Ages of Giants with High Resolution Spectroscopy
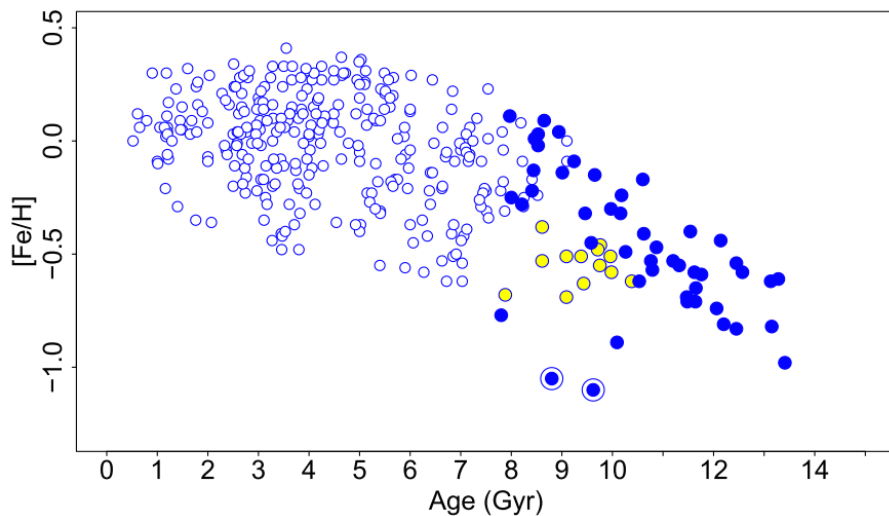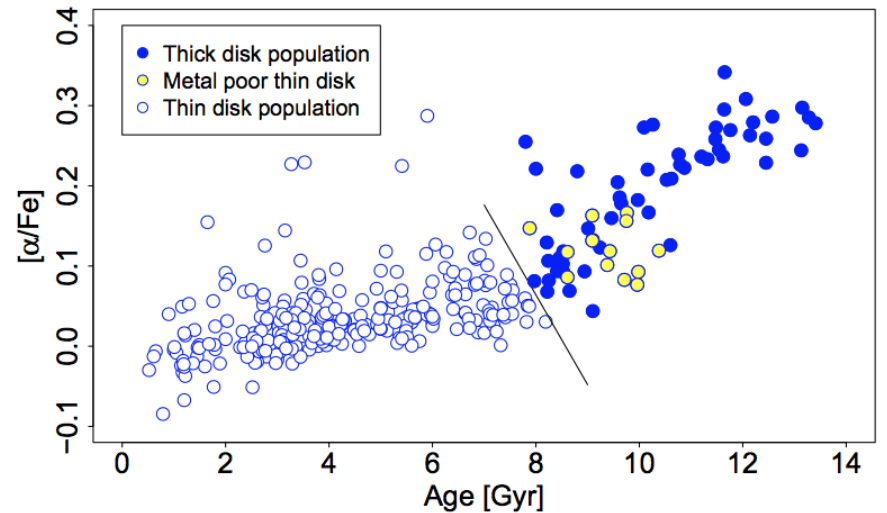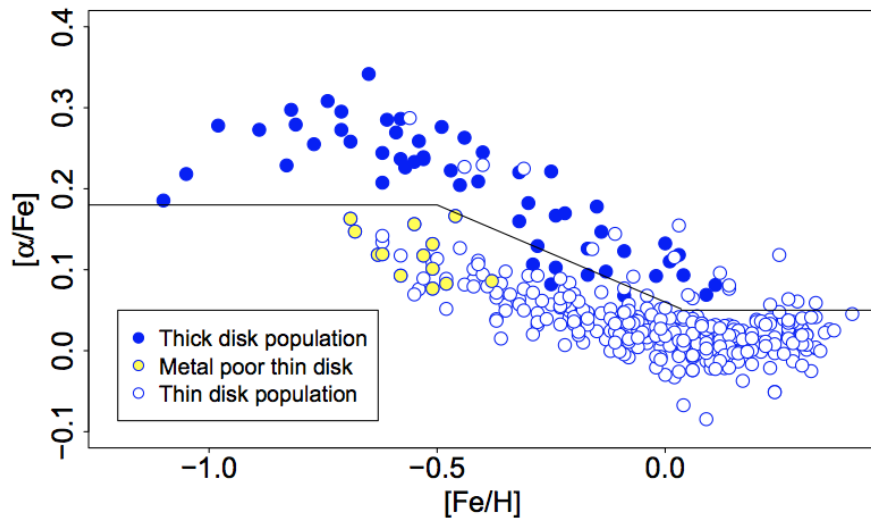
Diane Feuillet

