# Exploring the Galactic Disc: Stellar Ages for TESS stars using spectroscopic informations from *Gaia*

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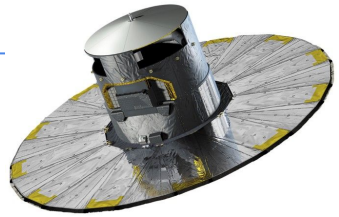
Observatoire de la CÔTE d'AZUR

UNIVERSIDAD DE GRANADA

# ESA space mission *Gaia*

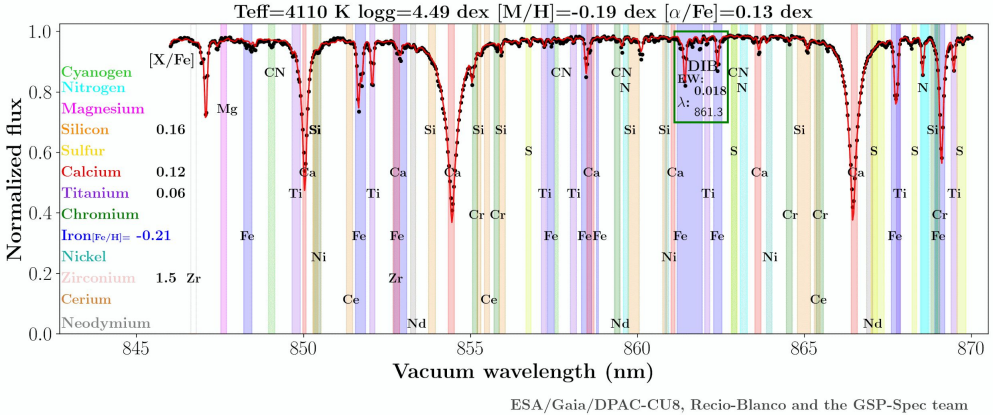


**Magnitude domain:**

- G up to ~ 20.7 for astrometry and photometry
- G up to ~ 16 for spectroscopy

**RVS (Radial Velocity Spectrometer):**

- wavelength domain between [846-870] nm
- medium resolving power of R ≈ λ/Δλ ≈ 11 500




ESA/*Gaia*/DPAC-CUs, Recio-Blanco & the **GSP-spec** *(Recio-Blanco et al. 2023)* team

Chemical abundances of 13 species & DIB

**GSP-spec** estimation of:

**Atmospheric parameters**

$T_{eff}$ log(g) [M/H] [α/Fe]

## NASA space mission *TESS*

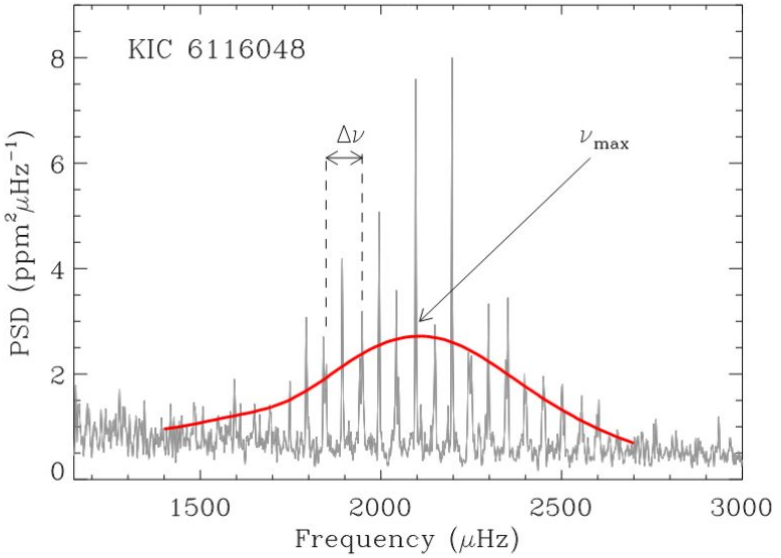
**Magnitude domain:** [600-1000]nm band up to ~ 15

**Resolution:** 21 arcsecond/pixel

**Wavelength domain:** four wide-field optical CCD cameras with [600-1 000] nm

$$\frac{g}{g_\odot} \simeq \left(\frac{\nu_{MAX}}{\nu_{MAX,\odot}}\right)\left(\frac{T_{eff}}{T_{eff,\odot}}\right)^{1/2}$$

