VIMOS@VLT photometric and spectroscopic survey of the Sagittarius dwarf Spheroidal Galaxy

G. Giuffrida(Roma, Univ. Tor Vergata), S. Zaggia(INAF-OAPD), C. Izzo(ESO), R. Buonanno(Roma, Univ. Tor Vergata, ASDC), G. Marconi(ESO), L. Monaco(ESO), L. Sbordone(INAF-OAT, INAF-OAR), T. Szeifert(ESO) , P. Bonifacio(Obs. Paris)

Abstract

The closest neighbour of the Milky Way (MW), the Sagittarius dwarf Spheroidal Galaxy (Sgr dSph) is being tidally destroyed by the interaction with our Galaxy, losing its stellar content along a huge stream clearly detectable within the Galactic Halo.
The stellar content and internal dynamics of Sgr dSph are poorly known due to its dimensions (about 20°×5° in the sky) . We thus undertook a photometric and spectroscopic survey of Sgr dSph with VIMOS@VLT, to derive colour – magnitude diagrams (CMD) and radial velocities across the extension of the galaxy.
We observed 8 fields along the major and minor axis of the galaxy (along 7° and 2° respectively), plus 6 globular cluster likely associated with the galaxy (NGC 4147, Pal5, Pal12, Arp2, Ter7, Ter8). All of them were observed with V and I filters. The photometric catalogue was then used to select target for VIMOS-MOS high resolution mode. We obtained spectra for about 1200 stars: 250 stars in the Sgr main body fields were established as Sgr dSph members, and will now be the subject of high resolution spectroscopy studies for the purpose of chemical analysis.
This constitutes one of the richest photometric and spectroscopic homogeneous catalog of Sgr dSph stars ever realized.
The survey led to discover a surprising variety in the CMDs at varying distances from the dSph center, with younger, more metal rich populations in the dSph nucleus, preliminary evidence for a metallicity gradient and some hint of dishomogeneity along the major axis.

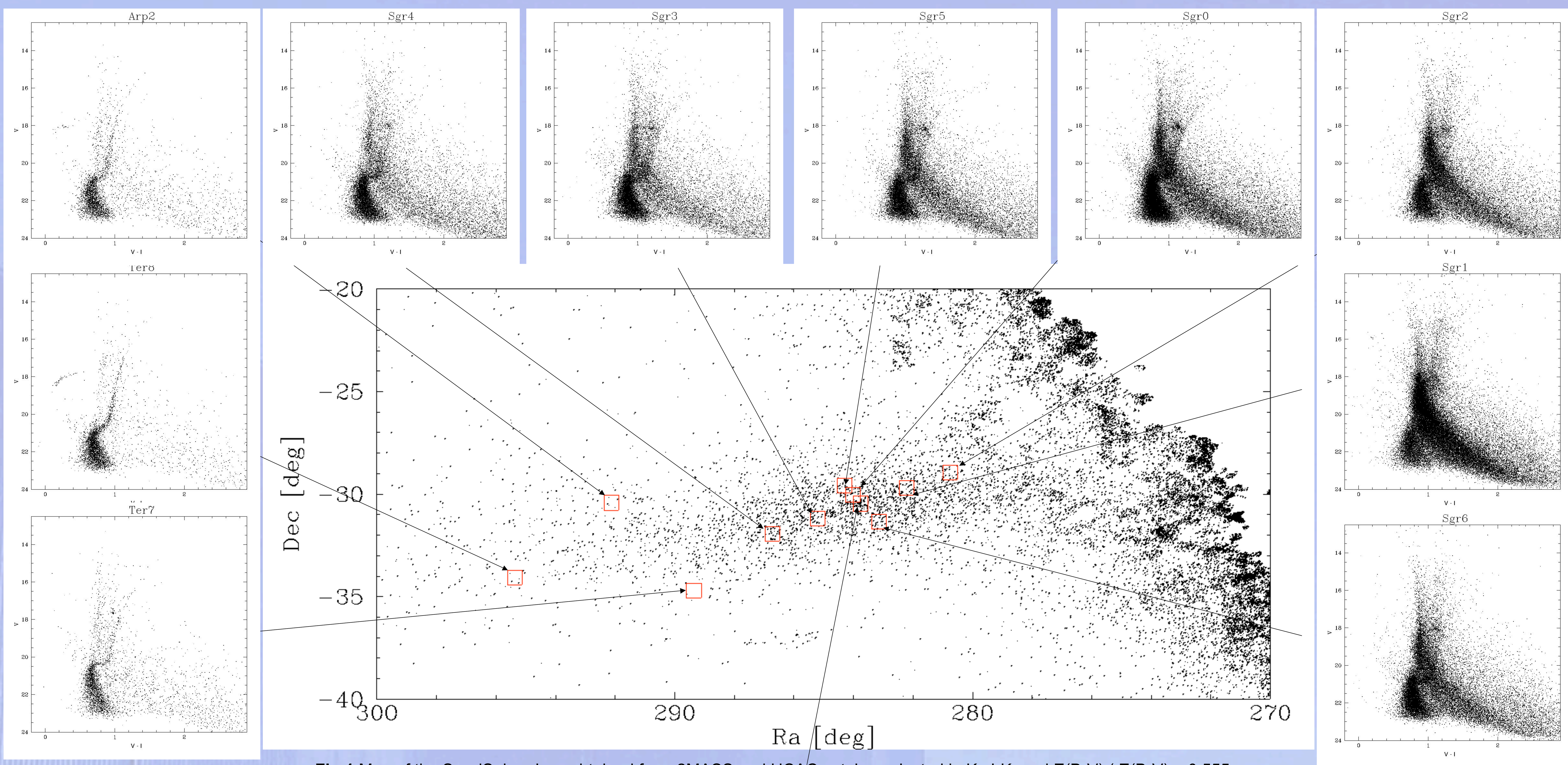
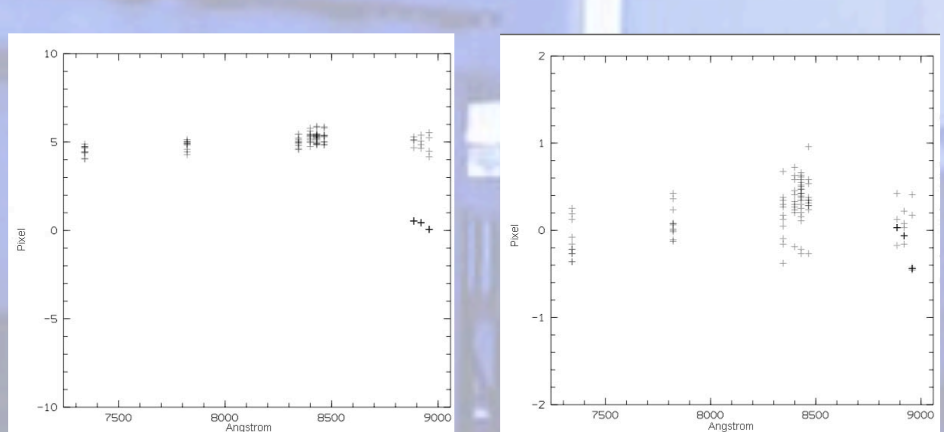


