Exploring the reliability of chemical traits for RGB stars using accurate asteroseismic ages

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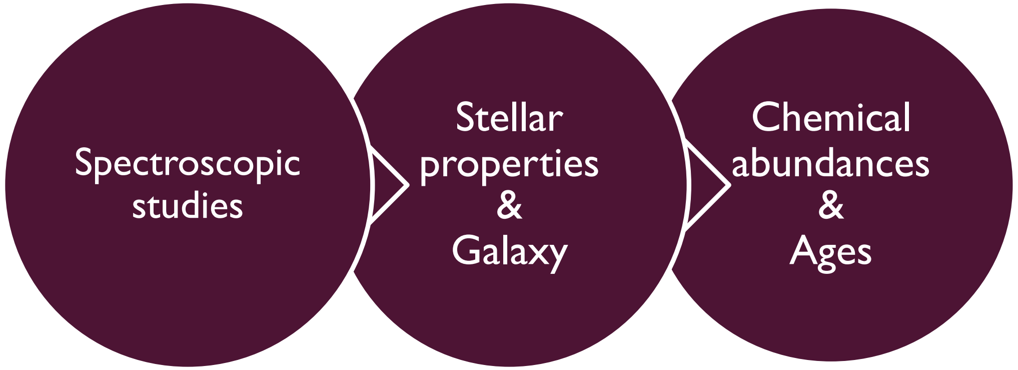
Spectral fidelity

Florence, 4-8 September

THE POWER OF STELLAR SPECTROSCOPY



Spectroscopic surveys (APOGEE, GALAH, Gaia+ESO) + space missions (Gaia) + simulations

Many applications

- Formation and evolution of the Galaxy
- Characterize stellar populations
- Understand star formation history
- Disentangle galactic components
- Age calibration

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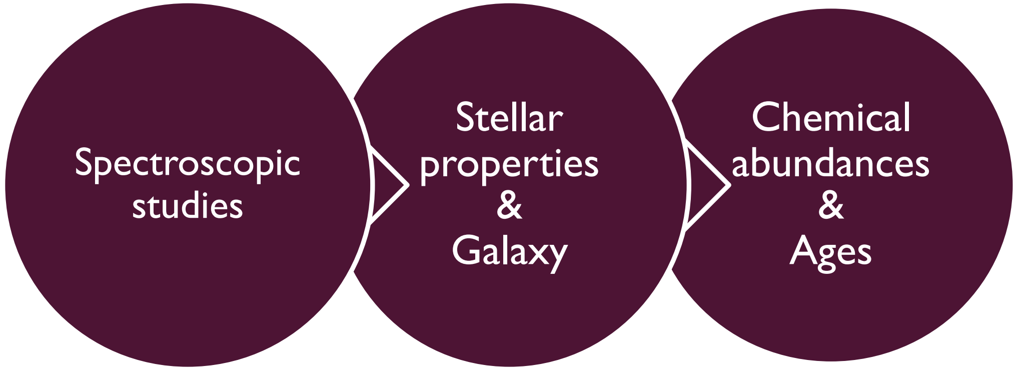

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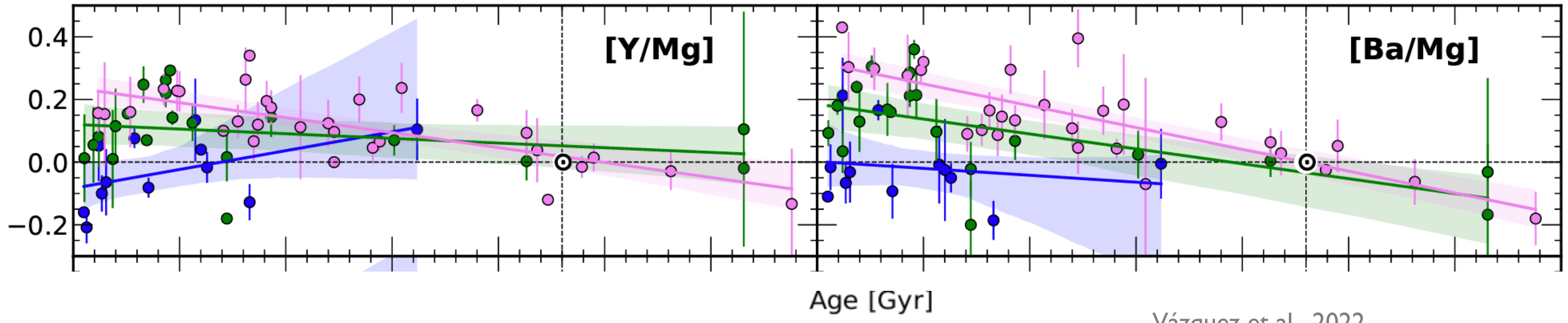
Chemical abundance ratios

CHEMICAL CLOCKS: HOW MUCH WE CAN TRUST THEM?

Chemical abundance ratios sensitive to ages (Nissen+2015/2020, da Silva 2012, Tucci Maia 2016…)



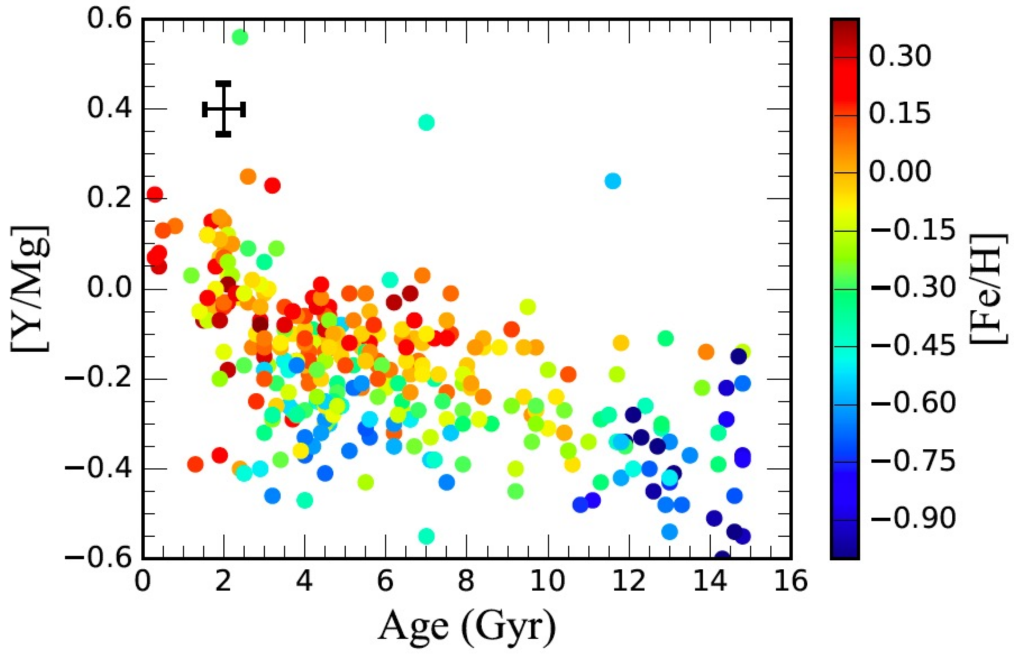
Vázquez et al., 2022

Their reliability and homogeneity have been investigated

Dependence on:

- Metallicity
- Environment

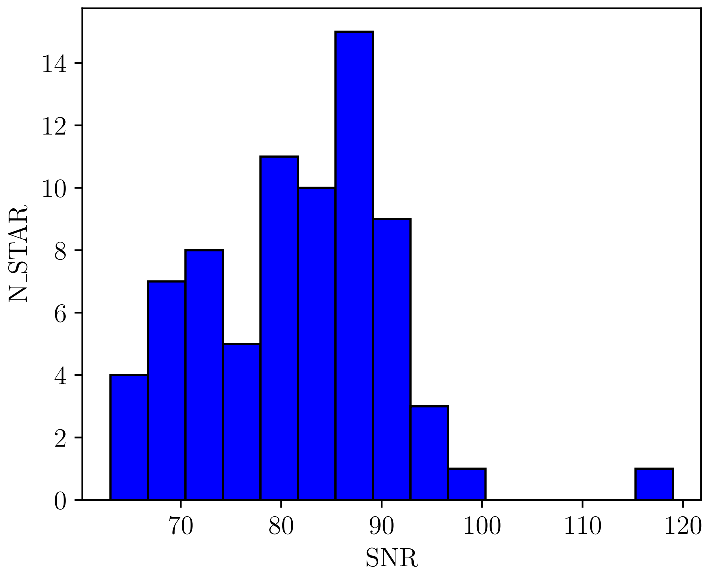
- Most informative traits?
- Which are their dependencies (metallicity, evolutionary stage, position…)?

