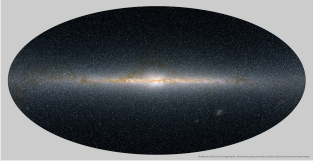

Galactic Disk Structure and Metallicity of Mono-age Stellar Populations from LAMOST

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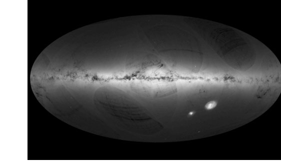
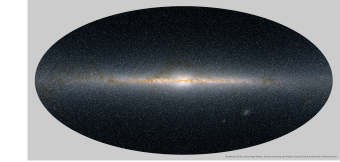
National Astronomical Observatories, Chinese Academy of Science

IAUS330, Nice, 2017-04-28

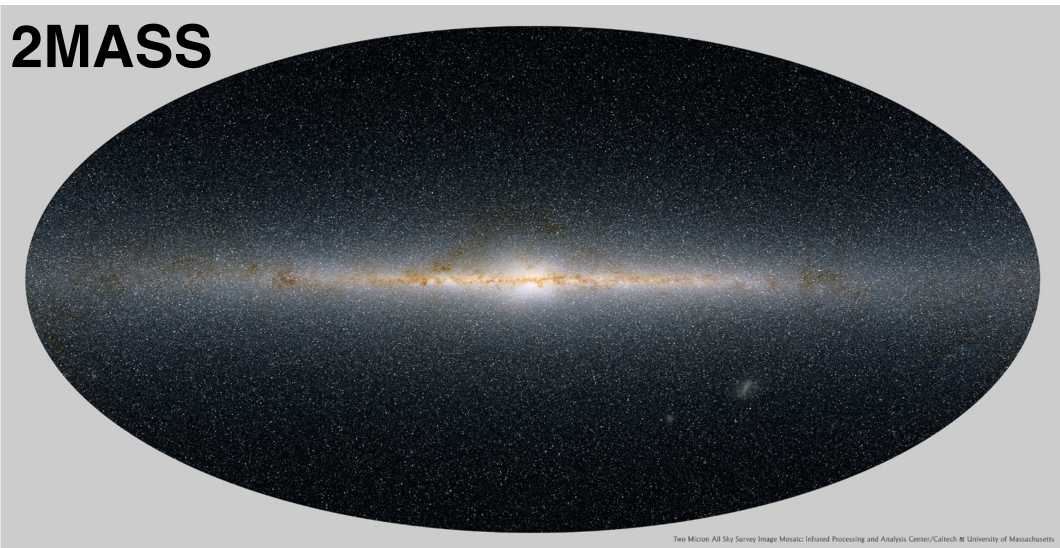


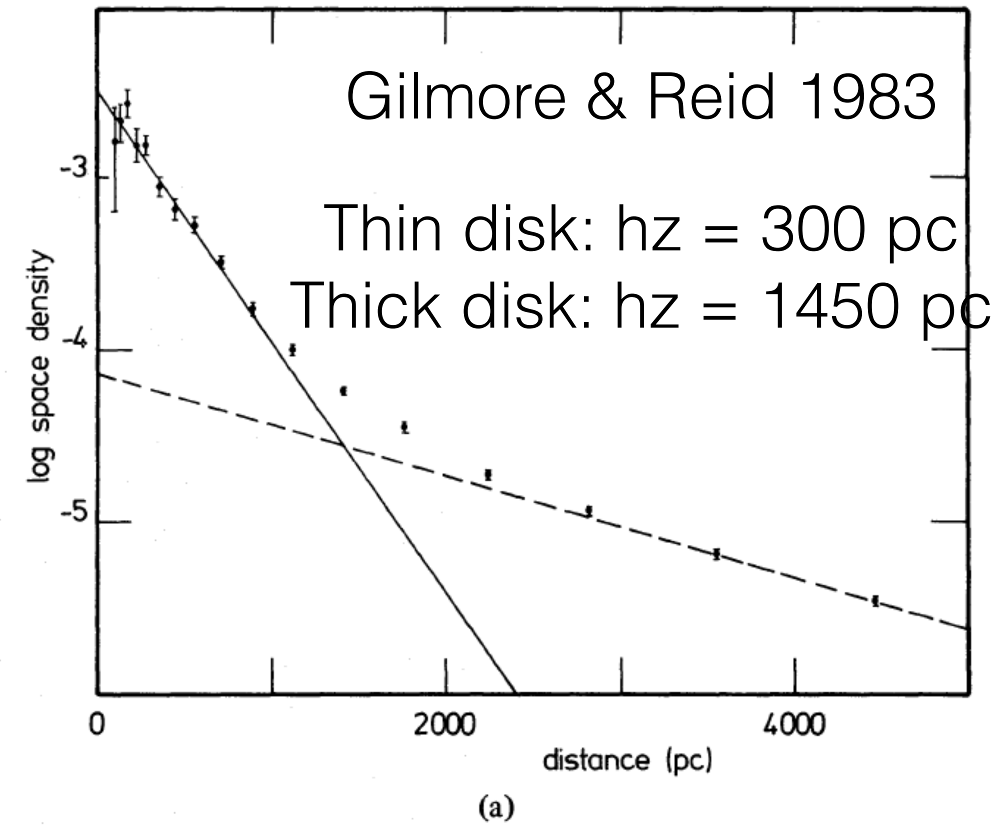
Outline

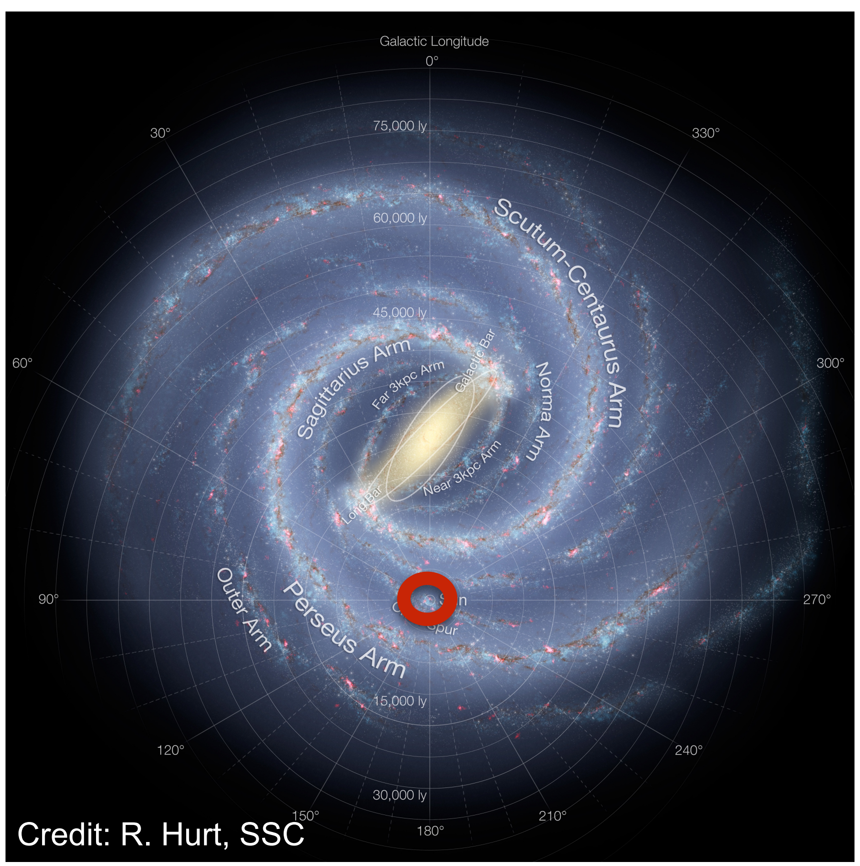
- Motivation
- The LAMOST Galactic surveys
- Stellar metallicity of mono-age populations
- Disk structures of mono-age populations
- Summary



