Exploring Nuclear Formation Processes at Intermediate Metallicity: The MINCE Project's Insights into Neutron-Capture Element Abundances

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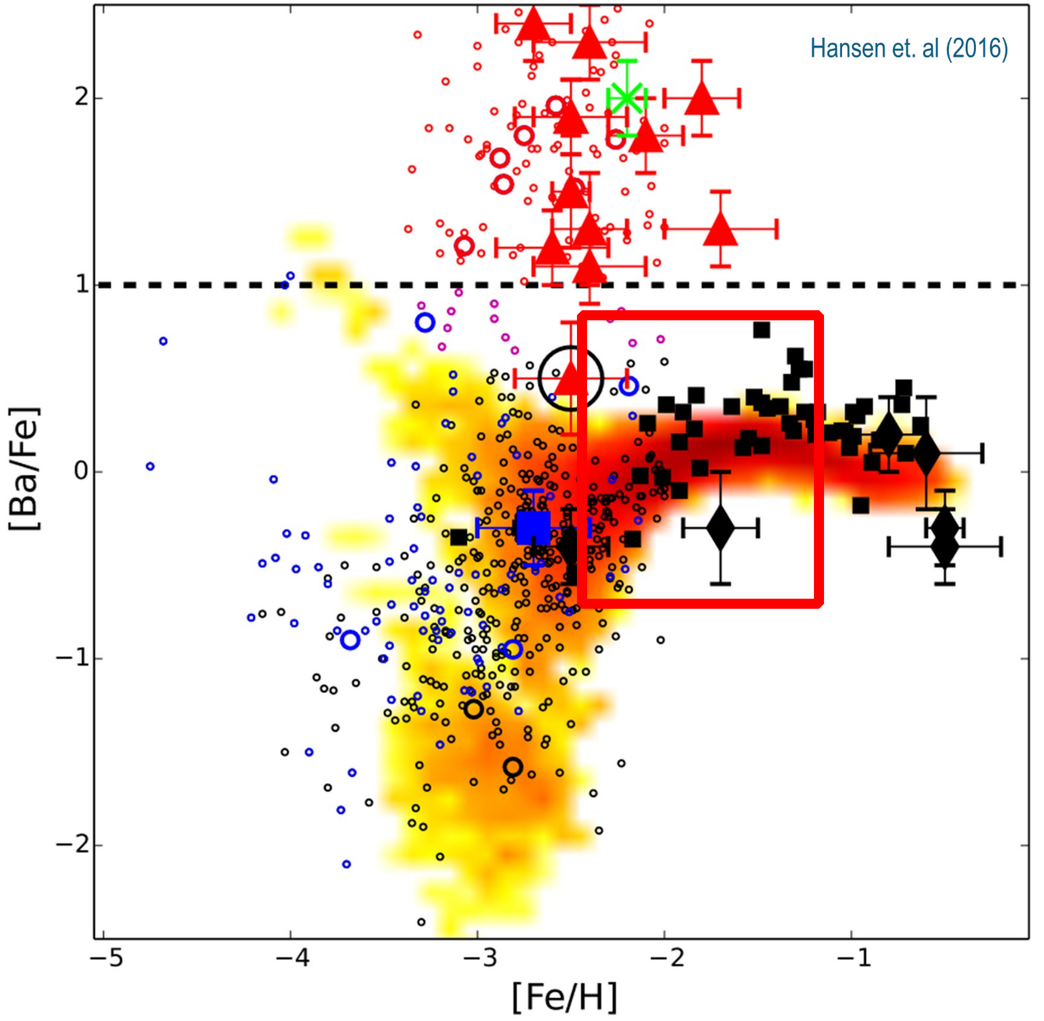
The MINCE Project – Overview and Motivation

Measuring at **I**ntermediate Metallicity **N**eutron-**C**apture **E**lements

- Focusing on studying neutron-capture elements
- Focus on −2.5 < [Fe/H] < –1.5
- Interaction of s-, r-, i-process
- Fills gap left by surveys like WEAVE and 4MOST and acts as high-resolution complement to lower-res large-scale surveys like APOGEE
- High-quality spectra from several telescopes for several hundreds of stars
- Homogeneous study (same codes, same line lists, …)

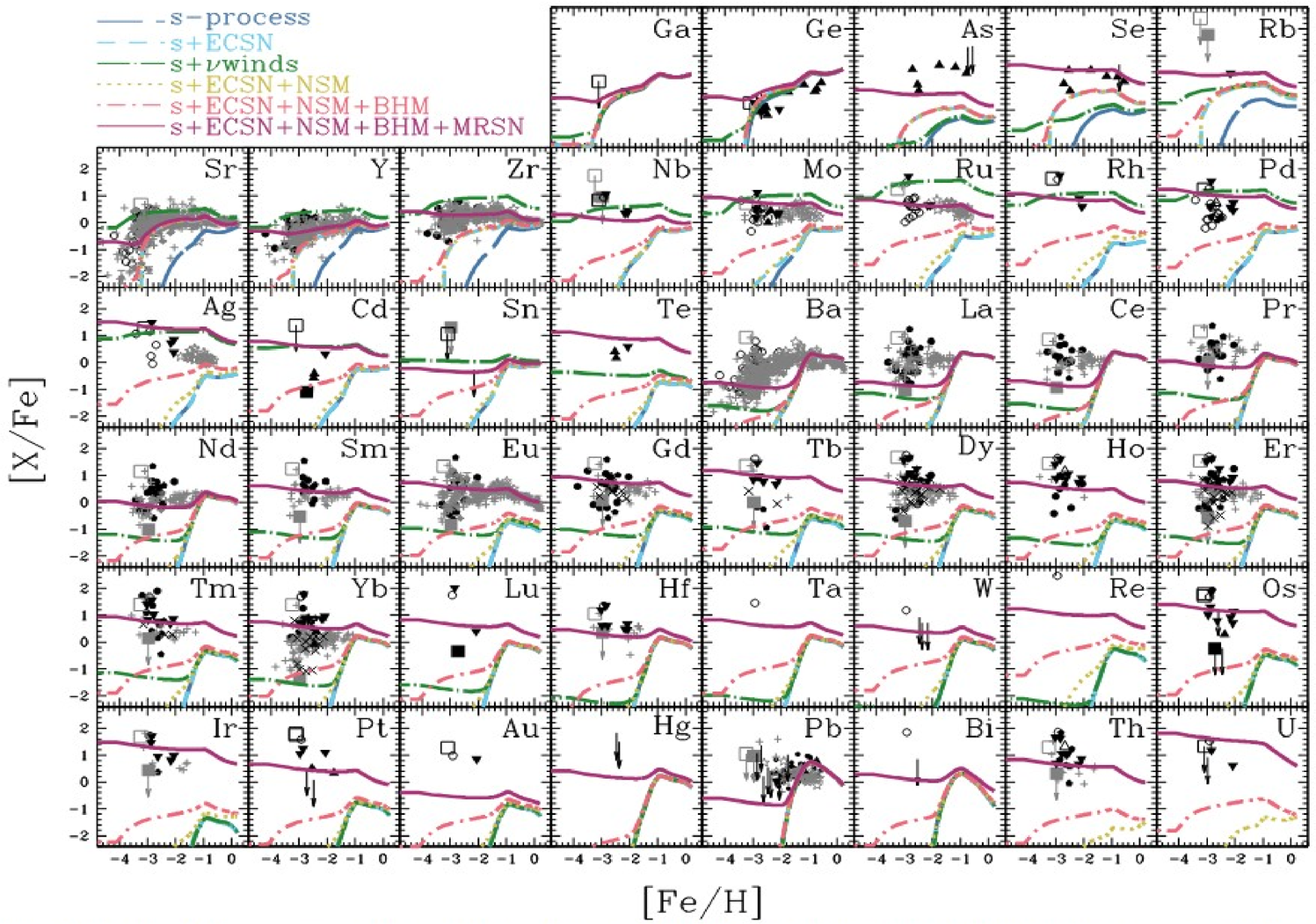


The MINCE Project – Contributions & Goals

- Sample of about 90 stars
- FEROS spectra (high-quality, optical)
- Wavelenght coverage: ~350nm to ~920nm
- Resolution: 48.000
- 1D, LTE

