

SpecCLIP II: Age measurements for 200 millions stars

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Isochrone fitting

The Most Efficient Way to Expand Stellar Samples with Age Estimates

To do isochrone fitting, we need:

1, T_{eff} or $(G_{BP} - G_{RP})_0$.

2, $\log g$ or G_0

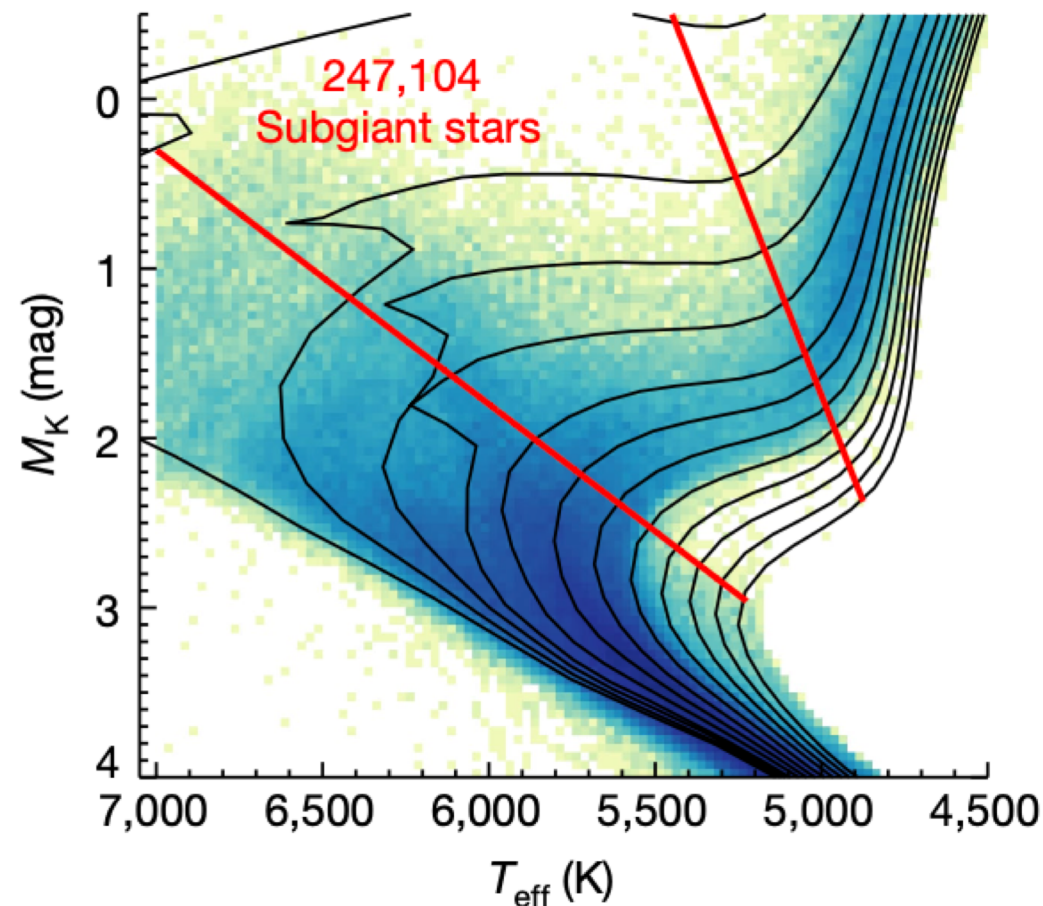
3, $[Fe/H]$ (or $[M/H]$)

Distance¹ by
Bailer-Jones et al. (2021)

