

# Planets around Low-Mass Stars and Brown Dwarfs

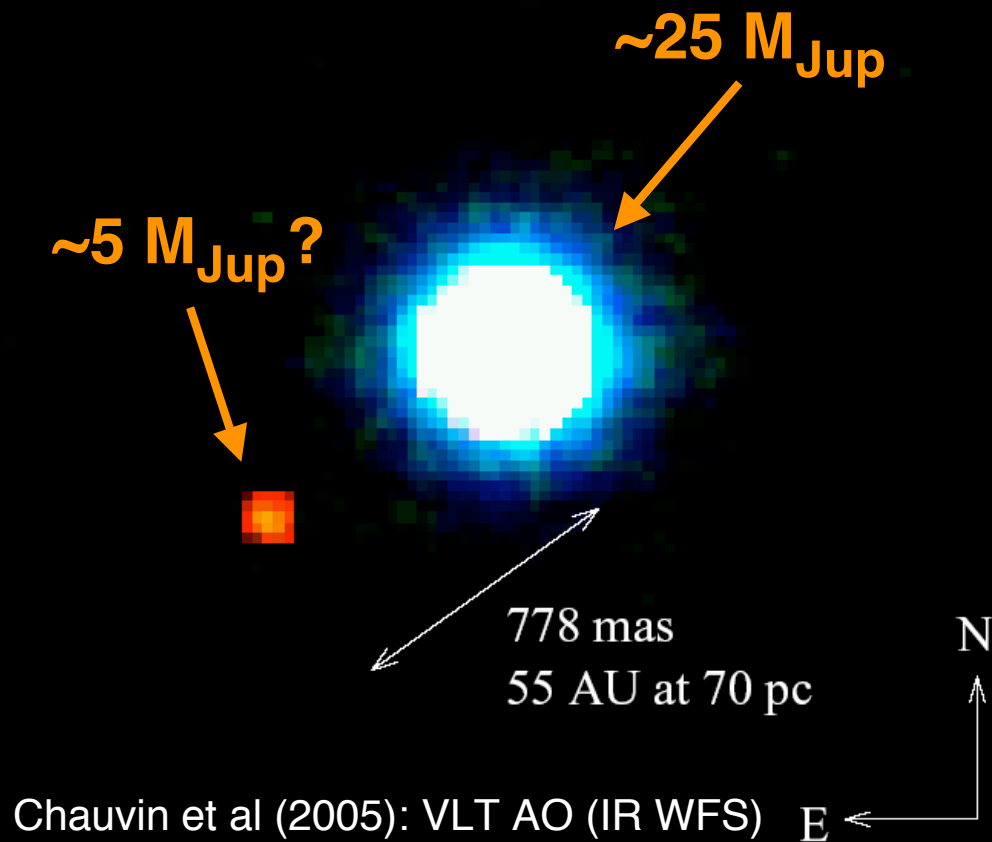
*Michael Liu*

Institute for Astronomy  
University of Hawaii

NGAO Workshop, UCSC/CfAO  
March 2007

# Planets around VLM stars & brown dwarfs

2MASSWJ1207334-393254



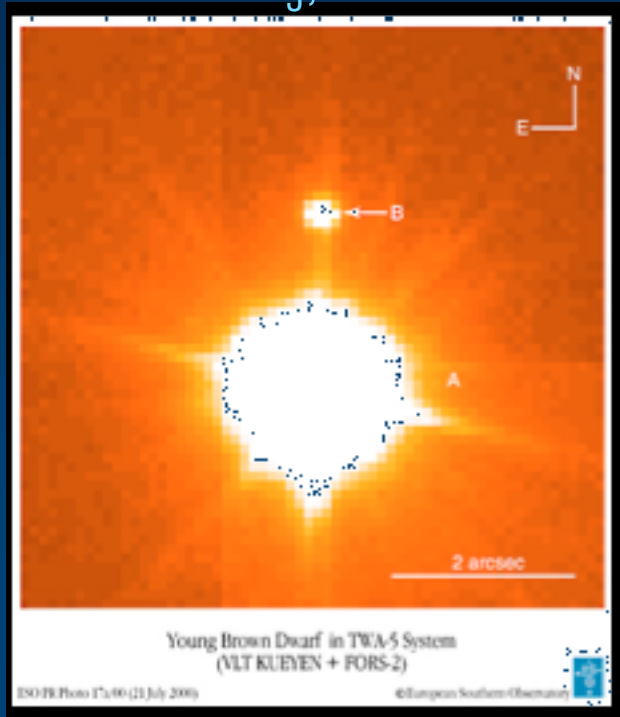
- Direct imaging and spectroscopy of planets easier around low-mass stars and brown dwarfs.
- Study objects with **SEDs & atmospheres** similar to “regular” exoplanets, but perhaps with diff origin.
- High contrast LGS + IR tip-tilt needed.

