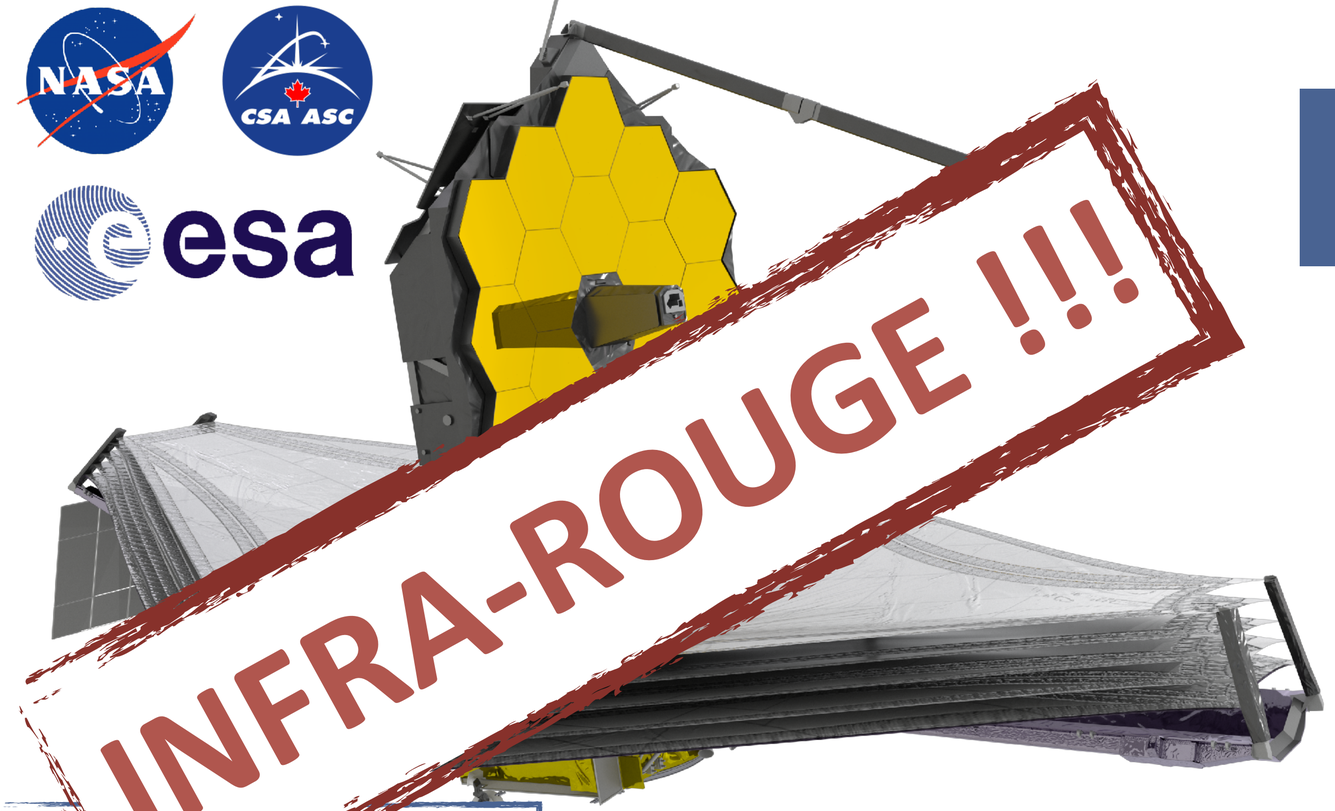
James Webb Space Telescope



INFRA-ROUGE !!!

diamètre 6.5 m

orbite L2 (1.5M km)