+

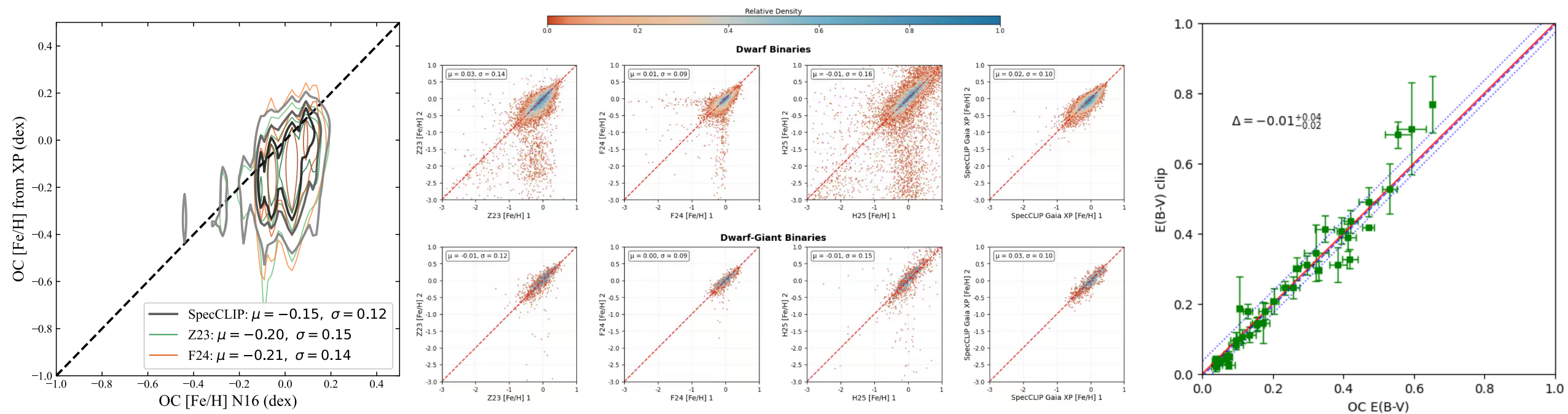
Reddening

$[Fe/H]$



From SpecCLIP

- Better XP based $[\text{Fe}/\text{H}]$ & $E(G_{BP} - G_{RP})$



Age measurements from isochrone fitting

- Data prepare:

Intrinsic color $\leftarrow$ Gaia mag + reddening from SpecCLIP catalog (calibrated)

Absolute magnitude $\leftarrow$ Gaia mag + reddening from SpecCLIP catalog (calibrated) + BJ distances

Metallicity $\leftarrow$ SpecCLIP catalog

- A Bayesian framework:

$$L(\tau, M, Z) = \left(\prod_{i=1}^n \frac{1}{\sqrt{2\pi} \sigma_i} \right) \times \exp\left(\frac{-\chi^2}{2}\right),$$

where the χ^2 is:

$$\chi^2 = \sum_{i=1}^n \left(\frac{O_i - P_i(\tau, M, Z)}{\sigma_i} \right)^2.$$

Age measurements from isochrone fitting

- Isochrone model used:

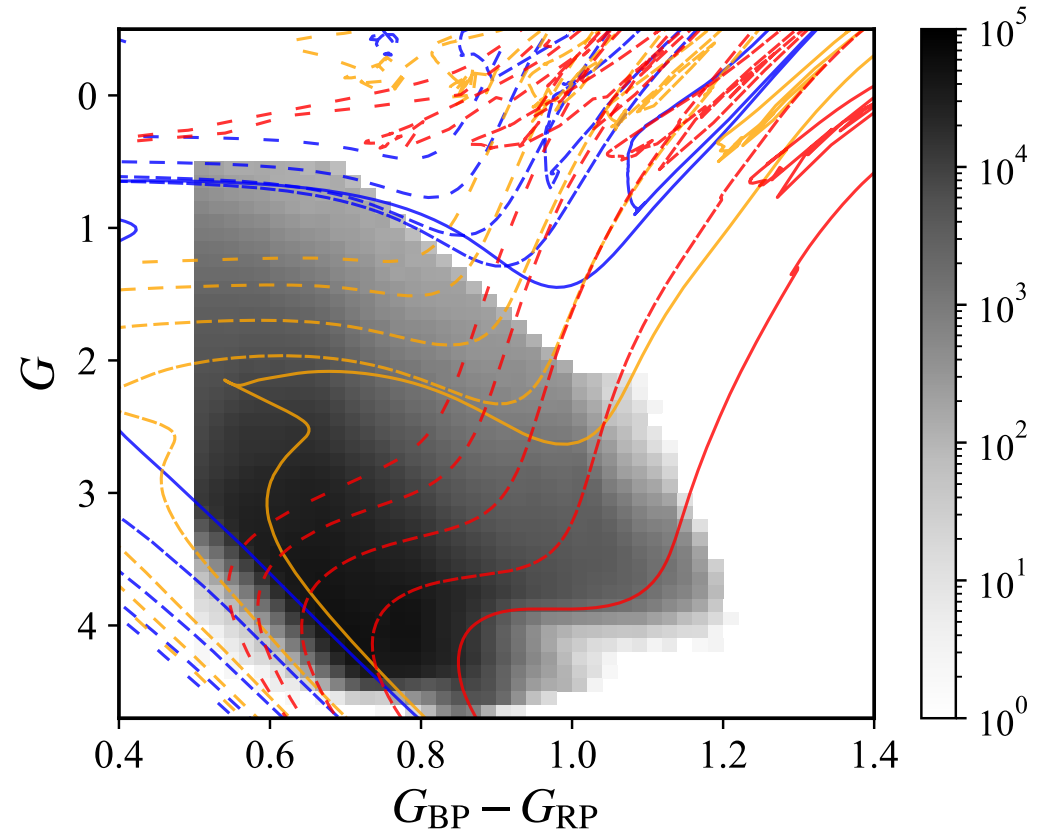
MIST version 1.2

$v/v_{\text{crit}}=0$

- Grids: [Fe/H]_init from -2.2 to 0.5, step: 0.05
Age: 0.1 Gyr to 1.2 Gyr, step: 0.1 Gyr
1.3 Gyr to 19,9 Gyr, step: 0.2 Gyr

Age result

- Total number: over 200 millions
- Need further selection:
 - Data quality
Controlled by flux_over_error
 - Blue star, weaker metal line
- Nature of isochrone fitting
MSTO & subgiants



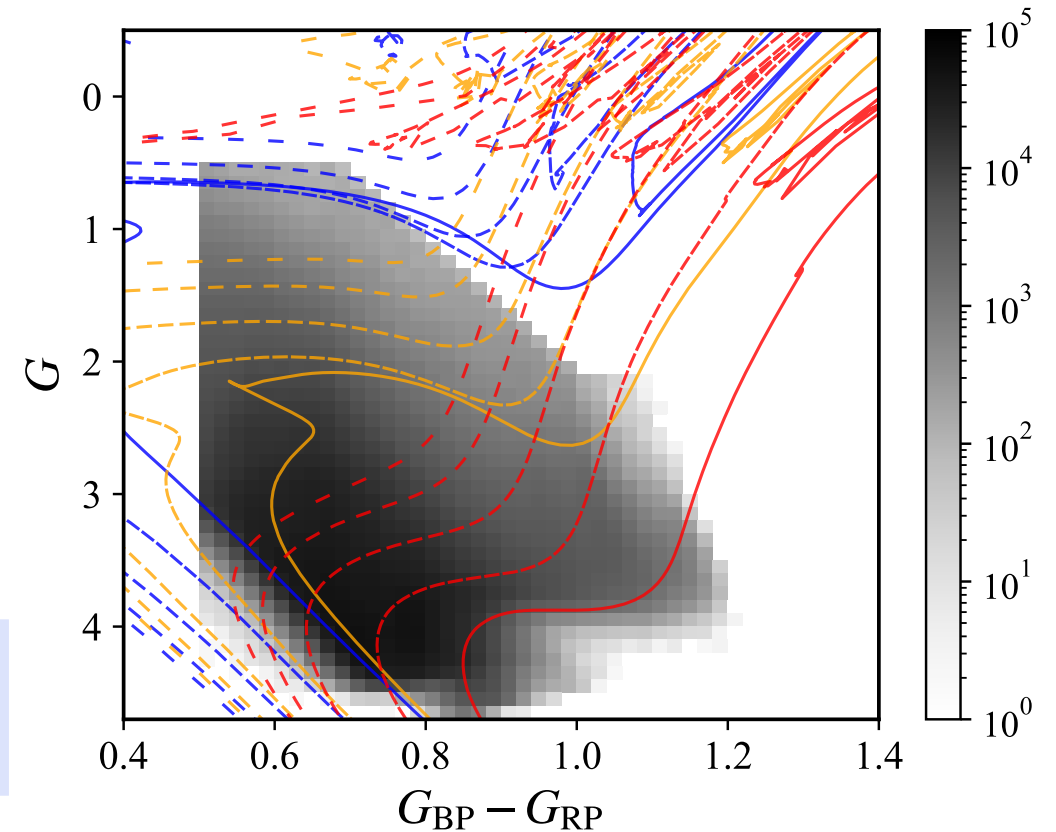
Age result

- Recommended sample:

Recommended Sample Selection:

- 1, High flux over error in BP, RP bands
- 2, $(G_{BP} - G_{RP})_0 > 0.5$
- 3, Only include main-sequence turn-off stars and subgiant stars

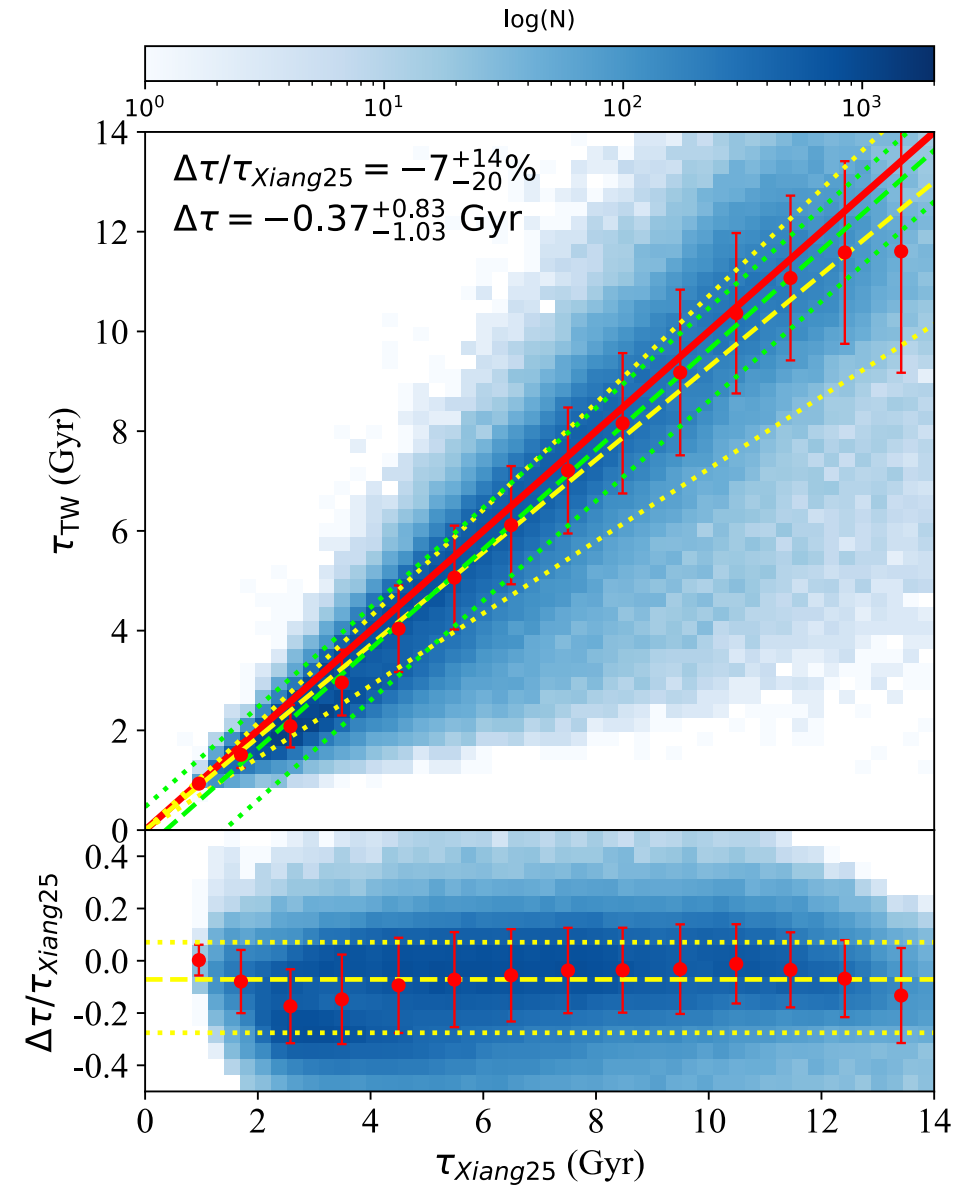
>8,000,000 Recommended Sample!
Largest Stellar Age Sample to date



