The composition of Barium stars and the s process in AGB stars

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A Celebration of CEMP and Gala of GALAH
Melbourne, 15. November 2017

Introduction – Ba stars

- G−K giants + dwarfs, [Fe/H] > -1.0
- strong spectral features: carbon molecular bands + s-process elements
- RV variation → binary systems
  → not intrinsic overabundance!
  → mass transfer
  → test: AGB s-process nucleosynthesis

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⟹ metal-rich analogs of CEMP-s stars

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$\Longrightarrow$ metal-rich analogs of CEMP-s stars

- [hs/ls] ← s=? hs=? ls=?

Sample data

- e. g.: Yang+ (2016): 19 stars, Allen&Barbuy (2006): 26 stars, Antipova+ (2004): 16 stars
- de Castro et al. (2016) sample:

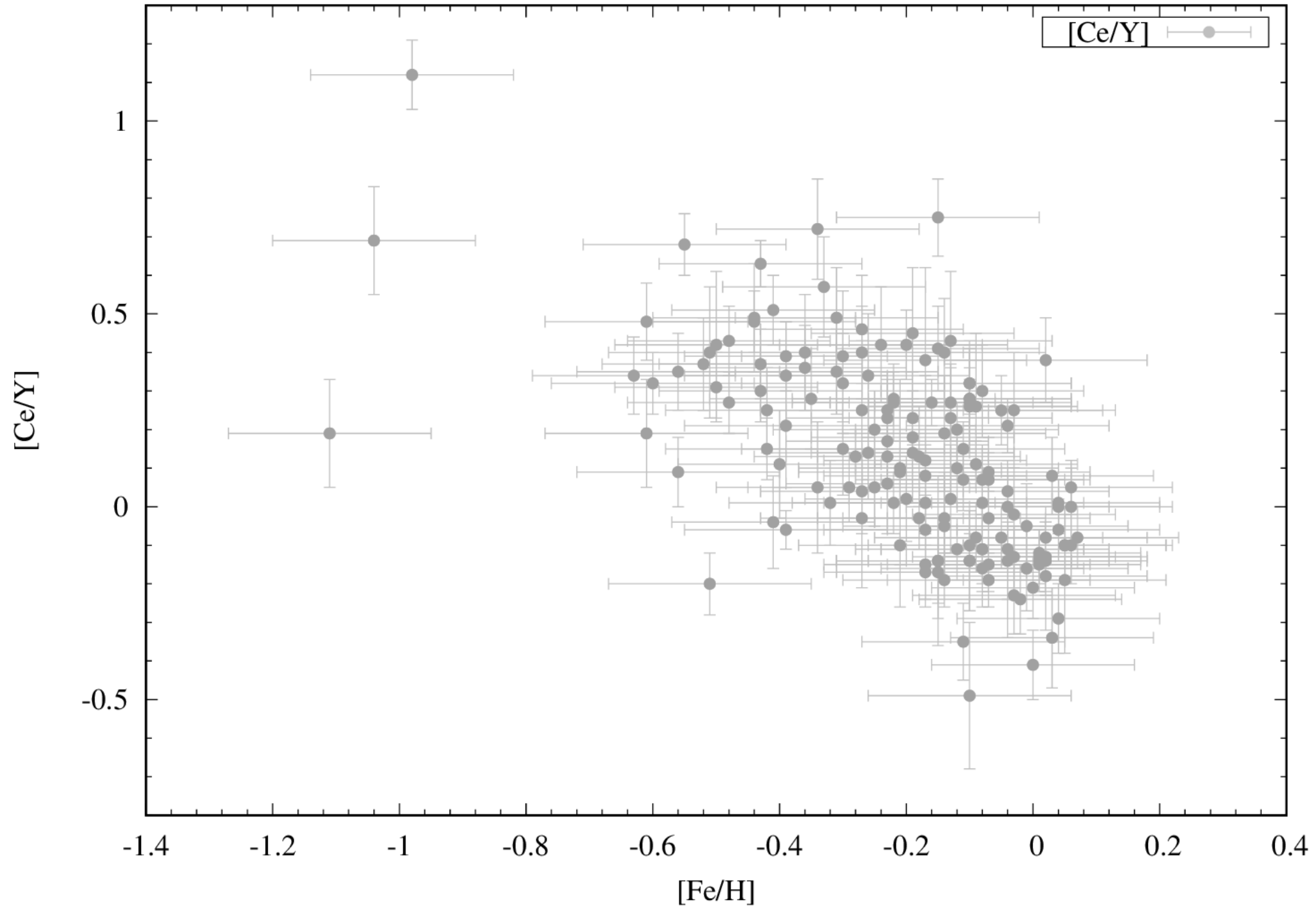
  - 182 giants (certain, candidate)

