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THE LIGHT CURVE OF i BOOTIS IN FEBRUARY 1975

The peculiar W UMa variable i Bootis, which is one of the components of the visual binary ADS 9494, is distinguished mainly by two most remarkable properties: 1) Among W UMa type stars this variable displays the strongest light curve variations observed. 2) Besides a smooth period variation, which is caused by the light time effect, reflecting the orbital motion of the variable around its visual component, certain period jumps have been observed, which may be caused by time dependent peculiarities of the mass transfer between the W UMa components. Both "activities" may be correlated in time, as suggested by Bergeat et al. (1972). This should be a motivation for the observers to monitor continuously the photometric behaviour of this most interesting object. In this paper two nearly complete light curves of i Boo are presented together with new minimum times.

The observations have been obtained in February 6/7 and 9/10 in 1975 with a photoelectric photometer, attached to the 36 cm (f/19) Cassegrain telescope of Hoher List Observatory. In combination with an RCA 1P21 photomultiplier and the filters UG 2 (1mm), BG 12 (1mm) + GG 385 (2mm) and GG 495 (2mm), respectively, a good realization of the Johnson UBV-system has been obtained. The nearby star BD +47^{o}2192 (m_{pg}=6.16, AOp) was used as comparison star. Whereas the variability of the magnetic field of this Ap-star has been demonstrated (Babcock and Cowling, 1953), the question of a possible photometric variability is rather controversial. Extensive photoelectric measurements by Schmidt and Schrick (1957), who used it as a secondary comparison star for their photometry of i Boo and who discussed its photometric behaviour thoroughly, and an earlier photometric investigation by Provin (1953) did not reveal any indication of variability. Measurements by Abt and Golson (1962) could also not clearly demonstrate a variable brightness. Nevertheless, because of two discordant measurements (one announced in the Cape Mimeogram No. 12, 1961, the other made by Osawa and Hato, 1962), which differ by $0^m_.08$, BD +47°2192 has been listed in the General Catalogue of Variable Stars, 1974, as BX Boo with an amplitude of $0^m_.08$. Though the variability of this star has not at all been demonstrated, we will be very cautious in the interpretation of our observations. In particular, the reality of any light curve anomaly has been examined by a closer inspection of the magnitude versus air mass plot for the comparison star.

The UBV data for i Boo, corrected for differential extinction and colour extinction, were plotted over phases based on the ephemeris given by Dürbeck (1975):

$$\text{Min I} = JD_{hel}\ 2439852.4903 + 0.2678159 \cdot E,$$

yielding the light curves shown in Fig. 1 and 2. Because of the above described uncertainties about the variability of the comparison star, we will distinguish carefully between certainly real light curve disturbances and those, which may be doubtful. Obviously, two kinds of disturbances are real, because they occur rapidly in both nights at exactly the same phases.

1) Absorption features at phases ± 0.125 from primary and secondary minima (that is exactly in the middle between the minima and the maxima), each of which can be recognized at least in one of the 6 light curves.

2) A larger disturbance after reaching the first maximum, namely between phases 0.25 and 0.35.

Moreover, as can be seen from Fig. 1 and 2, these light curve anomalies vary considerably with wavelength and with time. It is quite interesting that similar disturbances like the second one is sometimes observed at different phases. For example, nearly just the same absorption feature like the one observed here appears in the light curve of Hopp et al. (1977) at the equivalent phases after reaching the <u>second</u> maximum (that means, it is shifted in phase for exactly half a period). For another example, similar light curve anomalies are also present in the observations of Schmidt and Schrick (1957), this time, however, at phases just <u>before</u> reaching first <u>and</u> second maxima. Whereas the physical reason for this kind of variable absorption effects has still to be investigated, it is rather unquestioned that the first kind of features, namely the absorptions at phases 0.125, 0.375, 0.625 and 0.875 are caused by absorbing matter between the two stars. Actually, numerical calculations of Breinhorst and Reinhardt (1974) have shown that in the case of W UMa a gaseous stream with reasonable properties, which is assumed to originate from the inner Lagrangian point, is able to produce at just these particular phases the observed absorption effects of the order of $0\overset{m}{.}01$ to $0\overset{m}{.}02$.

