

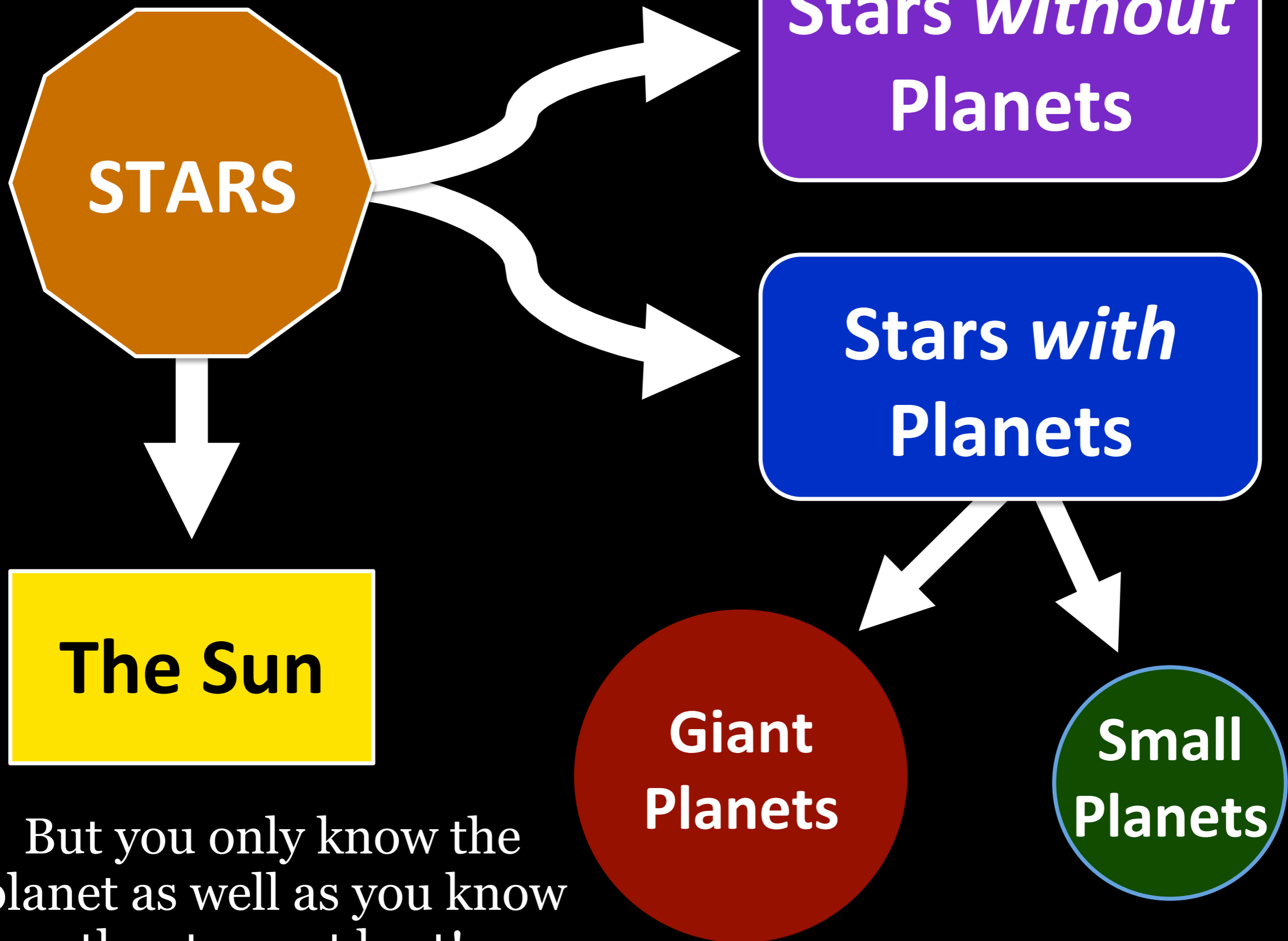
Connecting Stellar Abundances & Planet Habitability

Chairs: Natalie Hinkel,
Elisa Delgado Mena, & Vardan Adibekyan
(Satellite Meeting 8)

