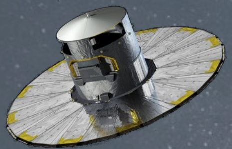
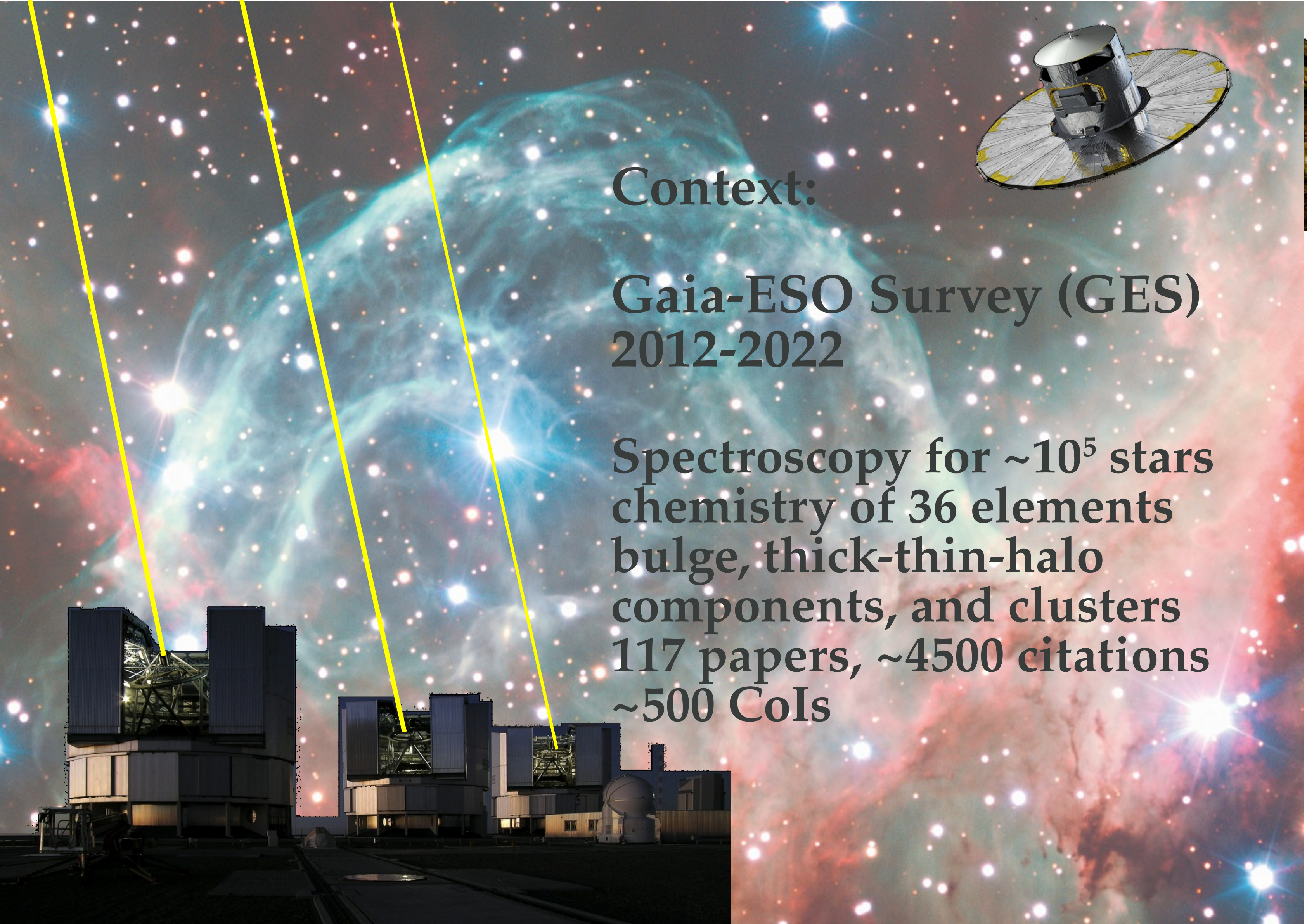


Exploiting the abundances of neutron-capture elements from the latest Gaia-ESO Survey (GES) data release.

Carlos Viscasillas Vázquez (Vilnius University; AO INAF-Arcetri)

