THE VARIABILITY OF HD 76536

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Abstract. The spectrophotometric and photometric observations of the WC star HD 76536 are reported. The flux and the magnitude variations appear to be periodic. The possibilities of a compact binary are discussed.

1. Introduction

HD 76536 (SAO 220658, WR 11, $V = 8.85$) is classified as WC 6 in the catalogue of van der Hucht *et al.* (1981). Photometric variations are reported by Moffat and Haupt (1974), Muzzio (1979), and Bromage *et al.* (1982). UV spectroscopic variations are reported, based on which Bromage *et al.* (1982) evoke a compact companion. The period of the binary is expected to be 3 to 5 days.

With the idea of detecting variations in magnitude and flux, HD 76536 was included in the programme of spectrophotometric observations of WR binary stars. Here we report the results and discuss the implications of such a binary system.

2. Observations and Results

The spectrophotometric observations were obtained during the season November 1984–May 1985 on unequally spaced dates from the automated spectrum scanner (Bappu, 1977) at the 102 cm telescope of the Vainu Bappu Observatory, Kavalur. A 600 lines mm^{-1} grating blazed at 7600 Å was employed to scan the spectrum in first order. The wavelength region covered was $\lambda\lambda$4500 to 6000 Å. The resolution is 20 Å. The spectrophotometric standards are taken from the list of Hayes (1970), Kuan and Kuhi (1976), and Breger (1976).

The emission line fluxes were obtained for all the scans for the λ4650 and λ5696 emission. The monochromatic magnitudes also were read out and these are shown in Figure 1. Both the quantities show large scatter but a gradual decrease on one day is immediately noticeable. On that occasion it was possible to monitor the star at intervals of almost 15 min (J.D. 2446048). On the same day another WN 5 star HD 50896 was monitored in between the 15 min intervals. That showed unusually *large* flux of emission lines (Shylaja, 1986). The standard stars were monitored more often to isolate the instrumental effects.

This sharp decrease in flux as well as magnitudes initiated a need for close monitoring. To achieve this, the photometer was employed at 40 cm reflector during March 1986. The run was for 5 days and only the V filter was used. The stars SAO 220657 (A2) and SAO 220662 (B3) were chosen as comparisons and SAO 220513 (B5) was used as a

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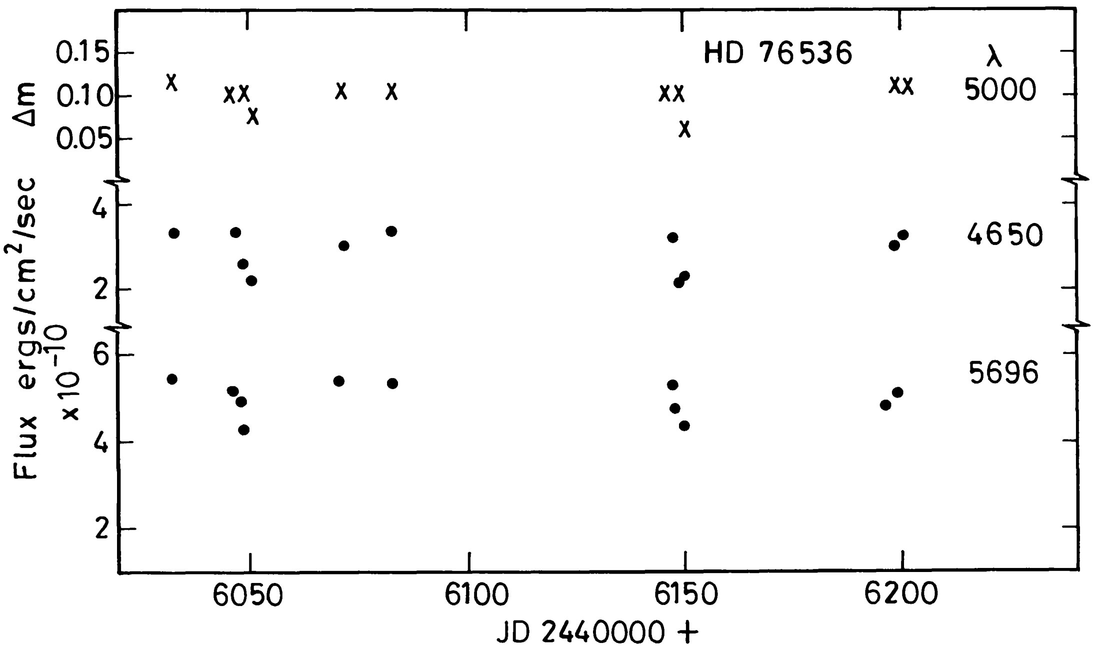