Pathways Towards Habitable Planets
Bern, Switzerland 13-17 July 2015

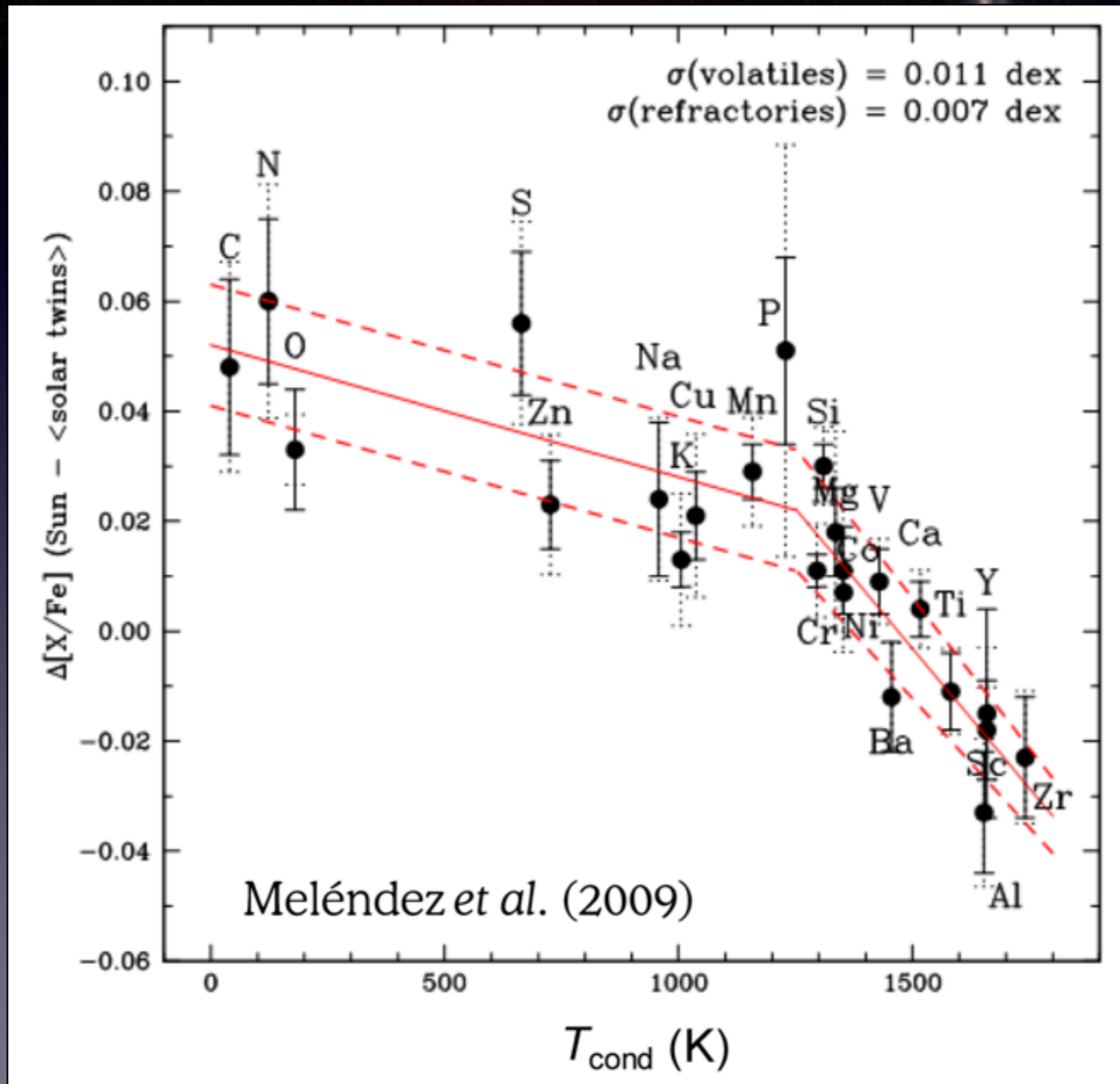
Meeting Logistics

- Session length = 2 days
- Number of laptop crashes = 1
- 195 min of talks (13 speakers with 15 min each)
- 105 min of questions or discussion, including 40 min of dedicated discussion at the end of Day 2
- Average of 26 people attending
- Bottles of Port wine consumed = 2



But you only know the planet as well as you know the star...at best!

Is the Sun Typical?...



...maybe not.

The refractories are depleted relative to volatiles in Kepler-10, when compared to its thick disk stellar twins

Fan Liu (ANU)

The most straightforward explanation is that a Solar V/R ratio is a chemical reflection of a rich *stellar* birth environment (like that of M67).

Andreas Korn (Uppsala Uni.)

Hosts vs. Non-Hosts

Previous studies yielded contradictory results

- Most studies found no systematic difference in abundances
(Takeda 2007; Bond et al. 2008; Neves et al. 2009; Delgado Mena et al. 2010)
- Possible enrichment in some species
(Bodaghee et al. 2003; Robinson et al. 2006; Brugamyer et al. 2011; Kang et al. 2011)

Hosts vs. Non-Hosts

We found that the lithium abundances in planet-hosting were lower compared to the stars for which no planetary systems.

But, BaII abundances were enriched in planet hosts.

Tamara Mishenina (Odessa Nat'l Uni)

No different behaviour can be inferred from nitrogen or carbon abundances for both samples.

