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ON THE TIME DISTRIBUTION OF FLARES ON UV CETI

The statistical analysis of time distribution of stellar flares on UV Ceti type flare stars was carried out by Oskanyan and Terebizh(1971) and by Lacy et al. (1976). Their investigations led to the result that the time sequence of flares had a nearly Poisson distribution which means that the distribution itself had a random character. Nevertheless, Oskanyan and Terebizh (1971) also pointed out the existence of a weak tendency that flares on UV Ceti occur in groups.

Recently Pazzani and Rodono (1981) found, that the time sequence of flares did not follow the Poisson distribution, and that the flare peaks and flare events showed a tendency to appear in groups.

In the present paper we used the results of synchronous photoelectric UVB flare observations on UV Ceti, carried out at the Maydanak station of the Tashkent Astronomical Institute, in the period of 1978-1982, simultaneously by three telescopes (Kilyackov et al., 1979, Melikian et al., 1981, Melikian et al., 1983). In this paper we present the results of our investigations of the time distribution of the UV Ceti flares using the observations, mentioned above.

The total observational time (94 hours and 15 minutes) was divided into 1131 and 283 parts. In the first case we got 5 minutes for one interval and 20 minutes in the second one. We calculated the number of intervals (n_k) with k ($k=0, 1, 2, \dots$) flare-ups. At the same time, we calculated the mathematical expectation values of the numbers of intervals (N_k) containing k ($k=1, 2, \dots$) flare-ups assuming a Poisson distribution for the occurrence of the flares. In calculating these quantities an average flare frequency, which was determined from our observational data as $\nu = 1.1$ flares/hour, was used. The n_k and N_k values are shown in Table I.

Table I

k	n_k	$t=5^{\text{min}}$	N_k	n_k	$t=20^{\text{min}}$	N_k
0	1053		1031	224		195
1	57		95	33		72
2	18		4	16		13
3	2		0.1	8		2
4	0		0	2		0.1
5	0		0	0		0
6	0		0	1		0

The comparison of the n_k and N_k values shows that there exists a systematic discrepancy between the two series of data. The values of n_k ($k \neq 1$) are always larger than the values of N_k for the corresponding k ($k \neq 1$), while for $k=1$ the values of n_k 's are smaller than their mathematical expected values for random distribution.

We determined the degree of agreement of the observed distribution of n_k 's with that of N_k 's with the help of the Pearson χ^2 criterion. We found, that the probability of agreement between the two distributions is lower than 0.01. The tendency of stellar flares to occur in groups is illustrated in Fig.1, where the results of our flare observations on UV Ceti made in 1979, are shown. The observational errors are as follows:

$$\sigma/U=0.15 - 0.30, \sigma/B=0.3 - 0.07, \sigma/V=0.04 - 0.09$$

Our results show, that there is a marked tendency for grouping within 5 minutes as well as within 20 minute intervals. This means, that there exists a tendency for flares to develop very soon subsequently the previous flare. In our opinion this tendency can be interpreted in such a way that there exists a physical relation between the successive flares. We suggest as a probable model for the interpretation for the flare grouping the multiplicity of convective-explosion-generated phenomena (Grandpierre, 1984a, 1984b). In this model one convective explosion can lead to the generation of more than one flare occurring within some minutes. Accordingly, the members of a flare group are generated simultaneously. This process can be described as a twin-birth of flares. In this process not only one flare can be described as a twin-like in the case of sympathetic flares, but the convective explosion, which generates shock waves and high energy particle beams, can lead to a more or less simultaneous appearance of more than one flare.

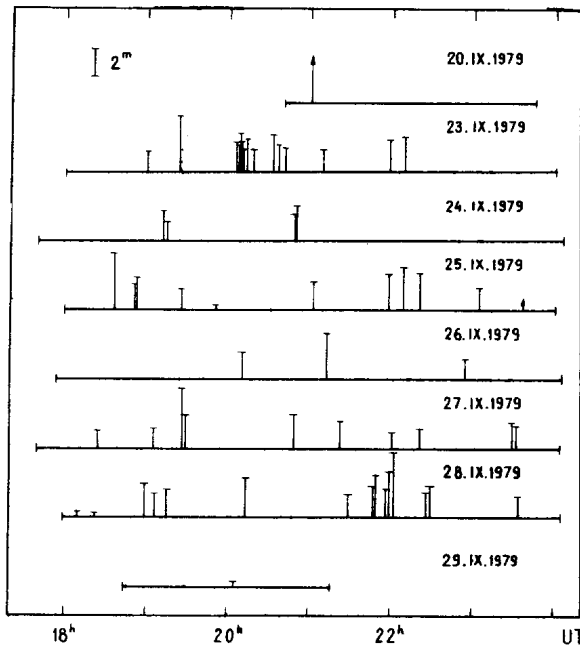


Fig.1. Time distribution of flares on UV Ceti. On the vertical axis the amplitudes of the flares are shown. Arrows at the photographic observations show that the real amplitudes are larger than the observed ones.

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