Massively determining stellar ages with SPInS

The Milky Way assembly tale
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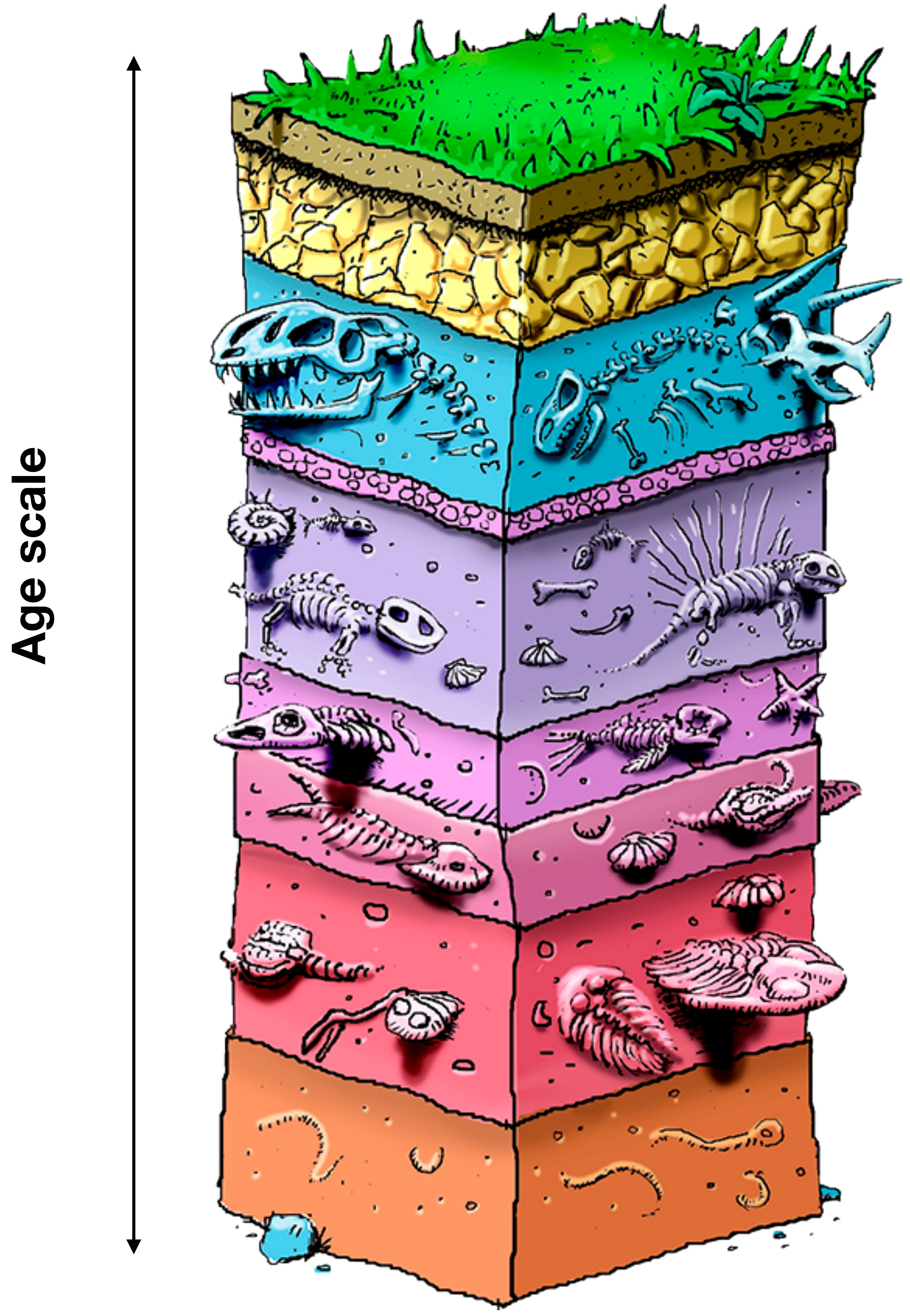
Context

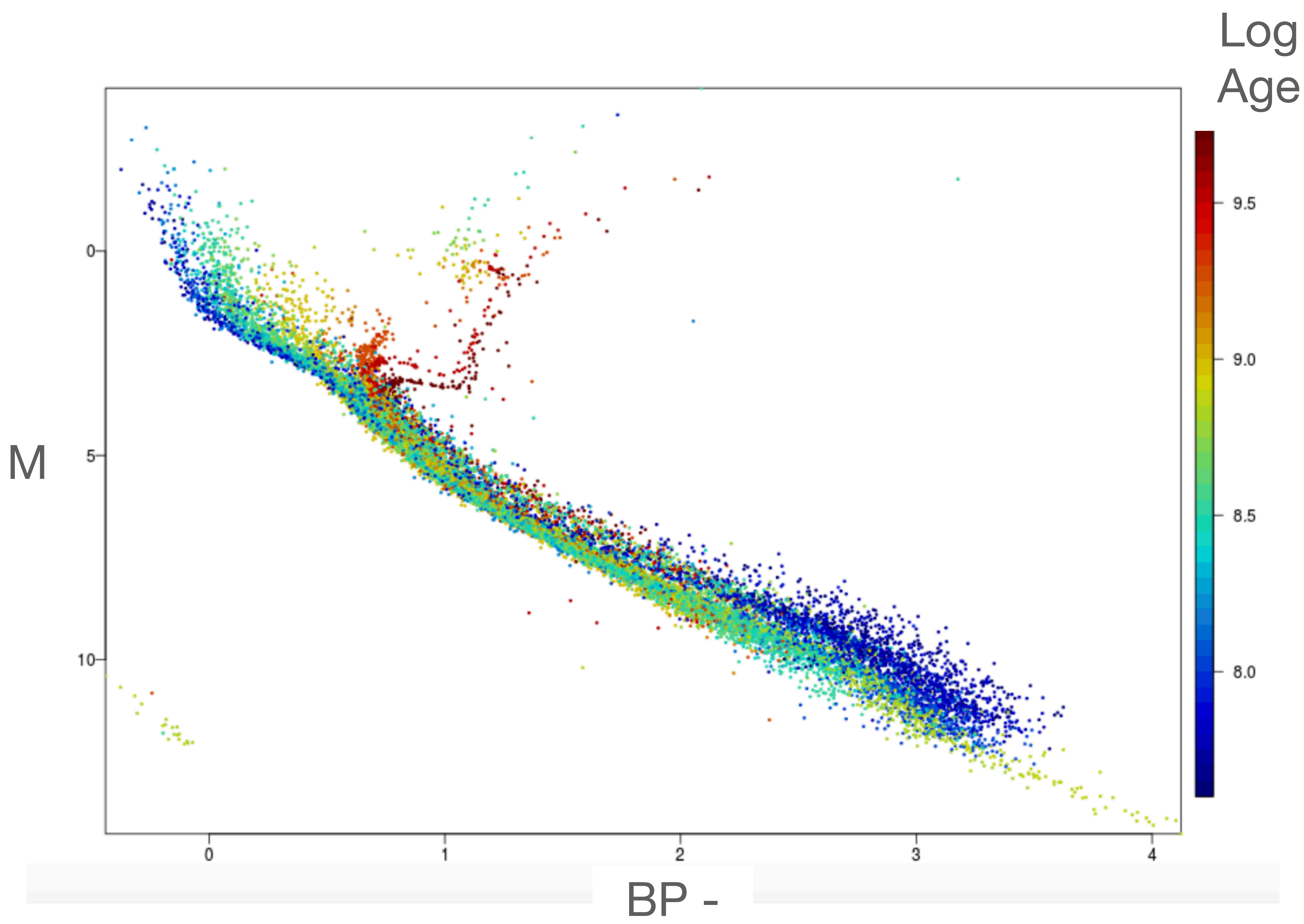


Reliable age estimates set the **time scales** of Galactic dynamical and chemical evolution

Most reliable methods?

