Studying the structure of the Milky Way halo with the SDSS

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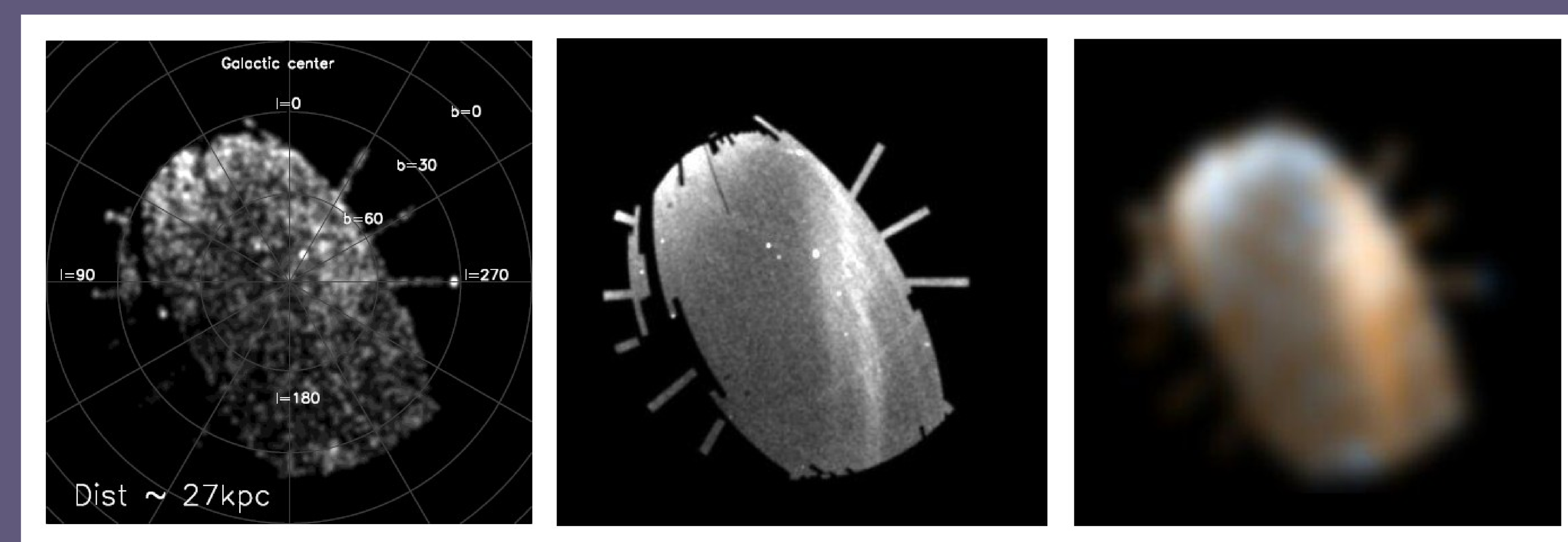
Abstract

The stellar halos of galaxies contain a lot of information about the assembly of galaxies owing to their long dynamical times and the relative absence of in-situ star formation. Substructures in the halo give important hints of accretion and merger events and enable us to study the role these events played in forming the Milky Way halo. To detect structures in the Milky Way halo in three dimensional space one needs information about the distance of objects. We use blue horizontal branch stars which have well-defined absolute magnitudes as standard candles to look for structures in the stellar halo with the SDSS.

