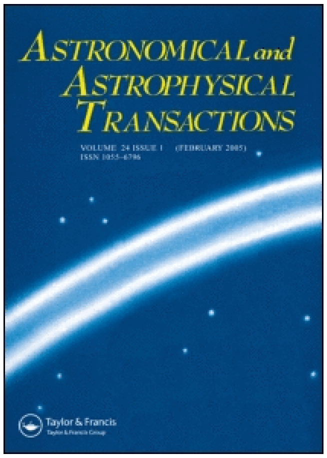

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DETECTION AND STRUCTURE OF STELLAR COMPLEXES IN THE LARGE MAGELLANIC CLOUD

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The search for all stellar complexes in the LMC is the aim of this investigation. Stellar complexes are typical large-scale structures where most recent star formation has occurred, dominated by recently formed stars, young stellar clusters, OB-associations, aggregates and several kinds of young objects. Using digitized direct plates we have developed a method to detect the stellar complexes and their components by means of star counts. Star counts in different colours and magnitude intervals are the main tool to derive properties of complexes, such as physical extents, masses and age variation of those systems. This method allowed us to detect several LMC complexes and specify some preliminary characteristics.

KEY WORDS LMC, star formation, stellar complexes

1 INTRODUCTION

It is generally accepted that stars form together by the fragmentation of a dense molecular cloud and that young stars always form clusters and associations. During the last few decades data have been accumulated which indicate that star clusters and associations are also formed as groups within the largest gas-star assemblages called "complexes" (Efremov, 1988).

Stellar complexes are indicators of recent star formation; they consist of recently formed stars (O, B spectral types), young clusters, associations, aggregates, young Cepheids, and several kinds of young objects, with dimensions 300–1200 pc and ages up to 100 Mys.

The various stellar systems in galaxies are very important tools in understanding both stellar evolution and star formation processes and are often related to the parent galaxy's morphology.

Kontizas *et al.* (1996) have proposed a method to detect the stellar complexes in the LMC by using star counts and spectral classification on direct and spectroscopic photographic plates. The main goal of this project is to identify all the stellar complexes in the LMC and measure the physical extents, total luminosities, masses and ages of those systems. Preliminary results are given in this paper.

2 OBSERVATIONS

We use photographic plates taken with the UK 1.2 m Schmidt Telescope in Australia. The plates are all stored in the Plate Library at the Royal Observatory Edinburgh and are measured in Edinburgh using the Observatory's fast measuring machine, SuperCosmos. The data are produced as catalogues of detected images (positions, magnitudes, etc.).

Various fields of the LMC have already been measured, in the U, R, and He ($\lambda = 4680$Å) wavebands to a brightness limit of 19–20 mag. U plates provide an excellent compromise between depth and crowding. Moreover, the blue stars of the upper main sequence stand out against the older, background stellar populations more clearly on these plates than on plates taken in redder wavelengths. Plates taken in the He waveband allow us to observe more clearly through gas and dust, such as the case of the central regions of associations.

3 REDUCTIONS

The catalogue data have been analysed using standard astronomical packages (MIDAS, IRAF) and software developed by us. The analysis is based on star counts, in selected magnitude ranges and various wavebands. Isopleths are produced on the star count images to detect the stellar complexes as enhanced regions of star density.

The basic criteria used for identifying and measuring the stellar complexes in the LMC are:

(1) The mean density of the candidate region is enhanced by 2–3σ with respect to the mean density of the surrounding field. We are looking for regions with dimensions of 300–1200 pc.

(2) The above regions must be dominated by young populations.

