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HD 115781: A LARGE-AMPLITUDE ELLIPSOIDAL VARIABLE

We began photometry of HD 115781 (= BD $+34^{\circ}2411$) after it appeared on a list of bright suspected variables (Hall 1983). The HD spectral type is G5 and the magnitudes (Haggkvist and Oja 1973) are $V = 8^{m}.13$, $B-V = 1^{m}.14$, $U-B = 0^{m}.94$. According to Griffin and Fekel (1985) it is a spectroscopic binary with an orbital ephemeris of

$$\begin{matrix} JD(hel.) = 2445280.30 & + & 18^{d}.6917\ n\ , \\ \pm\ .03 & & \pm\ .0012 \end{matrix} \qquad (1)$$

where the initial epoch is a time of maximum positive radial velocity.

As shown in Table I, differential photometry was obtained on a total of 40 nights in 1984 at three different observatories. The comparison star was HD 115707 = BD $+33^{\circ}2324$, which is only 40 arc minutes away. Nightly means, of the three individual measures obtained on each night, are given in Table II. The first 31 are Lines, the next 5 Barksdale, the last 4 Stelzer. Each value of ΔV, in the sense variable minus comparison, has been corrected for differential atmospheric extinction and transformed differentially to V of the UBV system.

It was immediately obvious that the brightness was varying nearly sinusoidally with a period of 9 or 10 days. By linear least squares we fit 14 times of maximum and minimum brightness, obtained from the light curve graphically, with the ephemeris

$$\begin{matrix} JD(hel.) = 2445803.8 & + & 9^{d}.31\ n\ , \\ \pm\ .3 & & \pm\ .06 \end{matrix} \qquad (2)$$

where the initial epoch is a time of maximum brightness. Twice our value of the period is $18^{d}.62 \pm 0^{d}.12$, consistent with the value in equation (1) found by Griffin and Fekel. This made us suspect that HD 115781 is varying as a result of the ellipticity effect. The suspicion is confirmed by the following reasoning. Times of maximum positive radial velocity should (in a circular orbit) correspond to times of quadrature, which should be times when an ellipsoidal variable reaches maximum brightness. The initial epoch in equation (1), brought forward by exactly 28 cycles, is JD(hel.) $2445803.668 \pm 0^{d}.045$. This differs from the epoch in equation (2) by only $0^{d}.1$, entirely consistent with the relevant uncertainties.

Table I

Tally of Observations

Observer	Location	Telescope	Nights	λ
Barksdale	Florida	14-inch	5	V
Lines	Arizona	20-inch	31	VB
Stelzer	Illinois	14-inch	4	V

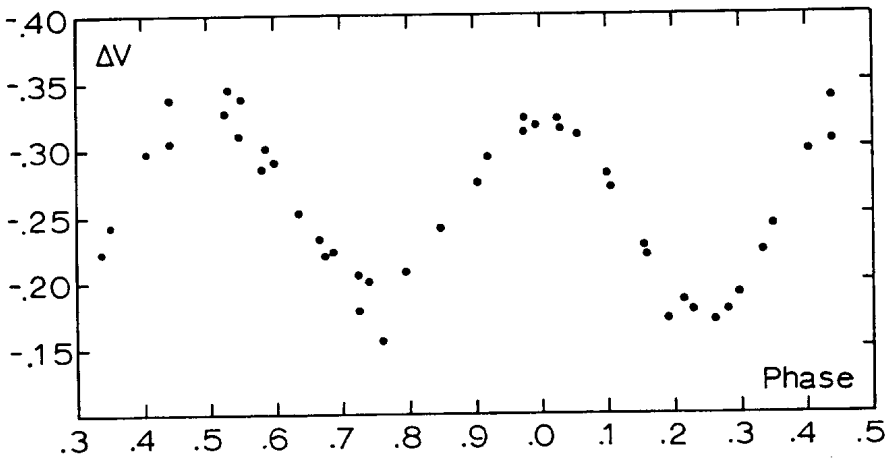

Figure 1

Light curve of HD 115781 in V, where Δ is in the sense variable minus HD 115707 and phase is computed with the ephemeris in equation (3) in which zero phase is at maximum brightness. The $0^m.16$ variation probably results from the ellipticity effect and there is no evidence of eclipses, the reflection effect, or an RS CVn-type asymmetry.

Figure 1 is a plot of the ΔV values in Table II, where phase is computed with the ephemeris

$$JD(hel.) = 2445803.8 + 18^d.69\ n\ . \qquad (3)$$

The light curve shape is characteristic of the ellipticity effect, although we note the $0^m.16$ amplitude is relatively large. Unequal depths of the two minima would indicate the differential reflection effect, but there is no clear indication of this. Unequal heights of the two maxima might

Table II

Nightly Mean Differential V Magnitudes of HD 115781

JD(hel.) 2445000+	ΔV	JD(hel.) 2445000+	ΔV	JD(hel.) 2445000+	ΔV
804.7847	$-0^m.310$	844.7055	$-0^m.171$	874.6761	$-0^m.208$
805.7056	- .270	846.7116	- .191	875.6865	- .241
806.7222	- .220	847.6935	- .242	889.6958	- .289
807.7332	- .185	848.6983	- .298		
813.6990	- .345	854.7096	- .205	797.6914	- .219
814.6885	- .301	859.7009	- .318	839.6753	- .294
820.6834	- .274	861.7098	- .281	840.6733	- .313
826.7171	- .178	862.7076	- .228	853.6440	- .232
827.6865	- .177	864.7179	- .170	854.6914	- .177
828.7211	- .223	869.6772	- .328		
830.6884	- .338	870.6757	- .284	830.6704	- .304
832.7035	- .337	871.6833	- .252	832.6528	- .310
840.7068	- .322	872.6839	- .222	836.6543	- .156
841.7245	-0.315	873.6762	-0.200	841.6504	-0.323

indicate the "wave" seen in RS CVn-type variables, but there is only a slight suggestion of this and, moreover, we could not find in the literature any report of the Ca II H and K emission which would indicate that HD 115781 is an RS CVn system. Eclipses would show up as anomalous faint points around $0^P.25$ and/or $0^P.75$, but we see no evidence of this.

The ΔB measures made by Lines are not reported here, but analysis did show that there is no significant change in B-V index as this variable goes through its $18^d.69$ cycle.

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