Metallicity distribution for planet-hosting stars from Penn State - Torun Planet Search

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Planet-metallicity relation:

- the fact that giant planets hosts (solar-type dwarfs) are more metal-rich than stars without planet companions is well accepted.
- is the metallicity of host star an important factor connected to the formation of planetary system?
- is there a planet occurrence - host metallicity relation for giants?

Mechanisms of planet formation:

- core accretion (Safronov, 1960; Pollack et al., 1996) formation of planet comes from the collisional accretion of planetesimals (dependence on metallicity)
- gravitational disk instability (Bodenheimer, 1974; Boss, 1997): formation of planet comes from the collapse of an unstable part of the protoplanetary disk (NO dependence on metallicity)

Planet-metallicity relation (dwarfs):

- Fischer & Valenti (2005) concluded that there is planet-metallicity relation: occurrence of gas giant planets around FGK-type dwarfs is very sensitive to metallicity of host star.
- Santos et al. (2001) and Ghezzi et al. (2010) showed that there is planet-metallicity relation which means that gas giant planets host stars (FGK-type dwarfs) tend to be more metal-rich compared to field stars without gas giant planets.
- Johnson et al. (2010) indicated that there is planet-metallicity relation: positive metallicity-planet occurrence relation for M-dwarf host stars, however it is lower compared to solar-mass stars.
- Buchhave et al. (2012) concluded that there is planet-metallicity relation and the average metallicity for giant planets host stars (late-type dwarfs) is higher than for smaller planets.
- Wang et al. (2015) showed that there is planet-metallicity relation for planets of all sizes around metal-rich host stars ($4800K < Teff \leqslant 6500K$, $\log(g) \geqslant 4.2$) which tend to be more abundant than around metal-poor stars.

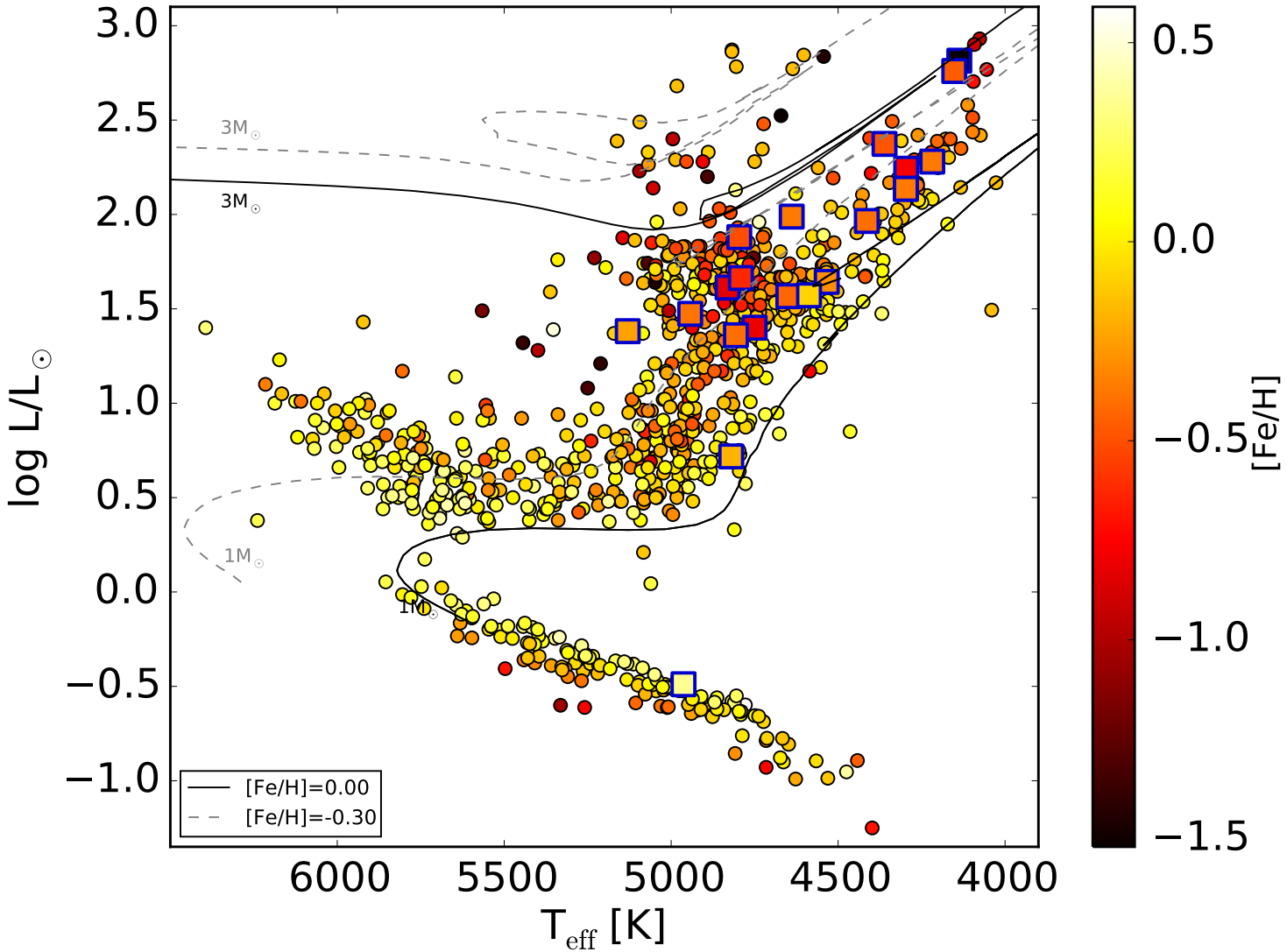
Planet-metallicity relation (subgiants):

