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PHOTOELECTRIC OBSERVATIONS OF THE FLARE STAR EV Lac IN 1978

Continuous photoelectric monitoring of the flare star EV Lac has been carried out at the Stephanion Observatory ( $\lambda = -22^{\circ}49'44''$ ,  $\varphi = +37^{\circ}45'15''$ ) during the year 1978, 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:

$$\begin{aligned}V &= v_0 + 0.036(b-v)_0 + 2.954, \\(B-V) &= 0.683 + 1.059(b-v)_0, \\(U-B) &= -1.484 + 1.022(u-b)_0.\end{aligned}$$

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  $\sigma(\text{mag}) = 2.5 \log(I_0 + \sigma)/I_0$  for different times (UT) of the corresponding monitoring intervals is given.

During the 70.9 hours of the monitoring time 5 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 the intensity deflection less sky background of the quiet star and  $I_f$  is the total intensity deflection less sky background of the

T A B L E I

Monitoring intervals in 1978

Date	Monitoring intervals (U.T.)	Total Monitoring Time	$\sigma$ (U.T.)
1978			
August			
22-23	20 <sup>h</sup> 51 <sup>m</sup> -21 <sup>h</sup> 19 <sup>m</sup> , 21 <sup>h</sup> 21 <sup>m</sup> -21 <sup>h</sup> 52 <sup>m</sup> , 21 <sup>h</sup> 55 <sup>m</sup> -22 <sup>h</sup> 23 <sup>m</sup> , 22 25 -22 42 , 22 53 -23 28 , 00 04 -00 40 , 00 43 -01 20 , 01 22 -01 27 , 01 33 -01 45 . 03 <sup>h</sup> 49 <sup>m</sup>		0.04(21 <sup>h</sup> 09 <sup>m</sup> ), 0.04(21 <sup>h</sup> 37 <sup>m</sup> ), 0.04(22 00 ) 0.04(22 27 ) , 0.04(23 16 ) , 0.05(00 22 ) , 0.06(01 04 ) , 0.06(01 34 ) .
23-24	21 24 -21 47 , 21 48 -22 04 , 22 07 -22 44 , 22 45 -23 09 , 23 13 -23 28 , 00 01 -00 16 , 00 18 -00 38 , 00 42 -01 13 , 01 16 -01 30 , 01 33 -01 53 .	03 35	0.04(21 51 ) , 0.05(22 25 ) , 0.04(23 16 ) , 0.04(00 21 ) , 0.04(00 59 ) , 0.04(01 35 ) .
24-25	21 27 -22 12 , 22 14 -22 43 , 22 46 -23 12 , 23 14 -23 41 , 00 27 -00 37 , 00 40 -00 51 , 00 54 -01 12 , 01 14 -01 28 , 01 30 -01 59 .	03 29	0.03(21 52 ) , 0.04(22 28 ) , 0.04(23 17 ) , 0.05(00 42 ) , 0.05(01 16 ) , 0.04(01 49 ) .
25-26	21 27 -21 59 , 22 02 -22 23 , 22 25 -22 48 , 22 51 -23 18 , 23 20 -23 45 , 23 53 -24 00 , 00 00 -00 09 , 00 11 -00 29 , 00 33 -00 49 , 00 52 -01 06 , 01 13 -01 29 , 01 45 -01 55 .	03 38	0.03(21 44 ) , 0.03(22 28 ) , 0.03(23 22 ) , 0.03(00 12 ) , 0.03(00 55 ) , 0.04(01 46 ) .
26-27	22 01 -22 39 , 22 42 -23 22 , 23 25 -24 00 , 00 00 -00 04 , 00 13 -00 48 , 00 50 -01 21 , 01 23 -01 54 .	03 34	0.03(22 22 ) , 0.03(23 06 ) , 0.03(23 47 ) , 0.03(00 36 ) , 0.04(01 25 ) .
28-29	22 22 -23 04 , 23 08 -23 41 , 23 43 -23 50 , 23 53 -24 00 , 00 00 -00 10 , 00 12 -00 27 , 00 38 -01 23 , 01 25 -01 40 , 01 42 -01 58 .	03 10	0.02(22 43 ) , 0.02(23 23 ) , 0.02(00 14 ) , 0.03(00 58 ) , 0.03(01 44 ) .
29-30	22 01 -22 45 , 22 47 -22 50 , 22 54 -23 37 , 23 39 -24 00 , 00 00 -00 04 , 00 16 -00 49 , 00 52 -01 32 , 01 35 -01 47 , 01 50 -01 58 .	03 28	0.03(22 22 ) , 0.03(23 13 ) , 0.04(00 00 ) , 0.04(00 34 ) , 0.04(01 19 ) , 0.04(01 51 ) .
30-31	22 57 -23 15 , 23 18 -23 29 , 23 32 -23 49 , 23 51 -24 00 , 00 00 -00 08 , 00 11 -00 27 , 00 29 -00 52 , 01 02 -01 18 , 01 20 -01 40 , 01 43 -01 58 .	02 33	0.02(23 19 ) , 0.02(23 52 ) , 0.03(00 30 ) , 0.03(01 29 ) .
September			
1-2	23 19 -24 00 , 00 00 -00 20 , 00 23 -01 00 , 01 03 -01 29 , 01 31 -01 47 .	02 20	0.02(23 45 ) , 0.02(00 48 ) , 0.02(01 20 ) .
2	22 45 -23 24 , 23 26 -23 38 , 23 42 -23 57 .	01 06	0.02(22 46 ) , 0.02(23 16 ) , 0.02(23 44 ) .