C. Viscasillas; L. Magrini; M. van der Swaelmen; G. Casali; G. Cescutti; G. Tautvaisiene; S. Randich

Santiago de Compostela, May 23, 2022

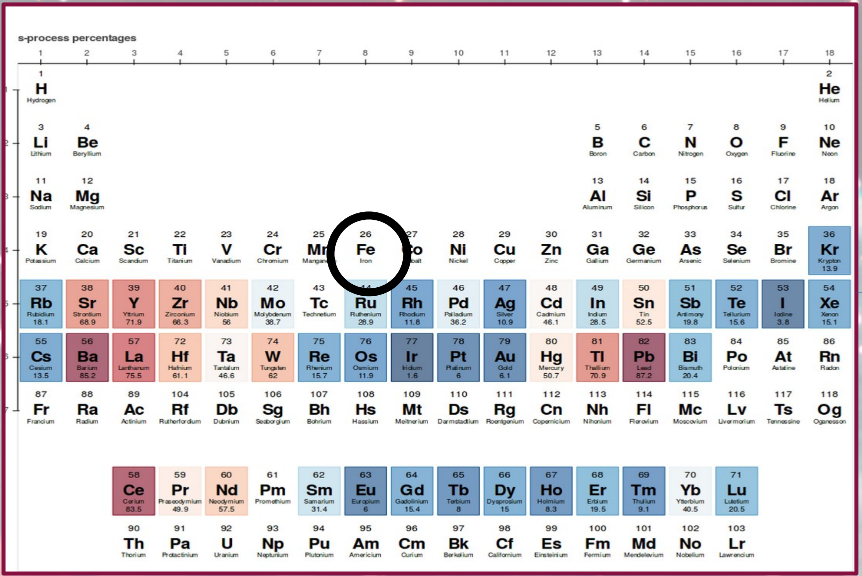


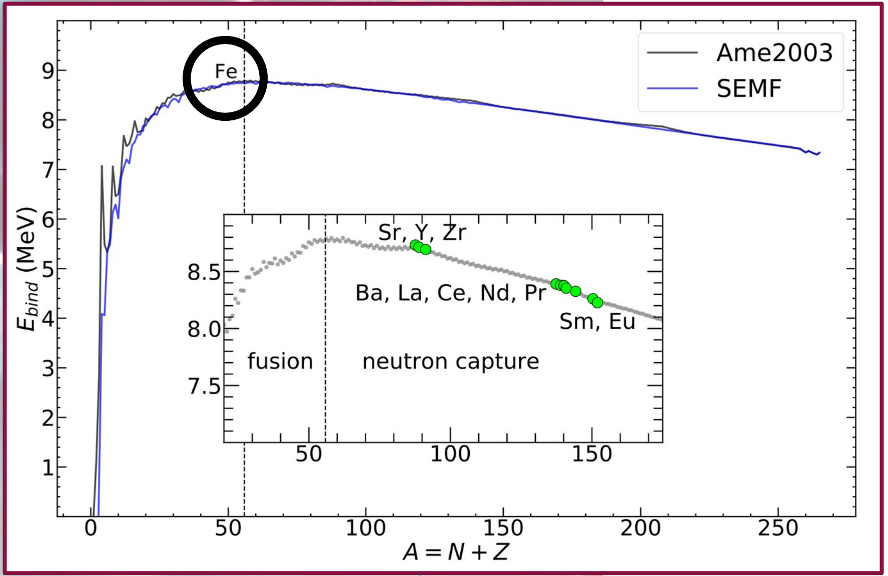
Context:

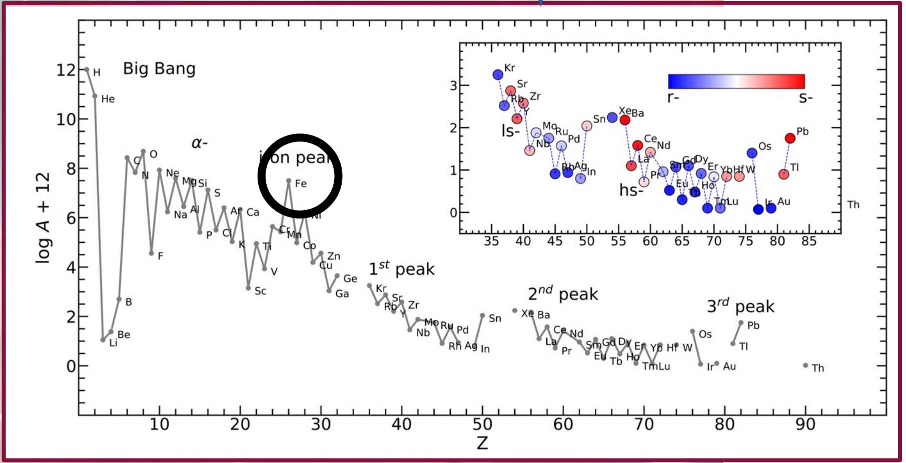
Gaia-ESO Survey (GES) 2012-2022

Spectroscopy for ~10^5 stars
chemistry of 36 elements
bulge, thick-thin-halo components, and clusters
117 papers, ~4500 citations
~500 CoIs