New Mexico State University

February 2, 2015

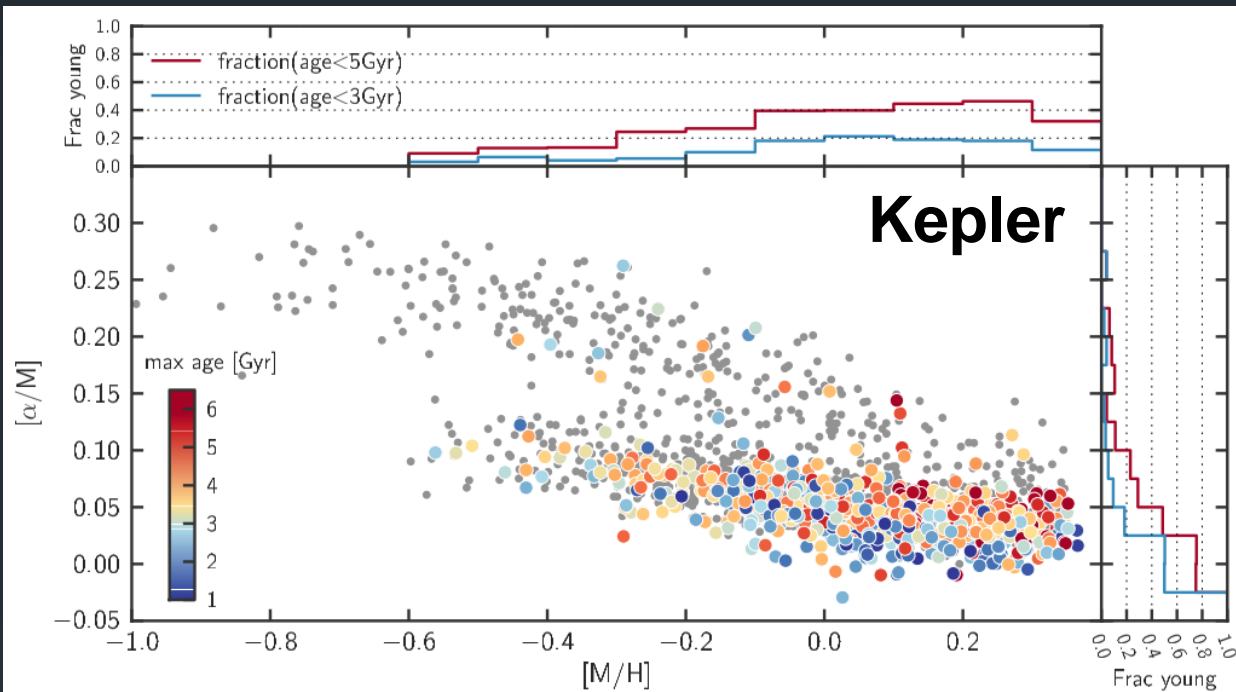Jon Holtzman, Leo Girardi

And the APOGEE Team

Ages and Abundances

Haywood+ 2013

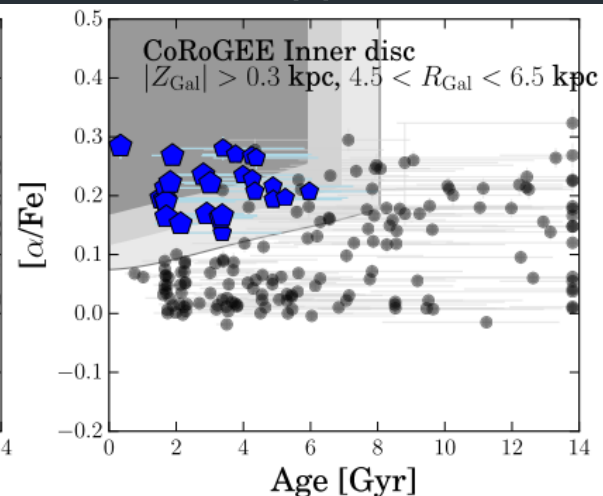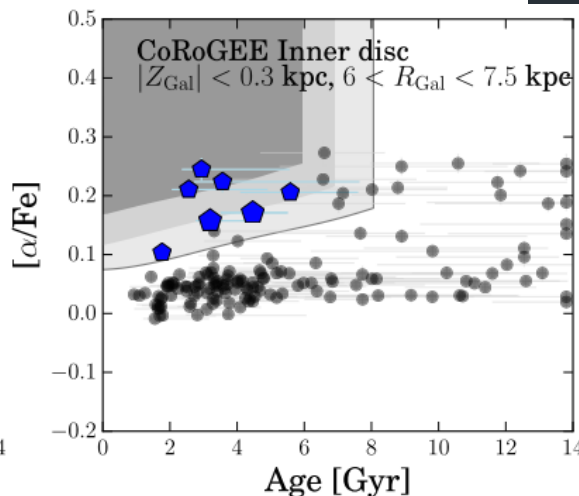Age adds crucial evolutionary information and population identification

