Keck Next-Generation AO:
Galactic Science

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Key Science Cases

1. Planets around VLM stars & brown dwarfs
   (Liu, Macintosh)

2. Galactic Center
   (Ghez, Lu, Weinberg)

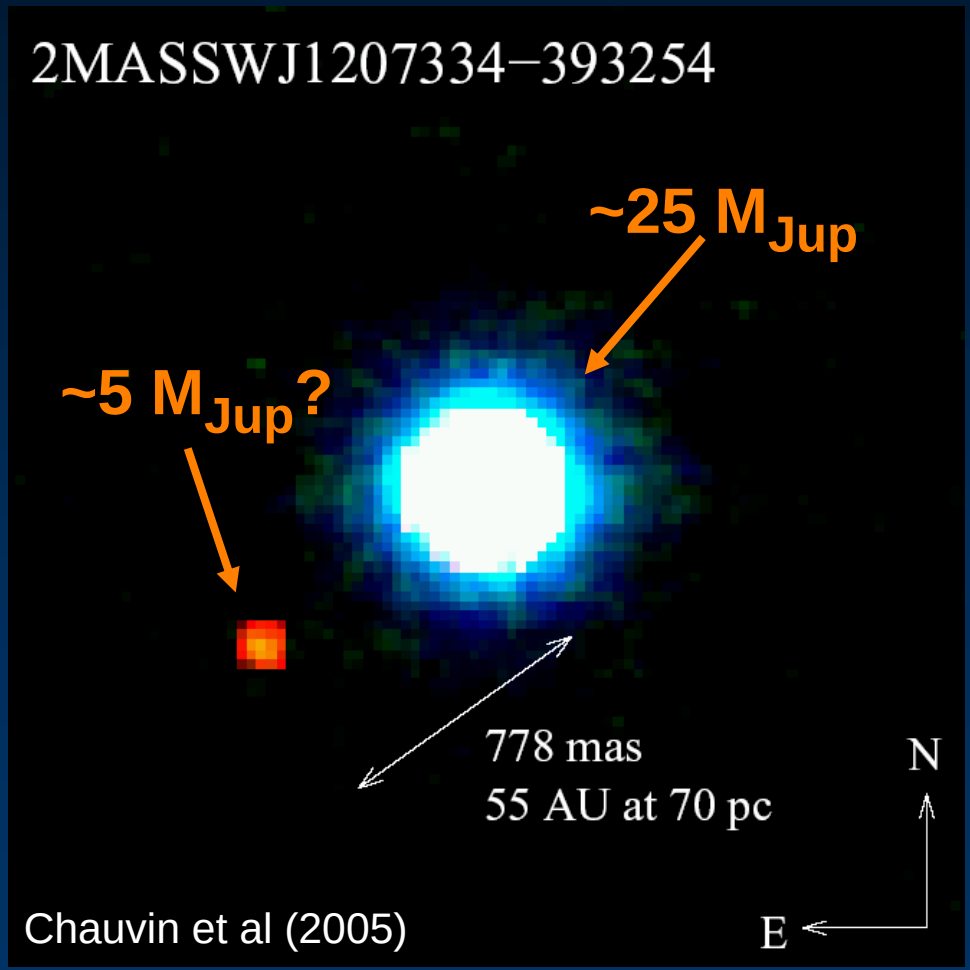
3. Debris Disks
   (Metchev, Liu)

4. Circumstellar environments of protostars
   (Hillenbrand, Greene)

Galactic Science:
Main Requirements

- Narrow-field, high Strehl only.
- Optical and IR coverage needed.
- Some specialized capabilities needed
  - High contrast coronagraphy
  - Polarimetry

