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The Frequency of Binary Companions Around KELT Planet Host Stars

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September 18, 2017

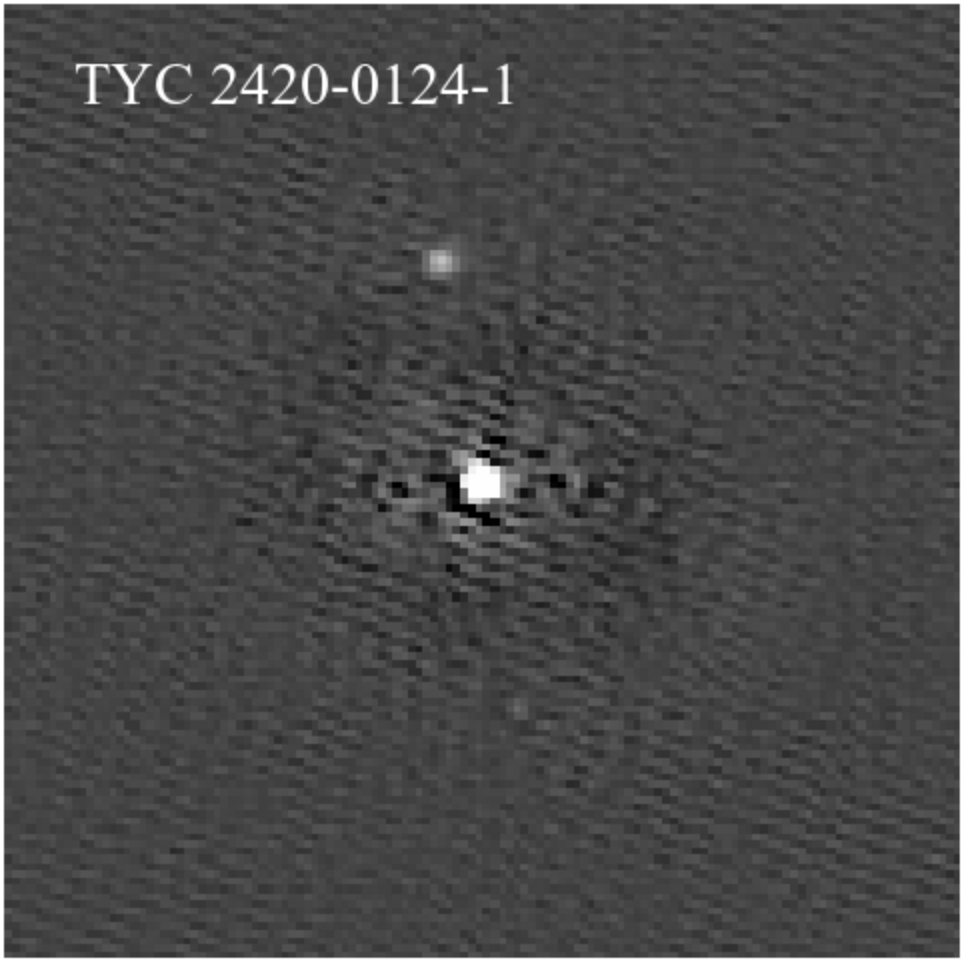
Background

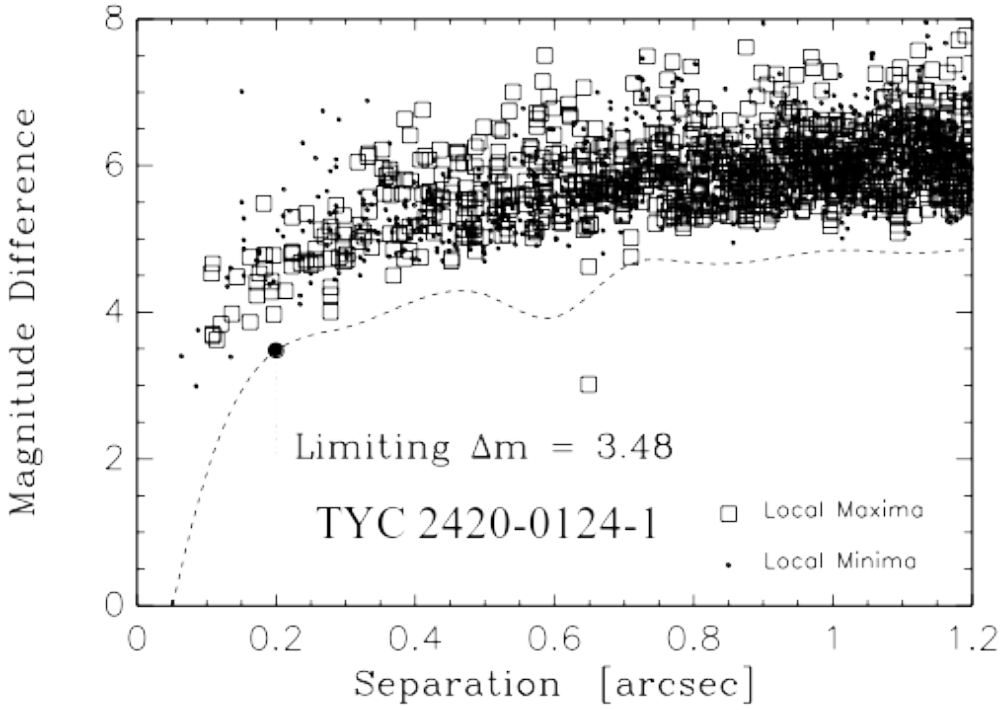
- Hot Jupiter formation mechanism still debated
  - Probably formed beyond snow line
  - How do they migrate inwards?
- Three main potential methods
  - Type II/other disk migration
  - Dynamical scattering
  - Kozai-Lidov/binary star interactions
    - Conceptually easy test: look for binary companions to hot Jupiter hosts

