Galactic stellar populations and planets for the HARPS GTO sample

Elisa Delgado Mena
Centro da Astrofisica da Universidade do Porto

and V. Zh. Adibekyan, N.C. Santos,
S. Sousa, G. Israelian, J.I. González Hernández,
M. Mayor, G. Khachatryan

Data

Na, Mg, Al, Si, Ca, Ti, Cr, Ni, Co, Sc, Mn and V for:

- 135 stars with planets from homogeneous high S/N HARPS GTO sample (26 of them host exclusively Neptunians and super-Earths)
- 976 stars from HARPS GTO comparison sample
- Precise stellar parameters from Sousa et al. (2008, 2011a, 2011b)

$4500\ K < T_{eff} < 6500\ K$

$-1.40 < [Fe/H] < 0.55$

Adibekyan et al. (2011, A&A, 535, L11)

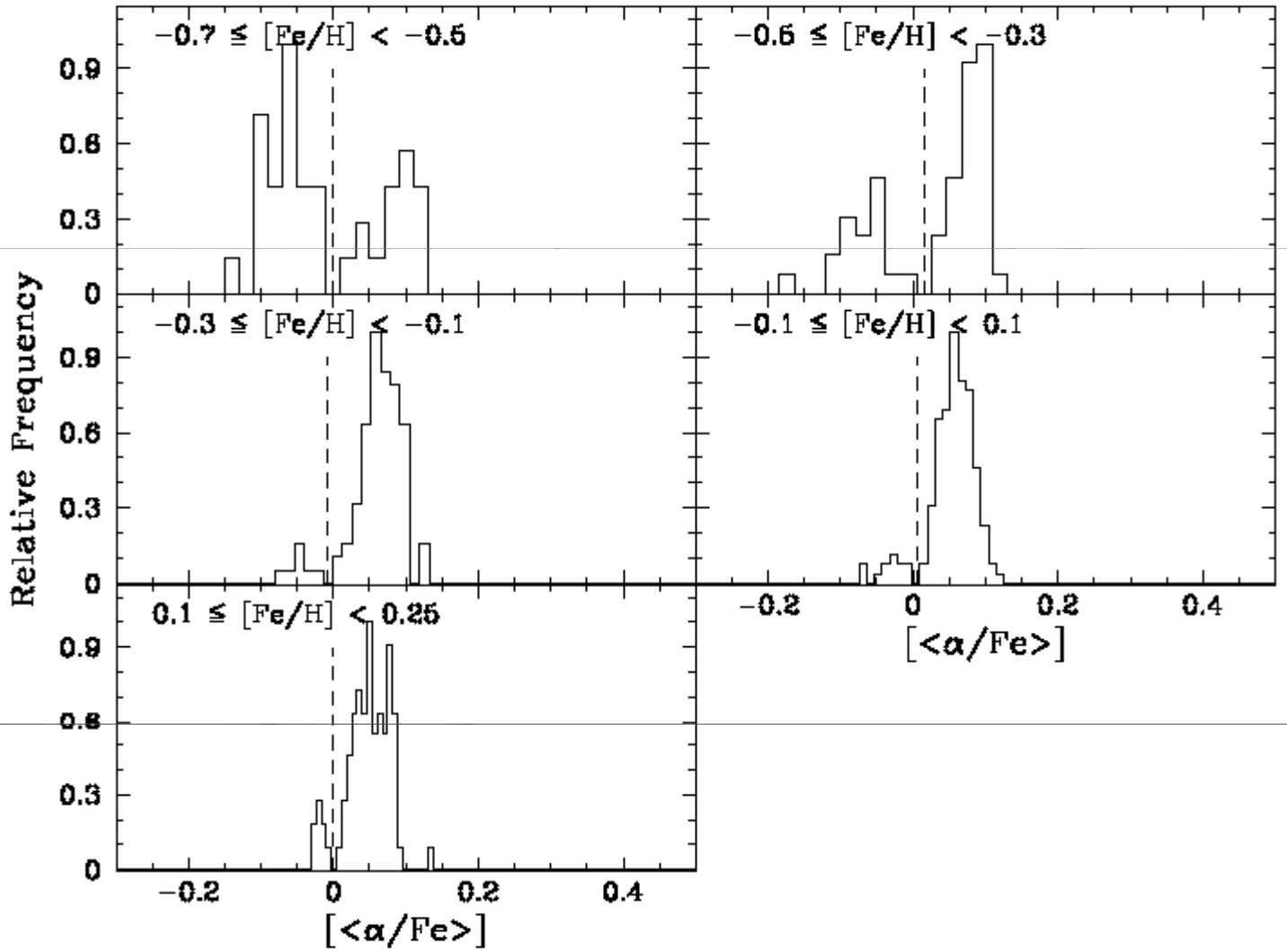
Adibekyan et al. (2012, A&A, submitted)

Main goal: Search for differences in planet host stars using HARPS complete survey with 1111 stars.