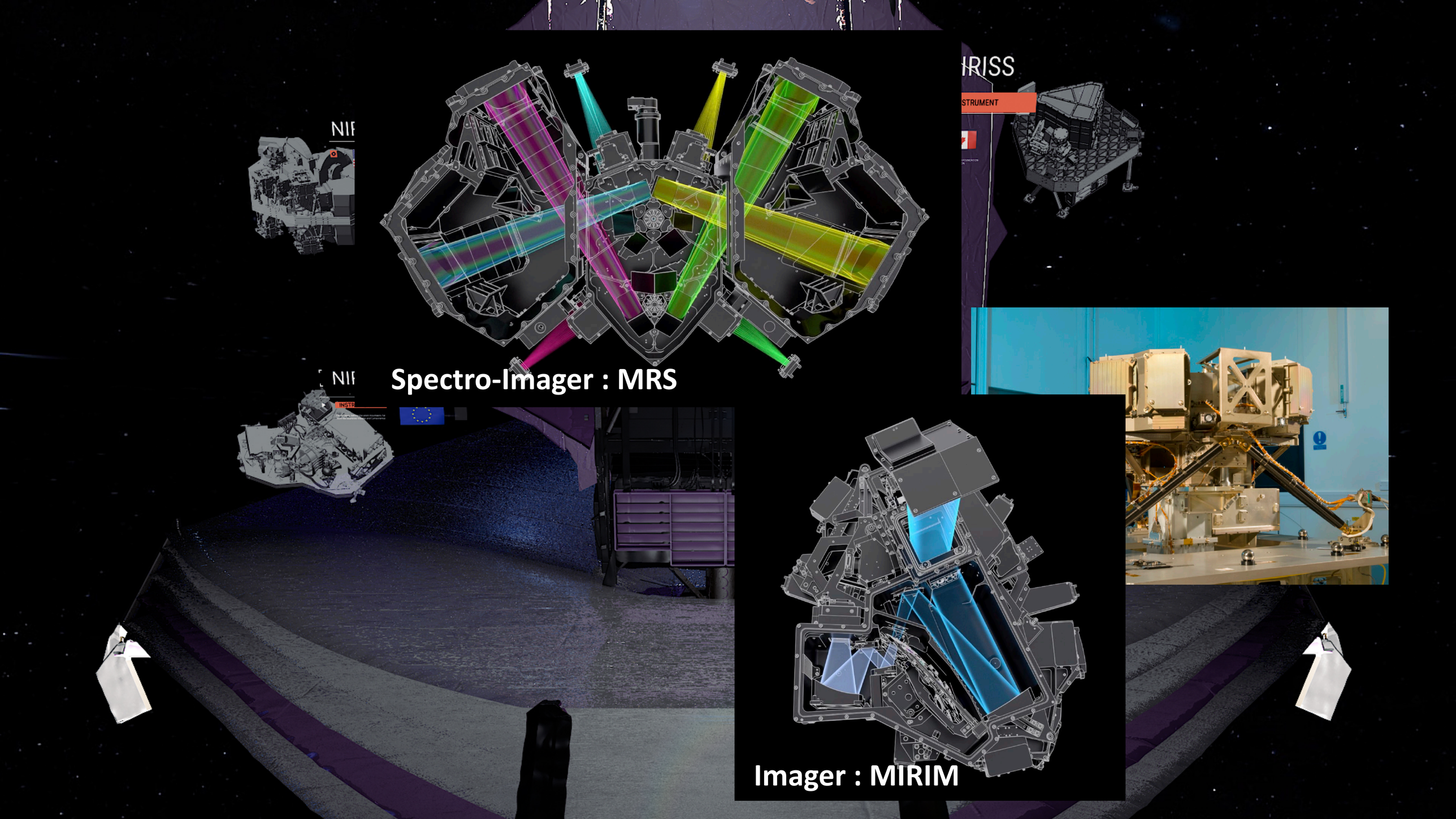
l'U[illegible]rs jeune

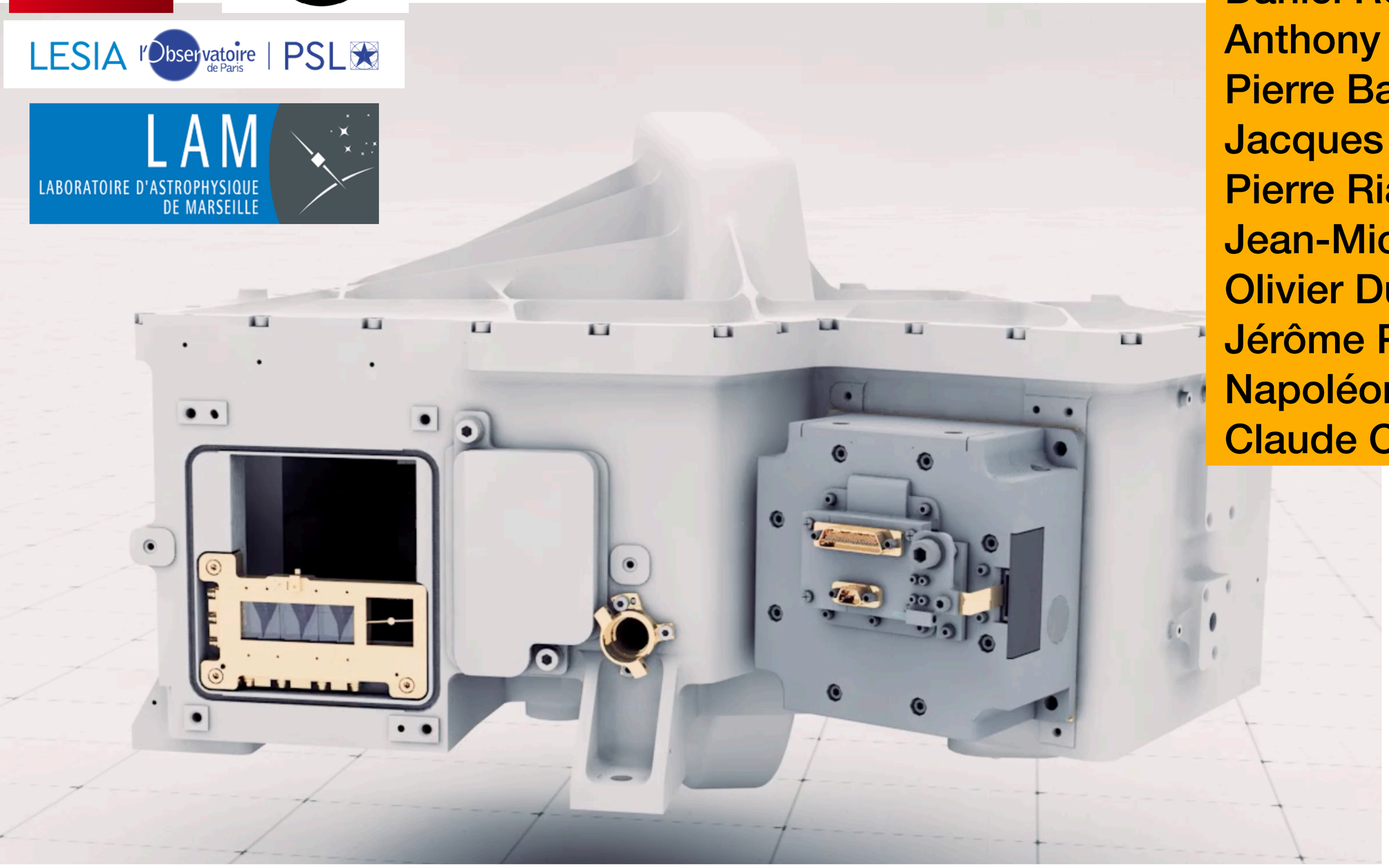
Evolution des galaxies

Caractéristiques des exoplanètes

Cycle des étoiles

25/12/2021 : lancement Ariane V


Spectro-Imager : MRS
Imager : MIRIM



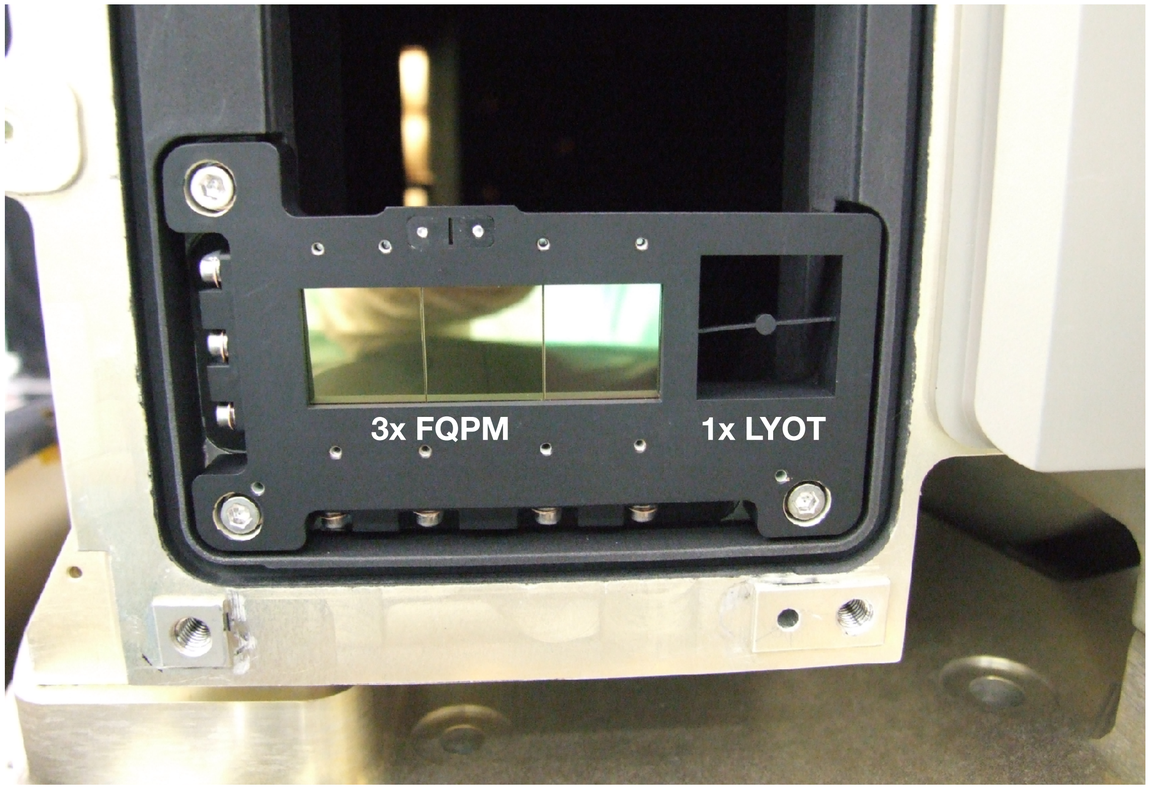
Team @ LESIA (since 2002)

Daniel Rouan
Anthony Boccaletti
Pierre Baudoz
Jacques Baudrand
Pierre Riaud
Jean-Michel Reess
Olivier Dupuis
Jérôme Parisot
Napoléon Nguyen Tuong
Claude Collin

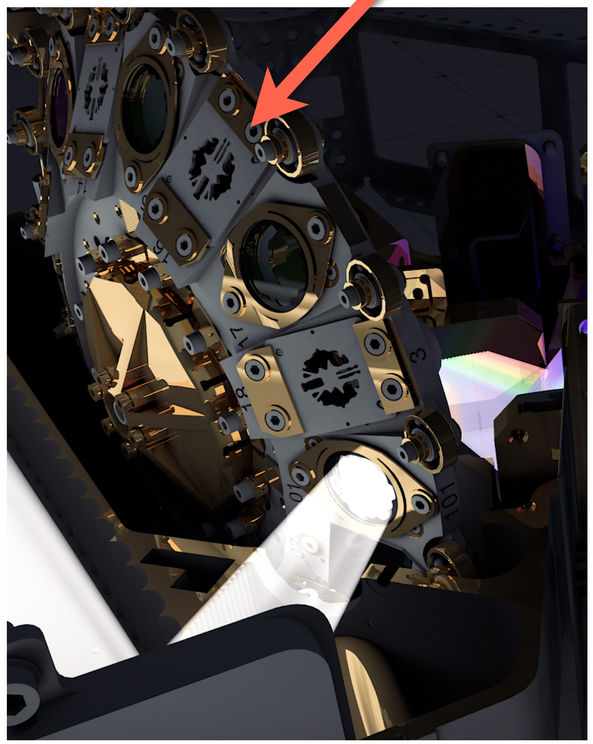
MIRI's coronagraph concept

A coronagraph is designed to attenuate the star light

combines a mask in the focal plane with a "Lyot" stop in the pupil



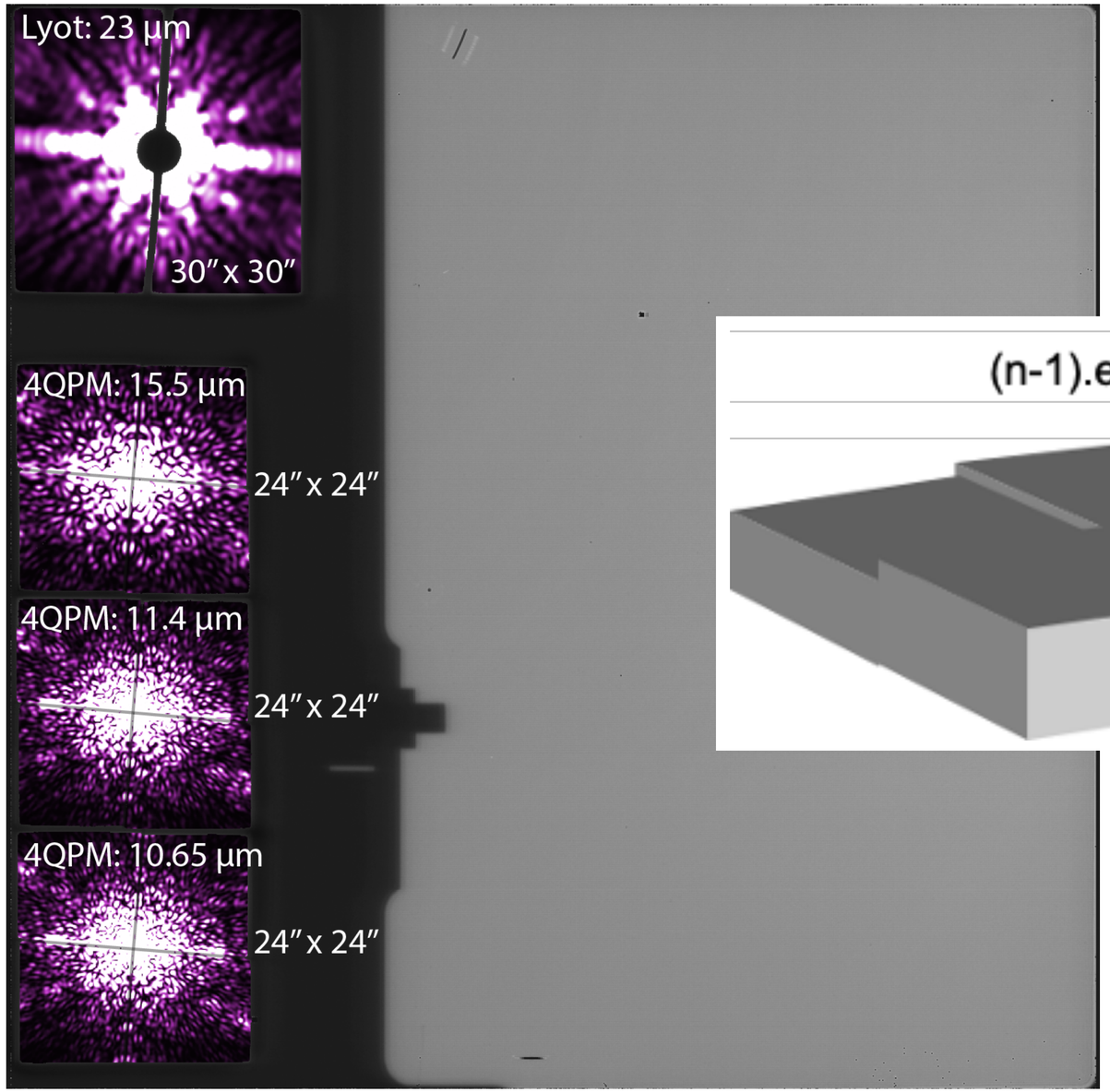
1. Coronagraphic masks in the entrance focal plane of MIRI



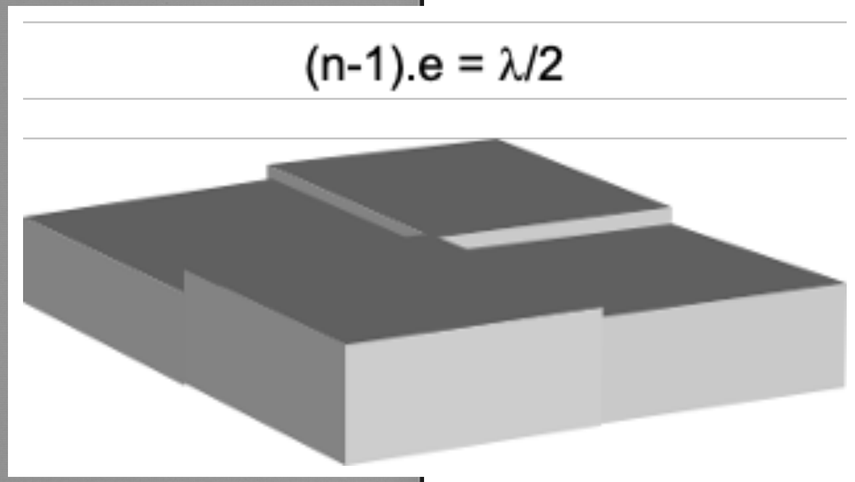
2. Lyot stops+IR filters in the filter wheel