Models of nucleosynthesis processes and astrophysical sites

Kobayashi+2020



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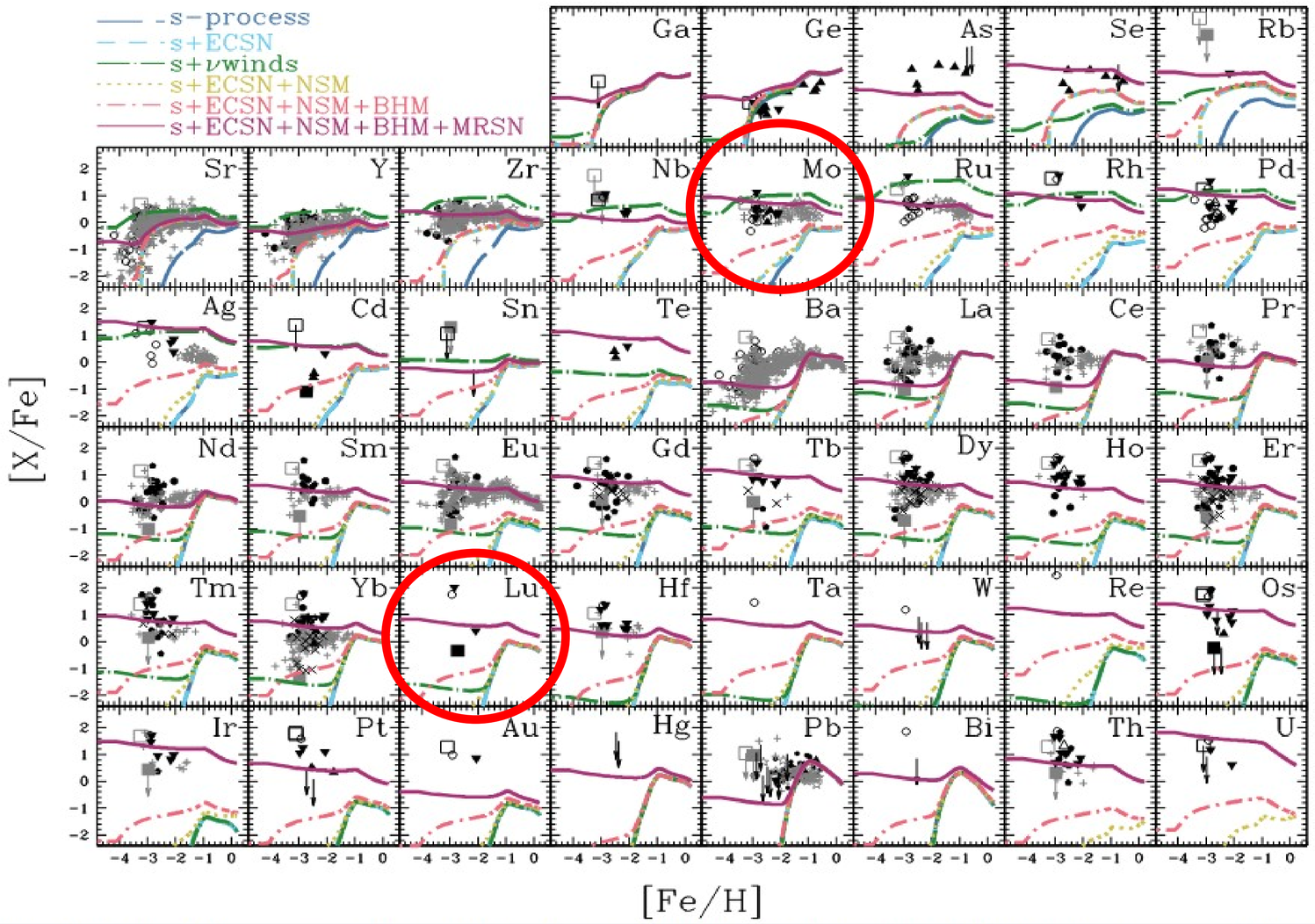

The MINCE Project – Publications

- 46 stars (MINCE I, Cescutti+2022 + MINCE II, Francois+2024) + 99 stars (MINCE III, Lucertini+2025) + about 90 stars (Schichtel+, in prep)
- Detailed chemical abundances, RV, and kinematics
- All in all, abundances agree well with GCE model predictions
- Strong consistency with results from previous (MINCE) studies – reinforces trends across samples

The MINCE Project – This Sample – Preliminary Results

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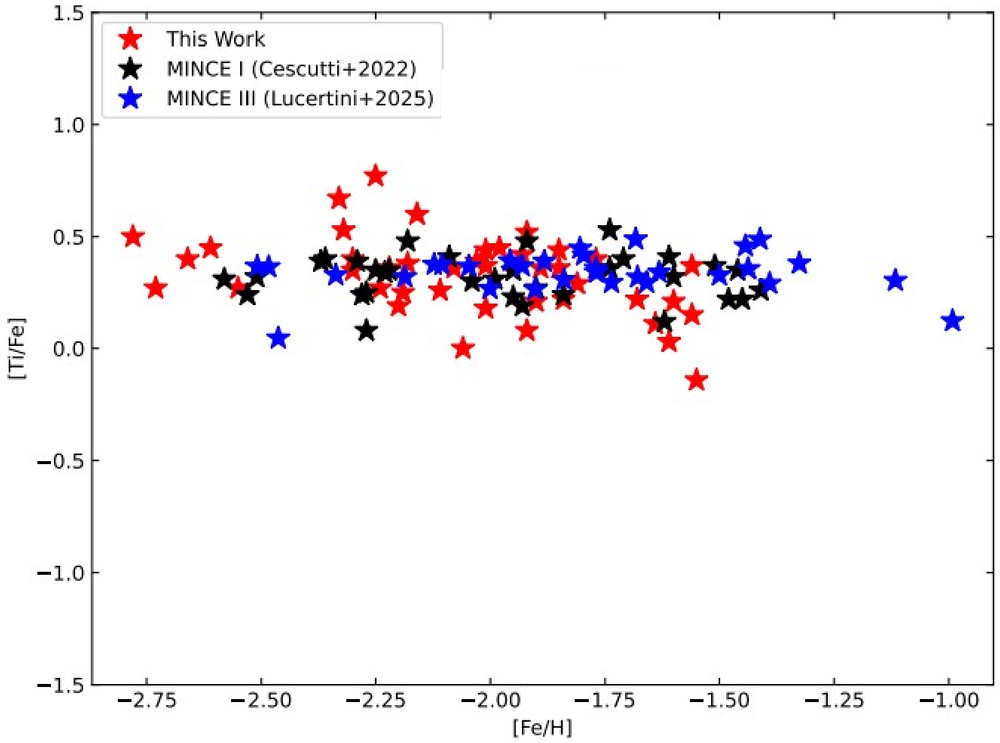

