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TY Leo IS NOT AN ECLIPSING BINARY STAR

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Discovery of the variable star TY Leo was announced by Hoffmeister (1933). He noted 5 minima and classified it as Algol-type. He included a finding chart. The eclipse ephemeris of Rugemer (1933) is Min I = 2425742.47 + 1.18466 E. Popper (1996) included the star in his program of spectroscopy of lower main-sequence eclipsing binary stars. On his 3 spectrograms, he saw no evidence of a second component, and noted that the lines are unusually sharp for the reported period of 1.2 days.

We have thoroughly observed TY Leo recently, both photometrically and spectroscopically, including visual estimates from the Harvard plate collection during the years from 1920 to 1951. We do not find it to be variable in light or radial velocity. Details of the observations are given below.

We have determined an accurate position for the star identified in Hoffmeister's finder chart from the Hubble Guide Star Catalogue: RA 10:52:27.06, Dec −05:05:17.1 (J2000). These coordinates are confirmed by measurements of the Digital Sky Survey.

CHSL observed by differential photometry with the URSA WebScope at the University of Arkansas (see Lacy et al. 2001 for a description of the observatory). Differential V magnitudes were obtained from Nov. 22, 2001 to Apr. 29, 2002 UT. A total of 1213 magnitudes were measured relative to the comparison star GSC 4920 499, which is in the same frame as TY Leo. The constancy of the comparison star was verified by differential measurements of GSC 4920 465, also in the same frame as TY Leo and the comparison star. The photometric measurements are plotted as a time series (Fig. 1) and as a light curve phased according to the ephemeris of Rugemer (1933; Fig. 2). No significant variations are seen. The standard error of an observation is 0.015 mag.

GT performed spectroscopic observations of TY Leo with an echelle spectrograph on the 1.5-m Tillinghast reflector at the F. L. Whipple Observatory (Mt. Hopkins, Arizona) over a period of 126 days. The single-order spectra cover 45 Å centered at 5187 Å, with a resolving power of $\lambda/\Delta\lambda = 35,000$. Radial velocities were obtained by cross-correlation with a synthetic template based on the latest model atmospheres by R. L. Kurucz, optimized to match the star. From this optimization an effective temperature of 6100 K was derived (SpT approximately F8V), along with a negligible rotational broadening. No significant variations are seen in the radial velocity, nor any sign of double lines in the spectra indicating binarity. The mean radial velocity is −10.20 km/s with a standard

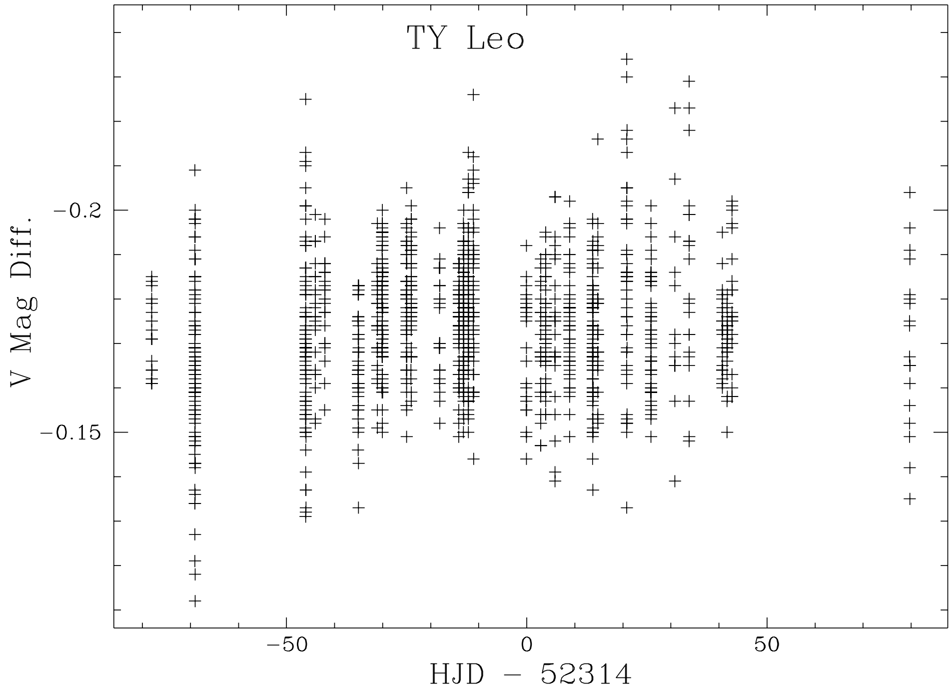

Figure 1. Time series of V-band differential photometric magnitudes of TY Leo.

deviation of 0.55 km/s. The individual radial velocity measurements (converted to the heliocentric frame) are listed below, and shown in Fig. 3.

PRG estimated the brightness of the star visually on 217 plates of the Harvard plate collection (AC Series) from January 1920 to December 1951. Good comparison stars are present in the field. No significant variations in the brightness of TY Leo are seen.

We conclude that TY Leo is not an eclipsing binary star. The failure to detect eclipses cannot in this case be due to nodal regression such as that of V907 Sco (Lacy et al. 1999) because no radial velocity variation is detected. It seems that the most probable cause is a mis-identification of the star by the discoverer (Hoffmeister), i.e., the star identified in the finder chart is not the variable star he discovered.

PRG would like to thank Alison Doane, curator of the Astronomical Photograph Collection at the Harvard College Observatory, for the use of the plates.

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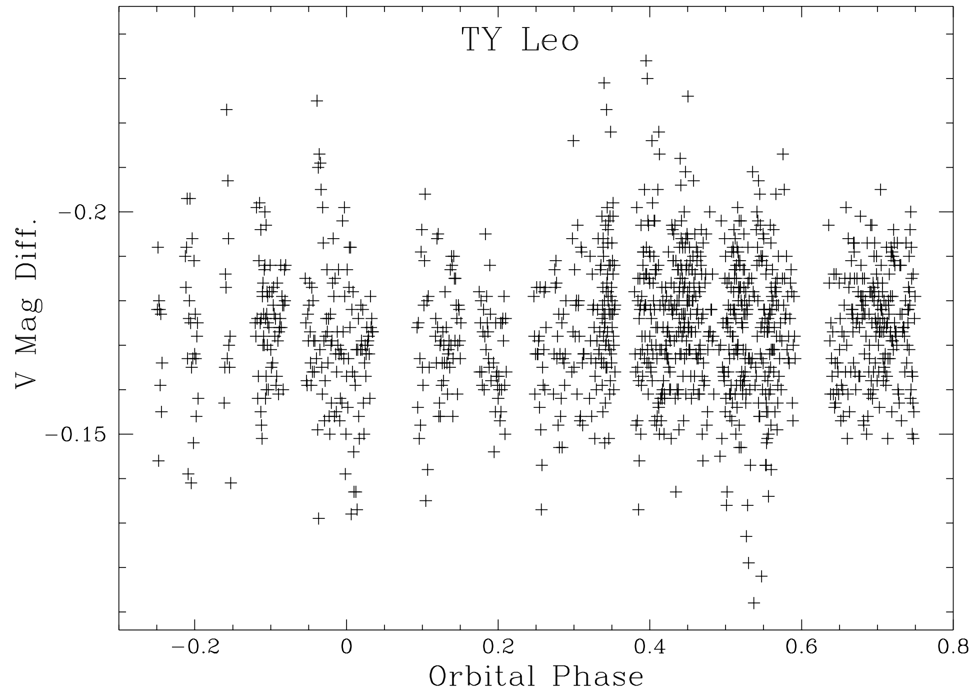

Figure 2. Light curve of TY Leo based on the measurements above, phased by the ephemeris of Rugemer (1933).

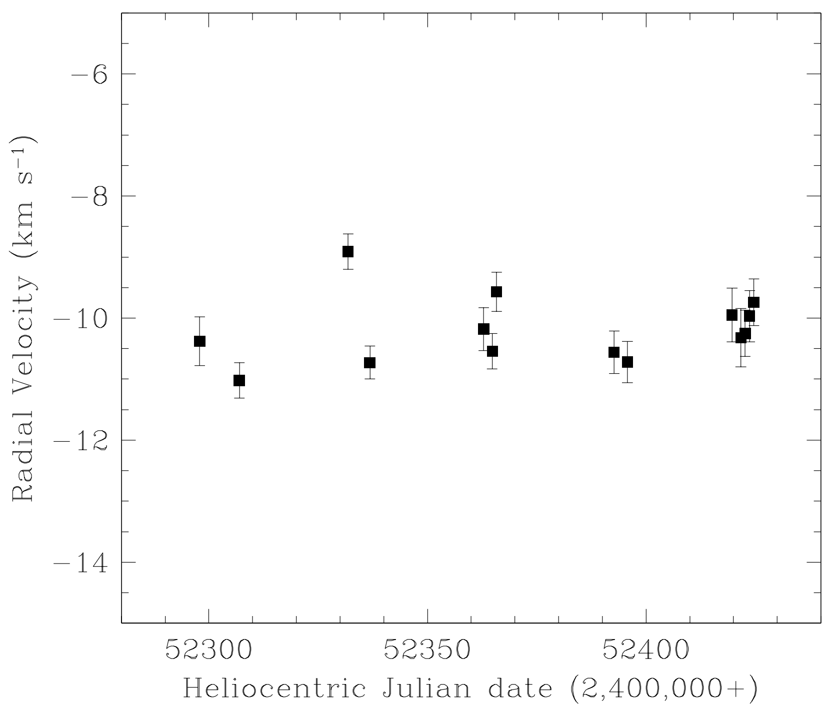

Figure 3. Radial velocity measurements of TY Leo.

Table 1.

HJD −2400000	RV	err
52297.9157	−10.38	0.40
52307.0030	−11.02	0.29
52331.8587	−8.91	0.29
52336.8387	−10.73	0.27
52362.8528	−10.18	0.35
52364.8030	−10.54	0.29
52365.8057	−9.57	0.32
52392.6965	−10.56	0.35
52395.7443	−10.72	0.34
52419.6835	−9.95	0.44
52421.6699	−10.32	0.48
52422.6698	−10.25	0.38
52423.6948	−9.97	0.42
52424.6635	−9.74	0.38

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V982 Oph IS A DWARF NOVA

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Name of the object:
V982 Oph

Equatorial coordinates:	**Equinox:**
R.A.= $17^h52^m38\overset{s}{.}49$ **DEC.=** $+07°33'04\overset{''}{.}4$	2000

Observatory and telescope:
Crimean Laboratory of the Sternberg Astronomical Institute, 40-cm astrograph

Detector:	Photoplate

Filter(s):	None

Date(s) of the observation(s):
1976–1990

Transformed to a standard system:	B_{pg}
Standard stars (field) used:	The B-band photoelectric standard sequence in NGC 6426 (S.Yu. Shugarov, private communication).

Availability of the data:
Upon request

Type of variability:	UG

Table 1. The 18 detected outbursts of V982 Oph

No.	JD24...	B_{pg}	No.	JD24...	B_{pg}	No.	JD24...	B_{pg}
#1	42870.546	< 17.2	#6	43332.356	15.28	#12	44428.350	15.28
	42871.574	< 16.4						
	42872.494	15.63	#7	43391.277	< 16.4	#13	44782.327	15.49
	42872.523	15.58		43394.288	15.54		44789.394	< 17.2
	42872.553	15.54		43395.262	15.49			
	42873.568	15.72		43399.256	16.50	#14	45137.428	16.50
	42874.531	15.58		43400.250	16.40			
	42874.564	15.58				#15	45915.327	16.32
	42875.531	15.63	#8	43424.216	< 17.2			
	42876.499	15.63		43425.241	17.00	#16	45941.312	16.07
	42876.531	15.80		43426.226	15.67			
	42876.562	15.89		43428.211	16.80	#17	46591.462	16.12
				43429.214	< 16.4		46596.478	< 17.2
#2	42982.309	16.32						
	42983.341	< 16.4	#9	43717.297	15.41	#18	48090.305	16.40
				43718.347	15.9:		48091.305	16.80
#3	43016.345	15.54					48092.427	< 17.2
			#10	44043.431	< 17.2			
#4	43243.437	15.76		44050.409	15.30			
	43249.546	16.03						
	43253.517	< 16.4	#11	44105.283	16.16			
				44106.318	16.07			
#5	43272.375	< 17.2		44107.290	17.20			
	43277.523	16.16		44110.301	< 16.4			
	43279.448	< 17.2		44111.300	< 17.2			

Remarks:

The variable V982 Oph (S 4187) was discovered by Hoffmeister (1949) who attributed it to Mira stars. A finding chart was published by Hoffmeister (1957). Götz (1957) also considers the star a long-period variable and reports one gradual rise of its brightness, from 16.9 to 15.9 during JD 2429785–2429845. The GCVS (4th edition) gives the type SR: for the star. Kinnunen and Skiff (2000) suggest an identification with the US Naval Observatory A2.0 catalog star at $17^h52^m36\overset{s}{.}27$, $+7°32'20\overset{''}{.}9$ (2000). This identification was found wrong in the course of our systematic check of identifications and positions for all GCVS stars in Ophiuchus, according to the program announced in Samus *et al.* (2002). Instead, we identify it with a blue star ($b - r = -0.6$ in the USNO A2.0 catalog). The coordinates given are from the Guide Star Catalogue, Version 2.2.01. The finding chart, based upon the POSS I blue image from the USNOFS Image and Catalogue Archive, is presented in Fig. 1. The star's brightness estimates on the Moscow collection plates reveal beyond doubt that it is a dwarf nova, changing its brightness between 15.3 and (17.2B. The star is visible on 39 of the 223 plates. A total of 18 outbursts were observed between JD 2442812–2448092. Figure 2 shows the light curve for two best-documented outbursts. A cycle value of 31 to 36^d can be expected. The brightness rise observed by Götz (1957) probably resulted from estimates belonging to 2 or 3 individual outbursts.

Acknowledgements:

We are grateful for the financial support to the Russian Foundation for Basic Research (grants 02-02-06569, 02-02-16069), to the Council of the program of support for leading scientific schools of Russia (project 00-15-96627), and to the Federal Scientific and Technological Program "Astronomy". This research has made use of the USNOFS Image and Catalogue Archive operated by the United States Naval Observatory, Flagstaff Station (`http://www.nofs.navy.mil/data/fchpix/`).

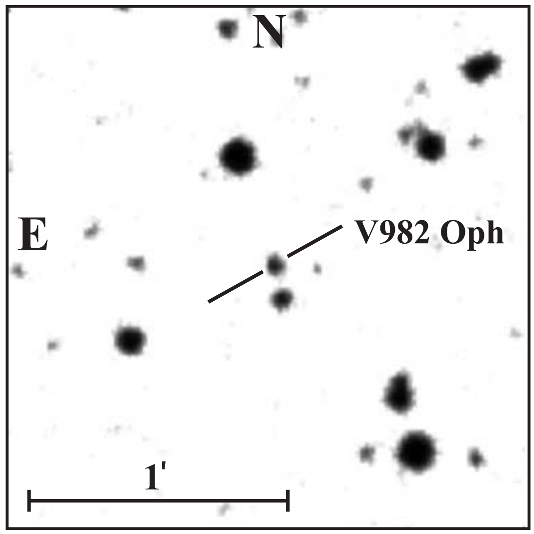

Figure 1. The finding chart for V982 Oph (from the blue POSS I image retrieved from the UNSOFS Image and Catalogue Archive).

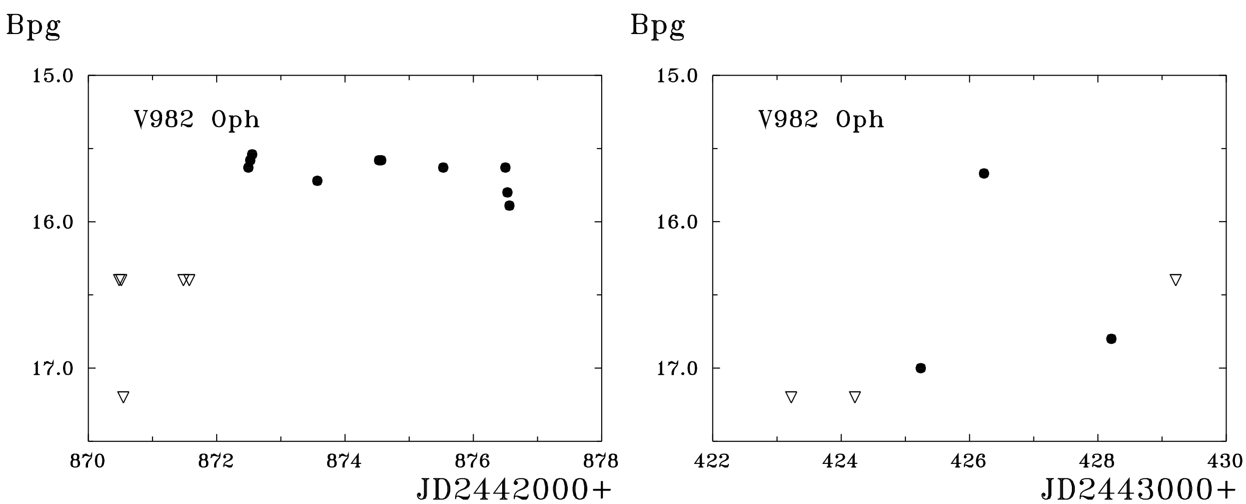

Figure 2. The light curves for two outbursts of V982 Oph.

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O – C ANALYSIS OF SV Cam OVER A CENTURY

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The RS CVn star SV Cam (HD 44982, SAO 1038, HIC32015, G2-3V/K4V, SB1, $m_{V_{\rm max}}$=9.34) is a totally eclipsing binary system with a short orbital period of 0.59 days. The system has been studied mainly photometrically since the 30-ties (Guthnick, 1929) and both components display magnetic activity similarly to the Sun. The presence of a third body was considered by several authors (e.g. Sarma et al., 1985 or Albayrak et al., 2001). The following $O-C$ analysis covers the years 1896 up to 2002 and thus represents more than 60,000 orbits.

The following linear ephemeris (Pojmański, 1998) has been used

$$\mathrm{MinI} = \mathrm{HJD}\ 2\ 449\ 350.3037 + 0.^{\rm d}593071\ \times E \qquad (1)$$

The final $O-C$ analysis consists of all primary minima from several database-like sources including recent observations by Zboril (2002). Most of these data are based on Albayrak et al.'s (2001) collected minima and, finally, from Hall and Kreiner (1980), Pierce (1938) and Wood (1946). Another potential source (Albayrak et al., 1999) contains mainly visual observations which did not improve the $O-C$ diagram. The times of minima in Table 1 (only available electronically via IBVS Web-page as file 5303-t1.txt) were processed according to the equation (1) and the $O-C$ residuals are displayed in Figure 1. The data suggest a quadratic term plus a sinusoidal variation. We fit the data with such an equation which gives the final ephemeris of:

$$\begin{array}{rl} \mathrm{MinI} = & \mathrm{HJD}\ 2\ 449\ 350.3045 + 0.5930718 \times E + 0.11075 \cdot 10^{-10} \times E^2 + \\ & \qquad\qquad \pm.0013 \quad \pm.0000017 \qquad\qquad \pm.0001 \\ & +0.0086 \times \sin[2\pi \times (E - 3319.6)/36073.77301] \\ & \ \pm.0004 \qquad\qquad\qquad\qquad \pm 3.3 \qquad \pm 4.8 \end{array} \qquad (2)$$

The $O-C$ residuals give further support for the existence of a third body orbit with a period that is close to that derived in Sarma et al. (1985), i.e. approximately 50 years. Note though that the first few observations (3 points in 1896) are uncertain.

If only the more precise photoelectric minima are considered the period from Albayrak et al. (2001) is confirmed. As pointed out by them, adopting the distance by Hipparcos,

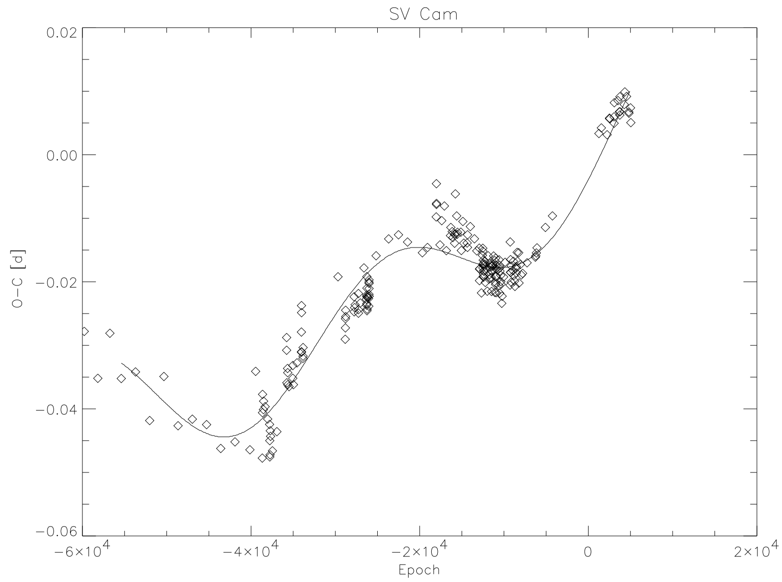

Figure 1. $O - C$ residuals based on the equation (1) for SV Cam and the fit with the equation (2).

the angular separation of the third body from the eclipsing pair is about $0\farcs19$ and should be observable.

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INFRARED LIGHT CURVES OF THE ALGOL BINARY AI Dra

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AI Dra (SAO 30164, HD 153345) was reported as a variable star by Schilt & Hill (1938) and as an eclipsing binary by Reim & Geyer (1955). Complete photoelectric light curves were observed by Cester (1960), Mauder (1962), Winiarski (1971) and more recently by Degirmenci et al. (2000) and Jassur, Kaledian & Kermani (2001). From the results of the published light curve analysis, carried out by different authors with differents analysis codes, the nature, transit or occultation, of the primary eclipse seems unclear (see Degirmenci et al., 2000 for references). Degirmenci et al. (2000) suggested that the system has a third component, with an orbital period of about 23 yr, but the L_3 contribution in the analysis of the B and V light curves that they recorded with the Wilson-Devinney (1971) code does not modify the parameters obtained. The spectroscopic observations (see Khalesseh, 1999 for references) suggest that the spectral types of AI Dra's components are A0 V and a late F or early G V–IV. The last radial velocity curves published by Khalesseh (1999) indicate a mass ratio $q=m_1/m_2=2.33$.

We observed AI Dra in the infrared J, H and K bands on different nights during 1996 and 1997 (see Table 1). The observations were carried out with the 1.5 m TCS telescope at the Observatorio del Teide (Tenerife, Canary Islands). A photometer with a focal plane chopper, and an InSb detector cooled with liquid nitrogen was used. Both the chopping amplitude and the aperture were set to 15″. AI Dra is a relatively bright system, providing a signal to noise ratio greater than 500 in each individual measurement. BD+52°2018, with a spectral type (A0) and magnitude very similar to that of AI Dra, was the main comparison star and showed no variability during the observation runs. The differential magnitudes of AI Dra (star–comparison) were arranged in heliocentric orbital phases according to the ephemeris of Kholopov (1985), namely,

$$\mathrm{MinI} = 2443291.627 + 1\overset{d}{.}1988146\ \mathrm{E} \quad .$$

In order to determine new geometrical elements from our first IR light curves of AI Dra, we used the code developed by Budding & Zeilik (1987). This program, based on the Information Limit Optimization Technique (ILOT), takes into account the ellipticity, gravity darkening and reflection effects. As output, it gives equivalent spherical radii to describe the sizes of the distorted stellar components, and their partial light contribution in the analysed light curve. It has been shown that this code produces geometrical parameters in good agreement with those derived using other existing light-curve fitting codes, even for contact binaries (see Banks 1993 and references therein). A circular orbit was assumed, as emerged from the duration and orbital phases of both eclipses. The limb darkening coefficients were interpolated from the values given by Claret, Díaz–Cordovés & Giménez (1995). The adopted temperatures, T_1= 9600 K and T_2= 6000 K, corresponding to A0V + F8–G0V–IV, (Straizys & Kuriliene 1981), were always fixed parameters. With the aim of having homogeneous photometric elements, we have also re-analysed the B and V light curves of Degirmenci et al. (2000). Different fits were performed, taken as initial values those obtained by differents authors. A third light was also considered, but the solutions pointed out a negligible L_3 contribution. The results of our best fits are given in Table 2, and the B, V, J, H and K models together with the observations are plotted in Figure 1. The obtained values are in good agreement with Jassur, Kaledian & Kermani (2001) and with some fits proposed by Mezzetti et al. (1980). However the B and V solutions given by Degirmenci et al. (2000) depart slightly from our solutions, with a smaller relative radii for the primary star, $r_1 \simeq 0.29$, and $k = \frac{r_2}{r_1}$=1.03. We have performed alternative B,V,J,H and K light curves fits with k=1.03 as fixed parameter, being also possible to attain an acceptable set of solutions with relative radii similar to Degirmenci et al. (2000) values, but the solutions given in Table 2 are slightly better. Fits were also carried out keeping the Khalesseh (1999) determination, namely k=0.78, as fixed parameter. Again we obtain a set of acceptable solutions, with a larger relative radius for the primary ($r_1 \approx$ 0.34), although the fits show larger errors.

From our analysis, we can conclude that AI Dra is an eclipsing binary with partial eclipses, discarding the previously suggested occultation solution.

Table 1: Observing runs

Observation Date	Observed Filters
29–30 April 1996	H, K
5–6 May 1996	J, H, K
6–7 May 1996	J, H, K
4–5 June 1996	J, H, K
2–3 July 1996	J, H, K
26–27 August 1996	J, H, K
27–28 August 1996	J, H, K
16–17 June 1997	J, H, K
17–18 June 1997	J, H, K

Table 2: *ILOT* light curves solutions

	B filter	V filter	J filter	H filter	K filter
L_1	0.952 ± 0.002	0.911 ± 0.002	0.729 ± 0.002	0.665 ± 0.002	0.643 ± 0.002
L_2	0.058 ± 0.002	0.089 ± 0.002	0.271 ± 0.002	0.335 ± 0.002	0.357 ± 0.002
r_1	0.309 ± 0.001	0.311 ± 0.001	0.319 ± 0.001	0.311 ± 0.001	0.316 ± 0.001
r_2	0.285 ± 0.001	0.288 ± 0.001	0.296 ± 0.001	0.289 ± 0.001	0.294 ± 0.001
$k = \frac{r_2}{r_1}$	0.926	0.929	0.934	0.930	0.933
i	$77.^\circ9 \pm 0.^\circ1$	$78.^\circ0 \pm 0.^\circ1$	$77.^\circ3 \pm 0.^\circ1$	$77.^\circ6 \pm 0.^\circ1$	$77.^\circ5 \pm 0.^\circ1$
${\chi_r}^2$	55	43	452	376	439
ϵ	0.008	0.007	0.01	0.01	0.01
N of points	111	111	302	332	334

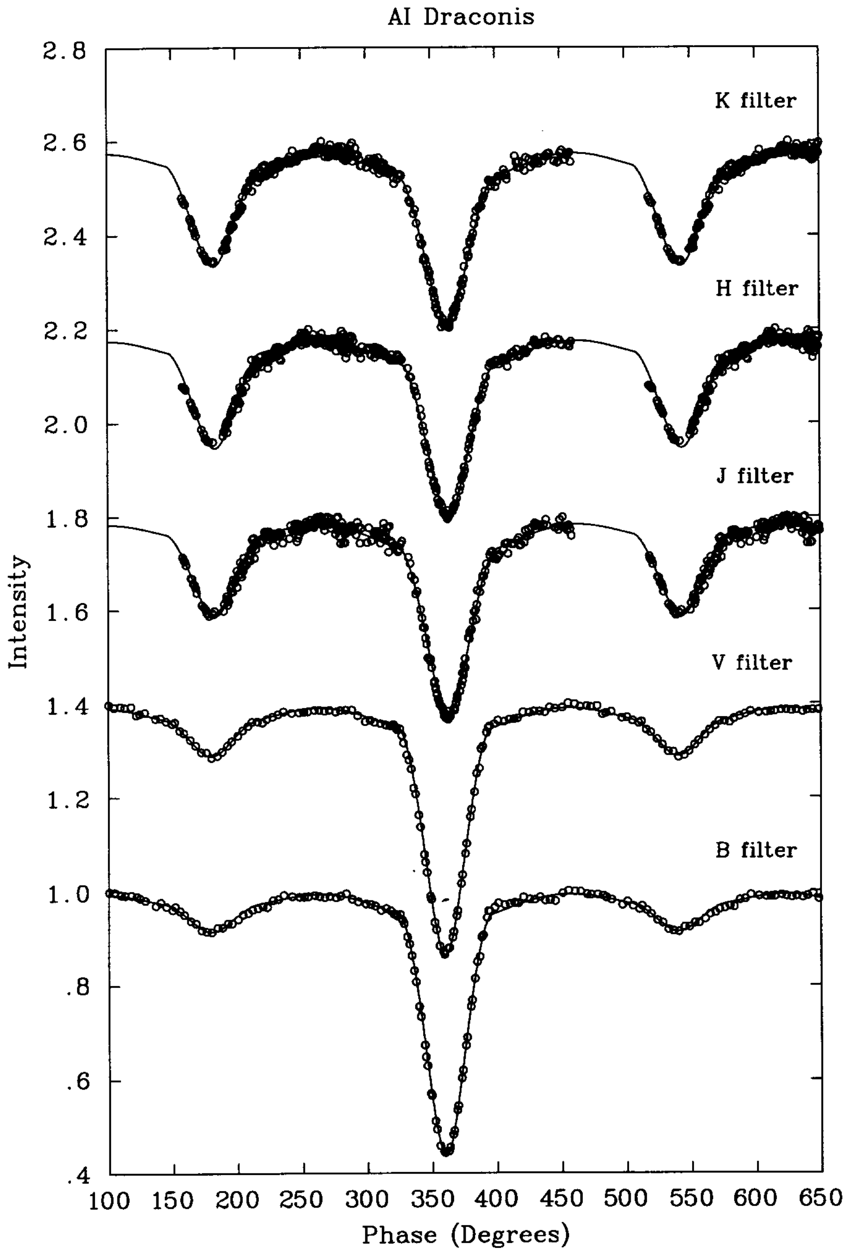

Figure 1. Observed light curves and the fits obtained with *ILOT*. For clarity, the V, J, H and K curves have been shifted by $0\overset{m}{.}4$, $0\overset{m}{.}8$, $1\overset{m}{.}2$ and $1\overset{m}{.}6$ respectively.

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GSC 4153-0634 - A NEW ECLIPSING BINARY

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Continuing our effort to discover the variability and period of photometric variations of X-ray sources found by the ROSAT satellite (Voges et al. 1999), we observed RXJ 114302+603436 (= GSC 4153-0634 = SAO 15610 = BD+61 1260). We made the photometric observations with our automated 0.5m telescope, Star I CCD and Johnson-Cousins VRI filters, and reduced them in a fashion similar to that described in Robb and Greimel (1999). The field of stars observed is shown in Figure 1.

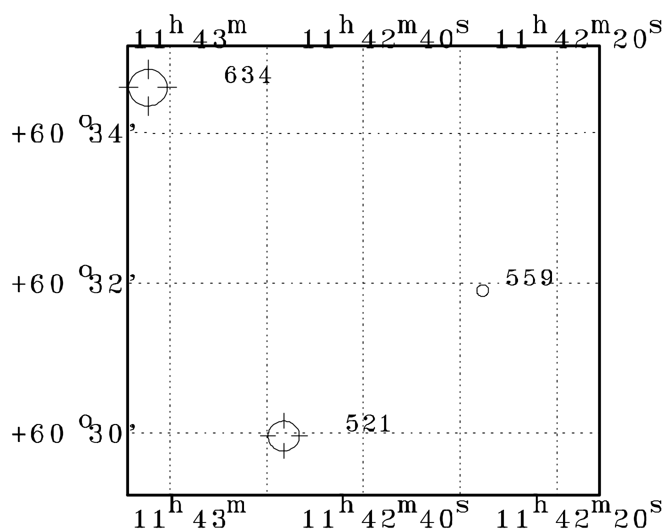

Figure 1. Finder chart labeled with the GSC identification numbers from region 4153.

Table 1 lists the stars' identification numbers and magnitudes from the Hubble Space Telescope Guide Star Catalog (GSC) (Jenkner et al., 1990) and positions from the USNO-A 2.0 catalog (Monet et al., 1998). The Julian Dates of observations (−2450000) and photometric bands used on those nights are 2402−05R, 2410R, 2433VI, 2435−39VRI, 2445−48VRI, 2459−61VRI, 2464−67VRI, and 2478VRI. The first nights of observations were marred by a dust particle on the CCD window and are used only for times of

Table 1: Stars observed in the field of GSC 4153-0634

Type	Star's GSC Id	R.A. J2000	Dec. J2000	GSC Mag.	ΔV Mag.	ΔR Mag.	ΔI Mag.
Variable	0634	$11^h43^m02.30^s$	$60°34'36.1''$	9.5	−0.953	−0.915	−0.866
Comparison	0521	$11^h42^m48.25^s$	$60°29'57.5''$	10.5	–	–	–
Check	0559	$11^h42^m27.58^s$	$60°31'54.4''$	13.2	2.621	2.602	2.567

Table 2: Times of Minimum Light -2450000

HJD	Error	Band	HJD	Error	Band
2402.9425	0.0004	R	2436.8993	0.0013	V, I
2404.7983	0.0002	R	2465.9166	0.0005	V, R, I
2410.9721	0.0004	R	2467.7683	0.0002	V, R, I
2433.8139	0.0011	V, I	2478.8799	0.0002	V, R, I

minimum light. The last seven nights were observed after the CCD window was cleaned and the data had reduced photometric uncertainties.

Our differential magnitudes are calculated in the sense of the star minus GSC 4153-0521. Brightness variations during a night were measured by the standard deviation of the differential magnitudes and for the best night are 0.004 between the variable and comparison stars (not during an eclipse) and 0.016 between the comparison and check stars. For each star the mean of the nightly means is shown as Δ magnitude in Table 1. The standard deviation of the nightly means is a measure of the night to night variations and for the check–comparison stars is 0.004 magnitudes. This excellent photometry shows that night to night variations in either of these stars must be less than a few millimagnitudes. We observed no significant variations in these stars in plots of the individual nights' data.

The star GSC 4153-0634 had obvious variations during some nights and both secondary and primary eclipses were seen. Times of minimum brightness of the star found using the method of Kwee and van Woerden (1956) from data within ±0.04 days are listed in Table 2. From these times of minimum light we find the ephemeris to be:

$$\text{HJD of Minimum Brightness} = 2452402\overset{d}{.}3278(7) + 1\overset{d}{.}23472(3) \times \text{E}.$$

where the uncertainties in the final digit are given in brackets and the RMS error of the fit is less than 0.0011 days. In Figure 2 the differential ΔR_c magnitudes phased at this period are plotted.

A spectrum obtained with the 1.8m telescope of the Herzberg Institute of Astrophysics is shown in Figure 3. Although it is not in the best region or dispersion for spectral classification the Hδ/CaI lines show that the star is late F type. This spectrum was observed at a time close to primary minimum. For GSC 4153-0634 the 2MASS[1] photometry catalog gives J=8.56, H=8.38 and K=8.32, all with uncertainty of about ±0.03 and the possibility that they were observed during an eclipse. Using Landolt (1992) standard stars, we found standardised magnitudes for GSC 4153-0634 to be V=9.57 ± 0.01, $B-V$=0.53 ± 0.01, $V-R$=0.31±0.01, and $R-I$=0.36±0.01 for phase=0.9. From the $V-K$ index we can esti-

[1]This publication makes use of data products from the Two Micron All Sky Survey, which is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation.

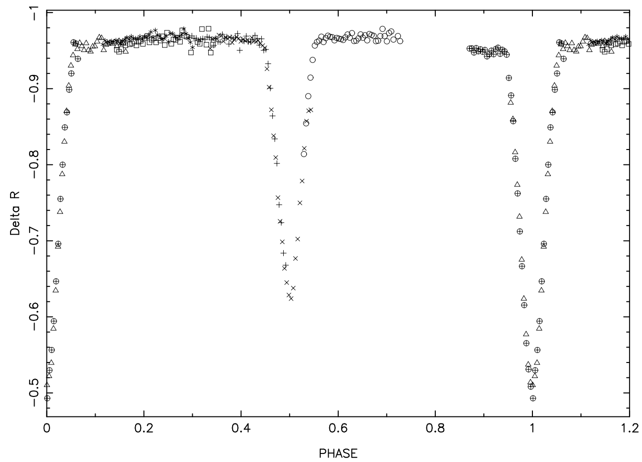

Figure 2. R_c filtered light curve of GSC 4153-0634 with different symbols for different nights.

mate a spectral type of F6V and thus a $E(B-V)$ of 0.06±0.03. From $E(B-V)$=0.06±0.03 a V extinction of 0.19 ± 0.09 follows, and the dereddened colors are consistent with our F-type spectral classification. These all indicate an approximately F6V spectral type for GSC 4153-0634 and a distance of approximately 200 parsecs.

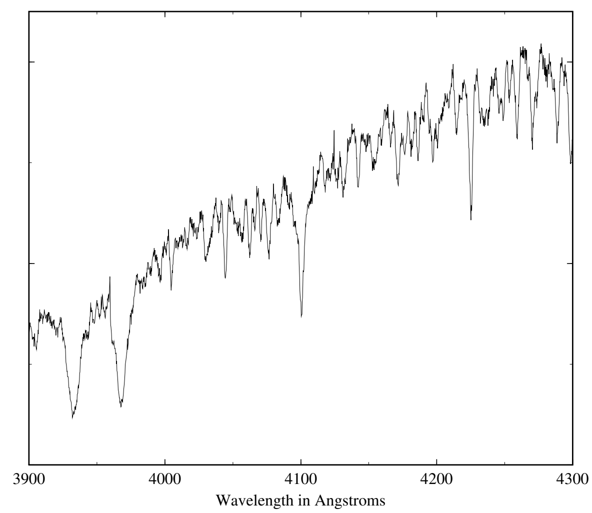

Figure 3. Spectrum of GSC 4153-0634 showing the Hδ absorption line at 4101Å and CaI at 4226Å

While a definitive solution to the light curve is not attempted with this data set, there exist physically plausible parameters which fit the data. Our light curve model, synthesised using Binmaker2 (Bradstreet, 1993) is plotted with the binned data points in Figure 4. From the spectral class we assume a temperature for the hot star of 6400K and appropriate limb darkening, gravity darkening (g=0.32) and reflection (R=0.5) coefficients. The set of parameters we found were: radius of hot star of 0.21 ± 0.03, radius of cool star of 0.18 ± 0.03 as fractions of the orbit diameter, temperature of the cool star of 6000K and an orbital inclination of $83^\circ \pm 2^\circ$. The uncertainty in the temperature difference of the two stars is $\sim$ 100K. The well separated stars make the mass ratio indeterminate, so we assumed a value of 0.85, consistent with the temperature difference. We needed

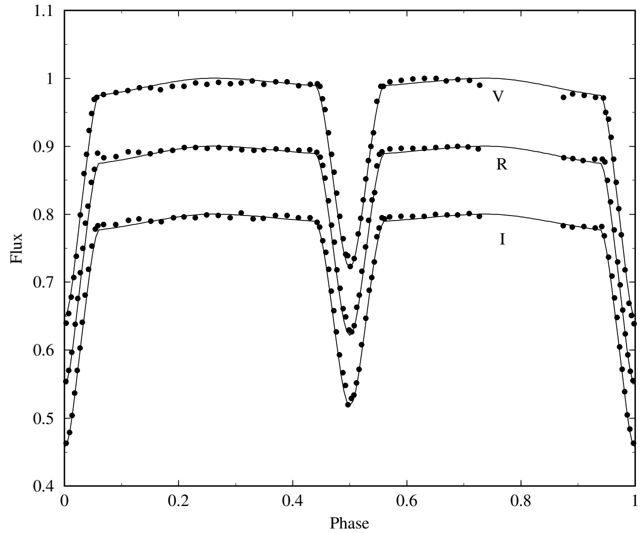

Figure 4. Model lines and light curve points of GSC 4153-0634

to include a cool spot of radius 10° on the cooler star's equator at 0° longitude to model the difference in maximum light. This well separated model is consistent in temperature difference, mass ratio and ratio of the radii with a F6V+F9V eclipsing binary star.

References:

Bradstreet, D.H., 1993, Binary Maker 2, Contact Software, Norristown, PA, 19401, USA
Jenkner, H., Lasker, B., Sturch, C., McLean, B, Shara, M., Russell, J., 1990, *AJ*, **99**, 2082
Kwee, K.K., & van Woerden, H., 1956, *Bull. Astr. Inst. Neth.*, **12**, 327
Landolt, A.U., 1992, *AJ*, **104**, 340
Monet, D., & al., 1998, USNO-A2.0, US Naval Observatory, Washington DC, USA
Robb, R.M., & Greimel, R., 1999, *ASP Conf. Ser.*, **189**, 198
Voges, W., Aschenbach, B., Boller, Th., Bräuninger, H., Briel, U., Burkert, W., Dennerl, K., Englhauser, J., Gruber, R., Haberl, F., Hartner, G., Hasinger, G., Kürster, M., Pfeffermann, E., Pietsch, W., Predehl, P., Rosso, C., Schmitt, J.H.M.M., Trümper, J., Zimmermann, H.U., 1999, *A&A*, **349**, 389

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CCD LIGHT CURVES OF ROTSE1 VARIABLES, XVI: GSC 2613:1412 Her, GSC 3098:683 Her, GSC 3098:1253 Her, AND GSC 2083:1870 Her

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

Detector:	SBIG ST-7 CCD camera

Method of data reduction:
Standard CCD-frame reduction using AIP4WIN software

Method of minimum determination:
Kwee – van Woerden algorithm

Observed star(s):				
Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp./check star(s)
GSC 2613:1412 ROTSE1 J172631.22+350115.6	EW	17 26 31.2	+35 01 16	GSC 2613:287 / GSC 2613:1372
GSC 3098:683 ROTSE1 J172803.29+434125.8	EW	17 28 03.3	+43 41 26	GSC 3098:851 / GSC 3098:1091
GSC 3098:1253 ROTSE1 J172844.89+434818.8	EW	17 28 44.9	+43 48 19	GSC 3098:1639 / GSC 3098:1750
GSC 2083:1870 ROTSE1 J173327.94+265547.5	EW	17 33 27.9	+26 55 48	GSC 2083:1693 / GSC 2083:426

Ephemeris:			
Star name	E 2400000+	P [day]	Source
ROTSE1 J172631.22+350115.6	52426.5561	0.392124	present paper
ROTSE1 J172803.29+434125.8	52442.5724	0.415381	”
ROTSE1 J172844.89+434818.8	52463.4300	0.241415	”
ROTSE1 J173327.94+265547.5	52463.4068	0.360847	”

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
GSC2613:1412 (Her)	51275.8698	21	s	none		ROTSE1
	52411.4620	27	s	none		
	52415.3808	11	s	none		
	52426.365	4	s	none		
	52426.5554	5	p	none		
	52442.4360	6	s	none		
	52463.4162	7	p	none		
	52483.4150	3	p	none		
GSC3098:683 (Her)	51288.8526	6	s	none		ROTSE1
	51295.7058	6	p	none		ROTSE1
	52411.4195	13	p	none		
	52415.3662	4	s	none		
	52426.3725	14	p	none		
	52442.5718	9	p	none		
	52463.5488	3	s	none		
	52483.4866	10	s	none		
GSC3098:1253 (Her)	51283.7609	20	s	none		ROTSE1
	51288.7022	13	p	none		ROTSE1
	52411.4089	33	s	none		
	52411.5252	8	p	none		
	52415.3878	11	p	none		
	52426.3761	20	s	none		
	52426.4918	8	p	none		
	52442.4264	6	p	none		
	52442.5477	21	s	none		
	52463.4289	11	p	none		
	52463.5515	10	s	none		
	52475.379	4	s	none		
	52475.5031	10	p	none		
	52483.4650	20	p	none		
GSC2083:1870 (Her)	51306.8926	5	p	none		ROTSE1
	52411.4455	20	p	none		
	52415.4139	2	p	none		
	52426.4205	3	s	none		
	52442.4772	9	p	none		
	52463.4064	8	p	none		
	52463.5857	13	s	none		
	52475.4953	6	s	none		
	52483.4344	8	s	none		

Explanation of the remarks in the table:

ROTSE1: Observations of Akerlof et al. (2000).

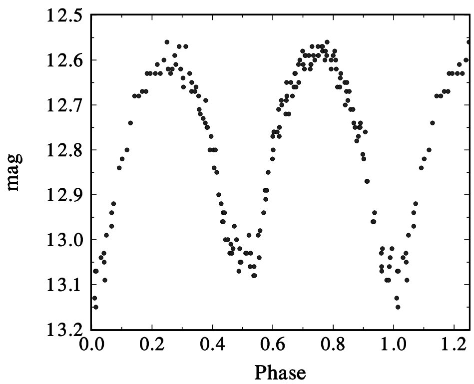

Figure 1. CCD light curve (without filter) of GSC 2613:1412

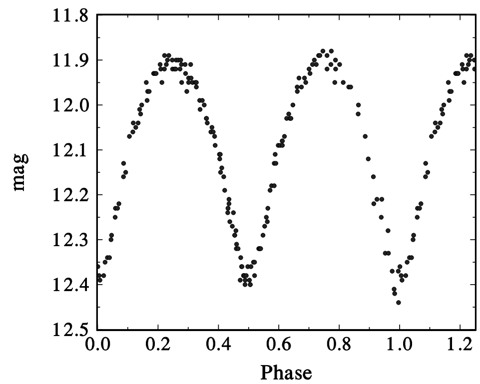

Figure 2. CCD light curve (without filter) of GSC 3098:683

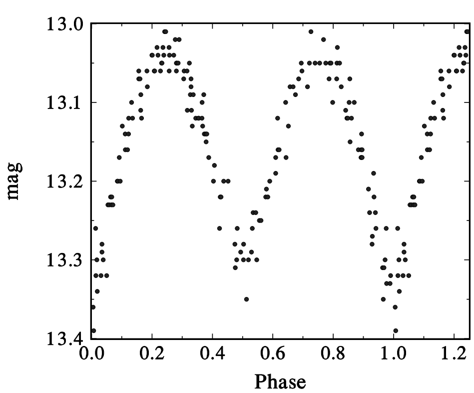

Figure 3. CCD light curve (without filter) of GSC 3098:1253

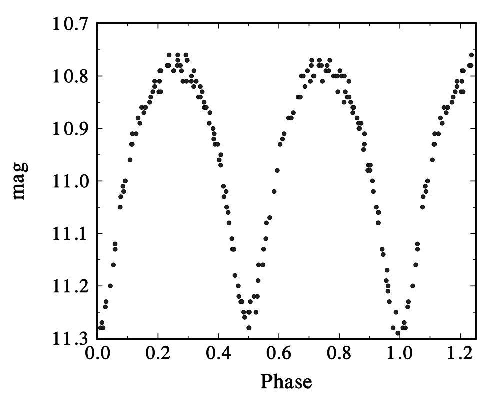

Figure 4. CCDlight curve (without filter) of GSC 2083:1870

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). This installment contains information on four variables in the constellation Hercules. The four stars were observed with our CCD equipment during 7 nights between JD 2452411 and JD 2452483. A total of 180 CCD frames were measured of GSC 2613:1412, 180 frames of GSC 3098:683, 171 frames of GSC 3098:1253 and 183 frames for GSC 2083:1870. Figures 1 through 4 show our observations folded with the elements given in the table of Ephemeris. These elements of variation are deduced from a linear fit to the normal minima from the ROTSE1 data and the timings of minimum derived from our data given in the table of Times of minima and also in Blättler (2002).

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

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

References:

Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

Blättler, E., 2002, *BBSAG Bulletin*, **128**

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STRÖMGREN DIFFERENTIAL PHOTOMETRY OF THE Be STAR θ CrB: 1999-2002

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The Be star θ Coronae Borealis (= HR 5778 = HD 138749) has had periods of both activity and inactivity (see, e.g., Percy et al., 1988 and Percy & Attard, 1992). Fabregat & Adelman (1998) and Adelman (1999) presented differential Strömgren *uvby* photometry from the Four College Automated Photoelectric Telescope (FCAPT) of this star from 1994 to 1999. Neither short term periodic variability with an amplitude $\geq$ 0.005 mag. nor long term variations $\geq$ 0.01 mag. were seen. Percy et al. (2002) confirm that the Hipparcos observations of θ CrB show no evidence of short-term variability. Recently Percy & Bakos (2001) reported that their observations of this star between 1996 and 1999 also indicated constancy. In this bulletin, I report on additional photometric observations with the FCAPT which show that this behavior has continued for three more years. These observations are inconsistent with those of Guerrero et al. (1992) which were obtained in 1989 when this star was in an active phase.

During the 1999-2000, 2000-2001, and 2001-2002 observing seasons an additional 49, 42, and 11 high quality observations, respectively, were made. Table 1 begins with the averages found by Adelman (1999) and summarizes the new observations, where c, ch and v are the comparison, the check and the variable star, respectively. The observing conditions, sequences and the comparison and check stars were the same as in Adelman (1999). The values for the last three seasons of observations are similar to those of the previous FCAPT observations. The new ensemble averages and standard deviations are very similar to those from Adelman (1999).

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Table 1. Summary of photometry for θ CrB.

Heliocentric Julian Date	u $v-c$	u $c-ch$	v $v-c$	v $c-ch$	b $v-c$	b $c-ch$	y $v-c$	y $c-ch$
all previous values								
average	−1.740	−0.346	−1.306	−0.044	−1.262	0.048	−1.241	0.100
std. dev.	0.008	0.006	0.006	0.004	0.006	0.005	0.005	0.004
1999-2000								
49 observations								
average	−1.741	−0.344	−1.303	−0.043	−1.267	0.041	−1.241	0.100
std. dev.	0.007	0.005	0.005	0.005	0.004	0.004	0.005	0.024
2000-2001								
42 observations								
average	−1.742	−0.344	−1.301	−0.042	−1.265	0.042	−1.237	0.100
std. dev.	0.005	0.005	0.006	0.007	0.006	0.004	0.006	0.004
2001-2002								
11 observations								
average	−1.744	−0.352	−1.304	−0.048	−1.269	0.039	−1.240	0.099
std. dev.	0.008	0.003	0.005	0.006	0.004	0.004	0.008	0.004
all FCAPT observations								
average	−1.741	−0.346	−1.305	−0.044	−1.263	0.047	−1.241	0.100
std. dev.	0.008	0.006	0.006	0.004	0.006	0.005	0.005	0.004

References:

Adelman, S. J., 1999, *IBVS*, 4729
ESA, 1997, *The Hipparcos and Tycho Catalogues*, SP-1200
Fabregat, J., Adelman, S. J., 1998, *A&A*, **329**, 579
Guerrero, G., Bossi, M., Scardia, M., 1992, *A&A*, **260**, 311
Percy, J. R., Attard, A., 1992, *PASP*, **104**, 1160
Percy, J. R., Bakos, A. G., 2001, *PASP*, **113**, 748
Percy, J. R., Coffin, B. L., Drukier, G. A., et al., 1988, *PASP*, **100**, 1555
Percy, J. R., Hosick, J., Kincaide, H., Pang, C., 2002, *PASP*, **114**, 551

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2 September 2002

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PHOTOMETRIC VARIABILITY OF FIRST J142643.2+315214

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Name of the object:
GSC 02553-00316 = TYC 2553 316 1

Equatorial coordinates:	**Equinox:**
R.A.= $14^h26^m43\overset{s}{.}21$ **DEC.=** $+31°52'16\overset{''}{.}1$	J2000

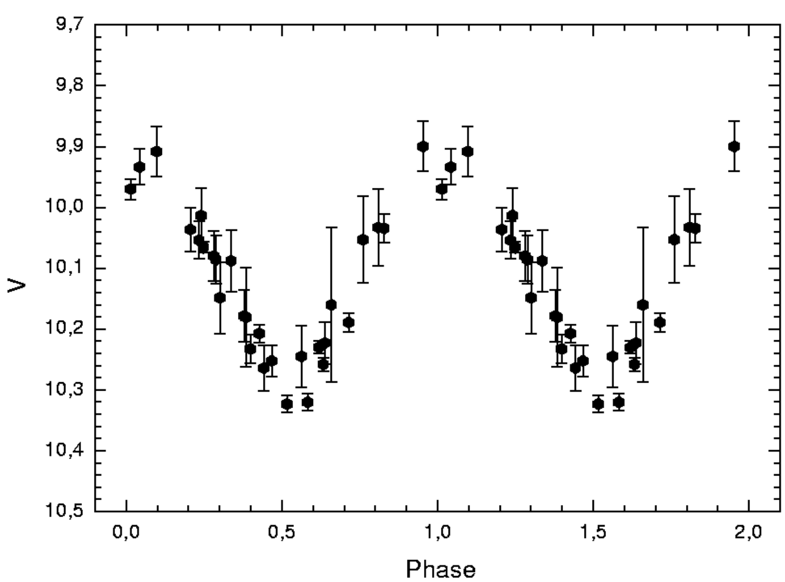

Figure 1. Observed optical light curve of FIRST J142643.2+315214

Observatory and telescope:
Piwnice Observatory 135mm semi-automatic CCD camera

Detector:	KAF 400 CCD

Filter(s):	V

Transformed to a standard system:	No

Availability of the data:
Upon request

Remarks:

FIRST J142643.2+315214 was found to coincide with optical object TYC 2553 316 1 (GSC 02553-00316) by Helfand et al. (1999). It is a 9.92 photographic magnitude star according to GSC Catalogue (Morrison et al. 2001) and a 10.344 (V_T) magnitude according to TYCHO (Høg et al. 2000). This object was found to be optically variable during a semi-automatic CCD sky survey program in Piwnice Observatory. Observations were obtained during 29 nights between April 21 and August 20, 2002. 142 individual observations obtained in total were averaged within 29 one-hour intervals before analysis. Period search was performed with ANOVA method of Schwarzenberg-Czerny (1996). Following results were obtained:

$$\begin{aligned} \text{HJD of minimum} &= 2452468.69 \pm 0.16 \\ \text{Period} &= 20\overset{\text{d}}{.}83 \pm 0\overset{\text{d}}{.}04 \\ \text{Total variation} &= 0.35 \pm 0.05\,\text{mag} \end{aligned}$$

According to SIMBAD there is another star BD+32°2472 (= RBS 1394 = 1RXSJ142643.5+315221) in the nearest optical neighbourhood of FIRST J142643.2+315214. Since FIRST J142643.2+315214 is the brightest local star and there is no real star at the position of BD+32°2472 we suggest that FIRST J142643.2+315214 = BD+32°2472. The $(B-V)_T$=1.24 for FIRST J1426 43.2+315214 is also adequate for the K2III spectral type of BD+32°2472.

References:

Helfand, D.J., Schnee, S., Becker, R.H., White, R.L., McMahon, R. 1999, *AJ*, **117**, 1568

Høg, E., Fabricius, C., Makarov, V. V., Urban, S., Corbin, T., Wycoff, G., Bastian, U., Schwekendiek, P., Wicenec, A. 2000, *A&A*, **355**, L27

Morrison, J. E., Rser, S.; McLean, B., Bucciarelli, B., Lasker, B. 2001, *AJ*, **121**, 1752

Schwarzenberg-Czerny, A. 1996, *ApJ*, **460**, L107

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V2540 Oph (Nova Oph 2002): LARGE-AMPLITUDE SLOW NOVA WITH STRONG POST-OUTBURST OSCILLATIONS

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V2540 Oph (Nova Oph 2002) was independently discovered by Katsumi Haseda and Yuji Nakamura at magnitude 9.0 on 2002 January 24 (Haseda et al. 2002). Retter et al. (2002) detected emission lines of hydrogen and Fe II, indicating that the object is an Fe II class nova caught in the early decline stage. Later examination of photographs revealed that the nova was already at magnitude 8.9 on 2002 January 19 (Seki et al. 2002).

Since the detection of the outburst, the nova has been intensively monitored by a number of observers. Figure 1 shows the light curve constructed from visual, CCD V-band and photovisual observations reported to the VSNET Collaboration.[1] The nova showed strong post-maximum oscillations up to 1 mag. The large-amplitude early stage oscillations resemble those observed in V1178 Sco = Nova Sco 2001 and V4361 Sgr = Nova Sgr 1996 (Kato, Fujii 2001). The light curve of V2540 Oph also resembles that of V2214 Oph = Nova Oph 1988 (Lynch et al. 1989), which has been later suggested to be a magnetic nova (Baptista et al. 1993).

Superimposed on these oscillations, the nova showed a steady fade at 0.033 mag d^{-1}. [This rate was determined using the data between 2452294 and 2452341, during which the general trend of the fading can be approximated by a single decline rate. The last part of the light curve, when the nova underwent a long-lasting brightening, was not used in this analysis. If we incorporate the last part of the light curve, the average decline rate becomes 0.013 mag d^{-1}, which may more severely constrain the following discussion]. By applying the recently calibrated relation (Downes, Duerbeck 2000) of absolute maximum magnitude vs rate-of-decline (MMRD) in classical novae, we obtain the expected absolute V-band maximum magnitude of $M_V = -6.8 \pm 0.6$. We performed the accurate astrometry with the images obtained by Kyoto 0.30-m telescope taken on Mar. 8.23 UT, which revealed the position of the nova as: R.A. = $17^h\ 37^m\ 34^s.385 \pm 0^s.017$, Decl. = $-16^\circ\ 23'\ 18''.19 \pm 0''.18$ (equinox 2000.0, using 59 UCAC1 reference stars). This position is marginally consistent of the reported position by K. Kadota, who measured Haseda's discovery films (Haseda et al. 2002). No corresponding object was found on DSS and 2MASS scans within $2''.5$ of the nova, setting an upper limit of the prenova magnitude of $\sim$21 (Figure 2; a wider field map together with the outburst image is shown in Figure 3).

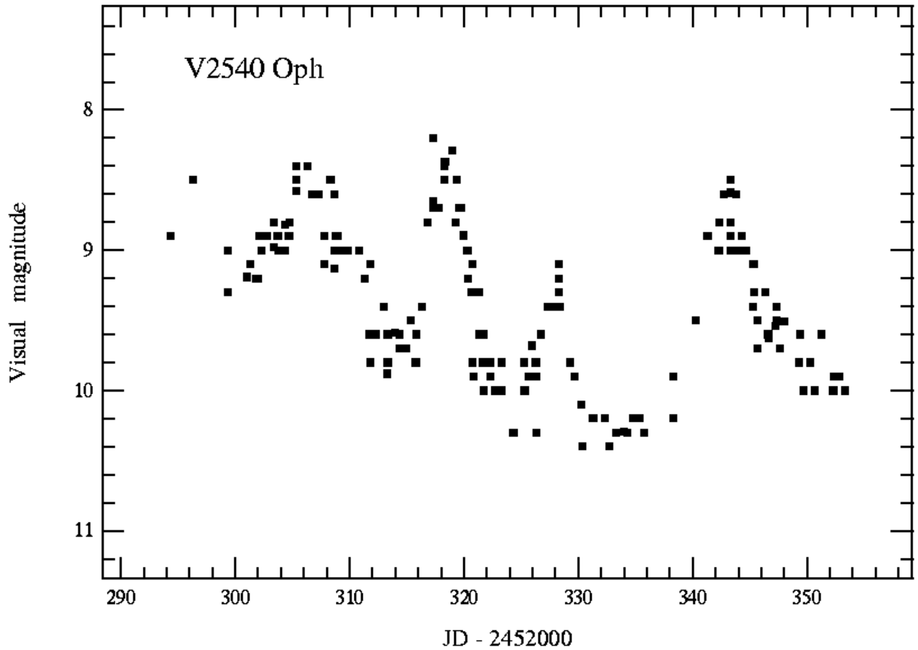

Figure 1. Light curve of V2540 Oph (Nova Oph 2002) constructed from visual, CCD V-band and photovisual observations reported to the VSNET Collaboration.

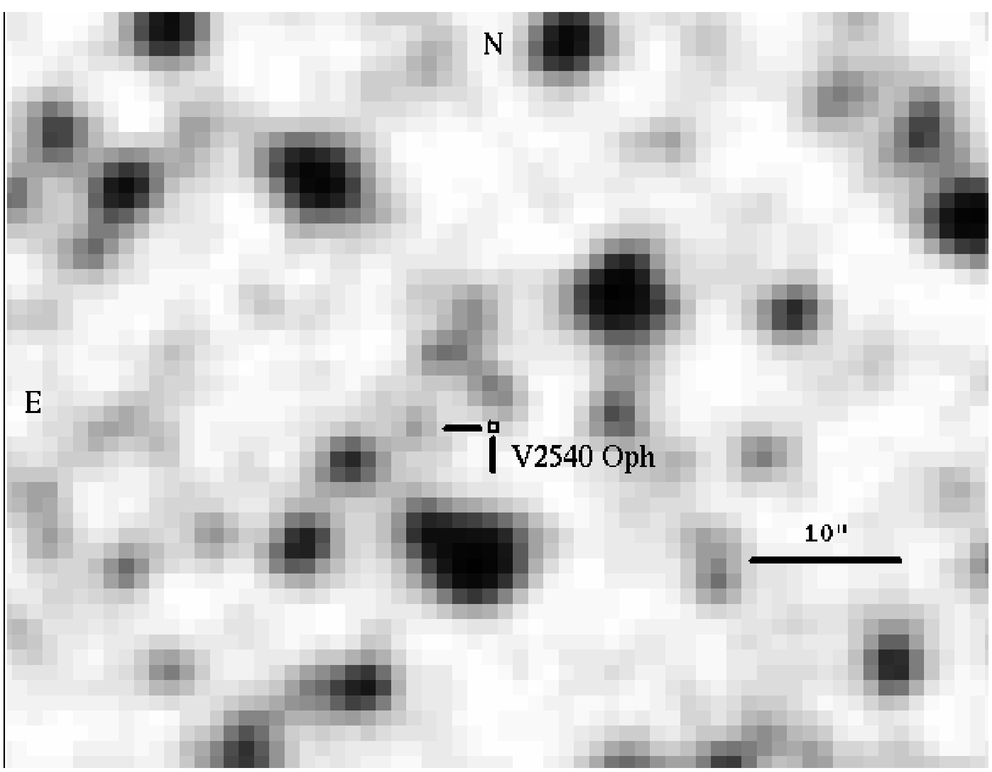

Figure 2. The position of V2540 Oph (square) on DSS2 red image. No prenova can be found to the image limit (mag ~21). The north is up, and the east is left.

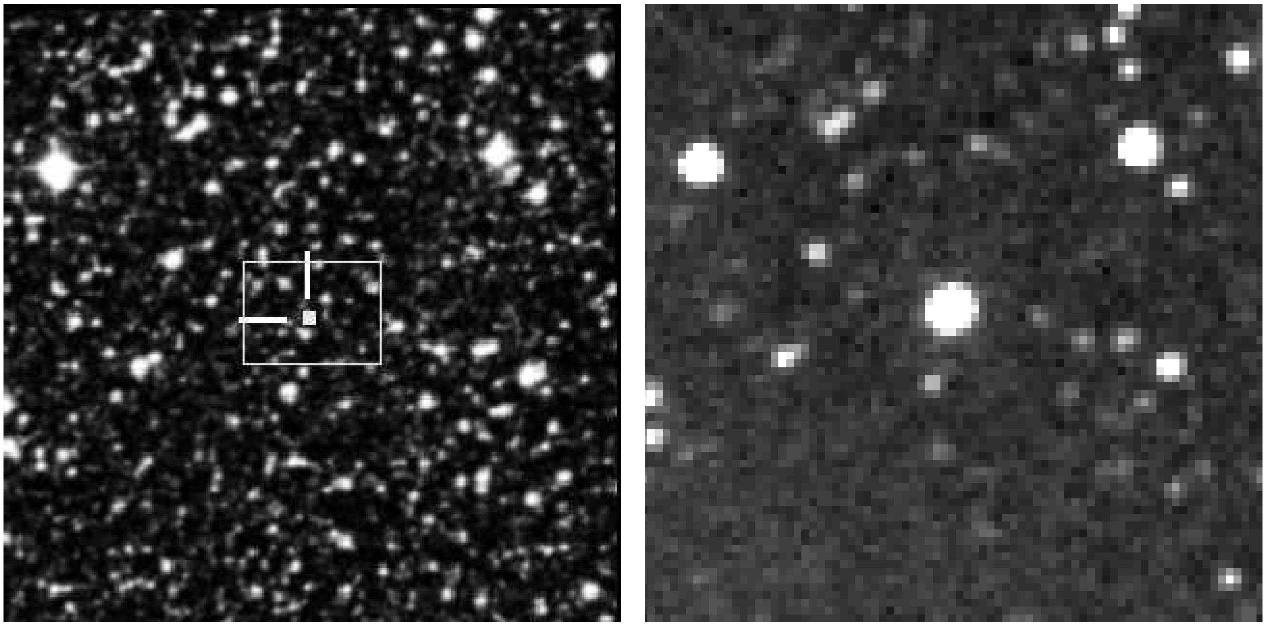

Figure 3. Field map of V2540 Oph. Each panel shows 5 arcminutes square, north is up, east is left. (Left) DSS image. A thick small square with a hair shows the position of V2540 Oph (see Fig. 2), and a thin box shows the field of Fig. 2. (Right) Kyoto image taken on 2002 Mar 8.23.

This indicates that the lower limit of the outburst amplitude is ∼12.5 (by adopting the observed maximum magnitude of 8.5), which is unusually large for a slow nova with a decay rate of 0.033 mag d^{-1}. By using the above expected absolute V-band maximum magnitude, we can set an upper limit of M_V∼5.7 for the nova progenitor. This magnitude is extremely faint for known prenova magnitudes and other novalike cataclysmic variables (Warner 1986, 1987). [Available observations suggest that the true maximum of the nova must have been missed. By considering this, both the decline rate and the outburst amplitude could be larger than the values in this discussion. However, we consider this effect will not severely affect the conclusion, because 1) the MMRD-relation (della Valle, Livio 1995, Downes, Duerbeck 2000) is known to be relatively flat (i.e. little depends on the decline rate) around the decline rate in question; a brighter maximum will therefore tend to pose a more stringent upper limit for the prenova), and 2) the reported spectrum (Retter et al. 2002) suggests that the object was caught during an early decay stage.]

Such a faint prenova magnitude would require a small mass-transfer rate, a small dimension of the disk, or a high inclination. Because V2540 Oph is a slow nova, the low mass-transfer rate is a rather unlikely explanation. We propose that the nova should have either a short orbital period or a high inclination. Among the well-observed classical novae, V2540 Oph most resembles the presumed magnetic nova V2214 Oph in many aspects: large outburst amplitude, slow rate of decline, and the presence of prominent oscillations. Since the characteristic double-wave orbital modulations were already present during the decay stage of V2214 Oph (Baptista et al. 1993), we strongly encourage observers to detect orbital signatures in V2540 Oph.

[1] http://www.kusastro.kyoto-u.ac.jp/vsnet/

We are grateful to all observers who reported vital observations to VSNET. This work is partly supported by a grant-in aid [13640239 (TK), 14740131 (HY)] from the Japanese Ministry of Education, Culture, Sports, Science and Technology. This research has made use of the 2MASS scan at NASA/IPAC Infrared Science Archive, the Digitized Sky Survey producted by STScI, and the VizieR catalogue access tool.

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LIGHT CURVE VARIABILITY IN XZ CANIS MINORIS

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XZ CMi is a short-period Algol that has previously been observed by Wilson (1966) and Terrell, Gunn, and Kaiser (1994; hereafter TGK) in the B and V passbands. In hopes of determining better system parameters and exploring the possibility of third light in the system as claimed by Rafert (1990), we decided to obtain $UBVR_cI_c$ photometry during the 2001-2002 observing season. XZ CMi was observed in the V passband from December, 2001 with the 24" telescope and ST-8 CCD at Sommers-Bausch Observatory (SBO) on the University of Colorado campus. The observation continued with the USNOFS 1.0m telescope and SITe CCD from February, 2002 and complete $UBVR_cI_c$ light curves were obtained.

Rafert (1990) used the Wilson-Devinney program (WD; Wilson and Devinney, 1971; Wilson, 1979) to fit the Wilson (1966) light curves. He found that third light in the amounts of 17% in V and 11% in B yielded better fits to the data than zero third light. On the other hand, Terrell and Wilson (1990) and TGK found acceptable fits without third light. Clearly the third light hypothesis was not strongly tested with data available in these previous studies. Based on our new observations, we can now state that third light was definitely present in these previous datasets. Figure 1 shows part of an I_c band image taken by Henden and clearly shows a visual companion 2.4" east and 0.5" south of XZ CMi.

Henden performed PSF-fitting to images taken on a night of relatively good seeing to measure the positions and colors of XZ CMi and the companion star. The data are listed in Table 1. Astrometry is based on the USNO-A 2.0 catalog and has less than 100 mas internal errors. The photometry has errors of 0.01 magnitudes or less. More complete photometric information about all stars within 5 arcmin of the variable can be found in file 5310-t3.txt at the IBVS web site.

Table 1. Standard magnitudes and color indices

Star	RA (J2000)	Dec (J2000)	V	$B-V$	$U-B$	$V-R_c$	R_c-I_c
XZ CMi	07:54:07.09	+03:39:20.6	10.122	0.371	−0.043	0.197	0.259
Companion	07:54:07.24	+03:39:20.1	12.097	0.663		0.416	0.404

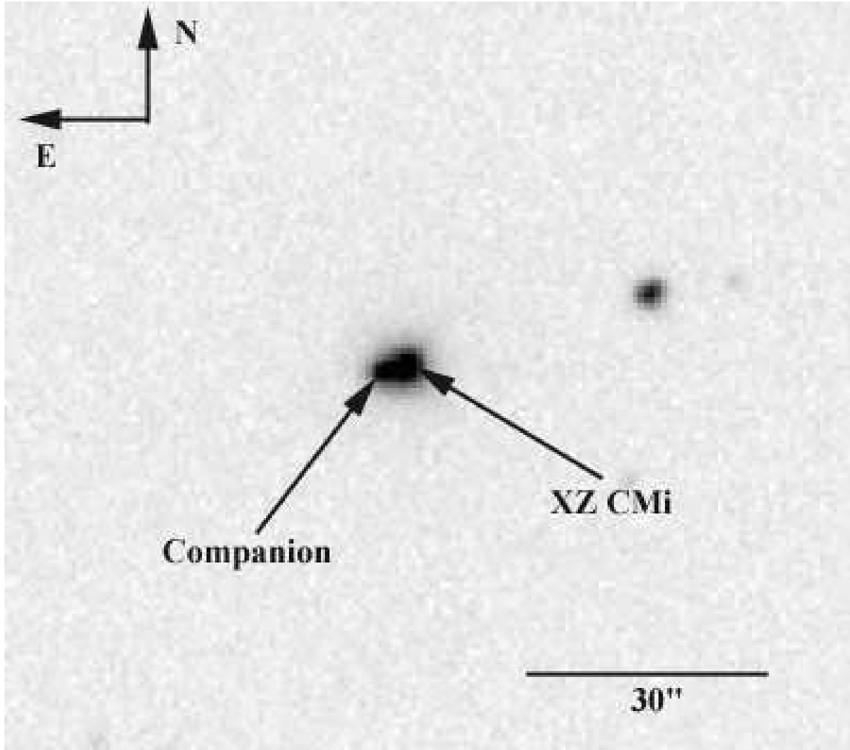

Figure 1. I-band image showing the fainter companion of XZ CMi.

As previously noted, our two datasets were obtained about two months apart. During that time the V light curve of XZ CMi changed noticeably. The SBO data show a mild asymmetry of about 0.01 magnitudes in the two maxima, with the maximum following secondary eclipse (i.e. phase 0.75) being the dimmer. By the time of the USNO observations, the asymmetry had grown to about 0.05 magnitudes. Previous datasets (Wilson, 1966 and TGK) were of lower precision but showed indications of slightly asymmetric maxima. Figure 2 shows our two V datasets. It is clear that the asymmetry in the light curves is affecting the maximum following secondary eclipse since the minima and the maximum following primary eclipse of the two datasets match up well. The most likely explanation for the asymmetries is the presence of large spots on the secondary star as is common in rapidly rotating stars with convective envelopes.

We performed a solution to our V observations using an unreleased version of the WD program that uses Kurucz atmosphere models to model the radiation of the stars. We used only data unaffected by the asymmetries, specifically data from phases 0.95 to 0.55. Because the most recently published ephemeris for the system (TGK) was obviously not valid for the current epoch, we adjusted the period and heliocentric Julian date of the primary minimum in our least squares fits. The fits were done in WD mode 5 which constrains the secondary star to fill its Roche lobe. Both of our datasets were obtained using aperture photometry and included the light of the companion star, so we fixed the third light to be 15% of the total system light at phase 0.25, based on the results of our PSF fits.

There has been some disagreement about the spectral type of XZ CMi. The GCVS lists it as F0 but Wilson (1966) argued that his photometry supported an A5 classification. Our photometry during secondary eclipse indicates a spectral type of about F2. Accordingly,

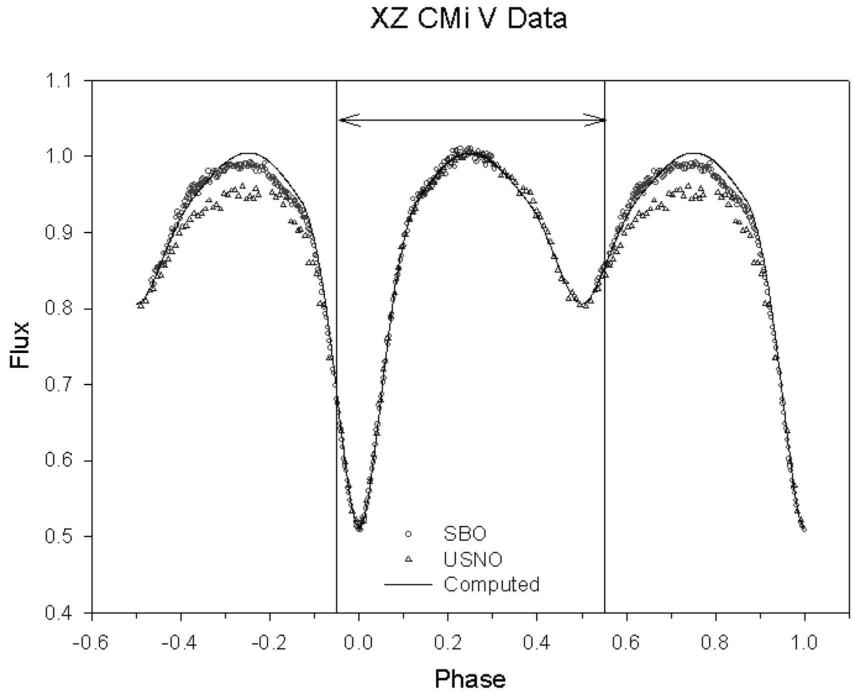

Figure 2. *V* light curves of XZ CMi. The arrows and vertical lines indicate the range of data used in the Wilson-Devinney solution.

we set T_1 to 7000 K in our solution. Unadjusted parameters such as the gravity darkening exponent and bolometric albedo were set to their theoretically expected values assuming that the envelope of the primary star was radiative and the secondary's was convective. The logarithmic limb darkening law was used with coefficients interpolated from the Van Hamme (1993) tables.

Table 2. Adjusted Parameters for Light Curve Solution

Parameter	Value	Std. Error
i	$78\overset{\circ}{.}8$	$0\overset{\circ}{.}2$
T_2	4910 K	20 K
q	0.68	0.02
Ω_1	3.48	0.04
$L_1/(L_1+L_2)_V$	0.85	0.05
HJD_0	2451957.6748	0.0011
P	$0\overset{d}{.}578852$	$0\overset{d}{.}000002$

Table 2 shows the results of our WD solution. The errors are the standard errors (1σ) from the least squares solution. The main differences between our solution and that of TGK are the higher mass ratio (0.68 versus 0.42) and a lower luminosity ratio (0.85 versus 0.92). A slight difference in the luminosity ratio is not surprising since the version of WD used by TGK used monochromatic effective wavelengths whereas the newer version that we employed uses actual filter bandpasses, and we included third light while TGK did not. The difference in the mass ratios is more troubling, an indication that perhaps the photometric mass ratio is not well-determined in this partially eclipsing system. We hope to obtain radial velocities of the system, as well as further photometry, during the next observing season.

The period derived from our light curve solution, 0.578852 days, is significantly larger than that found by TGK, 0.578809 days, and by Wilson (1966), 0.578811 days. Period changes are not unexpected since XZ CMi is semidetached and shows signs of large-scale magnetic activity. We encourage observers to measure frequent times of minimum to help characterize the nature of the period changes during this period of apparently heightened activity.

The SBO data are available from the IBVS web site as 5310-t4.txt and the USNO data are available as file 5310-t5.txt.

DT wishes to acknowledge the continued support of Keith Gleason at SBO for a generous allocation of time on the SBO 24" for this and other binary star projects.

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EIGHT NEW RR LYRAE STARS IN THE NORTH GALACTIC CAP

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In the course of photometric studies of field blue horizontal branch stars (Kinman, Suntzeff and Kraft, 1994 and later unpublished studies), it has been found that several of the candidates are RR Lyrae variables. This paper gives Johnson BV photometry for eight of these stars. Two of them have been identified as RR Lyrae variables in the ROTSE1 catalogue (Akerlof, 2000) and this classification is confirmed. Identifications are given in Table 1 where the coordinates are taken from the USNO A2.0 Star List (http://ftp.nofs.navy.mil/data/fchpix).

Table 1. Identifications and positions for the variables

Identification	R.A.	Dec.	Other ID
	J 2000		
NSV 5476[a]	$12^h09^m17\overset{s}{.}0$	$+33°39'36''$	Case A-F 020[b]
Case A-F 791[c]	$12^h47^m16\overset{s}{.}3$	$+35°12'06''$	ROTSE1 J124716.30+351206.2[d]
Case A-F 155[b]	$12^h53^m51\overset{s}{.}2$	$+32°09'56''$	
Case A-F 163[b]	$12^h54^m47\overset{s}{.}4$	$+31°16'45''$	KSK94 SA57 013[e]
KSK94 SA57 019[e]	$12^h56^m51\overset{s}{.}2$	$+28°10'35''$	GSC 1995 01702[f]
KSK94 SA57 047[e]	$13^h05^m14\overset{s}{.}5$	$+28°37'14''$	GSC 1995 00782[f]
KSK94 SA57 060[e]	$13^h09^m29\overset{s}{.}7$	$+27°01'00''$	GSC 1996 01661[f]
Case A-F 882[c]	$13^h17^m03\overset{s}{.}5$	$+36°06'58''$	ROTSE1 J131703.38+360656.3[d]

[a] New Catalogue of Suspected Variables, Kholopov (1982).
Suspected variable 1 (Table 8) in Kinman et al., (1966)
[b] Case A-F star (Sanduleak, 1988).
[c] Case A-F star (MacConnell et al., 1993).
[d] ROTSE1 Catalogue (Akerlof, 2000).
[e] Kinman et al., 1994.
[f] Space Telescope Guide Sar Catalogue (Lasker et al. 1990).

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

The V and $B-V$ for these variables are given in Table 2 (file 5311-t2.txt at the IBVS web site). The sources for these data (listed in the first column of Table 2) are:

(a) photoelectric observations made with the Mk III photometer operated on the Kitt Peak 1.3-m telescope (with chopping secondary) between 1989 and 1995. Observational details may be found in Sec. 3.1 of Kinman, Suntzeff and Kraft (1994).

(b) CCD observations made with CCDPHOT on the Kitt Peak 0.9-m telescope between 1995 and 1999. Observational details may be found in Sec 2 of Kinman (1998).

(c) photoelectric observations made with the 42-inch John S. Hall telescope of the Lowell Observatory, Arizona during May 2002. The Kron aperture photometer was used with a 24″ diameter aperture and the detector was a thermo-electrically cooled EMI 6256 photomultiplier. Standard stars (Landolt, 1992) were observed each night so that the magnitudes are on the Johnson system.

Periods were determined both with a phase dispersion minimization program (Lafler & Kinman 1965) and a periodogram program (Horne & Baliunas 1986). The periods found for Case A-F 791 and Case A-F 882 agree with those given in the ROTSE1 Catalogue (Akerlof, 2000). Several of these variables have quite low amplitudes and would not have been easily detected by blinking photographic plates. Table 3 gives the ephemerides and a summary of the photometric data and the V light curves are given in Fig. 1. The scatter in the light curves of NSV 5476 and Case A-F 155 suggests that secondary periods may be present.

Table 3. Ephemerides and Photometric Data for Variables

ID	Period (days)	HJD Max +2400000.	V_{max} B_{max}	V_{min} B_{min}	M-m† n_{obs}‡	RR type
NSV 5476	0.3266873	49043.590	14.82	15.20	0.47	RR*c*
			14.96	15.47	41	
Case A-F 791	0.6184320	50528.277	14.18	15.15	0.13	RR*ab*
			14.32	15.57	42	
Case A-F 155	0.2979233	48722.690	14.75	15.30	0.35	RR*c*
			14.83	15.55	58	
Case A-F 163	0.2953118	47654.582	14.46	15.02	0.40	RR*c*
			14.59	15.29	52	
KSK94 SA57 019	0.2581435	47654.668	14.37	14.79	0.45	RR*c*
			14.49	15.02	41	
KSK94 SA57 047	0.6485456	47295.604	14.25	14.58	0.28	RR*ab*
			14.58	15.01	40	
KSK94 SA57 060	0.6224220	47295.705	14.01	14.36	0.20	RR*ab*
			14.34	14.81	35	
Case A-F 882	0.6773250	50532.856	14.00	15.03	0.17	RR*ab*
			14.10	15.46	19	

† Light curve asymmetry. ‡ No. of observations in B and V (the same in both colors)

Acknowledgements: I would like to thank the Director of the Lowell Observatory for allowing me to use the Lowell 42-inch telescope for this work. I am also most grateful to Dr David Schleicher (Lowell) both for help in using the Kron photometer and in the preliminary reduction of the data. I am also very grateful to Dr Przemek Wozniak (LANL) for his help with the ROTSE1 catalogue. This research has made use of the SIMBAD database, operated at CDS Strasbourg, France.

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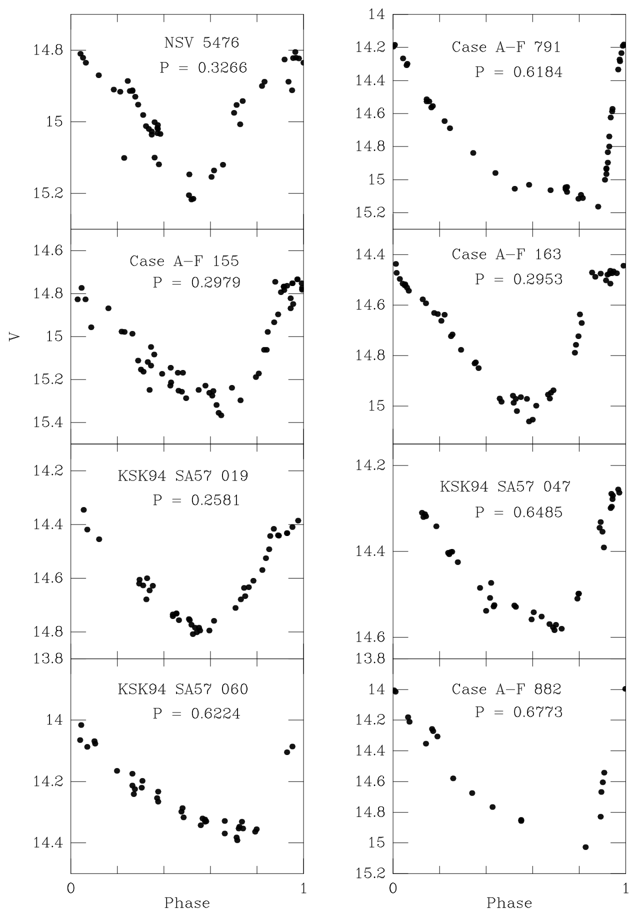

Figure 1. Light curves of variables (ordinate V magnitude)

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GK Dra: A DELTA SCUTI STAR IN A NEW ECLIPSING SYSTEM DISCOVERED BY HIPPARCOS

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GK Dra (HIP 82056, HD 152028, spectral type G0) has been discovered to be an eclipsing system by the Hipparcos satellite (V_T^{max}=8$^m_.$81, B_T^{max}=9$^m_.$21, Δm=0.4 mag and almost equal depth of primary and secondary eclipses; ESA 1997), that provided the following ephemeris for the primary eclipses:

$$\text{Min. I} = \text{HJD } 2448515.6 + 16^{d}_{.}96 \times E.$$

No other information exists in the literature for this star, and we decided in 1999 to place it on the Asiago eclipsing binary program (e.g. Dallaporta et al. 2000, Munari et al. 2001). At the time of writing, spectral monitoring with the Asiago Echelle+CCD spectrograph is half completed (29 high resolution spectra secured in 25 different nights and distributed in orbital phase), while acquisition of B,V photometry is completed. We present here the basic results of photometry, a full orbital solution including radial velocity data being postponed to conclusion of the spectroscopic campaign.

We observed in B and V (standard Johnson filters) from a private observatory near Cembra (Trento), Italy. The instrument was a 28 cm Schmidt-Cassegrain telescope equipped with an Optec SSP5 photometer. The diaphragm had a size of 77 arcsec, and usual exposure time was 10 seconds. HD 151541 (HIP 81813, V_J=7$^m_.$56, $(B-V)_J$=0.76, spectrum K1V) was chosen as a comparison and HD 152376 (HIP 82214, V_J=7$^m_.$61, $(B-V)_J$=+1$^m_.$10, spectrum K0) as a check star.

All the observations were corrected for atmospheric extinction and color corrections (via calibration on Landolt's equatorial fields), and the instrumental differential magnitudes were transformed into the standard Johnson BV system. The variable, comparison and check stars are very close on the sky so the atmospheric corrections were rather small.

Altogether we obtained 1309 observations in B and 1328 in V from April 2000 to February 2002. Typical error for both B and V observations is 0$^m_.$01. The light curves of GK Dra in each band as well as the $B-V$ color variations are shown in Fig. 1. Expanded plots around primary and secondary eclipse are shown in Fig. 2.

To the aim of determining the orbital period, we have performed a period search with various tools, all converging on the same result:

$$\text{Min. I} = \text{HJD } 2452005.56(\pm 0.01) + 9\overset{d}{.}9742(\pm 0.0001) \times E.$$

The 16.96 day period reported in the Hipparcos Catalogue is obviously wrong when applied to our photometry. The almost exactly 10 day period makes impossible to cover all orbital phases by observing for just a couple of years. We were lucky that at the time we performed our observations the inconvenient beating did not affect full coverage of both primary and secondary eclipses.

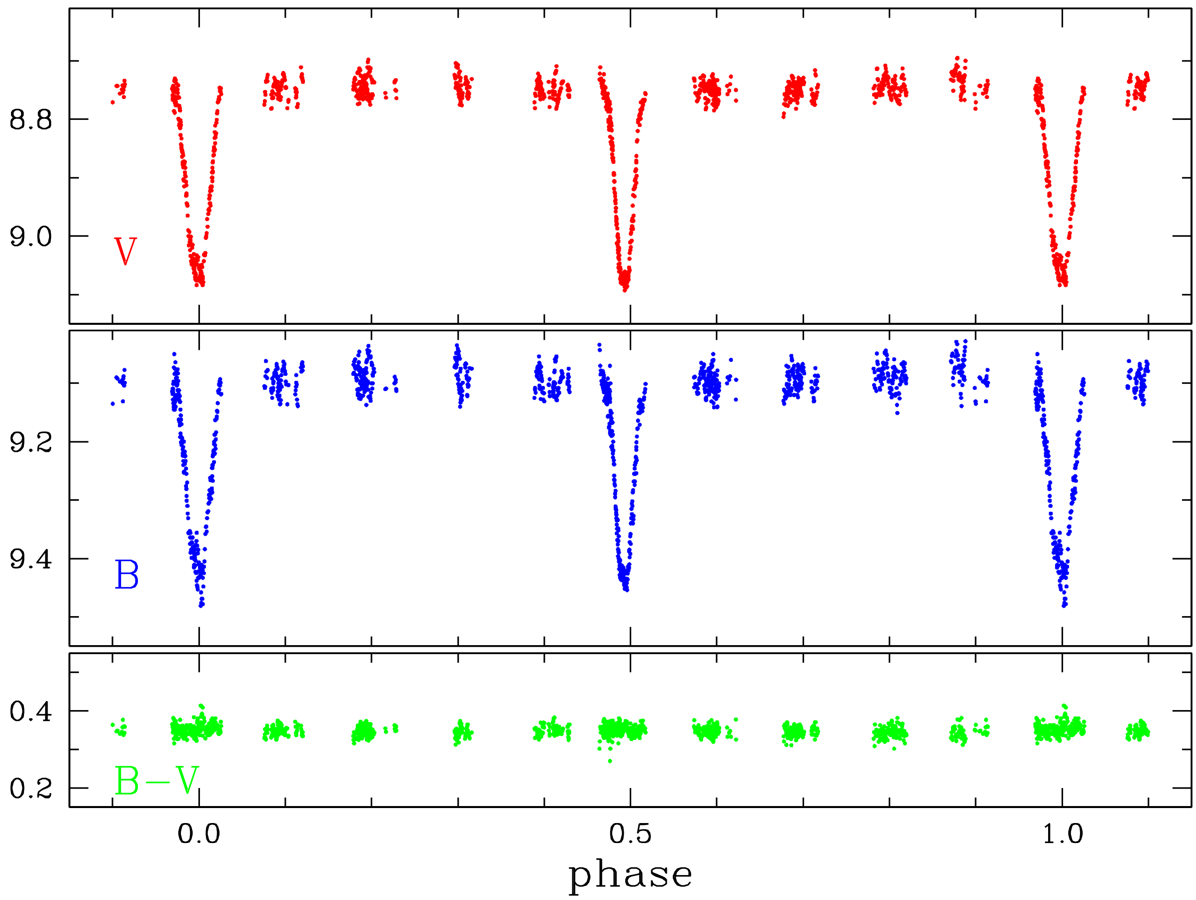

Figure 1. *B*, *V* and color curves of GK Dra folded with the 9.9742 period.

Primary and secondary eclipses last for about 0.050 and 0.039 of the orbital period, and their depth in *B* is about 0.37 and 0.36 mag, respectively. Maximum brightness outside eclipses is *B*=9.08 and *V*=8.73 mag. The secondary eclipse falls at phase 0.493 instead of 0.500, indicating a modest eccentricity of the system. Figure 2 compares primary and secondary eclipses and shows that no colour variation is present during eclipses.

The derivation of accurate photometric values is disturbed by the fact that one of the components is itself a variable star, which causes the apparent *noise* in the light curve of Figure 1. The intrinsic variable star is the one passing in front during primary eclipse, which is the reason for the less *noisy* secondary one. Its variability is rapid (about 2.7 hours) and of low amplitude (about 0.04 mag), reminiscent of the δ Sct type.

For a preliminary analysis of the properties of the δ Sct component we have isolated

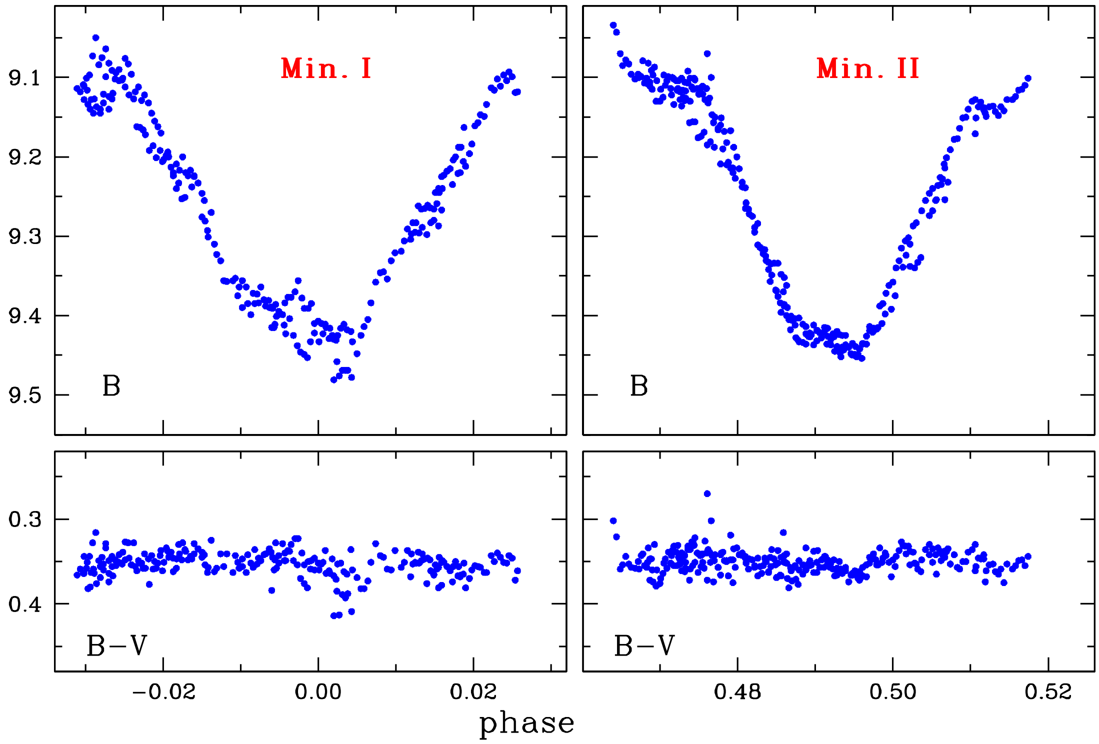

Figure 2. Expanded view around the primary and secondary eclipses of GK Dra.

the data pertaining to a narrow range of orbital phases, and performed a period search on them. We have selected the data falling between 0.75 and 0.85 in orbital phase, and we have found a stable and phased sinusoidal variation with an amplitude of ΔB=ΔV=0.040 mag following the ephemeris

$$\text{Min. I} = \text{HJD } 2450005.588(\pm 0.003) + 0\overset{\text{d}}{.}1137601(\pm 0.0003) \times E.$$

A phase plot of the δ Sct variability is presented in Figure 3.

No color variation is associated to the δ Sct variability, and its true amplitude is around Δm ~0.08 mag when the light of the non variable component is subtracted. Small differences (0.01 mag) in the mean brightness from night to night are evident.

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ESA, 1997, *The Hipparcos and Tycho Catalogues*, ESA SP-1200
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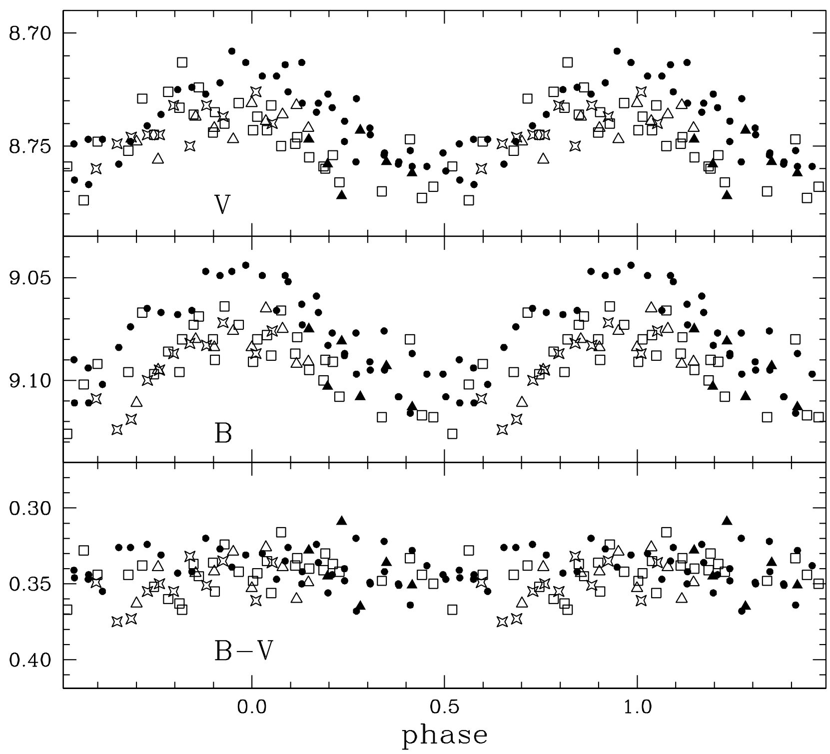

Figure 3. Pulsational light curve with P=2.7 hour of the δ Sct component of GK Dra. Different symbols are associated to different observing dates: night 13/14 Jan 2001 to open triangles, 22/23 Feb 2001 to filled circles, 13/14 Apr 2001 to filled triangles, 23/24 Apr 2001 to stars, and 22/23 June 2001 to open squares.

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NEW TIMES OF MINIMA OF ECLIPSING BINARY SYSTEMS

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[3] Department of Astronomy, Eötvös Loránd University, Budapest, P.O. Box 32, H–1518 Hungary

[4] on summer training at Baja Astronomical Observatory

Observatory and telescope:
50-cm $f/8.4$ Ritchey–Chrétien telescope of the Baja Astronomical Observatory (Hungary) 50-cm $f/15$ Cassegrain telescope, 60/90cm Schmidt-telescope and 1m $f/13.3$ RCC telescope of the Konkoly Observatory at Piszkéstető Mountain Station (Hungary)

Detector:	SBIG ST-7 CCD camera (ST7) Apogee AP-7 CCD camera (AP7) UBVRI Photometer (Pi50) Photometrics CCD-camera(Schmidt, 1m RCC)

Method of data reduction:
Reduction of the CCD frames was made with a customly developed IRAF[1] package.

Method of minimum determination:
The minima times were computed with parabolic fitting, and in some cases with linearized Pogson-method or Kwee-van Woerden method (Kwee & van Woerden, 1952).

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

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
AB And	EW	23 11 32	+36 53 35	BD+36°5018	51534.2504	0.33189106	1
OO Aql	EW	19 48 13	+09 18 32	1058-0689	38613.2222	0.50678848	2
IM Aur	EA	05 15 30	+46 24 21	3358-1208	38327.7974	1.2472891	3
AS Cam	EA	09 05 29	+69 29 45	HD 35169	44939.24524	3.4309638	4
VW Cep	EW	20 37 21	+75 35 57	BD+75° 739	44157.4131	0.2783146	2
XX Cep	EA	23 38 20	+64 20 03	4288-0150	44839.8022	2.3373266	2
DK Cyg	EW	21 35 03	+34 35 45	2712-1841	51000.0999	0.4706929	5
LS Del	EB	20 57 10	+19 38 59	1656-0356	51000.2257	0.36384021	5
AK Her	EW	17 13 58	+16 21 01	1536-1266	42186.4600	0.42152201	2
GU Her	EA	16 32 05	+30 23 10	2581-1969	50983.46694	4.34320188	6
HS Her	EA	18 50 50	+24 43 12	2113-1427	40146.6080	1.637438	2
V994 Her	EA	18 27 46	+24 41 51	BD+24° 3426	48501.1239	2.08309	7
UV Leo	EA	10 38 21	+14 16 04	0845-0255	38440.72633	0.60008478	2
V1353 Ori	EW	05 42 58	-00 42 46	4767-0774	50100.26097	0.4714531	8
W UMa	EW	09 43 45	+55 57 09	3810-1196	50554.7444	0.33363554	9
DW UMa	EA	10 33 53	+58 46 54	3822-0772*	46229.00691	0.13660653	10
				3822-0070**			
				3822-0072***			
GSC 3822-1056	EW	10 33 58	+58 52 16	3822-0772*	50495.5212	0.30989069	11
				3822-0070**			
				3822-0072***			

Source(s) of the ephemeris:

1. Pribulla et al., 2001
2. Kholopov et al., 1985
3. Bartolini & Zoffoli, 1986
4. Kozyreva et al., 1996
5. Kiss et al., 1999
6. Borkovits et al., 2001
7. ESA, 1997
8. present paper
9. Morgan et al., 1997
10. Bíró, 2000
11. Bíró & Borkovits, 2000

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
AB And	52511.3418	1	I	V	0.0041	Csiz/1m RCC
OO Aql	52481.5095	1	I	R,V,B	0.0205	Bír+Kov/AP7
IM Aur	52304.281	1	II	V	−0.014	Bor/AP7
	52305.529	1	II	V	−0.014	Bír/AP7
AS Cam	52365.3753	2	II	V	−0.1911	Moór+Köny/Schmidt
VW Cep	52506.4320	2	I	V,R	0.1375	Bor/Pi50
	52506.4329	2	I	B	0.1384	Bor/Pi50
XX Cep	52466.4673	3	I	V	−0.0316	Bor/AP7
DK Cyg	52512.4415	1	I	V,R,I	0.0053	Csiz/1m RCC
LS Del	52200.3569	2	II	R	0.0043	Bor/AP7
AK Her	52360.5365	1	II	R	0.0105	Bor/AP7
	52437.4639	1	I	R	0.0101	Bor/AP7
GU Her	52338.557	1	I	R	0.011	Bor/AP7
	52362.432	:	II	R	−0.002	Bor/AP7
HS Her	52417.5275	2	I	V	−0.0409	Bír/AP7
V994 Her	52488.4984	6	I:	R	0.3402	Bír+Kov+Kós+Pál/AP7
	52488.4994	1	I:	V	0.3412	Bír+Kov+Kós+Pál/AP7
	52488.4997	3	I:	B	0.3415	Bír+Kov+Kós+Pál/AP7

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
UV Leo	52307.5076	7	I	V	0.0222	Bor/AP7
V1353 Ori	51952.3645	1	II	–	0.0000	Heg/AP7
W UMa	52364.5035	1	II	b,y	−0.0469	Csiz/ 1m RCC
DW UMa	52298.4349	1	I	V	−0.0001	Bor/AP7*
	52298.5708	3	I	V	−0.0008	Bor/AP7*
	52347.4769	5	I	R	0.0001	Bor/AP7**
	52347.6132	1	I	R	−0.0002	Bor/AP7**
	52366.3283	1	I	R	−0.0002	Bor/AP7***
GSC 3822 1056	52263.4567	2	I	–	0.0024	Bor/ST7**
	52298.480	1	I	V	0.008	Bor/AP7*
	52298.626	1	II	V	−0.001	Bor/AP7*
	52347.4387	1	I	R	0.0036	Bor/AP7**
	52347.5950	5	II	R	0.0049	Bor/AP7**
	52366.3401	2	I	R	0.0016	Bor/AP7***
	52366.497	1	II	R	0.004	Bor/AP7***

Explanation of the remarks in the table:

Observer(s)/Instrument
Asterisks indicate the comparison stars used in the actual reduction of DW UMa and GSC 3822 1056, as labeled in Table 'Observed star(s)'.

Acknowledgements:

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Bíró, I.B., Borkovits, T., 2000, *IBVS* 4967
Borkovits, T., Bíró, I.B., Kovács, T., 2001, *IBVS* 5206
ESA, 1997, *The Hipparcos and Tycho Catalogues*
Morgan, N., Sauer, M., Guinan, E., 1997, *IBVS* 4517
Kholopov, P.N., et al., 1985, *General Catalog of Variable Stars*, 4th Eds.
Kiss, L.L., Kaszás, G., Fűrész, G., Vinkó, J., 1999, *IBVS* 4681
Kozyreva, V.S., Zakharov, A.I., Khaliullin, Kh.F., 1996, *IBVS* 4690
Kwee, K.K., & van Woerden, H., 1956, *Bull. Astron. Inst. Neth.*, **12**, 327
Pribulla, T., Vanko, M., Parimucha, S., Chochol, D., 2001, *IBVS* 5056

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DETECTION OF A PULSATING COMPONENT IN THE ECLIPSING BINARY RX Hya

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[2] Astronomical Observatory, Odessa National University, Odessa, Ukraine

[3] Dept. of Astronomy and Space Science, Chungbuk National University, Cheongju, 361-763, Korea

Observatory and telescope:
Sobaeksan Optical Astronomy Observatory, 61cm telescope

Detector:	SITe 2K CCD camera

Filter(s):	*B*

Transformed to a standard system:	No

Availability of the data:
Upon request

Method of data reduction:
Standard CCD-frame reduction using the IRAF[1] package.

Table 1. Photometric parameters of observed stars

ID	Name	RA (J2000)	DEC (J2000)	V	(B−V)	Sp. Type
VAR	RX Hya	$09^h05^m41\overset{s}{.}16$	$-08°15'39''.7$	$8\overset{m}{.}9\sim11\overset{m}{.}6^\dagger$	$0\overset{m}{.}20$	A8†
C1	BD−07°2718	$09^h06^m16\overset{s}{.}58$	$-08°06'44''.5$	$9\overset{m}{.}70$	$1\overset{m}{.}40$	–
C2		$09^h05^m40\overset{s}{.}89$	$-08°15'23''.0$	$11\overset{m}{.}5^\ddagger$	–	F3‡

† : from the GCVS (Kholopov et al. 1988)
‡ : Vyas & Abhyankar (1989)

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

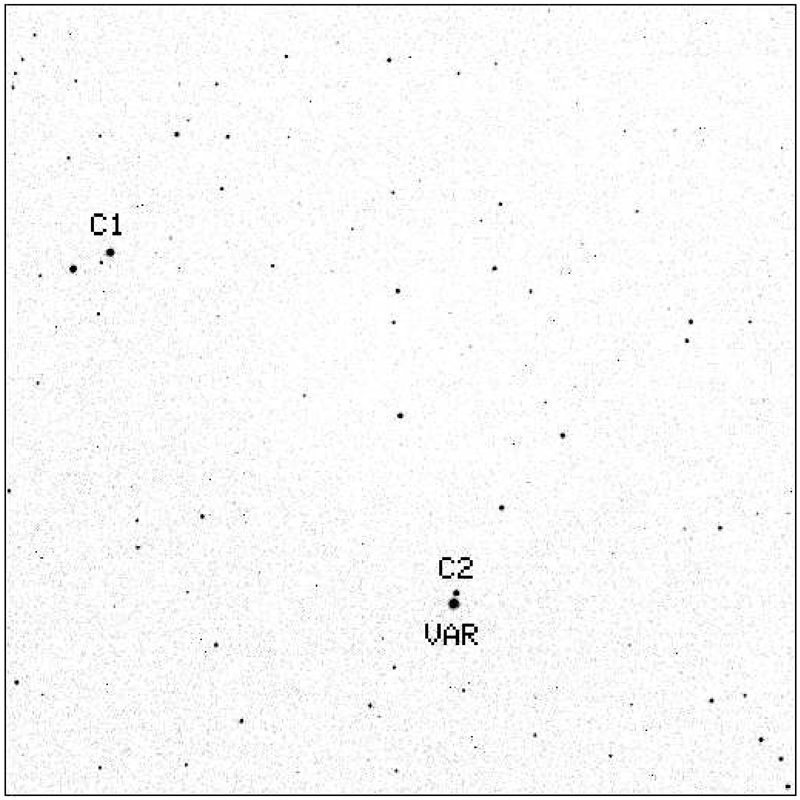

Figure 1. An observed CCD image (20.′5×20.′5) near the eclipsing binary RX Hya (VAR). The comparison star (C1, BD−07°2718) and the check star (C2) are marked. North is up and east is to the left

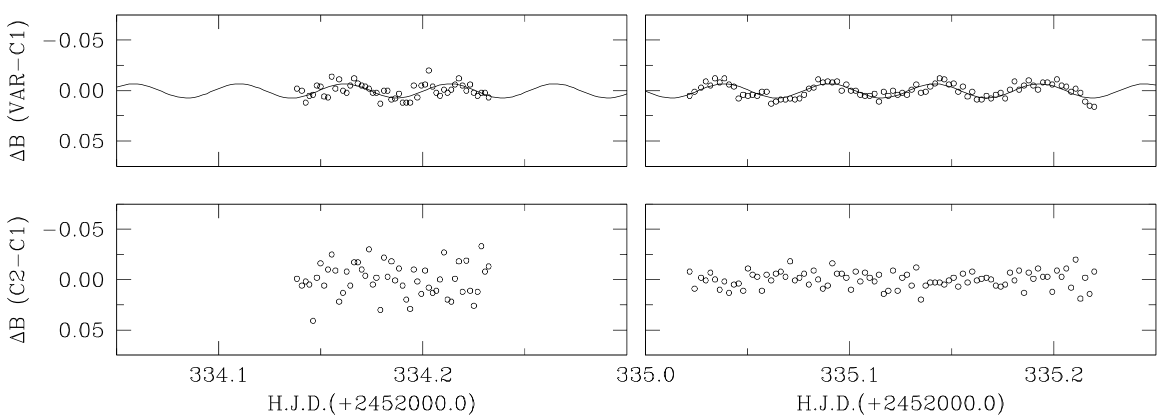

Figure 2. Differential magnitudes of the variable and check stars, after correction for the second-order atmospheric extinction. Sinusoidal curves with semi-amplitude of 7.0 mmag and frequency of 19.39 cycles/day, obtained in this study, are superimposed in the upper panels

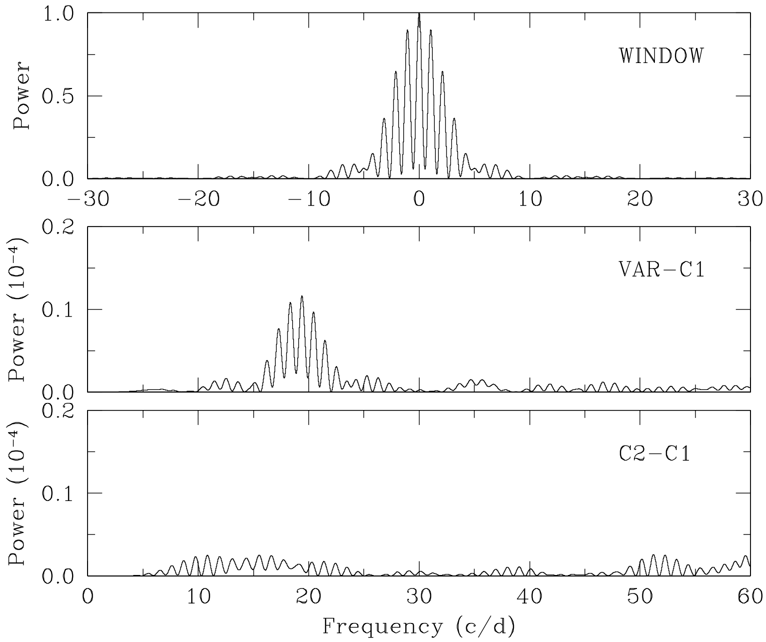

Figure 3. Power spectra of the variable and check stars. Window spectrum is in the top panel. The dominant pulsation frequency of the variable star RX Hya is shown at 19.39 cycles/day in the middle panel. The spectrum of the check star plotted in the bottom panel shows only noise-level powers

Remarks:

As a part of the observational survey to search for A-F spectral type pulsating components in eclipsing binary systems, in collaboration with the Central Asian Network group (Mkrtichian et al. 2002a), we performed time-series CCD observations of the eclipsing binary RX Hya in February 28 and March 1, 2002, with *B* filter. Among several stars near the variable star, the brightest star BD−07°2718 was chosen as comparison star. We applied simple aperture photometry to get instrumental magnitudes with an aperture radius of 6.″0; typical atmospheric seeing was about 2.″7 during the observing runs.

