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PHOTOELECTRIC OBSERVATIONS OF THE FLARE STAR EV Lac IN 1974

Continuous photoelectric monitoring of the flare star EV Lac has been carried out at the Stephanion Observatory ($\lambda=-22^{o}49'44"$ $\varphi=+37^{o}45'15"$) during the years 1974 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 2-6-1974 to 12-8-1974

$$V = v_o + 0.053\ (b-v)_o + 2.380,$$
$$(B-V) = 0.858 + 1.043(b-v)_o,$$
$$(U-B) = -1.782 + 1.020(u-b)_o,$$

and for the time interval from 13-8-1974 to 31-10-1974

$$V = v_o - 0.018(b-v)_o + 2.297,$$
$$(B-V) = 0.886 + 1.004(b-v)_o,$$
$$(U-B) = -1.818 + 0.974(u-b)_o.$$

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 noice fluctuation $\sigma(mag) = 2.5\ \log(I_o+\sigma)/I_o$ for different times (UT) of the corresponding monitoring intervals is given.

During the 74.55 hours of monitoring time 23 flares were observed the characteristics of which are given in Table II. For each flare the following characteristics (Andrews et al.,1969) are given: a) the date and universal time of flare maximum, b) the duration before and after maximum (t_b and t_a, respectively), as well as the total duration of the flare, c) the value of the

Flare Star EV Lac, 1974

Table I

Date 1974	Monitoring intervals (U.T.)	Total Monitoring Time	σ (U.T.)
July			
10-11	23^h34^m-23^h58^m, 0001-0035, 0038-0113,	1^h33^m	0.02(23^h47^m), 0.02(00^h13^m), 0.02(00^h52^m).
11-12	2321-2357, 0001-0022, 0024-0038, 0043-0120.	1^h48^m	0.03(23^h36^m), 0.02(00^h17^m), 0.02(00^h46^m), 0.02(01^h15^m)
13	0033-0100, 0103-0133	0^h57^m	0.01(00^h46^m), 0.01(01^h23^m),
16-17	2331-0001, 0004-0032, 0034-0106,	1^h30^m	0.01(23^h47^m), 0.01(00^h15^m), 0.01(00^h55^m).
17-18	2301-2332, 2334-0008, 0011-0039, 0041-0109	2^h01^m	0.01(23^h22^m), 0.01(00^h00^m) 0.01(00^h24^m), 0.01(00^h50^m).
18-19	2216-2247, 2251-2326, 2328-2359, 0010-0038, 0041-0108, 0114-0121.	2^h39^m	0.01(22^h38^m), 0.01(23^h16^m), 0.01(23^h46^m), 0.01(00^h24^m), 0.01(00^h54^m).
August			
7-8	22^h11^m-22^h40^m, 2242-2308, 2311-2340, 2354-0020, 0022-0049, 0052-0118.	2^h43^m	0.03(22^h12^m), 0.04(22^h45^m), 0.03(23^h13^m), 0.03(23^h39^m), 0.03(00^h13^m), 0.03(00^h48^m) 0.03(01^h16^m).
9-10	2035-2102, 2105-2137, 2148-2217, 2227-2248, 2250-2320, 2331-2359, 0043-0114.	3^h18^m	0.02(20^h37^m), 0.02(21^h06^m), 0.02(21^h49^m), 0.02(22^h28^m), 0.02(22^h54^m), 0.02(23^h32^m), 0.02(23^h58^m), 0.02(00^h44^m), 0.02(01^h13^m).
10-11	2239-2306, 2308-2332, 2335-0008, 0021-0044, 0047-0120.	2^h20^m	0.02(22^h40^m), 0.02(23^h10^m), 0.02(23^h47^m), 0.02(00^h22^m), 0.02(00^h53^m), 0.02(01^h16^m).
11-12	2012-2040, 2042-2112, 2115-2144, 2159-2227, 2230-2259, 2303-2330, 0012-0057, 0059-0119.	3^h56^m	0.01(20^h13^m), 0.02(21^h18^m), 0.01(21^h43^m), 0.02(23^h28^m), 0.02(00^h16^m).

