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BF Draconis

The star BD+69°1006 = BV379 = BF Dra was reported as an eclipsing variable by Strohmeier, Knigge and Ott (1962). Döppner (1962) established the elements of variation from photographic photometry and gave a finder chart. These elements were further refined by Strohmeier, Knigge and Ott (1963), yielding

$$JD_{hel,\,min} = 2436317.579 + 5.60545 \cdot E. \qquad (1)$$

With these data, BF Dra was included in the GCVS (Kholopov et al., 1985).

As far as we know, no complete photoelectric light curve of this rather bright variable has been published. The only three photoelectric measurements known to us were obtained by Lacy (1992) in order to establish the mean brightness at maximum light and the mean colours of BF Dra (V=9.823±0.005, B-V = 0.489±0.005, U-B = -0.022 ±0.003).

Between 1988 and 1993, we have secured a set of photoelectric observations covering the whole light curve of BF Dra in blue light, as well as complete photoelectric coverage of the primary minimum in the visual part of the spectrum from three different observatory sites. RD and MW used the 35cm Schmidt-Cassegrain telescope of R. Scafraniec Observatory in Metzerlen, Switzerland in connection with a commercial, uncooled, photon-counting photometer of the „Starlight-1" type. This photometer is equipped with an EMI 9924A photomultiplier tube and a filter set very close to the standard Johnson UBV system. FA observed with his private, automated telescope at Zweikirchen, Germany, also a 35cm Schmidt-Cassegrain system outfitted with an uncooled photometer tube (EMI 9781A) and a set of filters matching the standard BV closely. Finally, MW collected more data at the Skalnate Pleso Observatory(1780m above sea level), Slovak Republik, employing a 60 cm reflecting telescope with a single-channel pulse-counting photoelectric photometer.

We have deposited the whole list of observations (262 in B, 127 in V) in the IAU Commission 27 Archives of Unpublished Photoelectric Photometry (Breger, 1988). All the data are in the instrumental system, with no correction for differential extinction applied. Since the comparison star is located close to the variable, this simplification is well founded. The general good agreement of the three different and independent sets of observations to within ±0.02 mag in

both colours supports this conclusion. In Figure 1 we show the whole set of blue observations, using the elements determined from the photoelectrically observed minima

$$JD_{hel,\,Min} = 2447276.3948 + 11.211079 \cdot E. \qquad (2)$$

For reasons that will be discussed below, the period given by Strohmeier et al. (1963) had to be approximately doubled.

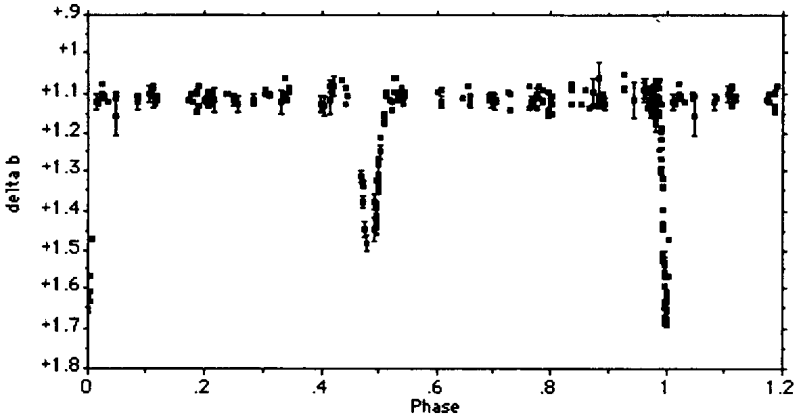

Figure 1: Photoelectric blue light curve of BF Draconis in the instrumental system. Differential magnitudes in the sense variable minus comparison star (HD176086 = SAO009270 = BD+70°1034) are shown.

BF Dra exhibits the typical light curve of a well detached binary system. The two minima are narrow and, because a difference in minimum brightness of 0.12 ± 0.02 mag is clearly discernible, well established. The BV photometry of FA during primary minimum shows, that the value of B-V changes only by 0.02 mag. Therefore, we can infer, that the two components in the system have about the same spectral type. The mean colours given by Lacy (1992) are indicative of a pair of unreddened stars of spectral type F7V, while the GCVS classifies BF Dra as an F8 star.