Rouan et al. 2000
Boccaletti et al. 2005
Baudoz et al. 2006
Boccaletti et al. 2015

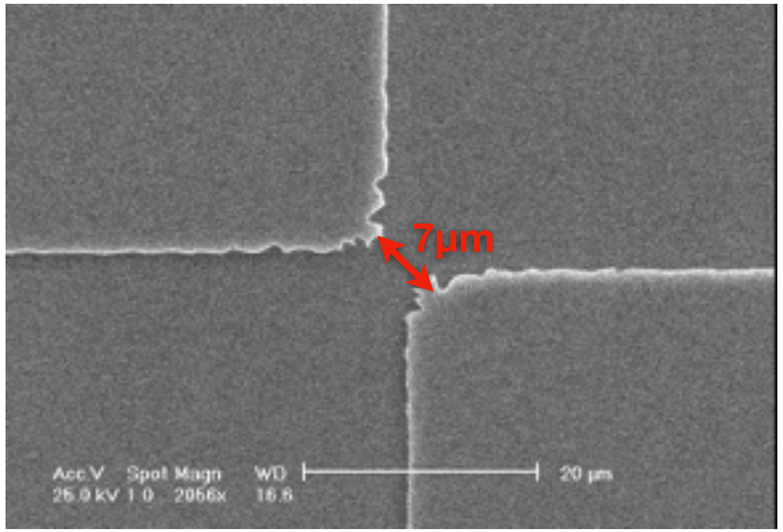
MIRI's coronagraph concept



4 Coronagraphic masks associated to 4 filters :
- 10.65 microns : Four Quadrant Phase Mask
- 11.40 microns : Four Quadrant Phase Mask
- 15.50 microns : Four Quadrant Phase Mask
- 23.00 microns : Lyot Mask

