

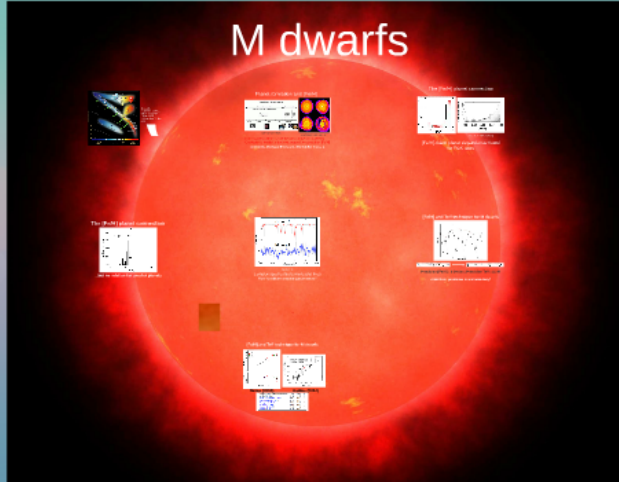


The star planet relation of M dwarfs

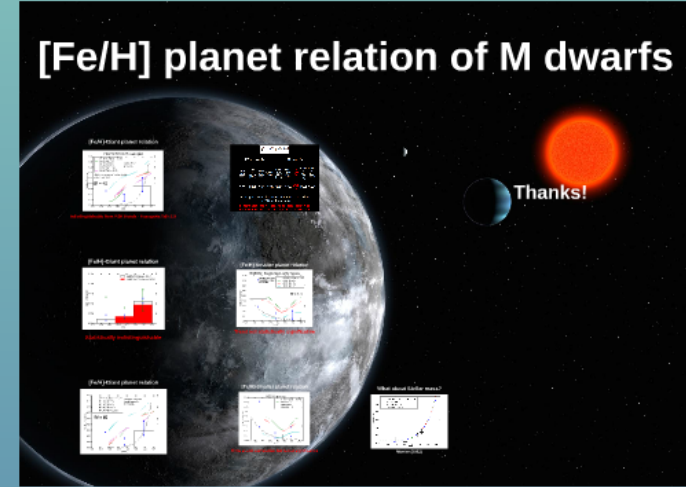
V. Neves
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X. Bonfils, N.C. Santos, X. Delfosse, T. Forveille



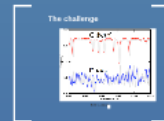
M dwarfs



[Fe/H] planet relation of M dwarfs



Thanks!