MW-Gaia Cost
STSM AO
INAF-Arcetri







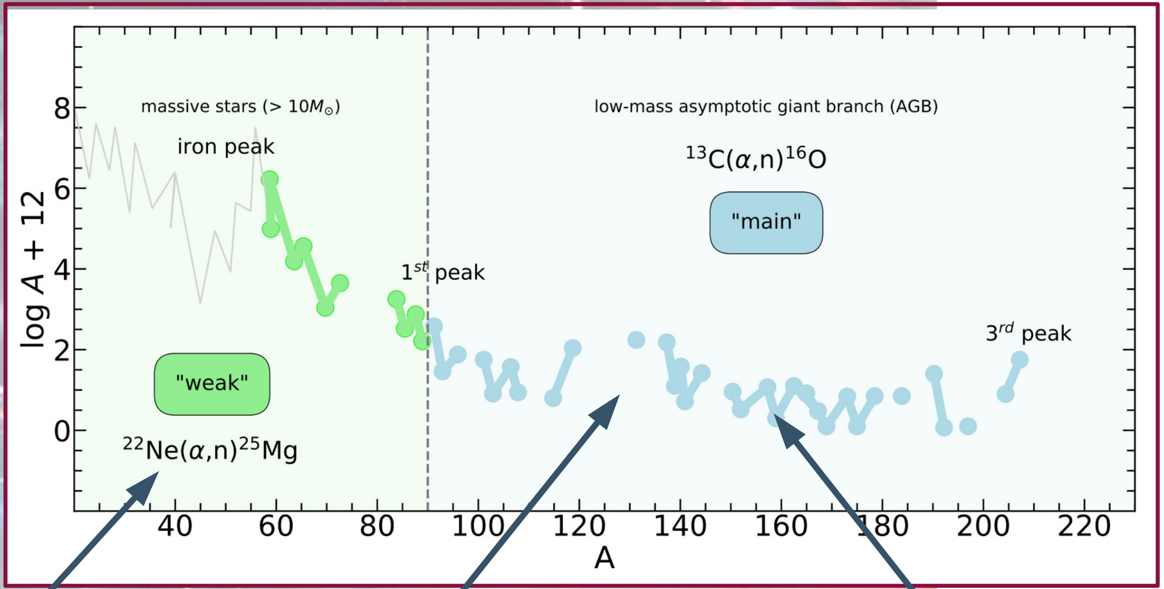
Neutron-capture elements:

special nucleosynthesis

s- and *r*- process

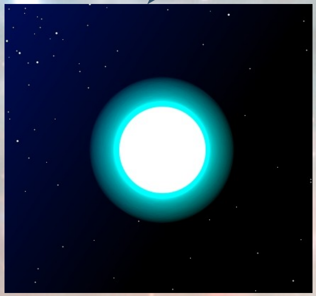
Viscasillas22 (PhD thesis)

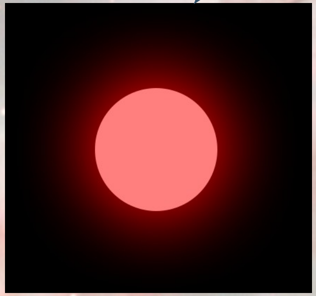
Viscasillas22 (PhD thesis)

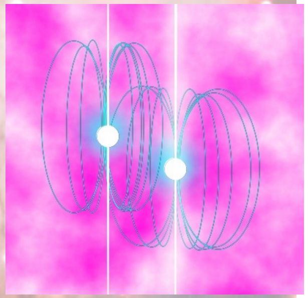


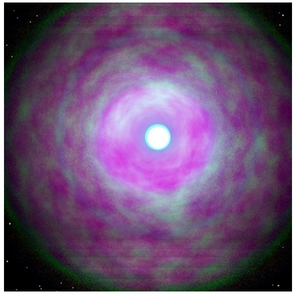
different origin and nature

astrophysical sites









applications of *s*-process and problems of *r*-process

Gaia
astrometry-
positions
~10^9 stars

+

Gaia
Spectroscopy-
chemistry-
RVs
~10^5 stars

+

?

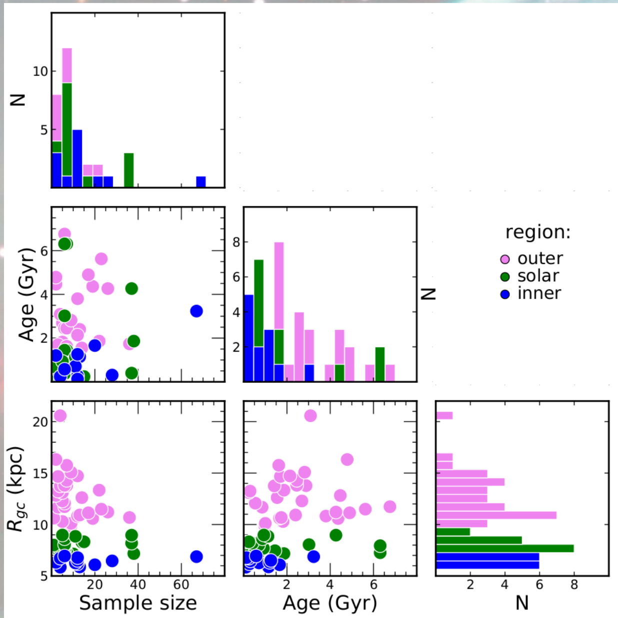
Ages

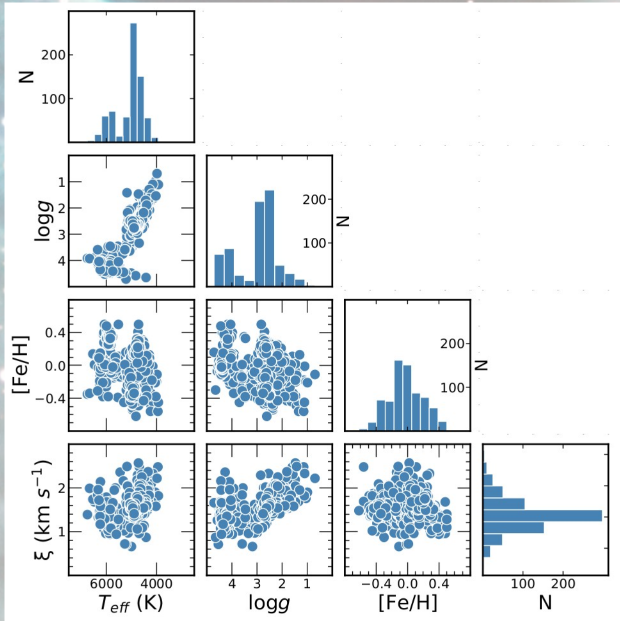
(missing variable)

