The future of Exoplanets Observation
With MATISSE

Jules Scigliuto PhD student,

Supervisors: Florentin Millour, Bruno Lopez, Mathis Houllé

Laboratoire JL Lagrange, Université Côte d’Azur, Observatoire de la Côte d’Azur, CNRS, Nice

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The future of ~~Exoplanets~~ Brown dwarf Observation With MATISSE

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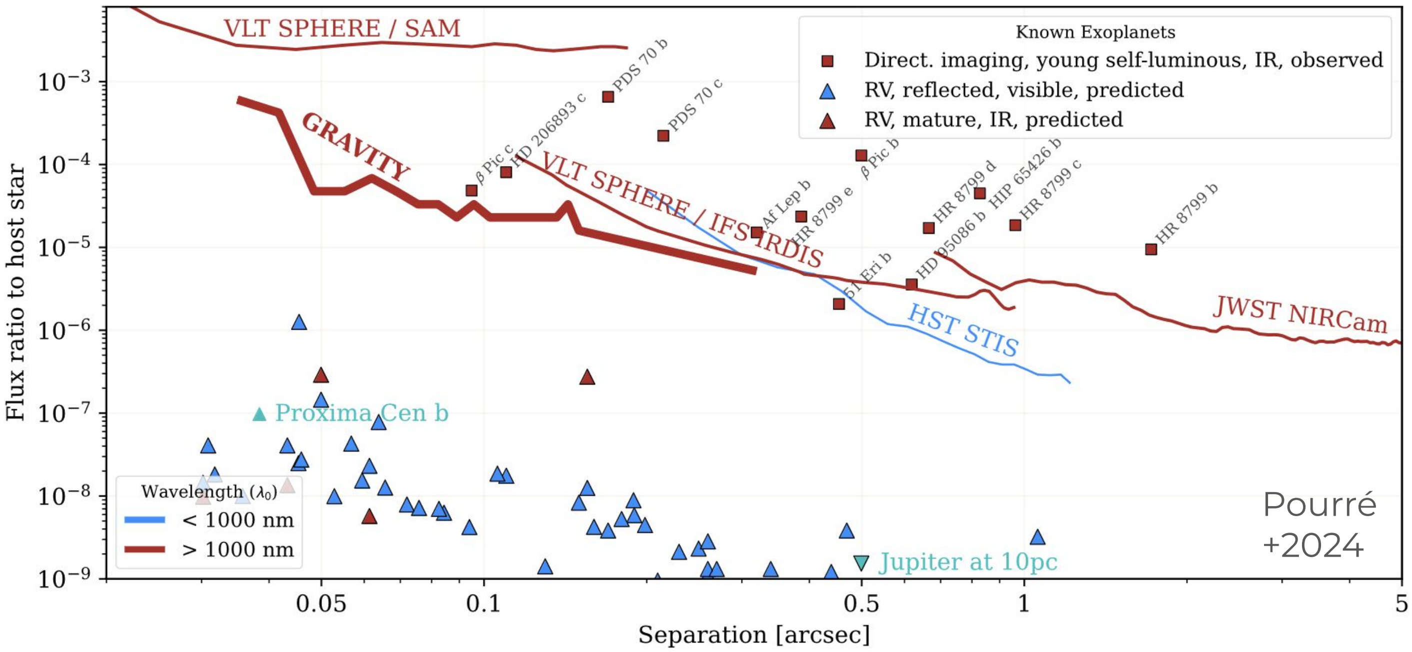
Why using IR-interferometry for exoplanets’ observations

Interferometric facility

→ The diffraction limit $\theta \approx \lambda/B$

→ Easier to disentangle the stellar flux from the planet one



Why using MIR-interferometry for exoplanets' observations

Interferometric facility

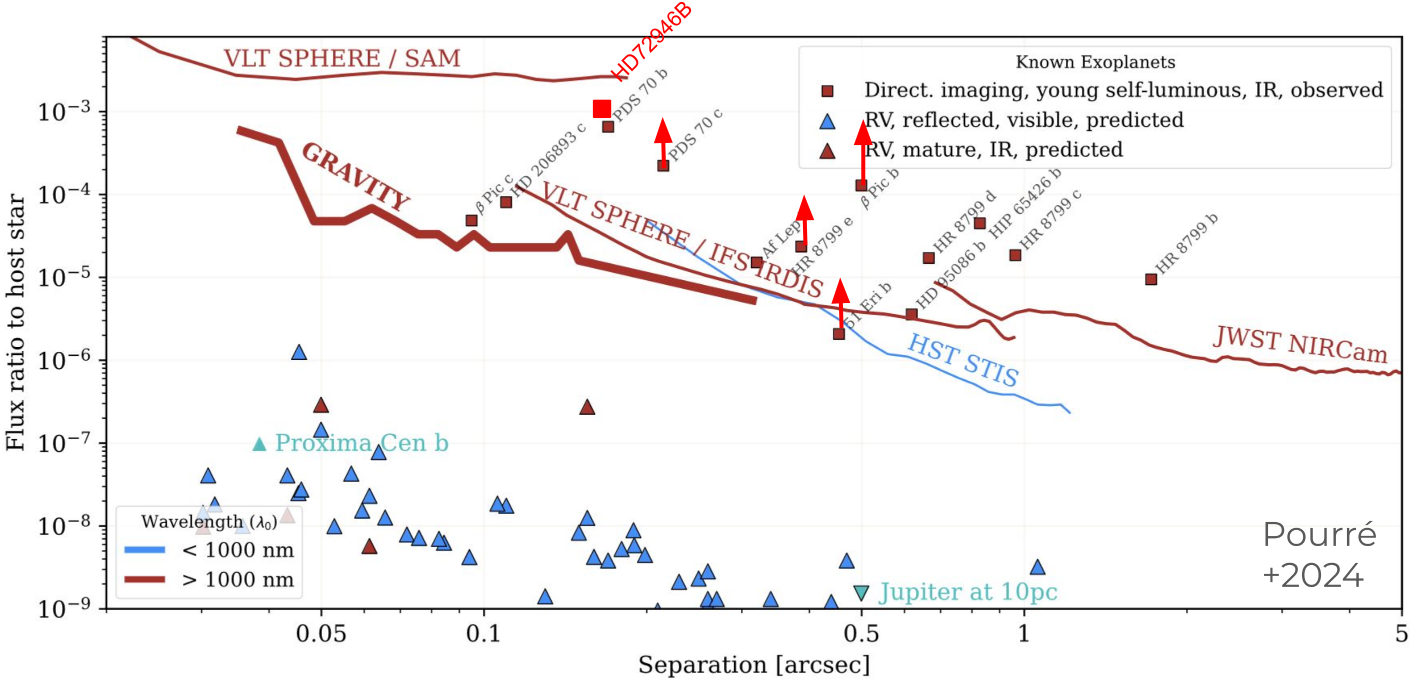
→ The diffraction limit $\theta \approx \lambda/B$

