EXOPLANETS: GAIA AND THE IMPORTANCE OF GROUND BASED SPECTROSCOPY FOLLOW-UP

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Outline

- Astrometry in synergy with radial velocity
- Chemical abundances and kinematics of G-, K-type field giants
- The contribution of Gaia data

Radial Velocity - Astrometry

- **RV**:
  - lower limit to the mass of the planet (msin***i***)
  - low-mass planets
  - more sensitive to planets **close** to the star (signal scales with 1/√a)

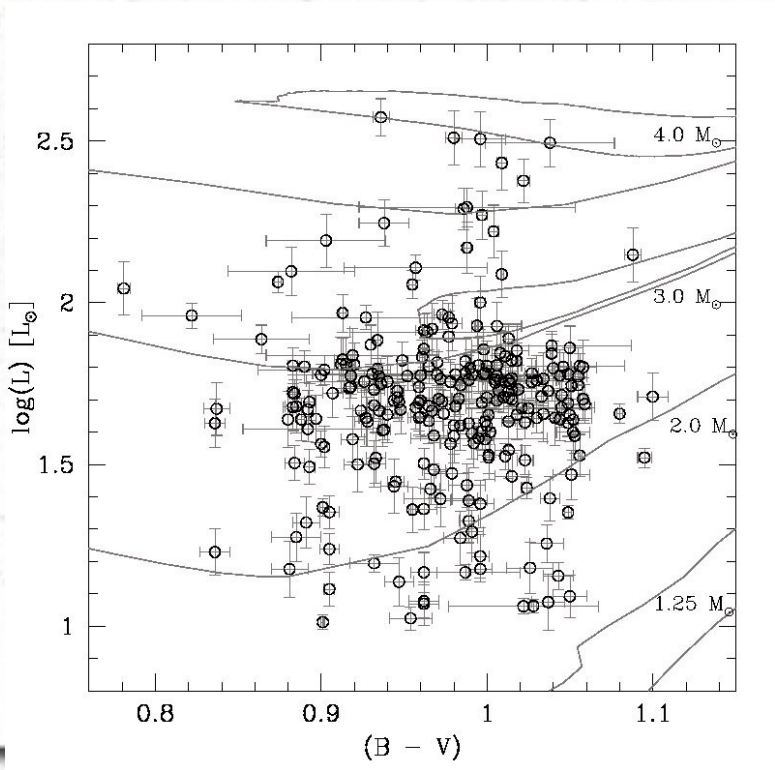
- **ASTROMETRY**:
  - inclination ***i*** of the orbital plane with respect to the plane of the sky and the position angle Ω of the line of nodes in the plane of the sky
  - long period planets
  - giants around active young stars
  - more sensitive to planets **far** from the star (signal scales linearly with the semimajor axis (a))

The giant stars sample

- a sample of evolved stars from the CORALIE extra-solar planet search program
- derived precise stellar parameters (Teff, ξ, logg, and [Fe/H])
- determined the chemical abundances for 12 elements (Na, Mg, Al, Si, Ca, Ti, Cr, Ni, Co, Sc, Mn, and V)

The parameters

- effective temperatures 4700 ≤ Teff ≤ 5600 K,
- surface gravities 2.2 ≤ log g ≤ 3.7 dex,
- microturbulence 1 ≤ ξt ≤ 3.2 km/s and
- in the metallicity range of -0.75 ≤ [Fe/H] ≤ 0.3 dex (Alves et al. 2014).



The motivation

- help us shed light on the statistical and evolutionary properties of planetary systems around giant stars