GALAH (~600,000 stars)
RAVE (~450,000 stars)
APOGEE (150,000 stars)
Upcoming: MAVIS,
HRMOS, MOONS

The sample:

Viscasillas, Magrini+22 (A&A) GES paper 112



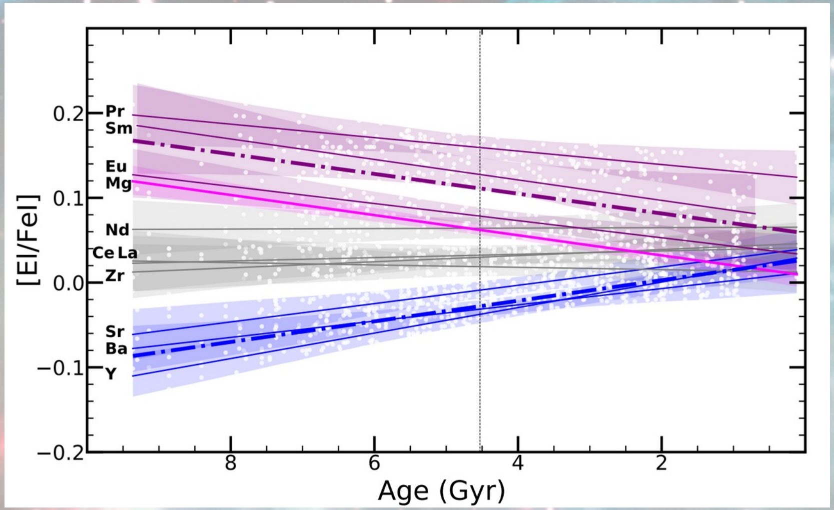


62 open clusters

~750 member stars

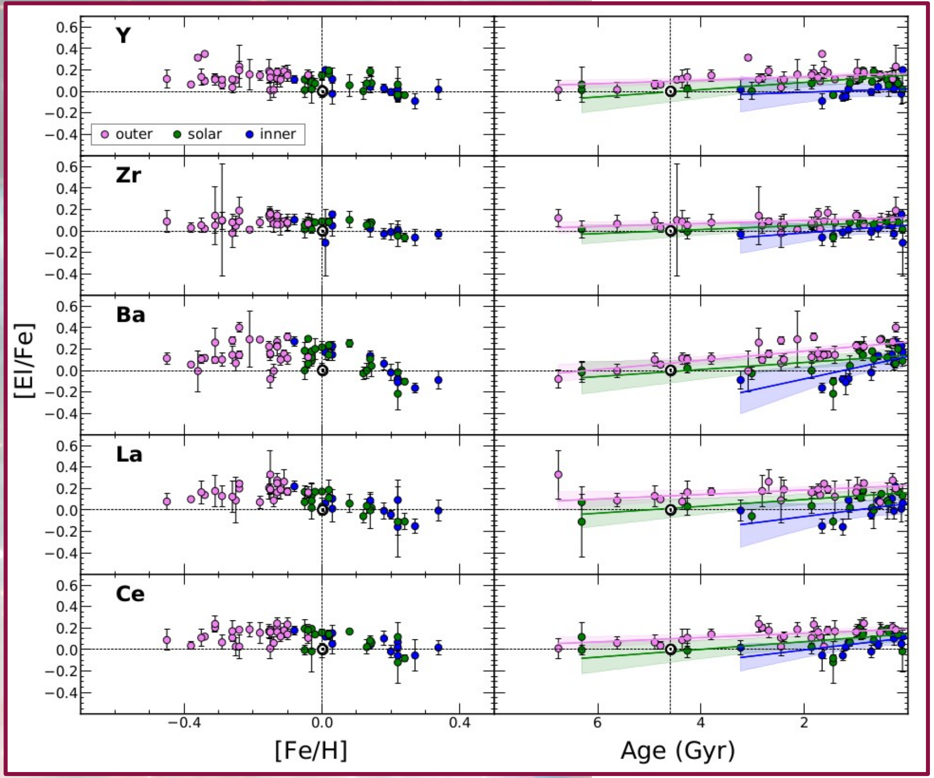
large sample of **open clusters**, most reliable tracers of the chemical evolution of the Galaxy
newest release of the Gaia-ESO Survey based on the high resolution spectroscopy of UVES.

