The life and times of the disc as viewed by LAMOST
(with a little help from RAVE & TGAS)

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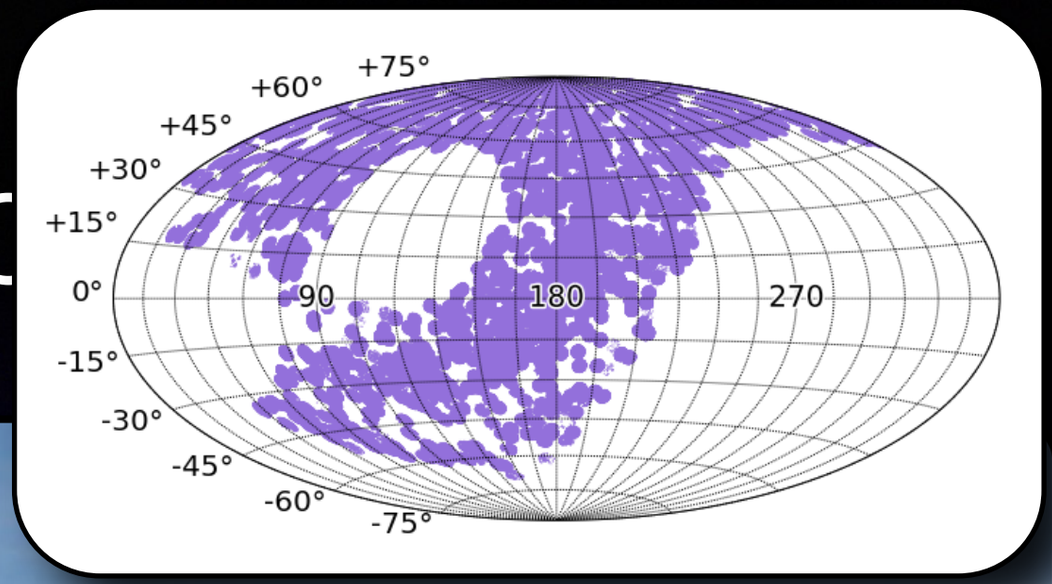
April 2017

Spectroscopy from LAMOST

- This 4m is China's largest optical facility. 4000 fibers across a 20 sq deg field of view, working at R ~ 2000
- Now into fifth year of the full survey, obtaining 1M stellar spectra per year
  - 3.9M unique stars with S/N > 20
  - 1.2M unique stars with S/N > 100
- SP_Ace analysis led by Corrado Boeche will be released later in the year, including [α/Fe] to 0.08 dex (other pipelines available, e.g. Ho et al. 2017, Xiang et al. 2017)
- International release of DR3 due in June 2017, with LAMOST-2 commencing next year

Spectroscopy fro



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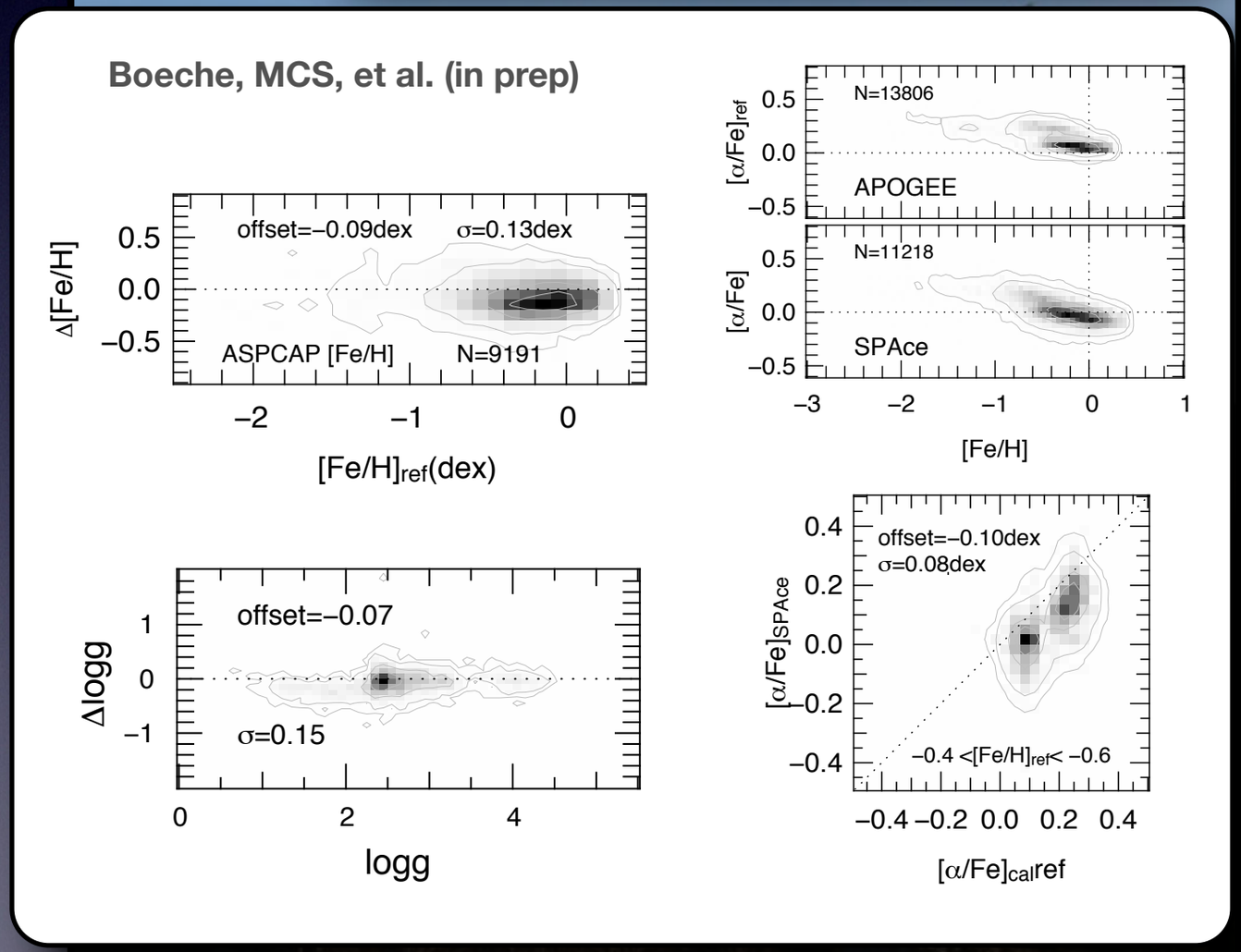

