

Understanding the Origin of Heavy Elements using Stellar Archaeology

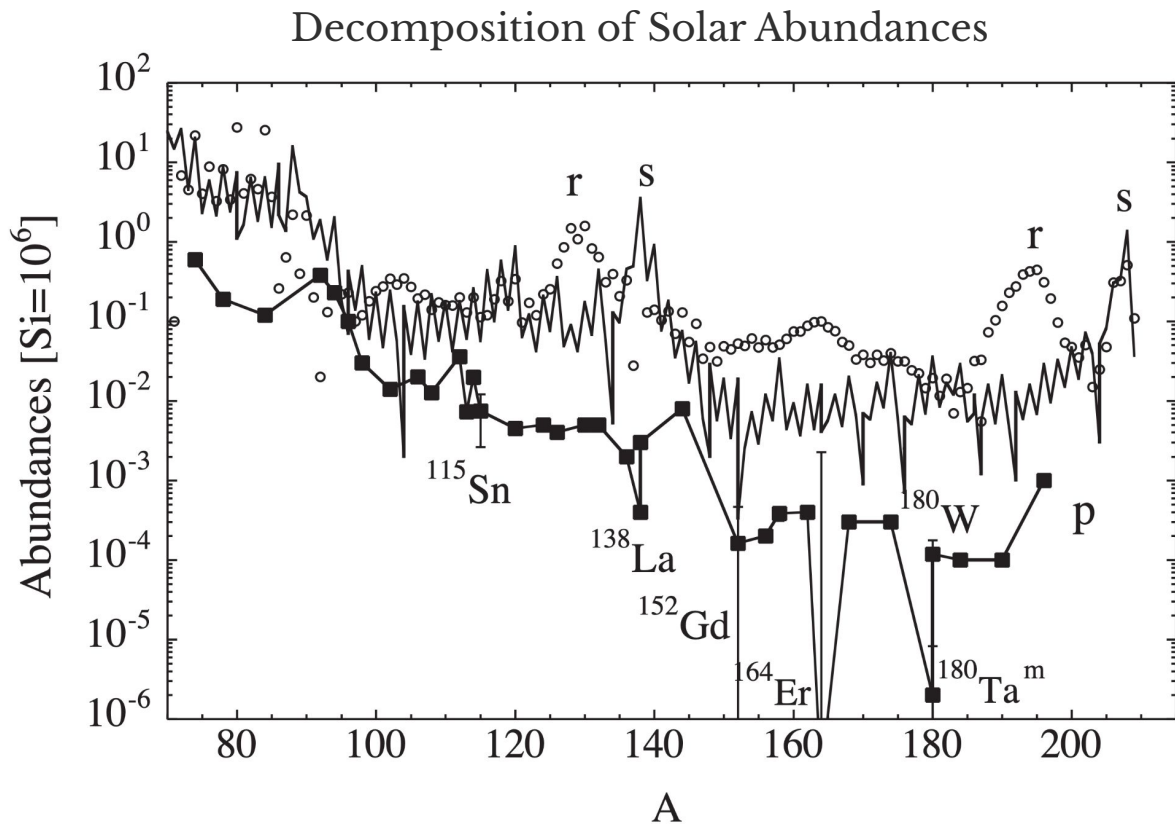
Ella Jackson (SMU)

