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A NOTE ON THE PERIOD BEHAVIOUR OF BL ERIDANI

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BL Eri (= BD −12°0818, HV 6277; Max: 11.5 mag P, Min: 12.2 mag P) is an eclipsing binary of the W UMa-type which had been neglected for a long time but recently it has attracted attention of observers. Its preliminary light elements based on photographic observations are given in GCVS4:

$$Min.I = JD(hel)\ \ 2429232.082 + 0\overset{\mathrm{d}}{.}4162 \times E \qquad (1)$$

First photoelectric photometry of BL Eri was done by Kern and Bookmyer (1986) in December, 1980, and January, 1981. They obtained four times of minimum light and published the improved elements:

$$Min.I = JD(hel)\ \ 2444606.5914 + 0\overset{\mathrm{d}}{.}41696010 \times E \qquad (2)$$

Yamasaki et al. (1988) observed this star photoelectrically in November, 1982, and in November, 1986. Their light elements

$$Min.I = JD(hel)\ \ 2444606.5901 + 0\overset{\mathrm{d}}{.}41691339 \times E \qquad (3)$$

fitted observations from 1982 (three minima timings) as well as previous times of minima. But observations from 1986 did not agree with these elements so the authors suspected a change (increase) in the orbital period. They calculated other elements which were also suitable for their observations from 1986:

$$Min.I = JD(hel)\ \ 2444606.5880 + 0\overset{\mathrm{d}}{.}41691506 \times E \qquad (4)$$

They supposed that the period change occurred within the interval of years 1980-1986.

Quingyao et al. (1994) obtained two photoelectric minima timings and derived the light elements:

$$Min.I = JD(hel)\ \ 2444606.5884 + 0\overset{\mathrm{d}}{.}41691591 \times E \qquad (5)$$

Qingyao et al. (1996) confirmed the period increase. Shengbang et al. (1996) on the basis of two new and nine old photoelectric times of minima and the light elements by Kern and Bookmyer (1986) came to the conclusion that the increase in period is continuous and can be described by the following elements with a quadratic term:

$$Min.I = JD(hel)\ \ 2444606.5833 + 0\overset{\mathrm{d}}{.}41691786 \times E + 4\overset{\mathrm{d}}{.}286 \times 10^{-9} \times E^2 \qquad (6)$$

Recently, Paschke (1997) analyzed all available times of minima of BL Eri including his nine visual and CCD minima timings and calculated the following linear ephemeris:

$$Min.I = JD(hel)\ \ 2444606.5928 + 0^{\rm d}.416916 \times E \qquad (7)$$

He agreed with Shengbang et al. (1996) that the O−C values had parabolic course but according to him the increase in period was 20 times slower in comparison to Shengbang's elements. He also noted that five O−C values (Nos 1, 8, 18, 26, and 27 in Table) extremely deviated from the others. They had to be excluded from the data set used for calculation of the elements. All published times of minimum light of BL Eri are listed in Table 1.

Table 1. List of minima timings of BL Eri

No.	JD hel 2400000+	Epoch	O-C	Method	Reference
1	29232.0820	−36877.0	0.1005	pg	Kholopov et al., 1985
2	43515.3150	−2617.5	−0.0002	vis	Locher, 1978a
3	43544.2970	−2548.0	0.0062	vis	Locher, 1978a
4	43749.6310	−2055.5	0.0090	vis	Locher, 1978b
5	43764.6460	−2019.5	0.0151	vis	Locher, 1979
6	43773.6030	−1998.0	0.0084	vis	Locher, 1979
7	43783.6030	−1974.0	0.0024	vis	Locher, 1979
8	43812.5390	−1904.5	−0.0373	vis	Locher, 1979
9	44603.6709	−7.0	−0.0035	pe	Kern, Bookmyer, 1986
10	44604.7146	−4.5	−0.0021	pe	Kern, Bookmyer, 1986
11	44606.5894	0.0	−0.0034	pe	Kern, Bookmyer, 1986
12	44607.6328	2.5	−0.0023	pe	Kern, Bookmyer, 1986
13	45298.8745	1660.5	−0.0073	pe	Yamasaki et al., 1988
14	45299.9170	1663.0	−0.0071	pe	Yamasaki et al., 1988
15	45300.9599	1665.5	−0.0065	pe	Yamasaki et al., 1988
16	47118.4950	6025.0	−0.0167	vis	Paschke, 1988a
17	47141.4400	6080.0	−0.0021	vis	Paschke, 1988a
18	47151.4150	6104.0	−0.0331	vis	Paschke, 1988a
19	47207.3160	6238.0	0.0012	vis	Paschke, 1988b
20	47535.4270	7025.0	−0.0007	vis	Paschke, 1989
21	48286.2900	8826.0	−0.0034	CCD	Paschke, 1991
22	48602.1026	9583.5	−0.0047	pe	Quingyao et al., 1994
23	48603.1452	9586.0	−0.0044	pe	Quingyao et al., 1994
24	48652.3420	9704.0	−0.0037	CCD	Paschke, 1992
25	49698.3920	11213.0	0.0041	CCD	Paschke, 1995
26	50096.6707	13168.5	−0.0804	pe	Shengbang et al., 1996
27	50099.5889	13175.5	−0.0807	pe	Shengbang et al., 1996
28	50114.2715	13210.5	0.0099	CCD	Agerer, Huebscher, 1996
29	50480.3220	14088.5	0.0081	CCD	Paschke, 1997
30	50485.3256	14100.5	0.0087	CCD	Paschke, 1997