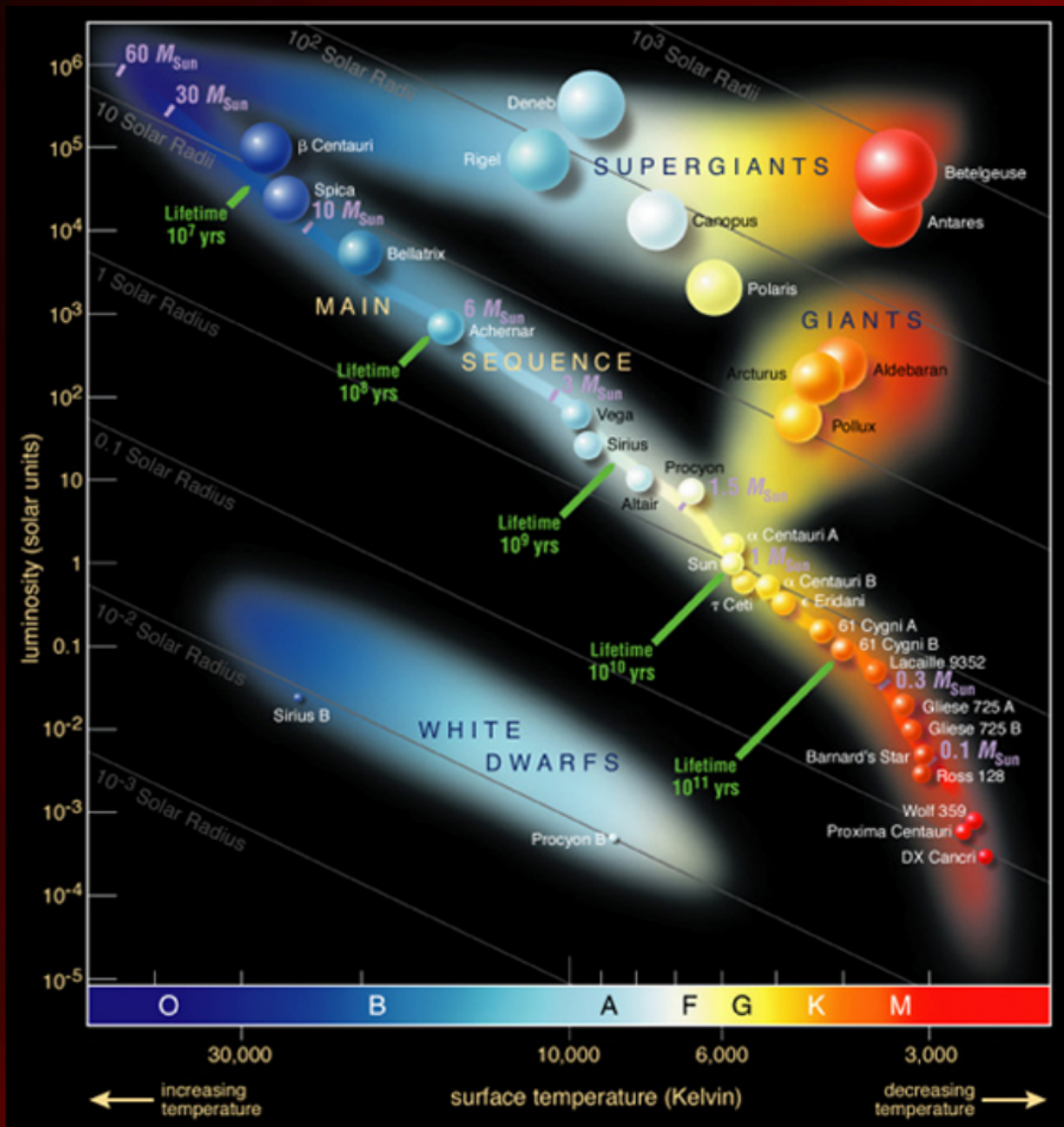
The star planet relation of M dwarfs

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M dwarfs

- Smallest, coolest, everywhere (75%)
- Long-lived
- No evolved M dwarf exist

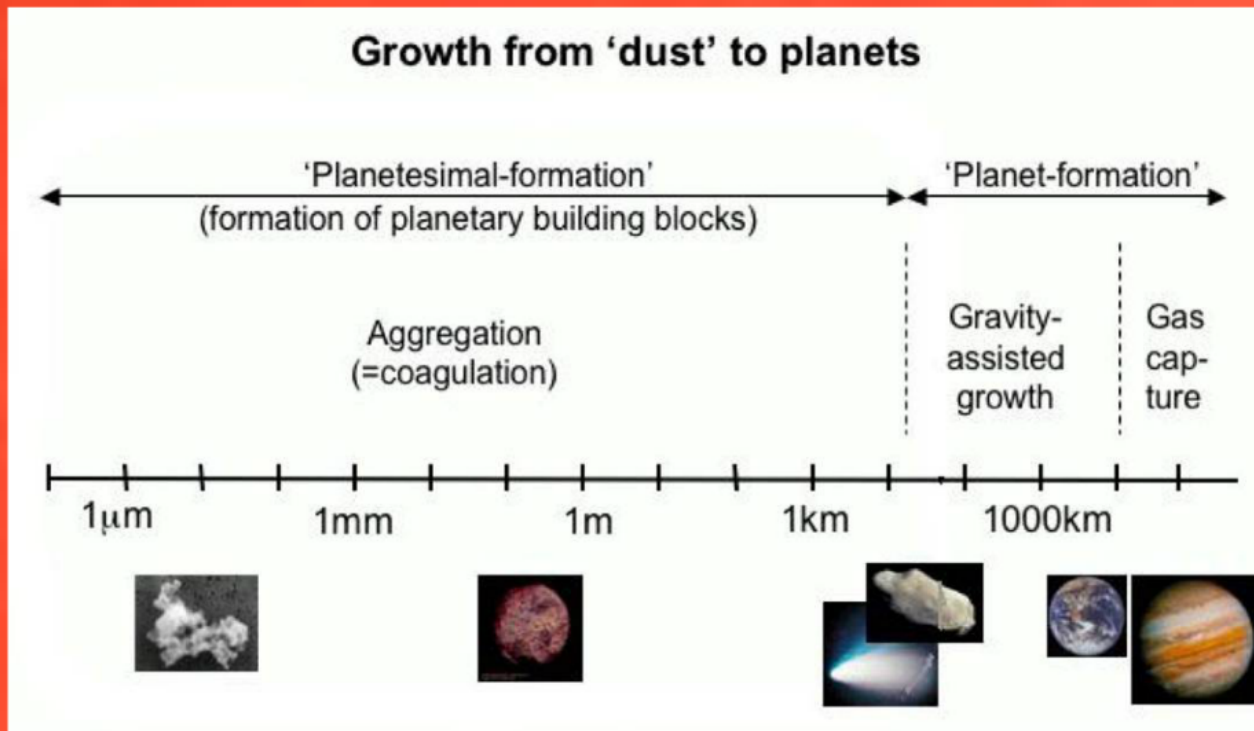
$$2300 < T_{eff} < 4000 \text{ K}$$

$$0.08 < M < 0.6 M_{\odot}$$

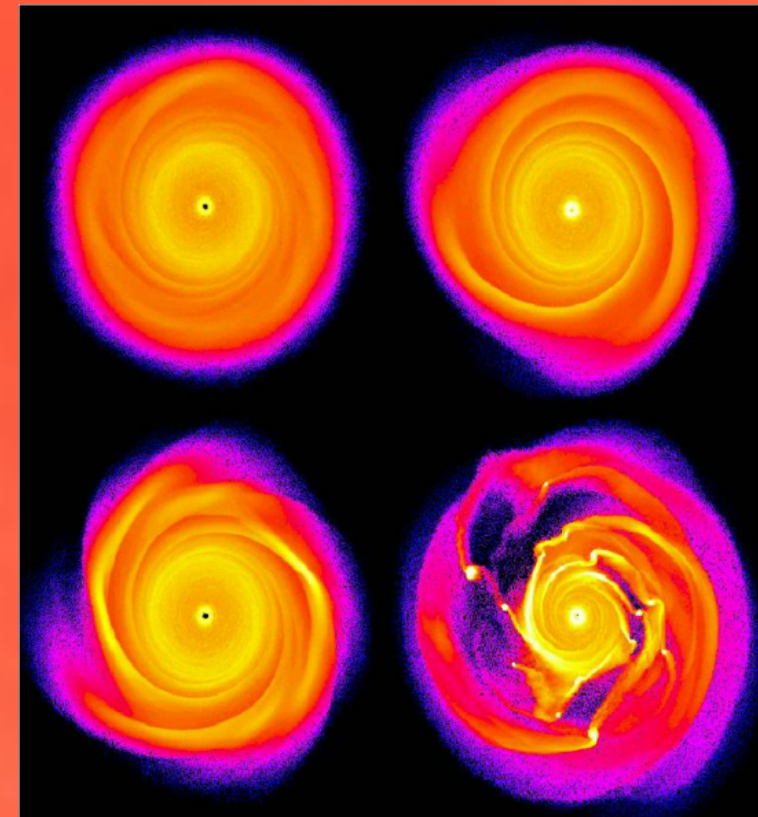
$$0.1 < R < 0.6 R_{\odot}$$

$$7.5 < M_V < 20 \text{ mag}$$

Planet formation and [Fe/H]