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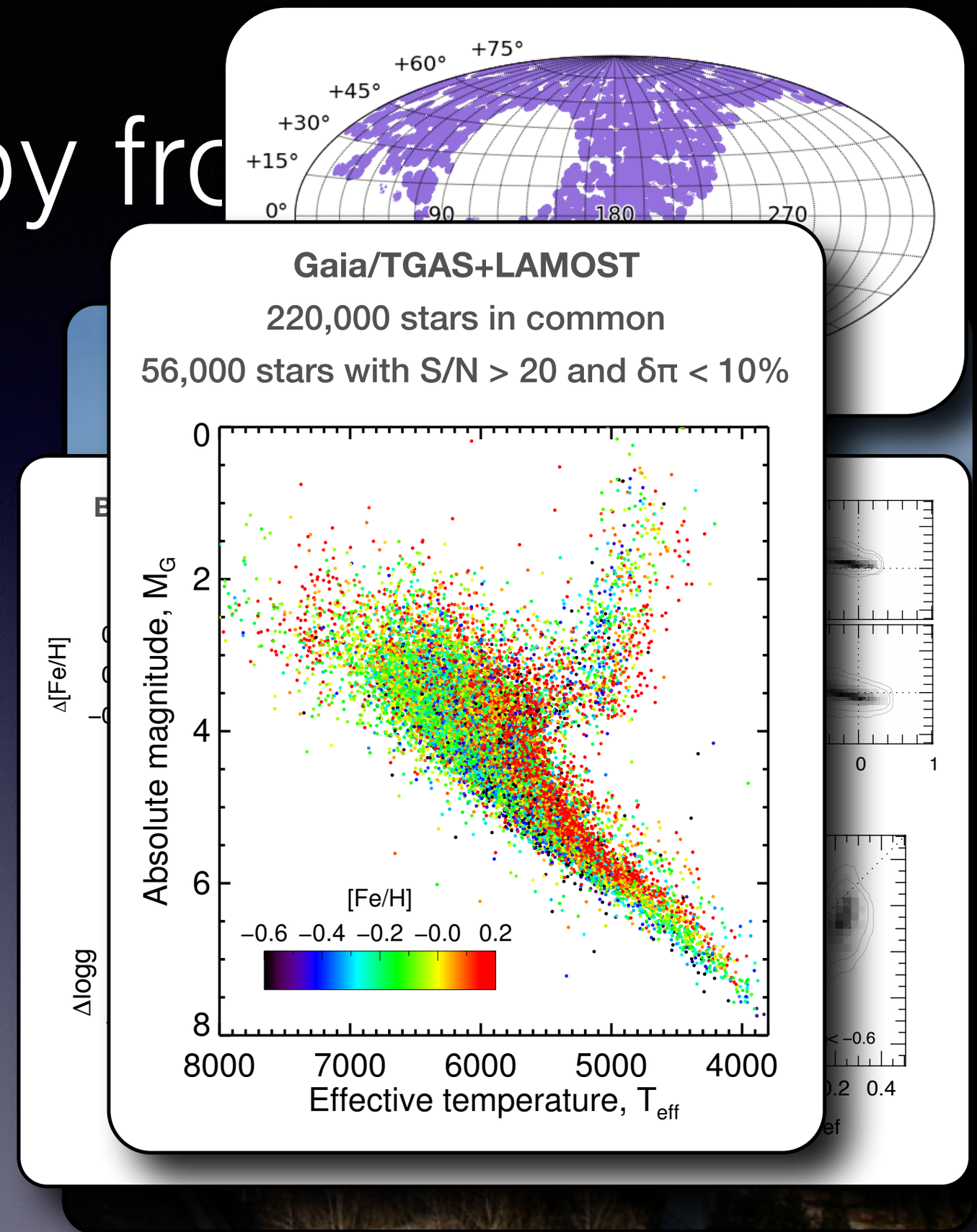
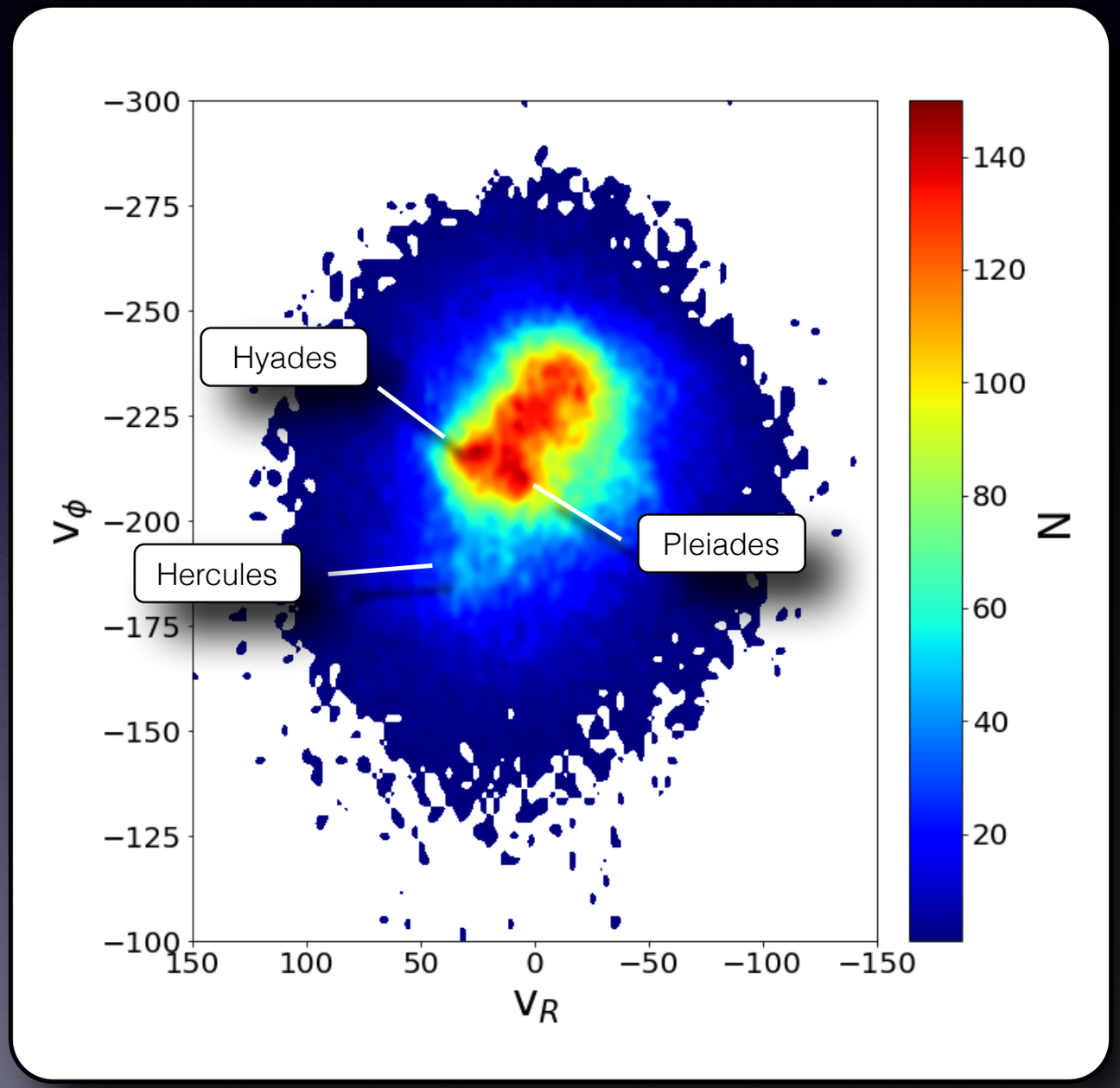


Our catalogue

- We have taken TGAS stars having dπ/π < 20% and spectroscopy from LAMOST (73k) and RAVE (67k), with typical S/N around 200/60
- Derived ages using the standard Jørgensen & Lindegren (2005) method, adopting the PARSEC isochrones, and calculated orbital parameters using MWPotential2014 from galpy
- Typical age errors 2-3 Gyr and velocity errors 5-10 km/s, within a volume of ~ 0.5 kpc



