The Magellanic Clouds

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The study of the Magellanic Clouds has developed significantly with the advent of automated digitisation of wide-field photography (COSMOS, APM), large format CCDs and multi-object fibre spectrographs.

In recent years we have been studying aspects of the geometry, structure and evolution of the Small Magellanic Cloud making extensive use of such tools. Photometry (using COSMOS) over an area of 100 square degrees in and around the SMC has allowed us to conduct a detailed study of the nature and spatial distribution of stellar populations in the SMC. The three dimensional structure of the SMC revealed by these data, in conjunction with radial velocities obtained with multi-fibre spectroscopy have led to a quantitative estimate of the effect of the tidal interaction between the LMC and the SMC.

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Carbon Stars in the Small Magellanic Cloud

A set of deep objective prism plates covering the outer regions of the Small Magellanic Cloud have been systematically searched for carbon stars. An extensive catalogue has been produced. Carbon stars are found up to 5 degrees from the centre of the SMC; their surface distribution is described.

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Extended Surveys of MC Star Clusters

The star clusters in the Magellanic Clouds are found to offer a rich variety of properties which can be used as a test of our theories on stellar and dynamical evolution. They also provide objects for testing the circumstances under which stellar systems form and survive in their parent galaxy.

The location of the clusters, distribution of their ages and dynamical parameters has shown that two star clusters systems exist in the LMC. These two systems may reflect the way our Galaxy has triggered star cluster formation during its very close encounter with the LMC:

i) one extended elliptical in shape system, which contains all intermediate and old star clusters either poor and/or rich in star number, and

ii) A system again elliptical but smaller, superimposed on the other (inlined by about 60 degrees from the latter), consisting of the most massive, very young LMC globular clusters, not yet conventionally relaxed.

The existence of very rich stellar associations, binary star clusters and very elliptical ones located in this system, may indicate that

a) massive star clusters have formed very recently and are still under formation, and

b) merging of two or more stellar systems is one mechanism which leads to the formation of large globular clusters in a galaxy.

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Grism Survey for C-stars in the MCs

A survey for carbon (C) stars in the Magellanic Clouds has been carried out with a green grism at the prime focus of the ESO 3.6 m telescope equipped with a triplet adapter. The spectral range obtained on the plates (4350-5300 Å) is achieved by combining a IIIa-J emulsion with a Schott GG435 filter. Two dimensional photometry of the grism spectra resulted in a magnitude m_{5220}, a colour equivalent $m_{4850} - m_{5220}$, and a carbon abundance index $C_2(EW)$. This technique was applied to 13 fields covering the main body of the Small Magellanic Cloud and to some selected fields in the Large Magellanic Cloud. The calibration of the derived quantities, using slit spectra of selected stars, allowed us to determine bolometric magnitudes for about 2000 C stars. The existence of natural groups of C stars has been pointed out. In particular a number of very faint C stars has been discovered.

From the experience we gained from this technique, we are now using the ESO Faint Object Spectrograph and Camera devices in the slitless spectroscopy mode equipped with low dispersion prisms and suitable interference filter in order to perform very deep surveys and identify very low-luminosity C stars in selected regions of the MCs and Local Group dwarf spheroidal galaxies.

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Hα Survey of the Milky Way and Magellanic Clouds

A survey of the ionized gas in the Milky Way and Magellanic Clouds is now being made by a team from Marseille Observatory with a small dedicated telescope (36 cm) at La Silla. It includes a scanning Fabry-Perot interferometer and a photon-counting system (see *A. & A.* 1992, **257**, 389). Each field covers 38′ x 38′ on the sky and provides radial velocities for the 256 x 256 pixels (1px = 9″ x 9″) with a high spectral resolution (better than 5 km/s). Hα is the most observed line but a lot of fields in the SMC and LMC were also observed in OIII line.

The aim of our observations is to improve our knowledge and understanding of the structure and kinematics of the SMC and LMC (including detection and detailed study of SNR). By now the SMC has been completely covered with 30 fields (Le Coarer et al., 1993, accepted in *A. & A.*) and a large part of the LMC (about 40 fields, most of them at both Hα and OIII).

About 150 fields have been already observed in the Milky Way, covering areas especially selected to help precising the number and shape of spiral arms. The radial velocities enable us to distinguish HII regions from different spiral arms seen along the same line of sight.

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CCD and Schmidt-plate Photometry and Astrometry in Region E of the LMC

We have investigated the possibility of crowded-field photometry on Schmidt plates of the LMC. ESO Schmidt plates of the SRC field 85 in the blue and visual passbands were scanned with the PDS2020GM^{plus} microdensitometers at Münster. This field includes Shapley Constellation III and the supergiant shell LMC 4. As a first test a field of 0.6° x 0.6° was extracted from the scans and has been reduced with DAOPHOT2. The subfield contains the LMC Key Programme Region E (de Boer et al., 1991. *Messenger*, **66**, 14), where Johnson BV CCD photometry of five overlapping fields centred on the association NGC 1948 is available (Vallenari, Bomans, de Boer, 1993. *A. & A.*, **268**, 137). The CCD photometry is used to calibrate the Schmidt-plate photometry. The resulting large number of stars with *BV* photometry is useful for a census of the brighter part of the colour-magnitude diagram in a very large area. One especially interesting topic is to look for hints of sequential star formation in this part of the LMC: we divided our region into a grid of subfields and compared the main sequence turnoff locations. As a second method we investigated the stellar density distribution of the blue stars. The next step will use several more plates of the region to enhance the reliability of our photometry.

Spherical positions for all stars on the Schmidt plates are derived using the PPM (Röser & Bastian 1991) as reference catalogue. Positions of stars appearing on the CCD frames only are determined relative to secondary reference stars from the first step.

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Wide-field Star Count Mapping of Large Regions of Star Formation in the Large Magellanic Cloud

A large area of the LMC central 'disk' (≈ 1.8 x 1.3 Kpc) has been studied by means of star count and spectral classification, to examine its morphology and stellar population. The star counts were carried out on a U plate taken with the 1.2m UK Schmidt Telescope, in order to derive the isodensity contour mapping of this region, which comprises the Shapley IX complex and some associations, catalogued by Lucke and Hodge. A smaller area (≈ 0.36 x 0.36 Kpc), centered on Shapley IX complex, was also studied on two I and V plates to define the boundaries of LMC complexes.

Spectral classification of stars brighter than B ≈ 18.5 mag was also carried out in the same areas using low dispersion objective prism plates taken with the 1.2m UK Schmidt Telescope. It is found that the studied stellar complexes are defined by the minimum isodensity contours where the dominant stellar content is OB stars. These regions delimit the loci of recent star formation events.

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Qualitative Analysis of the Stellar Content in LMC Clusters and Nearby Fields from Objective Prism Spectra

A large number of stellar fields in and around star clusters at various regions covering the entire LMC have been studied by means of objective prism spectra taken with the 1.2m UK Schmidt Telescope. Spectral classification of stars (as faint as B = 18.5 mag) in the central crowded cluster regions is possible only with low dispersion spectra, which give one spectral type accuracy. Medium prism spectra provide better classification accuracy (3 spectral subtypes) but they only detect stars at B = 16.5 mag.

The distribution of spectral types in each area corrected for completeness and field contamination is a very good age indication of the stellar population in the examined area. The age distribution of spectral types in the studied areas shows that in the central LMC 'disk' the age of the stellar population is mixed with various age groups from 10^7 to very old whereas the extended large elliptical 'disk' comprises stars from 3×10^8 to a few times 10^9. Between the central 'disk' and the large one there is a north and south population with age of about $1 - 3 \times 10^8$ yr.

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