Polling Before the Election

How to Cheaply Forecast Planetary Conditions to Prioritize Follow-up

ExoPAG 11

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“Major Spectroscopic Features and Signal-to-Noise of a Transiting Earth for a Total Co-added Observation Time of 200 hr, for a 6.5 m Space-Based Telescope for the Sun and M stars”

Feature	G2V	M0V	M1V	M2V	M3V	M4V	M5V	M6V	M7V	M8V	M9V
O_3	16.9	9.1	9.7	8.9	8.6	9.2	9.4	9.5	9.6	8.6	9.6
H_2O	4.8	5.0	6.0	6.2	6.6	7.9	10.5	13.0	14.7	14.9	18.9
CO_2	8.5	9.7	11.7	12.3	13.3	16.1	22.2	28.2	32.5	33.7	43.4
H_2O	11.0	12.8	15.5	16.4	17.7	21.6	30.1	38.5	44.6	46.4	60.2
CH_4	2.0	2.5	3.1	3.3	3.6	4.5	6.5	8.5	9.9	10.5	13.8
O_3	6.2	7.8	9.5	10.3	11.2	13.9	20.0	26.3	30.9	32.7	43.2
CO_2	5.9	7.5	9.2	9.9	10.9	13.5	19.5	25.8	30.4	32.2	42.6

Kaltenegger & Traub (2009)

…assuming every transit is observed, 200 hours of transit data for a single planet in the habitable zone of an M3V star (period of 25 days) will require a 4.9 year baseline

(For M dwarf context, see Muirhead talk next!)

Even modest eccentricities can sterilize the surface of M dwarf planets

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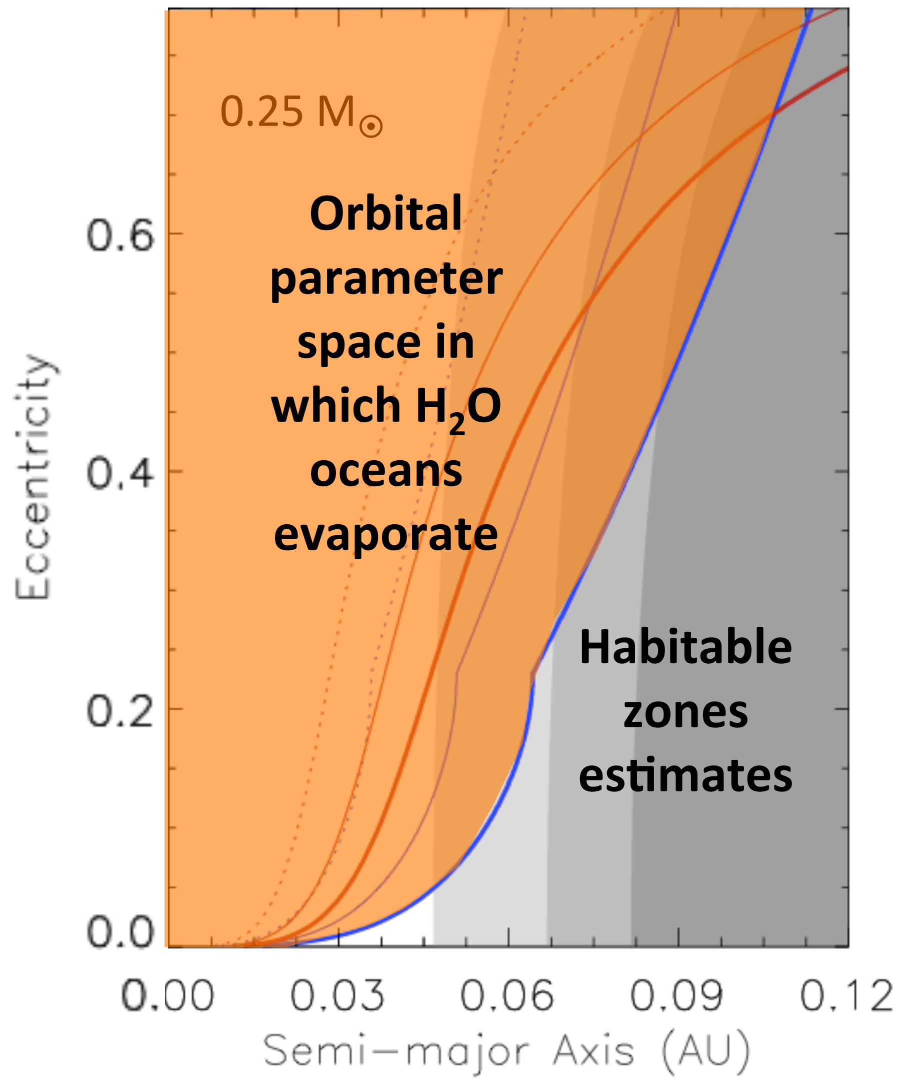