Age result

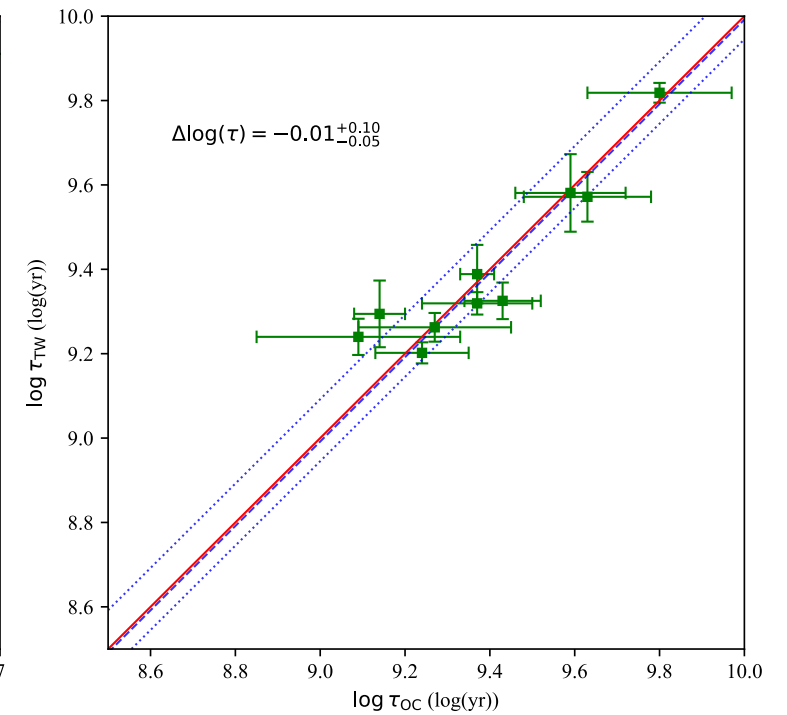
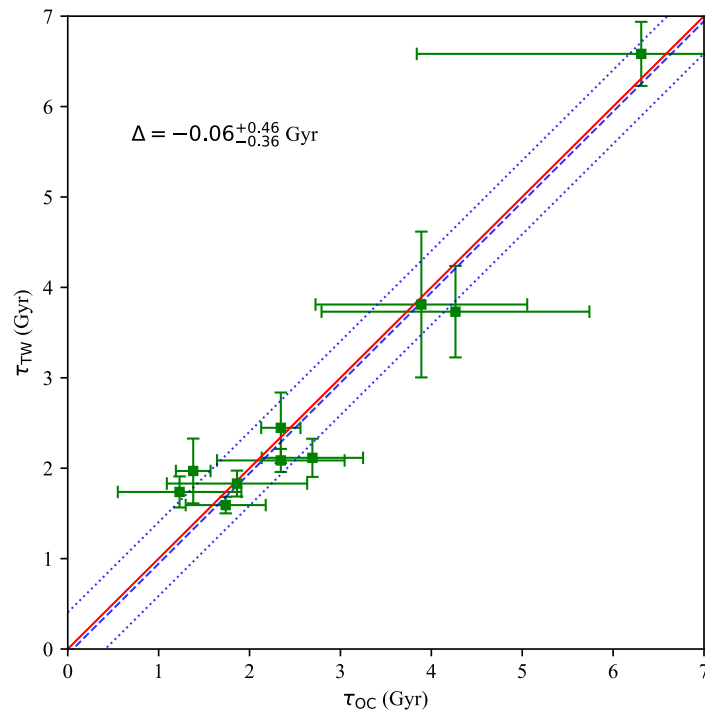
- Validation tests I
X-match with Xiang et al. 2025:
A subgiant sample with ages

