

FIRE AND ICE: CONFRONTING PLANET FORMATION THEORY WITH THE E-ELT

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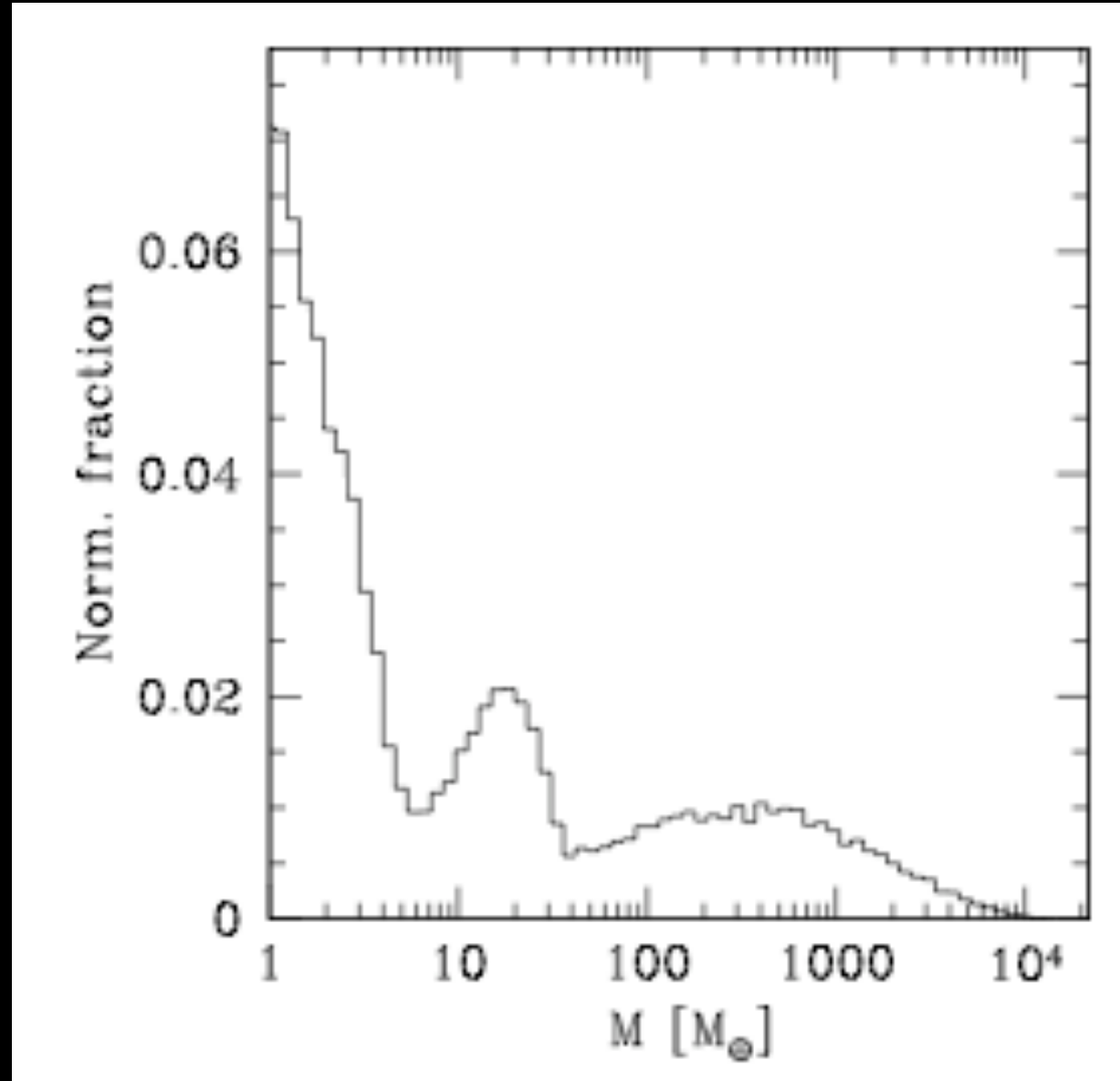
Maddalena Reggiani
Sascha Quanz

ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

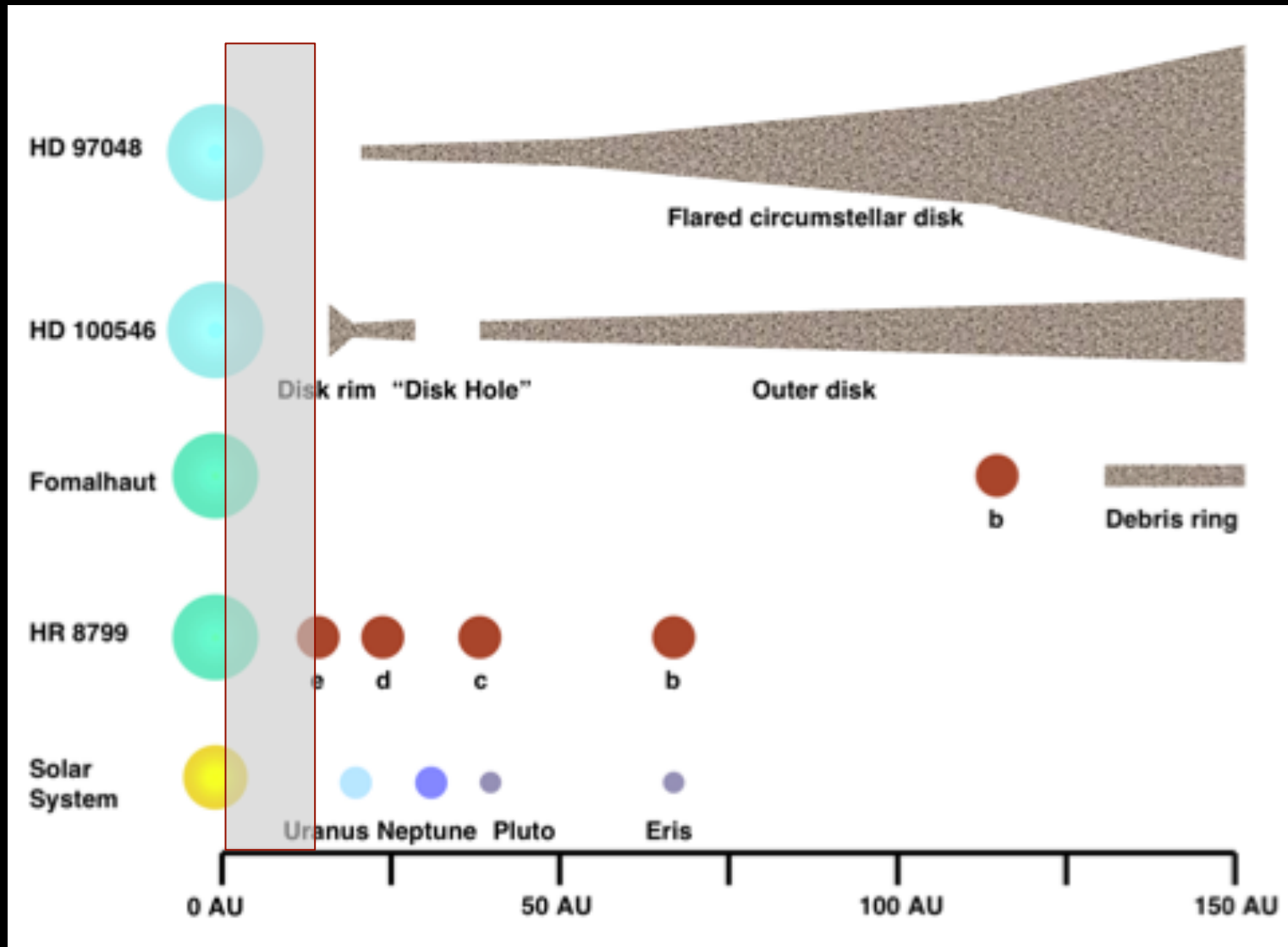
<http://www.astro.ethz.ch/>

Planet Formation Models: Some success, but so much we do not understand...



Ida & Lin (2004)
Mordasini et al. (2009)
Helled et al. (2014)
Benz et al. (2014)