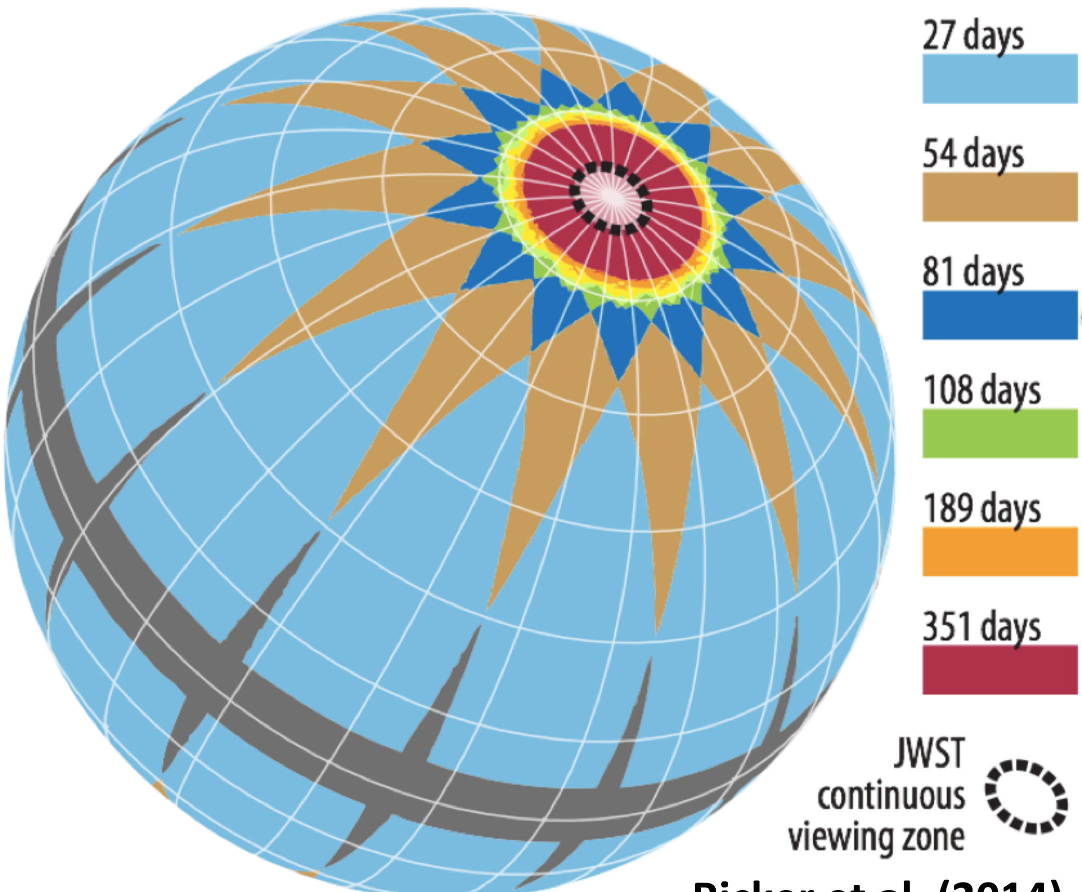
Barnes et al. (2013)

There is a growing body of evidence for links between dynamical history and inexpensive observables

If you could pick two other cheap* pieces of information to have in hand, what would they be?

1. Is there another transiting planet?

Cost: ~Free



Ricker et al. (2014)

Average of 1.5 planets/ detected system!