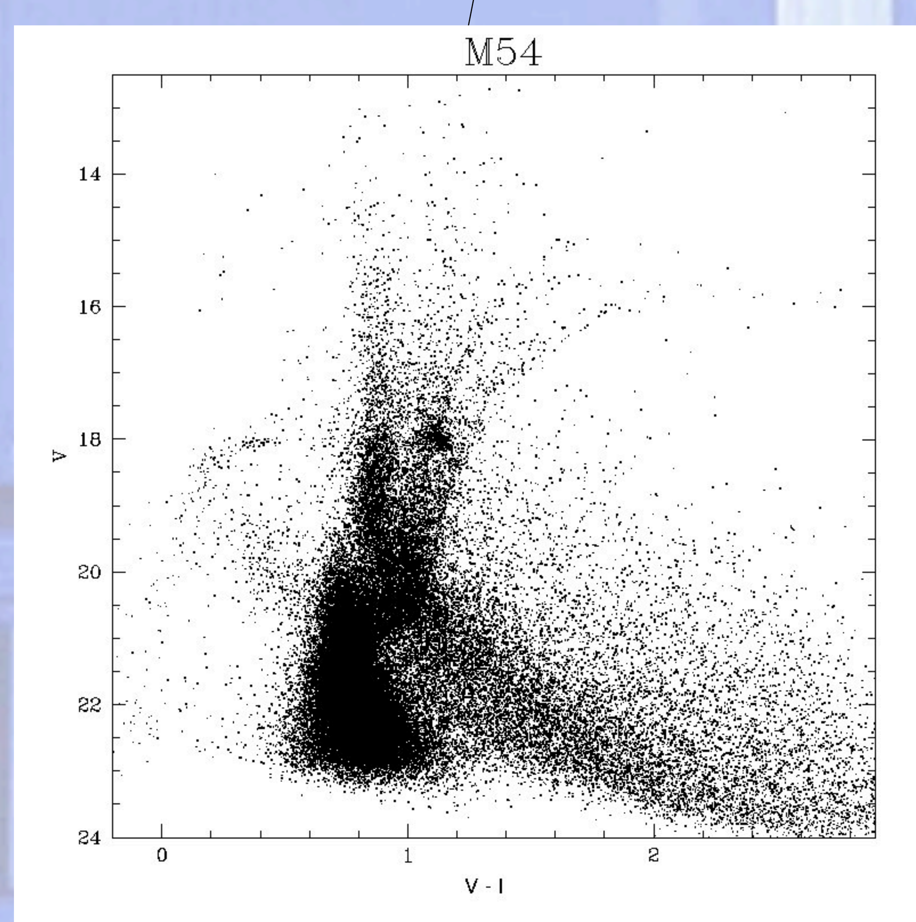
Fig.1 Map of the Sgr dSph galaxy obtained from 2MASS and UCAC catalog selected in K, J-K, and E(B-V) (E(B-V) < 0.555, 0.95 < $(J\text{-}K)_0$ < 1.10, 10.5 < K_0 < 12, see Majewski et al. 2003). Every observed field is connected with CMDs obtained from photometry.

