



Planets in a different light

The potential of direct imaging in the mid infrared

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Ground-based thermal infrared astronomy - past, present and future

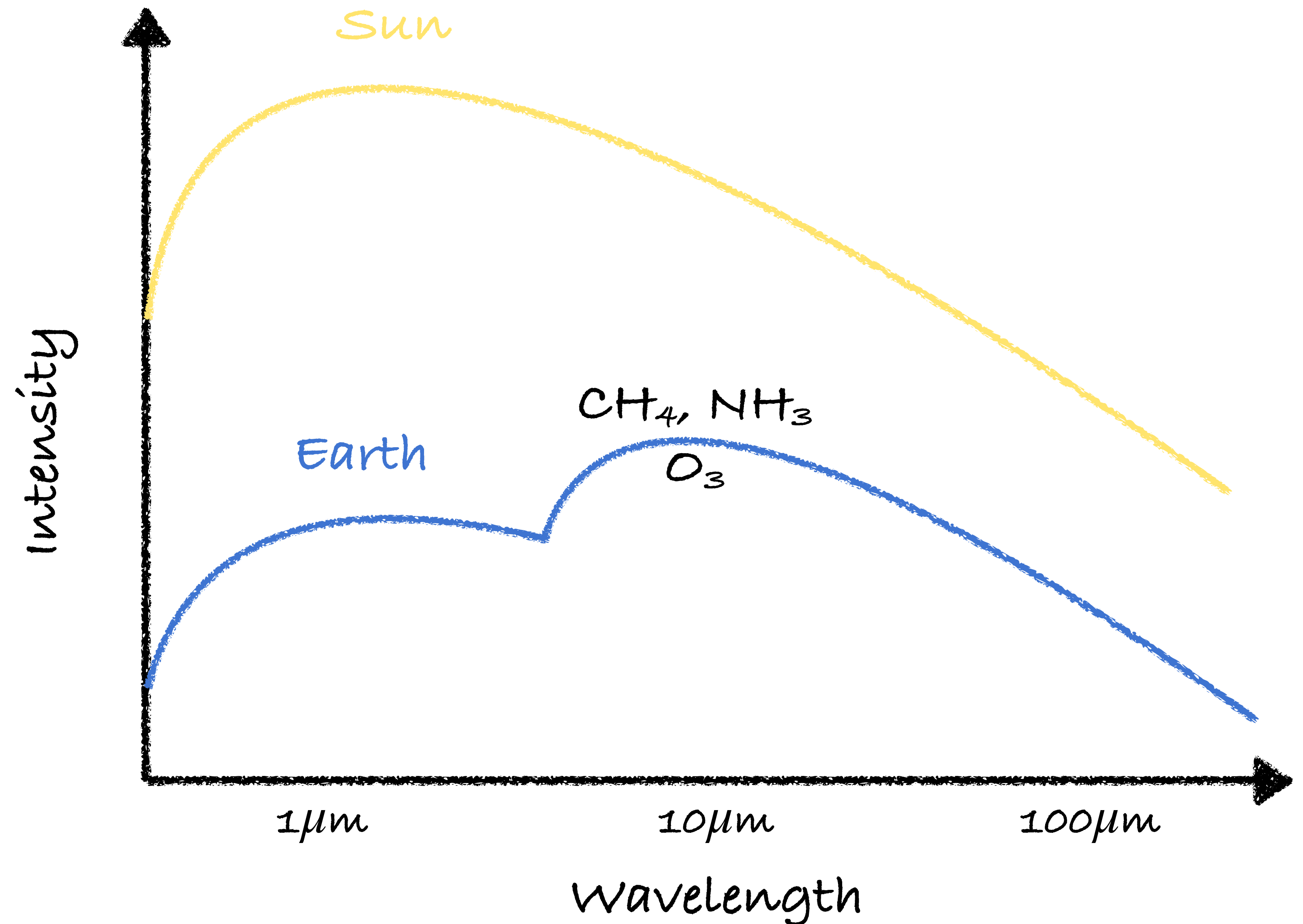
12 - 10 - 2020

