Substructure revealed by RR Lyraes in SDSS Stripe 82

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Wyn Evans, Vasily Belokurov
stripe 82 is ideal for finding variables

- ~300 sq deg
- 8 years
- ~30 epochs (some >80)
- ugriz photometry
- some spectra

Light-Motion-Curve & Higher Level Catalogues (Bramich et al. 2008)

- ~4 million lightcurves, proper motions
- mean magnitudes, colours, variability statistics

Belokurov et al. 2007

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RR Lyraes are excellent standard candles

Why?
- well-defined absolute magnitude
- common and ubiquitous
- large distances (>100 kpc)

How?
- colour, period, metallicity cuts
- absolute magnitudes -> distances (errors ~ 5%)

407 RR Lyraes
there's a lot of substructure in the halo

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Kollmeier et al 2009
brightest RR Lyraes visible at 130 kpc

- Monte Carlo integrations
  - LF assumed Gaussian ($\mu$ and $\sigma$ consistent with our sample)
  - no change with metallicity
- flat out to $r \sim 100$ kpc
- brightest RR Lyraes visible at $r \sim 130$ kpc
density is best fit by a broken power law

- smooth halo models
  \[ \rho \propto r^{-n}, \quad n \approx 3 \]

- broken power law
  \[ n_{\text{inner}} \approx 2.5 \]
  \[ n_{\text{outer}} \approx 4.7 \]
  \[ r_{\text{turn}} \approx 23 \text{ kpc} \]

- drop off at \( \sim 40 \text{ kpc} \)

- substructure dominant
  - Hercules-Aquila \( \sim 58\% \)
  - Sagittarius \( \sim 14\% \)
  - Pisces \( \sim 7\% \)
  - total \( \sim 79\% \)

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We extracted a set of RR Lyraes from SDSS Stripe 82 and used them to look for substructure in the Galactic halo.

- We found two previously-known substructures, the Hercules-Aquila Cloud and the Sagittarius Stream, and one new substructure, the Pisces Overdensity.

We studied the distribution of RR Lyraes in the halo:

- RR Lyraes are visible in SDSS out to ~130 kpc
- The density distribution is best fit by a broken power law with a sharp drop off at ~40 kpc.