Scatter: $\sim 17\%$



Age result

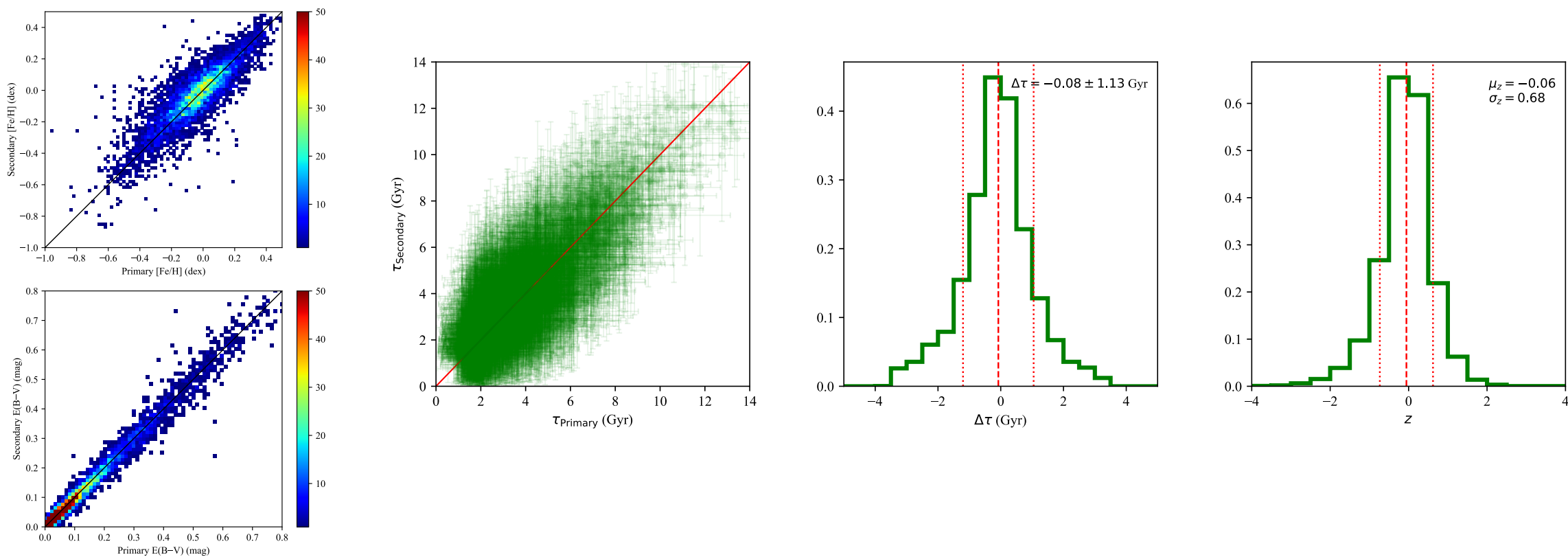
- Validation tests II
With open clusters



