The Chemical Homogeneity of Sun-like Stars in the Solar Neighborhood

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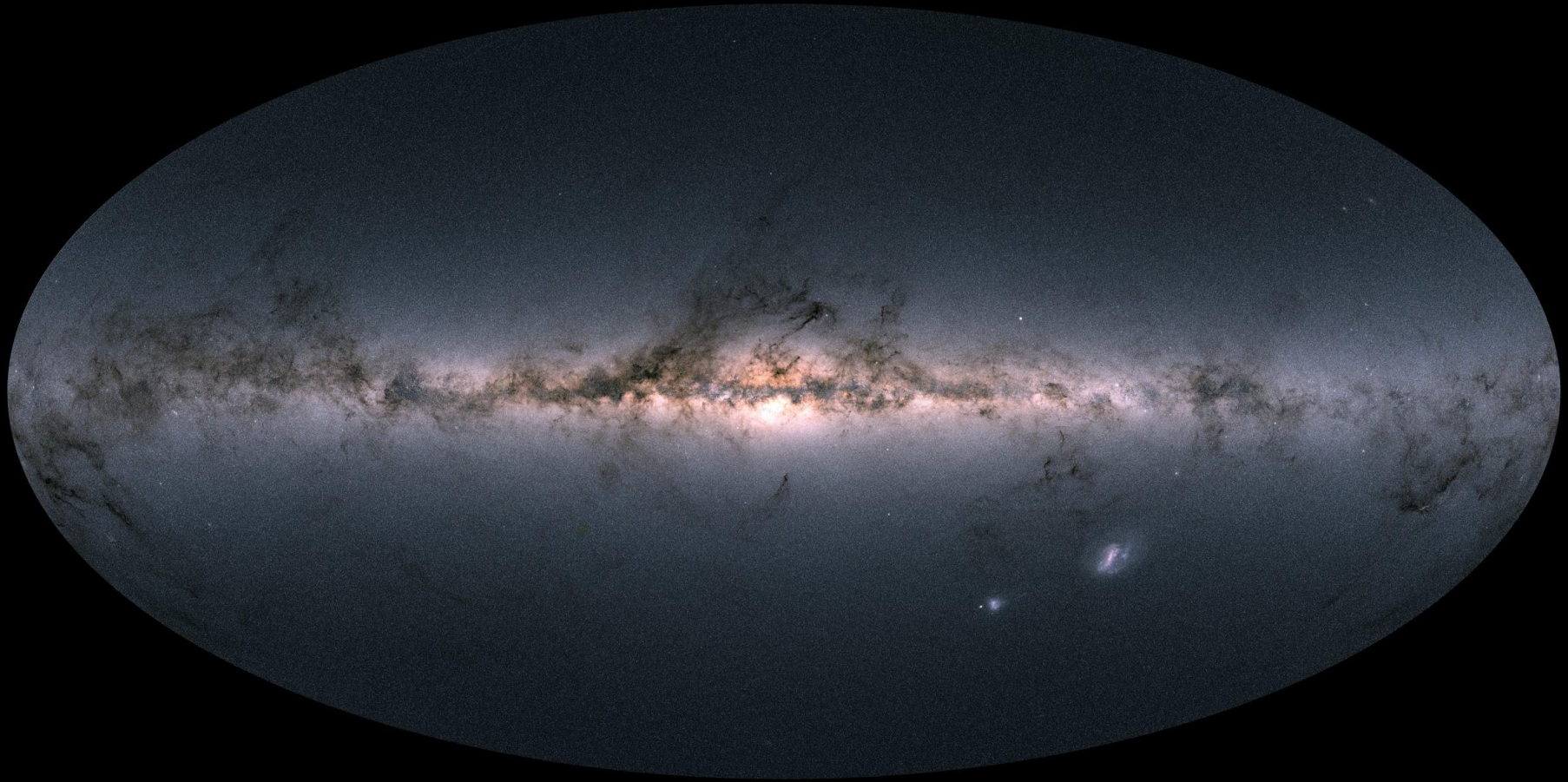
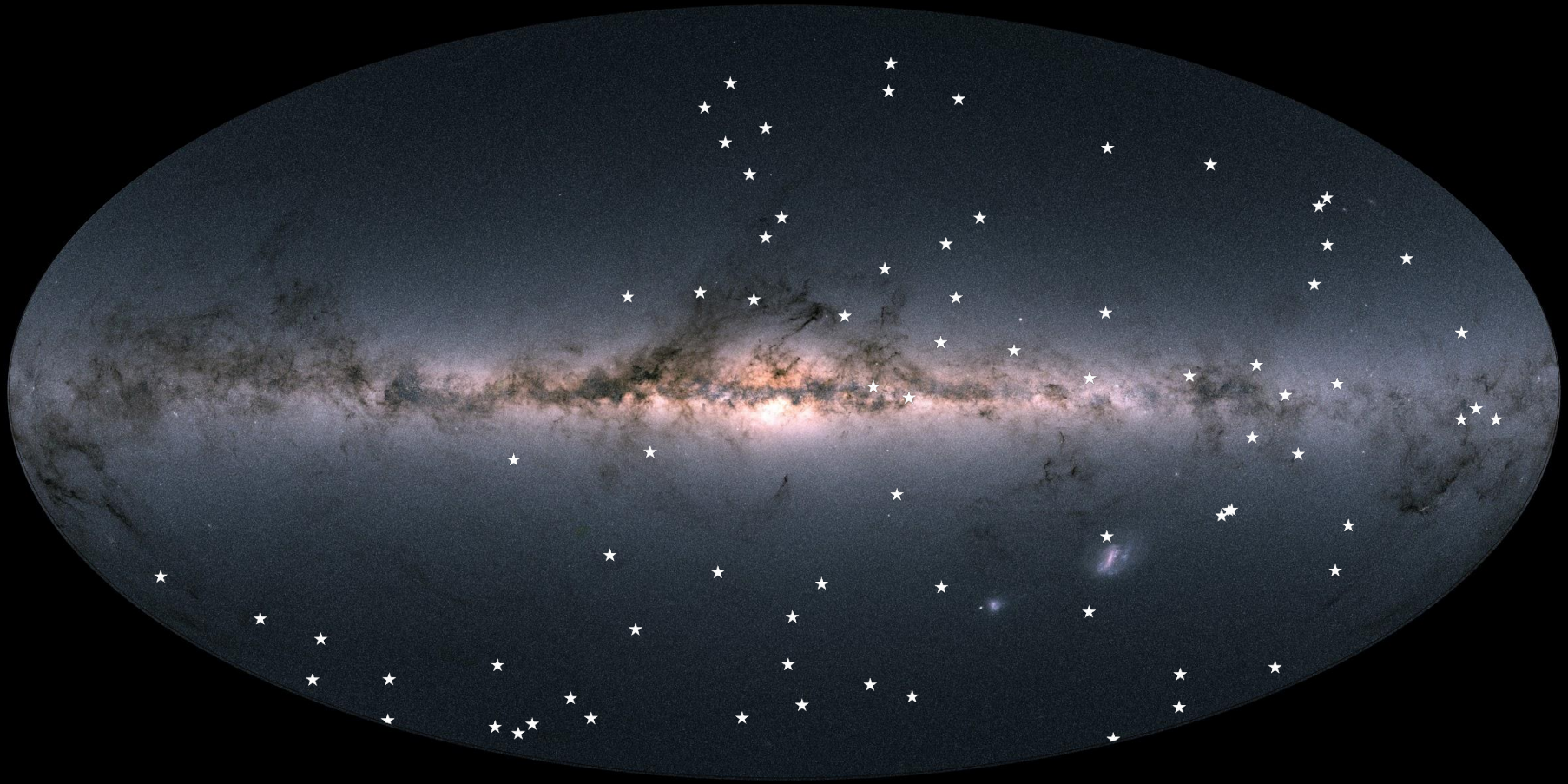
