010_285

Equatorial coordinates:	**Equinox:**
R.A.= $23^h12^m13\overset{s}{.}0$ **DEC.=** $+59°35'59\overset{''}{.}2$	2000.0

Observatory and telescope:
Esteve Duran Observatory, 0.6-m Cassegrain telescope; US Naval Observatory Flagstaff Station, 1.0-m Ritchey–Chrétien telescope

Detector:	CCD in both cases
Filter(s):	B, V, R_c, I_c
Comparison star(s):	GSC 4010_463

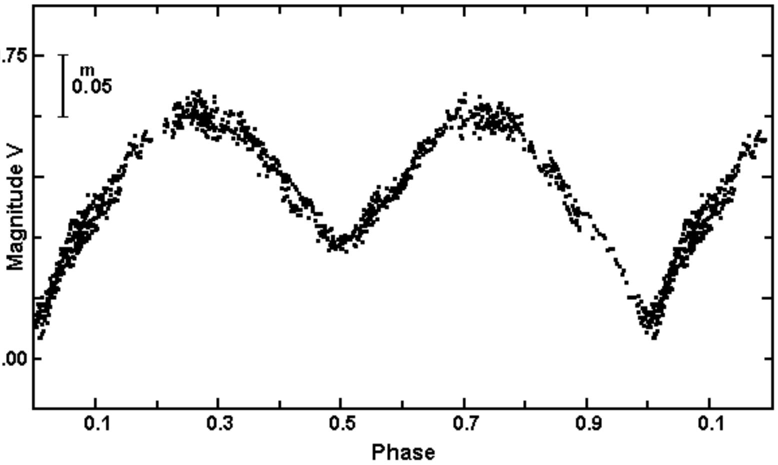

Figure 1.

Check star(s):	GSC 4010_1201

Transformed to a standard system:	Johnson–Cousins
Standard stars (field) used:	Landolt standards (Landolt, 1992)

Availability of the data:
Upon request

Type of variability:	EB

Remarks:

V807 Cas was discovered as a variable star by the Hipparcos mission (ESA, 1997). It was classified as a periodic variable with a $0^{\mathrm{d}}.97463$ period, a mean V magnitude of $10^{\mathrm{m}}.79$, and an average $B-V = 0^{\mathrm{m}}.340$ without specifying variability type. V807 Cas is in the center of PK110–0.1, which was initially classified as the planetary nebula We 1–12. Recent spectroscopic data by Kimeswenger (1998) indicate that V807 Cas has a B1V spectral type, and that We 1–12 is not a planetary nebula but an isolated H II region, as was also suggested by earlier works (e.g. Zijlstra et al. 1990; Kaler and Feibelman 1985). Kimeswenger also claims that V807 Cas is the only source of excitation of the H II cloud.

Our analysis of the satellite data suggested that V807 Cas was actually an EB eclipsing binary star with a period close to twice the one given in the Hipparcos catalogue. To investigate further about the variable nature of V807 Cas, this object was observed in a collaborative program between Esteve Duran Observatory and the U.S. Naval Observatory Flagstaff Station. This star was monitored in the V band for 17 nights, from July to September 1997. Table 1 (available electronically through IBVS Web-site as 5009-t1.txt) lists the standard V magnitudes and color indices of field stars near the variable.

Observations show that V807 Cas is in fact an EB eclipsing binary system with a period close to two days (Figure 1). The phased light curve presents a primary minimum with a depth of 0.18 magnitudes, and a secondary minimum during which the star fades 0.11 magnitudes. At maximum light, V807 Cas has a V magnitude of 10.80 ± 0.01. It was also found an average $B-V = 0.319 \pm 0.003$. After combining our data with HIPPARCOS photometry the following ephemeris was computed:

$$\begin{array}{rll} \text{Min. I} = \text{HJD} & 2450652.428 + & 1^{\mathrm{d}}.949189 \times E. \\ & \pm 0.006 & \pm 0.000015 \end{array}$$

If V807 Cas is actually the source of excitation of PK110–0.1, additional photometric and spectroscopic data might help to solve the system, and obtain a more precise measurement of the H II region distance and its properties.

Acknowledgements:

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

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HD 264300 IS A LOW AMPLITUDE RED VARIABLE

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[3] USRA/USNO, P.O. Box 1149, Flagstaff, AZ 86002-1149, USA, e-mail: aah@nofs.navy.mil

Name of the object:
HD 264300 = BD +05°1417 = GSC 156_1457 = SAO 114441

Equatorial coordinates:	**Equinox:**
R.A.= $6^{\mathrm{h}}48^{\mathrm{m}}30\overset{\mathrm{s}}{.}12$ **DEC.=** $+5^\circ 00' 26\overset{''}{.}92$	2000.0

Observatory and telescope:
Mollet Observatory, 0.41-m Newtonian telescope; U.S. Naval Observatory, 1-m Ritchey–Chrétien telescope

Detector:	CCD
Filter(s):	B, V, R_c, I_c
Comparison star(s):	GSC 156_1475
Check star(s):	None
Transformed to a standard system:	Johnson–Cousins
Standard stars (field) used:	Landolt standards (1992)

Availability of the data:
From the IBVS Web-site as 5010-t1.txt

Type of variability:	L:

Remarks:
While performing observations of the new eclipsing binary star GSC 156_1365 (Gomez et al., 2000) it was found that HD 264300, with a V magnitude of 9.39 ($B-V=1.31$) and K5 spectral type, was slightly variable. The star was observed in the V band for 89 nights from 1997 to 1998. Additional observations were also obtained in the BR_cI_c bands. Data show that during this period the V magnitude of this star fluctuated between 9.32 and 9.42 with an apparent irregular behaviour (Figure 1). The following color indices were obtained for HD 264300: $B-V=1.298\pm0.016$, $V-R_c=0.668\pm0.032$, and $R_c-I_c=0.609\pm0.023$.

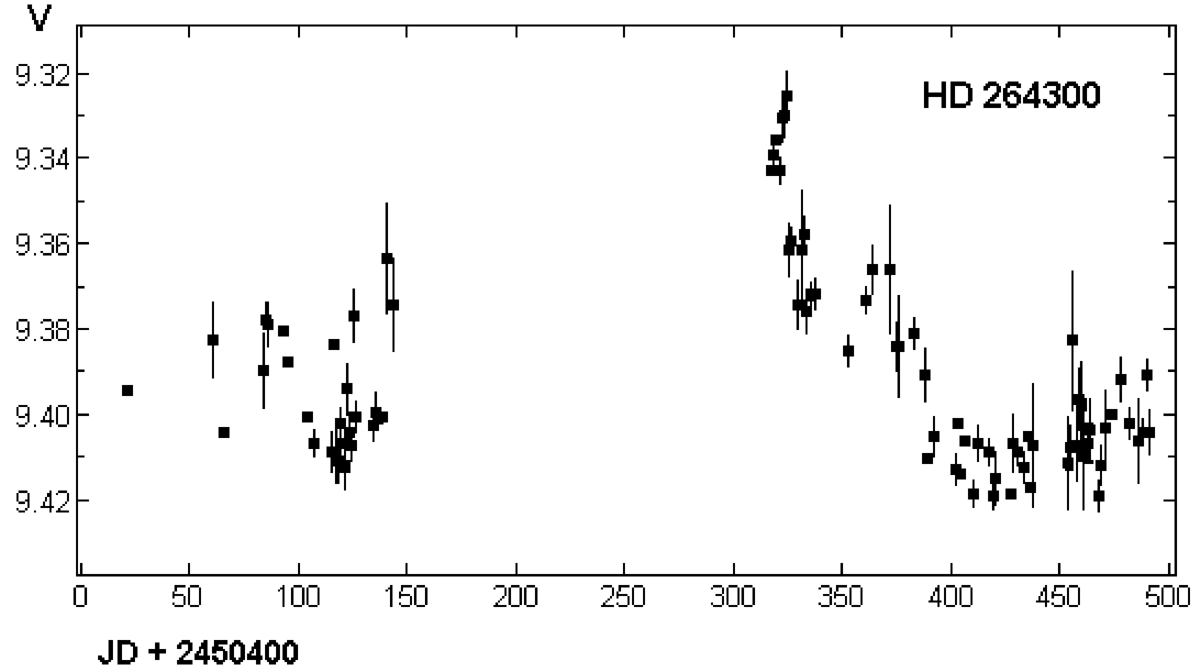

Figure 1.

References:

Gomez-Forrellad, J.M., Henden, A.A., Guarro-Flo, J., 2000, *IBVS*, No. 4972
Landolt, A.U., 1992, *AJ*, **104**, 340

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1994 BV PHOTOELECTRIC OBSERVATIONS OF CG Cyg

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Photometric observations for CG Cyg have been reported previously by Dapergolas et al. (1994); Heckert (1994); Zeilik et al. (1994) and references therein. The star is among the most peculiar ones of the short-period chromospherically active binary stars. As noted by Dapergolas et al. (1994) the system presents irregularities outside of the eclipses and the depths of the minima changes with time. All these suggests that CG Cyg is a complex system, with changing active regions, due probably to photospheric activity.

CG Cyg was observed for the period 4–16 August 1994 with the 1.2-m Kryonerion telescope and a single channel photon counting photometer described by Dapergolas and Korakitis (1987). The photometer employs a high gain 9789QB phototube and conventional B, V filters. Its output is fed to a microcomputer enabling rapid data access. The data reduction method is the standard one and as a comparison star BD $+34^\circ 4216$ was used. The constancy of the comparison star was verified by Milone et al. (1979). The data presented here were obtained with an accuracy of $\pm 0\overset{m}{.}015$. Table 1 lists the dates of observations and phases covered and number of points obtained. Our observations where nearly simultaneous with those of Heckert (1994).

In Table 2 the times of minima and the $O-C$ values are listed for the V and B bands, respectively. Times of minima are calculated using the method described by Kwee and van Woerden (1956) whereas the $O-C$ values were determined from the linear ephemeris $\mathrm{HJD}_{\mathrm{min\,I}} = 2439425.1221 + 0\overset{d}{.}631141 \times E$, given by Milone and Ziebarth (1974).

The data are modeled using the Information Limit Optimization Technique (ILOT) described by Budding and Zeilik (1987). The main assumptions of the ILOT are: (1) the activity in general is most apparent in the hotter (primary) star, (2) maculation effects are separable from proximity and eclipse effects, and (3) a cool circular spot model adequately represents the key parameters of stellar magnetic activity–these are longitude, latitude, size (area), and temperature of the active (spotted) regions.

The derived residuals from the initial fit of Fig. 1a are plotted in Fig. 1c. Then into the distortion wave a circular spot of 0 K temperature was fitted. The results are seen in Table 3. The fits are performed independently for both colours V and B. The results of the spot fitting agree, within the errors, to those found by Zeilik et al. (1994) and Heckert (1994). It is found that the spot for CG Cyg tend to cluster in Active Longitude Belt, around the 270° as it is noticed by Zeilik et al. (1994). We tested several times to fit a

Table 1: Dates of observations and phases covered

JD 2440000 +	Date	Phase	Points V	Points B
9569	04 August 1994	.77 .12	95	81
9570	05 August 1994	.36 .78	113	110
9572	07 August 1994	.56 .84	92	93
9577	12 August 1994	.45 .88	111	113
9578	13 August 1994	.01 .48	134	132
9579	14 August 1994	.67 .09	112	112
9581	16 August 1994	.78 .14	92	91

Table 2: Types and times of minima

Date	Type	V colour HJD 2440000 +	V colour $O-C$	B colour HJD 2440000 +	B colour $O-C$
4/8/1994	I	$9569.4836 \pm .0002$	0.051	$9569.4837 \pm .0001$	0.051
5/8/1994	II	$9570.4324 \pm .0012$	0.554	$9570.4323 \pm .0004$	0.554
12/8/1994	II	$9577.3740 \pm .0006$	0.553	$9577.3742 \pm .0005$	0.553
13/8/1994	I	$9578.3197 \pm .0003$	0.051	$9578.3199 \pm .0001$	0.051
14/8/1994	I	$9579.5821 \pm .0001$	0.051	$9579.5821 \pm .0001$	0.051
16/8/1994	I	$9581.4758 \pm .0002$	0.052	$9581.4758 \pm .0002$	0.052

Table 3: CG Cyg spot parameters

		V band	B band
Longitude	λ_1	276.7 ± 8.0	286.6 ± 7.6
Latitude	β_1	56.2 ± 33.6	62.1 ± 20.3
Radius	γ_1	10.4 ± 4.8	12.0 ± 4.5
χ^2		84.6	87.

Table 4: CG Cyg clean parameters

Filter	L_1	$k = r_2/r_1$	$\Delta\theta_0$	r_1	i (deg)	L_2	χ^2
V	$0.689 \pm .030$	$0.936 \pm .056$	-18.37 ± 0.1	$0.240 \pm .006$	$82.2 \pm .4$	$0.288 \pm .046$	80.5
B	$40.707 \pm .023$	$0.956 \pm .045$	-18.37 ± 0.1	$0.237 \pm .005$	$82.1 \pm .3$	$0.273 \pm .004$	80.8

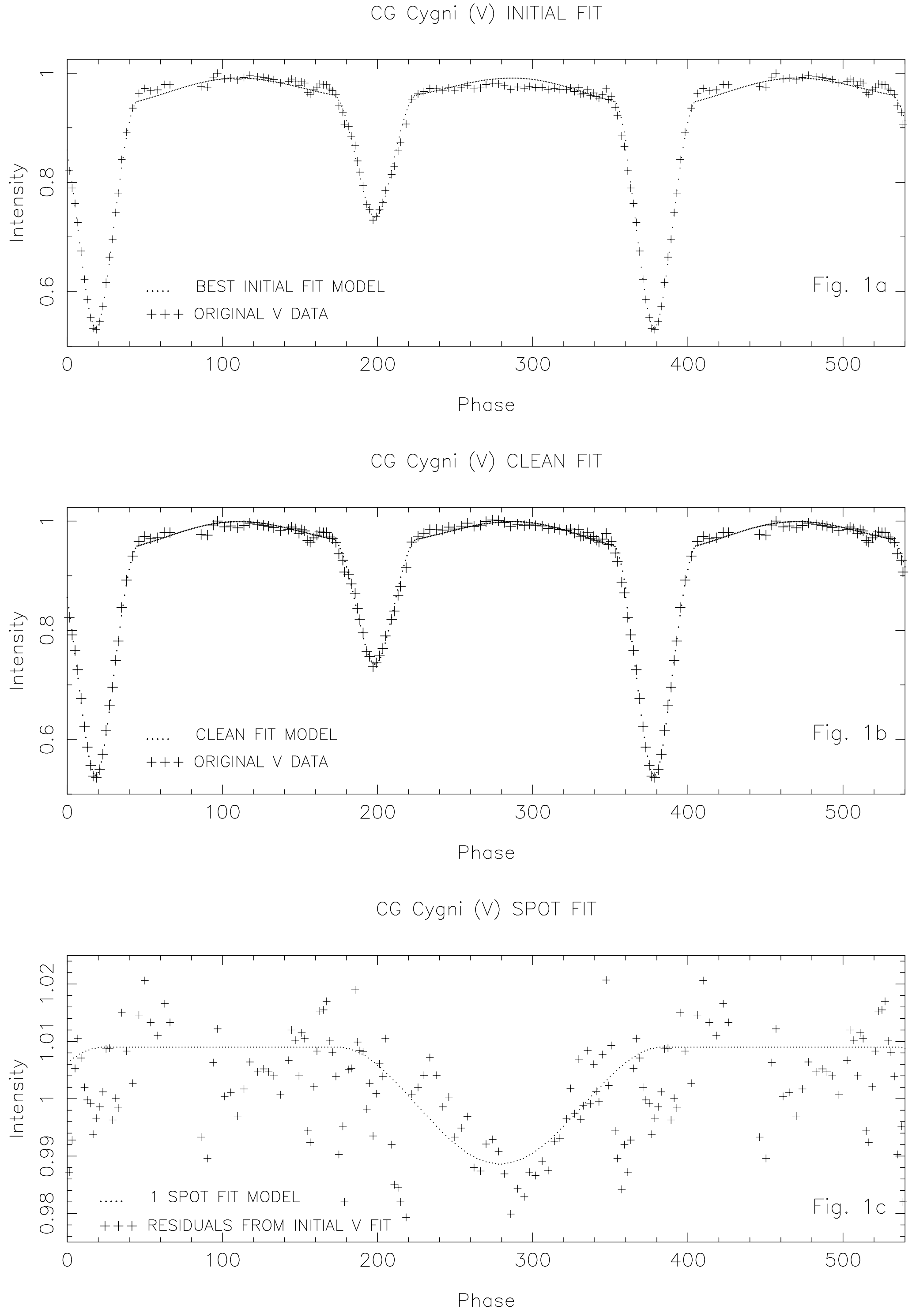

Figure 1. Initial, clean and spot fits. Phases are given in degrees

second spot with fixed latitude at 45°, as it is described by Heckert (1994), but the results were very uncertain. This result means that our data sample with $S/N \approx 75$ is unable to detect small spots. This is in agreement with a series of verification tests of the ILOT programs reported by Rhodes et al. (1990). However, a small distorsion in the observed light curve of the star is seen toward the first quadrature of the system (see spot fit in Fig. 1c). This distorsion was more evident a few days later when the star was observed from Mt. Laguna with the 61-cm telescope (Heckert 2000) and clearly showed a second spot.

The results of spot fitting where inserted in the initial fit model and a clean fits was made (Fig. 1b). So the distortion wave was removed and the clean parameters are seen in Table 4. The values of L_1, k, r_1, i (deg), and L_2 agree with those found by Zeilik et al. (1994) and Heckert (1994). From the results presented in Table 4 assuming constant inclination i and phase correction $\Delta\theta_0$ the mass ratio $q = m_2/m_1$ of the system can be derived. For V colour and for B the values of mass ratio are $q = 0.571 \pm 0.108$ and $q = 0.647 \pm 0.089$ respectively. These values are in agreement with those found by Heckert (1994) and Popper (1993), and strengthen the hypothesis that the mass ratio of CG Cyg is lower than 1.0.

From our data set it seems that CG Cyg changes its spot structure rather rapidly and probably is one of the most active RS CVn type binary system.

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NSV 24505: A SEMIREGULAR VARIABLE

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NSV 24505 (GSC 1578-1162, $18^{\rm h}33^{\rm m}47\overset{\rm s}{.}58$, $+19^\circ 02' 14\overset{''}{.}7$, $V = 11.2$) was found to be variable during the photographic survey conducted by Collins (1992) as part of the UK Nova Search Programme, and reported under the name TAV 1831+19, assigned by *The Astronomer* group. It is not recorded on the True Visual Magnitude Photographic Star Atlas but does appear on the Atlas Stellarum. The NSV designation was given in the recent supplement (Kazarovets et al. 1998) on the basis of Collins' report covering the first three years of observations. Photographic observations have continued up to the present time and an analysis of these, together with additional observations by Takamizawa and Haseda, is presented here.

The variable is the northern component of a close ($\sim 5''$) N-S pair with the slightly fainter star, GSC 1578-1746 ($V = 12.1$). The GSC and USNO A1.0 catalogues give similar positions but the pair does not appear in USNO A2.0. The variable is also identified with the weak infrared source FSC 18315+1859.

Collins' observations were made with a 135-mm fl $f/2.8$ lens and recorded on gas hypered Kodak TechPan 2415 film. Takamizawa and Haseda's observations were both made with 10-cm $f/4$ twin patrol cameras using Kodak T-Max 400 film. The band pass of all the systems giving $m_{\rm pv}$ is very broad. The magnitude of the variable was determined by visual inspection of the films, relative to nearby stars with GSC magnitudes.

The data were analysed using a least-squares sine periodogram, which is shown in Figure 1. The only significant peaks appear at a period of 163 days and its 1-year and 1-day aliases. A fit to the data with this period gives an amplitude, $\Delta m \sim 0\overset{\rm m}{.}7$ which is not unexpected for a semiregular variable. The phase diagram for this period is shown in Figure 2. After subtracting this variation from the data a search for secondary periods revealed nothing. The quantity of data merits a closer look at the light curve, which is shown in some detail in Figure 3. Different types of behaviour are clearly visible at different times. A strong cyclical, pattern consistent with the 163 day period can be seen (JD $\sim$ 2447600, 2449000) but there are also very rapid variations, where the whole magnitude range is covered in $\sim$ 30 days (JD $\sim$ 2448350, 2449850), and cycles with only marginal variation (JD $\sim$ 2448000, 2451300). Recent visual observations discussed by Collins et al. (2001) suggest more rapid variations, although their extent is difficult to assess.

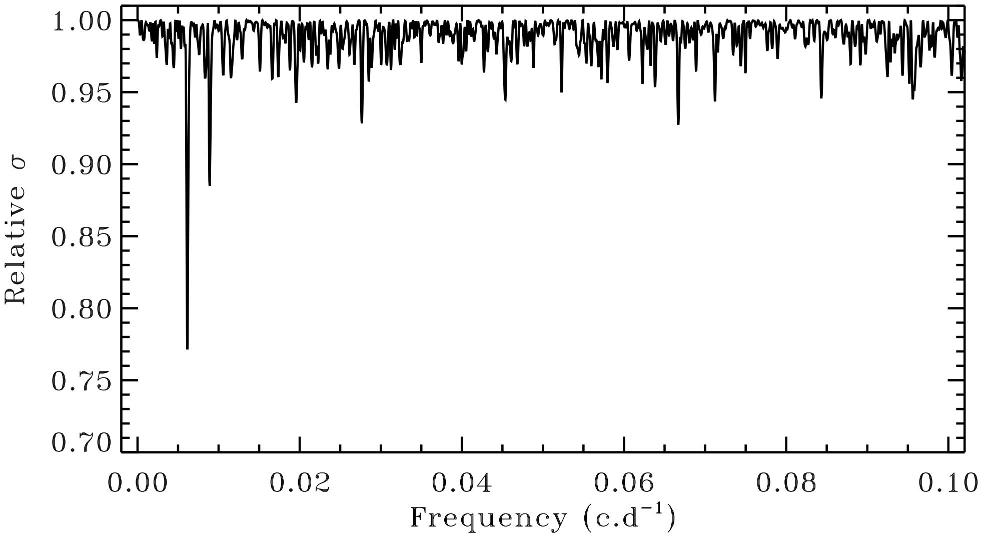

Figure 1. The least-squares sine periodogram of all the photographic data, showing the relative standard deviation with frequency. The main feature lies at a period of 163 days, while the second feature is the 1-year alias. Other than the 1-day aliases there are no significant features above 0.1 cycles day^{-1}

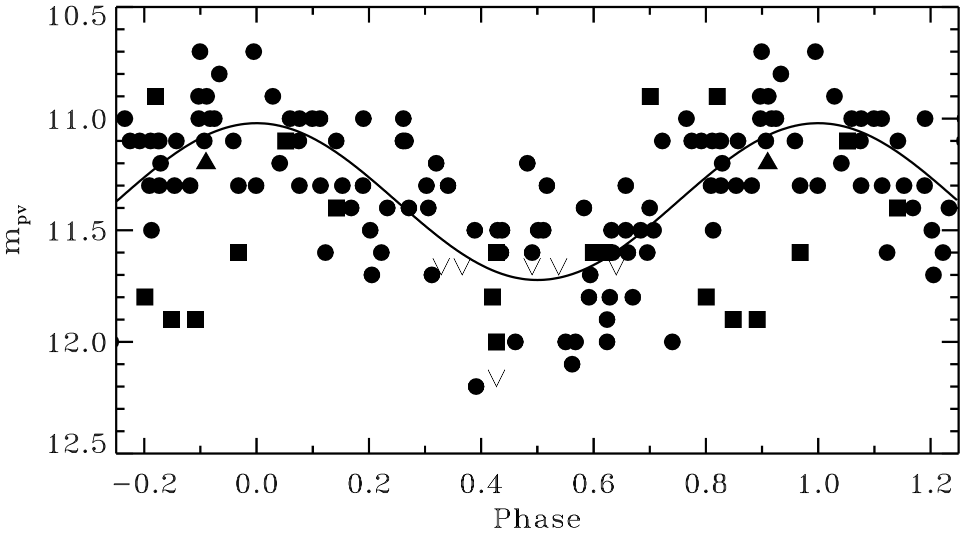

Figure 2. The phase diagram of the photographic data folded with a period of 163 days, with the data of Collins (filled circles and upper limits), Takamizawa (filled squares) and Haseda (filled triangles) identified

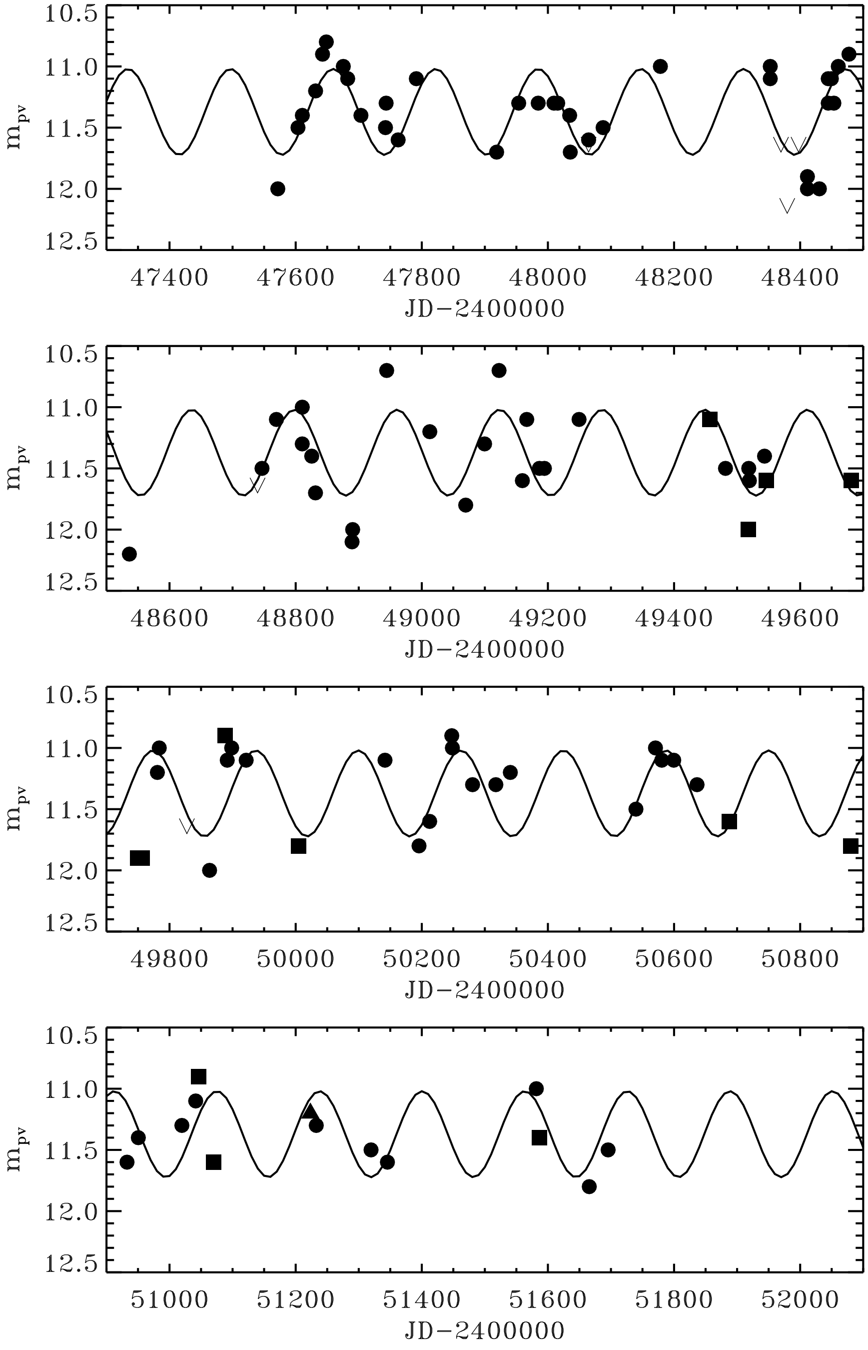

Figure 3. Light curve of NSV 24505 for 1989–2000, from the photographic observations. The same symbols are used as in Figure 2. Each panel shows 1200 days and the different phases of cyclical, marginal and rapid variation can be seen. The mean light curve from Figure 2 has been over plotted

NSV 24505 is shown to be a semiregular variable with a basic period of 163 days, which has remained viable through over ten years of data. Significant additional variation in the form of larger and more rapid variations are superimposed together with periods of reduced activity. There do not appear to be any significant secondary periodicities.

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Hα OBSERVATIONS OF T CrB

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The recurrent nova T Coronae Borealis is classified as a symbiotic star with one of the shortest orbital period, as well as the longest period cataclysmic variable. Hα observations have been obtained by Anupama & Prabhu (1991), Anupama (1997), and Hric et al. (1998). Variability and orbital modulation of the equivalent width were reported in these papers.

Here we present new Hα data acquired during the last years. The Hα observations of T CrB were obtained during the period February 1993–September 2000 with the Coudé spectrograph of the 2.0-m RCC telescope at the Bulgarian NAO “Rozhen” using different CCD detectors. The data processing has been done with the IRAF software package. The equivalent widths (EW) of the Hα emission lines are measured relatively to the local continuum and are summarized in Table 1. The typical error of the measurements is about 10 per cent.

Hereafter, we will use the spectroscopic ephemeris $T_0 = \mathrm{JD}\ 2447918.62 + 227\overset{\mathrm{d}}{.}5687 \times E$ of Fekel et al. (2000). The zero epoch corresponds to a time of maximum velocity of the red giant.

The long term behaviour of the EW(Hα) is presented in Fig. 1a. The data before JD 2448500 are from Anupama & Prabhu (1991). The data after it are our observations and four measurements by Mikołajewski et al. (1997). A new maximum is observed sometimes between JD 2450600–2450900 when the EW(Hα) reached values ≥ 20 Å. It decreased slowly to values < 5 Å after this maximum. This behaviour is more or less similar to variability observed around JD 2447000. In both cases the EW reached values ~ 30 Å and dropped to < 5 Å on a time scale of about 1000 days, although the evolution in the former one seems to be slightly steeper.

The highest values in our data set are EW(Hα) ≥ 30 Å. It deserves to be noted that our highest values are at phase 0.36 of the $227\overset{\mathrm{d}}{.}5687$ period. Anupama & Prabhu (1991) observed extreme values at a close orbital phase, i.e. EW(Hα) ≥ 35 Å at JD 2446860, corresponding to orbital phase 0.35. Analyzing photographic and visual light curves, Peel (1990) discovered a tendency for short lived brightenings to occur at phases 0.33 and 0.20 (recalculated in terms of the ephemeris used here). The flare like events of 1963 and 1975 (see Palmer & Africano 1982 and references therein) are at phases 0.55 and 0.38 respectively. All these results support the idea that short lived eruptions occur sometimes, most probably around phase ~ 0.35.

Table 1: Hα observations of T CrB

HJD 2400000 +	EW [Å]	HJD	EW	HJD	EW	HJD	EW
49024.62	7.5	50244.29	16.9	51007.41	13.4	51247.41	10.3
49027.62	6.4	50321.35	14.6	51028.28	14.9	51247.49	11.2
49180.49	3.1	50564.52	18.4	51028.37	13.9	51441.30	5.9
49225.43	6.8	50565.48	20.4	51029.28	14.9	51441.31	6.5
49353.63	5.7	50566.36	21.2	51029.35	14.9	51632.53	7.3
49353.65	5.8	50618.34	28.4	51030.35	15.1	51632.55	7.0
49356.64	4.4	50705.23	18.2	51030.36	14.6	51681.31	4.3
49376.54	3.7	50705.24	17.8	51031.26	14.0	51681.33	4.5
49491.51	3.2	50732.19	30.0	51031.28	14.4	51717.38	6.5
50115.55	5.3:	50732.21	31.3	51091.23	11.5	51742.30	4.2
50181.47	15.4	50881.48	13.8	51091.24	11.0	51742.32	4.6
50182.40	19.6	50919.45	20.8	51096.25	9.8	51774.27	5.4
50182.54	18.3	50919.50	21.0	51096.26	10.1	51774.28	5.5
50211.39	12.8	50923.48	20.7	51184.59	6.4	51775.31	4.7
50212.48	17.4	50969.30	13.4	51184.61	7.3	51805.27	2.4
50242.32	13.3	51004.29	12.7	51185.63	8.4		
50243.31	14.0	51005.40	11.9	51185.66	9.5		
50244.44	17.4	51006.43	13.6	51186.58	7.6		

It is difficult to say what can be the reason for this short flare like events. Most probably they are resulting from increase of mass transfer. However, the orbit is assumed to be almost circular, with eccentricity $e < 0.02$, and perhaps this is a spurious eccentricity, result of tidal effects (Kenyon & Garcia 1986; Belczyński & Mikołajewska 1998). In any case it is remarkable that the majority of the brightening events (of the EW(Hα) and the optical magnitude) takes place around ~ 0.35.

In the previous investigations, a modulation of the EW(Hα) with the orbital phase has been supposed (i.e. Hric et al. 1998). We performed periodogram analysis applying PDM (Stellingwerf 1978) and CLEAN (Roberts et al. 1987) algorithms. We used the whole data set and different subsets, with and without subtraction of fit to the data. The fits were low order polynomial over the whole data set or over the lower values only. Very weak traces of the orbital period are visible only when we use our data after removing the highest values, i.e. using only the points with EW < 25 Å. The corresponding periodogram is plotted in Fig. 1b.

In Fig. 1c we plotted our data folded with the orbital period of 227.5687 days. In this panel the circles represent values less than 25 Å, and the crosses refer to EW > 25 Å. As the crosses are very different from the other measurements, we suppose that the extreme values above 25 Å are caused by short lived brightenings. If we have in mind the circles only (i.e. EW < 25 Å) two maxima appear to be visible. One is at phase about 0.9–1.2 and the second at 0.6. They are shifted relatively to the maxima detected by Hric et al. (1998), even if we use the same ephemeris. It is worth noting that in Fig. 1c the data are plotted without subtracting any fit. The fact that our maxima are shifted relatively to those detected by Hric et al. (1998) points out that the variability of the Hα induced by the binary rotation, is not very stable, if it exists at all. Hric et al. (1998) suggested that the orbital modulation of Hα might be a result of the presence of two other emitting

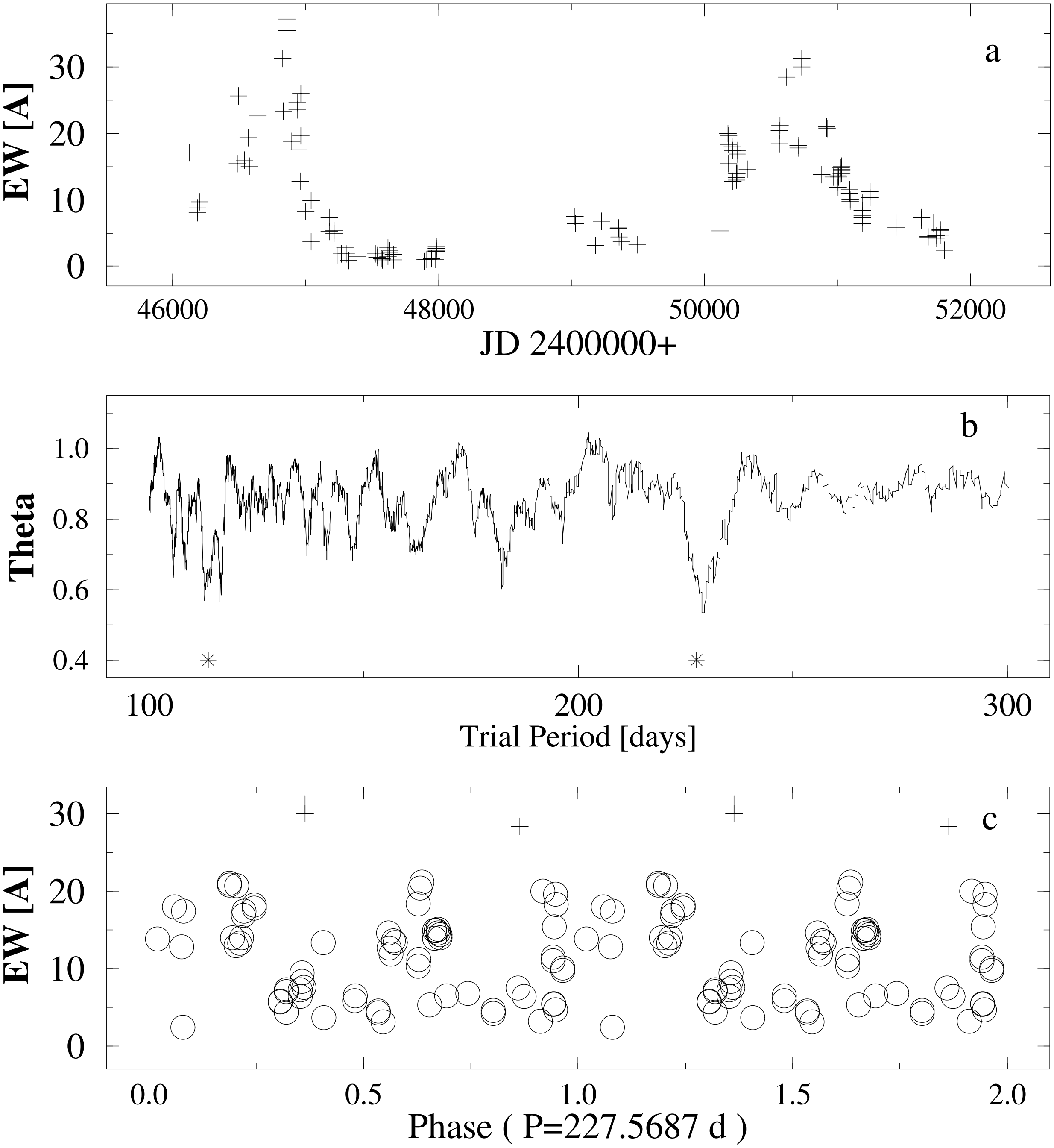

Figure 1. The EW(Hα) variability of T CrB. **a)** The long term behaviour. Two maxima are visible about JD 2446800 and about JD 2450700. **b)** Periodogram for the EW(Hα) using only our data and values less than 25 Å. The asterisks indicate the orbital and half orbital period. **c)** Our EW(Hα) observations folded with the orbital period. The circles refer to EW $<$ 25 Å, and the crosses refer to EW $>$ 25 Å

regions (which emission is superimposed on the emission of the accretion disk) — one identified with the gas stream through the inner Lagrangian point (L_1) and the second fed by matter rotating around the hot component but not captured by the accretion disk. The shift of our maxima as well as the big scatter indicate that the position of these two regions is probably variable. This could be a result of variability of the mass transfer rate, the angular momentum transfer rate, or/and variability of the size of the accretion disk.

It deserves noting that the IUE observations of the integrated UV-flux (1250–3200 Å) during the period JD 2446000–JD 2447200 do not exhibit considerable variations (Selvelli et al. 1992). In the same time (see Fig. 1a) the EW(Hα) shows an increase from 10 Å to 30 Å followed by a decrease to values less than 5 Å. Because the integrated UV flux is a good representation of the mass accretion rate, this points out that the variability of Hα is probably a result of changes in the angular momentum accretion rate and the size (and/or the structure) of the accretion disk rather than changes in the mass accretion rate.

High resolution observations and analysis of the Hα emission line profiles could throw a new light over this issue.

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THE EUV SOURCE HD 52452: DISCOVERY OF A LIKELY TRIPLE SYSTEM

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HD 52452 (BD +26°1435 = SAO 78998, $V = 7.96$) has been identified by Mason et al. (1995) as the optical counterpart of the EUV bright source RE J70222+255054 detected in the Wide Field Camera all-sky survey by ROSAT (Pounds et al. 1993). It is reported in the Tycho Catalogue (TYC 1899 688 1) as a suspected variable with a parallax of 17.0 ± 6.4 mas (Perryman et al. 1997) and it is classified as a G5 star in the SIMBAD database. HD 52452 has been included since late 1994 in a program of spectroscopic and photometric observations aimed at the classification of EUV stellar sources detected by EXOSAT and ROSAT (Cutispoto et al. 1999, 2000). In this paper we report on the discovery of the optical variability of HD 52452 and on its inferred spectral classification.

The UBV photoelectric photometry presented here were collected from 16 November 1994 to 23 February 1995 by the 80-cm Automated Photometric Telescope (APT-80) at the *M. G. Fracastoro* station of Catania Astrophysical Observatory on Mt. Etna (1725 m *a.s.l.*). The APT-80 feeds a single channel charge-integration photometer equipped with an uncooled Hamamatzu R1414 SbCs photomultiplier and Johnson's standard UBV filters. The differential photometry of HD 52452 (**v**) was made using HD 52071 (K2III; $V = 7.12$; $B - V = 1.26$, $U - B = 1.27$) as comparison star (**c**), and HD 51530 (F7V; $V = 6.21$; $B - V = 0.51$, $U - B = -0.01$) and HD 50692 (G0V; $V = 5.77$; $B - V = 0.60$, $U - B = 0.05$) as check stars ($\mathbf{ck}_1$ and $\mathbf{ck}_2$, respectively). Ten seconds integrations in the U, B and V filters and an observing sequence $\mathbf{ck}_2$–**c**–$\mathbf{ck}_1$–**c**–**v**–**v**–**v**–**c**–**v**–**v**–**v**–**c** were adopted. After sky background subtraction, the measurements were corrected for atmospheric extinction. Normal points were computed by averaging each sequence of six $\mathbf{v} - \mathbf{c}$ differential values and transformed into the UBV Johnson standard system (Table 1). The typical standard deviations of the normal points are of the order of $0\overset{\mathrm{m}}{.}01$ in V and B filters and $0\overset{\mathrm{m}}{.}015$ in the U filter. No significant light variations were detected from the differential measurements of the comparison and check stars. During the whole observing period these stars were constant within about $\pm 0\overset{\mathrm{m}}{.}015$ in the V-band.

From the present data HD 52452 resulted to be variable with a peak-to-peak amplitude of $\Delta V \simeq 0\overset{\mathrm{m}}{.}16$. The set of photometric data was analysed using a Scargle–Press period search routine (Scargle 1982, Horne & Baliunas 1986) and a photometric period $P = 0.42304 \pm 0.00015$ day, with a *false-alarm-probability* FAP = 8.1%, was found. Fig. 1 shows the V-band, $B - V$, and $U - B$ light curves for the mean epochs 1994.92 (open

Table 1: Heliocentric Julian day, rotational phase, V magnitude, $B-V$ and $U-B$ colours of HD52452. Phases are reckoned from the photometric ephemeris HJD = 2449672.0 + $0\overset{\mathrm{d}}{.}42304 \times E$

HJD	Phase	V	$B-V$	$U-B$
2449672.6213	0.468	8.005	0.691	0.221
2449682.6683	0.215	7.959	0.706	0.206
2449683.6579	0.554	7.986	0.720	0.221
2449699.6492	0.351	8.001	0.702	0.218
2449700.6261	0.660	8.042	0.702	0.227
2449701.4792	0.676	8.040	0.690	0.218
2449703.5877	0.660	8.032	0.698	0.234
2449752.5680	0.428	7.986	0.724	0.228
2449754.4465	0.868	8.125	0.718	0.213
2449756.4505	0.604	8.008	0.699	0.221
2449757.4588	0.987	8.070	0.723	0.238
2449761.4301	0.374	7.996	0.697	0.196
2449766.4177	0.162	7.957	0.705	0.223
2449768.4409	0.944	8.116	0.714	0.229
2449771.4734	0.112	7.972	0.690	0.214
2449772.4665	0.459	7.975	0.699	0.200

triangles) and 1995.12 (filled circles). Phases are reckoned using the ephemeris HJD = $2449672.0 + 0\overset{\mathrm{d}}{.}42304 \times E$. The V-band light curve is double peaked and shows no evidence of eclipses. Both $B-V$ and $U-B$ colours are constant within the photometric precision.

HD 52452 was observed spectroscopically with the McMath telescope (Kitt Peak, AZ) in October 12, 14 and 17, 1994. The 12 and 14 October high resolution spectra were collected in the Li I 6708 Å region (Fig. 2). These spectra show the existence of two components: a rather fast ($v \sin i = 14 \pm 2$ km s^{-1}) and a very fast rotating star ($v \sin i \geq 60$ km s^{-1}). The Li I line was not detectable (EW < 4 mÅ). The 17 October spectrum was collected in the Hα region (Fig. 3): only the very fast rotating component is visible and the Hα is partially filled-in. The procedures of spectroscopic observation, reduction and analysis are given in Cutispoto et al. (1999, 2000).

The lack of Li, implying that the star is not young, and the very high rotation of one of the two visible components strongly suggest that the very fast rotating star is an SB1 close binary system, whose high rotation rate is attributable to tidal coupling. Assuming for this SB1 component an inclination of the orbital plane $i < 50$ degrees (which is an upper limit for the SB1 to be non eclipsing), and by using the method described by Cutispoto et al. (1999, 2000), we infer that HD 52452 is a triple system consisting of a G4V + late-G very fast rotating SB1 and a G5:V slower rotating companion. This spectral classification ($M_V \simeq 3.8$, $D \simeq 68$ pc) is in fairly good agreement with the absolute magnitude of HD 52452 derived from the distance listed in the Tycho catalogue ($D = 59^{+35}_{-16}$ pc).

In order to compute the X-ray luminosity of HD 52452 we converted into flux the Count Rate (CR) and Hardness Ratio (HR) values from RASS–BSC (Rosat All Sky Survey–Bright Source Catalogue) using as conversion factor ECF = $(8.31 + 5.30\mathrm{HR}) \times 10^{-12}$ erg cm^{-2} given by Fleming et al. (1995). By adopting a distance of 68 pc, the X-ray luminosity, in the 0.2–2.5 keV energy band, turns out to be $L_{\mathrm{X}} = 5.0 \times 10^{30}$ erg sec^{-1}.

On the basis of the currently available data, we are confident that HD 52452 is a triple system consisting of a tidally coupled G4V + late-G SB1, which rotates with a period

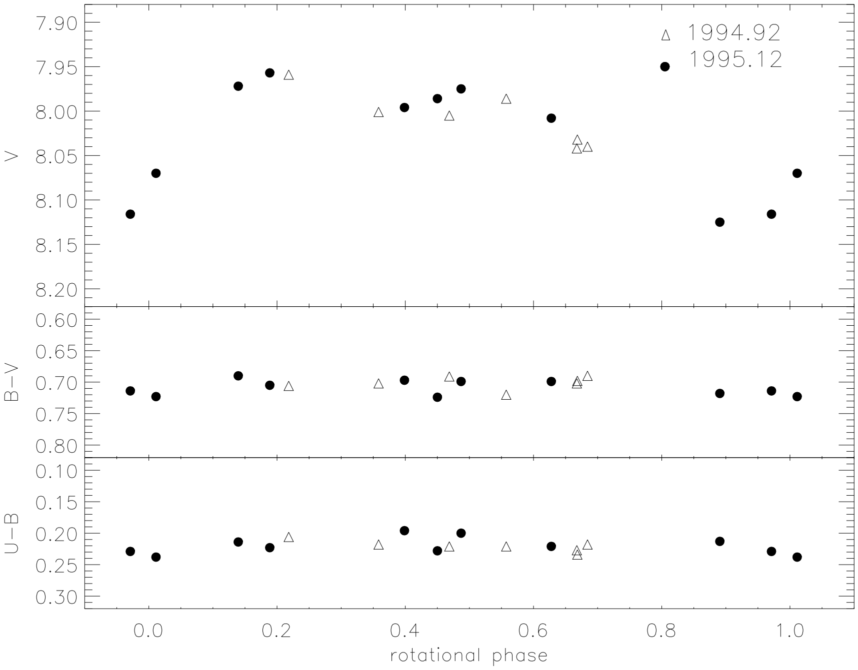

Figure 1. The V-band, $B-V$, and $U-B$ light curves for the mean epochs 1994.92 (open triangles) and 1995.12 (filled circles). Phases are reckoned using the ephemeris HJD $= 2449672.0 + 0\overset{\mathrm{d}}{.}42304 \times E$

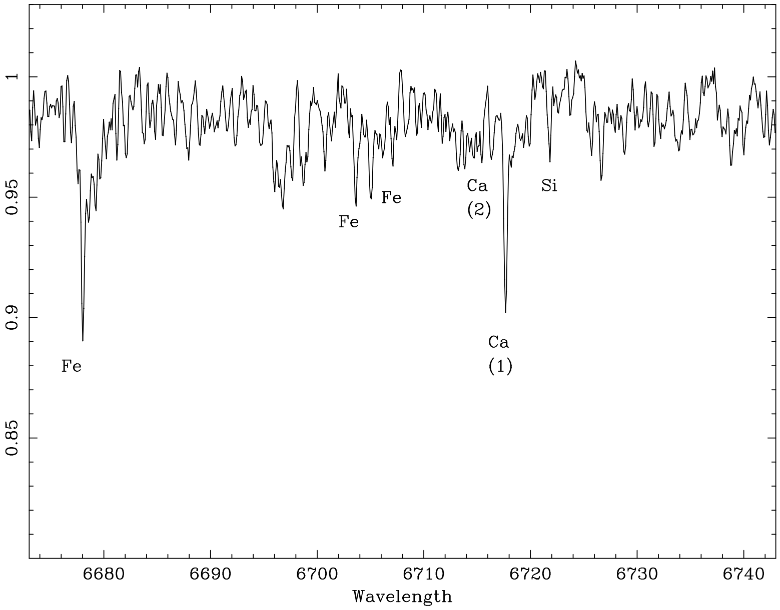

Figure 2. The October 12, 1994 spectrum of HD 52452 in the Li 6708 Å region. The rather fast ($v \sin i = 14 \pm 2$ km s^{-1}) and a very fast rotating star's components ($v \sin i \geq 60$ km s^{-1}) are visible

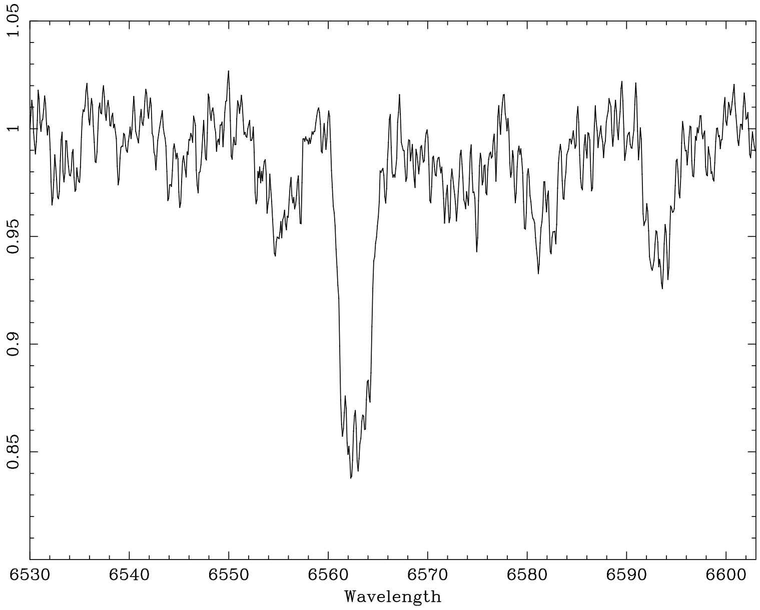

Figure 3. The October 17, 1994 spectrum of HD 52452 in the Hα region. Only the very fast component is visible and the Hα line is partially filled-in

of $P \simeq 0\overset{d}{.}423$ and it is responsible for most of the observed optical variability, and a G5:V companion. The observed photometric variability is likely to be attributable to the presence of cool spots on the photospheres of both components of the SB1 system. However, a non negligible contribution to the observed optical variability, though not revealed by our periodogram analysis, may come from the G5V star, whose rotation, according to the above mentioned *vsini*, spectral classification and inclination of the orbital plane, is expected to be quite fast ($P \sim 2\overset{d}{.}5$).

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HISTORICAL ARCHIVE PHOTOMETRY OF μ CEPHEI

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One aspect of proposed "virtual observatory" schemes that is largely ignored is making available archival data in the published literature. In the case of variable stars these provide a crucial element missing from the mass of contemporary data: significant temporal baselines. For many variables the actual published dataset is quite meager. For short-period variables (*e.g.* RR Lyrae and eclipsing variables), often only times of minimum/maximum are published, but not the observations from which these were derived. Thus the data cannot be reanalyzed with current methods to measure phase and period changes, for example. Nevertheless, the total number of observations available is comparable to the all the amateur visual data collected by international variable-star organizations. Yet it remains "hidden" both by incomplete on-line bibliographic indexing and by the simple fact that much of the data are in what are now considered to be obscure journals and observatory publications, most no longer published at all.

As a way of indicating what is available for one bright, well-studied variable, I have collected visual estimates and BV photoelectric photometry for μ Cephei (HR 8316 = HD 206936), Herschel's "Garnet Star", the fourth-magnitude M-supergiant in southern Cepheus near the IC 1396 nebula complex. The star has been well-observed visually for over 150 years, despite its rather small amplitude, which makes meaningful visual magnitude estimates difficult.

The historical visual data has been thoroughly summarized by Hassenstein (1938), who provided about 2100 mean values from some 10,000 observations by numerous observers. About half the data are by a single observer, Joseph Plassmann, whose remarkable and consistent series covers a 55-year interval. The data in Hassenstein's monograph extend from the year 1848 to 1938, and include dense series of visual observations in the 1930s by Plassmann and by the well-known astronomer Dean McLaughlin (1946), as well by Hassenstein himself. Roughly another 5000 observations are worked over. The whole collection is placed on a common photometric zero-point, which from internal evidence turns out to be very nearly $m_v = V + 0.2$. About half a dozen individual observations spanning $\sim 20^{\rm d}$ goes into each mean value. I have excluded most of the data given only in the text (rather than the main table of the appendix), since these add very little, and are often noted by Hassenstein as being unsatisfactory (just too scattered) even after systematic errors are taken into account.

Hassenstein's compendium has no large gaps apart from a span of somewhat more than a year in 1866-67, and the ten years ending in 1882, when Plassmann started observing the star. Several hundred important early observations were made by Julius Schmidt, Friedrich Argelander, and Eduard Heis.

The 1938 monograph and a later paper (Hassenstein 1954) include some 200 *photoelectric* observations made using the Potsdam 30cm refractor with an unfiltered blue-sensitive tube. The magnitude differences supplied for the comparison stars (the red giants 12 Cep = HD 207528 and 20 Cep = HD 209960) match the standard B system within $0\overset{m}{.}01$, so I have used modern B magnitudes for those stars to derive B for μ Cep in the lists. (Hassenstein published magnitudes with the zero-point adjusted to that of the visual system of the 1938 monograph—reasonable at the time—but luckily he also showed magnitude *differences* in his tables.) The night-to-night *rms* scatter in these data is $0\overset{m}{.}03$ to $0\overset{m}{.}05$, versus $\sim 0\overset{m}{.}15$ for the visual data. The main value in the photoelectric data is to show that the visual observations by Plassmann and McLaughlin in the 1930s are excellent, and to extend the dataset until 1940.

Larsson-Leander (1963) obtained about five years of V and $P-V$ (similar to $B-V$) photoelectric observations of high-quality ($rms \sim 0\overset{m}{.}015$ in V) in the late 1950s. The data density is such that it can replace the visual record of the star for this interval. Indeed, Larsson-Leander compares the contemporaneous AAVSO lightcurve with his photoelectric series, showing that the visual data indicate spurious activity when the star was constant—another indication of the difficulty of visual observations of small-amplitude variables.

More recently, photoelectric observations have been made rather intermittently, but even so, a significant range of Julian dates is covered with data that is superior to the visual record. Useful series have been published by Johnson *et al.* (1966), Coyne & Kruszewski (1968), and by Krisciunas (1986). A longer series has been published by Dombrovsky *et al.* (1968, 1970, 1971, 1972, 1974), and continued by Polyakova (1975, 1978), as part of work on the variability of polarization in this and other late-type variables.

To the best of my knowledge this is the sum of published visual and broadband photoelectric data on the star not included in amateur variable-star databases, and is not published electronically (*e.g.* Hipparcos). Percy *et al.* (1996) describe photoelectric observations obtained by members of the AAVSO. These 456 observations cover an interval of 2200 days (Dec. 1986–Dec. 1992); the data were not published with the paper, but are available by request from the AAVSO. In a recent conference poster, Percy *et al.* (2001) indicate they have obtained a further ten-year series of photoelectric observations using robotic telescopes, which will significantly extend the photometric record for the star.

The archival data have been analyzed many times (*e.g.* Ashbrook *et al.* 1954, Sharpless *et al.* 1966, Polyakova 1975). It is worth noting that Ashbrook *et al.* and Sharpless *et al.* use only the Plassmann data from the Hassenstein monograph, but interpolated it so as to produce a uniform 40^{d} sampling interval, reducing the dataset to some 500 points, which was required for their relatively primitive lightcurve analysis. Even the more elaborate analysis of Mantegazza (1982) restricts itself to this coarsely-binned dataset excluding all modern data. Polyakova is the only author to include photoelectric data in her analysis. Finally, an analysis of recent visual data by Brelstaff *et al.* (1997) remains the best available despite its restricted dataset. Specifically, they show that periods found by others near 700^{d} and 950^{d} are aliases of a $\sim 850^{\mathrm{d}}$ period nearly always present in the data since 1848, where the star dips down to $m_v = 5.0$–5.2.

The historical data files are separated into four sections as follows:

`5015-t1.txt` (62 kB),
`5015-t2.txt` (11 kB),
`5015-t3.txt` (7 kB),
`5015-t4.txt` (7 kB).

These are plain ASCII tables showing Julian Dates, magnitudes, colors, and bibliographic information. `5015-t1.txt` contains the bulk of the old visual observations assessed and homogenized by Hassenstein; `5015-t2.txt` gives Hassenstein's own visual and photoelectric observations, including delta-magnitude values; `5015-t3.txt` lists Larsson-Leander's photoelectric observations; `5015-t4.txt` shows photoelectric observations from other sources mentioned above. The files are accessible in the IBVS website, and copies of the files have been submitted to the 'vsnet' service (`http://www.kusastro.kyoto-u.ac.jp/vsnet`), and will also be kept at the Lowell Observatory ftp area (`ftp://ftp.lowell.edu/pub/bas/varseq`).

In any future study of the star's variability, these data should of course be merged with the visual observations that continue to be collected nightly by amateur observers worldwide, and archived by various international variable-star organizations. Indeed, it is easy to propose that groups such as the AAVSO, BBSAG, AFOEV, and the Kyoto 'vsnet' organization should spearhead the effort to get the old data into machine-readable form and perform the task of reducing them to a homogeneous photometric scale. Large numbers of fields presently have photoelectric/CCD sequences published to facilitate this. More generally, for stars brighter than about 11^{m} it is now possible to use the Tycho-2 photometry, corrected to the Johnson system (*e.g.* Bessell 2000), to make zero-point and scale adjustments to the comparison stars and observations of visual and photographic data. Upcoming photometric surveys should allow this calibration to be extended to the faintest variable stars in the literature.

I would like to thank Greg Shelton (USNO–Washington Library) for providing a copy of one of the Leningrad *Trudy* papers. I also appreciate comments on this report received from John Greaves and John Percy.

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PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES AND NEW ELEMENTS FOR SEVERAL STARS

(BAV MITTEILUNGEN NO. 132)

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In this 43rd compilation of BAV results, photoelectric observations obtained in the years 1999 and 2000 are presented on 79 variable stars giving 164 minima. All moments of minima 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: Eclipsing binaries

Variable	Min JD 24...	±	Obs	$O-C$			Fil	Rem
UU And	51464.3767	.0002	RAT RCR	+0.0242		GCVS 85		1)
	51467.3489	.0001	RAT RCR	+0.0238		GCVS 85		1)
WZ And	51471.3449	.0001	RAT RCR	+0.0157		GCVS 85		1)
XZ And	51512.3884	.0005	QU	+0.0981		GCVS 85	$-Ir$	5)
AA And	51468.3842	.0005	AG	−0.0836		GCVS 85	BV	2)
AB And	51518.3213	.0010	ATB	−0.0148		GCVS 85		1)
AD And	51426.4966	.0007	AG	−0.0497		GCVS 85	BV	2)
BL And	51436.32 :		RAT RCR	+0.00		GCVS 85		1)
	51469.5533	.0002	RAT RCR	+0.0004		GCVS 85		1)
LO And	51398.4927	.0014	AG	+0.0061		GCVS 85	BV	2)
	51426.4533	.0005	AG	−0.0259	s	GCVS 85	BV	2)
OT And	51425.4354	.0020	HSR				V	4)
RY Aqr	51487.2327	.0005	KI	−0.0540		GCVS 85	$-Ir$	1)
EL Aqr	51498.3045	.0009	KI	+0.0016		GCVS 85	$-Ir$	1)
OO Aql	51393.4238	.0002	KI	+0.0097		GCVS 85	$-Ir$	1)
V343 Aql	51412.3794	.0004	KI	−0.0342		GCVS 85	$-Ir$	1)
V417 Aql	51378.4357	.0004	AG	−0.0446		BAVR 2)	BV	2)
	51388.4348	.0003	KI	−0.0440		BAVR 2)	$-Ir$	1)
HP Aur	51425.5903	.0010	HSR	+0.0420		GCVS 85	V	4)
HW Aur	49643.5194		MS	−0.0006		BAVM 132		1)
	49952.5912	.0022	MS	−0.0007	s	BAVM 132		1)
	49978.4964	.0026	MS	+0.0013	s	BAVM 132		1)
	50034.4235	.0007	MS	+0.0011		BAVM 132		1)
	50043.2526		MS	−0.0004	s	BAVM 132		1)
	50432.3915	.0011	MS	+0.0022		BAVM 132		1)
	50445.3368	.0018	MS	−0.0040		BAVM 132		1)
	50718.5046	.0009	MS	+0.0031		BAVM 132		1)
UW Boo	51317.5015	.0004	AG	−0.0010		GCVS 85	BV	2)

Table 1 (cont.)

Variable	Min JD 24...	±	Obs	$O-C$			Fil	Rem
AW Cam	51470.2999	.0001	DIE	−0.0024		GCVS 85		7)
FF Cnc	51534.4134	.0021	FR	−0.0723	s	BAVM 65		5)
YZ CVn	51322.4894	.0002	RAT RCR					1)
BO CVn	51362.4360	.0005	AG				*BV*	2)
SX Cas	51387.497		BRN STK	%−17.139		GCVS 85		4)
TV Cas	51392.4253	.0005	AG	−0.0112		GCVS 85	*V*	1)
	51430.4889	.0008	AG	−0.0121		GCVS 85	*B*	1)
AE Cas	51423.5381	.0002	RAT RCR					1)
AX Cas	51430.4630	.0001	RAT RCR	−0.0606		GCVS 85		1)
BH Cas	51430.404 :	.002	AG					1)
CW Cas	51546.2919	.0010	AG	−0.0570		GCVS 85	*BV*	2)
MM Cas	50719.4197	.0007	FR	−0.5598		BAVR 1)		5)
MS Cas	51464.5446	.0003	RAT RCR					1)
	51471.5801	.0002	RAT RCR					1)
PV Cas	51549.4145	.0007	QU	−0.0118		SAC 69	−*Ir*	4)
	51557.3136	.0005	QU	+0.0102	s	SAC 69	−*Ir*	4)
V357 Cas	51468.4013	.0004	AG	+0.0552	s	GCVS 85		1)
V359 Cas	49615.712 :	.001	AG	−0.003		BAVM 132		1)
	49627.4502	.0003	AG	+0.0004		BAVM 132		1)
	49644.3991	.0002	MS	−0.0010		BAVM 132		1)
V384 Cas	51467.2923	.0020	HSR	−0.1357		GCVS 85		4)
V389 Cas	51469.4103	.0005	AG	+0.1509		GCVS 85	*BV*	2)
V523 Cas	51468.3824	.0001	RAT RCR	+0.0414		GCVS 85		1)
WW Cep	51362.4539	.0007	AG	−0.0023	s	BAVM 71		1)
CM Cep	51470.4793	.0002	RAT RCR					1)
	51498.3660	.0001	RAT RCR					1)
DK Cep	51432.5447	.0001	RAT RCR	+0.0336		GCVS 85		1)
DL Cep	49933.5164	.0033	MS	+0.0031		BAVM 132		1)
	49951.4493	.0017	MS MSR	+0.0007		BAVM 132		1)
	50000.3616	.0011	MS	−0.0016		BAVM 132		1)
	50005.2539	.0016	MS	−0.0007		BAVM 132		1)
	50022.3774	.0022	MS	+0.0027	s	BAVM 132		1)
	50750.3864	.0008	MS	+0.0001		BAVM 132		1)
EF Cep	51435.4214	.0003	RAT RCR	−0.0381		GCVS 85		1)
EG Cep	51472.2818	.0001	DIE	+0.0188		GCVS 85		7)
EM Cep	51435.3868	.0010	AG	−0.0721	s	GCVS 85	*V*	2)
GW Cep	51391.5409	.0002	RAT RCR	−0.0166	s	BAVR 3)		1)
IO Cep	51472.2880	.0002	RAT RCR	−0.0175		GCVS 85		1)
IP Cep	49909.4297	.0018	MS	−0.0013		BAVM 132		1)
	49912.5798	.0014	MS	+0.0026	s	BAVM 132		1)
	49918.4224	.0010	MS	+0.0024		BAVM 132		1)
	49928.3090	.0008	MS	+0.0010		BAVM 132		1)
	49931.4608	.0005	MS	+0.0067	s	BAVM 132		1)
	49935.4983	.0007	MS	−0.0009		BAVM 132		1)
	49997.5205		MS	−0.0031		BAVM 132		1)
	50224.4978	.0004	MS	+0.0010	s	BAVM 132		1)
	50370.5661	.0003	MS	−0.0025		BAVM 132		1)
	50717.5413	.0006	MS	−0.0041		BAVM 132		1)
NS Cep	51435.4743	.0008	AG	+0.0893	s	GCVS 85		1)
PX Cep	50360.4344	.0005	AG					1)
	50707.5251	.0016	AG					1)
	50904.5165	.0004	AG					1)
V383 Cep	51435.4826	.0010	AG	−0.0035		BAVM 64	*BV*	2)
V489 Cep	50715.5206	.0017	AG	−0.0059	s	BAVM 94		1)
	50825.3308	.0005	AG	−0.0044	s	BAVM 94		1)
	50904.5054	.0015	AG	+0.0059	s	BAVM 94		1)
	51033.474 :	.002	AG	+0.013		BAVM 94		1)
	51434.4051	.0010	AG	+0.0151		BAVM 94		1)
	51471.4404	.0006	AG	+0.0219	s	BAVM 94		1)
VV Cet	51494.3940	.0007	KI	+0.0898		GCVS 85	−*Ir*	1)

Table 1 (cont.)

Variable	Min JD 24...	±	Obs	$O-C$			Fil	Rem
BR Cyg	51468.4016	.0040	MZ	+0.0007		GCVS 85		6)
CV Cyg	51479.401 :	.005	MZ	−0.011	s	SAC 68		6)
GO Cyg	51385.4045	.0016	AG	+0.0594	s	GCVS 85	*BV*	2)
KR Cyg	51325.4531	.0007	FR	+0.0019		GCVS 85		5)
	51391.3746	.0020	FR	+0.0016		GCVS 85		5)
	51393.4932	.0010	FR	+0.0073	s	GCVS 85		5)
KR Cyg	51434.4798	.0007	AG	+0.0040		GCVS 85	*BV*	2)
	51459.4121	.0014	FR	+0.0043	s	GCVS 85		5)
	51468.2868	.0010	FR	+0.0050		GCVS 85		5)
V345 Cyg	49930.4594	.0004	AG	+0.0023		BAVM 132		1)
	50700.4823	.0002	FR	−0.0005		BAVM 132		5)
	50750.3096	.0013	FR	+0.0138		BAVM 132		5)
	50949.5456	.0020	FR	−0.0021		BAVM 132		5)
	51416.5439	.0020	FR	−0.0005		BAVM 132		5)
	51468.4288	.0013	FR	−0.0042		BAVM 132		5)
V382 Cyg	51413.4316	.0011	AG	+0.0642	s	GCVS 85	*BV*	2)
	51429.4568	.0007	AG	+0.0625		GCVS 85	*BV*	2)
V401 Cyg	51393.4875	.0009	AG	+0.0328	s	GCVS 85	*V*	2)
V444 Cyg	51413.275	.008	AG				*BV*	2)
V477 Cyg	51430.4240	.0016	AG	+0.7062		SAC 58	*BV*	2)
	51434.4127	.0004	AG	+0.0010		SAC 58	*BV*	2)
	51481.3554	.0005	MZ	+0.0040		SAC 58		6)
V478 Cyg	51429.4777	.0014	AG	+0.0058		GCVS 85	*BV*	2)
V488 Cyg	51325.4070	.0004	FR	+0.1020	s	GCVS 85		5)
	51391.5439	.0007	FR	+0.0983	s	GCVS 85		5)
	51393.5033	.0015	FR	+0.0960		GCVS 85		5)
	51416.4821	.0015	FR	+0.0937		GCVS 85		5)
	51443.3931	.0010	FR	+0.1001		GCVS 85		5)
	51459.3679	.0005	FR	+0.1002	s	GCVS 85		5)
	51468.3372	.0003	FR	+0.1014	s	GCVS 85		5)
V642 Cyg	51343.5054	.0014	HSR	+0.2503		GCVS 85		4)
V680 Cyg	51467.3046	.0010	AG	+0.0167		BAVR 1)	*V*	2)
V687 Cyg	51384.53 :	.01	AG	−0.01	s	GCVS 85	*V*	2)
V753 Cyg	49844.4016	.0005	MS	+0.0021		BAVM 69		1)
	50180.5888	.0005	MS	+0.0002		BAVM 69		1)
	50190.5895	.0002	MS	+0.0009		BAVM 69		1)
	50192.4940	.0007	MS	+0.0006		BAVM 69		1)
	50376.3021	.0031	MS	+0.0000		BAVM 69		1)
	50603.4448	.0011	MS	+0.0007		BAVM 69		1)
	50705.3497	.0004	MS	+0.0013		BAVM 69		1)
V841 Cyg	51393.4595	.0009	AG	+0.0104		GCVS 85	*V*	2)
V859 Cyg	51393.3926	.0010	AG	−0.0386	s	GCVS 85	*V*	2)
V885 Cyg	51389.4509	.0022	AG	−0.0683		GCVS 85	*BV*	2)
V889 Cyg	51384.535 :	.003	AG	−0.130	s	GCVS 85	*BV*	2)
V1034 Cyg	51430.4209	.0043	AG	−0.0108	s	GCVS 85	*BV*	2)
V1187 Cyg	51433.4971	.0007	AG	−0.0151		BAVM 73		1)
V1191 Cyg	51433.4949	.0003	AG	+0.0044		GCVS 85		1)
V1196 Cyg	51398.4943	.0012	AG					1)
	51469.3821	.0004	AG					1)
V2181 Cyg	50700.4404	.0012	FR	+0.0130	s	BAVM 105		5)
	50703.5917	.0005	FR	+0.0093		BAVM 105		5)
	50749.4730	.0012	FR	+0.0000		BAVM 105		5)
	50750.3394	.0009	FR	+0.0059	s	BAVM 105		5)
	50754.3519	.0008	FR	+0.0030	s	BAVM 105		5)
	50756.3548	.0001	FR	−0.0018		BAVM 105		5)
	50772.4151	.0004	FR	−0.0032		BAVM 105		5)
	50944.4561	.0002	FR	−0.0521		BAVM 105		5)
	50948.4649	.0005	FR	−0.0588		BAVM 105		5)
	50987.4702	.0010	QU	−0.0605		BAVM 105	$-Ir$	4)
	51032.4770	.0021	FR	−0.0839	s	BAVM 105		5)

Table 1 (cont.)

Variable	Min JD 24...	±	Obs	$O-C$			Fil	Rem
V2181 Cyg	51034.4948	.0005	FR	−0.0738		BAVM 105		5)
	51036.5038	.0023	FR	−0.0725	s	BAVM 105		5)
	51040.5025	.0053	FR	−0.0892	s	BAVM 105		5)
	51103.3132	.0010	QU	−0.0914		BAVM 105	V	4)
	51315.4987	.0005	FR	+0.1367	s	BAVM 105		5)
	51391.4804	.0011	FR	+0.1120		BAVM 105		5)
	51393.4942	.0010	FR	+0.1182	s	BAVM 105		5)
	51416.4337	.0005	FR	+0.1124	s	BAVM 105		5)
	51443.3834	.0022	FR	+0.1013	s	BAVM 105		5)
	51459.4483	.0004	FR	+0.1044	s	BAVM 105		5)
	51468.3328	.0008	FR	+0.0976		BAVM 105		5)
TY Del	51471.2859	.0004	KI	+0.0481		GCVS 85	$-Ir$	1)
ET Del	51393.5059	.0006	KI				$-Ir$	1)
EX Del	51414.4217	.0004	KI	−0.0716		GCVS 85	$-Ir$	1)
FZ Del	51469.3052	.0002	KI	−0.0351		GCVS 85	$-Ir$	1)
GG Del	51368.4788	.0003	KI	−0.0165		GCVS 85	$-Ir$	1)

Remarks:

AG : Agerer, F., Tiefenbach
BRN: Brauner, B., Herford
FR : Frank, P., Velden
KI : Kleikamp, W., Marl
MSR: Moschner, J., Lennestadt
QU : Quester, W., Esslingen
RCR: Rätz, Ch., Herges-Hallenberg
ATB: Achterberg, Dr. H., Norderstedt
DIE : Dietrich, M., Radebeul
HSR: Husar, Dr. D., Hamburg
MS : Moschner, W., Lennestadt
MZ : Maintz, G., Bonn
RAT: Rätz, M., Herges-Hallenberg
STK: Strunk, J., Leopoldshöhe

$-Ir$ = filter KG/2
: = uncertain
s = secondary minimum
1) = photometer CCD 375 × 242 uncoated
2) = photometer EMI 9781A, filter V = GG495, 1 mm; B = BG12, 1 mm + GG385, 2 mm
4) = photometer ST-7
5) = photometer OES-LcCCD11
6) = photometer LC14
7) = photometer pictor 1616XT
GCVS *yy* = General Catalogue of Variable Stars, 4th ed. 19*yy*
SAC *vv* = Rocznik Astronomiczny No. *vv*, Krakow (SAC)
BAVM *nnn* = BAV Mitteilungen No. *nnn*
BAVM 64 = BAV Mitteilungen No. 64= IBVS No. 3837
BAVM 65 = BAV Mitteilungen No. 65= IBVS No. 3859
BAVM 71 = BAV Mitteilungen No. 71= IBVS No. 4131
BAVM 73 = BAV Mitteilungen No. 73= IBVS No. 4133
BAVM 94 = BAV Mitteilungen No. 94= IBVS No. 4406
BAVR 1) = BAV Rundbrief 32, 36f
BAVR 2) = BAV Rundbrief 33, 152f
BAVR 3) = BAV Rundbrief 33, 160f

New elements

HW Aur $\quad \mathrm{Min\ I} = \mathrm{HJD}\ 2449278.5208 + 1\overset{\mathrm{d}}{.}1774168 \times E$
$\pm 31 \qquad \pm 5$

V359 Cas $\quad \mathrm{Min\ I} = \mathrm{HJD}\ 2429079.67261\overset{\mathrm{d}}{.}3038757 \times E$
$\pm 82 \qquad \pm 5$

DL Cep $\quad \mathrm{Min\ I} = \mathrm{HJD}\ 2449933.5133 + 1\overset{\mathrm{d}}{.}6304850 \times E$
$\pm 32 \qquad \pm 5$

IP Cep $\quad \mathrm{Min\ I} = \mathrm{HJD}\ 2436812.4041 + 0\overset{\mathrm{d}}{.}8989037 \times E$ valid from JD 2435000
$\pm 45 \qquad \pm 4$

V345 Cyg $\quad \mathrm{Min\ I} = \mathrm{HJD}\ 2449930.4571 + 2\overset{\mathrm{d}}{.}0755410 \times E$ valid from JD 2435000
$\pm 21 \qquad \pm 5$

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PHOTOELECTRIC MINIMA OF SELECTED ECLIPSING BINARIES AND MAXIMA OF PULSATING STARS

(BAV MITTEILUNGEN NO. 133)

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In this 44th compilation of BAV results, photoelectric observations obtained in the years 1999 and 2000 are presented on 126 variable stars giving 168 minima and maxima. 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: Eclipsing binaries

Variable	Min JD 24...	±	Obs	$O-C$			Fil	Rem
RR Dra	51315.4247	.0003	AG	+0.0549		GCVS 85	BV	2)
	51414.5215	.0002	RAT RCR	+0.0555		GCVS 85		1)
CV Dra	51354.4155	.0008	AG	−0.0010		BAVM 69	BV	2)
EF Dra	51331.481 :	.003	AG	+0.017	s	BAVM 63	BV	2)
FN Her	51330.4364	.0007	KI	+0.1044		GCVS 85	$-Ir$	1)
HS Her	51397.4074	.0005	AG	−0.0165		GCVS 85	BV	2)
V878 Her	51323.436 :	.002	AG				BV	2)
	51386.4451	.0040	AG				BV	2)
SW Lac	51426.392 :	.002	MZ	−0.062		GCVS 85		6)
EK Lac	51436.5339	.0001	RAT RCR	−0.0039		GCVS 85		1)
NW Lac	51465.392	.002	RAT RCR					1)
V364 Lac	50660.5116	.0015	FR	−0.0037		BAVR 4)		1)
	51035.4382	.0004	FR	−0.0068		BAVR 4)		5)
SW Lyn	51557.3317	.0005	DIE	+0.0273		GCVS 85		7)
TZ Lyr	51316.4827	.0001	RAT RCR	+0.0035		GCVS 85		1)
UZ Lyr	51457.3885	.0028	ATB	−0.0099		GCVS 85		1)
FG Lyr	51326.5050	.0008	RAT RCR					1)
NY Lyr	51420.4986	.0002	RAT RCR	+0.0699		GCVS 85		1)
QU Lyr	51467.3191	.0012	AG	−0.0028	s	GCVS 85		1)
V406 Lyr	51399.3920	.0007	AG	−0.0131	s	BAVM 72		1)
IX Mon	51554.3656	.0002	RAT RCR					1)
V527 Mon	51555.4683	.0006	KI	−0.0192		GCVS 85	$-Ir$	1)
V714 Mon	50849.2784	.0004	MS					1)
	51208.4297	.0005	KI				$-Ir$	1)
RV Oph	51348.4503	.0003	KI	−0.0055		GCVS 85	$-Ir$	1)
V456 Oph	51354.4711	.0003	KI	+0.0148		GCVS 85	$-Ir$	1)
V501 Oph	51387.4106	.0004	KI	−0.0072		GCVS 85	$-Ir$	1)
V506 Oph	51346.5063	.0006	KI	+0.0258	s	GCVS 85	$-Ir$	1)
V508 Oph	51358.4538	.0004	KI	+0.0045		GCVS 85	$-Ir$	1)

Table 1 (cont.)

Variable	Min JD 24...	±	Obs	$O-C$			Fil	Rem
V839 Oph	51390.4060	.0004	AG	−0.0632	s	GCVS 85	BV	2)
ER Ori	51555.3516	.0003	KI	+0.0254	s	GCVS 85	$-Ir$	1)
GU Ori	50904.3750	.0005	FR					5)
	51165.3671	.0002	FR					5)
	51165.6013	.0003	FR					5)
	51176.4278	.0003	FR					5)
	51225.3767	.0002	FR					5)
U Peg	51480.3591	.0005	KI	−0.0798		GCVS 87	$-Ir$	1)
AT Peg	51469.418 :	.002	MZ	+0.008		GCVS 87		6)
BB Peg	51471.3810	.0005	KI	+0.0036	s	GCVS 87	$-Ir$	1)
BN Peg	51486.2945	.0004	DIE	−0.0002		GCVS 87		7)
BO Peg	51486.2571	.0009	KI	−0.0185		GCVS 87	$-Ir$	1)
BY Peg	51426.4458	.0008	AG					1)
DK Peg	51465.4217	.0006	KI	+0.0565		GCVS 87	$-Ir$	1)
IK Per	51470.4169	.0070	HSR	−0.0951		GCVS 87		4)
KR Per	51512.3087	.0002	DIE	−0.0054		GCVS 87		7)
Y Psc	51468.3976	.0004	KI	−0.0165		GCVS 87	$-Ir$	1)
SX Psc	51470.3551	.0002	RAT RCR					1)
UZ Sge	50688.4351	.0050	FR					5)
CU Sge	51389.4128	.0003	KI	+0.0154		GCVS 87	$-Ir$	1)
GR Tau	51486.3991	.0004	DIE	−0.0258		BAVR 1)		7)
X Tri	51518.5302	.0014	ATB	−0.0375		GCVS 87		1)
BP Vul	51397.4114	.0003	KI	−0.0071		GCVS 87	$-Ir$	1)
	51464.3104	.0001	DIE	+0.9200		GCVS 87		7)
HI Vul	51354.4765	.0006	AG	−0.0476		GCVS 87		1)

Table 2: Pulsating stars

Variable	Max JD 24...	±	Obs	$O-C$		Fil	Rem
CI And	51562.5002	.0021	ATB				1)
DU And	51469.4641	.0025	HSR	+0.1471	GCVS 85		4)
GP And	51467.5582	.0007	ATB	+0.0005	GCVS 85		1)
	51551.355	.001	MZ	+0.000	GCVS 85		6)
OV And	51562.2804	.0021	ATB	−0.0049	MVS11,133		1)
SX Aqr	51518.2041	.0008	KI	+0.0071	BAVR 7)	$-Ir$	1)
BR Aqr	51412.5253	.0005	KI	−0.1181	GCVS 85	$-Ir$	1)
CP Aqr	51467.2722	.0008	KI	−0.0794	GCVS 85	$-Ir$	1)
CY Aqr	51420.3560	.0005	RAT RCR	+0.0125	GCVS 85		1)
	51483.3450	.0004	KI	+0.0099	GCVS 85	$-Ir$	1)
	51518.383	.001	MZ	+0.012	GCVS 85		6)
HH Aqr	50700.518	.002	AG				1)
	51429.445	.002	AG				1)
AA Aql	51483.2477	.0008	KI	+0.0005	BAVM 78	$-Ir$	1)
	51782.4461	.0006	KI	+0.0007	BAVM 78	$-Ir$	1)
V341 Aql	51769.4325	.0017	MZ	+0.0298	GCVS 85	$-Ir$	6)
RV Ari	51555.2277	.0005	KI	−0.0018	GCVS 85	$-Ir$	1)
RW Ari	51467.3517	.0050	HSR	+0.1703	GCVS 85		4)
RS Boo	51685.4534:	.0016	MZ	+0.0161	BAVR 2)		6)
TW Boo	51708.4877	.0027	MZ	−0.0159	GCVS 85	$-Ir$	6)
	51716.4672	.0010	MZ	−0.0206	GCVS 85	$-Ir$	6)
UY Boo	51317.4759	.0040	HSR	+0.1460	SAC 68		4)
CM Boo	51703.4541	.0006	QU	−0.0007	BAV unp	V	4)
CQ Boo	51679.4735	.0007	QU	−0.0008	BAVR 5)	V	4)
TT Cnc	51586.4316	.0009	KI	+0.0731	GCVS 85	$-Ir$	1)
AN Cnc	51644.5161	.0028	ATB				1)
AQ Cnc	51549.4653		RAT RCR	−0.0576	GCVS 85		1)
	51661.3591	.0035	ATB	−0.0618	GCVS 85		1)
RV CMi	51575.498	.008	PS	−0.278	GCVS 85		3)
AD CMi	51577.530	.002	MZ	+0.004	GCVS 85		6)
AL CMi	51551.540	.010	PS	−0.148	GCVS 85		3)
RV Cet	51497.4185	.0018	KI	+0.1549	GCVS 85	$-Ir$	1)

Table 2 (cont.)

Variable	Max JD 24…	±	Obs	$O-C$		Fil	Rem
V Com	51569.5500	.0090	RAT RCR	+0.0212	GCVS 85		1)
ST Com	51669.3880	.0014	KI	−0.0118	GCVS 85	$-Ir$	1)
RV CrB	50210.5020	.0010	QU	+0.0165	GCVS 85		4)
UY Cyg	51470.4293	.0020	MZ	+0.0446	GCVS 85		6)
	51483.324	.001	MZ	+0.043	GCVS 85		6)
KP Cyg	51352.4603	.0060	HSR				4)
V939 Cyg	51670.404	.002	AG	−0.023	BAVM 92		1)
CK Del	51467.3719	.0015	ATB				1)
DX Del	51458.3358	.0042	ATB	+0.0420	GCVS 85		1)
DD Dra	51315.5690	.0030	AG	−0.0017	BAVR 6)	BV	2)
	51326.3731	.0014	HSR	+0.0182	BAVR 6)		4)
	51352.5010	.0020	AG	+0.0026	BAVR 6)	BV	1)
	51748.507	.001	AG	−0.066	BAVR 6)	BV	2)
RT Equ	51496.250	.008	PS	+0.056	GCVS 85		3)
BK Eri	51471.4781	.0015	KI	−0.1168	GCVS 85	$-Ir$	1)
RR Gem	51513.4119	.0010	QU	+0.1533	GCVS 85	$-Ir$	4)
	51549.5674	.0010	QU	+0.1536	GCVS 85	$-Ir$	4)
SZ Gem	51626.3962	.0028	ATB	−0.0397	GCVS 85		1)
	51629.4042	.0007	QU	−0.0385	GCVS 85	V	4)
	51642.4377	.0030	MZ	−0.0346	GCVS 85		6)
GI Gem	51627.394	.004	ATB	+0.064	GCVS 85		1)
TW Her	51759.3901	.0023	MZ	−0.0074	GCVS 85	$-Ir$	6)
VX Her	51716.4101	.0009	KI	−0.0129	BAV unp	$-Ir$	1)
	51716.415	.004	PS	−0.008	BAV unp		3)
VZ Her	51679.5161	.0025	MZ	+0.0498	GCVS 85	$-Ir$	6)
	51746.4479	.0022	MZ	+0.0518	GCVS 85	$-Ir$	6)
CQ Lac	51472.4646	.0021	ATB				1)
CZ Lac	51768.5099	.0014	MZ	−0.0800	GCVS 85	$-Ir$	6)
ST Leo	51679.4061	.0032	MZ	−0.0096	GCVS 85	$-Ir$	6)
SU Leo	51575.624	.003	PS	−0.072	GCVS 85		3)
AA Leo	51643.355	.007	PS	−0.049	GCVS 85		3)
EH Lib	51704.4349	.0005	KI	+0.0040	GCVS 85	$-Ir$	1)
RZ Lyr	51481.3598	.0015	ATB	−0.0198	GCVS 85		1)
CN Lyr	51468.3310	.0035	ATB	+0.0059	BAVR 3)		1)
KX Lyr	51268.5507	.0035	HSR				4)
ST Oph	51327.4856	.0008	KI	−0.0175	GCVS 85	$-Ir$	1)
V445 Oph	51316.4890	.0007	KI	+0.0168	GCVS 85	$-Ir$	1)
V452 Oph	51296.5627	.0025	ATB				1)
V567 Oph	51377.4266	.0009	KI	−0.0703	GCVS 85	$-Ir$	1)
	51714.4458	.0011	KI	−0.0715	GCVS 85	$-Ir$	1)
V816 Oph	51715.4472	.0006	KI			$-Ir$	1)
VV Peg	51465.3043	.0005	KI	−0.0291	GCVS 87	$-Ir$	1)
AE Peg	51387.5886	.0007	KI	+0.1977	GCVS 87	$-Ir$	1)
	51398.5167	.0006	KI	+0.1983	GCVS 87	$-Ir$	1)
	51787.4488	.0009	KI	+0.2088	GCVS 87	$-Ir$	6)
AO Peg	51472.2781	.0013	KI			$-Ir$	1)
AV Peg	51482.3235	.0009	KI	+0.0644	GCVS 87	$-Ir$	1)
	51487.398	.003	MZ	+0.064	GCVS 87		6)
	51498.324	.003	MZ	+0.060	GCVS 87		6)
BH Peg	51470.3575	.0015	KI	−0.0753	GCVS 87	$-Ir$	6)
	51495.3528	.0008	ATB	−0.0787	GCVS 87		1)
	51511.3764	.0010	QU	−0.0800	GCVS 87	$-Ir$	4)
BP Peg	51468.3017	.0005	KI	+0.0418	GCVS 87	$-Ir$	1)
	51469.4004	.0021	ATB	+0.0450	GCVS 87		1)
DH Peg	51495.2334	.0021	KI	+0.0162	GCVS 87	$-Ir$	1)
DY Peg	51426.3476	.0010	HSR	−0.0018	GCVS 87		4)
	51458.4348	.0008	ATB	−0.0022	GCVS 87		1)
	51470.321	.000	MZ	−0.003	GCVS 87		6)
AR Per	51486.441 :	.003	MZ	+0.001	BAV unp		6)
	51509.4266	.0007	QU	+0.0073	BAV unp	$-Ir$	4)

Table 2 (cont.)

Variable	Max JD 24...	±	Obs	$O-C$		Fil	Rem
AR Per	51569.425	.001	MZ	+0.003	BAV unp		6)
RY Psc	51487.3799	.0015	KI	−0.2058	GCVS 87	$-Ir$	1)
AN Ser	51715.4686	.0014	MZ	−0.0061	GCVS 87	$-Ir$	6)
AV Ser	51298.6120	.0005	KI			$-Ir$	1)
CW Ser	51325.4376	.0010	KI	+0.0283	GCVS 87	$-Ir$	1)
SS Tau	51197.3649	.0011	KI	−0.0427	GCVS 87	$-Ir$	1)
	51498.4753	.0006	KI	−0.0317	GCVS 87	$-Ir$	1)
U Tri	51433.4582	.0014	HSR	−0.0304	GCVS 87		4)
UX Tri	51471.6262	.0007	ATB	−0.0003	BAV unp		1)
	51494.5030	.0017	ATB	−0.0027	BAV unp		1)
	51522.5401	.0035	ATB	+0.0191	BAV unp		1)
RV UMa	51238.5288	.0005	QU	+0.0718	GCVS 87	V	4)
TU UMa	51270.5146	.0035	ATB	−0.0292	GCVS 87		1)
	51569.4226	.0010	QU	−0.0263	GCVS 87	$-Ir$	4)
ST Vir	51317.3819	.0009	KI	+0.1328	GCVS 87	$-Ir$	1)
UU Vir	51654.3929	.0009	KI	−0.0132	GCVS 87	$-Ir$	1)
AE Vir	51660.4919	.0011	KI			$-Ir$	1)
AF Vir	51308.3976	.0011	KI	+0.0472	GCVS 87	$-Ir$	1)
BB Vir	51299.5075	.0006	KI	+0.1828	GCVS 87	$-Ir$	1)
BC Vir	51301.4141	.0010	KI	+0.0121	GCVS 87	$-Ir$	1)
FU Vir	51255.4797	.0009	MS	+0.1622	GCVS 87		1)
	51266.3937	.0060	HSR	+0.1634	GCVS 87		4)

Remarks:

AG : Agerer, F., Tiefenbach
DIE : Dietrich, M., Radebeul
HSR: Husar, Dr. D., Hamburg
MS : Moschner, W., Lennestadt
PS : Paschke, A. Rüti (CH)
RAT: Rätz, M., Herges-Hallenberg
ATB: Achterberg, Dr. H., Norderstedt
FR : Frank, P., Velden
KI : Kleikamp, W., Marl
MZ : Maintz, G., Bonn
QU : Quester, W., Esslingen
RCR: Rätz, Ch., Herges-Hallenberg

$-Ir$ = filter KG/2
: = uncertain
s = secondary minimum
1) = photometer CCD 375 × 242 uncoated
2) = photometer EMI 9781A, filter V = GG495, 1 mm; B = BG12, 1 mm + GG385, 2 mm
3) = photometer Cryocam 80A, without filter
4) = photometer ST-7
5) = photometer OES-LcCCD11
6) = photometer LC14
7) = photometer pictor 1616XT
GCVS *yy* = General Catalogue of Variable Stars, 4th ed. 19*yy*
MVS *vv*, *ppp* = Mitteilungen über Veränderliche Sterne; volume *vv*, page *ppp*
SAC *vv* = Rocznik Astronomiczny No. *vv*, Krakow (SAC)
BAVM *nnn* = BAV Mitteilungen No. *nnn*
BAVM 63 = BAV Mitteilungen No. 63 = IBVS No. 3811
BAVM 72 = BAV Mitteilungen No. 72 = IBVS No. 4132
BAVR 1) = BAV Rundbrief 35, 1f
BAVR 2) = BAV Rundbrief 36,157f
BAVR 3) = BAV Rundbrief 43, 57f
BAVR 4) = BAV Rundbrief 47, 33f
BAVR 5) = BAV Rundbrief 48,189f
BAVR 6) = BAV Rundbrief 49, 6
BAVR 7) = BAV Rundbrief 48, 57f
BAV unp = BAV unpublished

Correction to IBVS No. 4912

UY	CVn	51245.410	HSR	must be deleted
DD	Dra	51273.6228	HSR	must be deleted
SY	Gem	51250.5464	ATB	must be deleted

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PRECISION LIGHT ELEMENTS AND LIGHT CURVE FOR THE ECLIPSING BINARY LD 355

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LD 355 = GSC 3560.1804 is located at $19^{\rm h}35^{\rm m}23\overset{\rm s}{.}12$, $+48^\circ03'00\overset{''}{.}75$ (J2000) and was discovered to be variable by Dahlmark (2000). The discovery report notes that five dimmings were observed and the star was classified as an eclipsing binary, with an uncertain period of $25\overset{\rm d}{.}81$ and a range of m_v = 13.8–14.6, where m_v are photo-visual (yellow sensitive) magnitudes.

In a continuing collaborative effort to investigate newly discovered and poorly studied eclipsing binary stars, a team of AAVSO members have used CCD, visual and photographic observations to more precisely determine the nature and brightness history of LD 355. Here we present the results of our investigation which include accurate light elements and the light curve, as well as photometric calibration of the variable and comparison stars.

As part of our study of LD 355, Guilbault and Hager visited the Harvard College Observatory and examined 220 archival blue-sensitive plates from the RH and Damon Patrol Series. The star was found to be faint or invisible on 7 (seven) of the plates. At the same time Guilbault began visual monitoring of LD 355 using a 0.32-m reflector and a sequence of steps to estimate the changes in brightness. The star was observed in eclipse on JD2451779 and JD2451841 but in each instance only the ascending branch of the light curve was observed. On the consecutive nights of JD2451842 and JD2451843, however, the entire eclipse was observed. From these observations a preliminary period was determined so that CCD observation could commence.

Photometric V-filtered observation of LD 355 was carried out by six of the authors. Henden used the USNO Flagstaff Station 1.0-m telescope and a SITe/Tektronix 1024 × 1024 CCD to observe the system. Kaiser's observations were made with a 0.35-m Schmidt–Cassegrain telescope (SCT) equipped with a ST-9E CCD from his Crescent Moon Observatory, while Billings used a 0.35-m SCT with an AP-7 CCD. Pullen used a 0.28-m SCT with a ST-6 CCD camera at the Clarke and Coyote Astrophysical Observatory. From their private observatories Hager used a 0.25-m SCT and a ST-9E CCD, and Lubcke used a 0.28-m SCT equipped with ST-9E CCD camera.

Using comparison stars selected on the basis of their magnitude and colors, LD 355 was observed by the above mentioned CCD observers on 14 nights from JD2451851 to JD2451905. A total of 647 CCD frames were measured, and from these data five (5) times of primary minimum and three (3) times of secondary minimum were determined. The times of primary minima derived from the visual data, the photographic minima from the Harvard plates, the minima of Dahlmark (2000), and the photometric times of minima are listed in Table 1.

Table 1: Times of minima, LD 355

HJD 2400000 +	Error ±	Epoch	$O-C$	Observer	Type
25327.871	-	−24022	−0.005	Harvard	ptg
26914.720	-	−22586	−0.081	Harvard	ptg
42220.527	-	−8736	+0.074	Dahlmark	ptg
43347.671	-	−7716	+0.015	Harvard	ptg
45606.554	-	−5672	+0.071	Harvard	ptg
45819.803	-	−5479	+0.035	Harvard	ptg
46881.865	-	−4518	+0.095	Harvard	ptg
47270.810	-	−4166	+0.044	Harvard	ptg
49989.323	-	−1706	+0.008	Dahlmark	ptg
50274.465	-	−1448	+0.034	Dahlmark	ptg
51255.616	-	−560	−0.145	Dahlmark	ptg
51513.298	-	−327	+0.049	Dahlmark	ptg
51842.5695	0.0009	−29	+0.0001	Guilbault	visual
51843.6716	0.0009	−28	−0.0029	Guilbault	visual
51853.6206	0.0002	−19	−0.0001	Kaiser	ccd − V filter
51853.6206	0.0001	−19	+0.0001	Lubcke	ccd − V filter
51854.7257	0.0002	−18	+0.0001	Billings	ccd − V filter
51874.6174	0.0000	0	+0.0000	Henden	ccd − V filter
51905.5599	0.0001	+28	−0.0002	Henden	ccd − V filter

Minima from all sources were fitted into a least squares solution with the CCD minima weighted as one hundred (100). The visual and photographic minima were weighted as one (1). In most cases the photographic exposures were of 60 minutes duration and the time of mid-exposure is the date the variable was estimated to be at minimum light. Both the visual and the photometric times of minimum were determined using the computer program *AVE* (Barbera, 2000) based on the Kwee–Van Woerden (1956) method. From that analysis we extracted the best period and combined it with the most accurate time of minimum to derive the following light elements:

$$\begin{array}{l} \text{Min. I} = \text{HJD } 2451874.6174 + 1\overset{\text{d}}{.}1051023 \times E. \\ \qquad\qquad\qquad\qquad\quad \pm 0.0005 \quad \pm 0.0000002 \end{array}$$

The CCD observations in the V passband were folded using the elements above and the phased V light curve in the instrumental system is shown in Figure 1. The curve shows that the star is an Algol-type (EA) eclipsing variable that fades from a maximum of $13\overset{\text{m}}{.}61 \pm 0.01$ to $15\overset{\text{m}}{.}24 \pm 0.01$ at primary minimum. The eclipse is total, with minimum light lasting 12 minutes and the duration of the eclipse is about 0.17 P_{orb}. A shallow secondary eclipse of $0\overset{\text{m}}{.}15 \pm 0.01$ occurs at phase 0.50.

Henden's 112 V-filtered observations centered on primary minimum on JD 2451874 and JD 2451905 were folded using the light elements given above and are represented in Figure 2. The symmetrical shape of the light curve and the flat bottom at minimum light are clearly evident.

Using all sky photometry, Henden observed the field of LD355 in standard Johnson-Cousins $BV(RI)_c$ bandpasses with magnitude and color errors less than $0\overset{m}{.}01$. The comparison and check stars were standardized as given in Table 2.

Table 2: Comparison and check stars

Star	GSC	RA (J2000)	DEC	V	$B-V$	$V-R_c$	$R-I_c$
comp.	3560:1870	19:35:26.70	+48:02:03.4	13.415	0.467	0.275	0.284
check	3560:1950	19:35:40.59	+48:01:51.7	13.190	0.695	0.386	0.359

More complete photometric information about all stars within 5 arcmin of the variable can be found in Henden (2000). Using these stars, Henden measured the magnitude and colors of LD 355 at maximum light and at primary and secondary minimum. These data are shown below in Table 3, with errors again less than $0\overset{m}{.}01$.

Table 3: Magnitude and color indices at maximum, primary and secondary minimum, LD 355

HJD 2400000 +	Phase	V	$B-V$	$V-R$	$R-I$
51857.6155	Maximum	13.608	0.310	0.176	0.191
51905.5588	Min I	15.235	0.524	0.353	0.366
51879.5903	Min II	13.754	0.252	0.141	0.154

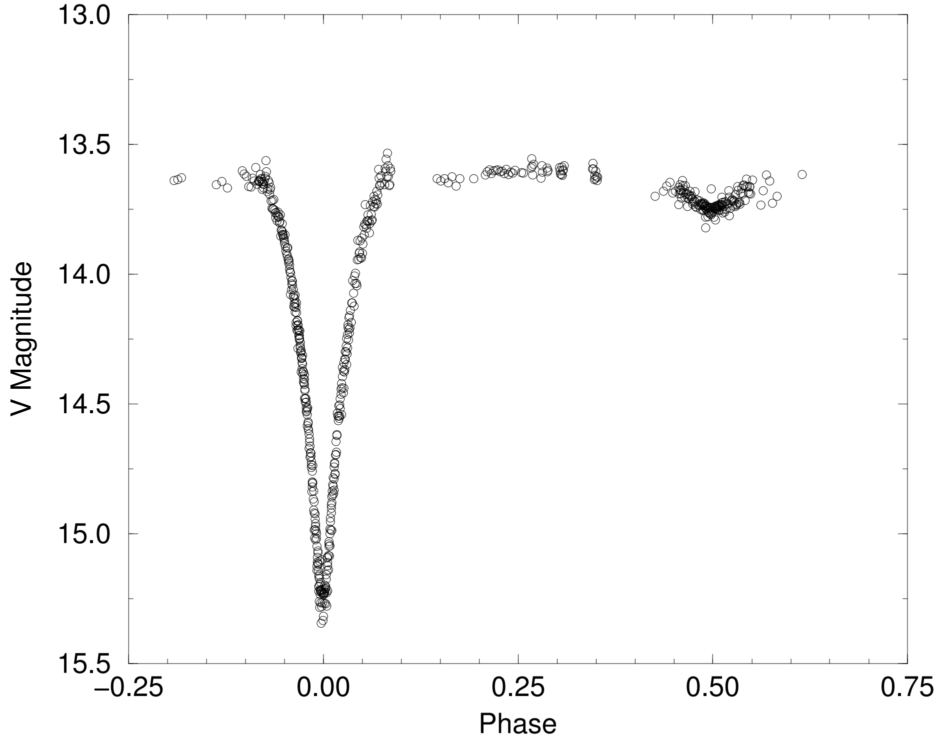

Figure 1. Phased light curve of LD 355 – V filter

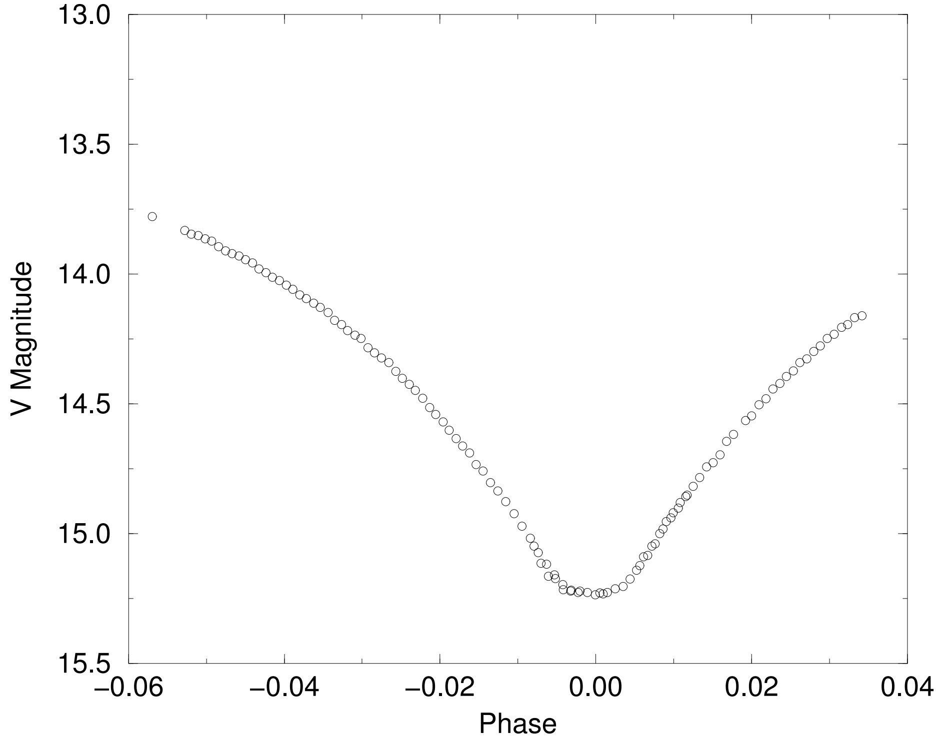

Figure 2. Differential phased light curve at primary minimum, LD 355 – *V* filter – Henden

Our CCD data are available elctronically from the IBVS website as 5018-t4.txt, and may be used by anyone wishing to do so. We ask that our work be cited if is used as the basis of further study of LD 355.