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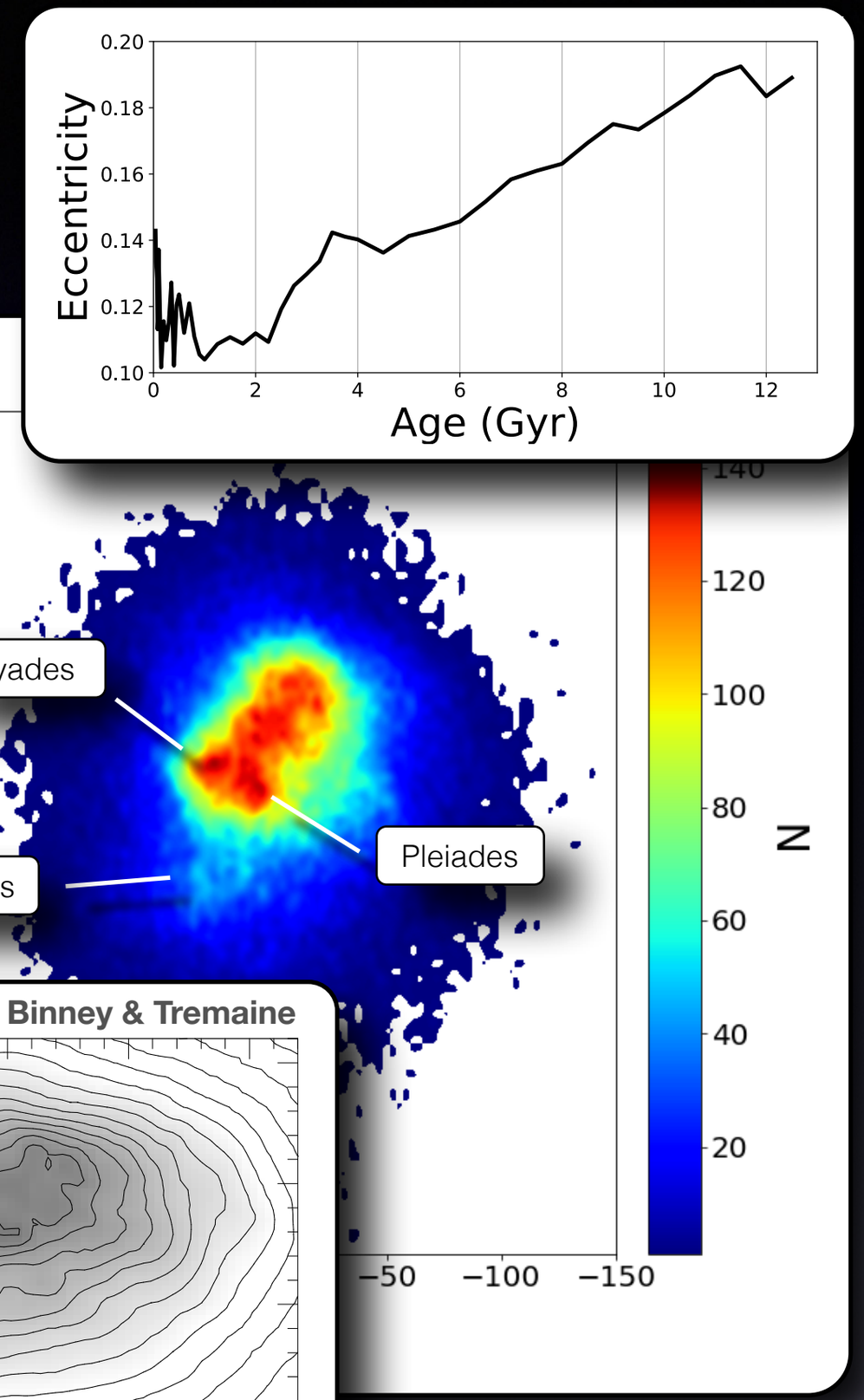
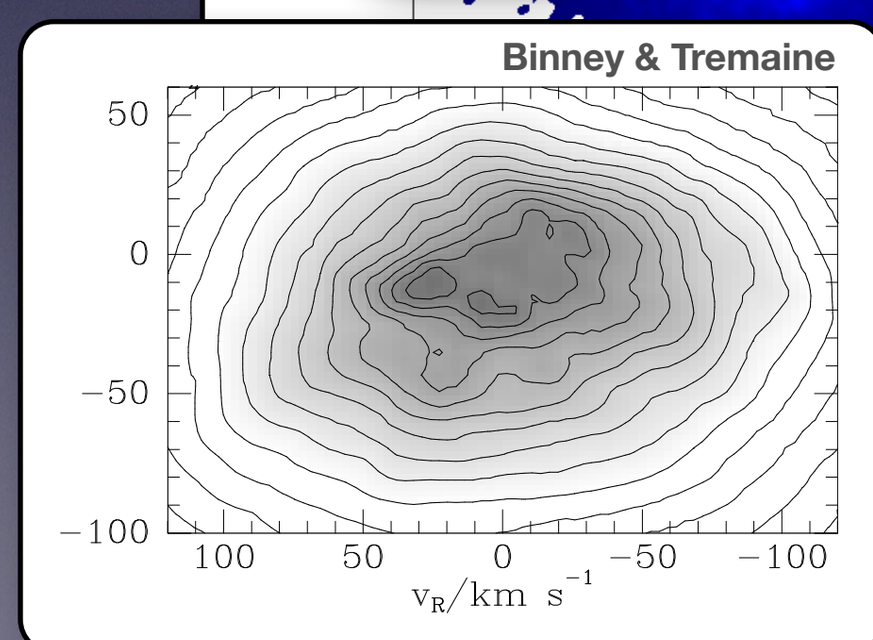
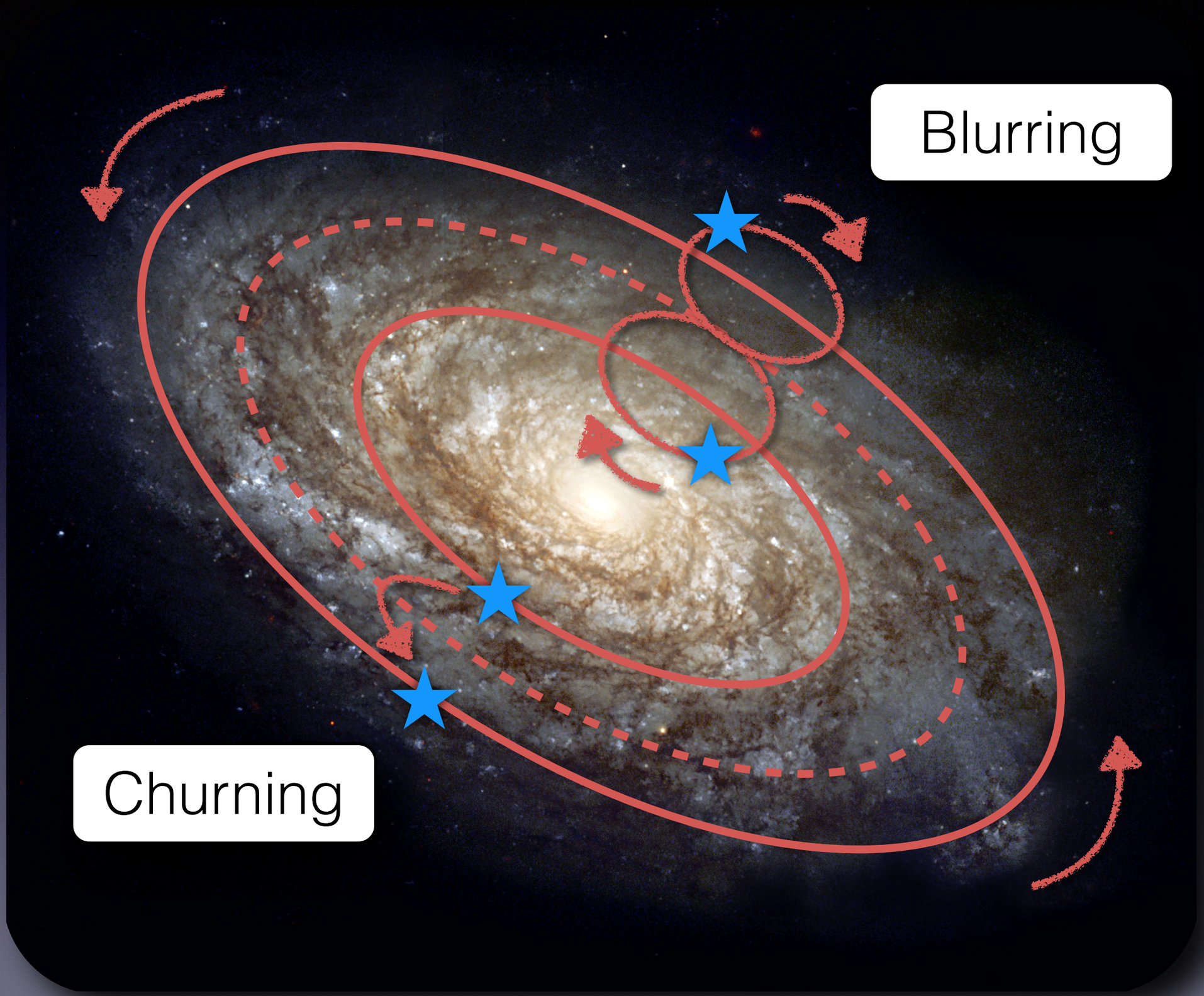