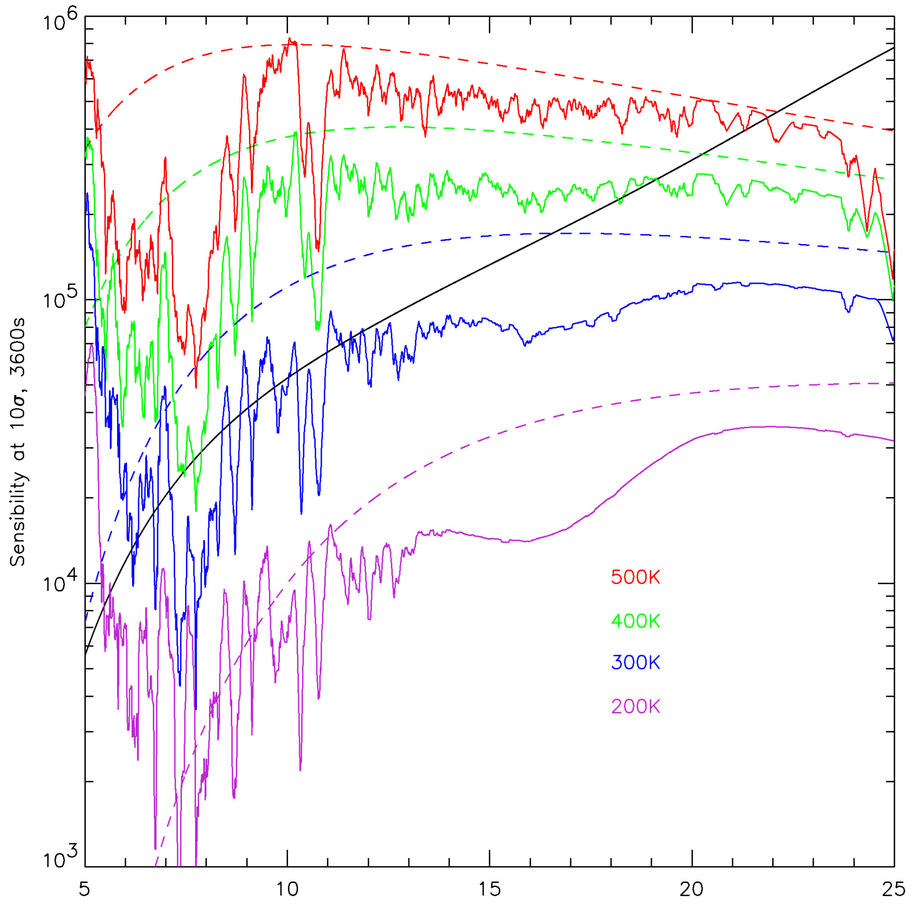


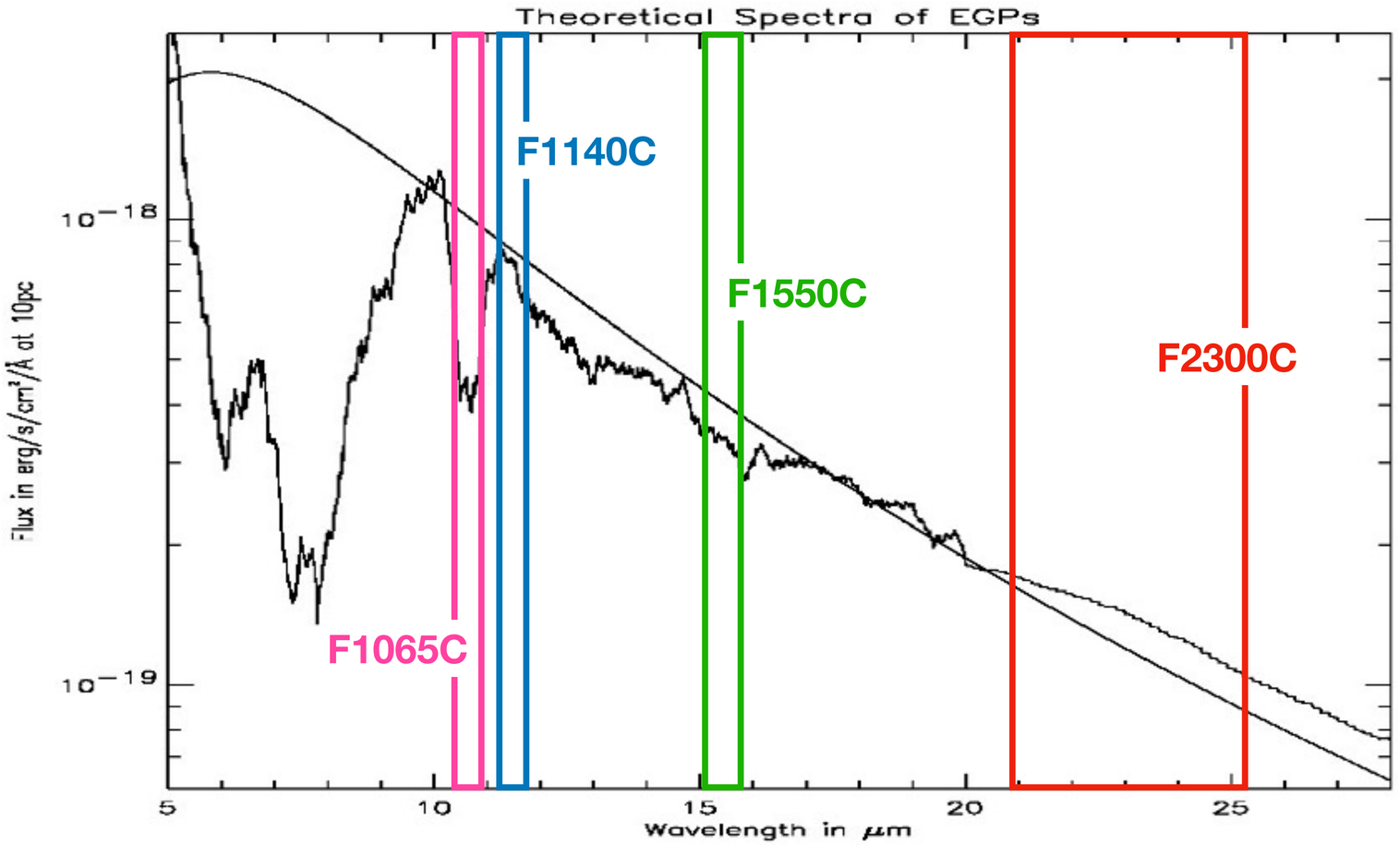
Rouan et al. 2000



FQPM are made in Germanium, using Reactive Ionic Etching

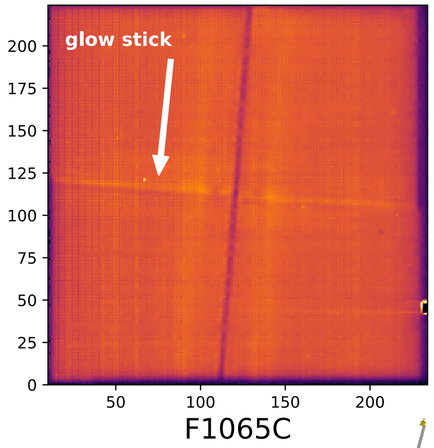
MIRI's coronagraph concept

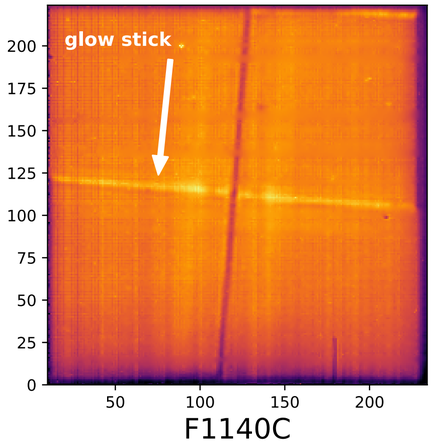


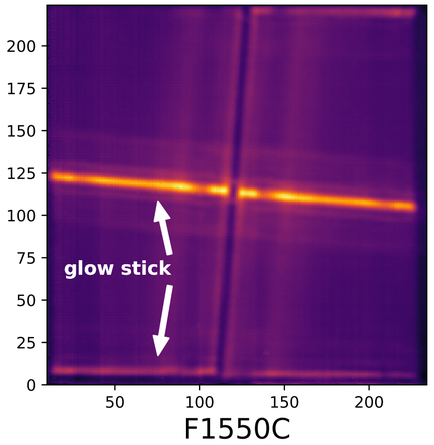


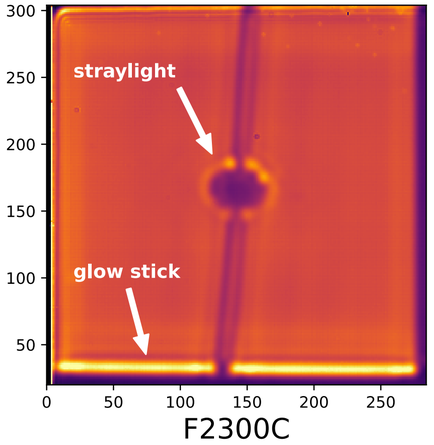
Sensitivity vs. planetary spectra

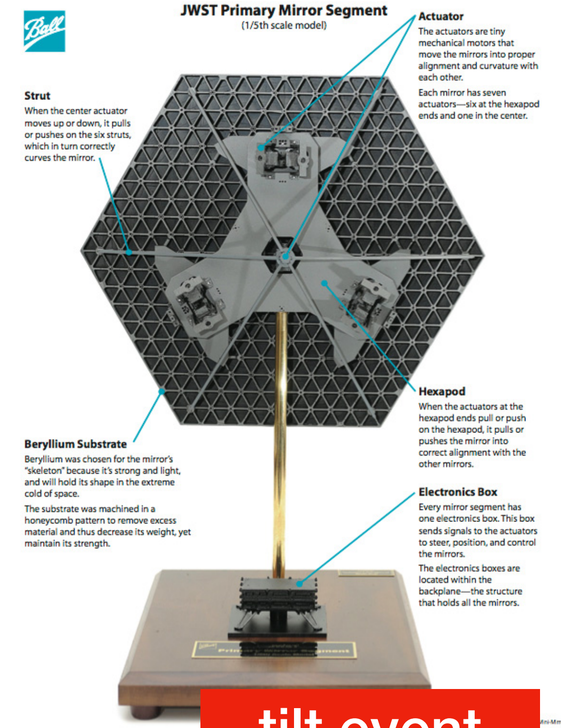
Some defects … from the telescope





