The Occurrence Rate of Giant Planets orbiting M-stars

"Peering Beyond the Ice-Line"

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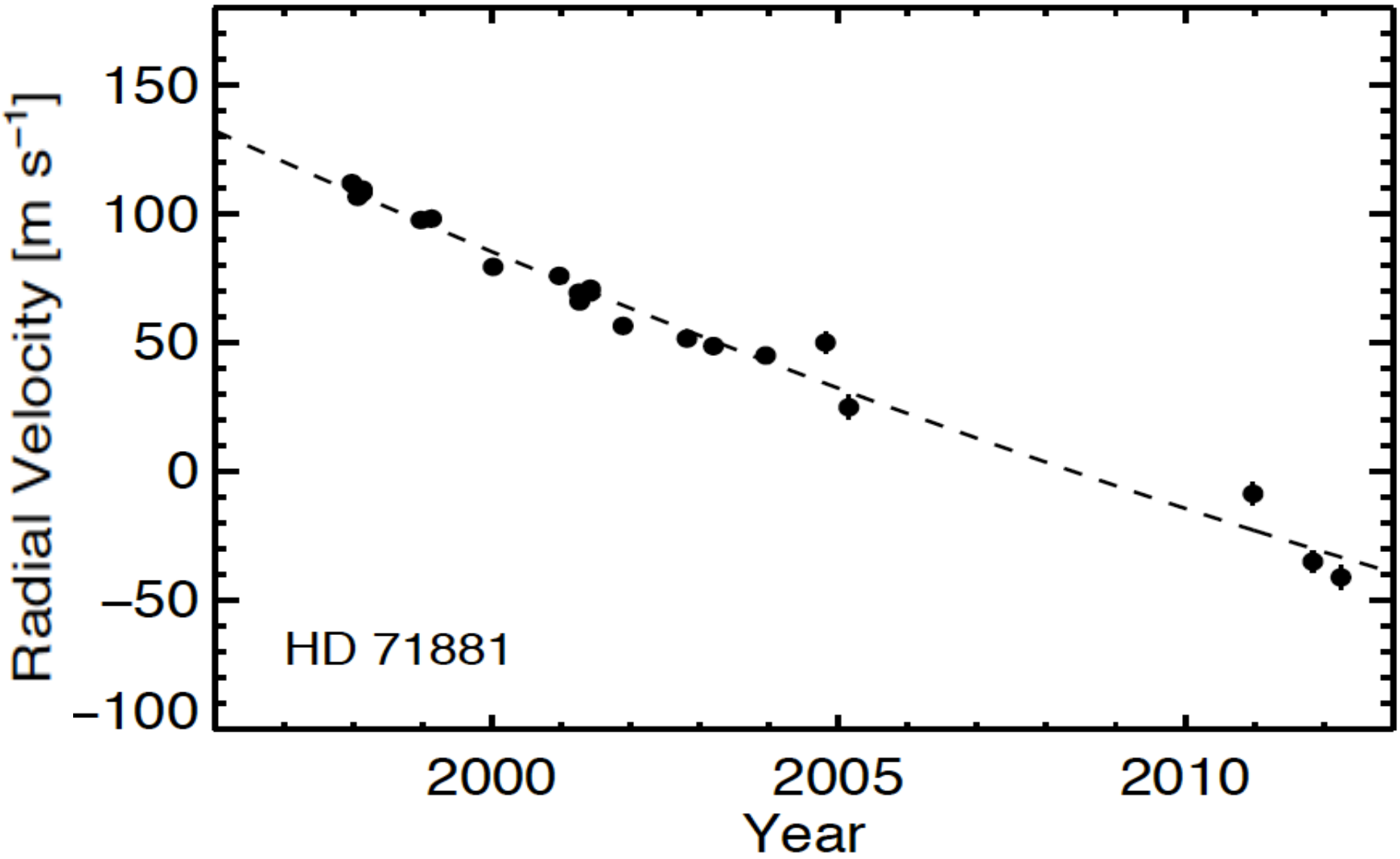
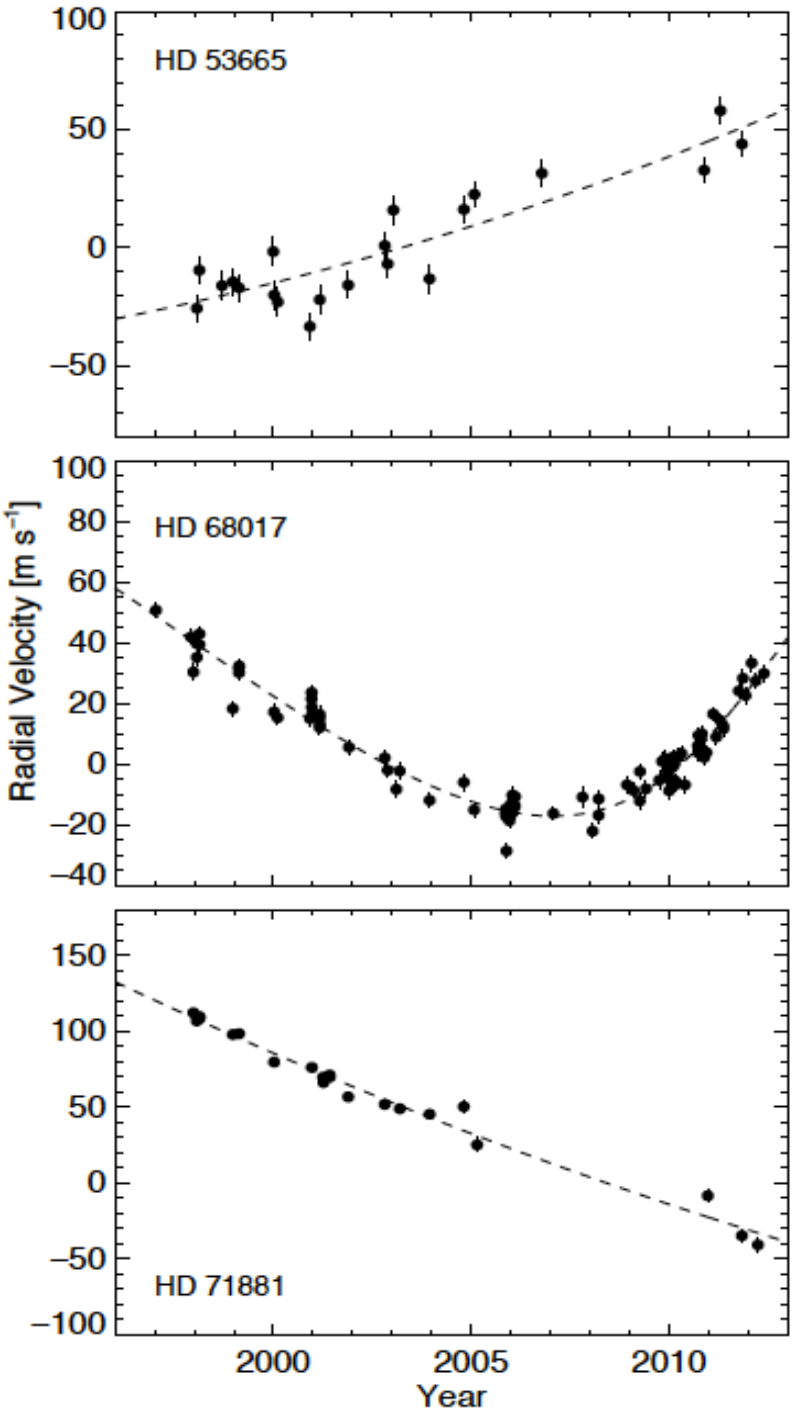
Planets Beyond the Reach of Kepler, AAS Boston, June 03, 2014