- Asteroseismology
- Isochrone fitting

G, G_{BP}, G_{RP} + parallax,3D extinction maps + [Fe/H], [α/M]



Gaia Collaboration et al. 2018

I. Testing the strategy in clusters

II. Large scale ages for field stars

SPInS: Stellar Parameters Inferred Systematically

[Lebreton & Reese 2020]

Stellar parameters inferred from **stellar evolution model grid** using **classical constrains**

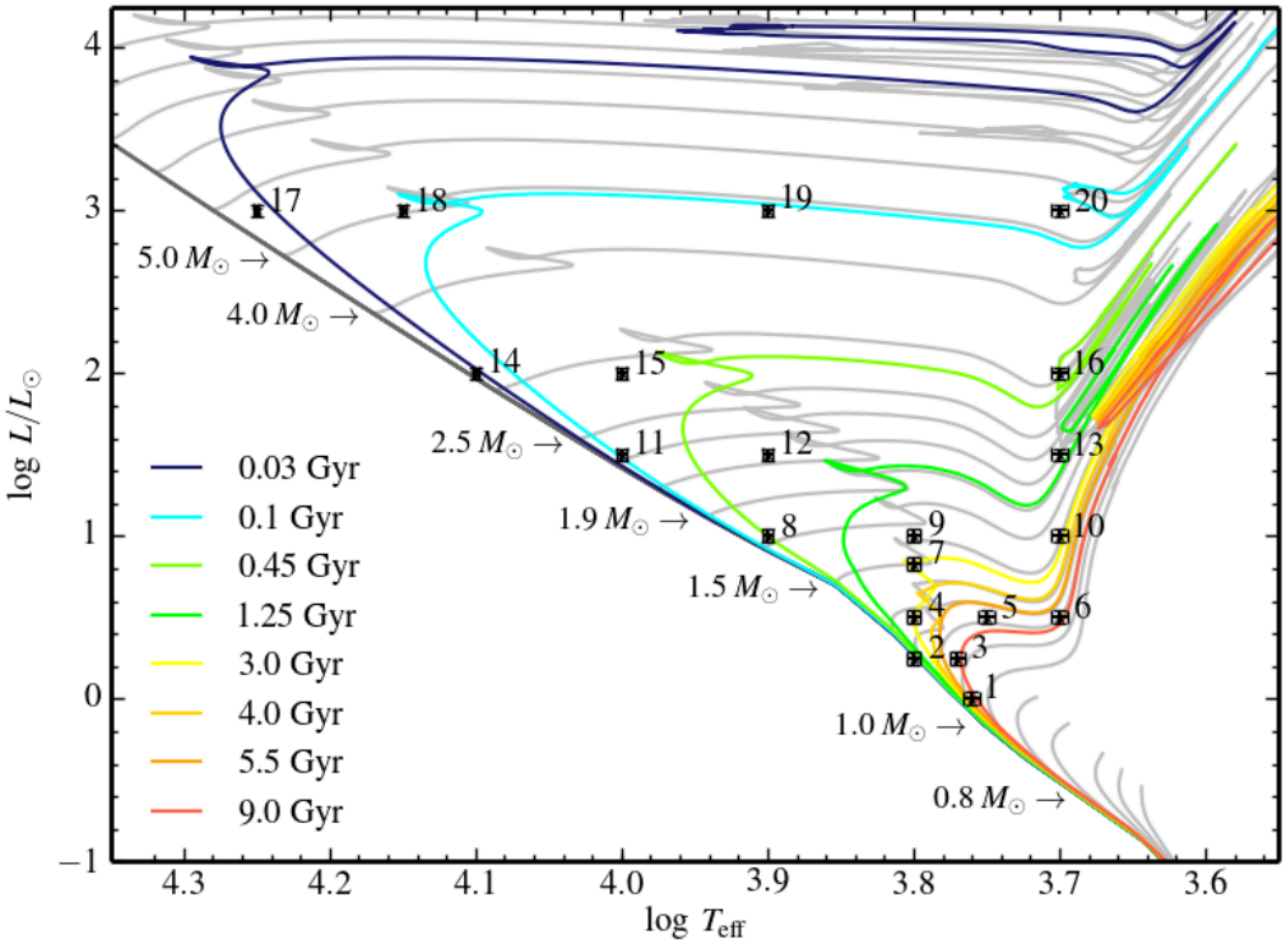
Bayesian approach → MCMC solver
→ Interpolation in grid
→ Priors

PDF sampling:
- Mass
- Age
- Metallicity

New implementation: convergence from the *integrated autocorrelation time* (τ) [Hogg & Foreman-Mackey 2018]

SPInS

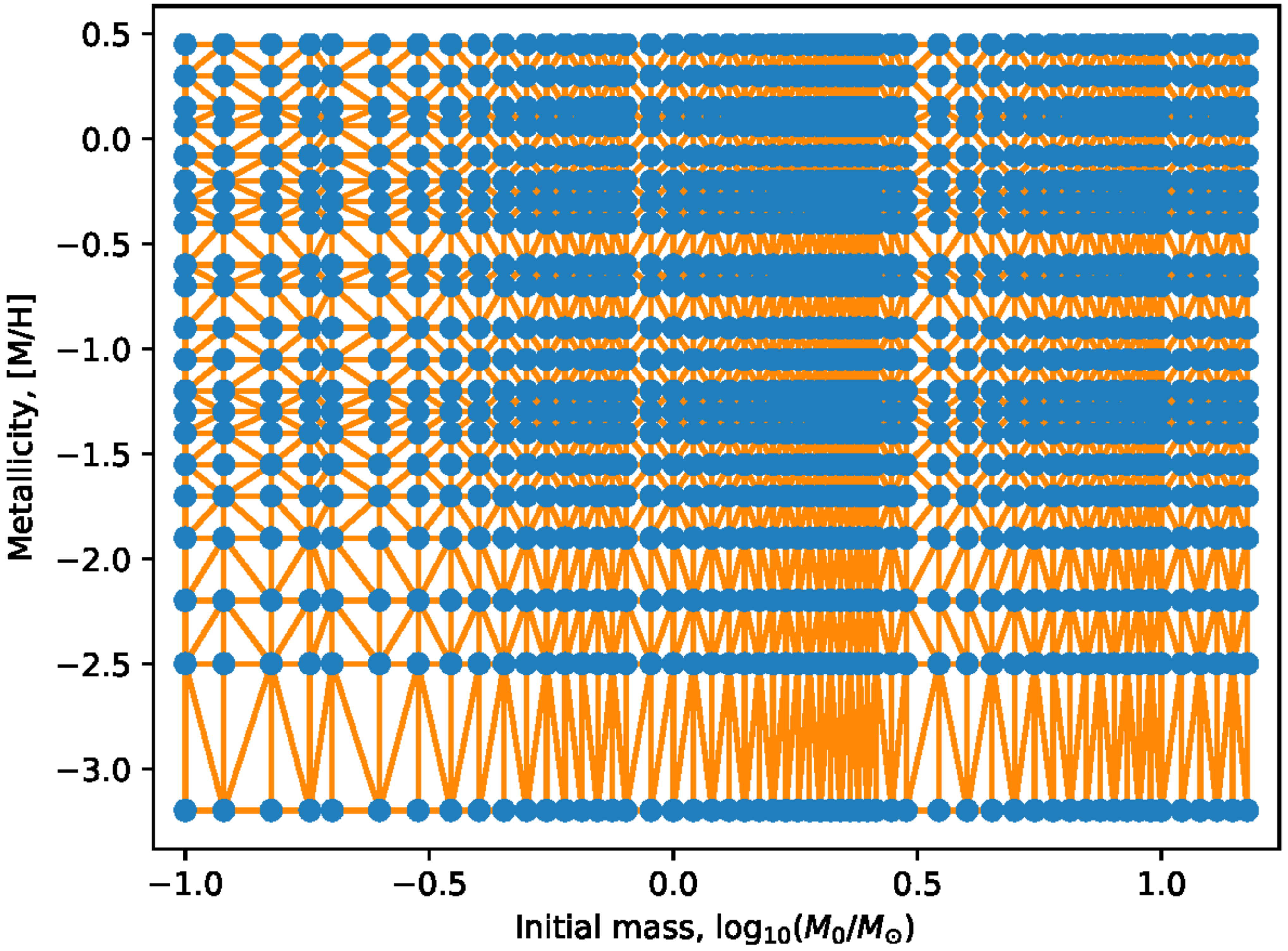
Reese Daniel / SPInS · GitLab



SPInS: Stellar Parameters Inferred Systematically

The **grid**: solar-scaled BASTI, overshooting, mass loss, diffusion

1,176 evolutionary tracks $M_0 = [0.1 M_\odot, 15 M_\odot]$ $[\mathrm{M/H}] = [0.45, -3.197]$