4 DISCUSSION

According to the above methodology and described criteria, many areas in the LMC have been identified as candidates of stellar complexes. It is significant to note

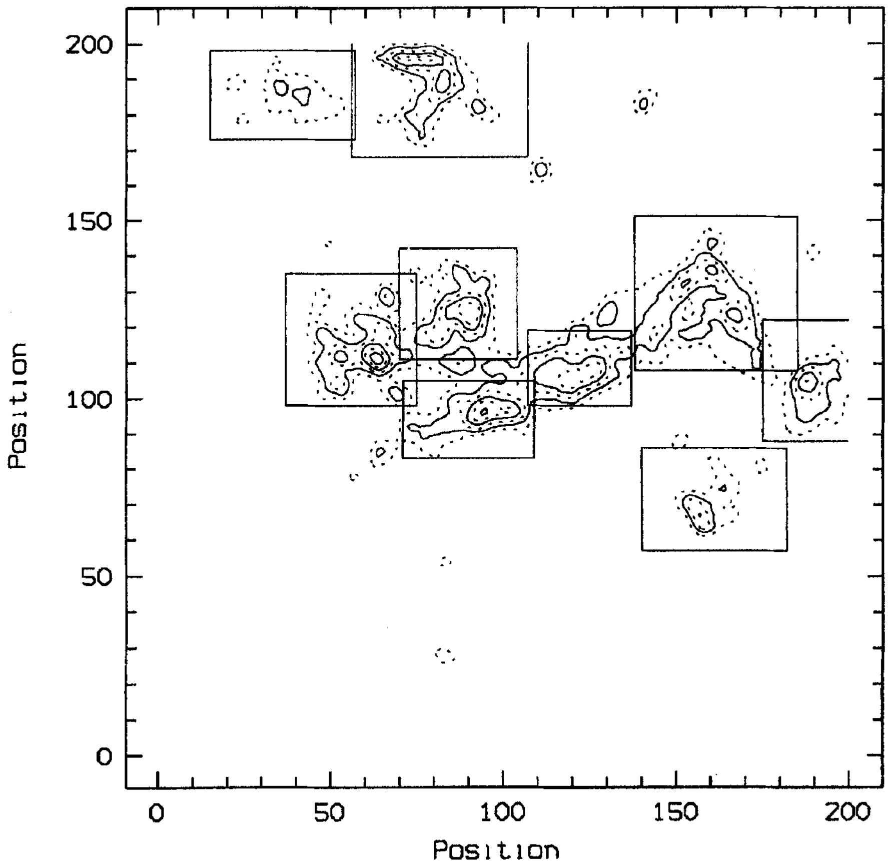

Figure 1 Isopleths of the central region of the LMC in the U plate using a magnitude slice showing the brightest stars. The minimum contour level is set at 3σ above the mean background density while the step between different contours is set at 2σ. The detected stellar complexes of this region are illustrated.

that the youngest and brightest components of those regions are revealed by the isopleths on star counts performed on the brightest magnitude ranges. The outer boundaries of complexes in which associations are embedded are best determined by the isopleths on the fainter stars. The above pattern is followed both in U and R plates.

Stellar complexes are best seen in the U-waveband as they mainly consist of young bright stars, while the less massive (older?) stellar population is better revealed on the red wavelengths.

Figure 1 shows a typical slice of bright objects ($U < 16.5$) where the detected areas are illustrated. Most of these regions coincide with the LMC Shapley Constellations (Shapley, 1956). The identified stellar complexes are the loci of many associations which are the main components of these structures.

