COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 2661

Konkoly Observatory
Budapest
6 February 1985
HU ISSN 0374 - 0676

CORRELATION BETWEEN THE MEAN AMPLITUDE OF THE FLARES AND THE LUMINOSITY OF THE FLARE STARS

It was pointed out (Mirzoyan et al., 1977) that there exists a correlation between the mean observed amplitudes and the minimum magnitudes of the flare stars in Pleiades (see Table I) . This correlation could be explained in terms of observational selection.

In the case of photographic observations all flares brighter than the plate limit can be registered if the amplitude $\Delta m \geq 0^m.5$ .However, the mean amplitudes of the observed flares are highly increasing towards the fainter stars below the plate limit. It is obvious that this increase can be the result of a selection effect. In their study, Mirzoyan et al. (1977) evaluated the probable mean amplitude of the flares on those stars which are below the plate limit in the minimum light. They concluded that the mean amplitude of the flares was strongly decreasing when ever fainter stars were considered (see Table I, values corrected for selection).

In this note the results of a more detailed study concerning the correlation between the mean amplitude and the luminosity of the flare stars are given, using the flares observed in U light in Pleiades, Orion and the solar neighbourhood.

Figure 1 shows how the mean amplitude of the flares (averaged in $1^m.0$ wide intervals) depends on the luminosity. Crosses and dots are used for denoting the flares in Orion and Pleiades, respectively. The solid lines 1 and 2 in Figure 1 can be considered as lines of constant energy. It is obvious that a given amount of the flare energy will result in a smaller amplitude flare on a more luminous star than on less luminous stars. It is worth mentioning that the flare stars in Orion are considered as being at the distance of Pleiades in the Figures 1 and 2.

As can be seen in Figure 1, at the plate limit the amplitudes of the flares are subjected to a strong increase. Similarly to the estimation by Mirzoyan et al. (1977) we estimated the number of the faint flares lost at the faint stars. The results allowed us to use a correction for the mean value of the amplitude of faint flare stars. Finally the curves 5 and 6 were obtained

	Mpg(min)	13^m-14^m	14^m-15^m	15^m-16^m	16^m-17^m	17^m-18^m	18^m-19^m	19^m-20^m	20^m-21^m	$\geq 21^m$
Δpg	observed	$1^m.2$	$1^m.2$	$1^m.2$	$1^m.4$	$2^m.0$	$3^m.2$	$4^m.0$	$5^m.0$	$6^m.0$
	corrected	1.2	1.2	1.2	1.4	1.6	1.6	1.6	1.7	1.7

Table I
Mean amplitudes of the flares

instead of observed curves 3 and 4 (see Figure 2). As can be seen in Figure 2 (curves 5 and 6) the mean values of the amplitudes became almost constant for all the stars. Neither the very small flares on the bright flare stars nor such flares on faint flare stars were taken into account, although the number of the latter flares has to be much greater.

These results show that the mean amplitude is almost constant, and even if it is increasing towards the faint flare stars, it cannot be represented by the curves 1 and 2 (see Figure 1). Moreover, if the small amplitude flares on the faint stars lost due to the observational selection are not taken into account, at those parts of the curves 3 and 4 where the observational selection is not considerable, the mean amplitude is either constant or (in the interval $11^m.5-17^m.5$) varying very slightly.

In order to make a comparison, the relation between the mean amplitude ($\Delta\bar{U}$)and the absolute magnitude of the flare star in the minimum (M_V) can be examined for the UV Ceti stars using Moffett's (1974) observational data. This relation is seen in Figure 3. For each of the 8 flare stars the amplitudes were averaged. The size of the circles in Figure 3 depends on the number of the flares. The mean amplitude is almost independent of the luminosity of the flare star.