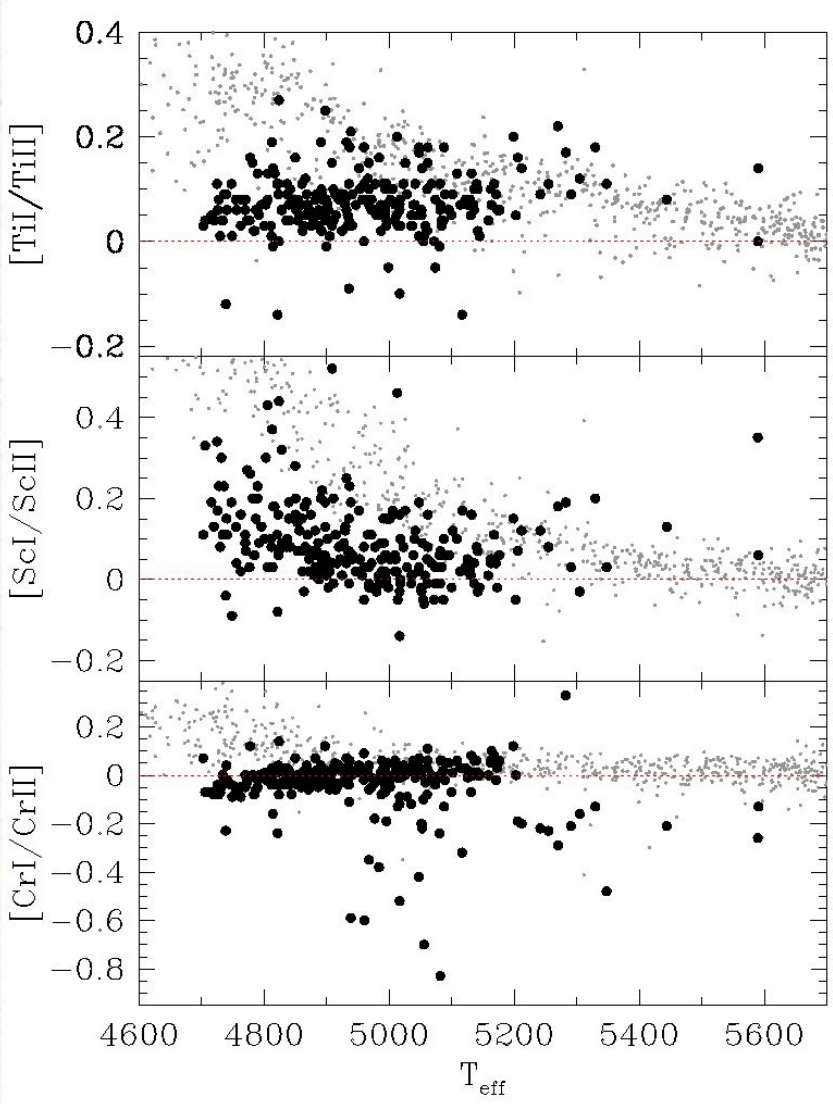
- no correlation between stellar metallicity and formation efficiency of giant planets (e.g., Pasquini et al. 2007)

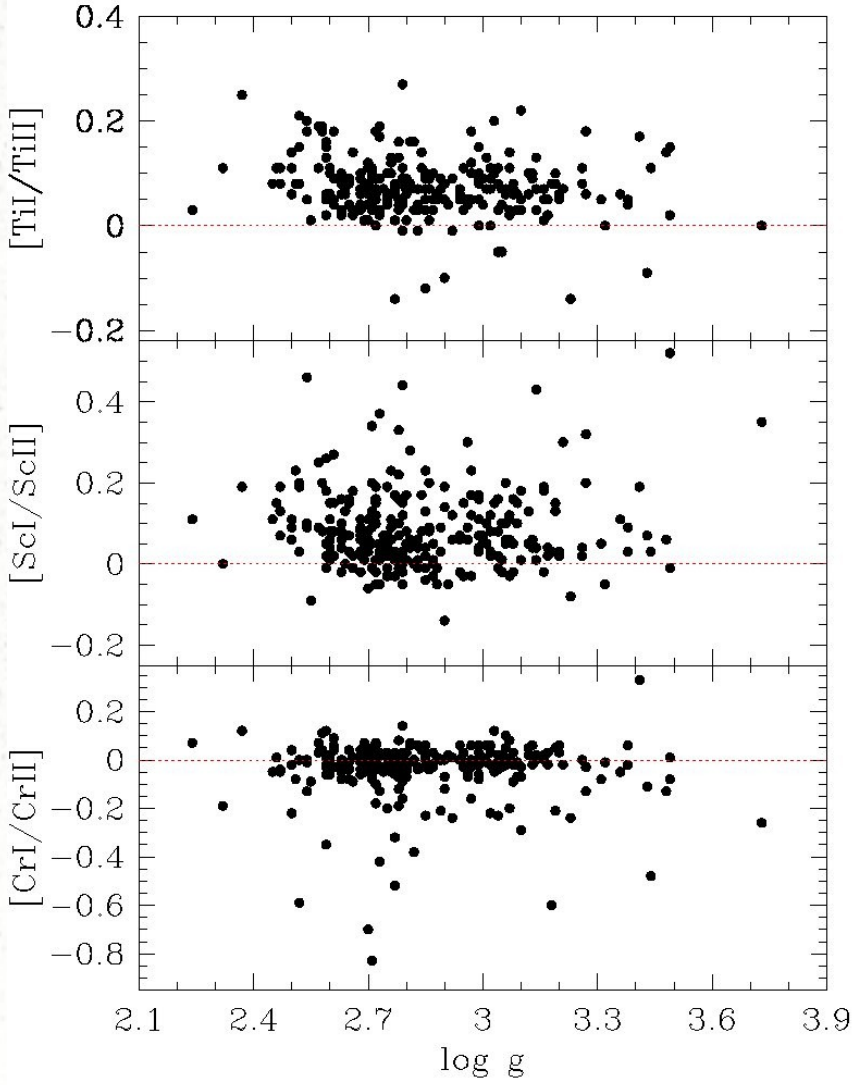
higher stellar mass of giants may compensate the lack of metals (e.g. Ghezzi et al. 2010)