(B. Montet, private comm. re: K2 yields for M dwarfs)

*requiring 1 hr of follow-up or less on few m ground-based telescope

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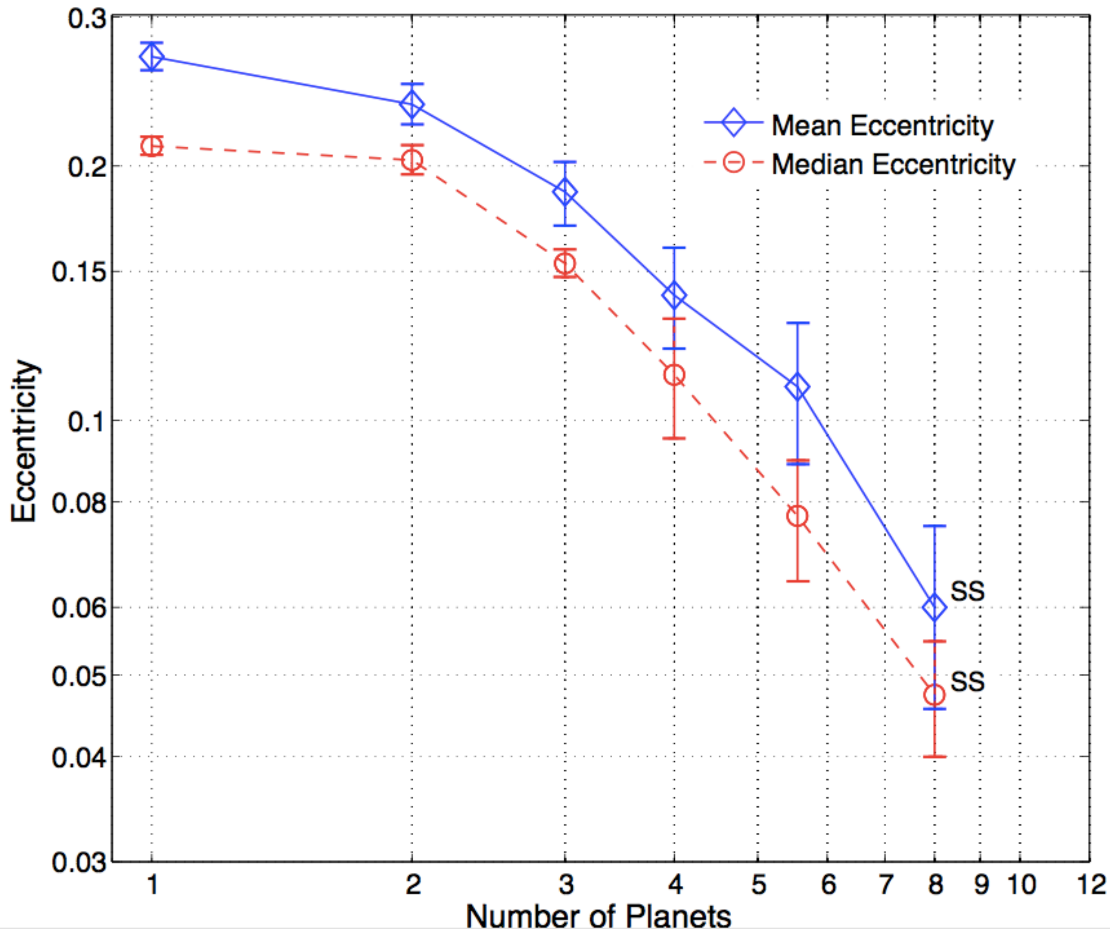

Limbach & Turner (2014)