Asteroseismic Ages

Kepler

CoRoT
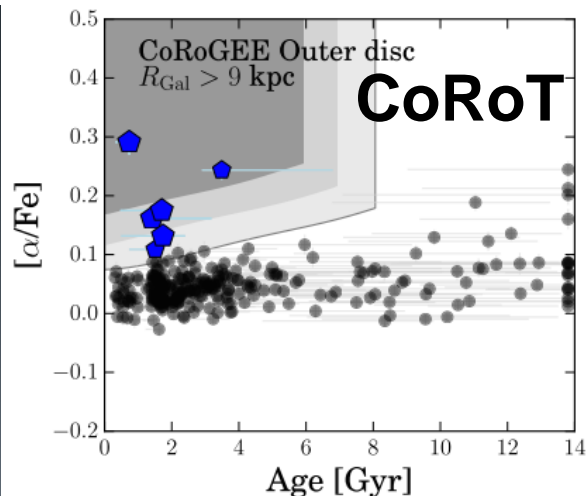
Martig+ 2015

- Recent discovery of young alpha-enhanced stars
- Need reliable ages for larger samples of stars.
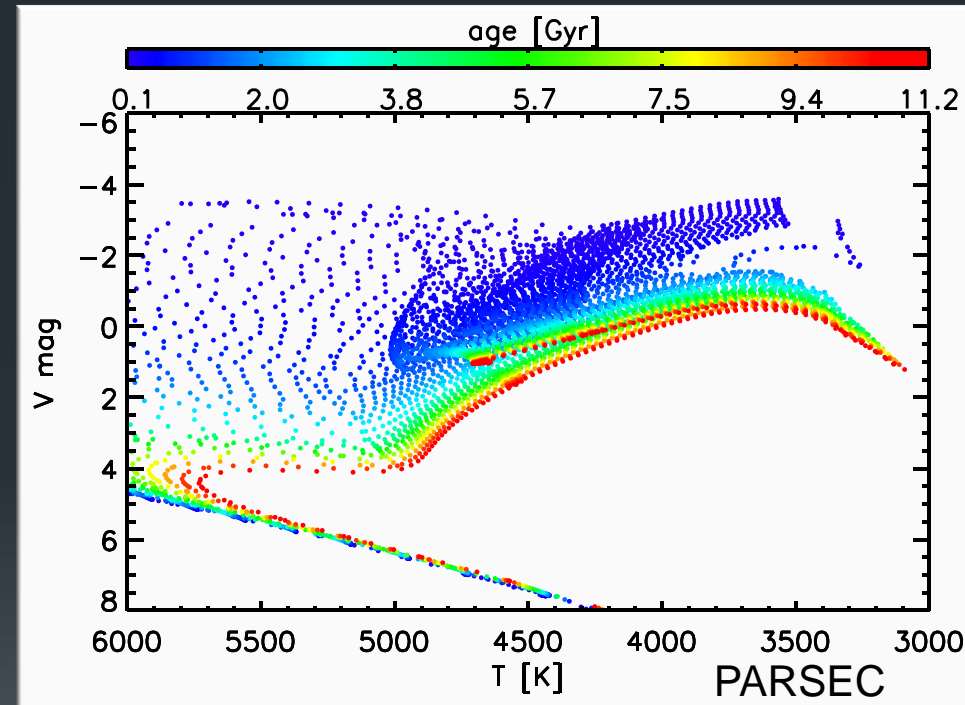- See Andrea Miglio talk on Wednesday

Chiappini+ 2015

Mass and Age of Giants

Good Distances:

- V mag puts better constraints on age
- Distance + APOGEE T_{eff} & logg gives mass estimate
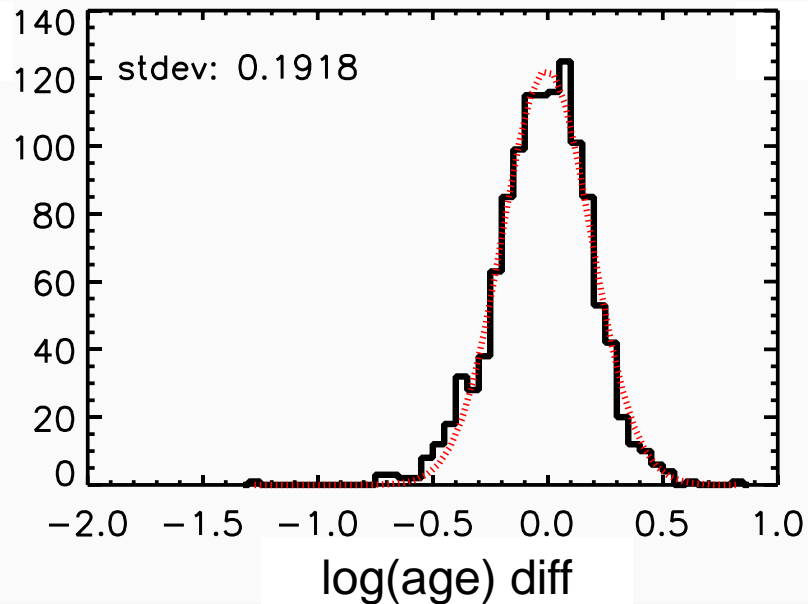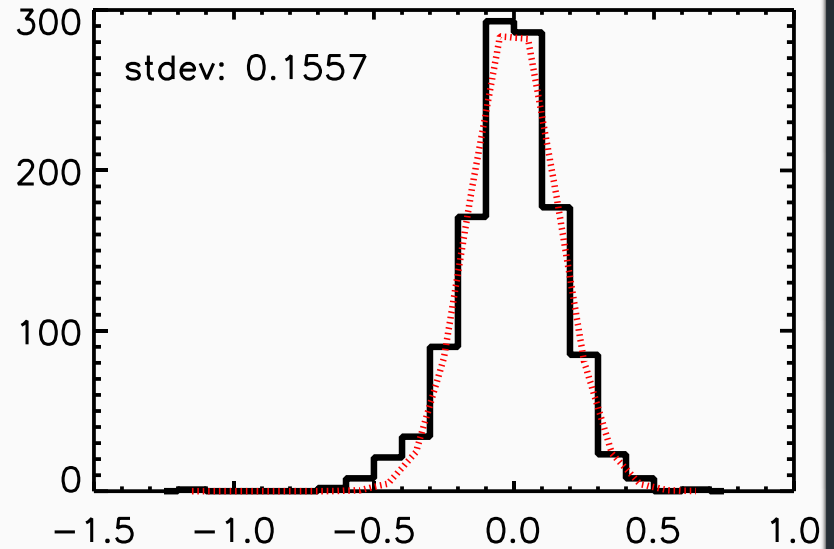- Mass error ≈ logg error = 0.15 dex

