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STUDYING GALAXY FORMATION AND EVOLUTION FROM LOCAL GROUP GALAXIES

C. Gallart,[1] A. Aparicio,[1] E. J. Bernard,[1] R. Carrera,[1] I. Drozdovsky,[1] S. L. Hidalgo,[1] A. Marín-Franch,[1] I. P. Meschin,[1] M. Monelli,[1] N. E. D. Noël,[1] and A. Rosenberg[1]

We present the main research activities of the IAC research Group "Stellar Populations in Galaxies", with emphasis on the topics that are directly related to planned research using the GTC.

We plan to conduct a comprehensive study of Local Group galaxies using a number of complementary tools to shed light into the two main mechanisms that determine galaxy formation and evolution:
1. The star formation history (SFH), and its influence on galaxy evolution, through: i) The study of deep colour-magnitude diagrams (CMD) of each galaxy; ii) the spectroscopic abundances of resolved stars; iii) the analysis of the properties of their variable stars; iv) the study of the Milky Way Cluster system.
2. The mass assembly and the dynamical evolution of each system, through: i) The stellar population gradients and kinematics of stars of different ages; ii) the dynamics of the Local Group and the influence of interactions on galaxy evolution.

This project is designed in order to make an excellent use of the GTC and its first light instruments, especially OSIRIS.

A. The SFH and its gradients from deep CMDs.

Our group has been traditionally dedicated to the derivation of SFHs from deep CMDs (see http://iac-star.iac.es/iac-star/). We are involved in two HST-ACS programs with a total of 113 orbits to obtain CMDs reaching the oldest main-sequence turnoffs in 5 isolated Local Group galaxies. In addition, we are studying the SFH of the Magellanic Clouds using ground based observations.

The presence of stellar population gradients in dwarf galaxies, with the youngest population concentrated toward their center is well known. However, the actual nature of the older structure, and its extension, is still uncertain. GTC/OSIRIS large field of view and superb sensitivity present the possibility to test the extent of the stellar *halo* of Local Group galaxies using horizontal branch stars. Spectroscopy will make it possible to distinguish stars actually belonging to the galaxy from foreground dwarf stars and compact high-z objects in the outer fields. Finally, using high-spectral resolution, we will study the dynamics of the luminous evolved stellar populations at a wide range of galactocentric distances.

B. Metallicities using the Ca II triplet.

We have obtained (R. Carrera, PhD Thesis) a new calibration of the CaII triplet strength in RGB stars as a function of metallicity, which is valid for a higher range of ages ($13 \leq$ age(Gyr) ≤ 0.25) and metallicities ($-2.2 \leq$ [Fe/H] $\leq +0.5$) than previous calibrations. It has been used to obtain metallicities for a large number of stars in the LMC and the SMC.

With the GTC and OSIRIS, we plan to extend this work to the rest of Local Group galaxies (d$\simeq$ 1 Mpc). Candidate RGB stars have I$\simeq$21–21.5 and will densely populate the OSIRIS field of view ($\simeq$30 stars/sq.arcmin) to allow us efficient use of multiobject spectroscopy. The high brightness of the sky in the CaII triplet region implies that the possibility of micro-slit nod-and-suffle is essential.

C. Variable stars

Variable stars offer a complementary tool to interpret the stellar populations of a galaxy. In particular, RR Lyrae reveal the presence of a very old ($\simeq$10 Gyr) stellar population, while short-period Classical and Anomalous Cepheids are tracers of populations up to a few hundred Myr and a few Gyr old respectively (Gallart et al. 2004, AJ, 127, 1486). Using variable stars as stellar population indicators is specially important when it is not possible to obtain CMDs reaching the oldest main-sequence turnoffs.

With the GTC and OSIRIS, we plan to carry on a systematic characterization of the variable star populations in Local Group galaxies (both dwarf galaxies and M31 and M33). This will complement our ACS imaging project: with ACS, only a handful of galaxies are being studied, and only part of their total extent is covered. To find RR Lyrae stars, the most challenging part of this project, we need to reach g'$\simeq$25.5 in short exposure times. OSIRIS allows us to do that in 10-15 minutes. In addition, its field of view is very well suited to cover most dwarf galaxies in one to a few fields.

[1]Instituto de Astrofísica de Canarias, Vía Láctea s/n, 38200, La Laguna, Tenerife, Spain (carme@iac.es).

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