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## THE FIRST BYURAKAN SPECTRAL SKY SURVEY. INVESTIGATIONS OF STARS OF LATE M AND C SPECTRAL CLASSES

K.S.GIGOYAN, V.V.HAMBARIAN, H.V.ABRAHAMIAN

Byurakan Astrophysical Observatory

The results of investigations of new faint M and C type stars discovered on the plates of the First Byurakan Spectral Sky Survey are reported. Among 161 newly discovered stars, 98 are identified with unknown IRAS point sources. It is probable, that the majority of new M stars are Mirids according to their distributions on the IRAS color - color diagram. For J - stars, a correlation between  $EW(C_2+CN)$  and  $EW(C_2(0,1))$  is found.

1. *Introduction.* In the course of 15 years (1965 - 80) in Byurakan Astrophysical Observatory by Markarian and his colleagues the First Byurakan Spectral Sky Survey (FBS) was carried out [1].

The main aim of the FBS was the search of galaxies with strong UV - excess at high galactic latitudes ( $|b| > 30^\circ$ ,  $\delta > -15^\circ$ ). The observations have been done using 1 m Schmidt telescope of the Byurakan Observatory with the combination of 1 $^\circ$ .5 objective prism (low - dispersion spectra in the range 3400-6900A, inverse dispersion 1800A/mm at  $H_\alpha$ ) [1,2]. Since 1987 the second part of the FBS is carried out in order to search and select star - like objects with strong UV - excess [3].

The search, selection of faint late M and C type stars are carried out on the plates of the FBS, including investigation of these objects at high galactic latitudes. The necessity of doing this work is connected with the fact, that systematic investigations of faint C and M stars at high galactic latitudes have not been done. Very faint C and M stars are of special interest, because they are relatively distant objects and probably a part of them are objects of Galactic halo population. Investigations of such faint "peculiar" stars at high latitudes, undoubtedly, is very important for the investigation of the structure, kinematics and the chemical composition of the Galactic halo.

The list of 583 faint M type stars at high galactic latitudes was published by Stephenson [4]. The data of 132 faint M and C type stars, discovered on the plates of the Case - survey, are presented by Sanduleak and Pesch [5].

Recently Green et al.[6] have started a wide - area CCD survey of very faint high - latitude carbon stars with the KPNO 0.9 m telescope.

In [7,8] is presented a survey of faint C stars at high galactic latitudes, however the results of spectroscopic investigations and IR - photometric data are presented for a small number of C stars, towards the north and south Galactic poles.

In this work we present some results of investigation of faint M and C stars, discovered on the plates of the FBS [9].

2. *Selection of C and M stars.* As it was mentioned above, low - resolution spectral observations in the range 3400 - 6900Å of FBS - survey permit distinguish star - like objects with strong UV - excess and red stars late spectral classes. Carbon stars can be recognized by the presence of absorption bands at 4737, 5165 and 5636Å of  $C_2$  molecule. Early - type carbon stars (R - stars) show also 4382Å band of  $C_2$ . The spectra of M stars show bands at 4584, 4762, 4950 and 5165Å of TiO. M stars of late - subclasses show mainly bands at 5445, 5850 and 6162Å of TiO.

The limiting magnitude of FBS - survey for stars of late spectral classes is estimated to be 15 - 15<sup>m</sup>.5 in V - band, accepting, that the limiting photographic magnitude of the survey is 17 - 17<sup>m</sup>.5 [2]. The bright limit for selection of M and C type stars depends, indeed, on the limit of each plate, which changes insignificantly from plate to plate. On the plates of the FBS this limit for C stars on average (for the bright nonvariable stars of R - classes, for which all the absorption bands of  $C_2$  become invisible due to photographic effects ) is estimated as  $m_v=10^m$ , on the basis of examination on the plates of several known bright R stars, having V - magnitudes in the Stephenson's carbon star catalogue [10].

This bright limit for M stars is estimated to be 11 - 11<sup>m</sup>.5. On the low - resolution spectra absorption bands of TiO of M stars brighter than 11<sup>m</sup> become invisible.

3. *Spectroscopic investigation of M and C stars.* For selected faint and M stars spectroscopic observations have been carried out with the spectrograph UAGS with YMK - 91B image - tube, placed in the Cassegrain focus of the 2.6 m telescope of the Byurakan Observatory. The slit spectra are obtained mainly in the wavelength range 4700 - 6800Å [11,12].

At the 2.6 m telescope we obtained about 300 slit spectra for 50 M and 45 C stars.

*M stars.* Spectral subclasses (pseudo - MK classes) for the first 15 faint M stars

are determined by means of spectral indices, taken from Pritchett and van den Berg work [13]. The results of two - dimensional classification are given in [11]. Two new faint stars (FBS 0748 + 410 and FBS 2221 + 375) are classified as M dwarfs and their absolute visual magnitudes are estimated [11].

*C stars.* 22 faint carbon stars (6 of them are ascribed to the group of carbon Mirids [14]) are studied spectroscopically. The one - dimensional classification (R and N) is carried out [15]. Spectroscopic characteristics such as color temperature, equivalent widths of most known absorption bands are determined.