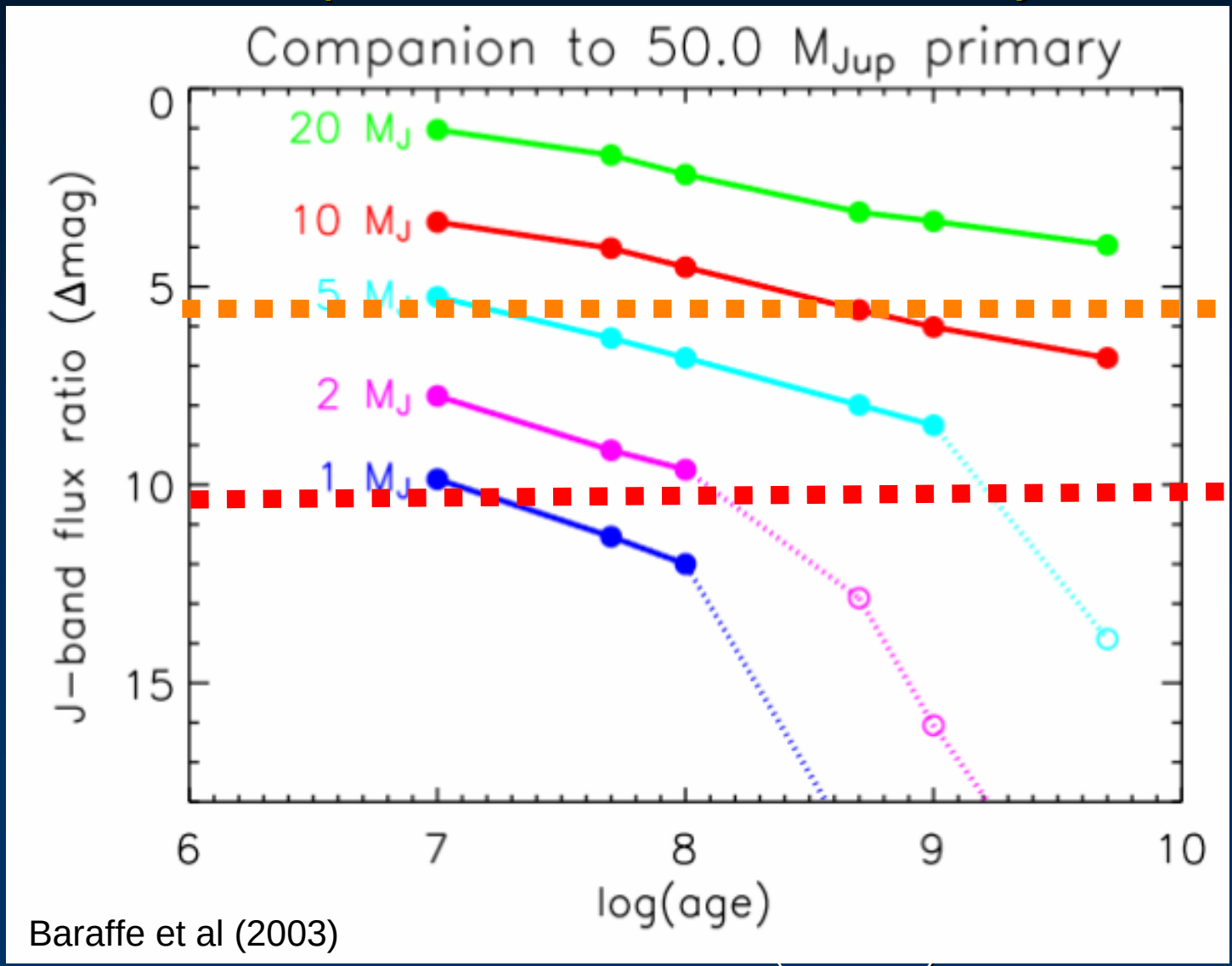
Planets around VLM stars & brown dwarfs



- Direct imaging of planets easier around VLM stars and brown dwarfs.
- Study objects with SEDs & atmospheres similar to "regular" exoplanets (but with different origin).
- *High contrast LGS* + *IR tiptilt* + *high efficiency* needed.

