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THE LIGHT VARIATIONS OF BINARY Be STAR HD 187399

In the course of systematic UBV photoelectric photometry of selected Be stars, HD 187399 (MWC 321, V 1507 Cyg) was measured at the Hvar Observatory during 38 nights in 1976, 1977 and 1978.

Merrill (1949) found this star to be a spectroscopic binary and computed its elements. Already, the star was known as an emission-line object (Merrill et al., 1925; Swings and Struve, 1943). Hutchings and Laskarides (1972) classified it as a B8 III star. From high-quality coude spectrograms Hutchings and Redman (1973) redetermined its orbital elements and found that they have remained constant over some 30 years. They concluded that it seems unlikely that the velocity variations are the result of temporary shell effects in an unstable envelope, and that the star is almost certainly a binary. However, the second absorption system and the emission lines indicate that there is gas streaming and mass loss of some kind. They also suggested that the primary fills its Roche lobe and loses mass at periastron, while the secondary appears to be more massive and observationally undetectable. The possibility of its being a black hole is also discussed in their paper.

HD 187399 has a very complex light-curve as was found by Hill et al. (1976). Their measurements were done in the DAO system. Hutchings (1974) was able to reproduce some of the observed features in the light-curve using a single-star model with the parameter, T_{eff} = 16000 K and R_p varying from 0.61 to 1.00 of the Roche limiting value.

Observations reported in this communication were carried out at the Hvar Observatory using a 65-cm reflector. Methods of observational and reduction techniques have been described

in detail by Harmanec et al. (1977). For each observing season, carefully checked colour transformation coefficients were used according to Pavlovski et al. (1979). So, all measurements were transformed to the international UBV system. The comparison star HD 188170 was used in 1976 while during the other two observing seasons this star served as a check and HD 186357 was used as a comparison. Accepted UBV magnitudes for these stars obtained from our UBV photometry relative to standard stars are as follows:

Star	V	B-V	U-B
HD 186357	6.506	0.325	0.114
HD 188170	7.319	- 0.082	- 0.377

The values for HD 188170 were derived differentially relative to HD 188170. All measurements are given in Table I. Cycles and phases are computed according to a spectroscopic ephemeris

$$T_{periastr.passage} = JD\ 2432465.98 + 27^{d}.9705 \times E$$

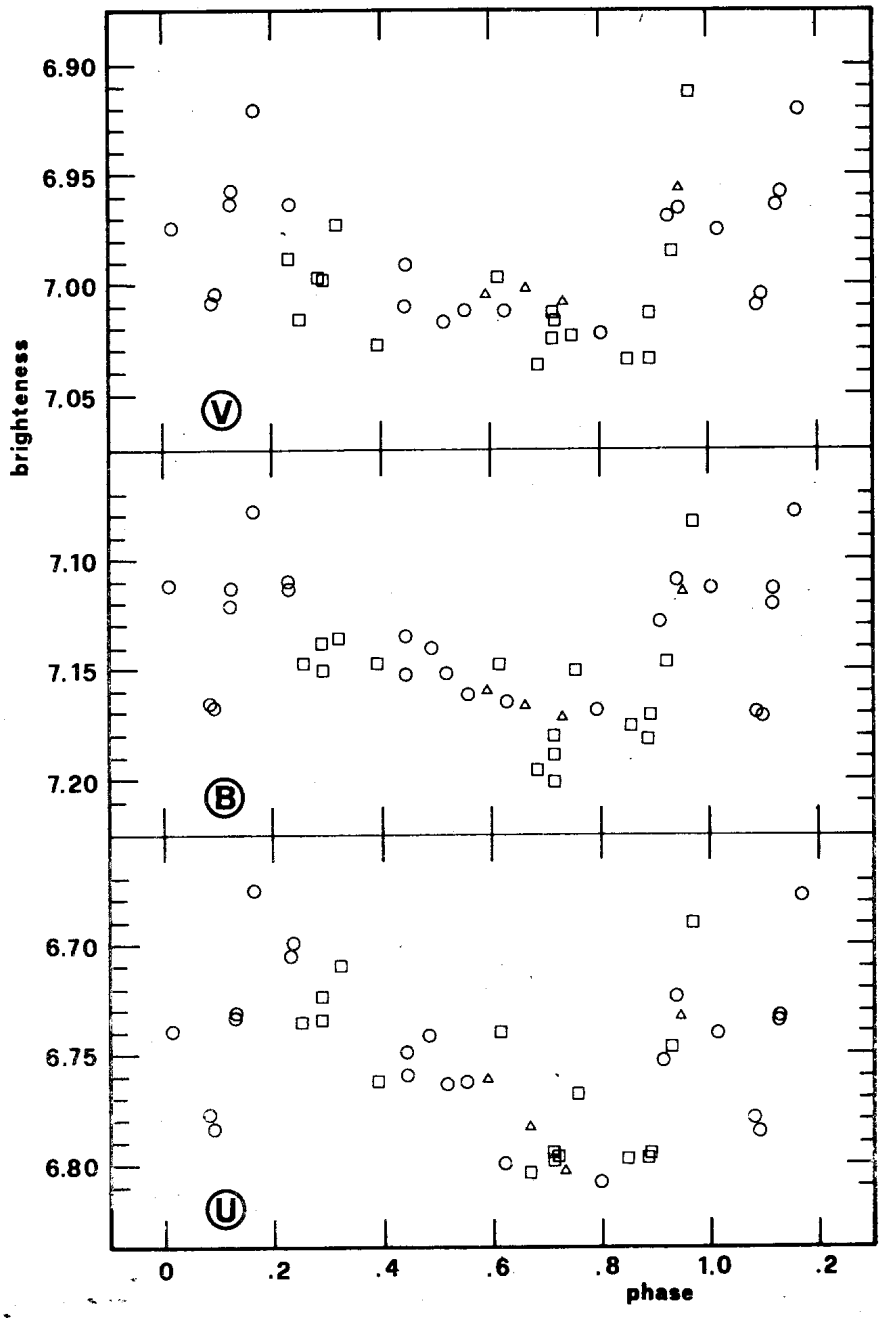
derived by Hutchings and Redman (1973).