T A B L E I (continued)

Date	Monitoring intervals (U.T.)	Total Monitoring Time	$\sigma$ (U.T.)
September			
3-4	22 <sup>h</sup> 48 <sup>m</sup> -23 <sup>h</sup> 26 <sup>m</sup> , 23 <sup>h</sup> 29 <sup>m</sup> -23 <sup>h</sup> 47 <sup>m</sup> , 23 <sup>h</sup> 50 <sup>m</sup> -24 <sup>h</sup> 00 <sup>m</sup> , 00 00 -00 11 , 00 16 -00 50 , 01 03 -01 48 . 02 <sup>h</sup> 36 <sup>m</sup>	0.02(23 <sup>h</sup> 10 <sup>m</sup> ), 0.02(23 <sup>h</sup> 59 <sup>m</sup> ), 0.02(00 33 ), 0.02(01 28 ) .	
5-6	00 28 -00 59 , 01 02 -01 15 , 01 17 -01 57 , 02 00 -02 15 .	01 39	0.02(00 47 ), 0.02(01 40 ) .
6-7	19 46 -20 27 , 20 29 -21 13 , 21 15 -22 14 , 22 23 -23 03 , 23 06 -23 23 , 23 25 -23 42 , 23 45 -23 54 , 00 19 -00 47 , 00 50 -01 05 , 01 15 -01 30 , 01 32 -01 44 , 01 46 -01 57 , 01 59 -02 08 .	05 17	0.02(20 14 ), 0.02(20 59 ), 0.02(21 50 ), 0.02(22 49 ), 0.02(23 28 ), 0.02(00 41 ), 0.02(01 37 ) .
9	21 36 -22 18 , 22 20 -23 00 .	01 22	0.02(22 05 ), 0.02(22 46 ) .
10-11	23 05 -23 56 , 23 58 -24 00 , 00 00 -00 11 , 00 12 -00 25 , 00 38 -00 58 , 01 04 -01 16 , 01 29 -02 00 .	02 20	0.02(23 31 ), 0.02(00 16 ) , 0.02(01 46 ) .
12	20 11 -20 49 , 20 51 -21 18 , 21 19 -21 47 , 22 28 -22 55 , 22 57 -23 05 , 23 07 -23 35 . 02 36	0.03(20 31 ), 0.03(21 21 ) , 0.03(22 43 ), 0.03(23 09 ) .	
19-20	20 09 -20 40 , 20 43 -21 16 , 21 19 -21 52 , 22 05 -22 25 , 22 39 -22 58 , 23 01 -23 25 , 23 46 -00 14 , 00 17 -00 46 , 00 48 -01 17 . 04 06	0.04(20 27 ), 0.04(20 55 ) , 0.04(21 29 ), 0.05(22 19 ) , 0.05(22 43 ), 0.05(23 11 ) , 0.05(23 55 ), 0.07(00 25 ) , 0.06(00 57 ) .	
20-21	19 33 -19 47 , 19 48 -20 17 , 20 20 -20 49 , 20 52 -21 30 , 21 40 -22 05 , 22 07 -22 37 , 22 40 -23 08 , 23 37 -23 52 , 23 55 -00 24 , 00 27 -00 57 , 01 08 -01 39 , 01 42 -02 16 . 05 32	0.05(19 41 ), 0.05(19 55 ) , 0.04(20 25 ), 0.04(21 05 ) , 0.05(21 48 ), 0.05(22 14 ) , 0.07(22 52 ), 0.04(23 41 ) , 0.06(00 03 ), 0.05(00 35 ) , 0.05(01 15 ), 0.06(01 50 ) .	
23-24	20 44 -21 10 , 22 16 -22 36 , 22 46 -23 17 , 23 20 -23 47 , 23 49 -00 22 , 00 36 -00 58 , 01 00 -01 26 , 01 31 -02 05 , 02 09 -02 17 . 03 47	0.03(20 50 ), 0.03(22 53 ) , 0.03(23 27 ), 0.04(23 58 ) , 0.04(00 50 ), 0.04(01 10 ) , 0.04(01 38 ) .	
24	21 33 -22 05 , 22 07 -22 33 .	00 58	0.03(21 40 ), 0.03(22 13 ) .
25	19 28 -20 04 , 20 06 -20 36 , 20 38 -21 40 . 02 08	0.03(19 48 ), 0.03(20 21 ) , 0.04(20 52 ) .	