  - high resolution spectra (FEROS, R = 48000)

  - wide range in T_{eff} (4100-5400 K), mass (1-6 M_{Sun}), metallicity

  - Ba star: if [s/Fe] ≥ 0.25 → 13 stars rejected
- estimated error → first time proper error analysis
  [hs/ls] → [Ce/Y], …

data from de Castro+ 2017



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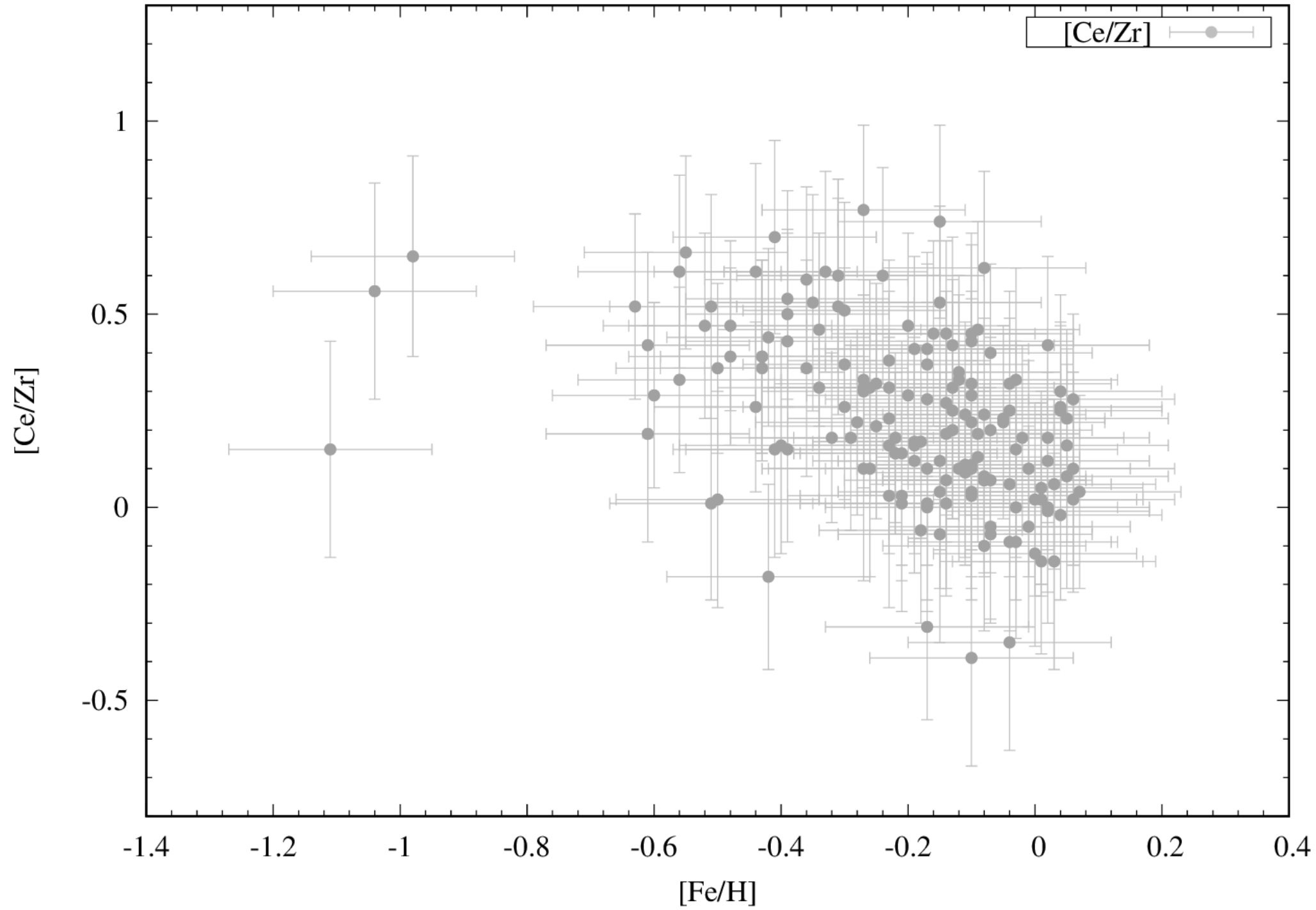