→ Easier to disentangle the stellar flux from the planet one

Observing in the mid-IR

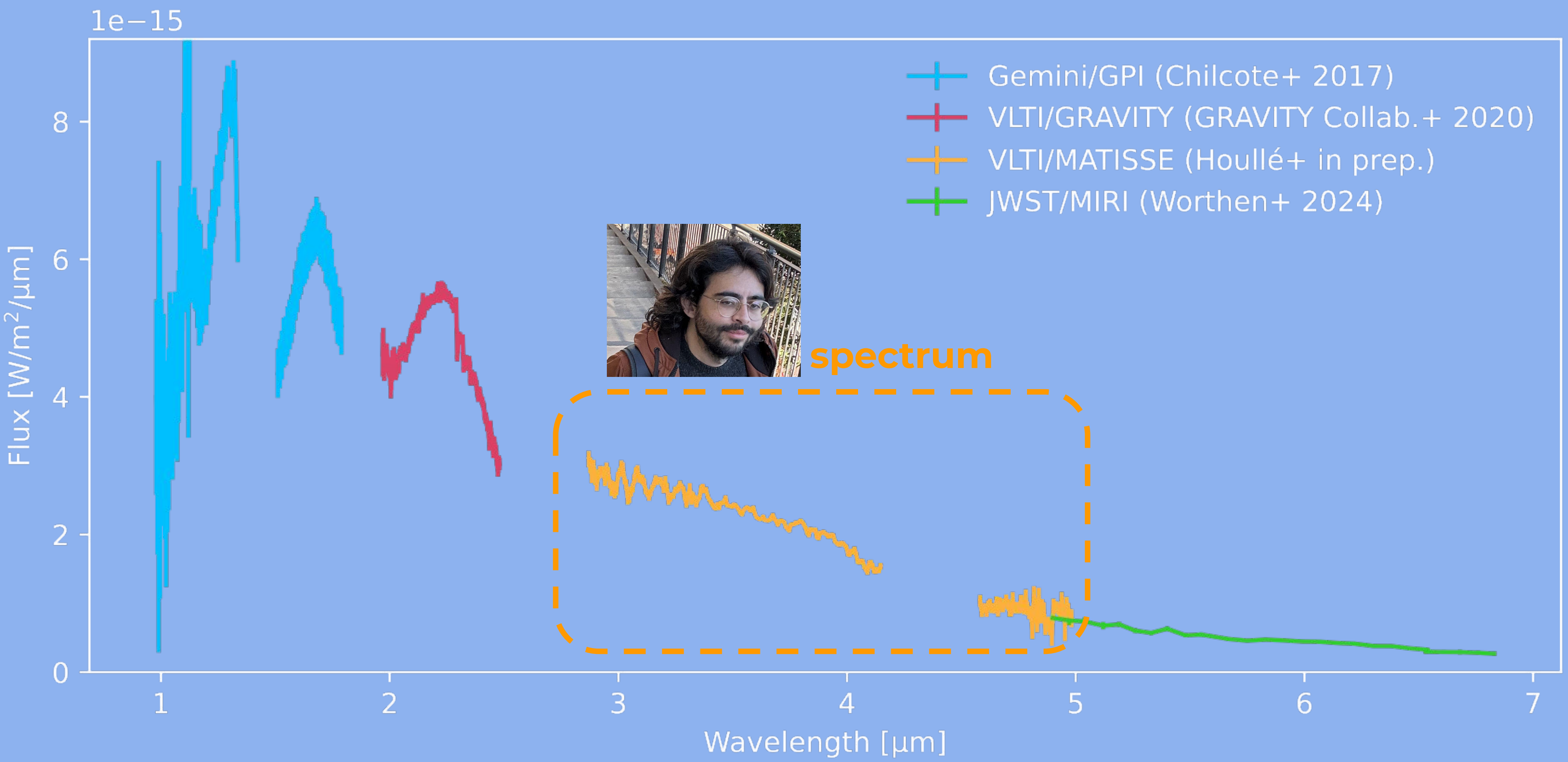
→ Lower the stellar flux and higher planet flux

