Stellar Complexes in the Large Magellanic Cloud

The concept of complexes and supercomplexes has been introduced relatively recently by Efremov (1988). Thus, Efremov defined as 'stellar complexes' giant groupings with sizes from ≈ 0.2 Kpc to 1.2 Kpc, comprising gas, clusters and OB associations, from 10^6 to 10^8 years old. Hence, complexes could be briefly defined as galactic hyperstructures, the principal components of which are extreme population I objects (Maravelias et al. 1992).

McKibben Nail & Shapley (1953) were in fact the first to distinguish the giant stellar and gaseous aggregates of the LMC, the well known Shapley 'constellations' I to V, whereas later on van den Bergh (1981) named the 'constellations' VI to IX. They seem to be the most active areas of the Cloud. Theoretical studies have appeared some years later (Feitzinger & Braunsfurth 1984) where it is proved that the distribution of emission regions and OB associations in the LMC is not random.

The main scope of this research project is the study of the large scale structures of star formation in the LMC, namely stellar complexes and supercomplexes, giving precise criteria, based on the assumptions by Efremov, for defining a complex and investigating its relation to star formation. On these grounds, star counts and spectral classification were carried out in some selected complexes of the LMC, namely Shapley I, IV, IX, as well as the newly defined Shapley X, in order to determine the boundaries and find the dominant stellar component of those areas. We present here some preliminary results for Shapley I, as a typical example of a stellar complex. An area of ≈ 360 pc x 360 pc, centred on $\alpha \approx 05^H 23^M$ and $\delta \approx -68°02'$ was examined.

The star counts were carried out on three plates, taken with the 1.2 m UK Schmidt telescope, in U, I and V respectively. A square réseau was fixed on the screen of a magnifying device, where each pixel corresponded to ≈ 11 pc for the LMC. Thus, the number density was measured there per ≈ 120 pc^2. A faint star limit was set up a little higher than the actual detection limit, to avoid confusion with the photographic emulsion grains, and compensate for the masking of faint stars in crowded areas. The counts were repeated after a lapse of some weeks in crowded areas and the mean values have been taken into account. In order to study the background effects and define a lower limit of the number density of stars inside this complex, star counts were carried out on the same plates in two (one being adjoining) fields at less crowded areas of the LMC, with dimensions ≈ 190 pc x 190 pc. The counting errors have also been considered. The mean values of number density are $\langle d \rangle \approx 9$ stars/A, $\langle d \rangle \approx 13$ stars/A and $\langle d \rangle \approx 19$ stars/A for U, I and V plates respectively, where A ≈ 120 pc^2, with standard deviation $\sigma \approx 2$ stars/A. Hence, the lower limit of the number density was defined to be:

$$d_{min} \approx \langle d \rangle + 3\sigma \qquad (1)$$

The data were processed with a contour plotting software package to produce the iso-contour mapping of this complex. The minimum contour was chosen to satisfy Equ. 1, while the step was taken to be equal to 2σ. Plates of various exposure times in various colours were used to reveal the structure for different detection limits and the stellar population as well. The iso-contour mapping reveals the morphology and the structure of Shapley I. In Fig. 1 we can see the iso-density map derived from the U plate, whereas the shaded areas illustrate the minimum boundaries of the I plate contour map superimposed, where it is evident that the peaks of this mapping correspond to the 'nuclei' of OB associations. It is very interesting to note that there exist some additional dense 'starry cores' in this complex, other than the OB associations listed by Lucke & Hodge (1970).

For the spectral classification, the best available copies of the UKST low dispersion prism UJ plates were used. The effectiveness and the criteria of the low dispersion objective prism plates for spectral classification have been discussed in the past by several authors, and are reviewed by Dapergolas et al. (1986) and by Kontizas et al. (1988). The accuracy of the classification is about one spectral type. Adopting a distance modulus of 18.5 mag for the LMC, we can observe stars brighter than $M_V = 0$ mag. Hence at the present magnitude range, A type main sequence stars and/or red