*(Brown et al. 1991; Chaplin & Miglio 2013; Christensen-Dalsgaard 2016)*



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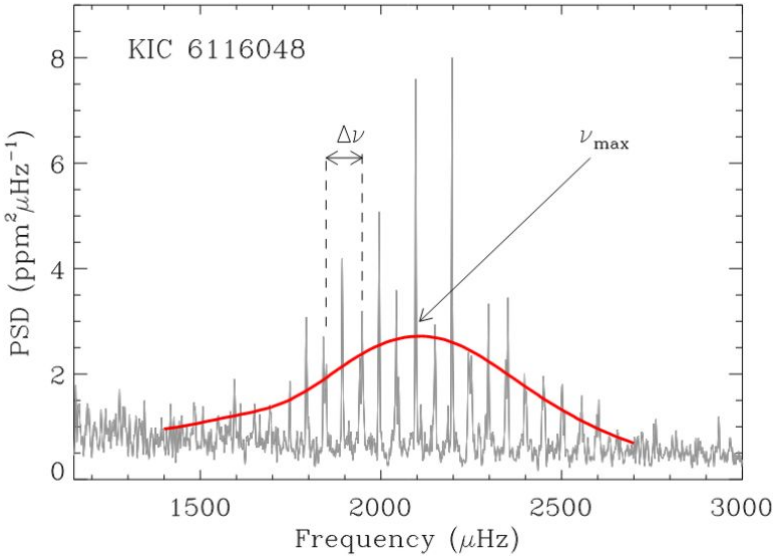
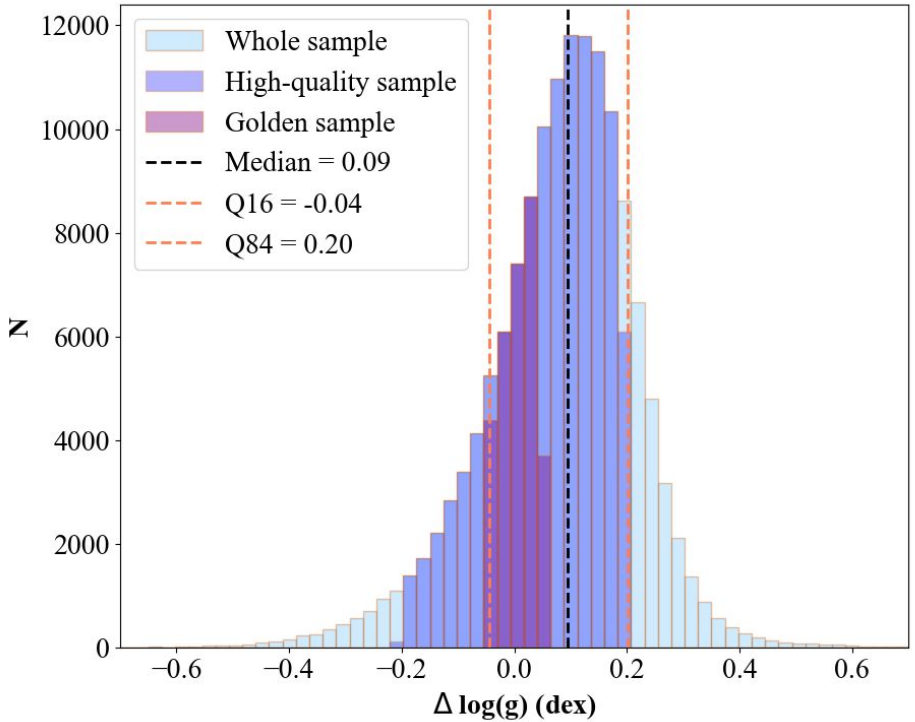
TESS GSP-Spec



## GSP-spec/TESS Catalog: Subsamples definition




$|\Delta log(g)| = log(g)_{spectro} - log(g)_{seismic}$

GSP-spec/TESS Input catalogue :
153,544 stars

**High quality sample**
- 115,869 stars
- $|\Delta log(g)| \leq 0.2$ dex

**Golden sample**
- 30,297 stars
- $|\Delta log(g)| \leq 0.05$ dex

- S/N ~ 150
- $Teff_{err}$ < 100 +/- 13 K
- $[M/H]_{err}$ < 0.1 +/- 0.05 dex
- $[alpha/Fe]_{err}$ < 0.015 +/- 0.01 dex

**spectroscopic data**

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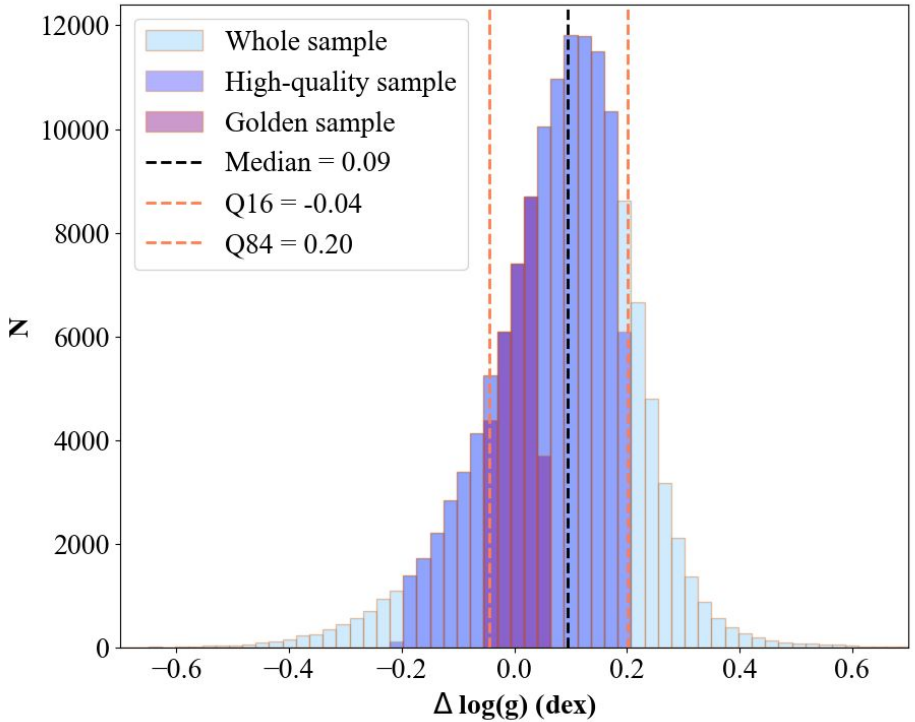