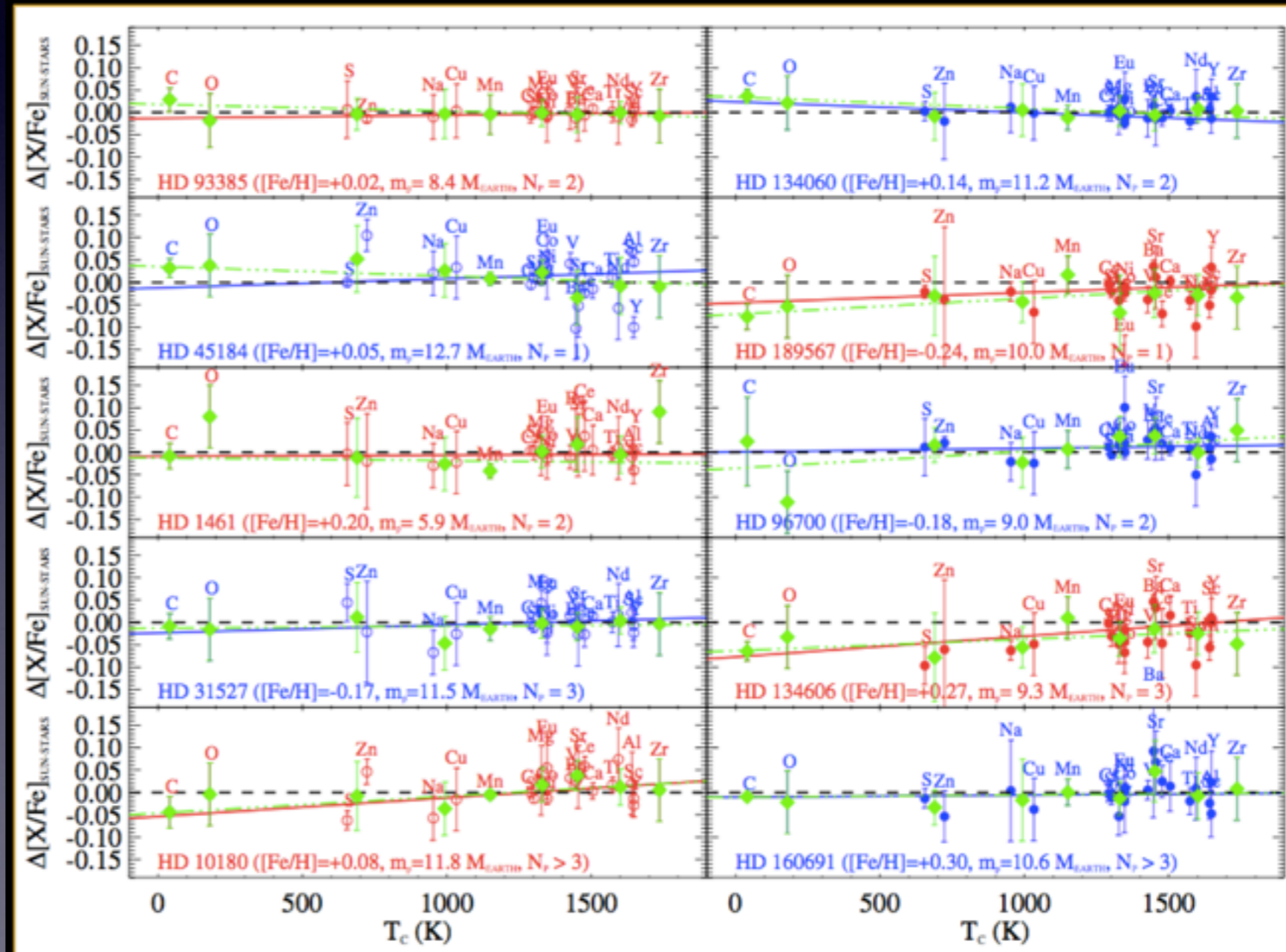
Results agree with other works (Ecuivillon et al. 2004; Delgado Mena et al., in preparation) → enriched in hosts

Lucía Suárez-Andrés (Instituto de Astrofísica de Canarias)

Hosts vs. Non-Hosts

González Hernández et al. (2013) : positive and negative slopes for solar and hot analogs with planets at different planet masses

There are different trends in stars with planets, which are not consistent between elements.



Planet Sizes

Metallicities of Kepler star with and without small planets are nearly identical:

$$[m/H]_{\text{STP}} = -0.02 \pm 0.02 \text{ dex}$$

$$[m/H]_{\text{SNTTP}} = -0.02 \pm 0.02 \text{ dex (only dwarf stars)}$$

Lars Buchhave (Harvard)

