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OBSERVATIONS OF θ CORONAE BOREALIS IN SUMMER 1984

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Harmanec (1983) suspected the Be star θ CrB to be a long-periodic spectroscopic binary with an orbital period of 510.87 days. The predicted time of a hypothetical primary eclipse from the orbital solution was found to coincide remarkably well with the $0^m.7$ deep photometric minimum observed by Roark (1971). The next primary eclipse was expected to occur on May 25 — June 15, 1984.

Here we present photometric and spectroscopic observations obtained during May, June and July 1984. M. Fernandes observed with a 10 inch Schmidt-Cassegrain and a Schnitzer type photometer furnished with an (uncooled) EMI 9781B tube and filters for B and V. At the same time, spectrograms of θ CrB were obtained with the Universal-Astro grating spectrograph at the 106 cm Cassegrain of the Hoher List Observatory (dispersion: 32.5 Å/mm, projected slit dimensions: 0.014 x 0.28 mm, wavelength range: λλ 3700-4800, emulsion: IIaO).

The photometric data are shown in Table I. Primary comparison star was η CrB while HD 138341 served as check star. The mean magnitude difference (in the sense 'Comp minus Check') was found to be $-1^m.15$ in B, and $-1^m.46$ in V, with no significant variations. The standard deviation of a single differential magnitude, corrected for atmospheric extinction and transformed to the standard system, is ± $0^m.015$. Assuming (V = 4.98, B-V = 0.58) for η CrB (Nicolet 1978), we get B = 4.04, V = 4.13 and B-V = -0.09 for θ CrB, in the interval JD 2445 844 ... 879. We may state that the star has remained constant within a few hundredth mag during this time. In July, a mild blueing occurred whereupon the star became slightly fainter. No check star observations were made at these dates, but on July 22, θ CrB was additionally compared with υ CrB (V = 5.78, B-V = +0.07), φ Boo (V = 5.24, B-V = +0.88), and HR 5741 (V = 5.46, B-V = +1.40) (Nicolet 1978), resulting in V = 4.20, B-V = -0.11. It is improbable that we should have missed the eclipse since its duration should be some 10 to 13 days. So presumably there was none.

Radial velocity data are presented in Table II. All measurements were made on a computer supported Abbé comparator with oscilloscopic setting at OHL.

Table I

HJD 2400000+	Phase	Var minus Comp ΔB	ΔV	Δ(B-V)	Var minus Check ΔB	ΔV	Δ(B-V)	Obs.
45 844.520	0.976	-1.530	...	...	-2.663	...	...	Fd
45 847.425	0.982	-1.521	-0.868	-0.653	-2.634	-2.289	-0.345	Fd
45 848.556	0.984	-1.459:	-0.852	-0.607:	-2.661	-2.300	-0.361	Fd
45 853.392	0.994	-1.519	-0.852	-0.667	-2.669	-2.332	-0.337	Fd
45 854.471	0.996	-1.511	-0.851	-0.660	-2.713:	-2.379:	-0.334:	Fd
45 855.409	0.998	-1.500	-0.830	-0.670	-2.666	-2.307	-0.359	Fd
45 857.407	0.001	-1.537:	...	...	-2.703:	...	...	Fd
45 862.514	0.011	-1.518	-0.865	-0.653	-2.671	-2.301	-0.370	Fd
45 863.453	0.013	-1.535	-0.865	-0.670	-2.689	-2.310	-0.379	Fd
45 869.507	0.025	-1.506	-0.825	-0.681	-2.652	-2.300	-0.352	Fd
45 871.431	0.029	...	-0.860	...	...	-2.320	...	Se
45 879.422	0.045	-1.513	-0.828	-0.685	...	...	...	Fd
45 889.458	0.064	-1.571	-0.843	-0.728	...	...	...	Fd
45 892.503	0.070	-1.486	-0.777	-0.709	...	...	...	Fd
45 904.5	0.094	-1.466	-0.808	-0.658	...	...	...	Fd

Photometric observations of θ CrB in 1984. Observers are M. Fernandes (Fd) and B. Schlereth (Se). Comparison star was η CrB, check star HD 138341. Phases are computed according to the ephemeris Min I = JD 2412 650.1 + $510^{d}.87$ E (Harmanec 1983). ":" denotes less reliable measurements. They were ignored in forming the mean values given in the text.