Comparison of BHB stars with MSTO stars as distance indicators

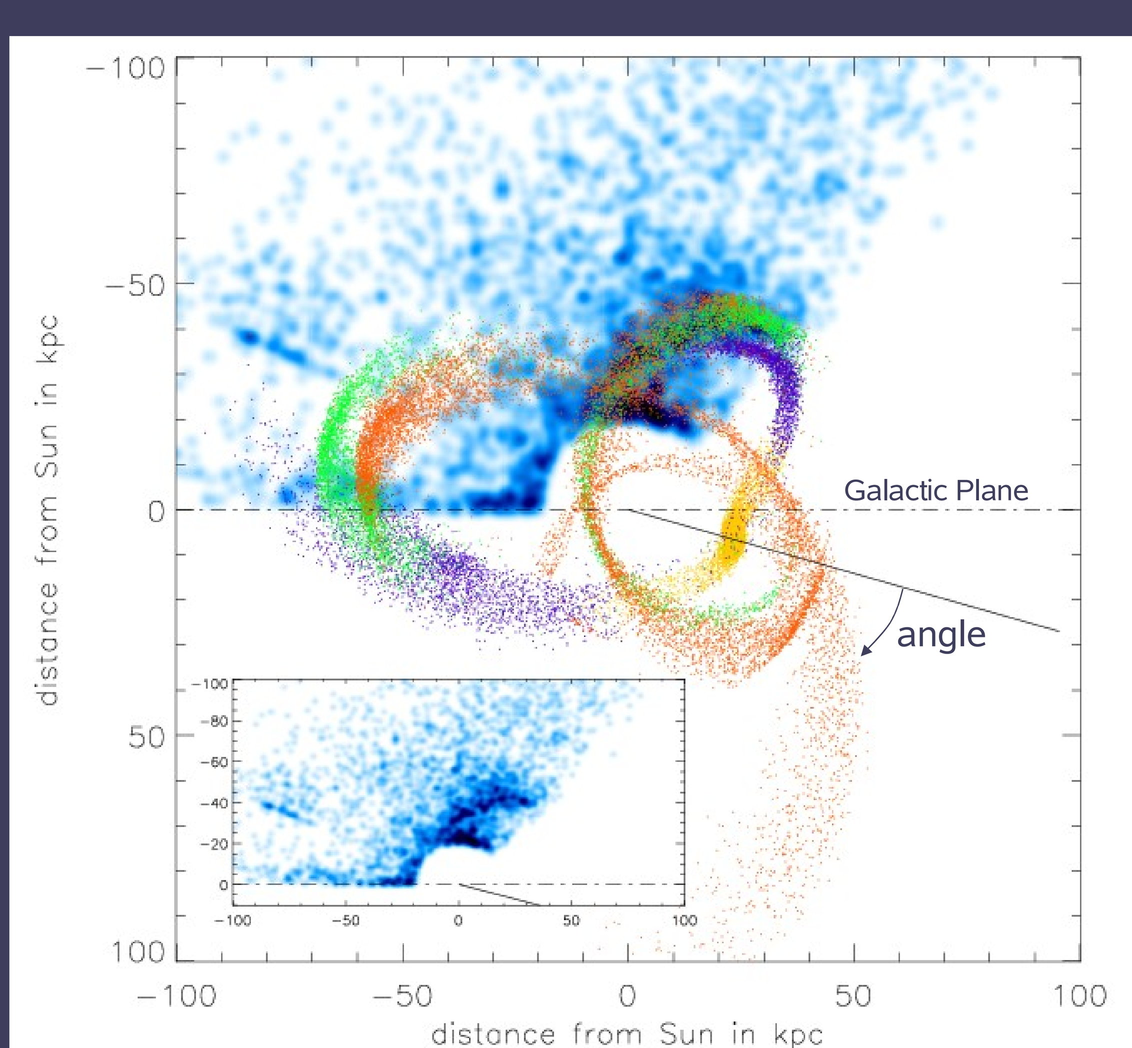


Distribution of BHB stars in a thick distance modulus slice (left panel) with the distance resolution degraded to match the resolution of main sequence turn-off (MSTO) stars (middle panel). The right panel shows the relative ratio of BHB to MSTO stars demonstrating large differences in the distributions for some structures. Our observation of significant stellar population variations in the Milky Way's stellar halo is in excellent accord with models in which the stellar halo is assembled from the disrupted debris of dwarf galaxies.

