The Structure of the Sagittarius Stellar Stream as Traced by Blue Horizontal Branch Stars

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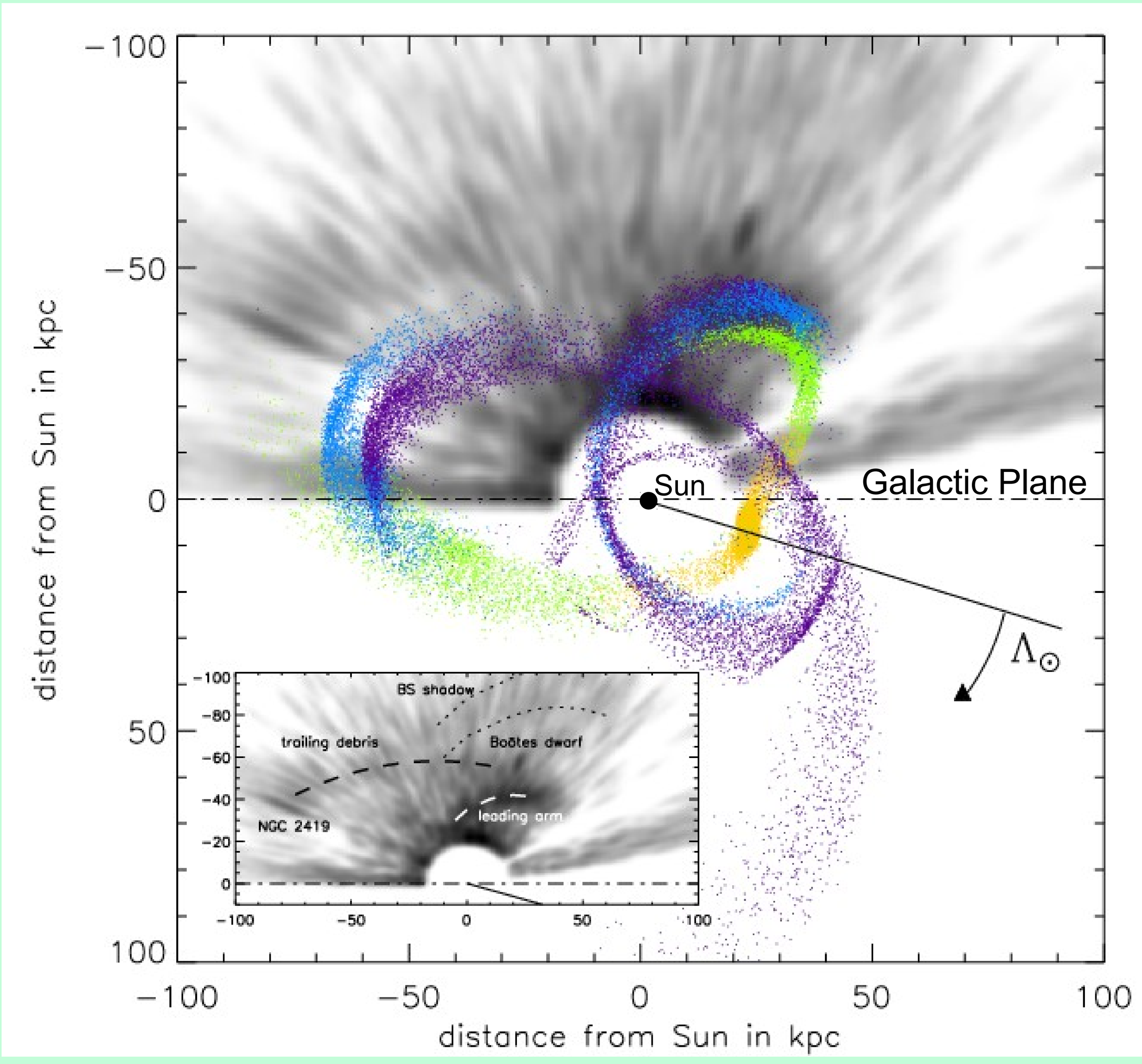
BHB Star Sample

We use a sample of blue horizontal branch (BHB) stars from the Sloan Digital Sky Survey Data Release 7 to explore the structure of the tidal tails from the Sagittarius (Sgr) Dwarf Galaxy. We use a method yielding BHB star candidates with up to about 70% purity from photometry alone (Xue et al. 2008, Bell et al. 2010). The resulting sample has a distance precision of roughly 5% and can probe distances in excess of 100 kpc.