Thin disc



Tautvaišienė, Viscasillas, Mikolaitis+21 (A&A)

Open clusters

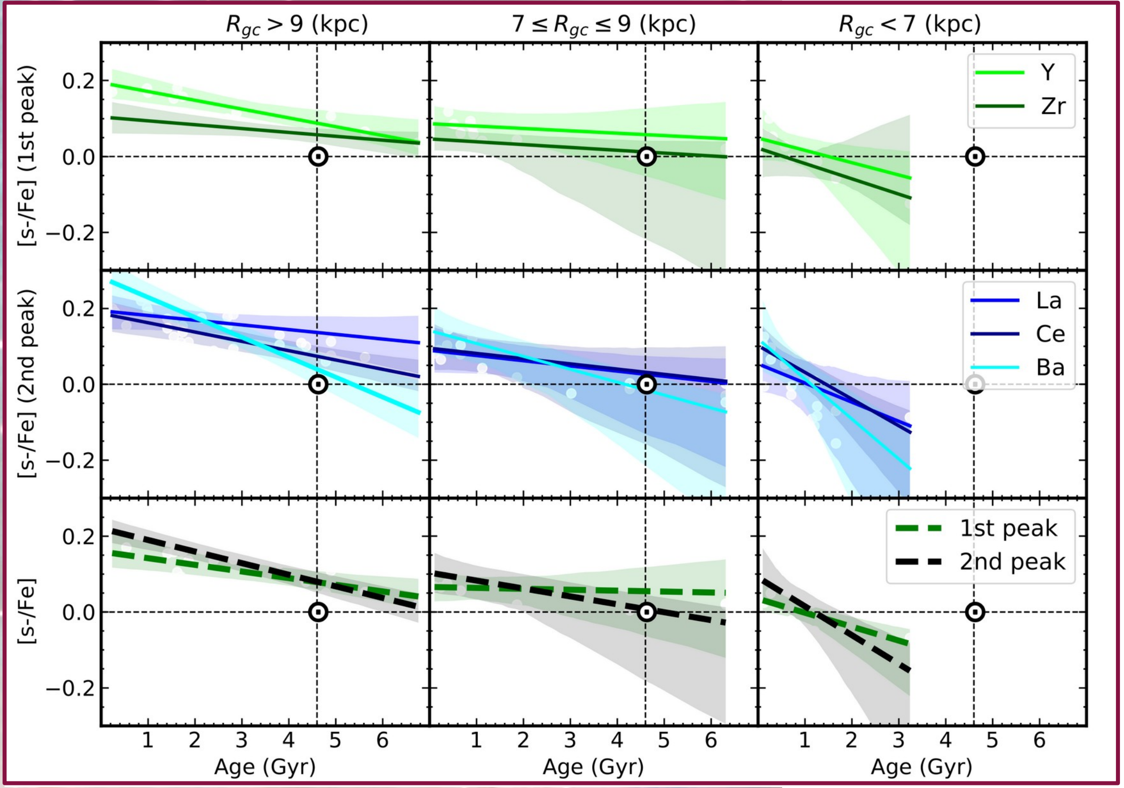


Viscasillas, Magrini+22 (A&A)

Chemical clocks
Sensitivity to age: Y and Ba

Sensitivity to age from another perespective

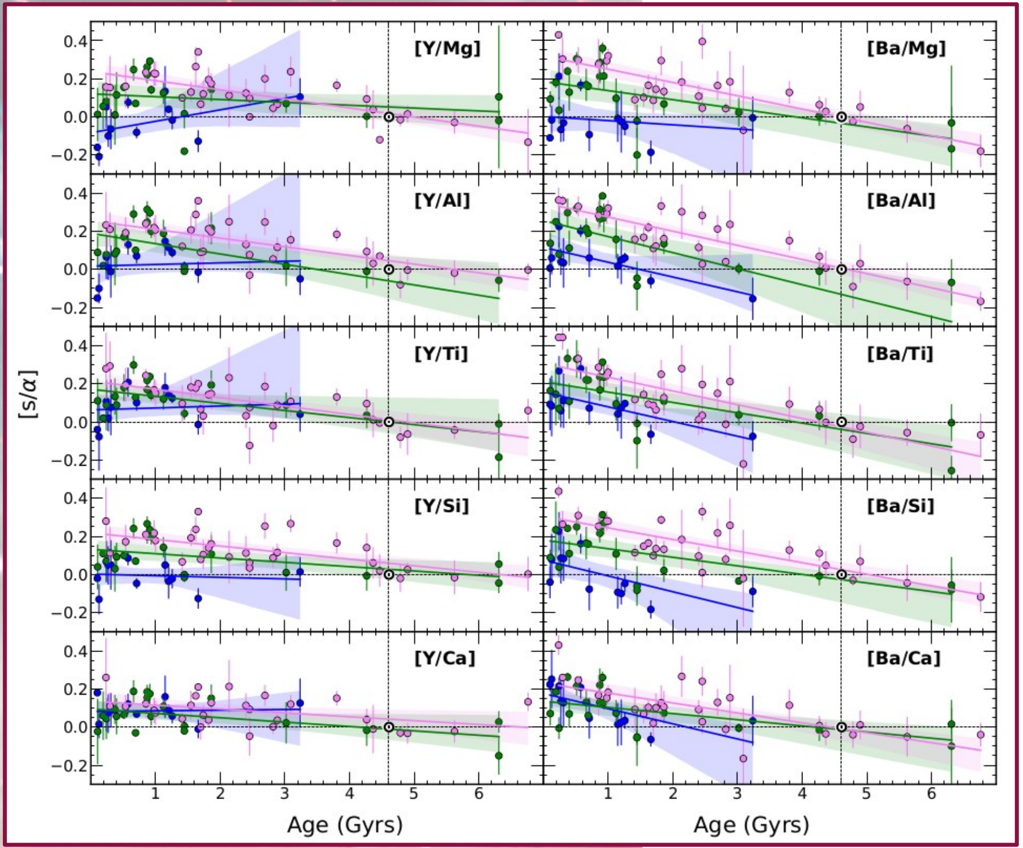
- Metallicity-dependent yields for s-process elements
- Differences between 1st and 2nd peaks



