



# The Outer Stellar Populations in the LMC

I. Meschin<sup>1</sup>, C. Gallart<sup>1</sup>, A. Aparicio<sup>1,2</sup>, R. Carrera<sup>1,3</sup>, M. Monelli<sup>1</sup>, P.B. Stetson<sup>4</sup>

<sup>(1)</sup> Instituto de Astrofísica de Canarias, Tenerife, Spain

<sup>(2)</sup> Departamento de Astrofísica, Universidad de La Laguna, Tenerife, Spain

<sup>(3)</sup> Centro de Investigaciones de Astronomía, Mérida, Venezuela

<sup>(4)</sup> Dominion Astrophysical Observatory, Herzberg Institute of Astrophysics, National Research Council, Victoria, Canada

## ABSTRACT

In the context of a major project aimed at obtaining detailed star formation histories across the Large Magellanic Cloud (LMC) disk, we present here the first results for the outermost fields in the northern direction (see Fig. 1, fields N3 to N5)

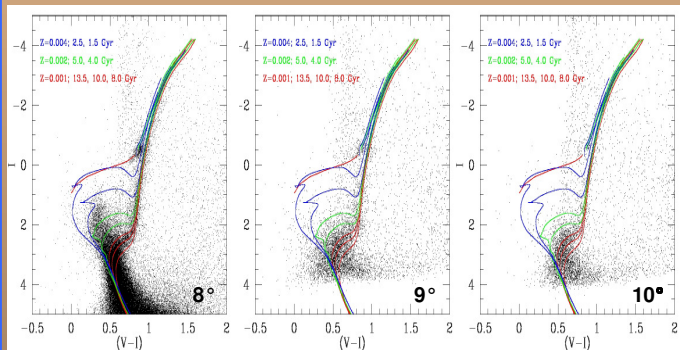
We report the presence of a substantial intermediate-age ( $> 4.5$  Gyr old and some  $\approx 1.5$  Gyr old stars) and old stellar population in these fields. **It is striking that, at 9 Kpc from the LMC center, there is still galaxy with intermediate-age stars.**

## OBSERVATIONS AND PHOTOMETRY

B, V and I images from several LMC fields were taken in 3 campaigns, the first two (1999 December and 2001 January) using the Mosaic II CCD Imager on the CTIO Blanco 4m telescope (Cerro Tololo, Chile) and the third (2005 January) using the WFI camera at the 2.2 m ESO/MPI telescope at La Silla Observatory (Chile). These wide field imagers provide a total field of  $36'' \times 36''$  (resolution  $0.27''/\text{pixel}$ ) and  $34'' \times 33''$  (resolution  $0.24''/\text{pixel}$ ) respectively. Seeing was typically around  $1''.0$ , except during the observations of fields N2 and N4 when it went up to  $1''.4$  and  $1''.2$  on average.

Several Landolt standards were also observed in photometric nights for calibrations purposes. The mosaic frames were pre-reduced in a standard way, using the MSCRED package within IRAF. Photometry of North LMC fields was obtained using DAOPHOT/ ALLFRAME suite of programs (Stetson 1987, 1994).

## FIRST RESULTS: THE LMC OUTER POPULATIONS



Here we show the  $[(V-I), I]$  CMDs of the 3 North-fields located at  $8^\circ$ ,  $9^\circ$  and  $10^\circ$  from LMC center. Stars with at least one valid measurement in each filter have been selected using the following limits for the photometric error and shape parameters given by ALLFRAME:  $\sigma_{(V-I)} = (\sigma_V^2 + \sigma_I^2)^{1/2} < 0.15$  and  $-0.5 < \text{sharp} < 0.5$ .