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Table I (Continued)

I3-I4	I947-20I2, 20I6-2043, 2049-2054, 2056-2I24, 2I35-2207, 22I0-2239, 2242-2309, 2329-2348, 003I-005I, 0054-0II9.	3^h57^m	0.02(19^h49^m),0.0I(20^hI6^m), 0.02(20^h52^m), 0.02($2I^h23^m$), 0.02(22^h00^m), 0.02(22^h34^m), 0.02(23^h05^m), 0.02(23^h37^m), 0.0I(00^h42^m), 0.02($0I^h08^m$).
I4	I956-20I7, 20I9-2029, 203I-2059, 2I02-2I3I.	I^h28^m	0.02($I9^h57^m$), 0.02(20^h33^m), 0.0I($2I^h04^m$), 0.02($2I^h30^m$).
22-23	I935-200I, 2003-2033, 2036-2I02, 2I22-2I52, 2200-2224, 2225-2300, 2347-00I7.	3^h2I^m	0.02($I9^h37^m$), 0.02(20^h05^m), 0.02(20^h32^m), 0.0I($2I^h0I^m$), 0.0I($2I^h34^m$), 0.02(22^h06^m), 0.0I(22^h38^m), 0.02(23^h59^m).
23-24	I905-I932, I934-I958, 2000-203I, 2043-2II0, 2II2-2I43, 2I48-2209, 2220-2248, 225I-23I3, 0005-0028, 003I-0I02, 0I04-0I37.	4^h58^m	0.02($I9^h07^m$), 0.02($I9^h37^m$), 0.0I(20^hII^m), 0.0I(20^h56^m), 0.0I($2I^h25^m$), 0.0I(22^h00^m), 0.0I(22^h36^m), 0.0I(23^h04^m), 0.0I(00^h05^m), 0.02(00^h45^m), 0.02($0I^hI5^m$).
24-25	I925-I952, I955-2026, 2029-2056, 2I07-2I4I, 2I44-2205, 2208-2236, 2249-23II, 0003-00I8.	3^h25^m	0.02($I9^h39^m$), 0.02(20^h09^m), 0.02(20^h39^m), 0.02($2I^hI5^m$), 0.0I(22^h00^m), 0.02(22^h30^m), 0.02(23^h03^m), 0.02(00^h06^m).
25-26	I938-2002, 2005-2034, 2036-2I05, 2II6-2I4I, 2I44-22I4, 22I7-2244, 2257-23I7, 00II-0033, 0036-0I09, 0II2-0I38.	4^h25^m	0.03($I9^h52^m$), 0.03(20^h22^m), 0.02(20^h56^m), 0.02($2I^h30^m$), 0.02(22^h00^m), 0.02(22^h30^m), 0.02(23^h00^m), 0.02(00^h20^m), 0.0I(00^h52^m), 0.0I($0I^h20^m$).
3I	2040-2II0, 2II3-2I42, 2I44-22I5, 2228-2257, 2307-2325.	2^hI7^m	0.04(20^h44^m), 0.04($2I^hI6^m$), 0.04($2I^h47^m$), 0.04(22^h3I^m), 0.04(23^hII^m).
September			
2-3	I94I-20I4, 20I7-202I, 2026-2048, 205I-2I2I. 2I34-2202, 2205-2238, 2240-2309, 0000-0029, 0032-0I02.	3^h58^m	0.04($I9^h45^m$), 0.04(20^hI9^m), 0.04(20^h54^m), 0.04($2I^h39^m$), 0.03(22^hII^m), 0.03(22^h43^m), 0.05(00^h05^m), 0.03(00^h35^m).

Table I (Continued)