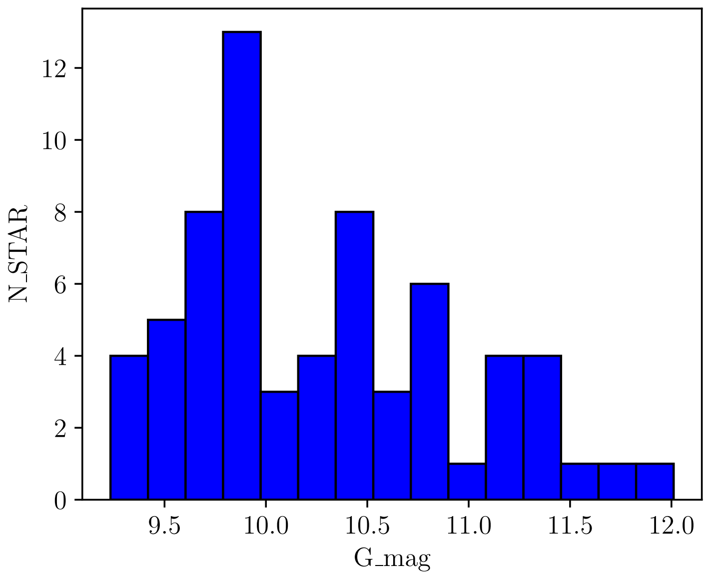


Feltizing et al., 2016

THIS SAMPLE

73 UVES spectra, R ~ 110 000





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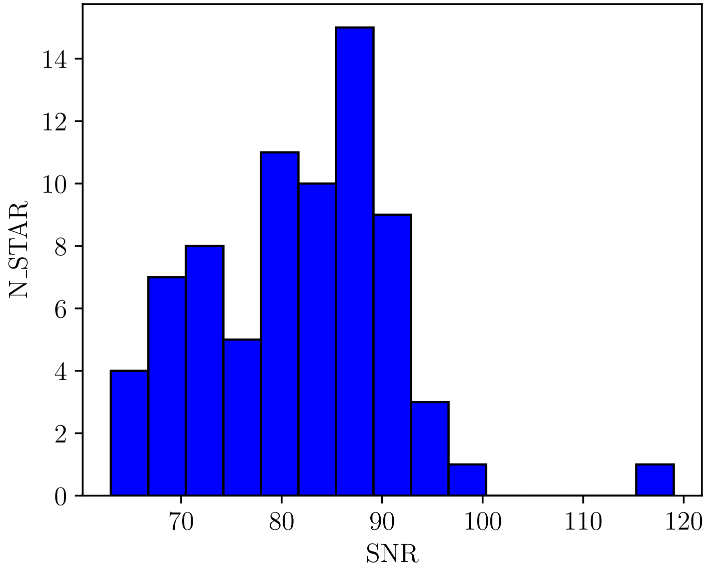
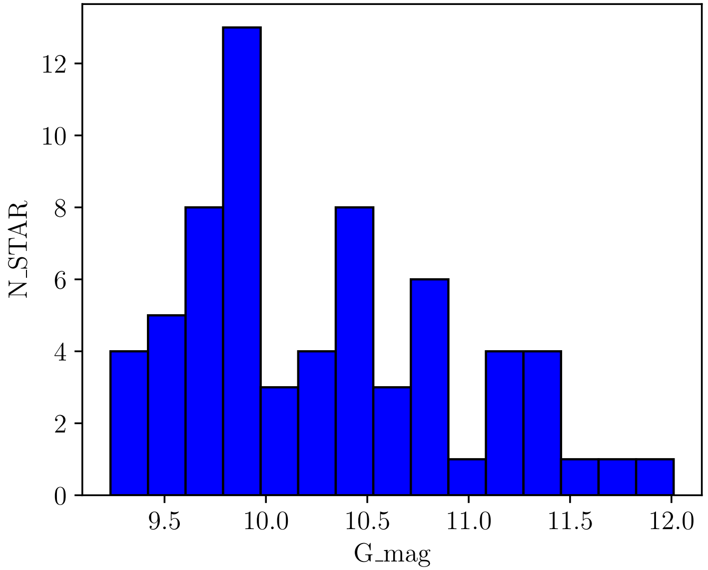
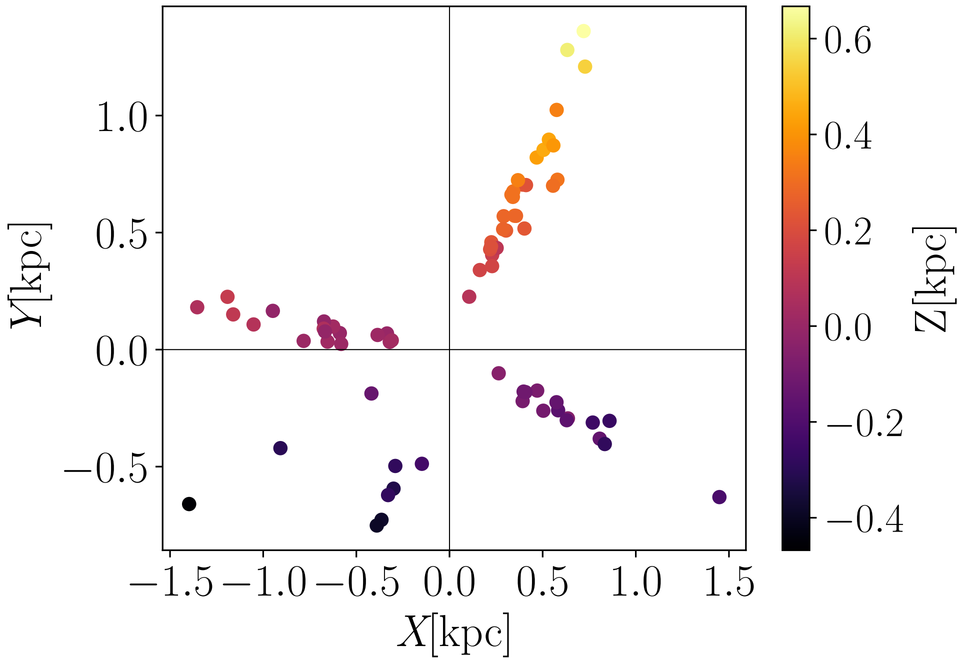
Disk bright field giants







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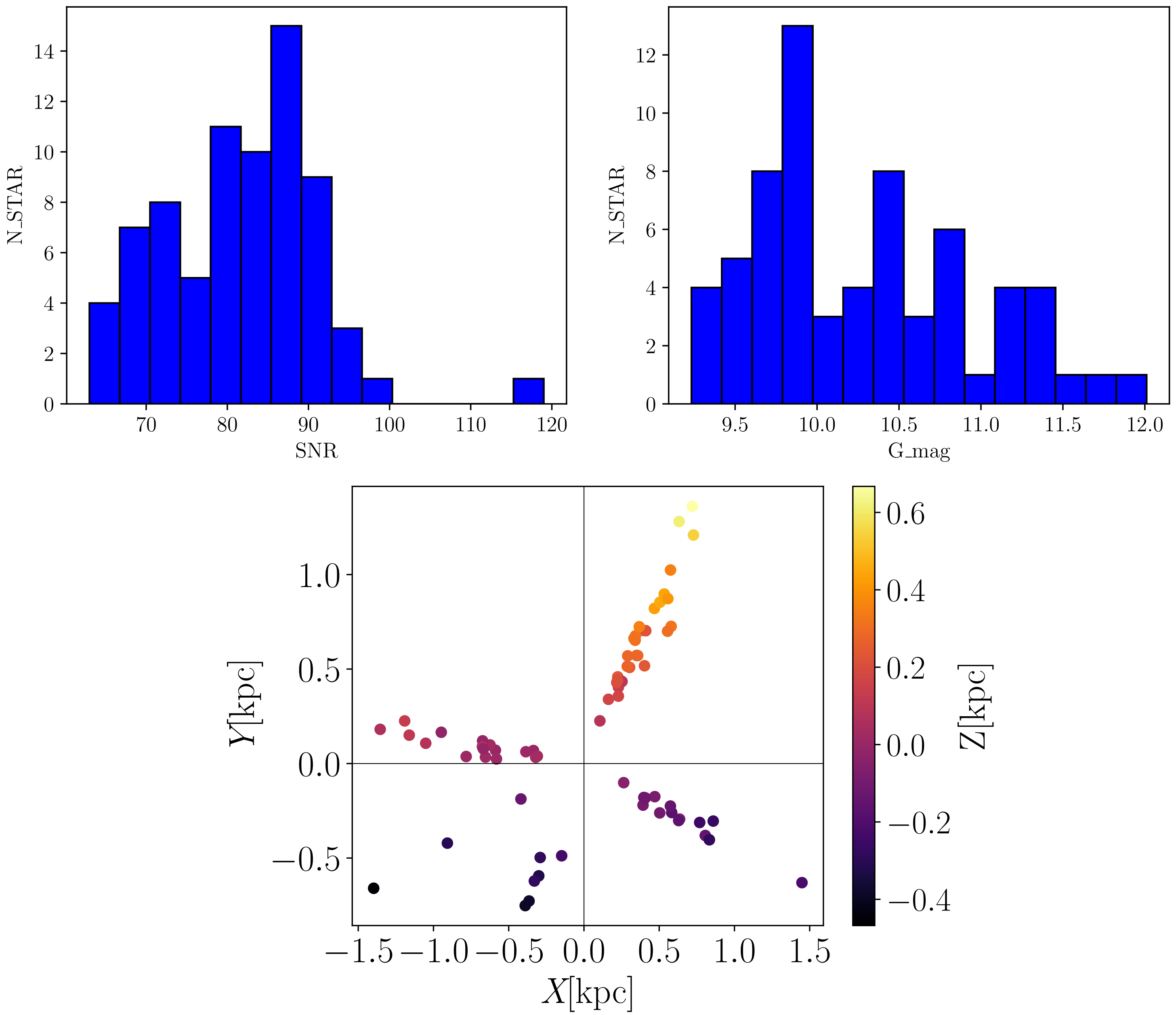
APOGEE fields

Wide metallicity range



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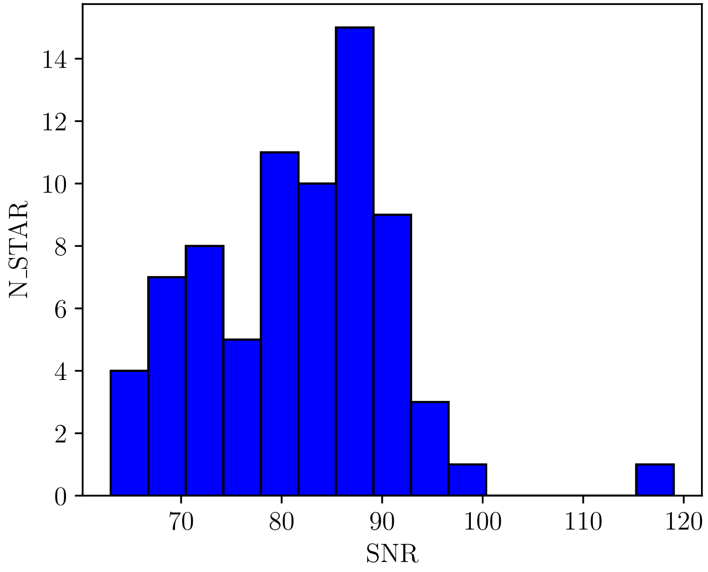
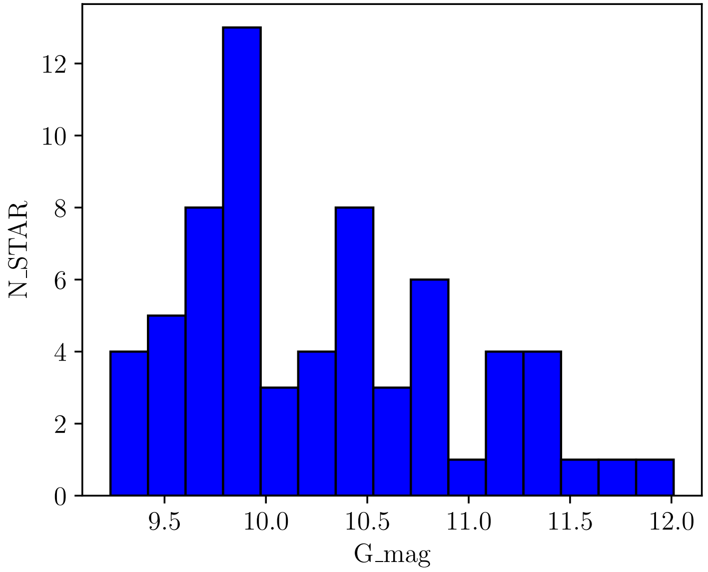
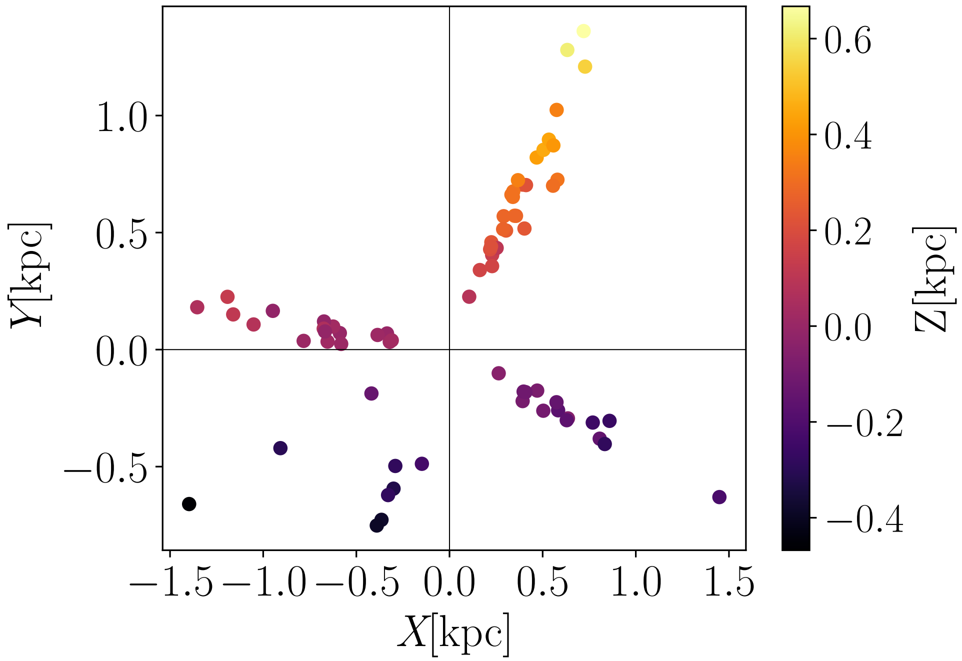
K2 fields