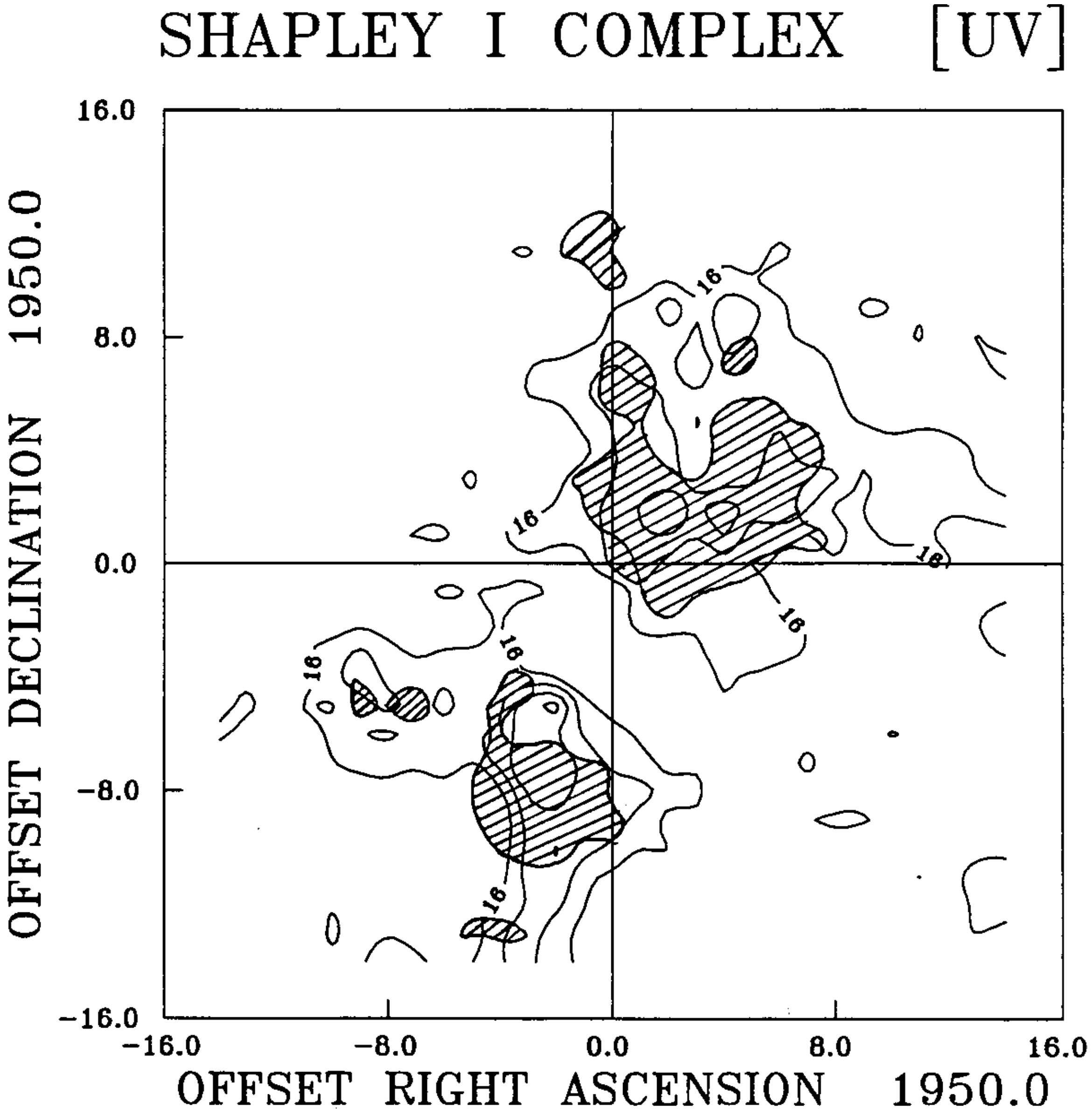

Figure 1.

giants of luminosity class III, are the faintest stars that can be detected. The distribution of OB stars (denoted altogether by the letter "B") in Shapley I, is illustrated in Fig. 2, where it is shown that the concentrations of the early type stars are mainly located inside the boundaries of this complex, as defined above by the iso-contour mapping.