The **observational constraints**

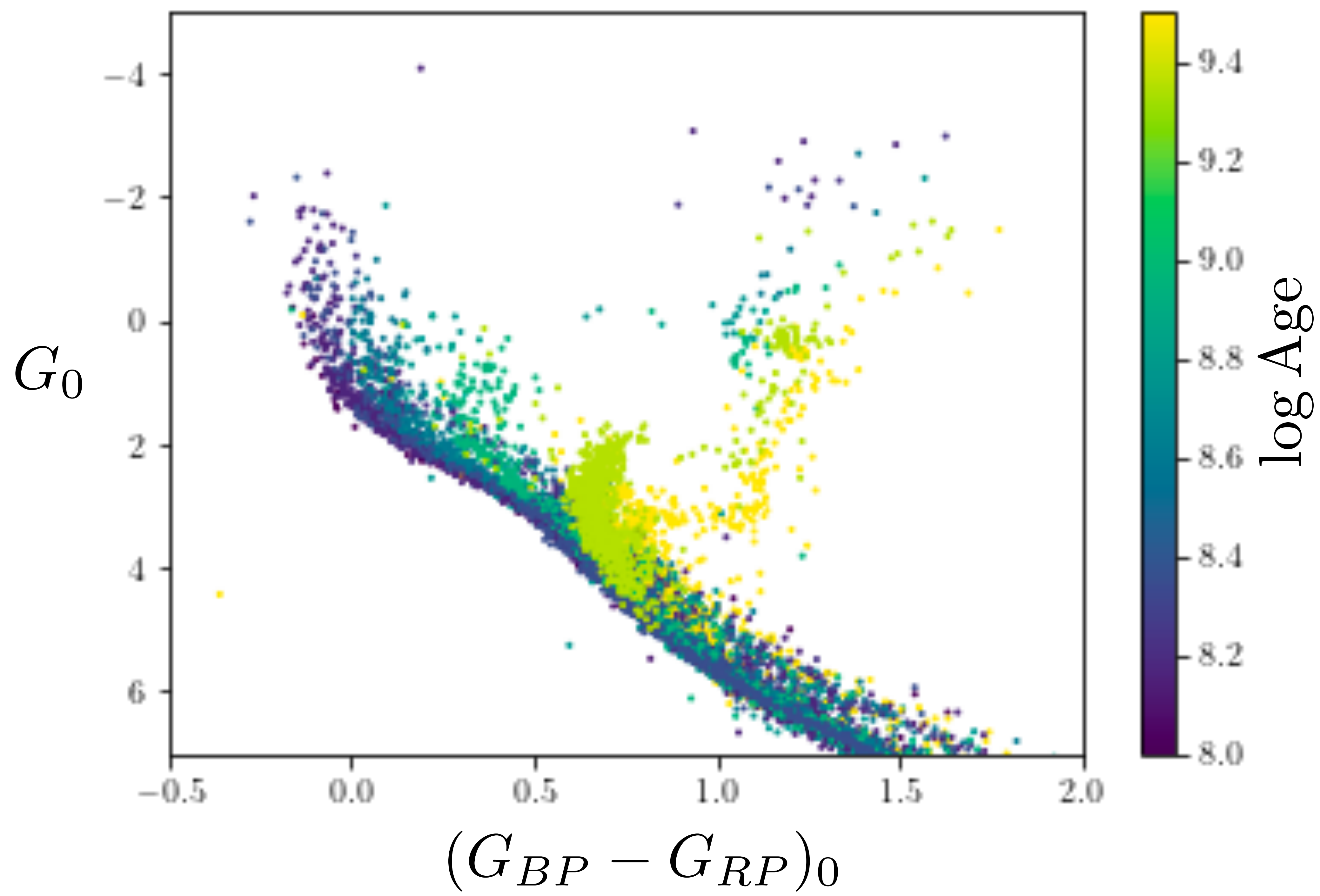
$M_G, (G_{BP} - G_{RP})_0, [\mathrm{M/H}]$

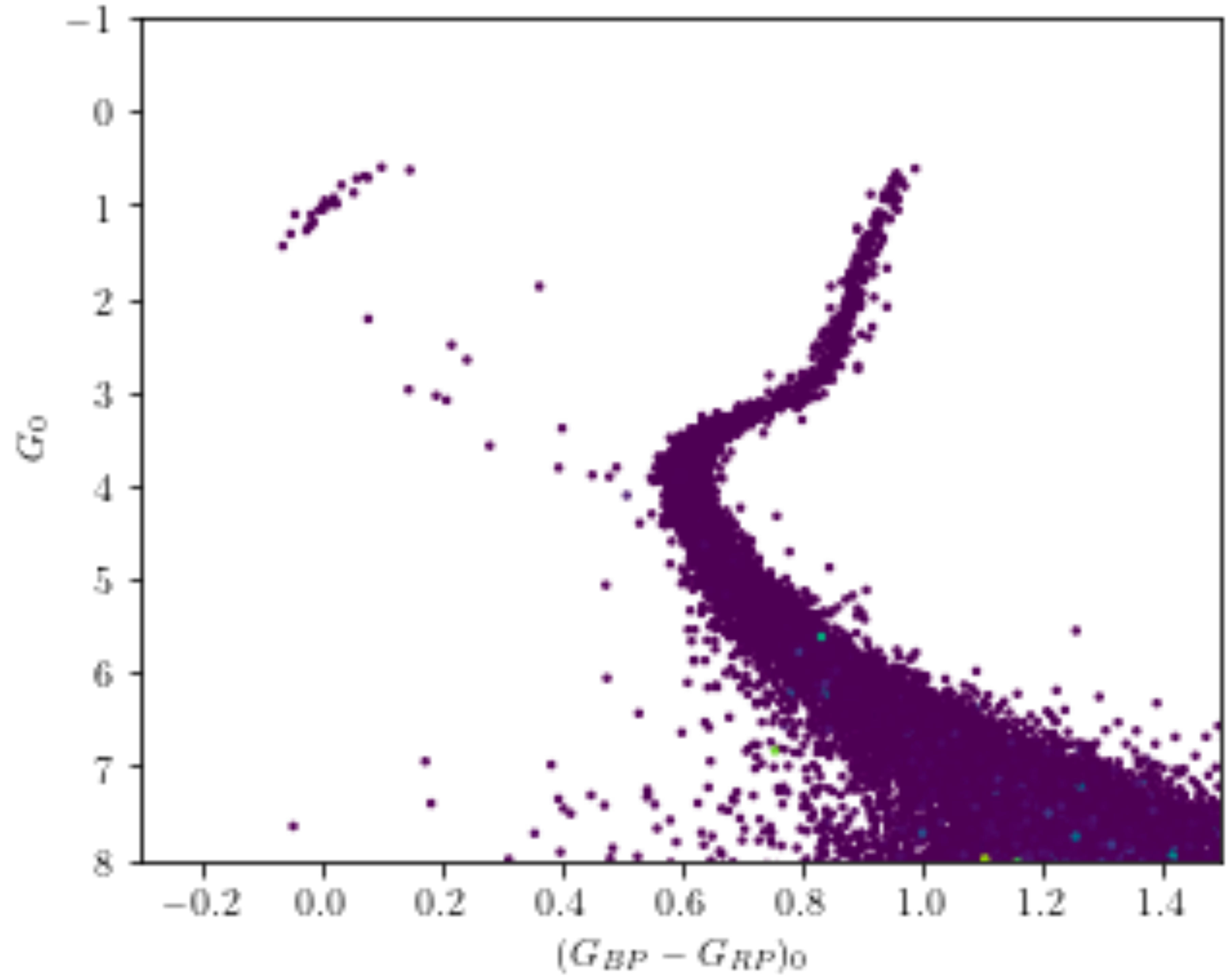
I. Testing the strategy in clusters

Among the best anchors to validate age estimations
Control sample to evaluate the capacity of SPInS to obtain ages of INDIVIDUAL stars