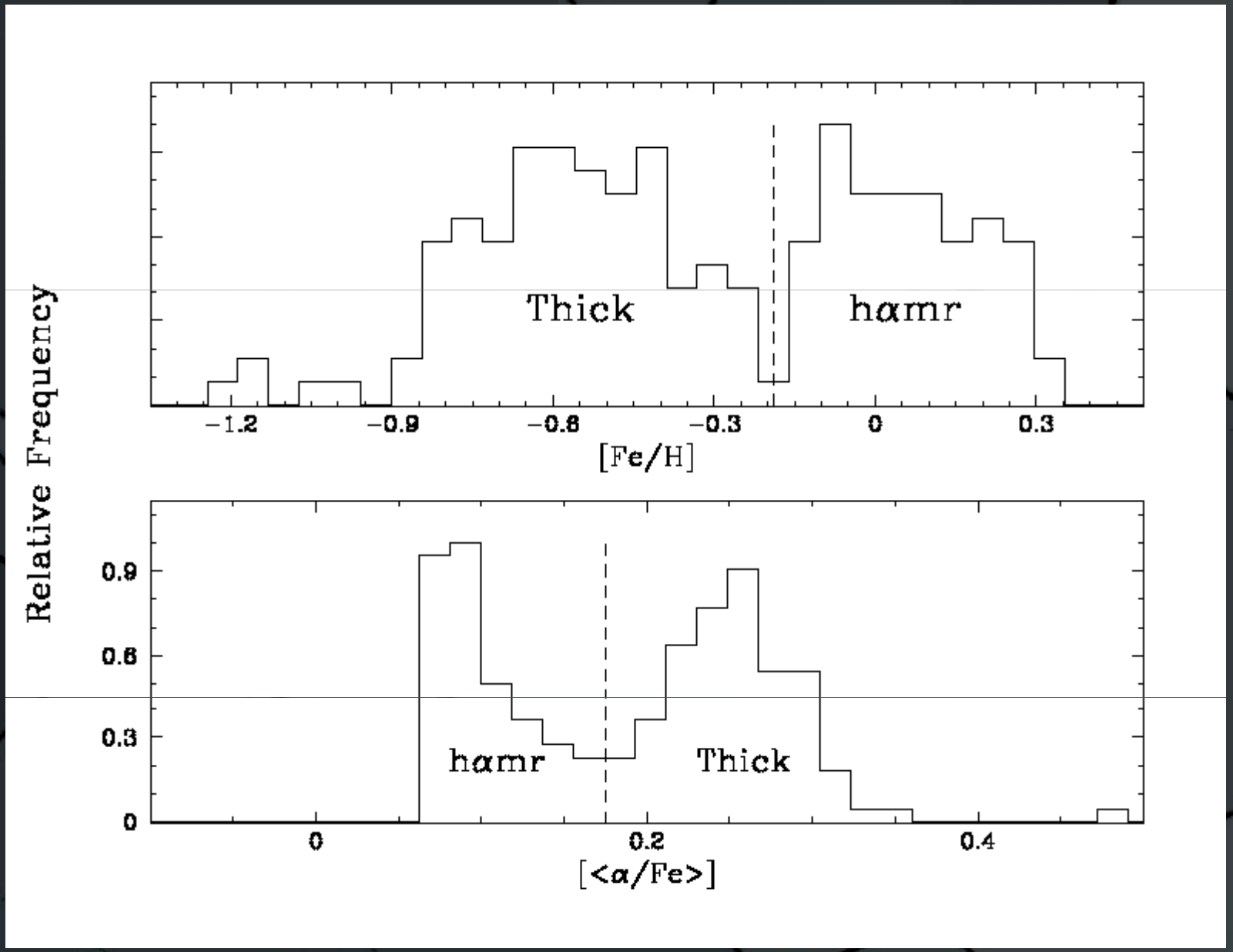
New population: High-alfa metal rich stars (-0.2 < [Fe/H] < 0.3)→ Soubiran & Girard (2005)
Separation based on minima of histograms of [α/Fe] and [Fe/H] distributions for stars with T_{sun} ± 300K
Stars with thin disk kinematics but thick disk ages and high [α/Fe] values.

At higher metallicities bulge stars are more α-enhanced than thin disk stars (Fullbright 2007, Bensby 2010, Alves-Brito 2010)

Link with inner disk→radial migration?



Adibekyan et al. (2011)



Adibekyan et al. (2011)

Main goal: Search for differences in planet host stars using HARPS complete survey with 1111 stars.