The Milky Way’s disk



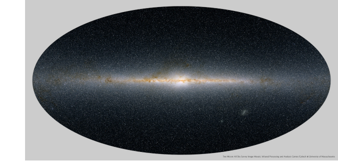




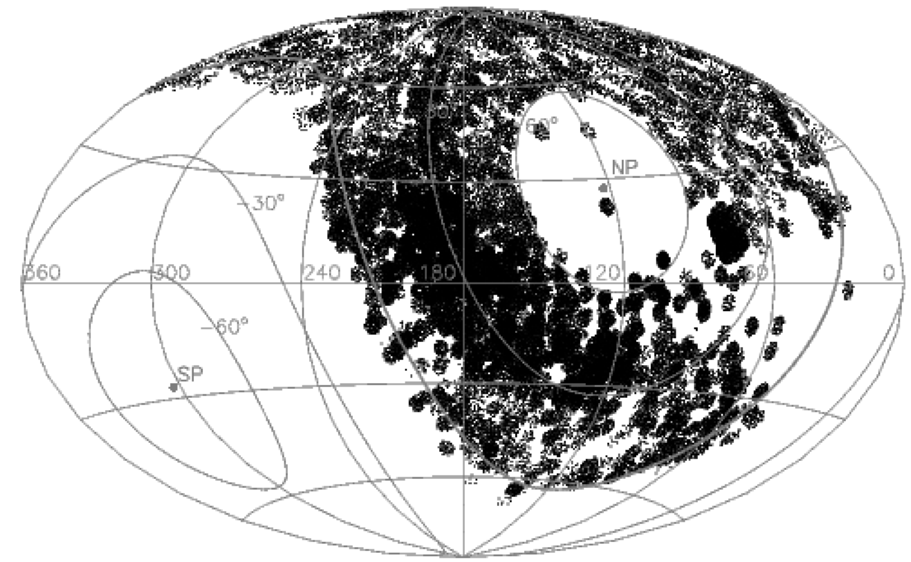
When did the disk start to form? and how?
What’s the star formation history of the disk?
How did the structure/metallicity of the disk evolve with time?

Disk structures & metallicity of mono-age stellar populations!

The LAMOST Galactic Spectroscopic Surveys

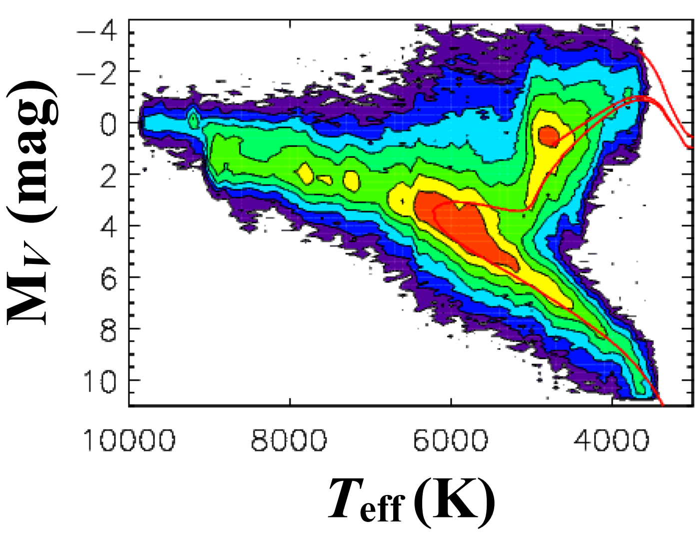


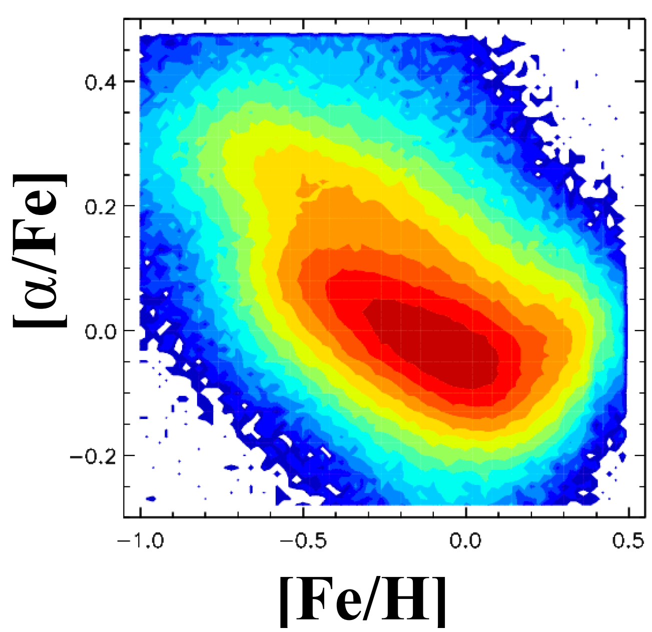
First five-year survey: 2012/10-2017/6
6.5 million stellar spectra by June, 2016
R~1800; magnitude range: 9 - 17.8 in r-band