We wish to express our gratitude to Dr. Martha Hazen, Curator of the Astronomical Photograph Collection at the Harvard College Observatory, for the use of the Harvard Patrol Plates on this and other variable star projects. We thank Marvin E. Baldwin, Chairman of the Eclipsing Binary Committee of the AAVSO, for his help in the preparation of this report. GWB acknowledges the use of software (KAPPA, PHOTOM) provided by the Starlink Project which is run by CCLRC on behalf of PPARC.

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ONE NEW AND ONE SUSPECTED DELTA SCUTI STAR: HD 192871 AND HD 230990

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During surveys for photometric variability among λ Bootis stars (e.g. Paunzen et al. 1998) and among central stars of young Planetary Nebulae (Handler 1998), we serendipitously discovered two new δ Scuti stars. These were preliminarily announced elsewhere (Handler & Paunzen 1995), and got the variable designations V383 Vul and V336 Sge. Here we would like to give a more complete account on those stars together with an astrophysical interpretation supplemented by additional data.

We obtained differential photoelectric photometry relative to two comparison stars with the Texas two-channel photometer — employing only channel 1 — attached to the 90-cm telescope at McDonald Observatory. An aperture of 27″ was used to minimize the influence of seeing and guiding. Filters and integration times used depended on the observing programme and will be described separately. Data reduction comprised deadtime correction, sky background subtraction, extinction correction and conversion to Heliocentric Julian Date (HJD).

HD 192871 was used as a comparison star for the λ Bootis star HD 192424; the second comparison star was HD 193668. These three stars are all around 7th magnitude and were observed for 40 seconds in each of the Strömgren v and b filters before switching to the next object. Whereas HD 192424 and HD 193668 turned out to be constant within the level of measurement accuracy, HD 192871 showed conspicious light variations. Reduced v filter light curves of all three stars are shown in Fig. 1.

A single-frequency solution to the differential v filter light curve of HD 192871 results in a formal period of 265 minutes and in a photometric amplitude of 28 mmag. However, it is obvious from Fig. 1 that the star is a multiperiodic variable; hence our period should not be taken at face value.

HD 192871 was also a target of the HIPPARCOS mission (ESA 1997). Indeed it was detected to be variable, but its light curve was classified as “unsolved”. From a new analysis, Koen & Eyer (2001) reported a period of 283 minutes for the star. We also performed a frequency analysis of the HIPPARCOS observations and obtained a complicated amplitude spectrum, with an attempted two-frequency solution not being sufficient to decrease the scatter down to measurement accuracy. It appears that the

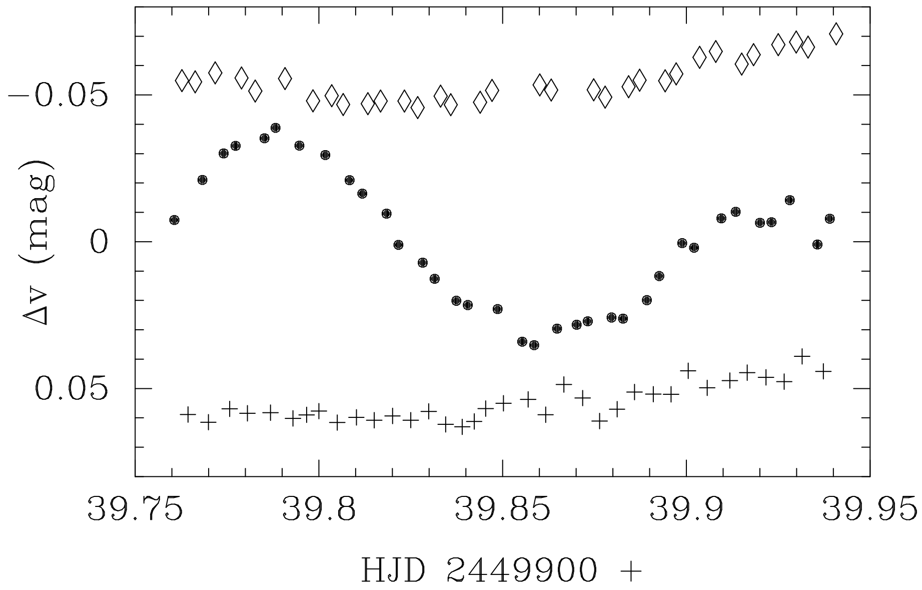

Figure 1. Reduced v filter time series of HD 193668 (diamonds), HD 192871 (filled circles) and HD 192424 (plus signs) as zero-point shifted instrumental magnitude variations. No correction for variations in sky transparency was applied to allow the reader to judge the quality of the data better

star has a rich frequency spectrum thus requiring further observations for a satisfactory solution of its light curve.

Turning to a discussion of the pulsational behaviour of the star, we first determined its absolute visual magnitude from its HIPPARCOS parallax and arrived at $M_v = 0.7 \pm 0.3$. Standard Strömgren indices from Hauck & Mermilliod (1998) are $b{-}y = 0.205$, $m_1 = 0.173$ and $c_1 = 0.884$. Since no Hβ photometry of the star was available, we obtained such a measurement as part of a larger programme (Handler 1999) and determined $\beta = 2.741$.

Applying calibrations for Strömgren photometry (Crawford 1979) and results of model atmosphere calculations (Kurucz 1991), this yields $\delta m_1 = 0.002$, $\delta c_1 = 0.218$, $M_v = 1.0 \pm 0.3$ (the latter in reasonable agreement with the HIPPARCOS results) as well as $T_{\rm eff} = 7100 \pm 100$ K and $\log g = 3.2 \pm 0.1$. A 265-minute pulsation period used in the equation

$$\log Q_i = -6.456 + 0.5\log g + 0.1 M_{\rm bol} + \log T_{\rm eff} + \log P_i \qquad (1)$$

resulting from the period-mean density relation then gives a pulsation "constant" $Q = 0.022 \pm 0.004$. The quoted error estimates are to be seen as rough guides. A comparison with published Q values (e.g. Fitch 1981) suggests that the star pulsates in modes around the second radial overtone.

Finally, we would like to comment on the spectral classification of the star. Its published spectral type is F3 II originating from the Case–Hamburg Northern Milky Way Luminous Stars Survey (Stock et al. 1960). Bouw (1981) gives an infrared spectral type of F6 II. However, our results supported by the consistent pulsational behaviour suggest that the star is rather F1 III. Our δm_1 value implies that the star is slightly more metal-rich than the Sun which could be part of the explanation for this discrepancy.

A second δ Scuti candidate we report here is HD 230990. It was used together with HD 231007 as comparison star for the Planetary Nebula WhMe 1. For these observations, the V filter was used. We adopted 60-second integrations for the 9th-magnitude comparison stars. However, we measured the much fainter WhMe 1 (instrumental $V \approx 13.4$) for

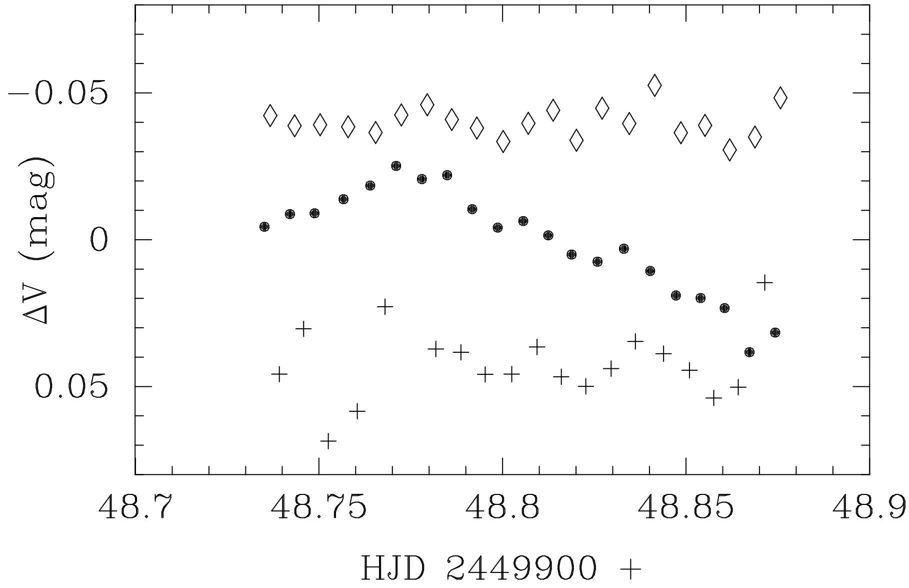

Figure 2. Reduced V filter time series of HD 231007 (diamonds), HD 230990 (filled circles) and WhMe 1 (plus signs) as zero-point shifted instrumental magnitude variations. No correction for variations in sky transparency was applied to allow the reader to judge the quality of the data better. The lower precision of the measurements of WhMe 1 is due to the faintness of this object, but they are of sufficient quality to show that HD 230990 is variable

3 minutes per observing cycle followed by a 30 second sky measurement. The variability of HD 230990 is demonstrated in Fig. 2.

Our derived time scale of the light variations of HD 230990 is coincidentally the same as for HD 192871, 265 minutes. We stress that this is only a lower limit, since we did not cover a full cycle of the light curve. The associated V amplitude is 22 mmag.

Owing to the faintness of HD 230990, little is known about this star, e.g. there are no HIPPARCOS observations and there were no published Strömgren colour indices at the time of the discovery of its variability. Consequently, we obtained $uvby\beta$ photometry of this star with the 0.5-m telescope and the Modular Photometer at the South African Astronomical Observatory. The β index, 2.781, was published by Handler (1999), but new $uvby$ colours were acquired in the night of July 18/19, 2000 as well. These yield standard values of $V = 9.34 \pm 0.02$, $b-y = 0.323 \pm 0.007$, $m_1 = 0.127 \pm 0.012$ and $c_1 = 0.893 \pm 0.012$, placing the star well inside the δ Scuti instability strip after dereddening.

Using the same procedures as before, we obtain $E(b-y) = 0.170$, $\delta m_1 = 0.016$, $\delta c_1 = 0.117$, $M_v = 1.8 \pm 0.3$, $T_{\rm eff} = 7600 \pm 100$ K and $\log g = 4.0 \pm 0.1$. This yields an uncomfortably high $Q > 0.074$ for a 265-minute lower limit to the period, which suggests that the star could pulsate in a gravity mode; we have no reason to doubt any of our measurements. It is also possible that HD 230990 is some short-period binary, but we add that such high Q values are unusual for δ Scuti stars, but not unprecedented. For instance, Koen et al. (1999) discussed several cases. Obviously, more observations of HD 230990 are required to infer a more reliable period and to prove its δ Scuti nature fully.

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LO Gem: FIRST DETERMINATION OF THE ORBITAL PERIOD AND LIGHT CURVE

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LO Gem (GSC 1868:2176; $06^h04^m12^s$, $+25^\circ20'$, J2000) is listed in the GCVS (Kholopov et al. 1985) as an E star varying from $11\overset{m}{.}5$ to $12\overset{m}{.}0$ (p). The star was first reported to be an Algol type binary system by Hoffmeister (1968). Ten times of minimum light were determined from Sonneberg photographic plates taken between 1933 and 1967; however no period was derived (Gessner & Meinunger 1973). A first indication of the period of LO Gem was provided by the work performed by several GEOS members, who collected 840 visual estimates, thus allowing the determination of 16 times of minimum light (Vandenbroere 1993). During five missions at Jungfraujoch Observatory between 1992 and 1997, GEOS teams obtained 128 photoelectric measurements in each of the B and V filters of the Geneva system, covering the complete light curve of LO Gem. These measurements were carried out using the "all sky" method: the atmospheric absorption coefficients were determined by measuring standard stars located at different airmasses. Although no comparison stars were used, the good quality of the photoelectric data (standard deviation about $0\overset{m}{.}010$ in both colours) could be evaluated from the stability of the atmospheric absorption coefficients during the night.

Two series of 351 measurements in the V and I_C colours (Johnson–Cousin system) were also performed with a CCD coupled to a 40-cm telescope in the observatory of one of the authors (N.B., Ghirone, Swiss Alps). Differential magnitudes were obtained by using four comparison stars, i.e. GSC 1868:2932, 1868:225, 1868:2279 and 1868:2280, whose positions are shown in the finder chart (Figure 1, S2 to S5, respectively). The standard deviation of the measurements are $0\overset{m}{.}014$ for the first night (around phase 0.5) and $0\overset{m}{.}017$ for the second one (around phase 0.0), as results from the analysis of the comparison stars' data.

To date, we have 3 photoelectric and 2 CCD minima at our disposal (they were given a triple weight) together with 16 visual minima to determine the period elements of LO Gem. We can refine this considering the photographic minima reported by Hoffmeister (1968) as well as those published by Gessner & Meinunger (1973). The result of the linear regression is the following:

$$\text{Min I} = \text{HJD } 2427368.371(6) + 2\overset{d}{.}2377825(18) \times E.$$

The uncertainty in the final digits are given in brackets. The photoelectric and CCD times of minima are reported in Table 1; the first visual times are listed in Vandenbroere (1997) and the latest one's will be submitted to the BBSAG Bulletin.

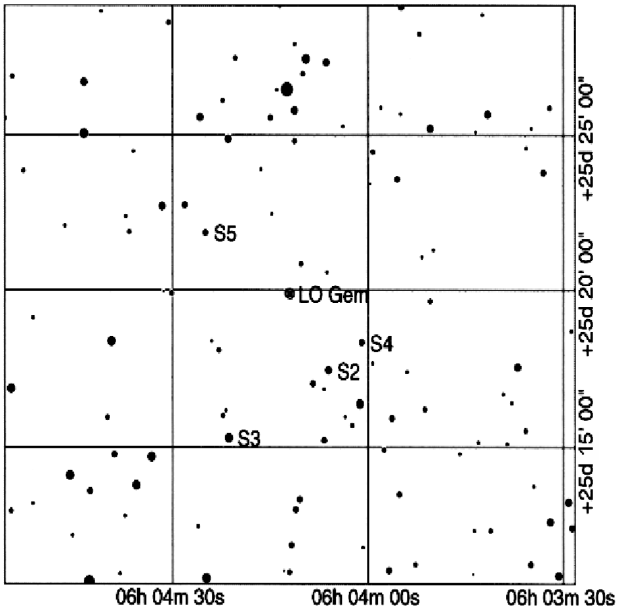

Figure 1. Finder chart of LO Gem

Table 1: Photoelectric and CCD minima of LO Gem

HJD	Mode	E	$O-C$
2448978.6439	p.e. V	9657	0.0072
2450342.5687	p.e. V	10266.5	0.0036
2450462.2948	p.e. V	10320	0.0083
2450811.3820	CCD V	10476	0.0014
2450812.5012	CCD V	10476.5	0.0017

Table 2: Orbital Parameters. Asterisks mark ouput parameters

Primary star	Secondary star
mass ratio = 0.76*	
inclination = 85°.8*	
wavelength = 550 nm	
Fillout = −4.33*	Fillout = −4.32*
Lagrangian L_1 = 0.53	Lagrangian L_2 = 1.65
Mean radius = 0.23	Mean radius = 0.19
temperature = 7000 K*	temperature = 6980 K*
luminosity = 0.60	luminosity = 0.40
gravity coefficient = 0.32	gravity coefficient = 0.32
limb darkening = 0.6	limb darkening = 0.6
reflection = 0.5	reflection = 0.5

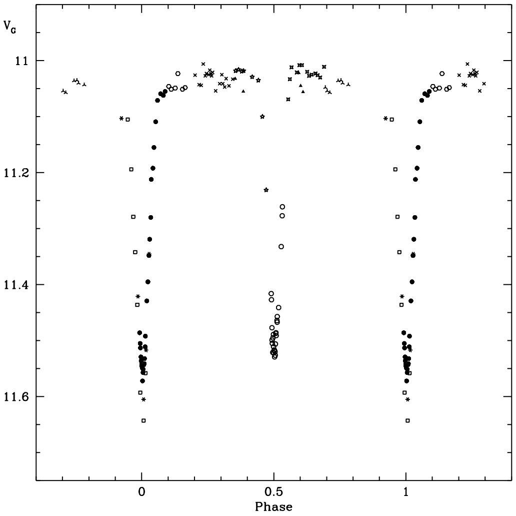

Figure 2. Photoelectric V measurements of LO Gem. Different symbols indicate measurements taken during different nights

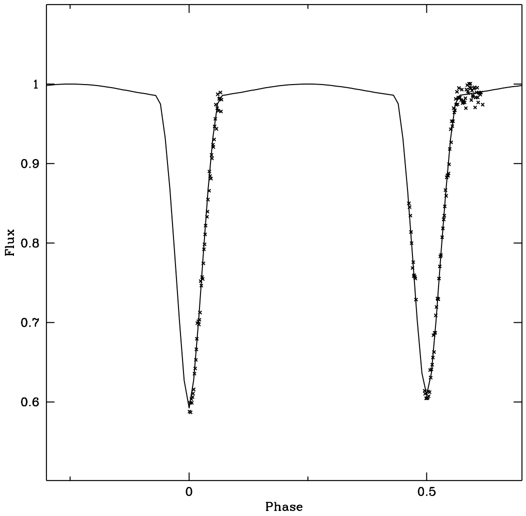

Figure 3. V band CCD light curve (points) with model (line) of the eclipsing system

Two of the ten photographic times of minima had to be rejected from the calculations because of their large $O-C$'s (+0.2638 d and +0.2377 d). Taking together all the times of minima reported to date, the $O-C$'s have not shown a significant period change since 1933.

Figure 2 shows the photoelectric V light curve of LO Gem, constructed using the ephemeris reported above. The brightness of LO Gem outside eclipse varies between $V = 11.01$ and $V = 11.06$. The standard deviation of the V measurements at maximum light is $0\overset{\mathrm{m}}{.}014$. The amplitude of the minima is $0\overset{\mathrm{m}}{.}60$ at phase 0 and $0\overset{\mathrm{m}}{.}53$ at phase 0.5; however, the depth of the primary minimum changes significantly during the different nights making it difficult to predict its correct amplitude (Figure 2). Changes of the atmospheric absorption coefficients during short time lapses can account for such variations; alternatively, we could not rule out the possibility of the intrinsic variability of one of the components, although the colour index of the system makes this possibility unlikely. The eclipse duration is 11.5% of the orbital period.

No significant changes in the $B-V$ colour index were detected during the minima. The $(B-V)_G$ colour index is $-0\overset{\mathrm{m}}{.}31 \pm 0.01$ at maximum light, which corresponds to $(B-V)_J = 0.52$. We used the procedure described by Meylan & Hauck (1981), considering LO Gem as a luminosity class V star. LO Gem belongs approximately to the spectral class F8–G0.

Considering that the amplitudes of the minima are almost identical (Figure 2), we cannot exclude the possibility of the half value for the orbital period. In this case, the absence of a detectable secondary minimum (corresponding to phases 0.25 and 0.75 in Figure 2) prompted us to speculate that the obscure companion would be too faint to be photoelectrically measurable. In order to obtain a more accurate result on the construction of a model of the binary system, we also considered the CCD measurements obtained during two subsequent minima. With Binmaker 2.0 (Bradstreet 1993) the light curve was modelled using both periods; the temperature of the larger star was set to 7000 K. The data, considering the $2\overset{\mathrm{d}}{.}23$ period, were best fitted using an inclination of 86°, a mass ratio of 0.76. The temperature of the smaller star was adjusted to 6980 K. Figure 3 shows the fit of the CCD measurements. The main parameters of the system are reported in Table 2.

Using the half period value and adding an artificial secondary minimum of $0\overset{m}{.}03$ amplitude, we verified that the proximity effects were clearly visible on the modelled light curve, and these could never fit the photoelectric and CCD data in a satisfactory way. Moreover, in the case of a $0\overset{m}{.}03$ secondary minimum, a colour change should be clearly detected due to the occultation of the cool companion whereas the observations reveal no significant changes in the $B-V$ and $V-I_C$ colour indices.

We therefore conclude that LO Gem's orbital period is $2\overset{d}{.}23$. The shape of minima indicate that the eclipses are nearly total. Being the amplitude of the minima $0\overset{m}{.}6$ we obtained an occultation of 85%.

The binary system LO Gem is therefore an EA type with very similar components of late F spectrum and an orbital period of $2\overset{d}{.}2377825$. Our study may not exclude that one or both star(s) is/are pulsating variable(s). Future studies will address this possibility.

We acknowledge Paolo Bernasconi for his help in reducing the CCD measurements, Roland Boninsegna and Joseph Remis for their help at Jungfraujoch Observatory, Andrea Manna, Gilles Allenbach, Julie Guignard and Carlo Barani for their contribution in this study.

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COMMISSIONS 27 AND 42 OF THE IAU
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NSV 5904: A NEW W UMa ECLIPSING BINARY

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NSV 5904 (GSC 3021 2642; $12^{\rm h}43^{\rm m}37\overset{\rm s}{.}22$, $+38^\circ44'16\overset{''}{.}4$; 2000.0) was first suspected to be a variable ranging from magnitude 11.2 to 12.0 (p) by Weber (1963). Since 1996, it has been visually monitored by two GEOS observers (Vandenbroere and Verrot) whose estimates confirmed the variability of the star showing an apparent period of $0\overset{\rm d}{.}16345$ (Vandenbroere 1999).

Photoelectric measurements were performed at the Jungfraujoch station on the basis of the collaboration between GEOS and Geneva Observatory. Nine BV points were obtained on two nights in December 1998 ("all-sky" photometry, see Table 1). The very small amplitude of the $B-V$ colour index suggested the eclipsing nature of NSV 5904. The orbital period calculated from 20 visual minima was 0.3268885 ± 0.00006 d.

Table 1: The V and $(B-V)_G$ photoelectric measurements of NSV 5904

HJD	V	$(B-V)_G$	Phase
2451170.5986	11.093	+0.020	0.582
2451170.6118	11.005	+0.010	0.622
2451170.6570	10.964	−0.015	0.761
2451170.6875	11.084	+0.002	0.854
2451172.6294	10.977	−0.011	0.794
2451172.6530	11.091	−0.000	0.867
2451172.6703	11.261	+0.015	0.920
2451172.6912	11.463	+0.038	0.983
2451172.7057	11.407	+0.018	0.028

After that, Martignoni made 228 CCD measurements of NSV 5904 in order to obtain its photometric light curve (see Fig. 1). He used an unfiltered CCD Seti 245C 378 × 242 attached to a 215-mm $f/5$ reflector at his private station in Busto Arsizio, Italy, and he chose GSC 3021 2613 ($11\overset{\rm m}{.}4$) and GSC 3021 0451 ($12\overset{\rm m}{.}9$) as comparison stars. The CCD light curve allowed him to discriminate between the primary and secondary minima. A more accurate orbital period was determined by means of 6 CCD and 16 new visual times of minima together with the 20 times already published (Vandenbroere 1999). The result of the linear regression, giving a double weight to the CCD times, is the following:

$$\begin{array}{rl}\text{Min I} = \text{HJD } 2450571.219 + & 0\overset{\rm d}{.}326890 \times E. \\ \pm 0.003 & \pm 0.000002\end{array}$$

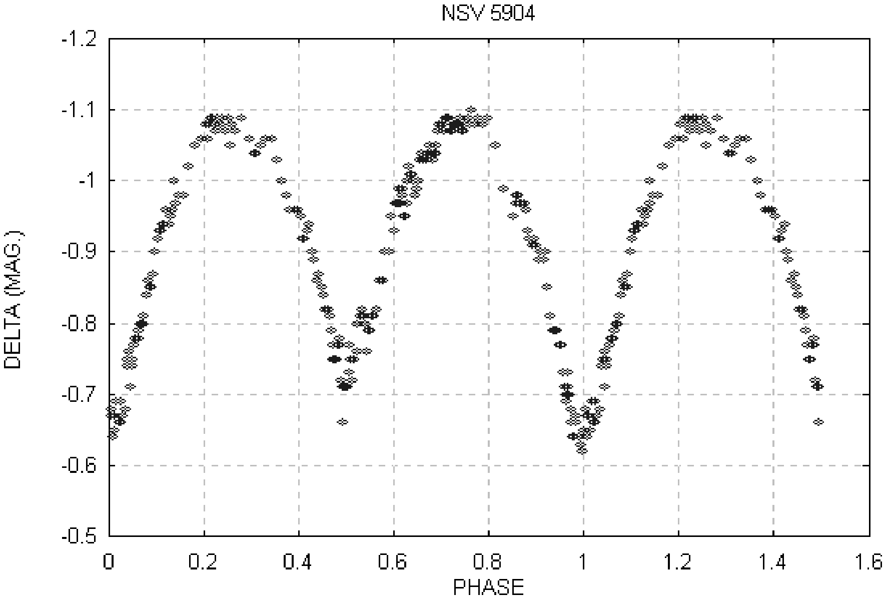

Figure 1. CCD unfiltered light curve of NSV 5904

The CCD minima can be found in Table 2. Visual timings are regularly published in the BBSAG bulletins or can be obtained from the authors. Phases and $O-C$'s in Tables 1 and 2 are calculated in respect with the above ephemeris.

Table 2: CCD minima of NSV 5904

HJD	E	$O-C$
2451679.3732	3390	−0.0038
2451687.3840	3414.5	−0.0018
2451688.3639	3417.5	−0.0026
2451694.4142	3436	+0.0002
2451696.3730	3442	−0.0023
2451711.4138	3488	+0.0015

Together with the B and V photoelectric measurements, we can deduce from the CCD light curve that NSV 5904 varies from magnitude 10.96 to 11.47 (V-light) at primary minimum, with a secondary minimum going to magnitude 11.40. The $(B-V)_G$ index of NSV 5904 varies very little around 0.01 which corresponds to a $B-V$ index of 0.78 after transformation to the UBV system and assuming luminosity class V.

An attempt to model the system was made using the Binary Maker software (Bradstreet 1993), but systematic deviations between observational points and fitting curve were always found. A more sophisticated method combined with multiwavelength observations should allow a better description; at this purpose, the original measurements are available from the IBVS website as 5021-t3.txt.

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LD 347: A NEW ECLIPSING BINARY

BAV MITTEILUNGEN NR. 134

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LD 347 = GSC 3120.1794 = USNO 1275–1075 0202 is located at $19^h05^m33\overset{s}{.}82$, $+39°20'04\overset{''}{.}40$ (J2000) and was discovered to be variable by Dahlmark (2000). In the discovery report it was classified as an eclipsing variable having a range between $12\overset{m}{.}3$ and $13\overset{m}{.}4$ (m_v) with an uncertain period of about 307 days. No further investigations have been published until today.

In order to determine first light elements for the system, we decided to use the plate archives held at the Harvard College Observatory (Guilbault) and the Sonneberg Observatory (Berthold), see Tables 1 and 2.

Table 1: Observational material

Observatory/Series	Number of plates	time-span (J.D.)
Harvard RH	78	2425327–2434072
Harvard Damon	301	2440067–2447823
Sonneberg Sky-Patrol	338	2435698–2450285

Table 2: Comparison stars

Designation	Sonneberg	Harvard	B magnitude
a	USNO 1275–1074 3996	USNO 1275–1074 3996	12.4
b	USNO 1275–1075 0296	USNO 1275–1075 0296	12.9
c	USNO 1275–1075 4169	USNO 1275–1075 4169	13.4
d	—	USNO 1275–1075 5124	13.8
e	—	USNO 1275–1074 8354	14.2

This survey has yielded a series of 32 new minima. They are listed together with that one published by Dahlmark (2000) in Table 3.

Table 3: Minima of LD 347 according to ephemeris (1)

HJD 24...	Epoch	$O-C$	Weight	Observer
26919.590	−1029	0.603	1	Guilbault
28056.617	−928	0.564	1	Guilbault
29812.640	−772	0.325	1	Guilbault
30251.547	−733	0.167	1	Guilbault
35779.286	−242	0.187	1	Berthold
36792.425	−152	0.097	1	Berthold
36837.357	−148	−0.002	2	Berthold
37028.617	−131	−0.130	1	Berthold
37659.230	−75	0.031	2	Berthold
38503.584	0	0.028	2	Berthold
39021.359	46	−0.068	1	Berthold
39055.319	49	0.117	1	Berthold
40023.462	135	0.065	1	Berthold
40383.468	167	−0.188	1	Berthold
40507.326	178	−0.169	2	Berthold
41982.314	309	0.009	1	Berthold
43659.742	458	−0.017	1	Guilbault
43670.744	459	−0.273	1	Guilbault
44346.554	519	0.052	1	Berthold
45089.755	585	0.219	1	Guilbault
45494.698	621	−0.129	1	Guilbault
45618.490	632	−0.175	1	Guilbault
45911.425	658	0.049	2	Berthold
45990.285	665	0.103	1	Berthold
46001.271	666	−0.170	1	Berthold
46237.742	687	−0.118	1	Guilbault
46260.459	689	0.082	1	Berthold
46316.628	694	−0.039	1	Guilbault
46699.545	728	0.103	1	Guilbault
46733.468	731	0.252	2	Guilbault
48095.440	852	−0.005	1	Berthold
50279.445	1046	−0.068	1	Berthold
51101.310	1119	−0.043	1	Dahlmark (2000)

Assuming a constant period from J.D. 2435000 until the end of our observations, the following ephemeris can be derived by least squares fitting:

$$\begin{array}{l} \text{Min I} = \text{HJD } 2438503.556 + 11\overset{\text{d}}{.}258085 \times E. \\ \qquad\qquad\qquad\qquad\quad \pm 31 \qquad\qquad \pm 59 \end{array} \qquad (1)$$

The points in the lightcurves given in Figures 1 and 2 are sliding means ($N = 3$) of the individual estimates, their magnitudes refer to the B values given in the USNO-A2.0 catalogue (Monet et al. 1998). Taking into consideration that the star was not visible on the Sonneberg plates in the very central part of the primary minimum, an estimation of the photographic amplitude from $12\overset{\text{m}}{.}85$ to $13\overset{\text{m}}{.}80$ can be made. The duration of the primary minimum can be estimated to $D = 0\overset{\text{P}}{.}1$. Furthermore, a secondary minimum

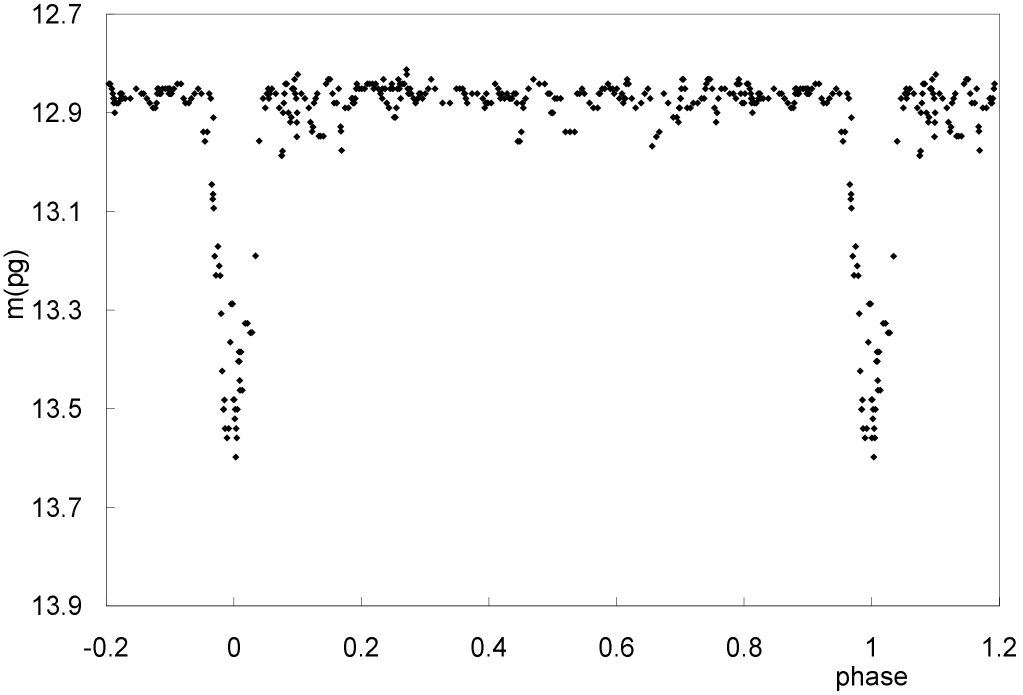

Figure 1. Photographic observations on Sonneberg Sky Patrol plates folded with the ephemeris given in Eq. (1)

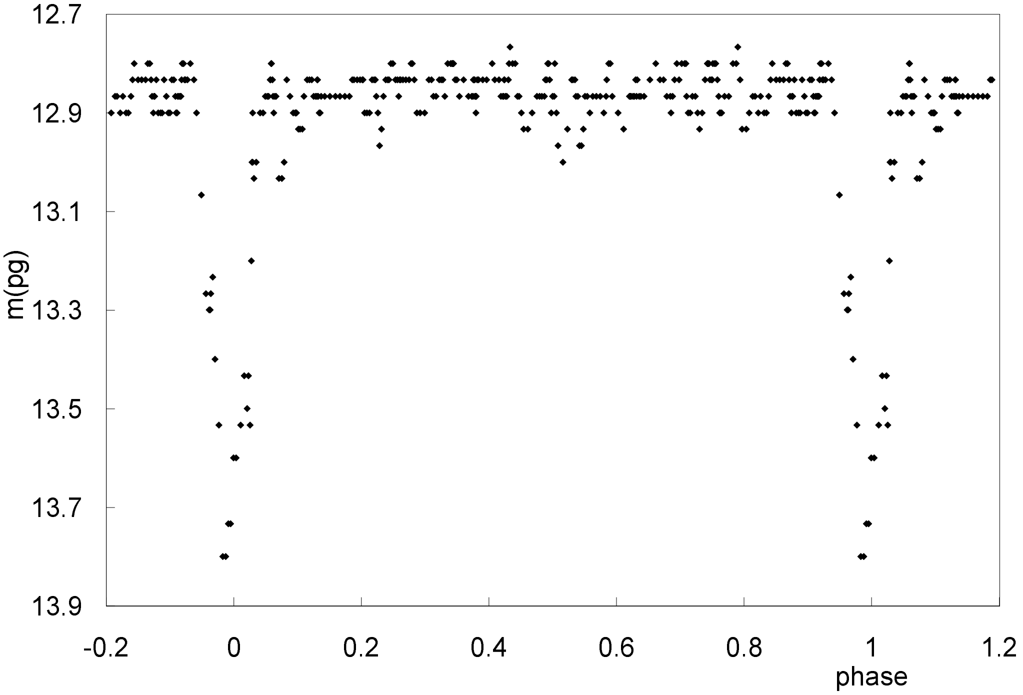

Figure 2. Photographic observations on Harvard Damon and RH series plates folded with the ephemeris given in Eq. (1)

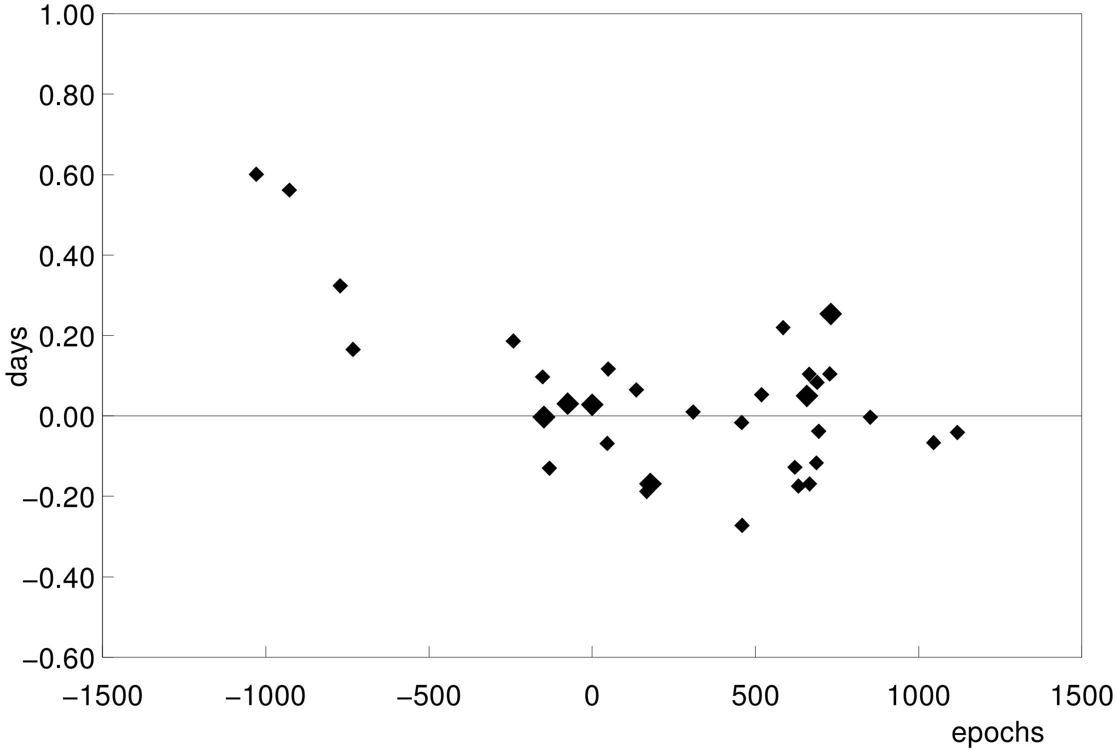

Figure 3. $O-C$ diagram of the available minima according to ephemeris (1)

of about $0\overset{\mathrm{m}}{.}1$ depth is indicated especially in the Harvard observations. The data are available from the IBVS website as 5022-t4.txt.

Figure 3 gives the $O-C$ diagram according to ephemeris (1), larger symbols refer to the minima with higher weight (see Table 3). At least the first four minima in our list may point to a shorter value of the period or a possible quadratic term in the elements effective in the past. But as the observational material is not numerous enough at this time, a further study on the older Harvard AC series plates will be undertaken to investigate the long-term behaviour of the star. Ephemeris (1) agrees as well with the unpublished observational material of Dahlmark.

We suggest spectroscopy and multicolour CCD photometry of this obviously well detached system to enable the determination of the fundamental parameters of the probably less distorted components.

Guilbault would like to thank Dr. Martha Hazen, Curator of the Astronomical Photograph Collection of the Harvard College Observatory, for the use of the plates on this and other variable star projects.

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UNUSUAL SHORT-PERIOD DWARF NOVA RX J2315.5–3049

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The ROSAT X-ray source RX J2315.5–3049 was identified with a 17.3-mag cataclysmic variable (Schwope et al. 2000). Schwope et al. (2000) classified the object as a dwarf nova. One of the authors (RS) visually detected first-ever outburst on 2000 July 8 ($m_v = 13.4$, Stubbings 2000a) and next outburst on 2000 October 26 ($m_v = 14.0$, Stubbings 2000b). We performed CCD observations on this later outburst. In this paper, we report our CCD observations and some peculiarities of this object.

The CCD observations were done using R_c-filtered PixelVision camera (SITe SI004AB chip, CryoTiger-cooled) attached to a 60-cm reflector at Ouda Station (Ohtani et al. 1992) and an R_c-filtered ST-7E camera attached to Meade 25-cm Schmidt–Cassegrain telescope at Kyoto University. Exposure time was 30 sec. The images were dark-subtracted, flat-fielded and analyzed with IRAF APPHOT package (IRAF is distributed by National Optical Astronomy Observatories in U.S.A.), and with Java$^{\mathrm{TM}}$-based aperture photometry package developed by one of the authors (TK), respectively. The differential magnitudes of the variable were measured against the comparison star GSC 7507.14 (USNO r-magnitude 12.1), whose constancy was confirmed by the check star GSC 7507.708 (USNO r-magnitude 12.2). We performed observations on five nights, but only upper limits were obtained on two nights. Table 1 is a summary of the observations. All the data are given in Tables 2 and 3, which appear electronically in the IBVS website as files 5023-t2.txt and 5023-t3.txt, respectively.

The visual observations were done by one of the authors (RS) with a 32-cm reflector. Magnitudes and upper limits were estimated using V-magnitude comparison stars.

Figure 1 (see Table 2) gives the long-term light curve of RX J2315.5–3049 covering 6 months. The abscissa is time in Julian Date and the ordinate is m_v or R_c-magnitude (the '∨' mark represent upper limits). Some observations by Pearce and Monard were supplied from their reports to VSNET. Two outbursts are clearly seen.

These observations revealed that RX J2315.5–3049 is a dwarf nova with a recurrent period of about 110 d, and a range of 13.4–17.3 m_v. The minimum magnitude corresponds to the V-magnitude by Schwope et al. (2000).

Figure 2 (see Table 3) gives the light curve of RX J2315.5–3049 on Oct. 27. The abscissa is time in Julian Date and the ordinate is the differential magnitude of Ouda data (filled circles), Kyoto data (open circles), or comparison (lines). Two humps with an amplitude

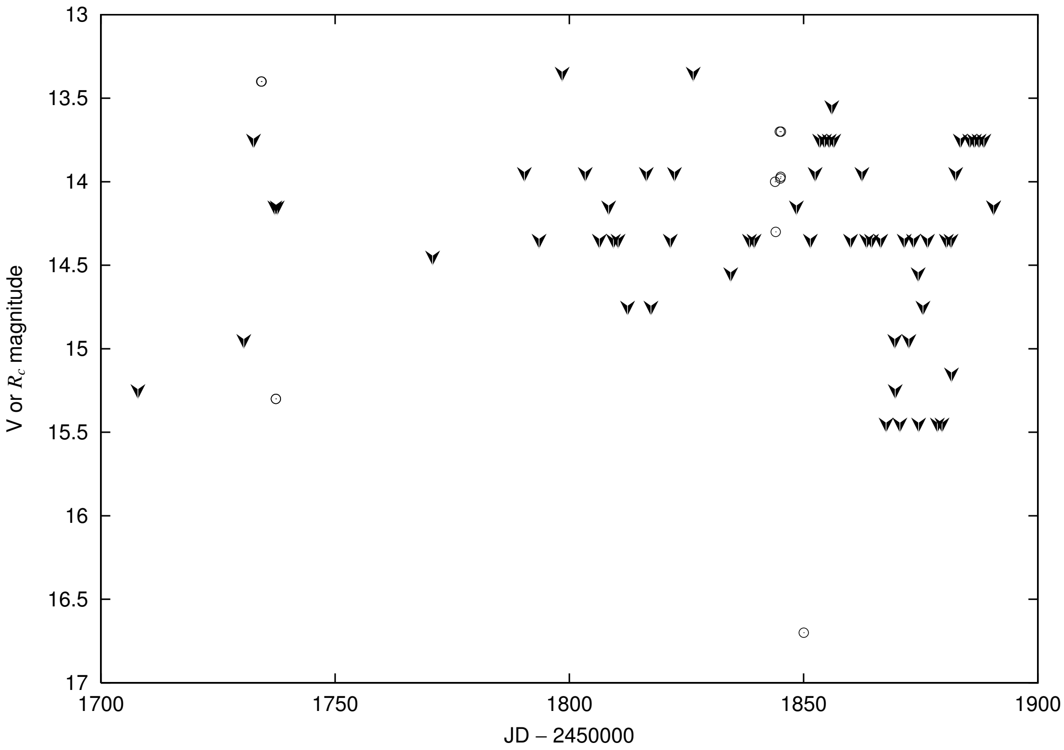

Figure 1. Long-term light curve of RX J2315.5–3049

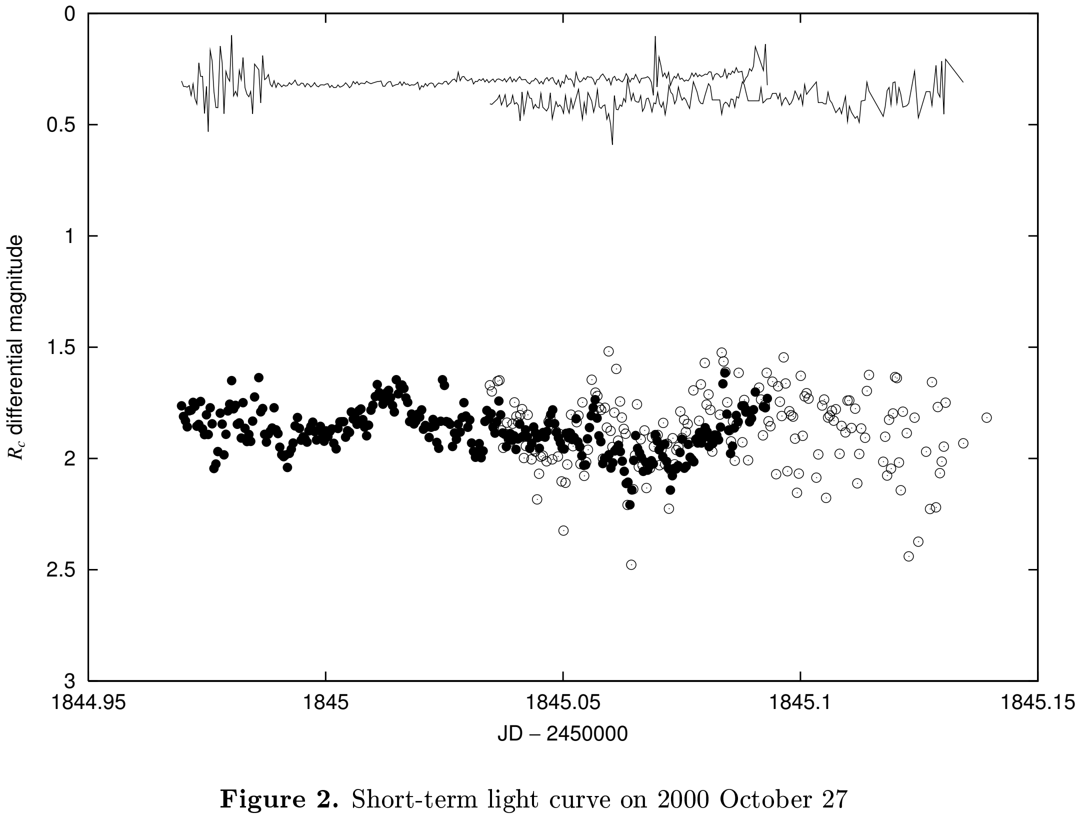

Figure 2. Short-term light curve on 2000 October 27

Table 1: Summary of the observations

start / end (JD − 2450000)	N^a	Exp (sec)	Filter	σ^b (mag)	$\Delta\mathrm{mag}^c$ (mag)	Site^d
1844.061 / 1844.063	4	30.0	R_c	-	2.2	O
1844.970 / 1845.093	299	30.0	R_c	0.05	1.88	O
1845.035 / 1845.139	201	30.0	R_c	0.3	1.87	K
1850.013 / 1850.048	17	30.0	R_c	0.02	4.6	O
1856.019 / 1850.022	10	30.0	R_c	-	>1.5	K
1860.017 / 1860.020	10	30.0	R_c	-	>2.3	K

[a] number of frames

[b] standard deviation of differential magnitudes of the comparison star: comparison − check

[c] nightly averaged differential magnitude relative to GSC 7507.14

[d] O: at Ouda, K: at Kyoto

of $\simeq 0\overset{\mathrm{m}}{.}3$ and a period of $0\overset{\mathrm{d}}{.}078$ were detected. The humps showed a smooth, rapid rise and a slower decline, which are very characteristic to superhumps in SU UMa-type dwarf novae. We therefore identify this hump feature as superhumps and consider this outburst as a superoutburst of an SU UMa-type dwarf nova (for a review of SU UMa-type dwarf novae and superhumps, see Warner 1995).

However, there are some atypical features. As indicated in Fig. 1, this outburst faded rapidly (within 9 d) as if it was a normal outburst, rather than a long-lasting superoutburst (cf. Warner 1995).

Furthermore, Augusteijn et al. (2000) reported that they have found an orbital period of $0\overset{\mathrm{d}}{.}058$ based on their photometry and spectroscopy. Augusteijn et al. (2000) also noted that they detected $\sim 0\overset{\mathrm{m}}{.}3$ eclipse-like feature in their quiescent light curve similar to that of WZ Sge. Our period is ∼ 30% longer than the reported period. If the observed features in our outburst photometry are genuine superhumps, this fractional superhump excess is exceptionally large among all SU UMa-type dwarf novae (the fractional largest superhump excess in SU UMa-type dwarf novae was 7.7% observed in TU Men, cf. Stolz et al. 1984, Nogami et al. 1998). If this large superhump excess is confirmed, this may require a new mechanism for exciting superhumps.

The other possible explanation may be that the period detected by Augusteijn et al. (2000) represents the spin period of an intermediate polar (IP), and that the period we detected represents the orbital or superhump period. In this interpretation, the ratio of orbital period versus spin period, 1.34 for RX J2315.5-3049, is close to 1.46 for EX Hya (Hellier et al. 1987), the well-known IP below the period gap. The relatively strong X-ray emission may also be explained by its suggested IP nature. If the latter possibility is confirmed, the object makes the second established member of the EX Hya-like IPs.

To understand the nature of RX J2315.5-3049, confirmation of the orbital period with spectroscopic or photometric observation is needed.

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GSC 3969.2430 Lac: A NEW SHORT PERIOD ECLIPSING BINARY

(BAV MITTEILUNGEN NO. 135)

AGERER, FRANZ

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Name of the object:
GSC 3969.2430

Equatorial coordinates:	**Equinox:**
R.A.= $22^{\rm h}09^{\rm m}37\overset{\rm s}{.}5$ **DEC.=** $52^\circ34'16''$	2000

Observatory and telescope:
Private observatory, 20-cm SCT

Detector:	SBIG ST6 camera
Filter(s):	None
Comparison star(s):	GSC 3969.2314
Check star(s):	GSC 3969.2134, GSC 3969.2994, GSC 3969.2152
Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	EW

Remarks:

In a photometric investigation in the field of IU Lac, GSC 3969.2430 showed to be variable. A check of the GCVS (Kholopov 1985) and NSV catalog (Kukarkin et al. 1982) did not reveal any previously known variable at this position. The brightness of GSC 3969.2430 is given as $12\overset{\rm m}{.}56$. Observations were performed in 6 nights between August and December 2000. The primary and secondary minima have an amplitude of $0\overset{\rm m}{.}22$ and $0\overset{\rm m}{.}19$ respectively. The minimum times are calculated according to the Kwee–van Woerden method (Kwee, van Woerden 1956). A least squares fit to the data given in Table 1 (weighting half those assigned by colon) led to the preliminary ephemeris:

$$\begin{array}{l} \text{Min I} = \text{HJD } 2451817.5495 + 0\overset{\rm d}{.}308894 \times E. \\ \qquad\qquad\qquad\qquad\qquad\quad \pm 2 \qquad\qquad \pm 5 \end{array} \tag{1}$$

Table 1: Observed times of minima for GSC 3969.2430, epochs and residuals computed with respect to the linear ephemeris derived in this paper

HJD 2400000 +	Type*	Epoch	$O-C$	HJD 2400000 +	Type*	Epoch	$O-C$
51771.3699	s	−150.5	+0.0001	51817.5489	p	0.0	−0.0006
51771.5226	p	−149.0	−0.0017	51838.5548	p	68.0	+0.0005
51816.314:	p	−4.0	+0.000:	51839.3283	s	70.5	+0.0018
51816.4691	s	−4.5	+0.0007	51839.4831	p	71.0	+0.0021
51816.6221	p	−3.0	−0.0007	51890.289:	s	235.5	−0.005:

* ‘p’ and ‘s’ denote primary and secondary minima, respectivelty

Acknowledgements:

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

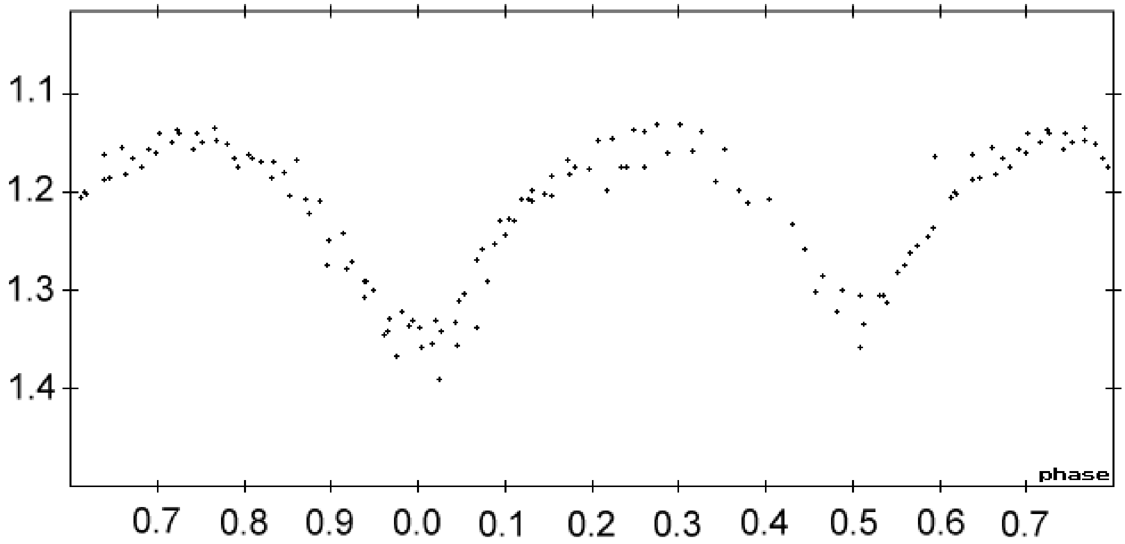

Figure 1. Differential light curve of GSC 3969.2430

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A POSSIBLE LIGHT CURVE OF R CORONAE BOREALIS FOR THE NEAREST FUTURE

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Some 30 stars are included in the group of the R Coronae Borealis (RCB) type variables (Rosenbush 1996). We can follow their history during at least 100 years, and we can definitely say that the manifestations of this type of variability ceased in one of the stars (UV Cas) and appeared in another star (FG Sge). Out this fact we can roughly estimate that the RCB variability phase lasts about 3000 years.

Under such transiency of the RCB phase we can expect that some variability parameters will change. In particular, the light variation periodicity might be initially absent and thereafter appear. From the study of the historical light curve Sterne (1934) established that the moments of light minimum onset are distributed ideally irregularly. Since that study the character of R CrB's variability has changed, and a 4400-day cycle in the sequence of minima has appeared (Rosenbush 1997). The cycle is characterized by high activity in its first half and by lower activity in the second half. The existence of regularity causes that minima occur more likely in September–December (Howarth 1977, Rosenbush 1997). Now the sixth cycle is observed. Parameters of cycles are given in Table 1.

Table 1: Onset and duration of cycles in R Coronae Borealis

Cycle number	Year of the onset	Julian Date of the onset	Duration of cycle, days
I	1933	2427730	5130
II	1948	2432860	4101
III	1960	2436961	4394
IV	1972	2441355	4200
V	1983	2445555	4435
VI	1995	2449990	?
VII	2007-08	-	-

The existence of this periodicity allows us to forecast a light minimum (or the whole light curve) at least until the end of the current cycle (Fig. 1). From the fold of these light curves we may say that minima may occur before JD 2452500 in two intervals: JD 2452100–2452200 (with a probability, which is a ratio of the number of events previously observed at this phase to the number of cycles, of 1/5) and JD 2452400–2452500 (with

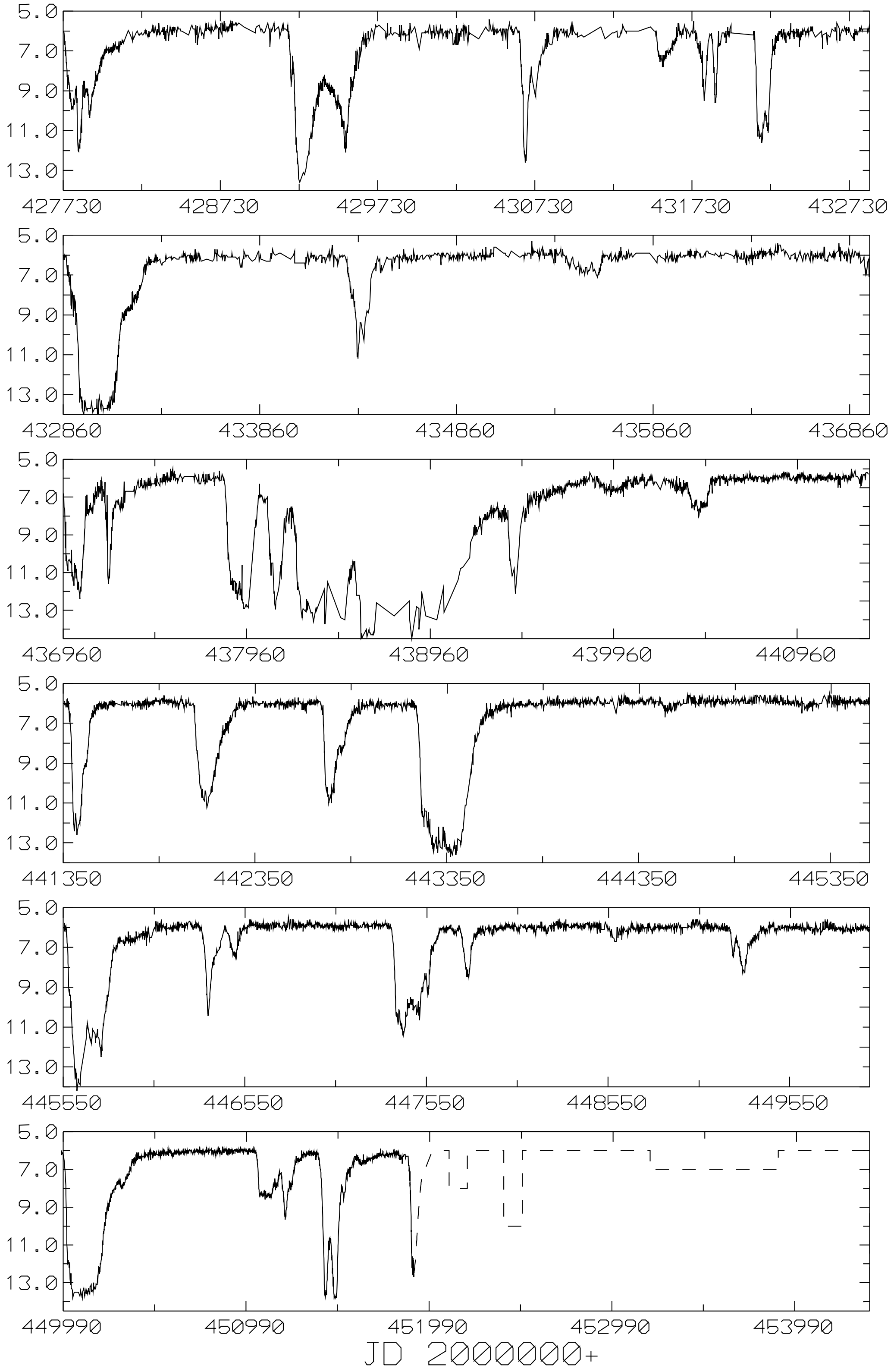

Figure 1. Light curve of R CrB separately for every cycle and normalized to the 4400-day duration in the time scale of 6th cycle according to Table 1, since 1933. Current visual observations of the VSOLJ members are given to JD 2451905

a probability of 2/5). Then a prolonged interval of relative quiescence would start, when only one shallow minimum in the JD 2453200–2453900 period is supposed to be observed. The 6th cycle will finish near JD 2454400 with the onset of the first deep minimum of 7th cycle.

The demonstrated possibility of light curve forecasting allows us to introduce an element of prediction that helps in planning future observations.

Acknowledgements. The author is grateful to the VSOLJ for the possibility of the unlimited access in the database, to the VSNET administrators and to all observers.

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THE OPTICAL BEHAVIOUR OF DELTA SCORPII

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Delta Scorpii (7 Sco, HR 5953, HD 143275, HIP 78401, IDS 15544-2220) normally resides at $V = 2.32$, $B-V = -0.12$ (according to measurements in the General Catalogue of Photometric Data, GCPD, Mermilliod et al., 1997) and has a spectral type of B0.2 IV. Although δ Sco is probably a close binary, a bewildering array of possible components have been suggested. Hanbury Brown et al. (1974) first (re)discovered δ Sco to be multiple, with a companion $\sim 1\overset{\rm m}{.}9$ fainter. The *Bright Star Catalogue* (Hoffleit, 1982) followed by the Washington Double Star catalogue (WDS, Worley & Douglass, 1997) and others, quote occultation results giving four components at separations of 0.01 mas ($V = 5.0$), $0\overset{''}{.}1$ ($V = 3.3$) and $0\overset{''}{.}186$ ($V = 4.9$). However, it should be pointed out that the closest companion apparently lies inside the primary, which has a diameter of 0.46 mas (Hanbury Brown et al., 1974), and is clearly an error. According to the Multiple Star Catalogue (MSC, Tokovinin, 1997) δ Sco comprises a spectroscopic binary (Levato et al., 1987) and the brighter companion at $0\overset{''}{.}1$. Optical interferometric measurements and a thorough analysis of the previous results by Bedding (1993) showed convincingly that all the observations referred to just two components in an elliptical orbit with a ten-year period. Modern speckle interferometry observations reveal that the components (Hp = 2.39 and 4.62) have a very eccentric orbit, with $e = 0.92$, $a = 0\overset{''}{.}107$, $P = 10.583$ years and $T_0 = 1979.41$ (Hartkopf et al., 1996), although the orbit was difficult to determine. Periastron passage occurred recently in July 2000. Although the secondary is over two magnitudes fainter than the primary it probably has a spectral type no later than about B3, if it lies on the main sequence.

The early literature on δ Sco contains several references to velocity variations (e.g., van Hoof et al., 1963). In the *Bright Star Catalogue* (Hoffleit, 1982; see also Smith, 1986) δ Sco is given as a possible SB1 with a period of ~ 20 days. Levato et al. (1987) made new observations, and also gave it as an SB1, but were unable to find a reliable period, the best was ~ 83 days, and did not provide an orbit. Smith (1986) found line-profile variations which were interpreted as being due to relatively short-lived, complex non-radial oscillations. In effect the star is a β Cephei variable, but it does not show consistent, periodic variations. The velocity variations are small, 10–20 $\mathrm{km\,s^{-1}}$, and the corresponding light variations are very low. δ Sco was included in the Be-star mass-loss survey with *Copernicus* (Snow, 1981), although it was not known to show any Be-star characteristics. It showed barely detectable mass loss, indicating at most only marginal Hα emission. Hα spectra given by Heasley & Wolff (1983), probably obtained around the same time, shown no indication of any emission. In 1990 Coté & van Kerkwijk (1993) observed broad Hα emission wings around the absorption core and proposed δ Sco as a Be star. They also noted that prior to this observation there had been no mention of any activity at Hα. According to unpublished observations by Hartkopf (quoted by Fabregat et al., 2000b) Hα emission has been visible on several occasions during the past five years.

In June and July 2000 visual observations of δ Sco by Otero (2000) showed a slow increase in brightness typical of a γ Cas-type outburst. Further visual observations were made regularly and these were later supported by photoelectric observations by Fraser made using a 20-cm F10 SCT with an Optec SSP3 photometer, with B and V filters. The comparison star used was ω^1 Scorpii ($V = 3.95, B - V = -0.04$) and the check star HIP 77911 ($V = 6.86$, $B - V = 0.04$). The data are available at the IBVS website as 5026-t1.txt.

The light curve of δ Sco is shown in Figure 1. The first observations at the end of June suggest that δ Sco was slightly above its usual level of $V = 2.3$ but it then brightened to a maximum of $V = 1.9$ (at $\sim$ JD 2451755) over some 25 days. During August it faded steadily to $V \sim 2.15$, and it then recovered during September, mimicking its initial rise. At the end of the observing season in mid October it had just started to decline from the second maximum (at $\sim$ JD 2451823, $V = 1.87$), which was probably brighter than the first.

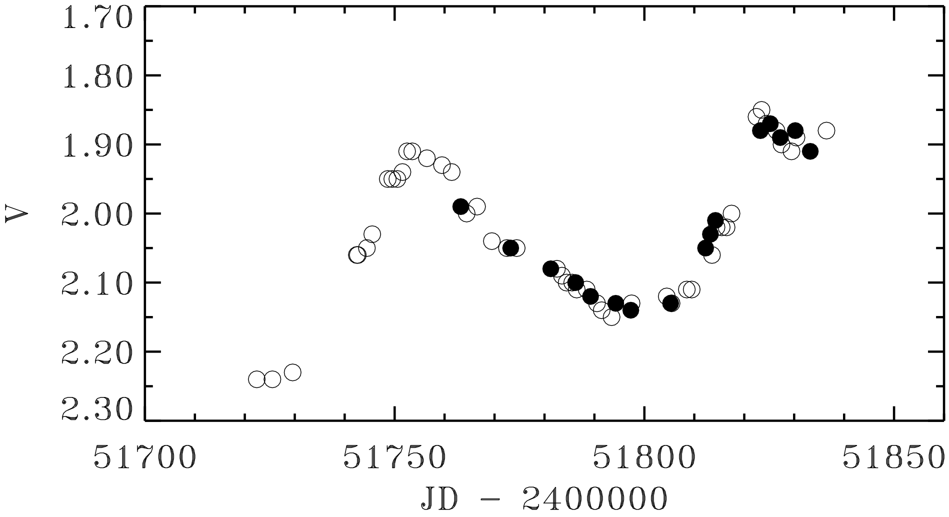

Figure 1. The light curve of δ Sco showing the visual (open circles) and photoelectric (filled circles) observations from this paper

Prompted by the optical brightening, spectroscopic observations in mid July by Fabregat et al. (2000a) show Hα purely in emission, confirming δ Sco as a Be star. Further spectra obtained by Fabregat et al. (2000b) and by the Be-star Spectroscopic Survey Project (only available electronically, see Buil, 2000) show only modest changes in the Hα profile while the star brightened by $0\overset{m}{.}4$. Indeed the the emission is seen fully developed on 2000 June 4 (see Buil, 2000), before the star had brightened significantly. During July the emission line developed a double peak but was otherwise largely unchanged.

The compilation of photometry in the GCPD shows that all the measurements of δ Sco lie close to $V = 2.32$ except for an isolated value of $V = 2.21$ (Hogg, 1958) recorded in 1958. As mentioned before, periastron passage of the speckle binary occurred in July (2000.58), and it is interesting to note that it also occurred in 1989.99, 1979.41, 1968.83, and 1958.24. *Hipparcos* observed δ Sco for over two years from just after the 1989.99 periastron passage and these observations, shown in Figure 2, suggest that δ Sco was slightly brighter than its normal value. According to the *Hipparcos* catalogue δ Sco shows possible micro variability but the most obvious variation in Figure 2 is a small, slow oscillation and fade. There does not appear to be any photometry at the other epochs but it raises the question of whether the optical outburst is triggered by the close approach of the secondary.

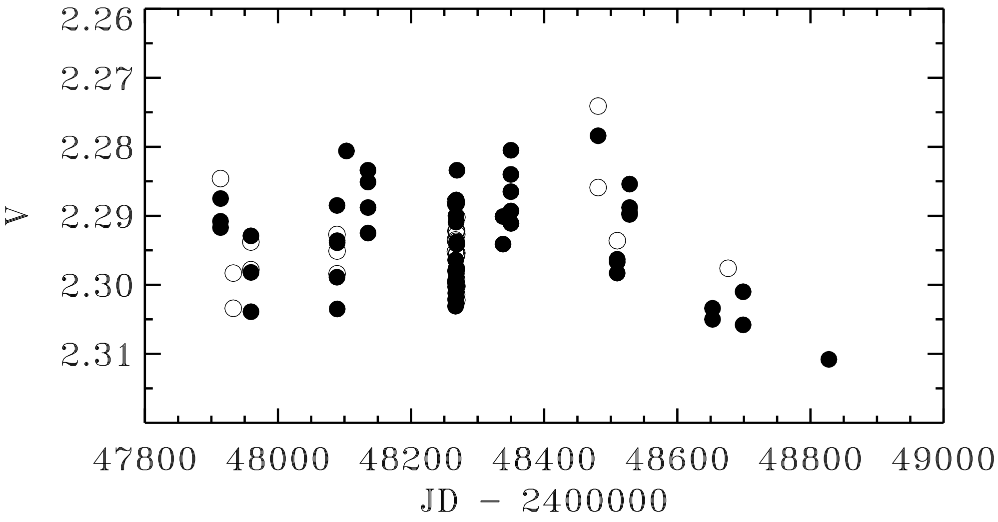

Figure 2. *Hipparcos* light curve of δ Sco showing the unflagged (filled circles) and flagged (open circles) observations. The *Hipparcos* (Hp) magnitudes are transformed to V

The total mass of the system can be calculated from the orbital period, 10.583±0.075 yr and the semi-major axis, 106.7±6.7 mas of the speckle orbit and the distance of the system, $\pi = 8.12 \pm 0.88$ mas (123 ± 13 pc) from *Hipparcos*, as $20.3 \pm 7.6\ M_{\odot}$. The primary alone probably has a mass $\sim 20\ M_{\odot}$ and the secondary, if it is as early as B3, could contain 8 $M_{\odot}$, which is accommodated by the uncertainty. As the two speckle components seem to more than adequately account for the total mass of the system there appears to be no room for any other fainter components or spectroscopic binary companions. At this distance the radius of the primary, from Hanbury Brown et al.'s measurement is a just acceptable $R = 6.1 \pm 0.9\ R_{\odot}$.

The separation of the components at periastron is ~ 1 AU, which does not seem very close, but the speed of approach will be $\sim 150\ \mathrm{km\,s^{-1}}$. Whether the rapid approach of such a star could disrupt the atmosphere of the primary is not clear.

The relationship between the optical outburst and the Hα emission is also not clear. Hα emission has been seen at some level for all of the past cycle, about ten years, but was apparently absent during the previous cycle. Apart from the current outburst and the possible event in 1958 the luminosity has apparently remained constant throughout most of both cycles. Even after the 1989.99 periastron passage there was only low level activity. The current optical outburst is unlike anything previously seen, in terms of both magnitude and duration. The Hα emission is also stronger than previously observed, but in detail it does not show a strong correlation with the brightness variations, which suggests that the mass loss and luminosity are not strongly coupled.

Observation of δ Sco during solar conjunction with *SOHO* (Farrell, 2001) and the most recent visual observations, during January 2001, suggest that the star remains in outburst, and may indeed be brightening. Further photometric and spectroscopic observations are encouraged.

It is a pleasure to thank John Greaves for helpful comments.

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TIMES OF MINIMA OF ECLIPSING BINARIES FROM ROTSE1 CCD DATA I: NAMED VARIABLES

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The ROTSE-1 survey (Robotic Optical Transient Search Experiment 1), designed for the detection of astrophysical transients, especially those associated with gamma-ray bursts, has yielded a large amount of CCD data on variable stars, as reported in Akerlof et al. (2000). With permission of the ROTSE-1 team, we have used these measurements publicly available through the internet (http://www.umich.edu/~rotse) to determine the times of minimum of eclipsing binaries.

In Table 1, the derived times are presented for the named variables according to the General Catalogue of Variable Stars. In each case, the data have been folded into a seasonal light curve using the best available elements of variation. In most cases, we used either the data from the latest edition of the General Catalogue of Variable Stars or the more actual ephemerides in SAC 72 (Rocznik Astronomiczny Obserwatorium Krakowskiego, 2001) or from other sources in the literature. Where no previous elements of variation were known, we employed the period values given in the ROTSE1 data base. It should be noted, that the GCVS periods for DP Herculis and ES Herculis are to be preferred over the ROTSE1 values. The time of minimum was then found with the help of the Kwee-Van Woerden algorithm (Kwee and Van Woerden, 1956).

We would like to express our gratitude towards the ROTSE team for making their data available to the general public. In addition, the cross-reference table provided by B. Skiff through M. Baldwin of the AAVSO is thankfully acknowledged. It proved to be very helpful for the identification of the ROTSE sources.

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ERRATUM FOR IBVS 4982

In IBVS No. 4982 the period of GSC 2646.1938 should read $0\overset{d}{.}2890550$ instead of $0\overset{d}{.}2860550$.

Table 1: Times of minima of eclipsing binaries

Star	Type	JD(hel, min)	Est. error	Star	Type	JD(hel, min)	Est. error
TU Boo	p	2451246.8098	$0\overset{\rm d}{.}0021$	OS Her	p	2451304.7322	$0\overset{\rm d}{.}0029$
	s	2451338.7443	0.0028	V342 Her	p	2451275.8470	0.0011
TY Boo	p	2451339.7500	0.0004		s	2451295.866	0.003
AR Boo	p	2451305.7312	0.0021	V366 Her	p	2451306.706	0.024
	s	2451320.7360	0.0008		s	2451310.8874	0.0015
CV Boo	p	2451258.8651	0.0008	V381 Her	s	2451258.876	0.005
	s	2451339.7597	0.0006		p	2451310.762	0.004
EW Boo	p	2451225.9064	0.0014	V387 Her	p	2451307.7584	0.0007
RV CVn	p	2451247.8110	0.0005		s	2451312.769	0.004
	s	2451334.7461	0.0004	V412 Her	s	2451283.788	0.005
YZ CVn	s	2451247.8728	0.0016		p	2451295.724	0.005
	p	2451310.7319	0.0013	V450 Her	s	2451295.7100	0.0025
BI CVn	p	2451258.6944	0.0008		p	2451305.717	0.004
	s	2451277.7129	0.0008	V477 Her	p	2451287.713	0.002
RW Com	s	2451258.7015	0.0004		s	2451287.8769	0.0011
	p	2451288.7288	0.0003	V502 Her	p	2451280.8461	0.0015
RZ Com	s	2451281.9016	0.0003		s	2451306.8870	0.0012
	p	2451312.8758	0.0004	V663 Her	s	2451260.891	0.003
EK Com	p	2451288.8642	0.0002		p	2451288.8684	0.0016
	s	2451340.7354	0.0004	V681 Her	p	2451274.9033	0.0011
TW CrB	s	2451283.7764	0.0008	V687 Her	p	2451258.8624	0.0014
	p	2451311.7468	0.0009		s	2451283.7749	0.0013
V753 Cyg	p	2451274.8715	0.0016	V719 Her	p	2451283.7341	0.0019
	s	2451304.8680	0.0008	V728 Her	p	2451285.6920	0.0004
V850 Cyg	s	2451243.886	0.013		s	2451305.7220	0.0008
	p	2451259.839	0.016	V731 Her	s	2451243.9885	0.0015
V997 Cyg	p	2451291.8078	0.0022		p	2451310.7184	0.0009
	s	2451304.8548	0.0027	V836 Her	s	2451259.91	0.03
V1763 Cyg	s	2451283.7514	0.0010		s	2451306.80	0.06
	p	2451312.7292	0.0015	V848 Her	s	2451262.917	0.003
V1918 Cyg	s	2451275.8345	0.0016		p	2451308.8586	0.0021
	p	2451288.8466	0.0007	V857 Her	s	2451306.7712	0.0005
AK Dra	p	2451275.8273	0.0012		s	2451308.8759	0.0010
DP Her	s	2451288.740	0.010	TZ Lyr	p	2451258.8404	0.0004
	p	2451312.748	0.003		s	2451306.7043	0.0013
TU Boo	p	2451246.8098	0.0021	EX Lyr	s	2451296.7667	0.0011
	s	2451338.7443	0.0028	V400 Lyr	s	2451274.8713	0.0012
ES Her	p	2451291.8187	0.0020		p	2451321.8742	0.0010
	s	2451304.7379	0.0017	V404 Lyr	s	2451308.698	0.004
GU Her	p	2451265.7877	0.0022		p	2451312.7094	0.0012
	s	2451280.951	0.003	V406 Lyr	s	2451265.9702	0.0015
HP Her	s	2451288.7143	0.0015		p	2451306.8668	0.0015
	p	2451295.7147	0.0015	V461 Lyr	p	2451311.789	0.013
IT Her	p	2451274.8872	0.0013	V449 Oph	p	2451306.9022	0.0003
	s	2451296.7743	0.0027		s	2451324.895	0.004
LT Her	s	2451287.7312	0.0009	V1125 Oph	p	2451259.8922	0.0020
	p	2451308.8692	0.0007		s	2451307.753	0.004
MS Her	s	2451274.8894	0.0012				
	p	2451297.8952	0.00111				

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CCD OBSERVATION OF MWC 560 = V694 Mon

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MWC 560 (= V694 Mon) is a symbiotic-like star whose character is still not clear. This star was discovered as an emission-line object $V = 12\overset{\mathrm{m}}{.}5$ by Merrill and Burwell (1943). Sanduleak and Stephenson (1973) gave a spectral classification of M4ep. One interesting phenomenon of MWC 560 is its flickering. Bond et al. (1984) first noted the rapid variation with amplitudes of about $0\overset{\mathrm{m}}{.}2$ and time scales of a few minutes. Flickering is a common property of CVs, but is rarely seen on symbiotic stars (Dobrzycka et al. 1996).

Tomov et al. (1990) reported an outburst reaching $V = 9\overset{\mathrm{m}}{.}1$, associated with remarkable blue-shifted absorption lines with velocities up to $-6500\ \mathrm{km\,s^{-1}}$. The strong shift implied a high-velocity and highly-collimated jet. These absorption lines showed rapid variability (Tomov et al. 1990, 1997). The magnitude dropped to $V \simeq 10.2$ by 1993 and has remained at this mean value up to now. The interval between the 1990 outburst and the 1995 small maxima agrees with the orbital period ~ 1930 day (Mikołajewski et al. 1998). At present the orbital phase may be the same as in 1990 and 1995, but the object is not in outburst now.

In this paper, we report time-resolved CCD observations of MWC 560 to detect flickering. The CCD photometric observations were done on 13 nights using ST-7E (unfiltered or R_c-filtered) and ST-7 (unfiltered) cameras attached to a 25-cm Schmidt–Cassegrain telescope at Kyoto University and an R_c-filtered PixelVision camera (SITe SI004AB chip, CryoTiger-cooled) attached to a 60-cm reflector at Ouda Station (Ohtani et al. 1992). The exposure times were 15 s and 5 s, respectively. The images were dark-subtracted, flat-fielded and analyzed with the Java$^{\mathrm{TM}}$-based aperture photometry package developed by one of the authors (TK) and with IRAF APPHOT package (IRAF is distributed by National Optical Astronomy Observatories in U.S.A.), respectively. We determined the differential magnitude of MWC 560 using the comparison star GSC 5396.1090 (Tycho $V = 10.66$, $B - V = 1.73$, so $R_c \simeq 9.7$, Skiff, 1998) whose constancy was confirmed with the check star GSC 5396.491. Table 1 is a summary of the observations.

R_c-magnitude of MWC 560 is about $9\overset{\mathrm{m}}{.}8$. Although the nightly average magnitudes seem to show slight variability both of the R_c-filtered and unfiltered data sets, more observation is needed to confirm this.

We analyzed the data set observed on six nights at Kyoto using DFT (discrete Fourier transform) algorithm. The light curves used for DFT analysis and the results are shown in Fig. 1. The abscissa is time in Julian Date or frequency, and the ordinate is differential magnitude or relative power. These spectra are shown at the frequencies higher than

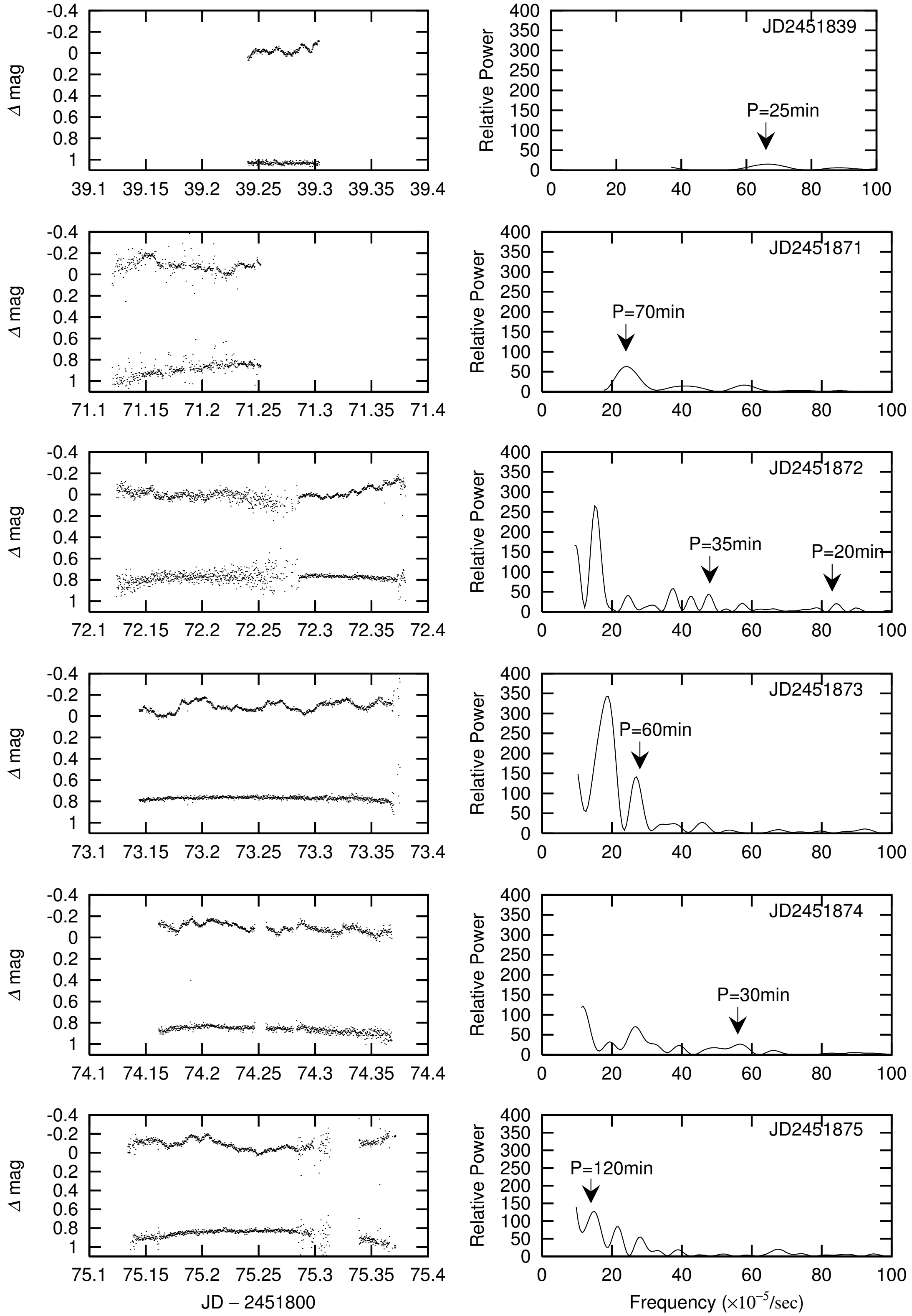

Figure 1. Light curve and power spectrum on individual night data

Table 1: Summary of observations

Start / end (JD − 2450000)	N^a	Exp (sec)	Filter	σ^b (mag)	Δmag^c (mag)	Site^d
1834.191 / .311	637	5.0	R_c	0.037	0.383	O
1839.240 / .303	295	15.0	none	0.027	−0.024	K1
1844.242 / .283	401	5.0	R_c	0.020	0.427	O
1849.314 / .332	55	5.0	R_c	0.037	0.450	O
1850.295 / .359	310	5.0	R_c	0.025	0.408	O
1852.280 / .327	471	5.0	R_c	0.026	0.272	O
1855.205 / .245	220	15.0	R_c	0.043	0.193	K2
1858.279 / .352	59	15.0	R_c	0.064	0.250	K2
1871.120 / .251	469	15.0	none	0.077	−0.084	K2
1872.124 / .372	975	15.0	none	0.045	−0.004	K2
1873.144 / .369	961	15.0	none	0.016	−0.091	K2
1874.161 / .367	810	15.0	none	0.031	−0.091	K2
1875.134 / .371	832	15.0	none	0.052	−0.087	K2

[a] number of frames

[b] standard deviation of differential magnitudes of the comparison star: comparison − check

[c] nightly averaged differential magnitude of MWC 560

[d] O: at Ouda, K1: at Kyoto with ST-7, K2: at Kyoto with ST-7E

that corresponding to the period equal to the half-duration of each observational run. The arrows in Fig. 1 are put for help and do not show precise peaks. 1 sigma of the comparison is about $0\overset{\text{m}}{.}02$–$0\overset{\text{m}}{.}08$, so the variation is real.

As shown in Fig. 1 left, we detect quasi-periodic modulation from minutes to hours with typical amplitude about $0\overset{\text{m}}{.}2$. Fig. 1 right shows some peaks from 20 min to 2 hours, but there is no peak coherent over the whole data set. The resultant time scales of variability and the apparent lack of rigid coherence have confirmed the findings in previous studies: Michalitsianos et al. (1993) found quasi-periodic variations with periods of 24, 35, and 58 min, superposed on hourly variability. Tomov et al. (1996) detected a periodicity of 70 min which was coherent over a few days. Dobrzycka et al. (1996) obtained 22 min period.

Our observation seems to suggest that the general characteristics of short-term variability in V694 Mon have been stable nearly a decade. The lack of coherence suggests that these dominant oscillations are quasi-periodic, rather than strictly periodic as expected from the magnetic rotator model (Tomov et al. 1992; Shore et al. 1994). We are going to continue this observation in order to clarify the nature of these periodicities.

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THE SHORT-PERIOD ECLIPSING BINARY GSC 3123.1618

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Variability of the star GSC 3123-1618 = ROTSE1 J185538.25+405859.0 was detected by the ROTSE1 CCD survey (Akerlof et al. 2000). Blättler and Diethelm (2000) presented an unfiltered light curve and found a period of $0^{\mathrm{d}}.2559007$. Our CCD photometry during the same observing season produced a V-band light curve and improved light elements.

Billings observed in the V band with a 0.35-m Schmidt–Cassegrain telescope and Apogee AP-7 CCD. Kaiser observed in VRI with a 0.35-m Schmidt–Cassegrain and SBIG ST-9E CCD. Terrell observed in B with a 0.60-m Cassegrain and SBIG ST-8 CCD at the Sommers–Bausch Observatory of the University of Colorado. Henden observed with the 1.0-m Ritchey–Chrétien telescope of the U. S. Naval Observatory, Flagstaff Station with a Tektronix/SITe 1024×1024 thinned, backside–illuminated CCD and BVR_cI_c filters. His photometry of the variable near maximum light and of the comparison and check stars is shown in Table 1 (photometry for other stars in the field can be found in Henden 2001). Henden also used the USNO-A2.0 astrometric catalog to determine the precise position for GSC 3123-1618 of $18^{\mathrm{h}}55^{\mathrm{m}}38^{\mathrm{s}}.20$, $+40^\circ 58' 57''.06$ (J2000).

Altogether, we obtained timings of 7 primary and 3 secondary minima (Table 2). Times of minima were determined with the computer program AVE (Barbera 2000) based on the Kwee–Van Woerden (1956) method. In addition to the 10 new minima reported here, we have included 5 minima timings published recently by Blättler (2000). A least-squares solution of the 15 timings resulted in the following light elements:

$$\begin{array}{l} \text{Min. I} = \text{HJD } 2451766.5840 + 0^{\mathrm{d}}.2559067 \times E. \\ \qquad\qquad\qquad\qquad\quad \pm 0.0001 \pm 0.0000001 \end{array}$$

Henden observed on two nights, at phase 0.70, $V = 13.444$ and phase 0.26, $V = 13.434$. We adopt the average of the two as the magnitude at maximum, 13.439 V. Differential measurements yield 14.61 V in primary minimum and 14.22 V in secondary minimum. The V-band light curve is shown in Figure 1. Terrell used the latest version of the Wilson–Devinney program (Wilson and Devinney 1971, Wilson 1979) to explore preliminary solutions for the system parameters. As expected for a light curve with partial eclipses, the mass ratio could not be determined. A grid of solutions at fixed values (0.5 to 1.5) of the mass ratio showed very little variation in the goodness of fit. Until the mass

Table 1: BVR_cI_c photometry with errors less than $0\overset{\mathrm{m}}{.}02$, GSC 3123.1618, comparison and check stars

Star	GSC	V	$B-V$	$V-R_c$	R_c-I_c
variable (max)	3123:1618	13.439	0.990	0.602	0.556
comparison	3123:0834	13.938	1.074	0.584	0.479
check	3123:0596	13.694	0.671	0.372	0.331

Table 2: Times of minima, GSC 3123.1618

HJD 2400000 +	Error ±	Epoch	$O-C$	Observer	Type
51721.6729	0.0003	−175.5	+0.0005	Kaiser	ccd − V filter
51722.8238	0.0001	−171.0	−0.0002	Billings	ccd − V filter
51732.8043	0.0001	−132.0	0.0000	Billings	ccd − V filter
51739.8413	0.0002	−104.5	−0.0004	Billings	ccd − V filter
51741.7610	0.0001	−97.0	−0.0001	Kaiser	ccd − V filter
51756.7314	0.0005	−38.5	−0.0002	Terrell	ccd − B filter
51756.8594	0.0002	−38.0	−0.0001	Terrell	ccd − B filter
51766.4559	0.0005	−0.5	−0.0001	Blättler	ccd − unfiltered
51766.5841	0.0005	0.0	+0.0001	Blättler	ccd − unfiltered
51771.4464	0.0006	+19	+0.0002	Blättler	ccd − unfiltered
51781.4271	0.0010	+58.0	+0.0005	Blättler	ccd − unfiltered
51781.5543	0.0015	+58.5	−0.0002	Blättler	ccd − unfiltered
51790.6392	0.0001	+94.0	0.0000	Kaiser	ccd − V filter
51864.5962	0.0001	+383	−0.0001	Billings	ccd − V filter
51867.6670	0.0001	395	0.0001	Billings	ccd − V filter

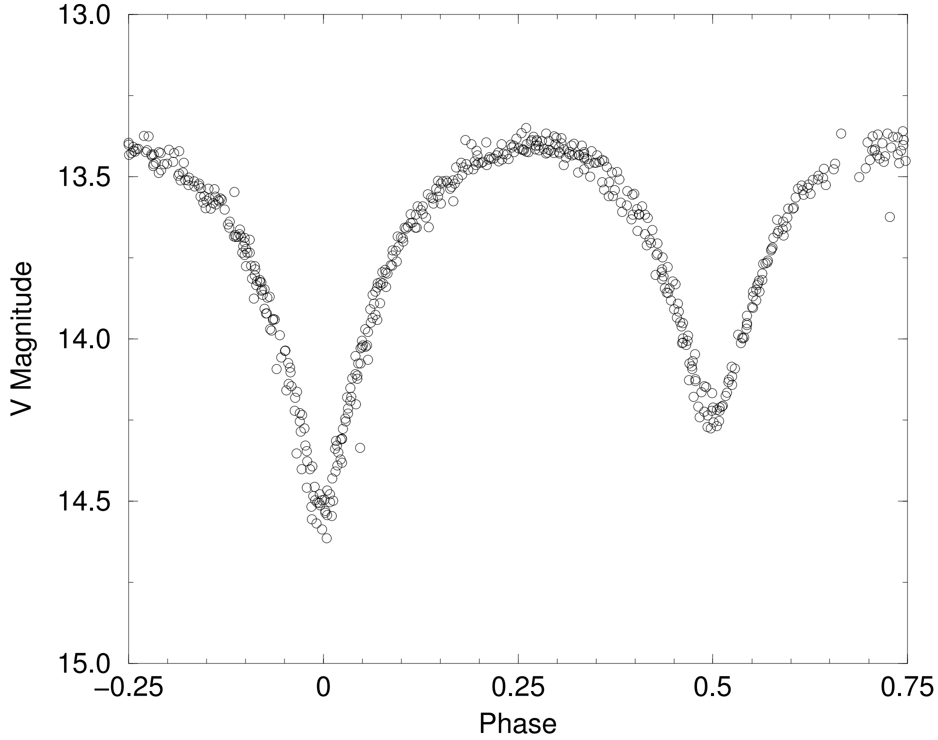

Figure 1. Phased light curve, GSC 3123.1618 – V filter

ratio can be determined by spectroscopic observations, we cannot make any definitive claims about the nature of the system. However, our solutions indicate that the system is in weak or broken contact.

This observing project was conducted in association with the AAVSO eclipsing binary program. We wish to thank Marvin Baldwin, chairman of the AAVSO Eclipsing Binary Committee, for bringing this variable to our attention. P.R. Guilbault and D.B. Williams assisted in preparing this report for publication. Billings acknowledges the use of software (KAPPA, PHOTOM) provided by the Starlink Project which is run by CCLRC on behalf of PPARC.

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ON THE VARIABILITY OF THREE GUIDE STAR CATALOGUE STARS

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Ground based CCD photometry of three Guide Star Catalogue (GSC) stars (GSC 0742602146, 0777501959 and 0781801912) is presented. Two of these objects (GSC 0742602146 and 0781801912) were already reported as variable by Zwintz et al. (2000). They have analyzed photometric data of the Fine Guidance Sensors of the Hubble Space Telescope. It is especially important to confirm these results with ground based observations in order to prove the reliability and stability of these sensors. Kuschnig et al. (1997) already reported the confirmation for two of such objects. But further data are needed to unambiguously establish the capability of these instruments to detect even very low amplitude variability.

The photometric observations were made in the nights 26/27.05. and 30/31.05.1995 with the 61-cm Bochum telescope at ESO–La Silla (observer: E. Paunzen). The telescope was equipped with a nitrogen-cooled Thompson 7882 CCD (384×576 pixel) corresponding to a field-of-view of about $3' \times 4'$. Continuous observations with an integration time of 60 seconds using a standard Johnson V filter were made.

A spectrum of GSC 0777501959 was observed with the 190-cm telescope at the South African Astronomical Observatory with the long slit spectrograph in the night of 31.01/01.02.2001 (observer: C. Foellmi). The 300 lines/mm grating gave a resolution of about 5 Å and covered a spectral range from 3000 to 8000 Å. The exposure time was 300 seconds.

The basic reduction steps (bias-subtraction, dark-correction, flat-fielding) were carried out within standard IRAF routines. Standard aperture photometry within the IRAF task APPHOT was performed. For each program star, three comparison stars within the corresponding field were chosen. These objects are listed in Table 1. They all turned out to be constant. For the final light curves (Figure 1) the differences of all comparison stars with respect to the corresponding program stars were calculated, but for reasons of clarity, only one differential light curve for each object was plotted in the corresponding figure. Since no photometric standard regions were observed, it is not possible to transform the final values to Johnson V. However, we are only interested in the variability of the program stars and not in determining more accurate apparent visual magnitudes.

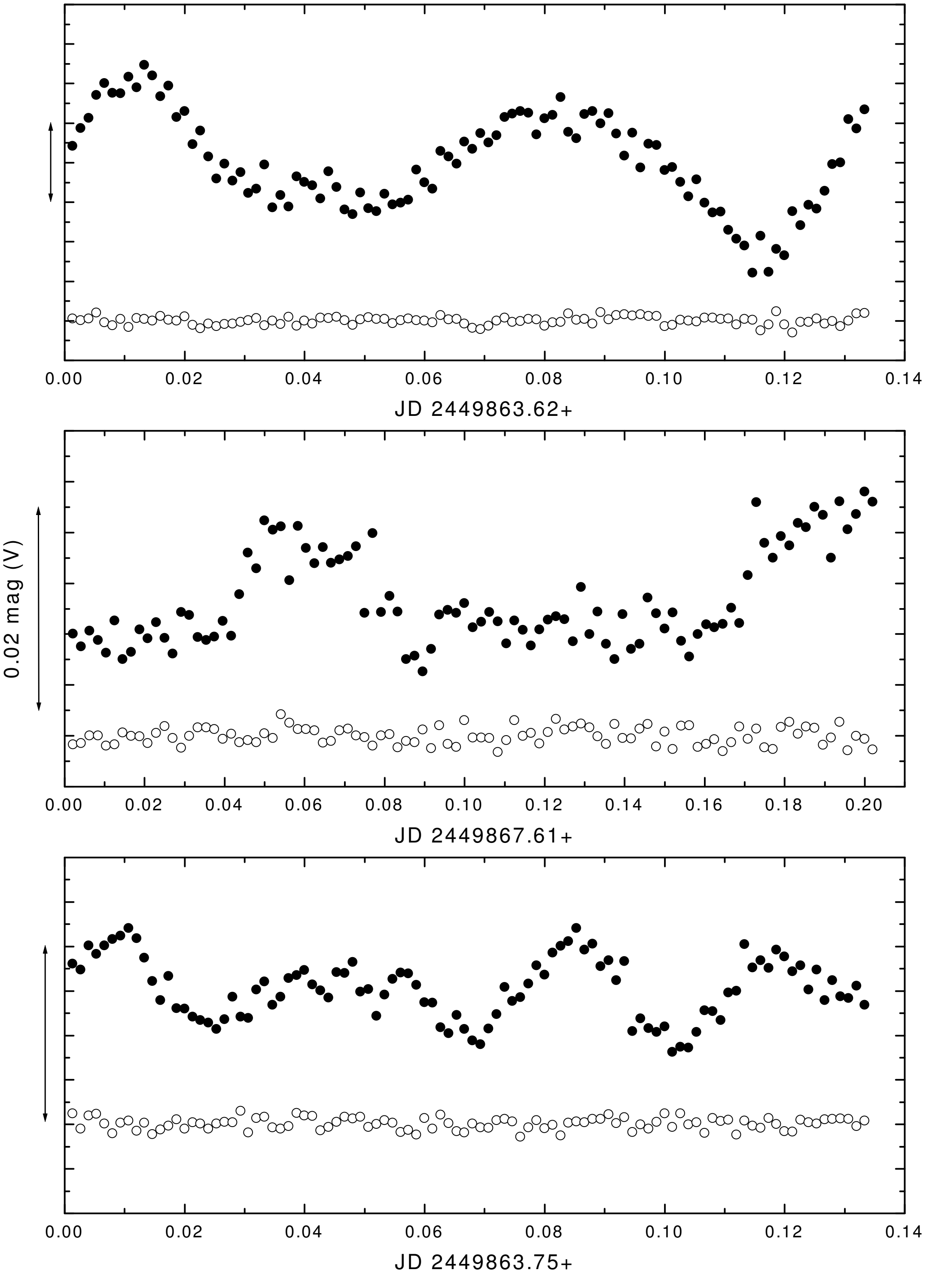

Figure 1. The light curves of GSC 0742602146 (upper panel), GSC 0777501959 (middle panel) and GSC 0781801912 (lower panel). The full circles are the differential data for (V − C1) whereas the open circles correspond to (C1 − C2). The arrows mark $0\overset{m}{.}02$ (V)

Table 1: All observed program and comparison stars

GSC	α (2000)	δ (2000)	V	
0742602146	19 40 00	−31 13 16	12.0	V
0742602121	19 40 05	−31 12 40	14.9	C1
0742602105	19 40 05	−31 12 15	14.5	C2
0742602163	19 39 53	−31 14 26	14.8	C3
0777501959	12 49 09	−41 12 26	12.4	V
0777501766	12 49 10	−41 12 04	14.9	C1
0777501872	12 49 12	−41 12 27	14.6	C2
0777501935	12 49 09	−41 13 29	15.6	C3
0781801912	14 32 00	−44 26 29	11.6	V
0781801932	14 32 06	−44 27 09	12.8	C1
0781802269	14 32 03	−44 28 38	14.4	C2
0781802447	14 31 54	−44 26 04	14.7	C3

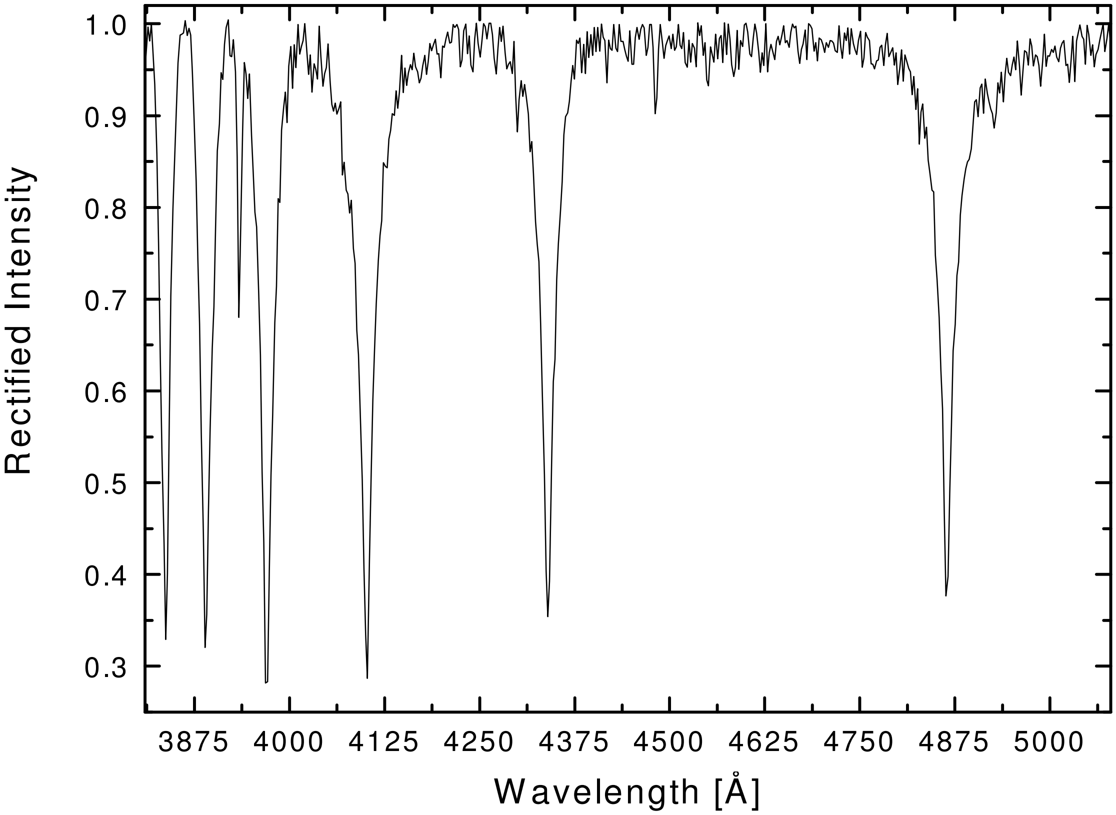

Figure 2. The classification spectrum of GSC 0777501959 which results in a spectral type of A3 V

Zwintz et al. (2000) reported δ Scuti type pulsation for GSC 0742602146 (VGS 17 therein) and GSC 0781801912 (VGS 19). VGS 17 shows multiperiodicity which is in line with the spectral classification (A9). The light curve presented in Figure 1 (upper panel) confirms this result. A dominant period of 120 minutes and an amplitude of $0\overset{\mathrm{m}}{.}02$ was found using a standard Fourier technique. Due to the rather short time scale of the observations, no additional period could be established.