- Fischer & Valenti (2005) showed that there is planet-metallicity relation and metallicity distribution of subgiants with planets is compatible with dwarf stars with planets.
- Ghezzi et al. (2010) and Jofré et al. (2015) indicated that there is planet-metallicity relation which means that subgiants with gas giant planets tend to be more metal-rich than subgiant stars without gas giant planets.
- Ghezzi et al. (2010) and Jofré et al. (2015) concluded that there is planet-metallicity relation, subgiant host stars show similar planet-metallicity relation compared with main-sequence host stars.

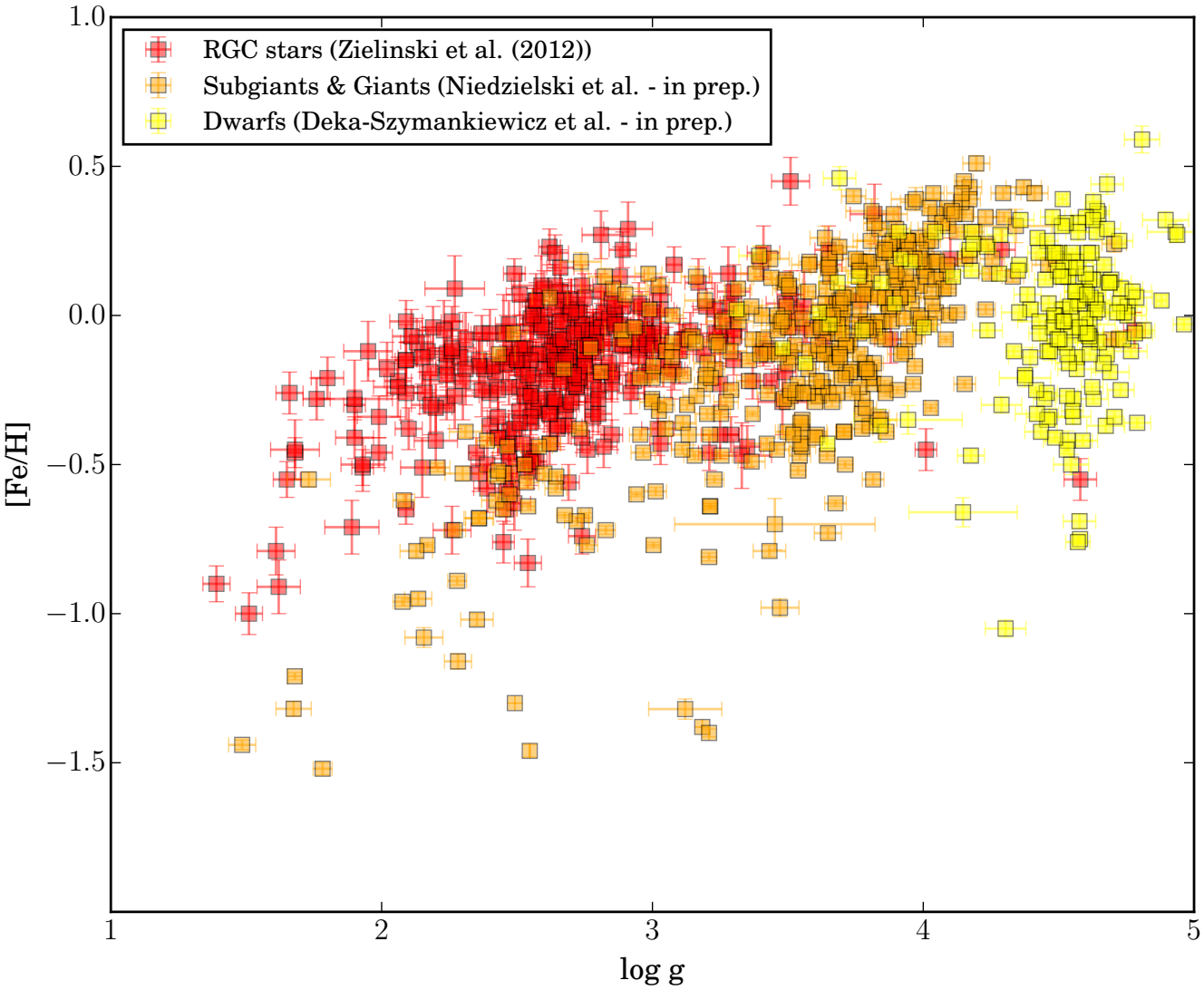
Planet-metallicity relation (giants):