In contrary to the above discussed disturbances, two kinds of light curve peculiarities may be doubtful:

1) Strong variations of the shapes of the minima with wavelength and with time. This is well pronounced in the observations of the primary minimum on Febr. 6/7, which seem to become considerably sharper with decreasing wavelength.

2) Strong variations of the relative height of the maxima with wavelength and with time. Comparing the observations of both nights, the wavelength dependence of the relative height of the maxima seem to run in opposite direction.

By application of the method of bisecting chords (Pogson's method) the times of primary and secondary minima have been determined for all light curves. After averaging over all three colours, O-C values have been calculated on the basis of the ephemeris of Dürbeck (1975). They are given in Table 1. Here the O-C values of the secondary minima have been derived under the assumption that they occur at phases 0.5 from primary.

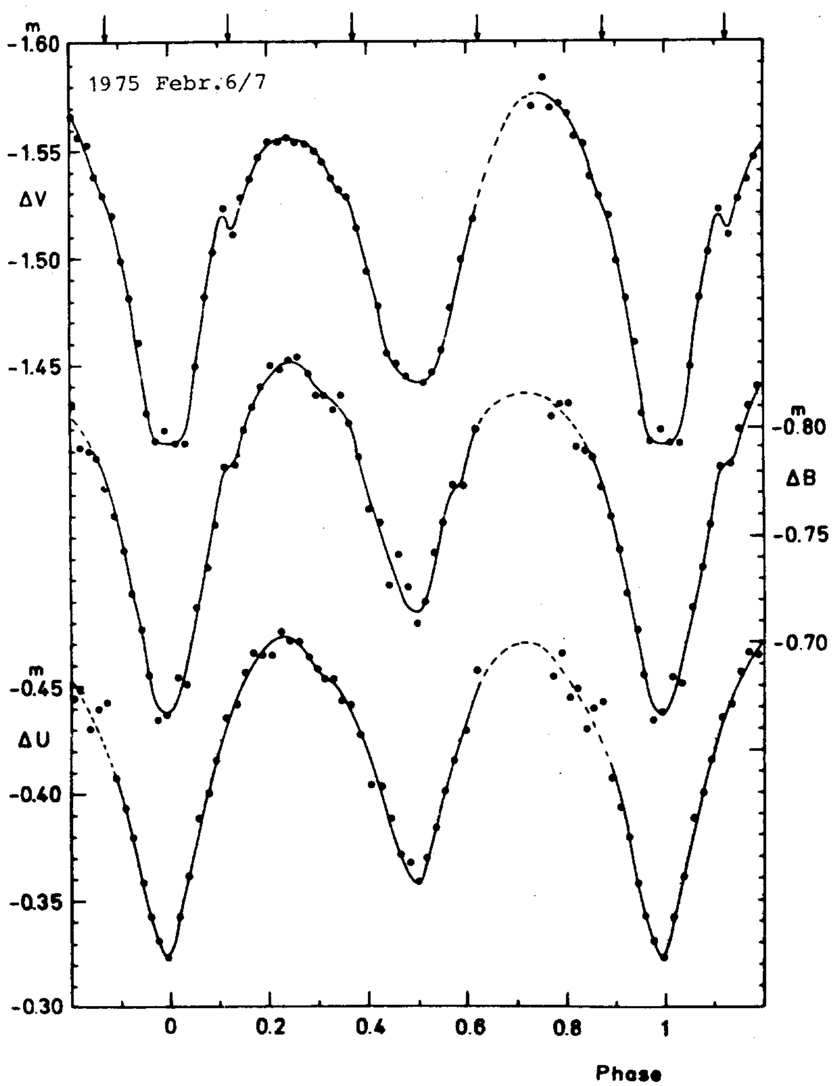

Fig.1 Light curve of i Bootis in 1975 Febr. 6/7 (variable minus comparison).