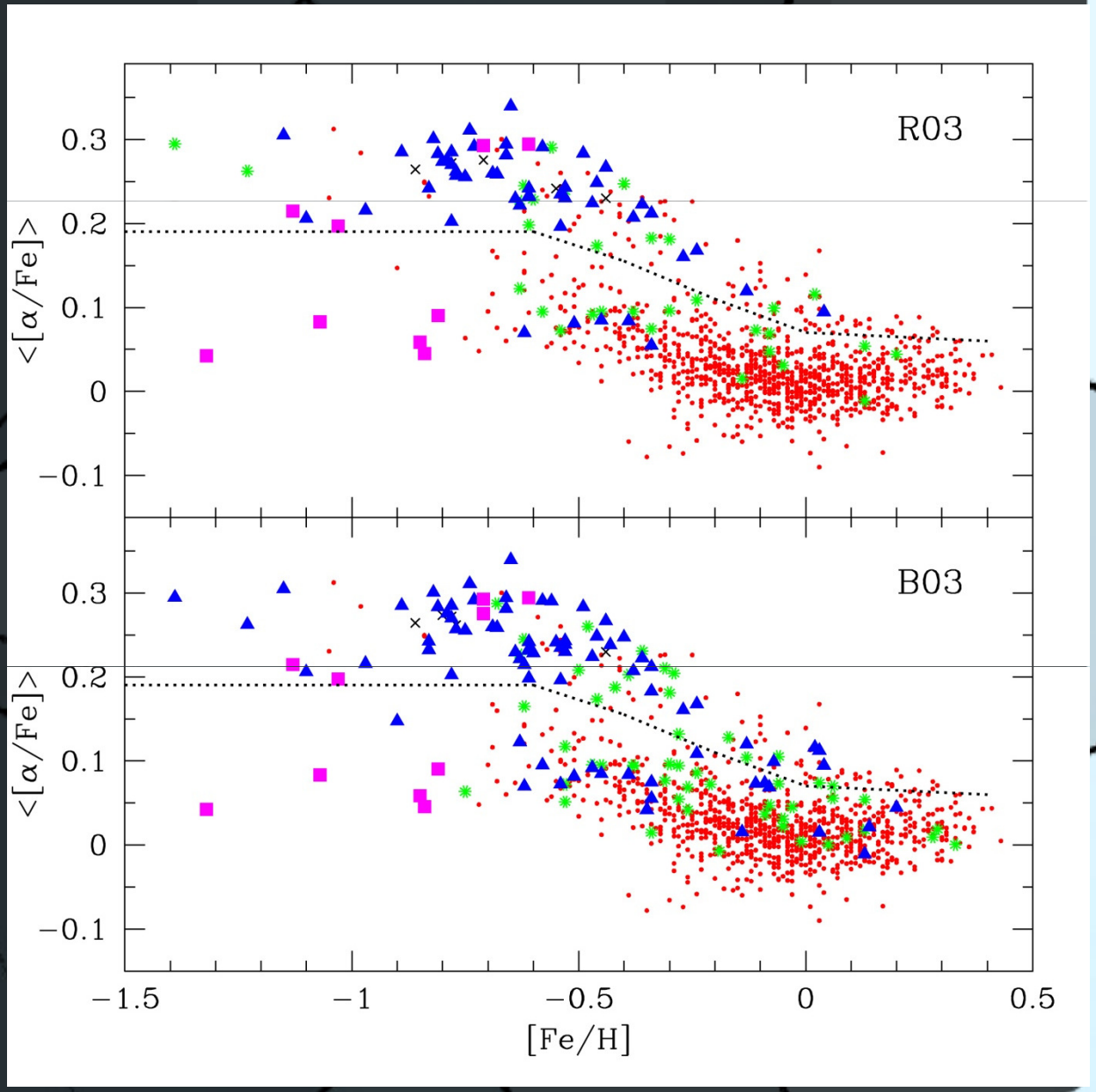
New population: High-alfa metal rich stars (-0.2 < [Fe/H] < 0.3)
Separation based on minima of histograms of [α/Fe] and [Fe/H] distributions for stars with T_{sun} ± 300K
Stars with thin disk kinematics but thick disk ages and high [α/Fe] values.