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9 individual chemical abundances available

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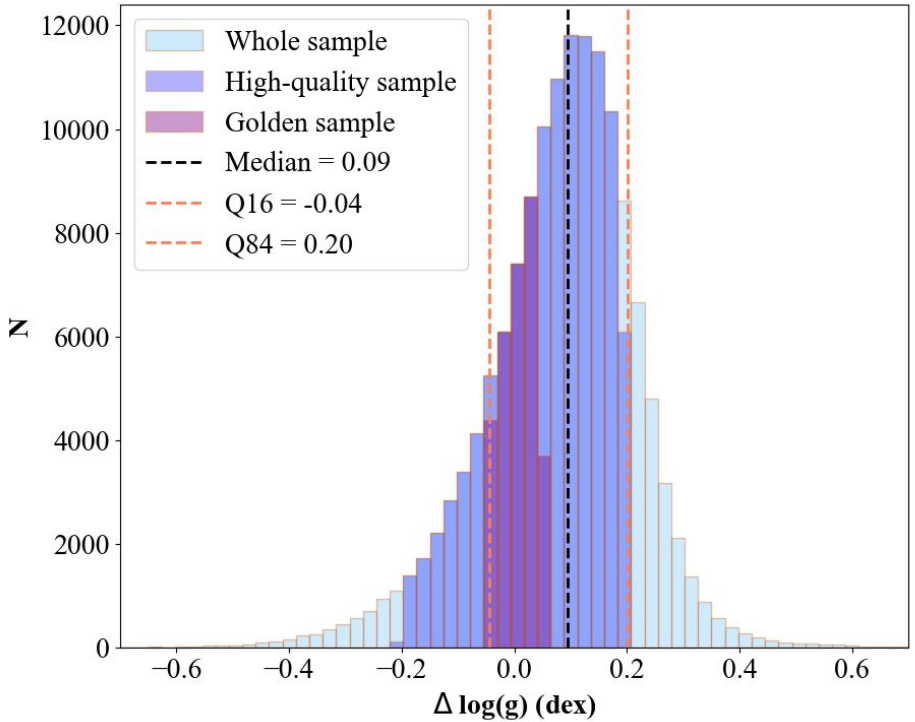


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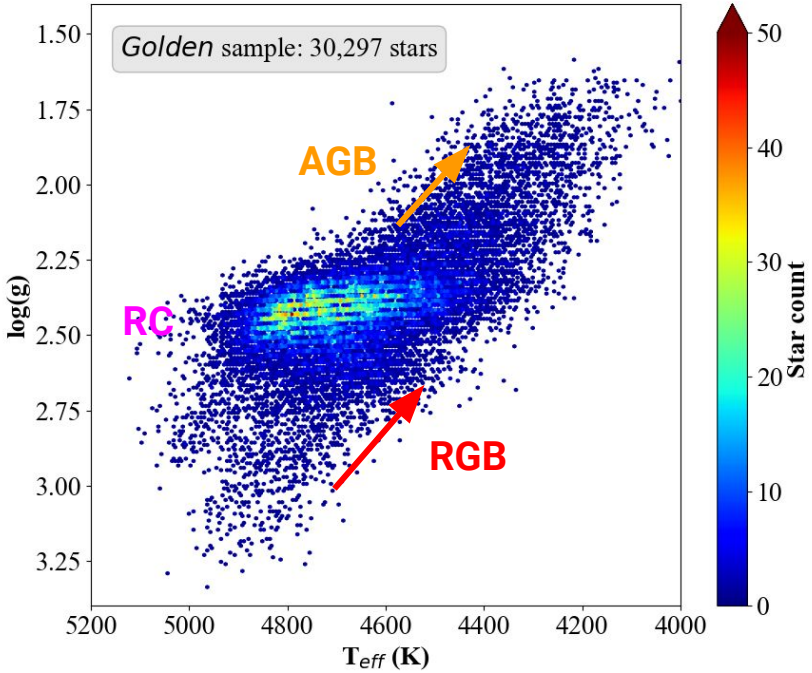
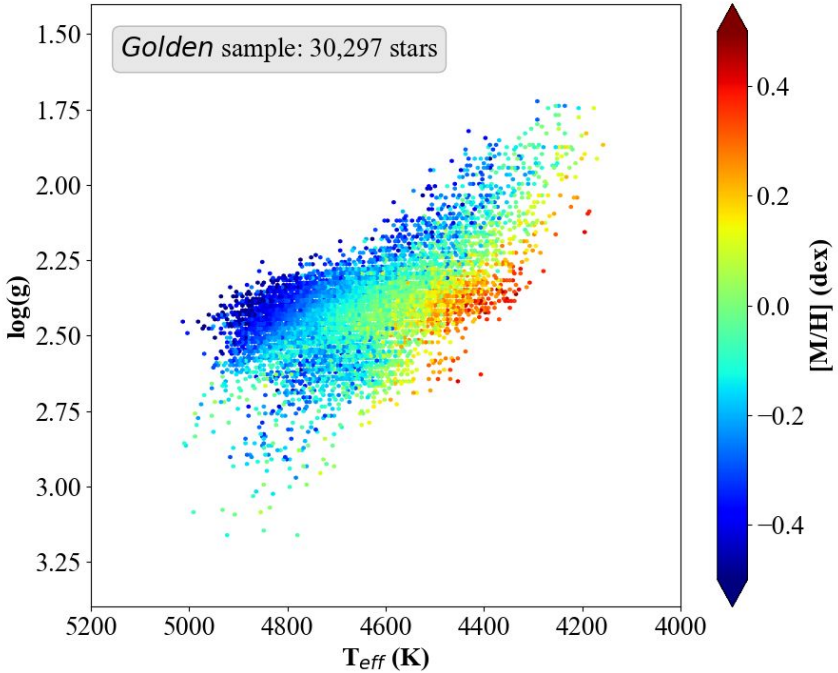
## Golden sample: Kiel diagrams