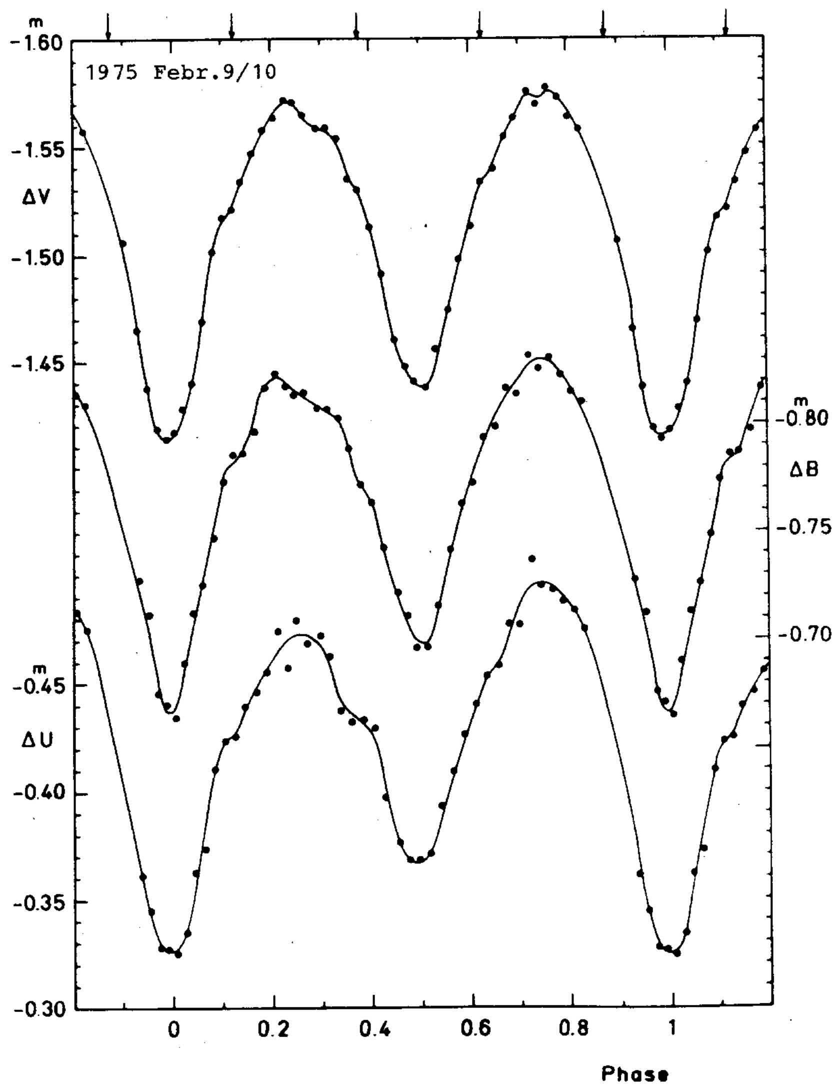

Fig.2 Light curve of i Bootis in 1975 Febr. 9/10 (variable minus comparison).

Table 1

Times of primary and secondary minima, averaged over all three colours

Epoch	Min.	JD_{hel}	O-C	ε_1	ε_2
9701	I	2442450.5712	-0.0011	±0.0006	±0.0005
	II	2442450.7059	-0.0004	0.0002	0.0006
9712	I	2442453.5168	-0.0015	0.0005	0.0004
	II	2442453.6511	-0.0011	0.0010	0.0004

ε_1 means the average error derived from the internal agreement of the three values

ε_2 means the error resulting from the estimated errors of the single minimum time determinations.

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