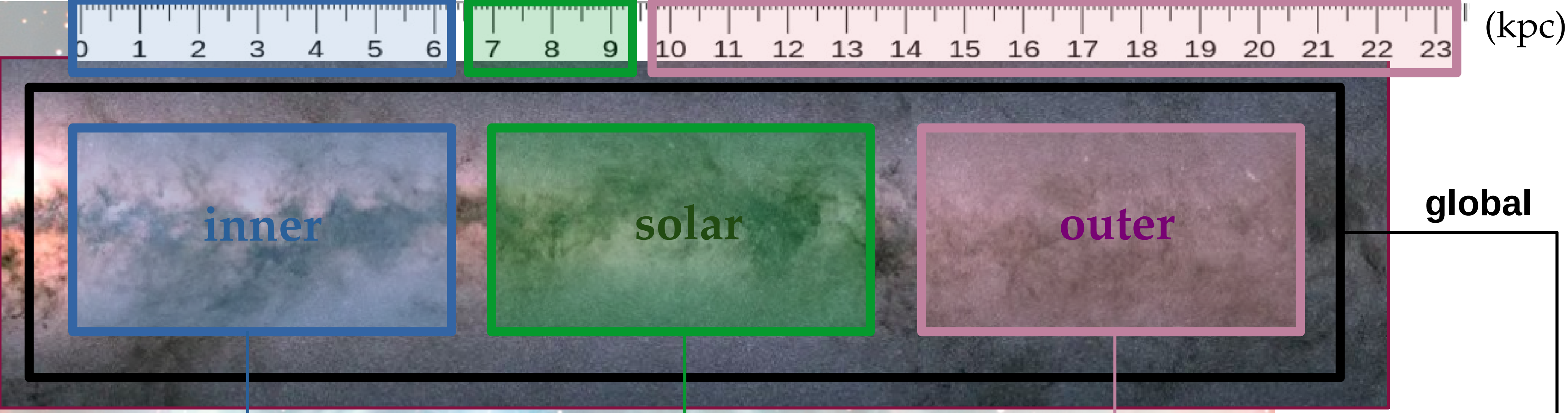
Magrini, Viscasillas+22 (Universe)

Chemical clocks: [s/α]

- We provide a set of 40 weighted MLR in 3 variables ([Fe/H], R_{gc} , and age).
- We apply 3 tests to our relations:
  a) in recovering the ages of the open clusters;
  b) in recovering the ages of member stars;
  c) to infer ages of field stars in [α/Fe]-[Fe/H] plane.
- We investigated the role of migration in our relations.



Viscasillas, Magrini+22 (A&A)