Asteroseismology







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APOGEE fields

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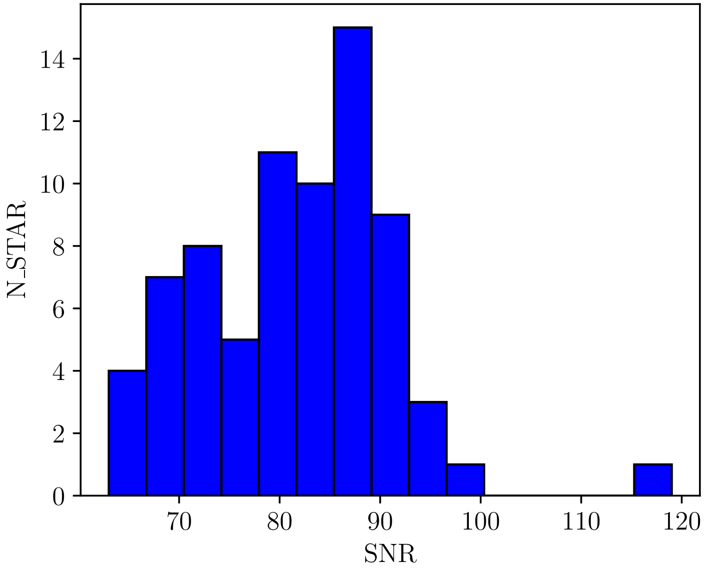
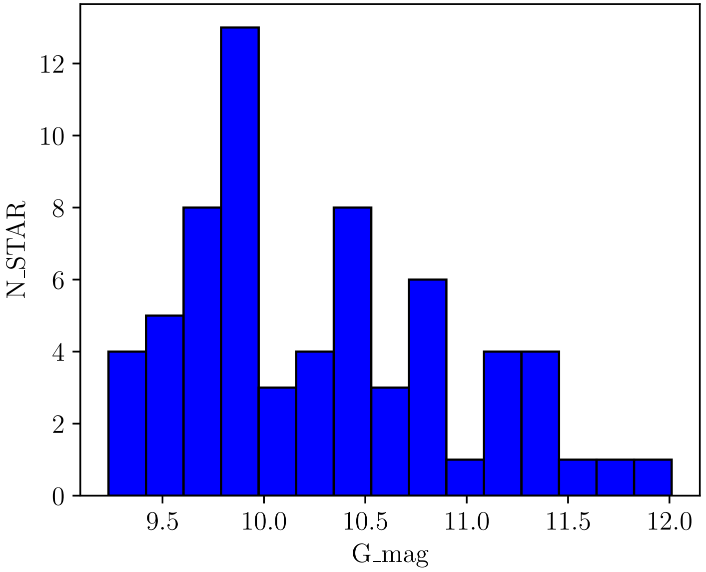
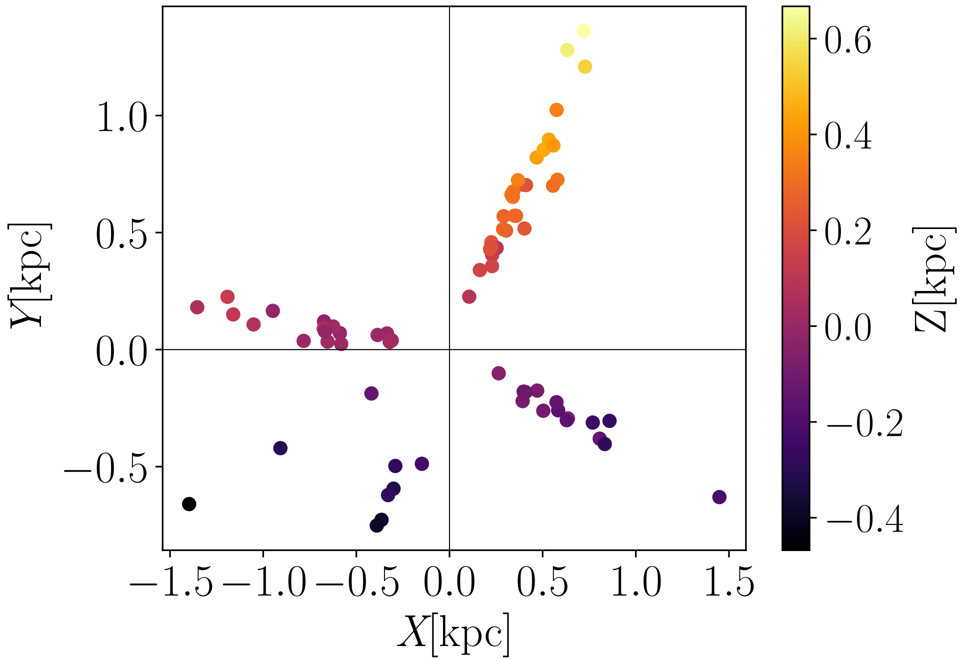
Asteroseismology

High precision abundances

Accurate ages

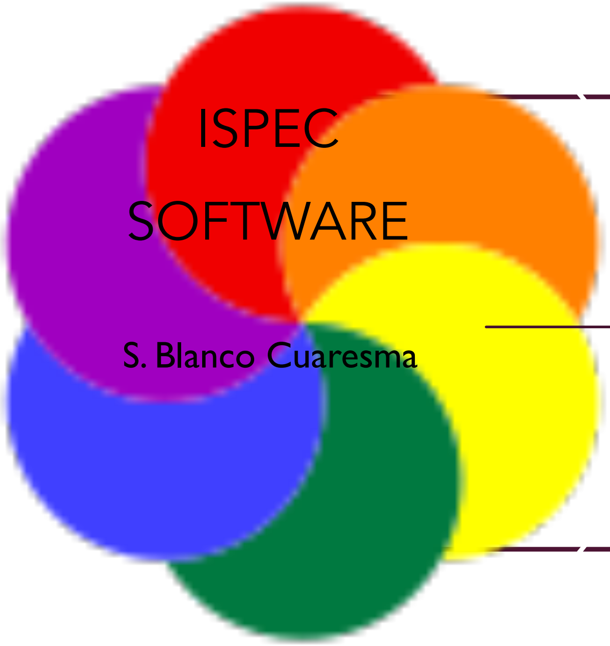






SPECTRAL ANALYSIS

ESO pipeline (VLT pipeline) for data reduction



PRE-PROCESSING: SKY-SUBTRACTION
NORMALIZATION

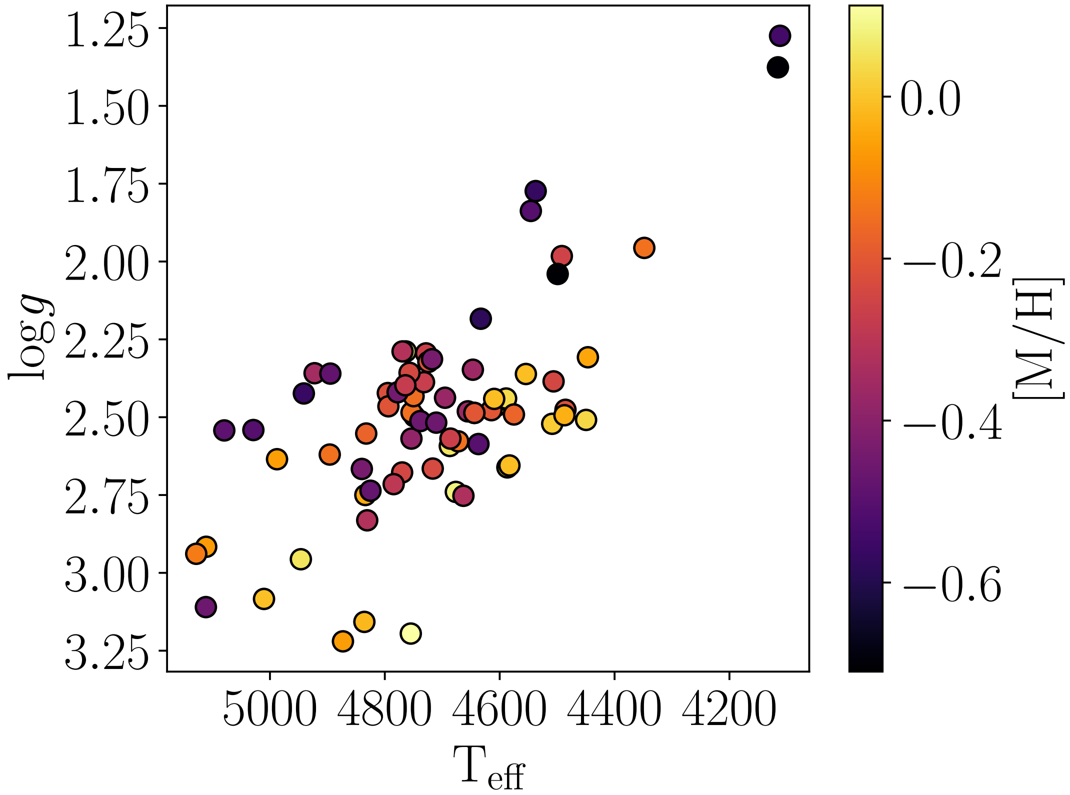
ATMOSPHERIC PARAMETRS

CHEMICAL
ABUNDANCES

STELLAR
SYNTHESIS

ATMOSPHERIC PARAMETERS

- Teff, log g, MH, broadening parameters
- Radiative code: TURBOSPECTRUM
- MARCS atmospheric model
- *Gaia*-ESO line-list (v6)