Reduction Methods

VIMOS-IMA : Bias subtraction and Flat Field correction were performed by ESO automatic pipeline, Imcombine and Imarith IRAF tasks have been applied to correct fringing on I band. Photometry was obtained using DAOPHOTII/ALLSTAR (Stetson 1987) and DAOPHOTII/ALLFRAME (Stetson 1994) packages.

VIMOS-MOS (HR_RED, R=2500): The spectra were reduced using ESO-VIMOS pipeline in interactive way: a long work was necessary to obtain good results. The wavelength calibration was really problematic : automatically reduced data showed a systematic errors in the wavelength calibration up to 3 Angstrom (5 pixel or 104 Km/s) and large uncertainty. The figure below shows a plot (observed wavelength) - (expected wavelength) in pixel of some well-known sky lines against the wavelength in Angstrom of the sky lines. The plots are obtained from the same spectra reduced automatically (left) and interactively (right).The improvement is obvious (note the different scale of plots).
Finally we have obtained an average rms of 0.2-0.3 pixel.





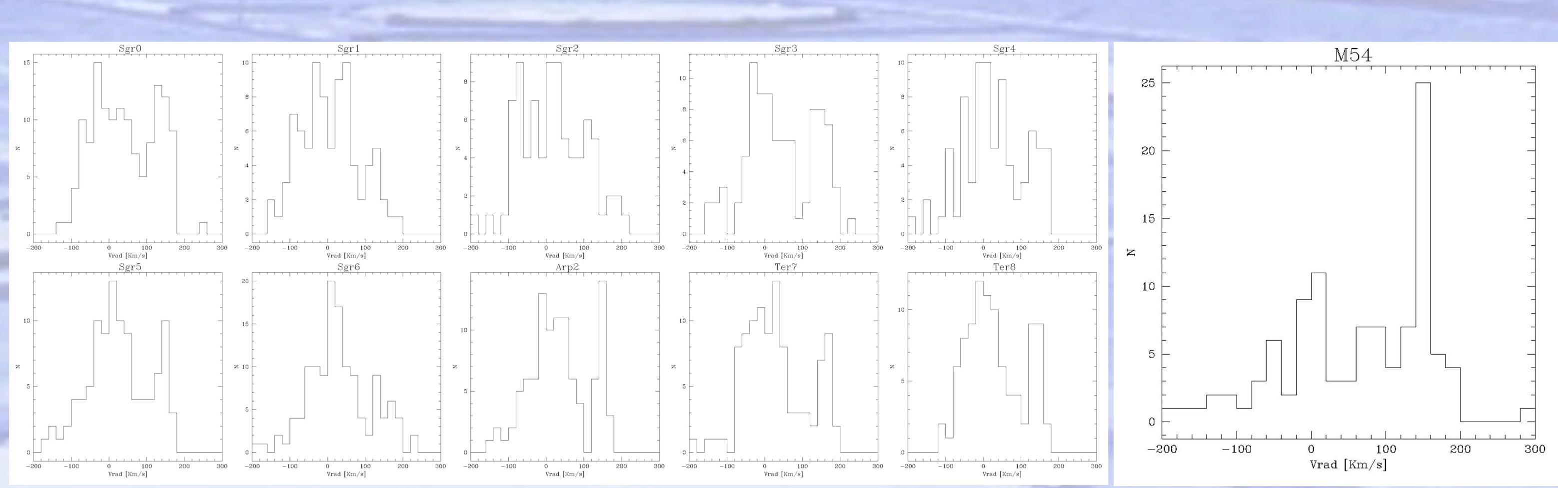


Fig.2 Histogram of radial velocities for each fields indicated in fig.1.