CASST 2026

Thursday, August 13

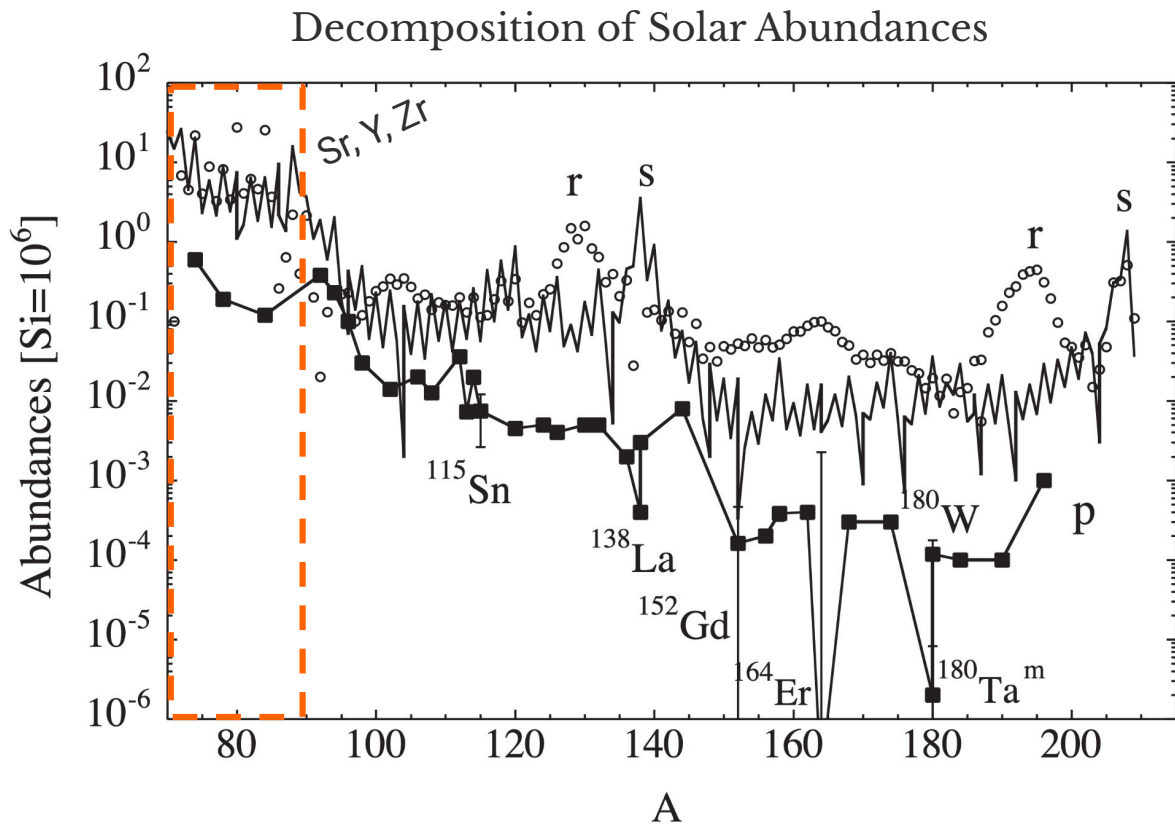


Context



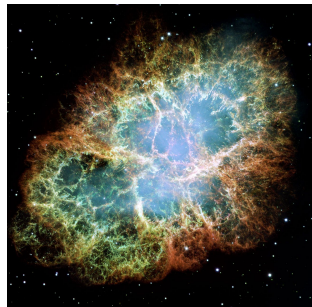
Stars fuse up to iron (Z=26) in their cores, everything else?

Context

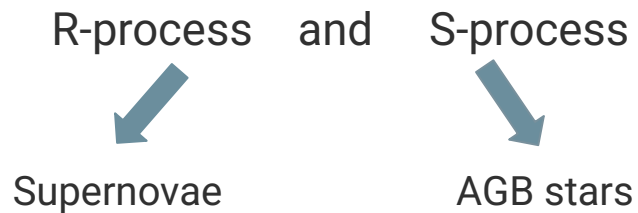


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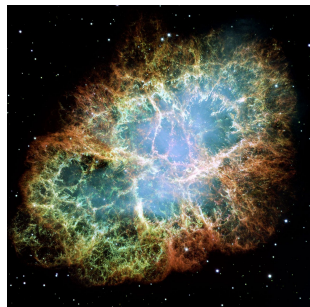
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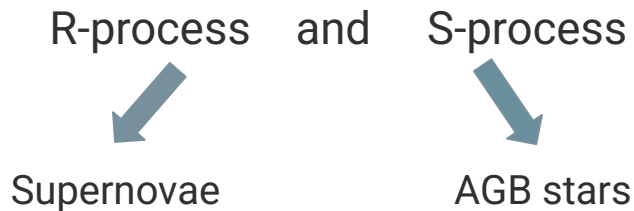
NASA, ESA



Context



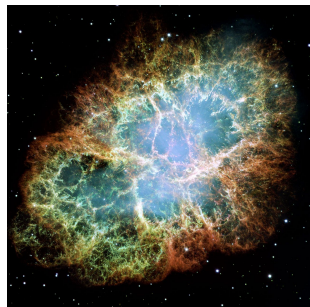
NASA, ESA



- Forms Sr, Y, Zr
- Tracer: Europium (Eu)
- Robust elemental signature

- Forms Sr, Y, Zr
- Tracer: Barium (Ba)
- Robust elemental signature

Context



NASA, ESA

R-process and S-process



Supernovae



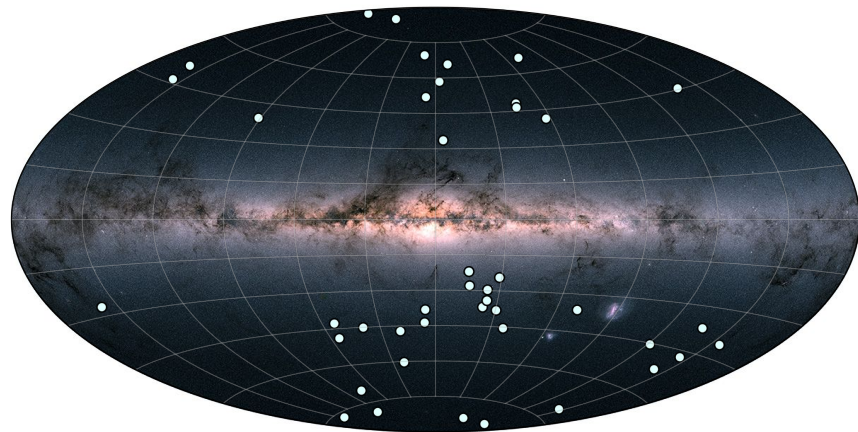
AGB stars

- Forms Sr, Y, Zr
- Tracer: Europium (Eu)
- Robust elemental signature
**seen in stellar observations
that it's not for all elements**