Contrast Requirements

(known BD binaries are nearly all <~0.5”)

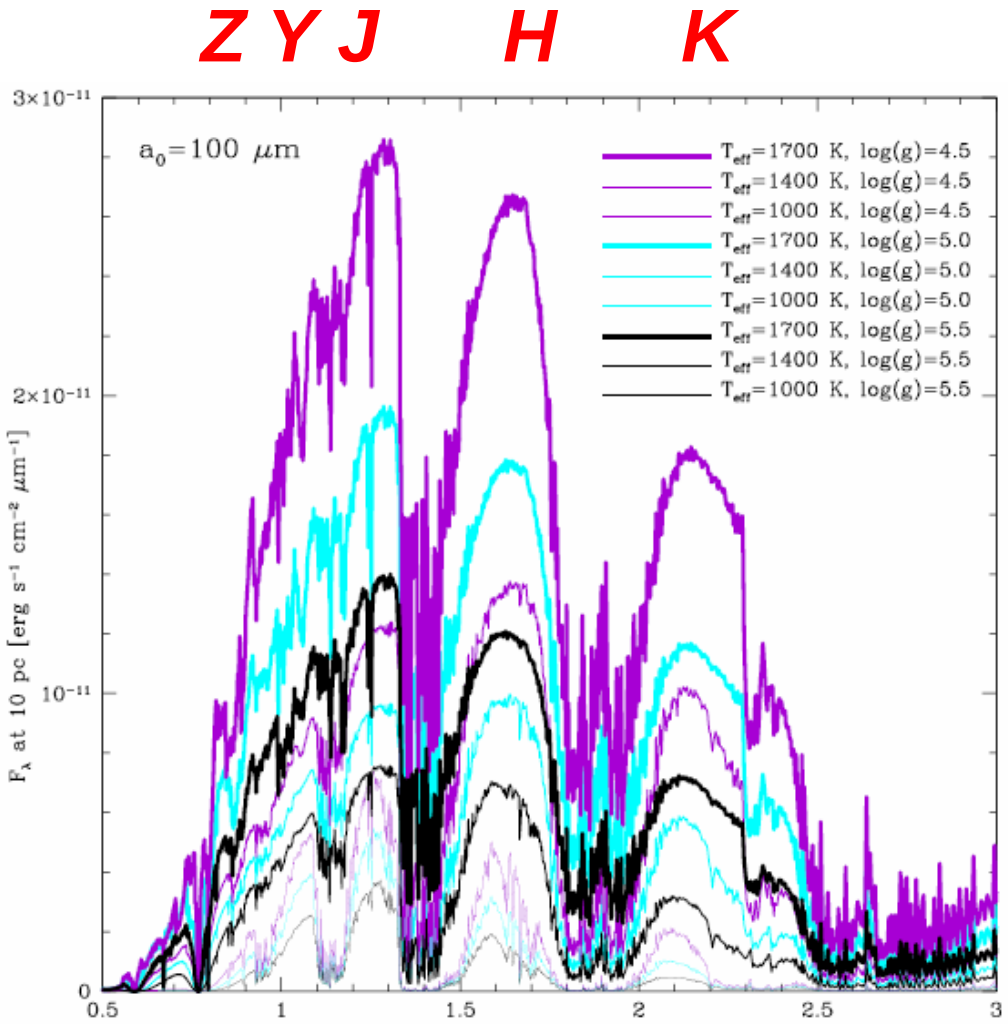


LGS now (r ~ 0.3”)

KPAO goal

Baraffe et al (2003)

Planet Characterization



Burrows et al (2006)

- Diagnostics
  - Surface gravity
    Proxy for age/mass
  - Metallicity
  - Clouds
- Observations
  - Opt/IR colors
    ZYJHKL' bands
  - Spectra
    R ~ few 100