The variability of VGS 19 was a matter of debate (Zwintz et al. 2000). The reasons were the reported apparent period (about 50 minutes which is approximately half the orbital period of the Hubble Space Telescope) and the very low amplitude (1.5 mmag). Furthermore, the $B-V$ value from the TYCHO catalogue ($0\overset{\mathrm{m}}{.}54$) was not compatible with Strömgren $uvby\beta$ photometry ($b-y=0\overset{\mathrm{m}}{.}179$) (Zwintz et al. 2000). It is out of scope of this note to solve this discrepancy. However, the light curve shown in Figure 1 (lower panel) results in a formal numerical solution with a period of 70 minutes and an amplitude of $0\overset{\mathrm{m}}{.}008$ confirming a δ Scuti type pulsation.

The photometric variability of GSC 0777501959 is evident from Figure 1 (middle panel; note that no other time resolved photometric data have been published yet) with a period of about 75 minutes and an amplitude of $0\overset{\mathrm{m}}{.}01$. But the nature of it was not clear at first sight because TYCHO photometry ($B-V=-0.269\pm0.175$) results in an early type spectral classification. Taking the (unknown) interstellar reddening into account (although with a galactic latitude of +21 degrees, it should not be very large), one derives a spectral type of B5 or even earlier. We therefore have decided to obtain a classification resolution spectrum. The classification follows the standard procedures within the MK classification scheme (Paunzen 2000). We derive a spectral type of A3 V (Figure 2) which places this star within the classical instability strip. One tends to believe that the V and B colors listed in the TYCHO catalog are mixed up resulting in $B-V=+0\overset{\mathrm{m}}{.}269$. However, we are confident that these objects show multiperiodic δ Scuti type pulsation.

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WY Tri: A NEW SU UMa-TYPE DWARF NOVA

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WY Tri is a UG-type cataclysmic variable (Downes et al. 1997) located at $\alpha = 02^{\rm h}25^{\rm m}00^{\rm s}\!.57$, $\delta = +32^{\circ}59'54''\!.9$ (J2000.0), with a magnitude range of 13.8 – >17.0 $\rm m_{pg}$. The object has been discovered by L. Meinunger (Meinunger 1986) in 1986 on plates of a field around β Trianguli, taken with the 40/160 and 40/195-cm astrographs of Sonneberg Observatory. Meinunger recognised the UG type of variability and gave the object the preliminary designation S 10919. He also published a finding chart, and noted that the variable is visible at minimum light on Palomar Atlas charts as a blue object. A detailed finding chart is given in (Downes et al. 1997).

Five distinct outbursts of WY Tri are listed by Meinunger, the brightest one showing the variable at 13.8 $\rm m_{pg}$, although the average maximum magnitude derived from his observations is 15.0 $\rm m_{pg}$ only. Apart from this, very little seems to have been published about the outbursting characteristics of WY Tri. More recently, the object has received some attention from amateur variable star observers around the world.

The shortest likely interval between outbursts of WY Tri is about 381 days, but from the sparse observations it is impossible to conclude whether this is the true outburst cycle of the object, or just a multiple. More intensive monitoring of WY Tri will be required to derive the precise values of the outburst and superoutburst cycles. The outburst amplitude is over $3^{\rm m}\!.2$.

The December 2000 outburst of WY Tri was first reported by Jochen Pietz (Pietz 2000), who found the object around $15^{\rm m}\!.7$ on unfiltered CCD images taken on 2000, December 16.914 UT. For the first time, this outburst was monitored intensively by CCD photometry, the results of which are discussed below.

Upon notification of the outburst of WY Tri through VSNET (Pietz 2000), an observing campaign was launched at the Belgian node of the Center for Backyard Astrophysics (CBA). The CBA is a multi-longitude network of professional and amateur astronomers (Patterson 1998), who study periodic phenomena in cataclysmic variables. Target campaigns and results of the CBA are regularly reviewed on the CBA Web site (http://cba.phys.columbia.edu).

The CBA campaign on WY Tri occurred during very favourable conditions, with the variable being visible almost all night long. We accumulated 29.7 hours of coverage over 4 nights and obtained 1336 datapoints. Details are listed in Table 1. Time-resolved and differential (variable−comparison) CCD photometry of WY Tri was done at CBA Belgium

Table 1: Log of photometry

UT Date	JD Start	Length (hr)	Points
20-Dec-2000	2451899.3499	4.58	246
21-Dec-2000	2451900.2334	7.87	354
22-Dec-2000	2451901.2134	8.40	391
23-Dec-2000	2451902.1976	8.88	345

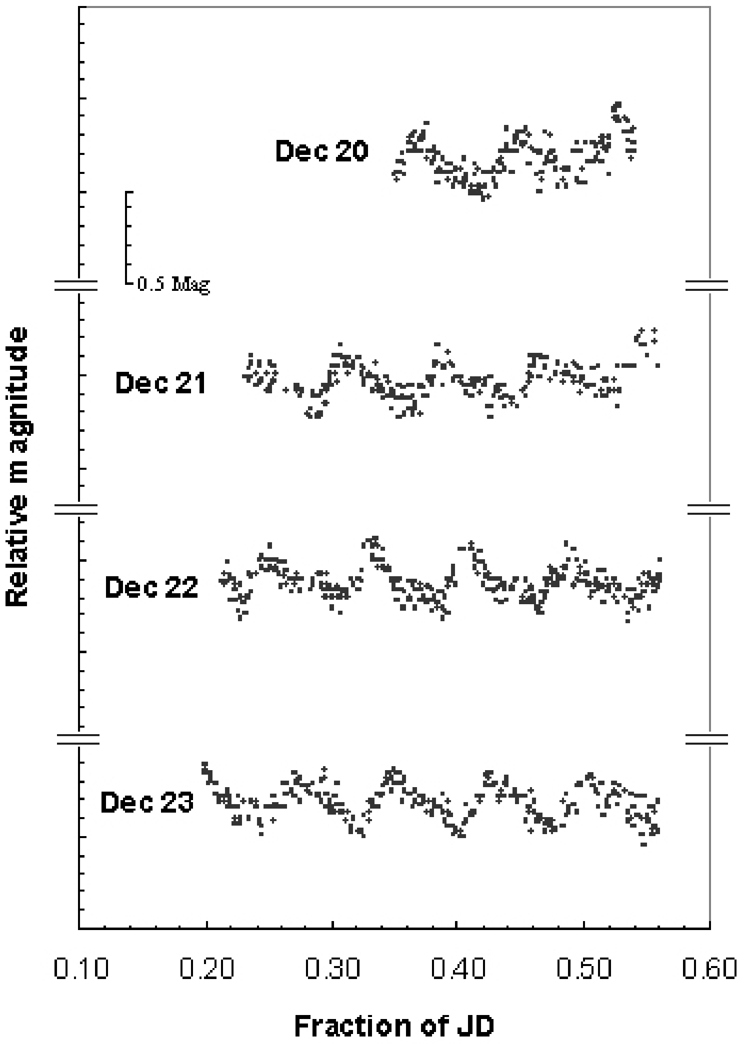

Figure 1. Light curve of WY Tri

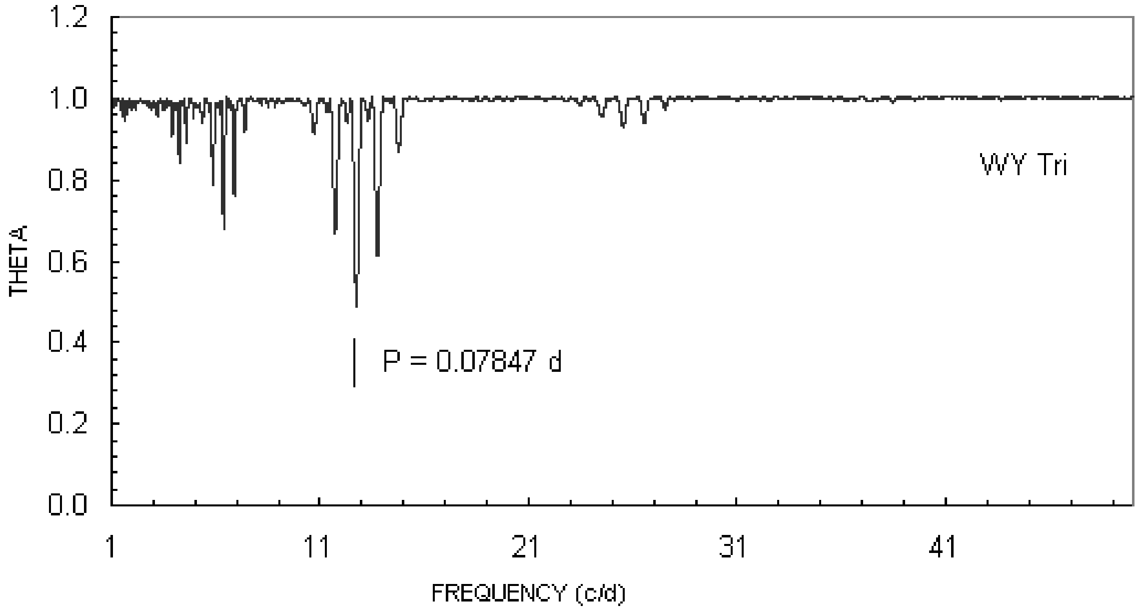

Figure 2. Period analysis of WY Tri

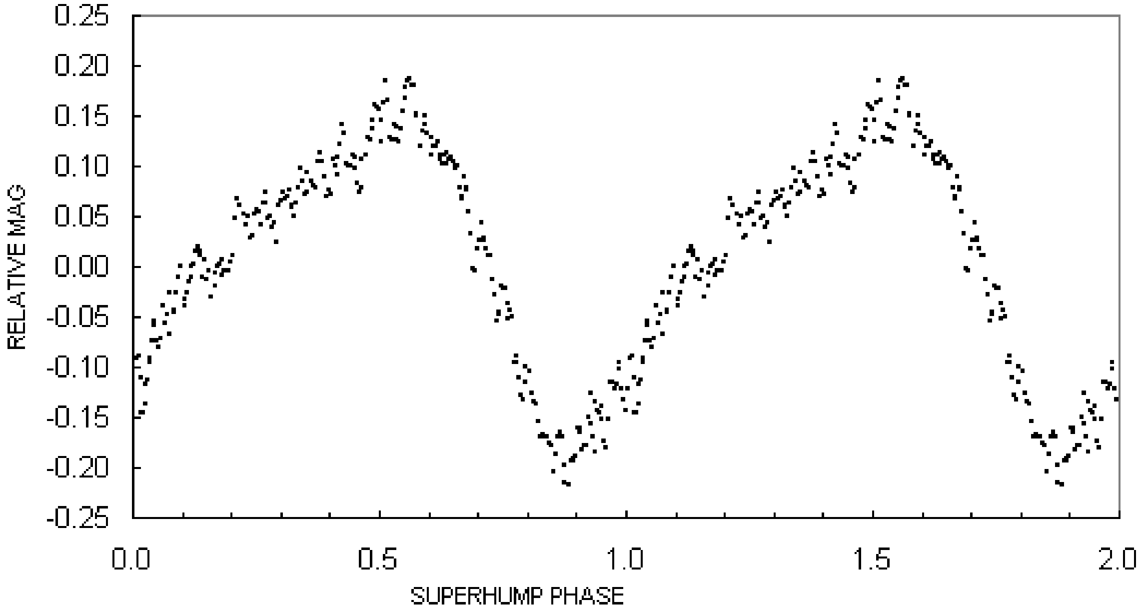

Figure 3. Averaged phase diagram of WY Tri

using a 0.35-m $f/6.3$ Schmidt-+Cassegrain telescope, mounted on an AstroTechniek FM-98 German equatorial mount, and equipped with a SBIG ST-7 CCD camera (Kodak KAF-0400 CCD for imaging and Texas Instruments TC211 CCD for guiding). For a complete description of the CBA Belgium Observatory equipment and software, see (Vanmunster et al. 2000a). During the 4 observing nights, we used GSC 2327 1839 ($11\overset{\mathrm{m}}{.}8$) as the comparison star, whose constancy was confirmed by other check stars.

Our December 20, 2000 observations revealed already fully grown superhumps with an amplitude of $0\overset{\mathrm{m}}{.}39$, and allowed the immediate classification of the object as a new SU UMa-type cataclysmic variable (Vanmunster 2000b). The initial stage of the outburst probably has been missed. Further observations at CBA Belgium were obtained over the next nights (Figure 1), allowing a more detailed analysis of the superhump period. After removing linear trends from the light curve, we performed a period analysis using the Phase Dispersion Minimization PDM method (Stellingwerf 1978). The resulting theta diagram is shown in Figure 2. The best superhump period is $0\overset{\mathrm{d}}{.}07847$ ($\pm\, 0\overset{\mathrm{d}}{.}00002$). The mean waveform of WY Tri is shown in Figure 3 (averaged data), and is a classical footprint of a common superhump profile. The superhump full amplitude was about $0\overset{\mathrm{m}}{.}39$.

The above superhump period value is in good agreement with results obtained at other observatories during the December 2000 outburst of WY Tri. In particular, data from Kyoto University, Japan and Copernicus Observatory, Czech Republic, yielded a superhump period of $0\overset{\mathrm{d}}{.}078483$ (Uemura 2000).

The December 2000 eruption light curve of WY Tri indicates a maximum magnitude of $15\overset{\mathrm{m}}{.}1$ (unfiltered CCD images), but since parts of the initial outburst phase likely have been missed, it is uncertain if this represents the true maximum magnitude value attained by the variable. The final fading of the object took place with an average decline rate of $0\overset{\mathrm{m}}{.}15$ per day, which is a typical value for dwarf novae in superoutburst.

We also examined the post-superoutburst behaviour of WY Tri, as some SU UMa-type dwarf novae are known to show rebrightenings during this stage. However, no evidence of such a rebrightening was found, both in our own CCD monitoring during two weeks following the steep decline, and in reports submitted to VSNET.

There is still an important amount of characteristics of WY Tri to be uncovered. Therefore, this object should receive all possible attention from both amateur and professional astronomers.

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EUVE J0854+390: A NEW CATACLYSMIC VARIABLE

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We report the identification of a new Cataclysmic Variable (CV) in the field of EUVE J0854+390. EUVE J0854+390 was detected in the Extreme Ultraviolet Explorer (EUVE) all-sky survey (Bowyer et al. 1996) at 30 cts/ksec in the 100 Å bandpass and reported in the Lampton et al. 1997 catalog of fainter EUVE sources with ROSAT detections. Follow-up optical observations of the class of unidentified EUVE all-sky survey sources ("NOID's") has previously had success in finding cataclysmic variables (e.g. EUVE J1429-38.0, Craig et al. 1995, 1996, & EUVE J2115-586, Craig et al. 1996; Vennes et al. 1996). We observed the field centered on the EUVE position of EUVE J0854+390 on 18 February 1997 as part of our EUVE NOID optical identification program with the Lick Shane 3-meter telescope and Kast spectrograph. The Kast is a double spectrograph with a blue side covering the wavelength region of 3600–5250 Å and ≈ 5500–7500 Å on the red side. This setup yields a spectral resolution of 1.7 Å/pixel.

There were three exposures of the CV, starting at 10:04 UT on Feb 18, 1997 and these are summarized in the observing log in Table 1. two of the exposures the slit was centered on other stars in the and the exposures were much shorter. result of spectra centered on other objects was also in the slit. The optical spectra of EUVE J0854+390 showed Balmer, He I (4471, 5876 Å) and He II (4686 Å) lines strongly in emission with the continuum increasing toward the blue and indicating the source is a CV, probably magnetic. The first 25 minute exposure found the lines to be blue-shifted by ≈ 200 km/s and was followed by a 60-minute exposure. This second observation found the source to be ≈ 2 times brighter and with the emission lines shifted to the red. The average line shift was about ≈ 6 Å or ≈ 400 km/s. The third exposure, started at 11:45 UT, found the source to be ≈ 7 times fainter than the previous exposure with lines red-shifted by ≈ 100 km/s, although limited by low signal. The measured radial velocities suggest the source period is less than 2 hours, although the poor sampling is not definitive, and further observations are needed. We show the two brightest optical spectra of EUVE J0854+390 from 18 February 1997 in Figure 1.

For the brightest spectrum we derived B magnitude of 16.4 for EUVE J0854+390 using spectrophotometry. The optical position derived from the Digitized Sky survey plate (see Figure 2) is: R.A. $08^{\mathrm{h}}54^{\mathrm{m}}14\overset{\mathrm{s}}{.}2$, Dec. $+39^\circ05'39\overset{''}{.}6$ (J2000) placing it about 15″ from the EUVE and ROSAT (1RXS J085413.1+390543) source positions. Follow-up observations are encouraged.

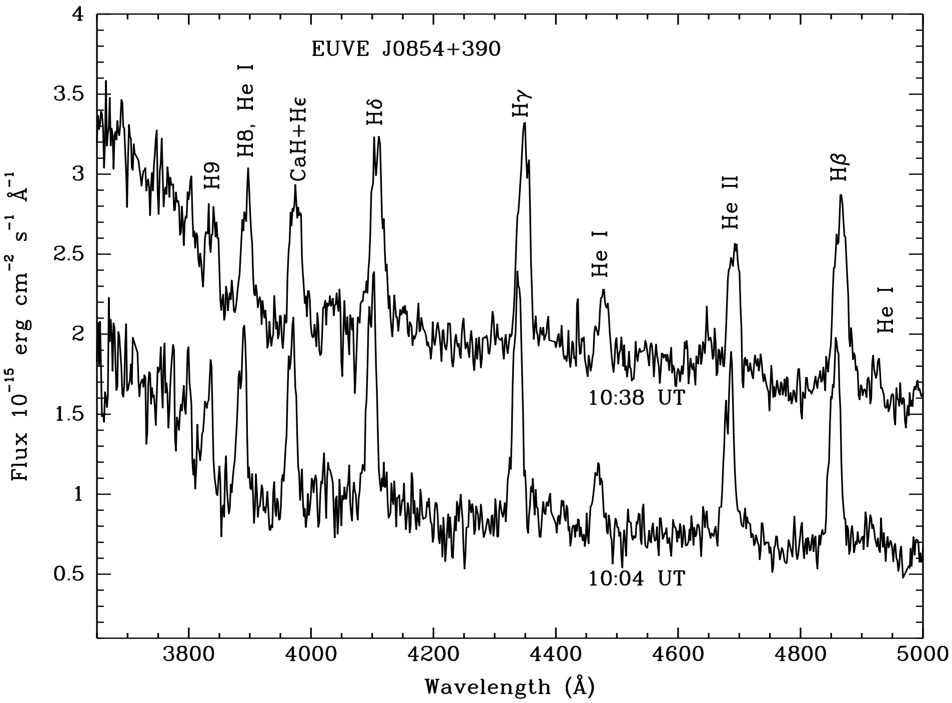

Figure 1. Kast blue-side spectra for CV EUVE J0854+390. The bottom spectrum was the first 30-minute exposure (10:04 UT) and was followed by an hour integration started 34 minutes later (10:38 UT). The second exposure found the source to be ≈2 times brighter with lines red-shifted by ≈ 6 Å

Table 1: Optical observing log

Source	R.A.$_{\rm opt}$	Dec.$_{\rm opt}$	Observation date	Exposure (sec)	Air mass
EUVE J0854+390	$08^{\rm h}54^{\rm m}14\overset{\rm s}{.}2$	$+39°05'39\overset{''}{.}6$	18 Feb 97 10:04 UT	1500	1.21
			18 Feb 97 10:38 UT	3600	1.32
			18 Feb 97 11:45 UT	1800	1.68

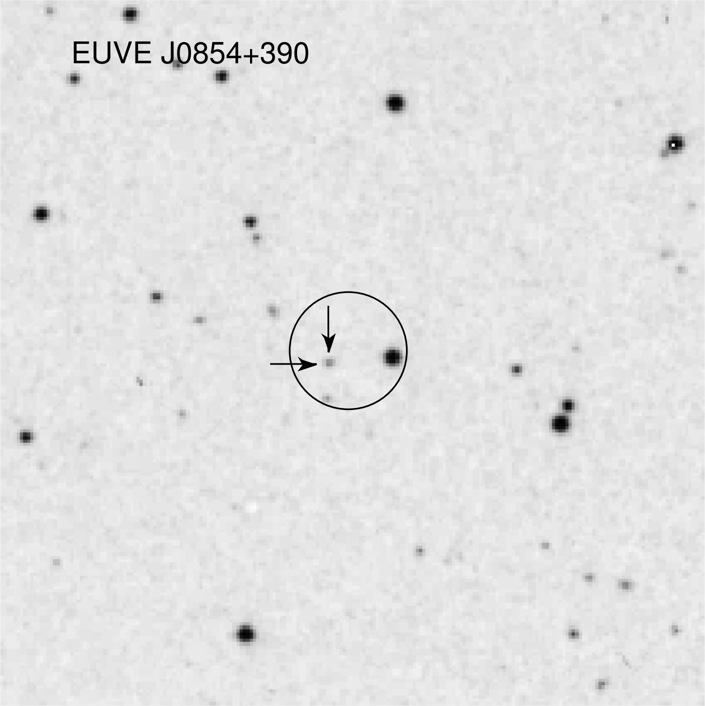

Figure 2. Optical finding chart ($6' \times 6'$) from the Digitized Sky Survey centered on the EUVE position from Lampton et al. (1997). The arrow indicates the CV. EUVE/ROSAT pointing uncertainty is indicated with a circle with a radius of $30''$. North is up and east to the left

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UBV PHOTOMETRY OF EF Boo

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EF Boo (BD +51°1929, SAO 29189) was first reported in the Tycho catalog (Høg et al., 1997). It was discovered as a part of the Hipparcos program by Perryman et al. (1997). The system has a spectral type of G5 and an EB-type light curve with an amplitude of $0\overset{m}{.}587$ ranging from $9\overset{m}{.}401$ to $9\overset{m}{.}988$ in V (HIPPARCOS, ESA, 1998). Samec et al. (1999) have carried out the first ground based photometric observations of the system in U, B and V bands and obtained the following improved ephemeris:

$$\text{H.J.D. Min I} = 2451283.6774(1) + 0\overset{d}{.}42060833(7) \times E. \qquad (1)$$

They have characterized the light curve as a typical W UMa type with spot activity.

New photometric observations of EF Boo were made on 3 nights during 2000 observing season with a 30-cm Maksutov telescope at the Ankara University Observatory. The observations were secured by using a single channel OPTEC SSP-5A photometer head which contains a side on R-1414 Hamamatsu photomultiplier and the UBV filter set close to the standard system. Differential observations, in the sense variable minus comparison, were corrected for the atmospheric extinction and the light time effect. The same star of Samec et al. (1999) was selected as comparison (SAO 29183 = BD +51°1927 = HD 127807). Their check star was rejected since they have reported that it is a variable star. The standard errors of our observations are about $0\overset{m}{.}024$, $0\overset{m}{.}015$, and $0\overset{m}{.}016$ in U, B and V filters, respectively.

Two new minima times were obtained from our observations by using the well known method of Kwee and van Woerden (1956). A list of all available minima times, together with ours, are given in Table 1. A new $O-C$ curve was formed by using all these epochs and the following improved light element was derived by fitting a linear function:

$$\text{H.J.D. Min I} = 2448500.3016(5) + 0\overset{d}{.}42051309(0) \times E. \qquad (2)$$

New light and color curves are shown in Figure 1 together with the Hipparcos light curve. Although the light curve is EW type, it was noted to be EB type in HIPPARCOS (ESA, 1998) due to a single erroneous observation in mid-primary eclipse. No significant phase dependence of the color curves in Figure 1 indicates contact configuration for the system. The light levels estimated by averaging data around the maxima and minima (by taking a $\Delta\Phi = \pm 0.03$ interval) and their differences are listed in Table 2. The errors in the estimates are slightly lower than the standard errors of the respective observations.

Table 1: All available minima times of EF Boo. The $O-C$ values were calculated by using Equation (2)

JD Hel. 2400000 +	Min	Filter	$O-C$	Reference
48500.30180	I		0.0002	HIPPARCOS ESA (1998)
51282.8356(6)	I	UBV	-0.0011	Samec et al. (1999)
51283.6776(1)	I	UBV	-0.0002	"
51283.8889(1)	II	UBV	0.0009	"
51284.7290(1)	II	UBV	-0.0001	"
51284.9386(6)	I	UBV	-0.0007	"
51712.391(17)	II	UBV	0.0003	This work
51719.330(04)	I	UBV	0.0007	This work

Table 2: The light levels and their differences in the light curves of EF Boo

	u	b	v	HIP
Max. light at 0.75	0.120	0.480	0.789	9.401
Max. light at 0.25	0.131	0.486	0.781	9.401
Min. light at 0.00	0.703	1.032	1.328	9.988
Min. light at 0.50	0.684	1.000	1.310	9.896
Δmax ($m_{0.75}-m_{0.25}$)	-0.011	-0.006	0.008	0.0
Δmin ($m_{0.00}-m_{0.50}$)	0.019	0.032	0.018	0.092
Depth of Min. I	0.578	0.549	0.543	0.587
Depth of Min. II	0.559	0.517	0.525	0.495

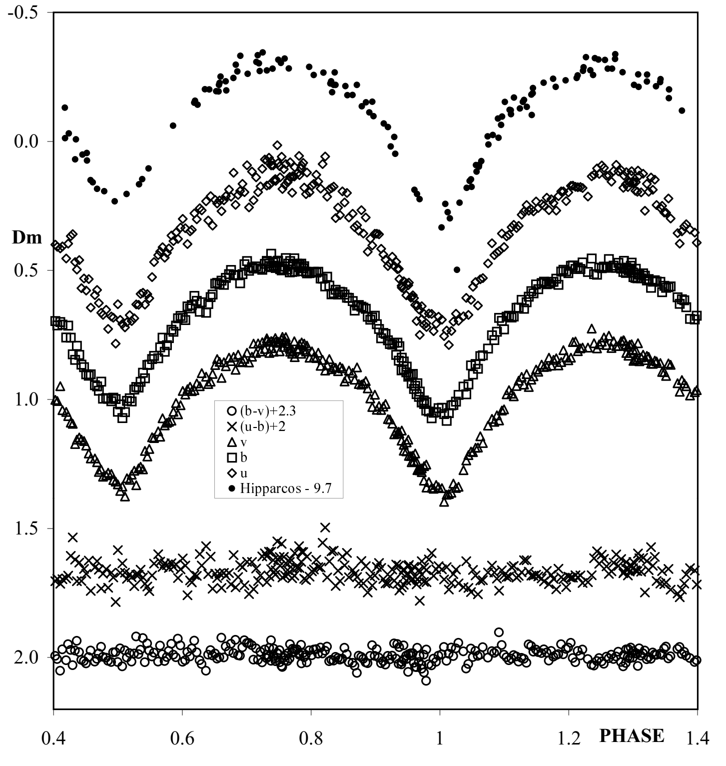

Figure 1. The light and color curves of EF Boo

A comparison of the light levels shows no sign of any asymmetry and O'Connell effect. However a comparison with HIP light curve reveals that the primary eclipse is slightly shallower while the secondary eclipse is slightly deeper in our light curves (see Table 2).

We acknowledge the observing time at the Ankara University Observatory, and the partial support by the Research Fund of Çanakkale Onsekiz Mart University.

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THE FIRST GROUND-BASED PHOTOMETRIC OBSERVATIONS OF V899 Her

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The relatively bright EW type binary V899 Her (HD 149684 = BD +33°2748, $\alpha_{2000} = 16^{\rm h}35^{\rm m}02\overset{\rm s}{.}0$, $\delta_{2000} = +33°12'48\overset{\prime\prime}{.}0$) was first discovered by HIPPARCOS (ESA, 1998). The photometric observations of the system by HIPPARCOS show a W UMa type light curve with an amplitude of $0\overset{\rm m}{.}121$ ranging from $7\overset{\rm m}{.}935$ to $8\overset{\rm m}{.}056$ and with two equal minima depths. The mean orbital period derived by HIPPARCOS from the best light curve fit is $0\overset{\rm d}{.}421173$ and the epoch is given as JD 2448500.136 (ESA, 1998). The spectral type of the system is given as F8.

The first ground-based observations of V899 Her were made on 2 nights during 2000 observing season with the same equipments and technique described by Özdemir et al. (2001). The comparison star is BD +33°2771 (HIP 81763), and the check stars are BD +34°2826 (HIP 81732), BD +34°2799 (HIP 80806), BD +34°2820 (SAO 65448), and BD +34°2776 (HIP 80279). Differential magnitudes, in the sense checks minus comparison, were used to determine the standard errors (which are $0\overset{\rm m}{.}020$, $0\overset{\rm m}{.}016$, and $0\overset{\rm m}{.}021$) of our observations in U, B and V bands, respectively.

The light and color curves were plotted in Figure 1 together with the HIPPARCOS light curve. The light level estimates by taking a $\Delta\Phi = \pm 0.03$ interval around the maxima and minima, and their differences are listed in Table 1. It can be seen in Figure 1 and Table 1 that the maxima of all light curves, especially in U band, show a marginal evidence of being unequal with exhibiting slightly higher maxima at 0.25. There is not any clear evidence for the asymmetry in the light curves. A new minima time is derived from the observations by using the Kwee and van Woerden (1956) method and given in Table 2, together with Hipparcos' determination. These minima times were used in forming the $O-C$ diagram of V899 Her and were fitted by a linear function to obtain a new light element of the system:

$$\text{H.J.D. Min I} = 2448500.13600 + 0\overset{\rm d}{.}42117220(4) \times E. \qquad (1)$$

We acknowledge the observing time at the Ankara University Observatory, and the partial support by the Research Fund of Çanakkale Onsekiz Mart University.

Table 1: The light levels and their differences in the light curves of V899 Her

	u	b	v	HIP
Max. light at 0.75	0.007	-0.026	-0.071	7.935
Max. light at 0.25	-0.008	-0.029	-0.075	7.939
Min. light at 0.00	0.131	0.109	0.065	8.056
Min. light at 0.50	0.141	0.102	0.061	8.054
Δmax. ($m_{0.75} - m_{0.25}$)	0.015	0.003	0.004	-0.004
Δmin. ($m_{0.00} - m_{0.50}$)	-0.010	0.007	0.004	0.002
Depth of Min. I	0.132	0.137	0.138	0.119
Depth of Min. II	0.142	0.130	0.134	0.117

Table 2: All available minima times of V899 Her. The $O-C$ values were calculated by using the improved ephemeris

JD Hel. 2400000 +	Min	Filter	$O-C$	Reference
48500.13600	I		0.0	HIPPARCOS ESA (1998)
51708.415(26)	II	UBV	0.0	This work

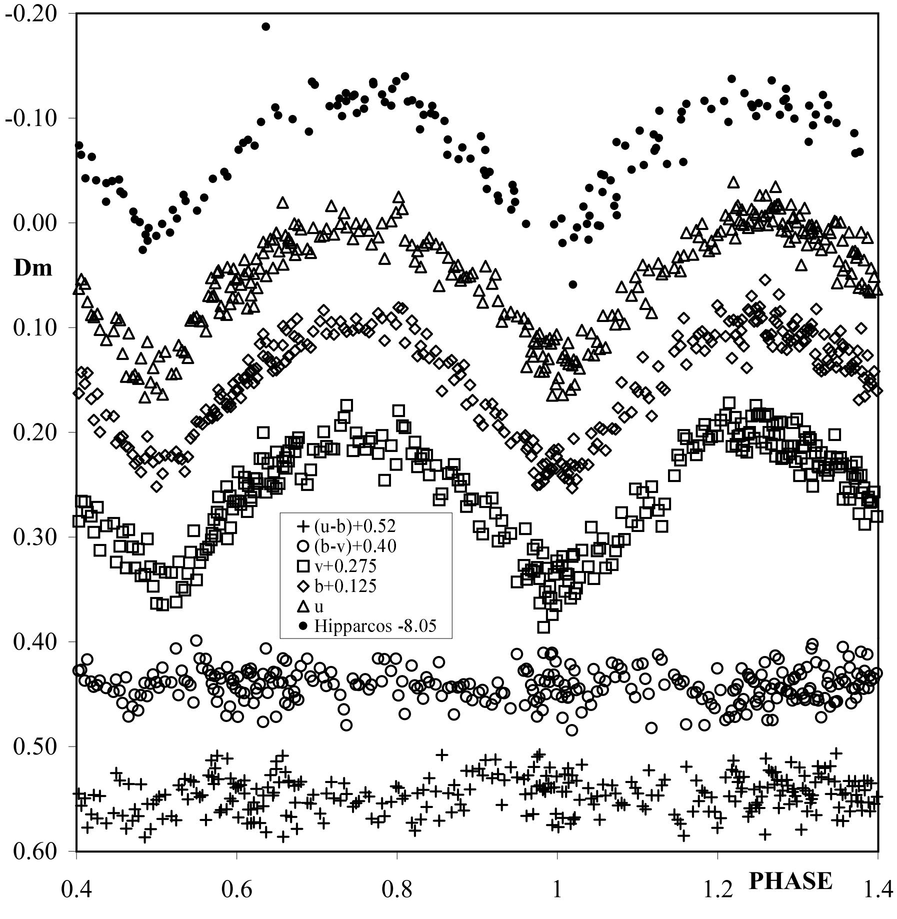

Figure 1. The light and color curves of V899 Her

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ERRATUM FOR IBVS 4941

In IBVS 4941 a minimum time (2448383.4256) of BO CVn is wrong. The correct value is 2448383.4156.

Berahitdin ALBAYRAK

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J1714.9+4210: A VARIABLE FAINT HIGH-LATITUDE CARBON STAR

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As a by-product of a variability–proper motion survey for quasars (Brunzendorf & Meusinger 2001), we detected a further member of the class of faint high-latitude carbon star (FHLCS). It was classified, at first, as a quasar candidate due to its strong variability and zero-proper motion, but was spectroscopically confirmed as a carbon star, called hereafter FHLCS J1714.9+4210. The basic data are summarized in Table 1. There is no entry in the SIMBAD database or in the IRAS FSC at this position. An independent identification of this star with an FHLCS has been announced by Kurtanidze & Nikolashvili (2000) who identified it with the entry #3801 in the Second edition of the General Catalogue of Cool Carbon Stars (Stephenson 1989).

Table 1: Basic data for FHLCS J1714.9+4210

R.A. =	(J2000.0)	$17^{\mathrm{h}}14^{\mathrm{m}}57\overset{\mathrm{s}}{.}5$
DEC =		$+42^\circ10'22\overset{''}{.}9$
	$= l$	67°
	$= b$	35°
	$= V$	$16\overset{\mathrm{m}}{.}1$
	$= U-B$	$> 1\overset{\mathrm{m}}{.}5$
	$= B-V$	$2\overset{\mathrm{m}}{.}6$
	$= V-R$	$1\overset{\mathrm{m}}{.}0$
	$= \mu_\alpha \cos\delta$	-1.2 ± 1.6 mas yr^{-1}
	$= \mu_\delta$	$+0.1 \pm 1.2$ mas yr^{-1}

A low-dispersion spectrum (Fig. 1) was obtained in July 1998 with CAFOS at the 2.2-m telescope of the German–Spanish Astronomical Centre on Calar Alto, equipped with a B-400 grism and a SITe1d CCD. Reduction and wavelength calibration of the spectra were done in a standard fashion using the MIDAS package. The spectrum with a resolution of 20 Å shows pronounced C_2 and CN bands and weak or absent atomic hydrogen lines. A second spectrum, taken two years later, shows only little variations of the overall picture. With its strong carbon bands and a sharp bandhead of C_2 at λ 6181, FHLCS J1714.9+4210 resembles stars which have been identified as dwarf carbon stars (dCs) due to their large proper motions; according to Green et al. (1992), these

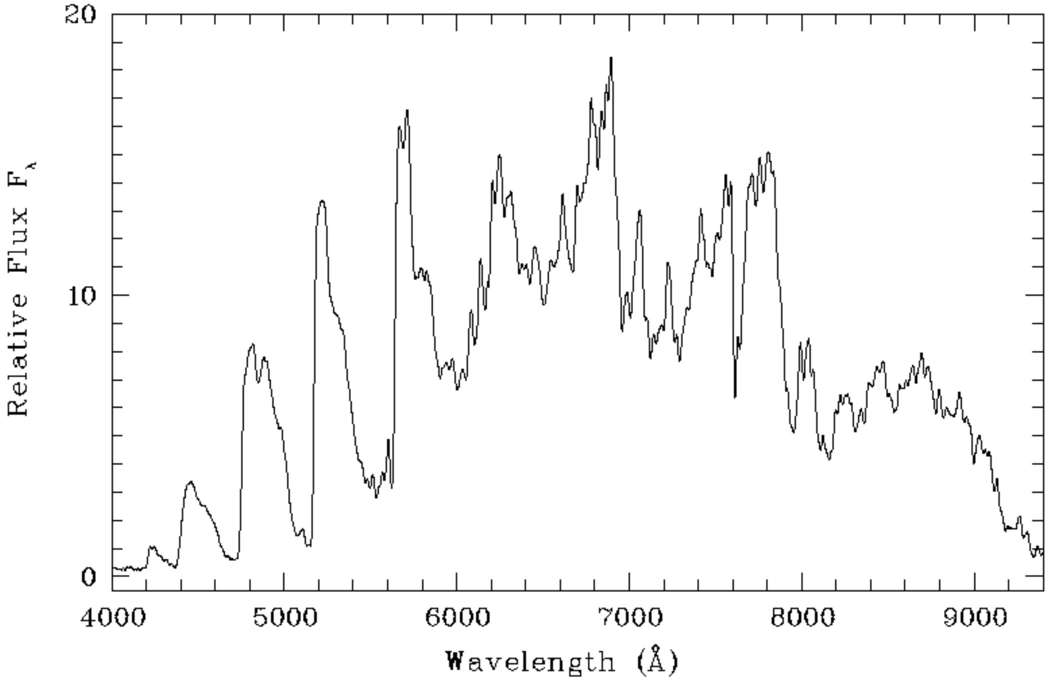

Figure 1. Low-dispersion spectrum (not flux-calibrated) of FHLCS J1714.9+4210

features are indicative of dCs rather than of giants. FHLCS J1714.9+4210 is probably an counter-example as it does not show a significant proper motion (see below).

The long-term B-band light-curve (Fig. 2) was obtained from the photometric reduction of 117 digitised Tautenburg Schmidt plates with limiting magnitudes $B_{\rm lim} = 19$–21 taken between 1964 to 1997. The plates were calibrated by means of published sequences of standard stars around M 92. Typical photometric errors on a single plate are $0\overset{m}{.}1$ to $0\overset{m}{.}2$ for the measured magnitude range. FHLCS J1714.9+4210 is found to be variable on a significance level larger than 99.99%. Although the sampling of the photometric data does not allow to study the structure of the light-curve in detail, strong fluctuations on short time-scales as well as long-term trends are clearly indicated. A period of 0.81 yr is indicated by Fourier technique on a significance level of 94%. On the other hand, the structure function analysis (e.g., Simonetti et al. 1995) provides no clear-cut evidence for any periodicity.

The colour indices given in Table 1 are based on the measurements on plates from the epoch 1968 ± 2. No colour-corrections have been applied since the Tautenburg colour system closely matches the Johnson system.

The absolute proper motion derived from the astrometric reduction of the B plates, which cover a baseline of more than three decades, is unverifiably low (Table 1). For comparison, the components of the mean absolute proper motion of the field stars are $(-3.4 \pm 0.1, -4.3 \pm 0.1)$ mas yr^{-1} with a mean total proper motion of $\mu = 6$ mas yr^{-1}. The reference frame is defined by 534 unambiguously identified and well-measured galaxies. The possibility that FHLCS J1714.9+4210 is a nearby dwarf having by chance such a small proper motion can be rejected on a significance level larger than 98%. The result of a zero-proper motion therefore suggests a giant star in the halo rather than a nearby dC. The galactic position of FHLCS J1714.9+4210, i.e. the galactocentric distance R and the height z above the galactic plane, are estimated to $(R, z) = (12\ \text{kpc}, 6\ \text{kpc})$ if $M_{\rm v} = 1$ (see

Wallerstein & Knapp 1998), but may be as large as (67 kpc, 40 kpc) if this star is at the tip of the AGB.

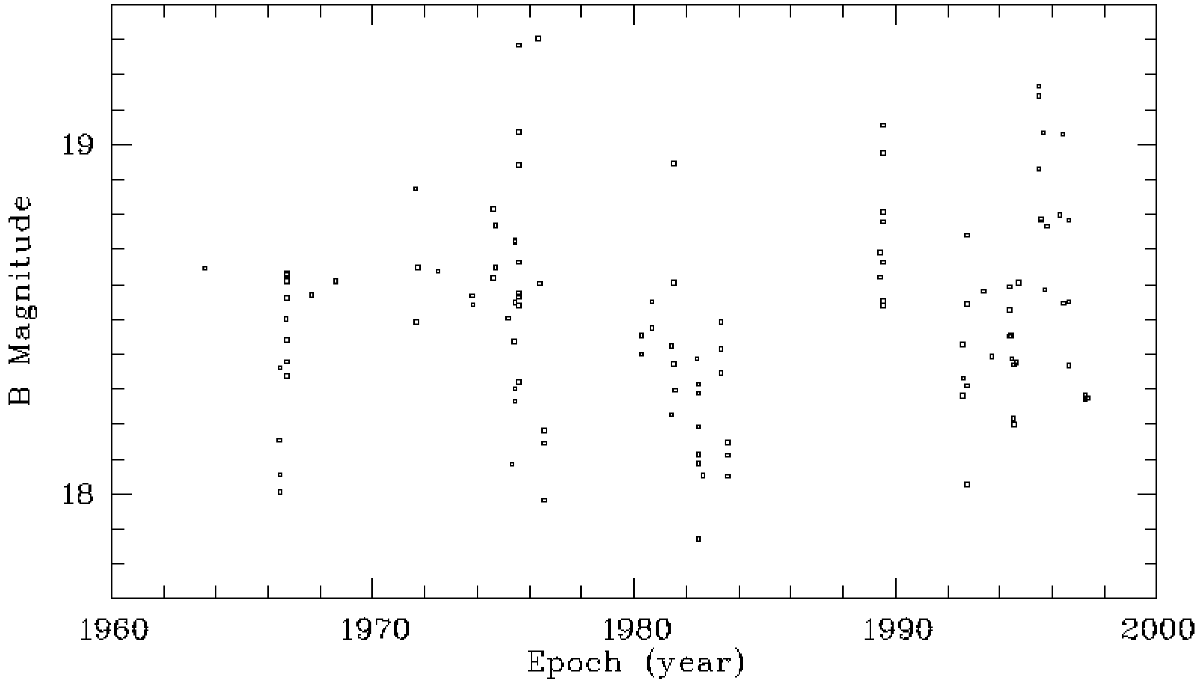

Figure 2. Long-term *B*-band lightcurve of FHLCS J1714.9+4210

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V-BAND OBSERVATIONS OF V4641 SAGITTARII

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In this note we report high time resolution V Johnson photometry of the microquasar V4641 Sgr (SAX J1819.3–2525 = XTE J1819–254). This source was discovered as an X-ray transient by BeppoSAX and RossiXTE satellites (In't Zand et al. 1999; Markwardt et al. 1999). On 1999 September, a very fast transient optical and X-ray outburst was observed, reaching up to $V \simeq 8\overset{\mathrm{m}}{.}8$ and 12 Crab units (Stubbings 1999; Smith et al. 1999). Rapid X-ray variability, by a factor of 4 on time scales of minutes, was observed at the time of the outburst (Wijnands & van der Klis 2000). Collimated radio ejecta were also detected on this occasion with possible superluminal velocities (Hjellming et al. 2000). All this evidence suggests the presence of a compact object, most probably a black hole. The spectral type of the mass donor and its distance have been estimated from optical observations as A2V and $D = 6100$ pc, respectively (Orosz et al. 2000). This distance value is significantly far away than the nearby ~ 0.5 kpc independently obtained from the radio data (Hjellming et al. 2000), based on the inferred proper motion of the ejecta and other assumptions. Recent photometric and spectroscopic work by Chaty et al. (2001a,b) give support to the optical estimates, with these basic parameters being constrained to be most likely B3-A2 V and $4 < D < 8$ kpc. If the high distance values are correct, V4641 Sgr should be considered a High Mass X-ray Binary (HMXRB) microquasar instead of a low mass system.

The previous optical photometric observations indicated variability on time scales of days and months (see e.g. Kato et al. 1999). The present note is mainly an attempt to explore the V4641 Sgr variability on much shorter time scales, i.e. from a few minutes to a few hours.

Our differential photometry observations were obtained with the 1.23-m telescope of the Centro Astronómico Hispano Alemán (CAHA) observatory, in Almería (Spain). We observed on three nights during the period 23–29 June 2000. Several filters were used, but only the V-band observations with wider time coverage are discussed here. The total number of V-band CCD frames processed was 117. The exposure times were of 30 s, with a readout time of 30 s since we used only a small part of the SITe#2b-17 chip. Only three suitable comparison stars could be found in the CCD frame being non-saturated, isolated enough and with brightness similar to the target source. We finally selected two of them whose magnitude differences remained well constant mostly within $\pm0\overset{\mathrm{m}}{.}012$, $\pm0\overset{\mathrm{m}}{.}020$, and

Table 1: V-band observations of V4641 Sgr

Julian Day	V	N_V
2451719.525	14.0	18
2451719.569	14.0	
2451723.475	14.0	25
2451723.571	14.0	
2451724.423	13.8	74
2451724.574	13.9	

$\pm 0\overset{\mathrm{m}}{.}015$, for the nights 23/24, 27/28, and 28/29 June, respectively. These differences are plotted in Fig. 1 and they are indicative of the quality of the different nights for differential photometry at the high air mass of the source.

Since we devoted most of our telescope time to V4641 Sgr, only one or two standard stars from the list of Landolt (1992) could be observed each night. Approximate photometric zero points were thus estimated using average extinction coefficients suitable for the CAHA site. In this way we derived V magnitudes for the comparison stars in the field, that we adopted in order to express the differential photometric results in an absolute scale. The absolute calibration achieved is believed to be accurate at the $\pm 0\overset{\mathrm{m}}{.}1$ level. This procedure is useful to provide an idea of the source real brightness and, of course, it does not change the relative variations seen in the data. In Table 1, the resulting Johnson V magnitudes (rounded to $0\overset{\mathrm{m}}{.}1$) are given for the beginning and the end of the night, and the N_V value refers to the number of exposures obtained for the corresponding night.

The brightness of V4641 Sgr during our run was in the range $V = 13.8$–14.0, i.e., considerably fainter than the values reported during the 1999 September outburst (Stubbings 1999). Our magnitudes are close to the faintest observed in the last year (see Kato et al. 1999; Chaty et al. 2001a,b).

In the X-ray domain, the quick-look results provided by the ASM/RXTE team indicated very low X-ray activity during the time of our Calar Alto observations, with the source being practically undetected at their beginning. Only on JD 2451723, the ASM flux increased to ~ 4 counts s^{-1}, thus suggesting a moderate enhancement of X-ray activity. Unfortunately, there is no ASM data for the last night of the CAHA run.

We attempted to search for variability over time scales of minutes to hours. The shortest time resolution achieved in our runs was about 1.5 minutes (100 s) and the observed behaviour of the source is presented in Fig. 2.

We did not detect variability, with amplitude higher than $0\overset{\mathrm{m}}{.}02$, on the shortest (few minute) time scales. In contrast, variability is certainly present on time scales of hours. In the lower panel, a brightness decrease of about $0\overset{\mathrm{m}}{.}1$ during 3.5 h is clearly visible. During this interval, the differences between the comparison stars remained constant practically within $\pm 0\overset{\mathrm{m}}{.}015$ (see Fig. 1). Therefore, the observed trend is fully reliable. A similar behaviour is also present in simultaneous I band data not included in this paper. Weak traces of a similar hour variability can be seen as well in the first night (upper panel in Fig. 2).

The other two HMXRB microquasars well observed at optical wavelengths are Cyg X-1 and SS 433. Cyg X-1 shows an ellipsoidal modulation in its light curve with amplitude $\Delta V = 0\overset{\mathrm{m}}{.}04$, with a difference only of $0\overset{\mathrm{m}}{.}02$ between the high and low X-ray states (Brocksopp et al. 1999; Karitskaya & Goranskij 1996). In contrast, SS 433 shows different classes

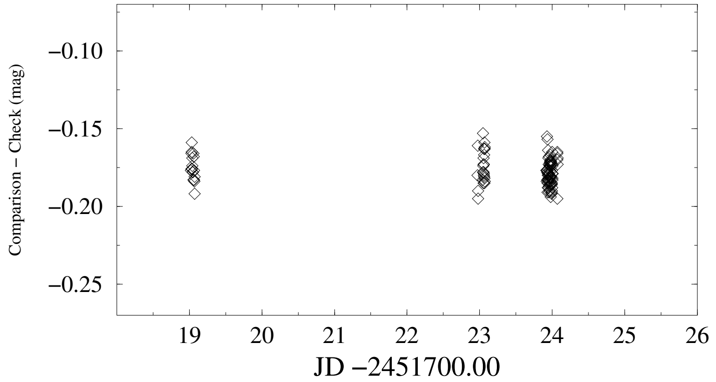

Figure 1. V magnitude differences between comparison and check star in the V4641 Sgr frames for the three different nights of observation

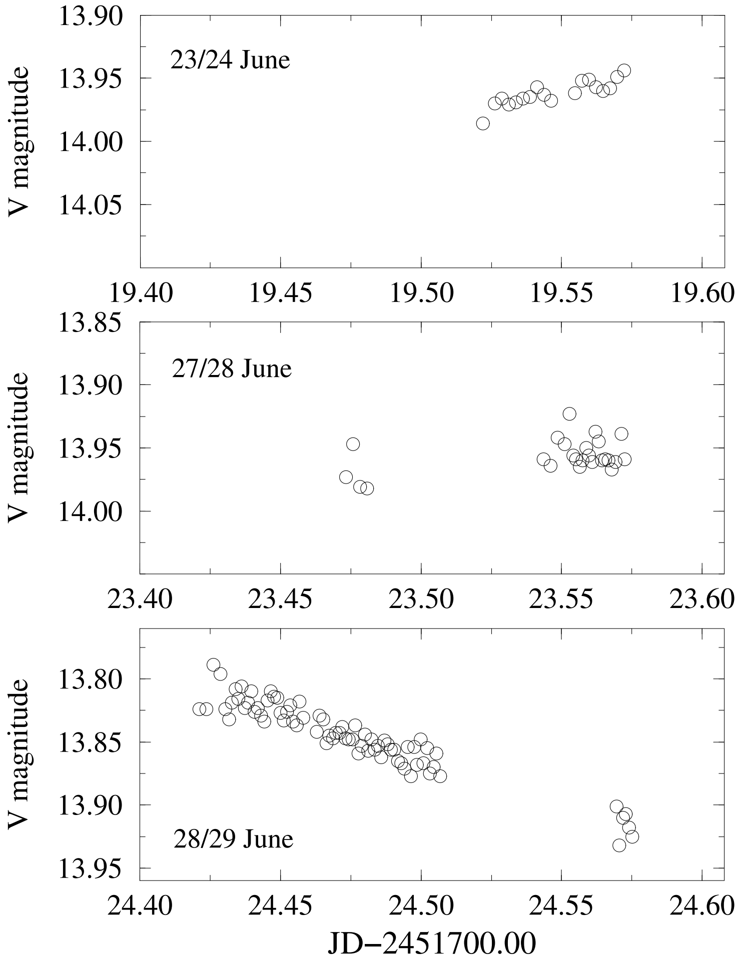

Figure 2. The Johnson V band observations of V4641 Sgr during June 2000. Short term variability, on time scale of minutes, is not visible. However, we do see during the last night a decrease in brightness of $\sim 0\overset{\mathrm{m}}{.}1$ over a time scale of about 3 hours. A similar variability probably occurred during the first night too. In all these three panels, the Y axis interval corresponds to $0\overset{\mathrm{m}}{.}25$, and the X axis size expands over 5 hours (= 0.208 days)

of optical variability identified by their corresponding time scales $\Delta\tau$ (see e.g. Zwitter et al. 1991): class (a) with $\Delta\tau > 6$ h; class (b) with $\Delta\tau \approx 1$ h; class (c) with $\Delta\tau \approx 10$ min. For classes (b) and (c), the amplitude does not exceed typically $0\overset{\mathrm{m}}{.}1$. The detected variations of V4641 Sgr are reminiscent, both in time scale and amplitude, of the SS 433 class (b) variability, which according to Zwitter et al. (1991) should be interpreted as originating in an extended corona surrounding the jets. However, with the present observations we cannot rule out alternative possibilities for the observed trend, such as being part of an ellipsoidal modulation or due to orbital and precessional motion (class a). The ellipsoidal modulation possibility is certainly a serious explanation to be considered, specially taking into account the evidence pointed out by Orosz et al. (2000) based on photographic archive data.

On the other hand, class (c) variability in SS 433 is probably connected with the jets. The fact that we do not see this kind of short term variations in V4641 Sgr is consistent with the radio quiet state of the source during the CAHA run. Although simultaneous radio monitoring from the Green Bank Interferometer (GBI) is not available, the GBI flux densities at cm wavelengths two months before our observations were already consistent with zero.

In any case, further extended photometric monitoring of V4641 Sgr would be advisable to better constrain the physical properties of this new microquasar not yet well studied.

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VARIABLE BSS CANDIDATES IN M 3 PROVED TO BE QUASARS

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The discovery of eclipsing binaries among blue straggler stars (BSS) is important to check ideas for the origin of the BSS phenomenon (binary merging versus collisional merging, e.g. Bailyn 1995) and, moreover, for the understanding of the dynamical evolution of dense stellar systems (Hut et al. 1992). In M 3, the radial BSS distribution seems to be consistent with a collisional origin in the centre and binary origin in the outskirts (Bailyn & Pinsonneault 1995).

In the framework of a variability–proper motion survey (VPMS) for quasars in the field centred on M 3 (Scholz et al. 1997), we detected three significantly variable star-like objects in the cluster halo region having typical BBS colours and magnitudes. Figure 1 shows the colour–magnitude diagram (CMD) for all star-like objects with a high cluster membership probability which have: (1) cluster-centric distances $5' \leq r \leq 24'$ (the innermost region is excluded to minimize effects of image crowding), (2) no nearby neighbour within a $7''$ distance, (3) proper motion vectors close to the centroid of M 3 (defined by stars selected by the first two constraints and having colour indices compatible with the cluster CMD), i.e. $|\vec{\mu} - \vec{\mu}_{\rm M3}| \leq 6$ mas yr^{-1}. Photometric and astrometric data were derived from Tautenburg Schmidt plates digitized by means of the APM facility, Cambridge. Johnson B magnitudes were measured on 57 plates, taken in the years 1964 to 1994. A further 6 V plates were used to obtain $B-V$ colour indices. Proper motions were derived from 81 plates altogether with a baseline of three decades. Variability was quantified by means of a simple yet powerful variability index $I_{\rm var}$ (for details, see Scholz et al. 1997). The three BSS candidates marked in Fig. 1 and listed in Table 1 proved to be variable on a significance level larger than 99.99%.

Follow-up low-resolution spectroscopy with CAFOS at the 2.2-m telescope of the German–Spanish Astronomical Centre on Calar Alto surprisingly revealed that all three variable BSS candidates are quasars with redshifts $z \approx 1$–1.5 (Table 1). Their absolute proper motions are consistent with both the cluster proper motion and the zero-proper motion constraint for quasars due to the small absolute proper motion of M 3. Of course, [HB93] 1340+287 was catalogued as a quasar long before (Hewitt & Burbidge 1989); our observations have just confirmed the earlier redshift measurement.

We conclude that samples of *variable* BSS candidates in the outer regions of high-latitude globular clusters can be substantially contaminated by low-redshift quasars.

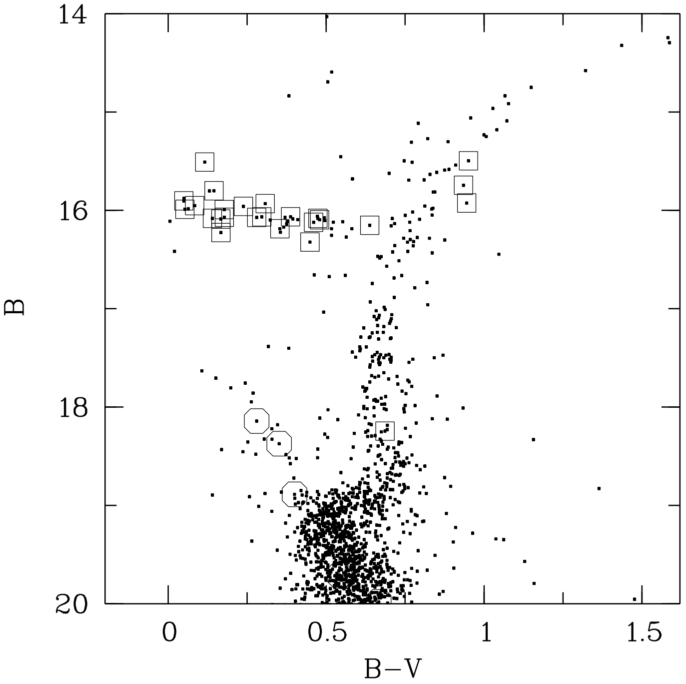

Figure 1. Colour–magnitude diagram of M 3. Strongly variable BSS candidates are marked by octagons, other strongly variable stars detected by the VPMS are indicated by open squares

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Table 1: Basic data for three variable BSS candidates in M 3

VPMS #	12 006	12 465	15 224
R.A. (J2000.0)	$13^{\mathrm{h}}41^{\mathrm{m}}07\overset{\mathrm{s}}{.}5$	$13^{\mathrm{h}}42^{\mathrm{m}}30\overset{\mathrm{s}}{.}9$	$13^{\mathrm{h}}42^{\mathrm{m}}54\overset{\mathrm{s}}{.}5$
DEC (J2000.0)	$+28^\circ39'36''$	$+28^\circ37'25''$	$+28^\circ28'06''$
B	18.9	18.1	18.4
$B-V$	0.40	0.28	0.35
I_{var}	2.8	3.4	2.3
SIMBAD identifiers	NSV 6388	RX J1342.5+2837	[HB93] 1340+287
spectroscopic identification	QSO ($z = 1.580$)	QSO ($z = 1.272$)	QSO ($z = 1.037$)

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TIMES OF MINIMUM OF ECLIPSING BINARIES FROM ROTSE1 CCD DATA, II: SUSPECTED AND RECENTLY NAMED VARIABLES

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In the first part of a series of papers (Diethelm, 2001), we have reported the timings of minimum light of known eclipsing binaries extracted from ROTSE-1 (Robotic Optical Transient Search Experiment 1) survey data, as reported in Akerlof et al. (2000). The original measurements are publicly available through the internet (http://www.umich.edu/~rotse).

In Table 1 of this second paper in the series, the derived timings are presented for the suspected and recently named variables according to the New Catalogue of Suspected Variable Stars (NSV). In each case, the data have been folded into a seasonal light curve using the ROTSE1 period value or the recently published elements of variation (see remarks on individual stars below). The time of minimum was then found with the help of the Kwee–Van Woerden algorithm (Kwee and Van Woerden, 1956).

Table 1: Times of minimum of eclipsing binaries

Star	Type of min.	JD(hel,min) (days)	est. error
ROTSE1 J124337.15+384415.1 = GSC 3021.2642	p	2451305.7378	0.0007
	s	2451306.8821	0.0004
ROTSE1 J125241.77+261637.4 = GSC 1995.2249	p	2451277.8543	0.0014
	s	2451288.8720	0.0015
ROTSE1 J131759.92+300801.0 = GSC 2535.670	s	2451260.8492	0.0001
	p	2451275.7062	0.0004
ROTSE1 J134651.80+225714.7 = GSC 1999.518	p	2451260.7047	0.0007
	s	2451286.8695	0.0007
ROTSE1 J181210.81+305512.9 = GSC 2622.1151	p	2451259.8761	0.0017
ROTSE1 J184241.47+452902.9 = GSC 3527.1195	s	2451304.860	0.002
	p	2451312.864	0.002

Remarks on individual variables:

ROTSE1 J124337.15+384415.1 = NSV 5904 = GSC 3021.2642 = WR 125: Very recently, Vandenbroere et al. (2001) have reported a complete CCD light curve of this EW type eclipsing binary. Our minima fit their elements of variation well ($O-C=-0.0030$ and -0.0028 days).

ROTSE1 J125241.77+261637.4 = NSV 19516 = GSC 1995.2249: This eclipsing binary is of the EB type ($m_\mathrm{p}=10.74$; $m_\mathrm{s}=10.68$). The maximum following the primary minimum is slightly brighter (10.53 mag) than the one following the secondary ($10.^\mathrm{m}55$).

ROTSE1 J131759.92+300801.0 = NSV 6177 = SVS 1257 = GSC 2535.670 = LL Com: During the course of this work, we became aware of the fact, that this EB type variable has already been investigated (Frank et al., 1996) and given a official name (LL Com). The minima reported in Table 1 yield $O-C$ values of +0.0439 and +0.0386 days in respect to the elements of variation given by Frank et al. (1996), indicating the necessity of a slight correction to their period (new value: 0.4069125 days), in good agreement with the period reported by the ROTSE team. We have also used the photographic data from the paper in which the variability of SVS 1257 was announced (Kurochkin, 1959) to deduce times of minimum light. These turn out to be: JDH2434127.370(2), JDH2435540.545(2) and JDH2435929.531(5), all of which are timing of primary minima. Since we have no additional timings in the large time gap between these measurements and our current data, no refinement of the period value is possible.

ROTSE1 J134651.80+225714.7 = GSC 1999.518 = S 8090: This variable is of the EW type with deep minima ($13.^\mathrm{m}1$–$13.^\mathrm{m}8$) and a rather short period ($0.^\mathrm{d}241168$ days)

ROTSE1 J181210.81+305512.9 = NSV 10369 = GSC 2622.1151 = S 8606: A close inspection of the ROTSE light curve made it plausible, that the value of the period has to be doubled to 1.123874 days. Although no observations around the phase of the secondary minimum are available, we are confident that this interpretation is correct. We find this variable to be an Algol type eclipsing binary with a primary minimum lasting for $D=0.^\mathrm{p}18=0.^\mathrm{d}19$ with an amplitude of $0.^\mathrm{m}65$ (12.65–13.3).

ROTSE1 J184241.47+452902.9 = NSV 11259 = GSC 3527.1195 = S 9326: This is another close binary of the EW type.

We would like to express our gratitude towards the ROTSE team for making their data available to the general public. In addition, the cross-reference table provided by B. Skiff through M. Baldwin of the AAVSO is thankfully acknowledged. It proved to be very helpful for the identification of the ROTSE sources.

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TWO NEW SHORT PERIOD VARIABLES: HD 88278 AND HD 128862

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Variability in both HD 88278 (HIP 49416) and HD 128862 (HIP72055) was first discovered by the *Hipparcos* mission, with both stars classified as “Unsolved” variables (ESA 1997). Periodogram analysis of the *Hipparcos* epoch photometry suggests single frequencies of 15.7 d^{-1} (amplitude 21 mmag, HD 88278) and 22.7 d^{-1} (amplitude 16 mmag, HD 128862) in the two sets of observations (Fig. 1). This prompted us to obtain short observing runs on these stars, in order to confirm the periodic variations.

All observations were made using the photoelectric Modular Photometer attached to the 0.5-m telescope of the South African Astronomical Observatory. Measurements consisted of a continuous stream of 10 second integrations through a B filter, with occasional interruptions in order to monitor the sky background. One short observation run (2.3 hours) on HD 88278, and two short runs on HD 128862 (durations of 2.7 and 3.5 hours), were obtained. Standard reduction procedures for such observations were followed. The resulting light curves, consisting of one minute averages of the reduced data, are shown in Figures 2 and 3.

A sinusoid with the frequency determined from the *Hipparcos* data was fitted to the HD 88278 data by least squares, and is plotted with the observations in Fig. 2. Given that no corrections to the data were made for atmospheric transparency variations, the fit is quite good. We conclude that the star is indeed variable with the *Hipparcos* frequency of 15.72375 d^{-1}. (The least squares uncertainty is 4 in the last quoted digit: the high accuracy is due to the long time baseline of the *Hipparcos* observations). The amplitude in the B-band is about 42 mmags.

It is clear from Fig. 3 that a single stable periodicity cannot adequately describe the observations of HD 128862 — for example, the amplitude during the first run is considerably lower. A near-perfect fit to the observations is possible with a four-frequency solution, but given the paucity of data, much credence could not be put in it, particularly as the amplitude of the star may simply be variable. Least squares fitting of a single sinusoid gives a best frequency of 10.4 d^{-1} (or nearby 1 d^{-1} aliases). There is no exceptional feature in the amplitude spectrum in Fig. 1 which corresponds to this rather obvious frequency in our data. However, examination of the window function of the *Hipparcos* data shows that strong aliases may be expected at separations of ~ 11.3 d^{-1} from the true frequencies in the data, so that the most prominent feature in Fig. 1 (bottom panel)

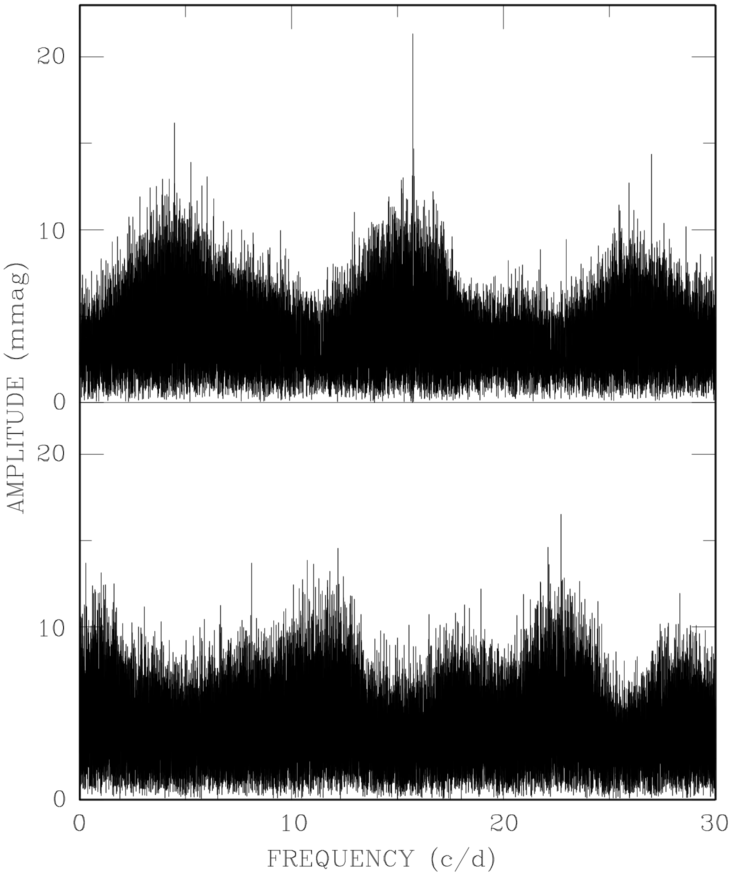

Figure 1. Amplitude spectra calculated for the *Hipparcos* epoch photometry of HD 88278 (top panel) and HD 128862 (bottom panel). Prewhitening by subtracting appropriate sinusoids from the datasets leaves residuals without any pronounced features in their amplitude spectra

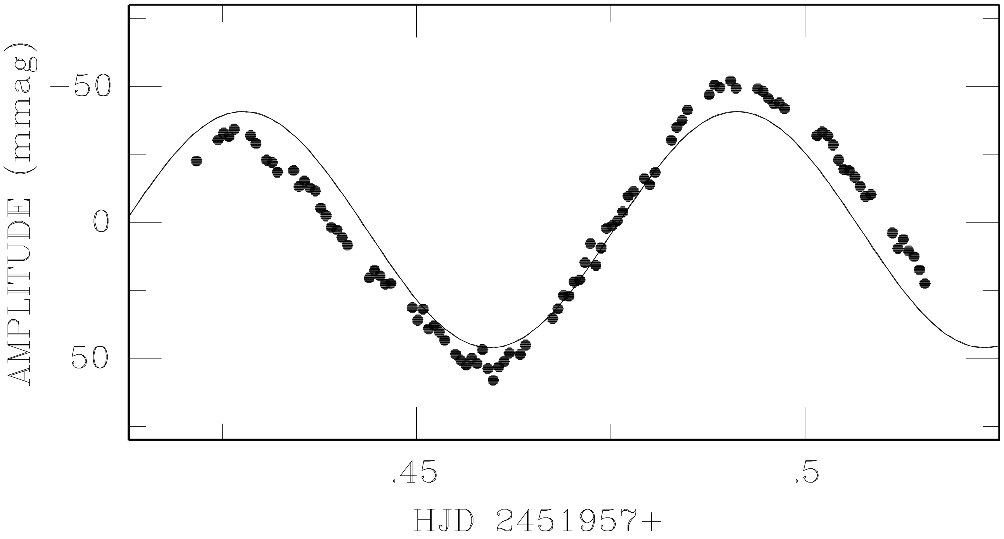

Figure 2. The B-band observations of HD 88278, and a fitted sinusoid with a frequency of 15.7 d^{-1}

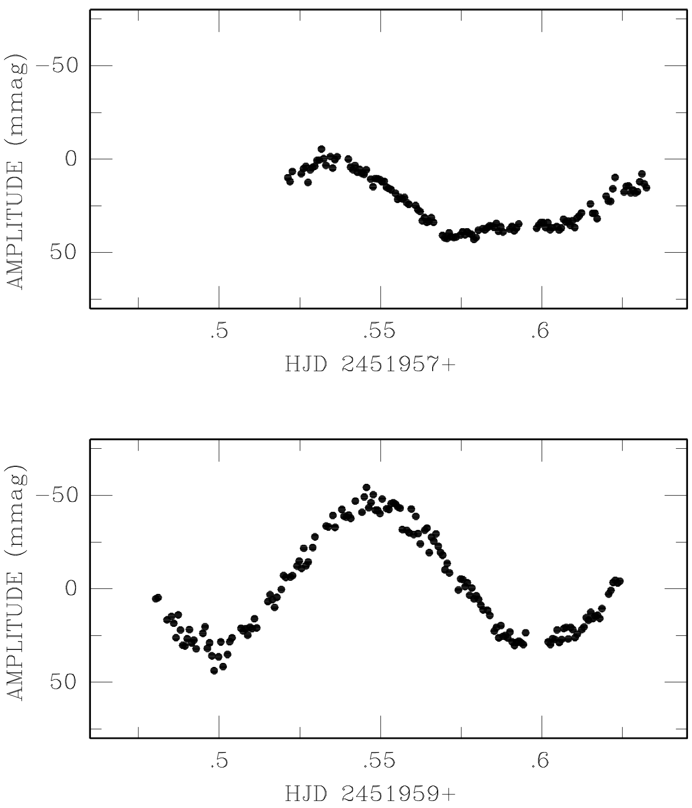

Figure 3. The B-band observations of HD 128862

may be an alias of a true frequency of 11.4 d^{-1}. The latter frequency is reconcilable with the results of our observations.

The *Hipparcos* parallaxes of the stars, together with their V magnitudes, give absolute visual magnitudes M_V of 1.52 ± 0.17 and 0.19 ± 0.75 for HD 88278 and HD 128862. These luminosities appear to be respectively too low and too high for the MK classifications of A4 III/IV (HD 88278) and F0 III/IV (HD 128862) (see Houk & Cowley 1975). Agreement is better with the photometric absolute visual magnitudes of 0.62 and 1.19 derived from Crawford's (1979) calibration of the Strömgren photometric indices (Hauck & Mermilliod 1998). Other information derived from the Strömgren photometry is similar $E(b-y)$ reddenings of 0.07 and 0.06, and δc_1 indices of 0.23 and 0.19, for HD 88278 and HD 128862 respectively. Finally, the Hβ and c_0 indices can be compared with the model results of Moon & Dworetsky (1985) to find $T_{\rm eff} = 8000$ K, $\log g = 3.6$ (HD 88278) and $T_{\rm eff} = 7400$ K, $\log g = 4.0$ (HD 128862).

The spectral types, periods and amplitudes of both stars are consonant with their being δ Scuti pulsators. We therefore proceed to calculate the implied pulsation constants

$$\log Q = -6.456 - \log f + 0.5 \log g + 0.1 M_{\rm bol} + \log T_{\rm eff},$$

f being the frequency in d^{-1}. For HD 88278 we use the *Hipparcos* frequency, while for HD 128862, $f \sim 11.4$ d^{-1} is assumed. Resulting pulsation constants are then 0.016, 0.013 (HD 88278) and 0.023, 0.030 (HD 128862), where the first value given for each star is based on the *Hipparcos* absolute magnitude, and the second on the photometrically derived M_V. These values are normal for δ Scuti stars.

The authors thank Dr Gerald Handler for supplying an unpublished list of candidate δ Scuti stars. This research made use of the SIMBAD database, operated at Strasbourg, France.

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CCD MINIMA OF SELECTED ECLIPSING BINARIES IN 2000

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Sixty new times of minima for various eclipsing binaries have been determined using an unfiltered CCD camera at the Prince George Astronomical Observatory in 2000.

The CCD camera, a SBIG ST6, was mounted at the cassegrain focus of the 61-cm telescope and cooled to -40° C. The camera used a telecompressor lens and operated at $f/7$. Images were taken continuously using the data acquisition software CCDSoft on "focus" mode. Depending on exposure time for the star (usually between 10 and 60 seconds), exposures were taken approximately every minute. The duration of observing runs varied between one and three hours, and typically covered 100–200 or more frames. Data reduction was by MIRA. For more details, see Nelson (2000).

A variety of methods (usually a minimum of three) was used to determine the time of minimum, depending on the nature of the data set. The methods available were: the tracing paper method, bisectors of chords, curve fitting (quadratic on central part, Fourier fit on the full curve if appropriate) — all on a spreadsheet, and Kwee–van Woerden (1956) — by separate software. For each time of minimum, the standard deviation of the resulting times (from the various methods) was used as a starting point in setting the estimated error, given in Table 1, column 5.

For each star, the available times of minimum in the literature were gathered and entered in a spreadsheet; the $O-C$ plots therein were used to predict times of minimum before observing on a given night and, based on earlier works, to determine the type of minimum. The latter is given in column 6 (I = primary, II = secondary).

The $O-C$ plots frequently hinted at, or sometimes strongly indicated a period change; this information is presented in column 7. The period behaviour for some of these stars has been well studied; others await new data and analyses. All the $O-C$ plots, in spreadsheet form, may be obtained from the World-Wide Web at the relevant URL in the references.

Some of the results were less accurate than desirable due to problems of sharply varying sky transparency during the run and limitations in the duration of the run due to the onset of clouds and other factors.

Another problem was the occasional ambiguous identity of the variable; the GCVS 4 position did not agree with the GSC catalogue position, or with RealSky images (100 × compression of POSS digital scans). In these cases, the equivalences are given in the footnotes.

Three light curves at minimum were chosen at random for display. See Figures 1–3.

Table 1

UT date	Star	Comp. star (GSC No.)	Minimum HJD 24...	Estimated error	Type	Period change?	New period
2000-10-15	AD And	3641-0023	51832.81735	$0^{\mathrm{d}}.00007$	I	–	$0^{\mathrm{d}}.9861911$
2000-06-02	BL And	3635-1961	51697.82162	0.00009	I	–	0.7223759
2000-09-25	CN And	2787-1803	51812.8787	0.0002	I	yes?	0.4627898
2000-10-11	DS And	2816-1250	51828.6893	0.0001	I	–	1.0105195
2000-08-05	LO And	3637-0897	51761.8118	0.0003	II?	yes?	0.3808235
2000-02-05	SS Ari*	1758-0121	51579.7217	0.0003	II	–	0.4059839
2000-09-27	ZZ Aur	2915-0468	51814.89102	0.00006	I	–	0.6012168
2000-12-28	AH Aur	1887-1240	51906.95915	0.0006	II	–	0.4942714
2000-02-13	AC Boo	3474-0834	51588.0118	0.0006	I	yes	0.3524441
2000-03-29	TY Boo	2568-0991	51632.79821	0.00005	I	–	0.3171503
2000-12-09	UZ CMi	0184-1875	51887.9262	0.0001	II	–	0.7619496
2000-09-23	AZ Cam	4547-1052	51810.8735	0.0001	I	yes?	1.3192308
2000-03-04	WW Cam	4673-1078	51607.7921	0.0006	I	yes?	2.2743713
2000-08-30	CW Cas	4020-1387	51786.8746	0.0002	II	yes?	0.3188638
2000-09-16	V364 Cas	3270-0612	51803.8936	0.0004	I	–	1.5430662
2000-09-26	V364 Cas	3270-0612	51813.9229	0.0003	II	–	1.5430662
2000-07-22	V523 Cas	3257-1068	51747.8792	0.0001	I	yes	0.2336930
2000-12-07	V541 Cas*	4050-0957	51885.8766	0.0001	II	–	0.9098486
2000-03-05	VZ Cep	4470-1497	51608.7237	0.0003	I	yes?	1.1833637
2000-12-11	WZ Cep	4486-1402	51889.6940	0.0001	I	–	0.4174453
2000-05-15	BE Cep	3996-0441	51679.8576	0.0002	II	–	0.4243941
2000-12-07	EF Cep	4523-0854	51885.7625	0.0004	I	–	0.6061077
2000-01-21	EG Cep	4585-0165	51564.86095	0.00008	I	–	0.5446224
2000-03-19	GW Cep A	4502-0724	51622.5520	0.0001	I	–	0.3188440
2000-03-31	GW Cep B	4502-0724	51634.80913	0.00015	II	–	0.3188440
2000-04-25	OT Cep	4504-0663	51659.80612	0.00005	I	–	0.9624610
2000-04-14	RW Com	1991-1659	51648.77918	0.00025	I	–	0.2373453
2000-05-12	RZ Com	1990-3503	51676.7736	0.0003	I	–	0.3385073
2000-07-24	CV Cyg	3137-0227	51749.8469	0.0002	II	–	0.9834109
2000-06-15	DK Cyg	2712-1841	51710.8499	0.0003	I	yes	0.4706928
2000-05-13	V387 Cyg*	2714-0538	51677.9260	0.0004	I	–	0.6405966
2000-07-17	V401 Cyg*	2654-1313	51742.8339	0.0002	I	yes	05827244
2000-09-25	V463 Cyg*	2656-4079	51812.7731	0.0002	I	–	2.1175747
2000-06-16	V513 Cyg	3170-0502	51711.8397	0.0002	I	–	1.0561803
2000-12-13	V680 Cyg	3968-0228	51891.8040	0.0003	I	–	1.1991437
2000-05-20	RZ Dra	3916-1962	51684.89711	0.00025	I	–	0.5508762
2000-03-06	RW Gem	1864-1948	51609.776	0.002	II	–	2.8654961
2000-04-16	GW Gem*	1933-0570	51650.77409	0.00007	I	–	0.6594445
2000-03-19	SZ Her	2610-1214	51622.96964	0.00025	II	–	0.8180968
2000-09-22	CO Lac	3992-1927	51809.9448	0.0002	I	apsidal	1.5422071
2000-05-26	EM Lac	3982-3238	51690.91843	0.00005	I	–	0.3891347
2000-09-21	PP Lac	3984-1619	51808.6546	0.0001	I	–	0.4011633
2000-03-26	XZ Leo	1412-0423	51629.807	0.002	I	yes	0.4877373
2000-05-08	CE Leo*	1985-1274	51672.79847	0.00005	I	–	0.3034290
2000-06-03	TZ Lyr	3107-0618	51698.82501	0.00005	I	–	0.5288272
2000-12-11	BO Mon*	4850-0630	51889.9281	0.0001	I	yes	2.2251719
2000-12-13	V496 Mon	0151-1326	51891.8954	0.0002	I	–	0.6607624
2000-05-26	V508 Oph*	1019-1850	51690.8308	0.0001	I	–	0.3447905
2000-12-28	V343 Ori*	0725-0502	51906.8087	0.0003	I	–	0.8091418
2000-09-27	BO Peg*	1127-1477	51814.7788	0.0001	I	yes?	0.5804273
2000-08-05	BX Peg*	2197-1946	51761.91545	0.0001	I	yes	0.2804168
2000-12-11	V432 Per*	2856-0823	51889.8058	0.0001	I	yes	0.3833100
2000-04-14	AU Ser	1502-1573	51648.88903	0.00013	I	yes	0.3864935

Table 1 (continued)

UT date	Star	Comp. star (GSC No.)	Minimum HJD 24...	Estimated error	Type	Period change?	New period
2000-02-12	RZ Tau	1274-1281	51586.7378	$0^{\rm d}.0001$	I	–	$0^{\rm d}.4156768$
2000-10-06	AH Tau	1804-2485	51823.8420	0.0001	I	yes?	0.3326779
2000-09-24	CT Tau	1871-0434	51811.8973	0.0001	I	yes	0.6668249
2000-10-05	EQ Tau*	1260-0575	51822.9035	0.0001	I	–	0.3413471
2000-01-29	XY UMa	3805-0990	51572.7472	0.0002	I	–	0.478996?
2000-01-30	AG Vir	0871-0330	51573.9120	0.0001	II	–	0.6426530
2000-04-25	GP Vul	2151-1825	51659.9171	0.0002	I	–	1.0324998

Notes:

SS Ari = GSC 1758-0116; V541 Cas = GSC 4051-1764; V387 Cyg = GSC 2714-0556; V401 Cyg = GSC 2654-2502; V463 Cyg = GSC 3170-0931; GW Gem = GSC 1933-0692; CE Leo = GSC 1985-1209; BO Mon = GSC 4837-1454; V508 Oph = GSC 1019-1840; V343 Ori = GSC 0725-1137; BO Peg = GSC 1127-0916; BX Peg = GSC 2197-1458; V432 Per = GSC 2856-1647; EQ Tau = GSC 1260-0909

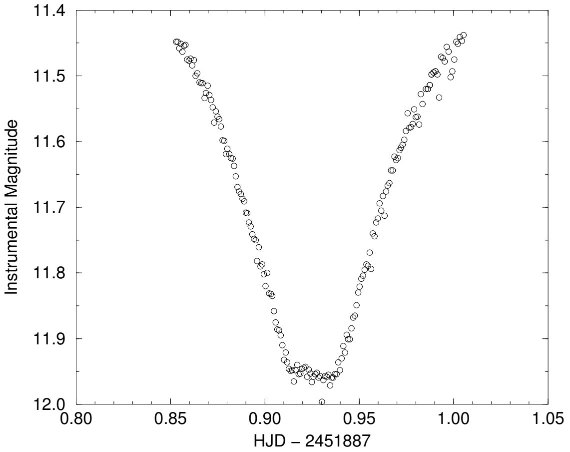

Figure 1. Secondary minimum of the $0^{\rm d}.76$ W UMa-type binary UZ Canis Minoris

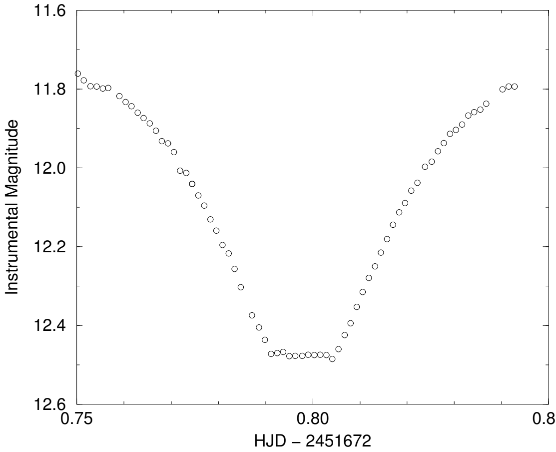

Figure 2. Primary minimum of the $0^{\rm d}.30$ W UMa-type binary CE Leonis

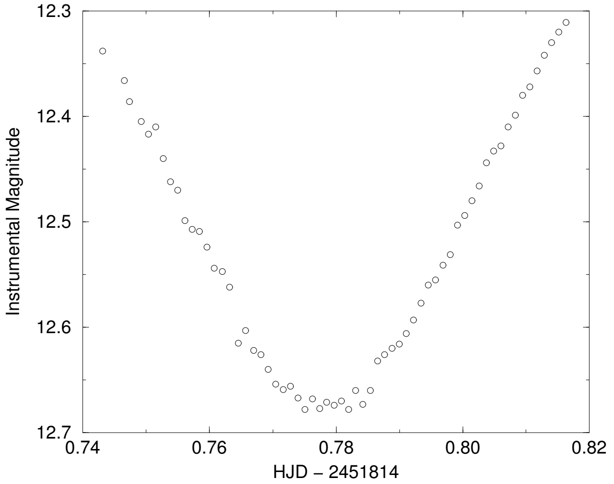

Figure 3. Primary minimum of the $0^{\rm d}.58$ β Per-type binary BO Pegasi

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`http://www.cnc.bc.ca/physics/EB_Database.htm`

ERRATUM FOR IBVS 5040

In IBVS 5040, the time of minimum for the GW Cep on 2002-03-19 (UT) should read 51622.8521.

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PERIODS OF 25 PULSATING RED GIANTS

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As stars expand and cool as red giants, they become pulsationally unstable. Initially, the amplitudes are a few hundredths to a few tenths of a magnitude, and the periods are days to weeks or more; these small-amplitude red variables (SARVs) are the subject of this paper. Later, the amplitude and period become much greater, and the star becomes a Mira star. This is one of a series of papers dealing with the search for, and study of SARVs; see Percy (1997) for a brief review.

Observations. The observations were obtained by the American Association of Variable Star Observers (AAVSO) photoelectric photometry program (Landis et al. 1992, Landis 2000). The results reported here are for two groups of stars: (i) those in Table 1 are stars in the general AAVSO PEP program which did not have sufficient measurements to be included in Percy et al. (1996); the data tend to be sparse at first, and then denser, as observers responded to the plea for more observations; (ii) those in Table 2 which are primarily stars which were assigned to specific observers (mostly RRT) as part of "Project SARV" (Percy et al. 1994). For both groups of stars, the measurements are made differentially in V only, relative to the comparison and check stars listed in the tables. They are corrected for differential extinction, and reduced to the standard V system using the catalogue values of the $B-V$ colors. The observations are available from the AAVSO: 25 Birch Street, Cambridge MA 02138, USA; e-mail: aavso@aavso.org

Analysis. The measurements were analyzed using light curves, power spectra, and autocorrelation diagrams, as described by Percy et al. (1996), who showed that these three techniques are useful and complementary in the analysis of stars like these. Analysis of the stars in Table 1 was done by LK; that of the stars in Table 2 was done by HD.

Results. The results are summarized in Table 1 and 2, which list the various designations of each star, the spectral type (from either the *Hipparcos Catalogue* (Perryman et al. 1997; hereinafter P97) or the *Bright Star Catalogue*), the amplitude ΔV, the time span of the data Δt in days (ending about JD 2451000), and the period of variability: more certain periods are given in bold-face type; less certain periods are denoted by a colon. A few of the stars were observed independently with an Automatic Photometric Telescope (Percy et al. 2000). Further notes are given below:

Table 1: Program stars and results

Name	HD	SpT	Comp and Check (HD)	ΔV	Δt (days)	Period (days)
T Cet	1760	M5/6Ib-II	2475, 1343	0.80	3800	110:, 280:
EG And	4174	M2e	3765, 4479	0.27	5550	**29, 240**
AK Hya	73844	M6III	73603, 74991	1.16	3100	50::
TV UMa	102159	M4III	101978, 102941	0.72	5800	600
GK Com	104207	M4III	104290, 102715	0.32	5300	—
SW Vir	114961	M7III	114866, 114783	1.85	5700	**155**
FH Vir	115322	M6III	115885, 114174	1.19	5650	72, 280
EV Vir	124304	M3III	124401, 124106	0.52	5550	**19.5, 57**
τ^4 Ser	139216	M5II-III	140027, 139074	1.08	5750	**110** + long
AZ Dra	151481	M2III	150010, 151541	0.55	1020	**352**
V973 Cyg	186776	M3III	187523, 186619	0.40	1950	**35, 376**
V1070 Cyg	203712	M7III	203713, 203857	0.83	4200	110, 470

Notes on Stars in Table 1: T Cet: unsolved, literature period 158.9 days (P97). **EG And:** unsolved (P97); periods 29 and 242 days (Percy et al. 2000). **AK Hya:** unsolved, literature period 75 days (P97). **TV UMa:** unsolved, literature period 42 days (P97). **GK Com:** unsolved, literature period 50 days (P97). **SW Vir:** period 153.6 days, literature period 150 days (P97); period 153.8 days (Percy et al. 2000). **FH Vir:** unsolved, literature period 70 days (P97). **EV Vir:** unsolved, literature period 120 days (P97). **τ^4 Ser:** unsolved, literature period 100 days (P97). **AZ Dra:** unsolved, no literature period (P97). **V973 Cyg:** unsolved, literature period 40 days (P97). **V1070 Cyg:** unsolved, literature period 73.5 days; complex variability with possible period of 60 days (Percy et al. 2000).

Table 2: Program stars and results

HR	Name	SpT	Comp and Check (HR)	ΔV	Δt (days)	Period (days)
211	NSV 00293	M4III	225, 213	0.22	1950	12? 32? 40?
284	WW Psc	M2III	294, 307	0.23	1900	**25**, 300
648	CSV 100168	M0III	624, 609	0.14	1950	32:, 275:
2286	μ Gem	M3III	2230, 2185	0.23	2400	**29**
2999	NSV 03721	M3III	3522, 3540	0.13	2400	22:, 360
3521	BO Cnc	M3III	3522, 3540	0.26	1950	**27**, 270
4267	VY Leo	M5III	4207, 4201	0.75	2650	48, 500
4483	ω Vir	M4III	4559, 4515	0.28	2250	**30**, 275
5331	FS Vir	M4III	5283, 5307	0.18	1850	20, 250
5352	CY Boo	M3III	5254, 5243	0.10	1800	**23**, 350:
6543	V642 Her	M4III	6542, 6577	0.29	2650	26 and/or 32
6815	V669 Her	M3III	6768, 6775	0.17	2650	**27**
7009	XY Lyr	M4.5II	7017, 7019	0.55	1575	**120**

Notes on Stars in Table 2: These were classified as "unsolved" by P97 unless otherwise noted. **HR 211:** very poor distribution of observations; Thompson (1999) found a time scale of about a month from a subset of these data, and from *Hipparcos* epoch photometry. **HR 648:** very sparse observations; no obvious time scale. **HR 2286:**

period 27 days plus long period (Percy et al. 2000). **HR 2999:** no obvious short period. **HR 4267:** period 46.34 days (P97). **HR 6543:** period 25.6 days, plus 500-1500 days (Percy et al. 2000); period 25 days (Percy et al. 1994); literature period 12 days (P97). **HR 6815:** period about 20 days (Percy et al. 1994); Thompson (1997) found a time scale of just over 20 days from a subset of these data.

Discussion. Previous papers in this series (see Percy 1997 for a list and review of these) have revealed both short (20–200 days) and long (hundreds or thousands of days) periods in SARVs. Note that most of the stars in Tables 1 and 2 have a period in the range of 20–50 days; these short periods are apparently radial pulsation periods (Percy & Parkes 1998). The nature of the long periods is unclear; two recent suggestions have been (i) the rotation of a non-uniform star (Cummings 1999) and (ii) a convectively induced oscillatory thermal mode (Wood 2000). The present results add to our database of periods of SARVs, which will be used to study the nature and systematics of both long and short periods.

Acknowledgements. We thank the AAVSO observers, headquarters staff, and especially the photoelectric archivist Howard J. Landis, for their essential contributions to this project. In addition, JRP thanks NSERC Canada for a Research Grant. Heather Dunlop and Lola Kassim were participants in the University of Toronto Mentorship Program, which enables outstanding senior high school students to work on research projects at the University of Toronto.

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UBVR PHOTOMETRY OF CONTACT BINARY XY LEONIS

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Name of the object:
XY Leo = BD +18°2307 = HIP 49136

Equatorial coordinates:	**Equinox:**
R.A.= $10^{\mathrm{h}}01^{\mathrm{m}}40\overset{\mathrm{s}}{.}39$ **DEC.=** $17^{\circ}24\overset{\prime}{.}5$	2000

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

Detector:	Hamamatsu, R4457 (PMT)

Filter(s):	U, B, V and R filters of Johnson UBV system

Comparison star(s):	BD +18°2306 = SAO 98898

Transformed to a standard system:	Johnson UBV
Standard stars (field) used:	

Availability of the data:
Upon request

Type of variability:	WUMa

Remarks:

In this paper we present $UBVR$ light curves of the contact binary XY Leo. We observed XY Leo on the nights of 5, 6 and 24 December 2000 using the 48-cm Cassegrain telescope of Ege University Observatory. The phases of the observations were calculated using the following light elements:

$$\mathrm{HJD\ Min.\,I} = 2451884.4470 + 0\overset{\mathrm{d}}{.}28410340 \times E.$$

Table 1 lists the dates of observations and the phases covered. The B, V and R light curves of XY Leo obtained on Dec. 5 and 6 are shown in Figure 1, and U, B, V and R light curves obtained on Dec. 24 are shown in Figure 2.

Acknowledgements:

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Table 1

Date	Phase
05 Dec.	0.17–0.71
06 Dec.	0.61–1.18
24 Dec.	0.60–1.63

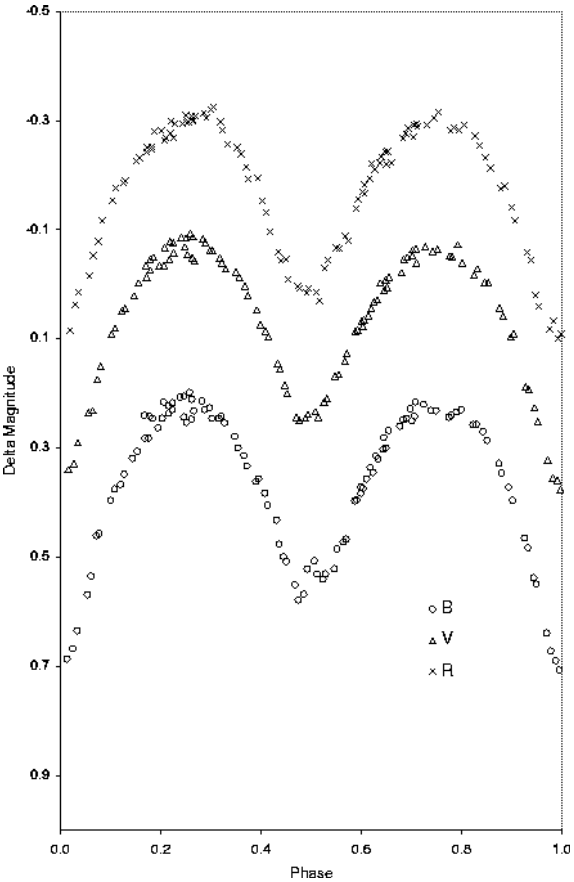

Figure 1. The light curves of XY Leo obtained on Dec. 5 and 6, 2000

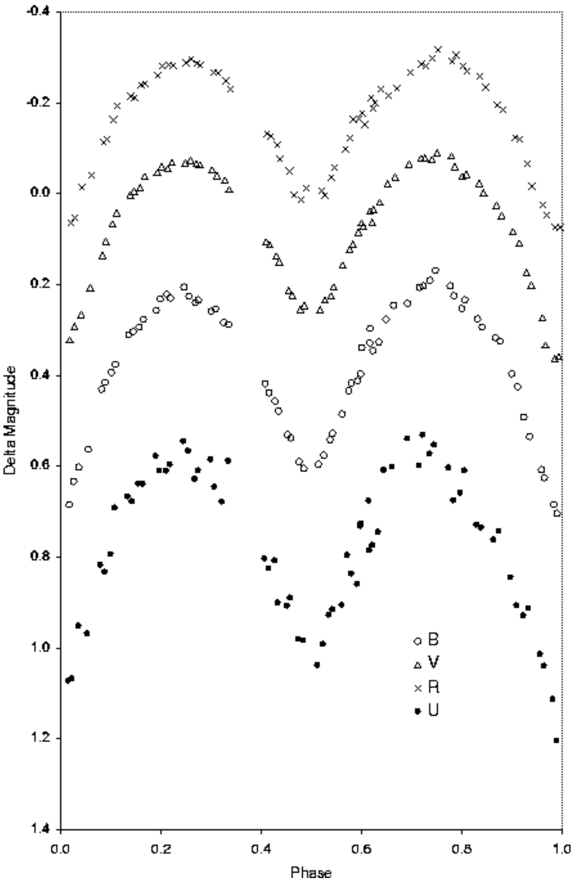

Figure 2. The light curves of XY Leo obtained on Dec. 24, 2000

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STARSPOTS ON THE YOUNG SOLAR-TYPE STAR π^1 URSAE MAIORIS

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π^1 Ursae Maioris (HD 72905, G1.5 V, $V = +5.63$, $B - V = +0.62$, $\pi_{\rm Hip} = 70.07 \pm 0.71$ mas) is a single solar-type star that has high levels of chromospheric and coronal X-ray emissions (Dorren & Guinan 1994; Gaidos 1998). The U, V, W space motions indicate that π^1 UMa is a member of the Ursa Maioris Star Stream with an age of ~ 350 Myr (Soderblom & Mayor 1993). Selected as a proxy for the young Sun some 4.2 Gyr ago and included in Villanova's *The Sun in Time* program, π^1 UMa has physical properties (except for age) similar to the Sun ($T_{\rm eff} \approx 5860$ K, [Fe/H] ≈ -0.08, $M \approx 1\ M_\odot$ and $L/L_\odot \approx 0.96$) (Gaidos 1998). *The Sun in Time* program (Dorren & Guinan 1994) is a multiwavelength study of solar-type stars (G0-5 V) ranging in age from Zero Age Main Sequence (ZAMS) to Terminal Age Main Sequence (TAMS).

The age associated with the membership of π^1 UMa in the UMa Star Stream is consistent with the observed high levels of coronal and chromospheric activity. This star is a moderately strong coronal X-ray source, with an X-ray luminosity $L_{\rm x} \approx 1.3 \times 10^{29}$ erg s^{-1}, approximately 40 times more luminous than the Sun (Guinan et al. 2000). X-ray flaring has also been observed on π^1 UMa, in particular a large X-ray flare recorded by the EXOSAT satellite during January 1984 (Landini et al. 1986). It also displays enhanced Mg II h+k and Ca II H+K chromospheric emissions. From Mt. Wilson Ca II K-line spectrophotometry, π^1 UMa is found to have about two times the Ca II emission of the Sun (Baliunas et al. 1995). This heightened activity throughout the upper atmosphere of the star is consistent with its young age and short rotation period ($P_{\rm rot} \approx 4.8$ days) that results from a more vigorous magnetic dynamo, as discussed below.

Differential photoelectric photometry of π^1 UMa was carried out using the 0.8-m Four College Consortium (FCC) Automated Photoelectric Telescopes (APT) located in Southern Arizona. The observations were conducted on more than 350 nights from October 1990 to March 2000, using $UBVRcIc$ filters. Using an integration time of 10 seconds, over 1500 observations were secured in each filter. Typically the observations were carried out for about 25 minutes per night. The observing sequence was the usual pattern of *sky–comparison–check–variable–comparison–sky*, employing HD 73108 (K1 III, $V = +4.60$, $B - V = +1.19$) as the primary comparison star. HD 72037 (A2m, $V = +5.46$, $B - V = +0.20$) served as the check star. The data were corrected for atmospheric extinction, using extinction coefficients determined from the analysis of the comparison star and standard stars. Both the comparison and check stars lie within ~ 1.5 degrees of π^1 UMa. Because of this, the resulting corrections for atmospheric extinction were always small. The photometry of the comparison and check stars show that both stars are constant in brightness to levels of less than ~ 6 mmag. This is confirmed by Hipparcos photometry where $\sigma_{\rm Hip} = 0.0006$, $\sigma_{\rm Hip} = 0.0005$ are given for the comparison and check star respectively.

To illustrate the photometric behavior of π^1 UMa, all of the V-band observations are plotted against Julian Day in Figure 1. The small open circles are the individual observations and the large filled circles represent 2 to 3 month brightness averages. As shown in the figure, long-term changes in the brightness are easily seen. When examined on an expanded time scale, the apparent "scatter" in the individual observations arises from low amplitude ($\sim 0^{\rm m}.020$–$0^{\rm m}.035$) periodic light variations with a period of $P \sim 5$ d. Similar brightness variations are found for the other data sets at different wavelengths. As in the case of other cool chromospherically-active stars, the low amplitude light variations most likely arise from an uneven distribution of cool starspots in the photosphere of the rotating star. As shown in the figure, the difference in the mean V-mag between the minimum brightness (1990–1992) and maximum brightness (1995–1998) is about $0^{\rm m}.035$. The present observations suggest a possible cycle length of 12-13 years. As discussed by Messina et al. (1999), the variations in the light amplitudes for similar solar-type stars primarily arise from the effects of differential rotation and varying starspot areal coverage. When the longitudinal separation of the two spot regions is less than $\sim 60°$ the spots appear on the same hemisphere of the star and produce the larger rotational modulated light variations. The lower amplitude light variations occur when the spots are separated in longitude by $\sim 180°$ or when the spots drift toward the rotational pole (or both). For example, the 1993 and 1996 light curves have the smallest light amplitudes while 1991, 1992 and 1995 light curves have the relatively large light amplitudes. Also note that in some years (e.g., 1990/91, 1994, and 1995) the mean light levels and light amplitudes appear to change very rapidly — i.e., on a time-scale of several weeks. In a future paper we plan a detailed analysis of all of the photometry that will include an investigation of differential rotation and variations in spot coverage.

It is not within the scope of this paper to discuss the entire data set. For illustrative purposes, the 5-colour photometry of π^1 UMa obtained during a run of clear nights in April 1991 is discussed and analyzed. We examined other data sets and this data set is representative of the light variations of π^1 UMa, and displays good coverage of the star's light curve. Small, sinusoidal-like light variations are apparent and it is clear that π^1 UMa is a low amplitude variable star. There is a definite wavelength dependence in the light amplitude. The light amplitudes found during April 1991 are: $U:\ 0.054 \pm 0.006$, $B:\ 0.038 \pm 0.005$, $V:\ 0.032 \pm 0.005$, $Rc:\ 0.030 \pm 0.004$, and $Ic:\ 0.027 \pm 0.005$.