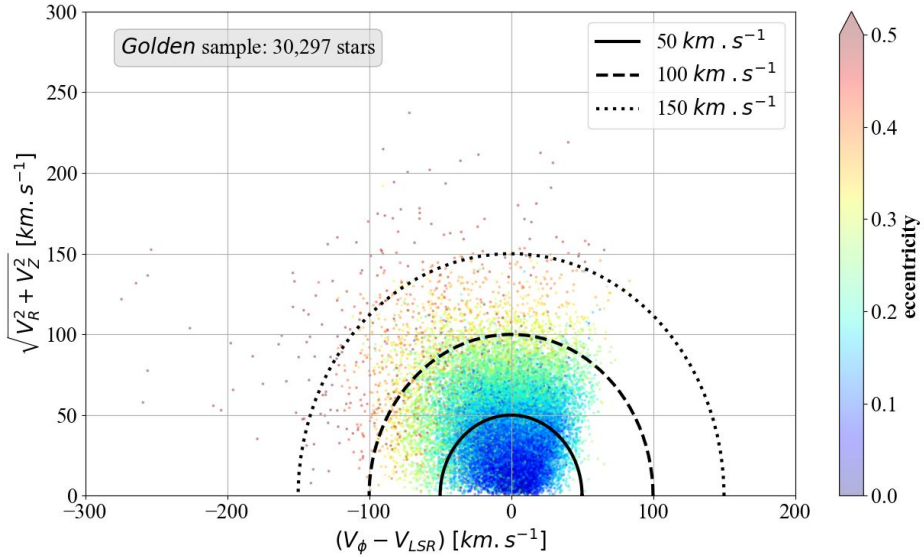



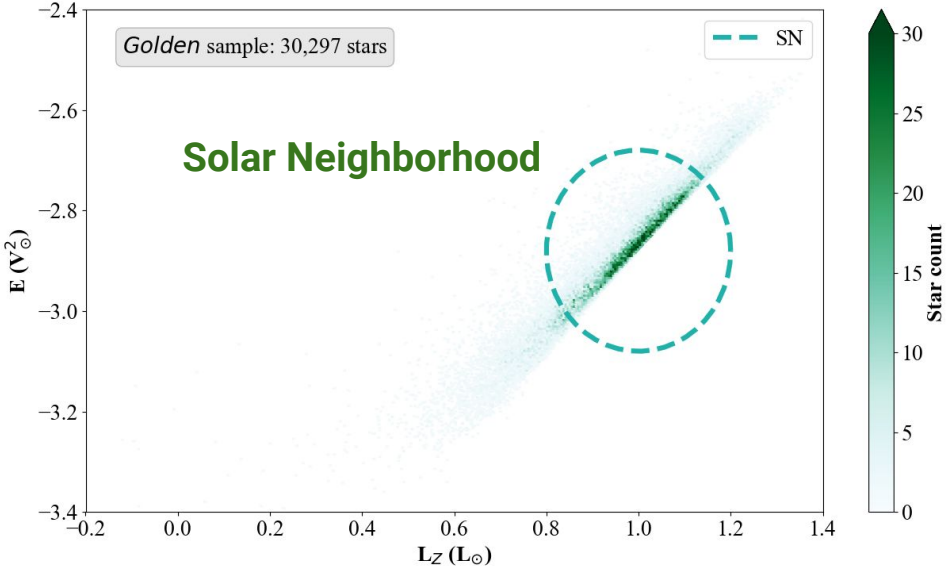

~ 75% of Golden sample stars are **RC** stars

~25% of Golden sample stars are **RBG** stars

## Golden sample: Kinematic properties

Orbital parameters derived by P.A. Palicio (P.A. Palicio et al. 2023)