Just to be confirmed in the reality of the above conclusion, again Moffett's (1974) observational results are used. For the sake of simplicity only the brightest (YY Gem) and the faintest (CN Leo) flare stars are considered here. Moffett (1974) calculated the energy in the U band for 6 flares on YY Gem ($M_V = 8^m.36$) and for 101 flares on CN Leo ($M_V = 16^m.55$). The mean energy of one flare on these stars is as follows:

$$\bar{E}_{U\ (YY\ Gem)} = 10^{33.02} \quad \text{erg},$$

$$\bar{E}_{U\ (CN\ Leo)} = 10^{28.36} \quad \text{erg}.$$

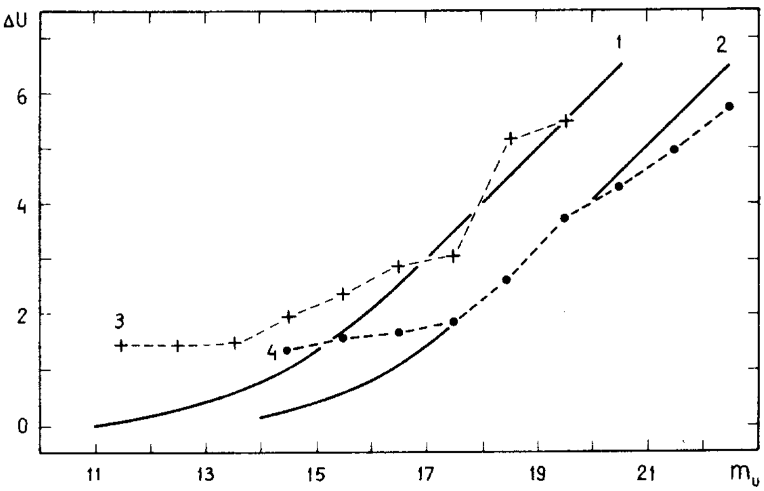

Figure 1

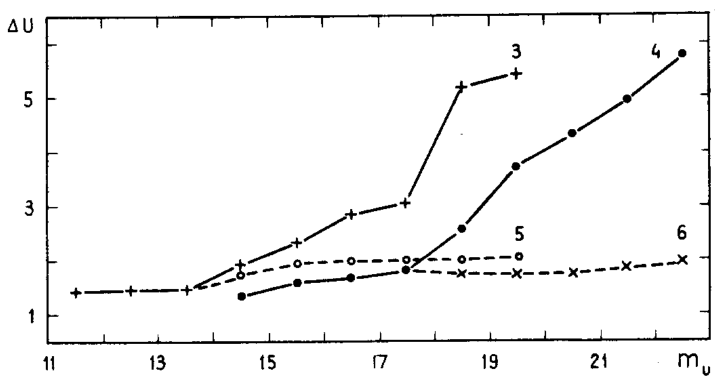

Figure 2

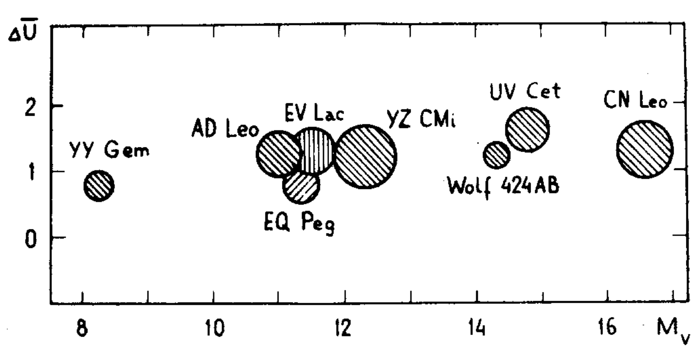

Figure 3

The ratio of these values is

$$\frac{\bar{E}_U \text{ (YY Gem)}}{\bar{E}_U \text{ (CN Leo)}} = 10^{4.66}$$

This means that the mean energy of one flare on YY Gem is more than 45 000 times larger than that of CN Leo. This number is larger by approximately one order of a magnitude than their luminosity ratio in the U band.

The independence of the mean flare amplitudes means that for equal amplitudes the ratio of the energy liberated in flares of stars with different luminosities is equal (in average) with the ratio of the luminosities of these stars. Therefore, if we consider the energy of the flare, the brighter stars are more active.

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References:

Mirzoyan,L.V., Chavushian,H.S., Erastova,L.K., Ohanian,G.B., Melikian,N.D., Natsvlishvili,R.Sh., Tsvetkov,M.K., 1977, Astrofizika, 13, 205.
Moffett,T.J., 1974, Ap.J. Suppl., 29, 1.