Isochrone Matching:
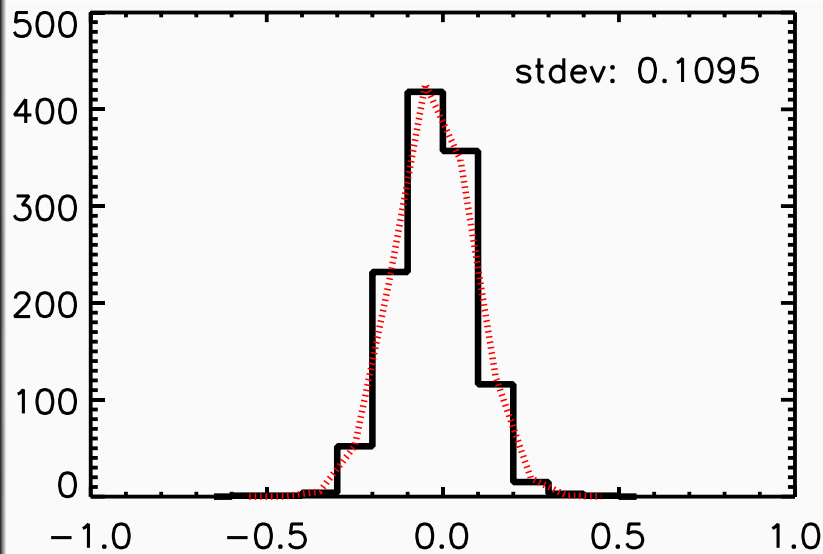
- P α $\exp[-(X_o-X_i)/2\Delta X_o]$
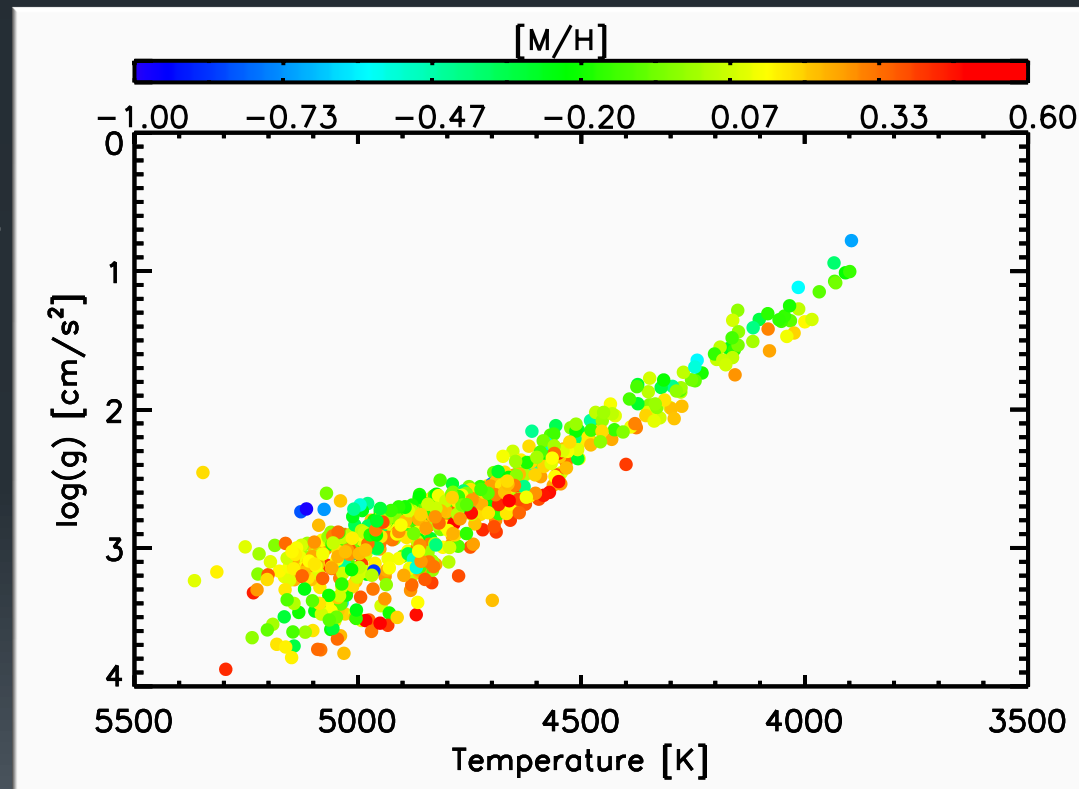- APOGEE: T_{eff}, [Fe/H], logg
- Hipparcos: V mag
- Both: mass