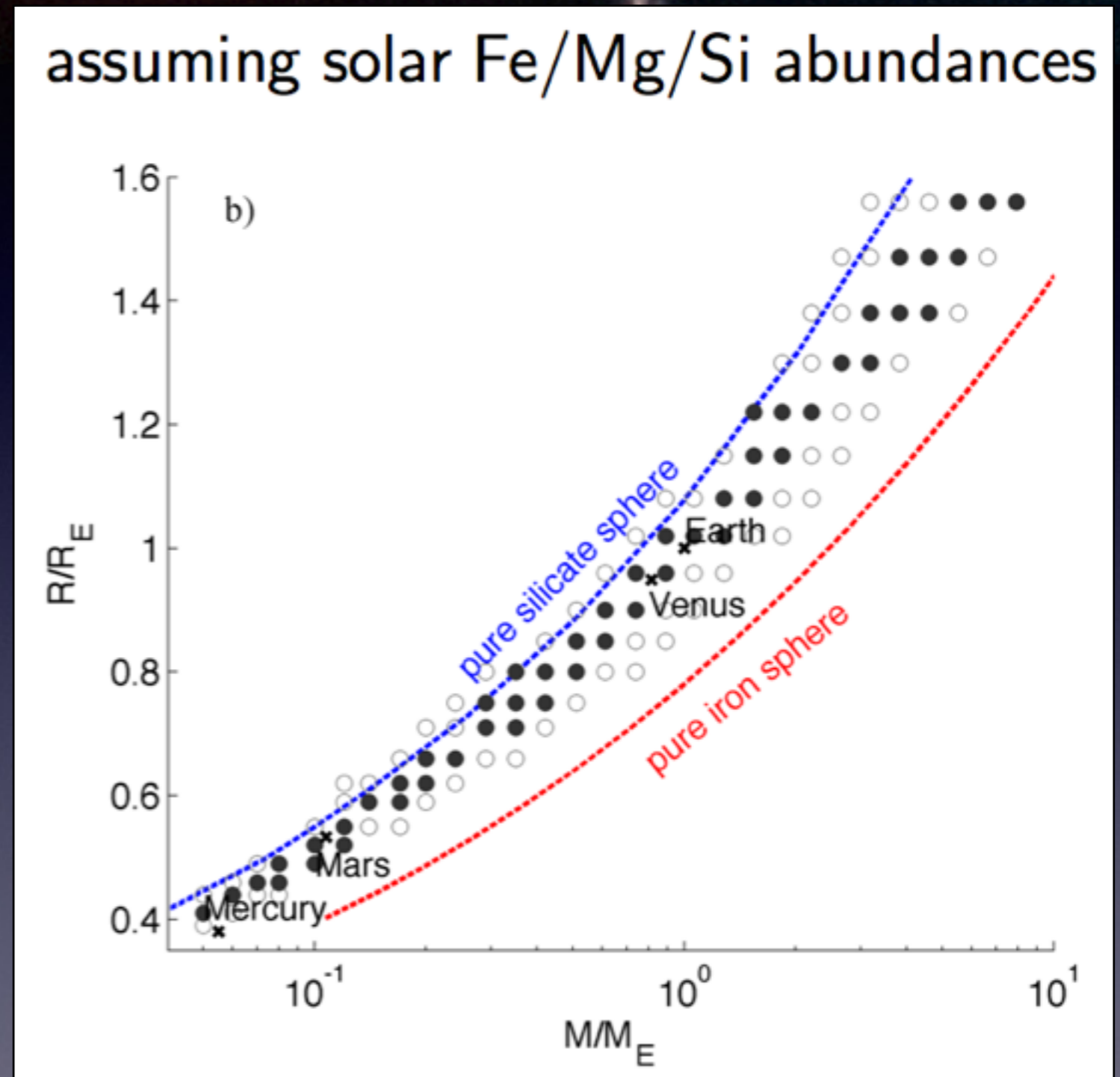
- **No differences SWDs/SWODs (stars with/out disks)**
- **SWDPs driven by the type of planet**
 - In agreement with core-accretion models
 - Correlation debris disc/low-mass planets?
 - Lack correlation debris discs/giant planets?

Jesus Maldonado (INAF)

Extending to Planets

Degeneracy in the models such that different planetary interiors can have identical mass and radii determinations.

Ask instead - what data can be explained by the models?



Caroline Dorn (Uni. of Bern)