3-4	2050-2115, 2309-2335, 2343-0010, 0013-0043, 0058-0109.	1^h59^m	0.03(20^h55^m), 0.04(23^h16^m), 0.04(23^h46^m), 0.04(00^h16^m), 0.03(01^h00^m).
4-5	2123-2154, 2157-2224, 2226-2256, 2345-0015, 0017-0045, 0047-0115.	2^h54^m	0.02(21^h27^m), 0.02(22^h01^m), 0.02(22^h31^m), 0.03(23^h48^m), 0.03(00^h20^m), 0.03(00^h50^m).
5-6	2026-2052, 2055-2123, 2126-2153, 2206-2223, 2322-2347, 2350-0019, 0022-0051, 0053-0111,	3^h19^m	0.03(20^h30^m), 0.02(21^h00^m), 0.03(21^h31^m), 0.03(22^h09^m), 0.05(23^h26^m), 0.03(23^h54^m), 0.04(00^h27^m), 0.05(00^h57^m).
6-7	2107-2134, 2137-2205, 2208-2235, 2328-2356, 2358-0025, 0028-0101.	2^h50^m	0.04(21^h10^m), 0.02(21^h40^m), 0.02(22^h12^m), 0.02(23^h31^m), 0.02(00^h02^m), 0.02(00^h31^m).
9-10	2024-2051, 2054-2125, 2127-2156, 2236-2303, 2306-2340, 2344-0001, 0003-0013, 0025-0054, 0057-0122.	3^h49^m	0.01(20^h29^m), 0.01(20^h59^m), 0.01(21^h30^m), 0.01(22^h40^m), 0.01(23^h27^m), 0.01(00^h06^m), 0.01(00^h36^m), 0.02(01^h03^m).
I4	2026-2056, 2059-2129, 2216-2245, 2247-2315, 2318-2322, 2326-2347.	2^h22^m	0.01(20^h31^m), 0.01(21^h00^m), 0.01(22^h19^m), 0.01(22^h55^m), 0.01(23^h28^m).
I5	2013-2040, 2043-2110, 2113-2140, 2227-2249, 2252-2316, 2319-2329, 2333-2350.	2^h34^m	0.01(20^h17^m), 0.01(20^h56^m), 0.01(21^h27^m), 0.01(22^h40^m), 0.01(23^h09^m), 0.02(23^h44^m).
I7	1956-2024, 2027-2055, 2057-2131, 2220-2234, 2236-2305.	2^h13^m	0.01(19^h58^m), 0.01(20^h28^m), 0.02(21^h00^m), 0.02(22^h25^m), 0.01(22^h39^m).
I9	1951-2020, 2022-2039, 2041-2121, 2220-2253.	1^h59^m	0.02(19^h53^m), 0.01(20^h26^m), 0.02(20^h45^m), 0.01(22^h23^m).
	Total	74^h33^m	

Flare Star EV Lac, 1974

Table II

Characteristics of the Flares Observed

Flare No.	Date 1974 July	U.T. max.	t_b min.	t_a min.	Duration min.	I_f-I_o/I_o max.	P min.	Δm mag.	σ mag.	Air mass
1	11	$00^h54^m.2$	0.5	1.8	2.3	0.09	0.09	0.10	0.02	1.03
2	13	01 26.75	0.35	1.15	1.5	0.08	0.04	0.09	0.01	1.01
3	18	00 02.3	0.2	5.7	5.9	0.14	0.15	0.14	0.01	1.05
	August									
4	10	22 56.65	2.0	3.9	5.9	0.10	0.18	0.11	0.02	1.03
5	10	23 49.6	0.5	3.4	3.9	0.18	0.21	0.17	0.02	1.01
6	11	00 04.0	2.9	3.3	6.2	0.10	0.22	0.10	0.02	1.01
7	11	01 17.8	0.2	0.7	0.9	0.08	0.04	0.08	0.02	1.02
8	11	22 49.5	0.3	9.4	9.7	2.51	1.92	1.37	0.02	1.03
9	12	00 35.5	1.0	46.0	47.0	1.07	4.81	0.80	0.02	1.04
10	23	20 17.9	0.9	1.8	2.7	0.08	0.08	0.08	0.01	1.18
11	24	00 55.2	0.4	2.8	3.2	0.17	0.18	0.17	0.02	1.07
12	24	01 29.05	1.1	4.0	5.1	0.28	0.37	0.27	0.02	1.13
13	24	21 33.6	0.9	4.5	5.4	0.11	0.21	0.12	0.01	1.05
14	24	21 49.65	0.7	6.6	7.3	0.25	0.28	0.24	0.01	1.04
15	25	20 26.95	2.6	6.2	8.8	0.13	0.39	0.13	0.03	1.15
16	25	20 45.55	1.7	2.5	4.2	0.10	0.14	0.10	0.02	1.11
17	26	00 42.8	0.2	0.8	1.0	0.04	0.02	0.05	0.02	1.07
	September									
18	2	19 48.6	2.0	12.8	14.8	0.93	3.75	0.71	0.04	1.04
19	5	20 37.0	5.65	7.85	13.5	0.67	3.16	0.56	0.03	1.06
20	9	23 29.2	1.1	4.5	5.6	0.14	0.24	0.14	0.01	1.05
21	10	01 07.4	0.9	10.5	11.4	0.84	1.83	0.66	0.02	1.23
22	15	23 11.6	0.5	2.8	3.3	0.18	0.16	0.18	0.01	1.06
23	15	23 23.5	1.5	0.8	2.3	0.21	0.14	0.21	0.01	1.07