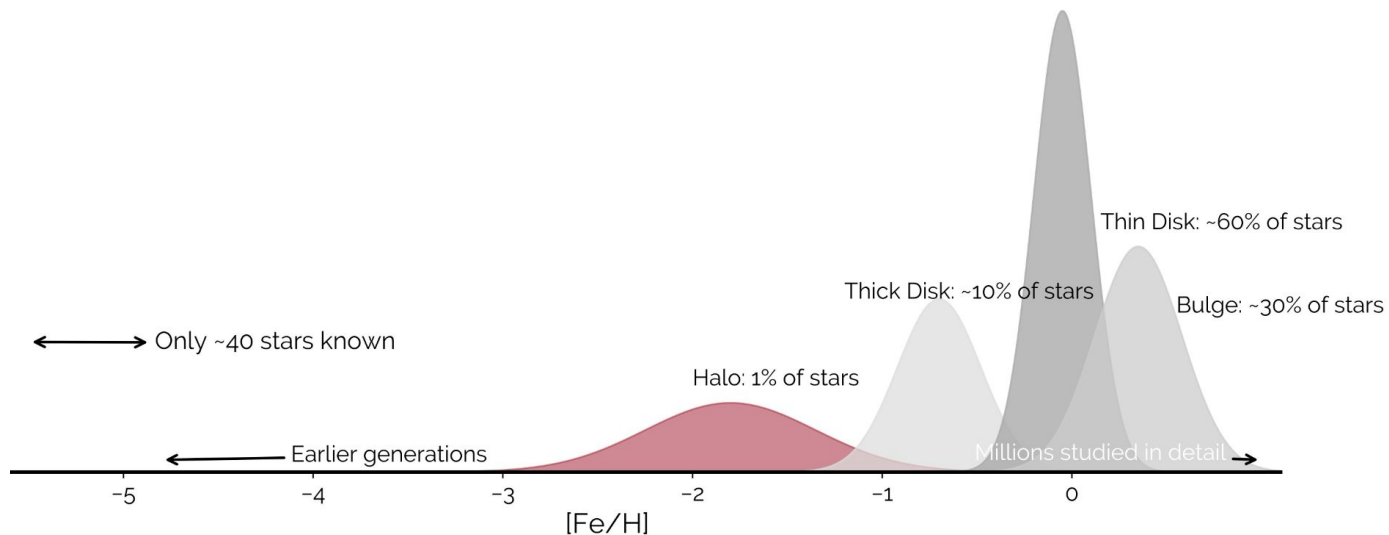
- Forms Sr, Y, Zr
- Tracer: Barium (Ba)
- Robust elemental signature

Where?

- What kind of stars can we see this in?
- Weak-r process?