Age result

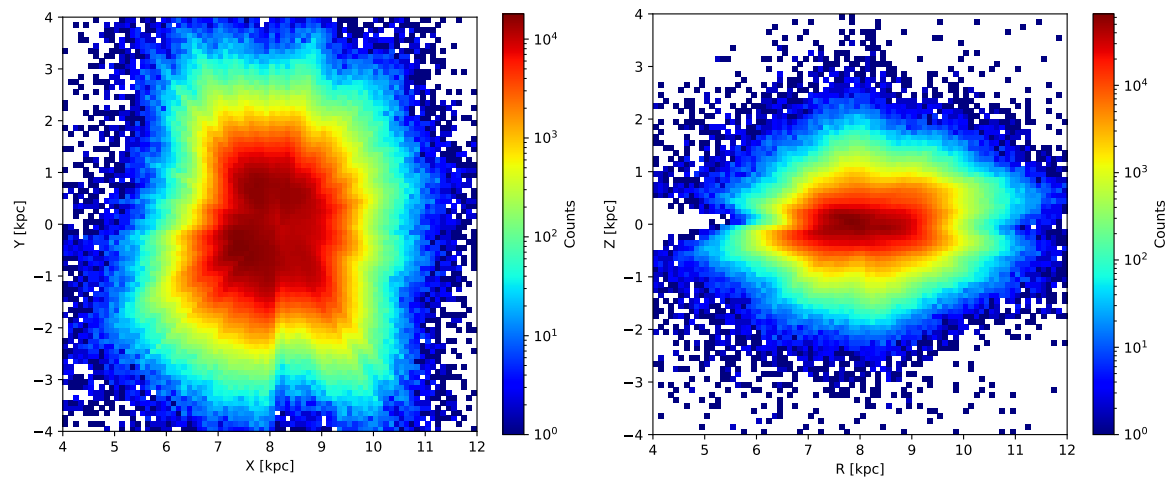
- Validation test III

Wide binary tests

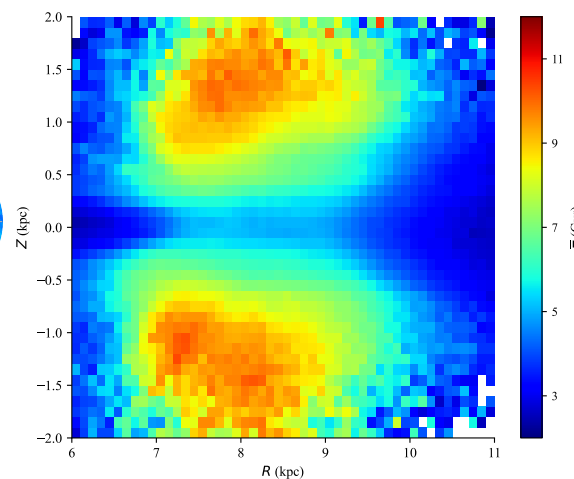
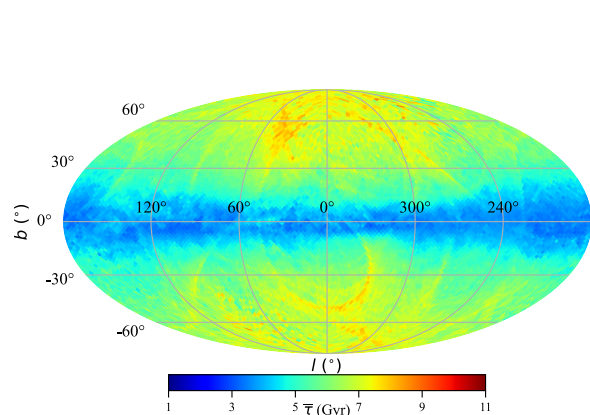


Age result

- General view (Recommended sample)

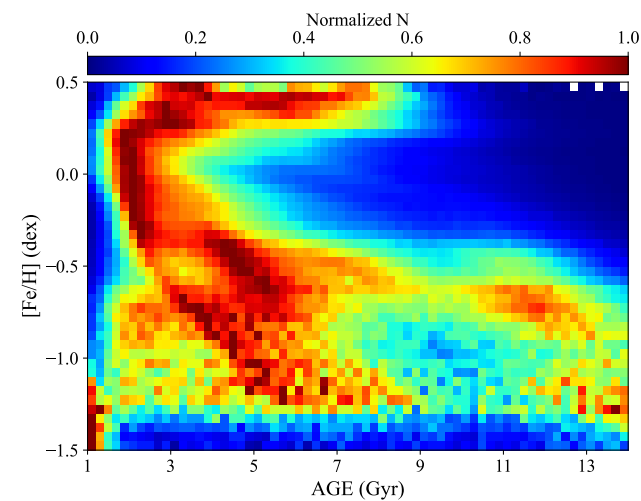
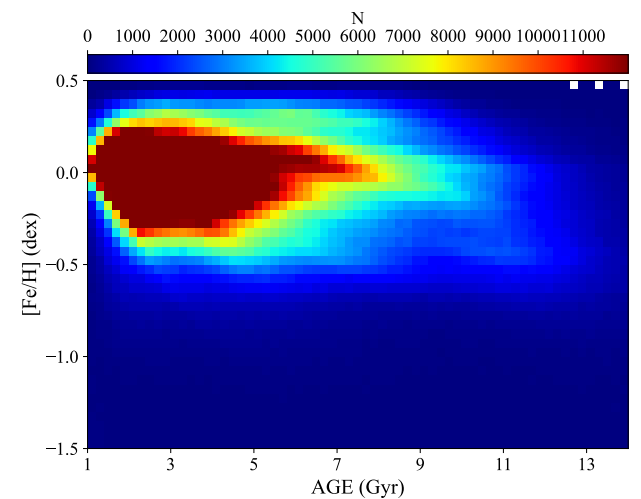


