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Mapping the Halo's RR Lyrae distribution

Simon Murphy, Stefan Keller, Sayuri Prior, Gary Da Costa
Research School of Astronomy & Astrophysics
Australian National University

RR Lyrae variable stars are ideal tracers of Galactic halo structure. We have recently undertaken a large-scale survey for RR Lyrae from 2000 deg^2 of 2- and 3-epoch, *V*- and *R*-band photometry along the entire ecliptic plane. Figure 1 shows the distribution of the 2700 survey fields analysed to date in Galactic coordinates.

To efficiently select RRLs from a limited number of observations and colour information, we have developed a unique statistical selection method based on well-known RRL variability and colour distributions. Monte Carlo simulations show that our methods are up to 80% complete, with typical completeness of 60-70% for RRL*ab*s and ~50% for RRL*c*s.

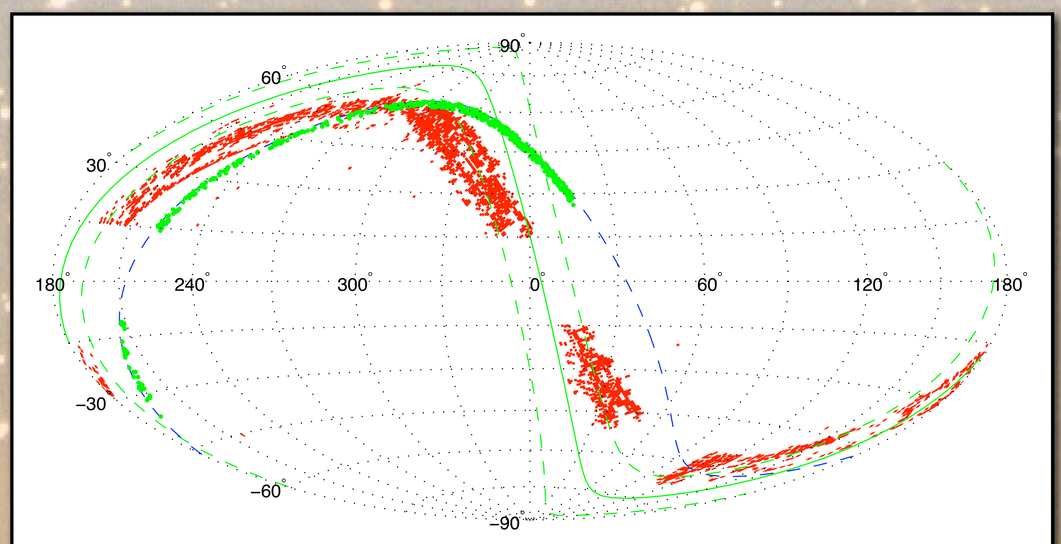

Figure 1: Survey fields in Galactic coordinates (red). The celestial equator is shown in blue with the QUEST-I RRL candidates in green. The green lines approximate the plane of debris from the Sgr dSph and ±10° from this plane.

Follow up photometry and spectroscopy confirms a low level of contamination (~25%), predominantly from blue eclipsing binaries and spurious photometry. Figure 2 shows the light and velocity variation for one of our confirmed candidates, a *V* = 16.8 RRL*ab*. Although it lies at a similar location and distance, its systemic velocity of 192.7 km s^{-1} is inconsistent with membership in the recently discovered Virgo overdensity (12.4^{hr} RA, d_{hel} = 19 kpc, e.g. Duffau et al. 2006 ApJ).