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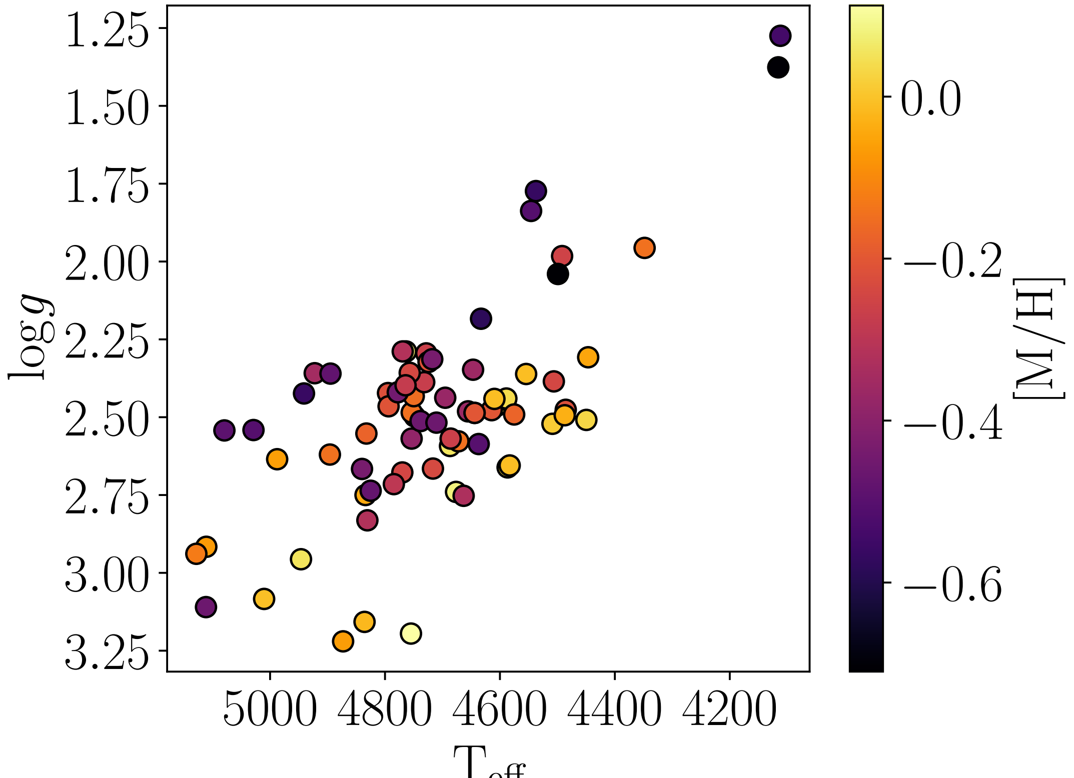
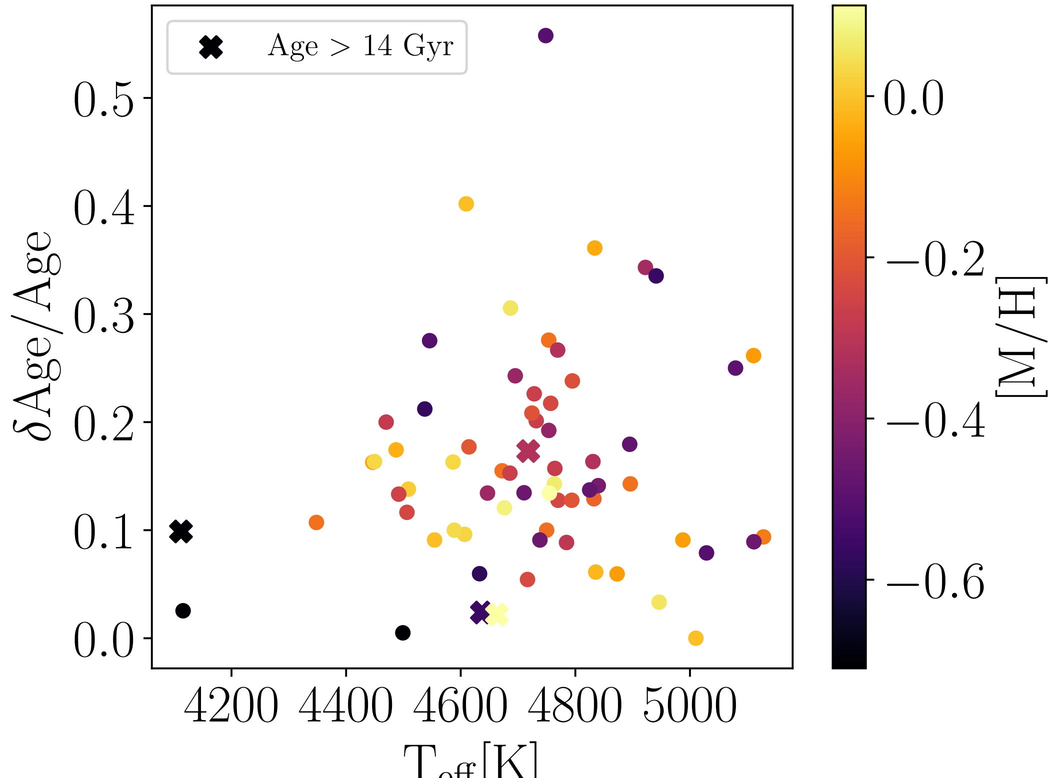


AGES

BASTA - BAyesian STellar Algorithm (Silva-Aguirre et al., 2015)
Grids of stellar models (BaSTI isochrones)

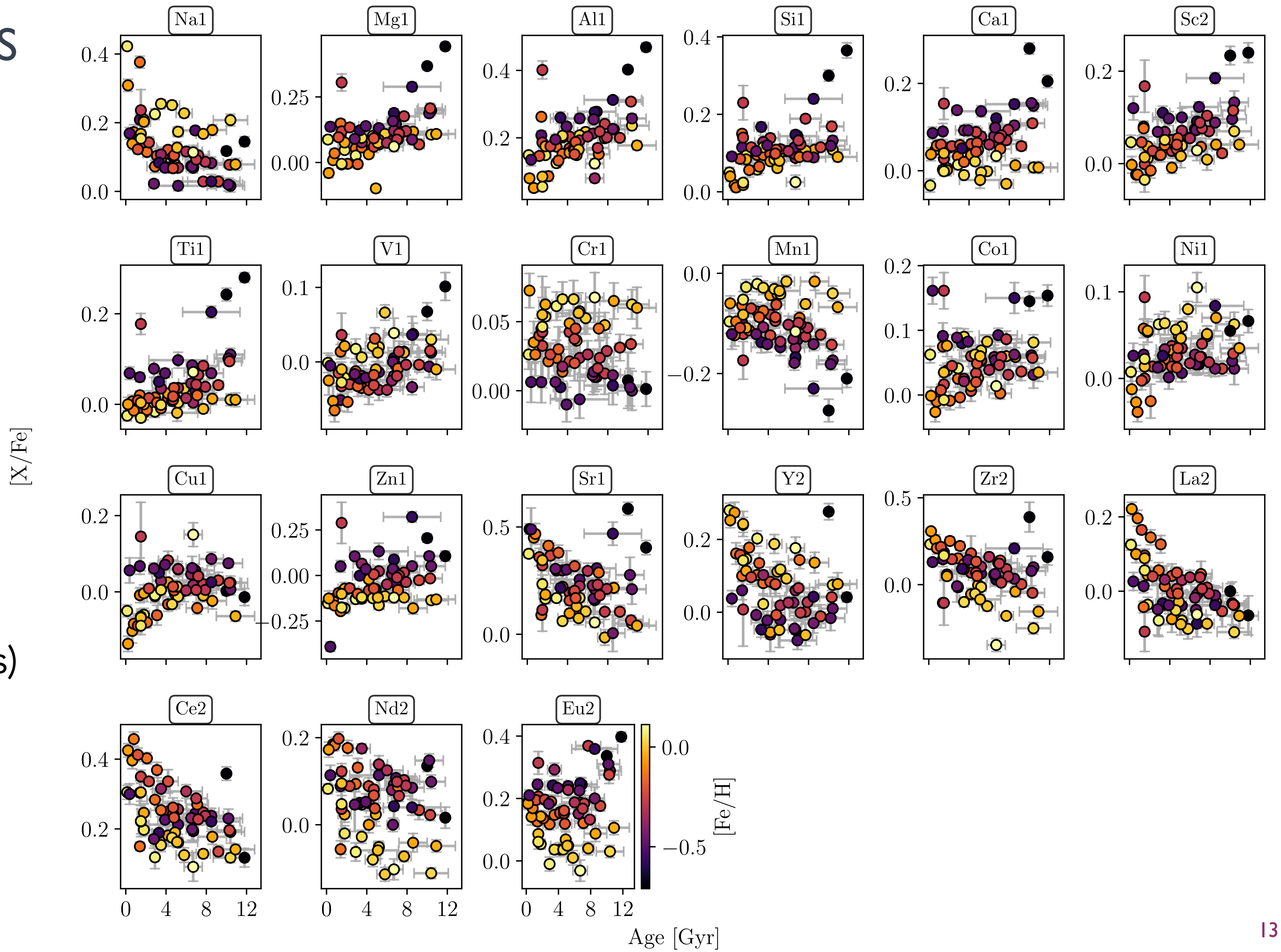
- asteroseismic information ($\nu_{max}, \Delta\nu$)+stellar parameters
- Diffusion+overshooting



CHEMICAL-AGE TRENDS

- Stellar synthesis
- Differential abundances with respect to the Sun
- GES line

- α-elements
- odd-z
- iron-peak
- n-capture (s and r process)