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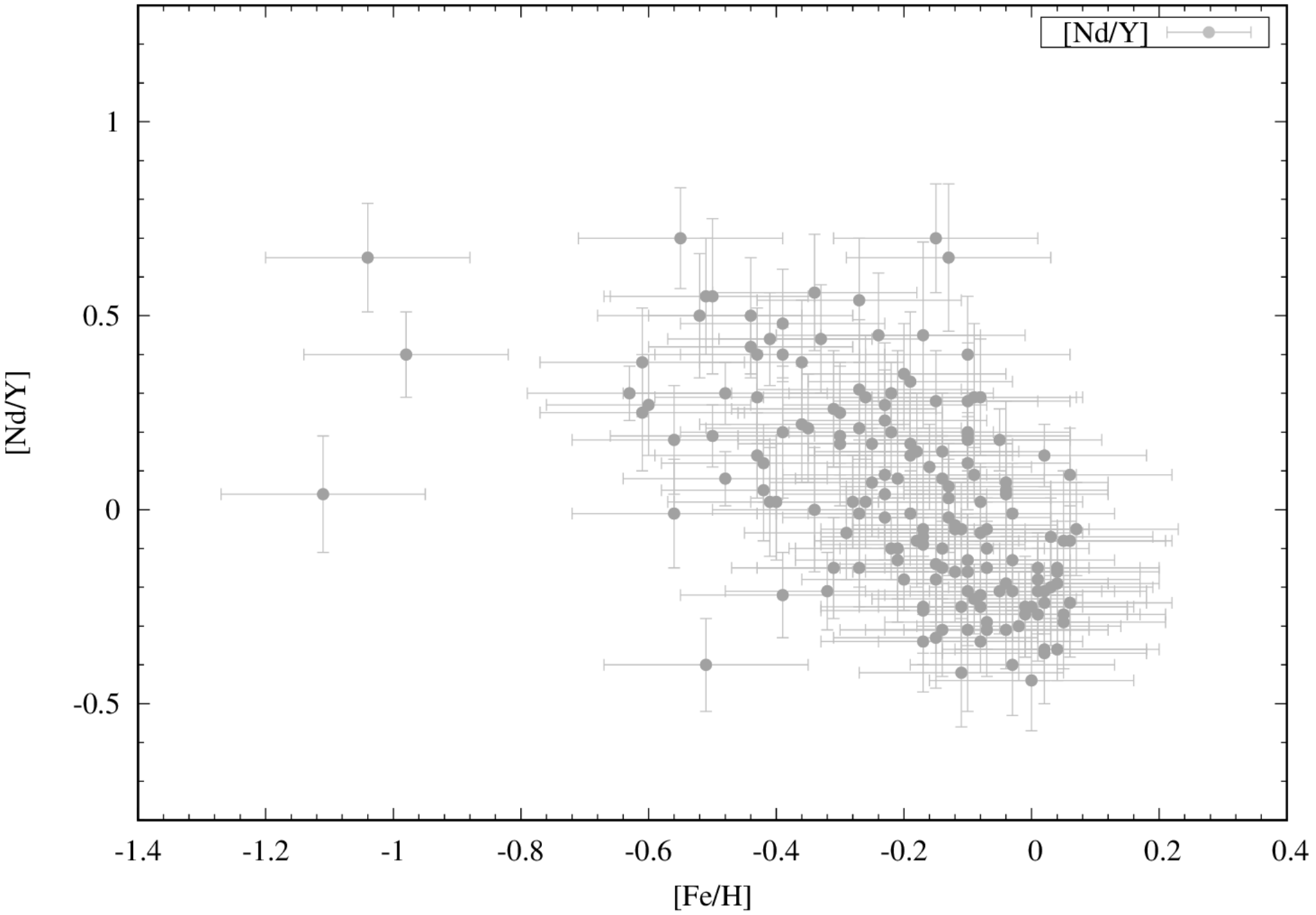