References:

Stetson P.~B., 1987, PASP, 99, 19
Stetson P.~B., 1994, PASP, 106, 250
Ibata R.~A et al. 1997, AJ, 113, 634
Majewski S.~R et al. 2003, ApJ, 599, 1082

RESULTS

We collected a large amount of data:

1) Photometry of about 330000 objects on Sgr dSph main body, M54 and the others globular clusters likely associated with Sgr dSph (Pal5, Pal12, Ter7, Ter8, NGC4147, Arp2).
2) Radial velocities for 815 stars in the Sgr dSph main body and M54 (225 have radial velocities compatible with Sgr dSph membership), and spectra of about 600 stars on the other globular clusters.

A first scientific result is presented in fig 3. Our data are compatible with Ibata et al. (1997) results with some interesting difference.First, Arp 2 appears to be independent from the motion of the Sgr dSph main body . Second, at low galactic latitude the velocity of the galaxy seems to be lower than suggested by Ibata's diagram. Comparison of the CMDs with synthetic population models is ongoing.
Finally, this work allowed us to derive a rich catalog of Sgr dSph candidate members which is at the same time extended across the whole galaxy and covering a good range in atmospheric parameters. The follow-up high resolution abundance analyses will thus provide insights in the evolution of Sgr dSph stellar populations.

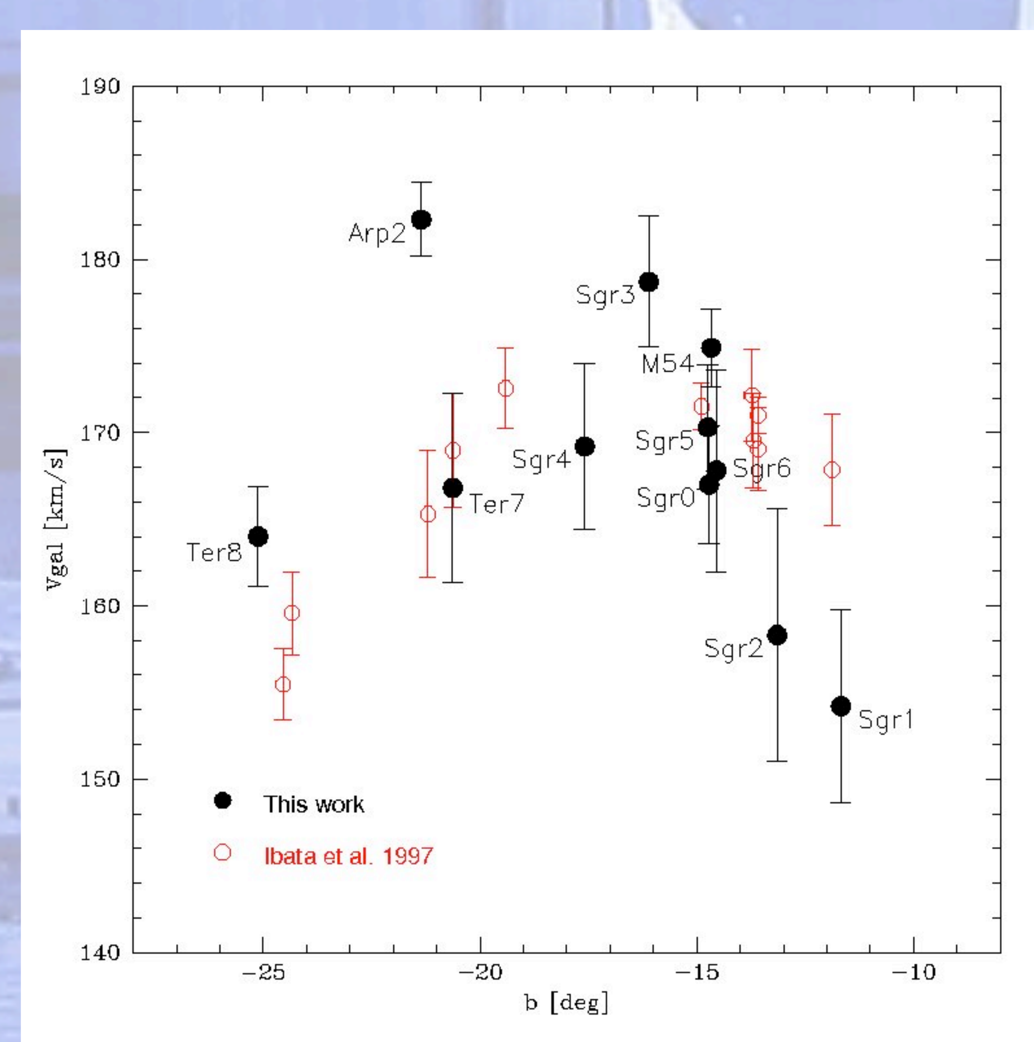


Fig.3 Mean galactocentric radial velocity along galactide latitude.