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PHOTOELECTRIC OBSERVATIONS OF THE FLARE STAR EV Lac IN 1973

Continuous photoelectric monitoring of the flare star EV Lac has been carried out at the Stephanion Observatory during the year 1973 using the 30-inch Cassegrain reflector of the Department of Geodetic Astronomy, University of Thessaloniki. Observations have been made with a Johnson dual channel photoelectric photometer in the B colour of the international UBV system. The telescope and photometer will be described elsewhere. Here we mention only that the transformation of our instrumental ubv system to the international UBV system is given by the following equations:

for the time interval from 19-6-1973 to 1-9-1973

$$\begin{aligned}V &= v_o + 0.031(b-v)_o + 1.383, \\(B-V) &= 0.770 + 1.046 (b-v)_o, \\(U-B) &= -1.347 + 1.010 (u-b)_o,\end{aligned}$$

and for the time interval from 2-9-1973 to 31-10-1973

$$\begin{aligned}V &= v_o + 0.030(b-v)_o + 1.756, \\(B-V) &= 0.845 + 1.042 (b-v)_o, \\(U-B) &= -1.778 + 1.102 (u-b)_o.\end{aligned}$$

The monitoring intervals in UT as well as the total monitoring time for each night are given in Table I. Any interruption of more than one minute has been noted. In the fourth column of Table I the standard deviation of random noise fluctuation  $\sigma(\text{mag}) = 2.5 \log(I_o + \sigma)/I_o$  for different times (UT) of the corresponding monitoring intervals is given.

During the 80.7 hours of monitoring time 15 flares were observed the characteristics of which are given in Table II. For each flare following characteristics (Andrews et al. 1969) are given: a) the date and universal time of flare maximum, b) the duration before and after the maximum ( $t_b$  and  $t_a$ , respectively), as well as the total duration of the flare, c) the value of the ratio

$(I_f - I_0)/I_0$  corresponding to flare maximum, where  $I_0$  is intensity deflection less sky background of the quiet star and  $I_f$  is the total intensity deflection less sky background of the star plus flare, d) the integrated intensity of the flare over its total duration pre-flares, if present,  $P = \int (I_f - I_0)/I_0 dt$ , e) the increase of the apparent magnitude of the star at flare maximum  $\Delta m(b) = 2.5 \log(I_f/I_0)$ , where  $b$  is the blue magnitude of the star in the instrumental system, f) the standard deviation of random noise fluctuation  $\sigma(\text{mag}) = 2.5 \log(I_0 + \sigma)/I_0$  during the quiet - state phase immediately preceding the beginning of the flare and g) the air mass at flare maximum. The light curves of the observed flares in the  $b$  colour are shown in Figs. 1-15.

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Reference:

Andrews, A.D., Chugainov, P.F., Gershberg, R.E. and Oskanian, V.S.  
1969, I.B.V.S. No. 326

Table I

Date	Monitoring intervals (U.T.)	Total Monitoring Time	$\sigma$ (U.T.)
1973			
June			
22	00h <sup>13</sup> m-00h <sup>40</sup> m, 0043-0109, 0112-0135	1h <sup>16</sup> m	0.04(00h <sup>18</sup> m), 0.05(01 03), 0.05(01 15).
24-25	2312-2325, 2329-2356, 2400-0026, 0035-0057, 0100-0138.	2 06	0.02(23 20), 0.02(23 48), 0.02(00 18), 0.02(00 48), 0.02(01 16).
26	0128-0156, 0159-0228, 0232-0301, 0309-0337.	1 54	0.02(01 31), 0.02(02 04), 0.02(02 36), 0.02(03 27).
26-27	2341-2350, 2352-0028, 0030-0038, 0040-0100, 0102-0135.	1 46	0.02(23 54), 0.02(00 55), 0.03(01 24).
27-28	2314-2339, 2343-0012, 0016-0049, 0057-0133.	2 03	0.02(23 36), 0.02(00 09), 0.02(00 36), 0.02(01 17).
28-29	2314-2342, 2345-0015, 0018-0046, 0054-0135.	2 07	0.02(23 36), 0.02(00 07), 0.02(00 42), 0.02(00 57).
29-30	2330-2355, 2358-0032, 0035-0103, 0110-0133.	1 50	0.02(23 34), 0.02(00 05), 0.02(00 41), 0.02(01 29).
30	2256-2330, 2332-2342.	44	0.02(23 02), 0.02(23 37).
July			
1	0001-0006, 0008-0019, 0028-0040, 0047-0119, 0121-0134.	1 13	0.03(00 12), 0.02(01 09), 0.02(01 26).
1-2	2303-2333, 2335-0006, 0009-0039, 0049-0115, 0119-0136.	2 14	0.02(23 07), 0.02(23 56), 0.02(00 32), 0.01(01 05), 0.02(01 23).
2-3	2318-2342, 2345-0013, 0017-0043, 0050-0114.	1 42	0.02(23 23), 0.02(23 48), 0.02(00 23), 0.02(00 55).
August			
30-31	1951-2022, 2024-2055, 2058-2129, 2134-2204, 2206-2225, 2227-2256, 2301-2310, 2312-2317, 2320-2329, 2332-2341, 2343-0002, 0005-0032, 0036-0055.	4 28	0.02(20 03), 0.02(20 41), 0.02(21 21), 0.02(21 54), 0.02(22 21), 0.02(22 45), 0.02(23 26), 0.02(23 59), 0.02(00 26), 0.04(00 51).
September			
3-4	2039-2107, 2109-2133, 2139-2211, 2243-2305, 2308-2332, 2335-0006, 0011-0040, 0042-0113, 0115-0142, 0147-0213, 0216-0239.	4 57	0.02(21 04), 0.02(21 26), 0.03(22 09), 0.02(22 55), 0.02(23 20), 0.02(23 59), 0.02(00 34), 0.02(01 05), 0.02(01 37), 0.04(02 06), 0.04(02 35).
5-6	1932-1959, 2002-2028, 2031-2059, 2105-2132, 2135-2139, 2142-2201, 2204-2242, 2335-2359, 0001-0029, 0031-0040, 0042-0100.	4 08	0.03(19 40), 0.03(20 12), 0.03(20 49), 0.02(21 15), 0.02(21 53), 0.02(22 14), 0.02(23 50), 0.02(00 13), 0.02(00 52).

