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UB STELLAR PHOTOMETRY AROUND THE ASSOCIATION OB 81 IN M 31: NEW OB ASSOCIATIONS

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Abstract. We present *UB* stellar photometry in a field centered on the stellar complex OB81 in the Southern part of the Andromeda galaxy. We investigate the stellar content of this area. The automatized search for OB associations was carried out using the friend-of-friends algorithm of Battinelli (1991). The van den Bergh's "association" OB 81 practically covers the substantial part of the spiral arm. The "new" associations have smaller sizes and look like bright cores within this "association". The mean size of 89 ± 11 pc is comparable with the mean size of the OB associations in LMC – 60pc, SMC – 70 pc and M33 – 60 pc, confirming the idea that the size of the associations does not depend on the morphological type of the galaxy.

1. Introduction

The stellar content investigations of the Local Group galaxies allow us to study in fine details the star formation history of these systems. They also provide important verification information for the stellar evolution theory. The Andromeda galaxy (M 31) is the closest spiral galaxy similar in size and structure to our galaxy – the Milky Way. It is therefore very important to study and compare the stellar populations in both galaxies. There are some large-scale CCD surveys of M 31 (Magnier et al. 1993; Haiman et al. 1994 and others) investigating separate small areas of this galaxy (Massey, Armandroff & Conti 1986; Hunter et al. 1996; Magnier et al. 1997; Veltchev et al. 1999). All of them are in *UBV* passbands. Large-scale *U* and *B* plates obtained with the 2-m Ritchey-Chretien telescope of the Rozhen Observatory (Bulgaria) were searched by Efremov et al. (1987) for new resolved star groups and for independent delineation of the boundaries of the known groups in M 31. Two hundred and ten groups were detected as real O-associations with the mean diameter of 80 pc. The main goal of this study is to outline the new OB associations in an approximately small area covering the association OB81 in spiral arm S4 using the objective method of Battinelli (1991).

2. Observations and data reduction

A set of UB frames of the area in the spiral arm S4 of Andromeda galaxy was obtained with CCD Photometrics camera attached to the 2-m Ritchey-Chretien telescope of the Bulgarian National Astronomical Observatory "Rozhen" on 6/7 August 2000. The exposure time of the images was 900 sec. The observing area was $5.6' \times 5.6'$ and covered the area centered on the association OB 81. The seeing during these observations was rather good than excellent: $1.5-1.8''$, but with stable and very good photometric conditions. The IRAF data reduction package was used to carry out the basic image reductions and the flat field correction. The Landolt (1992) standards were taken before and after the observations. The transformation equations to the standard Johnson UB system are:

$$\begin{aligned} B &= 1.012b + 0.032(U-B) + 0.023(U-B)^2 - 0.056X - 2.556 \\ U-B &= 1.156(u-b) - 0.021(u-b)^2 - 0.054X - 3.126 \end{aligned}$$

where b, u are instrumental magnitudes, UB are standard ones and X is the airmass.

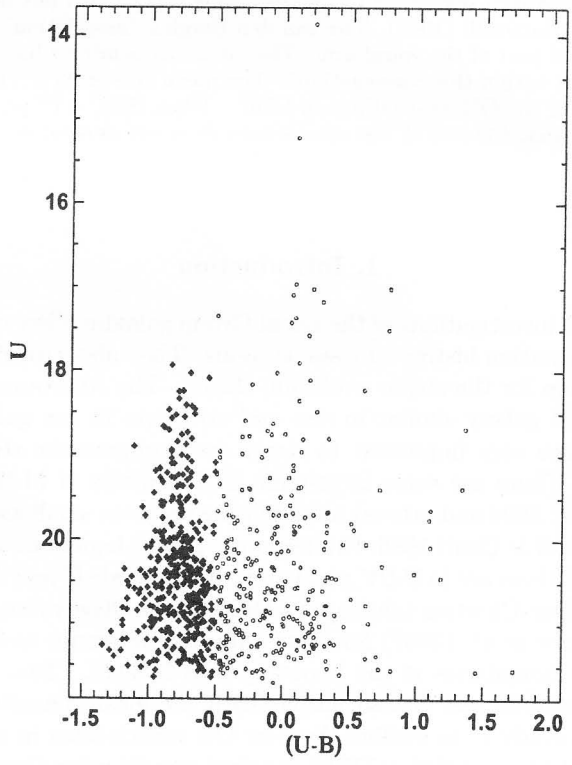

Fig. 1: $(U-B, U)$ color-magnitude diagram obtained for the area around the association OB 81 in M 31. Only stars with photometric errors larger than 0.15 in all filters are plotted.