ratio $(I_f-I_o)/I_o$ corresponding to flare maximum, where I_o in the intensity deflection less sky backgroung 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, including pre-flares, if present, $p=\int(I_f-I_o)/ I_o dt$, e) the increase of the apparent magnitude of the star at flare maximum $\Delta m(b)=2.5\log(I_f/I_o)$, where b is the blue magnitude of the star in the instrumental system, f) the standard deviation of random noice fluctuation $\sigma(mag)=2.5 \log(I_o+\sigma)/I_o$ 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. 1-23.

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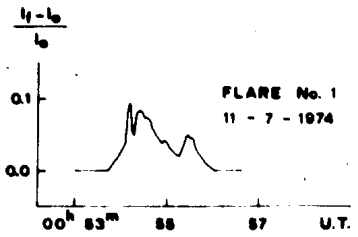
Reference :

Andrews, A.D., Chugainov, P.F., Gershberg, R.E. and Oskanian,V.S.: 1969, I.B.V.S. No. 326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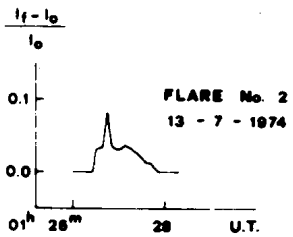
57
U.T.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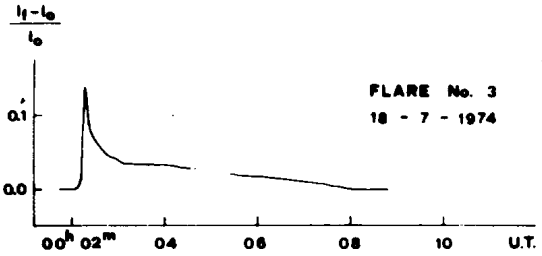
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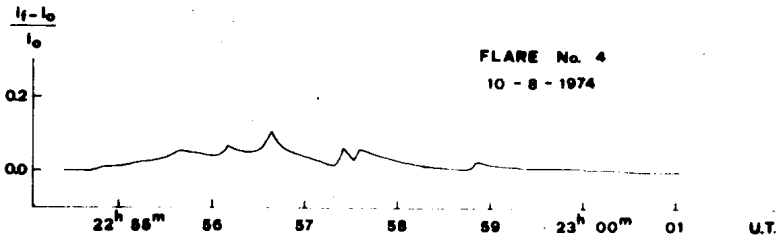
04
06
08
10
U.T.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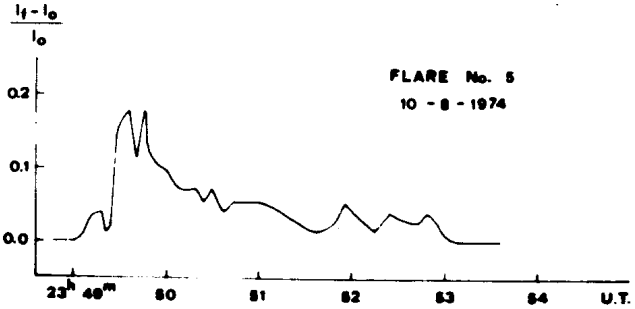
56
57
58
59
23h 00m
01
U.T.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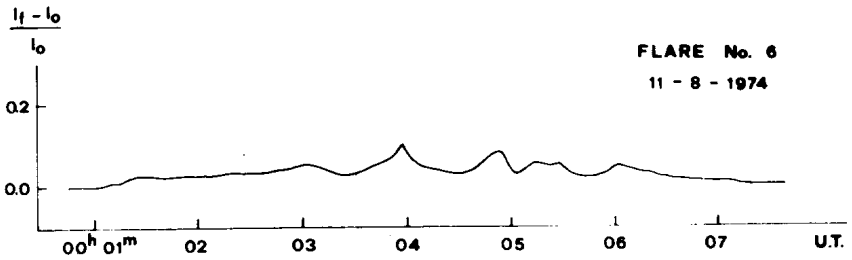
50
51
52
53
54
U.T.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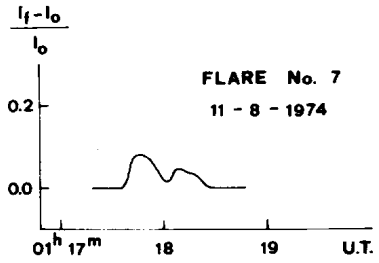
00h 01m
02
03
04
05
06
07
U.T.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0.0