7 662 stars → **thin disc stars** → ecc. < 0.1 & (VTot − VLSR) < 20 km/s

2 479 stars → **thick disc stars** → ecc. < 0.2 & 40 < (VTot − VLSR) < 120 km/s

## Asteroseismic Ages Determination

### Bayesian Tool

**PARAM**
(da Silva et al. 2006, Rodrigues et al. 2014)

## Asteroseismic Ages Determination

**Bayesian Tool**

**Input parameters:**

GSP-Spec
- Teff
- [M/H]
- L

TESS
- $\nu_{MAX}$
- $\Delta\nu$

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## Asteroseismic Ages Determination

### Bayesian Tool

**Input parameters:**

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- [M/H]
- L

TESS
- $v_{MAX}$
- $\Delta v$

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**Output parameters:**
- M
- R
- log(g)
- **age**
- absolute magnitudes

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Stellar Ages for **30,297** stars provided by **A. Miglio (Bologna)**

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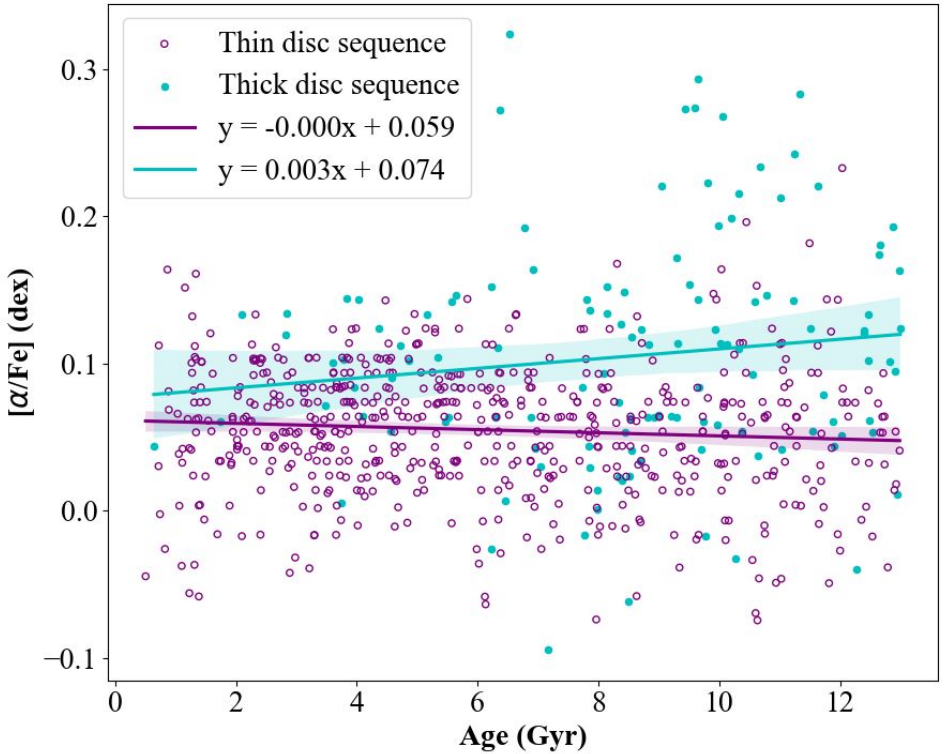
**Strict filtering** on Age uncertainties, mass difference,.. : 2,153 stars