APOGEE + Gaia

Simulated Sample - PARSEC

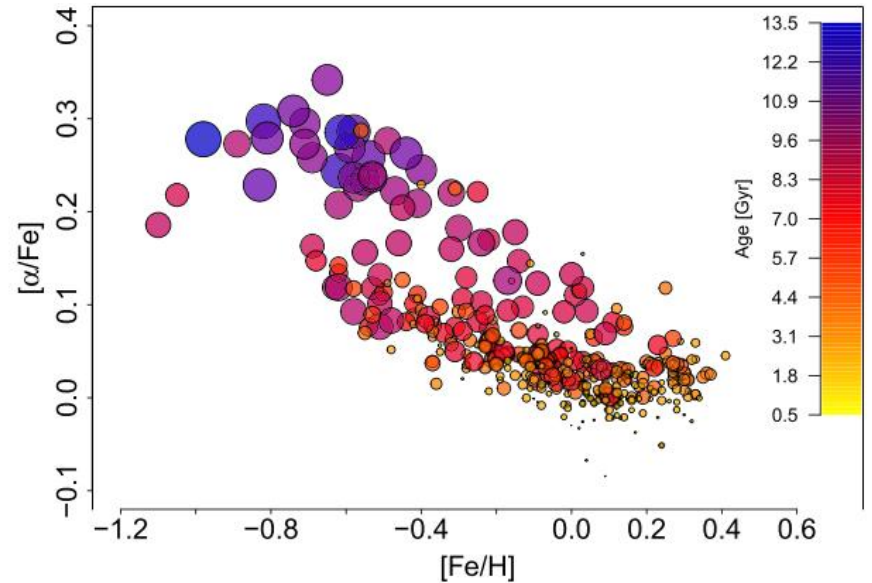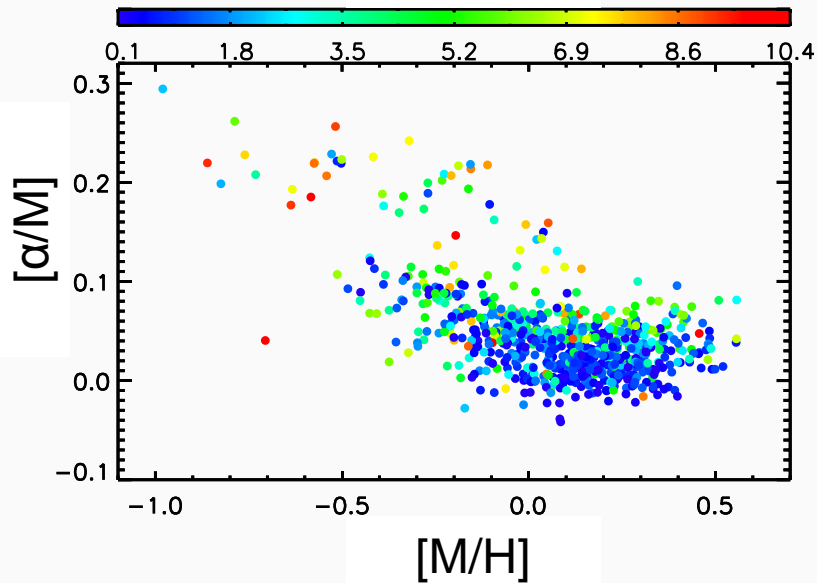