Fig. 1. Variation of flux of emissions at λ5696 and λ4650 and the monochromatic magnitude at 5000 Å (from Table I).

TABLE I

The fluxes and monochromatic magnitudes of HD 76536

J.D. 2440000+	Flux $\times 10^{-10}$ ergs cm^{-2} s^{-1} 4650	5696	Magnitude diff. Δm
6034.321	4.75	7.11	4.30
6047.416	4.77	6.71	4.30
.425	4.72	6.62	4.31
.468	4.74	6.56	4.36
6048.324	2.93	6.02	4.31
.332	2.86	5.66	4.29
.342	2.87	5.81	4.33
.349	2.73	5.32	4.36
.368	2.46	4.62	4.26
.385	2.57	5.11	4.19
.421	2.46	4.81	4.21
.437	2.39	4.50	4.22
.459	2.43	4.61	4.25
.474	2.31	4.39	4.18
6071.361	4.11	6.82	4.31
6083.278	4.72	6.66	4.33
.446	4.87	6.91	4.30
6148.119	4.51	6.78	4.31
.185	3.31	6.02	4.36
.220	2.64	5.81	4.38
6150.119	2.68	4.77	4.22
6197.143	4.08	5.97	4.37
6198.152	4.61	6.22	4.38

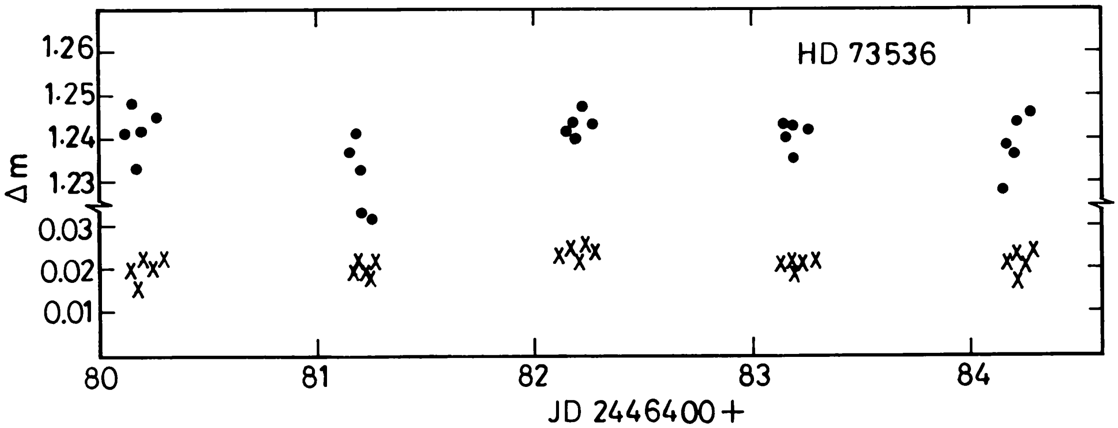

Fig. 2. *V* photometry of HD 76536. The magnitude difference of HD 76536 with respect to comparison (dots) and that of comparison 1 to comparison 2 (from Table II).