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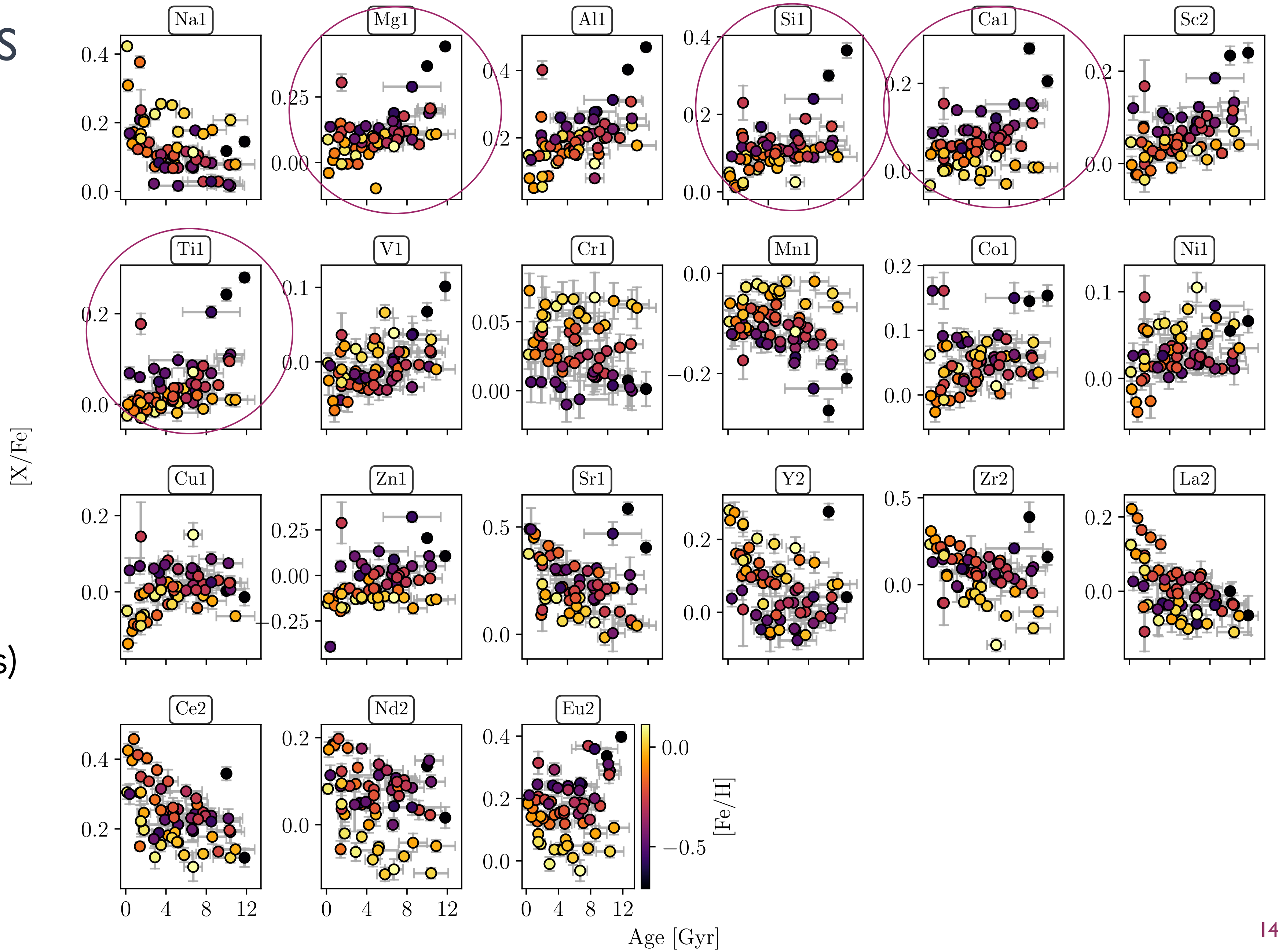

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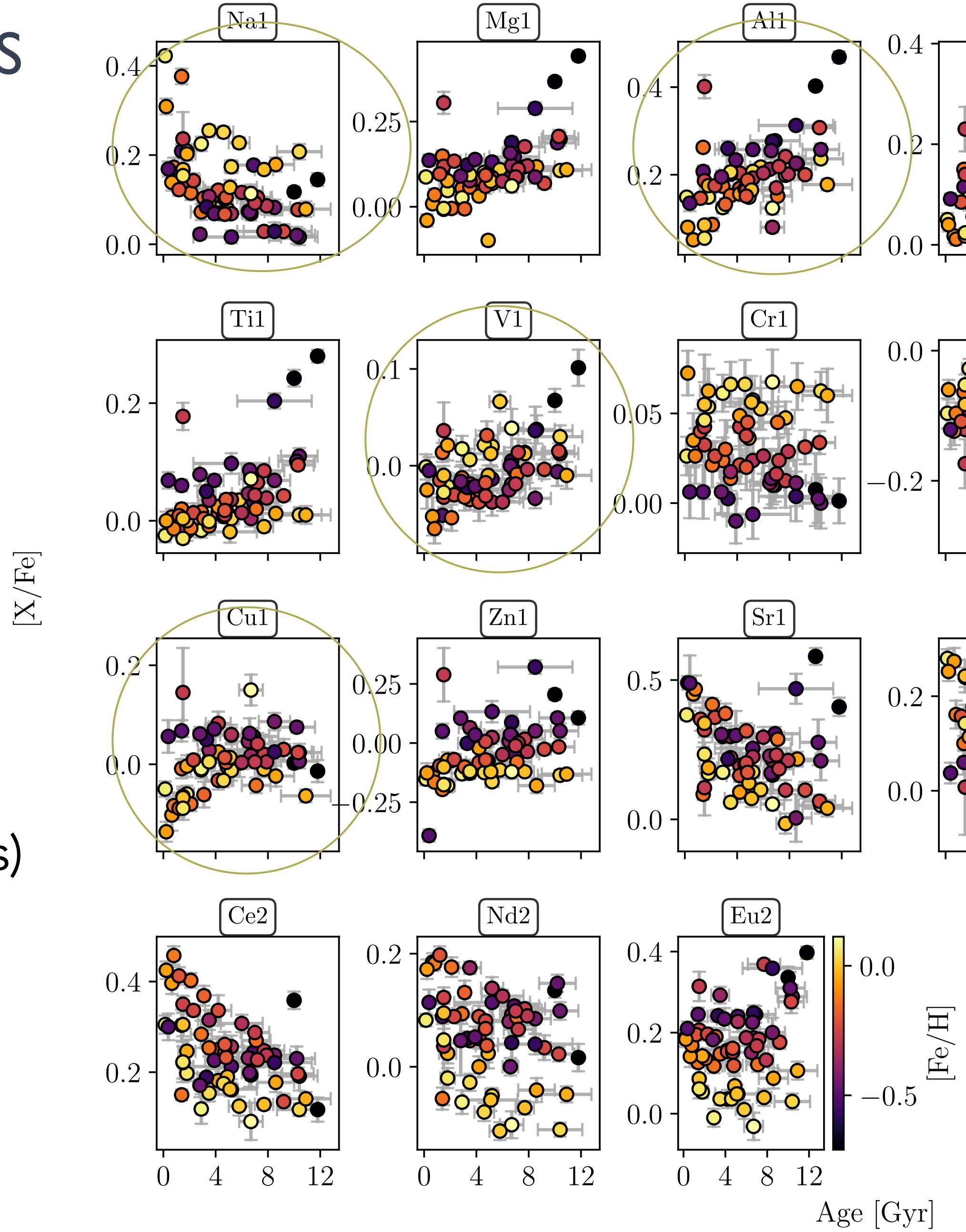

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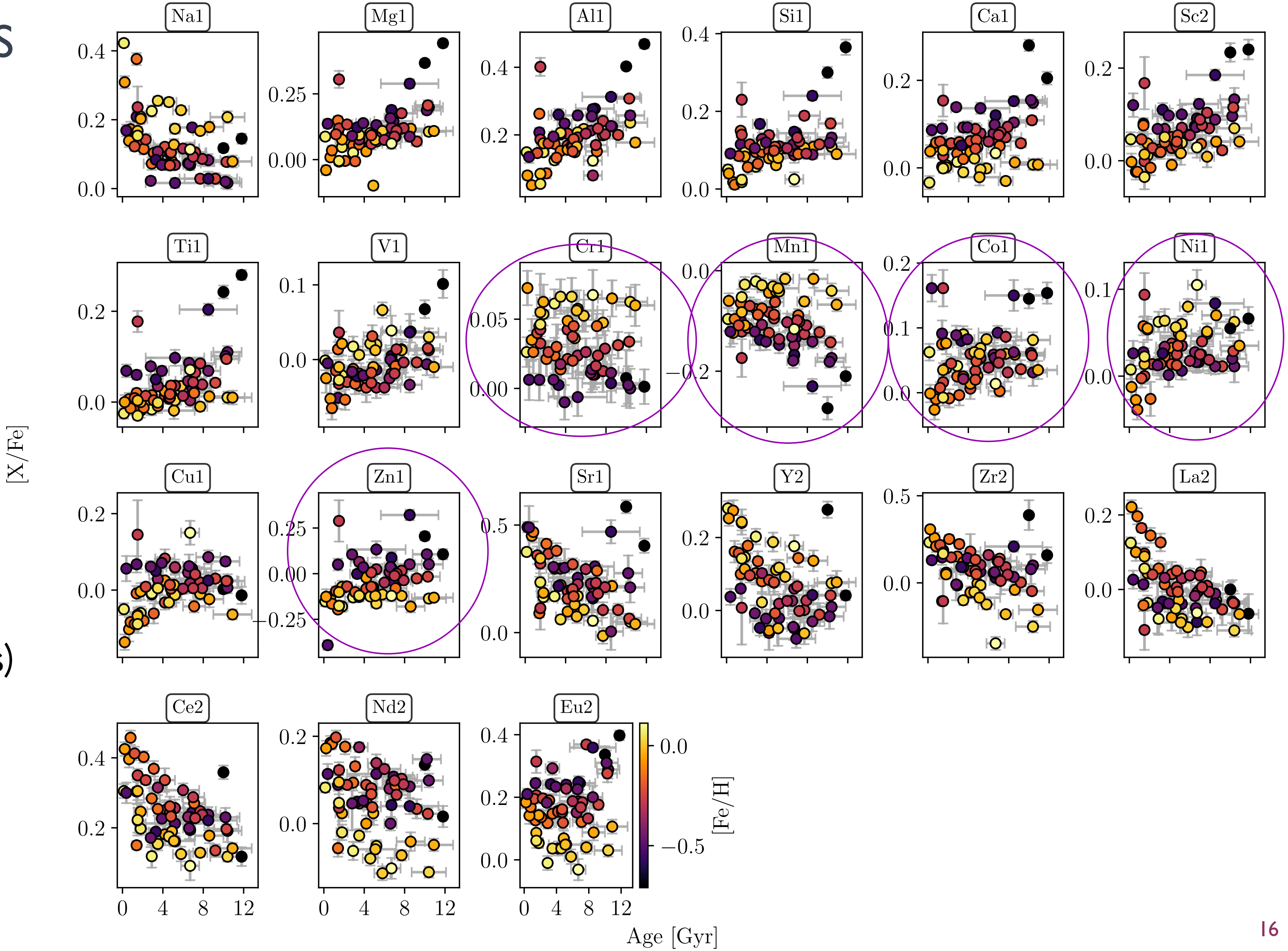