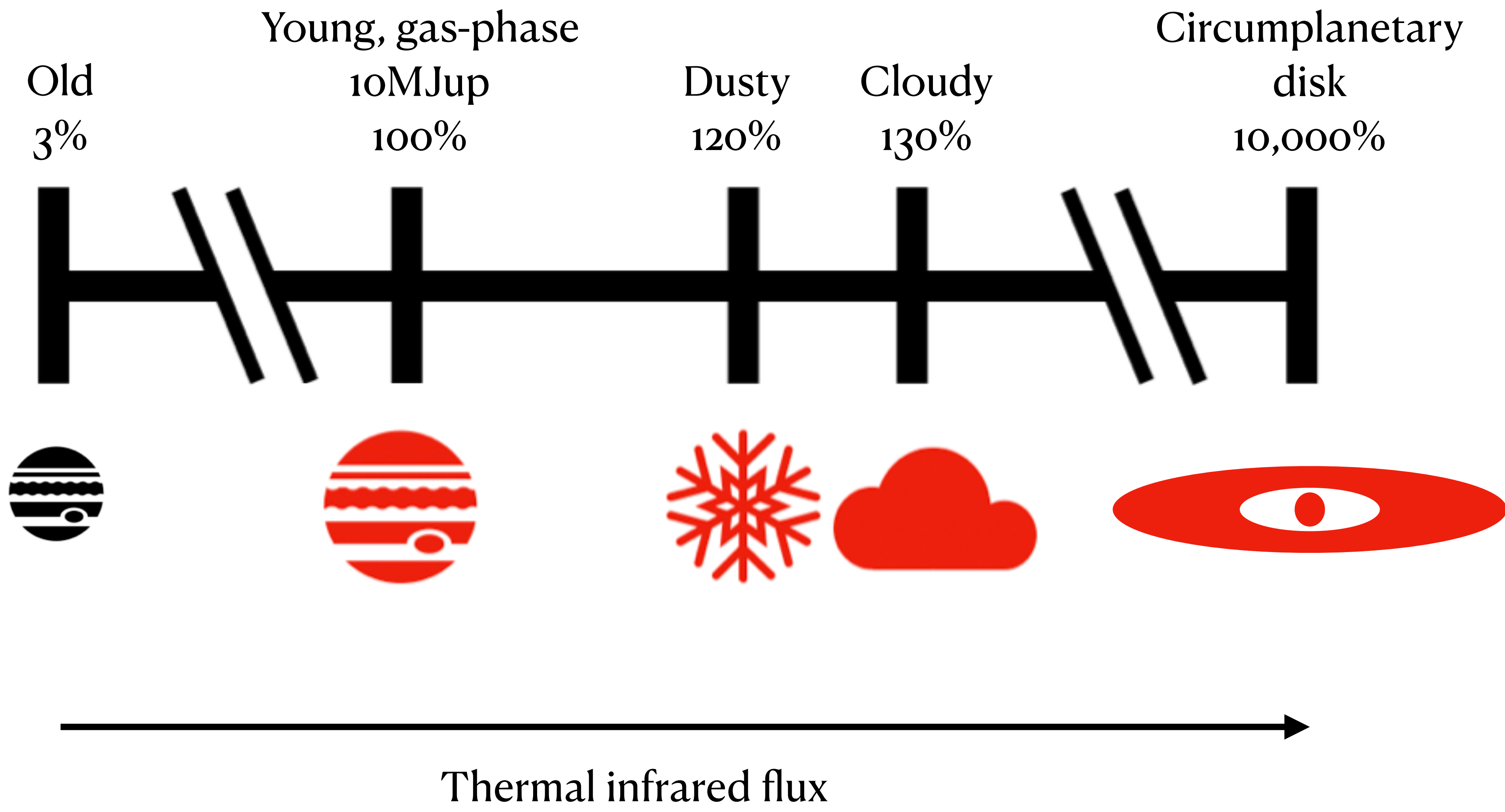
Mario van den Ancker (ESO), Paulo Miles Paez (ESO), Markus Kissler-Patig (ESA), Valentin Ivanov (ESO),
Davide Fedele (INAF), Sascha Quanz (ETH Zurich)

Credit: ESO/L. Calçada/P. Delorme/Nick Risinger (skysurvey.org)/R. Saito/VVV Consortium