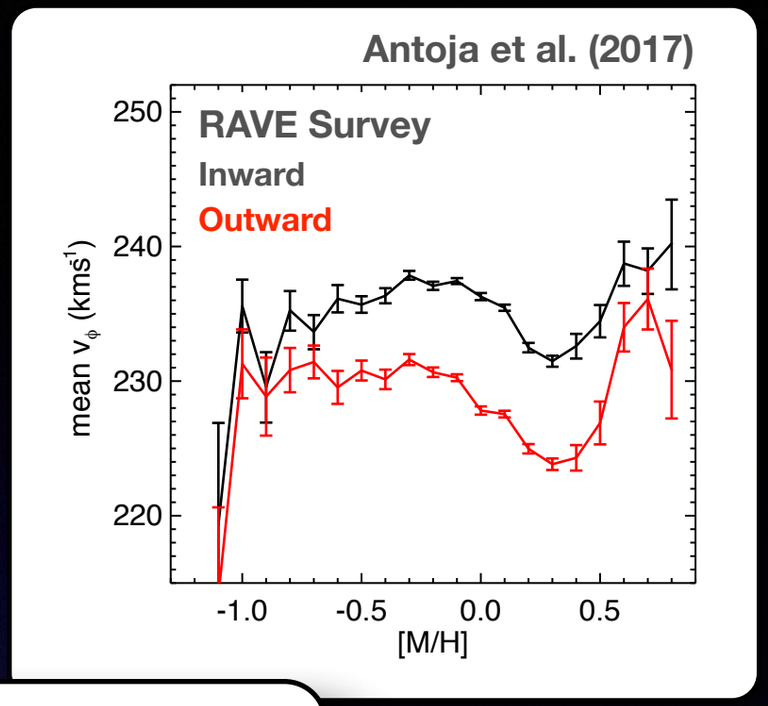


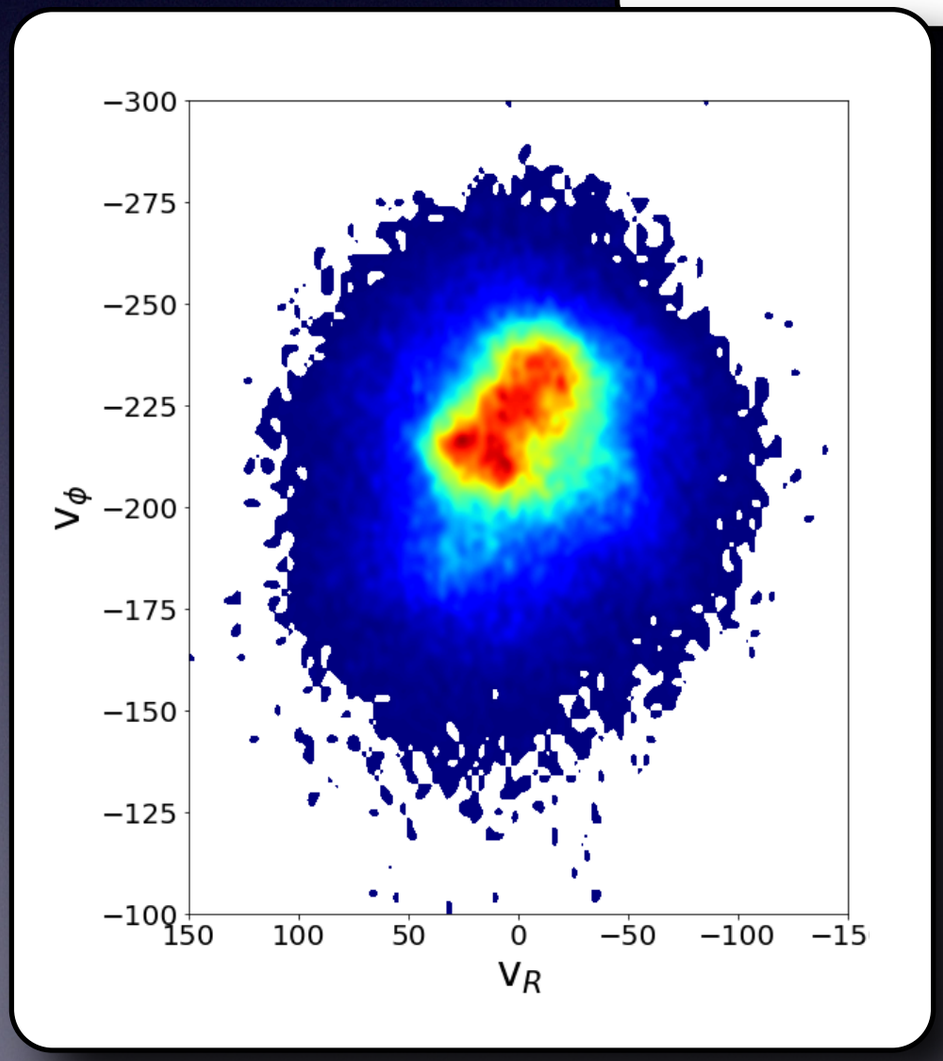


Selwood & Binney (2002); Schönrich & Binney (2009)

Radial flows

- In an equilibrium axisymmetric system, the properties of stars moving inward should be the same as those moving outward
- Antoja et al. (2017) used RAVE data to show this is not the case
- This is a consequence of the tilt in the UV plane, which is particularly prominent in the young stars
- We see that the older stars are more phase-mixed with less asymmetry in v_R





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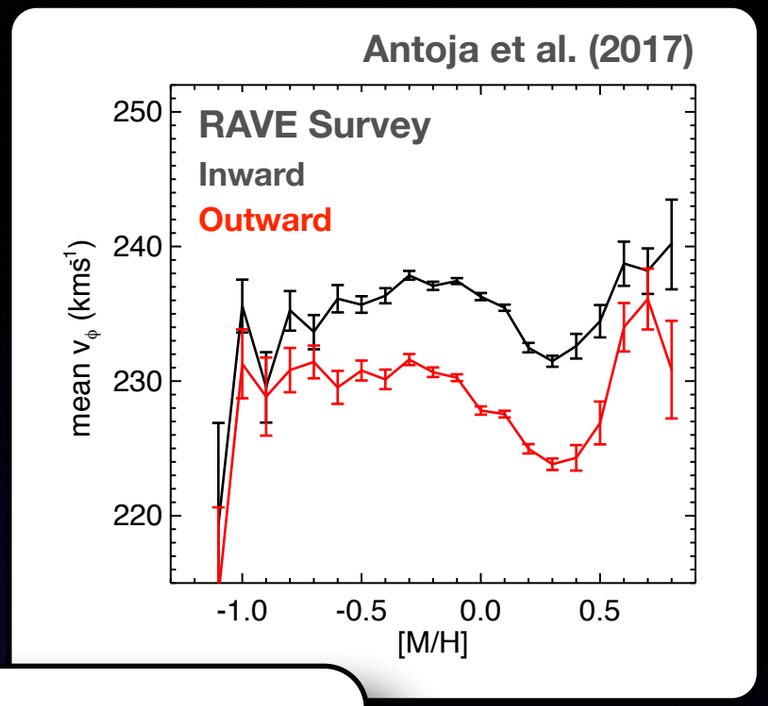