No shortage of science targets

1. Mostly all off-axis T/T stars (maybe)
2. In general, tradeoff between age & distance…

- **Solar neighborhood**: *t~Gyrs, d<20 pc*
  - 2MASS/SDSS surveys of L & T dwarfs: N~500
  - New IR surveys for Y dwarfs (***UKIDSS, VISTA***): N~dozens?
  - Volume-limited surveys (***Pan-STARRS***): N~1000s
- **Young field objects**: *t~10-100 Myr, d<50 pc*
  - Ongoing kinematic & spectroscopic searches: N~100's
- **Star-forming regions**: *t<10 Myr, d~150 pc*
  - Ongoing wide-field IR surveys: N~100's

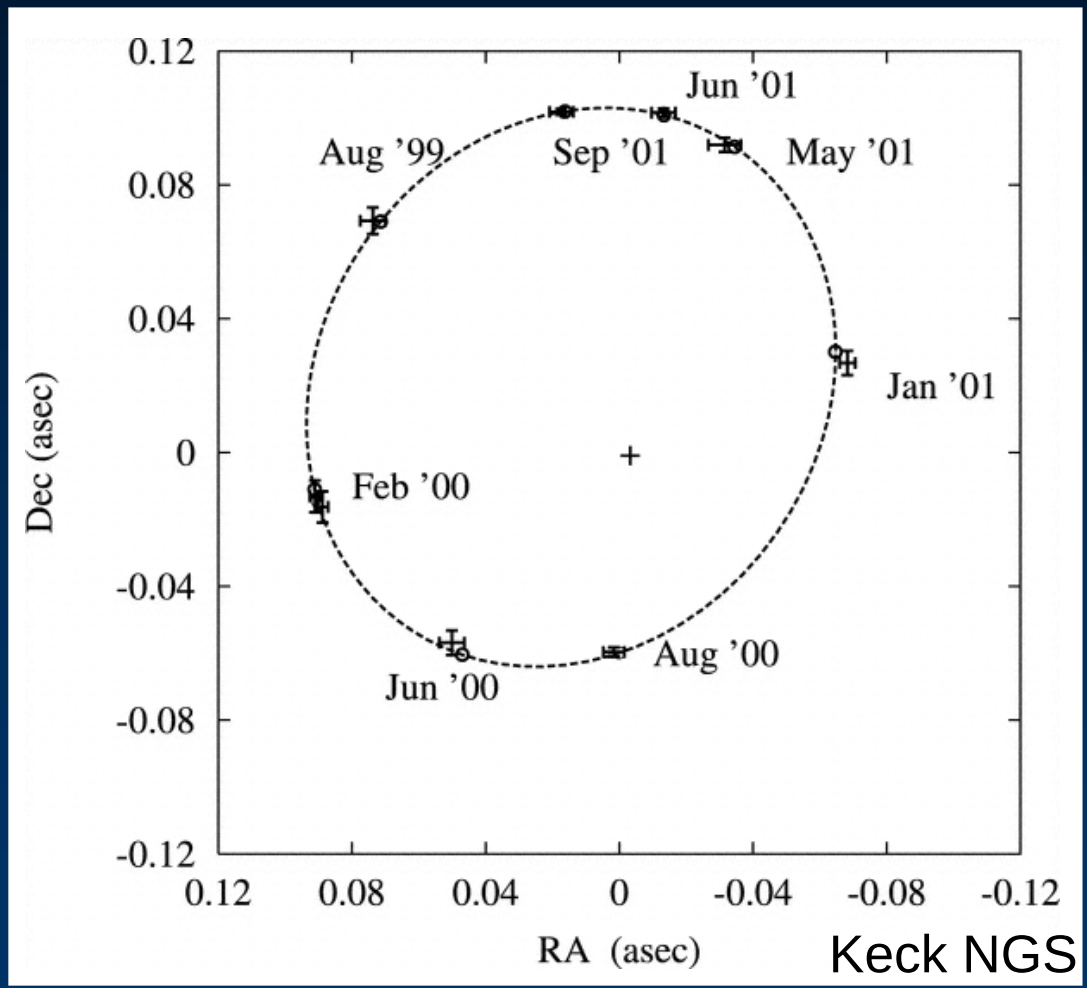
Simulation Plan

1. Estimate pt source detection curve for YJHK (*Δmag vs separation*) .

2. Combine with substellar evolutionary models and notional target list (distance vs age).

3. Identify feasible/optimal bands for search & characterization.

Related low-mass science



Zapatero-Osorio et al 2004

- Dynamical masses of BD binaries.
  Only ~2 systems have been measured so far.