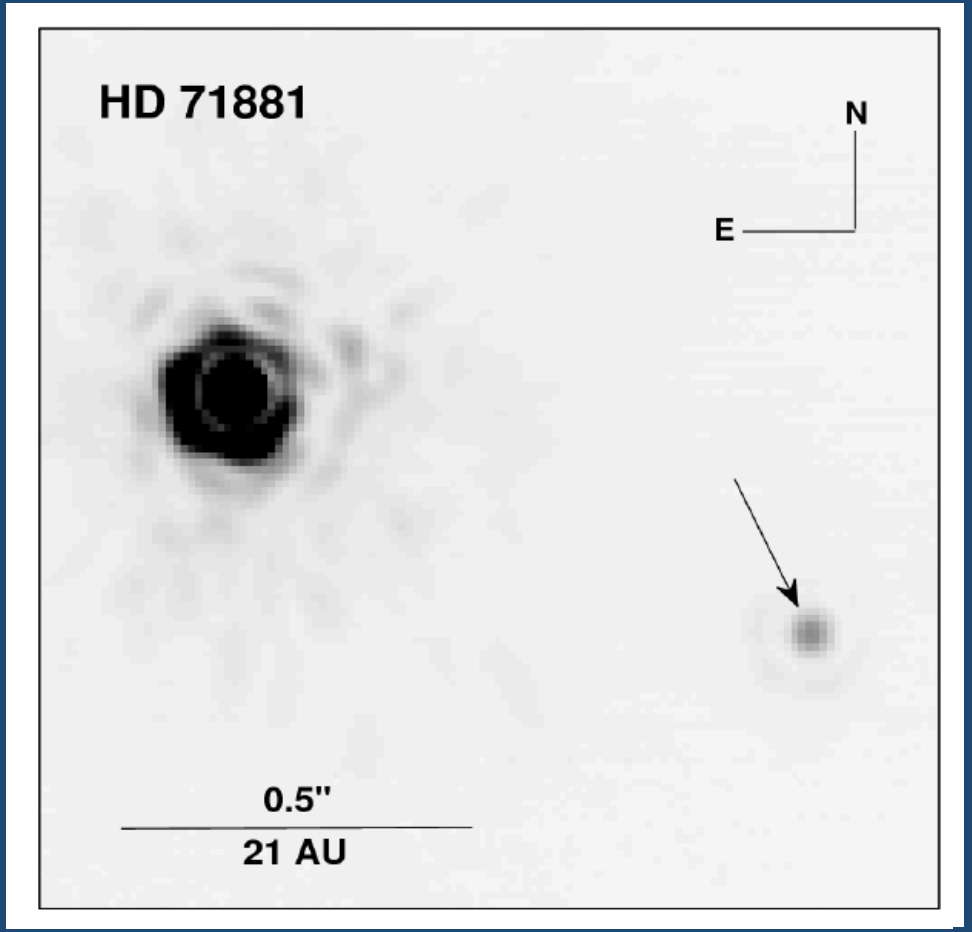
The TRENDS High-Contrast Imaging Program

