



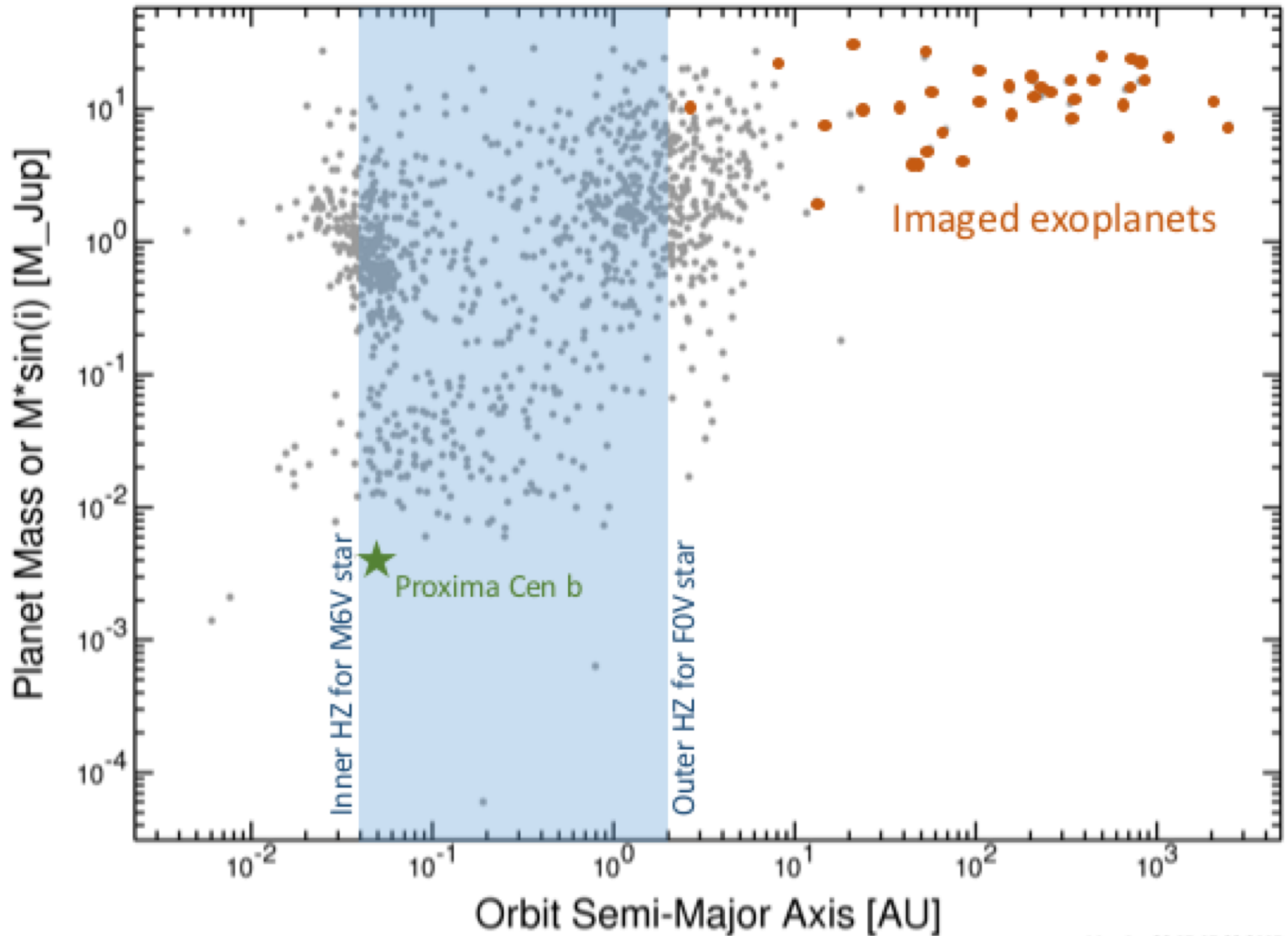
Characterizing Proxima b with a mid-infrared nulling spectrograph