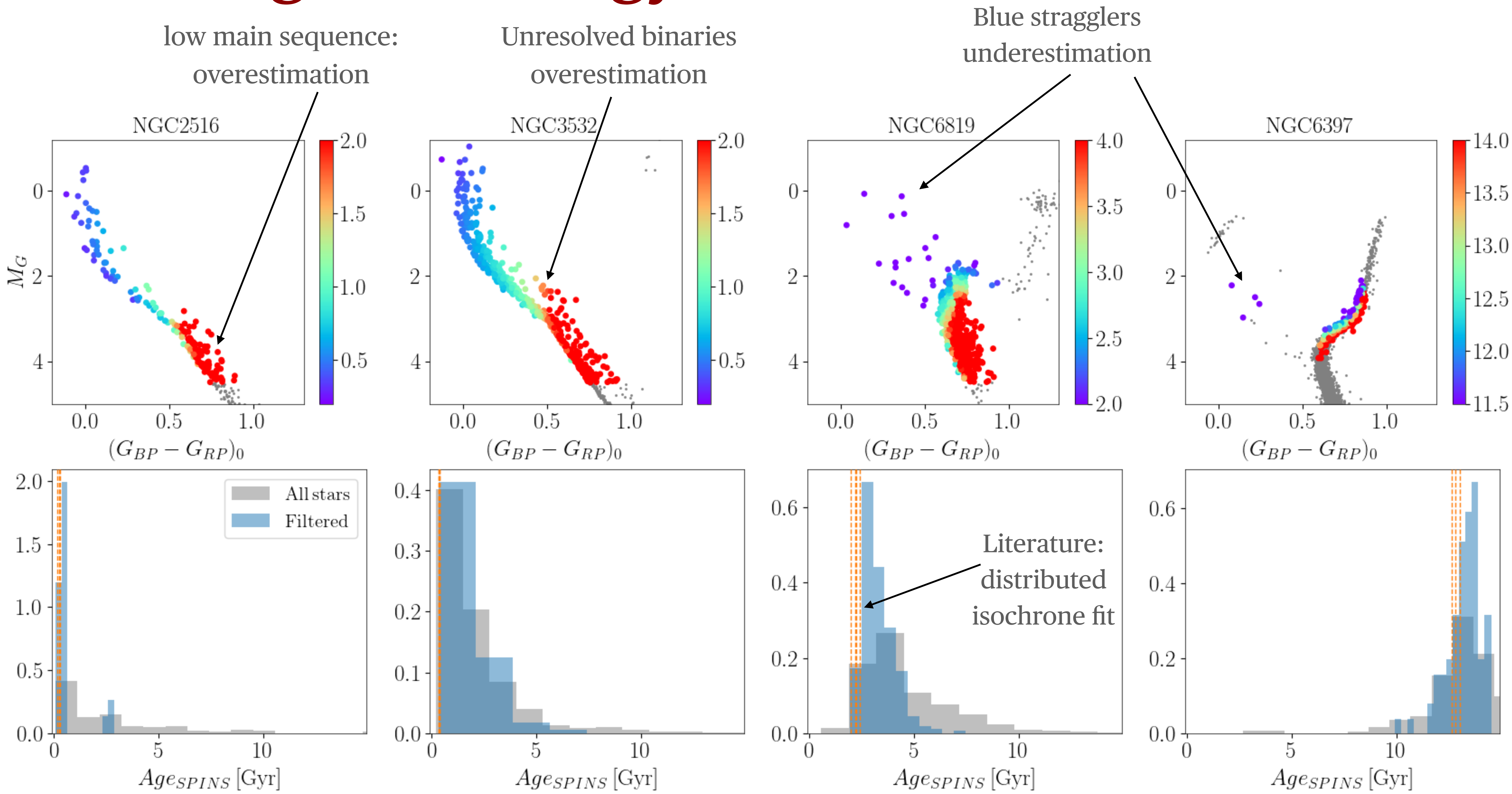
13 **Open clusters** with Age = [70Myr, 7Gyr], [Fe/H] = [-0.11, 0.11]
1 **globular cluster** NGC 6397 (d = 2.5 kpc, Age=12.8 Gyr [Correnti et al. (2018);
[Fe/H]= -1.98, [alpha/Fe] = 0.36 [Carretta et al. (2019)] ← Metallicity scaling using Salaris+1993