L-band contrast



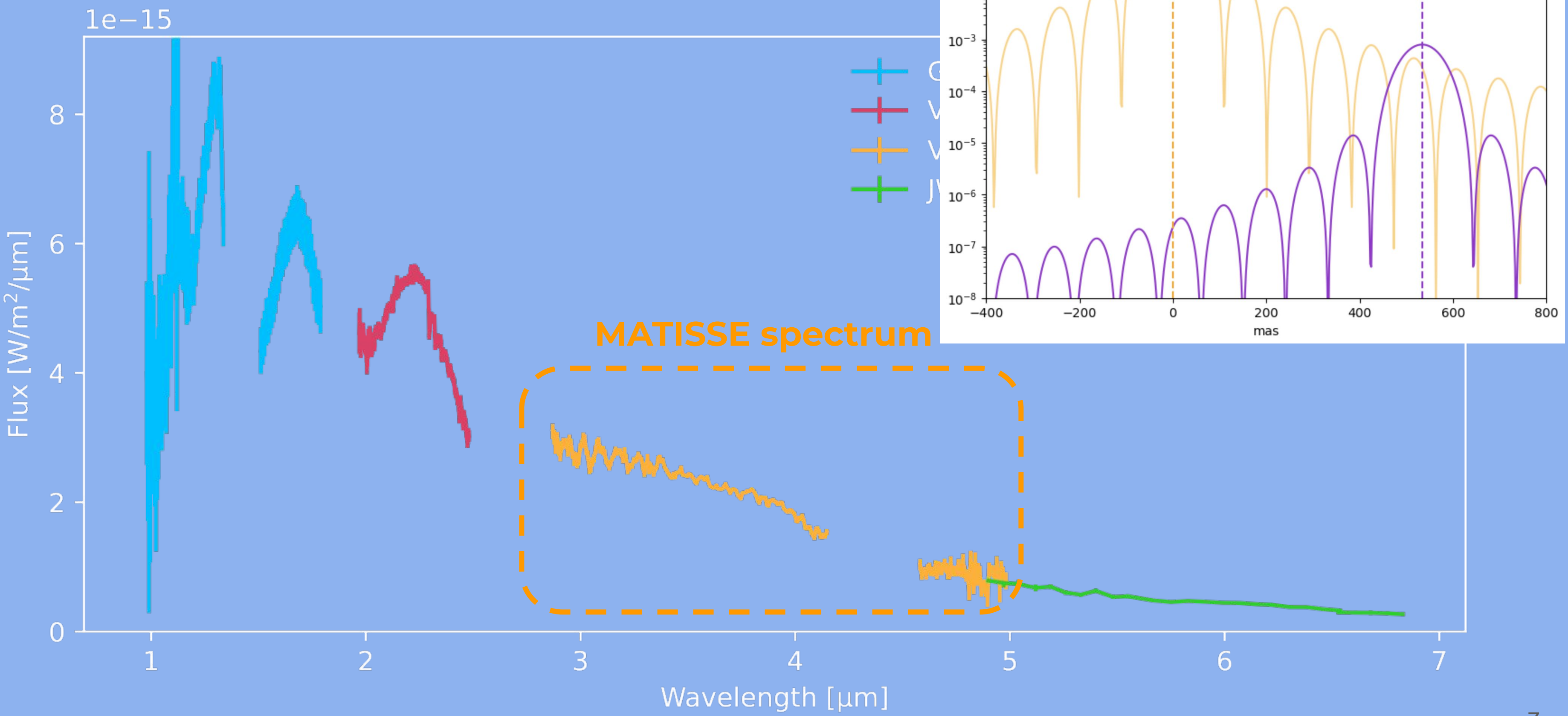
Pourré +2024

Successful MATISSE spectrum: β Pic b



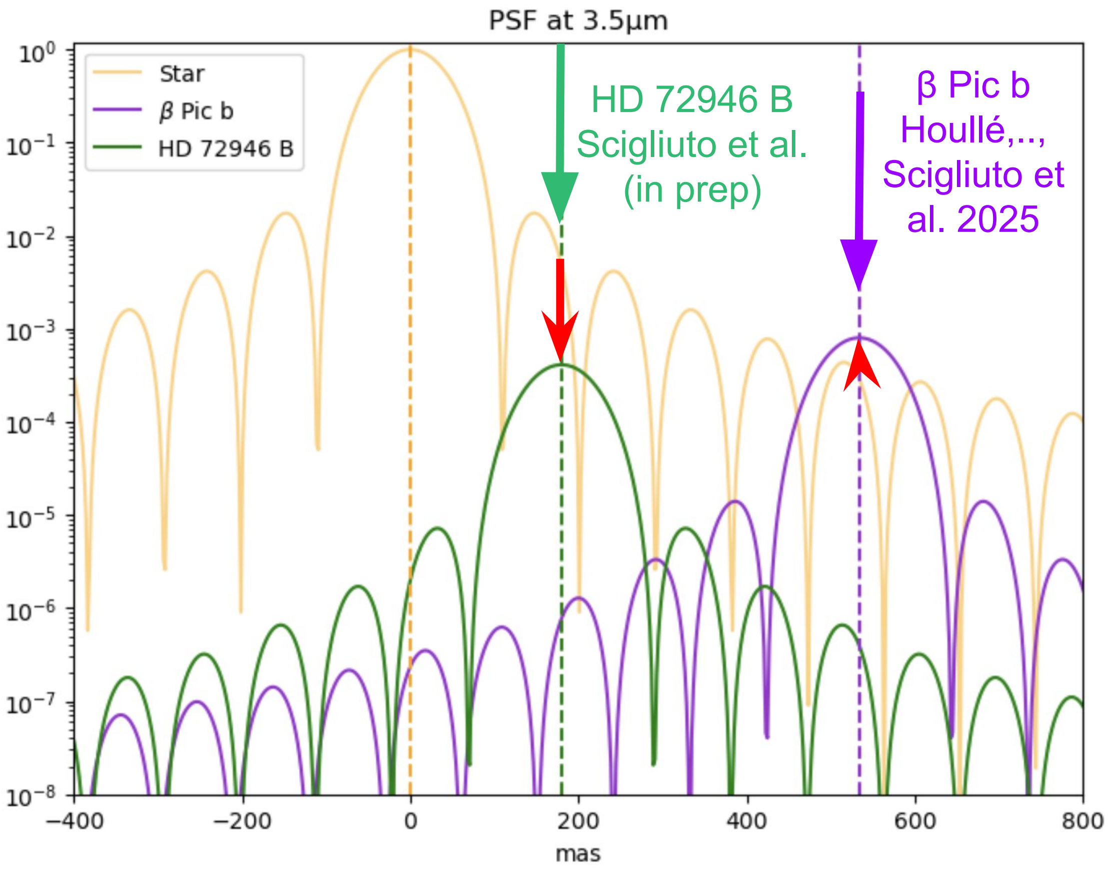
Houllé+2025

Successful MATISSE spectrum: β Pic b

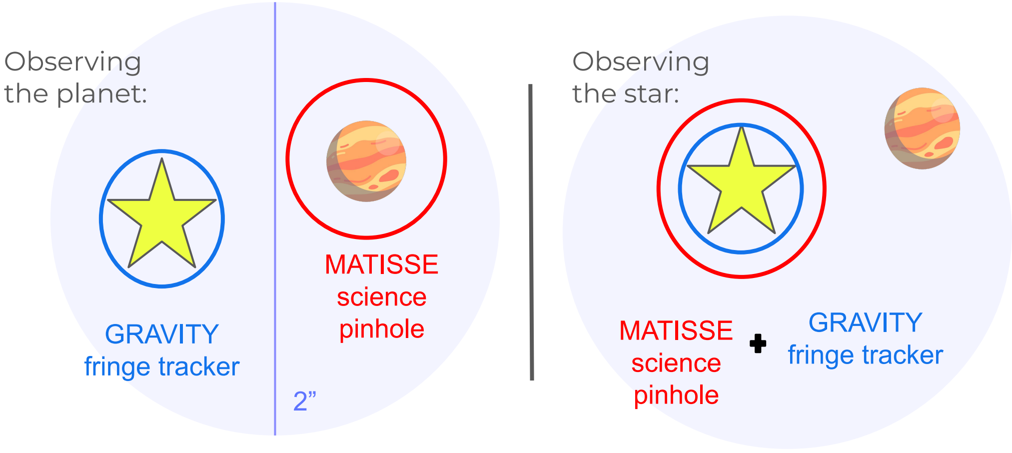


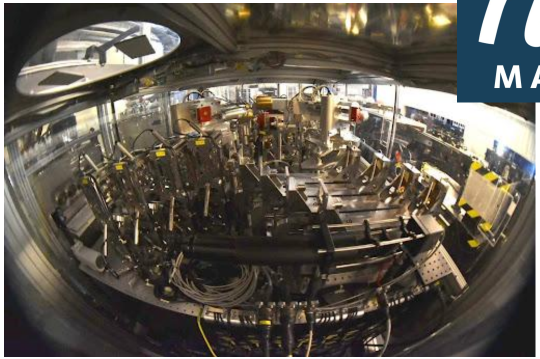
Houllé+2025

Which conditions are required to be able to observe with MATISSE



MATISSE : The instrument for extra solar companions atmosphere





Today MATISSE + GRA4MAT :

→ GRAVITY = **fringe tracker** (FT)
→ Improvement in term of sensitivity
→ **Increase the exposure** time to many seconds (DIT: 100ms → 10s)
→ Now limited to **telluric background noise**