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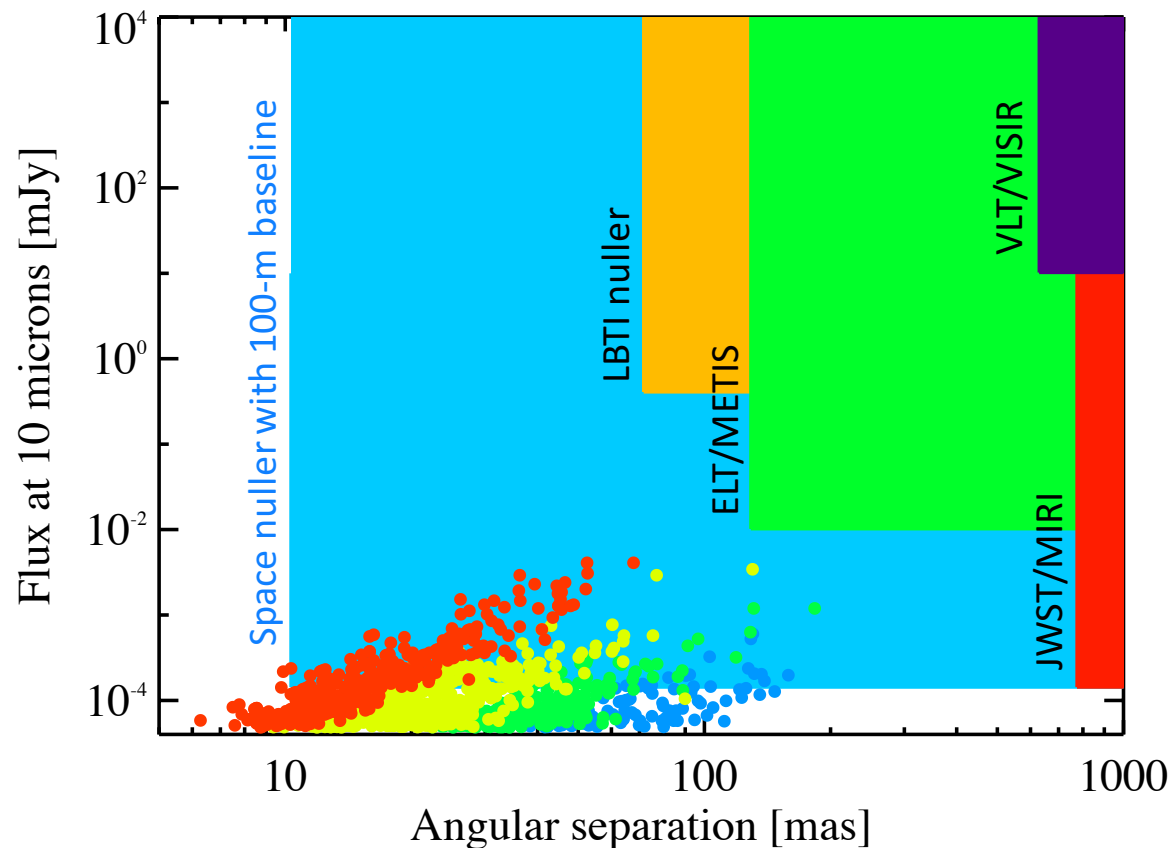
A. Léger, O. Absil, A. Garcia Munoz, J.L. Grenfell, M. Godolt, J. Loicq, J. Kammerer, S. Quanz, H. Rauer, L. Schifano, and F. Tian

Direct imaging: context



Challenges for direct imaging

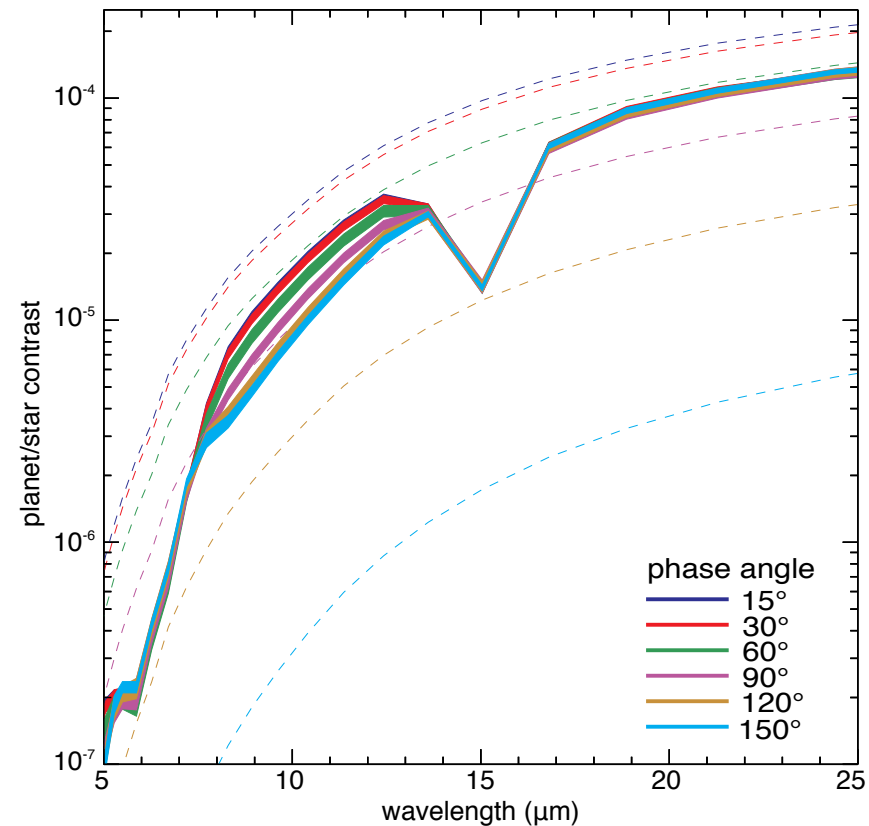
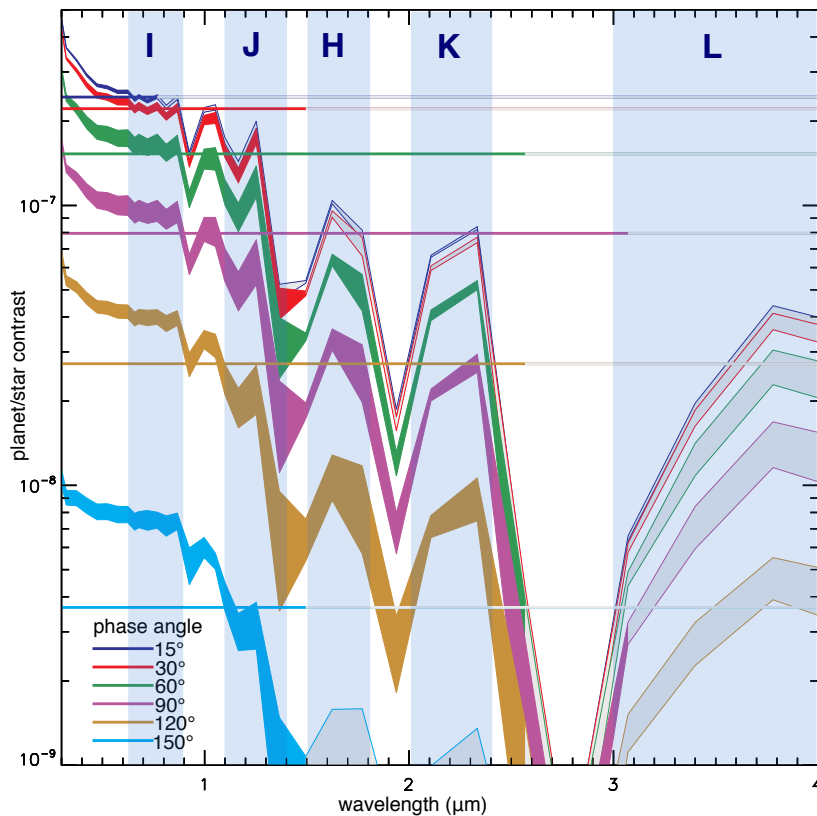
1. Contrast: need advanced wavefront and/or phase control techniques
2. Angular resolution: need large telescopes (or baselines)
3. Sensitivity: need large collecting area