} ~4,000 MSTO & SG





I. Testing the strategy in clusters



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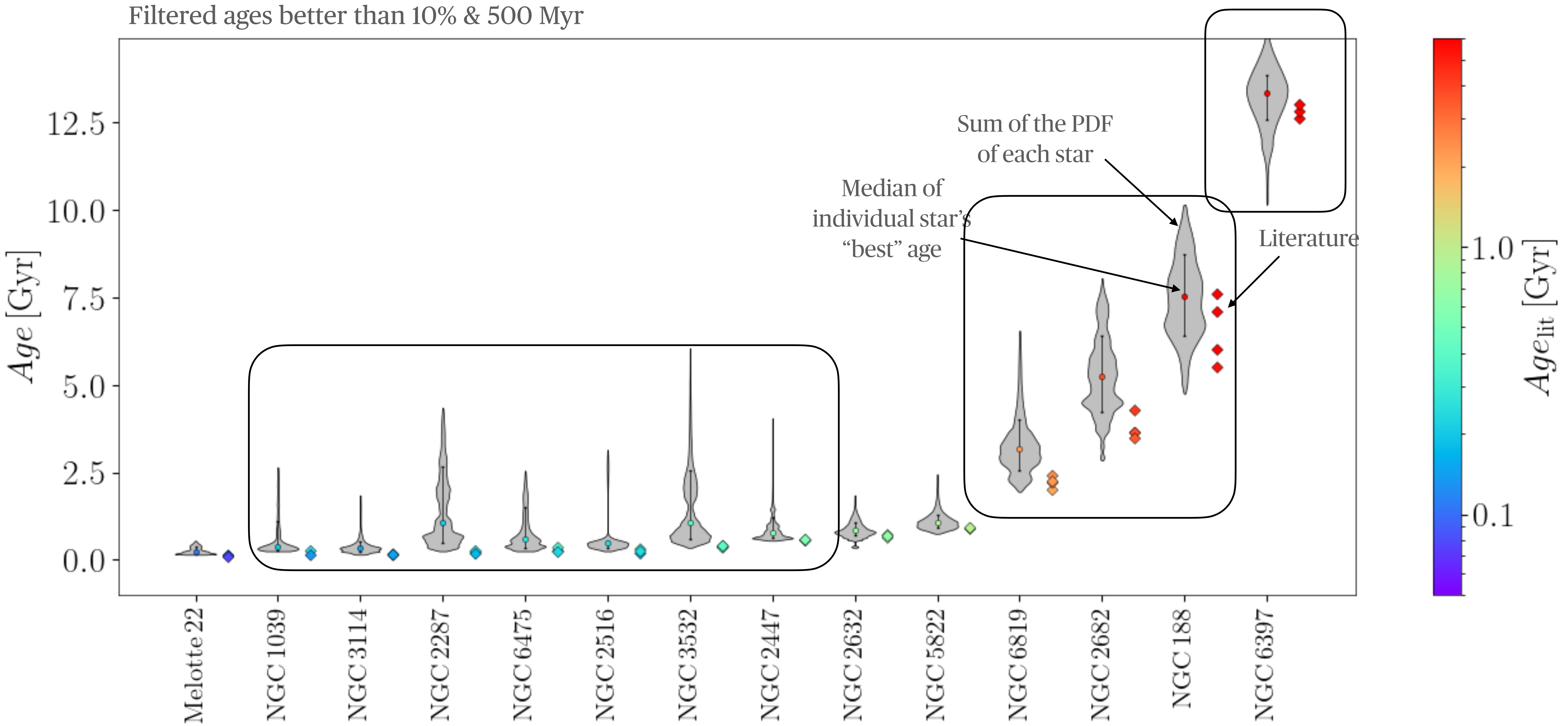
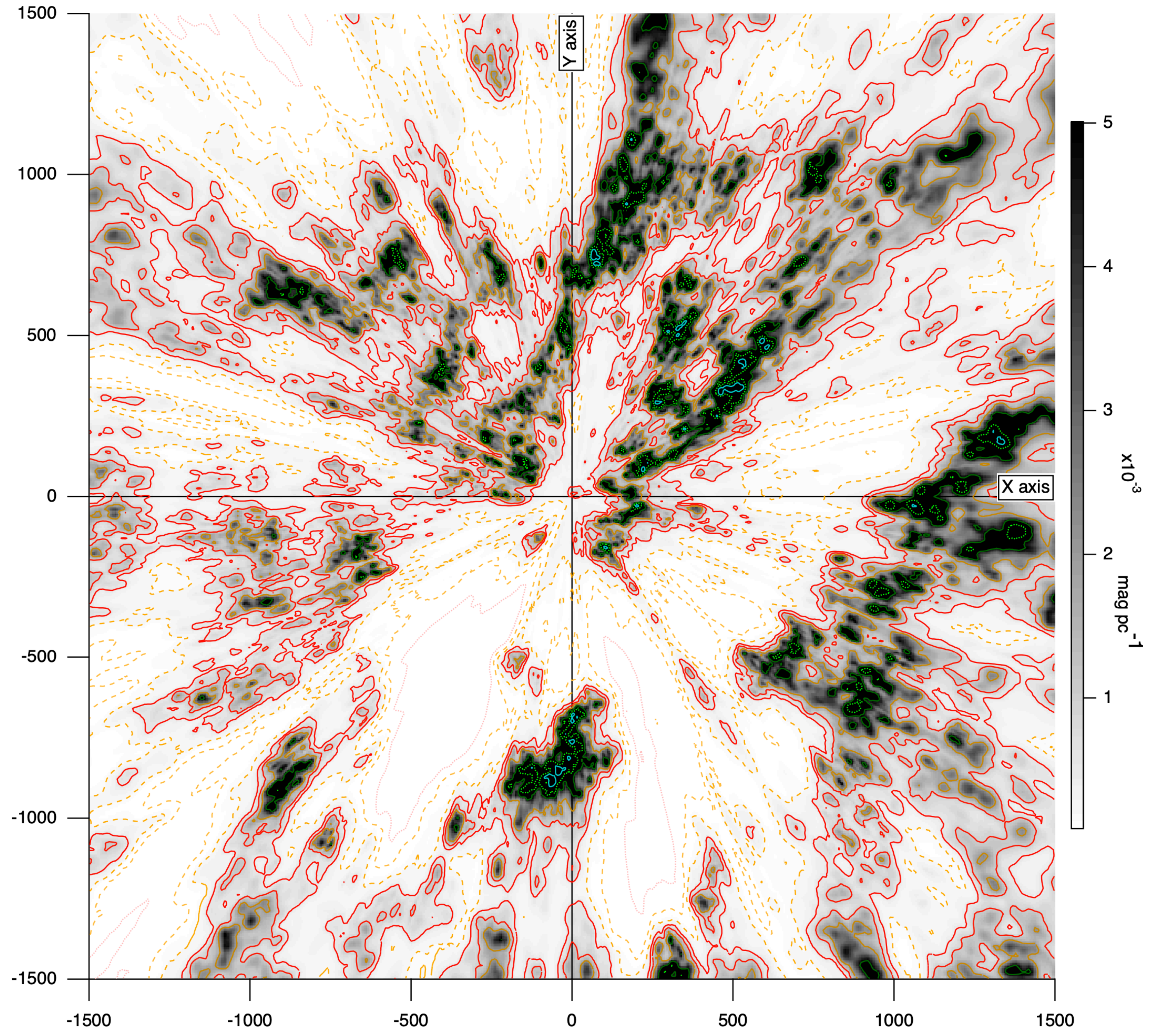


II. Large scale ages for field stars

Gaia **absolute CMD**

⇒ restriction to good uncertainties in :
parallax (~ 1%)
Absolute magnitudes (~0.03)
RUWE (<1.2)

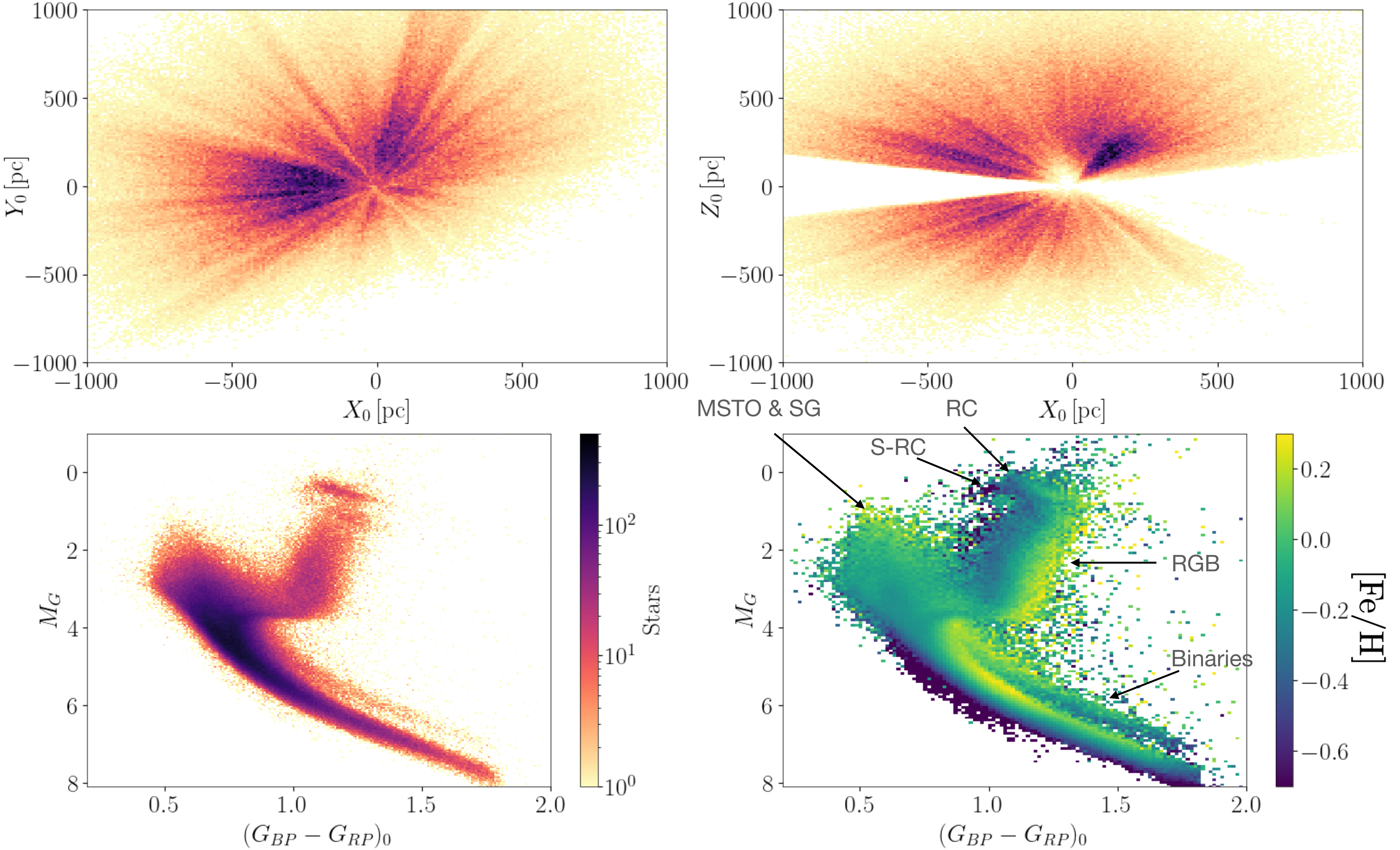
⇒ good estimation of **reddening:**
3D extinction maps [Vergely, Lallement & Cox 2022]
(3kpc x 3kpc x 800 pc, resolution 10 pc)
Avoiding low latitude regions



