CCD AND SCHMIDT-PLATE PHOTOMETRY AND ASTROMETRY IN REGION E OF THE LMC

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1. Shapley Constellation III and Supergiant Shell LMC 4

Shapley Constellation III in the north of the LMC is one of the largest associations in the LMC. It is surrounded by a ring of H II regions and diffuse H II filaments called Supergiant Shell LMC 4 (Goudis & Meaburn 1978). LMC 4 is suspected to be a site of large scale propagation of star formation (Dopita et al. 1985), but recent studies (Reid et al. 1987; Vallenari et al. 1993) show that the situation is far from simple.

The NE part of LMC 4 is part of LMC selected region E (de Boer et al. 1991). As part of an ESO Key Program, CCD photometry of several fields in this region has been obtained (Bomans et al. 1993). Because of the large size of the selected regions (30 x 30 arcmin) and especially of Shapley Constellation III as a whole (1.4 by 1.4 deg.), it is not yet manageable to take CCD photometry of the entire region. To reach a census of the whole region, we decided to scan Schmidt plates, perform photometry on the scans using DAOPHOT 2 and calibrate the data using the photometry of the CCD frames in a similar manner as done by Hatzidimitriou et al. (1989) for the outer regions of the SMC.

2. Observations

The ESO Schmidt plates used here were originally taken for the measurement of the absolute proper motion of the Magellanic Clouds (Tucholke & Hiesgen 1991). They cover the ESO/SRC–Survey fields. LMC Region E is situated in the overlap region of the fields no. 85 and 86. Blue plates (IIaO + GG385) and plates in the visual passband (103aD + GG495) were scanned with the PDS 2020 GM^{plus} microdensitometers of the Astronomical Institute Münster with an aperture of 20 x 20 μm^2 and a step width of 15 μm in x and y, corresponding to 1″.

3. Photometry

We started our project in a test region of 0.06 square deg. centred on the association NGC 1948 for which we have extensive CCD photometry (Vallenari et al. 1993). We used one B and one

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V plate each and DAOPHOT 2 for the reduction. An approximate magnitude scale can be estimated using the CMD derived from the CCD photometry. The main sequence is nicely visible and also the intermediate age population (red giant region and He burning clump) typical for LMC fields can be seen. The limiting magnitude is about 19. At the top of the main sequence, the saturation of the bright stars on the plate is obvious. For these stars, short-exposed plates are needed. By averaging the photometry from different plates we plan to bring the photometric accuracy below 0.1 mag.

We found 3700 stars common to both plates. Extrapolating to the whole region E, we expect to get about 20,000 stars between 11 and 19 magnitude in V.

We will use the final database to analyze the recent star formation activity in Shapley Constellation III by comparing luminosity functions for subfields of our survey area and the stellar density distribution of stars in B-V, V bins defined in the CMD.

4. Astrometry

Spherical positions for all stars on the Schmidt plates were computed using the PPM South catalogue (Bastian et al. 1991) as reference. 162 PPM stars fainter than 9.0 mag on field 85 and 161 stars on field 86 were used. For astrometric modelling of the Schmidt plates we applied a simple transformation with quadratic terms in x and y. Schmidt plates show systematic residuals from such simple models due to their complicated geometry, which could be overcome by the subplate overlap technique (Taff et al. 1990). Due to the relatively small number of reference stars, the use of this technique was not possible for the present case.

We tested the random and systematic errors of the positions by comparison of the solutions for fields 85 and 86, which used almost completely different sets of PPM stars. Using 2249 stars in common, the mean differences are $\Delta\alpha\cos\delta = 0''.27 \pm 0''.44$; in declination we find $\Delta\delta = 0''.49 \pm 0''.43$. We conclude that the positions are accurate (random error) to $0''.28$ and precise (systematic error) to $< 0''.5$. 22% of the stars show differences larger than 1", with 3% of the differences larger than 2". These numbers are not impressive from the astrometric viewpoint, but present a large progress for the vast majority of the stars in this field, where identification and coordinate determination for telescope operation are notoriously difficult. The systematic error may be reduced by the use of a denser reference catalogue and improved reduction methods, the random errors by scans of additional plates. The Schmidt-plate positions served as reference stars for the astrometric reduction of the CCD frames. Internal errors of $0''.2$ to $0''.3$ were reached using a linear transformation model.

The data will also be used to create a position catalogue of Magellanic Cloud stars (de Boer 1992). Photometry and astrometry in selected region E will serve as a database for ROSAT point source identification in this field.

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