TABLE II

Photometry of HD 76536

(Comp. 1 = SAO 220513; Comp. 2 = SAO 0220662)

J.D. 2446400+	HD 76536 – Comp. 2	Comp. 1 – Comp. 2
80.108	1.340	0.133
.153	1.348	0.117
.176	1.334	0.123
.230	1.341	0.121
.279	1.345	0.124
81.112	1.337	0.120
.140	1.341	0.123
.179	1.333	0.120
.224	1.322	0.118
.254	1.321	0.123
82.094	1.342	0.124
.140	1.343	0.126
.173	1.340	0.123
.226	1.347	0.126
.244	1.343	0.124
83.096	1.343	0.121
.130	1.339	0.123
.181	1.343	0.119
.210	1.335	0.121
.242	1.342	0.123
84.111	1.328	0.121
.134	1.338	0.123
.182	1.337	0.118
.224	1.343	0.118
.254	1.346	0.125

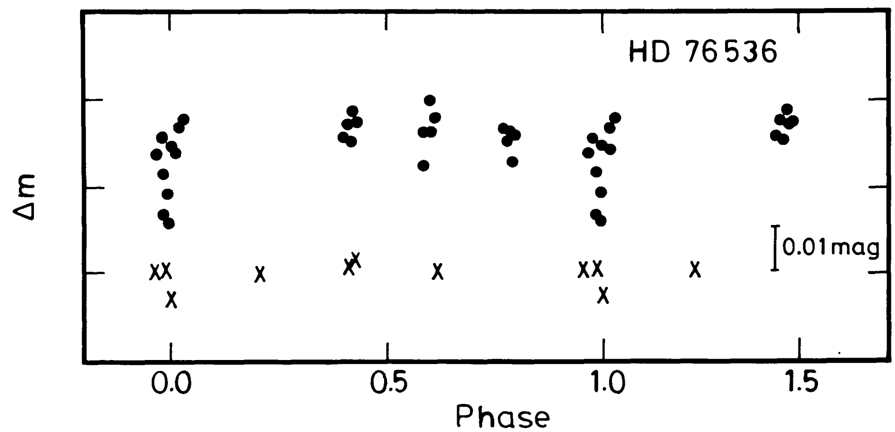

Fig. 3. The V observations and monochromatic magnitudes folded over a period of 2.42 days with J.D. = 2446480.279 as the epoch.

check star. The runs were in the conventional $C_1 - V - C_2 - C$ mode (with sky in between) each for about 10 min. The mean of the 10 min run was used for calculating the magnitude.

Since SAO 220657 is suspected to be a variable (Moffat and Haupt, 1974) this was not included for the magnitude difference estimates.

The photometry results are shown in Figure 2. There is an apparent decrease in magnitude on two occasions. Since the duration of the runs is only 5 days it is difficult to derive any period. A rough estimate of 2.4 days agrees with the result. Extrapolating this to the observations of the previous year, for reaching the decrease in flux, the period can be estimated as 2.42 days (see Figure 3). *This is only a very rough estimate*. The actual period can be obtained only after monitoring it continuously over 4–5 cycles.

3. Discussion

Bromage *et al.* (1982) have suggested a period of 3 to 5 days after observig one dip in the light curve and interpreting it as one of the minima. If the light curve of HD 76536 is similar to that of HD 50896 in which only one minimum is seen (Firmani *et al.* , 1980), the period of 2.42 days itself can be adopted for the light curve also.

The flux variations of HD 50896 and HD 76536 also are similar (Shylaja, 1986), i.e., there is a decrease of the flux at the phase corresponding to the dip, in the continuum light curve. The situation was the same in case of the WC 7 binary HD 152270 (Shylaja, 1988), which showed a decrease of the flux of high excitation lines. Therefore, in spite of the scatter of the observed points, we may interpret that the high excitation lines of C III and C IV are originating closer to the system and, therefore, show the 'eclipse' phenomenon.

The He II λ4686 line is a blend with λ4650 and, therefore, it is very difficult to measure the flux. He II lines originate in the outer regions and are not likely to participate in the eclipse even when the angle of inclination is favourable (Shylaja, 1987) as seen in WN systems. Therefore, if measurements are made with better resolution, the He II at λ4686 may not show the decrease in flux at the phase corresponding to the dip in continuum. In case of WN systems there is an increase in flux while the measurement on (WC 7 + 0) HD 152270 showed a scatter. However, in case of HD 76536 an increase in flux at this phase has been reported for He II λ1640 (Bromage *et al.* , 1982).

The radial velocity variations provide an important clue about the nature of the binary. Therefore, continuous high dispersion spectroscopy will probably solve the question on the binary nature of HD 76536 emphatically.

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