Benefits of the mid-IR

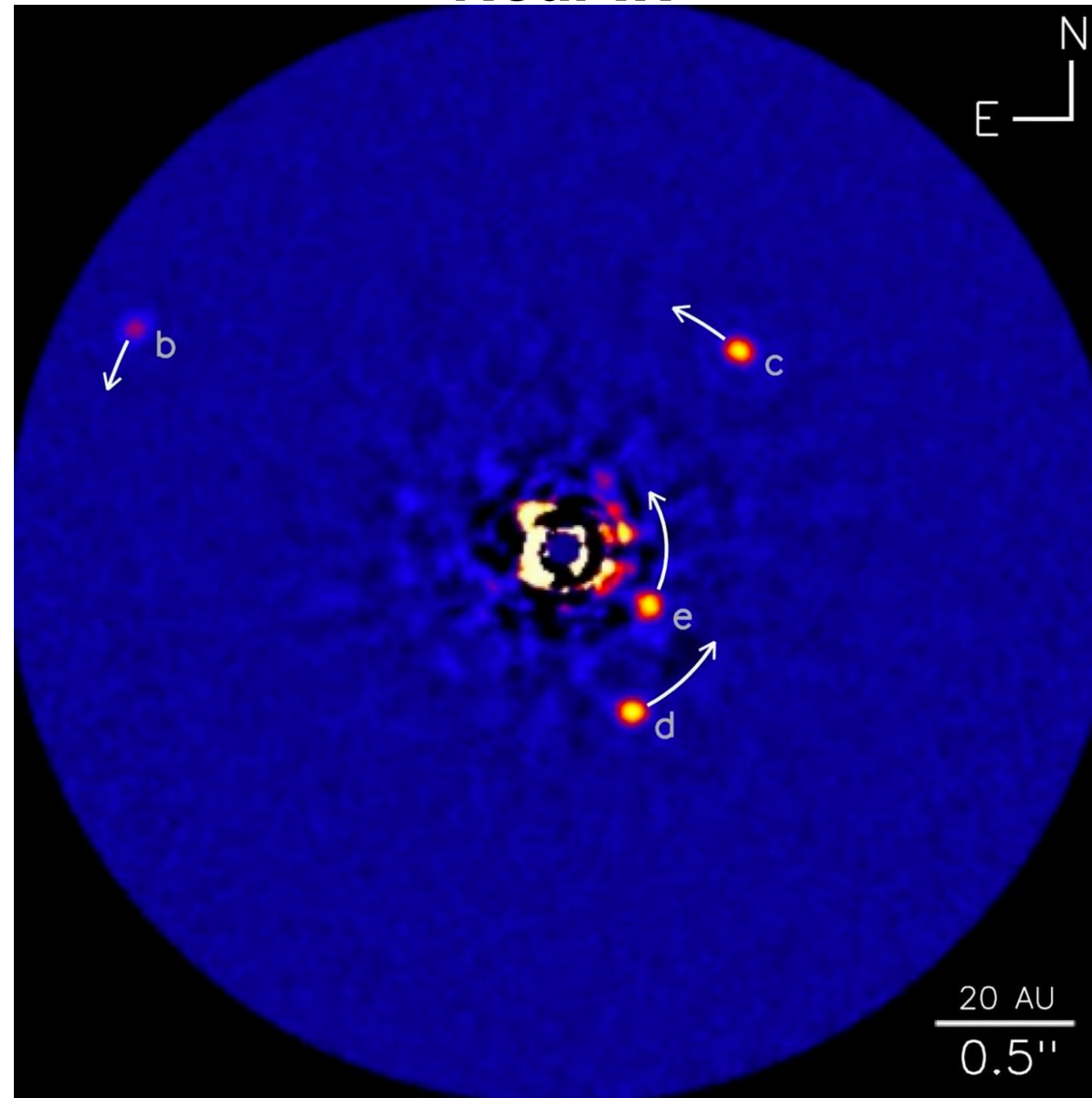
- Planet-star contrast
- Planet atmospheres
- Planet formation:
Core accretion vs.
Disk instability
- Habitable zone