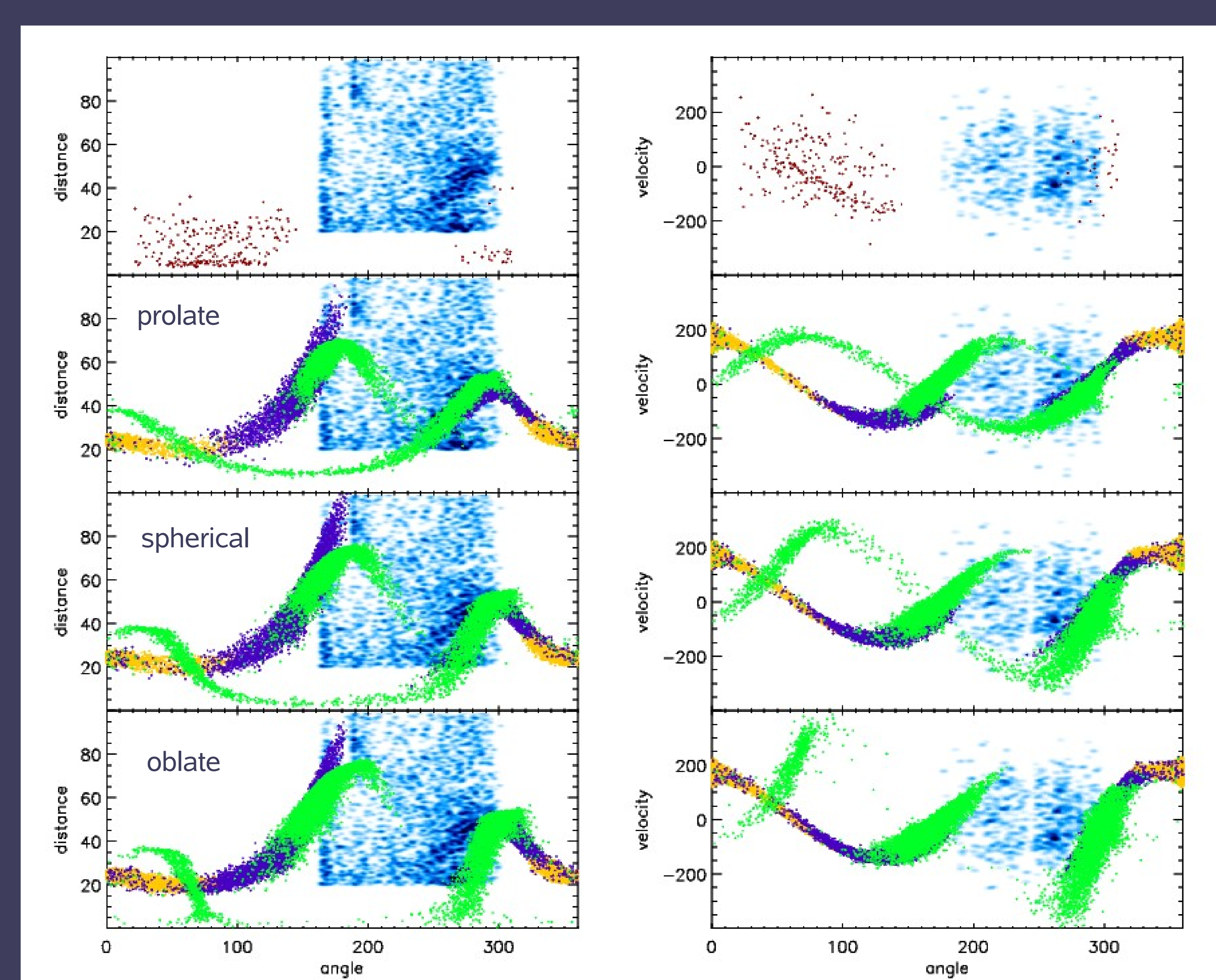
Structures in planes through the Galactic Center

We search for structures in distance slices like these shown above. To study their kinematic properties we construct planes through the Galactic Center. On these maps we included the effects of distance uncertainties. Individual objects are weighted by their probability to be a BHB star.

We use the Sagittarius dwarf galaxy debris as a test case for the potential of the method. Together with radial velocity measurements for BHB stars we compare the data with models of the Sagittarius debris by Law et al. 2005.



BHB star density distribution (blue, see also small panel) in a plane through the Sagittarius stream. The inner 20 kpc are cutted out to enhance the contrast in the outer regions. Overlayed is the debris models by Law et al. 2005 for a prolate Galactic halo potential. The different colors indicate the debris produced in different orbits, yellow standing for debris lost in the last 0.5 Gyrs, purple, green and red for two, three and four orbits ago, respectively. The solid line defines 0° for the longitudal coordinate system we use in the plots on the right.



Using the longitudal coordinate system defined in the plot on the left, we compare with models derived for different halo potentials (Law et al. 2005). This is shown in the lower three rows for three different implementations for the Galactic halo potential. The left panels show the spacial distribution, whereas on the right the distribution of radial velocities in dependence of the angle is shown. In the upper panels the BHB star distributions is shown together with a sample of M giants from Majewski et al. 2004.

References:
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D. R. Law, K. V. Johnston, S. R. Majewski 2005, ApJ, 619, 807
S. R. Majewski et al. 2004, ApJ, 128, 245