possible spectroscopic analysis issues in giant stars (e.g. Santos et al. 2009)

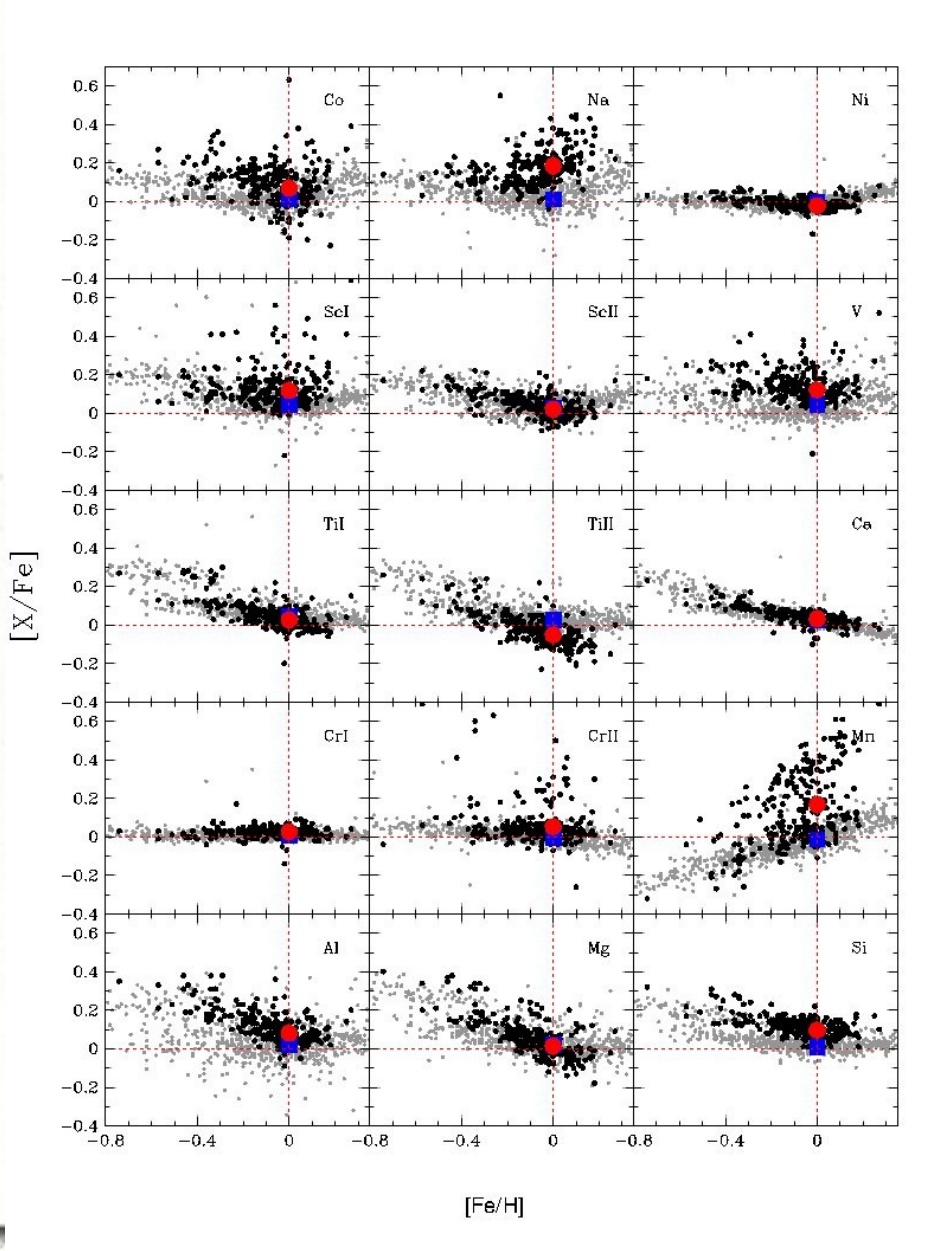
selection biases in giant star samples (Mortier et al. 2013b)