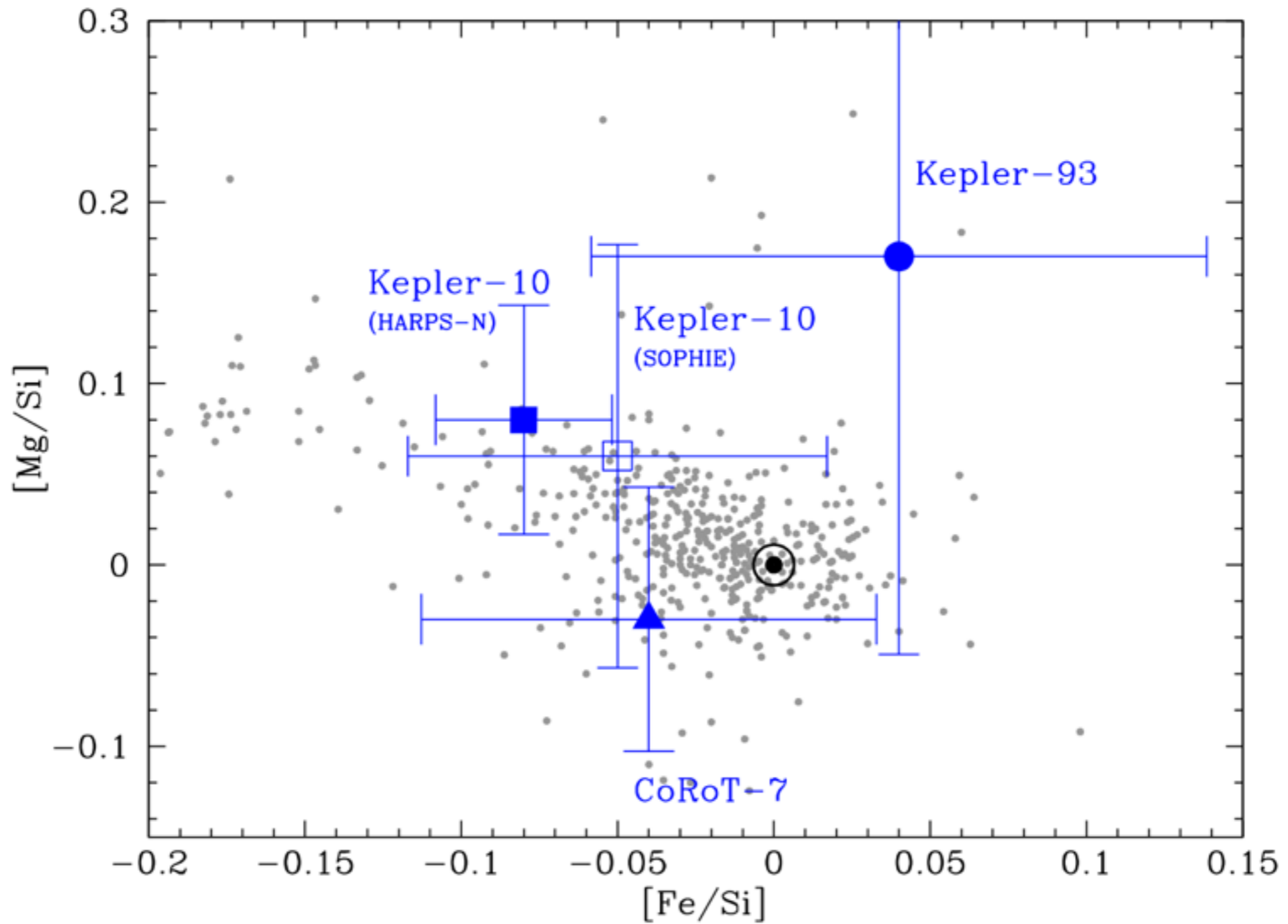


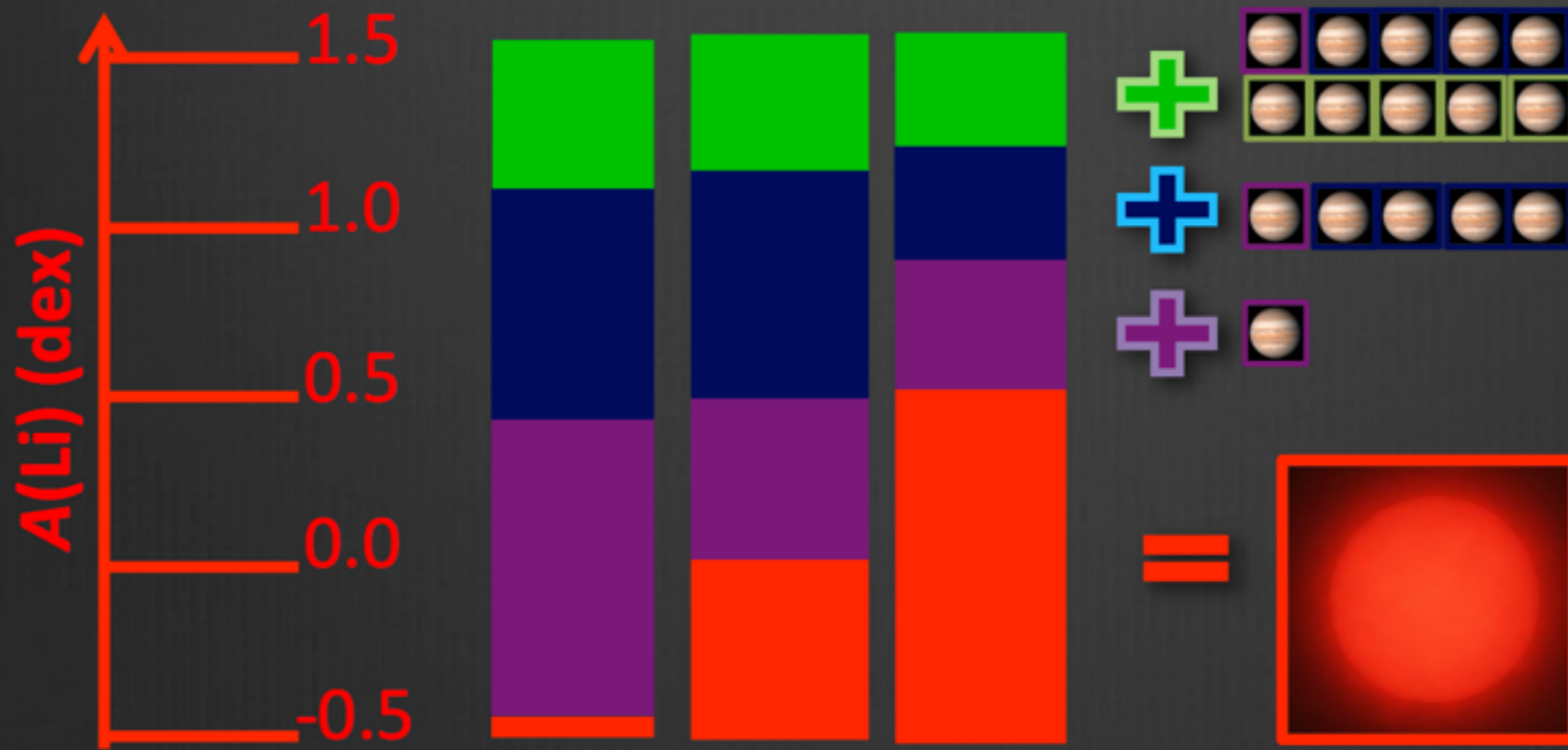
Figure: Santos et al. 2015.