Core-accretion scenario

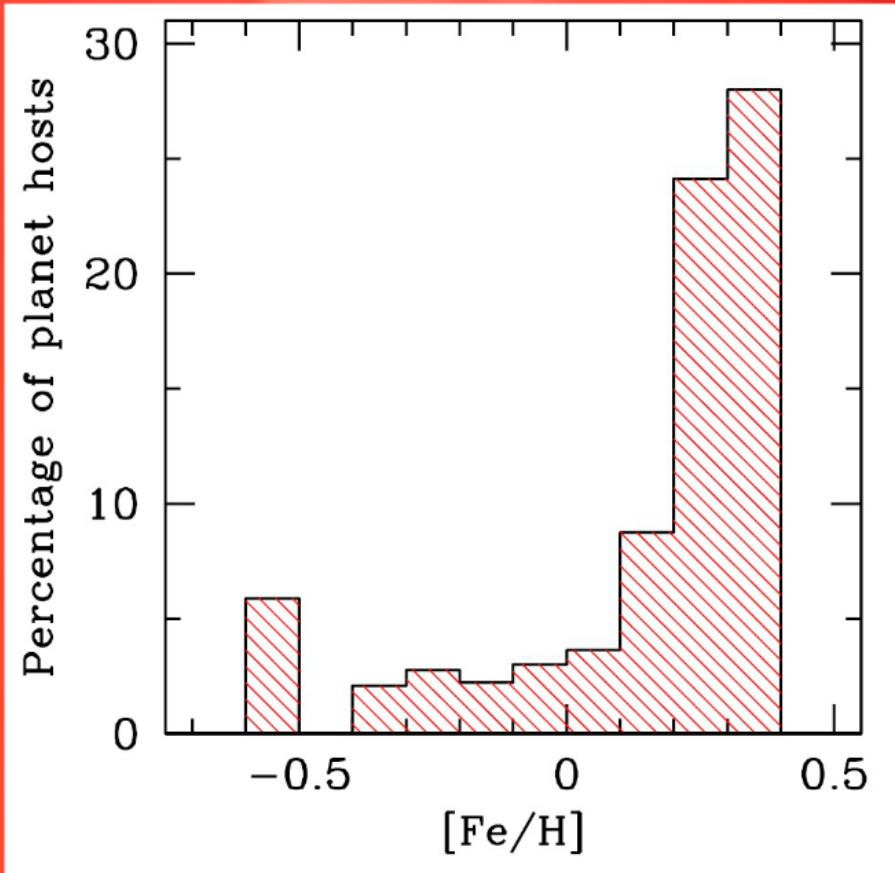


Gravitational instability simulation

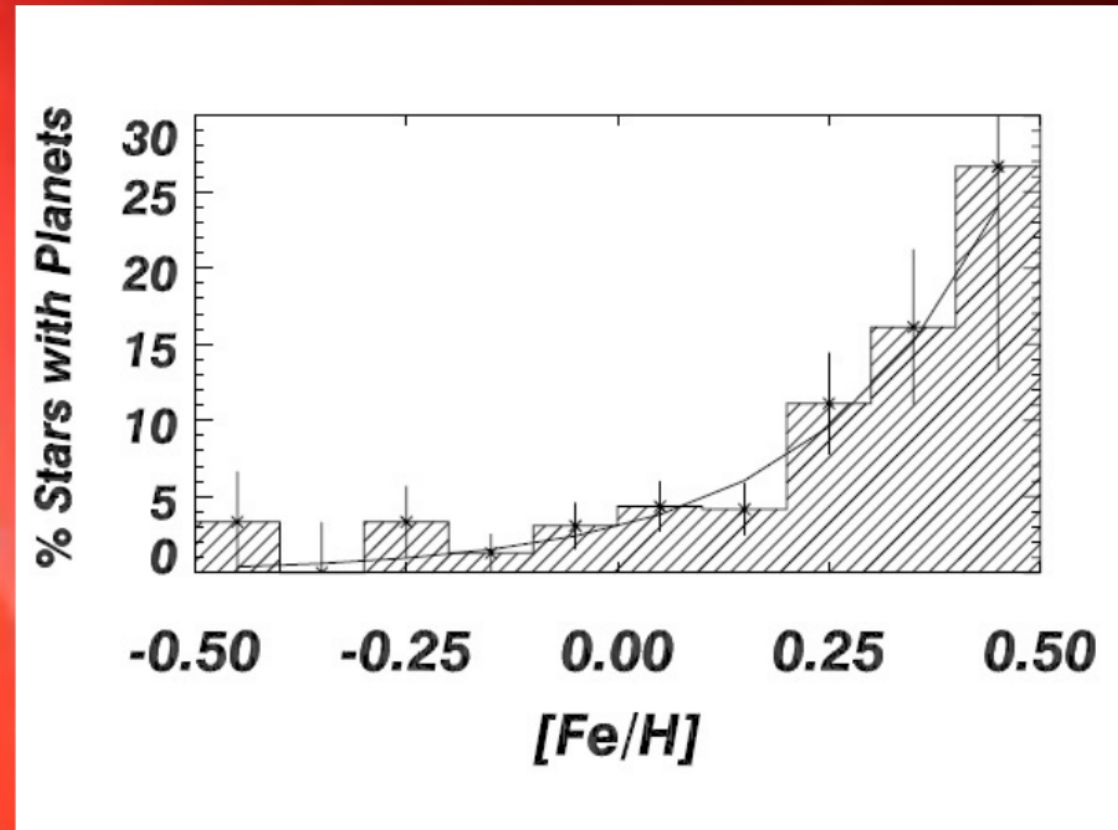
Core accretion Giant planet formation depends on [Fe/H].
Gravitational instability does not depend, in general, on [Fe/H]

(elements, disk/gas timescale, disk/stellar mass...)

The $[Fe/H]$ planet connection



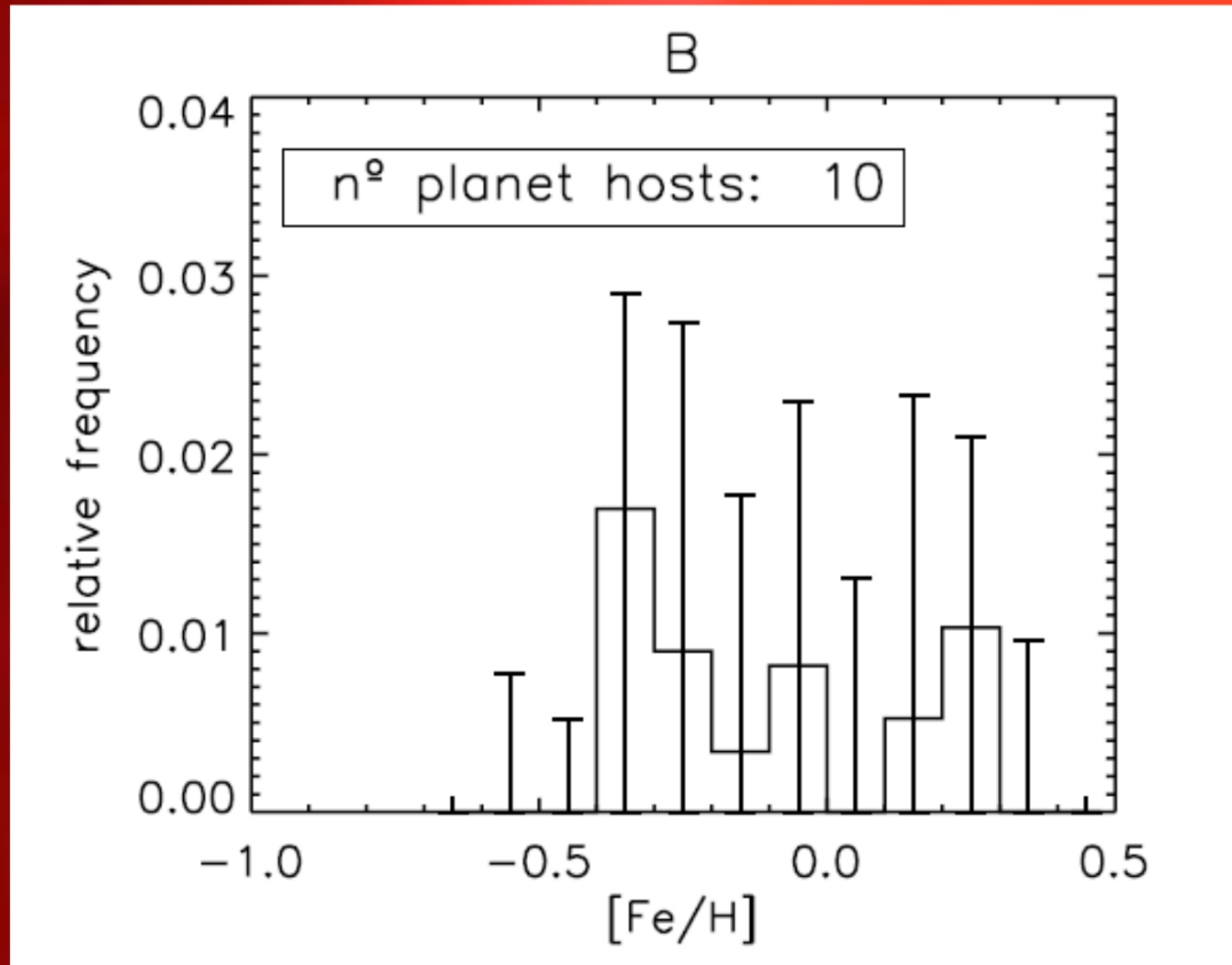
Santos (2004)