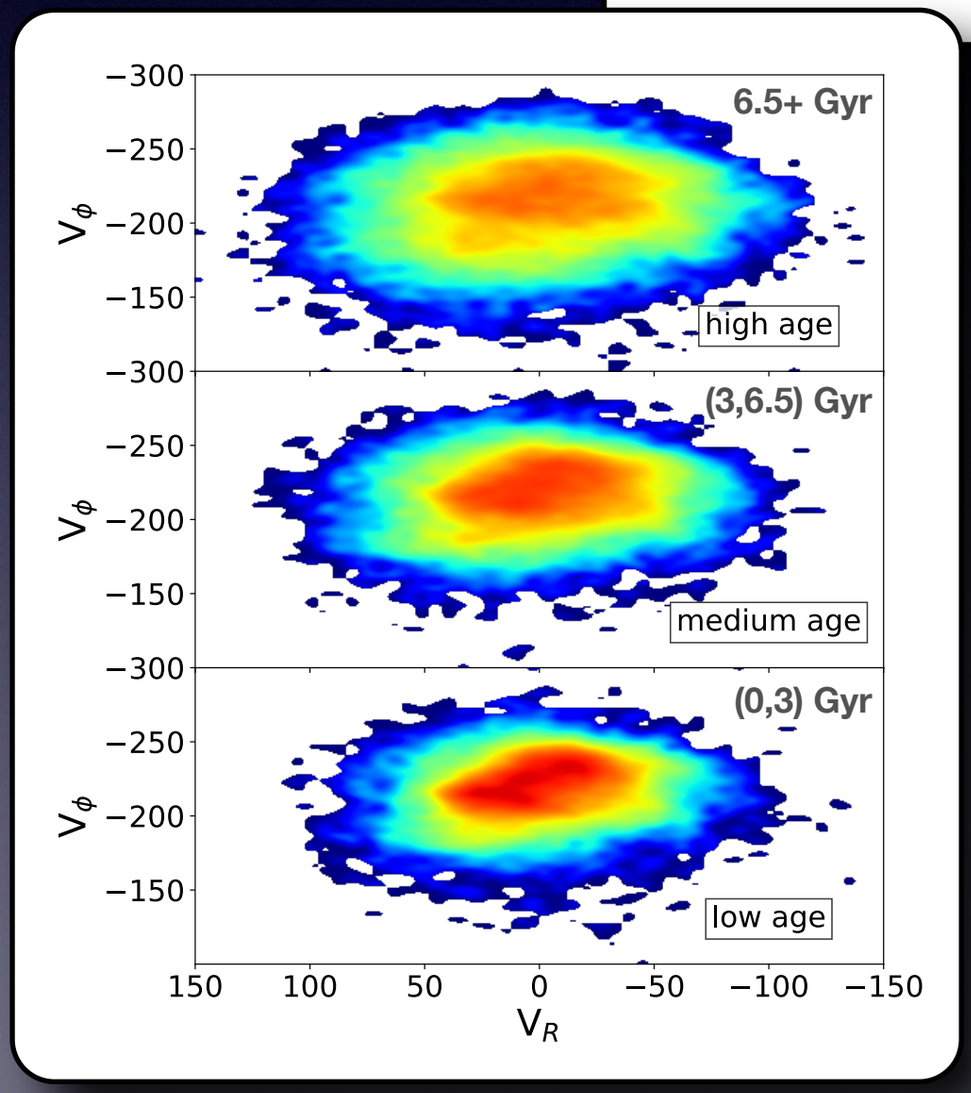

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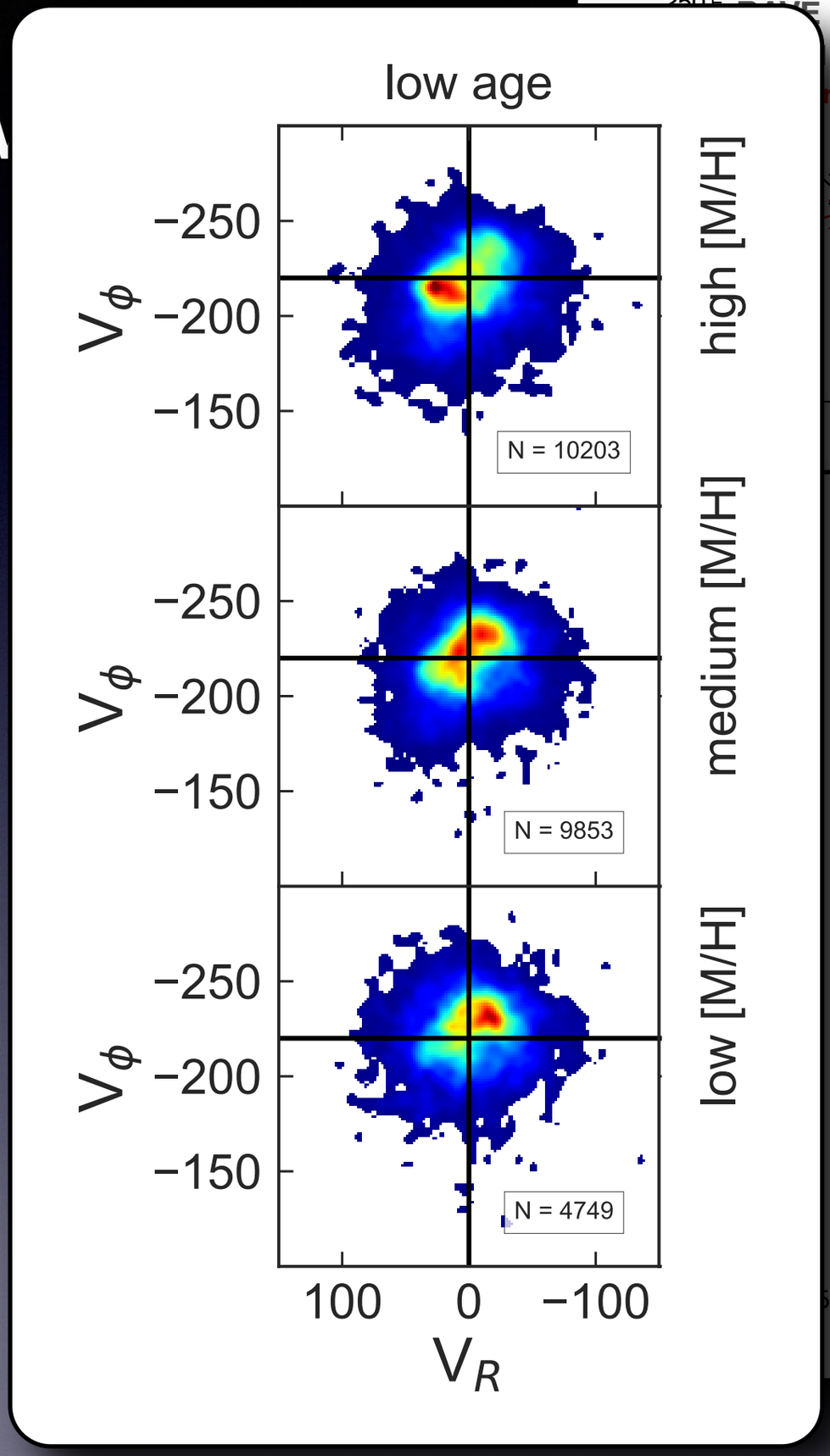