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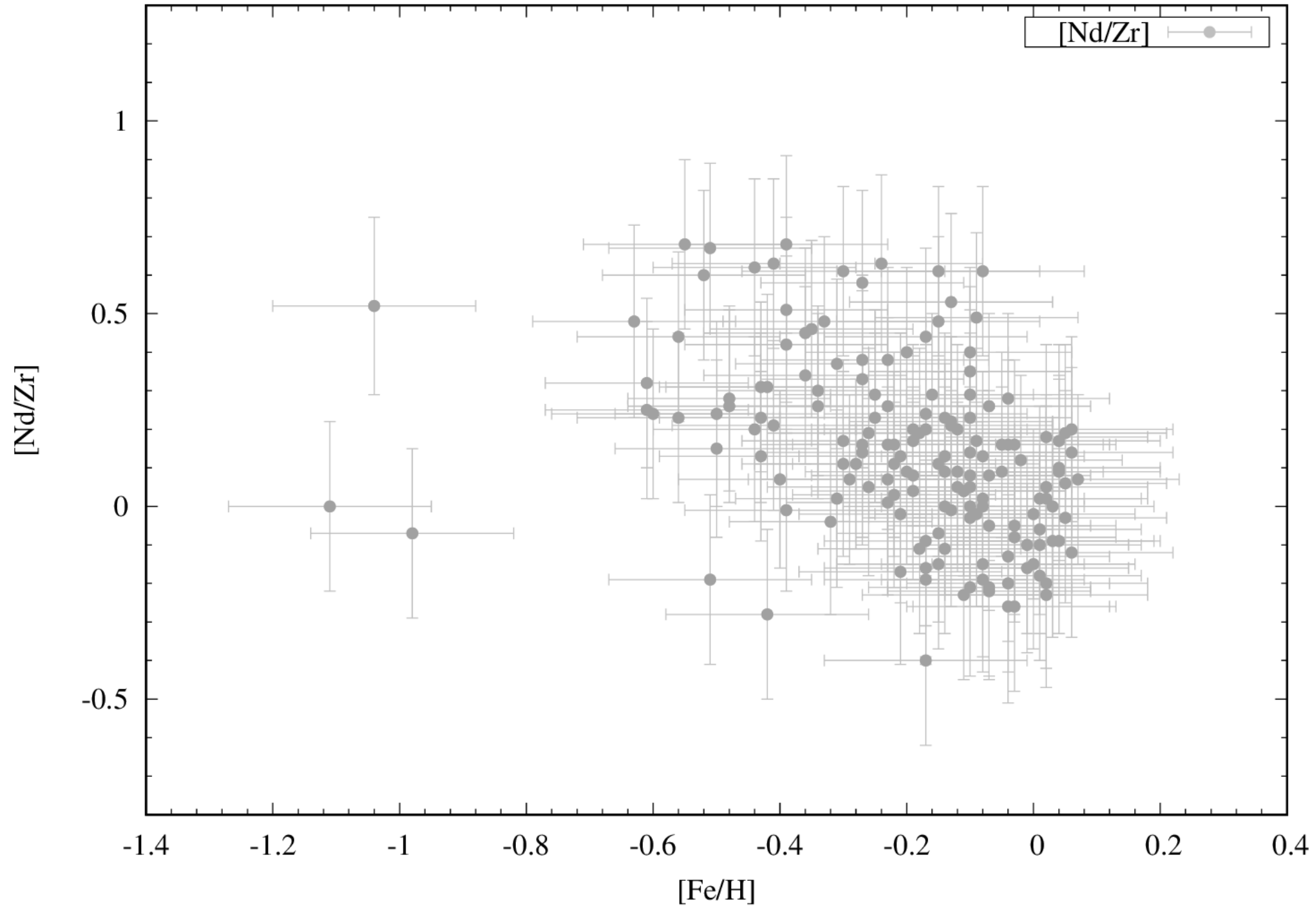
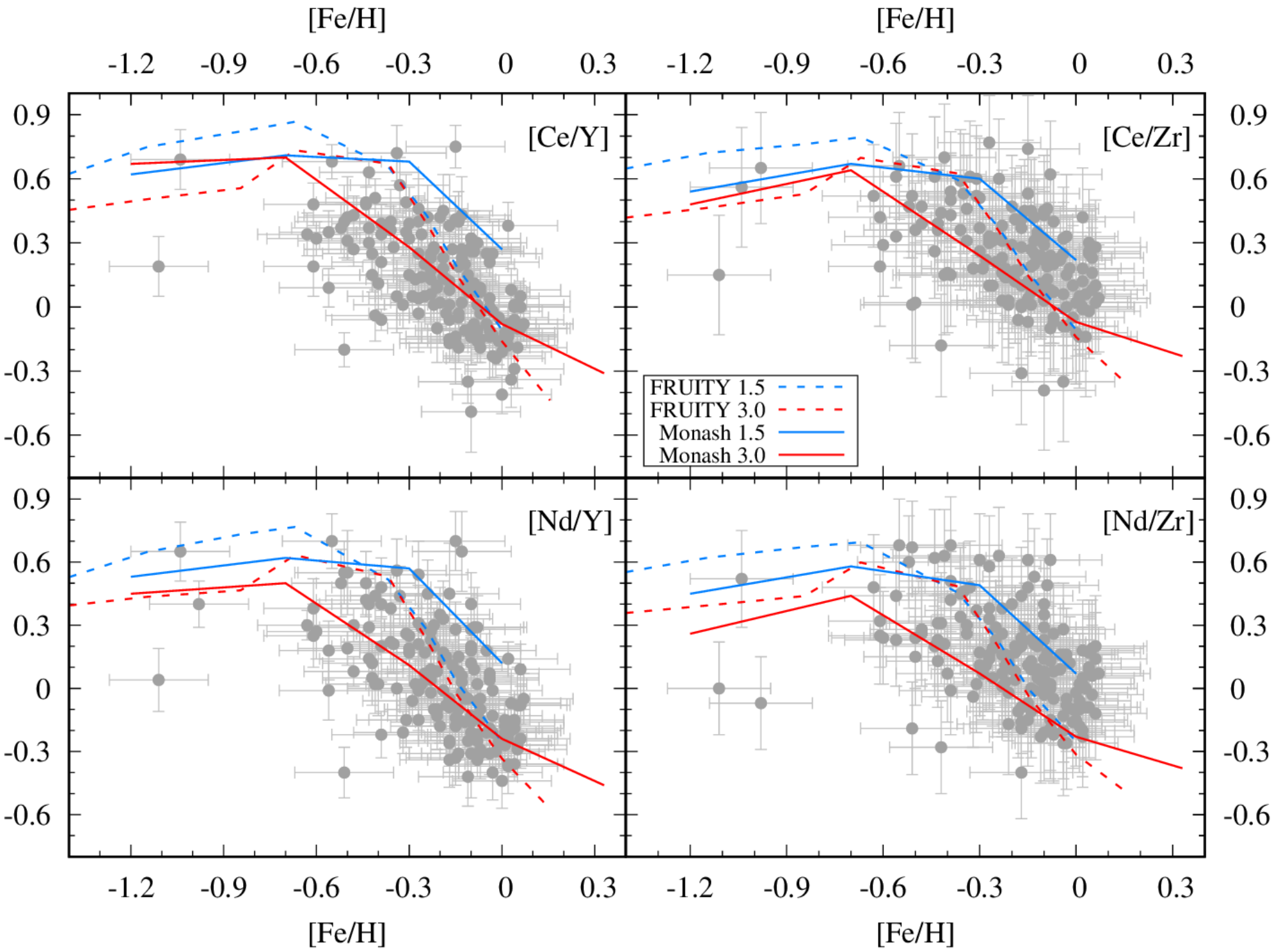