The young star HR 8799

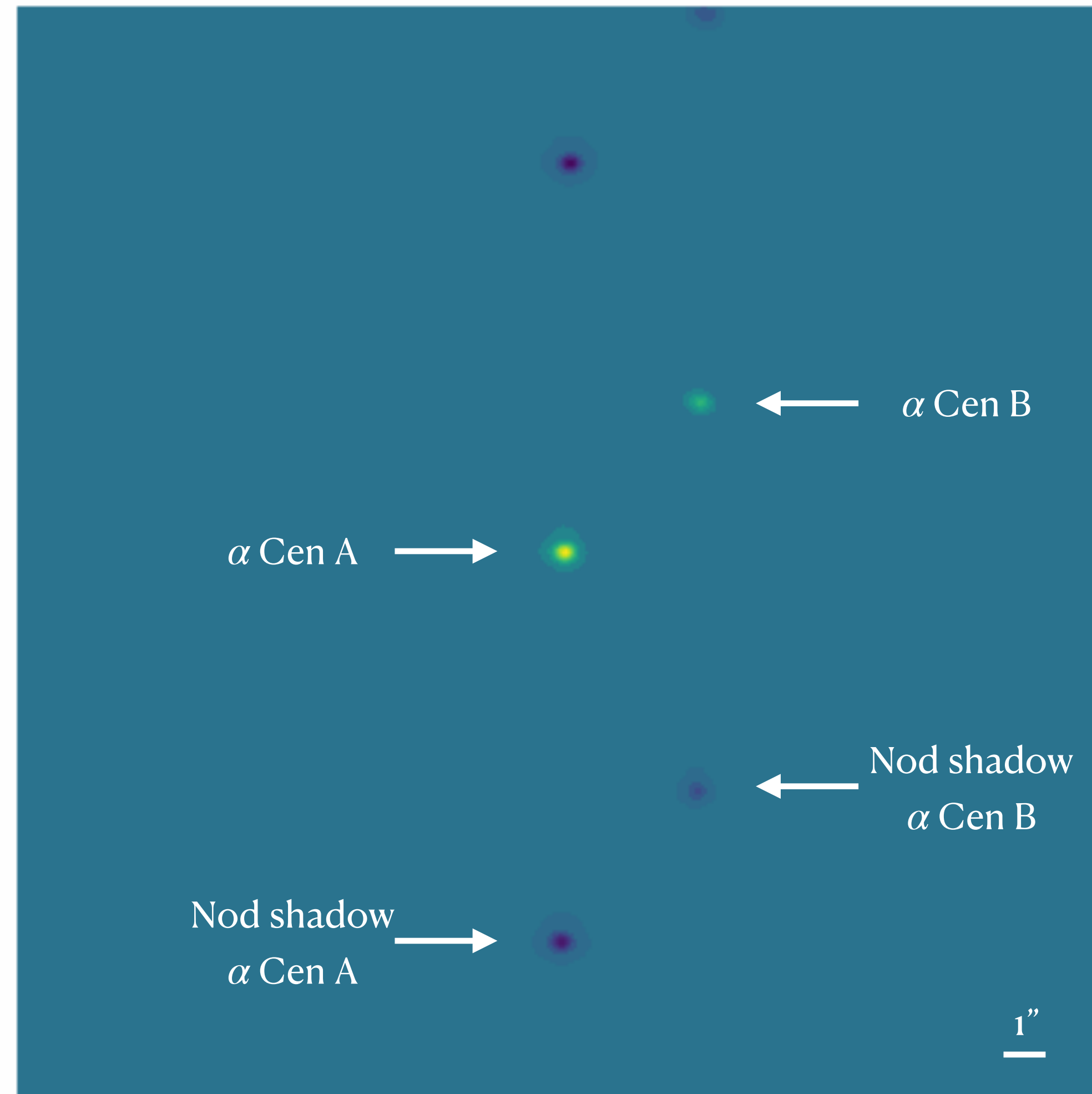
Near IR



NIRC-HIA/C.Marois/W.M. Keck Observatory

Circularised PSF Subtraction

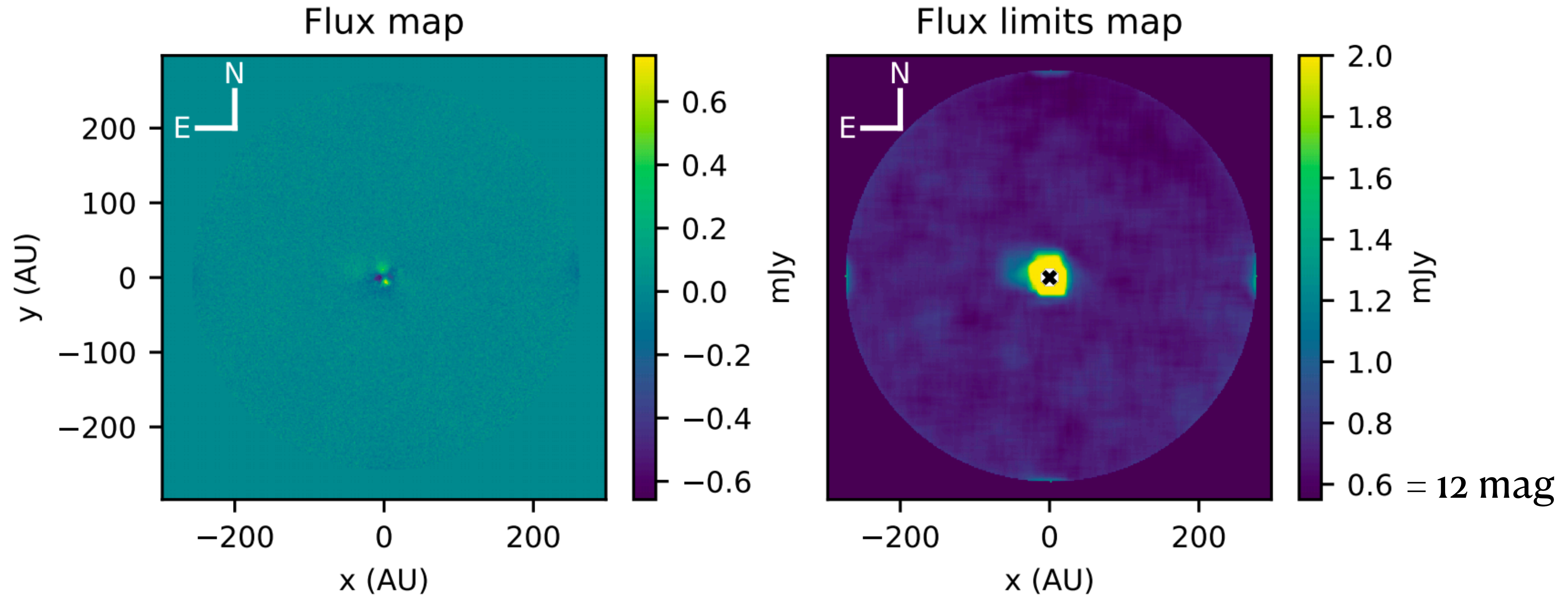
- α Cen
- G+K binary star
- VISIR



