Simulating observations of the β-Pictoris system with the JWST/MIRI instrument

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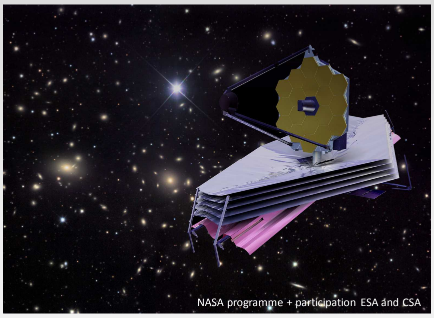
The James Webb Space Telescope : a 6.5 meter InfraRed telescope in Space [1]



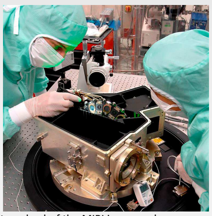
To be launched by an Ariane rocket in **2018**

What can JWST/MIRI observations bring?

First observations at 10 μm of β-Pic b?

Favourable contrast planet/star : **about 10^{-3}** at 10 microns.
Nevertheless need of a coranagraph

Larger PSF: β-Pic b is at best at 0.4 arcsec from its host star → **at about λ/D at 10 μm.**
Need of more than a Lyot coranagraph



Filter wheel of the MIRI imager, where we can see one of the pupil coranagraph mask. MIRI coranagraphs have been uilt by LESIA and integrated in the imager of MIRI at Saclay .

MIRI has such a coranagraph!: a 4 quadrant phase masks[3]
In fact three of them at λ :
10.6 μm, 11.3 μm, 15.5 μm.

Conclusions

β-Pic will be a **prime target for MIRI**. The observation of β-Pic b will be challenging. Observing at various times may be a way to remove the dust contribution . In any case a better knowledge of the dust disk will be obtained (for example photometric stability…)

Other observing modes of MIRI, Slit (or slitless) Low Resolution Spectroscopy (LRS) (R=100 at 7 μm) and Medium Resolution integral field spectroscopy MRS (R=1300-3700) , can provide unique information on the dust disk.

Four instruments built and delivered to the NASA Goddard Space Center

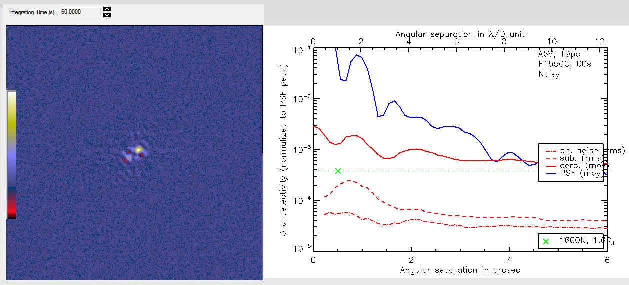
The 4 instruments integrated on the ISM, at the Goddard Nasa Space Center

NIRCAM: Near-IR CAMera (1-5 μm)
NIRSPEC : Near-IR SPECtrometer (1-5 μm)
NIRIS: Near-IR Imager and Slitless Spectrograph (0.6-5 μm)
MIRI : Mid-IR Instrument (5-28 μm) [2]

Simulations of β-Pic b observations

MIRI **very sensitive** : two to three orders of magnitude more sensitive than ground-based instruments

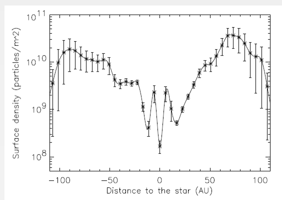
When just considering the star and the planet : the planet is detected in **about 1 minute**!



Based on the simulator by A. Boccaletti et al. [4 and 5]

But the dust disk will probably dominate at the JWST spatial resolution (MIRI PFOV of 0.11 arcsec).
From [6] and [7], we can derive a flux of the order 3-16 mJy at 0.4 arcsec from the star, to be compared to an expected planet flux in the 3 mJy range .

Note also the intriguing increase of dust around 10 AU found in [7], which might be an indication of planet – dust interaction.



References :
[1] for example M. Clampin, SPIE talk June 2014 (YouTube)
[2] G. Wright et al. 2014, PASP, submitted
[3] D. Rouan et al., 2000, PASP 112, 1479
[4] A. Boccaletti et al., Adv. Spc. Res., 36, 1099; [4]5A. Boccaletti et al., PASP, submitted
[6] P.O. Lagage, P.O., and Pantin, E., 1994 Nature 369, 628; [7] E. Pantin E. et al., 1997, A&A 327,1123