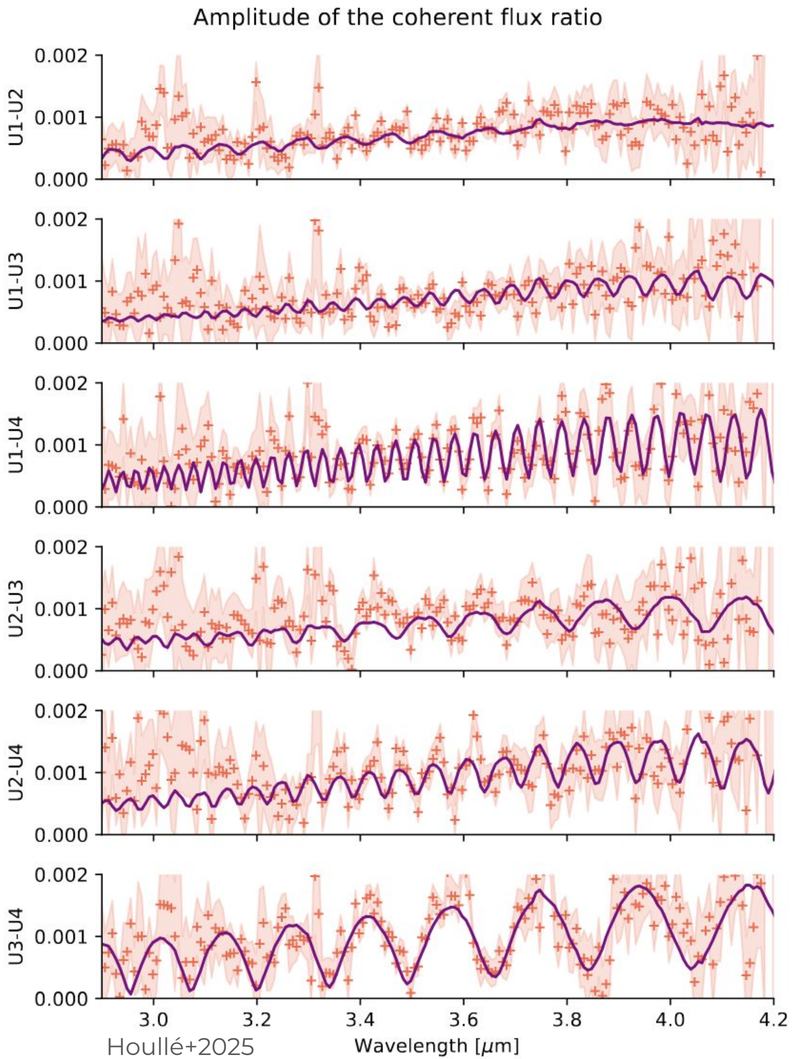
MATISSE + GRA4MAT
→ Narrow angle observation in a FOV of 2” with UT.
Spatial filtering of MATISSE (135 mas) lowering the stellar contribution.

2 cases so far!

Bright companions *case of β Pic b*

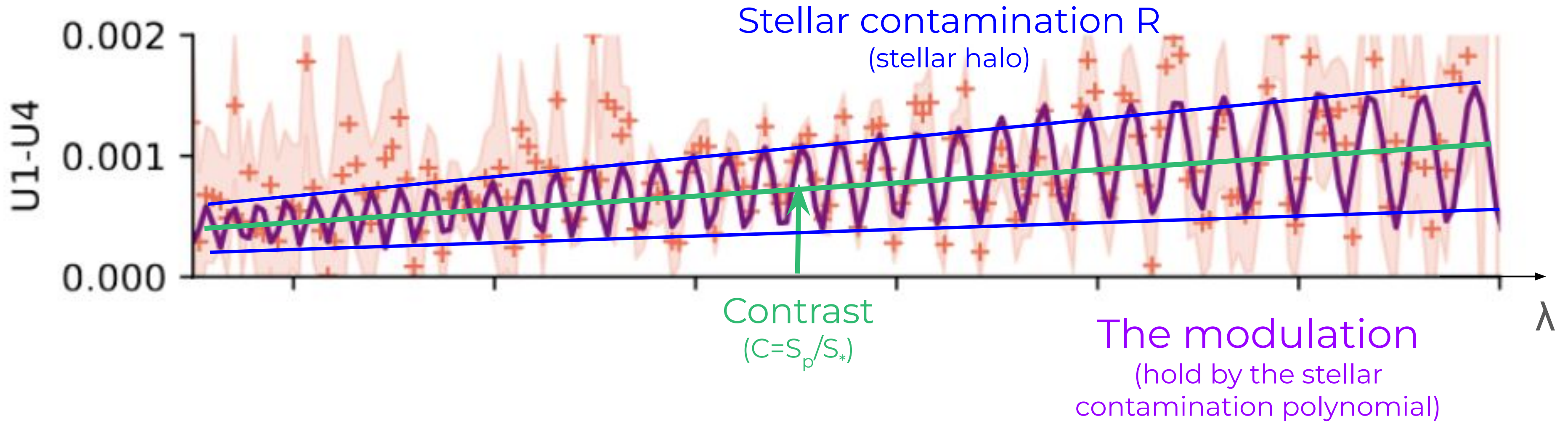
→ The companion is brighter than the star at its position.

→ The amplitude is dominated by the planet spectrum



Houllé+2025

2 cases so far!