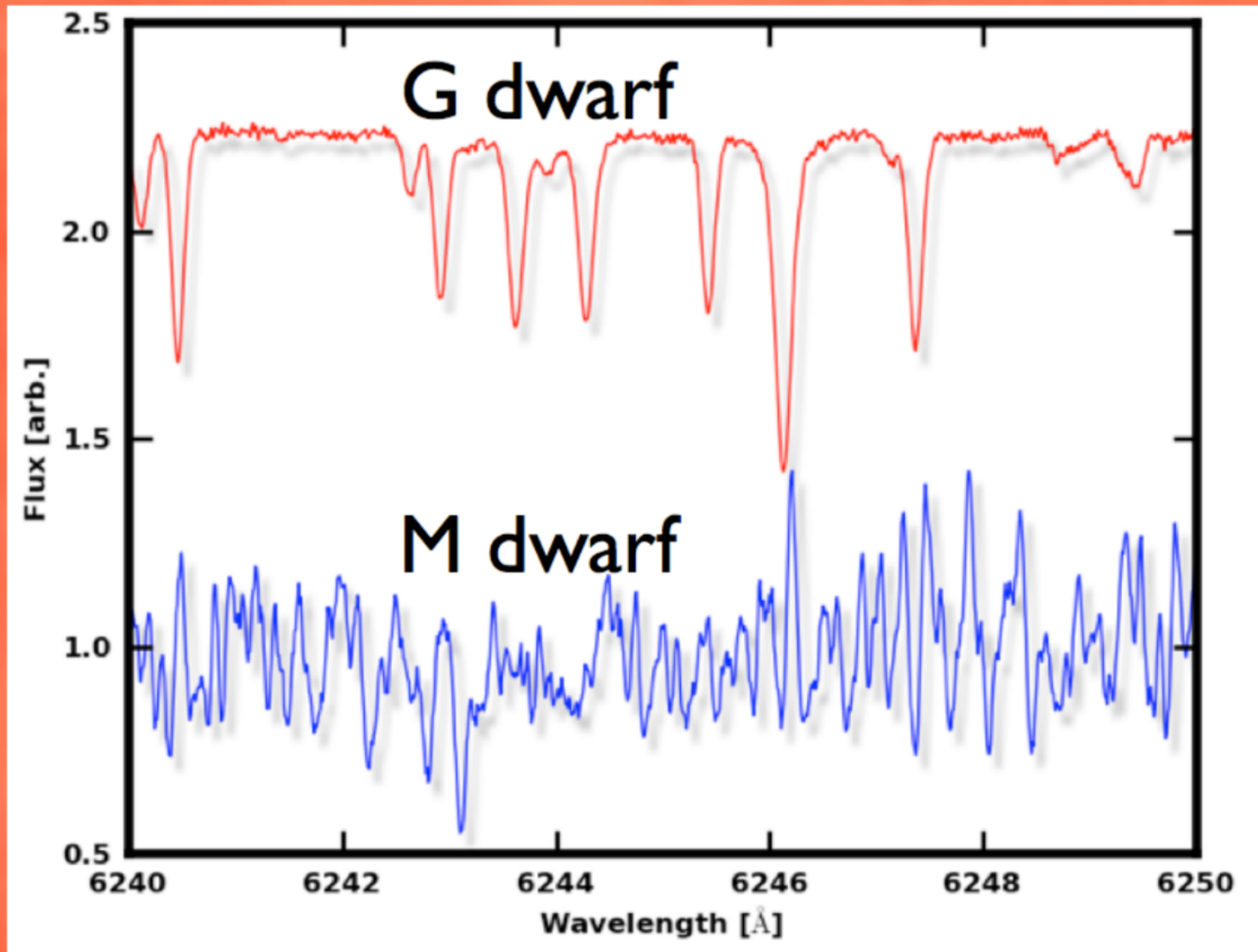
Fischer & Valenti (2005)

$[Fe/H]$ -Giant planet dependence found
for FGK stars

The [Fe/H] planet connection



 Prezi **but no relation for smaller planets**

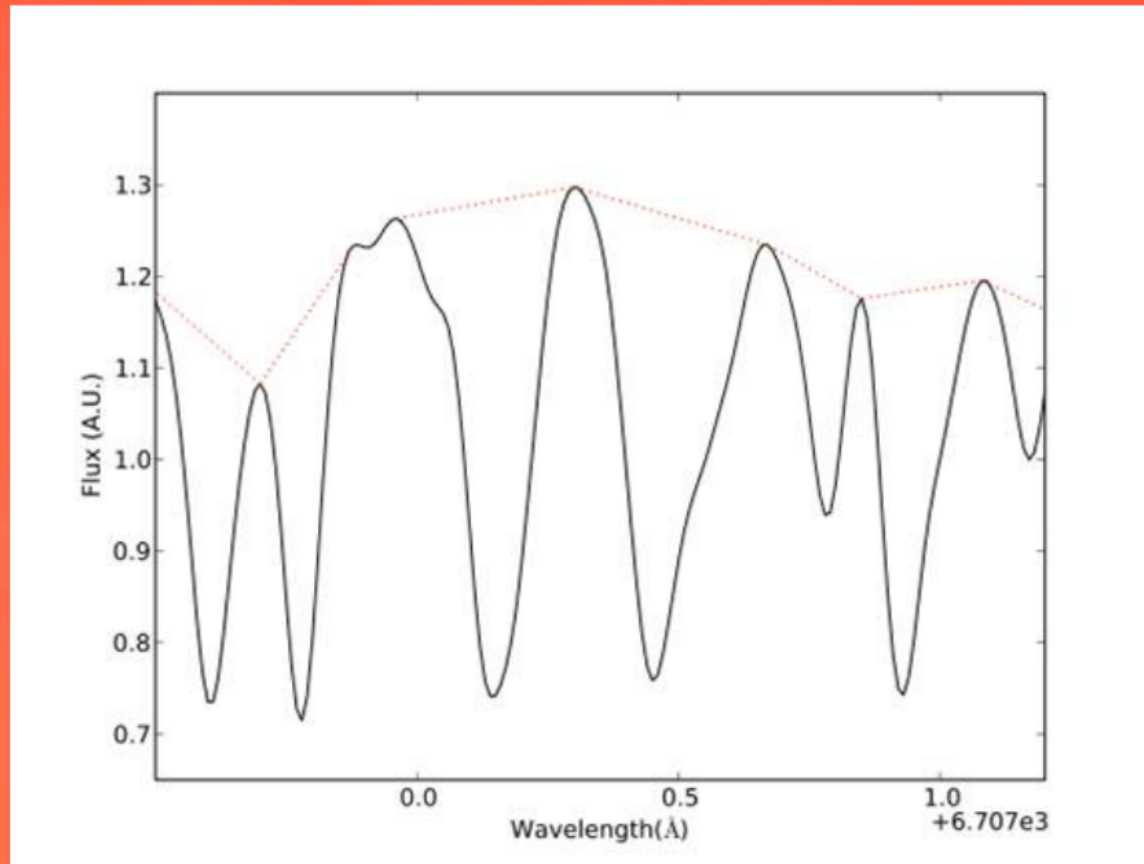


Bonfils (2012)

Complex spectra due to molecular lines
How to obtain precise parameters?