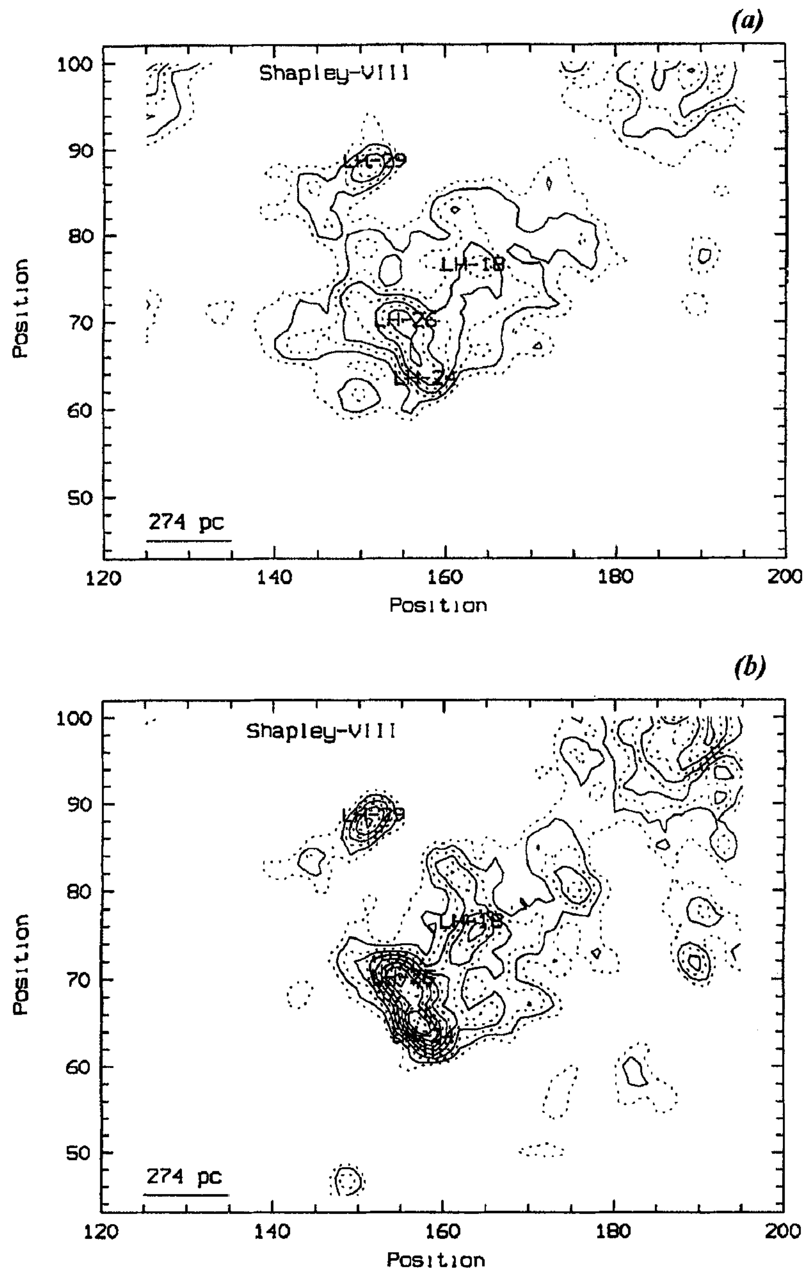

Figure 2 Isopleth contours for the Shapley VIII complex. The minimum contour level is set at 3σ above the mean background density while the step between different contours is set at 1σ. (a) in the U plate for all the detected stars; (b) in the U plate for stars with magnitude > 17; the outer boundaries of this area can be seen; (c) in the U plate for the brightest stars (mag < 16.5); The associations are revealed; (d): in the R plate for the brightest stars; (e): in the He waveband for a slice of bright stars; The centres of the associations are more clearly seen.