TaRgetting bENchmark-objects with Doppler Spectroscopy



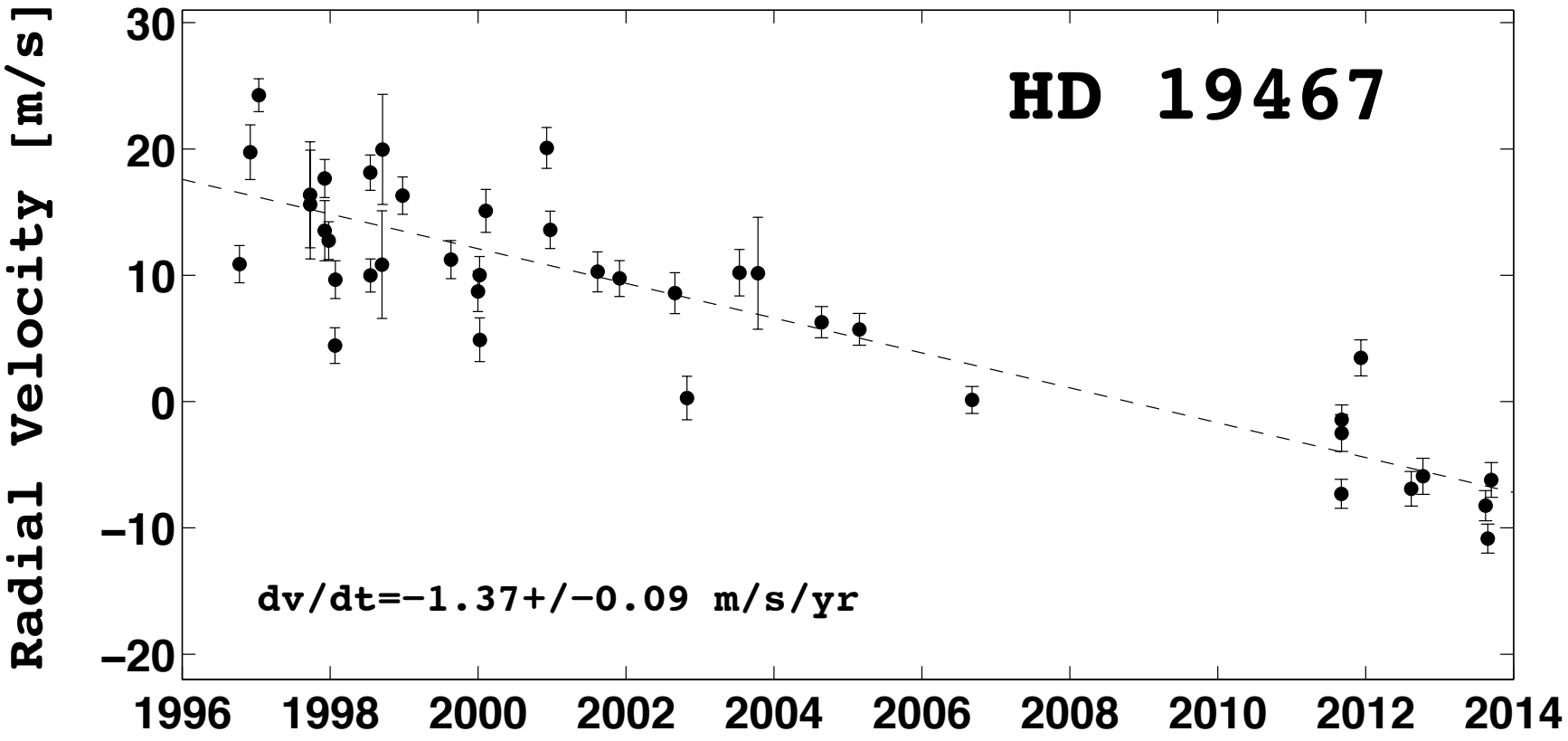


Corresponding Direct Image



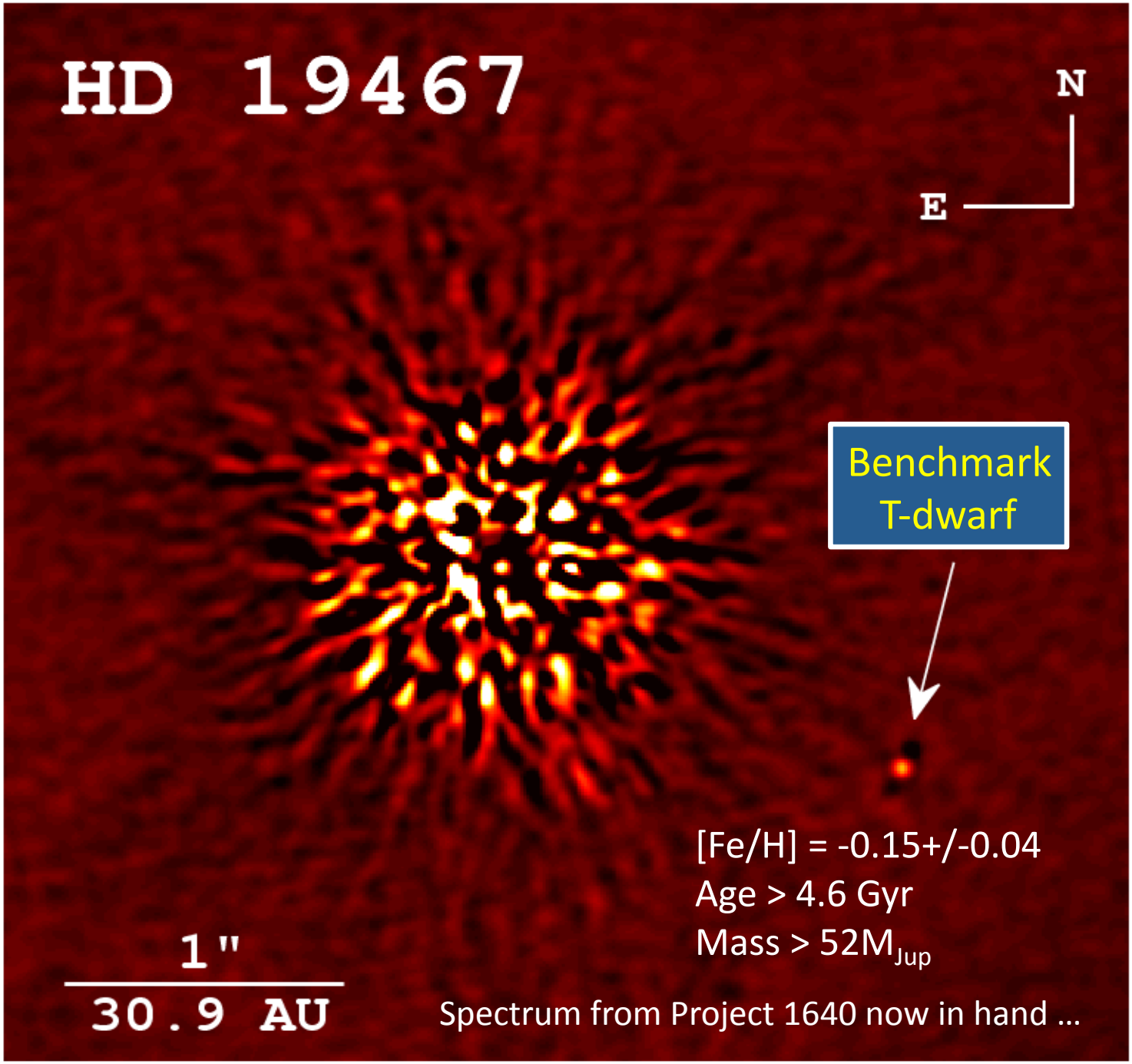
Crepp et al. 2012b, ApJ, 761, 39

The TRENDS High-Contrast Imaging Survey. V. Discovery of an old and cold benchmark T-dwarf