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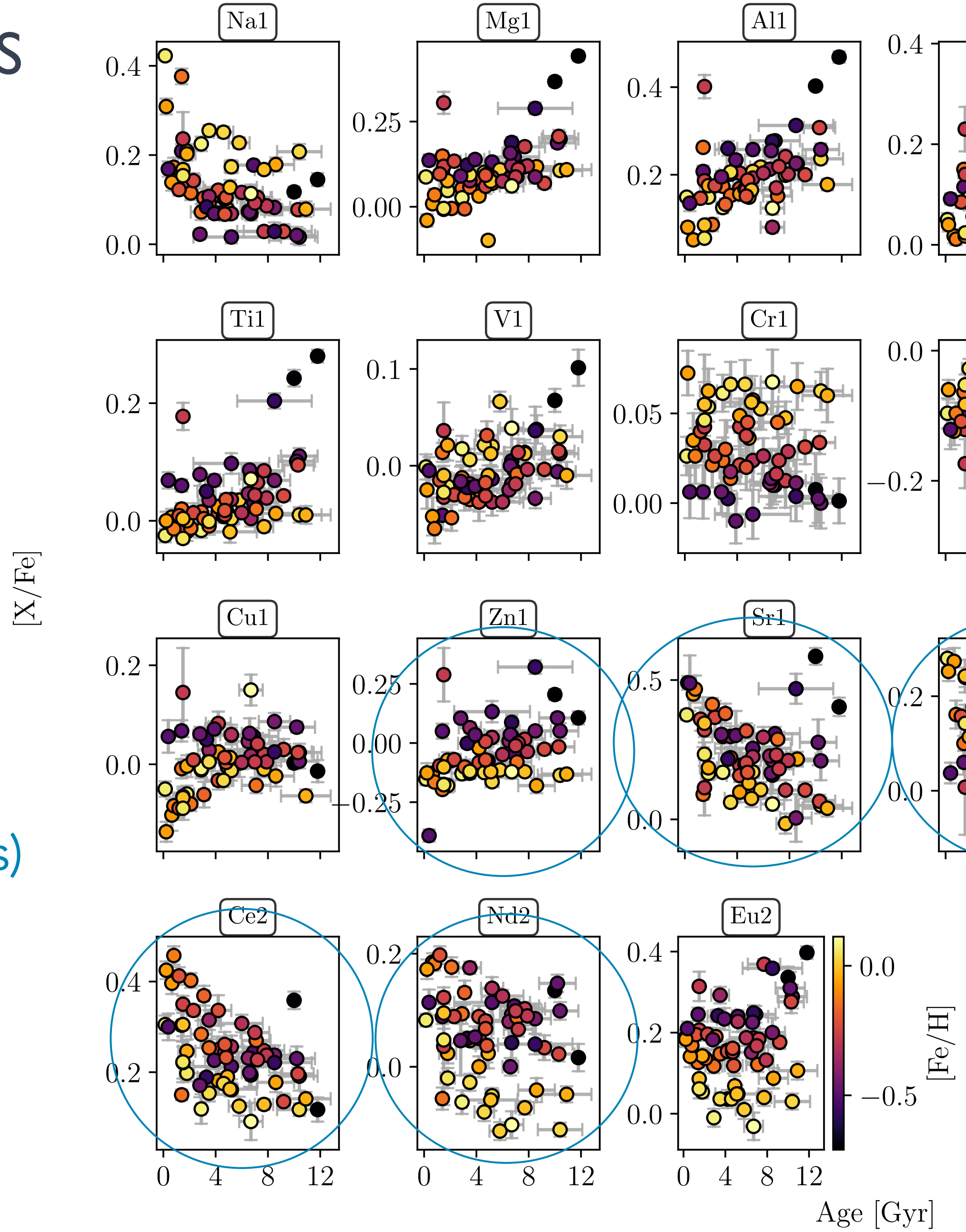

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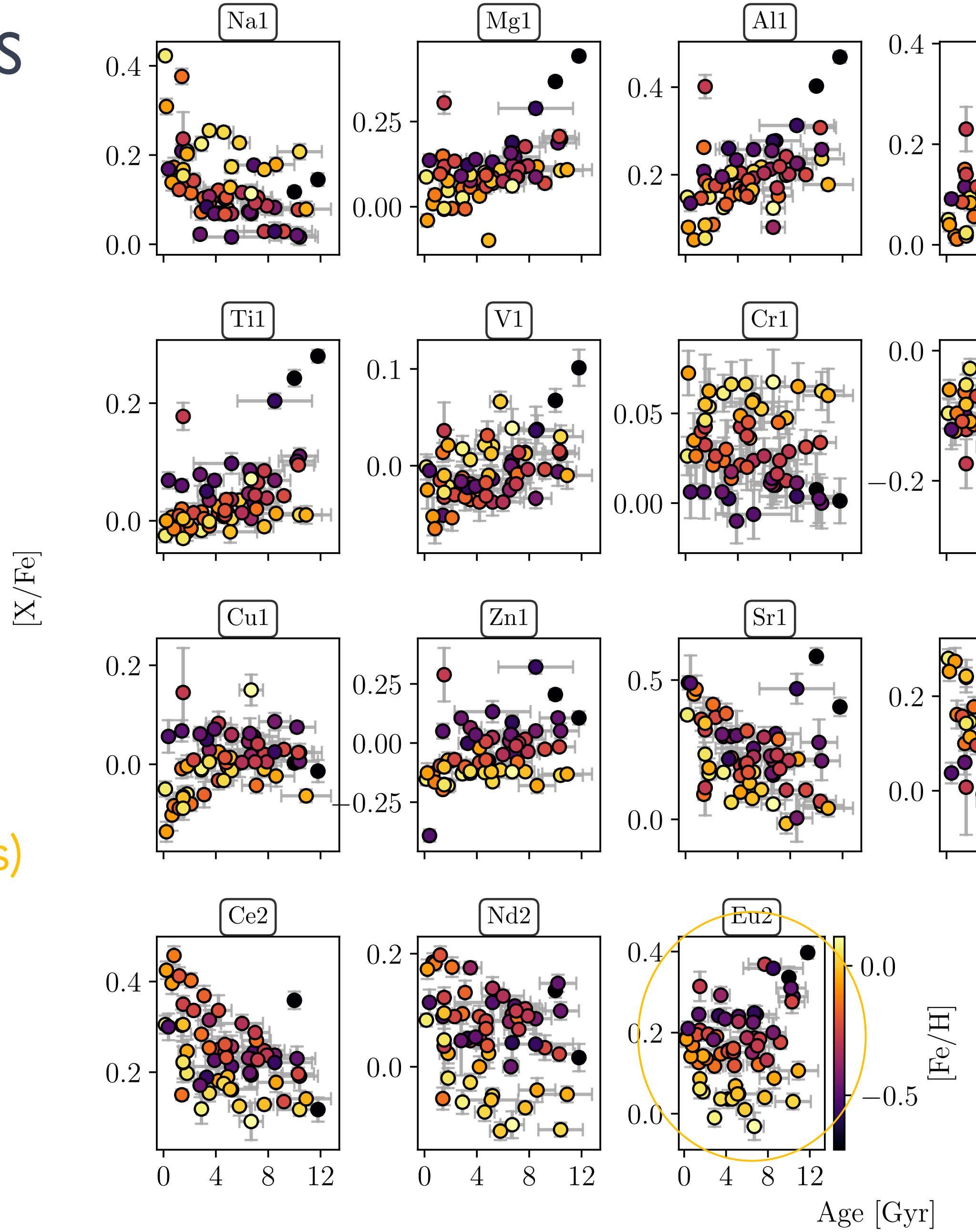

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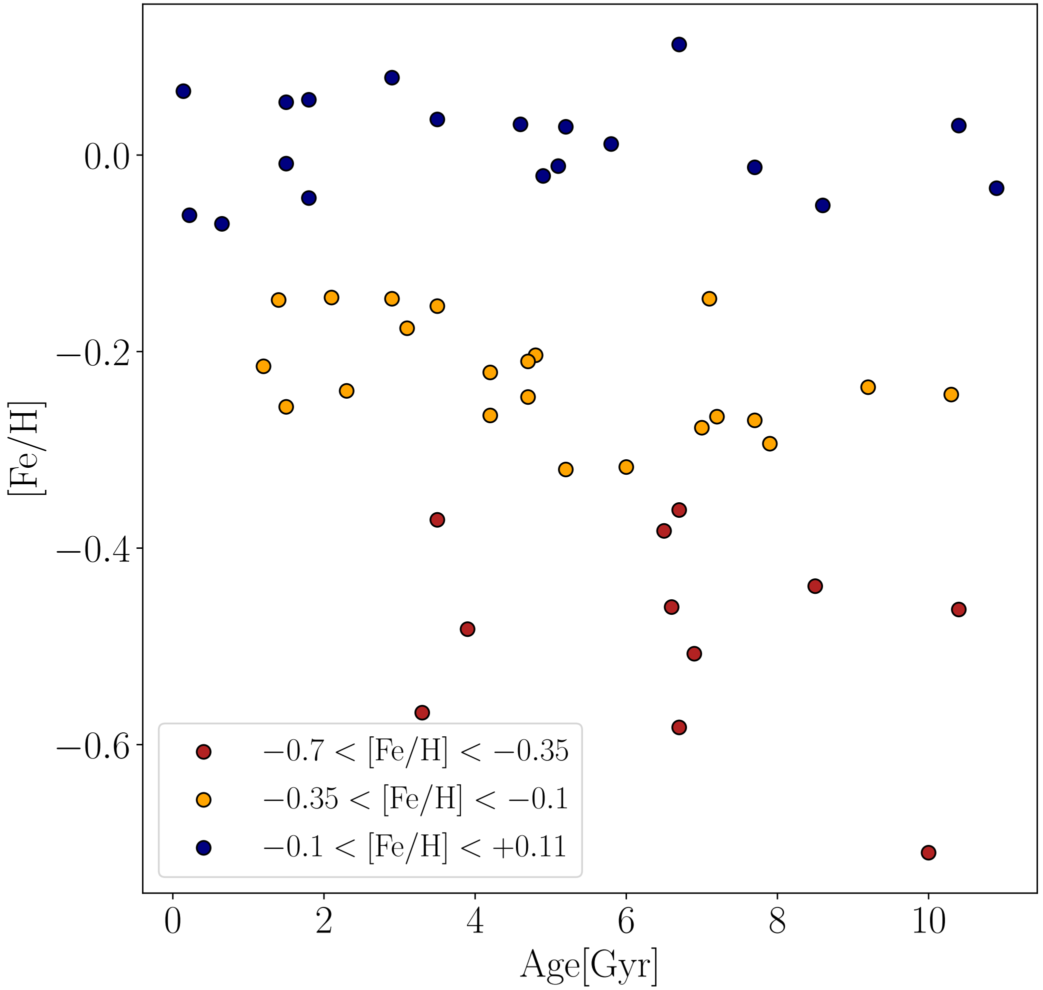
METALLICITY DEPENDENCE