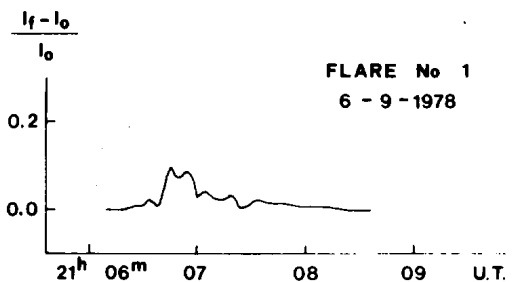
T A B L E I (continued)

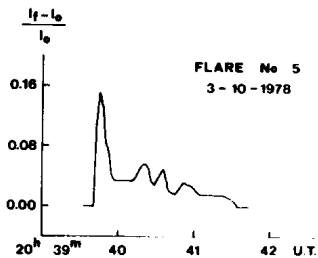
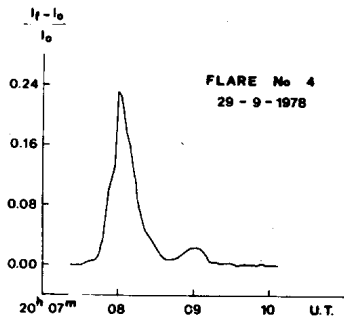
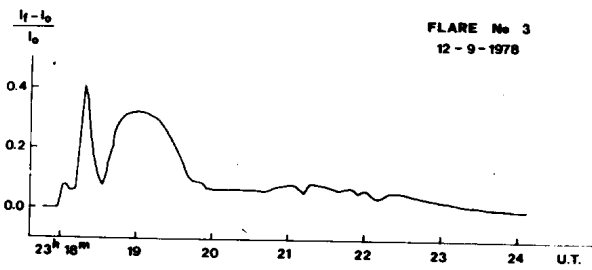
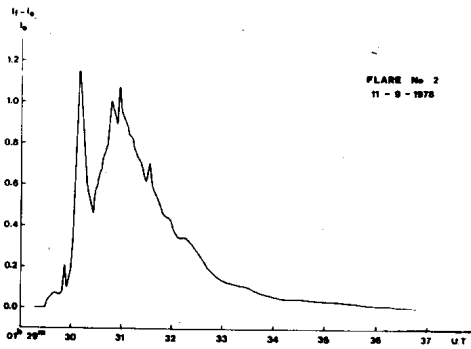
Date 1978	Monitoring intervals(U.T.)	Total Monitoring Time	$\sigma$ (U.T.)
September			
26	19 <sup>h</sup> 08 <sup>m</sup> -19 <sup>h</sup> 38 <sup>m</sup> , 19 <sup>h</sup> 41 <sup>m</sup> -20 <sup>h</sup> 22 <sup>m</sup> , 20 <sup>h</sup> 25 <sup>m</sup> -21 <sup>h</sup> 03 <sup>m</sup> , 21 14 -21 45 .	02 <sup>h</sup> 20 <sup>m</sup>	0.03(19 <sup>h</sup> 18 <sup>m</sup> ), 0.02(19 <sup>h</sup> 55 <sup>m</sup> ), 0.03(20 34 ), 0.03(21 28 ).
27	20 24 -20 57 , 21 00 -21 33 .	01 06	0.03(20 42 ), 0.03(21 19 ).
29	19 51 -20 31 , 20 34 -21 09 , 21 11 -21 36 ,	01 40	0.02(20 00 ), 0.02(20 46 ), 0.02(21 20 ).
30	20 41 -21 11 , 21 14 -21 40 .	00 56	0.02(20 50 ), 0.02(21 27 ).
October			
3	18 59 -19 30 , 19 33 -20 05 , 20 07 -20 53 .	01 49	0.04(19 15 ), 0.03(19 55 ), 0.03(20 36 ).
	TOTAL	70 <sup>h</sup> 54 <sup>m</sup>	

T A B L E II

Characteristics of the Flares Observed

Flare No	Date 1978	U.T. max	$t_b$ min	$t_a$ min	Duration min	$I_F - I_0 / I_0$ max	P min	$\Delta m$ mag	$\sigma$ mag	Air mass
1	Sept 6	21 <sup>h</sup> 06 <sup>m</sup> .78	0.45	1.72	2.17	0.10	0.05	0.10	0.02	1.03
2	11	01 30.18	0.70	6.65	7.35	1.15	1.88	0.83	0.02	1.31
3	12	23 18.32	0.40	5.60	6.00	0.40	0.60	0.37	0.03	1.05
4	29	20 08.02	0.54	1.86	2.40	0.23	0.09	0.22	0.02	1.01
	Oct									
5	3	20 39.76	0.20	1.80	2.00	0.15	0.07	0.15	0.03	1.01





star plus flare, d) the integrated intensity of the flare over its total duration, including pre-flare, 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. 1-5.

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Reference:

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