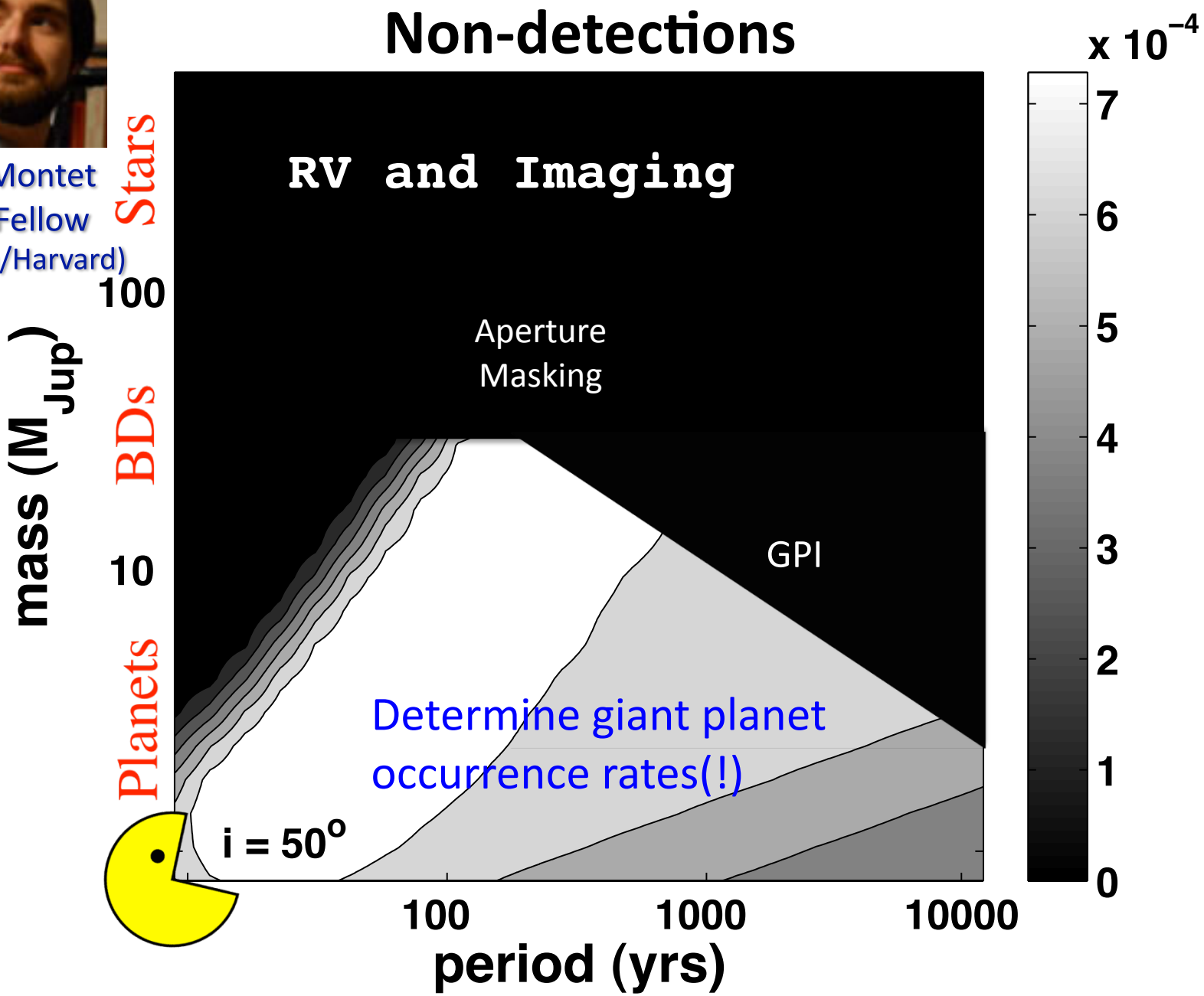


Crepp et al. 2014, ApJ, 781, 29

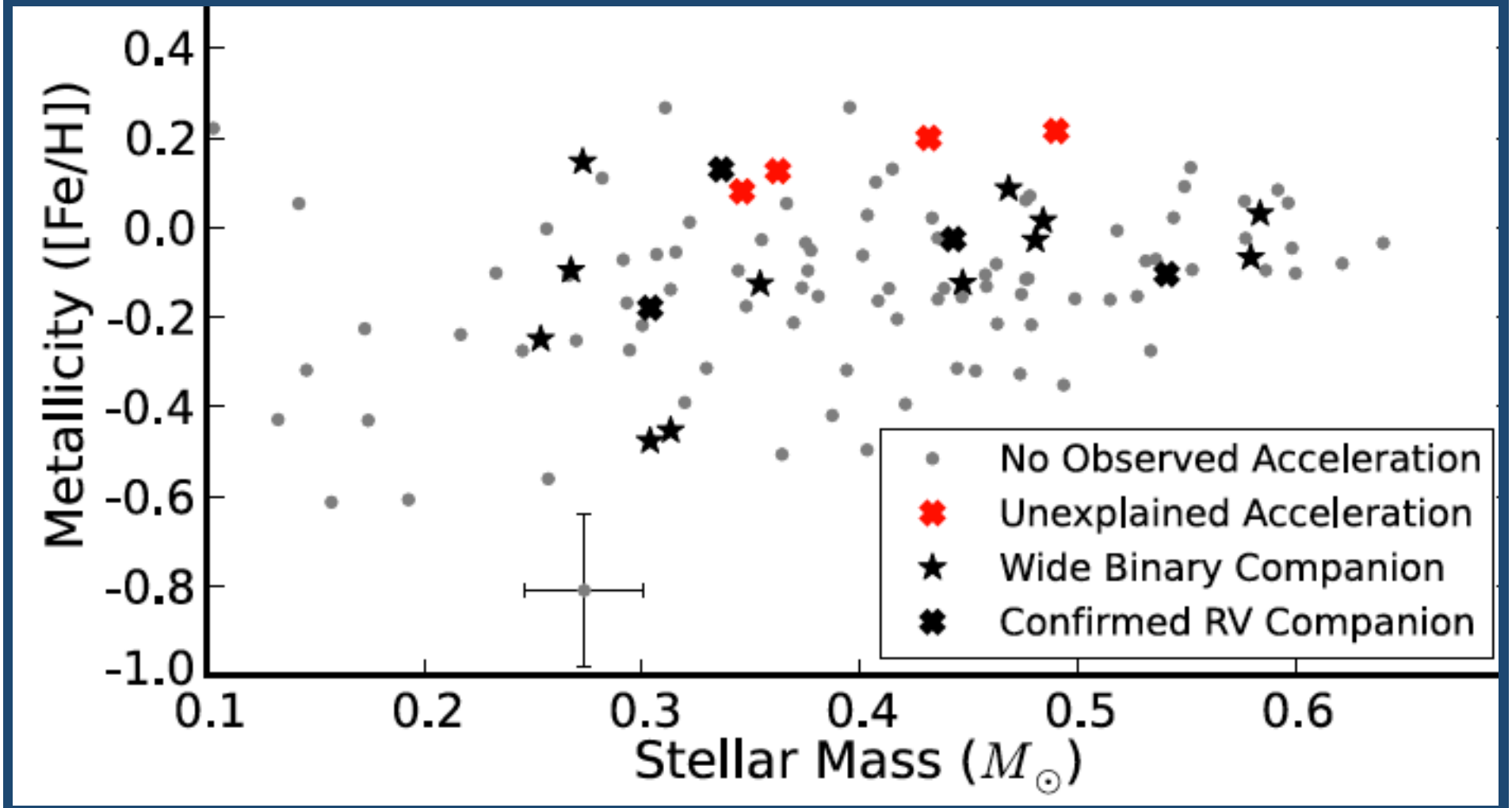
Crepp et al. 2014, ApJ, 781, 29



Ben Montet
NSF Fellow
(Caltech/Harvard)