We observed the variable star during out-of eclipsing orbital phases around 0.77 (H.J.D. 2452334.2) and 0.18 (H.J.D. 2452335.1), calculated from the GCVS data (Kholopov et al. 1988). Differential magnitudes were calculated according the standard differential photometric method. We corrected for the second-order atmospheric extinction effect, the slow airmass-related light variation, because the color index of the comparison star was quite different from that of the variable star and the data were obtained at large airmasses ranging from 1.4 to 2.5.

We have clearly detected oscillation features of the variable star RX Hya (Figure 2). In order to derive its period, we performed Fourier analysis (Kim & Lee 1996). Figure 3 displays power spectra of the variable and check stars. We obtained a dominant frequency of 19.39 cycles/day and a semi-amplitude about 7 mmag in B-band for the variable star.

Remarks:

Mkrtichian et al. (2002b) suggested a new pulsating group defined as "the (B)A-F spectral type mass-accreting main-sequence pulsating stars in semi-detached Algol-type binary systems". Their pulsation characteristics are very similar to those of δ Scuti type stars, but this evolution is different due to mass-accretion. Considering spectral type, sinusoidal light curves, frequency and amplitude of pulsation, and the membership in a semi-detached Algol type system, we suggest that the primary component of RX Hya is a new, seventh member of this pulsating group.

Acknowledgements:

This research made use of the SIMBAD database, operated at CDS, Strasbourg, France

Reference:

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Kim, S.-L., Lee, S.-W., 1996, *A&A*, **310**, 831

Mkrtichian, D.E., Kusakin, A.V., Gamarova, A.Yu., et al., 2002a, in *Observational aspects of pulsating B & A stars*, ed. C. Sterken, & D.W. Kurtz, *ASP Conf. Ser.*, **256**, 259

Mkrtichian, D.E., Kusakin, A.V., Gamarova, A.Yu., Nazarenko, V., 2002b, in *Radial and nonradial pulsations as probes of stellar physics*, ed. C. Aerts, T.R. Bedding, & J. Christensen-Dalsgaard, *ASP Conf. Ser.*, **259**, 96

Vyas, M.L., Abhyankar, K.D., 1989, *A&AS*, **81**, 67

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MULTICOLOR OBSERVATIONS OF V838 Mon

PRICE, A.[1]; MATTEI, J.[1]; HENDEN, A.[2]; WEST, D.[3]; BEDIENT, J.[4]; NELSON, P.[1]; SMELCER, L.[1]; KLINGLESMITH, D.[1]; LUEDEKE, K.[1]; SHERROD, C.[1]; O'CONNOR, S.[1]; OKSANEN, A.[1]; TEMPLETON, M.[1]

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Name of the object:
V838 Mon (GSC 04822-00039, USNO-A2.0 0825-03833116)

Equatorial coordinates:	**Equinox:**
R.A.= $07^h04^m04^s.801$ **DEC.=** $-03°50'50''.77 \pm 0''.3$ (Kiyota 2002)	2000

Detector:	Various AAVSO observer instruments. Details available upon request.

Filter(s):	CCD: V, B, I_C, R_C; PEP: V, B; Visual

Date(s) of the observation(s):
2001.12.22 – 2002.05.03

Comparison star(s):	Finder chart and comparison stars are available at `http://charts.aavso.org/`. Comparison stars were based on the Tycho-2 catalog (comparison $V < 10^m.5$) and field photometry by Henden (comparison $V > 10^m.6$).

Availability of the data:
Available by e-mailing `aavso@aavso.org`.

Type of variability:	Novae

Remarks:

The AAVSO has collected 2640 visual, 480 CCD, and 18 PEP observations of V838 Mon over a 135 day period following its discovery on Jan 6.6 (Brown 2002). R band observations plotted prior to the discovery were obtained using the Stardial CCD image archive (McCullough 1997). Figure 1 is CCD + PEP data. Error depends on the observer and is available upon request but typically can be estimated to be $\pm\ 0^{\rm m}_{.}1$. Figure 2 shows visual data.

Acknowledgements:

The visual observations come courtesy of 195 observers in 29 countries. The complete list of observers is available via the AAVSO Online Light Curve Generator at `http://www.aavso.org/adata/curvegenerator.shtml`. We would also like to thank the following observers for providing supplemental CCD coverage: Rubright, G.; Arnold, J.; Phelps, M.; Mattei, M.; Van Werven, A.; Tikkanen, P.; Gandet, T.; and Hodgson, W.

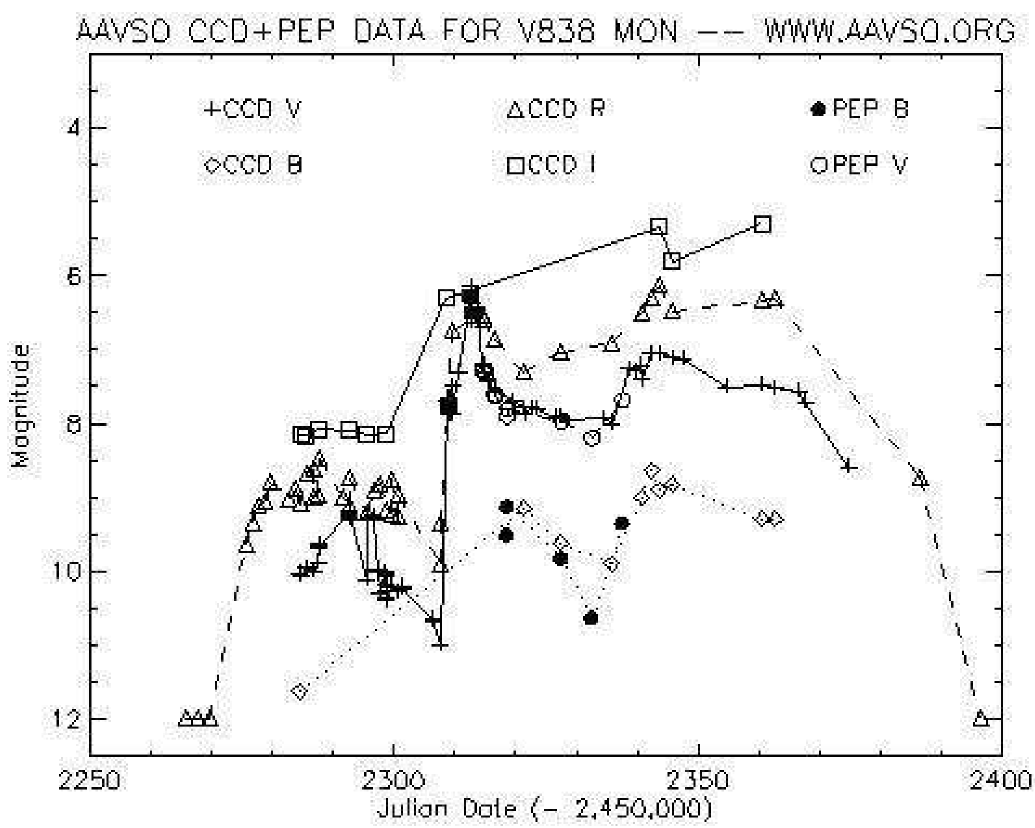

Figure 1. CCD & PEP Data

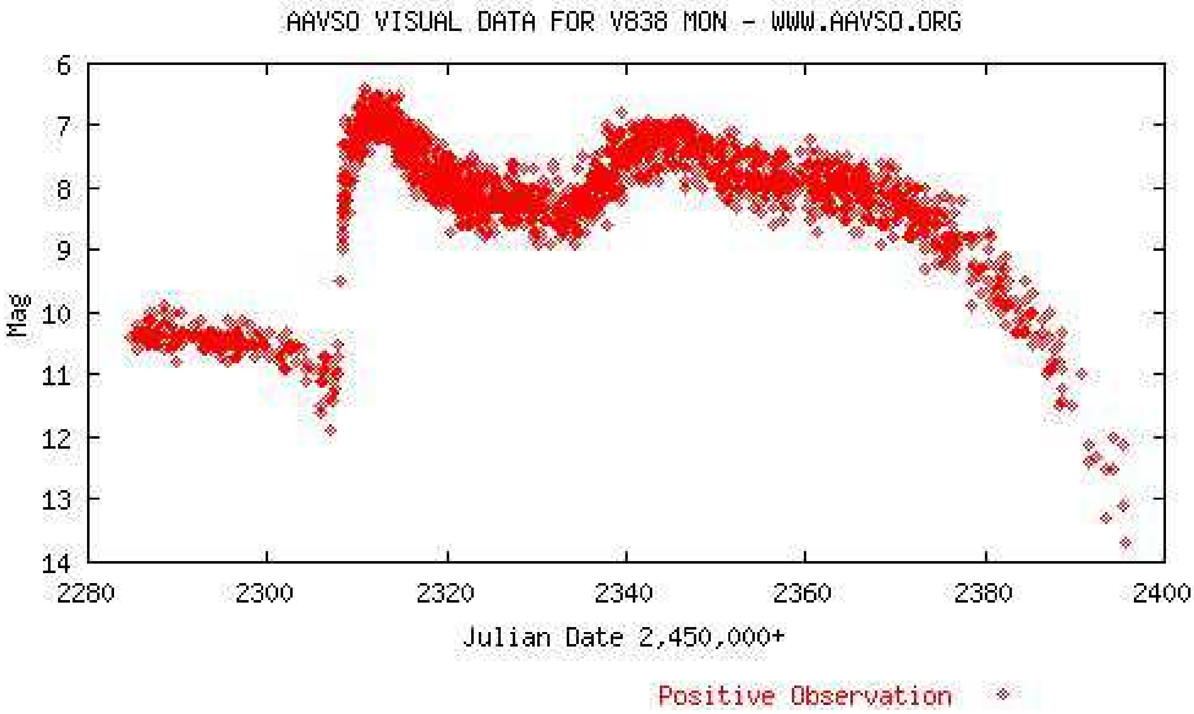

Figure 2. Visual Data

References:

Kiyota, S., 2002, *IAUC*, **7786**
Brown, N. J., 2002, *IAUC*, **7785**
McCullough, P., Thakkar, U., 1997, *Publ. Astron. Soc. Pac.*, **109**, 1264

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FT Cam: AN ANALOGOUS OBJECT TO IR Com

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FT Cam (=Antipin Var64) is a dwarf nova discovered by Antipin (1999). The object was photometrically studied by Kato et al. (2001) during the 2000 February outburst. Kato et al. (2001) revealed a rather monotonous decline at a rate of 0.82 mag d^{-1}, without a signature of superhumps. From these observations and the past record, Kato et al. (2001) suggested that FT Cam may be an SS Cyg-type star, but there remained a possibility that we have only observed normal outbursts of an SU UMa-type star.

Recently, Thorstensen and Fenton (2002) reported the detection of a spectroscopic orbital period ($P_{\rm orb}$) of 0.07492(8) d. Such a short period (below the period gap of cataclysmic variables) would naturally suggest an SU UMa-type classification (Warner 1995)[1]. However, the apparent lack of long outbursts (superoutbursts) in the photometric record of FT Cam, which qualify an object to be an SU UMa-type star, has raised a new problem (Thorstensen and Fenton 2002). Both Kato et al. (2001) and Thorstensen and Fenton (2002) remarked that only short outbursts have been observed, and no superoutburst-like long outbursts have been yet recorded. This conclusion has been confirmed with the observations reported to VSNET (`http://www.kusastro.kyoto-u.ac.jp/vsnet/`) up to 2002 September. Since the object has been monitored more than 4 yr (with occasional gaps; there remains a small possibility that some superoutburst occurred in an unfortunate gap), the apparent lack of superoutbursts is unusual, since the longest expected supercycle length for SU UMa-type dwarf novae is ~1000 d, unless there is a special mechanism, such as that which seems to be working in WZ Sge-type stars (Ichikawa and Osaki 1994). Only three short outbursts (1998 September, 2000 February, 2002 February) have been recorded during this period.

Among the possible "special mechanisms" to suppress dwarf nova-type outbursts, Kato et al. (2001) have suggested that FT Cam may be an intermediate polar (IP), whose magnetic field can suppress dwarf nova-type outbursts (Angelini and Verbunt 1989). However, time-resolved photometry by Thorstensen and Fenton (2002) did not reveal the presence of coherent pulse, which is expected to be present in an IP. The weakness of HeII emission line (Thorstensen and Fenton 2002) also prefers the non-magnetic (non-IP) nature.

[1] There are a few known dwarf novae below the period gap, which have not been yet demonstrated to be SU UMa-type stars in spite of sufficient observations. IR Com, as we will discuss later, is such an example.

Table 1. Comparison of X-ray Properties of FT Cam and IR Com[a]

Object	Count rate	HR1	HR2	V
FT Cam	0.050	1.00	0.47	17.5
IR Com	0.061	1.00	0.44	17.0

[a] The X-ray data are taken from Voges et al. (1999).

We alternatively propose that FT Cam is an analog of IR Com, another peculiar dwarf nova with a short orbital period ($P = 0.08704$ d) and infrequent outbursts (Kato et al. 2002 and references therein). The number of recorded outbursts of IR Com between 1997 and 2002 is only three, and no long outbursts (superoutbursts) have been yet conclusively detected. All of these features are common to FT Cam.

We also note that the X-ray properties of FT Cam is extremely close to those of IR Com (Table 1). In particular, the remarkable agreement in hardness ratios and flux ratios (X-ray count rate/optical flux) is striking. In view of these properties, as well as remarkably similar outburst properties, FT Cam and IR Com make almost a "twin" among short-$P_{\rm orb}$ dwarf novae. Up to now, HT Cas has been proposed to have analogous properties with IR Com (Kato et al. 2002). Since both IR Com and HT Cas are eclipsing systems, the presence of a non-eclipser FT Cam provides us new opportunities in studying these unusual systems at different binary inclinations. Since HT Cas is known to very infrequently show superoutbursts (e.g. Zhang et al. 1986; no superoutburst has been recorded since 1985), we still have chance to eventually see a superoutburst of FT Cam. Future confirmation of such a superoutburst will provide an observational test for proposed mechanisms of suppressing outbursts in some unusual short-$P_{\rm orb}$ dwarf novae (e.g. Lasota et al. 1995).

We are grateful to all observers who reported vital observations to VSNET. This work is partly supported by a grant-in aid (13640239) from the Japanese Ministry of Education, Culture, Sports, Science and Technology.

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Angelini, L., & Verbunt, F., 1989, *MNRAS*, **238**, 697
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Kato, T., Uemura, M., & Yamaoka, H., 2001, *IBVS*, 5082
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Lasota, J.-P., Hameury, J.-M., & Huré, J. M., 1995, *A&A*, **302**, L29
Thorstensen, J. R., & Fenton, W. H., 2002, *PASP*, in press (astro-ph/0209172)
Voges, W., Aschenbach, B., Boller, T. et al., 1999, *A&A*, **349**, 389
Warner, B, 1995, *ApSS*, **226**, 187
Zhang, E.-H., Robinson, E. L.,& Nather, R. E., 1986, ApJ, **305**, 740

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CCD PHOTOMETRY OF THE SX PHOENICIS STAR BL CAMELOPARDALIS

WOLF, M.[1]; CRLÍKOVÁ, M.[1]; BAŠTA, M.[1]; ŠAROUNOVÁ, L.[2]; ŠTĚPÁN, J.[1]; ŠVÉDA, L.[1]; VYMĚTALÍK, O.[1]

[1] Astronomical Institute, Charles University Prague, V Holešovičkách 2, CZ-180 00 Praha 8, Czech Republic
e-mail: wolf@cesnet.cz

[2] Astronomical Institute, Academy of Sciences, CZ-251 65 Ondřejov, Czech Republic, e-mail: lenka@asu.cas.cz

Name of the object:
BL Cam = GD 428

Equatorial coordinates:	**Equinox:**
R.A.= $03^h47^m19\overset{s}{.}0$ **DEC.=** $+63^\circ22'46''$	2000

Observatory and telescope:
Ondřejov Observatory, 0.65-m reflecting telescope

Detector:	Apogee AP7 CCD camera in primary focus, Peltier cooled
Filter(s):	V

Date(s) of the observation(s):
November 2001 - September 2002

Comparison star(s):	GSC 4067.0077, GSC 4067.0071, GSC 4067.0748

Availability of the data:
Upon request.

Type of variability:	DSCT, SX Phe

Remarks:
We cannot confirm the result of Hintz et al. (1997) that the star has a constantly increasing pulsational period. See the $O-C$ diagram (drawn using all the data from the literature) enclosed. This star deserves a continuous monitoring.

Acknowledgements:
This work was supported by the research plan J13/98: 113200004 Investigations of the Earth and the Universe. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France, and of NASA's Astrophysics Data System Bibliographic Services.

Reference:

Hintz, E.G., Joner, M.D., McNamara, D.H., et al., 1997, *PASP*, **109**, 15

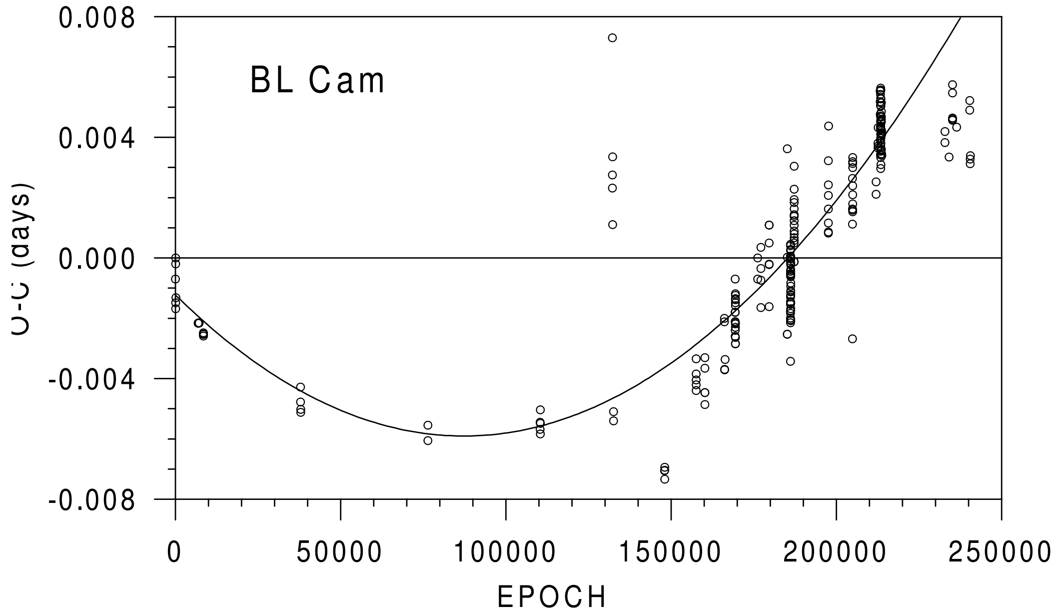

Figure 1. The $O - C$ diagram for BL Cam using the ephemeris given in Hintz et al. (1997). The solid curve is a second-order polynomial fit to all measurements of previous observers.

Table 1: New precise times of maximum light for BL Cam.

JD Hel. – 24 00000	Error [days]	Observers
52229.4277	0.0002	MB, LŠv
52229.4672	0.0002	MB, LŠv
52279.6288	0.0005	MW
52320.2527	0.0002	MC, MW
52320.2919	0.0002	MC, MW
52320.3318	0.0002	MC, MW
52320.3712	0.0002	MC, MW
52320.4091	0.0002	MC, MW
52369.3203	0.0002	MW, LŠa
52522.5843	0.0005	MW
52522.6238	0.0005	MW
52530.4021	0.0002	JŠ, OV
52530.4414	0.0002	JŠ, OV
52530.4806	0.0002	JŠ, OV

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ON THE VARIABILITY OF GSC 5149.2845 (BRH V121) AND GSC 5170.0175 (BRH V122)

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VAR 1:

Name of the object:
GSC 5149.2845

Equatorial coordinates:	**Equinox:**
R.A.= $19^h38^m22\overset{s}{.}2$ **DEC.=** $-03°32'37''$	2000

Comparison star(s):	GSC 5149.2931, $V \approx 11\overset{m}{.}0$

Check star(s):	GSC 5149.2509

Type of variability:	W UMa

VAR 2:

Name of the object:
GSC 5170.0175

Equatorial coordinates:	**Equinox:**
R.A.= $20^h20^m23\overset{s}{.}9$ **DEC.=** $-03°48'59''$	2000

Comparison star(s):	GSC 5170.0119, $V \approx 11\overset{m}{.}3$

Check star(s):	GSC 5166.2478

Type of variability:	RRab

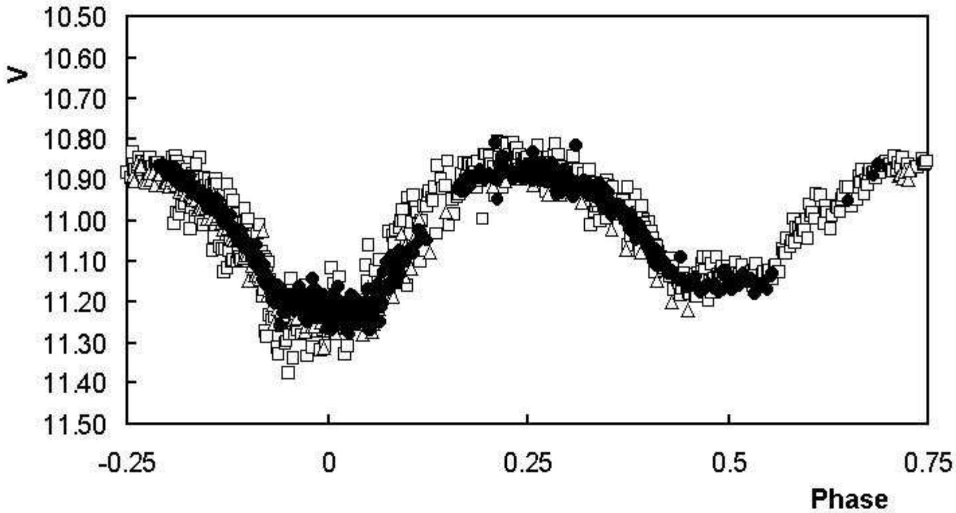

Figure 1. The phase diagram of GSC 5149.2845, CCD observations of K. Bernhard (filled circles), S. Kiyota (open triangles) and O. Pejcha (open squares), assuming that the comparison star GSC 5149.2931 has V=11.0 mag

Observatory and telescope:
K. Bernhard: Private observatory, 20-cm Schmidt-Cassegrain telescope (1); S. Kiyota: Private observatory, 25-cm Schmidt-Cassegrain telescope (2); O. Pejcha: Brno observatory, 40-cm Newtonian telescope (3)

Detector:	K. Bernhard: Starlight Xpress SX CCD camera; S. Kiyota: SBIG ST-6 CCD camera; O. Pejcha: SBIG ST-7 CCD camera;

Filter(s):	K. Bernhard: None; S. Kiyota, O. Pejcha: V

Transformed to a standard system:	No

Availability of the data:
Upon request

Remarks:
The variability of GSC 5149.2845 and GSC 5170.0175 has been found as part of a programme to discover and classify new variables using CCD observations of selected fields on the edge of the northern Milky Way (Bernhard & Lloyd 2000). Further observations of 5149.2845 were performed on 9 nights in the first, on 4 nights in the second and on 3 nights in the third observatory between August and September 2002. GSC 5170.0175 was observed on 7 nights in September 2002 in the first observatory. The ephemeris were calculated using the "Phase Dispersion Minimization" method.

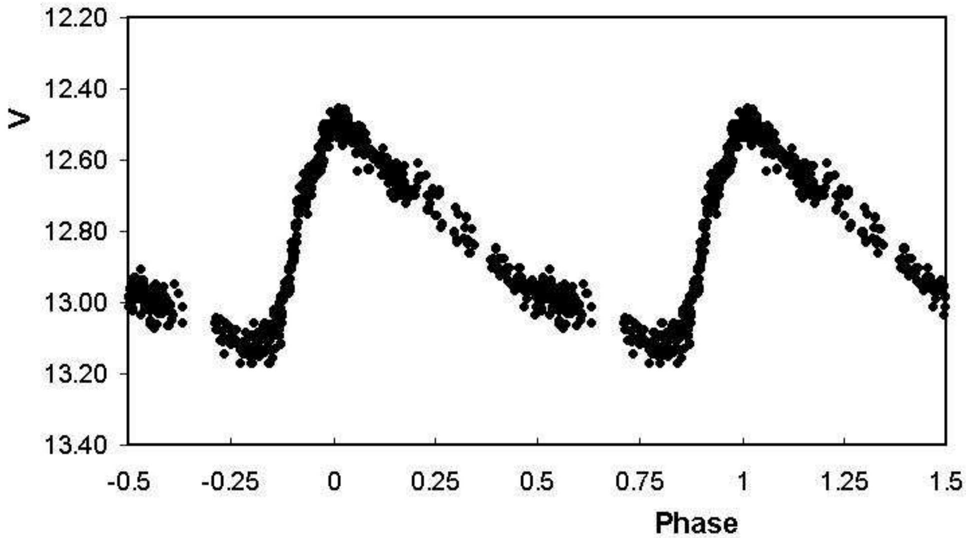

Figure 2. The phase diagram of GSC 5170.0175, CCD observations of K. Bernhard (filled circles), assuming that the comparison star GSC 5170.0119 has V=11.3 mag

Remarks:

The light curves show variations of a W UMa star for GSC 5149.2845 and of a RRab star for GSC 5170.0175.
Vizier investigations show that GSC 5149.2845 is a likely X-ray source (1RXS J193821.2-033245), which supports the classification as a W UMa variable.:
GSC 5149.2845:

$$\begin{array}{rl} \mathrm{MinI} = \mathrm{HJD}\ 2452522.440 + 0\overset{\mathrm{d}}{.}4128 \times E. \\ \pm 7 \qquad\quad \pm 1 \end{array} \tag{1}$$

GSC 5170.0175:

$$\begin{array}{rl} \mathrm{Max} = \mathrm{HJD}\ 2452523.40 + 0\overset{\mathrm{d}}{.}5152 \times E. \\ \pm 1 \qquad\quad \pm 1 \end{array} \tag{2}$$

Acknowledgements:

This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France. The authors thank John Greaves for helpful comments. O. Pejcha acknowledges overall support and the use of the telescope of the Nicholas Copernicus Observatory and Planetarium in Brno.

Reference:

Bernhard, K., Lloyd, C., 2000, *IBVS*, No. 4920

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V432 Aur: A NEW ECLIPSING SYSTEM

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V432 Aur (= HD 37071 = BD $+36°1204$, spectral type G0) has been discovered as a variable star by the Hipparcos satellite (HIC 26434, V_T=8$^{\rm m}_{.}$07, B_T=8$^{\rm m}_{.}$58, H_P=8$^{\rm m}_{.}$14) which did not however recognized its type of variability. V432 Aur was therefore logged as an "unsolved" variable in the *Hipparcos Catalogue* (ESA 1997), with an amplitude of H_P= 0.47 mag. V432 Aur is located (J2000.0) at α=05$^{\rm h}$37$^{\rm m}$32$^{\rm s}_{.}$44 and δ=+37°05′12$''_{.}$4, corresponding to galactic coordinates l=172$^{\circ}_{.}$18 and b=+02$^{\circ}_{.}$87. The parallax measured by Hipparcos is $\pi = 8.43 \pm 1.58$ mas, corresponding to a distance of 118 pc.

The inability of Hipparcos to recognize the type of variability for V432 Aur probably derives from the low number of observations it was able to secured: 53 in the H_P band and 62 in both V_T and B_T bands. An amplitude of $\sim$0.4/0.5 mag and a spectral type G0 suggested us that V432 Aur could be an eclipsing system, and we therefore decided to place it on the Asiago eclipsing binary program (e.g. Dallaporta et al. 2000, 2002, Munari et al. 2001). At the time of writing, acquisition of radial velocities with the Asiago Echelle+CCD spectrograph is progressing, while B,V photometry is completed. We present here only the basic photometric results, a full orbital solution including radial velocity data being postponed to the conclusion of the spectroscopic campaign.

We observed in B and V (standard Johnson filters) from a private observatory near Cembra (Trento), Italy. The instrument was a 28 cm Schmidt-Cassegrain telescope equipped with an Optec SSP5 photometer. The diaphragm had a size of 77 arcsec, and the exposure time was usually 10 seconds. HD 36974 (HIP 26385, V_T=8$^{\rm m}_{.}$249±0.016, $B_T = 9.052 \pm 0.021$, spectrum G5) was chosen as comparison star and HD 36930 (TYC 2416 970 1, V_T=8$^{\rm m}_{.}$352±0.015, B_T = 8$^{\rm m}_{.}$835 ± 0.020, spectrum F8) as a check star. The comparison has been measured against the check star at least once every observing run. In all, 202 measures of the magnitude difference comparison-check have been collected, providing a constant magnitude difference with a standard deviation of 0.006 mag. Our results therefore confirm and improve Hipparcos/Tycho findings that both the comparison and the check stars are not variable, and therefore well suitable to serve in the photometry of V432 Aur.

In all, 1407 measurements in V, and 1006 in B have been collected of V432 Aur between Dec. 1998 and Feb. 2002. All the observations were corrected for atmospheric extinction and color corrections (via calibration on Landolt's equatorial fields), and the instrumental differential magnitudes were transformed into the standard Johnson UBV system. The variable, comparison and check stars are very close on the sky so the atmospheric corrections were rather small (6 arcmin for HD 36974 and 10 arcmin for HD 36930). The close similarity of the color between the variable, comparison and check stars and the fact that all observations have been obtained for zenith distances 60°argue for a high internal consistency of our photometry of V432 Aur.

As expected, V432 Aur has turned out to be an eclipsing binary system. Spectroscopy reveals it to be a nice SB2 system. The primary eclipse follows the ephemeris:

$$\text{Min. I} = \text{HJD } 2451571.4123(\pm 0.0003) + 3^{\rm d}\!.08175(\pm 0.00001) \times E.$$

The B and V photometric data folded to this ephemeris are presented in Figure 1.

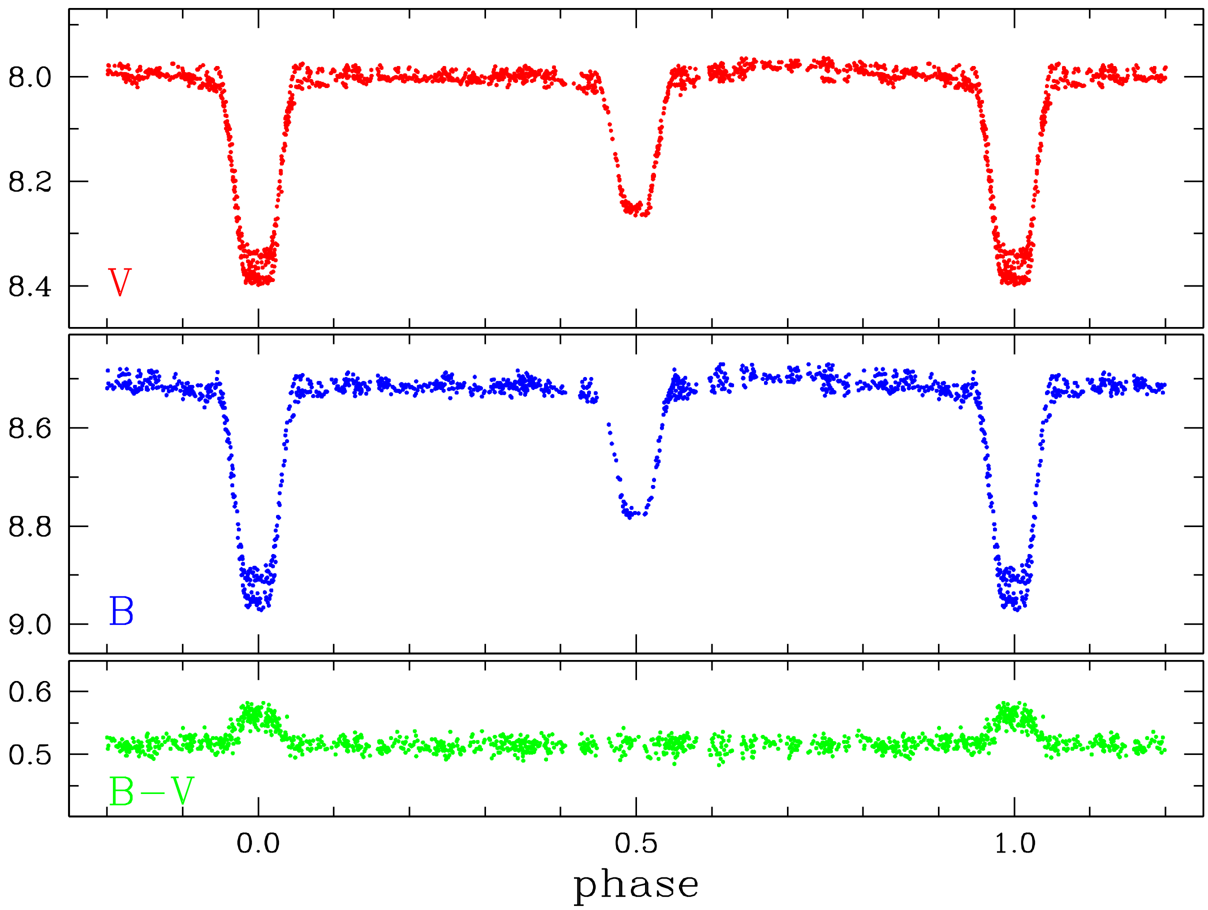

Figure 1. B, V and color curves of V432 Aur folded to the 3.08175 day orbital period.

Both primary and secondary eclipses are flat bottomed with totality lasting about 0.035 of the orbital period (∼2.6 hours). The primary star (that behind at primary eclipses) appears bluer by $\Delta(B-V)$ ∼0.05 corresponding to ΔT_{eff} ∼210 K. The primary eclipse is ∼0.37 mag deep. The secondary is well centered at phase 0.5 (thus no indication of an eccentric orbit) and is ∼0.26 mag deep.

The secondary star is intrinsically variable. As Figure 1 clearly shows, there is a large data *scatter* during the primary eclipse (ΔV ∼0.05 mag), that reduces outside eclipses (to ΔV ~0.02 mag). The scatter disappears during secondary eclipse (or at least it goes below the $\Delta V \leq 0.01$ mag). Figure 2 offers an expanded view of the lightcurve around the primary and the secondary eclipses. It is impossible to mark with different symbols data belonging to individual observing runs, because the V432 Aur data come from 126 different observing nights.

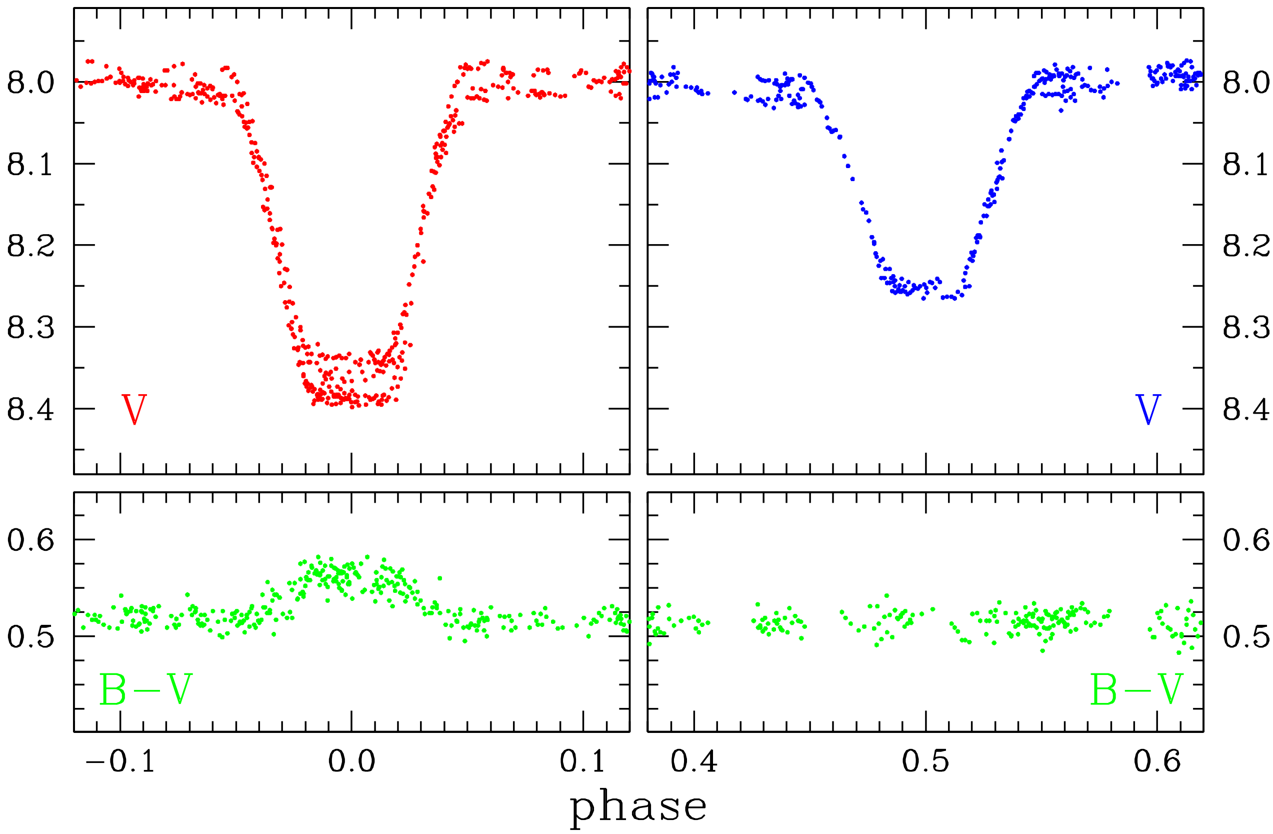

Figure 2. Expanded view around the primary and secondary eclipses of V432 Aur.

This scatter pattern is not connected to instrumental effects (observations from many different nights contributes to the light curve around both the primary and secondary eclipses), nor to variability of the comparison and/or check stars, that have been proven to be photometrically highly stable. The picture is consistent with the secondary star in V432 Aur being itself variable.

Which type of variable the secondary star might be is too uncertain at the moment. The time-scale of variability seems longer than a few hours. We have investigated the data outside eclipses searching for some indication of periodicity but without success. Given the minimal difference in $B-V$, the secondary star seems a couple of sub-types cooler than the primary, or a G2 star. More sophisticated investigations are required to determine which type of variable star is the secondary star in V432 Aur, and they will be attempted when the spectroscopic campaign will be concluded and the full orbital solution achieved.

Finally, Figure 3 graphs for comparison the Hipparcos and Tycho data folded to the orbital ephemeris above derived for V432 Aur. The paucity of H_P data in the eclipses and the large noise of the V_T and B_T data account for the *unsolved variable* status of V432 Aur in the Hipparcos catalogue.

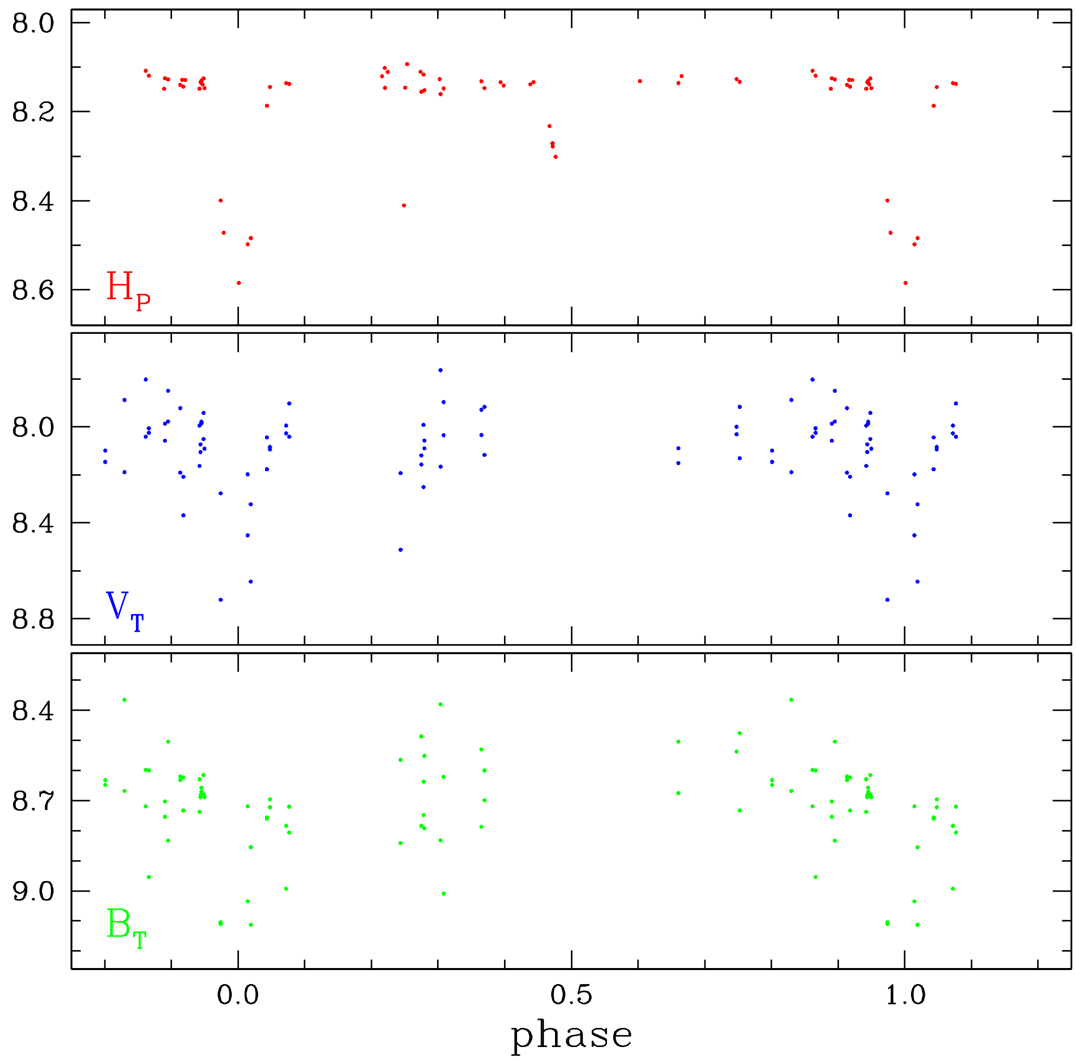

Figure 3. Hipparcos H_P and Tycho B_T and V_T data for V432 Aur folded to the 3.08175 day orbital period.

Acknowledgements. This study was partly sponsored by Polish KBN Grant 5 P03D 00320

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Dallaporta, S., Tomov, T., Zwitter, T., Munari, U., 2002, *IBVS*, 5312
ESA, 1997, *The Hipparcos and Tycho Catalogues*, ESA SP-1200
Munari, U., Tomov, T., Zwitter, T., Milone, E. F., Kallrath, J. et al., 2001, *A&A*, **378**, 477

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ON FOUR PULSATING VARIABLES

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Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp./check star(s)
GSC 4982-1512	HADS/SX Phe	14 18 36.76	−06 37 37.6	*
GSC 4988-707	RR Lyr	14 30 51.60	−02 44 24.6	*
GSC 6328-971	RR Lyr	20 21 59.72	−16 26 19.7	*
V1038 Oph	RR Lyr	16 32 26.04	−04 53 49.9	*

* R magnitudes of about 10 USNO-A stars in the fields

Observatory and telescope:

Les Engarouines Observatory (IAU astrometric code 164), 0.212m Newton; F.-X. Bagnoud Observatory (code 175), 0.600m Newton; Les Pérouses Observatory (hereafter LPO), 0.203m Schmidt-Cassegrain; Blauvac Observatory (code 627), 0.257m Newton; DeKalb Observatory (hereafter DKO), 0.355m Schmidt-Cassegrain.

Detector:	KAF-1600 CCD at 164 and at 175; KAF-401E CCD at LPO; KAF-400 CCD at 627; KAF-3200ME CCD at DKO.

Filter(s):	None, roughly R at 164, LPO and 627; R and V at 175; R at DKO.

Availability of the data:

Upon request

Method of data reduction:

Standard CCD-frame reduction using `IRAF` at 175, and `Prism` elsewhere.

Date(s) of the observation(s):	
GSC 4982-1512	2002–05–15, 16, 17; 2002–06–12, 13 (164)
	2002–05–17 (175)
	2002–07–17 (LPO)
GSC 4988-707	2002–05–15, 16, 17; 2002–06–12, 13, 15, 16 (164)
GSC 6328-971	2002–05–07, 08, 13, 16; 2002–08–05 (164)
	2002–08–18 (DKO)
V1038 Oph	2002–06–15; 2002–07–05, 07, 08; 2002–08–01, 02 (627)
	2002–08–07, 08, 09, 10 (KBO)

Star name	HJD of a max.	Period	Tot. var.	M–m	Type
GSC 4982-1512	2452415.6540	$0^{d}.0676535$	$0^{m}.39$	0.3	HADS/SX Phe (?)
	±0.0006	$\pm 0^{d}.0000005$	$\pm 0^{m}.02$		
GSC 4988-707	2452422.113	$0^{d}.32313$	$0^{m}.31$	0.35	RR Lyr
	±0.014	$\pm 0^{d}.00004$	$\pm 0^{m}.02$		
GSC 6328-971	2452496.7839	$0^{d}.58840$	$0^{m}.48$	0.2	RR Lyr
	±0.0029	$\pm 0^{d}.00026$	$\pm 0^{m}.02$		
V1038 Oph	2452470.3330	$0^{d}.333066$	$0^{m}.36$	0.3	RR Lyr
	±0.0021	$\pm 0^{d}.000012$	$\pm 0^{m}.02$		

Table 1. Light curve parameters from the data analysis by the CourbRot software (Behrend, 2001). The rising fraction of the light curve is denoted M–m. Uncertainties correspond to one standard-deviation.

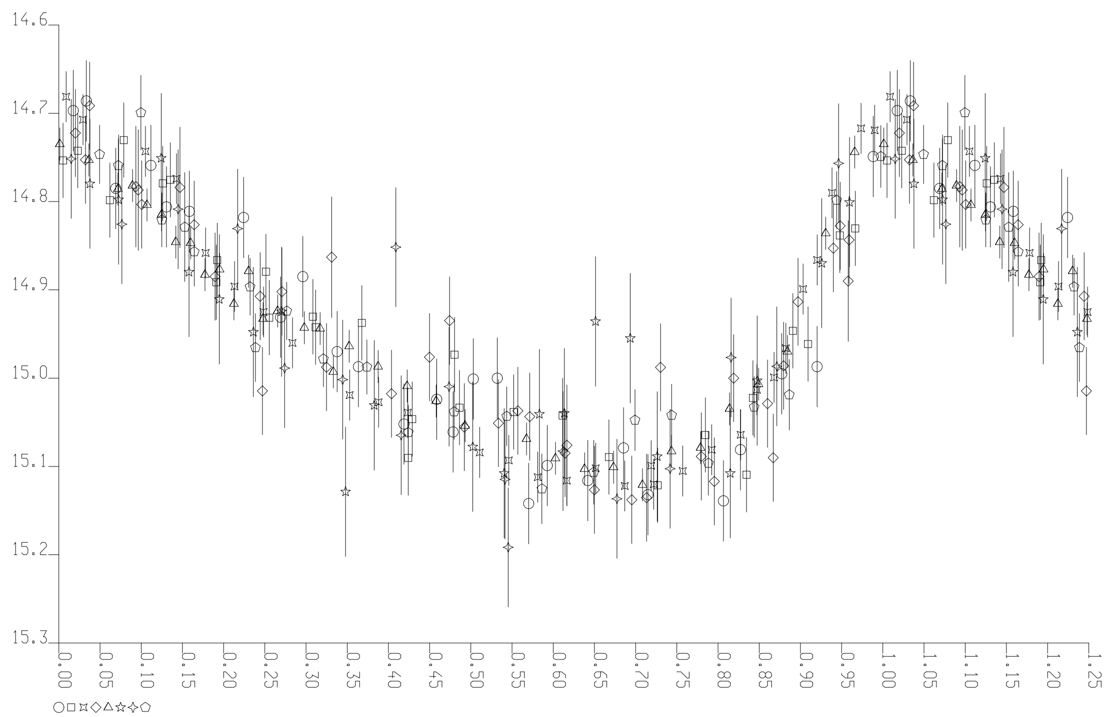

Figure 1. Unfiltered light curve of GSC 4982-1512, $P = 0^{d}.0676535$. The small labels denote the chronologic order of the series of observations in Figs. 1-4.

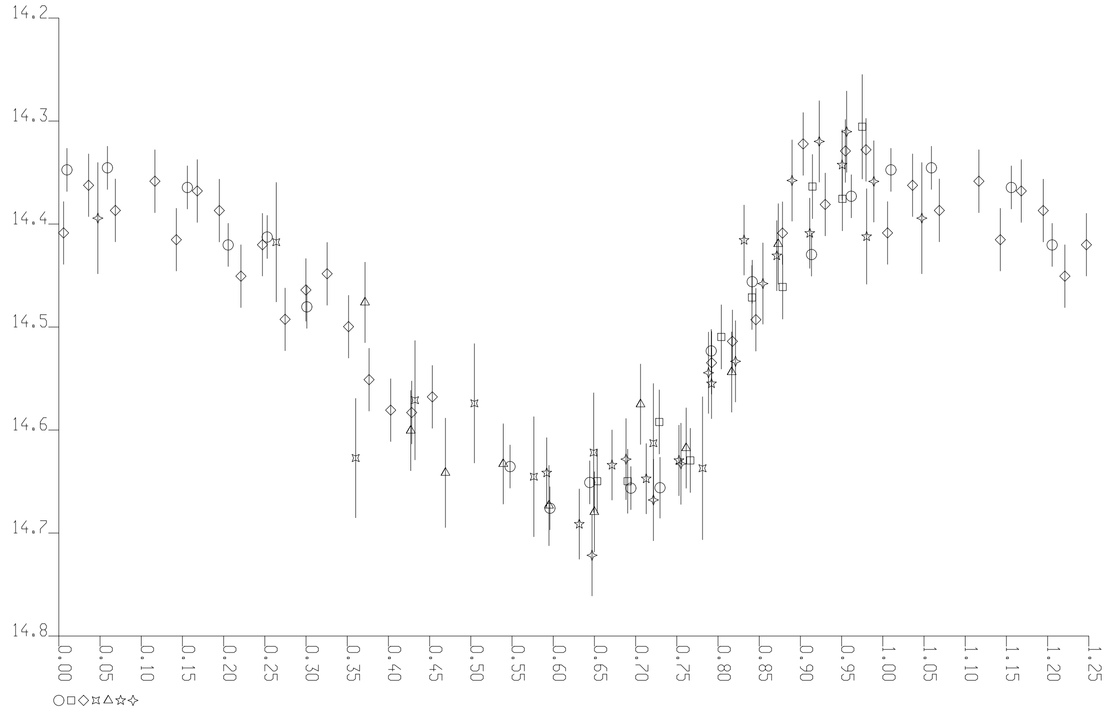

Figure 2. Unfiltered light curve of GSC 4988-707, $P = 0\overset{d}{.}32313$.

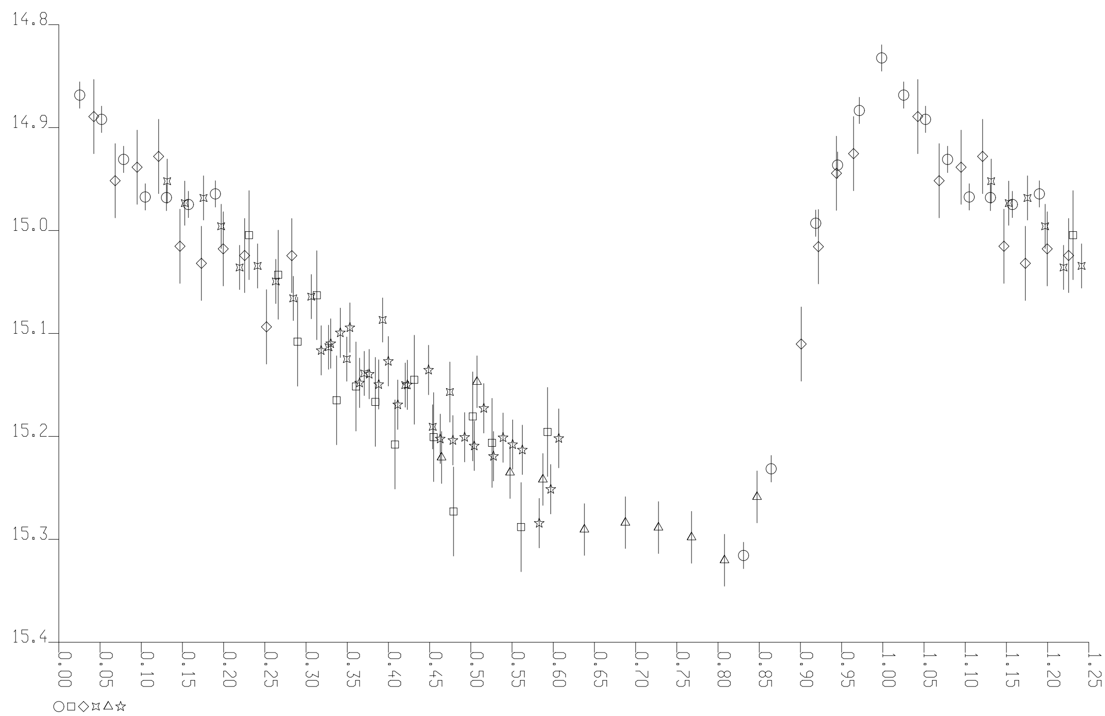

Figure 3. Unfiltered light curve of GSC 6328-971, $P = 0\overset{d}{.}58840$.

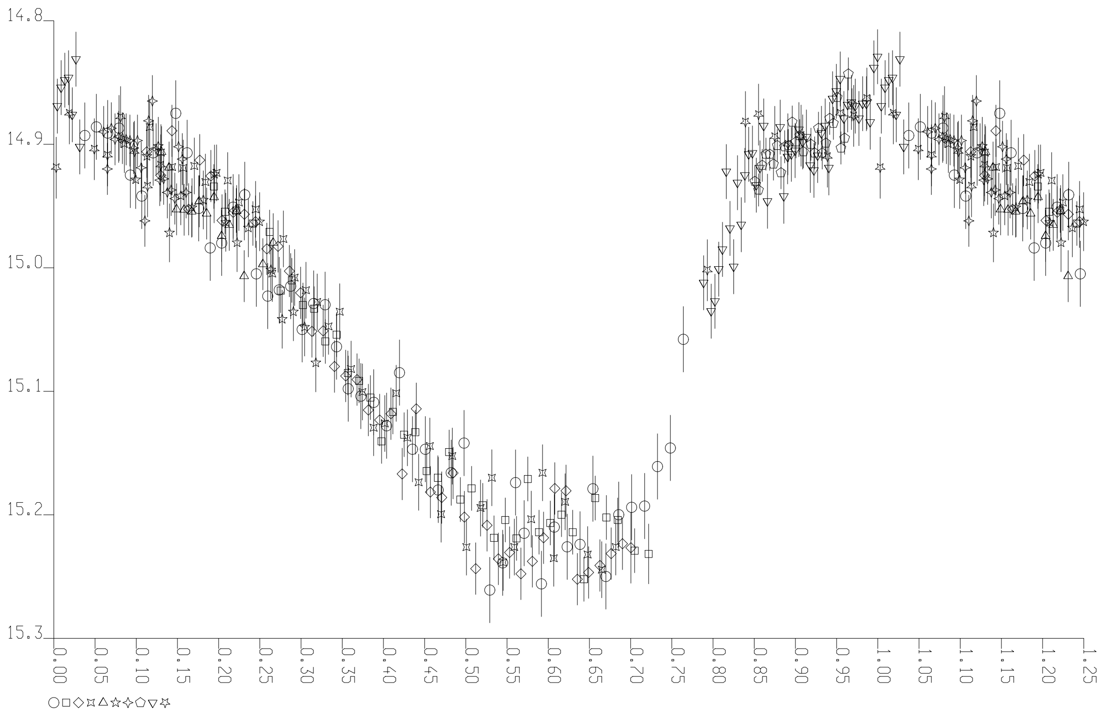

Figure 4. Unfiltered light curve of V1038 Oph, $P = 0^{d}.333066$.

The variability of GSC 4988-707, GSC 4982-1512 and GSC 6328-971 were found by Bernasconi in the course of asteroidal light curve determination.

V1038 Oph: Roy has found on his frames V1038 Oph to be at 15″ South of the position reported in the SIMBAD database. Kinman, Wirtanen and Janes (1965 - hereafter KWJ) reported a period very near $6^{h}.00$ for V1038 Oph. The complete set of observations clearly showed an incompatibility with the period in KWJ, a new period was determined to be near $8^{h}.00$ - see Fig. 4, and numerical results in Table 1. As a check, the data in KWJ were reduced with this new value as an indication of the period; the obtained periodicity is $0^{d}.33315 \pm 0^{d}.00013$ and the light curve's shape is more typical for a RR Lyr than the one from the original paper. This illustrates the difficulty to obtain alias-free solutions, from a single station, for objects with periods very near 1/4 and 1/3 of a day.

Acknowledgements: These researches used the Simbad database, operated by the CDS at Strasbourg, France.

References:

Behrend, R., 2001, *Orion*, **304**, 12
Kinman, T. D., Wirtanen, C. A., Janes, K. A., 1965, *ApJS*, **11**, 223 (labeled KWJ)

ERRATUM FOR IBVS 5320

The coordinates of GSC 4988-707 and GSC 6328-971 were in error; the correct values are:

GSC 4988-707	14 30 56.52	-03 11 09.2
GSC 6328-971	20 21 53.99	-16 27 03.6

R. Behrend

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A CONTACT BINARY SYSTEMATICALLY CHANGING ITS BRIGHTNESS

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The OGLE–II project has led to discovery of over 200,000 variable stars in the region of the Galactic Bulge (Wozniak et al. 2002). Most of this material remains to be analysed. In the course of a casual survey of the results by the second of us, a W UMa-type binary systematically changing its brightness has been noted. The star, BUL_SC27_506 (OGLE–II Bulge Scan 27, Star 506) is located at J2000: $17^{h}48^{m}02\overset{s}{.}67$, $-35^{\circ}28'20\overset{''}{.}8$. The photometric data in the I–band are available from the OGLE Internet site:
`ftp://bulge.princeton.edu/ogle/ogle2/bulge_dia_variables/plain_text/`
`/BUL_SC27/bul_sc27_506.dat.gz`.

Figure 1 shows the I-band magnitudes of the star over the three year span of the OGLE–II project. One can note the 0.1 – 0.12 magnitude wide band of the eclipsing-star variability superimposed on a climbing trend over the duration of the project. The observations were obtained typically once per night and were rather evenly distributed over time within each of the visibility seasons of 1997, 1998 and 1999. The photometric data have been analysed for the periodic content, giving the orbital period of $P = 0\overset{d}{.}403586 \pm 0\overset{d}{.}000007$. The same data, but expressed in flux units for an easier inter-comparison of the brightness variations between the seasons, are shown in a phase plot in Figure 2; the magnitude $I_0 = 15\overset{m}{.}43$ has been assumed as the reference level. The initial epoch was set at $T_0 = 2,450,551.861 \pm 0.008$. This epoch is very preliminary as the moments of the apparent light minima are obviously affected by the evolving stellar spots. At this moment, there is no information on the colour index of the star and on the amount of reddening, so that we cannot evaluate M_V for the system nor its distance. Judging by the orbital period and using the period – colour relation, any value within $0\overset{m}{.}35 < (V-I)_0 < 1\overset{m}{.}2$ appears to be possible, giving the likely distance within $1.5 < d < 4$ kpc (or less, if the reddening is large).

The three light curves shown in Figure 2 correspond to the three observing seasons 1997 – 1999. Each of the seasonal light curves has been Fourier decomposed into a 5-term cosine series with one sine term (to capture the light curve asymmetry), $l(\phi) = \sum_{i=0}^{4} a_i \cos(i2\pi\phi) + b_1 \sin(2\pi\phi)$. The coefficients are given in Table 1. The second line for each season gives the standard mean errors of the coefficients estimated using the "bootstrap" method. Only a_2, b_1, and a_1 for the first season significantly differed from zero, indicating the well-known low information content of light curves of partially-eclipsing

Table 1. Fourier coefficients and their errors of the light curve decomposition.

Year	a_0	a_1	a_2	a_3	a_4	b_1
1997	0.8992	−0.0051	−0.0338	−0.0005	0.0000	−0.0225
	0.0011	0.0014	0.0012	0.0014	0.0016	0.0014
1998	0.9309	0.0022	−0.0329	−0.0014	−0.0015	0.0016
	0.0021	0.0025	0.0022	0.0033	0.0026	0.0034
1999	0.9553	0.0017	−0.0347	0.0000	−0.0024	−0.0059
	0.0016	0.0021	0.0021	0.0023	0.0024	0.0022

W UMa systems. The light curve evolved over time during each of the seasons, so that part of the scatter in the seasonal light curves and the low accuracy of the Fourier coefficients was obviously due to the stellar spot evolution. As one can directly see in Figure 2, but also through a comparison of the first cosine and sine terms, the light curve changed from an asymmetric one with a well defined primary deeper eclipse in 1997 into somewhat similar light curves with equally deep minima, but with different mean light levels. The largest changes took place at the first minimum, apparently in relation to a slow disappearance of a large spot or of a group of spots. The overall changes caused by the spots were comparable those due to the eclipsing effects and amounted to about 10%. This has an important implication for the $M_V = M_V(\log P, CI)$ calibrations for the W UMa-type systems (where CI is for a colour index, such as $B-V$ or $V-I$; Rucinski 1994, Rucinski & Duerbeck 1997) and directly illustrates the inherent limitations of these calibrations.

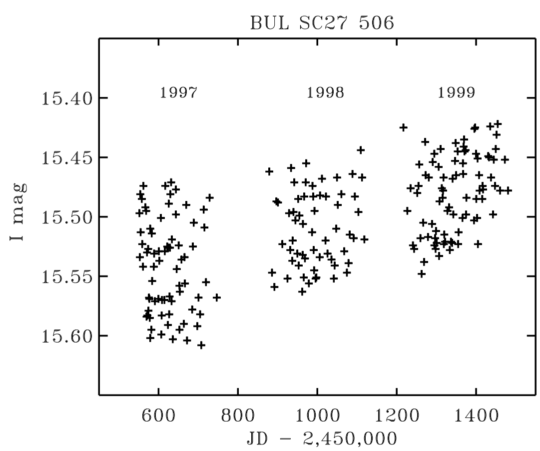

Figure 1. The I-magnitude OGLE–II observations of BUL_SC27_506 in three seasons 1997 – 1999.

Large changes of the *shape* of the light curves of W UMa-type systems have been noticed before. They have been normally explained by changes in the surface distribution of dark stellar spots. The particularly large light curve shape changes, with quasi-periodic mutual eclipse interchanges within only 3.5 years, were observed for TZ Boo (Hoffmann 1980). However, the case described here is – we believe – the first one where the changes *in the shape and in the light level* are very clearly visible in a continually monitored contact binary. This is due to the extended nature and high photometric stability of the OGLE–II program. Clearly, the more distorted light curve of 1997 was associated with a lower level of brightness. As the spots receded over 1998 – 1999, the brightness level increased and the light curves became more symmetric.

The time scales of the spot activity build-up and decay in W UMa-type binaries are currently unknown, but are of great interest because the solar-type component stars rotate typically 80 – 120 times faster then the Sun. Yet, the time scale of the spot re-organisation does not seem to be very dissimilar from the solar cycle of 11/22 years. The micro-lensing projects, such as OGLE, or similar project aimed at studying stellar-variability for very large numbers of stars, appear to be ideal in resolving several questions related to activity in very close binary stars with components spun up to very high rotation rates by tidal forces. Not only that such systematic surveys can answer the questions on the duration of activity cycles, but also the basic question of the overall statistics can be addressed: How prevalent are the spots? What percentage of the binaries suffer from them at a given time? How large are the typical systematic brightness changes? How do these activity-cycle variations relate to the binary star physical parameters?

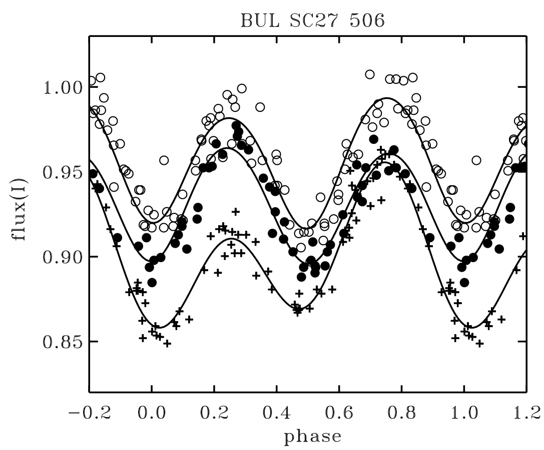

Figure 2. The phased observations of BUL_SC27_506 with the period and the initial epoch as in the text. The brightness is expressed in flux units with the reference level $I_0 = 15.43$. The seasonal curves are for 1997 (crosses), 1998 (filled circles) and 1999 (open circles). The continuous lines give the Fourier fits, with the coefficients given in Table 1.

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CCD OBSERVATIONS OF A NOVA AND TWO SUPERNOVAE IN EXTERNAL GALAXIES

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VAR 1:

Name of the object:
Nova in M31

Equatorial coordinates:	**Equinox:**
R.A.= $00^h42^m18\overset{s}{.}47$ **DEC.=** $41°12'38\overset{''}{.}9$	J2000.0

Comparison star(s):	Selected field stars

Type of variability:	Nova

VAR 2:

Name of the object:
2001ds in NGC 1654

Equatorial coordinates:	**Equinox:**
R.A.= $02^h10^m08\overset{s}{.}73$ **DEC.=** $36°42'20\overset{''}{.}3$	J2000.0

Comparison star(s):	GSC 2321 971

Type of variability:	Supernova

VAR 3:

Name of the object:
2002bo in NGC 3190

Equatorial coordinates:	**Equinox:**
R.A.= $10^h18^m6\overset{s}{.}51$ **DEC.=** $21°49'41\overset{''}{.}7$	J2000.0

Comparison star(s):	PG 1047+003, PG 1047+003A, PG 1047+003B

Type of variability:	Supernova

Observatory and telescope:
TUBITAK National Observatory (TUG), 1.5 m Russian - Turkish Joint Telescope (RTT150)

Detector:	ST-8E

Filter(s):	B, V, R_C

Transformed to a standard system:	yes
Standard stars (field) used:	Landolt (1992), Landolt & Henden (2001)

Remarks:
The nova in M31 was discovered by Martin and Li (2001), the supernova 2001ds in UGC 1564 by Boles (2001), and the supernova 2002bo in NGC 3190 by Cacella and Hirose (2002). Background in each galaxy was subtracted by optimal image subtraction technique. Differential magnitudes with respect to comparison stars selected in each field were transformed to the standard magnitudes using colour coefficients determined from Landolt standards (Landolt 1992, Henden and Landolt 2001). We note, in the case of the nova in M31, that no nova is reported in its position by Shafter and Irby (2001) in their two nova surveys in M31.

Table 1: Nova in M31

HJD (2450000+)	B	V	R_C	σB	σV	σR_C
2142.5141	17.80	17.64	17.39	0.06	0.01	0.01
2143.4908	17.97	17.81	17.58	0.03	0.01	0.01
2145.5026			17.76			0.02
2146.5457	18.54	18.49	18.16	0.02	0.01	0.01
2148.5224	18.86	18.84	18.45	0.02	0.01	0.01
2150.5694	18.80	18.74	18.36	0.02	0.01	0.01
2151.5421	19.04	18.90	18.61	0.01	0.01	0.01
2157.4721	19.29	19.31	19.01	0.03	0.01	0.02
2163.5311		19.54	19.09		0.02	0.02
2165.4843	19.89	19.82	19.38	0.02	0.01	0.01
2166.5078	19.78	19.83	19.17	0.15	0.02	0.01
2184.4733	20.84	20.85	19.92	0.03	0.03	0.03
2189.4734		21.00	19.77		0.02	0.02

Table 2: Supernova 2001ds in UGC 1654

HJD (2450000+)	V	R_C	σV	σR_C
2142.59		18.47		0.02
2143.59	19.05	18.49	0.03	0.02
2146.57		18.61		0.03
2190.41	20.57	19.94	0.04	0.03

Table 3: SN 2002bo in NGC 3190

HJD (2450000+)	V	$B-V$	$V-R_C$
2349.457	14.39	0.23	0.40
2351.390	14.13	0.22	0.35
2353.439	13.92	0.22	0.32
2373.442	14.72	0.25	0.40
2413.276	16.03	0.60	0.43

Reference:

Boles, T., 2001, *IAUC*, 7684
Cacella, P., & Hirose, Y., 2002, *IAUC*, 7847
Henden A. A. & Landolt A. U., 2001, *IBVS*, No. 5166
Landolt, A. U., 1992, *AJ*, **104**, 340
Martin, P., & Li, W. D., 2001, *IAUC*, 7684
Shafter, A. W., & Irby, B. K., 2001, *ApJ*, **563**, 749

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CCD PHOTOMETRY OF T UMi

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T Ursae Minoris (= GSC 04408 00163 = HD 118556; $\alpha = 13^{\rm h}34^{\rm m}41.09^{\rm s}$, $\delta = 73^\circ25'53.10''$ [J2000]) is a Mira type star, with spectral type varying between M4e and M6e and with range of optical light variations between visual magnitudes 7.8 and 15.0. In the fourth edition of the GCVS (Kholopov et al., 1985) a period of 301 days is given for its light variations. Detailed analysis of its light curve came out in papers of Gál and Szatmáry (1995) and Mattei and Foster (1995). Gál and Szatmáry (1995) showed that the period of T UMi is strongly decreasing: between JD 2440000 and JD 2449250 the period dropped from 314.5 days to 283.2 days. They attributed this change to a change of luminosity due to a shell flash in the helium burning shell. The period was constant before JD 2440000 suggesting that T UMi is just after the beginning of the shell flash. Using calculations of Wood and Zarro (1981), Gál and Szatmáry (1995) suggested that the period will start increasing again in few decades.

CCD photometry of T UMi has been done at Valašské Meziříčí observatory between 1999 January and 2001 May using astrocamera ZEISS 120/540 mm with attached SBIG ST-7 CCD camera and V filter. CCDOPS software bundled with SBIG cameras was used for photometry. GSC 4408 01074 (= PPM 8412 = SAO 7813 = BD +74 540; $V = 9.28$ mag, $B-V = 0.93$ mag) was used as the comparison star. A total of 456 measurements has been obtained in the course of 4 cycle. Measurements have typical errors of about 0.03 mag. Four maxima timings could be determined using the Kwee and von Woerden (1956) method implemented in AVE (Barbera, 2000) and their values are given in Table 1. The light curve of T UMi is shown in Figure 1. Observations can be retrieved through IBVS website (5323-t2.txt).

An $O-C$ diagram of maxima timings of T UMi based on data from AFOEV database and observations from Table 1 is presented in Figure 2. Changes of the length of the period (distances of subsequent maxima) are plotted in Figure 3. The fitted line corresponds to the period decrease of 2.3 days/cycle. The period used for construction of Figure 2 was taken from GCVS (301 d) and JD 2443052 was used as the basic maximum.

Acknowledgements: This work has made use of the SIMBAD database, operated at CDS, Strasbourg, France. The NASA ADS Abstract Service was used to access data and references.

The author is thankful to Ondřej Pejcha for help with preparation of figures.

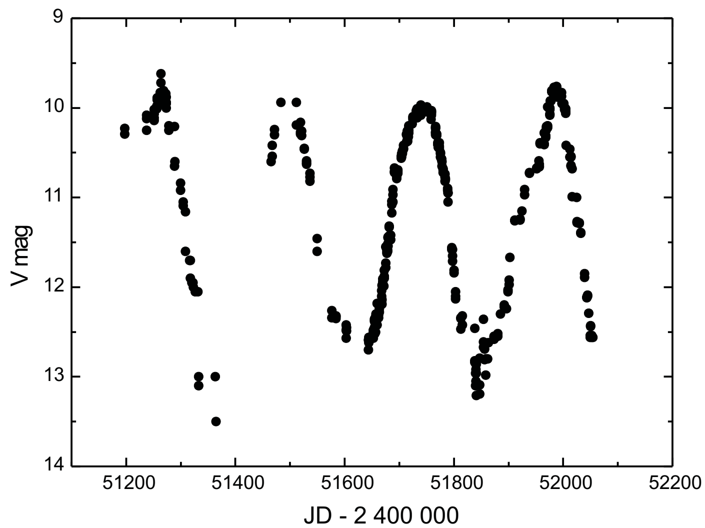

Figure 1. Light curve of T UMi.

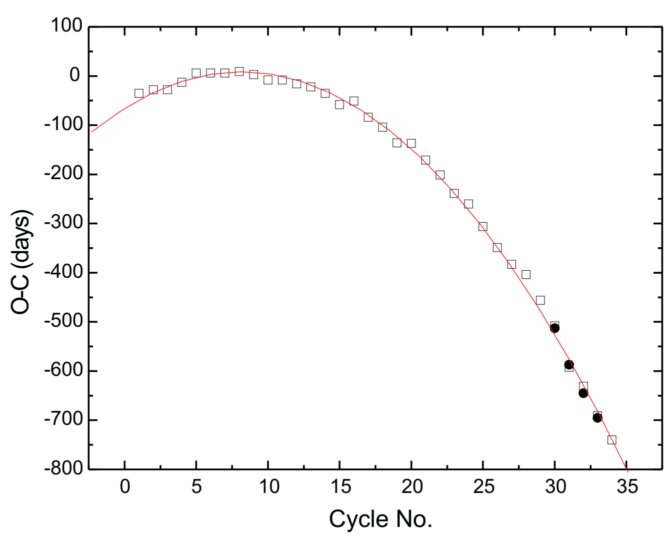

Figure 2. $O - C$ diagram of maxima timings of T UMi based on data from the AFOEV database (maxima 1-34; open squares) and from observations from this paper (maxima 30-33; solid circles). The solid curve is a quadratic fit to the data.

Table 1: Maxima timings of T UMi.

Geo. JD	Error	Filter	Maxima	$O-C$
2451267.8	0.5	V	30	−513
2451494.5	1.3	V	31	−587
2451738.4	0.3	V	32	−645
2451989.5	0.2	V	33	−695

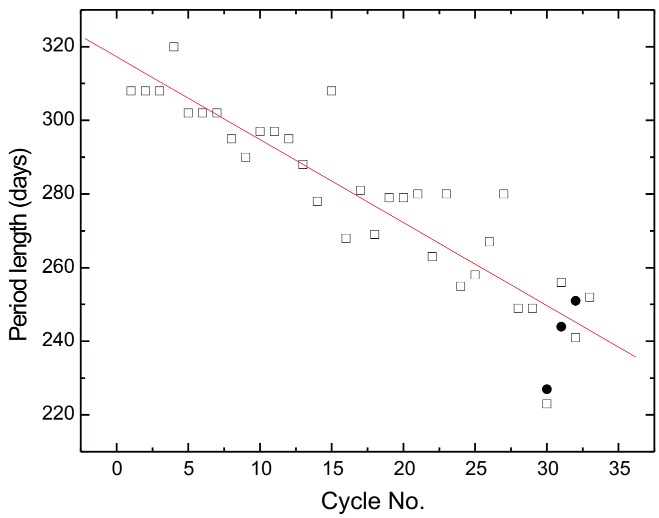

Figure 3. Evolution of the length of the period. Symbols are same as in Figure 2. The solid line corresponds to period decrease of 2.3 days/cycle.

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FURTHER OBSERVATIONS OF THE RECENTLY DISCOVERED NOVA Aql 1985

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Antipin et al. (2002) recently reported the discovery of a nova in Aquila in 1985 on Moscow and Sonneberg plates at $19^{\rm h}02^{\rm m}14^{\rm s}.5$ $+13^\circ 03'04''$. The nova peaked at $m_{\rm pg} \sim 10.6$ on $JD = 2446266$ (1985 July 19) and faded by three magnitudes in about 80 days. The pre-cursor to the nova is not visible on the Palomar Observatory Sky Survey (POSS) plates taken in 1952, but a post-outburst object is visible on the POSS II plates taken in 1987 and 1990, with $r = 18.6 \pm 0.2$ and $b = 20.0 \pm 0.2$.

Plates from around the time of outburst from the Harvard College Observatory have been examined and further estimates of the brightness of the nova have been made. All but one the plates come from the Harvard Damon Patrol series with blue sensitive emulsions. One deep plate from the MC series taken before the outburst was examined to clearly identify the field and standards. The magnitude of the nova has been estimated by eye relative to comparison stars using the B magnitudes given by Antipin et al. or b magnitudes from the USNO A2.0. The comparisons used, and the magnitudes adopted were the most appropriate for these plates and are given in Table 1. The estimates are given in Table 2 and subsets are plotted in Figure 1, showing the 100 days around maximum, and the extended light curve in Figure 2.

The new data closely follow the light curve of Antipin et al. from a few days after the maximum until it becomes invisible at $m_{\rm pg} \sim 14.2$ after 80 days. Maximum occurred between the two upper limits near 2446264.7 and the observations at 2446266.5. The general agreement with Antipin et al. is good but around 30 days after maximum there is

Table 1: Adopted comparison magnitudes

Name	B/b	Source	Name	B/b	Source
GSC1048-1591	11.10	Antipin et al.	GSC1048-0259	14.8	USNO A2.0
GSC1047-0749	11.35	Antipin et al.	0975-13930192	15.1	USNO A2.0
GSC1048-0076	12.5	USNO A2.0	0975-13931248	15.4	USNO A2.0
GSC1048-0106	13.0	USNO A2.0	0975-13928199	16.5	USNO A2.0
GSC1048-0223	13.9	USNO A2.0	0975-13930036	16.9	USNO A2.0
GSC1052.0042	14.05	Antipin et al.			

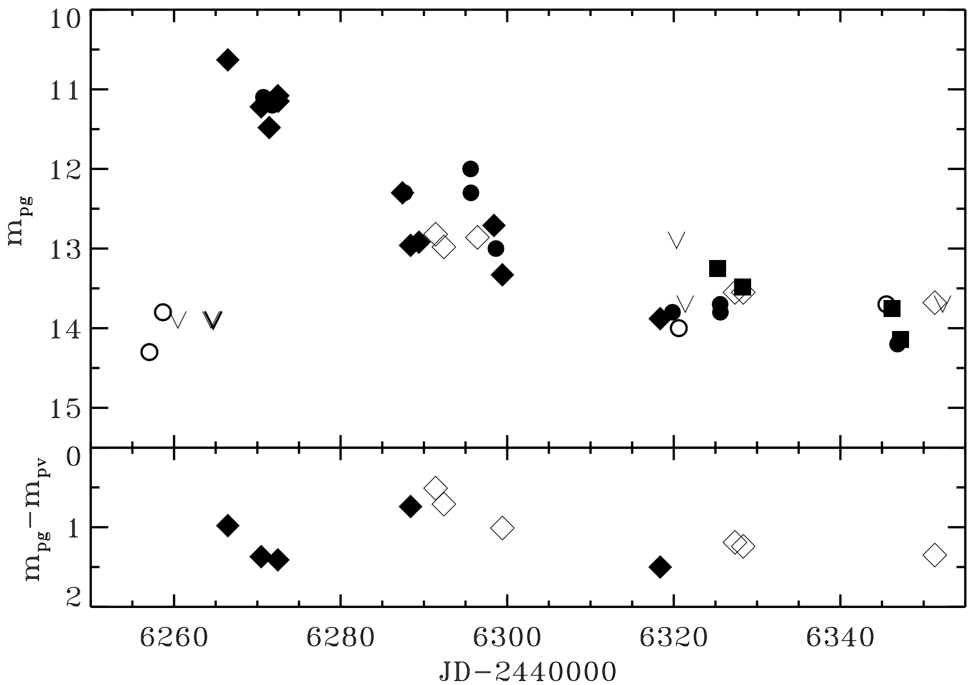

Figure 1. (Above) Detail of the light curve for 100 days around maximum. Filled and open circles, and heavy upper limits, this paper; filled and open diamonds, and light upper limits, Sonneberg data, and filled squares Moscow data, from Antipin et al. (Below) Approximate $B-V$ from the Sonneberg data.

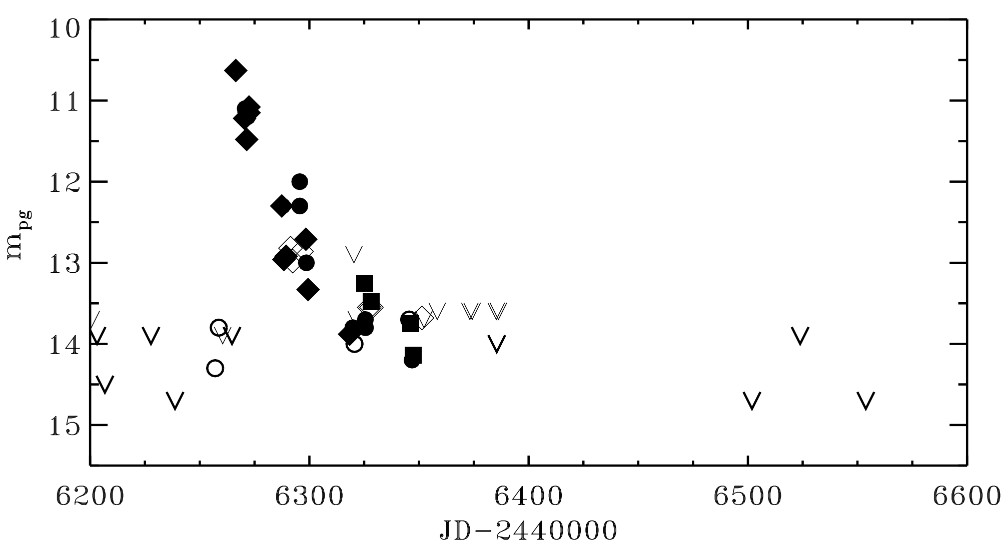

Figure 2. The extended light curve of the N Aql 1985 outburst. The symbols are the same as in Figure 1.

Table 2: Magnitude estimates of N Aql 1985

JD	m_{pg}	JD	m_{pg}	JD	m_{pg}
2433096.000	> 16.9	2446270.727	11.1	2446346.861	14.2
2446112.915	> 14.0	2446271.780	11.2	2446385.470	> 14.1
2446139.892	> 14.0	2446287.663	12.3	2446501.891	> 14.8
2446173.832	> 14.8	2446295.608	12.0	2446523.856	> 14.0
2446203.159	> 14.0	2446295.642	12.3	2446553.792	> 14.8
2446206.759	> 14.6	2446298.648	13.0	2446652.684	> 13.7
2446227.747	> 14.0	2446319.843	13.8	2447376.637	> 13.0
2446238.716	> 14.8	2446320.601	14.0:	2447378.587	> 14.0
2446257.042	14.3::	2446325.567	13.7	2447406.573	> 12.9
2446258.670	13.8:	2446325.598	13.8	2447716.710	> 14.0
2446264.704	> 14.0	2446345.531	13.7:	2447763.578	> 14.0

additional variation that may be due to oscillations associated with the transition stage (see Figure 1).

The nova is also positively seen about 7 days prior to maximum at $m_{\rm pg} \sim 14.0$, and is placed well below this a few days previously. Pre-maximum halts are rarely observed but have been seen in fast and slow novae. The statistics of these events are poor but the halt seen here is possibly fainter and earlier than the accepted norm. Two faint limits in the tail of the light curve place the nova below $m_{\rm pg} \sim 15$ about 230 days after maximum (see Figure 2).

Figure 1 also shows the $m_{\rm pg} - m_{\rm pv}$ colour from the Sonneberg data. The colour appears to be quite red around maximum and then becomes bluer, consistent with the behaviour seen in smoothly varying novae (van den Bergh & Younger 1987). At maximum novae typically have $(B-V)_0 = 0.25$ and $(B-V)_0 = 0.0$ when two magnitudes below maximum (van den Bergh & Younger 1987, Downes & Duerbeck 2000). Assuming that $B - V = m_{\rm pg} - m_{\rm pv} + 0.1$ then N Aql 1985 has $B - V \approx 1.4$ and $B - V \approx 0.8$ at maximum and two magnitudes below, respectively. These implying significant reddening of, $E_{B-V} \approx 1.0$ and $A_V \approx 3.5$ magnitudes.

The average rate of decline has been measured over the periods JD 2446266 to 2446305 and 2446330 to derive $T_2 = 31$ days and $T_3 = 66$ days respectively. Using the absolute magnitude to rate-of-decline calibration of Downes & Duerbeck (2000) the absolute magnitude at maximum, $M_{\rm V} = -7.5$ and $M_{\rm V} = -7.4$ for T_2 and T_3 respectively. Also the absolute magnitude after 15 days, $M_{\rm V,15} = -6.6$ The absolute magnitude of novae at quiescence is, $M_{\rm V} \sim 5$ implying a brightening in this case of some 12 magnitudes. Given $m_{\rm pv} = 9.7$ and $m_{\rm pg} = 10.6$ at maximum this implies quiescent magnitudes of $V \sim 22$ and $B \sim 23$, both well below the limit of the POSS plates, and consistent with the negative result of Antipin et al.

Acknowledgements. It is a pleasure to thank Alison Doane, Curator of the Harvard College Photographic Plate Collection, for her assistance in accessing the archive.

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DETECTION OF A PULSATING COMPONENT IN THE ECLIPSING BINARY AB Per

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[2] Dept. of Astronomy and Space Science, Chungbuk National University, Cheongju, 361-763, Korea

[3] Astronomical Observatory, Odessa National University, Shevchenko Park, Odessa, 65014, Ukraine

Observatory and telescope:
Sobaeksan Optical Astronomy Observatory, 61cm telescope

Detector:	SITe 2K CCD camera

Filter(s):	B, V

Transformed to a standard system:	No

Availability of the data:
Upon request

Method of data reduction:
Standard CCD-frame reduction using the IRAF[1] package.

Table 1. Photometric parameters of observed stars

ID	Name	RA (J2000)	DEC (J2000)	V	$(B\text{-}V)$	Sp. Type
VAR	AB Per	$03^h37^m45^s.20$	$+40°45'49''.4$	$9^m.69$	$0^m.43$	A5
C1	HD 275605	$03^h38^m06^s.82$	$+40°44'58''.3$	$10^m.55$	$0^m.48$	F5
C2	GSC 02866-01819	$03^h36^m54^s.76$	$+40°54'58''.1$	$11^m.7$	$1^m.0$	–

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

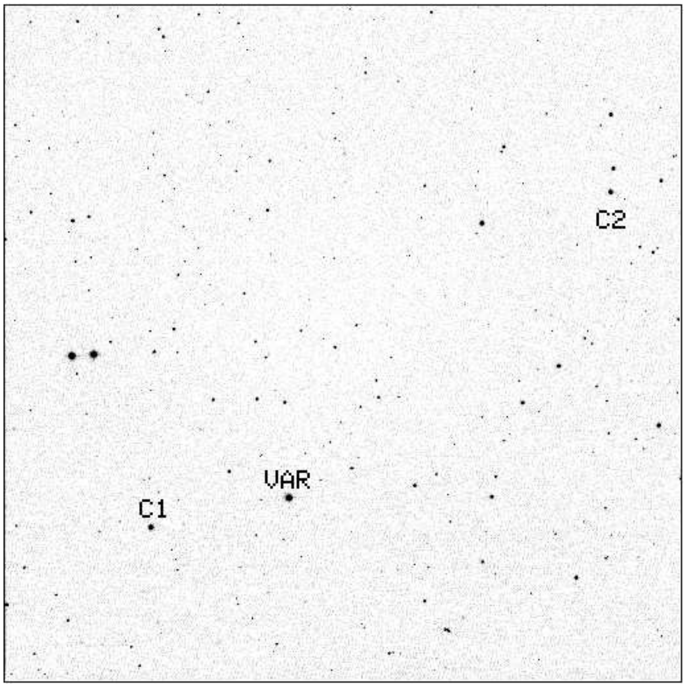

Figure 1. A *B*-band observed CCD image (20′.5×20′.5) near the eclipsing binary AB Per (VAR). The comparison star (C1) and the check star (C2) are marked. North is up and east is to the left

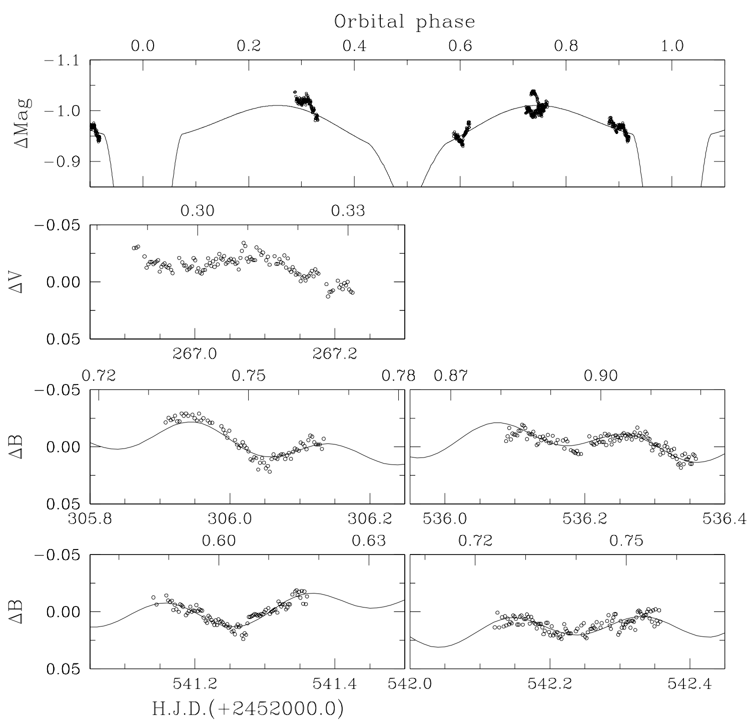

Figure 2. Differential magnitudes between the variable star AB Per and the comparison star C1. The synthetic light curves represented by solid lines in the top panel were constructed using the Wilson-Devinney (1971) method and photometric parameters presented in the literature. The lower five panels show residuals after fitting the curve to the data. Sinusoidal curves obtained from the multiple frequency analysis are superimposed on the residuals in four *B*-band panels

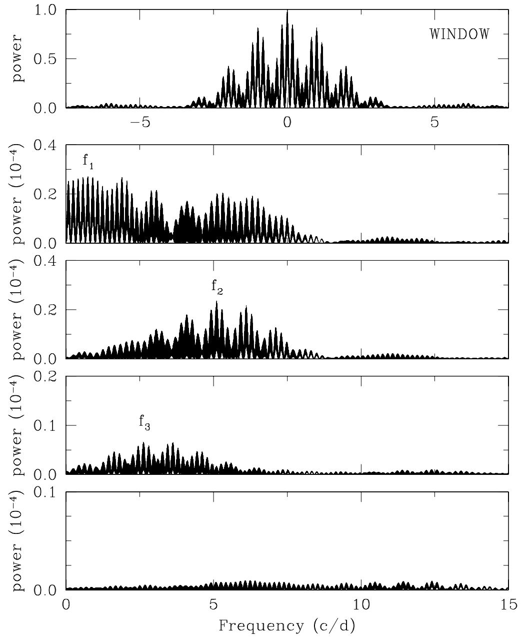

Figure 3. Power spectra of AB Per. Window spectrum is in the top panel. The successive pre-whitening procedure shows three frequencies of $f_1 = 0.747$ c/d, $f_2 = 5.106$ c/d and $f_3 = 2.624$ c/d

Remarks:

During the observational survey to search for A-F spectral type pulsating components in eclipsing binary systems, in collaboration with the Central Asian Network group (Mkrtichian et al. 2002a), we detected short-term variabilities of AB Per in out-of eclipsing orbital phases. Observations were performed for five nights from December 23, 2001 to September 24, 2002, with B or V filter. We applied simple aperture photometry to get instrumental magnitudes with an aperture radius of $4\overset{''}{.}8$; typical atmospheric seeing was about $2\overset{''}{.}4$ during the observing runs. The comparison star C1 did not show any peculiar light variations.

Figure 2 shows light variations of AB Per. Because the light elements in the GCVS (Kholopov et al. 1988) might have some problems (Isles 1991), we calculated the orbital phases from the following elements which were newly derived from all previously-known minimum epochs (Kreiner et al. 2001),

$$\text{Min} \quad \text{H.J.D.} = 2422987.3254 + 7.16007115 \times E.$$

In order to remove the eclipsing light variations, we constructed synthetic curves using the Wilson-Devinney (1971) method and photometric parameters from the literature (Brancewicz & Dworak 1980, Budding 1985, van Hamme 1993). Residuals after fitting the curves to the data show short-term variabilities with a period of about 0.2 day and $\Delta B \sim 0\overset{\mathrm{m}}{.}04$. We estimated its period from the multiple frequency analysis (Kim & Lee 1996), using only the B-band data. Figure 3 displays the power spectra of the residuals. The successive prewhitening procedure shows three frequencies of $f_1 = 0.747$ c/d (cycles per day), $f_2 = 5.106$ c/d and $f_3 = 2.624$ c/d.

Remarks:

The first frequency was selected in order to remove long-term trends of the residuals. The second frequency was clearly detected in the power spectra. Its period value of 0.196 day is much smaller in comparison with the orbital period of about 7.16 day for AB Per. The variable star AB Per is a member of a semi-detached eclipsing binary system which revolution and rotation are normally supposed to be synchronised. Very probably f_2 does not originate from rotation-induced variabilities such as ellipsoidal variability or surface inhomogeneity. Instead, it is more reasonable that f_2 is a pulsating frequency of the primary component. Considering the spectral type, sinusoidal light curves, frequency and amplitude of pulsation, and the membership in a semi-detached Algol type system, we suggest that the primary component of AB Per is a new, eighth member of the oscillating EA group (Mkrtichian et al. 2002b, Kim et al. 2002).

The third frequency with the smallest amplitude is uncertain so far whether it is a real frequency of the star ; f_3 seems to be the sub-harmonic frequency of f_2, $f_3 \approx 1/2\ f_2$. More intensive and long time-based observations of AB Per are needed.

Acknowledgements:

We thank Dr. S.C. Kim for his careful reading. This research made use of the SIMBAD database, operated at CDS, Strasbourg, France.

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Mkrtichian, D.E., Kusakin, A.V., Gamarova, A.Yu., Nazarenko, V., 2002b, in *Radial and nonradial pulsations as probes of stellar physics*, ed. C. Aerts, T.R. Bedding, & J. Christensen-Dalsgaard, *ASP Conf. Ser.*, **259**, 96

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IDENTIFICATION OF V735 SAGITTARII

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V735 Sgr is a variable star discovered by Luyten in the course of the Bruce Proper Motion Survey (Luyten 1936). The variable was reported at coordinates R.A. $17^{h}53\overset{m}{.}5$, Dec. $-29°33'$ (1900.0) with a blue photographic brightness variation between 14.2 – 15.5 mag.

Plaut gave a finding chart for the variable (Plaut 1948). However, at the position marked on that chart, there is a close pair of stars (7 arcsec separation). The astrometry of the two stars by Henden (using USNO-A2.0) are:

$$\text{R.A. } 17^{h}59^{m}51\overset{s}{.}79,\ \text{Dec. } -29°33'55\overset{''}{.}7\ (2000.0) \cdots \text{star N}$$
$$\text{R.A. } 17^{h}59^{m}52\overset{s}{.}03,\ \text{Dec. } -29°34'01\overset{''}{.}7\ (2000.0) \cdots \text{star S}$$

Vogt and Bateson observed V735 Sgr in outburst and identified the variable as "the south-eastern component of a close pair" (Vogt and Bateson 1982). The listing for V735 Sgr in the General Catalog of Variable Stars (GCVS) is based on their observations, with the star classified as having irregular short variations, with coordinates of R.A. $17^{h}59^{m}52^{s}$, Dec. $-29°33\overset{'}{.}8$ (2000.0), and photographic brightness variations between 13.5 – 16.5 mag.

Hazen investigated the Bruce plate marked by Luyten, and found that the brightness of star N differs between two plates, whereas the brightness of star S does not differ.

Henden observed this pair in 1999 July and August, using the 1.0-m telescope at USNO Flagstaff Station. Table 1 shows the photometry. The brightness variation of star N confirms the Luyten identification. On the other hand, star S is constant within the photometric errors. The $B-V$ colour of star N is not particularly red, so does not conflict with the classification in the GCVS.

In conclusion, the remark by Vogt and Bateson was a mistake and V735 Sgr is the north-western component of this pair. Figure 1 shows an accurate chart identifying V735 Sgr.

Table 1: Henden photometry of the pair

Star	HJD	V mag	$B-V$
N	2451379.8048	14.775 ± 0.009	0.801 ± 0.010
N	2451380.7678	14.507 ± 0.006	0.827 ± 0.007
N	2451402.6682	14.697 ± 0.007	0.785 ± 0.009
S	2451379.8048	14.748 ± 0.005	0.892 ± 0.007
S	2451380.7678	14.771 ± 0.005	0.881 ± 0.007
S	2451402.6682	14.759 ± 0.005	0.878 ± 0.006

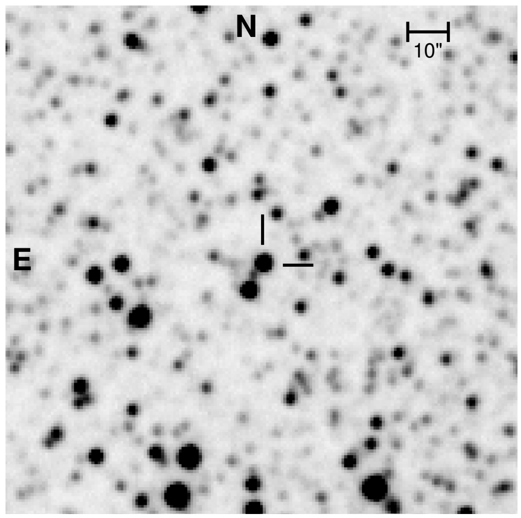

Figure 1. V-band chart of V735 Sgr

References:

Luyten, W. J., 1936, *Astron. Nachr.*, **261**, 451
Plaut, L., 1948, *Leiden Annals*, **20**, 1
Vogt, N., Bateson, F. M., 1982, *A&AS*, **48**, 383

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

Number 5327

Konkoly Observatory
Budapest
29 October 2002

HU ISSN 0374 – 0676

NSV 10892 IS A W UMa ECLIPSING BINARY

KOPPELMAN, M. D.[1]; WEST, D.[2]; PRICE, A.[3]

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Name of the object:
NSV 10892 = HD 170451

Equatorial coordinates:	**Equinox:**
R.A.= $18^h29^m13\overset{s}{.}016$ **DEC.=** $06°47'13\overset{''}{.}76$	2000

Observatory and telescope:
M. Koppelman: Starhouse Observatory, MN USA, 102-mm refractor; T. Droege: Private Observatory TASS TOM1, IL USA, dual 100-mm refractors; D. West: West Skies Observatory, KS USA, 0.2m SCT

Detector:	M. Koppelman: SBIG ST-237A; T. Droege: Custom built dual CCD 442A; D. West: SBIG ST-9E

Filter(s):	M. Koppelman: Johnson V; T. Droege: Johnson V and Cousins I_c; D. West: Johnson/Cousins BVR_cI_c

Date(s) of the observation(s):
2002.06.08 – 2002.08.08

Comparison star(s):	GSC 00445-01017, GSC 00445-01293, SAO 123778

Transformed to a standard system:	M. Koppelman: no; T.Droege: no; D.West: Johnson/Cousins
Standard stars (field) used:	SAO 123778

Availability of the data:
Through IBVS Web-site as file 5327-t1.txt

Type of variability:	EW

Remarks:

Variability of HD 170451 was noted in 1958 (Hiltner, 1958) and it is currently designated NSV 10892 in the Combined General Catalogue of Variable Stars (Kholopov, 1998). Variability was clearly demonstrated by data acquired from the TASS survey (Droege, 2002; Henden, 2001) in June of 2002. The period and nature of the variability was not immediately apparent. The difference of the simultaneous V and I_c TASS observations is constant with a standard deviation of less than $0.^{m}01$ in the variation of the difference.

Over 1400 V observations were made at Starhouse Observatory to characterise the light curve. The V magnitudes were derived from differential photometry against GSC 00445-01017 and GSC 00445-01293 using Tycho-2 V magnitudes calculated from $V = V_t - 0.090(B_t - V_t)$ (Hog, 2000). These observations put the amplitude of the star at $0.^{m}36$, with a maximum of $V=9.^{m}36$ and a minimum of $V=9.^{m}72$. Standard deviations of the comparison stars' magnitudes were less than $0.^{m}02$.

Using data from TASS and Starhouse, the period was determined by least-squares Fourier fitting. A preliminary ephemeris for the system is

$$\begin{array}{rl}\text{Min. I} = \text{HJD } 2452454.7107 + & 0.^{d}375296 \times E \\ \pm 0.0004 \pm & 0.000003\end{array} \quad (1)$$

Figure 1 shows the characteristic shape of a W UMa binary. The system is most likely associated with the bright X-ray source 1RXS J182912.6+064717, giving further evidence that it is a W UMa system with X-ray emission arising from coronal activity.

BVR_cI_c photometry from West Side Observatory using the Cousins standard SAO 123778 (Cousins, 1980) resulted $B-V=0.^{m}65$, $V-R_c=0.^{m}32$, and $V-I_c = 0.^{m}69 \pm 0.^{m}03$ colour indices of the variable. These observations were taken near the primary minimum at HJD 2452492.6222.

Coordinates are from the Tycho catalog, adjusted for proper motion by VizieR.

Acknowledgements:

Thanks to Tom Droege, Chris Lloyd and everyone involved with The Amateur Sky Survey. The CCD camera used by D. West was provided through the AAS Small Grants Program. This research made use of the SIMBAD database, operated by the CDS at Strasbourg, France.

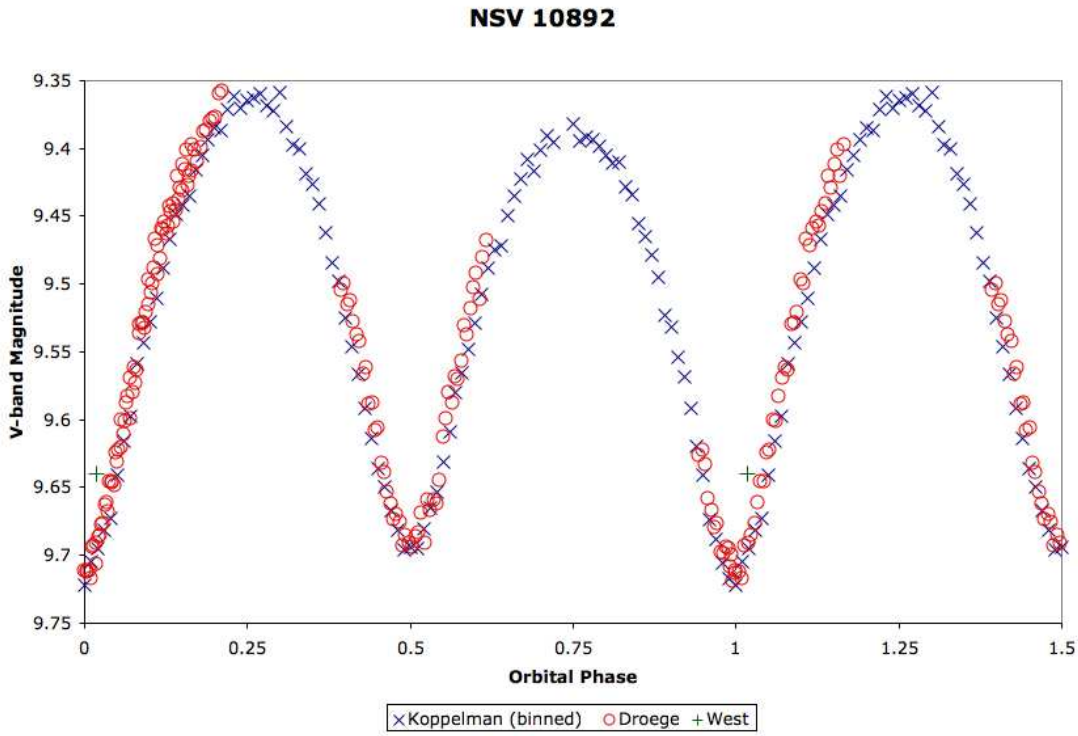

Figure 1. V magnitude vs. orbital phase.