Vardan Adibekyan (Instituto de Astrofísica)

Planet Forming Elements

Use red giants to view abundances in engulfed planets.

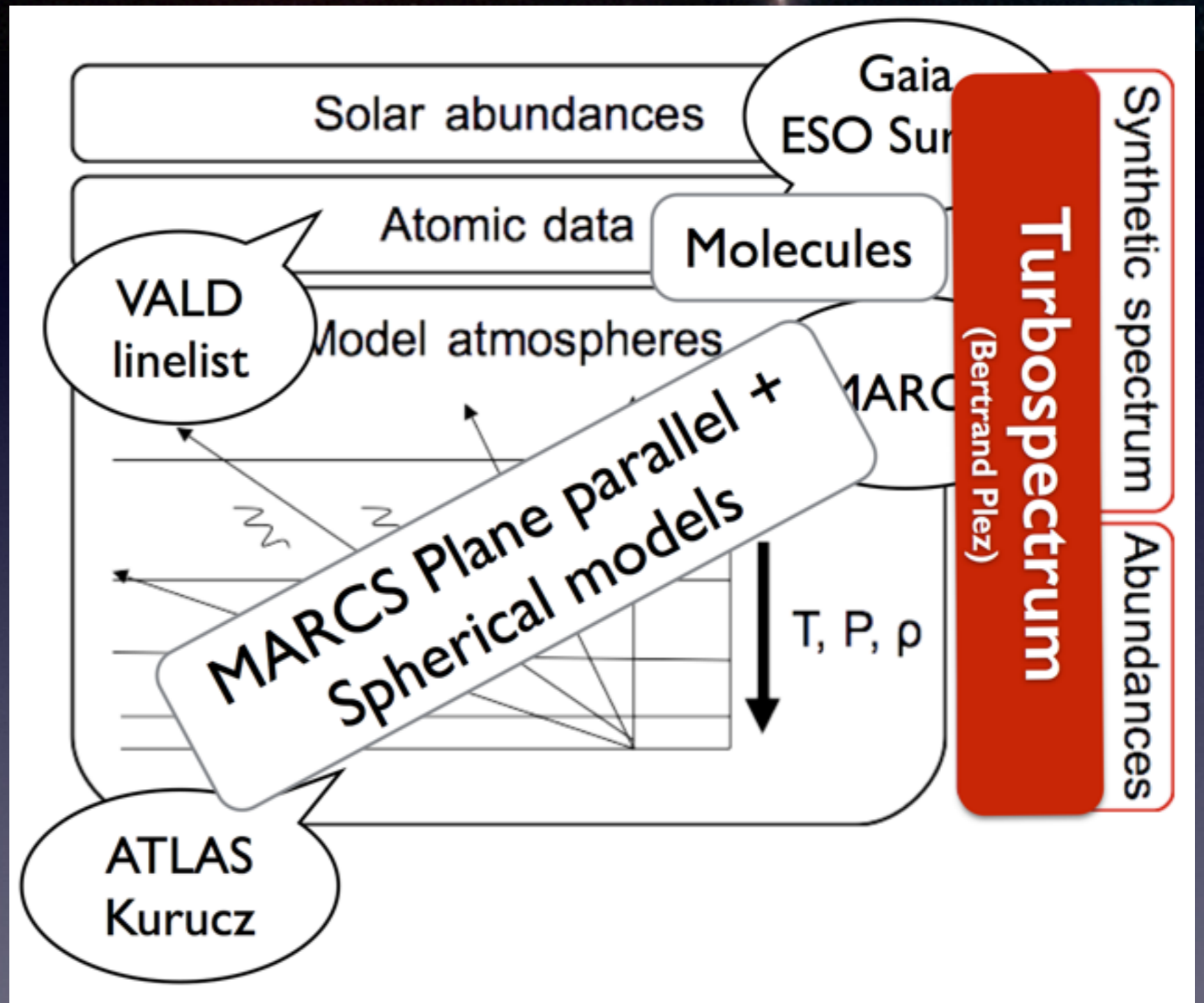
- ☾ Light elements (Li, Be, B) are depleted in red giants
- ☾ Thus, replenished Li, Be, B = planet engulfment candidate