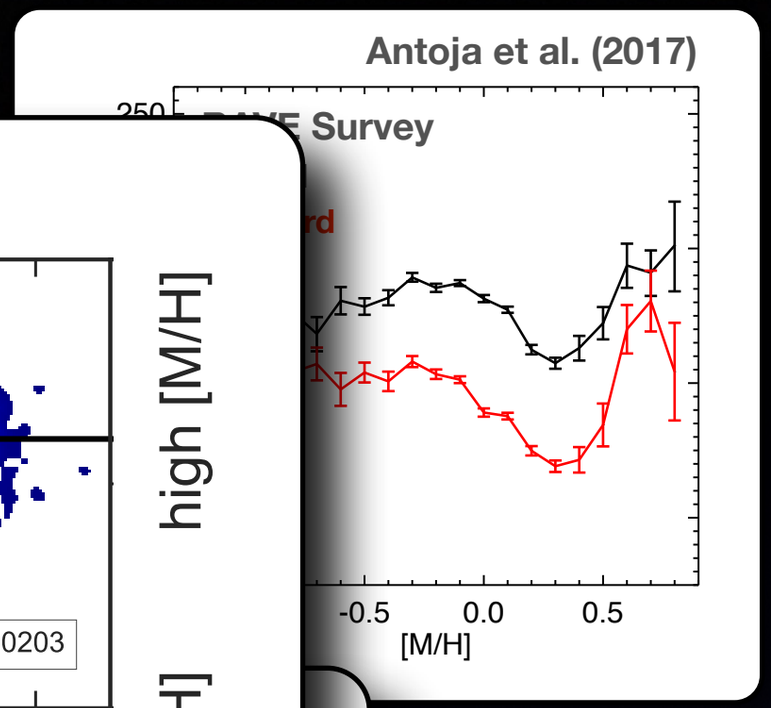
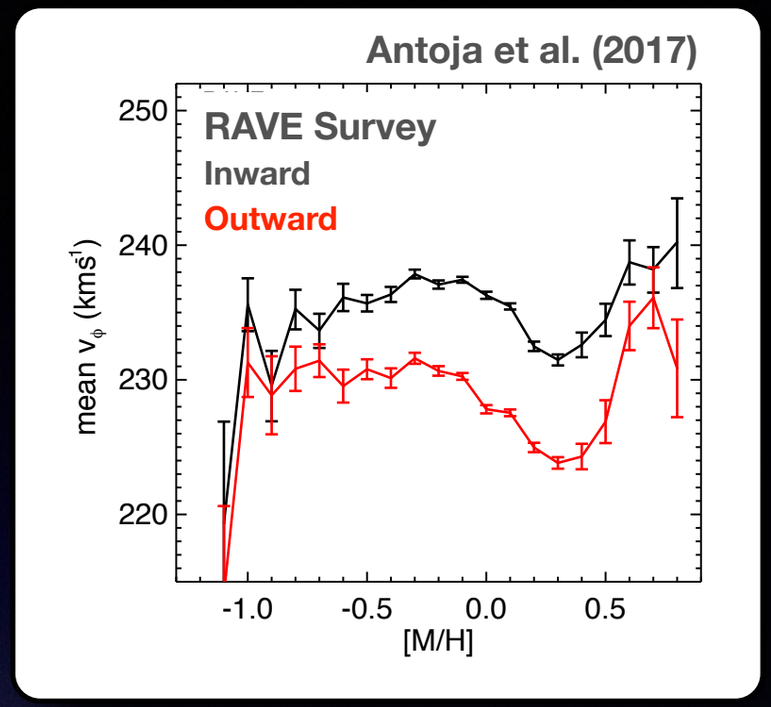
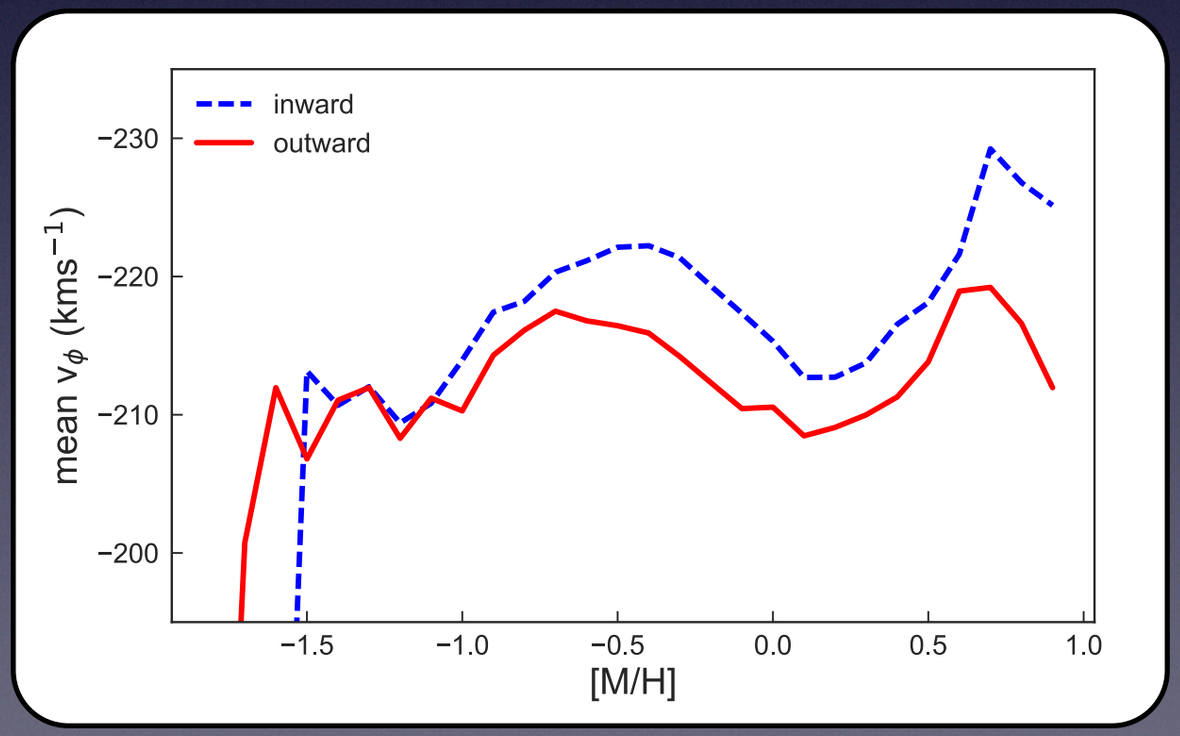