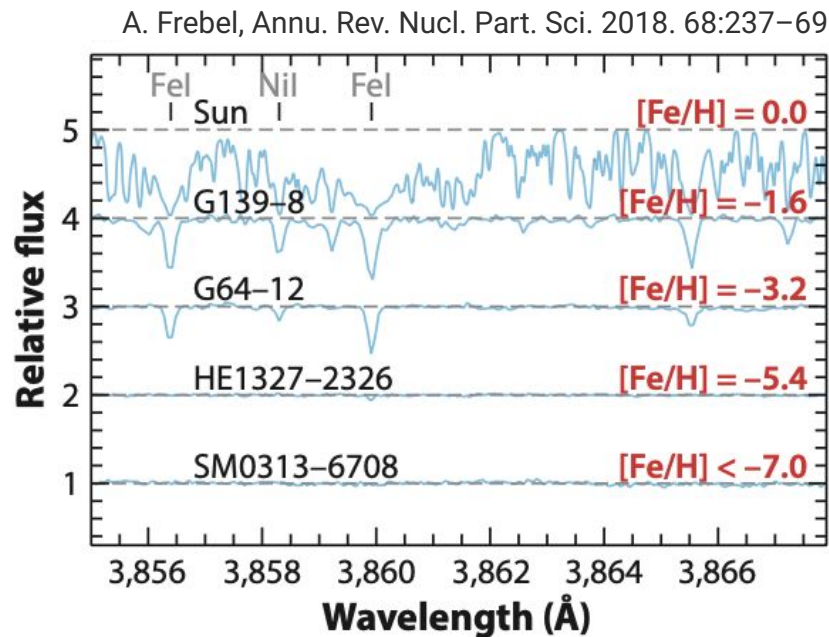


Positions of some limited-r stars in the Milky Way Galaxy



Data

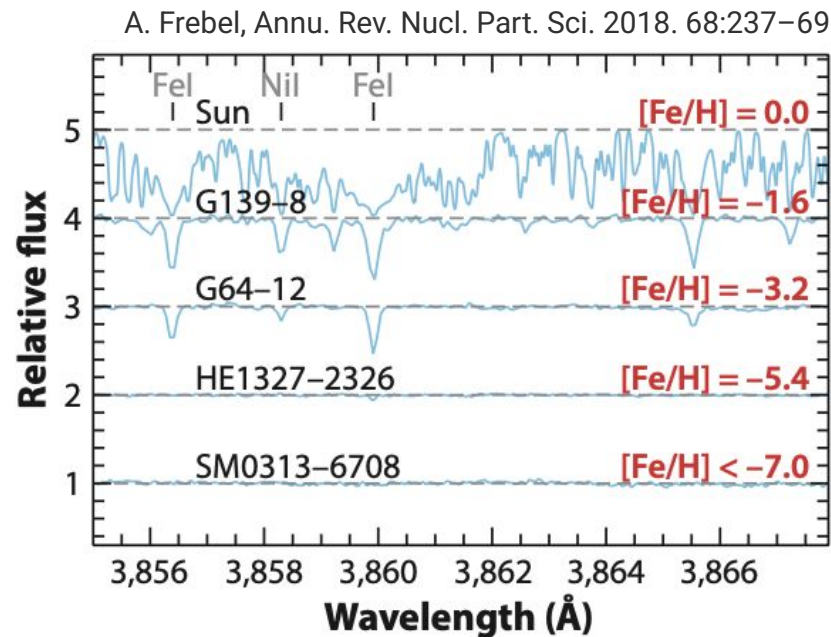
- High resolution spectra



Metallicity: $[Fe/H] = \log_{10}(N(Fe)/N(H))_{\star} - \log_{10}(N(Fe)/N(H))_{\odot}$

Data

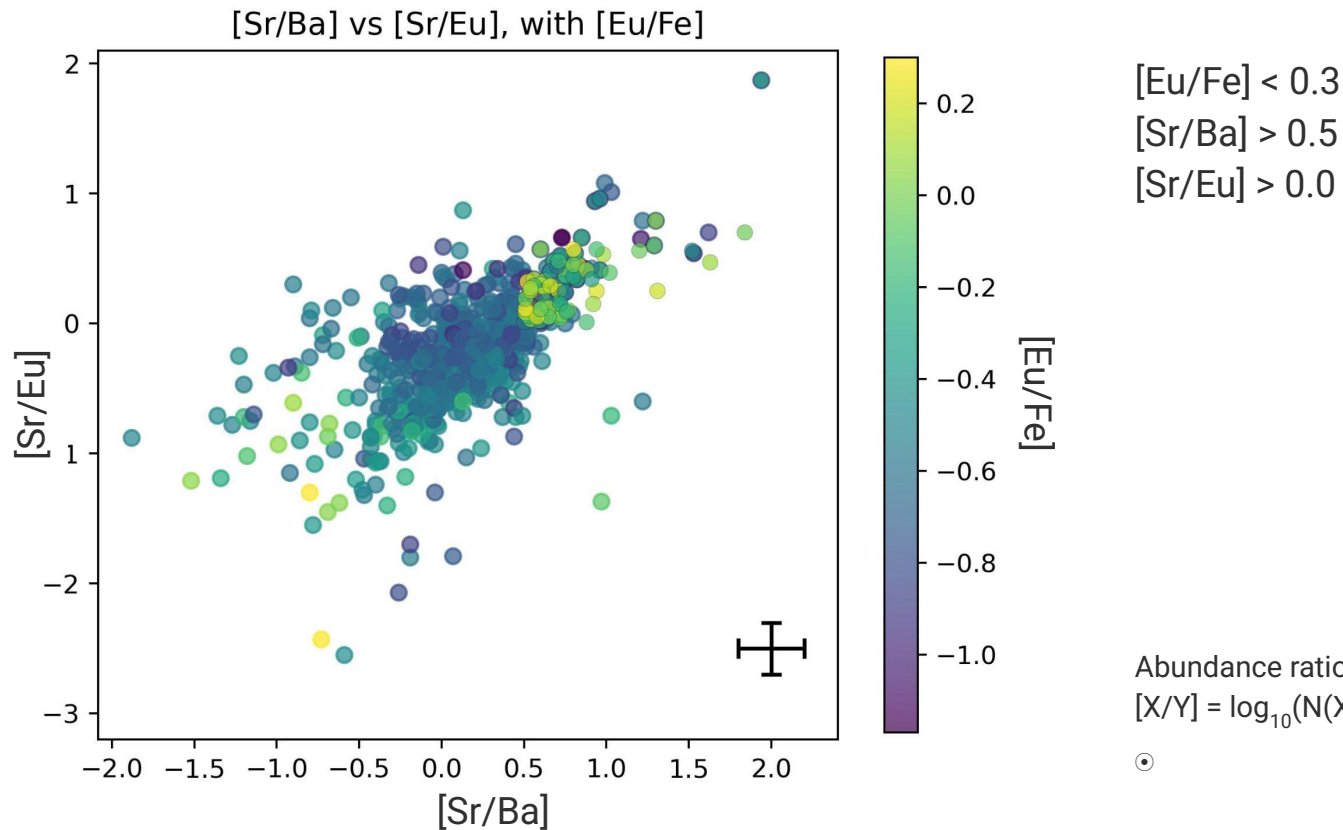
- High resolution spectra
- RPA , SAGA, JINAbase
- Need to ensure each star is accounted for only once