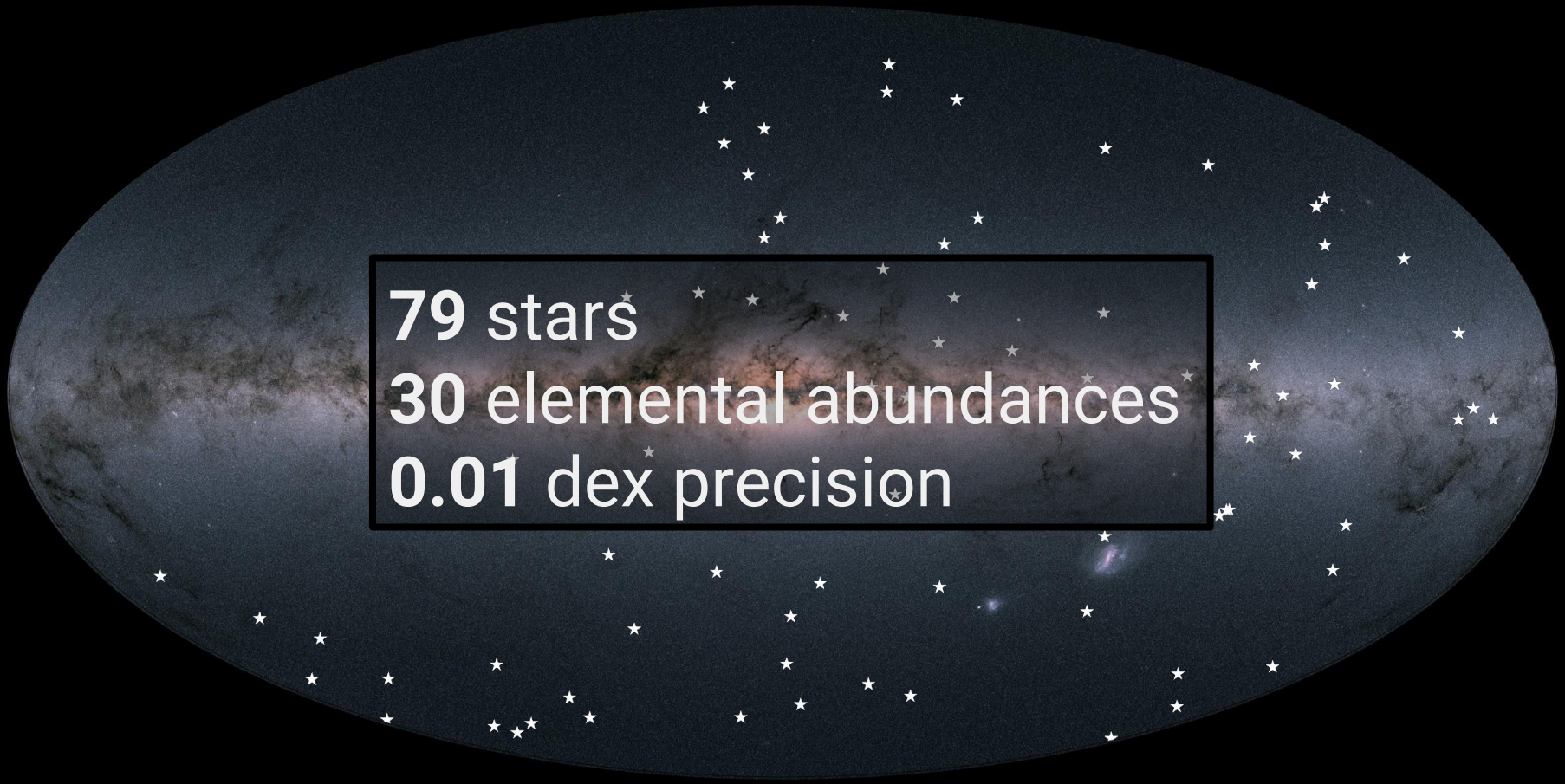
with collaborators: Jorge Melendez, Jacob Bean, Lorenzo Spina, Ivan Ramirez, Martin Asplund, Alan Alves-Brito, Leonardo dos Santos, Stefan Dreizler, David Yong, TalaWanda Monroe, Luca Casagrande