Spatial
distribution



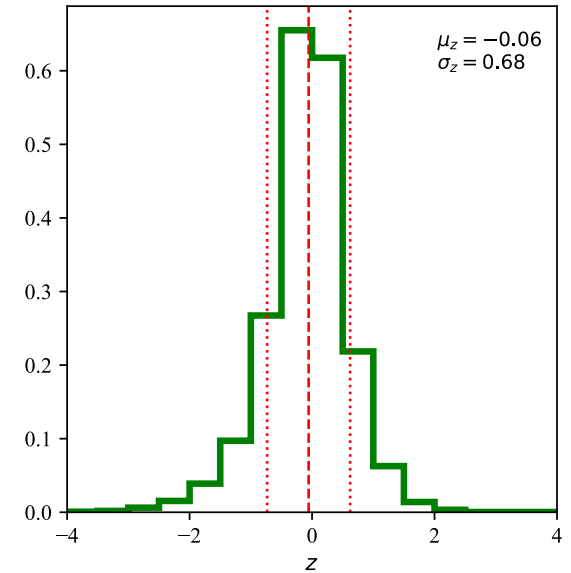
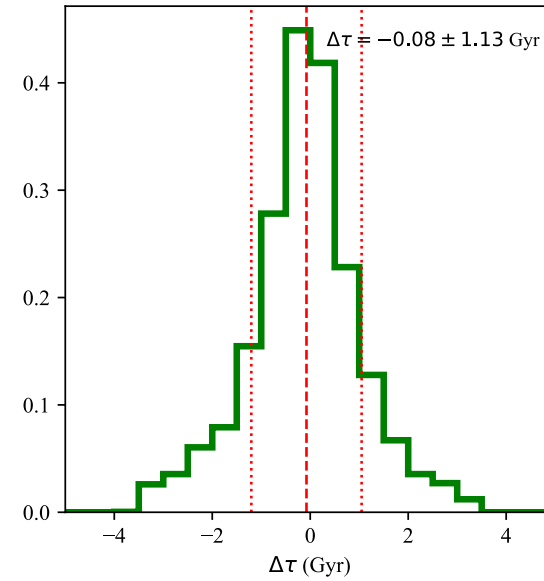
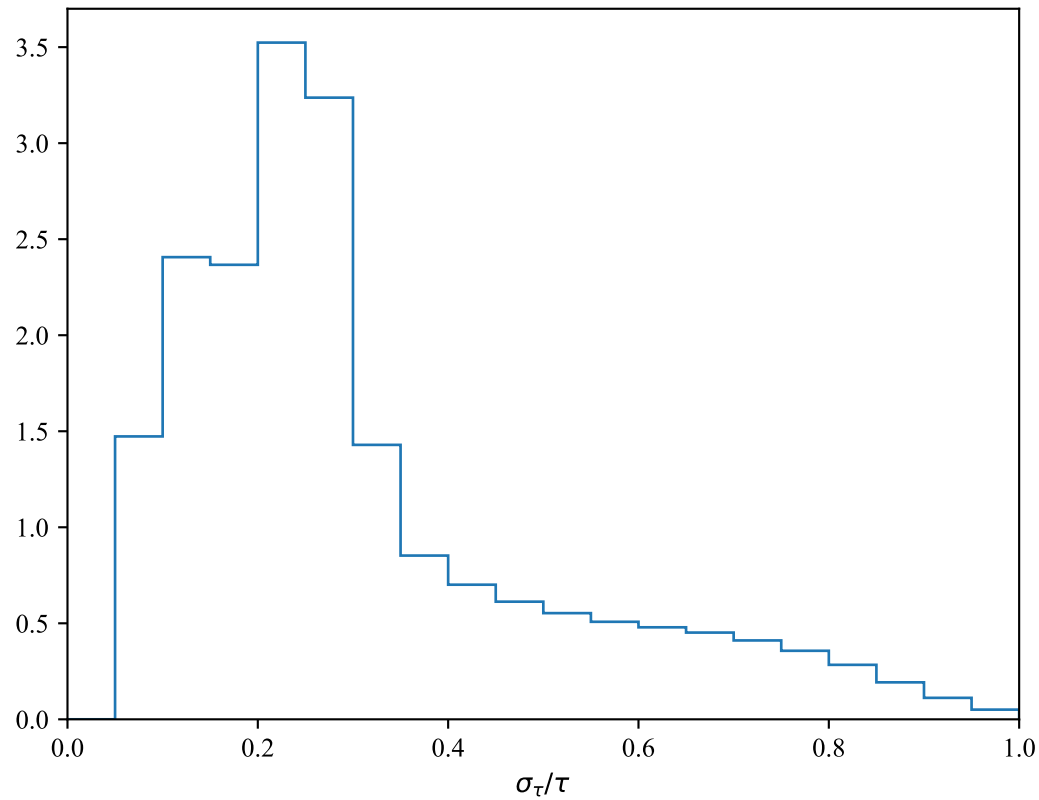
Age
distribution

Age metallicity distribution



Age result

- Typical uncertainties: (only for recommended sample)



Age result

- Different isochrone models