Joleen Carlberg (NASA GSFC)

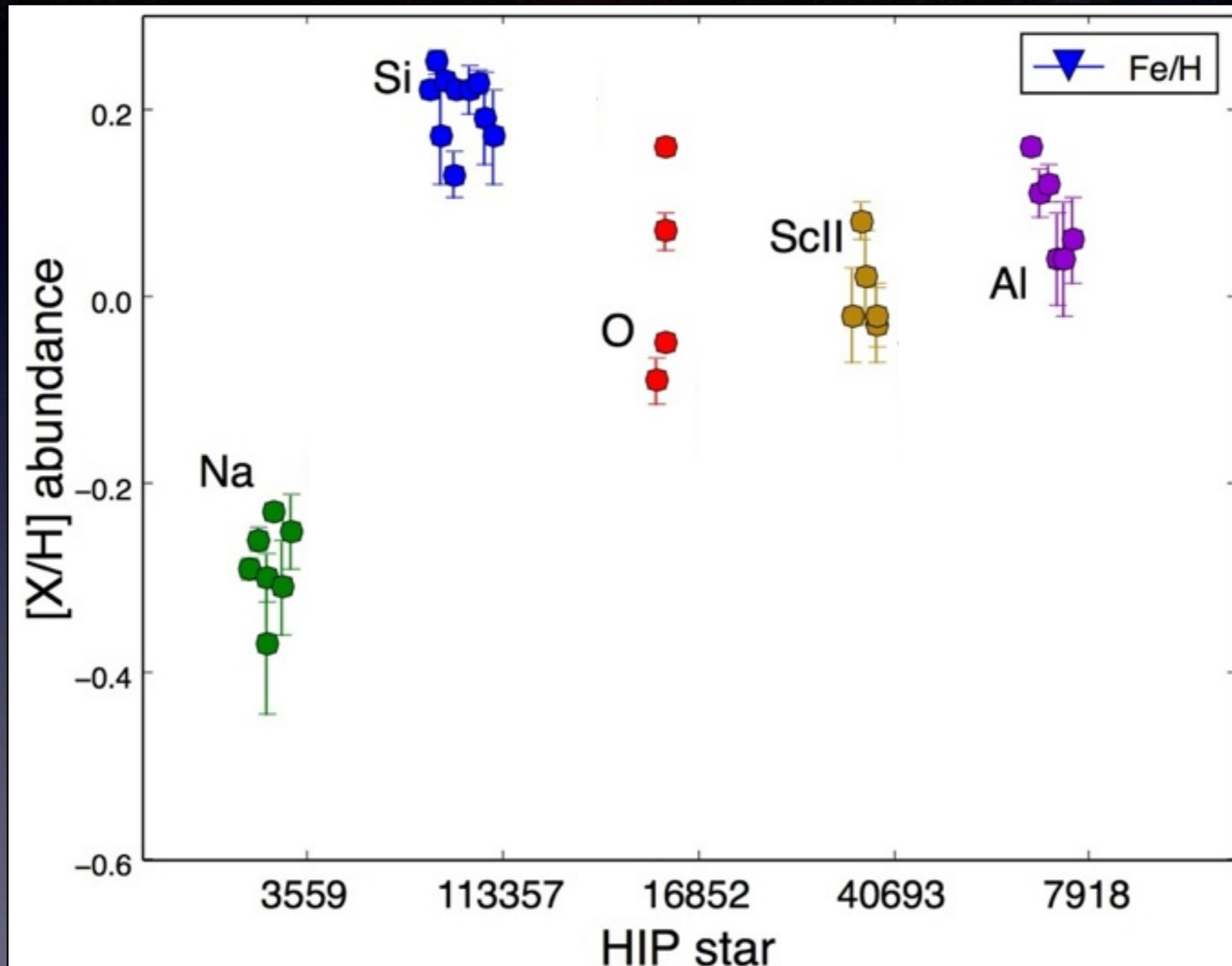
What do we *really* know?

Wide variety of models and tools to determine abundances (shown here for iSpec).