The April 1991 photometry was analyzed with the Scargle–Press period search routine (Scargle 1982) and a period of $P_{\rm ptm} = 4.79 \pm 0.08$ days was found. Period searches of other subsets of data indicate that the period is variable with time. Preliminary period studies of the 1990-2000 observations indicate that the period ranges from $P \sim 4.6$ to 5.1 days. This range of apparent periods is similar to the periods of $P \approx 4^{\rm d}.6$–$4^{\rm d}.82$ found by Donahue (1993) from the Scargle (1982) periodogram analysis of Ca II H+K spectrophotometry obtained at Mt. Wilson from 1984–1991. More recently, Gaidos et al. (2000) report periods between $4^{\rm d}.62$–$5^{\rm d}.46$ and a mean period of $4^{\rm d}.89$ from the photoelectric photometry made during 1993–1999. For chromospherically-active stars like π^1 UMa, the observed photometric period is the rotation period of the surface of the star, where the spots are located. The observed variations of the photometric period most likely arise from differential rotation as starspots form at different stellar latitudes, perhaps over an activity cycle. From its periodic low amplitude light variations and its high levels of chromospheric and coronal activity, π^1 UMa should be classified as a BY Draconis variable star.

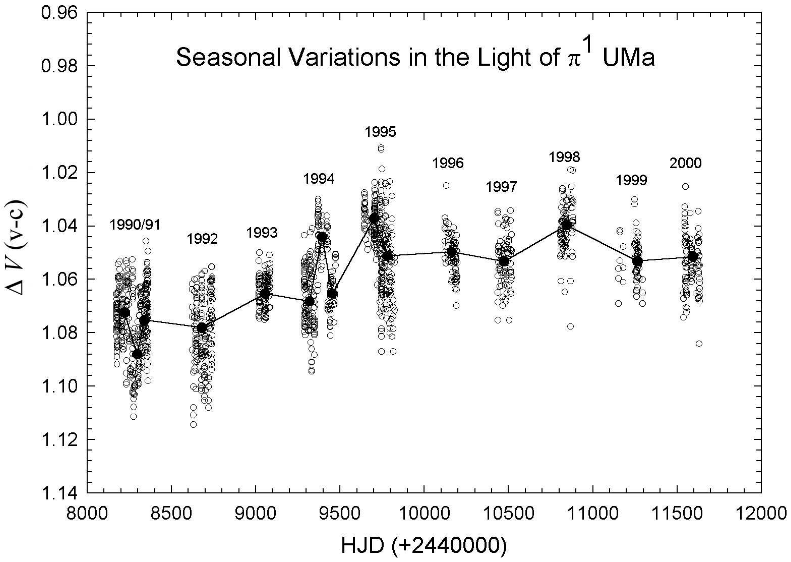

Figure 1. The V-band light variations of π^1 UMa in the years from 1990 through 2000 are plotted versus time. Long-term (possibly cyclic) changes in the mean brightness are shown. The numerous small open circles are the individual 10-second observations; the larger filled circles are approximately 2 to 3 month brightness means. As discussed in the text, the apparent scatter within the seasonal data sets arises primarily from the rotational modulation of brightness from starspots

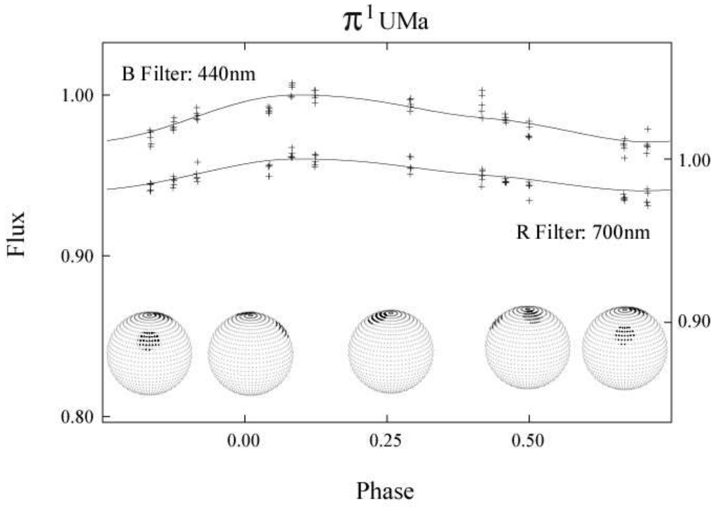

Figure 2. The normalized intensities from B and Rc photometry of π^1 UMa are plotted versus photometric phase. The observations were carried out during April 1991. The phases were computed with the $P_{\rm ptm} \approx P_{\rm rot} = 4\overset{\rm d}{.}79$. The best fitting spot model curves (see text) are shown among the observations and the corresponding 3-dimensional representations of the spot configuration on the star's surface are depicted at four different phases: 0.75, 0.00, 0.25, and 0.50

The light curves were analyzed on the assumption the light variations arise from starspots using a modified version of Binary Maker 2.0 (Bradstreet 1993). Spots of uniform temperature and circular shape were assumed, and a photospheric $T_{\rm eff}$ of 5860 K (Cox 2000), appropriate for its G 1.5 V spectral type was adopted. An inclination of about 70° (angle of the stellar pole relative to the line of sight) was used, as calculated from a $v \sin i = 9.5$ km s^{-1} (Soderblom 1982; Fekel 1997), and a stellar radius of $R \approx 1 R_\odot$ as inferred by the spectral type. The photometric data used in analysis was phased using an arbitrary time of minimum light and $P_{\rm ptm} \approx P_{\rm rot} = 4.79$ days. These observations were normalized and transformed to intensity units. For the modelling we use the effective wavelengths and the transmission functions of the different filters. The B and R observations are shown in Figure 2 along with the best-fitting model fits. Below the light curves in Fig. 2 is the geometric representation of the star with starspots, shown at different rotation phases. The $UBVRcIc$ light curves were fit using manual iteration. For April 1991, π^1 UMa was found to have two mid-latitude spots located at latitude $\approx$ 40°±25° and the other at 65°±15°. The spots have a longitudinal separation of $\Delta\ell \approx 110° \pm 15°$. Both spots were about $14° \pm 3°$ in radius, resulting in a total spot coverage of the star of about 3%, or if symmetry about the stellar equator is assumed (as seen in the Sun), the spot coverage can be as high as $\sim$ 6%, depending on spot latitude. This spot coverage is about 30 times greater than observed for the Sun ($\sim$ 0.2%), even during the maximum of the sunspot cycle (Cox 2000). The temperature difference between the cooler spots and the photosphere was found to be $\Delta T \approx 500\pm100$ K. This quantity is well constrained from the wavelength dependence of the light variations. However, because of the low amplitudes of the light variations and the lack of contemporaneous Doppler imaging, there are large uncertainties in the latitudes of the spots. Thus the values found for the starspot properties are not unique. However, they should be considered as representative of spot areas, distributions, and temperatures at the time of observations.

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DP PEGASI: CCD LIGHT CURVE AND ELEMENTS OF VARIATION

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The star DP Pegasi = GSC 1675.1817 = HV 6121 (at $21^h22^m56\overset{s}{.}0$, $+22°03'46''$, (J2000); GSC-magnitude: 13.3) was first reported by Shapley and Hughes (1934) to be variable. They classified the star as an eclipsing binary of unknown period with a photographic range of $13\overset{m}{.}3$–$14\overset{m}{.}2$ and remarked that they had found 11 minima on their photographic plates, without giving further information. An intensive search of the Harvard College Observatory's archive by PG was not successful in locating the original data. According to the SIMBAD data base, no other source of information concerning the variability of DP Pegasi is available.

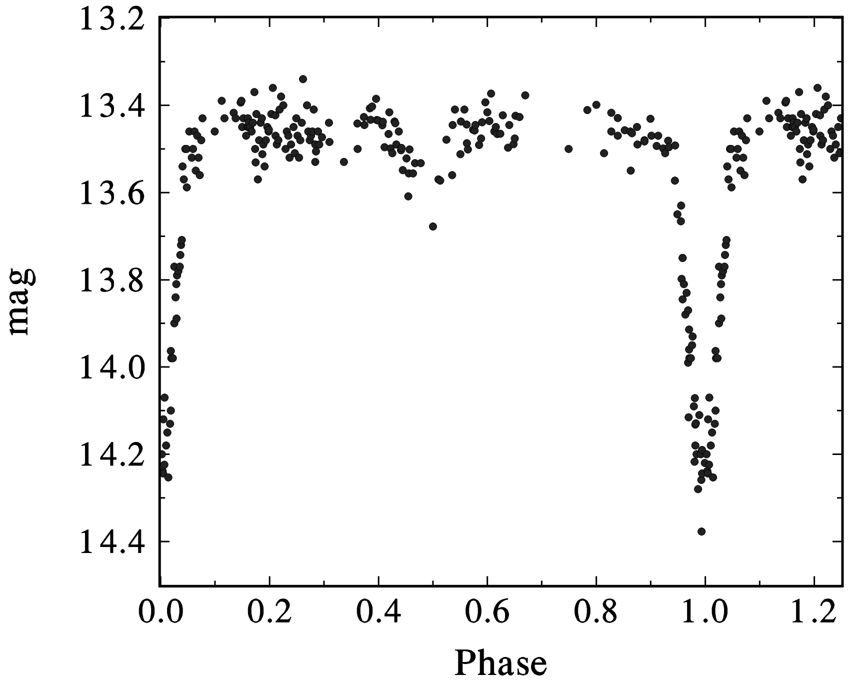

Figure 1. Phased CCD light curve of DP Pegasi (no filter)

Table 1: Times of primary minimum, DP Pegasi

HJD 2400000 +	Error ±	Epoch	$O-C$	Observer	Method
42743.479	–	−5279	+0.140	Harvard	ptg
43050.688	–	−5094	+0.011	Harvard	ptg
43070.598	–	−5082	−0.014	Harvard	ptg
43776.627	–	−4657	−0.033	Harvard	ptg
44512.628	–	−4214	+0.018	Harvard	ptg
44934.532	–	−3960	−0.046	Harvard	ptg
45635.557	–	−3538	−0.084	Harvard	ptg
45645.573	–	−3532	−0.036	Harvard	ptg
45695.453	–	−3502	+0.006	Harvard	ptg
45939.641	–	−3355	−0.016	Harvard	ptg
51513.283	0.003	0	+0.005	Diethelm	ccd, no filter
51757.490	0.003	+147	+0.003	Diethelm	ccd, no filter
51767.457	0.003	+153	+0.002	Diethelm	ccd, no filter
51797.3607	0.0010	+171	+0.0024	Blättler	ccd, no filter

We have started an observing campaign with our CCD equipment in order to clarify these open questions. RD used the 35-cm RC-telescope and a SBIG ST-6 CCD-camera (no filter) of the R. Szafraniec Observatory, Metzeren, Switzerland, securing a total of 111 observations in 26 nights between JD 2451459 and JD 2451925. EB observed with a SBIG ST-7 CCD-camera (no filter) mounted on a 15-cm refractor at his private observatory in Wald, Switzerland. He gathered a total of 124 measurements in two nights, namely JD 2451797 and JD 2451799. All CCD exposures were dark-subtracted and flat-fielded before aperture photometry was performed. No correction for differential extinction was applied due to the proximity of the comparison stars to the variable and the limited accuracy of our photometry at the brightness level of DP Pegasi ($\pm 0\overset{\rm m}{.}03$). We used GSC 1675.1720 (GSC-magnitude: 13.8) as primary comparison star, while several field stars, some not contained in the GSC, served as check stars, proving the constancy of the comparison star.

In Figure 1, we show the results of our photometry, folded with the period ($1\overset{\rm d}{.}661272$) we considered to yield the best representation of our observations.

In order to improve the period value, PG searched the plate collection of Harvard College Observatory for minima of the variable. The plates of the Damon and RH patrol series yielded a number of dimmings given in Table 1 along with the CCD timings already published in the BBSAG Bulletins. The $O-C$ values are calculated from the elements:

$$\begin{array}{rl}\text{Min. I} = \text{HJD } & 2451513.278 + 1\overset{\rm d}{.}6612879 \times E. \\ & \pm 0.005 \quad \pm 0.0000060\end{array}$$

Acknowledgements: Photometry at the R. Szafraniec Observatory is supported financially by the "Emilia Guggenheim-Schnurr" foundation and RD wishes to acknowledge this help gratefully. We also wish to express our gratitude towards A. Doane, acting Curator ofthe Astronomical Photograph Collection at the Harvard CollegeObservatory, for the use of the Harvard Patrol Plates on this and other variable star projects. This research made use of the SIMBAD data base, operated at CDS, Strasbourg, France.

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V404 LYRAE IN THE FIELD OF THE VERY OLD GALACTIC CLUSTER NGC 6791

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V404 Lyrae was listed as a β Lyrae type eclipsing binary by Popova and Kraicheva (1984) in the field of the old galactic cluster NGC 6791 (its age is $t = 8 \pm 0.5$ Gyr, $m - M = 13\overset{\mathrm{m}}{.}42$, $E_{B-V} = 0.10$, Chaboyer et al. 1999). In the GCVS (Kholopov et al. 1985) the following ephemeris is found:

$$\text{Min. I} = \text{HJD } 2435836.462 + 0\overset{\mathrm{d}}{.}73094585 \times E. \tag{1}$$

According to our knowledge neither spectroscopic information nor light curve is available for V404 Lyr and there are only observations of minima published in the literature.

Therefore we observed the star on seven nights using the 1-m RCC-telescope of the Konkoly Observatory. The detector was a 1024×1024 electronically cooled Photometrics CCD-camera and we applied a 2×2 binning on the chip. We used Johnson–Cousins $V(I)_C$ filters. All frames were cleaned from cosmic ray events and we made bias and flat-field corrections. Dome-flats were used. The dark-current was negligible. The average seeing was about $2\overset{''}{.}4$. The log of observations can be found in Table 1. In order to determine the instrumental magnitudes we used the IRAF/DAOPHOT package. From our observations we could determine two new moments of minima (see Table 2).

Table 1: Log of observations

Date of observation	V	I	Phase coverage	Note
JD 2451691	92	91	0.04 - 0.24	
2451692	72	72	0.38–0.52	
2451725	60	60	0.59–0.72	
2451728	9	9	0.82–0.83	thin clouds
2451729	30	30	0.16–0.22	
2451772	170	174	0.82–0.17	full moon
2451773	21	48	0.25–0.35	

In Table 2 the $(O-C)_{\mathrm{GCVS}}$ represent the residuals using ephemeris (1). A linear fit to the data has been yielded better elements:

$$\begin{aligned}\text{Min. I} = \text{HJD } 2435836.448 &+ 0\overset{\mathrm{d}}{.}7309432 \times E \\ \pm 0.014 &\pm 0.0000006\end{aligned} \tag{2}$$

and the residuals are listed in Table 2 as $(O-C)_2$.

Table 2: Times of minima of V404 Lyr

HJD	E	Error	$(O-C)_{\rm GCVS}$	$(O-C)_2$	Reference
2449787.5943	19086.5		−0.0657	−0.0011	Agerer & Huebscher (1997a)
2449799.6564	19103		−0.0642	+0.0005	”
2449857.3968	19182		−0.0685	−0.0037	”
2449865.4441	19193		−0.0616	+0.0033	”
2450158.5502	19594		−0.0648	+0.0011	Agerer & Huebscher (1997b)
2450248.4586	19717	±.0001	−0.0627	+0.0035	”
2450346.4006	19851	±.0021	−0.0675	−0.0086	Agerer & Huebscher (1998)
2450379.2939	19896	±.0014	−0.0667	0.0000	”
2450593.4582	20189	±.0011	−0.0696	−0.0021	Agerer & Huebscher (1999)
2450894.6115	20601	±.0007	−0.0660	+0.0026	”
2451299.5501	21155	±.0007	−0.0714	−0.0013	Agerer & Huebscher (2000)
2451308.698	21167.5	±.004	−0.060	+0.0098	Diethelm (2001)
2451312.7094	21173	±.0012	−0.0691	+0.0010	”
2451692.4324	21692.5	±.0005	−0.0724	−0.0010	this paper
2451772.4730	21802	±.0002	−0.0704	+0.0012	this paper

The comparison and check stars were GSC 3121-1597 and USNO 1275-1113 0035, respectively. These stars were standardized as given in Table 3 using our observations on some Landolt-standards located in the SA 113 area (Landolt 1983).

Table 3: Comparison stars for V404 Lyrae

Star	V	$V-I_C$
GSC 3121-1597	11.82	+0.51
USNO 1275-1113 0035	13.53	+0.78

To get the light-curve we used differential photometry. In order to determine the transformation constants for differential photometry, we applied the observations of Messier 67 which were made with the same instrument during January and February, 2000 on three nights by I. Tóth. Using the method described in Henden and Kaitchuck (1982) we got the transformation equations. The V light curve and the $V-I_C$ colour curve are shown in Figs. 1-2. The individual data points are available on the IBVS homepage.

At maximum light the brightness and colour index of V404 Lyr are $V=11.39$, and $V-I_C=0.47$, respectively. In order to estimate the distance modulus we used the method described in Dworak (1975). The interstellar reddening was estimated as $A_V=3.0\times E_{B-V}=0\overset{\rm m}{.}30$ and the E_{B-V} was taken from Chaboyer et al. (1999). The distance modulus is 9.0±1 magnitudes (its error comes mainly from the uncertainty of the inclination) which is significantly smaller than the distance modulus of NGC 6791 (i.e. $13\overset{\rm m}{.}42$, see above). Therefore V404 Lyr is not a member of this cluster.

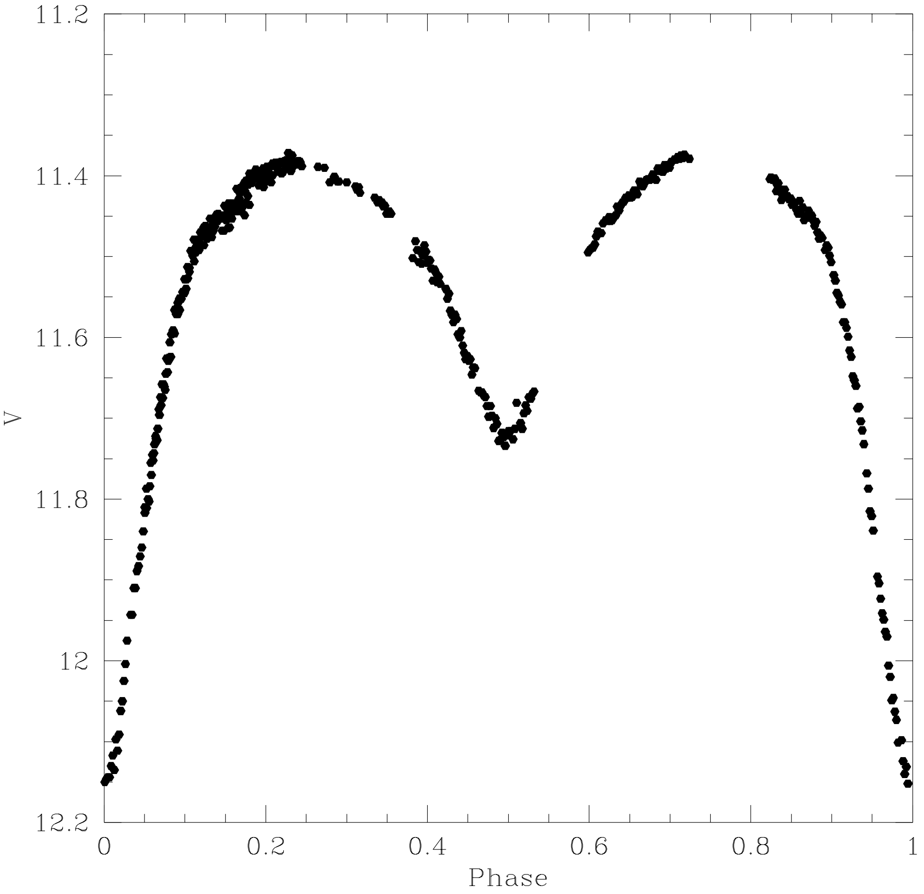

Figure 1. V-light curve of V404 Lyr

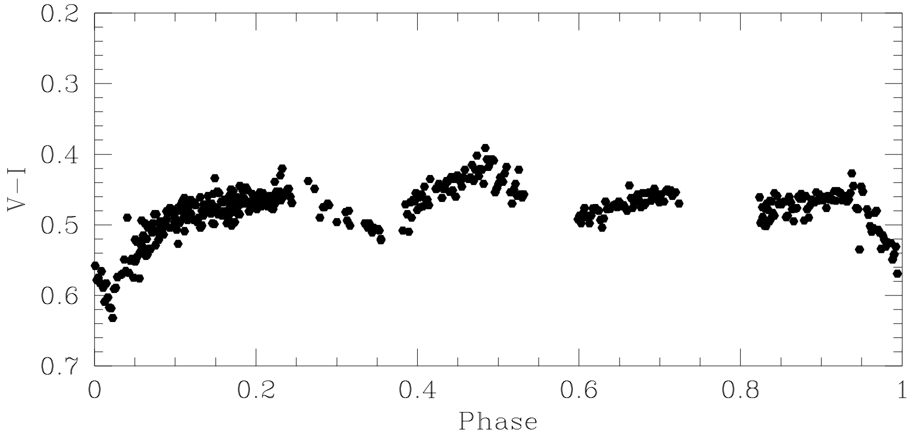

Figure 2. $V - I_C$ colour curve of V404 Lyr. Note that the system is redder at primary minimum and bluer at secondary one

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YY Her — SECONDARY ECLIPSES IN THE SYSTEM REVEALED

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The star YY Her belongs to the classical symbiotic binaries with nova-like outbursts. It was discovered to be a variable by Wolf (1919). On the basis of the next observations (Plaut 1932 and Böhme 1938) it has been classified as an irregular variable. Finally Herbig (1950) described the spectrum in detail and identified it as symbiotic. YY Herculis is a little bit fainter than most of the long-term monitored symbiotic stars, which is the reason that the historical light curve has been covered insufficiently and unhomogeneously so far. The photometric history has been described by Munari et al. (1997b). There have been observed 4 large outbursts and 6 small eruptions since 1890. The last large outburst which appeared in 1993 was studied in detail by Tatarnikova et al. (2000). Munari et al. (1997a) and Munari et al. (1997b) on the basis of analysis of all photometric and spectroscopic data excluded eclipses as the cause of the light variability.

The new photometric observational material presented in this paper was performed with the Newton 180/700 telescope equipped with an originally constructed CCD Camera based on Texas Instruments chip TC 211 and using B (440 nm), V (540 nm), R (680 nm), and I (825 nm) filters for modified Johnson–Kron–Cousins system. The magnitudes of the comparison stars for CCD photometry were obtained through the calibration on the basis of the standard stars published in Landolt (1973, 1983, 1992). The observations were secured from July 2, 1995 till November 29, 2000. All data are collected in Table 1 and are depicted in Figure 1. The observational errors do not exceed $0\overset{m}{.}03$ for B, $0\overset{m}{.}02$ for V, and $0\overset{m}{.}01$ for R and I colours, respectively.

There are three deep minima and one smaller drop (may be two) of the brightness evident on the light curve in all four colours. Despite a certain mismatch between the times of deep minima and ephemeris published by Munari et al. (1997b) the mutual distance of the minima suggests their connection to the orbital period. Since the drop of the deep minima in B colour reaches one magnitude, the heating effect proposed by Munari et al. (1997b) could not be invoked to explain the variation (Skopal 1996). Smaller minima, clearly visible at our light curves (Figure 1) were not mentioned yet in the literature.

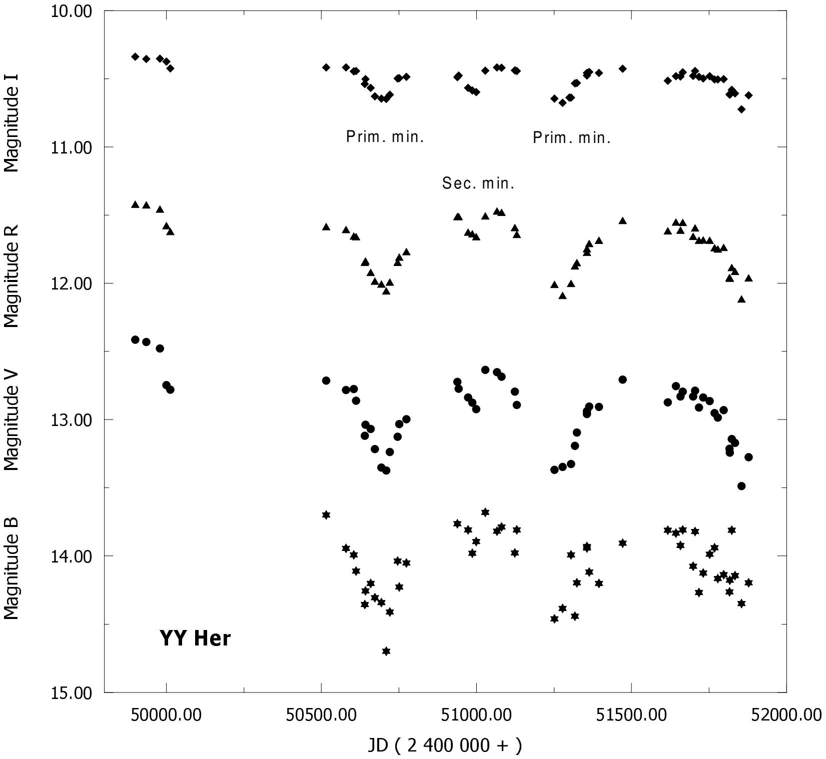

Figure 1. CCD light curves of YY Herculis in *B*, *V*, *R*, and *I* colours. Primary and secondary minima are marked

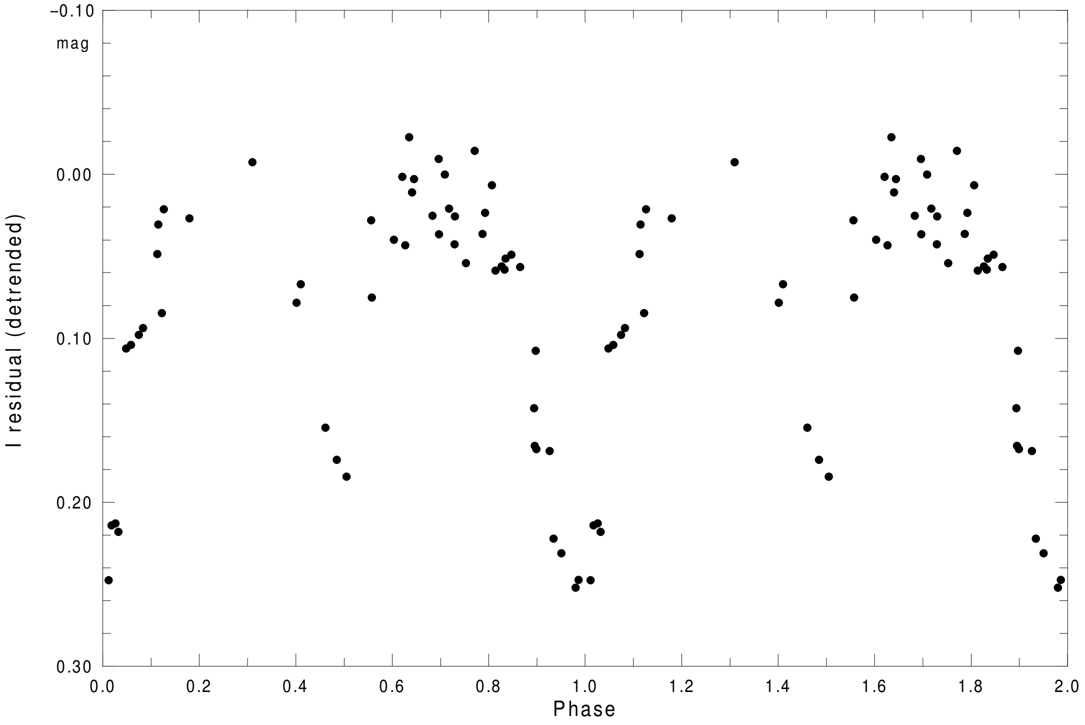

Figure 2. Phase diagram of YY Her in *I* colour

Table 1: CCD photometric observations of YY Herculis

$\mathrm{JD_{hel}} - 2400000$	B_c	V_c	R_c	I_c	$\mathrm{JD_{hel}} - 2400000$	B_c	V_c	R_c	I_c
49899.4157	‘*’	12.42	11.43	10.34	51123.2626	14.00	12.80	11.60	10.44
49935.3954	‘*’	12.43	11.43	10.36	51130.2594	13.81	12.89	11.65	10.44
49979.3559	‘*’	12.48	11.47	10.35	51250.6112	14.46	13.37	12.02	10.65
50000.3220	‘*’	12.75	11.59	10.37	51277.5430	14.39	13.35	12.10	10.68
50012.3261	‘*’	12.78	11.63	10.42	51299.4134	‘*’	‘*’	‘*’	10.64
50515.6262	13.70	12.76	11.59	10.42	51304.4071	13.99	13.33	12.01	10.64
50579.4392	13.94	12.78	11.61	10.42	51317.4335	14.44	13.19	11.88	10.53
50604.4002	13.99	12.78	11.66	10.45	51323.4164	14.20	13.10	11.86	10.53
50611.4272	14.11	12.86	11.67	10.44	51355.4073	13.93	12.96	11.78	10.48
50639.4201	14.36	13.12	11.86	10.54	51356.3779	13.94	12.94	11.76	10.46
50641.4184	14.26	13.04	11.84	10.50	51363.4100	14.12	12.91	11.72	10.45
50658.3890	14.20	13.07	11.93	10.57	51394.3846	14.20	12.91	11.69	10.46
50672.3839	14.31	13.22	11.99	10.63	51471.3315	13.91	12.71	11.55	10.43
50693.3355	14.34	13.35	12.02	10.65	51616.6201	13.81	12.87	11.62	10.52
50708.3134	14.70	13.37	12.07	10.65	51643.5527	13.83	12.75	11.56	10.48
50720.3281	14.41	13.24	12.00	10.62	51657.4787	13.92	12.83	11.62	10.49
50745.2722	14.04	13.13	11.86	10.50	51665.4733	13.81	12.80	11.56	10.45
50750.2660	14.23	13.03	11.82	10.50	51698.4447	14.08	12.83	11.67	10.48
50773.2227	14.05	13.00	11.78	10.49	51705.4399	13.82	12.79	11.60	10.44
50937.4498	13.76	12.72	11.52	10.49	51717.4404	14.27	12.91	11.69	10.49
50942.4581	‘*’	12.77	11.52	10.48	51731.4458	14.13	12.84	11.69	10.50
50972.4199	13.81	12.84	11.63	10.57	51751.4599	13.99	12.86	11.69	10.48
50986.4108	13.98	12.88	11.65	10.59	51767.3990	13.94	12.95	11.75	10.51
50998.4593	13.89	12.92	11.67	10.60	51778.3671	14.17	12.99	11.76	10.51
51028.4116	13.68	12.64	11.51	10.44	51797.3235	14.14	12.93	11.75	10.50
51066.3218	13.82	12.65	11.48	10.42	51815.2950	14.26	13.21	11.97	10.61
51080.3115	13.79	12.69	11.49	10.42	51817.2966	14.18	13.24	11.97	10.62

All data were taken at the Beluša Private Observatory

Therefore we performed detailed period analysis of all data accessible to us. Our new data were supplemented by older data secured in the frame of the international campaign of long-term monitoring of symbiotic stars (Hric and Skopal 1989) at the Kryonerion, Skalnaté Pleso and Wroclaw observatories. Moreover the *UBV* photoelectric photometry published by Munari et al. (1997a,b) and Tatarnikova et al. (2000) as well as *IR* photoelectric photometry by Munari et al. (1997b) were adopted.

We removed the stages of activity from the data, determined zero points for particular observatories and detrended the data due to unmonotonous decline after the outburst in 1993. Such reduced data have undergone in the detailed period analysis. We found in the data a very pronounced period around 587 d as well as its half value in all the five colours. On the basis of the results we can explain the deep minima in the sense of the eclipses of the hot component by the cool giant. We tried to explain the secondary minima by pulsation of the cool giant like in our previous papers for AG Dra (Friedjung et al. 1998, Petrík et al. 1998 and Gális et al. 1999). Such explanation is not very probable for YY Herculis because the secondary minima are relatively narrow, quite deep and they appeared exactly in the middle between two primary minima.

The most probable explanation of the secondary minimum is the eclipses of the cool giant by the circumstellar envelope around the hot component. When discussing the light curve shape it is necessary to mention the distinctive features on the smooth light curve running. The abrupt drop of brightness at orbital phase 0.88 as well as the rise of brightness at orbital phase 0.12 can be explained by the eclipse of the white dwarf in the system. The next drop in brightness at phase 0.94 is probably due to eclipse of the bright spot. The striking rise of brightness at orbital phase 0.55 and consecutive short-term variations (flickering) is probably connected with bright spot appearance. Moreover we have information about a circular orbit from the position of secondary minima. For better understanding of the particular features see Figure 2.

For determination of the times of primary minima we have selected the best covered minimum in V colour during the period of JD 2450500–2450937. As a result we can present the ephemeris of primary minima as follows:

$$\mathrm{JD(I)}_{\mathrm{min}} = 2450701\overset{\mathrm{d}}{.}6 \pm 1^{\mathrm{d}} + 587\overset{\mathrm{d}}{.}54 \pm 0\overset{\mathrm{d}}{.}5 \times E.$$

We can summarize, that the secondary minima were revealed in this study and they are prescribed to the eclipses of the cool giant by the envelope around the hot component. Moreover, the confirmed existence of the primary minima agrees with the suggestion mentioned by Tatarnikova et al. (2000).

We have to emphasize that for confirmation of our model it is inevitable to cover the light curve at least in phase interval 0.25–0.65 during this observational season. We would like to call up an observational campaign dedicated to this object by the method of photoelectric or CCD photometry in $UBVRI$ colours. In order to cover the secondary minimum short observations are desirable with one-week frequency. There is a strong suspicion for the rapid variability (flickering) after the orbital phase of 0.55 (mid of October 2001). For the purpose of flickering activity study it is necessary to obtain few-hours data per night in any colour, most preferably in U and B. Charts with comparison stars are available in electronic form as ps files upon request (via e-mail) from the authors. We would like to ask the participants of this campaign to send the observational data in electronic form in the format of Heliocentric Julian Date and the corresponding magnitude.

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ACCURATE POSITIONS OF VARIABLE STARS IN THE WESTERN PART OF THE LARGE MAGELLANIC CLOUD BAR

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Three catalogues of variable stars in the Large Magellanic Cloud have been published recently (Grison et al., 1995, Alcock et al., 1997, Udalski et al., 1999). They are based on observations with CCD detectors for gravitational lensing experiments. Analogous work of Hughes (1989) was performed on the base of photographic observations in the LMC. In these catalogues, besides photometric data, equatorial coordinates of variable stars are given. The authors of the three cited papers used observations carried out with Schmidt telescopes or the Digitized Sky Survey (DSS) to determine the positions of stars. DSS is also based on observations with Schmidt telescopes. Such star positions can contain systematic errors of 0.6–0.7 arcsec (Udalski et al., 1999, Udalski et al., 1998).

In order to facilitate the procedure of position determinations, we have compiled a catalogue of reference stars in the western part of the LMC bar. This catalogue contains accurate positions of 436 stars in the Tycho frame (Høg et al., 1998), the positions are given in the electronic Table 1 (5047-t1.txt). It constitutes a reference net with the mean density of 200 stars per square degree in the bar area and can be a reference catalogue for accurate position determinations with CCD detectors. The overwhelming majority of stars (405) in this catalogue are Harvard variables (Hodge and Wright, 1967). Other stars are 18 Dublin variables (Butler and Wayman, 1974) and 7 variables discovered by Kurochkin et al. (1989). Several reference stars in our catalogue are not variables. Why variable stars were chosen as reference ones? The variables with good history are the best studied objects in the LMC (finding charts, photometry, positions and so on). Therefore we can easily identify them and compare our coordinates with those in other catalogues. Moreover, position determinations for variable stars in the modern reference frame would be useful.

We had at our disposal a number of plates of the LMC taken with two telescopes, the double meniscus astrograph AZT-16 ($F = 207$ cm, $D = 70$ cm, field $5^\circ \times 5^\circ$) at Cerro Roble Astronomical Station and the 1-m reflector ($F = 712$ cm, field diameter 2.5°) at Las Campanas Observatory, both in Chile. Unfortunately it was impossible to measure the plates of the 1-m reflector because of their large size exceeding the maximum size of a plate which we can measure using our ASCORECORD measuring machine. We have prepared contact film copies of these plates and measured them instead of the plates. The 1-m reflector has a high resolution. So two faint stars at a distance of 2 arcsec are seen apart. However, the images of Tycho reference stars (10^{m}–12^{m} in B) are too large on the plates of the reflector and cannot be measured accurately. Thus we cannot determine accurate star positions in the Tycho frame using these plates directly.

On the other hand, the astrograph is very suitable for such a procedure. It has a large field without any distortion. The images of Tycho stars on the astrograph plates are well measurable. However, the astrograph has a short focal length, therefore additional errors appear in star positions because of star crowding if we deal with such areas as the LMC bar. Let us consider briefly this problem.

Many stars of the LMC bar look on the plates as complex images consisting of two or more very close components. The distances between them are smaller than the image size on the astrograph plates because of the short focal length. If the plates are photographed in different observing conditions, such as differing spectral bands, different exposures, brightness changes due to variability, the complex image looks variously on different plates. After measurements of such plates, we shall get various positions for stars with complex images. The coordinate differences for the double meniscus astrograph can exceed the typical position error by a factor of 3 or even more. As a measure of star crowding influence upon the derived coordinates, we use two values, R_ξ and R_η, of coordinate ranges

$$R_\xi = \xi_{\rm max} - \xi_{\rm min}, \qquad R_\eta = \eta_{\rm max} - \eta_{\rm min},$$

where ξ, η are the standard coordinates, derived from measurements of m plates, $\xi_{\rm max}$ and $\xi_{\rm min}$ are maximum and minimum coordinates of a star among these m values (similarly for the η coordinate).

The typical position error for the double-meniscus astrograph is 0.2 arcsec. We had 3 measurable astrograph plates (2 in B and 1 in V band) and got 3 values of right ascension and declination for each star. The values R_ξ and R_η varied from zero to 1 arcsec and more. To use the best properties of both telescopes, we have applied a two-stage reduction method. At the first stage, the so-called "first determination", we measured three plates of the astrograph, derived the equatorial coordinates of variable stars and the values R_ξ and R_η. We assigned that there were no significant systematic errors because of crowding in the positions of stars with R_ξ, R_η of 0.5–0.6 arcsec and less, as these values also included errors of measurements. Therefore we regarded the positions derived in the first determination with R_ξ, R_η less than 0.65 arcsec as final ones, as the maximum range exceeds the mean-square error approximately four times for variates.

All measurements in the first determination were subdivided into 8 series. In each series, we used 20–25 reference Tycho stars for determinations of plate constants and equatorial coordinates of 50–60 variable stars. Turner's linear method was used for transformation of the measured coordinates to the reference frame. Mean deviations of the measured and the Tycho positions were 0.2–0.3 arcsec. If we know the mean values of R_ξ, R_η for some stars, we can estimate the values of standard errors σ_ξ, σ_η (Smirnov and Dunin-Barkovskij, 1969). For 266 variable stars having, in the first determination, R_ξ, R_η less than 0.65 arcsec, these values and their 98% confidence regions are, in arcsec,

$$\sigma_\xi = 0.20 \quad \text{(conf. reg. 0.19–0.22)}; \qquad \sigma_\eta = 0.18 \quad \text{(conf. reg. 0.17–0.20)}.$$

These stars are denoted in the 4th column of Table 1 as 'DMA'.

37% of the catalogue stars had, at this stage, at least one value of R_ξ or R_η in excess of 0.65 arcsec because of the crowding effect. The coordinates of such stars have been redetermined at the second stage. For this purpose, we measured film copies of two plates taken with the 1-m reflector in B and in V bands. At this stage, the variable stars with R_ξ, R_η less than 0.4–0.5 arcsec were used as reference ones. The influence of star crowding in this case was less than at the first stage because of the long focal length of the reflector, accordingly the ranges R_ξ, R_η were usually 0.1–0.2 arcsec. The standard errors σ_ξ, σ_η of variable stars coordinates at the second stage are 0.1 arcsec. Such values are typical for the telescope of 7 m focal length and confirm the possibility to use the film copies instead of the original plates. These stars are denoted in the 4th column of Table 1 as '1 m vs'.

Some variable stars formerly regarded as single ones have proved visual doubles, with a typical distance between their components of about 2 arcsec. If we cannot indicate the variable star in such a pair, we give the coordinates of both components.

It is impossible to form a reference frame consisting of variable stars around a star situated at the edge of the area covered by the catalogue. Around each of such stars, a second reference frame containing 7–9 nearest field stars in a small area, not more than $10' \times 10'$, was formed . The coordinates of the secondary reference stars were determined by means of the same procedure as that used in the first determination, *i.e.* three astrograph plates were measured. We have determined the positions of 26 variable stars using such small reference frames. These stars are denoted in the 4th column of Table 1 as '1 m fs'.

The catalogue now presented is not uniform in the sense of positional accuracy. The most accurate positions are those for stars with images remeasured on the reflector plates. Their accuracy is 0.1 arcsec, but this value shows only that there is a good agreement of two individual positions. In reality, there are systematical errors in these positions, at least because of the magnitude equation.

Using our catalogue, we have estimated the accuracy of the positions in the GCVS Volume V and in the OGLE catalog (Udalski et al., 1999). The accuracy of the first catalog is 0.4–0.9 arcsec in the LMC bar, but there are systematic errors of 0.3–1.1 arcsec. These values have been derived from the comparison of 403 star positions in our catalogue and in GCVS one like as described further for the OGLE catalogue. The comparison of our catalogue with the OGLE catalogue has been carried out using 196 stars in common. We divided them into 14 groups (14 star in each group) in right ascension direction and calculated, for each group, the mean coordinate differences between the two catalogues. These mean values we regarded as systematical differences between the two catalogues for 14 discrete values of right ascension. They depend on coordinates and change from 0.3 to 0.6 arcsec and from 0.0 to 0.3 arcsec in right ascension and declination respectively. The authors of the OGLE catalogue wrote about a possible systematic error about 0.6 arcsec due to the reduction procedure using the DSS as the reference means. We believe that the cause of the systematical differences is the complex distortion of Schmidt plates the DSS was based on, as the double-meniscus astrograph has no distortion and our measurements of the reflector plates were corrected for third-order distorsions.

We identified EROS, MACHO and OGLE variables using the coincidence of their coordinates only. The coordinates of any star in these catalogues differed from those in our catalogue not more than by 1 arcsec. Some Cepheids in close pairs were identified using OGLE positions.

The analysis of the coordinate differences depending on right ascension only made us to reject our assumption that there were no significant systematic errors because of crowding in the positions of stars with small values of R_ξ, R_η. We have found some stars with small values (0.3–0.4 arcsec) of R_ξ, R_η but with significant deviations (to 0.3–0.4 arcsec) of our positions from the OGLE ones, after accounting for the systematic differences between these catalogues. Therefore we have redetermined the positions of 34 such stars previously determined using the plates of the astrograph. We have remeasured their images on the plates of the 1-m telescope and have achieved a significant decrease of the position differences with the OGLE catalogue. Thus, the small values of R_ξ, R_η in the first determination do not signify that there is no noticeable error (to 0.4 arcsec) because of star crowding in the positions of such stars. Note that the OGLE catalogue was based on observations with a telescope of more than 12 m focal length, therefore the influence of star crowding was significantly less than in the case of the double meniscus astrograph. Having discovered this fact, we have decided to improve our catalogue by redetermining the position of those stars. These are the stars denoted in the 4th column of Table 1 as 'DMA'. For this end, we have to measure the plates of the 1-m telescope.

However, while working on this project, it would be reasonable to publish the first version of our catalogue, which has been created in the most modern reference frame and is free from systematic errors inherent to those catalogues which are based on observations with Schmidt telescopes.

The catalogue presented consist of two parts: a table of coordinates with identifications and plate information and remarks to individual stars. This file is supplementing the IBVS publication and can be retrieved electronically from the IBVS website as well as from http://astrometric.sai.msu.ru/.

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RECLASSIFIED AND NEW VARIABLES IN THE ARCHIVAL HARVARD COLLEGE OBSERVATORY LMC PHOTOMETRY

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In 1960, Cecilia H. Payne-Gaposchkin and Sergei Gaposchkin initiated the task of studying the variable stars in the Magellanic Clouds, by analysing the photographic material collected on these small galaxies by the Harvard College Observatory (HCO) since the end of the 19th century. Their task entailed the identification and characterization of 3806 variables, most of them Cepheids. Lists of these variables were published in three summary catalogues (Payne-Gaposchkin and Gaposchkin, 1966; Gaposchkin, 1970; Payne-Gaposchkin, 1971).

Original brightness estimates were never published and lost for several years. Fortunately, thanks to Dr. Douglas Welch, the assistance of Dr. Martha Hazen of Harvard College Observatory, and the efforts of the members of the Royal Astronomical Society of Canada, Hamilton Centre, and of the Hamilton Amateur Astronomers, a fraction of these original photographic measurements were retrieved, converted into electronic format, and made public on the Internet at http://physun.physics.mcmaster.ca/HCO/. Photographic measurements are listed in the form of arbitrary brightness steps relative to comparison stars versus Julian Day, but they are sufficient to search for periodicities and compute light curves.

In the electronic format list, under 300 stars in the LMC are labeled as unknown type variables. After consulting the catalogues by Payne-Gaposchkin and Gaposchkin (1966) and Gaposchkin (1970), it was found that most of these were labeled as irregular variables. For all these objects, we performed a search on the SIMBAD database and also analysed the photometric data looking for periodicities using the DFT algorithm (Deeming, 1975). We found that 50 of these stars show strong periodicities but were misclassified and do not appear in the SIMBAD database, or remain as misclassified in the subsequent literature.

Results are presented in Tables 1 and 2. Table 1 lists the found Cepheids and Table 2 the eclipsing binary stars and long period variables. For both tables, in the first column is the Harvard Variable number (HV), second and third columns are the observing log for HCO measurements, and the fourth column includes the original variable type according to Gaposchkin (1970). He reported 418 irregular variables in the LMC, which he divided in two groups according to the found photographic amplitude of variation, and named as IN (Irregular Normal, amplitude < 1 mag) and II (Irregular Important, amplitude > 1 mag), we reference these variables as just "Irregular". When a variable is not listed in the LMC and SMC summary catalogues, and does not appear in the SIMBAD database, we fill the entry with a line. In Table 1 the column labeled "Epoch" refers to a maximum light epoch, whereas in Table 2 it indicates a minimum (primary if possible) epoch for eclipsing binary variables, and a maximum one for LPV if given. All epochs are listed in the form JD $-$ 2, 400, 000.0. To derive light curves we divided folded data in 25 bins where datapoints were averaged. Figures 1–4 depicts the averaged folded light curves of the found Cepheids, and Figures 5–7 those of the other variable types in Table 2, all of them in the form of the given arbitrary brightness steps versus phase. Error bars are also represented.

In the columns "Maximum photographic magnitude" and "Amplitude" in Tables 1 and 2 we give the photographic maximum brightness and amplitude as listed by Gaposchkin (1970). Since he did not give any information about the used comparison stars nor the transformation function from arbitrary brightness steps into magnitudes, it was not possible to obtain a reliable calibrated magnitude scale for the folded and averaged light curves.

Table 1: Cepheids

HV	Initial and final observing time: JD $-$ 2, 400, 000.0	N	Original variable type	Period (days)	Epoch	Max. pg. br.	Ampl.	Rem.
2286	12697.847–34748.499	422	Irregular	4.56272	12702.6	15.49	0.71	(1)
2357	13847.841–34748.499	410	Irregular	1.829460	13849.6	16.75	1.12	
2469	13875.807–34748.499	407	Irregular	2.66772	13878.2	16.31	0.44	
2501	13847.841–29203.426	176	Irregular	1.717088	13853.9	15.35	0.80	
2645	13877.808–34748.499	269	—	2.73766	13880.2	—	—	(2)
2655	13875.807–34748.499	277	Irregular	2.65942	13878.2	15.75	1.03	
2887	13876.814–33104.662	103	Irregular	1.891734	13879.3	15.95	0.68	
5712	13847.841–34748.499	458	Irregular	9.2021	13855.4	15.46	0.55	
5721	13847.841–34748.499	429	Irregular	2.82811	13849.5	15.72	0.82	
5773	13875.807–34748.499	399	Irregular	1.694576	13877.2	16.45	1.00	
5779	13875.807–34748.499	403	Cepheid?	25.056	13886.6	16.07	1.18	(3)
5805	12697.847–34748.499	437	Irregular	4.21435	12698.8	15.80	0.32	
5811	13877.808–34748.499	338	Irregular	4.02085	13881.2	16.17	0.90	
5873	13875.807–34748.499	361	—	2.056488	13877.4	—	—	(2)
5890	13847.841–34748.499	398	Irregular	1.937684	13849.9	17.15	0.60	
12034	13875.807–34748.499	498	—	5.83191	13878.6	—	—	(2)
12059	13847.841–34748.499	397	Irregular	2.75024	13849.8	16.71	0.70	
12435	13875.807–33718.266	256	—	4.05659	13877.7	—	—	(2)
12456	13876.814–33154.626	105	Irregular	2.95195	13880.9	17.16	0.34	
12469	13847.841–34748.499	407	Irregular	6.22927	13851.4	16.06	0.60	
12482	13847.841–34748.455	374	Irregular	39.314	13888.3	15.84	0.36	
12543	13876.814–33154.626	107	Cepheid	2.96383	13877.7	16.55	0.80	(4)
12593	13876.614–33178.615	112	Irregular	5.1058	13879.0	15.81	0.63	
12599	13894.749–34458.245	284	Irregular	2.73973	13895.5	16.55	0.73	
12755	13876.814–33154.626	106	Irregular	3.06231	13880.8	16.55	0.82	
12773	13876.814–33104.662	102	Cepheid?	4.0090	13879.3	16.49	0.51	(3)
12778	13875.807–33618.400	72	Irregular	3.07733	13879.4	16.27	1.06	
12786	13876.614–33178.615	100	Cepheid?	2.25383	13876.9	15.95	1.05	(3)
12799	13876.614–33178.615	105	Irregular	2.19124	13878.4	16.27	0.31	
12811	13875.807–34399.267	127	Irregular	4.80176	13880.1	16.88	0.35	
12966	13875.807–34748.499	339	—	2.693701	13876.7	—	—	(2,5)

Table 2: Eclipsing and long period stars

HV	Initial and final observing time: JD − 2,400,000.0	N	Original variable type	Type	Period (days)	Epoch	Max. pg. br.	Ampl.	Rem.
2240	13847.841–34748.499	416	Eclipsing	EA	65.701551	13893.5	14.96	1.33	
2433	12722.865–34748.499	429	—	EB	1.418044	12725.5	—	—	(2)
2595	11623.895–34748.499	450	Irregular	LPV	606.	—	13.03	0.81	
2635	13875.807–34748.499	355	Irregular	?	93.2	—	14.50	1.00	
2659	13875.807–34748.499	413	Irregular	EA/EB	1.919658	13879.6	16.03	0.58	
5703	23681.879–34748.499	458	Irregular	EA/EB	1.984795	12724.1	15.74	1.00	
5816	13847.841–34748.499	458	Eclipsing	EA	5.083092	13848.3	16.57	0.44	(6)
5876	13877.808–34748.499	384	Eclipsing	EB	3.502503	13880.4	16.73	0.44	(7)
11981	13847.841–34748.499	421	Irregular	EA/EB	4.643420	13849.1	17.08	0.71	
12053	13575.807–34748.499	418	Irregular	EA/EB	2.956570	13575.8	14.75	0.60	
12232	13876.814–34399.267	228	Irregular	EB	0.962995	13877.7	15.71	0.98	
12454	13876.814–33154.626	108	Irregular	EA:	3.234030	13879.6	16.18	1.32	
12466	13847.841–34748.499	325	Irregular	EA/EB	1.709208	13849.9	16.55	0.66	
12487	13875.807–34748.455	196	—	EB:	3.747154	13878.9	—	—	(2)
12540	13875.807–34748.499	383	Irregular	LPV	431.8	14052	16.20	0.71	
12597	13875.807–34458.245	430	—	EB	56.26	13930.3	—	—	(2)
12598	13875.807–34458.245	413	—	EB	1.421479	13878.2	—	—	(2)
12801	11627.875–34399.267	226	Irregular	EA	6.332834	11639.1	15.53	0.93	
12958	13922.617–33678.362	302	Irregular	EB:	6.060316	13928.6	15.22	0.78	

Remarks:

(1) Butler (1978) classifies this object as a Cepheid with an uncertain period of 2.7510 days.
(2) This object is not in the summary catalogues by Payne-Gaposchkin (1971) and Gaposchkin (1970) neither appears in SIMBAD database.
(3) Gaposchkin (1970), labeled this object as an uncertain Cepheid. He did not give a period.
(4) Gaposchkin (1970) indicates that this object is a Cepheid, but he does not give a period.
(5) Uncertain variable according to Hodge and Wright (1966).
(6) Characterized by Payne-Gaposchkin (1971) as an eclipsing variable with a period of 3.388762 days.
(7) Characterized by Payne-Gaposchkin (1971) as an eclipsing variable with a period of 1.270806 days but somewhat uncertain due to data scatter.

The periods in Table 2 for the eclipsing binary variables were not directly obtained from the DFT analysis. This algorithm was implemented in our AVE software for photometric data analysis (Analisis de Variabilidad Estelar, or Stellar Variability Analysis), which allowed to compute the DFT, visually identify the peaks of the transformed data, and automatically display folded light curves for the selected periods. Inspection of light curve morphology indicated if photometric data had to be folded with a double period in the case of eclipsing binaries, which could also be done automatically by the software.

We performed a consistency check for the newly found Cepheids. A P–L diagram was plotted using the data in Table 1, including a list of photometrically observed LMC Cepheids by several authors compiled by Madore (1985) covering a wider range of periods. Average B apparent magnitudes for 26 of the 31 new Cepheids were estimated by adding to the available maximum brightness photographic magnitudes in Table 1, half of the variation amplitude also listed in the same table. Figure 8 illustrates the results. 23 of these match the short period end of the P–L diagram except HV 5779, HV 12482, and HV 2501. HV 5779 and HV 12482 lay about 2 magnitudes below the P–L line, suggesting that they might be Population II Cepheids. The case of HV 2501 is more uncertain, perhaps it is a distant Milky Way interloper, or even not a Cepheid variable. (The uncertainties of the photographic magnitudes might also contribute to the derivations.)

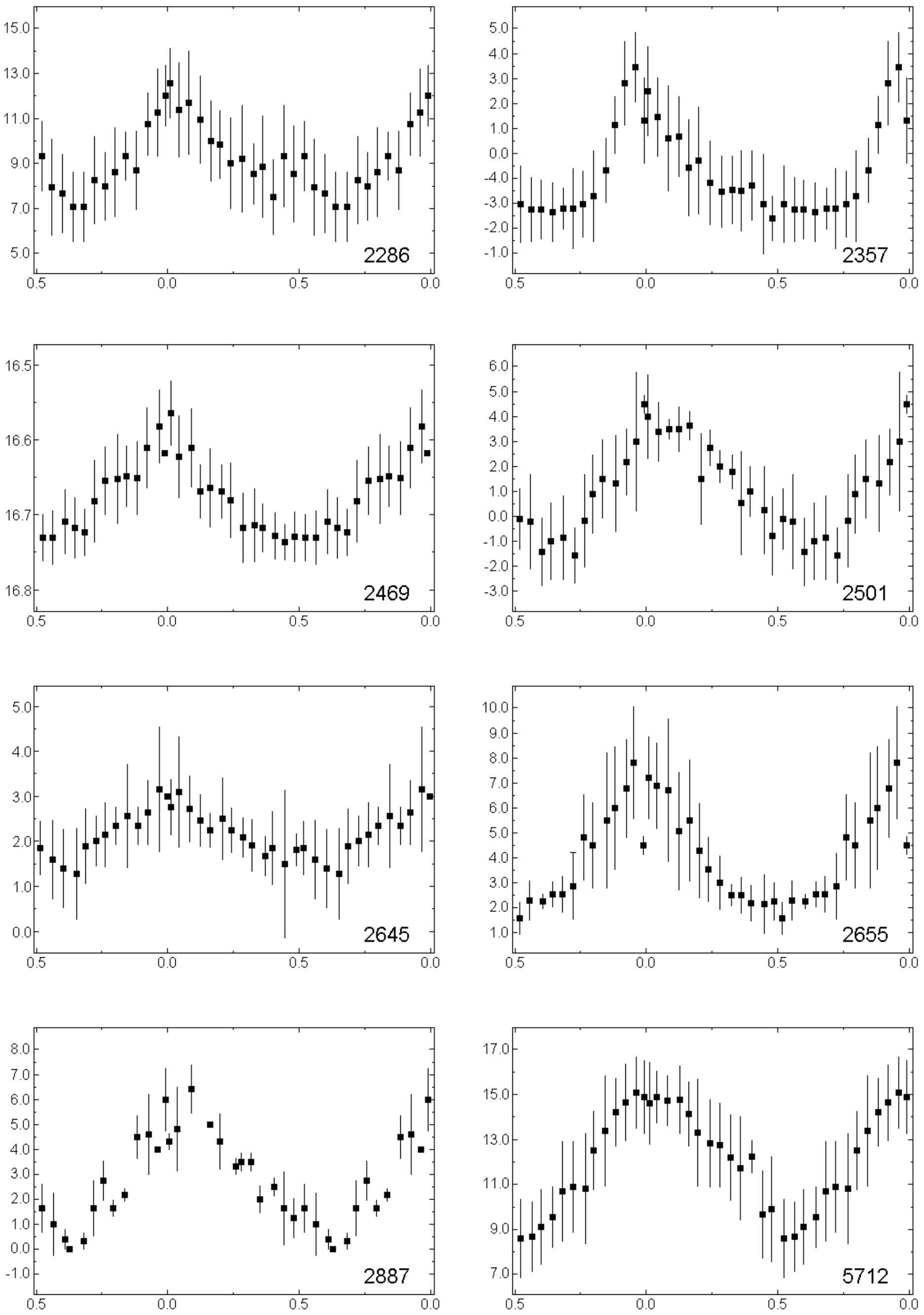

Figure 1. Folded light curves of the newly found Cepheids listed in Table 1

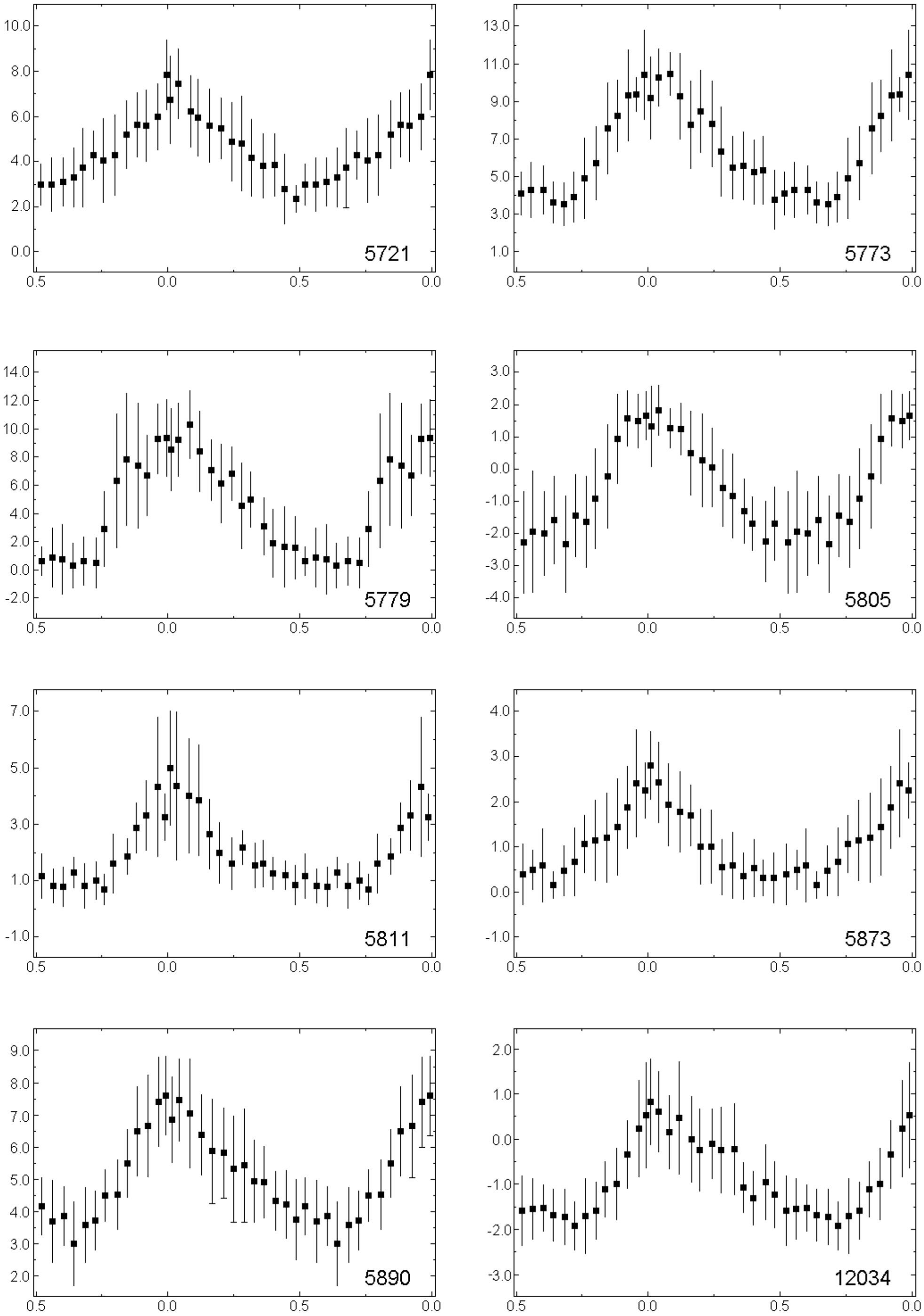

Figure 2. Folded light curves of the newly found Cepheids listed in Table 1 (cont.)

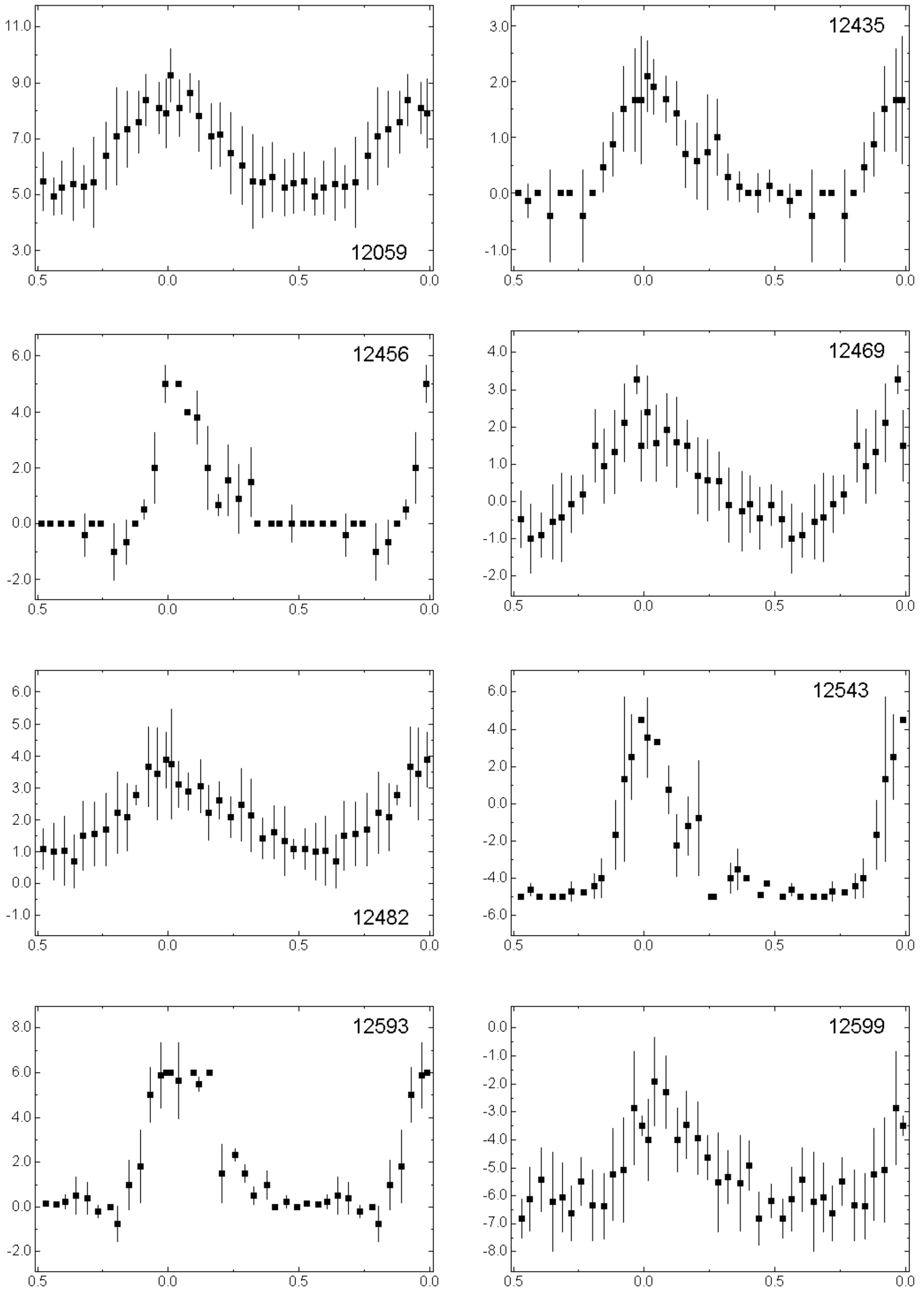

Figure 3. Folded light curves of the newly found Cepheids listed in Table 1 (cont.)

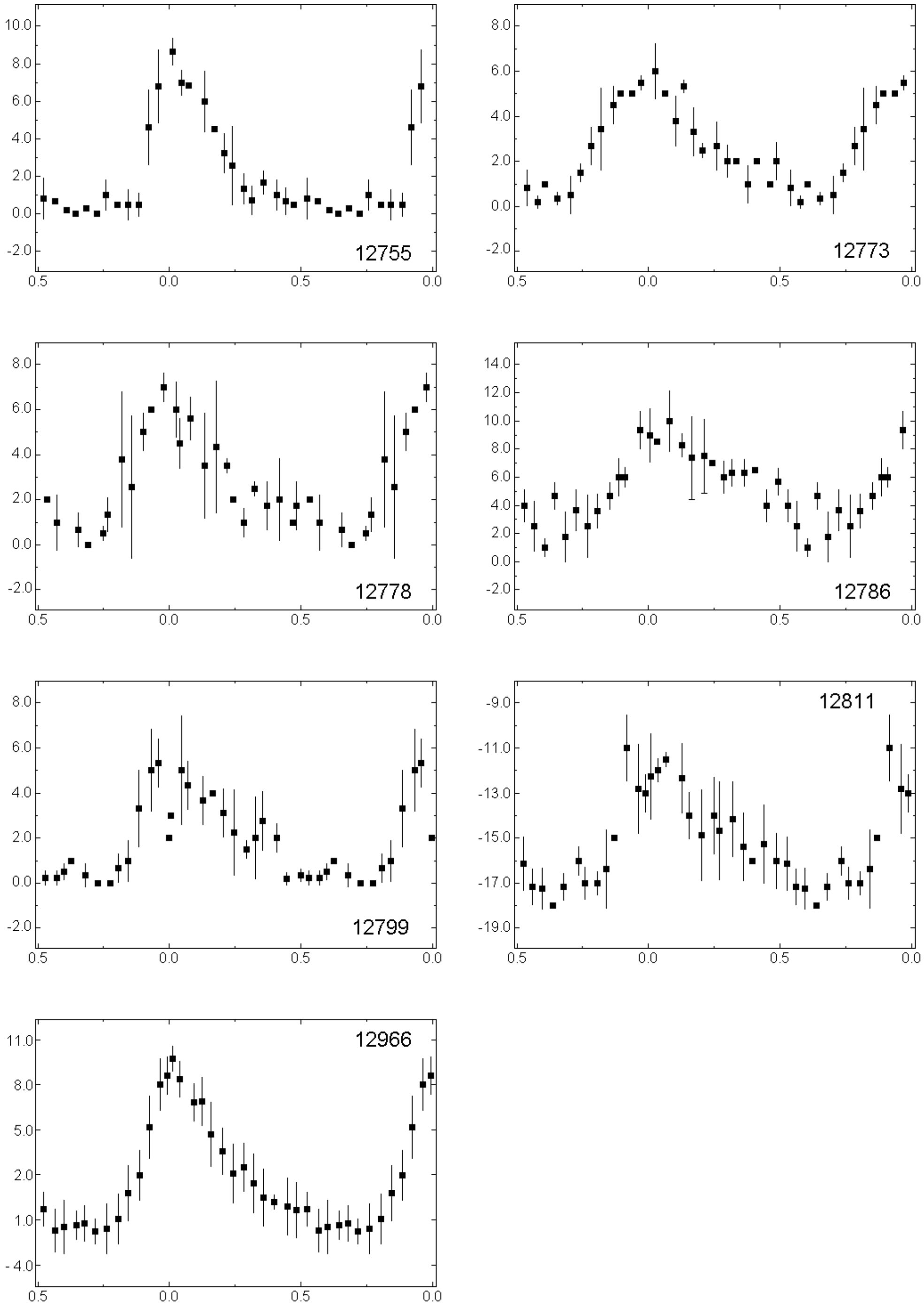

Figure 4. Folded light curves of the newly found Cepheids listed in Table 1 (cont.)

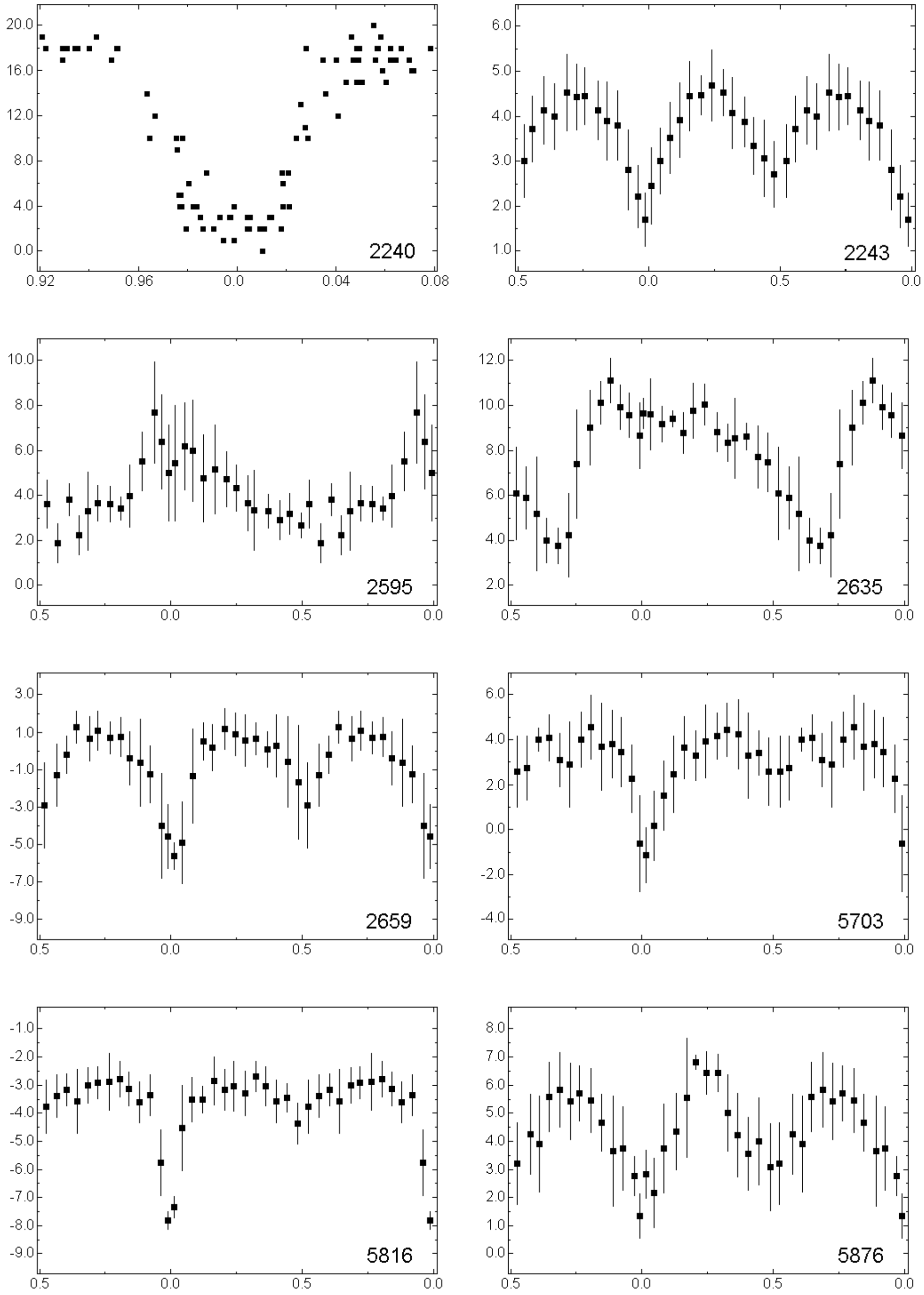

Figure 5. Folded light curves of eclipsing binary stars and other variables listed in Table 2

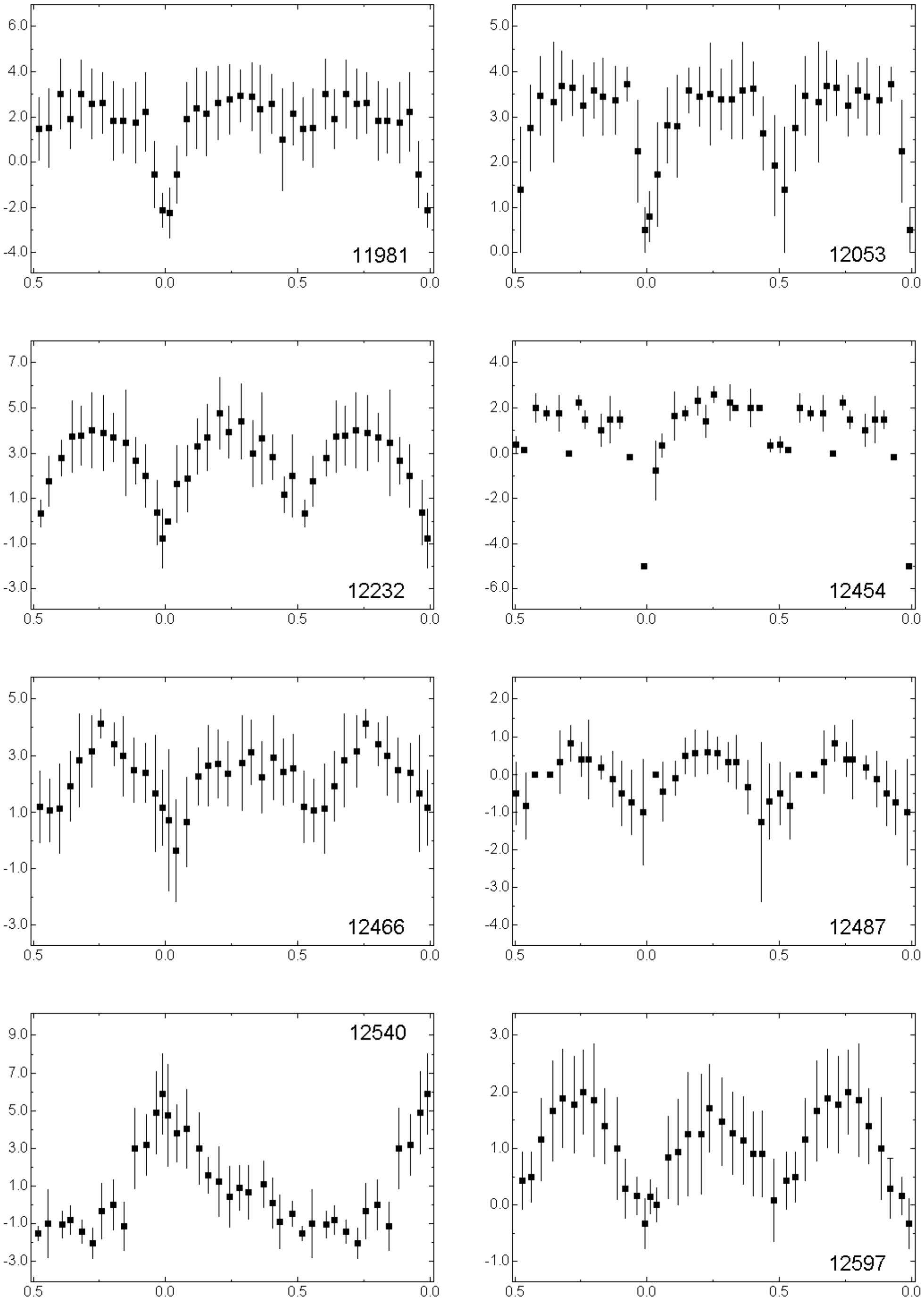

Figure 6. Folded light curves of eclipsing binary stars and other variables listed in Table 2 (cont.)

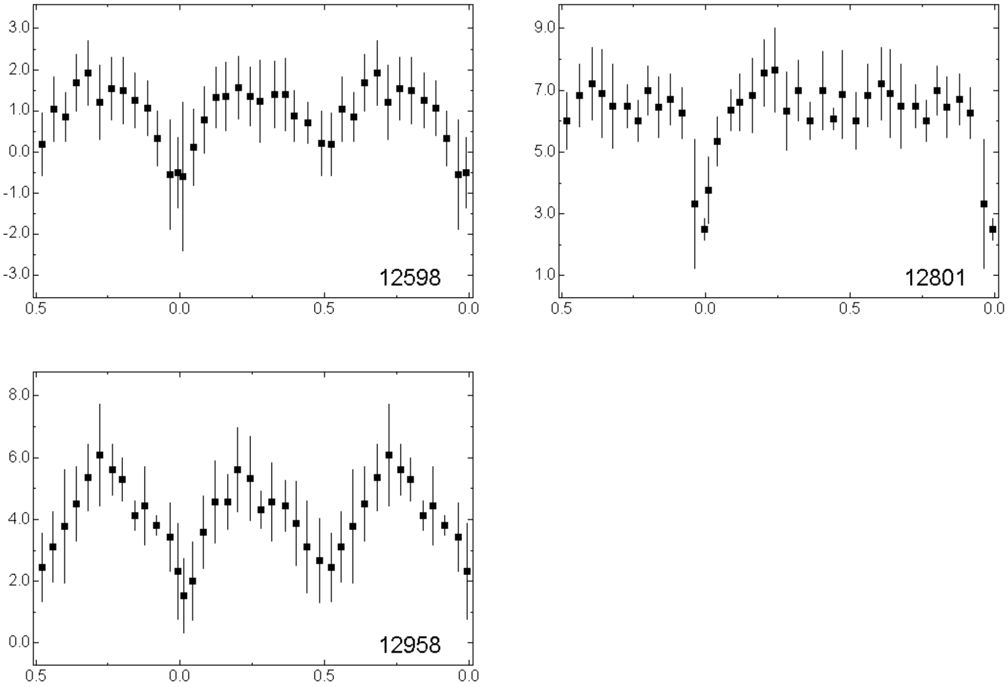

Figure 7. Folded light curves of eclipsing binary stars and other variables listed in Table 2 (cont.)

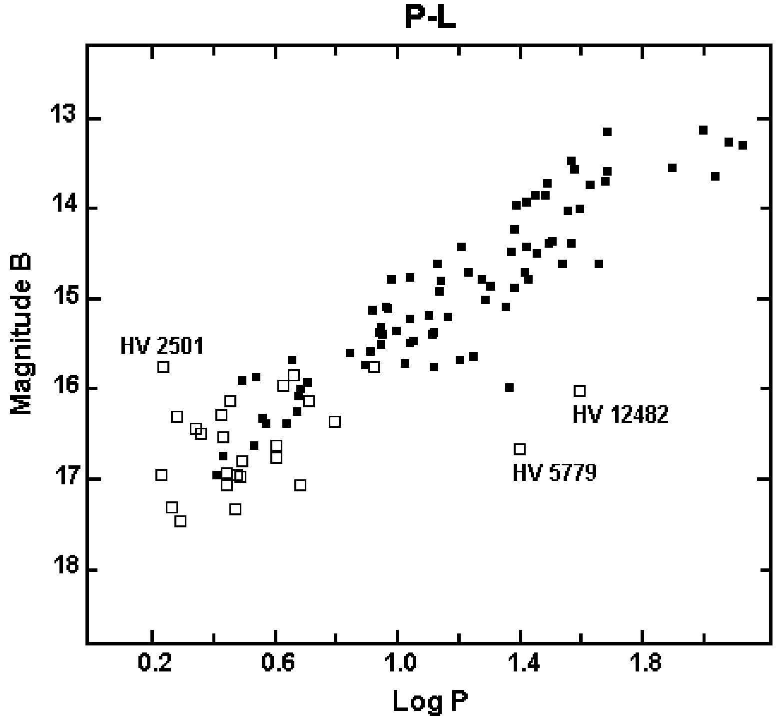

Figure 8. *P–L* diagram where open squares represent Cepheids listed in Table 1 and small solid squares Cepheids compiled by Madore (1985)

In Table 2 is HV 2240. Although this star was correctly characterised by Gaposchkin (1970) and Payne-Gaposchkin (1971) as an eclipsing binary, it is worth mentioning some new information obtained from the original photographic data set. Payne-Gaposchkin (1971) gives a period of 65.724613 days for this variable, but we found that data are better folded with a period of 65.702 days. In Figures 5–7 the light curve of HV 2240 is depicted around phase 0.0 showing that main eclipses are occultations. Butler (1978) supplied B and V data on this star but his photometric observations did not show a complete primary minimum, although they indicated that during the detected eclipses HV 2240 fades at least 2 magnitudes in V, and that the $B-V$ color index changes from 0.14 at maximum light to 0.72 at minimum. Even though the secondary eclipse does not appear in ours or Butler's light curve, these results strongly suggest that the secondary eclipse might be very shallow, and that the 65.7 day period is the real one.

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TWO NEW CONTACT BINARY STARS

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When performing the unfiltered photometric CCD observations of the minor planet (5690) we discovered two new field variable stars in October, 2000. We made follow-up multicolour observations through BVR_C filters of these stars on four nights in December, 2000. In this paper we report the results of these observations. The new variable stars have been named continuing the designation system of Csák et al. (2000b).

The observations were carried out with the 60/90/180 cm Schmidt-telescope of the Piszkéstető Mountain Station of the Konkoly Observatory. The detector was a Photometrics AT200 CCD camera (1536×1024 pixels) giving a $29' \times 18'$ field of view. The reduction of the discovery frames was the same as has been described in Csák et al. (2000a), while in December we made differential photometry relative to selected local comparison stars GSC 3762-0061 and GSC 3762-0231 (Guide CD-ROM Star Chart, 1997). Individual data are avaliable at the IBVS website as files 5049-t3.txt (V31) and 5049-t4.txt (V32).

Due to instrumental difficulties we could not transform the measurements to the standard system, but the light curve shape of the new variables and the lack of colour variations (constant amplitude in every band) suggested that these ones are W UMa type stars. We have got a relatively good phase coverage for both stars so we could do an accurate period search for each stars using the Period98 software (Sperl, 1998). We present the obtained phased light curves in Figs. 1-2. It is notable that both of primary and secondary minima of V32 are total eclipses. It means that the inclination of the eclipsing system should be near to 90 degrees, so – for example – the inclination ambiguity is almost completely exluded from the light curve modelling and stellar mass determination. The basic data of the new variables (celestial coordinates, epochs, periods etc.) are summarized in Table 2. We have collected 13 times of minimum of the stars using low order polynomial fitting for V31 and bisecting chords method for V32. The obtained times of minimum are collected in Table 1.

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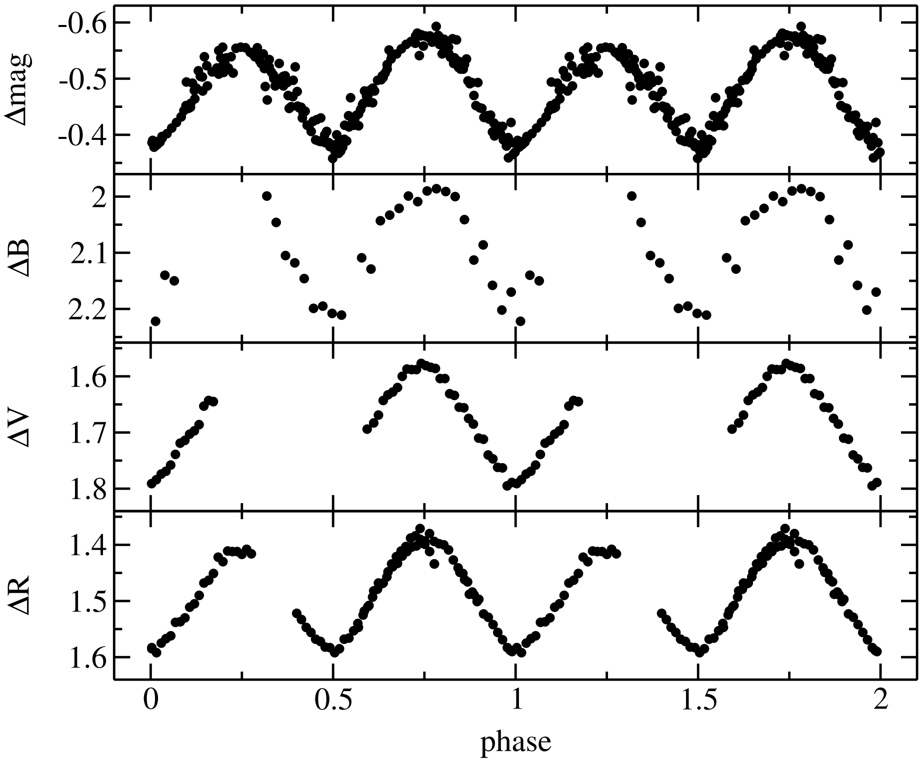

Figure 1. Unfiltered, *B*, *V* and *R* light curves of V31

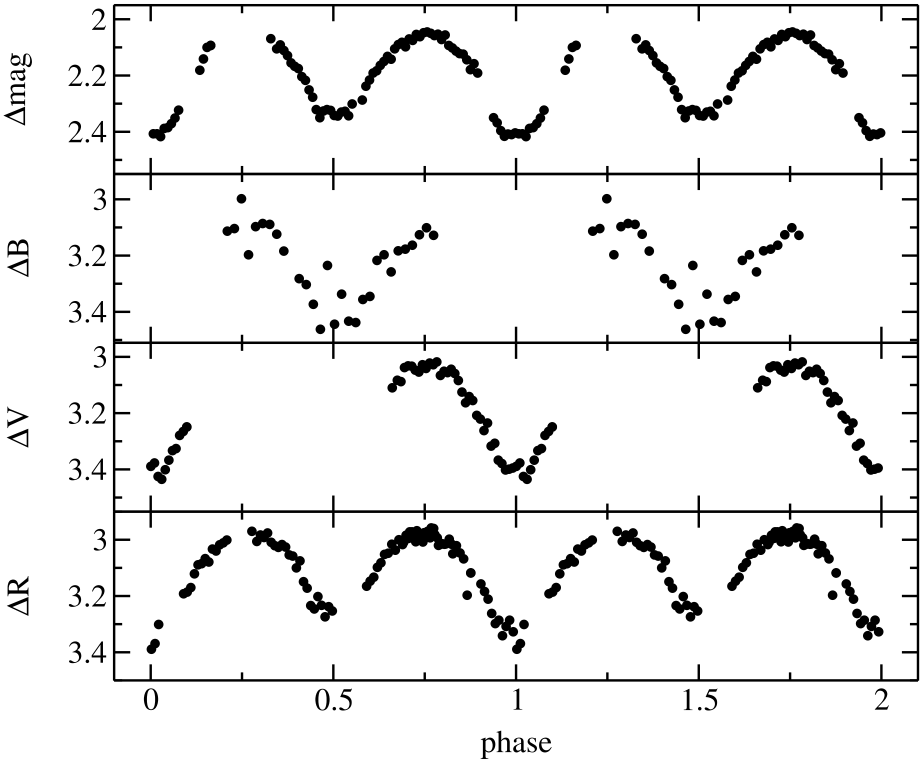

Figure 2. Unfiltered, *B*, *V* and *R* light curves of V32

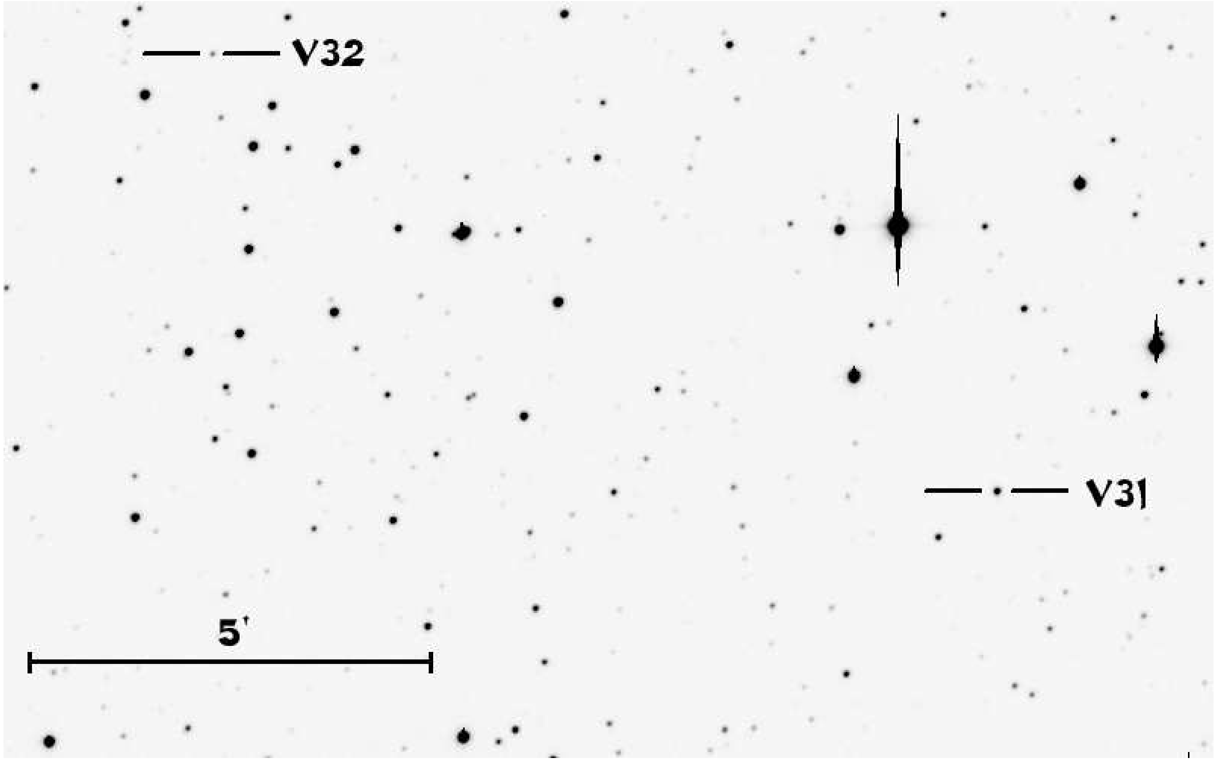

Figure 3. Finder chart for V31 and V32. The center of the frame is $\alpha(2000) = 05^{\mathrm{h}}58^{\mathrm{m}}50\overset{\mathrm{s}}{.}0$, $\delta(2000) = +59^\circ 48' 00\overset{''}{.}0$, North is up, East is to the left

Table 1: Times of minimum for V31 and V32

Star	HJD	Type	Star	HJD	Type
V31	2451830.4310	–	V31	2451883.5383	–
V31	2451830.5730	–	V32	2451880.3732	
V31	2451880.3583	–	V32	2451880.5571	
V31	2451880.4936	–	V32	2451881.2853	II
V31	2451881.3242	–	V32	2451881.4668	I
V31	2451881.4662	–	V32	2451883.4788	
V31	2451883.3975	–			

Table 2: Basic data of the new variables. The coordinates were taken from USNO-A1.0

	V31	V32
R.A. (2000)	$05^{\mathrm{h}}58^{\mathrm{m}}15\overset{\mathrm{s}}{.}56$	$05^{\mathrm{h}}59^{\mathrm{m}}25\overset{\mathrm{s}}{.}69$
Dec. (2000)	$+59^\circ 46' 22\overset{''}{.}46$	$+59^\circ 51' 23\overset{''}{.}95$
Epoch	2451830.4310	2451881.4668
Period (days)	0.276593	0.365721
V magnitude	14.5	16.0
V amplitude	0.2	0.4
Type	EW	EW

References:

Csák, B., Kiss, L.L., Szabó, Gy., Sárneczky, K., Sziládi, K., 2000a, *IBVS*, No. 4875
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ON THE VARIABILITY OF STARS

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In several IBVS contributions, my students, colleagues, and I investigated the Hipparcos photometry (ESA 1997) of stars in the Bright Star Catalogue 5th edition (Hoffleit & Warren 1991) and the Supplement of the 4th edition (Hoffleit et al. 1983). We found the mean amplitude as a function of spectral type. We identified the most variable stars and noted some which should be considered by observers for further study. We discussed the presence of unusually quiescent stars and when space permitted gave lists. By excluding the values from stars whose spurious variability is due to binarity as noted by the Celestia program (ESA 1998), we attempted to give values for single stars. Then by removing values due to stars whose photometric amplitudes based on three years of data were atypically large compared to the mean for the spectral type, we attempted to provide average values for most typical stars. But due to the way they were selected, these average values are thus likely to be smaller than one would find for a randomly selected star of a particular spectral type, especially in the instability strip or for types where a large percentage were primary stars of binary systems.

Figure 1 plots luminosity class vs. Harvard spectral type. It displays mean amplitudes multiplied by 1000, combines the Ia and Ib supergiants, and does not show intermediate type values. To help visualize the least variable stars, I used larger font sizes for smaller amplitudes and for those amplitudes less than $0\overset{m}{.}023$ I used bold face to aid visualization. The data are from: Adelman & Albayrak (1997) for A0–A7 I supergiants, Adelman, Cay, Cay, & Kocer (2000) for the F supergiants and the A II stars, Adelman, Yüce, & Engin (2000) for O and B supergiants, Adelman, Mayer, & Rosidivito (2000) for O9–B5 III–V stars, Adelman, Gentry, & Sudiana (2000) for B6–B9 III–V stars, Adelman, Flores, & Patel (2000) for A0–A2 III–V stars, Adelman (2000c) for A3–F0 III–V stars, Adelman, Coursey, & Harris (2000) for F1–F9 III–V stars, Adelman, Davis, & Lee (2000) for G0–G9 stars, Adelman (2000a) for early K stars, and Adelman (2000b) for K5–M stars. As Hipparcos only obtained stellar photometry for three years, stars with much longer periods are unlikely to have been found to be variable unless their amplitudes are very large. Further the means certainly include some small amplitude variables which remain to be discovered. The average values are based on at least three, but in some cases over 100 values. Almost all of these stars are members of Population I.

The smallest amplitudes ($0\overset{m}{.}015$ to $0\overset{m}{.}022$) are between spectral types A0 and K0. The most pronounced region of least variability is found among the A stars. It is centered at spectral types A0 IV and A0 V, runs to A4 III and A4 IV and then to A6 IV. The classical instability strip occurs in the late A and early F stars. Then there is another less pronounced region of least variability which is centered at F2 III and proceeds to F6 IV and F6 V, then to F9IV and to K0 II. It includes the G6 II stars which have the smallest mean amplitude of $0\overset{m}{.}015$. Many stars with convective envelopes are likely to be long term variables with solar-type dynamos and periods greater than 3 years. In the late B stars, there is a region of not quite minimal variability from B7 III to B9 IV. Near B2 and B3 among the main sequence band stars one can see an increase in amplitude where the β Cep and similar types stars are found.

	O9	**B0**	B1	B2	B3	B4	**B5**	B6	B7	B8	B9	**A0**	A1	A2	A3	A4	**A5**	A6	A7	A8	A9	**F0**	F1	F2	F3	F4	**F5**	F6	F7
I	49	49	49	49	58	58	58	58	58	58	58	52	52	52	52	52	36	36	36	36	36	41	41	41	41	41	41	41	41
II	29	29	29	29	28	28	28	28	28	28	28	36	36	36	36	36	36	29	29	29	29	25	25	25	25	25	25	25	25
III		27	42	55	36	33	32	28	25	26	26	25	25	**22**	23	**20**	**22**		25	**19**	28	25	23	**21**	**22**	28	**21**	25	40
IV		25	33	32	28	30	30	30	30	28	24	**20**	**22**	**22**	**22**	**22**	**22**	**20**	24	23	26	23	28	23	24	29	25	**22**	26
V	42	35	35	32	33	38	32	32	28	25	25	**22**	**22**	23	26	27	24	26	29	28	29	28	26	26	24	23	**22**	**21**	27

	F7	F8	F9	**G0**	G1	G2	G3	G4	**G5**	G6	G7	G8	G9	**K0**	K1	K2	K3	K4	**K5**	K6	K7	**M0**	M1	M2	M3	M4	**M5**	M6	M7
I	41	41	41	23		23	**20**		**22**			30		35	35	35	40	57	60										
II	25	25	25						23	**15**		23		**19**	24	26	27	43	33				83		146	302	493		
III	40	**22**		23		**22**	28	**20**	25	24	23	24	**22**	25	25	27	26	29	35	34	34	43	62	83	126	193	328	478	3120
IV	26	25	**20**	32	**20**	23	**20**		28	**20**		30	25	25	28														
V	27	26	25	25	24	26	24	28	29	**22**	30	25	30	34	44	37	31	40	247										

spectral type

Figure 1. The amplitude of variability as a function of Harvard spectral type and luminosity class. The values are 1000 times the amplitudes in magnitudes

Eyer & Grenon (1997) investigated photometric variability in the HR diagram among all the stars investigated by Hipparcos. For the most part our general conclusions about minimal variability are similar, but some differences are due to the use of different sources for the spectral types. Those stars with composite spectra complicate the analysis. The most important difference is that they believe that the G8 II to G8 V stars are the most stable, but I prefer instead the A stars noted above. This may reflect my experience in studying the magnetic CP stars and being able to more readably exclude them from the sample.

These studies despite their problems still provide useful guidance for selecting appropriate comparison stars for differential photometry. But it is still desirable to investigate the published data, especially the photometry and radial velocities, before using a star as a comparison and even more so as a standard.

To extend such studies, it would be desirable to have a greater consistency of the spectral types. The Michigan Catalogue of Two-Dimensional Spectral Types for the HD Stars (see, e.g., Houk & Swift 1999) when completed will admirably serve this purpose. Further a consistent method of eliminating significant photometric contributions from stellar companions is needed such as the use of multi-filter photometry (see Moro & Munari 2000 for a census of systems) of which the Strömvil system (Straizys, Crawford & Philip 1996) is one of many possible choices and/or spectrophotometry. Finally one has to extend the time span of the observations to at least order 10 years which is difficult using a space mission alone, but might be possible with a network of ground-based telescopes obtaining photometry consistent with that from one or more space missions.

Acknowledgements. SJA wishes to thank the Citadel Development Foundation for their support.

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DISCOVERY OF A SECONDARY SPECTRUM IN THE SB1 SYSTEM HD 434

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Radial velocity variations of HD 434 (HIP 728, BD +27°3, SAO 73772, $m_V = 6.47$) were discovered by Shajn (1951) who also classified the spectrum as A2s. Palmer et al. (1968) classified the star as A4Vm and estimated its $v \sin i = 60$ km s^{-1}. Hube & Gulliver (1985) reported a preliminary orbit based on 38 spectrograms of a reciprocal dispersion 15 Å/mm. Later on, Margoni et al. (1992), using photographic spectra of 42 Å/mm, confirmed the orbital elements. Nevertheless, in the same year Sreedhar Rao & Abhyankar (1992) published the radial velocity curve obtained from 33 photographic spectra (33 Å/mm and the resolution of 0.66 Å) which differs significantly in V_0 and K from that of Hube & Gulliver (1985). They also speculated about a secondary spectrum and concluded that the secondary component should be at least $1\overset{m}{.}5$ fainter in the visible so that it was not seen in their and previous spectra. CCD observations were called for.

Our spectroscopic observations were carried out with the 2-m RCC telescope of the Bulgarian National Astronomical Observatory in the frame of our observational program on Am-stars in binary systems. Photometrics AT200 camera with a SITe SI003AB 1024 × 1024 CCD chip, (24 μm pixels) was used in the Third camera of the coudé spectrograph to provide spectra in two different spectral regions 100 Å wide and centered on 6440 Å and 6720 Å with $R = 32000$. The typical S/N ratio is 250–350. Wavelength calibration has the r.m.s. error of 0.005 Å. IRAF standard procedures have been used for bias subtracting, flat-fielding and wavelength calibration. Telluric lines have been removed using spectra of hot, fast rotating stars. Rectification, equivalent widths and radial velocities were measured using the EQWREC2 code (Budaj & Komžík 2000). The log of observations is listed in Table 1.