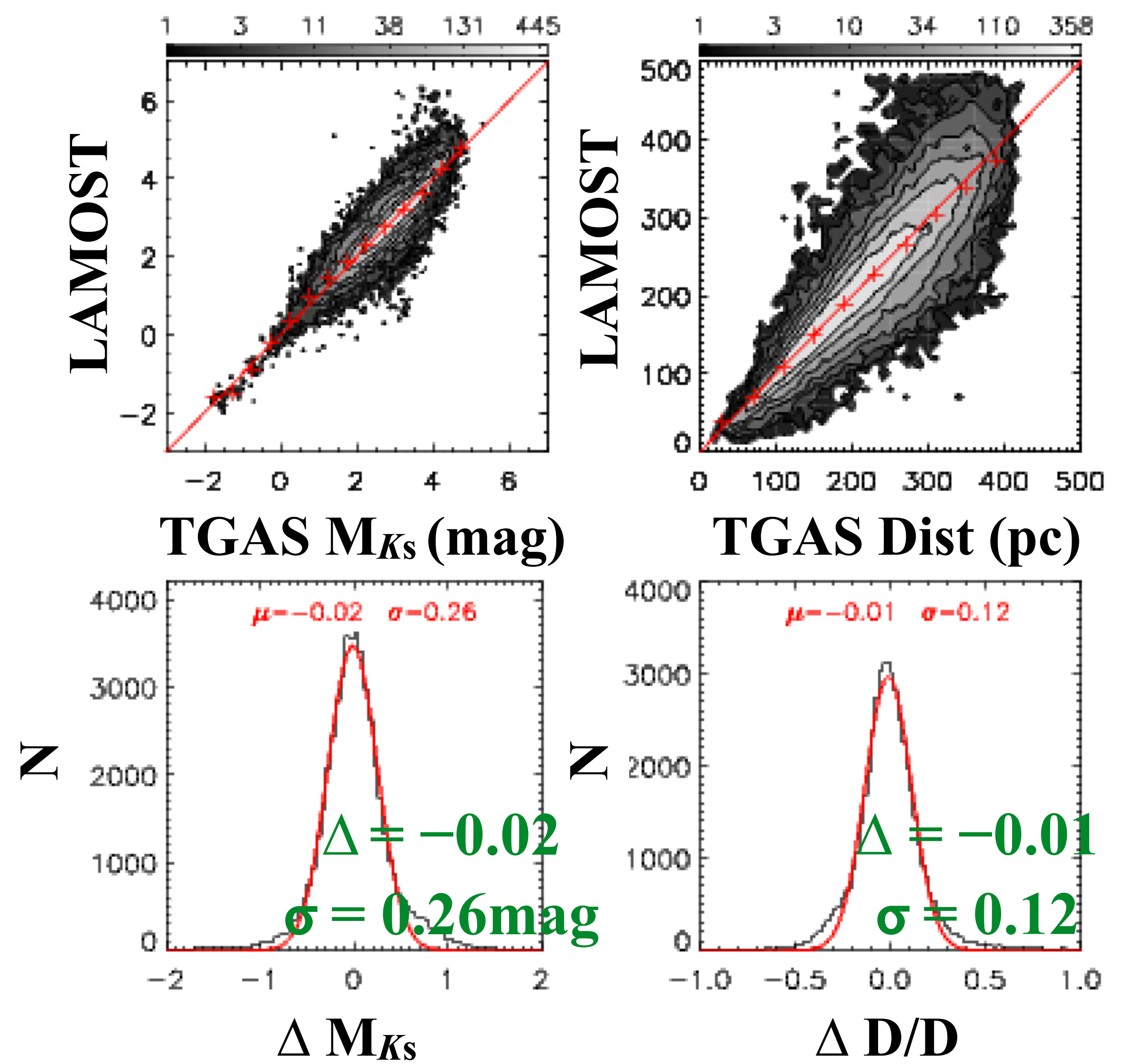


Robust stellar parameters with LSP3: V_r(5km/s), T_{eff}(100K), log*g* (0.1dex), [Fe/H](0.1dex), [a/Fe] (0.05dex) [C/H]&[N/H](0.1dex), E_{B-V} (0.04mag), M_V(0.3mag), Distance(15%), age

+ Proper motions from Gaia: >12 dimensions

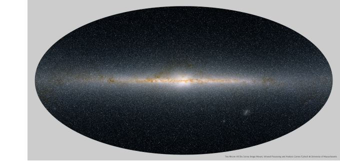


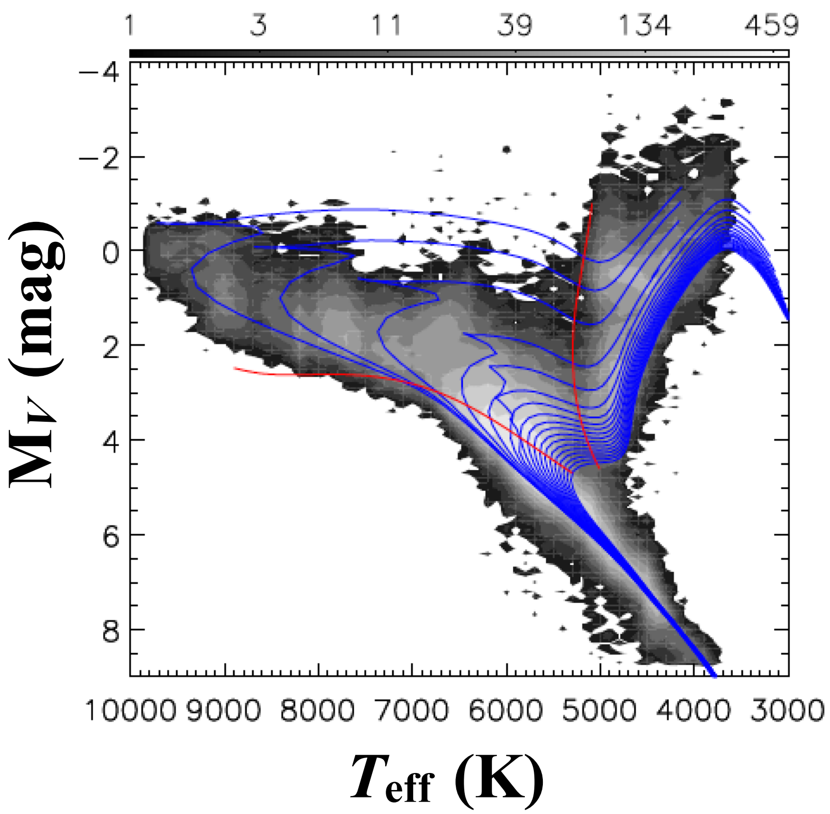




Xiang et al. 2017, MNRAS, 464, 3657; *ibid*, 467,1890

The LAMOST MSTO star sample





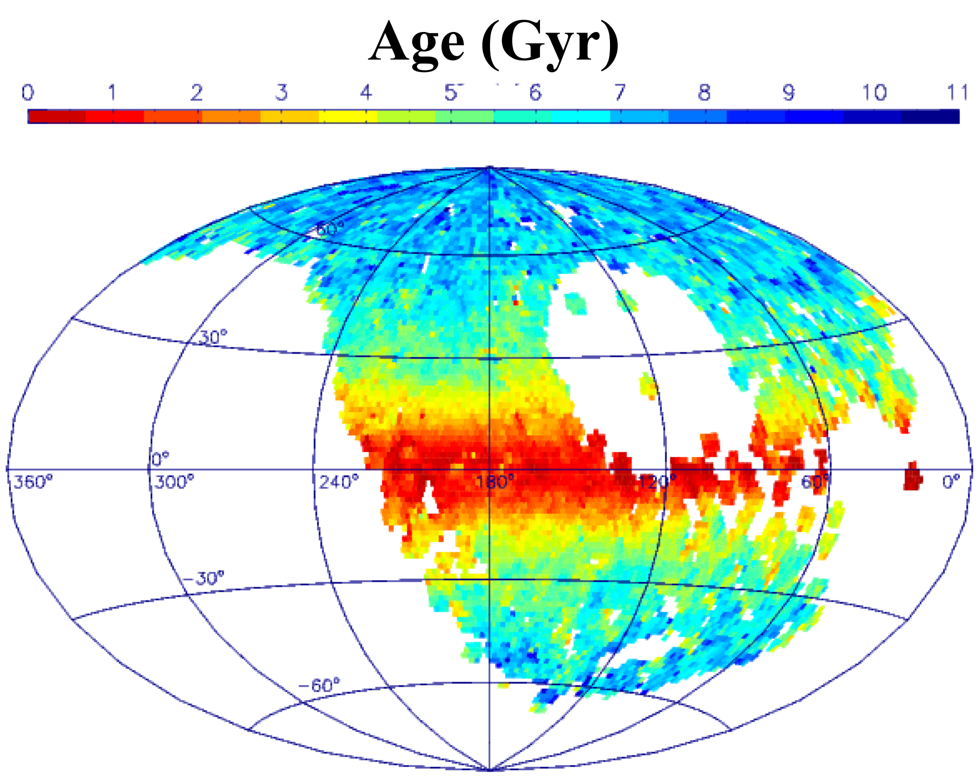
One million stars defined in the $T_{\rm eff}$ — M_V diagram

