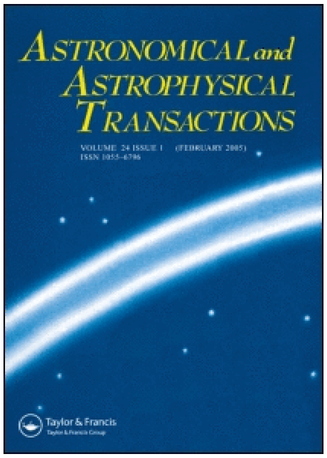

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DETECTING THE VARIATION IN THE LOWER MASS LIMIT OF STELLAR ASSOCIATIONS IN GALAXIES

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Properties of OB stellar associations in the LMC have been determined from digitized UK Schmidt plates. This material provides a homogeneous data set for revealing the intrinsic differences among the various associations at different locations in the parent galaxy. Isodensity contours, from star counts, and spectral classification offer very good criteria for the exact definition of the OB association, considered as the single unit system among the most recent stellar populations of a galaxy. The isodensity contours are derived for different magnitude levels, in order to trace the limits where the image of each association is detectable. It is found that the faint limits of the LMC associations, examined so far, vary by about four magnitudes, partly depending on their spatial distribution. This finding implies differences in the mass function and, possibly, the star formation mechanism in this galaxy.

KEY WORDS Magellanic clouds, stellar associations

1 INTRODUCTION

The stellar associations are the poorest stellar systems, in total number of stars, and are scattered in large areas of galaxies. Therefore, their definition and the determination of their properties is a difficult task. Their importance, however, is of great significance since they trace the most recent star formation history in a galaxy (Kontizas *et al.*, 1994; Hodge, 1986).

The two major problems of star formation in galaxies are:

(1) the star formation mechanism, therefore the slope of the IMF;

(2) the lower and upper mass range in a specific star-forming region.

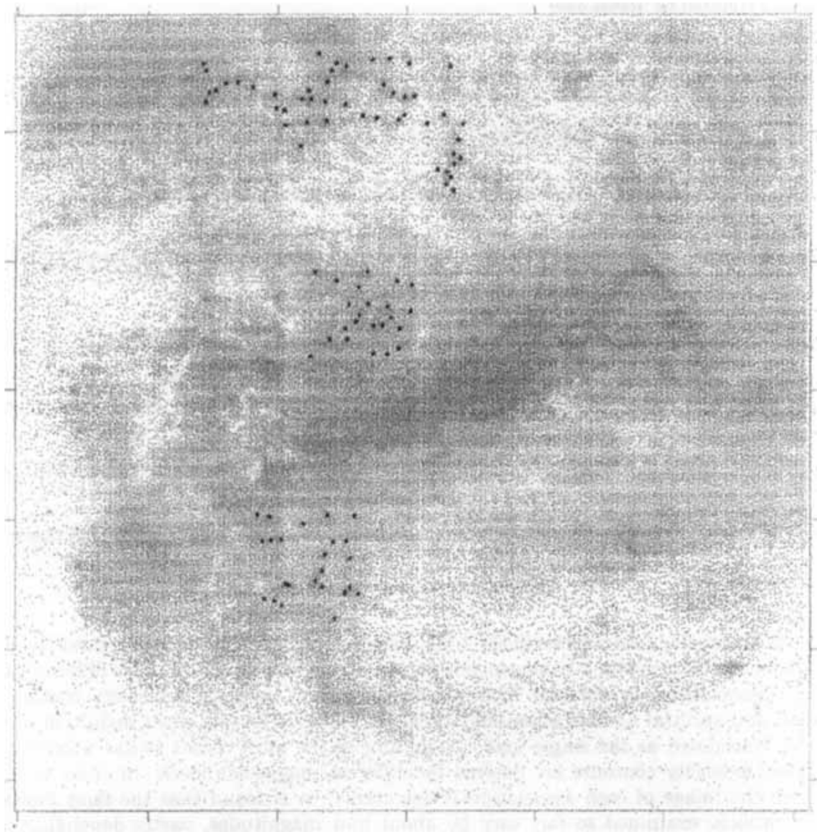

Figure 1 The areas of the LMC field plate examined for properties of stellar associations. All objects found so far are indicated by stars.

In the present work we report the first results of our investigation of the OB associations in the Large Magellanic Cloud, particularly with regard to the variation of the lower limit of the luminosity function. The spatial distribution of these variations is also searched for.

2 OBSERVATIONS AND REDUCTION

The material and the method used is described by Kontizas *et al.* (1994). It consists of photographic plates, taken with the UK Schmidt telescope and digitized by either APM (Cambridge) or SuperCOSMOS (ROE) measuring machines. The results reported here are derived using the catalogue of all stars detected by APM on plate U12346, in the U band. This catalogue, containing about 900 000 stars in an area roughly 5.4×5.4 kpc, is used to identify stellar systems and to determine the associations in selected areas, randomly situated around the LMC bar (Figure 1).