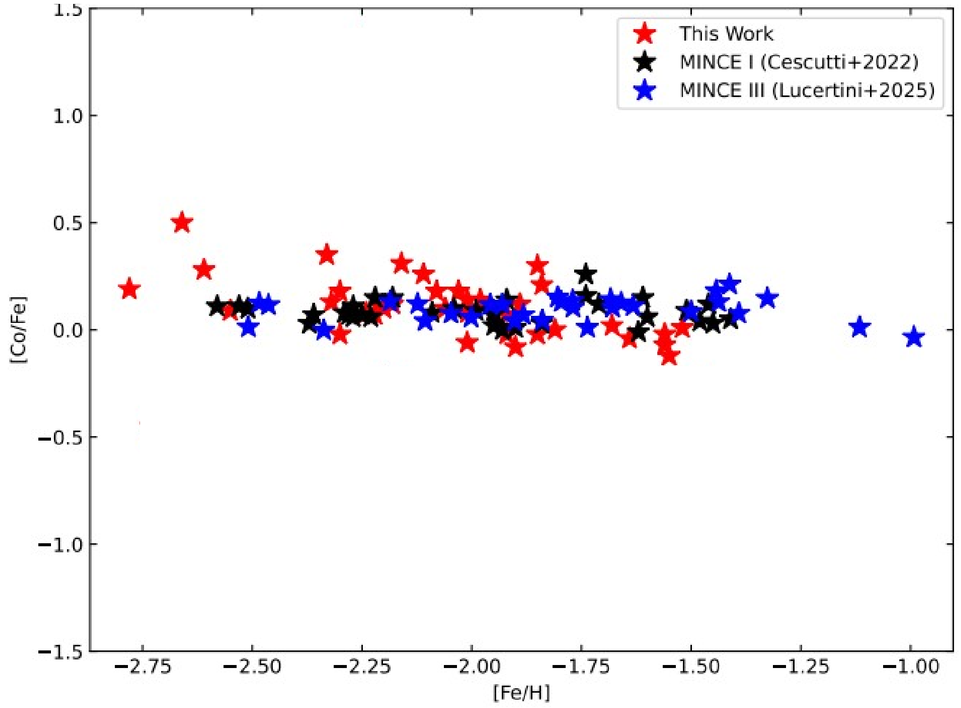

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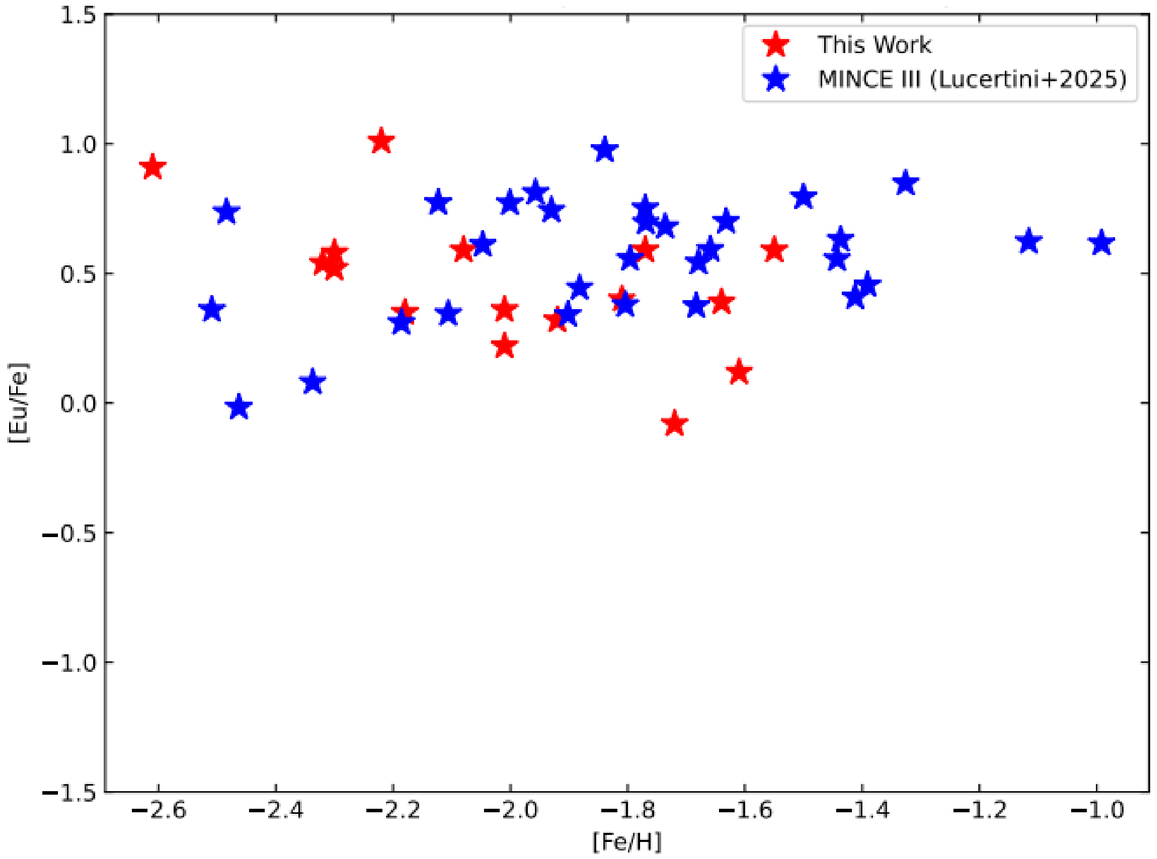
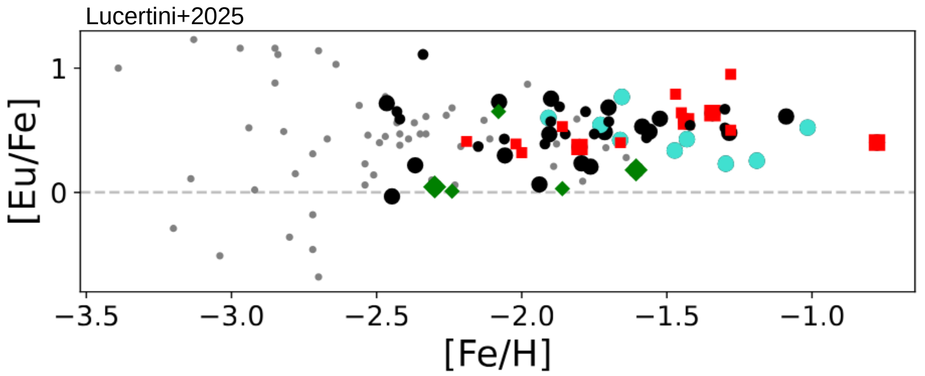
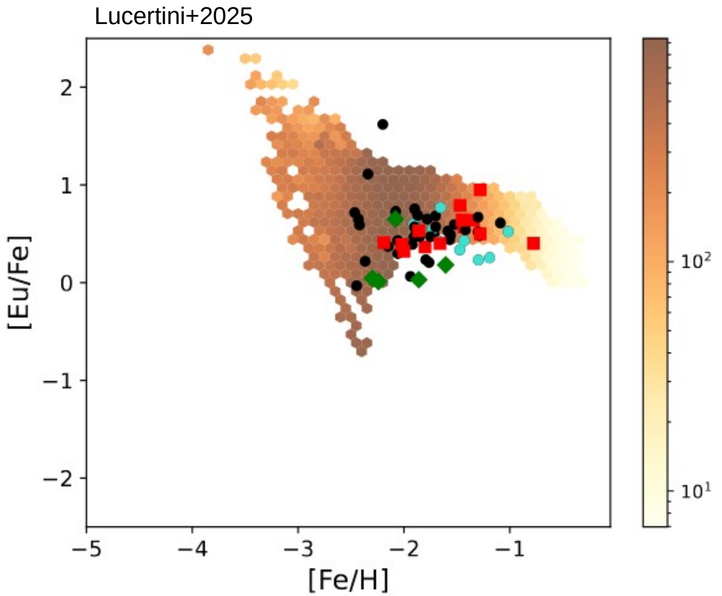
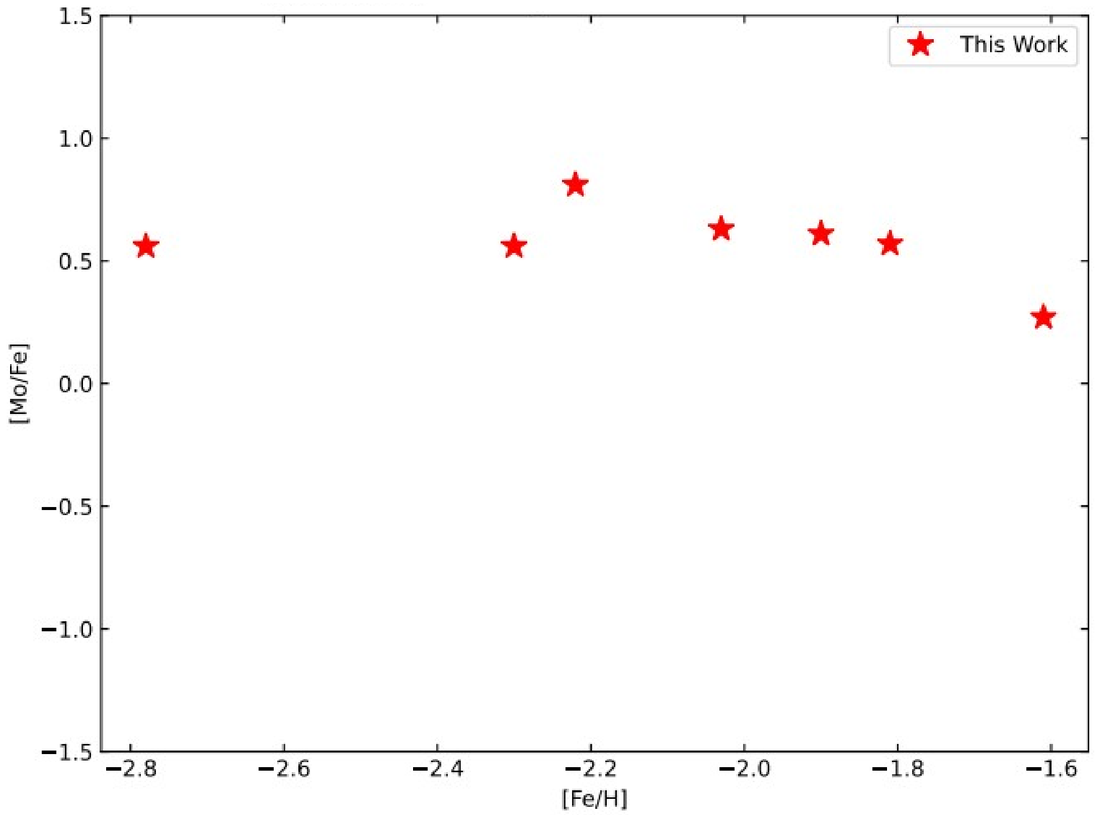