$$[s/\alpha] = m_1 \cdot Age + m_2 \cdot R_{gc} + m_3 \cdot [Fe/H] + c$$

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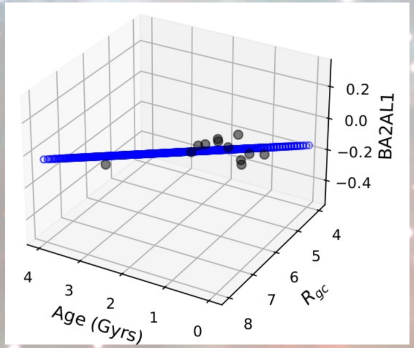
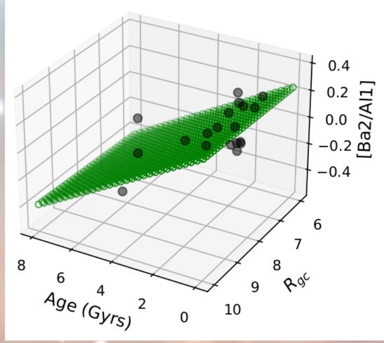
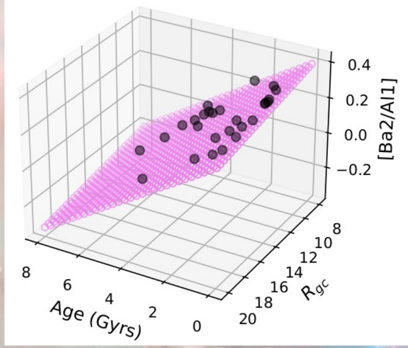
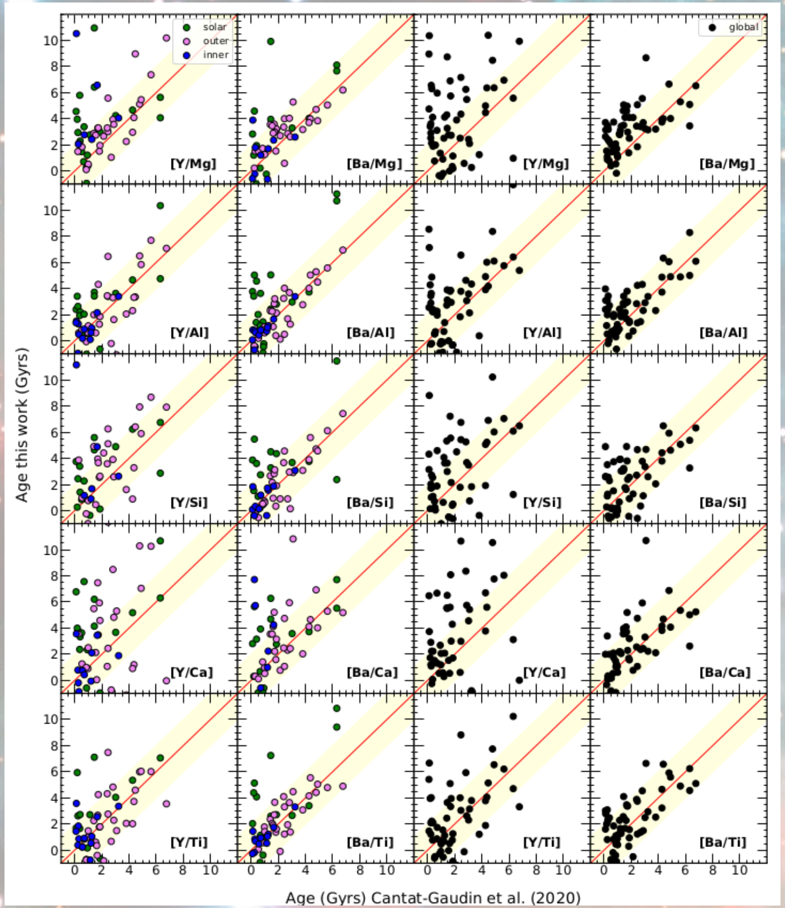




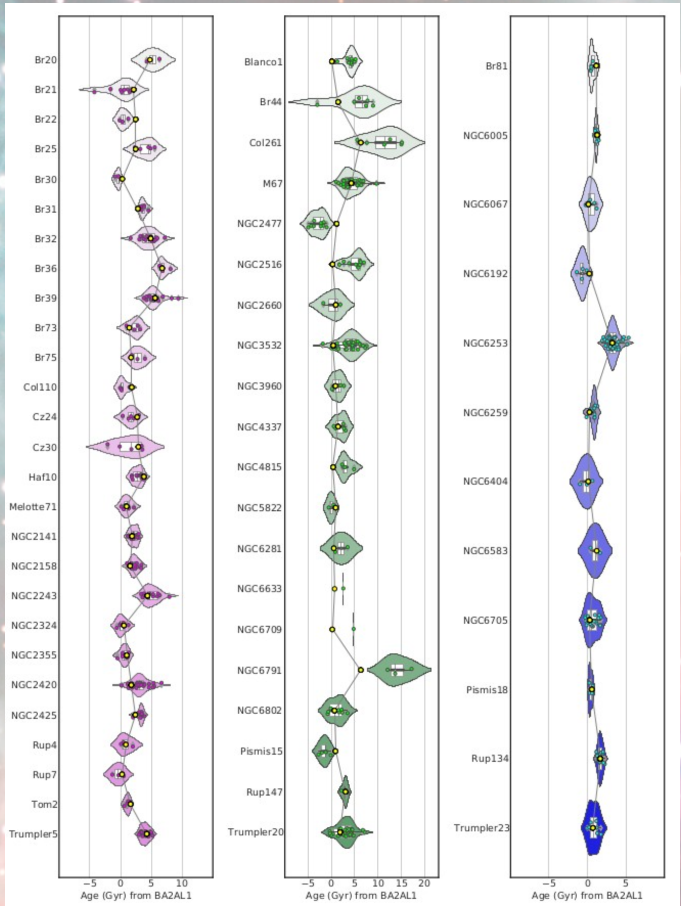


Viscasillas, Magrini+22 (A&A)