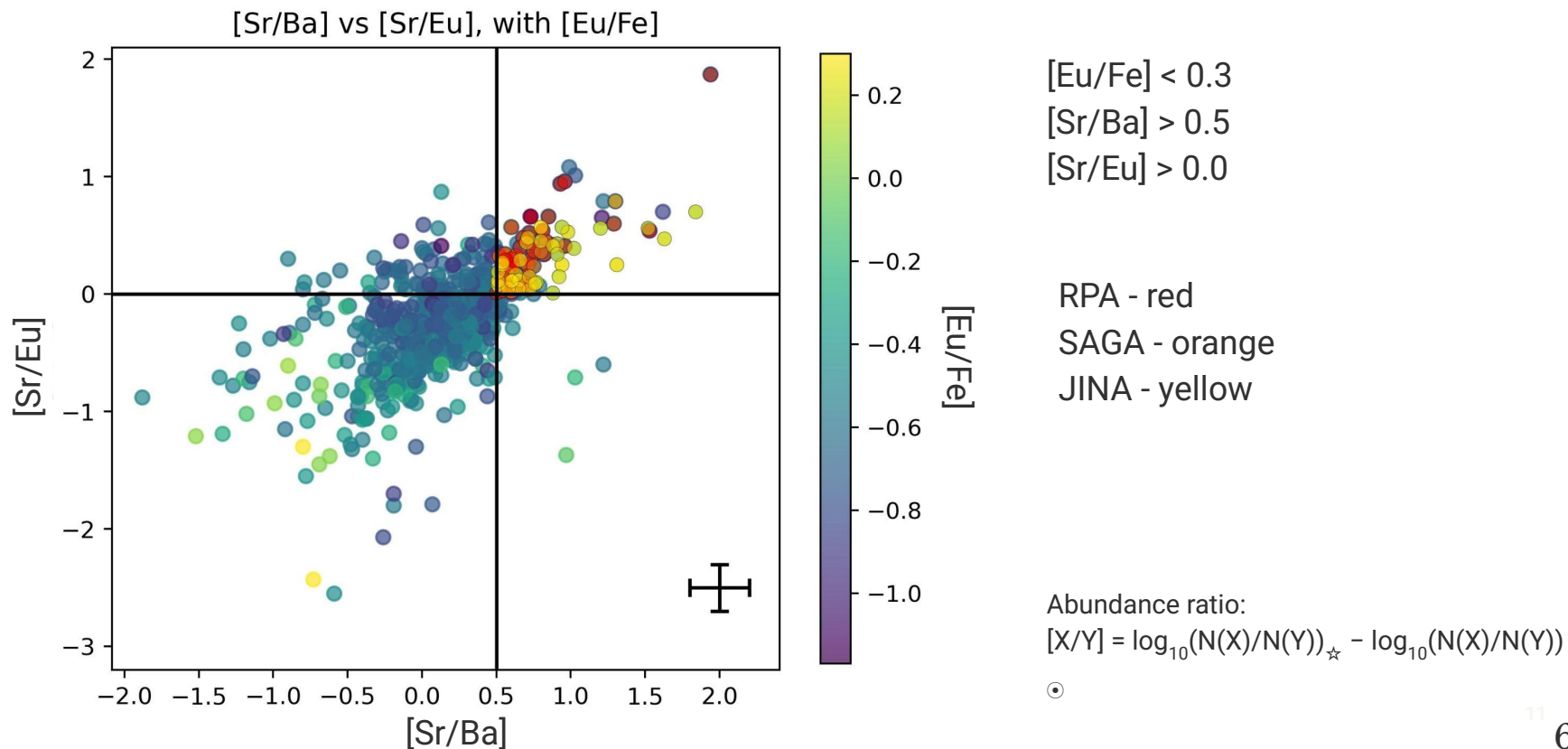
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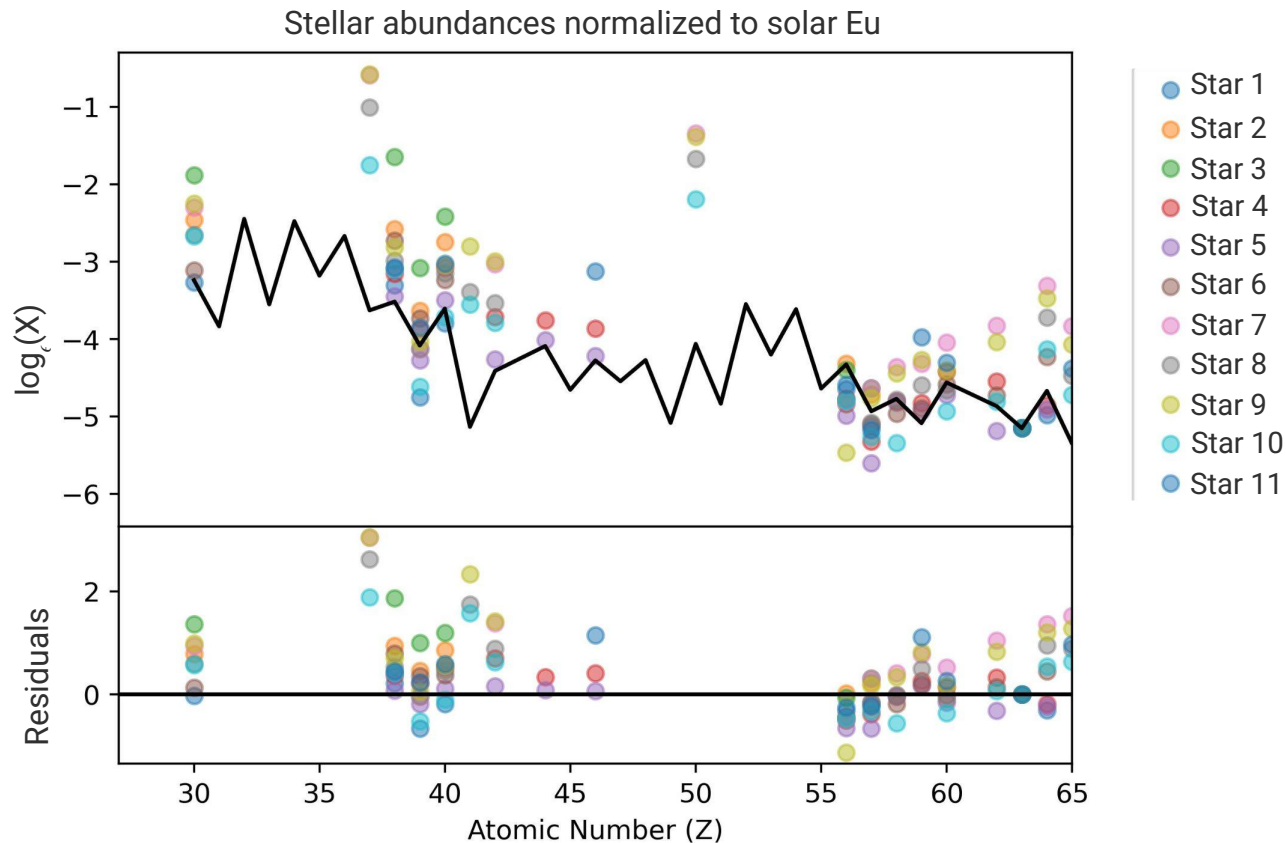
Finding limited-r stars