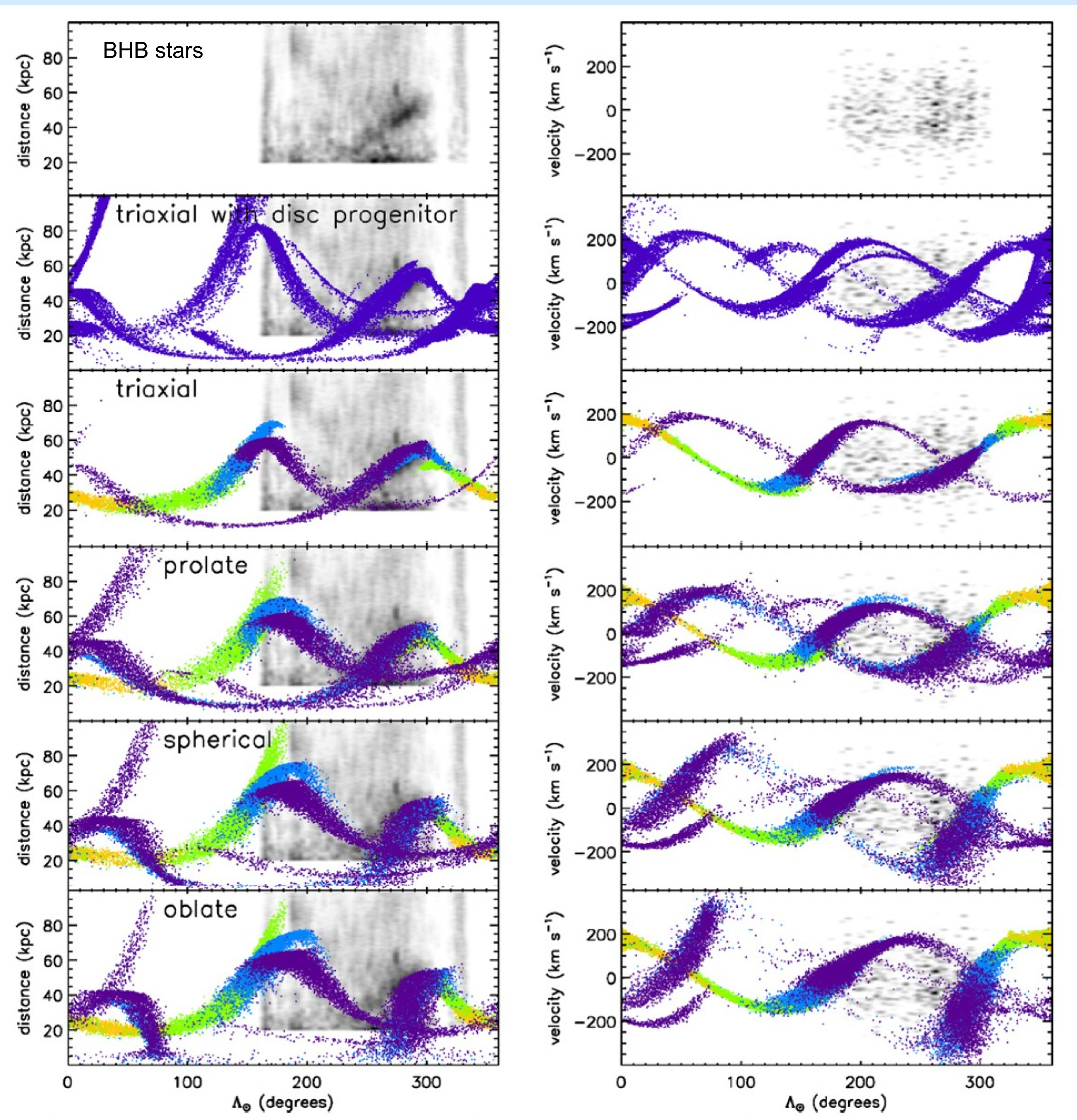
Sagittarius Orbital Plane

The figure on the left shows the BHB star distribution (grey) in the Sagittarius plane compared to models of the stream assuming a prolate potential (Law et al. 2005, colours indicate debris stripped from the progenitor on different passages). The BHB stars are shown as a density map taking into account both the distance uncertainties and the BHB star probability. The solid line on the lower right illustrates the definition of the longitudinal coordinate system which is used in the figures below.