Table 1: List of observations, HD 434

Date	HJD (2400000 +)	Region [Å]
03.01.2001	51913.1625	6667–6770
04.01.2001	51914.1977	6389–6492

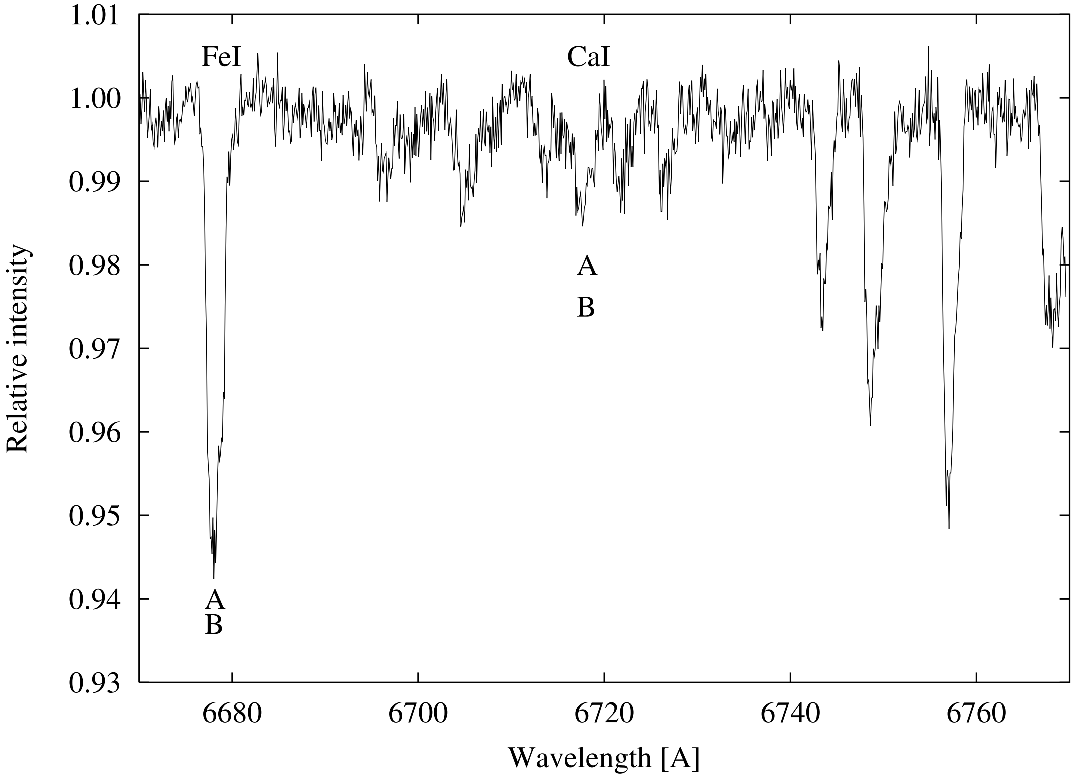

Figure 1. HD 434, phase = 0.97. Both components are mixed

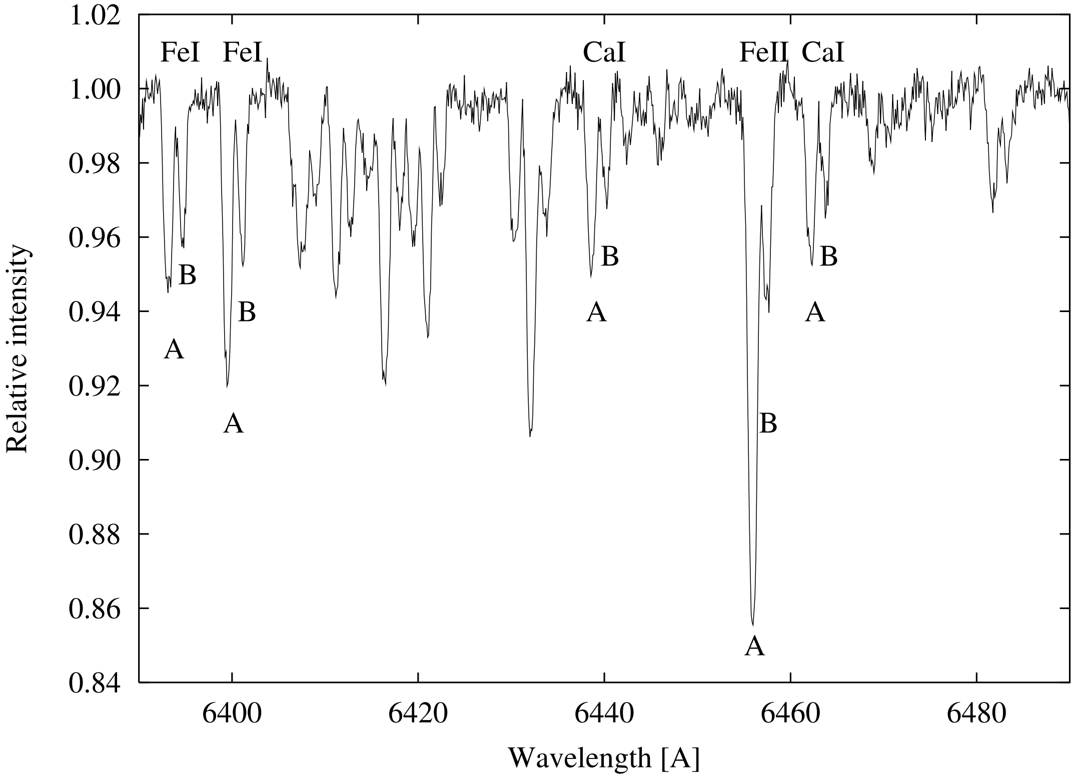

Figure 2. HD 434, phase = 1.00, next day. Both components are clearly resolved

The secondary component lines are not seen in our first spectrum of HD 434 (orbital phase 0.97, Fig. 1) (phases were computed following the ephemeris

$$T = 2447186.26 + 34\overset{\text{d}}{.}25999 \times E,$$

(where T is the time of periastron passage) given by Sreedhar Rao & Abhyankar (1992)). However, a clear secondary spectrum was observed next day (orbital phase 1.00, Fig. 2) although the orbital period is quite long. It appeared due to the high eccentricity of the orbit ($e = 0.41$). From the ratio of equivalent widths of the Ca I 6718 and Fe I 6678 lines, ([Ca/Fe] = 0.27), we can infer that at least the brighter A component has strong Am peculiarity. This ratio is about 0.9 for normal stars but can be as low as 0.2 for the strongest Am stars (Boesgaard 1987, Burkhart & Coupry 1989, 1991, 1997, Iliev et al. 1998). The spectrum obtained at phase 1.00, with clearly separated lines of components, allows us to obtain more information. It is apparent that the projected rotational velocity of the A component is much lower than previously thought (about 32 km s^{-1}, half of the previous value). We were also able to determine the value of $v \sin i$ of the B component and it seems to be very much the same, about 27 km s^{-1}. From the Ca and Fe lines of this spectrum it seems that not only the A but both components exhibit pronounced Am anomalies. Although we have no spectrum from the region 6667–6770 Å at phase 1.00 (the [Ca/Fe] ratio used for classification purposes has to be determined from the lines of Ca I 6718 and Fe I 6678), we found that the Ca I lines are weak, what is a typical feature of Am stars. Radial velocities measured from the spectrum at phase 1.00 are: $v_{\text{A}} = -21.8 \pm 0.4$ km s^{-1}, $v_{\text{B}} = 52.2 \pm 0.3$ km s^{-1}. The orbital period is rather long (≈ 34 days), and possible synchronization in this system would give another support to the hydrodynamical synchronization mechanism of Tassoul & Tassoul (1992) which remains operative for rather large orbital periods up to $P_{\text{orb}} \approx 100$ days. The pronounced Am anomalies of both components and the rather eccentric orbit seem to conform the hypothesis of Budaj (1996, 1997, 1999) about a stabilization mechanism in binary systems competing with diffusion processes.

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CCD LIGHT CURVES OF ROTSE1 VARIABLES, IX: GSC 2530.488 CVn, GSC 1991.1390 Com, GSC 1991.1633 Com

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VAR1

Name of the object:
GSC 2530.488 = ROTSE1 J122607.59+355548.9

Equatorial coordinates:	**Equinox:**
R.A.= $12^h26^m07^s\!.6$ **DEC.=** $+35°55'49''$	2000.0

Comparison star(s):	GSC 2530.525

Check star(s):	GSC 2530.547

VAR2

Name of the object:
GSC 1991.1390 = ROTSE1 J123204.87+262248.1

Equatorial coordinates:	**Equinox:**
R.A.= $12^h32^m04^s\!.94$ **DEC.=** $+26°22'48''\!.6$	2000.0

Comparison star(s):	GSC 1991.1415

Check star(s):	GSC 1991.1422

VAR3

Name of the object:
GSC 1991.1633 = ROTSE1 J123305.53+270803.4

Equatorial coordinates:	**Equinox:**
R.A.= $12^h33^m05^s\!.5$ **DEC.=** $+27°08'03''$	2000.0

Comparison star(s):	GSC 1991.1669

Check star(s):	GSC 1991.1840

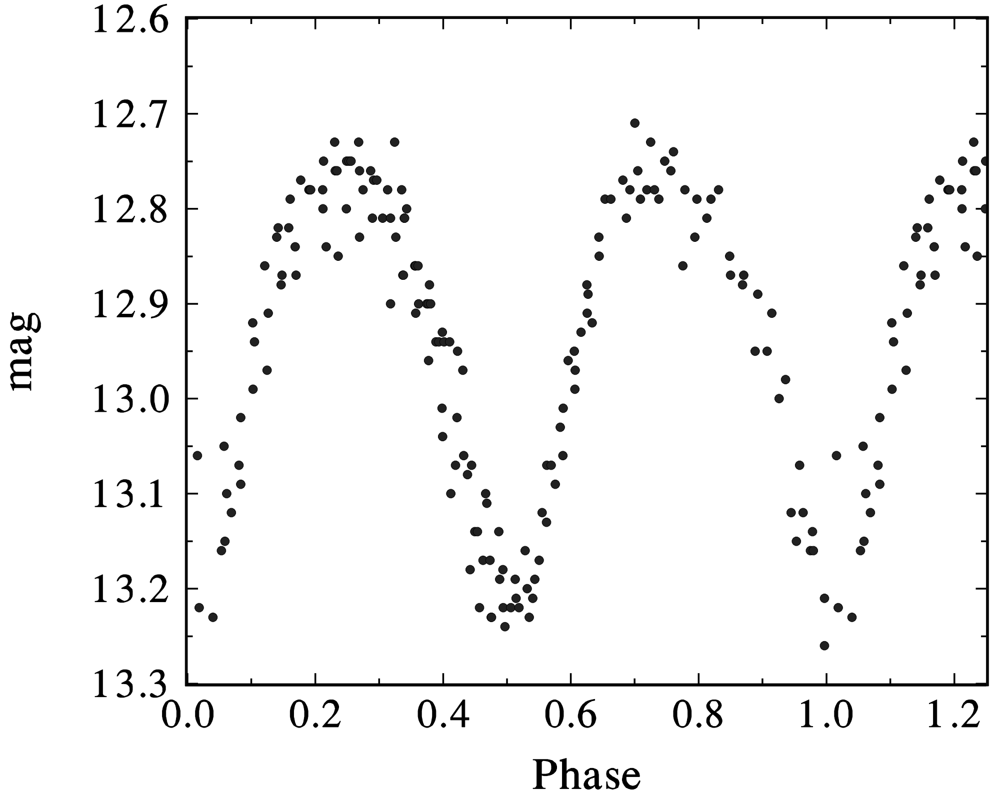

Figure 1. CCD light curve (without filter) of GSC 2530.488

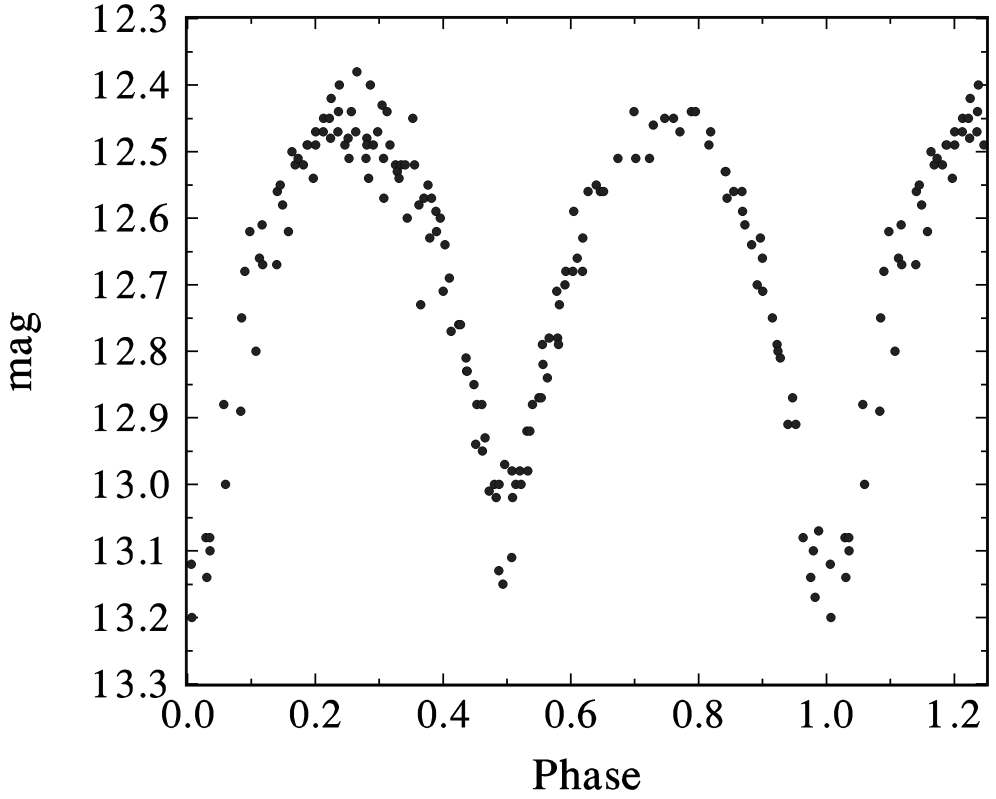

Figure 2. CCD light curve (without filter) of GSC 1991.1390

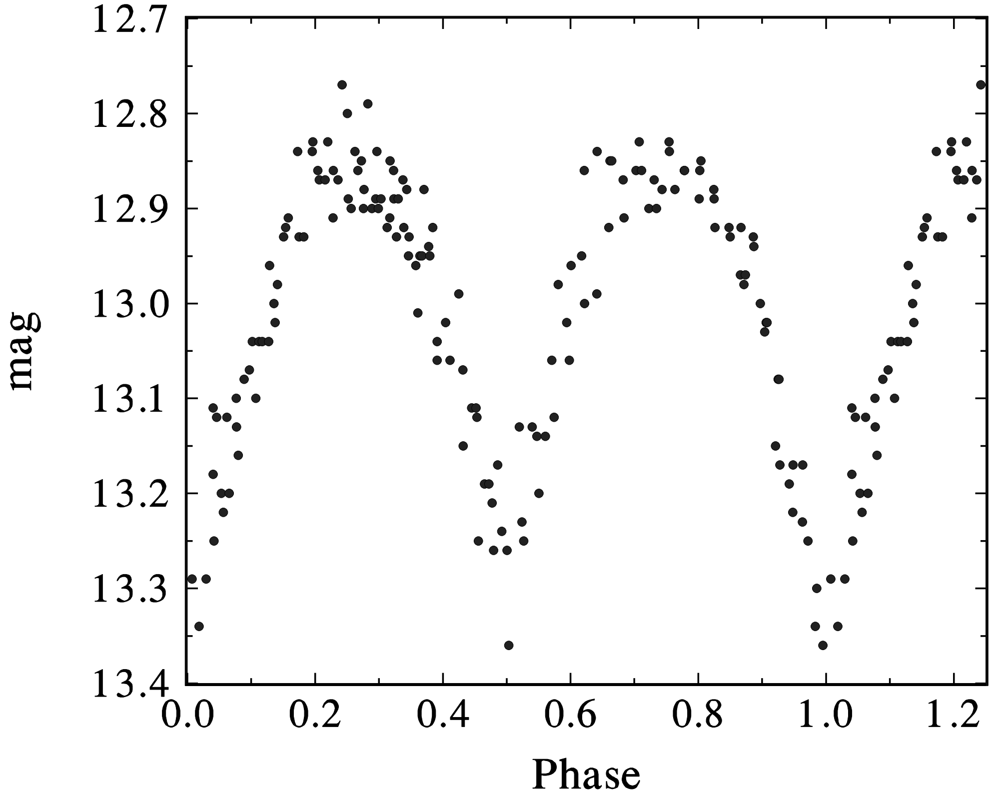

Figure 3. CCD light curve (without filter) of GSC 1911.1633

Observatory and telescope:
Private observatory, Schlüsselacher, Wald, 0.15-m refractor

Detector:	SBIG ST-7 CCD camera

Filter(s):	None

Availability of the data:
Upon request from diethelm@astro.unibas.ch

Type of variability:	EW

Remarks:

As a byproduct of the ROTSE1 CCD survey, a large number of new variables have been discovered (Akerlof et al., 2000). In a series of papers, we report unfiltered CCD observations for some of the close binary systems (type EW) in the list of Akerlof et al. (2000). GSC 2530.488 (VAR1 in this paper) was observed with our CCD equipment as mentioned above during 5 nights between JD 2451951 and JD 2451984, while the data on GSC 1991.1390 (here VAR2) and GSC 1991.1633 (VAR3) were collected during the same 5 nights. A total of 171 CCD frames were measured for VAR1, 162 frames for VAR2 and 160 frames for VAR3. Figures 1, 2 and 3 show our observations folded with the elements

GSC 2530.488 $\mathrm{JD(min,hel)} = 2451967.325(2) + 0.365714(30) \times E;$
GSC 1991.1390 $\mathrm{JD(min,hel)} = 2451967.3479(9) + 0.2863601(9) \times E;$
GSC 1991.1633 $\mathrm{JD(min,hel)} = 2451967.4962(9) + 0.3379351(17) \times E.$

These elements of variation are deduced from a linear fit to the newly determined normal minima from the ROTSE1 data (VAR1: HJD 2451244.6766(15), primary, HJD 2451246.6826(16), secondary; VAR2: HJD 2451312.7287(3), primary; VAR3: HJD 2451246.6822(14), primary, HJD 2451260.7032(8), secondary) as well as the minima derived from our data and given in Blättler (2001).
The elements of variation for GSC 2530.488 given above should be checked since the number of revolutions between the ROTSE1 data and ours is somewhat ambiguous. GSC 1991.1390 and GSC 1991.1633 are situated within the Coma Cluster (Melotte 111, AV 2059 and AV 2139 respectively).

Acknowledgements:

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

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A NEW FAINT W UMa TYPE VARIABLE IN THE GALACTIC HALO

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Equatorial coordinates:	**Equinox:**
R.A.= $23^{\mathrm{h}}48^{\mathrm{m}}01^{\mathrm{s}}$ **DEC.=** $+00^\circ 53' 59''$	2000.0

Observatory and telescope:
Bohyunsan Optical Astronomy Observatory (BOAO), 1.8-m reflector

Detector:	Thinned back illuminated SITe 2048 × 2048 chip
Filter(s):	V
Transformed to a standard system:	No
Type of variability:	W UMa

Availability of the data:
Electronically from the IBVS website as file 5053-t1.txt

Remarks:
A new faint ($\langle V \rangle \approx 17\overset{\mathrm{m}}{.}7$) halo W UMa type variable star was discovered for two nights observation using the BOAO 1.8-m reflector. We carried out aperture photometry via the APPHOT program in the IRAF package in order to determine the differential photometric magnitudes. The exposure time was 300 seconds.

Acknowledgements:
This work was partly supported by Korea Research Grant, KRF-2000-015-DP0444.

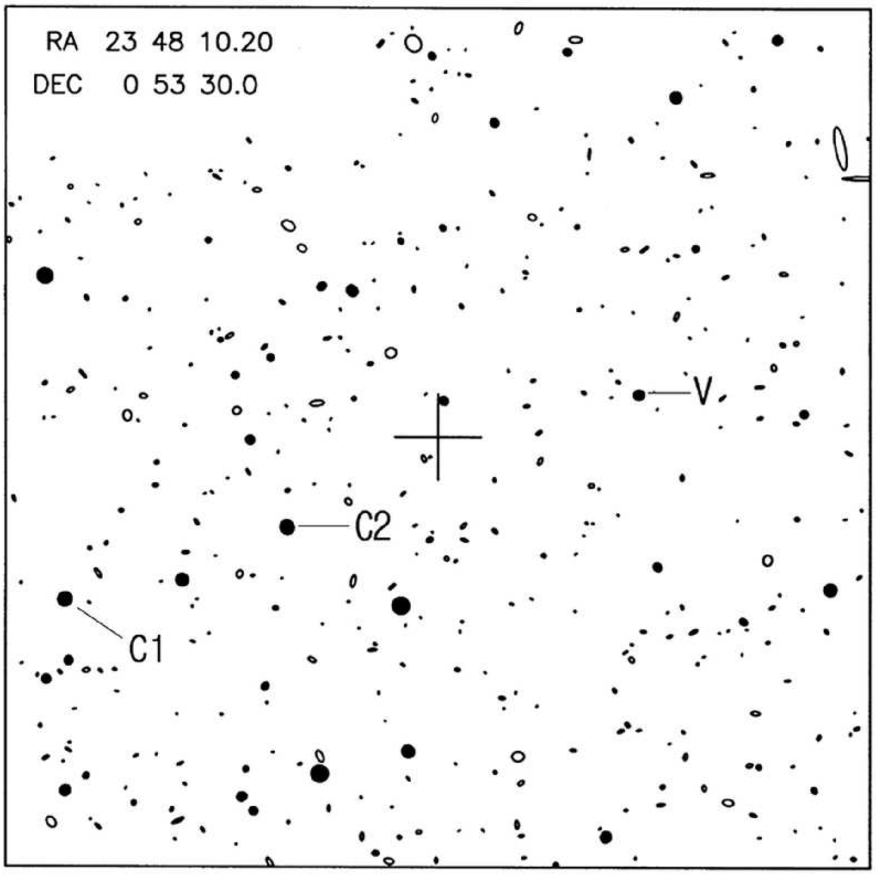

Figure 1. Finding chart of the new variable. The coordinate (2000.0) of the center marked with '+' is denoted on the upper left side. The field of view is 10′ × 10′

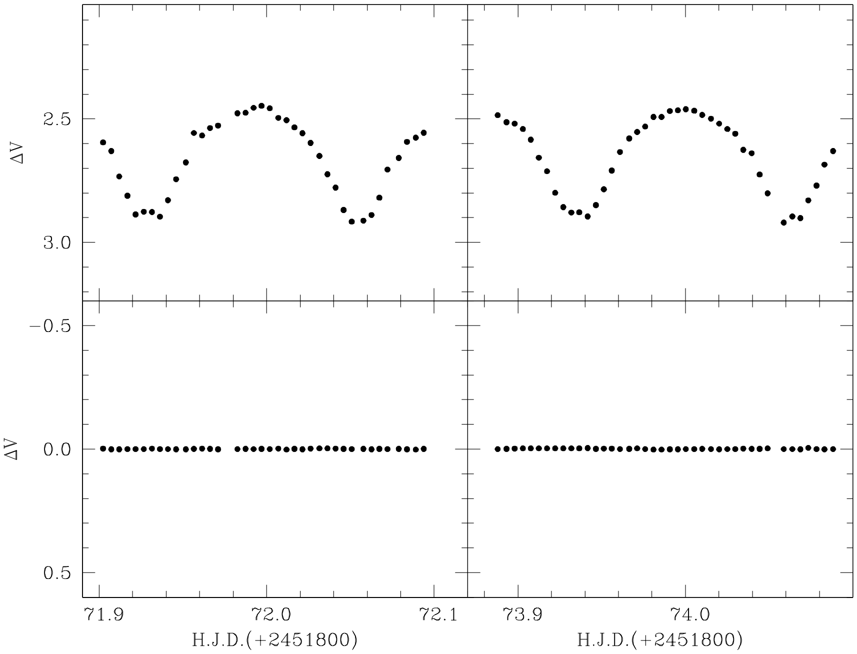

Figure 2. Top: Light curve of the new variable; bottom: magnitude differences between the comparison and check stars

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NEW OBSERVATIONS OF THE POSSIBLE HIGH AMPLITUDE δ SCUTI VARIABLE V854 SCORPII

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The variability of V854 Sco (= CSV 2614 = HV 10535 = GSC 5617-00730) was discovered by E. Hughes Boyce (1942) who classified the star as an eclipsing variable of type W UMa, varying between magnitudes 13.9 and 14.5, but gave no elements. Robinson (1967) estimated the magnitude of V854 Sco on 200 plates of the Harvard Observatory collection, taken between JD 2427900 and JD 2430133, with exposure times of 45 minutes. A period of 0.1024012 ± 0.0000001 day was found, with a mean variation between photographic magnitudes 13.05 and 13.41. He also noted a larger dispersion of the data at maximum, compared to the minimum, and attributed this to a cycle-to-cycle variation of the amplitude. Due to the long exposure times, the mean amplitude could be underestimated. The characteristics of V854 Sco compiled by Rodríguez et al. (1994) are based on these data. Kinman (1998) refers to V854 Sco as a possible high amplitude δ Scuti star (HADS) located high above the galactic plane. To our knowledge there exists no colour information for this object.

We observed V854 Sco in the spring of 2000 with the 0.35-m telescope of CBA Belgium and the 0.4-m telescope of Beersel Hills Observatory (see Vanmunster et al. (2000) for a complete description of the CBA Belgium Observatory equipment and software). Both telescopes are equipped with an ST7 CCD-camera. We used a 2×2 binning mode. Due to the faintness of the star and the low altitude above the horizon, no filter was used. Exposure times varied between 120 and 200 seconds. Observations were made on five nights from JD 2451673 to 2451704, spanning a total time base of 31 days (see Table 1). Respectively 288 (CBA) and 47 (BHO) data points were obtained, with a total observing time amounting to 14 hours. The CBA frames were calibrated and reduced using the profile fitting algorithm of the software package MIPS (Buil et al. 1993). The frames taken at BHO were reduced with the aperture photometry procedure of the Mira AP software package[†]. The comparison star was GSC 5617-00683 ($14\overset{m}{.}0$). The standard deviation of the measurements check minus comparison star was $0\overset{m}{.}02$ on JD 2451679 ($n = 47$). An offset in mean magnitude for the latter data with respect to the rest of the data was applied on a telescope-to-telescope basis. All differential magnitudes were computed with respect to the same comparison star. They are available on request.

[†] MIRA AP is distributed by Axiom Research, Inc.

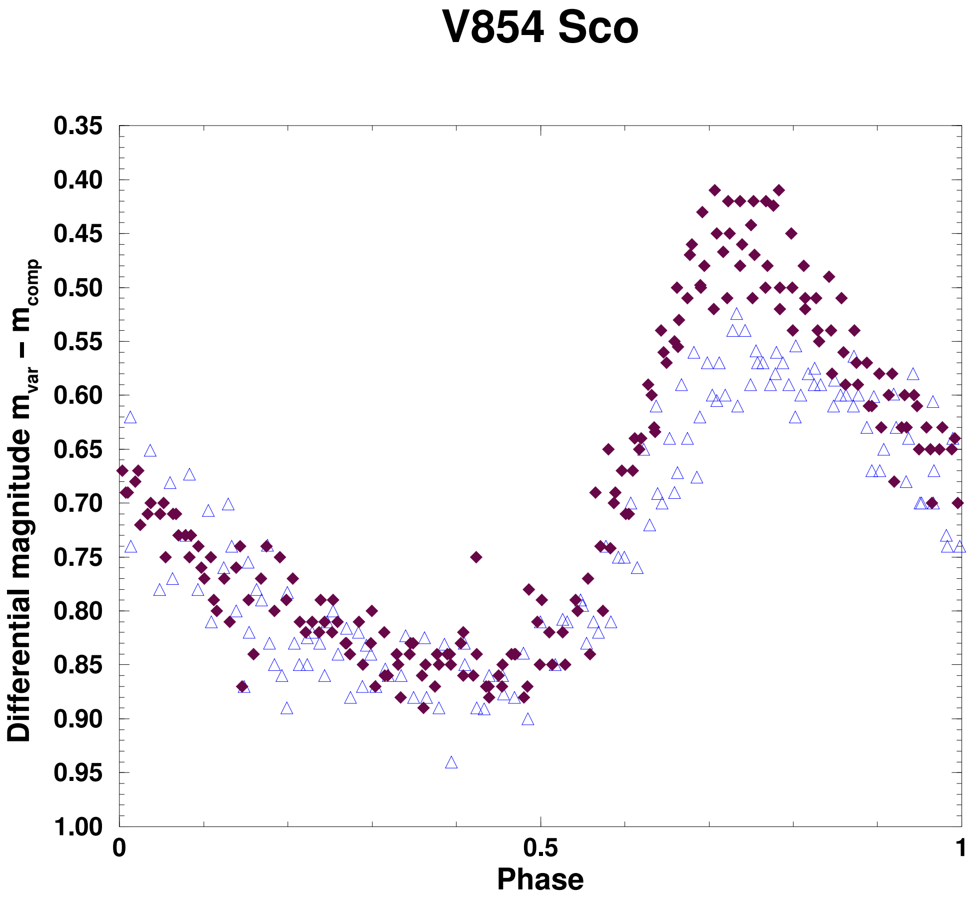

Figure 1. The V854 Sco data phased against the frequency of 9.7644123 c/d: filled diamonds represent the data on JD 2451679.428–2451679.521 ($n = 39$), 2451693, 2451704 while open triangles are used for JD 2451673, 2451679.525–2451679.544 ($n = 8$), 2451690

Table 1: Log of observations

Date	JD+	No. data	Telescope
May 8/9, 2000	673	29	CBA
May 14/15	679	47	BHO
May 25/26	690	74	CBA
May 28/29	693	104	CBA
June 8/9	704	81	CBA

'JD+' stands for 'JD 2451000+'

The data were frequency-analysed with Period98 (Sperl, 1998). We obtained the same period as reported by Robinson (1967): 0.102413 ± 0.000002 days, corresponding to the frequency of 9.7644 ± 0.0002 cycles per day (c/d). Fig. 1 shows the mean light curve phased against the best fitting frequency of 9.7644123 c/d. The mean peak-to-peak amplitude in white light is $0\overset{\mathrm{m}}{.}34$ in good agreement with the range in photographic magnitude (Robinson, 1967). The error in frequency means that we believe that a shift in phase of 0.07 or larger between the first and the last timing of maximum light can be detected in the data string ($\Delta\phi = \Delta f \times$ number of cycles). With a full amplitude of $0\overset{\mathrm{m}}{.}34$, such a phase shift corresponds to a deviation of $0\overset{\mathrm{m}}{.}023$, which is of order of the estimated noise level. This error in frequency is thus an upper limit. However the peak-to-peak amplitude varies by as much as $0\overset{\mathrm{m}}{.}15$. The shape of the light curve varies strongly within two subsequent cycles, as can been seen in Fig. 1 (see different symbols for different sets of data). The skewness of the light curve is strongest at maximum amplitude. We have applied a fit to all the data taking the first harmonic into consideration, giving:

$$\begin{array}{lll}
f = 9.7644 \text{ c/d}; & a_1 = 0\overset{\mathrm{m}}{.}162; & \phi_1 = 0.969; \\
2f = 19.5288 \text{ c/d}; & a_2 = 0\overset{\mathrm{m}}{.}049; & \phi_2 = 0.338; \\
t_0 = \text{JD } 2451673.4793; & \multicolumn{2}{l}{\text{mean difference} = 0\overset{\mathrm{m}}{.}703}
\end{array}$$

and a residual standard deviation equal to $0\overset{\mathrm{m}}{.}045$ ($0\overset{\mathrm{m}}{.}057$ without the harmonic term). The residual dispersion in amplitude is concentrated mainly around the phase of maximum light. The parameters characterizing the shape of the light curve in a Fourier decomposition give $R_{21} = 0.33$ and $\Phi_{21} = 2.51$. The latter value is a bit low compared to other δ Scuti stars (Poretti et al., 1990).

In conclusion we report the constancy of the period for this high amplitude δ Scuti star over a time range of almost 60 years. In addition we confirm that the mean peak-to-peak amplitude fluctuates by as much as $0\overset{\mathrm{m}}{.}15$. From the re-occurrence of a similar light curve shape on a time scale of several days, one can expect beating between two closely spaced frequencies. We searched but found no indication for a second frequency in our data. However this does not argue against the existence of a second frequency, as it could well be that coverage with respect to the corresponding beat period is insufficient.

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THREE NEW SOUTHERN EMISSION-LINE LATE-TYPE DWARFS

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As part of the NASA Nearby Stars / Space Interferometry Mission Preparatory Science program, we are obtaining classification resolution spectra of all 3600 dwarf and giant stars earlier than M0 within 40 pc of the Sun in the *Hipparcos* catalog (Perryman 1997). While our sample only extends to stars earlier than M0, we have included in our program stars from the *Hipparcos* catalog out to 40 pc which have no known spectral type. Many of these stars are M-type dwarfs. During an observing run in early February 2001 at the Cerro Tololo Interamerican Observatory, we obtained spectra of the fainter southern stars in our program on the 1.5-m telescope with the Cassegrain spectrograph. The spectra are of resolution 2.6 Å (2 pixels), with a spectral range from 3800–5150 Å. During the observing run, we also obtained spectra of a number of late-type MK standards.

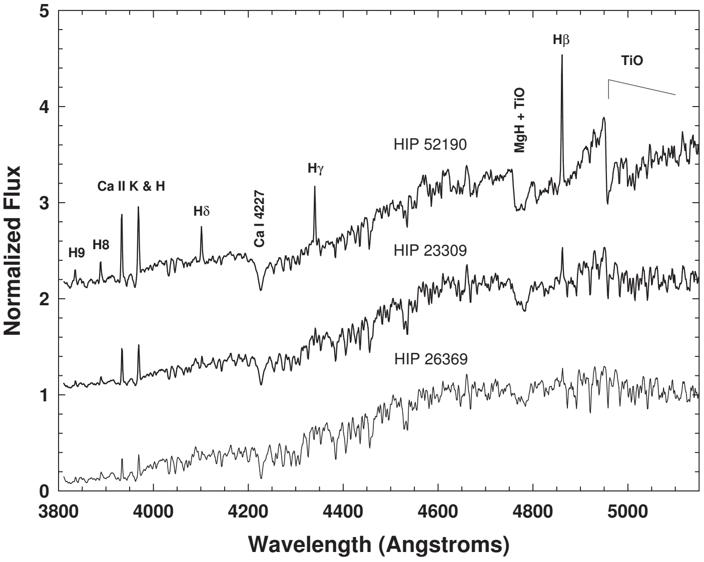

Figure 1. Spectra of three new southern emission-line stars. The fluxes have been normalized at a common point, and the spectra offset by one flux unit for clarity

Table 1: Data for new emission-line dwarfs

JD 2450000 +	Star	Spectral type	EW (Å) Ca II K	V	Parallax (mas)	Error (mas)
1947.833	HIP 52190	M2 Ve	11.6	11.02	68.38	3.76
1948.566	HIP 23309	K7 Ve	9.8	10.02	38.08	1.07
1945.569	HIP 26369	K4.5 Ve	5.8	9.84	41.23	15.54

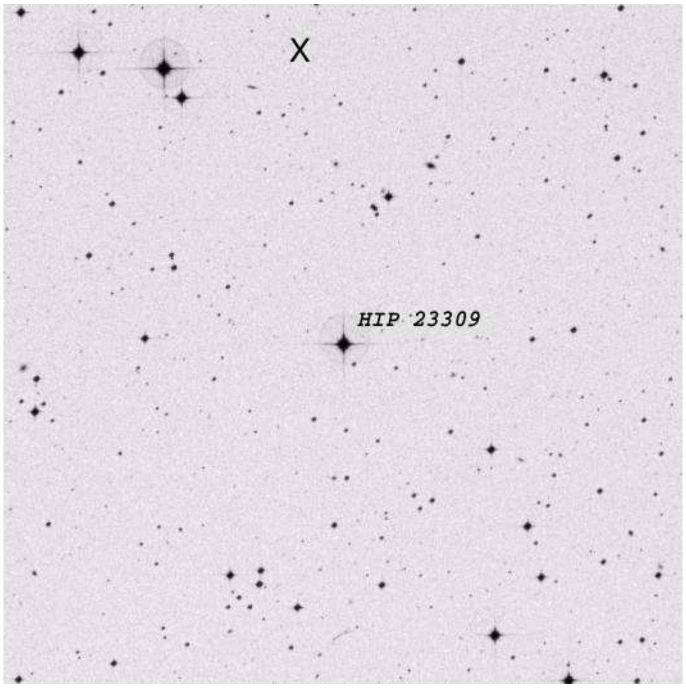

Figure 2. A finding chart for HIP 23309, a newly discovered emission-line star. The catalog position for the star UGP 105 is indicated by an 'X' at top center. The chart is 15′ × 15′. North is at top, east is to the left. The brightest star in the upper lefthand corner is CD −57°1055 which, according to Simbad, has a spectral type of F8

Two of the stars, HIP 52190 and HIP 23309 (CD −57°1054), on our program show prominent emission lines in Ca II K & H and the Balmer lines, (see Figure 1) but seem not to have been recorded as emission line objects in the literature. The third star, HIP 26369, also illustrated in Figure 1, turns out to be a chromospherically-active companion to a very active primary.

HIP 52190 shows strong Balmer-line emission as well as strong emission in Ca II H & K. The total exposure time for our spectrum was 1600 seconds, distributed over 4 separate exposures. The individual exposures, however, do not reveal a change in the emission-line strengths, and thus, if this is a flare star, the spectrum in Figure 1 likely represents the quiescent state. We can find no reference to this high proper motion star as a flare or emission-line star in the literature. Its *Hipparcos* parallax places it at a distance of 14.6 parsecs, but it was not included in the Catalogue of Nearby Stars (Gliese & Jahreiss 1991). This star was discovered by *Hipparcos* to be a binary with a separation of $1\overset{''}{.}32$.

HIP 23309 shows moderately strong emission in Hβ and quite strong emission in Ca II

H & K. The Simbad Database records a spectral type of K7 V for HIP 23309, but we can find no other spectral type for this star in the literature, nor any reference to this star as an emission-line star. The source for the K7 V spectral type is a compilation by Jaschek (1978), but the coordinates in that compilation do not correspond to the *Hipparcos* position for HIP 23309, but to the star UGP 105 in the Upgren et al. (1972) catalog. UGP 105 is given a spectral type of K7 V in the Upgren et al. catalog, and thus it seems likely that HIP 23309 has been confused with UGP 105. Simbad gives a position for UGP 105 a few minutes north of the position of HIP 23309, but it is listed as having a V magnitude of 9.2, considerably brighter than $V = 10.02$ assigned to HIP 23309 in the *Hipparcos* catalog. However, no star occurs at the position of UGP 105! To help clarify this situation, we include a finding chart for HIP 23309 (Figure 2).

A third star of interest is HIP 26369 (HD 37572 B) which shows fairly strong emission in Ca II H & K. This star makes a wide visual binary ($18.3''$ separation) with a well-known chromospherically active star, HD 37572 (UY Pic) which is both a *ROSAT* (Pounds et al. 1993) and *Extreme Ultraviolet Explorer* (Bowyer et al. 1994) source. No spectral type for HIP 26369 shows up in the Simbad Database, and a search of relevant catalogs and references was unsuccessful. Our spectrum of HIP 26369 is displayed in Figure 1.

We have used our spectra to classify these stars on the MK system. This information is presented in Table 1. Photometry and parallaxes in Table 1 are from the *Hipparcos* catalog.

This research is supported under NASA/JPL Contract #1219099. Spectra obtained for this project are released on our NStars website: http://stellar.phys.appstate.edu/. This research made use of the SIMBAD database, operated at CDS, Strasbourg, France. Figure 2 was prepared from the Digitized Sky Survey which is based on images taken for the SERC-J survey, Royal Observatory Edinburgh. Cerro Tololo Interamerican Observatory is operated by the Association of Universities for Research in Astronomy, Inc., under contract with the National Science Foundation.

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NEW PHOTOELECTRIC MINIMA AND UPDATED EPHEMERIDES OF SELECTED ECLIPSING BINARIES

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We present 58 new minima times of 23 eclipsing close binaries obtained from July 1999 to March 2001 as a part of the program of their full light-curve coverages. The $UBVR$ photoelectric observations were taken at the Skalnaté Pleso (SP) and Stará Lesná (SL) observatories of the Astronomical Institute of the Slovak Academy of Sciences. In both cases the 0.6-m Cassegrain telescope equipped with a single-channel pulse-counting photoelectric photometer was used. For all observations a 10-second integration was used. Data reduction, the atmospheric extinction correction and transformation to the standard international UBV system were carried out in the usual way. We have calculated the times of minima separately for all filters using the Kwee and Van Woerden's method, parabola fit, sliding integration method, tracing paper and "center of mass" method which were described in detail by Ghedini (1982). The computer codes were kindly provided by Komžík (2000). To eliminate the influence of the photospheric activity on the minima times (e.g., for RT And and XY UMa), for computations of the primary and secondary minima we have used only observations in the phase intervals ± 0.02 and ± 0.04, respectively. The average times of the primary (I) and secondary (II) minima in different passbands and their probable errors are given in Table 1.

We have also collected all available minima times of these eclipsing binaries from literature and from compilations kindly provided by Kreiner (2000). The CCD, photoelectric and visual minima were weighted according to their average precision. Since the period changes in close binaries are rather often and pronounced, the presented ephemerides (Table 2) were obtained by fitting the data in the last section of the $O-C$ diagram which is approximately linear. The orbital periods of a large fraction of the presented binaries (AB And, BX And, SV Cam, VW Cep, EF Dra, SW Lac, XY UMa) are modulated by the presence of further component(s) in the system. Hence, the linear ephemerides of these systems are expected to be valid with a sufficient precision (0.01–0.02 in phases) only during few years. This is the case for multiple systems like VW Cep or EF Dra, where apparent changes of the orbital period has recently been quite large.

Detailed light-curve analysis and study of the period changes will be published elsewhere.

Acknowledgements: This study was supported by VEGA grant 1157/2001 of the Slovak Academy of Sciences.

Table 1: New times of primary (I) and secondary (II) minima. The standard errors are given in parentheses

System	JD$_{\rm hel}$ 2400000 +	Min.	Obs.	Fil.	System	JD$_{\rm hel}$ 2400000 +	Min.	Obs.	Fil.
AB And	51776.53314(5)	I	SL	B	SV Cam	51921.2796(9)	I	SP	V
	51776.53387(3)	I	SL	V		51924.5381(4)	II	SP	R
	51777.36296(3)	II	SL	B		51924.5388(3)	II	SP	V
	51777.36365(5)	II	SL	V		51997.4852(9)	II	SP	R
	51833.2869(1)	I	SL	V		51997.4898(9):	II	SP	V
	51833.28697(3)	I	SL	B	EG Cep	51718.44352(15)	I	SP	R
	51833.45306(5)	II	SL	V		51718.44389(5)	I	SP	V
	51833.45315(10)	II	SL	B		51718.44413(13)	I	SP	B
	51925.22047(6)	I	SL	B		51772.36150(8)	I	SL	B
	51925.22064(2)	I	SL	V		51772.36160(12)	I	SL	V
BX And	51800.5452(3)	I	SL	B	GW Cep	51968.3054(1)	II	SL	BV
	51800.5454(2)	I	SL	V	VW Cep	51707.4008(2)	I	SL	V
	51838.3734(1)	I	SL	B		51707.4013(4)	I	SL	B
	51838.3739(1)	I	SL	V		51716.4465(3)	II	SL	B
	51838.3743(1)	I	SL	U		51716.4478(2):	II	SL	V
RT And	51776.45476(4)	I	SL	V		51772.52501(6)	I	SL	V
	51776.45495(4)	I	SL	B		51772.52522(8)	I	SL	U
	51778.3411(2):	I	SP	R		51772.52561(8)	I	SL	B
	51778.3416(2)	I	SP	B		51777.5339(2)	I	SL	V
	51778.3417(1)	I	SP	V		51777.5346(2)	I	SL	B
SS Ari	51928.25849(5)	I	SL	V	YY CrB	51975.6053(1)	I	SL	V
	51928.25893(3)	I	SL	B		51975.6056(1)	I	SL	B
44i Boo	51704.4907(2)	I	SL	V	EF Dra	51968.5766(1)	I	SL	B
	51704.4909(2)	I	SL	B		51968.5772(1)	I	SL	V
	51705.4260(2)	II	SL	B	FU Dra	51925.67608(5)	I	SL	B
	51705.4270(2)	II	SL	V		51925.6756(1)	I	SL	V
	51556.6529(2)	I	SP	V		51927.6701(4)	II	SL	V
	51556.6530(3)	I	SP	R		51927.6710(1)	II	SL	B
	51556.6538(1)	I	SP	B		51952.5134(3)	II	SL	V
	51668.4679(2)	II	SL	V		51952.5140(1)	II	SL	B
	51668.4689(13):	II	SL	B		51952.6665(2)	I	SL	B
	51968.4253(1)	II	SL	V		51952.6679(1)	I	SL	V
	51968.4265(1):	II	SL	B	SW Lac	51389.51309(2)	I	SL	V
V523 Cas	51822.4264(2)	I	SP	V		51389.51313(2)	I	SL	B
	51822.4267(2)	I	SP	R		51389.51316(5)	I	SL	U
	51822.4269(1)	I	SP	B		51536.24001(13)	II	SP	B
AO Cam	51798.5673(2)	II	SL	V		51536.24003(8)	II	SP	R
	51798.5675(1)	II	SL	B		51536.24012(8)	II	SP	V
SV Cam	51435.54893(9)	I	SL	U		51772.4445(1)	I	SL	B
	51435.54893(3)	I	SL	B		51772.4448(1)	I	SL	V
	51435.54909(3)	I	SL	V		51860.32001(3)	I	SL	V
	51536.37178(5)	I	SP	V		51860.32028(8)	I	SL	B
	51536.37209(2)	I	SP	R	UV Lyn	51898.4814(1)	I	SL	B
	51536.37238(4)	I	SP	B		51898.4821(2)	I	SL	V
	51550.3096(3)	II	SL	B		51929.39972(5)	II	SL	V
	51550.3116(3)	II	SL	V		51929.4004(2)	II	SL	B
	51878.5746(4)	I	SP	V		51929.6066(1)	I	SL	V
	51878.5757(5)	I	SP	R		51929.6068(2)	I	SL	B
	51878.5762(4)	I	SP	B		51958.4490(2)	II	SL	V
	51921.2792(6)	I	SP	R		51958.4496(5)	II	SL	B
	51921.2793(4)	I	SP	B	U Peg	51778.4966(1)	II	SL	B

Table 1: (continued)

System	$\mathrm{JD}_{\mathrm{hel}}$ 2400000 +	Min.	Obs.	Fil.	System	$\mathrm{JD}_{\mathrm{hel}}$ 2400000 +	Min.	Obs.	Fil.
U Peg	51778.4970(1)	II	SL	V	EQ Tau	51930.2550(5):	II	SL	V
	51794.4230(4):	I	SL	B		51930.2565(1)	II	SL	B
	51794.4241(1)	I	SL	V	AW UMa	51536.5917(1)	I	SP	R
	51860.3852(1)	I	SL	B		51536.5922(1)	I	SP	B
	51860.3858(2)	I	SL	V		51536.5923(2)	I	SP	V
V432 Per	51911.2699(8):	I	SP	R		51928.5919(3):	II	SL	B
	51911.2714(7)	I	SP	B		51928.5933(1)	II	SL	V
	51911.2728(12)	I	SP	V	W UMa	51556.48346(10)	II	SL	B
AH Tau	51956.24554(6)	II	SL	V		51556.48373(4)	II	SL	V
	51956.2459(2)	II	SL	B		51597.52083(7)	II	SL	B
EQ Tau	51896.2932(1)	I	SL	B		51597.52084(8)	II	SL	V
	51896.29324(5)	I	SL	V	XY UMa	51919.5420(2)	I	SL	U
	51911.3122(2)	I	SL	V		51919.5421(2)	I	SL	B
	51911.31279(6)	I	SL	B		51919.54283(3)	I	SL	V

Table 2: New ephemerides of the selected eclipsing close binaries. The standard errors are given in parentheses, e.g., the entry 51534.2504(5) should be interpreted as 51534.2504 ± 0.0005. The reference gives last paper dedicated to the system or particularly to study of period change.

System	JD_0 2400000 +	Period	Interval	Period change	Reference
AB And	51534.2504(5)	$0\overset{\mathrm{d}}{.}33189106(4)$	1981–2001	LT + ↗	Borkovits et al. (1996)
BX And	36528.8118(22)	0.61011285(11)	1981–2000	LT ?	Demircan et al. (1993)
RT And	32443.7967(5)	0.62892932(2)	1968–2000	↘	Pribulla et al. (2000a)
SS Ari	41947.151(5)	0.4059836(2)	1993–2001	↘	Demircan et al. (1993)
44i Boo	50945.4898(6)	0.26781916(7)	1988–2001	↗	Gherega et al. (1994)
V523 Cas	47000.1839(5)	0.23369229(4)	1987–2000	↗	Lister et al. (2000)
AO Cam	45745.6391(6)	0.32990473(7)	1980–2000	→	Rucinski et al. (2000)
SV Cam	33777.389(2)	0.59307318(8)	1979–2001	LT ?	Albayrak et al. (1999)
EG Cep	26929.3962(20)	0.54462278(5)	1976–2000	↗	Chochol et al. (1998)
GW Cep	47000.1436(12)	0.31882954(11)	1989–2001	↘	Pribulla et al. (2001b)
VW Cep	33898.424(23)	0.2783131(4)	1997–2000	LT + ↘	Pribulla et al. (2000b)
YY CrB	50955.8688(12)	0.37656421(9)	1998–2001	→	Rucinski et al. (2000)
EF Dra	51789.2125(12)	0.4240257(2)	1989–2001	LT + ↗ ?	Pribulla et al. (2001b)
FU Dra	50866.2768(5)	0.30671682(13)	1991–2001	→	Rucinski et al. (2000)
SW Lac	51056.2896(3)	0.32071510(9)	1993–2000	LT + ↗	Pribulla et al. (1999a)
UV Lyn	47000.4197(10)	0.41498460(15)	1988–2001	↗	Lu et al. (1999)
U Peg	33512.032(4)	0.37477742(10)	1985–2000	↘	Borkovits et al. (1996)
V432 Per	48601.3750(7)	0.3833120(2)	1991–2001	LT ?	Agerer (1992)
AH Tau	47000.2689(5)	0.33267164(7)	1975–2001	↘ ?	Liu et al. (1991)
EQ Tau	47000.3566(7)	0.34134666(10)	1984–2001	LT or ↘	Buckner et al. (1998)
AW UMa	38044.892(10)	0.4387259(3)	1994–2001	↘ + LT ?	Pribulla et al. (1999b)
W UMa	50554.7428(2)	0.33363551(3)	1984–2000	LT ?	Depasquale et al. (1999)
XY UMa	35216.398(5)	0.47899819(16)	1994–2001	LT + ↗	Pribulla et al. (2001a)

LT: light-time effect, ↗: period increase, ↘: period decrease, →: constant period

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V802 Aql IS AN ECLIPSING BINARY OF W UMa-TYPE

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V802 Aql (= GSC 5119-00948; $\alpha_{2000} = 18^{\rm h}58^{\rm m}55^{\rm s}$; $\delta_{2000} = -03^\circ 1\overset{\prime}{.}2$) was discovered by Bakos (1950) who classified it as an RR Lyrae star varying between magnitudes 13.7 and 14.2 with a period of $0\overset{\rm d}{.}1338$, based on 25 observed minima. Rodríguez et al. (2000) included the star in their latest catalogue of δ Scuti stars.

We observed V802 Aql on two nights in 1996 and on four nights in 2000. We obtained respectively 130 and 347 data points, totalling 12.7 hours of photometry. We used a 0.40-m telescope. In 1996 this instrument was equipped with a Hisis24 CCD camera, in 2000 with a ST7 CCD camera. Both cameras have a Kodak KAF400 chip. No filter was used. Exposure times varied between 70 and 120 seconds, depending on sky conditions. The images were reduced with the aperture photometry procedure of the Mira AP software package[†].

The brightness of the variable was measured with respect to the average of GSC 5119-01018 and GSC 5119-00575. The standard deviation of the differential magnitudes between both comparison stars was $0\overset{\rm m}{.}006$. The data were frequency-analysed with "Period", a period search program developed by one of us (P. Wils) based on the PDM method (Stellingwerf, 1978). The following times of minima were observed:

Type	Mag	JD Hel.
Min II	0.295	2450300.434
Min II	0.325	2451780.457
Min I	0.369	2451781.392
Min I	0.349	2451782.463
Min II	0.288	2451784.471

Our results show that V802 Aql is an eclipsing binary of type W UMa with a period of $0\overset{\rm d}{.}2677 \pm 0\overset{\rm d}{.}0003$. Fig. 1 shows the phased light curve with two unequal minima: the primary minimum (Min I) is $0\overset{\rm m}{.}35$ deep, the secondary minimum (Min II) is $0\overset{\rm m}{.}30$ deep. Both minima are total with a duration of $0\overset{\rm d}{.}02$.

The corresponding ephemeris is:

$$\begin{array}{l} \text{Min. I} = \text{HJD } 2451781.392 + 0\overset{\rm d}{.}2677 \times E. \\ \qquad\qquad\qquad\qquad\quad \pm 0.001 \pm 0.0003 \end{array}$$

[†] The Mira AP software is distributed by Axiom Research Inc.

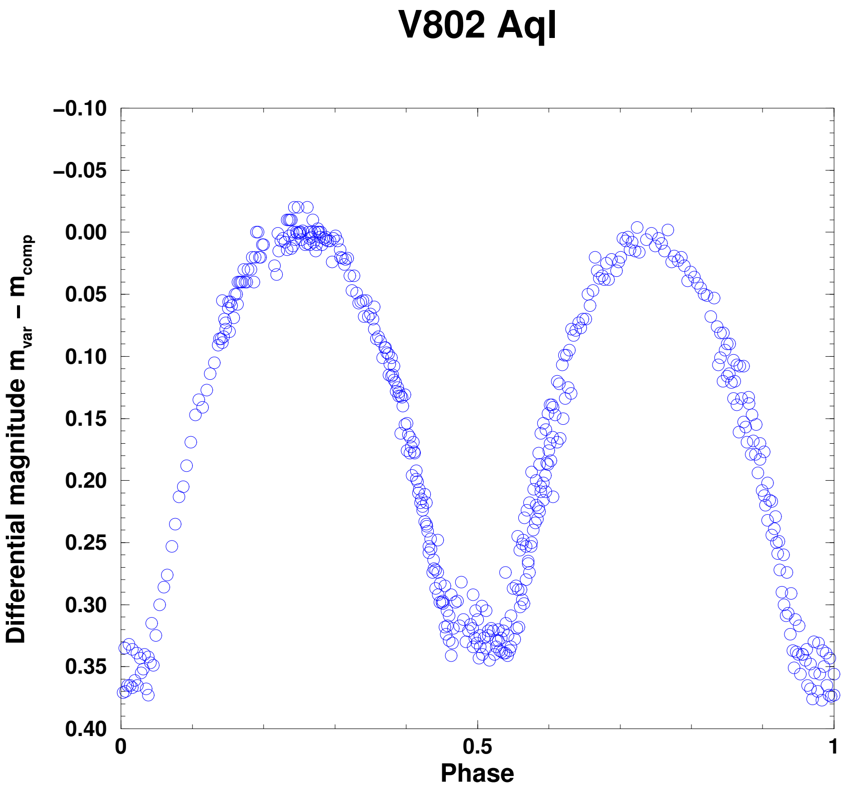

Figure 1. Phase diagram for V802 Aql (against the period of $0^{\mathrm{d}}.2677$)

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NEW DWARF NOVAE ON MOSCOW PLATES

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A search for new variable stars on Moscow archive plates resulted in the discovery of two new UG stars (TK 4 and TK 5). The coordinates of TK 5, taken from the USNO A2.0 catalog, and for TK 4, measured on a DSS image, are listed in Table 1. The finding charts are shown in Figure 1. The TK numbers of the new variables continue the numbering system first introduced in Kryachko and Solovyov (1996).

The stars were estimated by eye on plates taken with the 40-cm astrograph in the Crimea. The magnitudes of comparison stars are given in Table 2. The standard sequence in NGC 6819 (Purgathofer, 1966) was used to obtain B-band magnitudes of comparison stars for TK 4 and TK 5.

Both stars are blue on Palomar prints.

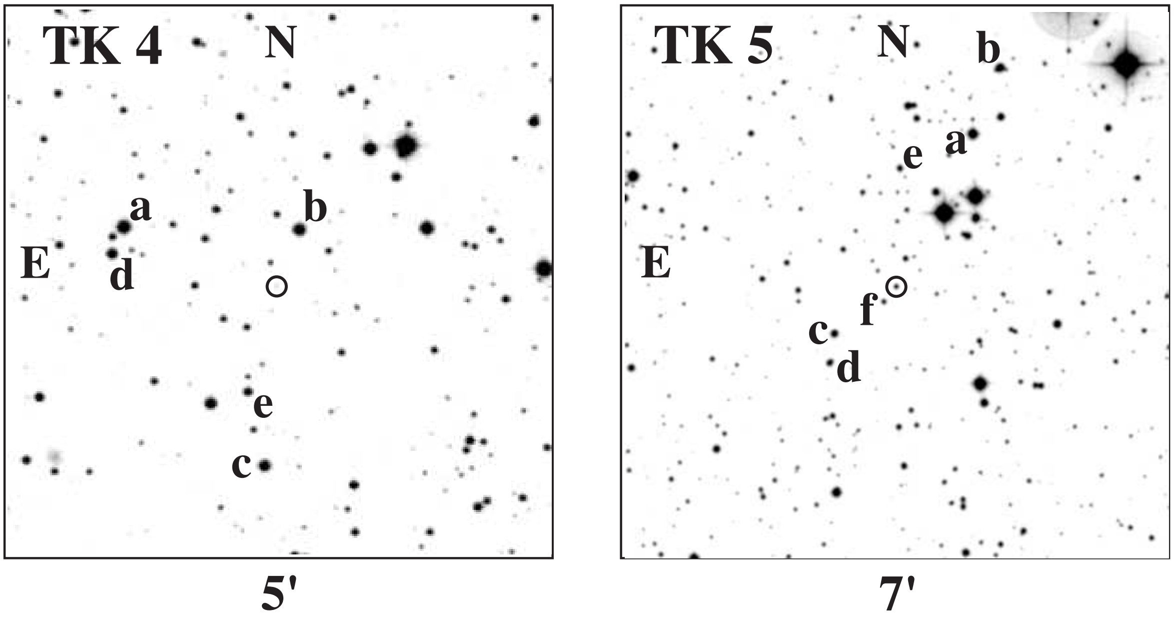

Figure 1. The finding charts and the comparison stars

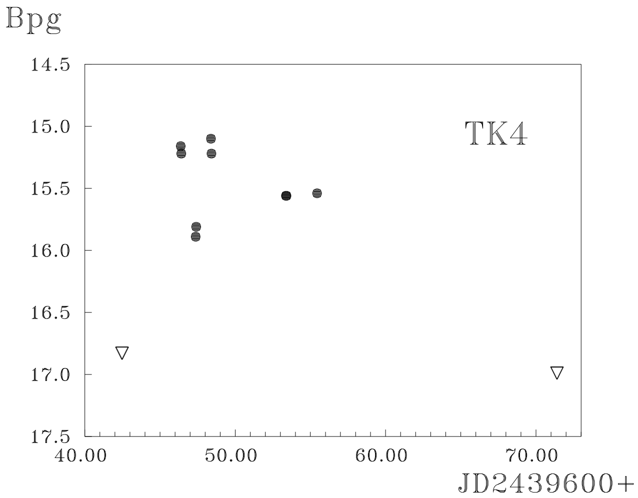

Figure 2. TK4 Lyr. The light curve of a long-lasting outburst showing a temporary fading

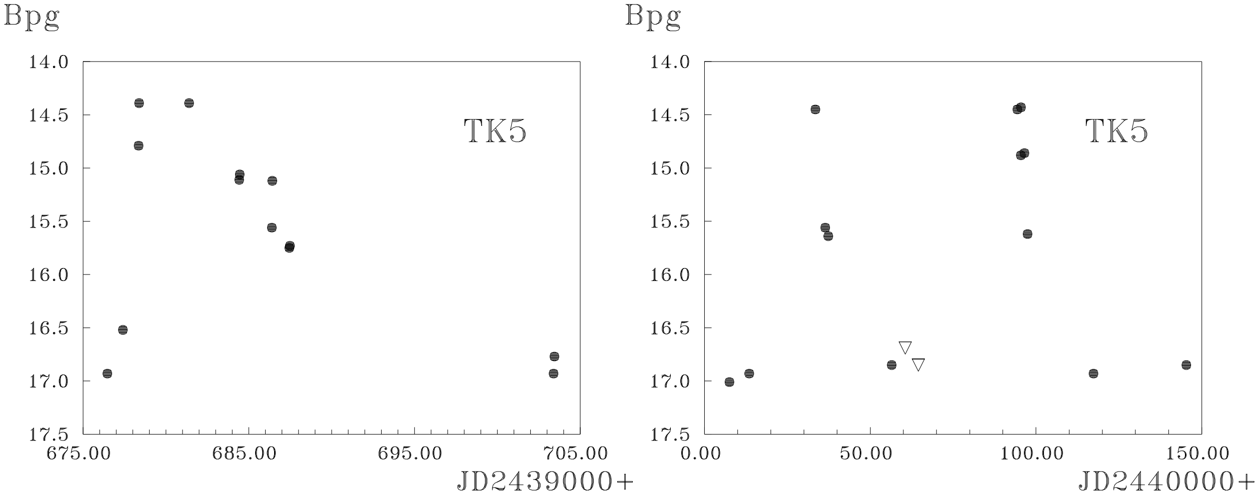

Figure 3. TK5 Lyr. Fragments of the light curve: the long-lasting outburst and two consecutive outbursts

Table 1: Coordinates of the new variables

Var	α (J2000.0)	δ(J2000.0)
TK 4	$19^{\rm h}13^{\rm m}58\overset{\rm s}{.}47$	$+40^\circ44'09\overset{\prime\prime}{.}1$
TK 5	$19^{\rm h}17^{\rm m}26\overset{\rm s}{.}5$	$+37^\circ10'41''$

Table 2: Comparison stars

Var	a	b	c	d	e	f
TK 4	14.62	15.34	15.73	15.94	16.83	
TK 5	13.77	14.65	15.47	15.98	16.19	16.69

TK 4 Lyr. We estimated the star on 226 plates taken in JD 2439345–2444436. The range of variability on our plates is $14\overset{\rm m}{.}86$–[$17\overset{\rm m}{.}2$. A total of three outbursts have been revealed. They belong to at least two different types: #3 is brighter and short-lasting, of less than 4 days duration, and #1 lasted more than 9 days, with a $0\overset{\rm m}{.}65$ deep local minimum on the plato, with at least 1 hour duration. We can assume this star to be a UGSU (SU UMa subtype) dwarf nova. The light curve of the outburst #1 is shown in Figure 2. This star is missing in the USNO A2.0 catalog; in $3''$ to the north-north-west, there is a USNO star at $19^{\rm h}13^{\rm m}58\overset{\rm s}{.}41$, $+40^\circ44'11\overset{\prime\prime}{.}5$ (2000.0) ($B = 19.5$, $R = 18.4$). TK4 is brighter than the latter star on the blue DSS-II image and fainter on the red image.

Further observations and search for superhumps are strongly encouraged.

Outbursts (JD 24. . .):

#1	39642.493	[16.8	#2	40033.436	[16.8
	39646.377	15.16		40036.406	[16.8
	39646.413	15.22		40037.334	14.86
	39647.371	15.89		40056.477	16.12
	39647.403	15.81		40060.525	[16.8
	39648.385	15.10			
	39648.418	15.22	#3	40386.484	[16.8
	39653.375	15.56		40387.450	14.91
	39653.407	15.56		40387.472	14.98
	39655.444	15.54		40390.469	[17.1
	39671.379	[17.0		40392.505	[16.8
	39671.411	[17.0			

TK 5 Lyr. The UG-type variability was discovered on the basis of 220 estimates (JD 2439345–2444436). The *B*-band magnitude changes in the range $14^{\rm m}\!\!.32$–[$17^{\rm m}\!\!.1$.

The star shows frequent outbursts, with a possible cycle around 60 days. Three best-observed outbursts, #1 and two consecutive ones, #4 + #5, are shown in Figure 3. The color index (blue minus red) is 0.7 in the USNO A2.0 catalog.

Outbursts on Moscow plates (JD 24...):

#1	39676.465	16.93	#3	39953.565	16.77	#6	40412.480	16.93
	39677.405	16.52		39965.391	15.81		40413.503	16.85
	39678.348	14.79		39965.498	15.62		40425.439	14.32
	39678.380	14.39		39966.469	15.79		40427.438	14.50
	39681.398	14.39		39966.498	15.81			
	39684.422	15.11		39968.470	16.85	#7	42988.411	[17.1
	39684.454	15.06		39968.495	16.85		43046.340	14.32
	39686.387	15.56					43047.397	14.43
	39686.420	15.12	#4	40007.495	17.01		43049.349	14.47
	39687.448	15.75		40013.490	16.93		43050.325	14.40
	39687.480	15.73		40033.436	14.45		43064.259	[16.9
	39703.393	16.93		40036.406	15.56		43065.262	[16.9
	39703.441	16.77		40037.334	15.64			
				40056.477	16.85			
#2	39716.467	16.93						
	39716.504	16.69	#5	40060.525	[16.7			
	39734.387	15.73		40064.517	[16.9			
	39734.423	15.88		40094.377	14.45			
	39735.339	15.81		40095.437	14.88			
	39735.372	16.19		40095.477	14.43			
	39735.408	16.29		40096.504	14.86			
	39737.290	16.69		40097.464	15.62			
	39739.370	16.69		40117.353	16.93			
				40145.351	16.85			

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Purgathofer, A., 1966, *Wien Mitt.*, **13**, No. 2

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OBSERVATIONS OF NSV 04832

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Name of the object:
SAO 81314 = BD +26°2077 = AGK +25°1146 = HD 89810 = PPM 100303 = IRC +30220 = GSC 1972_454

Equatorial coordinates:	**Equinox:**
R.A.= $10^{\mathrm{h}}22^{\mathrm{m}}23^{\mathrm{s}}$ **DEC.=** $+25°29'59''$	2000.0

Observatory and telescope:
Mollet Observatory; 6-cm refracting telescope

Detector:	CCD

Filter(s):	*V*

Comparison star(s):	SAO 81303 = BD +26°2072 = AGK +25°1145 = HIP 50632 = PPM 100278 = GSC 1972_644

Check star(s):	SAO 81321 = BD +25°2241 = AGK +25°1150 = PPM 100309 = GSC 1969_704

Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	SR

Remarks:
NSV 04832, with a Tycho *V* magnitude of 8.877 and a *B* magnitude of 10.305 and a spectral type M8, was announced as a variable star by Neugebauer and Leighton (1969), who indicated that this star underwent light variations in the *I* band between $5\overset{\mathrm{m}}{.}08$ and $5\overset{\mathrm{m}}{.}47$. To know more about NSV 04832 the star was observed from 2 March to 13 June 1997 for 41 nights. Figure 1 displays the obtained light curve, suggesting a SR type. The maximum detected amplitude was of 0.70 magnitudes. More observations are needed to ascertain its long term behaviour.

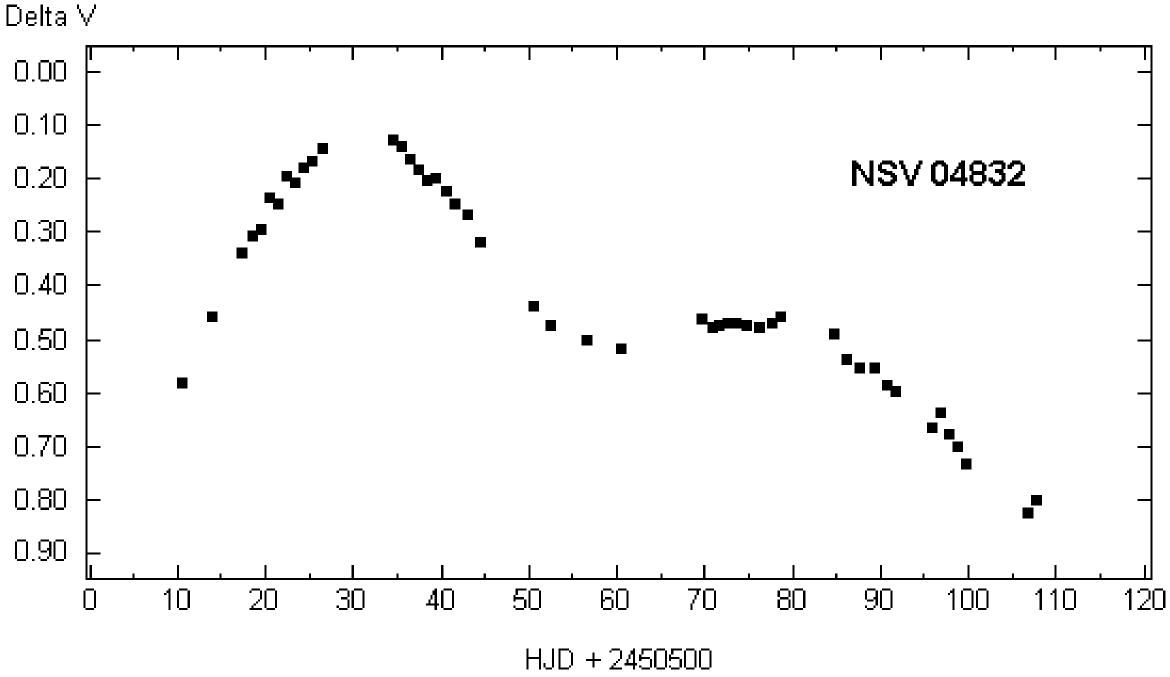

Figure 1.

Reference:

Neugebauer, G., Leighton, R.B., 1969, Two-micron Sky Survey

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TIMES OF MINIMUM OF ECLIPSING BINARIES FROM ROTSE1 CCD DATA, III: VARIABLES CLASSIFIED AS TYPE E

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In the third installment of this series of papers (Diethelm, 2001a and 2001b), we report the timings of minimum light of newly discovered variables from ROTSE1 (Robotic Optical Transient Search Experiment 1) survey data, as reported in Akerlof et al. (2000). The original data are publicly available through the Internet (http://www.umich.edu/~rotse).

Table 1 contains the times of minimum of 73 stars whose variability was discovered for the first time by the ROTSE1 team and classified as E type eclipsing binaries, ordered according to RA. In each case, the data have been folded into a seasonal light curve using the ROTSE1 period or twice that value (see also Table 2). The time of minimum was then found with the help of the Kwee–Van Woerden algorithm (Kwee and Van Woerden, 1956). Since the CCD measurements of the ROTSE1 survey were obtained in a random fashion as viewed from the variable stars period, the phase coverage of the individual light curves is sometimes less than pleasing. It must also be noted that some of the variables have double entries in the ROTSE1 catalogue, the second identifier being given in the second row of the variables data in Table 1.

With the purpose of aiding prospective investigators of theses variables, we give in Table 2 the basic light curve parameters as deduced from the ROTSE1 photometry. Due to the uneven phase coverage, some of the given parameter values are rather uncertain and we would like to point out the necessity of in-depth studies of these stars. As far as we know, such a study has been instigated by the AAVSO (for ROTSE1 J170250.47+213959.0 see Lubcke et al., 2000; ROTSE1 J165241.80+124905.2, ROTSE1 J170610.49+495523.6, ROTSE1 J174103.55+273429.1 and ROTSE1 J181941.87+501037.3 in progress) as well as by members of the BBSAG.

Among the stars assigned to the E type by the ROTSE1 team, we find some to be questionably classified. ROTSE1 J141308.66+295950.7 = GSC 2013.854 is a δ Scuti variable with a period of $0\overset{\mathrm{d}}{.}141084$ and an amplitude of $0\overset{\mathrm{m}}{.}3$ (13.2–13.5). The light curves of the four stars ROTSE1 J173012.01+141446.4 = GSC 1004.171, ROTSE1 J173334.66 = GSC 3087.1020, ROTSE1 J175053.54+265448.8 = GSC 2085.1541 and ROTSE1 J190111.36+460037.7 = GSC 3541.692, folded with the period value as determined by the ROTSE1 team, all show peculiarities which make the classification as eclipsing binaries unlikely.

In the 'remarks' column of Table 2, *D* and *d* stand for the duration of the minimum and of totality, respectively, while the suffixes p and s denote primary and secondary minimum.

Table 1: Times of minimum of eclipsing binaries

ROTSE1 Variable	Min.	JD(hel,min) − 2400000	Est. err.
J123201.49+352959.7 =	s	51251.691	0.002
= GSC 2530.2276	p	51312.7322	0.0004
J123309.33+375820.2 =	s	51251.812	0.003
= GSC 3018.1509	p	51286.7110	0.0012
J123730.26+260451.8 =	p	51260.8579	0.0009
= GSC 1990.1198	s	51288.876	0.005
J125214.17+385630.8 =	s	51278.719	0.003
= GSC 3021.507	p	51304.736	0.002
J133619.29+292341.1 =	p	51312.729	0.002
= GSC 2004.1075			
J140916.76+383732.0 =	-	51259.8645	0.0009
= GSC 3034.593			
J141451.43+273415.3 =	p	51259.8633	0.0004
= GSC 2013.1067	s	51260.8551	0.0014
J143723.34+380442.7 =	s	51275.865	0.003
= GSC 3036.930 =	p	51286.7052	0.0006
= J143723.43+380442.1			
J143820.20+363225.6 =	s	51260.8547	0.0007
= GSC 2560.421 =	p	51311.7377	0.0004
= J143820.24+363225.5			
J144005.64+263401.6 =	s	51278.700	0.005
= GSC 2018.65 =	p	51286.681	0.003
= J144005.69+263402.2			
J145312.48+284221.4 =	p	51229.863	0.007
= GSC 2023.1133	s	51286.76	0.04
J145730.93+240251.4 =	p	51258.8604	0.0009
= GSC 2017.1099	s	51265.8135	0.0017
J150029.61+334021.7 =	p	51221.8497	0.0005
= GSC 2565.667	s	51287.859	0.011
J151726.64+381336.3 =	p	51223.8574	0.0010
= GSC 3045.520	s	51286.717	0.007
J152155.16+335604.1 =	-	51222.8497	0.0012
= GSC 2566.776	-	51275.875	0.002
J161005.08+253654.9 =	p	51275.8724	0.0007
= GSC 2038.674	s	51288.8774	0.0007
J161050.39+372857.0 =	p	51242.813	0.002
= GSC 2579.69	s	51248.795	0.005
J162108.79+253924.1 =	p	51286.881	0.002
= GSC 2047.270			
J163153.48+252717.2 =	s	51258.851	0.002
= GSC 2048.120	p	51275.853	0.002
J163213.55+133847.6 =	p	51252.844	0.002
= GSC 972.932	s	51281.93	0.02
J163516.73+124618.9 =	p	51310.7734	0.0011
= GSC 968.535			
J164508.42+203701.5 =	p	51295.8959	0.0014
= GSC 1528.683	s	51323.907	0.004
J164755.15+351756.5 =	s	51259.861	0.013
= GSC 2588.69	p	51308.870	0.003
J163213.55+133847.6 =	p	51252.844	0.002
= GSC 972.932	s	51281.93	0.02
J163516.73+124618.9 =	p	51310.7734	0.0011
= GSC 968.535			
J164508.42+203701.5 =	p	51295.8959	0.0014
= GSC 1528.683	s	51323.907	0.004
J164755.15+351756.5 =	s	51259.861	0.013
= GSC 2588.69	p	51308.870	0.003
J165039.95+274420.0 =	s	51265.8329	0.0004
= GSC 2066.1210 =	p	51265.9804	0.0004
= J165039.99+274421.1			
J165241.80+124905.2 =	s	51265.842	0.003
= GSC 983.1044	p	51311.91	0.02
J165252.60+383930.6 =	p	51258.867	0.002
= GSC 3071.260 =	s	51274.8909	0.0008
= J165252.61+383930.4			
J165551.74+245335.9 =	p	51259.8648	0.0008
= GSC 2063.902 =	s	51287.8691	0.0008
= J165551.78+245336.1			
J165656.96+291907.1 =	s	51244.014	0.005
= GSC 2071.671	p	51283.779	0.006
J165819.76+334022.8 =	s	51243.9841	0.0002
= GSC 2594.1289 =	p	512295.8786	0.0004
= J165819.81+334022.2			
J165924.08+151220.7 =	s	51274.918	0.003
= GSC 1522.599	p	51323.9074	0.0010
J165930.95+191256.1 =	p	51288.8869	0.0004
= GSC 1530.1382			
J170101.20+492314.7 =	p	51265.8278	0.0015
= GSC 3504.856	s	51308.7177	0.0014
J170250.47+213959.0 =	p	51288.7439	0.0007
= GSC 1534.753	s	51306.8893	0.0004
J170610.49+495523.6 =	p	51307.706	0.003
= GSC 3504.168			
J170922.13+123957.6 =	p	51275.8837	0.0009
= GSC 985.811			
J171059.94+461719.7 =	p	51285.7006	0.0005
= GSC 3501.2083	s	51306.873	0.005
J171130.30+231411.2 =	s	51287.81	0.02
= GSC 2061.529	p	51310.903	0.005
J171642.01+212305.9 =	p	51274.9115	0.0017
= GSC 1548.713	s	51310.920	0.007
J171649.91+382159.8 =	s	51265.78	0.01
= GSC 3073.1983	p	51307.745	0.004
J171727.89+271301.9 =	p	51286.8856	0.0017
= GSC 2069.150	s	51287.724	0.004
J171824.82+222850.0 =	p	51274.9145	0.0006
= GSC 1548.678	s	51304.7652	0.0012
J172007.77+133956.4 =	p	51283.7995	0.0013
= GSC 990.545	s	51308.770	0.007
J172142.55+405423.5 =	s	51265.918	0.007
= GSC 3090.1337	p	51311.884	0.009
J172303.57+175701.2 =	p	51295.891	0.002
= GSC 1541.2560	s	51322.7706	0.0012
J172441.74+135356.5 =	s	51283.7923	0.0011
= GSC 1003.1915	p	51306.9009	0.0005
J172601.97+304710.4 =	s	51288.4	0.2
= GSC 2605.545	p	51304.90	0.04
J172659.31+244147.6 =	p	51265.8307	0.0015
= GSC 2079.1360			
J172741.29+274503.5 =	p	51291.827	0.003
= GSC 2083.557			
J172817.01+211557.0 =	p	51278.7902	0.0012
= GSC 1550.1808			
J173621.16+303212.7 =	p	51295.868	0.003
= GSC 2606.1006			

Table 1: (cont.)

ROTSE1 Variable	Min.	JD(hel,min) − 2400000	Est. err.	ROTSE1 Variable	Min.	JD(hel,min) − 2400000	Est. err.
J173921.13+354208.6 =	p	51286.7253	0.0019	J182138.35+421008.6 =	-	51310.8700	0.0011
= GSC 2618.1282	s	51304.7388	0.0015	= GSC 3112.179			
J174103.55+273429.1 =	p	51296.743	0.005	J182301.05+400833.0 =	s	51258.842	0.002
= GSC 2084.777	s	51308.8718	0.0017	= GSC 3108.1692 =	p	51288.851	0.003
J174150.84+475104.3 =	s	51243.938	0.004	= J182301.06+400833.1			
= GSC 3514.790	p	51312.7161	0.0008	J183907.69+415653.5 =	p	51257.8337	0.0015
J174323.11+475142.3 =	s	51274.8757	0.0017	= GSC 3113.1384	s	51261.8328	0.0012
= GSC 3514.864	p	51275.8589	0.0011	J185343.48+372338.0 =	s	51274.935	0.008
J174555.29+523805.8 =	s	51280.8477	0.0008	= GSC 2650.1900	p	51280.844	0.004
= GSC 3889.1362	p	51306.863	0.003	J185901.50+522814.9 =	s	51306.92	0.02
J174743.80+463230.6 =	p	51243.9763	0.0015	= GSC 3553.1117	p	51310.79	0.05
= GSC 3510.396	s	51311.871	0.004	J191518.85+522933.9 =	s	51280.863	0.005
J174953.04+370839.6 =	p	51265.8306	0.0009	= GSC 3554.949	p	51297.8838	0.0013
= GSC 2619.833				J191533.92+443704.9 =	p	51297.859	0.002
J175852.80+481025.0 =	s	51286.858	0.004	= GSC 3133.1149			
= GSC 3515.865	p	51304.8686	0.0009	J192506.85+455603.1 =	p	51277.8307	0.0013
J175909.41+493607.4 =	p	51277.8466	0.0007	= GSC 3543.1026 =	s	51312.699	0.005
= GSC 3519.401	s	51308.714	0.004	= J192506.86+455603.0			
J181521.80+390545.4 =	-	51257.829	0.002	J192531.82+425110.1 =	p	51286.8516	0.0014
= GSC 3103.919 =	-	51311.7397	0.0013	= GSC 3142.528	s	51306.688	0.005
= J181521.82+390544.8				J193206.64+523706.3 =	p	51295.843	0.002
J181941.87+501037.3 =	p	51274.858	0.010	= GSC 3921.991	s	51311.724	0.005
= GSC 3533.1400				J193658.15+474828.1 =	-	51257.8458	0.0015
J182102.31+443841.1 =	p	51305.710	0.004	= GSC 3560.1105	-	51277.859	0.004
= GSC 3116.1047 =	s	51323.864	0.002				
= J182102.34+443840.5							

Table 2: Basic parameters of eclipsing binaries light curves

ROTSE1 Variable	Type	Period (days)	$m_{\rm max}$	$m_{\rm p}$ (mag)	$m_{\rm s}$	Remarks
J123201.49+352959.7	EB:	0.30599(2)	13.6	14.4	14.2	
J123309.33+375820.2	EA	0.49498(5)	12.7	13.2:	12.8	pronounced reflection effect ($0^{\rm m}.2$)
J123730.26+260451.8	EW	0.35684(5)	12.8	13.3	13.2	$d_{\rm p} = 0^{\rm p}.09$, $d_{\rm s} = 0^{\rm p}.11$
J125214.17+385630.8	EB	0.64244(9)	12.0	12.3	12.2	
J133619.29+292341.1	EA	1.24931(2)	12.5	13.2	12.6:	$D = 0^{\rm p}.09$:
J140916.76+383732.0	EW:	0.42695(7)	12.3	12.6	-	
J141451.43+273415.3	EW	0.65957(8)	11.9	12.3	12.2	
J143723.34+380442.7	EA	1.0335(2)	11.3	11.8	11.4	$D = 0^{\rm p}.15$, $d = 0^{\rm p}.03$
J143820.20+363225.6	EA	0.47778(2)	10.3	10.8	10.7	$D = 0^{\rm p}.17$
J144005.64+263401.6	EA	3.198(1)	10.8	11.2	11.1	$D = 0^{\rm p}.18$, $d = 0^{\rm p}.04$
J145312.48+284221.4	EA	3.077(2)	12.0	12.4	12.1:	$D = 0.09$
J145730.93+240251.4	EB	0.81880(7)	11.1	11.4	11.15	
J150029.61+334021.7	EA	1.25695(6)	11.4	12.0	>11.5	$D = 0^{\rm p}.14$:
J151726.64+381336.3	EB	0.56896(7)	12.1	12.4	12.3	
J152155.16+335604.1	EA	0.48872(2)	13.1	13.7	13.7:	$D = 0^{\rm p}.10$
J161005.08+253654.9	EA	0.53083(2)	12.5	13.2	13.1	$D = 0^{\rm p}.15$
J161050.39+372857.0	EA	0.7037(1)	12.8	13.5	13.0	$D = 0^{\rm p}.18$
J162108.79+253924.1	EA	0.5615(2)	12.1	>12.5	12.2:	$D = 0^{\rm p}.16$:, $d \neq 0^{\rm p}$(?)
J163153.48+252717.2	EB	0.8292(3)	12.2	12.6	12.4	
J163213.55+133847.6	EA	2.324(1)	12.0	12.4	12.1	$D = 0^{\rm p}.16$
J163516.73+124618.9	EA	1.0538(7)	12.0	>12.2		$D = 0^{\rm p}.11$:
J164508.42+203701.5	EA	1.4367(3)	12.1	12.5	12.45	$D = 0^{\rm p}.12$
J164755.15+351756.5	EB	0.6853(3)	13.4	13.7	13.6	
J165039.95+274420.0	EW	0.29802(1)	11.8	12.4	12.25	
J165241.80+124905.2	EA	0.81526(8)	13.0	14.0:	13.5	$D = 0^{\rm p}.12$:
J165252.60+383930.6	EA	0.9712(2)	10.9	>11.4	11.2	$D = 0^{\rm p}.14$
J165551.74+245335.9	EW	0.39165(3)	11.6	12.1	12.0	
J165656.96+291907.1	EA	1.3015(2)	12.0	12.3	12.15	$D = 0^{\rm p}.18$:
J165819.76+334022.8	EW	0.26818(1)	11.8	12.4	12.3	noticeable O'Connell effect
J165924.08+151220.7	EA	0.50779(3)	12.4	13.0	12.8:	$D = 0^{\rm p}.17$, RS CVn-like wave

Table 2: (cont.)

ROTSE1 Variable	Type	Period (days)	m_{max}	m_{p} (mag)	m_{s}	Remarks
J165930.95+191256.1	EA	1.1137(2)	12.5	13.0:		$D = 0^{\mathrm{P}}.14$:
J170101.20+492314.7	EA	1.1143(3)	11.6	>12.1	11.8	$D = 0^{\mathrm{P}}.21$
J170250.47+213959.0	EB	0.51115576	12.0	13.1	12.45	see Lubcke et al., 2000
J170610.49+495523.6	EA:	0.41035(2)	13.3	>14.0		four discordant measurements
J170922.13+123957.6	EA	1.3276(2)	11.8	12.3	12.3:	$D = 0^{\mathrm{P}}.17$
J171059.94+461719.7	EB	0.51024(5)	10.9	11.4	11.15	
J171130.30+231411.2	EA	4.211(4)	12.5	12.95	12.55:	$D = 0^{\mathrm{P}}.17$:
J171642.01+212305.9	EB	0.7273(1)	10.8	11.2	11.0	
J171649.91+382159.8	EA:	1.4736(6)	12.4	12.9	12.55	$D = 0^{\mathrm{P}}.17$
J171727.89+271301.9	EB	0.5582(1)	12.5	12.8	12.7	
J171824.82+222850.0	EW	0.37084(3)	12.2	12.65	12.55	
J172007.77+133956.4	EB	0.6483(1)	11.9	12.3	12.1	
J172142.55+405423.5	EB	1.876(1)	10.2	10.3	10.25	
J172303.57+175701.2	EA	0.9434(1)	11.8	12.2	12.1	$D = 0^{\mathrm{P}}.14$
J172441.74+135356.5	EW	0.45757(4)	11.3	11.8	11.7	noticeable O'Connell effect
J172601.97+304710.4	EA	10.93(5)	12.6	13.8	12.8	$D = 0^{\mathrm{P}}.10$:
J172659.31+244147.6	EA	0.59943(6)	11.9	12.4	11.95	$D = 0^{\mathrm{P}}.23$
J172741.29+274503.5	EA	1.5768(7)	12.1	12.8		$D = 0^{\mathrm{P}}.26$:, period to be doubled?
J172817.01+211557.0	EA	1.2979(3)	11.4	12.0:		$D = 0^{\mathrm{P}}.17$
J173621.16+303212.7	EA	1.658(2)	10.8	11.0		$D = 0^{\mathrm{P}}.14$:
J173921.13+354208.6	EW	0.34314(7)	11.3	11.6	11.55	
J174103.55+273429.1	EW	0.39782(2)	11.5	12.1:	12.0	
J174150.84+475104.3	EB	0.53950(5)	11.8	12.3	12.0	
J174323.11+475142.3	EW:	0.39426(4)	12.4	13.0	12.85	
J174555.29+523805.8	EB	0.61210(7)	12.0	12.55	12.3	
J174743.80+463230.6	EB	0.48667(7)	12.3	13.0	12.7	
J174953.04+370839.6	EA	1.2661(2)	12.0	13.5	12.05	$D = 0^{\mathrm{P}}.26$:
J175852.80+481025.0	EB	0.53778(6)	11.3	11.75	11.55	
J175909.41+493607.4	EA	0.58802(9)	12.7	13.2	12.85	$D = 0^{\mathrm{P}}.23$
J181521.80+390545.4	EA	1.2396(1)	11.9	12.3	12.25	$D = 0^{\mathrm{P}}.13$
J181941.87+501037.3	EA	0.64596(2)	11.6	>13.0		$D = 0^{\mathrm{P}}.28$:
J182102.31+443841.1	EA	1.2524(1)	11.7	12.3	12.2	$D = 0^{\mathrm{P}}.16$
J182138.35+421008.6	EA	0.9927(1)	10.6	11.0		$D = 0^{\mathrm{P}}.14$, l. c. very unevenly sampled
J182301.05+400833.0	EW	0.8706(2)	10.8	11.3	11.3	pronounced O'Connell effect
J183907.69+415653.5	EB	0.53355(8)	12.3	12.7	12.6	
J185343.48+372338.0	EW	0.7870(2)	12.7	13.0:	13.0:	poorly sampled light curve
J185901.50+522814.9	EA	7.60(1)	12.2	12.6	12.35	$D = 0^{\mathrm{P}}.11$, RS CVn-like wave
J191518.85+522933.9	EA	0.9716(8)	11.4	11.8	11.7	$D = 0^{\mathrm{P}}.14$
J191533.92+443704.9	EA	1.0617(1)	10.5	11.1	10.8:	$D = 0^{\mathrm{P}}.12$:
J192506.85+455603.1	EA	1.0729(1)	12.1	12.6	12.5	$D = 0^{\mathrm{P}}.15$
J192531.82+425110.1	EW	0.6962(2)	11.6	12.0	11.9	
J193206.64+523706.3	EB	0.9072(2)	11.6	12.1	11.9	
J193658.15+474828.1	EA:	0.8170(1)	11.5	11.75	11.7	$D = 0^{\mathrm{P}}.14$:

We would like to express our gratitude towards the ROTSE1 team for making their data available to the general public. In addition, the cross-reference table provided by B. Skiff through M. Baldwin of the AAVSO is thankfully acknowledged. It proved to be very helpful for the identification of the ROTSE1 sources.

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MAXIMA OF THE SX PHOENICIS STAR BL CAMELOPARDALIS

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We report here a total of 56 times of maximum light for the multiperiodic SX Phe star BL Cam (Zhou et al. 1999). The maxima were collected at the Xinglong Station of Beijing Astronomical Observatory in 1999. The observations were carried out with a red-sensitive Thomson TH7882 576 × 384 CCD photometer (Wei et al. 1990; Zhou et al. 2001) attached to the 85-cm Cassegrain telescope. A Johnson V filter was used. The CCD has an imaging size of 13.25×8.83 mm^2 corresponding to a sky field of $12'\!.3 \times 8'\!.4$ ($1''\!.2$/pixel, a pixel size is 23 μm^2). Four stars in the field of BL Cam were selected as references. They are

C1 = GSC 4067_0554 ($RA = 03^{\mathrm{h}}47^{\mathrm{m}}13^{\mathrm{s}}\!.74$, $DEC = 63^\circ 21' 17''\!.3$, 2000.0, 13.8 V),
C2 = GSC 4067_0077 ($RA = 03^{\mathrm{h}}47^{\mathrm{m}}13^{\mathrm{s}}\!.67$, $DEC = 63^\circ 20' 50''\!.0$, 2000.0, 12.1 V),
C3 = GSC 4067_0071 ($RA = 03^{\mathrm{h}}47^{\mathrm{m}}04^{\mathrm{s}}\!.77$, $DEC = 63^\circ 24' 10''\!.4$, 2000.0, 11.7 V),
C4 = GSC 4067_0748 ($RA = 03^{\mathrm{h}}46^{\mathrm{m}}46^{\mathrm{s}}\!.00$, $DEC = 63^\circ 21' 27''\!.7$, 2000.0, 12.0 V).

Exposure times ranged from 30 to 70 s, depending on the nightly condition of seeing. The atmospheric extinction was not taken into account in view of the close spacing of the observed stars. The differential colour effect between the variable and the reference stars are largely eliminated by taking the mean combination of the latter. Hence the differential magnitudes of BL Cam are calculated relative to the four comparison stars as $V - (C1 + C2 + C3 + C4)/4$. The magnitude differences between the comparison stars generally show a typical standard deviation of $0^{\mathrm{m}}\!.010$. For the nights of good seeing a better value of about $0^{\mathrm{m}}\!.006$ was obtained. These four comparison stars were detected to be non-variables at the accuracy of observation.

Figure 1 gives the differential V light curves versus Heliocentric Julian Day from 21 October 1999. We determined the times of maximum light by second-order polynomial fitting the points around each peak of the light curves. The error of the determination is about 0.00035 days. The times of maxima are listed in Table 1. The maxima are helpful for the study of period change. One may use the new maxima together with those available in the literature to improve the period behaviour of BL Cam. We hope to publish a thorough investigation on the amplitude and period variability of this star when collecting additional time-series data after a span of a couple of years.

Table 1: New times of maximum light for BL Cam. Cycle numbers (E) and $O-C$ values were calculated with the ephemeris $\mathrm{HJD_{max}} = 2443125.8048 + 0.03909760 \times E$ (McNamara & Feltz 1978)

HJD 2451000.0 +	E	$O-C$	HJD 2451000.0 +	E	$O-C$
416.30826	212046	0.01377	470.38297	213429	0.01650
416.34776	212047	0.01417	471.20348	213450	0.01596
436.32804	212558	0.01558	471.24214	213451	0.01552
441.25489	212684	0.01613	472.18199	213475	0.01703
441.29337	212685	0.01551	472.22119	213476	0.01713
441.33240	212686	0.01545	472.25928	213477	0.01612
466.23884	213323	0.01672	472.29851	213478	0.01626
466.27836	213324	0.01714	472.33891	213479	0.01756
466.31781	213325	0.01749	473.19747	213501	0.01597
466.35692	213326	0.01750	473.23787	213502	0.01727
467.21695	213348	0.01739	473.27597	213503	0.01628
467.25568	213349	0.01702	473.31483	213504	0.01604
467.29362	213350	0.01586	473.35369	213505	0.01580
467.33312	213351	0.01626	473.39256	213506	0.01557
467.37262	213352	0.01666	474.21313	213527	0.01509
468.23237	213374	0.01627	474.25381	213528	0.01668
468.27059	213375	0.01539	474.33187	213530	0.01654
468.30996	213376	0.01566	479.14052	213653	0.01619
468.34972	213377	0.01632	479.18032	213654	0.01689
469.21109	213399	0.01755	479.21971	213655	0.01718
469.24992	213400	0.01728	479.25726	213656	0.01563
469.28797	213401	0.01623	479.29727	213657	0.01655
469.32718	213402	0.01634	479.33645	213658	0.01663
469.36754	213403	0.01761	479.37564	213659	0.01672
470.22616	213425	0.01608	480.15712	213679	0.01625
470.26449	213426	0.01531	480.19609	213680	0.01612
470.30322	213427	0.01494	480.23456	213681	0.01549
470.34392	213428	0.01655	483.16685	213756	0.01546

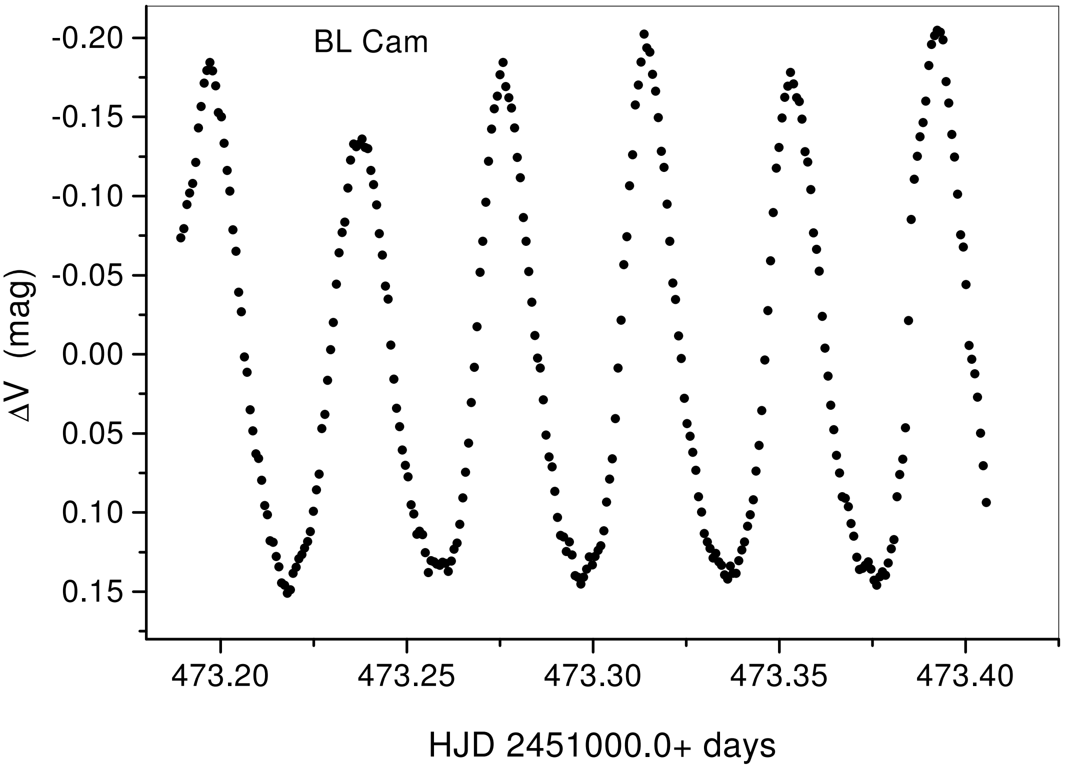

Figure 1. The CCD differential V light curves (dots) of BL Cam from 21 October 1999

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PRE-DISCOVERY PHOTOMETRY OF THE γ DORADUS-TYPE PULSATING STAR HR 8330 (= HD 207223)

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Recently Kaye et al. (1999) presented B, V photometry and spectroscopy of HR 8330 (HD 207223; $V = 6\overset{\mathrm{m}}{.}18$; $B - V = +0.37$; F2 V-IV) that show it to be a γ Doradus-type pulsating variable star. The photometry was carried out during 1997/98 and shows that HR 8330 to have phased, low amplitude sinusoidal light and radial velocity variations with a period of $P \sim 2\overset{\mathrm{d}}{.}6$. As discussed by Kaye et al. (1999) and references therein, γ Dor stars are a newly discovered class of generally young $\sim$ F0-2 V to V-IV stars having periods that range from $0\overset{\mathrm{d}}{.}4$ to 3^{d}. These stars are generally characterized by low amplitude light variations ($< 0\overset{\mathrm{m}}{.}03$ in V) and small radial velocity variations of several $\mathrm{km\,s^{-1}}$. So far about a dozen stars have been identified as bona-fide γ Dor variables, along with an additional number of suspected members of this class. The exact nature of the pulsations in these stars is not well understood but they are thought to be due to photospheric non-radial pulsations (NRP). The simultaneous photometry and high dispersion spectroscopy carried out by Kaye et al. (1999) strongly suggests, at least for HR 8330, that non-radial g-mode pulsation is the cause of the observed periodic light and radial velocity variations.

Our photometry of HR 8330 was carried out over two intervals in 1995. Most of the observations were made on 26 nights between 29 May–5 July, 1995. Six nights of additional photometry were obtained from 26 September to 2 December, 1995. HR 8330 was not the primary target of this study but was originally used as a check star for the photometric study of the young, spotted solar-type star HN Peg. The differential photoelectric photometry was made using the 0.75-m Four College Automatic Photoelectric Telescope (located in southern Arizona) and a set of filters closely matched to the Strömgren *uvby* photometric system. The usual observing pattern of *sky–comparison–check–variable–comparison–sky* was employed. 13 Peg (HD 207652; F2 IV; $V \approx 5\overset{\mathrm{m}}{.}32$; $B - V = +0.37$) served as the primary comparison star. Several Strömgren standards were also observed on most nights.

The stars were observed with integration times of 10 seconds for about 25 minutes per night. Typically two independent measures of HR 8330 were obtained each night. The observations were reduced in the usual way and the delta-magnitudes were corrected for differential atmospheric extinction and recorded times were converted to Heliocentric Julian Day Number. About 55–60 differential measures of HR 8330 were obtained in each bandpass. The differential photometry of HR 8330 relative to 13 Peg indicated somewhat larger than expected scatter ($\sim \pm 0\overset{\mathrm{m}}{.}015$) in the measured deltamags. However, a closer

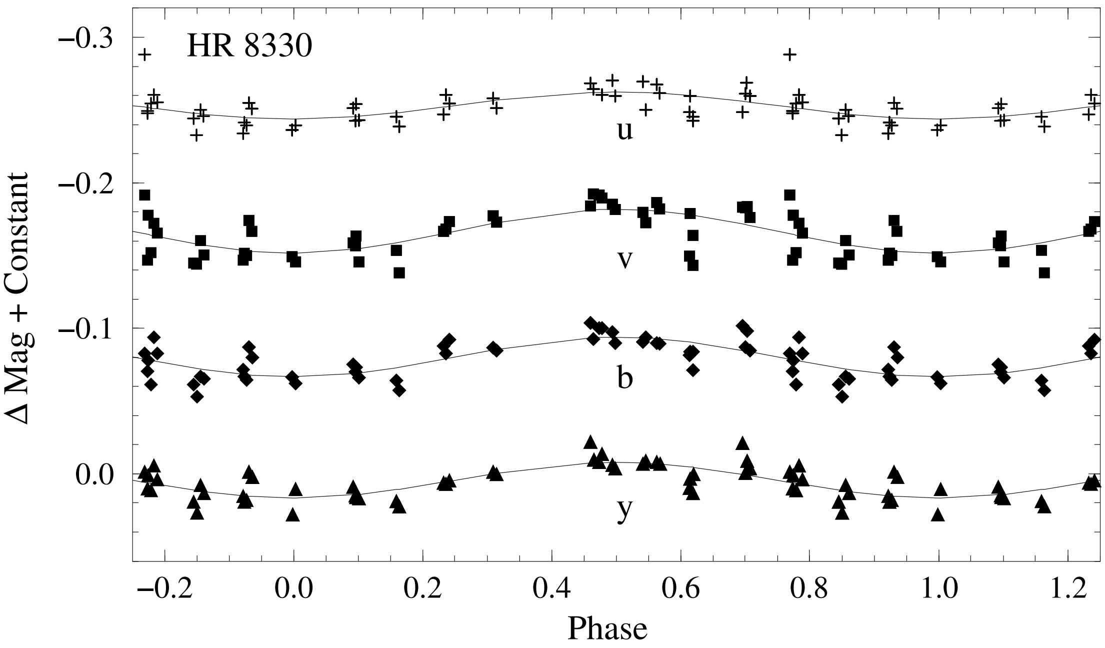

Figure 1. The differential *uvby* observations of HR 8330 are plotted against pulsation phase using the period of $P = 2\overset{d}{.}59396$. Phase 0.0 is adjusted to occur at brightness minimum. The curves plotted among the observations are least squares Fourier fits to the data sets.

scrutiny of the photometry using several constant standard stars revealed that HR 8330 has small ($0\overset{m}{.}02$–$0\overset{m}{.}03$) light variations and that 13 Peg (at least over the interval of our observations) was constant in brightness to < 8 mmags. The apparent constant nature of 13 Peg indicated by our limited photometry is supported by Hipparcos photometry which lists values of $\sigma_{\rm Hip} = 0\overset{m}{.}0007$ and Hipparcos "scatter" measure of 6 mmags.

It should be noted, however, that 13 Peg may not be an ideal comparison star because it is an astrometric binary (COU 14; $P = 26.1$ yr; $a = 0\overset{\prime\prime}{.}366$ arcsec; $\delta{\rm mag}_{\rm Hip} = 1\overset{m}{.}1$) in which the fainter companion has been reported to be a variable star (see Tamazian et al. 1999). Also, we note that 13 Peg is included in the New Catalog of Suspected Variable Stars (NVS 13891; Kukarkin et al. 1982). The inclusion of 13 Peg in the NCSVS is due to the assignment of $V = 6.16$ for the star from the photometry of Fernie (1976). This value is quite different from the value of $V \sim 5\overset{m}{.}32$ found from other photometric studies before or after that time. For example, from our study, and transforming y to V, we also find that $V = 5\overset{m}{.}32 \pm 0\overset{m}{.}01$ for 13 Peg. We suggest a possible solution to this apparent puzzle. It turns out that HR 8330 and 13 Peg have nearly the same declinations and have right ascensions that differ by ~ 4 min. Moreover, both stars have nearly identical spectral types and colors. However, as given above, the mean V-mag of HR 8330 is $V \sim 6\overset{m}{.}18$ and $B - V = +0.37$, which are nearly identical to the values of $V = 6\overset{m}{.}16$ and $B - V = +0.35$ reported by Fernie for 13 Peg. Thus, we tentatively suggest that the V, $B - V$, and $U - B$ values given by Fernie (1976) may be actually those of HR 8330 instead of 13 Peg. Of course, more observations are needed to resolve this problem. But for the purposes of this paper and in a separate paper on HN Peg, we consider 13 Peg as the primary comparison star. For long term studies, we do not recommend using 13 Peg as a comparison star until the problem of the possible variability of its fainter companion is fully resolved.