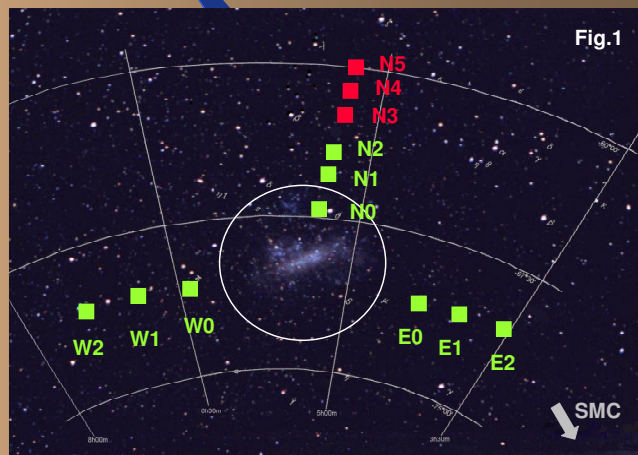
The CMD of field N3 is deeper (it reaches 2 magnitudes below the old MS turnoff) than the other two (1.2 mag for N4 and 1.5 mag for N5). This is due to the different diameters of the telescopes used and to the different integration times, which are both greater for the N3 field (see Table 1). BaSTI isochrones (Pietrinferni et al. 2004) have been superposed.

Each of these CMDs show, for the first time, the details of the age structure of the stellar population in these outer parts of the LMC. Field N3 ( $8^\circ \sim 7$  Kpc) was studied and presented in Gallart et al. (2004). They showed the presence of a substantial intermediate-age stellar population in this field, with a relatively strong gradient in the number of 2.5-4 Gyr old stars. The surface brightness profile of the LMC remains exponential and shows no evidence of disk truncation out to this radius. CMDs of field N4 ( $9^\circ \sim 8$  Kpc) and N5 ( $10^\circ \sim 9$  Kpc) disclose the same behavior, i.e. the presence of intermediate-age population with a relatively strong gradient in the density of stars with age in the  $\approx 4$ -5 Gyr range. A group of stars brighter and bluer than the main population is well matched by a 1.5 Gyr isochrones. Its number shows a genuine gradient, decreasing outwards, which would indicate that a small burst of star formation 1.5 Gyr ago (or merged event) was more intense in the inner regions of LMC. The fainter stars in the subgiant branch are well matched by the 13.5 Gyr ( $Z=0.001$ ) isochrone, but no blue extended horizontal branch can be seen in the CMDs.

**It is striking that, at 9 Kpc from the LMC center, there is still galaxy with intermediate-age stars.**

## THE PROJECT

We are undertaking a major project aimed at obtaining detailed star formation histories across the LMC disk, in order to characterize its stellar population gradients and to delimit the total extent of its stellar population. To this end, we have imaged 12 fields, 6 toward approximately the North of the bar at  $3^\circ$ ,  $5^\circ$ ,  $6^\circ$ ,  $8^\circ$ ,  $9^\circ$  and  $10^\circ$  from the LMC center ( $\sim 3$ , 4, 5, 7, 8 and 9 Kpc), and 6 fields in the East-West directions at  $\sim 5$ , 6.5 and 8 Kpc on both sides of the bar (see Fig. 1). This will allow us to find its actual outer edge and to fully characterize the differences in the SFH at each side of the bar. For all these fields we have obtained color-magnitude diagrams reaching the oldest MS turnoffs.



Field	Telescope	Integration Time [sec]
N3 ( $8^\circ \sim 7$ Kpc)	4m CTIO Blanco	V 5400 - I 4800
N4 ( $9^\circ \sim 8$ Kpc)	2.2 m ESO/MPI	V 2799 - I 900
N5 ( $10^\circ \sim 9$ Kpc)	2.2 m ESO/MPI	V 2700 - I 2700

Table 1

## ONGOING WORK

We are currently making the photometry of 6 fields (3 to East and 3 to West) at  $\sim 5$ , 6.5 and 8 Kpc from the LMC center in B and I bands in order to determine detailed star formation histories at different galactocentric distances and in different directions, and to see whether the 1.5 Gyr stellar population seen at large galactocentric distance is related to a global or localized event.

Also we are interested in detecting the signature of possible interactions LMC-SMC in the fields towards the East, that may be reflected in the star formation histories of these regions.

Moreover we plan to look for variable stars in the central fields (E1 to East and W1 to West)

## REFERENCES

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