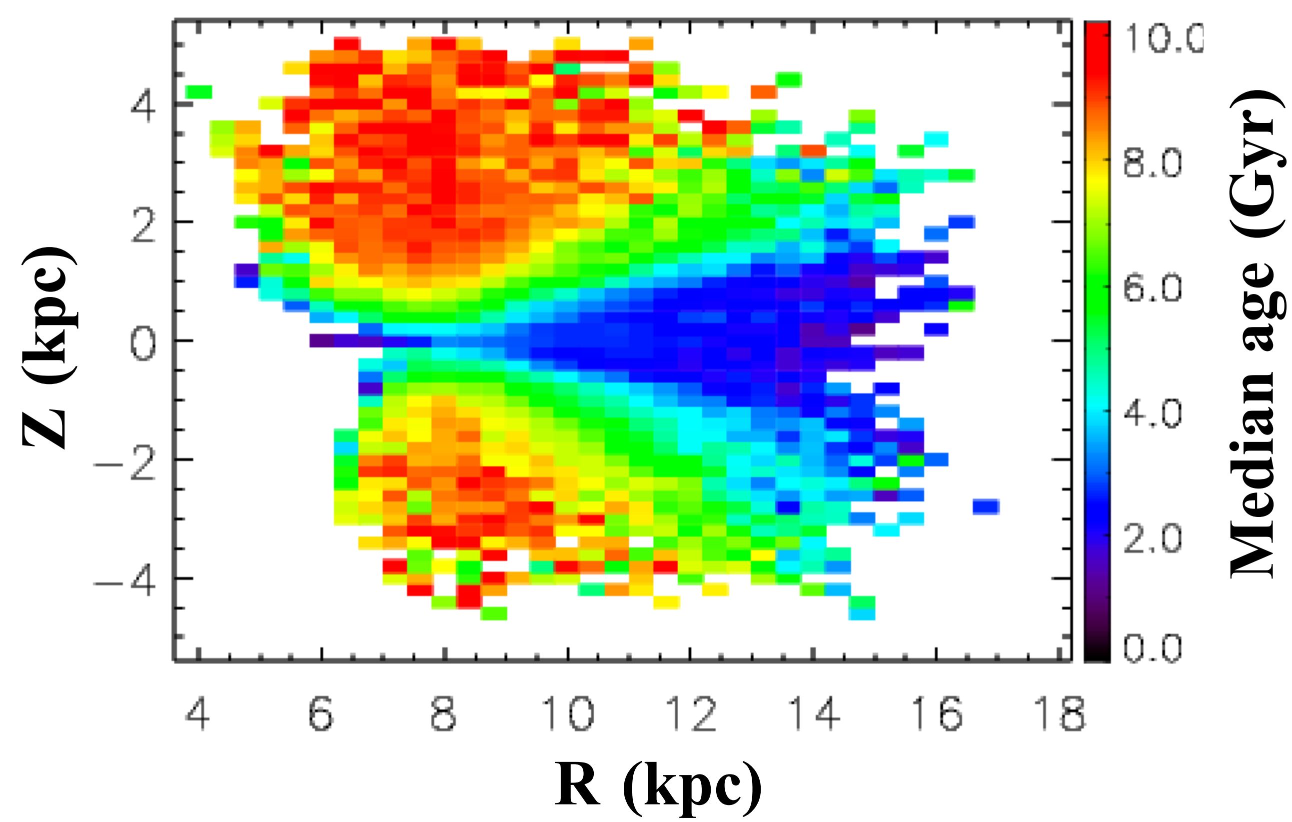
$T_{\rm eff}$ < 10000 K, [Fe/H] > −1 dex, M_V cut
SNR > 20 (SNR > 50 for 60 per cent stars)

Stellar **age** and **mass** are estimated from $T_{\rm eff}$, M_V, [Fe/H], [α/Fe] with isochrones in Bayesian scheme

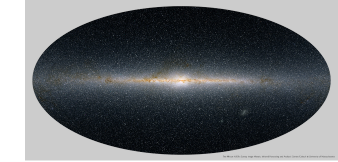
Uncertainties: 20-30% in age; <10% in mass