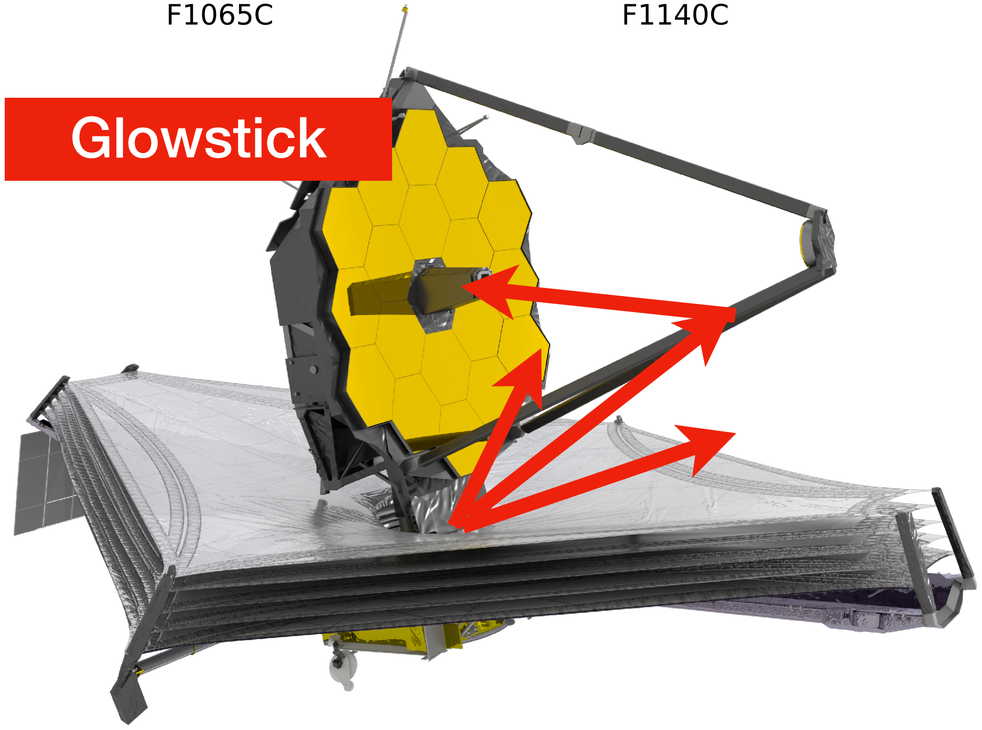


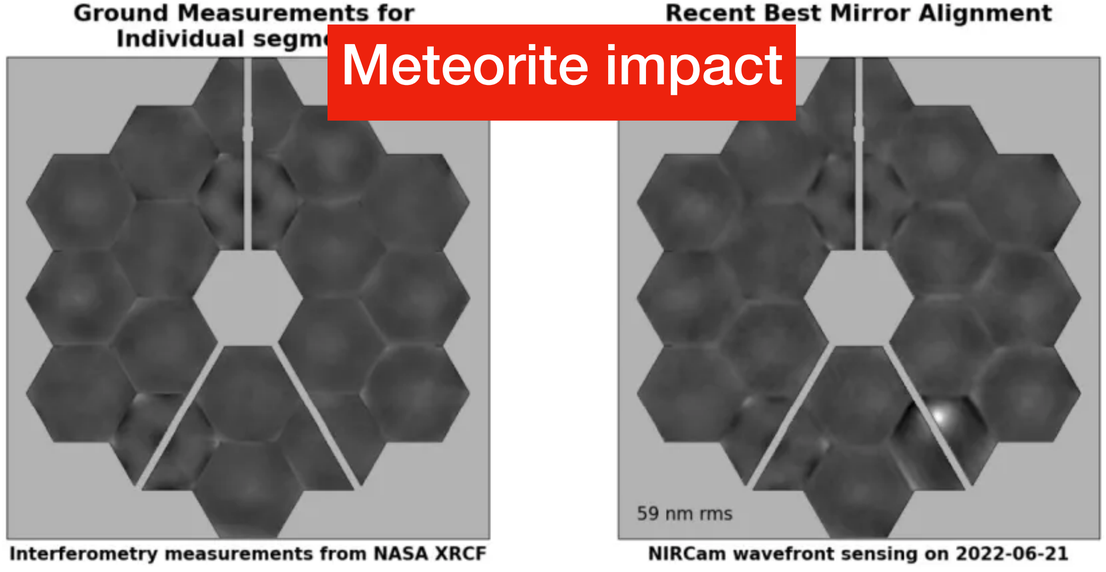




tilt event

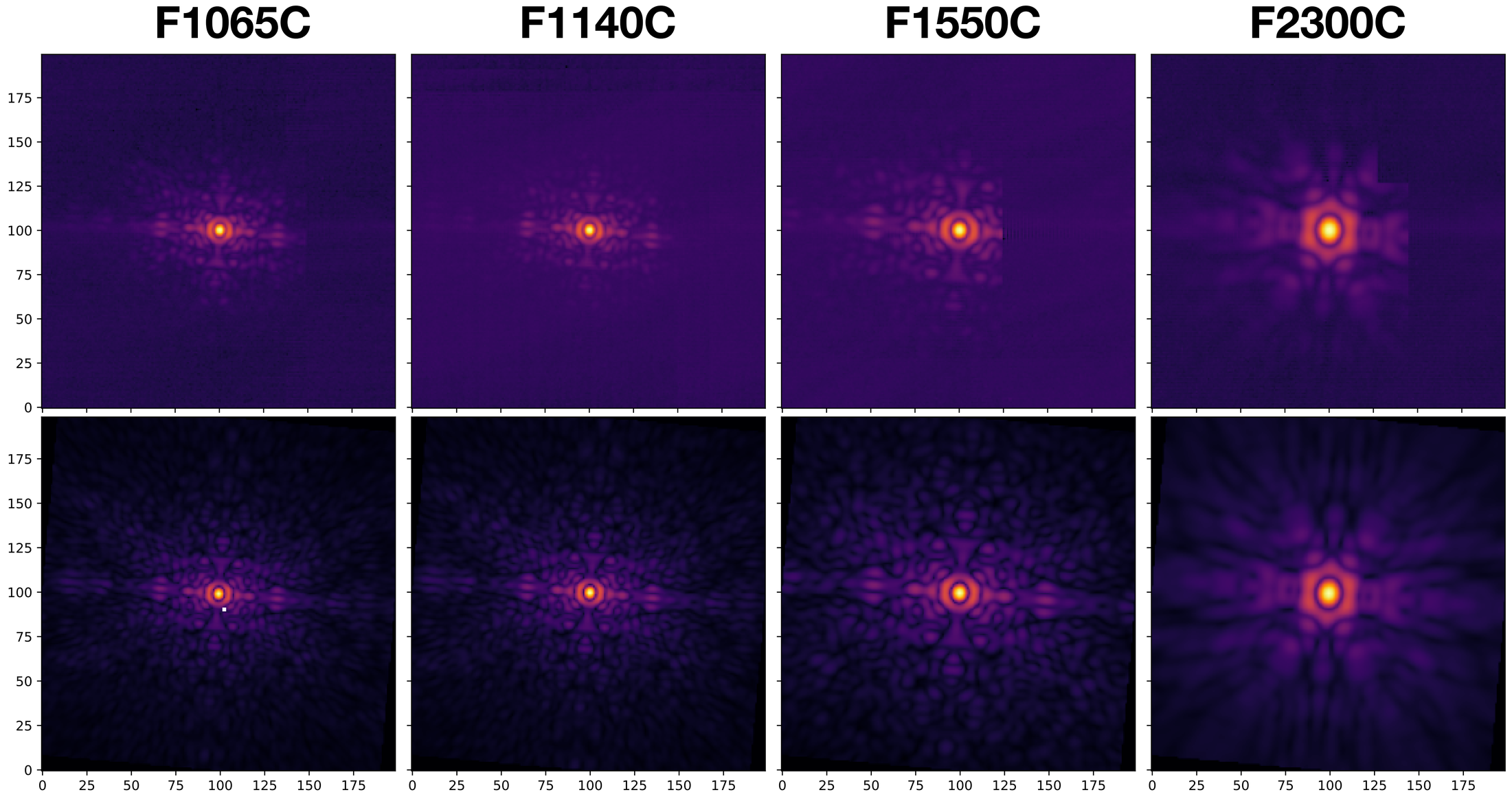
Glowstick



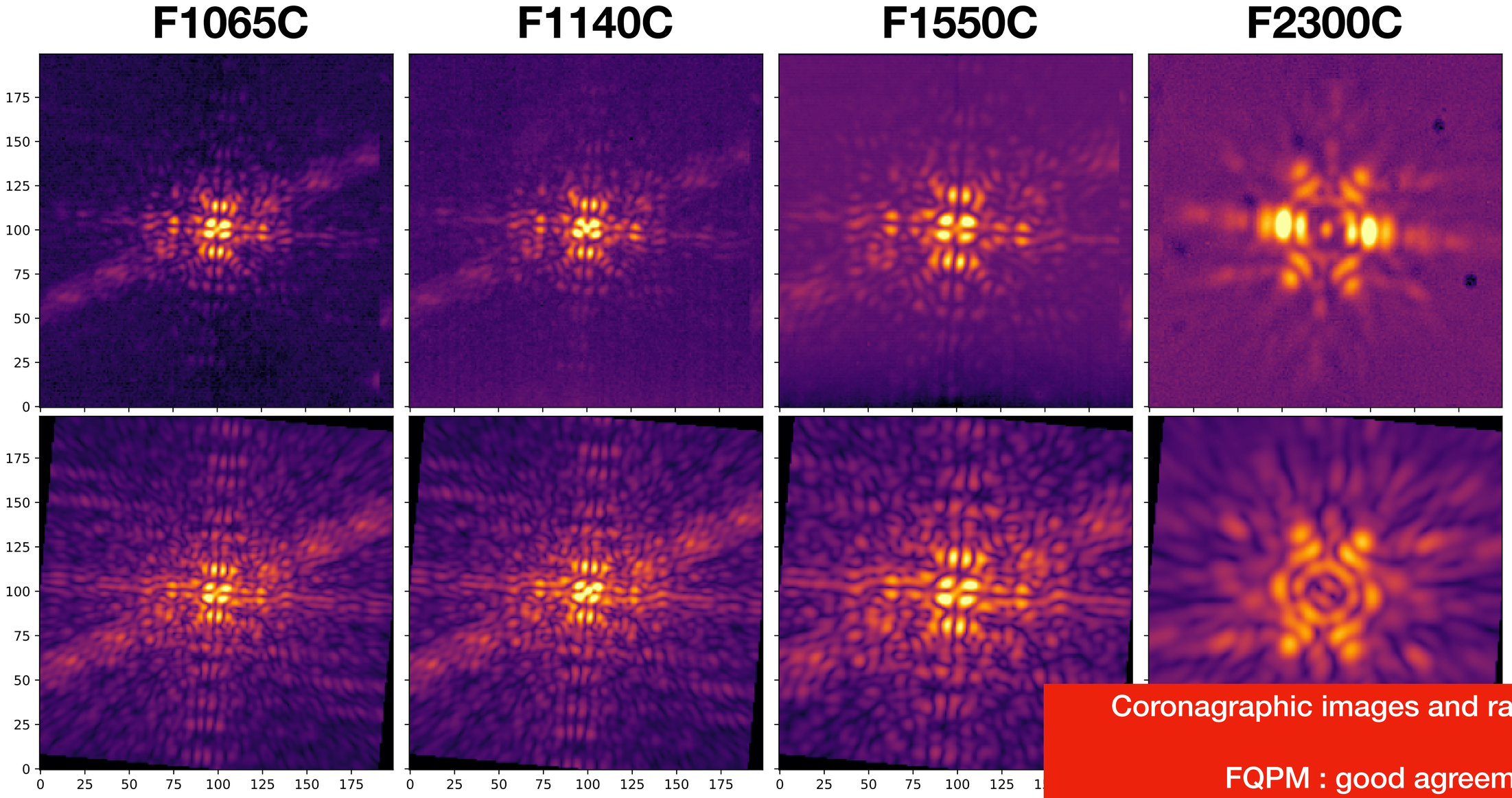


Meteorite impact

MIRI's Performance on sky : PSF



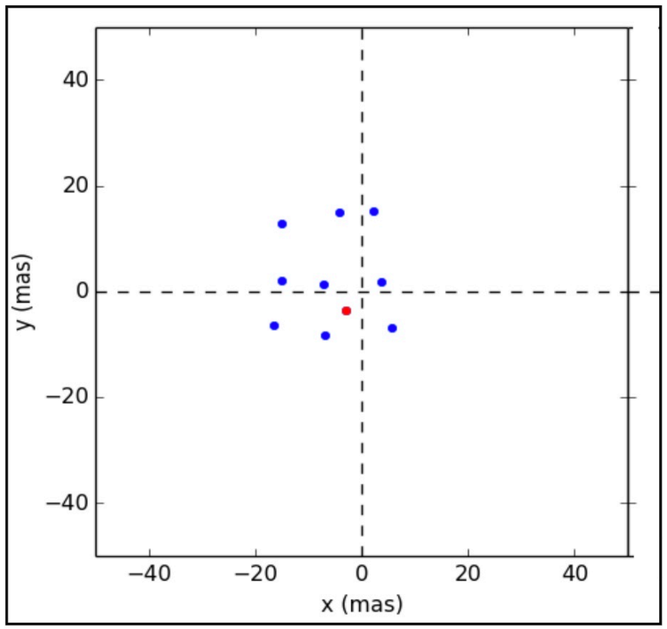
MIRI's performance on sky: CORONO

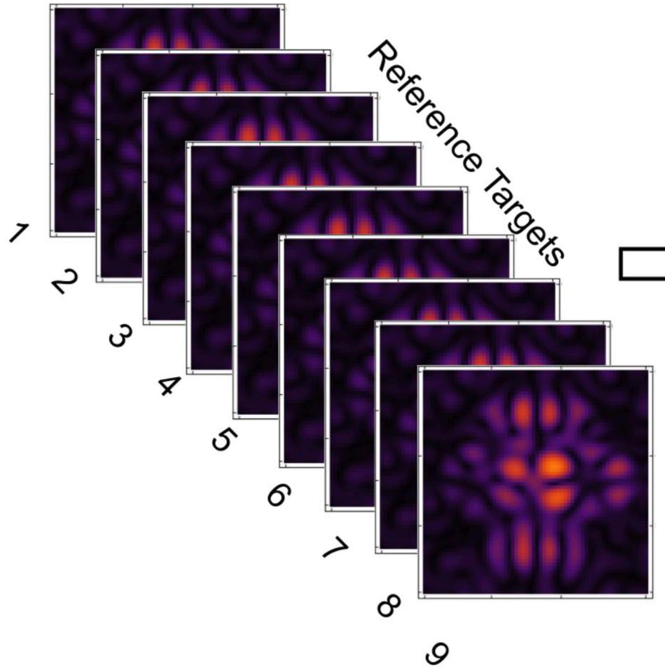


Coronagraphic images and raw contrasts

FQPM : good agreement
Lyot : discrepancy (bright horizontal diffraction)