Finding limited-r stars



Limited-r stars

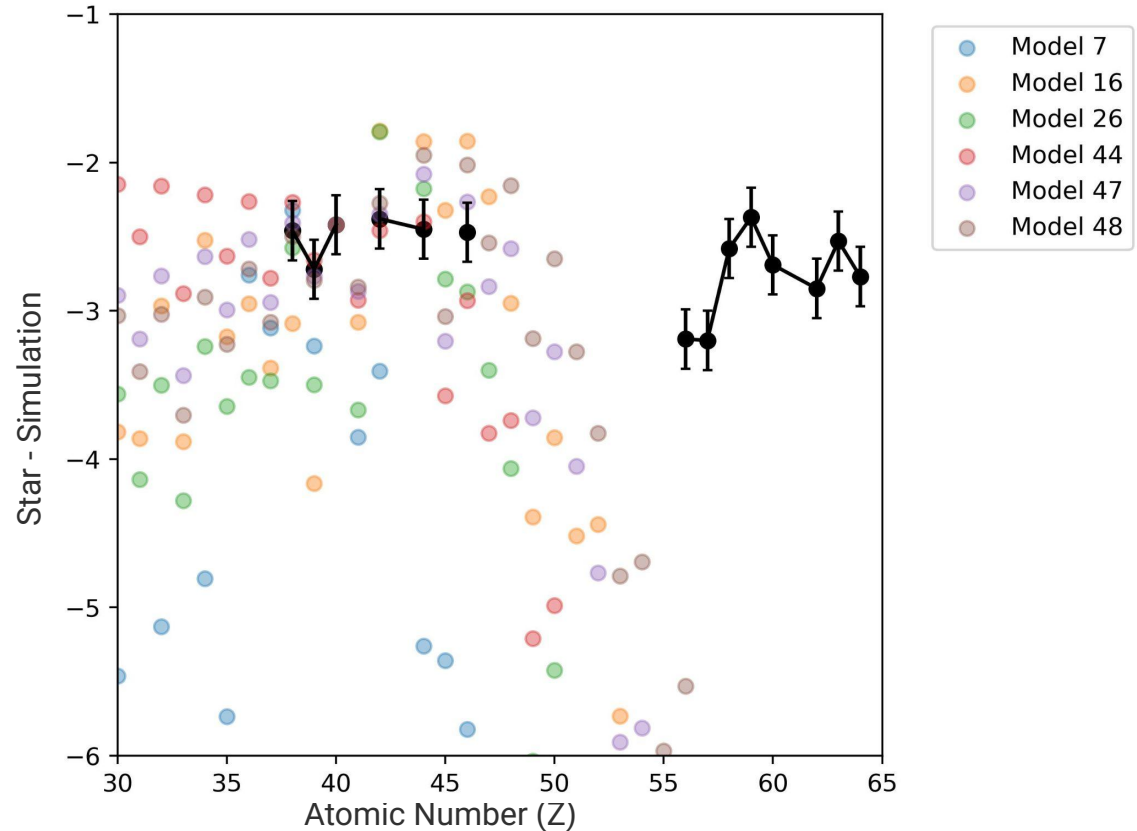


Comparing to Simulations

- 50 neutrino driven wind in CCSN simulations
- Model parameters:
 - electron fraction
 - Entropy
 - expansion timescale