Trailing Arm

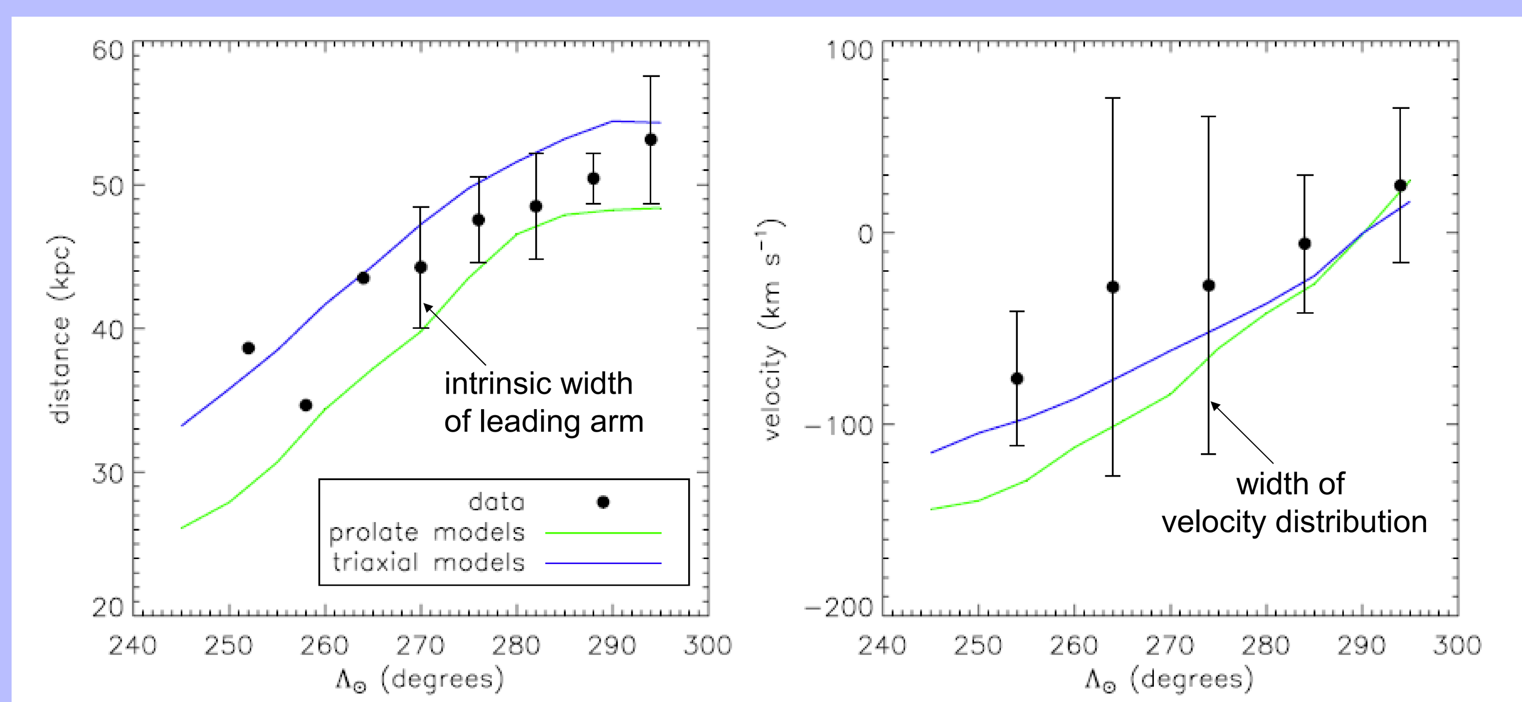
A possible extension to the trailing arm at distances of 60–80 kpc from the Sun is indicated by the dashed black line in the inset panel on the left. This feature has an estimated significance of at least 3.8σ. Current models predict that a distant “returning” segment of the debris stream should exist, but place it substantially closer to the Sun (see big panel on the left and model comparison below) where no debris is observed in our data.