References:

Cousins, A. W., 1980, *South African Astr. Obs. Circ.*, **No. 5**, 234
Droege, T., 2002, The Amateur Sky Survey (TASS), `http://www.tass-survey.org/`
Henden, A. A., 2001, *JAAVSO*, **29** , 118.
Hiltner, W. A. et al., 1958, *ApJ*, **127**, 539
Hog, E. et al., 2000, *A&A*, **355**, L27
Kholopov, P.N., 1982, New Catalogue of Suspected Variables, (Moscow: Nauka)

COMMISSIONS 27 AND 42 OF THE IAU
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V928 AND V929 OPHIUCHI

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Name of the object:
V928 Oph

Equatorial coordinates:	**Equinox:**
R.A.= $18^h40^m28\overset{s}{.}93$ **DEC.=** $+12°04'01\overset{''}{.}4$	2000

Observatory and telescope:
Crimean Laboratory of Sternberg Astronomical Institute, 40-cm astrograph

Detector:	Photoplate

Filter(s):	None

Transformed to a standard system:	$B_{\rm pg}$
Standard stars (field) used:	Calibrated using surrounding stars of the USNO A2.0 catalog

Date(s) of the observation(s):
JD 2437023–2448414

Availability of the data:
Upon request

Type of variability:	RRAB

Remarks:
V928 Oph (S 4338) was discovered by Hoffmeister (1949) who attributed it to the long-period variable stars. His finding was later confirmed by Götz (Götz and Wenzel, 1956) who, on the base of about 150 photographic brightness estimates (JD 2425688–2434253), attributed it to Miras, with a period of 140^d and a photographic range from $13\overset{m}{.}9$ to fainter than $15\overset{m}{.}5$, and reported three times of maxima. The finding chart was published by Hoffmeister (1957), it permits a reliable identification with modern positional catalogs (Kinnunen and Skiff, 2000), and the corresponding star is by no means red. Decades ago (Richter, 1965) it was noticed that the star's colour was discrepant with its classification. Our new estimates show that the star is an RRAB variable varying between $14\overset{m}{.}9$ and $17\overset{m}{.}0$, with the light elements Max JD Hel = 2445961.289 + $0\overset{d}{.}497511 \times E$. The finding chart is shown in Fig. 1 (left panel), the light curve is presented in Fig. 2.

Name of the object:
V929 Oph

Equatorial coordinates:	**Equinox:**
R.A.= $18^h40^m56\overset{s}{.}37$ **DEC.=** $+08^\circ17'50\overset{''}{.}7$	2000

Observatory and telescope:
Crimean Laboratory of Sternberg Astronomical Institute, 40-cm astrograph

Detector:	Photoplate

Filter(s):	None

Transformed to a standard system:	B_{pg}
Standard stars (field) used:	Calibrated using surrounding stars of the USNO A2.0 catalog

Date(s) of the observation(s):
JD 2437023–2448414

Availability of the data:
Upon request

Type of variability:	LB

Remarks:
V929 Oph (S 4339) was discovered by Hoffmeister (1949). He could not determine a reliable variability type but suspected that the star was an eclipsing binary. Götz and Wenzel (1956) found the same type, with variations between photographic magnitudes 15.0 and 15.6, and determined the light elements; they considered the derived period value ($2\overset{d}{.}3401$) uncertain because of too few observations. Four times of minima were published. The finding chart was published by Hoffmeister (1957), it permits a reliable identification with modern positional catalogs (Kinnunen and Skiff, 2000). The star is red, it is associated with the IRAS Point Source Catalog object IRAS 18385+0814. Our first guess was that the two stars had been mixed up by their Sonneberg investigators. However, neither V928 Oph turned out to be eclipsing, nor V929 Oph is a Mira. Our study reveals apparently irregular variations of V929 Oph between $14\overset{m}{.}7$ and $16\overset{m}{.}2$. The finding chart is presented in Fig. 1 (right panel) and a fragment of the light curve is shown in Fig. 3. The reason for the wrong classification of both stars in Sonneberg publications remains unclear.

Acknowledgements:
The work of the GCVS team is supported, in part, by grants from the Russian Foundation for Basic Research (grant 02-02-16069), The Federal Scientific and Technological Program "Astronomy", and the program of support for leading scientific schools of Russia (00-15-96627). The Digitized Sky Survey images are provided by the Hubble Space Telescope Science Institute under support from grant NAG W-2166 of the USA Government. Thanks are due to Dr. S.V. Antipin for his assistance during the preparation of the manuscript.

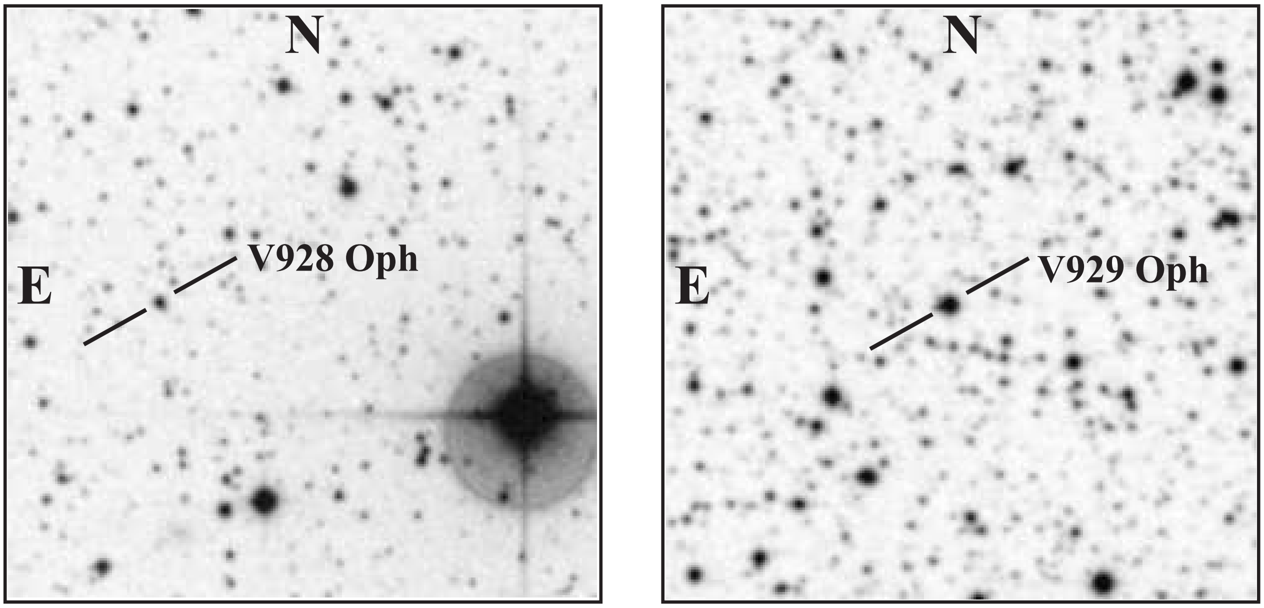

Figure 1. The finding charts for V928 Oph (left) and V929 Oph (right). Both charts show $4' \times 4'$ fields from the second Digitized Sky Survey, in blue light for V928 Oph and in red light for V929 Oph.

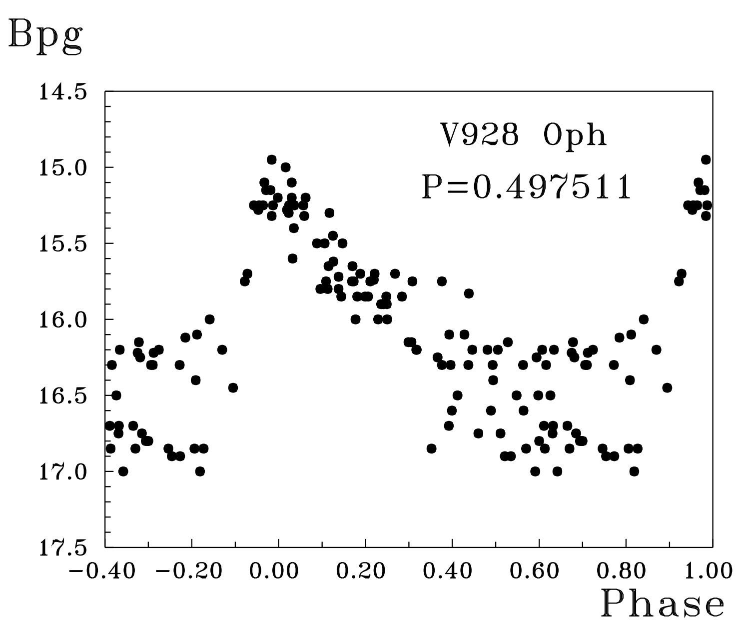

Figure 2. The light curve of V928 Oph, folded with the elements presented above.

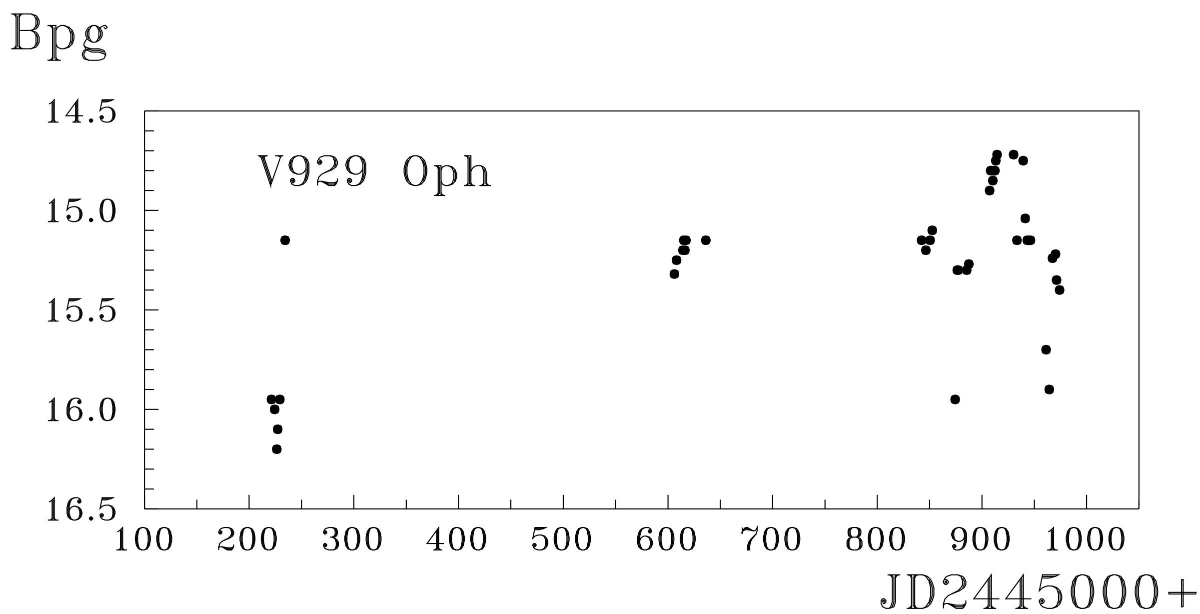

Figure 3. A fragment of the light curve of V929 Oph.

References:

Götz, W., Wenzel, W., 1956, *Veröff. Sternw. Sonneberg*, **2**, 5

Hoffmeister, C., 1949, *Ergänzungshefte Astron. Nachr.*, **12**, 1

Hoffmeister, C., 1957, *Mitt. veränd. Sterne*, **Nr. 303**

Kinnunen, T., Skiff, B.A., 2000, *IBVS*, No. 4905

Richter, G., 1965, *Astronomische Abhandlungen. Professor Dr. Cuno Hoffmeister zum 70. Geburtstag gewidmet*, Leipzig: J.A. Barth, **S. 98**

COMMISSIONS 27 AND 42 OF THE IAU
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ON FIVE W UMa VARIABLES

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Observed star(s):				
Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp./check star(s)
GSC 1414-851	EW	$09^h47^m33\overset{s}{.}78$	$+18°21'43\overset{''}{.}1$	*
GSC 2511-773	EW	$10^h31^m26\overset{s}{.}52$	$+31°38'33\overset{''}{.}2$	*
GSC 0876-362	EW	$12^h24^m22\overset{s}{.}97$	$+10°35'14\overset{''}{.}0$	*
GSC 0316-779	EW	$14^h05^m43\overset{s}{.}23$	$+00°34'11\overset{''}{.}6$	*
GSC 5764-892	EW	$20^h44^m17\overset{s}{.}99$	$-12°48'01\overset{''}{.}5$	*

* R magnitudes of about 10 USNO-A stars in the fields

Observatory and telescope:
Les Engarouines Observatory (IAU astrometric code A14), 0.212m Newton; Village-Neuf Observatory (code 138), 0.20m Schmidt–Cassegrain.

Detector:	KAF-1600 CCD at A14; KAF-1602E CCD at 138.

Filter(s):	None, roughly R at both A14 and 138.

Availability of the data:
Upon request

Method of data reduction:
Standard CCD-frame reduction using `Prism`.

Date(s) of the observation(s):	
GSC 1414-851	2002–04–18, 19, 20, 21; 2002–05–12 (A14)
GSC 2511-773	2002–03–09, 13; 2002–04–06, 17 (A14)
GSC 0876-362	2002–04–18, 19; 2002–05–12 (A14)
GSC 0316-779	2002–04–20, 21; 2002–05–12, 13, 14 (138)
	2002–06–12, 13, 15 (A14)
GSC 5764-892	2002–08–05, 07, 14 (A14)

Table 1. Light curve parameters from the data analysis by the `CourbRot` software (Behrend, 2001). Uncertainties correspond to one standard-deviation.

Star name	HJD of a pr. min.	Period	Tot. var.	Type
GSC 1414-851	$2452385\overset{\rm d}{.}2621$	$0\overset{\rm d}{.}354076$	$0\overset{\rm m}{.}64$	W UMa
	$\pm0\overset{\rm d}{.}0014$	$\pm0\overset{\rm d}{.}000022$	$\pm0\overset{\rm m}{.}01$	
GSC 2511-773	$2452355\overset{\rm d}{.}9645$	$0\overset{\rm d}{.}389131$	$0\overset{\rm m}{.}23$	W UMa
	$\pm0\overset{\rm d}{.}0029$	$\pm0\overset{\rm d}{.}000021$	$\pm0\overset{\rm m}{.}01$	
GSC 0876-362	$2452386\overset{\rm d}{.}422$	$0\overset{\rm d}{.}30817$	$0\overset{\rm m}{.}16$	W UMa
	$\pm0\overset{\rm d}{.}006$	$\pm0\overset{\rm d}{.}00004$	$\pm0\overset{\rm m}{.}01$	
GSC 0316-779	$2452415\overset{\rm d}{.}018$	$0\overset{\rm d}{.}399249$	$0\overset{\rm m}{.}29$	W UMa
	$\pm0\overset{\rm d}{.}004$	$\pm0\overset{\rm d}{.}000004$	$\pm0\overset{\rm m}{.}01$	
GSC 5764-892	$2452496\overset{\rm d}{.}3652$	$0\overset{\rm d}{.}32275$	$0\overset{\rm m}{.}56$	W UMa
	$\pm0\overset{\rm d}{.}0018$	$\pm0\overset{\rm d}{.}00005$	$\pm0\overset{\rm m}{.}02$	

Remarks:

The Simbad database reports no variable stars in the vicinity of these five objects. The period of GSC 0316-779 we obtained was refined using *V* observations by the TASS Mark III Photometric Survey (Richmond et al., 2000). GSC 0316-779 was found to be variable by Ch. D., the other stars by L. B., each time in the course of asteroidal light curve determination.

Acknowledgements:

These researches used the Simbad database, operated by the CDS at Strasbourg, France, and some data from the TASS Photometric Survey.

References:

Behrend, R., 2001, *Orion*, **304**, 12

Richmond, M. W., Droege, T. F., Gombert, G. et al., 2000, *PASP*, **112**, 397

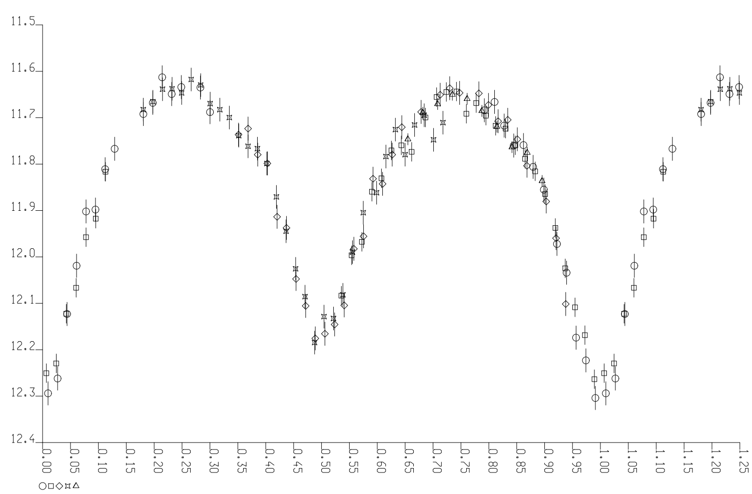

Figure 1. Unfiltered light curve of GSC 1414-851, $P = 0\overset{\rm d}{.}354076$. The small labels denote the chronologic order of the series of observations in Figs. 1-5.

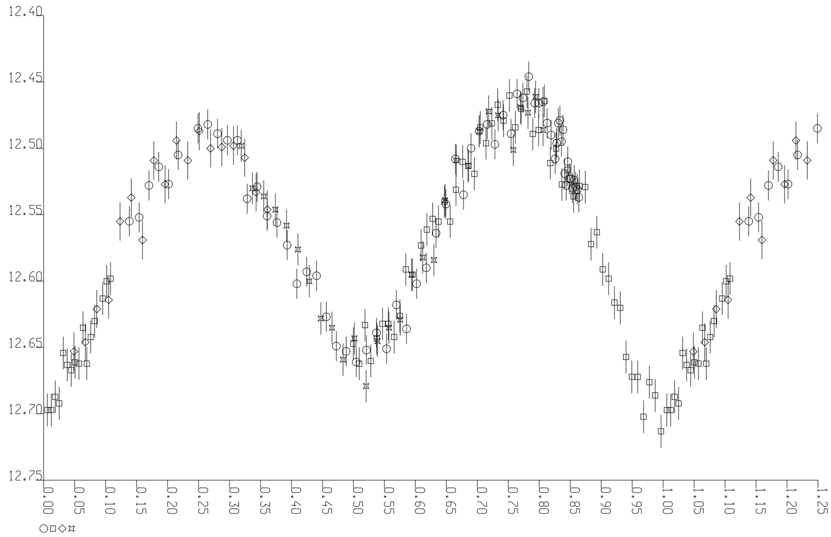

Figure 2. Unfiltered light curve of GSC 2511-773, $P = 0\overset{\rm d}{.}389131$.

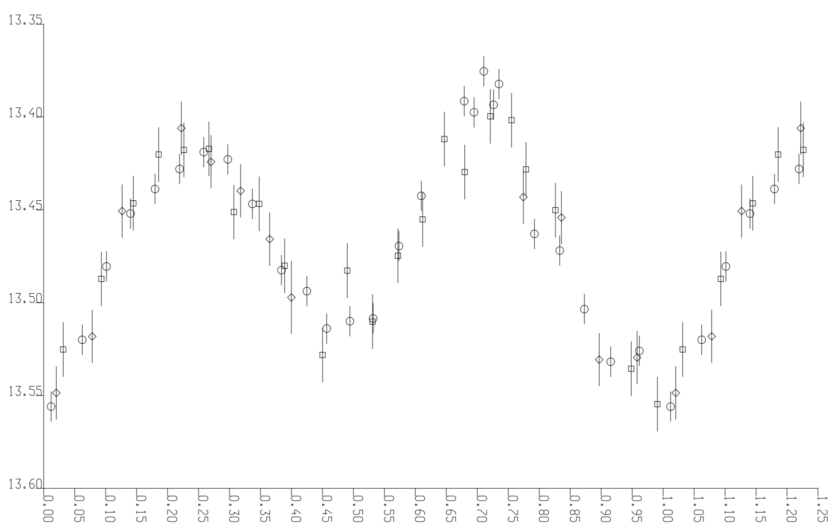

Figure 3. Unfiltered light curve of GSC 0876-362, $P = 0\overset{\rm d}{.}30817$.

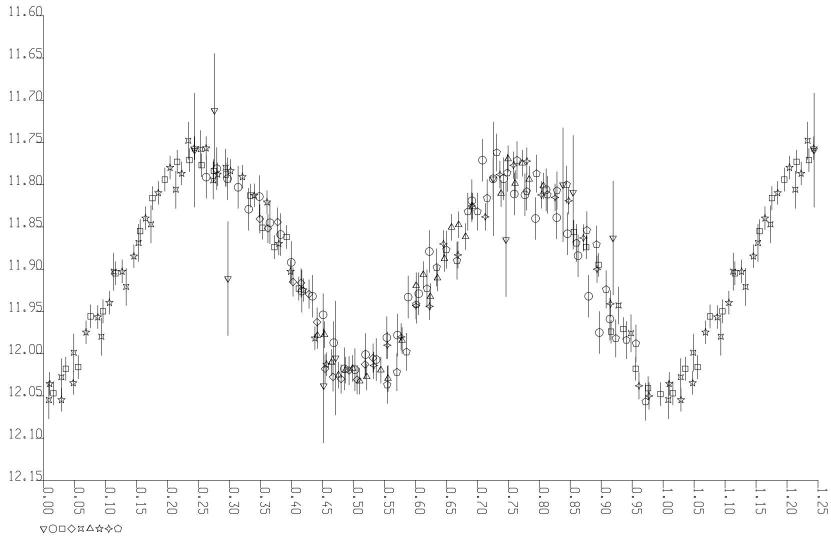

Figure 4. Unfiltered light curve of GSC 0316-779, $P = 0^{\mathrm{d}}.399249$. Triangles represent TASS' V-observations, shifted by $-0^{\mathrm{m}}.19$, made during 1998.

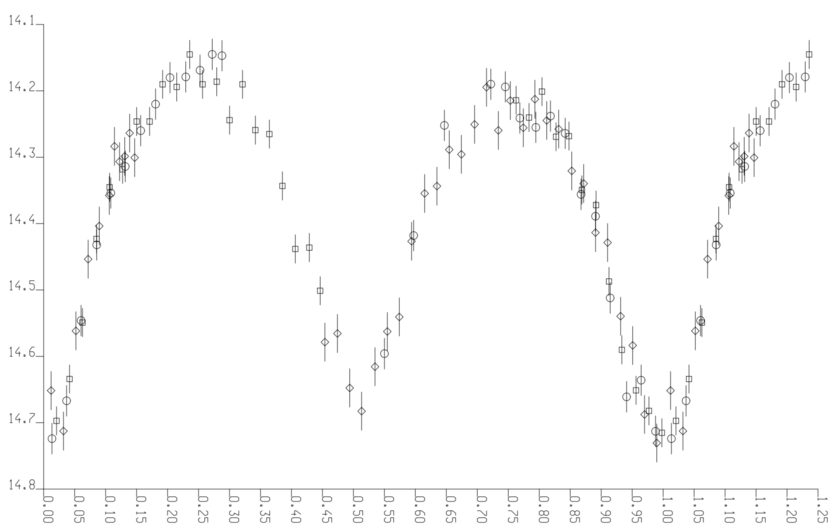

Figure 5. Unfiltered light curve of GSC 5764-892, $P = 0^{\mathrm{d}}.32275$.

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INFORMATION BULLETIN ON VARIABLE STARS

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5 November 2002

HU ISSN 0374 – 0676

PHOTOELECTRIC MINIMA OF V2150 Cyg AND OU Ser

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Observatory and telescope:
40 cm Cassegrain telescope of the TÜBİTAK† National Observatory.

Detector:	OPTEC SSP-5A photometer, Hamamatsu 4457 PMT.

Method of data reduction:
Reduction of the observations were made in the usual way.

Method of minimum determination:
Times of minima were determined by the method of Kwee and van Woerden (1956).

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
V2150 Cyg	EW	$21^h18^m11^s$	$+30°35'22''$	SAO 71155	48500.4340	0.5918560	1
OU Ser	EW	$15^h22^m43^s$	$+16°15'41''$	HD 136440	48500.2780	0.2967645	1

Source(s) of the ephemeris:
1. The Hipparcos & Tycho Catalogues (ESA, 1997)

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
V2150 Cyg	52130.6209	0.0002	II	V	0.0381	CY
	52149.5576	0.0008	II	V	0.0354	CY
	52171.4554	0.0005	II	V	0.0345	CY
	52187.4321	0.0007	II	V	0.0312	CY
OU Ser	52130.4683	0.0004	II	V	0.0185	CY
	52133.4360	0.0009	II	V	0.0186	CY
	52441.6112	0.0008	I	V	0.0039	CY
	52476.4866	0.0005	II	V	0.0094	CY

†TÜBİTAK : The Scientific and Technical Research Council of Turkey

Explanation of the remarks in the table:
CY: Cahit Yeşilyaprak (Observer)

Acknowledgements:
The author would like to thank the *TÜBİTAK National Observatory (TUG)* for the observing time and equipment support. The author is grateful to Prof. Zeki Aslan and Prof. Zeynel Tunca for their guidance and helpful comments.

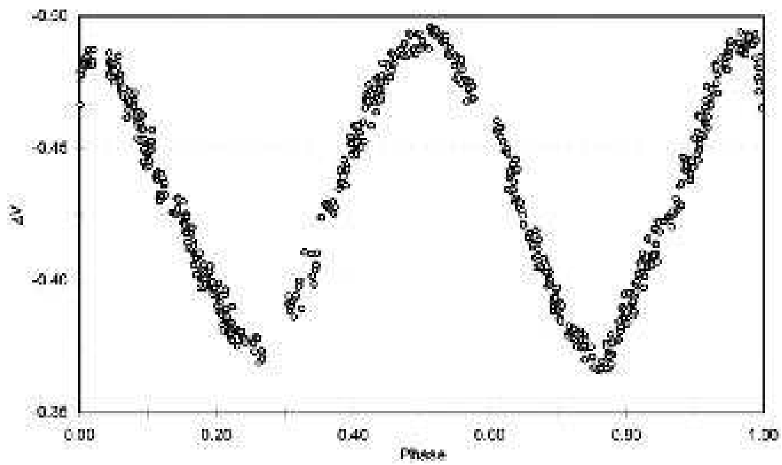

Figure 1. Differential light curve of V2150 Cyg

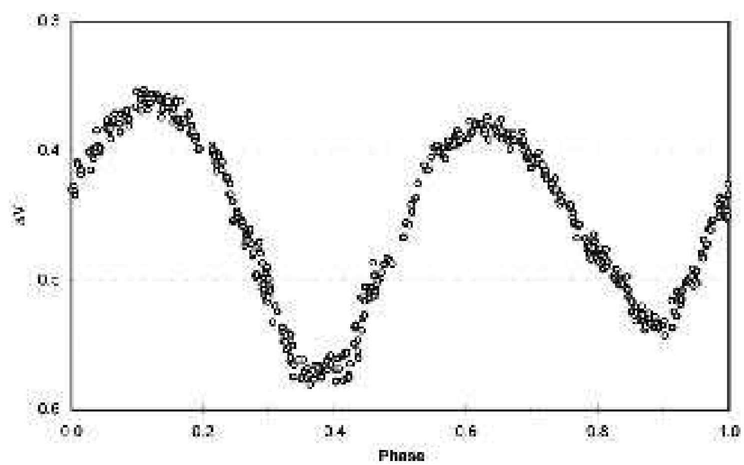

Figure 2. Differential light curve of OU Ser

References:

ESA, 1997, *The Hipparcos & Tycho Catalogues*, ESA SP-1200

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

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HIP 60725 AND CU CVn: TWO NEW δ Sct STARS

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In the period from 1996 to 1998, a few δ Sct stars were observed from Monegrillo and Mollet del Valles Observatories in Spain while monitoring a small set of selected HIPPARCOS variable stars. In both cases a 40cm Newtonian telescope was used. The telescopes were also equipped with a Johnson V filter and a SX Starlight CCD camera with a Sony ICX027BL chip cooled by a Peltier system to about -25°C. Dark frames and flat fields were obtained and used to perform image cleaning. Photometric reductions were carried out using a synthetic aperture differential magnitude extraction method and the software package LAIA (Laboratory for Astronomical Image Analysis).

The HIPPARCOS variables, discovered by the satellite mission, were selected on the basis of a reanalysis of the satellite data, which suggested that the actual variable type for some objects could be different from the one assigned in the HIPPARCOS and TYCHO catalogues (ESA, 1997). This new analysis was based on a search for periodicities in the satellite photometric data and on inspection of the light-curve morphology. We present here our observations and results for two of these HIPPARCOS variables HIP 60725, and CU CVn (HIP 67357), which are shown to be new δ Sct stars. `Period98` (Sperl, 1998) was used to analyse our photometric and the Hipparcos Epoch Photometry data series. Table 1 shows the observational log, and Table 2 gives some additional basic information on these objects. The spectral types were retrieved from the HIC (Turon et al., 1993), and equatorial coordinates from the Hipparcos Catalogue (ESA, 1997).

Table 1. Observational log

Star	Observation period	Comp. star	Check star	Data points	Remarks
HIP 60725	13 Mar-11 Jul 1998	SAO 002046	GSC 4556-800	607	1
HIP 67357	16 Feb-27 Feb 1998	HIP 67327	–	467	2

[1] Monegrillo Observatory, 40-cm telescope

[2] Mollet del Valles Observatory, 40-cm telescope

Table 2. Basic data

Star	GCVS Name	Spectral type	Equatorial coordinates (epoch 2000)
HIP 60725	–	F0	$\alpha = 12^{\rm h}26^{\rm m}43\overset{\rm s}{.}735$ $\delta = +81°28'26\overset{''}{.}27$
HIP 67357	CU CVn	F0	$\alpha = 13^{\rm h}48^{\rm m}20\overset{\rm s}{.}117$ $\delta = +31°24'03\overset{''}{.}80$

HIP 60725 (= SAO 2041 = GSC 04557-09079) is listed in the HIPPARCOS catalogue as an unsolved variable (ESA, 1997). Our analysis of the Hipparcos data shows a main frequency at 7.5306±0.0004 c/d, or a 0.13279 day period. The new photometric data show that HIP 60725 is actually a small amplitude variable (maximum amplitude of 0.1 mag in the V band), which displays strong amplitude changes from night to night. Its F0 spectral type as well as the short period and the multiperiodic character of the light-curve are good indicators of light variations due to δ Sct pulsations.

A Fourier analysis of the ground-based data indicates that there are two pairs of strong frequencies at 7.512 and 7.530 c/d, and at 7.655 and 7.673 c/d, with a typical error for all of them of ±0.003 c/d. As there is a strong 7-day feature in the spectral window, these pairs are clearly 7-day aliases of each other. Among the detected frequencies in these data, the frequency at 7.530 c/d corresponds to the main frequency detected in the satellite photometry with a semi-amplitude of 27 mmag (25 mmag in the ground based data). As an additional test, our photometric data and the HIPPARCOS data were merged after removing their respective average values. A subsequent frequency analysis revealed that all the data could be folded on a 0.132792 ± 0.000001 day period, showing that this period is real and stable within the given errors since the HIPPARCOS era (mean epoch of 1991.25) until our 1998 observations (Fig. 1). The 7.673 c/d frequency is then its 7-day alias.

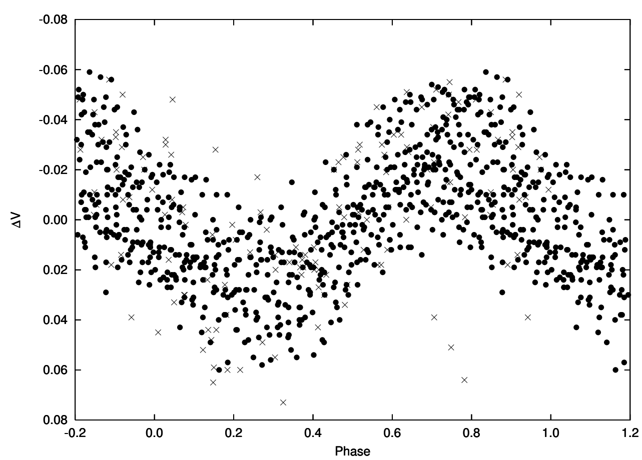

Figure 1. HIP 60725 satellite (crosses) and new photometric data (points) folded on the 0.132792 day period. Phase zero is assigned arbitrarily.

Since the light-curve of HIP 60725 shows a strong amplitude modulation, a second period was searched for. The satellite and ground-based data sets were prewhitened to remove the 0.13279 day period component and its alias forest. The ground-based prewhitened data showed two strong peaks at 7.656 c/d and 7.798 c/d in the frequency domain, which again are two 7-day aliases of the same frequency (the abovementioned 7.512 c/d alias also appears but with a lower amplitude). The frequency at 7.798 c/d can also be identified in the HIPPARCOS data. If both prewhitened data sets are merged, the 7.798 c/d frequency becomes the dominant one with a semi-amplitude of 16 mmag and all observations can be folded on a 0.128233 ± 0.000001 day period (Fig. 2). Its presence in the two independent data sets suggests that is a genuine frequency. Table 3 summarizes our results of the frequency analysis.

Table 3. Results of detected frequencies in the satellite data

Data set	Name	Frequency (c/d)	Semi-ampl. (mag)	Period (days)	S/N	Ground-based detection?
HIP 60725	f_1	7.530	0.027	0.1328	5.5	y
	f_2	7.798	0.020	0.1282	5.5	y
CU CVn	f_1	14.742	0.023	0.0678	10.3	y
	f_2	12.561	0.009	0.0821	4.8	n

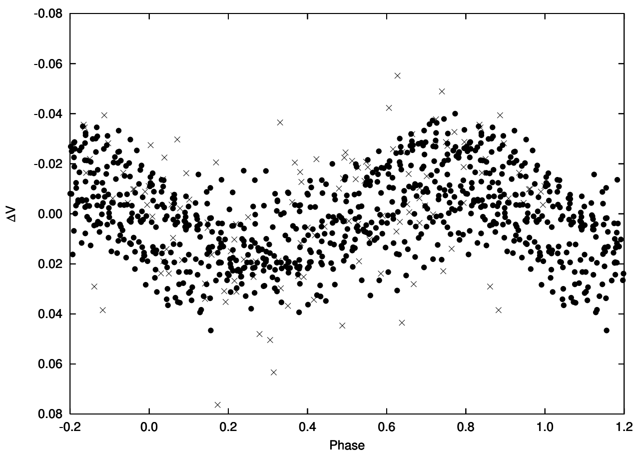

Figure 2. HIP 60725 satellite (crosses) and new photometric data (points) folded on the 0.128233 day period after removing the main 0.132792 day component.

CU CVn (HIP 67357) is listed as a periodic variable in the HIPPARCOS catalogue with a mean period of 0.1356670 days (ESA, 1997) and was classified as an EW: in the 74th Special Name-List (Kazarovets et al. 1999). A period analysis of the Hipparcos Epoch Photometry data shows a dominant frequency at 14.7419 ± 0.0004 c/d (period of 0.067834 ± 0.000002 days). Our photometric observations in the V band show that this object is a small-amplitude variable star with a maximum total amplitude of 0.06 mag, and rapid as well as irregular light-curve changes (Fig. 3). As for HIP 60725, its F0 spectral type, the short period as well as the rapid modulation probably caused by multiperiodicity are indicators of pulsation of the δ Sct type.

Although the small number of observed nights, only six, makes it difficult to obtain a reliable Fourier analysis of the new data for CU CVn, the frequency at 14.742 c/d is present, but only as part of a forest of 1 day aliases and not as the strongest component. As a matter of fact, even a satisfactory folded light-curve based on the 0.067834 day period could not be achieved after merging all available (ground-based and satellite) photometric data. The rapid modulation of the light-curve indicates that this object is a

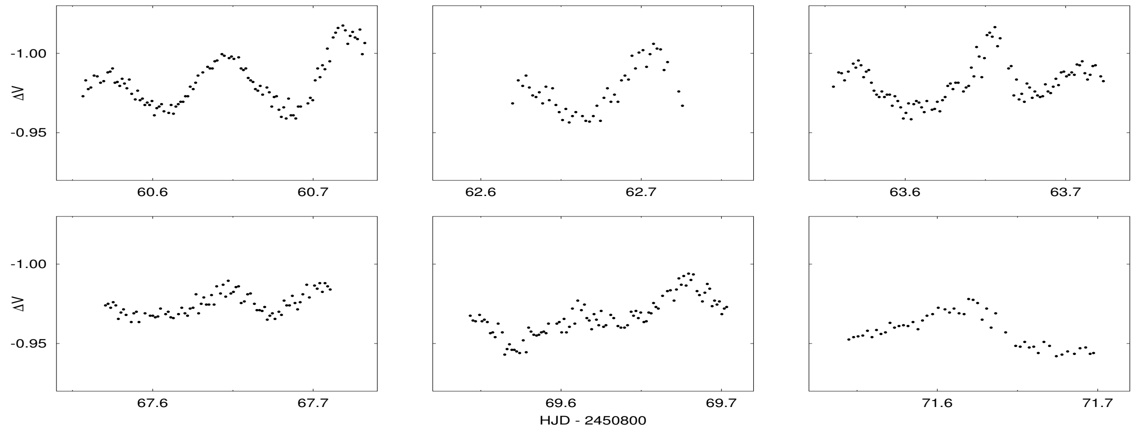

Figure 3. Ground-based light-curve in V light of CU CVn.

probable multiperiodic variable. Prewhitening of the satellite data suggests the presence of at least another frequency at 12.5606 ± 0.0004 c/d, which is very close to the frequency at 12.5869 ± 0.0004 detected in the prewhitened ground-based data. However, both cannot be unambiguously identified as corresponding to the exact same frequency. Table 3 illustrates the results for the HIPPARCOS data only. It is obvious that larger data sets spread over many nights are needed - especially in the case of CU CVn - to have a better knowledge of all the frequencies that are excited in these new δ Sct variables.

Acknowledgements: This research is based on data obtained by the Hipparcos astrometry satellite. Use has been made of the SIMBAD data base operated at the *Centre de Données Astronomiques (Strasbourg)* in France.

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Turon, C., Creze, M., Egret, D., Gomez, A., Grenon, M., Jahreiß, H., Requieme, Y., Argue, A. N., Bec-Borsenberger, A., Dommanget, J., Mennessier, M. O., Arenou, F., Chareton, M., Crifo, F., Mermilliod, J. C., Morin, D., Nicolet, B., Nys, O., Prevot, L., Rousseau, M., Perryman, M. A. C., 1993, Version 2 of the Hipparcos Input Catalogue, *Bull. Inf. Centre Donnees Stellaires*, **43**, 5

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GSC 03129-01490: A NEW δ Sct STAR IN LYRA

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We report on the variability of GSC 03129-01490 (coordinates: $\alpha = 19^{\rm h}11^{\rm m}59\overset{\rm s}{.}73$, $\delta = +42^\circ18'46\overset{\prime\prime}{.}0$, equinox 2000.0) discovered during a CCD photometric survey of the field of NSV 11814 (also named WR 92, see note below), with the 0.4-m Newtonian telescope at Monegrillo Observatory (Spain), from 14 June 1996 to 16 August 1996. CCD characteristics as well as photometric reduction methods are the same as those mentioned in an earlier paper (Vidal-Sáinz et. al. 2002). Photometric observations were performed using GSC 03129-00938 and GSC 03129-02917 as comparison and check stars, respectively. GSC 03129-01490 (V magnitude of 10.88) is included in the Tycho-1 catalogue (ESA, 1997), and has a $B-V$ colour index of $+0.379\pm0.112$. Its measured trigonometric parallax is 65.8 mas $\pm$ 30.4 mas.

Our observations show that GSC 03129-01490 is a rapid multiperiodic variable with an observed total V amplitude of about 0.11 mag (Fig. 1). To analyse the periodic nature of the photometric data, `Period98` (Sperl, 1998) was used. The frequency analysis shows two strong frequencies, f_1 and f_2, at 6.761 ± 0.004 and 13.139 ± 0.004 c/d, respectively (Fig. 2). After prewhitening for these main frequencies in the data, two additional frequencies, f_3 and f_4, appear at 5.990 ± 0.004 and 10.946 ± 0.004 c/d, respectively. Although the semi-amplitudes of f_3 and f_4 are close to the light-curve's scatter of 0.006 mag, they show a high signal-to-noise ratio indicating that these are very probably genuine frequencies. The frequency analysis is summarized in Table 1.

The lack of precise spectral information for this object together with the large uncertainties on the $B-V$ and parallax values, hinder the determination of the true nature of this variable star: assuming zero reddening, the possible range in $B-V$ values indicates a late A- to a late F-type star (Lang, 1992). In the hypothesis of a F5 main-sequence star with an absolute visual magnitude of +3.5 mag (Lang, 1992) it would appear that the parallax would need to be a few milliarcseconds at most (i.e. at the 2σ limit of the measured parallax), as the apparent V magnitude of 10.88 mag leads to a distance modulus of 3.3. The disagreement is even larger assuming an earlier spectral type. However, the multiperiodic character of the light-curve, the location of the computed frequencies ranging between 5 and 20 c/d and the suggestion that the colour index is a more reliable indicator of the probable spectral type than the Tycho-2 parallax for this fainter star, strongly suggest that GSC 03129-01490 is a new multiperiodic δ Scuti star.

Table 1. Identified frequencies

Name	Frequency (c/d)	Ampl./2 (mag)	Period (days)	S/N
f_1	6.761	0.020	0.1479	8.4
f_2	13.139	0.016	0.0761	11.3
f_3	5.990	0.010	0.1669	6.3
f_4	10.946	0.007	0.0914	4.9

A few comments are in order regarding the identification of NSV 11814. In the NSV Catalogue (Kholopov, 1982), NSV 11814 is identified with WR 92, and also assigned to GSC 03129-01490 (CDS, Strasbourg). In the original finding chart (Weber, 1959), WR 92 can be identified with GSC 03129-01382. So, NSV 11814 should be identified as GSC 03129-01382 and not as GSC 03129-01490. GSC 03129-01382 was also photometrically monitored but no light variations above noise level were detected.

Acknowledgements: This research has made use of the SIMBAD data base operated at the *Centre de Données Astronomiques de Strasbourg*, France. We thank Dr. P. Lampens for helpful comments improving the text.

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Weber, R., 1959, *Journal des Observateurs*, **42**, N. 7, 106

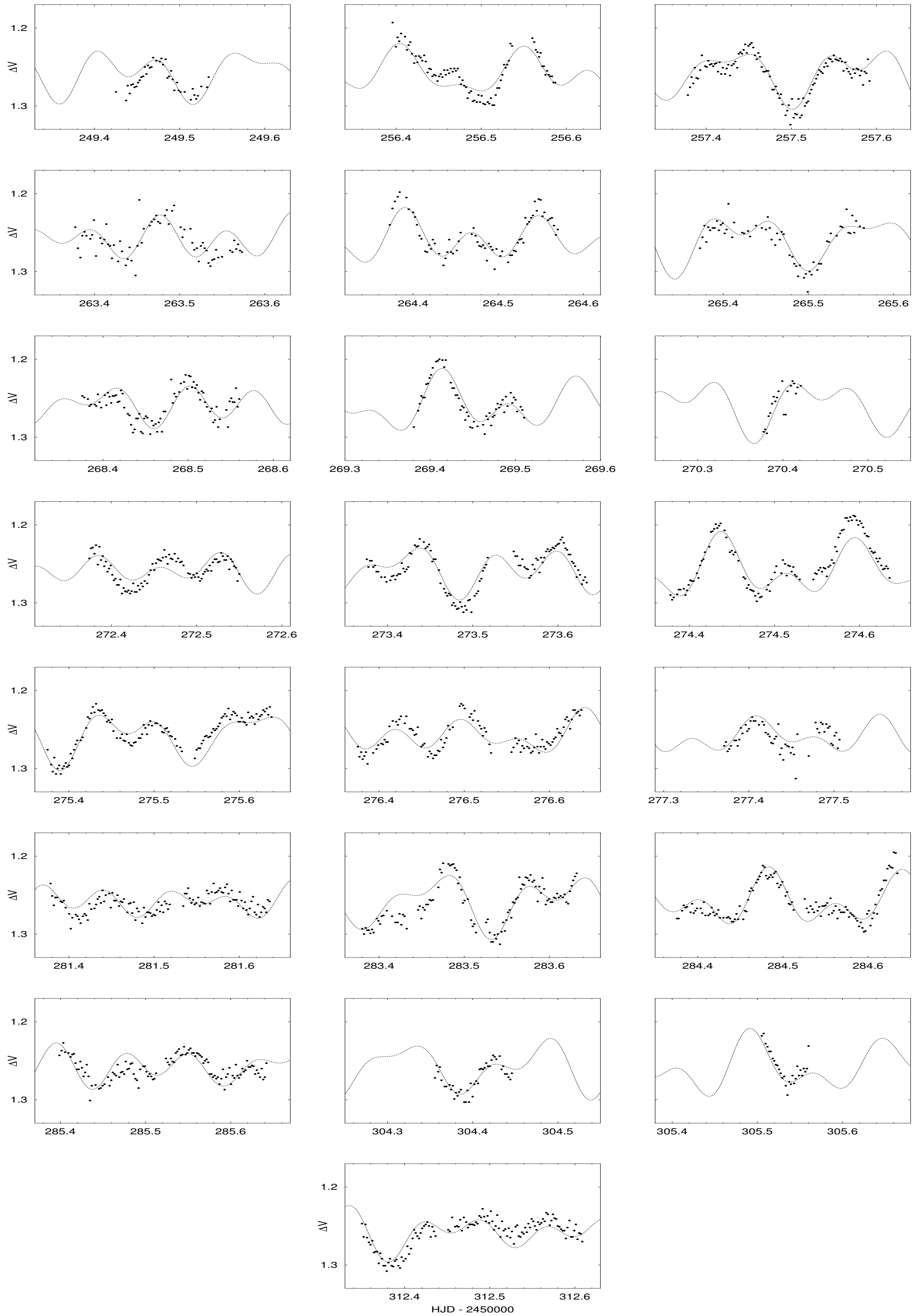

Figure 1. Observed light-curve of GSC 03129-01490 between June and August 1996, fitted with a 4-frequency model.

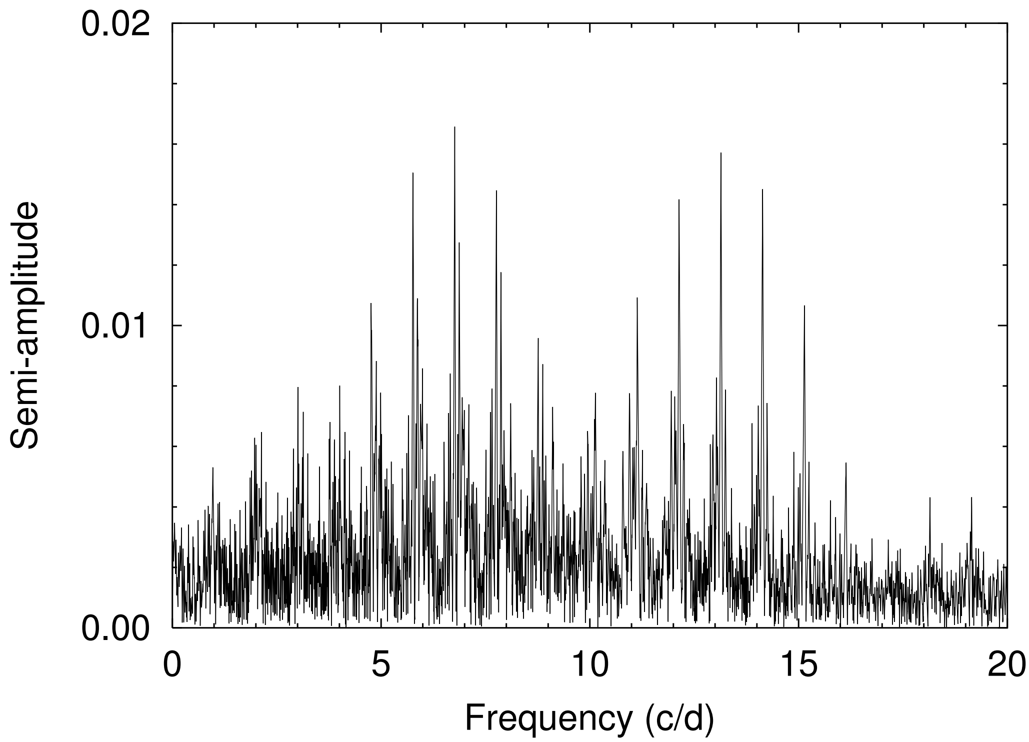

Figure 2. Power spectrum of GSC 03129-01490 photometric data showing the two dominant frequencies at 6.761 and 13.139 c/d.

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CCD LIGHT CURVES OF ROTSE1 VARIABLES, XVII: GSC 3528:44 Her, GSC 3532:939 Her, GSC 2629:1932 Her AND GSC 3532:174 Her

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

Detector:	SBIG ST-7 CCD camera

Method of data reduction:
Standard CCD-frame reduction using AIP4WIN software

Method of minimum determination:
Kwee – van Woerden algorithm

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp./check star(s)
GSC 3528:0044 ROTSE1 J180733.29+465435.0	EW	$18^h07^m33\overset{s}{.}3$	$+46°54'35''$	GSC 3524:161 / GSC 3524:223
GSC 3532:0939 ROTSE1 J180801.30+502451.8	EW	$18^h08^m01\overset{s}{.}3$	$+50°24'52''$	GSC 3532:1003 / GSC 3532:1199
GSC 2629:1932 ROTSE1 J180818.61+343436.0	EW	$18^h08^m18\overset{s}{.}6$	$+34°34'36''$	GSC 2629:1601 / GSC 2629:1409
GSC 3532:0174 ROTSE1 J180947.50+490254.0	EW	$18^h09^m47\overset{s}{.}5$	$+49°02'54''$	GSC 3532:224 / GSC 3532:395

Ephemeris:

Star name	E 2400000+	P [day]	Source
ROTSE1 J180733.29+465435.0	52526.4776	0.382655	present paper
ROTSE1 J180801.30+502451.8	52526.4937	0.309005	”
ROTSE1 J180818.61+343436.0	52526.3704	0.291353	”
ROTSE1 J180947.50+490254.0	52526.4286	0.2278765	”

Times of minima:						
Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
GSC 3528:0044 (Her)	51260.8469	8	s	none		ROTSE1
	51295.8598	6	p	none		ROTSE1
	52495.4826	25	p	none		
	52502.3709	8	p	none		
	52526.4760	6	p	none		
	52533.3651	6	p	none		
	52548.2893	9	p	none		
	52548.4812	14	s	none		
	52568.3786	23	s	none		
GSC 3532:0939 (Her)	51310.7142	9	s	none		ROTSE1
	51310.8705	12	p	none		ROTSE1
	52495.4335	21	s	none		
	52502.3921	11	p	none		
	52526.3387	10	s	none		
	52526.4940	7	p	none		
	52533.2900	13	p	none		
	52533.4456	13	s	none		
	52546.2733	20	p	none		
	52548.2788	13	s	none		
	52548.4348	8	p	none		
	52548.5893	9	s	none		
GSC 2629:1932 (Her)	51259.8599	5	p	none		ROTSE1
	51265.8340	5	s	none		ROTSE1
	52502.4791	5	p	none		
	52526.3716	12	p	none		
	52526.5155	3	s	none		
	52533.3634	14	p	none		
	52546.3279	16	s	none		
	52548.3670	12	s	none		
	52568.3254	11	p	none		
GSC 3532:0174 (Her)	51275.8425	4	p	none		ROTSE1
	51312.8723	12	s	none		ROTSE1
	52495.4374	5	p	none		
	52502.3878	8	s	none		
	52502.5015	6	p	none		
	52509.3367	2	p	none		
	52526.3149	17	s	none		
	52526.4288	14	p	none		
	52526.5424	17	s	none		
	52533.3794	13	s	none		
	52533.4936	11	p	none		
	52536.3419	16	s	none		
	52548.3051	12	p	none		
	52548.4187	4	s	none		
	52548.5324	9	p	none		

Explanation of the remarks in the table:
ROTSE1: Observations of Akerlof et al. (2000).

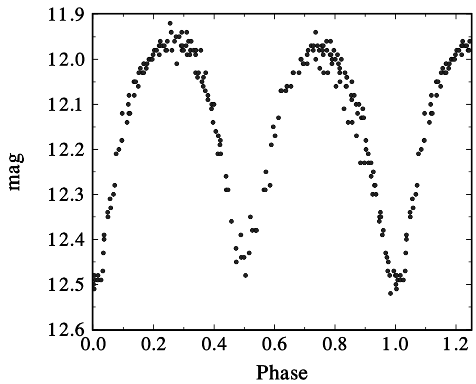

Figure 1. CCD light curve (without filter) of GSC 3528:0044

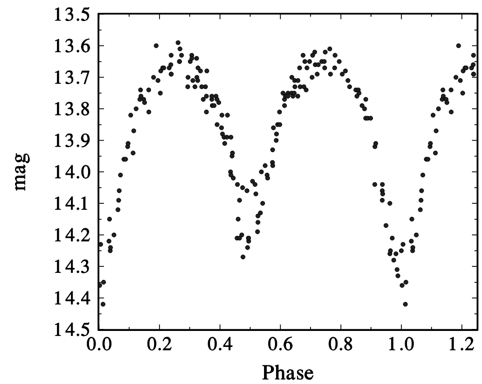

Figure 2. CCD light curve (without filter) of GSC 3532:0939

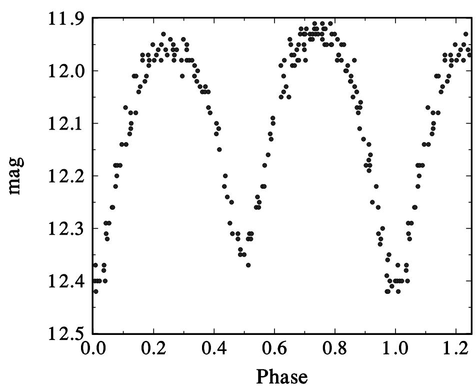

Figure 3. CCD light curve (without filter) of GSC 2629:1932

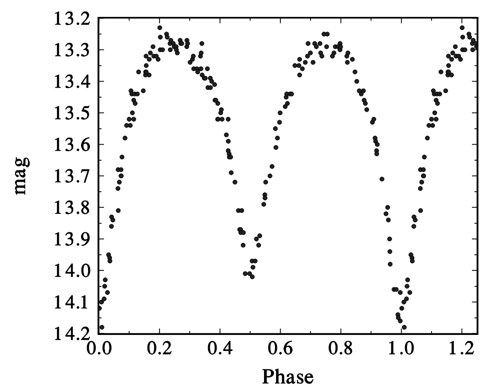

Figure 4. CCD light curve (without filter) of GSC 3532:0174

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). This installment contains information on four variables in the constellation Hercules. The four stars were observed with our CCD equipment during 7 nights between JD 2452495 and JD 2452568. A total of 216 CCD frames were measured of GSC 3528:0044, 187 frames of GSC 3532:0939, 194 frames of GSC 2629:1932 and 193 frames for GSC 3532:0174. Figures 1 through 4 show our observations folded with the elements given in the Table of Ephemeris. These elements of variation are deduced from a linear fit to the normal minima from the ROTSE1 data and the timings of minimum derived from our data given in the table of Times of minima and also in Blättler (2003). In the case of GSC3532:0174, we find an interesting contact binary with one of the shortest periods of revolution known, comparable to CC Comae.

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

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

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Akerlof, C., Amrose, S., Balsano, R., Bloch, J., Casperson, D., Fletcher, S., Gisler, G., Hills, J., Kehoe, R., Lee, B., Marshall, S., McKay, T., Pawl, A., Schaefer, J., Szymanski, J., Wren, J., 2000, *AJ*, **119**, 1901

Blättler, E., 2003, *BBSAG Bulletin*, **129**, in preparation

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ASTROMETRIC AUTHENTICATION OF RX J2309.8+2135 AS A NEARBY DWARF NOVA CANDIDATE

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RX J2309.8+2135 = 1RXS J230949.6+213523 is an X-ray source discovered through the ROSAT all-sky survey (Voges et al. 1999). Wei et al. (1999) reported its optical identification and provided a classification as a cataclysmic variable (CV) without further specification. Schwope et al. (2000) tentatively classified this object as a symbiotic binary based on the presence of a strong M-type stellar component. Most recently, however, Schwope et al. (2002) reported a refined classification as a CV based on the complete absence of high ionization lines and the line ratios (He I and Balmer lines) unlike those of symbiotic stars. Schwope et al. (2002) further proposed the spectral type of M3. Assuming that the secondary star is a Roche-lobe filling M3 dwarf star, Schwope et al. (2002) suggested an extremely small distance of ∼30 pc. This implication is surprising since this would break the nearest record of CVs (the best established example being WZ Sge: 45 pc, J. Thorstensen, cited in Steeghs et al. (2001)). We therefore reexamined this possibility.

We have examined the available astrometric catalogs (Table 1), and detected a large proper motion of $2''.8$ in 40.1 yr. This value has been confirmed by a direct comparison of DSS 1 and 2 plate scans. The detected proper motion corresponds to $0''.069 \pm 0''.012$ yr^{-1}. This value is comparable to nearby dwarf novae with large proper motions (WZ Sge: $0''.078 \pm 0''.007$ yr^{-1}, Kraft and Luyten 1965; GW Lib: $0''.066 \pm 0''.012$ yr^{-1}, Thorstensen et al. 2002; V893 Sco: $0''.067 \pm 0''.015$ yr^{-1}, Thorstensen 1999; 1RXS J232953.9+062814: $0''.056 \pm 0''.005$ yr^{-1}, Uemura et al. 2001, Kimeswenger et al. 2002). This large proper motion makes the object likely a nearby object. Assuming an upper limit transverse velocity of 100 km s^{-1}, the upper limit of the distance becomes ∼300 pc, which is consistent with independent distance determinations of CVs with similar proper motions (Thorstensen et al. 2002). The upper limit of $M_{\rm V}$ of the secondary thus becomes +8.5, which safely excludes the possibility of a symbiotic binary with a giant secondary. This indication is consistent with the suggested luminosity classification based on the CaH absorption at 6382 Å (Schwope et al. 2002). The present astrometry thus authenticates RX J2309.8+2135 as a nearby dwarf nova candidate. Even at a reasonable distance of ∼100 pc, the outburst maxima of RX J2309.8+2135 would reach $V \sim 9^{\rm m}$. At the suggested distance of ∼30 pc, the maxima would reach even $V \sim 7^{\rm m}$ (Warner 1986). These values indicate that RX J2309.8+2135 is a candidate for the brightest dwarf novae in the entire sky.

Table 1. Astrometry of RX J2309.8+2135.

Source	R. A.	Decl.	Epoch
	(J2000.0)		
USNO A2.0	$23^h09^m49^s.27$	$+21°35'20''.0$	1951.613
GSC 2.2.1	$23^h09^m49^s.17$	$+21°35'17''.7$	1991.754

However, the observed properties of RX J2309.8+2135 is rather unusual for a typical dwarf nova. The spectral type of M3 usually indicates an orbital period longer than 2–3 hr. Although CVs with such periods usually have relatively high mass-transfer rates (Warner 1995), the weak contribution of a disk continuum in the published spectra of RX J2309.8+2135 suggests the contrary. The lack of outburst detection between 2002 January and October (VSNET observations) seems to support a low mass-transfer rate. We know another secondary-dominated system with a low mass-transfer rate, CW 1045+525 (Tappert et al. 2001). These objects may represent a hitherto unidentified class of long-period CVs with the lowest mass-transfer rates, or these system may be undergoing excursions to long-lasting low states as in VY Scl-type stars (Warner 1995). The rather narrow appearance of emission lines in the published spectra resembles those of low states in VY Scl-type stars (Robinson et al. 1981), although a nearly pole-on view of a dwarf nova is also consistent with the observation. Since the orbital period of RX J2309.8+2135 has not yet been established, there also remains a possibility of an object with an anomalously hot, bright, evolved secondary (Uemura et al. 2002). The object is a very good candidate for future detailed photometric and radial velocity studies.

We are grateful to Pavol A. Dubovsky and Timo Kinnunen who reported observations to VSNET. This work is partly supported by a grant-in aid [13640239 (TK), 14740131 (HY)] from the Japanese Ministry of Education, Culture, Sports, Science and Technology.

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Budapest
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HU ISSN 0374 – 0676

IDENTIFICATION AND LIGHT ELEMENTS OF BW Lib

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Name of the object:
BW Lib = GSC 6192.1522

Equatorial coordinates:	**Equinox:**
R.A.= $15^h31^m40\overset{s}{.}08$ **DEC.=** $-20°27'17\overset{''}{.}5$	2000

Observatory and telescope:
Crimean Laboratory of Sternberg Astronomical Institute, 40-cm astrograph

Detector:	Photoplate

Filter(s):	None

Comparison star(s):	GSC	α (J2000)	δ (J2000)	B_{pg}
	6192.1322	$15^h32^m08\overset{s}{.}3$	$-20°19'55''$	$13\overset{m}{.}33$
	6192.0857	$15^h31^m53\overset{s}{.}8$	$-20°27'55''$	$14\overset{m}{.}31$
	6192.1144	$15^h31^m47\overset{s}{.}4$	$-20°28'08''$	$15\overset{m}{.}03$

Transformed to a standard system:	$B_{\rm pg}$
Standard stars (field) used:	Calibrated using the photoelectric standard sequence in NGC 5897 (Sandage and Katem, 1968)

Date(s) of the observation(s):
JD 2440413–2448425

Availability of the data:
Upon request

Type of variability:	EA

Remarks:

The eclipsing variable star BW Lib (HV 10673) was discovered by Hanley (1942) who mentioned the presence of a faint companion to the north-west. Ashbrook (1942) gives the photographic light range from $13^{\mathrm{m}}.2$ to $14^{\mathrm{m}}.9$ and the period $0^{\mathrm{d}}.93235$. No timings of minima were ever published for the star. A finding chart was presented by Tsesevich and Kazanasmas (1971). It shows a star approximately in $2'$ of the discoverer's position. However, there is a candidate star GSC 6192.1522 close to the position published by Hanley (1942) and with a companion agreeing with the description. We looked through several plates of our collection and immediately found a deep minimum on HJD 2440413.311 (in fact, the deepest minimum on our plates). Later on, our identification was confirmed by a finding chart based upon the discoverer's sketch and kindly sent to us by Dr. M.L. Hazen (Harvard Observatory). The best values of the period derived from the total of our 77 photographic brightness estimates do not differ significantly from that published by Ashbrook (1942), and thus we suggest the following light elements:
Min JD hel = $2440413.311 + 0^{\mathrm{d}}.93235 \times E$. The finding chart is shown in Fig. 1, the light curve is presented in Fig. 2. The wrong chart by Tsesevich and Kazanasmas identifies BW Lib with one of our comparison stars, GSC 6192.1144.

Acknowledgements:

The work of the GCVS team is supported, in part, by grants from the Russian Foundation for Basic Research (grant 02-02-16069), The Federal Scientific and Technological Program "Astronomy", and the program of support for leading scientific schools of Russia (00-15-96627). The Digitized Sky Survey images are provided by the Hubble Space Telescope Science Institute under support from grant NAG W-2166 of the USA Government. Thanks are due to Dr. M.L. Hazen for sending us the finding chart confirming our identification and to Dr. S.V. Antipin for his assistance during the preparation of the manuscript.

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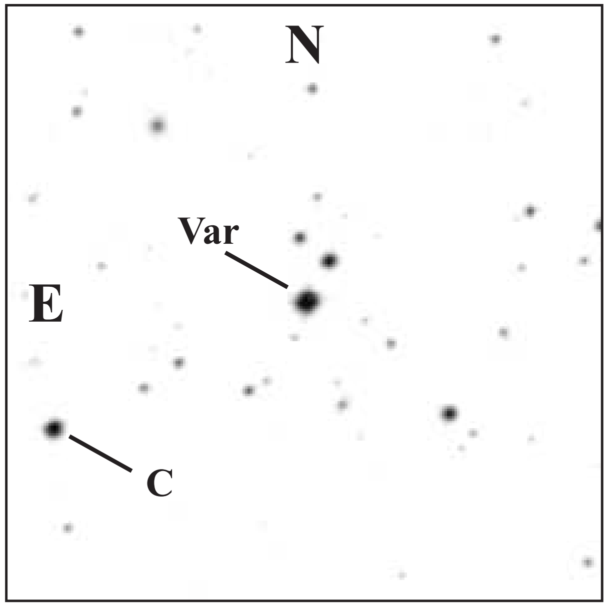

Figure 1. The finding chart for BW Lib. The chart shows a $4' \times 4'$ field from the second Digitized Sky Survey, in red light. The star marked "C" is GSC 6192.1144, erroneously identified with BW Ser in Tsesevich and Kazanasmas (1971).

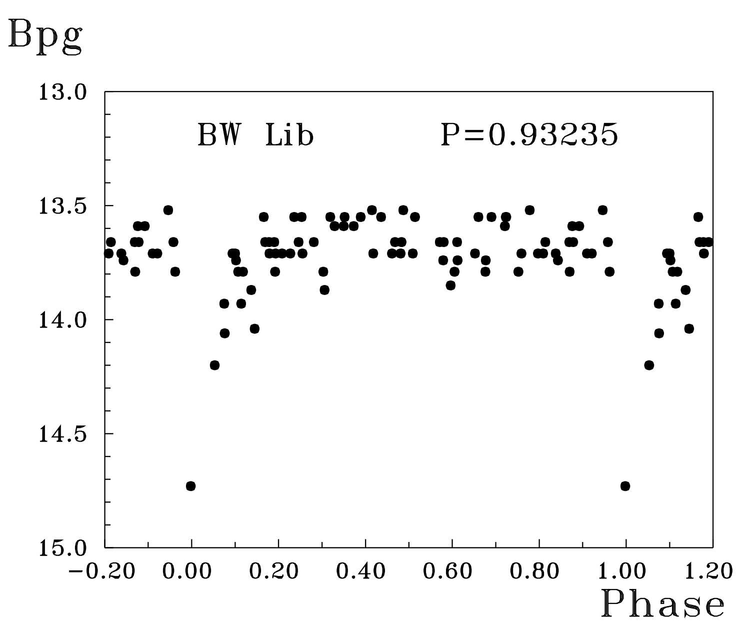

Figure 2. The light curve of BW Lib, folded with the elements presented above.

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INFORMATION BULLETIN ON VARIABLE STARS

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CCD OBSERVATIONS OF THE OUTBURST OF V838 Mon

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Name of the object:
V838 Mon

Equatorial coordinates:	**Equinox:**
R.A.= $07^h04^m05^s$ **DEC.**= $-03°50'51''$	2000

Observatory and telescope:
P. Sobotka and O. Pejcha: N. Copernicus Observatory Brno, 40 cm Newtonian telescope; L. Šmelcer: Valašské Meziříčí Observatory, Schmidt-Cassegrain 280/1764 telescope; L. Král and M. Kolasa: Johann Palisa Observatory, photo lens ($D = 55$ mm, $f = 600$ mm); K. Hornoch: Private observatory, 35 cm Newtonian telescope; F. Lomoz: Sedlčany Observatory, photo lens ($D = 90$ mm, $f = 360$ mm)

Detector:	P. Sobotka, O. Pejcha, L. Šmelcer, L. Král and M. Kolasa: SBIG ST-7 camera; K. Hornoch: SBIG ST-6 camera; F. Lomoz: SBIG ST-5 camera;

Filter(s):	P. Sobotka and O. Pejcha: V, R, I; L. Šmelcer: V; L. Král and M. Kolasa: R filter of the RGB set (`http://www.sbig.com/sbwhtmls/Oldfilterchart.htm`; K. Hornoch: R_C; F. Lomoz: R, G, B filters of the RGB set

Comparison star(s):	GSC 4822.3559, (V = 10.707 mag, $B-V$ = 0.037 mag, Henden 2002)

Check star(s):	GSC 4822.0321

Transformed to a standard system:	No

Availability of the data:
Through the IBVS Web-site (5336-t1.txt).

Type of variability:	Unique

Remarks:

V838 Mon was discovered as an apparent nova by Brown (2002) at photographic magnitude 10. The photometric evolution has been very slow since discovery. The star has faded almost to magnitude 11 until 2002 Feb. 1. However, on 2002 Feb. 2 one of us (L. Šmelcer) noticed on his CCD frames that V838 Mon suddenly brightened to magnitude 8 in the V band. The information was relayed by Brát (2002).

Here we present all 4217 CCD observations of the MEDUZA Group (part of Variable Star Section of the Czech Astronomical Society). To search for periodicities in our high speed photometry (carried out during the rising to the second maximum) we have fitted and subtracted a straight line from data taken during each night and in each passband and submitted them to the DFT (Sperl 1998). We did not detect any real period above 0.02 mag level.

Acknowledgements:

We acknowledge the overall support and the use of the telescope with CCD camera of the N. Copernicus Observatory and Planetarium and Observatory and Planetarium of Johann Palisa. This research made use of the SIMBAD data base, operated by the CDS at Strasbourg, France.

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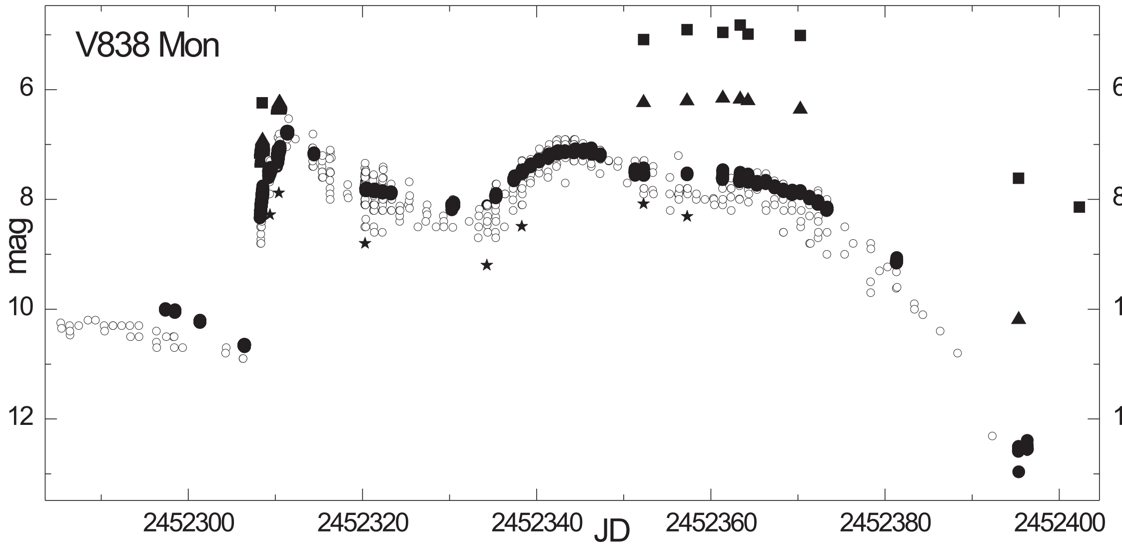

Figure 1. MEDUZA CCD and MEDUZA + VVS, WVS Belgium visual observations of V838 Mon. Filled circles represents CCD V, star shaped symbols CCD B, triangles CCD R and squares CCD I respectively. Visual observations are plotted as open circles.

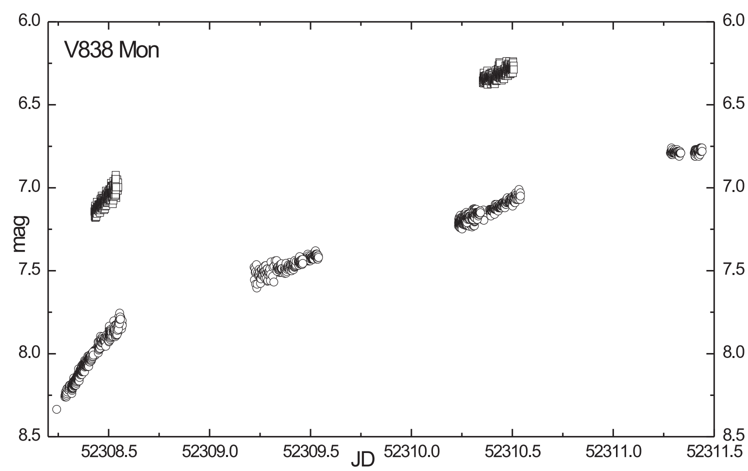

Figure 2. MEDUZA CCD observations of the second outburst of V838 Mon. Open circles represents CCD V data and open squares represents CCD R data.

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FIRST LIGHT CURVE AD ELEMENTS OF AB Cnc

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Name of the object:
AB Cnc, GSC 809 338

Equatorial coordinates:	**Equinox:**
R.A.= $08^h37^m37^s$ **DEC.=** $+14°35'55''$	2000.0

Comparison star(s):	GSC 809 322

Check star(s):	GSC 809 470 and GSC 809 162

Observatory and telescope:
Vyskov observatory, Czech Republic, RL 300/1200 mm telescope

Detector:	CCD camera SBIG ST-7, 382×255 pixels, $19' \times 13'$ FOV

Filter(s):	unfiltered CCD band

Transformed to a standard system:	No

Date(s) of the observation(s):
from February 2001 to May 2002

Method of data reduction:
Images were processed by MUNIDOS photometry software package. (Hroch, Novak, 1997)

Method of minimum determination:
The times of minima (see table 1) were derived by means of Tintagel programme (Gaspani, 1995).

Type of variability:	EA

Availability of the data:
Upon request

Ephemeris:			
Star name	E 2400000+	P [day]	Source
AB Cnc	52404.3602 ± 0.0007	0.872823 ± 0.000005	this paper

Times of minima:						
Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
AB Cnc	52030.3549	0.0009	sec.	–	– 0.0006	K, H
	52322.3158	0.0011	prim.	–	0.0010	M
	52369.4469	0.0018	prim.	–	– 0.0004	K
	52404.3602	0.0007	prim.	–	0.0000	H

Explanation of the remarks in the table:
Observer: H=Hajek, K=Koss, M=Motl

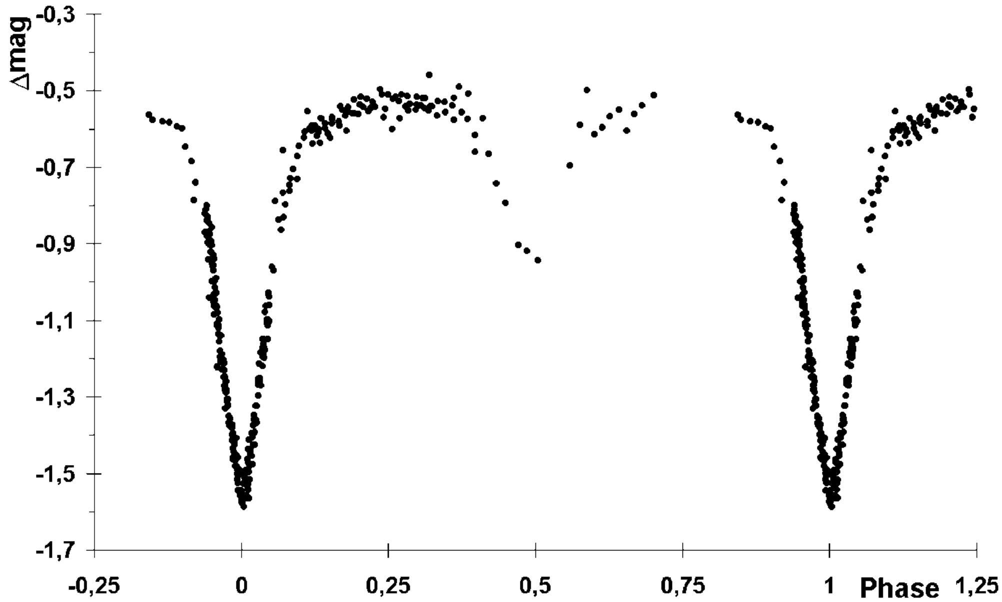

Figure 1. Folded light curve of AB Cnc.

Remarks:
The variability of this star was discovered by O. Morgenroth (1935) who gave the first designation as AN 203.1935 Cnc. The star is also mentioned by Zakirov and Shaidulin (1985) as a member of Praesepe cluster (NGC 2632). We present the first photoelectric light-curve and elements of the system. The light curve elements were determined with the help of our Varplot application (Motl, 2001). Figure 1 displays the folded light curve, magnitudes are instrumental and they are relative to the comparison star used. The depth of the primary and the secondary minima is about $1\overset{m}{.}1$ and $0\overset{m}{.}4$, respectively.

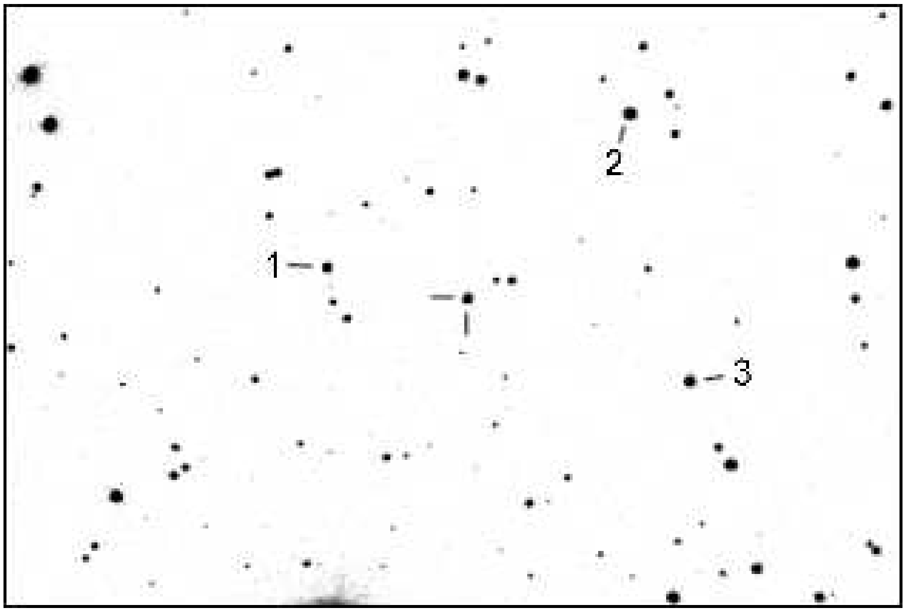

Figure 2. Identification map of AB Cnc (bars), comparison star (No. 1) and two check stars (No. 2 and 3). The size of the field is 19 × 13 arcminutes, unfiltered CCD band, 20-second exposure.

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PERIOD CHANGE AND SURFACE ACTIVITY OF THE ECLIPSING BINARY UV LEONIS

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UV Leonis is a $V = 8\overset{m}{.}9$ eclipsing binary that consists of two solar-type G0 and G2 stars ($M_1 = 1.13M_\odot$, $M_2 = 1.09M_\odot$, $R_1 = 1.081R_\odot$, $R_2 = 1.186R_\odot$, $T_1 = 5916K$, $T_2 = 5861K$; Frederik & Etzel, 1996) for which period change and surface activity have already been reported by Wunder (1995), Frederik & Etzel (1996), Popper (1997) and Snyder (1998). We present the results based on a thorough photometric study conducted at the Črni Vrh Observatory, Slovenia, that accompany the published $O-C$ catalog by Kreiner et al. (2000).

We obtained Johnson B and V photometric measurements of UV Leonis from Feb 27, 2000 to Apr 04, 2001 with a 19-cm, f/4 flat field $S-C$ telescope and HiSys-44 CCD imaging detector: in total 1564 measurements in B and 1579 in V filter. Measurements have been reduced by the `DAOPHOT` package (Stetson 1987) based on 6 standard stars: `HIP 51949`, `HIP 52070`, `TYC 845 73 1`, `TYC 845 71 1`, `HIP 51902` and `HIP 52099`. Standard deviation of the data was measured from the comparison star `TYC 845 73 1` of a constant magnitude that is comparable to that of UV Leonis. The minima extraction has been done with the algorithm proposed by Kwee & Van Woerden (1956); we present the results in Table 1.

In recent years a significant effort has been made to estimate the $O-C$ behaviour as a function of time: a sudden change in period was suggested by Wunder (1995), a sine function fitted to the quadratic change of $O-C$ by Snyder (1998). By inspecting the $O-C$ catalogue by Kreiner et al. (2000) with added data from Bíró & Borkovits (2000), Borkovits et al. (2001, 2002) and from this paper, we find that the sudden (discrete) change in period is a preferable assumption, as demonstrated by Fig. 1. The data of minima from the catalog prior to 1949 have not been used in calculations because of their poor accuracy. Fig. 1 shows that a sudden change in period appeared at HJD $\sim$ 2444362 (May 1980) with the following ephemeris deduced before and after the change:

$$\mathrm{HJD_{min}} = 2437616.2091(4) + 0.6000849(21)\mathrm{E} \qquad \text{for HJD} < 2444362, \qquad (1)$$

$$\mathrm{HJD_{min}} = 2448617.5761(3) + 0.6000864(12)\mathrm{E} \qquad \text{for HJD} > 2444362. \qquad (2)$$

Error estimates are based on the accuracy of the minima determination for HJD and $O-C$ dispersion for period. They are given in parentheses to show the accuracy of the last decimal place. Ephemeris are generally consistent with the results of Wunder (1995), though observations obtained in the last 6 years contribute to a more reliable linear solution since the period change (Eq. 2).

HJD_{min} (error)	Type	Pts.	Filter	HJD_{min} (error)	Type	Pts.	Filter
2451602.4045 (3)	Primary	5	B	2452001.4634 (2)	Primary	31	B
2451602.4068 (7)	Primary	5	V	2452001.4641 (2)	Primary	31	V
2451606.6073 (2)	Primary	58	B	2451625.5089 (3)	Secondary	120	B
2451606.6073 (1)	Primary	58	V	2451625.5091 (2)	Secondary	119	V
2451626.4097 (2)	Primary	120	B	2451952.5575 (6)	Secondary	31	B
2451626.4098 (2)	Primary	119	V	2451952.5574 (4)	Secondary	32	V
2451956.4576 (4)	Primary	22	B	2451955.5581 (6)	Secondary	32	B
2451956.4579 (4)	Primary	22	V	2451955.5581 (7)	Secondary	32	V
2451957.6582 (2)	Primary	16	B	2451961.5544 (6)	Secondary	28	B
2451957.6579 (2)	Primary	16	V	2451961.5536 (6)	Secondary	28	V
2451959.4584 (5)	Primary	31	B	2451963.3589 (5)	Secondary	13	B
2451959.4584 (3)	Primary	31	V	2451963.3588 (5)	Secondary	13	V
2451962.4586 (4)	Primary	32	B	2451991.5611 (9)	Secondary	12	B
2451962.4587 (3)	Primary	32	V	2451991.5603 (9)	Secondary	12	V

Table 1. Our primary and secondary minima of UV Leonis. HJD is given with an error estimate in parentheses for the last two decimal places. We also present the number of data points (Pts.) that have been used for minima determination. B and V stand for Johnson B and V filters.

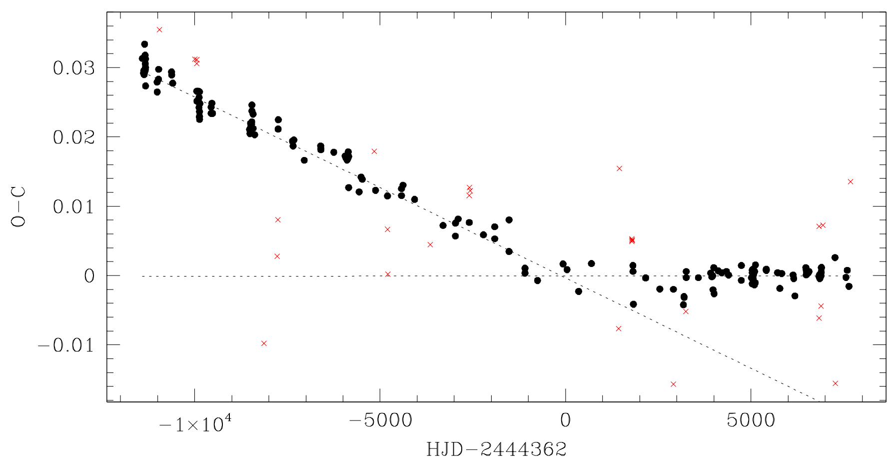

Figure 1. $O-C$ diagram for UV Leonis. Dashed lines represent the ephemeris before (Eq. 1) and after (Eq. 2) the sudden period change at HJD $\sim$ 2444362 (May 1980). Data taken from Kreiner et al. (2000), Bíró et al. (2000), Borkovits et al. (2001, 2002) and this paper (see text for details). The points marked with a cross were considered as outlayers and were not used in ephemeris calculation.

To try to understand the underlying physics that could govern such a sudden period change, we made a crude estimate of the mass loss that could cause such a change. From the equation of total orbital angular momentum (L) and the Kepler's law we obtain the following relationship:

$$\frac{\mathrm{d}L}{L} = \left[\frac{2}{3} + \frac{q}{3(1+q)}\right]\frac{\mathrm{d}m_1}{m_1} + \left[1 - \frac{q}{3(1+q)}\right]\frac{\mathrm{d}m_2}{m_2} + \frac{1}{3}\frac{\mathrm{d}P}{P}, \tag{3}$$

where $q = m_2/m_1$ and P is the period of UV Leonis. The angular momentum change dL can only be 0 or negative and the mass ratio is close to 1 so both square brackets have the value of 5/6. In order to cause the period change of $\mathrm{d}P/P = 2.5 \times 10^{-6}$ the total mass lost from the system had to be no less than 1.9×10^{24} kg or a third of the mass of the Earth. Since our binary consists of two main sequence stars that appeared undisturbed around HJD 2444362, we see no plausible physical background to justify such a significant mass loss effect. The period change might, on the other hand, be assigned to the near-periastron passage of an unobserved third body of low mass. We plan to investigate this assumption furtherly.

Based on purely photometric data, Frederik & Etzel (1996) proposed the presence of the two near-polar dark spots on the outer hemisphere of the cooler star, which accounted for their model result that the hotter, more massive star is the smaller and less luminous one. This result has been argued by Popper (1997), who based his work on purely spectroscopic data to conclude that the hotter star is the more luminous one.

Our measurements have been obtained in two consecutive seasons, the first one in 2000 (1973 measurements) and the second one in 2001 (1176 measurements). The unmistakable vertical shift in light curves between the two seasons (Figs. 2, 3) shows the signs of UV Leonis' surface activity. The magnitudes of standard stars remained constant at all times, so instrumental errors are ruled out; the vertical shift is real.

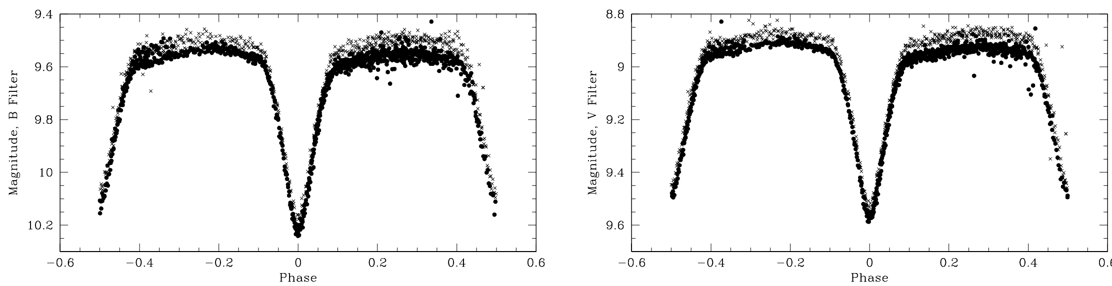

Figure 2. The B (left) and V (right) filter light curves of the seasons 2000 (filled circles) and 2001 (crosses).

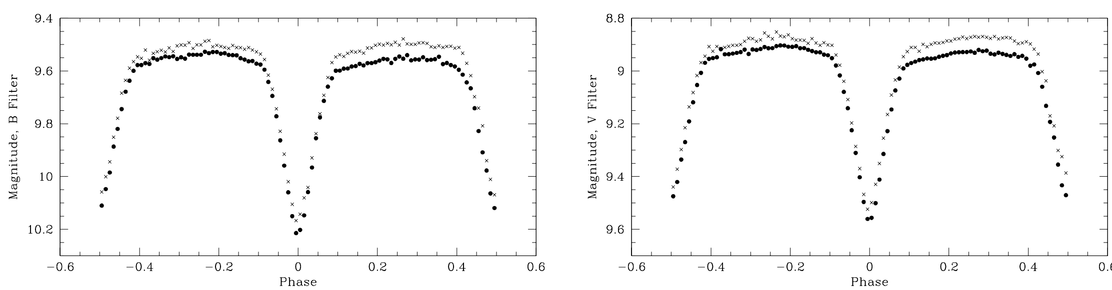

Figure 3. The B (left) and V (right) filter binned light curves of the seasons 2000 (filled circles) and 2001 (crosses). The data has been binned to 100 points in phase to demonstrate that the difference between both seasons is only a vertical offset.

The magnitude offset shown in Fig. 3 is $\sim 0.03-0.05$, the second season measurements being *brighter* than the first season. This yields a flux difference of $\sim 3\%$ to 5% or a total surface temperature difference of $\mathrm{d}T/T \sim 0.01$. If we adopt the average temperature factor of dark spots from Frederik & Etzel (1996) ≈ 0.85 ($\mathrm{d}T/T \sim 0.15$), then such spots should cover $\sim 1/15 \approx 7\%$ of stellar surfaces. The distribution of these dark spots on stellar surfaces is a non-trivial problem because of modeling degeneracies. However, to obtain a strict vertical shift observed in Figs. 2 and 3, two plausible distributions make sense: 1) large near-polar spots which don't get eclipsed at any time and 2) a fair amount of small, uniformly distributed spots over the visible surface.

This paper is a preliminary study of UV Leonis based exclusively on photometric data. A complete spectrophotometric study including 74 echelle spectra obtained at the 1.8m Ekar telescope (Asiago, Italy) is being analysed and will be presented later.

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Erratum

Anton Paschke reports a probable typing error in IBVS 1325. The time of the minimum of XX Cep observed by R. Diethelm in 1975 (as printed in IBVS 1325: 42439.383 Diethelm 1975) should be 42439.370 according to the BBSAG Bulletin No. 20.

12 September 2002

The Editors

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TWO NEW ECLIPSING BINARIES: V1626 Ori (Brh V38) AND GSC 0486-4828 (Brh V64)

(BAV Mitteilungen Nr. 144)

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Further observations and analysis are presented of two suspected eclipsing binaries recently discovered by Bernhard (2000a, 2000b). Further details of the program are given by Bernhard & Lloyd (2000) and an up-to-date list of the variables can be found at `http://mitglied.lycos.de/klausbernhard/`. Details of the equipment used are given by Lloyd et al. (2002) and Quester & Bernhard (2001).

V1626 Ori = BrhV38 = GSC 0721-2377 ($06^{\rm h}05^{\rm m}20^{\rm s}.118$ $+10^\circ04'25''.54$ Tycho-2) was initially reported as a possible eclipsing system by Bernhard (2000a) on the basis of eight nights of survey data. Further photometry on 16 nights have confirmed that it is an eclipsing binary with a period of just over one day. The reference star used was GSC 0721-0968 with $V \approx 12^{\rm m}.2$. Two primary minimum have been observed and the times are given in Table 1. The ephemeris of primary minimum is given by

$$HJD_{\rm MinI} = \underset{\pm 29}{2452223.5824} + \underset{\pm 3}{1^{\rm d}.137793} \times E$$

V1626 Ori appears at the limit of the Tycho-2 catalogue (Høg et al. 2000) with a rather unreliable $V = 12^{\rm m}.5 \pm 0^{\rm m}.3$ and $B - V = -0^{\rm m}.1 \pm 0^{\rm m}.4$ while the USNO A2.0 catalogue gives $b = 11^{\rm m}.6$ and $b - r = 0^{\rm m}.7$ (Monet et al. 1998).

A photometric model of the system has been derived using the LIGHT2 code (see Hill et al., 1989). In this system there is nothing to guide to choice of mass ratio but given the difference in the eclipse depths it is likely that $q < 0.5$. A range of mass ratios, $1.0 > q > 0.1$, and temperatures have been explored and it must be conceded that a wide variety of photometric parameters provide almost identical fits to the light curve. However, only a small range of models are physically consistent with the primary being

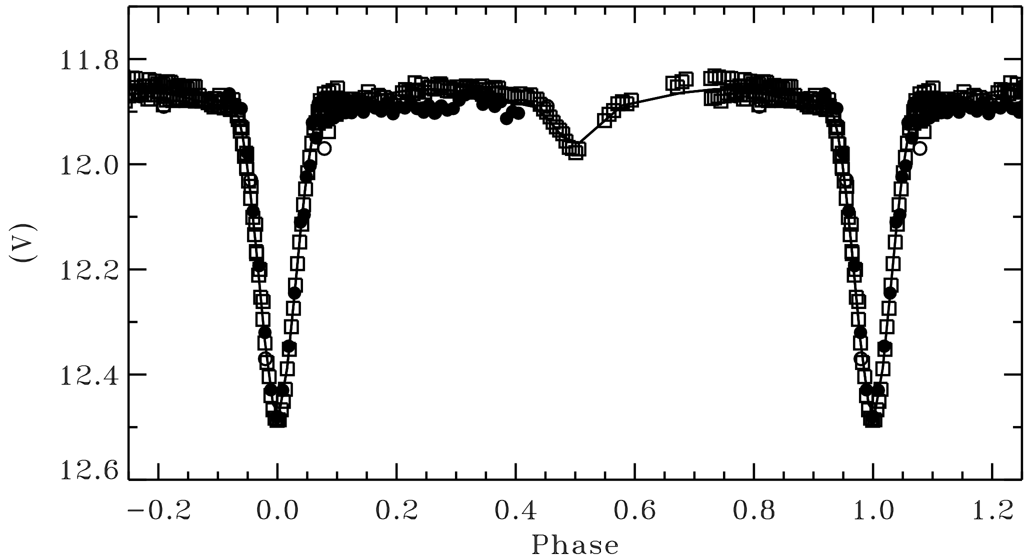

Figure 1. The phase diagram of V1626 Ori = Brh V38 assuming that the reference star GSC 0721-0968 has $V = 12\overset{m}{.}2$. The CCD observations of Moschner (open squares), Frank (filled circles) and Bernhard (open circles) are folded with the ephemeris given in the text. The fit is described in the text.

a main-sequence star, and these have $T_1 \sim 6600$ and $q < 0.5$, corresponding to an F5 V star. The parameters are only weakly dependent on q, but with $q < 0.2$ the secondary fills its Roche lobe.

The fit to the light curve shown in Figure 1 was obtained with $q = 0.3$ and $T_1 = 6600$ K (fixed), yielding $T_2 = 4600 \pm 100$ K, $i = 77^\circ \pm 1^\circ$, $R_1/a_0 = 0.23 \pm 0.01$ and $R_2/a_0 = 0.24 \pm 0.02$. A star of spectral type F5 V, has $M = 1.4\mathrm{M}_\odot$ and $R = 1.3\mathrm{R}_\odot$ (Cox 2000), giving $a_0 = 5.8\ \mathrm{R}_\odot$, and $R_1 = 1.3\mathrm{R}_\odot$ from the model. The temperature of the secondary corresponds to an early K-type star with a radius, $R_2 = 1.4\mathrm{R}_\odot$, which is substantially larger than expected for an early K-type star. For $q < 0.5$ there is little to separate the solutions so the secondary may fill its Roche lobe or is close to it. If it does fill its Roche lobe then $q < 0.2$, implying $M_2 < 0.3\mathrm{M}_\odot$.

Table 1: Brh V38 - Times of minima

HJD	$O-C$	Min	HJD	$O-C$	Min
2451957.3379(12)	−0.0009	I	2452223.5824(3)	+0.0000	I

BrhV64 = GSC 0486-4828 ($19^{\rm h}34^{\rm m}21\overset{s}{.}486$ $+03^\circ54'43\overset{''}{.}33$) was initially reported as a probable eclipsing system by Bernhard (2000b) following several long runs of observations. Further extensive photometry during the 2000 and 2001 observing seasons has confirmed that it is an eclipsing binary, with a period of just under ten days. In total four minima have been observed and they are given in Table 2. The reference star used was GSC 0486-3453 with $V \approx 12\overset{m}{.}3$. The ephemeris of primary minimum is given by

$$HJD_{\rm MinI} = \underset{\pm 103}{2452137.5441} + \underset{\pm 5}{9\overset{d}{.}27850} \times E$$

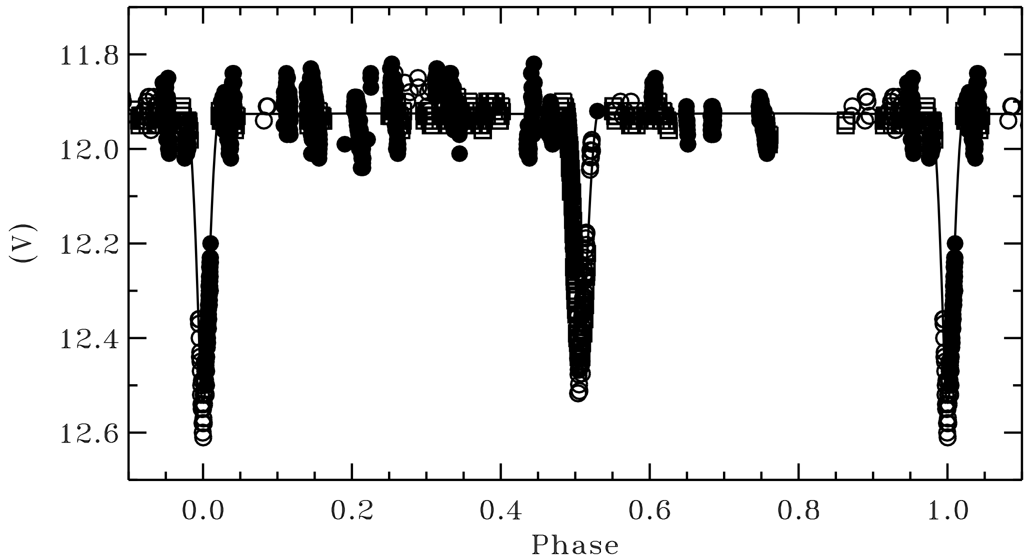

Figure 2. The phase diagram of BrhV64 = GSC 0486-4828 assuming that the reference star GSC 0486-3453 has $V = 12^{\mathrm{m}}.3$. The CCD observations of Frank (open squares), Quester (open circles) and Bernhard (filled circles) are folded with the ephemeris given in the text. The fit is described in the text.

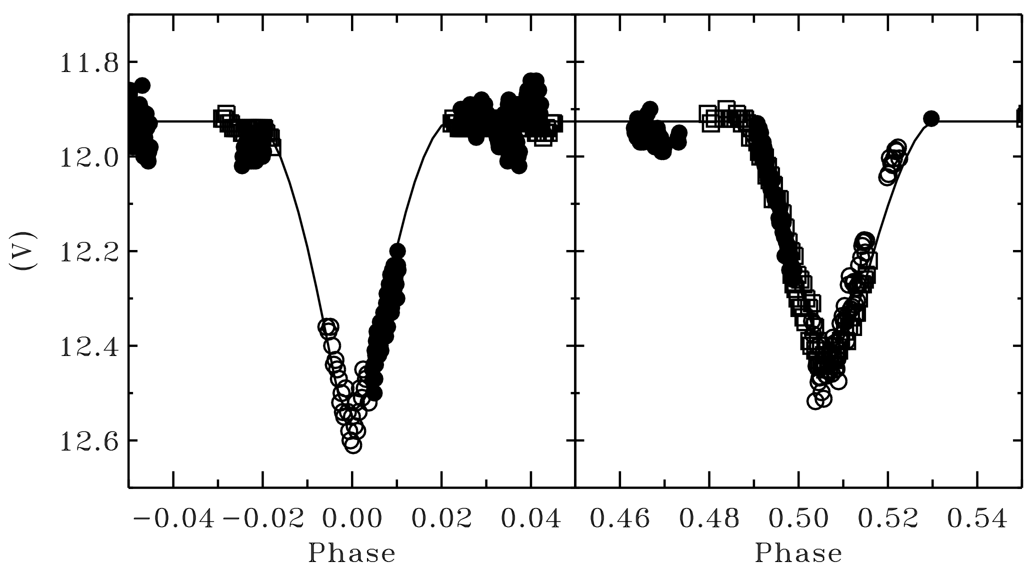

Figure 3. Detail of the primary and secondary minima. The symbols are as in Figure 2.

Table 2: Brh V64 - Times of minima

HJD	$O-C$	Min	HJD	$O-C$	Min
2452137.5441(17)	+0.0000	I	2452179.3590(7)	+0.0013	II
2452151.5251(11)	+0.0029	II	2452448.4309(29)	−0.0033	II

The light curve, given in Figure 2, shows that both eclipses are nearly equal in depth, at close to $0^{\mathrm{m}}.7$, indicating that the system contains two similar stars. Figure 3 shows that there is a small but clear difference in the eclipses, which eliminates the half period, but also that the secondary eclipse is slightly displaced, to $\phi = 0.5065$, indicating a small eccentricity.

A photometric model of the system has again been derived using the LIGHT2 code (see Hill et al., 1989). The mass ratio is unknown but given the similarity of the eclipses it is reasonable to assume initially that $q \sim 1.0$. Similar fits to the light curve are found for a range of temperatures, so T_1 and T_2 are unconstrained, but the relative radii are found to be almost independent of temperature. A temperature for the primary, $T_1 = 10\,500$ K has been adopted as this provides a physically consistent set of values for both stars, assuming that they lie on the main sequence.

Adopting $q = 1$ and $T_1 = 10\,500$ K (fixed), gives $T_2 = 10\,000 \pm 100$ K, $R_1/a_0 = 0.080 \pm 0.002$, $R_2/a_0 = 0.063 \pm 0.002$, $i = 89^{\circ}.8 \pm 0^{\circ}.2$, $e = 0.04 \pm 0.01$ and $\omega = 74^{\circ} \pm 6^{\circ}$. This fit is plotted in Figures 2 and 3. The primary corresponds to a main-sequence star near spectral type B9, which has $M = 3.3$ $\mathrm{M}_{\odot}$ and $R = 2.7$ $\mathrm{R}_{\odot}$ (Cox 2000), giving $a_0 = 34.0$ $\mathrm{R}_{\odot}$, and $R_1 = 2.7$ from the model. The secondary is marginally cooler and smaller, with $R_2 = 2.2$ $\mathrm{R}_{\odot}$, making it an early A-type star. This result is also consistent with the Tycho-2 photometry which gives $V = 11^{\mathrm{m}}.96 \pm 0^{\mathrm{m}}.13$ and $B - V = 0^{\mathrm{m}}.08 \pm 0^{\mathrm{m}}.23$. As the system is detached, apparently unevolved, and has $i = 90^{\circ}$ it would appear to be an ideal candidate for testing the fundamental parameters of main-sequence stars.

Acknowledgements. It is a pleasure the acknowledge the use of the SIMBAD database, operated by the CDS at Strasbourg, France.

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A NEW ECLIPSING BINARY NEAR BL Cam

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Name of the object:
W1

Equatorial coordinates:	**Equinox:**
R.A.= $03^{\rm h}\ 47^{\rm m}\ 45\overset{\rm s}{.}03$ **DEC.=** $63^\circ\ 28'\ 25''\!.8$	2000.0

Observatory and telescope:
BOAO (Bohyunsan Optical Astronomy Observatory), 1.8m reflector (f/8, Cassegrain focus)

Detector:	Thinned back illuminated SITe 2048×2048 chip ($11\overset{'}{.}6 \times 11\overset{'}{.}6$)

Filter(s):	B, V

Date(s) of the observation(s):
JD 2451871, 2451872, 2451874, 2452269−2452272

Transformed to a standard system:	Landolt 1992
Standard stars (field) used:	

Availability of the data:
From the IBVS website, as 5340-t1.txt

Type of variability:	EB

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
W1	51871.186	0.001	I	V	0.0000	
	51872.163	0.001	I	V	−0.0015	
	51874.122	0.001	I	V	+0.0005	
	52272.375	0.005	I	V	−0.0013	

Remarks:

Time-series BV CCD photometry was performed over five nights for W1 from November 4, 2000 to December 28, 2001. Using `IRAF/CCDRED` package, we processed CCD images to correct overscan regions, trim unreliable subsections, subtract bias frames and correct flat field images. Instrumental magnitudes were obtained using the `Point Spread Function` fitting photometry routine in `IRAF/DAOPHOT` package (Massey & Davis, 1992). We applied the ensemble normalisation technique (Gilliland & Brown, 1988) to standardise the instrumental magnitudes of all stars in the time-series CCD frames. A new faint field eclipsing binary star ($\langle V\rangle = 19.92$ mag, $\langle B\rangle - \langle V\rangle = 0.84$ mag) was discovered.
$O-C$ values were calculated according to the following ephemeris:

$$\text{Min I} \;=\; \text{HJD } 2451871.186 \;+\; 0.326171 \times E.$$

The period is preliminary, similar solution as shown in Fig. 2 can be obtained with other periods in the 0.325-0.329 d period range.

References:

Gilliland, R. L., Brown, T. M., 1988, *PASP*, **100**, 754
Landolt, A. U., 1992, *AJ*, **104**, 340
Massey, P., Davis, L. E. 1992, A User's Guide to Stellar CCD photometry with IRAF

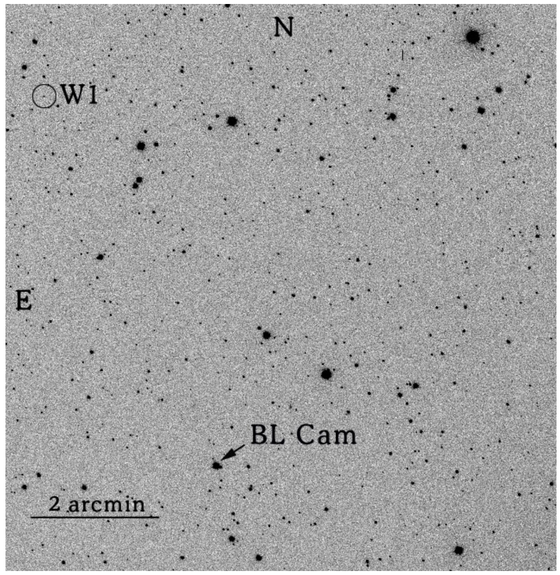

Figure 1. Finding chart of the new variable star, W1 in the field of BL Cam.

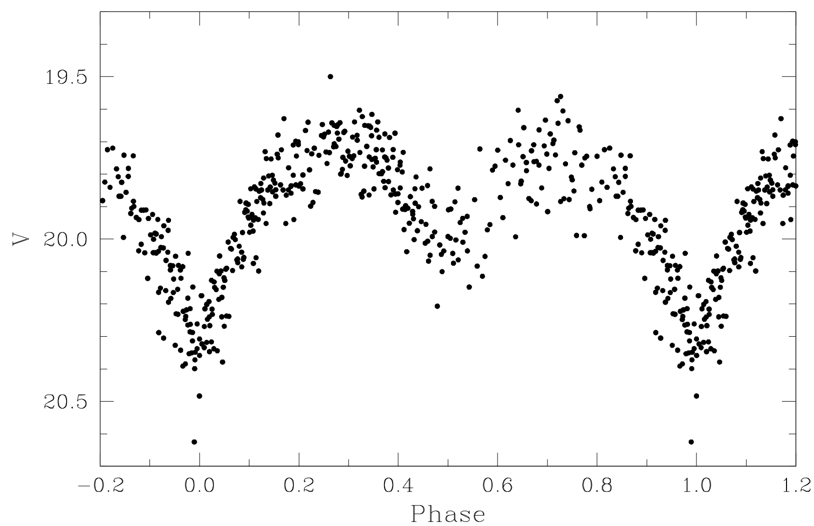

Figure 2. Light curves of the new variable star, W1.

