

FLARE ACTIVITY OF STARS IN THE TAURUS REGION

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ABSTRACT. Using the actual observational data on photometric and spectral stellar activity in the region of central area of the Taurus Dark Clouds complex, the question of flare activity of the stars and its connection with another kinds of activities is considered. The comparison of stellar flares in this region with that of in other associations and clusters (especially, Orion and Pleiades) is made and the youth of the group in Taurus is shown. The detection of flaring variables (including stars with T Tauri-type features) in Taurus region is the evidence in favour of evolutionary connection of these stages.

1. INTRODUCTION

It is well known, that flare stars are in the early stages of stellar evolution. The establishment of this regularity by Ambartsumian [1] and Haro [2] has stimulated the investigations in this field. Until now the regions of more than ten stellar systems were studied for search of flare stars (see, for example, [3]). One of them is T-association Taurus T3, connected with central area of the Taurus Dark Clouds (TDC).

2. DATA AND RESULTS

The first flare stars in the TDC were detected by Haro and Chavira [4]. A bit later some other flare stars in this region were found by Petit [5], Tsesevich [6] and Huang et al [7]. Systematic and extensive investigations of flare stars in the TDC were carried out at Byurakan astrophysical observatory [8-10]. Total exposition time of the TDS patrolling by chain method is equal to about thousand hours.

Until 1987 in the TDC region 102 flare stars are found, on which 122 flares were fixed. 9 stars had 2, 4 stars 3 and 1 star 4 flares.

An important result is the detection of flares on 13 irregular Orion population variables [11], including at least 7 T Tauri stars. It turned out, that 21 flare stars had H α -emission in spectrum. For 3 of them emission was detected by us [12].

3. GENERAL DISCUSSION

Two-dimensional distribution of flare stars in the TDS has shown, that it is not connected with the changes of average surface density of stars (i.e. with respective transparency of area). The preferable location of these flare stars is similar to the location of TDC's irregular variables.

An important result of our observations was the detection of flares on approximately 20% of irregular variables (Hojaev [11]). It turned out, that at least more than a half of these flare irregular variables are of T Tauri type.

They include the both components of visual binary system FY/FZ Tau. FY Tau was more active, which showed 3 strong flares from 1980 till 1984. 2 flares with an interval of approximately a month was shown by another star of T Tauri type - VY Tau and one of them is evidently double (see Fig.1a).

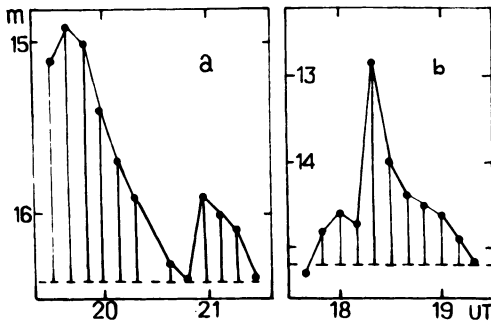


Figure 1. The light curves of /a/ VY Tau flash (15.11.83, U filter); /b/ CI Tau flare (03.02.83, without filter). The dotted line corresponds to the minimum, before and after flare.

Slow and of complex structure flare was demonstrated by T Tauri type star - CI Tau (Fig.1b), which obviously had preflare.

Among the flare stars of the TDC region the H α -emission

was observed in a quarter of them. Relative number of them is close to that of Orion, where approximately on 30% of flare stars the H α -emission was observed.

The comparison of the distributions of flare stars by their luminosities in the TDC, Orion and Pleiades shows their similarity by form, as well as the shift of distribution's maximum towards lower luminosities with the increasing of the system's age (see [13]).

On Hertzsprung-Russel diagram of flare stars in the TDC region as well as flare stars in the Orion are situated in a broad width around ZAMS line, which is in accordance with youth of the TDC system.

The brightest flare stars according to our photometry had $V=12^m.5$, which agree with the earliest S_p of them near G9-K0.

On flare stars in the TDC region some "slow" flares by classification of Haro were fixed. The ratio of "slow" flares to "fast" ones in the TDC (= 4%) is close to analogous ratio for the Orion association (= 5%). In particular such percentage is observed among the flares of irregular variables. In this case 3 of 13 flares were "slow". Thus, due to major properties (the presence of irregular variables including doubtless T Tauri stars with the flares, H α -emission flare stars, "slow" flares, the earliest S_p of the brightest flare star, as well as complex character of light curves of numerous flares and presence of extremely active flare stars) the TDC system is alike the young Orion association. But, the average rate of the flares in the TDC region (near 0.00025 flare per hour) is a bit lower than in Orion and NGC 2264 (0.0005 fl.per h.) and Pleiades (0.00035 fl.per h.). Though it contains also flare stars with respectively high rate of flares (approx. 0.0033 fl.per h.).

Based on all above mentioned data we can conclude about the youth of the subsystem of flare stars in the TDC region. The further study of the flare activity in the TDC region seems to be very perspective.

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GAHM: Are any of your flare stars in the Taurus-Auriga region identical to any of the post-T Tauris located by Walter et al. (1986) ?

HOJAEV: Some of these flare stars certainly are identical to obvious T Tauri type stars of the Taurus-Auriga complex, while it was no identification with known post T Tauri stars. Moreover, post T Tauri stars on the average are brighter than many flare stars so we believe it would be desirable to carry out observations with the specific purpose of detecting optical flares on these stars.

PARSAMIAN: VY Tau is a very interesting T Tauri star. The discovery of classical flares on this star is very important. Can you tell me what the flare amplitudes were for VY Tau?

HOJAEV: This star has shown two flares separated by about one month in our ultraviolet observations with the 40 inch Byurakan Schmidt. The first flare had an amplitude of 1.5 magnitude, the second had 1.1.

PARSAMIAN: What were the pre-flare and post-flare brightness levels for VY Tau?

HOJAEV: VY Tau is approximately 16.4 magnitude in U.