Table I (cont.)

Date	Monitoring intervals (U.T.)	Total Monitoring Time	$\sigma$ (U.T.)
1973 September			
7-8	19 <sup>h</sup> 54 <sup>m</sup> -20 <sup>h</sup> 18 <sup>m</sup> , 2021-2045, 2048-2127, 2133-2201, 2258-2329, 2333-2359, 0002-0018, 0019-0034, 0042-0102, 0106-0128, 0131-0157, 0207-0219.	04 <sup>h</sup> 43 <sup>m</sup>	0.02(20 <sup>h</sup> 09 <sup>m</sup> ), 0.03 (20 33), 0.03(21 12), 0.02(21 55), 0.02 (23 20), 0.02(23 53), 0.02(00 31), 0.02 (00 58), 0.02(01 23), 0.02(01 44), 0.02 (02 09).
8-9	2009-2034, 2037-2041, 2043-2104, 2107-2132, 2139-2211, 2313-2344, 2347-0013, 0017-0045, 0053-0102, 0107-0116, 0119-0145, 0148-0201, 0204-0226.	04 31	0.05(20 22), 0.04 (20 55), 0.06(21 26), 0.05(21 47), 0.04 (23 37), 0.04(23 59), 0.03(00 34), 0.03 (01 09), 0.02(01 52), 0.03(02 15).
9-10	1934-1952, 1954-2001, 2004-2031, 2034-2059, 2108-2137, 2140-2202, 2255-2322, 2324-2329, 2332-2345, 2347-2358, 0001-0010, 0013-0033, 0053-0114, 0118-0142, 0146-0217.	04 49	0.04(19 46), 0.06 (20 16), 0.05(20 44), 0.04(21 21), 0.05 (21 42), 0.04(23 04). 0.04(23 51), 0.03 (00 19), 0.02(01 06), 0.02(01 31), 0.04 (01 57).
15-16	1842-1910, 1913-1932, 2017-2023, 2025-2054, 2057-2114, 2124-2132, 2136-2148, 2253-2324, 2327-2351, 0000-0028, 0037-0102, 0105-0138, 0144-0211.	4 47	0.06(18 54), 0.04 (19 15), 0.05(20 28), 0.05(21 08), 0.04 (21 39), 0.05(22 59), 0.03(23 49), 0.05 (00 15), 0.06(00 45), 0.06(01 12), 0.05 (01 48).
16-17	1840-1905, 1909-1939, 1943-2014, 2020-2038, 2041-2048, 2051-2119, 2222-2240, 2244-2314, 2317-2346, 2353-0020, 0023-0053, 0056-0130, 0141-0213.	5 39	0.03(18 50), 0.04 (19 22), 0.03(20 05), 0.04(20 33), 0.04 (21 12), 0.04(22 33), 0.04(22 58), 0.05 (23 31), 0.04(00 04), 0.04(00 44), 0.06 (01 10), 0.07(01 56).
17-18	1838-1902, 1905-1939, 1941-2009, 2013-2040, 2046-2109, 2206-2235, 2238-2310, 2313-2352, 2357-0005, 0011-0028, 0031-0059, 0137-0156.	5 08	0.02(18 52), 0.03 (19 33), 0.03(20 04) 0.03(20 35), 0.02 21 04, 0.03(22 29), 0.04(23 02), 0.03 (23 44), 0.03(00 24), 0.03(00 51), 0.03 (01 39).
18	2037-2102, 2104-2113, 2115-2127, 2129-2139, 2141-2145, 2149-2201.	1 12	0.02(20 50), 0.03 (21 17), 0.03(21 42).
20	1854-1923, 1927-1959, 2001-2037, 2040-2116.	2 13	0.02(19 13), 0.02 (19 42), 0.02(20 22), 0.02(21 07).

