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THE MASSIVE ECLIPSING Be STAR BINARY V 505 MONOCEROTIS

HD 48914 = V 505 Mon, a member of the association Mon OB2, is an eclipsing binary with a B4 or B5 supergiant primary component showing $H\alpha$ emission, sometimes with narrow central shell absorption (Boulon et al. 1974; Turner, 1976). Its orbital period of about $53\overset{d}{.}8$ has been determined by means of photoelectric photometry (Chochol and Kučera 1981; Chochol et al. 1985). The light curve shows secondary minima so pronounced that Chochol and Kučera (1981) could not single out whether the period was $26\overset{d}{.}9$, or whether it was $53\overset{d}{.}8$. But the radial-velocity curve by Stagni et al. (1982)—the only hitherto published spectroscopic study of V 505 Mon—and the work of Chochol et al. (1985) confirm that the longer period is the correct one.

Stagni et al. (1982) derive the radial-velocity orbits of both components, and estimate the system parameters, including masses of the order of 50 and $27m_{\odot}$. For a rediscussion of these parameters, see De Greve et al. (1983).

The purpose of this study is to give an improved ephemeris of this very interesting massive Be star binary, based on photoelectric *uvby* photometry obtained in the framework of the LTPV project at ESO. A total of 248 differential *uvby* measurements, obtained between October 1992 and February 1993 at the ESO 50 cm and the Danish 50 cm telescopes at the La Silla Observatory in Chile, were used. Most of the observations were obtained in an observing sequence APB, where P is the program star V 505 Mon, and A (=HD 48434) and B (=HD 49567) are the comparison stars. Their mean magnitudes (and corresponding standard deviations) in the four Strømgren channels are listed in Table 1. The y channel magnitudes correspond to the Johnson V standard, the b, v and u magnitudes were derived from the definition of the Strømgren indices. Part of the photometric data were published by Manfroid et al. (1991) and by Sterken et al. (1993), to which we refer for the journal of observations, and for details on the data reduction procedures.

Table 1. Program and Comparison Stars: Average Magnitudes and Standard Deviations

HD	Name	Sp	$\overline{u}$ σ_u	$\overline{v}$ σ_v	$\overline{b}$ σ_b	$\overline{y}$ σ_y
48914	V 505 Mon	B4Ib	7.874 .198	7.360 .112	7.283 .111	7.253 .110
48434	HR 2479	B0 III	6.055 .021	6.033 .014	5.950 .011	5.876 .011
49567	HR 2517	B3 II-III	6.495 .017	6.148 .012	6.122 .012	6.172 .013

In order to utilize the differential photometry, we determined, for each sequence and for each comparison star, the difference between the actual measurements and the overall general average given in Table 1, and corrected the u, v, b and y data of 505 V Mon with the corresponding deviation from the mean. In such a way the magnitudes of the variable were corrected according to the observed deviations of the comparison stars from their overall mean values.

Table 2. Times of Eclipse Minima of V 505 Mon. Times of minimum marked with : were not used in the determination of ephemeris (1)

	E	u		vby	
		HJD -244 0000	$O-C$ d	HJD -244 0000	$O-C$ d
Primary Minima	0	5252.5	-1.3	5253.8	0.0
	8	5685.3:	+1.3	5685.8:	+1.8
	14	6005.1:	-1.5	6005.2:	-1.4
	21	6382.6	-0.4	6382.7	-0.3
	22	6436.0	-0.8	6436.6	-0.2
	23	6490.4	-0.2	6490.5	-0.1
	35	7137.2	+1.4	7136.1	+0.3
	37	7244.4	+1.0	7243.3	-0.1
	41	7458.6	+0.1	7458.6	+0.1
	48	7835.6	+0.7	7835.0	+0.1
	49	7889.4	+0.7	7888.7	0.0
Secondary Minima	15.5	6087.2	-0.1	6887.5	+0.2
	16.5	6140.7	-0.3	6140.9	-0.1
	21.5	6410.1	+0.2	6410.0	+0.1
	35.5	7163.0	+0.3	7162.9	+0.2
	43.5	7592.5	-0.4	7592.6	-0.3
	56.5	8291.6	-0.4	8291.6	-0.4

The observed times of all primary and secondary minima are given in Table 2, together with their cycle numbers. Unfortunately, the authors of the published photoelectric data did not give individual times of eclipse minima. However, their zero-epochs HJD 244 1328.06 (Chochol et al. 1985) and HJD 244 4635.318 (Chochol and Kučera 1981) respectively refer to cycle numbers $E = -73$ and $E = -11.5$ of Table 2. A least-squares fit using these two times of reference, as well as 9 primary and all 6 secondary minima of Table 2 yields an improved ephemeris for the primary eclipse minimum

$$\begin{array}{l} \text{HJD (minimum)} = 244\ 5253.71 + 53\overset{d}{.}7745\ \text{E} \\ \qquad\qquad\qquad\qquad\quad \pm 6 \qquad\ \pm 17 \end{array} \tag{1}$$

Two primary minima ($E = 8$ and 14) have not been used for deriving (1), because of the corresponding excessively-large $O - C$ deviations. The original light curves are, in fact, not very complete and have rather large gaps in the coverage of ingress and egress, and the associated times should be considered as uncertain. The 1300-day cycle in $O - C$,

as announced previously (Vogt and Mennickent 1993), depends entirely on these two uncertain times of minimum, and the reality of its existence cannot be established from the data available at this moment.

Our light curves indicate that there is a strong variability in the shape of the primary eclipse minima, especially in their width, and that there are also some irregular variations during the phases outside eclipses. In y, b and v, the depth of primary and secondary eclipses are nearly the same, while primary eclipses normally last longer. Their similarity of eclipse depths explain why, in the discovery paper, the authors were not able to distinguish between the 27-day and 54-day period solutions. However, in the u band, the primary eclipses are much deeper than the secondary eclipses, another confirmation that the 54-day period is the correct one.

Presently we are analyzing the light curves in order to determine the relative shapes of the stellar components, together with some basic parameters of the emitting envelope. A more detailed study is in preparation.

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