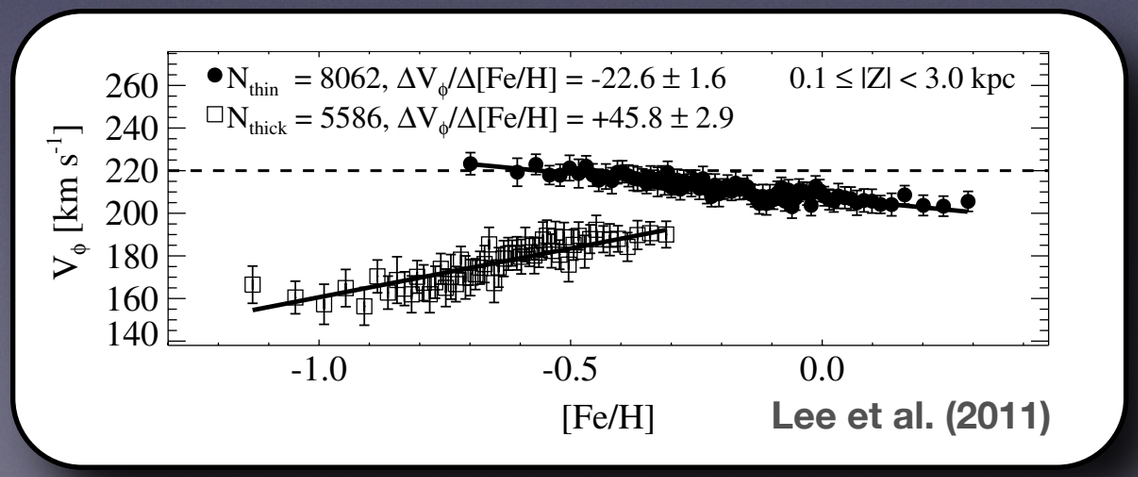


Angular momentum evolution

- What about the overall shape of the v_ϕ distribution?
- The main points to take away are:
  - Thick disc becomes apparent for the old metal poor stars
  - The majority of stars follow the trend expected for blurring, with (unsurprisingly) the eccentricities matching the velocities
  - At the metal-rich end, there is a hint of churning manifesting as an uptick in v_ϕ (with corresponding dip in eccentricity)







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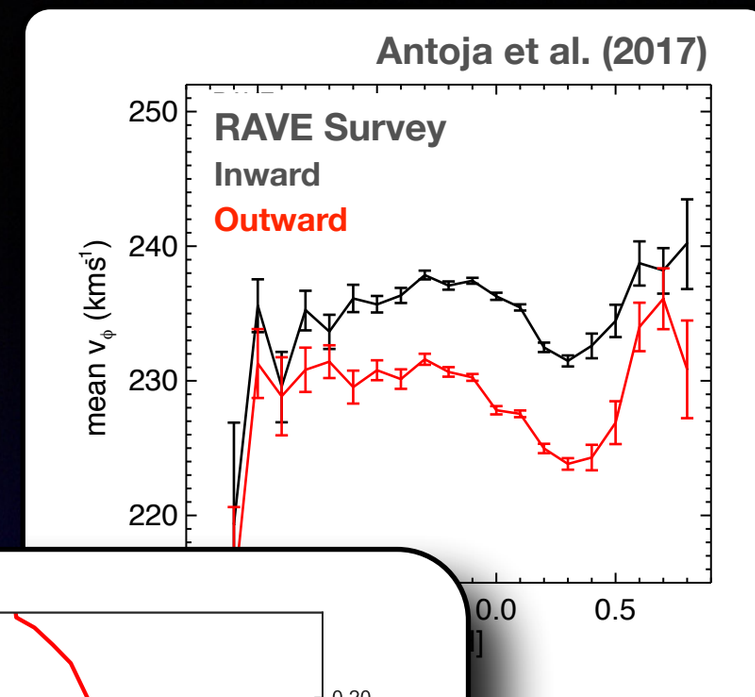
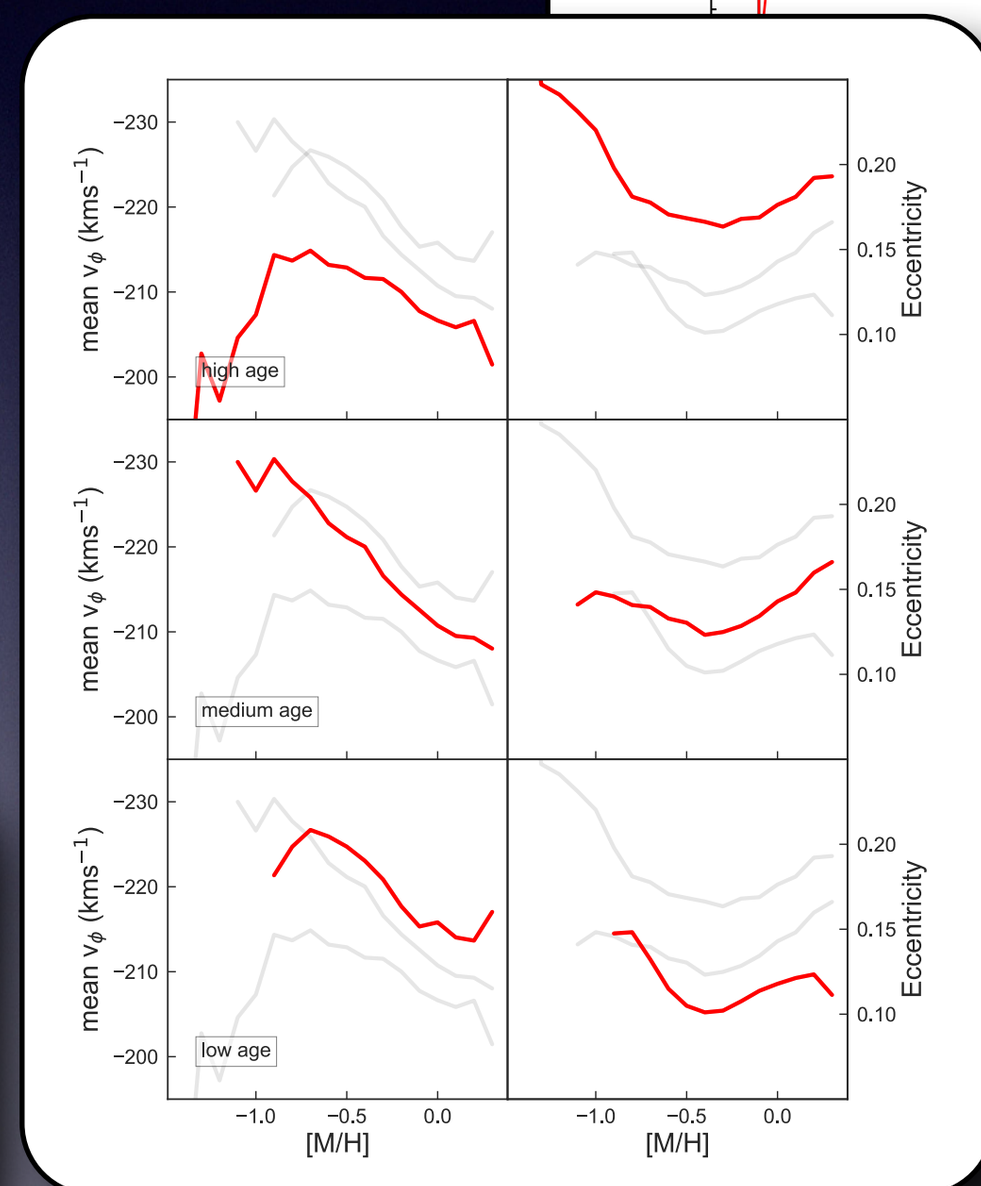
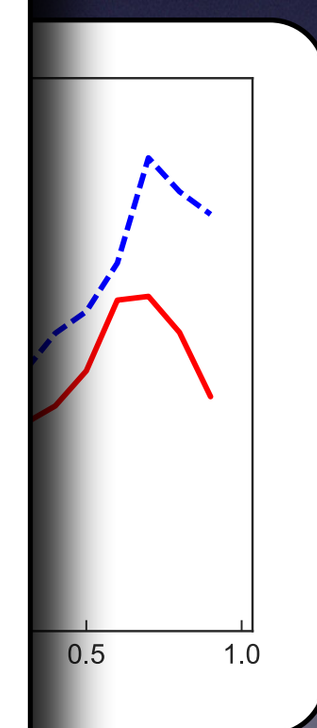
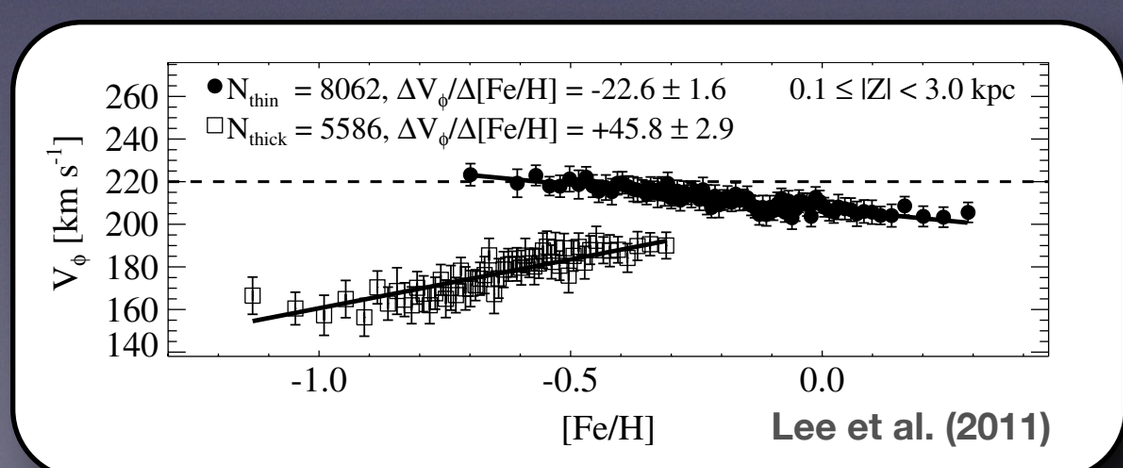