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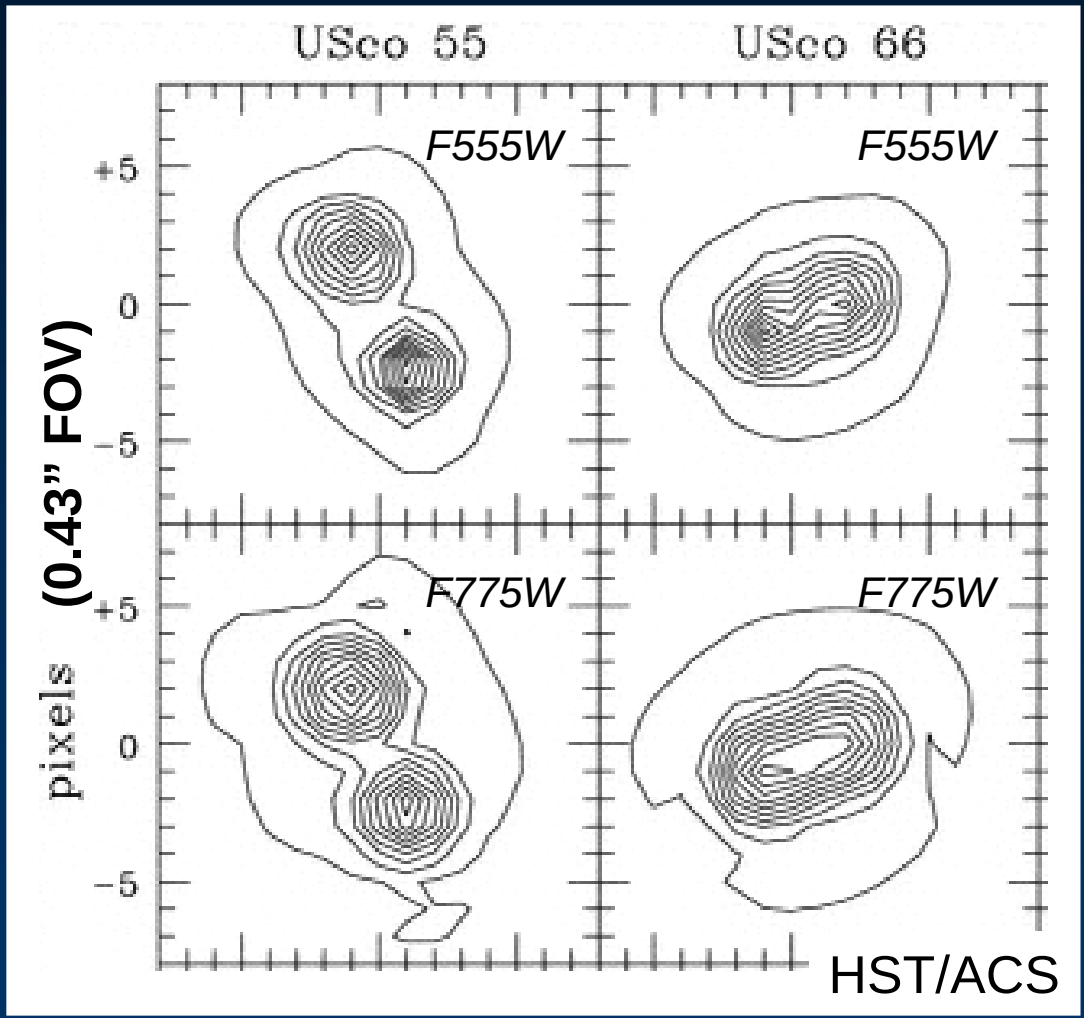

Kraus et al (2005)

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- Multiplicity of newly formed objects.
  Testing BD formation models at young ages.