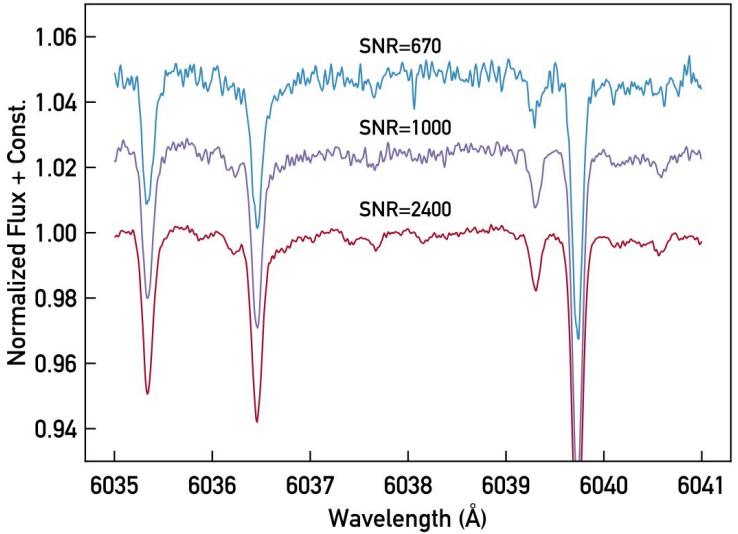





79 stars
30 elemental abundances
0.01 dex precision

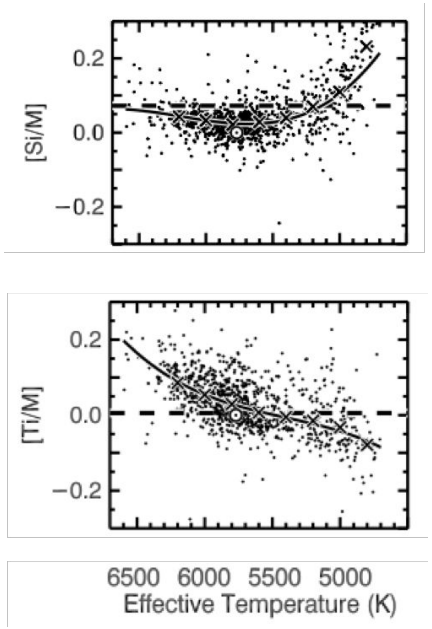
HARPS Solar Twin Planet Search
5 years, 100 nights, 68 stars
P.I. Jorge Melendez

Coadded spectra: median
SNR ~ **1000** pix^{-1} @ 600nm

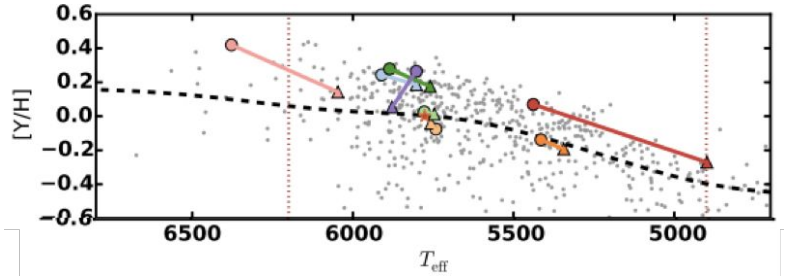


Exoplanets: see Bedell+2015; Melendez, Bedell+2016

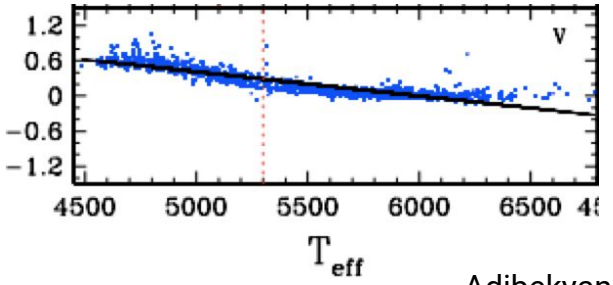
The limiting factor in a high-resolution, high-SNR spectroscopic abundance analysis is not in the data but in the **stellar models** employed.



