Dwarf Galaxies: From the Deep Universe to the Present
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Stellar chemo-kinematics of isolated dwarf spheroidal galaxies

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Abstract. The study of dwarf spheroidal galaxies (dSph) is of great importance to understand galaxy evolution at the low-mass end. In the Local Group the majority of them are found to be satellites of the Milky Way or M31. The closest ones have been studied in great detail, however it is hard to constrain if their present-day observed properties are mainly caused by internal or environmental mechanisms. In order to minimize these effects and gain an insight into their intrinsic properties, we are studying two of the three isolated dSph galaxies in the Local Group, i.e. Cetus and Tucana, located far beyond the virial radius of the Milky Way and M31. We present here results from our recently published analysis of Cetus (Taibi *et al.* 2018) and preliminary results for Tucana (Taibi *et al.*in prep.).

Keywords. galaxies: dwarf, Local Group - stars: kinematics, metallicity - techniques: spectroscopy

1. Introduction

We observed a sizable spectroscopic sample of individual red giant branch stars with VLT/FORS2 instrument in MXU mode for Cetus and Tucana – 80 and 50 targets, respectively, of which 54 and 42 are probable members. The spectra have a resolution of $R \sim 2600$ and cover the region of the CaII triplet around 8600Å from which we obtained velocities and metallicities ([Fe/H]). The resulting median S/N for both samples was of 25 pxl^{-1}. Our targets reach out to more than 5 half-light radii ($5R_e$) allowing us to obtain information on the large scale properties of the two galaxies (see top Fig. 1).

2. Chemical and Kinematic Analysis

We determined Equivalent Widths (EWs) for member stars by fitting the CaT lines with true Voigt profiles. We used the Starkenburg *et al.* (2010) relation to obtain [Fe/H] from the EWs. We found that Cetus (Tucana) is a metal-poor system with a significant metallicity spread: average [Fe/H] $= -1.80$ (-1.64) dex, M.A.D. scatter $= 0.49$ (0.45) dex. Mean [Fe/H] values for both galaxies agree with the Luminosity-Metallicity relation (Kirby *et al.* 2013b). The metallicity distribution as a function of the elliptical radius (see bottom Fig. 1) presents for both galaxies a metallicity gradient: -0.09 (-0.06) dex/R_e, akin to what found for other dSphs of similar mass but inhabiting a range of environments (e.g. MW dSphs as well as VV124 and Phoenix; see Leaman *et al.* 2013, Schroyen *et al.*

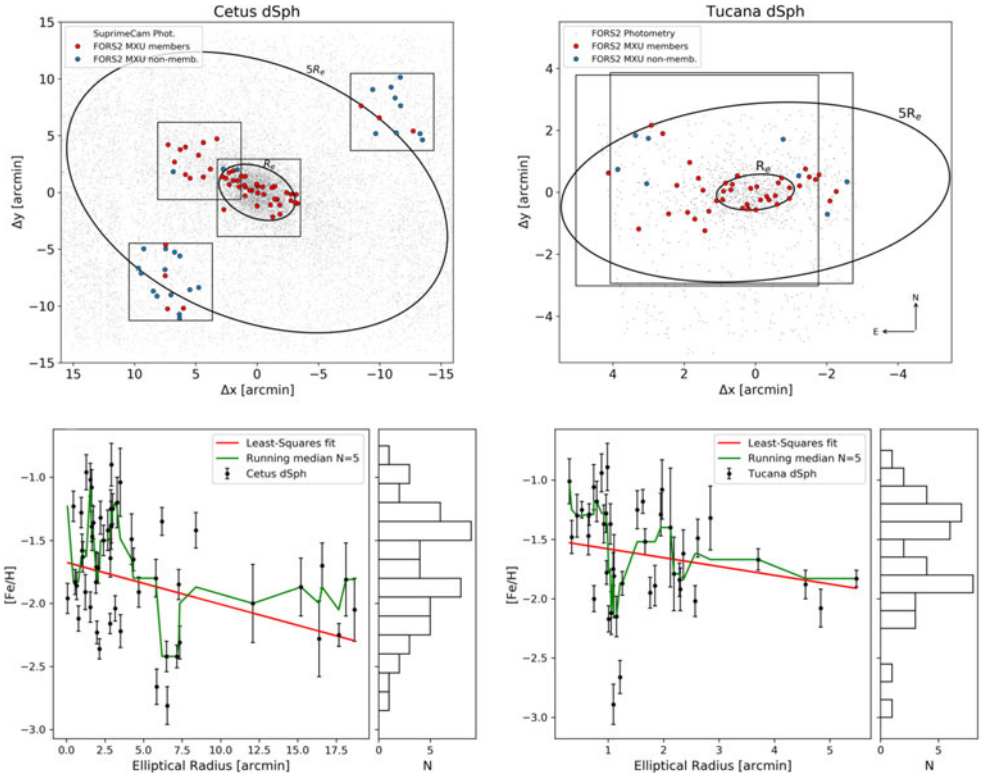

Figure 1. *Top:* Spatial distribution of stars along the line-of-sight to the Cetus (left) and Tucana (right) dSphs. Black points represent photometric data; FORS2 MXU targets classified as members are marked with red circles, while the non-members are marked with blue circles. The large squares indicate the FORS2 pointings. The ellipses indicate 5 times the galaxies half-light radius R_e. *Bottom:* individual metallicity measurements as a function of the elliptical radius for Cetus (left) and Tucana (right). The red line is the least-squares linear fit to the data, while the green line represents the running median boxcar having a 5-point kernel size.

2013, Kirby *et al.* 2013a, Kacharov *et al.* 2017). This seems to suggest that metallicity gradients can be mainly caused by internal rather than environmental effects.

We obtained heliocentric velocities for Cetus (Tucana) with median accuracy of ±5 km/s (±6 km/s). We tested for the presence of rotation and the significance of a linear rotation model vs. a dispersion-only one. The Bayesian analysis showed that Cetus and Tucana are mainly dispersion-supported systems – $\sigma_v = 11.0^{+1.6}_{-1.3}$ ($12.9^{+2.0}_{-1.7}$) km/s, with no (weakly) significant signs of internal rotation. There are also tentative indications of two chemo-kinematically distinct sub-populations in Cetus, with the more metal-poor (MP) stars showing a hotter kinematics than the metal-richer (MR) ones. However this latter result would benefit from a larger sample.

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