Xiang et al., submitted

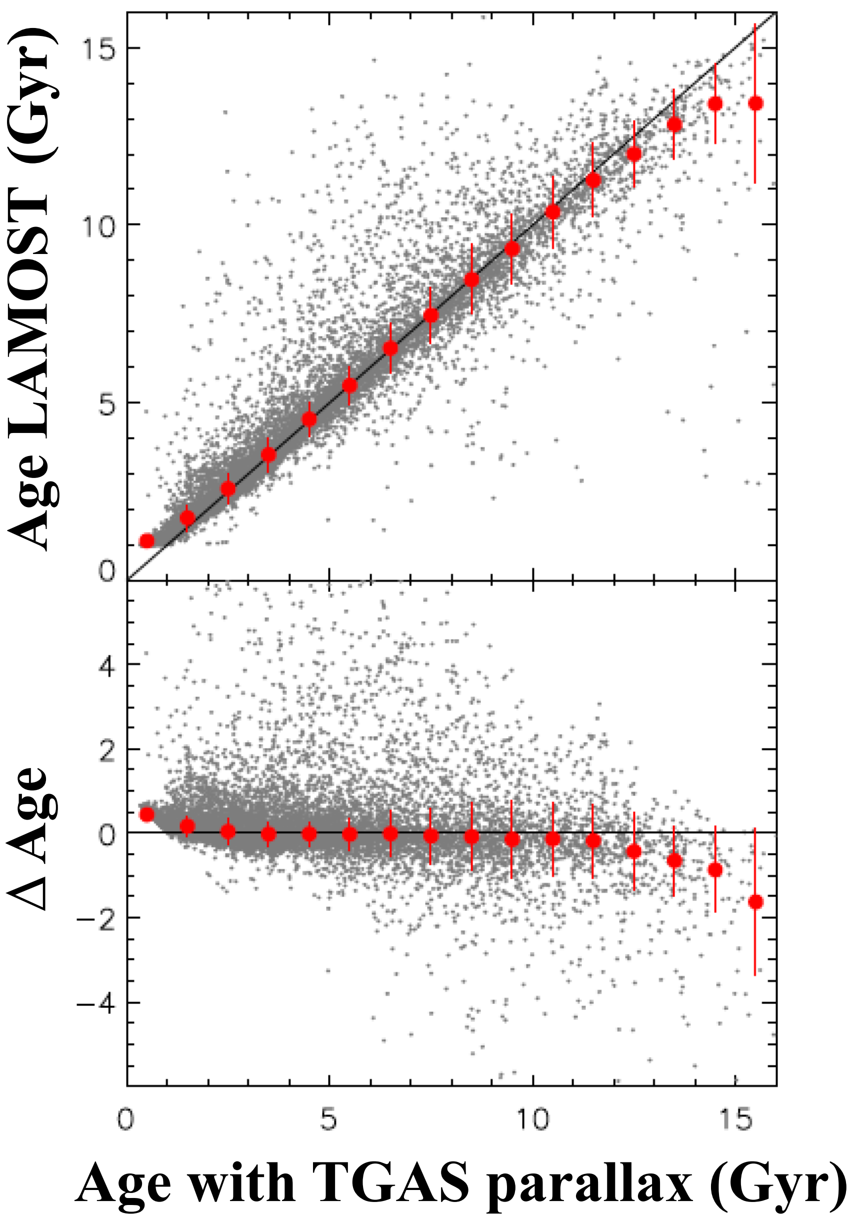


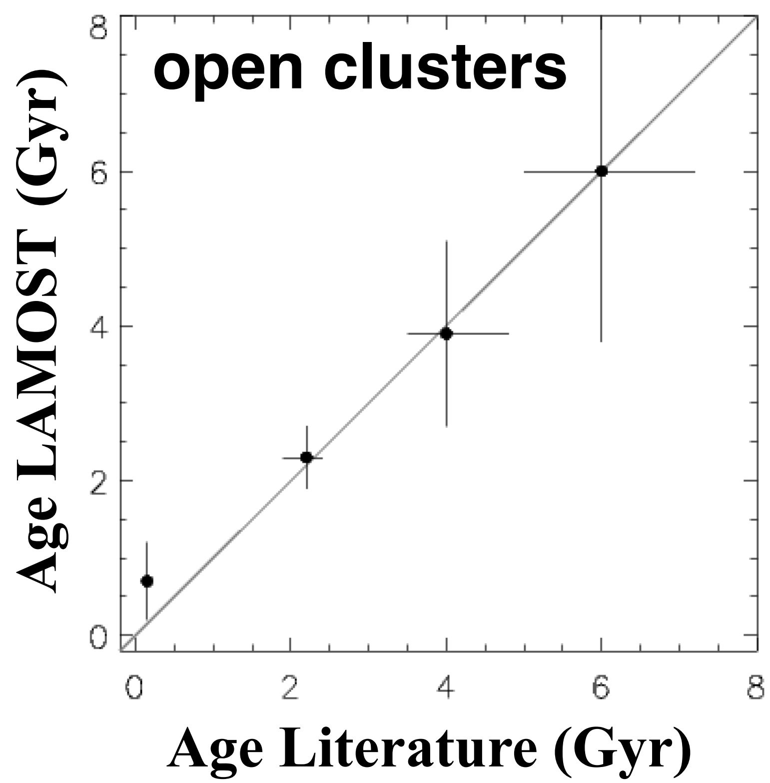


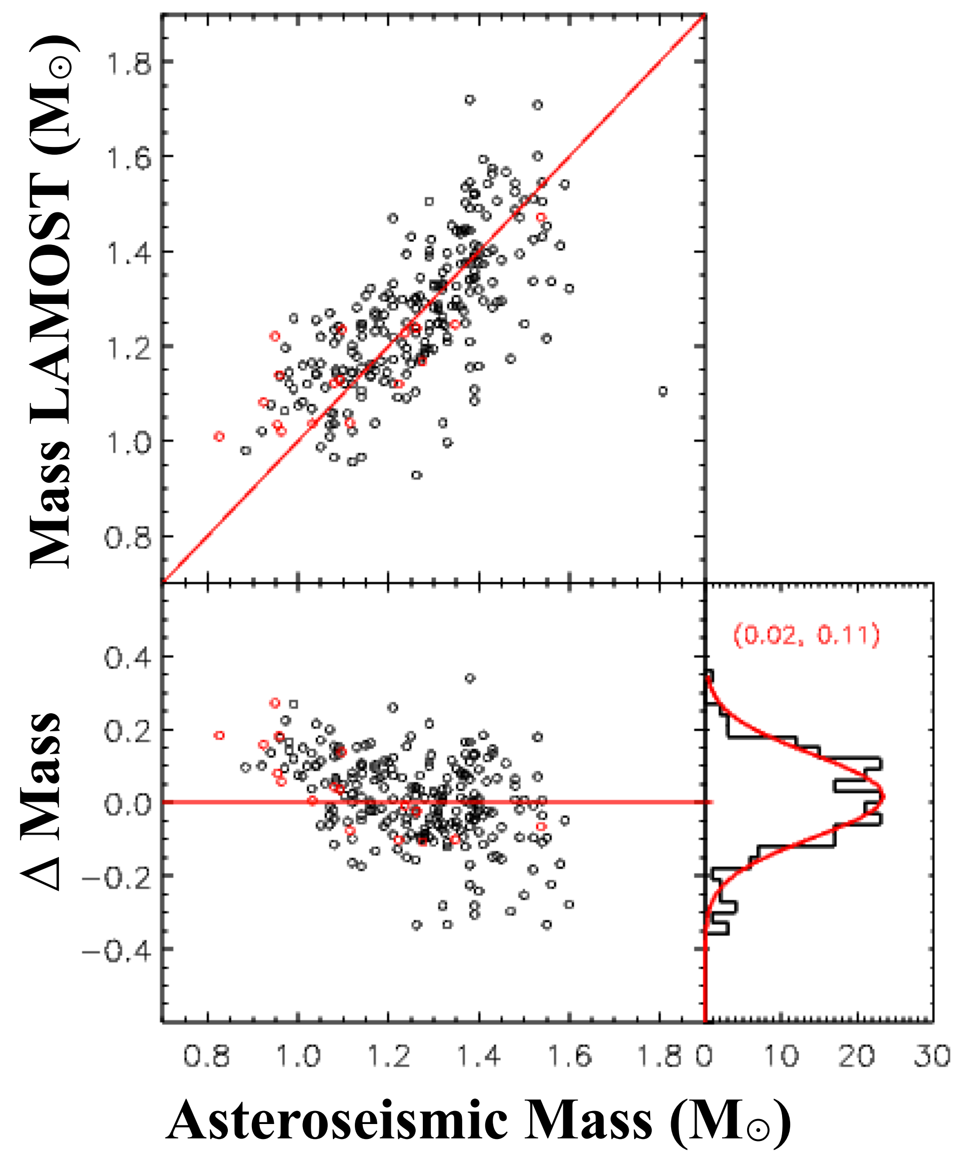
Validations of age & mass estimates



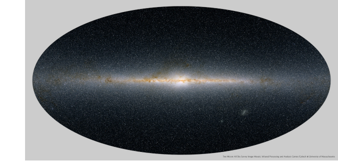
- **Gaia TGAS, Asteroseismology, Open clusters, Mock stars, duplicate observations**

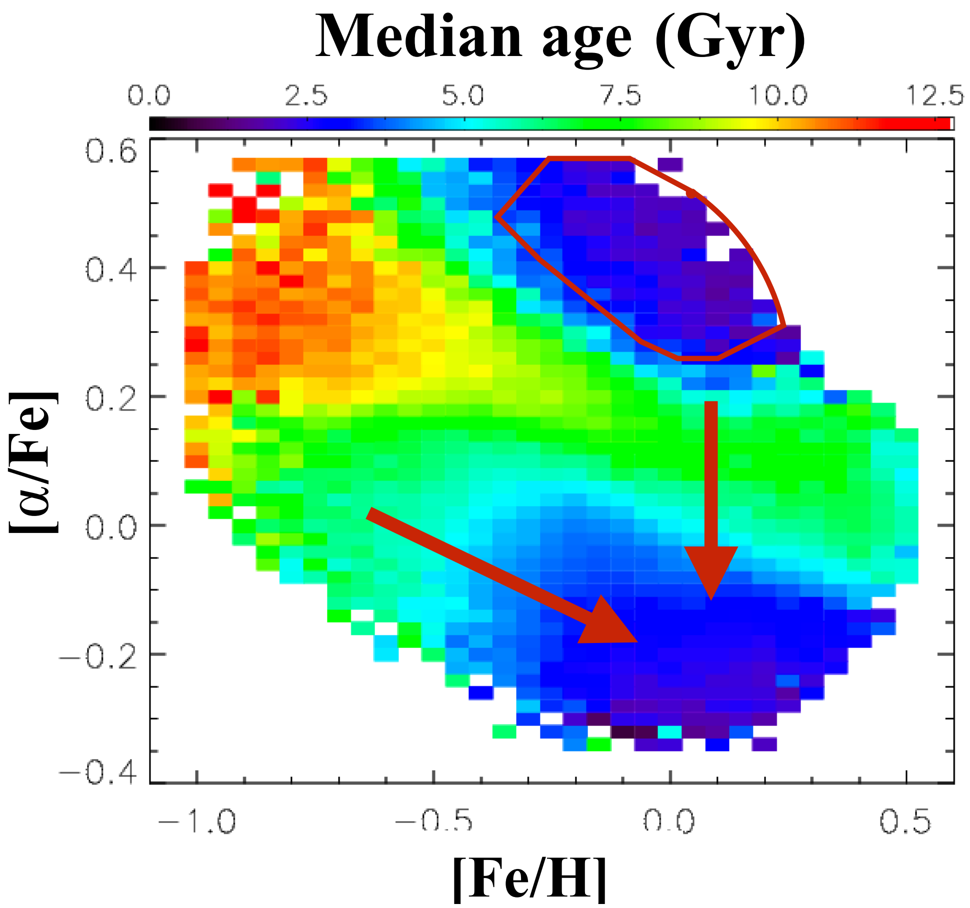






Age — [Fe/H] — [α/Fe]

