



MiniGrant Checs

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Abstract

Stellar ages are the missing ingredient to complete the portrait of our Galaxy. One of the most promising methods to derive them is based on the relation between stellar chemical composition and age, using the so-called *chemical clocks*. **But how universal are chemical clocks? Can we apply them to all Galactic populations?**

With this project, we aim at observationally and theoretically investigating the application of chemical clocks to the disc of our Galaxy: i) constraining, with observations of star clusters, the variation of the chemical-clock relations in the Galactic disc; ii) estimating the impact of metallicity on the nucleosynthesis of the s-process elements and ii) applying the new yields to a Galactic evolution model, iterating with observational constraints.

Funds: 20000 euro

Schede: Galactic Archeology, STar formation and evolution with open clusters OC-GAST laura.magrini

Heavy Element Nucleosynthesis HEN sergio.cristallo

Galactic Archaeology in Trieste GAT gabriele.cescutti

CHECS (CHEMical ClockS)

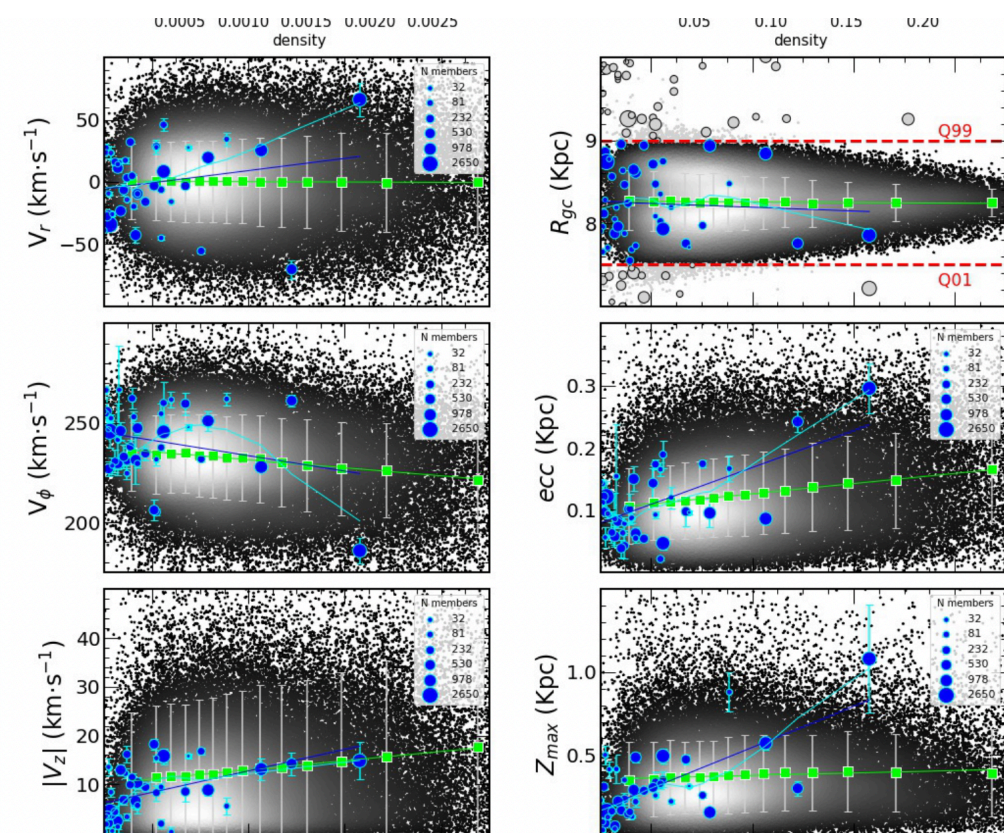
Seeking a theoretical foundation for the use of chemical clocks

First Year Activities Report



First milestone (1):

- Confirming the reliability of the **use of star clusters as disc tracers** (Viscasillas Vazquez, LM et al, 2023, A&A accepted) *"The role of radial migration in open cluster and field star populations with Gaia dr3"*