Test 1:
recovering the ages of the open clusters



Test 2:
recovering the ages of member stars

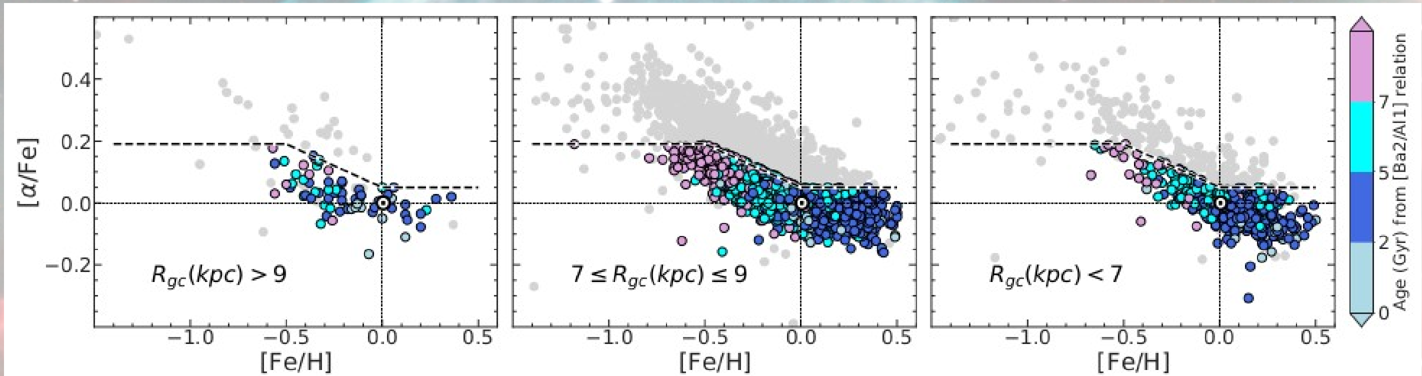


Viscasillas, Magrini+22 (A&A)

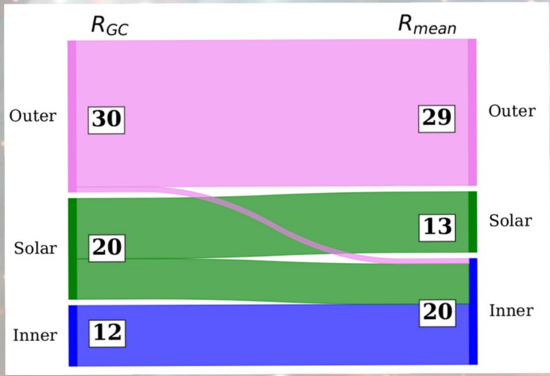
$$\text{Age} = m_1'\cdot[s/\alpha] + m_2'\cdot R_{gc} + m_3'\cdot[\text{Fe/H}] + c'$$

Test 3: infer ages of field stars

Viscasillas, Magrini+22 (A&A)



oldest stars: higher [α/Fe] ratio
youngest stars: solar or slightly sub-solar ratios



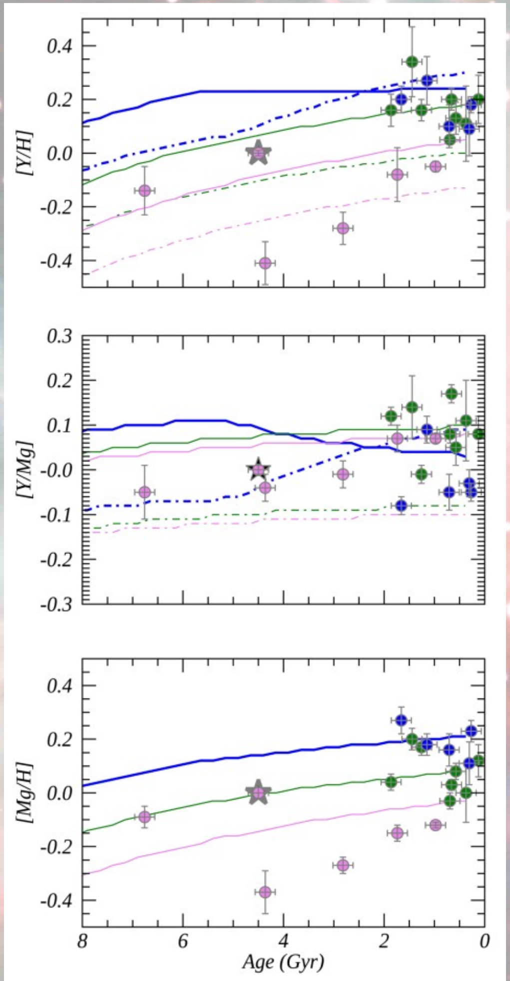
effects of migration

A theoretical explanation

Magnetic-buoyancy-induced mixing in AGB stars.

Less efficient production of Y at high metallicity, which affects this ratio on the inner disc.

MAGN yields (continuous)
FRUITY yields (dot-dashed)



Magrini+21a (A&A)

Take home messages:

- Is possible to calculate ages directly from abundances using chemical clocks relations.
- The s-process elements Y and Ba are the most age-sensitive.
- There are no unique relations, they are different for each chemical clock and in each galactic region.
- The relations have a strong dependence on the galactocentric distance.
- [Ba/Al] and in general abundance ratios involving barium, provide the best recovering factor.
- Able to reproduce the ages of the individual member stars with a precision better than 2 Gyr.
- Use the relations only on samples with the same characteristics (population, metallicity ranges, and galactocentric distance) and only consider ages in the range covered by the relationships.

Next steps:

The *r*-process, GES paper 115:

"The Gaia-ESO survey: placing constraints on the origin of r-process elements"

Van der Swaelmen, Viscasillas Vázquez et al. (2022)
(A&A, recommended for publication)

To be continued…

at EAS SS15
"The Renaissance of Open Cluster Science with Gaia"

See you in Valencia!

Gracias