3 metallicity bins



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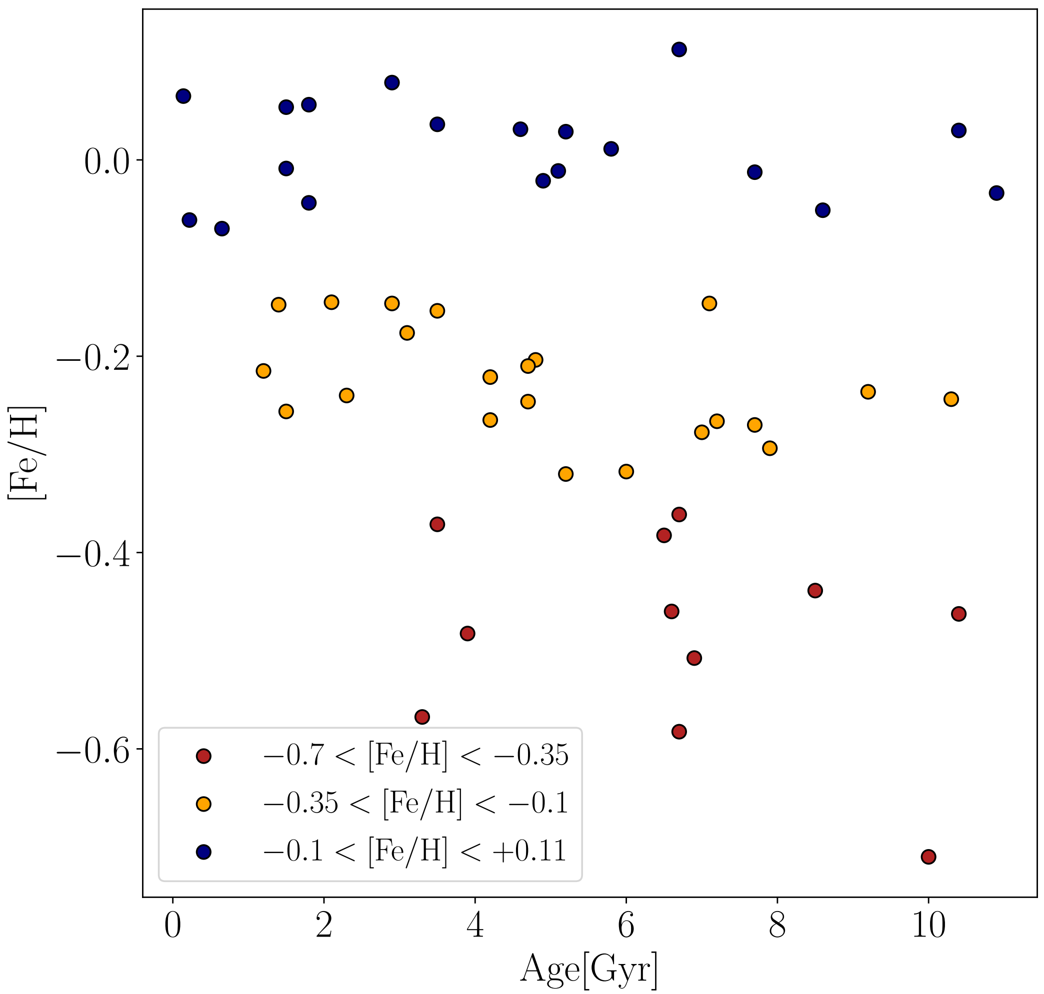
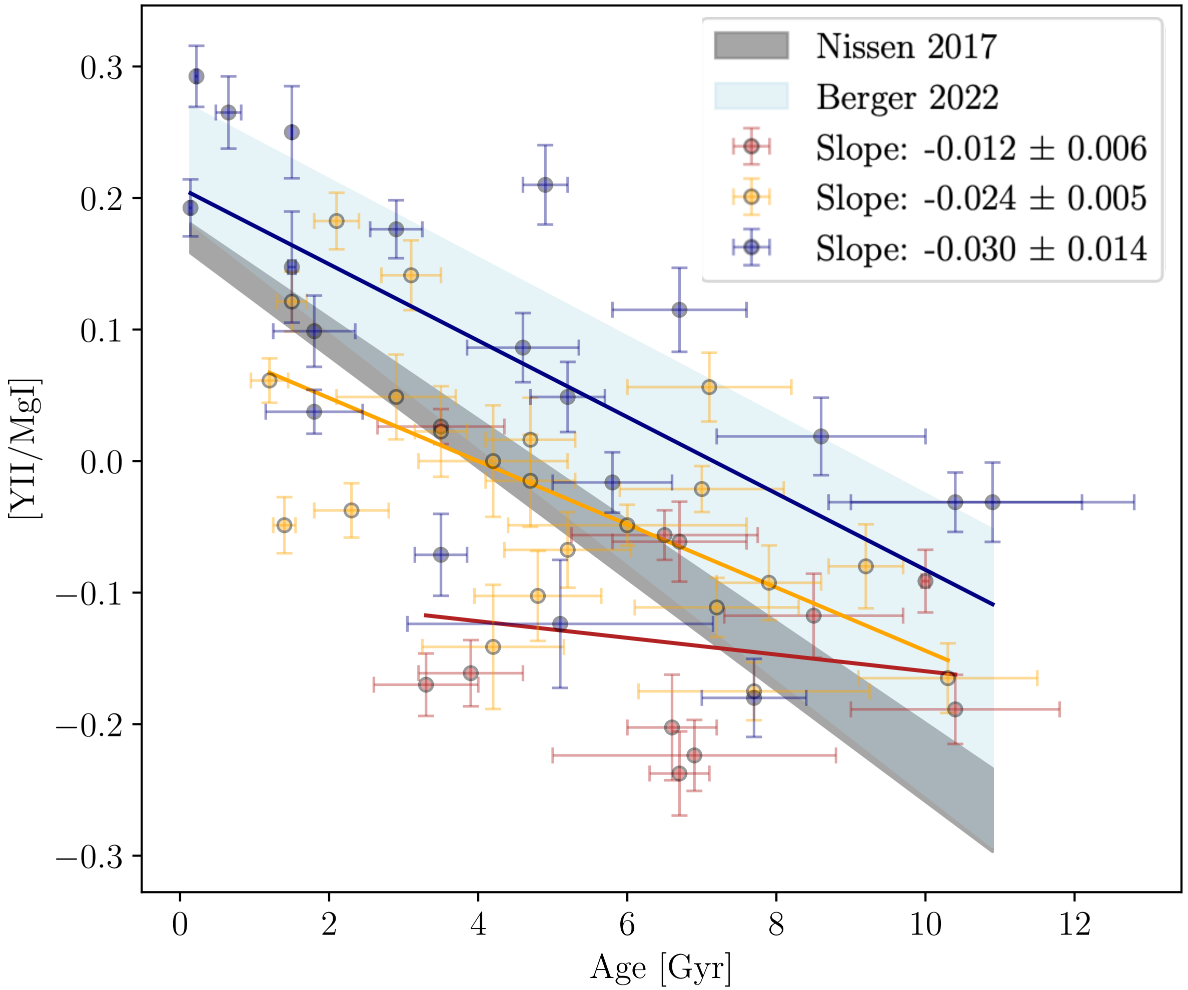
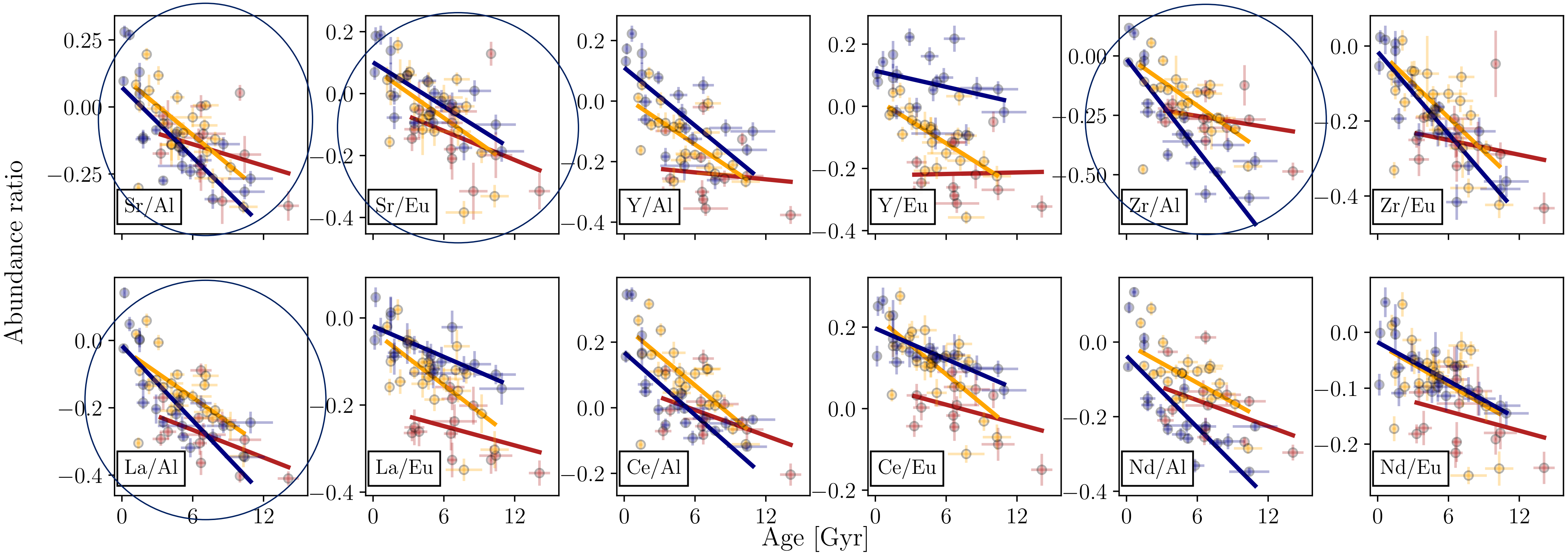