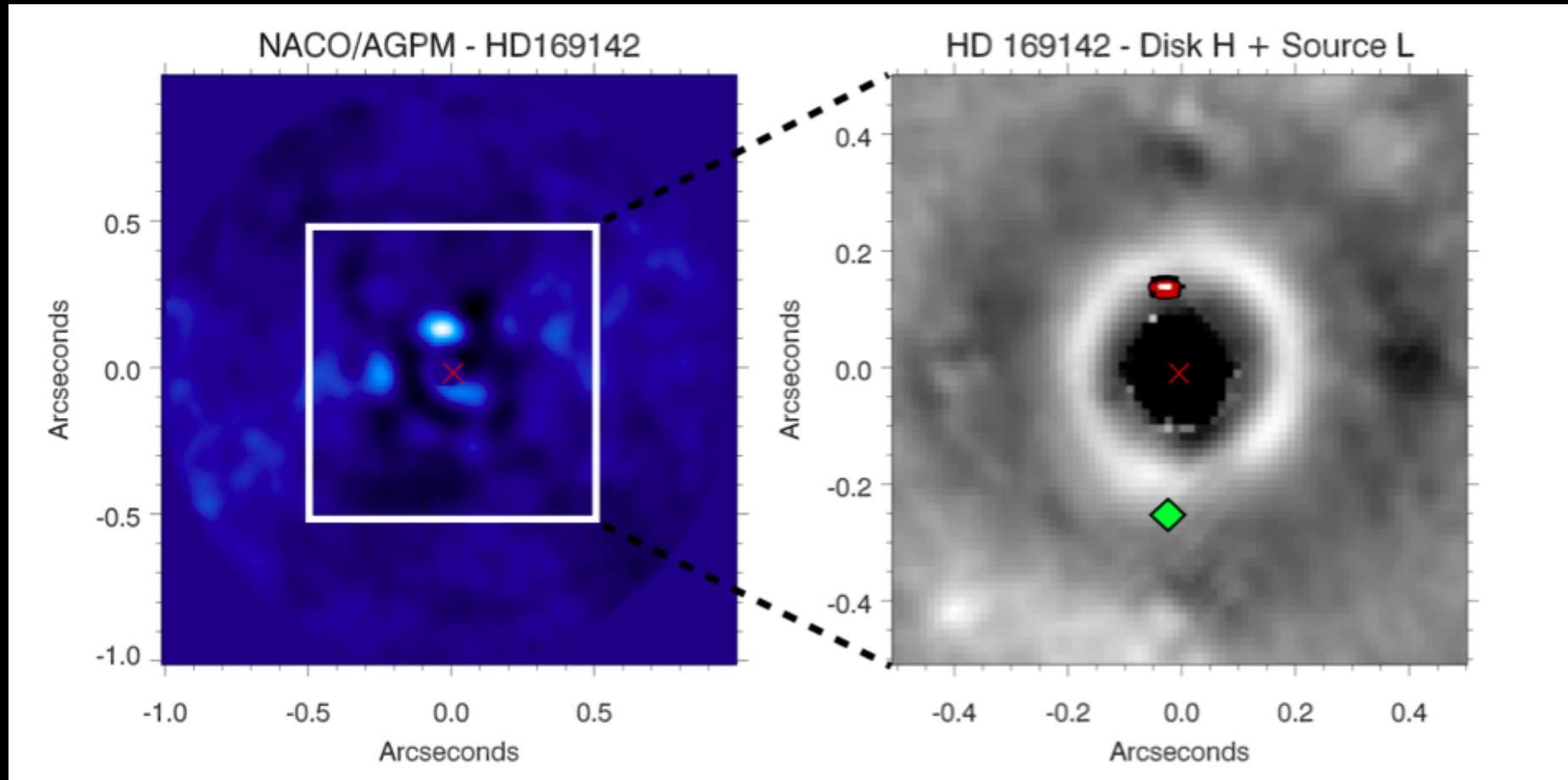
Observing Disks and Planets



10 AU resolution limit:

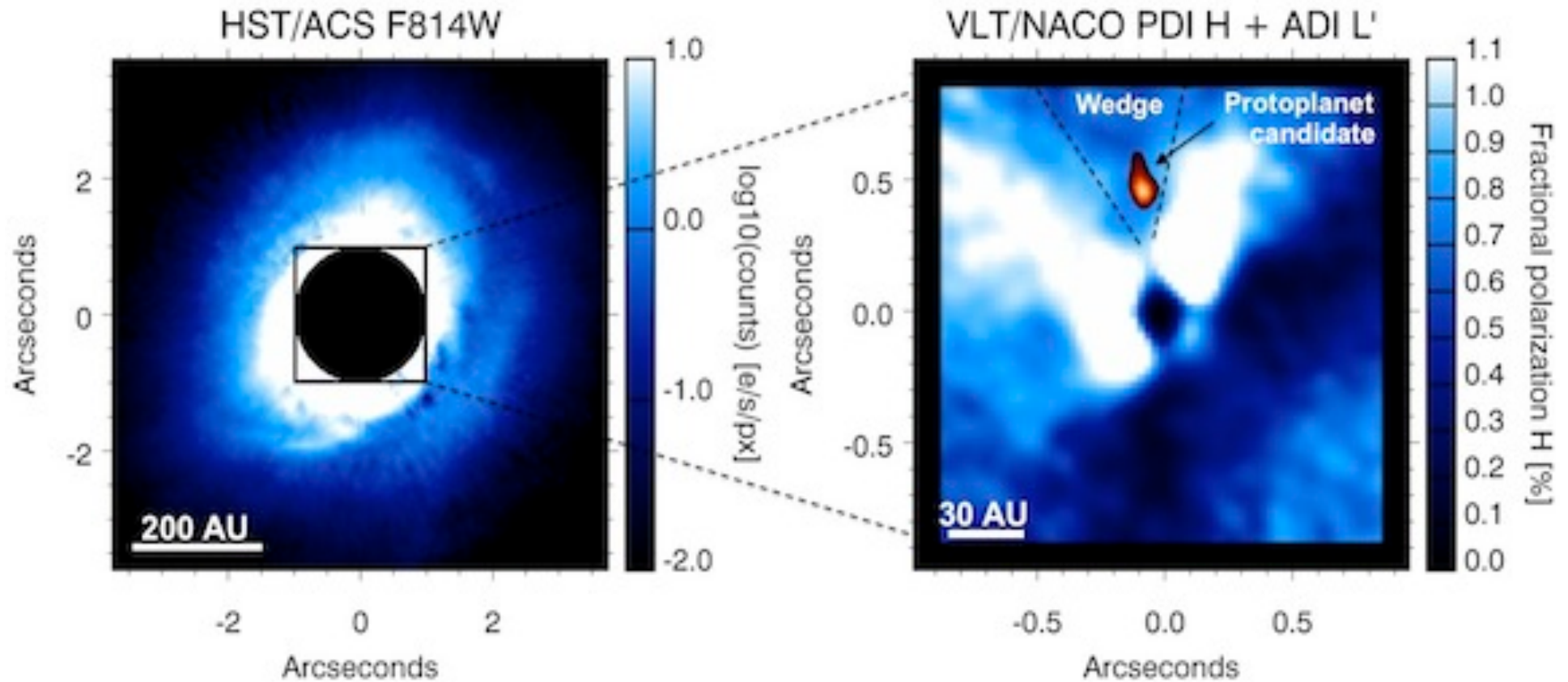
Quanz et al. (Messenger, 2011)

Use Disk Imaging to Find Planets...



Quanz et al. 2013a/b; Avenhaus et al. 2013; Garufi et al. 2013; Reggiani et al.

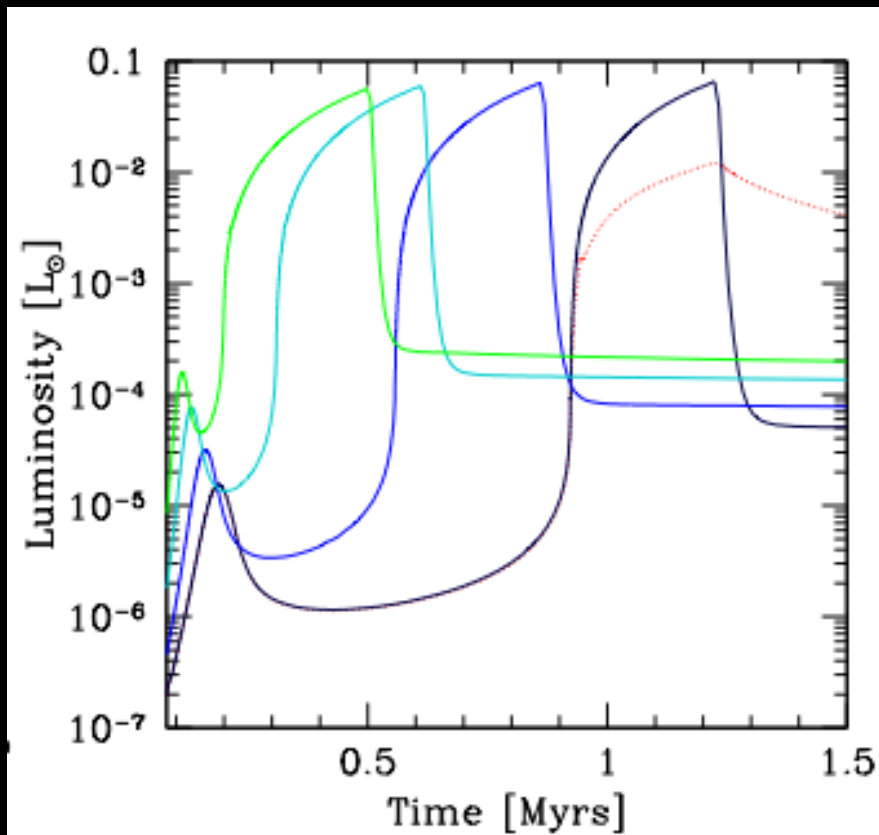
Proto-planets forming > 20 AU?