[Fe/H] and Teff technique for M dwarfs

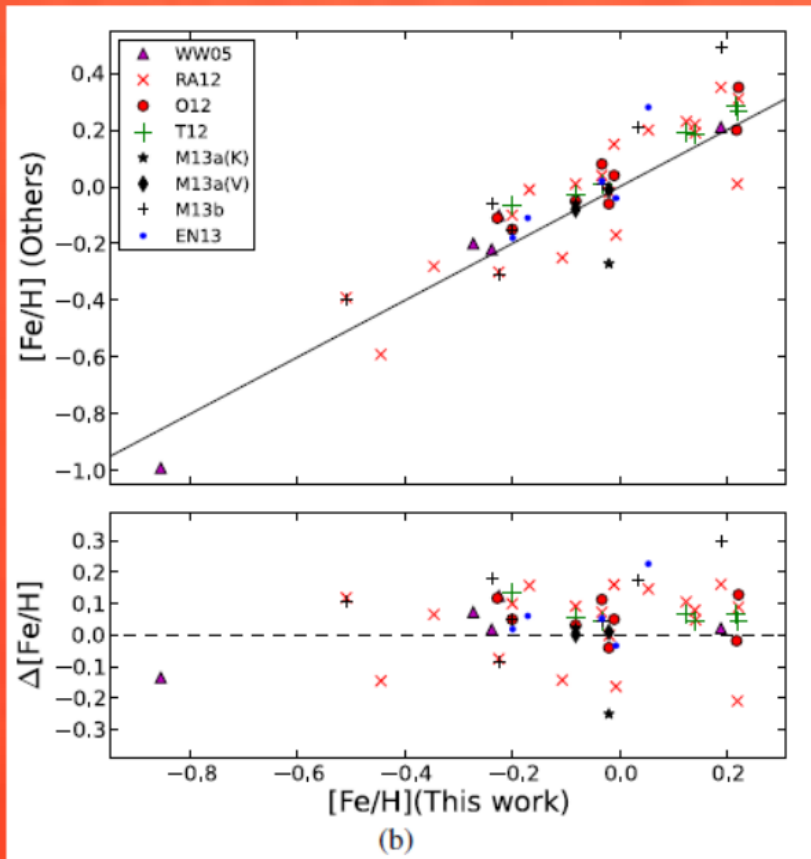


$$W_{i,m} = \alpha_i [Fe/H]_m + \beta_i T_{eff,m} + \gamma_i \longrightarrow [[Fe/H], T_{eff}, Ind]_{3,m} = (C_{3,i}^T C_{i,3})^{-1} C_{3,i}^T W_{i,m}$$

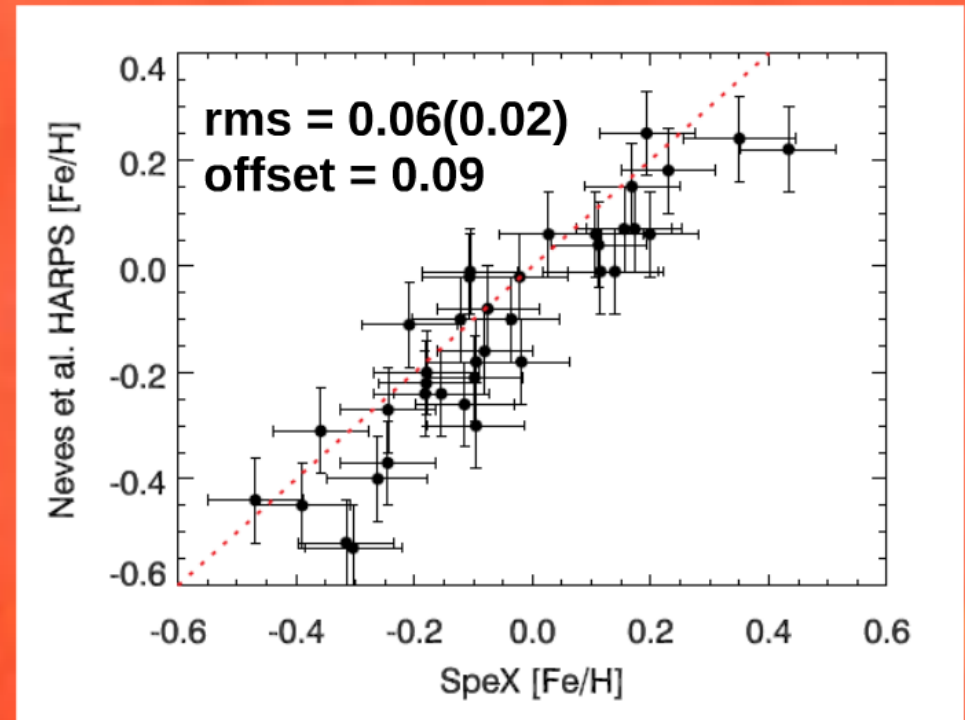
Precision [Fe/H] : 0.09 dex; Precision Teff: 110 K

Attention: precision is not accuracy!

[Fe/H] and Teff technique for M dwarfs



Neves (2014)



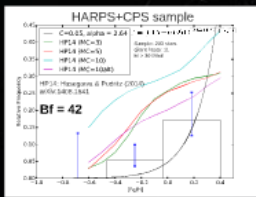
Gaidos (2014)

Spectroscopic [Fe/H] determinations	rms	offset	N
All [Fe/H] values	0.11	0.05	55
Woolf & Wallerstein (2005)	0.09	-0.02	5
Rojas-Ayala et al. (2012)	0.12	0.03	19
Önehag et al. (2012)	0.08	0.05	8
Terrien et al. (2012)	0.07	0.06	7
Mann et al. (2013b)	0.16	0.11	7
Newton (2013)	0.11	0.07	5

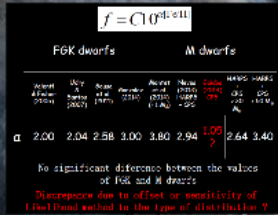
[Fe/H] planet relation of M dwarfs

Thanks!