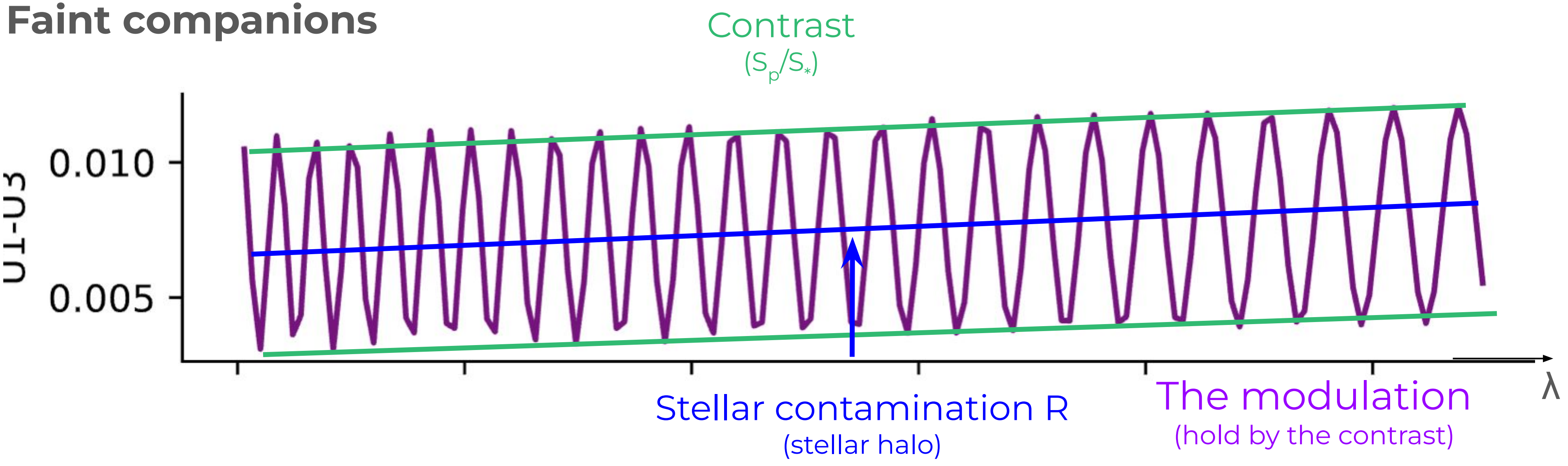
Bright companions

→ In the case of a bright companion **$S_p \sim RS_*$** Hence, the reference (OPD=0µm) is at the planet position.

$$\frac{F_p}{F_\star} = \frac{T_p}{T_\star}\left[C + Re^{i\frac{2\pi}{\lambda}\vec{\alpha_\star}\vec{u}}\right]$$

2 cases so far!

Faint companions



This is the case that regroup most of the planet we know today
(L-band flux <1mJy)

The case of HD 72946 B

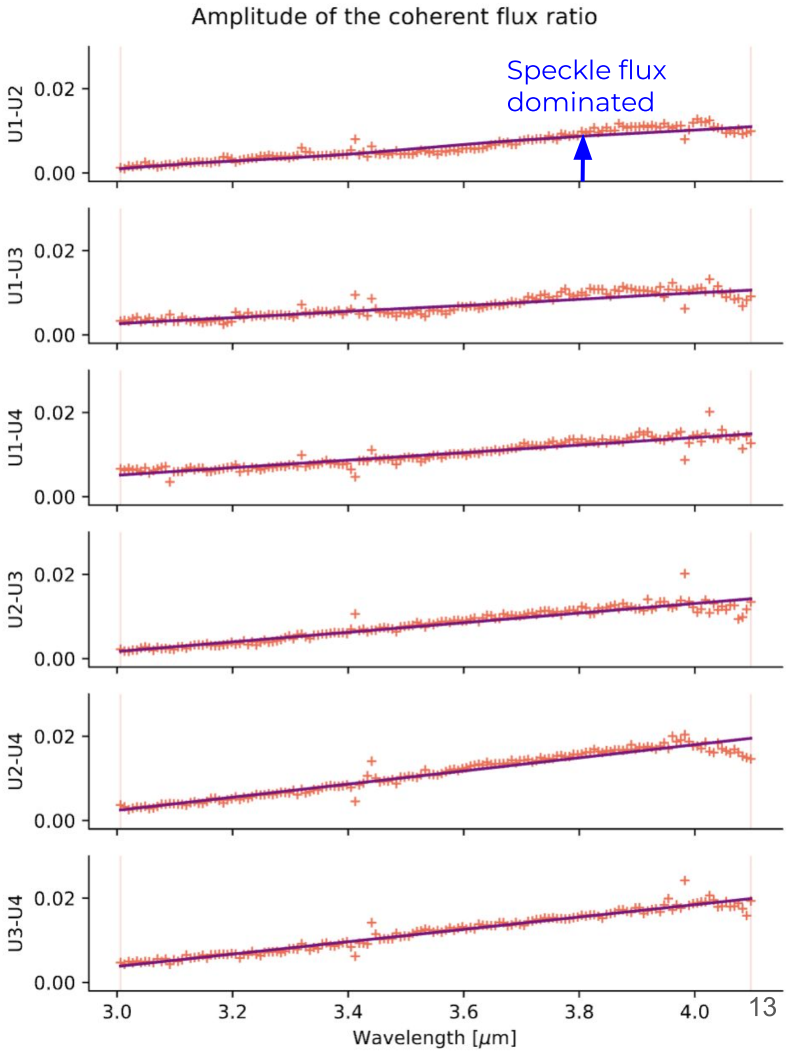
Faint companions

→ The companion is fainter than the star at its position

→ The companion's flux is drowned in the stellar halo.

→ The amplitude is dominated by the stellar flux

→ In the case of a faint companion **S_p<<RS_*** Hence, the reference (OPD=0μm) is at the star position.