II. Large scale ages for field stars

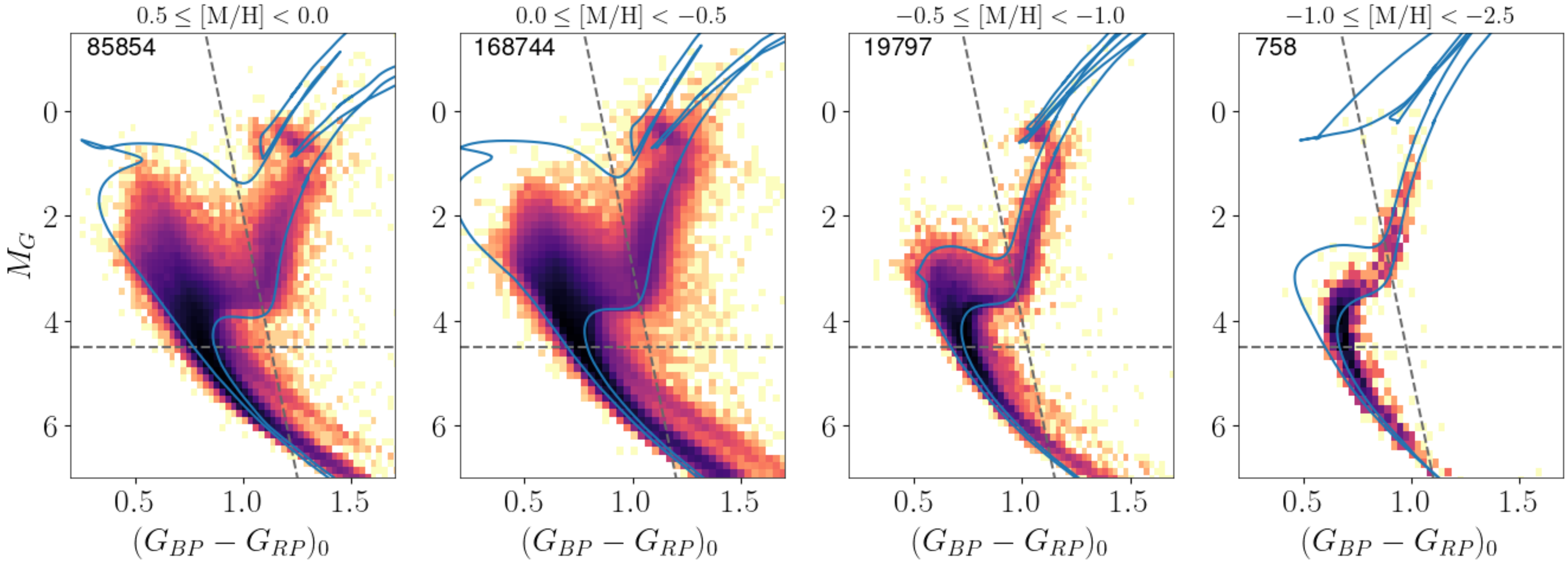
Absolute CMD

[Fe/H] & [alpha/M] from
LAMOST DR8
LRS & MRS
(Selecting errors < 0.05)



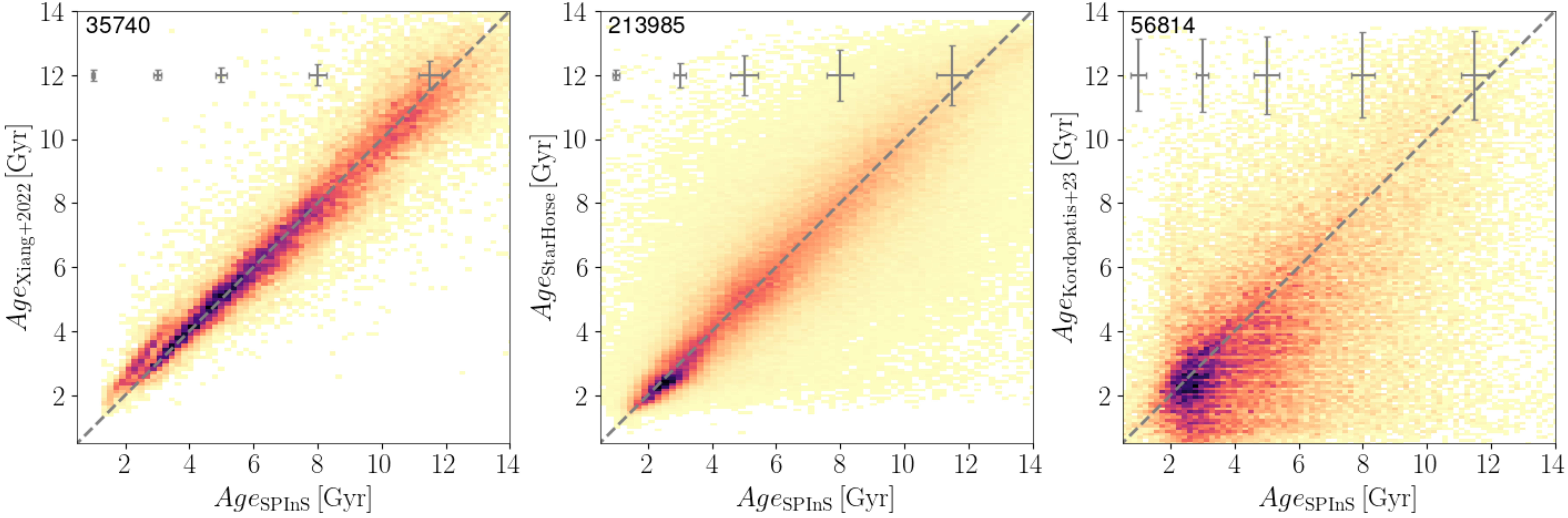
II. Large scale ages for field stars

Selection of main sequence turnoff and subgiant stars as Queiroz+2023 (StarHorse)
Sample of ~250k stars (LRS), ~35k stars (MRS)