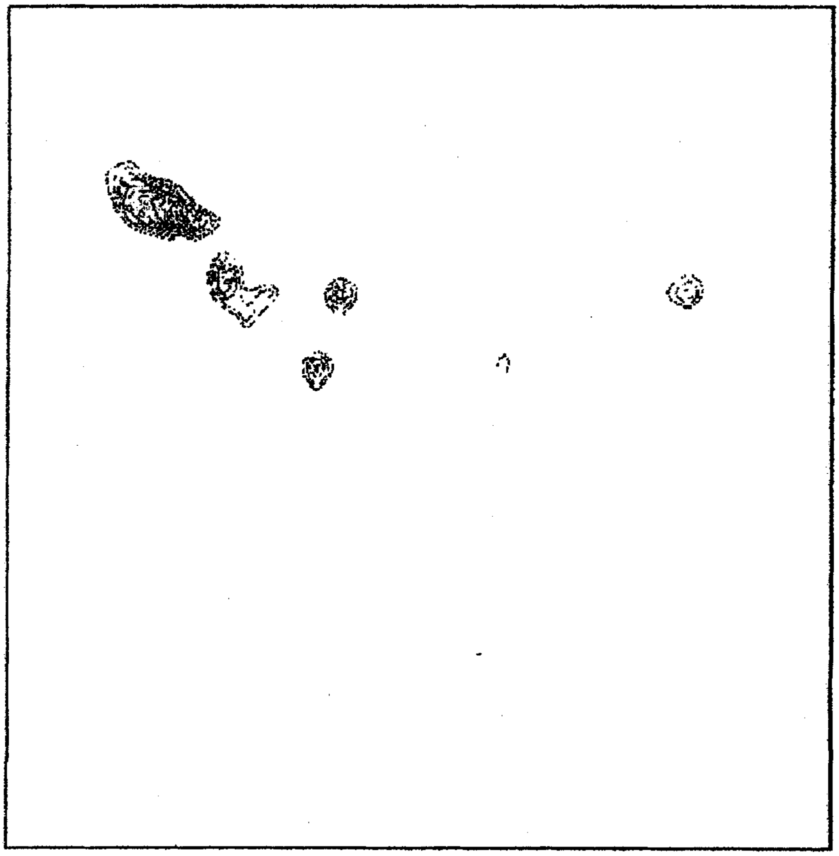

Figure 2 Detail of area 2 (approximate size 360 × 360 pc) showing the difference in clustering at various luminosity levels. Isodensity contours for level 1050–1150 ($U \approx 20$).

The above data have been analysed using the IRAF package, as well as software developed for this project. Several areas, of size roughly 1 kpc square, are selected around the LMC bar and star counts are performed, in a grid with cell size of 10 pc. The stars in each area are distributed in several luminosity groups, according to the approximate (instrumental) magnitude determined by the measuring machine. Isodensity contours, corresponding to various luminosity levels, are produced in each area and are compared in order to establish the luminosity limits of each object detected. In several cases it is found that the detected stellar systems show differences in the lower luminosity level, at which they appear to reveal a single core unit (Figures 2 and 3).

The primary criterion for the detection is the existence of a set of contours where the star number density exceeds the average (surface) density of the general background by 3σ. It is worth mentioning that the background density is deduced by analysing the histogram of stellar density in the area examined.

