

# A PHOTOELECTRIC STUDY OF THE MAGNETIC STAR $\beta$ CORONAE BOREALIS

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Photoelectric observations of the periodic magnetic variable  $\beta$  CrB were made during the 1966 and 1968 seasons in approximately the UBV system. The brightness is found to vary in the same period as the magnetic field. Maximum brightness coincides with maximum positive field in all wavelength regions. The minima of the B and U curves are shifted in phase by 0.09 and 0.16 cycle respectively.

Among the magnetic stars  $\beta$  Coronae Borealis is distinctive for its rather strong magnetic field in conjunction with its late spectral type, F0p. According to Babcock [1], during 1952-1956 the magnetic field varied between  $-960$  and  $+1020$  gauss, with no definite period. In 1964 R. Steinitz reviewed Babcock's measurements and established an  $18^d.5$  period for the variation of the effective magnetic field, with a considerable scatter in the individual observations. Preston and Sturch [2] observed  $\beta$  CrB in 1966 and obtained an improved period. Their curve for the magnetic field is characterized by the elements

$$JD(\text{crossover}) = 2434\,217.50 + 18.487 E$$

at points where the effective field  $H_e = 0$  and  $dH_e/dt > 0$ .

Since the brightness of all known stars having a regularly varying field varies with the same period as the field, we have considered it of interest to make photometric observations of  $\beta$  CrB.

Photoelectric observations of  $\beta$  CrB were obtained with the 13-inch reflector at Simeiz during two seasons, 1966 and 1968. Three different filters were used, giving a photometric system close to the UBV system. The comparison star used was  $\gamma$  CrB ( $V = 3^m.85$ ,  $B - V = -0^m.01$ ,  $U - B = -0^m.04$ ). On 30 nights of observation, 178 measurements were made in each filter. These observations show

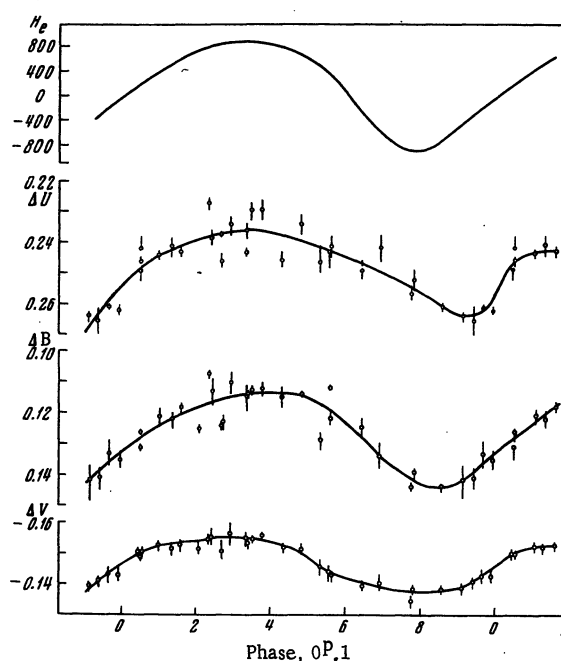


Fig. 1

that the brightness of  $\beta$  CrB varies in all colors with the same period as the field variation. The amplitudes in the V, B, and U regions are 0.02, 0.03, and  $0^m.03$ , respectively.

Table 1 presents the observational data. Column 2 gives the mean epoch of the observations for each night, while the third column contains the

TABLE 1

Date	JD 2439000 +	Phase	$\Delta V$	$\Delta B$	$\Delta U$	$n$
1966 Jun 25	302.347	0.050	-0.149	0.128	0.242	8
Jul 6	313.306	0.642	-0.140	0.125	0.249	3
7	314.308	0.696	-0.143	0.134	0.242	3
10	317.300	0.858	-0.139	0.144	0.261	4
11	318.307	0.913	-0.139	0.142	0.264	2
18	325.315	0.292	-0.157	0.110	0.234	3
23	330.303	0.562	-0.144	0.112	0.243	3
Aug 5	343.295	0.264	-0.153	0.124	0.237	5
6	344.300	0.319	-0.155	0.116	0.236	6
7	345.312	0.374	-0.156	0.112	0.229	3
8	346.295	0.427	-0.152	0.115	0.246	4
9	347.306	0.481	-0.152	0.114	0.234	3
18	356.284	0.967	-0.143	0.133	0.261	3
1968 Apr 22	969.408	0.132	-0.152	0.122	0.241	5
24	971.397	0.240	-0.156	0.113	0.238	5
26	973.390	0.348	-0.155	0.112	0.229	8
May 4	981.389	0.780	-0.139	0.139	0.252	8
	2440000 +					
Jun 29	32.344	0.537	-0.146	0.131	0.246	7
Jul 7	45.328	0.239	-0.155	0.107	0.227	12
17	55.311	0.779	-0.135	0.144	0.257	10
22	60.319	0.050	-0.151	0.126	0.246	10
23	61.324	0.104	-0.153	0.121	0.244	8
24	62.325	0.158	-0.155	0.118	0.243	10
25	63.317	0.212	-0.152	0.125	0.250	10
26	64.314	0.265	-0.151	0.123	0.246	5
27	65.322	0.320	-0.154	0.114	0.243	10
Aug 19	88.266	0.561	-0.143	0.122	0.241	9
26	95.260	0.940	-0.141	0.141	0.265	5
27	96.260	0.994	-0.143	0.135	0.262	3
28	97.256	0.048	-0.151	0.131	0.248	3

phase computed from the elements of the curve for the magnetic field variation [2]. The instrumental magnitude differences  $\Delta V$ ,  $\Delta B$ , and  $\Delta U$  are expressed in the sense  $(\beta \text{ CrB}) - (\gamma \text{ CrB})$ , and  $n$  is the number of observations.

The light curves corresponding to the observations in the three wavelength regions are plotted in Fig. 1. The length of the vertical bars indicates the rms error of the observations. The results of the 1966 and 1968 observations do not differ appreciably. For comparison Preston and Sturch's curve for the field variation [2] is plotted on the same scale. Figure 1 shows that in the visual spectral region the brightness varies in phase with the field: maximum positive field agrees in phase

with maximum light, and maximum negative field with minimum light. In the B and U regions the minima are shifted in phase relative to the field by 0.09 and 0.16 cycle respectively. All four curves exhibit a similar shape with approach to maximum, but the magnetic field declines more steeply and precedes the decline in B and U light.

#### LITERATURE CITED

1. H. W. Babcock, *Astrophys. J. Suppl.*, **3**, No. 30 (1958).
2. G. W. Preston and C. Sturch, *The Magnetic and Related Stars*, ed. R. Cameron, Mono Book Corp., Baltimore (1967), p. 111.