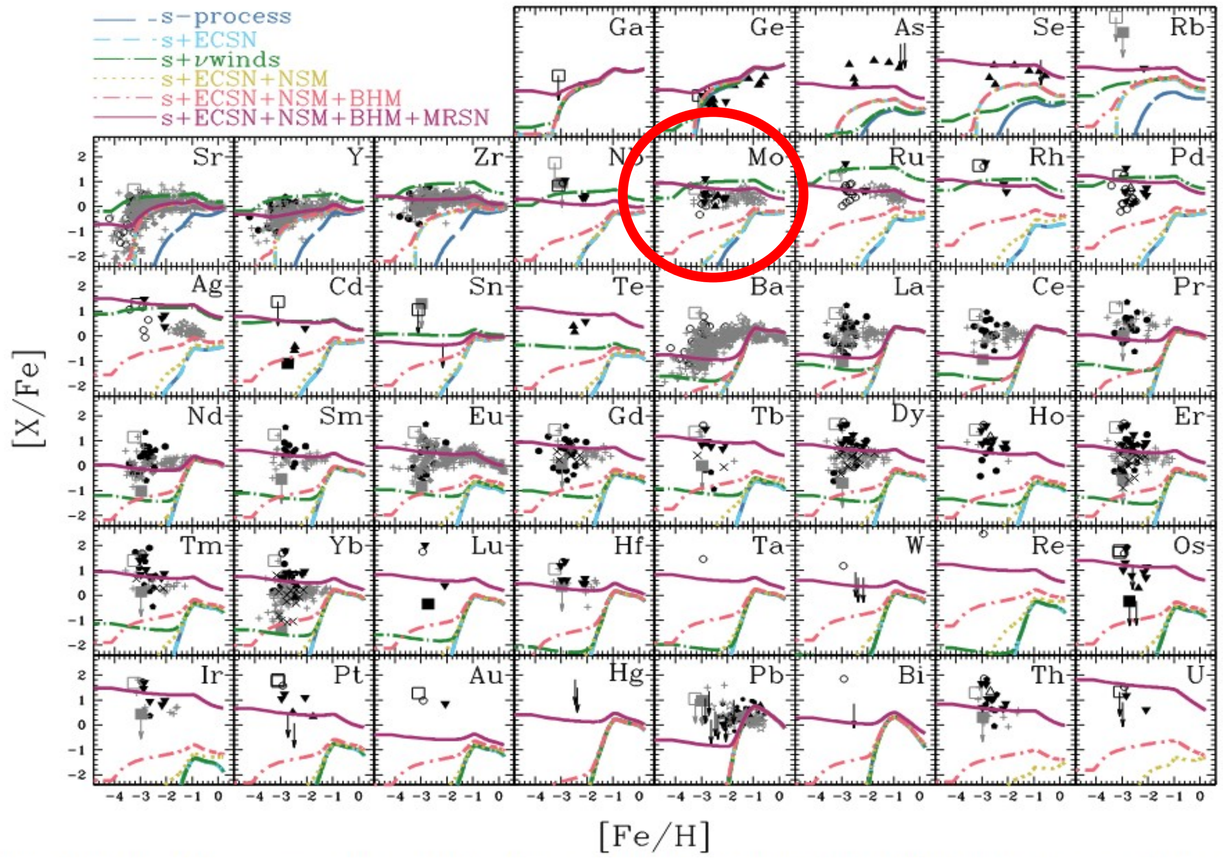




MINCE – This Sample – Chemical Abundances – Mo and Lu (Preliminary)



Kobayashi+2020



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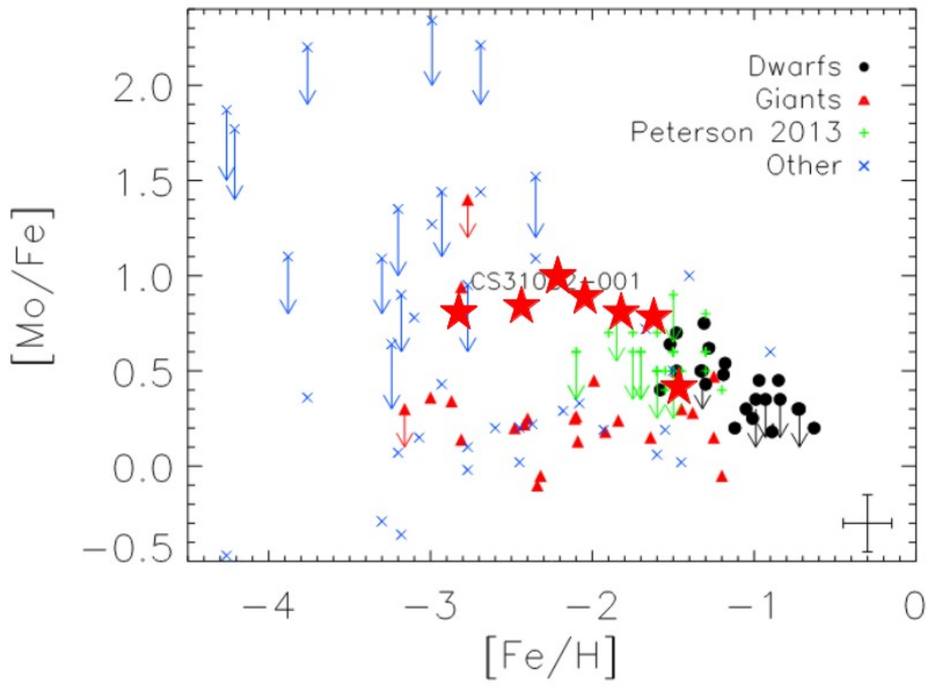
Hansen+2014



