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V961 CYGNI

The detached eclipsing binary V961 Cygni (HBV 258 = GSC 2660.3699; $\alpha(2000) = 19^{\rm h}43^{\rm m}58\overset{\rm s}{.}3$, $\delta(2000) = +32°52'14''$, $V = 11.7$ mag) is a neglected, rather faint binary with an orbital period of about 2.04 days. It was supposed as a possible system for the study of the apsidal motion (Hegedüs, 1988). It was discovered to be a variable star photographically by Wachmann (1961), who obtained also the first photographic light curve and determined an orbital period of 2.0378 days. Unfortunately, this system has not been studied in detail for more than 30 years.

Our new CCD photometry of V961 Cyg was carried out on 26 and 29 July 1995 at the Ondřejov Observatory using a 65cm reflecting telescope with a CCD-camera (SBIG ST-6) in the primary focus. The measurements were done using the standard Johnson R filter with 45 or 60 s exposure time. The stars GSC 2660.2383 ($V = 11.1$ mag) and GSC 2660.1867 ($V = 11.5$ mag) on the same frame as V961 Cyg served as a comparison and check stars. The CCD data were reduced using software developed at Ondřejov Observatory by P. Pravec and M. Velen. No correction was applied for differential extinction, due to the proximity of the comparison star to the variable (1.1 arcmin) and the resulting small differences in the air mass. The moments of minimum and their error were determined using the Kwee–van Woerden (1956) method. These times are presented in Table 1. In this table, N stands for the number of observations used in the calculation of the minimum time. The epochs were calculated using the linear light elements given by Wachmann (1961):

$$\text{Pri. Min.} = \text{HJD } 2\,434\,237.401 + 2.0378068 \times \text{E}.$$

Figure 1 shows the differential R-magnitudes during the primary minimum observed at JD 2 449 928 (circles). Our measurements of secondary minimum (crosses) were shifted exactly by 1.5 period (+ 3.0567 d) and are also plotted to the same date. The light amplitude in R colour for primary minimum according to our measurement is $A_1 = 0.63 \pm 0.02$ mag, for secondary minimum $A_2 = 0.28 \pm 0.02$ mag. The duration of both minima D_1, D_2 seems to be almost identical.

Table 1. New times of minimum of V961 Cyg

JD Hel.– 2400000	Epoch	Error (days)	N
49925.3961	7698.5	0.0005	45
49928.4523	7700.0	0.0002	47

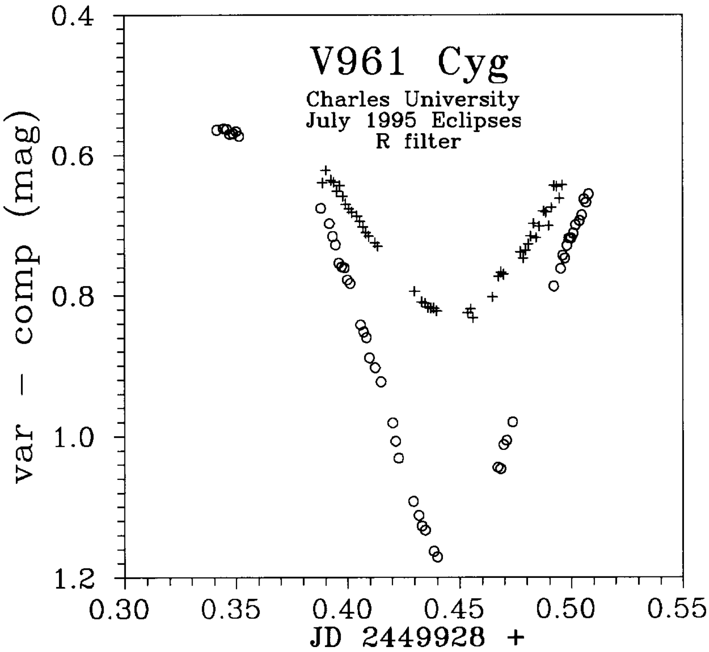

Figure 1. A plot of differential R-magnitudes obtained during primary eclipse of V961 Cyg on 29 July 1995 (circles). The measurements of the secondary minimum were shifted in time by 1.5 period and are plotted as crosses together with the primary minimum.

