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THE STAR FORMATION AND CHEMICAL ENRICHMENT HISTORY OF THE FORNAX DSPH GALAXY[1]

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RESUMEN

Presentamos diagramas color-magnitud profundos a diferentes distancias galactocéntricas de la galaxia esferoidal enana del Grupo Local Fornax, así como resultados preliminares sobre las metalicidades de sus estrellas individuales, obtenidas a partir de espectroscopía del triplete del Ca II. Estos datos se van a usar para una determinación fiable de la historia de formación estelar y de enriquecimiento químico de esta galaxia.

ABSTRACT

We present new deep color-magnitude diagrams at different galactocentric distances of the Local Group dwarf spheroidal galaxy Fornax, and preliminary results on metallicities of individual stars, obtained from Ca II triplet spectroscopy. These data will be used to reliably derive the star formation and chemical enrichment histories of this galaxy.

Key Words: **GALAXIES: INDIVIDUAL (FORNAX); GALAXIES: ABUNDANCES; GALAXIES: STELLAR CONTENT**

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1. INTRODUCTION.

The nearest galaxies offer the opportunity of studying their evolutionary status in great detail, through the information offered by their resolved stars. Color-magnitude diagrams (CMD) reaching the oldest main-sequence turnoffs give accurate star formation history information (see Gallart 2000) while spectroscopy of the brightest stars provides metallicities, which combined with photometry, will provide insight on the chemical enrichment history. Indeed, the combination of both types of data is the most powerful tool to break the classical age-metallicity degeneracy in stellar populations and to derive reliable and accurate star formation and chemical enrichment histories (Gallart et al. 2002).

In the last decade, a number of CMDs reaching the oldest main-sequence turnoffs have beautifully shown the varied star formation histories among the Milky Way satellites. Spectroscopic studies providing detailed chemical abundances of the stars in these galaxies are, however, scarce, due to the large investment of large-aperture telescope time required. An economical way of obtaining metallicity information involves low resolution spectroscopy. The Ca II triplet offers the possibility of obtaining global [Fe/H] values for individual stars with reasonable precision ($\leq$ 0.2 dex), and this technique has developed into a popular way of using low-resolution spectra to estimate the abundances of stars in globular clusters and dSph galaxies.

We undertook a study of the star formation and chemical enrichment history of the Local Group dSph galaxy Fornax with the twofold approach mentioned above: we used the VLT with FORS1 to obtain photometry reaching the oldest main-sequence turnoffs and Ca II triplet spectroscopy of a sample of red giant branch (RGB) stars in the same fields. Our main results are described below.

2. DEEP COLOR-MAGNITUDE DIAGRAMS.

We obtained old main-sequence turnoff photometry in three fields at two galactocentric distances in the dSph Fornax, using FORS1 at the VLT. The observations were performed in service mode in July 2000, with the requirement of seeing $\leq$ 0.6”, which is key to perform photometry in fields affected by stellar crowding.

Figure 1 shows the CMDs at the two galactocentric distances. The CMD in Figure 1a corresponds to the central field, while Figure 1b displays the combined CMD of the off-center fields. Our goal is to derive the complete star formation history in these fields, and test for possible spatial variations, using synthetic CMDs (as in Gallart et al. 1999) and the input on Z(t) from the Ca II triplet study (see below). These results will be presented in Gallart et

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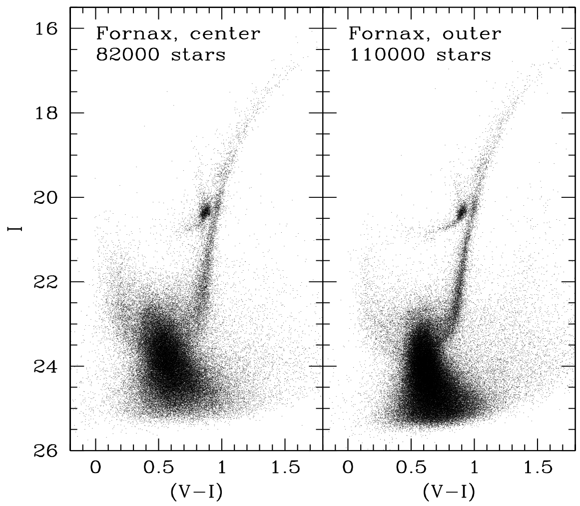

Fig. 1. a) CMD for a FORS1 field centered in Fornax; b) composite CMD for the two fields situated ≃11 arcmin North

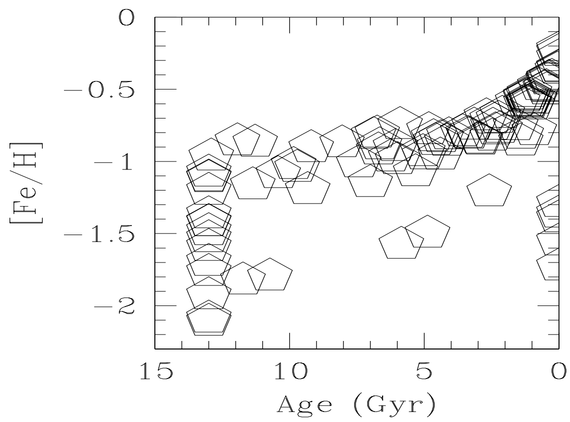

Fig. 2. Preliminary age-metallicity relation obtained for Fornax from Ca II triplet spectroscopy and RGB photometry.

al. 2002.

3. STELLAR METALLICITIES FROM THE CA II TRIPLET

We obtained Ca II triplet spectroscopy for about 100 RGB stars in the central region of Fornax, using FORS1 at the VLT, in December 1999. We used grism GRIS-600I+15, resulting in a central wavelength near 7490 Å, a dispersion of 1.06 Å per pixel, and a resolution R≃1530. The excellent seeing conditions during the observations -most of the time below 0.8" seeing- allowed us to use slitlet widths of 0.7 arcsec. We observed seven fields, with an average of 17 targets per field. For each, two 20-min exposures were acquired.

We find a large metallicity dispersion in Fornax, with about 20% of the objects having low abundances (-2.5 ≤ [Fe/H] ≤ -1.3), and about 35% having abundances greater than 47 Tuc ([Fe/H]=–0.7). The peak of the metallicity distribution occurs at [Fe/H] ≃ –0.9. The most metal rich stars have Ca II triplet equivalent widths W(Ca) as strong as the average of the metal-richer LMC population in Cole et al. (2000). This allows us to put an upper limit to the metallicity of the stars in Fornax, which lie in a somewhat uncertain area of the W(Ca)-[Fe/H] calibration (see Pont et al. 2002 for a thorough discussion of this point).

The combination of the spectroscopic metallicity for each star with its color on the RGB provides a constraint on its age, and therefore, a well delineated age-metallicity relation can be obtained, especially for the more metal-rich, young stars: the colors of most metal-rich RGB stars are much bluer than those of an old globular cluster of the same metallicity, and lead to the conclusion that they must be much younger. Indeed, while for each given metallicity, stars older than ≃ 3 Gyr have a small range in color, the younger stars are substantially and increasingly bluer with decreasing age. In Figure 2 we display a preliminary version of the Fornax age-metallicity relation obtained by Pont et al. (2002).

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