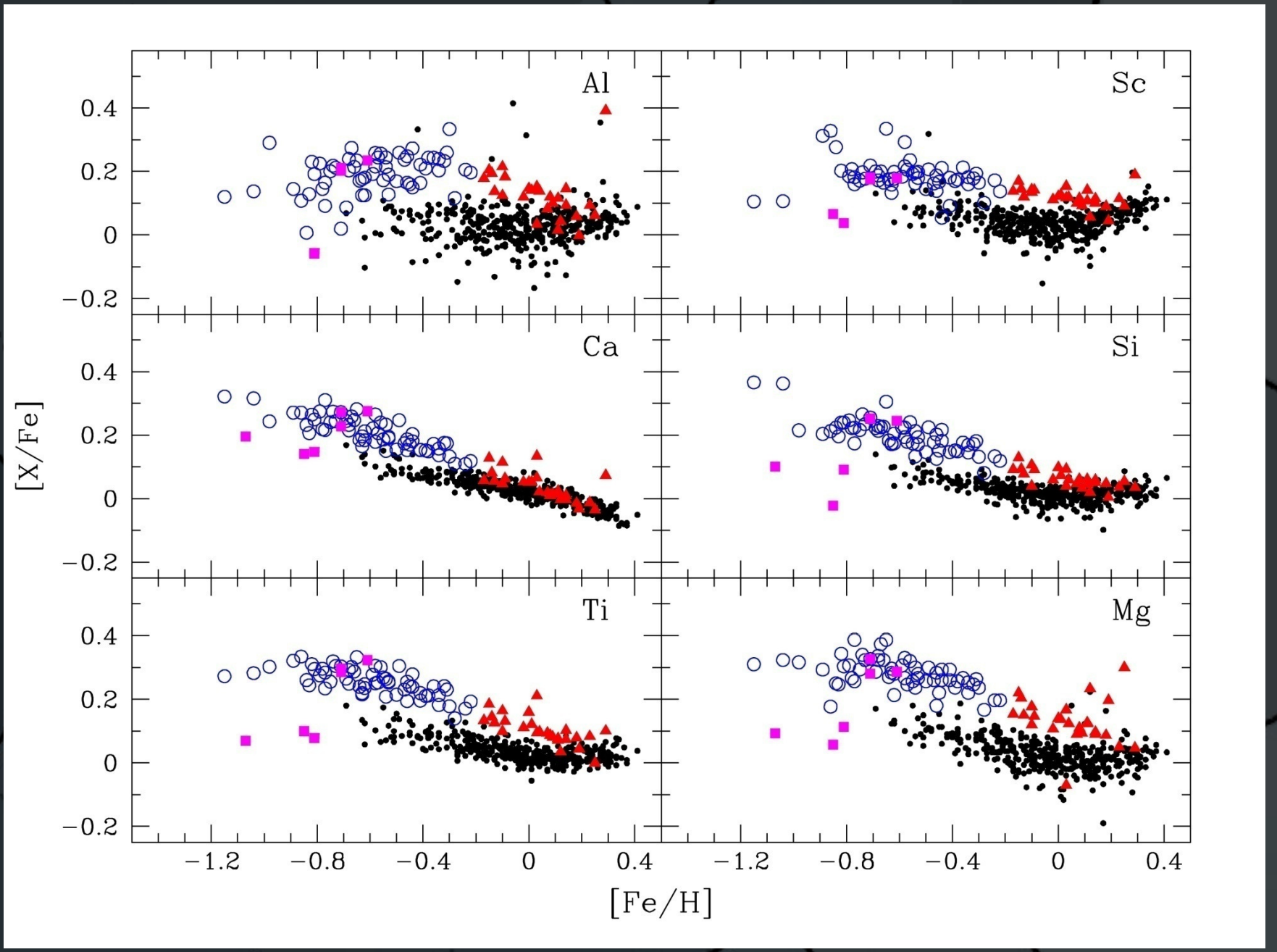
At super-solar metallicities bulge stars are more α-enhanced than thin disk stars (Fullbright 2007, Bensby 2010, Alves-Brito 2010)