Proxima b

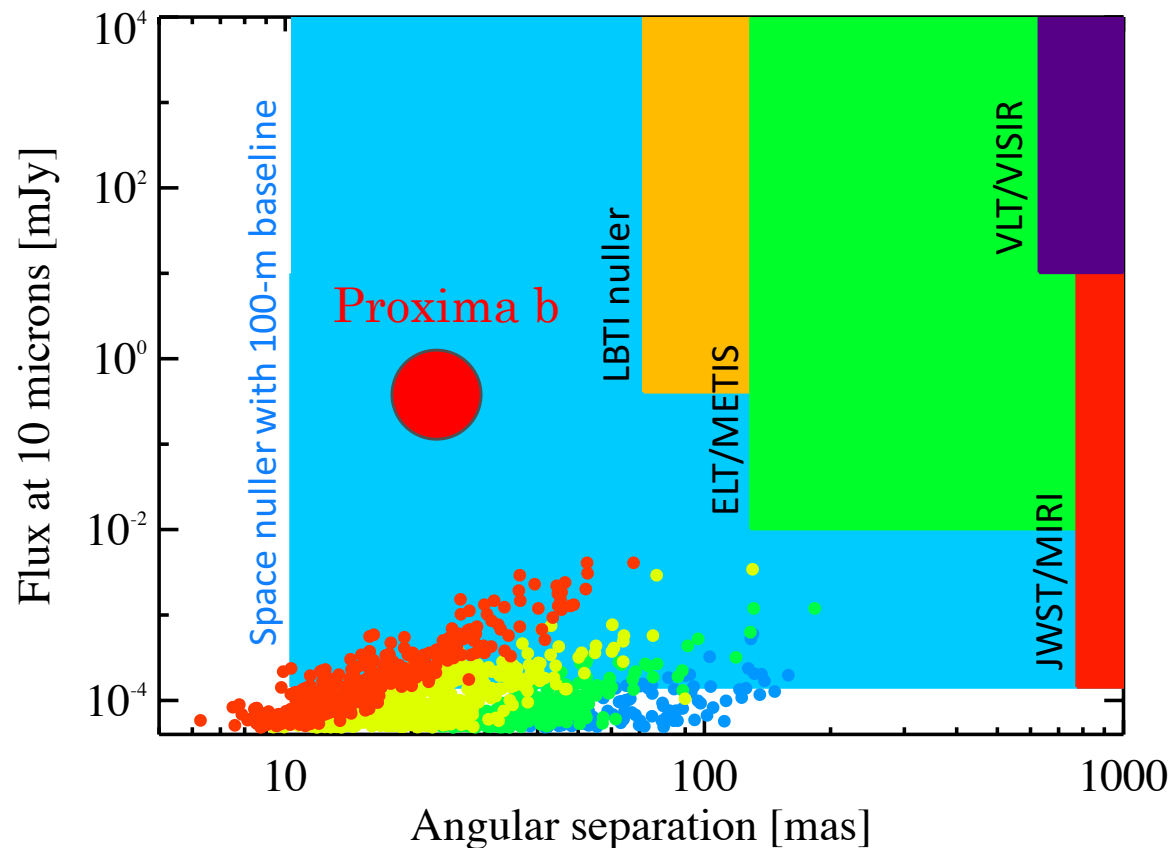
1. Contrast: favorable (M-type hosts star)
2. Angular resolution: very tight ($\sim 30\text{mas}$)
3. Sensitivity: “favorable” as nearest rocky exoplanet

Turbet et al. 2016



Proxima b

1. Contrast: favorable (M-type hosts star)
2. Angular resolution: very tight (~ 30 mas)
3. Sensitivity: “favorable” as nearest rocky exoplanet