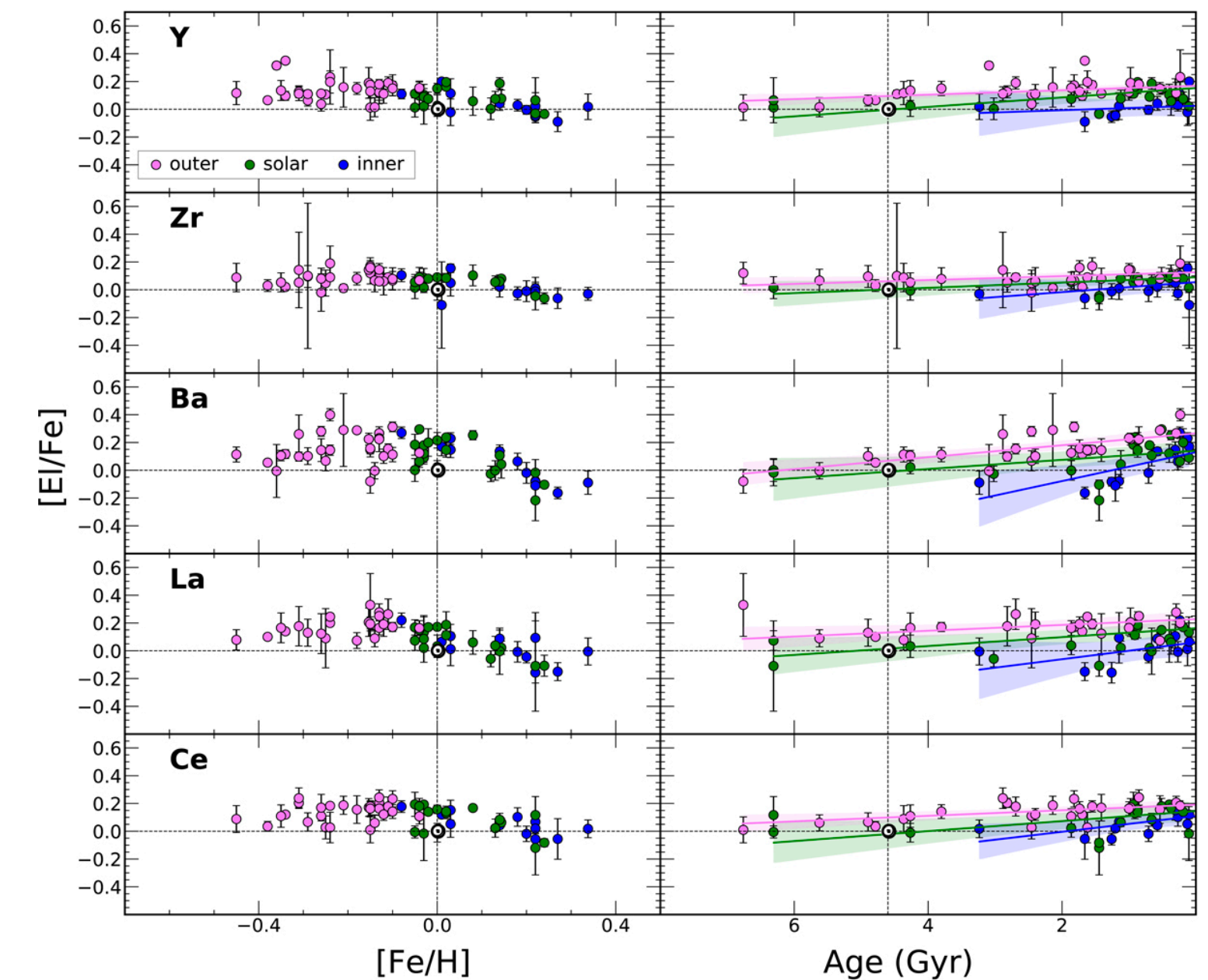
Evolution over time of orbital properties and velocities of open clusters (in blue) and field stars (in grey)

Improving understanding of observational tracers: Study of the effect of stellar migration in field stars and clusters, for a better understanding of the role of stellar migration in the disc.

First milestone (2):

- Investigating the chemical clocks in 2D in the Galactic disc (Viscasillas Vazquez, LM et al, 2022, A&A, 660, 135) *"The Gaia-ESO survey: "Age-chemical-clock relations spatially resolved in the Galactic disc"*

Exploiting the Gaia-ESO database of open clusters: Study of a wide variety of chemical clocks across the Galactic disc using open clusters to calibrate the relationships between ages and chemical abundances.