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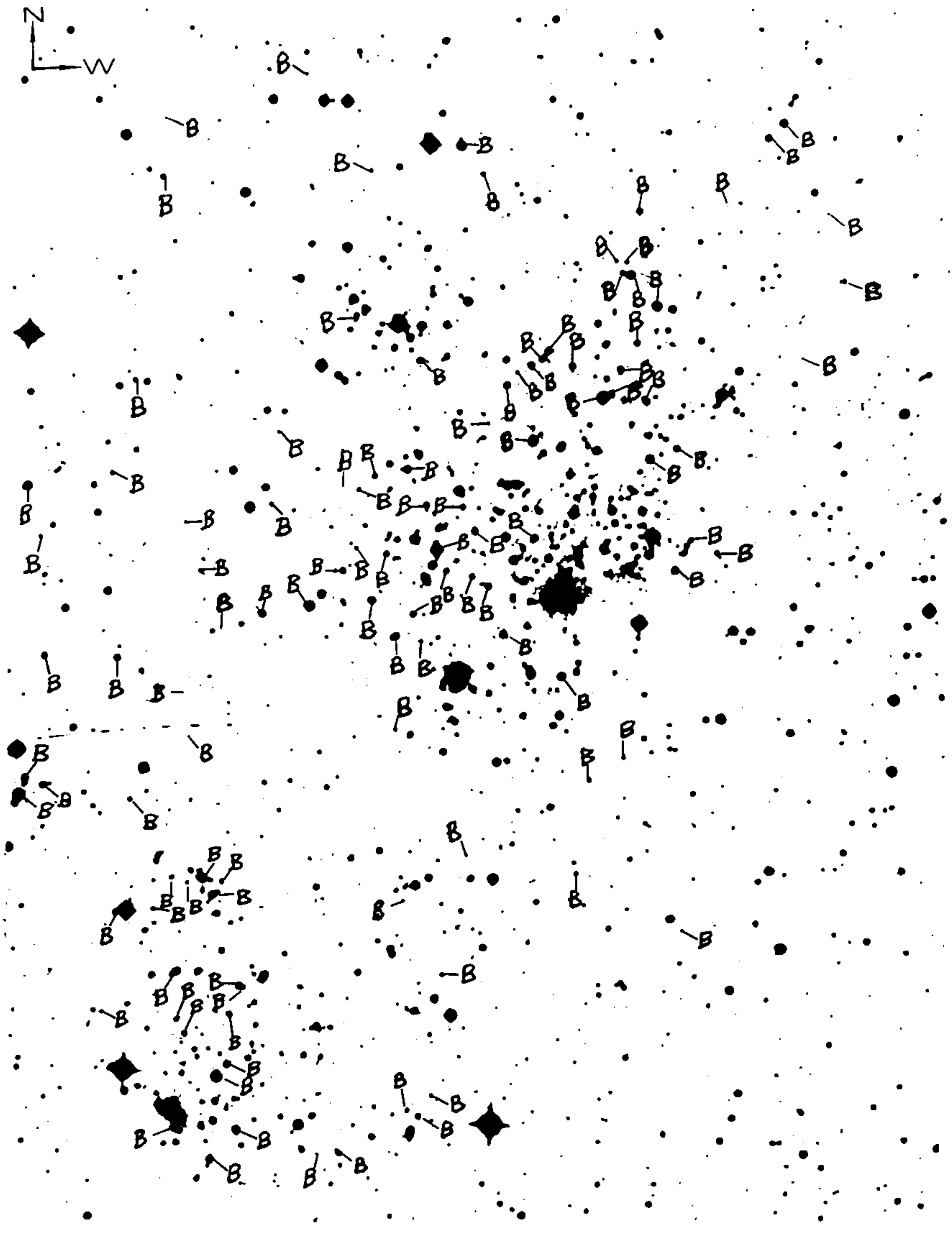

Figure 2.

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Stellar Population and Galactic Evolution: A Photometric and Astrometric Sample Survey

1. Introduction

Strasbourg Observatory, Besançon Observatory (France), C.A.I., Observatoire de Paris and U.P. State Observatory (India) are conducting a sample survey in UBV photometry and proper motions as part of an investigation of galactic structure and evolution supported by the Indo-French centre for the Promotion of Advanced Research — Centre Franco-Indien pour la Promotion de la Recherche Avancée. The project is based on Schmidt plates (from Tautenburg, Palomar, ESO and OCA [Observatoire de la Côte d'Azur] telescopes) digitized with the MAMA machine (C.A.I., Insu Paris). The high astrometric quality of the MAMA gives access to micronic accuracy leading to a few mas per year accuracy on proper motions, using plates spread along a 30 year baseline. Medium photometric accuracy and high proper motion accuracy for complete faint star probes in large fields will give access to the properties of star samples out of the solar neighbourhood. The Schmidt sample survey is complemented by deep CCD photometry in some fields in order to get a wider magnitude range and to give access to faint or remote populations. To interpret this multidimensional data set we have developed a synthetic approach of galaxy modelling. Model simulations compared to observed stellar distributions in the space (V, B-V, U-B, μ_l, μ_b) will lead to suitable tests for galactic structure, dynamics and evolution.

2. Description of the Survey Plan

2.1 Sample survey

The chosen directions constitute a set of fields at high and intermediate latitudes and in the galactic plane:

- near the North Galactic pole (M3, l = 50°, b = 80° [Soubiran, 1992]);