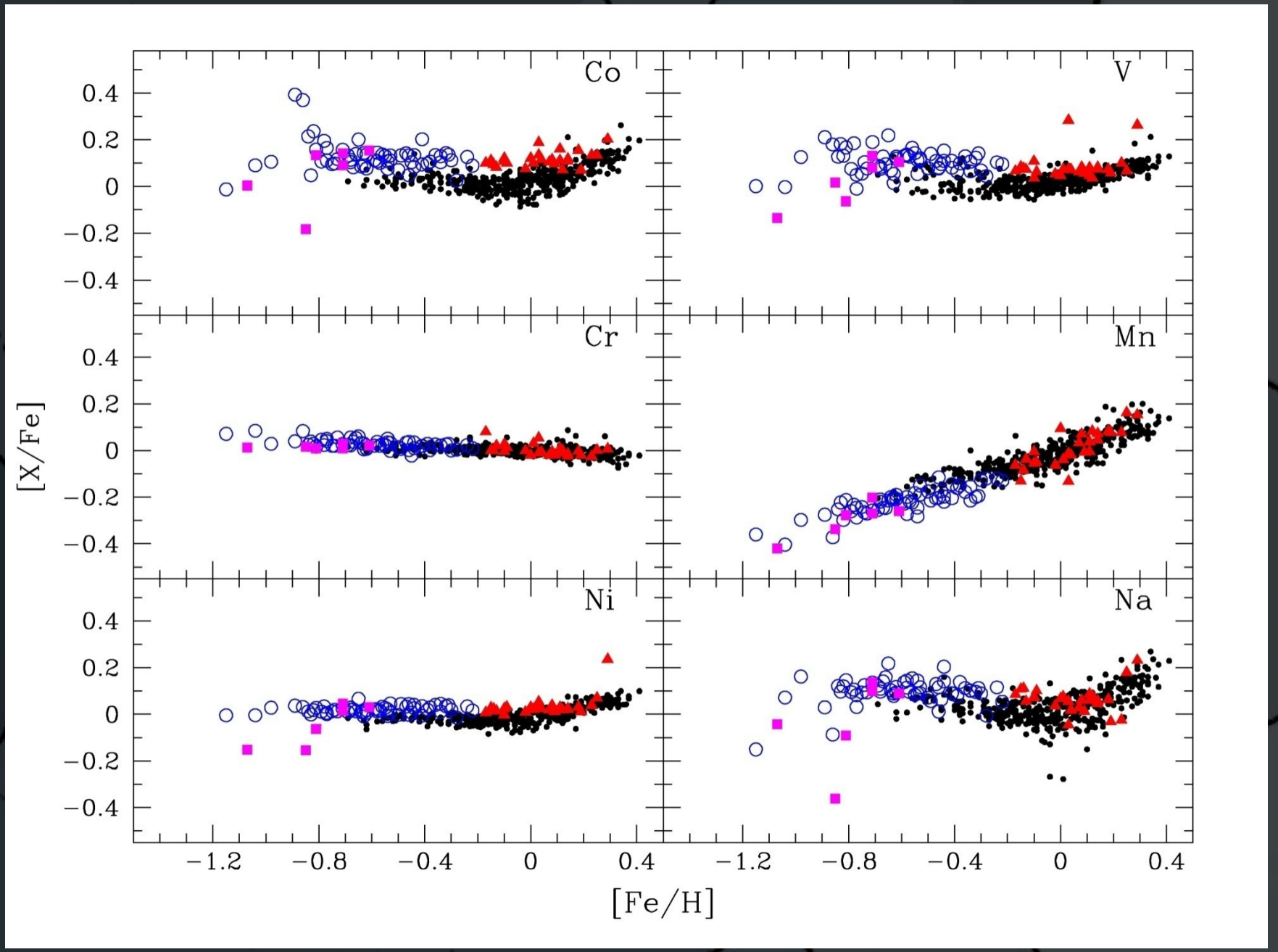
Link with inner disk→ radial migration?