The dispersion curve for each plate is computed as a 4th-order polynomial fitted by least squares to reference line measurements (about 20 iron arc lines, wavelengths taken from standard sources). Stellar lines measured were Hγ to H11, and the He I lines λ4026 and λ3819, but only the Balmer lines were usable for radial velocity determination. All lines are quite broad and shallow so that the errors are rather large. Internal mean measurement errors range from ± 5 km/s to ± 15 km/s. A cursory look at the spectrograms does not reveal anything unusual, like emission peaks; however, such features as weak shell lines or absorption cores (noticed in some spectra) presumably have influenced the results. Systematic effects show up also in the radial velocities derived from different lines in the same spectrum, which become more negative with increasing Balmer number. Nevertheless, mean values formed from the same

Table II

Plate No.	HJD 2400000+	Phase	Hγ	Hδ	Hε	H8	H9	H10	H11	$\overline{RV}$
CS 7696	45 838.408	0.964	- 19.5	- 25.1	- 37.1	- 24.6	- 29.4	- 49.7	- 33.1	- 31.2
CS 7699	45 841.592	0.971	- 24.4	- 19.3	- 32.1	- 13.4	- 48.2	- 34.4	- 55.9	- 32.5
CS 7700*	45 841.599	0.971	+ 7.9	- 9.1	- 4.2	- 29.2	- 14.4	- 26.0	- 25.2	(- 14.3)
CS 7710	45 843.639	0.975	- 11.3	- 5.9	- 27.4	- 20.7	- 50.2	- 41.1	- 36.0	- 27.5
CS 7711	45 843.648	0.975	- 12.1	- 22.4	- 23.5	- 46.4	- 39.2	- 41.9	- 53.6	- 34.2
CS 7713*	45 848.517	0.984	- 11.1	- 46.4	- 93.2	- 19.5	- 61.1	- 97.4	-104.9	(- 61.9)
CS 7715	45 863.487	0.013	+ 2.5	- 37.7	- 35.8	- 49.4	+ 1.7:	- 52.9	- 44.0	- 30.8
CS 7716	45 863.498	0.013	- 15.4	- 22.4	- 39.3	- 42.9	- 45.0	- 25.2	- 31.7	- 31.7
CS 7726	45 866.458	0.019	- 2.8	- 21.1	- 30.7	- 33.2	- 18.6	- 52.3	- 54.1	- 30.4
CS 7728	45 869.398	0.025	- 27.9	- 6.8	- 24.9	- 48.0	- 49.0	- 18.3	- 32.1	- 29.6
CS 7745	45 870.407	0.027	- 13.5	- 6.8	- 36.6	- 28.5	- 34.5	- 54.9	- 38.0	- 30.4
CS 7763*	45 871.388	0.029	+ 19.8	- 14.9	- 18.5	- 26.0	- 7.2	- 33.6	- 47.5	(- 18.3)
CS 7784	45 880.500	0.047	- 6.8	- 7.7	- 32.9	- 44.2	- 47.3	- 72.7	- 79.5	- 41.6
CS 7790	45 894.400	0.074	+ 0.8	- 30.2	- 28.0	- 36.1	- 15.7	- 10.2	- 22.6	- 20.3
CS 7804	45 911.389	0.107	- 28.2	- 33.3	- 36.4	- 44.4	- 42.5	- 47.4	+ 3.3:	- 32.7
< RV >	45 865	0.017	- 13.2	- 19.9	- 32.1	- 36.0	- 38.1	- 41.8	- 43.7	- 31.1
σ			± 10.5	± 11.0	± 5.2	± 11.9	± 12.2	± 17.4	± 16.0	± 4.8

Measurements of the radial velocity (in km/s) of θ CrB in 1984. The spectrograms CS 7700, CS 7713 and CS 7763 were disregarded in forming the averages of Table 2. σ is the standard deviation of the values in the respective column.

set of lines for each spectrum should at least contain information about radial velocity changes. If we condense successive radial velocity measurements into group averages, we obtain

RV = -31.4 ± 1.4 km/s at Phase 0.971
-30.6 ± 0.3 km/s at Phase 0.019
-31.5 ± 6.2 km/s at Phase 0.076

i.e. no significant change in radial velocity, whereas the spectroscopic orbit of Harmanec (1983) predicts a rapid decrease of about 30 km/s during the time interval covered by our observations. Incidentally, let us note, that the most reliable RV determinations of θ CrB available in the literature — those of Poeckert and Duric (1980) — are also consistent with the assumption of constant radial velocity (at about -29 km/s). We therefore conclude that the orbit given by Harmanec is not real.

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References:

Harmanec, P.: 1983, Bull. Astron. Inst. Czechoslovakia 34, 324.
Nicolet, B.: 1978, Astron. Astrophys. Suppl. 34, 1-49.
Poeckert, R., Duric, N.: 1980, Publ. Dom. Astrophys. Obs. 15, 327.
Roark, T.P.: 1971, Astron. J. 76, 634.