Comparison to Models



Distance and velocity of the Sgr stream for data and models as functions of orbital longitude (coordinate system is illustrated in figure on the top). Models by Penarrubia et al. (2010; triaxial potential with disc progenitor), Law & Majewski (2010; triaxial potential with spheroidal progenitor) and Law et al. (2005; prolate, spherical and oblate potentials with spheroidal progenitors). The best match to the leading arm, which is the most prominent feature in the data, is seen for the models using triaxial and prolate potentials.

Distance and Velocity Dispersion of the Leading Arm

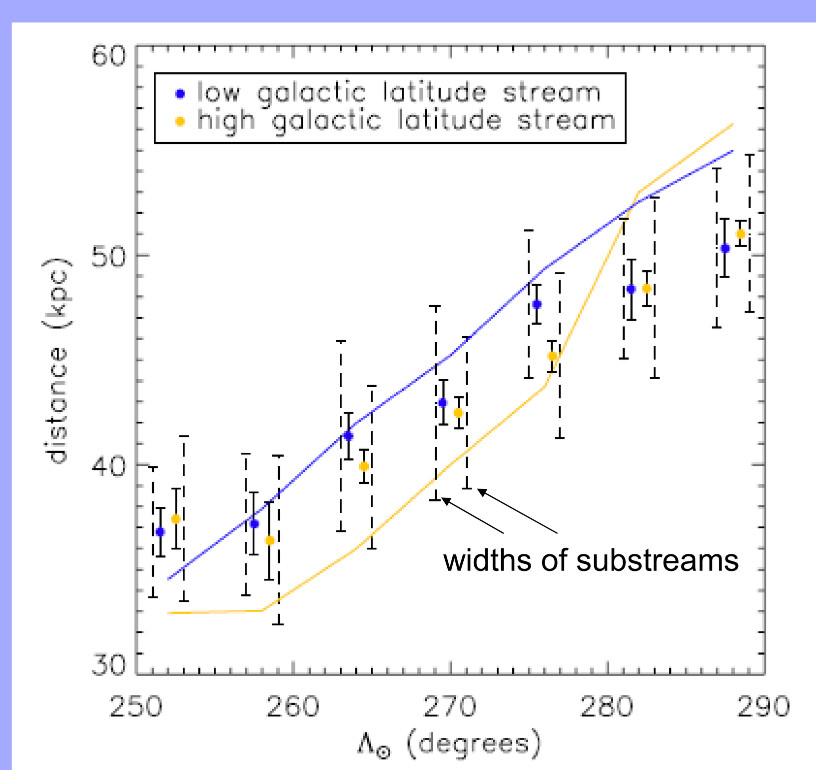


Distance and velocity dispersion of data for the leading arm. The blue and green lines show the mean values for the best matching models (prolate potential: Law et al. 2005, triaxial potential: Law & Majewski 2010).
Exploiting the distance precision of our tracers, we estimate the mean line-of-sight thickness of the leading arm to be about 3 kpc. Based on the spatial distribution we perform a selection for likely membership to the leading arm on the spectroscopic sample. For this subsample we estimate the mean velocity dispersion to be about 37 km s−1, which is in reasonable agreement with models of Sgr disruption.

Bifurcation of the Leading Arm Perpendicular to the Plane

Following up on the bifurcation perpendicular to the orbital plane of the stream observed mainly in more abundant stellar populations (e.g. Belokurov et al. 2006) we also measure the mean distance and line-of-sight thickness of the two branches in BHB stars.

The figure shows the mean distance and the distance error corrected line-of-sight thickness of the two branches as determined from the spatially selected sample of Sgr BHB stars from the leading arm. The data (dots) is not showing a clear trend for the distance offset between the two branches as seen in models (Penarrubia et al. 2010, solid lines) and also some other studies on different stellar populations (e.g. Niederste-Ostholt et al. 2010) and is also much smaller, differing by only 1–2 kpc in distance. Correnti et al. (2010) find similarly small offsets in Red Clump stars.



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For more details: Ruhland, C., et al. 2011, ApJ, 731,119