LIGHT CURVE OF THE ELLIPSOIDAL VARIABLE HD 1826

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ABSTRACT. Between 1983 and 1985 photoelectric observations in the B spectral band of the star HD 1826 were made at both institutions. The observations have been fitted to a truncated Fourier series. Systematic deviations of the order of 0.01 mag have been noticed. Secular increase of the rotational period was found.

КРИВАЯ БЛЕСКА ЭЛЛИПСОИДАЛЬНОЙ ПЕРЕМЕННОЙ HD 1826. В 1983 – 1985 гг. были получены фотоэлектрические наблюдения HD 1826 в спектральной области B в обсерваториях Ватерлоо и Скалнате Плесо. Наблюдения были обработаны методом анализа Фурье. Наблюдаются систематические отклонения порядка 0.01 звездной величины. Было обнаружено вековое нарастание периода вращения.

SVETELNÁ KRIVKA ELIPSOIDÁLNEJ PREMENNEJ HVIEZDY HD 1826. V období 1983 až 1985 boli získané fotoelektrické pozorovania HD 1826 v B spektrálnej oblasti na observatóriách Skalnaté Pleso a Waterloo. Pozorovania boli spracované metódou Fourierovej analýzy. Zistili sa systematické odchylky rádu 0.01 mag. Dokázalo sa sekulárne predlžovanie rotačnej periódy.

1. INTRODUCTION

The star HD 1826, SAO 73938 (V=6.85, spectral type A3 V) is a singlelined spectroscopic binary with a period of 1.43 days. McCrosky and Whitney (1982) announced the star to be an ellipsoidal variable. The light curve in both the V and B spectral bands was published be Gonzales-Bedolla et al. (1986). The authors fitted their observations to a simple harmonic series.Using the procedure of Morris (1985) they derived the most likely parameters of the binary system.

When McCrosky and Whitney announced the variability of the star but failed to publish the light curve we have placed the star on our observing program in 1983.

2. OBSERVATIONS

Observations of HD 1826 have been made in the B spectral band. For comparison star we chose the star HD 1606 of spectral type B8 and the star HD 1439 of spectral type A1 V served as a check star. The magnitude difference between the two stars was constant, the check star being the fainter by 0.081 $\pm$ 0.001 mag. The description of the instrumentation for photoelectric photometry at University Astronomical Observatory in Waterloo was published elsewhere (Bakos, 1983). The detailed description of the automatized photoelectric photometer at Skalnaté Pleso Observatory, its photometric characteristics and functioning were published in a series of papers (Horák et al., 1976; Klocok et al., 1986; Kreiner and Tremko, 1987). The integration interval of one measurement at Skalnaté Pleso Observatory was 10 seconds. As short variations of the brightness are improbable, we grouped the measurements obtained within few minutes into one observation.The observations obtained at both observatories are included in the Table 1. Table 1 is selfexplanatory. The brightness variation of the variable star is relatively small as its semiamplitude is $0\overset{m}{.}016$ only. The observations were corrected for differential extinction. For the interpretation the observations obtained with the accuracy better than 0.005 mag were used only.

Combining the epochs of maxima of Gonzales-Bedolla et al. (1986) and our we have improved the orbital period of the system (and the rotational period of the ellipsoidal star). The new elements are as follows:

$$\mathrm{Max}_{\mathrm{hel}} = \underset{\pm 14}{2444854{,}8800} + \underset{\pm 2}{1.432321}\,E + \underset{\pm 1}{3.379} \times 10^{-9}\,E^2$$

The elements show the secular increase of the orbital period of the system (or the change of the rotational period of the brighter component). The true cause of the increase of the period is unknown. Speculations are possible only: the mass transfer effect or light-time effect?

The light curve has been plotted in Fig. 1a as a function of phase. It was fitted to a truncated Fourier series of the form:

$$l = A_o + A_1 \cos \varphi + A_2 \cos 2\varphi + B_1 \sin \varphi + B_2 \cos 2\varphi$$

By a method of least squares the following coefficients have been derived:

$A_o = 0.980 \pm 0.002$ $\quad A_1 = -0.003 \pm 0.003$ $\quad A_2 = 0.016 \pm 0.005$

$B_1 = 0.005 \pm 0.005$ $\quad B_2 = -0.003 \pm 0.004$

This curve has been drawn in Fig. 1a.