# Planets around v. young stars (1-10 Myr)

- NGAO surveys of the youngest stars (*optically faint*) can probe a unique, and largely unexplored, regime.

## TWA 5B

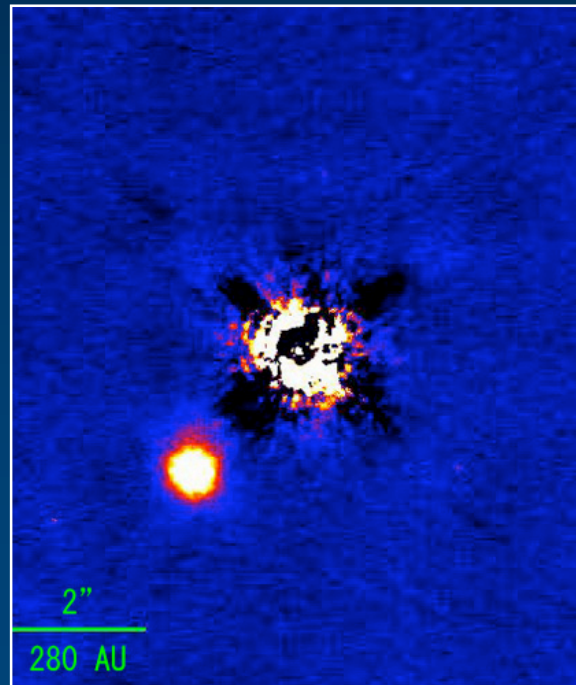
~20 M<sub>J</sub>, 100 AU



Lowrance et al 1999  
Neuhauser et al 2000

## DH Tau B

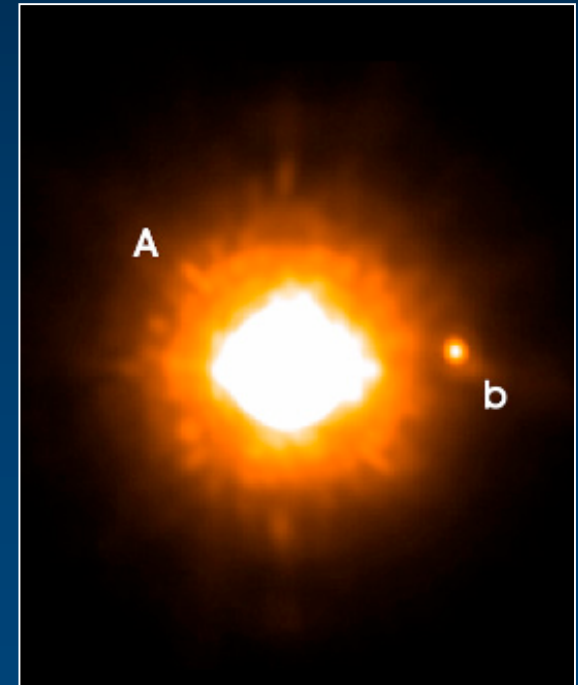