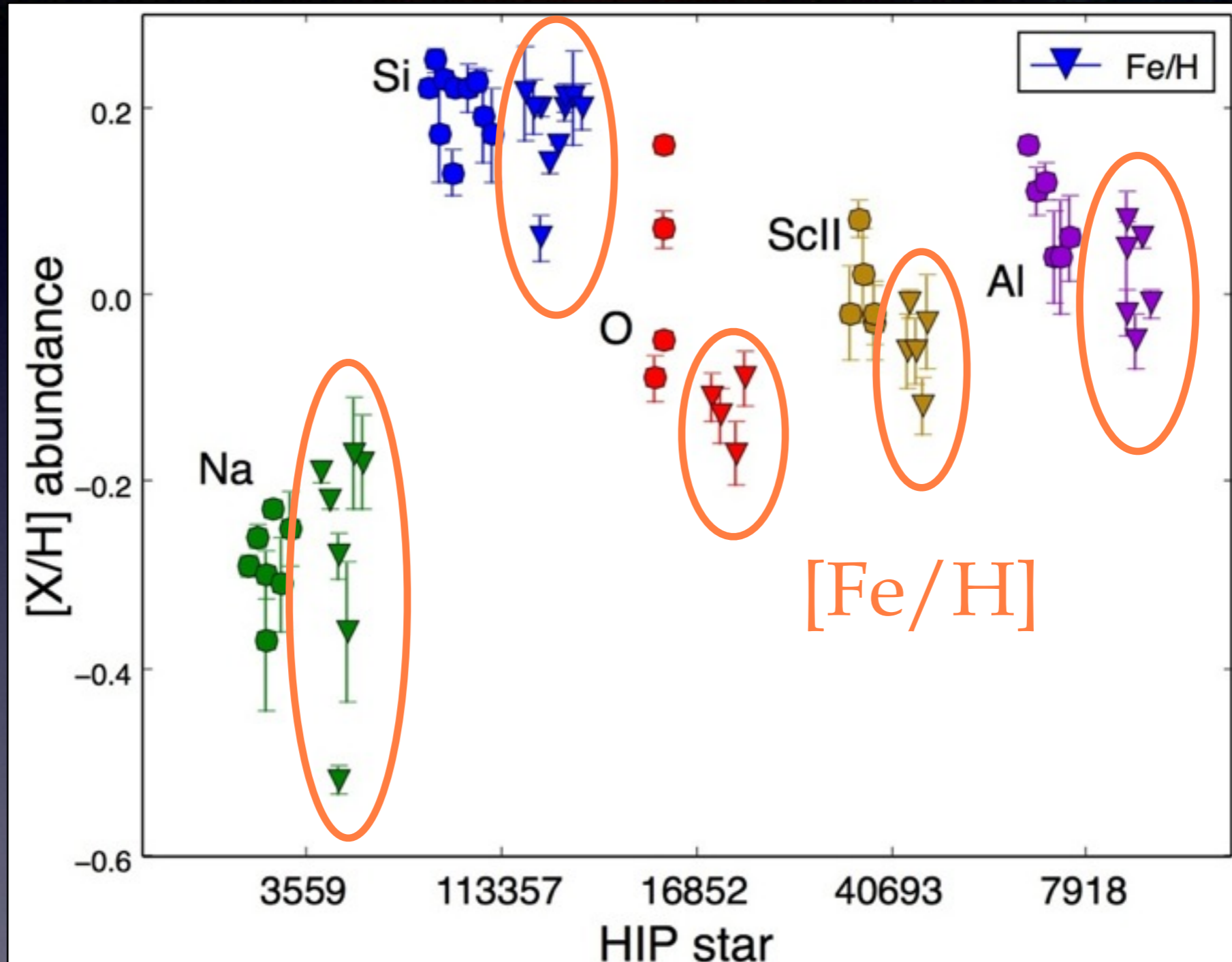
Sergi Blanco-Cuaresma (Université de Genève)

...still figuring that out.



Hinkel et al. (2014)

...still figuring that out.



Hinkel et al. (2014)

Silver Lining

Whatever is the nature of open cluster Ba enhancement, we can exploit it as an indication of youth and/or membership..

Valentina D'Orazi (INAF)

A COMPARISON OF STELLAR ELEMENTAL ABUNDANCE TECHNIQUES AND MEASUREMENTS

NATALIE R. HINKEL¹, MICHAEL D. PAGANO¹, PATRICK A. YOUNG¹, STEVEN J. DESCH¹, ARIEL D. ANBAR¹, VARDAN ADIBEKYAN², SERGI BLANCO-CUARESMA³, JOLEEN CARLBERG^{4, 5}, ELISA DELGADO MENA², BENGT EDVARDSSON⁶, PIETER GRUYTERS^{6, 7}, ULRIKE HEITER⁶, ANDREAS KORN⁶, FAN LIU⁸, THOMAS NORDLANDER⁶, NUNO C. SANTOS^{2, 9}, CAROLINE SOUBIRAN¹⁰, SERGIO G. SOUSA²

...in prep.

Summary

There are a number of basic un-answered questions:

- ➔ What is the “precise” $[X/H]$ abundance of a star?
- ➔ Is the Sun typical?
- ➔ Is there a chemical difference between stellar hosts and non-hosts? Planetary mass difference?
- ➔ What elements are important for planet formation?

But the community is working together to come to some resolution.