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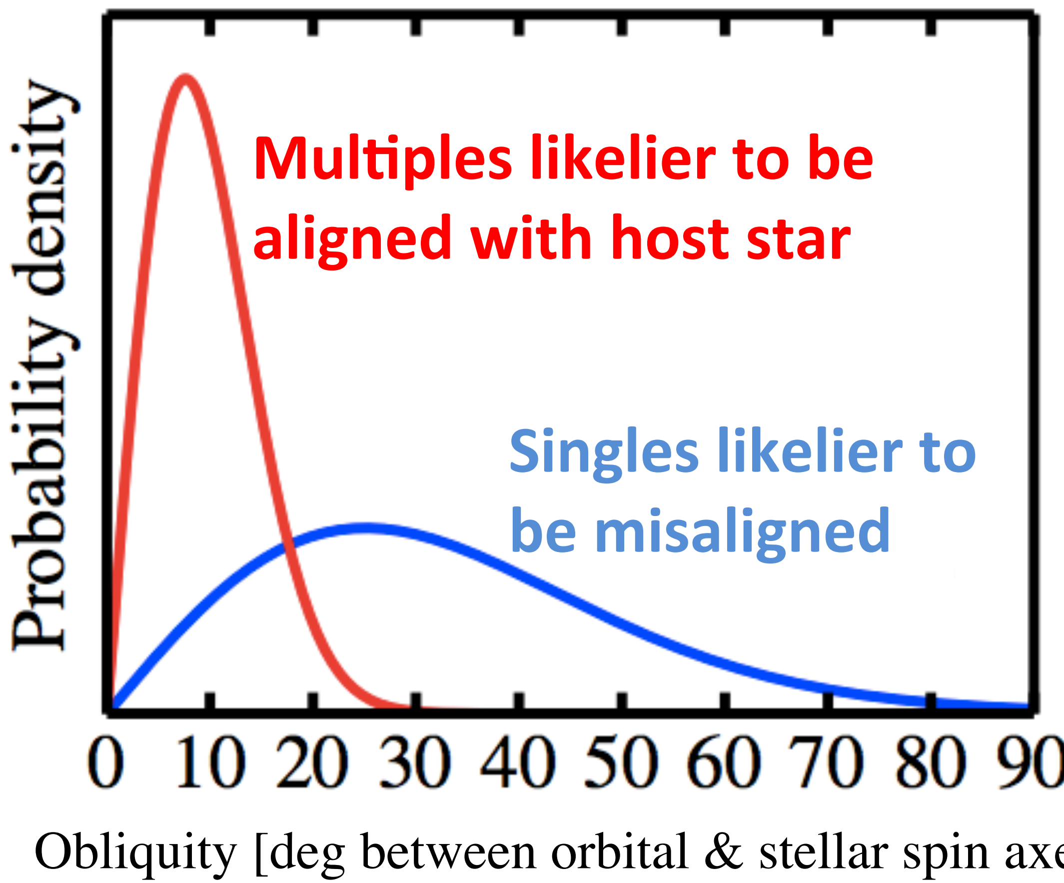
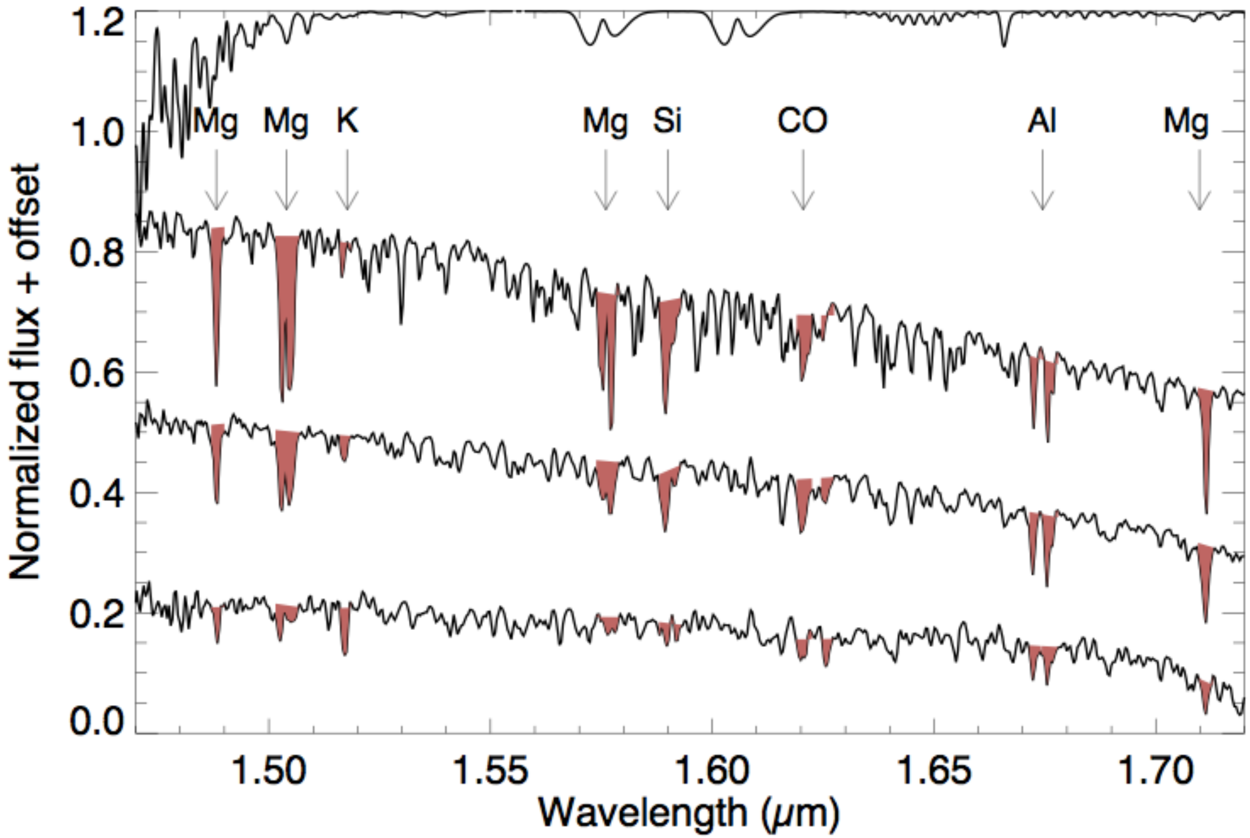