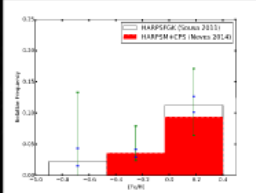
[Fe/H]-Giant planet relation



Indistinguishable from FGK trends - Hasegawa Talk 5.9

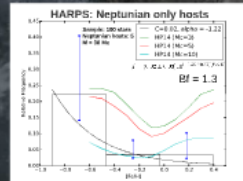


[Fe/H]-Giant planet relation



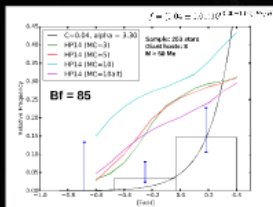
Statistically indistinguishable

[Fe/H]-Smaller planet relation

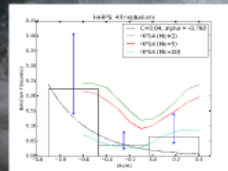


Trend not statistically significant

[Fe/H]-Giant planet relation

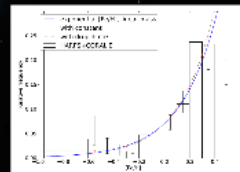


[Fe/H]-Smaller planet relation



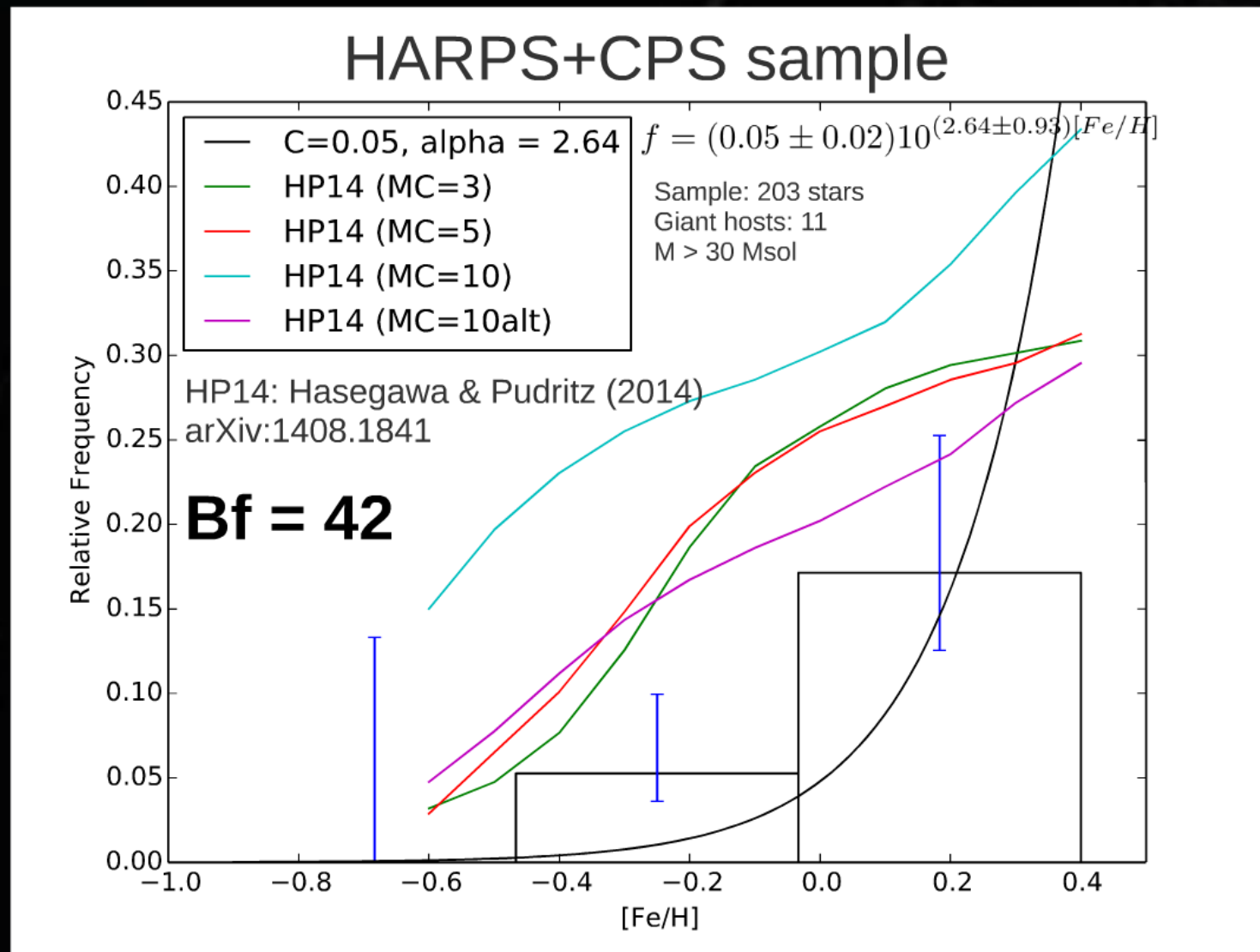
Hints at anti-correlation but is not significant

What about Stellar mass?

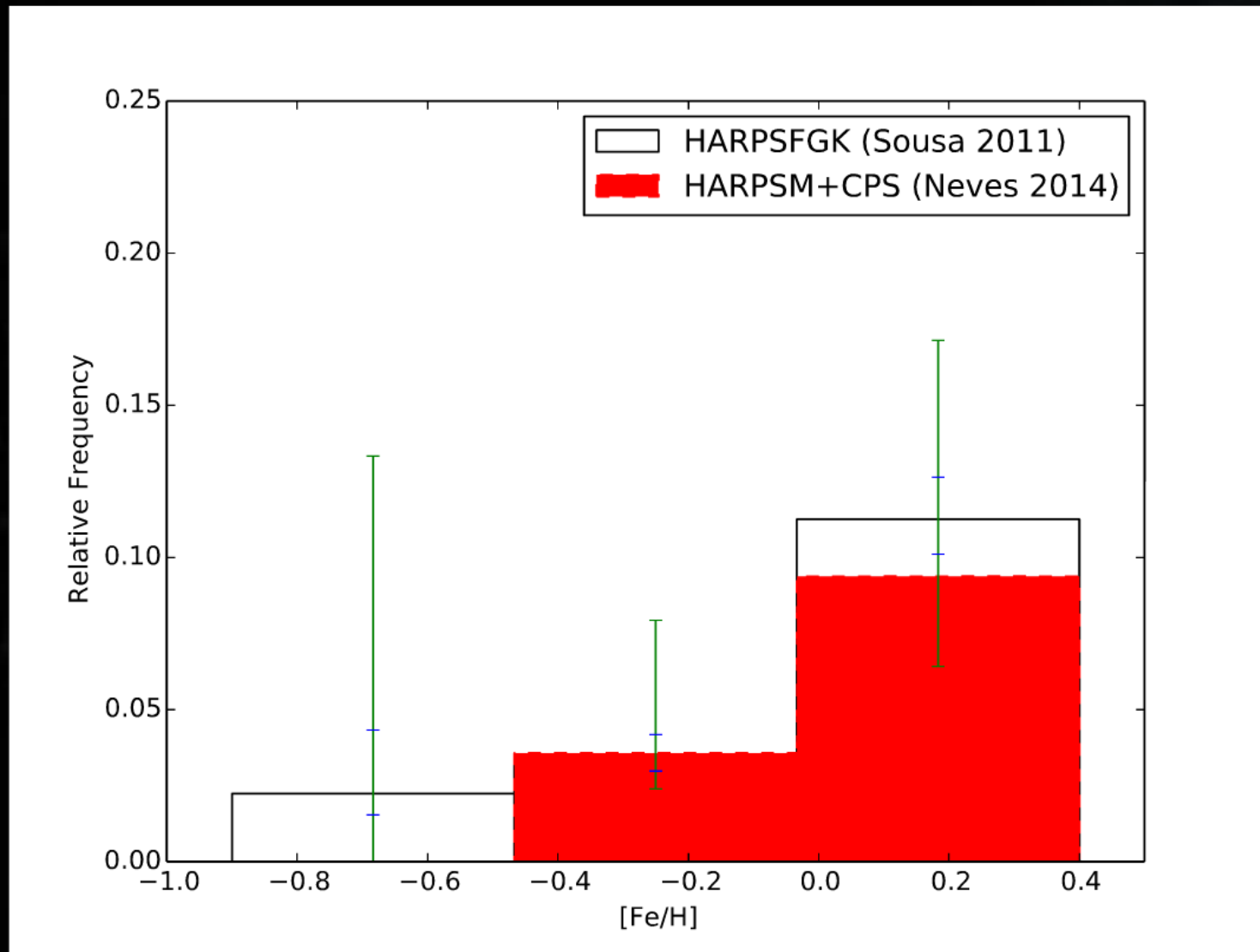


Mortier (2013)