Testing the stellar parameters



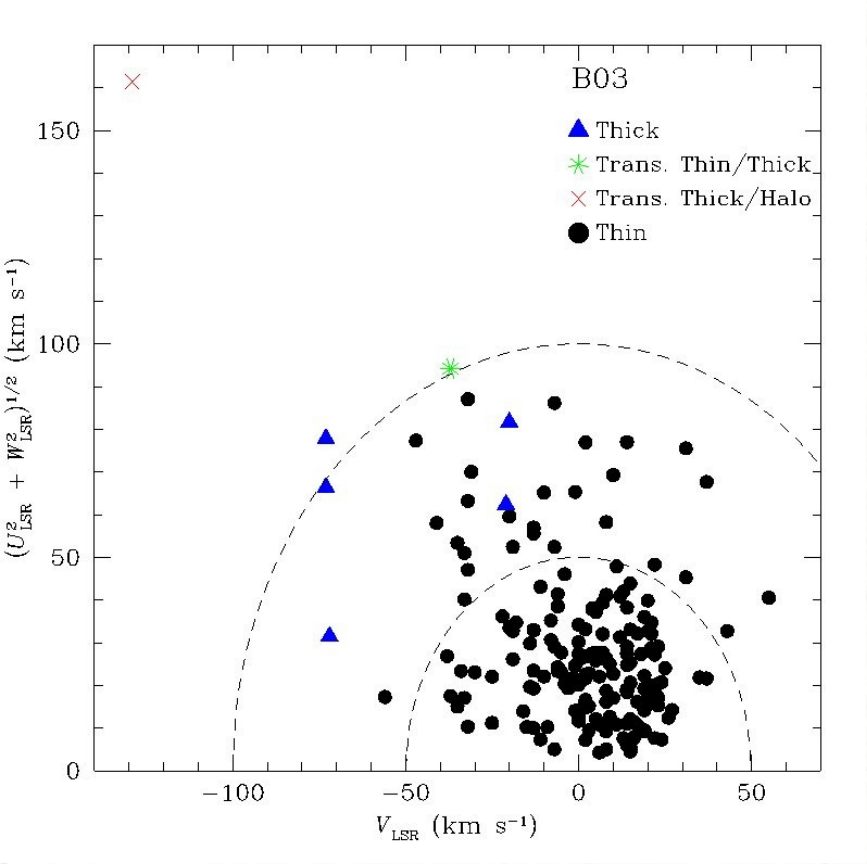


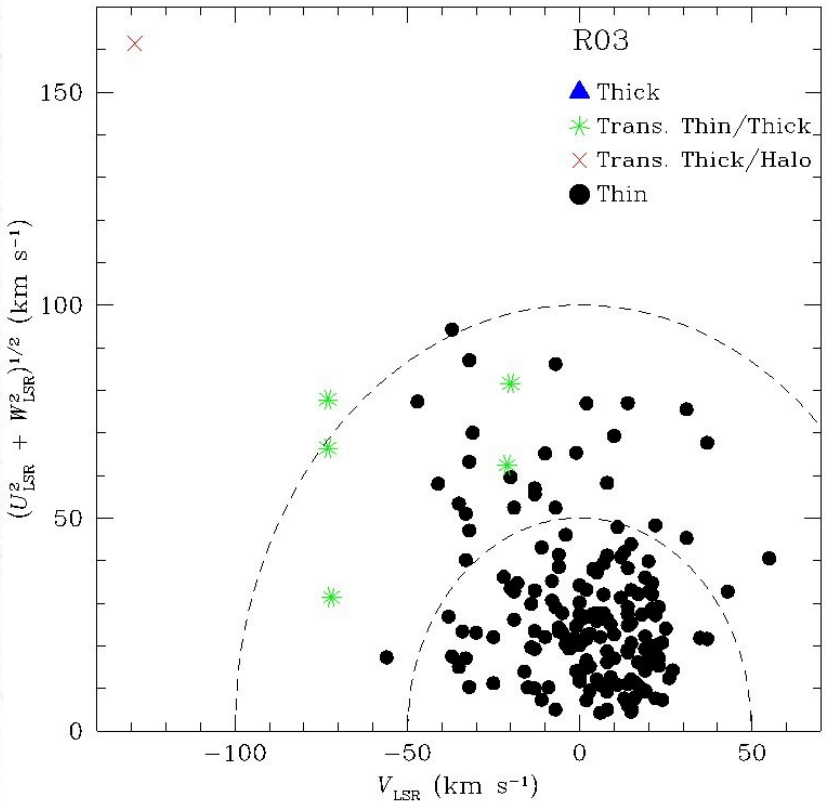
[X/Fe] vs. [Fe/H]