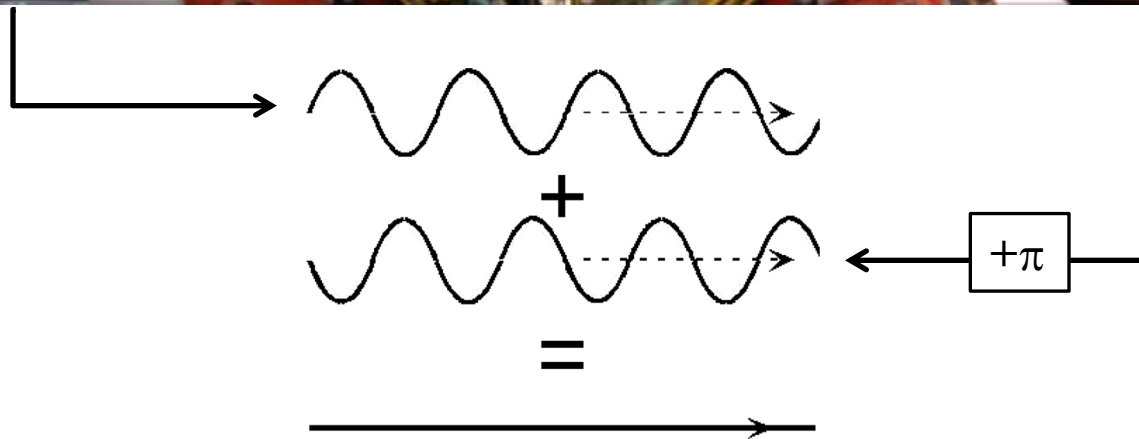
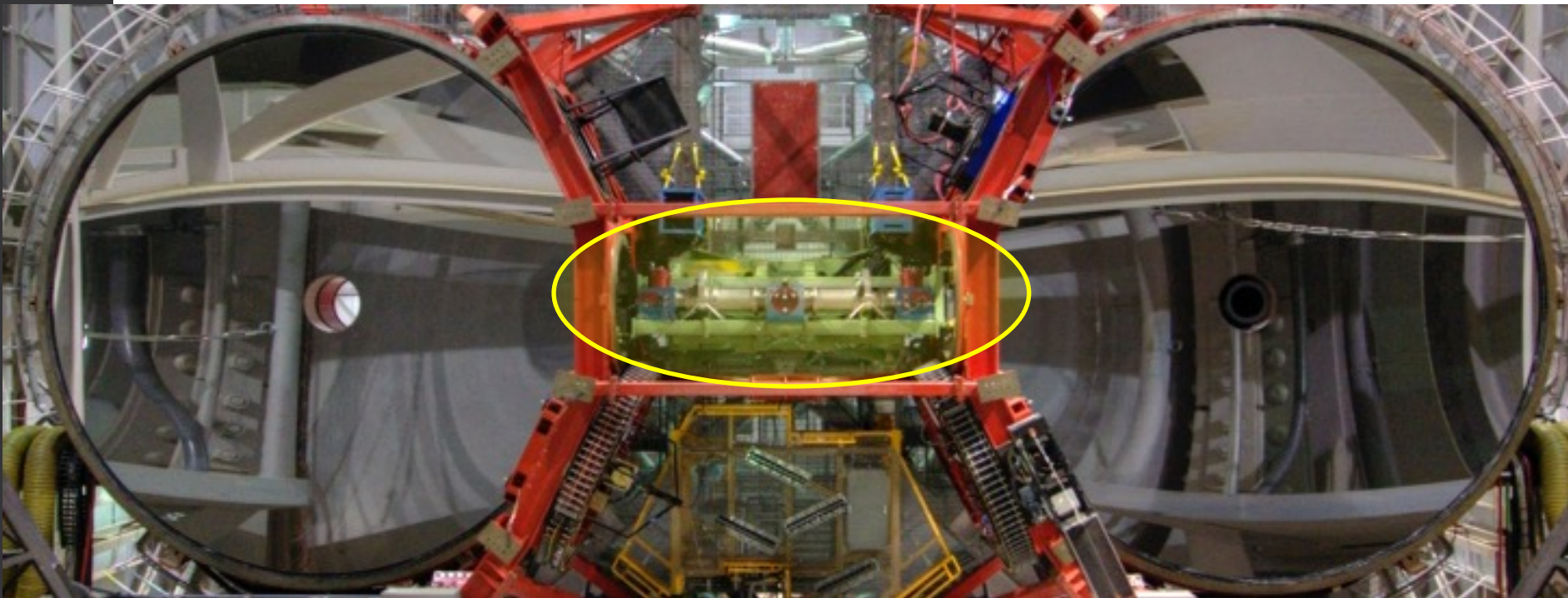