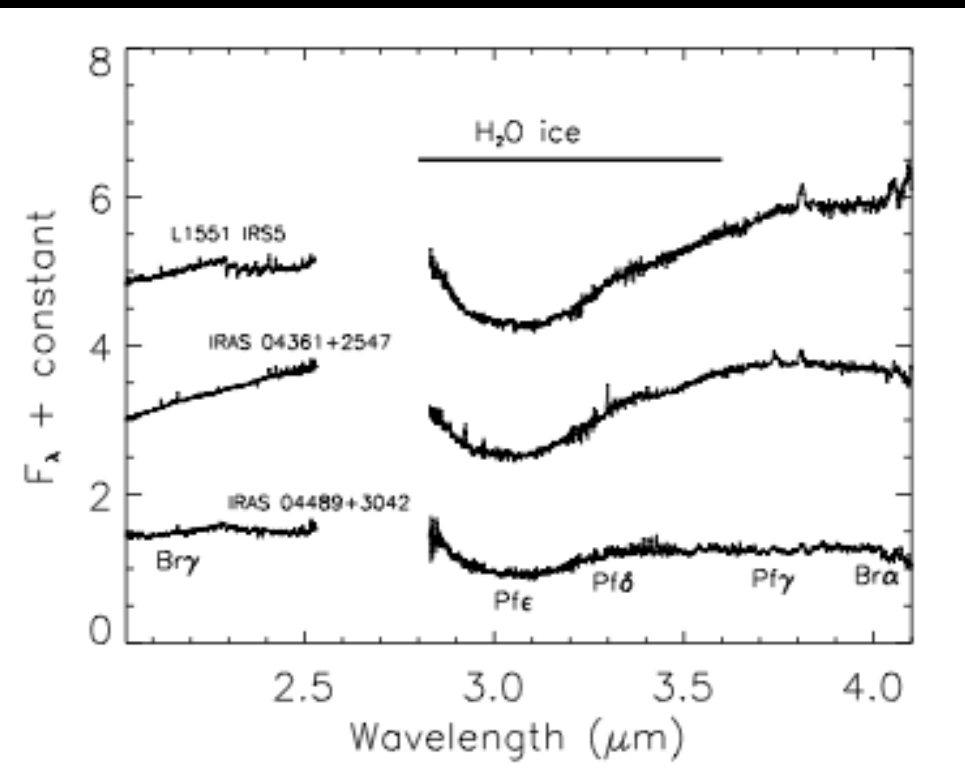
HD 100546b: Source at 40-50 AU. Reconfirmed in L- and M-band (not K-band). Point source with extended emission.

From Quanz et al. (2013); see also Kraus & Ireland (2011)

Lumin. + Spectra (Teff, log[g], Macc, comp?) versus age distinguish models of formation



Protoplanet Luminosity Evolution
e.g. Mordasini et al. (2013)



Protoplanet Accretion?
cf. Prato et al. (2009)

Direct (Non) Detections of Gas Giant Planets

No massive planets
at large orbital radii.

[3 M_{Jup} @ 30 AU]

$$dN/da \sim a^p$$

Lafrenerie et al. (2007);

Nielsen & Close (2009);

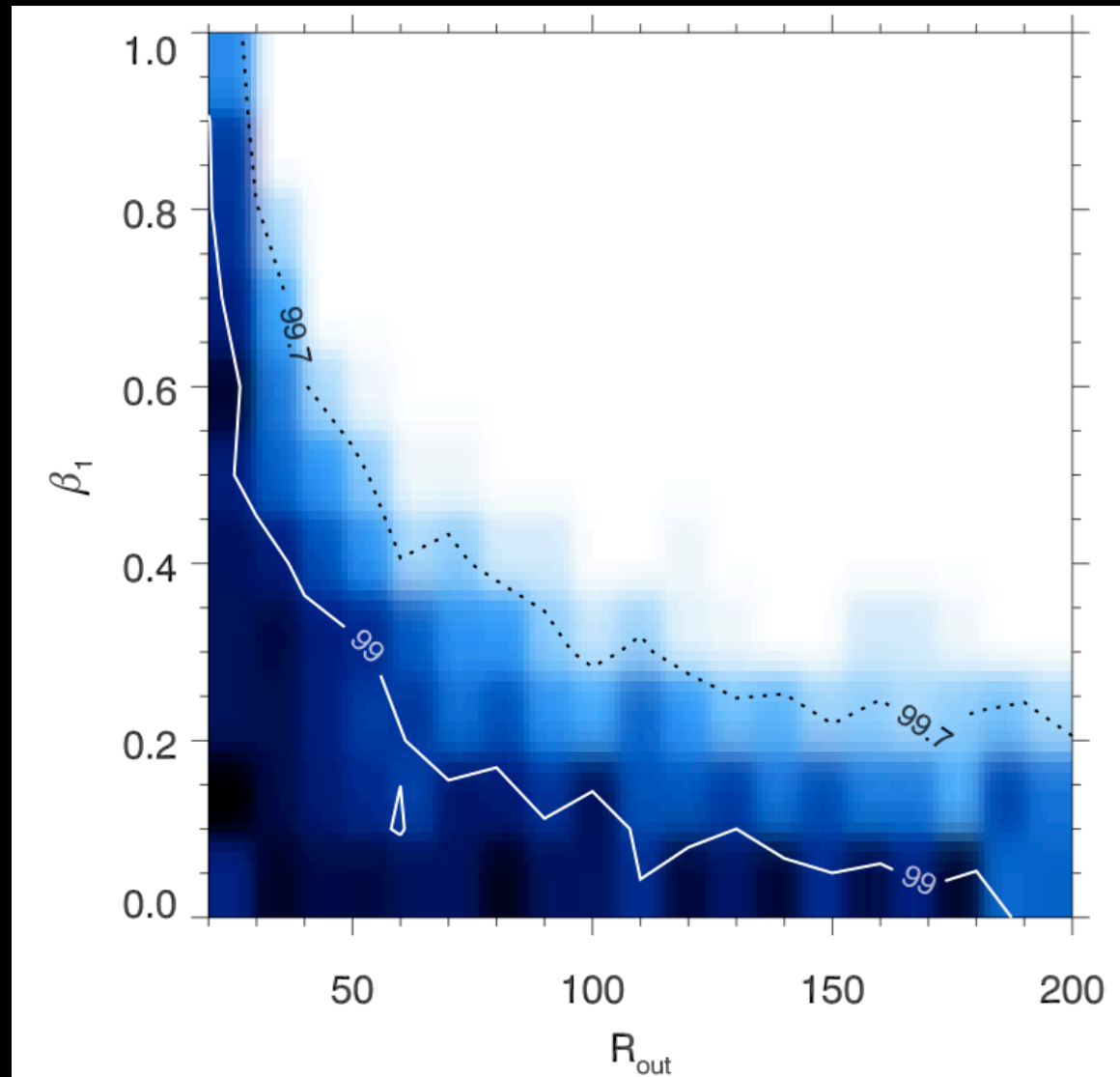
Heinze et al. (2010);