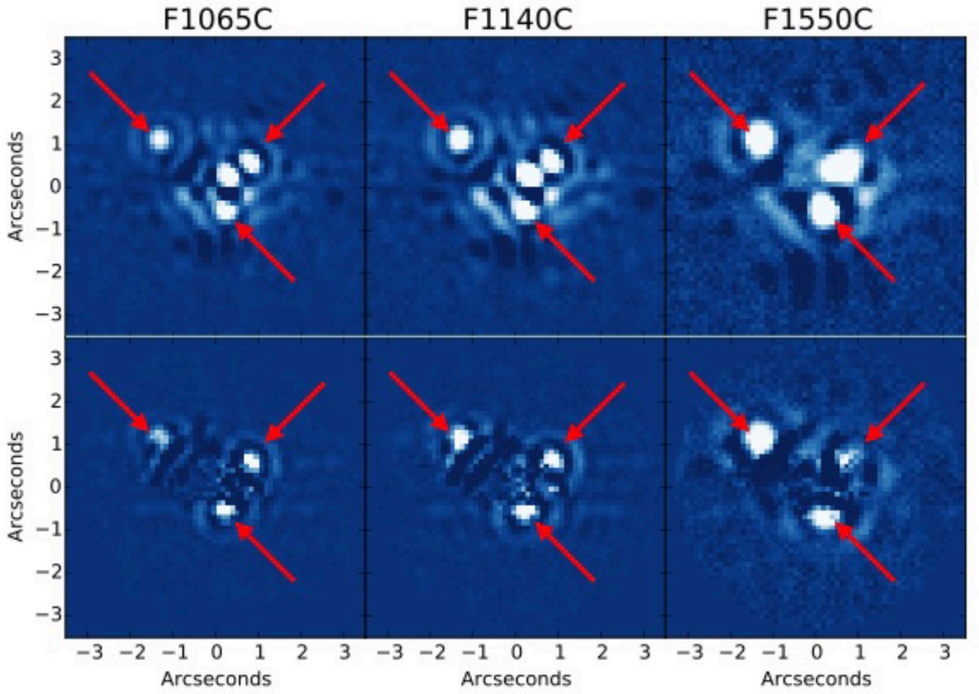
MIRI's performance on sky : SGD





Concept of Small Grid Dither

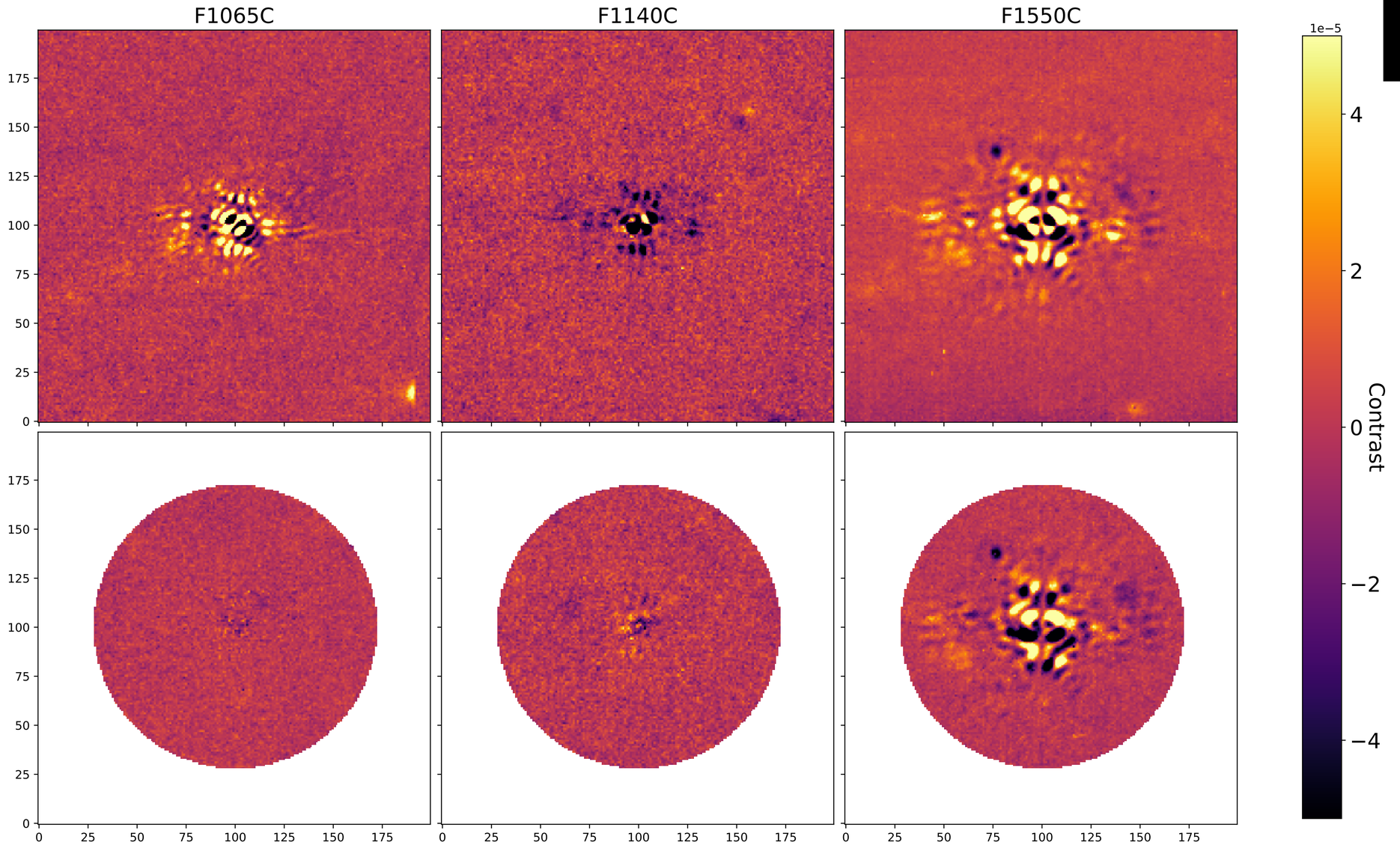
Align
+
LOCI/KLIP



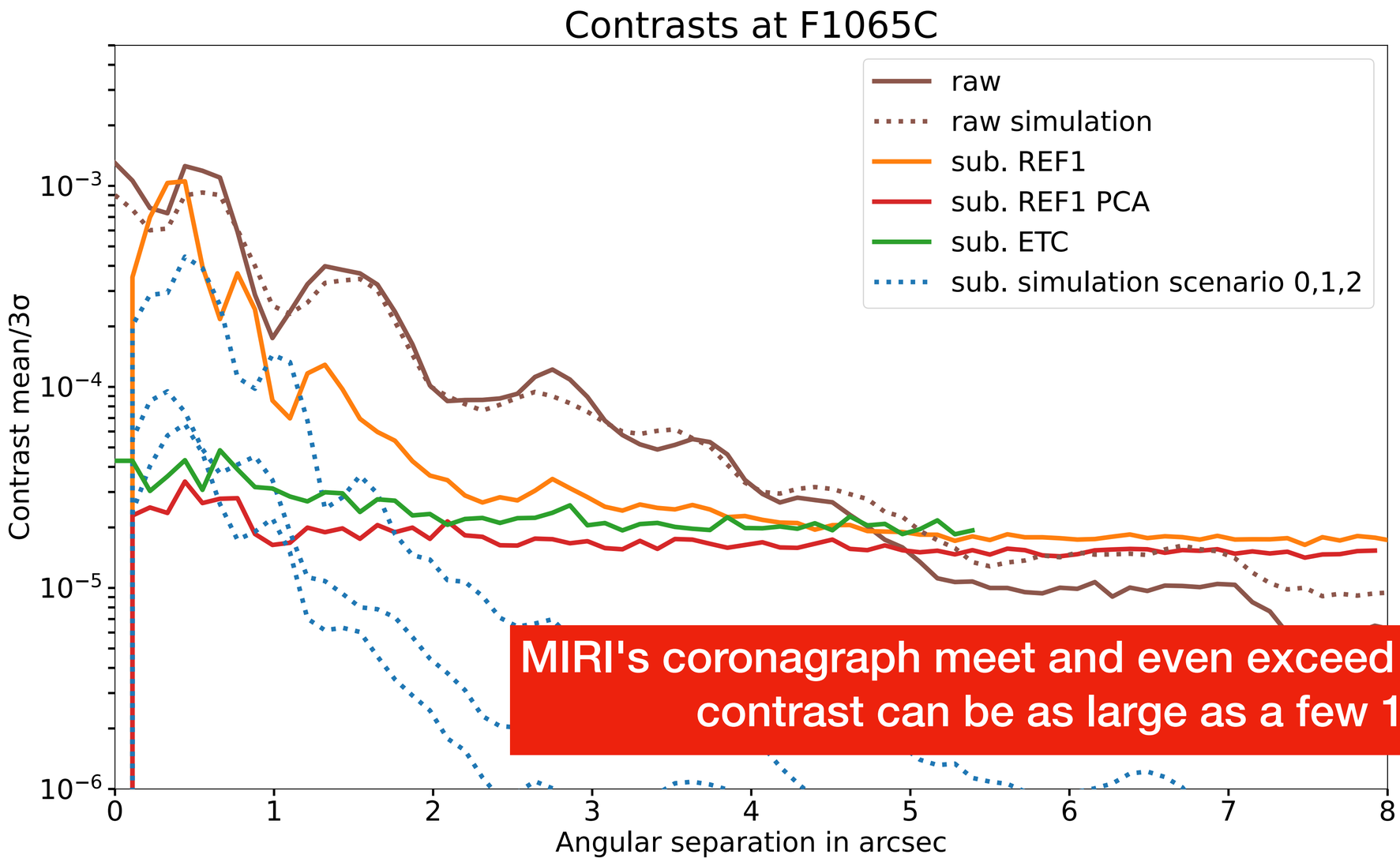
Soummer et al. 2014
Lajoie et al. 2016

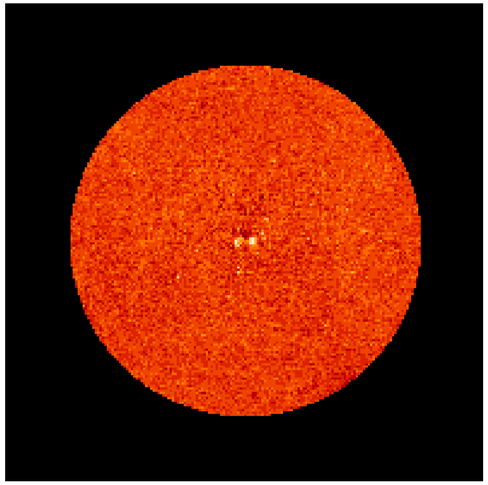
MIRI's performance on sky : RDI

direct subtraction & PCA



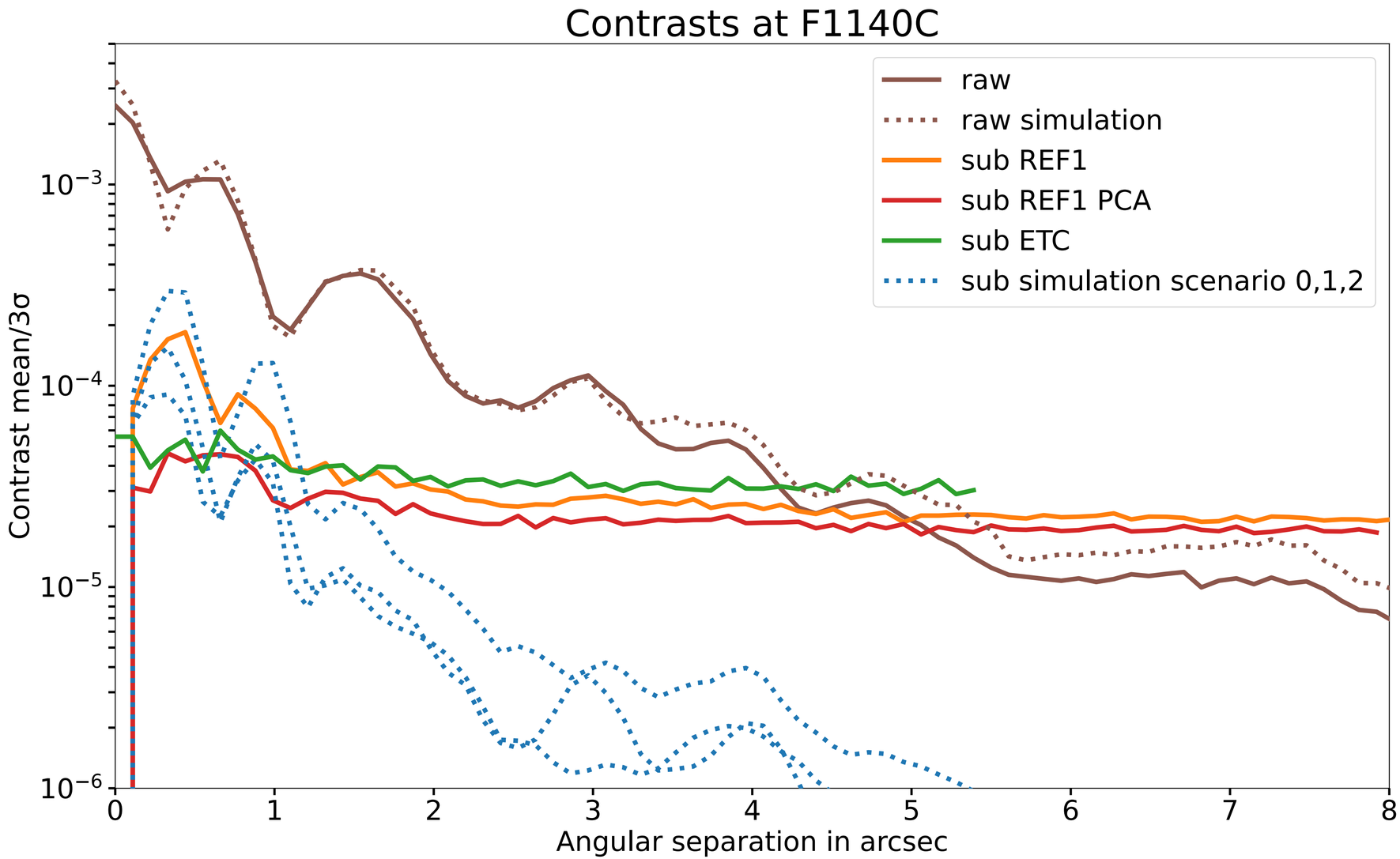
MIRI's performance on sky : contrast F1065C