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NEW PHOTOELECTRIC AND CCD MINIMA AND UPDATED EPHEMERIDES OF SELECTED ECLIPSING BINARIES

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We present 90 new minima times of 35 eclipsing binaries obtained from March 2001 to November 2002 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 UBV system were carried out in the usual way. VRI CCD observations were obtained at the Roztoky Observatory ($\lambda = 21°28'54''$E, $\varphi = 49°33'57''$N). The 40cm Cassegrain telescope equipped with the SBIG ST-8 CCD camera and standard VRI filters was used. The exposure times for the V and RI passbands were 20 s and 10 s, respectively. The frames were reduced using standard procedure (bias and dark subtraction, flat field correction) and the brightness of the variable was determined by aperture photometry with respect to usually two close standard stars using the MuniPack package (`http://www.ian.cz/munipack/`). Since the field of view of the camera is $7'.9 \times 11'.9$ no extinction correction to the differential magnitudes has been applied.

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). The average times of the minima from all used filters are given in Table 1. Part of the new minima of 44i Boo can be found in Pribulla et al. (2001). For DU Boo we determined only one normal primary minimum from all observations obtained in spring 2002.

We have also collected all available minima times of these eclipsing binaries from literature and from compilations provided by Kreiner (2001). The CCD, photoelectric and visual minima were weighted according to their average precision. Since the period changes in close binaries are rather frequent and pronounced, the presented ephemerides (Table 2) were obtained by fitting the data in the last approximately linear section of the $(O-C)$ diagram. The orbital periods of some of the presented binaries (e.g., AB And, BX And, V523 Cas, SV Cam, VW Cep, EF Dra, SW Lac, XY UMa) are modulated by the presence

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

System	JD_{hel} 2400000+	Min.	Obs.	Fil.	System	JD_{hel} 2400000+	Min.	Obs.	Fil.
RT And	52251.2951(1):	I	SP	RVR	SS Com	52403.5158(4)	I	RO	VRI
	52481.4838(1)	I	SL	BV		52404.3402(4)	I	RO	VI
AB And	52258.2736(2)	II	SL	BV		52404.5485(2)	I	RO	VI
	52484.4591(1)	I	SL	BV	YY CrB	52352.5466(2)	I	SL	UBV
BX And	52231.2850(1)	I	SL	BV	CG Cyg	52490.4190(1)	I	SL	BV
EP And	52200.3698(1):	II	SL	BV	V1191 Cyg	52413.4450(4)	I	RO	VRI
SS Ari	52528.5036(2)	II	SL	BV		52445.4067(2)	I	RO	VRI
V402 Aur	52224.467(2)	II	SL	UBV		52456.3748(1)	I	RO	RI
44i Boo	52363.5934(5):	I	SP	BVR		52465.4622(4)	I	SL	BV
	52364.5293(1)	II	SL	BV		52528.3033(4)	II	SL	BV
DU Boo	52380.2145(3)	II	SL	BV		52548.3544(3)	II	SL	BV
	52380.7202(2)	I	SL	BV	EF Dra	52031.3346(2)	I	SL	V
FI Boo	52043.4593(3)	II	SL	BV		52139.4607(1)	I	SL	BV
	52053.4095(2)	I	SL	B		52189.2824(2)	II	SL	BV
SV Cam	52195.2740(1)	I	SL	BV		52203.2757(1)	II	SL	BV
	52198.5365(2)	II	SL	BV		52252.2516(8)	I	SP	BVR
	52200.3178(3)	II	SP	BVR		52321.5799(1)	II	SL	BV
	52200.6124(3)	I	SP	BVR		52348.5043(2)	I	RO	VRI
	52282.4535(4)	I	SP	BR		52352.3203(1)	I	RO	RI
DN Cam	52247.5230(1)	II	SL	UBV		52352.5360(3)	II	RO	VR
	52568.4322(3)	II	SL	UBV		52401.5073(3)	I	SL	BV
FN Cam	52445.3947(3)	I	SL	UBV		52550.3423(2)	I	SL	BV
TX Cnc	52348.4185(3)	I	SL	BV	FU Dra	52464.4278(3)	II	SL	BV
	52352.4397(2)	II	SL	BV	SW Lac	52156.3371(2)	I	SL	UBV
WY Cnc	52339.4598(6)	II	SL	V		52191.4550(1)	II	SL	UV
	52342.3736(1)	I	SL	UBV		52505.4351(2)	II	SL	BV
	52352.3260(1)	I	SP	BVR	AM Leo	52397.3557(1)	I	SL	BV
CW Cas	52200.2777(1)	I	SL	BV	V714 Mon	52309.3076(2)	I	SL	BV
	52311.2418(1)	I	SL	BV		52311.3742(1)	I	SL	BV
	52527.4299(2)	I	SL	BV	V432 Per	52320.2634(2)	I	SL	UBV
V523 Cas	52504.4610(2)	II	SL	BV		52547.3745(3)	II	SL	UBV
	52504.5786(1)	I	SL	V		52547.5653(3)	I	SL	UBV
VW Cep	52139.3413(2)	I	SL	UBV		52585.3201(3)	II	SL	BV
	52182.3447(4)	II	SL	UBV	XY UMa	52251.4842(4)	I	SP	BVR
	52202.2363(1)	I	SP	BVR		52278.5530(10)	II	SL	BV
	52202.3801(2)	II	SP	BVR		52311.3600(3)	I	SP	BVR
	52202.5157(3)	I	SP	BVR		52311.6028(8)	II	SP	BVR
	52240.5074(6):	II	SP	UBVR		52322.3777(1)	I	SL	BV
	52452.4398(4)	I	SL	UBV		52322.6132(1)	II	SL	VB
	52453.4164(3)	II	SL	UBV		52351.3539(8)	II	RO	VRI
WZ Cep	52217.3841(3)	II	SL	BV		52351.5951(2)	I	RO	VRI
EG Cep	52444.4255(1)	I	SL	BV	AA UMa	52367.5846(3)	II	RO	RI
GW Cep	52185.2687(2)	I	SL	BV	AW UMa	52311.6006(6)	II	SL	UBV
	52185.4285(1)	II	SL	BV	ER Vul	52492.4670(2)	I	SL	V
EE Cet	52548.4392(3)	II	SL	UBV		52512.3626(4)	II	SL	BV

Table 2: New ephemerides of the observed eclipsing close binaries. The standard errors are given in parentheses, e.g., the entry 52137.5296(14) should be interpreted as 52137.5296±0.0014.

System	JD_0 2 400 000+	Period	Interval	Period change
RT And	52481.4848(3)	0.62892929(2)	1971 - 2002	↘
AB And	52484.4584(6)	0.33189189(12)	1994 - 2002	LT + ↗
BX And	52231.2862(7)	0.61011291(10)	1981 - 2002	LT ?
EP And	52137.5296(14)	0.40411058(15)	1982 - 2001	→
SS Ari	52528.7093(13)	0.40598385(19)	1981 - 2002	↘
V402 Aur	52224.7691(12)	0.6034992(3)	1991 - 2001	
44i Boo	52364.6634(7)	0.26781915(6)	1988 - 2002	LT + ↗
DU Boo	52380.720(2)	1.0558882(9)	1991 - 2002	
FI Boo	51718.3979(14)	0.3899978(4)	1991 - 2001	
CW Cas	52527.4311(8)	0.3188621(2)	1994 - 2002	↘
V523 Cas	52504.5730(7)	0.23369229(5)	1987 - 2002	LT
SV Cam	52282.4579(6)	0.59307301(9)	1979 - 2002	LT ?
DN Cam	52568.6830(6)	0.49830902(15)	1991 - 2002	
FN Cam	52445.3977(9)	0.6771318(5)	1991 - 2002	
TX Cnc	52352.6287(13)	0.38288247(9)	1977 - 2002	↗ ?
WY Cnc	52352.3270(7)	0.82936867(14)	1984 - 2002	↘
VW Cep	52506.4328(9)	0.27831149(17)	1995 - 2002	LT + ↘
WZ Cep	52217.5933(17)	0.41744491(12)	1982 - 2001	
EG Cep	52444.4282(6)	0.54462272(6)	1974 - 2002	↗
GW Cep	52185.5871(7)	0.31882957(12)	1991 - 2001	↘
EE Cet	52548.6291(10)	0.3799207(3)	1991 - 2002	
SS Com	52403.5127(19)	0.4128184(6)	1996 - 2002	↗
YY CrB	52352.5464(6)	0.3765642(3)	1991 - 2002	→
CG Cyg	52490.4173(5)	0.63114360(10)	1990 - 2002	LT ?
V1191 Cyg	52548.5110(16)	0.3133818(8)	1997 - 2002	↗
EF Dra	52550.3408(7)	0.42402593(9)	1989 - 2002	LT + ↗ ?
FU Dra	52464.5785(5)	0.30671687(11)	1991 - 2002	→
SW Lac	52505.5960(8)	0.32071417(16)	1994 - 2002	LT + ↗
AM Leo	52397.3557(13)	0.36579762(12)	1988 - 2002	LT ?
V714 Mon	52311.3756(9)	0.34450930(15)	1995 - 2002	→
V432 Per	52547.5658(7)	0.3833101(2)	1997 - 2002	LT ?
XY UMa	52351.5911(5)	0.47899511(4)	1931 - 2002	LT + ↗
AA UMa	52367.8160(14)	0.46812712(15)	1987 - 2002	↗
AW UMa	52311.8218(12)	0.4387261(2)	1995 - 2002	↘
ER Vul	52512.7111(11)	0.69809518(13)	1978 - 2002	→

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

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.

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ON THE VARIABILITY AND NATURE OF V379 PEGASI

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V379 Peg = FBS 2351+228 = SVS 2550 = NSV 26158 was discovered as a UV-excess object during the first Byurakan Survey (FBS). Lipovetskii and Stepanyan (1981) detected the object on JD 2442329 (1974) showing a spectrum of a $B-A$ type blue star with a UV continuum. Lipovetskii and Stepanyan (1981) also commented that the object appears red on Palomar Sky Survey plates. The object was spectroscopically studied by Kopylov et al. (1988).

Kopylov et al. (1988) described that FBS 2351+228 shows a late M-type spectrum with prominent TiO bands, Ca I 4227Å and Na D absorption lines. The Balmer lines were in very narrow emission. Kopylov et al. (1988) reported that the spectrum of FBS 2351+228 resembles those of the quiescent states of the recurrent novae T CrB and RS Oph. According to this suggestion, the star has been regarded as a candidate recurrent nova or a symbiotic binary (cf. Downes et al. 1997, 2001). The star has been given a designation as a suspected variable star (NSV 26158) in the NSV Supplement (Kazarovets et al. 1998). The NSV Supplement gave a variability range of 15–16 $m_{\rm pg}$ following Lipovetskii and Stepanyan (1981).

We noticed, however, that this object has a significant proper motion, suggesting that the object is a nearby object rather than a distant, luminous symbiotic binary. Table 1 lists the available astrometry (errors are typically less than $0''.3$). From these values, we have determined a proper motion of $0''.065 \pm 0''.010$ yr^{-1}, PA = 236°. This value has been confirmed by a direct comparison of the DSS 1 and 2 scans, and a possible systematic error is confirmed to be small by a overplotting the cataloged positions of surrounding stars (see 5342-f2.gif, 5342-f3.gif in the electronic IBVS edition: the yellow, green, and red circles represent USNO A2.0, GSC 2.2.1 and 2MASS positions, respectively. The large proper motion of V379 Peg is apparent). The value is also in good agreement with the proper motion of $0''.063$ yr^{-1}, PA = 240° in USNO B1.0 (Monet et al. 2002).

This large proper motion makes the object likely a nearby object. Assuming an upper limit transverse velocity of 100 km s^{-1}, the upper limit of the distance becomes ~300 pc (see also Kato and Yamaoka 2002). The upper limit of $M_{\rm V}$ of the secondary thus becomes +8, which safely excludes the possibility of a symbiotic binary with a giant secondary.

Table 1. Astrometry of V379 Peg.

Source	R. A.	Decl.	Epoch
	(J2000.0)		
USNO A2.0	23 53 51.069	+23 09 20.39	1953.608
GSC 2.2.1	23 53 50.922	+23 09 19.09	1990.661
2MASS	23 53 50.892	+23 09 18.75	1998.751

Table 2. Snapshot CCD photometry of V379 Peg.

JD	mag[a]	error	N
2451775.173	14.37	0.04	3
2451782.188	14.42	0.03	11
2451783.211	14.44	0.19	2
2451785.272	14.33	0.02	19

[a] Unfiltered CCD magnitude, zero point adjusted to R_c

The spectrum published in Kopylov et al. (1988) also lacks the evidence of a strong He II line, which is usually seen in symbiotic binaries. The likely presence of the CaH absorption at 6382 Å makes the low luminosity classification more likely. From these data, we conclude that V379 Peg is neither a symbiotic binary nor a recurrent nova candidate.

The variable star designation V379 Peg was given primarily based on the 1999 and 2000 reports of the possible outburst detections (Kazarovets et al. 2001). However, these detections were done with unfiltered CCD observations by L. T. Jensen (Kato 1999) and T. Vanmunster (Vanmunster 2000a). The maximum magnitude quoted in Kazarovets et al. (2001) apparently refers to the unfiltered CCD observation by T. Vanmunster, who reported a unfiltered CCD magnitude of 13.9 on 2002 August 9. The minimum magnitude in Kazarovets et al. (2001) apparently refers to T. Kinnunen's visual observations preceding these detections.

We must note, however, V379 Peg is a red object (GSC 2.2.1 magnitudes: $r = 14.04$, $b = 15.96$, 2MASS magnitudes: $J = 11.35$, $H = 10.76$, $K_s = 10.51$), which is consistent with the above spectroscopic classification. Since the reported "outburst" red-sensitive CCD observations had magnitude close to the r magnitude in GSC 2.2.1, it is most likely these CCD detections were not true outbursts, but were simply bright detections of a red object on red-sensitive CCDs. The lack of short-term variation during the claimed outburst (Vanmunster 2000b) is also suggestive of this interpretation. The lack of significant variability was also confirmed by our follow-up snapshot CCD observations (Table 2, taken at RIKEN, 20-cm telescope and an unfiltered AP-7 camera), following the claimed 1999 outburst detection. Although there was a historical hint of variability of 15–16 $m_{\rm pg}$ (Lipovetskii and Stepanyan 1981), we conclude that the claimed large-amplitude variability of V379 Peg has not yet been confirmed.

We further obtained time-resolved unfiltered CCD photometry on 2002 November 5, with two telescopes (RIKEN: 25-cm reflector, AP-6E CCD, 40 s exposure, 130 frames; Kyoto: 25-cm Schmidt–Cassegrain telescope, ST-7E CCD, 30 s exposure, 84 frames). The magnitudes were determined relative to GSC 2252.2143, whose constancy during the observation was confirmed by a comparison with GSC 2252.1995. A 0.061 mag was added to the Kyoto magnitudes to correct the systematic difference between the instruments. The resultant light curve (Figure 1) did not reveal significant variation larger than the observational errors.

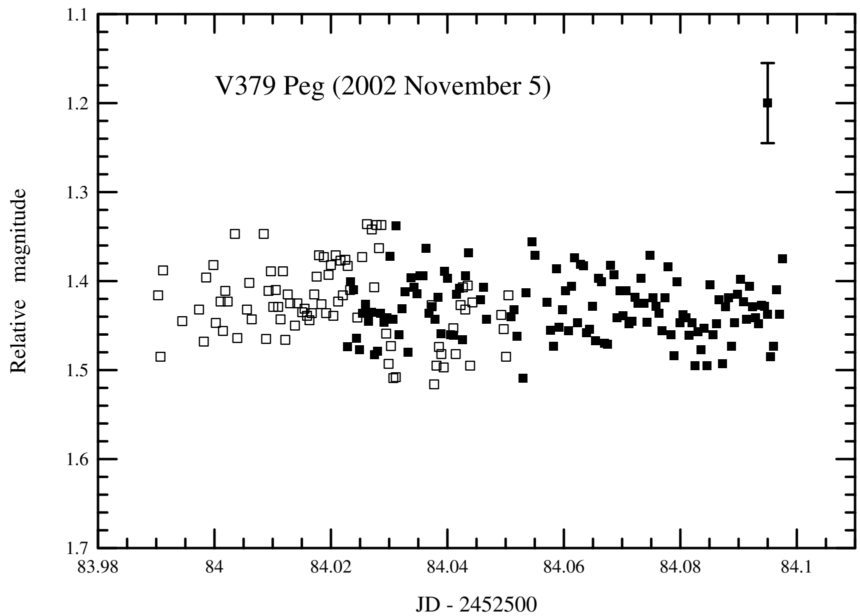

Figure 1. Light curve of V379 Peg on 2002 November 5. The filled and open squares represent RIKEN and Kyoto observations, respectively. No significant variation was detected larger than the observational errors.

From the presence of a UV excess (in 1974) and Balmer emission lines, V379 Peg seems to be a binary of a white dwarf and a red dwarf. If this object is indeed a cataclysmic (CV) type binary, the lack of a blue continuum in the spectrum (in Kopylov et al. 1988) suggests that the object has a very low accretion rate. This object, together with RX J2309.8+2135 (Kato and Yamaoka 2002), may comprise a previously overlooked nearby population of CV-type binaries with low mass-transfer rates. However, if the very blue object detected in 1974 was indeed the presently identified V379 Peg, the reported magnitude (15 $m_{\rm pg}$) corresponds to $M_V \leq +7$, which is unusually faint for a CV-type outburst (cf. Warner 1987). V379 Peg can alternatively be a detached binary of a white dwarf and a red dwarf. The narrowness of the emission lines and the lack of short-term photometric variability may prefer the detached binary interpretation. In either cases, the claimed very blue appearance of the spectrum in 1974 (Lipovetskii and Stepanyan 1981) still remains a mystery.

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BD+14°5016 - A NEW EW ECLIPSING BINARY

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Name of the object:
BD +14°5016 = GSC 01720-00658 = SAO 108714

Equatorial coordinates:	**Equinox:**
R.A.= $23^h36^m55\overset{s}{.}367$ **DEC.=** $15°48'06\overset{''}{.}43$	2000

Observatory and telescope:
Piwnice Observatory, 135mm semi-automatic CCD camera

Detector:	SBIG ST-7 CCD Camera

Filter(s):	SBIG CFW-8 *V*, *B*

Date(s) of the observation(s):
2002.09.13 – 2002.11.07

Comparison star(s):	GSC 01720-00595, GSC 01720-00518, GSC 01720-00735

Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	EW

Table 1. Times of minima

Min. HJD	Error	Type	Filter	$O-C$ [day]
2452534.2999	0.0014	II	*V*	−0.0010
2452534.6031	0.0008	I	*V*	−0.0016
2452552.7715	0.0013	II	*V*	+0.0008
2452553.073	0.003	I	*V*	−0.0024
2452582.706	0.002	II	*V*	+0.0014
2452583.007	0.002	I	*V*	−0.0014
2452583.3386	0.0032	II	*B*	−0.0028
2452583.6441	0.0011	I	*B*	−0.0018

Remarks:

BD +14°5016 was found to be variable during the Semi-Automatic Variability Search program at the Piwnice Observatory. The presented photometric data were collected in both B and V filters, during 16 moonless nights between September and November 2002. 334 individual measurements of brightness were made, 275 in V band and 59 in B. The shape of the phased light curve, presented in Figure 1, indicates variability of the W UMa type.

According to SIMBAD, BD +14°5016 is a V=9$^{\rm m}_{.}$50 magnitude star of F2 spectral type, with $B-V$=0$^{\rm m}_{.}$31. Our observations show that at the maximum light the star reaches V=9$^{\rm m}_{.}$28 and B=9$^{\rm m}_{.}$63. The primary and secondary minima have an amplitude of ΔV_1=0$^{\rm m}_{.}$47 and ΔV_2=0$^{\rm m}_{.}$41 respectively. The observed amplitudes in B are identical. No noticeable colour variation with phase was detected. The phase-averaged $(B-V)$=0$^{\rm m}_{.}$35. (Note that our B, V magnitudes are not transformed to the standard system.) The maximum following the second minimum is 0$^{\rm m}_{.}$04 fainter in both bands suggesting presence of a spot placed on the surface of one of the components.

Differential aperture photometry and astrometric reduction of the CCD frames were applied. The coordinates and magnitudes of comparison stars were taken from TYCHO-2 Catalogue (Høg et al. 2000). The V and B magnitudes were calculated from the following formulae:

$$V = V_t - 0.090(B_t - V_t), \quad (1)$$

$$B = V + 0.850(B_t - V_t). \quad (2)$$

The period was found with the ANOVA method of Schwarzenberg-Czerny (1996). The times of both minima were computed from the presented light-curve with the Kwee-van Woerden method (Kwee, van Woerden 1956). A preliminary ephemeris for the primary minimum is:

$$\begin{array}{rl}\text{Min. I} = \text{HJD } 2452558.1703 + & 0^{\rm d}_{.}636889 \times E. \\ \pm 0.0003 \pm & 0.000004\end{array} \quad (3)$$

The shape of the phased light curve (Fig. 1) clearly shows that the secondary minimum is located at phase ϕ=0.52. This fact is confirmed by large $O-C$ values calculated from equation (3) for the observed secondary minima. Therefore the following ephemeris for the secondary minimum has been obtained:

$$\begin{array}{rl}\text{Min. II} = \text{HJD } 2452557.8658 + & 0^{\rm d}_{.}636889 \times E. \\ \pm 0.0006 \pm & 0.000004\end{array} \quad (4)$$

To estimate accuracy of calculated minima the collected data were divided in three sessions and for each session individual times of minima were determined by the digital tracing paper method. The $O-C$ values, presented in Table 1, were calculated for primary and secondary minima from equation (3) and (4) respectively.

Acknowledgements:

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

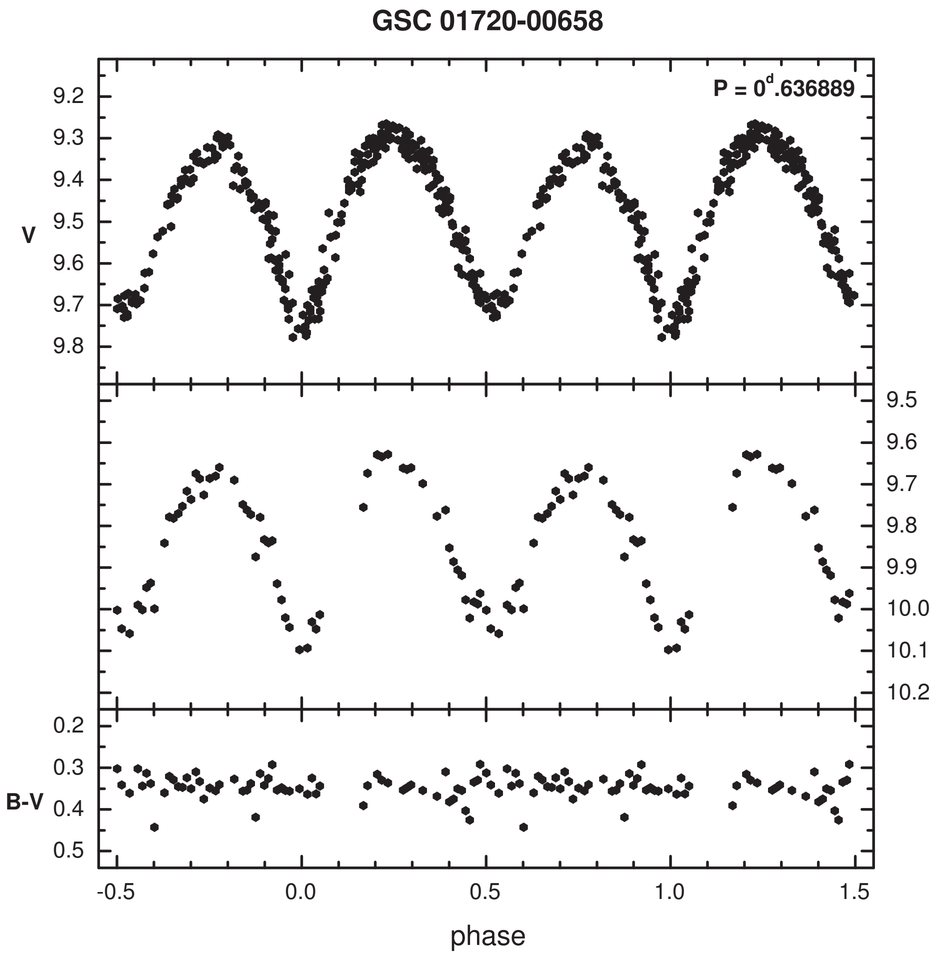

Figure 1. *V*, *B* and colour curves obtained for GSC 01720-00658

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PERIOD CHANGE IN S SEXTANTIS

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S Sextantis is a well-observed Mira variable, with a mean period of roughly 260 days. Merchán Benítez & Jurado Vargas (2000) found a strong period decrease in S Sextantis based upon AFOEV and VSOLJ data spanning JD 2442000 to 2451340 (1973 - 1999). They found that the period decreased monotonically from the GCVS period of 264.8 days to under 250 days, much larger than would be expected from "normal" cycle-to-cycle variations often found in Miras. From this, they hypothesized that S Sextantis had just undergone a helium shell flash. A few other variables are known to exhibit similar period changes, with T UMi being the most spectacular case (Gál & Szatmáry 1995; Mattei & Foster 2000)

We analyzed the S Sextantis data from the AAVSO International Database, which is well-covered from JD2427871 to JD2452433 (1935 - 2002), to determine whether this period change began prior to JD2442000. We used the *weighted wavelet transform* (Foster 1996) developed at AAVSO to study the time evolution of the pulsations. The wavelet transform produces a three-dimensional representation of the pulsation behavior with the amplitude as a function of both time and period.

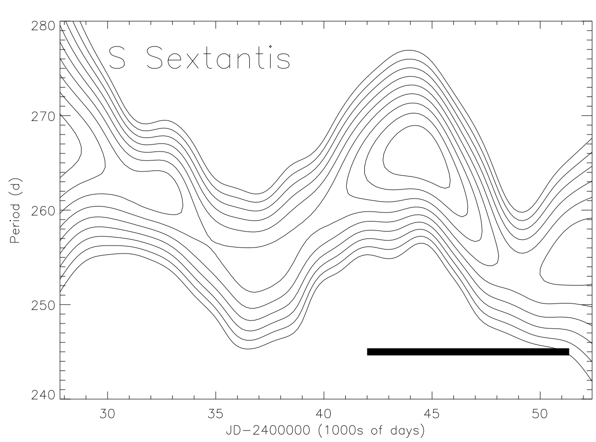

Figure 1. Wavelet transform of S Sextantis. Contours represent amplitude in magnitudes. The solid line at lower right represents the span of the Merchán Benítez & Jurado Vargas data.

The results of the wavelet transform are shown in Figure 1. We find that for the span of time analyzed by Merchán Benítez & Jurado Vargas, the AAVSO data reproduces their observed period change. However, we find that the behavior of the period over time is far from monotonic, instead appearing as a “sinusoid” with a period of roughly 50 years, and a full “amplitude” of the period change of nearly twenty days. We also find that the amplitude of pulsation has changed nearly in lockstep with the period, with lowest amplitudes corresponding to the shortest periods.

The behavior of S Sextantis with time is strange in comparison to most Mira variables. Although Miras can exhibit very large *cycle-to-cycle* period variations, they rarely exhibit changes that are as orderly as those seen here. Zijlstra & Bedding (2002) make note of a small group of Miras which exhibit long-term, orderly period changes, giving them the designation of “meandering Miras.” In fact the pulsation behavior of S Sextantis is remarkably similar to that of that of T Cep and S Ori, both of which show evidence of the same sinusoidal variation in period. However, Zijlstra and Bedding note that at least 15 percent of Miras with periods longer than 400 days show evidence of meandering periods. Thus it isn't clear whether S Sextantis' behavior has the same cause, or whether this meandering behavior is limited to long-period stars. We show the period and amplitude variability of S Sextantis with T Cep, R Nor, and S Ori in Figure 2.

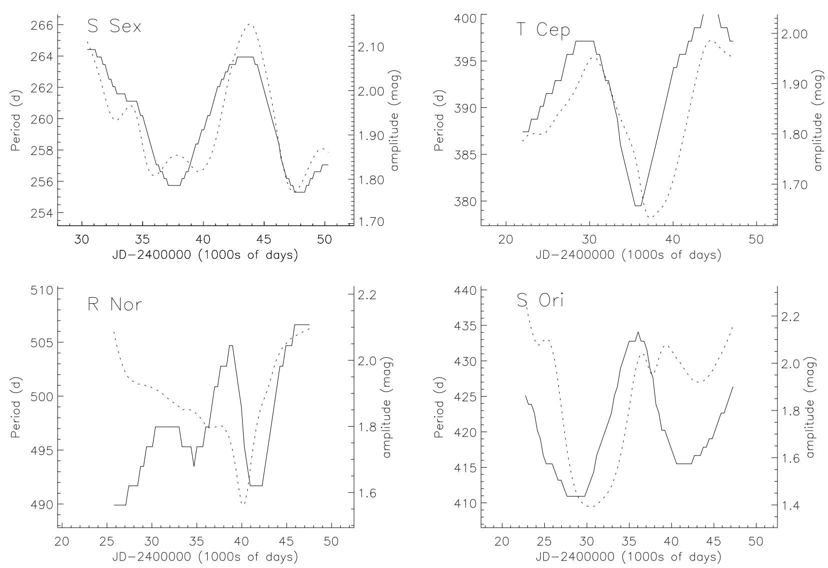

Figure 2. Period (solid lines) and amplitude (dotted lines) evolution in S Sextantis and three “meandering Miras:” T Cep, R Nor, and S Ori. Note how the period and amplitude changes appear to be correlated.

Given the nature of the period variation in S Sextantis, it is unlikely that evolution is the cause. The shell flash evolution models of Vassiliadis and Wood (1993) do not exhibit short-term oscillations in period like those observed here; stars undergoing shell flashes have excursions in period of several tens of percent, with timescales of ~ 1000 y. As yet, we have no explanation of what might cause this period variation. Nonlinear interactions between two or more pulsation modes have been suggested as reasons for chaotic behavior in the semi-regular and irregular variables (Buchler et al. 1996), and a weakly-nonlinear process could be at work here. Mode-switching does not seem possible since the period and amplitude variations are smooth, and the difference between maximum and minimum periods are smaller than the expected difference between radial overtones. Interaction with a binary does not seem likely as there is no mention of S Sextantis being a close binary or symbiotic star in the literature, although the sinusoidal nature of the variation is striking. We suggest that S Sextantis is an interesting target for further study.

We thank the 288 observers worldwide who contributed the observations that made this study possible.

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CONFIRMATION OF A DOUBLE NATURE OF THE THIRD BODY IN SZ Cam

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The eclipsing binary system SZ Cam is the brightest object of the open cluster NGC 1502. The primary was classified as O9.5V by Budding (1975). Using high-resolution spectroscopy, Mayer et al. (1994) identified the system as triple, composed of a close binary orbiting a massive companion. Lorenz et al. (1998) estimated the minimum mass of the tertiary component as 19.7 $M_\odot$ and proposed that the third body is a close binary.

In this message the preliminary results of a new spectral investigation of this eclipsing binary are presented. In total 26 CCD spectra of SZ Cam close to quadrature phases were taken with the Coude-echelle spectrometer (Musaev, 1996) of the Zeiss-1000 (D = 1m) telescope at the Special Astrophysical Observatory by Russian Academy of Sciences (SAO RAS) during three nights in December 2000. In order to provide wavelength calibration, one spectrum of α CMa was taken in the same fashion as those of SZ Cam.

The CCD TDK1024 (1242 × 1152 pixels, 22.5 × 22.5 microns) cooled by liquid nitrogen was used for registration of the spectral orders. The linear dispersion was 3 Å mm^{-1}, and the resolving power was in the range of 39000 to 40000. Useful wavelength interval in each order was ∼60 Å, and all orders covered the range from 3600 Å to 9000 Å. The exposure time of 30 minutes yielded signal-to-noise ratios of about 40 to 60. Data reduction was performed with echelle spectra processing program package DECH20T (Galazutdinov, 1992).

The most prominent lines besides H_α and H_β were $HeI(4922, 5016, 5876)$; other lines were much weaker. In all of the spectra HeI lines from the primary and secondary components of the close binary as well as those from the third body can easily be recognized. The line features were fitted with individual Gaussian profiles for each stellar component using the Marquardt nonlinear least squares method for the optimization of the following parameters: central wavelength, full width at half maximum, and amplitudes of the Gaussian function. The simultaneous fit with three Gaussian functions was required.

Typical line features and Gaussian fits of helium lines are shown in Figure 1. Using this set of three different Gaussian profiles, it was possible to derive the radial velocity curves of the eclipsing binary components and the third body. Radial velocities were calculated including the barycentric correction for the mass center of the solar system.

The radial velocity curves of the primary and secondary components were fitted separately with functions $V_i + K_i \sin(2\pi\varphi)$ ($i = 1, 2$ for the primary and secondary components, respectively) using the linear least squares method to optimize the free parameters K_i with fixed systemic velocities $V_i = V_0 = -15.3 \pm 2.5$ km/s; here φ denotes the orbital phase. The value of V_0 is the arithmetic mean of V_1 and V_2 which correspond to the best fits of the radial velocity curves when V_i and K_i are regarded as free parameters.

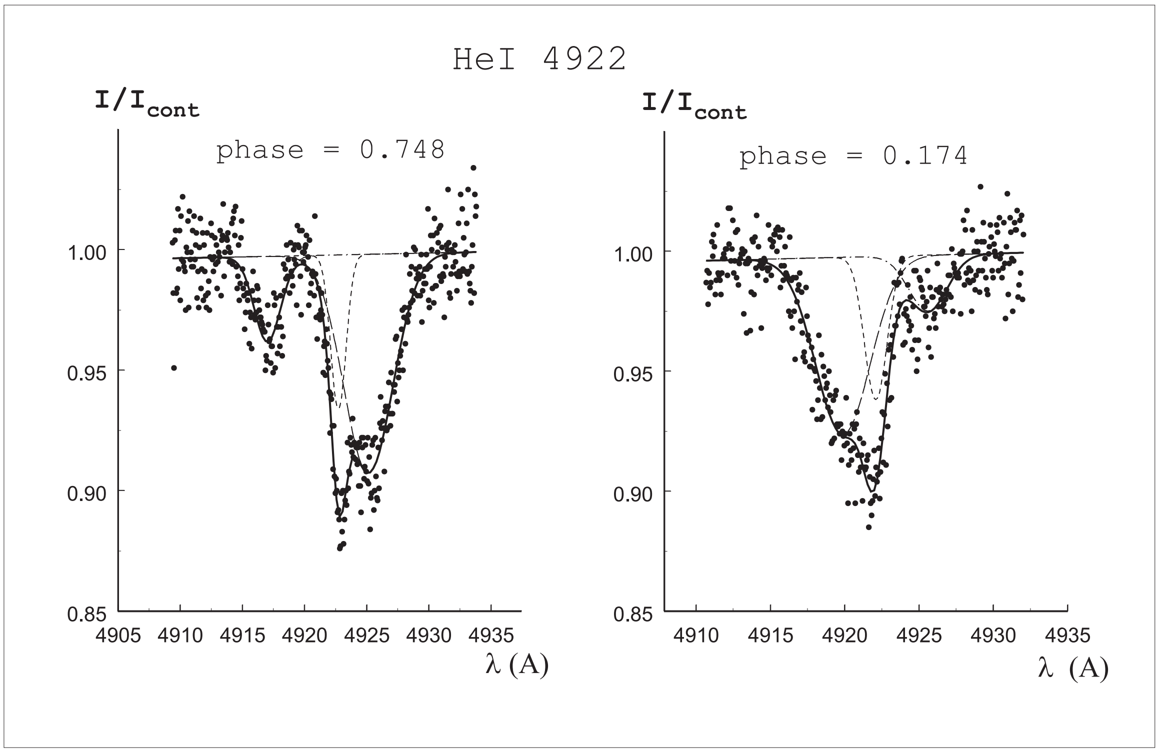

Figure 1. Typical profile of *HeI* 4922 spectral line around both quadrature phase. References: The fitted Gaussian functions are drawn as long-dashed, dash-dotted and dashed lines for the primary and secondary component and the third body, respectively. The resulting fit is shown as solid line; • – the spectral data.

It was estimated that $K_1 = 196.1 \pm 3.6$ km/s, $K_2 = 269.5 \pm 4.0$ km/s and the spectroscopic mass ratio of SZ Cam $q = K_1/K_2 = M_2/M_1 = 0.73 \pm 0.02$. This value of the mass ratio slightly differs from the value $q = 0.69$ obtained by Lorenz et al. (1998).

The radial velocities of the third body obtained from deconvolution of three blended spectral lines of *HeI* showed variability from night to night. The values of radial velocities and their accuracy for the third body are listed in Table 1. The values of phases and radial velocities of the third body averaged over each night are given in the last two columns of Table 1. The phases were calculated using the elements of the third body given by Lorenz et al. (1998).

Table 1: The radial velocities of the third body

$JD_{\odot} - 2\,400\,000$	φ	HeI 4922		HeI 5016		HeI 5876			
		V_r	σ	V_r	σ	V_r	σ	$\overline{\varphi}$	$\overline{V_r}$
51886.3710	0.794	32.2	2.1	16.8	9.2	24.2	2.3		
51886.3929	0.801	36.8	3.1	11.4	8.4	27.5	2.3		
51886.4148	0.809	39.8	2.1	18.3	3.2	26.0	2.4		
51886.4370	0.817	35.4	2.0	16.3	5.6	21.2	2.1		
51886.4596	0.825	36.6	1.8	11.1	7.2	24.8	2.4	0.826	26.9
51886.4814	0.833	40.8	2.2	21.1	5.4	29.4	1.8		±2.3
51886.5033	0.841	42.5	1.9	38.2	7.5	25.8	1.8		
51886.5255	0.849	43.0	2.5	27.5	8.5	24.6	1.8		
51886.5478	0.857	38.2	2.4	–	–	28.8	2.7		
51887.4971	0.196	−14.6	6.1	−22.5	6.3	−21.5	2.0		
51887.5193	0.204	−15.3	4.8	−24.3	4.0	−21.3	2.1		
51887.5415	0.212	−15.4	6.1	−31.9	3.5	−26.7	3.1	0.215	−22.7
51887.5641	0.220	−13.0	3.4	−31.3	4.0	−22.7	2.4		±1.3
51887.5867	0.228	−17.0	3.9	−23.1	6.1	−25.8	2.9		
51889.1752	0.796	27.6	3.0	9.2	5.0	18.9	1.5		
51889.1967	0.804	29.4	2.5	12.8	4.7	–	–		
51889.2183	0.812	32.2	2.3	16.2	4.2	23.6	1.8		
51889.2398	0.819	40.0	4.0	17.1	3.2	–	–		
51889.2613	0.827	39.4	4.2	17.7	4.0	24.4	1.9	0.825	27.6
51889.2828	0.835	37.4	3.2	12.4	4.3	–	–		±1.9
51889.3044	0.842	43.5	2.6	19.3	4.2	23.7	1.6		
51889.3259	0.850	46.8	3.2	24.6	5.5	27.5	1.8		

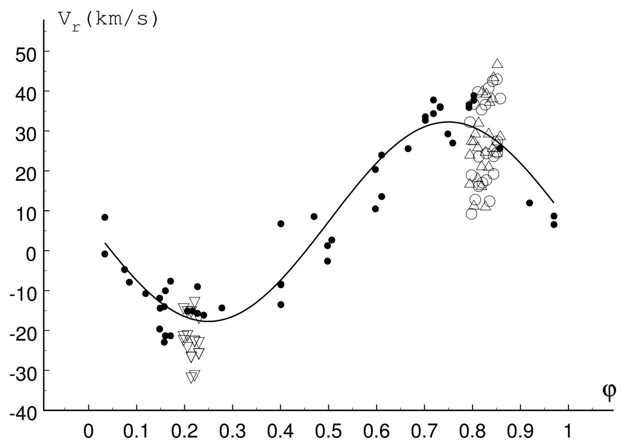

Figure 2. Radial velocity curve of third body. Phase were calculated using ephemeris $JD_\odot = 2448998.^{d}0608 + 2.^{d}7966 \cdot E$ (Lorenz et al., 1998). References: The curve $V_r(\varphi)$ (Lorenz et al., 1998) is shown as solid line; • – data by Lorenz et al.(1998); ◯ – our data obtained December 7, 2000 ($\varphi = 0.^{p}79 - 0.^{p}86$), ▽ – December 8, 2000 ($\varphi = 0.^{p}20 - 0.^{p}23$) and △ – December 10, 2000 ($\varphi = 0.^{p}80 - 0.^{p}86$).

In Figure 2 our data on radial velocities of the third body is shown along with the data and radial velocity curve of Lorenz et al. (1998). It is seen that (despite the 5 – 7 years epoch difference between our observation and the results of Lorenz et al., 1998) the radial velocities of the third body obtained by us correspond well with the radial velocity curve calculated according to the ephemeris by Lorenz et al. (1998).

It is also necessary to note that the mean values of the radial velocities of the third body obtained by us at the same phases in December 7, 2000 (JD 2451886) and December 10, 2000 (JD 2451889) are practically equal (see Table 1).

Thus, it is possible to make a conclusion that the third component in the system is really a close binary (though we register radial velocity variations of primary component only) and the light elements for the third body obtained by Lorenz et al. (1998) are confirmed.

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DRAMATIC CHANGE OF OUTBURST PROPERTIES IN LX And

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LX And was originally discovered as an RV Tau star during a survey for RR Lyr-type stars (Kinman et al. 1982). Uemura et al. (2000) revealed that the object actually shows dwarf nova-type outbursts. Following this new classification, Morales-Rueda and Marsh (2002) spectroscopically confirmed the dwarf nova-type nature. Although the orbital period has not been established, the outburst characteristics (Uemura et al. 2000) and infrared colors (Hoard et al. 2002) make a classification of an SS Cyg-type dwarf nova likely.

The mean periods of LX And have been reported to be 36.469 d (Kinman et al. 1982) or 21–30 d, most likely ∼26 d (Uemura et al. 2000). The object has been closely monitored by visual observers around the world since the discovery of the dwarf nova-type nature. From the recent outburst detections, we noticed a dramatic change of the outburst properties of this object.

Figure 1 shows the long-term light curve based on the observations reported to VSNET (`http://www.kusastro.kyoto-u.ac.jp/vsnet/`) and Uemura et al. (2000). The accuracy of the visual observations are usually 0.2–0.3 mag, which would not affect the following discussion. Table 1 shows the list of outbursts. The initial date of the outburst detections and the observed maxima are given. When there are sufficient data around the peak brightness, we took an average of the observations.

Table 2 shows the mean outburst intervals of the continuous segments of the light curve (there are unavoidable gaps in observation around the solar conjunction). The mean intervals and the errors were determined by using a linear fit to the observed times of the outbursts.

The data clearly demonstrate that this object shows a large variation (16–36 d) of the outburst mean intervals (Figure 2). We have ruled out, by a close inspection of the entire data, a possibility that a period doubling (30–36 d and 16 d) is not a result of missed outbursts. A dense CCD light curve by Uemura et al. (2000) also rejects this possibility.

The ratio between the maximum mean interval $\Delta T_{\rm max}$ and the minimum mean interval $\Delta T_{\rm min}$ is 2.2, which far exceeds the typical values (1.2–1.5) reported in other SS Cyg-type dwarf novae (Bianchini 1990). LX And is thus shown to be a rare system with a huge variation of long-term outburst intervals. Although it was not clearly demonstrated, a report of a long-term variation of mean magnitudes (Kinman et al. 1982), which originally classified the object to be an RVb type star, may have been a result of a similar long-term trend.

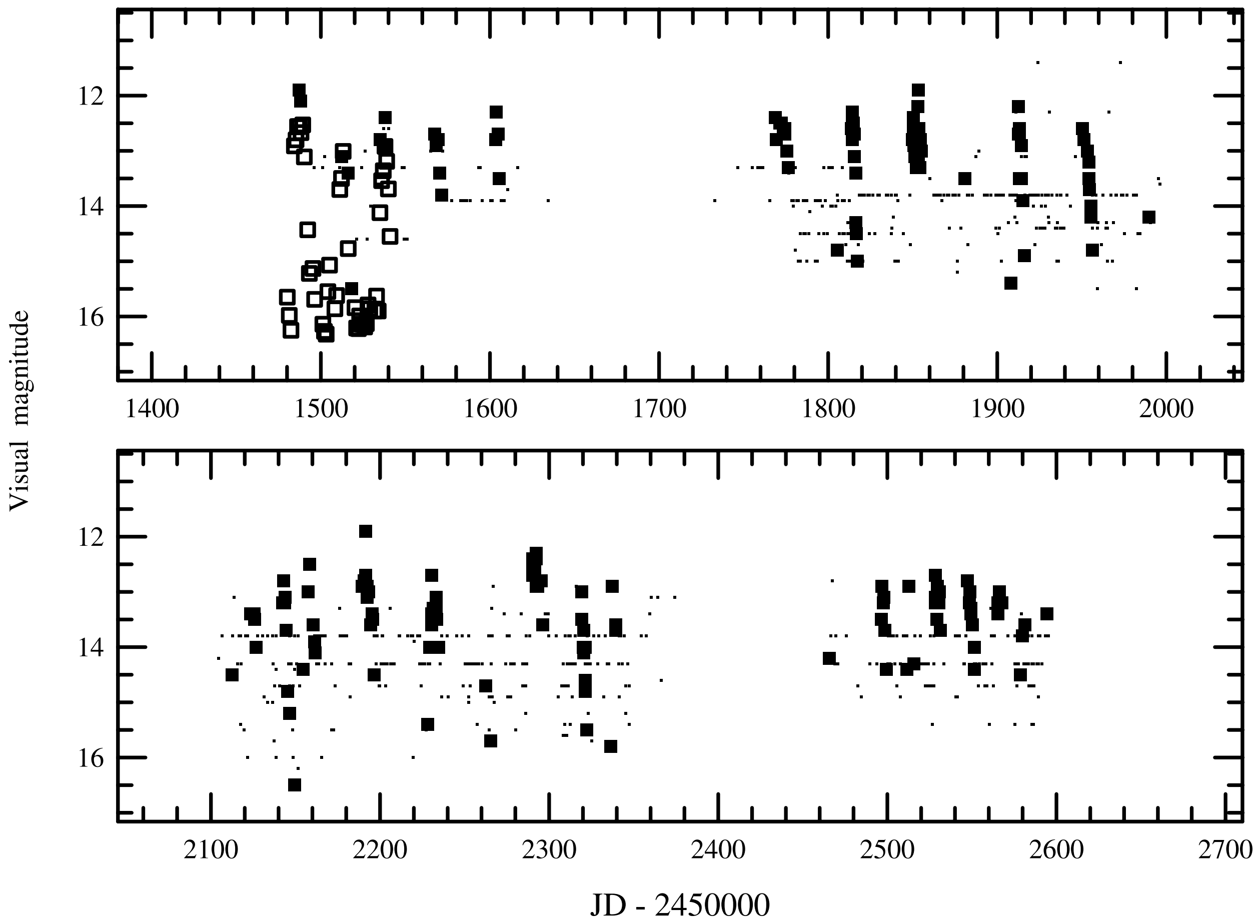

Figure 1. Light curve of LX And based on VSNET observations and Uemura et al. (2000). The large and small symbols, and open squares represent positive and negative (upper limit) visual observations, and CCD observations, respectively.

Table 1. Outbursts of LX And.

JD[a]	Max	JD[a]	Max	JD[a]	Max
51484	12.2	51950	12.6	52337	12.9
51511	13.0	51990	14.2[b]	52466	14.2[b]
51535	12.8	52123	13.4	52496	12.9
51567	12.7	52142	13.0	52512	12.9
51603	12.3	52155	12.5	52528	13.1
51769	12.4	52189	12.3	52547	12.8
51814	12.5	52229	13.0	52565	13.1
51850	12.4	52263	14.7[b]	52578	13.6
51881	13.5	52290	12.5	52594	13.4
51912	12.2	52319	13.2		

[a] JD−2400000.

[b] True maximum probably missed.

Table 2. Mean outburst intervals.

Start	End	Period	Error
JD−2400000		(d)	(d)
51484	51603	29.4	1.4
51769	51990	35.6	0.8
52123	52155	16.0	1.7
52155	52337	31.0	1.4
52496	52594	16.5	0.3

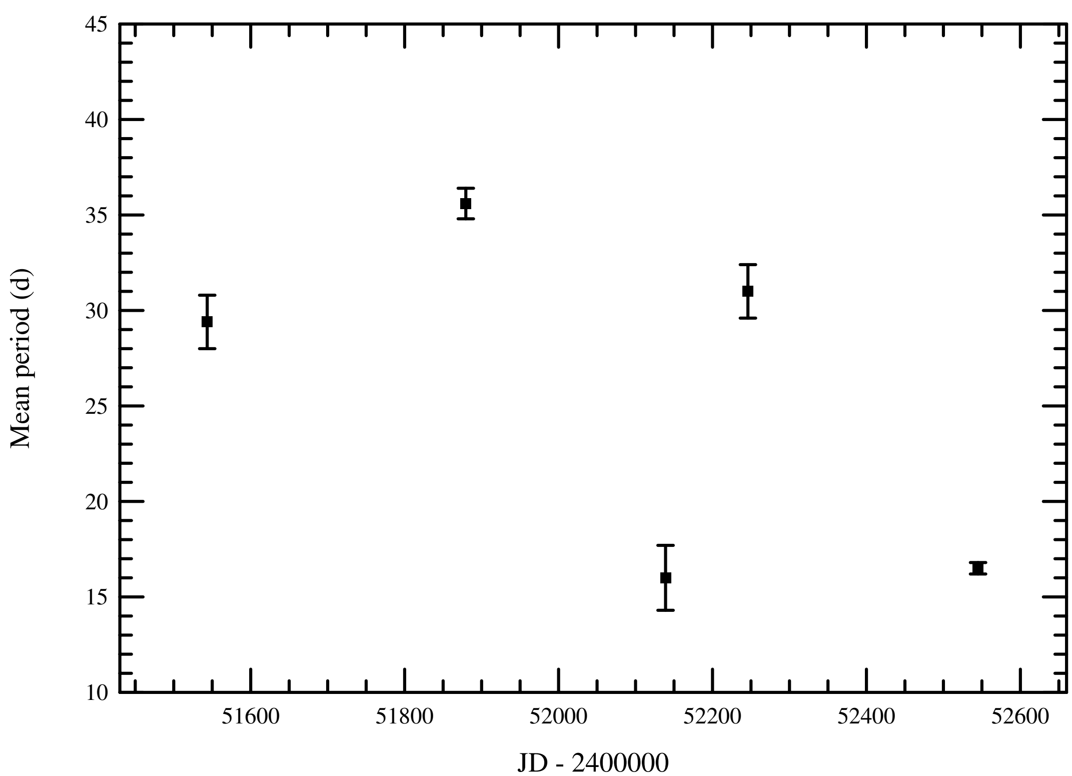

Figure 2. Variation of the mean outburst intervals of LX And.

As suggested by Bianchini (1990) and Ak et al. (2001), such a long-term variation can be attributed to solar-type activity cycle in a cataclysmic binary. LX And would be a promising target for a future more comprehensive work in search of a further signature of a solar-type activity cycle.

An alternative explanation is the dramatic change of the state of the accretion disk, as demonstrated in the SU UMa-type dwarf nova V503 Cyg by Kato et al. (2002). In this case, we do not necessarily require a variable mass-transfer rate, but would require a still unidentified mechanism causing the state changes in the accretion disk.

We are grateful the members of VSNET for reporting crucial observations. This work is partly supported by a grant-in-aid (13640239) from the Japanese Ministry of Education, Culture, Sports, Science and Technology.

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PHOTOMETRY OF OW Gem

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Variability of the long period eclipsing binary OW Geminorum (= HDE 258878 = BD+17°1281, spectral type F2 Ib-II, $V_{\max}=8\overset{\mathrm{m}}{.}22$) was discovered by Kaiser in 1988 while conducting a photographic nova patrol (Kaiser et al. 1988). Kaiser (1988) also determined the system's long period of 1258 days. Williams (1989) discovered the high eccentricity. Griffin and Duquennoy (1993) have given a thorough report based on radial velocity studies.

Four primary eclipses have occurred since discovery; three have published observations, either visual or photometric (Williams and Kaiser 1991; Pravec 1992; Hanzl et al. 1993; Hager 1996; Derekas et al. 2002). Unfortunately, coverage was sparse due to longitudinally limited observing sites or solar conjunction. The secondary eclipse has had

Table 1. Standard magnitudes and color indices, Henden

Star	GSC	V	$B-V$	$U-B$	$V-R_c$	R_c-I_c
var max	1332.0490	8.217	0.689	0.437	0.418	0.433
var primary min	1332.0490	9.673	1.005	0.619	0.589	0.595
var secondary min	1332.0490	8.317	0.646	0.420	0.390	0.409
comp	1332.0564	9.004	0.239	0.065	0.148	0.158
check	1332.0578	9.900	0.325	0.006	0.204	0.206

Table 2. Observers and equipment used

Observer	Telescope	CCD/Photometer	Filter(s)	Campaign
DHK	0.35-m	ST-9E	BVR_c	'95 p, '02 ps
AAH	1.00-m	SITe Tektronix	$UBV(RI)_c$	'02 ps
SD	0.20-m	ST-9E	V	'02 s
EGM	0.20-m	Starlight Express	V	'02 p
JGF	0.10-m, 0.41-m	Starlight Express	V	'02 ps
JAH	0.45-m	ST-9E	V	'02 p
RAK	0.25-m	ST-6	$BV(RI)_c$	'02 p
PK	0.35-m	FLI	V	'02 p
GCL	0.27-m	ST-9E	$V(RI)_c$	'02 p
ACP	0.27-m	ST-6	$BV(RI)_c$	'02 p
DT	0.40-m, 0.60-m	Photometrics CCD, ST-8	V	'95 p, '02 p
DW	0.20-m	ST-9E	V	'02 ps
REZ	0.60-m	Photometrics CCD	$BV(RI)_c$	'95 ps, '02 p
DBW	0.90-m	SSP-3	V	'95 p
BM	0.20-m	Lynxx	V	'95 p
GWW	0.40-m	Photometrics CCD	V	'95 p

extremely little coverage published, consisting of three photoelectric observations from Williams (Williams 1989).

The AAVSO's eclipsing binary team has conducted a multi-filtered international campaign on OW Gem covering the primary and secondary eclipses in 1995 and 2002. Henden used the USNO 1.0-m telescope with a SITe 1024 × 1024 thinned, backside illuminated CCD and standard Johnson-Cousins standard $UBV(RI)_c$ filters along with Landolt standards to determine standard magnitudes for the variable and the comparison stars. These data are in Table 1 with all errors under 0.01 mag. GSC 1332.0564 was used as the comparison and GSC 1332.0578 as the check star for all four eclipses. Derekas et al. (2002) reported possible variability in GSC 1332.0564, although we do not see this in our data.

Photometric data about all stars within 5 arcmin of the variable are available at `ftp://ftp.nofs.navy.mil/pub/outgoing/aah/sequence/owgem.dat`. Sixteen observers from two continents participated in the campaigns, see Table 2.

Results of the campaigns are listed in Table 3. Primary times of minimum were determined with the software *AVE* (Barbera 2000) based on the Kwee and Van Woerden method (Kwee-van Woerden 1956). Using a Fourier curve-fitting technique, Nelson determined the time of secondary minimum. Light curves for all eclipses are found in Figures 1-4.

The primary minima are consistent with the light elements given below, which are from Williams and Kaiser (1991). The secondary minimum occurs at phase 0.232 using the same elements. A full model of OW Geminorum will be published elsewhere.

$$\text{Min. I} = \text{HJD } 2415779.0 + 1258\overset{\text{d}}{.}59 \times E.$$

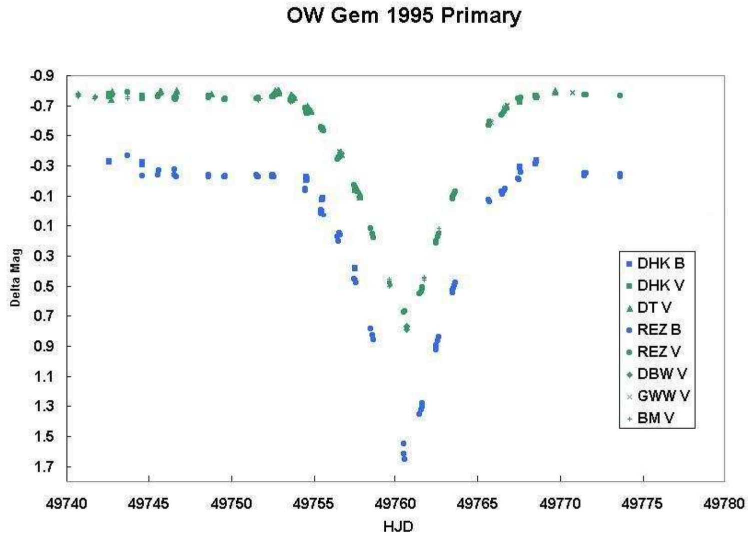

Figure 1.

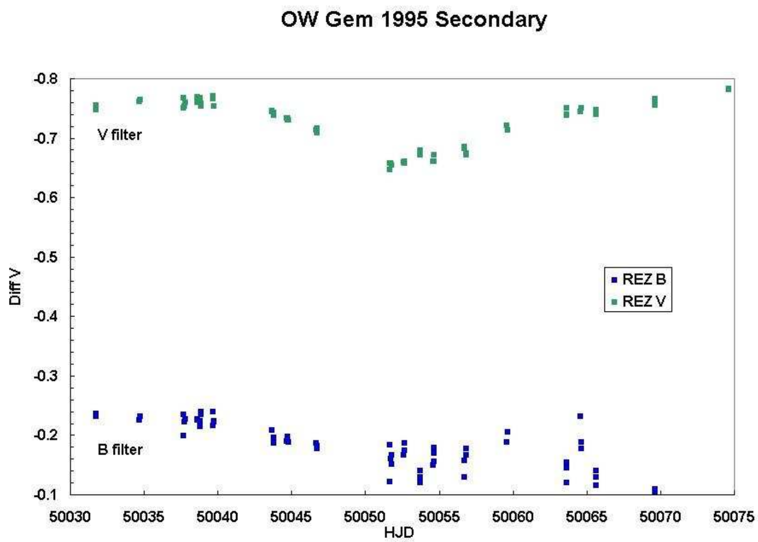

Figure 2.

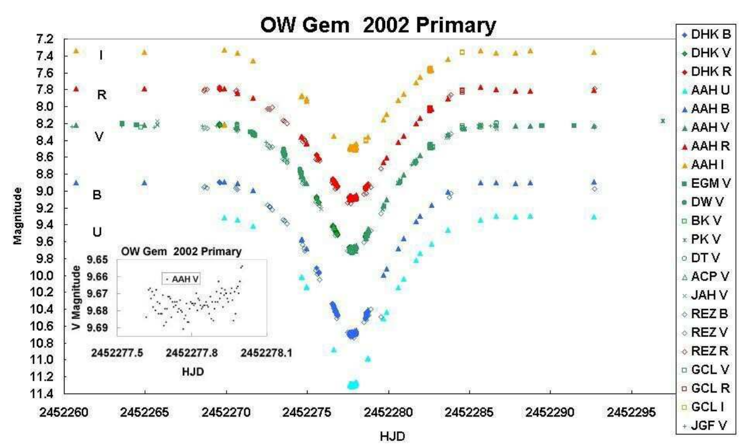

Figure 3.

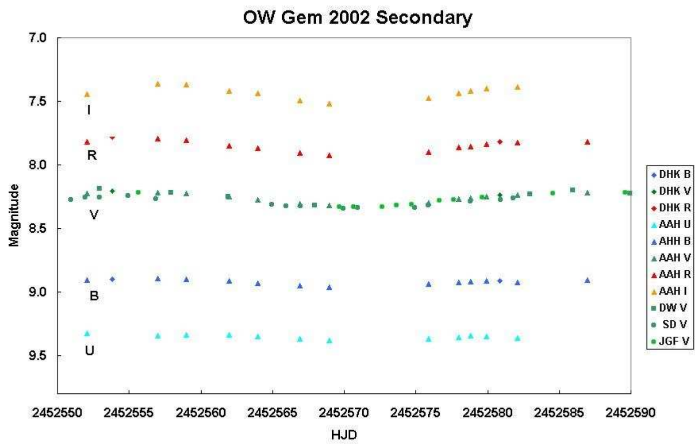

Figure 4.

Table 3. Times of minimum

Eclipse	Time of minimum (error)
1995 primary	2449760.59 (2)
1995 secondary	2450053.2 (2)
2002 primary	2452277.77 (1)
2002 secondary	2452570.9 (1)

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HD 67852: A NEW δ SCUTI VARIABLE

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The early-F star HD 67852 was used as a photometric comparison star with the T8 0.8 m automatic photoelectric telescope (APT) at Fairborn Observatory[1] in our program to follow brightness changes in a large sample of solar-type stars (Baliunas et al. 1998; Henry 1999). It was recognized as a low-amplitude variable from 51 Strömgren *by* observations in the 2000–2001 observing season and placed on the observing menu of the T3 0.40 m APT at Fairborn the next year to obtain additional Johnson BV measurements.

Very little is known about HD 67852. Olsen (1979) estimated it to be either a reddened Ap star, a λ Bootis star, or, less plausibly, a field horizontal branch star, based on its Strömgren indices. Gray (1989) obtained a spectrum and classified it as F0 Vn, noting that it was broad-lined and possibly somewhat metal-weak. The *Hipparcos* satellite made 64 photometric measurements and found no variability (ESA 1997). The *Hipparcos* mean $V = 7\overset{\mathrm{m}}{.}72$, $B-V = 0\overset{\mathrm{m}}{.}245$, and parallax of 0.00845 arcseconds place the star on the main sequence near the middle of the δ Scuti instability strip. García-Sánchez et al. (2001) found HD 67852 to be one of 156 stars that have passed or will pass closer than five parsecs to the Sun within ± 10 Myr of the present; their results show the star encountered the solar system about 4.3 Myr ago at a heliocentric distance of 2.9 pcs. By the *Hipparcos* epoch, the star had moved out to a distance of 118 pcs and continues to recede from the Sun with a radial velocity of 26 ± 7 km s^{-1} (García-Sánchez et al. 2001).

In this paper, I analyze the $\sim$360 Johnson BV observations obtained with the T3 APT between 2001 September and 2002 May. The data acquisition, reduction, and analysis methods, incorporating the method of Vaniĉek (1971), have been described in Henry et al. (2001). The photometric observations were made differentially with respect to HD 66950 ($V = 6\overset{\mathrm{m}}{.}40$, $B-V = 1\overset{\mathrm{m}}{.}06$, K0) as the comparison star and HD 65123 ($V = 6\overset{\mathrm{m}}{.}35$, $B-V = 0\overset{\mathrm{m}}{.}51$, F6 V) as a check star. The check minus comparison ($K-C$) differential magnitudes were constant to 0.006 and 0.007 mag (standard deviation) in B and V, respectively, which is close to the limit of precision for the T3 APT. The variable minus comparison ($V-C$) differential magnitudes had standard deviations of 0.013 and 0.011 mag in B and V, respectively, indicating definite variability in HD 67852. The individual photometric observations are available on the Tennessee State University Automated Astronomy Group web site[2].

[1] For further information on Fairborn Observatory see `http://www.fairobs.org`.
[2] See `http://schwab.tsuniv.edu/papers/ibvs/hd67852/hd67852.html`.

An important feature of the Vaniĉek technique is its ability to find multiple periods without prewhitening. Power spectra of the $(V-C)$ and $(K-C)$ differential magnitudes in both the B and V passbands were computed with the Vaniĉek method over the frequency range 0.01–50 day^{-1}, which corresponds to the period range 0.02–100 days. No evidence for periodic variability in the $(K-C)$ observations was found, confirming the suitability of the comparison and check stars as photometric references. The results for the $(V-C)$ observations in B are given in Figure 1, which has been truncated at a frequency of 20 day^{-1} since no variability at higher frequencies was found.

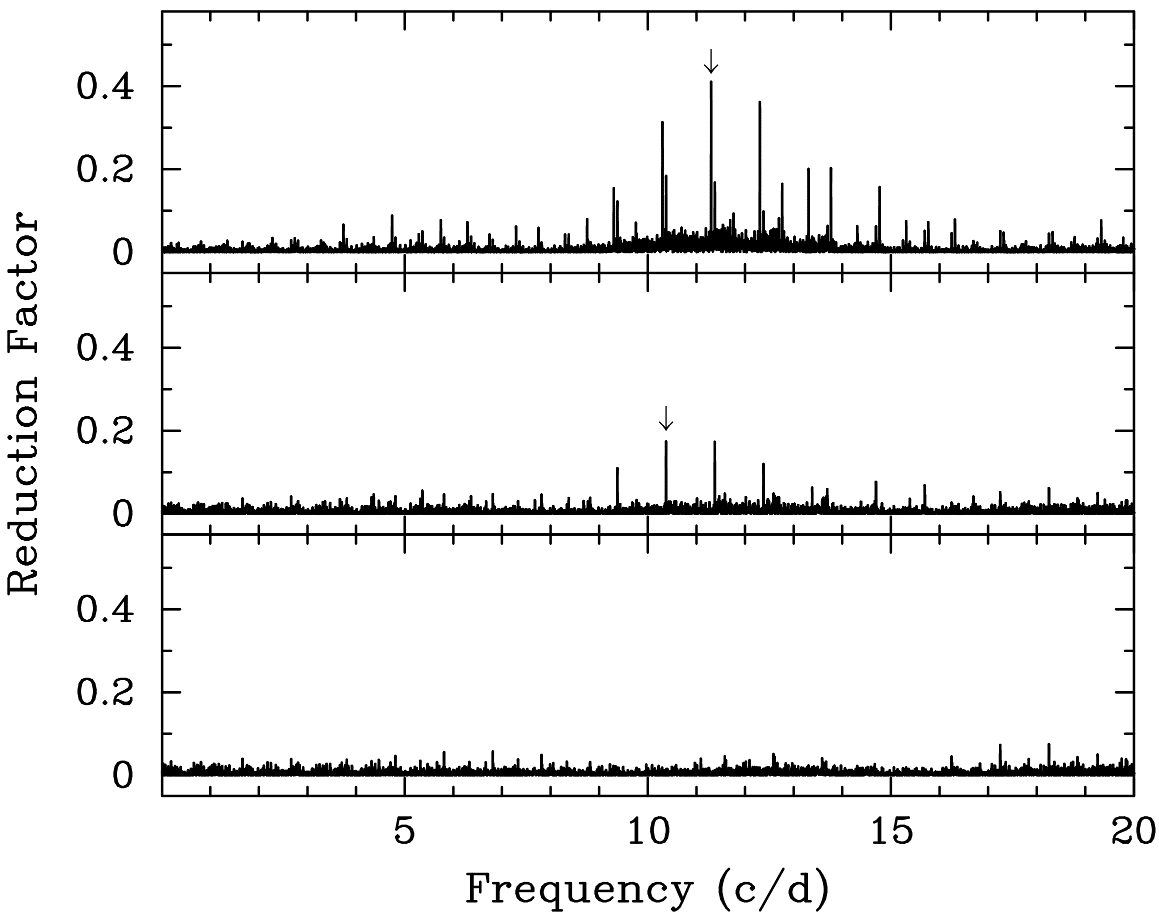

Figure 1. Power spectra of the HD 67852 Johnson B observations obtained with the T3 APT. The top panel reveals the strongest frequency at 11.3027 day^{-1}. With that frequency fixed, the power spectrum in the middle panel was computed, revealing a second frequency at 10.3756 day^{-1}. The power spectrum in the bottom panel was computed with the first two frequencies fixed and reveals no additional frequencies.

Two frequencies were detected, corresponding to periods of 0.088474 and 0.096380 days. The peak-to-peak amplitudes in B were 23.3 and 15.7 mag, respectively. As can be seen in the middle panel of Figure 1, the identification of the second frequency is somewhat ambiguous; it and its 1-day alias have similar reduction factors. Therefore, it is possible that 11.377 day^{-1} is the correct second frequency. Essentially the same results were obtained with the V dataset. The results are summarized in Table 1. The B/V amplitude ratios for the two periods are 1.46 and 1.63, respectively. The times of minimum in the two passbands agree within their errors for both periods.

Table 1. Photometric Analysis of HD 67852.

Photometric Band	$N_{\rm obs}$	Frequency (day^{-1})	Period (days)	Peak-to-Peak Amplitude (mmag)	$T_{\rm min}$ $(HJD - 2,450,000)$
B	371	11.3027	0.088474	23.3	2,300.031
		±0.0003	± 0.000002	± 1.5	± 0.001
		10.3756	0.096380	15.7	2,300.081
		±0.0002	± 0.000002	± 1.7	± 0.002
V	358	11.3028	0.088474	16.0	2,300.030
		±0.0002	± 0.000002	± 1.3	± 0.001
		10.3750	0.096386	9.6	2,300.082
		±0.0002	± 0.000002	± 1.5	± 0.002

The B observations are plotted in Figure 2, where they have been phased with the two periods and computed times of minimum from Table 1. To render the low-amplitude variability more evident, the observations in each panel have been prewhitened to remove the other period. The photometric variations at both periods closely approximate sinusoids.

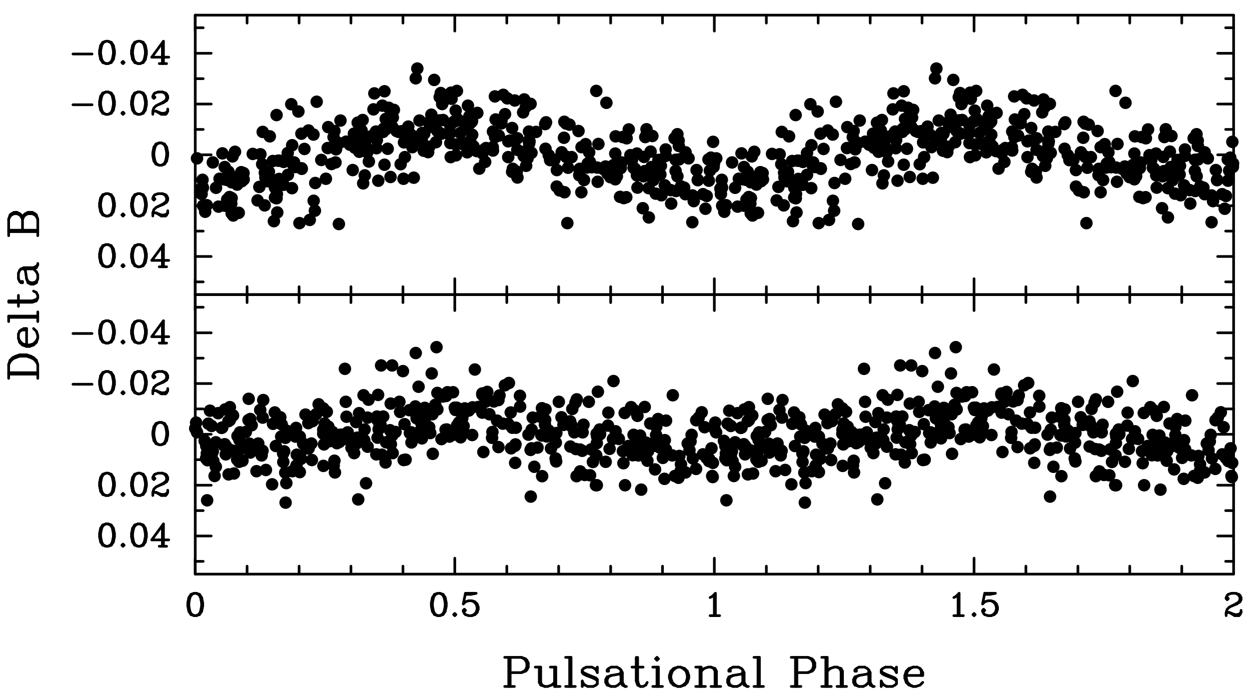

Figure 2. The Johnson B photometry phased with the two detected periods and times of minimum from Table 1. The observations are phased with the 0.088474-day period in the top panel and with the 0.096380-day period in the bottom panel. In each case, the data have been prewhitened to remove the other period.

The majority of known δ Scuti variables are Population I objects pulsating with low amplitudes in nonradial p modes (Breger 2000). The catalog of Rodríguez et al. (2000) shows that nearly 30% of the 636 known δ Scuti stars have amplitudes smaller than 0.02 mag, which implies that many more low-amplitude variables are yet to be discovered. The high-amplitude δ Scuti stars (HADS) and the Population II SX Phe subgroups have much higher photometric amplitudes of 0.3 mag or more (Breger 2000). As seen in Figure 5 of Rodríguez et al. (2000), the high-amplitude stars have low rotational velocities ($v \sin i < 20$ km sec^{-1}), while the low-amplitude stars rotate much more rapidly. HD 67852 clearly belongs to the more common low-amplitude, rapidly-rotating subgroup of δ Scuti variables.

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TIMES OF LIGHT MAXIMA OF SOME RRab STARS

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Seventy years ago L. Detre initiated a systematic photometry survey of bright northern RR Lyrae stars in order to discover secondary periodicities in their pulsation. Since 1954 the observations have been carried out photoelectrically with the 60 cm Newton telescope at Budapest, Svábhegy (in integrated light in the first three years) and later, since 1972 the 50 cm Cassegrain telescope at Piszkéstető, Mountain station was also used to the photometry. The observations were made by the staff of the observatory (mostly by L. Csank, L. Detre, K. Gefferth, M. Lovas, K. Oláh and B. Szeidl).

The results on RRab stars with stable light curves have partly been published (AN Ser: Kanyó & Szeidl 1974; AT And, SU Dra, RR Leo, TT Lyn, AR Per: Oláh & Szeidl 1978; TW Her, VZ Her, AV Peg, TU UMa: Szeidl et al. 1986). In Table 1 we collected the times of light maxima of the rest of the RRab stars with stable light curves ever observed photoelectrically at Konkoly Observatory. These data might be useful in constructing their $O-C$ diagrams. The times given in Table 1 are mean values of the blue and yellow maximum times. (An asterisk in Table 1 indicates that the observations were made in integrated light.)

The RRab stars which exhibited Blazhko effect (RS Boo, TT Cnc, Z CVn, XZ Cyg, RW Dra, XZ Dra, DL Her, RR Gem, RR Lyr, BH Peg, AR Ser, RV UMa) were observed more regularly. The observations of some of these stars have already been published (RS Boo: Kanyó 1986; RW Dra: Szeidl et al. 2001b; XZ Dra: Szeidl et al. 2001a; RR Lyr: Szeidl et al. 1997; RV UMa: Kanyó 1976).

Acknowledgements:

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Table 1:

Star name	Times of maxima HJD	Star name	Times of maxima HJD
XX And	2436141.5267*	UY Cyg	36397.5250
	36144.4176		36452.4741
	36157.4269		36788.3365
	36451.5846		36790.5800
	36819.4634		40428.4395
	39381.6014		40438.5287
	39389.5510		45896.4495
	39418.4600		
	40500.4147	SW Dra	2435238.4795*
	40515.5918		35561.4846*
	41605.5121		35562.6230*
	41983.5145		35569.4597*
	45604.5560		36613.6692
			36616.5181
X Ari	2442403.3775		36644.4333
	42716.5439		43578.4700
	43459.5025		
	44172.5208	SZ Gem	2436605.3781
	45622.6365		36614.3989
			37315.4909
ST Boo	2435127.6595*		39536.5271
	36673.4502		
	36696.4758	VX Her	2436744.4685
			40422.4710
S Com	2436670.5335		
	36672.2910	RR Leo	2443560.5004
	36693.4080		43911.5572
UY Cyg	2435284.5260*	V LMi	2436629.5110
	35338.3540*		36630.5979
	36351.5478		

Remark: ST Boo is probably an RR Lyrae star with Blazhko effect (Lange & Firmanyuk 1975).

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NEW ELEMENTS FOR V651 Her AND V1058 Oph

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V651 Her

The variability of V651 Her (=S9618 = GSC 962.0663) was announced by Hoffmeister (DCEP: $13^{m}_{.}0 - 14^{m}_{.}0$) and first elements were derived from Berdnikov et al. (1995):

$$\text{Min. I} = \text{HJD } 2449827.9 + 3^{d}_{.}1745 \times E.$$

Recent estimations, made on 244 photographic plates taken with the Sonneberg Observatory 40cm Astrograph, have yield 8 new times of primary minima (see Table 1). A least-squares solution including the times of the three deepest measurements from Berdnikov et al. (1995) yields the following linear ephemeris:

$$\begin{aligned}\text{Min. I} = \text{HJD } 2444373.417 &+ 3^{d}_{.}174878 \times E.\\ \pm 0.025 &\pm 0.000017\end{aligned}$$

With respect to the magnitudes given in Table 3, the photographic amplitude of V651 Her was determined to $12^{m}_{.}6 - 13^{m}_{.}9$ (Min. II: $12^{m}_{.}9$); GCVS type E.

Table 1. Minima of V651 Her according to the ephemeris derived in this paper

Nr	HJD	Method*	Epoch	$O-C$	Observer
1	37112.450	P	−2287.0	−0.020	Häussler
2	38528.508	P	−1841.0	+0.041	Häussler
3	39293.497	P	−1600.0	−0.115	Häussler
4	44370.400	P	−1.0	+0.158	Häussler
5	44373.426	P	0.0	+0.009	Häussler
6	44427.411	P	17.0	+0.021	Häussler
7	49132.497	P	1499.0	−0.062	Häussler
8	49475.493	P	1607.0	+0.047	Häussler
9	49634.1239	E	1657.0	−0.0665	Berdnikov
10	49808.8747	E	1712.0	+0.0660	Berdnikov
11	49827.7782	E	1718.0	−0.0797	Berdnikov

* P denotes photographic plate minima and E photoelectric observations

V1058 Oph

The variability of V1058 Oph (=S9625) was announced by Hoffmeister (EA, $15^{\rm m}_{\cdot}5 - 17^{\rm m}_{\cdot}0$ photographic, without ephemeris). A recent investigation, made on 214 photographic plates, has yielded 10 times of primary minima (see Table 3). A least-squares solution has yielded the following linear ephemeris:

$$\text{Min. I} = \text{HJD } 2444749.462 + 5^{\rm d}_{\cdot}688195 \times E.$$
$$\pm 0.016 \pm 0.000025$$

With respect to the magnitudes given in Table 3, the photographic range of V1058 Oph was determined to $15^{\rm m}_{\cdot}8 - 17^{\rm m}_{\cdot}3$ (Min. II: $16^{\rm m}_{\cdot}1$); GCVS type E.

Further photometry is urgently needed in the case of V1058 Oph to determine the subtype of variability. An eccentric orbit cannot be excluded for this system.

Table 2. Minima of V1058 Oph according to the ephemeris derived in this paper

Nr	HJD	Method*	Epoch	$O-C$
1	38583.446	P	−1084.0	−0.013
2	38640.336	P	−1074.0	−0.005
3	38856.523	P	−1036.0	+0.031
4	44402.422	P	−61.0	−0.060
5	44732.466	P	−3.0	+0.068
6	44749.430	P	0.0	−0.032
7	45056.580	P	54.0	−0.045
8	46592.474	P	324.0	+0.037
9	46649.374	P	334.0	+0.055
10	48088.400	P	587.0	−0.033

* P denotes photographic plate minima

Table 3. Comparison stars

	V651 Her		V1058 Her	
Nr	GSC/USNO	m*	GSC/USNO	m*
1	962.0315	$12^{\rm m}_{\cdot}2$	410.0503	$15^{\rm m}_{\cdot}6$
2	962.2150	$12^{\rm m}_{\cdot}8$	410.0219	$16^{\rm m}_{\cdot}3$
3	962.1517	$13^{\rm m}_{\cdot}4$	0900-09216665	$16^{\rm m}_{\cdot}6$
4	962.0335	$14^{\rm m}_{\cdot}0$		

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

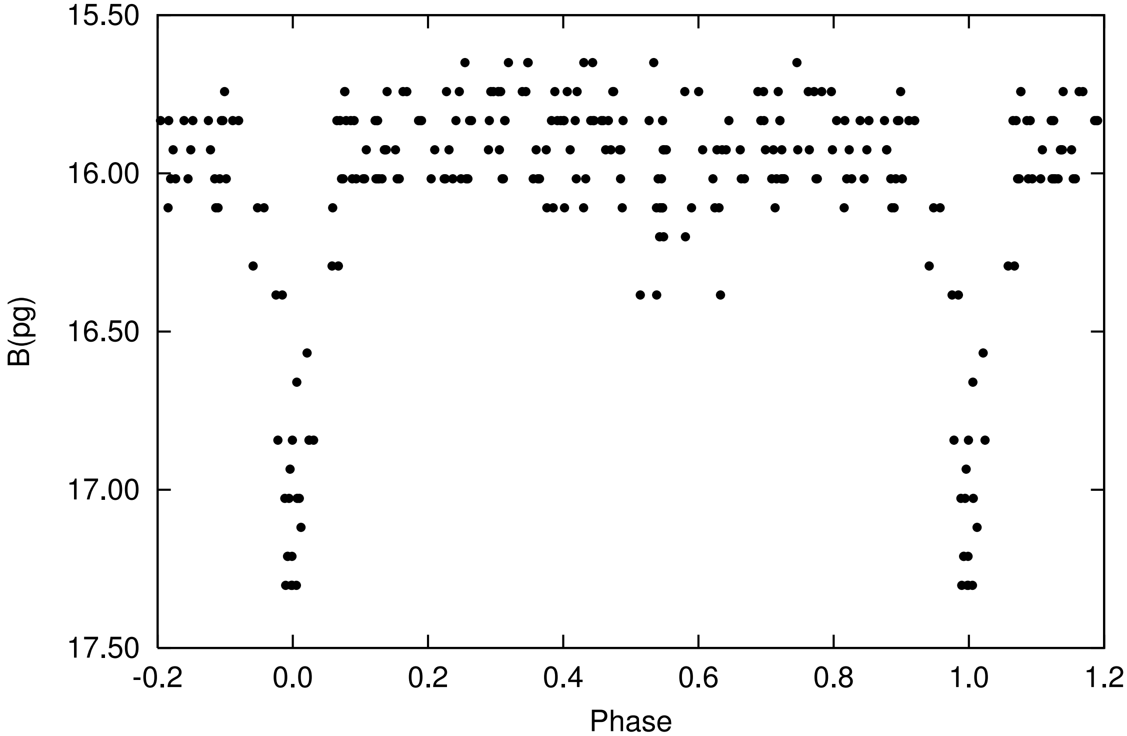

Figure 1. Photographic light curve of V1058 Oph

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

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FR Cnc = BD +16°1753 - A YOUNG ACTIVE MAIN-SEQUENCE STAR

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The star BD +16°1753 ($\alpha_{2000} = 08^h32^m30\overset{s}{.}5$ and $\delta_{2000} = +15°49'26''$) of $V = 10.43$ mag and spectral type K8V is an optical counterpart of the bright soft X-ray source 1ES 0829 + 15.9 = 1RXS J083230.9+154940 (Elvis et al. 1992; Schachter et al. 1996; Voges et al. 1999). BD +16°1753 is 33 ± 2 pc distant (Perryman et al. 1997) implying an absolute magnitude of 7.8 and a ratio of X-ray to bolometric luminosity f_x/f_{bol} of $\sim 10^{-3}$ which shows that the star has an active corona at at the 'saturation' limit. It has been classified as an 'unsolved' Hipparcos variable star (FR Cnc) of 0.17 magnitudes amplitude variability (Perryman et al., 1997), and as a suspected BY Dra-type variable, i.e., having variability due to the rotational modulation of starspots, by Kazarovets et al. (1999). Using the mean radial velocity of 25.5 km/s (Upgren et al. 2002) and the Hipparcos Catalogue distance and proper motions, the galactic space velocity components (U, V, W) of BD +16°1753 are (−24.1, −22.8, −5.1) km/s. This clearly places the star inside the young disk population boundaries in the (U, V) and (V, W) diagram (Montes et al. 2001).

Broad band BVR photometric observations of FR Cnc were carried out from the State Observatory Naini Tal using the $2K \times 2K$ CCD camera during the years 2001 - 2002. We have also taken low resolution spectra from 104-cm telescope at State Observatory Naini Tal using the HR-320 spectrograph with the $1K \times 1K$ CCD camera. The dispersion of the spectrograph was 100 Å/mm.

Both photometric and spectroscopic data were reduced using the standard packages under IRAF[1]. We have been able to do accurate differential photometry as both the comparison (S1) and check (S2) stars are within the $13' \times 13'$ field of view of the CCD camera as shown in Fig 1. The corresponding USNO-A2.0 numbers for S1 and S2 are 1050-05766844 and 1050-05766589. The comparison star (S1) is also identified as TYC 1392 2110 1. Correlated periodic variations have been observed in the V magnitude and the $(V - R)$ colour of FR Cnc. The top and the middle panels of Fig. 2 show the differential magnitude and the $(V - R)$ colour variations folded against the most significant period of $0\overset{d}{.}827$ found (see below). An arbitrary epoch of JD 2451943.1980 has been used. The data shown are from observations carried out in 27 November - 5 December 2001 (Fig. 2a), 11 December 2001 - 1 January 2002 (Fig 2b) and 31 January

[1]IRAF is distributed by the National Optical Astronomy Observatories, USA

- 4 February 2002 (Fig. 2c). The star was found to become redder when fainter and bluer when brighter. The differential magnitudes of the check star with respect to the comparison star are also plotted in Fig. 2 (bottom panels). No significant light variation was detected between the different measures of the comparison and check stars, indicating that the light of the comparison star was indeed constant during the observations. The full set of data was analysed using the standard period finding techniques and photometric period $0\overset{d}{.}827 \pm 0.002$ was found. The amplitude of variation in V band and change in phase of the minima are tabulated in Table 1. The errors in determination of ΔV and phase minima are ± 0.003 mag and ± 0.03 to ± 0.06, respectively. The light curves for the epochs (a) and (c) clearly show the secondary minima indicating the presence of two spots (or groups of spots) separated by 0.5 in phase. Secondary minima could not be determined during the epoch (b) observation.

Figure 3 shows a low-resolution normalized spectrum of FR Cnc taken on 29 April 2002. H_α emission is clearly seen. In late type stars H_α emission is a good indicator of chromospheric activity. Changes of the photometric amplitude and phase on a time scale of a few rotations are quite commonly seen among active stars as their spot distributions vary. The observed rotational period of FR Cnc is unusually short, however.

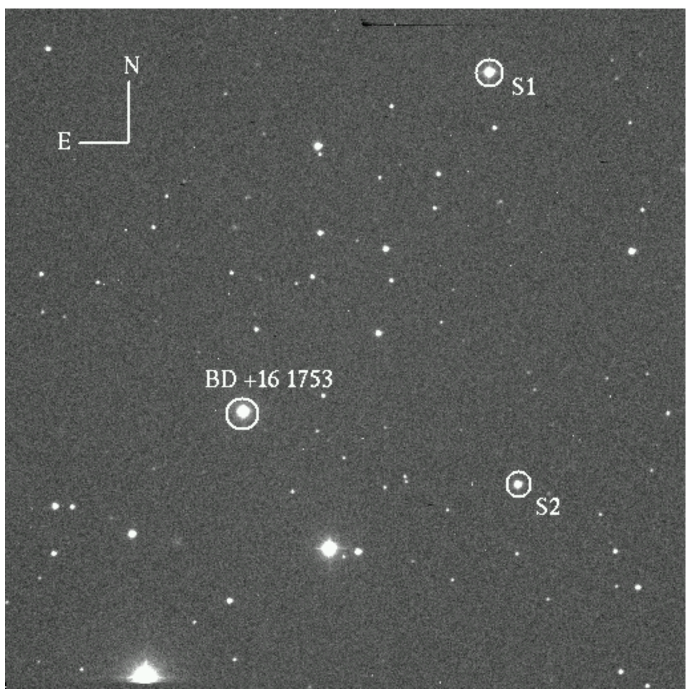

Figure 1. Identification chart of FR Cnc, Where S1 and S2 are comparison and check stars, respectively.

Its youth, amplitude variation, phase change, H_α emission and soft X-ray emission suggest that the star FR Cnc is an active and spotted star with photometric period of $0\overset{d}{.}827 \pm 0.002$ (the likely stellar rotation period). It is more likely to be a single star than a binary star, given the lack of radial velocity variations (based on two measurements!), although the fact that its absolute magnitude is $\sim$ 0.8 magnitudes brighter than that of a canonical K8 V star is a weak evidence for a binary status. However, to further understand the nature of this star, high-resolution spectroscopic observations coordinated with simultaneous photometric observations are urgently needed. We are accordingly planning to monitor this object further.

Table 1: Maximum amplitude in V band (ΔV) and phase of the minima at different epochs

Epoch	ΔV (mag)	Phase minima	
		I	II
(a)27 Nov - 5 Dec 2001	0.06	0.40	0.90
(b)11 Dec 2001 - 1 Jan 2002	0.10	0.30	–
(c)31 Jan - 4 Feb 2002	0.10	0.27	0.78

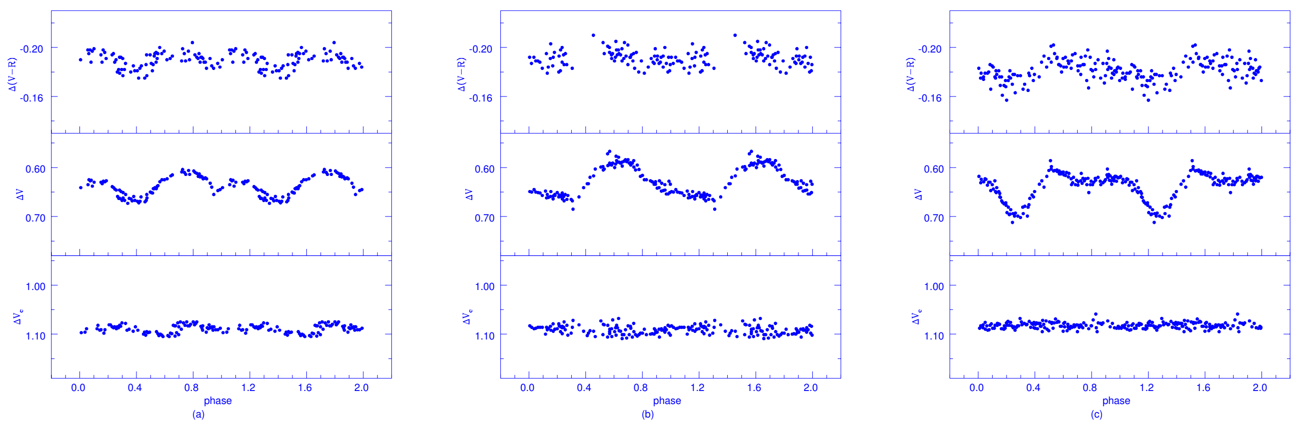

Figure 2. Differential V and $(V-R)$ light curves of the star BD $+16°1753$ and differential V light curve of the comparison star: (a) during 27 November - 5 December 2001; (b) 11 December 2001 - 1 January 2002; and (c) 31 January - 4 February 2002

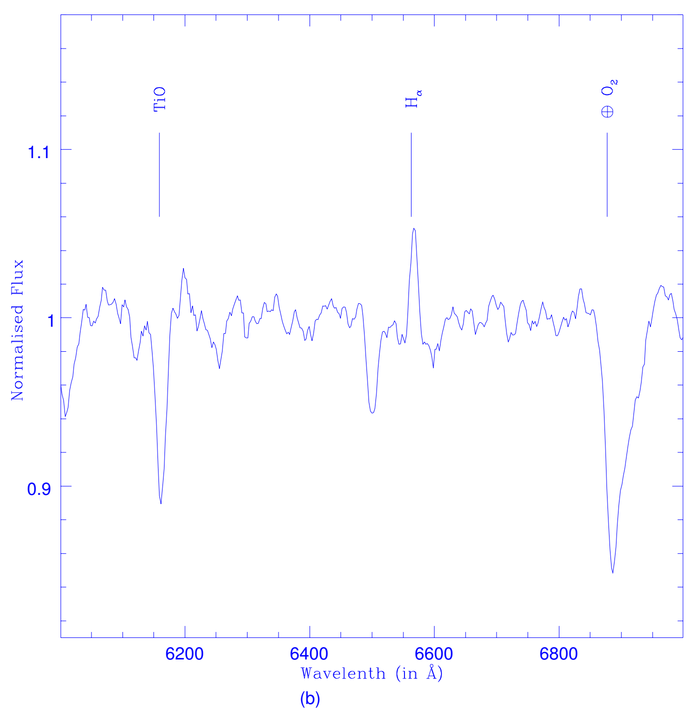

Figure 3. Low-resolution spectrum of BD $+16°1753$

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δ SCORPII: VISUAL PHOTOMETRIC VARIABILITY IN 2000-2002

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δ Scorpii is a previously unremarkable early-B star that underwent a sudden, large visual outburst and transitioned to a strong Be-state in mid-2000. Otero, Fraser, and Lloyd (2001) described their post-eruption photometry and briefly discussed the *Hipparcos* photometry and some spectroscopic aspects of the star. Miroshnichenko et al (2001), hereafter METAL, published an extensive study of their post-outburst spectroscopy, and they correlated the Otero, Fraser, and Lloyd photometry with their observations. δ Sco is also a long-period visual binary star, whose orbit was interferometrically determined by Hartkopf, Mason, and McAlister (1996) and spectroscopically by METAL; the period is 10.58 years, and the eccentricity is extremely high.

This paper describes δ Sco's visual photometric behavior from the outburst's discovery in 2000 through 11 October 2002 and correlates it with some aspects of METAL's observations. Our observations show that a quasi-periodic and transient variation of very close to 71 days in length existed during most of the outburst, through approximately 1 June 2002. That quasi-periodic variation is superposed upon a long-term trend of so far indeterminate length. We also identify three main phases of the outburst and determine estimated dates for the outburst's start and for the long-term trend maximum.

Our light curve shows that the amplitude of the 71-day variability has generally decreased with time, and that there are time intervals, of approximately the same length as the 71-day quasi-periodic variability, during which the amplitude appears to have been statistically zero (i.e., "lulls"). During the last ~75 days of our data, only the long-term variability has been apparent. A fuller discussion of our data is in preparation.

The existence of a putative periodicity of 78 days in published radial velocity data (dating from 1903 through 1975) and in the early outburst photometry was suggested by Gandet (2001a); the period was later estimated to fall between 68 and 78 days (Gandet, 2000b). A ~70-day-long variability is consistent with the time scale of the variations in the Hα EW and relative intensity reported in METAL during ~50 days on either side of periastron. We note, without bias, the intriguing similarities between the putative spectroscopic period and the photometric mid-term-length variation reported here, and of their transient nature.

Our observations consist of previously published (Otero et al. 2001) visual (v) and photoelectric photometry (V); and from more recent visual (Otero), photoelectric (Fraser)

Table 1.
Comparison Star Magnitudes and Colors

Site*	Star	HR	V	$B-V$	$U-B$	Sp. Type
1	λ Sco	6527	1.62	−0.23	−0.89	B2IV+B[1]
1	ϵ Sgr	6879	1.84	−0.03	−0.13	B9.5III
1	α Pav	7790	1.93	−0.20	−0.71	B2IV
1	σ Sgr	7121	2.09	−0.21	−0.75	B2.5V
1	γ Cen	4819	2.16	−0.02	−0.01	A0IV+A1IV
1	α Lup	5469	2.30	−0.22	−0.89	B1.5III[1]
1,3	$\beta^{1,2}$ Sco[2]	5984	2.50	−0.07	−0.87	B1V
1,2,3	ω^1 Sco	5993	3.95	−0.04	−0.81	B1V
3	λ Lib	5902	5.03	−0.03	−0.56	B2.5V
2	HD 142315	——	6.86	+0.04	−0.21	B8V

Notes: [1] Low amplitude ($\leq$0.05 mag) β Cep variables. Their use does not affect the visual data meaningfully; there are no other suitable comparison stars when δ Sco is near this magnitude.
[2] Unresolved visually. The V magnitude is the combined magnitude; the colors and spectral type of only the primary component are given. The two components are virtually identical in color and spectral type.

* Site codes: (1) Buenos Aires, Argentina (Otero); (2) Sunninghill Observatory, South Africa (Fraser); (3) Lizard Hollow Observatory, Arizona USA (Gandet).

and CCD V photometry (Gandet). A qualitative comparison of the visual observations with the PEP and CCD data (see Figure 1) beautifully demonstrates the notable precision of which visual observations are capable using the observing techniques developed by SO (described in Stefl et al 2002). The individual observations are available in electronic tabular form, at the IBVS website as 5352-t2.txt.

Fraser used a .20-m SCT with an Optec SSP-3 photometer. He used the comparison and check stars given in Otero et al (2001). Otero used a set of comparison stars from which the two closest to δ Sco in magnitude at any one time were chosen. Gandet used a .28-m SCT, stopped to a 1-inch aperture, with an SBIG ST7-E CCD photometer and V (Bessell) filter. Table 1 lists the comparison and check stars, and their adopted Johnson magnitudes and colors, used at each site.

Fraser adopted the differential photoelectric photometry reduction techniques used in the AAVSO PEP observing program, which results in magnitudes on the Johnson system. No corrections for color or extinction were applied to Otero's visual observations (Stefl et al., 2002).

Gandet used aperture photometry to determine differential V and $B-V$ with respect to ω^1 Sco on two nights and $\beta^{1,2}$ Sco on one night; both components of β Sco were included within the aperture. Mean extinction and seasonal transforms measured previously at the LHO site were used to place the observations on the Johnson system; the V-band extinction coefficient at the LHO site is quite consistent between nights of photometric quality within a particular season. The nominal $B-V$ difference, δ Sco *minus* ω^1 Sco, of −0.08, was adopted for the transforms, and the resulting corrections were no larger than 0.015 mag in V.

We have therefore assumed that all of our observations are on the Johnson system. Our B-band data are too few to confidently reach a conclusion about color variations, but there is some indication that the star may have reddened by up to $\sim$0.1 in $B-V$ since the outburst began.

Otero's visual magnitudes (filled circles), Fraser's (open circles), and Gandet's CCD V magnitudes (crosses) are shown in Figure 1, plotted against Geocentric JD. The estimated maximum internal uncertainty of the PEP and CCD observations is ± 0.02 mag and ± 0.05 mag for the visual observations.

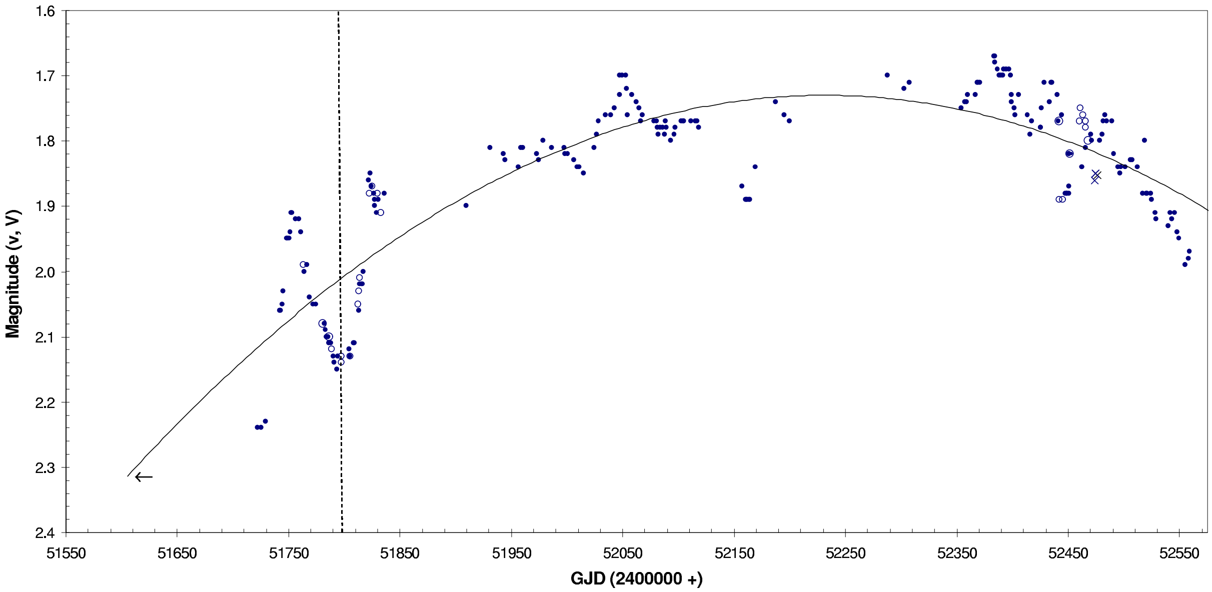

Figure 1. Visual, PEP V, and CCD V observations, through 11 October 2002, of δ Scorpii. See text for an explanation of the symbols.

We used Scargle's periodogram algorithm, as implemented in the AVE software (Barberá, 2000), to search the entire data set of our raw magnitudes for peaks in the power spectrum. The range of inverse frequencies tested was from .1 to 400 days. The power spectrum shows strong peaks near 180, 251, and 400 days. Possible alias periods due to seasonal gaps in the observations are related to the true period by $1/\mathrm{P}_{alias} = (1/\mathrm{P}_{true}) \pm \mathrm{n}/365.25$ days (see, e.g., Percy and Kastrukoff 2001). If a truly periodic variability of 71 days in length is present in our data, then the three strong peaks are closely related by that relation to the ~800-day time interval covered by the observations and to the approximate length of the observing season; the 180-day peak corresponds to an "observing gap" of ~71 days. The magnitude range of the long-term trend has so far been ~0.6 mag while the amplitude of the mid-term variation, when it is visible, has averaged ~0.2 mag, so the long-term variation would therefore be expected to dominate the power spectrum. We concluded, as a result, that two of the strong peaks are aliases, and the 180-day peak is a signature of variability of ~71-days.

The next strongest peaks in the power spectrum are at 68 and 88 days, but the peaks at inverse frequencies larger than about 70-75 days could be ruled out by the first two season's photometry. There were no significant peaks near one day in the power spectrum. Variability greater than 0.01 mag on a time scale ≤ 3.0 hours was not seen in observations made by Fraser and Gandet on three separate nights; those observations, and the large difference in longitude between their sites, virtually rule out any variations on a time scale near one day on those nights.

To determine probable dates for the outburst's start and long-term maximum light, we performed a least squares, quadratic fit to our raw magnitude data; the solid curve in Figure 1 represents the resulting fit. Assuming a nominal pre-outburst magnitude of $V = 2^{\mathrm{m}}.32$ (Hoffleit and Jaschek, 1982), our admittedly crude approximation indicates that the outburst began on about JD 2451600, shown in Figure 1 by the left-facing arrow. That date qualitatively agrees with METAL's estimate. The long-term trend's maximum, as predicted by our quadratic, occurred on approximately JD 2452240; that date is close to two 71-day cycles after the decrease in disk density found by METAL and is within 4% of six 71-day cycle lengths after periastron. The vertical dotted line in Figure 1 represents the time of periastron passage determined by METAL.

There are at least three possible lulls visible in the Figure 1 and 2 light curves, each of approximately 70-75 days in length, during which the magnitude residuals are essentially constant. The average standard deviation of the mean magnitude during a lull is $\sim\pm 0.02$ mag, while the same quantity for ex-lull intervals is $\sim\pm 0.10$ mag, calculated using the residuals from the quadratic fit to the entire data set.

The first two (sequential) lulls begin on approximately JDs 2451940 and 2452100; they occur before the long-term trend maximum and could not have begun less than $\sim$145 days apart. The first lull begins $\sim$140 days after periastron, which is very close to the time METAL finds that the disk density decreased suddenly; that interval is within 1.5% of two 71-day cycles long. Because of gaps in the data, we do not know if the lulls reoccur with a characteristic frequency or if each lull's duration is the same. The third putative lull begins by JD 2452287, at the latest, and lasts through approximately JD 2452355, an interval of $\sim$65 days; however, because of a gap in the observations, the duration of this lull could be as long as $\sim$71 days.

The last recognizable 71-day cycle begins on about JD 2452355, following the end of the putative third lull, and ends on about JD 2452420. We can only say that it is a minimum of $\sim$65 days in length; its time-of-onset may not have been observed; a longer duration is not be ruled out by our observations.

Figure 2 is an expanded time scale of our data after long-term maximum. A quadratic fit made to only these data (dotted line) clearly shows a departure from the quadratic fit to the entire data set (solid line). The descending branch is steeper than the ascending branch, whereas the descending branch of the 71-day variation is shallower than the ascending branch. The magnitude residuals, from the post-maximum quadratic fit, of the most recent $\sim$65 days of our data set are essentially zero.

While fitting separate quadratics to subsets of the data may apparently represent the long-term brightness variation's behavior more closely, that process could be extended to increasingly shorter time intervals without gaining necessarily meaningful physical insight, and potentially useful information on the gross behavior of the brightness variations could be lost. We therefore adopt the "one-quadratic-fits-all" approach we have used here as being adequate for our purposes, but note that there are no *a priori* reasons to expect the light curve to be either symmetrical or unsymmetrical about maximum.

Onset of what we characterize as the chaotic state occurs on about JD 2452455, although the date is somewhat arbitrary, as can be seen from Figure 2. A transition to the chaotic phase may involve a sudden decrease in what we have called the quasi-periodic variability to $\sim$35 days, on about JD 2452420 that lasts approximately one cycle-length; the stability of the light curve appears increasingly degraded after that. The quasi-periodic variability's length may decrease further until the start of the chaotic state. We cannot say either that the quasi-regular photometric variability of δ Sco presented here has had the same length, character, or that it has existed at all, at previous epochs.

The outburst so far may be divided into three phases, or states. The first phase is a post-outburst, pre-chaotic interval, during which the 71-day quasi-periodic variation was

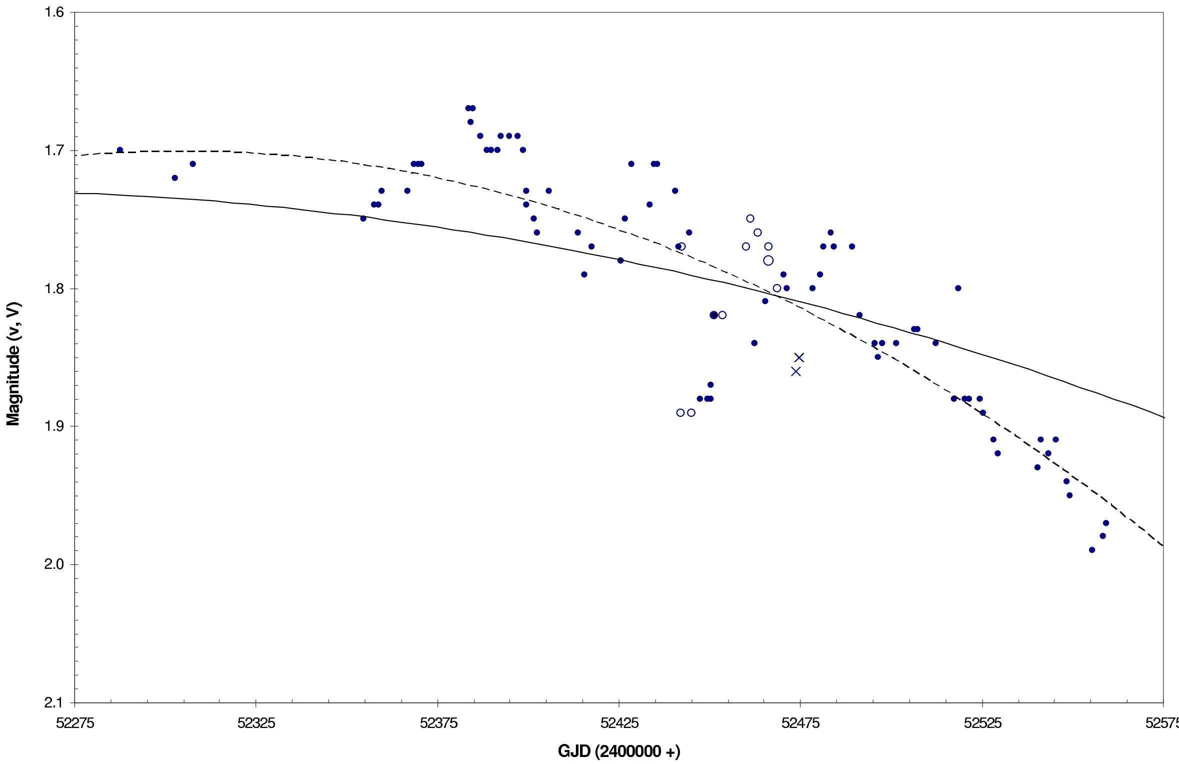

Figure 2. δ Scorpii raw magnitudes after long-term maximum. The solid and dashed lines are quadratic fits to the entire data set and to only the post-maximum data, respectively. The symbols are the same as in Figure 1.

apparent. Soon after the long-term trend's maximum, a second phase began in which the 71-day variability initially decreased in length and the light curve gradually entered a chaotic state of behavior. The third, post-chaotic state, of the outburst was in progress at the cut-off date of our observations (11 October 2002) and is primarily characterized by the presence of only the long-term trend variability. If mid-term-length photometric variability resumes soon after our cut-off data and the length of the lulls remains essentially constant, this third phase can be considered a lull.