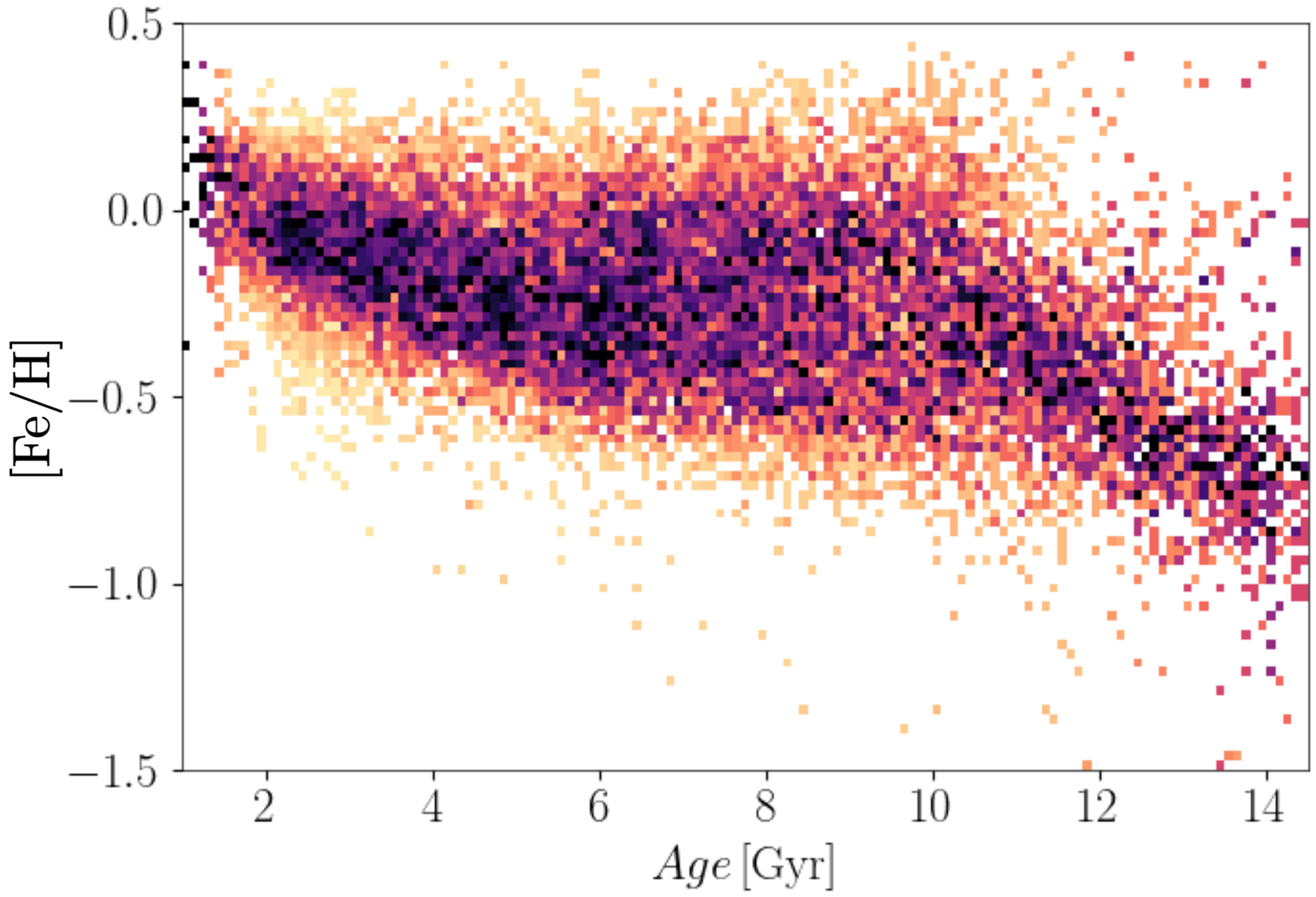
II. Large scale ages for field stars

Comparison with recent catalogues in the literature

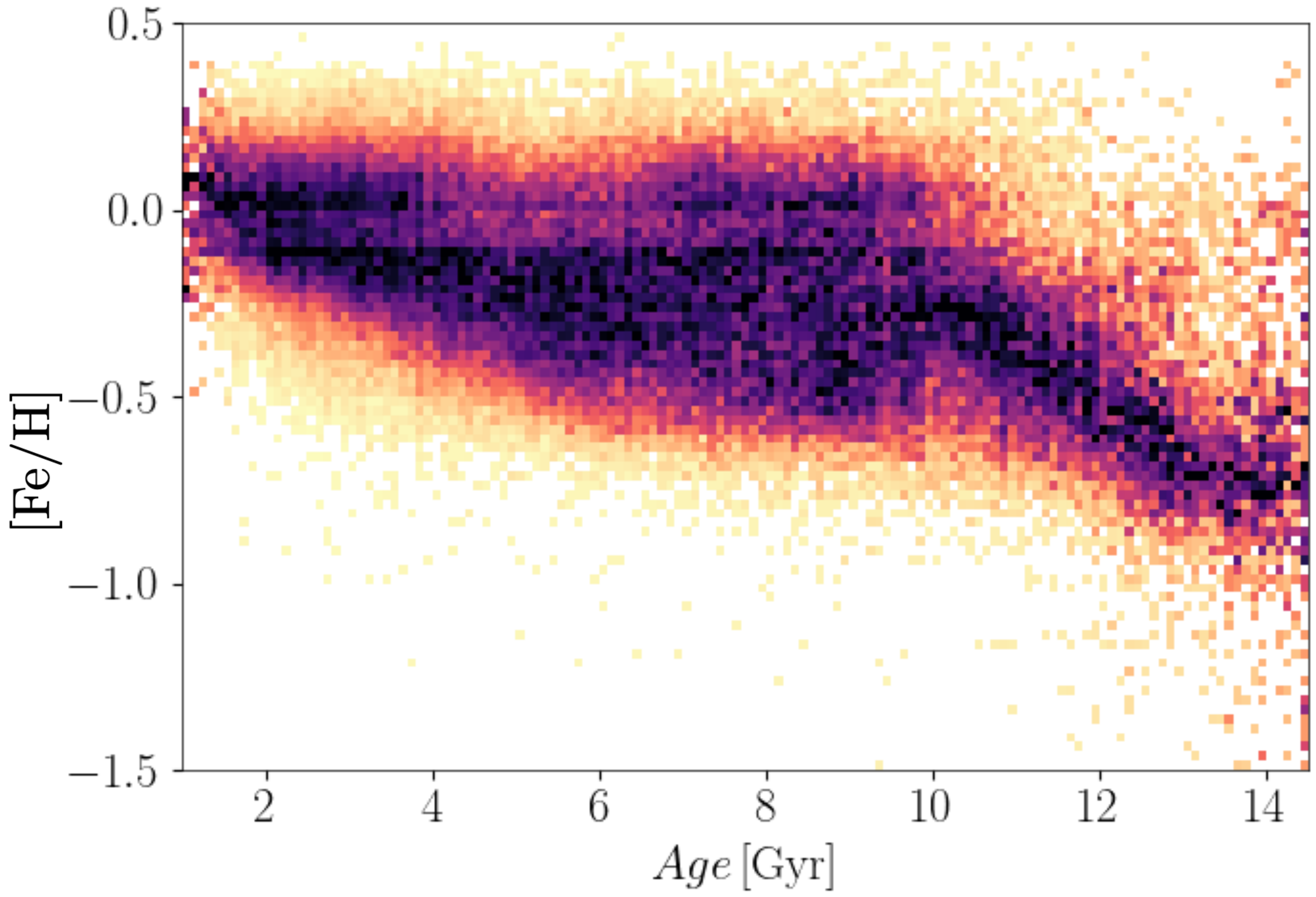


II. Large scale ages for field stars

Age-metallicity relation



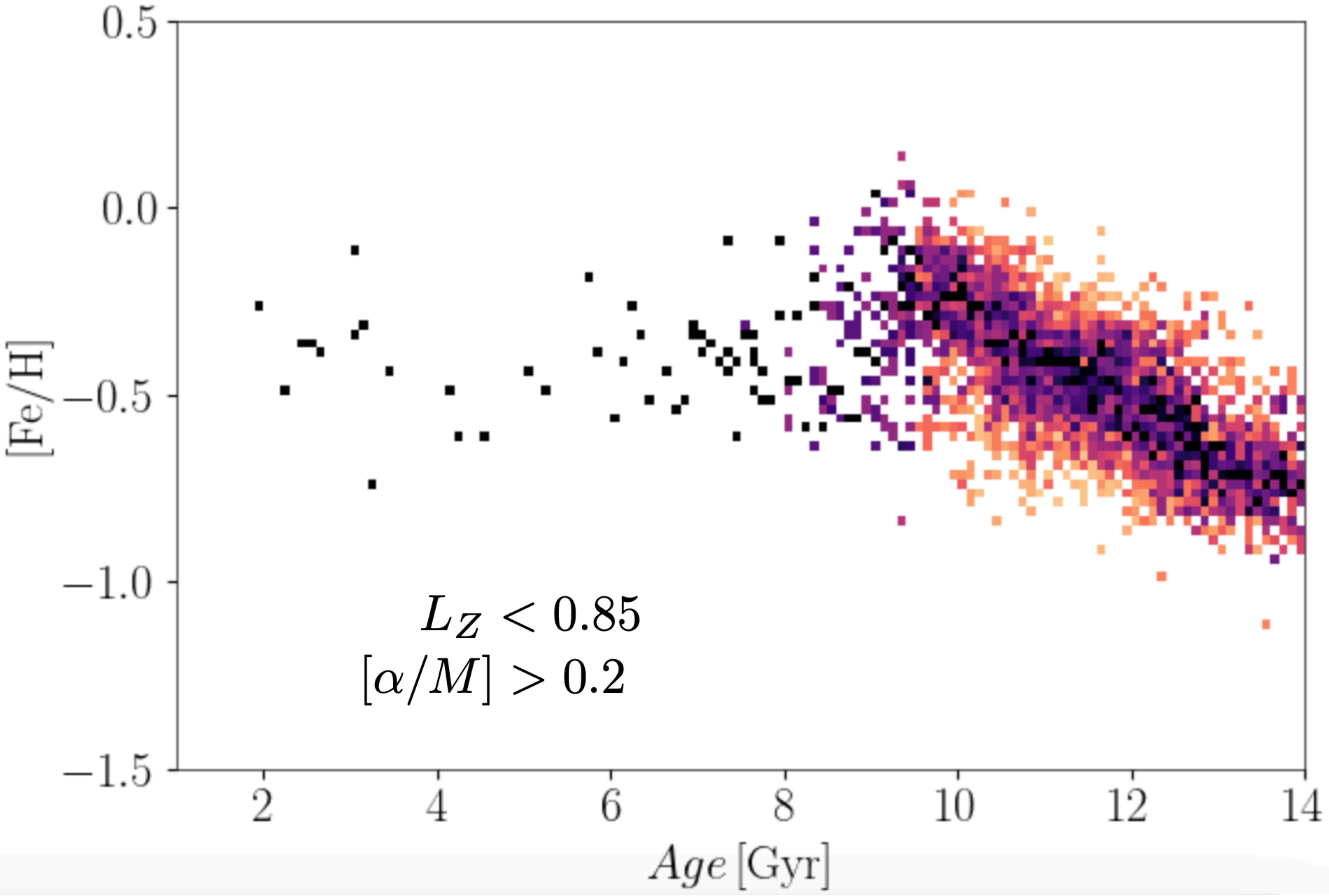
MRS 35k stars



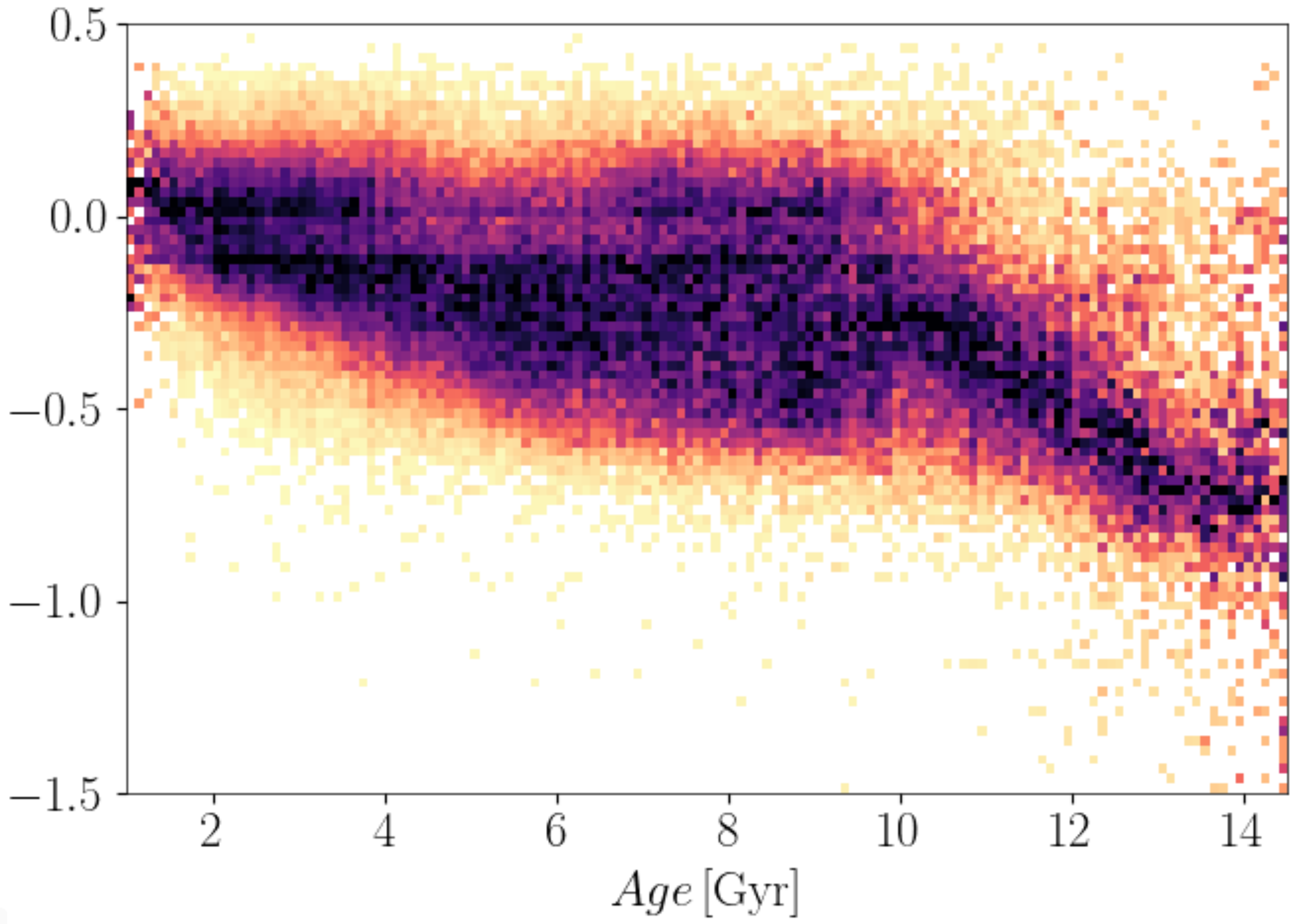
LRS 250k stars

II. Large scale ages for field stars

Age-metallicity relation



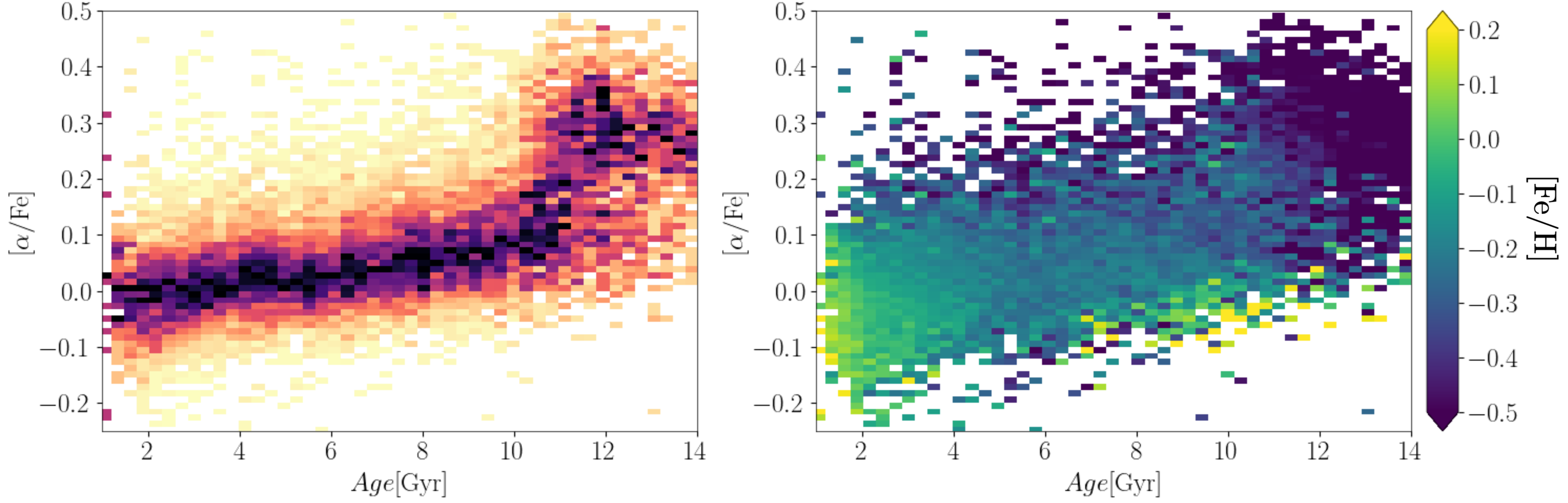
MRS 35k stars



LRS 250k stars

II. Large scale ages for field stars

Alpha-age relation [MRS]



Conclusions

- Ages with **SPInS** are reliable using only absolute colour-magnitude diagrams + metallicities

- **Clusters** are great to test goodness of ages, and understand possible biases
    - Unresolved binaries/blue stragglers
    - Young low main sequence stars

- For a local sample (~ 1 kpc) of **245k & 35k stars in LAMOST DR8**
    - Expected age-metallicity relation with tight and clean thick disk sequence
    - Alpha vs age relation

[Casamiquela et al. in prep.]