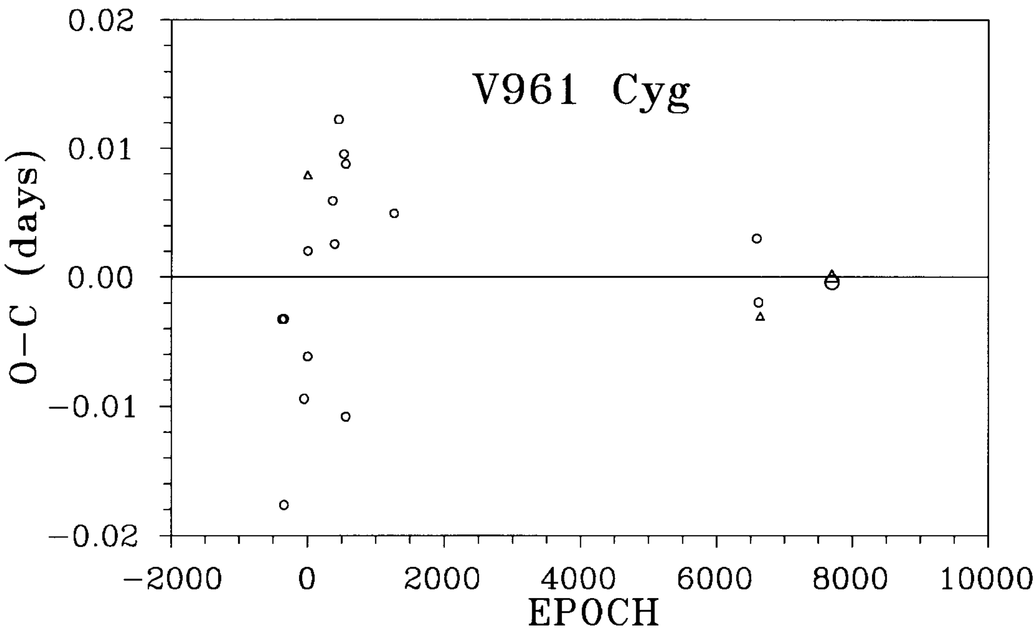

Figure 2. O−C residuals for the times of minimum of V961 Cyg. The individual primary and secondary minima are denoted by circles and triangles, respectively. Larger symbols correspond to the CCD measurements.

The change of period and possible apsidal motion of V961 Cyg was studied by means of an O−C diagram analysis. We took into consideration the photographic measurements obtained by Wachmann (1961) as well as the photographic times of minimum obtained by the BAV observers (Moschner 1990, Frank 1992). The time of primary minimum published by Moschner (1989) was not taken into consideration because the large O−C deviation (0.02 days). The photographic times of minimum were weighted with a weight of 1, 2 or 3 according to Wachmann (1961). Our times of minimum were used with a weight of 10.

The O−C residuals for all moments of minimum are shown in Figure 2. The original 13 times of primary minimum obtained by Wachmann (1961), as well as the mean time of secondary minimum for this epoch are also plotted.

We analysed the O−C diagram and the light curve using the current observations. Our results indicate that this binary has no significantly eccentric orbit. The secondary minimum occurs exactly at the phase 0.5 and the duration of primary and secondary eclipses is practically identical. Therefore, this system could be excluded from the list of possible candidates for apsidal motion study.

For the current use we derive the following linear light elements:

$$\begin{array}{rll} \text{Pri.Min.} = \text{HJD}\ 2\,449\,928.4527 & + & 2.0377986 \times E. \\ \pm.0005 & & \pm.0000008 \end{array}$$

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