CHECS (CHEMical ClockS)

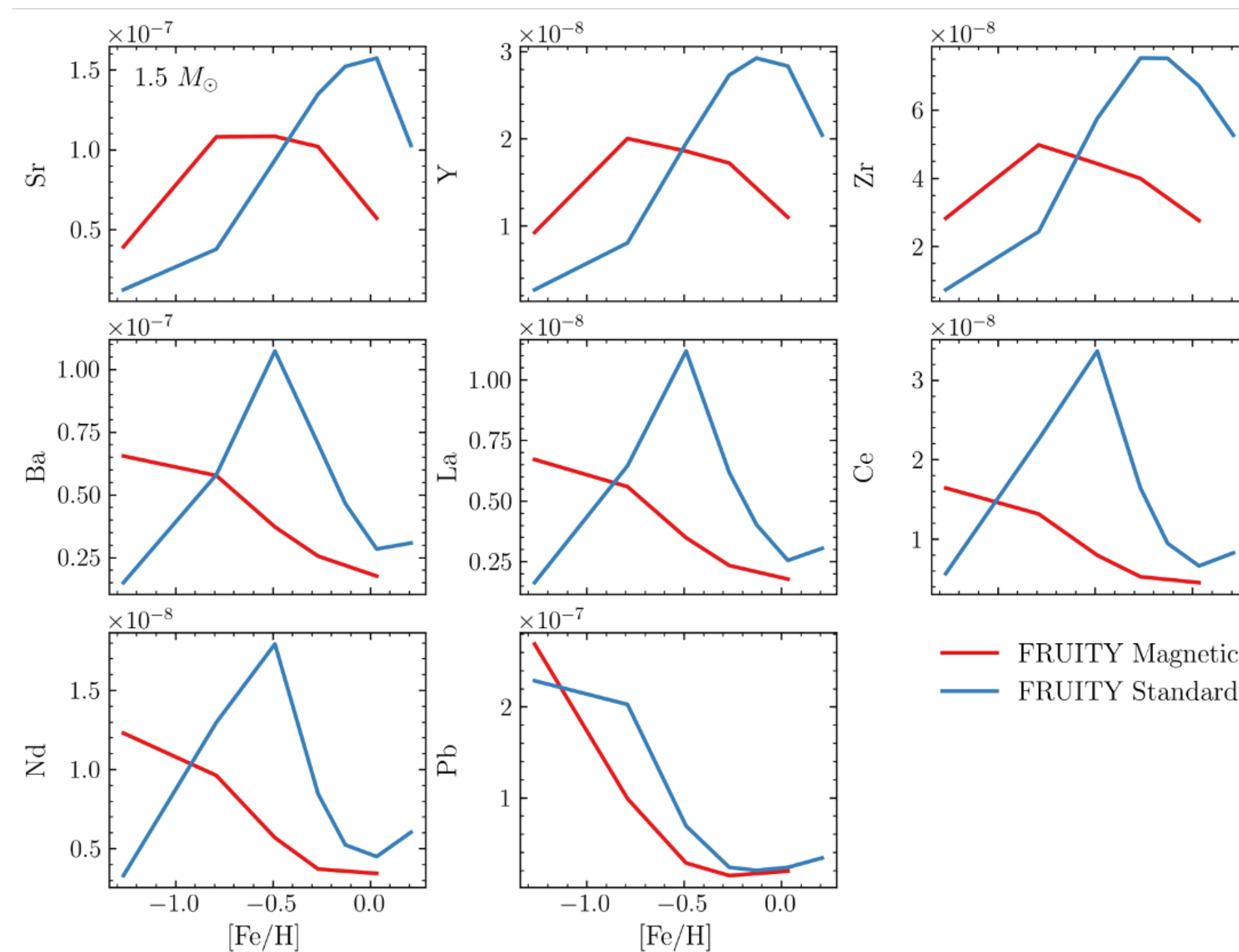
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First Year Activities Report



Second milestone:

- Development of a new set of stellar yields for AGB stars including the effect magnetic field



Going beyond the state of the art:

Yields for low and intermediate mass AGB stars are under development by Sergio Cristallo and Diego Vescovi in the framework of the project

Example of stellar yields for a 1.5 Msun star in the standard case (FRUITY Standard) and in the case where the magnetic field is considered (FRUITY Magnetic).