Table 1

Photoelectric photometry of HD 1826

J.D. hel. 2440000+.	Phase	ΔB	J.D. hel. 2440000+.	Phase	ΔB	J.D. hel. 2440000+.	Phase	ΔB
5354.5065	0.8215	1.368	6341.7107	0.0550	1.333	6344.5576	0.0425	1.334
5567.8345	0.7601	1.379	6343.5312	0.3248	1.353	6344.5679	0.0497	1.333
5602.7547	0.1402	1.348	6343.5394	0.3326	1.346	6344.5756	0.0550	1.333
5616.7359	0.9015	1.332	6343.5508	0.3418	1.346	6344.5783	0.0563	1.332
5617.6845	0.5637	1.343	6343.5653	0.3514	1.340	6344.5832	0.0622	1.329
5638.6316	0.1883	1.370	6343.5808	0.3614	1.338	6345.3568	0.6060	1.349
5639.6678	0.9118	1.333	6343.5967	0.3722	1.336	6345.3686	0.6080	1.348
5646.6643	0.7965	1.378	6343.6130	0.3822	1.332	6345.3784	0.6153	1.348
5660.6016	0.5270	1.340	6343.6240	0.3900	1.330	6345.3890	0.6232	1.345
5932.8102	0.5741	1.342	6343.6373	0.3987	1.326	6345.4010	0.6319	1.350
5937.8073	0.0629	1.337	6343.6491	0.4074	1.326	6345.4120	0.6392	1.352
5960.7532	0.0830	1.338	6344.4735	0.9830	1.338	6345.4224	0.6468	1.351
5963.7367	0.1660	1.365	6344.4839	0.9904	1,338	6345.4355	0.6554	1.354
6018.5982	0.4685	1.325	6344.4941	0.9976	1.337	6345.4471	0.6634	1.359
6074.5030	0.4994	1.336	6344.5006	0.0028	1.335	6345.4585	0.6716	1.359
6289.8466	0.8452	1.367	6344.5109	0.0092	1.336	6345.4699	0.6795	1.357
6321.7890	0.1463	1.348	6344.5222	0.0172	1.334	6345.4806	0.6872	1.360
6333.7312	0.4839	1.328	6344.5314	0.0243	1.330	6345.4902	0.6937	1.361
6336.7452	0.5882	1.347	6344.5492	0.0367	1.335	6359.8594	0.7258	1.362

3. DISCUSSION

As Fig. 1a indicates there small systematic deviations between the observed points and the theoretical light curve. In Fig. 1b we have plotted the O-C´s against the phase (the continuous curve). The largest deviations, of the

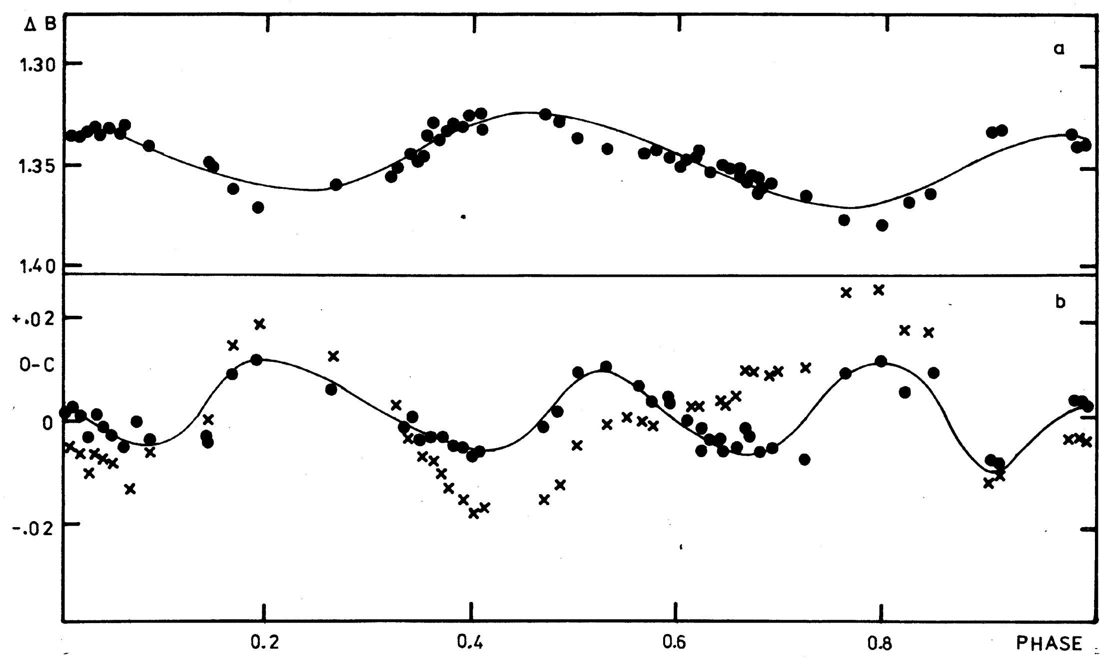

Fig. 1

Fig. 1 a/ theoretical light curve of HD 1826. b/ crosses - deviation of observations published by Gonzales-Bedolla et al.; circles - deviation of present observations.

order of 0.01 mag are noticed at the phase of the two minima. Similar deviations appear on the ascending branch of the maximum at phase 0.9 as well as on the descending branch at phase 0.5. Our fit to the residuals is much better than that produced by the simple equation of Gonzales-Bedolla et al. which has been represented by crosses in Fig. 1b. These deviations appear to be of the order of the amplitude of the light curve. From our observations it is obvious that the two maxima differ by 0.005 mag (the O'Connel effect?).

The relation of the light curve with the coefficients of equation a is as follows. A_o represents the average brightness of the system. Since the luminosity of the secondary component is much lower than that of the primary A_o could be assumed to represent the average brightness of the A-type star alone. The negative value of A_1 represents the reflection effect. According to Table IV of Gonzales-Bedolla et al. (1986) the mass of the secondary is less than one solar mass, thus its heating effect on the primary is small.

The ellipticity of the primary is given by the coefficient A_2. Its value is the same as that derived by the just mentioned authors. The parameters of the binary system have been summarized in their Table IV. The remaining coefficients take care of the asymmetry of the light curve as mentioned earlier.

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