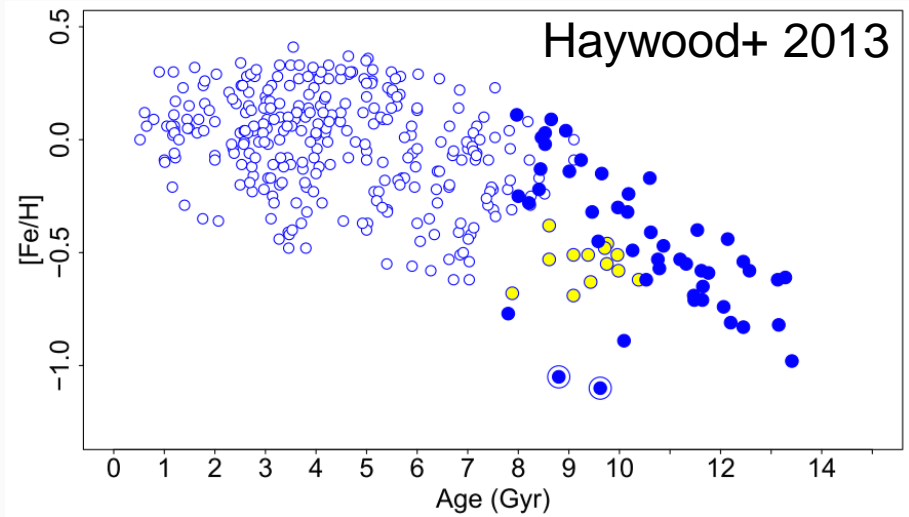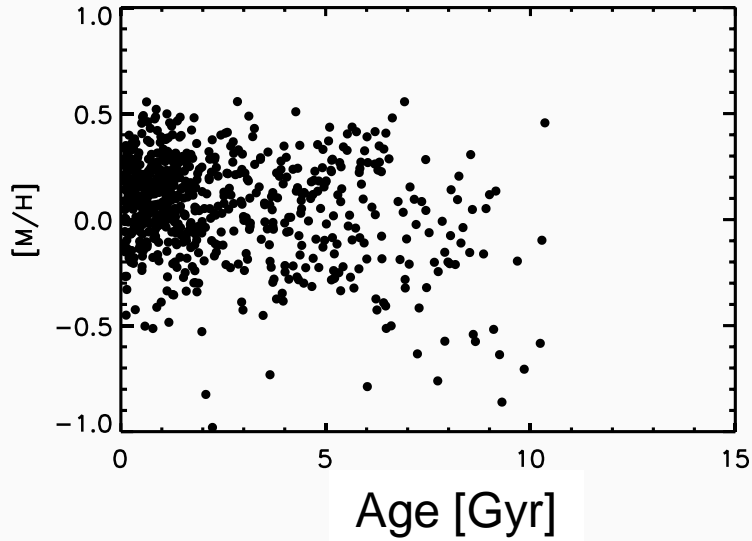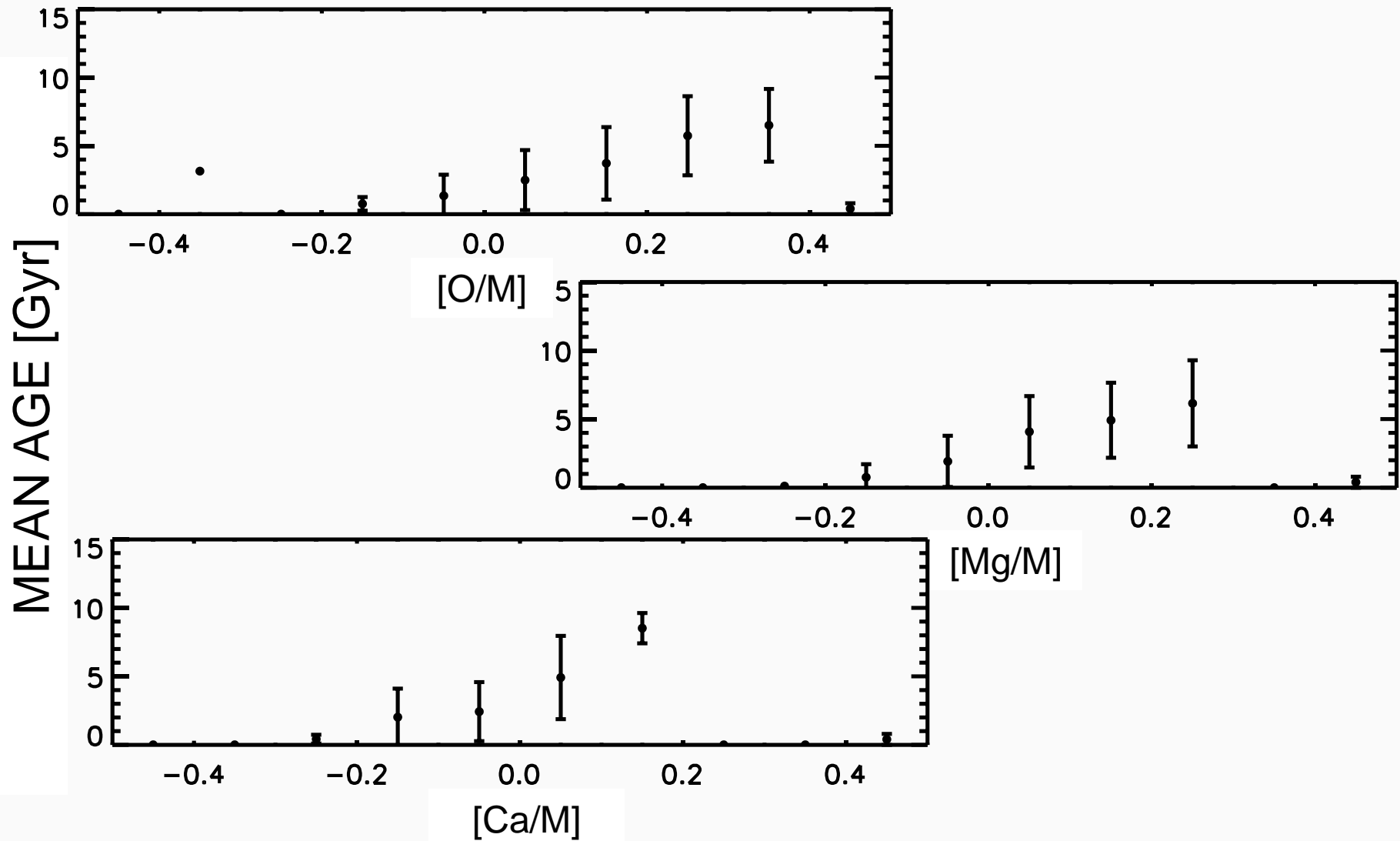# Solar Neighborhood Sample

