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PHOTOELECTRIC OBSERVATIONS OF THE CLOSE ECLIPSING BINARY VW CEPHEI

Differential photoelectric photometry of the close eclipsing binary VW Cephei (SAO 9828, M_v=7.45±0.12, B−V=+0.73±0.20) was carried out during the summer 1993 at the station of Capanne di Cosola (AL, Italy). A total of 473 data points were collected in the instrumental V color.

The comparison star was HIC 103219 (SAO 9911, M_v= 6.047±0.031, B−V= +0.934 ±0.015) and the check one was HIC 101824 (SAO 9836, M_v= 7.076±0.031, B−V= +0.934 ±0.015).

Photometry of VW Cephei was carried out with a 200mm Schmidt–Cassegrain f15 telescope equipped with a solid state photoelectric photometer Optec SSP3 operating in the Johnson–Morgan B and V bands.

Five heliocentric times of minimum were computed using the available observations. The heliocentric times of minimum obtained with the Minimum Entropy SOP method (MEMSOP, Gaspani 1993a) are listed in Table 1. The O−C residuals computed with respect to the ephemeris (Navratil, 1994):

$$T_{min}\,(\mathrm{HJD}) = 2448862.5255 + 0\overset{d}{.}27831460\times E \qquad (1)$$

are listed in the same table. It is interesting to remark that all the residuals are systematically negative. This means that the ephemeris (1) must be updated in order to satisfy our data.

On the other hand the moments of minima observed by Abbott et al. (1994) as well as Vinkó et al. (1993) give as yet negative residuals of comparable magnitude with respect to the ephemeris (1).

Therefore we computed an updated ephemeris making use of our data as well as the recent data of Navratil (1994), Abbott et al. (1994) and Vinkó et al. (1993) in order to increase the accuracy of the least squares fit.

On the basis of the available times we obtained the following least squares fit:

$$\begin{aligned}\mathrm{Min.I}\,(\mathrm{HJD}) = {} & 2448862.5220 + 0\overset{d}{.}2783076\times E \\ & \pm\ 0.0026\ \pm\ 0.0000024\end{aligned} \qquad (2)$$

Table 2 shows the residuals computed with respect to the ephemeris (2).

VW Cephei is an active close binary whose light curve shows temporal changes. This variability has been interpreted as arising from the presence of dark starspots located mainly on the photosphere of the more massive star of the system (Bradstreet and Guinan, 1990).

After these premises, it seems to be useful to try to recover the true light curve from the noisy data in order to show changes in the height of the maxima, depth of the minima and photometric perturbations.

