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NEW PHOTOELECTRIC LIGHT CURVES OF VW CEPHEI

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VW Cep (BD +75°752, HD 197433, SAO 9828) is a W-type W UMa system with chromospherically-active components of G5V and G8V spectral types. The apparent brightness $V_{\max} \approx 7.3$ mag, short period ($P \approx 0.27832$ days) and pronounced variations of its light curve, make the system a frequent target of photometric observations. The orbital period varies both due to the presence of a third body (Hershey, 1975) and intrinsic physical processes in the eclipsing binary. The starspot model seems to be most probable for explanation of the enhanced light-curve variations (Yamasaki, 1982; Linnel, 1986, 1991; Hendry et al., 1992).

The U, B, V and R photoelectric photometry was performed over 11 nights from September 1998 to January 2000 at the Stará Lesná (SL) and Skalnaté Pleso (SP) Observatories of the Astronomical Institute of the Slovak Academy of Sciences. The 0.6-m Cassegrain telescope equipped with a single-channel pulse-counting photoelectric photometer was used. The journal of observations is listed in Table 1. For all observations a 10-second integration was chosen. SAO 9836 was used as a comparison star (Table 2). Its stability was checked on two nights (September 9 and 14, 1999) with respect to three other stars. The comparison star was found to be stable within 0.01 mag. The magnitudes of comparison stars S1, S2 and CH, calculated using the average of the published magnitudes of S5 (see: <http://obswww.unige.ch/gcpd/gcpd.html>), are given in Table 2. Their mean errors are lower than 0.008 mag. Data reduction, the atmospheric extinction correction and transformation to the standard system were carried out in the usual way.

We have calculated the times of minima separately for all three filters using the Kwee and Van Woerden's method, parabola fit, sliding integration method, tracing paper and "centre of mass" method which were described in detail by Ghedini (1982). The computer codes were kindly provided by Dr. R. Komžík (1999). The minima times prior to August 1999 have been already published (Pribulla et al., 1999). The average times of the primary (I) and secondary (II) minima and their probable errors found by these methods are given in Table 3. Average times of the minima from U, B, V and R passbands were used to determine the ephemeris valid throughout our photometry. Not weighted least squares fitting led to the following ephemeris:

$$\text{Min (I)} = \text{HJD } 2\,451\,067.2820 + 0^{\text{d}}2783140 \times E. \quad (1)$$

± 6 ± 5

Table 1: Journal of photometric observations.

Date	HJD _{mean} 2400000 +	Phases	Filters	Obs.
1998 Sep 10	51067.462	0.189 – 1.118	UBV	SL
1998 Dec 2	51150.367	0.461 – 1.598	UBV	SL
1998 Dec 3	51151.311	0.642 – 1.214	UBV	SL
1999 Jul 18	51378.464	0.826 – 1.347	UBV	SL
1999 Aug 8	51399.423	0.037 – 0.768	UBV	SL
1999 Aug 28	51419.321	0.843 – 1.984	UBV	SL
1999 Sep 3	51425.363	0.358 – 0.864	UBV	SL
1999 Sep 14	51436.514	0.250 – 0.986	UBV	SL
1999 Nov 29	51512.422	0.156 – 0.727	BV	SL
1999 Dec 6	51519.272	0.774 – 1.292	BV	SL
2000 Jan 12	51556.269	0.687 – 1.114	BVR	SP

Table 2: Comparison stars and their magnitudes

Star	SAO	HD	V	$B - V$	$U - B$	Sp.
S1	9836	197665	7.07	0.38	0.11	F2
S2	9841	197750	8.11	1.19	1.21	K0
CH	9824	197306	8.67	1.04	0.63	K0
S5	9899	199476	7.81	0.69	0.16	G5

Table 3: New times of minima of VW Cep

JD _{hel} 2400000 +	σ	Type	Filter
51399.4496	0.0001	II	U
51399.4502	0.0001	II	B
51399.4505	0.0001	II	V
51436.4639	0.0001	II	U
51436.4637	0.0002	II	B
51436.4641	0.0006	II	V
51512.3080	0.0005	I	B
51512.3057	0.0005	I	V
51512.4480	0.0006	II	B
51512.4466	0.0004	II	V
51519.26293	0.00006	I	B
51519.26298	0.00012	I	V
51556.2784	0.0002	I	B
51556.2782	0.0001	I	R

All individual U , B and V observations are plotted in Fig. 1, using ephemeris (1). These data sets can be freely downloaded from address:

<http://www.ta3.sk/parimuch/archive.html>.