Valenti & Fischer 2005

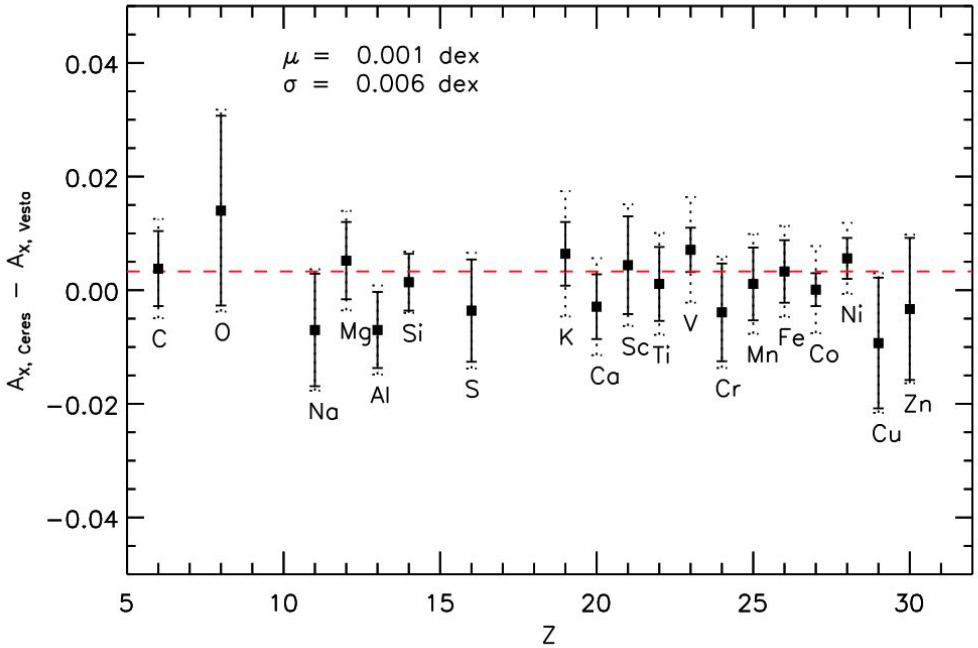


Brewer+2016



Adibekyan+2012

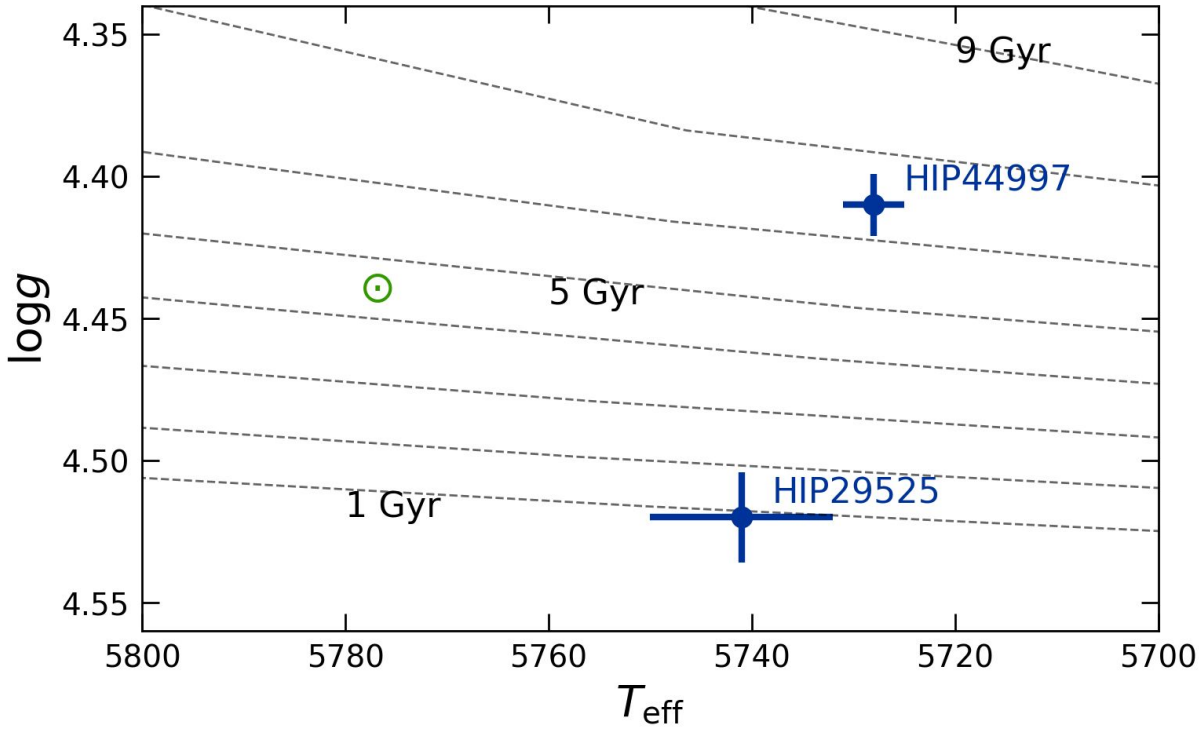
We can side-step this problem with **twin stars*** and achieve **0.01 dex or 2% precision on abundances** (a factor of 5 better than a typical spectroscopic analysis!)