CHECS (CHEMical ClockS)

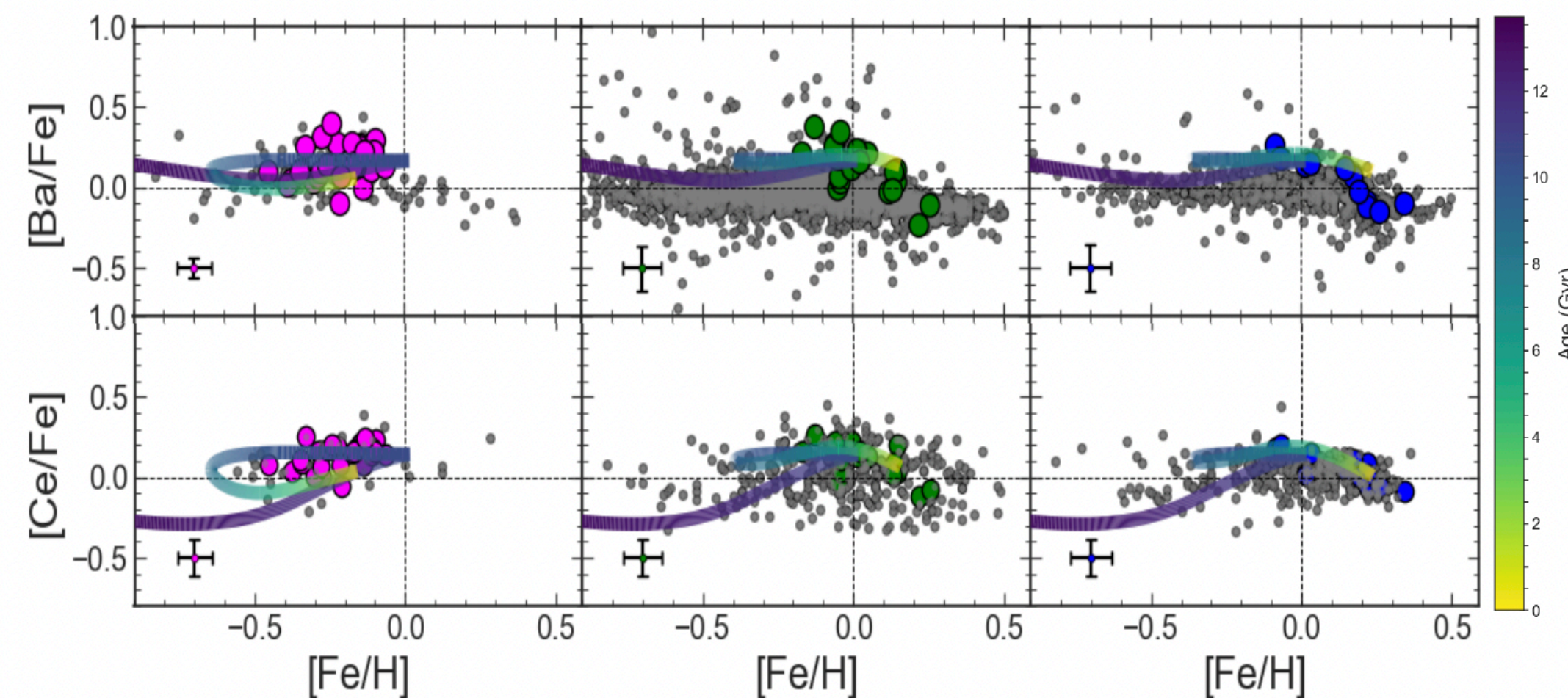
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First Year Activities Report



Third milestone:

- Development of a chemical evolution model for the study of neutron capture elements (Molero, LM, et al. 2023, MNRAS, 523, 2974) "*Origin of neutron-capture elements with the Gaia-ESO survey: the evolution of s- and r-process elements across the Milky Way*"



Starting from the state of the art:

Yields for low and intermediate mass AGB stars from the FRUITY database were used in the model, applying a factor of 2 decrease to reproduce the observational data.

Comparison of model curves with observational data (of field stars in grey and clusters in magenta (outer disc), green (solar neighbourhood) and blue (inner disc)). The model curves are colour-coded with the age of the stellar populations.

CHECS (CHEmical ClockS)

Seeking a theoretical foundation for the use of chemical clocks

First Year Activities Report



What the project funded

Presenting the group results:

- Participation to EAS (Laura Magrini, Mathieu Van Der Swaelmen)
- Participation to "STARS across the Universe" (Laura Magrini and Diego Vescovi)
- Participation to "Spectral Fidelity" (Laura Magrini, Mathieu Van Der Swaelmen)

Mobility

- Visit by Carlos Viscasillas for collaboration and participation in meetings

Workshop organisation

- Organisation of the Workshop 'From star clusters to field stars' in Florence, 22-23 November 2023

Preparing for new instrumentation

- Participation to the WST Science meeting in Vienna (May 2023) (Laura Magrini)

Criticality: There were no major criticality because the group already collaborates successfully for some time. The group also benefited from the entry of new young researchers (Marta Molero and Mathieu Van Der Swaelmen).