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SIMULTANEOUS PHOTOELECTRIC OBSERVATIONS OF AD LEONIS

As a part of the programme for investigation of fast (several seconds) flares and short time-scale variations on late spectral classes stars (flare stars, cataclysmic variables, red giants et al.) at the Department of Astronomy of the Bulgarian Academy of Sciences, simultaneous photometric monitoring of the flare star AD Leo was carried out on February 3, 1990.

The observations were made in U-colour of the standard UBV system using two identical single channel photon-counting photoelectric photometers, attached to 60 cm Cassegrain telescopes in the National Astronomical Observatory Rozhen and in the Belogradchik Astronomical Observatory. The photometers used have been described by Panov et al. (1982) and Antov et al. (1991). The altitude above the sea level is 1750 m at Rozhen and 630 m at Belogradchik. The distance between them is 270 km. The accuracy in the time synchronization between the two observatories was approximately 2 sec.

The star with coordinates $\alpha_{1950}=10^h16^m48^s$, $\delta_{1950}=20^0 8'.5$ was used as a comparison star for the observations made at Belogradchik and for the observations made at Rozhen. du(mag) is the difference between AD Leo and the comparison star in the instrumental system. The amplitude of the flares Δm_u was calculated regarding the quiet state phase of the star AD Leo immediately before flare.

The data processing has been made by Kirov, Antov and Genkov's program system (Kirov et al. (1990)).

The integration time was 1 sec. The monitoring intervals in U.T., as well as the total monitoring time for the night are given in Table 1. The standard deviation of random noise fluctuation σ_{mag} was calculated when the intensity in impulses was

lessened with the sky background. They are $\sigma_{mag} \leq 0.06$ for the observations at Rozhen and $\sigma_{mag} \leq 0.09$ for the observations at Belogradchik.

Table 1

Monitoring intervals (U.T.) in 3/4 Feb 1990

Monitoring intervals (U.T.)	σ (U.T.)
(at Rozhen)	
$19^h37^m18^s$ $19^h52^m23^s$, $19^h54^m07^s$ $20^h13^m41^s$	007(19^h44^m), 006(20^h04^m)
20 15 49-20 37 41, 20 39 12-21 06 00	007(20 26), 005(20 52)
21 08 19-21 30 23, 21 33 38-21 54 53	005(21 19), 005(21 44)
21 56 50-22 18 45, 22 26 12-22 50 59	004(22 07), 004(22 36)
22 52 27-23 22 38, 23 24 58-23 43 15	004(23 07), 005(23 35)
23 45 55- 0 11 14, 0 27 50- 0 36 31	004(23 58), 005(0 32)
Total monitoring time $4^h15^m38^s$.	
(at Belogradchik)	
$21^h04^m35^s$ $21^h06^m16^s$, $21^h08^m02^s$ $21^h17^m56^s$	010(21^h05^m), 009(21^h12^m)
21 18 12-21 29 15, 21 30 30-21 40 08	010(21 23), 009(21 35)
21 40 25-21 50 57, 21 51 58-22 01 53	010(21 44), 009(21 55)
22 02 05-22 10 52, 22 11 58-22 26 03	011(22 05), 009(22 18)
22 27 02-22 41 29, 22 42 32-22 55 22	010(22 33), 009(22 48)
22 55 39-23 09 36, 23 19 05-23 31 45	010(23 02), 008(23 29)
23 31 58-23 39 32, 23 40 30-23 51 56	007(23 35), 008(23 45)
23 52 13- 0 03 32, 0 04 41- 0 18 50	008(23 57), 006(0 11)
0 19 07- 0 30 22, 0 31 20- 0 45 04	009(0 25), 009(0 38)
0 45 18- 0 54 37, 0 55 56- 1 05 35	008(0 49), 005(1 00)
1 05 50- 1 15 35, 1 16 45- 1 28 03	008(1 10), 008(1 22)
1 28 19- 1 39 15, 1 40 15- 1 49 49	006(1 33), 008(1 45)
1 50 07- 1 54 50	007(1 52)
Total monitoring time $4^h28^m17^s$.	