The case of HD 72946 B

Faint companions

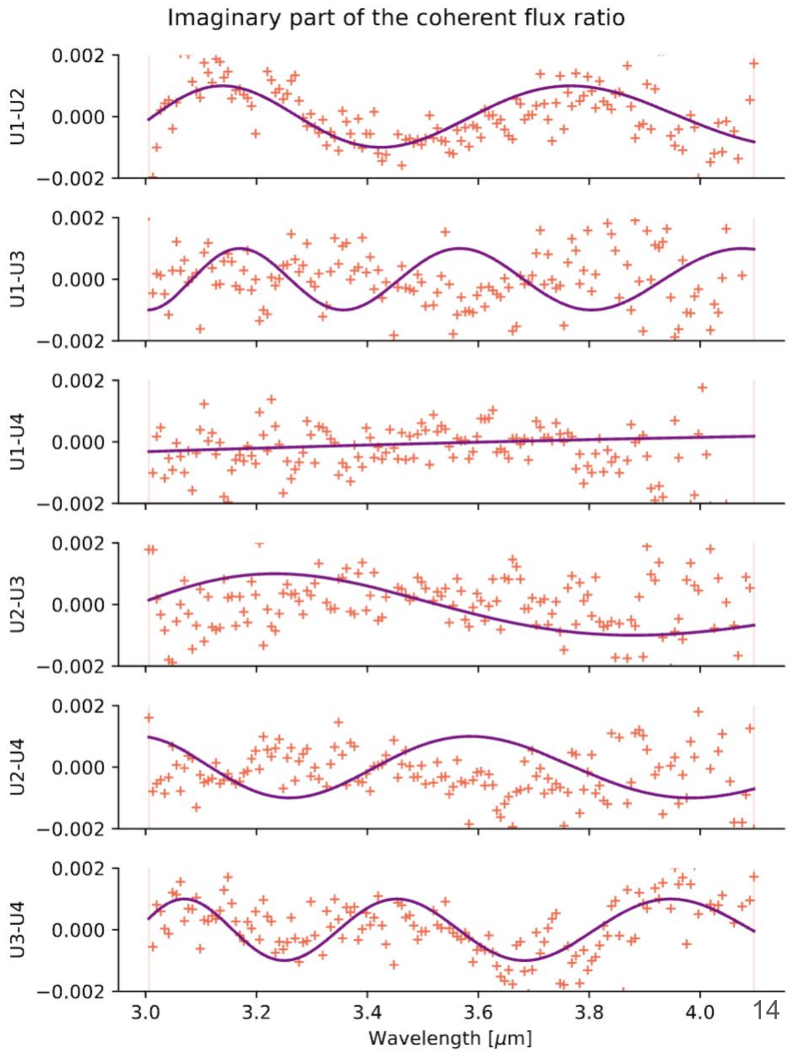
→ The companion is fainter than the star at its position

→ The companion's flux is drowned in the stellar halo.

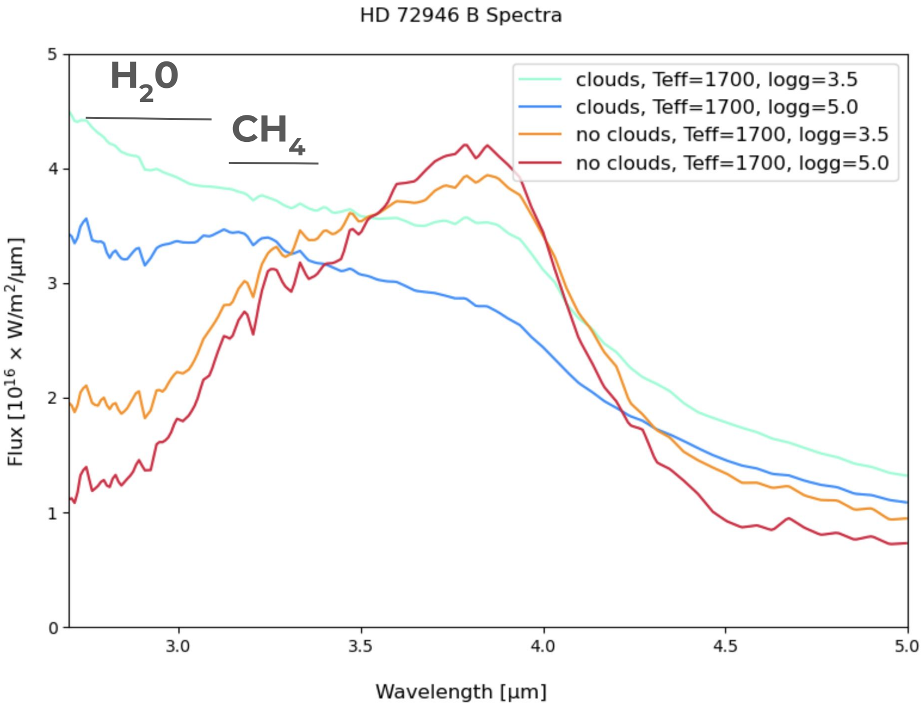
→ The amplitude is dominated by the stellar flux