In Figure 2, we give the primary minimum, both in B and V, while Figure 3 shows the secondary minimum in blue light. It is immediately evident, that the two minima are of unequal duration, and that the secondary is displaced from phase 0.5 by a small amount. Although the secondary minimum is not sufficiently covered by observation, we find the following parameters describing the two minima of BF Dra:

$\Phi_{Min\ II} = 0.484 \pm 0.002$; $A_{B,Min\ I} = 0.57 \pm 0.01$; $A_{B,Min\ II} = 0.45 \pm 0.02$

$$D_I = 0.028\ p \pm 0.001 = 0.314\ d \pm 0.011$$
$$D_{II} = 0.056\ p \pm 0.005 = 0.63\ d \pm 0.06$$

These results indicate a slight ellipticity of the orbit of BF Dra. From the data given above, we have tried to derive the parameters of this orbit by applying the arguments of Martynov (1973):

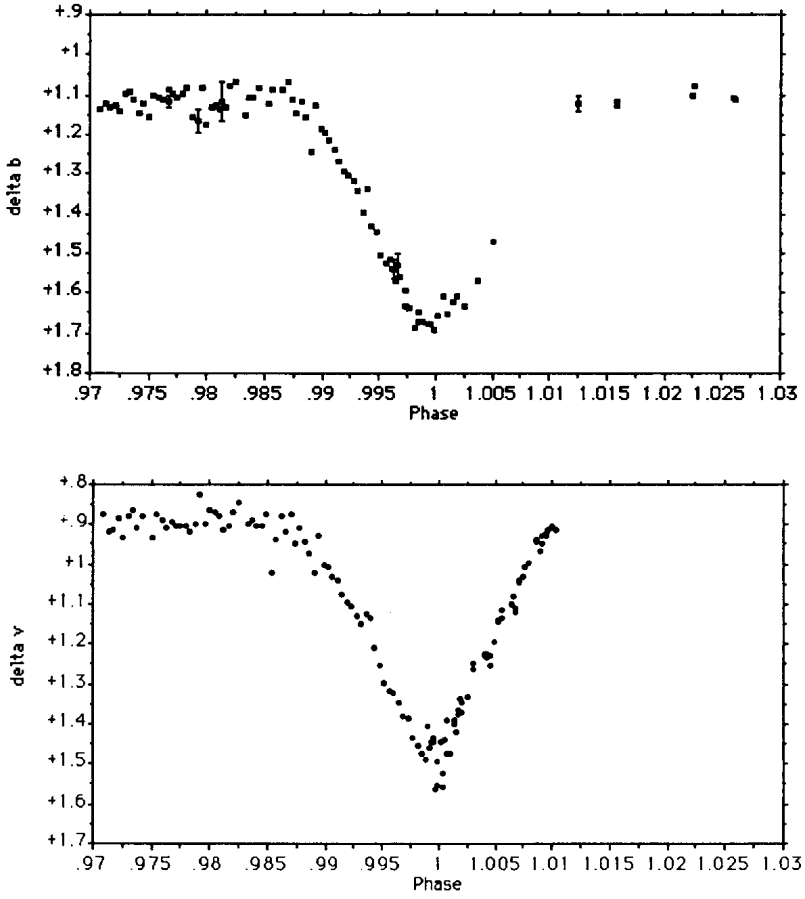

Figure 2: Primary minimum of BF Draconis in blue (above) and in visual light.

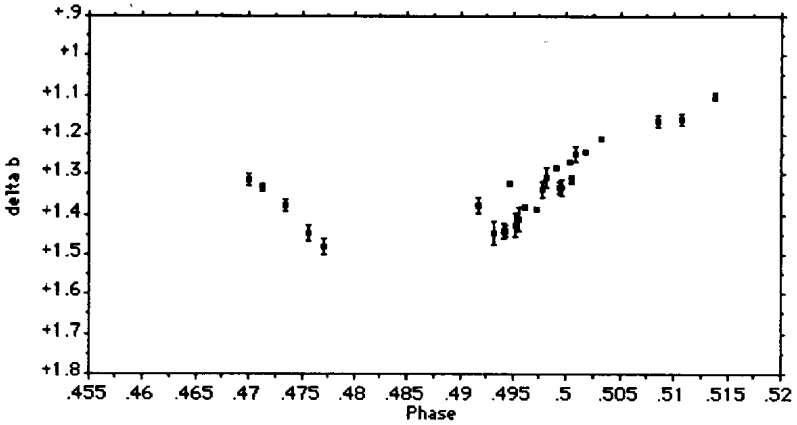

Figure 3: Secondary minimum of BF Draconis in blue light

Considering the spectral type (F7V), the length of the period, the narrow eclipses and the nearly equal depth of both minima, we can assume the orbital inclination i to be very close to 90°. From the phase of secondary minimum and the ratio $D_{II} : D_{I}$, we derive the values for the excentricity e = 0.33 and for the current longitude of the periastron $\omega = 94°$. Further observations are needed to clarify the exact physical nature of this interesting star.

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References:

Breger, M: 1988, PASP **100**, 751
Döppner, M: 1962, MVS No. 699
Kholopov P.N. et al.: 1985, General Cat. of Variable Stars, 4th ed. , Moskow
Lacy, C. H: 1992, AJ **104**, 801
Martynov D. Y: 1973, in „Eclipsing Variable Stars", editor: B. V. Tsesevich, John Wiley and Sons, New York - Toronto, p. 270
Strohmeier W., Knigge, R., Ott, H: 1962, Bamb. Veröffentl. V, No. 14
Strohmeier W., Knigge, R., Ott, H: 1963, Bamb. Veröffentl. V, No. 16