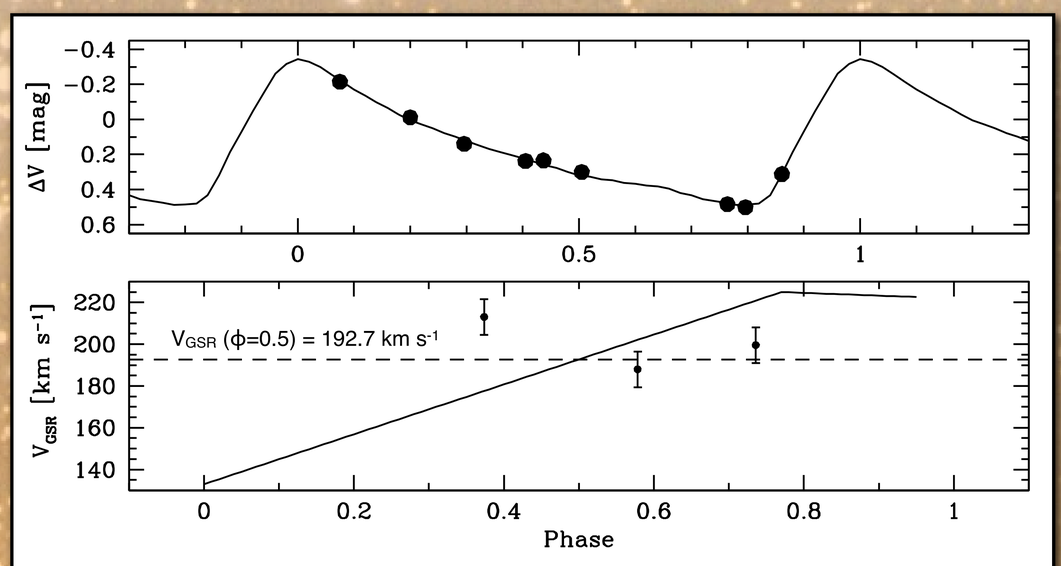

Figure 2: Candidate follow-up observations. The fitted RRL*ab* light curve has a 0.74 mag (*V*) amplitude and 0.60^d period.

From our sample of ~1500 candidates we have analysed the RRL number density profile for a spherical halo. The best fit to this model is shown in FIgure 3. In addition to confirming the shallower slope of ~ -2.5 first reported by Vivas & Zinn (2006 AJ), a substantial steepening of the density profile is seen at *R* > 50 kpc, which could indicate an edge to the outer stellar halo.