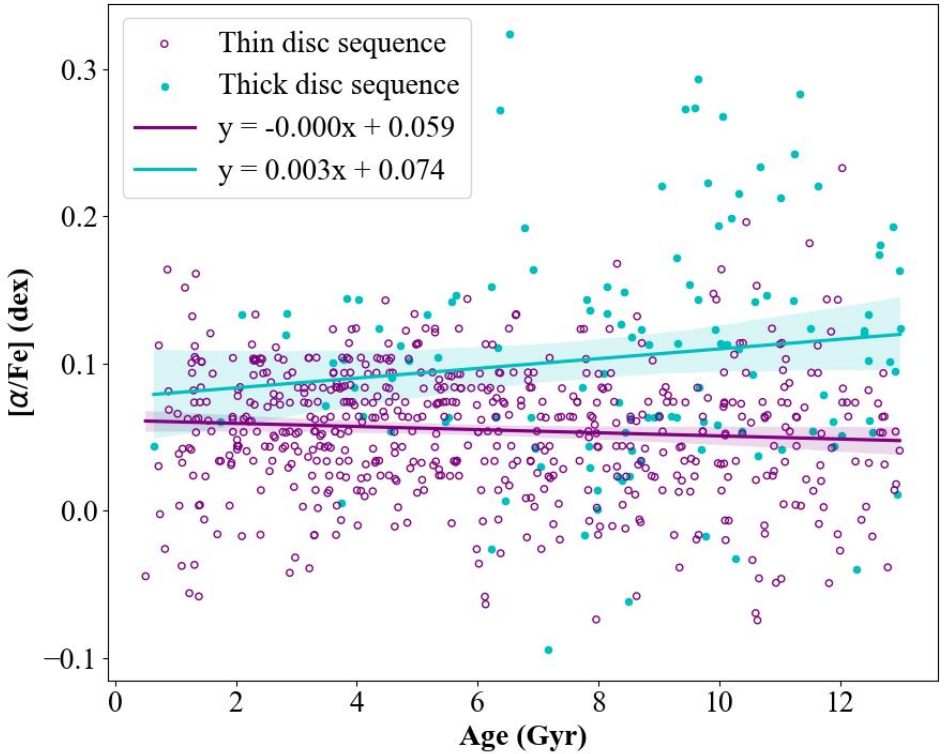
## Thin and Thick disc sequences

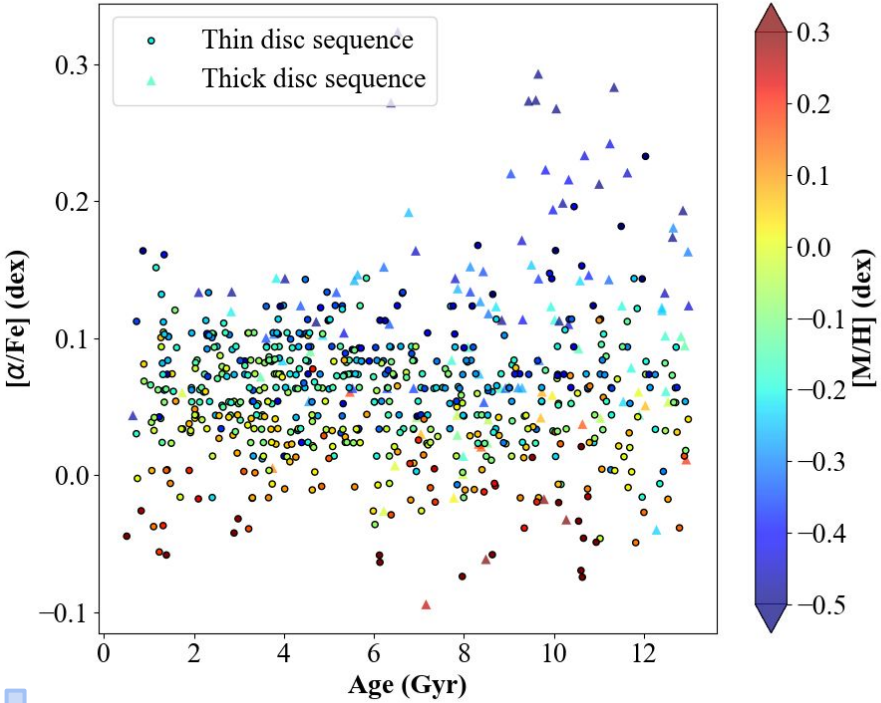



Thin and Thick disc sequences are only defined by kinematic properties:

thin disc → ecc. < 0.1 & (VTot − VLSR) < 20 km/s
thick disc → ecc. < 0.2 & 40 < (VTot − VLSR) < 120 km/s