[s-processed/alpha] element



CHEMICAL TRAITS

[n-capture/Al] & [s/r] processed elements

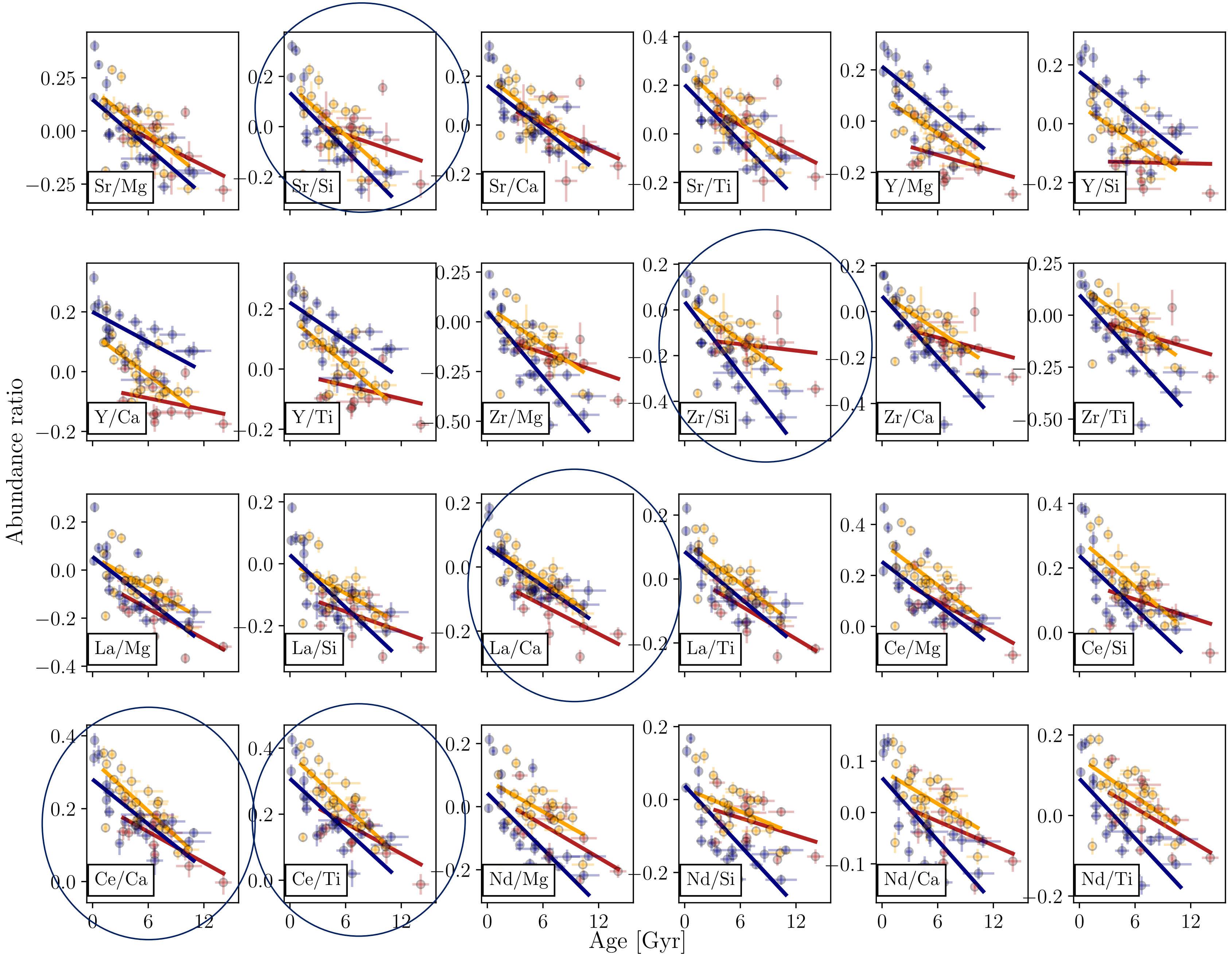


Loss of correlation for lower metallicities

CHEMICAL TRAITS

[n-capture/alpha] elements

- Trends ⇔ Different production timescales
- Influence of [Fe/H]
- Strong relations for Zr and Sr
- Different production paths

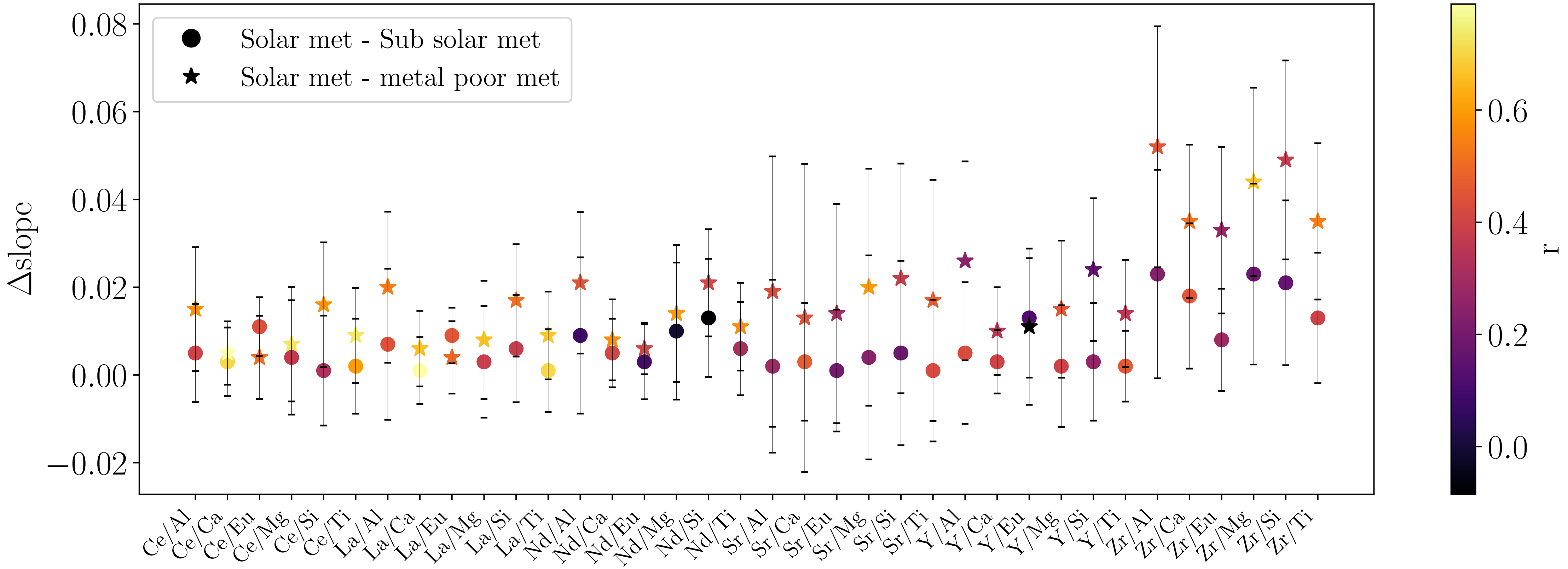


INFORMATIVE AND UNIVERSAL TRAITS

- Most informative traits (higher correlation)
- More universal (smaller Δslopes)

Giant stars

Solar met: -0.1< [Fe/H] < +0.11
Sub solar: -0.35 < [Fe/H] < -0.1
Metal poor: -0.7 < [Fe/H] < -0.35



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Giant stars → **SPECTRAL FIDELITY**

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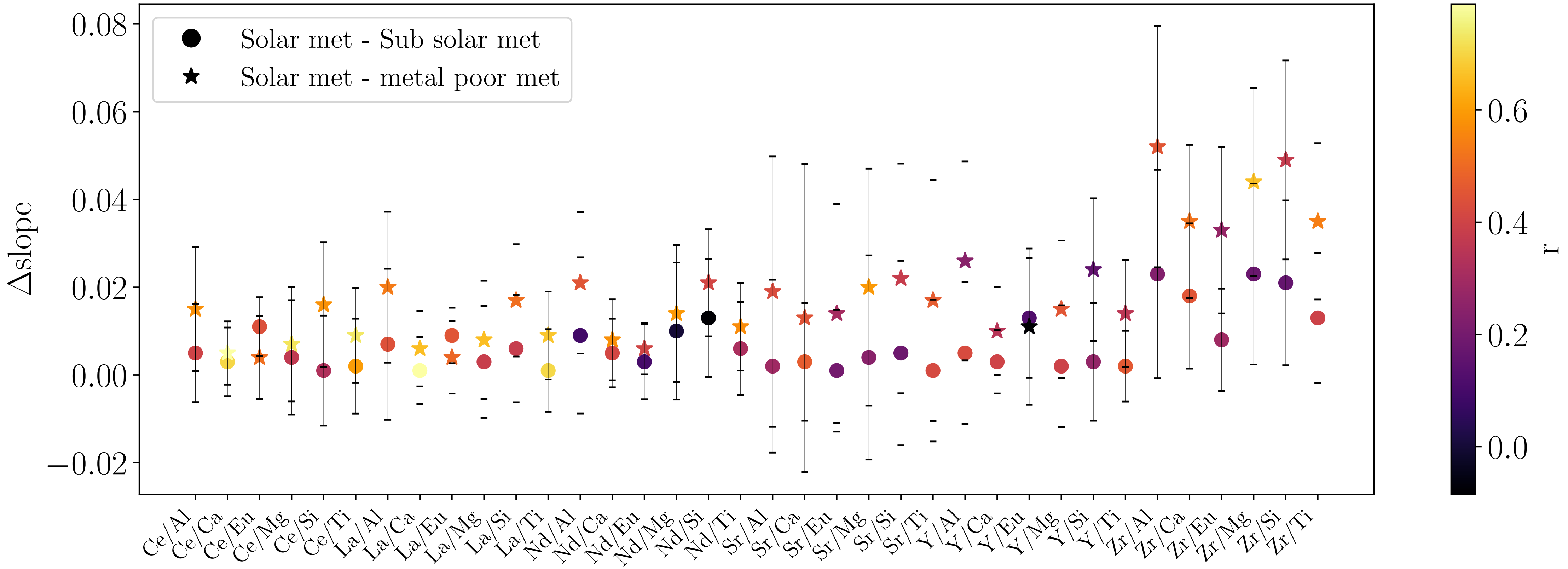

THANK YOU FOR YOUR ATTENTION!