~40 M<sub>J</sub>, 330 AU



Itoh et al 2004

## GQ Lup B

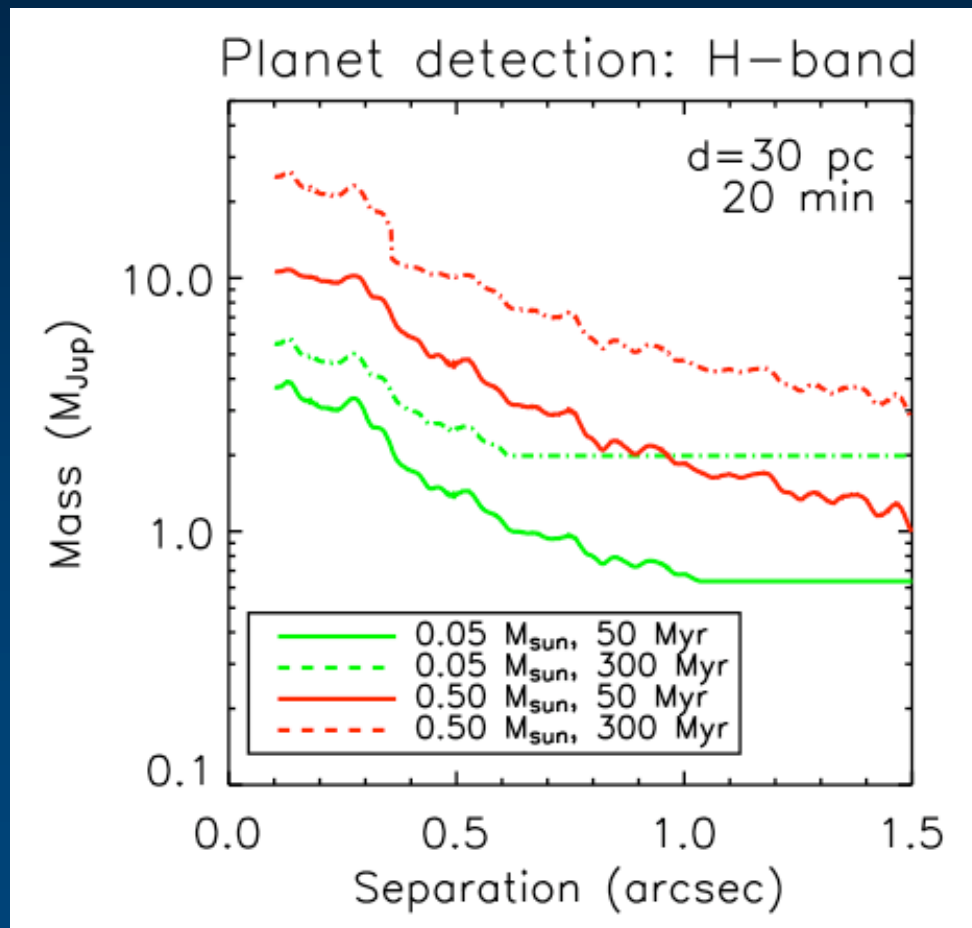
~20 M<sub>J</sub>, 100 AU



Neuhauser et al 2005

# NGAO: Planet detection sensitivity

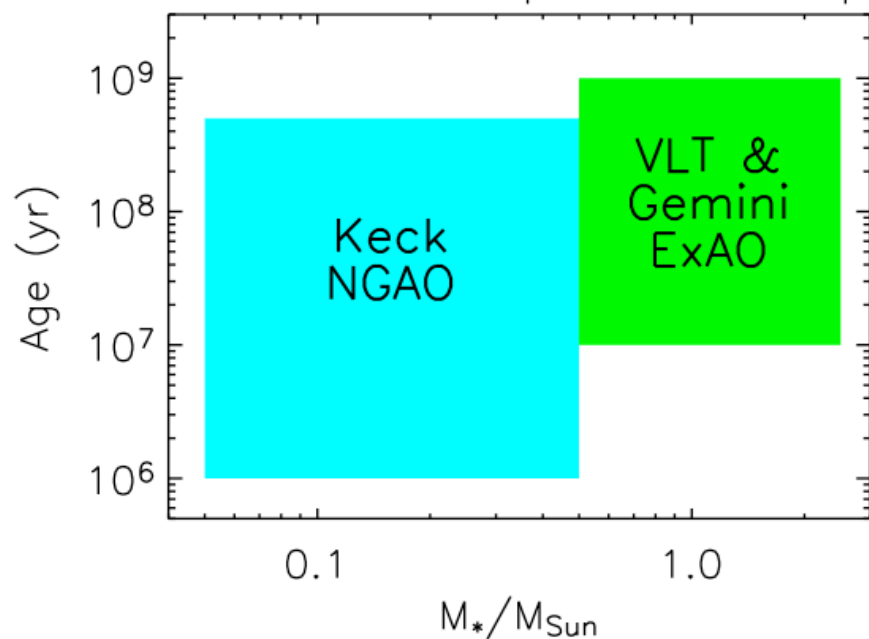
- Very high contrast in near-IR enables imaging of Jovian-mass planets around low-mass stars and brown dwarfs.