Method from Petit dit de la Roche et al. (2020), MNRAS

HR 8799

VISIR at the VLT, $8.7\mu\text{m}$

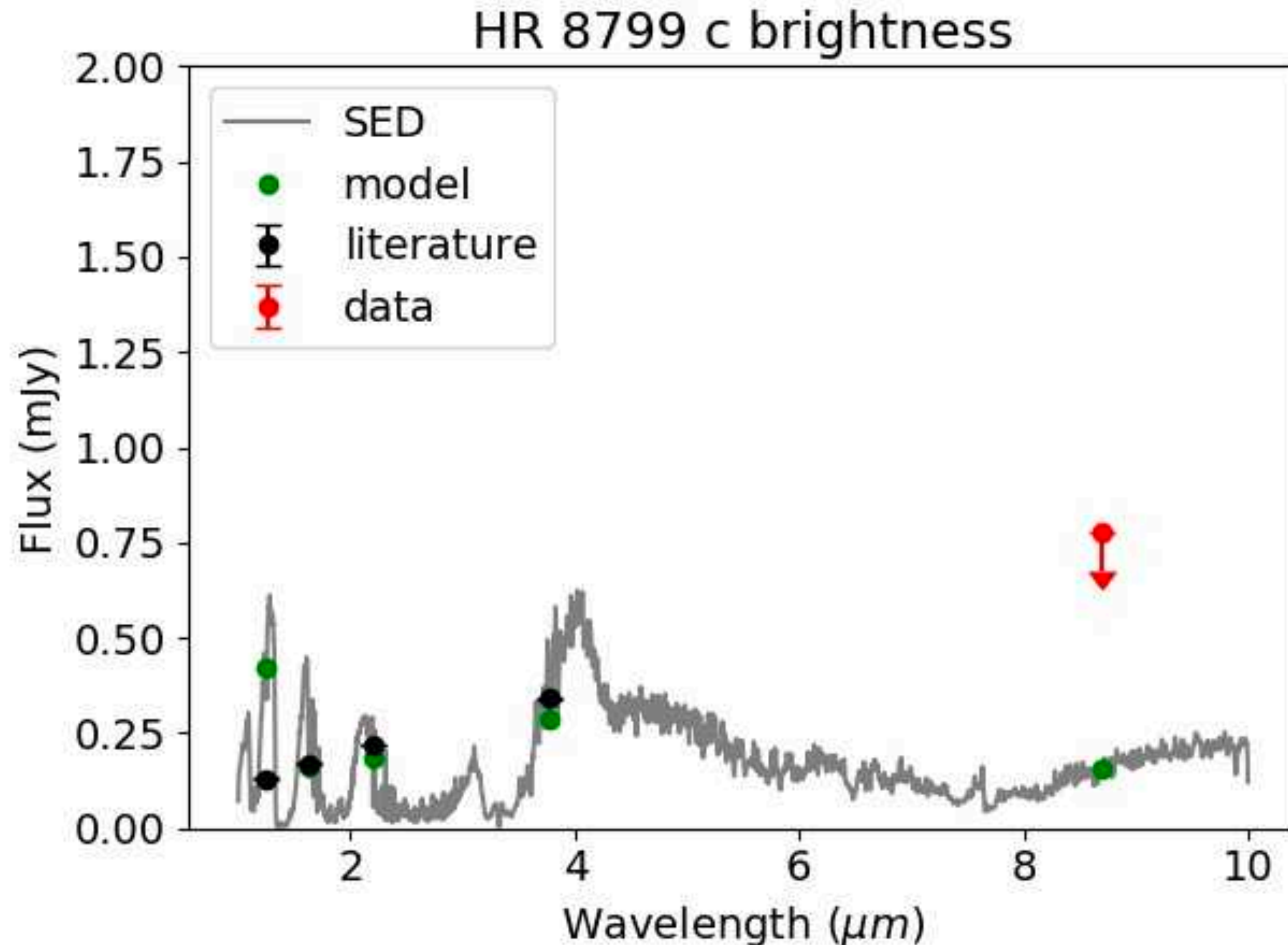


HR 8799 Flux limits

BT Settl model

$T = 1100 \text{ K}$

$\log(g) = 4.5$



Flux limit ADI:

$3.7 \text{ mJy} = 10 \text{ mag}$