An attentive examination of the spectra of faint carbon stars and the spectra of some of bright carbon stars show, that in the spectra of most of them a depression in the range of 5700 - 6200A is observed, but in the spectra of some of them this depression is stretched up to 6700A. For 44 C stars (22 faint and 22 bright) we have determined equivalent widths of the total absorption in the range 5720 - 6765A assuming, that these points are the points of quasi - continuum, and in this wavelength range are situated the absorption bands of  $C_2$  and CN mainly. When we compared the equivalent width of  $C_2$  (0, 1) Swan band and the equivalent width of a total absorption in the range 5720 - 6765A the following picture is observed. As shown in Fig. 1, there are concentration in the region  $100A < EW(C_2+CN) < 225A$ , and  $100A < EW(C_2(0, 1)) < 200A$ , but J - stars - stars with strong isotopic bands in the spectrum (the

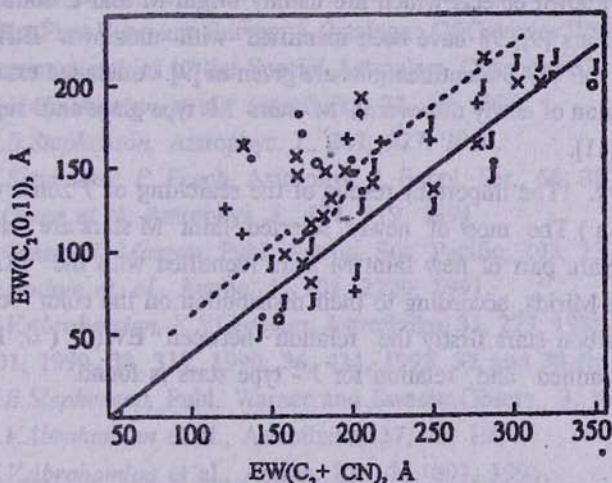


Fig. 1. The relation between the equivalent width of Swan (0,1) band and equivalent width of a total absorption in a range 5720 - 6765A. The straight line is drawn only for J - type stars by the least square method. Dotted line separates the J - stars from others. Symbols: N stars are plotted as dots, R - N stars as plus sign, R stars as open circles, crosses - bright N stars, closed circles - bright R stars [12,15].

isotope of carbon and cyanogen molecules) are situated along a straight line, drawn by the least square method (the dotted curve separates the J - stars from others).

The relation between equivalent widths of two bands for J - type stars has the following form:

$$EW(C_2(0, 1)) = 0.7 EW(C_2 + CN) - 30.72 \quad (n = 17, r = 0.95)$$

This relation was given firstly in our previous work [12]. Additional observations of large number of J - stars will allow to examine this correlation in more details. The next important question is whether the isotopic bands are observed in the spectra of stars having strong depression in the 5700 - 6700Å range, i.e. whether these stars are J - type stars.

4. *IR - photometry.* Near - infrared photometry was carried out for 13 faint carbon stars at J, H and K bands [16].

The photometric data in J and K bands [16] are used to estimate the effective temperatures and the bolometric magnitudes of investigated stars. Using the data in K band for 4 carbon stars (they have indices  $J - K > 1^m.7$ ) distances, therefore absolute bolometric magnitudes were estimated [16].

5. *IRAS identification.* The selected M and C stars have been identified with the IRAS point sources [17, 19]. 124 stars of 285 found in 7 FBS -survey zones have been identified with known objects which are mainly bright M and C stars. Among 161 new discovered stars [9], 98 have been identified with unknown IRAS point sources. The results of IRAS identifications are given in [9]. A detailed examination shows, that in the region of newly discovered M stars M type giant and supergiants (Mirids) are located [11].

6. *Conclusions.* The important results of the searching of 7 zones of FBS - are the followings: a) The most of newly selected faint M stars are stars of late subclasses, b) the main part of new faint M stars identified with the IRAS point sources, probably are Mirids, according to their distribution on the color - color diagram and, c) for carbon stars firstly the relation between  $EW(C_2(0, 1))$  and  $EW(C_2 + CN)$  is examined and relation for J - type stars is found.

# ПЕРВЫЙ БЮРАКАНСКИЙ СПЕКТРАЛЬНЫЙ ОБЗОР НЕБА. ИССЛЕДОВАНИЕ ЗВЕЗД ПОЗДНИХ М И С СПЕКТРАЛЬНЫХ КЛАССОВ

К.С.ГИГОЯН, В.В.АМБАРЯН, Г.В.АБРАМЯН

Приведены результаты исследования новых слабых звезд М и С спектральных классов, выявленных на пластинках Первого Бюраканского спектрального Обзора Неба. 98 звезд из 161 идентифицированы с IRAS источниками. Согласно расположению на IRAS цвет - цвет диаграмме, большая часть новых М звезд, вероятно, являются Миридами. Для J - звезд обнаружена корреляция между эквивалентными ширинами суммарного поглощения в области 5700 - 6700Å.

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