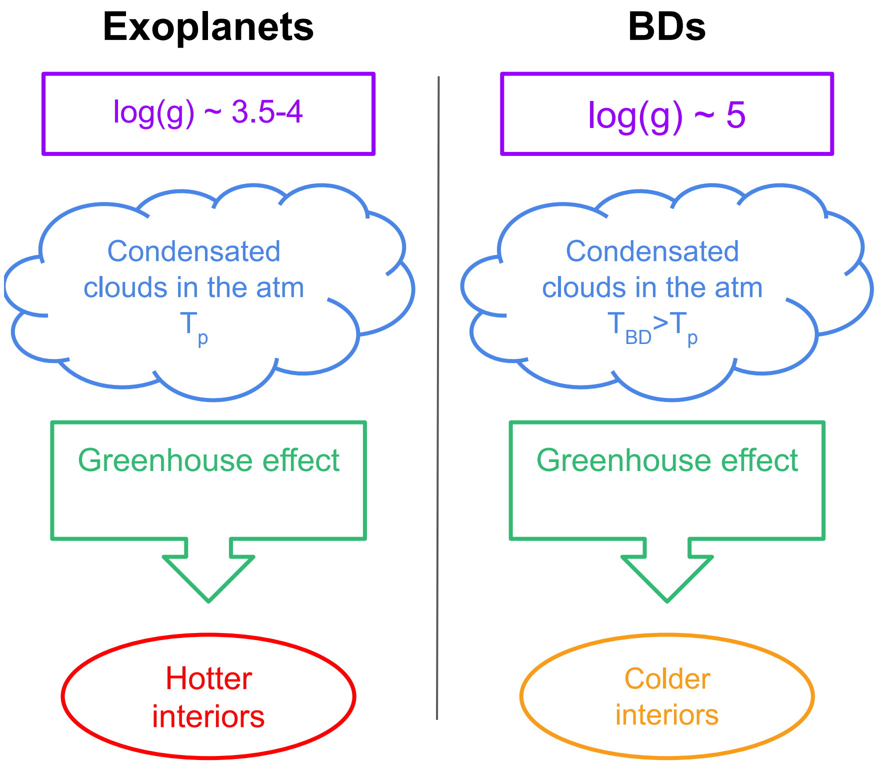
→ In the case of a faint companion **$S_p \ll RS_*$** Hence, the reference (OPD=0µm) is at the star position.

→ Subtracting the speckle flux, we retrieve the modulation, hold by the **contrast 1e-3**



Perspective: atmospheric features in Brown Dwarf atmosphere



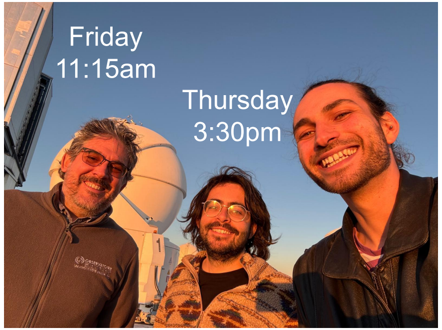


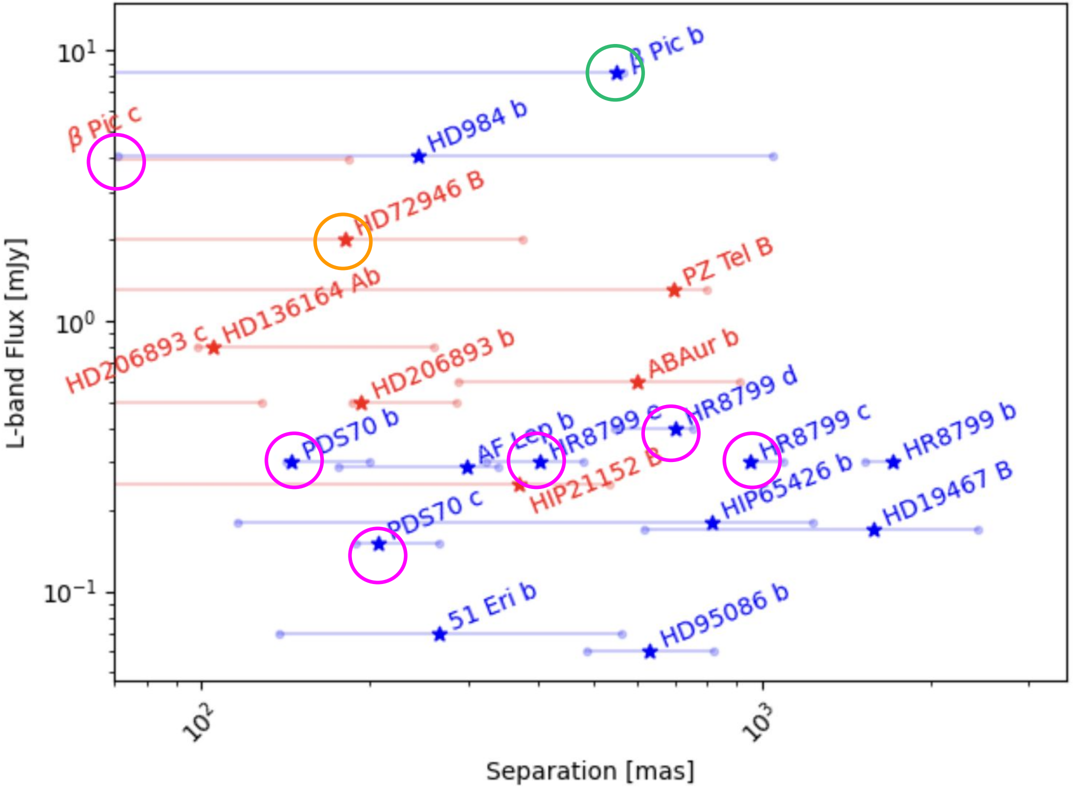
→ Silicate clouds tends to smooth spectra (CH_4 and H_2O absorption features)

Perspectives

→ Refind the astrometry determination
→ Extract the spectrum of HD 72946 B
→ Publish it !

Long term:
→ Extend this method to other companions
(rounded in pink)





Let's keep in touch: jules.sciglituto@oca.eu

Thanks for listening!

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