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OBSERVATIONS OF SPIKY FLARES OF BY Dra
AND EV Lac

During the last years an investigation of flare stars with high time resolution has been carried out at Byurakan Observatory. With the use of the automatic electrophotometer in which the output signal is recorded only in the case when it exceeds the mean level by a given amount (say 3σ or 6σ), several short flares of the star EV Lac have been detected (Zalinian, Tovmassian, 1986). A group of spiky flares (Fig.1) similar to one detected by Jarrett and van Rooyen (1979) was recorded.

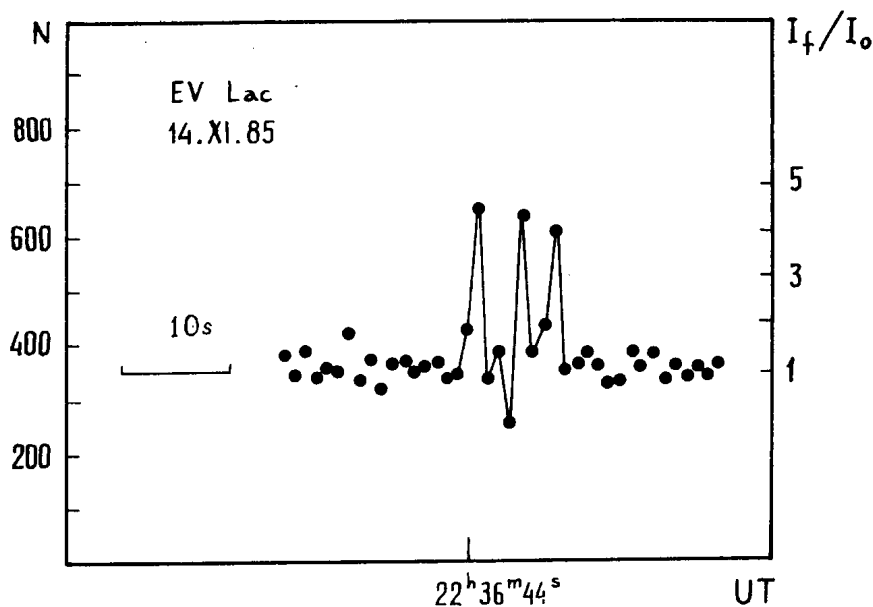


Figure 1

Spikes of EV Lac observed with a one-channel (U) electrophotometer

In our case three spikes with a duration of about 2-3 sec each have taken place in 10 sec. The brightness of the star in each spike increased by about 1.5 magn.

But the records of spiky type short flares of 1-2 sec duration may always cause suspicion - do they represent a real increase of star brightness or they may be a result of some impulsive processes in the used photomultiplier or in the amplifier circuits of the electrophotometer. In order to solve this problem a two-channel fast electrophotometer was constructed (Zalinian, 1987). The first observations were made mainly in U now we have a possibility of simultaneous monitoring of the observed stars in two colours - U and B.

In 9 hours of observations with the 40 cm telescope using this two-channel electrophotometer with 0.1 sec time constant one typical flare of BY Dra of about 4 sec duration was detected (Fig.2).

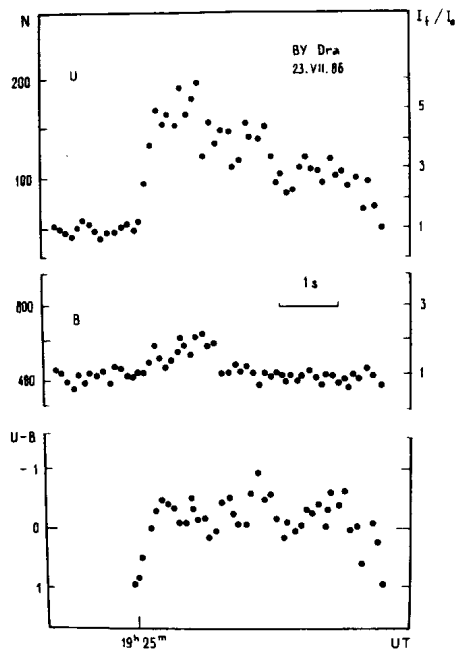


Figure 2: Light curves of BY Dra flare in U and B and the U-B colour curve of the flare

The brightness of the star increased by about 2 magn. in U. In B filter the increase of the brightness was ~ 1 magn. The increase of the brightness in U occurred in 1 sec, faster in the first (0.2 sec) and then a bit slower. The U-B colour of the star was about -0.25 and varied little during the flare event.

At the same period of observations a group of 7 spikes in U exceeding the level of the fluctuations of the BY Dra radiation of minimum by more than 6σ have been recorded (Fig. 3). The duration of each spike is less than 0.2 sec. Spikes occurred in about 1.5-4 minutes one after another. The brightness of the star in each spike increased by about two times. In case of non-simultaneous observations in B, such flares of brightness could hardly be considered as real, though similar groups of flares of a little bit longer durations have been detected earlier by observations only in U (Jarrett and van Rooyen, 1979). In our observations two or maybe three spikes in U were accompanied with simultaneous spikes in B, which by more than 3σ , exceeded the mean level of the signal determined as usually in our electrophotometer by the preceding 100 counts. The simultaneous registration of these flares in two independent channels convinces in their reality.

Three flares of EV Lac have been detected during 13 hours of observations. The duration of the first flare (Fig.4) with an amplitude of 2.8 magn. in U was only 0.4 sec. The increase of the brightness occurred in less than 0.1 sec. The flare is confidently recorded in B, as well. The U-B colour of this flare did not change during the flare, as in the case of the described flare of BY Dra, and it was -0.4 . The second flare (Fig.5), observed in the following night after the first one, belongs to the type of very rare powerful flares with an amplitude of about 5 magn. in U. The duration of the brightness increase in this case was about 0.2 sec and that of the whole flare was about 0.7 sec. The colour of this flare, as usually in the case of powerful flares, was very blue, $U-B \approx -2.5$.

