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BV LIGHT CURVES OF BY Dra IN 1986

BY Dra (= BD +51 2402 = HD 234677 = SAO 31048) is the prototype binary system (M0Ve + M0Ve) of the flare stars which also shows low-amplitude quasi-periodic light variability outside of flares. This variability is generally attributed to rotational modulation of starspots (Rodono' 1986). Previous photometry of this very interesting star was presented by Rodono' et al. (1983).

We present BV differential photometry carried out during the period 8 July - 8 November 1986, on 22 nights with a single-channel photon-counting photometer fed by a 0.91m Cassegrain telescope. Our principal comparison star was HD 172268 (= BD +51 2408 = SAO 31070), while HD 172468 (=BD +51 2410 = SAO 31077) was observed several times each night, as check star.

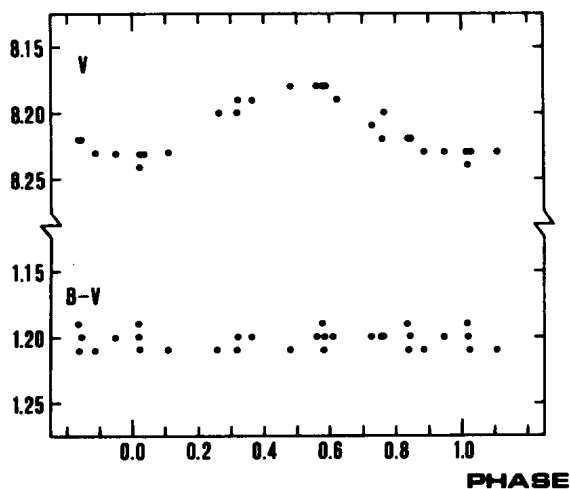


Figure 1

V, B-V light curves of BY Dra obtained at Catania Observatory during the period July - November 1986. Phases were computed from the ephemeris given by Chugainov (1966):  $JDo = 2438983.612 + 3.836xE$ .

Table I  
Photometric observations of BY Dra

JDe	PHASE	V	B-V
2446000.0+			
619.4549	.5743	8.18	1.19
620.4535	.8346	8.22	1.19
621.4944	.1060	8.23	1.21
622.4653	.3590	8.19	1.20
623.4556	.6172	8.19	1.20
624.4722	.8822	8.23	1.21
678.4204	.9459	8.23	1.20
682.5171	.0138	8.23	1.20
683.4565	.2586	8.20	1.21
685.3637	.7559	8.22	1.20
686.4045	.0272	8.23	1.21
687.5217	.3186	8.19	1.20
688.5217	.5793	8.18	1.21
708.4042	.7623	8.20	1.20
709.3779	.0161	8.24	1.19
711.4557	.5578	8.18	1.20
714.3657	.3164	8.20	1.21
716.3697	.8388	8.22	1.21
730.3324	.4787	8.18	1.21
731.2870	.7236	8.21	1.20
742.2400	.5829	8.18	1.20
743.2319	.8415	8.22	1.10

The observations were corrected for atmospheric extinction. Nightly mean BV differential magnitudes (variable - comparison star) were computed with reference to several standard stars. The following values of the V magnitude and B-V color for the comparison star BD +51 2408 were assumed: V=7.893 B-V=1.259 (Vogt, 1975).

Mean JDe, V magnitudes and B-V color of BY Dra are listed in Table I. Photometric phases, also listed in Table I, were computed using the photometric ephemeris derived from Chugainov (1966):

$$JDe = 2438983.612 + 3.836xE$$

The resulting V light curve and B-V color are presented in Fig.1. No significant B-V color variation is observed. Nightly standard deviations for V and B-V data are 0.01 and 0.015 mag, respectively.

We also obtained spot models for the BY Dra V light curve, assuming two spotted circular areas and using our computer code based on the analytical method outlined by Friedemann and Gurtler (1975) and already presented by Rodono' et al. (1986). We adopted the following values for the parameter involved in the model:

$i$  (inclination of the star rotation axis with respect to the line of sight) = 30 degree;

$\mu$  (limb darkening coefficient) = 0.85;

$L_s/L_p$  (luminosity ratio between the secondary and the primary component of the system) = 0.52;

$V_0$  (unspotted V magnitude) = 8.00;

$T_s$  (photospheric temperature) = 4100 K;

$T_{spot}$  (spot temperature) = 3500 K;

The resulting latitudes for the two spots are 81 and 25 degrees. The radii are 38 and 13 degrees respectively. The two spots are 245 degrees apart in longitude (Figure 2).

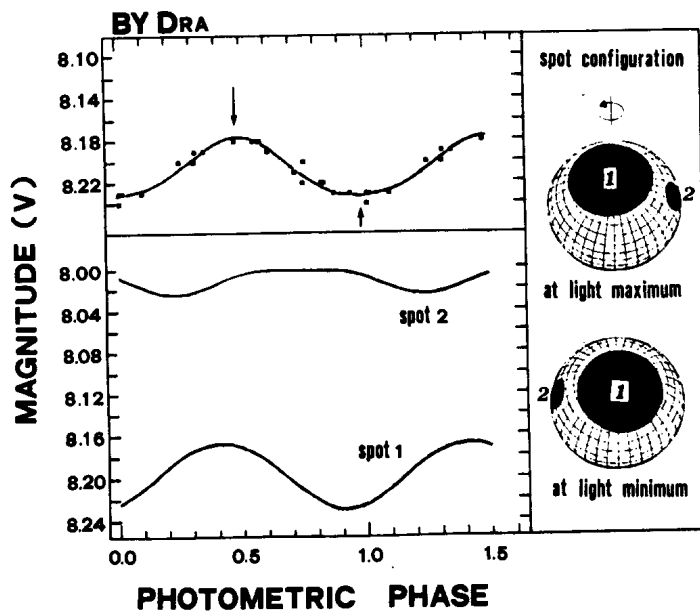


Figure 2

Results of two-spot model fit for the observed light variations (upper panel). The bottom panel shows the contribution of each spot, arrows indicate the phase of light maximum ( $\downarrow$ ) and light minimum ( $\uparrow$ ); the corresponding spot configurations are presented on the right hand panel.

In previous papers (Vogt 1981, Melkonian et al. 1981, Olah and Soliman 1984), the question concerning the variability of the comparison stars HD 172468 and HD 172268 has been raised. From our observations of BY Dra in the years 1984, 1985 and 1986 the following seasonal average  $\Delta mag$ , in the sense HD 172268 minus HD 172468, result :

1984	$\Delta V = .378 \pm .005$	$\Delta B = .370 \pm .006$
1985	$\Delta V = .375 \pm .006$	$\Delta B = .372 \pm .006$
1986	$\Delta V = .372 \pm .007$	$\Delta B = .369 \pm .007$

Although no systematic variation can be inferred from these observations, we sometimes obtained nightly mean values that seem to indicate some variability. At present time we are not able to ascertain if one, or both, of the comparison are variable. Nevertheless, as obtained by Olah and Soliman (1984), the light curves generally show higher scatter using HD 172268 as comparison than using HD 172468. For this reason we prefer HD 172268 as comparison, but further dedicated observations of these two stars are necessary.

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