- Sample chosen from Hipparcos catalogue
- Parallax errors less than 10%
- H < 8 mag
- $(J-K)_0 > 0.5$
- Observed with NMSU 1m+APOGEE connection

700 stars observed to SNR 100

Literature Comparison

Elemental Abundances

Waiting for Gaia

Need a larger sample to statistically examine detailed abundance variations with absolute time on a Galactic scale.
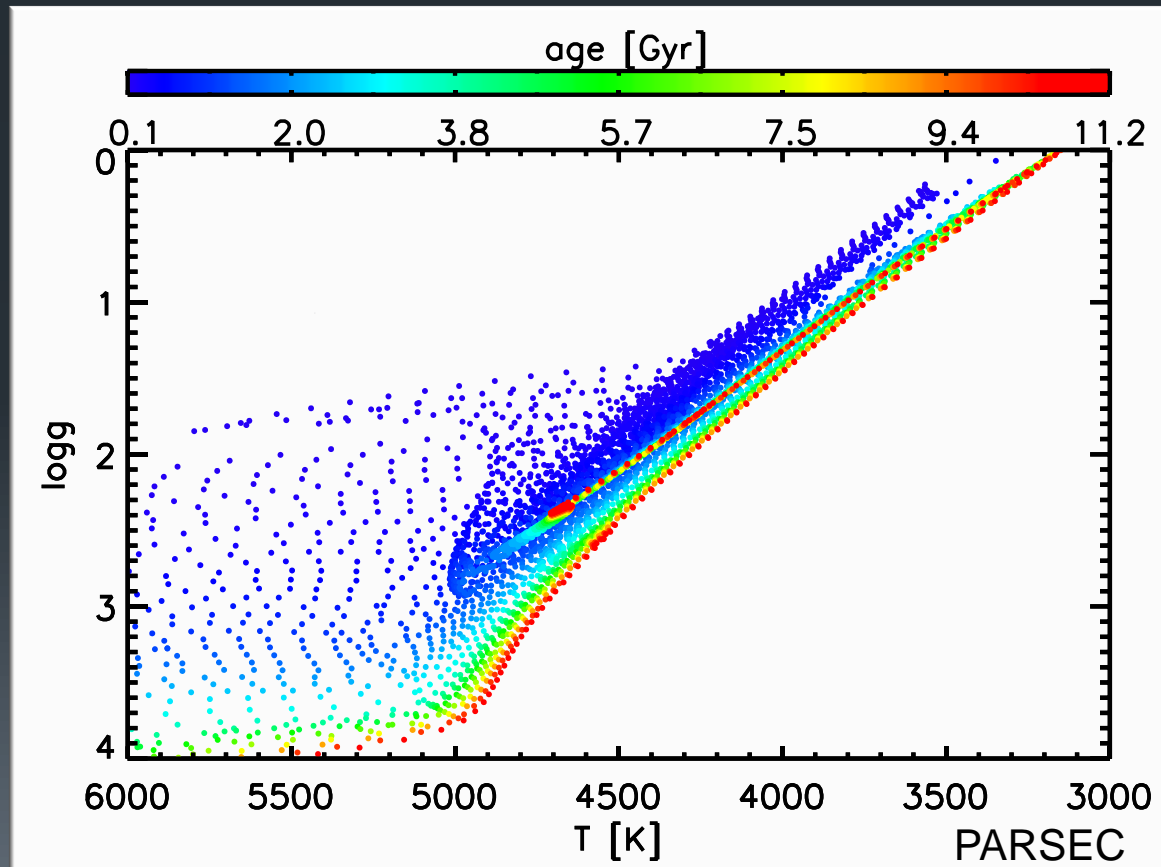
Developing a method of age determination with the goal of extending to full APOGEE sample with Gaia distances
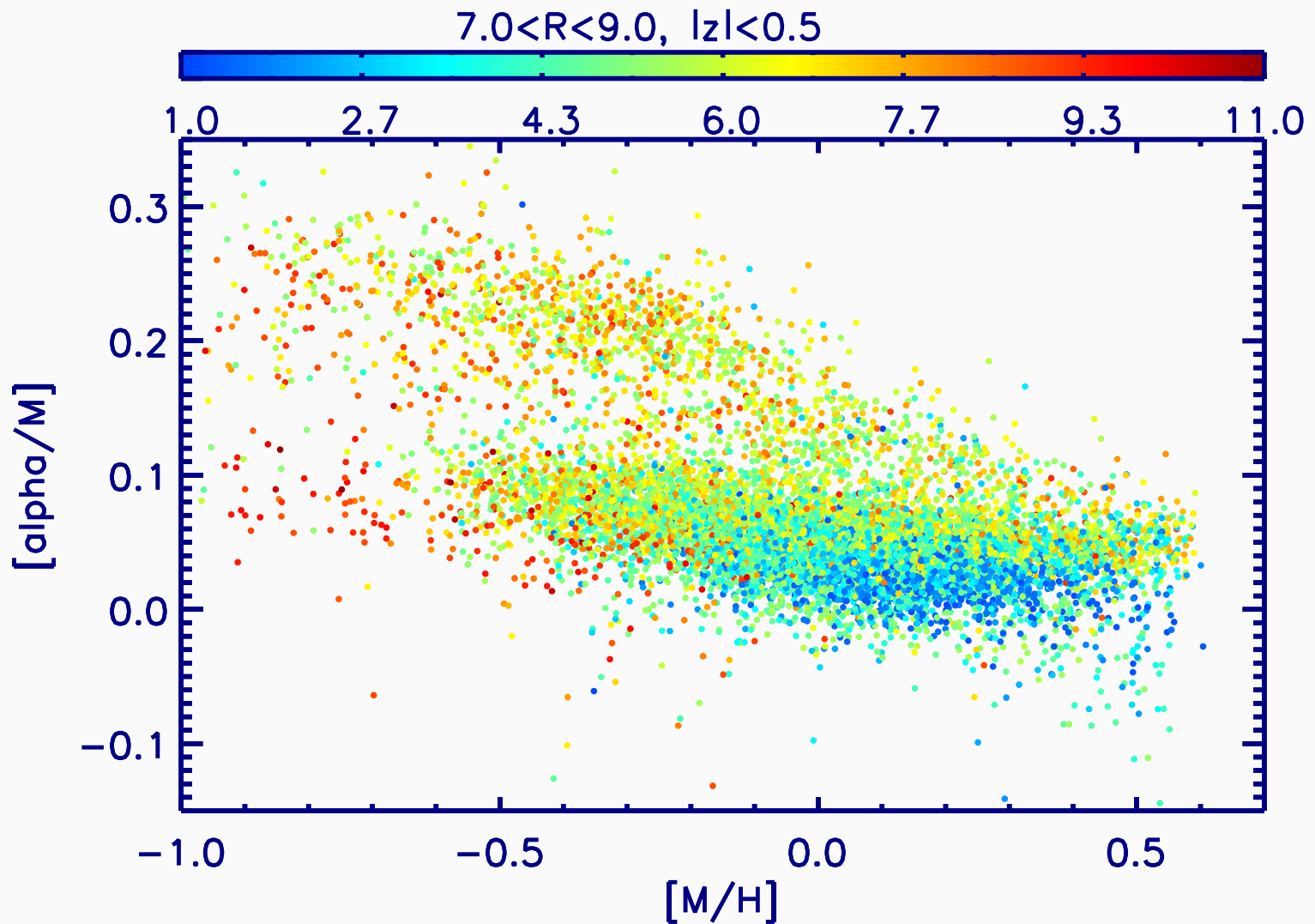
Until then, get ages at the same time as distances