We stress the importance of the extremely high eccentricity of the binary orbit. As METAL has pointed out in connection with the eruption's origins, strong interactions between the components and the circumstellar envelope near periastron passage occur. Considered as a binary star, δ Sco thus presents a virtually unique opportunity to explore questions of binary- and Be-star evolution taking place in a highly eccentric, perhaps relatively rapidly evolving, binary system.

The first author is gratefully indebted to Anatoly Miroshnichenko for making his δ Scorpii paper available prior to publication and for his generous counsel. We are equally indebted to Arne Henden, Christopher Lloyd, and Myron Smith for their suggestions during previous incarnations of this paper. The comments of the anonymous referee were helpful and considered.

This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France, and of NASA's Astrophysics Data System.

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NEW ELEMENTS FOR THE ECLIPSING BINARY GO Vul

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Name of the object:
GO Vul = HBV 327 = GSC 2147.0989

Equatorial coordinates:	**Equinox:**
R.A.= $19^h46^m35\overset{s}{.}4$ **DEC.=** $+27°5'59''$	2000

Observatory and telescope:
Ondřejov Observatory, Czech Republic, 0.65-m reflecting telescope

Detector:	CCD camera Apogee AP7 in primary focus, Peltier cooled

Filter(s):	Johnson's R

Date(s) of the observation(s):
18 August 2002 – 12 November 2002

Comparison star(s):	GSC 2147.1315, GSC 2147.1413

Transformed to a standard system:	No

Availability of the data:
Upon request, see also http://nyx.asu.cas.cz/~lenka/dbvar/

Type of variability:	EA

Remarks:

GO Vul was discovered as a variable star by Wachmann (1966), who derived the first light elements:

$$\text{Pri. Min.} = \text{HJD } 24\,34628.337 + 1\overset{d}{.}00892787 \times E.$$

Our measurements phased with this period indicate that there are two types of primary minimum (see Fig. 1). It implies that the true orbital period is double. A least squares fit to all times of minimum light led to the following light elements, which we propose for future use:

$$\text{Pri. Min.} = \text{HJD } 24\,52505.4944 + 2\overset{d}{.}0178517 \times E.$$

The primary and secondary minima have an amplitude of $0\overset{m}{.}45$ and $0\overset{m}{.}37$, respectively. The minimum times in Table 1 are calculated by the bisecting cord method.

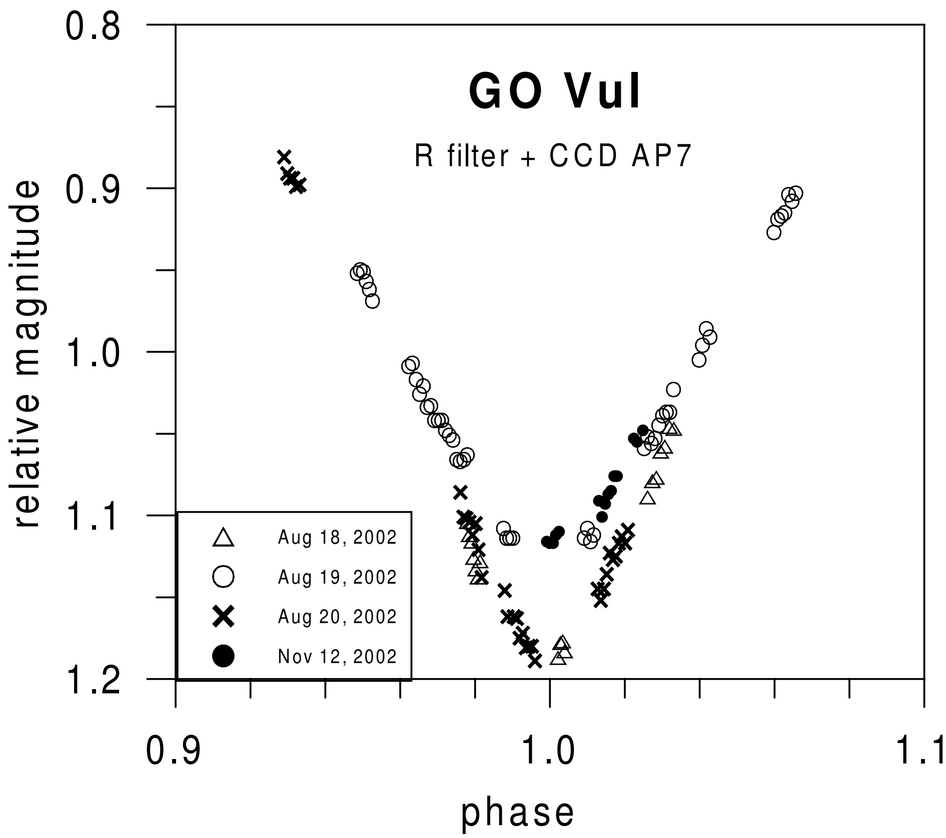

Figure 1. The light curve of GO Vul phased with the Wachmann's period of 1.009 days. The triangles and crosses correspond to the primary minima, the dots and circles to the secondaries, respectively.

Acknowledgements:

This work was supported by the research plan J13/98: 113200004 Investigations of the Earth and the Universe. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France, and of NASA's Astrophysics Data System Bibliographic Services.

Table 1: New precise times of minimum light for GO Vul.

JD Hel. – 24 00000	Error [days]	Points	Type
52505.4943	0.0008	18	Pri.
52506.5035	0.0004	51	Sec.
52507.5120	0.0006	35	Pri.

Reference:

Wachmann, A. A., 1966, *Astron. Abhandlungen Hamburg*, **6**, 97

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THE ABSOLUTE MAGNITUDE (M_V) OF TYPE *AB* RR LYRAE STARS

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RR Lyrae stars are commonly used as tracers of the halo population in both galactic and extragalactic work. Such studies require a knowledge of their absolute magnitude M_v. If their metallicity is known, it has been customary to use an empirical linear relation in terms of [Fe/H]:

$$M_v = A[Fe/H] + B \quad (1)$$

Chaboyer (1999) gives 0.23 and 0.93 while Cacciari (2002) gives 0.23 and 0.92 for the coefficients A and B, respectively. These values are consistent with the widely-used LMC modulus of 18.50±0.10 (Freedman *et al.*, 2001), van der Marel *et al.* (2002)). If we assume a mean RR Lyrae metallicity of −1.6, these relations give an $\langle M_v \rangle$ of +0.55 or +0.56 with an uncertainty of about ±0.10 mag.; this is in the middle of the range of recent direct determinations of the M_v of type *ab* RR Lyrae stars (Popowski & Gould, 1999).

Kovács & Walker (2001) have given an empirical expression for M_v in terms of the period (P) and Fourier coefficients (A1 and A3) of the variables:

$$M_v = -1.876 \log P - 1.158A1 + 0.821A3 + K \quad (2)$$

Here K is a constant which must be determined. Benedict *et al.* (2002) derived an M_v of +0.61±0.10 for RR Lyrae itself from a parallax derived from HST data; this corresponds to a modulus (corrected for extinction) of 7.06. RR Lyrae shows a 41-day modulation of its amplitude (Blazhko effect) and the amplitude of this modulation also varies over a 4-year period (Detre & Szeidl, 1973). Jurcsik *et al.* (2002) have examined the Fourier coefficients of RR Lyrae and shown that they only correspond to those of a normal type *ab* star when both RR Lyrae has the maximum amplitude of its 41-day cycle and when the amplitude of the 4-year cycle is at a minimum. Observations that fulfil this condition were made by Hardie (1955) in the interval JD 2 434 553 to JD 2 434 560. The corresponding cycles in Hardie's data are 34749 to 34761 (using Walraven's period of 0.56683735 days). The Fourier coefficients A1 and A3 derived from this portion of Hardie's data are 0.31539 and 0.09768, respectively. Using these in eqn. (2), one finds K = 0.43.

One can check this result by comparing the absolute magnitudes derived by eqn. (2) against those obtained from eqn. (1) using a group of nearby RR Lyrae stars that have both well-determined Fourier coefficients and also known metallicities. There are 73 type *ab* stars whose Fourier coefficients are given by Jurcsik & Kovács (1996) that also have

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

[Fe/H] given by Layden *et al.* (1996). For these one can calculate both M_v(Four) from eqn. 2 with K = 0.43, and also M_v(Fe) from eqn. (1) using Cacciari's coefficients. The differences (Δ M_v = M_v(Four) − M_v(Fe)), are plotted in Fig. 1 against (a) log P and (b) metallicity [Fe/H]. Eight of these variables (shown by crosses in Fig. 1) have peculiar relations between their Fourier components according to Jurcsik & Kovács (1996); two of these AN Ser (P = $0^d.52$ days, [Fe/H] = −0.04) and TV Lib (P = $0^d.27$ days, [Fe/H] = −0.27) clearly show abnormally large ΔM_v in Fig. 1. The scatter in ΔM_v is larger for stars of longer period and lower metallicity. This is understandable since the longer period stars have lower amplitudes and so their Fourier coefficients will be less well determined for a given photometric accuracy. Similarly, the metallicities will be more poorly determined in the lower metallicity stars whose lines are weaker. Additionally, there may be physical differences between the Oosterhoff I and II populations that contribute to this increased dispersion. Omitting the eight stars that have peculiar relations between their Fourier coefficients, the remaining 65 stars have a mean value of ΔM_v of +0.010±0.008 with an *rms* deviation for a single star of 0.063 mag. If one includes all these stars except AN Ser and TV Lib, the mean value of ΔM_v is +0.007± 0.008 with an *rms* deviation for a single star of 0.066 mag. Thus the two ways of estimating M_v for type *ab* RR Lyrae stars give very similar results in this sample of 71 stars.

There will be cases where neither [Fe/H] is known nor is it possible to get the Fourier components from the light curves with sufficient accuracy. One cannot simply replace the expression containing the Fourier coefficients (in eqn. 2) with a constant because this expression shows some correlation with log P. An adjustment must be made to the coefficient of log P to allow for this; one then gets:

$$M_v = -1.619 \log P + 0.20 \tag{3}$$

Calling this absolute magnitude M_v(Per), the differences δM_v = M_v(Per) − M_v(Fe) were calculated and are plotted in Fig. 2 against (a) log P and (b) [Fe/H] for *all* 73 stars in the Jurcsik & Kovács sample. None of the eight stars that have peculiar Fourier coefficients (shown in Fig. 2 by crosses) are anomalous in this plot. For all 73 stars the mean value of δM_v is −0.003±0.006 mag. with an *rms* deviation for a single star of 0.048 mag. For this sample of stars therefore, eqn. (3) is at least as good an estimator of M_v as eqn (2), although there appears to be a slight trend of δM_v with [Fe/H].

A semi-empirical relation for M_v in terms of log P and the blue amplitude of the variable (A_B) has been given by Castellani & De Santis (1994) and was further discussed by De Santis & Cassisi (2002). Now A_B correlates with log P, and so eqn. (3) can also be regarded as a simplified version of such relations

The three empirical relations given by equations (1), (2) and (3) allow alternative ways of finding M_v for a sample of RR Lyrae stars that may be used (and compared) depending on the observational data that is available. They are generally consistent with a widely used modulus (18.50) for the LMC.

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† For early discussions of such relations see Sandage (1958) and Kinman (1959)..

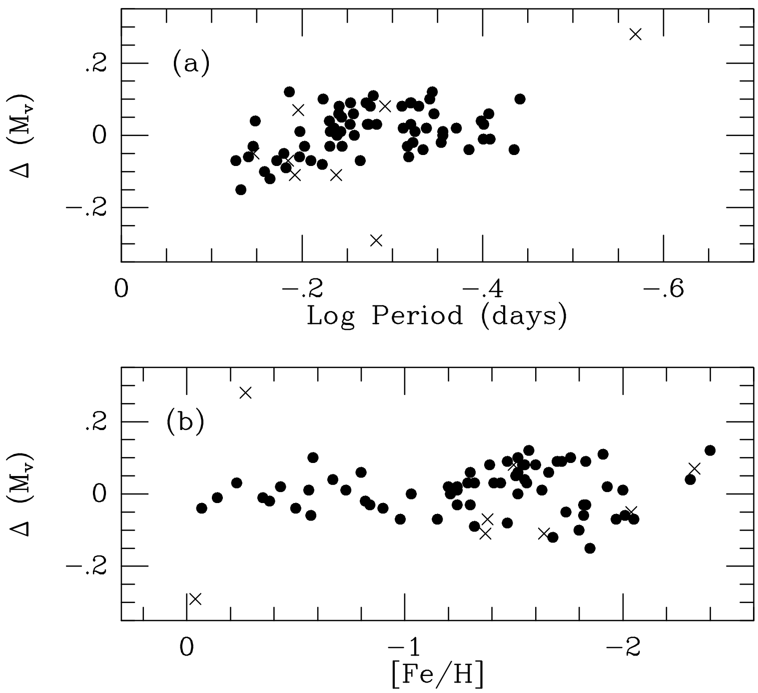

Figure 1. The magnitude difference ΔM_v as a function (a) of $\log P$ and (b) [Fe/H]

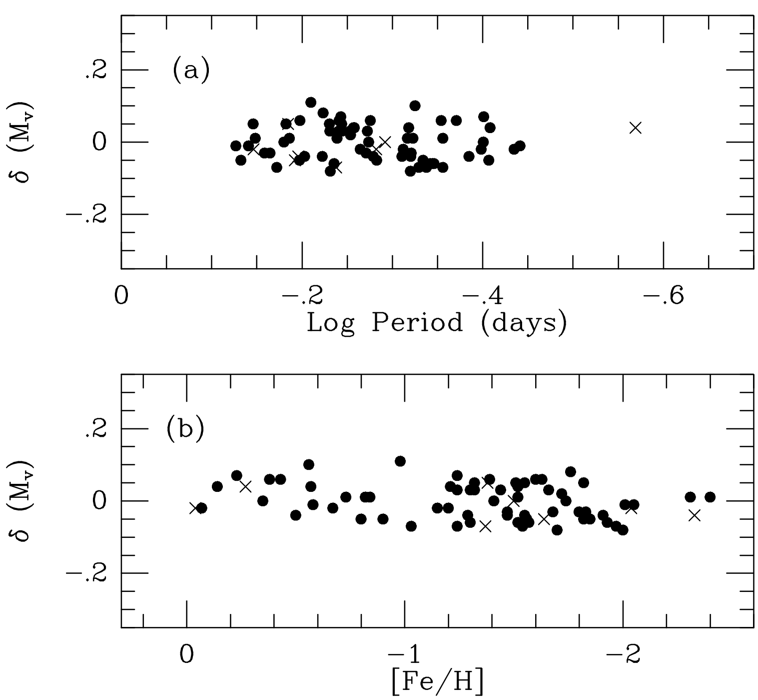

Figure 2. The magnitude difference δM_v as a function (a) of $\log P$ and (b) [Fe/H]

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NEW STRÖMGREN PHOTOMETRY OF AI DRACONIS: NO PULSATIONS DETECTED

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Recently, Narusawa et al. (2002) reported on short period variability of the bright Algol-type eclipsing binary AI Draconis. These authors detected periodic oscillations with an amplitude of about 0.03 – 0.05 mag outside eclipses, which were interpreted as caused by the δ Scuti-type pulsations of the main component in the system. The confirmation of stellar pulsations in an eclipsing binary system is an important issue as such stars are attractive observing targets for asteroseismology (e.g. Mkrtichian et al. 2002, Kim et al. 2002). Independent determination of the physical parameters (mass, radius, temperature) gives strong constraints on the possible mode identification, thus allowing a firm asteroseismologic analysis. If confirmed, its eclipsing+pulsating nature would imply that AI Dra is one of the brightest (m_V =7.05 – 7.83 mag) among such stars with a relatively short-period ($P_{\rm orb} \approx 1.19$ days). That is why we made follow-up observations of the star in July, 2002. The main aim of this note is to present our results on the reported rapid variability.

The Strömgren *uvby* photometric observations were acquired on 8 nights in July, 2002 (all nights between July 19–27, except July 21). We used the 0.9-m telescope of the Sierra Nevada Observatory (Spain) equipped with a four-channel spectrograph photometer. For the differential photometry, we used HD 154199 ($V = 6.89$, $b - y = 0.044$, $m_1 = 0.169$, $c_1 = 0.978$ mag) and HD 154731 ($V = 8.21$, $b - y = 0.167$, $m_1 = 0.159$, $c_1 = 0.900$ mag) as a comparison and check stars, respectively (magnitudes are from SIMBAD database). The same stars were utilized by Narusawa et al. (2002) and other observers as well. The magnitude differences remained constant at a level of ±0.01 mag in *vby* and ±0.02 in *u* and the estimated photometric accuracy of the target data is ±0.006 mag in $b-y$, ±0.01 mag in V and m_1 and ±0.015 mag in c_1. We note that hints for variability of the check star at the millimag level were deduced (see later). The standardized dataset consists of 2634 individual points with a total coverage of 51 hours distributed almost equally in time and is available at the IBVS website as 5355-t2.txt

We could determine three new epochs of minimum, two corresponding to primary minima, one to a secondary minimum. We list them in Table 1. Data were phased with the ephemeris $HJD_{\rm min} = 2452480.5581 + 1.1988146E$, where the period was taken from the GCVS. The phased light and colour curves are presented in Fig. 1.

[†] ON LEAVE FROM UNIVERSITY OF SZEGED, HUNGARY

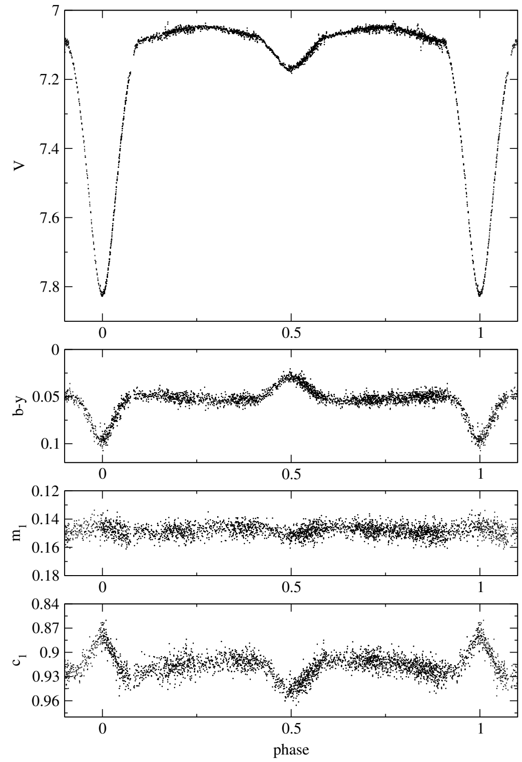

Figure 1. The light and colour curves of AI Dra.

The full light curve does not show any extra scatter (larger than the one expected from the observational uncertainties) which might be associated with some additional short period variation. There are several overlapping parts of the phase diagram which were obtained on different nights. Their agreement also excludes night-to-night variations of the light curve shape larger than 0.015 mag, at least within the eight nights of our observations. Furthermore, the colour curves are consistent with a pure eclipsing light variation with two components of strongly different temperatures.

Besides the visual inspection of the light curves, we performed a frequency analysis of the individual *uvby* data. For this, we have subtracted the mean eclipsing light variation from the original observations. The residual data show the deviations from the mean. Any low-amplitude oscillation is expected to appear at certain but the same frequency in all bands with characteristic wavelength dependence of the amplitude.

For the analysis, we used `Period98` of Sperl (1998). Additionally, we have computed Fourier spectra for the comp *minus* check data to give further insights into the frequency content of our observations (see Fig. 2 for details). The results can be summarized as follows. We could not identify any high-frequency component in the residual light curves with an amplitude larger than 1 mmag. In the low-frequency range (i.e. $f < 10$ c/d) there is a peak exactly at 2 c/d and its alias peaks are also visible (see the window function in Fig. 2). We attribute this to an observational effect. On every night, the star was followed until its air mass not reached 2–2.3. That is why there is an increase in scatter (and consequently, slight shifts of the mean value) at the ends of the nightly subsets. Since none of the subsets is longer than half a day and they occur strictly repeatedly, the effect causes an apparent signal in the observations. And finally, contrary to our expectations, we did find a high-frequency component (at $f \approx 31.3$ c/d, or $P \approx 46$ min), but in

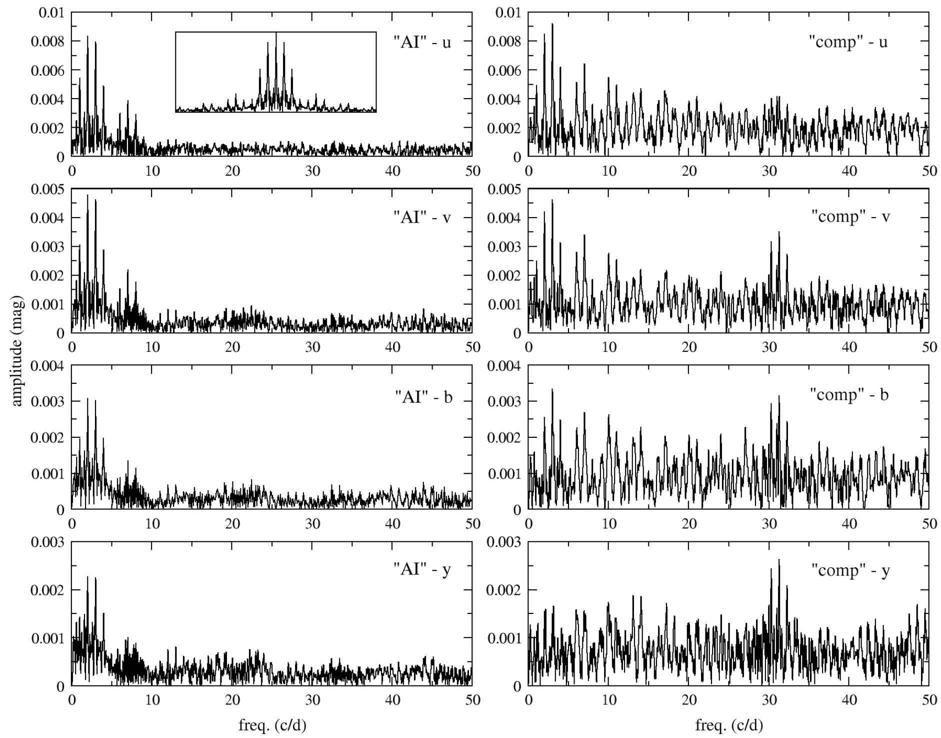

Figure 2. Frequency spectra of the residual and comp *minus* check data. The small insert shows the window function.

Table 1: Times of minimum and Nightfall light curve solution

HJD_{min}	2452479.3600 (I)	2452480.5581 (I)	2452483.5539 (II)
	primary	secondary	
temperature	9800 K (fixed)	5680±50 K	
mean radius	0.287±0.015	0.296±0.015	
fill factor	0.67±0.03	1.00±0.03	
inclination	$77^{\circ}\!.4\pm0^{\circ}\!.5$		

the comparison star data. The amplitude shows the expected wavelength dependence for stellar pulsation (the bluer the band the higher the amplitude is). The lack of this frequency in the residual data suggests that the check star is the variable one, not the comparison. Therefore, we conclude that the secondary comparison HD 154731 is a low-amplitude δ Scuti star, which is in accordance with its spectral type (A2). On the other hand, we can safely exclude δ Scuti-type oscillations of AI Dra above the millimag level. The 0.03 – 0.05 mag oscillations reported by Narusawa et al. (2002) are not confirmed.

Finally, we have fitted the mean *uvby* light curves of AI Dra to derive physical parameters of the components from Strömgren photometry for the first time. For this, we have used the Nightfall software of Wichmann (1998). We have adopted the spectroscopic mass-ratio of $q = 0.43$ by Khalesseh (1999), while the primary's temperature was fixed at 9800 K (Değirmenci et al. 2000). The best Nightfall solution was found when included detailed reflection calculations (3 iterations), square-root terms in the limb-darkening law and fractional visibility. All four bands were used to reach the optimal fit (Fig. 3). Here the mean residuals range from -0.0105 mag (in u) to -0.0006 mag (in y). The parameters

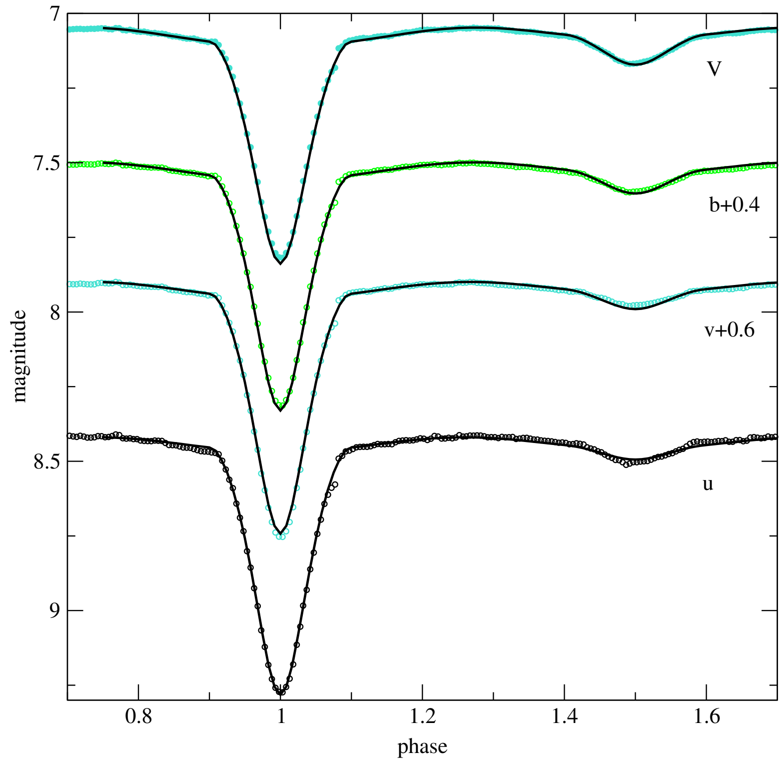

Figure 3. Light curve fits (solid lines) of the mean data (dots) for AI Dra.

of the system, including the three new epochs of minimum are summarized in Table 1.

Generally, our results are consistent with the previous parameter determinations. The secondary is likely to fill its Roche-lobe, thus the system is in semi-detached configuration. This is exactly the same conclusion as found by, e.g. Değirmenci et al. (2000). The infrared light curve solution of Arévalo & Lázaro (2002) is also in good agreement with ours. Therefore, our Strömgren photometry gave supporting evidence for the overall picture of the system outlined by earlier studies. Further accurate photometric observations are expected to yield more information on the presence or absence of short period variability on a much longer time base.

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A NEW VARIABLE FAINT CARBON STAR IN THE M92 FIELD

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This paper announces the discovery of the second variable high latitude carbon star (FHLCS), J1710.4+4329, by the variability and proper motion (VPM) survey in the M92 field. The VPM survey is a search project for variable sources in two 10 square degrees fields around the globular clusters M3 and M92. Although aimed at the detection of active galactic nuclei, variable stars are found as well by the VPM survey. For example, we re-detected the FHLCS J1714.9+4210 (Meusinger & Brunzendorf 2001) which is one of the most variable stars among the $\sim$ 20 000 star-like objects in the database for the M92 VPM field.

The new FHLCS J1710.4+4329 was also classified as a quasar candidate because of its significant variability in combination with a zero proper motion. Spectroscopic follow-up observations revealed a carbon star. The basic data on positions (J2000.0) and magnitudes are summarized in Table 1. The R magnitude is taken from the GSC-II. The sources of all other data are digitized Tautenburg Schmidt plates reduced in the framework of the VPM survey. For a detailed discussion of the observational material and the data reduction see Brunzendorf & Meusinger (2001, 2002). There is no entry in the SIMBAD database at the position of J1710.4+4329. In particular, the star is registered neither in the GCVS (Kholopov et al. 1998) nor in the carbon star database (Alksnis et al. 2001). With J1710.4+4329, the number of known C stars in the VPM field around M92 increases to four. The corresponding C star surface density of $>$ 0.5 per square degree is a factor of $\sim$ 10 larger than the mean value (lower limit) from the SDSS (Margon et al. 2002). A remarkable C star overabundance in this field has been noticed already by Kurtanidze & Nikolashvili (2000).

Table 1. Basic data for FHLCS J1710.4+4329.

Parameter	Value
α	$17^{\rm h}\,10^{\rm m}\,27\overset{\rm s}{.}0$
δ	$+43^\circ\,29'\,24\overset{''}{.}4$
$U_\circ$	$18\overset{\rm m}{.}26\pm0\overset{\rm m}{.}26$
$B_\circ$	$17\overset{\rm m}{.}51\pm0\overset{\rm m}{.}08$
$V_\circ$	$15\overset{\rm m}{.}96\pm0\overset{\rm m}{.}10$
R	$15\overset{\rm m}{.}45\pm0\overset{\rm m}{.}40$
$\mu_\alpha\ \cos\delta$	$-0.7\pm0.9\,{\rm mas\,yr}^{-1}$
μ_δ	$-0.3\pm0.8\,{\rm mas\,yr}^{-1}$

A low-dispersion spectrum (resolution ~ 20 Å) of J1710.4+4329 was obtained in July 2002 with CAFOS at the 2.2 m telescope of the German-Spanish Astronomical Centre on Calar Alto, Spain, equipped with a B-400 grism and a SITe1d CCD. The raw spectrum was reduced by means of standard MIDAS procedures. At first glance, the spectrum of J1710.4+4329 (Fig. 1) resembles that one shown by Green et al. (1992) for the proper motion carbon star CLS50. The Swan C_2 bands are very pronounced. On the other hand, the sharp bandhead of C_2 at $\lambda 6191$Å is present in CLS50 but not in J1710.4+4329. Following Green et al., this feature can be used as an indicator for dwarf carbon (dC) stars.

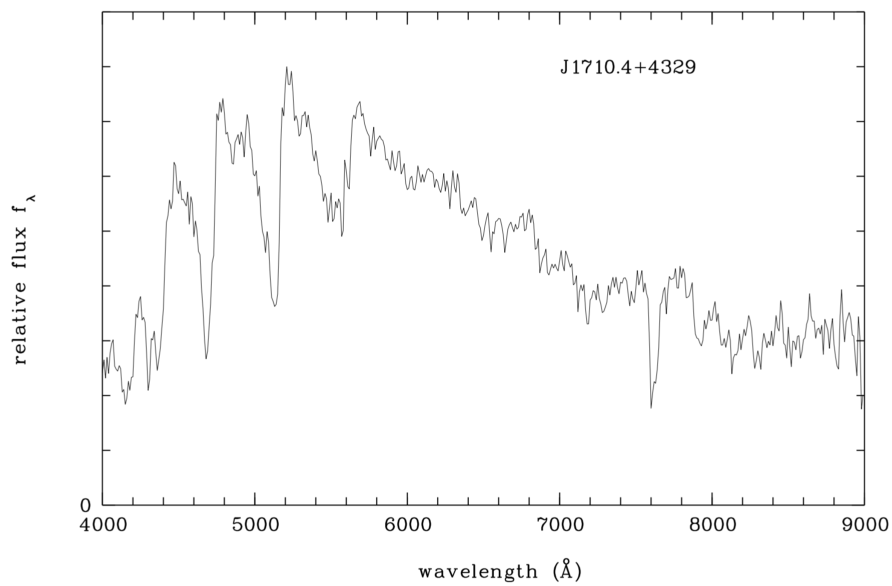

Figure 1. Flux-calibrated low-dispersion spectrum (relative flux f_λ) of J1710.4+4329.

In the context of the VPM survey, the strength of variability of an object is measured by means of B-band variability indices. The variability index of an object is determined by the number of measured epochs and the measured magnitude scatter in units of the typical magnitude scatter at the same magnitude. The index is directly related to the probability of an object to be variable (see Brunzendorf & Meusinger 2001 for more details). In a first version of the survey in the M92 field, variability indices were computed from the reduction of 117 B plates taken between 1964 and 1997 (Brunzendorf & Meusinger 2001). A completely revised photometric data reduction (Brunzendorf & Meusinger 2002) resulted in a substantial improvement of the photometric accuracy at the faint end ($B \approx 20$) for a reduced number of epochs. At the magnitude of J1710.4+4329, the mean photometric error (standard deviation) is $\sigma_0(B) = 0.055 \pm 0.010$. The full range of measured magnitudes for J1710.4+4329 is $B = 17\overset{m}{.}35 - 17\overset{m}{.}67$ (Fig. 2a) with a standard deviation $\sigma = 0.08$. The corresponding variability index of $I_\sigma = 3.3$ means that J1710.4+4329 is variable on a significance level larger than 99.9%. With $I_\sigma > 2$, J1710.4+4329 was classified as a high-priority quasar candidate. 86% of the high-priority candidates were spectroscopically confirmed as quasars (Brunzendorf & Meusinger 2002). This result illustrates that the high-priority VPM quasar candidates constitute a remarkably clean sample of variables.

Another robust method to detect variability from small numbers of unevenly sampled data is provided by structure function (SF) analysis. The first order SF of B magnitudes is defined as $S(\tau) = \langle [B(t+\tau) - B(t)]^2 \rangle$, where τ is the time-lag between two observations and the angular brackets indicate the time-average. For a stationary random process with a variability timescale $\tau_{\rm min} \ll t_{\rm var} \ll \tau_{\rm max}$ the SF increases from $S = 2\sigma_0^2$ for $\tau \ll t_{\rm var}$ to $S = 2\sigma^2$ for $\tau \gg t_{\rm var}$, where σ_0^2 is the variance due to measurement noise and σ^2 is the total variance. The plateau of the SF at $\tau > t_{\rm var}$ can be used to derive a physically meaningful characteristic variability time scale. (For more details see e.g., Hughes et al. 1992; Meusinger et al. 1994; Simonetti et al. 1985). The SF becomes more complicated if variability is a multi-modal process with different timescales. The SF from the lightcurve of J1710.4+4329 (Fig. 2, right) suggests a dominant long-term variability mode with a timescale of a decade or longer. This is consistent with the high long-term variability index $I_\Delta = 2.1$ from the VPM survey (for definitions see Brunzendorf & Meusinger 2001). Smaller fluctuations on shorter timescales (< 1 yr) are also indicated by the SF.

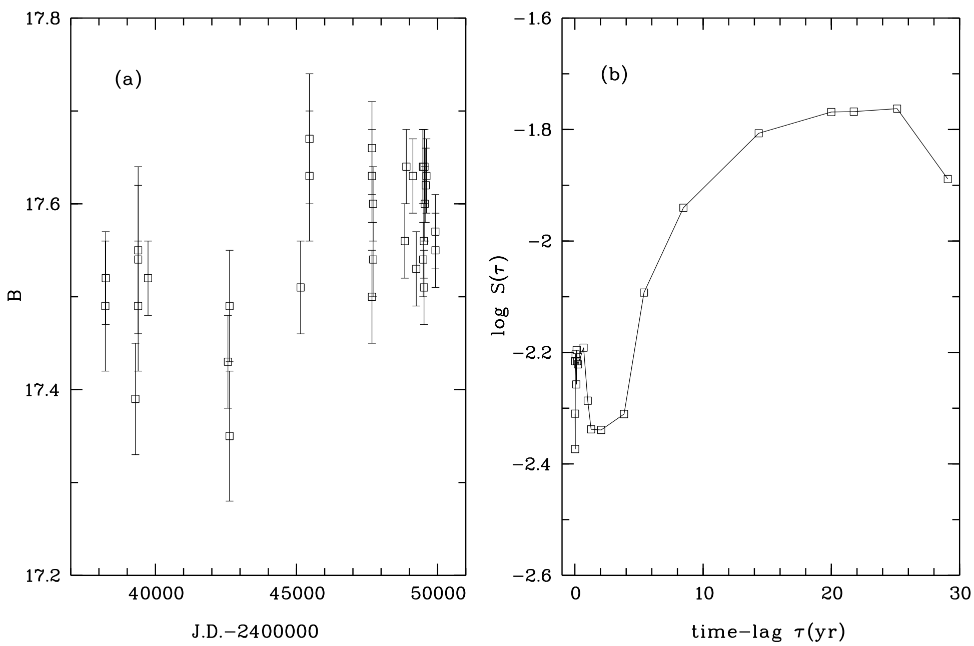

Figure 2. (a) Lightcurve $B(t)$ and (b) first-order structure function $S(\tau)$ for J1710.4+4329.

A comparatively small number of U and V Schmidt plates were measured in the framework of the VPM survey. The U and V magnitudes were used for colour information only. The magnitude measurements in the different passbands have different time baselines. In order to minimize the effect of long-term variability on the colour indices the mean magnitudes given in Table 1 are related to the epoch interval 1968±2 since the distribution of the observing epochs is similar for the three bands in this interval. The magnitudes are corrected for standard galactic extinction. The extinction calculation from the NED, following Schlegel et al. (1998), provides $A_{\rm U} = 0.082$, $A_{\rm B} = 0.065$, and $A_{\rm V} = 0.04$. No instrumental colour-corrections have been applied since the Tautenburg photographic colour system closely matches the Johnson system.

Carbon stars can be dwarfs, subgiants, giants, or supergiants. The galactocentric distance R and the height z above the galactic plane could therefore be as large as $(R, z) \approx$(60 kpc, 35 kpc) for J1710.4+4329. The real distance depends of course on the luminosity class and on the amount of extinction by circumstellar dust which are both unknown. For a nearby late-type dwarf a non-zero proper motion is expected. Proper motion data were derived from the astrometric reduction of 135 B plates with a baseline of more than three decades and were transformed into the reference frame of more than 600 quasars and unambiguously identified galaxies. The absolute proper motion of J1710.4+4329 is smaller than the detection threshold of less than 1 mas yr^{-1} (Table 1). For comparison, the components of the mean absolute proper motion derived for the field stars are $(-3.4 \pm 0.1, -4.3 \pm 0.1)$ mas yr^{-1} with a mean total proper motion of μ =6 mas yr^{-1}. The possibility that J1710.4+4329 has by chance such a small proper motion can be rejected on a significance level larger than 98%. As for FHLCS J1714.9+4210 (Meusinger & Brunzendorf 2001), the zero proper motion of J1710.4+4329 does not support an interpretation as a nearby dC.

Acknowledgments:

This research is based on observations made with the 2.2 m telescope of the German-Spanish Astronomical Centre, Calar Alto, Spain. The research has made use of the SIMBAD database which is operated at CDS, Strasbourg, France, the NASA/IPAC Extragalactic Database (NED) which is operated by the Jet Propulsion Laboratory of Technology under contract with the National Aeronautics and Space Administration, and of the Guide Star Catalogue-II (GSC-II) which is a joint project of the Space Telescope Science Institute and the Osservatorio Astronomico di Torino.

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TIMES OF MINIMA OF ECLIPSING BINARIES

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Observatory and telescope:
URSA Observatory at the University of Arkansas (`ursa.uark.edu`); 10-inch Schmidt-Cassegrain reflector.

Detector:	1020×1530 pixels SBIG ST8EN CCD cooled to (typ.) -20° C; $1\farcs15$ square pixels; $20'$(N-S)×$30'$(E-W) field of view.

Method of data reduction:
Virtual measuring engine (Measure 1.96) written by C.H.S. Lacy (2002)

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

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
CO And	EA/SD:	$01^h11^m25^s$	$+46^\circ57'49''$	03268 00400	52245.65158	3.655326	1
HP Aur	EA/DM	$05^h10^m22^s$	$+35^\circ47'47''$	02401 00760	52263.62901	1.4228192	1
CV Boo	EA/DM	$15^h26^m20^s$	$+36^\circ58'53''$	02570 00511	52321.84559	0.8469935	1
SW Cnc	EA/SD:	$09^h09^m00^s$	$+09^\circ35'42''$	00812 00083	52339.81190	1.799211	1
MU Cas	EA/DM	$00^h15^m52^s$	$+60^\circ25'54''$	01331 04014	51876.5835	9.652926	2
V396 Cas	EA/DM	$23^h13^m36^s$	$+56^\circ44'06''$	01337 04006	52180.7074	5.50545	2
V459 Cas	EA/DM	$01^h11^m30^s$	$+61^\circ08'48''$	00792 04030	51144.6845	8.458294	2
V651 Cas	EA/DM	$23^h48^m34^s$	$+57^\circ44'57''$	04009 00049	52261.65238	0.9968096	1
VZ Cep	EA/DM	$21^h50^m11^s$	$+71^\circ26'38''$	01497 04470	52054.8522	1.1833648	2
DV Cep	E	$20^h43^m19^s$	$+72^\circ22'30''$	04455 00968	46763.3552	1.1619732	3
V1061 Cyg	EA/DM	$21^h07^m21^s$	$+52^\circ02'58''$	00278 03600	51159.3789	2.346643	1
GX Gem	EA/DM	$06^h46^m09^s$	$+34^\circ24'53''$	02444 00702	52334.75	4.0385	1
LV Her	EA/DM	$17^h35^m32^s$	$+23^\circ10'31''$	00580 02076	52066.6996	18.4359391	4
RW Lac	EA/DM	$22^h44^m57^s$	$+49^\circ39'28''$	03629 02473	52253.6669	10.36922	1
FO Ori	EA/DS:	$05^h28^m10^s$	$+03^\circ37'23''$	00105 02195	52275.6149	18.80058	1
V530 Ori	EA/DM	$06^h04^m34^s$	$-03^\circ11'42''$	04786 01469	52305.3115	6.1107799	1
V482 Per	EA/DM	$04^h15^m41^s$	$+47^\circ25'20''$	03332 00388	52266.8056	2.4467549	1
V514 Per	EB/DM	$03^h19^m39^s$	$+50^\circ07'12''$	03319 01713	52261.5563	1.8191	1
RXJ0212.3	E	$02^h12^m19^s$	$-13^\circ30'41''$	05283 01513	50185.5067	6.709914	5
EN Tau	EA/SD:	$05^h56^m43^s$	$+25^\circ14'18''$	01867 00549	52296.8535	2.4762	1
V1094 Tau	EA/DM	$04^h12^m04^s$	$+21^\circ56'51''$	01263 00925	49701.7059	8.988487	6
AT Vul	EA/SD:	$19^h53^m59^s$	$+23^\circ33'52''$	02140 02219	50716.3794	3.98039	7
BP Vul	EA/DM	$20^h25^m33^s$	$+21^\circ02'18''$	01837 01644	51063.6717	1.9403491	8

Source(s) of the ephemeris:
1: This paper, 2: Lacy et al. (2002), 3: Ratz (2001), 4: Torres (2001), 5: Torres (2002), 6: Kaiser & Frey (1998), 7: Agerer & Huebscher (1998), 8: Denger (2002)

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
CO And	52245.65158	0.00016	1	V	0.00000	
	52267.58334	0.00011	1	V	−0.00020	
HP Aur	52252.9581	0.0003	2	V	+0.0002	Sec. phase=0.5
	52263.62901	0.00007	1	V	0.00000	
	52267.89787	0.00013	1	V	+0.00040	
	52270.74330	0.00014	1	V	+0.00019	
	52287.8168	0.0003	1	V	−0.0001	
	52302.7587	0.0004	2	V	+0.0022	
	52317.6964	0.0002	1	V	+0.0003	
	52332.6364	0.0002	2	V	+0.0007	
	52563.84481	0.00016	1	V	+0.00095	
	52607.95200	0.00018	1	V	+0.00074	
	52615.7779	0.0006	2	V	+0.0011	
CV Boo	52296.01170	0.00016	2	V	−0.00059	Sec. phase=0.5
	52301.94066	0.00010	2	V	−0.00058	
	52321.84559	0.00006	1	V	0.00000	
	52323.96230	0.00015	2	V	−0.00077	
	52329.8912	0.0003	2	V	−0.0008	
	52332.85643	0.00007	1	V	−0.00008	
	52343.86691	0.00006	1	V	−0.00051	
	52346.83147	0.00008	2	V	−0.00043	
	52354.87817	0.00007	1	V	−0.00017	
	52355.72529	0.00013	1	V	−0.00004	
	52380.71035	0.00020	2	V	−0.00129	
	52427.7190	0.0003	1	V	−0.0008	
	52433.64812	0.00012	1	V	−0.00061	
	52449.74157	0.00012	1	V	−0.00004	
	52471.7622	0.0002	1	V	−0.0012	
SW Cnc	52258.8473	0.0004	1	V	−0.0001	
	52266.9462	0.0012	2	V	+0.0023	Sec. phase=0.5
	52339.81190	0.00024	1	V	0.00000	
	52589.9020	0.0004	1	V	−0.0002	
	52598.8979	0.0002	1	V	−0.0004	
MU Cas	52262.6990	0.0004	1	V	−0.0015	
	52519.6565	0.0020	2	V	+0.0017	Sec. E=52181.8024
	52600.5550	0.0006	1	V	+0.0021	
V396 Cas	52282.5586	0.0003	2	V	+0.0004	Sec. phase=0.5
	52615.63889	0.00011	1	V	+0.00094	
V459 Cas	52252.71631	0.00016	1	V	−0.00470	
	52269.6326	0.0006	1	V	−0.0050	
	52286.5500	0.0002	1	V	−0.0042	
	52586.75193	0.00013	2	V	+0.00445	Sec. E=51148.8375
V651 Cas	52244.70689	0.00009	1	V	+0.00027	
	52261.65238	0.00007	1	V	0.00000	
	52299.53059	0.00008	1	V	−0.00055	
	52518.82918	0.00018	1	V	−0.00008	
	52610.53533	0.00008	1	V	−0.00041	
VZ Cep	52463.7053	0.0003	2	V	+0.0006	Sec. phase=0.5
	52464.8881	0.0003	2	V	−0.0000	
	52482.6387	0.0005	2	V	+0.0001	
	52518.73064	0.00019	1	V	−0.00056	
DV Cep	52440.75806	0.00010	1	V	+0.00180	

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
V1061 Cyg	52448.8603	0.0003	2	V	+0.0011	Sec. phase=0.5
	52482.8861	0.0003	1	V	+0.0005	
	52589.6558	0.0005	2	V	−0.0020	
	52602.56431	0.00011	1	V	0.00000	
	52609.60438	0.00012	1	V	+0.00011	
GX Gem	52562.8908	0.0003	2	V	−0.0345	Sec. phase=0.5
LV Her	52432.8790	0.0003	2	V	−0.0067	Sec. E=52064.1669
	52490.72613	0.00020	1	V	−0.00007	
RW Lac	52253.6669	0.0003	1	V	0.0000	
	52486.9009	0.0004	2	V	−0.0055	Sec. E=51076.6925
	52590.5925	0.0004	2	V	−0.0061	
	52616.58812	0.00018	1	V	−0.00148	
FO Ori	52275.6149	0.0003	1	V	0.0000	
V530 Ori	52323.6440	0.0002	1	V	+0.0002	
V482 Per	52250.9000	0.0004	2	V	0.0000	Sec. phase=0.5
	52266.8056	0.0003	1	V	0.0000	
	52276.5957	0.0003	1	V	+0.0031	
	52287.6027	0.0004	2	V	+0.0014	
	52288.8255	0.0006	1	V	−0.0009	
	52589.7781	0.0005	1	V	+0.0009	
V514 Per	52261.5563	0.0004	1	V	0.0000	
	52591.7351	0.0009	2	V	+0.0122	Sec. phase=0.5
RXJ0212.3	52597.7469	0.0009	2	V	+0.0261	Sec. phase=0.5
EN Tau	52295.6225	0.0007	2	V	+0.0071	Sec. phase=0.5
V1094 Tau	52601.87764	0.00014	2	V	0.00000	Sec. E=52601.87764
AT Vul	52449.836	0.002	2	V	−0.003	Sec. phase=0.5
BP Vul	52425.79570	0.00017	1	V	−0.00107	
	52487.88765	0.00015	1	V	−0.00029	
	52488.81917	0.00020	2	V	+0.00066	
	52495.64880	0.00011	1	V	−0.00054	
	52562.5517	0.0003	2	V	−0.0001	
	52595.5379	0.0005	2	V	+0.0002	

Remarks:

A sample of the observations has been published by Lacy, Hood & Straughn (2001). In that same publication, the ephemeris of WW Cep is wrongly attributed to “This paper”. The correct attribution is Agerer (1994).

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DETECTION OF SHORT-PERIOD OSCILLATION IN V592 Cas

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V592 Cas was originally discovered as a blue, luminous object (LS I +55°8) in the northern Milky Way. Greenstein et al. (1970) suggested that this object may be a cataclysmic variable (CV), based on their spectroscopy. On the blue spectrum by Greenstein et al. (1970) broad Balmer lines were in absorption, while He II and C III/N III were in emission, which made UX UMa-type CV classification likely (Warner 1976). Africano and Quigley (1978) obtained high-speed photometry of this object, and concluded that rapid, non-periodic variations (up to amplitudes of 0.4 mag) were present. With this finding, the object received a variable star designation of V592 Cas (Kholopov et al. 1981). Zwitter and Munari (1994) presented a CCD spectrum, which showed Hα and possibly He I in emission, confirming the CV nature. Downes et al. (1995) reported a temporal variation of the emission lines, particularly in the appearance of the C III/N III lines.

Huber et al. (1998) obtained time-resolved photometry and spectroscopy, and obtained an orbital period of $P_{\rm orb} = 0.114$ d. Huber et al. (1998) suggested that V592 Cas appears to be a nova-like CV in the period gap. Taylor et al. (1998) reported a radial-velocity study and long-term photometry of this object, and reported a refined orbital period of 0.115063(1) d. Taylor et al. (1998) also reported the presence of superhumps with periods of 0.12228(1) and possibly 0.11193(5) d, qualifying V592 Cas as a permanent superhump system.

Here we report on the detection of short-term, coherent photometric oscillations in V592 Cas taken on 2002 October 21. The observation was performed with a 36-cm Schmidt–Cassegrain telescope and an unfiltered SX-10XE camera. The exposure time was 45 s, and the errors of a single exposures was estimated to be 0.007 mag. The zero-point calibration (approximately on the $R_{\rm c}$ system) was performed using the comparison stars by Henden and Honeycutt (1995). The raw data are publicly available in vsnet-obs 41976 and 41977.[1]

The resultant light curve is shown on Figure 1. The existence of short-period recurrent brightenings is apparent. Such strong short-term oscillations were not apparent at the time of the observations by Taylor et al. (1998).

Figure 2 shows the power spectrum of the light curve. A strong signal at a frequency of 66.6(4) d^{-1}, corresponding to a period of 0.0150(1) d, is present. There was no indication of superhumps close to a period of 0.112–0.122 d as shown by Taylor et al. (1998).

[1] `http://www.kusastro.kyoto-u.ac.jp/vsnet/obs41000/msg00976.html` and `http://www.kusastro.kyoto-u.ac.jp/vsnet/obs41000/msg00977.html`

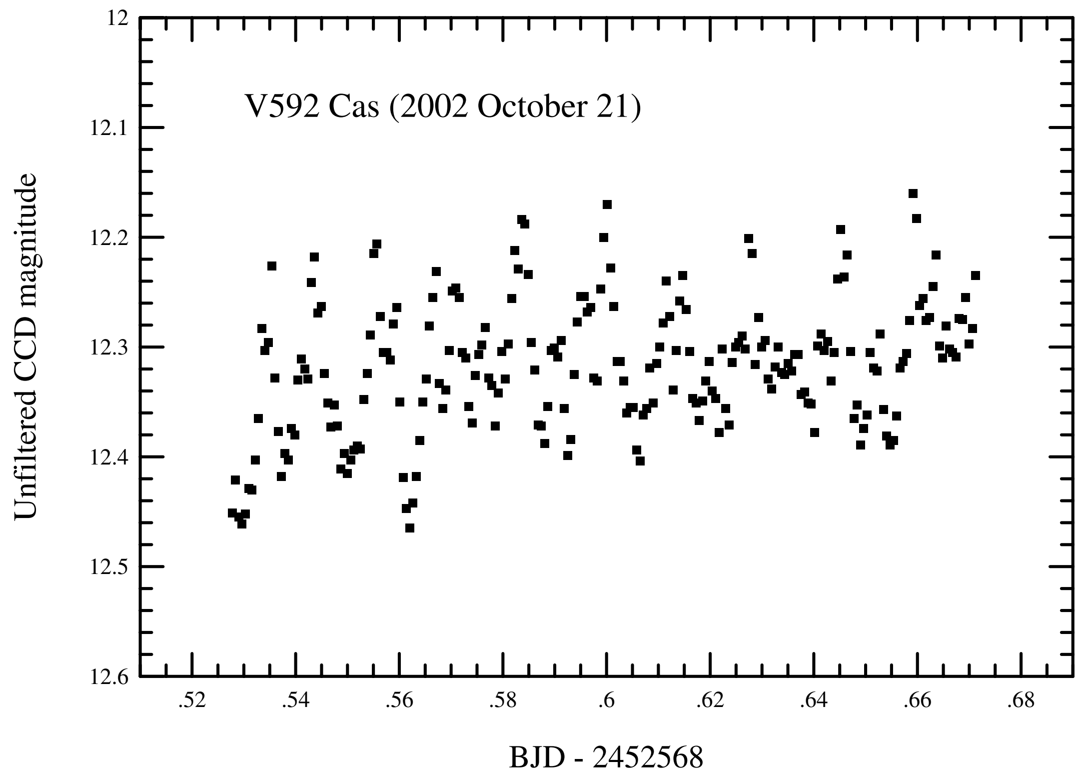

Figure 1. Light curve of V592 Cas on 2002 October 21. Short-period recurrent brightenings were observed.

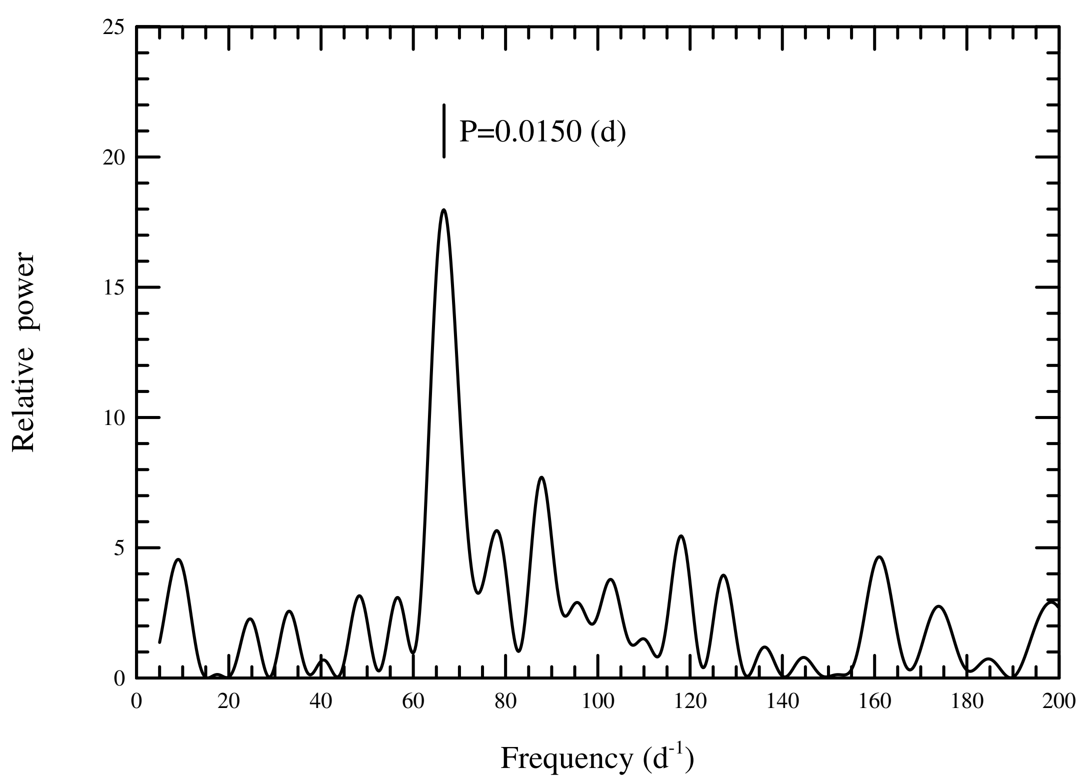

Figure 2. Power spectrum of V592 Cas on 2002 October 21.

Figure 3 shows the averaged profile of this 0.0150-d oscillation. The profile more resembles those of quasi-periodic oscillations (QPOs) rather a sinusoid. The variation looked almost coherent within the length of this observation.

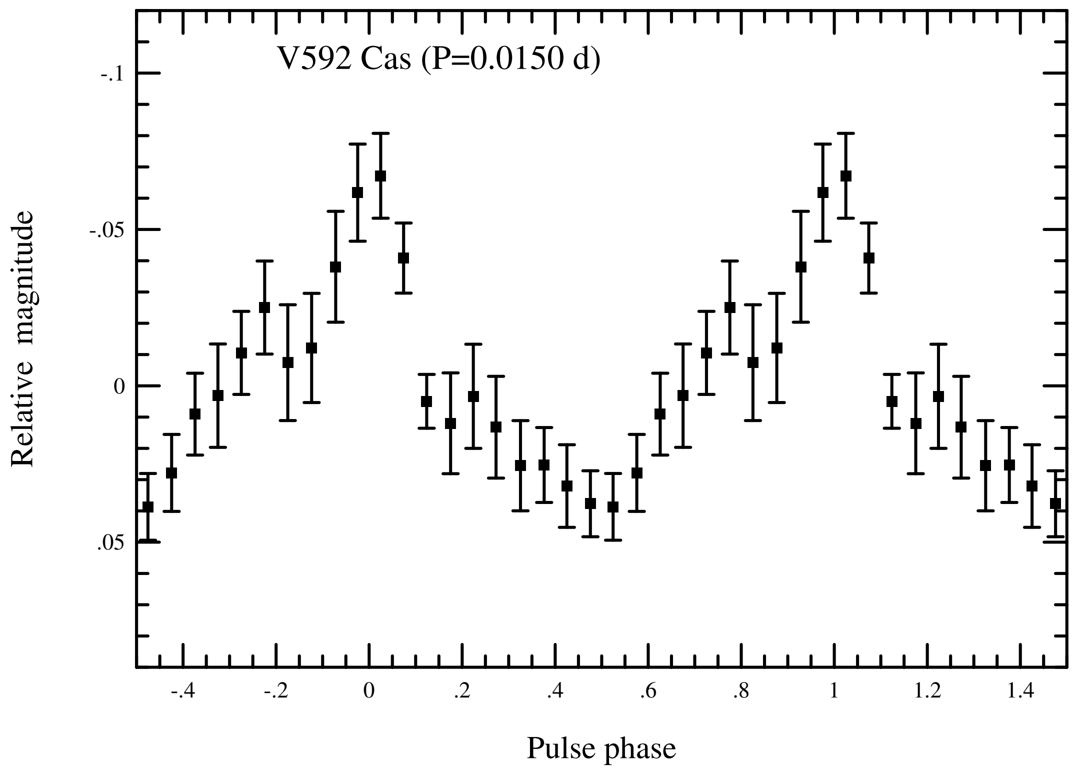

Figure 3. Averaged profile of the 0.0150-d oscillation.

From this observation and the available literature, V592 Cas appears to have two distinct states: (1) state with prominent superhumps and less prominent short-term variations (cf. Taylor et al. 1998) and (2) state with prominent short-term, seemingly coherent, variations, almost lacking superhump-type variations (this study). It is not yet clear whether these states correspond to different excitation states observed in spectroscopy (Downes et al. 1995). According to Patterson et al. (2002), short-period high-amplitude QPO-like oscillations in novalike variables may be a signature of weakly magnetized white dwarf as in intermediate polars (IPs). The presently observed ratio of $P_{\rm oscillation}/P_{\rm orb}$ = 0.13, similar to those of typical equilibrium spin rates of IPs (cf. King 1993; Wu and Wickramasinghe 1991), is also suggestive of this interpretation. If this possibility is confirmed, V592 Cas may be a unique object in the period gap showing both properties of permanent superhumps and occasional IP-like, nearly coherent, photometric oscillations.

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SV Cam: LIGHT CURVE PARAMETERS AND SPOT ACTIVITY BETWEEN FEBRUARY 2000 AND APRIL 2001

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SV Cam is a $P = 0.6$-day detached eclipsing RS CVn binary with a well pronounced surface activity. Recently Albayrak et al. (2001) presented results of 2 nights of photometric observations in 2000. A detailed light curve analysis pointed to a presence of two low temperature surface spots. The authors also derived parameters of a light curve fit. This year Lehmann, Hempelmann & Wolter (2002) published a detailed spectroscopic study that unambiguously determined absolute masses of both stars.

Here we present the results of a 2-year photometric monitoring of SV Cam and compare the results with the studies mentioned above. The observations were obtained on 21 nights between February 2000 and April 2001, altogether 504 points in V and 502 in B Johnson filters. The instrument was a 50-cm Ritchey-Chretien telescope located at Monte Zugna (altitude 1620 m) near Rovereto (Trento, Italy). It is equipped with a SSP5 photometer. The diaphragm had a size of 50 arcsec. Each point in the light curve was obtained as an average of 5 exposures of 5 seconds each. HD 45635 (K0) was chosen as a comparison star and TYC 4537 880 1 (F0) as a check star. Standard deviations of comparison star against the check star are 0.031 in V and 0.015 in B, the difference being due to the better B sensitivity of the SSP5 photometer. Table 1 reports the times of observed primary minima.

Table 1. Times of primary photometric minima with their standard deviations and type of filter used.

HJD −2451000.0	filter	HJD −2451000.0	filter	HJD −2451000.0	filter
587.3770 ± 0.0040	V	594.4937 ± 0.0005	B,V	597.4583 ± 0.0010	B,V
603.3892 ± 0.0003	B,V	718.4447 ± 0.0003	B,V	964.5718 ± 0.0004	B,V

The light curves are plotted in Figures 1a-d. Fig. 1e gives the value of the $B-V$ index obtained by linear interpolation of the bracketing V-band measurements to the epoch of the B-colour observation. Observations were always obtained by continuously switching between B and V filters. Orbital smearing of the $B-V$ index is negligible, as the time difference between consecutive B and V exposures was typically only 50 seconds.

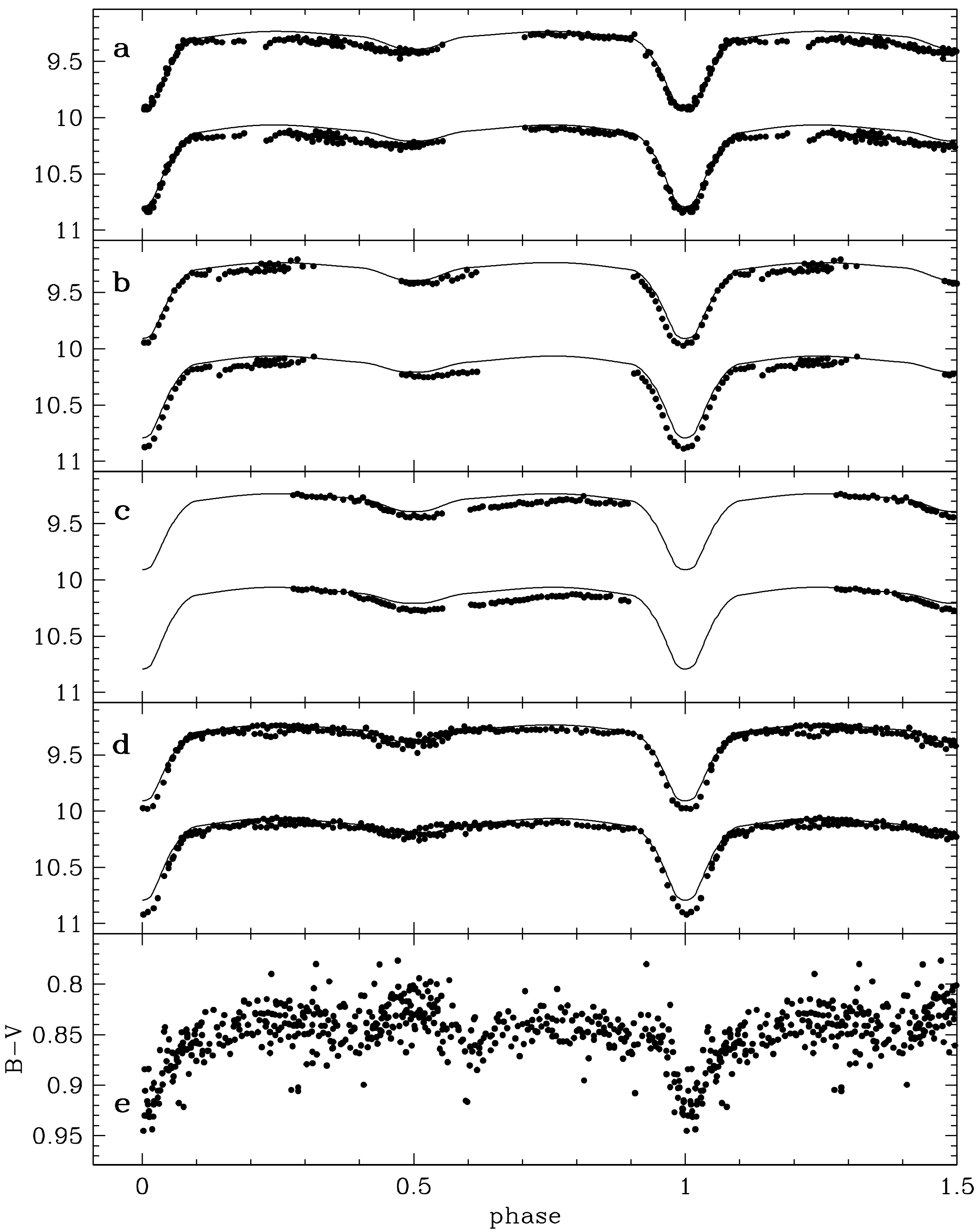

Figure 1. **(a-d):** V (upper) and B (lower) light curves of SV Cam for the observing intervals: $2451540 < HJD < 2451640$ (a), $2451640 < HJD < 2451800$ (b), $2451800 < HJD < 2451900$ (c), $2451900 < HJD < 2452000$ (d). Smooth curves are results of a theoretical model based on the literature that does not allow for the presence of dark surface spots. **(e):** $B - V$ light curve.

The whole set of photometric observations can be divided into four intervals of ~ 100 days. It is obvious that the light curves (Fig. 1a-d) do not repeat exactly in consecutive orbital cycles. Occasional fadings can be attributed to the presence of surface spots.

In order to assess the spot activity we used parameter values from the literature to construct a theoretical model that forms an upper envelope to all measurements in Fig. 1a-d. The results of the Wilson-Devinney code (WD98) computation using a fitting environment of Prša (2003) are plotted as smooth curves in Fig. 1. Parameters of the model are reported in Table 2. Note that we followed published models for values of most parameters, hence their errors are not quoted. In particular, relative dimensions of both components, their temperatures and gravity darkening coefficients were taken from Table 4 of Albayrak et al. (2001). On the other hand the values for masses of both components and absolute dimension of the orbit is derived much more accurately from spectroscopic observations, so we used the values reported in Lehmann et al. (2002). In addition we found that the value of inclination angle should be lowered from 89.6 deg (Albayrak et al. 2001) to 85 ± 1.5 ($2\,\sigma$) degrees; otherwise the eclipses would be deeper than observed. This is similar to the results of Kjurkchieva et al. (2000).

Table 2. Modeling parameters for a circular orbit without spots (smooth curves in Fig. 1).

parameter	value	ref.	parameter	value	ref.	parameter	value	ref.
Period (days)	0.5930718	L	T_1 (K)	6440	A	T_2 (K)	4480	A
Epoch (HJD)	2451465.7975	L	M_1 ($M_\odot$)	1.090	L	M_2 ($M_\odot$)	0.700	L
a ($R_\odot$)	3.60	L	V_γ (km s^{-1})	-14.0	L	e	0.0	L
R_2/R_1	0.63	A	R_1 ($R_\odot$)	1.29		R_2 ($R_\odot$)	0.81	
$q = \frac{M2}{M1}$	0.6422	L	$M_{bol,1}$	3.77		$M_{bol,2}$	6.34	
i (deg)	85.0		$\log g_1$	4.25		$\log g_2$	4.46	

Sources: L = Lehmann et al. 2002; A = Albayrak et al. 2001

Figure 2 plots the difference between the observed values and the theoretical spot-free model. Notable sinus-shaped fadings due to the presence of spots are present on at least three occasions, i.e. during time intervals *a*, *c* and *d*. Table 3 reports their phase ranges and V- and B-band depths. The situation changes from one time interval to another. This suggests that surface spots on the primary star of SV Cam last for ≈ 100 days and that they appear at different stellar longitudes.

Table 3. Presence of surface spots in different time intervals. Orbital phase of spot visibility and the fading of the binary system in the V and B bands at the moment of meridian passage are given. The errors are 0.03 in phases and 0.01 in magnitudes.

time interval	phase(start)	phase(end)	$\Delta\,V$	$\Delta\,B$
2451540 < HJD < 2451640 (a)	0.1	0.5	$0\overset{m}{.}10$	$0\overset{m}{.}10$
2451800 < HJD < 2451900 (c)	0.4	0.9	$0\overset{m}{.}10$	$0\overset{m}{.}12$
2451900 < HJD < 2452000 (d)	0.6	0.9	$0\overset{m}{.}05$	$0\overset{m}{.}05$

We performed a detailed modeling of the spot positions, sizes and temperatures. The results are somewhat ambiguous, but consistent with a large spot surface area and moderate temperature contrast. In particular, the spot observed during time interval c is most likely a large equatorial spot on the primary star with the temperature of 6000 ± 200 K.

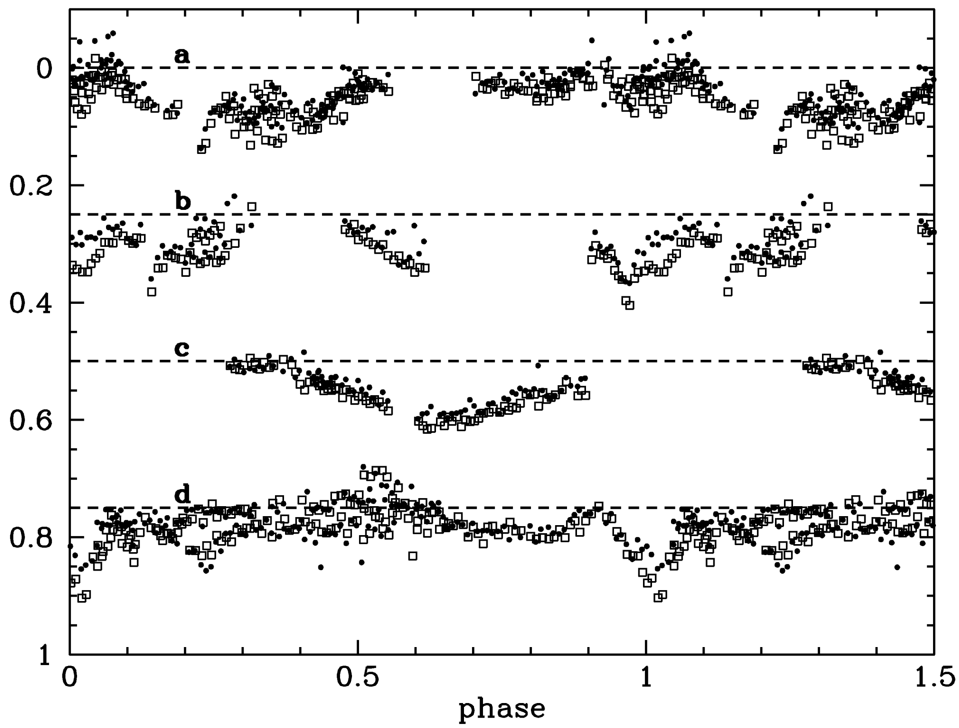

Figure 2. Difference between the observed V (dots) and B (open squares) magnitudes and the theoretical un-spotted curve reveals the presence of surface spots. Curves (a-d) correspond to the time intervals defined in Fig. 1. A vertical offset of 0.25 was applied to consecutive intervals.

When on meridian it covers 23 ± 7 % of the primary star's visible surface. The spot during interval d is smaller (covering 9 ± 3 % of the primary star's visible surface) but with a similar temperature.

These results are similar to the surface areas of spots found by Albayrak et al. (2001), but our temperature contrast is much smaller and possibly easier to justify with a physical model. A sharp dip near the primary minimum of interval d could be due to a spot activity which changed the shape of the eclipse of the brighter and spotty primary star.

This preliminary analysis of the light curve will be upgraded with results from 40 Echelle spectrograms with wide wavelength coverage that were obtained with the Asiago 1.8-m telescope atop Mt. Ekar. We expect to be able to directly address the spectral type and chemical composition of the primary, one of the primary sources of error in studies of SV Cam so far.

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NEW TIMES OF MINIMA OF ECLIPSING BINARY SYSTEMS

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Observatory and telescope:
48-cm Cassegrain telescope of the Ege University Observatory
40-cm Cassegrain telescope of the TÜBİTAK National Observatory.

Detector:	SSP-5A Hamamatsu, R4457 (PMT)

Method of data reduction:
Reduction made by ATMEX[1] (http://astronomy.sci.ege.edu.tr/~keskinv/Software.html).

Method of minimum determination:
The minima times were computed with parabolic fitting and Kwee-van Woerden method (Kwee & van Woerden, 1956)

Observed star(s):							
Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
RT And	EB	$23^h11^m10^s$	$+53°01'33''$	BD+52°3383	51142.4937	0.62892979	1
AW UMa	EW	$11^h30^m04^s$	$+29°57'53''$	BD+31°2270	38044.8150	0.43872910	2
V836 Cyg	EB	$21^h21^m24^s$	$+35°44'11''$	BD+35°4461	47764.4462	0.653410818	3

Source(s) of the ephemeris:
1. Pribulla et al., 1999a
2. Pribulla et al., 1999b
3. Zhukov & Markova, 1993

[1]ATMEX is produced by Varol Keskin

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
RT And	51792.4927	8	II	B,V,R	−0.0001	kY
	51794.3793	8	II	B,V,R	−0.0001	kY
	51815.4472	2	I	B,V,R	−0.0014	kY
	51830.5434	3	I	B,V,R	+0.0005	kY
	51863.2460	1	I	B,V,R	−0.0012	kY
	51884.3162	7	II	B,V,R	−0.0002	kY
	51912.3028	2	I	B,V,R	−0.0010	kY
	52120.4774	3	I	B,V	−0.0021	kY
AW UMa	51947.4571	7	II	B,V	−0.0250	ErK+Bur
	51949.4334	4	I	B,V	−0.0230	ErK+Bur
	51951.4075	6	II	B,V	−0.0232	ErK+Bur
	51977.5109	5	I	B,V	−0.0242	ErK+Bur
	52064.3780	7	I	B,V	−0.0254	ErK+Bur
	52313.5750	2	I	B,V	−0.0265	ErK+Bur
	52345.3822	2	II	B,V	−0.0272	ErK+Bur
V836 Cyg	52151.4617	8	I	B,V	−0.0152	Bur+ErK
	52153.4227	5	I	B,V	−0.0160	Bur+ErK
	52156.362	1	I	V	−0.0152	Bur+ErK
	52172.3715	4	II	B,V	−0.0159	Bur+ErK
	52499.4108	8	II	B,V	+0.0231	Bur+ErK
	52516.3983	5	II	B,V	+0.0219	Bur+ErK

Explanation of the remarks in the table:

Observer(s)
kY: K. Yakut; ErK: N. Erkan; Bur: B. Ulaş

Acknowledgements:

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Pribulla, T., Chochol, D., Rovithis-Livaniou, H. & Rovithis, P., 1999b, *A&A*, **345**, 137
Zhukov, G. V. and Markova, L. T., 1993, *IBVS*, 392.

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PHOTOELECTRIC MINIMUM TIMES OF SOME ECLIPSING BINARY STARS

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Observatory and telescope:

40-cm Cassegrain telescope of the TÜBİTAK National Observatory and 30-cm Maksutov telescope of the Ankara University Observatory.

Detector:	OPTEC SSP-5A photometer containing a side-on R1414 Hamamatsu photomultiplier.

Method of data reduction:

Reduction of the observations were made in the usual way (Hardie 1962).

Method of minimum determination:

Kwee & van Woerden (1956).

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
BK Peg	EA/D	$23^h47^m08^s$	$+26°34'00''$	HD 223154	41587.725618	5.48991138	1
U Cep	EA/SD	$01^h02^m18^s$	$+81°52'32''$	HD 6006	20354.6993	2.4929034	2
EM Cep	EW/KE	$21^h53^m48^s$	$+62°36'52''$	HD 208440	40134.7326	0.806187	3
CQ Cep	EB/DM/WR	$22^h36^m54^s$	$+56°54'21''$	HD 214259	50267.43158	1.6412299	4
IU Aur	EB/SD	$05^h27^m52^s$	$+34°46'58''$	HD 35619	38448.4068	1.811474	5
ER Vul	EW/DW/RS	$21^h02^m26^s$	$+27°48'26''$	HD 200546	40182.2621	0.69809409	6

Source(s) of the ephemeris:

1.: Demircan et al. (1994); 2.: Kim, C-H. and Han, W. (1996); 3.: Breinhorst and Karimie (1980); 4.: Demircan et al. (1997); 5.: Mayer and Drechsel (1987); 6.: İbanoğlu et al. (1985)

† TÜBİTAK : The Scientific and Technical Research Council of Turkey

Times of minima:						
Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
BK Peg	50319.4175	0.0004	II	UBV	−0.0121	MT, BC
	50706.4701	0.0003	I	UBV	0.0016	MT, BC
	51052.3325	0.0007	I	UBV	−0.0004	HA
	51137.4160	0.0004	II	UBV	−0.0105	HA
U Cep	51138.3074	0.0001	I	UBV	−0.0095	HA
	51381.3993	0.0008	II	BVR	0.0243	HA
EM Cep	50709.4090	0.0001	I	UBV	−0.0784	HA
CQ Cep	51013.3843	0.0003	II	UBV	0.0137	HA
	51022.3990	0.0002	I	$UBVR$	0.0016	HA
IU Aur	50737.4515	0.0005	I	UBV	0.0050	HA
	50872.3901	0.0006	II	UBV	−0.0111	HA
ER Vul	50640.4202	0.0002	I	BV	0.0106	FFÖ
	50669.3908	0.0002	II	BV	0.0103	FFÖ

Explanation of the remarks in the table:

Observers: MT: Mehmet TANRIVER, BC: Bekir CANDAN, HA: Hasan AK, FFÖ: Ferhat F. ÖZEREN

Acknowledgements:

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Mayer, P. and Drechsel, H., 1987, *A&A*, **183**, 61

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A NEW VARIABLE STAR IN THE VICINITY OF YY Her

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While monitoring the field of YY Her (cf. the observing campaign called up by Hric et al., 2001, and Sobotka & Hric, 2001, on behalf of the MEDUZA[†] group) we have noted that a very red star IRAS F18122+2053 ($V \approx 16.5$ mag, $V - R \approx 2.5$ mag, $R - I \approx 2.5$ mag) located at $\alpha = 18^h14^m23\overset{s}{.}15$, $\delta = +20°54'28\overset{''}{.}6$ (J2000) varies its brightness. The observations were carried out using the 0.4 m ($f = 1.75$ m) Newtonian telescope of Nicholas Copernicus Observatory and Planetarium in Brno and the 0.3 m ($f = 1.2$ m) Newtonian telescope of the Vyškov Observatory both equipped with SBIG ST-7 CCD camera and VR_CI_C filters. Frames (typically two to six in each band per night) were processed using MUNIDOS 2.2 (Hroch, Novák and Král, 2001). Although the field stars were measured by Henden and Munari (2001), we did not attempt to put our measurements on the standard system due to the redness of the star. Instead, GSC 01579 00432 ($V = 12\overset{m}{.}040$; Henden and Munari, 2001) was chosen as the comparison star for differential photometry. Its constancy was checked by using several field stars. The spectral response differences between observatories were removed by a zero-point shift. Weighted averages of CCD observations made on the same night with the same filter and at one observatory were made. Magnitude errors served as weights. The data are available through IBVS website as 5362-t1.txt.

In Figure 1 we present R and I differential light curves of IRAS F18122+2053. Data in V band confirm the variability, but are not plotted due to their low quality.

Averaged observations were submitted to a PDM period searching algorithm (Widjaja, 1996) resulting a period of 98 days. The colour of the star and the amplitude and period of the light variations indicate that, IRAS F18122+2053 is most probably a semiregular variable star.

[†]http://www.meduza.info

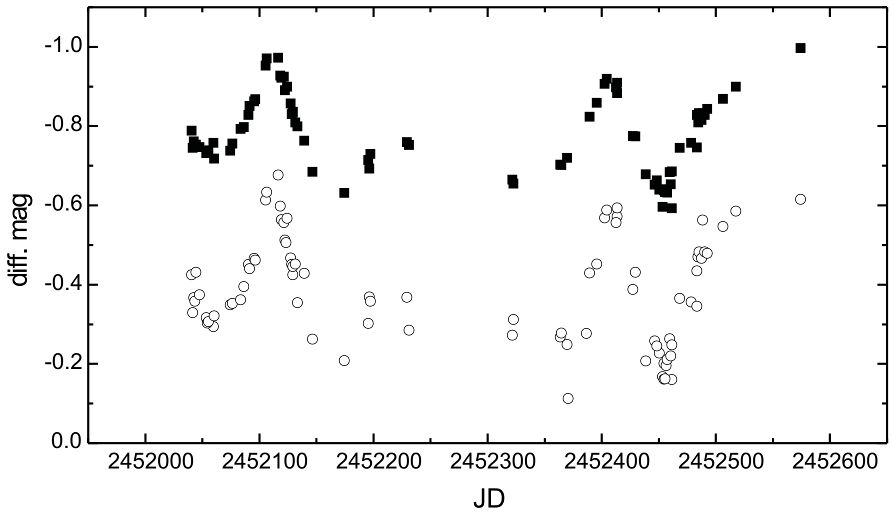

Figure 1. Light curves of IRAS F18122+2053. Open circles and filled squares are measurements in R and I filters, respectively. The datasets were shifted for plot clarity.

Acknowledgements: We acknowledge overall support and the use of the telescope with CCD camera of the Nicholas Copernicus Observatory and Planetarium. We would like to thank L. Král for software support.

This work has made use of the SIMBAD database, operated at CDS, Strasbourg, France. The NASA ADS Abstract Service was used to access data and references.

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Henden, A. A., Munari, U., 2001, *A&A*, **372**, 145

Hric, L., et al., 2001, *IBVS*, No. 5046

Hroch, F., Novák, R., Král, L., 2002, `http://munipack.astronomy.cz`

Sobotka, P., Hric, L., 2001, *MEDUZA Circular*, **21**, 1 (available through `ftp://astro.sci.muni.cz/meduza/circular/21cirk.pdf`)

Widjaja, A., 1996, `http://www.kusastro.kyoto-u.ac.jp/vsnet/etc/prog.html`

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NEW ELEMENTS FOR 5 RR LYRAE STARS

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The variability of these stars was announced by Hoffmeister (1967); no further observations or ephemeris were published until today. Recent estimations, made on photographic plates taken with the Sonneberg Observatory 40cm Astrograph during the years 1964-1994, have allowed to determine the type of variability as well as first elements (see Table 1). The given elements were obtained by means of least-squares solutions. Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 3. Individual data are available upon request.

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

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	M−m	No. of Plates
V546 Her	RRab	45003.6964	0.46725775	$13^m.8$	$15^m.2$	$0^P.15$	242
NSV 07922	RRab	44749.3766	0.60430458	$13^m.2$	$13^m.8$	$0^P.13$	215
NSV 07978	RRab	44343.4623	0.46250664	$13^m.1$	$14^m.3$	$0^P.11$	240
NSV 08101	RRab	44345.4754	0.62073206	$13^m.6$	$15^m.2$	$0^P.13$	242
NSV 08147*	RRab	38532.4478	0.5367217	$14^m.0$	$15^m.6$	$0^P.11$	77
		46641.3907	0.5367432				144

* Variable period; elements valid for J.D. 2437110-2439648 and J.D. 2442924-2449488, respectively

Table 2. Individual maxima and $O-C$ values according to the elements derived in this paper

Star	HJD (max.)	Epoch	$O-C$	Star	HJD (max.)	Epoch	$O-C$
V546 Her	38549.468	−13813	0.003	NSV 07978	38501.551	−12631	0.010
	38556.466	−13798	−0.008		38533.459	−12562	0.005
	38585.440	−13736	−0.004		38852.576	−11872	−0.007
	38935.435	−12987	0.015		38940.464	−11682	0.004
	39262.486	−12287	−0.015		42987.396	−2932	0.003
	39284.453	−12240	−0.009		44266.680	−166	−0.006
	39619.496	−11523	0.010		44343.447	0	−0.015
	39648.436	−11461	−0.020		44374.440	67	−0.010
	39917.607	−10885	0.011		44732.432	841	0.002
	44016.399	−2113	0.019		44757.401	895	−0.004
	44343.447	−1413	−0.014		45077.463	1587	0.003
	44365.436	−1366	0.014		45491.404	2482	0.001
	44372.452	−1351	0.021		45854.459	3267	−0.012
	44373.369	−1349	0.004		48088.400	8097	0.022
	44757.432	−527	−0.019		49154.458	10402	0.002
	45003.703	0	0.007	NSV 08101	38502.523	−9413	−0.002
	45054.605	109	−0.022		38640.336	−9191	0.008
	45055.575	111	0.013		38852.619	−8849	0.001
	45223.331	470	0.024		39620.472	−7612	0.009
	45441.498	937	−0.018		39638.467	−7583	0.002
	46612.425	3443	−0.039		44345.475	0	0.000
	46613.415	3445	0.016		44373.393	45	−0.015
	46649.374	3522	−0.004		44427.411	132	−0.001
	47770.330	5921	0.001		45055.575	1144	−0.017
NSV 07922	38553.465	−10253	0.024		45854.459	2431	−0.015
	38556.466	−10248	0.003		49193.416	7810	0.024
	38579.425	−10210	−0.002		49216.362	7847	0.003
	38585.440	−10200	−0.030	NSV 08147	38532.440	−10877	0.164
	38852.576	−9758	0.004		38640.336	−10676	0.174
	39260.475	−9083	−0.003		39615.549	−8859	0.125
	39286.461	−9040	−0.002		44370.428	−4231	−0.002
	39648.436	−8441	−0.005		44749.388	−3525	0.017
	44016.399	−1213	0.044		44757.401	−3510	−0.021
	44749.388	0	0.012		45052.610	−2960	−0.021
	45491.435	1228	−0.027		45223.331	−2642	0.016
	46612.425	3083	−0.022		46612.425	−54	0.019
	48356.506	5969	0.036		46641.392	0	0.002
	49098.546	7197	−0.010		48804.454	4030	−0.010
	49193.416	7354	−0.016				

Table 3. Comparison stars and cross references

	V546 Her S 9614 GSC 969.0808		NSV 07922 S 9615 GSC 395.1432		NSV 07978 S 9619 GSC 396.1719	
Comp. No.	GSC	m*	GSC	m*	GSC	m*
1	969.1224	$13\overset{\mathrm{m}}{.}5$	395.1503	$13\overset{\mathrm{m}}{.}4$	396.2048	$13\overset{\mathrm{m}}{.}3$
2	969.0789	$14\overset{\mathrm{m}}{.}3$	395.1769	$13\overset{\mathrm{m}}{.}7$	396.2031	$13\overset{\mathrm{m}}{.}9$
3	969.0517	$14\overset{\mathrm{m}}{.}9$	395.1562	$13\overset{\mathrm{m}}{.}9$	396.2000	$14\overset{\mathrm{m}}{.}4$
4	969.0654	$15\overset{\mathrm{m}}{.}4$				

	NSV 08101 S 9624 GSC 410.2317		NSV 08147 S 9626 GSC 410.1242	
Comp. No.	GSC	m*	GSC	m*
1	397.2150	$12\overset{\mathrm{m}}{.}9$	410.1534	$14\overset{\mathrm{m}}{.}5$
2	410.2347	$14\overset{\mathrm{m}}{.}3$	410.1390	$14\overset{\mathrm{m}}{.}9$
3	410.2261	$14\overset{\mathrm{m}}{.}9$	410.0796	$16\overset{\mathrm{m}}{.}0$

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

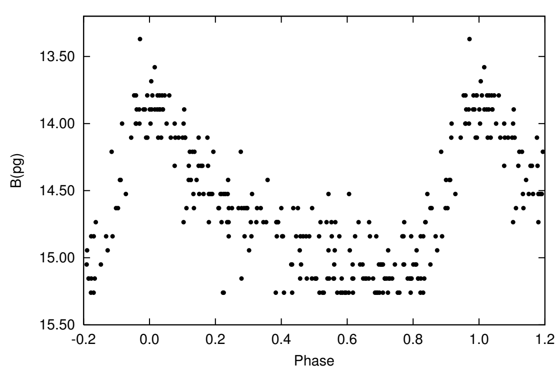

Figure 1. Light curve of V546 Her

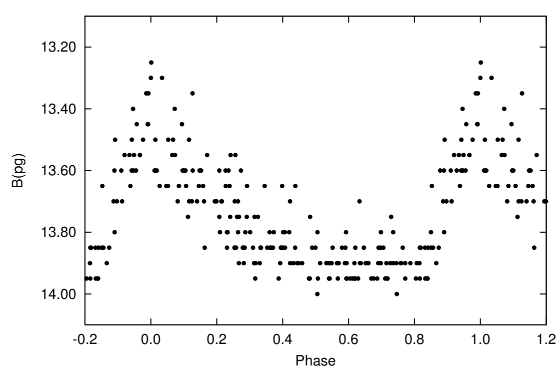

Figure 2. Light curve of NSV 07922

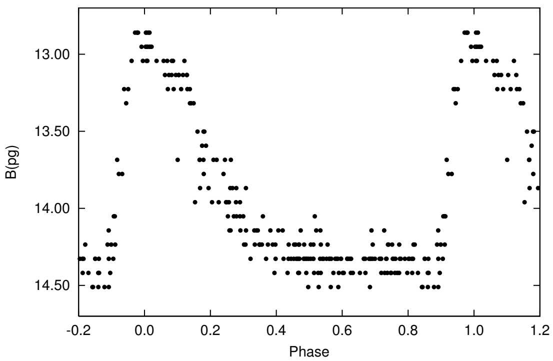

Figure 3. Light curve of NSV 07978

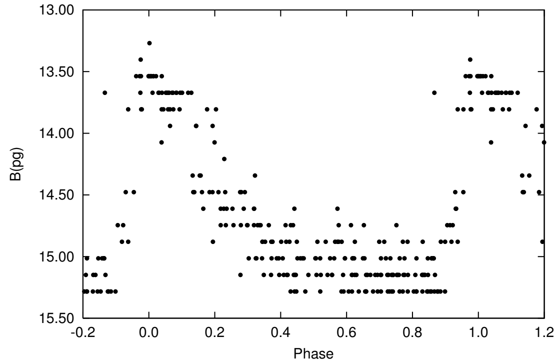

Figure 4. Light curve of NSV 08101

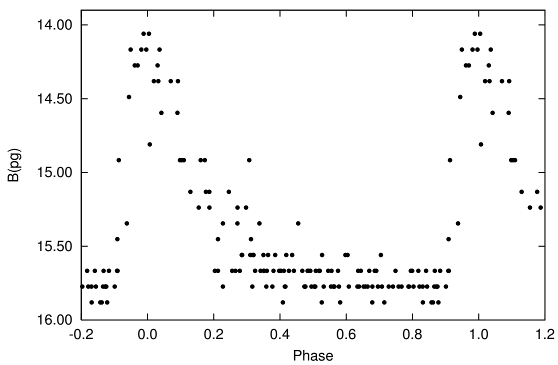

Figure 5. Light curve of NSV 08147

Reference:

Hoffmeister, C., 1967, *Astron. Nachr.*, **289**, 205

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THE FIRST ECLIPSING BINARY OBSERVATIONS AT THE ULUPINAR ASTROPHYSICS OBSERVATORY

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Observatory and telescope:
The Çanakkale Onsekiz Mart University (ÇOMU) Ulupinar Astrophysics Observatory was built in 2001, close by the slopes of Mt. Ida, overlooking ancient Troy. The location (longitude: $01^h45^m54^s$ E, latitude: $40°06'01''$ N, altitude: 410 m) has about 200 clear nights in a year. It is only ten km from Çanakkale, but it is sheltered by a low ridge from most of scattered night glow. The observatory owns two (30 cm (T30) and 40 cm (T40)) Meade Schmidt-Cassegrain telescopes with an SBIG ST-237 CCD camera and a SSP-5A photometer, containing a Hamamatsu, R 4040 photomultiplier tube(PMT). Further details about the observatory and its equipment were given by Demircan (2003).

Method of data reduction:
Reduction of the CCD frames was made with MUNIDOS[1] software, and reduction of photoelectric observations was made by ATMEX[2] software.

Method of minimum determination:
Kwee – van Woerden method (Kwee & van Voerden, 1952), and in some cases, depending on the nature of the data set, several procedures written by A. Gaspani (1995) based on artificial neural networks were used.

[1]Hroch, F., Novák, R., 1997, MUNIDOS, `http://munipack.astronomy.cz/`

[2]Keskin, V., 2001, ATMEX, `http://astronomy.sci.ege.edu.tr/~keskinv/`

Observed star(s):							
Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
AB And	EB	23 11 32	+36 53 36	GSC 2763:0683	45502.1040	0.33188902	1
AD And	EB	23 36 45	+48 40 15	GSC 3641:0419	39002.4445	0.98619443	1
BX And	EW	02 09 03	+40 47 39	GSC 2833:0053	48237.4893	0.61011419	1
XZ Aql	EA	20 22 13	-07 21 03	GSC 5174:0186	47743.4700	2.13918369	1
OO Aql	EW	19 48 13	+09 18 32	GSC 1058:0409	39322.6916	0.50679190	1
V417 Aql	EW	19 35 24	+05 50 18	GSC 0490:2611	43016.2099	0.37031370	1
TZ Boo	EW	15 08 09	+39 58 12	GSC 3044:0740	52390.3886	0.29716474	present paper
AC Boo	EW	14 56 28	+46 21 44	GSC 3474:0880	52407.4388	0.35244147	present paper
TY Cap	EA	20 24 30	−12 57 55	GSC 5749:1055	44793.4527	1.42345612	1
RZ Cas	EA	02 48 56	+69 38 03	GSC 4312:1101	48960.2260	1.19524980	1
AB Cas	EA	02 37 32	+71 18 16	GSC 4320:0403	46849.2820	1.36687530	1
IR Cas	EB	23 06 52	+54 04 52	GSC 3998:1901	28750.2740	0.68068890	1
IV Cas	EA	23 49 31	+53 08 05	GSC 4001:1392	40854.6480	0.99851747	1
XX Cep	EA	23 38 20	+64 20 03	GSC 4288:0241	41539.5307	2.33732600	1
DK Cep	EA	21 58 33	+60 56 54	GSC 4262:2154	33590.5578	0.98590874	1
EG Cep	EA	20 15 57	+76 48 36	GSC 4585:0413	40050.4491	0.54462274	present paper
YY CrB	EW	15 50 32	+37 50 07	GSC 3054:1278	51674.3541	0.37656417	present paper
ZZ Cyg	EA	20 23 53	+46 55 18	GSC 3576:1596	45000.3501	0.62861631	1
V836 Cyg	EB	21 21 24	+35 44 11	GSC 2715:0264	44853.4914	0.65341148	1
V859 Cyg	EW	19 27 13	+28 56 50	GSC 2137:2999	34629.4119	0.40499999	1
RZ Dra	EA	18 23 06	+58 54 13	GSC 3916:1962	44177.5609	0.55087616	1
AI Dra	EA	16 56 18	+52 41 54	GSC 3886:0105	37544.5092	1.19881489	1
RZ Equ	EA	21 17 52	+09 50 06	GSC 1109:2135	37161.3730	1.96143000	2
EW Lyr	EA	18 33 16	+37 45 13	GSC 3105:1934	26499.6842	1.94874423	1
PY Lyr	EW	19 20 26	+28 56 44	GSC 2136:3105	34980.4372	0.38576273	1
V508 Oph	EW	17 58 49	+13 29 47	GSC 1019:1849	44785.3350	0.34479220	1
AT Peg	EA	22 13 24	+08 25 31	GSC 1136:1084	45640.4590	1.14609013	1
BB Peg	EW	22 22 57	+16 19 28	GSC 1682:1530	43764.3416	0.36150147	1
FG Sct	EW	18 44 57	−06 08 30	GSC 5126:4019	29017.5579	0.27057207	1
V Sge	E/NL	20 20 15	+21 06 09	GSC 1643:1423	50169.4910	0.51419534	1
V Tri	EB	01 31 47	+30 22 02	GSC 2293:1382	48573.6604	0.58520570	1
RT UMi	EA	17 04 06	+80 19 45	GSC 4576:0151	26631.3010	1.84197580	1
AH Vir	EW	12 14 21	+11 49 10	GSC 0869:0551	47569.6110	0.40752300	1

Source(s) of the ephemeris:

1. Kreiner et al., 2000
2. Khopolov et al., 1985

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
AB And	52510.3486	3	I	–	0.0761	149, c
AD And	52505.4228	9	I	–	0.0042	47, c
BX And	52514.3830	5	I	–	−0.0068	21, c
XZ Aql	52492.5279	6	I	–	0.1740	126, c
OO Aql	52505.3277	7	I	–	−0.0348	104, c
	52508.3695	16	I	–	−0.0338	120, c
V417 Aql	52498.4486	16	II	–	−0.0550	77, c
	52511.4103	2	II	–	−0.0551	25, c
TZ Boo	52367.3542	7	II	B, V, R	−0.0041	37, p
	52387.4136	11	I	B, V, R	−0.0034	33, p
	52388.3060	10	I	B, V, R	−0.0024	39, p
	52390.3827	8	I	B, V, R	−0.0059	43, p
AC Boo	52407.4402	7	I	B, V, R	0.0014	37, p
	52409.3785	7	II	B, V, R	0.0013	32, p
TY Cap	52521.4056	3	I	–	0.0096	49, c
RZ Cas	52537.6186	3	I	B, V	0.0099	38, p
AB Cas	52490.4170	5	I	–	0.0406	236, c
IR Cas	52512.4113	1	I	–	−0.0315	29, c
	52527.3849	3	I	–	−0.0330	37, c
IV Cas	52497.3579	5	I	–	−0.0038	194, c
XX Cep	52515.5559	3	I	–	−0.0574	55, c
DK Cep	52495.3570	10	I	–	−0.0009	413, c
EG Cep	52577.3173	10	I	–	0.0006	180, c
YY CrB	52469.4692	4	II	B, V, R	−0.0001	35, p
	52473.4240	4	I	B, V, R	0.0007	39, p
ZZ Cyg	52493.4256	5	I	–	−0.0310	308, c
V836 Cyg	52528.4862	3	I	–	0.0236	31, c
V859 Cyg	52524.3749	9	I	–	0.0384	43, c
RZ Dra	52496.3363	7	I	–	−0.0055	89, c
AI Dra	52458.3834	5	II	V	0.0175	46, p
RZ Equ	52468.4761	11	I	–	0.1034	318, c
EW Lyr	52515.3885	1	I	–	−0.0312	63, c
PY Lyr	52469.4388	2	I	–	0.0625	265, c
	52470.4020	1	II	–	0.0613	237, c
V508 Oph	52486.4355	7	II	–	−0.0057	19, c
	52513.3314	1	II	–	−0.0036	23, c
AT Peg	52512.3486	8	I	B, V, R	−0.0668	36, p
BB Peg	52513.4118	2	I	–	0.0116	108, c
FG Sct	52472.3579	7	I	–	−0.0104	179, c
	52472.4943	3	II	–	−0.0093	194, c
V Sge	52523.3653	21	I	–	−0.0240	81, c
V Tri	52497.4679	3	I	–	0.0033	79, c
RT UMi	52529.4791	16	I	–	−0.0016	59, c
AH Vir	52397.4148	2	II	B, V, R	0.0826	41, p
	52398.4328	2	I	B, V, R	0.0818	32, p

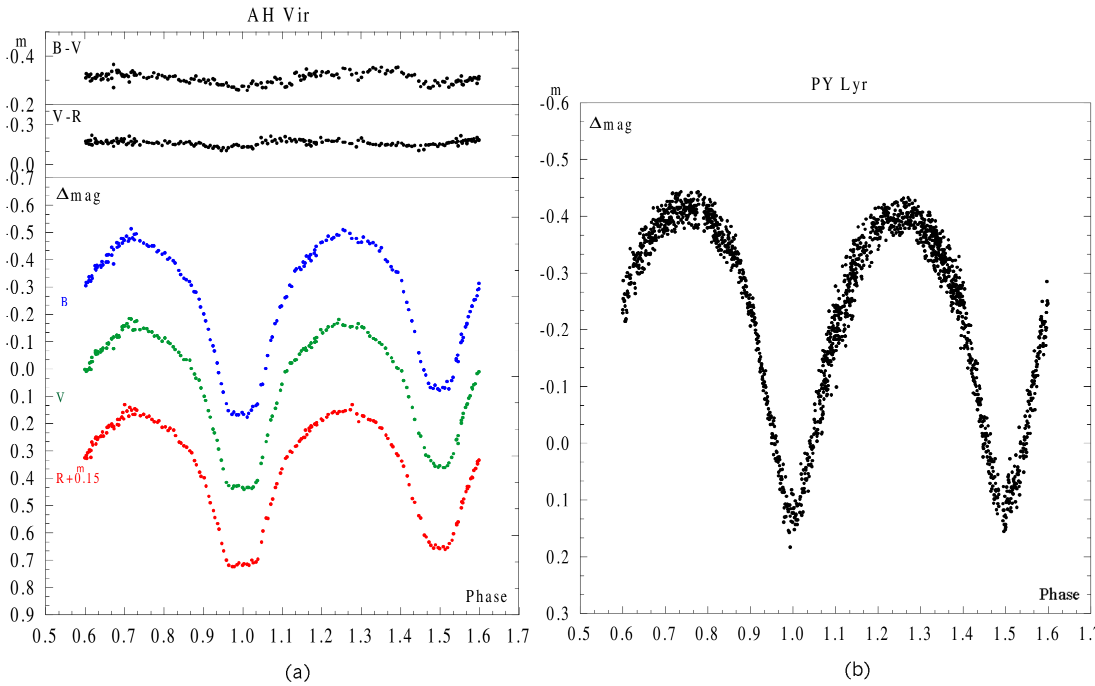

Figure 1. (a) Photoelectric light and color curves of AH Vir and (b) Unfiltered CCD light curve of PY Lyr

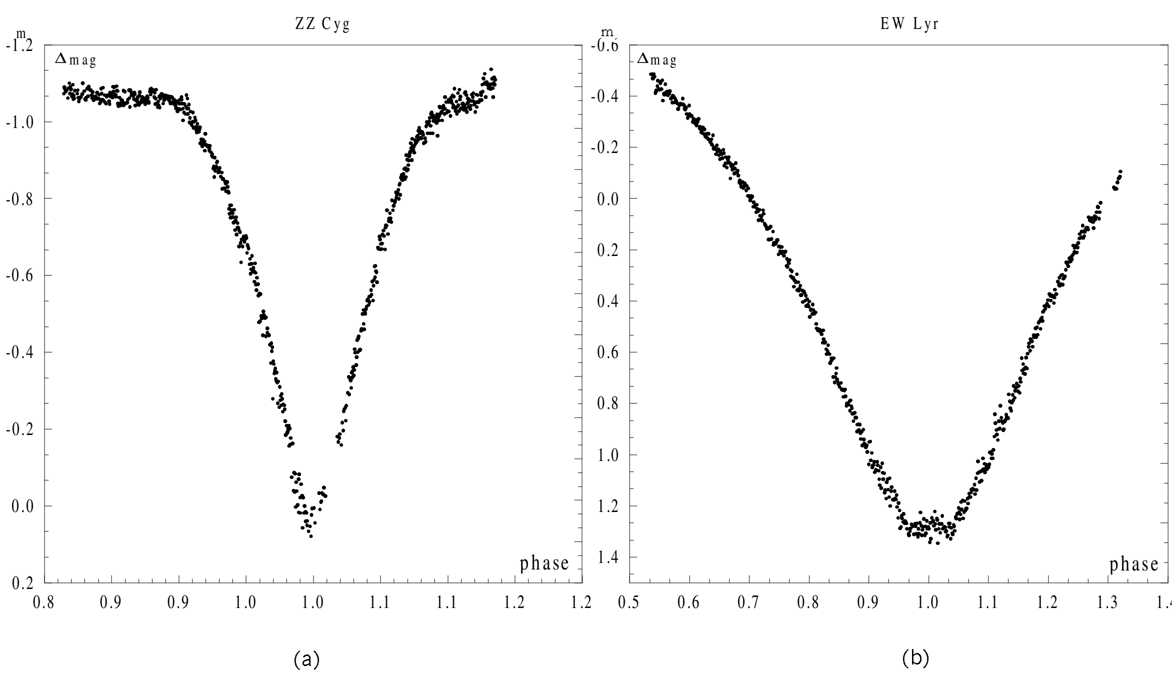

Figure 2. Unfiltered CCD minima of (a) ZZ Cyg and (b) EW Lyr

Remarks:

The 33 stars, whose details are listed in Table 1, were observed using either conventional filtered Johnson standard (BVR) photoelectric photometry with the SSP-5A or unfiltered with the ST-237. 45 times of minima, primary and some secondary, are listed in Table 2, together with $O-C$ values corresponding to the Table 1 ephemerides. The remarks column of Table 2, e.g. 147,c, gives first the number of data points used in the calculation of each minimum time followed by an identification of which system was used; thus "c" refers to the 30 cm + ccd combination and "p" means the single channel photometer on the 40 cm telescope. We show, in Figures 1, & 2, selected light curves corresponding to these reported results.

Figure 1a shows a typical light curve (AH Vir) obtained with the single channel photometer on the 40 cm telescope. In Fig 1b, the moderate low amplitude ~12.5-13 mag W UMa binary PY Lyr light curve reflects a reasonable level of scatter for 20 sec integrations. The measured standard error on a run of 300 points is 0.018 mag, for example, as compared with 0.015 mag, corresponding to purely Poissonian counting statistics. Similar calculations for other binaries at comparable magnitudes show similar (~2%) individual datum accuracies and point to essentially high steadiness of attainable conditions at the site. Light curves of such variables will be presented in more detail in subsequent IBVS articles.

Asymmetry around the outer tangencies of the short period system ZZ Cyg and the distinct totality observed for EW Lyr (Fig 2a,b) present interesting challenges for further study of these deep-minimum classical Algols.

