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COMPLETE CCD V, R, I LIGHT CURVES OF BM URSAE MAJORIS

BM Ursae Majoris (S 7742) was discovered by Hoffmeister (1963) and was identified as a short period variable. Busch (1966) classified the variable as an RR Lyrae type-c star, determined five timings of minimum light, and calculated preliminary light elements. Shugarov (1975) correctly identified BM UMa as an EW-type eclipsing variable, and gave an improved ephemeris. Hoffmann (1981) published photoelectric B, V light curves from one night's observations along with two times of minimum light and an improved ephemeris based on his and previous timings. Despite the fact that his curves showed rather high scatter and indicated that BM UMa was most likely a contact binary, he applied the Russell-Merrill technique and came to the conclusion that the eclipses were complete. Based on the atlas of Anderson and Shu (1979), he concluded that the fill-out was on the order 50% which would be quite an unusual value for a system of this type. Hoffmann's observations are available on microfilm (1984). Eighteen visual timings of minimum light have been published in various issues of the BBSAG (#57−#95).

As a part of our recent campaign to obtain complete, definitive, multiband light curves of compact non degenerate systems near the low period limit ($0^d.22$), we have obtained V, R, I CCD light curves of BM UMa. Our present observations of this 14^m variable were made from 22−24 March 1991, inclusive at Lowell Observatory, Flagstaff, Arizona. An RCA CCD camera system was utilized, in conjunction with the 1.07m John S. Hall reflector telescope with the F/8 secondary. The 320 x 512 pixel CCD chip was cooled with liquid Nitrogen throughout the observing interval to −130°C. Approximate coordinates of the check, comparison and the variable star are given in Table 1. About 130 images in V, 115 images in R and 75 in I were obtained with integration times ranging from 90 to 180 seconds.

Table 1

Star	R. A. (2000)	Dec. (2000)
BM UMa	$11^h11^m18^s.9$	46°25'41"
Comparison	$11^h11^m20^s.1$	46°26'08"
Check	$11^h11^m19^s.8$	46°23'39"

Four mean epoch of minimum light were determined from the observations made during one secondary and three primary eclipses. The bisection of chords technique was utilized to determine all epochs in V, R and I. These are given in Table 2 accompanied by their standard deviations in parentheses. The two earlier photoelectric epochs by Hoffmann (1981) also appear in Table 2. The six precision epochs were introduced into a least

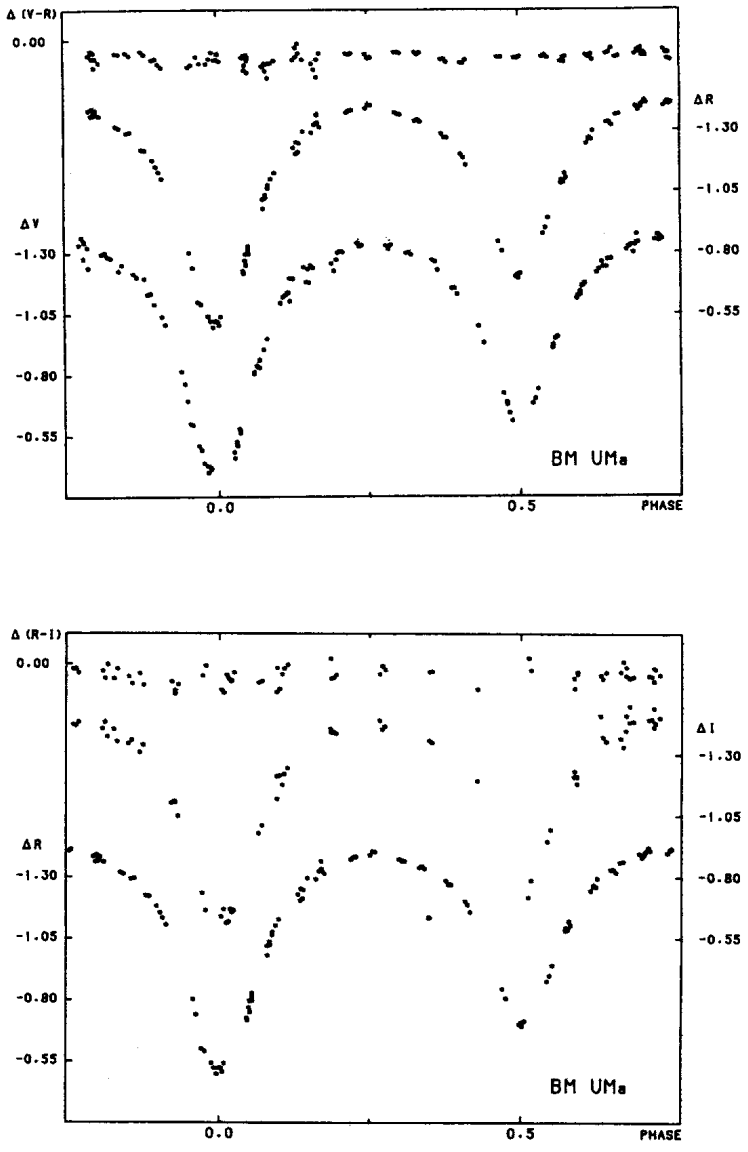

Fig. 1-CCD Light curves of BM UMa as defined by the individual observations.

squares solution to obtain a linear ephemeris. A quadratic ephemeris was also determined from *all available epochs* of minimum light with visual timings given a weight of 0.1. The epochs determined from CCD and photometric observations were given a weight of 1.0 with the exception of our last timing which was given a lower weight of 0.5. The improved ephemerides are:

$$\text{JD Hel Min. I} = 2444292.3496(\pm 8) + 0^{d}.27122007(\pm 7) \times E \text{ and,}$$

$$\text{JD Hel Min. I} = 2444292.3520(\pm 14) + 0.27121927(\pm 8) \times E - 1^{d}.03(\pm 11) \times 10^{-10} \times E^{2}$$

Table 2

JD HEL. 2400000+	Minimum	Cycles	$(O-C)_1$	$(O-C)_2$
44292.3496	I	0.0	−0.0000	−0.0020
44292.4853	II	0.5	0.0000	−0.0023
48338.9529(4)	I	14920.0	−0.0002	−0.0020
48339.7656(4)	I	14923.0	−0.0011	−0.0029
48339.9022(6)	II	14923.5	−0.0002	−0.0019
48340.8547	I	14927.0	0.0031	0.0013

The linear ephemeris was used to calculate the $(O-C)_1$ residuals in Table 2 and phases of the present observations. The quadratic ephmeris was used to calculate the $(O-C)_2$ residuals. The quadratic term in the second ephemeris is rather large and is statistically significant. It is slightly larger than the value determined for BX Peg (Samec 1990, Samec and Hube 1991). BX Peg is coalescing rapidly into a single star due to magnetic braking. So, BM UMa may be in a similar phase.

The V, R, and I light curves of BM UMa as defined by their individual observations are shown in Figure 1 as differential magnitude (variable−comparison) versus phase. The analysis of the observations in underway.

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