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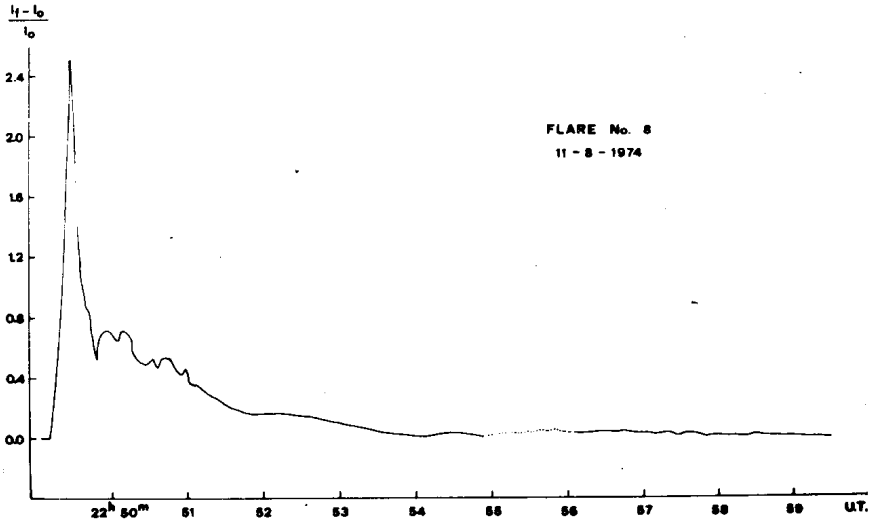
18
19
U.T.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11 - 8 - 1974
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2.0
1.6
1.2
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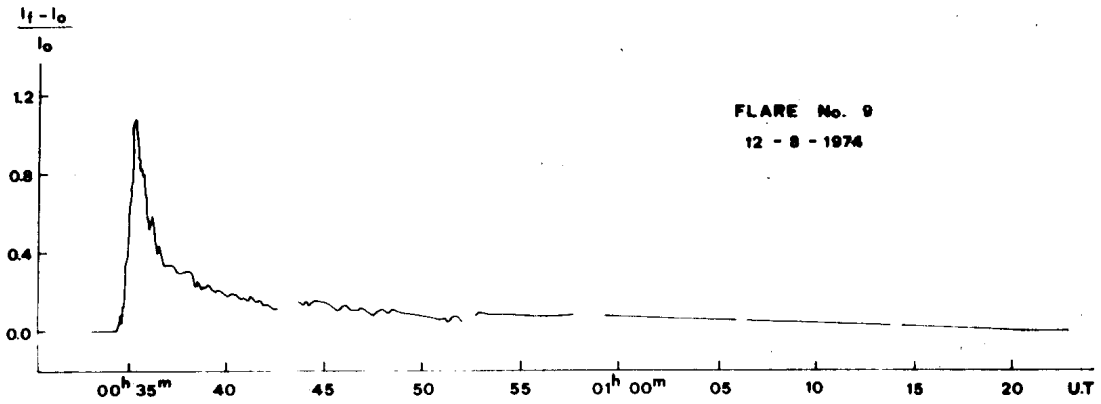
0.0
22h 50m
51
52
53
54
55
56
57
58
59
U.T.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0.8
0.4
0.0
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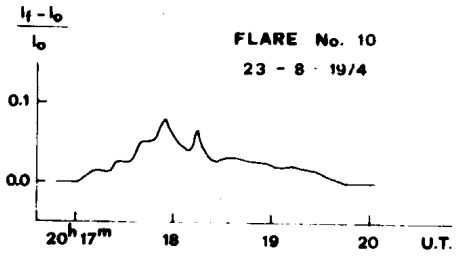
40
45
50
55
01h 00m
05
10
15
20
U.T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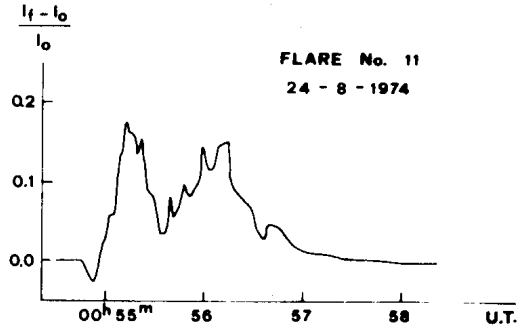
18
19
20
U.T.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58