Kinematical separation based on Robin (2003) and Bensby (2003)→ contamination

- Thin disc
- Thick disc
- Trans. Thin-thick
- Trans. Thick-halo
- Halo

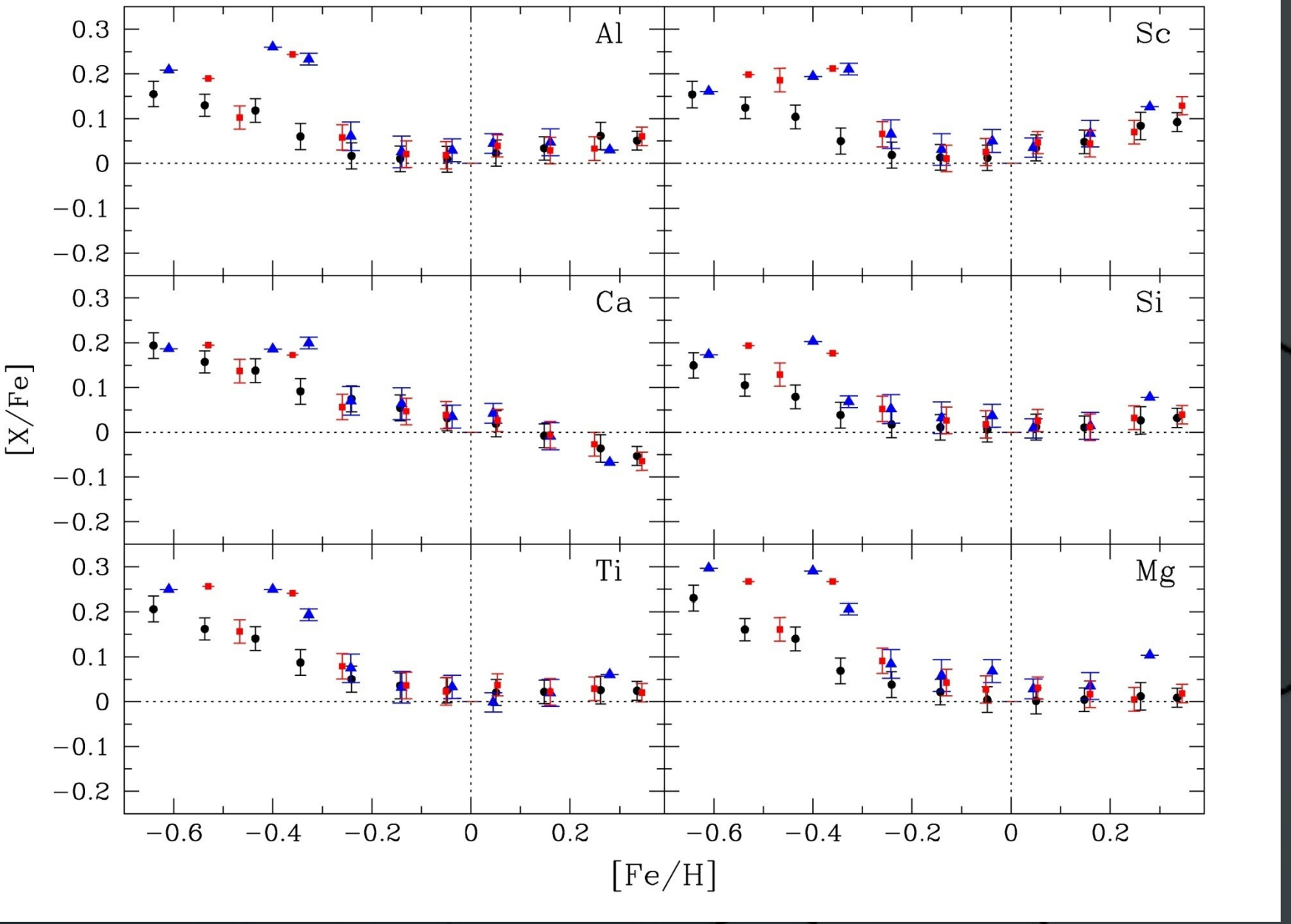


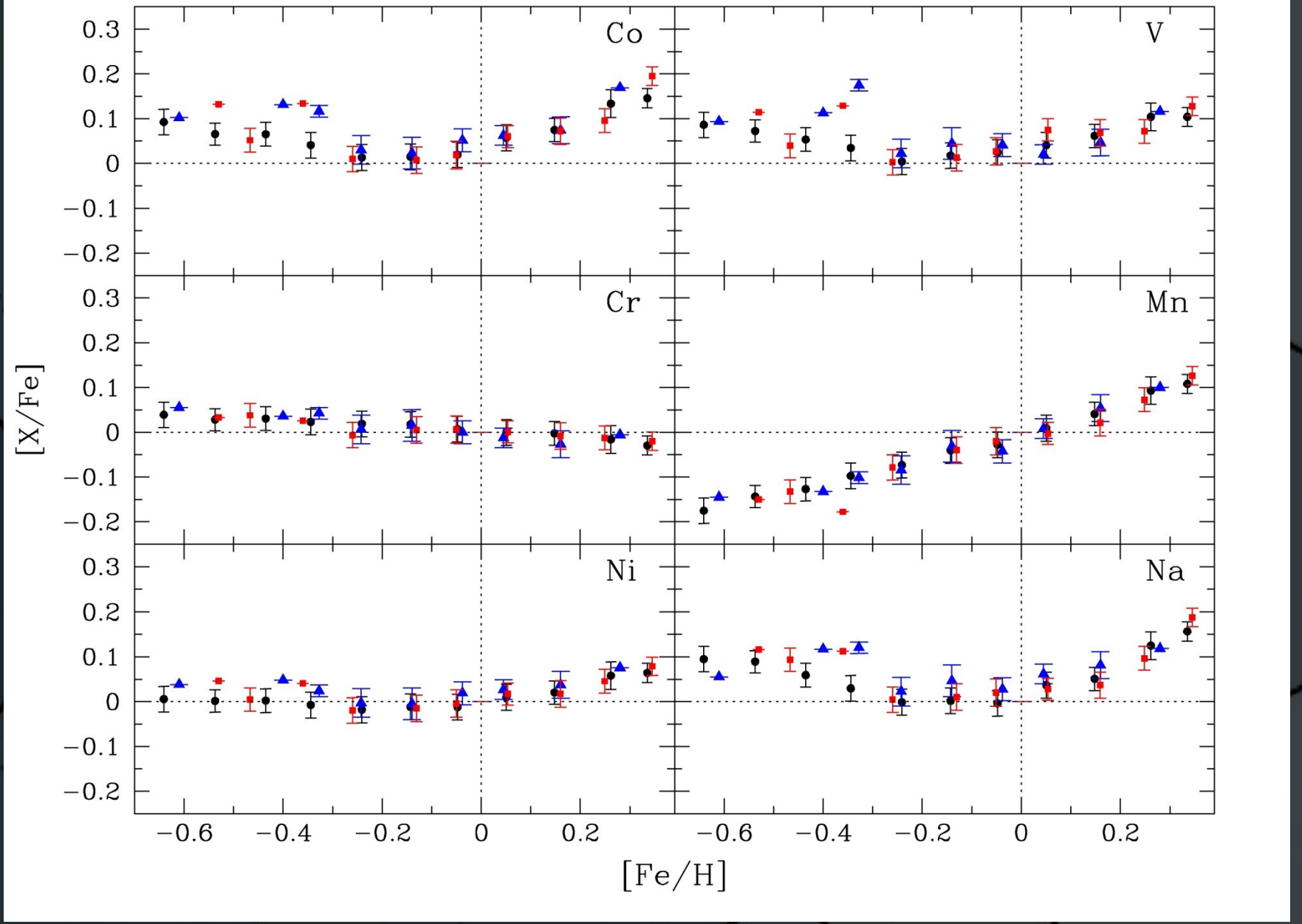

Al
Sc
Ca
Si
Ti
Mg
[X/Fe]
[Fe/H]
0.4
0.2
0
−0.2
−1.2
−0.8
−0.4
0
0.4


Co
V
Cr
Mn
Ni
Na
[X/Fe]
[Fe/H]
0.4
0.2
0
−0.2
−0.4
−1.2
−0.8
−0.4
0
0.4

Are stars with planets chemically different?

- Giant planet hosts show general overabundances [X/H] due to its higher metallicity
- Several works found higher [X/Fe] for stars with planets with respect to stars without planets at the same metallicity→ no clear conclusion
- We confirm that frequency of stars with giant planets increases with higher abundances but not for Neptunian hosts.
- Most of the Neptunian hosts present [Al/Fe], [Sc/Fe], [Si, Fe] and specially [Mg/Fe] higher than 0 → some metals other than iron are involved in process of planet formation specially when [Fe/H] is low.