Model comparison

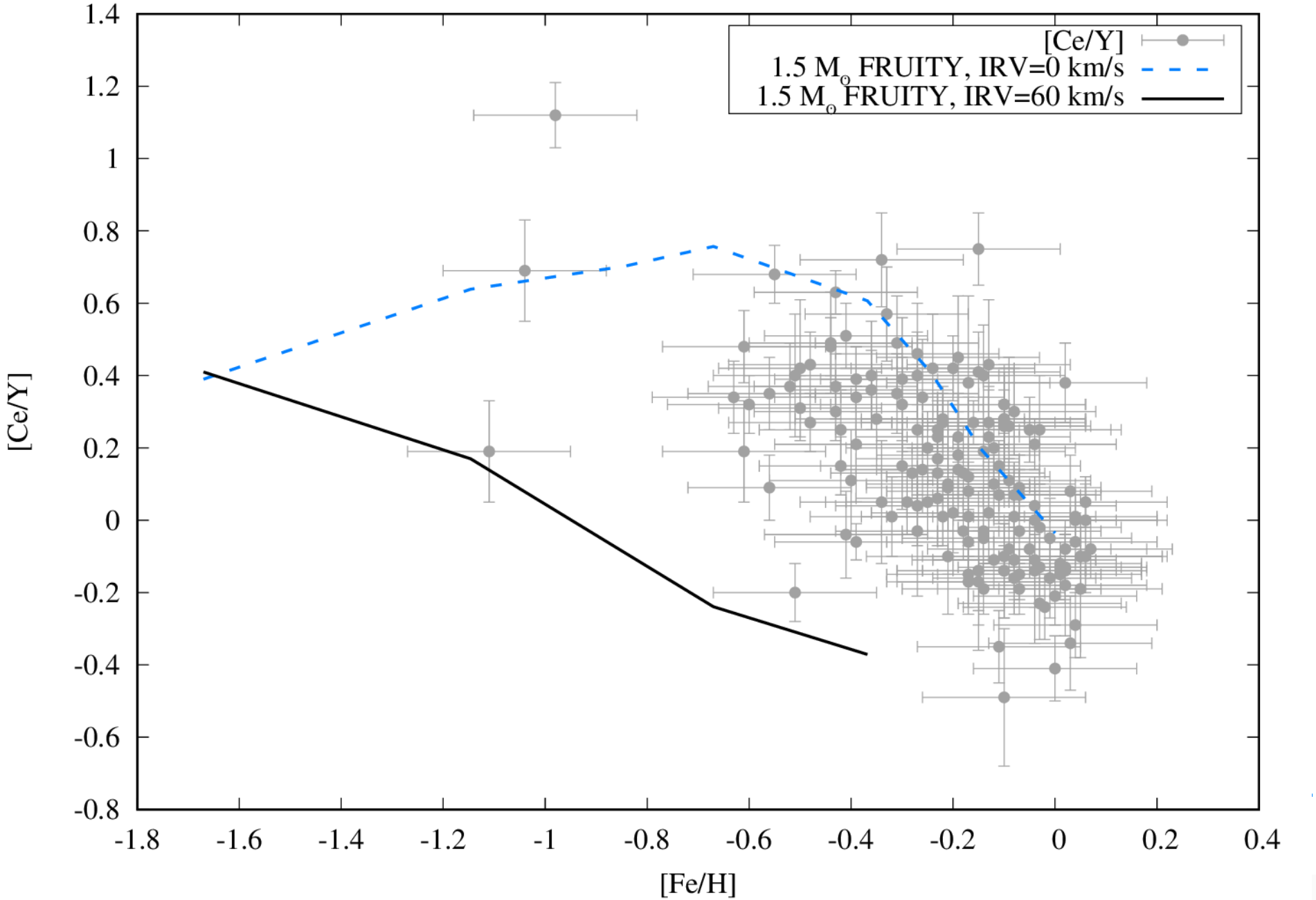
- final TP, without rotation, [s/Fe] ≥ 0.25
- different metallicities, masses
- FRUITY + Monash