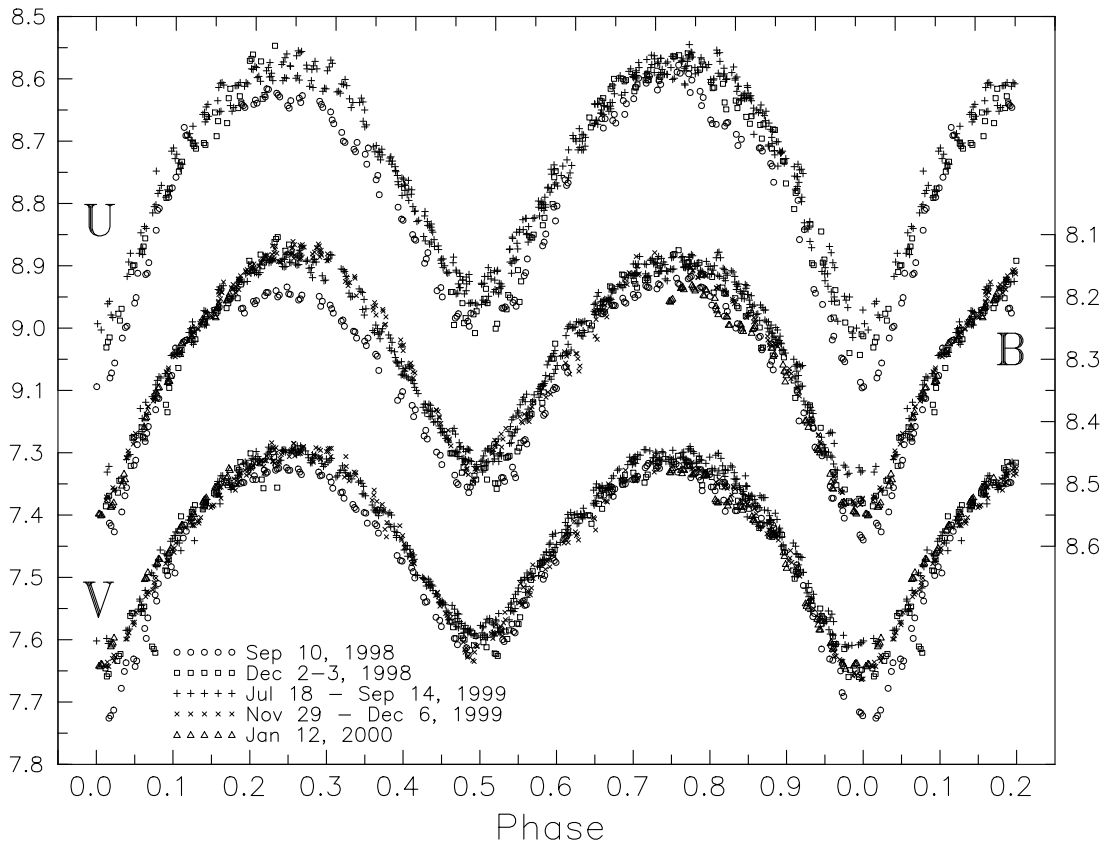


Figure 1. UBV light curves of VW Cep

Our observations show pronounced variations of the light curve. The changes are best visible during the primary minimum (Fig. 1). Its depth is highly variable. The primary minimum was sufficiently covered on five nights – September 10, 1998, December 3, 1998, July 18, 1999, December 6, 1999 and January 12, 2000. The minimum was deepest on the first night and shallowest on the third night. On September 10, 1998 VW Cep seems to be somewhat fainter than during other nights. This is best visible in B passband in maximum at the phase 0.25 ($\Delta\text{mag} = 0.06$).

The observed light curves are quite asymmetric – max I (at the phase 0.25) is about 0.02 mag brighter than max II (at the phase 0.75). The descending branch of the secondary minimum in the U light is fainter than the ascending one. The overall variations of the light curve, however, were only about 0.06 mag over the whole interval of observations.

A more detailed light-curve and period analysis will be published elsewhere.

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References:

Ghedini, S., 1982, *Software for Photometric Astronomy*, Willmann-Bell Publ. Comp., Richmond

- Hendry, P.D., Mochnacki, S.W., Collier-Cameron, A., 1992, *Astrophys. J.*, **399**, 246
Hershey J.L., 1975, *Astron. J.*, **80**, 662
Komžík, R., 1999, *private communication*
Linnell, A.P., 1986, *Astrophys. J.*, **300**, 304
Linnell, A.P., 1991, *Astrophys. J.*, **383**, 330
Pribulla, T., Chochol, D., Parimucha, Š., 1999, *IBVS*, No. 4751
Yamasaki, A., 1982, *Astrophys. Space Sci.*, **85**, 43