

RAPID SPIKE FLARES ON AD Leo AND EV Lac

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ABSTRACT. Photoelectric U - band observations of the flare stars A Leo and EV Lac during the last 9 years obtained at the Bulgarian National Astronomical Observatory revealed 8 rapid spike flares on AD Leo and 9 rapid spike flares on EV Lac which duration is less than 6 seconds. The corresponding total monitoring time is 173.6 hours for AD Leo and 173.3 hours for EV Lac.

1. Introduction

During the last years special attention has been focused on the problem of rapid spike flares. Their time-scales could provide the clues to discriminate between thermal and non-thermal flare theories. Thermal flare models require rise times of flares longer than 0.2 - 0.6 s, and for the star EV Lac this value is 0.3 - 0.4 s (Shvartsman et al. /1988/, Beskin et al. /1988/ and Shvartsman et al. (1988/ carried out high time resolution studies of stellar flares and found no significant flare activity on time-scales $3 \cdot 10^{-7}$ s - 10^{-1} s. Their results seem to confirm the thermal origin of stellar flares. However, Tovmassian and Zalinian /1988/ reported a number of rapid spike flares on EV Lac and BY Dra with rise time of about 0.2 s and amplitudes in the U filter up to 5 mag. Gershberg and Petrov /1986/ reported a 3.1 mag spike flare on EV Lac with rise time of less than 0.6 s. Millisecond radio spikes on AD Leo were detected by Lang and Willson /1986/. These results clearly show the need for further flare studies with high time resolution.

2. Observations and discussion

During the last 9 years regular monitoring U - filter observations were carried out at the Rozhen National Astronomical Observatory using the 60 cm telescope and the one-channel photon counting photometer. Observations were taken with an integration time of 1 s. This time resolution can provide information for the occurrence of rapid flares with a duration of several seconds in a longer time period.

In Table 1, spike flares of AD Leo are listed, which have a duration of less than 6 s. The total monitoring time was 173.63 hours.

In Table 2, spike flares of EV Lac with duration of less than 6 s are listed. The total monitoring time for EV Lac was 173.34 hours. Figs 1 and 2 show some of the light curves. During the 9 years of operation the photometric equipment proved to be rather stable. Therefore we believe these events are not due to instrumental problems. From Table 1, the frequency of rapid flares on AD Leo is 0.05 flares per hour. The cumulative flare frequency for this star included all flare energies greater than $\log E_U = 30$ is 0.66 /Pettersen et al., 1986/. From Table 2, the frequency of rapid flares on EV Lac is 0.05 flares per hour. The cumulative flare frequency included all energies greater than $\log E_U = 31$ for this star is 0.25 /Lacy et al., 1976/. Typical energies of rapid spike flares on both stars are $\log E_U \approx 29.5$ ergs.

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TABLE 1. Spike flares on AD Leo

Date	UT	Flare rise time /s/	Amplitude $/I_{o+f} - I_o/I_o$	Noise σ/I_o
1982 Mar 25	22 ^h 51 ^m 52 ^s	1	0.47	0.03
1983 Mar 15	21 27 06	2	0.67	0.06
1983 May 14	20 16 28	1	2.93	0.10
1983 May 14	20 39 54	1	4.07	0.10
1984 May 17	20 38 31	2	1.65	0.06
1986 Jan 14	22 28 53	1	0.79	0.05
1986 Mar 6	21 58 50	4	2.45	0.04
1989 Feb 3	21 42 16	1	0.31	0.04

TABLE 2. Spike flares on EV Lac

Date	UT	Flare rise time /s/	Amplitude $/I_{o+f} - I_o/I_o$	Noise σ/I_o
1983 Oct 6	21 ^h 05 ^m 08 ^s	2	1.08	0.11
1985 Aug 17	00 17 48	1	0.39	0.10
1985 Aug 17	00 17 51	1	0.39	0.10
1985 Aug 17	01 23 31	3	1.00	0.10
	01 23 34	1	1.00	0.10
	01 23 36	1	1.00	0.10
	01 23 38	1	1.00	0.10
1986 Dec 3	17 40 51	1	2.61	0.06
1987 Sep 13	00 12 58	2	4.39	0.12

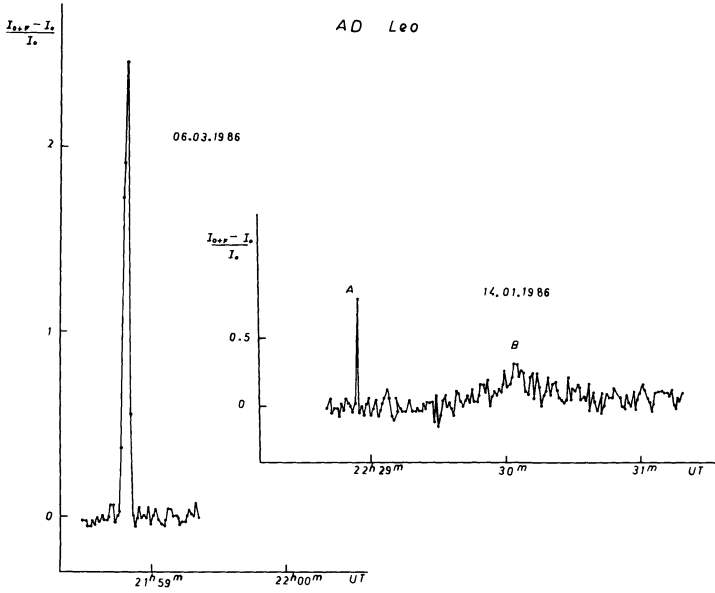


Figure 1

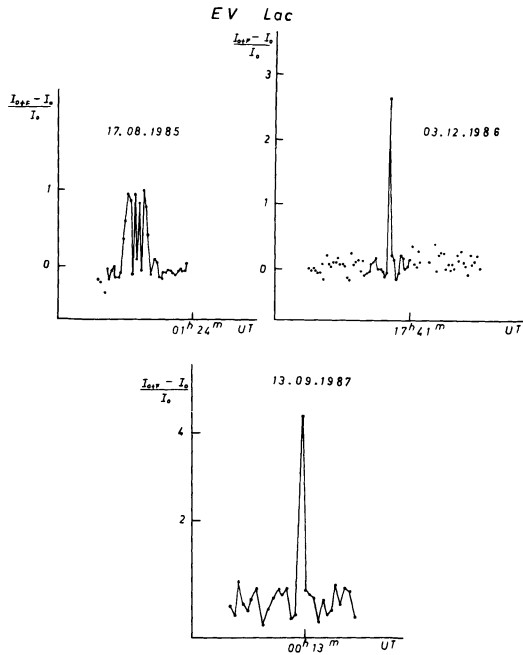


Figure 2