Table 2

Date	Flare no.		U.T. max	t_b min	t_a min	Duration min	$\frac{I_f - I_0}{I_0}$	Δm_u	σ_{mag}
3/4 Feb 1990	1	R.	$21^h09^m44^s$	0.07	0.12	0.19	0.37	0.34	0.07
		B.	21 09 47	0.07	0.12	0.19	0.47	0.42	0.10
	2	R.	21 46 35	0.5	14.0	14.5	1.11	0.81	0.05
		B.	21 46 36	0.5	14.0	14.5	1.16	0.84	0.10
	2a	R.	21 48 58	0.07	0.10	0.17	0.19	0.19	0.05
		B.	21 48 59	0.07	0.10	0.17	0.16	0.16	0.06
	3	R.	23 33 26	0.3	1.5	1.8	0.96	0.73	0.05
		B.	23 33 28	0.3	1.5	1.8	1.18	0.84	0.08

R. – Rozhen, B. – Belogradchik

Three flares were observed during the 4.26 hours total monitoring time at Rozhen and 4.47 hours at Belogradchik. The data for these flares are given in Table 2 in the following form:

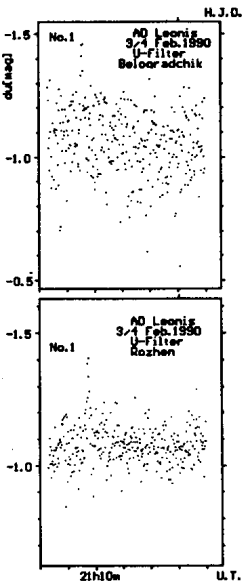

Figure 1

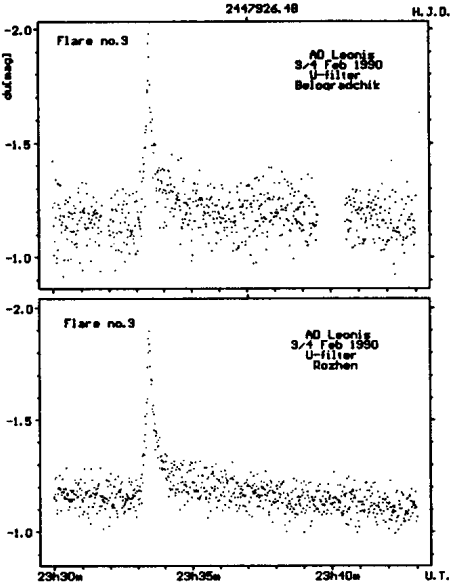

Figure 2

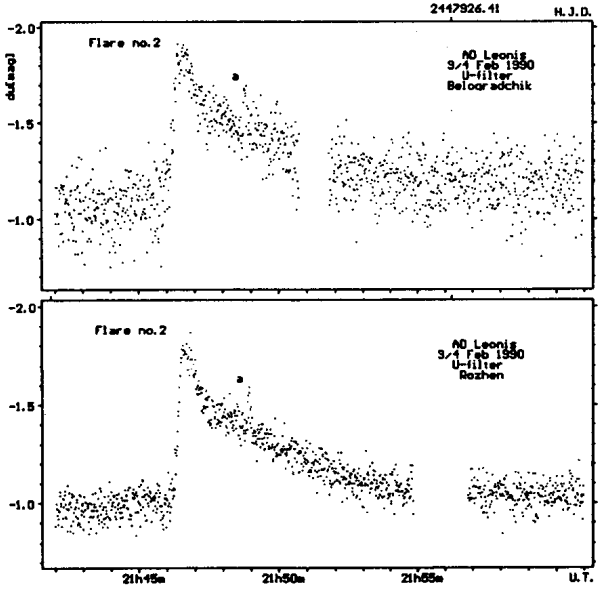

Figure 3

– date;

– number of the flare;

– U.T. of the maximum;

– the duration before and after the maximum (t_b and t_a respectively), as well as the total duration of the flare;

– the value of the ratio $(I_f-I_0)/I_0$ corresponding to the flare maximum, where I_0 is the intensity in impulses of the quiet star lessened with sky background and I_f is the total intensity in impulses of the star plus flare lessened with the sky background.

– the increase of the stellar brightness of the star at flare maximum Δm_u, where m_u is the ultraviolet magnitude of the star in the instrumental system;

– the standard deviation of random noise fluctuation $\sigma_{mag} = 2.5\log(I_0+\sigma)/I_0$, during the quiet-state phase immediately preceding the beginning of the flare.

The light curves of the observed flares are shown in Fig. 1–3. Some small details from the light curves obtained at Rozhen and Belogradchik with a good coincidence are seen. A detail is pointed out with the small letter 'a'. Data for the flares and the detail are given in Table 2. There are indications for decreasing of the brightness just before the flare no.2.

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