The solution: nulling interferometry

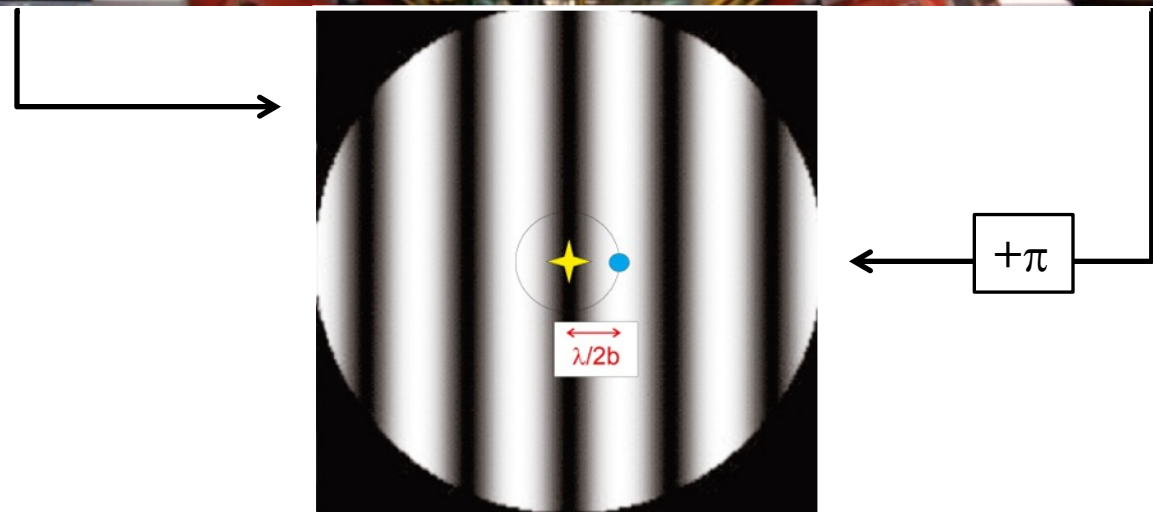
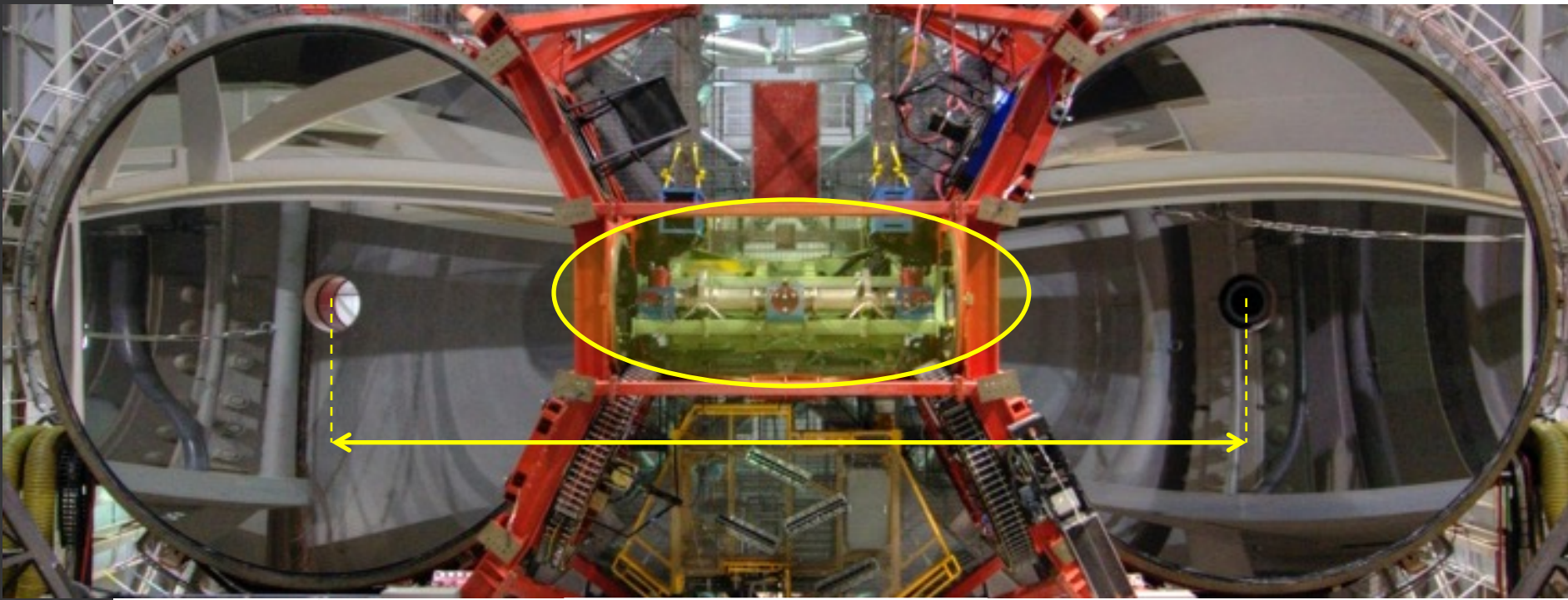
- Key advantages:
 - Interferometry provides the required **angular resolution**
 - Nulling provides the required **contrast** ($\sim 10^{-4}$ already demonstrated from the ground, Menesson et al. 2011, Defrère et al. 2016)
- Must be space-based to get **reasonable integration times**