Availability of the data:

Upon request

Acknowledgements:

For the development of the Ulupinar Observatory, technical support has come from Varol Keskin, financial support has come from the Çanakkale Onsekiz Mart University Research Foundation.

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ON THE VARIABILITY OF THE DWARF NOVA EM CYGNI

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Dwarf novae (DNe) are a type of cataclysmic binary stars that undergo quasi periodic eruptions of a few magnitudes. In EM Cyg the increase in brightness is of about 2 mag, from $V \simeq 14^{\rm m}_{.}4$ to $V \simeq 12^{\rm m}_{.}5$ (Downes & Shara 1993), and generally occurs every 20-30 days. The variable is both an eclipsing binary and a double-lined spectroscopic binary. Initially it was classified as a nova-like, but successive observations allowed the classification to be refined and EM Cyg was included in the class of DNe. The usually regular eruption cycle is occasionally interrupted by irregular low-amplitude fluctuations in brightness which suggested that it belongs to the Z Cam type subclass (see Downes & Shara 1993). As usual for this class of objects, the infrared emission of EM Cyg is dominated by the late-type (K2V) secondary star (Jameson et al. 1981), whereas optical data suggest that the primary's light is dominated by the contributions of accretion disk and bright spot.

From measurements of the radial velocity variations, Robinson (1974) was able to derive the orbital elements and the masses of the components of the binary system. However, the spectrum of the secondary star was heavily veiled by the strong continuum arising from the accretion disk, and the measured radial velocities were of relatively low accuracy. More accurate results were obtained by Stover et al. (1981), who estimated the orbital period (P=6.98 h), the masses of the accreting white dwarf and the mass-losing secondary star: $M_1 = (0.56 \pm 0.05)M_\odot$ and $M_2 = (0.76 \pm 0.10)M_\odot$. Recently, North et al. (2000) discovered that the spectrum is contaminated by light from a K2-5 V star, in addition to the K-type mass donor star. They revised the value of the mass ratio that combined with the orbital inclination $i = 67^\circ \pm 2^\circ$ leads to masses of $M_1 = (1.12 \pm 0.08)M_\odot$ and $M_2 = (0.99 \pm 0.12)M_\odot$.

We observed this dwarf nova at the Perugia Astronomical Observatory from June to October 1997, and from August to October 2000. We have also observed EM Cygni at the Teramo Astronomical Observatory in August-September 1998, for a total of 45 different observational nights. Table 1 shows all the BVR_CI_C magnitudes with the Julian Date and the date of the night (not the UT date). 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. In particular we are interested in identifying the accretion disk emission during all the outburst cycle, because DNe offer the best conditions in which to study the uncertain physics of the disk.

All the data are obtained in the BVR_CI_C Johnson-Cousins broad bands. The instruments used and the photometric techniques have been already described in Spogli

Table 1: $BV(RI)_C$ magnitudes of EM Cyg

Date	JD (2450000+)	B	V	R_C	I_C
28/06/97	628.585	13.41 ± 0.11	12.95 ± 0.05	12.59 ± 0.05	
02/07/97	632.550	13.88 ± 0.09	13.20 ± 0.07	12.72 ± 0.05	12.32 ± 0.05
06/07/97	636.537	14.05 ± 0.09	13.45 ± 0.03	12.93 ± 0.05	12.34 ± 0.04
07/07/97	637.547	14.01 ± 0.08	13.40 ± 0.02	12.91 ± 0.04	12.33 ± 0.04
08/07/97	638.565	14.26 ± 0.08	13.58 ± 0.03	13.04 ± 0.04	12.42 ± 0.04
09/07/97	639.551	14.06 ± 0.08	13.48 ± 0.03	12.92 ± 0.04	12.35 ± 0.04
10/07/97	640.562	14.21 ± 0.08	13.45 ± 0.04	13.03 ± 0.04	12.43 ± 0.04
11/07/97	641.529	14.14 ± 0.10	13.50 ± 0.03	12.95 ± 0.03	12.40 ± 0.04
12/07/97	642.541	14.11 ± 0.09	13.57 ± 0.04	12.98 ± 0.03	12.38 ± 0.04
25/07/97	655.441	12.52 ± 0.08	12.35 ± 0.04	12.12 ± 0.03	11.72 ± 0.04
26/07/97	656.443	12.64 ± 0.08	12.45 ± 0.03		
28/07/97	658.446	12.99 ± 0.06	12.72 ± 0.02	12.42 ± 0.04	11.96 ± 0.04
30/07/97	660.455	13.50 ± 0.08	13.17 ± 0.02	12.79 ± 0.04	12.28 ± 0.05
01/08/97	662.421	13.95 ± 0.08	13.23 ± 0.03	12.80 ± 0.04	12.30 ± 0.04
04/08/97	665.412	14.40 ± 0.08	13.81 ± 0.03	13.24 ± 0.05	12.65 ± 0.05
07/08/97	668.419	14.20 ± 0.11	13.45 ± 0.05	13.10 ± 0.05	12.50 ± 0.05
14/08/97	675.405	12.97 ± 0.05	12.65 ± 0.04	12.35 ± 0.03	11.95 ± 0.05
18/08/97	679.399	14.27 ± 0.04	13.54 ± 0.03	13.05 ± 0.03	12.59 ± 0.04
20/08/97	681.395	14.15 ± 0.11	13.57 ± 0.03	13.15 ± 0.03	12.53 ± 0.05
22/08/97	683.391	14.18 ± 0.10	13.46 ± 0.04	12.98 ± 0.03	12.55 ± 0.04
29/08/97	690.384	13.55 ± 0.08	13.14 ± 0.02		
17/09/97	709.349	14.34 ± 0.11	13.59 ± 0.03	13.03 ± 0.03	12.45 ± 0.05
18/09/97	710.350	14.14 ± 0.09	13.50 ± 0.02	13.00 ± 0.03	12.39 ± 0.05
24/09/97	716.325	12.99 ± 0.05	12.67 ± 0.02	12.38 ± 0.03	11.95 ± 0.05
04/10/97	726.308	14.04 ± 0.08	13.41 ± 0.02	12.95 ± 0.03	12.37 ± 0.04
05/10/97	727.321	14.12 ± 0.13	13.48 ± 0.04		
16/10/97	738.253	13.55 ± 0.06	13.07 ± 0.03		
17/10/97	739.329	12.51 ± 0.05	12.31 ± 0.03	12.08 ± 0.03	11.70 ± 0.04
18/10/97	740.285	12.35 ± 0.06	12.20 ± 0.03	11.98 ± 0.04	11.62 ± 0.04
19/10/97	741.286	12.61 ± 0.06	12.39 ± 0.03	12.19 ± 0.04	11.80 ± 0.05
22/10/97	744.282	13.05 ± 0.06	12.77 ± 0.04	12.45 ± 0.03	12.02 ± 0.04
31/08/98	1057.450	13.52 ± 0.04	13.03 ± 0.04	12.61 ± 0.04	12.27 ± 0.05
01/09/98	1058.416	13.54 ± 0.04	13.08 ± 0.05	12.58 ± 0.04	12.18 ± 0.05
02/09/98	1059.333	13.07 ± 0.04	12.74 ± 0.04	12.46 ± 0.04	
19/08/00	1776.357	13.45 ± 0.04	13.04 ± 0.04	12.72 ± 0.04	12.18 ± 0.04
20/08/00	1777.385	13.37 ± 0.04	12.98 ± 0.04	12.69 ± 0.04	12.21 ± 0.04
21/08/00	1778.333	13.60 ± 0.07	13.01 ± 0.05	12.66 ± 0.04	12.07 ± 0.04
25/08/00	1782.328	13.21 ± 0.05	12.83 ± 0.05	12.61 ± 0.05	12.09 ± 0.05
29/08/00	1786.331	13.45 ± 0.05	13.06 ± 0.06	12.68 ± 0.05	12.16 ± 0.05
11/09/00	1799.313	13.04 ± 0.09	12.75 ± 0.06	12.42 ± 0.04	11.98 ± 0.05
12/09/00	1800.312	12.77 ± 0.08	12.59 ± 0.04	12.39 ± 0.03	11.96 ± 0.04
15/09/00	1803.308		13.01 ± 0.04	12.67 ± 0.04	12.14 ± 0.04
22/09/00	1810.299	14.22 ± 0.04	13.54 ± 0.04	13.04 ± 0.03	12.43 ± 0.05
12/10/00	1830.293				11.74 ± 0.04
28/10/00	1846.246				12.38 ± 0.04

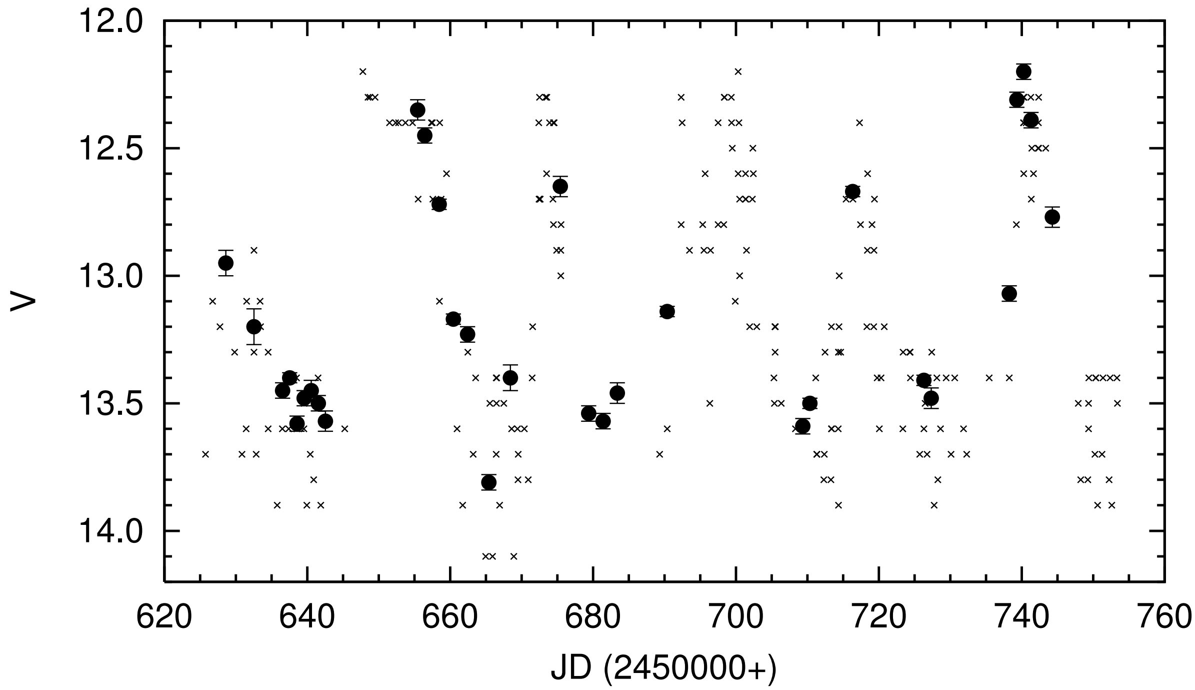

Figure 1. V light curve of EM Cyg during the summer-autumn 1997. Circles represent the data here reported, while the small crosses are visual estimates available from VSNET

et al. (1998). In this work, we used the calibration stars reported in Misselt (1996) with the number 2, 4, 5, 8, and 11. 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 airmass. The weighted means and standard deviations of the obtained values are: $I_C(2) = 12.28 \pm 0.06$, $I_C(4) = 12.51 \pm 0.06$, $I_C(5) = 13.00 \pm 0.05$, $I_C(8) = 10.99 \pm 0.05$, and $I_C(11) = 12.12 \pm 0.08$.

Figure 1 shows the V data during the summer-autumn 1997, and the visual estimates available from VSNET (`http://vsnet.kusastro.kyoto-u.ac.jp/vsnet/`). The comparison shows that we have a good coverage of all the outburst phases. Table 2 remarks the principal photometric characteristics of all the dataset: the extreme magnitudes and the average color indices at maximum and at minimum.

Table 2: Photometric characteristics of EM Cyg from our observations

	B	V	R_C	I_C	$(B-V)_{ave}$	$(V-R_C)_{ave}$	$(V-I_C)_{ave}$
Maximum	12.3	12.2	12.0	11.6	0.2	0.2	0.6
Minimum	14.4	13.8	13.2	12.7	0.7	0.5	1.1

We computed the flux density of EM Cyg using the same procedure described in Spogli et al. (1998), adopting the interstellar reddening $E(B-V)$=0.03 as reported by Bruch (1984). The spectral distribution is dominated by the emission of the secondary star during the minimum, and we tried to isolate its contribution with the simple assumption that the overall emission is mainly due to the secondary and the accretion disk. In this phase we have neglected the presence of another red star (North et al. 2000) because the spectral types are similar (K2-5V). Figure 2 shows an example of decomposition of the spectral emission in two components. We have considered the canonical emission of a

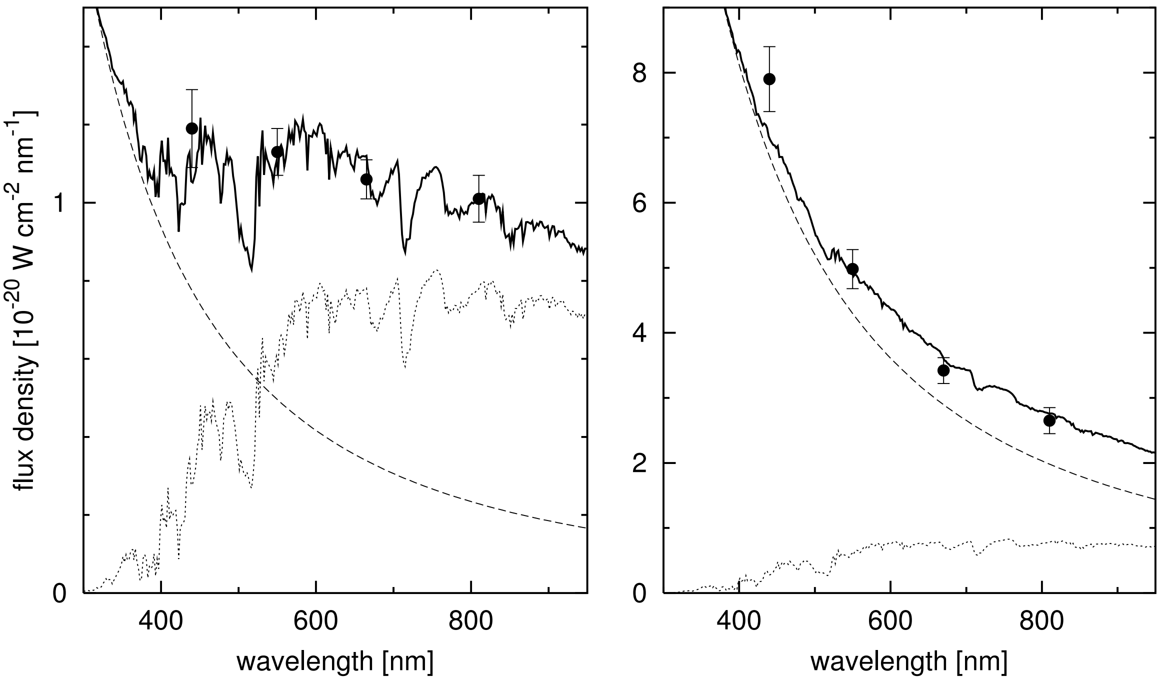

Figure 2. BVR_CI_C data points converted in density flux at minimum (left panel) and at maximum (right panel). Dotted lines represent the secondary star, while the dashed lines represent the theoretical emission of a steady-state accretion disk. The integrated light coming from the emission disk and the secondary (bold lines) is a rough but good approximation of the EM Cyg emission in the optical region

steady-state accretion disk $F(\lambda) \propto \lambda^{-7/3}$, while the emission of the secondary is simulated via Kurucz's spectra of dwarf stars with solar metalicity (Kurucz 1993). The best fit in all the phases of the outburst cycle is obtained considering the emission of a 4250 K star, and an accretion disk that varies of a factor ten from the passive cooling of the quiescence to the brightness of the outburst maximum. This model is obviously too simplistic and doesn't take into account all the components of the system, but reproduces quite well the variability dynamics during the outburst. Another component (probably the hot spot) or a physical model of the accretion disk may be necessary to compensate the strong blue emission during the outburst.

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THREE NEW W UMa BINARIES: GSC 0766-1248 (Brh V40), GSC 0471-2133 (Brh V60) AND GSC 0763-0572 (Brh V103)

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Further observations are presented of three new W UMa systems recently discovered by Bernhard (2000a, 2000b, 2002). Details of the observing programme are given by Bernhard & Lloyd (2000) and an up-to-date list of the variables can be found at http://mitglied.lycos.de/klausbernhard/. Details of the equipment used are given by Lloyd et al. (2002) and Bernhard et al. (2001).

Table 1: Brh V40 - Times of minima

HJD	Cycle	$O-C$	Min
2451924.4334(11)	−24	+0.0001	I
2451951.3609(8)	0	+0.0004	I
2451955.2867(13)	3	−0.0007	II
2451965.3864(6)	12	+0.0013	II

Brh V40 = GSC 0766-1248 ($07^h13^m34\overset{s}{.}142$ $+10^\circ15'12\overset{''}{.}91$ Tycho-2) was initially reported as a short-period variable by Bernhard (2000a) on the basis of six nights of survey data. Brh V40 has $V = 11\overset{m}{.}42 \pm 0\overset{m}{.}10$ and $B-V = +0\overset{m}{.}40 \pm 0\overset{m}{.}14$ from the Tycho-2 catalogue (Høg et al. 2000), while the USNO A2.0 catalogue gives a consistent $r = 12\overset{m}{.}0$ and $b-r = 1\overset{m}{.}0$ (Monet et al. 1998). Further extensive photometry during 2001 and 2002 has confirmed that it is a W UMa binary with a period of just over one day. The reference star used was GSC 0766-0142 with $V = 12\overset{m}{.}11$ (Tycho-2). A total of four minima have been observed which are given in Table 1. The ephemeris of primary minimum is given by

$$\mathrm{HJD_{MinI}} = \underset{\pm 5}{2451951.3605} + \underset{\pm 6}{1\overset{d}{.}121968} \times E\ .$$

The light curve is given in Figure 1 and shows an amplitude of nearly $0\overset{m}{.}6$. The secondary eclipse is slightly less deep and is probably total, indicating that the inclination

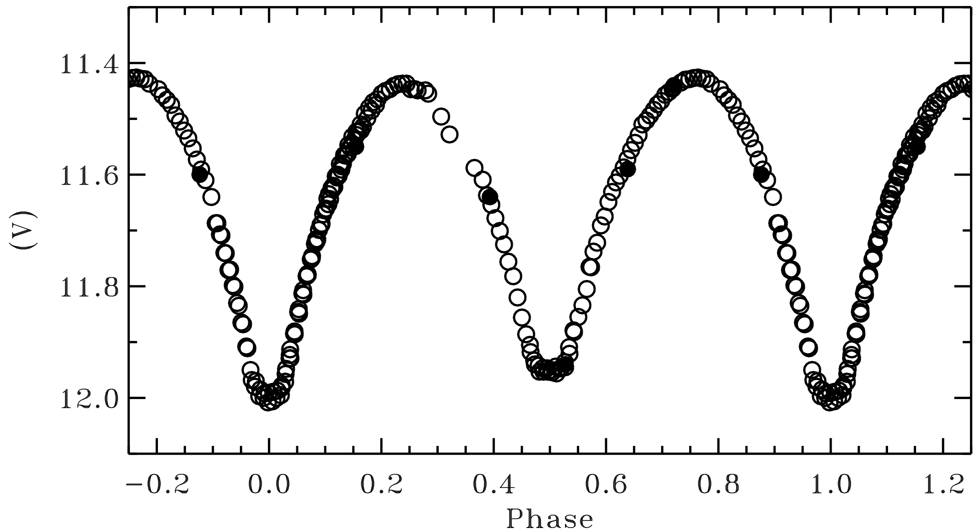

Figure 1. The phase diagram of Brh V40 = GSC 0766-1248. The observations of Moschner (open circles) and Bernhard (filled circles) are folded with the ephemeris given in the text.

is close to 90°. The period is long for a W UMa system: it lies in the top $\sim 1\%$ of the EW variables in the GCVS (Kholopov et al. 1998) and these systems are often not in contact (classified EW/D or /DM) or are referred to as Beta Lyrae variables (EB/...). Typical systems in this group are AT Cam (EW/DM:) and AZ Cam (EB/DM), which are probably just detached (Zhai et al. 1984). However, while their amplitudes are similar to that of Brh V40 their light curve are less sinusoidal, suggesting that Brh V40 is more nearly a contact system.

Table 2: Brh V60 - Times of minima

HJD	Cycle	$O-C$	Min
2451838.2531(14)	−1066	+0.0003	II
2452464.5607(13)	0	+0.0028	I
2452475.4301(8)	18	−0.0022	II
2452484.5417(9)	34	−0.0015	I
2452489.5412(19)	42	+0.0016	II
2452556.2575(18)	156	+0.0022	I

Brh V60 = GSC 0471-2133 ($19^h14^m39\overset{s}{.}648$ $+03°50'39\overset{''}{.}85$ Tycho-2) was initially reported as a probable short-period variable of unknown type by Bernhard (2000b). Photometry from Tycho-2 gives $V = 12\overset{m}{.}0 \pm 0\overset{m}{.}2$ and $B-V = -0\overset{m}{.}2 \pm 0\overset{m}{.}3$ while USNO A2.0 gives $r = 11\overset{m}{.}6$ and $b-r = 0\overset{m}{.}8$. Extensive photometry during 2000 and 2002 has shown that it is a W UMa system, although the colour suggests that it is probably an early spectral type. The reference star used was GSC 0471-2309 with $V = 11\overset{m}{.}67$ (Tycho-2). Six times of minima have been observed and these are given in Table 2. The ephemeris of primary minimum is given by

$$\mathrm{HJD_{MinI}} = \underset{\pm 5}{2452464.5579} + \underset{\pm 7}{0\overset{d}{.}5878039} \times E\ .$$

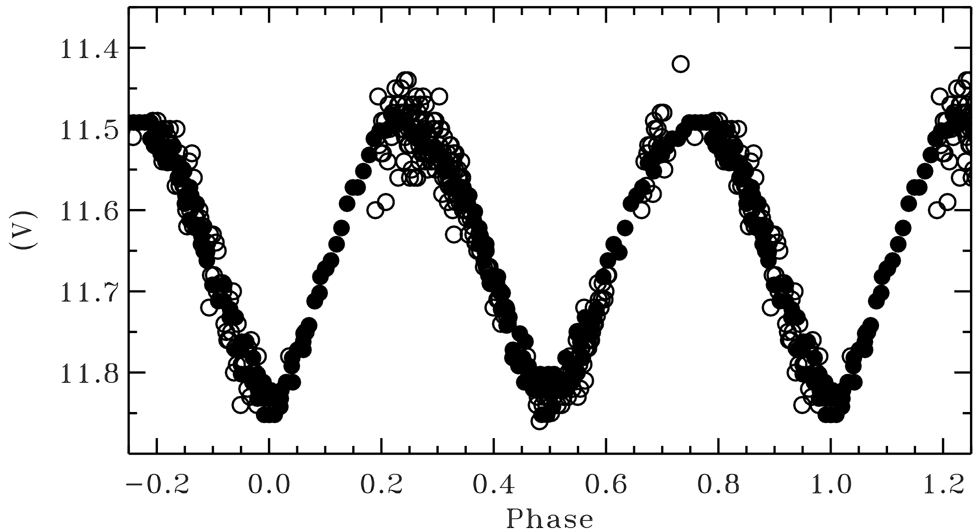

Figure 2. The phase diagram of Brh V60 = GSC 0471-2133. The observations of Bernhard (open circles) and Frank (filled circles) are folded with the ephemeris given in the text.

The light curve is given in Figure 2 and shows an amplitude of $0\overset{m}{.}35$, with both minima reaching almost the same depth. The secondary minimum may be marginally less deep than the primary, and is apparently broader, but the eclipse is probably not total.

Table 3: Brh V103 - Times of minima

HJD	Cycle	$O-C$	Min
2452318.0524(3)	−43	−0.0006	I
2452325.0886(2)	−27	+0.0002	II
2452336.3876(4)	0	−0.0001	I
2452361.3321(5)	58	+0.0007	II
2452362.3974(6)	61	+0.0000	I

Brh V103 = GSC 0763-0572 ($07^h16^m57\overset{s}{.}323$ $+09°12'35\overset{''}{.}46$ Tycho-2) was initially reported as a short-period variable by Bernhard (2002) following several long runs of observations. It has $V = 10\overset{m}{.}61 \pm 0\overset{m}{.}06$ and $B-V = +0\overset{m}{.}64 \pm 0\overset{m}{.}09$ from the Tycho-2 catalogue, and $r = 10\overset{m}{.}4$ and $b-r = 1\overset{m}{.}0$ from the USNO A2.0 catalogue. Further extensive photometry during 2002 has shown that it is W UMa binary. The reference star used was GSC 0763-0631 with $V = 9\overset{m}{.}82$ (Tycho-2). Five times of minima have been observed and these are given in Table 3. The ephemeris of primary minimum is given by

$$\mathrm{HJD}_{\mathrm{MinI}} = \underset{\pm 4}{2452336.3877} + \underset{\pm 3}{0\overset{d}{.}426388} \times E\ .$$

The light curve is given in Figure 3 and shows an amplitude of $0\overset{m}{.}5$. The secondary eclipse is slightly less deep and is probably total, indicating that the inclination is close to 90°. The instrumental $V - I_c$ from the TASS archive (`http://www.tass-survey.org`) shows a small variation in colour with the system being coolest during primary minimum.

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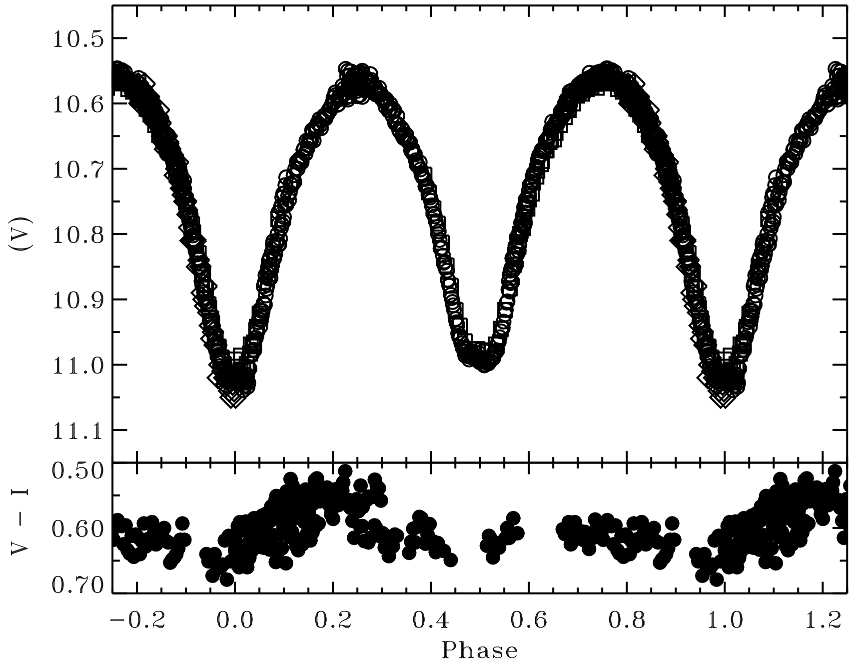

Figure 3. (Above) The phase diagram of Brh V103 = GSC 0763-0572. The observations of Moschner (open squares), Kiyota (open circles) and Bernhard (open diamonds) are folded with the ephemeris given in the text. (Below) The TASS instrumental $V - I_c$ magnitudes.

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LX CYGNI: A MIRA VARIABLE WITH A DRASTIC PERIOD INCREASE

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LX Cygni – α:21^{h}55^{m}57^s.03; δ:+48°20′52″.6 (J2000) – is a poorly-studied Mira variable of spectral type S. Although this object has been studied spectroscopically as part of several S-star surveys, little has been published about its pulsation behavior beyond its discovery and subsequent description in the *General Catalog of Variable Stars* (GCVS). Variability was first noted by Hoffmeister (1930). Additional observations were made by Olivier et al. (1940), and the period was determined to be about 461 days, with photographic maxima and minima of 11.9 and 16.5 magnitudes, respectively (Prager & Shapley 1941). Semakin (1955) summarized the work to date on LX Cyg, noting that the period had been variously measured between 454 and 465 days. Finally, the GCVS 4th edition (Kholopov et al. 1985) lists the period as 465.3 days (epoch JD 2438895), noting that between JD 2415000 and 2433300, 460.0 days was a better fit.

This variation in reported period is unremarkable, given the cycle-to-cycle variations in period seen in many Mira variables. However, since 1967, LX Cygni has apparently undergone a significant change in pulsation behavior. The American Association of Variable Star Observers (AAVSO) archive of visual observations – spanning JD 2439818 to 2452605 (November 23, 1967 to November 26, 2002) – show that a dramatic increase in period has occurred since JD 2440000. The period has grown from 460 days to over 580 days, an increase of nearly 25 percent.

For our time-series analysis, we used 961 visual observations by 84 different observers in the AAVSO International Database. Although we have additional CCD data taken in the Johnson *V* filter, we chose not to include them in the long-term analysis in order to keep the data set as homogeneous as possible. We have instead analyzed the CCD observations separately and discuss them below. We used the *weighted wavelet transform* developed at AAVSO (Foster 1996) to perform the time-series analysis. The wavelet transform allows one to measure the time evolution of the Fourier spectrum of a given dataset, and it is quite sensitive to even small changes in period over both short and long timescales.

We computed the wavelet transform several times with a range of frequencies and wavelet windows. We show the data and a representative wavelet transform in Figure 1, and plot the period and amplitude of the strongest peak as a function of time in Figure 2. Figure 2 clearly shows that the period has increased since the start of the AAVSO data in 1967. The behavior of the period is uncertain at the start and end of the data set due to edge effects of the wavelet transform.

We also note that the amplitude computed from the wavelet transform appears to be variable over the span of observations. It is possible that the real amplitude of the star has changed over time, but this may be an artifact of the wavelet analysis. Wavelet amplitude is sensitive to data gaps, so seasonal windows may be the cause. Analysis of the amplitude variation is continuing, and will be published in a forthcoming paper.

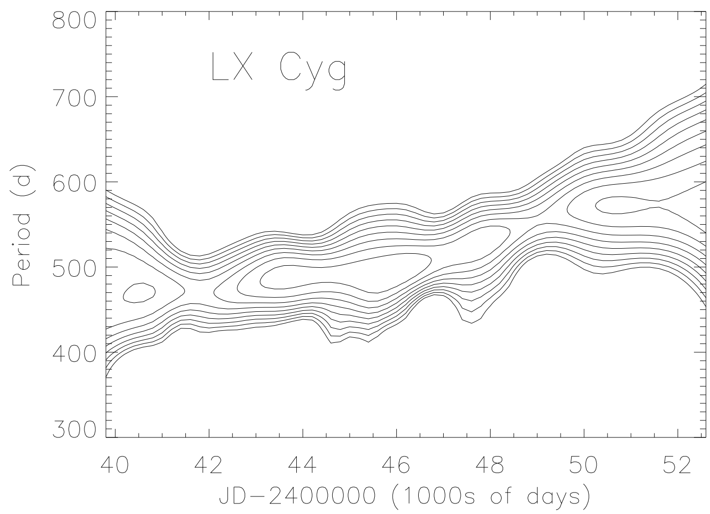

Figure 1. Wavelet transform of LX Cyg. Contours represent the wavelet statistic, w, a measure of the statistical significance of the signal (see Foster 1996). Strongest signal lies at the center of the contours. The wider bands at the beginning and end of the data stream are edge effects, and are artificial.

To confirm our analysis, we also analyzed the available CCD V-band observations from the AAVSO International Database. These observations consist of 106 CCD observations made by six observers, spanning JD 2451236 to 2452601 (February 26, 1999 to November 22, 2002). While the data span is not long enough to reliably determine whether the period is variable, we measured the spacing between the two maxima and three minima present in the data and found a period of 590 ± 10 days. In addition, we visually inspected the older data collected by Olivier et al. (1940), spanning JD 2427334 to 2429595 (1933 to 1939). Although their data are very sparse, the measured separation between the two clearly defined maxima is 465 $\pm$10 days, which is consistent with the published period for that epoch.

The rapid period increase beginning at JD 2445000 appears to be a continuous process, rather than an abrupt, discontinuous change. Therefore, it appears that mode-switching is *not* the reason for the change. If the period continues to increase at the current rate, than this may indicate that LX Cygni is in the middle of a thermal pulse. According to the models of Vassiliadis & Wood (1993), each thermal pulse begins with a sharp period *decrease*, followed by a short, high-amplitude oscillation in period (a decrease by half, and an increase by as much as a factor of three). A period increase of 100 days over a few decades is seen in some of their models, and if LX Cygni is in the midst of a thermal pulse, the period may continue to increase significantly in the coming decades.

LX Cygni appears to be an excellent candidate for a Mira variable undergoing thermal pulses, as the magnitude of the period change is similar (though opposite in sign) to that of T UMi, a star which has undergone a rapid period *decrease* since 1968 (Mattei & Foster 1995; Gál & Szatmáry 1995), as well as that of TY Cas (Hazen & Mattei 2002). Whereas

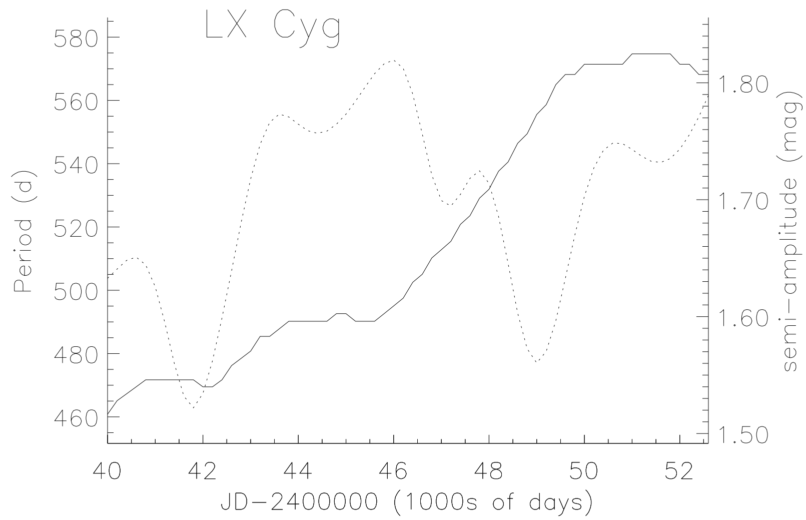

Figure 2. Strongest period (solid line) and its amplitude (dotted line) derived from the wavelet transform of LX Cyg. The period is clearly increasing throughout the span of available data. Because of edge effects in the wavelet transform, it is not clear whether the period has reached a plateau 580 days, or whether it will continue increasing. Continued monitoring over the next several years is strongly encouraged. The amplitude also appears to be variable, and a more sensitive analysis of this variation is underway.

T UMi and TY Cas may have just begun thermal pulses, LX Cygni may be in a later stage since thermal pulses are expected to begin with a period decrease. Further observations of LX Cygni are warranted and strongly encouraged. A more comprehensive analysis of this star is currently in preparation for publication.

We thank the 90 observers worldwide who have contributed over 1000 observations of LX Cygni to the AAVSO International Database. We also thank G. Foster for helpful discussions on this analysis.

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IDENTIFICATION OF V379 PEGASI

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A recent paper by Kato, et al. (2002) discussed the lack of variability of the star identified as V379 Peg (NSV26158, Peg 7). This field is part of an upcoming paper on cataclysmic variable sequences (Henden and Sumner 2003). Relatively deep $UBV(RI)_C$ photometry has been performed of this field using the USNO Flagstaff Station (NOFS) 1.0m telescope and SITe 1024×1024 CCD.

The star identified by Kato and others is quite red and has relatively large proper motion (−56mas/year RA; −32mas/year Dec; from USNO-B (Monet et al., 2003)). The original discovery papers list V379 Peg as a UV-excess object (FBS 2351+228), as well as having a blue spectrum (Lipovetskii and Stepanyan 1981). A later paper by Kopylov et al. (1988) shows an object with a late M-type spectrum with narrow hydrogen emission lines, so some confusion is obviously present.

Examining our photometry, we believe that V379 Peg has been misidentified. A better candidate is a blue object about 22″to the east of the red star that is the bluest object in a 20′×20′field. The coordinates and magnitudes of both objects are:

Star	RA(J2000)	Dec(J2000)	V mag	$B-V$	$U-B$	$V-R$	$R-I$
blue	$23^h53^m52^s.47$	$+23°09'20''.5$	18.47(2)	0.24(2)	−0.70(3)	0.46(3)	0.44(4)
red	$23^h53^m50^s.88$	$+23°09'18''.8$	15.14(1)	1.53(1)	1.08(2)	1.06(1)	1.41(1)

Photometry was performed on multiple nights using Landolt (1992) standard stars of wide color and airmass for calibration. Photometric errors in the last digit are shown in parenthesis. The UCAC2 reference catalog was used for astrometry, with absolute coordinate errors under 100mas. The coordinate epoch is 2001.312. The blue object's proper motion from USNO-B is zero within errors.

Both of these objects were also observed with the Astrocam near-IR camera (Aladdin 1024×1024 InSb detector) on the NOFS 1.55m telescope. The magnitudes, using 2MASS second incremental data release values for stars in the same field, are:

Star	J(nofs)	J(2mass)	K(nofs)	K(2mass)
blue	16.93(3)		15.84(4)	
red	11.36(1)	11.35(2)	10.54(1)	10.51(3)

Note that the NIR magnitudes for the red object agree with the 2MASS values, further indicating little or no variability. A finding chart with the blue and red objects marked is shown in Figure 1. A file containing the calibrated $UBV(RI)_C$ magnitudes of all stars within 10 arcmin of the variable is given in 5368-t3.txt on the IBVS-website.

Based on the broad-band colors, the red object is a close match to an M4V (Cox 2000) star. The blue object is puzzling. The red colors look like an unreddened K0III star, but the blue colors do not match this classification. They appear more like an O star reddened by $E(B-V) \sim 0.55$, but using this reddening makes the red colors match something closer to A/F. Note that the NIR colors further complicate the issue, since the "blue" object is quite red. We propose that the blue object is exhibiting a composite spectrum, with a blue and a red star involved. This is common for interacting binaries such as cataclysmic variables.

Unfiltered time-series photometry was performed on 021204 and 021220 UT for both stars, and also on 021215 UT (under poor conditions) for the red star. Figure 2 shows the data for the blue star. No obvious periodicity is visible, though the scatter is larger than Poisson statistics (±0.03mag) would suggest. Such flickering is common for cataclysmic variables. Figure 3 shows the data for the red star. Some small fluctuations are present, indicating at most some low amplitude variability.

In summary, we propose that the blue star is the star observed in the FBS survey and is mismarked on the Lipovetskii and Stepanyan (1981) finding chart. The spectrum taken by Kopylov et al. (1988) was of the red star and not of the UV-excess object. A modern spectrum would solidify the identification, but until such is available, we recommend observing the blue star for further outburst activity.

We acknowledge the help of U. Munari (U. Padova) in the interpretation of the broad-band colors. This paper makes use of the Two Micron All Sky Survey (2MASS), a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation.

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Monet, D., Levine, S., Canzian, B., Ables, H., Bird, A., Dahn, C. et al., 2003, *AJ*, in press.

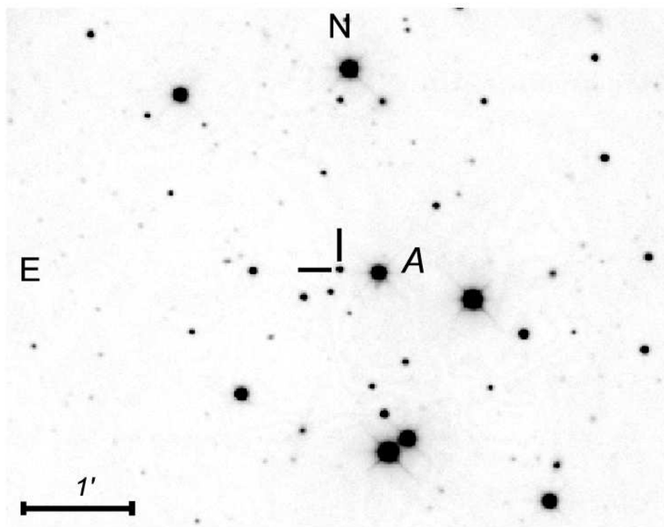

Figure 1. V-band chart of V379 Peg. Chart size is $5' \times 6'$. Star "A" is the red star from Kato et al. 2002

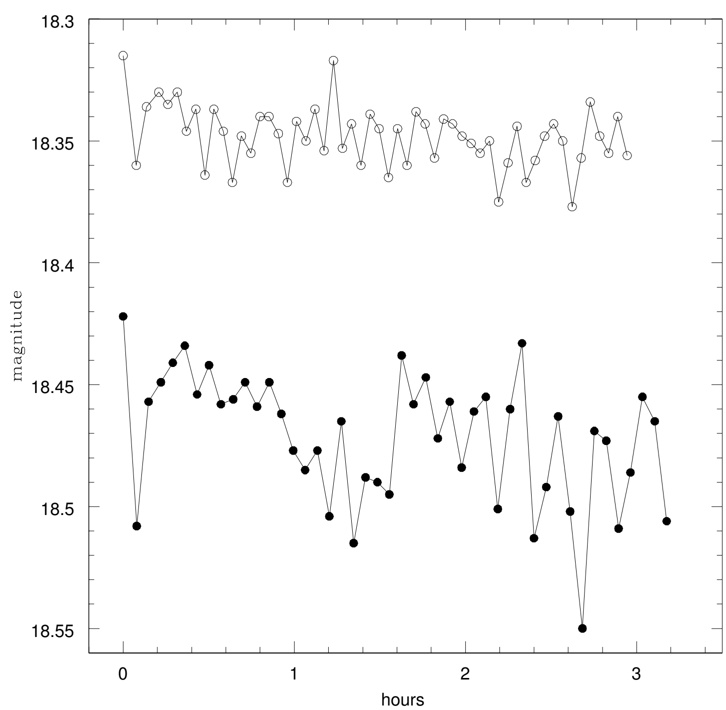

Figure 2. Unfiltered light curve for the blue candidate. Open circle data is for 021204; filled circle data is for 021220. Horizontal axis is hours since the beginning of each time series. The two nights have been offset by 0.1mag for clarity.

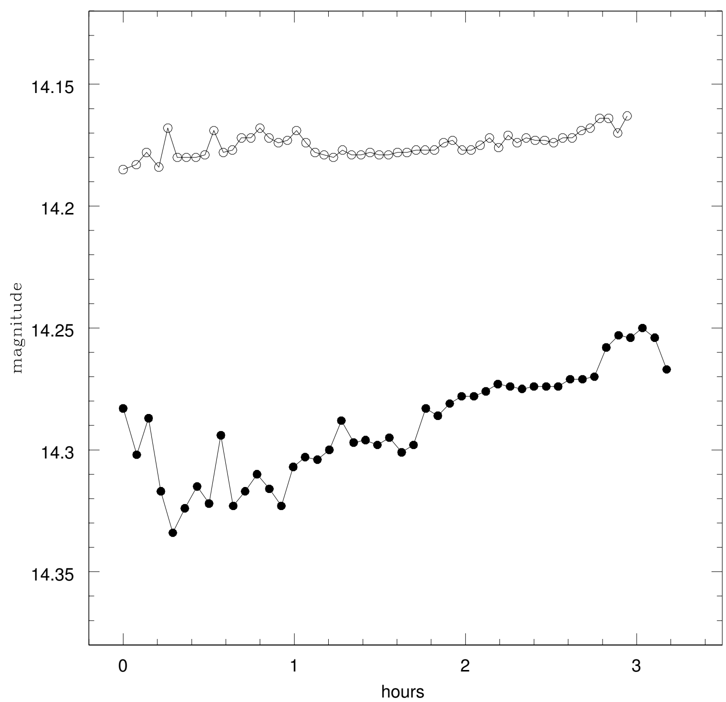

Figure 3. Unfiltered light curve for the red candidate. Open circle data is for 021204; filled circle data is for 021220. Horizontal axis is hours since the beginning of each time series. The two nights have been offset by 0.1mag for clarity.

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ELEMENTS FOR 5 RR LYRAE STARS IN OPHIUCHUS

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The variability of these stars was announced by Hoffmeister (1967); no further observations or ephemeris were published until today. Recent estimations, made on photographic plates taken with the Sonneberg Observatory 40cm Astrograph during the years 1964-1994, have allowed to determine the type of variability as well as first elements (see Table 1). The given elements were obtained by means of least-squares solutions. Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 3. Individual data are available upon request.

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

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	M−m	No. of Plates
V1053 Oph	RRab	44024.427 ±6	0.5783325 ±7	$14^m_.7$	$15^m_.5$	$0^p_.15$	206
V1056 Oph	RRab	44024.444 ±12	0.5927557 ±15	$15^m_.2$	$16^m_.4$	$0^p_.13$	182
V1059 Oph	RRab	44372.334 ±9	0.6872508 ±10	$14^m_.2$	$15^m_.5$	$0^p_.16$	222
V1060 Oph	RRab	44370.391 ±4	0.4403777 ±3	$15^m_.1$	$16^m_.1$	$0^p_.13$	194
V1061 Oph	RRab	44376.398 ±13	0.5893621 ±13	$15^m_.0$	$16^m_.4$	$0^p_.13$	215

Table 2. Individual maxima and $O-C$ values according to the elements derived in this paper

Star	HJD (max.)	Epoch	$O-C$	Star	HJD (max.)	Epoch	$O-C$
V1053 Oph	38502.523	−9548	0.014	V1059 Oph	44376.427	6	−0.031
	38528.508	−9503	−0.026		44732.466	524	0.012
	38531.424	−9498	−0.001		45822.442	2110	0.009
	38557.467	−9453	0.017		46644.382	3306	−0.003
	38579.425	−9415	−0.002		49098.546	6877	−0.012
	38583.446	−9408	−0.029		49193.416	7015	0.018
	38937.420	−8796	0.005	V1060 Oph	38530.538	−13261	−0.004
	39299.462	−8170	0.011		38531.424	−13259	0.001
	44024.435	0	0.008		38549.468	−13218	−0.011
	45055.617	1783	0.023		38579.425	−13150	0.001
	46641.392	4525	0.010		39299.462	−11515	0.020
	47262.496	5599	−0.015		39918.613	−10109	0.000
	49488.498	9448	−0.014		44370.400	0	0.009
V1056 Oph	38557.467	−9223	0.008		44373.467	7	−0.007
	38883.487	−8673	0.013		45055.617	1556	−0.002
	38937.420	−8582	0.005		45056.500	1558	0.000
	39618.468	−7433	−0.023		45082.472	1617	−0.010
	44024.414	0	−0.030		45854.459	3370	−0.005
	44749.419	1223	0.035		49193.416	10952	0.008
	45082.497	1785	−0.016	V1061 Oph	37112.470	−12325	−0.040
	46612.425	4366	0.009		38530.538	−9919	0.023
V1059 Oph	38533.459	−8496	0.007		38533.459	−9914	−0.003
	38555.466	−8464	0.022		38579.425	−9836	−0.007
	38882.544	−7988	−0.031		39288.461	−8633	0.026
	38902.485	−7959	−0.020		44373.482	−5	0.031
	39238.572	−7470	0.001		44376.400	0	0.002
	39917.607	−6482	0.032		44749.455	633	−0.009
	44343.463	−42	−0.007		45053.591	1149	0.016
	44365.436	−10	−0.026		45056.537	1154	0.015
	44372.369	0	0.035		45854.475	2508	−0.043
	44374.390	3	−0.006		46612.425	3794	−0.013

Table 3. Comparison stars and cross references

	V1053 Oph S 9622 GSC 397.2567		V1056 Oph S 9623 USNO 0900-09177312	
Comp. No.	GSC	m*	GSC	m*
1	397.2315	$14.^{m}3$	397.0078	$14.^{m}5$
2	397.2376	$15.^{m}1$	397.2414	$16.^{m}0$
3	397.2340	$15.^{m}5$	397.0116	$16.^{m}3$
4	397.2565	$15.^{m}7$		

	V1059 Oph S 9628 USNO 0975-08854021		V1060 Oph S 9629 USNO 0975-08929161	
Comp. No.	GSC/USNO	m*	GSC/USNO	m*
1	977.1260	$13.^{m}7$	977.1000	$14.^{m}5$
2	977.1420	$14.^{m}4$	0975-08924076	$15.^{m}4$
3	0975-08854635	$15.^{m}1$	0975-08926346	$16.^{m}3$
4	0975-08854985	$15.^{m}9$		

	V1061 Oph S 9630 USNO 0975-08968969	
Comp. No.	GSC/USNO	m*
1	982.1367	$14.^{m}8$
2	982.1923	$14.^{m}9$
3	0975-08970180	$16.^{m}1$

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

Reference:

Hoffmeister, C., 1967, *Astron. Nachr.*, **289**, 205

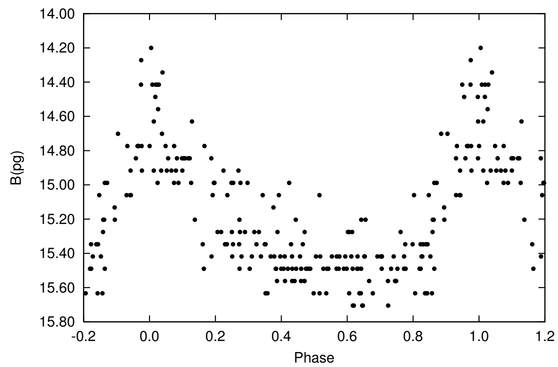

Figure 1. Light curve of V1053 Oph

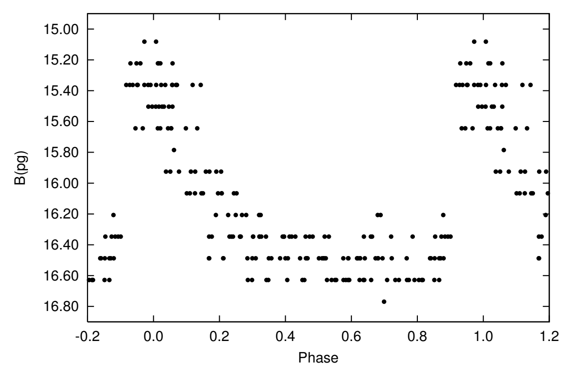

Figure 2. Light curve of V1056 Oph

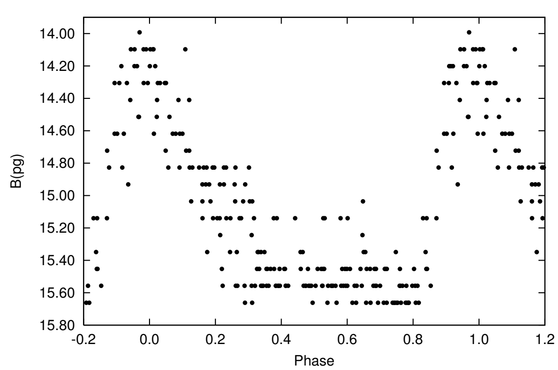

Figure 3. Light curve of V1059 Oph

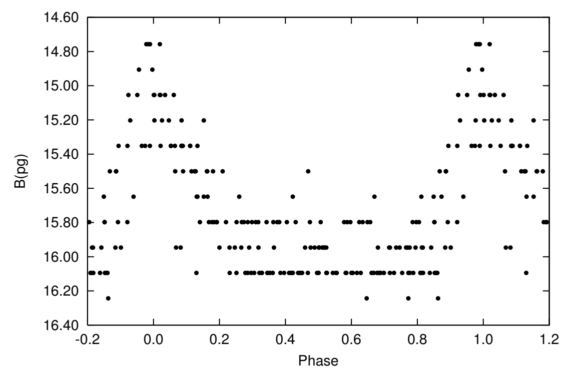

Figure 4. Light curve of V1060 Oph

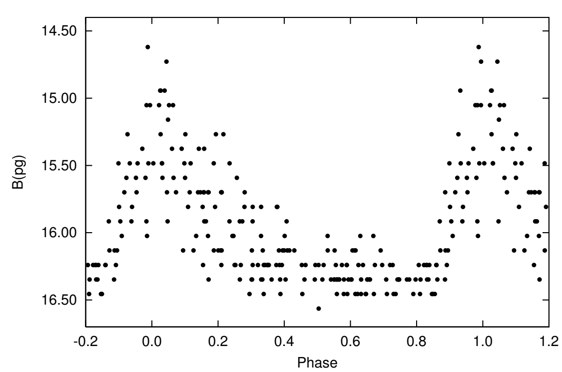

Figure 5. Light curve of V1061 Oph

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GSC 02757-00769 - A NEW EW BINARY SYSTEM

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Name of the object:
GSC 02757-00769 = TYC 2757 769 1

Equatorial coordinates:	**Equinox:**
R.A.= $22^h56^m30\overset{s}{.}899$ **DEC.=** $33°55'12\overset{''}{.}07$	2000

Observatory and telescope:
Piwnice Observatory of the Nicholas Copernicus University, 135 mm f/2.8 semi-automatic CCD camera

Detector:	SBIG ST-7 CCD camera

Filter(s):	SBIG CFW-8 *V*

Date(s) of the observation(s):
2002.09.15 – 2002.12.07

Comparison star(s):	GSC 02757-00477 = SAO 72866 = BD+33°4614 (C1), GSC 02757-01283 = SAO 72860 = BD+33°4612 (C2), GSC 02757-00871 (C3)

Transformed to a standard system:	No

Availability of the data:
Upon request (aniedzi@astri.uni.torun.pl).

Type of variability:	EW

Remarks:

GSC 02757-00769 (TYC 2757 769 1) was found to be variable by Semi-Automatic Variability Search[1] sky survey operating at the Piwnice Observatory. 243 individual photometric measurements were collected during 18 nights between September and December 2002. The obtained light curve, shown in Figure 1, indicates variability of the W Ursae Majoris type.

According to the Guide Star Catalogue (Morrison et al. 2001) GSC 02757-00769 is a 10.03 photographic magnitude star. In the TYCHO-2 Catalogue (Høg et al. 2000) it is recorded as a star of V_T=10$^{\rm m}_{.}$586 with the $(B-V)_T$=0$^{\rm m}_{.}$53. The calculated Johnson V magnitude is V=10$^{\rm m}_{.}$53 and the $(B-V)$=0$^{\rm m}_{.}$49. The 184 epoch photometry data points listed in Tycho are not available because of low quality (F. Ochsenbein - priv.com.)

At the maximum light GSC 02757-00769 reaches m_V=10$^{\rm m}_{.}$50 and varies in brightness with an amplitude of Δm_V=0$^{\rm m}_{.}$24. The secondary minimum seems to be shallower and the maximum following the primary minimum is noticeably fainter. Presented here magnitudes were determined with the differential aperture photometry against comparison stars for which V magnitudes were calculated from TYCHO-2 Catalogue with formula: $V = V_T - 0.090(B_T - V_T)$.

The period search was performed with the ANOVA method of Schwarzenberg-Czerny (1996). The time of the primary minimum was computed with the Kwee-van Woerden method (Kwee, van Woerden 1956). A preliminary ephemeris is following:

$$\begin{array}{rl} \text{Min. I} = \text{HJD } 2452555.49881 + 0^{\rm d}_{.}419195 \times E. \\ \pm 0.00023 \pm 0.000031 \end{array} \quad (1)$$

GSC 02757-00769 is not present in the SIMBAD data base, therefore for proper identification we present a finding chart in Figure 2. The sky image comes from our sky survey and shows a 30′×30′ field centered at the star of interest.

Practically all W UMa stars in the Solar neighborhood are identified as X-ray emitters (Stępień, Schmitt and Voges 2001). It is also the case of GSC 02757-00769. In the angular distance of 8 arcsec from this object there is an X-ray source 1RXS J225630.4+335507. We suggest that GSC 02757-00769 and 1RXS J225630.4+335507 are in fact the same object. Due to positions coincidence we also identify GSC 02757-00769 with the IR source observed within 2MASS survey - 2MASS J2256308+335512.

Acknowledgements:

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

[1]For further information on SAVS see `http://www.astri.uni.torun.pl/~gm/SAVS/`.

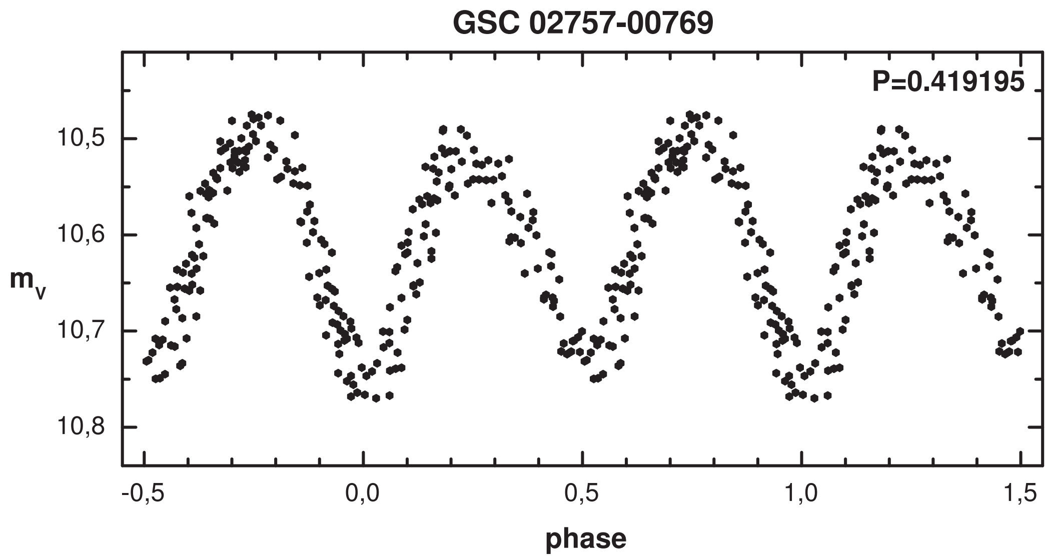

Figure 1. CCD light curve of GSC 02757-00769 obtained in V filter

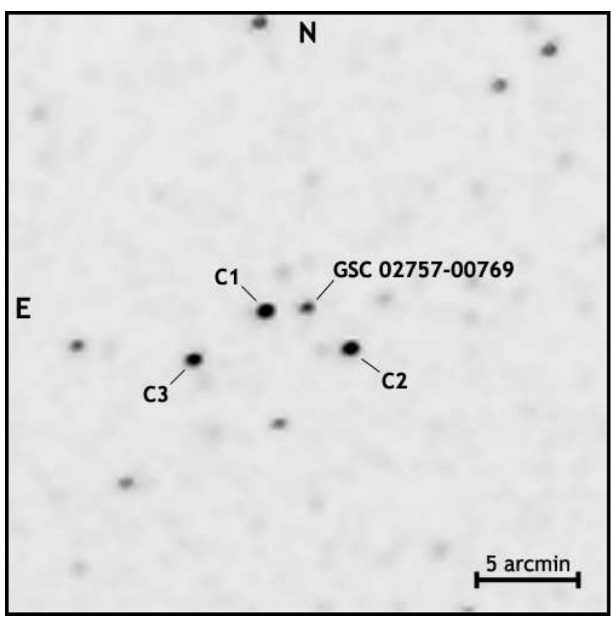

Figure 2. Finding chart for GSC 02757-00769. The field is $30' \times 30'$ wide.

References:

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CCD MINIMA FOR SELECTED ECLIPSING BINARIES IN 2002

NELSON, ROBERT H.

1393, Garvin Street, Prince George, BC, Canada, V2M 3Z1; e-mail: bob.nelson@shaw.ca

Observatory and telescope:
Sylvester Robotic Observatory[1] (SRO): 33 cm f/4.5 Newtonian on Paramount GT-1100s mount.

Detector:	SBIG ST7e, 1″.24 pixels, 15′.8 × 10′.5 FOV, cooled to -10°C < T < -30 °C

Method of data reduction:
Aperture photometry using MIRA, by Axiom Research

Method of minimum determination:
Digital tracing paper method, bisection of chords, curve fitting, and (occasionally) Kwee and van Woerden (1956). See Nelson (2000) for more information.

Observed star(s):

Star Name	GCVS type	J2000 RA*	J2000 Dec	Comp. Star	Epoch − 2400000	Latest Period (d)
RT And	EA/DW/RS	23.1110	53.0133	GSC 3998:2212	52566.7024	0.6289283
WZ And	EB/KE:	1.0143	38.0550	GSC 2799:1170	52513.7977	0.6956630
AB And	EW/KW	23.1132	36.5335	GSC 2763:0735	52559.6322	0.3318910
AD And	EB/DW:	23.3645	48.4016	GSC 3641:0023	52633.6243	0.9862163
BX And	EW/DW:	2.0903	40.4739	GSC 2833:0089	52604.6742	0.6101144
LO And	EW/KW	23.2706	45.3331	GSC 3637:0299	52524.7879	0.3808220
EP And	EW/KW	1.4229	44.4542	GSC 2827:0575	52601.6481	0.4041105
ZZ Aur	EB/KE	5.4542	41.0859	GSC 2915:0220	52633.7473	0.6012168
BF Aur	EB	5.0503	41.1719	GSC 2899:0175	52600.6934	1.5832226
HL Aur	EB/SD	6.1913	49.4207	GSC 3383:0823	52600.8134	0.6225055
KU Aur	EA/SD:	6.2756	30.2323	GSC 2422:0809	52618.8453	1.3195725
WW Cam	EA/DM	4.3125	64.2145	GSC 4073:0510	52528.907	2.2743633
AO Cam	EW/KW	4.2813	53.0245	GSC 3732:1016	52631.7377	0.3299284
BU Cas	EA/DM	1.2841	61.0755	GSC 4031:1639	52619.5771	2.2551969
GT Cas	EA/SD	0.1330	58.1659	GSC 3665:0996	52524.6942	2.9897984
MM Cas	EA/SD	0.5435	54.2636	GSC 3672:0189	52639.5873	1.1584800
MN Cas	EA/DM	1.4203	54.5736	GSC 3675:1855	52493.8614	1.9169249
OX Cas	EA/DM	1.0900	61.2814	GSC 4030:0987	52608.5841	2.4893439
V357 Cas	EB	23.2951	54.5800	GSC 4033:1848	52563.7916	0.7607589
V366 Cas	EW/DW	1.0826	58.4417	GSC 3681:0642	52537.8238	0.7292900
V459 Cas	EA/DM	1.1130	61.0848	GSC 4030:0348	52565.6717	8.4582654

Observed star(s):						
Star Name	GCVS type	J2000 RA*	Dec	Comp. Star	Epoch − 2400000	Latest Period (d)
BE Cep	EW/KW	22.4121	58.3636	GSC 3996:0441	52490.8752	0.4243941
EF Cep	EW	4.4540	80.4426	GSC 4523:0854	52535.812	0.6061075
OT Cep	EA	0.2922	82.1005	GSC 4504:0663	52557.7838	0.4812310
SS Cet	EA/SD	2.4836	1.4827	GSC 0047:0638	52565.8290	2.9739807
XZ CMi	EA	7.5407	3.3854	GSC 0185:1509	52605.9685	0.5788091
V387 Cyg	EW/K:	21.1537	37.2952	GSC 2714:0043	52517.7527	0.6405973
V628 Cyg	EW	21.3404	47.1422	GSC 3595:1315	52538.7802	0.6516518
V700 Cyg	EW/KW	20.3113	38.4741	GSC 3153:0819	52609.5920	0.3400219
V1073 Cyg	EW/KE	21.2500	33.4115	GSC 2711:2412	52569.6317	0.7858582
YY Eri	EW/KW	4.1209	-10.2810	GSC 5315:0565	52550.9432	0.3214990
RW Gem	EA/SD:	6.0128	23.0828	GSC 1864:1888	52619.8506	2.8654963
EY Gem	EB/KE	6.4532	17.1331	GSC 1334:0226	52626.7388	0.9411168
GW Gem	EB/SD	7.5229	27.0916	GSC 1933:0570	52585.8672	0.6594456
DF Hya	EW/KW	8.5502	6.0537	GSC 0225:0943	52600.9568	0.3306063
SW Lac	EW/KW	22.5342	37.5619	GSC 3215:1406	52607.5828	0.3207186
VX Lac	EA/SD	22.4101	38.1920	GSC 3214:1036	52489.8547	1.0745058
VY Lac	EB/KE	22.4959	45.0016	GSC 3227:0195	52482.8311	1.0362311
CM Lac	EA/DM	22.0005	44.3308	GSC 3197:1602	52537.6998	1.6046917
EM Lac	EW/KW	22.2355	54.0108	GSC 3982:1914	52551.6860	0.3891346
SW Lyn	EA/DW	8.0742	41.4802	GSC 2976:1660	52607.8091	0.6440658
FR Ori	EB/SD:	5.5104	9.2633	GSC 0718:0690	52635.7590	0.8831629
BX Peg	EW/KW	21.3853	26.4223	GSC 2197:1871	52546.6670	0.2804186
CC Peg	E	21.3942	28.2455	GSC 2201:0061	52534.7137	0.6056033
RT Per	EA/SD	3.2340	46.3436	GSC 3312:1534	52554.7167	0.8494059
RV Per	EA/SD	4.1038	34.1555	GSC 2366:1876	52547.8658	1.9734905
WY Per	EA/SD	3.3825	42.4041	GSC 2870:1440	52546.8189	3.3270740
XZ Per	EA/SD	4.0928	46.3358	GSC 3328:1131	52555.8134	1.1516284
V432 Per	EW/KW	3.1011	42.5210	GSC 2855:0585	52516.9010	0.3833116
V449 Per	EA/KE	2.5733	35.1401	GSC 2334:0150	52517.9391	0.9462100
V579 Per	EW?	3.3912	41.1658	GSC 2870:2649	52559.7957	0.4656232
UV Psc	EA/D:/RS	1.1655	6.4842	GSC 0026:0669	52607.6729	0.8610407
RZ Tau	EW/KW	4.3638	18.4518	GSC 1270:0877	52551.941	0.4156706
CU Tau	EW/KW	3.4737	25.2313	GSC 1804:2270	52551.8458	0.4122054
EQ Tau	EW/KW	3.4813	22.1922	GSC 1260:0575	52608.6852	0.3413479
V781 Tau	EW/KW	5.5013	26.5743	GSC 1870:0514	52554.9210	0.3449080
V Tri	EB/SD	1.3147	30.2202	GSC 2293:1331	52528.7718	0.5852056
RV Tri	EA/SD	2.1318	37.0101	GSC 2321:1715	52548.734	0.7536616
XY UMa	EB/DW/RS	9.0956	54.2917	GSC 3805:0479	52559.9583	0.4789863

* RA values are in the format HH.MMSS, Dec in DD.MMSS. 'G' stands for 'GSC'.

Source(s) of the ephemeris:
$O-C$ charts using all available published times of minima. See 'Bob Nelson's $O-C$ Files' in the references. The epochs above are the latest and best times of minima (which usually coincide with the times newly reported here).

Times of minima:						
Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
RT And	52566.7024	0.0002	s	V	–	
WZ And	52513.7977	0.0002	s	clear	–	
AB And	52559.6322	0.0002	s	R	–	
AD And	52633.6243	0.0003	p	clear	–	
BX And	52604.6742	0.0001	p	I	–	
LO And	52524.7879	0.0001	s	clear	–	
EP And	52601.6481	0.0001	s	clear	–	

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
ZZ Aur	52633.7473	0.0001	p	clear	–	
BF Aur	52600.6934	0.0005	P	clear	–	
HL Aur	52600.8134	0.0002	p	clear	–	
HL Aur	52635.6739	0.0001	p	clear	–	
KU Aur	52618.8453	0.0003	p	clear	–	C-K slope
WW Cam	52528.907	0.002	p	clear	–	
AO Cam	52631.7377	0.0001	p	clear	–	
BU Cas	52619.5771	0.0001	p	clear	–	
GT Cas	52524.6942	0.0004	p	clear	–	
MM Cas	52639.5873	0.0002	p	clear	–	
MN Cas	52493.8614	0.0003	p	clear	–	
OX Cas	52608.5841	0.0004	p	clear	–	
V357 Cas	52563.7916	0.0004	s	clear	–	
V366 Cas	52537.8238	0.0003	s	clear	–	
V459 Cas	52565.6717	0.00005	p	clear	–	
BE Cep	52490.8752	0.00005	s	clear	–	
EF Cep	52535.812	0.001	s	clear	–	
OT Cep	52557.7838	0.0002	p	clear	–	
SS Cet	52565.8290	0.0003	p	clear	–	
XZ CMi	52605.9685	0.0001	p	clear	–	
V387 Cyg	52517.7527	0.0001	p	clear	–	
V628 Cyg	52538.7802	0.0001	p	clear	–	
V700 Cyg	52609.5920	0.0003	p	clear	–	
V1073 Cyg	52569.6317	0.0002	p	V	–	
YY Eri	52550.9432	0.0001	s	V	–	
YY Eri	52619.7447	0.0002	s	V	–	
RW Gem	52619.8506	0.0001	p	clear	–	
EY Gem	52626.7397	0.0003	p	clear	–	C-K slope
GW Gem	52585.8672	0.0003	p	clear	–	
DF Hya	52600.9568	0.0002	s?	clear	–	
SW Lac	52607.5828	0.0001	p	I	–	
VX Lac	52489.8547	0.00003	p	clear	–	
VY Lac	52482.8311	0.0002	p	clear	–	C-K slope
CM Lac	52537.6998	0.0001	p	V	–	
EM Lac	52551.6860	0.0001	p	clear	–	
SW Lyn	52607.8091	0.0001	p	V	–	
FR Ori	52635.7585	0.0005	p	clear	–	C-K slope
BX Peg	52546.6670	0.00005	s	clear	–	
CC Peg	52534.7137	0.0003	s	clear	–	
RT Per	52554.7167	0.0001	p	clear	–	
RV Per	52547.8658	0.0005	p	clear	–	
WY Per	52546.8189	0.00008	p	clear	–	
XZ Per	52555.8134	0.00005	p	clear	–	
V432 Per	52516.9010	0.00004	p	clear	–	
V432 Per	52550.8236	0.0004	s	clear	–	
V449 Per	52517.9391	0.0004	p	clear	–	
V579 Per	52559.7957	0.0005	p	V	–	
UV Psc	52607.6729	0.0001	p	clear	–	
RZ Tau	52551.941	0.001	p	clear	–	
CU Tau	52551.8458	0.0001	p	clear	–	
EQ Tau	52608.6852	0.0002	p	clear	–	
V781 Tau	52554.9210	0.0003	p	V	–	
V Tri	52528.7718	0.0002	s	clear	–	
V Tri	52547.792	0.001	p	clear	–	
V Tri	52554.8155	0.0001	p	clear	–	
RV Tri	52548.734	0.001	p	clear	–	
XY UMa	52559.9583	0.0001	p	clear	–	

Explanation of the remarks in the table:
'C-K slope' refers to a change in the C-K plot of 0.01 magnitudes or greater over the observing run. See below.

Remarks:
In the case of bright stars, V, R or I filters were used to maintain the same exposures (of 1-5 minutes) which were required for low random errors. Check stars (K1, K2, ...) were used for all program stars in addition to the comparison (C). However, for some, the plot of comparison-check (C-K) magnitude difference versus time revealed a disturbing change of 0.01 - 0.02 magnitudes over a time span of 0.05 - 0.08 days. Further analysis of one of the stars, FR Ori, revealed that check stars having nearly equal airmasses gave a check2-check1 (i.e, K2-K1) plot versus time constant to within 0.004 (2) magnitudes whereas a third check star (K3) having a line of centres with K1 perpendicular to the horizon gave K3-K1 changes of 0.023 (3) magnitudes. Since the C-V (variable) line was also perpendicular to the horizon, a tentative correction was applied to the light curve resulting in a disturbing 0.00055 day shift in the time of minimum. This calls into question the accuracy with which some times of minima are reported, here and elsewhere. (For now, no corrections are included in any of the times reported here.) Further discussion and analysis will be presented in a future IBVS note.

Acknowledgements:
Thanks are due to Environment Canada for the website satellite images (see below) that were essential in predicting clear times for observing runs in this cloudy locale. Thanks are also due to Attilla Danko for his Clear Sky Clocks, (see below). Much use was made of the Eclipsing Binary Ephemeris Generator; thanks Shawn. The author is also a Guest User of the Canadian Astronomy Data Centre, which is operated by the Dominion Astrophysical Observatory for the National Research Council of Canada's Herzberg Institute of Astrophysics.

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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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NEW TIMES OF MINIMA OF ECLIPSING BINARY SYSTEMS

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Observatory and telescope:
50-cm $f/8.4$ Ritchey–Chrétien telescope of the Baja Astronomical Observatory, Hungary (BA50) 40-cm Cassegrain telescope of the TUBITAK National Observatory, Turkey (TUG40) 30-cm Cassegrain telescope of Ege University Observatory, Turkey (EGE30)

Detector:	Hamamatsu, R 4457 PMT at TUBITAK National Observatory Hamamatsu, R 4457 PMT at Ege University Observatory Apogee Ap-7 SiTE 502B CCD at Baja Astronomical Observatory

Method of data reduction:
Reduction of the CCD frames was made with a customly developed IRAF† package.

Method of minimum determination:
The minima times were computed with parabolic fitting, and in some cases with linearized Pogson-method or Kwee-van Woerden method (Kwee & van Woerden, 1956).

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
V397 Cep	EA	00 03 24	+73 10 28	BD+72° 1135	48501.1800	2.08684	1
V442 Cyg	EA	20 27 52	+30 47 28	GSC 2685-1364	44919.561	2.3859437	2
MR Del	EA	20 31 13	+05 13 09	HD 195235	51744.37964	0.52168929	3
V401 Lac	EA	22 08 21	+49 13 16	BD+48° 3613	48501.7900	1.95010	1
V402 Lac	EA	22 09 15	+44 50 47	GSC 3210-1215	48500.980	3.7820	1
V1123 Tau	EB	03 34 59	+17 42 38	GSC 1238-0661	48500.3570	0.399957	1
V1128 Tau	EB	03 49 28	+12 54 44	GSC 0664-1304	48500.0620	0.3053732	1

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

Source(s) of the ephemeris:
1. ESA, 1997
2. Lacy and Frueh, 1987
3. Soydugan et al., 2002

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
V397 Cep	51727.4294	12	I	U,B,V	−0.0052	TUG40
	51747.4065	8	II	U,B,V	0.1469	TUG40
	51752.471	1	I	–	−0.006	Bor+SzI/BA50
	51800.4655	2	I	–	−0.0085	Bír/BA50
	51843.4053	1	II	–	0.1510	Bor/BA50
	51845.48217	1	II	–	0.14107	Bír/BA50
	51850.5486	17	I	U,B,V	−0.0096	TUG40
V442 Cyg	51780.3424	2	II	–	0.0003	Bor/BA50
MR Del	51739.4231	16	II	B,V,R	−0.0005	TUG40
	51744.3804	8	I	B,V,R	0.0008	TUG40
	51781.4196	4	I	–	0.0000	Bor/BA50
	51822.3719	4	II	–	−0.0003	Bír/BA50
	52130.4291	9	I	B,V,R	−0.0006	EGE30
	52135.3863	8	II	B,V,R	0.0005	EGE30
V401 Lac	51842.3465	2	I	–	0.0035	Bír/BA50
V402 Lac	51839.3033	1	II	–	0.7083	Bír/BA50
V1123 Tau	51832.5518	5	II	–	−0.0470	Bír/BA50
	51837.3523	5	II	–	−0.0459	Bor/BA50
	51877.5481	1	I	–	−0.0458	Heg/BA50
V1128 Tau	51822.5237	2	I	–	0.0013	Bír/BA50
	51830.4633	4	I	–	0.0012	Bír/BA50
	51830.6165	4	II	–	0.0017	Bír/BA50

Explanation of the remarks in the table:
Observer(s) (only at Baja Observatory)/Instrument

Acknowledgements:

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A LONG-TERM PHOTOMETRIC STUDY OF THE PMS STAR V391 Cep

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V391 Cep is a pre-main sequence (PMS) star located in the dark clouds northwest of the emission nebula NGC 7129. The star was discovered as a strong H_α emission source in our objective prism survey (Semkov and Tsvetkov 1986). Our photographic photometry (Semkov 1993a) suggests that the star is irregular variable with amplitude of about 2 magnitudes. The optical spectrum of V391 Cep obtained in 1992 (Semkov 1993b) shows the main spectral characteristics of the Classical T Tauri stars (CTTs). The star is surrounded with a small cometary nebula seen on deep red and infrared images. V391 Cep is also included in the list of H_α emission stars (No 71) published by Kun (1998). The position of the star (J2000.0) in the Aladin Sky Atlas is R.A. = $21^{\mathrm{h}}40^{\mathrm{m}}27\overset{\mathrm{s}}{.}62$ and Dec = $66^\circ35'22\overset{''}{.}2$.

The CCD photometric data presented in this paper are the continuation of our photographic investigation of V391 Cep (Semkov 1993a). Observations were made with three telescopes: the 2-m RCC and 50/70/172 cm Schmidt telescopes of the National Astronomical Observatory Rozhen (Bulgaria) and 1.3-m RC telescope of the Skinakas Observatory[1] of the Institute of Astronomy, University of Crete (Greece). The first CCD observations of V391 Cep in the period 1993-1996 ware made with SBIG ST6 camera attached to the 2-m RCC telescope. Since 1997 Photometrics CCD cameras with 2-m RCC and 1.3-m RC telescopes and SBIG ST8 camera with 50/70 cm Schmidt telescope were used. The technical parameters and chip specifications for used cameras are summarized in Table 1. The typical exposure times are 60-120 sec for R_C and I_C, 120-180 sec for V and 300 sec for B and U filters. All frames ware taken through a standard Johnson-Cousins set of filters. All frames obtained with Photometrics cameras are bias subtracted and flat fielded. CCD frames obtained with ST6 and ST8 cameras are dark subtracted and flat fielded. Aperture photometry was performed using IDL based DAOPHOT routines.

In order to facilitate transformation from instrumental measurements to the standard system a sequence of seven comparison stars in the field of V391 Cep was calibrated in $UBVR_CI_C$ bands. Calibration was made during seven clear nights, four with 1.3-m RC telescope and three with 2-m RCC telescope. Standard stars from Landolt (1992) were used as reference. At least six standard fields in different air masses were observed every night. Table 2 contains the measured $UBVR_CI_C$ magnitudes and corresponding mean errors of the mean for comparison sequence. The stars are labeled from A to G in order

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

of their V-band magnitude. The standards ranging from V=12$^{\rm m}_{.}$730 to V=16$^{\rm m}_{.}$691 and from $B-V$=0$^{\rm m}_{.}$632 to $B-V$=1$^{\rm m}_{.}$349. The finding chart of the comparison sequence is presented in Fig. 1. The field is $6' \times 6'$, centered on V391 Cep. North is at the top and east to the left. The chart is retrieved from the STScI Digitized Sky Survey Second Generation Red.

Table 1: CCD cameras and chip specifications

Telescope	2-m RCC	2-m RCC	1.3-m RC	50/70 cm Scm
CCD type:	ST-6	AT200	CH360	ST-8
Chip:	TC-241	SITe SI003AB	SITe SI003B	KAF 1602E
Size:	375 × 242	1024 × 1024	1024 × 1024	1530 × 1020
Pixel size:	23 × 27 μm	24 × 24 μm	24 × 24 μm	9 × 9 μm
Scale:	$0''_{.}30 \times 0''_{.}34$/pixel	$0''_{.}33$/pixel	$0''_{.}5$/pixel	$1''_{.}1$/pixel
Field:	$1'_{.}5 \times 2'_{.}0$	$5'_{.}6 \times 5'_{.}6$	$8'_{.}5 \times 8'_{.}5$	$28' \times 18'_{.}7$
Gain:	6.7e^-/ADU	4.93e^-/ADU	5.3e^-/ADU	2.3e^-/ADU
RON:	3.1ADU/rms	3.9ADU/rms	2.6ADU/rms	6.2ADU/rms

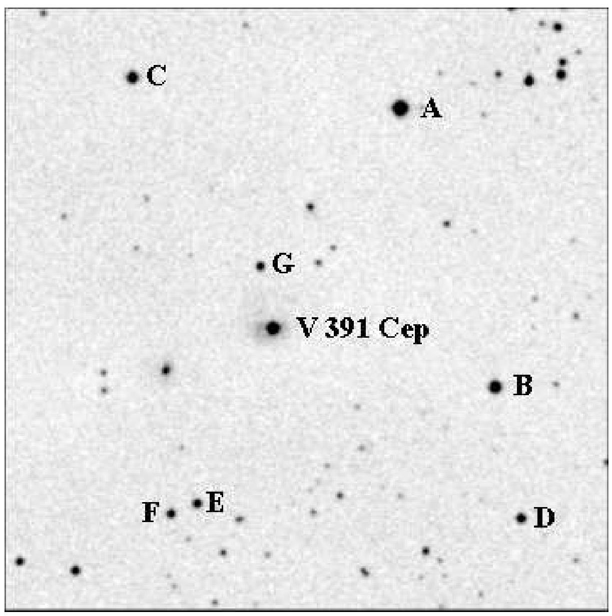

Figure 1. A finding chart of the comparison sequence in the field of V391 Cep

The results from our CCD photometric observations are given in Table 3. The table contains Date, Julian Date, V magnitude, $U-B$, $B-V$, $V-R_C$ and $V-I_C$ indices and telescope used. Fig. 2 shows the long-term B-band light curve of V391 Cep in the whole period of observations (1984-2002). In the figure the filled circles denote our photographic observations (Semkov 1993a) and the open circles denote CCD photometric data from this paper. A considerable change of the amplitude of brightness of V391 Cep is seen from Fig. 2. Since 1986 the amplitude of brightness (B-band) decrease gradually from 2$^{\rm m}_{.}$1 to 0$^{\rm m}_{.}$3 at the present time. It is generally accepted that CTTs are surrounded with an

Table 2: Photometric data for $UBVR_CI_C$ comparison sequence.

Star	V	σ_V	I_C	σ_I	R_C	σ_R	B	σ_B	U	σ_U
A	12.730	.029	11.980	.025	12.358	.027	13.429	.076	13.676	.045
B	14.089	.021	13.348	.034	13.728	.015	14.721	.054	14.856	.064
C	14.500	.037	13.643	.032	14.057	.026	15.339	.052	15.708	.028
D	15.721	.019	14.697	.035	15.189	.048	16.722	.033	17.487	.098
E	16.272	.022	14.780	.040	15.539	.015	17.555	.028	–	–
F	16.429	.014	14.903	.036	15.703	.016	17.626	.072	–	–
G	16.691	.037	15.142	.042	15.881	.048	18.040	.038	18.377	.112

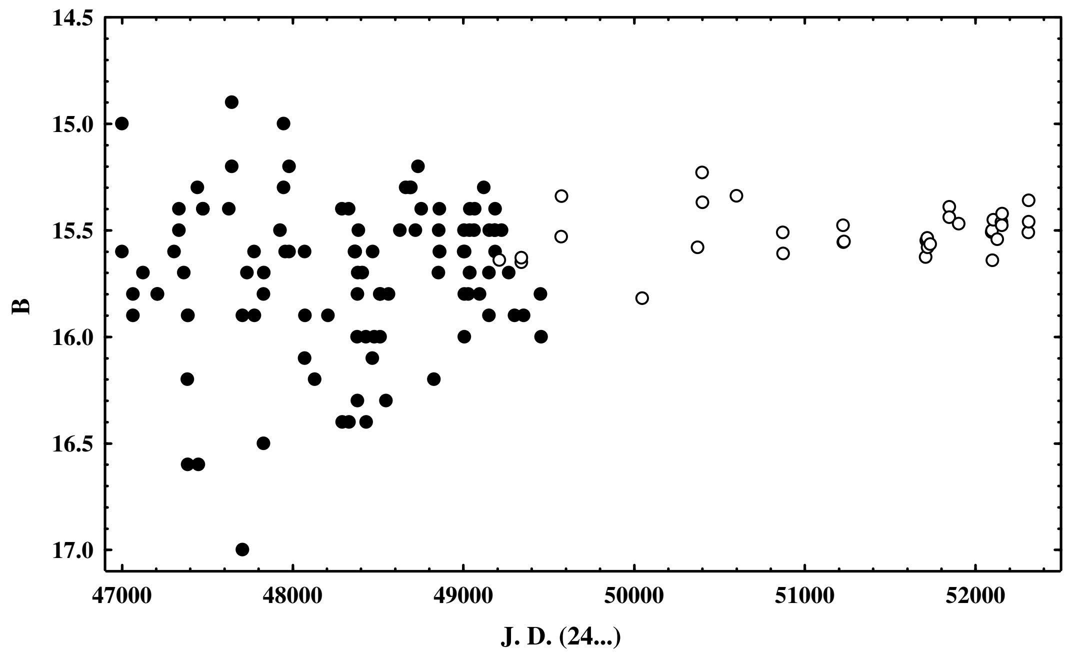

Figure 2. B-band light curve of V391 Cep in the period 1984-2002

extended circumstellar disks and such change in activity of V391 Cep can be caused by an irregular accretion rate.

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Table 3: Photometric observations of V391 Cep in the period August 1993 - February 2002

Date	J.D. (24...)	V	$U-B$	$B-V$	$V-R_C$	$V-I_C$	Tel.
12.08.1993	49212.425	14.34	–	1.30	0.85	–	2m
13.08.1993	49213.378	14.38	–	–	–	–	2m
14.08.1993	49214.369	14.33	–	–	–	–	2m
18.12.1993	49340.322	14.39	–	1.26	0.86	1.82	2m
19.12.1993	49341.267	14.41	–	1.22	0.81	1.69	2m
7.08.1994	49572.398	14.53	–	–	0.98	1.83	2m
8.08.1994	49573.435	14.42	–	1.11	0.97	1.79	2m
10.08.1994	49575.436	14.21	–	1.13	0.88	1.70	2m
26.11.1995	50048.420	14.56	–	1.26	0.95	1.80	2m
15.10.1996	50372.418	14.34	–	1.24	0.82	1.58	2m
11.11.1996	50399.405	14.17	–	1.06	0.85	1.53	2m
13.11.1996	50401.369	14.32	–	1.05	0.95	1.57	2m
2.06.1997	50601.539	14.120	–	1.219	0.823	1.685	2m
28.02.1998	50872.590	14.301	−0.110	1.209	0.850	1.779	2m
1.03.1998	50873.598	14.357	−0.080	1.253	0.870	1.784	2m
4.03.1998	50876.635	14.285	–	–	–	–	2m
16.02.1999	51225.621	14.255	−0.060	1.222	0.878	1.796	2m
17.02.1999	51226.577	14.363	−0.050	1.193	0.873	1.787	2m
21.02.1999	51230.592	14.339	–	1.215	0.858	1.750	2m
8.03.2000	51611.655	14.374	–	–	–	–	2m
13.06.2000	51709.485	14.407	−0.286	1.220	0.845	1.767	1.3m
14.06.2000	51710.497	14.314	–	–	0.825	1.704	1.3m
15.06.2000	51711.493	14.313	–	–	–	1.705	1.3m
16.06.2000	51712.490	14.349	–	1.200	–	1.736	1.3m
21.06.2000	51716.512	14.374	–	1.178	–	1.749	1.3m
21.06.2000	51717.392	14.366	–	–	–	1.804	1.3m
22.06.2000	51718.449	14.372	–	1.174	0.849	1.727	1.3m
23.06.2000	51719.448	14.346	–	1.191	0.837	–	1.3m
24.06.2000	51720.384	14.382	–	1.198	–	1.729	1.3m
11.07.2000	51736.507	14.363	−0.283	1.203	0.843	1.731	1.3m
29.10.2000	51847.379	14.23	–	1.16	0.80	1.77	Scm
30.10.2000	51848.419	14.30	–	1.14	0.84	1.81	Scm
24.12.2000	51903.287	14.33	–	1.14	0.82	1.80	Scm
27.05.2001	52057.492	14.22	–	–	–	1.72	Scm
5.07.2001	52095.559	14.307	−0.258	1.202	0.837	1.709	1.3m
6.07.2001	52097.298	14.325	–	1.176	–	1.730	1.3m
8.07.2001	52099.293	14.386	–	1.255	–	1.751	1.3m
16.07.2001	52106.536	14.287	–	1.164	–	1.706	1.3m
7.08.2001	52128.528	14.322	–	1.220	–	1.737	1.3m
1.09.2001	52153.592	14.303	–	1.159	–	–	1.3m
2.09.2001	52154.575	14.327	–	1.150	–	1.762	1.3m
5.09.2001	52157.546	14.287	–	1.136	–	1.770	1.3m
5.02.2002	52311.261	14.30	–	1.21	0.85	1.82	Scm
6.02.2002	52312.259	14.21	–	1.15	0.82	1.79	Scm
7.02.2002	52313.247	14.29	–	1.17	0.84	1.81	Scm

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LONG-TERM BEHAVIOR OF Hα EMISSION IN BU Tau

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One approach to better understand Be stars is to provide systematic, frequent, long-term monitoring of the magnitudes and spectra of these objects. This is something that amateur astronomers can do. Those who are equipped with appropriate spectrographs and who can systematically observe these stars over years can supply information about changes in Hα equivalent width (EW). In this note, I report my spectroscopic observations of the Hα emission line in BU Tau (Pleione, 28 Tau) measured in units of EW. Hα emission was first detected in BU Tau by E. C. Pickering in 1890. Hirata (1995) describes the range of research on this interesting object in an excellent survey.

For all but two observations of BU Tau, I used the 200 mm Schmidt-Cassegrain telescope at the Cologne Stargazer's Association Observatory in the mountains of Odenthal, Germany (latitude: 51°02′, longitude: 7°15′). My spectrograph with diffraction grating has a dispersion of 0.39 Å/pixel and a wavelength range of 6400Å to 6700Å. The detector is a Kodak KAF400 sensor with 768×512 pixels. Pixels are 9×9 micrometers. The resolving power is R=10.000. This telescope and instrument serve my extensive Be star monitoring program. For observations on JD 2450840 and JD 2451165, I used a Maksutov objective prism spectrograph that has f=1.000 mm, a flint glass prism with 30-degree breaking angle, and a dispersion of 5.6 Å/pixel. Its resolving power is R=1.500. CCD frames containing spectra were processed with standard techniques, and Hα emission line EW's were measured in Richard Gray's program, `MK32`.

The variations of the spectrum of BU Tau, from 1938 to 1975, have been described in detail by Gulliver (1977) who give a well documented bibliography of the star. I did not observe the development of absorption lines for singly ionized elements in BU Tau such as appeared in the spectrum of 88 Her in 1959, as Balmer emission decreased. Figure 1 shows Hα behavior from JD 2440601 to JD 24526648 (1970 to 2003). This includes observations by Hirata (1995), Klotz (2003), Slettebak and Reynolds (1978), Andrillat and Fehrenbach (1982), Fontaine et al. (1982), Sharov, Lyutyi, and Esipov (1994), Menchenkova and Luthardt (1993), and Ojha and Joshi (1991). My observations cover the period JD 2450840 to JD 2452648. A minimum of about 2Å occurred in emission strength near JD 2441584, while a maximum of 41Å was achieved about JD 2450840. Hirata (1995) describes the overall increase in EW as an effect of an active Be phase. Given this condition, interesting, brief decreases in EW occurred at JD 2445187 and JD 2449367 in route to maximum.

My measurements began when the intensity of Hα was near maximum. Immediately following, however, came a very steep descent to a brief minimum of about 5Å. Harmanec

(1993) interprets the steep rise that was first observed on JD 2451850 as evidence for a new Be phase. Figures 2a and 2b compare line profiles as observed at different times with the two spectrographs. The table lists my individual measurements of EW, FWHM (full width half maximum) and peak intensity for Hα emission.

Table 1

HJD	EW [Å]	FWHM [Å]	Intensity F/Fc
2450840.315*	41	20.1	2.89
2451165.377*	37	21	2.55
2451586.363	5	4	1.28
2451852.439	14	5.6	3.01
2451873.481	21	7.1	3.95
2451923.314	31	7	5.45
2452618.356	28	7.2	5.7
2452649.365	27	7.3	5.21

*: Objective prism spectra (dispersion=5.6 Å/pixel).

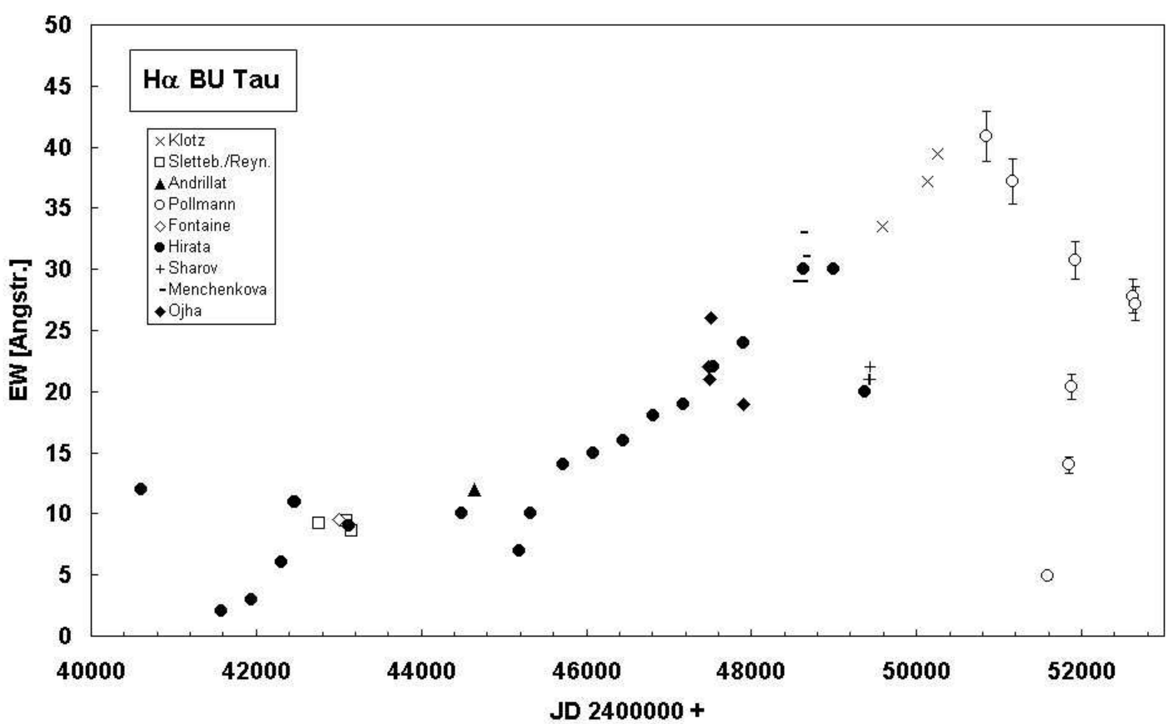

Figure 1. Changing Hα intensity in BU Tau over 33 years as measured by several observers.

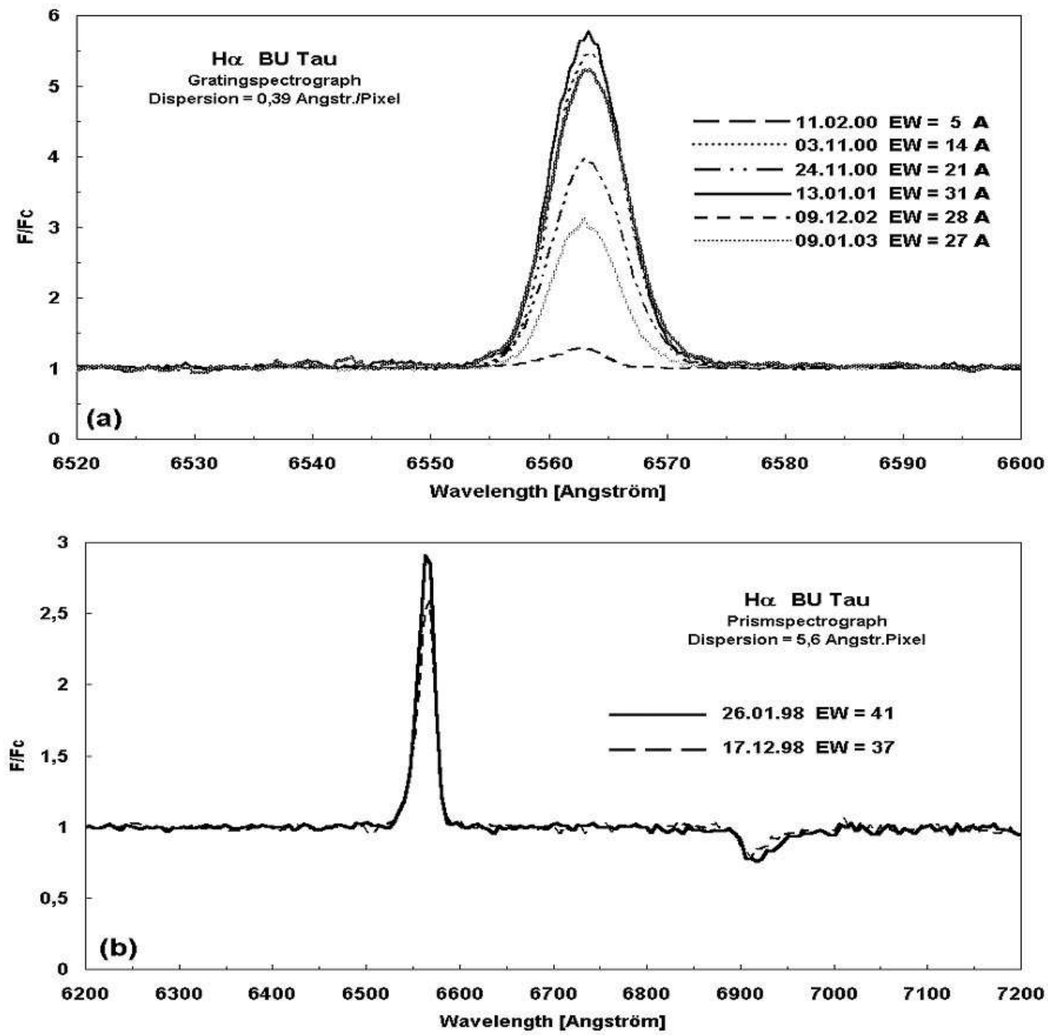

Figure 2. Comparison of Hα emission line profiles in BU Tau from JD 2450840 to JD 2452648 with results from the grating spectrograph and the objective prism spectrograph shown in 2a and 2b, respectively.

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SPECTROSCOPIC BINARIES IN THE OPEN CLUSTER TRUMPLER 16 REVISITED

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The open cluster Trumpler 16 is near the Carina nebula (NGC 3372). There is a large amount of literature on the clusters in this region. The spectral morphology of members of Trumpler 16 has been studied by Levato & Malaroda (1982) and references therein. The cluster's distance has been determined using different methods, and there is an agreement that it is around 3.5 kpc. This value obviously depends on the interstellar absorption which may be abnormal for this cluster. Trumpler 16 is a rich cluster with a large variety of objects like WR stars, O3 stars, spectroscopic binaries and η Carinae. The age estimated for Trumpler 16 is approximately 10^7 years (Massey & Johnson, 1993).

The study of spectroscopic binary systems is needed to tackle a classic problem in astronomy: the stellar mass determination. A good knowledge of mass for individual stars allows the calibration with other stellar parameters which are most easily observable, and also permits to test current stellar evolution theories. Spectroscopic binaries in open clusters are important in yet another context. It has been proposed that the average projected rotational velocity of the stars in an open cluster depends on its content of close spectroscopic binaries and chemically peculiar magnetic stars (Abt & Sanders, 1973). Both tidal and magnetic braking are responsible for reducing the rotation. (Levato et al., 1987; Abt et al., 1973)

We used the Jorge Sahade-2.1m Telescope at CASLEO, San Juan, Argentina. A REOSC echelle spectrograph was employed during the following nights: February 27th 1996, from April 21st to 23rd 2000 and from March 10th to 11th 2001. The spectra centered on the blue wavelength region were recorded on a TEK1024 CCD and the resolution was 0.14 Å/pixel. The usual flat-fields and bias frames were obtained each night and the wavelength calibration was done using a Th-Ar lamp. The reduction was made with the standard procedure, using IRAF[1]

We have selected five stars for this project, that are probable members of Trumpler 16, suggested by Levato et al. (1991). Three of them were chosen because the number of available radial velocity measurements was smaller than ten, and the other two because the authors considered them radial velocity variables. To derive the radial velocities we have measured the Doppler shifts of H, He I, He II, Si IV, C IV, N III, C III lines. (Walborn et al. 2000), and applied heliocentric correction to the measurements. The observational results for the three stars for which we have recalculated the orbits are given in Table 1,

[1]IRAF is distributed by the National Optical Astronomy Observatories, operated by AURA, Inc., under cooperative agreement with the NSF.

where we have indicated in successive columns the Julian Date, the average radial velocity for each spectra, the number of lines measured, and the probable errors. The stars are identified by their HD number or Feinstein, Marraco and Muzzio (1973) numbers.

Table 1: Radial Velocity Observations

Identification	Julian Date	RV (Km/s)	n n	P.E. (Km/s)
	2450141.73	−85.39	6	2.0
	2451656.52	18.46	7	6.2
#112	2451657.52	54.45	8	5.8
	2451657.61	50.24	7	7.0
	2451658.57	−30.15	8	10.7
	2451979.76	−76.7	9	11.5
	2451979.78	−118.91	4	15.5
HD 93161	2451979.79	−91.11	12	8.6
	2451980.61	−105.69	6	8.8
	2451980.65	−96.64	8	12.3
	2451980.77	−97.58	10	9.8
	2451979.74	−181.2	7	6.1
	2451979.77	−174.7	7	12.2
#104	2451980.57	−19.7	7	5.8
	2451980.63	2.3	5	10.3
	2451980.74	109.2	7	18.6
	2451980.79	123.4	6	25.6

We have added the new observations presented in Table 1 to those published by Levato et al. (1991) and searched for periods, using Morbey's code (Morbey, 1978) and, when successful, computed orbital elements starting from the results from Levato et al. (1991) improving them with the code of Bertiau & Grobben (1969).

For HD 93161, #112 and #114 stars, we found new orbital parameters, while for #10 and #110, we could not find any significant evidence of variability. We have applied an analysis of variance test (Conti et al., 1977) which confirms that the distribution of the observations for stars #110 and #10 does not depart significantly from a random one. The new orbital elements for stars HD 93161, #112, and #114 are shown in Table 2.

Table 2: Orbital Elements obtained in this work

Element	HD 93161	#104	#112
a sin **i** (km)	3.72×10^6	4.03×10^6	3.67×10^6
K (km/s)	50.9±5.1	162.8±11.4	86.0±4
e	0.309±0.116	0.156±0.057	0.249±0.026
$\omega(^\circ)$	184.4±17.8	85.7±28.4	286.6±8.8
$\mathbf{T_0}$ (J.D.) (2.400.000+)	45778.39±0.22	45779.37±0.13	45773.02±0.1
P (days)	$5.60486\pm9\times10^{-5}$	$1.82303\pm1\times10^{-5}$	$4.07997\pm2\times10^{-5}$
$\mathbf{V_0}$ (km/s)	−44.5±3.4	−32.7±7.5	−19.1±1.7
Mass Function	0.06±0.03	0.78±0.18	0.24±0.02

Figures 1, 2 and 3 show the radial velocity curves for #104, #112 and HD 93161, respectively.

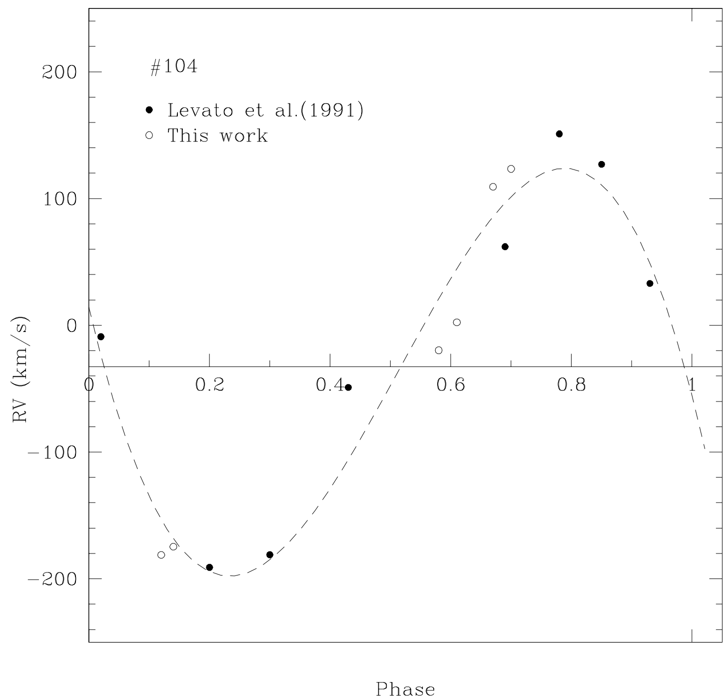

Figure 1. Radial velocity curve of #104

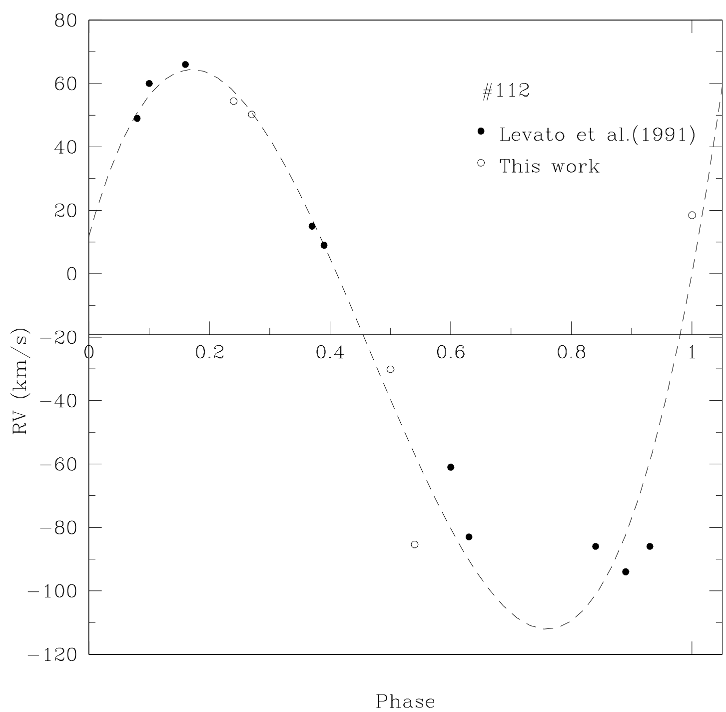

Figure 2. Radial velocity curve of #112

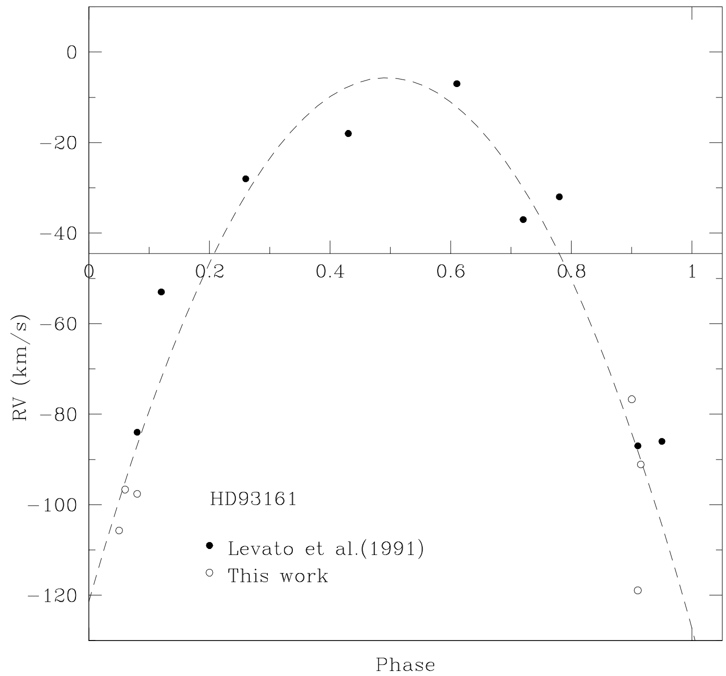

Figure 3. Radial velocity curve of HD 93161

Summarizing, we have recalculated new orbital elements for three spectroscopic binary systems which belong to the open cluster Trumpler 16 and obtained the mass function for these three systems. We could not find significant radial velocity variations for #110 and #10 of the same cluster.