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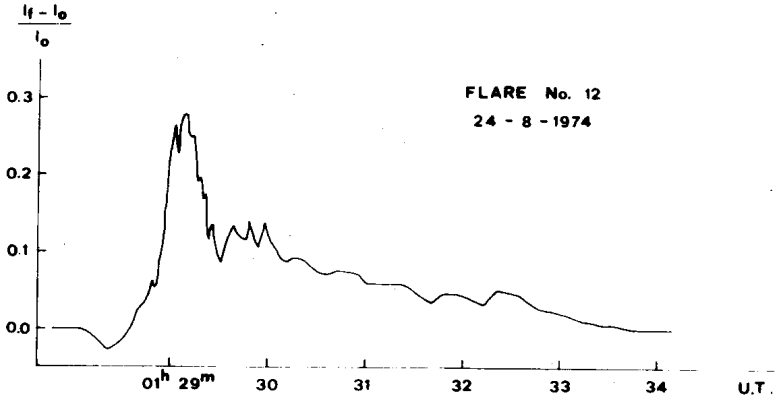
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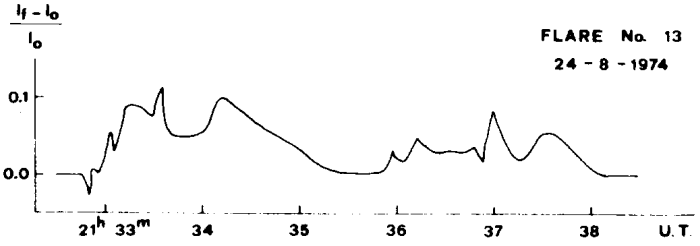
30
31
32
33
34
U.T.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34
35
36
37
38
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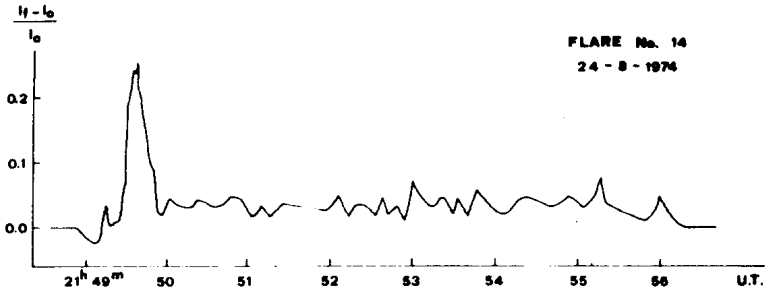
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0.0
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24 - 8 - 1974
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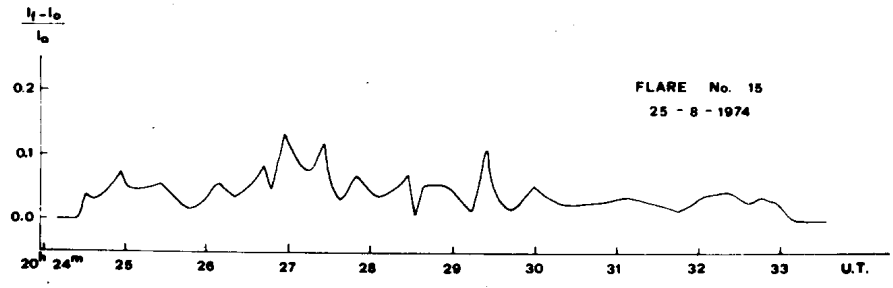
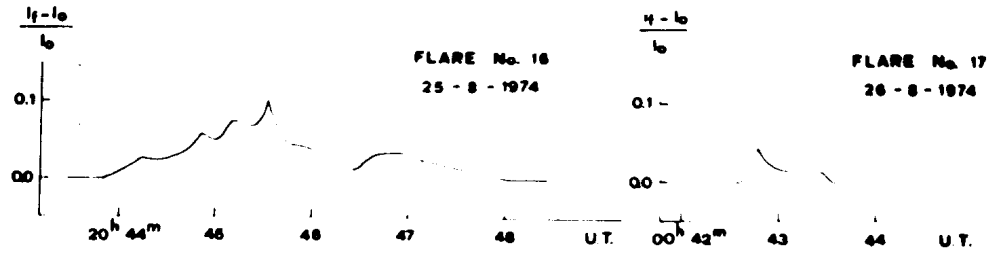
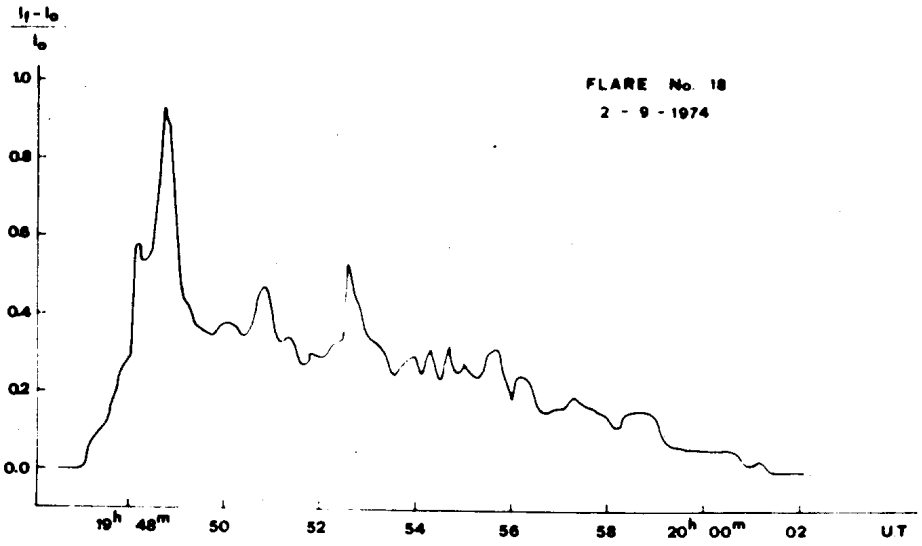
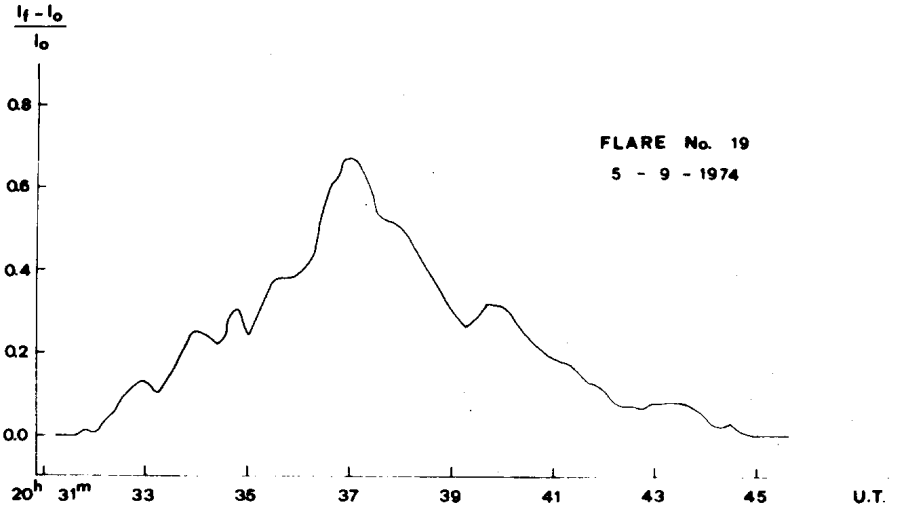
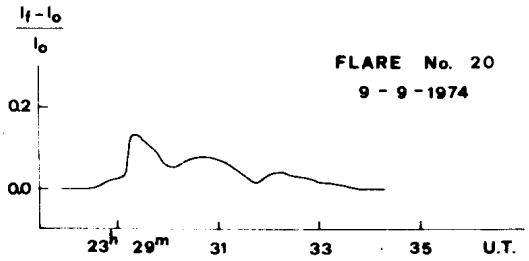
50
51
52
53
54
55
56
U.T.