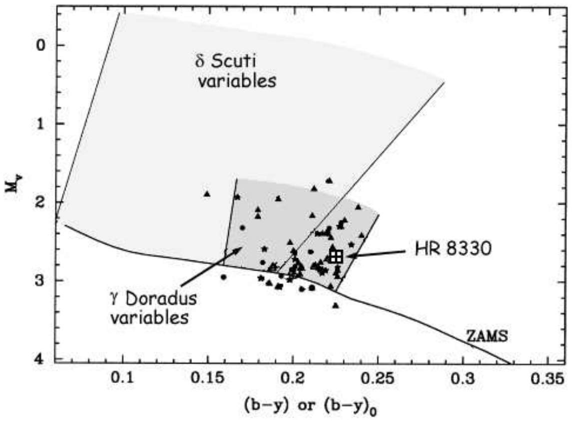

Figure 2. The location of HR 8330 in the $M_{\rm v}$–$(b-y)$ diagram (adapted from Handler 1999) is shown along with the regions occupied by δ Scuti variables and γ Dor variables (and candidates). As shown HR 8330 is located about $0\overset{\mathrm{m}}{.}5$ above the Zero Age Main Sequence (ZAMS), in a region where γ Dor stars are typically found

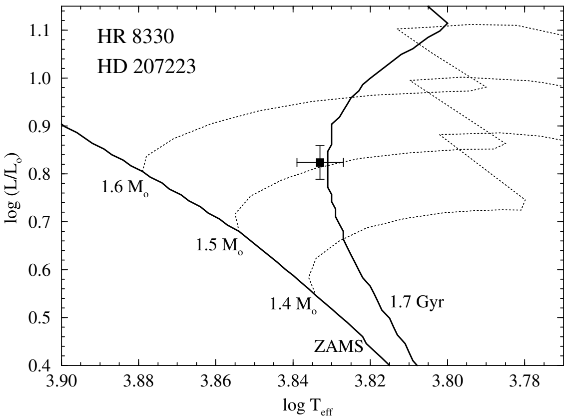

Figure 3. The location of HR 8330 in the $\log(L/L_\odot)$–$\log T_{\rm eff}$ diagram is shown. The evolution tracks from Schaller et al. (1992) are shown for $1.4M_\odot$, $1.5M_\odot$, $1.6M_\odot$ stars. The best fit of the observations to the models indicates a mass of $M \approx 1.5M_\odot$ and an evolutionary age of $\tau \approx 1.7$ Gyr

After the discovery of HR 8330 as a γ Dor-type variable by Kaye et al. (1999), we re-examined our photometry and phased the observations with their light elements:

$$T_{\min} = \mathrm{HJD}\ 2450758.440 + 2\overset{\mathrm{d}}{.}59396 \times E.$$

The observations, plotted against phase using this ephemeris, clearly show low amplitude sinusoidal light variations similar to those published by Kaye et al. (1999). Plots of differential u, v, b, y δ-mags (HR 8330 minus 13 Peg) with least squares Fourier fits to the data sets are shown in Figure 1. The light curves were first constructed using just the May–July 1995 observations. As seen in the figure, HR 8330, unlike most other γ Dor stars, lacks a significant systematic wavelength dependence. The following are the computed light amplitudes found from least squares fits: u (Ampl. $= 0\overset{\mathrm{m}}{.}018 \pm 0\overset{\mathrm{m}}{.}009$), v (Ampl. $= 0\overset{\mathrm{m}}{.}030 \pm 0\overset{\mathrm{m}}{.}008$) b (Ampl. $= 0\overset{\mathrm{m}}{.}028 \pm 0\overset{\mathrm{m}}{.}006$) and y (Ampl. $= 0\overset{\mathrm{m}}{.}024 \pm 0\overset{\mathrm{m}}{.}005$). Several other γ Dor-type stars show multiple periods (e.g., see Zerbi et al. 1997 and Kaye and Zerbi 1997) but there is no evidence for this for HR 8330 from the 1995 or the 1997–98 observations. However, additional periods could be present but they would be difficult to detect because the brightness range for HR 8330 is relatively small and the number of observations too few.

The observations were analyzed with the Scargle-Press power spectrum program (Scargle 1982). In carrying out the period study, we used the more heavily populated May-July 1995 data subsets. Although the u, v, b, y observations were analyzed, the strongest signals of a period were found for v, b, and y data sets, so these were used to determine the period. The mean period for the 1995 observations found from the power spectrum analysis is thus: $P_{1995-\mathrm{ptm.}} = 2\overset{\mathrm{d}}{.}603 \pm 0\overset{\mathrm{d}}{.}004$. This period is very close to the mean period found by Kaye et al. (1999). We tried to improve the photometric period by adjusting the period to make the 1995 photometry phases of minimum and maximum light to agree with the 1997–98 observations. Using the light elements of Kaye et al. (1999), we found that the minimum light occurred near $(0.05 \pm 0.03)P$. The period that yielded the best fit is $P_{1995-98\ \mathrm{ptm.}} = 2\overset{\mathrm{d}}{.}593464$. For future photometry of HR 8330, we recommend using the time of light minimum $T_{\min}$ from Kaye et al. and the above period found from a time baseline of 3 years.

The location of HR 8330 in the M_{V}–$(b-y)$ diagram, plotted along with the regions occupied by δ Scuti and γ Dor stars, is shown in Figure 2. This figure was adapted from Handler (1999) and the value of $M_{\mathrm{V}} = +2\overset{\mathrm{m}}{.}67 \pm 0\overset{\mathrm{m}}{.}04$ is calculated from the Hipparcos parallax of $\pi_{\mathrm{Hip}} = 19.9 \pm 0.8$ mas and $V = 6\overset{\mathrm{m}}{.}18$. The value of $(b-y) = +0\overset{\mathrm{m}}{.}226$ was obtained from SIMBAD and agrees well with our value for this index. As shown in Fig. 2, HR 8330 is located about $0\overset{\mathrm{m}}{.}5$ above the main-sequence in a region of the M_{V}–$(b-y)$ diagram where γ Dor variables are typically located. The mass and evolutionary age of HR 8330 are also estimated using the stellar evolution grids of Schaller et al. (1992). From the Strömgren indices $(b-y) = +0.226$, $m1 = 0.164$, $c1 = 0.632$ and $\beta = 2.705$ from SIMBAD, and using the Strömgren photometry-T_{eff} calibrations of Napiwotzki (1997), values of $T_{\mathrm{eff}} = 6800 \pm 100$ K and [Fe/H] = 0.02 were obtained. Applying the small bolometric correction of BC = $0\overset{\mathrm{m}}{.}02$ from Flower (1996), the values of $M_{\mathrm{Bol}} = 2\overset{\mathrm{m}}{.}69 \pm 0\overset{\mathrm{m}}{.}04$ and $\log L/L_{\odot} = 0.824 \pm 0.035$ are computed. With the computed values of $\log L/L_{\odot}$, $\log T_{\mathrm{eff}}$, and [Fe/H] and using the evolution grids of Schaller et al. (1992), the following stellar properties were derived: $M = (1.50 \pm 0.05)M_{\odot}$, $\log g = 4.07 \pm 0.06$, $R = (1.87 \pm 0.25)R_{\odot}$, and age $(\tau) = 1.7 \pm 0.4$ Gyr. HR 8330 is plotted in Fig. 3, in the theoretical $\log L/L_{\odot}$ vs. $\log T_{\mathrm{eff}}$ plot from Schaller et al. (1992). The values found by us for HR 8330 are very similar to those given in Table 1 of Kaye et al. (1999). The small differences arise primarily from the differences in the Strömgren system calibrations and in the evolutionary models or relations used. As shown in the figure, HR 8330 is evolved off the main-sequence and has a mass, age and T_{eff} appropriate for its spectral type of F2 V-IV. Unlike a number of other γ Dor stars, which appear young, HR 8330 is evolved.

In summary, we confirm the identification of HR 8330 as a γ Dor-type variable star and give a more refined period for the star from the analysis of the 1995 and 1997–98 observations. In addition we have estimated the physical properties and evolutionary age of HR 8330. Although we find no evidence of variability of the comparison star, 13 Peg, we recommend that this star not be used as a comparison star for studying HN Peg or HR 8330 in the future. A safer choice for a comparison star is HD 209166 ($V = 5\overset{\mathrm{m}}{.}60$; $B-V = 0.34$; F4 III). HD 209166 was used by Kaye et al. (1999) and found to be constant in brightness.

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A SPECTRUM OF R CrB DURING RECOVERY FROM 2000 MINIMUM

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The eponym of the R Coronae Borealis stars was observed by V. Klochkova, V. Panchuk and M. Yushkin with the prime focus echelle spectrometer of a 6-m telescope (Panchuk et al. 1998) on 7 January, 2001 during a program not directly devoted to R CrB stars. At the moment of these observations the star happened to be in the recovery state after a quite deep ($V \sim 13$ in minimum) brightness decline which started 53 days earlier according to AFOEV (2001) data.

The spectra were obtained with a spectropolarimetric device attached before the slit and each set of exposures consists of two exposures with different position of the analyser of linear polarization. In this note, however, the polarization measurements are not addressed. The spectra cover the wavelength region $\lambda\lambda$ 5000–6600 with the resolution $R \approx 12000$. The reduction of the spectra was performed using the image reduction system IRAF[†].

The 2000 decline started only about 260 days after the recovery from the previous very deep decline and therefore it is not clear whether some residual effects of that decline were present. Before the 1995–1996 decline which was thoroughly discussed by Kameswara Rao et al. (1999) the star stayed at its maximum brightness for much longer time.

Our spectra reveal most of the spectroscopic components found in earlier accounts:

1. Sharp emission lines. The low excitation lines of Sc II, Ti II, Fe II, Fe I, Mg I, Y II and Ba II were observed in emission. These are the lines belonging to the type E2 according to Alexander et al. (1972). The radial velocity measured from those lines is 16.8 ± 2.5 km s^{-1}.

The mean systemic velocities published for different observations differ more than the stated errors. We adopt the mean value of 22.5 km s^{-1} (Kameswara Rao et al. 1999). In that case the sharp emission lines show a blueshift around 6 km s^{-1} which is very close to the value of 4 km s^{-1} reported by Kameswara Rao et al. (1999) and this supports their suggestion that the sharp emission lines are the permanent features.

The onset of the decline on JD 2451863 started at maximum light of the pulsational variations, or more precisely, the brightness smoothly followed the cosine curve from its maximum to decline. Photometrically, the last cycle before the onset of decline is better distinguishable than the previous ones.

Here raises a question how the systemic velocity compares with the photospheric velocity. If the photospheric radial velocity at the onset of decline had its maximum value

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[†] 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.

as for the 1995–1996 decline and the radial velocity has the period of about 43 days with the range of 6 $\mathrm{km\,s^{-1}}$ (Kameswara Rao et al. 1999) we could expect that at the moment of our observations ($\phi = 1.23$) the photospheric radial velocity should have been at its mean value. This assumption is, however, not fully justified. The fadings of R CrB and its radial velocity variations are not found to be locked to photometric phases (Fernie 2000).

Many authors have found that the pulsational period in the photometric variation of R CrB is itself variable (e.g. Lawson & Kilkenny 1996). Now, more data on R CrB photometry is available. We analysed for periodicities the photometry from the full time interval covered by AAVSO Monographs (1963–1995) (Mattei et al. 1991 & 1996) and AFOEV Database (1995–2000), excluding obvious light declines. As a tool a set of codes ISDA for irregularly spaced data analysis developed by Pelt(1992) was used. The mean period of 45.5 days was found for 1993–2000. The shorter intervals limited by the fadings gave very much different periods spanning from 35.3 to 51.4 days confirming the earlier results by other authors. The time dependence of those periods was also studied. There is a slight indication that these periods themselves vary cyclically with a timescale around 3.3 years or its multiples.

All sharp emission lines show an inverse P Cygni profile. In Fig. 1. some of these lines are shown. The mean differential velocity between the emission core and the redshifted absorption minimum is $\Delta v_{\rm r} = 42.0 \pm 2.5$ $\mathrm{km\,s^{-1}}$.

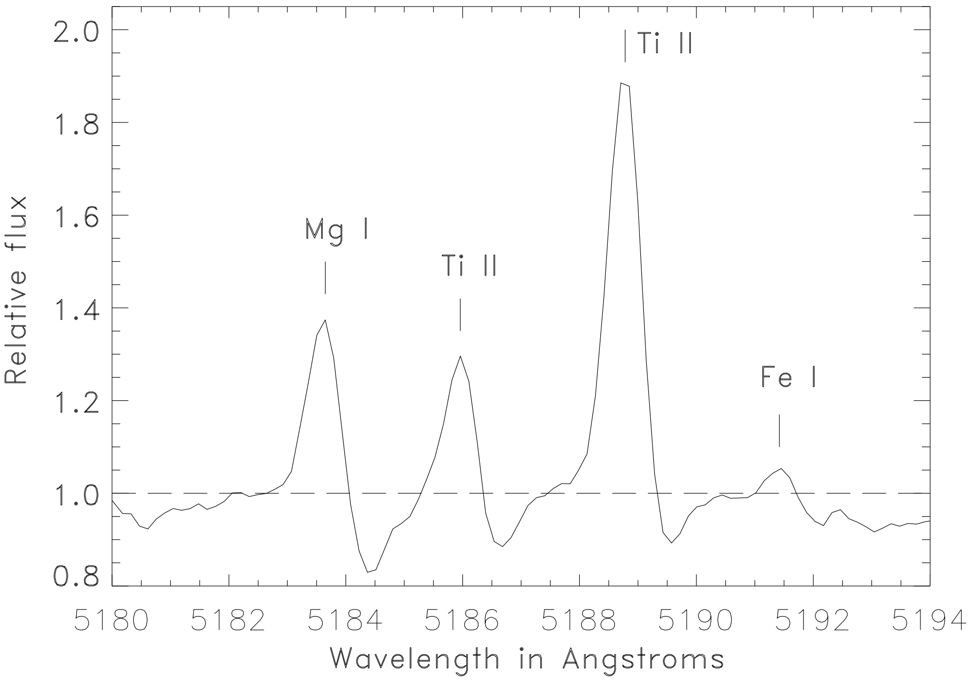

Figure 1. The group of sharp emission lines at λ 5190. Note the large (42 $\mathrm{km\,s^{-1}}$) redshift of the absorption components

2. Photospheric absorption lines. Along with the emission lines the star showed a rich absorption spectrum. The strongest lines belonged to C I. Other lines included Fe I, Fe II, Cr I, O I, Mg I, Na I, and Si II. The mean radial velocity found from these lines is 38.4 ± 3.2 km s^{-1} without any noticeable dependence from the line strength and excitation potential. Compared with the mean systemic velocity this corresponds to the redshift of around 16 km s^{-1}. The explanation of this redshift was proposed by Kameswara Rao et al. (1999) as the effect of multiple scattering of the photospheric photons by the circumstellar dust moving out from the star. The effect was in details studied by Van Blerkom & Van Blerkom (1978) and shown to depend both on the optical and geometrical parameters of that cloud. Therefore from this single datum the expansion velocity of the cloud could not be determined.

Returning to the redshifted absorption components of the sharp emission lines one could expect that those are the absorption lines corresponding to the emission lines and are also redshifted due to the scattering. Vanture & Wallerstein (1995) explained the similar pseudo-P Cygni profiles in the spectrum of RY Sgr on the recovery phase as the superposition of blueshifted emission lines and photospheric lines at the systemic velocity. However, in our case the redshift of these absorption components compared to the photospheric velocity is much larger (around 36 km s^{-1}) than the other absorption lines (16 km s^{-1}). Therefore the scattering in the same clouds could not explain these results.

3. Molecular emission. The emission in C_2 (0,0) λ 5165, (0,1) λ 5635 and (0,2) λ 6191 bands was visible but too weak for radial velocity measurements.

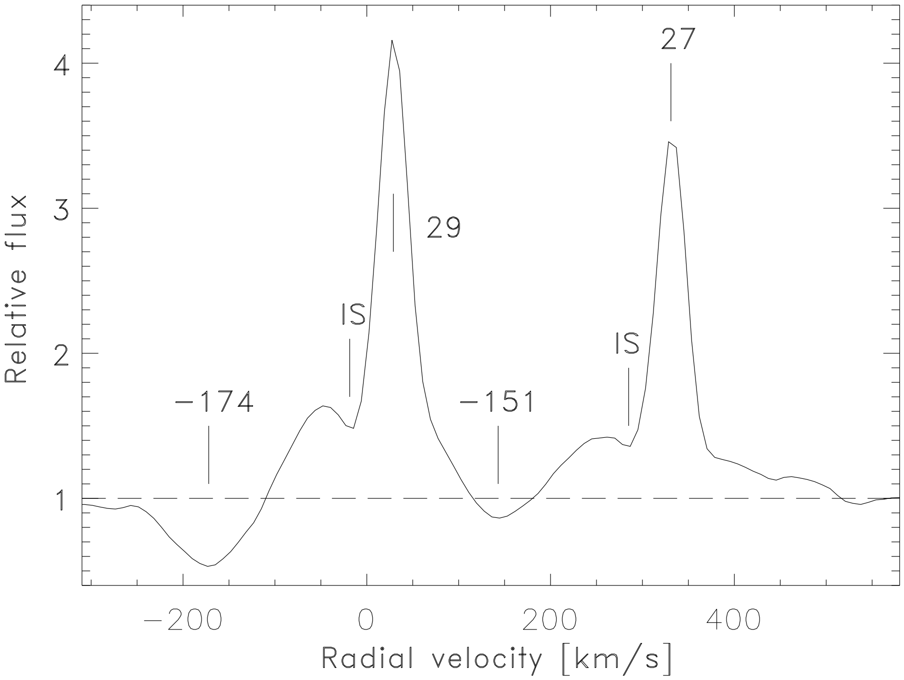

Figure 2. Na I doublet in the spectrum of R CrB in velocity scale. The sharp and broad emission components and interstellar and high speed absorptions are visible and their radial velocities indicated

4. Broad emission lines. From the category of broad emission lines only the broad components of Na I doublet were observed. Fig. 2. shows the Na I doublet. The full width at its base of D_1 is almost 400 km s^{-1}. The width of D_2 is about a half of that due to blending with the absorption in D_1. The radial velocity of the blueshifted absorption component of D_2 is -174 km s^{-1} measured at the deepest point of the profile. The full width at the continuum level is 133 km s^{-1}. The He I λ 5876 line, which showed broad emission during the 1995–1996 decline (Kameswara Rao et al. 1999), was present in absorption.

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References:

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GSC 8527-373: A NEW DELTA SCUTI VARIABLE

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Name of the object:
GSC 8527-373

Equatorial coordinates:	**Equinox:**
R.A.= $05^h35^m12\overset{s}{.}1$ **DEC.=** $-58^\circ 01' 08\overset{''}{.}3$	J2000

Observatory and telescope:
Regent Lane Observatory, 0.35-m Schmidt–Cassegrain telescope

Detector:	Santa Barbara Instruments Group ST6B
Filter(s):	None, roughly *R*
Comparison star(s):	GSC 8527-378
Transformed to a standard system:	No

Availability of the data:
Upon request. Data are available for the following nights: 6–9, 12, 21, and 26 December 2000; 3, 13, 17, 26 January, and 7–8 February 2001

Remarks:

The variability of GSC 8527-373 was first recognized while reducing data obtained on the night of February 7, 2001 while monitoring the CV variable TW Pictoris as part of the Center for Backyard Astrophysics program of investigating CV stars. Poor positioning of the telescope resulted in GSC 8527-373 being chosen as a check star, and it was then noticed that it was varying. Since TW Pictoris had been monitored since December 6, 2000, there were a large number of nights with data on the new variable. The best data available were from the first nights that the program on TW Pictoris was commenced. Analysis of the data yields an ephemeris of

$$\mathrm{HJD}\ 2451885.00015 + 0\overset{d}{.}0796766 \times E. \qquad (1)$$

Since the amplitude of GSC 8527-373 is less than $0\overset{m}{.}2$ as measured in the unfiltered camera-telescope system, and the period is less than 2 hours, this would suggest that the star is probably a δ Scuti type variable.

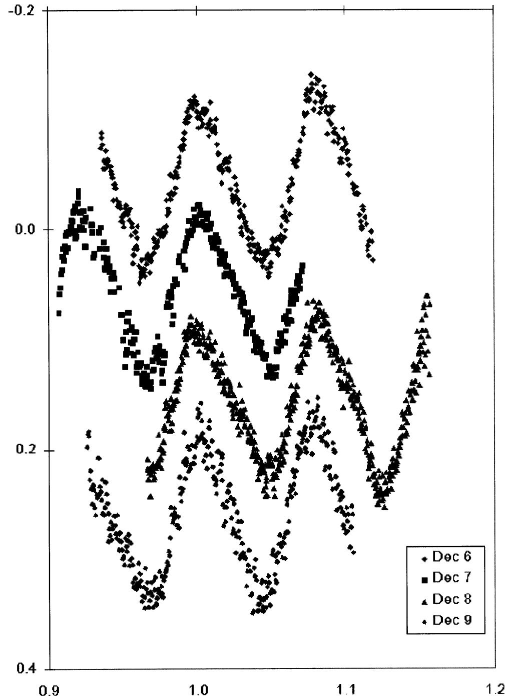

Figure 1. Unfiltered CCD measures on the nights of December 6–9. These have been fitted to ephemeris (1). The night of December 6 is shown at the actual Variable−Comparison values, the remaining nights are offset by $0\overset{\mathrm{m}}{.}1$, $0\overset{\mathrm{m}}{.}2$ and $0\overset{\mathrm{m}}{.}3$, respectively. The time scale is in fractional JD but the daily starting points have been adjusted to fit the ephemeris

Acknowledgements:

The author would like to acknowledge the assistance of the following individuals in the preparation of this paper:

Stan Walker, Wharemaru Observatory, Kaitaia, New Zealand, for his reduction of the data to heliocentric dates, and the production of the light curve figure.

Fred Velthius and Jennie McCormick, Farm Cove Observatory, Pakuranga, New Zealand, for data obtained on the night of Dec 8, 2000 with a 25-cm Schmidt–Cassegrain telescope and a Santa Barbara Instruments Grougp ST6B camera.

Sebastian Otero of Buenos Aires, Argentina, for confirming that GSC 8527-373 had not been recognized as a variable and giving guidance that leads to the conclusion that the new variable belongs to δ Scuti class.

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NSV 03007 IS AN EW ECLIPSING BINARY SYSTEM

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Name of the object:
NSV 03007 = GSC 3376_287 = HV 07649 = CSV 000766

Equatorial coordinates:	**Equinox:**
R.A.= $20^{\mathrm{h}}22^{\mathrm{m}}10^{\mathrm{s}}$ **DEC.=** $+31^\circ15'12''$	2000.0

Observatory and telescope:
Esteve Duran Observatory, 0.6-m Cassegrain telescope

Detector:	CCD
Filter(s):	*V*
Comparison star(s):	GSC 3376_1091
Check star(s):	GSC 3376_254
Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	EW

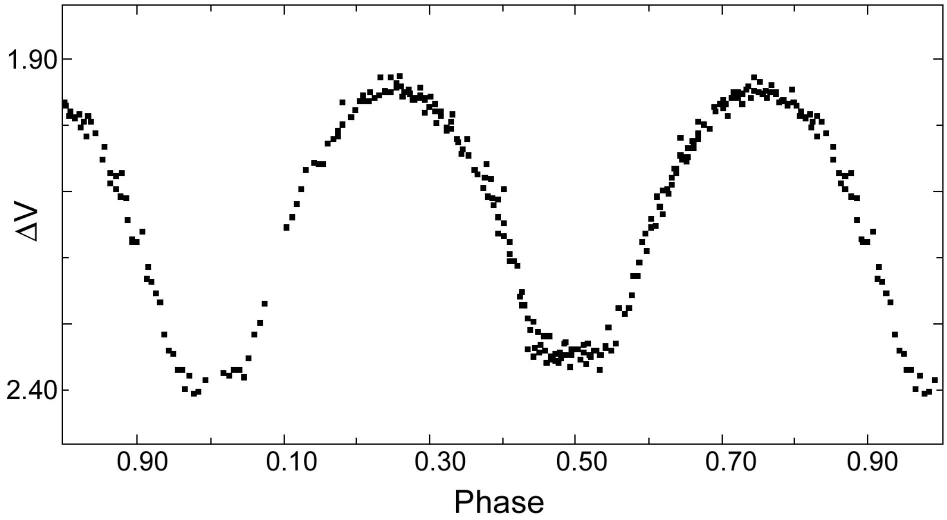

Figure 1. Folded light-curve of NSV 03007

Remarks:

The variability of NSV 03007 was announced by Boyd in 1937, and listed in the NSV catalogue (Kholopov, 1982) as an RR Lyr variable with a photographic magnitude variation between 13.7 and 14.3. The star, observed during a NSV survey searching for faint variables, was successfully monitored for 6 nights from October 2, 2000 to March 18, 2001. Observations show that this object is actually an EW eclipsing binary system with a period of about $0\overset{d}{.}385$ (Figure 1). The star fades $0\overset{m}{.}44$ during minimum I and 0.40 during the secondary eclipse. Taking as a reference the V magnitude of the check star derived from Tycho observations (ESA, 1997), our photometry indicates that the minimum V magnitude for NSV 03007 is of 13.17. Although some fundamental observational data about this star are still unknown, a preliminary analysis using the Wilson–Devinney code (Wilson, 1998) suggests that the mass ratio between the two components could be as small as 0.2. The following ephemeris was computed:

$$\begin{array}{l} \text{Min. I} = \text{HJD } 2451966.464 + 0\overset{d}{.}384758 \times E, \\ \qquad\qquad\qquad\qquad \pm\, 0.002 \pm 0.000020 \end{array}$$

in addition to the two secondary minimum timings: HJD 2451960.498 and 2451962.422.

References:

Boyd, C. D., 1937, *Harvard Bulletin*, No. 905
ESA, 1997, The Hipparcos and Tycho Catalogues, ESA SP-1200
Kholopov, P. N., editor, 1982, New Catalogue of Suspected Variable Stars, Moscow
Wilson, R. E., 1998, Computing Binary Star Observables (Reference Manual to the Wilson–Devinney Program), Dept. of Astronomy, University of Florida, Gainesville

ERRATUM FOR IBVS 5065

The coordinates for NSV 03007 given in IBVS 5065 are in error. The actual ones (2000), according to its identification with GSC 3376-0287 and SIMBAD database are:

$$\begin{aligned} \text{R.A.} &= 06^{\text{h}}32^{\text{m}}46\overset{\text{s}}{.}2 \\ \text{Dec.} &= +46^\circ 23' 32\overset{''}{.}82\,. \end{aligned}$$

Enríque García-Melendo

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HD 193986 IS AN ALGOL-TYPE ECLIPSING BINARY STAR

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Name of the object:
HD 193986 = BD +30°4003 = HIP 100443 = SAO 69906 = PPM 84803 = GSC 02672-00976 = ADS 13760 AB

Equatorial coordinates:	**Equinox:**
R.A.= $20^{\mathrm{h}}22^{\mathrm{m}}10^{\mathrm{s}}.19$ **DEC.=** $+31^{\circ}15'11''.5$	2000.0

Observatory and telescope:
Monegrillo Observatory, 41-cm Newtonian telescope

Detector:	CCD

Filter(s):	*V*

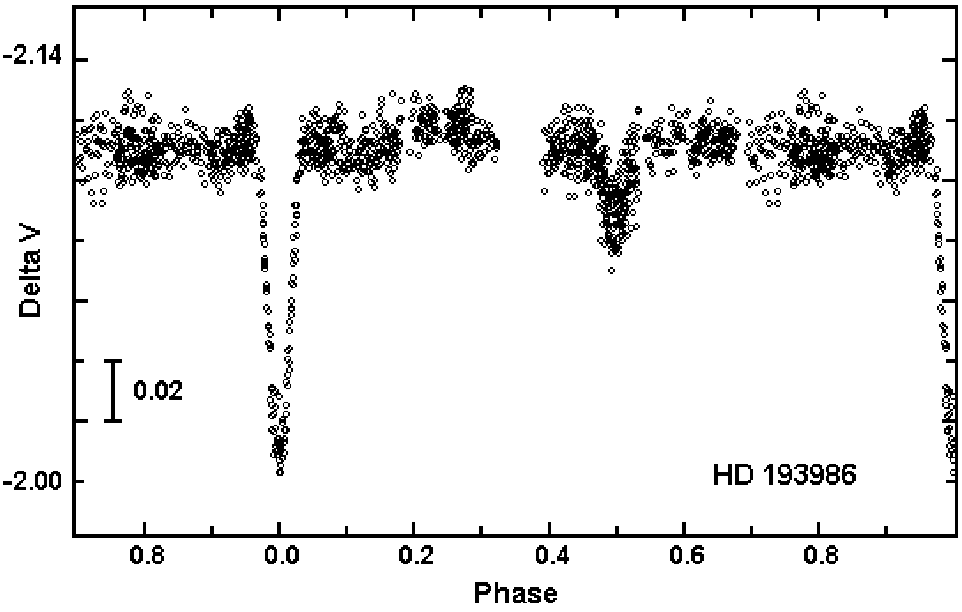

Figure 1.

Comparison star(s):	HD 332218 = GSC 2672-0986

Check star(s):	1: GSC 2672-1930 2: GSC 2672-1406

Transformed to a standard system:	No

Availability of the data:

Upon request

Type of variability:	EA

Remarks:

HD 193986, an object with a V magnitude of 8.63 and an A0 spectral type, is a variable discovered by the Hipparcos mission (ESA, 1997) after detecting light variations between $8\overset{\mathrm{m}}{.}64$ and $8\overset{\mathrm{m}}{.}76$. It could not be assigned a variable type and was catalogued as an unsolved variable. HD 193986 is also a double star (ADS 13760 AB, Aitken, 1932) whose components, of magnitudes 9.7 and 9.9, are $0\overset{\prime\prime}{.}3$ apart.
The analysis of the Hipparcos satellite data indicated that this star might be an Algol-type eclipsing binary star with a period of $1\overset{\mathrm{d}}{.}3955$ or double. To confirm the analysis results this star was observed for 27 nights, between July 9, 2000 and November 9, 2000. Photometric observations showed that HD 193986 is in fact an EA variable with a period of $2\overset{\mathrm{d}}{.}79$. The star fades $0\overset{\mathrm{m}}{.}10$ at primary minimum and $0\overset{\mathrm{m}}{.}03$ at the secondary one. Since it could only be performed joint photometry of the optical binary system, brightness variations must have a larger amplitude for the variable component. The following ephemeris could also be computed:

$$\begin{array}{rl}\text{Min I} = \text{HJD } 2451809.4772 + 2\overset{\mathrm{d}}{.}791185 \times E. \\ \pm\, 0.0006 \pm 0.000010 \end{array}$$

Acknowledgements:

I am grateful to J. M. Gomez-Forrellad for his analysis of the Hipparcos data, which allowed to solve this variable.

References:

Aitken, R.G., 1932, Carnegie Inst. Washington D.C., Publ. 417
ESA, 1997, The Hipparcos and Tycho Catalogues, ESA SP-1200

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TIMES OF MINIMA OF ECLIPSING BINARIES

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We report times of minima of eclipsing binary stars derived from V-band photometric observations made by an automated observatory at the University of Arkansas (the URSA telescope). The URSA telescope is a 10-inch aperture Meade LX-200 $f/6.3$ with an SBIG ST8EN CCD camera (before 2000 September 1, an SBIG ST6 camera was used). Observations were made through a Bessel V filter. The observations were 60 seconds integrations followed by 30 seconds as the image was downloaded and stored on the control computer. Images were dark-subtracted and flat-fielded before being processed by a virtual measuring engine (manual measurements were made before 2000 November 14). Differential magnitudes were measured relative to a comparison star and a check star in the same $20' \times 30'$ frame. Constancy of the comparison stars on a time scale of months has been verified by comparisons with a third comparison star in the field. Pixel size was 1.15 arcsec^2. For each variable star, the ultimate measurement accuracy for differential magnitude measurements depends on the availability of suitably bright comparison stars within the same image, which is $30'$ wide E–W and $20'$ wide N–S. This ultimate accuracy can range from $0\overset{m}{.}004$ to $0\overset{m}{.}02$ for our program stars. Additionally, we sometimes observe through thin cirrus. This can double the standard errors. A sample of the observations is shown in Figure 1. Heliocentric times of minima were estimated by using the method of Kwee and van Woerden (1956) as adapted to a Macintosh computer. Uncertainties in the times of minima were estimated from the values of standard error computed by the method. In Table 1, primary eclipses are designated as type 1 eclipses, and secondary eclipses as type 2.

Table 1

Star	JD of Min − 2400000	Type of Eclipse
KP Aql	51751.6264 ± 0.0005	1
WW Cam	51474.7295 ± 0.0006	2
AY Cam	51919.8679 ± 0.0005	1
	51974.5666 ± 0.0006	1
	51989.60769 ± 0.00014	2
	52015.5921 ± 0.0005	1
IT Cas	51826.6876 ± 0.0010	1
MU Cas	51876.5835 ± 0.0004	1
V459 Cas	51863.63570 ± 0.00014	1
	51867.7992 ± 0.0005	2
	51918.5502 ± 0.0004	2
WW Cep	51739.7305 ± 0.0014	2
	51868.55092 ± 0.00015	2
	51914.5600 ± 0.0004	2
RT CrB	51993.8053 ± 0.0011	2
RW CrB	51931.9083 ± 0.0003	1
	51936.9931 ± 0.0004	1
	51982.7572 ± 0.0004	1
	52011.8148 ± 0.0004	1
	52023.8029 ± 0.0004	2
	52024.8899 ± 0.0003	1
V477 Cyg	51720.7450 ± 0.0004	1
V885 Cyg	52025.8414 ± 0.0006	2
V1061 Cyg	52015.90554 ± 0.00011	1
UZ Dra	52017.86742 ± 0.00012	2
DI Her	51757.7215 ± 0.0013	2
RW Lac	51750.6943 ± 0.0006	2
RU Mon	51862.9000 ± 0.0003	1
TY Tau	51582.6638 ± 0.0007	1
	51862.7781 ± 0.0005	1
	51868.7074 ± 0.0005	2
	51869.7830 ± 0.0004	2
	51875.7080 ± 0.0002	1
	51876.7850 ± 0.0004	1
	51877.8624 ± 0.0003	1
	51882.7130 ± 0.0004	2
	51883.7900 ± 0.0006	2
	51924.7290 ± 0.0010	2
	51931.7309 ± 0.0004	1
	51943.5824 ± 0.0005	1
	51951.6609 ± 0.0007	2
	51985.6011 ± 0.0003	1
CF Tau	51919.7246 ± 0.0005	2
	51966.5772 ± 0.0007	2

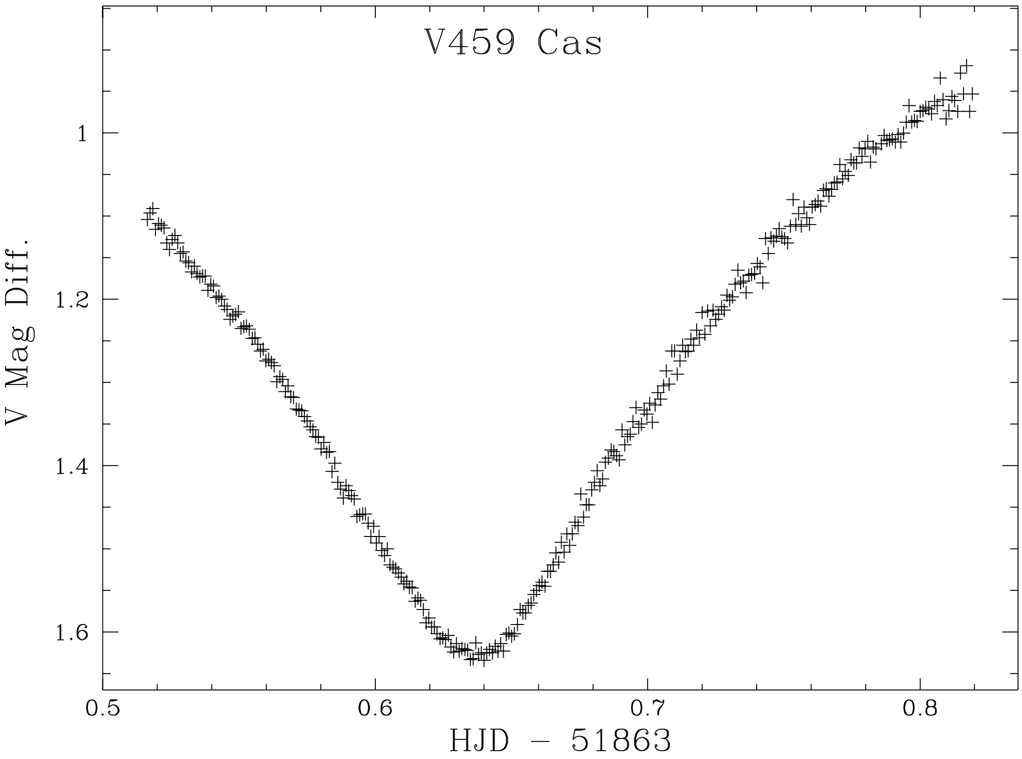

Figure 1. A sample observation of a primary eclipse on 2000 November 15 UT. Approximately the last half of the observations were made through thin cirrus clouds. Note that the standard error of the observations was larger then

Reference:

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

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THE ORBITAL V-BAND LIGHT CURVE OF V4641 SAGITTARII

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V4641 Sgr was discovered by Goranskij (1978) during the outburst in June 1978 when it brightened up to $12^{\mathrm{m}}.4$ B, about two magnitudes over the mean quiet level. At first, it was misidentified with GM Sgr in GCVS IV, and classified as a possible nova-like variable. Later it was shown that the star was an early A type binary with possible period of $0^{\mathrm{d}}.7365$ (Goranskij, 1990). He measured the astrometric position, $18^{\mathrm{h}}19^{\mathrm{m}}21^{\mathrm{s}}.7$, $-25^\circ24'25''$ (converted to Eq. 2000.0), about $1''.1$ from modern VLA radio interferometric one by Hjellming et al. (2000). The problem of identification was finally solved by Hazen et al. (2000).

In January, 1999 the star was found in X-rays (in't Zand et al., 1999), the source was called SAX J1819.3-2525. Later in September, 1999 the star underwent another outburst (Kato et al., 1999) detected in optical, radio, and X-rays. The star ejected relativistic jets, like known microquasars (Hjellming et al., 2000). Recently Orosz et al. (2000) have determined the spectroscopic orbital period of $2^{\mathrm{d}}.8173 \pm 0^{\mathrm{d}}.00013$ for V4641 Sgr.

I monitored V4641 Sgr with CCD SBIG ST-7 and ST-8 in V and R bands since 2000 July 24 to August 21 using the 38-cm telescope of Crimean Astrophysical Observatory and the 60-cm telescope of Sternberg Institute Crimean station. The star was observed only near sky meridian in V band because of its low declination. The comparison star was **e** (Goranskij, 1990), $V = 13^{\mathrm{m}}.38$. Several frames were taken each night, mean values and mean square residuals were calculated. CCD observations are given in the Table 1, and signed there with 'ST-7' and 'ST-8'. Additionally I used my single photoelectric observation taken with the 1-m telescope of Mt. Sanglock Observatory on JD 2446708.108 (Goranskij, 1990), and few photoelectric observations taken with the 1-m telescope of Tien-Shan Observatory on JD 2449578 and 2449599. These observations were taken with single channel $UBVRI$ and $WBVR$ photometers, and signed with 'ptm' in Table 1.

The orbital period was justified using Moscow plate collection eye estimates (stored in the VSNET archive, vsnet-obs No. 26925), and the recent observations. New elements are the following:

$$\mathrm{Min\ I} = 2451764.298 + 2^{\mathrm{d}}.81728\,(\pm 1) \times E.$$

The value of orbital period is close to that by Orosz et al. (2000). The V band light curve is shown in Figure 1. It indicates strong ellipsoidal variation with the amplitude of about $0^{\mathrm{m}}.30$. The primary minimum is deeper than the secondary by $0^{\mathrm{m}}.10$. The light changes reflect only the tidal distortion of the A2 companion. My pre-outburst photoelectric observations were taken in the phases close to Min I and Min II. They have not shown any change in the relative depth of minima since that time.

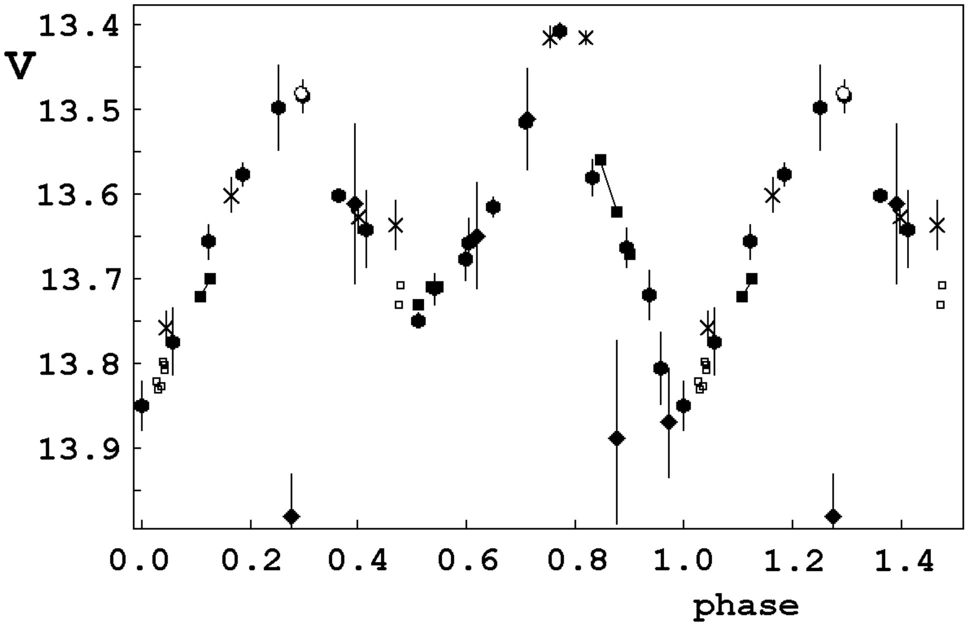

Figure 1. The light curve of V4641 Sgr in V band.
Symbol meaning is the following: filled circles are my observations with CCD ST-7, the crosses are those ones with CCD ST-8, open circle is a single photoelectric observation at Mt. Sanglock (Goranskij, 1990), open squares are my Tien-Shan photoelectric observations, filled squares are the observations by Marti et al. (2001), and filled rhombs are observations by Chaty et al. (2001). Vertical lines are mean square residuals

Table 1: Photoelectric and CCD observations of V4641 Sgr

JD_{hel} 24...	V	r.m.s.	Device	JD_{hel} 24...	V	r.m.s.	Device
46708.1080	13.480	0.020	ptm	51762.3172	13.484	0.020	ST-7
49578.1689	13.821	0.020	ptm	51763.3037	13.615	0.011	ST-7
49578.1756	13.831	0.020	ptm	51764.3018	13.850	0.029	ST-7
49578.1868	13.826	0.020	ptm	51765.3204	13.602	0.002	ST-7
49578.1975	13.797	0.020	ptm	51766.2965	13.515	0.007	ST-7
49578.2036	13.801	0.020	ptm	51767.2739	13.774	0.040	ST-7
49578.2092	13.807	0.020	ptm	51768.2801	13.641	0.046	ST-7
49599.1473	13.730	0.020	ptm	51769.2845	13.407	0.009	ST-7
49599.1518	13.707	0.020	ptm	51770.2791	13.656	0.020	ST-7
51750.3342	13.758	0.020	ST-8	51771.3671	13.749	0.009	ST-7
51751.3391	13.626	0.020	ST-8	51772.2725	13.580	0.021	ST-7
51752.3342	13.414	0.013	ST-8	51773.2765	13.576	0.014	ST-7
51754.3476	13.636	0.029	ST-8	51774.2711	13.712	0.019	ST-7
51755.3351	13.415	0.008	ST-8	51775.2692	13.663	0.023	ST-7
51756.3080	13.601	0.020	ST-8	51776.2800	13.497	0.050	ST-7
51760.3485	13.677	0.024	ST-7	51777.2645	13.657	0.028	ST-7
51761.2988	13.719	0.029	ST-7	51778.2600	13.806	0.042	ST-7

The published observations by other authors are also taken into account. The monitoring results by Marti et al. (2001) fit the light curve with $-0\overset{\text{m}}{.}25$ offset. It seems that this is a systematic error. Four of six observations by Chaty et al. (2001) fit the curve well without correction, but two of them surprisingly fall down out of the curve. The photometric amplitude of variations in the quiet state does not exceed $0\overset{\text{m}}{.}5$ what is less than the published photographic one of $1\overset{\text{m}}{.}2$ (Goranskij, 1990).

References:

Chaty, S., Mirabel, I.F., Marti J., Rodriguez, L.F., 2001, astro-ph/0102105
Goranskij, V.P., 1978, *Astron. Tsirkular*, No. 1024, 3
Goranskij, V.P., 1990, *IBVS*, No. 3464
Hazen, M.L., Hoffleit, D., Welther, B.L., Williams, 2000, *JAAVSO*, **28**, 99
Hjellming, R.M., Rupen, M.P., Hunstead, R.W., et al., 2000, *ApJ*, **544**, 977
in't Zand, J., Heise, J., Bazzano, A., et al., 1999, *IAU Circ.*, No. 7119
Kato, T., Uemura, M., Stubbings, R., Watanabe, T., Monard, B., 1999, *IBVS*, No. 4777
Marti, J., Zamanov, R., Paredes, J.M., Ribo, M., 2001, *IBVS*, No. 5036
Orosz, J.A., Kuulkers, E., van der Klis, M., et al., 2000, *IAU Circ.*, No. 7440

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PHOTOELECTRIC MINIMA TIMES OF SOME ECLIPSING BINARIES

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We present 24 photoelectric minima times of 5 selected eclipsing binary systems. All observations were obtained with the 30-cm Maksutov telescope at the Ankara University Observatory. Differential observations were secured by using an OPTEC SSP-5A photometer head which contains a side on R-1414 Hamamatsu photomultiplier. The filters used are in close accordance with the standard Johnson's UBV and reductions of the observations have been performed in the usual way (Hardie, 1962).

The moments of minima and their standard errors for each filter were calculated by using the well known method of Kwee & van Woerden (1956). All results are listed in Table 1 with the minimum types, filters and observers.

References:

Hardie, R., 1962, *Astr. Tech.: Stars and Stellar Systems*, Vol. II, Univ. of Chicago Press, Chicago

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

Table 1: Minima times of the observed systems

System	Min HJD 2400000 +	Error	Min type	Filter	Observer (*)
44i Boo	51851.26017	±0.00049	I	*B*	Gr
	51851.26598	±0.00353	I	*V*	Gr
WY Cnc	51958.37627	±0.00021	I	*B*	Öz
	51958.37546	±0.00033	I	*V*	Öz
SW Lac	51738.44838	±0.00056	I	*U*	Ad
	51738.44924	±0.00093	I	*B*	Ad
	51738.44911	±0.00069	I	*V*	Ad
	51874.27251	±0.00045	II	*U*	Ny
	51874.27339	±0.00043	II	*B*	Ny
	51874.27334	±0.00036	II	*V*	Ny
	51881.32895	±0.00067	II	*U*	Tn
	51881.32785	±0.00018	II	*B*	Tn
	51881.32784	±0.00022	II	*V*	Tn
	51888.22210	±0.00028	I	*U*	Dn
	51888.22195	±0.00020	I	*B*	Dn
	51888.22185	±0.00021	I	*V*	Dn
UV Lyn	51935.41371	±0.00028	I	*U*	Gd
	51935.41595	±0.00032	I	*B*	Gd
	51935.41661	±0.00021	I	*V*	Gd
	51949.51982	±0.00024	I	*B*	Ak
	51949.52276	±0.00042	I	*V*	Ak
DI Peg	51035.40130	±0.00021	I	*U*	Gr
	51035.40058	±0.00028	I	*B*	Gr
	51035.40044	±0.00021	I	*V*	Gr

(*) Ad: E. Adalı, Ak: U. Akçay, Dn: Ö. Dengiz, Gd: L. Gürdemir, Gr: B. Gürol, Ny: N. Naymaz, Öz: F. Özkan, Tn: E. Tınaz

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OUTBURST PHOTOMETRY OF DK Cas

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DK Cas is a poorly studied dwarf nova which was discovered by Hoffmeister (1943). The fourth edition of the General Catalogue of Variable Stars gives a range of 15.3–19.5 p. Little has been known regarding its nature and outburst characteristics. However, there have been a few evidences that outbursts of this object are relatively rare. Bruch et al. (1987) observed this object on 17 nights and found no outbursts. A vigorous search for outbursts since 1995 by visual and CCD observers (mainly by T. Vanmunster and G. Poyner), contributed to VSNET (http://www.kusastro.kyoto-u.ac.jp/vsnet/) had yielded no positive detections until the detection by P. Schmeer on 1999 November 27 (Schmeer 1999). Since the low frequency of outbursts as well as a relatively large outburst amplitude makes DK Cas a good candidate for an SU UMa-type dwarf nova, we started time-resolved CCD photometry.

The CCD observations were done using an unfiltered ST-7 camera attached to the Meade 25-cm Schmidt–Cassegrain telescope. The exposure time was 30 s. The images were dark-subtracted, flat-fielded, and analyzed using the Java$^{\mathrm{TM}}$-based PSF photometry package developed by one of the authors (TK). The magnitudes were determined relative to BD +56°35 = GSC 3661.1642, whose Tycho-2 magnitude is $V = 10.02 \pm 0.03$ and $B - V = +0.28 \pm 0.04$. The constancy of comparison star during the run was confirmed by comparison with GSC 3661.1306. The log of observations together with nightly average magnitudes is given in Table 1. The light curve drawn from these data is presented in Figure 1.

DK Cas reached a maximum (unfiltered CCD magnitude 14.86, roughly corresponding to an R_c magnitude assuming the usual color close to $B - V = 0.0$ for outbursting dwarf novae) within two days of the outburst detection. The object stayed at maximum for three days and started fading slowly. Time-resolved CCD photometry during the outburst plateau showed only slow variation with small random fluctuations, and no clear indication of periodic modulations (Figure 2). In addition to the presence of a short plateau at maximum, followed by a slow fade, the absence of clear superhump modulations is sufficient to rule out the object as being an SU UMa-type dwarf nova. The suggested classification of an SS Cyg-type star (UGSS) is supported by this observation.

The later part of the fading from outburst is characterized by a linear fade at a rate of 0.30 ± 0.01 mag d^{-1}, which is relatively slow among SS Cyg-type dwarf novae. Based on the calibration by Szkody and Mattei (1984) of Bailey's relation, the orbital period of DK Cas is expected to be longer than 5 hours, and is most likely longer than that of a

Table 1: Nightly averaged magnitudes of DK Cas

JD start[a]	JD end[a]	mean mag[b]	error[c]	N[d]
51509.992	51510.024	5.075	0.049	37
51511.002	51511.185	4.978	0.004	415
51512.056	51512.176	4.986	0.005	302
51516.187	51516.292	5.243	0.015	262
51520.162	51520.165	5.803	0.061	10
51521.147	51521.150	5.995	0.140	10
51521.981	51521.984	6.309	0.090	10
51522.975	51522.979	6.603	0.122	10
51523.965	51523.969	6.923	0.098	8

[a] JD − 2400000

[b] Magnitude relative to BD +56°35

[c] Standard error of nightly average

[d] Number of frames

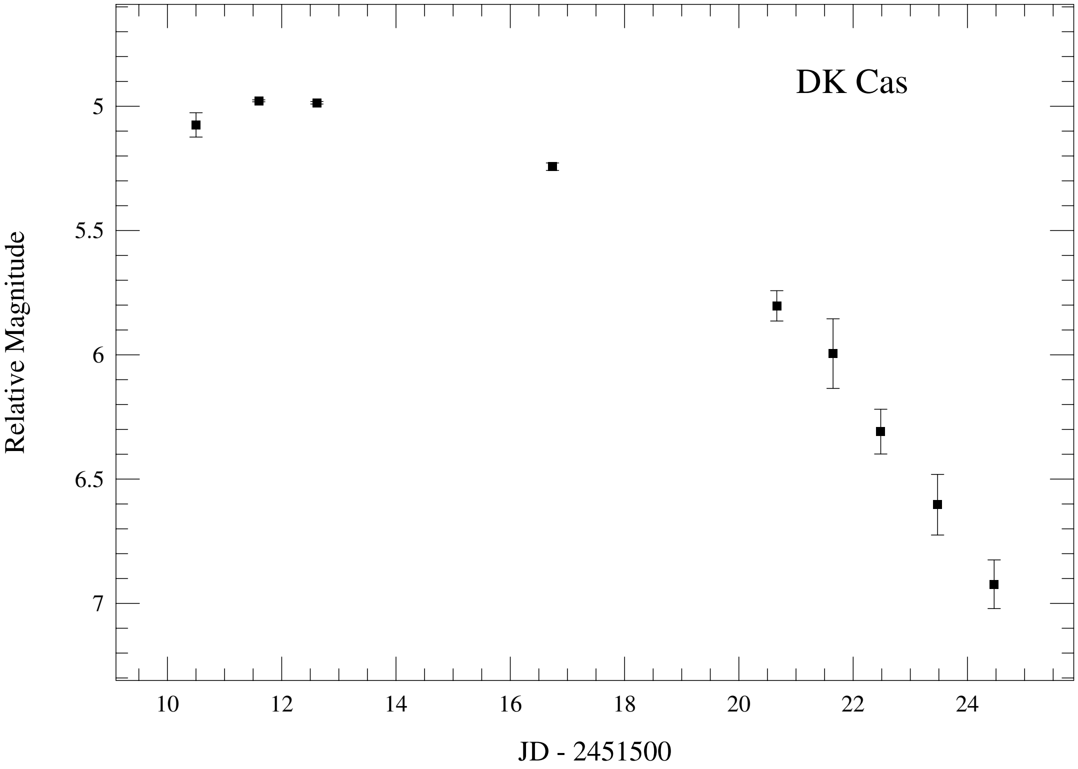

Figure 1. Light curve of DK Cas

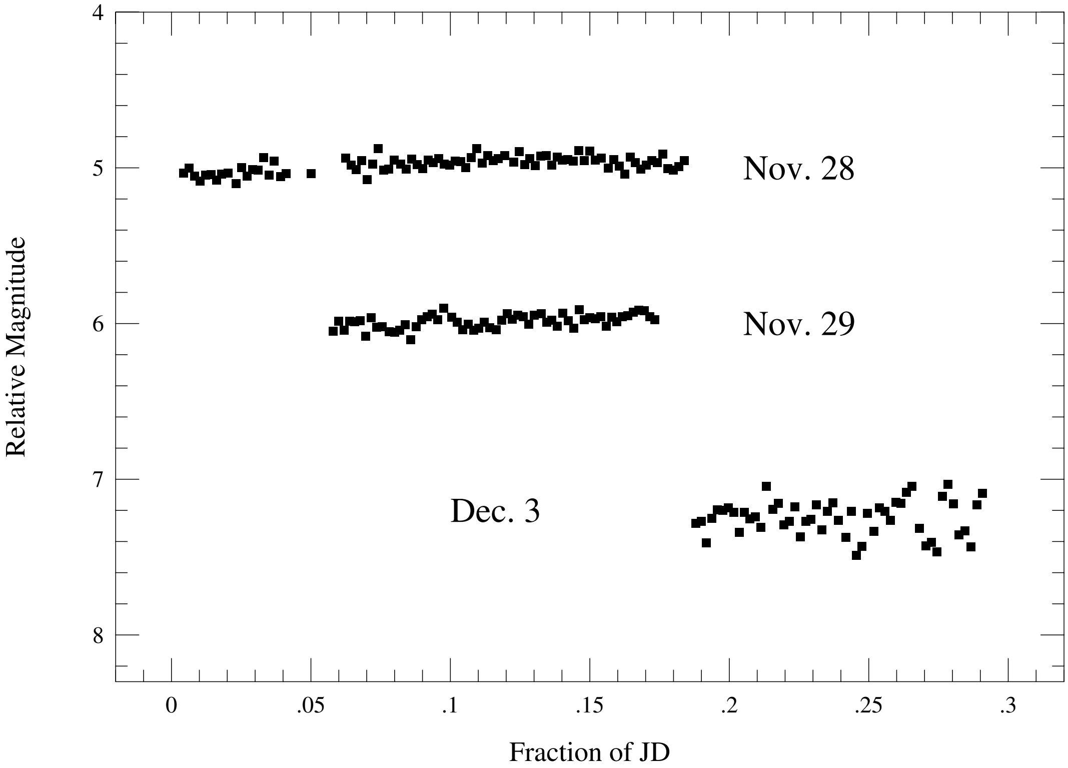

Figure 2. Time-series photometry of DK Cas. Each point represents an average of adjacent five frames. The magnitudes are arbitrarily shifted for clarity

long-period system DX And (10.6 hours, Drew et al. 1993). Although recent spectroscopic observation by Liu and Hu (2000) was not able to detect a feature of the secondary, the above data suggest that DK Cas belongs to a rare class of long-period dwarf novae with a low outburst frequency (i.e. low mass-transfer rate), a further spectroscopic search for the secondary and accurate determination of the orbital period are highly encouraged.

The authors are grateful to VSNET members for providing dense observations covering years, and P. Schmeer for promptly and publicly notifying the outburst. Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists (MU).

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ON THE SUPERCYCLE OF SX LMi

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SX LMi is an SU UMa-type dwarf nova, which was originally discovered as a faint blue star in the north Galactic pole region (Iriarte and Chavira 1957; Sanduleak and Pesch 1984). The nature of the object was finally revealed by the secure detection of superhumps during its outburst in 1994 December (Nogami et al. 1997).

Nogami et al. (1997) argued that SX LMi has a relatively peculiar character based on their extensive research on relations between outburst amplitudes and supercycle lengths of known SU UMa stars. Their most important conclusion is that SX LMi has a relatively small superoutburst amplitude ($\sim 3\overset{\mathrm{m}}{.}8$) while the suggested supercycle has a fairly normal value of 250 d. SX LMi was thus proposed as a candidate for the missing link between ER UMa stars (for a review, see Kato et al. 1999) and the usual SU UMa-type dwarf novae. Other suggested candidates include HS Vir (Kato et al. 1998), NY Ser (Nogami et al. 1998), CI UMa (Nogami and Kato 1997) and V503 Cyg (Harvey et al. 1995). However, none of these objects show perfectly intermediate outburst characteristics between ER UMa stars and usual SU UMa-type dwarf novae, as discussed in Kato et al. (2000). SX LMi and CI UMa were listed in Kato et al. (2000) as objects having less regular superoutbursts. SX LMi was also discussed by Nogami et al. (1997) as having a possibly anomalous disk viscosity parameter. Since the historical superoutbursts of SX LMi (also cited in Nogami et al. (1997)) looked to have occurred less regularly, a more comprehensive search for superoutbursts is indispensable to reveal the nature of the object, and to test the arguments presented by Nogami et al. (1997) and Kato et al. (2000).

Observations reported to VSNET (http://www.kusastro.kyoto-u.ac.jp/vsnet/) were analyzed, which almost completely covered the object since 1995 November, except solar conjunction periods. These visual observations were done using V-magnitude calibrated comparison stars, and their errors are an order of 0.2–0.3 mag, which will not affect the following discussion. Figure 1 shows the overall light curve from VSNET observations. Arrows represent upper limits, but upper limits brighter than 14.5 mag are omitted from this figure in order to avoid confusion. The light curve clearly shows relatively regular occurrence of bright outbursts reaching 13.0–13.5 mag. These outbursts might be naturally considered as superoutbursts based on their duration and brightness, but we have tried to adopt more secure identifications based on superhump detection. Recent CCD observations by Iwamatsu et al. (2001, in preparation) has confirmed that the 2001 January long outburst is a genuine superoutburst. Together with past observations described in Nogami et al. (1997), we can now safely identify long and bright outbursts as superoutbursts.

Table 1: Superoutbursts of SX LMi

JD start	peak magnitude	duration (d)
2450238	13.2	> 2
2450545	13.2	14
2450819	13.2	> 4
2451131	13.1	11
2451631	13.1	11
2451935	13.1	> 4

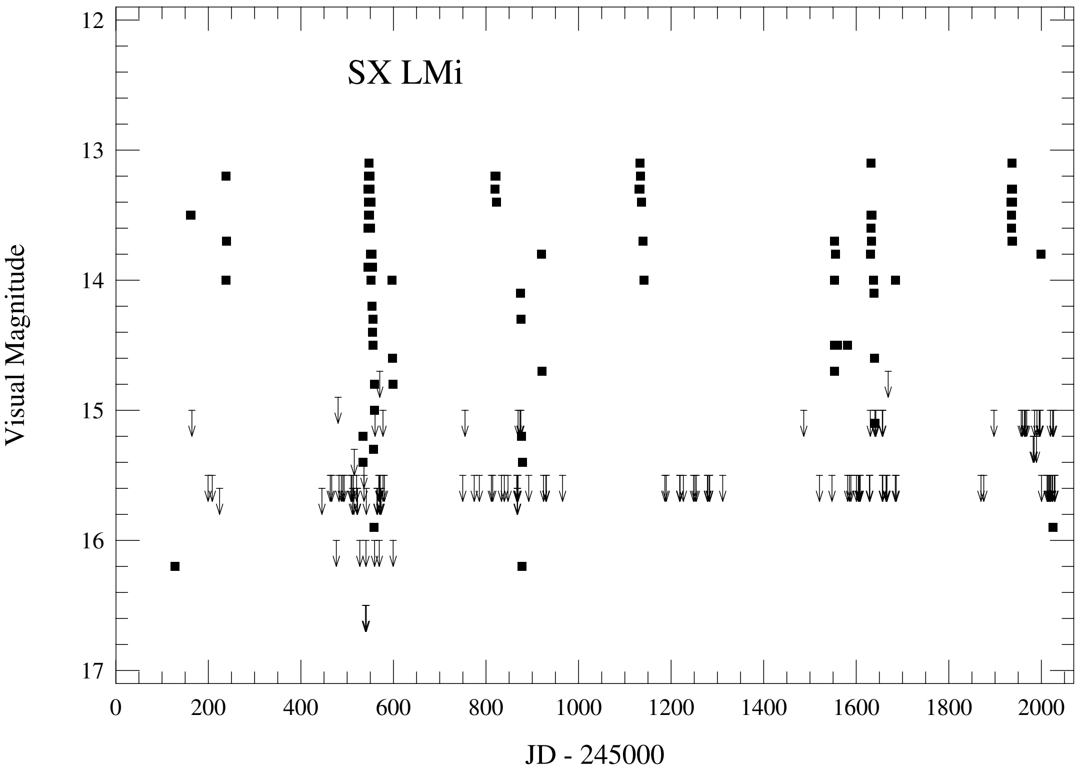

Figure 1. Light curve of SX LMi

By assuming one missed superoutburst between JD 2451131 and 2451631 (the object was not observed because of the solar conjunction), these observations indicate that SX LMi relatively regularly showed superoutbursts with a cycle length of 250–312 d. The mean period of supercycle is 279 d, which is slightly longer than one suggested by Nogami et al. (1997). The present observation has confirmed previously unrecognized regular occurrence of superoutbursts, which also strengthen the finding by Nogami et al. (1997) that normal outbursts are relatively infrequent compared to the relatively short supercycle length. This seems to make a striking difference from HS Vir (Kato et al. 1998) and NY Ser (Nogami et al. 1998), and suggests a different origin of the SX LMi peculiarity.

The authors are grateful to VSNET members, especially to Gary Poyner, Gene Hanson, Timo Kinnunen, Mike Simonsen and Eddy Muyllaert for providing crucial observations.

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BVR PHOTOMETRY OF SN2000E

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The supernova SN2000E was discovered by Valentini et al. (2000) on January 26.73 in the NGC 6951 galaxy. From February 1 to May 15, 2000 we have observed the supernova SN2000E at Pulkovo Observatory with a ZA-320 32-cm reflector (Bekiashev et al. 1998) equipped with SBIG ST-6 CCD camera. The observations were made in the B, V and R bands of Johnson's photometric system.

Stellar images on the frames were measured by aperture photometry technique using "Apex" code developed at Pulkovo Observatory (Devyatkin et al. 2000).

The field of view of the instrument with ST-6 camera is $9'.5 \times 7'.5$. Hence no standard stars were found in the same frame with the supernova. During several nights we observed four standard stars (HD 194258, HD 196229, HD 196848, HD 197894) taken from "The catalogue of $WBVR$ magnitudes of bright stars of Northern sky" (Kornilov et al. 1991). An additional star G262-16 (Carney & Latham, 1987) was also observed (in B and V only). These stars are located within 1 to 4 degrees from the supernova. Using these five stars we found rough magnitudes for 20–30 field stars located in the same frame as the supernova. This procedure was made by a method similar to usual differential photoelectric photometry. The brightness of the supernova was referred to this group of field stars for all dates of observations.

The results are listed in Table 1 and drawn in Figure 1. We estimate the final accuracy of the results $0^{\rm m}.12$ for B, $0^{\rm m}.08$ for V and $0^{\rm m}.06$ for R from February to March (JD 2451576–2451634). In April and May (after JD 2451640) the brightness of the supernova decreased and the brightness of the sky background increased (because the latitude of Pulkovo Observatory is +60°). Hence accuracy of the observations became worse: $0^{\rm m}.25$ for B, $0^{\rm m}.20$ for V and $0^{\rm m}.13$ for R.

Our observations started 6 days after the discovery of the supernova. The first three measurements (made during 5 days) were significantly brighter than the discovery brightness of the supernova in B and V (Valentini et al. 2000). Very probably, our observations started at the maximum light of the supernova. After this time the supernova started fading with a rate of approximately 0.06, 0.05 and 0.04 magnitudes/day in B, V and R, respectively.

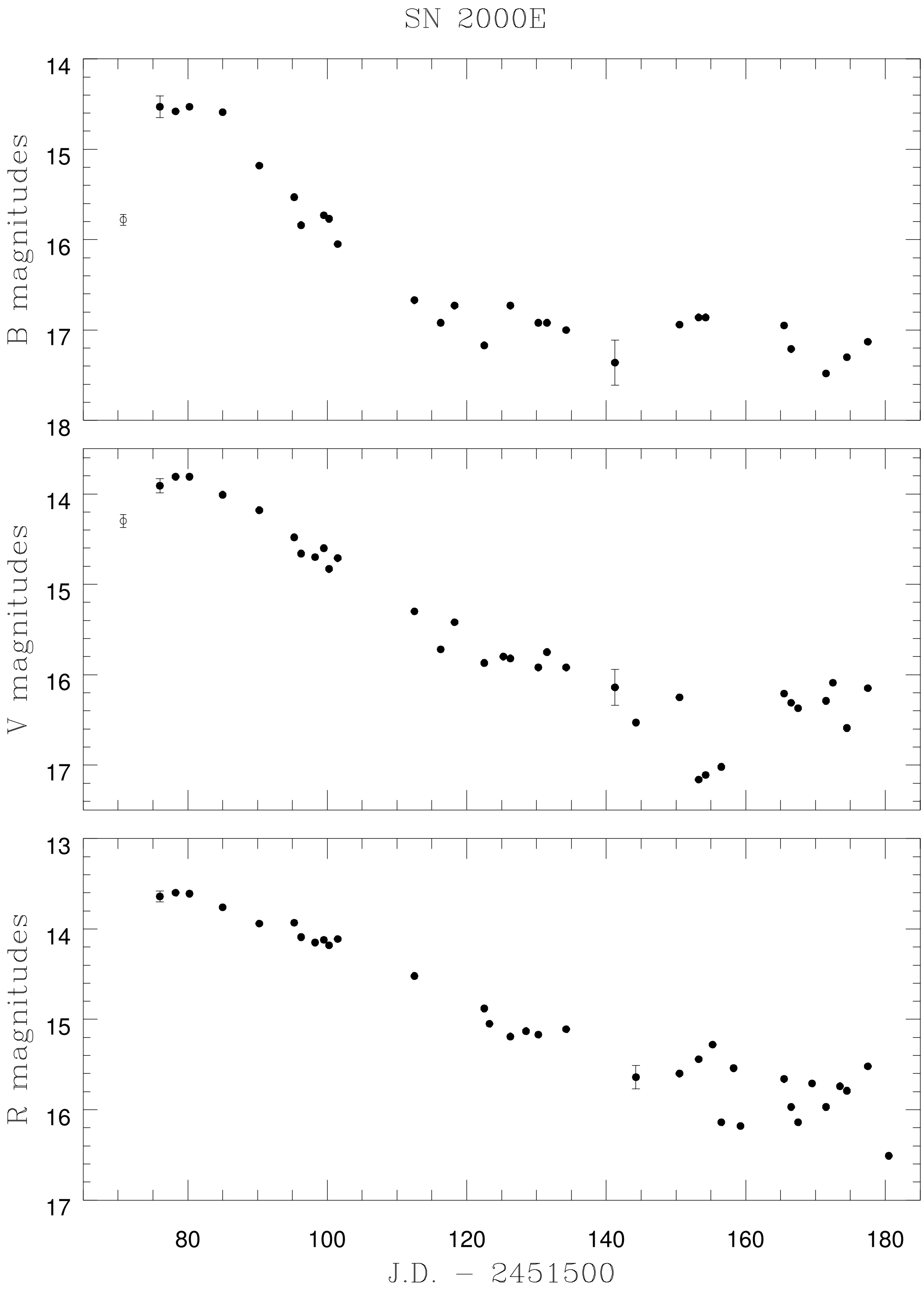

Figure 1. Observations of SN 2000E in B, V and R colours. The open circles show the discovery brightness of the supernova from Valentini et al. (2000), with their error bars. For comparison, we also plot the errors of the first data of the two parts of our observations with different accuracies, see text

Table 1

JD	B	V	R_J
2451576.198	14.53	13.91	13.64
2451578.332	14.58	13.81	13.60
2451580.225	14.53	13.81	13.61
2451585.199	14.59	14.01	13.76
2451590.240	15.18	14.18	13.94
2451595.227	15.53	14.48	13.93
2451596.378	15.84	14.66	14.09
2451598.353		14.70	14.15
2451599.511	15.73	14.60	14.12
2451600.396	15.77	14.83	14.18
2451601.505	16.05	14.71	14.11
2451612.554	16.67	15.30	14.52
2451616.319	16.92	15.72	
2451618.260	16.73	15.42	
2451622.449	17.17	15.87	14.88
2451623.276			15.05
2451625.334		15.80	
2451626.373	16.73	15.82	15.19
2451628.481			15.13
2451630.386	16.92	15.92	15.17
2451631.411	16.92	15.75	
2451634.358	17.00	15.92	15.11
2451641.398	17.36	16.14	
2451644.362		16.53	15.64
2451650.446	16.94	16.25	15.60
2451653.395	16.86	17.16	15.44
2451654.370	16.86	17.11	
2451655.376		18.56	15.28
2451656.413		17.02	16.14
2451658.379			15.54
2451659.374			16.18
2451665.421	16.95	16.21	15.66
2451666.443	17.21	16.31	15.97
2451667.446		16.37	16.14
2451669.483			15.71
2451671.440	17.48	16.29	15.97
2451672.487		16.09	
2451673.465			15.74
2451674.425	17.30	16.59	15.79
2451677.423	17.13	16.15	15.52
2451680.440			16.51

Acknowledgments. The authors thank Pulkovo Observatory researchers A. Gritsuk, E. Kornilov, V. Kouprianov and A. Salovatova for collaboration in the observations as well as I. Kanaev and N. Sokolov for useful discussion.

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Valentini, G., et al., 2000, *IAU Circ.*, No. 7351

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PERIOD DETERMINATION FOR V576 HERCULIS AND V1116 CYGNI

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V576 Herculis and V1116 Cygni are suspected RR Lyrae stars listed in the General Catalog of Variable Stars (GCVS) without periods. Both stars were observed with the 24-inch Cassegrain reflecting telescope and Tektronics 1024×1024 CCD camera at Wellesley College between May 1999 and September 2000. During each night of observation, we took twilight flats in each filter, dark and bias images, and several variable star images in each of the R and V filters. Images were processed with standard techniques in IRAF. We did differential photometry on each variable compared to several comparison stars in the field and between all pairs of comparisons. We chose the most stable pair of comparisons as the primary comparison and check star. After an approximate period was determined with least square fitting following the prescription of Horne and Baliunas (1986), we made phase diagrams and refined the period visually. When the period is changed by the listed uncertainty, the phase diagram data from the earliest cycle is definitely out of alignment with the data from the oldest cycle.

We note that the position of both stars in the GCVS is incorrect. A recent SIMBAD search turned up two papers by Kato (1999) which confirm the positions we found. V576 Herculis is GSC 2105-1084; the comparison we used is GSC 2105-274 and the check is GSC 2105-70. Neither V1116 Cygni nor its comparison and check stars have a Guide Star catalog number, so we give a finder chart in Figure 1.

V1116 Cygni was observed on 17 different nights with a total of 85 images in each filter. We have determined an ephemeris of:

$$\begin{array}{rl} \text{Max} = \text{HJD } 2451809.589 + & 0\overset{\text{d}}{.}53854 \times E. \\ \pm\, 4 \qquad\quad & \pm\, 5 \end{array} \tag{1}$$

The phase diagram for the V filter is given in Figure 2. The V filter amplitude is 1.2 magnitudes, and the R filter amplitude is approximately one magnitude.

V576 Herculis was observed on 14 different nights with a total of 112 images in each filter. We have determined an ephemeris of:

$$\begin{array}{rl} \text{Max} = \text{HJD } 2451802.649 + & 0\overset{\text{d}}{.}40378 \times E. \\ \pm\, 4 \qquad\quad & \pm\, 5 \end{array} \tag{2}$$

The phase diagram for the V filter is given in Figure 3. The V filter amplitude is about 1.25 magnitudes, and the R filter amplitude is about one magnitude.

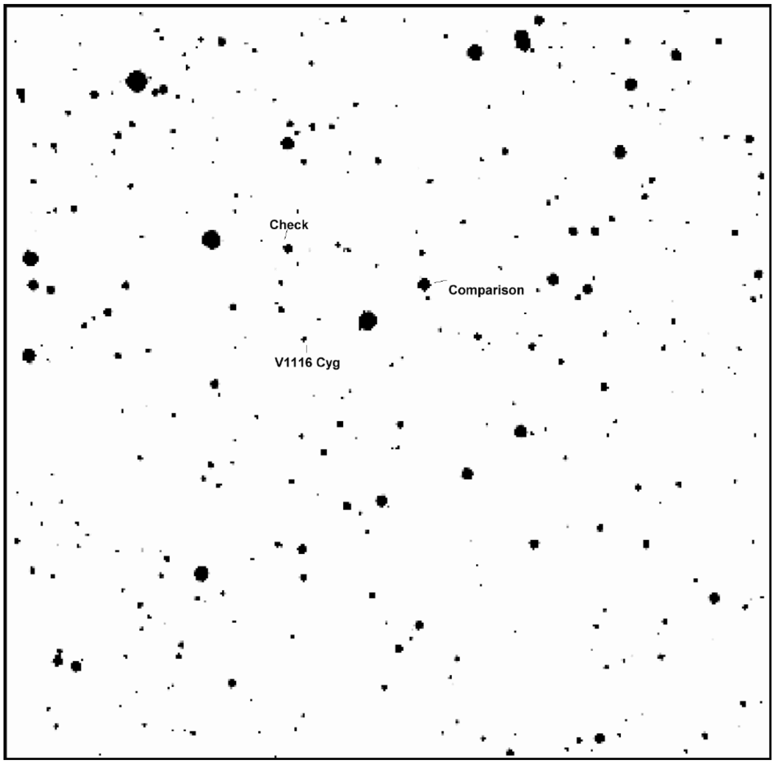

Figure 1. A finder chart for V1116 Cygni. Each side is about 15″

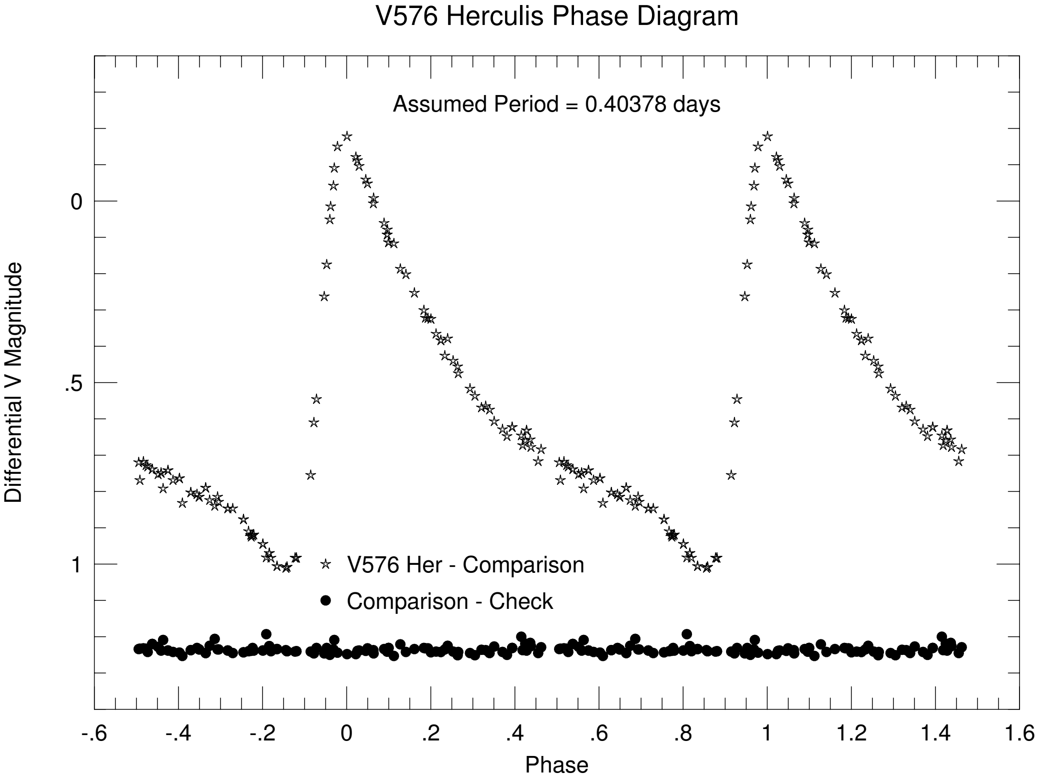

Figure 2. The *V* filter phase diagram for V576 Herculis using ephemeris (1)

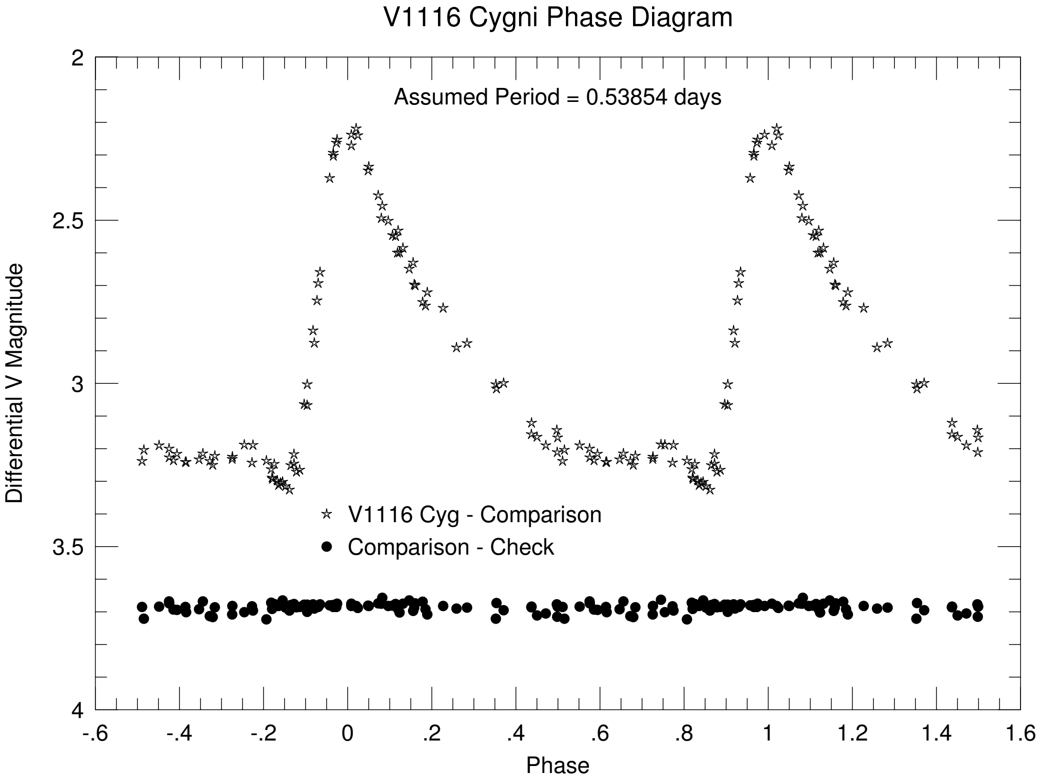

Figure 3. The V filter phase diagram for V1116 Cygni using ephemeris (2)

We have thus confirmed that V576 Herculis and V1116 Cygni are RR Lyrae stars; the amplitude and the rapid increase in brightness indicates that both stars are probably of the the RRab type.

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CCD LIGHT CURVE AND NEW ELEMENTS OF BE Eri

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Name of the object:
BE Eri (= HV 10408 = GSC 4739.0640 = USNO A2.0 0825.01095819)

Equatorial coordinates:	**Equinox:**
R.A.= $4^{\mathrm{h}}38^{\mathrm{m}}3\overset{\mathrm{s}}{.}44$ **DEC.=** $-1^{\circ}59'44\overset{''}{.}3$	2000

Observatory and telescope:
Private station in Busto Arsizio, Italy, 0.21-m Newton ($F/5.0$)

Detector:	DTA Seti 245C CCD Camera

Filter(s):	None

Comparison star(s):	GSC 4739.0650 = USNO A2.0 0825.01095247 ($11\overset{\mathrm{m}}{.}6$ R)

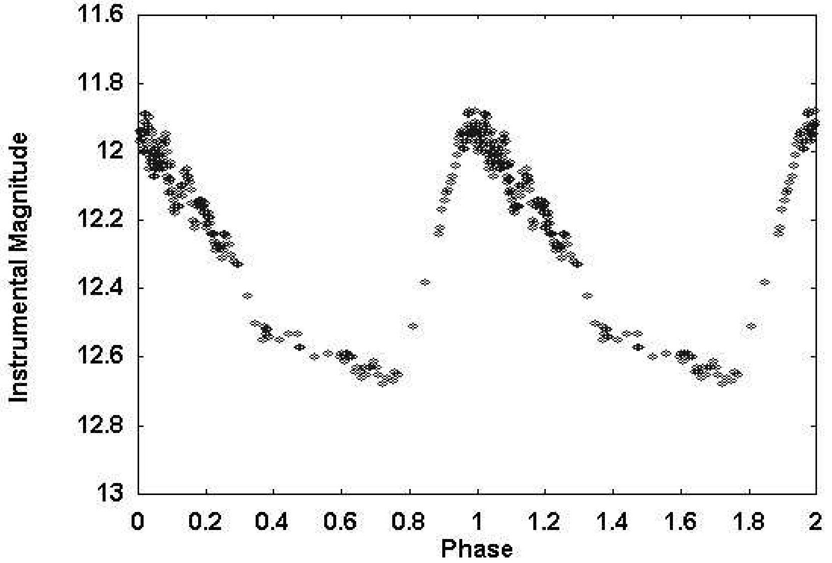

Figure 1. Unfiltered CCD light curve of BE Eri

Table 2: Times of maxima

HJD		$E_{(1)}$	$(O-C)_{(1)}$	$E_{(2)}$	$(O-C)_{(2)}$	Observer/Reference
2439055.337	ptg	−2657	−0.079	−2657	−0.106	Pop & Todoran (1973)
2439805.345	ptg	−1363	0.004	−1363	−0.016	”
2440249.280	ptg	−597	0.011	−597	−0.004	”
2440288.157	ptg	−530	0.059	−530	0.044	”
2440289.306	ptg	−528	0.049	−528	0.034	”
2440595.300	ptg	0	0.046	0	0.034	”
2440617.324	ptg	38	0.047	38	0.036	”
2440624.245	ptg	50	0.014	50	0.002	”
2440966.190	ptg	640	0.030	640	0.022	”
2441299.404	ptg	1215	0.009	1215	0.003	”
2441310.434	ptg	1234	0.028	1234	0.022	”
2441332.387	ptg	1272	−0.042	1272	−0.047	”
2441350.386	ptg	1303	−0.009	1303	−0.014	”
2441353.300	ptg	1308	0.008	1308	0.003	”
2449998.790	CCD	16226	−0.080	16226	−0.004	Schmidt & Seth (1996)
2451169.442	CCD	18246	−0.099	18246	−0.012	Martignoni, this paper
2451941.395	CCD	19578	−0.093	19578	0.002	”

Check star(s):	GSC 4739.0676 = USNO A2.0 0825.01096410 ($11\overset{\mathrm{m}}{.}9$ R); GSC 4739.0638 = USNO A2.0 0825.01094601 ($12\overset{\mathrm{m}}{.}1$ R)

Transformed to a standard system:	No

Availability of the data:

Through IBVS Web-site as file 5074-t1.txt

Type of variability:	RRAB

Remarks:

BE Eri was discovered as variable stars by Hanley and Shapley (1940): they found the RR Lyrae nature and gave first period of variation. Afterwards the variable was investigated by Pop and Todoran (1973) who published times of maxima and the following linear elements of variation:

$$\mathrm{Max} = \mathrm{HJD}\ 2440595.254 + 0\overset{\mathrm{d}}{.}57954 \times E. \qquad (1)$$

They were able also to point out a Blazhko's effect with an approximate periodicity of $94P$. Further time of maximum was published by Schmidt and Seth (1996). We observed BE Eri from JD 2450169 to JD 2451941 obtaining 230 measures: from the light curve produced (Fig. 1), two new time of maxima were determined and, by means of timings found in the literature, we were able to derived the following new linear elements of variation calculated by the least squares method:

$$\begin{array}{c} \mathrm{Max} = \mathrm{HJD}\ 2440595.266 + 0\overset{\mathrm{d}}{.}5795345 \times E. \\ \pm\, 0.009 \pm 0.0000013 \end{array} \qquad (2)$$

Published and new times of maximum light are reported in Table 2.

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HD 93917 IS A NEW EW ECLIPSING BINARY STAR

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Name of the object:
HD 93917 = SAO 137825 = BD $-01^\circ2452$ = AG $-02^\circ623$ = PPM 178307 = GSC 4917_22

Equatorial coordinates:	**Equinox:**
R.A.= $10^{\mathrm{h}}50^{\mathrm{m}}29^{\mathrm{s}}\!.72$ **DEC.=** $-02^\circ41'43''\!.1$	2000.0

Observatory and telescope:
Zaragoza city private observatory, 15-cm Newtonian telescope

Detector:	CCD
Filter(s):	V
Comparison star(s):	HD 93832 = SAO 137817 = BD $-01^\circ2450$ = AGK $-02^\circ0622$ = PPM 178303 = GSC 4916_646
Check star(s):	1: HD 93729 = SAO 137809 = PPM 178300 = BD $-01^\circ2448$ = AGK $-02^\circ0619$ = GSC 4916_385; 2: PPM 178299 = BD $-01^\circ2448$ = AGK $-02^\circ0618$ = GSC 4916_632; 3: GSC 4917_21
Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	EW

Remarks:

During a routine patrolling in search for new variables it was found that HD 93917, with a V magnitude of 9.01 ($B-V=0.55$) and K0 spectral type, is a W UMa eclipsing binary star with a period of 10.6 hours. The star was observed for 12 nights between March 14 and 27 April 2001. The amplitude of the variation is $0^{\mathrm{m}}\!.34$ for the primary minimum and $0^{\mathrm{m}}\!.33$ for the secondary one. The following ephemeris was computed:

$$\begin{array}{l} \mathrm{Min\,I} = \mathrm{HJD}\ 2452015.4354 + 0^{\mathrm{d}}\!.44342 \times E. \\ \qquad\qquad\qquad\qquad\quad \pm\,0.0008\ \pm\,0.00010 \end{array}$$

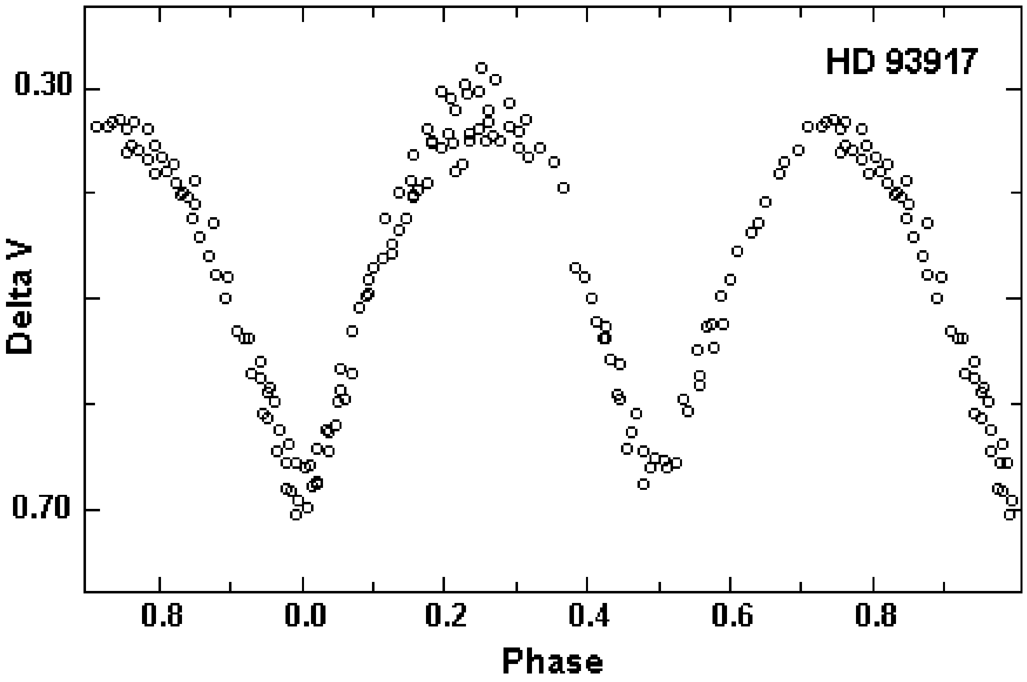

Figure 1.

Acknowledgements:

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

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BINARY STAR MORPHOLOGY AND THE NAME OVERCONTACT

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Rucinski (1997) has suggested that *contact binary*, rather than *overcontact binary,* be used as the logically and historically correct name for common envelope systems. He cites 5 recent examples within IBVS of *overcontact* being used in place of *contact*, and many more examples could be cited from the general literature. Rucinski kindly avoids assessing blame for the new trend, but the writer probably bears primary responsibility (Wilson, 1994, 2001). Although Rucinski interprets the cited examples as mistakes, it will be argued below that - in terms of both logical consistency and of history - those papers are using *contact* and *overcontact* correctly.

A literature survey shows the terms *critical lobe* and *limiting lobe* to be essentially interchangeable, with both referring to the largest closed equipotential that surrounds only one component of a binary. *Roche lobe* has the same meaning for some authors, while others use *Roche lobe* only for synchronously rotating, circular orbit cases. *Roche limit* is an infrequent synonym for *Roche lobe* that now seems out of favor, perhaps because the term has another meaning in regard to tidal disruption of satellites. G.P. Kuiper was probably first to understand the roles of critical lobes and first to use the word *contact* in a morphological context. His extensive paper on β Lyrae (Kuiper, 1941) developed morphological ideas quantitatively and demonstrated remarkable early insights into the mechanical equilibrium of close binaries. By *contact*, Kuiper meant contact between the two stars (p. 137 of Kuiper, 1941). Two new terms, *detached* and *semi-detached*, were coined by Z. Kopal (1955). The former condition has both stars within their limiting lobes and the latter has one star within its lobe and the other accurately touching (contacting or filling) its lobe. Kopal also used *contact*, but defined it to mean accurate contact of a star with its lobe (p. 427 of Kopal, 1955), in contrast with Kuiper's meaning. To Kopal, *contact binary* meant a binary with both star surfaces accurately coincident with their lobe surfaces. Obviously he did not believe in common envelope systems, as shown at many places in his writings - a view that now conflicts with observations of W UMa's and would even be considered unphysical. Nevertheless it will be argued below that Kopal's lobe-filling definition of contact serves morphology well and that we therefore need search no further for a useful definition.

Of course modern astrophysics is free to adopt whatever meaning of *contact* leads to the most consistent morphology, but let us examine history for perspective. Rucinski (1997) asserts that "The group of contact binaries was defined clearly by Kopal (1959, Sec. VII.6) as systems filling the common envelope encompassing both stars". However Rucinski's claim is not supported by a reading of that section. Kopal comments on the meaning of contact at only one place in his Section VII.6, which is in the middle of p. 526, where he states: "... both components of W UMa type systems appear to fill completely their respective Roche limits - a property which has earned them the designation of contact systems". Kopal also shows a schematic diagram of the three morphological types on his p. 483, where the illustrated contact system just fills the "figure eight" of the inner contact surface with no excess, so there is no common envelope. Then on p. 546 he specifically emphasizes the distinction between the Kuiper and Kopal definitions of contact, writing: "...whereas we propose to regard as contact binary (or component) a star whose surface coincides with its Roche limit, Kuiper's definition ...does not mean that mere contact exists, but a common envelope as well". Kopal had already made similar comments about contact systems at least 5 years earlier (p. 39 of Kopal, 1954; p. 149 of Kopal and Shapley, 1956). He avoided a problem with common envelope cases by disbelieving in them. So Kopal did define contact clearly, but not as contact between stars or existence of a common envelope as stated by Rucinski, but in the same way as contact is now most frequently used (*i.e.* accurate contact with a lobe).

Usage prior to 1994 usually involved a hybrid of the Kuiper and Kopal morphologies, with the Kuiper meaning of contact when the two stars are mutually involved (*contact binary* meaning that the stars touch) and the Kopal meaning for each star's relation to its lobe (*semi-detached* meaning that one star contacts its lobe and the other does not). Things would be simpler with *contact* having the same meaning for all morphological types, which they do in the Kopal scheme but not in the hybrid scheme. The hybrid scheme was formally inconsistent, but the inconsistency did not cause a practical problem within the 3-type morphology because, with synchronous rotation, contact of both stars with their lobes implied star-star contact. So common envelope systems were usually called contact binaries, although much less often (*e.g.* Wilson and Rafert, 1981; Wilson, Van Hamme, and Pettera, 1985; Wilson, 1988) they were called overcontact binaries - a name that reserved the word contact for its lobe-filling meaning while providing a pictorial name for common envelope binaries.

An extension or generalization of the Kopal morphology has come along in a fourth morphological type called *double contact* (Wilson, 1979). To appreciate the idea of double contact, one must recognize a generalized definition of a limiting lobe that applies for non-synchronous as well as synchronous rotation and for eccentric as well as circular orbits: *A limiting lobe is an equipotential for which the effective gravity is zero on the line of centers at periastron* (Wilson, 1979). Double contact becomes meaningful for super-synchronously rotating stars and involves filling of both lobes *without* star contact (not even point-contact), thus forcing a decision - does contact mean star-star or star-lobe? We shall have a consistent terminology regardless of whether rotation is synchronous if we keep the star-lobe definition, and any excess beyond lobe filling is well described by *overcontact.* The change in usage noted by Rucinski came after the name overcontact was coupled with an explanation of the 4-type morphology (Wilson, 1994). Rucinski prefers use of overcontact for binaries that overflow the outer contact surface, as in Kuiper (1941). Although such systems are exceedingly rare, Rucinski's preference is an entirely reasonable use of the name. However we need to agree on what overcontact is to mean and my suggestion is to continue using overcontact in the sense adopted in many recent papers and agree on another name for contact with the outer contact surface. Perhaps it can be as straightforward as *outer-contact binary.*

With regard to counter arguments, Rucinski says that "the equipotential is not a solid surface in space and there is nothing to be in contact with". However abstract surfaces certainly can be in contact - abstraction lies at the foundation of science. Actually the idea of contact always is an abstraction - the contact of material objects is as much an abstraction as the contact of mathematically defined surfaces. Of course, the surface of a star is an abstraction. Far from being impermissible, abstraction is a primary ingredient in scientific thinking. Therefore a star can certainly be in contact with its critical lobe. The concept has been used for many decades without stirring doubts as to its essential meaning and is a core concept of binary star morphology. Were we to grant that a star cannot be in contact with a non-material surface, we would have to admit that it cannot be detached from it either (detached from that which does not exist?).

In conclusion, Kuiper's common envelope physics was more in keeping with modern ideas than were Kopal's point-contact binaries, but the issue at hand is the meaning of the word contact in terms of history and logical usefulness. Historically, Kopal definitely meant star on lobe, not star on star. Logically, Kopal's lobe-filling definition avoids inconsistency and allows for a natural generalization to non-synchronous and eccentric orbit cases. Explanations of generalized 4-type morphology are in Wilson (1994; 2001) and on pp. 87-89 of Kallrath and Milone (1999).

I thank S. Wyithe for calling Rucinski's paper to my attention and W. Van Hamme for comments.

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PHOTOMETRIC PERIODICITY OF BZ Cam DURING THE 1999 FADING

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BZ Cam is a well-known cataclysmic variable of novalike (NL) category, which does not show dwarf nova-type outbursts. BZ Cam is renowned for its surrounding bow shock nebula (Krautter et al. 1987; Hollis et al. 1992), and highly variable appearance of P Cyg profiles in its spectra (originally discovered by J. R. Thorstensen and presented in Patterson et al. 1996; Ringwald and Naylor 1998). BZ Cam has been playing an important role in understanding the formation of high-speed winds from cataclysmic variables. The binary nature of BZ Cam was studied by Lu and Hutchings (1985) and Patterson et al. (1996). The best determined orbital period is $0.^{\rm d}153693(7)$.

Another noteworthy characteristic of BZ Cam is its occasional fadings, which makes BZ Cam as one of VY Scl-type novalike variables. The first historical fading was discovered on Harvard Plates by Garnavich and Szkody (1988). The second ever-observed fading was in 1999 (Watanabe 2000, 2001). We performed CCD observations during this fading.

The CCD observations were done using an unfiltered ST-7 camera attached to the Meade 25-cm Schmidt–Cassegrain telescope. The exposure time was 30 s. The images were dark-subtracted, flat-fielded, and analyzed using the Java$^{\rm TM}$-based aperture photometry package developed by one of the authors (TK). The magnitudes were determined relative to GSC 4362.125 ($V = 12.87$, $B - V = +0.78$) which constancy was confirmed using GSC 4362.861 ($V = 14.00$, $B - V = +0.67$). The magnitudes of the comparison and check stars are taken from Henden and Honeycutt (1995). A total of 957 observations between 1999 October 3 and 1991 December 8 were obtained. Our observations were done at the bottom of the fading. Barycentric corrections were applied to the observed times before the following analysis.

The resultant light curve is shown in Figure 1. The object showed short-term variations but little long-term variation, which is consistent with that the observations were done at the bottom of the fading. The period analysis using the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978) has revealed a clear (more than 5-sigma) periodicity close to the reported orbital period (Figure 2). The strongest period is $0.^{\rm d}15634(1)$, which is 1.7% longer than the orbital period. The averaged amplitude at the orbital period is less than $0.^{\rm m}03$, which excludes the orbital period as the origin of variations.