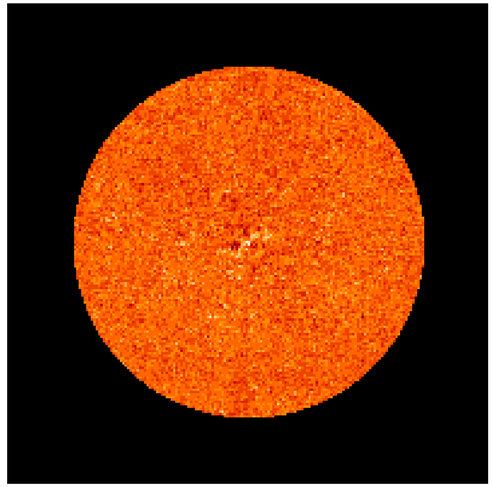




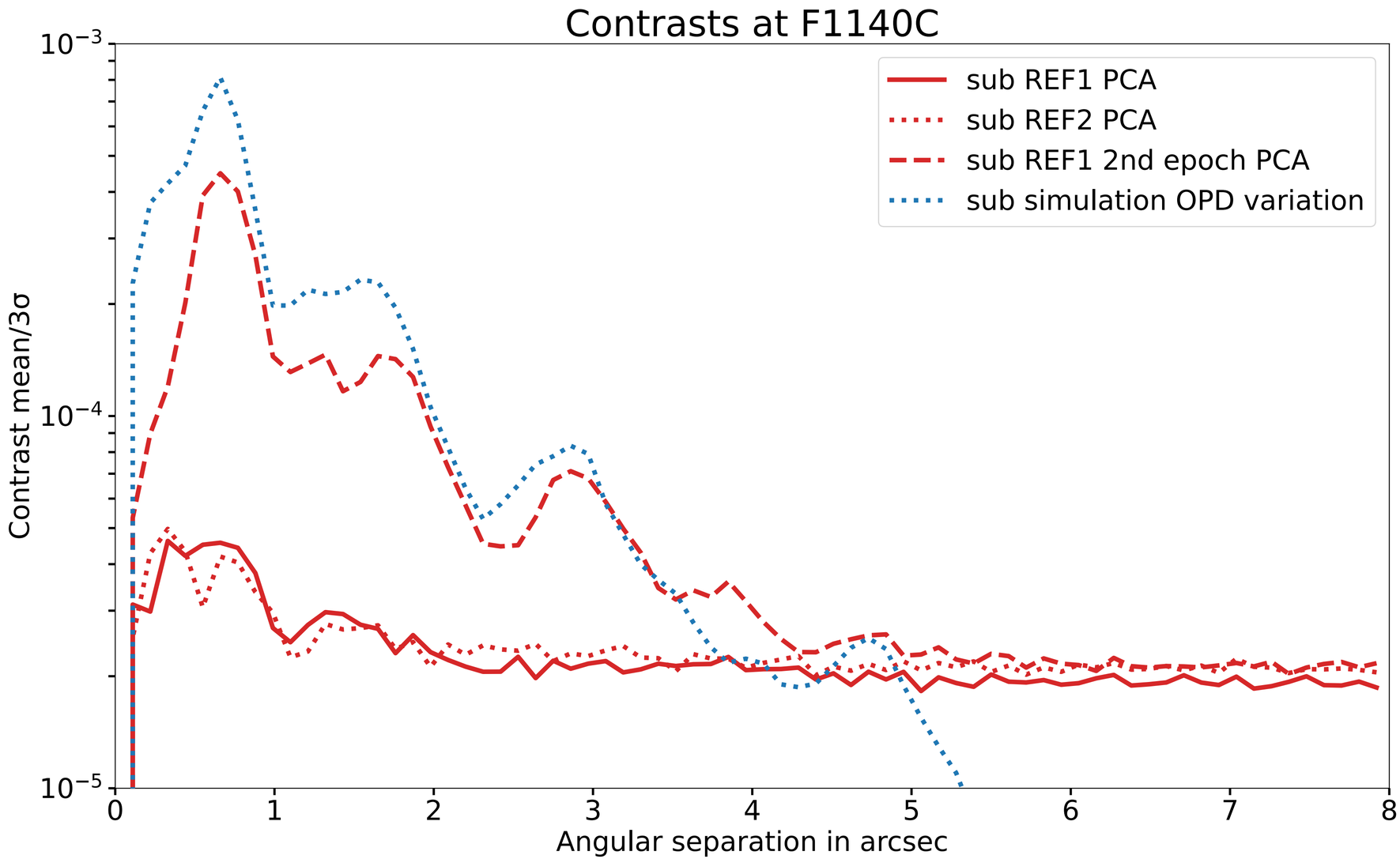
MIRI's coronagraph meet and even exceed requirements
contrast can be as large as a few 10^-5

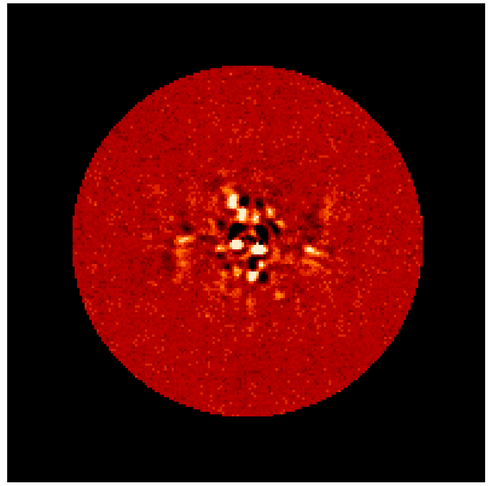
MIRI's performance on sky : contrast F1140C



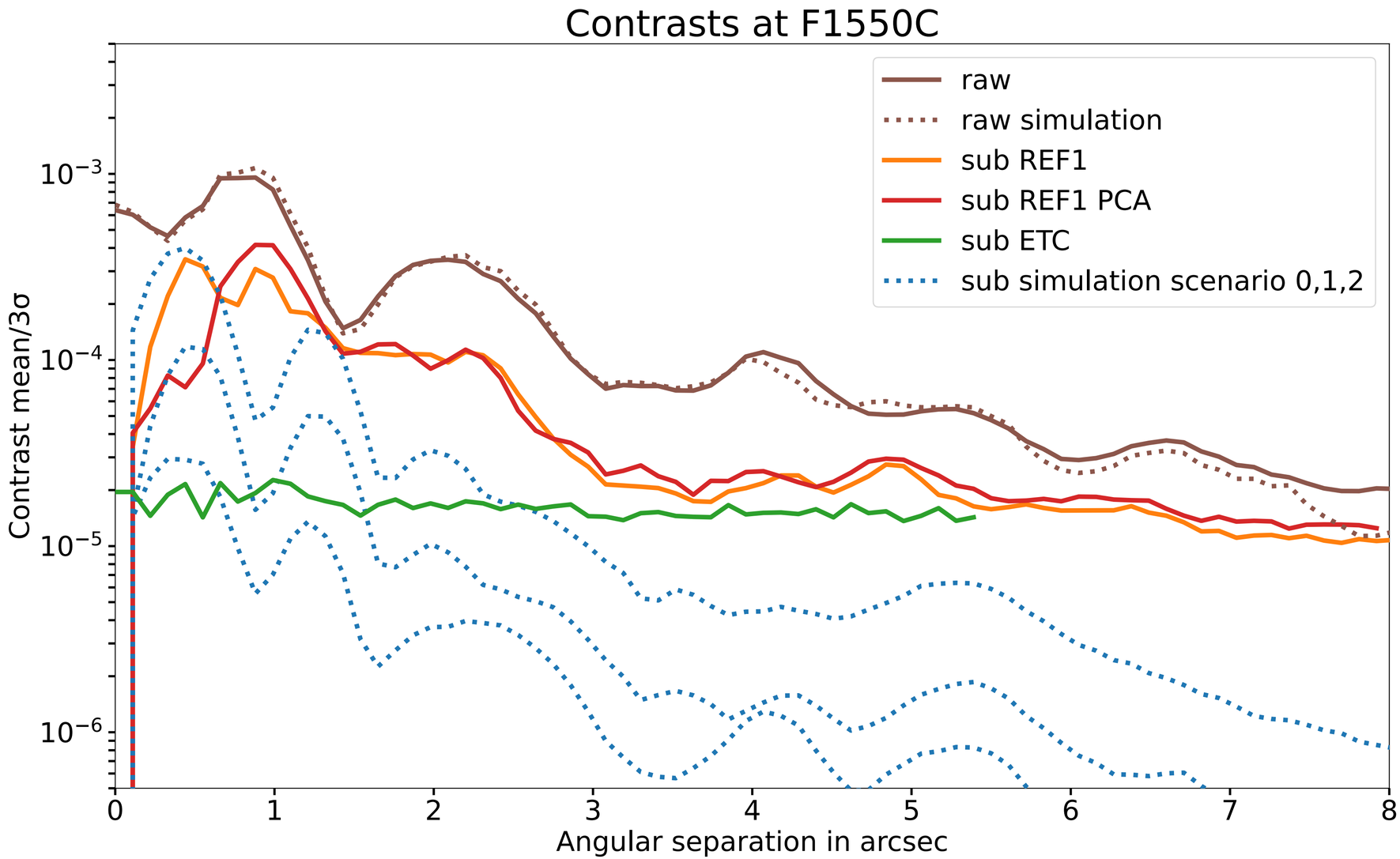


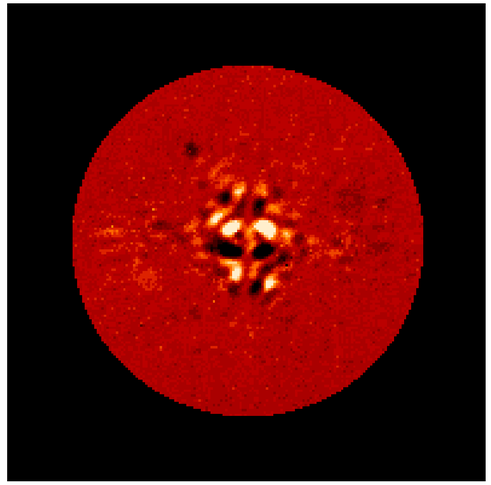
MIRI's performance on sky : contrast F1140C