Nulling interferometry



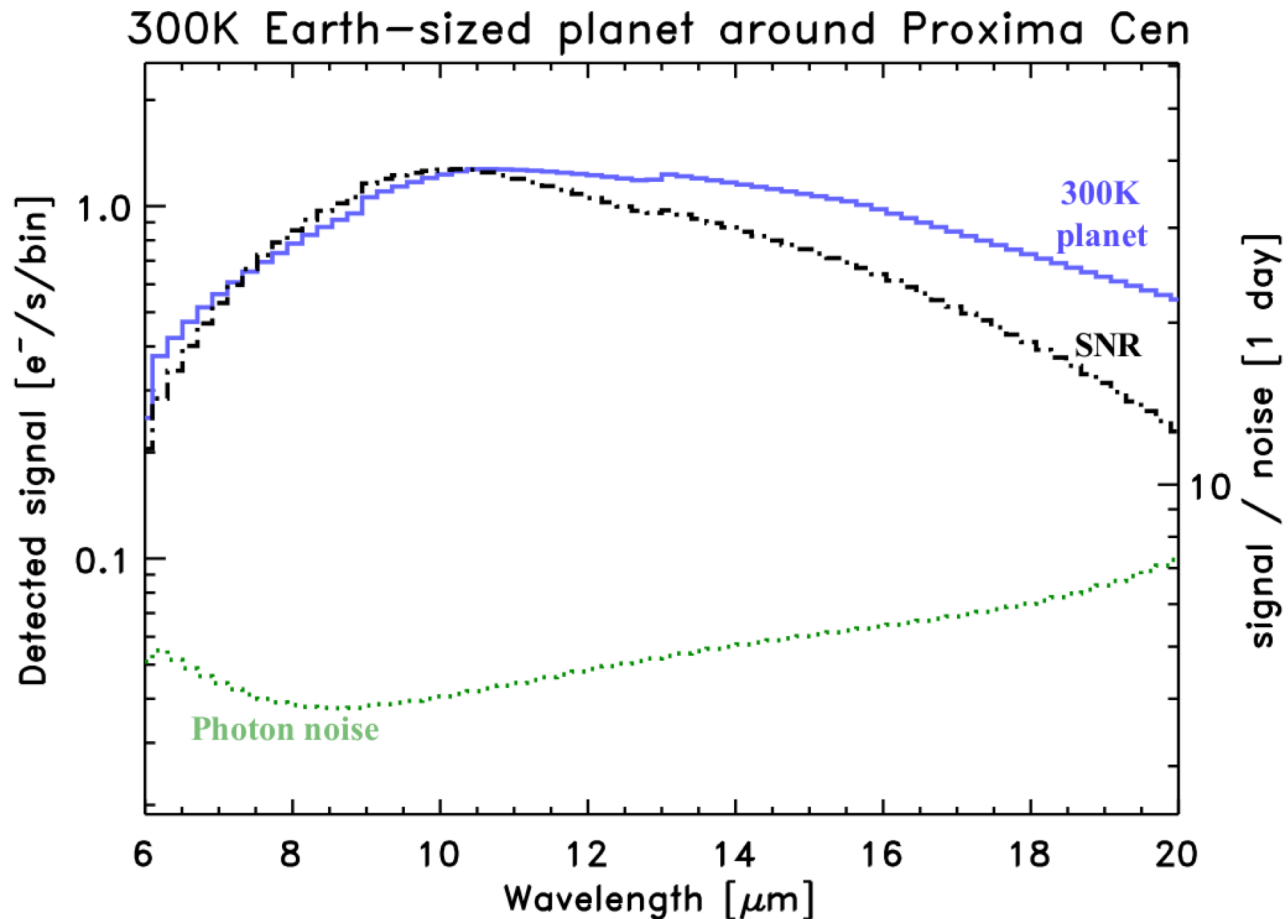


Nulling interferometry



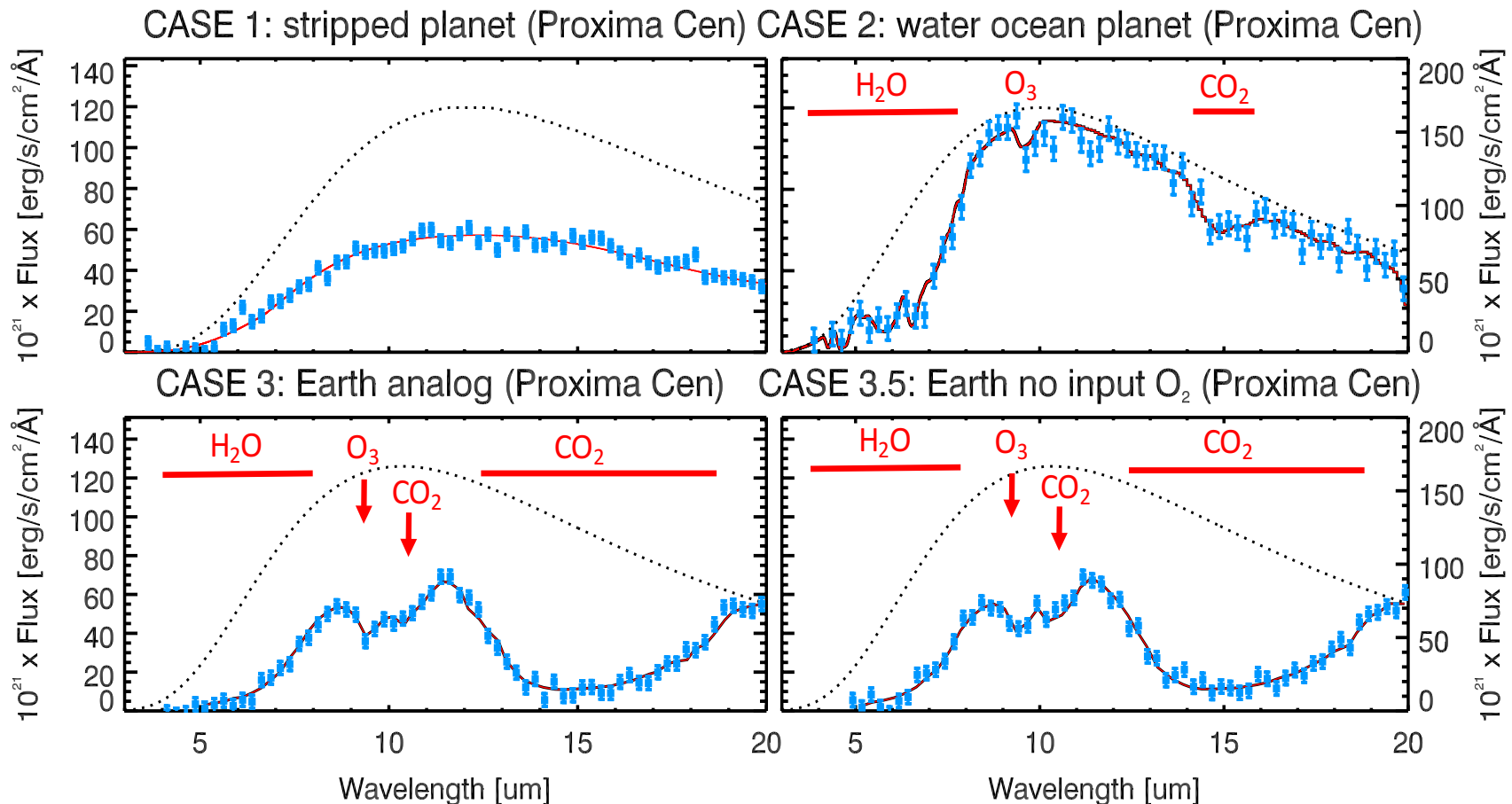
Detection and spectroscopy (1/2)