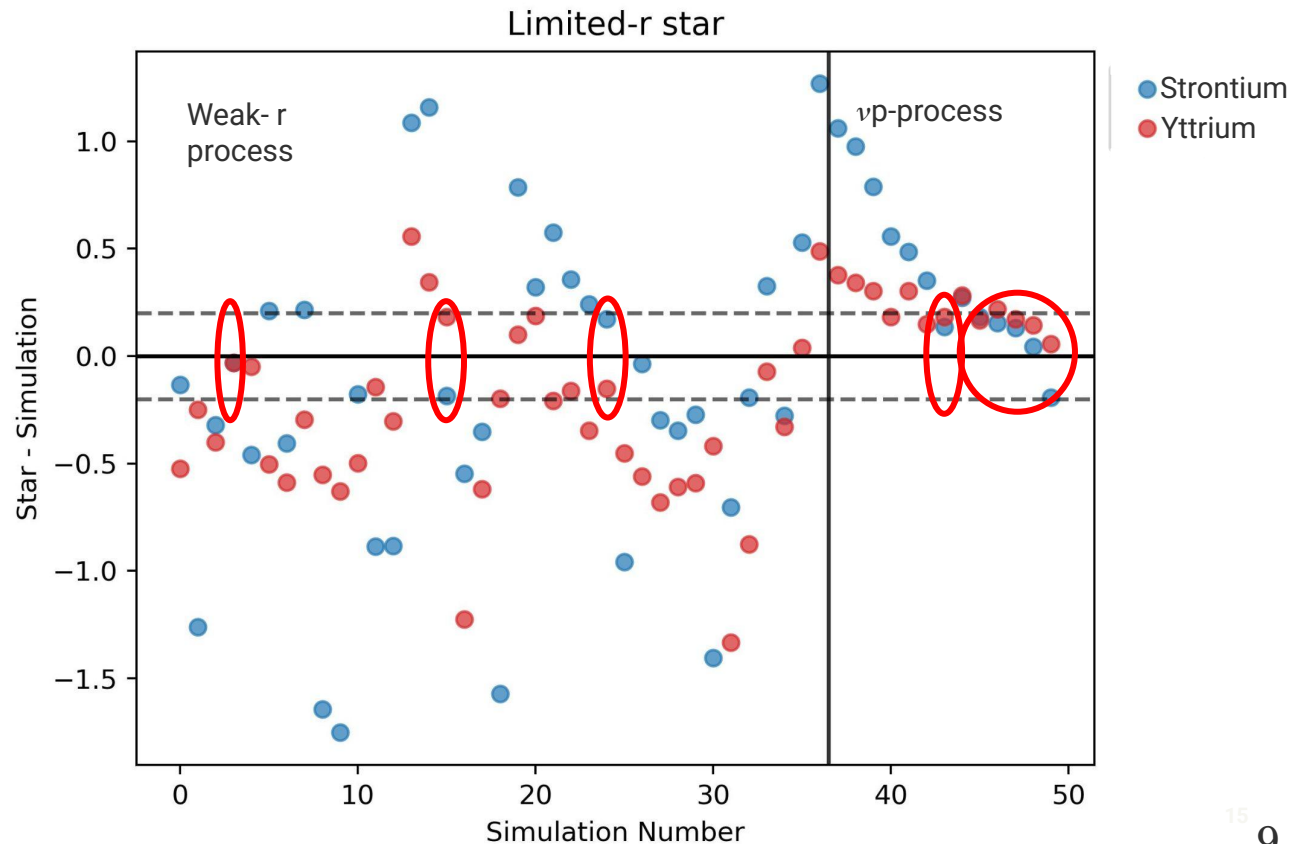
Comparing to Simulations

- 50 neutrino driven wind in CCSN simulations
- Model parameters:
 - electron fraction
 - Entropy
 - expansion timescale
- Majority of stars only have Sr, Y, Zr measurements



Comparing to Simulations

- 9 simulations explain abundances
- Require further observation to reduce uncertainties



What's next?

1 - Continue investigating comparisons to simulations