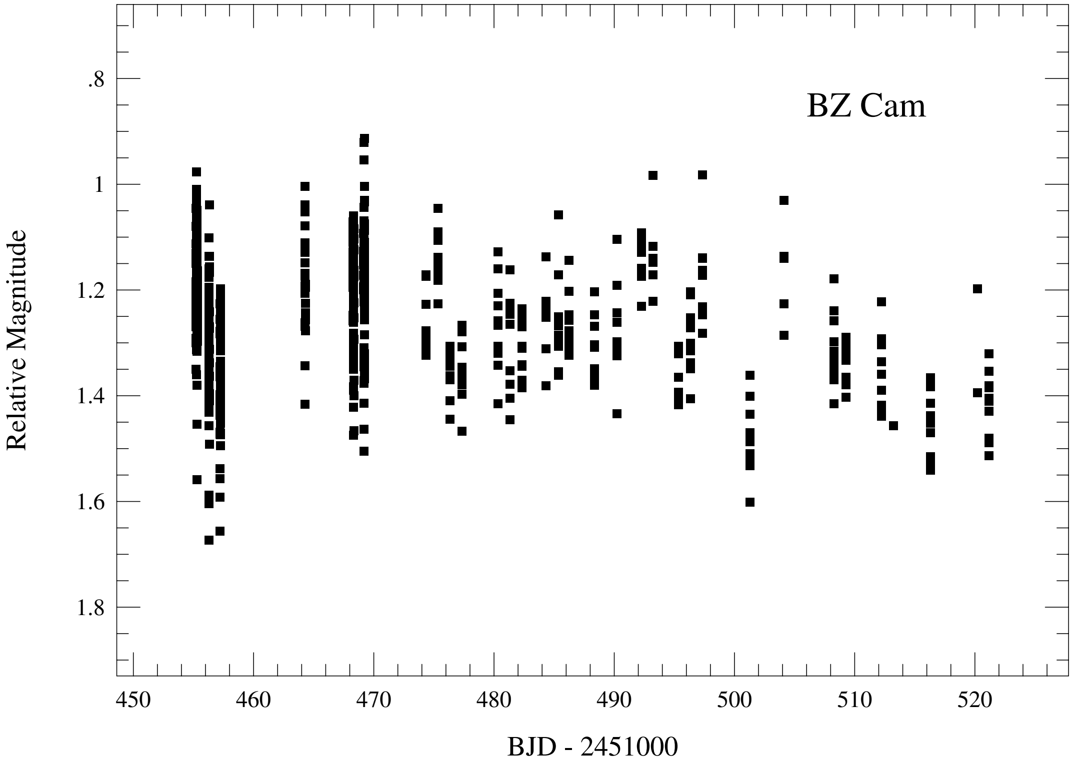

Figure 1. Light curve of BZ Cam

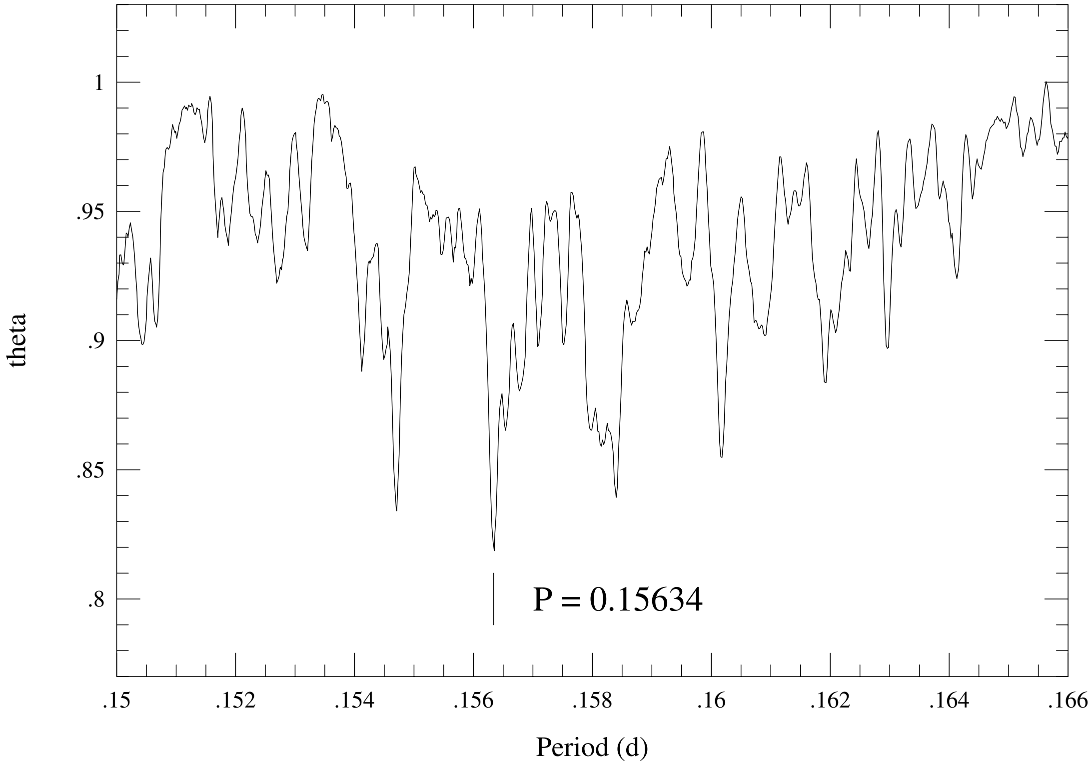

Figure 2. Periodogram of BZ Cam

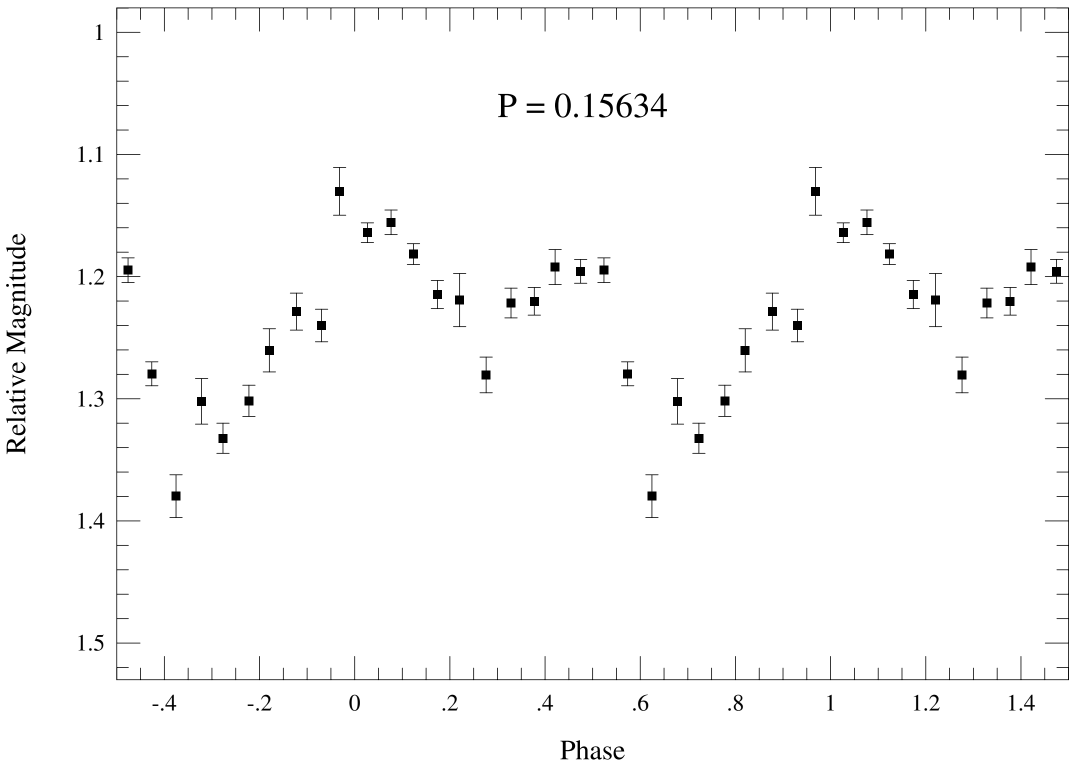

Figure 3. Phase-averaged light curve at $P = 0\overset{\mathrm{d}}{.}15634$

The detection of a strong period slightly longer than the orbital period strongly suggests the presence of superhumps. Observations in the high state by Patterson et al. (1996) also suggested the presence of signals close to, but slightly different from the orbital period, but the amplitude of present observation (slightly larger than $0\overset{\mathrm{m}}{.}2$) is much larger than those ($0\overset{\mathrm{m}}{.}03$) suspected by Patterson et al. (1996). The profile of the light curve (Figure 3) is also characteristic to those of usual superhumps, but has a shoulder on the fading branch, which is reminiscent of some of low-amplitude superhump candidates reported by Patterson et al. (1996). Our observation suggests that superhumps in BZ Cam is enhanced during its low state (*transient* permanent superhumps?), phenomenologically contrary to SU UMa-type dwarf novae, which usually show superhumps during superoutbursts. The fractional superhump excess of 1.7% is relatively small for objects of this orbital period (e.g. Patterson 1999). Different excitation mechanisms may be responsible for superhumps in BZ Cam, from other novalike systems with permanent superhumps.

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SU UMa-TYPE DWARF NOVA V369 Peg

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V369 Peg = NSV 26006 = KUV 23012+1702 was originally discovered as a variable, ultraviolet-excess object (Kondo et al. 1984). Wegner and Dupuis (1993) took a low-resolution spectrum of this object and described that "Hα and Hβ look as if they have emission cores", and gave a spectroscopic classification of sdBe. The variability of KUV 23012+1702 was studied on Moscow plates by Antipin (1998). Antipin (1998) discovered that the star is a dwarf nova with a variability range of 15.8–$<$ 18.0 p. Antipin (1998) also noted the presence of two kinds of outbursts, bright ones lasting more than 8 days and faint ones lasting less than 5 days. KUV 23012+1702 was thus considered as a very good candidate for an SU UMa-type dwarf nova. This object received a GCVS designation of V369 Peg (Kazarovets et al. 2000).

J. Pietz detected an outburst on 1999 November 3, and detected hump features with an amplitude of $0\overset{m}{.}35$ from his November 4 CCD observations (Pietz 1999). We started time-series CCD observations during this apparent superoutburst.

The CCD observations were done using an unfiltered ST-7 camera attached to the Meade 25-cm Schmidt–Cassegrain telescope. The exposure time was 30 s. The images were dark-subtracted, flat-fielded, and analyzed using the Java$^{\mathrm{TM}}$-based PSF photometry package developed by one of the authors (TK). The magnitudes were determined relative to GSC 1711.839 (Tycho-2 magnitude: $V = 11.44 \pm 0.12$, $B - V = +0.87 \pm 0.26$), whose constancy during the run was confirmed using GSC 1711.2320. Table 1 summarizes the log of observations. Barycentric corrections to the observed times were applied before the following analysis.

Figure 1 presents the overall light curve. The figure shows a long outburst (superoutburst) and following two short (normal) outbursts occurring on JD 2451509 and JD 2451522. The initial superoutburst detected by Pietz lasted until November 18, followed by a rapid decline. The duration of superoutburst was thus 15 days. The interval of two subsequent normal outbursts was 13 days, which can be regarded as the typical recurrence time of this dwarf nova. The short recurrence time and the small outburst amplitude suggests that the object is a rather active dwarf nova.

The data between JD 2451488 and 2451497 (superoutburst plateau), after subtracting the linear trend of decline, were analyzed using the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978). The resultant theta diagram is shown in Figure 2. The best superhump period is 0.08484 ± 0.00010 d. The other one-day aliases were excluded by independent detections of the same signal by Pietz (1999) and Vanmunster (1999a, 1999b).

Table 1: Nightly averaged magnitudes of V369 Peg

JD start[a]	JD end[a]	mean mag[b]	error[c]	N^d
51488.982	51489.125	4.294	0.045	160
51489.994	51490.207	4.329	0.038	249
51490.959	51491.206	4.486	0.043	164
51492.020	51492.192	4.593	0.019	418
51493.029	51493.181	4.586	0.022	378
51496.031	51496.184	4.945	0.029	365
51497.027	51497.156	4.987	0.042	265
51499.031	51499.034	-[e]	-	4
51500.028	51500.133	5.336	0.531	52
51501.028	51501.173	7.032	0.327	302
51502.033	51502.064	8.818	1.611	80
51503.135	51503.143	7.122	1.589	20
51504.056	51504.061	9.8:	3.0	14
51505.059	51505.163	6.736	1.205	9
51507.003	51507.003	-[e]	-	1
51509.002	51509.005	5.955	0.276	10
51510.996	51511.001	-[e]	-	10
51512.051	51512.055	9.120	2.081	11
51513.038	51513.042	6.954	0.784	10
51520.005	51520.009	8.084	1.083	10
51521.001	51521.004	-[e]	-	10
51521.905	51521.994	5.112	0.092	17
51522.968	51522.971	6.022	0.309	10
51523.970	51523.974	7.211	0.699	11

[a] JD – 2400000

[b] Magnitude relative to GSC 1711.839

[c] Standard error of nightly average

[d] Number of frames

[e] Object below detection limit (typically below 17^{m})

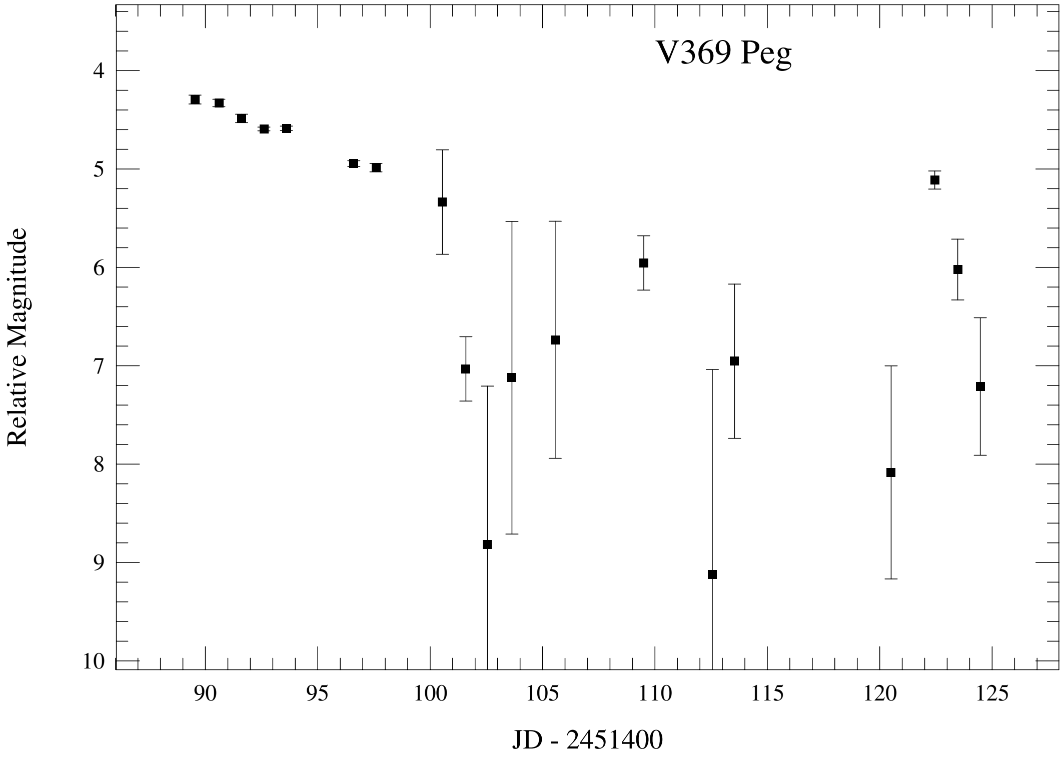

Figure 1. Light curve of V369 Peg. Relatively large errors were caused by the faintness of the object

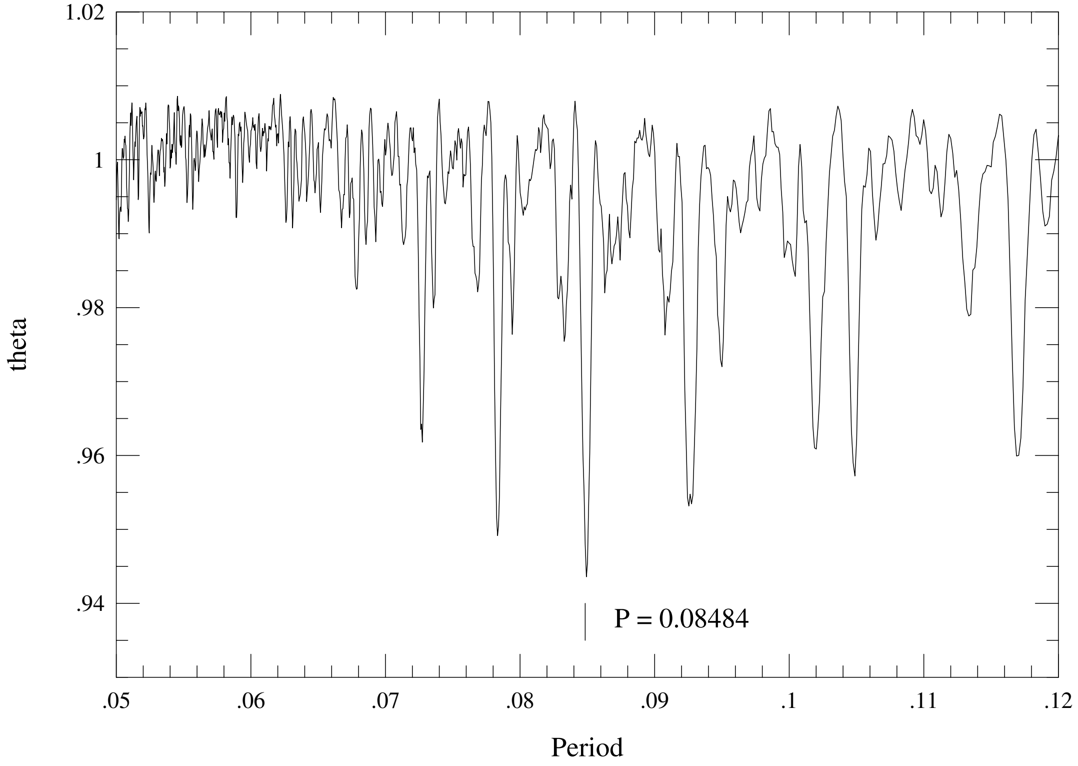

Figure 2. Periodogram of V369 Peg

Figure 3 shows the phase-averaged light curve of superhumps. The superhumps had a large amplitude of $\sim 0^{\mathrm{m}}_{\cdot}3$. The superhump period of $0^{\mathrm{d}}_{\cdot}0848$ makes V369 Peg as one of SU UMa-type dwarf novae with long orbital periods. The overall pattern of outbursts looks similar to the long-period system YZ Cnc. Further detailed observations are encouraged to precisely determine the system parameters.

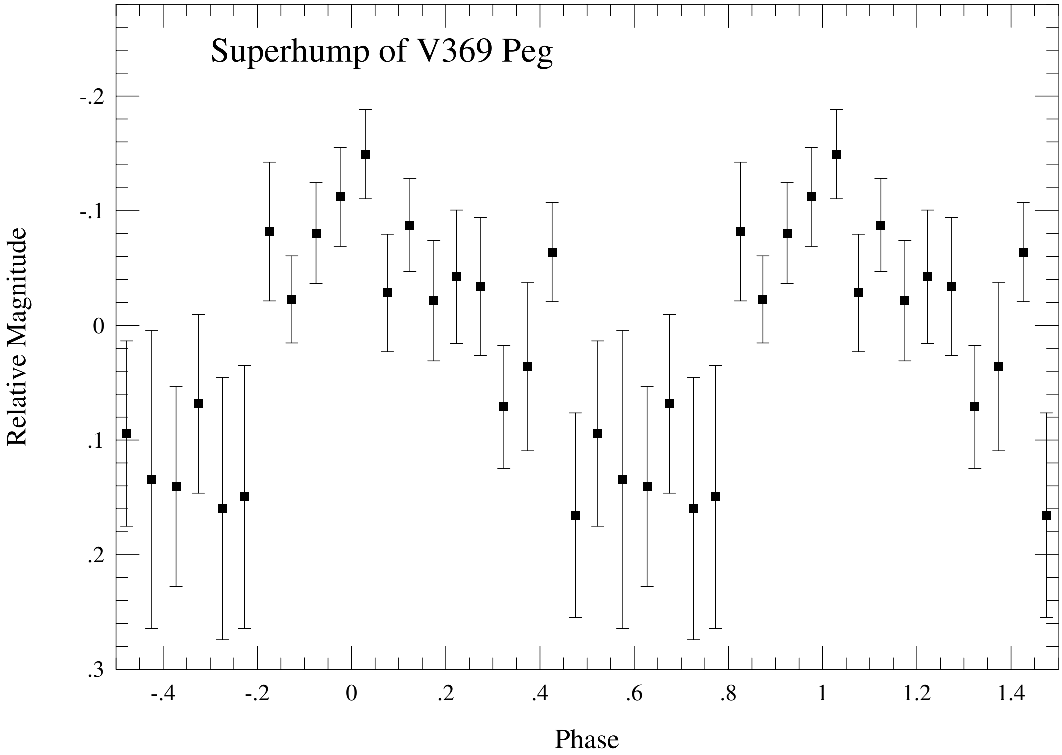

Figure 3. Superhump profile of V369 Peg

The authors are grateful to VSNET members for notifying us of outbursts, and exchanging timely information.

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THE DISCOVERY OF BRIGHTNESS VARIATIONS OF HD 280340 AND GSC 2895-1173

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* Guest User, Canadian Astronomy Data Centre, which is operated by the Herzberg Institute of Astrophysics, National Research Council of Canada

We observed HD 280340 as part of a continuing search for photometric variations in stars which are known X-ray sources. The star HD 280340 = RXJ 050147+380541 = GSC 2895-1453 was discovered to be a source of X-rays by the ROSAT satellite (Voges et al. 1999). The Tycho catalog (ESA 1997) includes HD 280340 with V_T = 10.677 and B_T = 11.342 and the primary comparison star, HD 280341 = GSC 2895-0471, with V_T = 10.095 and B_T = 10.753 both consistent with the spectral type of approximately G3.

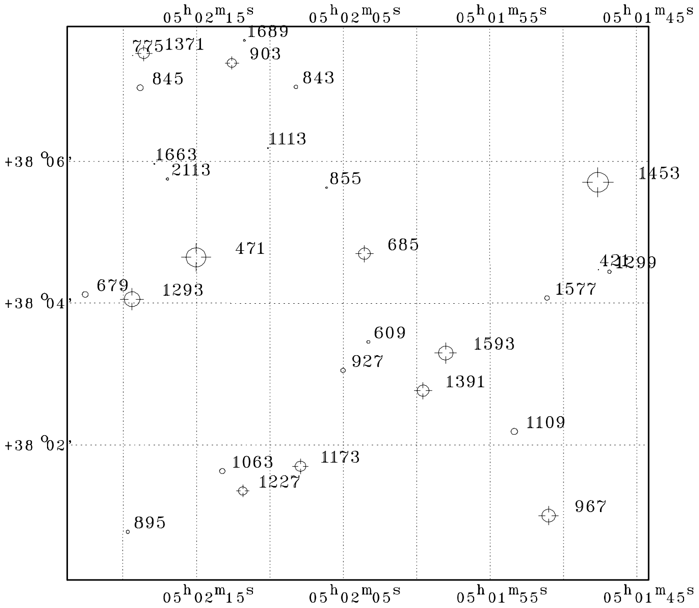

Figure 1. Finder chart labeled with the GSC numbers

Figure 1 shows the field of stars observed with the automated 0.5-m telescope of the Climenhaga Observatory at the University of Victoria and reduced in a fashion similar to

Table 1: Stars observed in the field of HD 280340

GSC No.	R.A. J2000	Dec. J2000	GSC mag	ΔR_c mag	Std. Dev. Between	Std. Dev. Within
HD 280340	$05^h01^m48^s$	$+38^\circ05'42''$	10.6	0.306	0.021	0.004
HD 280341	$05^h02^m15^s$	$+38^\circ04'38''$	10.0	-	-	-
2895-1293	$05^h02^m19^s$	$+38^\circ04'03''$	11.0	1.326	0.006	0.011
2895-0679	$05^h02^m23^s$	$+38^\circ04'07''$	13.6	3.473	0.014	0.014
2895-0685	$05^h02^m04^s$	$+38^\circ04'42''$	12.0	2.743	0.002	0.007
2895-1593	$05^h01^m58^s$	$+38^\circ03'18''$	11.3	2.238	0.003	0.005
2895-1391	$05^h02^m00^s$	$+38^\circ02'46''$	12.0	1.866	0.007	0.006
2895-1109	$05^h01^m53^s$	$+38^\circ02'11''$	13.5	3.333	0.004	0.015
2895-0967	$05^h01^m51^s$	$+38^\circ01'00''$	11.6	2.558	0.003	0.008
2895-2113	$05^h02^m17^s$	$+38^\circ05'45''$	14.6	4.671	0.024	0.040
2895-1063	$05^h02^m13^s$	$+38^\circ01'38''$	13.8	3.696	0.022	0.024
2895-1227	$05^h02^m12^s$	$+38^\circ01'21''$	12.9	3.839	0.014	0.024
2895-1173	$05^h02^m08^s$	$+38^\circ01'42''$	12.4	3.549	0.039	0.017
2895-0927	$05^h02^m05^s$	$+38^\circ03'03''$	14.0	4.091	0.028	0.028
2895-0609	$05^h02^m03^s$	$+38^\circ03'27''$	14.4	4.244	0.023	0.035
2895-1577	$05^h01^m51^s$	$+38^\circ04'04''$	14.0	3.938	0.011	0.024
2895-1299	$05^h01^m47^s$	$+38^\circ04'27''$	14.3	3.967	0.019	0.025

that described in Robb and Greimel (1999). The Julian Dates (− 2450000) of the nights of observations were 1925, 1932, 1935, 1936, 1937, 1947, 1950, 1951, 1952, 1953, 1954, 1959, 1960, 1961, 1963 and 1966. Table 1 lists the stars' identification numbers, coordinates (J2000) and magnitudes from the Hubble Space Telescope Guide Star Catalog (GSC) (Jenkner et al. 1990). Observations were made using a filter closely matching the Cousins R band (Cousins 1981). Our differential ΔR_c magnitudes are calculated in the sense of the star minus HD 280341. Brightness variations during a night were measured by the standard deviation of the differential magnitudes and are listed for the most photometric night in the last column as 'Std. Dev. Within'. For each star the mean of the nightly means is shown as ΔR_c in Table 1. The standard deviation of the nightly means is a measure of the night to night variations and is called 'Std. Dev. Between' in Table 1.

The 'Std. Dev. Between' for stars GSC 2895-0685−HD 280341 is $0\overset{\mathrm{m}}{.}002$, so we feel this shows that night to night variations in both these stars are less than a few millimagnitudes. A 'Std. Dev. Within' of 0.005 indicates that HD 280341 is constant at this level and we observed no significant variations in plots of the individual nights' data. Therefore we conclude that HD 280341 is constant in brightness at the millimagnitude level at the daily and hourly time scales. Stars with a 'Std. Dev. Within' approximately equal to the 'Std. Dev. Between' and which showed no obvious variations in the nightly plots, we believe were constant for the time period observed and at the precision of the standard deviations calculated.

The star HD 280340 had obvious variations during some nights and obvious variations from night to night and is a new variable star. Shown in Figure 2 is the chi-squared of a fit of the data to sine curves as a function of period. Thus we find the ephemeris is:

$$\mathrm{HJD\ of\ Maximum\ Brightness} = 2451925\overset{\mathrm{d}}{.}00(10) + 2\overset{\mathrm{d}}{.}85(5) \times E$$

where the uncertainties in the final digit are given in brackets and the root-mean-square error of the fit is $0\overset{m}{.}01$. The 2517 differential R_c filtered magnitudes phased at this period are plotted in Figure 3 with different symbols for each of the nights. HD 280340 is a late type star, and an X-ray source with a small amplitude photometric variation consistent with typical BY Dra stars. The large apparent scatter is attributable to the small amplitude of the variation and possibly changes in the morphology and position of the spots. Photometric observations should be continued to monitor for flares, changes in the spot distribution and period changes.

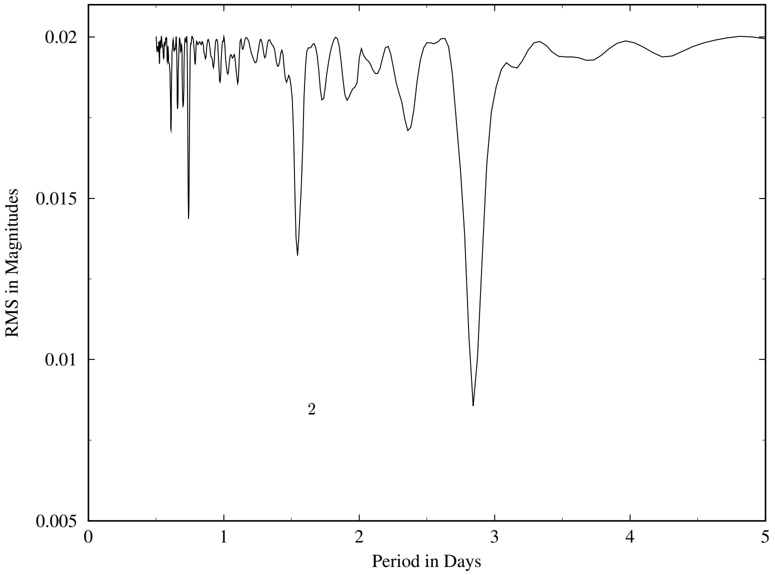

Figure 2. Periodogram for HD 280340 in 2001

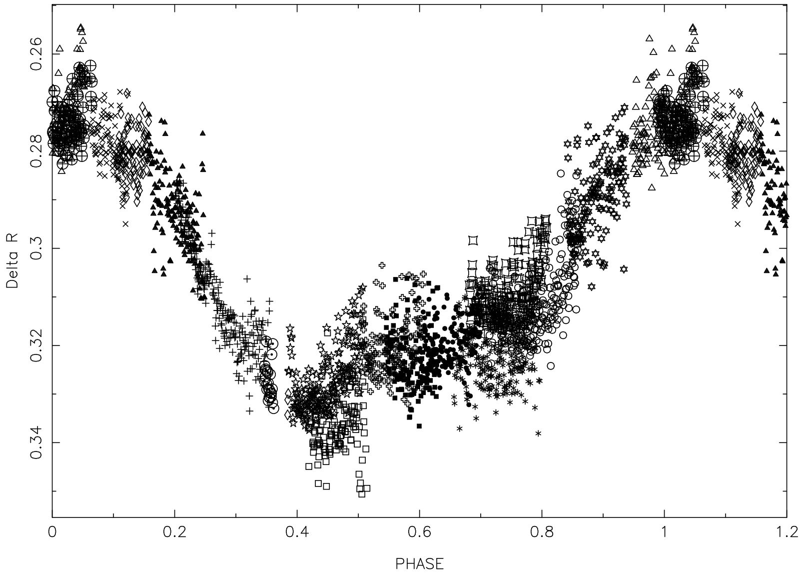

Figure 3. R_c filtered light curve of HD 280340 for winter 2001

The field star GSC 2895-1173 = (USNO2 1275-04179369) has a larger standard deviation from night to night than its standard deviation during a night indicating night to night variability. Its light curve is shown in Figure 4 with error bars of $0^{\mathrm{m}}.01$, which we estimate to be approximately the correct uncertainty.

The color of GSC 2895-1173 from the USNO2 catalog (Monet et al. 1996) is $B-R=1.9$ and for HD 280340 (G3 spectral class) the USNO2 gives $B-R=1.4$ implying that GSC 2895-1173 has a late-type spectral class. While we cannot be certain what kind of variable star it is we expect it to be either a very low amplitude Cepheid or a K-giant variable (Robb and Cardinal 1998).

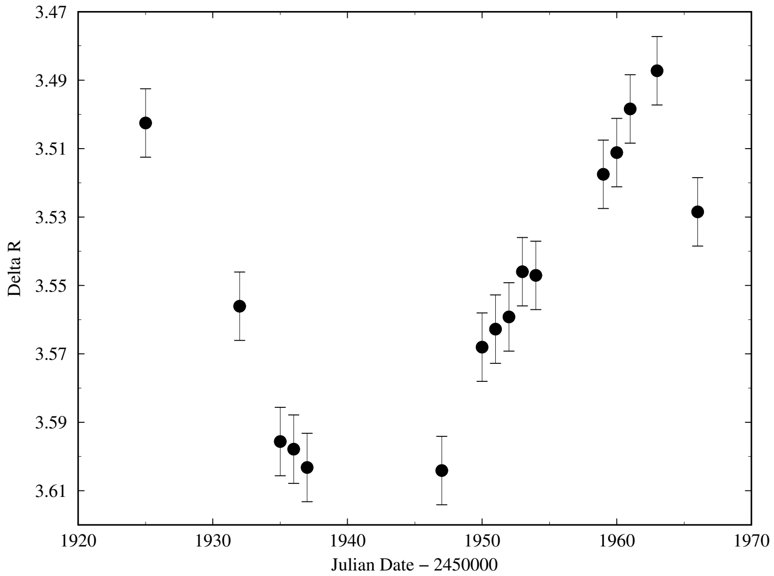

Figure 4. R_c filtered light curve of GSC 2895-1173 – HD 280341 for winter 2001

Continued photometry is important to ascertain the reason for the variability of GSC 2895-1173. Spectroscopic observations will be valuable to determine a precise spectral class for the stars and to measure radial velocities to check for duplicity.

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TIMES OF MAXIMUM LIGHT FOR AE URSAE MAIORIS

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Name of the object:
AE UMa

Equatorial coordinates:	**Equinox:**
R.A.= $09^{\mathrm{h}}36^{\mathrm{m}}53\overset{\mathrm{s}}{.}17$ **DEC.=** $+44^\circ04'00\overset{''}{.}5$	2000

Observatory and telescope:
Photo-lens ($D = 55$ mm, $f = 600$ mm) at Observatory and Planetarium of Johann Palisa, Ostrava, Czech Republic

Detector:	SBIG ST-7
Filter(s):	Unfiltered
Comparison star(s):	GSC 2998_1249
Check star(s):	GSC 2998_35, GSC 2998_512

Availability of the data:
Upon request

Type of variability:	SX Phe

Remarks:

Six new times of maximum light with cycle numbers and $O - C$ determined from Kholopov et al. (1985) are reported below. The MUNIDOS 2.11 software package (Hroch & Novák, 1999) was used for observation processing. The JD of maximum and the error of the determination of maximum were obtained by the Gaspani's (1995) method. The errors mean a standard deviation of the determination.

HJD	Error	Cycle	$O - C$
2451269.508	0.002	182117	0.002
2451283.441	0.002	182279	0.000
2451283.525	0.002	182280	−0.002
2451283.609	0.001	182281	−0.004
2451318.363	0.001	182685	−0.001
2451318.446	0.002	182686	−0.003

Acknowledgements:

T. Havlík and L. Král would like to express gratitude to their colleagues from Project Eridanus (`http://ostrava.astronomy.cz/`) for their collaboration, and to Dr. Tomáš Gráf, the director of the observatory, for his support.

This paper is a result of cooperation of the Czech observatories and astronomers working in observing programmes of the Czech Astronomical Society, namely B.R.N.O. (`http://var.astro.cz/brno/`) and MEDUZA (`http://www.meduza.org/`).

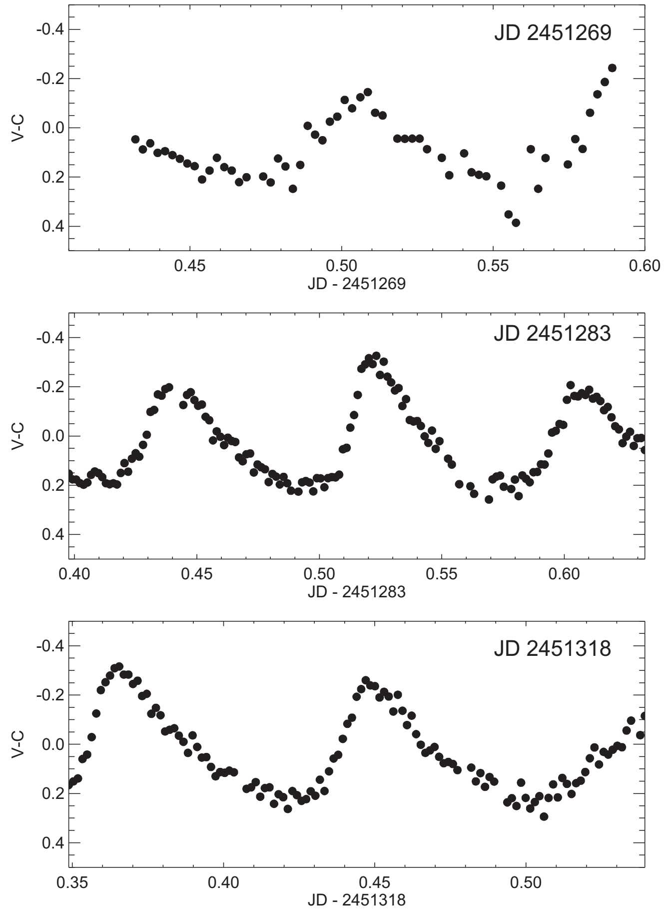

Figure 1. Our light curves of AE UMa

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PHOTOMETRY OF CI Cam DURING QUIESCENCE IN 1999

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CI Cam is the optical counterpart of the intense, rapidly fading X-ray nova XTE J0421+560 in 1998 (Smith et al. 1998; Paciesas and Fishman 1998; Wagner and Starrfield 1998). An ejection of relativistic jets was observed (Hjellming and Mioduszewski 1998a, 1998b), which has made CI Cam = XTE J0421+560 one of the most renowned Galactic microquasars. Before the giant outburst in 1998, CI Cam had been known as a variable star, classified as a possible symbiotic star. The variability of this star was discovered by Miroshnichenko (1994). Miroshnichenko (1994) reported that spectroscopy of the CI Cam = MWC 84 revealed absorption features typical for late-type stars. Miroshnichenko (1994) also reported a photometric period of $11\overset{d}{.}7$ with an amplitude of $0\overset{m}{.}3$. In order to confirm this suggested periodicity, we performed CCD photometry.

The CCD observations were done using an unfiltered ST-7 camera attached to the Meade 25-cm Schmidt–Cassegrain telescope. The exposure time was 30 s. The images were dark-subtracted, flat-fielded, and analyzed using the Java$^{\mathrm{TM}}$-based aperture photometry package developed by one of the authors (TK). The magnitudes were determined relative to GSC 3723.54, whose Tycho-2 magnitude is $V = 10.50 \pm 0.04$ and $B - V = +0.79 \pm 0.07$. The constancy of comparison star during the run was confirmed by comparison with GSC 3723.65 and GSC 3723.80.

A total of 259 useful frames between 1999 October 22 and 1999 December 28 were obtained. The light curve drawn from the resultant data is presented in Figure 1. The light curve shows relatively irregular variation, with a total amplitude of $0\overset{m}{.}2$. Small, nightly variations are superimposed on a general, slowly declining trend. A period analysis has yielded no coherent periodicity between 1 and 30 d. There was no indication of the 11.7-d periodicity. Post-outburst photometry between 1998 August and 1999 February (Clark et al. 2000) reported small variations, but the small number of data points made it impossible to analyze the possible periodicity or the time scale of variations. Clark et al. (2000) suggested a possible effect of the 1999 event in their post-outburst data. Our photometry at later epochs than theirs is expected to more closely reflect the quiescent activity.

The most remarkable short-term variation in our data was observed on JD 2451485 (1999 November 2), when a $0\overset{m}{.}10$ jump was observed within one day. The brightening lasted less than one day, and the object faded by $0\overset{m}{.}09$ on the subsequent night. The time scale of the variation was comparable to the e-folding time of $\sim 0\overset{d}{.}5$ d of the 1999 event. Since CI Cam was observed to be X-ray active even during quiescence (cf.

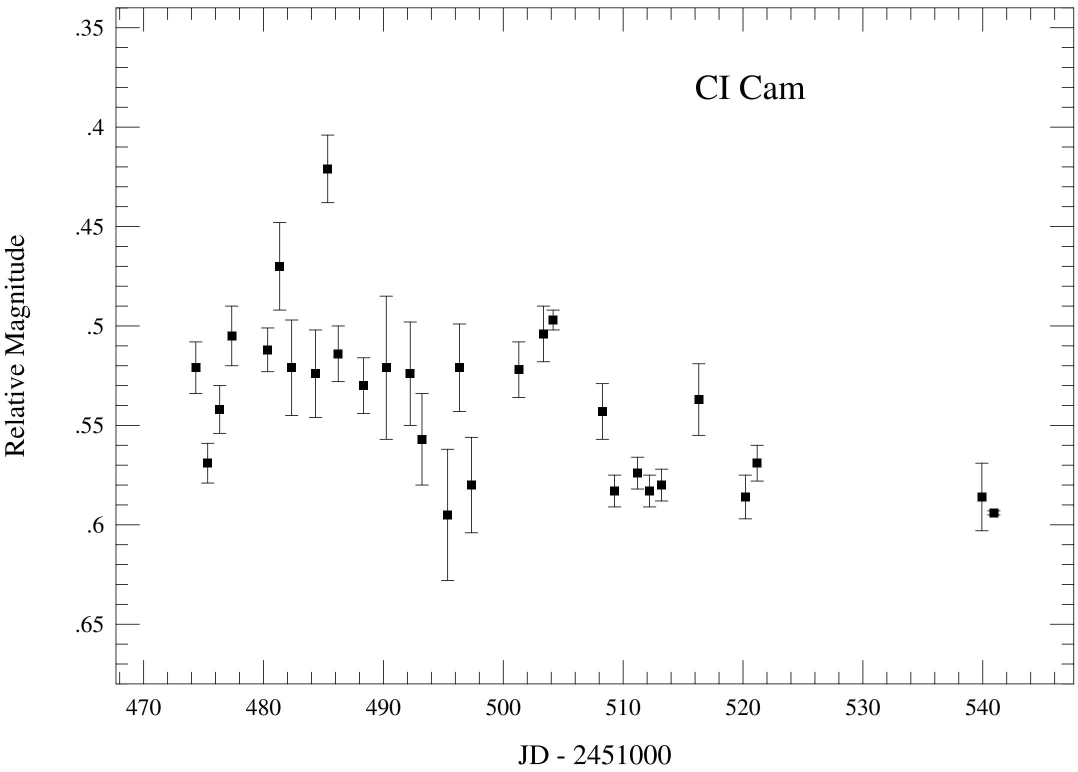

Figure 1. Light curve of CI Cam. Each point represents nightly averaged magnitudes

Parmar et al. 2000), it is not surprising if a "miniature" outburst may have been responsible for the transient optical brightening. The BATSE earth-occultation light curve (http://cossc.gsfc.nasa.gov/batse) does not show a marked increase of the X-ray flux on the corresponding day, but has a slightly increased detections 5 to 10 days after the optical brightening. The optical brightening thus may have been a precursor to the weak X-ray activity.

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FT Cam: OUTBURST PHOTOMETRY AND PROPER MOTION

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FT Cam (= Antipin Var64) is a dwarf nova discovered by Antipin (1999). Antipin (1999) reported two outbursts on Moscow plates, indicating that the outbursts are relatively rare. The next outburst was detected by Pietz (1998) on 1998 September 23.91 UT at magnitude 14.7. Visual observations by Kinnunen (1998) suggested the possible presence of short-term variations. This outburst faded relatively quickly. In spite of intensive monitoring by VSNET observers, no further outburst had been detected until Schmeer (2000a) reported another one on 2000 February 27.166 UT at unfiltered CCD magnitude 14.4. A later announcement by Pietz (2000) tells that the outburst started on February 26.8 UT, at unfiltered CCD magnitude 13.85. Pietz (2000) reported that the star was fainter than 15.5 on the previous night. The large observed interval (521 d) between outbursts supports the low outburst frequency reported by Antipin (1999). We started CCD time-resolved photometry to test the presence of short-term variations.

The CCD observations were done using an unfiltered ST-7 camera attached to the Meade 25-cm Schmidt–Cassegrain telescope. The exposure time was 30 s. The images were dark-subtracted, flat-fielded, and analyzed using the Java$^{\mathrm{TM}}$-based aperture photometry package developed by one of the authors (TK). The magnitudes were determined relative to GSC 4049.90, whose Tycho-2 magnitude is $V = 11.08 \pm 0.08$ and $B - V = +0.30 \pm 0.11$. The constancy of the comparison star during the run was confirmed using several anonymous fainter stars. We obtained 228 useful frames on 2000 February 27, covering $0\overset{\mathrm{d}}{.}126$. The light curve drawn from these data is presented in Figure 1.

The light curve shows a rather monotonous decline at a rate of 0.82 mag d^{-1}. No apparent large-amplitude modulations nor periodic waves were detected. The lack of apparent superhumps was also confirmed by independent observations by Pietz (2000). The relatively rapid decline was confirmed by G. Poyner who observed the star at $14\overset{\mathrm{m}}{.}7$ on 2000 February 28.810 UT. Schmeer (2000b) further reported that the star had returned to quiescence on 2000 March 1.140 UT. These observations suggests that all known (including Antipin's detections) outbursts of FT Cam only last 2–3 d. Although the lack of apparent superhumps may be suggestive of an SS Cyg-type star, it may be that we have only observed normal outbursts of an SU UMa-type star. Further monitoring for outbursts, and detailed observations during outbursts are strongly encouraged.

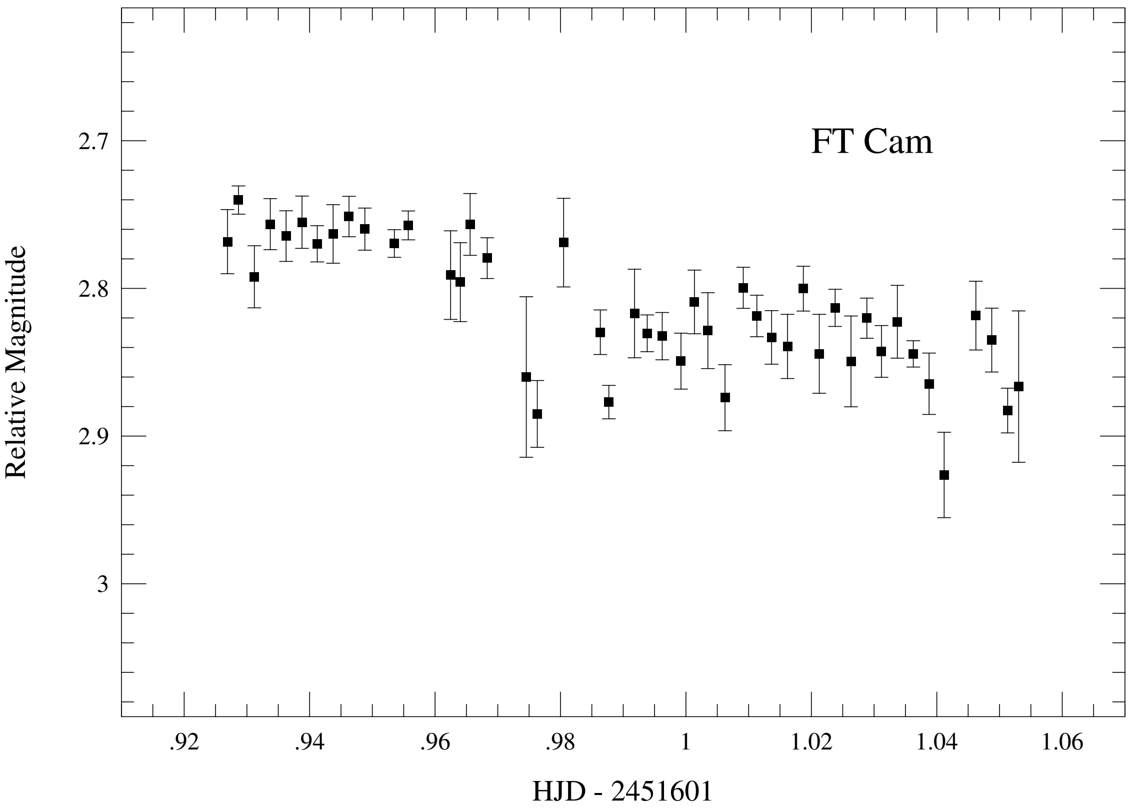

Figure 1. Light curve of FT Cam. Each point represents an average of $0\overset{\mathrm{d}}{.}0025$ bin

Astrometry of FT Cam from our outburst images has yielded the J2000.0 position of $03^{\mathrm{h}}21^{\mathrm{m}}14\overset{\mathrm{s}}{.}33$, $+61^\circ05'26\overset{\prime\prime}{.}3$ (based on 13 GSC-ACT stars). This value is pretty close to other reported astrometry of $03^{\mathrm{h}}21^{\mathrm{m}}14\overset{\mathrm{s}}{.}33$, $+61^\circ05'26\overset{\prime\prime}{.}0$ (Antipin 1999) and $03^{\mathrm{h}}21^{\mathrm{m}}14\overset{\mathrm{s}}{.}35$, $+61^\circ05'26\overset{\prime\prime}{.}1$ (Schmeer 2000a), but our result is considered as more accurate because we used the ICRS-based astrometric grid, GSC-ACT. The corresponding USNO A2.0 star (on the same astrometric grid) has end figures of $14\overset{\mathrm{s}}{.}415$, $25\overset{\prime\prime}{.}73$, which is $0\overset{\prime\prime}{.}8$ different from the current measurement. The comparison of DSS 2 plate taken on 1993 December 11 with DSS 1 (epoch 1954.074) further confirms the noticeable proper motion between them. The observed proper motion $0\overset{\prime\prime}{.}02$ yr^{-1} is relatively large among dwarf novae (cf. Harrison et al. 2000; Thorstensen 1999). The observed proper motion suggests that FT Cam is a relatively nearby object, likely located within 1 kpc from us, corresponding to the maximum tangential velocity of 100 $\mathrm{km\,s^{-1}}$ (for a discussion on velocity dispersions of cataclysmic variables, see Harrison et al. 2000). The inferred conservative upper limit $M_V = +4$ mag of the absolute magnitude in outburst is marginally consistent with known absolute magnitudes of dwarf novae (Warner 1987). However, many of observed maxima having been fainter than 14.5, the object may be intrinsically fainter than usual dwarf novae. This possibility may be strengthened by the low outburst frequency and shortness of outbursts, which are relatively unusual for dwarf novae, but are more typical for outbursts of intermediate polars (IPs). Since the accretion disks in IPs are magnetically truncated, this may explain the low luminosity and short duration of outbursts. The identification of FT Cam with a relatively hard ROSAT source 1RXS J032114.1+610535 may be a further support for the IP interpretation. Further observations in quiescence in order to search for possible coherent oscillations are encouraged.

The authors are grateful to VSNET members for providing crucial observations covering years, and P. Schmeer for promptly and publicly notifying the outburst. Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists (MU).

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KN Gem: MISCLASSIFIED BECAUSE OF MISIDENTIFICATION

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The variable star KN Gem = AN 645.1936 was discovered by Morgenroth (1936), whose publication includes a finding chart. He attributed the star to possible U Gem variables: it was observed bright on a single plate, on January 24, 1936. The next night's plate does not show the star, it was fainter than $14^{\mathrm{m}}.5$. The variability range was given as 13^{m} to fainter than $15^{\mathrm{m}}.5$. Because of only one positive observation, the star was kept in catalogs of suspected variables (Prager 2863, CSV 779), though the discoverer specially stated that the object did not look like a plate defect and probably was not a minor planet. Later Meinunger (1965) claimed that Morgenroth had misclassified the star. According to Meinunger's photographic observations, the star is red, belongs to Mira variables, and has the light elements $\mathrm{Max} = 2428194 + 156^{\mathrm{d}}.0 \times E$. This finding was the reason for the GCVS team to give the star its final variable star designation. The only other paper known to the author that apparently mentions positive observations of KN Gem belongs to the AFOEV team (1970). It states that the star was always at 13^{m} during 91 visual observations (JD 2439790–2440707).

The GCVS group is now working on improved positions for all "old" variable stars. KN Gem attracted our special attention because Gulyaev (1995) had warned us that the charts by Morgenroth (1936) and by Tsessevich and Kazanasmas (1971) had different stars indicated as KN Gem (as a rule, in such cases we decide in favor of the chart published by the discoverer).

We were surprised to find that there was no red star in the position of KN Gem. The Morgenroth (1936) chart, in agreement with the chart published by Brun and Petit (1959), leads to a region with several candidate stars from the US Naval Observatory A2.0 catalog, the brightest of them at $6^{\mathrm{h}}35^{\mathrm{m}}53^{\mathrm{s}}.94$, $+26^\circ52'58''.1$ (2000.0), with the blue magnitude $15^{\mathrm{m}}.0$ and the $b - r$ color index $-0^{\mathrm{m}}.3$. (The Tsessevich & Kazanasmas star is GSC 1888.143, its USNO A2.0 blue magnitude and color index are respectively $13^{\mathrm{m}}.3$ and $0^{\mathrm{m}}.9$.)

Interesting enough, the chart in Morgenroth (1936), reproduced in Fig. 1, though labeled "645.1936", actually shows two variable stars, 645.1936 and 646.1936. The latter star is the designated GCVS star BR Gem. The GCVS gives for it the Mira type and the light elements $\mathrm{Max} = 2439909 + 155^{\mathrm{d}}.80 \times E$. A list of maxima of BR Gem, derived from Sonneberg plates, was published by Van de Voorde (1943); all of them have their counterparts in the list of maxima of KN Gem determined from Sonneberg plates by Meinunger (1965), deviations are within errors. Thus we definitely conclude that all Meinunger's results for KN Gem actually refer to BR Gem.

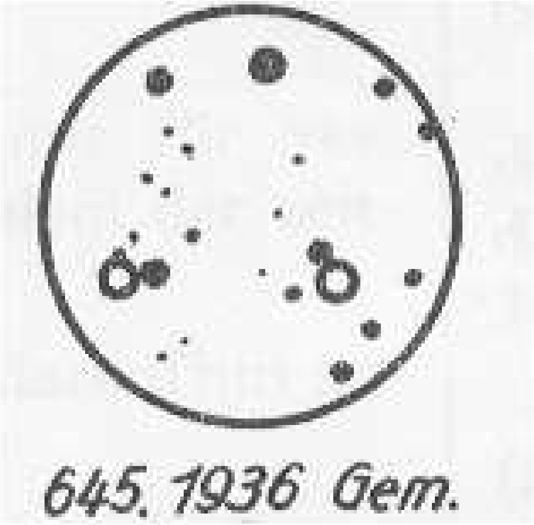

Figure 1. The finding chart from Morgenroth (1936). According to Morgenroth, the diameter of the displayed field is 10′; south is on top. Of the two stars marked, 645.1936 = KN Gem is to the left and 646.1936 = BR Gem, to the right

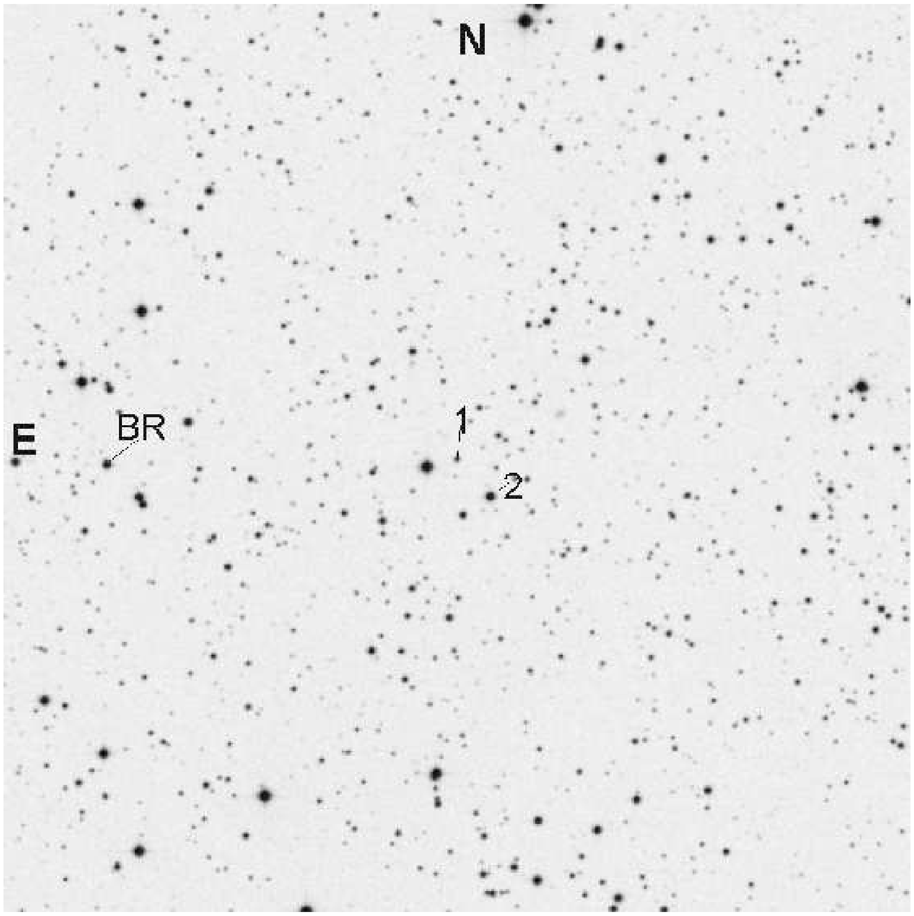

Figure 2. The 15′ × 15′ field around KN Gem (from the second-generation Digitized Sky Survey, red image). 1: the brightest USNO A2.0 candidate (see text); 2: the star marked in Tsessevich & Kazanasmas (1971). BR Gem = GSC 1888.611 is also shown

I have checked 85 plates of the field taken with the 40-cm astrograph of the Crimean Laboratory, Sternberg Astronomical Institute, on JD 2433307–2438499 and 2445756–2447918. No outbursts have been detected. The $15^{\mathrm{m}}.0$ candidate, mentioned above, can be slightly variable.

My final conclusion is that KN Gem is no Mira but remains an unconfirmed U Gem variable. The blue color of the candidate makes the U Gem classification possible, but by no means proven.

The stars mentioned above are identified in Fig. 2. Astronomers having access to the original Morgenroth's plate of January 24, 1936 are encouraged to check if the image of KN Gem is actually no plate defect and to measure the star's accurate position.

Our GCVS work is supported, in part, by grants from the Russian Foundation for Basic Research and the Program of Support to Russia's Leading Scientific Schools (grants 99-02-16333, 00-15-96627) and from the Russian Federal Scientific and Technological Program "Astronomy". I am grateful to Dr. S.V. Antipin for stimulating discussion.

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TWO NEW ALGOL-TYPE ECLIPSING BINARIES

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This report presents some results of a search for new variable stars conducted with the 25-cm photographic refractor ($f/6.3$ Cooke triplet) and blink comparator at Indiana University's Goethe Link Observatory, made available through a cooperative arrangement with the Indiana Astronomical Society. The blue-corrected astrograph recorded a field of 6.4 × 8.0 degrees on 20 × 25-cm Kodak SB-5 X-ray film (blue sensitive) and reached a limiting magnitude of 15.0 B in a 30-minute exposure.

The two eclipsing variables listed below are not officially designated in the General Catalogue of Variable Stars or subsequent Name Lists. Following the detection of variability at Link, each star was investigated at the Harvard College Observatory plate collection to confirm variability and determine the type and period. Magnitudes of comparison star sequences were determined by eye estimates using photoelectric B magnitudes of stars in nearby fields of the Guide Star Photometric Catalogue (Lasker et al. 1988).

GSC 5409-1201 (Pup). ($07^{\rm h}30^{\rm m}01\overset{\rm s}{.}7$ $-14^\circ28'22\overset{''}{.}8$ (B1950); type EA, 12.8–<15.0 $m_{\rm ptg}$.) Discovery of variability was first mentioned briefly in Williams (1996). Observed on 543 Harvard plates. Depth of minimum remains uncertain, variable fainter than plate limit. Duration of primary minimum is about 0.09 P. Magnitude estimates were recorded for each of the first 119 plates. To save time, only observations fainter than maximum were recorded from the remaining 424 plates. These observations are listed electronically as 5084-t3.txt, available through the IBVS Web site. The following light elements were determined by least squares analysis of the 19 observations of the variable at least 1 magnitude below maximum, 13.8 $m_{\rm ptg}$ or fainter (Table 1):

$$\begin{array}{rl}\text{Min. I} = \text{HJD } 2432891.408 + & 10\overset{\rm d}{.}984156 \times E. \\ \pm 0.061 & \pm\, 0.000075\end{array}$$

The $O-C$ residuals in Table 1 and the light curve (Figure 1) are based on these elements. The period is just 20 minutes longer than 11 sidereal days.

Table 1: Plate minima, GSC 5409-1201

HJD 2400000 +	Mag (ptg)	Epoch	$O-C$ (days)
25619.516	14.1	−662	−0.381
25982.473	<15.0	−629	+0.099
26762.318	<14.0	−558	+0.069
28596.530	<15.0	−391	−0.073
28596.577	<14.0	−391	−0.026
28837.861	14.1	−369	−0.394
28848.849	14.2	−368	−0.390
28937.401	<14.0	−360	+0.289
29585.435	14.7	−301	+0.258
29717.359	13.9	−289	+0.372
32891.575	<15.0	0	+0.167
32891.587	<15.0	0	+0.179
42447.658	<14.0	870	+0.035
45753.942	14.2	1171	+0.088
46115.961	<14.0	1204	−0.370
46116.032	<14.5	1204	−0.299
46446.025	13.9	1234	+0.169
47258.823	14.4	1308	+0.139
49389.671	<15.0	1502	+0.061

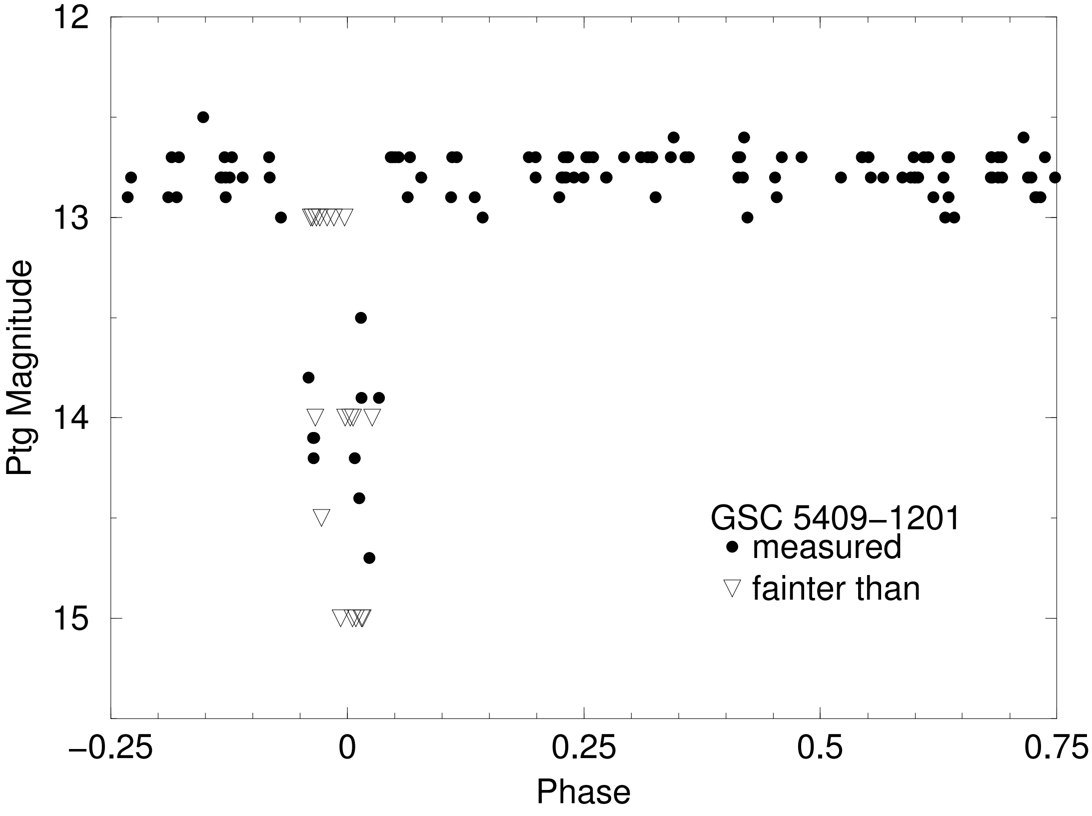

Figure 1. Photographic phased light curve, GSC 5409-1201

Table 2: Plate minima, GSC 3002-0454

HJD 2400000 +	Mag (ptg)	Epoch	$O-C$ (days)
25290.813	<14.2	−4732	+0.119
27092.797	14.2	−3761	+0.015
27374.884	<14.8	−3609	+0.003
27532.588	14.7	−3524	−0.045
28961.655	14.6	−2754	−0.029
29429.655	14.4	−1963	−0.054
31084.864	<14.5	−1610	+0.019
34072.774	14.5	0	−0.086
42485.727	14.4	4533	+0.027
44996.764	<14.5	5886	+0.018
45289.892	14.2	6044	−0.088
45757.717	14.2	6296	+0.048
46438.810	<14.2	6663	+0.022
46492.646	<14.5	6692	+0.036
46878.712	14.1	6900	+0.073
47264.629	<14.5	7108	−0.039
49801.651	<15.0	8475	−0.046

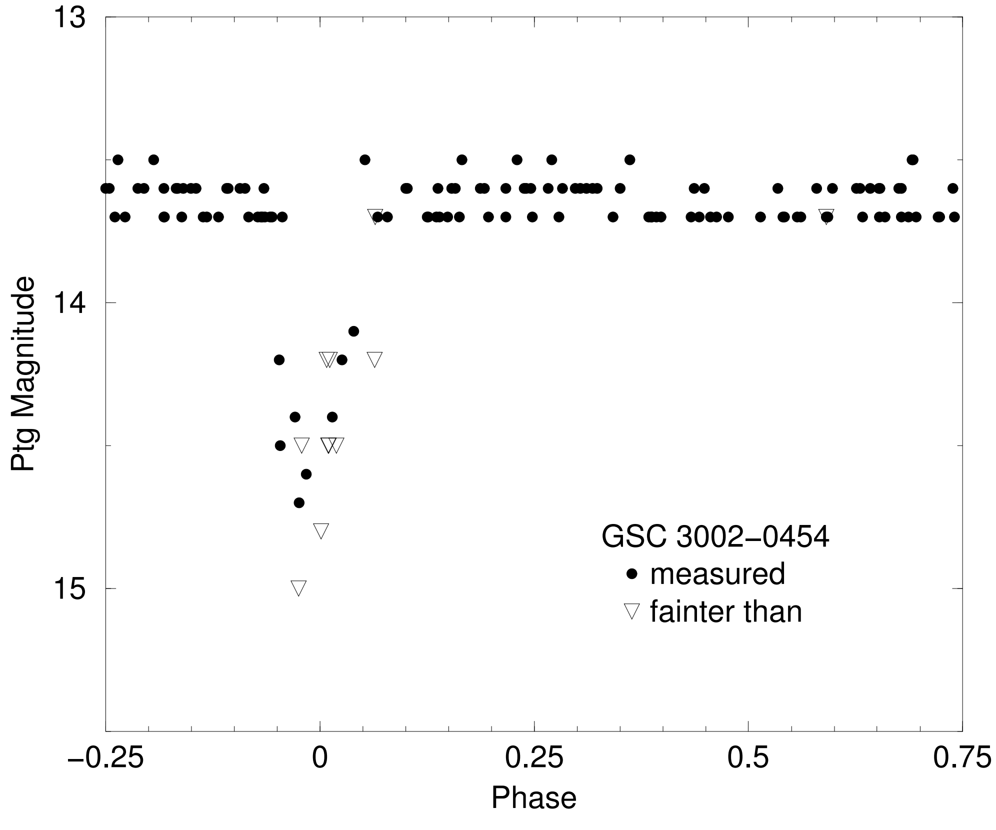

Figure 2. Photographic phased light curve, GSC 3002-0454

GSC 3002-0454 (UMa). ($10^{\mathrm{h}}26^{\mathrm{m}}56\overset{\mathrm{s}}{.}4$, $+40^\circ 11' 51\overset{''}{.}0$ (B1950); type EA, 13.6–<15.0 m_{ptg}.) Observed on 142 Harvard plates (magnitude estimates available electronically as 5084-t4.txt through the IBVS Web site). Faint or invisible on 17 plates, but these observations do not define the times of mid-eclipse very well because the minima are much deeper than the faint limit on the patrol plates. As a result, attempts to find the period were frustrated by sidereal day aliases. Visual monitoring by M. E. Baldwin and P. R. Guilbault revealed that the period is close to $1\overset{\mathrm{d}}{.}856$. The following light elements were determined by least squares analysis of the 17 times when GSC 3002-0454 was fainter than maximum (Table 2):

$$\begin{array}{rl}\text{Min. I} = \text{HJD } 2434072.860 + & 1\overset{\mathrm{d}}{.}8559010 \times E. \\ \pm 0.015 \pm & 0.0000003\end{array}$$

The $O-C$ residuals in Table 2 and the light curve (Figure 2) are based on these elements. New visual and CCD times of minima, *BVRI* photometry, and light curve parameters will appear in Baldwin et al. (2001).

I wish to thank the Indiana University Astronomy Department for use of the Link Observatory facilities. I am also grateful to Martha Hazen for extensive use of the Harvard plates, to M. E. Baldwin and P. R. Guilbault for finding the period of GSC 3002-0454, and to Guilbault and G. W. Billings for preparing this report for publication.

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LARGE-AMPLITUDE IRREGULAR VARIABLE V559 Lyr

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V559 Lyr is a variable star discovered by Takamizawa (1998) as TmzV32. Takamizawa (1998) noted little variation between 1994 and 1997, but reported a deep fading by $1\overset{\mathrm{m}}{.}7$ in 1998 March. The object was then considered as a possible eclipsing variable, and its suggested classification was taken over in the 75th Name List of Variable Stars (Kazarovets et al. 2000). One of the authors (T. Kinnunen) noted a gradual rise until early 1999, which made this classification unlikely. Since the sudden fade and gradual rise looked more characteristic of an R CrB-type star, we called for an intensive observing campaign through VSNET Collaboration (http://www.kusastro.kyoto-u.ac.jp/vsnet/).

The observations were taken photographically by Takamizawa and visually by four observers. Takamizawa used twin patrol cameras equipped with $D = 10$ cm $f/4.0$ telephoto lens and unfiltered T-Max 400 emulsions. Visual observations were done with 44.5-cm, 20-cm, 30-cm and 40-cm reflectors by Kinnunen, Nakatani, Itoh and Sato, respectively. All observations used GSC magnitudes for comparison stars. Calibration of GSC magnitudes in this field, using Tycho-2 V-magnitudes, has yielded a negligible scatter and zero-point error (typically less than $0\overset{\mathrm{m}}{.}2$). The overall uncertainty of estimates will not exceed $0\overset{\mathrm{m}}{.}4$, which will not affect the following discussion. The total number of positive estimates was 156.

The overall light curve based on these observations is shown in Figure 1. A well-observed sudden fading between JD 2451250 and 2451300, following the slow rise (JD 2450900–2451250, mentioned above), is evident. Although the light curve became more complex after that, the general tendency of fadings and slower recovery is not inconsistent with an R CrB-type variation. We took a low-resolution spectrum with a 1.88-m telescope at Okayama Astrophysical Observatory (OAO) on 2000 April 29. The dispersion was 5.9 Å/pixel. The reduction was done with IRAF (IRAF is distributed by the National Optical Astronomy Observatories), using the flux calibration standard of Feige 34. The spectrum

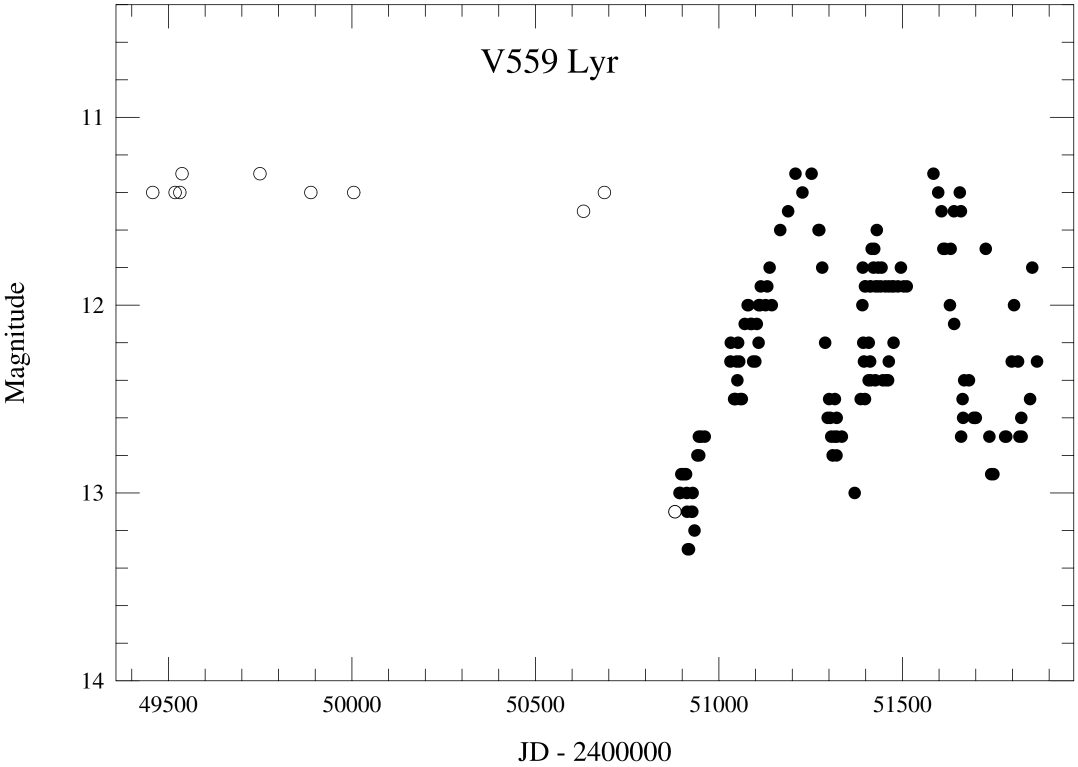

Figure 1. Light curve of V559 Lyr. Open and filled circles represent photographic and visual observations, respectively

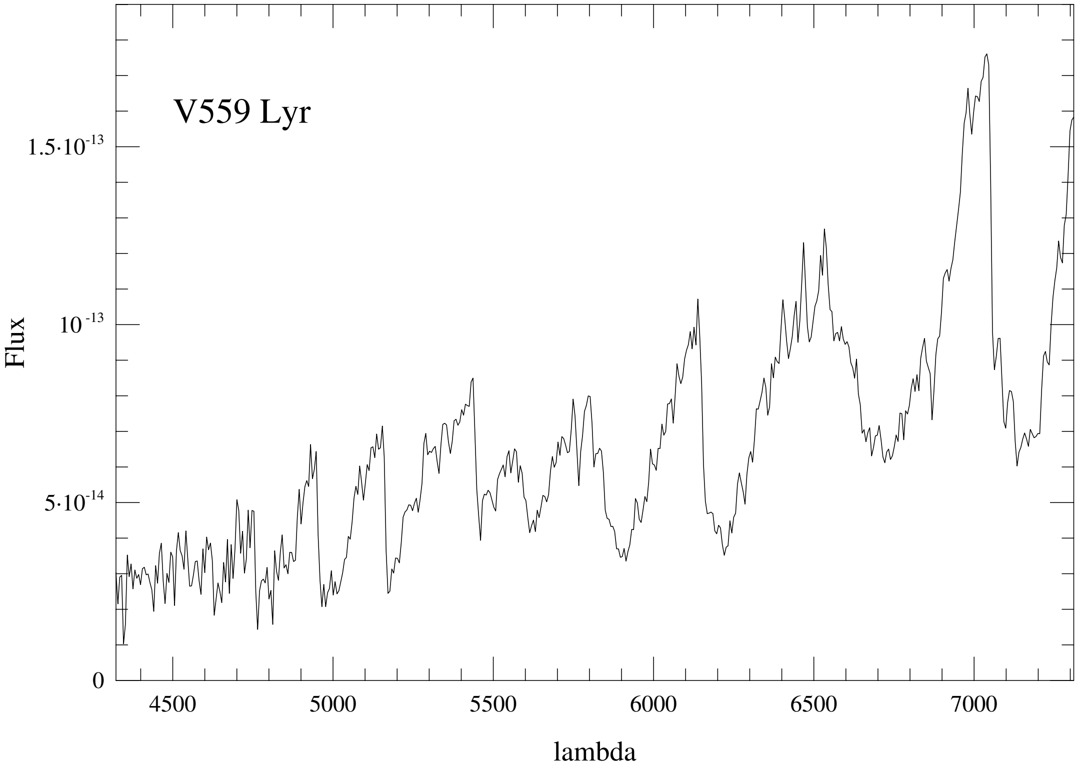

Figure 2. Spectrum of V559 Lyr. The unit in flux is erg $\mathrm{s}^{-1}\,\mathrm{cm}^{-2}\,\text{Å}^{-1}$

is shown in Figure 2, which clearly shows an M-type spectrum with TiO absorption features. The overall feature of the spectrum is consistent with a normal M 3-5 III star. The spectrum is inconsistent with the R CrB-type classification, and the star is most likely a large-amplitude irregular L-type variable star.

Large-amplitude L- and SR-type stars are relatively rare and, some of them are cool carbon-rich stars which are considered to occasionally produce dusts. Some stars, like V517 Oph (Kilkenny et al. 1992) and DY Per (Alksnis 1991, 1994) are sometimes considered as intermediate stars between R CrB stars and hydrogen-rich L- and SR-type stars (for a review, see Clayton 1996). Such stars may be analogous to R CrB-type stars in the mechanism of occasional deep fadings, but the case is not yet clear for V559 Lyr. More detailed observations of the chemical composition are therefore needed. It is noteworthy that this variable was included in the ROTSE test field (Akerlof et al. 2000), but the object was not picked up as a variable star. Since ROTSE observed the field since 1998, the object should have shown considerable variation during this period. A retrospective study on the ROTSE data may reveal more details of the variability of V559 Lyr.

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CONFIRMATION OF Z Cir AS A MIRA VARIABLE

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The conclusion by van Hoof (1964) that Z Cir "is almost certainly an R Coronae Borealis star" was based on 326 photographic plates. He particularly noted "the existence of the long-living flat maximum which had been noticed earlier by the Harvard observers."

Subsequently, Feast (1965) reported a spectrum typical of a Mira-type variable. In Figure 1 we show visual observations of Z Cir by AJ that confirm classification as a Mira, with a period of 386 days. The observations do not extend down to minimum light which, from other observations by other RASNZ observers, occurs at visual magnitude 14 to 14.5. The maxima, on the other hand, are well sampled here and show no sign of the flatness reported by van Hoof.

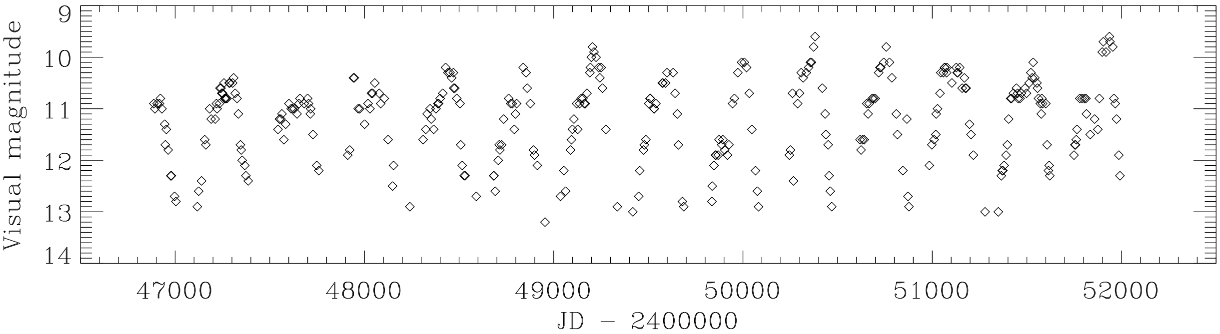

Figure 1. Visual light curve of Z Cir

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STABILITY OF PULSATION OF V577 OPHIUCHI

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V577 Ophiuchi (11.01 V, A8) is an eclipsing binary with a non-circular orbit (eccentricity $e = 0.22 \pm 0.08$) and a δ Sct-type primary component (Diethelm 1993). Previous observations clearly show the intrinsic pulsational variation superimposed on the eclipse light curve. The pulsation just disappears in the primary minimum and has almost double amplitude in the secondary one (Volkov 1990). In order to detect the multiperiodicity of the pulsation of V577 Oph, we observed the star in 2000. The data were collected with a red-sensitive Thomson TH7882 576×384 CCD photometer (Wei et al. 1990; Zhou et al. 2001) on the 85-cm Cassegrain telescope at the Xinglong Station of the Beijing Astronomical Observatory of China. The CCD has an imaging size of 13.25×8.83 mm^2 corresponding to a sky field of $12\overset{'}{.}3 \times 8\overset{'}{.}4$ ($1\overset{''}{.}2$/pixel, a pixel size is 23 μm^2). Two stars in the field of V577 Oph were selected as references. They are

C1 = GSC 00444_01191 ($RA = 18^{\rm h}16^{\rm m}46\overset{\rm s}{.}55$, $DEC = 06°57'08\overset{''}{.}2$, 2000.0, 12.6 V),
C2 = GSC 00444_02025 ($RA = 18^{\rm h}17^{\rm m}02\overset{\rm s}{.}51$, $DEC = 06°54'37\overset{''}{.}6$, 2000.0, 11.5 V).

Exposure times were 30 s. A Johnson V filter was used. Atmospheric extinction was not taken into account in view of the close spacing of the observed stars. The differential colour effect between the variable and the reference stars are largely eliminated by taking the mean combination of the latter. Hence the differential magnitudes of V577 Oph are calculated relative to the two comparison stars as V − (C1 + C2)/2. The magnitude differences between the comparison stars generally show a typical standard deviation of $0\overset{\rm m}{.}010$. For the nights of good seeing a better value of about $0\overset{\rm m}{.}006$ was obtained. These two comparison stars were detected to be non-variables at the accuracy of observation.

A preliminary Fourier analysis based on the data from four nights (11, 12, 21 and 30 June 2000) demonstrates that the light variations of V577 Oph can be well fitted with a single pulsation frequency $f = 14.3903$ cycle d^{-1} ($P = 0.069491$ d) having a semi-amplitude of $0\overset{\rm m}{.}0289$. The fitting yields the residuals with a standard deviation of $\sigma = 0\overset{\rm m}{.}0162$. We tried fitting the light curves with two more frequencies. When an additional second term at 16.2738 cycle d^{-1} was considered, the σ or the quality of fitting was not significantly improved. We recalled that all the observations collected in 1987–1990 by Volkov (1990) revealed the stability of pulsation in 2.5 year interval period. The period given in the ephemeris $\mathrm{HJD_{max}} = 2447620.379 + 0.0694909 \times E$ (Volkov 1990) is in close agreement with the present value. Therefore, we think that the pulsation frequency of V577 Oph has been quite stable since 1987. The question of amplitude variability is still open. Figure 1 displays the observed (dots) and fitted (lines) light curves of the star from the four nights.

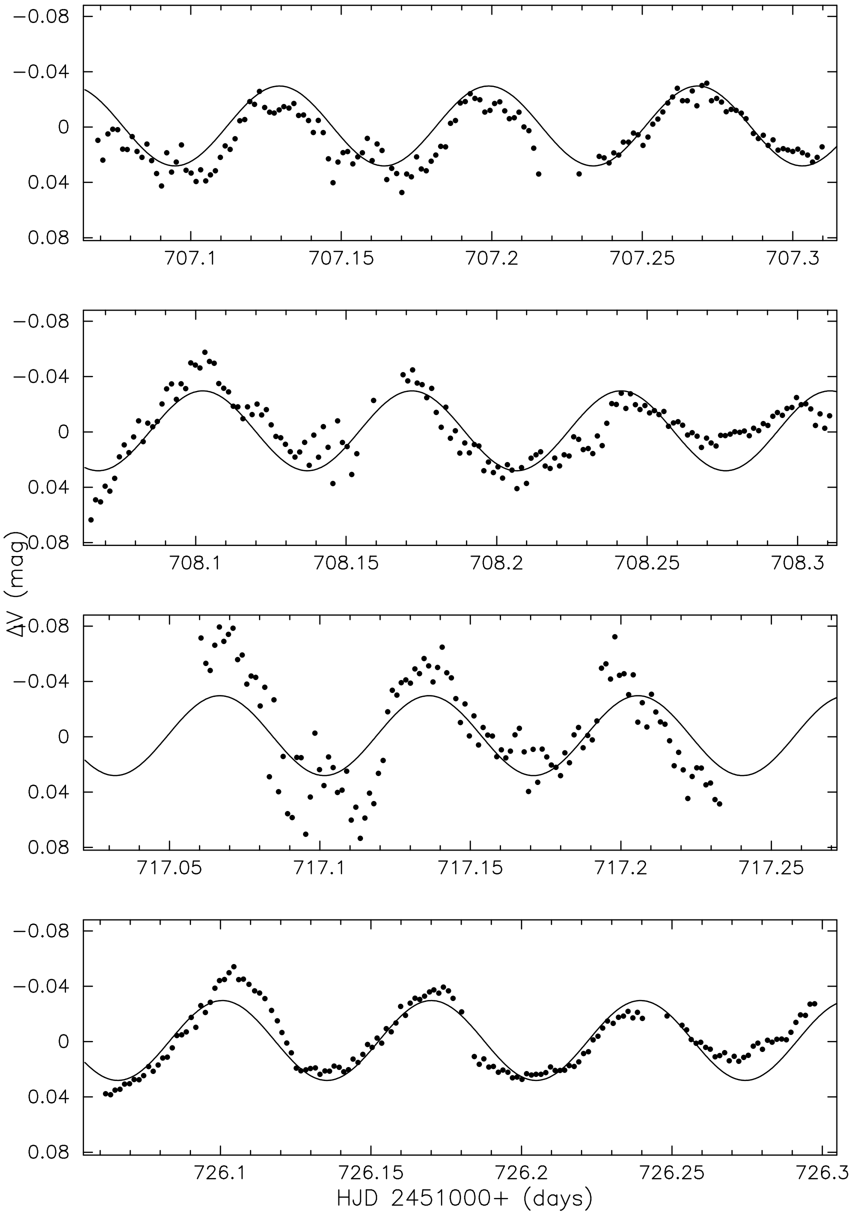

Figure 1. CCD differential light curves of V577 Oph from four nights in June 2000

Acknowledgements. This work was supported by the Natural Science Foundation of China.

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THE DISCOVERY OF BRIGHTNESS VARIATIONS OF GSC 0870-0798

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As part of a continuing search for photometric variations in stars which are known X-ray sources, we observed GSC 0870-0798. This star also known as RXJ114746+125408 was discovered to be a source of X-rays by the ROSAT satellite (Voges et al. 1997). Mason et al. (1995) found the star to be a source of EUV and included it in their catalog as 2RE J114746+125404. Stephenson (1986) classified its spectral type as K4 in his catalog of large proper motion stars in which he listed it as BPM87617. The Tycho catalog (ESA 1997) reported $V_T = 11.014$ and $B_T = 12.194$ for GSC 0870-0798 and $V_T = 8.316$ and $B_T = 8.801$ for the primary comparison star, GSC 0870-0467 = HD 102483, consistent with spectral types of approximately K2 and F7, respectively.

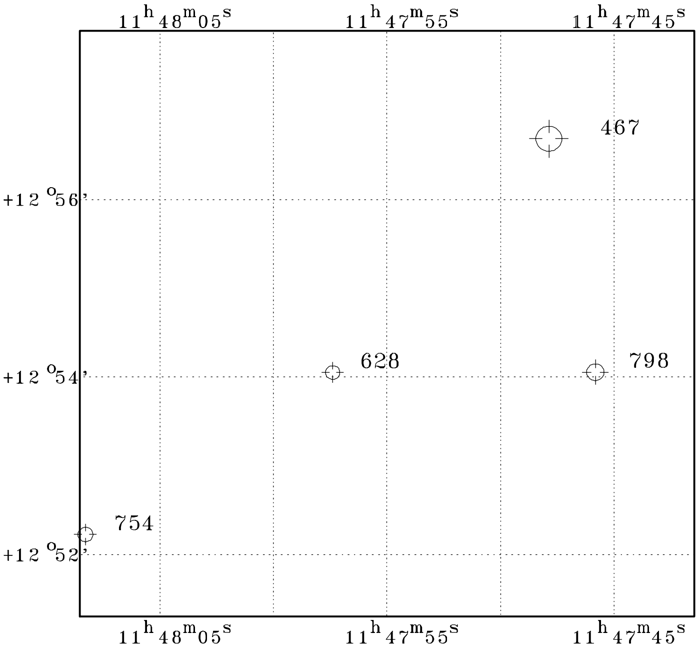

Figure 1. Finder chart labeled with the GSC identification numbers from region 0870

Table 1: Stars observed in the field of GSC 0870-0798

GSC No.	R.A. J2000	Dec. J2000	GSC Mag.	ΔR_c Mag.	Std. Dev. Between	Std. Dev. Within
00870-0798	$11^h47^m45^s$	$+12°54'03''$	10.5	2.183	.033	.004
00870-0467	$11^h47^m47^s$	$+12°56'41''$	8.2	-	-	.006
00870-0628	$11^h47^m57^s$	$+12°54'03''$	11.4	2.939	.005	.006
00870-0754	$11^h48^m08^s$	$+12°52'13''$	11.2	2.848	.003	.007

The field of stars observed with the automated 0.5-m telescope of the Climenhaga Observatory at the University of Victoria is shown in Figure 1. The data were reduced in a fashion similar to that described in Robb and Greimel (1999). Table 1 lists the stars' identification numbers, coordinates (J2000) and magnitudes from the Hubble Space Telescope Guide Star Catalog (GSC) (Jenkner et al. 1990). Observations were made using a filter closely matching the Cousins R band (Cousins 1981). The Julian Dates(-2450000) of ten observations are 2009, 2010, 2011, 2014, 2018, 2019, 2020, 2021, 2025, and 2026.

Our differential ΔR_c magnitudes are calculated in the sense of the star minus GSC 00870-0467. Brightness variations during a night were measured by the standard deviation of the differential magnitudes and are listed for the most photometric night in the last column as "Std. Dev. Within". For each star the mean of the nightly means is shown as ΔR_c in Table 1. The standard deviation of the nightly means is a measure of the night to night variations and is called "Std. Dev. Between" in Table 1.

The "Std. Dev. Between" for stars GSC 0870-0754–GSC 0870-0467 is $0^{\mathrm{m}}_{\cdot}003$ so we feel this shows that any night to night variations in either of these stars must be less than a few millimagnitudes. We observed no significant variations in the comparison star GSC 0870-0467 in plots of the individual nights' data and a "Std. Dev. Within" of 0.004 sets an upper limit on hourly variations.

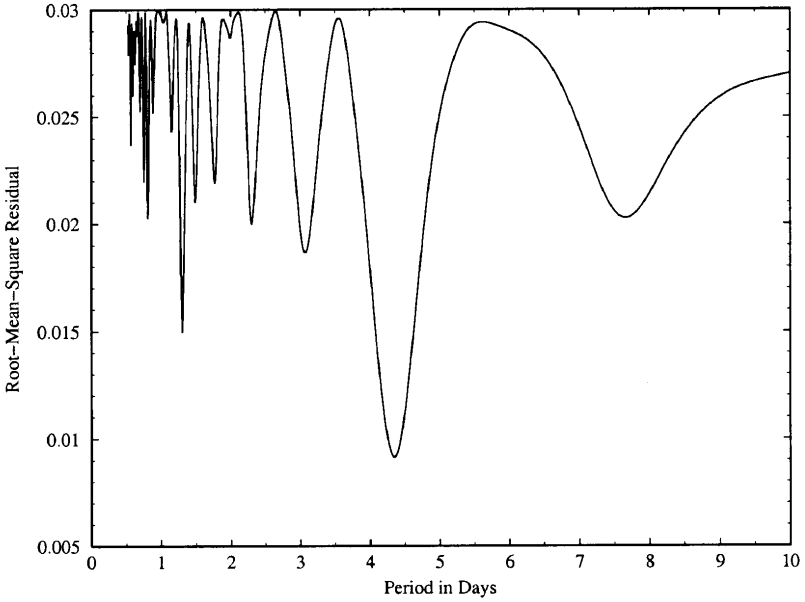

Figure 2. Periodogram for GSC 0870-0798 in 2001

Only the star GSC 0870-0798 had obvious variations and thus it is a new variable star. The chi-squared of a fit of the data to sine curves as a function of period is shown in Figure 2. Thus we find the ephemeris:

$$\text{HJD of Maximum Brightness} = 2452009^{\text{d}}\!.7(9) + 4^{\text{d}}\!.45(20) \times E$$

where the uncertainties in the final digit are given in brackets and the root-mean-square error of the fit is $0^{\text{m}}\!.01$. The 1413 differential R_c filtered magnitudes phased at this period are plotted in Figure 3 with different symbols for each of the nights. The small variations seen during some of the nights are probably real, but more data will be necessary to elucidate their nature.

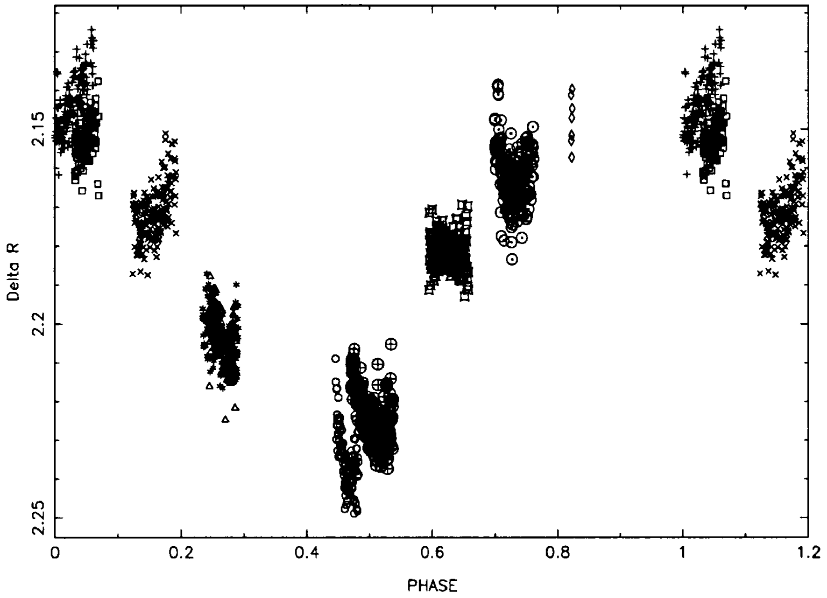

Figure 3. R_c filtered light curve of GSC 0870-0798 for winter 2001

GSC 0870-0798 is an EUV and X-ray source and a K4 spectral type dwarf star with a small amplitude photometric variation similar to typical BY Dra stars. Photometric observations should be continued to monitor for flares, changes in the spot distribution and period changes. Spectroscopic observations will be valuable to determine a precise spectral class for the star, to check for emission in the hydrogen and Ca H & K lines and to measure radial velocities to check for duplicity.

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EIGHT NEW SMALL AMPLITUDE VARIABLES

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Long term photometric monitoring of variable stars with Automatic Telescopes (APT) likely leads to the detection and characterization of a number of new variables used as comparison stars. Detections of new variable stars in the course of our monitoring programme of AGB variables with the Vienna APTs on Washington Camp, Arizona, have been reported by e.g. Lebzelter (1999). In the present paper we analyze data on further eight small amplitude variables.

Table 1: Summary of our observations and their results. The two stars listed at the bottom have been observed in the V- and I-bands, the other stars in B and V

Star	V-amplitude [mag]	spectral type	period [d]	variability type	Program star	Comparison star
SAO 15812	0.08	M2	20–50	SR/L	SS Dra	HD 108720
SAO 18231	0.05	K5	15–20	SR/L	SZ Dra	HD 179238
HD 291070	0.10	M2	40–50	SR/L	V352 Ori	HD 41061
SAO 90186	0.08	M0	40	SR/L	TW Peg	HD 209420
HD 103847	0.05	G5	13	solar type	GK Com	HD 104785
HD 170270	0.04	K5	10	SR/L	V585 Oph	HD 169930
SAO 154153	0.3	M0	25	?	AC Pup	HD 70738
HD 105036	0.1	M0	20	SR/L	RW Vir	HD 105061

Photometric data have been obtained between March and December 2000. From mid July to mid September the telescope was closed due to the bad weather season. Typically, every second night a data point has been obtained. The accuracy of the individual measurements is better than $0\overset{m}{.}02$. The first six stars listed in Table 1 have been observed in Johnson B and V filters, while SAO 154153 and HD 105036 have been monitored in V and I. The latter two have been observed continuously since November 1996.

None of the eight stars has left any significant echo in the literature, except for HD 103847, which will be discussed below. All objects of our sample have been measured by the Hipparcos/Tycho mission (van Leeuwen et al. 1997). For three stars, HD 103847, SAO 154153 and HD 105036, usable parallax measurements exist due to this mission. According to this, HD 103847 and SAO 154153 are both main sequence stars, while HD 105036 is a supergiant. Due to the failure to measure a parallax for the other objects, we classified these stars as giants or supergiants on the basis of their visual brightness values. Jorissen

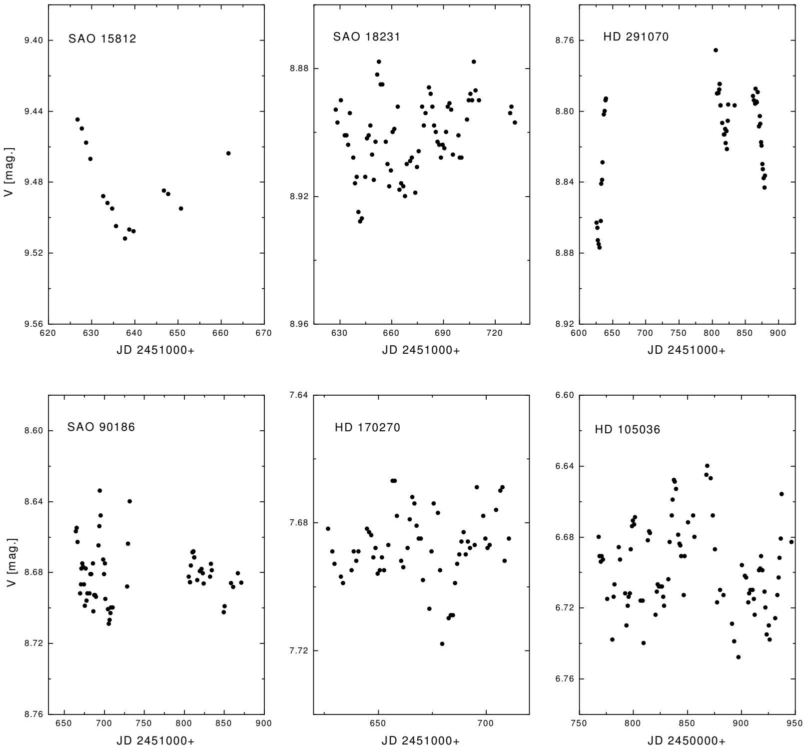

Figure 1. Visual light curves of the stars in Table 1

et al. (1997) have noted that small amplitude variability is very common among red giants of spectral type K and M. It is therefore not surprising that we detected variability of these stars. The Hipparcos mission found variability already in two stars of our sample, namely HD 103847 and HD 105036. Both stars have been classified as unsolved variables. The light amplitudes given by the Hipparcos catalogue are in reasonable agreement with our data. According to the Hipparcos catalogue none of the program stars is a close binary.

All of the eight stars show semiregular to irregular light changes with periods of a few ten days and amplitudes up to $0\overset{\mathrm{m}}{.}1$. In Fig. 1 we show the light curves for these stars except HD 103847 and SAO 154153 for which light curves will be presented below. As the periods of the variations are very short compared to the total time span of observations, we show only representative parts of the light change for the sake of clarity. The scale on the magnitude axis is the same for all objects ($0\overset{\mathrm{m}}{.}18$) except HD 170270 and SAO 18231, for which it has been enlarged. The K and M type giants can therefore all be classified as either semiregular or irregular variables. The nature of the light change and the time span of our observations do not allow a more detailed classification. Similarly, we can give only a range for the typical time scale of the variability. The severe problems in determining an accurate value of the period have been discussed already in an earlier paper (Lebzelter 1999). We note that there is a clear difference in the time scale and amplitude of the variability between the K and the M type giants of our sample, the latter having longer periods and larger amplitudes.

Two stars of our sample seem to be worth a further discussion. HD 103847 has the earliest spectral type of the stars in our sample. According to Strassmeier et al. (2000), this star shows H and K Ca II emission lines. Together with its spectral type, luminosity and period, it follows that HD 103847 is likely to show the same type of variability as the sun, but at a higher level of activity. According to our measurements, the $B-V$ variation of this star is very small (i.e., essentially below $0\overset{m}{.}015$). Therefore, we only show the variation of the B magnitude of this star in Fig. 2.

For the time shown, the light curve can be fitted rather well by a sinus curve with a period of 13 d and a B-amplitude of $0\overset{m}{.}05$. A period about twice as long cannot be ruled out. Further observations of this star are needed to determine the period accurately. Determination of the period is also complicated due to the fact that on longer time scales, the amplitude changes. The variability of the spots is occurring on a time scale similar to the rotation period of the star. This is in accordance with the results of Strassmeier (1990) and Strassmeier et al. (1997), who already reported amplitude and period variations of similar stars, presumably being due to rapid starspot variability.

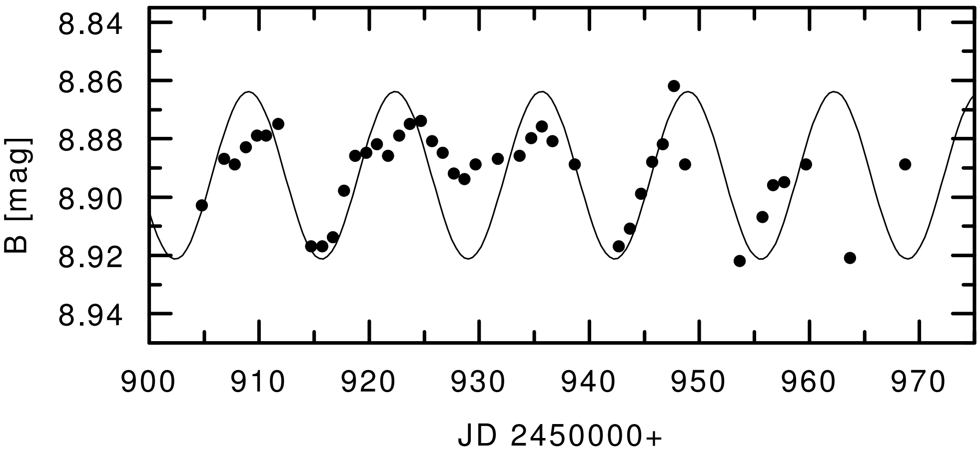

Figure 2. The B-band variation of HD 103847

The second interesting star is SAO 154153. According to its parallax the star is a M type dwarf. The Tycho catalogue lists a $B-V$ value of 1.592. Our measurements give a $V-I$ of 2.6, suggesting a spectral type later than M0. Photometry would therefore be in agreement with the star being either a giant or a dwarf. In the latter case (which is favoured by the parallax measurement), SAO 154153 might belong to the BY Dra group, meaning that the light variability is due to rotational modulation of surface structures. Its visual light curve and $V-I$ variation are shown in Fig. 3. A serious obstacle to classifying this object as BY Dra variable is, however, that the $V-I$ variation of this star, compared to its V amplitude, is untypically large for a spotted star. While an amplitude in $V-I$ of about 0.1 to 0.15 has been observed in spotted stars, in such cases the visual amplitude is still several times higher (e.g. Strassmeier & Oláh 1992). Amado et al. (2000) discussed models of different types of spots (solid spot, umbra/penumbra model, umbra/facula spot model) and their effect on light and colour curves. According to this study (see their Fig. 3) a similar V and $V-I$ amplitude may occur for umbra/facula spots. However, we could not find observational evidence for such a combination in the literature.

We conclude that our data and the information found in the literature are not sufficient for a reliable classification of this star. If the parallax measurement would be wrong, the results would also be in agreement with a classification as semiregular variable. However, in the Tycho catalogue this star was marked with astrometric quality '3' (T40) indicating rather high photometric accuracy. This star clearly needs further investigation to reveal its nature.

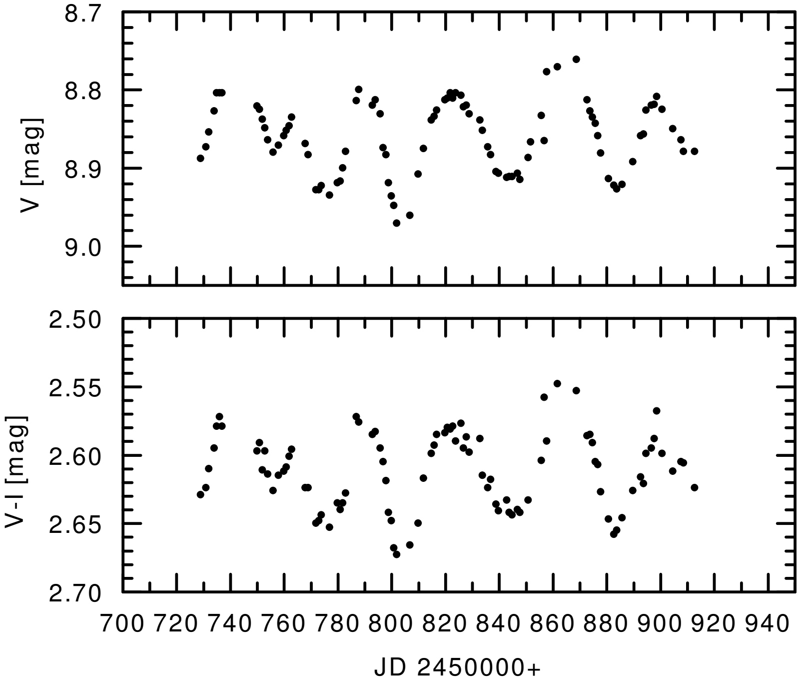

Figure 3. The visual light curve and $V - I$ variation of SAO 154153

Finally we note that HD 105036 has already been used as a comparison star for RW Vir before (Wisse & Wisse 1971). In that investigation the authors found a small scale variability in RW Vir with an amplitude of $0\overset{\mathrm{m}}{.}05$. Based on our data we assume that their result was influenced by the variability of HD 105036. From our data we did not find that kind of variability in RW Vir. The light change of RW Vir itself will be presented and discussed elsewhere.