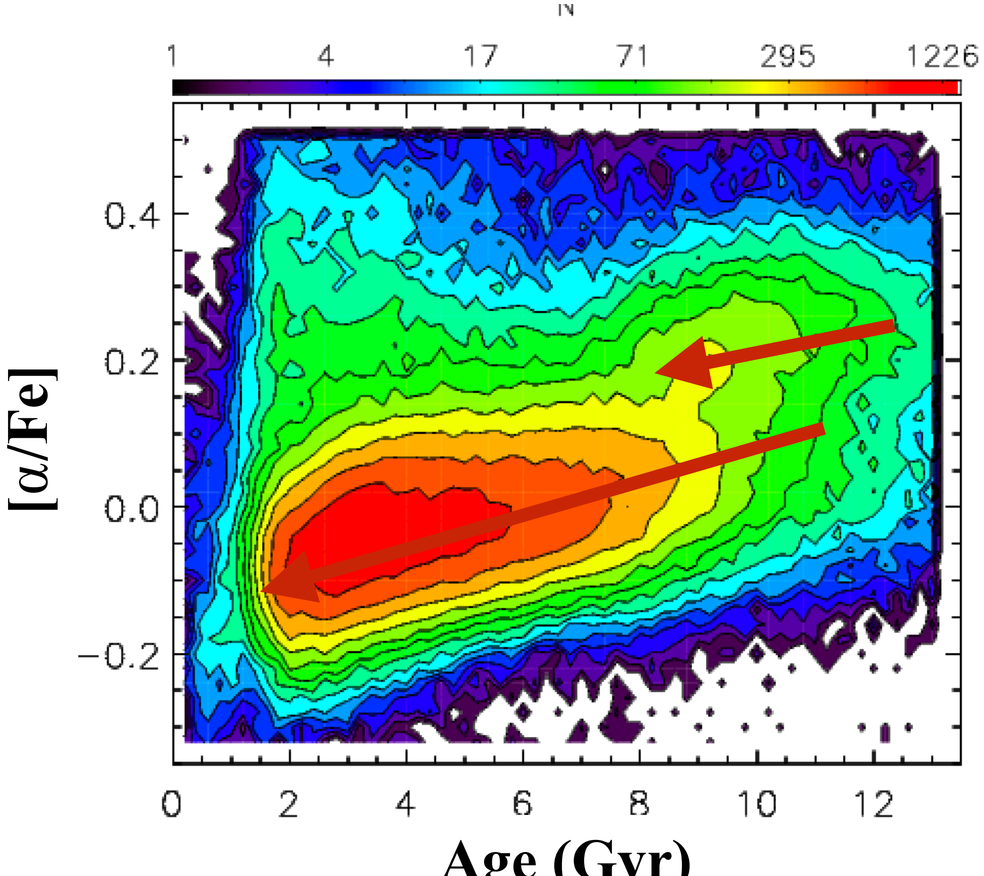


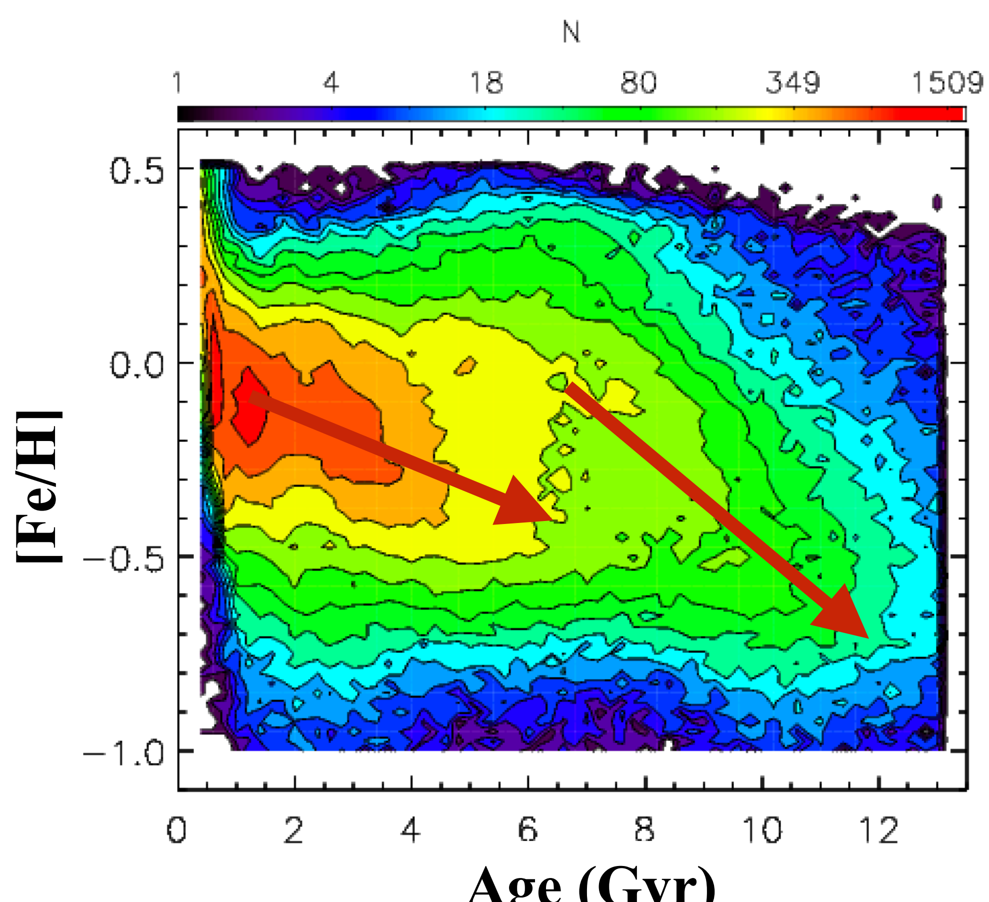


[Fe/H]-poor, [α/Fe]-rich stars are old
Sharp demarcation between intermediate-age and young stars
Decreasing trend of "thin disk" stars
Young, α-rich stars: binaries, BSS, HB, bad spectrum