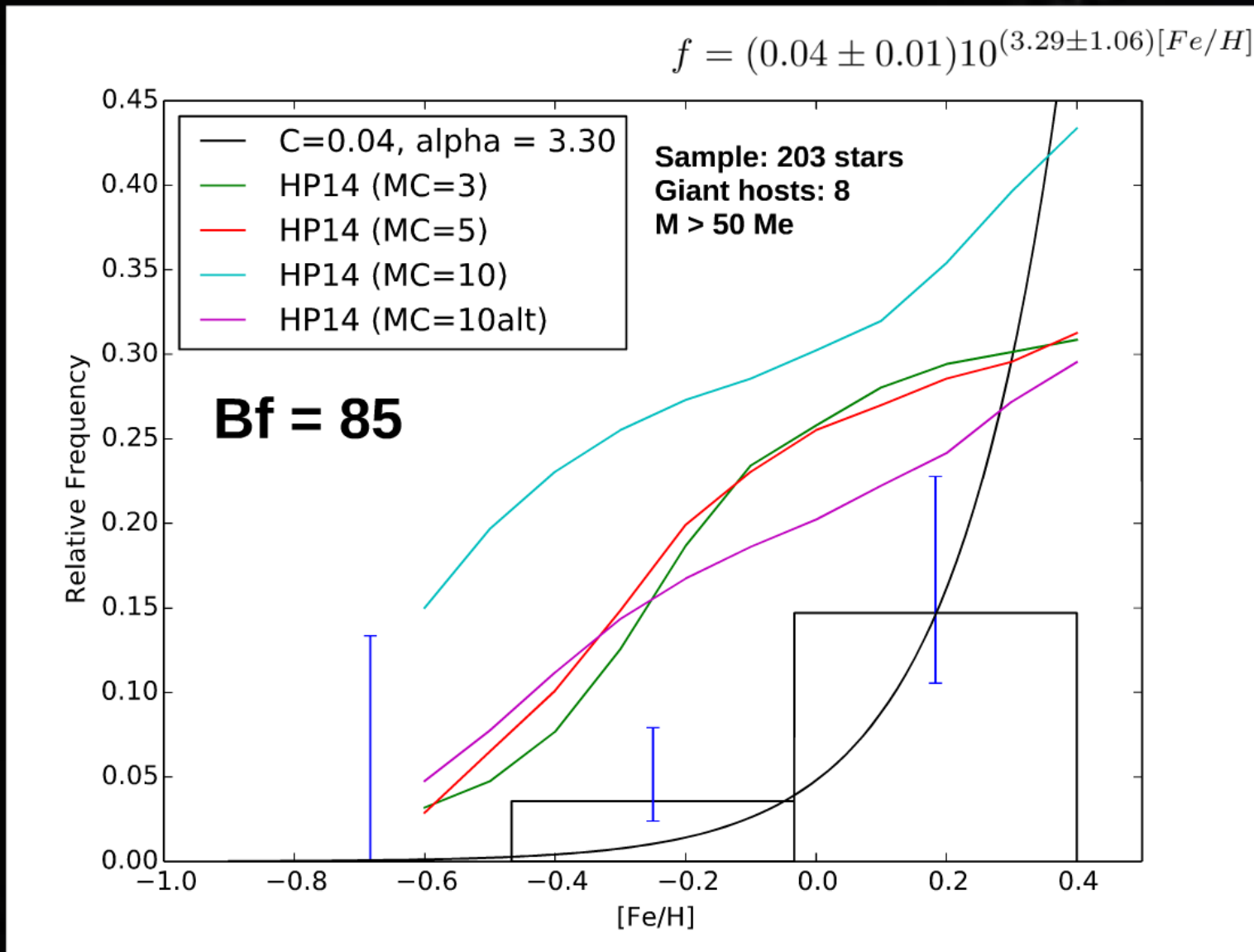
[Fe/H]-Giant planet relation



[Fe/H]-Giant planet relation



[Fe/H]-Giant planet relation



$$f = C10^{\alpha[\text{Fe}/\text{H}]}$$

FGK dwarfs

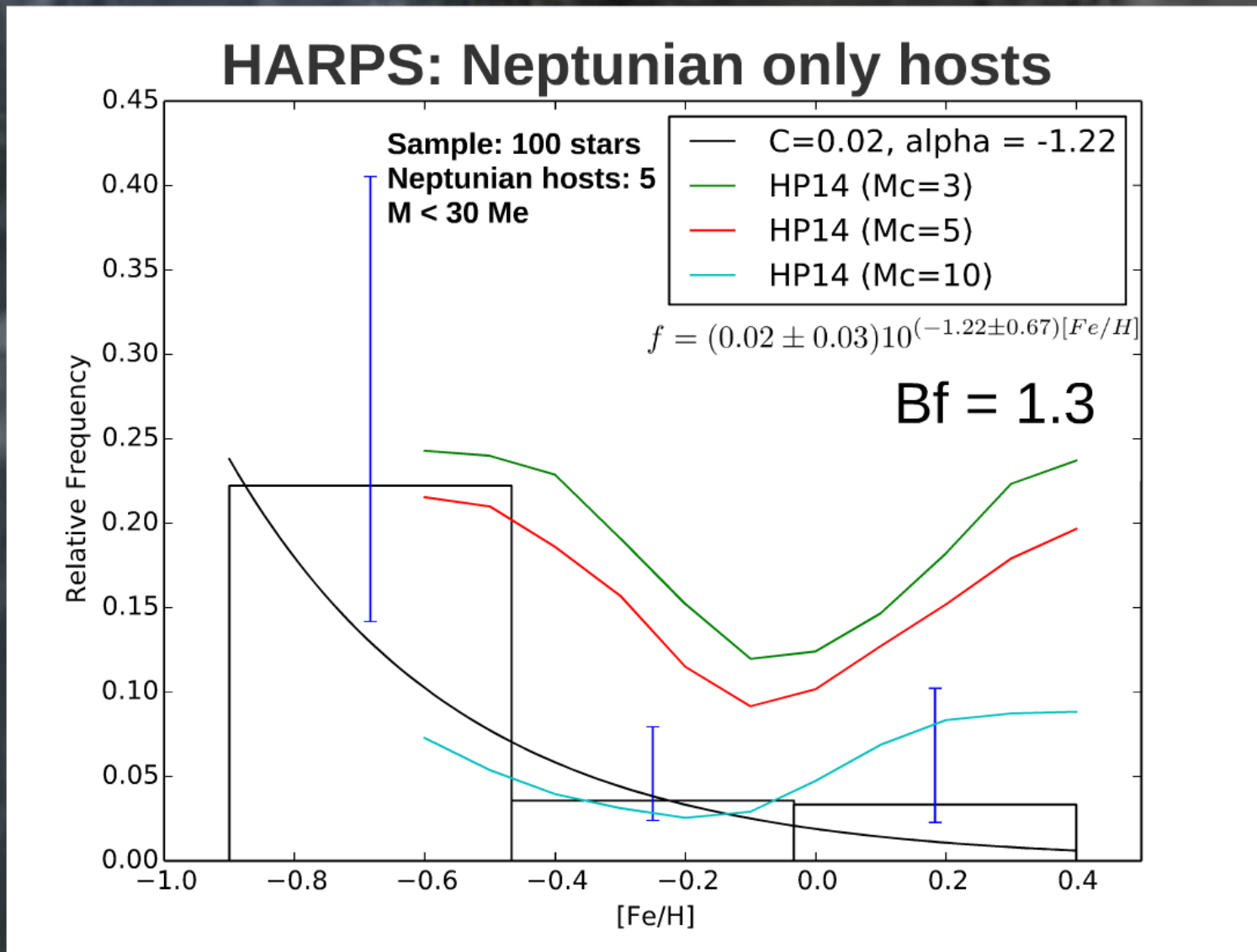
M dwarfs

	Valenti & Fisher (2005)	Udry & Santos (2007)	Sousa et al. (2011)	Gonzalez (2014)	Montet et al. (2014) (> 1 M _J)	Neves (2013) HARPS + CPS	Gaidos (2014) CPS	HARPS + CPS > 30 M _⊕	HARPS + CPS > 50 M _⊕
α	2.00	2.04	2.58	3.00	3.80	2.94	1.05 ?	2.64	3.40