Chauvin et al. (2010);

Delorme et al. (2011);

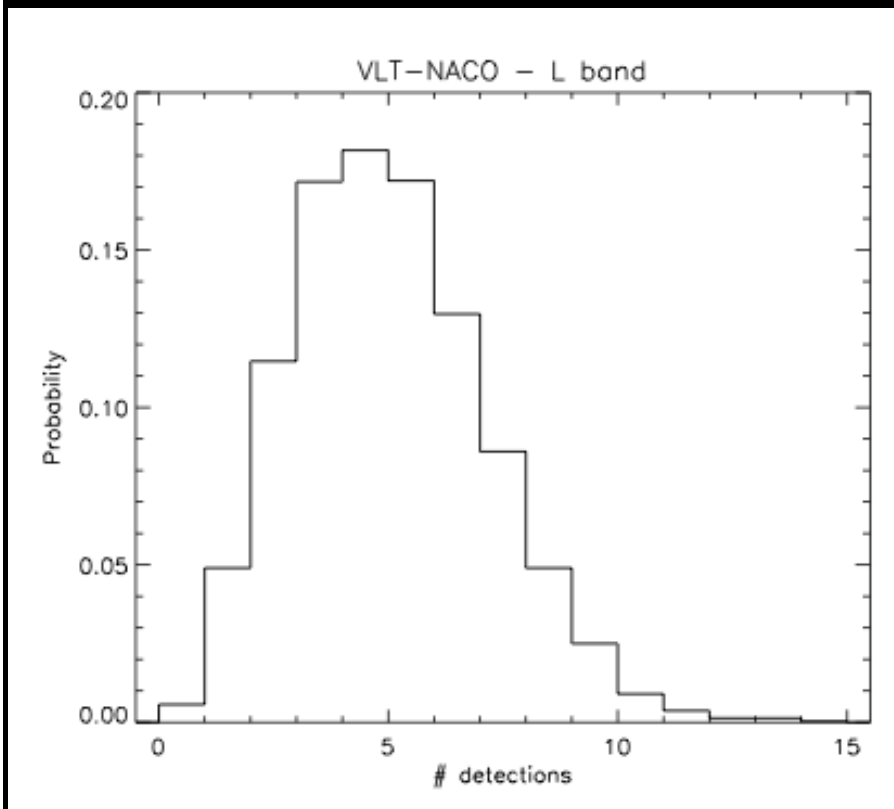
Vigan et al. (2012);

NACO-LP: Chauvin et al. in prep

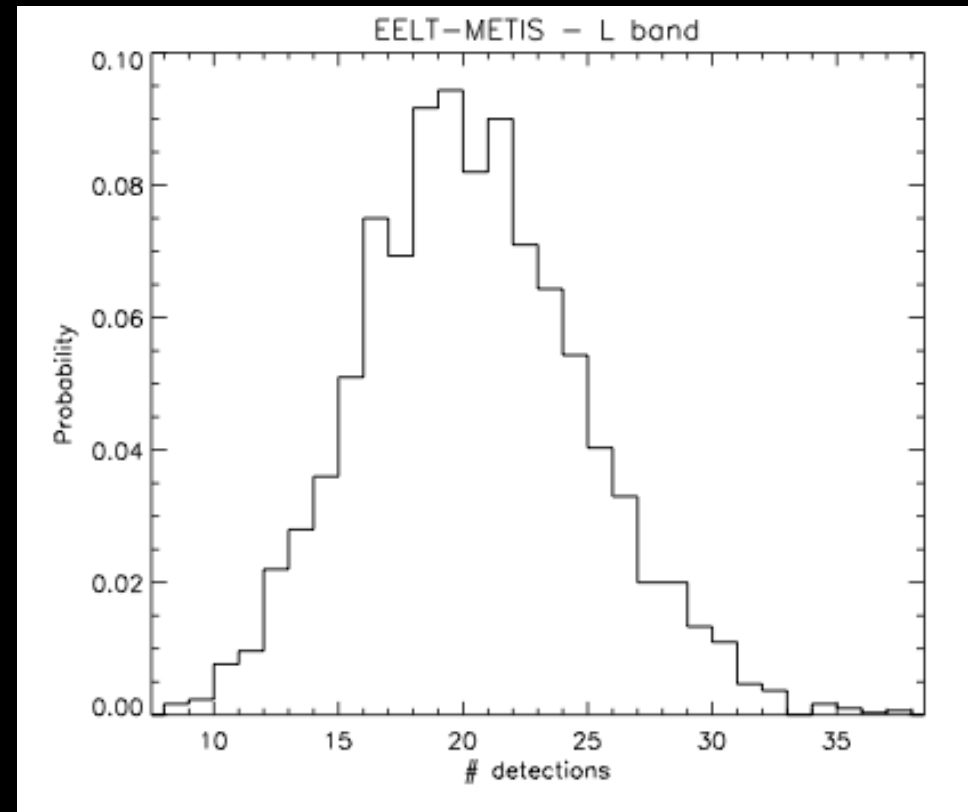


Reggiani et al. (2014)

L-band Imaging Of Young Nearby Planets:



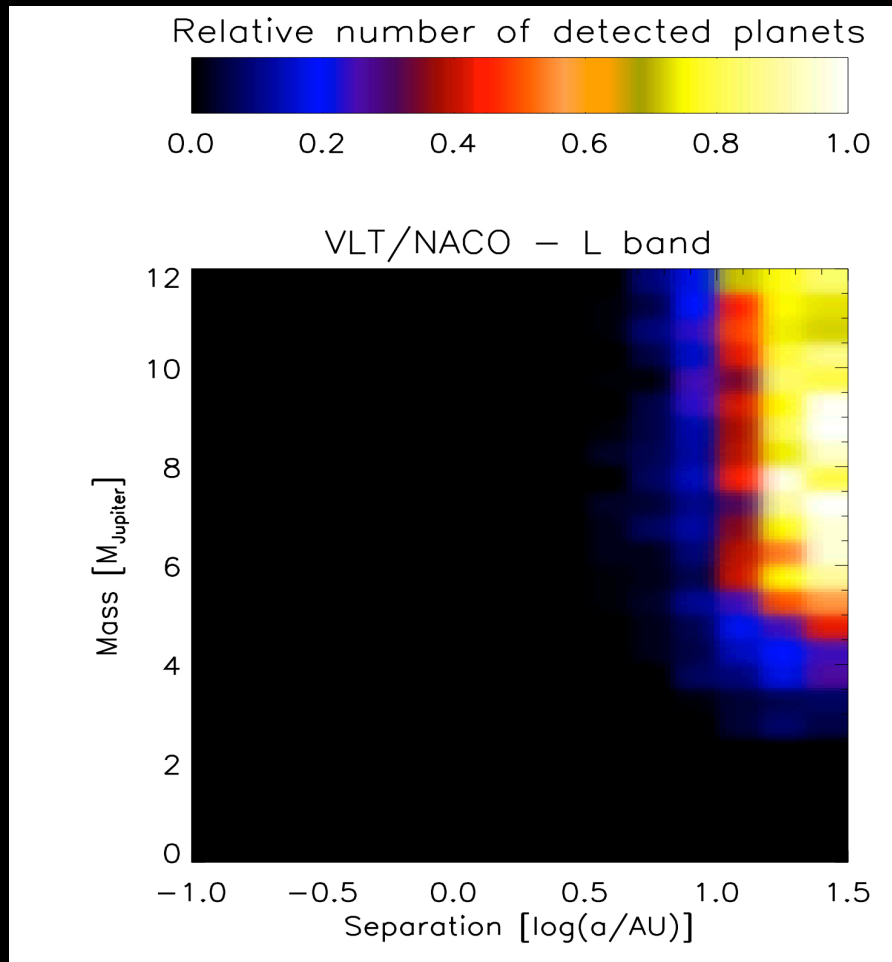
VLT NACO



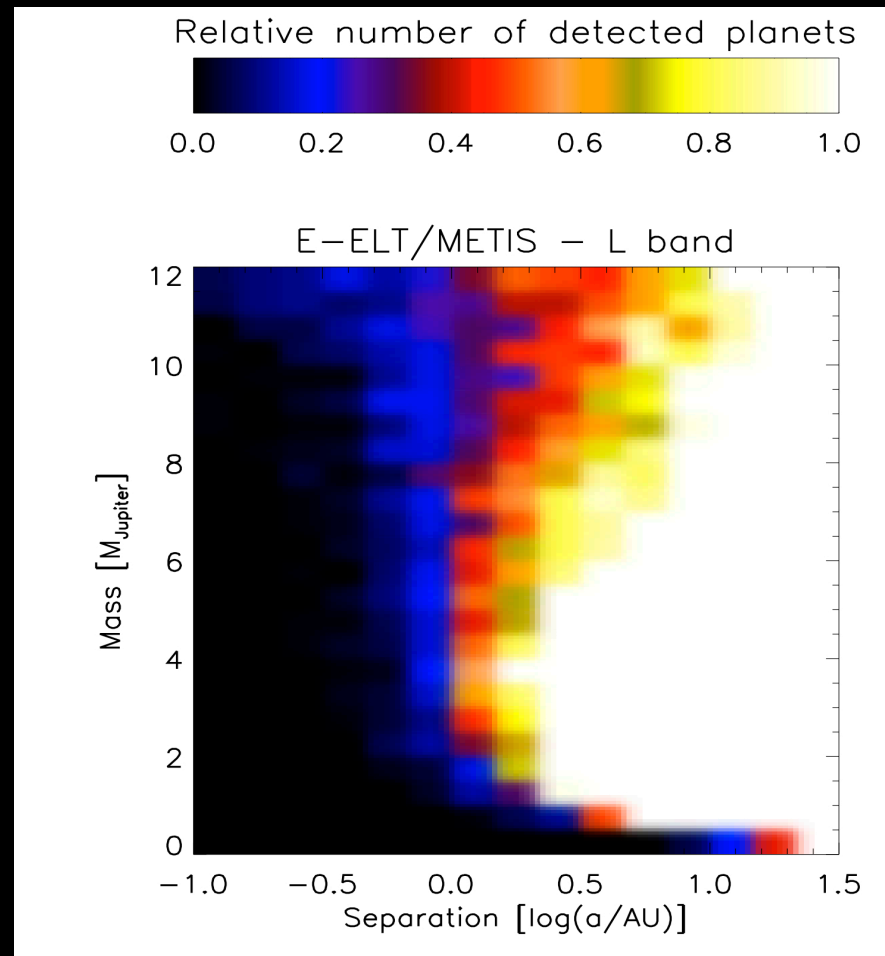
E-ELT METIS

M. Reggiani (PhD thesis)

L-band Imaging Of Young Nearby Planets:

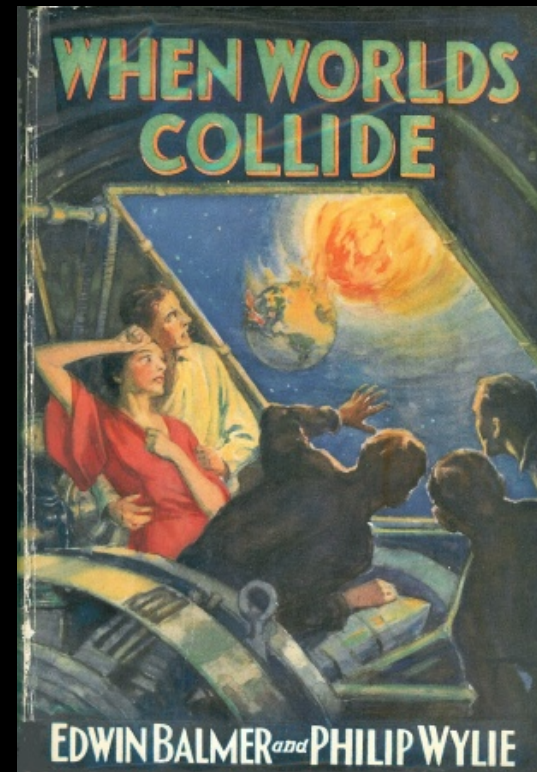
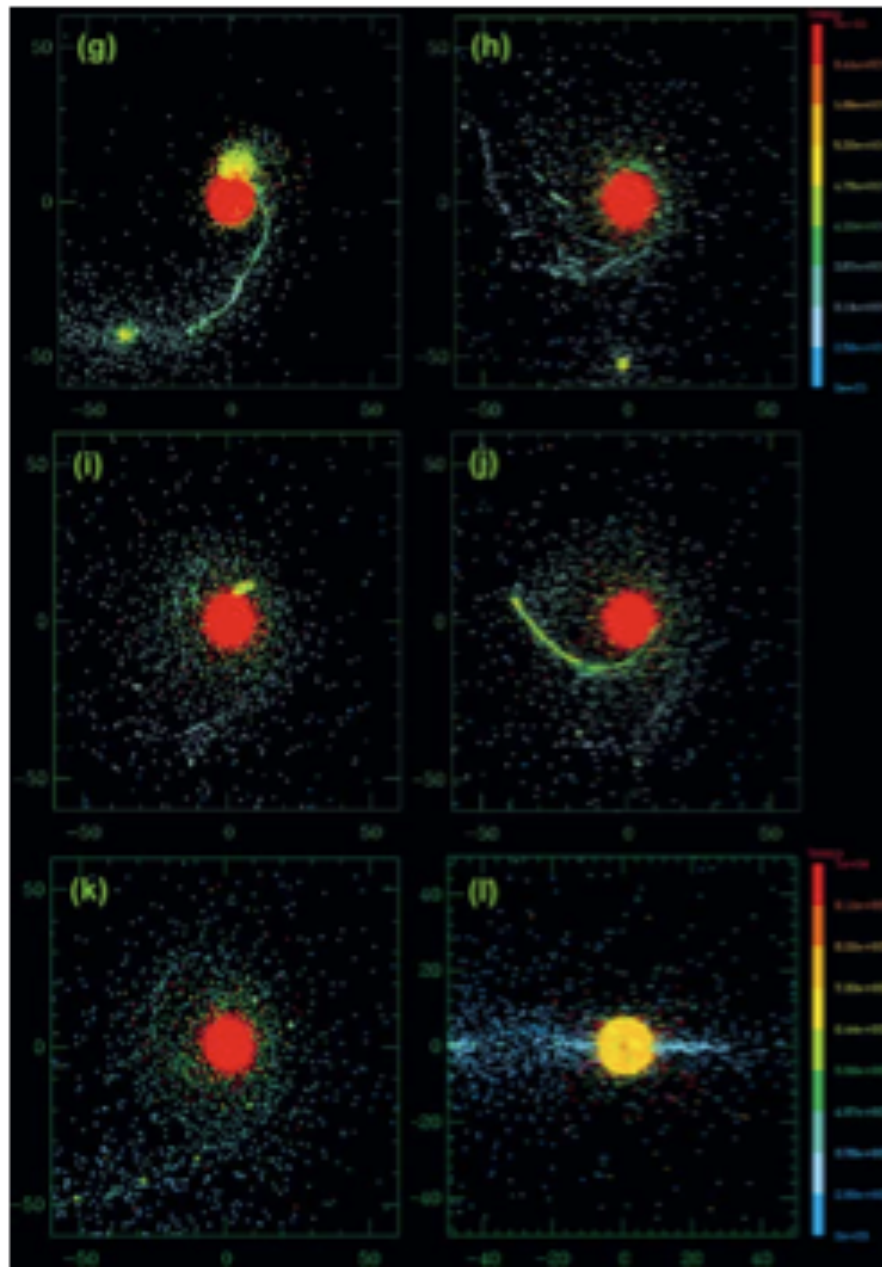