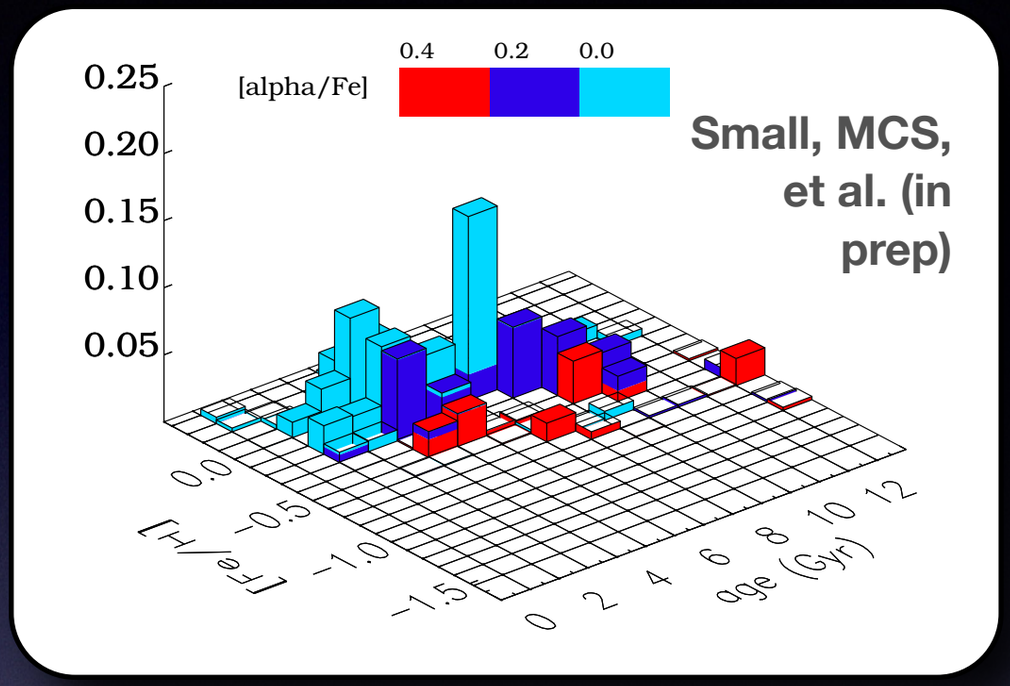


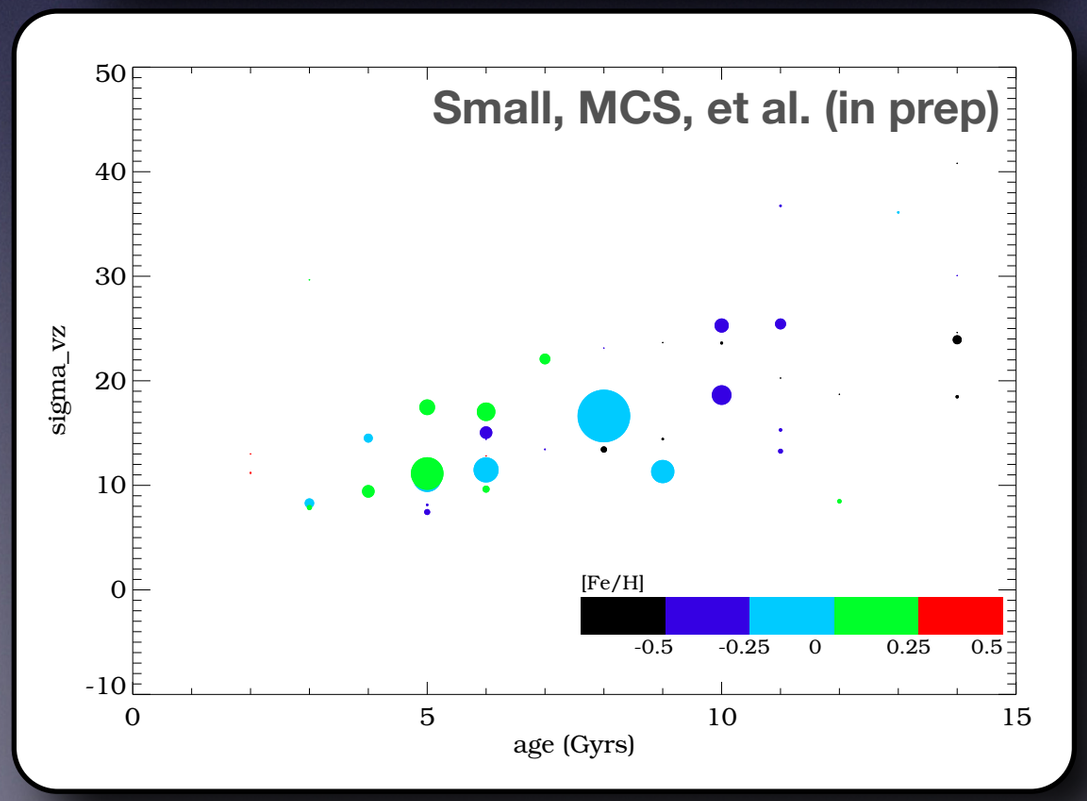




Ages for populations

- Working with postdoc Emma Small, whose background is in modelling star formation histories using photometry
- Our approach is to models the whole population, rather than attempting to estimate individual ages
- We have applied this to the RAVE data with encouraging results
- Also important for probing chemical evolution of the Milky Way bulge beyond the reach of Gaia parallaxes





Summary

- LAMOST has a LOT of high quality spectra, with DR3 coming in the summer. There are caveats: radial velocity offset (Tian+ 2014) or incorrectly estimated errors (Schönrich+ 2017)

- We can estimate ages for large numbers of stars and the prospects for Gaia DR2 are immense

- We can unveil the complexities of the disc, understanding how the kinematic landscape has been shaped over time

- By confronting simulations with these results, we can better understand the processes at play and also uncover their limitations