- Ideal target for mid-infrared interferometer.
- SNR in 1 day of integration with four 75-cm aperture and $R = 40$



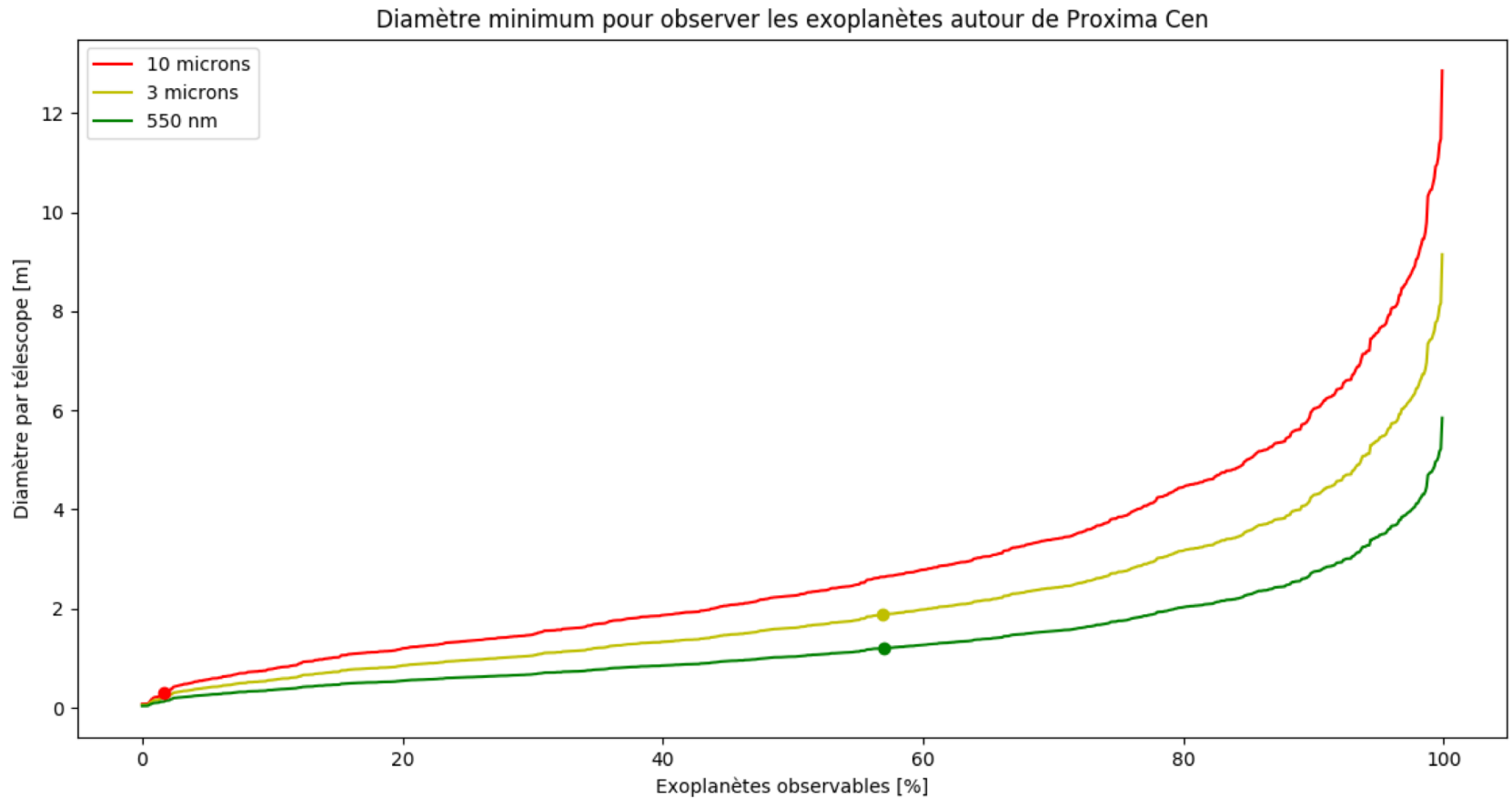
Detection and spectroscopy (2/2)