No significant difference between the values of FGK and M dwarfs

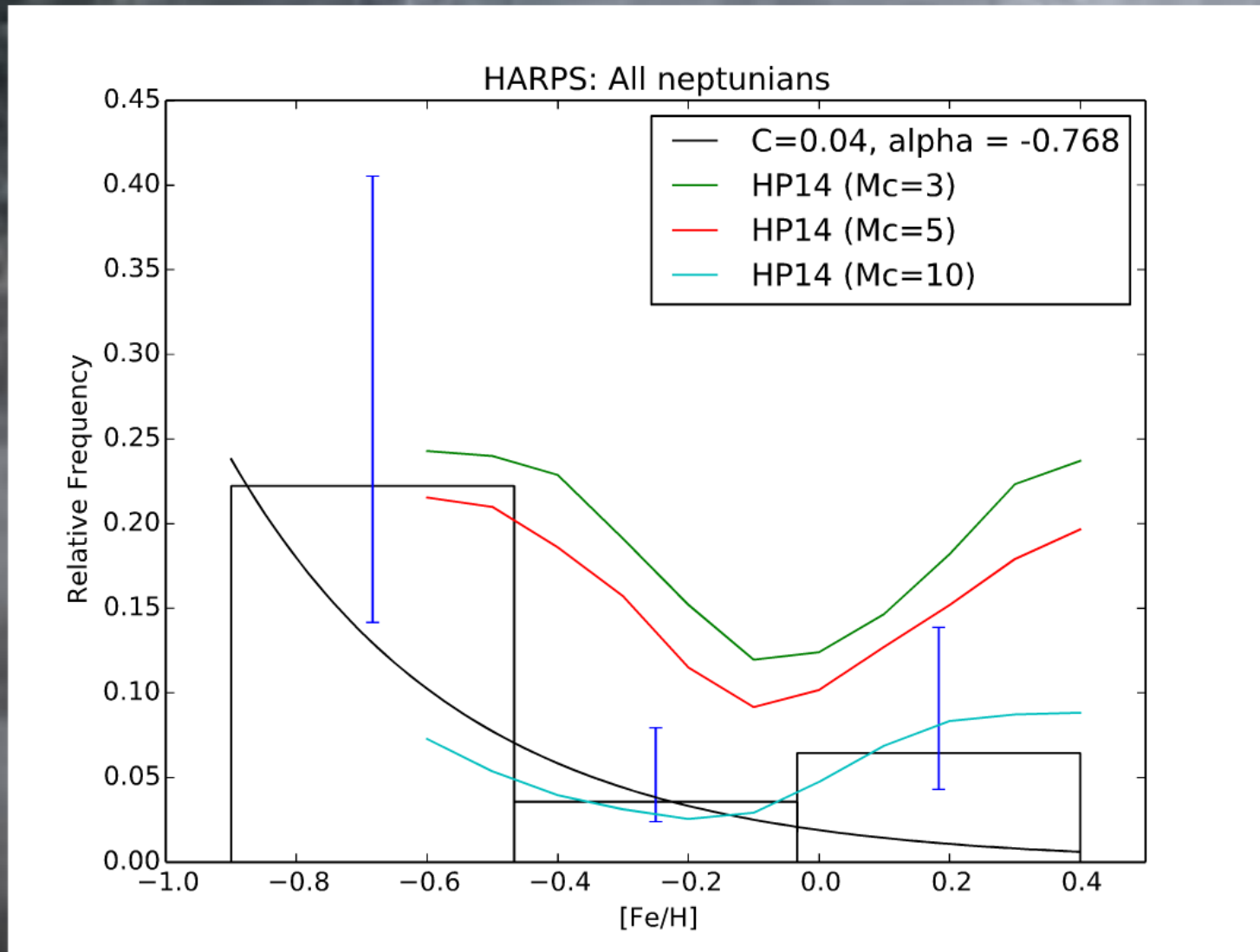
Discrepancy due to offset or sensitivity of Likelihood method to the type of distribution ?

[Fe/H]-Smaller planet relation



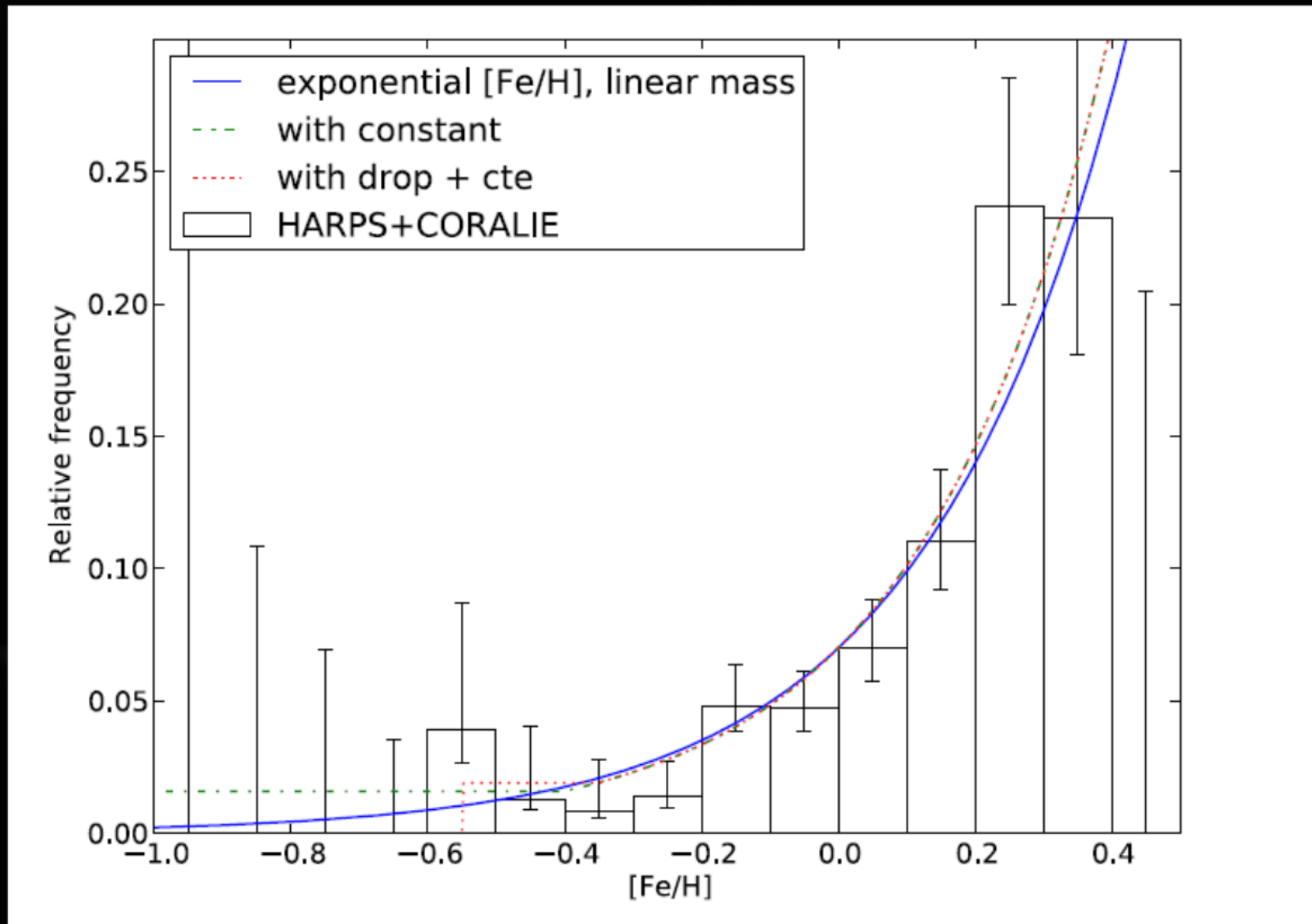
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[Fe/H]-Smaller planet relation



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Thanks!