The stellar photometry of the frames was performed with the point-spread function fitting routine ALLSTAR available in DAOPHOT (Stetson 1993). Complete details of the data reduction and analysis may be found in Georgiev et al. (1999). The stars with values of DAOPHOT CHI > 2 and those with formal errors from the PSF fitting greater than 0.15 mag are rejected so the final photometry list contains 687 stars. The zero-point errors of the transformations to the standard UB system are 0.04 mag.

3. Results

Figure 1 represents the $(U-B), U$ color-magnitude diagram (CMD). To construct this CMD only the stars with photometric errors not larger than 0.15 in both filters have been selected. The mean feature is distinctive plume of luminous blue stars in the Andromeda galaxy (black crosses) mixed with the foreground stars of the Milky way mostly with $U - B > 0$.

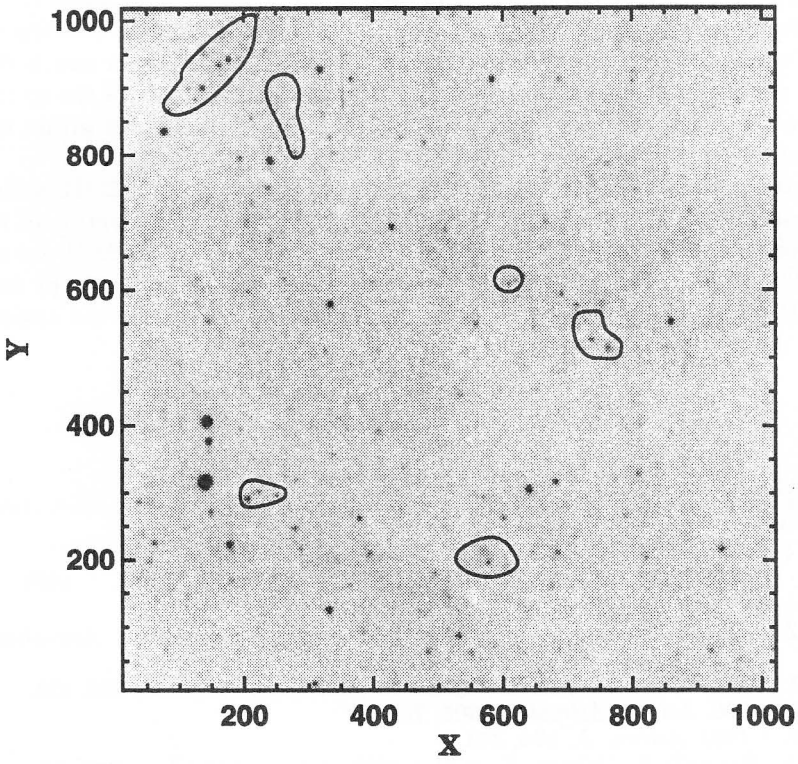

Fig. 2: Map of the associations in observational area outlined by Battinelli (1991) algorithm.

The automatized search for OB associations was carried out using the method of Battinelli (1991) (so called friend-of-friends algorithm). The bright blue stars from the main sequence in M 31 were selected by strong photometric criterion by magnitude $(18 < U < 22)$ and color $((U - B) < -0.5)$. In the most cases friend-of-friends algorithm selects the minimum number of 4 OB stars in some clump in order to have

Table 1: Mean sizes and bright OB members in the new associations

Name	X	Y	size(pc)	bright OB members
A1	740	530	87	6
A2	580	192	83	8
A3	256	854	91	9
A4	224	292	76	5
A5	153	937	134	15
A6	610	604	65	5

a "real" association. We put in our case the same minimum number of stars.

The map of the association boundaries resulting from the automatized search is shown in Fig. 2. The X, Y coordinates in pixels, the mean size of the associations in pc and number of bright OB members in each of them are given in Table 1.

The friend-of-friends algorithm selects 6 associations with sizes between 65 and 137 pc (with accepted true distance modulus of 24.2). The mean size is 89 ± 11 pc. The association OB 81 practically covers the substantial part of the spiral arm. The "new" associations have smaller sizes and look like bright cores within van den Bergh's associations.

Comparing M 31 with the Magellanic Clouds, M 33 and NGC 6822 (Bresolin et al. 1998, Ivanov 1996, Vetchev et al. 1999) we can see that the distribution of the OB associations is similar with peak between 40 and 80 pc. Those in M 31 are slightly larger – 90pc. The mean size is comparable with LMC – 60pc, SMC – 70 pc and M33 – 60 pc (Bresolin et al. 1998), confirming the idea that the size of the associations does not depend on the morphological type of the galaxy.

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