- Simulated observations ($R=40$, blue points) imposing a S/N of 20 on continuum detection at $10\ \mu\text{m}$ (Léger et al. in prep).
- All spectral features detected in a single visit (besides O_3):



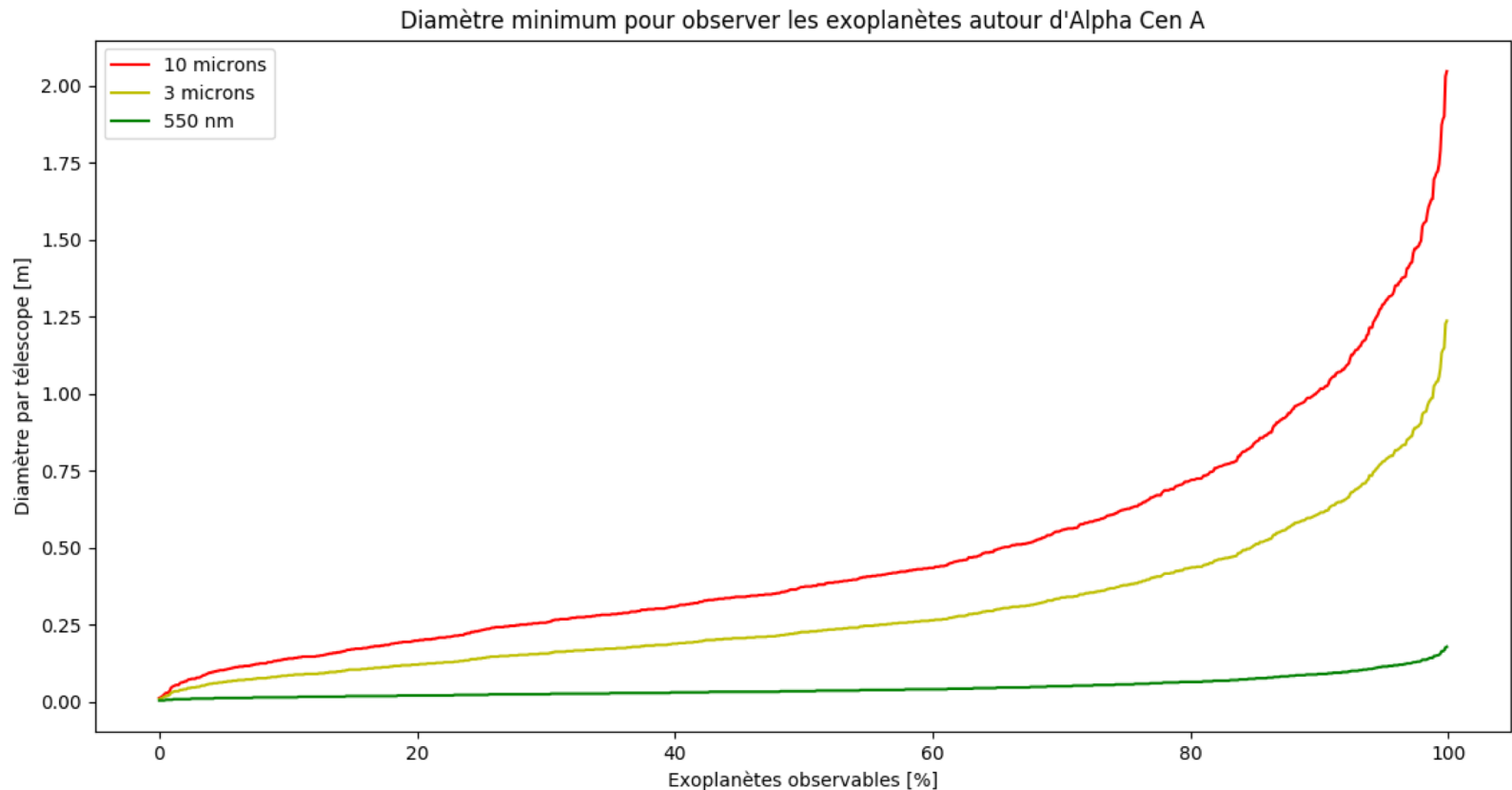
Detecting more Proxima planets

- Aperture diameter required to detect a given ratio of planets **based on Kepler's statistics** (work in progress, L. Schifano)



What about alpha Cen?

- Aperture diameter required to detect a given ratio of planets **based on Kepler's statistics** (work in progress, L. Schifano)
- Ongoing design study with Liège space center (CSL)





Take away

- A 75-cm space-based interferometer can take a thermal infrared spectrum ($R=40$) of Proxima b in one day
- Mission design currently under study with the Liège Space Center
- Want to be involved? ddefrere@uliege.be