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The chemistry of the neighbors: detailed abundances in the Sgr and CMa dwarf galaxies

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Abstract. We summarize the results of our ongoing investigation of the chemical abundances in the Sagittarius Dwarf Spheroidal Galaxy (Sgr dSph) and in the Canis Major Overdensity (CMa). 12 RGB stars were analyzed in the Sgr dSph, plus 5 in the associated globular Terzan 7, together with three CMa candidate members. Detailed abundances have been derived for up to 23 elements from Oxygen to Europium.

Key words. Stars: abundances – Stars: atmospheres – Galaxies: individual: Sgr dSph – Galaxies: individual: CMa – Galaxies: abundances – Galaxy: globular clusters: individual: Terzan 7 – Galaxy: globular clusters: individual: Palomar 12 – Galaxy: abundances

1. Introduction

In recent years, Local Group dwarf galaxies have acquired an increasing importance since they are believed to constitute the relic "building blocks" out of which major galaxies should have formed. In particular, the discovery of Sgr dSph (Ibata et al. 1995), and the subsequent detection of its tidal debris in the Halo (see e.g. Majewski et al. 2003) clearly showed how dwarf galaxies still play an important role in the evolution of major galaxies like the Milky Way. More recently, the tidal structure known as GASS (Galactic Anticenter Stellar Structure, see Newberg et al. 2002; Crane et al. 2003) has been associated to the still controversial detection of a dwarf galaxy remnant in CMa (see Martin et al. 2004; Bellazzini et al. 2004; Momany et al. 2004).

2. Sgr dSph and Terzan 7

We are conducting a study on the chemical abundances in Sgr dSph and in the associated globular cluster Terzan 7, by analyzing high resolution VLT-UVES spectra of RGB stars, and deriving abundances for up to 23 elements from Oxygen to Europium. So far, results for Iron and α elements have been published in Bonifacio et al. (2004) for 12 Sgr dSph main body stars ($T_{eff} \sim 4900$ K and $\log g \sim 2.5$). For two of them an analysis for 21 elements has been presented in Bonifacio et al. (2000). In Sbordone et al. (2005 B) we analyze 5 Terzan 7 stars (T_{eff} between 3945 and 4421 K, $\log g$ between 0.8 and 1.3). Sulfur abundances for

Send offprint requests to: L. Sbordone three of the Ter 7 stars have been presented in Caffau et al. (2005). In all cases (except in Bonifacio et al. 2000), we have employed our Linux-ported version of the ATLAS-WIDTH-SYNTHE suite (Kurucz 1993; Sbordone et al. 2004; Sbordone 2005 C) to compute stellar atmosphere models and spectral syntheses, and to derive abundances.

The studied stars in the Sgr dSph main body show high metallicity ([Fe/H] between -0.8 and solar) and an undersolar [α/Fe] ratio, decreasing with increasing metallicity. Sgr dSph appears to fall on the same [Fe/H] vs [α/Fe] sequence with the other LG dSph, populating the Fe-rich, α-poor end of the sequence. This indicates that a prolonged albeit slow star formation has taken place in the galaxy, a fact confirmed also by the very young age of the studied population (age < 2 GYr). We looked for traces of interstellar gas in Sgr dSph, to support for such a recent star formation, finding only little traces of ISM (see Monai et al. 2005). Also the other studied elements present many significant departures from solar ratios, with underabundant Na, Al and Sc, deficient Ni, Cu and Zn, and strongly overabundant La, Ce and Nd. The five Ter 7 stars appear to share the same "chemical signature", showing a mean [Fe/H]=0.59 and solar [α/Fe].

The chemical pattern displayed by the young Sgr dSph population can be used to probe stellar populations, now belonging to the Milky Way (MW), to verify if they formed inside the Sgr dSph system. A striking example of this is Palomar 12, a young MW globular cluster, which abundances have been measured by Cohen (2004). This cluster was already suspected to have been tidally stripped from Sgr dSph (e. g. Bellazzini et al. 2003). Actually, Pal 12 chemical pattern appears to strikingly reproduce the one we find in Sgr dSph, even in the most significant departures from the solar ratios (such as α elements, Al, Ni, Cu, Zn, La, Ce...), thus leading to consider essentially sure its origin inside the Sgr dSph system.

3. The CMa overdensity

Shortly after the detection of the CMa overdensity, we undertook an exploratory program based on VLT-FLAMES spectra, to study the chemical abundances of CMa candidate member stars. In Sbordone et al. (2005 A) we present the results on the three UVES stars that appeared suitable as CMa members, analyzed with the same techniques described above. Based on chemical abundances, one of them is most likely a MW interloper, a second one is of uncertain origin, while the third one shows a rather peculiar abundance pattern that makes it unlikely to have originated inside the MW. It is a metal rich ([Fe/H]=0.15) subgiant (T_{eff}=5367 K, log g=3.5), showing again underabundant α elements, high La, Ce and Nd abundance, but, at odds with what we find in Sgr dSph, a significant Cu overabundance ([Cu/Fe]=0.25). The radial velocity of this star, also, appears to be the one that satisfies better the reported dynamics of the CMa overdensity.

References

Bellazzini, M., Ferraro, F. R., & Ibata, R. 2003, AJ, 125, 188 (2003)

Bellazzini, M., et al., 2004, MNRAS, 354, 1263

Bonifacio, P., et al., 2000, A&A, 359, 663

Bonifacio, P., et al. 2004, A&A, 414, 503

Caffau, E., Bonifacio, P., Faraggiana, R., & Sbordone, L. 2005, A&A, 436, L9

Crane, J. D., et al., 2003, ApJ, 594, L119

Cohen, J. G. 2004, AJ, 127, 1545

Ibata, R. A., Gilmore, G., & Irwin, M. J. 1995, MNRAS, 277, 781

Kurucz R. L., 1993, CDROM 13, 18

Majewski, et al., 2003, ApJ, 599, 1082

Martin, N. F., et al., 2004, MNRAS, 348, 12

Momany, Y., et al., 2004, A&A, 421, L29

Monai, S., Bonifacio, P., & Sbordone, L. 2005, A&A, 433, 241

Newberg, H. J., et al. 2002, ApJ, 569, 245

Sbordone, L., Bonifacio, P., Castelli, F., & Kurucz, R. L. 2004, MSAIS, 5, 93

Sbordone, L., et al., 2005, A&A, 430, L13 (2005 A)

Sbordone, L., et al., 2005, A&A, 437, 905 (2005 B)

Sbordone, L. 2005, MSAIS, 8, 61 (2005 C)