Cristallo+ 2016,
Cristallo+ 2015,
Straniero+ 2014,
Piersanti+ 2013,
Cristallo+ 2011,
Cristallo+ 2009

Karakas &
Lugaro 2016,
Fishlock+ 2013,
Karakas+ 2017
in prep


[Fe/H]
-1.2
-0.9
-0.6
-0.3
0
0.3
0.9
0.6
0.3
0
-0.3
-0.6
[Ce/Y]
[Ce/Zr]
[Nd/Y]
[Nd/Zr]
FRUITY 1.5
FRUITY 3.0
Monash 1.5
Monash 3.0

…with rotation



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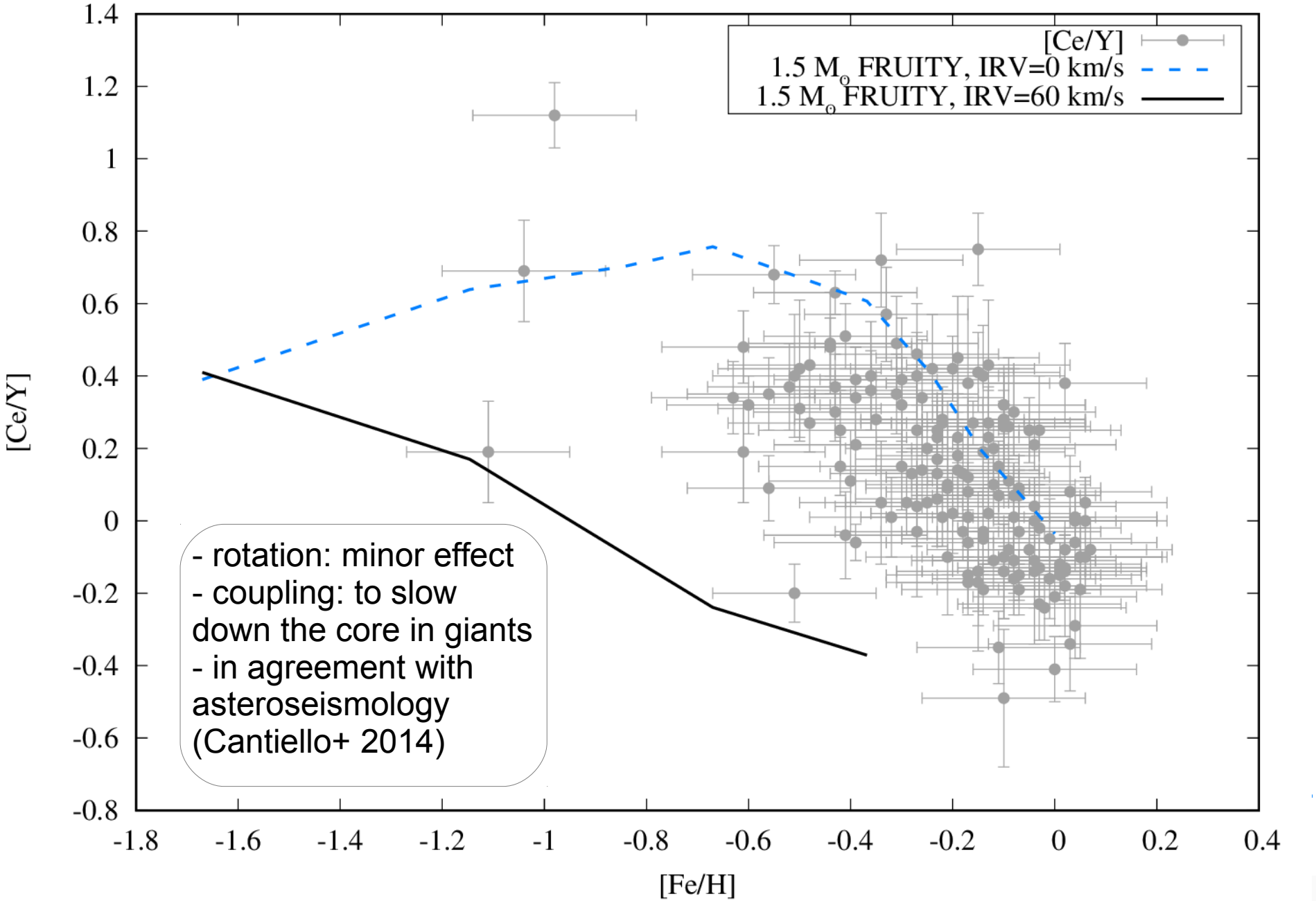
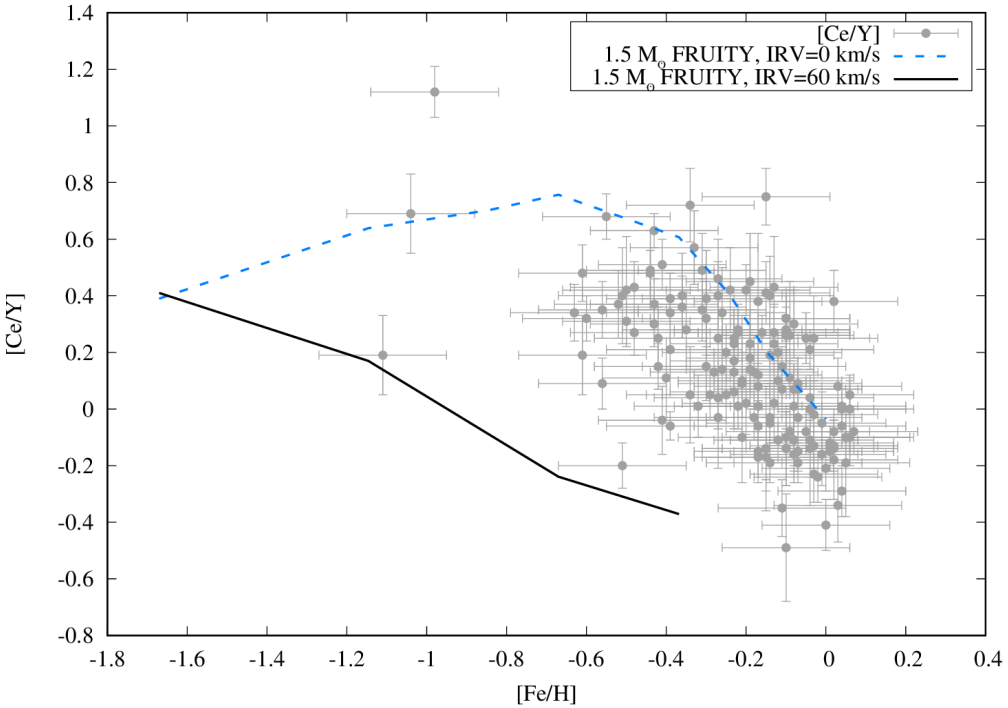


Summary

- new Ba star observations
  → split elements, own error bar
- trend agree with models
- rotational mixing: minor effect
  → in agreement with asteroseismology (Cantiello+ 2014)