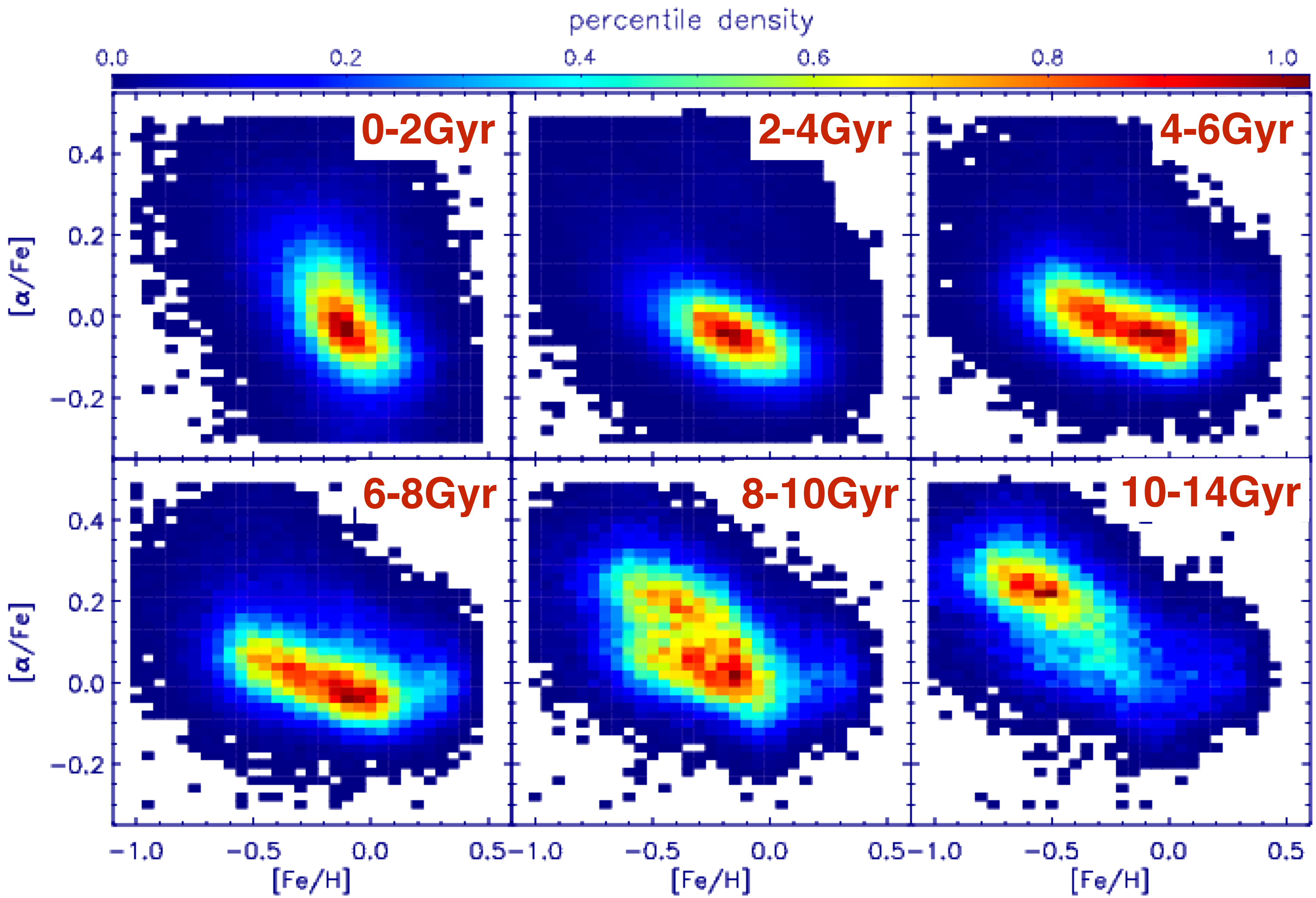
Double sequence of age—[α/Fe]
Double sequence of age—[Fe/H]

Xiang et al., submitted



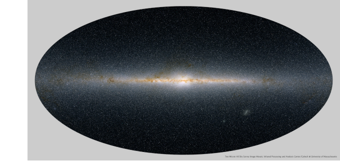


[Fe/H] — [α/Fe] of Mono-age populations

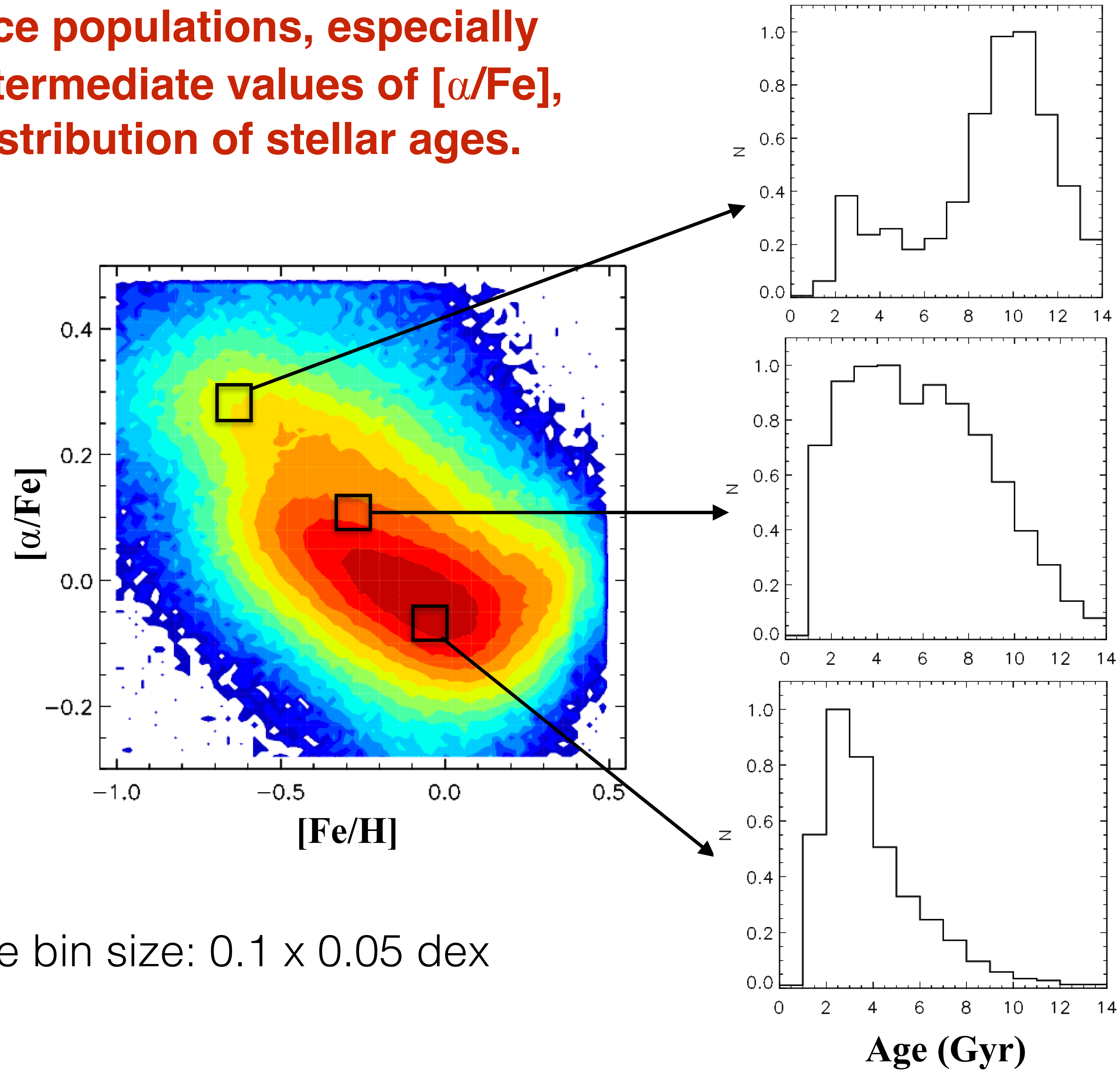


The "thick disk" sequence disappear when age < 8Gyr
The "thin disk" sequence occur at 8-10 Gyr ago

Age of mono-abundance populations

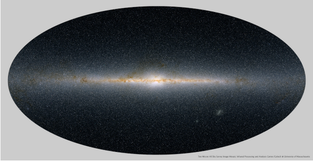


Mono-abundance populations, especially for those with intermediate values of [α/Fe], exhibit wide distribution of stellar ages.