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IW And IS A Z Cam-TYPE DWARF NOVA

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IW And (S 10792) is a blue variable discovered by Meinunger (1975). Meinunger (1980) studied the object spectroscopically and described that the object seems to be a unique object: in spite of broad absorption lines of Hβ, Hγ and Hδ resembling those of an O or early B dwarf or subdwarf, the spectrum was found to be featureless around Hα. Meinunger (1980) further stated that a couple of doubtful emission lines at the limit of detectability seem to be present. From 330 observations for the period JD 2440802–46706, Meinunger and Andronov (1987) found that 72% of the observations are in the inactive state (15.1–15.3) of the star. The object infrequently showed maximum brightness (18% of time, 13.7–15.0 mag) and minimum brightness (10% of time, 15.4–17.3 mag). Meinunger and Andronov (1987) stated that such behavior is significantly different from those of dwarf novae or polars. More recently, Liu et al. (1999) obtained a higher quality spectrum, and detected Hα emission line with broad absorption troughs. Although Liu et al. (1999) classified the object as a confirmed cataclysmic variable, the exact nature of the object has not been evident owing to the lack of dense photometric observations.

We observed IW And on 55 nights between 2001 December 6 and 2002 March 25. The observations were done using an unfiltered ST-7E camera (system close to R_c) attached to the Meade 25-cm Schmidt-Cassegrain telescope. The exposure time was 30 s. The images were dark-subtracted, flat-fielded, and analysed using the Java^{TM}-based PSF photometry package developed by one of the authors (TK). The differential magnitudes of the variable were measured against GSC 2811.1573 (Tycho-2 V-magnitude 12.05, $B-V$=0$^{m}_{.}$11), whose long-term constancy was confirmed to 0.10 mag by comparison with GSC 2811.2117 (Tycho-2 V-magnitude 11.57, $B-V$=0$^{m}_{.}$69). The log of observations is summarized in Table 1.

The resultant light curve is shown in Fig. 1. The light curve clearly shows oscillations at the beginning of the observation. After that, the object entered a standstill. The behavior is quite characteristic to a Z Cam-type dwarf nova entering a standstill (Szkody and Mattei 1984; Honeycutt et al. 1998; Oppenheimer et al. 1998; Kato 2001). There was even a small hint of small-amplitude oscillations during the early part of the standstill which are quite analogous to those of Z Cam (Kato 2001) and HX Peg (Honeycutt et al. 1998). The last observation may indicate that the object was caught during an outburst from the standstill. The present observations establish that IW And is a previously

Table 1. Nightly averaged magnitudes of IW And

Mid-JD[a]	Mean mag[b]	Error[c]	N[d]	Mid-JD[a]	Mean mag[b]	Error[c]	N[d]
52250.1090	2.224	0.005	31	52305.8840	2.794	0.014	31
52250.9993	1.973	0.006	31	52306.8847	2.721	0.017	31
52252.1208	1.967	0.007	31	52309.9958	2.675	0.037	10
52255.1118	2.215	0.017	31	52311.8993	2.846	0.024	31
52255.9875	2.325	0.043	12	52312.8972	2.786	0.030	31
52257.0632	2.688	0.044	31	52316.9007	2.675	0.010	31
52257.9840	3.293	0.013	31	52317.8951	2.713	0.019	31
52259.9757	4.398	0.048	31	52318.8986	2.639	0.017	31
52260.9667	4.686	0.067	31	52319.8931	2.591	0.031	31
52261.9993	4.908	0.094	31	52320.9243	2.647	0.012	31
52262.9660	4.415	0.034	31	52323.9382	2.887	0.179	5
52266.9660	3.366	0.022	31	52325.9062	2.738	0.014	31
52267.9562	4.186	0.043	31	52327.9569	2.659	0.039	31
52270.9486	5.017	0.119	31	52329.9188	2.866	0.013	31
52276.9639	2.753	0.021	29	52330.9021	2.852	0.032	31
52277.9076	2.985	0.010	31	52336.9167	2.802	0.028	31
52279.0493	3.347	0.159	6	52337.9062	2.732	0.044	26
52282.9604	2.589	0.011	31	52341.9042	2.718	0.036	18
52286.9056	2.741	0.012	31	52342.9590	2.817	0.041	12
52291.9104	2.852	0.042	31	52344.9076	2.875	0.046	31
52293.8875	2.753	0.012	31	52345.9132	2.770	0.041	31
52296.8764	2.641	0.013	31	52346.9090	2.672	0.036	31
52297.8875	2.704	0.027	31	52348.9111	2.800	0.087	19
52298.8861	2.748	0.017	31	52351.9181	2.728	0.031	31
52301.9292	2.767	0.026	31	52352.9146	2.619	0.051	31
52302.9847	2.769	0.038	31	52353.9153	2.829	0.079	20
52303.8979	2.813	0.021	31	52358.9181	2.121	0.030	22
52304.9639	2.858	0.024	31				

[a] JD−2400000.
[b] Relative magnitude to GSC 2811.1573.
[c] Standard error of nightly average.
[d] Number of frames.

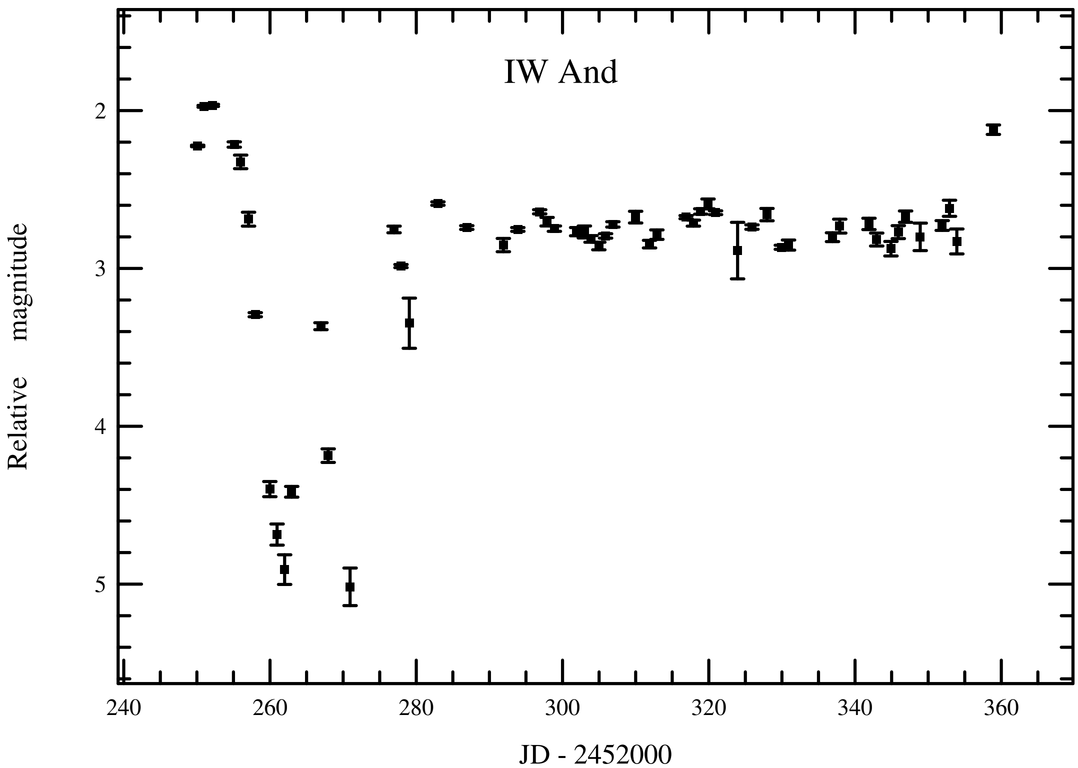

Figure 1. Light curve of IW And

unrecognized Z Cam-type dwarf nova. The "inactive" state described in Meinunger and Andronov (1987) must have been standstills.

Although determination of the actual duty cycle of standstills would require further continuous observations, we regard the 72% of observations being inactive state mentioned in Meinunger and Andronov (1987) to mean the percentage of the duty cycle of standstills in this star. Among Z Cam stars, the duty cycle (nearly 72%) of standstills is exceptionally high. Although Z Cam stars have long been understood as intermediate systems between dwarf novae and novalike (NL) systems (e.g. Meyer, Meyer-Hofmeister (1983)) in the framework of the disk-instability model (see Osaki (1996) for a review), there has been a wide gap between Z Cam stars and NL systems. IW And may be the first object to fill this gap. Since such an object is expected to provide strong observational constraints to the mechanism of Z Cam stars (Meyer and Meyer-Hofmeister 1983; Honeycutt et al. 1998; Buat-Ménard et al. 2001), further continuous observations to precisely determine the pattern of outbursts and standstills, and spectroscopic observations to determine system parameters (orbital period, component masses etc.) are strongly encouraged.

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THE PERIOD OF V2109 Cyg REVISITED

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V2109 Cyg is a variable star discovered by the Hipparcos mission (ESA 1997), and classified as an RRc with a maximum magnitude of 7.49 and variation amplitude of 0.16 mag in the V band. The following ephemeris was also determined:

$$\text{Max.} = \text{BJD } 2448500.0280(1) + 0\overset{\text{d}}{.}1860656(3) \times \text{E}$$

Nevertheless, the real physical nature of this star, based only in the morphology of its light-curve and its period, is controversial. Its period, which falls outside the typical observed range for RRc variables, and its light curve morphology, are similar to those displayed by the largest amplitude δ Sct stars. Thus, Kazarovets *et al.* (1999) classified V2109 Cyg as a δ Sct variable, and Rodríguez *et al.* (2000) included this object in their catalogue of δ Sct variables according to photometric data published by Hauck and Mermilliod (1998), who in turn extracted them from the work by Olsen (1983). In addition to this, Kiss *et al.* (1999) observed V2109 Cyg photometrically and spectroscopically, and indicated that it is a monoperiodic RRc star which probably pulsates in the second overtone mode. More recent photometric and spectroscopic observations indicate that this star is, again, a δ Sct variable (Rodríguez 2002).

In their work, Kiss *et al.* also performed a period analysis and found for this object a slightly shorter period ($0\overset{\text{d}}{.}186049(5)$) than the one detected by the Hipparcos mission. They concluded that a sudden period change had taken place between 1991 and 1998. However, V2109 Cyg had been observed in the V band for six nights a year before, between 16 July and 5 September 1997 from Mollet Observatory (unpublished data), by using an automatic 8-cm telescope. After merging Mollet Observatory data with the satellite photometry the results obtained by that time matched the period obtained by the Hipparcos mission. As a consequence, if there were a period change, it had to happen in the one-year interval between 1997 and 1998. To check this possibility, V2109 Cyg was observed again from Mollet Observatory with a 10-cm telescope for 7 nights, between 1 and 19 July 2001.

The new observations were consistent with those taken in 1997, ruling out any period shortening. Figure 1 plots V2109 Cyg photometric data obtained by the Hipparcos satellite and from Mollet Observatory in 1997 and 2001 folded with the $0\overset{\text{d}}{.}186049$ period. It can be seen that the phase light-curve cannot be adequately reconstructed.

In order to search for a more consistent period, an analysis of the $O-C$ residuals based on maximum timings was performed. In this analysis those maximum timings obtained

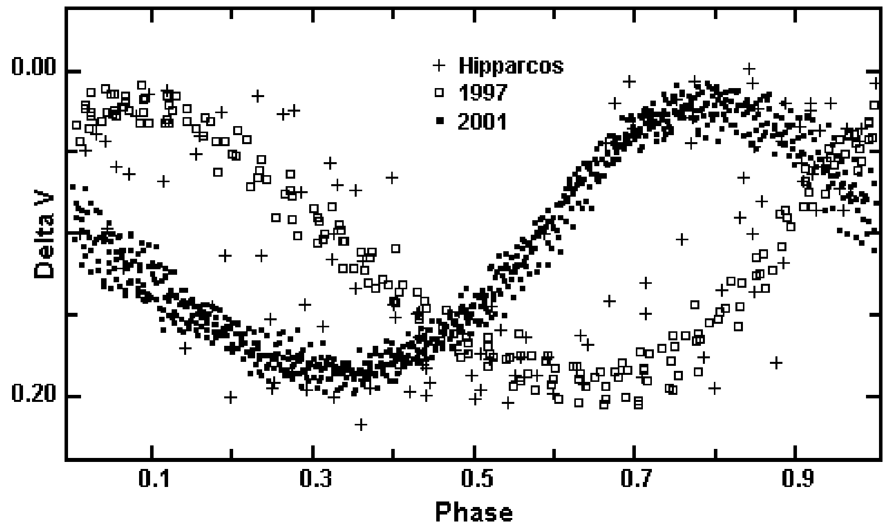

Figure 1. Light curve of V2109 Cyg folded on the $0^{\mathrm{d}}.186049$ period.

by Kiss *et al.* were also included. Figure 2a is a plot of $O-C$ residuals according to the Hipparcos ephemeris, where it can be seen that the Hipparcos period is slightly shorter than the real one as displays the trend of increasingly positive residuals. The new period was computed to correct the trend shown in Figure 2a by assuming a constant period throughout the entire 1991-2001 interval, and therefore a linear increase of $O-C$ residuals based on the satellite ephemeris. For such a purpose, a least-squares linear fit was performed on the $O-C$ data. The corrected period is $0^{\mathrm{d}}.18606637(22)$, and Figure 2b shows the resulting $O-C$ diagram after using the new value. Figure 3 shows the phase curve for V2109 Cyg after folding the data according to the 0.18606637-day period. This time the phase curve could be satisfactorily reconstructed.

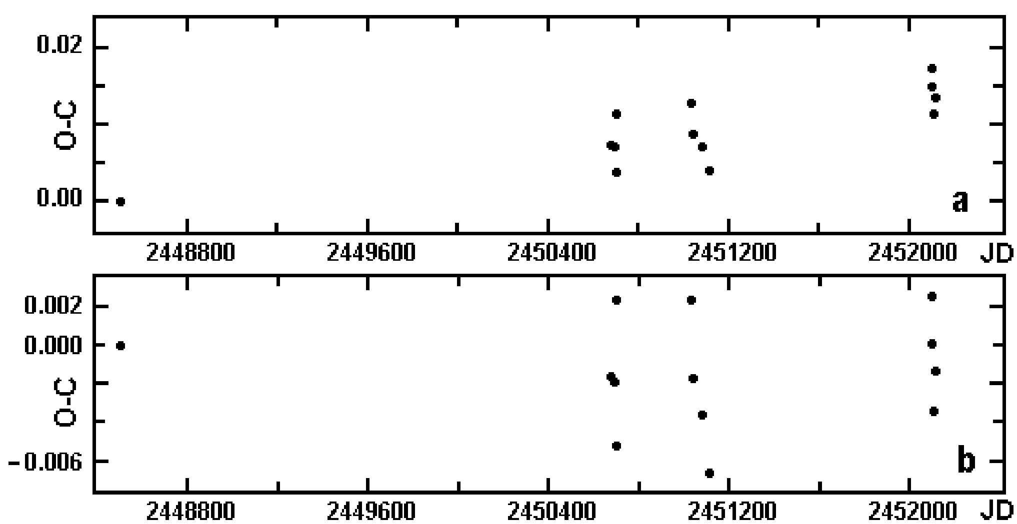

Figure 2.

In conclusion, the data seem to be consistent with a constant period in the 1991-2001 interval. Table 1 gives, as a summary, a list of all known timings and $O-C$ residuals after using the $0\overset{d}{.}18606637(22)$ period.

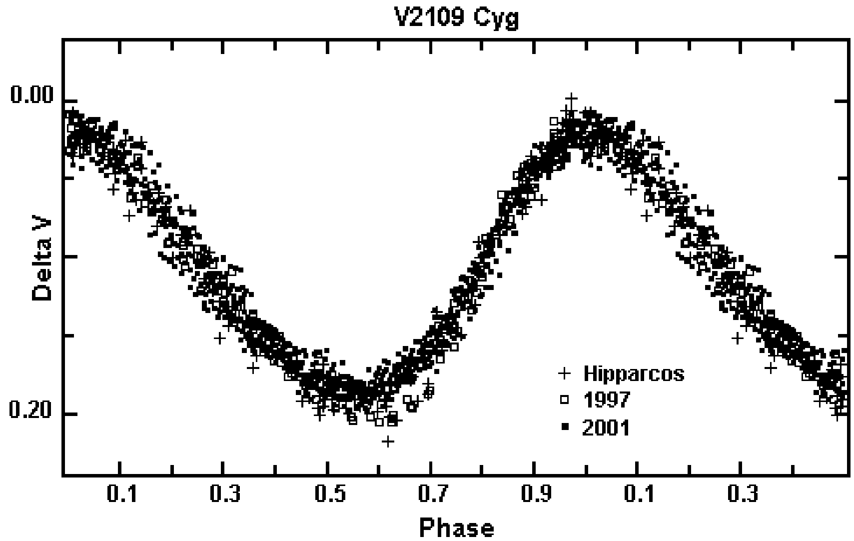

Figure 3. Light-curve of V2109 Cyg folded on the $0\overset{d}{.}18606637$ period.

Table 1

Maximum	Epoch	$O-C$	Source
2450673.4677	11681	−0.0026	present paper
2450689.4691	11767	−0.0019	present paper
2450695.6135	11800	+0.0023	present paper
2450697.4666	11810	−0.0052	present paper
2451032.3936	13610	+0.0023	Kiss *et al.* (1999)
2451037.4134	13637	−0.0017	Kiss *et al.* (1999)
2451080.3928	13868	−0.0036	Kiss *et al.* (1999)
2451110.3465	14029	−0.0066	Kiss *et al.* (1999)
2452093.5303	19313	+0.0025	present paper
2452098.5517	19340	+0.0001	present paper
2452101.5252	19356	−0.0035	present paper
2452110.4585	19404	−0.0013	present paper

Acknowledgements: I wish to express my gratitude to J. Delgado Pin for writing a computer program to determine maximum timings for asymmetric light-curves, and to Joan A. Cano and Rafael Barberá for writing the software for obtaining and reducing the CCD frames. I wish also thank E. Rodríguez from Instituto de Astrofísica de Andalucía for kindly providing me with information about the nature of V2109 Cyg, and E. García-Melendo for his discussion of the results.

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TIMES OF MINIMA FOR NEGLECTED ECLIPSING BINARIES IN 2002

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

Detector:	CB245 camera, Peltier cooling, TI TC245 chip, 11′ × 8′ FOV, 252 × 242 pixels.

Method of data reduction:
Reduction of the CCD frames was made with sextractor and custom-written applications.

Method of minimum determination:
The times of minima were computed using the Kwee and van Woerden method as implemented in AVE [1].

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
CN And	EW	00 20 30	40 13 34	2787-1927*	41577.2970	0.4627959	1
CO And	EA	01 11 25	46 57 50	3268-400	26985.5100	1.827663	1
GZ And	EW	02 12 14	44 39 32	2842-919	41976.6950	0.305018	1
LO And	EW	23 27 07	45 33 22	3637-716	44081.5580	0.380852	1
EK Aqr	EW	23 39 16	−09 09 04	5829-938	39726.5600	0.61299	1
V1353 Aql	EB	19 24 21	16 02 42	1600-958	34461.5290	1.4147979	1
AH Aur	EW	06 26 05	27 59 56	1887-1240	36495.5710	0.4942624	1
HW Aur	EB	05 01 25	39 48 11	2899-1313	29250.6630	1.177404	1
AO Cam	EW	04 28 14	53 02 46	3732-1016	44559.9604	0.329917	1
TX Cnc	EW	08 40 02	19 00 00	1395-1070	38011.3909	0.382881537	1
WX Cnc	EA	08 46 51	32 51 04	2487-162	25620.3770	1.2245888	1
AK CMi	EA	07 40 16	03 57 11	187-673	43101.6720	0.5658975	1
AX Cas	EB	01 23 50	61 34 26	4030-1984	28626.4420	0.600376	1
BH Cas	EW	00 21 21	59 09 04	3665-848	49998.618	0.405890	2
BS Cas	EW	01 21 39	59 10 26	3682-1338	27984.4890	0.4404832	1
EP Cas	EB	23 52 59	57 26 49	4009-1361	28179.1820	0.8134394	1
V366 Cas	EW	01 08 26	58 44 17	3681-640	35075.4610	0.72927425	1

* GSC name

[1] AVE is written by Rafeal Barbera (rbarb@astro.gea.cesca.es) and the software can be obtained from `http://www.astrogea.org/soft/ave/introave.htm`

Observed star(s):							
Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
V384 Cas	EA	00 45 28	47 34 59	3266-1178*	36073.5160	1.108273	1
V520 Cas	EW	23 42 07	55 54 40	4004-975	41186.3690	0.48959	1
V541 Cas	EW	02 34 29	63 20 28	4051-648	39026.5420	0.909026	1
WY Cep	EB	22 46 21	67 42 22	4476-173	25123.0800	1.249056	1
NS Cep	EA	20 45 23	60 43 12	4246-1715	30639.3000	0.7763644	1
TX Cet	EB	01 56 06	00 44 20	4686-547	43082.6343	0.74084025	1
VY Cet	EW	01 49 34	−19 37 30	5857-1716	35429.0210	0.3408097	1
LO Cyg	EB	21 44 03	45 52 37	3591-1877	26267.4120	0.6292321	1
V505 Cyg	EB	20 29 29	32 47 46	2689-458	28099.4260	0.667672	1
V836 Cyg	EB	21 21 23	35 44 10	2715-2996	44853.4903	0.6534122	1
V877 Cyg	EB	19 30 52	32 12 04	2659-2463	35344.5130	0.8397642	1
V1141 Cyg	EW	19 39 53	36 39 43	2668-780	38001.4040	0.84909682	1
ET Del	EB	20 54 56	08 23 24	1090-2533	31432.5590	1.010784	1
LS Del	EW	20 57 10	19 38 53	1656-356	42687.4180	0.3638	1
RU Eri	EB	03 54 44	−14 55 59	5311-42	42359.3456	0.63219951	1
WW Eri	EB	05 05 05	−07 33 36	4762-349	26586.4530	0.926497	1
BL Eri	EW	04 11 48	−11 47 20	5315-263	29232.0820	0.4162	1
AZ Gem	EB	06 34 33	14 28 26	745-1048	26000.5640	1.006183	1
GW Gem	EB	07 52 29	27 09 22	1933-570	25645.5798	0.659444013	1
MS Her	EW	18 16 53	27 39 43	2100-912	26419.4980	0.6052626	1
EM Lac	EW	22 23 55	54 01 08	3982-1917	38259.5444	0.38913342	1
PP Lac	EW	22 42 38	53 25 01	3984-1519	45595.4380	0.401163	1
V342 Lac	EW	22 14 00	51 56 28	3618-677	33861.4954	0.7005779	1
V344 Lac	EW	22 18 47	51 59 13	3618-1289	45222.5635	0.39222768	1
EP Mon	EA	06 56 35	−05 20 35	4809-1327	32888.5760	1.1480993	1
IX Mon	EB	06 57 40	11 48 04	756-1290	27100.4080	1.1032704	1
NN Mon	EA	07 19 26	−01 25 59	4816-2900	30131.2530	0.912339	1
V396 Mon	EW	06 38 37	03 36 22	151-1077	34769.4175	0.39634498	1
V458 Mon	EW	06 57 49	02 12 00	153-1252	34769.5000	0.49521352	1
V514 Mon	EW	06 49 19	00 03 29	148-99	33330.4064	0.55737224	1
V530 Mon	EW	07 03 15	03 15 04	166-2402	33294.4200	0.52552935	1
EU Peg	EA	23 01 26	27 20 20	2243-1242	33981.9250	0.721114	1
HW Per	EB	03 58 42	44 43 41	2876-1970	28023.5270	0.634828	1
V450 Per	EA	02 59 24	41 46 01	2854-2486	38407.4460	0.948666	1
VZ Psc	EW	23 27 47	04 51 14	581-207	43832.2060	0.2611865	1
RS Sct	EB	18 49 11	−10 14 35	5697-600	44437.1658	0.6642384	1
BV Tau	EB	05 38 36	22 54 58	1861-1826	46052.6300	0.93044	1
CT Tau	EW	05 58 50	27 04 48	1871-434	45404.3590	0.6668303	1
GW Tau	EB	04 30 10	25 32 46	1833-974	16900.2300	0.6413291	1
FR Vul	EA	19 36 21	26 45 47	2146-4529	34981.3980	0.94185866	1
GU Vul	EW	19 48 56	26 23 17	2148-723	34985.4230	0.77422704	1
GSC 5178-1376	EW	20 48 13	−01 29 28	5178-1373	51463.5725	0.272218	3

* GSC name

Source(s) of the ephemeris:

1.: Kholopov et al., 1985; 2.: Metcalfe, 1997; 3. Dvorak, 2000

Times of minima:						
Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
CN And	52555.6557	2	I	–	0.0591	
CO And	52539.9063	3	I	–	0.0122	
GZ And	52504.8489	1	I	–	0.1526	
LO And	52510.7114	1	II	–	0.1369	
EK Aqr	52527.6670	4	I	–	0.0368	
V1353 Aql	52552.5972	3	I	–	0.0475	
AH Aur	52537.9368	3	I	–	−0.0032	
HW Aur	52545.8623	3	I	–	0.2612	
AO Cam	52607.6550	1	I	–	−0.0014	

Times of minima:						
Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O - C$ [day]	Rem.
TX Cnc	52611.843	1	I	–	0.030	
WX Cnc	52629.917	1	I	–	0.009	
AK CMi	52596.8492	1	I	–	−0.0170	
AX Cas	52576.5730	2	I	–	−0.0684	
BH Cas	52537.6746	6	I	–	−0.0999	
BS Cas	52527.8055	4	I	–	0.0331	
EP Cas	52585.5830	2	I	–	−0.0348	
V366 Cas	52539.6463	2	II	–	0.2654	
V384 Cas	52566.7055	2	I	–	−0.1293	
V520 Cas	52575.701	1	I	–	0.000	
V541 Cas	52610.5718	1	I	–	−0.0098	
WY Cep	52548.6232	2	I	–	0.0206	
NS Cep	52556.5635	4	I	–	0.4965	cycle count uncertain
TX Cet	52552.8063	2	I	–	0.0111	
VY Cet	52611.6341	1	I	–	0.0105	
LO Cyg	52587.643	1	I	–	0.081	
V505 Cyg	52549.686	1	I	–	0.111	
V836 Cyg	52524.5618	1	I	–	0.0123	
V877 Cyg	52581.5424	6	I	–	0.0294	
V1141 Cyg	52551.5866	2	I	–	0.0594	
ET Del	52538.7236	3	I	–	−0.0161	
LS Del	52550.5508	3	II	–	0.1524	
RU Eri	52630.6672	2	I	*V*	−0.0238	
WW Eri	52625.7069	3	I	–	0.0557	
BL Eri	52624.7486	1	I	–	0.1546	
AZ Gem	52566.8926	2	I	–	0.0789	
GW Gem	52628.7304	2	I	–	0.0205	
MS Her	52566.538	1	II	–	0.301	
EM Lac	52629.5129	3	I	–	0.0039	
PP Lac	52589.6764	3	I	–	−0.0385	
	52602.5135	4	I	–	−0.0386	
V342 Lac	52555.573	1	II	–	0.2072	
V344 Lac	52601.5480	3	I	–	0.0052	
EP Mon	52565.8929	1	I	–	−0.0993	
IX Mon	52637.7788	3	I	–	−0.0292	
NN Mon	52638.7594	7	I	–	0.1033	
V396 Mon	52602.9056	2	I	–	−0.0543	
V458 Mon	52587.7882	5	I	–	0.0105	
V514 Mon	52627.7337	5	I	–	−0.0144	
V530 Mon	52597.7630	4	I	–	−0.1759	
EU Peg	52581.6528	2	I	–	0.0344	
HW Per	52611.7076	3	I	–	0.0225	
V450 Per	52596.7098	2	I	–	0.0664	
VZ Psc	52545.6999	5	I	–	0.0511	
RS Sct	52539.5429	1	I	–	−0.0029	
BV Tau	52550.9138	3	I	–	0.1208	
CT Tau	52590.7511	2	I	–	−0.0380	
GW Tau	52576.6755	5	I	–	−0.0510	
FR Vul	52554.5930	2	I	–	−0.0039	
GU Vul	52580.5231	3	I	–	0.0164	
GSC 5178-1376	52565.5162	1	I	–	0.0052	

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FIRST BVR PHOTOMETRY OF TV URSAE MINORIS

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[3] İstanbul University Observatory, TR-34452 İstanbul, Turkey

[4] Baja Astronomical Observatory of Bács-Kiskun County, Baja, Szegedi út, P.O. Box 766, H-6500, Hungary

Name of the object:
TV UMi = BD +73°654 = HIP 73474 = HD 133767

Equatorial coordinates:	**Equinox:**
R.A.= $15^{h}00^{m}59^{s}.69$ **DEC.=** $+73^{\circ}03'11''.5$	2000

Observatory and telescope:
Ege University Observatory, 48-cm Cassegrain telescope Baja Observatory, 50-cm Ritchey-Chrètien telescope

Detector:	Hamamatsu, R 4457 (PMT) SiTE 502B (Apogee AP-7 CCD)

Filter(s):	Johnson B, V and R unfiltered (Baja)

Comparison star(s):	BD +73°660 = SAO 8166 (Ege) BD +73°655 = SAO 8148 (Baja)

Check star(s):	BD +73°645 = HD 131493

Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	EB

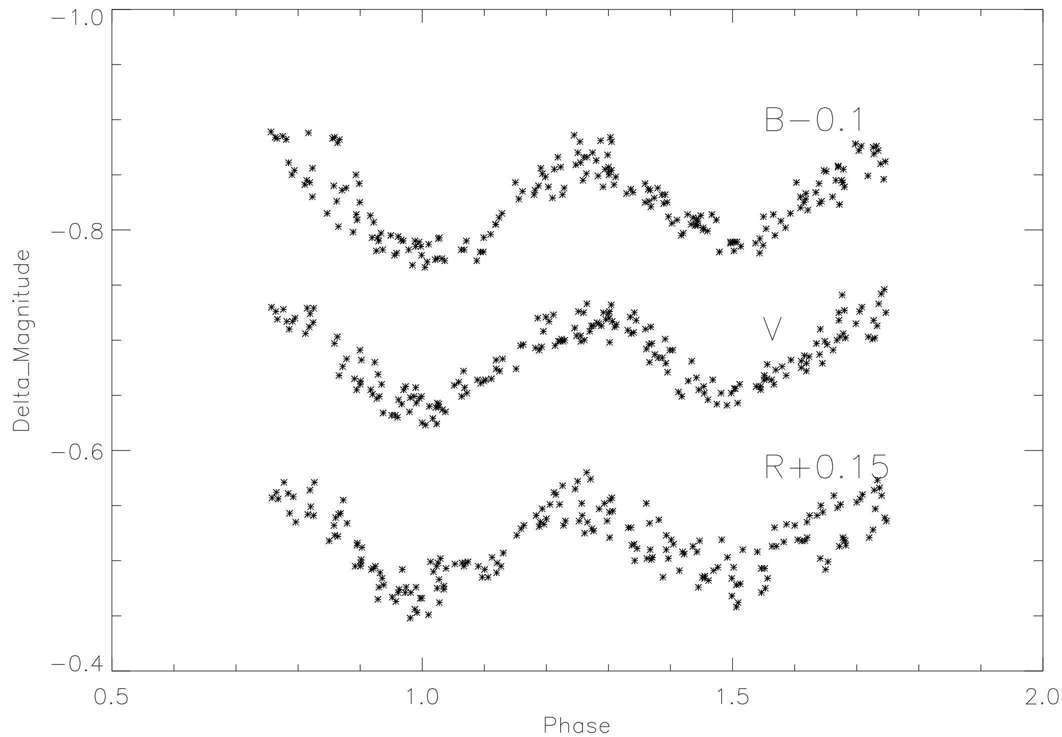

Figure 1. B, V and R light curves of TV UMi obtained at the Ege University Observatory.

Remarks:

In this paper we present B, V and R light curves of the eclipsing binary TV UMi. The variability of TV UMi was discovered by HIPPARCOS (ESA, 1997). The photometric observations of the system by HIPPARCOS show an EB type light curve (Kazarovets et al., 1999). The light elements of the system were given (ESA, 1997) as follows:

$$\text{HJD Min. I} = 2448500.2744 + 0\overset{\text{d}}{.}415546 \times E.$$

The spectral type of the system is given as F8 (ESA, 1997). The first ground-based photometric observations were made over 9 nights during 2000 observing season at the Ege University Observatory and 3 nights at Baja Observatory as a part of the bilateral photometric campaign of the two institutes. The derived light curves for B, V, R colours are illustrated in Figure 1. The obtained minima times are given in Table 1. The $O-C$ values are calculated on the base of our improved ephemeris (see below). Using the data given in Table 1 we derived the following, improved light elements and their errors:

$$\text{HJD Min. I} = 2448500.272(8) + 0\overset{\text{d}}{.}415550(1) \times E.$$

The phases in Figure 1 are calculated using the above elements.

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
TV UMi	48500.2744	–	I	–	0.0022	Hipparcos
	51684.421	2	II	B,V,R	$-$ 0.003	Ege
	51731.382	2	II	B,V,R	0.001	Ege
	51762.331	2	I	B,V,R	-0.009	Ege
	51765.448	1	II	–	-0.008	Baja
	51766.487	1	I	–	-0.008	Baja
	51773.344	1	II	–	-0.008	Baja
	52091.448	1	I	B,V,R	-0.007	Ege
	52100.398	3	II	B,V,R	0.009	Ege

Acknowledgements:

This work was partly supported by Hungarian National Grant OTKA T030743.

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Kazarovets, A. V., et al., 1999, *IBVS*, 4659

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CCD TIMES OF MINIMA OF SOME ECLIPSING BINARIES IN 2002

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Observatory and telescope:
Piwnice Observatory of the Nicholas Copernicus University,
135 mm f/2.8 semi-automatic CCD camera

Detector: SBIG ST-7 CCD Camera

Method of data reduction:
Reduction of the CCD frames was made with a software developed for the Semi-Automatic Variability Search[1] sky survey.

Method of minimum determination:
The minima times were computed with Kwee-van Woerden method (Kwee, van Woerden 1956), and in some cases with the digital tracing paper method.

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
SX Aur	EB/KE:	$05^h11^m43^s$	$+42°09'55''$	HD 33785	40162.3355	1.2100802	1
CK Boo	EW/KW	$14^h35^m04^s$	$+09°06'49''$	GSC 910 654	42896.8759	0.3551501	1
ET Boo	EB	$14^h59^m20^s$	$+46°49'04''$	SAO 45350	52394.5564	0.6451	2
FI Boo	EW:	$15^h22^m06^s$	$+51°10'55''$	HD 137608	51718.3979	0.3899978	3
YY CrB	EW	$15^h50^m32^s$	$+37°50'08''$	HD 140847	52400.3669	0.376584	4
MR Cyg	EA/SD	$21^h58^m57^s$	$+47°59'00''$	HD 208786	33396.4069	1.67703362	1
V891 Cyg	EA/DM	$19^h33^m38^s$	$+29°16'22''$	SAO 87322	34663.449	1.9057825	1
DI Peg	EA/SD	$23^h32^m15^s$	$+14°58'09''$	SAO 108689	45196.488	0.7118168	1
W UMa	EW/KW	$09^h43^m45^s$	$+55°57'09''$	HD 83728	45765.7385	0.33363749	1
TX UMa	EA/SD	$10^h45^m20^s$	$+45°33'58''$	HD 93013	49749.3470	3.06328888	4
VV UMa	EA/SD	$09^h38^m07^s$	$+56°01'07''$	HD 83728	45815.3365	0.687380	1

Source(s) of the ephemeris:

1. Kholopov et al., 1998;
2. Present paper;
3. Pribulla et al., 2002;
4. Kreiner et al., 2001

[1] For further information on SAVS see http://www.astri.uni.torun.pl/~gm/SAVS/.

Times of minima:						
Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
SX Aur	52358.7329	0.0032	I	R	−0.0010	
	52627.3752	0.0017	I	V	−0.0035	
CK Boo	52399.5141	0.0023	I	V	+0.0645	
	52399.6869	0.0008	II	V	+0.0597	
ET Boo	52394.5564	0.0026	I	V	+0.0000	
FI Boo	52400.3133	0.0011	II	V	−0.0126	
	52400.4915	0.0009	I	V	+0.0043	
YY CrB	52400.1796	0.0008	I	V	−0.0087	
	52400.3653	0.0009	II	V	−0.0113	
MR Cyg	52500.325	0.005	II	V	−0.011	
	52501.1736	0.0019	I	V	−0.0003	
V891 Cyg	52505.4276	0.0010	I	V	+0.0429	
DI Peg	52542.7862	0.0010	II	V	−0.007	
	52572.6843	0.0011	II	V	−0.0053	
	52573.0329	0.0006	I	V	−0.0126	
W UMa	52364.3776	0.0003	I	R	−0.0432	
	52364.2126	0.0006	II	R	−0.0414	
TX UMa	52365.3973	0.0031	I	R	+0.0017	
VV UMa	52364.6349	0.0006	I	R	−0.0582	
	52364.2754	0.0011	II	R	−0.0740	

Acknowledgements:

The authors wish to thank Dr. Waldemar Ogłoza and Prof. Jerzy M. Kreiner for advice.

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Kreiner, J.M., Kim, C.H., Nha, I.S., 2001, *An Atlas of O−C Diagrams of Eclipsing Binary Stars*, vol. I-VI (available via the Internet: `http://www.as.wsp.krakow.pl/o-c/`)

Kwee, K. K., van Woerden, H. 1956, *Bull. Astr. Inst. Netherlands*, **12**, No. 464, 327

Pribulla, T., Vaňko, M., Parimucha, Š., Chochol, D., 2002, *IBVS*, No. 5341

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GSC 4288-186: A NEW ECCENTRIC BINARY

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During a campaign of photometry on XX Cep in the summer of 2002, one of the stars in the field was discovered to be variable by VB. We observed the star at the Çanakkale Onsekiz Mart University's Ulupinar Astrophysics Observatory (ÇOMU UAO) (latitude, $40°06'01''$ North, longitude, $01^h45^m54^s$ East, altitude, 410 m). We made the measurements with a 30 cm Meade LX200 Schmidt-Cassegrain telescope at f/10 and f/3.3, and using an SBIG ST-237 CCD Camera without filters. Exposure times ranged from 6 to 10 seconds.

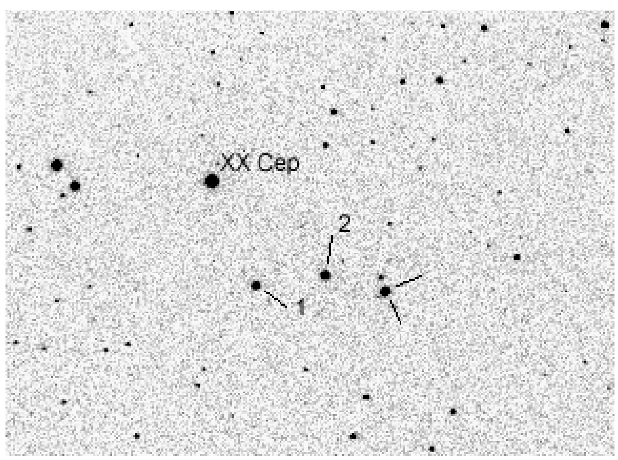

Figure 1. Identification map of GSC 4288-0186 (bars), comparison star (No. 1) and check star (No. 2). The size of the field is $16.6'\times12.5'$, unfiltered CCD band, 6-seconds exposure.

The star has been observed over 20 nights to confirm the variability and determine the period. The Julian dates of observations (+2452000) are 515, 535, 536, 537, 538, 539, 540, 551, 552, 553, 555, 571, 575, 576, 577, 579, 591, 593, 594, 602. Catalogue information for the variable, comparison and check stars are given in Table 1. We show the finding chart for the observed stars in Figure 1.

CCD images were processed by the MUNIDOS photometry software package (Hroch, 1997). Our differential magnitudes are calculated in the sense of star minus GSC 4288-0241. Times of minima of the star were first found using the method of Kwee- van Woerden (1956) and, depending on the nature of the data set, by the Taranis programme, which is

Table 1: Stars observed in the field of GSC 4288-0186

Type	Star's GSC Id	R.A. J2000	Dec. J2000
Variable	0186	$23^h37^m43\overset{s}{.}30$	$64°18'11\overset{''}{.}6$
Comparison	0241	$23^h38^m09\overset{s}{.}00$	$64°17'56\overset{''}{.}6$
Check	0100	$23^h37^m55\overset{s}{.}57$	$64°18'22\overset{''}{.}3$

Table 2: Times of Minimum Light −2400000

HJD	Error	Type
52515.4800	0.0045	II
52591.2761	0.0001	I
52594.3713	0.0014	II

based on an artificial neural network (Gaspani, 1995). The times of minima, with their uncertainties, are presented in Table 2. From these times of minimum light we find the ephemeris to be:

$$\text{HJD of Primary Minimum} = 2452591.2761(1) + 5\overset{d}{.}63508(2) \times \text{E}.$$

where the uncertainties in the final digit are given in brackets In Figure 2, the differential unfiltered magnitudes phased at this period are plotted.

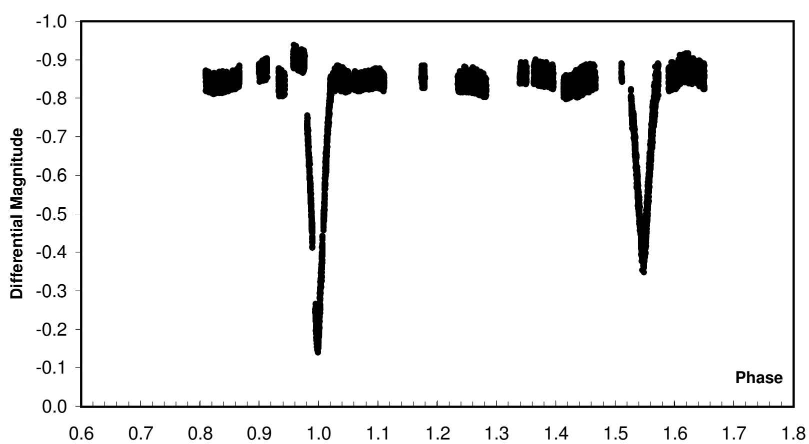

Figure 2. Unfiltered light curve of GSC 4288-0186.

Some of our initial raw data were compromised by moonlight, which introduced non-linearities into the measurements. As well, the broad bandwidth of the unfiltered observations can introduce other non-linearities into the magnitude comparison process, especially with larger air masses (cf., e.g. Golay, 1974). These facts should be kept in mind in relation to the apparent out of eclipse variation.

While a definitive model for the system has not been attempted at this stage, there exist physically plausible parameters which fit the data. For light curve modelling we used `ILOT` (Banks, T. & Budding, E., 1990). From the spectral class, we assume a temperature for the hot star of 8100 K and we have then used standard theoretical values for the limb darkening, gravity brightening and effective albedo coefficients given this temperature and effective wavelength (cf. e.g. Budding, 1993). The wavelength-independent parameters we found are: the radius, relative to the mean separation, of the hot star is 0.085 ± 0.007, that of the cool star is 0.081 ± 0.006, orbital inclination $88^\circ \pm 0^\circ\!.5$, eccentricity of the orbit 0.075 ± 0.01 and longitude of the periastron ϖ=25° ± 1°. The well separated stars make the mass ratio photometrically indeterminate, so we assumed a value of 0.78, consistent with the temperature difference for a Main Sequence model, given the respective luminosities. This well separated model is then reasonably self-consistent in temperature difference, mass ratio and ratio of the radii with a A5V+A7V Main Sequence eclipsing binary system.

This type of modelling has proved effective in locating optimal eccentricity and orientation parameters for well detached systems like this. It will be interesting to check for secular variations of the latter parameter (ϖ) in future years.

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ERRATUM FOR IBVS 5381

Errata for the paper IBVS No. 5381 titled *"GSC 4288-186: a New Eccentric Binary"*: Minima times reported as

52515.4800	II
52591.2761	I
52594.3713	II

should be changed as

52515.4840	II
52591.2817	I
52594.3767	II

Volkan Bakis

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A NEW POSSIBLE LONG PERIOD IN THE OPTICAL VARIABILITY OF T TAURI

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T Tauri is a well-known prototype of pre-main-sequence variable stars. Its photometric behavior can be studied for a time interval exceeding one century, and it shows a rather unusual feature: whereas the star was quite active before 1920ies, its variability became rather low-amplitude and smooth later on.

From the photometric data base (Herbst et al., 1994) available on Internet, we retrieved 1358 V, $B-V$, $U-B$ measurements of T Tau, mainly from observations by Zaitseva (1978), Herbst et al. (1983), Rydgren et al. (1984), Kardopolov and Filipyev (1985), Herbig et al. (1986), Bouvier et al. (1988), Herbst et al. (1988), and appended them with 13 V, $B-V$, $B-R$, $W-B$ observations acquired by one of us (Ismailov, 1997). This data set was used for our Fourier frequency analysis according to the method suggested by Scargle (1982), in the later modification by Horne and Baliunas (1986) (the code we applied was written by I. Antokhin). We analyzed subsets of data as well as the complete set, with trend removed. The most significant frequency in the low-frequency domain is $f = 0.000456 \pm 0.000035$ d^{-1}, corresponding to the period $P = 2192$ days. This frequency is represented in the complete data set as well as for its different subsets. In the following, we use the mean value $P = 2200 \pm 150$ days, or about 6 years, derived from several versions of the subsets.

The light curve folded with the above period value is shown in Fig. 1. The general trend between the minimum in 1962 and the maximum in 1985 ($\Delta V = 0\overset{m}{.}4$), with subsequent new fading, has been removed using a third-power polynomial. Clumps of data points, corresponding to individual years, are evident. Despite a large scatter, reaching $0\overset{m}{.}4$ for some years, a periodic component with the amplitude of $0\overset{m}{.}2$ is apparent. From the photoelectric data set, we derive 5 times of minima (2439066, 1965; 2442696, 1975; 2444911, 1982; 2447167, 1988; 2449280, 1993). For better feeling of the reliability of these minima, we present a combined photoelectric light curve in Fig. 2; the Roman numbers indicate the fragments of the light curve used to derive each minimum. Apparently, these minima are of different reliability, but the presence of each of them seems beyond doubt.

It is interesting to check if this period value can be verified using historical visual and photographic observations. The well-known combined visual light curve of T Tau was published by Lozinskii (1949). This light curve causes some questions, probably because the author, who wished to present a smoothed light curve instead of individual data points, did not pay enough attention to his smoothing procedures. Namely, the light curve does not show clear invisibility gaps at one-year intervals, to be expected for a star in a zodiac constellation. If we, nevertheless, consider this standard source of data on the long-term variability of T Tau, we are not able to connect the minima present in this light curve to the above five minima using a period value close to six years. However, it is worth noting that the two best-pronounced minima of the historical light curve, approximately on JD 2402800 and JD 2409500, are separated by 6700 days, almost exactly three suggested periods. It is more difficult to isolate individual minima of the suspected long-term variability in the historical light curve based upon the data in Beck and Simon (2001) because of its large scatter.

If real, the six-years period is not very easy to explain. Quite obviously, it is too short to be an orbital period of any of the numerous companions of T Tau reported in the literature. Fadings of young stars are often explained by dust clumps crossing the line of sight. A proto-planetary body at several astronomical units from the star, not yet directly revealed, could orbit T Tau with the needed period. But it seems impossible to connect the recent data with the historical minima, making interpretations like eclipses by permanently present bodies unlikely; cometary bodies, appearing and persisting for decades and then disappearing, can be an alternative. Also, cycles resembling solar activity come to mind. Note that the recent photoelectric data show continuous brightening of T Tau from 1962 till 1985, with subsequent fading. This unusual behavior of the star needs a special explanation.

One of us (N.N.S.) would like to acknowledge partial financial support of his variable star studies through grants for the Russian Foundation for Basic Research (No. 02-02-16069), Federal Program “Astronomy”, and programs of the Presidium of Russian Academy of Sciences.

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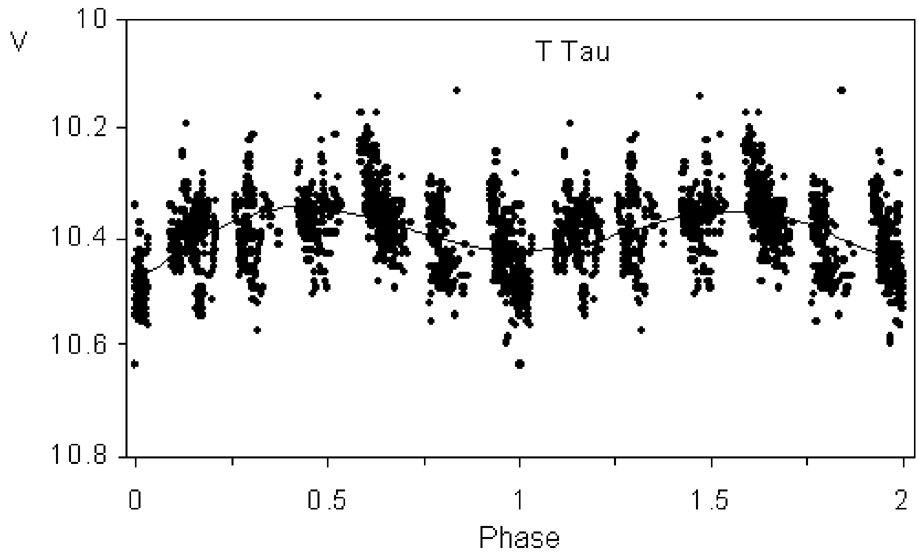

Figure 1. The photoelectric light curve of T Tau folded using our suggested 2200-day period after the removal of the slow trend.

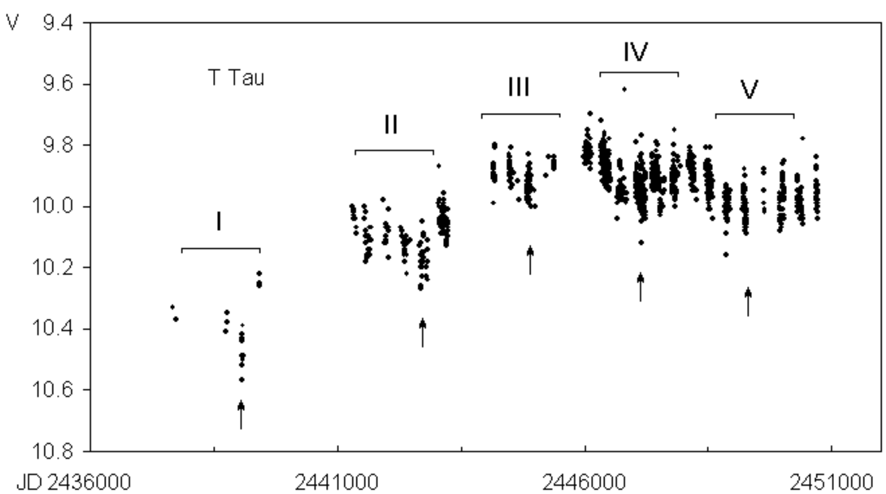

Figure 2. The combined photoelectric light curve of T Tau with minima indicated.

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A REVISED PERIOD FOR AY Aur

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AY Aur, α:$05^{\mathrm{h}}56^{\mathrm{m}}06^{\mathrm{s}}$; δ:$+32^{\mathrm{d}}08^{\mathrm{m}}\!.5$, (J2000 – FK5) is a Mira-type variable with a visual magnitude range of 10.0 – 16.0. The period according to the 4th edition of the *General Catalog of Variable Stars* (GCVS) (Kholopov et al., 1985) is 186.6 days, changed from the period of 373.6 days in the 3rd edition of the GCVS (Kukarkin et al., 1971).

In 1960, AY Aur was included as a survey of stars needing more observations commissioned by B. V. Kukarkin, who was then President of IAU Commission 27. That survey was performed by the University of Oklahoma Observatory under Balfour S. Whitney. Whitney determined the period to be 186.8 days (Whitney 1960). Regrettably, Mr. Whitney is deceased and no more information on the survey is available through the observatory.

The Third Edition of the GCVS references this survey but continues to list AY Aur with a period of 373.6 days in the tables. This was the mean value for the total number of observations available at the time (Samus, 2000). The period determined by Whitney was later used in the Fourth Edition of the GCVS.

372 visual observations covering 22 years from the AAVSO International Database were put through a Fourier analysis routine developed at AAVSO. The `CLEANEST` and `SLICK` algorithms (Foster, 1995) utilize a date compensated discrete fourier transform (Ferraz-Mello, 1981), and were developed specifically to deal with unevenly-spaced time-series measurements. A CLEANest analysis of long term visual data gives a revised period of 389.8 days. Theoretical error is ±0.3 days but experience shows it to be underestimated by a factor of 2 because it assumes a true sinusoid. A DCDFT analysis of 54 CCD V-band observations covering 3 years from the AAVSO International Database gives a period of 390.0 days.

Figure 1 shows the spectrum of the DCDFT analysis. The strongest peak is located at 389.8 days, with two higher-order Fourier harmonics at 195.4 and 129.5 days indicating a non-sinusoidal light curve. The theoretical errors of the latter two periods are both 0.3 days, though as with the dominant period, these are probably a factor of two too low.

We believe that the current GCVS period is incorrect, and is due to the window function of the data dominated by a one cycle per year alias. The GCVS period of 186.8 days is very close to the inverse sum of the 389.8 day period and one cycle per year:

$$\Pi_{\mathtt{GCVS}} \simeq \frac{1}{(1/389.8\,\mathtt{d}) + (1/365.25\,\mathtt{d})} = 188.6\,\mathtt{days}$$

This suggests that earlier Fourier analysis were confused by the large annual data gaps. This is particularly important here, given that the intrinsic period is very close to one year. Visual inspection of the earliest AAVSO data shows large gaps of six months or more, and often the minima are sparsely sampled if at all. The most recent data has much smaller annual gaps, and the shorter GCVS period is clearly ruled out.

Figure 2 is a plot of AAVSO visual and CCD V-band observations with calculated maxima and minima beginning on JD 2452272.758 and going backward using the 389.8 day period. The maxima was derived by applying a 3rd degree polynomial fit to the last cycle in the light curve.

A weighted wavelet transform (Foster, 1996) of all AAVSO optical and CCD data reveals no significant period change over the span of 1969 – 2002. Figure 3 shows a plot of the results of wavelet analysis. Error is estimated to be ± 0.0008 days based on the length of observational data.

In addition to these visual and CCD V-band observations, we conducted a survey of the Damon Series blue photographic plates at the Harvard College Observatory. Only observations near maximum were possible due to the interference of GSC 2410 799, a nearby star with a V mag of 12.5. 38 photographic observations were made from 1968 – 1989. They are plotted in Figure 2 as different symbols along with visual and CCD V-band observations. Their fit with our calculated maxima and minima acts as an independent data set confirming our new period.

We thank 72 observers worldwide for their observations which made this study possible. We would also like to thank Ronald Zissell, Stephen O' Connor, Robert James, and Thomas Michalik for their CCD V-band observations. We acknowledge Alison Doane and the Harvard College Observatory for access to their Astronomical Photograph Collection. Finally, we thank Nikolai N. Samus, George Hawkins, Emily Lu and Elizabeth Waagen for assistance in preparation of this work.

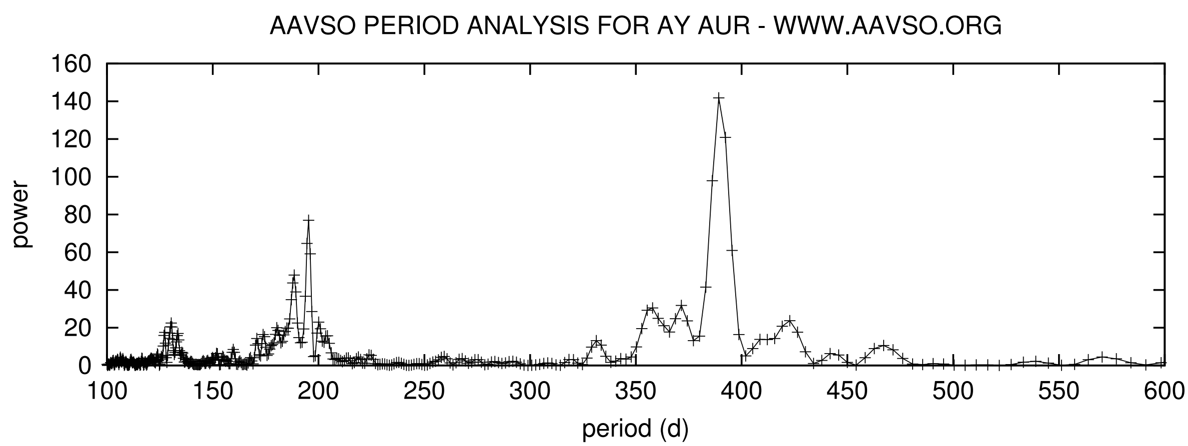

Figure 1. CLEANest Fourier transform of AY Aur visual data spanning JD 2440949.8 - 2452605.9 (December 29, 1970 – November 27, 2002).The dominant period is 389.8d. The 195.4 day period is an Fourier harmonic. We believe the source of the 188.5 day period to be an artifact of annual data gaps, but more data is needed.

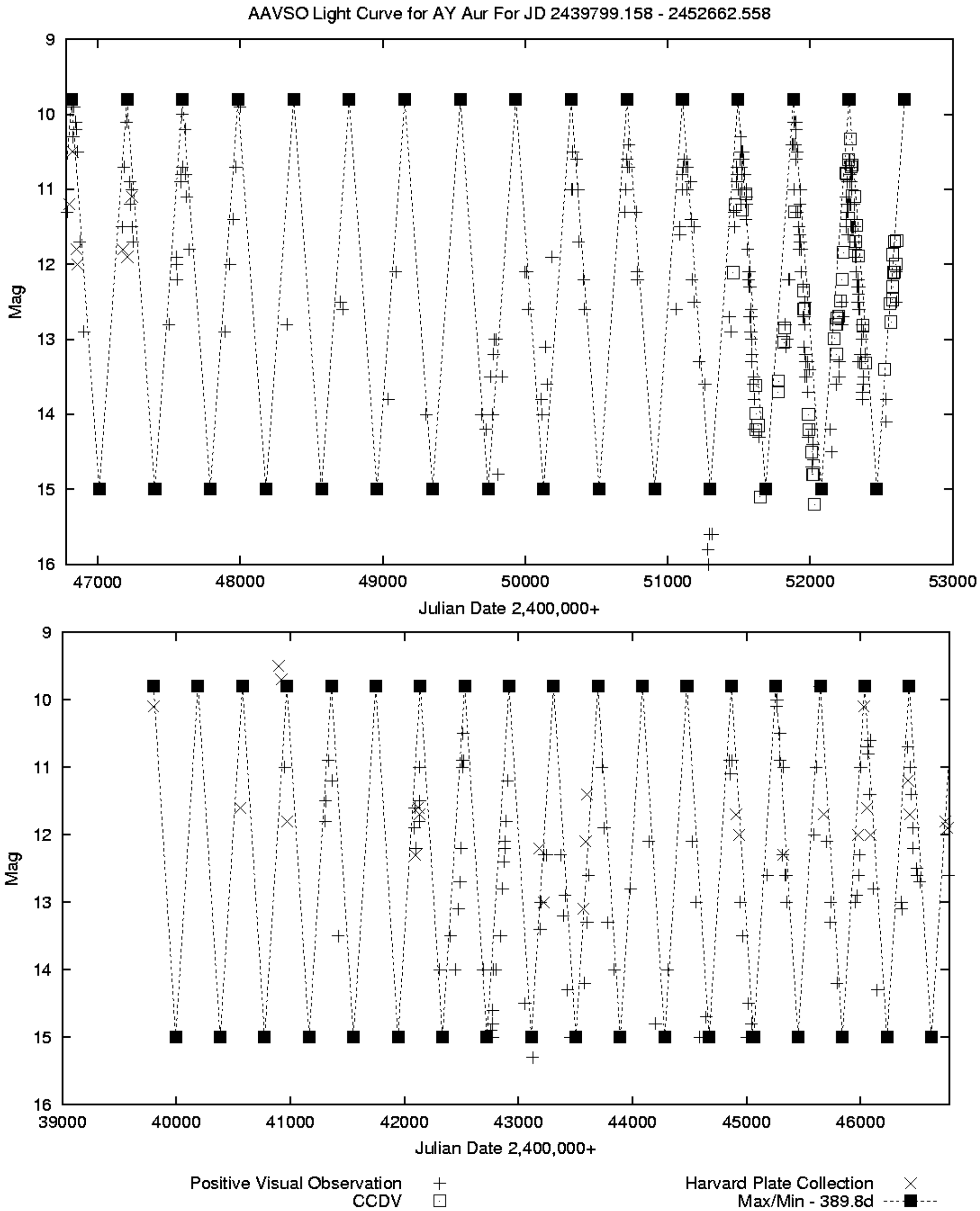

Figure 2. AAVSO Visual, CCD V-band, and Harvard photographic observations plotted with the 389.8 day period.

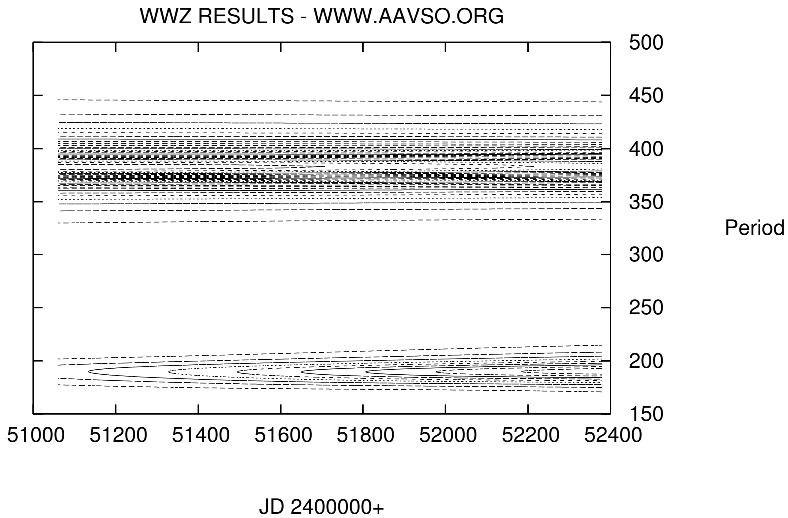

Figure 3. Contour plot of weighted wavelet transform analysis. The new period is the solid line between 350 and 450 days. The contour between 175 and 225 days is the Fourier harmonic.

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Kukarkin, B. V., et al., 1971, *General Catalog of Variable Stars, 3rd edition*, Moscow
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Whitney, B. S., 1960, *Astron. J.*, **65**, 381

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DISCOVERY OF ANOTHER MIRA VARIABLE IN THE FIELD OF V4641 Sgr

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This Note is the fourth in a series of Notes (e.g. Gieles et al., 2002a,b,c) where we report new variable stars discovered during our extensive CCD monitoring program of the black hole binary V4641 Sgr (SAX J1819.3-2525, Orosz et al., 2001). The field of V4641 Sgr has been monitored with the YALO 1m telescope (Bailyn et al., 1999) at Cerro Tololo using the ANDICAM optical/IR camera and the V and I filters during much of the 2001 and 2002 seasons. In this Note we report discovery of another Mira variable in the field of V4641 Sgr. We also give additional observations of two other Mira variables in the field (Gieles et al., 2001c).

As a result of our monitoring campaign, we have the light curves of about 15 000 stars in a $9' \times 9'$ field containing V4641 Sgr. We searched for variables by comparing the standard deviation σ of the light curves and by computing the maximum power in a Lomb-Scargle periodogram (Lomb, 1976; Scargle, 1982) for each star. These two techniques are well suited for finding either large amplitude variables (these have large values of σ) or smaller amplitude periodic variables (these have large L-S power).

Previously, by using the data complete through the end of the 2001 observing season, we easily identified two high-amplitude long-period variable stars that we classified as Mira variables. One of these stars was identified with GM Sgr, while the other one was previously unknown (Gieles et al., 2002c). We had also found a star that showed relatively large brightness variations, but we were unsure of its classification. By including the data from the 2002 season, it became clear that this unidentified variable star was another Mira variable. Table 1 gives an overview of the photometric information of the newly identified variable. For comparison, we also give updated information on the other two Mira variables in the field (Gieles et al., 2002c). Figures 1, 2, and 3 show the light curves folded on the best-fitting periods found using the "pdm" task in IRAF. Figure 4 shows a finding chart for the newly identified Mira variable. As in our previous Note, the name of the new variable is based on its coordinates in equinox 2000 and is given the prefix YALO.

The new Mira has a period of about 408 days, and is extremely red, with $V - I \approx 4.7$ at maximum light and $V - I \approx 6.1$ at minimum light (the reddening in the direction of V4641 Sgr is relatively low with $E(B - V) \approx 0.25$, Orosz et al., 2001). Mira variables with periods less than about 400 days are thought to pulsate in an overtone, whereas Mira variables with periods more than about 400 days are thought to pulsate in the fundamental mode (e.g. van Leeuwen et al., 1997). The folded light curve of the new variable YALO J181910.5 – 252742 (Figure 1) has somewhat of a saw-tooth character, whereas the folded light curves of YALO J181936.7 – 252553 ($P = 200$ days, Figure 2) and YALO J181921.5 – 252538 = GM Sgr ($P = 216$ days, Figure 3) are more sinusoidal. Hence the new variable YALO J181910.5 – 252742 may be a fundamental pulsator.

The light curves of the two shorter-period variables (Figures 2 and 3) do not repeat precisely from cycle to cycle, a feature that is fairly common for the Mira variables (e.g. Whitelock, 1996). Also, many Mira variables do not have stable periods (Whitelock, 1996), which seems to be the case here for the two shorter-period variables. The updated period of 200 days we find for YALO J181936.7 – 252553 is shorter than the 208 days we found earlier, while the revised period of 216 days we find for GM Sgr is a bit longer than the 212 days found by us earlier (Gieles et al., 2002c) and also by Kato et al., (2001). Continued monitoring of these sources will be needed to better establish the mean pulsational periods and the modes of pulsation.

Table 1. Photometric data.

Coordinates (J2000) RA	DEC	V range	$V-I$ range	period (days)	$T_0^{\dagger}$ (HJD 2 450 000+)	ID*
18:19:10.9	−25:27:42.0	15.6 – 20.0	4.7 – 6.1	408	2050	1
18:19:36.7	−25:25:53.1	12.0 – 16.8	2.3 – 4.9	200	2114	2
18:19:21.5	−25:25:37.6	13.1 – 18.2	2.9 – 5.5	216	2104	GM Sgr

†Time of maximum brightness.
* 1: YALO J181910.5 – 252742
2: YALO J181936.7 – 252553

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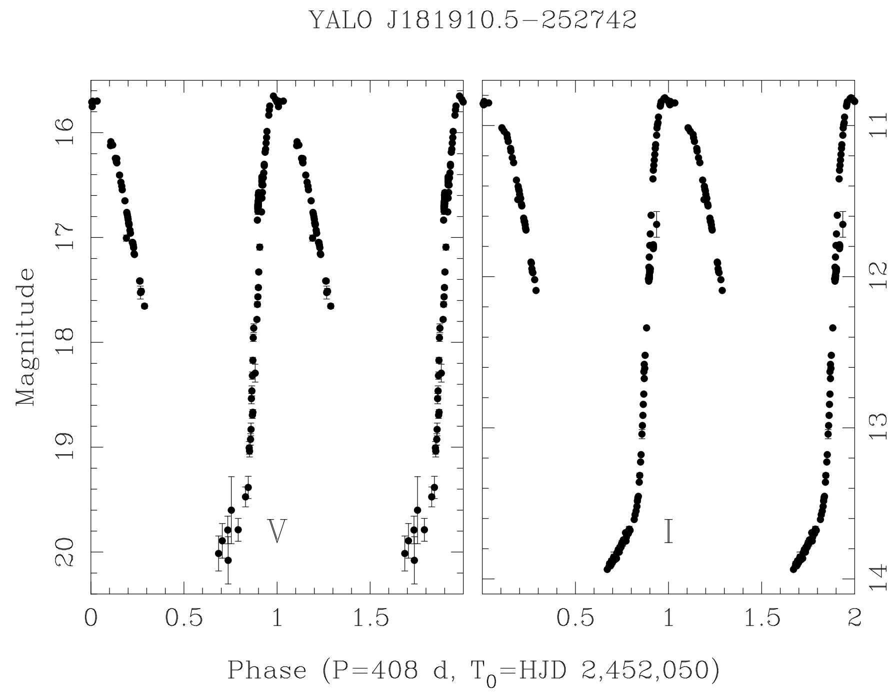

Figure 1. Folded V (left) and I (right) light curves of YALO J181910.5 − 252742.

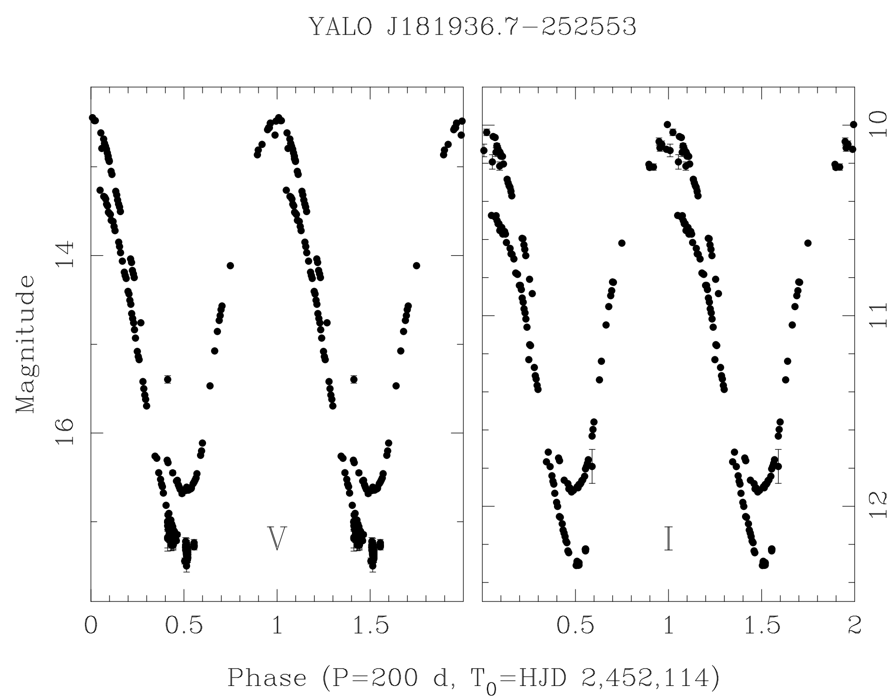

Figure 2. Folded V (left) and I (right) light curves of YALO J181936.7 − 252553.

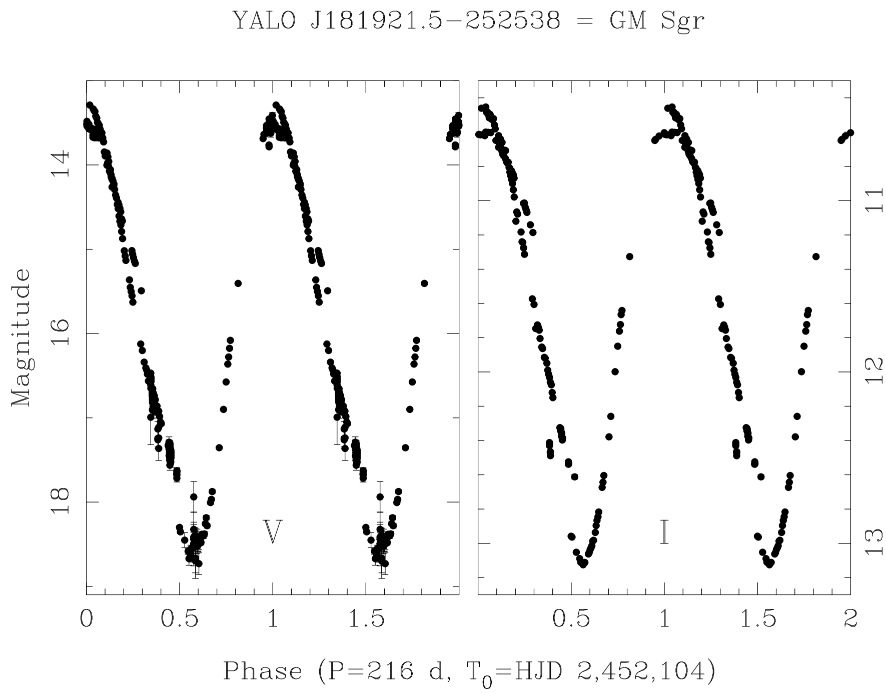

Figure 3. Folded V (left) and I (right) light curves of YALO J181921.5 − 252538 = GM Sgr.

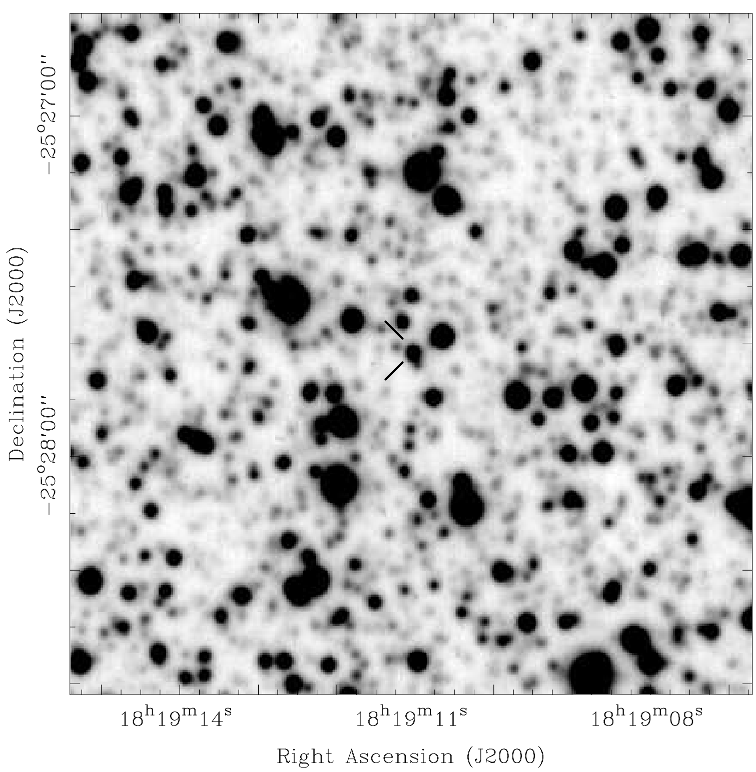

Figure 4. V-band finding chart of YALO J181910.5 − 252742. The bright star immediately to the northwest is the variable star YALO J181910.6 − 252739 (Gieles et al., 2002a).

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ELEMENTS FOR 6 RR Lyr STARS

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The variability of these stars was announced by Hoffmeister (1967, 1968); no further observations or ephemeris were published until today. Recent estimations, made on photographic plates taken with the Sonneberg Observatory 40cm Astrograph during the years 1964-1994, have allowed to determine the type of variability as well as first elements (see Table 1). The given elements were obtained by means of least-squares solutions. Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 3. Individual data are available upon request.

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

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	M−m	No. of Plates
V547 Her	RRab	44454.358 ±3	0.5575412 ±5	$14\overset{m}{.}9$	$15\overset{m}{.}4$	$0\overset{P}{.}14$	222
V549 Her	RRab	44374.393 ±4	0.5851995 ±6	$15\overset{m}{.}2$	$16\overset{m}{.}1$	$0\overset{P}{.}10$	203
V605 Her	RRab	44704.486 ±9	0.6112963 ±12	$13\overset{m}{.}8$	$15\overset{m}{.}1$	$0\overset{P}{.}14$	240
V612 Her	RRab	45056.610 ±7	0.5803605 ±10	$14\overset{m}{.}8$	$15\overset{m}{.}9$	$0\overset{P}{.}08$	218
V613 Her	RRab	45003.696 ±4	0.6716550 ±7	$14\overset{m}{.}7$	$15\overset{m}{.}8$	$0\overset{P}{.}16$	231
V1322 Oph	RRab	45003.726 ±7	0.4695495 ±6	$15\overset{m}{.}1$	$16\overset{m}{.}4$	$0\overset{P}{.}14$	209

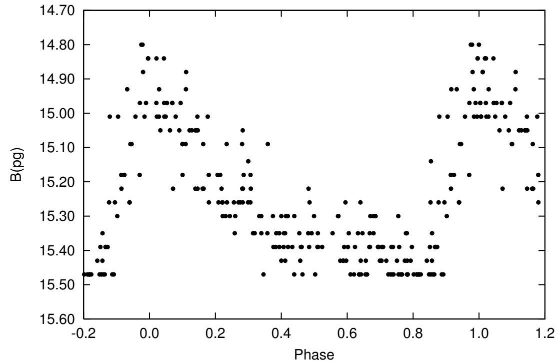

Figure 1. Light curve of V547 Her

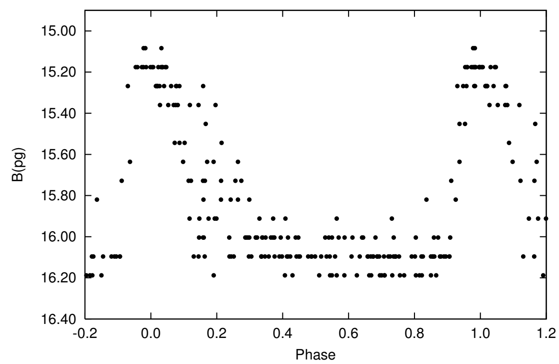

Figure 2. Light curve of V549 Her

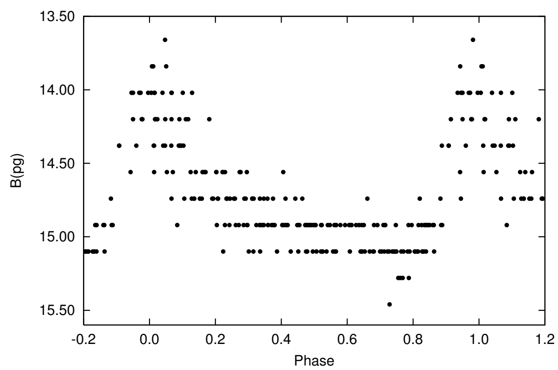

Figure 3. Light curve of V605 Her

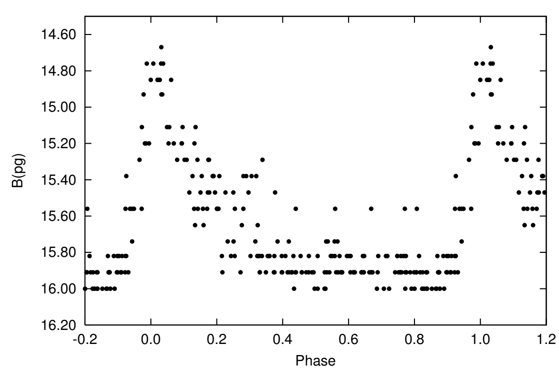

Figure 4. Light curve of V612 Her

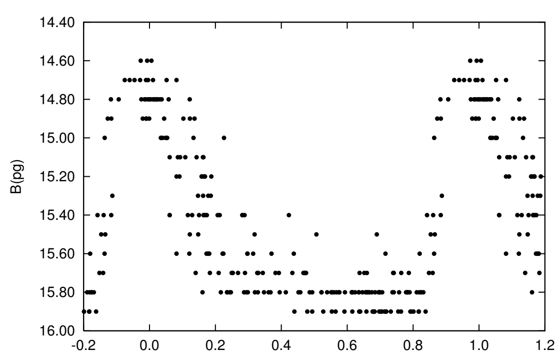

Figure 5. Light curve of V613 Her

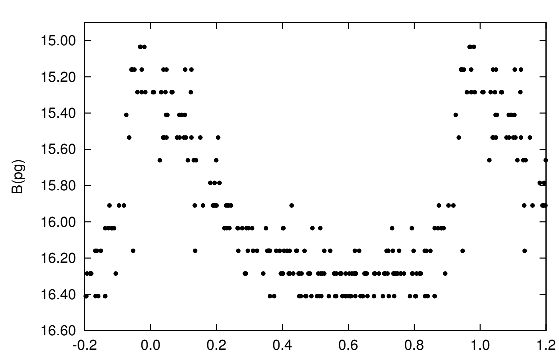

Figure 6. Light curve of V1322 Oph

Table 2. Individual maxima and $O - C$ values according to the elements derived in this paper

Star	HJD (max.)	Epoch	$O-C$	Star	HJD (max.)	Epoch	$O-C$
V547 Her	38502.600	−10675	−0.005	V605 Her	49488.498	7826	0.007
	38525.464	−10634	−0.000	V612 Her	38852.576	−10690	0.020
	38583.446	−10530	−0.002		38902.485	−10604	0.018
	38817.602	−10110	−0.014		39263.465	−9982	0.013
	39238.572	−9355	0.013		43336.414	−2964	−0.008
	42953.451	−2692	−0.006		43365.422	−2914	−0.018
	44372.400	−147	0.001		43372.369	−2902	−0.035
	44454.368	0	0.010		43376.427	−2895	−0.039
	45052.624	1073	0.024		45056.622	0	0.012
	45104.440	1166	−0.011		48088.400	5224	−0.013
	45525.401	1921	0.006		48839.411	6518	0.011
	46644.382	3928	0.002		49132.497	7023	0.015
	48088.400	6518	−0.012		49475.493	7614	0.018
	48839.411	7865	−0.009	V613 Her	38556.466	−9599	−0.014
V549 Her	38502.523	−10034	0.022		38591.425	−9547	0.019
	38642.363	−9795	−0.001		38910.446	−9072	0.004
	38883.487	−9383	0.021		38914.457	−9066	−0.015
	39261.519	−8737	0.014		39270.456	−8536	0.007
	39611.444	−8139	−0.010		39918.613	−7571	0.017
	39615.549	−8132	−0.002		42987.396	−3002	0.008
	39618.468	−8127	−0.009		44024.400	−1458	−0.023
	44024.435	−598	−0.009		44343.463	−983	0.004
	44266.694	−184	−0.022		44345.459	−980	−0.015
	44371.455	−5	−0.012		44376.379	−934	0.009
	44374.384	0	−0.009		44427.425	−858	0.009
	44704.472	564	0.026		45003.681	0	−0.015
	45052.624	1159	−0.015		45104.417	150	−0.027
	45055.550	1164	−0.015		45223.331	327	0.004
	45082.472	1210	−0.012		45822.429	1219	−0.014
	45810.465	2454	−0.008		47262.496	3363	0.024
	46644.382	3879	0.000		48831.466	5699	0.008
	49124.477	8117	0.020		48862.358	5745	0.004
	49216.362	8274	0.028	V1322 Oph	37112.470	−16806	−0.008
V605 Her	38503.528	−10144	0.032		38530.538	−13786	0.021
	38525.464	−10108	−0.039		38585.440	−13669	−0.014
	38555.466	−10059	0.009		38852.619	−13100	−0.009
	38852.550	−9573	0.003		38901.492	−12996	0.031
	38901.492	−9493	0.042		38940.464	−12913	0.030
	39558.604	−8418	0.010		39238.572	−12278	−0.026
	39615.469	−8325	0.025		39263.465	−12225	−0.019
	39618.468	−8320	−0.033		39618.468	−11469	0.005
	39637.421	−8289	−0.030		44375.442	−1338	−0.027
	39645.439	−8276	0.041		44376.395	−1336	−0.013
	39648.436	−8271	−0.018		44454.370	−1170	0.017
	39918.613	−7829	−0.034		45003.703	0	−0.023
	44374.370	−540	−0.016		47770.330	5892	0.019
	44704.491	0	0.005		49124.477	8776	−0.015
	48804.454	6707	0.004		49132.497	8793	0.023

Table 3. Comparison stars and cross references

	V547 Her S 9791 GSC 962.0157		V549 Her S 9793 USNO 0975−08523569	
Comp. No.	GSC	m*	GSC	m*
1	962.0118	$14.^{m}8$	0975−08520651	$14.^{m}9$
2	962.0154	$15.^{m}2$	0975−08523583	$15.^{m}6$
3	962.0167	$15.^{m}2$	0975−08524879	$15.^{m}8$
4	961.1300	$15.^{m}6$		

	V605 Her S 10313 GSC 969.1035		V612 Her S10316 GSC 962.1872	
Comp. No.	GSC/USNO	m*	GSC/USNO	m*
1	969.1162	$13.^{m}5$	962.1584	$14.^{m}4$
2	969.1236	$13.^{m}8$	962.2094	$14.^{m}9$
3	969.1915	$15.^{m}6$	962.1963	$15.^{m}5$
4			962.2040	$16.^{m}1$

	V613 Her S 10317 USNO 0975−08576473		V1322 Oph S10326 USNO 0975−08786753	
Comp. No.	GSC/USNO	m*	GSC/USNO	m*
1	966.0393	$14.^{m}4$	984.2203	$14.^{m}8$
2	966.0519	$15.^{m}0$	984.1587	$15.^{m}5$
3	966.1955	$15.^{m}3$	0975−08787248	$16.^{m}3$
4	0975−08575604	$16.^{m}1$		

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

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Hoffmeister, C., 1967, *Astron. Nachr.*, **290**, 43
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FIRST BVR PHOTOMETRY OF V821 CASSIOPEIAE

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Name of the object:
V821 Cas = BD +52°3571 = HIP 118223 = HD 224557

Equatorial coordinates:	**Equinox:**
R.A.= $23^h58^m49^s.17$ **DEC.**= $+53°40'19''.8$	2000

Observatory and telescope:
Ege University Observatory, 48-cm Cassegrain telescope Baja Observatory, 50-cm Ritchey-Chrètien telescope

Detector:	Hamamatsu, R 4457 (PMT) SiTE 502B (Apogee AP-7 CCD)

Filter(s):	Johnson B, V and R unfiltered (Baja)

Comparison star(s):	BD +52°3575 = HIP 118259 GSC 4001-0292, 4001-1473 (Baja)

Check star(s):	BD +52°3580 = SAO 35989

Transformed to a standard system:	No

Availability of the data:
Upon request

Type of variability:	EA

Remarks:

In this paper we present B, V and R light curves of the eclipsing binary V821 Cas. The variability of V821 Cas was discovered by HIPPARCOS (ESA, 1997). The photometric observations of the system by HIPPARCOS show an EA type light curve. The light elements of the system were given (ESA, 1997) as follows:

$$\text{HJD Min. I} = 2448500.4459 + 1\overset{\text{d}}{.}76975 \times E. \ (1)$$

The spectral type of the system is given as A0 (The Henry Draper Catalogue, Cannon and Pickering, 1918-24). We observed V821 Cas on 9 nights at the Ege University Observatory and 4 nights at Baja Observatory. The derived light curves for B, V, R colours are illustrated in Figure 1. The obtained minima times are given in Table 1. Individual least-squares fits to the primary and the secondary times of minima give the following linear elements:

$$\text{HJD Min. I} = 2451767.4106(4) + 1\overset{\text{d}}{.}7697534(6) \times E, \ (2)$$

$$\text{HJD Min. II} = 2451768.167(4) + 1\overset{\text{d}}{.}7696(2) \times E. \ (3)$$

The $(O-C)$ values in Table 1 are calculated using the above elements. The phases in figure 1 are calculated using the light elements of equation (2). The probable difference between two periods in equations (2) and (3) indicates the existence of apsidal motion in the system. New observations show that the duration of the secondary minimum is longer than the primary one in each colour (the mean durations are $0\overset{\text{d}}{.}258$ and $0\overset{\text{d}}{.}241$, respectively). The location of the secondary minima in the light curve appears clearly shifted from phase 0.5 to phase 0.425. We can deduct an orbital eccentricity of roughly 0.12, and a periastron angle of 163 degrees for the initial epoch given in equation (2). Thus, our observations confirm the system as a new candidate for the study of apsidal motion (Giménez and Hegedüs, 2000).

Table 1

Times of minima:

Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
V821 Cas	51767.4100 (1)	I	–	−0.0006	Baja	
	51774.4893 (2)	I	–	−0.0003	Baja	
	51797.4962 (2)	I	–	−0.0002	Baja	
	51797.4967 (4)	I	B, V, R	0.0003	Ege	
	51805.330 (1)	II	B, V, R	0.0014	Ege	
	51819.4840 (8)	II	B, V, R	−0.0014	Ege	
	51835.4153 (6)	II	–	0.0035	Baja	

Acknowledgements:

This work was partly supported by Hungarian National Grant OTKA T030743.

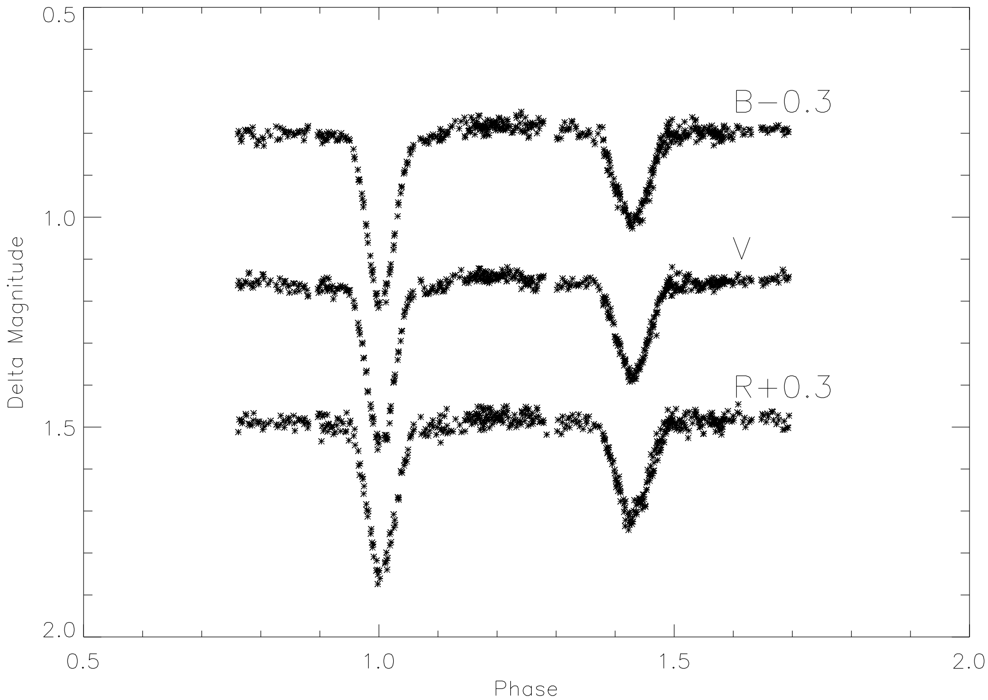

Figure 1. *B*, *V* and *R* light curves of V821 Cas obtained at the Ege University Observatory.

References:

Cannon, A. J. and Pickering, E. C., 1918-1924, *The Henry Draper Catalogue*, Ann. Astron. Obs. Harvard College, **91-99**

ESA, 1997, *The Hipparcos and Tycho Catalogues*, SP–1200

Giménez, A. and Hegedüs, T., 2000, *Catalogue of Detached Eccentric Eclipsing Binary Systems* (electronic database)

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PHOTOMETRIC OBSERVATIONS OF VW LMi AND THE NEW BINARY SYSTEM V345 Gem

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In this paper we present new observations of the HIPPARCOS variables VW LMi and V345 Gem from Mollet and Monegrillo Observatories. At both places telescopes were fitted with a SX Starlight CCD camera with a Sony ICX027BL chip cooled by a Peltier system to about -25°C. Dark frames and flat fields were obtained and used to perform image cleaning. Photometric observations were taken in the B and V bands, and reductions were carried out using a synthetic aperture differential magnitude extraction method and the software package `LAIA` (Laboratory for Astronomical Image Analysis). Table 1 summarizes the observational log for both stars. Table 2 gives some additional basic data for these objects.

Table 1. Observational log

Star	HIP number	Observation period	Comparison star	Remarks*
VW LMi	HIP 54003	27 Dec 1997-24 Apr 1998	HIP 53969	1
V345 Gem	HIP 37197	25 Dec 1998-21 Mar 1999	HD 60913	2

*1: Mollet Observatory, 41 cm Newtonian telescope.

2: Mollet and Monegrillo Observatories, 41 cm Newtonian telescope.

Table 2. Basic data

Star	Spectral type	Equatorial coordinates (epoch 2000.0)	$B-V$**
VW LMi	F3V	$\alpha = 11^{\rm h}02^{\rm m}51\overset{\rm s}{.}909$ $\delta = +30°24'54\overset{''}{.}71$	0.410 ± 0.015
V345 Gem	F0	$\alpha = 07^{\rm h}38^{\rm m}30\overset{\rm s}{.}224$ $\delta = +33°42'41\overset{''}{.}51$	0.476 ± 0.015

**Spectral type and $B-V$ colour index retrieved from the HIPPARCOS Catalogue (ESA 1997).

VW LMi is a variable star discovered by the HIPPARCOS mission (ESA, 1997) and catalogued as an EW in the 74th Special Name-List (Kazarovets *et al.*, 1999). Dumitrescu (2000) reported ground-based photometric observations on this star and four minimum timings. In the HIPPARCOS catalogue the following ephemeris is given:

$$\text{Min. I} = \text{BJD } 2448500.1960(10) + 0\overset{d}{.}477547(3) \times \text{E}$$

We performed a new period analysis based on our new photometric data and the already existing observations. The new B and V light-curves also allowed computing a first estimate of some physical parameters for this binary system.

To recompute the period of VW LMi, an analysis of $O - C$ residuals based on times of minimum was performed. Table 3 lists the timings based on our observations. When the HIPPARCOS period (0.477547 days) was used, it was found to be a short estimate of the real one as indicated by an increasing trend of positive $O - C$ residuals. Assuming no period changes from 1991 to 2000, the trend was removed after a least squares linear fit, resulting in a new revolving time of 0.4775942(3) days for the binary system. Figure 1 shows the folded light-curves in the B and V bands using the new period. Although longer surveillance is still needed in the long term to monitor the behaviour of VW LMi, the satellite data and our photometry could be merged and satisfactorily folded on the new refined period, suggesting that it has remained stable during the 1991-2000 interval.

Table 3. Minimum timings for VW LMi

Minimum	Photometric band	Epoch
2450809.6214 ± 0.0002	V	4836.0
2450835.6495 ± 0.0002	V	4890.5
2450872.4224 ± 0.0001	V	4967.5
2450877.4658 ± 0.0001	V	4978.0
2450921.3707 ± 0.0002	B	5070.0

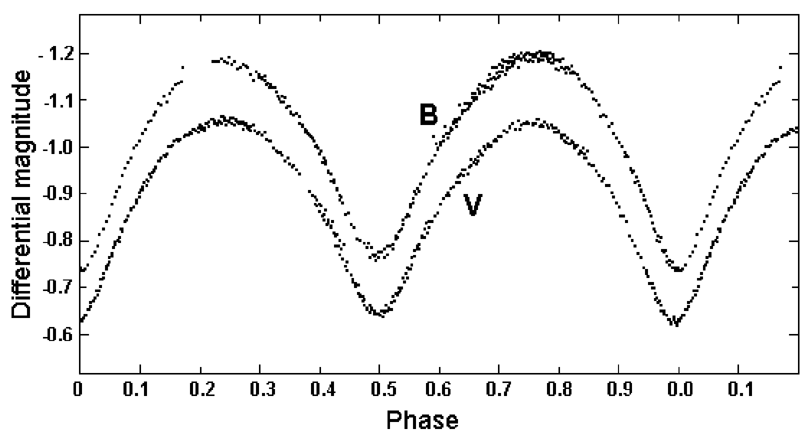

Figure 1. Differential B and V light-curves of VW LMi, folded with the period of 0.47754916 days obtained in this work

The differential B and V data were analysed using the Wilson-Devinney method (Wilson, 1998), assuming convective envelopes and a temperature of the primary ($T_1 = 6700$ K) according to the spectral type of VW LMi. Because the lack of information about the mass ratio, we varied it from 0.3 to 0.8 in steps of 0.1, performing for each value a complete set of cycles of refinement. The solution corresponding to the minimum residual (obtained for $q = 0.4$) suggests a system with an inclination of about 70°and relative luminosities (in both B and V bands) of 0.7 and 0.3 for the primary and secondary, respectively.

V345 Gem was also discovered by the HIPPARCOS mission, and catalogued as a periodic variable (ESA 1997) with a period of 0.1373890(5) days. An origin for maximum light was given at the BJD = 2448500.0260 (10), but no variable type was specified. In a preliminary search for EW candidates among the HIPPARCOS variables, Duerbeck (1997) classified V345 Gem as a suspected pulsating variable. This star was afterwards included in the 74th Special Name-List (Kazarovets et al., 1999) as DSCT. In subsequent literature, this object is still referred to as a δ Sct star (Rodriguez *et al.*, 2000), but later on Rodriguez and Breger (2001) indicated that it might be an EW with a 0.275-day period. V345 Gem is also the visual binary CCDM 07385+3343AB (Dommanget and Nys, 1994), consisting of a pair of 8.2 and 9.5 V magnitude stars separated by 3.0 arcseconds. Kazarovets *et al.* (1999) commented that "variability [of V345 Gem] might be due to the fainter (B) component".

This star was included in our observing program after concluding that its light-curve morphology, based on the HIPPARCOS photometric data folded on a 0.274778-days period (doubling that given in the HIPPARCOS Catalogue), suggested an EW or ELL type instead of a pulsating variable. Observations confirm that this star is an EW variable (Figure 2) with V and B amplitudes of 0.07 magnitudes, and primary minima about 0.005 magnitudes deeper than secondary minima in both B and V bands. Times of minimum from ground-based observations are listed in Table 4, which allowed, along with the HIPPARCOS data, to compute the following ephemeris:

$$\text{Min. I} = \text{BJD } 2448362.7224(10) + 0\overset{\text{d}}{.}2747736(2) \times \text{E}$$

Since our photometry actually consists of joint light measurements of the visual double system, if star A is the variable then the V amplitude is 0.10 mag, or 0.34 mag if component B is the eclipsing binary system.

Table 4. Minimum timings for V345 Gem

Minimum	Photometric band	Epoch
2451185.3344 ± 0.0004	B	10272.5
2451185.4730 ± 0.0003	B	10273.0
2451186.4350 ± 0.0003	B	10276.5
2451192.3396 ± 0.0004	B	10298.0
2451192.4772 ± 0.0008	B	10298.5
2451215.4217 ± 0.0002	V	10382.0
2451221.3292 ± 0.0002	V	10403.5
2451222.4275 ± 0.0002	V	10407.5
2451223.3904 ± 0.0005	V	10411.0
2451226.4131 ± 0.0005	B	10422.0
2451227.3723 ± 0.0006	B	10425.5
2451258.4240 ± 0.0004	B	10538.5

Acknowledgements: We would like to thank Joan A. Cano and Rafael Barberá for writing the software for obtaining and reducing the CCD frames. Use has been made of the SIMBAD database operated at the Centre de Données Astronomiques (CDS, Strasbourg, France) and the Astrophysics Data System (ADS).

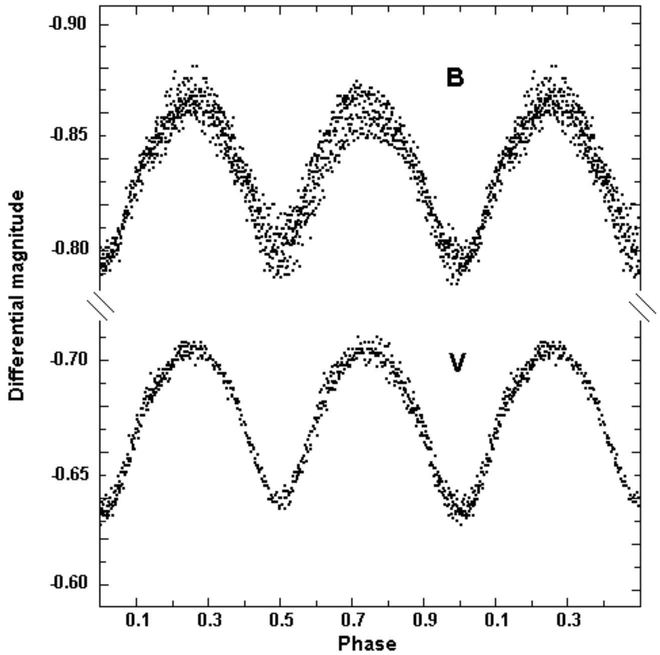

Figure 2. Differential B and V light-curves of V345 Gem

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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:

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

Enríque García-Melendo

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THE 2002 OUTBURST OF THE INTERMEDIATE POLAR GK PERSEI

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GK Per (Nova Per 1901/A 0327+43) is an intermediate polar with $P_{\rm orb} = 1.99$ days (Crampton et al., 1986) and $P_{\rm spin} = 351$ sec (Watson et al., 1985). Fluctuations by about 1 mag appeared after the nova explosion. Later, they developed into infrequent 2–3 mag outbursts (e.g. Hudec, 1981; Sabbadin & Bianchini, 1983) which were accompanied by brightenings in X-rays (e.g. King et al., 1979). The model for the thermal instability of the disk was able to reproduce the basic features of the outbursts although some problems remained (Kim et al., 1992). Dramatic variations of the energetics of the outbursts and the recurrence times occurred during the last five decades (Šimon, 2002). Nowadays, the outbursts of GK Per are quite infrequent and occur once per about 3 years. The last outburst in 2002 gave an opportunity to check if the trends in the outburst properties, determined by Šimon (2002), still hold because the activity of dwarf novae is known to undergo large, rapid changes.

This analysis makes use of the visual data of GK Per, obtained from the database of AFOEV, (CDS, Strasbourg, France) and VSNET (Japan). The reason is that the monitoring of dwarf novae is almost entirely the domain of the associations of amateur observers. The observations are mostly visual but they are very numerous and come from a large number of observers. The objectivity of the features in the light curves can therefore be assessed very well. Visual data, if treated carefully, can be very useful for analysis of long-term activity (e.g. Percy et al., 1985; Cannizzo & Mattei, 1992; Richman et al., 1994). Accuracy even better than 0.1 mag can be achieved by averaging the data, which is quite sufficient for analyses of these large-amplitude variable stars. In addition, modern methods for the data processing enable a better evaluation of the important information contained in this kind of data.

In order to smooth the light curve of GK Per, the observations were binned into one-day means. The resulting curve was then fitted by the code `HEC13`, written by Dr. P. Harmanec and based on the method of Vondrák (1969 and 1977). This method can fit a smooth curve no matter what the course of the data is. After several trials the input parameters of the fit $\epsilon = 10^{-1}$, the length of the bin $\Delta T = 5$ days were found to satisfy the course of the data. These parameters were adjusted so that just the main course of the curve was reproduced. The standard deviation of the residuals of the fit was 0.1 $m_{\rm v}$ but it should be kept in mind that this value reproduces both the observational inaccuracies and the real fluctuations which are observed during the outbursts of GK Per (e.g. Morales- Rueda et al., 1996).

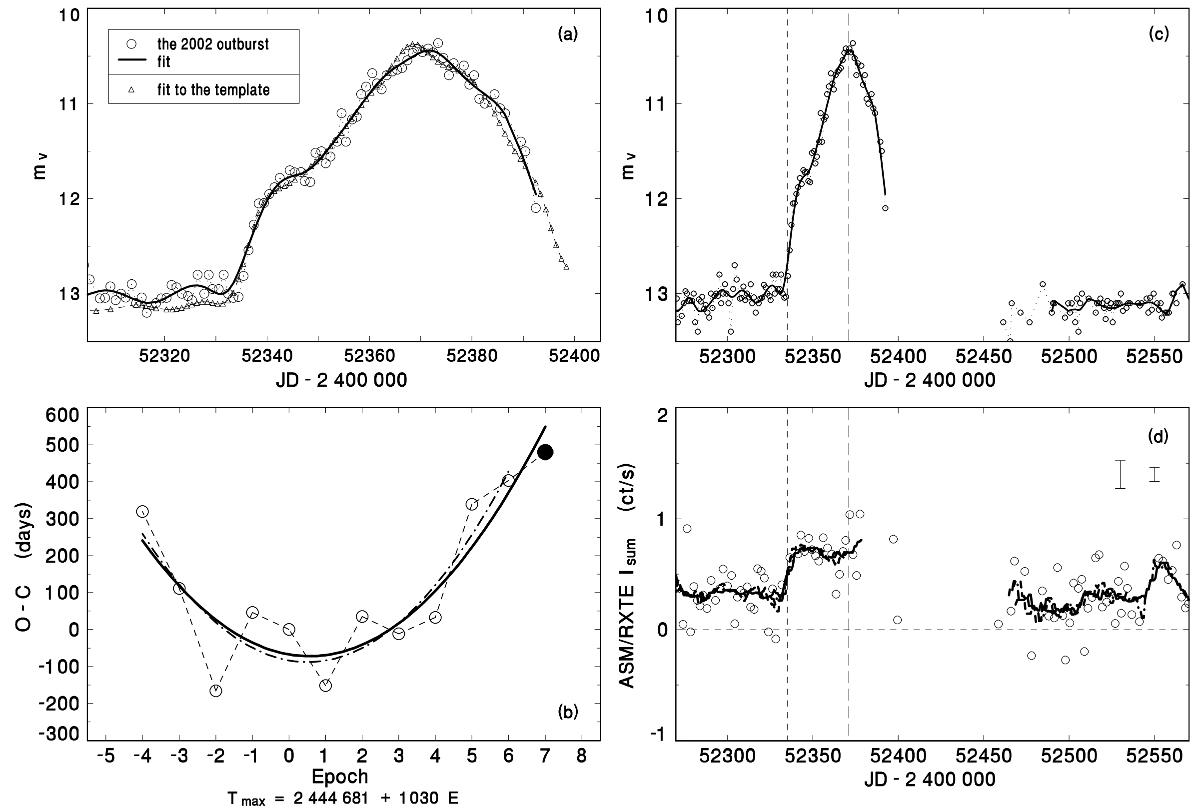

Figure 1. **(a)** The optical light curve of the 2002 outburst. The empty circles represent the one-day means while the solid curve denotes their fit by the code HEC13. For comparison, the empty triangles mark the fit to the template outburst used in Šimon (2002), shifted by 1107 days. **(b)** The $O-C$ diagram for the outbursts over the interval following the dramatic change of the outburst behaviour. The position of the 2002 outburst is marked by the filled circle. The solid and the dashed parabolae represent the fits with and without the 2002 outburst. **(c and d)** Relation between the outburst light curves in the optical and hard X-ray (1.5–12 keV) passbands. Two-day means of the $ASM/RXTE$ data, formed from the original daily means that had $\sigma_{\rm q} < 0.4$ count/sec, are plotted. The larger error bar denotes the typical $\sigma_{\rm q}$ of the daily means while the smaller one marks the standard deviation of the two-day means. The two-sided moving averages for $Q = 6$ days (dashed line), $Q = 8$ days (dot-dashed line) and $Q = 10$ days (solid line) are shown in **d**. The dashed vertical lines mark the moments of the onset and the maximum light of the outburst in the *optical* region.

