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

Radial Velocity [m/s]

\( \frac{dv}{dt} = -1.37 \pm 0.09 \text{ m/s/yr} \)

Benchmark T-dwarf

[Fe/H] = -0.15 +/- 0.04
Age > 4.6 Gyr
Mass > 52M_{Jup}

Spectrum from Project 1640 now in hand...
Non-detections

RV and Imaging

Aperture
Masking

GPI

Determine giant planet occurrence rates(!)

mass (M_{Jup})

RV Only

Aperture
Masking

GPI

Non-detections

period (yrs)

mass (M_{Jup})

RV and Imaging

Aperture
Masking

GPI

Determine giant planet occurrence rates(!)

i = 50°

0

1

2

3

4

5

6

7

x 10^{-4}
The Frequency of Giant Planets around M-dwarfs


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.
Conclusion #3:
Our results are consistent with gravitational microlensing.

Cumming et al.
Cassan et al.
Clanton & Gaudi 2014a,b

**Microlensing → RV’s**

**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(!)