The **black dots** represent the stars of the sample and the **gray small dots** represent stars from Adibekyan et al. (2012b) with Teff = T_{sun} ± 500 K.
The **red circle** and **blue square** show the average [X/Fe] value of stars with [Fe/H] = 0.0 ± 0.1 dex.

Kinematics and stellar populations

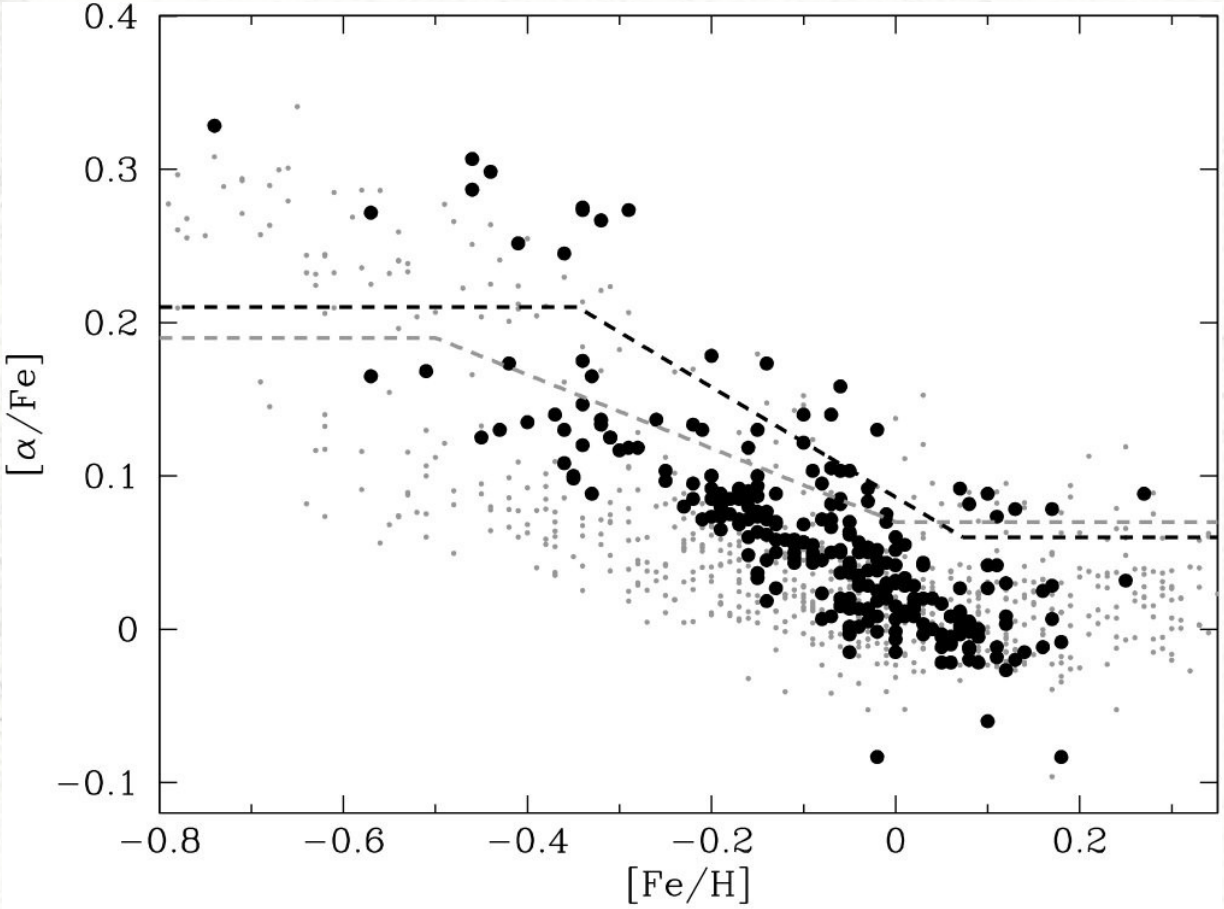




Bensby et al. (2003) ⟶ B03

Robin et al. (2003) ⟶ R03

[α/Fe] vs. [Fe/H]