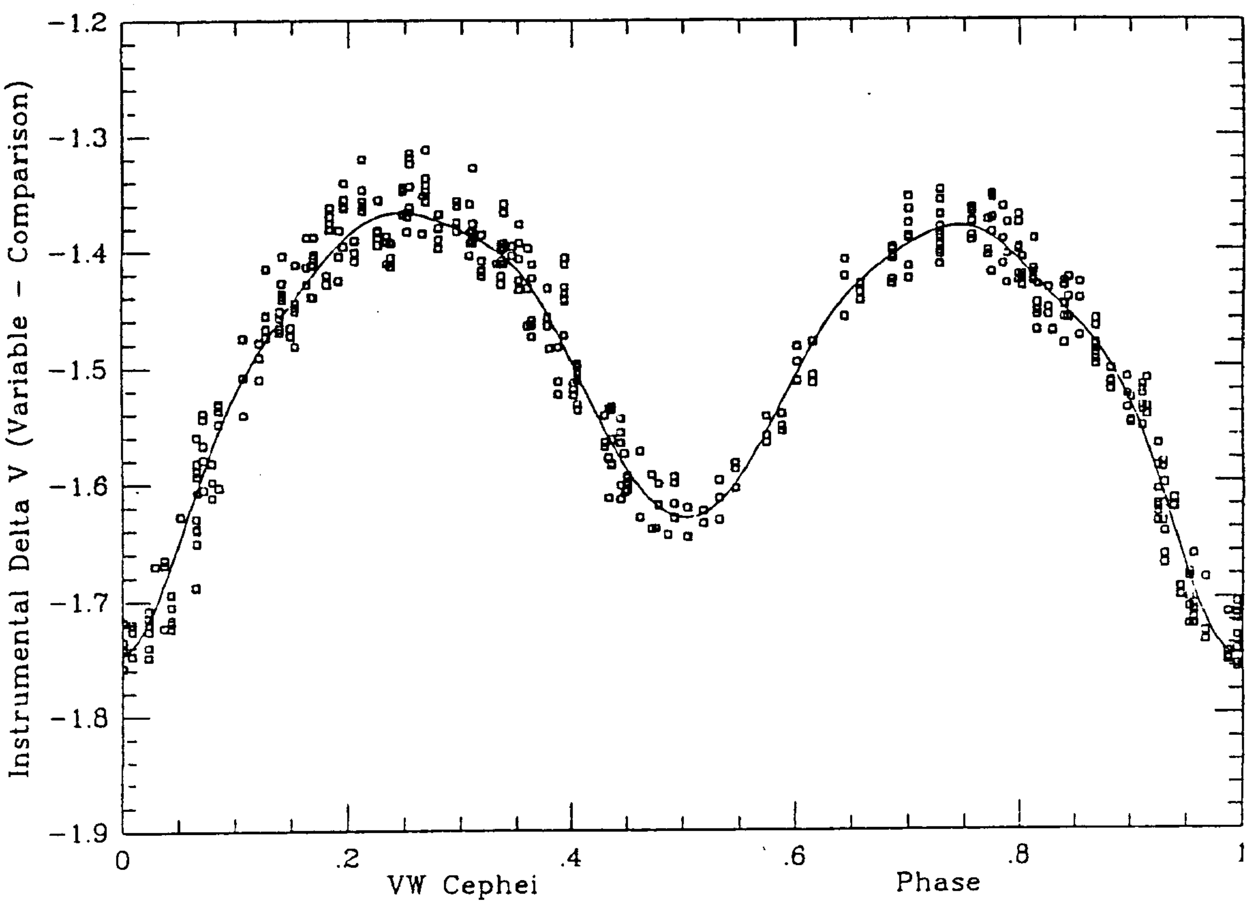

Figure 1. Light curve of VW Cephei. The solid line is the signal restored with the optimum Wiener filter and the squares are the individual data points.

Table 1. Heliocentric times of minimum

Observed Minima	E	O−C	
2449186.479 ±0.003	1164	−0.005	(Min.I)
2449191.479 ±0.008	1182	−0.014	(Min.I)
2449192.457 ±0.006	1185.5	−0.010	(Min.II)
2449192.604 ±0.005	1186	−0.003	(Min.I)
2449193.42 ±0.02	1189	−0.022	(Min.I)

In order to recover a convenient estimate of the true signal from the noisy data we processed the noisy phased data with a signal restoration technique based on the Optimum Wiener Filter Theory (Gaspani, 1993b).

Figure 1 shows the restored light curve, graphed as a solid line across the original data points and Table 3 shows the results obtained.

Table 2. Residuals from the ephemeris (2).

Epoch E	Observed time of minimum JD 2440000+	Residual (O−C)	Source
−7.5	8860.438	0.002	(a)
−0.5	8862.386	0.002	(a)
0.0	8862.525	0.003	(a)
1161.0	9185.637	−0.001	(b)
1164.0	9186.479	0.006	(c)
1164.5	9186.614	0.003	(b)
1165.0	9186.750	−0.001	(b)
1182.0	9191.479	−0.003	(c)
1185.5	9192.457	0.001	(c)
1186.0	9192.604	0.008	(c)
1189.0	9193.420	−0.011	(c)
1261.0	9213.465	−0.004	(d)
1401.0	9252.431	−0.001	(d)
1404.5	9253.405	0.000	(d)

(a) Navratil (1994), (b) Abbott et al. (1994), (c) Aluigi et al. (present paper), (d) Vinkó et al. (1993)

Table 3

	Delta V (VW Cep−HIC 103219)
Primary Minimum	−1.748
Maximum I	−1.367
Secondary Minimum	−1.630
Maximum II	−1.380

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