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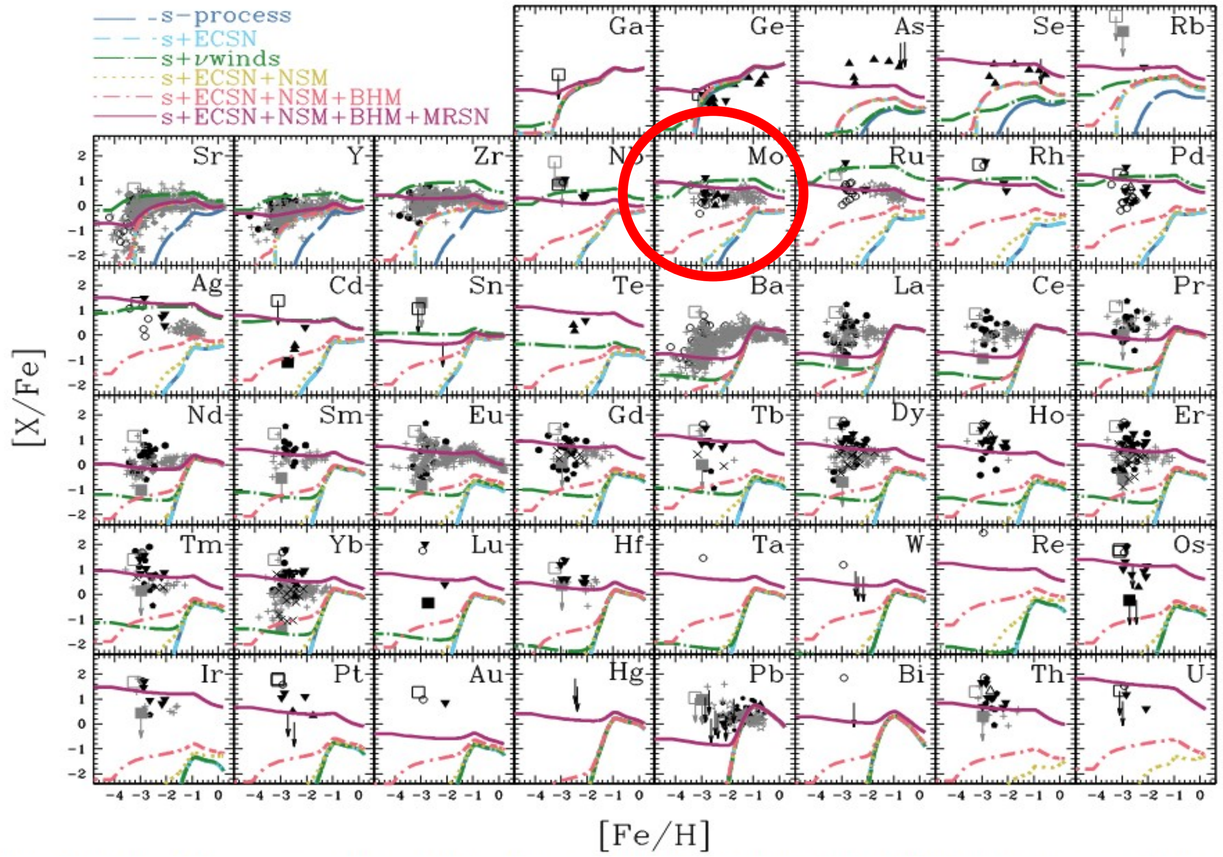

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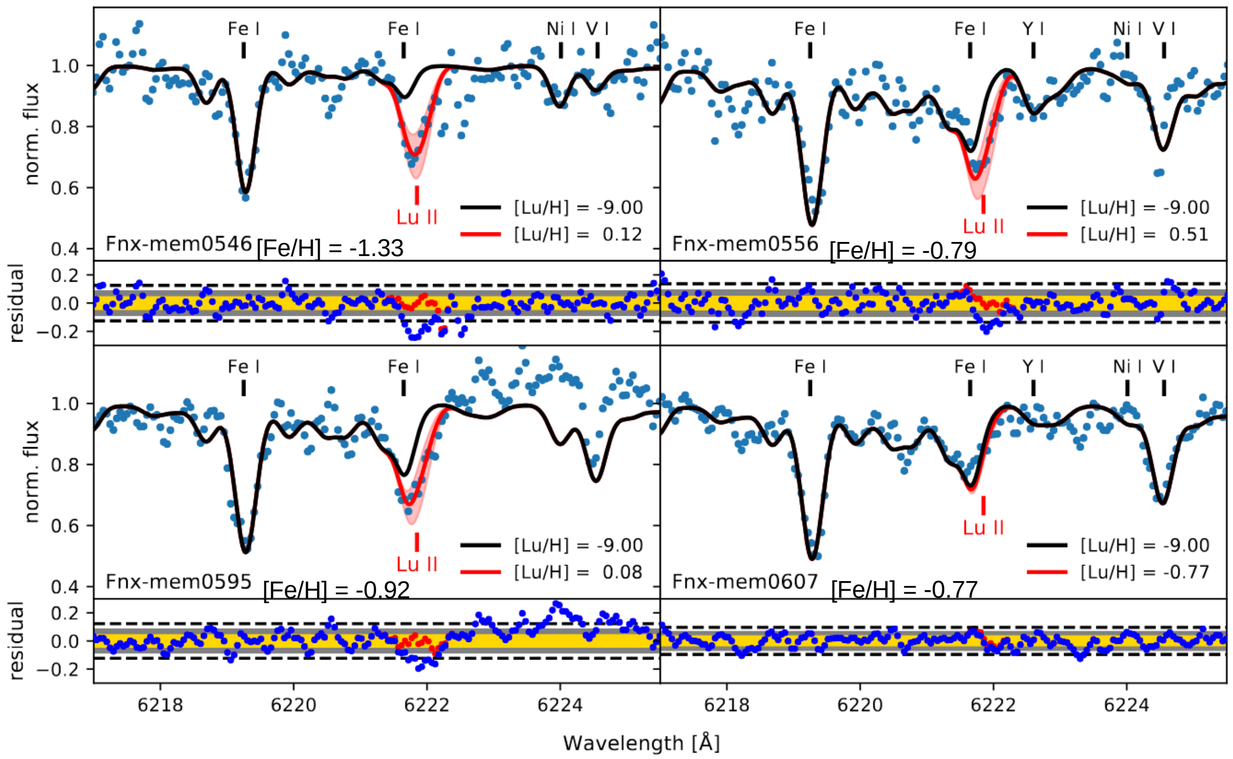