Morton & Winn (2014)

If you could pick two other cheap* pieces of information to have in hand, what would they be?

2. Is the host star relatively metal-poor ([Fe/H]<0)?

Cost: <1 hr with an NIR spectrograph



Newton et al. (2014)

cheap*

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Cost: <1 hr with an NI

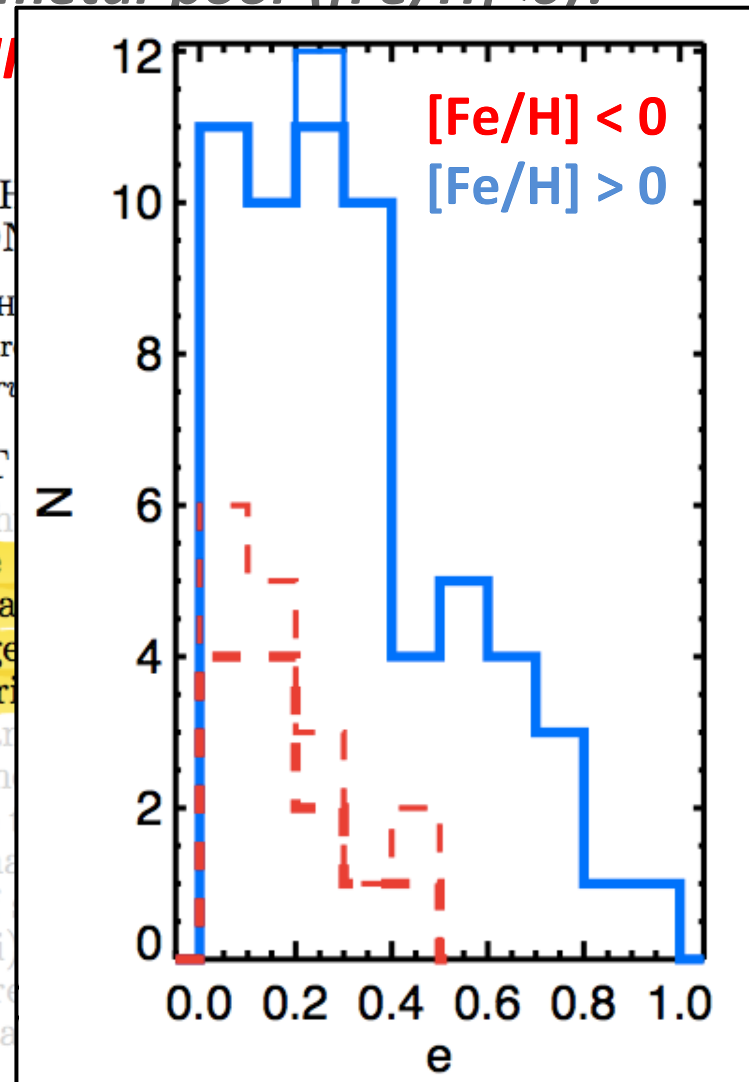
GIANT PLANETS ORBITING METAL-RICH STARS SH ... ET
INTERACTION

Rebekah I. Dawson[1] and Ruth
Harvard-Smithsonian Center for Astrophysics, 60 Gar
Received 2013 February 6; accepted 2013 Febru