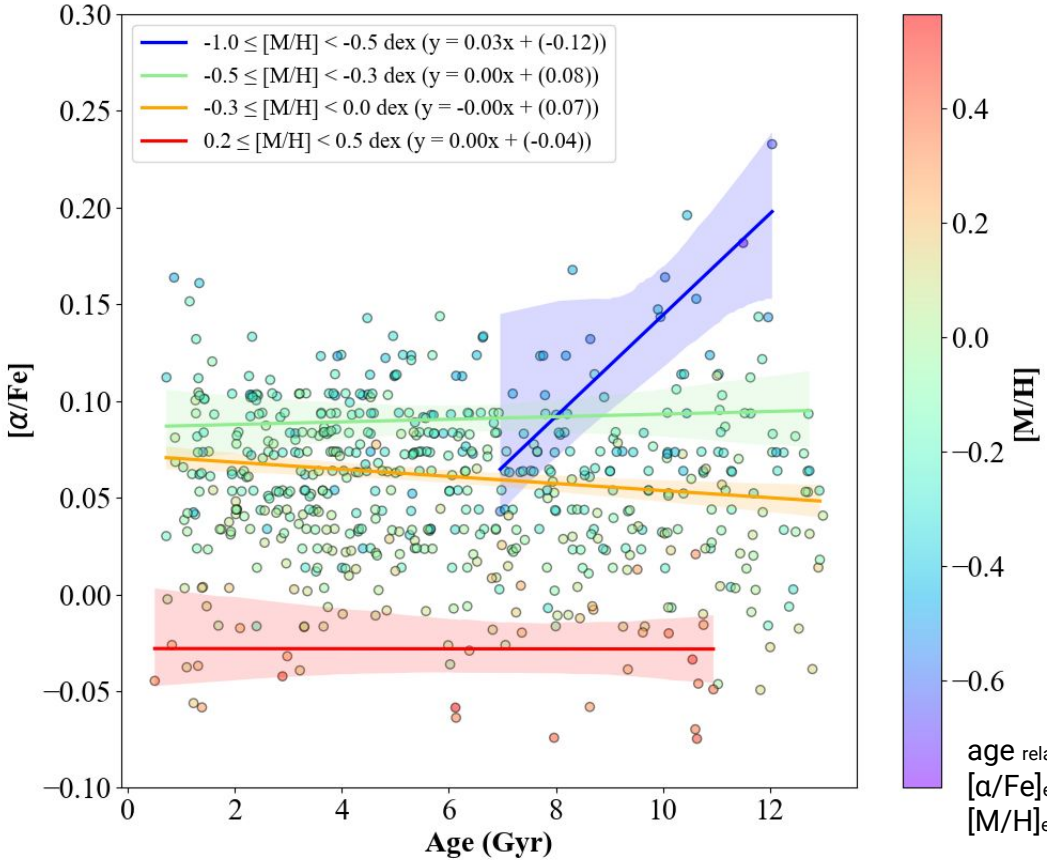
## Thin and Thick disc sequences




Thick disc sequence: mostly old metal-poor stars.
Thin disc sequence: the lower envelope is mostly occupied by metal-rich stars.

## [α/Fe]-Age trends in different [M/H]-bins for Thin disc stars




age $_{relat.err}$ < 0.50
$[\alpha/Fe]_{err}$ = 0.01 dex
$[M/H]_{err}$ = 0.02 dex

- significant spread in stellar age at any [α/Fe] value (for [α/Fe] < 0.13 dex )
- σ[α/Fe] ~ 0.05 dex
- **for [M/H] > -0.5 dex:**
  - stars covering almost all the range in age
  - flat trend, without change in the slope

coexistence of different stellar population in the Solar neighbourhood

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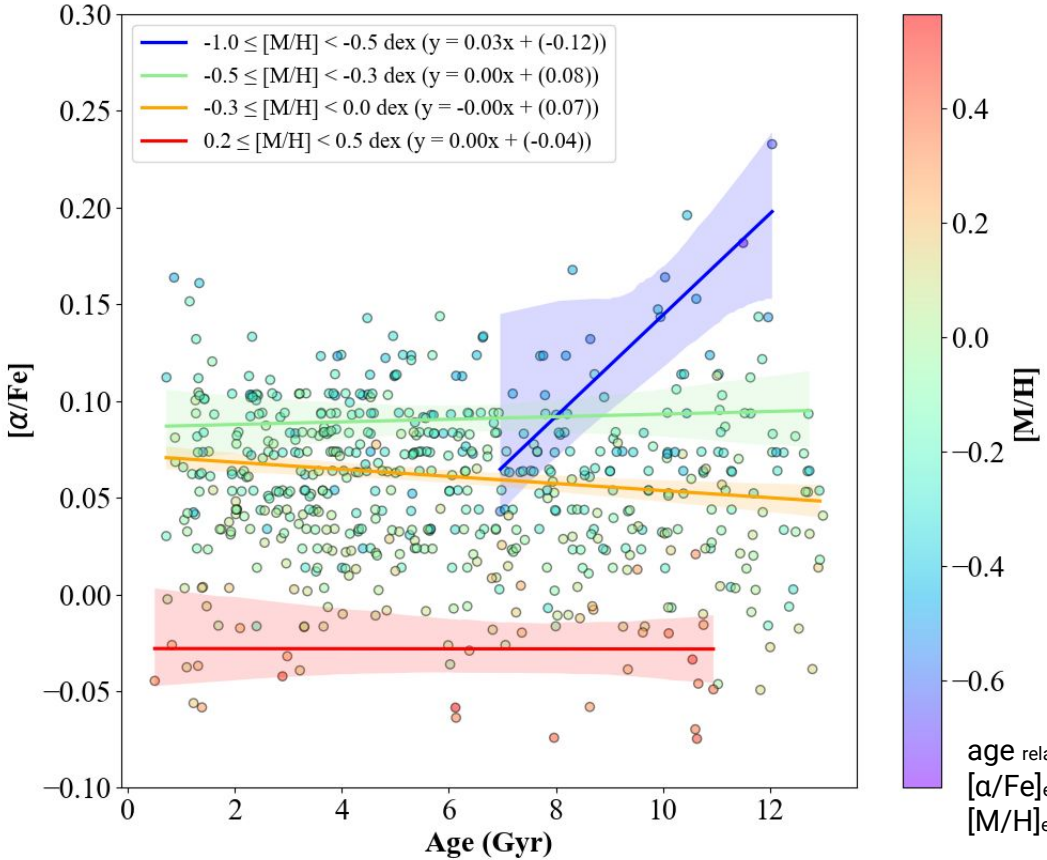