Bedell+2014

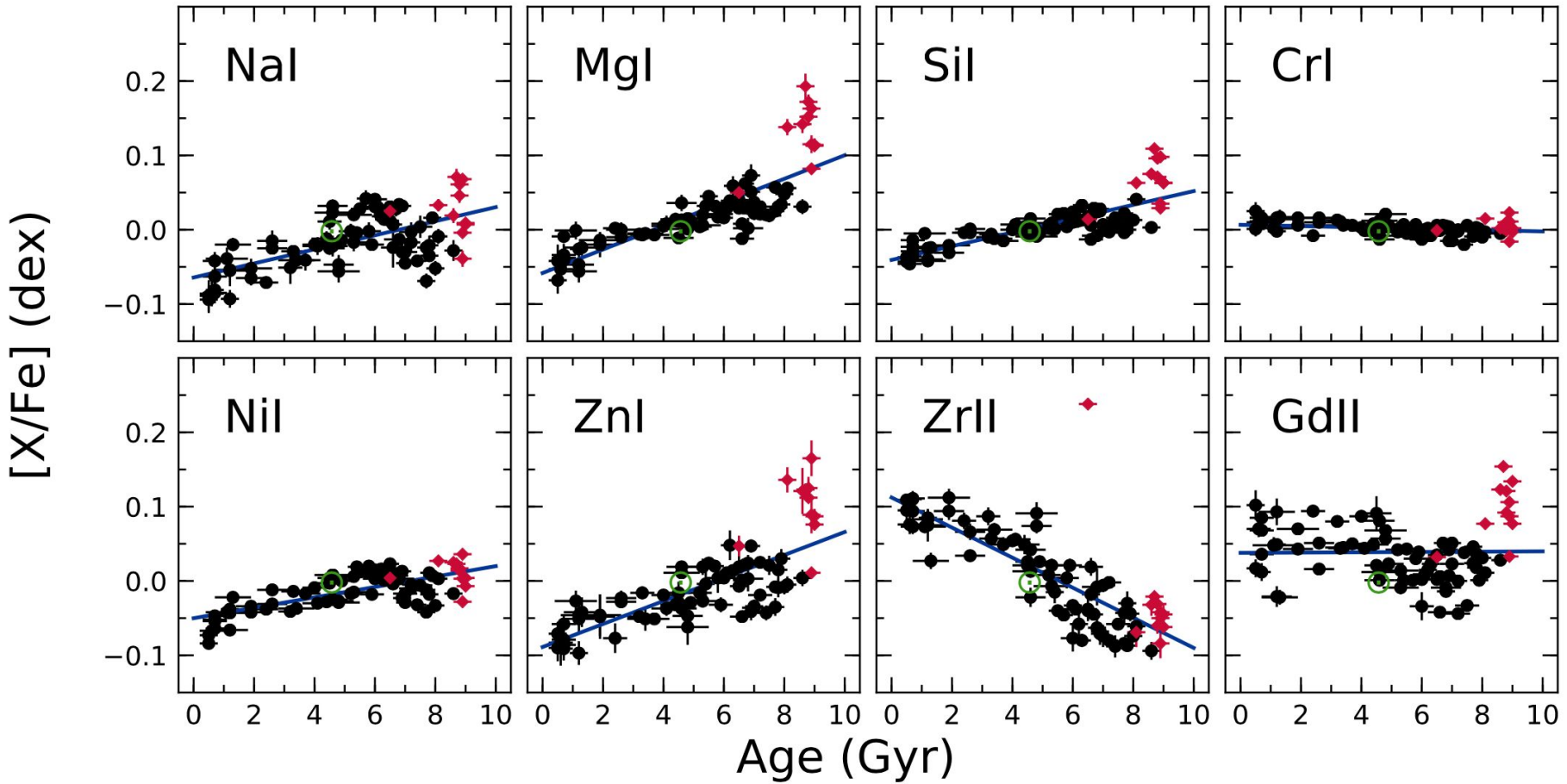
* Typical definition of a "twin":