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A STUDY OF THE NON-ECLIPSING BINARY SV GEMINORUM

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SV Geminorum = GSC 1868.0220 = HIP 28472 = HV 3093 is located at $06^{\rm h}00^{\rm m}41\overset{\rm s}{.}01$, $+24^\circ28'26\overset{\prime\prime}{.}06$ (J2000). In the GCVS (Kholopov et al. 1985) the star is classified as an Algol-type (EA/SD) eclipsing variable that fades from a maximum of $m_{\rm v} = 10.55$ to $m_{\rm pg} = 12.0$ at primary minimum, where $m_{\rm v}$ are photovisual (yellow sensitive) magnitudes, and $m_{\rm pg}$ are photographic (blue sensitive) magnitudes. Variability was discovered by Cannon and announced by Pickering (1908). A period could not be determined at the time of discovery. Enebo (1910) determined a preliminary period in 1909 and followup observations by Enebo (1913) yielded the improved light elements: $2418662.46 + 4\overset{\rm d}{.}00604 \times E$. The star was later studied by the Milton Bureau at the Harvard College Observatory and the period was revised by Woodward (1943) to $4\overset{\rm d}{.}0061216$, who noted that "Minima seem shallow in recent years". Whitney (1959) examined 173 photographic plates exposed between 1953 and 1958 which "show no certain indication of an eclipse". A preliminary investigation by Guilbault of the photographic plate collection at Harvard revealed that eclipses in the early 1900's were 1.0 mag or greater in depth, but did, in fact, appear more shallow by 1920.

The only radial velocity curve of SV Gem is by Struve (1945) who found an eccentricity of 0.16. Unfortunately the velocity curve is noisy and poorly sampled, and the solution was redetermined as circular in Lucy and Sweeney's (1971) large re-evaluation of orbits with small eccentricities. For further details see the discussion in Batten et al.'s (1989) Eighth Catalogue. Struve gives the spectral type as B3 or possible B2.

A search of the literature has failed to find any subsequent study which explores the long-term light behavior of SV Gem in detail. For that reason we decided to conduct an extensive survey of the archival photographic plate collection at Harvard to record the changing light curve amplitude of this unusual star over the last 100 years.

1002 blue sensitive plates from the AC Patrol Series, RH Patrol Series, and the Damon Patrol Series were examined. Coverage is continuous from 1894–1989, except a twenty year gap (1953–1972) when no exposures were taken at Harvard. Magnitude estimates were made by eye, using a comparison star sequence taken from the USNO-A2.0 catalogue (Monet et al. 1998). At maximum light the star was judged to be $m_{\rm pg} = 11.2$, and the accuracy of the plate estimates is about $\pm 0\overset{\rm m}{.}1$.

A summary of our results is shown in Table 1. The duration of the eclipse of SV Gem is 0.15 the orbital period, or 14.4 hours. The time of each dimming is the midpoint of the exposure, generally one hour in duration, and therefore in some cases may not represent the absolute minimum attained. The epoch, $O - C$ and phase values were calculated using the elements $2418662.488 + 4^{\mathrm{d}}.0061216 \times E$ (Woodward 1943). So that the changes in the amplitude of the eclipse may be readily seen, the magnitude estimate for each observation is listed in the last column. All our photographic data are available electronically as 5090-t2.txt through the IBVS Web site.

Table 1: Harvard plate observations at minimum light, SV Geminorum

HJD 2400000 +	Year	Epoch	$O - C$	Phase	$m_{\rm pg}$
15429.571	1901	−807	+0.023	0.006	12.7
15665.778	1901	−748	−0.131	0.967	11.6
16138.691	1903	−630	+0.060	0.015	12.4
16146.613	1903	−628	−0.030	0.992	12.0
16158.534	1903	−625	−0.128	0.968	11.8
16166.593	1903	−623	−0.002	0.979	<12.0
16174.620	1903	−621	−0.066	0.983	12.0
16222.557	1903	−609	−0.202	0.949	11.5
16358.886	1903	−575	−0.082	0.980	12.1
16382.866	1903	−569	−0.138	0.965	12.2
16799.707	1904	−465	+0.066	0.016	12.0
16823.727	1904	−459	+0.049	0.012	12.0
16839.718	1904	−455	+0.015	0.004	11.8
16843.767	1904	−454	+0.058	0.015	12.2
16915.581	1904	−436	−0.237	0.941	11.5
17496.794	1906	−291	+0.087	0.022	12.2
17528.776	1906	−283	+0.020	0.005	12.6
17552.755	1906	−277	−0.037	0.991	12.7
17977.599	1908	−171	+0.158	0.039	11.5
18209.819	1908	−113	+0.023	0.006	<11.5
18245.781	1908	−104	−0.070	0.982	11.9
18297.823	1908	−91	−0.107	0.973	11.8
18662.682	1909	0	+0.194	0.048	11.5:
18742.523	1910	+20	−0.087	0.978	12.3
18962.820	1910	+75	−0.127	0.968	11.4
19443.542	1912	+195	−0.140	0.965	11.8
20092.790	1913	+357	+0.117	0.029	11.5
20805.815	1915	+535	+0.052	0.013	11.4
20809.836	1915	+536	+0.067	0.017	11.5
20877.649	1916	+553	−0.224	0.944	11.4
21310.610	1917	+661	+0.075	0.019	11.5
21558.822	1917	+723	−0.091	0.977	11.8
21979.615	1919	+828	+0.058	0.015	11.6
22692.743	1921	+1006	+0.096	0.024	11.4
26706.728	1931	+2008	−0.052	0.979	11.5
28096.878	1935	+2355	−0.026	0.993	11.5
28100.824	1935	+2356	−0.086	0.978	11.4
28164.718	1935	+2372	−0.290	0.928	11.5
28469.857	1936	+2448	+0.346	0.086	11.6
28525.683	1936	+2462	+0.123	0.030	11.4
30712.858	1942	+3008	−0.043	0.989	11.4

All photographic data gathered at Harvard were folded with the elements mentioned above. For the dual purposes of clarity and illustration the data were grouped according to diminishing eclipse amplitude into four separate light curves, shown in Figure 1. The earliest observed dimming occurred in 1901 at an amplitude of 1.50 mag, but by 1908 the depth of primary minimum was on the order of $1\overset{\mathrm{m}}{.}0$–$1\overset{\mathrm{m}}{.}2$. From that time forward the eclipse becomes more shallow as reported by Woodward, and by 1920 the eclipse cannot have been more than $0\overset{\mathrm{m}}{.}2$–$0\overset{\mathrm{m}}{.}4$ deep. This decline in amplitude continued throughout the 1940's and our data suggests by mid-century the eclipses had turned off completely and had not returned as of 1989.

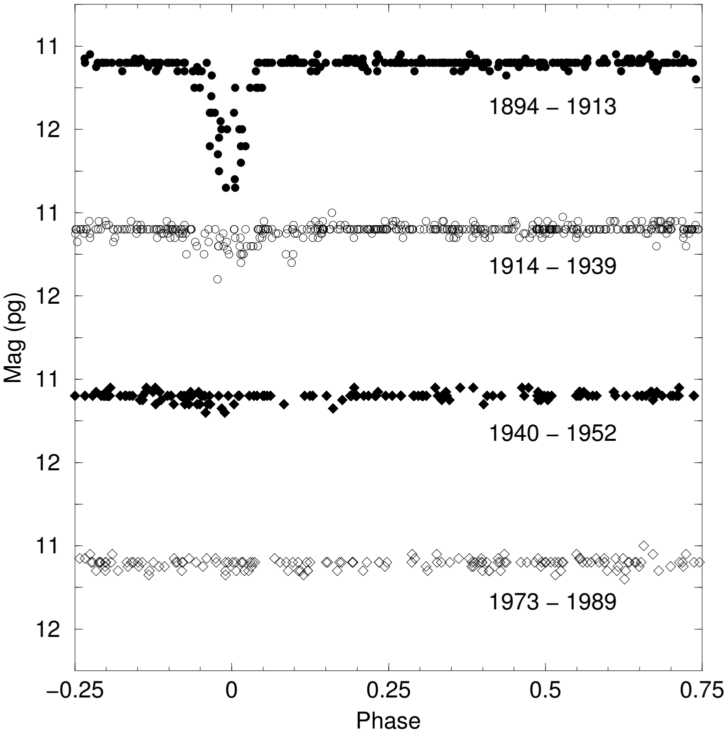

Figure 1. Phased light curve, SV Geminorum

Given that the period of SV Gem is very nearly equal to 4 sidereal days, observation of the system is difficult from any one geographical location, and it is therefore understandable that the star has been neglected. Visual monitoring by Guilbault during the calculated phases of eclipse on 2451512, 2451520 and 2451524, recent unfiltered CCD observation by Paschke at orbital phase 0.940 and at phases 0.12–0.02, and data gathered by the Hipparcos satellite at phase 0.96 through phase 0.12 have failed to show any convincing evidence of variability at the present time.

SV Geminorum therefore belongs to a select group of eclipsing binary stars in which dramatic light changes can be observed over a relatively short period of time. Our data, together with the observations of Woodward (1943) and Whitney (1959), show the cessation of eclipses to have occurred shortly after 1942. Other systems that have exhibited similar behavior are V907 Scorpii (Sandberg Lacy et al. 1999), whose eclipses have turned on and off twice within modern history, and SS Lacertae (Milone et al. 2000, Torres and Stefanik 2000) whose eclipses have ceased altogether.

Similarly in SV Gem, the most likely explanation for the disappearing eclipses is apsidal motion or nodal regression of the eclipsing binary caused by a third body. However, both require that the orbit is eccentric and Lucy and Sweeney's orbital solution is circular. The data are from Struve's original paper so the orbit is in desperate need of a modern determination. Without an accurate orbit and reliable spectral types for the components it is impossible to estimate when SV Gem will start eclipsing again, but given the speed of the disappearance of the eclipses the apsidal or nodal period may be relatively short. However, as it has been about 50 years since any obvious eclipses the definition of short is relative.

We would like to express our gratitude to Alison Doane, acting Curator of the Astronomical Photograph Collection of the Harvard College Observatory for allowing us access to the plates. Without her help this project would not have been possible. We also wish to thank Gary Billings of the AAVSO, who drew the light curves used in this report. We are grateful to Leonid Berdnikov of the Sternberg Astronomical Institute for his help in finding the discovery reference papers, and to Roger Diethelm of the BBSAG for helping with the translation of those documents to English.

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STANDSTILL OF THE HELIUM ER UMa STAR, V803 Cen

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A small group of helium-rich variable stars, known as AM CVn stars, are considered as ultra-short period interacting binary white dwarfs (for a review, see Warner 1995). Some of AM CVn stars show large-amplitude variations, and have been considered to be analogous to (hydrogen-rich) dwarf novae. The authors have revealed that two of these systems (CR Boo and V803 Cen) show regular alternations of bright and faint states (Kato et al. 2000a, 2000b), which bear characteristics of ER UMa stars, hydrogen-rich SU UMa-type dwarf novae with very short supercycles (for a review of ER UMa stars, see Kato et al. 1999). The overall and phased light curves of V803 Cen in Kato et al. (2000b) clearly showed these features. However, the behavior of V803 Cen suddenly changed after 2000 June outburst. The star did not return to its faint states as observed in Kato et al. (2000b), but varied mostly between $13\overset{\mathrm{m}}{.}3$ and $14\overset{\mathrm{m}}{.}0$, with some short occasional excursions to brighter maxima. Figure 1 show the overall light curve by the VSNET Collaboration (http://www.kusastro.kyoto-u.ac.jp/vsnet/), as an extension of Kato et al. (2000b).

In order to check the persistence of the 77-d supercycle as reported by Kato et al. (2000b), the data of the best-sampled period of JD 2451873–2452040 were analyzed. The observations were done as described in Kato et al. (2000b) and with a 32-cm reflector by (P.N.). The total number of observations in this period was 206. Neither Fourier nor Phase Dispersion Minimization (PDM) method (Stellingwerf 1978) gave no clear periodicity between 10 and 100 d, indicating that the 77-d supercycle has completely disappeared (see Figure 2). This change is very reminiscent of a standstill of Z Cam-type dwarf nova. The possibility that these helium ER UMa stars spend some time in their "standstill" state has been proposed by Kato et al. (2000a) from past observations of CR Boo, and is also consistent with the locations of these object close to the thermal stability border predicted by the disk instability theory (Tsugawa and Osaki 1997). The present observation first clearly demonstrate such a standstill actually appears in helium ER UMa stars. Such standstills have not been observed in hydrogen-rich ER UMa stars (ER UMa, V1159 Ori, RZ LMi and DI UMa). This may suggest that mass-transfer rates are more variable in helium ER UMa stars than hydrogen-rich ER UMa stars.

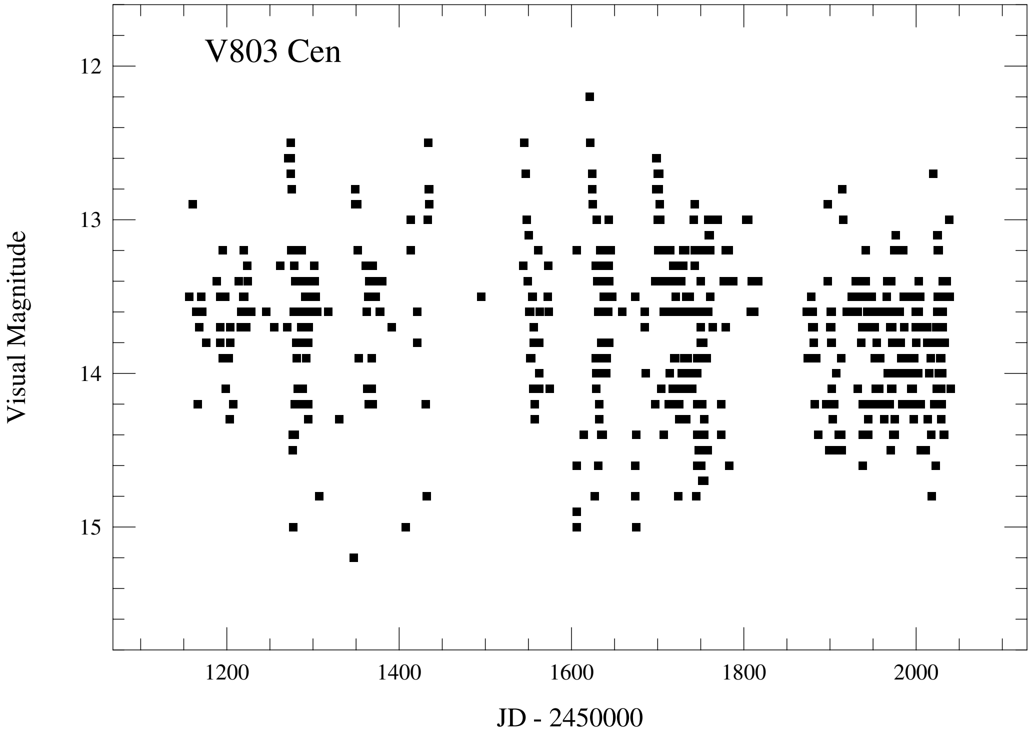

Figure 1. Overall light curve of V803 Cen

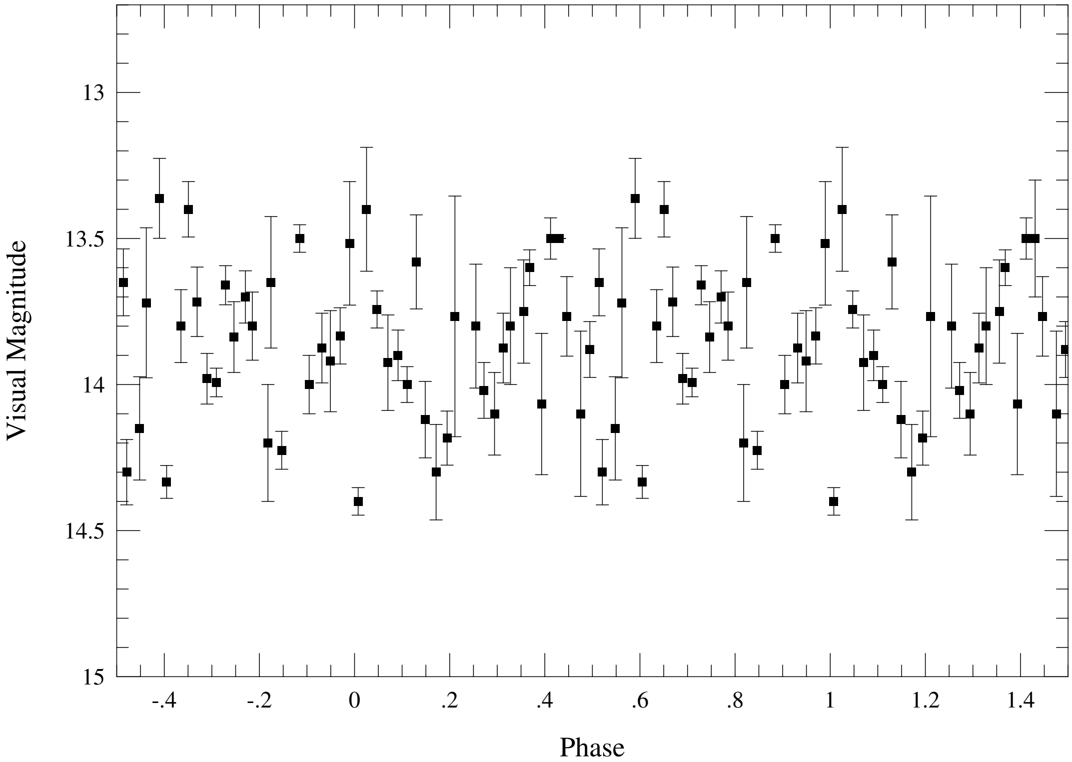

Figure 2. Phase-averaged light curve at a period of 77 d. The 77-d supercycle has completely disappeared

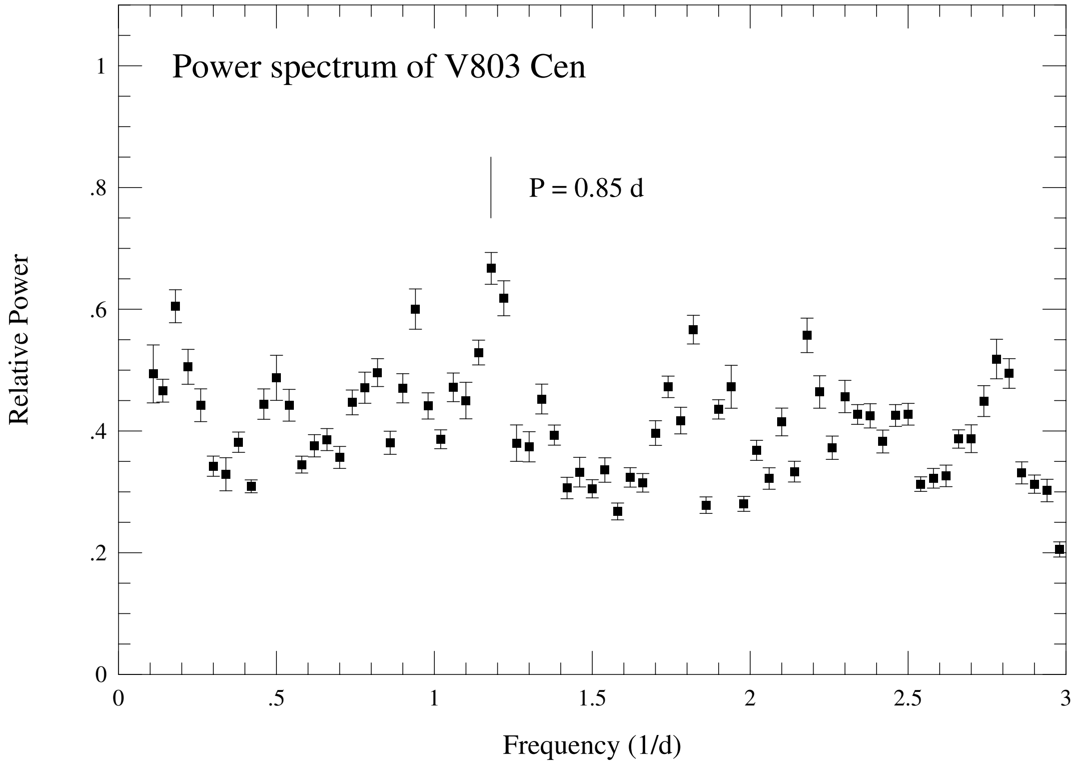

Figure 3. Power spectrum between frequencies 0.1 and 3.0 d^{-1}. Each point represents power and error averaged over 0.04 d^{-1} frequency bin. The signal at frequency close to 0.15 d^{-1} is the one-day alias of the main signal, which is likely to be reject as a true signal, as this disappears in better-sampled data (Figure 4)

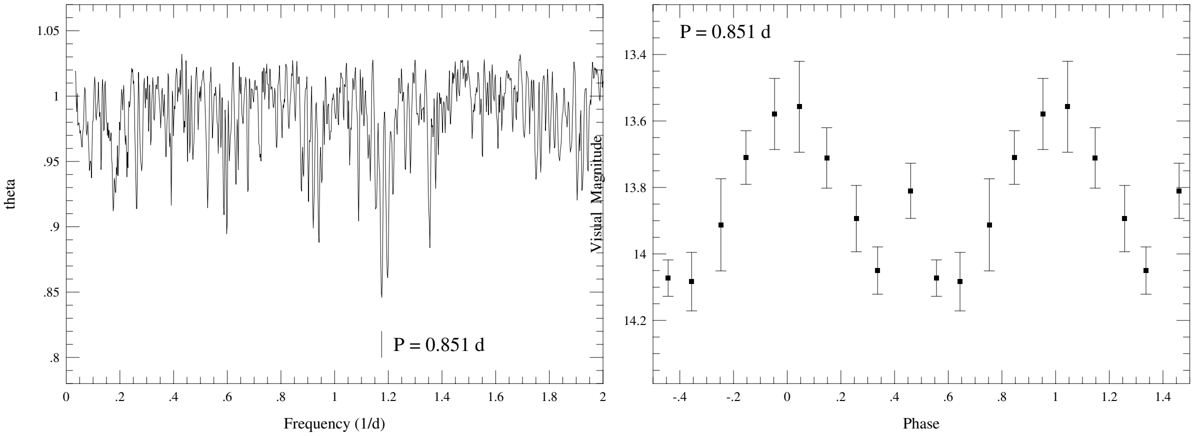

Figure 4. Period analysis (left) and phase-averaged light curve (right) at $P = 0\overset{\mathrm{d}}{.}851$ (frequency = 1.175 d^{-1}) for JD 2451971–2452040

During this standstill, low-amplitude ($\sim$ 0.5–1 mag) variations were present throughout the period. This may be equivalent to the 22 ± 1 hr period reported by Patterson et al. (2000). Fourier analysis of the data shows a significant increase of the power near this period, but has a maximum power at a shorter period of $\sim$ 20 hr (Figure 3). Detailed period analysis of the data, by dividing them into several shorter segments, has yielded the strongest power in the period of JD 2451971–2452040, during which the period of $0^{\rm d}.851$ is dominantly seen (Figure 4). However, this period was less significant between JD 2451873–2451970. In the period of JD 2451873–2451930, the variation has possibly had a longer period of $0^{\rm d}.96$. These findings indicate that the $\sim$ 20 hr variation is one of major causes of variation in this standstill, but the nature of this variation was highly variable both in amplitude and period.

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OUTBURST PHOTOMETRY OF IS Del

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IS Del (= S 10699) was discovered by Richter (1970). Kazzenova and Shugarov (1993) performed extensive photographic observations and found that this dwarf nova undergoes outbursts very frequently. The observation by Kazzenova and Shugarov (1993) also showed the existence of long outbursts. The above features are in part reminiscent of an active SU UMa-type dwarf nova, like YZ Cnc. The author started CCD photometry in order to test this possibility, and found that the object entered a long outburst on 1996 September 11.

The observations were done on seven nights between 1996 September 8 and 18, using a CCD camera (Thomson TH 7882, 576×384 pixels, on-chip 2×2 binning adopted) attached to the Cassegrain focus of the 60-cm reflector (focal length = 4.8 m) at Ouda Station, Kyoto University (Ohtani et al. 1992). An interference filter was used which had been designed to reproduce the Johnson V band. The exposure time was 90–120 s depending on the transparency. The frames were first corrected for standard de-biasing and flat fielding, and were then processed by a microcomputer-based PSF photometry package developed by the author. The magnitudes were determined relative to GSC 1632.1157 (Tycho-2 magnitude: $V = 12.04 \pm 0.29$, $B - V = +0.29 \pm 0.28$), whose constancy during the run was confirmed using two check stars GSC 1632.2126 and GSC 1632.1243. Barycentric corrections to observed times were applied before the following analysis. Table 1 lists the log of observations, together with nightly averaged magnitudes.

The light curve drawn from these data is presented in Figure 1. The outburst lasted at least for seven nights, and is comparable in duration to long outbursts listed in Kazzenova and Shugarov (1993). The outburst was flat-topped, which is not characteristic of a superoutburst of an SU UMa-type dwarf nova. Time-series photometry on JD 2450341 and 2450342 did not show any hint of periodic modulations attributable to superhumps (Figure 2). An analysis using the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978) did not yield any significant signal below $0\overset{d}{.}1$. Since the maximum length of each run was $0\overset{d}{.}16$, the possibility of a longer period could not be excluded. All the available observations supports that IS Del is an SS Cyg-type dwarf nova (UGSS-type in the GCVS classification), with occasional long outbursts. The observed amplitude of outburst was $2\overset{m}{.}9$, which corresponds to the range of 15.6–18.4 V, by adopting the Tycho-2 magnitude for the comparison star.

Table 1: Nightly averaged magnitudes of IS Del

start[a]	end[a]	mean mag[b]	error[c]	N[d]
50334.942	50334.944	6.430	0.152	3
50337.981	50337.982	3.821	0.037	2
50340.986	50341.149	3.556	0.102	75
50341.951	50342.112	3.689	0.143	85
50343.037	50343.058	3.593	0.142	15
50344.095	50344.096	3.668	0.061	2
50345.031	50345.033	4.263	0.028	2

[a] BJD − 2400000

[b] Magnitude relative to GSC 1632.1157

[c] Standard error of nightly average

[d] Number of frames

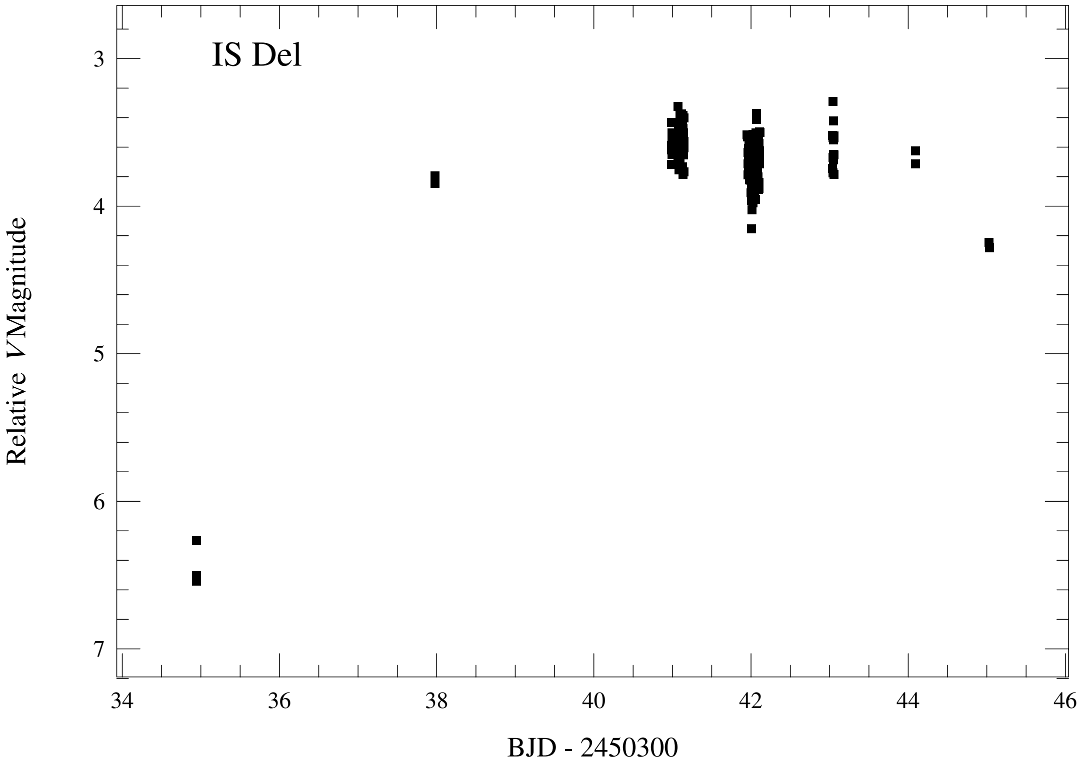

Figure 1. Light curve of the 1996 September outburst of IS Del

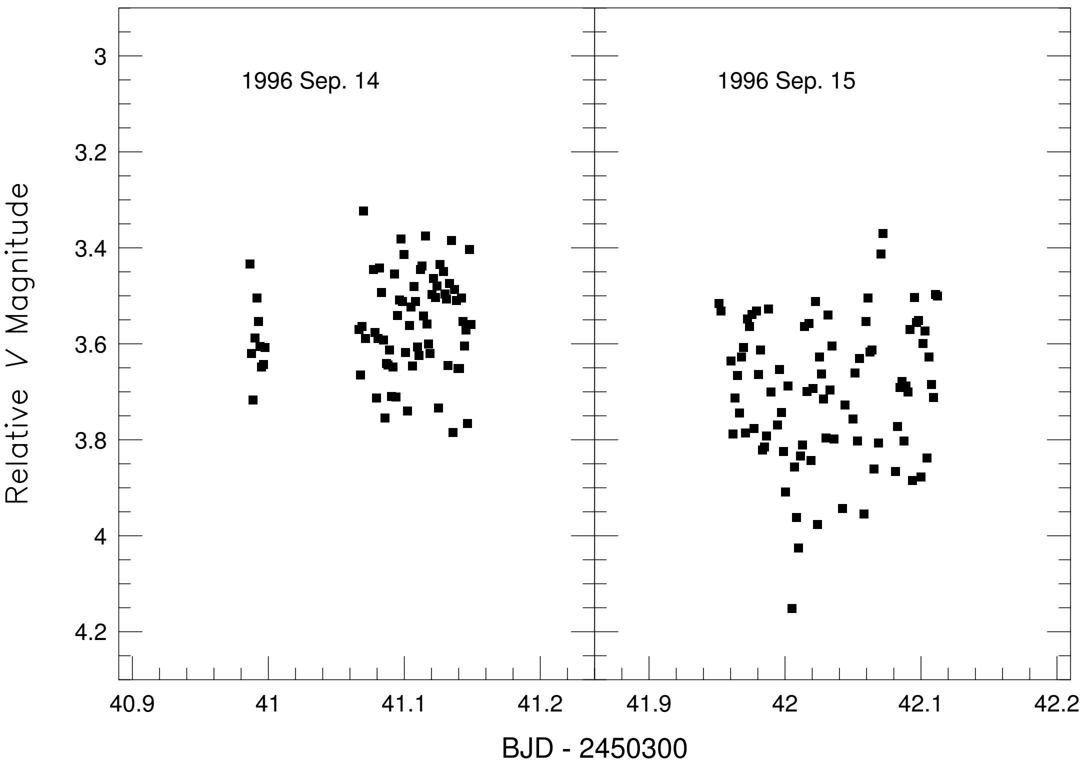

Figure 2. Enlarged light curve near maximum

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OSCILLATION DURING A STANDSTILL OF Z Cam

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The standstill phenomenon in Z Cam stars has been still poorly understood, even in the present successful era of the disk instability model (for a review, see Osaki 1996). This phenomenon is usually regarded as a state of enhanced mass-transfer rate ($\dot{M}$) in dwarf novae (cf. Warner 1995), which mimics novalike (NL) systems having thermally stable disks. However, it has been an old and new problem for theoreticians to reproduce standstills by numerical simulations. Meyer and Meyer-Hofmeister (1983) proposed that a normal outburst below the critical surface density can trigger a standstill, which is maintained by an enhanced mass-transfer caused by increased irradiation. Even the most recent detailed modeling (Buat-Ménard et al. 2001), by taking irradiation and enhanced mass-transfer into account, is far from satisfactory reproduction of observed properties of standstills and Z Cam stars. The most striking departure from observations can be seen when the system enters a standstill. Theories involving enhanced mass-transfer are accompanied by the increased system luminosity, and the disk is thermally most stable at the beginning of standstills. Honeycutt et al. (1998) systematically studied standstills of Z Cam stars, and concluded that some of them showed damping oscillations when entering a standstill, on the contrary to theoretical predictions. The same feature in RX And was reported by Szkody and Mattei (1984). However, the conclusion by Honeycutt et al. (1998) was largely based on their observation of HX Peg, which differs from other "classical" Z Cam stars in that it shows relatively frequent and short standstills and rather anomalous behavior in its excursions between standstills and outbursting states (Honeycutt et al. 1998). Whether such damping oscillations when entering standstills are a common feature of Z Cam stars, is therefore left as an open question.

The author has examined visual observations of Z Cam reported to VSNET (http://www.kusastro.kyoto-u.ac.jp/vsnet/) and found small-scale outbursts occurring in the early part of a standstill (Figure 1). These visual observations used V-band comparison stars and have typical errors of $\sim 0\overset{\mathrm{m}}{.}2$, which will not affect the discussion. The entrance to this standstill was not associated with a gradual brightening of preceding minima, as observed in Szkody and Mattei (1984) and Honeycutt et al. (1998). Hence the observed phenomenon does not have a feature of damping oscillations. The mean recurrence time of these small outbursts is 12 day, which is about the half of intervals (20–25 d) of preceding normal outbursts, which is different from the phenomenon in Szkody and Mattei (1984), who reported small outbursts during standstill having a similar recurrent time to those of usual outbursts. The present phenomenon strongly suggests the presence of weak disk instability occurring in the early stage of a standstill, when the accretion

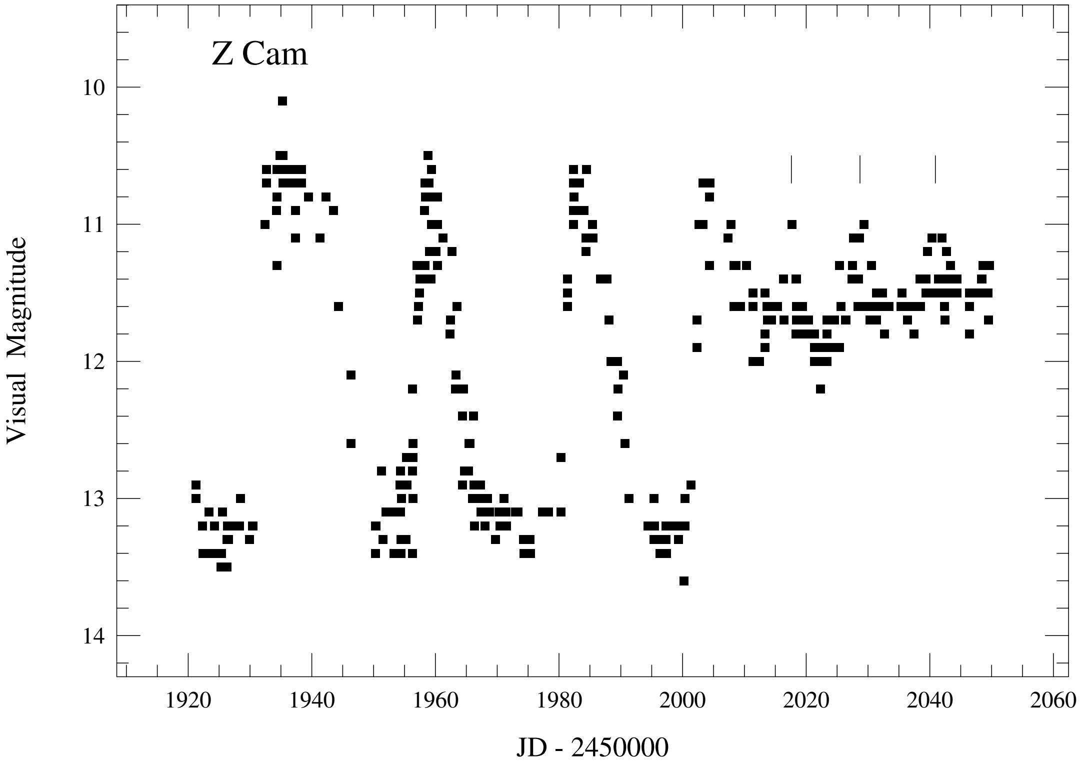

Figure 1. Light curve of Z Cam. Ticks show small outbursts in the early stage of standstill

disk is thought to be most stable. The present discovery of departure from theories in the prototypical, and most typical, Z Cam star also suggests that such departures are a common features of Z Cam stars, which need to be explained by future theories.

The authors are grateful to many VSNET members for providing vital observations.

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BVRI OBSERVATIONS OF CZ ORIONIS IN OUTBURST

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CZ Ori is a very active dwarf nova (DN) that varies from $V = 16.6$ during quiescence to $V = 11.2$ in outburst (Ritter & Kolb 1998). It was discovered by Hoffmeister (1928) and first photometric observations were made by Nijland (1935) and later by Rosino (1941). The star has been monitored by the AAVSO, BAA and VSS, RASNZ ever since. The inter-outburst period is of 26 days (Bateson 1979). Williams (1983) made the first low dispersion spectrophotometric observations of CZ Ori: the spectrum show a typical quiescence DN spectrum with hydrogen and HeI in emissions. Szkody & Mattei (1984) analysed its long-term light curve and classified it as a U Gem star, with only normal outbursts. Szkody (1987) emphasized the narrow profile of the hydrogen lines as an indication of the small inclination of the system. In the same paper Szkody gives the colours of CZ Ori: $B - V = 0.33$ and $U - B = -1.12$, obtained when the system was at lowest level of brightness ($V = 16.77$); the UBV light curve of CZ Ori does not show any orbital modulation which might be ascribed to the presence of a hot spot in the disk.

Spectroscopic observations of the variable during an outburst were made by Spogli & Claudi (1994): they determined an orbital period of $0^{\mathrm{d}}.2147$ studying radial velocities of the Hβ line of the Balmer series and the masses of the two component of the binary system: $M_1 = 0.94\ M_\odot$ and $M_2 = 0.56\ M_\odot$; these values are accepted and reported by Mennickent (1999). Ringwald et al. (1994) in the same year measured a value of the orbital period of $0^{\mathrm{d}}.2189$ and they classified the secondary as a star of M2.5 ± 1.0 type. CZ Ori at quiescence was was never detected as an X-ray source during two satellite X-ray surveys (Cordova et al. 1981, Watson et al. 1987).

Table 1

	B	V	R_c	I_c
Maximum Outburst	12.43 ± 0.05	12.42 ± 0.05	12.36 ± 0.02	12.11 ± 0.02
Minimum of Light	16.8 ± 0.3	16.35 ± 0.15	15.70 ± 0.06	14.86 ± 0.04
Mean Values at Minimum	15.9 ± 0.5	15.7 ± 0.3	15.1 ± 0.3	14.4 ± 0.2
Outburst Amplitude	3.6	3.3	2.7	2.2
Decay Rates (mag/day)	0.37 ± 0.02	0.34 ± 0.02	0.31 ± 0.02	0.25 ± 0.02
	$B - V$	$V - R_c$	$V - I_c$	
Mean values at Maximum	0.01	0.18	0.46	
Mean Values at Minimum	0.17	0.52	1.29	

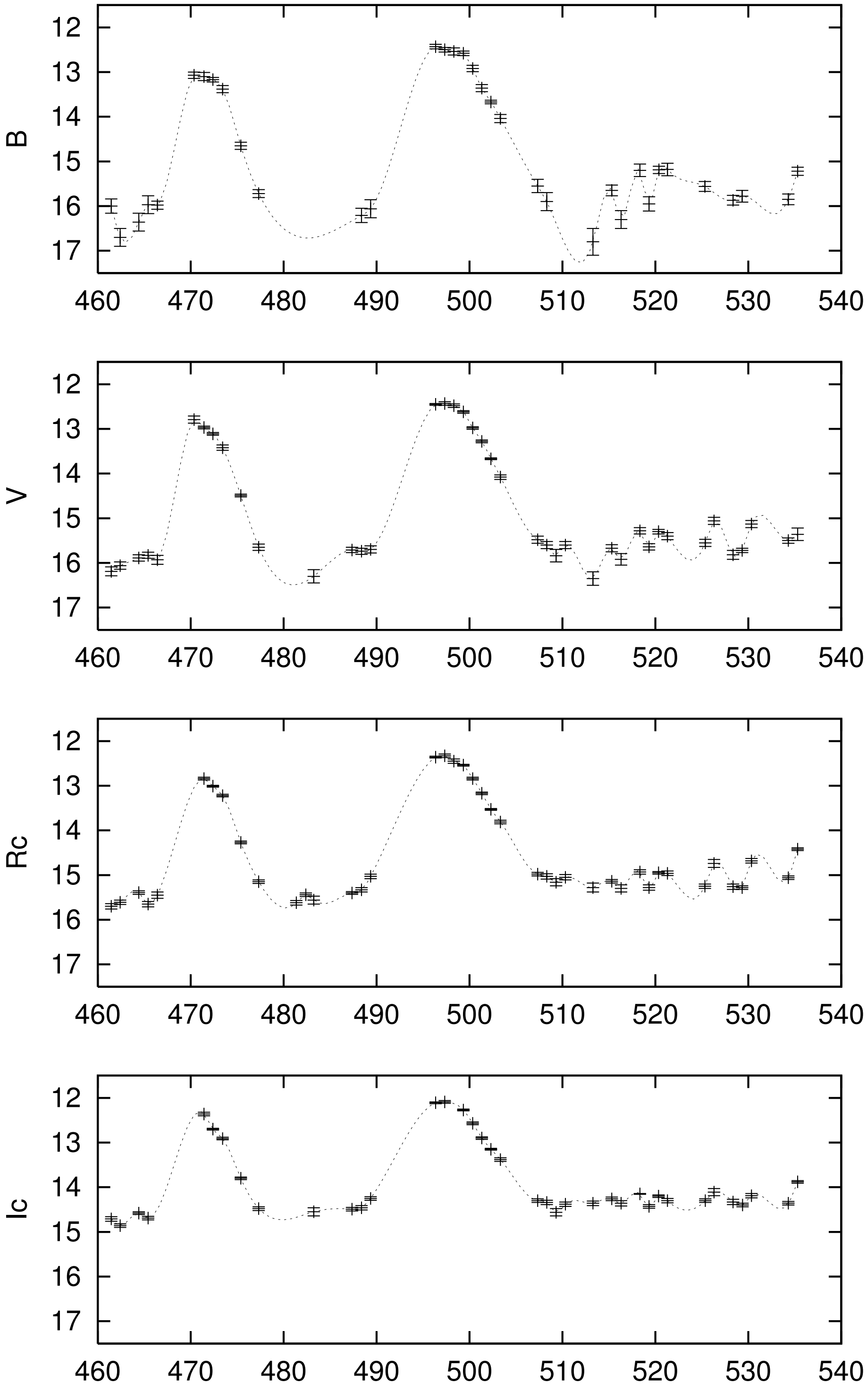

Figure 1. BVR_cI_c light curves of CZ Ori vs. the Julian Day starting from 2450000. Dotted lines connect consecutive points by natural cubic splines after rendering the data monotonic

Table 2: BVR_cI_c magnitudes of CZ Ori

J.D. (2450000 +)	B	V	R_c	I_c
461.4525	16.00 ± 0.16	16.19 ± 0.10	15.70 ± 0.06	14.71 ± 0.05
462.4084	16.70 ± 0.20	16.06 ± 0.08	15.61 ± 0.05	14.86 ± 0.04
464.4150	16.36 ± 0.20	15.89 ± 0.07	15.39 ± 0.04	14.58 ± 0.03
465.4187	15.97 ± 0.20	15.83 ± 0.07	15.65 ± 0.06	14.69 ± 0.04
466.4102	15.98 ± 0.09	15.93 ± 0.10	15.45 ± 0.07	
470.3591	13.07 ± 0.07	12.79 ± 0.08		
471.4247	13.11 ± 0.09	12.97 ± 0.03	12.84 ± 0.03	12.36 ± 0.04
472.3917	13.17 ± 0.05	13.11 ± 0.03	13.01 ± 0.02	12.70 ± 0.02
473.4352	13.38 ± 0.08	13.42 ± 0.06	13.22 ± 0.03	12.91 ± 0.03
475.3879	14.65 ± 0.08	14.49 ± 0.03	14.27 ± 0.03	13.80 ± 0.03
477.3190	15.72 ± 0.09	15.65 ± 0.07	15.15 ± 0.04	14.48 ± 0.04
481.3748			15.62 ± 0.05	
482.3879			15.44 ± 0.04	
483.2310		16.30 ± 0.15	15.56 ± 0.09	14.55 ± 0.09
487.3591		15.71 ± 0.06	15.40 ± 0.03	14.49 ± 0.04
488.3877	16.21 ± 0.16	15.74 ± 0.07	15.33 ± 0.05	14.46 ± 0.05
489.3534	16.06 ± 0.20	15.70 ± 0.08	15.03 ± 0.05	14.25 ± 0.04
496.3594	12.43 ± 0.05	12.45 ± 0.02	12.36 ± 0.02	12.11 ± 0.02
497.3412	12.50 ± 0.05	12.43 ± 0.04	12.33 ± 0.04	12.09 ± 0.03
498.3188	12.54 ± 0.08	12.48 ± 0.04	12.46 ± 0.05	
499.3427	12.58 ± 0.05	12.62 ± 0.03	12.54 ± 0.02	12.27 ± 0.02
500.3429	12.92 ± 0.07	12.98 ± 0.03	12.84 ± 0.03	12.57 ± 0.03
501.3289	13.36 ± 0.08	13.28 ± 0.03	13.17 ± 0.03	12.90 ± 0.03
502.3053	13.67 ± 0.04	13.67 ± 0.02	13.53 ± 0.02	13.15 ± 0.02
503.3295	14.04 ± 0.09	14.08 ± 0.05	13.81 ± 0.04	13.38 ± 0.04
507.3394	15.55 ± 0.15	15.48 ± 0.08	14.98 ± 0.04	14.30 ± 0.04
508.3113	15.90 ± 0.20	15.60 ± 0.08	15.03 ± 0.06	14.34 ± 0.05
509.3217		15.84 ± 0.14	15.16 ± 0.08	14.56 ± 0.08
510.3264		15.60 ± 0.08	15.05 ± 0.06	14.38 ± 0.05
513.2787	16.80 ± 0.30	16.35 ± 0.15	15.28 ± 0.13	14.36 ± 0.05
515.3085	15.65 ± 0.12	15.67 ± 0.08	15.14 ± 0.04	14.26 ± 0.04
516.3151	16.30 ± 0.20	15.92 ± 0.13	15.30 ± 0.08	14.36 ± 0.06
518.3369	15.20 ± 0.14	15.28 ± 0.07	14.93 ± 0.05	14.15 ± 0.01
519.3096	15.95 ± 0.16	15.64 ± 0.07	15.28 ± 0.06	14.43 ± 0.04
520.3347	15.18 ± 0.12	15.40 ± 0.05	14.91 ± 0.03	14.19 ± 0.03
520.3756	15.19 ± 0.11	15.20 ± 0.09	15.00 ± 0.05	14.22 ± 0.05
521.3016	15.18 ± 0.14	15.40 ± 0.08	14.96 ± 0.05	14.30 ± 0.05
525.3262	15.33 ± 0.13	15.66 ± 0.14	15.19 ± 0.06	14.22 ± 0.07
525.3785	15.79 ± 0.15	15.48 ± 0.08	15.31 ± 0.06	14.38 ± 0.04
526.3138		15.06 ± 0.08	14.74 ± 0.09	14.11 ± 0.08
528.3525	15.87 ± 0.11	15.82 ± 0.10	15.26 ± 0.06	14.33 ± 0.06
529.3319	15.48 ± 0.13	15.55 ± 0.05	15.03 ± 0.04	14.38 ± 0.03
529.3789	16.08 ± 0.15	15.90 ± 0.09	15.55 ± 0.07	14.42 ± 0.04
530.3485		15.13 ± 0.08	14.68 ± 0.05	14.19 ± 0.05
534.3127	15.85 ± 0.12	15.50 ± 0.06	15.06 ± 0.04	14.36 ± 0.04
535.3105	15.22 ± 0.09	15.36 ± 0.14	14.42 ± 0.03	13.88 ± 0.03

Here we present the BVR_cI_c photometric observations of CZ Ori during the period from 12 January 1997 to 27 April 1997 for a total of 43 days. The instruments used and the photometric techniques have been already described in Spogli et al. (1998). We used the calibration stars reported in Misselt (1996) with the numbers 2, 3, 4, 5, and 10. Moreover we calibrated these comparison stars with the I_c filter by observing, on photometric nights, several standard stars (Landolt 1992) having $B - V$ from -0.2 to 1.4, over a wide range of airmasses. The weighted means of the values obtained are:

$I_c(2) = 12.28 \pm 0.05$, $I_c(3) = 13.04 \pm 0.05$, $I_c(4) = 14.20 \pm 0.05$, $I_c(5) = 13.74 \pm 0.05$, and $I_c(10) = 14.40 \pm 0.08$.

We observed two outbursts with the maximum around JD 2450470 and JD 2450496, and we followed the decline. Unfortunately, in both cases we lacked the ascending phase. The light curves in the BVR_cI_c bands are presented in Figure 1, while Table 1 reports the main characteristics. All the photometric data are reported in Table 2. Our data show variations in the light curve during the minimum, more evident at shorter wavelengths, that require more investigation. The light curves show a linear decay with the average rates reported in Table 1.

BVR_cI_c observations of dwarf novae allow to evaluate the optical spectral behaviour and, therefore, they can be used as a test to compare theoretical models of accretion disk emission. In particular they can be used to verify the theoretical flux distribution of a stationary infinitely large accretion disk whose surface elements radiate as a black body ($F(\nu) \propto \nu^{1/3}$, see Warner 1995). The results presented here are part of a project devoted to gain multi-band light curves of a sample of DNe, with the goal of increasing the historical database and information on this class of variable sources which can help to constrain theoretical models. To study the behavior of the optical continuum of CZ Ori during the outburst, we converted the BVR_cI_c magnitudes in fluxes using the conversion factors reported by Bessell (1979). The extinction coefficient can be neglected (Bruch & Engel 1994). The spectral flux distribution of CZ Ori, during the two outbursts, is well described by a power law ($F(\nu) \propto \nu^{\alpha}$) with the slope α that varies from 0.2 to 0.4. The mean value in this phase is $\alpha = 0.31 \pm 0.05$: there is a substantial agreement with the predicted emission from an accretion disk in a stationary state.

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IMPROVED EPHEMERIS FOR AQ Com

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The light variation of AQ Comae Berenices = SV 8064 ($\alpha_{2000} = 12^{\rm h}42^{\rm m}42\overset{\rm s}{.}7$, $\delta_{2000} = +21^\circ52'18''$) was discovered and classified as a W UMa-type star by Hoffmeister (1964) but he did not publish the light-curve. The object was put into the "Catalogue of Eclipsing and Spectroscopic Binary Stars in the Regions of Open Clusters" (Kraicheva and Popova, 1984) as a possible member of the Coma star cluster (Melotte 111).

The exact position was determined by Skiff (1999). The General Catalogue of Variable Stars (Kholopov et al., 1998) lists $15\overset{\rm m}{.}2$ - $15\overset{\rm m}{.}7$ for the range of variability and $0\overset{\rm d}{.}28208$ for the period. According to our best knowledge there is no published CCD photometry for this star by now and the possible variation of its period has never been studied.

In order to determine a new ephemeris we observed this variable on three nights using the 1-m RCC telescope of Konkoly Observatory. The detector was a Wright CCD camera and V and I_C filters were applied. Comparison stars were GSC 1444-3087 and GSC 1444-1725. Reduction procedure were the same as described in Csizmadia & Sándor (2001). Minima obtained by application of the Kwee–van Woerden method (see Kwee and van Woerden, 1956) are listed in Table 1.

Table 1: Times of minima of AQ Com

Minimum light	Error	E	Type	Filter	$O-C$
JD 2451924.514	0.002	−3.5	II	V	+0.000
2451924.517	0.001	−3.5	II	I	+0.003
2451925.4982	0.0007	0	I	V	+0.0003
2451925.4972	0.0016	0	I	I	−0.0013
2451952.6480	0.0004	96.5	II	I	+0.0000

From these minima we have calculated the following ephemeris:

$$\text{Min. I} = \text{HJD } 2451925.498(5) + 0\overset{\rm d}{.}28134(23) \times E. \tag{1}$$

According to this improved ephemeris $O-C$ residuals are also listed in Table 1.

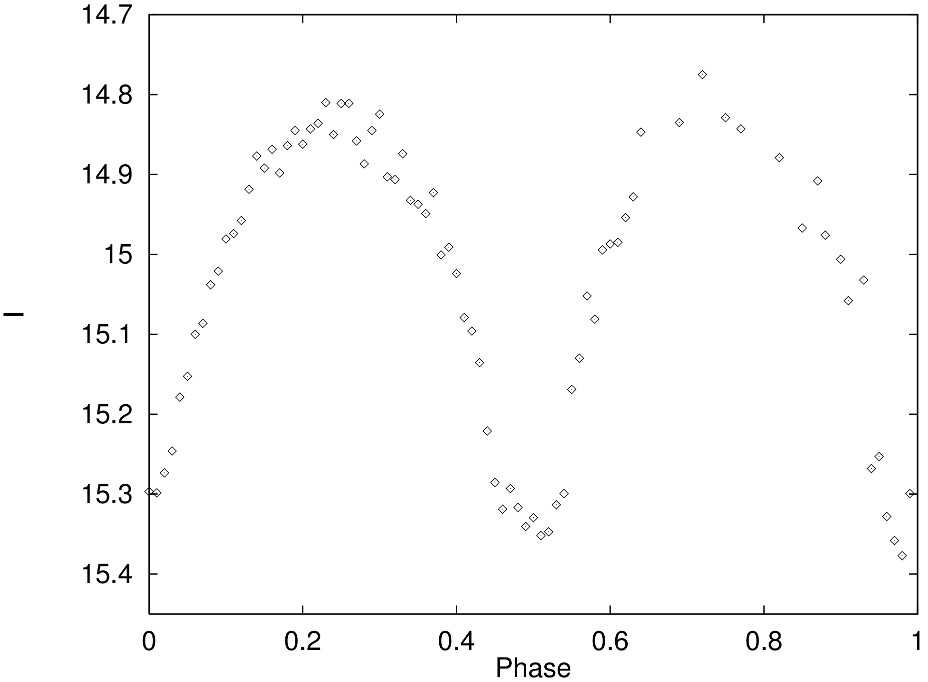

Figure 1. I_C light-curve of AQ Com

Unfortunately, because of the bad weather conditions we were unable to obtain a more precise light-curve. The averaged light-curve has a scatter of about 0.07 magnitude. I_C light-curve is plotted in Figure 1.

From observations on January 14/15, 2001 standardized magnitudes of the system at phase 0.25 were determined. For this purpose we also observed standard stars in the field of M67 open cluster (Joner and Taylor, 1990). We got that $V = 15.26$ and $V - I_C = 0.40$ at maximum light. The distance of the system can also be estimated. Rucinski (1997) gave $M_I = -4.4^{+1.3}_{-1.6} \log P + 2.3^{+0.9}_{-0.6}(V - I)_0 - 0.2^{+0.2}_{-0.3}$. The galactic latitude of AQ Com is 84°. Neglecting interstellar absorption and reddening in the direction of AQ Com we found its distance 2200^{+200}_{-300} pc and the system is above the Galactic plane with about 2190^{+200}_{-300} pc.

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CCD PHOTOMETRY OF THE FIELD OF EX CANCRI

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During a test course of our CCD photometer, the Johnson V photometry of the field of EX Cancri in the old open cluster M67 was obtained. This note presents the preliminary results for four of the observed variables: EX Cnc, ES Cnc, EV Cnc and AH Cnc. EX Cnc is a δ Sct star and is now found to be a multiperiodic pulsator; ES Cnc is an EA binary, i.e. an Algol-type eclipsing system; EV Cnc and AH Cnc are two EW/KW binaries, i.e. they are contact systems of the W Ursae Majoris-type eclipsing variables, with ellipsoidal components of F0-K spectral type.

The observations were carried out with a red-sensitive Thomson TH7882 576 × 384 CCD photometer (Wei et al. 1990; Zhou et al. 2001) on the 85-cm Cassegrain telescope at the Xinglong Station of the Beijing Astronomical Observatory of China in 2000. The CCD has an imaging size of 13.25×8.83 mm^2 corresponding to a sky field of $12\overset{\prime}{.}3 \times 8\overset{\prime}{.}4$ ($1\overset{\prime\prime}{.}2$/pixel, a pixel size is 23 μm^2). Among the stars observed in the field of EX Cnc, followings were selected as reference:

C1 = GSC 00814_01205 ($\alpha = 08^{\rm h}51^{\rm m}27\overset{\rm s}{.}02$, $\delta = 11^\circ51'52\overset{\prime\prime}{.}5$, 2000.0, 10.8 V),
C2 = GSC 00814_01425 ($\alpha = 08^{\rm h}51^{\rm m}31\overset{\rm s}{.}94$, $\delta = 11^\circ51'16\overset{\prime\prime}{.}6$, 2000.0, 10.4 V),
C3 = GSC 00814_01311 ($\alpha = 08^{\rm h}51^{\rm m}32\overset{\rm s}{.}16$, $\delta = 11^\circ50'03\overset{\prime\prime}{.}5$, 2000.0, 12.5 V),
C4 = GSC 00814_01147 ($\alpha = 08^{\rm h}51^{\rm m}29\overset{\rm s}{.}01$, $\delta = 11^\circ50'33\overset{\prime\prime}{.}0$, 2000.0, 9.9 V),
C5 = GSC 00814_01981 ($\alpha = 08^{\rm h}51^{\rm m}39\overset{\rm s}{.}24$, $\delta = 11^\circ50'03\overset{\prime\prime}{.}6$, 2000.0, 12.2 V).

The atmospheric extinction was not taken into account in view of the close spacing of the observed stars. However, it can be largely eliminated by subtracting a linear-fitted line from the differential light curves if they are significantly affected by the changing air mass during a night. The differential colour effects between the variables and the reference stars were not significant. The differential magnitudes for these four variables are established as (EX Cnc – C4 or C1), (ES Cnc – C2), (EV Cnc – C3) and (AH Cnc – C5). The magnitude differences between the comparison stars generally show a typical standard deviation of $0\overset{\rm m}{.}010$. For the nights of photometric quality a better value of about $0\overset{\rm m}{.}006$ was obtained. All the above comparison stars were detected to be non-variables at the accuracy of observation. Exposure times were 30 s and all data were sampled into 60-s bins.

A preliminary Fourier analysis based on the data of EX Cnc collected on six nights (9, 10, 26, 27, 28 and 29 February 2000) demonstrates that the light variations of EX Cnc can be roughly fitted with three pulsation frequencies $f_1 = 17.9978$, $f_2 = 19.5674$ and $f_3 = 20.6559$ cycle d^{-1} having semi-amplitudes of $0\overset{\rm m}{.}0047$, $0\overset{\rm m}{.}0058$ and $0\overset{\rm m}{.}0039$, respectively.

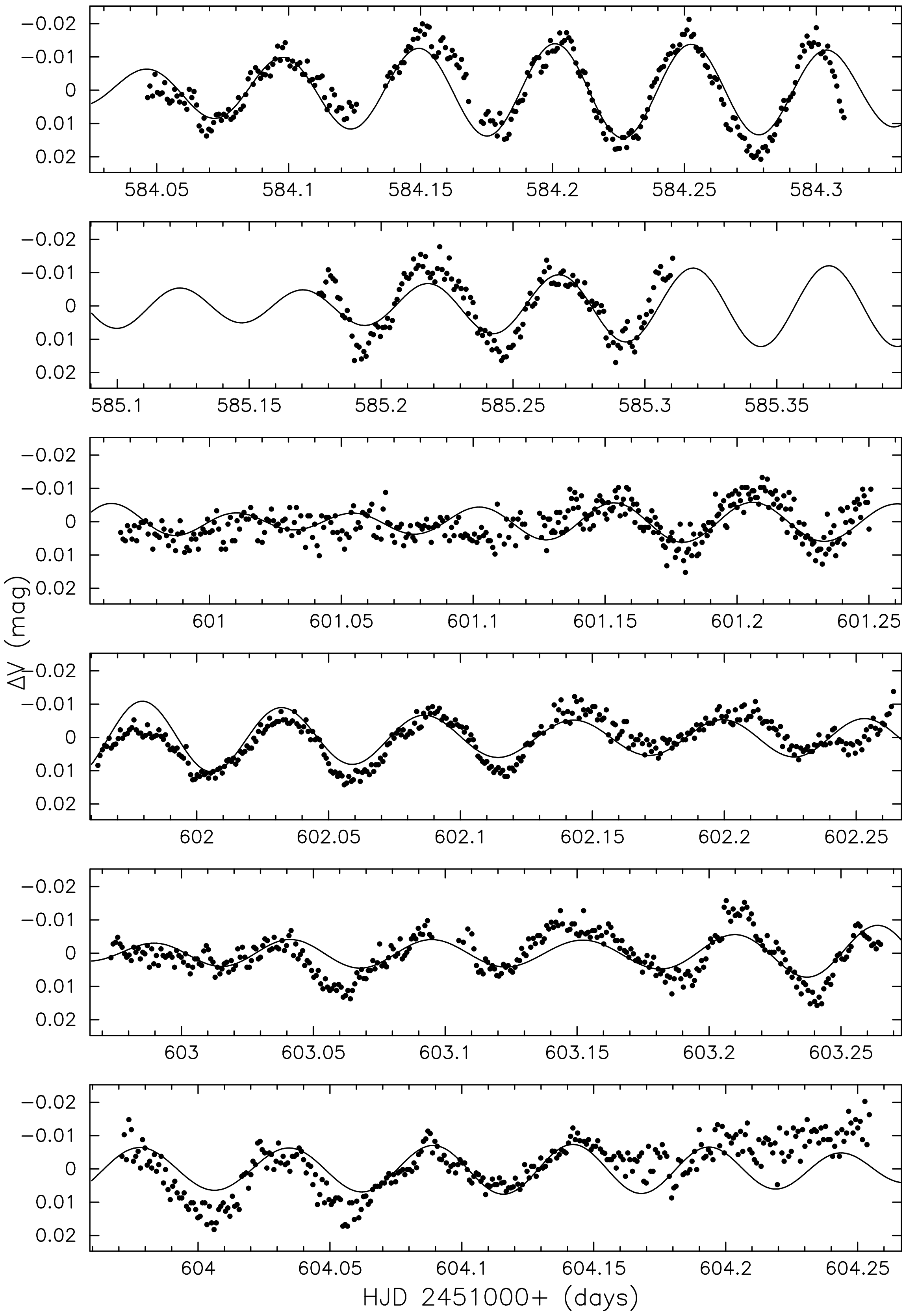

Figure 1. CCD differential light curves of EX Cnc from 9, 10, 26, 27, 28 and 29 Feb. 2000

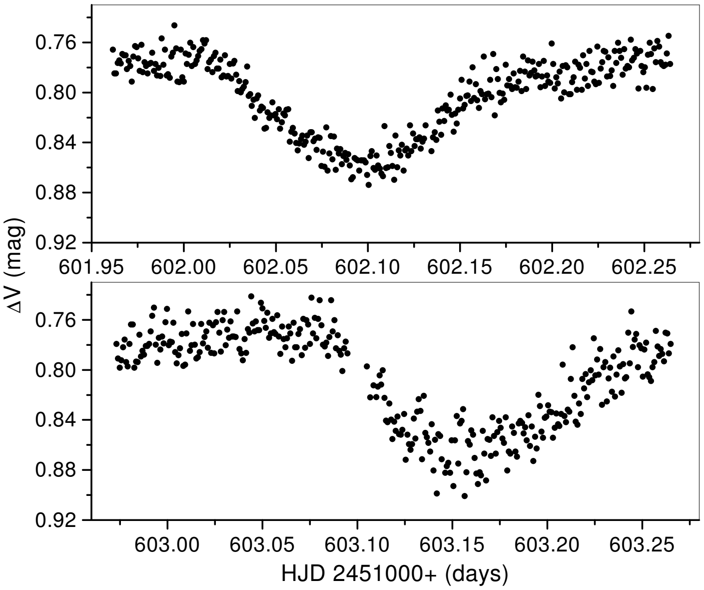

Figure 2. CCD differential light curves of ES Cnc from 27 and 28 Feb. 2000

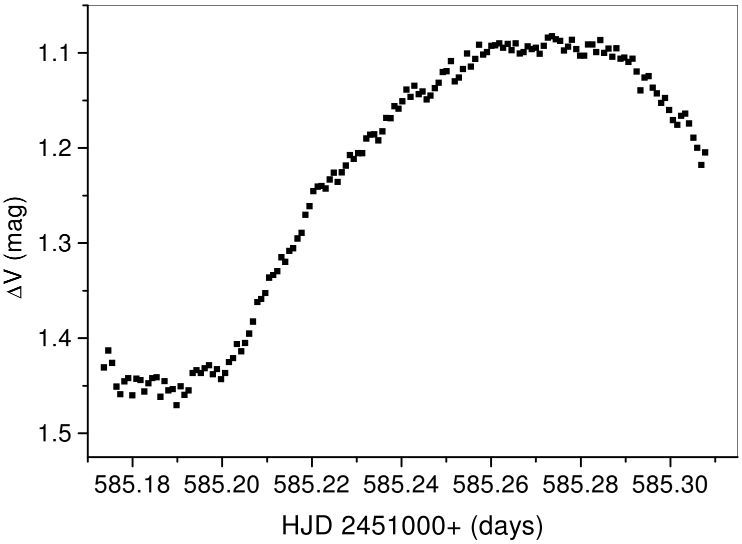

Figure 3. CCD differential light curves of AH Cnc from 10 Feb. 2000

The fitting yields the residuals with a standard deviation of $\sigma = 0\overset{\text{m}}{.}0049$, conforming to the observational accuracy. The results suggest EX Cnc is a multi-mode pulsator. Figure 1 depicts the observed (dots) and fitted (lines) light curves of EX Cnc from the six nights. When looking at the third panel and the last two panels of Figure 1, however, we note the poor fit occurred for the leading part of 26 February, the ending part of the night 29 February and the most data from 28 February. The reason for the former two cases might be resulted from bad seeing. For the latter case, it seems that additional frequencies are still not uncovered.

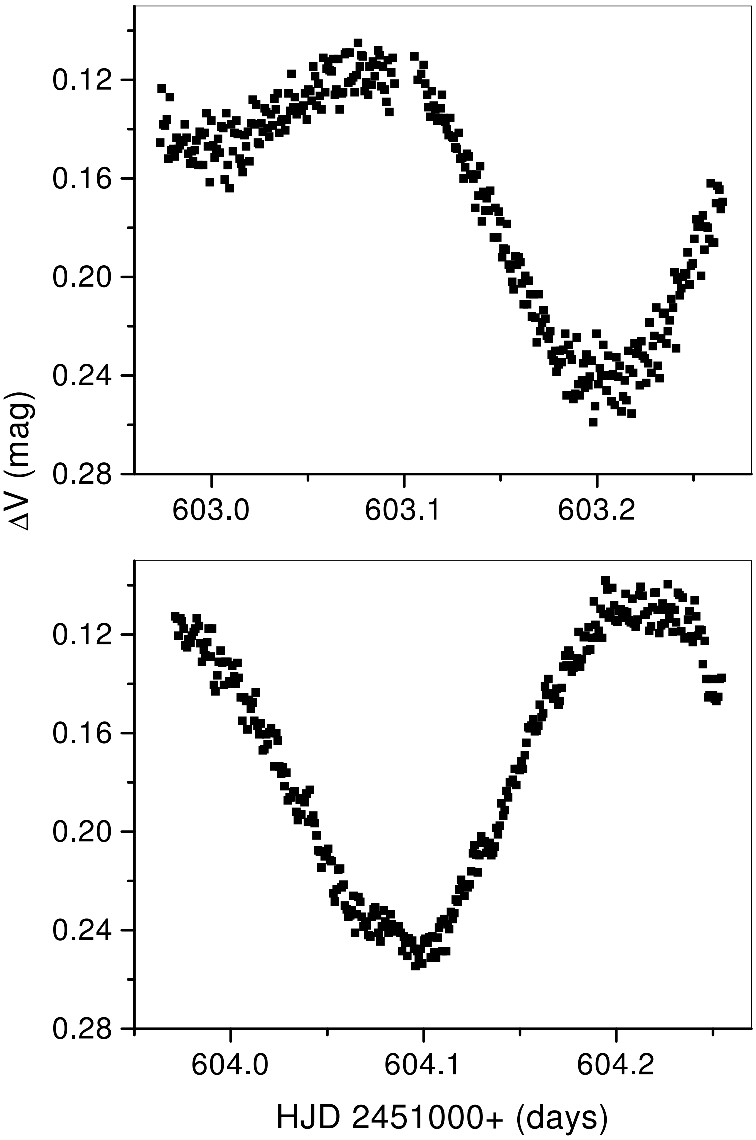

Figure 4. CCD differential light curves of EV Cnc from 28 and 29 Feb. 2000

During the test course, except the centered target EX Cnc, other observed stars in the field were arbitrarily selected from night to night because of the task of instrument test and variables survey. Therefore the three other binaries were not continuously observed with EX Cnc over all the six nights. Figures 2–4 present the light curves we obtained during this course. Detailed information for the binaries needs further observations and studies. The time-series data are available upon request from the author.

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OUTBURST PHOTOMETRY OF TmzV36

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TmzV36 is a variable star discovered by Takamizawa (1998). The J2000.0 coordinates are $09^{\rm h}16^{\rm m}50\overset{\rm s}{.}7$, $+28^\circ49'42''$. Takamizawa (1998) reported only two positive detections on 1994 November 29–30. He also reported that the star is visible at mag 18 on DSS 1. Since Takamizawa's record suggested an outburst of a dwarf nova-type variable, the object has been monitored since 1998 by VSNET (http://www.kusastro.kyoto-u.ac.jp/vsnet/) members. No further outburst had been reported until Schmeer's detection on 1999 November 17.528 UT, at unfiltered CCD magnitude of 14.7 (Schmeer 1999). The rapid rise reported by Schmeer (1999), together with the subsequent evolution of the event, confirmed the suggested dwarf nova-type classification. The lack of further outbursts until 2001 April supports the low frequency of outbursts in TmzV36. We started time-resolved CCD photometry upon this alert, only $1\overset{\rm d}{.}3$ after Schmeer's detection.

The CCD observations were done using an unfiltered ST-7 camera attached to the Meade 25-cm Schmidt–Cassegrain telescope. The exposure time was 30 s. A total of 621 useful frames were obtained. The images were dark-subtracted, flat-fielded, and analyzed using the Java$^{\rm TM}$-based PSF photometry package developed by one of the authors (TK). The flux of the object was determined relative to GSC 1957.358 (GSC magnitude 12.65), whose constancy during the run was confirmed by comparison with anonymous fainter stars. Barycentric corrections to the observed times were applied before the following analysis. The log of observations together with nightly average magnitudes is given in Table 1. The light curve drawn from these data is presented in Figure 1.

As seen in Figure 1 and Table 1, TmzV36 rapidly faded following the outburst maximum. The maximum rate of decline was 1.0 mag d^{-1}, which is comparable to those of normal outbursts of SU UMa-type dwarf novae. However, some of short-period SS Cyg-type dwarf novae also show similar rapid declines. The exact classification of the dwarf nova subtype awaits further observations. The object returned to quiescence within 7 days of the outburst detection. The measured amplitude of the outburst from this observation was $3\overset{\rm m}{.}0$. Since Takamizawa's detection in 1994 was $1^{\rm m}$ brighter than the present outburst, there may be two types of outbursts, possibly suggesting the SU UMa-type nature. Figure 2 shows the enlarged light curve of the first three nights of the outburst. Only rapid fading was observed, and no definitely periodic modulations attributable to superhumps were detected.

Table 1: Nightly averaged magnitudes of TmzV36

start[a]	end[a]	mean mag[b]	error[c]	N[d]
51501.341	51501.349	2.970	0.044	12
51502.141	51502.245	3.519	0.020	201
51503.173	51503.340	4.512	0.029	264
51504.108	51504.150	5.480	0.318	80
51508.349	51508.365	6.258	0.946	23
51509.358	51509.370	5.881	0.264	17
51512.227	51512.230	5.780	0.492	10
51513.222	51513.225	5.866	0.984	8
51516.333	51516.337	6.425	0.949	6

[a] BJD − 2400000
[b] Magnitude relative to GSC 1957.358
[c] Standard error of nightly average
[d] Number of frames

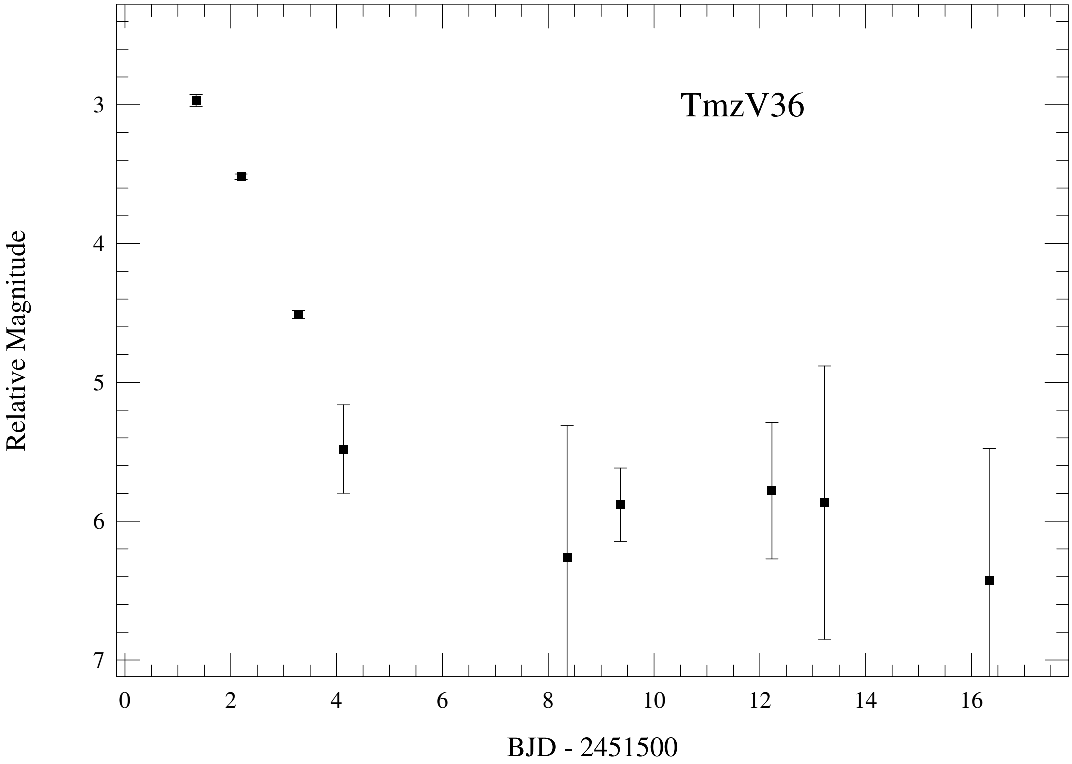

Figure 1. Light curve of TmzV36

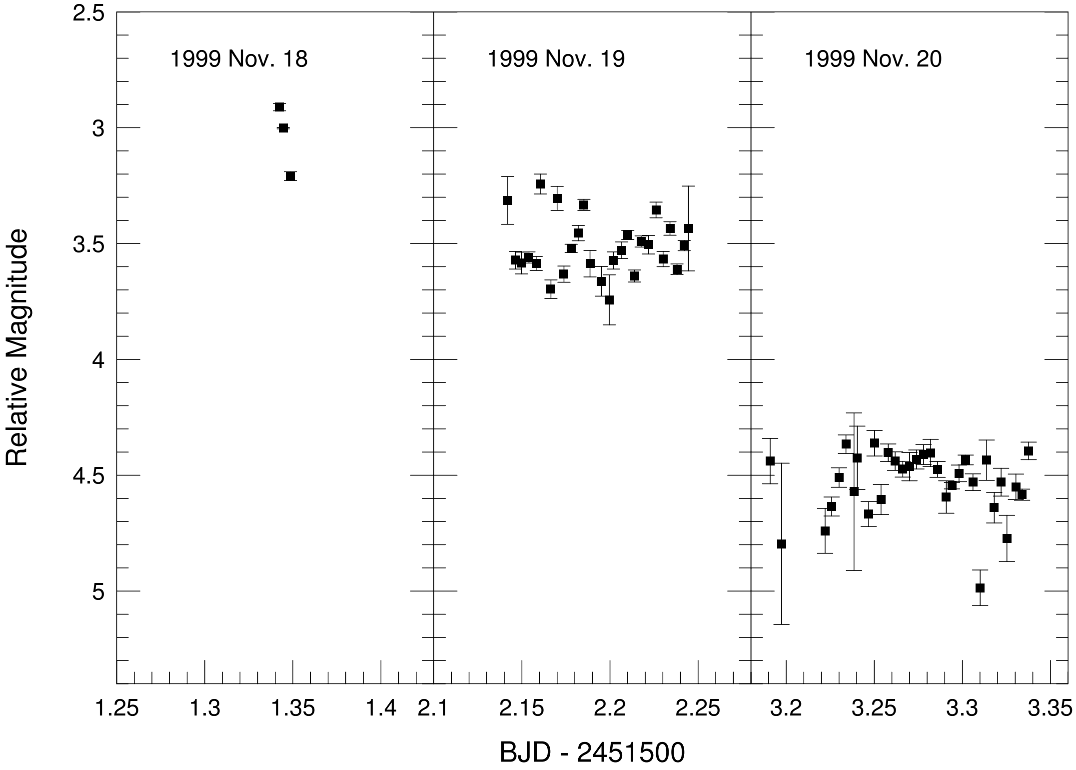

Figure 2. Enlarged light curve of TmzV36. Each point represents averages and errors of 0.004-d bins

The authors are grateful to VSNET members for providing visual observations covering years, and P. Schmeer for promptly and publicly notifying the outburst. Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists (MU).

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OUTBURST PHOTOMETRY OF DX And

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DX And is a well-known dwarf nova with a long orbital period ($P = 0\overset{\mathrm{d}}{.}4405$, Bruch et al. 1997). DX And is also famous for its long outburst recurrence time (270–330 d, Simon 2000). Only few known cataclysmic variables (CVs) have similar characteristics. The best known among these CVs is the famous old nova GK Per, which at the same time shows dwarf nova-type outbursts. GK Per is also known as an intermediate polar (IP). The dwarf nova outbursts of GK Per is unique in that they show standstills during their rises (cf. Kim et al. 1992). Another noteworthy feature of GK Per is the presence of quasi-periodic oscillations (QPOs) with periods 2–30 min in outburst (Kato et al., in preparation). Since DX And has similar system and outburst parameters, we attempted to search for the possible existence of similar modulations during an outburst of DX And. The outburst we studied was the 1996 December one, whose initial rise was detected on December 10 by R. J. Modic at visual magnitude of 13.9. We undertook CCD observations starting on the next night.

The observations were done on eight nights between 1996 December 11 and 1997 January 3, using a CCD camera (Thomson TH 7882, 576 × 384 pixels, on-chip 2 × 2 binning adopted) attached to the Cassegrain focus of the 60-cm reflector (focal length = 4.8 m) at Ouda Station, Kyoto University (Ohtani et al. 1992). An interference filter was used which had been designed to reproduce the Johnson V band. The exposure time was 30–50 s depending on the brightness of the object. The frames were first corrected for standard de-biasing and flat fielding, and were then processed by a microcomputer-based aperture photometry package developed by one of the authors (TK). The magnitudes were determined relative to GSC 3242.510 ($V = 12.72$, $B-V = +0.47$), whose constancy was confirmed using GSC 3242.216 ($V = 13.33$, $B-V = +0.38$). The magnitudes are taken from Misselt (1996). A total of 355 useful frames were obtained. Barycentric corrections to observed times were applied before the following analysis. Table 1 lists the log of observations, together with nightly averaged magnitudes.

Figure 1 shows the light curve drawn from the data in Table 1. The decline from the maximum was quite linear, at a mean rate of 0.35 mag d^{-1}. This value would be useful in further calibration of the Bailey's relation (cf. Szkody and Mattei 1984). On JD 2450438–2450439, we undertook a long time-series to search for possible QPOs. The exposure times were 30 s, yielding a net time resolution of 37 s. Figure 2 shows the enlarged light curve. The upper panel shows the raw observations. The lower panel shows averaged

Table 1: Nightly averaged magnitudes of DX And

start[a]	end[a]	mean mag[b]	error[c]	N[d]
50428.889	50428.892	0.637	0.008	5
50438.856	50439.006	0.296	0.002	330
50439.861	50439.862	0.597	0.013	3
50440.853	50440.854	1.037	0.058	3
50441.855	50441.856	1.419	0.049	3
50443.009	50443.010	1.796	0.059	3
50444.877	50444.879	2.356	0.024	5
50451.870	50451.872	2.289	0.020	3

[a] BJD – 2400000
[b] Magnitude relative to GSC 3242.510
[c] Standard error of nightly average
[d] Number of frames

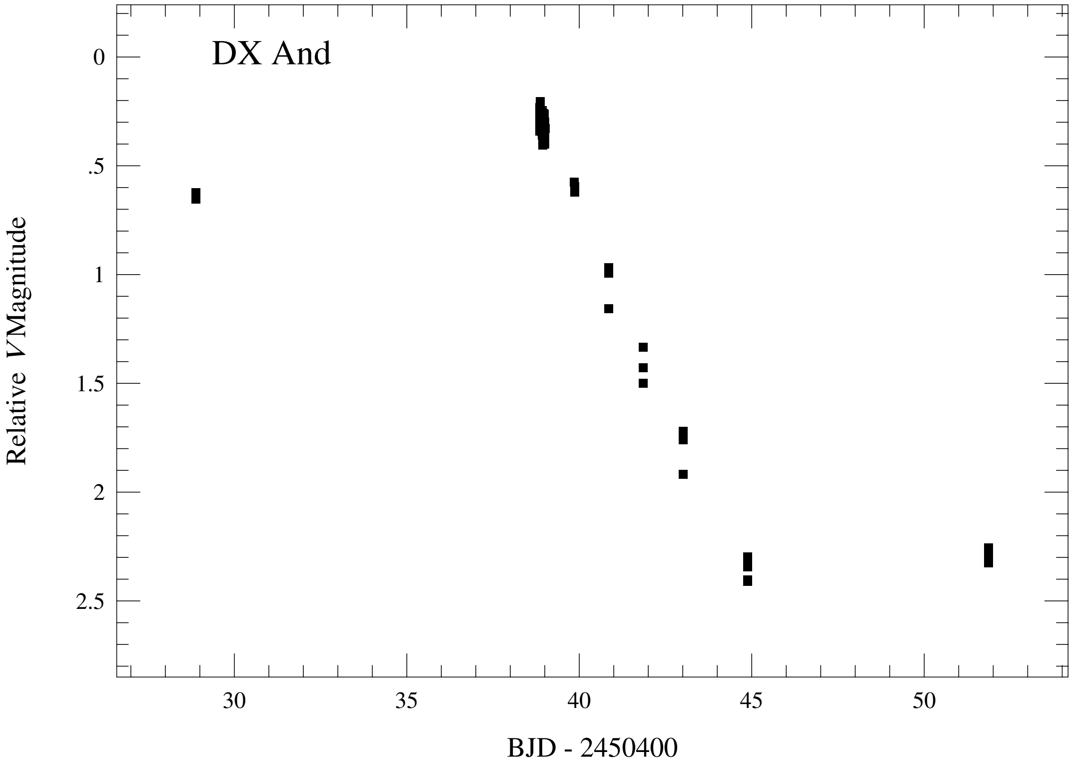

Figure 1. Light curve of the 1996 December outburst of DX And

observations in 0.008-d bins, after subtracting the linear decline. Except for slow, small-amplitude variations with a characteristic time-scale of $0\overset{d}{.}05$ (Figure 2, lower panel), no significant periodicity was found between $0\overset{d}{.}001$ and $0\overset{d}{.}1$. This observation excludes the presence of large-amplitude QPOs as seen in GK Per.

Both GK Per and DX And show slowly developing outbursts, likely explained by inside-out propagation of disk instability (Kim et al. 1992; Simon 2000). There may be a chance that unique features (e.g. QPOs) during outbursts of GK Per is reproduced in DX And, if the origin of such features is related to the outburst mechanism. The present observation, however, does not support this possibility, and suggests that the manner of development of disk instability may not be the major cause of QPOs during outbursts of GK Per. Alternately, the IP-nature may play a more important role in producing the QPOs in GK Per. The consequence of the IP-nature on the disk oscillations still needs to be investigated, both observationally and theoretically.

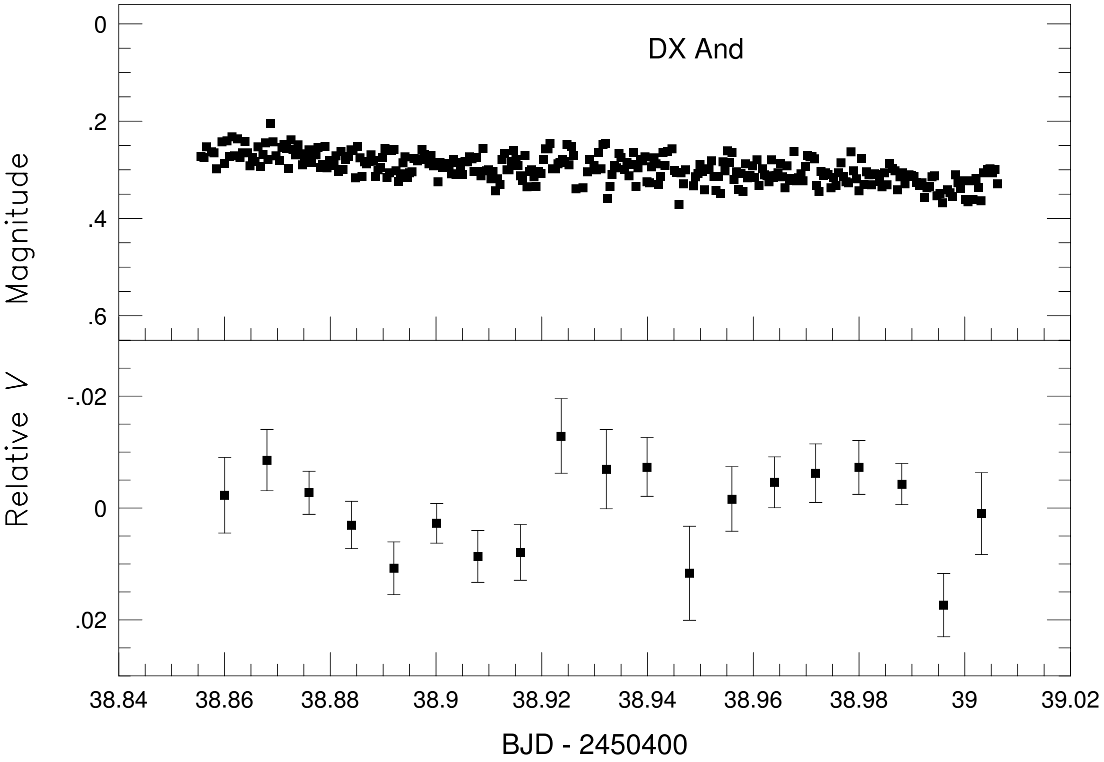

Figure 2. Enlarged light curve of DX And. The upper panel shows raw individual observations. The lower panel shows the averages and standard errors in 0.008-d bins, after subtracting the linear decline

The authors are grateful to VSNET members for promptly and publicly notifying the outburst.

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UNUSUAL SLOW FADING OF STANDSTILL IN AT Cnc

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AT Cnc is a well-established Z Cam-type dwarf nova with clear alternations of dwarf nova-type phase and standstills (see Nogami et al. 1999 for the extensive review on this object). The presence of standstills, in addition to outbursts, is the defining feature of Z Cam stars, and standstills are considered to be equivalent to non-outbursting novalike (NL) variables with thermally stable accretion disks (cf. Osaki 1996 for a review of disk instability in dwarf novae). Standstills in Z Cam stars usually terminate with a sudden fading to quiescence, whose rate of decline is roughly equal to the rate of decline from outbursts.

The recent standstill of AT Cnc began in 2000 November, and has shown peculiar phenomena until now, 2001 May. [N.B. The portion prior to the standstill was not well covered by observations, since the object was only visible in the morning twilight. Several negative estimates with upper limits below 14th magnitudes indicate that the object had not started this standstill before October.] The object has been monitored as a part of VSNET Collaboration (http://www.kusastro.kyoto-u.ac.jp/vsnet/). Visual observations have been made by a number of observers, using the comparison star sequences calibrated in the V band. The typical error of visual estimates is $0\overset{m}{.}2$ mag, which will not affect the following discussion. The light curve drawn from these observations is presented in Figure 1. A portion of the long-term light curve of AT Cnc is presented for comparison in Figure 2, which clearly shows the normal outbursting state of this dwarf nova. The remarkable difference between the figures demonstrates how unusual the present behavior is. The long-term light curve covering the 1995–2001 period is also available at

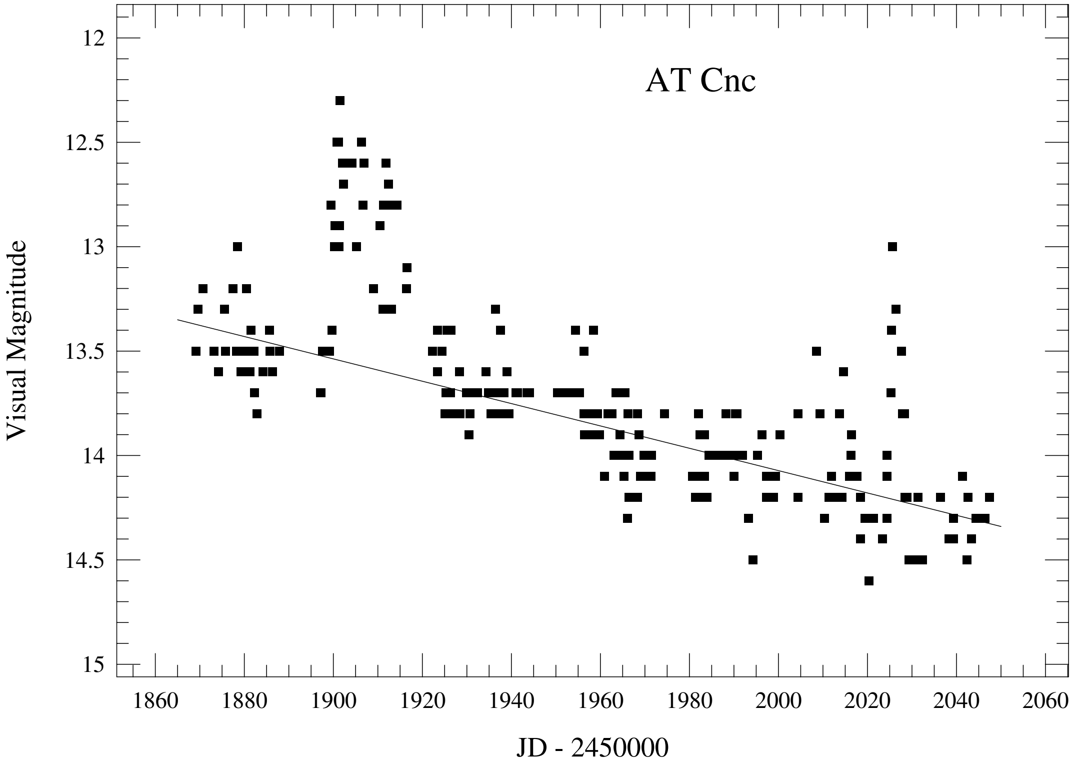

Figure 1. Light curve of AT Cnc. The solid line shows the decline at the rate of 0.0054 $\mathrm{mag\,d^{-1}}$

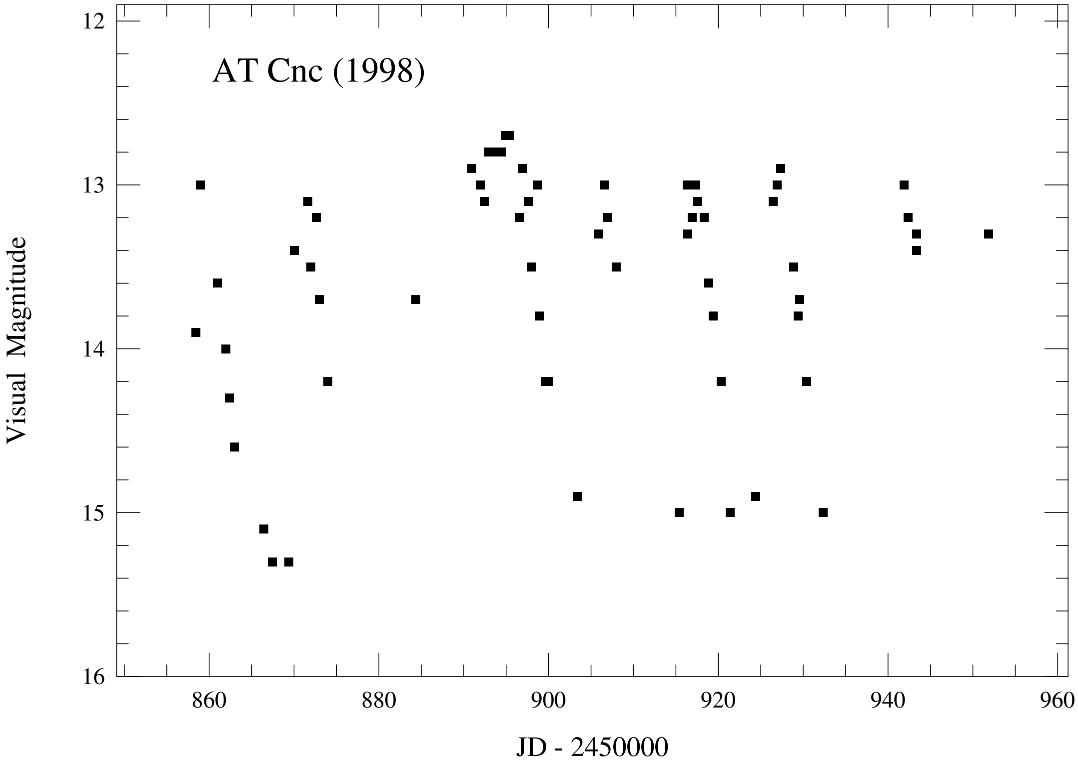

Figure 2. Light curve of AT Cnc in 1998, showing normal outburst cycles

http://www.kusastro.kyoto-u.ac.jp/vsnet/LCs/index/CNCAT.html . The first noticeable event during this standstill occurred in 2000 December (around JD 2451900), an outburst starting from the standstill. Since dwarf nova outbursts are believed to be a consequence of thermal disk instability, which occurs when the mass-transfer rate is below a certain limit, $\dot{M}_{\rm crit}$ (cf. Osaki 1996), such an outburst from the standstill is unexpected if it is triggered by the thermal disk instability. Another small outburst occurred in 2001 April (around JD 2452026), but this may be of different nature, as it was on the slow fading branch on the standstill, as described below.

The other very peculiar feature of this standstill is the slow fading throughout the standstill (except two "outbursts" described above). Such a trend is extremely peculiar among all known Z Cam stars. The rate of decline, measured by linear fitting to the light curve, after removing the two "outbursts", is 0.0054 $\rm mag\,d^{-1}$, corresponding to the e-folding time of $\sim$ 200 d, which is totally inconsistent with the usual fading rate (0.3–0.4 $\rm mag\,d^{-1}$) of this dwarf nova. This fading rate is more characteristic to slow fadings in VY Scl-type novalike variables (cf. Table 1 of Honeycutt et al. 1994). Together with the similarity of standstills with novalike variables, this similarity of fading rate and pattern suggests that we may be witnessing a VY Scl-type phenomenon (temporary reduction of mass-transfer rate) in a Z Cam star. However, as discussed in Honeycutt et al. (1994) and also in King et al. (1998), the standard disk-instability theory predicts that the system should undergo dwarf nova outbursts as the mass-transfer rate decreases. What has been observed in AT Cnc is the contrary: the "outbursts" are much more infrequent and smaller than in its normally outbursting state.

In VY Scl-type stars, an idea has been proposed to solve the same dilemma (Leach et al. 1999). Leach et al. (1999) could reproduce the VY Scl-type fading, without causing major outbursts, by taking the irradiation by the hot white dwarf into account. One may speculate that the same process may be taking place in the present peculiar standstill of AT Cnc. This is not the only similarity of AT Cnc with VY Scl-type stars. Nogami et al. (1999) discovered an intermittent P Cyg-type absorption feature which they interpreted as winds. Such intermittent winds are more commonly seen in VY Scl-type stars, and are rare in dwarf novae. The best example is BZ Cam (originally discovered by J. R. Thorstensen and presented in Patterson et al. 1996; see also Ringwald and Naylor 1998). The spectroscopic evidence of similarity of AT Cnc to BZ Cam was already addressed by Nogami et al. (1999), and the present observation of standstill may be an additional support to the relation between these seemingly different classes of objects. There may be a common underlying mechanism to produce the observed VY Scl-type or VY Scl-like features, as well as high-speed winds, in AT Cnc and BZ Cam. Since some of VY Scl-type stars are suspected to be steadily burning hydrogen on the surface of their white dwarfs (Greiner et al. 1999), the present anomalous state of AT Cnc would be an attractive target to search for similar phenomenon in a Z Cam-type dwarf nova.

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NOVA Aql 2001: ANOTHER V723 Cas-TYPE SLOW NOVA?

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Nova Aql 2001 = V1548 Aql was originally discovered by M. Collins as a variable star TAV J1907+117 (Hurst 2001a). The object was reported to be at photographic magnitude 10.9 on 2001 May 11.99 UT. The object was suspected at magnitude 12.1 on Apr. 25, but the measurement may have been affected by crowding of the field (Hurst 2001a,b). The possibility as some sort of an eruptive variable was suggested based on the lack of bright infrared counterpart on IRAS surveys (Kato 2001). The object was announced as a possible nova (Hurst 2001b). Spectroscopic confirmation as a nova was made by several groups (Benn et al. 2001; Shemmer 2001). The nova was observed already very faint ($\sim$ 12.5–13.0) on May 16–17, suggesting a rapid fade. However, prediscovery photographs by Takamizawa (2001) revealed that the nova was already bright in late February. This suggests that the nova had a long premaximum halt before its final rise to maximum.

Such behavior was also observed in previous novae, most notably in V723 Cas = Nova Cas 1995. Figure 1 shows the comparison between light curves of Nova Aql 2001 and V723 Cas. The horizontal scales were slightly different between these objects, but the overall features resemble each other within a factor of $\sim$ 40% difference in time scales. This striking similarity makes Nova Aql 2001 as a "twin" nova to V723 Cas, the best-observed slowest nova in the modern times. This similarity is consistent with the low expansion velocity (mean FWHM of 1100 $\mathrm{km\,s^{-1}}$, Shemmer 2001), which is comparable to the small FWHM of 600 $\mathrm{km\,s^{-1}}$, observed in Hα emission line of V723 Cas (Della Valle et al. 1995). The small difference in the FWHM between these two objects may suggest that the evolution of Nova Aql 2001 may be more rapid, which looks consistent with the time scales in the light curves, but the direct comparison of values may be still premature because the spectra were taken at different stages of nova explosions. The likely progenitor of Nova Aql 2001 was identified as a star having USNO A2.0 magnitudes of $r = 18.7$ and $b = 19.6$ (Uemura et al. 2001). This makes the outburst amplitude of $\sim$8 mag, which is roughly comparable to that of V723 Cas ($\sim$ 10 mag).

Long premaximum halts were also observed in historical novae, HR Del and possibly in DO Aql. The almost identical appearance of premaximum halts and sharp maxima suggest that a common mechanism is responsible for producing such, still poorly understood, features in slow novae. Both V723 Cas and HR Del showed oscillations after the main peak (as is also seen in the lower panel of Figure 1). If similar phenomenon occurs in Nova Aql 2001, the expected time of the second maximum is around JD 2452080–2452090

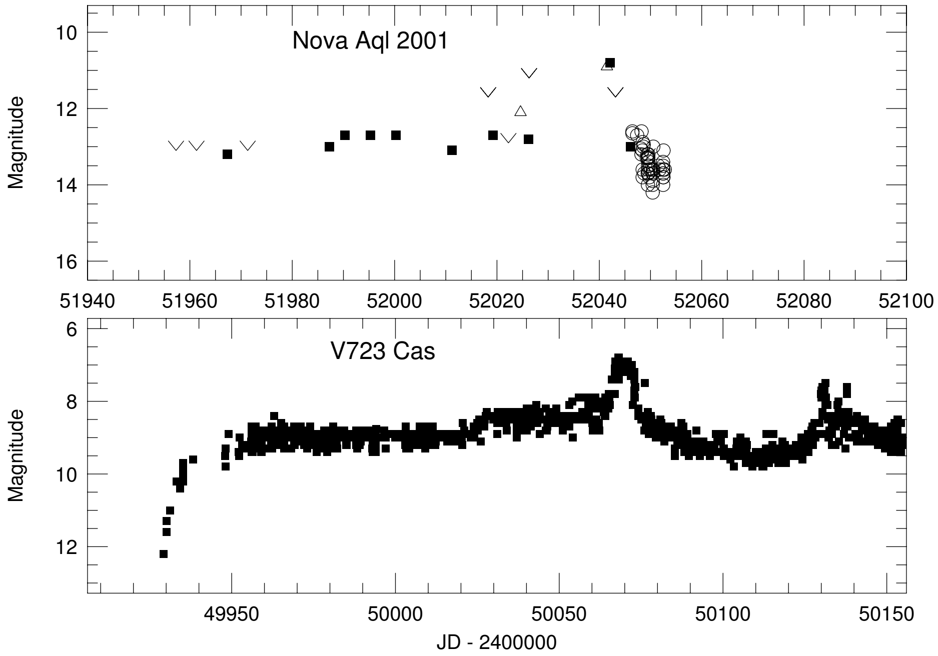

Figure 1. Comparison of light curves between Nova Aql 2001 and V723 Cas. The symbols in the upper panels: discovery and prediscovery photographic observations by Collins (open triangles), photographic observations by Takamizawa (filled squares), visual and V-band CCD observations reported to VSNET (open circles, including some observations reported to IAU Circulars) and photographic upper limits ('∨'-marks). The light curve of V723 Cas (lower panel) are drawn from reports to VSNET

(late June, 2001), but the expected dates should be treated as approximate since the early stage of Nova Aql 2001 was not very well sampled. The cause of such nova oscillations still being poorly understood, intensive observations around this period would be encouraged.

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