2 - Galactic chemical evolution

Summary

1 -

Some very metal poor stars show enhanced abundance in elements Sr - Ag ($Z = 38-47$)

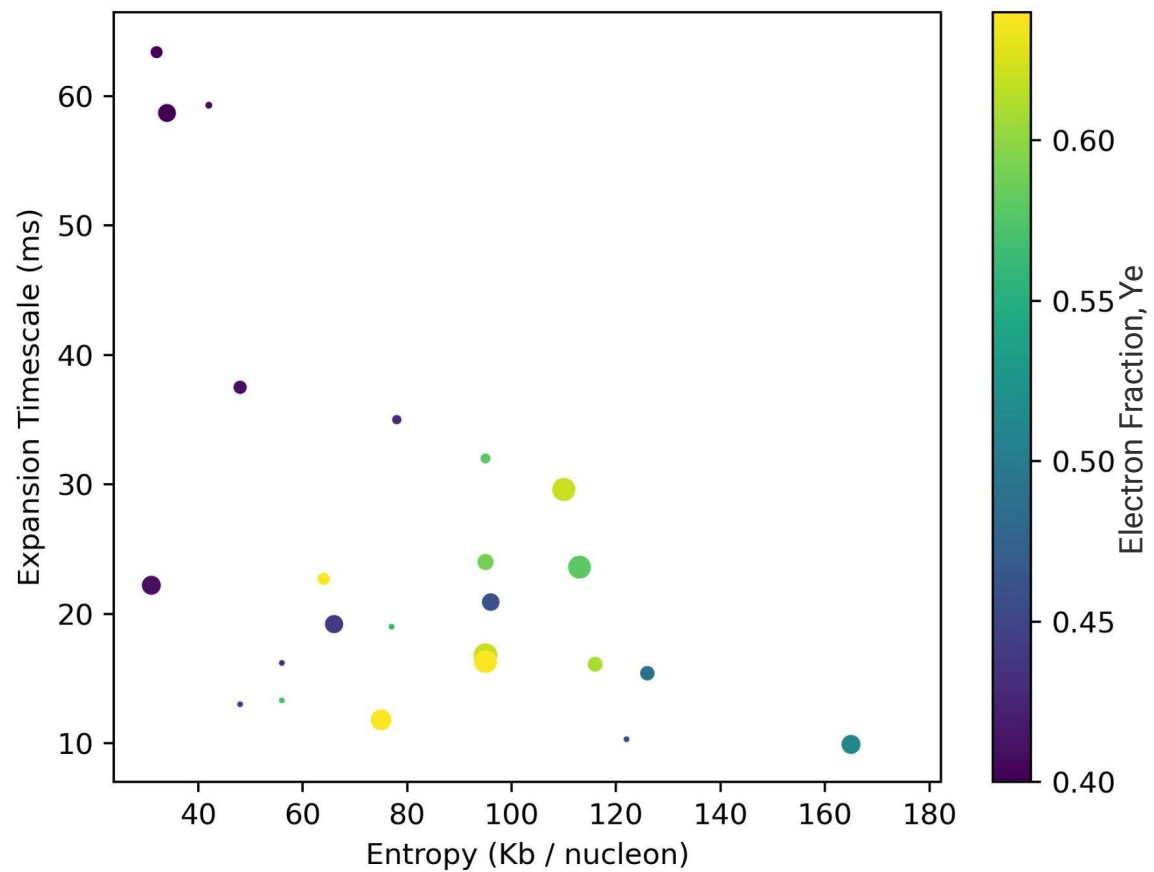
2 -

Analyzed databases to find limited-r stars

Total: 80 of 14, 427 stars

3 -

Compare limited-r stars to predictions of nucleosynthesis in supernovae, need further constraints on data



Europium vs Metallicity