ΔTeff $\lesssim$ 100 K,
Δlog(g) $\lesssim$ 0.1 dex,
Δ[Fe/H] $\lesssim$ 0.1 dex



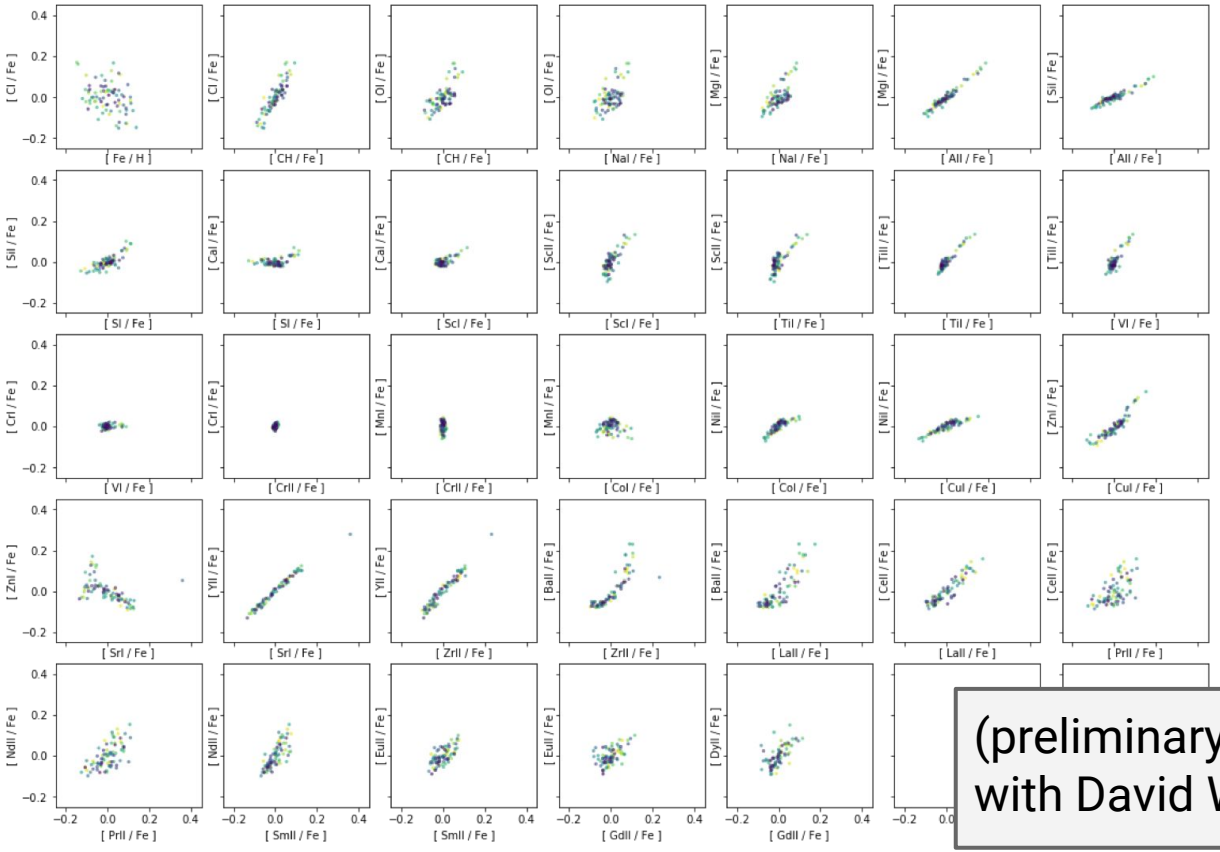
Age uncertainty
~ 0.5 Gyr

See also Spina+2018, MNRAS 474, 2580



Bedell+2018, arxiv:1802.02576

What is the dimensionality of abundance space?



(preliminary) work with David W. Hogg

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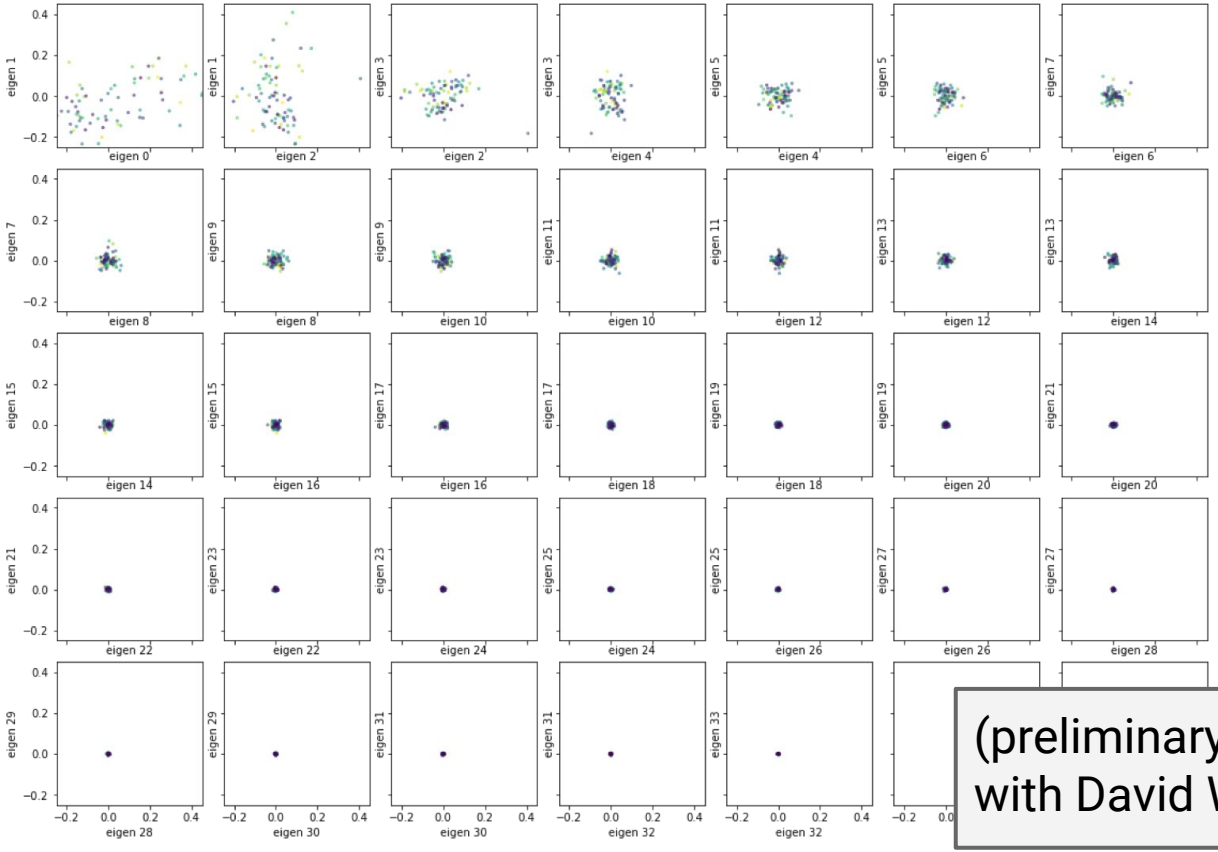
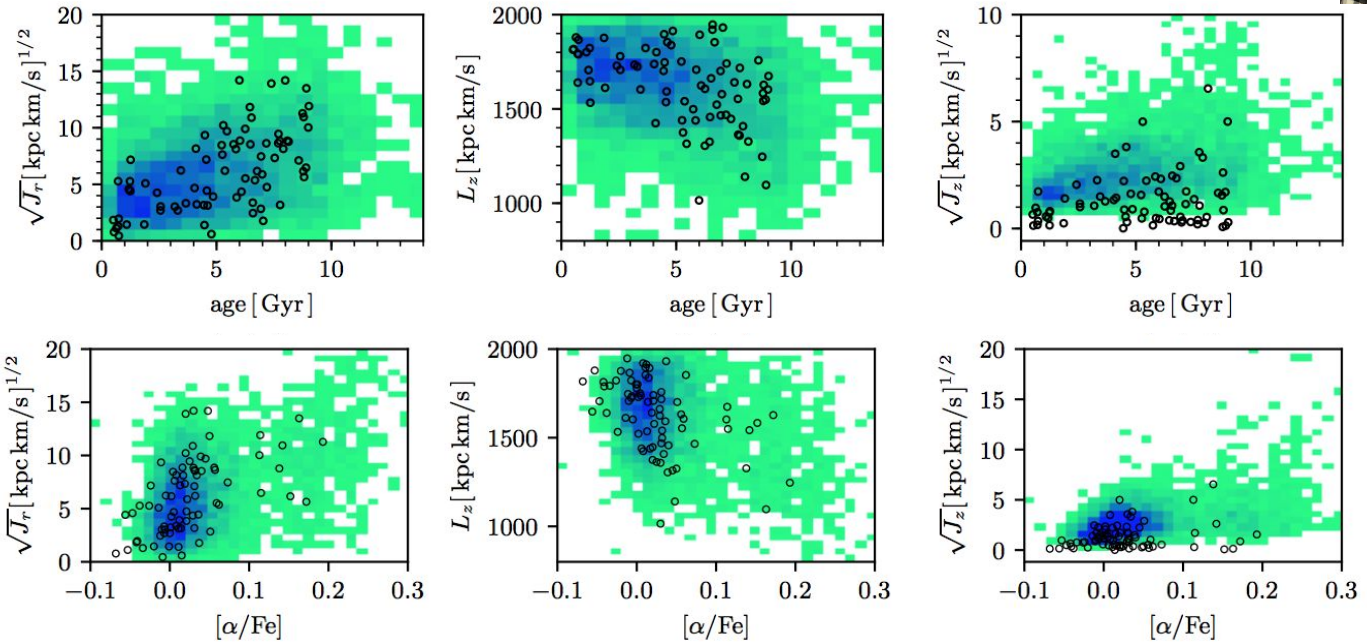