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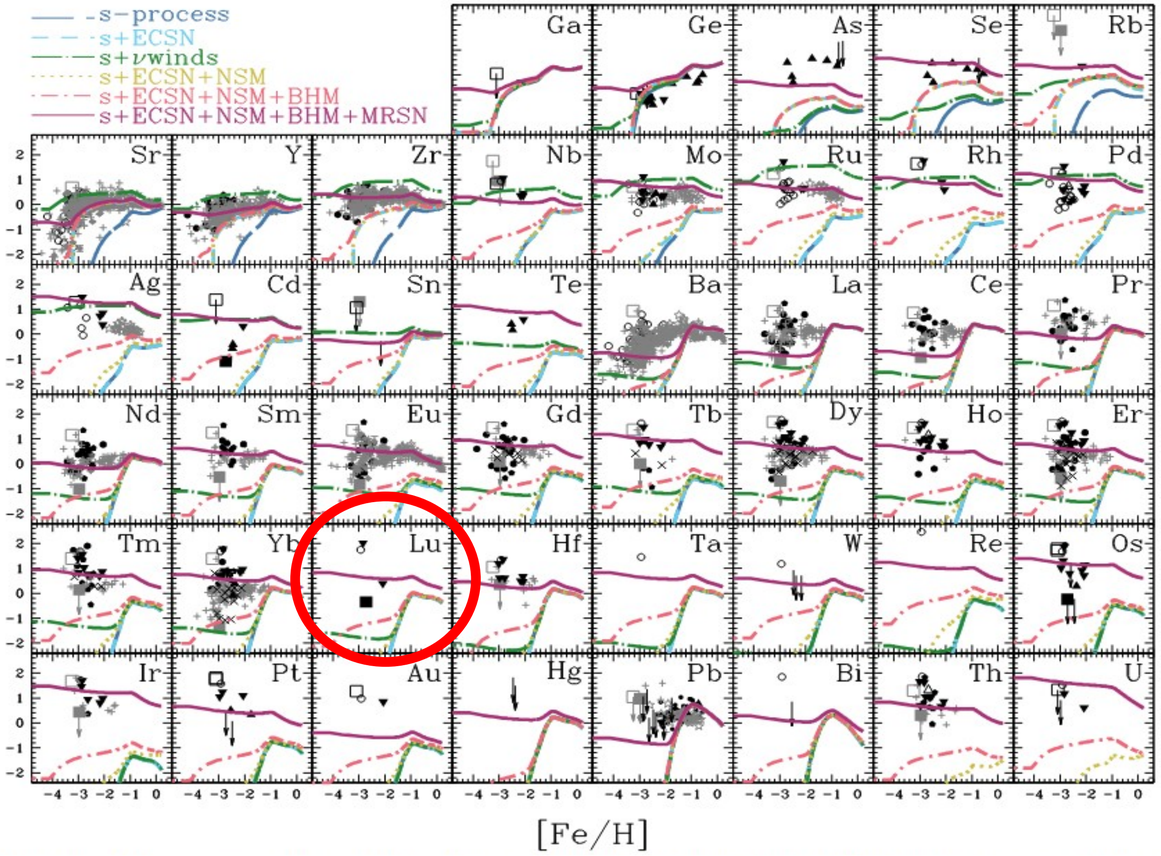

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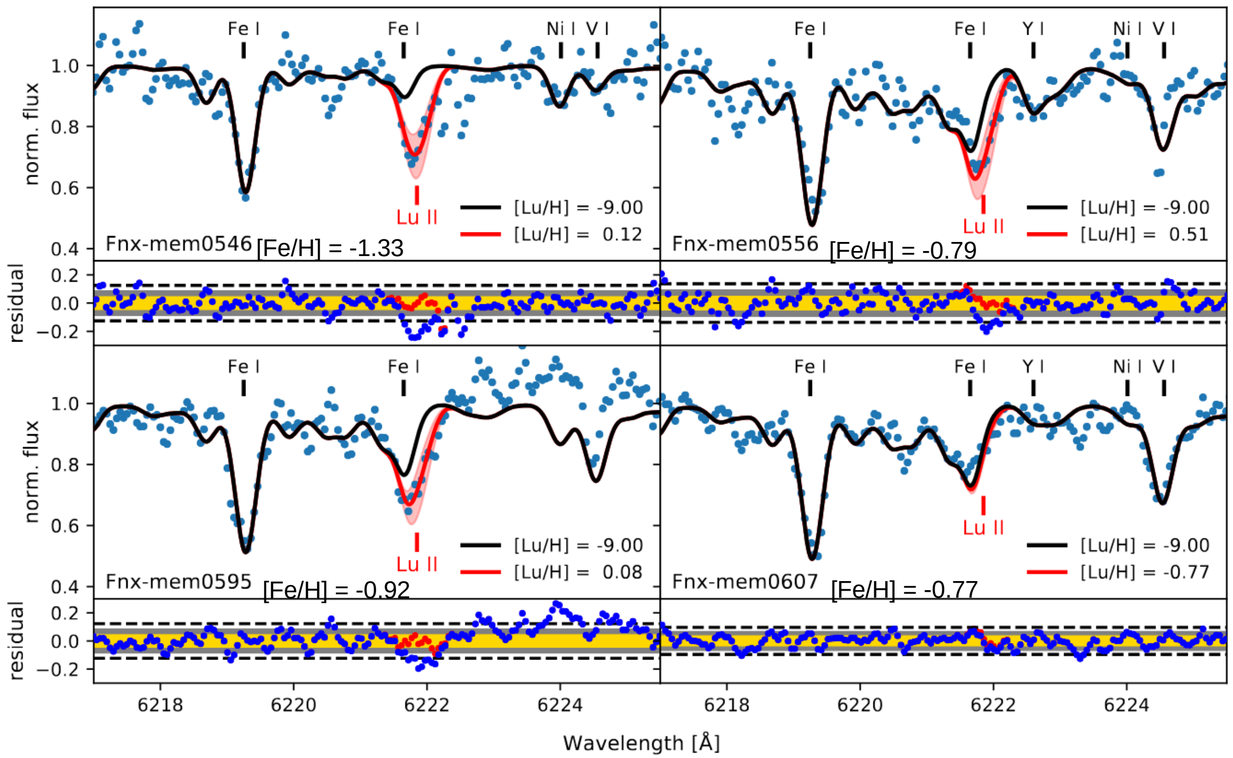

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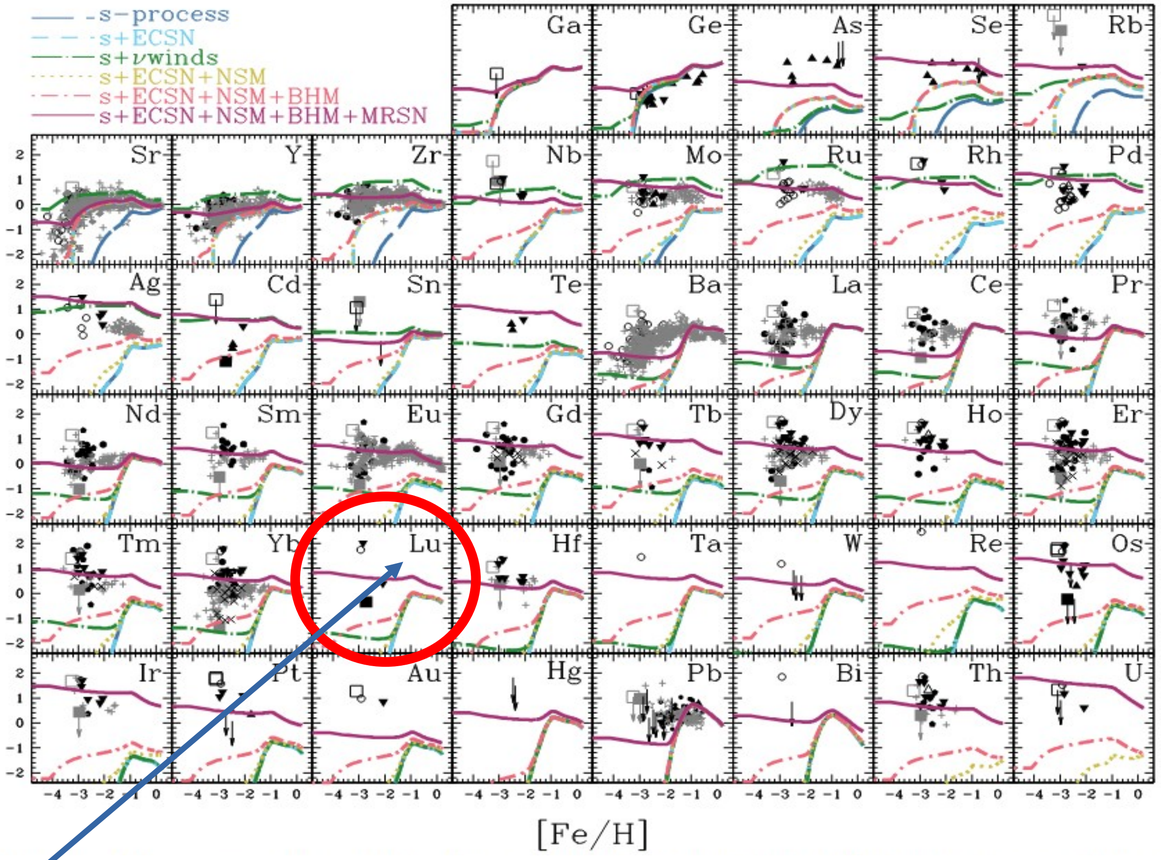