- Hekker & Meléndez (2007) and Reffert et al. (2015) showed that there is planet-metallicity relation and giant stars with planets have higher metallicity than average metallicity of giants without planet companions.
- Pasquini et al. (2007) and Takeda et al. (2008) concluded that there is NO planet-metallicity relation: there is a lack of positive metallicity-planet occurrence for planet host giant stars.
- Mortier et al. (2013) showed that there is NO planet-metallicity relation which means that the mean metallicity of planet host giant stars is lower than dwarfs with planets.
- Jofré et al. (2015) indicated that there is NO planet-metallicity relation: there are no differences between metallicity of giants with and without planets.

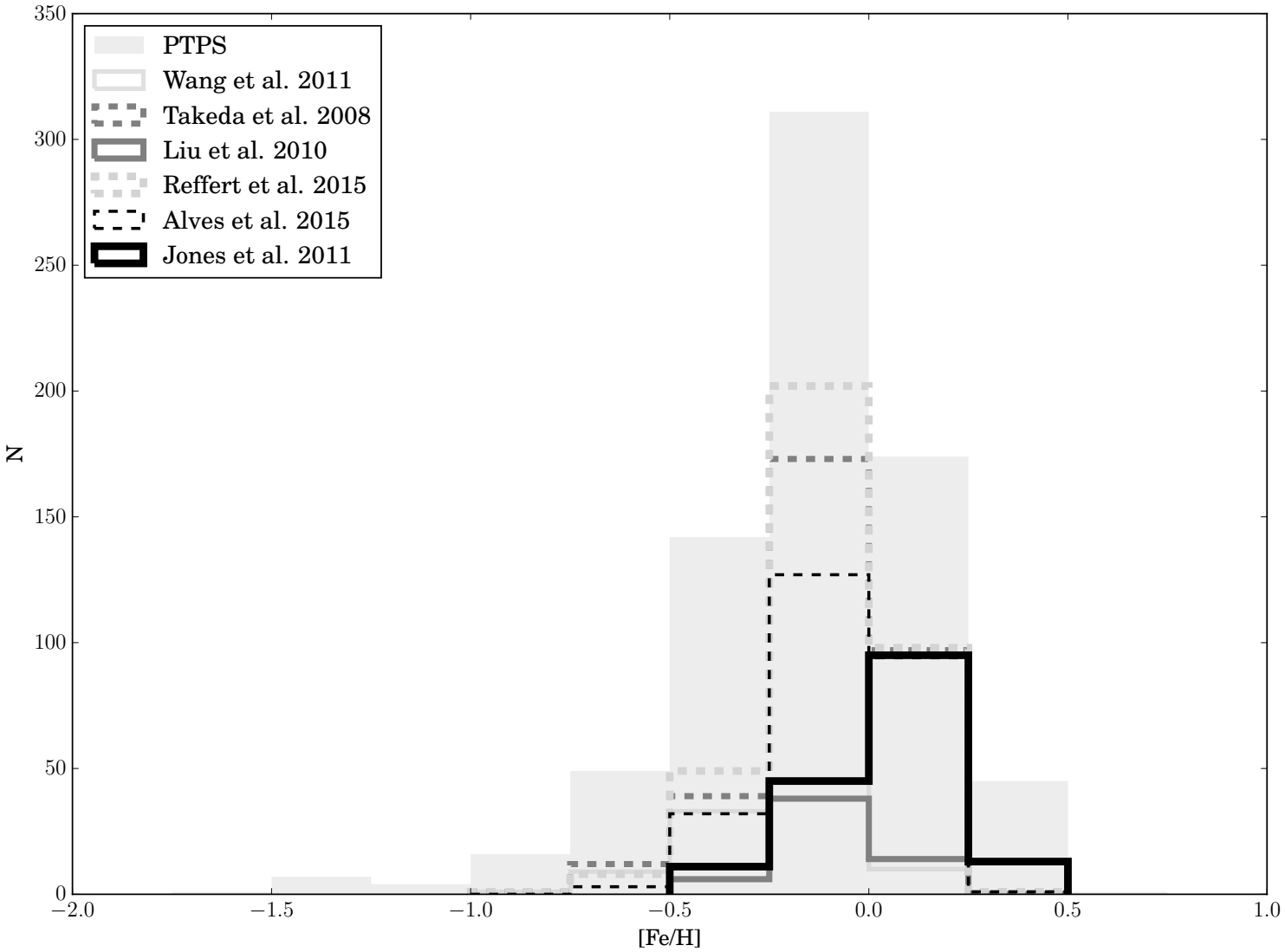
Pennsylvania-Torun Planet Search (PTPS) sample:



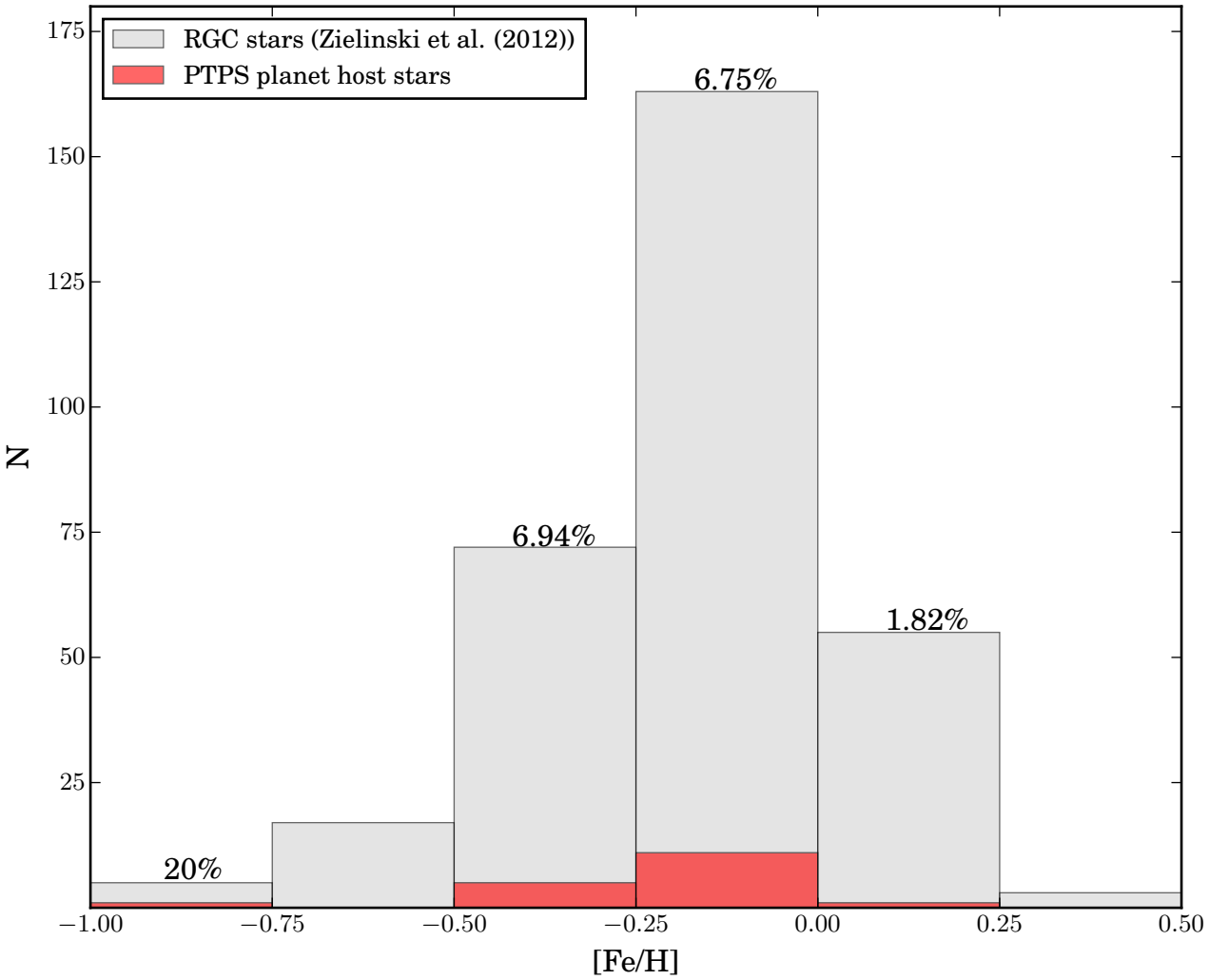
Metallicity of PTPS sample:



Metallicity for evolved stars from several projects:



PTPS planets and metallicity:



Kolmogorov-Smirnov test results:
D = 0.34
p-value = 0.03

K-S test shows that the metallicity distribution of giants with planets is consistent with that without planets.

Conclusions:

- PTPS sample (RGC) shows no evidence of planet occurrence - stellar metallicity relation
- only uniform samples suitable for such studies.