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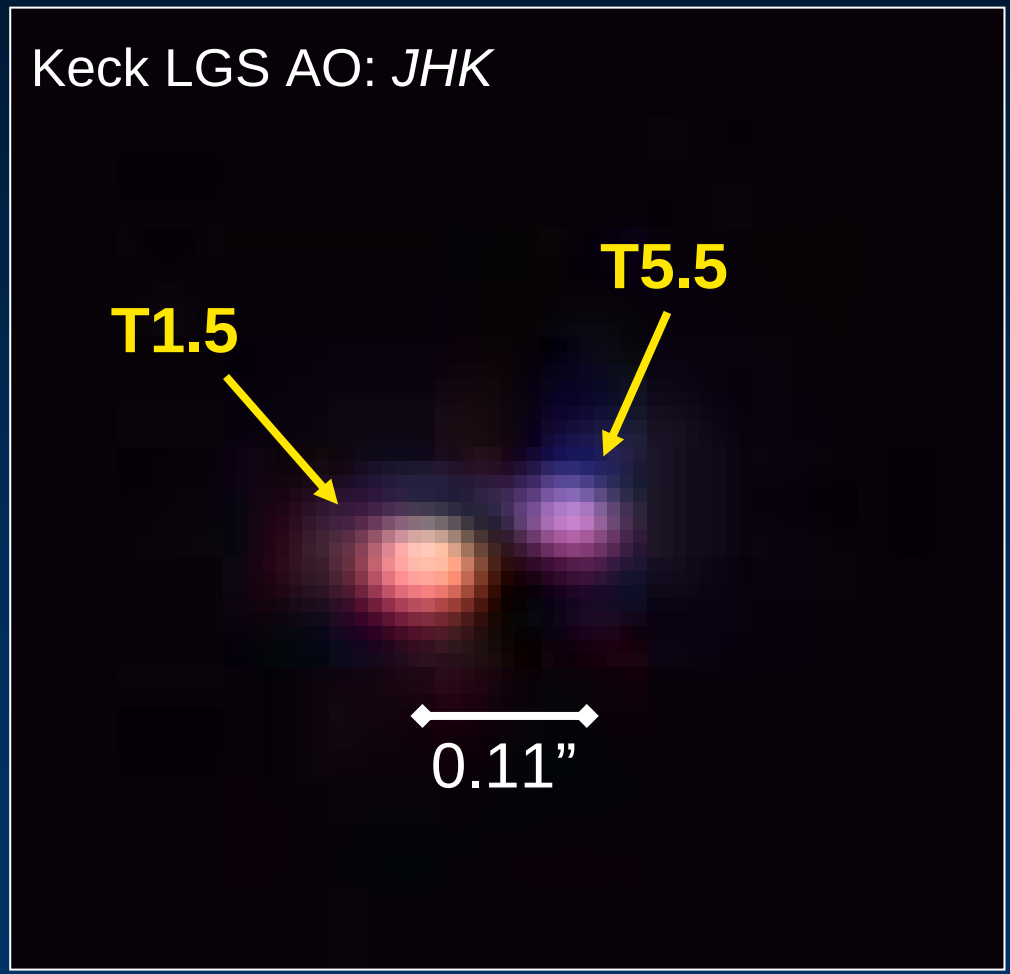

Liu et al (2006)

- Dynamical masses of BD binaries.
  Only ~2 systems have been measured so far.
- Multiplicity of newly formed objects.
  Testing BD formation models at young ages.
- Benchmark binaries.
  Probing the physics of ultracool atmospheres.