- significant spread in stellar age at any [α/Fe] value (for [α/Fe] < 0.13 dex )
- σ[α/Fe] ~ 0.05 dex
- **for [M/H] < -0.5 dex:**
  - [6-13] Gyr stars
  - linear correlation of [α/Fe] with age, positive slope
- presence of a few young, metal-poor and high-[α/Fe] stars

age $_{relat.err}$ < 0.50
$[\alpha/Fe]_{err}$ = 0.01 dex
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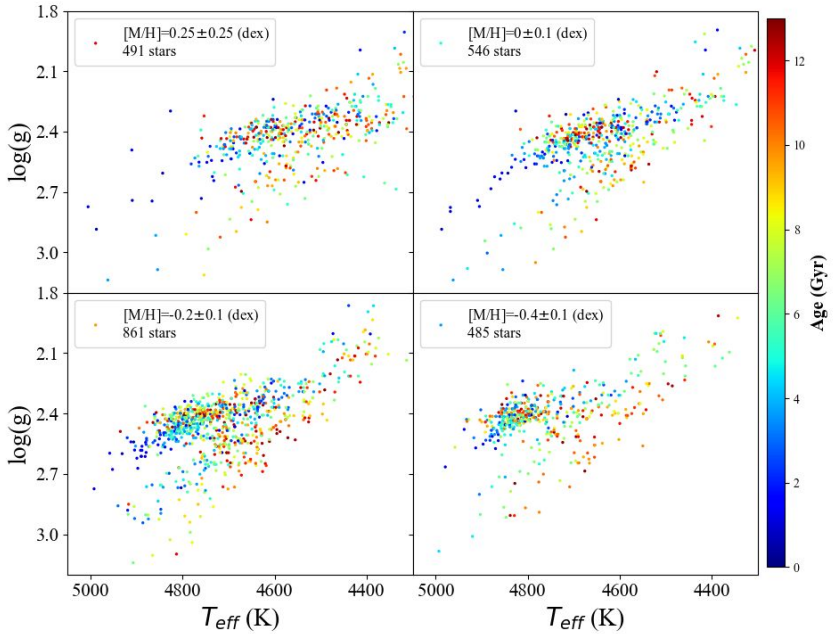
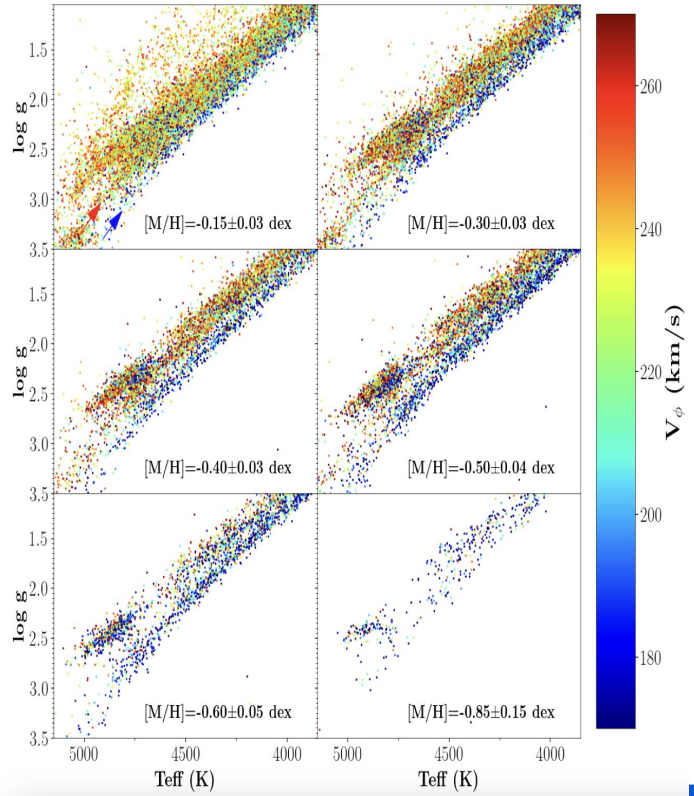
## Double RGB and RC sequences of disc stars

Two evolutionary paths of mono metallicity star population show:

- different age distributions → the hotter population being the younger one
- the thin (high Galactic rotational velocities) and thick (lower Galactic rotational velocities) discs




Recio-Blanco et al. 2024

## Summary and Perspectives

- GSP-Spec/TESS input catalog: 153,544 stars
- Subsamples definition based on the parameters quality and the agreement between $\log(g)_{spectro}$ from Gaia GSP-Spec and $\log(g)_{seismic}$ from TESS
- Stellar Ages for the Golden sample
- We planned to have stellar Ages for the whole sample → explore the physico-chemical map of the Galactic disc

➡ **Paper in prep. with P. de Laverny, A. Recio-Blanco, P.A. Palicio, A. Miglio, J. Montalban, C. Abia**

➡ **We will provide an electronic table available of the stars with their parameters derived: masses, ages,...**

# Thank you for your attention

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