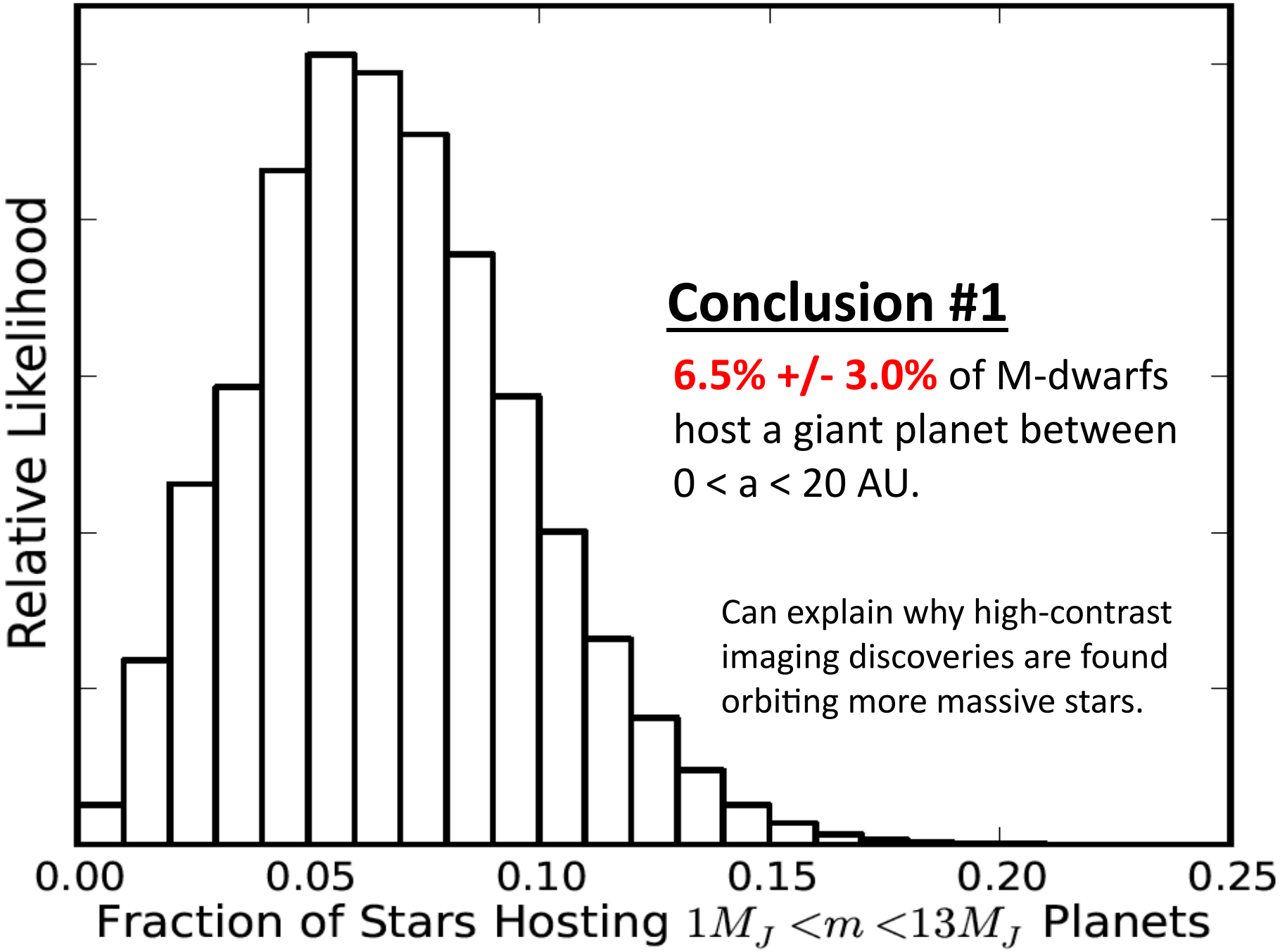


The Frequency of Giant Planets around M-dwarfs



Montet et al. 2014, ApJ, 781, 28

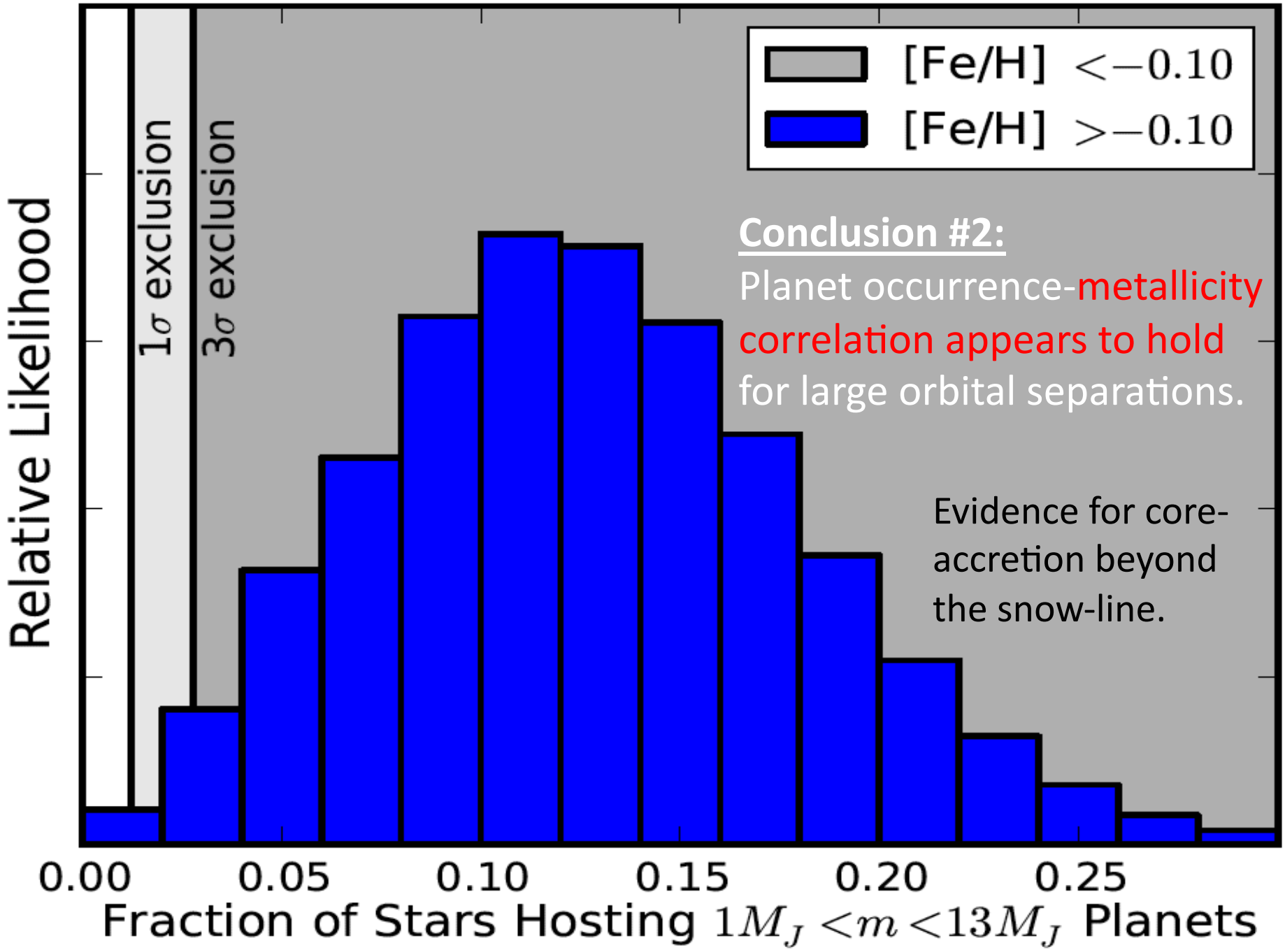
11.8 year time baseline
29 RV measurements



Conclusion #1

6.5% +/- 3.0% of M-dwarfs host a giant planet between 0 < a < 20 AU.