The moment of the light maximum $T_{\rm max}$ = JD 2452371±2 was determined by fitting a polynomial to the upper part of the outburst light curve. The peak magnitude, $m_{\rm max}$, was determined to be 10.4. In order to assess the profile of the curve with respect to the previous events, a match of a template (the same as the one used in Šimon (2002); the preceding outburst with the maximum in JD 2451280) was applied. Also the template was smoothed by `HEC13` with the above-mentioned parameters. The result can be seen in Fig. 1a.

The relation of the 2002 outburst to the previous evolution of the recurrence time $T_{\rm C}$ can best be assessed from the $O-C$ diagram. The method of the $O-C$ residuals from some reference period (e.g. Vogt, 1980; Šimon, 2000) enables us to determine T_C in a dwarf nova and to analyse its variations. This method is not sensitive to the exact length of the reference period. The ephemeris, representative of the recent interval and determined by Šimon (2002), was used (Eq. 1). The position of the 2002 outburst in the $O-C$ diagram is marked in Fig. 1b along with the quadratic fits.

$$T_{\rm max} = 2\,444\,681 + 1030\ E \qquad (1)$$

The 2002 outburst of GK Per was covered by the All Sky Monitor (ASM) onboard the *Rossi X-ray Timing Explorer* ($RXTE$) satellite (http://xte.mit.edu/). Although the signal was relatively weak, the main trends in the X-ray light curve could be determined with certainty by a careful fitting. The $ASM/RXTE$ data cover a large part of the outburst (although partly affected by the interval of the seasonal invisibility) and so they give us a rare opportunity to compare the behaviour in the hard X-ray and optical regions. In order to lower the noise of the X-ray data, only daily means with the quoted uncertainty, σ_q, smaller than 0.4 count/sec were used. Two-day means were then calculated. We note that the rapid fluctuations in Fig. 1d are likely to be mainly caused by the observational noise. The data were therefore carefully smoothed. The two-sided moving averages were calculated for $Q = 6$, 8 and 10 days. Q refers to the semi-interval of days, within which the data were averaged. The resulting X-ray light curve is shown in Fig. 1d. The individual fits to the ASM data are in good agreement. The optical light curve is shown on the same scale for comparison (Fig. 1c).

This analysis of the 2002 outburst and its comparison with the previous dramatic evolution of the activity (Šimon, 2002) revealed that the outburst parameters stabilized. The very good agreement between the profile of the whole observed part of the 2002 event and the template (even including the most variable rising branch) reflects the large similarities in the processes involved. Notice particularly the rapid initial rise by about 1.0 m_v, followed by a significantly slower rise to the maximum. This can be interpreted in terms of the inside-out type of outburst (Smak, 1984; Hameury et al., 1998). In this case, the heating front (HF) starts in the inner disk region, propagates outward and need not reach the outer disk radius. Nevertheless, we note that the stabilization of $m_{\rm max}$ of the recent outbursts in GK Per suggests that the extent of the disk brought to the hot state stabilized – most probably the outer radius of the disk was reached by the HF. The shape and slope of the rising branch are the most sensitive to the location of the start of the HF. The almost identical profiles then also suggest that the onset of the HF occurred in quite a similar disk region.

The trend in the $O-C$ curve continues (Fig. 1b). The fit with the 2002 event differs just a little from that without it. T_C is governed by the disk viscous time scale for the inside-out type outbursts and therefore depends on the viscosity parameter in quiescence $\alpha_{\rm cool}$. It therefore appears that $\alpha_{\rm cool}$ appears to have remained almost the same for the recent several outbursts.

The relation between the optical and X-ray light curve is complicated in GK Per. The rise of the outburst in the X-ray region is very fast and coincides with the initial rapid rise in the optical passband. It displays a clearly flat profile later on although the optical flux further increases. The end of the outburst is affected by the conjunction with the Sun but the data are consistent with the simultaneous finish of the optical and X-ray outburst. We emphasize that the relation between the start of the optical and X-ray outburst is not trivial in GK Per. The relatively faint and short optical outburst in 1978 was accompanied by the X-ray brightening, whose onset preceded the optical rise by about 40 days (King et al., 1979; Bianchini & Sabbadin, 1985). Indeed, the models by Kim et al. (1992) predict that a brightening in X-ray and UV can precede the optical outbursts in GK Per by 80–120 days. Such a precursor was definitely absent in the 2002 event. The discordance between the optical and X-ray curves can imply a large change of the geometry of the accretion flow, e.g. blocking of hard X-rays by the thickened disk (Yi et al., 1992). Another alternative can be the radiation drag (Yi & Vishniac, 1994). We can conclude that the relation between the optical and X-ray course during the 2002 outburst confirms the stabilization of the activity of GK Per because it displays quite similar properties as in the two previous events in 1996 and 1999 (Šimon, 2002).

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THE LIGHT CURVE OF THE NEW CATACLYSMIC VARIABLE SDSS J015543.40 +002807.2

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SDSS J015543.40 +002807.2 was identified as a likely magnetic CV by Szkody et al. (2002) using colour and spectral criteria. The system was also proposed to be of high inclination and to have an orbital period of about 87 min. We present here the first light curve of the object. We observed SDSS J015543.40 +002807.2 with the Nordic Optical Telescope (2.56m) during one night of remote observations in the Nordic-Baltic Research Course "Astrophysics of Interacting Stars", Moletai, Lithuania, August 11-25, 2002, using StanCam and the V filter of NOT Optical Filters collection. We collected a time series of ≈ 101 min duration using 60 s exposures and 7 s readout time.

Our differential magnitudes are calculated in the sense of SDSS J015541.53 +002812.11 (which we use as a comparison star) minus the target. There were no significant variations in the comparison star during the sequence.

Table 1. The SDSS data for the object and comparison star (J2000, magnitudes)

Star	u	g	r	i	z
SDSS J015543.40 +002807.2	15.90	15.23	15.18	15.41	15.57
SDSS J015541.53 +002812.11	19.46	17.49	16.74	16.35	16.15

The shape of the light curve is quite similar to the light curve shapes of other AM Her type stars (see, for example, Sirk and Howell, 1998), but has an unusually deep and sharp minimum (about $5\overset{m}{.}9$) of 408 (± 67) seconds duration (0.08 phase), which is likely due to the total eclipse of the white dwarf and the accretion stream by the late-type secondary. The $\approx 1^{m}$ minimum before the eclipse might be identified as the far-field accretion stream dip (Sirk and Howell, 1998) superposed on a hump of around 2445-4560 seconds (0.47-0.88 phase).

It is possible to estimate the mass of the secondary using the relation $M_{sec} = 3.18 \cdot 10^{-5} P$, where P is the orbital period in seconds (Warner, 1976). Then the secondary mass is about $0.17 M_{\odot}$. Assuming a white dwarf mass in the range of $0.3 M_{\odot} - 1.4 M_{\odot}$ we can make an estimate of the inclination (Downes et al., 1986; Bailey, 1990) and the semi-major axis of the orbit. The depth of the eclipse also proves that SDSS J015543.40 +002807.2 belongs to the group of high inclination systems. We get $i \approx 78^{\circ}$ for the WD mass about $0.3 M_{\odot}$ and $i \approx 90^{\circ}$ for the mass $0.83 M_{\odot}$ (Chanan et al., 1976). We find from Kepler's third law that the semi-major axis varies from $3.3 \cdot 10^{10}$ cm (for a circular orbit at 90°) to $4.5 \cdot 10^{10}$ cm, if the semi-amplitude K is about 406 km/s (see Szkody et al., 2002). Then

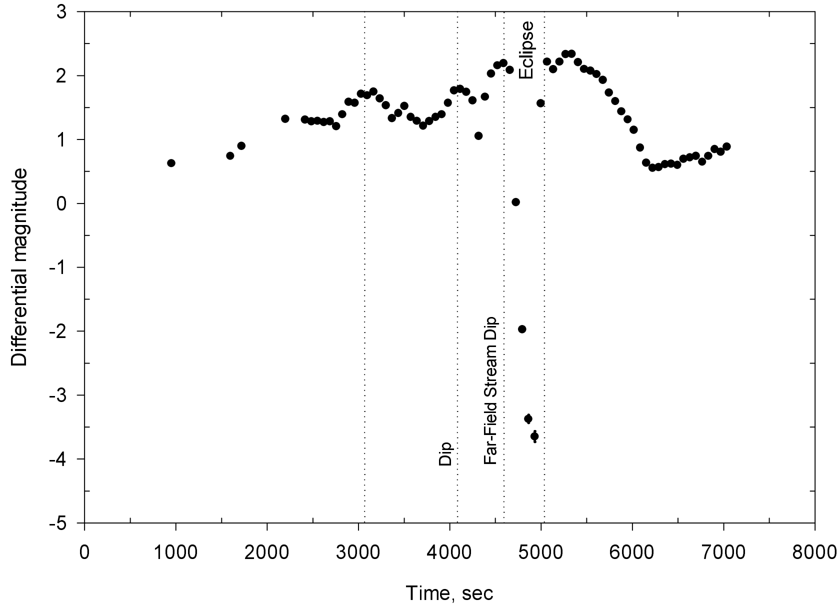

Figure 1. *V* filtered light curve of SDSS 015543.40 +002807.2. The zero point of the time scale corresponds to JD2452506.6157. Errors are less than the symbol size except for the two deep eclipse points. We also mark the possible interpretation of the curve features on the plot.

a very rough estimate of the bright stream size and/or the accretion region on the WD surface might be done assuming that the orbit is circular, and $i = 90°$. The maximum size of the bright stream in the orbital plane is determined by the time for the WD+bright region to pass into the secondary shadow, about $8.2 \cdot 10^9$ cm. This value is larger than typical WD radii ($\approx 7 - 8 \cdot 10^8$ cm) and has to include some light from the emitting stream as well.

The final conclusions about the object geometry and the model construction need to be done after further photometric observations throughout several cycles at different wavelengths are accomplished, as well as polarimetry which will establish the angle between the magnetic pole and rotation axis.

The paper is based on observations made with the Nordic Optical Telescope, operated on the island of La Palma jointly by Denmark, Finland, Iceland, Norway, and Sweden, in the Spanish Observatorio del Roque de los Muchachos of the Instituto de Astrofisica de Canarias.

The authors would like to thank Paula Szkody and Jan-Erik Solheim for the nice idea to observe SDSS J015543.40 +002807.2 and for useful consultations during the work. Also we wish to acknowledge support of Nordic-Baltic Research Course “Astrophysics of Interacting Stars” by NorFA (Nordic Research Academy) (grant 010189). And we want to give the special thanks to the NOT staff for their help during observations.

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NEW PHOTOELECTRIC PHOTOMETRY OF THE YOUNG STAR LO PEGASI

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The single, young K8 V star LO Peg (Bowyer et al., 1996) is a member of the Local Association (Jeffries and Jewel, 1993; Montes et al., 2001) and it has a high projected equatorial velocity of 69 kms^{-1} (Jeffries et al., 1994). LO Peg is an active star showing strong Hα and Ca II H, K emission lines (Jeffries et al., 1994). It has generally been chosen as a target star for Doppler imaging studies due to its short period. There are a few photometric studies on this active star up to now. So, we observed it as a part of our observing program on the young, solar type stars.

The photometric observations were carried out using SSP-5 photometer equipped to the 30 cm Schmidt-Cassegrain type telescope of Ege University Observatory between July 24 and October 31, 2002. BD +22°4417 (G0, V=9$^{\rm m}_{.}$03) and BD +22°4377 (K0, V=8$^{\rm m}_{.}$27) are chosen as the comparison and the check stars, respectively. The nightly mean differential V magnitudes and standard deviation are 0$^{\rm m}_{.}$806 and 0$^{\rm m}_{.}$014, ensuring the constancy of both comparison and check stars at this level. We obtained a total of 655 differential magnitudes (in the sense variable minus comparison) in Johnson B and V filters during 18 nights and, corrected for atmospheric extinction. The extinction coefficients were calculated for each band using the observed magnitudes of the comparison star. The times were also reduced to the Sun's center. The standard deviation of each observed point is approximately 0$^{\rm m}_{.}$018 in V band and 0$^{\rm m}_{.}$028 in B.

Jeffries et al. (1994) proposed six probable rotational periods and they stated that the periods of 0$^{\rm d}_{.}$38417 (9$^{\rm h}_{.}$22) and 0$^{\rm d}_{.}$42375 (10$^{\rm h}_{.}$17) are the more likely periods. Robb and Cardinal (1995) eliminated completely the possibility of the 0$^{\rm d}_{.}$38417 period. We used the following ephemeris to compute the phases of observations:

$$\mathrm{HJD} = 24\ 48869.93 + 0^{\rm d}_{.}42375 \times \mathrm{E}$$

It appears that the shape and the amplitude of the light curve are changing during the observing season. Therefore, we divided our data into five different groups. The light curves and $B-V$ colour curves obtained in this study are shown in Figure 1. The phases of minima are determined by representing the light curves with free hand curve, and the properties of the light curves are given in Table 1.

The light curves show wave-like distortion that is a good indicator of the spot activity. The colour curves of the first three groups do not indicate a significant variation, while

Table 1. The properties of the light curves.

Data Groups	JD range (24 52000 +)	Amplitude (mag)	θ_{min} (I)	θ_{min} (II)
I	480 – 488	0.080	0.8	0.1
II	495 – 507	0.067	0.0	
III	511 – 512	0.070	0.0	0.7
VI	536 – 542	0.069	0.7	
V	549 – 579	0.046	0.4	

those of the last two groups show remarkable changes. As can be seen from Figure 1 the light curves have three properties clearly seen: (1) Generally, they show strong asymmetry which implies the effect of the second starspot (θ_{min} II), its traces are quite obvious in Groups I and III. (2) The amplitude of the light curves slightly decreases from the beginning of the observing season to the end of it. These amplitudes are much lower than those given in the literature (the amplitudes of $0\overset{m}{.}15$ and $0\overset{m}{.}20$ were given by Jeffries et al. (1994) and Robb and Cardinal (1995), respectively). (3) It can be clearly seen that there is a shift at the phase of the wave-like distortion. When we compare the light curves presented in Groups I and V, this phase shift is quite evident. Robb and Cardinal (1995) mentioned about the amplitude variation on a daily timescale, but there is no comment about shifting at the wave minimum in the literature. The cycle-to-cycle variation of both the amplitude and the phase of the wave minimum were also reported for some rapidly rotating, young stars like FR Cnc (Pandey, 2002), AB Dor (Bos, 1994; Donati and Collier-Cameron, 1997) and Speedy Mic (Barnes et al., 2001). We need more photometric observations to determine the activity nature of LO Peg.

The authors would like to thank Dr. K. Olah for her valuable suggestions.

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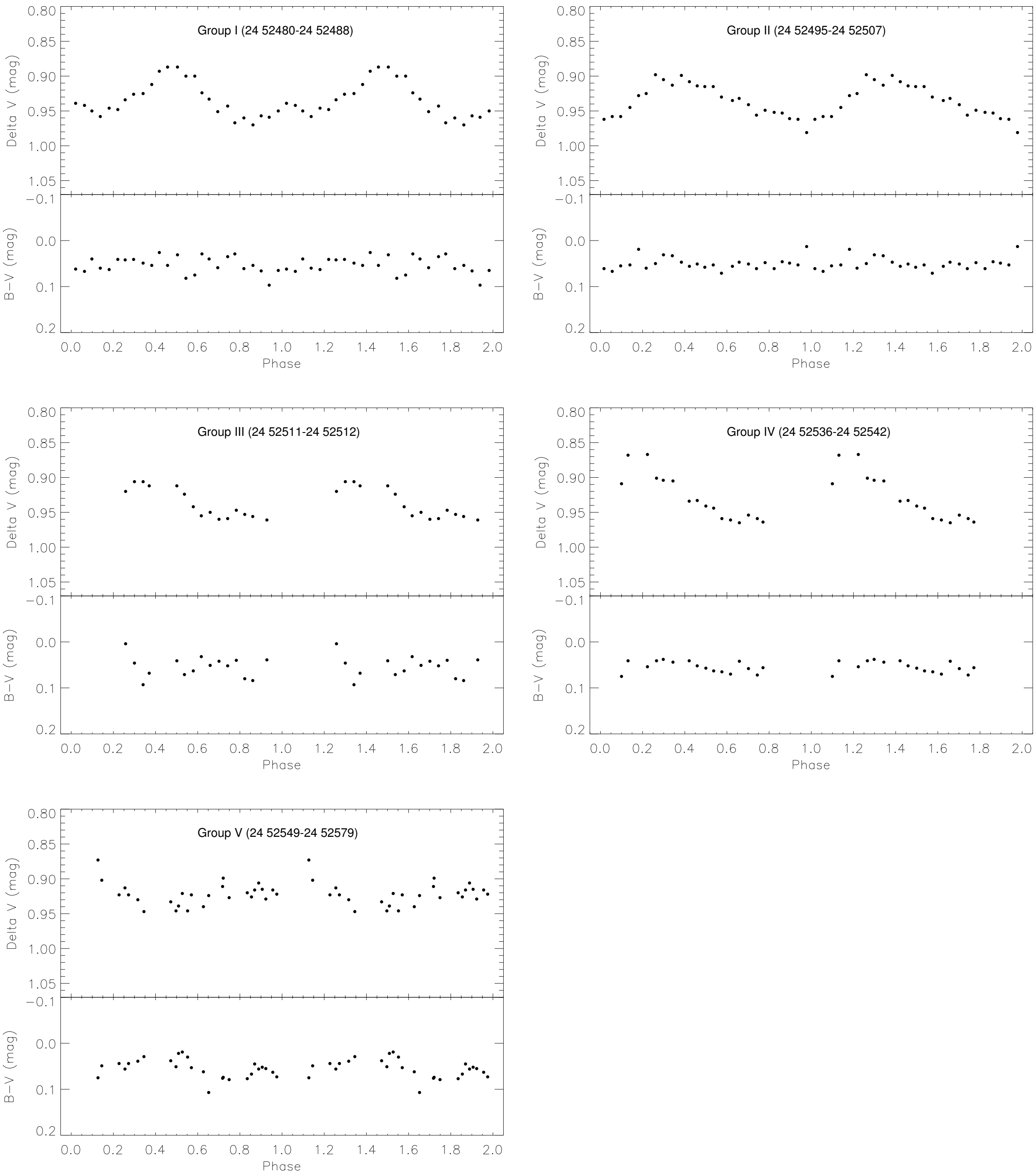

Figure 1. The light curves of LO Peg in V band. The data show the average observing points with 0.04 phase intervals.

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V781 Tau: IMPROVED EVIDENCE FOR AN ORBITAL PERIOD CHANGE

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V781 Tau (= SAO 077615) is a G0 over-contact ($\sim$ 23%) binary. It was discovered by Harris (1979). Cereda et al. (1988) presented a photometric, and Lu (1993) a radial velocity analysis, while Zwitter et al. (2003) explored the spectroscopic and photometric solution based on Hipparcos photometry and GAIA-mode spectroscopic observations.

The orbital period is 0.34 days with the value changing with time. Liu & Yang (2000) established that the binary ephemeris published by Cereda et al. (1988):

$$\mathrm{Min.I} = \mathrm{HJD}\ 2443853.9096 + 0.3449094 \times \mathrm{E} \tag{1}$$

was not followed exactly. The residuals pointed to a quadratic solution with the binary period decreasing with time:

$$\mathrm{Min.I} = \mathrm{HJD}\ 2443853.9110 + 0.344909292 \times \mathrm{E} - 2.5 \times 10^{-11} \times \mathrm{E}^2 \tag{2}$$

This corresponds to a period decrease of $\mathrm{d}P/P = -5.0 \times 10^{-11}$.

Conclusions of Liu & Yang (2000) were based on 14 photographic observations of minima by Berthold (1983) and on 15 photoelectric minima determinations by Cereda et al. (1988), Pohl et al. (1987) and Keskin & Pohl (1989). Liu & Yang added two minima obtained in 1997 and 1998. These two points proved crucial for the determination of the parabolic term of the ephemeris (Eq. 2) and need robust confirmation by extending measurements of the times of minima well into the descending branch of the parabolic approximation. We report here on 10 additional minima secured between Nov-2001 and Jan-2003 to the aim of confirming the trend and strengthen the solution. This increases the total number of minima observed after the year 1990 to 12, therefore substantially decreasing the uncertainty of the orbital ephemeris.

Observations were obtained at the Remanzacco observatory (13°18′59″ E, 46°5′11″ N) by members of A.F.A.M. (Associazione Friulana di Astronomia e Meteorologia). A 0.45-m F/24 Cassegrain telescope was used. The detector was an 1P21 photoelectric photometer. B and V filters conform to the Johnson system. Table 1 summarizes the observing log. Each data point listed in the № column of Table 1 is actually an average of twelve consecutive 5-sec integrations. The comparison star was TYC 1870-514-1 (V=9$^{\mathrm{m}}_{.}$68, B=10$^{\mathrm{m}}_{.}$08)

Table 1. Observations of V781 Tau used to determine times of photometric minima. Columns give the HJD, number of observations and type of filter used.

HJD	№	filter	HJD	№	filter	HJD	№	filter
2452229	56	B	2452230	51	B	2452231	89	B
2452252	82	B	2452260	41	B	2452587	21	V
2452652	41	V	2452658	60	V	2452659	49	V
2452665	86	B	2452666	61	B			

with colours very similar to V781 Tau. Typical errors of individual V and B band observations of V781 Tau are ~ 0.007 mag.

Times of minima were determined by the algorithm of Kwee & Van Woerden (1956). Table 2 reports times of 10 new minima together with their cycle number and residuals with respect to the ephemeris of Equation 1.

Table 2. Times of photometric minima with their standard deviations, type of minimum and filter used. The last two columns give the cycle number and ($O-C$ in days) according to the Equation 1.

HJD		type	filter	E	$(O-C)$
2452229.5042	± 0.0018	sec.	B	24283.5	− 0.0128
2452230.5361	± 0.0009	sec.	B	24286.5	− 0.0157
2452231.3946	± 0.0006	prim.	B	24289.0	− 0.0194
2452231.5723	± 0.0012	sec.	B	24289.5	− 0.0142
2452252.4369	± 0.0066	prim.	B	24350.0	− 0.0166
2452252.6076	± 0.0057	sec.	B	24350.5	− 0.0183
2452260.3694	± 0.0027	prim.	B	24373.0	− 0.0170
2452658.3967	± 0.0066	prim.	V	25527.0	− 0.0151
2452659.4252	± 0.0039	prim.	V	25530.0	− 0.0214
2452666.3276	± 0.0015	prim.	B	25550.0	− 0.0172

Figure 1 is an $O-C$ diagram of the period change for V781 Tau. The figure is identical to that in Liu & Yang (2000), but supplemented with our new observations from Table 2. We note that our minima show a certain degree of scatter. Average difference between the observed points and the parabolic solution is -0.0003 ± 0.0024 days. This is in general agreement with errors of minima determination (Table 2). But average $(O-C)$ residuals for the two observing seasons lie exactly on the parabolic ephemeris given by Equation 2. Our new data points clearly confirm the parabolic ephemeris of Liu & Yang. The observations from the literature have widely varying and sometimes subjective error estimates. We therefore refrain from re-estimation of errors of the Liu & Yang ephemeris.

We conclude that the period change in V781 Tau is now better constrained. Wang (1994) and Liu & Yang (2000) suggested that period decreases due to shrinking of the less massive star in a binary. The stars are in contact, so the missing volume is immediately filled by material from the other star. Change in the mass ratio of the stars finally decreases the orbital period. The shrinking star releases some gravitational energy to support its surface effective temperature higher than the other star. Zwitter et al. (2003) find that the component with the lower mass in V781 Tau is ~ 220 K hotter than the more massive one. Such a scenario may be common among the binaries of W UMa type.

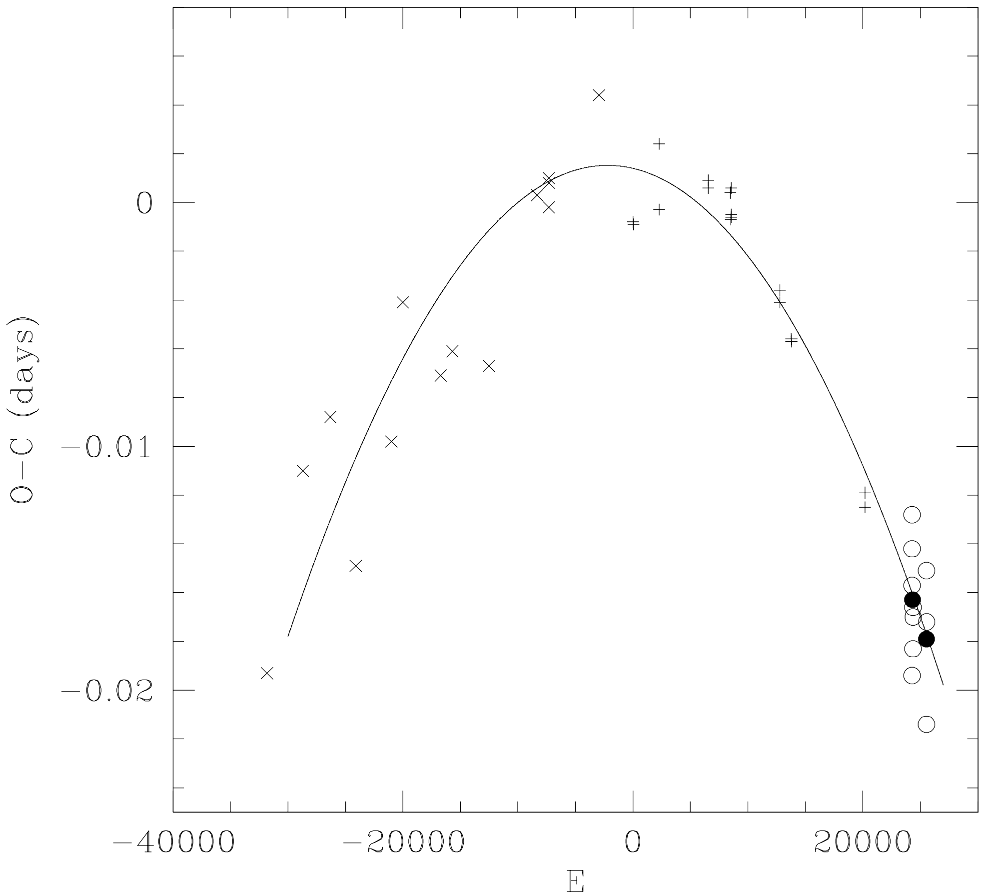

Figure 1. $O-C$ diagram of the period change for V781 Tau. Crosses indicate photographic observations and plus signs are photoelectric observations from the literature. Open circles mark photoelectric minima from this paper. Filled circles are their yearly averages for the 2001/2002 and 2002/2003 observing seasons. The curve denotes parabolic ephemeris from Equation 2.

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UBV OBSERVATIONS OF THE Be STAR γ Cas (1983-87)

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The Be star γ Cassiopeiae is ejecting rings of gas due to its rapid rotation, therefore this is also a shell star. Its visual magnitude varies between about 3.0 and 1.6, although usually it stays around 2.5. This star is one of ROSAT's bright sources and also an IRAS source.

Over six years of 1982-1988, i.e. in the period of an international campaign (see Horaguchi et al., 1994), the Be star, γ Cas has been observed at Yonsei University Observatory (YUO). As comparison HR113 was observed (see Table 1). During that period we used the 40-cm (at Campus Station) and the 61-cm (at Ilsan Station) reflectors of YUO which were equipped with PMT photometers and UBV filters, and with a chart recorder. The Campus Station is at the downtown and the Ilsan Station is in the suburb of Seoul. One or more standard stars were observed continuously throughout the nights, and extinction coefficients at each observing station were determined, some of them are listed in Table 2.

Table 1. Some information on γ Cas as program star and HR113 as comparison.

Star	BD	HD	R.A. (1950.0)	Dec. (1950.0)	Sp.	V	$(B-V)$	$(U-B)$	Ref.*
γ Cas	+59°0144	5394	$00^h53^m40^s$	+60°26′47″	BOIVe	2.47	+2.47	−0.15	1
HR113	+59°0068	2626	$00^h27^m32^s$	+59°42′05″	B9IIIn	5.94	+0.01	−0.36	1, 2

* 1: Hoffleit (1982), 2: Harmanec et al. (1981)

Table 2. UBV extinction coefficients at YUO.

$JD_\odot$2440000+	k_v	k_b	k_u	$JD_\odot$2440000+	k_v	k_b	k_u
5635.5	0.32	0.505	0.88	6340.5	0.261	0.327	0.50
5709.5	0.327	0.533	0.93	6359.5	0.372	0.507	0.87
5731.5	0.380	0.547	0.90	6372.5	0.176	0.395	
5740.5	0.257	0.433	0.78	6384.5	0.240	0.349	0.78
5987.5	0.540	0.800		6400.5	0.289	0.396	0.62
5987.5	0.540	0.800		6404.5	0.407	0.481	0.71
5994.5	0.181	0.362	0.70	6444.5	0.194	0.336	0.69
6003.5	0.298	0.505	0.89	6444.5	0.194	0.336	0.69
6072.5	0.163	0.357	0.74	6454.5	0.358	0.559	0.93
6271.5	0.604	0.770	1.35	6459.5	0.373	0.564	0.91
6338.5	0.235	0.417		6467.5	0.308	0.500	0.82
6339.5	0.324	0.435	0.65	6491.5	0.432	0.633	0.97

Table 3. Constants for UBV standardization in 1982-1988 at YUO.

Observing Season	C_1	C_2	C_3	C_4	C_5	C_6	Observatory*
82 09 0183 08 31	1.506	−0.069	0.415	0.867	−0.625	1.167	C
83 09 0184 05 31	1.545	−0.015	0.320	0.916	−0.361	1.092	C
86 06 0187 01 06	0.200	−0.050	0.350	0.890	0.050	1.150	C
87 01 2987 08 31	1.265	−0.015	−0.375	0.891	−0.560	1.230	C
87 09 0188 05 31	0.865	−0.047	0.375	0.890	−0.395	1.200	C
82 10 0183 08 31	1.040	−0.050	0.330	0.890	−0.480	1.095	I
83 09 0184 09 20	0.850	−0.050	0.330	0.895	−0.490	1.135	I
84 09 2184 12 05	−0.512	−0.038	0.355	0.890	−0.460	1.118	I
84 12 0685 08 31	1.100	−0.069	0.345	0.900	−0.535	1.123	I
85 09 0185 11 30	1.290	−0.050	0.320	0.863	−0.345	1.128	I
85 12 0186 08 31	0.935	−0.042	0.285	0.895	−0.395	1.195	I
86 09 0186 10 30	0.865	−0.103	0.295	0.880	−0.450	1.130	I
86 11 0186 11 10	2.700	0.000	0.192	0.808	−0.125	1.175	I
86 11 1187 02 25	1.242	0.035	−0.350	0.835	−0.395	1.140	I
87 02 2687 08 16	0.885	−0.065	0.275	0.920	−0.475	1.120	I
87 08 1787 10 25	0.808	−0.060	0.368	0.887	−0.395	1.105	I
87 10 2687 11 03	0.808	−0.060	0.368	0.887	−0.558	1.105	I
87 11 0488 02 31	0.450	−0.060	0.368	0.887	−0.395	1.105	I

* C: Campus Station, I: Ilsan Station

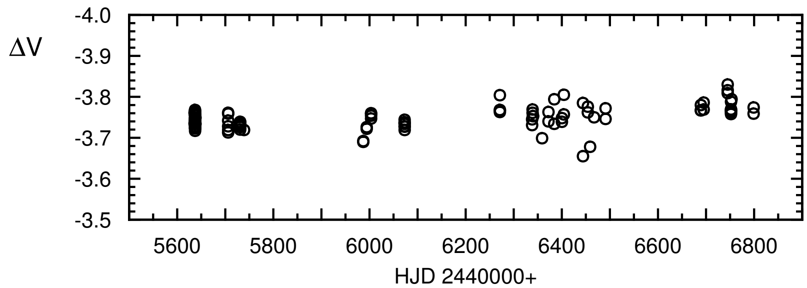

Figure 1. ΔV light curve of γ Cas in 1983-1987.

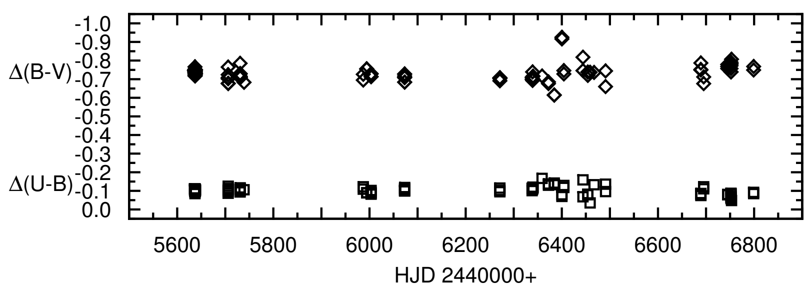

Figure 2. Color index curves of γ Cas in 1983-1987.

The UBV observation sequence of the program star for one observation point is approximately same as that suggested by Harmanec et al. (1977). Recorded tracings on the chart paper at a given time for each filter are determined with the sky brightness subtracted. For the comparison star the readings in the three filters were determined at different time, but for the program star the observing time is fixed as the epoch of observation with the middle filter. For standardization the usual equations

$$V - v = C_1 + C_2(B - V), \quad B - V = C_3 + C_4(b - v), \quad U - B = C_5 + C_6(u - b)$$

Table 4. *UBV* Observations of γ Cas (1983-1987).

$JD_\odot$ 2440000+	ΔV	$\Delta(B\text{-}V)$	$\Delta(U\text{-}B)$	$JD_\odot$ 2440000+	ΔV	$\Delta(B\text{-}V)$	$\Delta(U\text{-}B)$
5636.0554	−3.725	−3.829	−4.576	6072.9921	−3.724	−3.828	−4.556
5636.0676	−3.751	−3.862	−4.609	6073.0042	−3.734	−3.836	−4.563
5636.9679	−3.738	−3.833	−4.579	6073.0141	−3.728	−3.828	−4.545
5636.9800	−3.746	−3.847	−4.600	6073.0253	−3.726	−3.839	−4.547
5637.0050	−3.756	−3.841	−4.607	6073.0749	−3.718	−3.817	−4.527
5637.0405	−3.745	−3.846	−4.598	6073.0860	−3.717	−3.828	−4.512
5637.0503	−3.737	−3.838	−4.582	6073.1002	−3.709	−3.827	−4.511
5637.0635	−3.752	−3.850	−4.593	6073.0042	−3.734	−3.836	−4.563
5637.0718	−3.758	−3.856	−4.609	6271.1281	−3.757	−3.872	−4.563
5637.0773	−3.754	−3.854	−4.607	6271.1416	−3.794	−3.896	−4.604
5637.1087	−3.749	−3.860	−4.600	6271.1547	−3.758	−3.860	−4.563
5637.1177	−3.734	−3.843	−4.584	6338.2612	−3.721	−3.834	−4.544
5637.1198	−3.728	−3.831	−4.563	6338.2752	−3.735	−3.836	−4.536
5637.1312	−3.732	−3.828	−4.568	6339.2005	−3.759	−3.867	−4.560
5637.1335	−3.730	−3.831	−4.566	6339.2175	−3.751	−3.864	−4.603
5637.1460	−3.728	−3.825	−4.573	6340.1858	−3.743	−3.858	−4.574
5637.1564	−3.732	−3.834	−4.579	6340.1946	−3.743	−3.863	−4.563
5637.1640	−3.723	−3.832	−4.574	6358.9883	−3.689	−3.856	−4.573
5637.1724	−3.717	−3.823	−4.560	6372.2259	−3.730	−3.867	−4.543
5637.1748	−3.718	−3.814	−4.562	6372.2403	−3.753	−3.883	−4.568
5637.1828	−3.747	−3.848	−4.582	6384.2264	−3.724	−3.857	−4.472
5637.1854	−3.740	−3.845	−4.579	6384.2660	−3.784	−3.926	−4.540
5637.1953	−3.713	−3.815	−4.532	6400.2058	−3.738	−3.808	−4.733
5637.2048	−3.713	−3.817	−4.541	6400.2198	−3.729	−3.808	−4.724
5637.2074	−3.707	−3.816	−4.534	6404.1937	−3.747	−3.876	−4.604
5637.2165	−3.733	−3.837	−4.560	6404.2076	−3.795	−3.913	−4.659
5637.2167	−3.713	−3.816	−4.546	6443.9570	−3.645	−3.804	−4.550
5638.1064	−3.739	−3.845	−4.595	6443.9658	−3.775	−3.843	−4.661
5638.1193	−3.724	−3.825	−4.554	6454.1053	−3.766	−3.848	−4.568
5706.0032	−3.751	−3.848	−4.572	6454.1155	−3.752	−3.831	−4.569
5706.0158	−3.703	−3.790	−4.555	6458.9173	−3.668	−3.703	−4.440
5706.0243	−3.718	−3.820	−4.522	6467.0148	−3.740	−3.873	−4.609
5706.0342	−3.732	−3.839	−4.547	6490.9468	−3.736	−3.872	−4.532
5706.0520	−3.749	−3.862	−4.540	6490.9692	−3.762	−3.858	−4.602
5706.0616	−3.709	−3.834	−4.510	6689.2299	−3.757	−3.843	−4.630
5730.9149	−3.729	−3.823	−4.608	6689.2599	−3.757	−3.832	−4.584
5730.9238	−3.721	−3.828	−4.556	6689.2698	−3.770	−3.850	−4.599
5730.9338	−3.725	−3.826	−4.556	6659.0916	−3.776	−3.898	−4.574
5730.9506	−3.726	−3.839	−4.548	6695.1009	−3.759	−3.870	−4.582
5730.9591	−3.728	−3.834	−4.542	6744.9829	−3.820	−3.900	−4.679
5730.9661	−3.716	−3.823	−4.532	6744.9930	−3.806	−3.885	−4.642
5730.9965	−3.710	−3.826	−4.542	6745.0002	−3.799	−3.879	−4.647
5731.0073	−3.717	−3.824	−4.537	6751.9196	−3.751	−3.838	−4.577
5739.0278	−3.709	−3.815	−4.498	6751.9274	−3.755	−3.836	−4.593
5987.0062	−3.680	−3.789	−4.515	6751.9354	−3.778	−3.841	−4.622
5987.0144	−3.682	−3.804	−4.499	6751.9429	−3.755	−3.825	−4.597
5994.1260	−3.712	−3.801	−4.557	6751.9606	−3.748	−3.806	−4.597
5994.1350	−3.716	−3.806	−4.560	6751.9680	−3.759	−3.824	−4.608
6003.2645	−3.750	−3.852	−4.565	6751.9752	−3.759	−3.843	−4.582
6003.2848	−3.744	−3.826	−4.556	6752.9983	−3.784	−3.832	−4.639
6003.2947	−3.737	−3.823	−4.551	6798.9658	−3.749	−3.841	−4.590
6003.3091	−3.749	−3.841	−4.555	6798.9755	−3.764	−3.849	−4.617

are used where ubv, UBV and C_i stand for instrumental magnitudes, standard UBV magnitudes, conversion constants, respectively. C_is listed in Table 3 are applied for each observing season. Details about observing and reducing procedures including the procedure of standardization to Johnson UBV system were described by Nha et al. (1986) and Jeong (1988).

In this period we obtained 312 observations (104 in U, 104 in B, 104 in V) as listed in

Table 4 and stored as electronic file available at the IBVS website as 5392-t4.txt. (These data had been already published by Jeong (1988), but are not easily available to the community because it was written in Korean and this is one aim of this paper to publish in IBVS.) Table 4 lists the observed data with respect to HR113. ΔV, $\Delta(B-V)$, and $\Delta(U-B)$ light and color index curves constructed with the data are shown in Figure 1 and Figure 2. Some light curves constructed using these (Jeong, 1988) data had been reported by Jeong & Lee (1988) and Horaguchi et al. (1994).

In 1965-1987 the visual magnitude of γ Cas has gradually increased. Jeong & Lee (1988) shows that its V magnitude of 2.20-2.15 in 1983-1987 slightly exceeded the level of its pre-outburst in the 1930s. They found that the V light of γ Cas reached its minimum three times during the 1969-1987 period when V/R was at maximum. Such a light behavior is also discussed by Jeong and Lee (1988) and Horaguchi et al. (1994), especially in connection with $B-V$ changes, V/R variations of Hα and Hβ, high velocity narrow absorption component exhibited in the far UV.

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THE MINIMA OF THE ECLIPSING BINARY SYSTEM Y Cyg

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Y Cyg (HD 198846) ($7^{\rm m}_{.}30 - 7^{\rm m}_{.}90$ (V), Sp O9.8V, P = $2^{\rm d}_{.}9963328$) is an eclipsing binary with many remarkable properties. Popper (1980) gives a spectral type of O9.8V for both components, so Y Cyg is one of a small number of O–type binary stars for which we can determine physical parameters. These parameters will provide (Hill and Holmgren, 1995) important constraints on evolutionary models of O–type stars. This binary system has a most awkward orbital period of 2.9963328 days (approximately 5 minutes shorter of three sidereal days), making it impossible to observe a complete orbital cycle from one observatory in a single observing season.

Y Cyg is the classic example of apsidal motion, with the period of this effect being 47.6 ± 0.2 years (Gimenez et al., 1987). Gies and Bolton (1986) have shown that Y Cyg is an OB runaway star, due to its large space velocity.

The author observed this system in 1989 at Kazan Station in Special Astrophysical Observatory (Russia) using the 48 cm reflector with an UBV photometer around Min I in V filter, and in 1990 at Crimean Station of Sternberg Astronomical Institute (Russia) using a $WBVR$ photometer at the Zeiss-600 telescope around Min II also in V filter. BD+34°4196 was used as a comparison star. Reduction for atmospheric absorption was applied.

The first complete photometric study of Y Cyg was that by Dugan (1931). Magalashvili and Kumsishvili (1959) (MK hereafter) presented a complete photometric light curve but only in one “colour” (actually the unfiltered photomultiplier response) (Hill and Holmgren, 1995). Both Dugan and MK presented analyses of their data. The data of MK were reanalyzed by Giuricin et al. (1980), using WINK light curve synthesis code (Wood, 1971). An international campaign by O’Connell (1977) resulted in an improved apsidal period, but an incomplete UBV light curve for Y Cyg. Stickland et al. (1992) observed it with IUE for radial velocity and also derived a light curve. Zaitseva, Lyutyi and Martynov (1971) observed also this system near Min I, II in accordance with the recommendations of the Commission 42 of the IAU. The quality of all the available light curves is not satisfactory (Hill and Holmgren, 1995).

From our observations we have determined the times of minima I, II using the method of Khaliullina and Khalliulin (1984) from our observations :

$$\text{Min I} = \text{JD Hel } 2447767.657 \pm 0.003$$
$$\text{Min II} = \text{JD Hel } 2448179.3802 \pm 0.0002$$

We obtained our observations many years ago, but to publish these minima still has importance, because there is a gap in photoelectric minima observations in that time :

Min I { 2446287.4210 – Pohl et al. (1987)
2448528.7316 – Caton and Burns (1993)

Min II { 2447304.4480 – BBSAG (1988)
2450672.3717 – Agerer and Hubscher (1998)

As an example in Figure 1 we show our observations in V filter obtained at Crimean Station (Min II) in 1990. The ΔV is the difference between V magnitudes of Y Cyg and the comparison star. The phases on the figure were calculated by the ephemeris of O'Connell (1977) :

$$\text{Min I} = \text{JD Hel } 2409453.4192 + 2\overset{d}{.}9963328 \text{ E} .$$

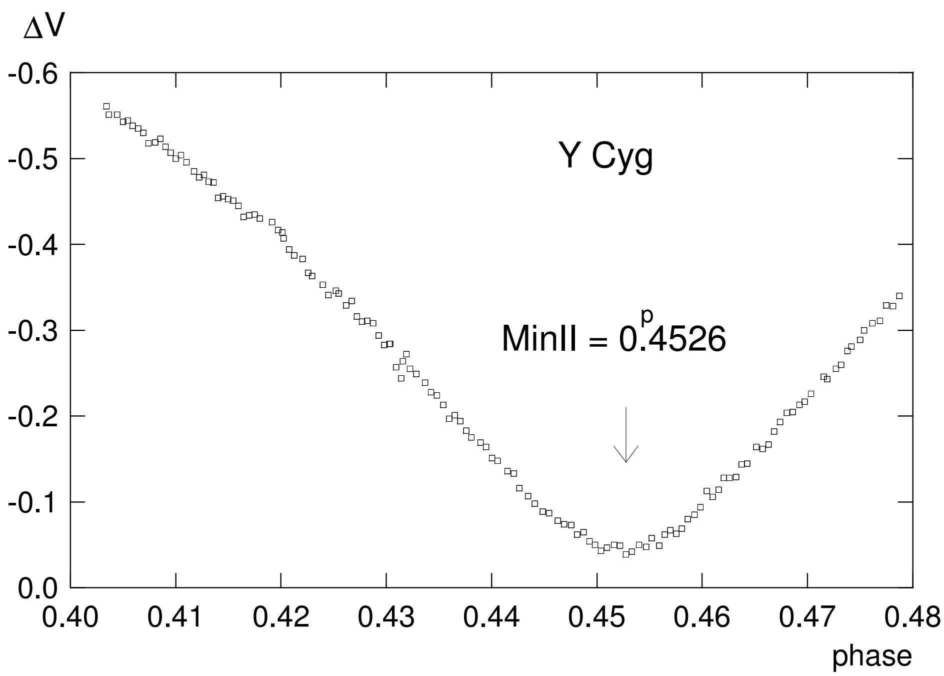

Figure 1. The light curve for Y Cyg in the secondary minimum (The Crimean observations).

The depth of MinII is $0\overset{m}{.}59(V)$ according to our estimation, the mean out-of-eclipse ΔV is $-0\overset{m}{.}630$ evaluated from six observations outside eclipses.

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DATABASE ON BINARIES AMONG GALACTIC CLASSICAL CEPHEIDS

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A new website has been created containing information on classical Cepheids in the Milky Way galaxy which are known to have physical companion(s). Its URL is:

`http://www.konkoly.hu/CEP/intro.html` .

This site complements the two other important databases on Cepheids (not only on binaries) that are available on the Internet:
– the Database of Galactic Classical Cepheids maintained by the David Dunlap Observatory (Fernie et al. 1995):
`http://ddo.astro.utoronto.ca/cepheids.html` ;
– and the McMaster Cepheid Photometry and Radial Velocity Data Archive:
`http://dogwood.physics.mcmaster.ca/Cepheid/HomePage.html` .

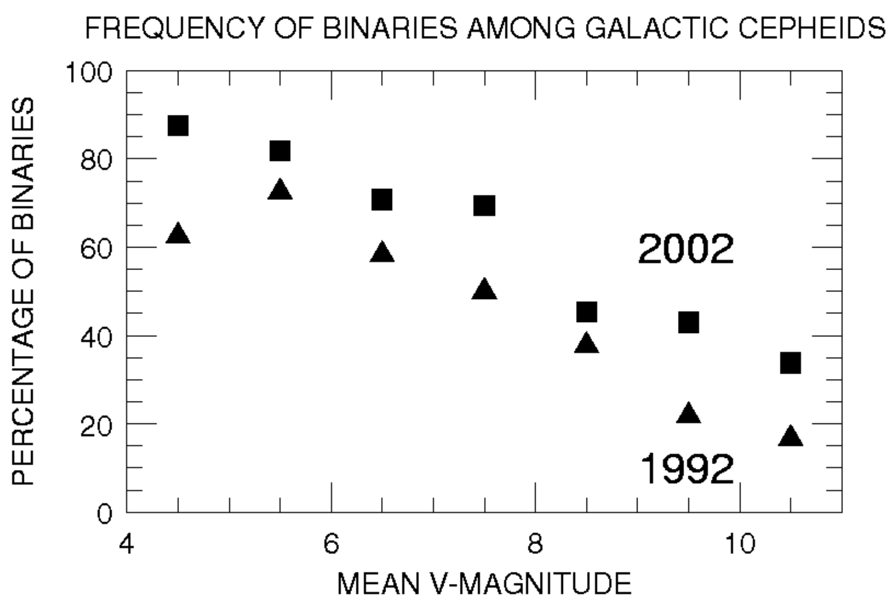

Figure 1. Frequency of occurrence of known binaries among the classical Cepheids in our Galaxy and its increase during the last decade (triangles: 1992; squares: 2002).

The site is intended to give easily accessible background information for those who are involved in performing or analysing photometric or spectroscopic observations of classical

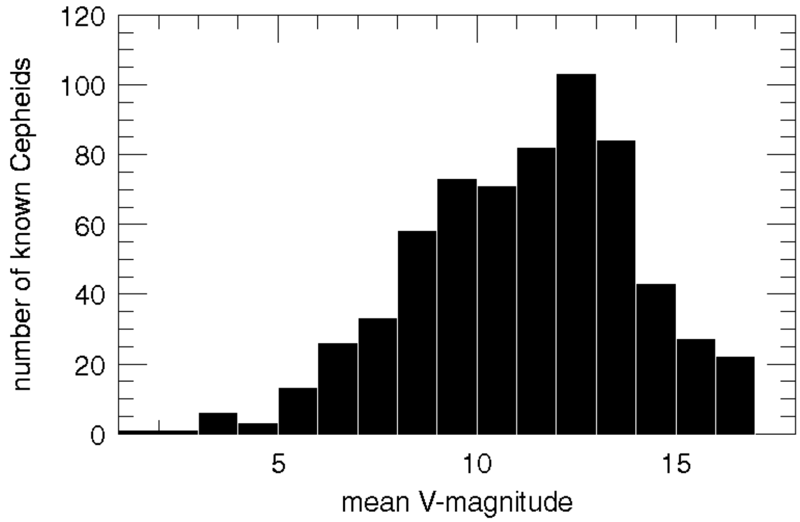

Figure 2. Histogram showing the distribution of Galactic Cepheids as a function of the average apparent brightness.

(i.e. Pop. I) Cepheids. When compiling this list, the published literature was critically reviewed, and whenever new pieces of information are available, the site is revised, updated and extended.

When involving binary Cepheids in any study that makes use of the regular behaviour of these variables, e.g. works related to the period-luminosity relationship, one has to pay special attention to the effect of companions. As far as photometric data are concerned, the effect of the companion is essential in deriving the apparent brightness and the intrinsic colour indices of the Cepheid. If the effect of a blue main-sequence companion is not taken into account (i.e. the observed brightness is attributed solely to the Cepheid), the apparent magnitude and colour indices can be falsified by several hundredth of a magnitude. The false (bluer) colour introduces an error in the derivation of the interstellar extinction, mimicking a smaller amount of absorption. Together with the brighter apparent magnitude (also due to the companion) the Cepheid seems to be more luminous than it is in reality. In brief, negligence of the companion(s) leads to an erroneous zero-point of the period-luminosity relationship (see e.g. Szabados, 1997).

It would be an easy but unreasonable solution to exclude Cepheids belonging to binary systems from the calibration of the period-luminosity relation because majority of classical Cepheids have one or more companions (Szabados, 2003). Figure 1 demonstrates the strong increase in the percentage of recently revealed binaries among Galactic Cepheids, as well as the still existing selection effect: the brighter Cepheids are amply studied from the point of view of duplicity but towards fainter Cepheids, these variables have not been properly investigated in order to point out their companion(s). The distribution of Galactic Cepheids as a function of the average apparent brightness is shown in Figure 2. It is seen that half of the known Cepheids in our Milky Way galaxy are fainter than 11th magnitude. It is worth mentioning that there are only 20 known binaries in the subsample (about 400 stars) containing the fainter half of the known Cepheid population.

The new database consists of three parts, each of them can be accessed from the Introduction, and the tables are interconnected by properly placed links. The main table contains the GCVS identification of the Cepheid linked to the SIMBAD Database (CDS, Strasbourg, France), the pulsation period, the mean brightness in the V band of the Johnson UBV system, the spectral type of the companion, the duplicity status of the Cepheid, remark on the importance or peculiarity of the given Cepheid, and a comprehensive but not exhaustive list of references linked to the bibliographical part of the site. A separate table contains the orbital elements for binary Cepheids, while the third part is the bibliography. Most of the references listed there are directly linked to the CDS bibliographic service or ADS.

Acknowledgements. The new database was compiled in the frame of the OTKA projects T029013 and T034584. Comments and additional information on new or already known binary Cepheids are welcome (to the address `szabados@konkoly.hu`), in order to update the content of the tables.

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ELEMENTS FOR 6 RR Lyr STARS

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The variability of these stars was announced by Hoffmeister (1967, 1968); no further observations or ephemeris were published until today. Recent estimations, made on photographic plates taken with the Sonneberg Observatory 40cm Astrograph during the years 1964-1994, have allowed to determine the type of variability as well as first elements (see Table 1). The given elements were obtained by means of least-squares solutions. Photographic amplitudes were derived with respect to magnitudes of the comparison stars given in Table 3. Individual data are available upon request.

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

Table 1. Summary of this paper

Star	Type	Epoch 2400000+	Period (day)	Max.	Min.	M−m	No. of Plates
V1057 Oph	RRab	44749.445	0.6180418	$14^m_.5$	$15^m_.8$	$0^P_.14$	236
		±7	±10				
V1122 Oph	RRab	45525.438	0.5037831	$14^m_.6$	$15^m_.8$	$0^P_.10$	236
		±5	±5				
V1130 Oph	RRab	44704.505	0.4494288	$14^m_.9$	$15^m_.6$	$0^P_.11$	217
		±5	±6				
V1429 Oph	RRab	45075.503	0.5750345	$13^m_.7$	$14^m_.6$	$0^P_.15$	230
		±8	±10				
V1600 Oph	RR(c:)	45003.673	0.3079728	$14^m_.6$	$16^m_.0$		214
		±4	±3				
NSV 8003	RRab	48067.418	0.7481946	$14^m_.3$	$15^m_.5$	$0^P_.17$	223
		±9	±12				

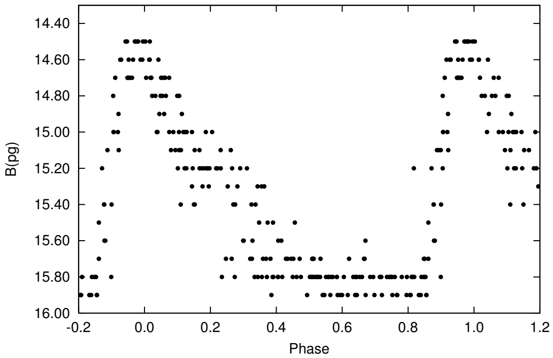

Figure 1. Light curve of V1057 Oph

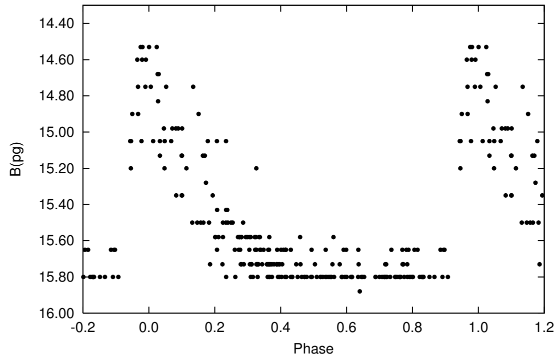

Figure 2. Light curve of V1122 Oph

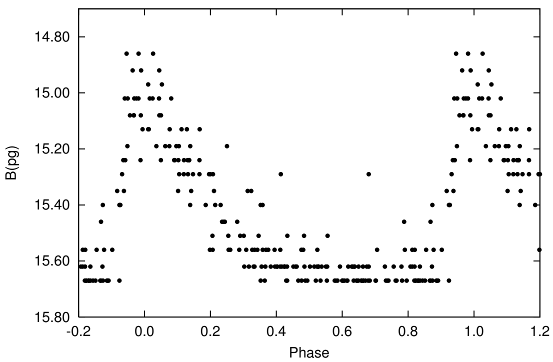

Figure 3. Light curve of V1130 Oph

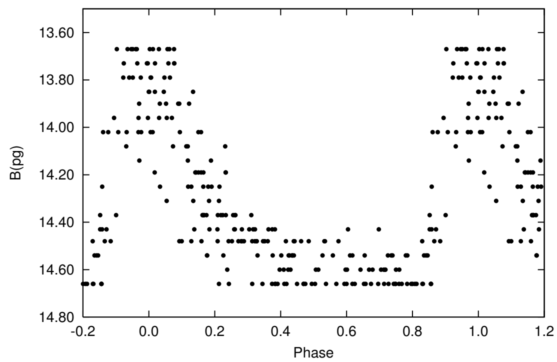

Figure 4. Light curve of V1429 Oph

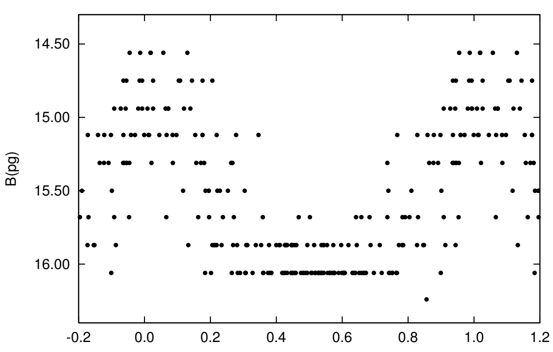

Figure 5. Light curve of V1600 Oph

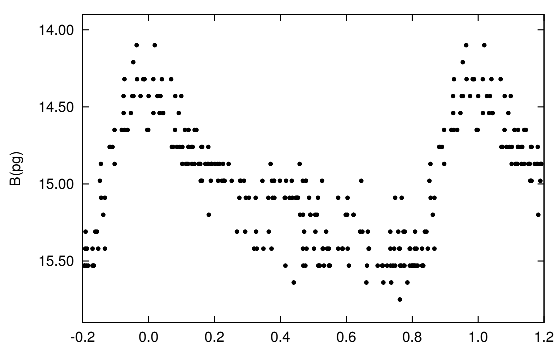

Figure 6. Light curve of NSV 8003

Table 2. Individual maxima and $O-C$ values according to the elements derived in this paper

Star	HJD (max.)	Epoch	$O-C$	Star	HJD (max.)	Epoch	$O-C$
V1057 Oph	38173.453	−10640	−0.027	V1130 Oph	49098.546	9777	−0.024
	38503.528	−10106	0.014	V1429 Oph	37112.443	−13848	0.017
	38521.480	−10077	0.043		38553.465	−11342	0.003
	38555.466	−10022	0.036		38557.467	−11335	−0.020
	38901.492	−9462	−0.041		38587.423	−11283	0.034
	38940.464	−9399	−0.006		38591.425	−11276	0.011
	39262.486	−8878	0.016		38902.485	−10735	−0.023
	39288.461	−8836	0.034		38936.462	−10676	0.027
	39317.451	−8789	−0.024		38940.464	−10669	0.004
	39618.468	−8302	0.006		39293.497	−10055	−0.034
	39917.607	−7818	0.013		43365.383	−2974	0.033
	42987.396	−2851	−0.012		44343.450	−1273	−0.034
	44024.485	−1173	0.003		44373.390	−1221	0.004
	44346.465	−652	−0.017		44427.411	−1127	−0.028
	44372.430	−610	−0.009		44749.455	−567	−0.003
	44427.411	−521	−0.034		45075.475	0	−0.028
	44749.455	0	0.010		45822.442	1299	−0.031
	45056.590	497	−0.022		46197.432	1951	0.037
	45854.459	1788	−0.045		46649.374	2737	0.002
	46613.415	3016	−0.044		49216.362	7201	0.036
	46644.382	3066	0.021	V1600 Oph	38521.480	−21048	0.017
	48804.454	6561	0.037		38525.464	−21035	−0.002
	48830.421	6603	0.046		38640.336	−20662	−0.004
	49482.423	7658	0.014		38852.550	−19973	0.017
V1122 Oph	38532.440	−13881	0.015		38856.523	−19960	−0.014
	38533.459	−13879	0.027		39261.519	−18645	−0.002
	38830.648	−13289	−0.016		39286.461	−18564	−0.006
	38882.544	−13186	−0.010		44346.465	−2134	0.006
	38936.462	−13079	0.003		44371.413	−2053	0.008
	39615.549	−11731	−0.009		44374.480	−2043	−0.005
	44454.383	−2126	−0.012		44375.420	−2040	0.011
	44732.466	−1574	−0.017		45003.681	0	0.008
	45525.433	0	−0.005		45053.547	162	−0.018
	46595.474	2124	0.001		45056.622	172	−0.022
	46649.374	2231	−0.004		45082.497	256	−0.017
	47262.496	3448	0.014		45525.401	1694	0.022
	49124.477	7144	0.012		46646.380	5334	−0.020
V1130 Oph	37110.502	−16897	−0.005		48067.410	9948	0.024
	38856.523	−13012	−0.014	NSV 8003	38502.523	−12784	0.025
	38883.487	−12952	−0.016		38532.440	−12744	0.014
	38901.492	−12912	0.012		38852.619	−12316	−0.034
	38910.446	−12892	−0.023		38882.544	−12276	−0.037
	38937.420	−12832	−0.015		38936.462	−12204	0.011
	39238.572	−12162	0.020		44427.430	−4865	−0.021
	39288.461	−12051	0.022		44454.368	−4829	−0.018
	39621.489	−11310	0.024		44757.432	−4424	0.027
	43656.448	−2332	0.011		46623.413	−1930	0.011
	44371.470	−741	−0.008		46641.392	−1906	0.033
	44372.369	−739	−0.008		46644.382	−1902	0.030
	44376.411	−730	−0.011		48067.408	0	−0.010
	44403.408	−670	0.020		48088.400	28	0.033
	44704.491	0	−0.014		49193.416	1505	−0.035
	44749.455	100	0.007		49214.391	1533	−0.009
	45054.605	779	−0.005		49475.493	1882	−0.027
	46976.404	5055	0.036				

Table 3. Comparison stars and cross references

	V1057 Oph S 9795 USNO 0975-08748081		V1122 Oph S 10320 USNO 0975-08646485	
Comp. No.	GSC	m*	GSC	m*
1	980.0340	$14^{m}.9$	983.0729	$14^{m}.4$
2	980.0037	$15^{m}.4$	983.0043	$14^{m}.6$
3	980.0593	$16^{m}.2$	0975-08646049	$15^{m}.2$
4			983.0903	$15^{m}.7$

	V1130 Oph S 10323 USNO 0975-08674496		V1429 Oph S10329 GSC 406.0812	
Comp. No.	GSC/USNO	m*	GSC/USNO	m*
1	979.1018	$14^{m}.7$	406.1414	$13^{m}.9$
2	979.0890	$14^{m}.9$	406.2020	$14^{m}.1$
3	979.1129	$15^{m}.4$	406.0354	$14^{m}.6$

	V1600 Oph S 10331 USNO 0975-08918791		NSV 8003 S9794 USNO 0900-09035305	
Comp. No.	GSC/USNO	m*	GSC/USNO	m*
1	977.1569	$14^{m}.2$	396.1045	$14^{m}.4$
2	977.1206	$14^{m}.7$	396.0067	$15^{m}.0$
3	0975-08919498	$16^{m}.6$	396.1111	$15^{m}.7$

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

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EK And IS NOT A SEMI-REGULAR VARIABLE

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EK And is classified as a semi-regular late-type giant displaying persistent periodicity in the General Catalog of Variable Stars, with coordinates of R.A. $01^h16^m13\overset{s}{.}5$, Decl. $+41°44'22''$(2000.0), V-band brightness variations between 10.3 – 11.4 mag, and period of 185 days.

The variations and period were obtained by Zinner (1922) from 26 visual observations from JD 2419471 to 2422656. Zinner also noted EK And is a companion easy to misidentify with a Mira type variable UZ And. Petit (1961) confirmed the variability and type of EK And as a semi-regular late-type giant displaying persistent periodicity, from 22 visual observations, with coordinates of R.A. $01^h10^m30^s$, Decl. $+41°12\overset{'}{.}8$ (1900.0), variations between 10.2 – 11.2 mag, and period of about 190 days.

However, evident brightness variations of EK And were not confirmed in recent CCD and visual observations.

Ohkura observed EK And for three months from September to December in 2000, with 0.16-m f/3.8 Wright-Schmidt reflector and SBIG ST-8 CCD. Figure 1 shows the light curve of the unfiltered CCD photometry. The observations covered a half of the period of EK And, but no variation larger than 0.18 mag was detected.

Smelcer observed EK And for about a half of a year twice, from September 1999 to February 2000, and from September 2000 to February 2001, with 0.12-m f/4.5 astrocamera and SBIG ST-7 CCD. Figure 2 shows the light curve of the V-band photometry. The observations covered the full period of EK And in both seasons, but no variation larger than 0.11 mag was detected.

Figure 3 shows the visual observations by three observers from 1995 to 2001, from the Variable Star Network (VSNET) database. All observations are within 11.2 ± 0.4 mag. No periodicity of 185 days was found.

In conclusion, EK And is not a semi-regular late-type giant with a brightness range of 1.1 magnitude. As EK And is close by another Mira type variable star UZ And, some misidentifications could occur in the old observations. Plaut (1977) gave the same identification for EK And and UZ And. The position and identification is definitely wrong for UZ And and is assumed to be correct for EK And.

We are grateful to the VSNET observers.

We thank Russian Foundation for Basic Research, Russian Federal Program "Astronomy", and the Program "Non-stable Processes in Astrophysics" of the Presidium of Russian Academy of Sciences for partial financial support of the GCVS work.

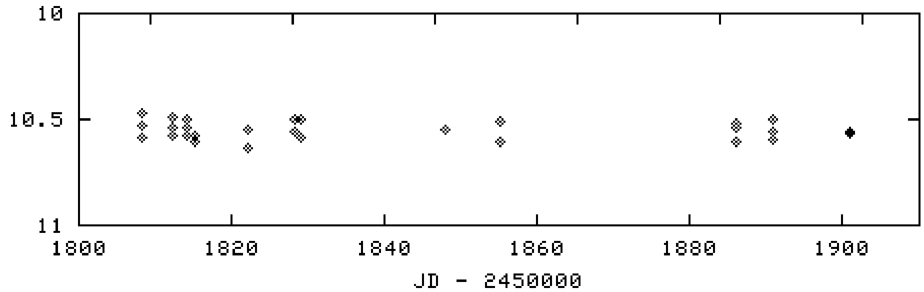

Figure 1. Unfiltered CCD observations by Ohkura

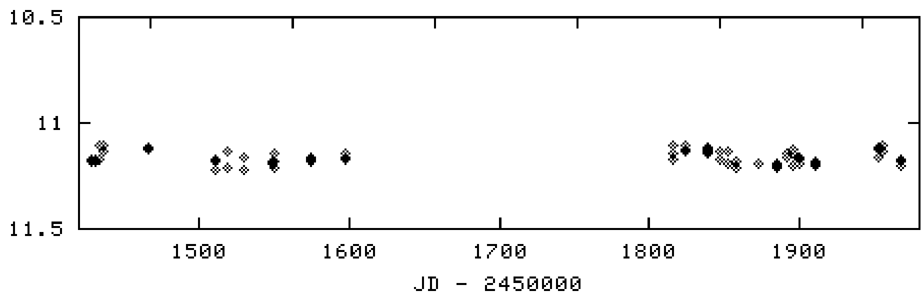

Figure 2. *V*-band observations by Smelcer

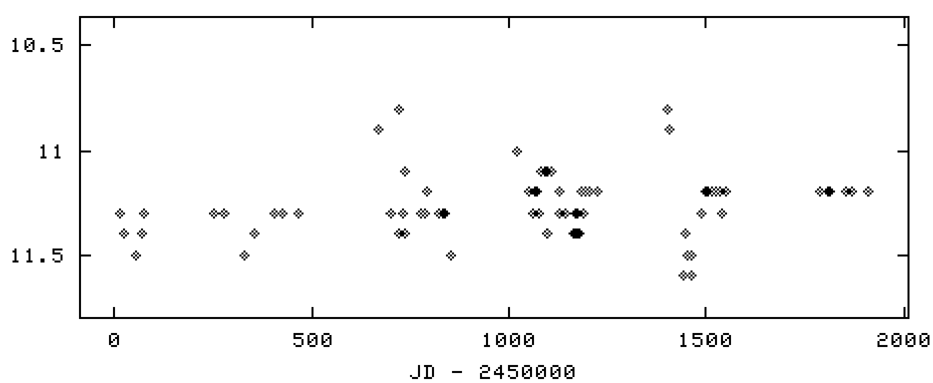

Figure 3. Visual observations by VSNET

References:

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A NEW BRIGHT HELIUM VARIABLE B STAR: HR 2949

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During a search for pulsational line profile variability in Bn stars, both components of the visual pair HD 61555/6 have been observed with FEROS at La Silla, Chile. While the results about Bn star variability will be reported elsewhere, the component with the lower $v \sin i$, HD 61556, was found to be spectroscopically variable.

A variability search in the photometric Hipparcos database (Koen & Eyer, 2002) revealed a period of $P = 1.9093$ d with an amplitude of $A = 0.0063$ mag. However, the Hipparcos identifier HIP 37229 corresponds to the combined light of both objects ($V = 3\overset{m}{.}83$, Hauck & Mermilliod, 1998), while the components in fact have $V = 4\overset{m}{.}53$ (HD 61555, B6 V) and $V = 4\overset{m}{.}78$ (HD 61556, B5 IV), also taken from Hauck & Mermilliod (1998). The latter star has been suspected to be variable already by Kukarkin & Kholopov (1982, NSV 3673). For the folded Hipparcos light curve (Figure 1), we adopt

$$T_{\rm min\ light} = {\rm JD}\,2448001.1 + E \times 1.9093$$

HD 61556 was observed spectroscopically four times with an exposure time of 300 seconds (Table 1). FEROS covers the wavelength range from 370 to 920 nm with a resolving power $R = \Delta\lambda/\lambda = 48\,000$ (Kaufer et al., 1997).

The equivalent widths of most lines, particularly the HeI lines, were found to be variable. Although the four spectra do not allow to derive the period independently, the two last spectra were taken one day apart. Since these latter two spectra roughly bracket the full observed range of variability, this supports a two day timescale in the equivalent width variations. In the following, we will, therefore, assume the photometric period also for the spectroscopic variations.

While the Balmer lines do not vary at all, the HeI lines are highly variable. When the star is bright the HeI lines are strong. Sorted by decreasing relative amplitude, lines of FeII, CII, and MgII vary in phase with HeI. Lines of SiII and SiIII vary in antiphase w.r.t. HeI.

Judging from the period and the nature of the spectral variations (Figs. 2 and 3), the star is likely a magnetic variable with a strong surface field having produced surface abundance inhomogeneities. Thus the period of 1.9093 d is the period of rotation. For a B5 IV star with a typical radius of $5\,{\rm R}_\odot$, this would imply $v_{\rm rot} \approx 130\,{\rm km\,s^{-1}}$. Since the equivalent widths of metal lines (Table 1) indicate this classification to be probably

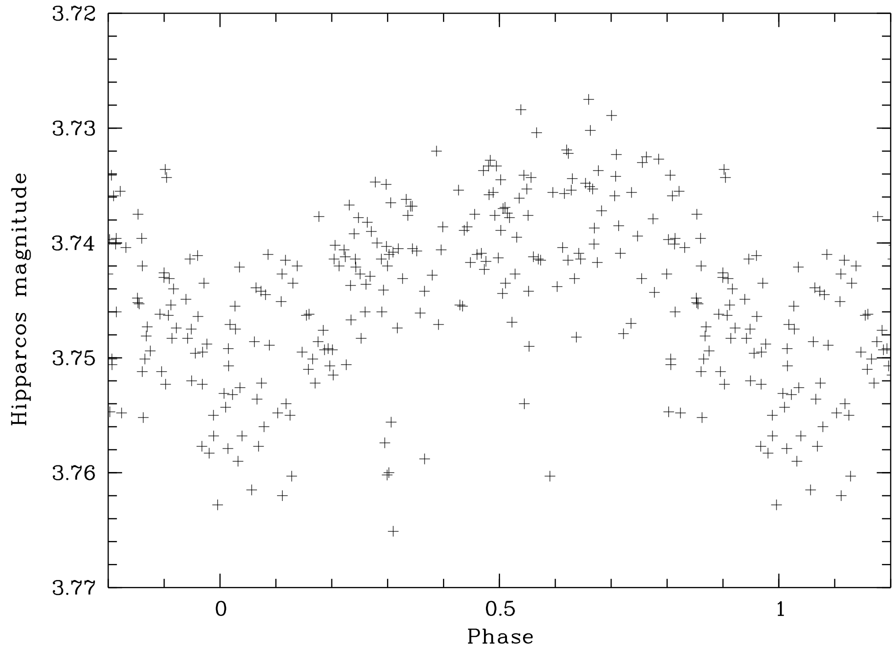

Figure 1. The photometry sorted with $P = 1.9093$ d. The Hipparcos magnitude differs somewhat from that in the V band. Note the outliers towards lower magnitudes are the result of partial disentanglement of the visual pair. For this reason also only measurements with a standard error of 0.01 mag or less are plotted.

slightly too cool, which is typical for undetected He-weak stars (Jaschek & Jaschek, 1987), the derived velocity should be a robust lower limit.

The width of the lines is about $v \sin i = 70\,\mathrm{km\,s^{-1}}$, which gives a relatively polar inclination of $i \approx 30°$ for the rotational axis.

Because the Hipparcos amplitude of 0.0063 mag corresponds to the variations of the combined light (around 3.83 mag), but the variable component is a star of only 4.78 mag, the real amplitude is higher by a factor of $10^{-0.4\times(3.83-4.78)} = 2.42$, i.e. about 0.015 mag.

These observations put HD 61556 among the brighter chemically peculiar B stars in the sky. Due to the photometric variability, it should be removed from the catalog of $uvby\beta$ standard stars (Perry et al., 1987).

Table 1. Spectroscopic observations and measured equivalent width for several lines. Typical uncertainties are in the order of 5 %.

Phase	Julian Date	W_λ [mÅ]				
		He I 4026	He I 4471	He I 6678	Fe II 4549	Si III 4553
0.04	2451151.770	700	680	230	64	91
0.28	2452686.511	740	590	220	61	96
0.61	2451196.764	1020	960	260	81	75
0.80	2452687.507	1000	890	250	81	77

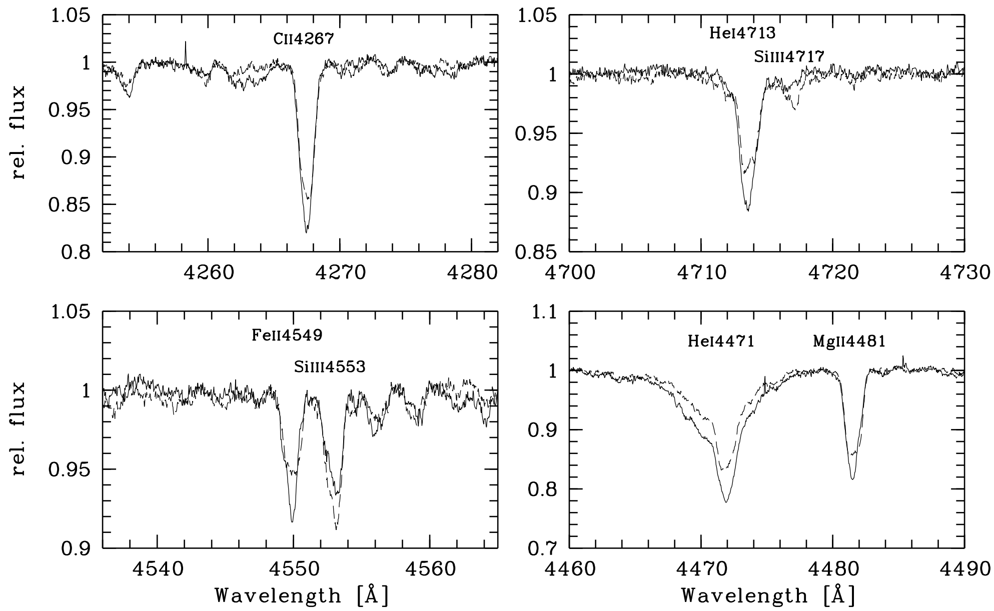

Figure 2. Spectroscopic line variations at phase 0.80 (full line) vs. phase 0.04 (dashed line). Most species behave like HeI, only Si lines vary in antiphase. Balmer lines are invariant.

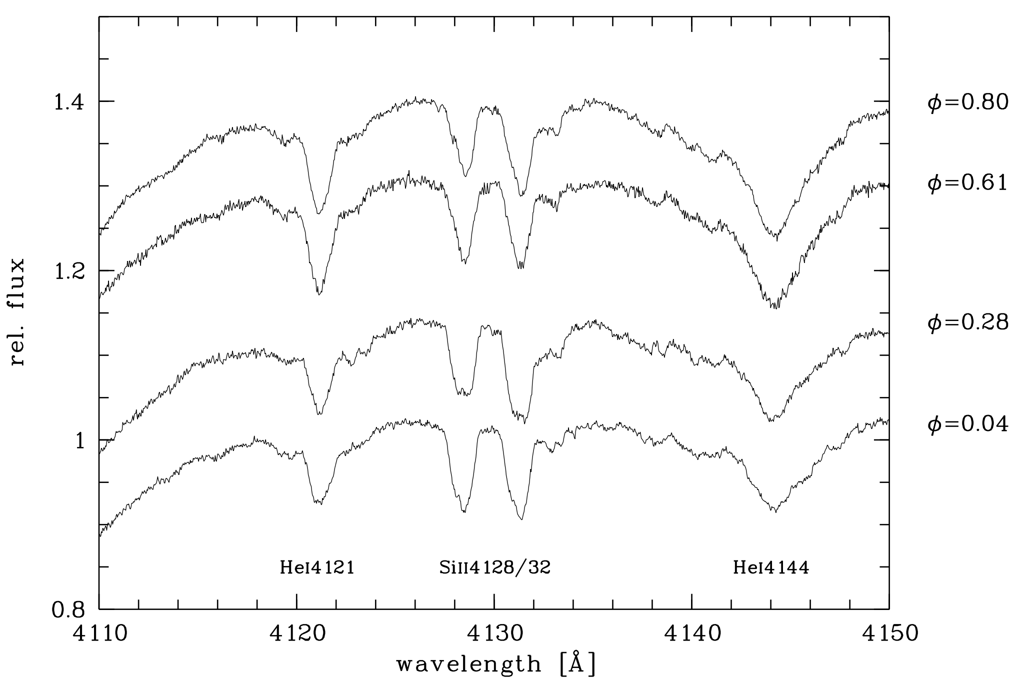

Figure 3. Variations of HeI and SiII lines. Note that not only the strength, but also the shape of the profile varies, as in the centre of the SiII lines.

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VV Cep OUTSIDE ECLIPSE

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The 1997-1999 eclipse of the binary VV Cep gave researchers further opportunities to analyze the system. Bauer, Bennett and Brown (1998) attributed strong, double-peaked emission lines such as Mg II and Fe II in the ultraviolet range 2700-3000 Angstroms to an expanding atmosphere. They also reported that the hot B star was, during one orbital period, shrouded in a rich absorption spectrum of singly ionized elements. According to Leedjärv, Graczyk, Mikolajewski and Puss (1999) the eclipse occurred 68 days later than predicted which may indicate an orbital period change due to mass transfer between the M and B stars. Further, they suggested that the cooler object may be an asymptotic giant branch star instead of a supergiant. Graczyk, Mikolajewski and Janowski (1999) came to the same conclusion. They found masses for the M and B stars of about 2.5 and 8 solar masses, respectively, with a total mass ejection of 0.008 solar mass and a loss rate of 4×10^{-4} solar mass per year.

In an earlier paper (Pollmann, 2001) I presented observations of Hα emission strength in VV Cep, as measured in equivalent width (EW), from JD 2450202 to 2452061. The rate of sampling was high enough to reveal the eclipse in detail and to show asymmetric distribution of Hα intensity across the accretion disk as determined at the times of ingress and egress.

In this paper I report on continued observations in the period JD 2452061 to 2452619. I used the 200 mm Schmidt-Cassegrain telescope at the Cologne Stargazer's Association Observatory in the mountains of Odenthal, Germany (latitude: $51°02'$, longitude: $7°15'$). My spectrograph with diffraction grating has a dispersion of 0.39Å/pixel and a wavelength range of 6400Å to 6700Å. The detector is a Kodak KAF400 sensor with 768×512 pixels. Pixels are 9×9 micrometers. The resolving power is R = 8200. Data after JD 2451852 and discussed by Pollmann (2001) have also been observed with this instrument. Current results reveal apparent stochastic variation in Hα EW with a range of about 10Å outside eclipse. Despite these dispersions the EW seems to have increased after the eclipse within the period represented here with an upward gradient of approximately 1 Å/200d. There is also variability on a timescale of many hundreds of days. In Figure 1 the latter is identified by a linear fit to post-eclipse observations. Table 1 collects the observations that is also available electronically at the IBVS website as 5398-t1.txt. Exploration of both types of change is a likely project for the years leading up to the next eclipse that begins in 2017.

Wright (1977) observed Hα emission out of eclipse between 1956 and 1976. I determined V/R ratios from his Figure 4 plots and show them in Figure 2 along with my V/R results. Wright observed nearly an entire orbit with relatively few observations, while I was limited to phases from 0.14 to 0.24 with relatively more observations starting from JD 2451852. Prior to this date the resolution of the observed spectra did not allow to obtain V/R ratios. Figure 2 shows a phase-related cycle of change in V/R. In the short but significant range in which we overlap, my results agree with the pattern of rapid decrease detected by Wright. Erratic, short-term change in V/R is also indicated. Line profiles for my first and last observations appear in Figure 3. Table 2 presents all the V/R observations. I continue to observe Hα emission in VV Cep and will report again in the future.

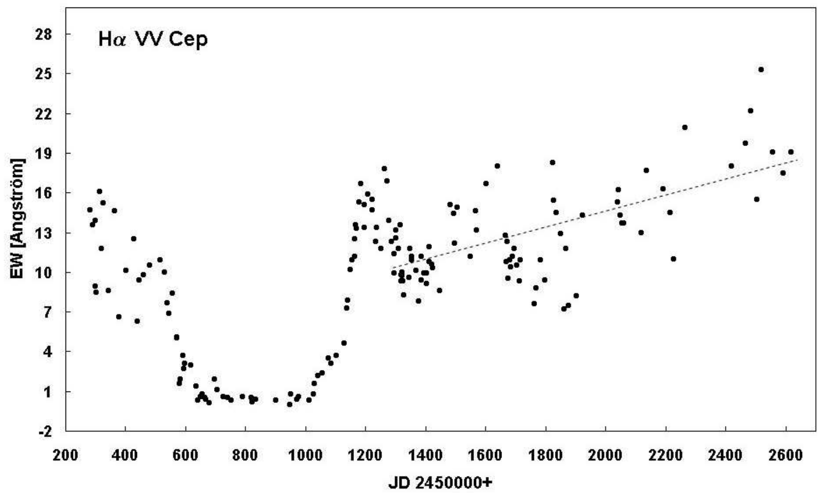

Figure 1. Hα equivalent width as a function of time for VV Cep before, during and after the 1997-1998 eclipse.

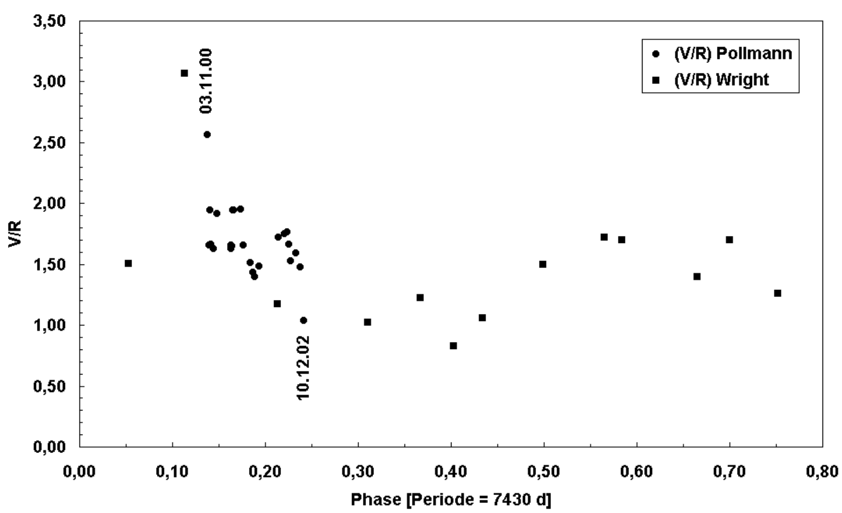

Figure 2. V/R ratio for the Hα emission line as a function of orbital phase as independently observed by Wright and Pollmann.

Table 1. Hα equivalent widths

JD 2450	EW [Å]	JD 2450	EW [Å]	JD 2450	EW [Å]	JD 2450	EW [Å]
282	14.7	752	0.3	1318	9.8	1685	10.4
291	13.6	790	0.6	1319	9.3	1690	11.2
298	13.9	819	0.5	1286	12.3	1696	11.8
299	8.9	823	0.2	1294	11.4	1703	10.5
301	8.5	835	0.4	1296	9.9	1712	9.3
313	16.1	902	0.3	1300	12.6	1716	10.9
321	11.8	949	0	1302	13.2	1447	8.6
327	15.2	952	0.8	1309	11.8	1762	7.6
343	8.6	970	0.4	1321	10	1769	8.8
363	14.6	976	0.6	1322	9.7	1782	10.9
379	6.6	1013	0.3	1324	9.3	1797	9.4
402	10.1	1027	0.8	1327	8.3	1825	18.3
428	12.5	1029	1.6	1345	9.6	1828	15.4
439	6.3	1040	2.2	1348	11.8	1835	14.5
444	9.4	1057	2.4	1353	11.2	1852	12.9
459	9.8	1077	3.5	1355	10.9	1863	7.2
480	10.5	1086	3.1	1376	7.8	1869	11.8
514	10.9	1102	3.7	1369	10.1	1877	7.5
529	10	1128	4.6	1385	11.2	1902	8.2
538	7.7	1137	7.3	1386	9.4	1924	14.3
546	6.9	1140	7.9	1395	9.9	2039	15.3
555	8.4	1150	10.2	1402	9.1	2042	16.2
570	5.1	1154	10.9	1403	9.9	2050	14.3
572	5	1164	11.2	1411	10.8	2055	13.7
581	1.6	1165	12.5	1413	11.9	2061	13.7
584	1.9	1168	13.6	1420	10.6	2120	13
592	3.7	1171	13.3	1424	10.3	2135	17.7
594	2.7	1178	15.3	1482	15.1	2191	16.3
597	3.1	1184	16.7	1495	14.4	2214	14.5
618	3	1196	13.4	1498	12.2	2228	11
635	1.4	1197	15.1	1505	14.9	2266	20.9
641	0.3	1208	15.9	1550	11.2	2420	18
649	0.6	1221	14.7	1567	14.6	2467	19.7
657	0.8	1222	15.5	1569	13.2	2485	22.2
664	0.5	1234	12.3	1601	16.7	2503	15.5
668	0.4	1237	13.4	1641	18	2519	25.3
679	0.1	1250	11.8	1665	12.8	2556	19.1
697	1.9	1263	17.8	1670	10.8	2593	17.5
704	1.1	1271	16.9	1671	12.3	2619	19.1
727	0.6	1278	13.9	1674	9.5		
741	0.5	1315	13.6	1681	10.9		

Table 2. Orbital Phase and Related V/R Ratios

JD	Phase	(V/R) Wright	JD	Phase	(V/R) Pollmann	JD	Phase	(V/R) Pollmann
2435572	0.053	1.504	2451852	0.138	2.563	2452191	0.184	1.510
2436810	0.113	3.067	2451863	0.139	1.655	2452214	0.187	1.433
2437554	0.214	1.174	2451869	0.140	1.941	2452228	0.189	1.395
2438272	0.310	1.019	2451877	0.141	1.662	2452266	0.194	1.481
2438694	0.367	1.222	2451902	0.145	1.625	2452420	0.214	1.723
2438960	0.403	0.828	2451924	0.148	1.919	2452467	0.221	1.750
2439189	0.434	1.059	2452039	0.163	1.659	2452485	0.223	1.764
2439675	0.499	1.501	2452042	0.164	1.631	2452503	0.226	1.665
2440165	0.565	1.720	2452050	0.165	1.650	2452519	0.228	1.530
2440304	0.584	1.699	2452055	0.165	1.944	2452556	0.233	1.592
2440908	0.665	1.400	2452061	0.166	1.944	2452593	0.238	1.479
2441166	0.700	1.700	2452120	0.174	1.950	2452619	0.241	1.034
2441555	0.752	1.263	2452135	0.176	1.660			

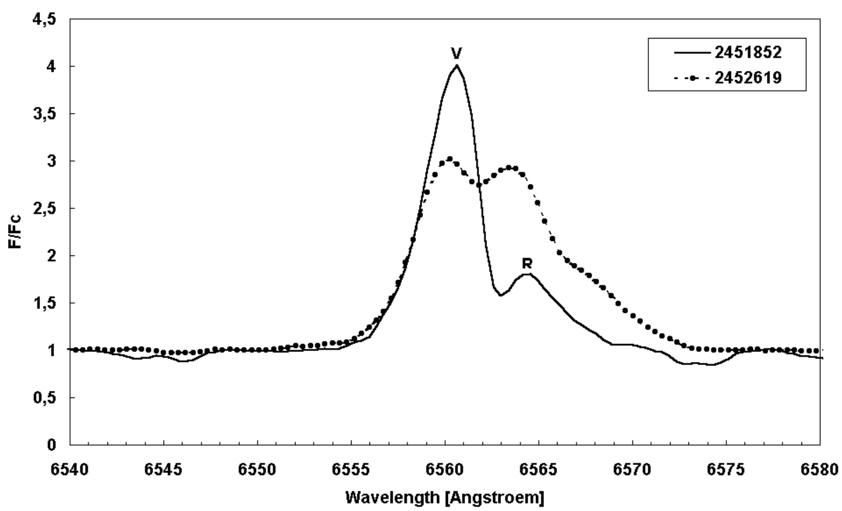

Figure 3. Hα emission line profiles at JD 2451852 and 2452619 as they appeared at phases 0.14 and 0.24, respectively.

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HU ISSN 0374 – 0676

NEW TIMES OF MINIMA OF ECLIPSING BINARY SYSTEMS

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Observatory and telescope:
40-cm f/10 Meade Cassegrain-Schmidt telescope of the Çanakkale Onsekiz Mart University Ulupinar Astrophysics Observatory 30-cm f/3.3 Meade Cassegrain-Schmidt telescope of the Çanakkale Onsekiz Mart University Ulupinar Astrophysics Observatory

Method of data reduction:
Reduction of the CCD frames was made with MUNIPACK[1] software, and reduction of photoelectric observations was made by ATMEX[2] software.

Method of minimum determination:
Kwee – van Woerden method (Kwee & van Woerden, 1952), and in some cases, depending on the nature of the data set, several procedures written by A. Gaspani (1995) based on artificial neural networks were used.

Observed star(s):

Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
RT And	EA	23 11 10	+53 01 34	GSC 3998:1794	36697.8570	0.63893088	1
WZ And	EB	01 01 43	+38 05 46	GSC 2799:0396	46025.7264	0.69566096	1
TT Aur	EB	05 09 42	+39 35 10	GSC 2899:0492	21242.2517	1.33273455	1
IU Aur	EB	05 27 52	+34 46 58	GSC 2411:1292	38448.4050	1.81147464	1
TY Boo	EW	15 00 47	+35 07 52	GSC 2568:0997	47612.6035	0.31714910	1
UW Boo	EA	14 20 59	+47 06 43	GSC 3472:0388	42404.7175	1.00471105	1
CK Boo	EW	14 35 03	+09 06 54	GSC 0910:0447	46183.5950	0.35515320	1
RZ Cas	EA	02 48 56	+69 38 03	GSC 4312:1101	48960.2260	1.19524980	1
DK Cep	EA	21 58 33	+60 56 53	GSC 4262:2154	33590.5578	0.98590874	1
EG Cep	EB	20 15 57	+76 48 36	GSC 4589:2757	40050.4491	0.54462274	2
SW Cyg	EA	20 06 28	+46 17 59	GSC 3559:0857	43692.3967	4.57294500	1
V859 Cyg	EW	19 27 12	+28 56 50	GSC 2137:1452	34629.4119	0.40499999	1

[1]Hroch, F., Novák, R., 1997, MUNIPACK, `http://munipack.astronomy.cz/`
[2]Keskin, V., 2001, ATMEX, `http://astronomy.sci.ege.edu.tr/ keskinv/`

Observed star(s):							
Star name	GCVS type	Coordinates (J2000) RA	Dec	Comp. star	Ephemeris E 2400000+	P [day]	Source
AX Dra	EB	12 40 14	+66 17 08	GSC 4168:0342	26767.6886	0.56816285	1
UX Eri	EW	03 09 53	−06 53 50	GSC 4714:0029	41922.3338	0.44528205	1
RX Gem	EA	06 50 11	+33 14 21	GSC 2440:1031	40555.8370	12.2085250	1
AP Leo	EW	11 05 05	+05 09 06	GSC 0268:0779	39536.5429	0.43035716	1
PY Lyr	EW	19 20 26	+28 56 44	GSC 2136:3105	34980.4372	0.38576273	1
ER Ori	EW	05 11 14	−08 33 23	GSC 5330:0364	43090.5300	0.42339943	1
BN Peg	EA	21 28 02	+05 00 12	GSC 5370:0247	33896.3700	0.71329807	1
II Per	EB	04 29 37	+44 25 32	GSC 2891:2911	30257.5500	0.47985400	3
V432 Per	EW	03 10 10	+42 51 21	GSC 2855:0535	48601.3776	0.38330910	1
XY Sct	EW	18 41 07	−06 04 31	USNO 0825:12607174	28729.5293	0.7852563	3
AH Tau	EW	03 47 12	+25 07 02	GSC 1804:2309	31822.3653	0.33267368	1
XY UMa	EB	09 09 56	+54 29 26	GSC 3805:0479	35216.5018	0.47899493	1
RU UMi	EB	13 38 57	+69 48 12	GSC 4402:1049	41596.3365	0.52492618	1

Source(s) of the ephemeris:

1. Kreiner et al., 2001;
2. Demircan et al., IBVS, 5364, 2003;
3. GCVS 4th edition, electronic version 2001.

Times of minima:						
Star name	Time of min. HJD 2400000+	Error	Type	Filter	$O-C$ [day]	Rem.
RT And	52577.3991	7	II	–	−0.0192	ccd
WZ And	52577.4507	1	I	–	−0.0107	ccd
TT Aur	52595.5079	9	II	–	0.0096	ccd
IU Aur	52699.2737	2	I	–	−0.0023	ccd
	52698.3748	7	II	–	0.0045	ccd
TY Boo	52707.4509	1	I	–	0.0057	ccd
UW Boo	52710.5313	5	II	–	−0.0098	ccd
CK Boo	52462.3796	6	I	B, V, R	0.0312	pe
RZ Cas	52539.4113	7	II	B, V	0.0097	pe
DK Cep	52553.5256	1	I	–	−0.0009	ccd
EG Cep	52654.3718	7	II	–	−0.0112	ccd
SW Cyg	52509.2909	2	I	–	0.2562	ccd
V859 Cyg	52577.2311	8	II	–	0.0384	ccd
AX Dra	52721.3642	1	I	–	−0.0034	ccd
UX Eri	52569.5092	7	I	–	0.0363	ccd
RX Gem	52654.6485	7	I	–	0.1632	ccd
AP Leo	52713.4024	1	II	–	−0.0312	ccd
PY Lyr	52476.3842	2	I	–	0.0641	ccd
	52477.3479	6	II	–	0.0634	ccd
ER Ori	52656.3972	4	I	–	0.0038	ccd
BN Peg	52551.2478	5	I	–	−0.0066	ccd
II Per	52552.4762	2	I	–	−0.0504	ccd
V432 Per	52578.4229	2	II	–	0.0218	ccd
XY Sct	52474.3912	3	II	–	−0.1107	ccd
AH Tau	52578.4707	1	I	–	−0.0662	ccd
XY UMa	52707.2102	11	II	–	−0.0310	ccd
RU UMi	52656.5193	6	I	–	−0.0118	ccd

Remarks:

The 25 stars, whose details are listed in Table 1, were observed using either conventional filtered Johnson standard (BVR) photoelectric photometry with the SSP-5A or unfiltered with the ST-237. 27 times of minima, primary and some secondary, are listed in Table 2, together with $O-C$ values corresponding to the Table 1 ephemerides. The remarks column of Table 2 gives an identification of which system was used; thus "ccd" refers to the 30 cm + ccd combination and "pe" means the single channel photometer on the 40 cm telescope.

The RS CVn binaries RT And and XY UMa show distorted light curves, so the determination of their minima may be subject to apparent variations due to maculation effect (cf. Olah, 2003), however Demircan (1999) has argued that these effects can be separated from genuine period changes over sufficiently long intervals of time. The classical Algols RX Gem and SW Cyg could be expected to follow inverted parabolic trends corresponding to the evolution of these systems. SW Cyg seems to have a cyclic variation superimposed on this, however, (cf. Kreiner et al., 2001) the remaining binaries in this sample generally show more complex variations of period which call for ongoing close attention to characterize.

Availability of the data:

Upon request

Acknowledgements:

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ERRATUM FOR IBVS 5399

Time of minimum of AH Tau was given as 52578.4707, but it should be 52578.5104.

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SPECTROSCOPIC AND PHOTOMETRIC SOLUTION OF THE BINARY SYSTEM BD+14°5016

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BD+14°5016 (SAO 108714, GSC 01720-00658) was discovered as a variable of W UMa type by Maciejewski et al. (2002). It is recorded in SIMBAD database as a $V{=}9\overset{\text{m}}{.}50$ magnitude star of F2 spectral type, with $B-V{=}0\overset{\text{m}}{.}31$. Photometric measurements from Tycho-2 Catalogue give $B-V{=}0\overset{\text{m}}{.}34$ which is more consistent with the spectral type. The binary shows a light curve with an amplitude slightly smaller than 0.5 mag and with unequal minima and maxima. Up to the present the classification of variability type has based on a light-curve morphology, typical for contact binaries. The presented three spectral observations show lines of both components and allow to determine preliminary radial velocity amplitudes and hence mass ratio of component stars. That quantity together with photometric data allows us to find preliminary solution of the system.

The spectroscopic observations were collected at the David Dunlap Observatory (DDO), University of Toronto, with the 1.9 m telescope and the Cassegrain spectrograph giving a dispersion of 10.8 Å mm^{-1}, corresponding to about 0.2 Å pixel^{-1} or about 12 km s^{-1} pixel^{-1}. The spectra were centered at 5185 Å with a spectrum coverage of 210 Å. The exposure time of 20 min was used for all spectra. For reduction standard IRAF†, procedures were employed. The velocity determinations were done with broadening function algorithm (Rucinski 1999) against a sharp-line standard star used as a template.

The radial velocity data are listed in Table 1. For every spectrum the Heliocentric Julian Date of the exposure, phase and radial velocity measurements with errors are given. The phase was calculated according to ephemeris given in Maciejewski et al. (2002). Because of light curve peculiarities (described below) the ephemeris for a secondary minimum was taken. As a template the star HD 89021 with radial velocity of $V_t = 18.1$ km s^{-1} (Evans, 1967) was used. Radial velocities were transformed to the solar system barycenter.

Table 1. Radial velocities measurements for BD+14°5016

HJD	Phase	V_1 [km s^{-1}]	V_2 [km s^{-1}]
2452571.698462	0.2410	-47.1 ± 1.5	238.7 ± 0.7
2452572.629192	0.7024	62.1 ± 0.5	-219.0 ± 1.2
2452576.711157	0.1116	-44.6 ± 0.2	155.8 ± 1.2

†IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

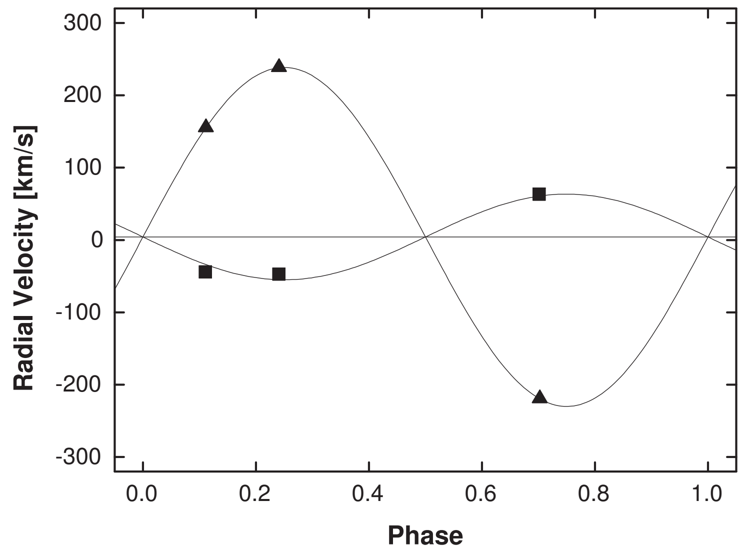

Figure 1. Radial velocities of BD+14°5016 plotted versus orbital phase.

The radial velocity orbits were solved by least squares fitting of a sinusoid for each component from the form $V(\phi) = \gamma + K_i \sin\phi$, with ϕ being the phase, γ – the velocity of system's barycenter and K_i – the velocity amplitude. The results are shown in Figure 1. The sine curves and the straight line denote circular-orbit fits and the average radial velocity γ, respectively. The derived orbital elements: the velocity amplitudes K_1 and K_2, average radial velocity γ, mass ratio q, orbit dimensions a, a_1, a_2 and component masses m_1, m_2 are presented in Table 2.

Table 2. Spectroscopic orbital elements of BD+14°5016

Element		Value
K_1	[km s^{-1}]	59.2 ± 7.9
K_2	[km s^{-1}]	234.2 ± 0.2
γ	[km s^{-1}]	4.2 ± 0.8
$q = m_2/m_1$		0.253 ± 0.034
$a \sin i$	[$R_\odot$]	3.69 ± 0.11
$a_1 \sin i$	[$R_\odot$]	0.74 ± 0.10
$a_2 \sin i$	[$R_\odot$]	2.947 ± 0.003
$m_1 \sin^3 i$	[$M_\odot$]	1.33 ± 0.08
$m_2 \sin^3 i$	[$M_\odot$]	0.34 ± 0.12

The photometric data were adopted from Maciejewski et al. (2002). The observations were obtained on 16 nights during September-November 2002 with the 135 mm f/2.8 semi-automatic CCD camera operating at the Piwnice Observatory of the Nicholas Copernicus University. From the original CCD V-band light curve a few bad points have been excluded. The final light curve, composed of 255 data points marked with crosses, is plotted in Figure 2. The different brightness maxima heights suggest the presence of a spot on the surface of one of the components (O'Connell effect). The primary minimum and brighter maximum are shifted in phase and falls in phase 0.98 and 0.23, respectively. The brighter maximum seems to be relatively broader at the side of primary minimum.

The data were analyzed with the Wilson-Devinney (WD) light and radial velocity curves analysis code (Wilson and Devinney, 1971; Wilson, 1979, 1990). The synthetic light curve was computed using the light curve (LC) program and the differential corrections procedure was performed with the DC program. WD software was operated in Mode 3. The temperature of the primary component T_1 was set at 6900 K, typical for dwarfs of F2 spectral type. That value places the primary below a boundary of 7200 K between stars with convective and radiative envelopes, therefore the convective model was finally considered. We also developed a radiative model, however the obtained solution turned out to be less consistent with data. Standard values of bolometric albedos, $A_1 = A_2 = 0.5$, and gravity darkening coefficients, $g_1 = g_2 = 0.32$ (Lucy, 1967), for convective envelopes were used. Limb darkening values for logarithmic law were interpolated from van Hamme's tables (van Hamme, 1993). The central wavelength for a near-Johnson V filter was assumed to be 5400 Å. Because of the light-curve peculiarities we assumed a spot solution from the beginning.

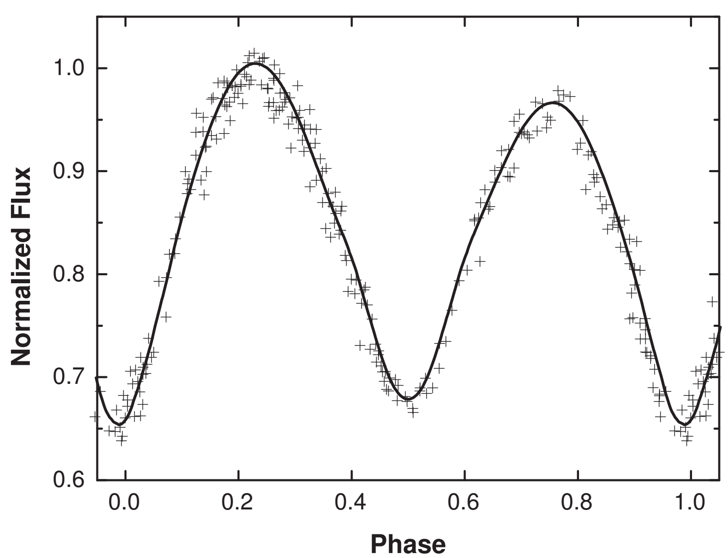

Figure 2. Observed (crosses) and computed (solid curve) light curve of BD+14°5016.

The calculated final light curve is displayed in Figure 2 (solid curve). The best results were obtained with a model including a hot spot located on the surface of the more massive component, near the neck connecting both stars. This superluminous region may be interpreted as a place where the gas stream from the secondary component strikes the surface of the primary. The final solution parameters are listed in Table 3 and the geometric representation of the model is shown in Figure 3. The system is in a large degree of overcontact of about 54%. The primary minimum is a transit indicating that BD+14°5016 is an A-type W UMa system. That is in agreement with its early spectral type.

Table 3. Solution parameters of BD+14°5016

Parameter	Value	Parameter	Value
$g_1 = g_2$	$0.32^\dagger$	r_1 (pole)	0.493
$A_1 = A_2$	$0.50^\dagger$	r_1 (side)	0.540
$x_1 = x_2(V)$	$0.694^\dagger$	r_1 (back)	0.573
$y_1 = y_2(V)$	$0.286^\dagger$	r_2 (pole)	0.275
$x_1 = x_2$ (bol)	$0.638^\dagger$	r_2 (side)	0.290
$y_1 = y_2$ (bol)	$0.252^\dagger$	r_2 (back)	0.356
i [°]	72.6 ± 0.3	M_1 [$M_\odot$]	1.53
T_1 [K]	$6900^\dagger$	M_2 [$M_\odot$]	0.39
T_2 [K]	6571 ± 25	R_1 [$R_\odot$]	2.076
$\Omega_1 = \Omega_2$	2.255 ± 0.005	R_2 [$R_\odot$]	1.181
Spot Latitude [°]	$90^\dagger$	$L_1/(L_1+L_2)$	0.791 ± 0.003
Spot Longitude [°]	333 ± 1	$L_2/(L_1+L_2)$	0.209 ± 0.003
Spot Radius [°]	7.8 ± 0.4	M_{bol1} [mag]	2.43
Spot Temp. Factor	1.55 ± 0.05	M_{bol2} [mag]	3.87

† assumed and unadjusted

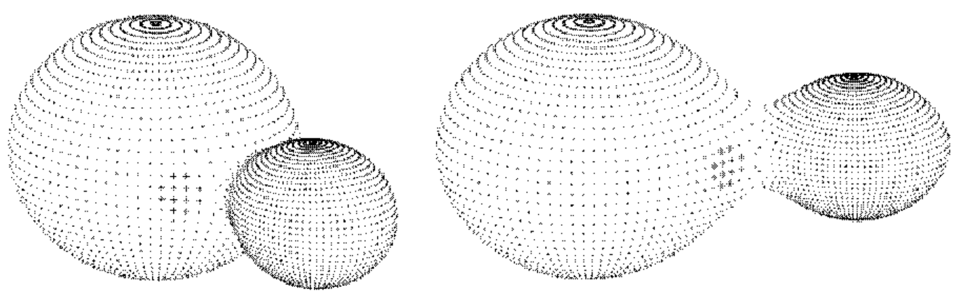

Figure 3. A three-dimensional model of BD+14°5016 for phases 0.1 and 0.25.

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