Flux limit cPSF:

$0.8 \text{ mJy} = 11.6 \text{ mag}$

Mass limit: $< 30 M_{\text{Jup}}$

Predicted Mass:

$7\text{-}8 M_{\text{Jup}}$

Mass limits with NEAR (=VISIR+AO)

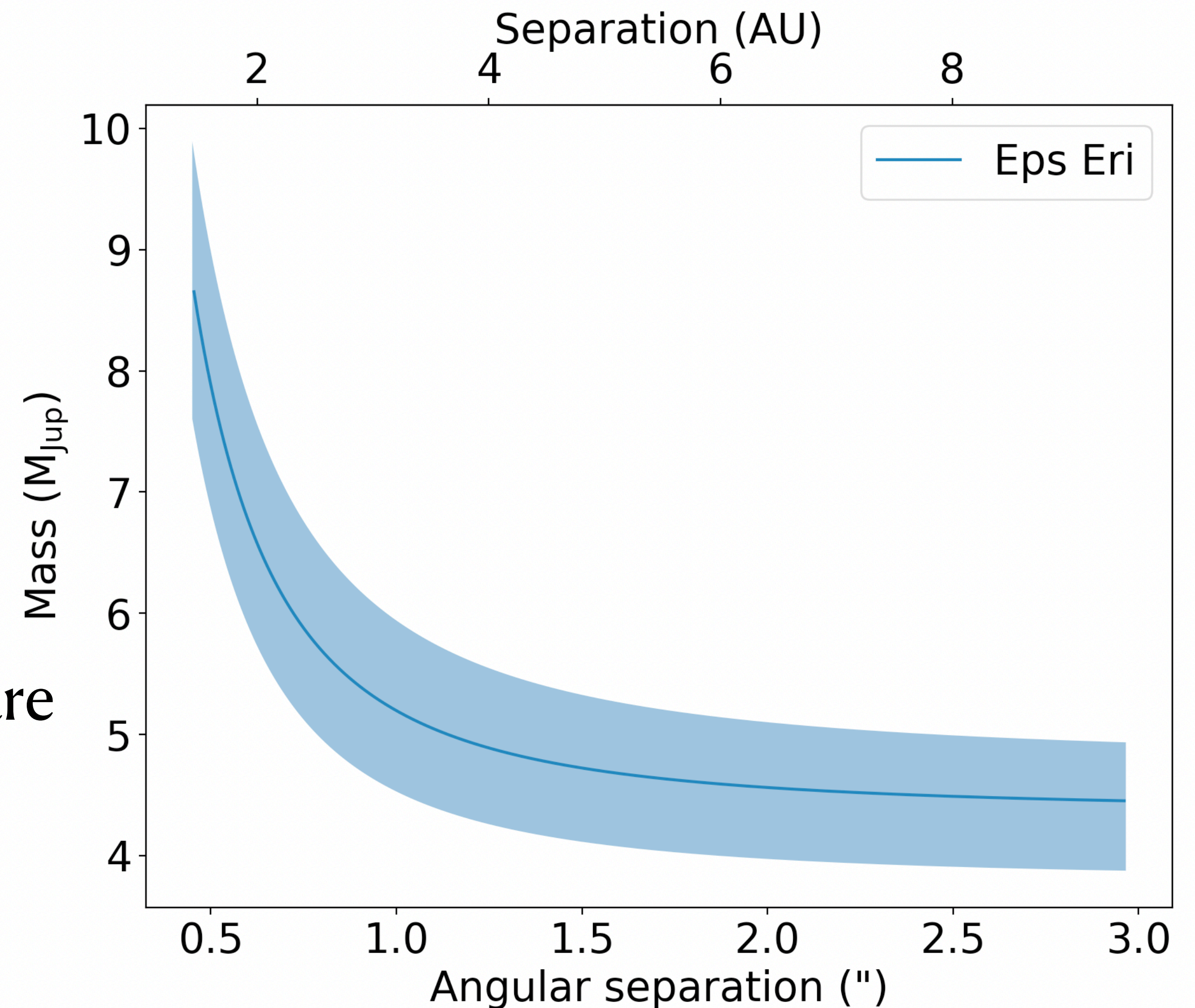
11 planetary systems:

4 old, in the solar neighbourhood
(Pathak et al. in prep)

6 young, with protoplanetary disks
(Petit dit de la Roche et al. submitted, A&A)

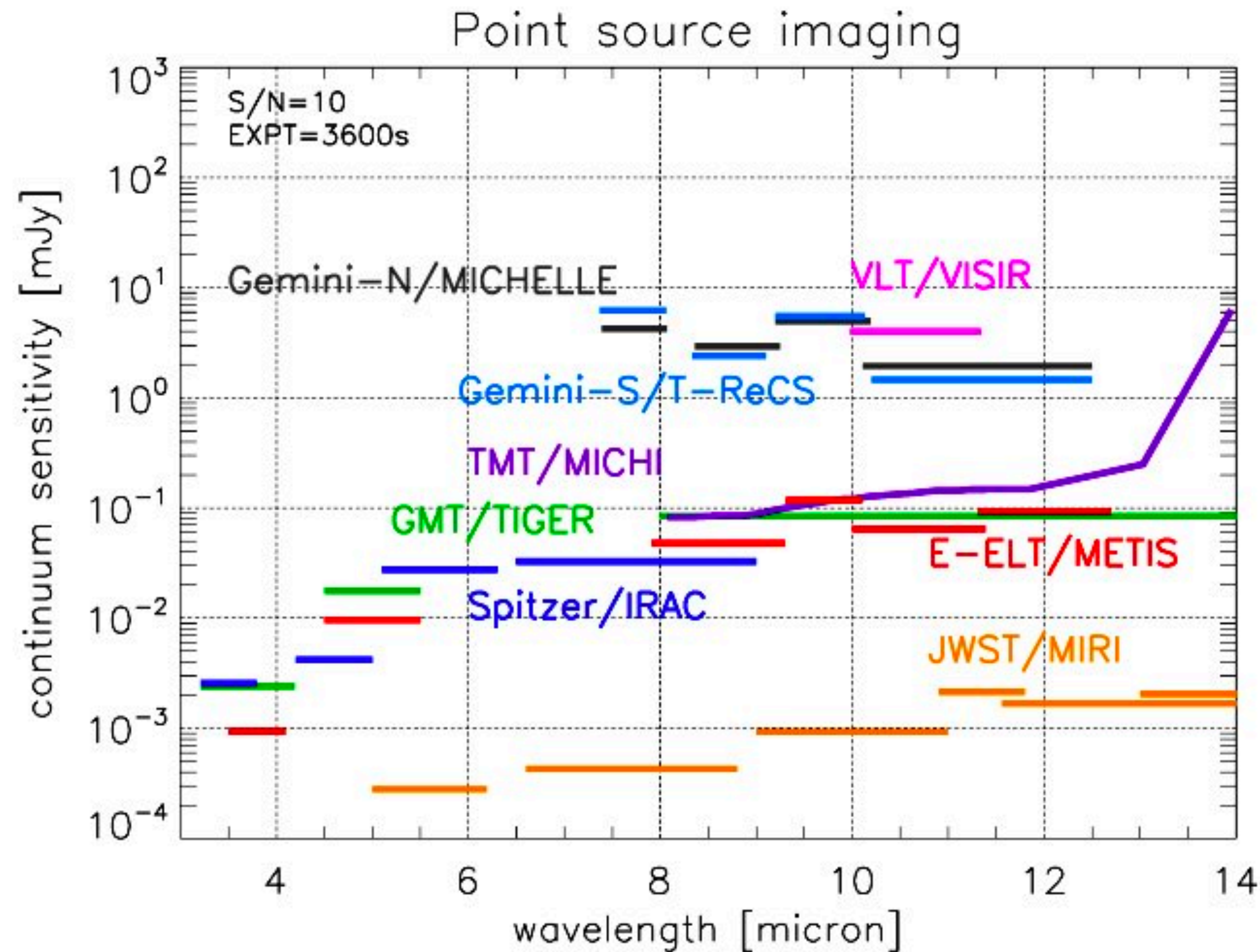
→ Giant planets at large separations are rare

