

CORRELATION BETWEEN FLARE STARS AND OTHER POPULATIONS IN  
YOUNG CLUSTERS AND STAR FORMING REGIONS

V. S. SHEVCHENKO, S. D. YAKUBOV.  
Astronomical Institut  
Uzbek Academy of Sciences  
USSR

ABSTRACT. Ratio between number OB-stars and that of comparatively bright flare stars in star forming regions are discussed.

This short note we present in addition to prof. L.V. Mirzoyan review (this issue). We want to draw attention to a very simple ratio between number of OB-stars and that of comparatively bright flare stars (f.s.) in clusters and Star Forming Regions (SFR).

The two following well-known arguments should be reminded.

- 1) Observed and calculated numbers of f.s. and various relations strongly depend on observational selection.
- 2) The only reliable fact is that the luminosity of bright f.s. in Orion cluster is much higher than that in Pleiades and older clusters.

The table displays an attempt to find such ratios between f.s. and other population in SFR, which should depend from the selection in the least way.

The table consists of two parts. The first one contains some SFR properties. Characteristics of SFR are derived from our results (Shevchenko, 1979, 1989). The distance module and  $A_v$  are obtained from our photoelectric five colour photometry made on mt. Maidanak. When estimating the masses and sizes of SFR we took into account the observations in CO-line and other data. For comparative analysis we used only f.s. grouping reliable connected with SFR. Here we do not discuss the more older Hyades and Coma clusters.

Ten years ago we suggested Pleiades and TDC be considered as the united complex (Stalbovski, Shevchenko, 1980). The table also contains the data for Pleiades cluster separately. The Orion f.s. grouping is studied in detail, while the data for NGC 7000/IC 5070 and RSF 2 Cyg due to the large distance and high  $A_v$  are not available. The data for other regions are too poor.

$N_{OB}$  is the number of OB-stars (spectral type to B9).

$N_{AG}$  is the number of stars with  $M_v$  from +1 to +5 (spectral type A, F, and early G).

$N_{Ae/Be}$  is the number of Ae/Be Herbig stars.

TABLE. FLARE STARS IN CLUSTERS AND STAR FORMING REGIONS (RSF)

RSF NAME	Pleiad. Cluster	1 Tau Pleiad.	1 Ori (M42)	3 Mon NGC	1 Oph NGC	2 Cyg NGC	4 Cyg NGC	1 Cep NGC
DATA		+ TDC		2264		6910	7000	7023
STAR FORMING REGIONS PROPERTIES								
Distance d(pc)	135	130	430	730	160	1100	675	300
	2	4	5	4	4	5	5	3
Mass (M)	4.10	3.10	2.10	5.10 ?	10	6.10	2.10	10
Size (pc)	10	10X30	20X60	10X20	10	50	40	2
Av(mag)	0.1	1.5	0.5	0.3	1.5	2.0	2.0	2.0
N OB(Mv<+1)	15	18	88	23	16	40?	>25	1
N AG (+1<Mv<+5)	154	171	210	>150	>80			6
N Ae/Be	-	2	4	2	1	7?	20?	1
N ea		120	540	200	100:	>40	210	2?

ASSOCIATIONS AND CLUSTERS FLARE STARS PROPERTIES  
THE OBSERVATIONAL DATA

Mv f.s. for	+11.3	+10.0	+8.1	+7.4	+9.0	+5.0	+5.9	+7.6
lim 17.5V	M4V	M2V	K7V	K5V	M1V	G4V	K0V	K6V
Monitor. time	3175	4112	1406	105	43	324	938	?
Sp of brightest f.s.	K2		K0	K0	K			
Mv of br. f.s.	+6.4	+6.4	<4.5	+5.1	+6.8?			+6.6?
N f.s.(total)	546	648	491	42	4	16	67	10
N f.s.Mv<+7.5	32	35	180	40	1?		55	2

CALCULATIONS AND RATIOS

Total N f.s.	994	1526	1471	442		129	403	
N f.s. 7.5/ /N OB	2.1	1.9	2.1	1.7			<2.3	2
N f.s. 7.5/ /N ea	0.3	0.3	0.2			0.2		

N ea is number of emission stars including T-Tau stars.

An information on f.s. is collected in the second part of the Table. First of all we emphasize that it was to be expected the observational selection strongly influence all the f.s. data. Mv for limit 17.5V is the calculated meaning Mv for limited value V=17.5. Sp lim is the corresponding spectral type for Gamma Cyg=NGC 6910 region is G4V. F.s. of such early spectral type are unknown. All discovered f.s. of this region probably belong to the solar vicinity.

Sp of brightest f.s., Mv of brightest f.s., N f.s.- are the observational data.

N f.s. ( $M_v < +7.5$ ) is the total number of observed f.s. more bright than 7.5 Mv.

This number is more or less free from the observational selection for all regions excepting two SFR in Cygnus. Total N f.s. is the calculated total number of f.s. by Ambartsumian method.

The mean value of  $(N \text{ f.s. } 7.5 / N \text{ OB})$  is approximately 2. This ratio is the most important as it is connected with luminosity function of young aggregates and shows the fundamental properties of all low mass stars in early stage of stellar evolution.

Besides, we note the following.

- 1) By increasing of observational limiting magnitude to 23U the discovery of large number new f.s. in region Gamma Cyg and NGC 7000 may be expected.
- 2) It is interesting to continue the f.s. observations in Rho Dph Dark Cloud region.
- 3) The f.s. are forming not only in large aggregates but in small SFR like NGC 7023 region. There are a lot of samples of similar compact SFR. After molecular cloud disintegration in small aggregates f.s. becomes a typical solar vicinity f.s.

#### REFERENCES

- Shevchenko V.S. (1979), *Astronomicheski Jurnal* 57, p.1162.  
 Shevchenko V.S. (1989), *Ae/Be Herbig Stars*, FAN, Tashkent.  
 Stalbovski D.I., and Shevchenko V.S. (1980), *Flare stars, fuors, and Herbig-Haro objects*, ed. L.V.Mirzoyan, Academy Sci. Arm. SSR, Yerevan, p.116.