ABSTRACT

Gas giants orbiting interior to the ice line are though ... a-
tion locations by processes that remain debated. Here ... s,
which together may indicate that two competing mecha ... le
disk migration, operating in environments with a range ... et
gravitational interactions, primarily triggered in metal-ri ... ts
can form. First, we show with 99.1% confidence that giar ... 1
and 1 AU orbiting metal-poor stars ([Fe/H]<0) are confin ... g
metal-rich stars. Second, we show with 93.3% confidence ... g
tidal circularization primarily orbit metal-rich stars. Fina ... st
a pile-up of hot Jupiters, helping account for the lack of ... e.
Migration caused by stellar perturbers (e.g. stellar Kozai) ... se
trends further motivate follow-up theoretical work addre ... es
can also produce the observed population of eccentric gia

Subject headings: planetary systems



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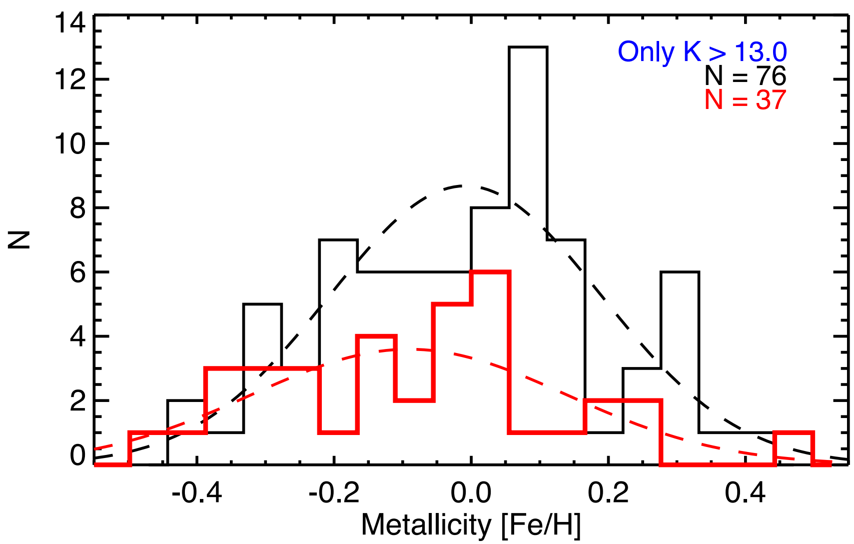
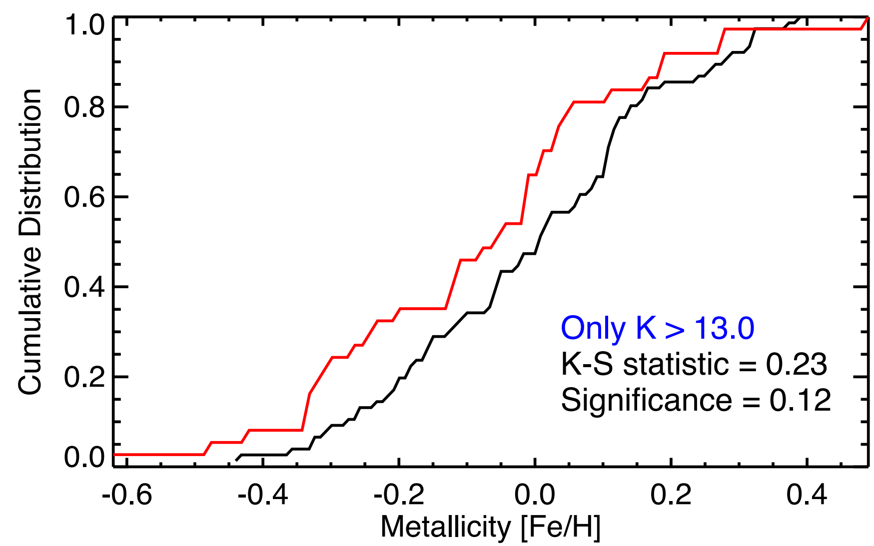
Stars with multiple transiting planets metal-poor compared to singles, with modest confidence





Ballard & Johnson (2014)

Summary

- *Risk assessment for M dwarf atmospheres tied to dynamical history of system*
- Fingerprints of dynamical history exist, and are relatively inexpensive to gather:
  - Existence of another transiting planet
  - Lower host star metallicity
  - (Age of M dwarf system, probed by galactic height and rotational modulation)