Explanations to the table: epochs and O−C residuals were calculated with respect to the elements (7), method of observation is denoted by abbreviations (pg = photographic, vis = visual, pe = classic photoelectric (photomultiplier), CCD = CCD camera).

Remark: minima timings No. 26 and No. 27 have large deviation from the preceding and following ones. The value of this deviation is close to two hours and may have originated from incorrect transformation of local time to universal time. An O−C diagram of BL Eri based on the elements (7) is presented in Figure 1.

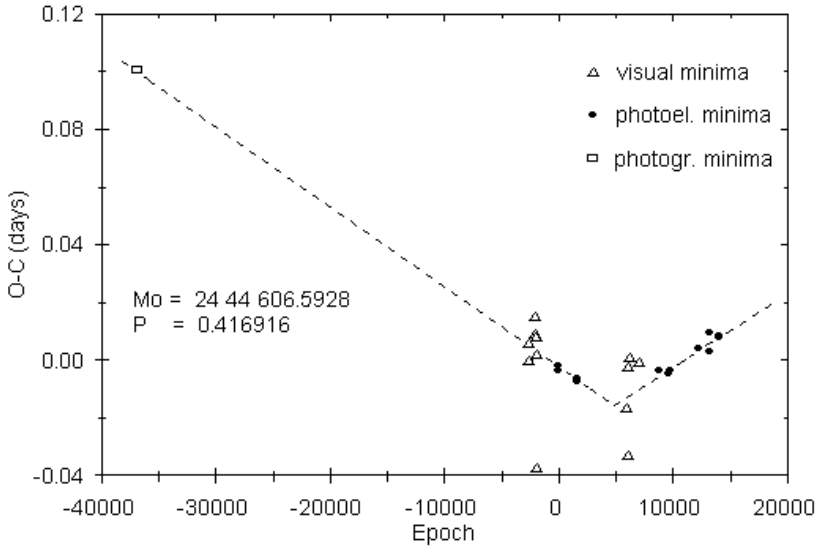

Figure 1. O−C diagram of BL Eri

There is a large gap between the first and the second O−C value but the diagram is sufficient for evaluation of the period behaviour. It can be seen that the general parabolic course suggested by Shengbang et al. (1996) and Paschke (1997) is only a rough approximation. In reality, there is one abrupt period increase by 0.46 second about JD 24 46 622 (July, 1986). Before and after this event the period remained constant. Light elements for the corresponding time intervals are as follows:

$$Min.I = JD(hel)\ \ 2444606.5906 + 0.41691322 \times E \quad (1938 - July, 1986) \qquad (8)$$

$$Min.I = JD(hel)\ \ 2448286.2880 + 0.41691855 \times E \quad (afterJuly, 1986) \qquad (9)$$

These elements were derived from the minima timings Nos 1-3, 6, 7, 9-16, and Nos 21-30, respectively, with the use of the least squares method. The values No. 26 and No. 27 were corrected by adding two hours.

Now it is clear that the elements (2) have erroneous period value and their use by Shengbang et al. (1996) prevented these authors from finding out that their two minima timings are also in error. The linear elements (4), (5), and (7) contain the period values that represent average values for the two time intervals. They have never been valid. The elements (3) are valid for the interval 1938-1986. For prediction of future minima only the elements (9) should be used.

BL Eri is interesting not only due to its period variation. It exhibits also peculiar variations of the light curve. It belongs among a few W UMa-stars which temporarily have flat (depressed) maxima that resemble rather maxima of close detached binaries than maxima of contact systems (cf. Yamasaki et al., 1988; Quingyao et al., 1994). There are also other signs of non-contact configuration of BL Eri (see e.g. Yamasaki et al., 1988). Yamasaki et al. have shown that the spectral type of BL Eri is approximately G0 IV-V and not B5 as stated in GCVS4. Thus BL Eri may be important from the evolutionary point of view (as a link between detached or semi-detached and contact systems) and the aim of this note is also to support Mr. Paschke's call for further observation of this star.

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