VLT NACO

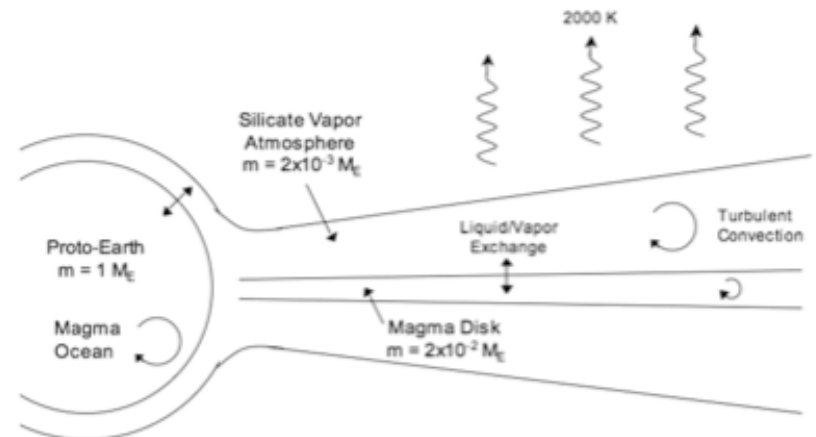


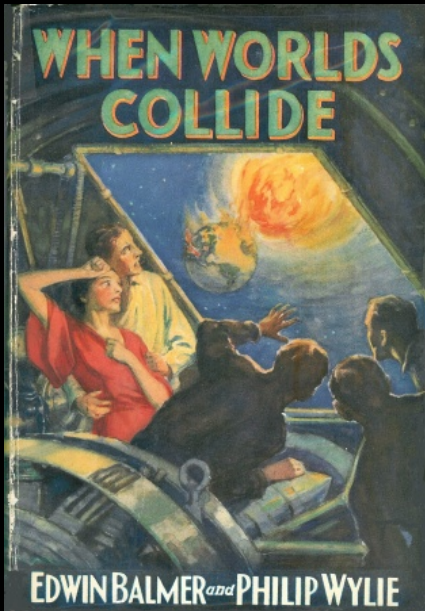
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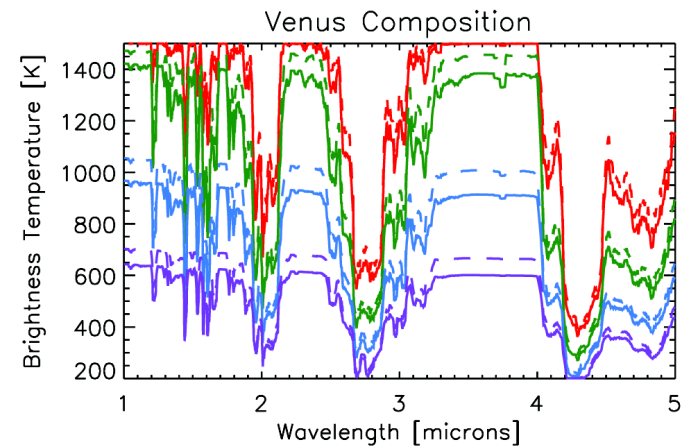
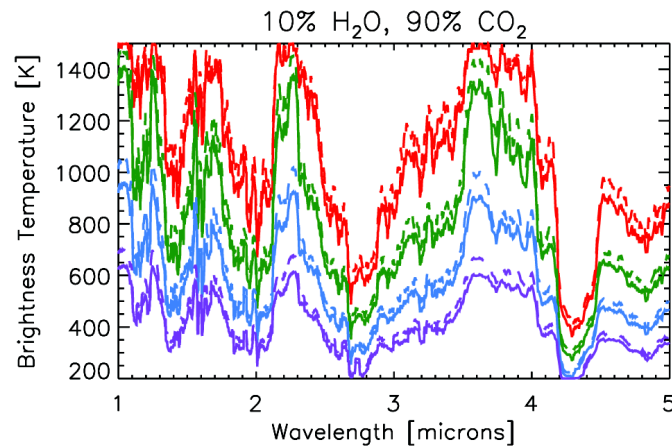
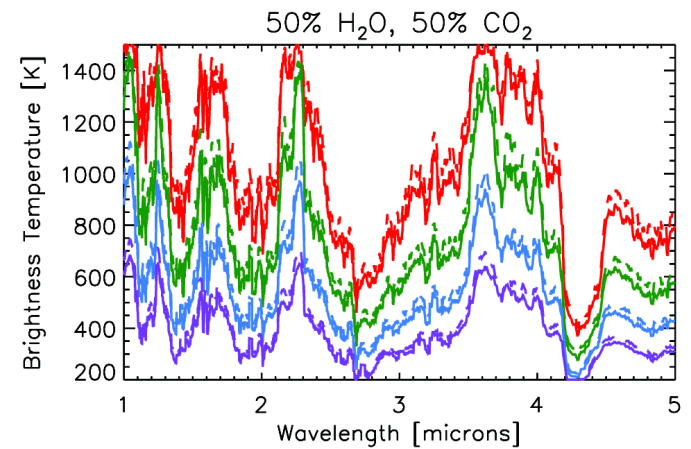
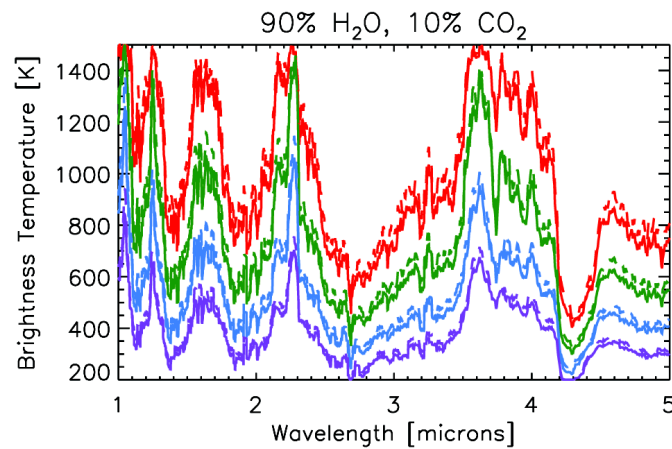
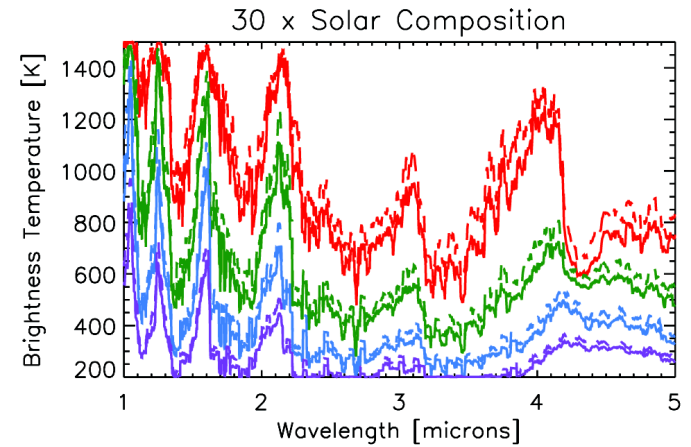
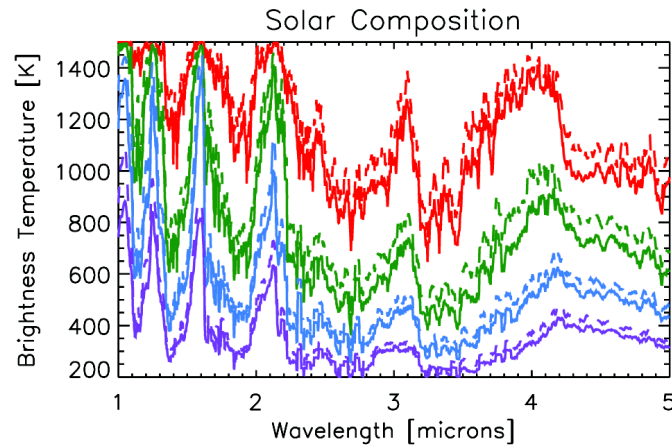
K. Pahlevan, D.J. Stevenson / Earth and Planetary Science Letters 262 (2007) 438-449





...you can see
them with the
E-ELT!

Miller-Ricci,
Meyer,
Seager,
Elkins-Tanton
(2009)



EXECUTIVE SUMMARY

- 1. The E-ELT will detect many protoplanets in formation as well as circumplanetary disks.**
- 2. Surveys for gas giant planets at orbital radii beyond the ice line will provide a powerful test of planet formation theory.**
- 3. Detections of hot protoplanet collision afterglows will test collisional theories of terrestrial planet formation in parallel.**