Table I (cont.)

Date	Monitoring intervals (U.T.)	Total Monitoring Time	$\sigma$ (U.T.)
1973 September			
22	19 <sup>h</sup> 38 <sup>m</sup> -20 <sup>h</sup> 09 <sup>m</sup> , 2011-2041, 2044-2104	1 <sup>h</sup> 21 <sup>m</sup>	0.02(19 <sup>h</sup> 55 <sup>m</sup> ), 0.02(20 38), 0.02(20 55).
24	1856-1928, 1931-2014, 2017-2043, 2130-2139, 2144-2153.	1 59	0.02(19 08), 0.02(19 47), 0.02(20 35), 0.02(21 49).
25	1926-1950, 1953-2046, 2050-2055, 2058-2103.	1 27	0.02(19 41), 0.02(19 58), 0.01(20 53).
26	1859-1932, 1933-1943, 1946-2032, 2037-2050.	1 42	0.02(19 05), 0.01(19 25), 0.02(20 30), 0.02(20 39).
27	1947-2009, 2011-2026, 2028-2101.	1 10	0.02(20 12), 0.02(20 42).
29	2105-2131, 2135-2141, 2142-2156, 2158-2203.	51	0.02(21 15), 0.01(21 51).
October			
1	1856-1923, 1926-1959, 2004-2037,	1 33	0.01(19 16), 0.02(19 50), 0.02(20 29).
2	1918-1944, 1947-2028, 2032-2114.	1 49	0.01(19 39), 0.01(20 12), 0.01(20 42).
7	1951-2028, 2031-2111.	1 17	0.03(20 27), 0.03(21 07).
19	1854-1925, 1928-1956, 1959-2031	1 31	0.01(19 07), 0.02(19 41), 0.02(19 19).
20	1854-1926.	32	0.02(19 05).
Total		80 <sup>h</sup> 42 <sup>m</sup>	

Table II

Flare No.	Date 1973	Characteristics of the Flares Observed								
		U.T. max.	$t_b$ min.	$t_a$ min.	Dura- tion min.	$I_f - I_o / I_o$ min.	$I_p$ max.	$\Delta m$ mag.	$\sigma$ mag.	Air mass
1	June 24	23 <sup>h</sup> 50 <sup>m</sup>	0.9	2.20	3.1	0.11	0.08	0.11	0.02	1.24
2	26	01 28.0	0.4	2.8	3.2	0.12	0.12	0.13	0.02	1.05
3	26	23 56.8	0.3	1.7	2.0	0.10	0.07	0.11	0.02	1.20
4	Aug. 30	22 23.6	0.2	0.5	0.7	0.18	0.03	0.18	0.02	1.01
5	Sept. 3	22 56.9	1.1	>3.3	>4.4	1.75	>2.00	1.10	0.02	1.01
6	7	20 36.65	0.3	7.45	7.75	1.62	2.39	1.05	0.03	1.05
7	7	21 18.9	0.5	2.8	3.3	0.23	0.22	0.23	0.03	1.02
8	8	02 12.0	0.6	6.1	6.7	1.10	1.31	0.81	0.02	1.43
9	17	19 35.6	0.3	1.7	2.0	0.31	0.11	0.29	0.03	1.38
10	18	21 31.3	1.3	5.4	6.7	0.14	0.26	0.15	0.03	1.01
11	18	21 52.1	1.1	2.3	3.4	0.11	0.05	0.11	0.03	1.01
12	25	20 01.9	2.1	42.1	44.2	2.86	13.85	1.47	0.02	1.02
13	26	19 07.5	0.2	0.6	0.8	0.06	0.01	0.06	0.02	1.07
14	Oct. 1	19 18.0	0.1	2.9	3.0	0.12	0.11	0.12	0.01	1.4
15	2	20 21.1	6.9	>6.8	>13.7	0.26	>0.54	0.25	0.01	1.01





