SPECTRAL OBSERVATIONS OF FLARE STARS

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ABSTRACT. Spectral observations of 6 flare stars in the Pleiades cluster are carried out which occupy different positions on the Hertzsprung-Russell diagram relative to the main sequence: above and below it. The spectral indices which are sensible to luminosity or temperature of the star photosphere are determined. Significant differences between indices of the stars belongings to these two groups are not detected.

1. INTRODUCTION

It is well known that red dwarf stars of young population on the HR diagram are located around the main sequence. For example, according to Haro and Chavira [1] flare stars in star clusters and associations are distributed on the HR diagram on both sides of the main sequence.

Meanwhile current theories of stellar evolution predict the location of young stars only above the main sequence.

For the study of possible differences between spectra of stars belonging to these two groups spectral observations of young red dwarf stars are begun. Here we present some preliminary results.

2. OBSERVATIONS

The spectral observations of 6 flare stars in the Pleiades are obtained with 6-m telescope of the Special Astrophysical Observatory of the USSR Academy of Sciences in North Caucasus.

Of observed flare stars 3 are located above and others-below the main sequence on the HR diagram.

The obtained spectra cover the range 3600-6800A. In all spectra strong emission lines are observed. The

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registrograms of spectra for two flare stars are presented on Fig. 1. To compare the obtained spectra the spectral indices introduced by Stauffer [4] and Stauffer and Hartmann [5] are used.

3. RESULTS

The results of our spectral observations are presented in Table 1 where the following data are given: flare star number [6], location of star relative to the main sequence [2,3], spectral indices of molecular bands and spectral class. The latters are determined by intrinsic colours R-I

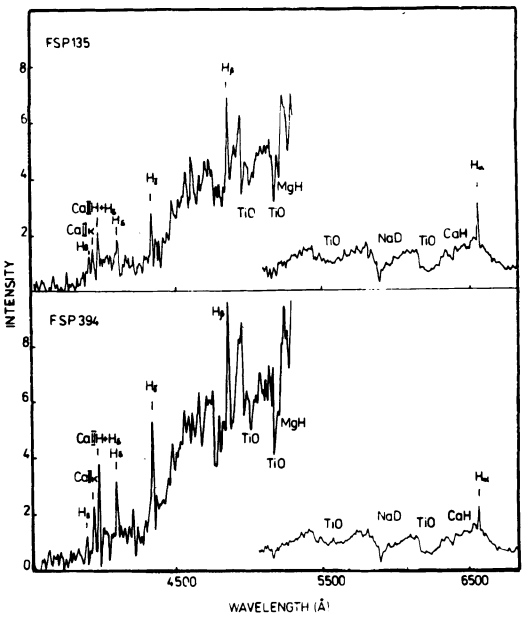

Figure 1. Registrograms of spectra obtained for flare stars located below (FSP 135) and above (FSP 394) the main sequence

using the tabulation (R-I,Sp) suggested by Joy and Abt [7]. The magnitudes R-I are derived from the TiO band strengths.

4. DISCUSSION

The simple comparison of the mean spectral indices (Table 1) determined for flare stars situated above and below the main sequence on the HR diagram shows that there are no significant differences between them.

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For more detailed comparison of the obtained data the correlations between indices sensible to temperature and gravity are used. It was expected that flare stars having different location relative to the main sequence should show different correlations.

Indeed they show that for the same value of the TiO spectral indices wich are sensible to star photospheric temperature considerable differences observed in spectral indices CaH and NaI'D'-sensible to star gravity. However , one can not be sure that these differences are conditioned by different correlations for the considered two groups of stars.

TABLE 1 Physical parameters of flare stars

Flare star	Location on HR diagram	Spectral indices							Sp
		TiO							
		D_{54}	D_{59}	D_{61}	D_{65}	CaH	Na'D'	MgH+ Mg'b'	
263	Above	0.237	0.290	0.088	0.210	4.8	11.0	-9.9*	M3
313	"	0.247	0.591	0.166	0.257	2.6	5.5	132.9	M5.5
394	"	0.231	0.611	0.159	0.257	1.7	5.5	139.9	M5.5
	Mean	0.238	0.497	0.138	0.241	3.0	7.3	87.5	
79	Below	0.223	0.663	0.154	0.258	5.6	16.8	132.8	M6
124	"	0.289	0.652	0.206	0.381	3.2	3.9	48.2	M6
135	"	0.223	0.615	0.187	0.279	3.0	6.1	90.7	M6
	Mean	0.245	0.643	0.182	0.306	3.9	8.9	90.6	

* - High-noise

Probably this uncertain result is due to the small number of flare stars of each group and possible errors in position determinations of studied flare stars on the HR-diagram.

We intend to discuss the considered problem after obtaining the spectra of a large number of stars located on both sides of the main sequence.

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LANG: How certain can you be that only a few stars are below the main sequence? You assume they belong to the same cluster and lie at the same distance. If your two stars were foreground objects they would be brighter than supposed and actually be on or above the main sequence.

MIRZOYAN: The existence of young stars located below the main sequence in the HR-diagram can probably not be doubted. For individual stars it is difficult to be sure, which is why a study of this problem should be made statistically for a large number of young stars. One possible data set would be flare stars that belong to a given system of stars.

SHAKHOVSKAYA: In the solar vicinity there are flare stars known to be members of binaries with the other component being a white dwarf. Other flare stars are members of old groups of stars. What do you think about this?

MIRZOYAN: The duplicity and multiplicity of flare stars cannot explain the appearance of stars below the main sequence in the HR-diagram.

GIAMPAPA: Can you discuss the flaring properties, and the flare characteristics, for M dwarf stars that are not dMe stars? In other words, what are flares like on M dwarfs without H-alpha emission? Is there a difference in the physics of the flare event between dMe and dM stars?

MIRZOYAN: The spectral classes of flare stars in star clusters and associations are unknown for the majority of the stars. in a few cases, when observed with high enough resolution, the spectra are like those of the UV Ceti stars in the solar vicinity. For example, all spectra obtained by us show strong emission lines. The other physical properties are similar to those of the UV Ceti stars. Taking into account these circumstances one can assume that the differences between dMe and dM stars as far as flare events in star clusters and associations are concerned, must be like those for the red dwarf stars in the solar vicinity. All differences between them are conditioned by the differences in their ages.