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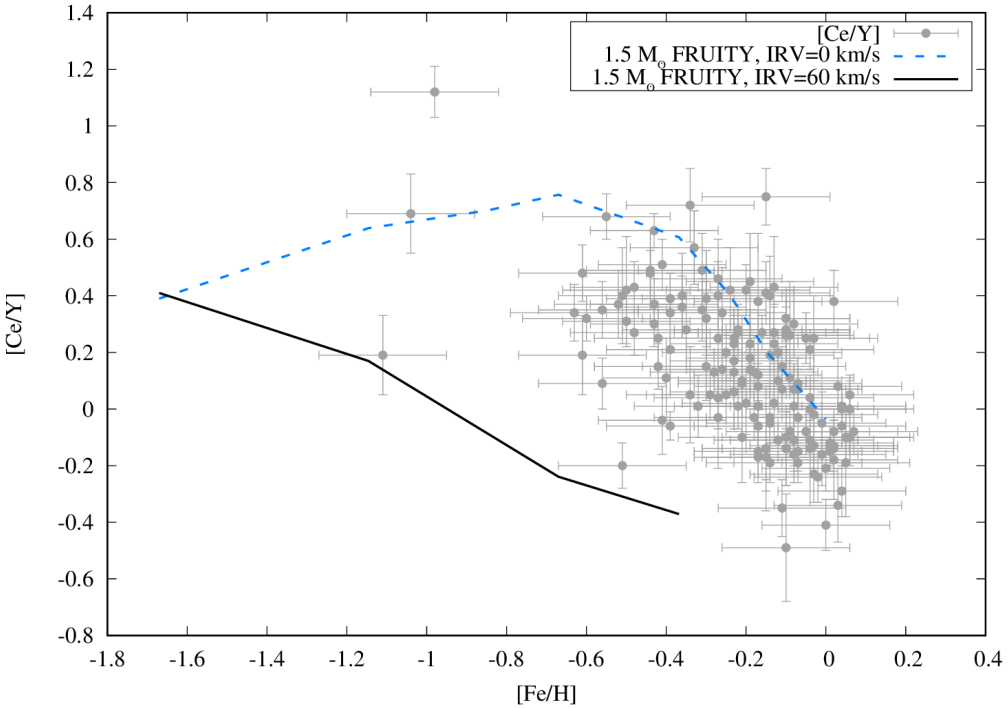

future plans:

- check different TDUs
- absolute abundances

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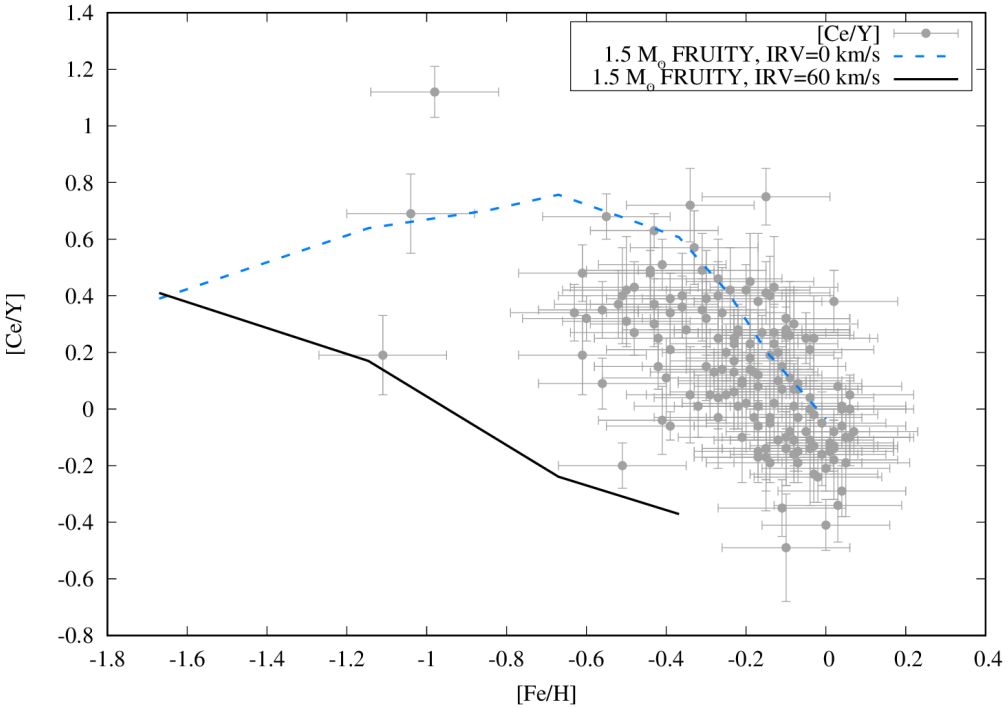

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Thank you for your attention!