- **This can only be done by NGAO.**  
*The stars are too optically faint for ExAO systems ( $I < 8-9$ ).*
- A unique avenue for testing planet formation models, by using a **wide range of stellar host mass and ages.**

# NGAO opens a unique realm for high contrast studies for a broad range of science programs.

Planet detection parameter space



**AO system**

**Contrast**

**Extreme AO**

**$10^7-10^8$**

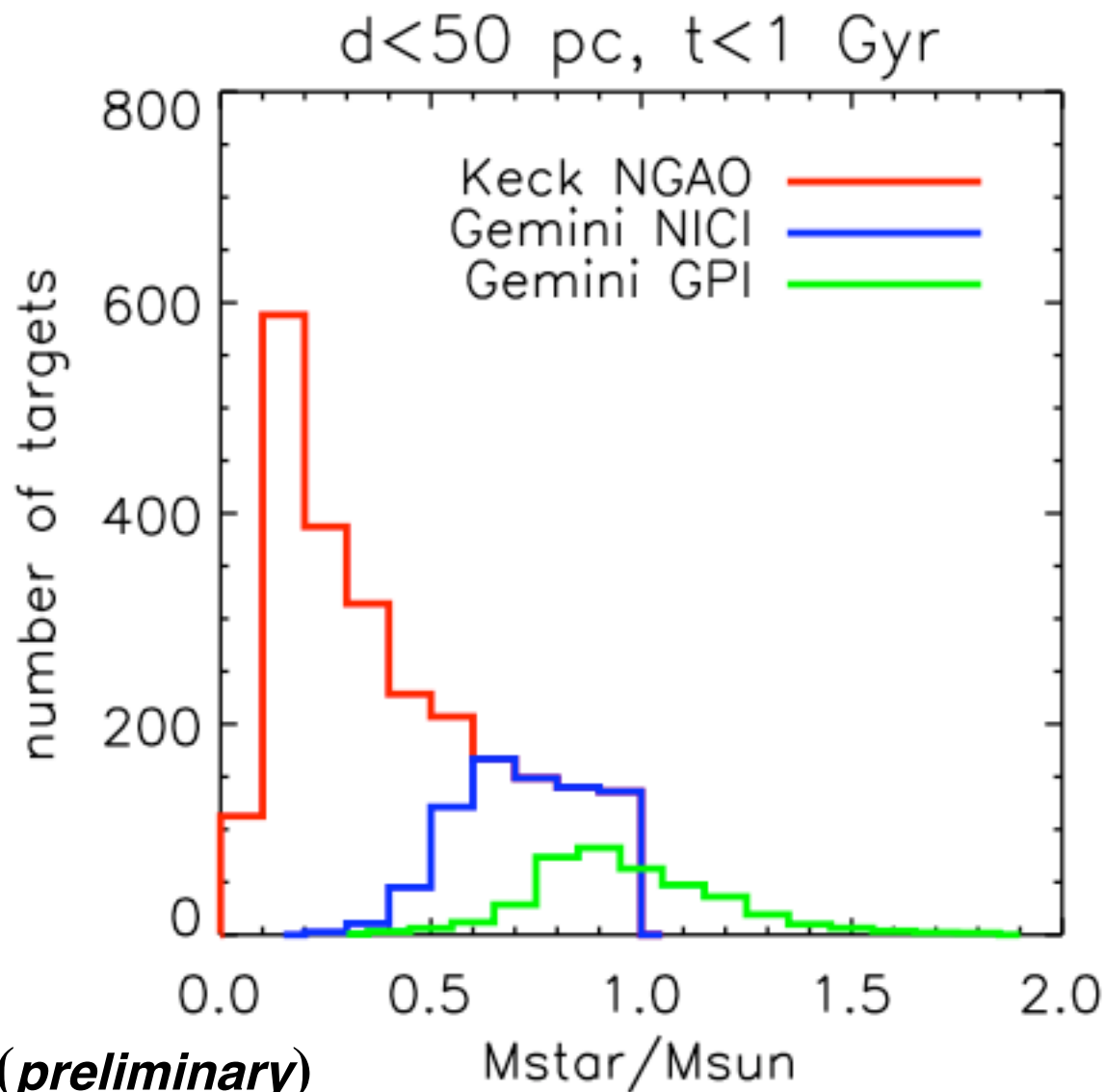
*v. bright stars only*

**Keck NGAO**

**$10^5-10^6$**

*many targets*

# Modeling the targets for NGAO



*(preliminary)*

- Census of solar neighborhood is very incomplete now ...
- But in  $\sim 5$  years will be much better (Pan-STARRS)
- Can build a budget of planet return as a function of contrast and IR T/T sensitivity