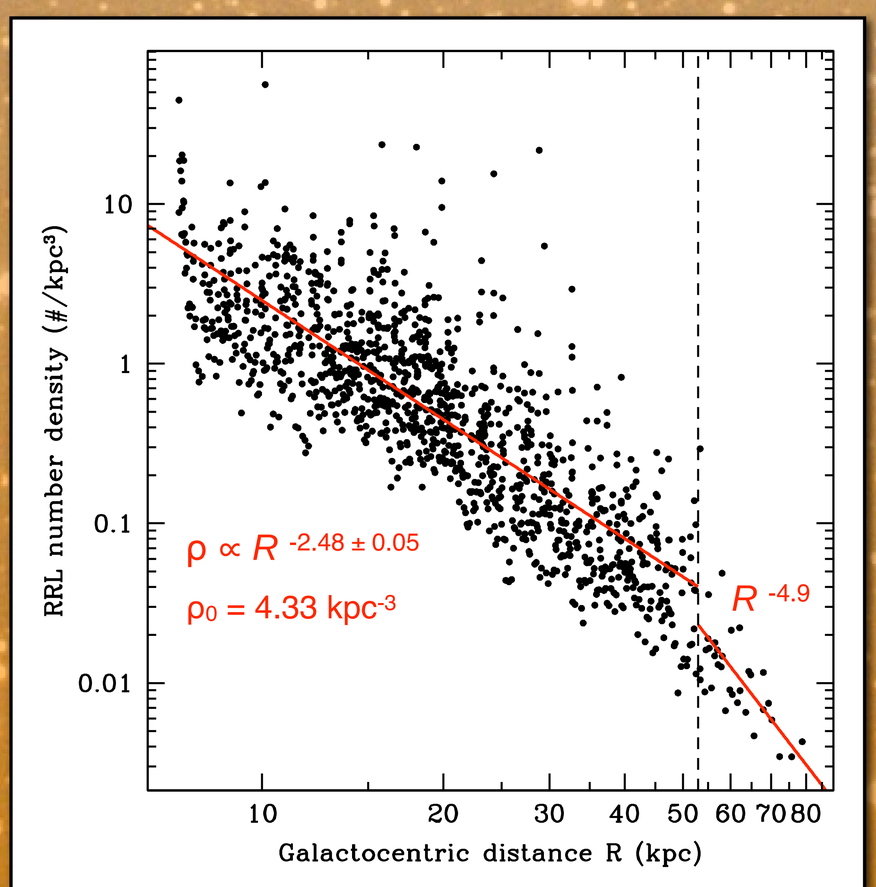

Figure 3. RRL number density as a function of Galactocentric distance for a spherically symmetric halo model. The best fits to the data are shown in red. Note the apparent underdensity at *R* > 53 kpc.

The spatial distribution of candidates has also been analysed for signs of substructure. Figure 4 shows a Monte Carlo generated statistical significance map for our candidate distribution. Several interesting sub-structures are apparent, including a large clump with strong significance at ~8^{hrs} RA approximately 32 kpc from the Sun.

Further details of the survey, selection methods and analysis will be available in an upcoming paper.

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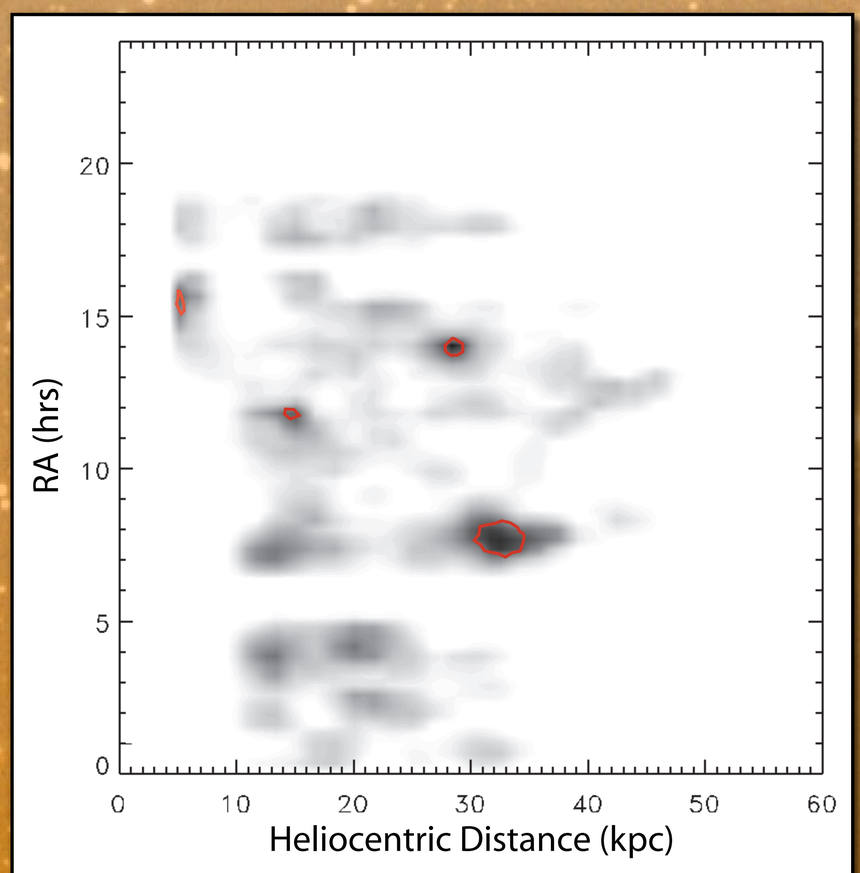

Figure 4: Significance map for a subset of our candidate distribution, based on an R^{-3} simulated halo. Contours show 10σ overdensities. The clump at ~5 kpc is presumably an artifact of the simulated halo, possibly related to completeness at the bright survey limit.