1 planet/brown dwarf boundary



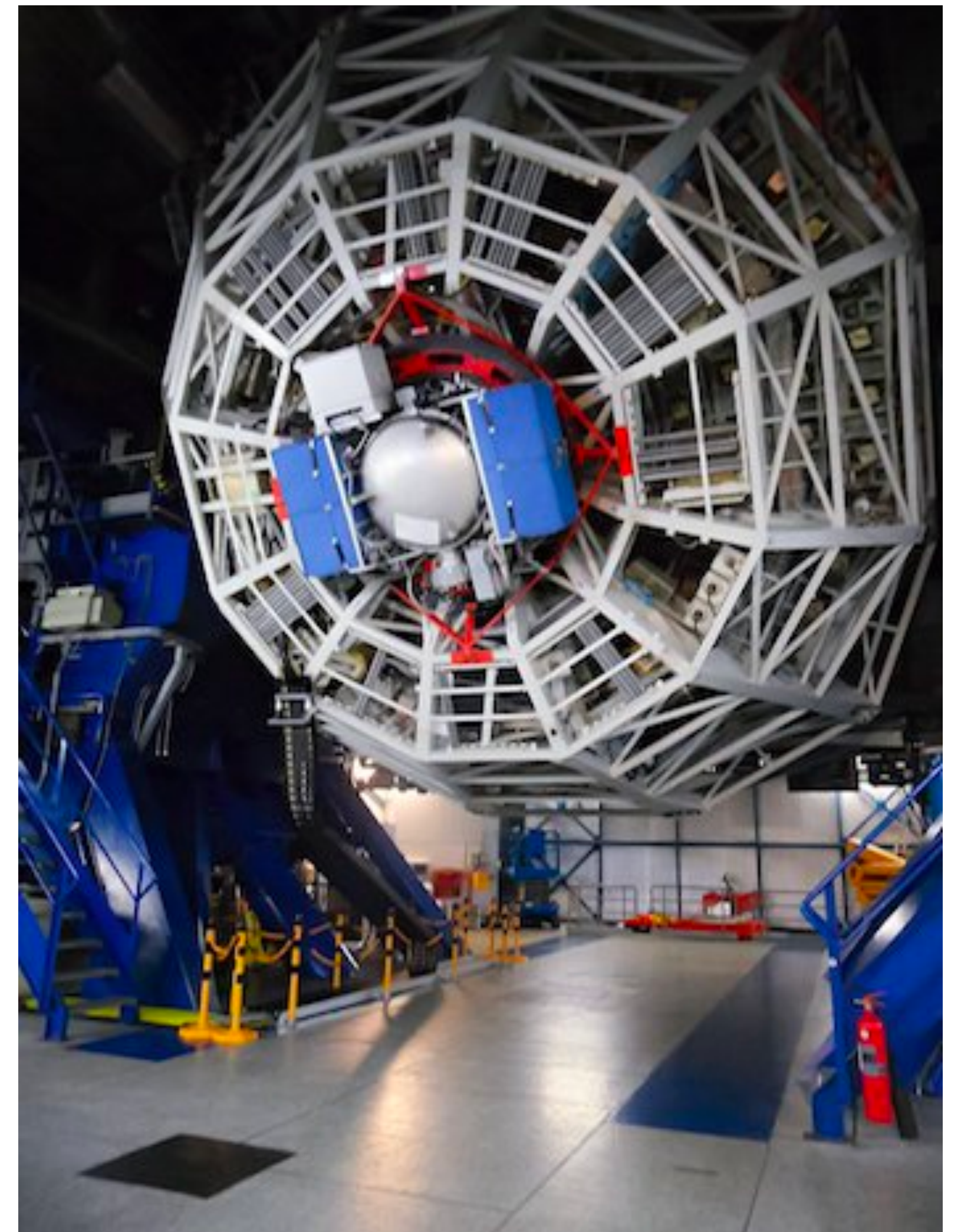
ELT/METIS

- 10x better sensitivity than NEAR
- 5x better spatial resolution
- 79/103 young, imaged exoplanets in <2h
- Earth mass planets in the habitable zone



Summary

- Direct imaging at 8-12 μm with VISIR and NEAR
- New circularised PSF subtraction
- Stringent mass limits on 11 planetary systems
- Increased spatial resolution and sensitivity of METIS on the ELT will be required in the future
- P.S. I'm looking for a job next fall (contact me via Slack or at dominique.petit@eso.org)



ESO/NEAR collaboration