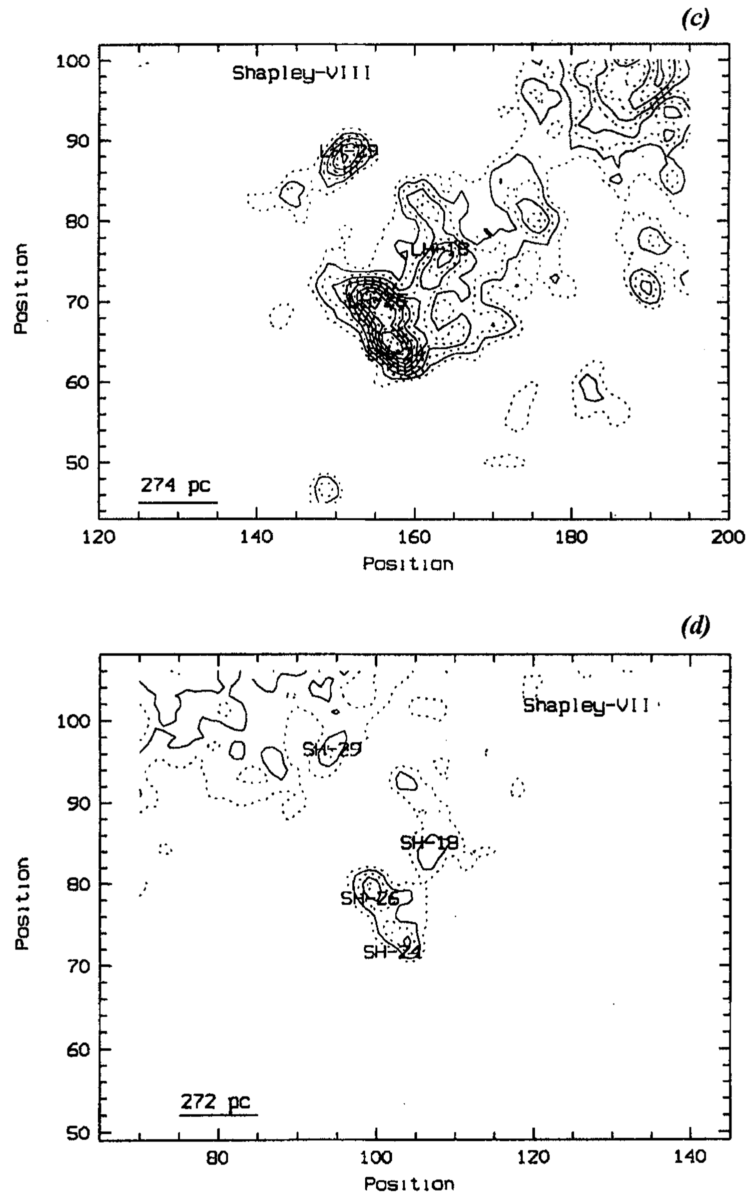

Figure 2 Continued.

One of the above areas, Shapley VIII, has been selected for further study. In Figure 2, we show the isopleths of this area in the U plate, first using all the detected stars (down to 20 mag, Figure 2(a)), secondly in a magnitude range of faint stars (20–17, Figure 2(b)) and finally using the brightest stars ($<$ 16.5, Figure 2(c)). It is obvious that the younger component of the complex, the associations, stands out

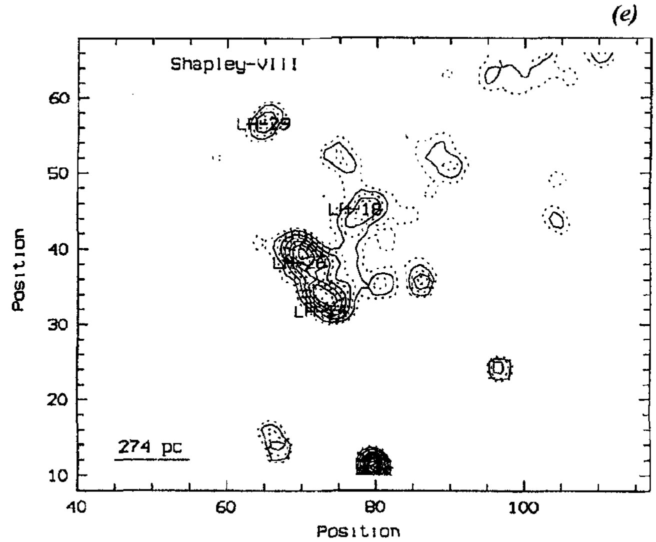

Figure 2 Continued.

against the general population in Figure 2(*c*), while the outer boundaries are best determined in Figure 2(*b*). The brightest slices of the same region are shown for the colours R and He (Figures 2(*d*), (*e*)).

We therefore adopt the 3σ isopleth as the observed size of a complex at each slice. The choice of the representative boundaries as found in the various brightness slices may differ but an average size will be adopted for comparison between them. The ages of the embedded associations determine the age of the stellar population of the complex.

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