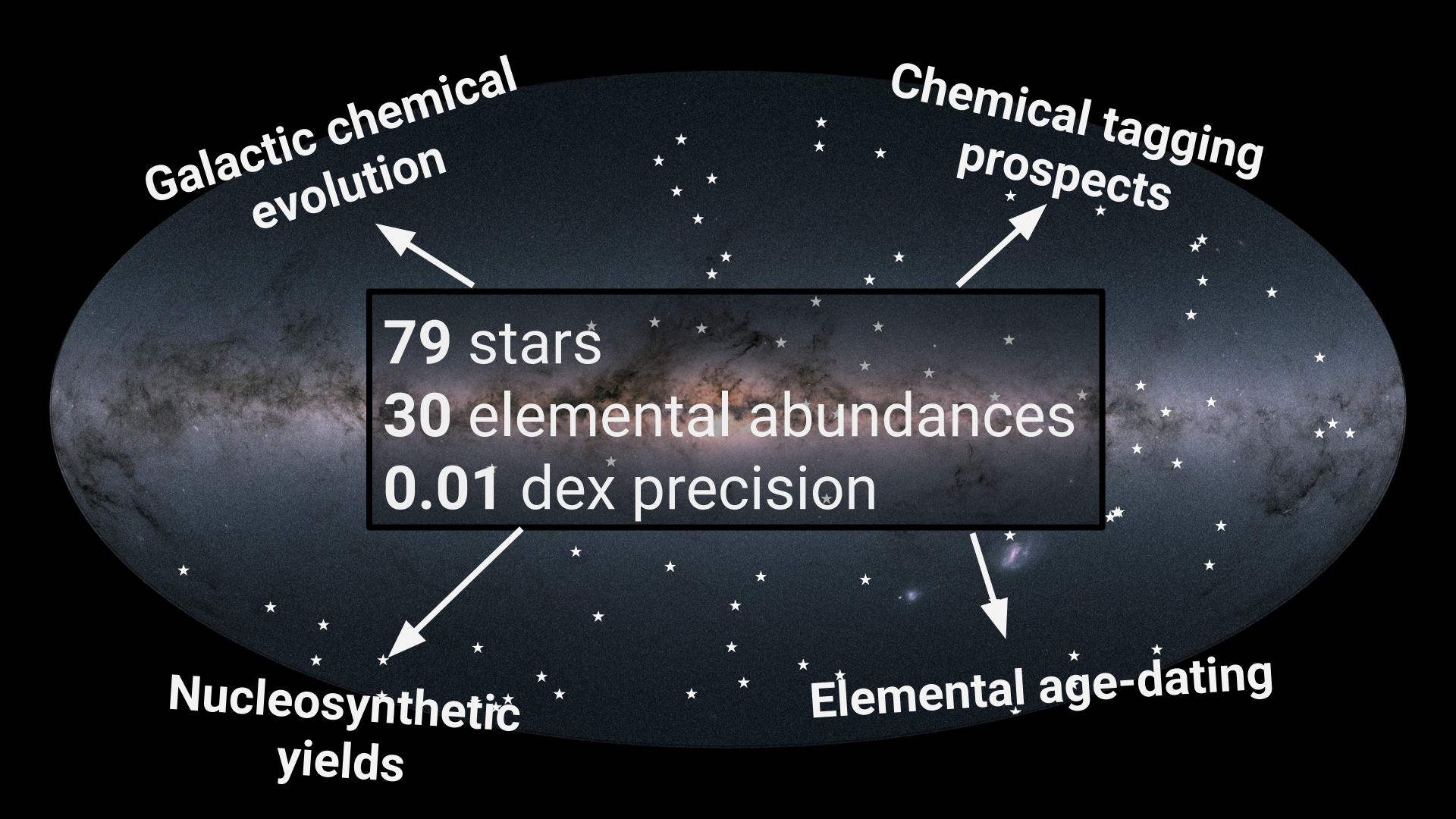
(preliminary) work with David W. Hogg

How do age & composition relate to kinematics?