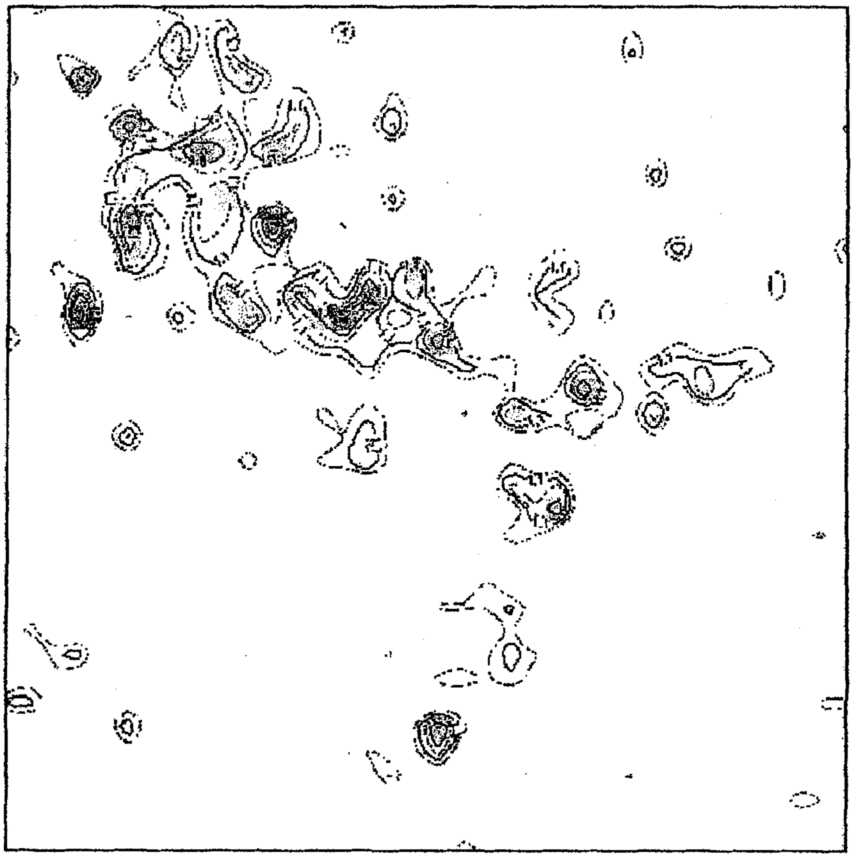

Figure 3 Same as Figure 2 Isodensity contours for level 1550–1650 ($U \approx 15$).

Once the objects (stellar systems) are identified, a second criterion is used in order to determine their nature: the existence of bright, blue stars (OB stars), as established by examination of these areas on objective prism plates. Finally, several key properties of the found associations are determined, like their position, dimension, shape, total number of stars, Spitzer radius (Spitzer, 1958), etc.

3 RESULTS AND DISCUSSION

So far, we have examined four areas of the LMC as described above (Figure 1) and we have detected 96 stellar groups. In addition to 27 associations, mentioned in the catalogue of Lucke and Hodge (1970), 69 other single-core objects are revealed. We are now in the process of spectral classification in these areas, in order to determine the nature of these stellar groups. The OB associations examined thus far have the following typical properties:

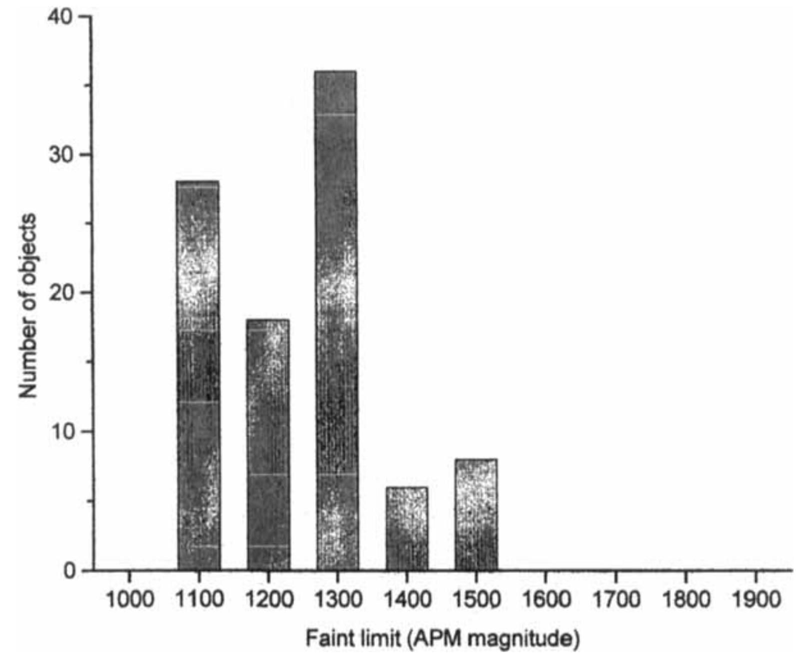

Figure 4 Histogram of the fainter magnitude of the detected objects. The numbers are assigned by APM. Larger numbers correspond to brighter stars, whereas 100 APM units correspond to one magnitude.

(1) maximum size from 30 to 100 pc, as determined by the 3σ isodensity contours;

(2) total stellar content that goes up to 450 stars (in excess of the background), for the largest associations;

(3) Spitzer radius from 7 to 25 pc.

In some cases, a single LH object seems to break up into many components and new objects are revealed.

The most interesting result, however, is the detected variation of the fainter magnitude (i.e. lower mass) limit of the associations, as illustrated in Figure 4. This histogram shows that the faint limit spans a significant luminosity range, of about four magnitudes. The small mass stars, which are not detected in the blue plate, are not formed at all or they are only in the protostar stage, in which case we should see them in the infrared.

With regard to the spatial distribution of this variation, no clear dependence is yet evident. It only seems that there is a preference of the bright-limited associations to occur in the Shapley II and III regions, which partly overlap our areas 1, 2 and 3.

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