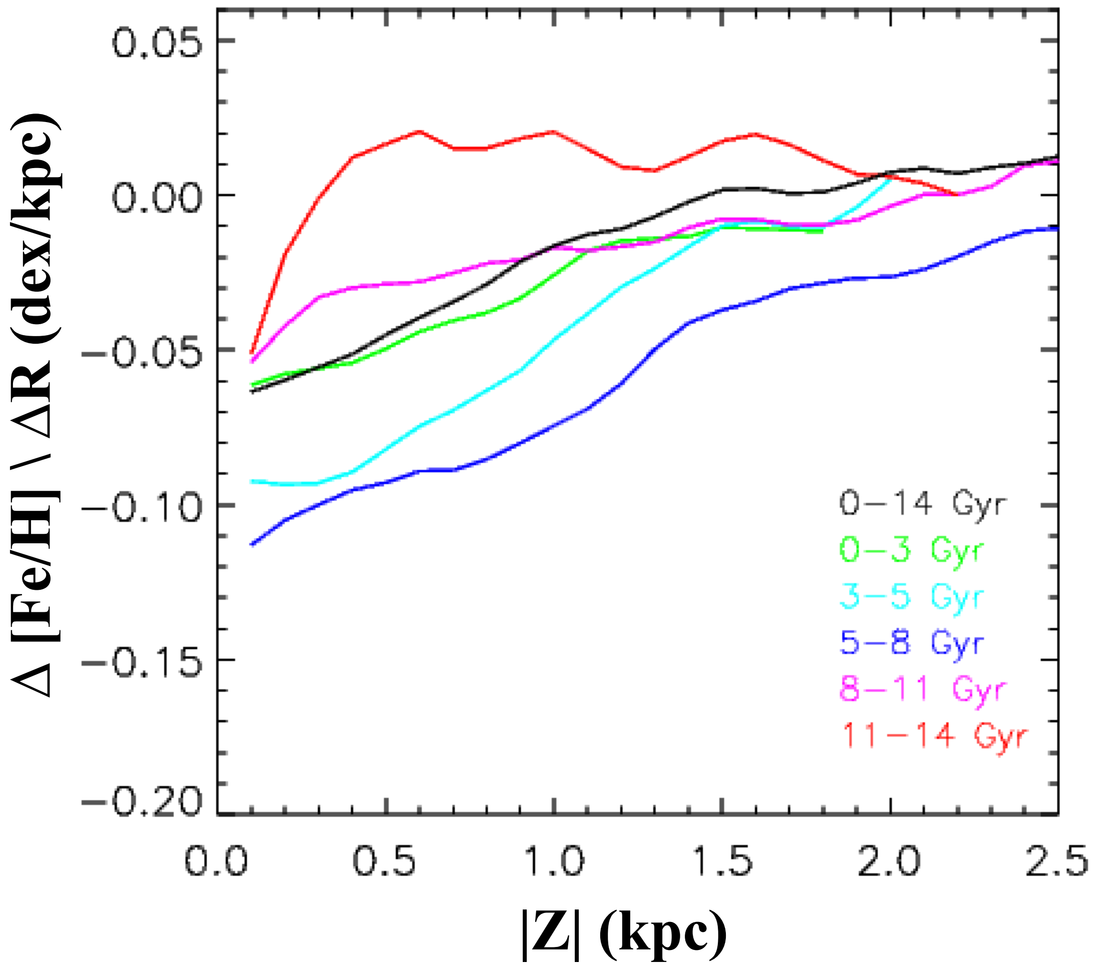


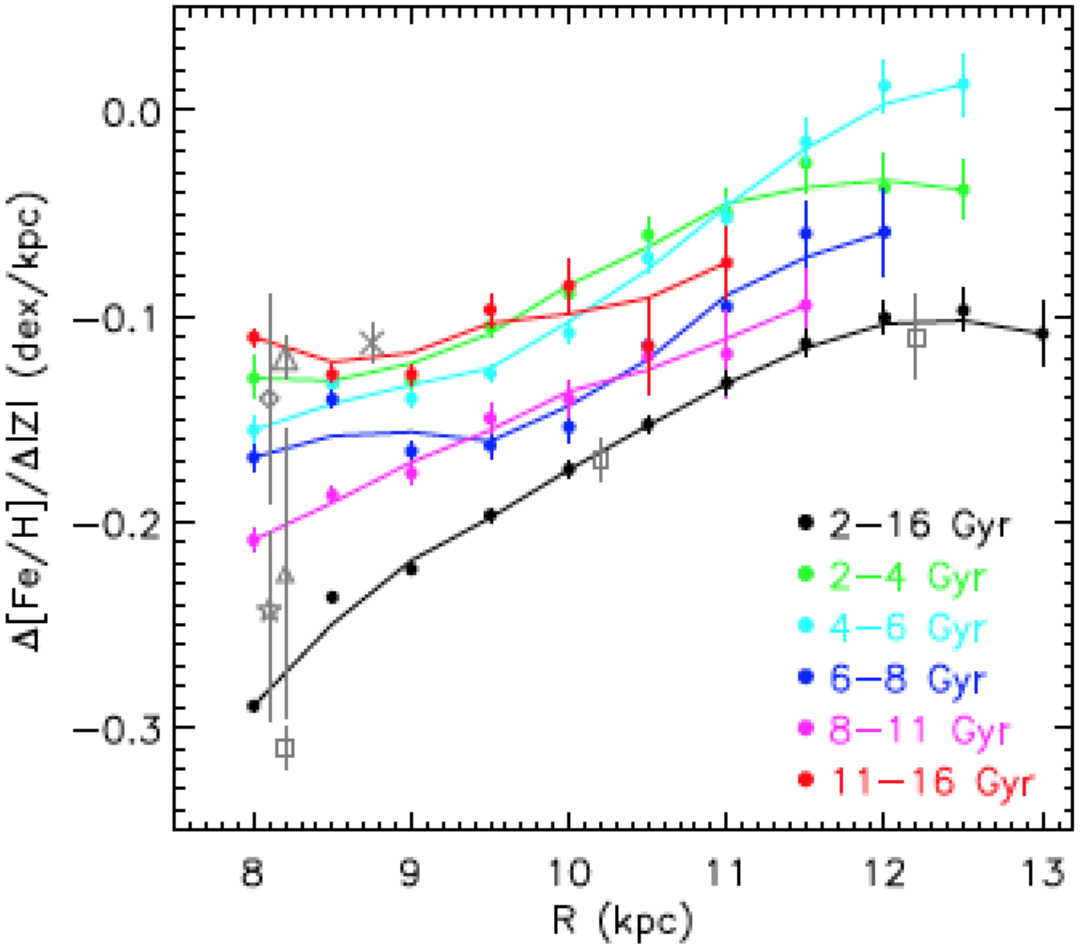
Mono-abundance bin size: 0.1 x 0.05 dex

[Fe/H]/[α/Fe] gradients of Mono-age populations



Xiang et al. (2015), RAA, 15, 1209



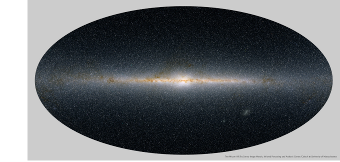


Significant temporal evolution of radial metallicity gradients

Maximal gradients at ~8Gyr

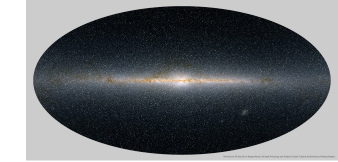
Significant temporal evolution vertical metallicity gradients; **oldest stars have negative vertical gradients of –0.1dex/kpc**

See **Wang Chun's poster (c7)** for spatial variations of **metallicity distribution function** and **[α/Fe] gradients** of mono-age populations



Summary

- **LAMOST Galactic surveys collected 7 million stellar spectra, simple target selection function; Accurate stellar parameters have been derived**
- **Robust ages and masses of a million disk stars**
- **Clear patterns among age -[Fe/H] -[α/Fe] correlations; The age-[Fe/H] relations show double negative sequences**
- **Temporal evolution of [Fe/H] & [α/Fe] gradients; Stars of ~8Gyr exhibit maximal radial gradients**
- **The “thin” disk sequence in the [Fe/H]-[α/Fe] plane arise from 8-10Gyr; the “thick” disk sequence becomes very weak below 8Gyr**
- **The stellar mass density distribution exhibits plenty of spatial and temporal features**



Take home message

Accurate ages have already come!

A combination of the LAMOST data with Gaia DR2+ will be certainly powerful resource to further characterize the Milky Way

Thanks for your attention