The MINCE Project – This Sample – Future Plans

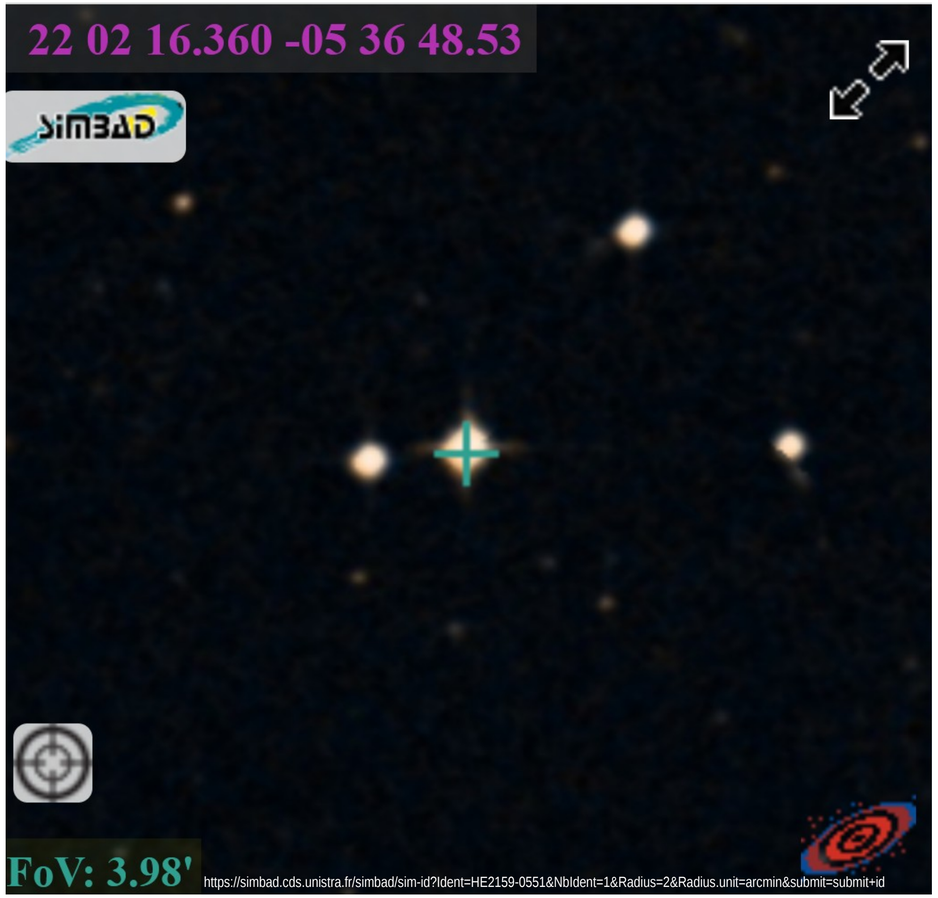
- Expand study to full sample
- Derive as many chemical abundances as possible, focus on Mo and Lu
- More detailed analysis of peculiar stars in the sample

HE2159-0551 – Peculiar Chemical Abundances

- Evolved red giant star

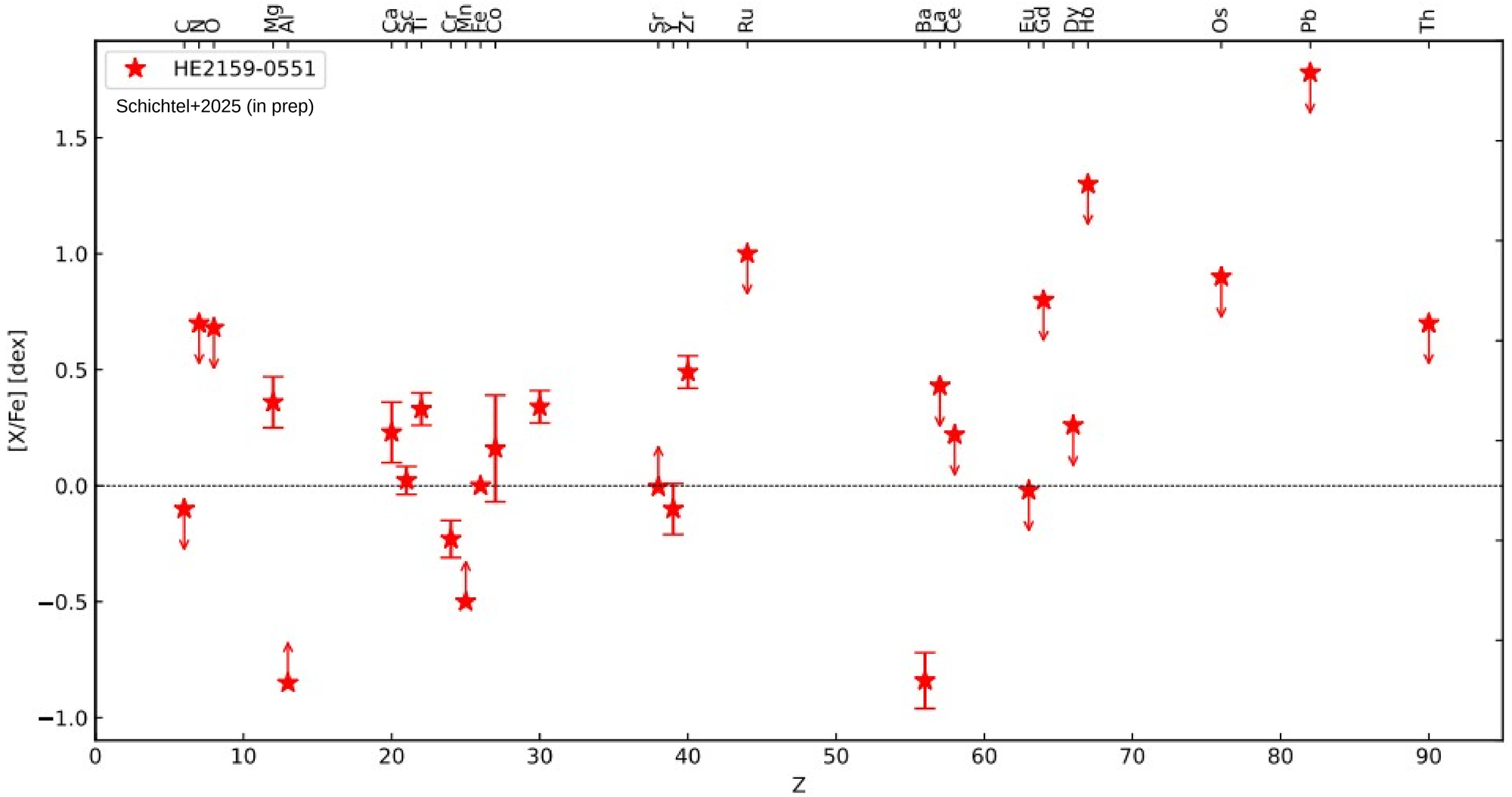
- Radial velocity:
  - This Work: -106.4 ± 1.2 km/s
  - Gaia: -106.38 ± 0.8 km/s
  - Hansen+2018: -106.65 ± 0.88 km/s

- Stellar parameters:
  - Temperature: 5000 ± 140 K
  - Metallicity: -2.6 ± 0.2 dex
  - Surface gravity: 1.8 ± 0.4 dex
  - Microturbulence: 2.4 ± 0.3 km/s



HE2159-0551 – Peculiar Chemical Abundances

Also attempted: Li, Be, S, Cu, Rb, Mo, Pd, Ag, Pr, Sm, Er, Pt, and U.