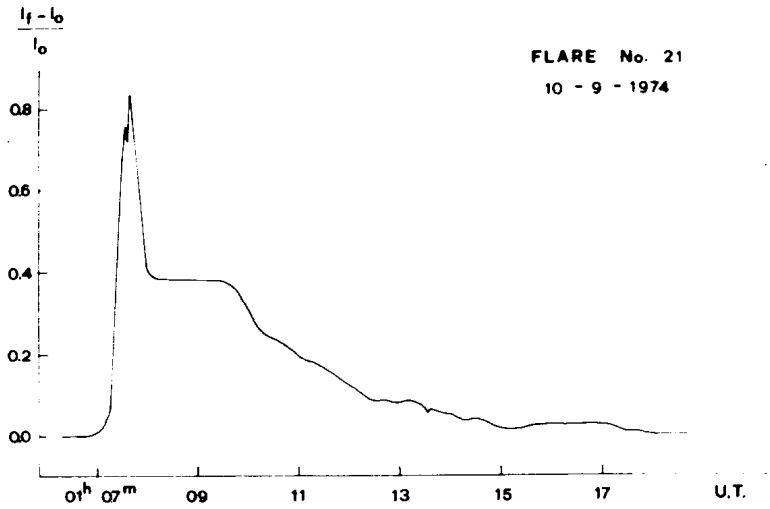

$\frac{I_f - I_o}{I_o}$
0.2
0.1
0.0
FLARE No. 15
25 - 8 - 1974
20h 24m
25
26
27
28
29
30
31
32
33
U.T.

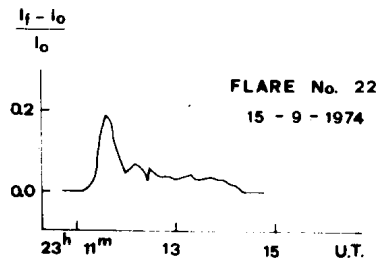

$\frac{I_f - I_o}{I_o}$
FLARE No. 16
25 - 8 - 1974
0.1
0.0
20h 44m
46
48
47
48
U.T.
$\frac{I_f - I_o}{I_o}$
0.1
0.0
00h 42m
43
44
U.T.
FLARE No. 17
26 - 8 - 1974

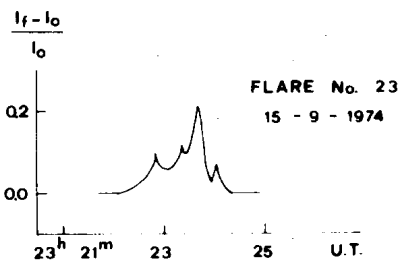

$\frac{I_f - I_o}{I_o}$
FLARE No. 18
2 - 9 - 1974
1.0
0.8
0.6
0.4
0.2
0.0
19h 48m
50
52
54
56
58
20h 00m
02
UT


$\frac{I_f - I_o}{I_o}$
FLARE No. 19
5 - 9 - 1974
0.8
0.6
0.4
0.2
0.0
20h 31m
33
35
37
39
41
43
45
U.T.


$\frac{I_f - I_o}{I_o}$
FLARE No. 20
9 - 9 - 1974
0.2
0.0
23h 29m
31
33
35
U.T.


$\frac{I_f - I_o}{I_o}$
FLARE No. 21
10 - 9 - 1974
0.8
0.6
0.4
0.2
0.0
01h 07m
09
11
13
15
17
U.T.


$\frac{I_f - I_o}{I_o}$
FLARE No. 22
15 - 9 - 1974
0.2
0.0
23h 11m
13
15
U.T.


$\frac{I_f - I_o}{I_o}$
FLARE No. 23
15 - 9 - 1974
0.2
0.0
23h 21m
23
25
U.T.