Photometric Research of Pre-flare and Extra-flare Activity of Flare Stars

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Preliminary results of a photometric search for non-flare activity of the flare star EV Lac during June-August 1994 are presented. These observations are part of the long-term project entitled "Investigation of pre-flare processes on flare stars" being carried out at the Observatory of the Jordan Valley Regional College since July 1994. The project was motivated by reports of the existence of slow, low-amplitude non-periodic variability of both spectral lines and continuum outside/between flares (Rodono et al. 1979, Roizman et al. 1984).

1 Observations

We used a 14-inch Compustar telescope with an SBIG ST-6 CCD-photometer and a set of *RGB* filters. The $8' \times 6'$ field of view of the photometer allows the measurement of EV Lac and four comparison stars on each frame. We exposed the EV Lac region every 2 min and then recorded the image. In order to reach the necessary accuracy we carried out differential photometry. The magnitude differences were calculated without reduction to the standard *BVR* photometric system. As the analysis of the data shows, we achieve the expected Poisson accuracy in spite of difficult observational conditions (our Observatory is located 200 m below sea level (and is unique in this sense!). So, we were able to detect low-amplitude BY Dra variability of EV Lac. The amplitude is 2.3%, for an estimated standard deviation ~2%. During our observations the EV Lac ephemeris was: $JD_{min} = 2449544.627 + 4.375 \cdot E$.

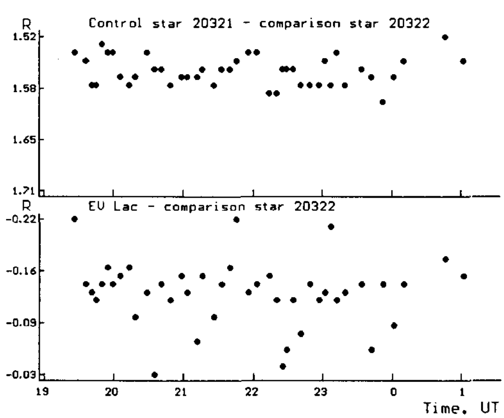

Fig. 1. Brightness differences of EV Lac and its two comparison stars (EV Lac-C1) and (C2 - C1) on 1994 August 13/14 in the red band.

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2 Discussion

It is important to stress that all stars were measured simultaneously and that EV Lac is brighter than the check star C2, at least in the green and red bands. This means that the difference cannot be due to fast variations of the atmospheric extinction or to different numbers of photons. Thus it appears that there are real fluctuations of EV Lac's brightness on a time scale of about several minutes or less. This would not be so surprising if we were only dealing with the blue band where the quiescent flux (both hydrogen lines and continuum) may be disturbed by numerous small flares (microflaring). The observed scatter is maximum in the red (according to the F-test the significance level is < 0.01). Taking into account that the real flux from EV Lac increases from the blue to the red and so the Poisson error, as well as the flare contribution, decreases, we may conclude that the cause of the additional scatter increases toward long wavelength.

This unusual "inverse" dependence of the observed scatter on wavelength offers us a possible explanation. Sometimes before flares short dips below the quiescent level are observed – negative preflares (NPF) (Cristaldi et al. 1982). According to the model of Grinin (1983), an NPF is due to weak impulsive heating leading to ionization of metals, and thus an increase of the H^- opacity, aresulting in a temporary decrease of the flux. Grinin's calculations show that this effect occurs at wavelengths excluding the strong molecular bands of TiO, and that the amplitude of an NPF increases towards long wavelength, as in our data.

Thus, in the first approximation the assumption that the negative preflares are the main reason for the observed fluctuations of the brightness of EV Lac does not contradict our observational data. In fact we assume that the "usual microflaring" observing in the U and B bands causes the "negative microflaring" that may be observed in the green and near infrared bands.

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