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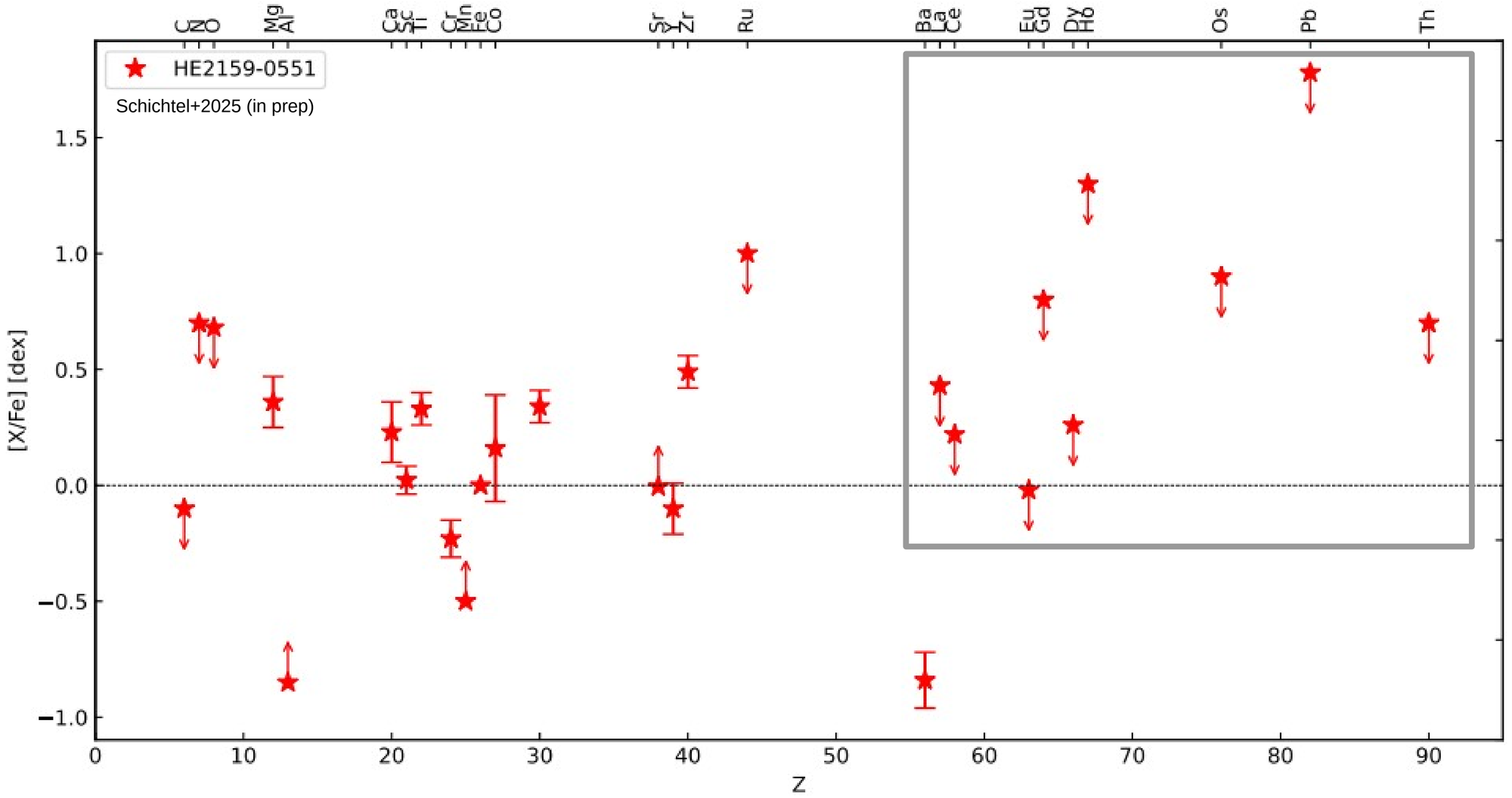

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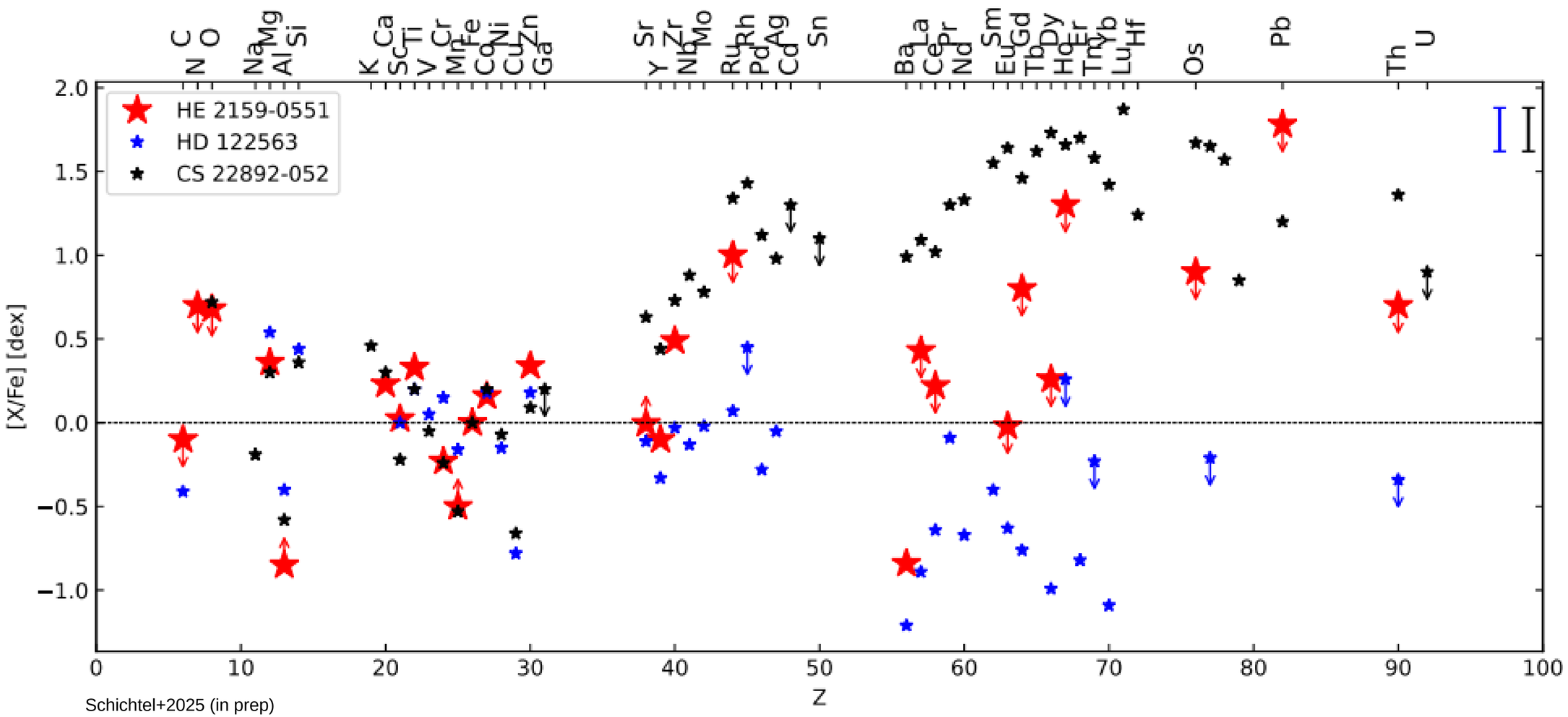

Schichtel+2025 (in prep)

Summary & Conclusion

MINCE:

- High-quality spectra
- Increased chemical abundance results in intermediate metallicity range
- Generally good agreement among studies and with models
- Deriving Mo and Lu abundances not easy – blends with other atomic & molecular lines

Peculiar stars…

- help to reconstruct the chemical evolution of the Milky Way – encapsulate contributions of earlier stellar populations
- provide insights into conditions present in early galaxy
- contribute to overall understanding of internal mixing processes and r-process site(s)
- help find production site(s) of elements
  → select those out of sample

Thank You For Your Attention!