Ages Without Distances

No Distances:

- Ages without distances are possible but crude
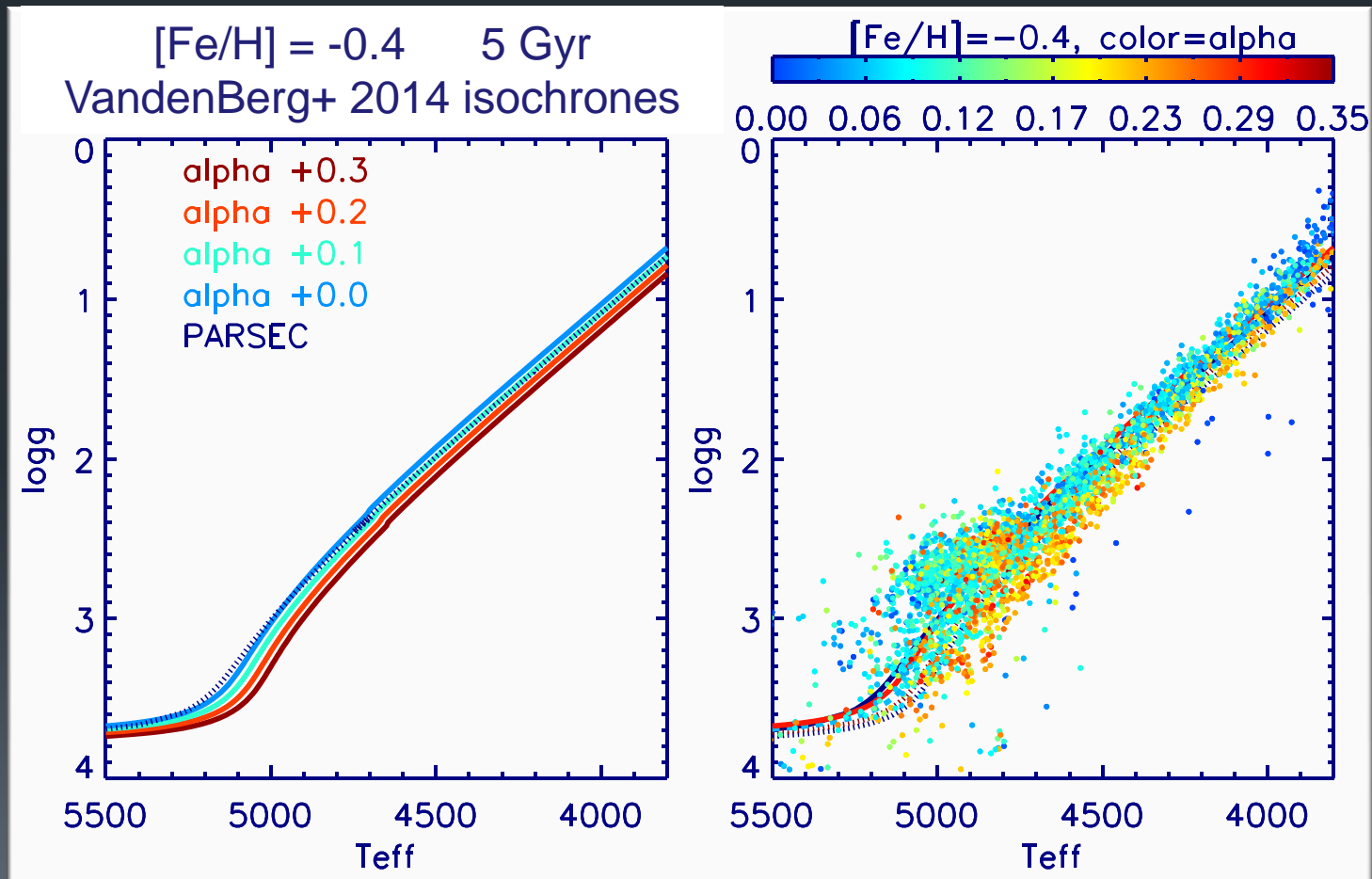- Need very accurate logg measurements
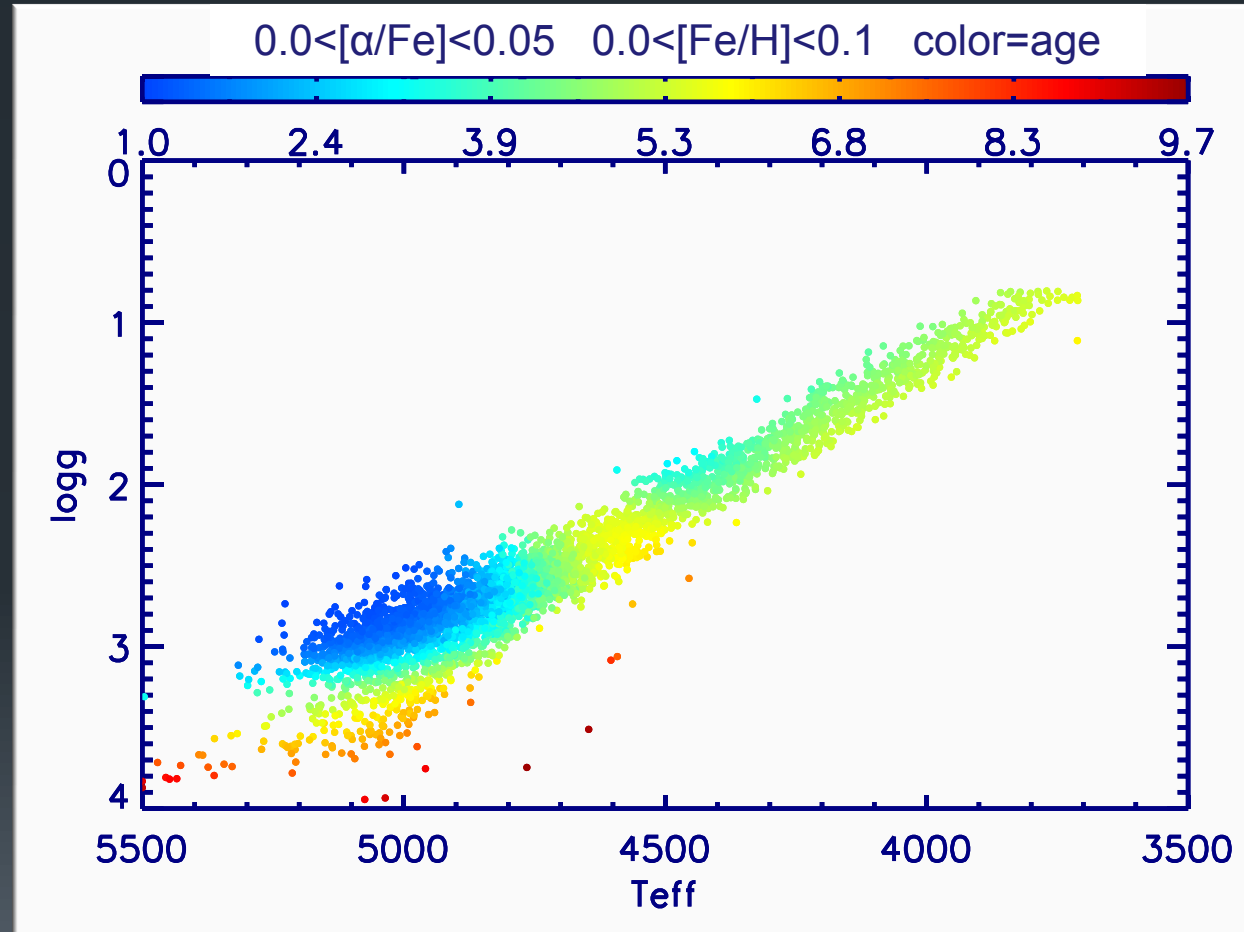- Get age and distance simultaneously

Full APOGEE Sample

Systematic Effects

Alpha enhancement makes stars cooler…
just as is expected in older stars
We see alpha gradient in APOGEE data

Systematic Effects

- Still see systematics in age at a single metallicity and alpha
- Expect smooth age sequence across the giant branch

Conclusions

Moving towards a Galactic sample with ages and detailed abundance with APOGEE and Gaia

Challenges:

Match observations to isochrones, including alpha enhancements

Applying Precision Astrophysics to Galactic Archaeology