The third flare (Fig.6) had an ordinary amplitude ~ 1.8 magn. in U. Its duration was 0.3 sec. The increase of brightness lasted 0.1-0.2 sec. The amplitude of the flare in B was ~ 1 magn. The U-B colour of the flare was about -1.0 .

Thus, the two-channel electrophotometer with a high time resolution permits us to detect short flares of flare stars with an appreciably high confidence.

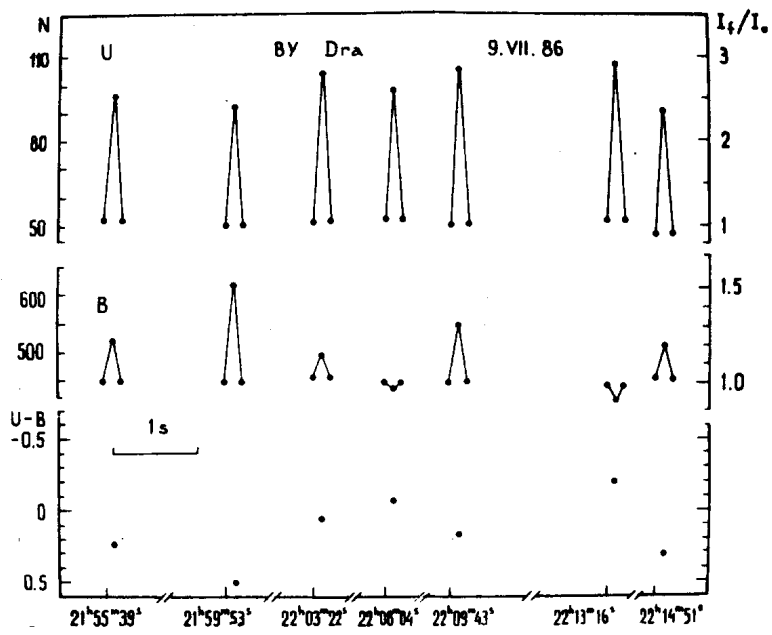


Figure 3: Sequence of spikes of BY Dra and corresponding U-B colours

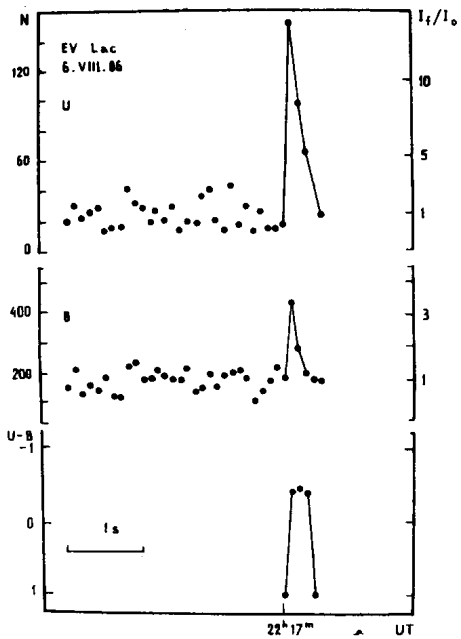


Figure 4: The flare of EV Lac observed on 6 August 1986

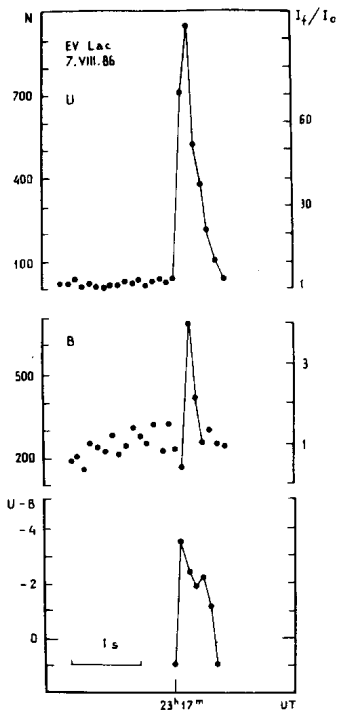


Figure 5

The flare of EV Lac observed on 7 Aug. 1986

The duration of some of the flares detected by us is so short that they would definitely be lost in observations with ordinary time constants of 10 - 20 sec. The detection of short flares evidences that the frequency of flares of flare stars is higher than it has usually been accepted.

The detection and study of spikes and fast rising parts of the light curves of flare stars is undoubtedly very important for understanding of the nature of these stars.

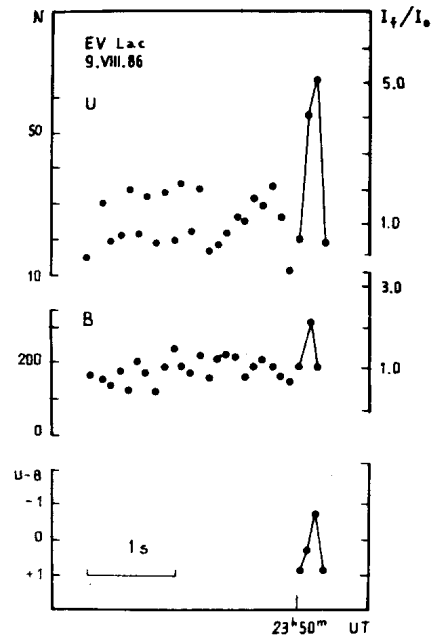


Figure 6

The flare of EV Lac observed on 9 Aug. 1986

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