Gus Beane



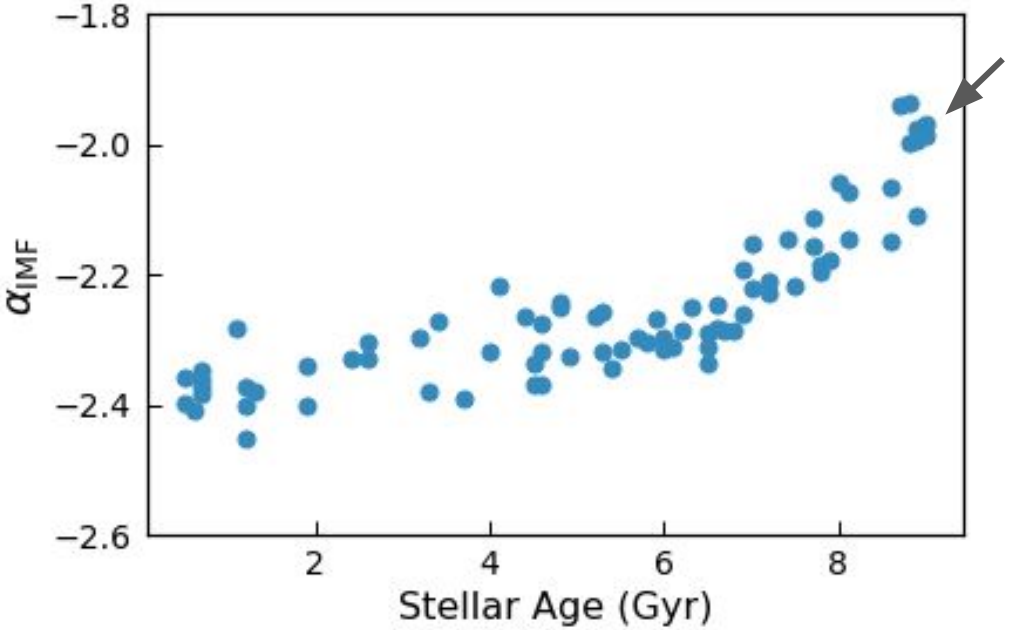
Beane, Ness, & Bedell arxiv:1807.05986


Galactic chemical evolution
Chemical tagging prospects
79 stars
30 elemental abundances
0.01 dex precision
Nucleosynthetic yields
Elemental age-dating

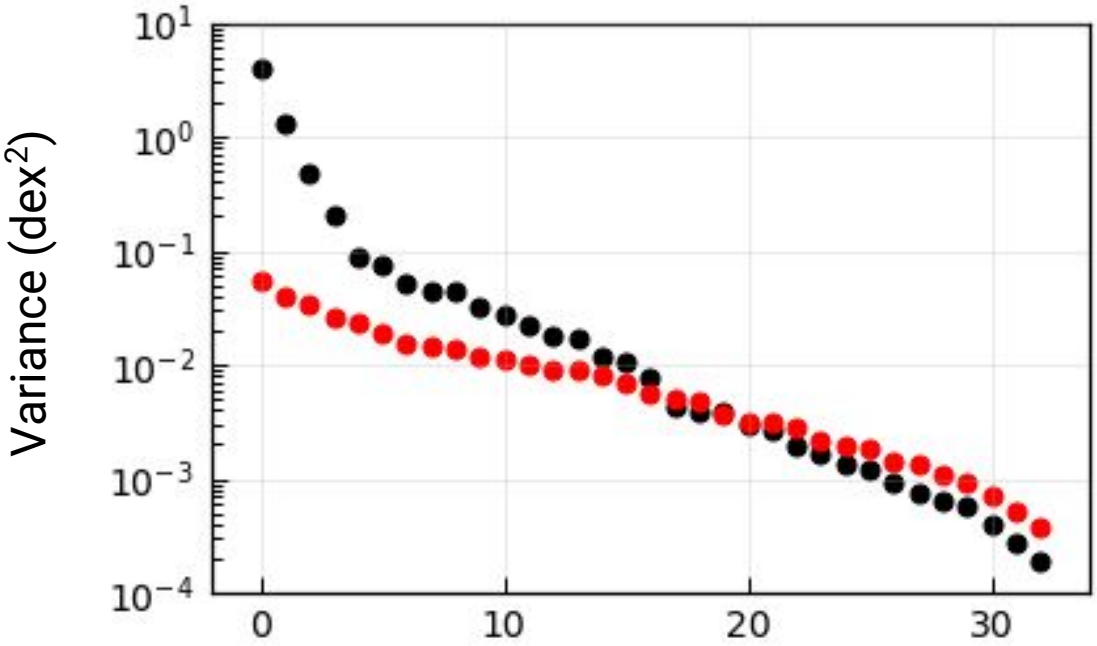
EXTRA SLIDES

How do these data constrain galactic evolution models?

With Jan Rybizki (very preliminary work):



Chempy best-fit single-zone model for each star


Variance (dex^2)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
10
20
30