Survey Design

- High resolution imaging
  - Speckle interferometry (Differential Speckle Survey Instrument on WIYN 3.5-meter)
  - Adaptive optics (Large Binocular Telescope Interferometer/ LMIRCam)
- Surveyed 79 stars
  - 12 KELT (Kilodegree Extremely Little Telescope) planet hosts visible in Northern Hemisphere
  - 67 comparison stars rejected by KELT
  - Selected on brightness and spectral type
    - Match KELT planet hosts (A & F stars/above 6200 K)
    - Close to true statistical control (hot Jupiters rare)

DSSI Sample Observation

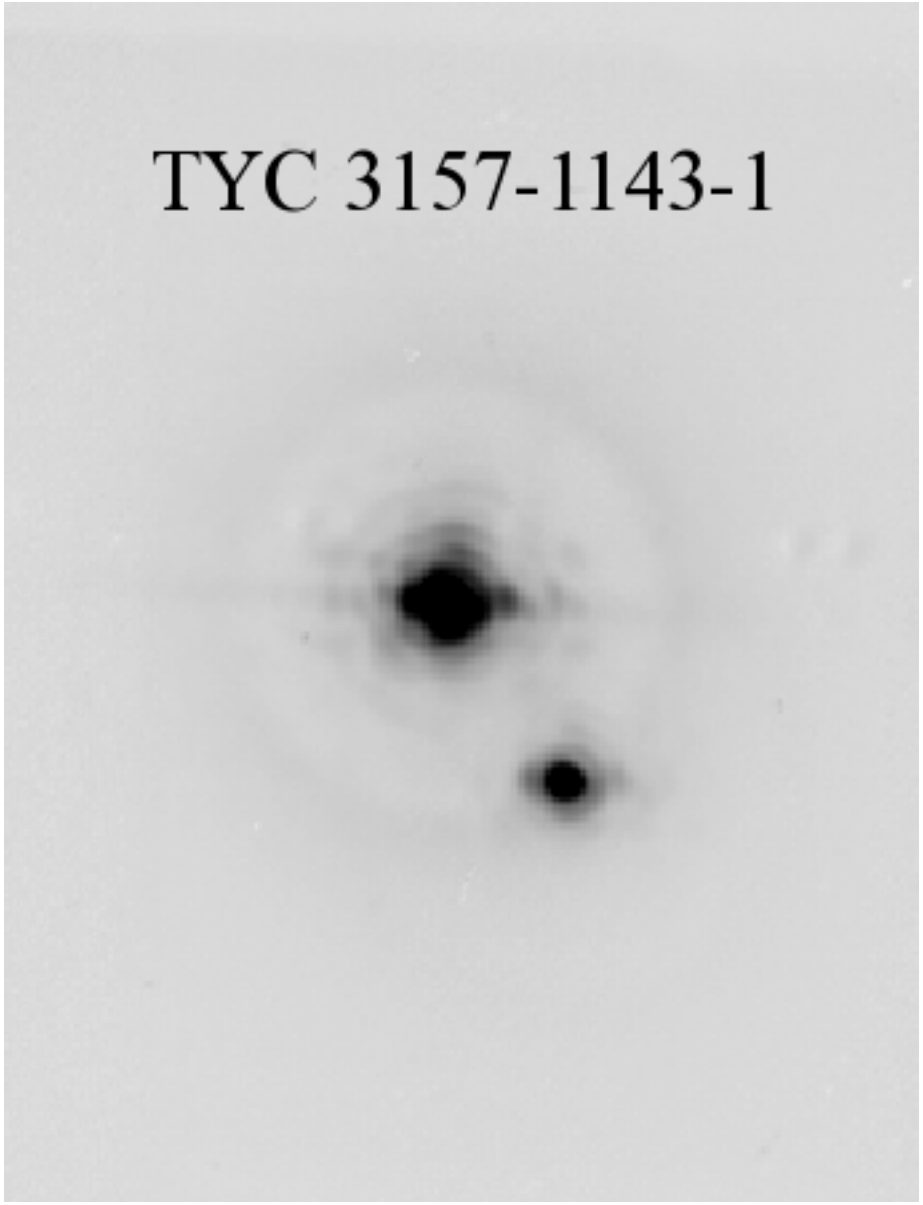


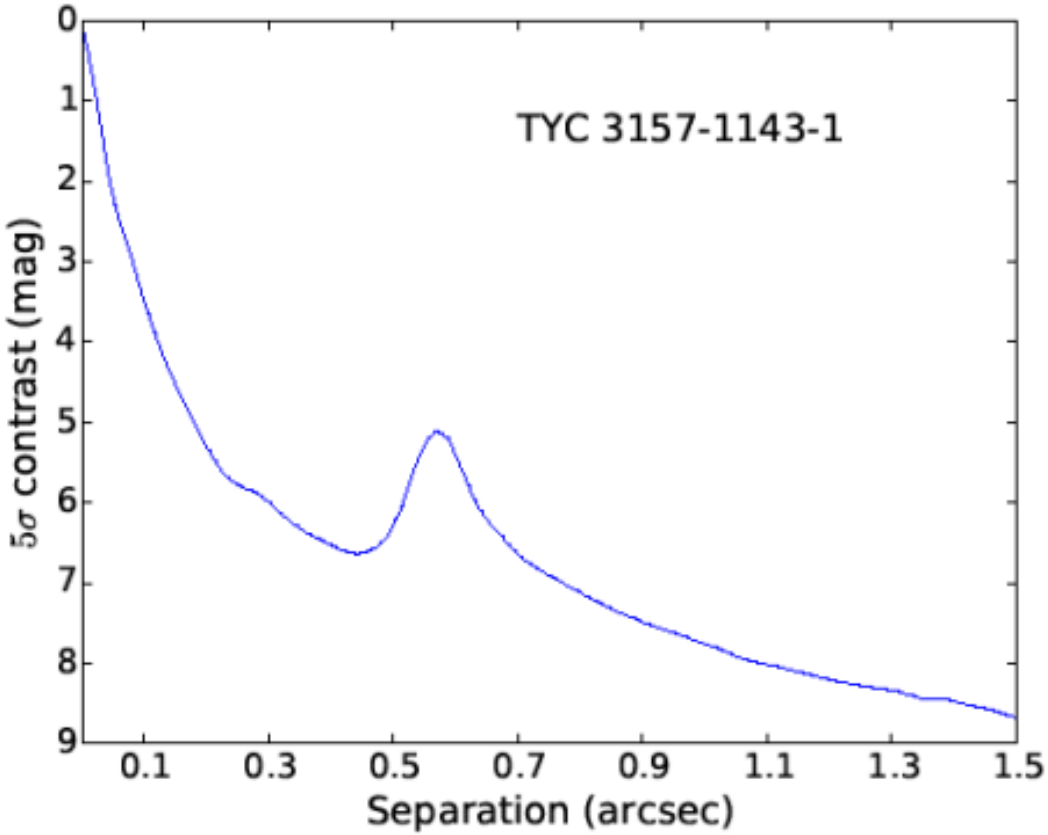


DSSI Results Summary

- Four comparison sample binaries observed (fifth rejected as contaminant)
  - Two previously unknown
- Companion fraction of $8.0^{+3.0}_{-2.4}$% (4/50)
  - 7.8±0.4% expected at WIYN (Horch et al. 2014)
  - Consistent with field FGK stars
- No constraints on hot Jupiter formation from DSSI data

LBTI Typical Performance (Good Seeing)





LBTI Results Summary

- Nine comparison sample candidate binaries observed
  - Two rejected as chance alignments
  - Six previously unknown companions
  - 36.8±6.3% companion fraction (9/19)
- No new KELT planet host companions observed
  - 50±8.1% companion fraction (all imaging sources; 9/18)
- 1.6σ excess
  - Binary companions likely slightly favor hot Jupiters

Conclusions and Future Work

- Hot Jupiter hosts have 1.6σ excess companion fraction
  - Binary stars likely favor hot Jupiter formation
  - Kozai/binary star interactions likely not dominant hot Jupiter formation mechanism
- Angular differential imaging
- Investigate spin-orbit misalignment
  - Are hot Jupiters with companions more likely to be misaligned?
- Compare multiplicity of hot Jupiter hosts to multiplicity of other planet hosts

High-Dispersion Coronagraphy

- Combine high-resolution spectrograph with high-contrast coronagraph to find exoEarths
- Benefits:
  - Higher background tolerance/lower contrast req.
  - Could trade contrast for throughput/bandpass, etc.
  - May lower cost of instrument
- Problems:
  - Detector noise/real estate
  - Photon noise (not enough integration time in the world…)

Goals

- Answer questions:
  - What exactly is gained with higher resolution?
  - What does instrument look like? IFU viable?
  - Can noise problems be solved? Hard barriers?
  - What do tradeoffs look like? How do they affect yield?
- Focused primarily on space-based instruments (HabEx/LUVOIR)