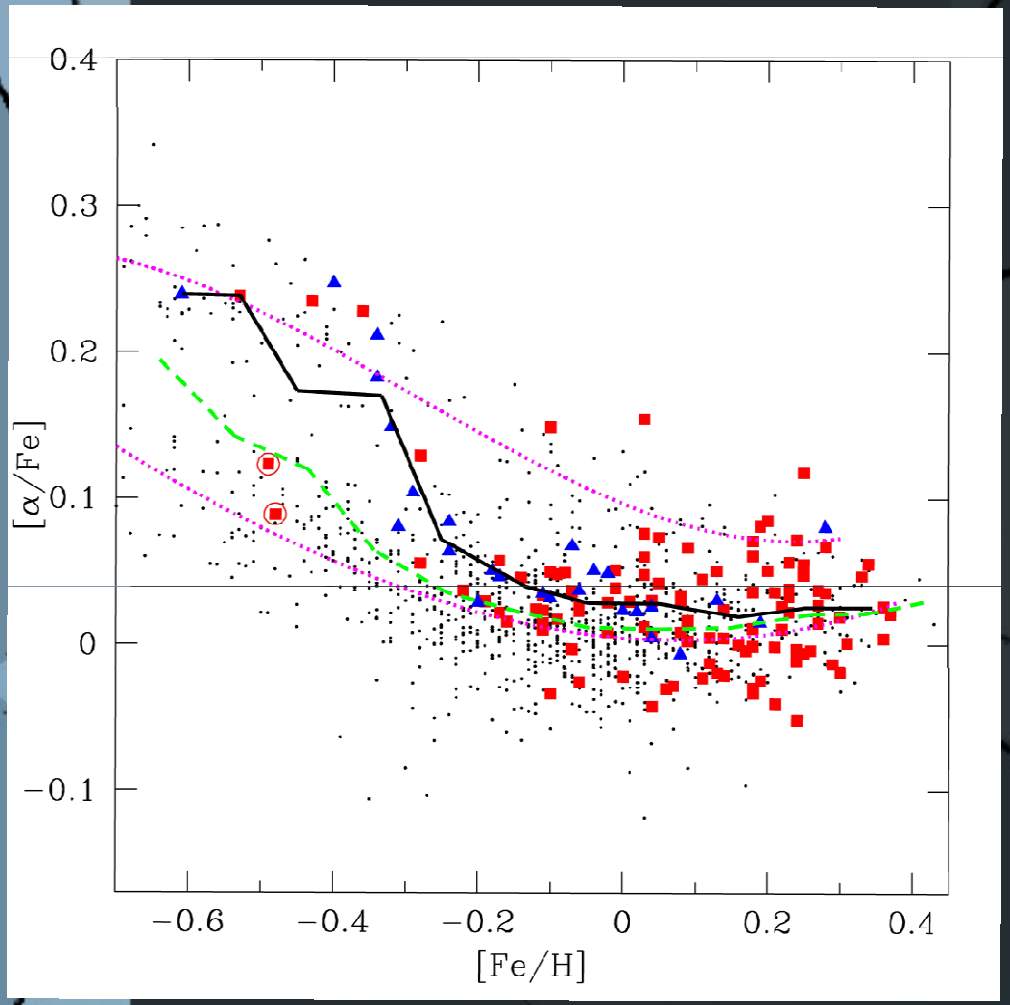

Al
Sc
Ca
Si
Ti
Mg
[X/Fe]
[Fe/H]
0.3
0.2
0.1
0
−0.1
−0.2
−0.6
−0.4
−0.2
0
0.2

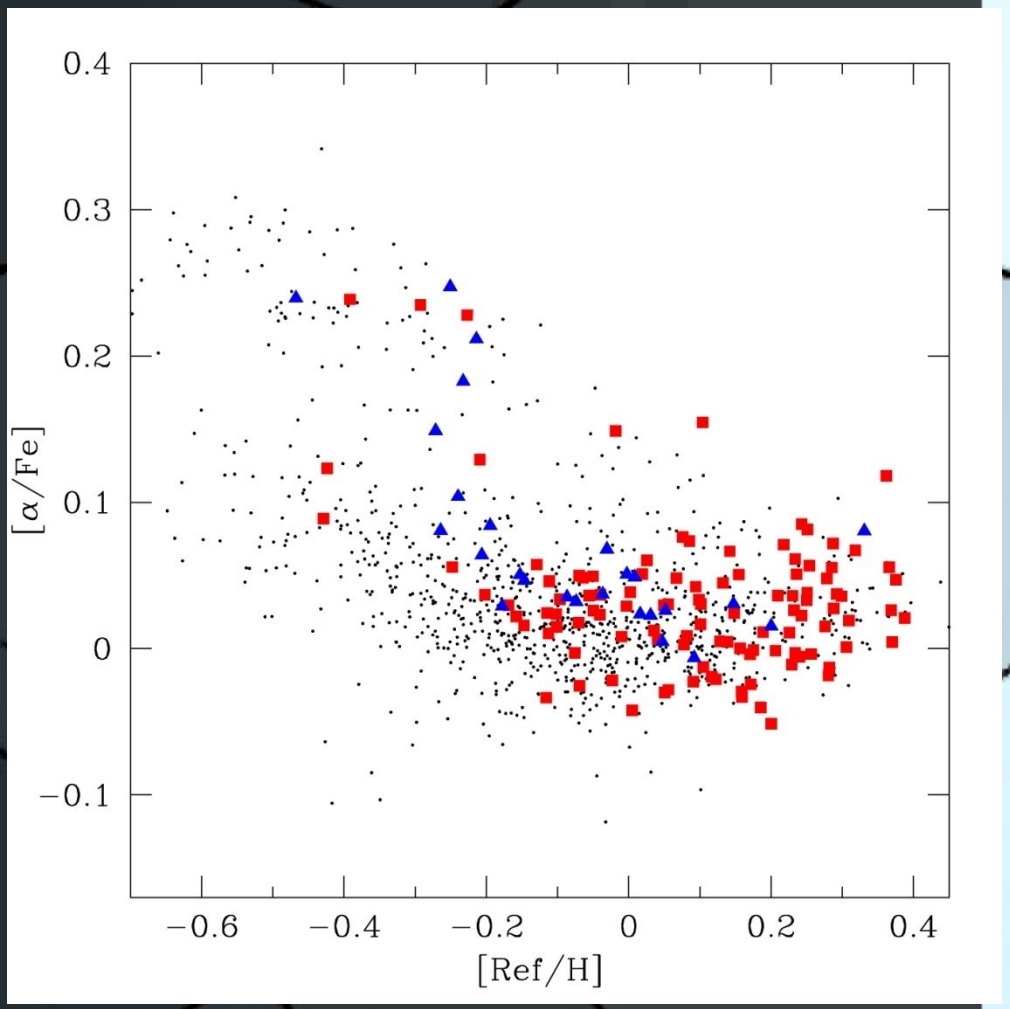

Co
V
Cr
Mn
Ni
Na
[X/Fe]
[Fe/H]
0.3
0.2
0.1
0
−0.1
−0.2
−0.6
−0.4
−0.2
0
0.2

Planet formation

- Giant planet incidence is greater among the thick disc for [Fe/H] < -0.3 (Haywood, 2009) → The main parameter for determining planet formation is the galactocentric distance and not [Fe/H]→molecular H ?
- There is no difference between planet hosts if using [Ref] index instead [Fe/H] (Gonzalez 2009; Adibekyan et al, 2012). Thin and thick distributions are the same (at low metallicities).

Planet formation





Planet formation

- Giant planet incidence is greater among the thick disc for [Fe/H] < -0.3 (Haywood, 2009) → The main parameter for determining planet formation is the galactocentric distance and not [Fe/H]→molecular H ?
- There is no difference between planet hosts if using [Ref] index instead [Fe/H] (Gonzalez 2009; Adibekyan et al, 2012). Thin and thick distributions are the same (at low metallicities).
- A certain chemical composition is required for planet formation.

Summary

- New population of high alfa metal rich stars with metallicities and dynamics of think disk but [α/Fe] abundances and ages typical of thick disk. Possible origin from the inner disk.
- These stars show differents [X/Fe] trends than thin disk stars for some elements.
- Stars with planets are α-enhanced at lower metallicities indicating that a certain amount of these elements is necessary for planet formation when [Fe/H] is low.

Thanks!

Kinematical clasification