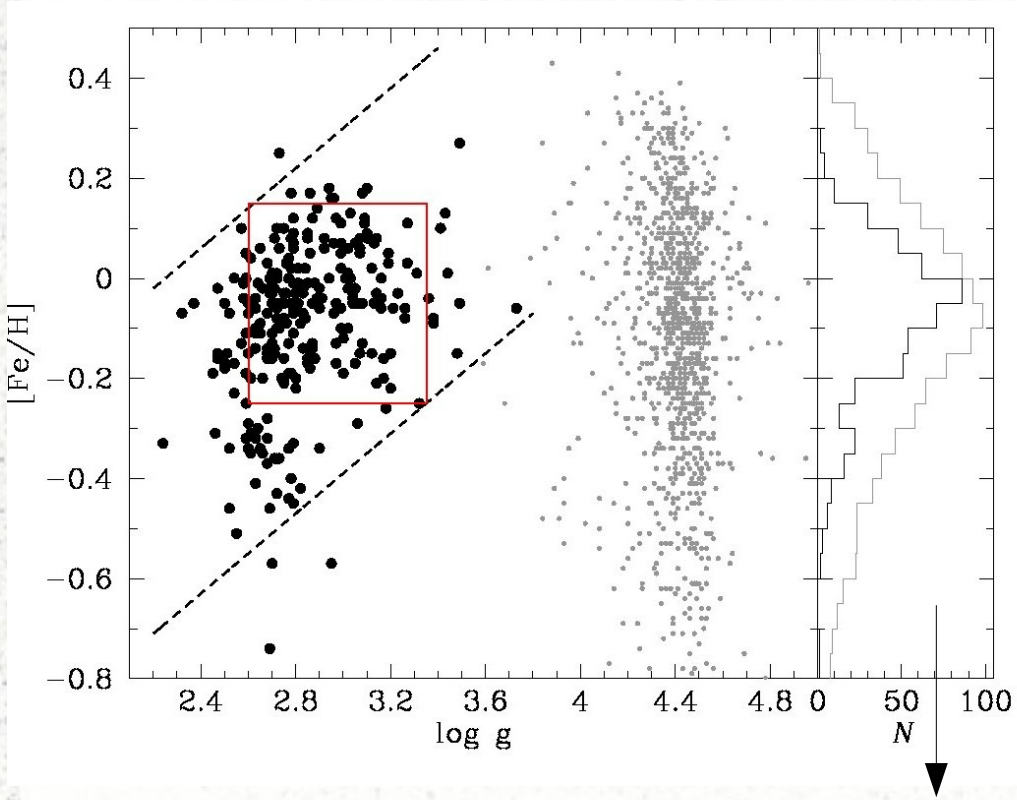


black dots = current sample

gray small dots = stars from Adibekyan et al. (2012b) with Teff = T_{SUN} ± 500 K.

The separation between the thick- and thin-disk stars for the two samples are presented in black and gray dashed lines.

[Fe/H] vs. log g



black dots = current sample

gray dots = the stars from Adibekyan et al. 2012

The two black dashed lines = the biases in the samples due to the B-V cut-off.

The metallicity distribution of the two aforementioned samples. The distribution of the giants stars (gray line) was multiplied by 2 for the better visual comparison. The median and its standard deviation is also presented for metallicity distributions of both giants and dwarfs.

Summary of the giant sample

- only one star known to orbit a planetary companion (HD 11977)
- this sample can be used as a homogeneous comparison sample to study planet occurrence around giant stars
- Our analyis confirms the overabundance of Na (also Al and Si to a less degree) in giant stars compared to the field FGK dwarf stars from Adibekyan et al. (2012b).

Contribution of Gaia data

Besides a precise characterization of the planets, it is really important to collect information on their parent stars

- Gaia: new several thousand of giant planets measurements and knowing well the properties of the parent stars, we will able to investigate their behaviour as a function of stellar mass, metallicity, age, etc.

- accurate parallax that can help us to calculate the surface gravity with less uncertainties

THANK YOU!!!