V, B and U observations are illustrated in Fig. 1. A peculiar light-curve shape similar to light variations of eclipsing binaries and its small amplitudes are seen. The behaviour of light variations in different spectral bands is very similar. We also note that during our observational runs, which span over 3 years, the light curves have remained stable, as was also noted previously by Hill et al. (1976). Our light curve quite well reproduces peculiarities found by Hill et al. The only other existing UBV values for HD 187399 are those of Haupt and Schroll (1974), from their photometric survey of shell stars. They found V=6.99, B-V=0.18 and U-B=-0.46. The date of their observations is unknown, so that their phase cannot be computed and directly compared with our measurements. Generally, V magnitude is in agreement with our values. Most probably, the large difference between indices is due to the fact that Haupt and Schroll used another comparison star, not due to real long-term variations.

As Kříž and Harmanec (1975) and Harmanec and Kříž (1976), we believe that this system presents a steady-state mass transfer of case B mass-exchanging systems. Most probably, a mass-losing star dominates the spectrum. The gas stream between the stars is dense enough to produce continuous absorption by Thomson scattering. Therefore we observe a broad minimum in the light curve

Table I

2 400 000^{d}+	Cycles and phase	V	B-V	U-B	N
43024.370	377.483	7.026	0.160	-0.391	6
43027.370	377.590	7.004	0.157	-0.399	8
43029.368	377.662	7.001	0.165	-0.385	8
43031.342	377.732	7.009	0.161	-0.367	12
43037.291	377.945	6.955	0.156	-0.376	4
43326.543	388.286	6.997	0.153	-0.426	3
43327.488	388.320	6.972	0.163	-0.426	6
43337.491	388.678	7.037	0.162	-0.390	4
43338.442	388.712	7.025	0.154	-0.382	5
43366.431	389.712	7.012	0.168	-0.388	5
43371.413	389.891	7.013	0.168	-0.383	5
43372.429	389.927	6.982	0.164	-0.400	5
43373.404	389.962	6.911	0.164	-0.388	5
43381.345	390.246	7.018	0.131	-0.410	5
43382.415	390.284	6.997	0.138	-0.404	5
43385.376	390.390	7.028	0.118	-0.381	5
43391.406	390.605	6.997	0.147	-0.410	5
43394.393	390.712	7.019	0.181	-0.405	5
43395.417	390.749	7.023	0.126	-0.384	5
43398.303	390.852	7.034	0.143	-0.380	5
43399.357	390.890	7.034	0.139	-0.380	5
43710.473	402.013	6.974	0.137	-0.372	4
43712.454	402.083	7.009	0.155	-0.389	3
43713.466	402.120	6.961	0.150	-0.381	5
43716.462	402.227	6.971	0.138	-0.408	5
43722.471	402.442	6.989	0.144	-0.385	5
43723.509	402.479	6.973	0.165	-0.401	5
43724.459	402.513	7.017	0.136	-0.389	4
43725.443	402.548	7.011	0.150	-0.399	5
43735.456	402.906	6.968	0.158	-0.374	5
43736.405	402.940	6.964	0.145	-0.387	5
43740.483	403.086	7.004	0.166	-0.386	5
43741.470	403.121	6.958	0.163	-0.387	5
43742.449	403.156	6.920	0.156	-0.397	5
43744.398	403.225	6.962	0.151	-0.406	5
43750.427	403.441	7.013	0.138	-0.388	5
43755.385	403.618	7.012	0.152	-0.364	5
43760.371	403.797	7.021	0.144	-0.357	7


6.90
6.95
7.00
7.05
7.10
7.15
7.20
6.70
6.75
6.80
brighteness
V
B
U
0
.2
.4
.6
.8
1.0
.2
phase

of the system in, or shortly after, the elongation with the mass-losing component approaching (phase around 0.8). Such a minimum is also wavelength-independent because of non-selective electron-scattering. The above discussion is qualitative only and a more quantitative and detailed study of such an important and interesting system is neededin the future.

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