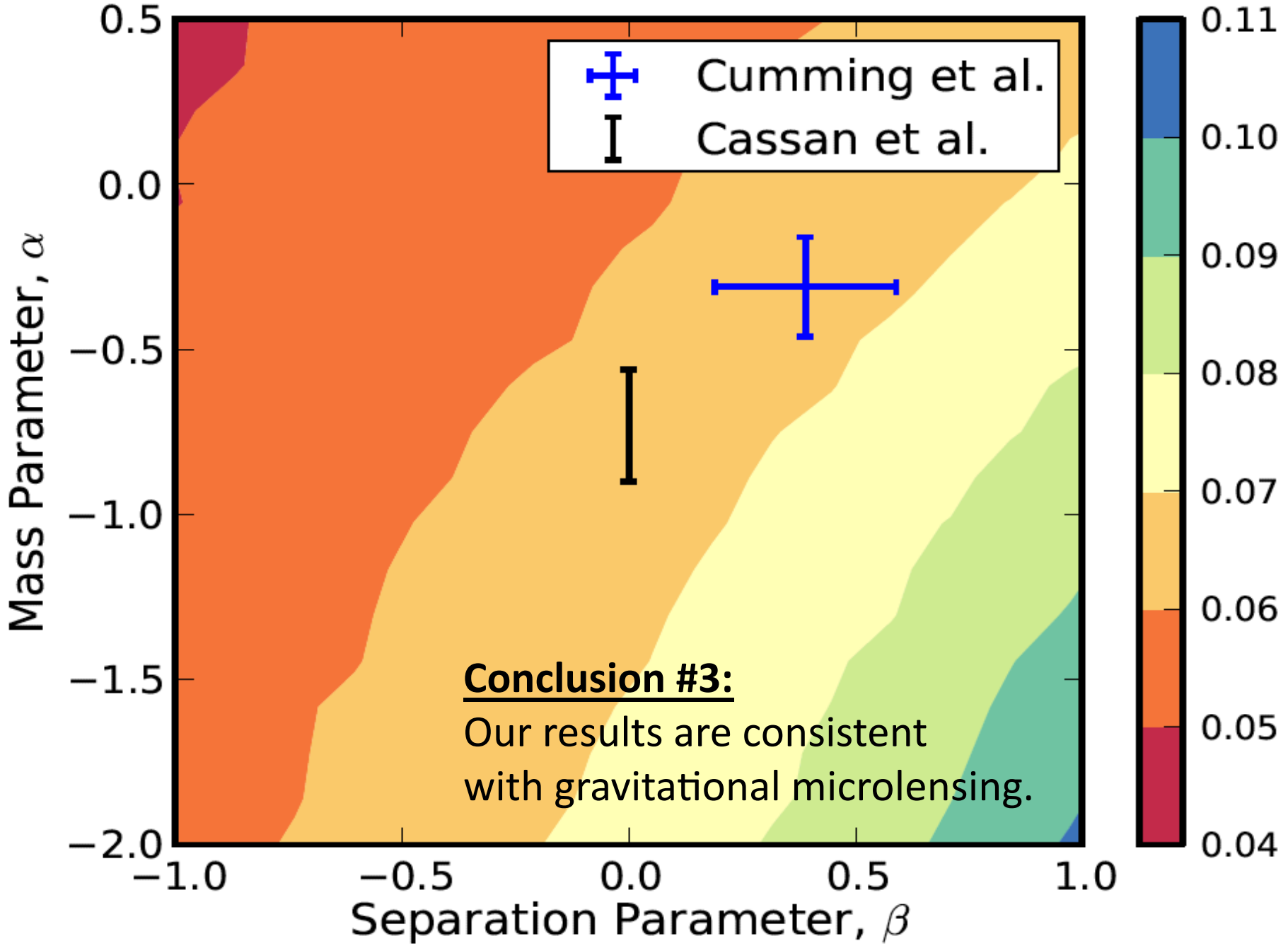
Can explain why high-contrast imaging discoveries are found orbiting more massive stars.



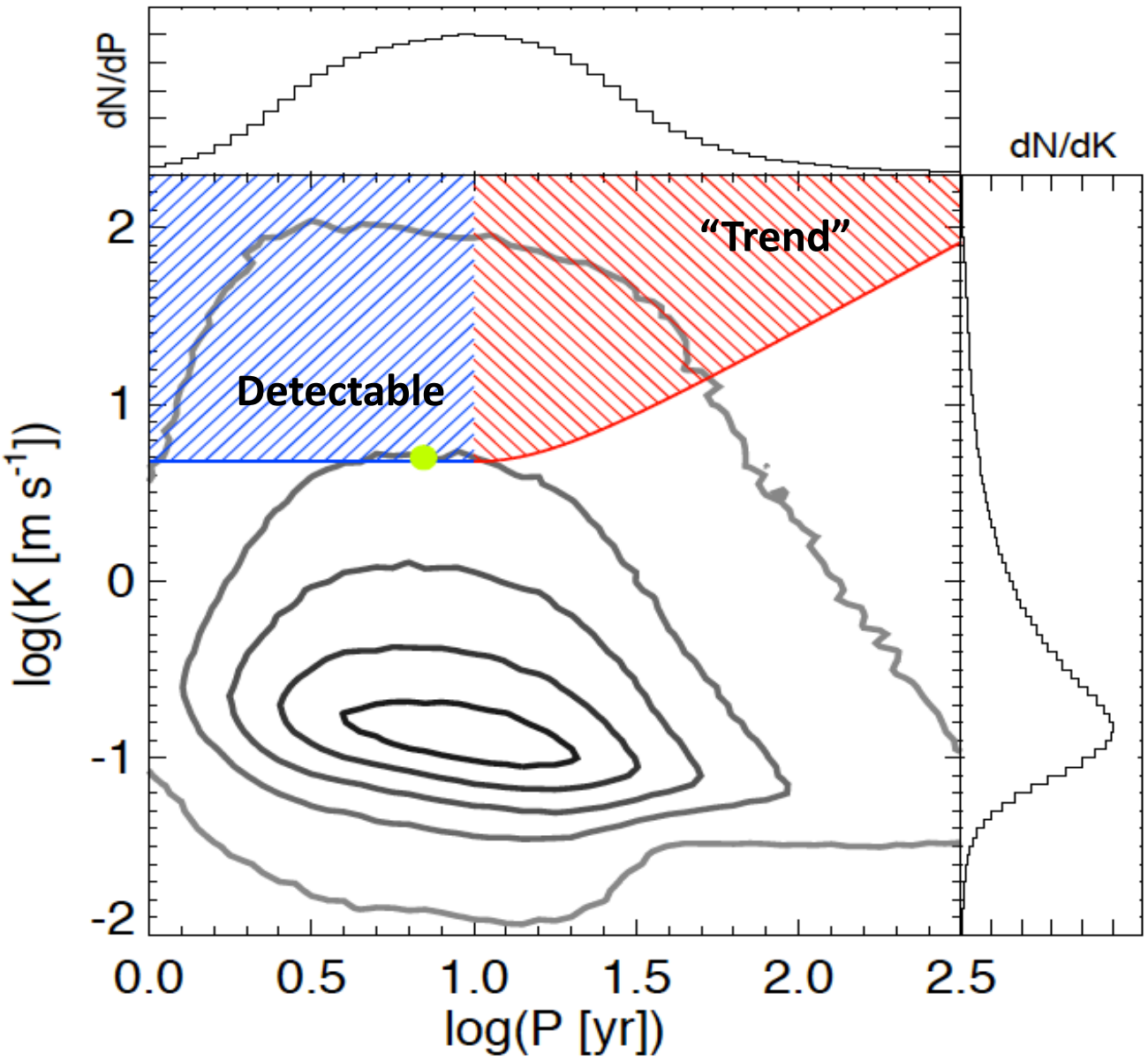
Conclusion #2:

Planet occurrence-metallicity correlation appears to hold for large orbital separations.

Evidence for core-accretion beyond the snow-line.


Cumming et al.
Cassan et al.
Conclusion #3:
Our results are consistent
with gravitational microlensing.
Mass Parameter, α
Separation Parameter, β
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−1.0
−0.5
0.0
0.5
1.0
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04

Microlensing → RV's



Clanton & Gaudi 2014a,b

Predicted Planets (P > 100 d)

CPS: 4.7 +/- 2.6
HARPS: 1.4 +/- 0.8

Actual Planets (P > 100 d)

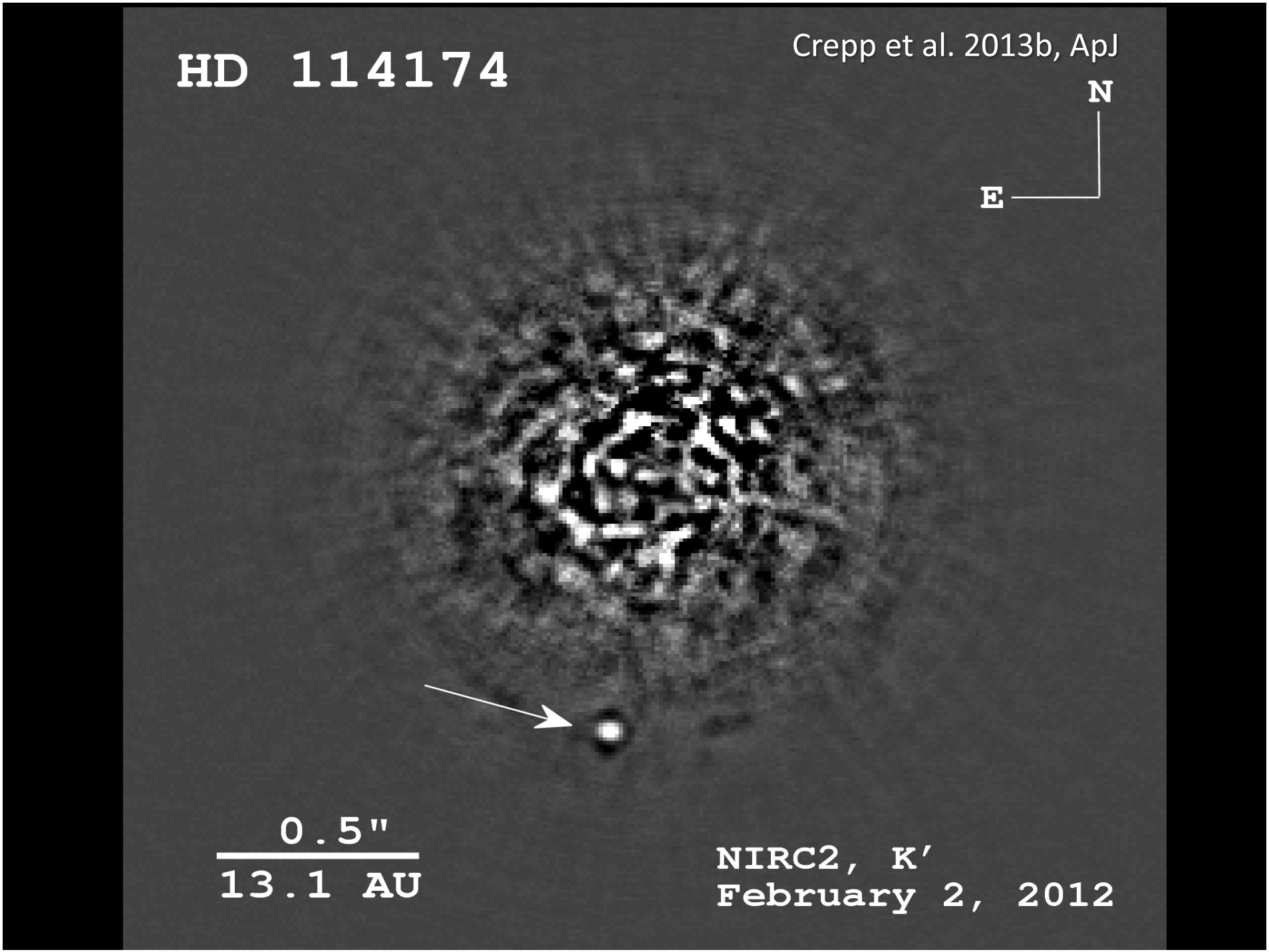
CPS: 4
HARPS: 1

Results consistent with Kepler …

Summary

- TRENDS discoveries of benchmark objects
  → HD 19467 B [T7-dwarf: mass, age, metallicity]

- TRENDS non-detections
  → Occurrence rate of giant planets [1-13M_{Jup}]
  6.5+/-3.0% from 0-20 AU
  → Planet occurrence-metallicity correlation holds
  → First independent check on μ-lensing results
  → Technique may be applied to KG-stars(!)


HD 114174
Crepp et al. 2013b, ApJ
N
E
0.5"
13.1 AU
NIRC2, K'
February 2, 2012