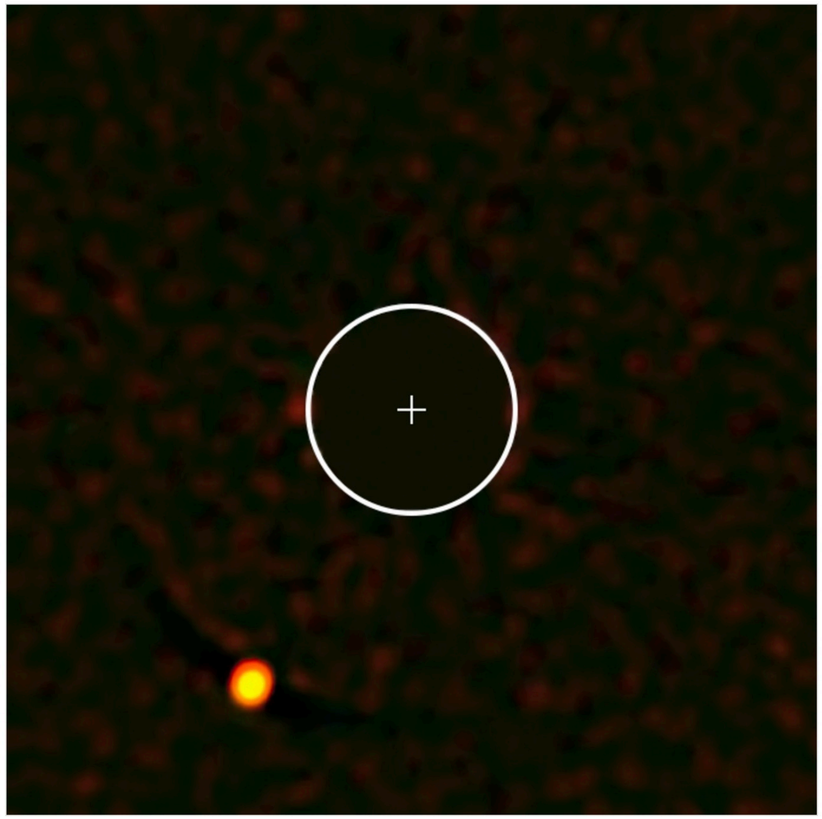
MIRI's performance on sky : contrast F1550C

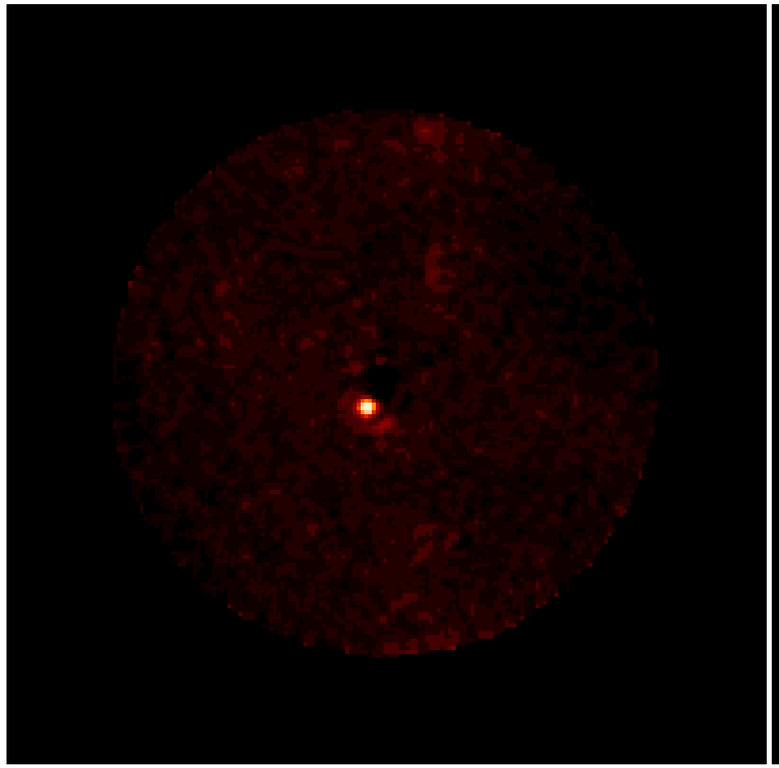


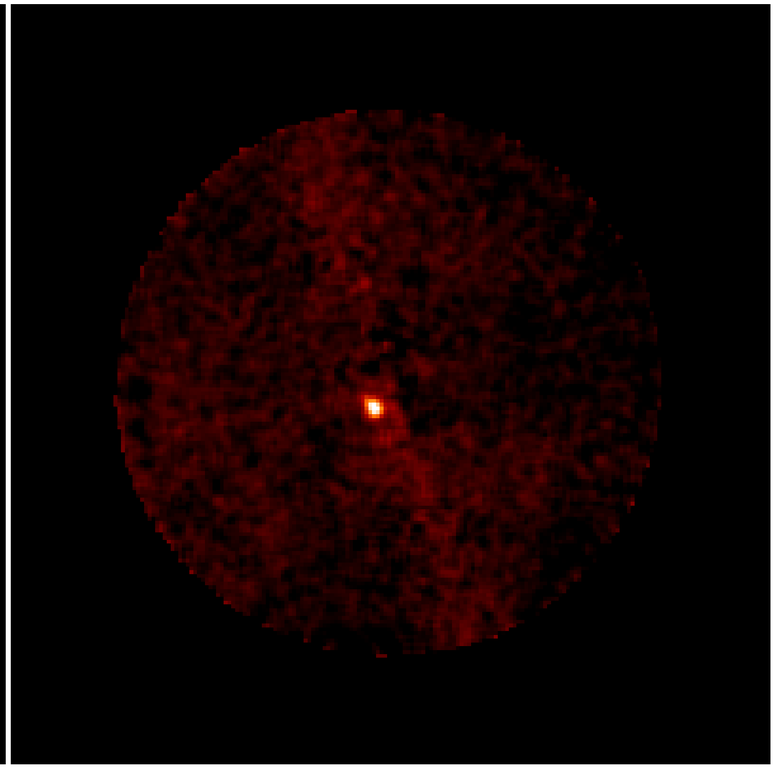


MIRI's performance on sky : ERS / HIP 65426

Chauvin et al. 2017







SPHERE

0.04'' @ 1.6µm

F1140C

0.36'' @ 11.40µm

F1550C

0.49'' @ 15.50µm

Exoplanetary systems to be observed in GTO

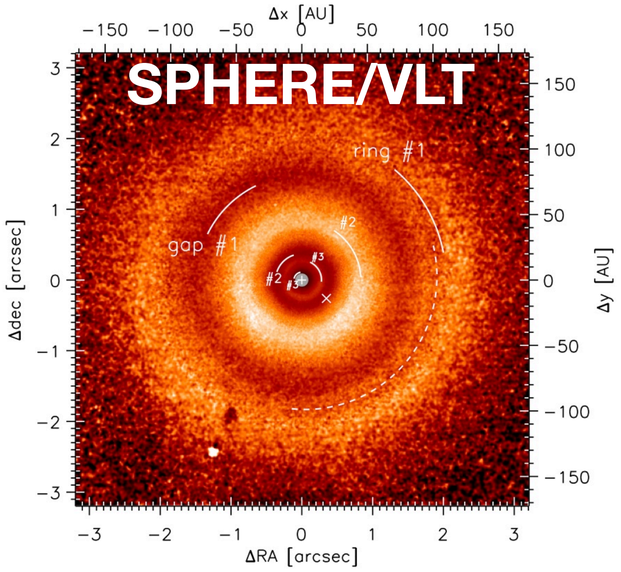
- HR 8799 bcd : 30 Oct- 9 Nov 2022
- GJ 504 b : 18 May - 11 Jul 2023
- HD 95086 b : 5 Mar - 6 Apr 2023
- HD 106906 b : 26 Jan - 22 Mar 2023

Other planetary systems

circumstellar disks

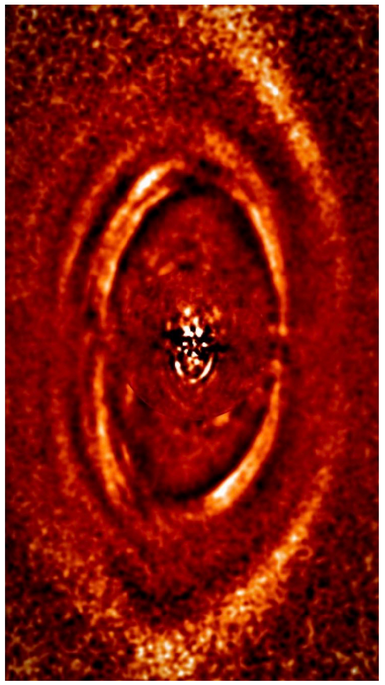
- morphology of micron size dust particles to ALMA (thermal regime) and SPHERE (scattered light) observations
- grain properties (silicates feature)

GTO target : TW Hya

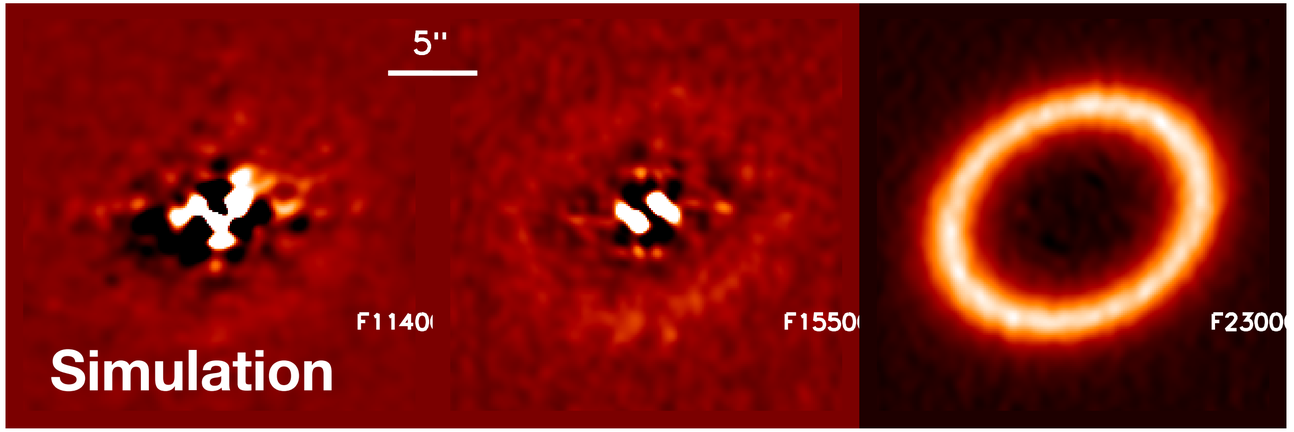


van Boekel et al. 2017

ERS target : HD141569



Perrot et al. 2016

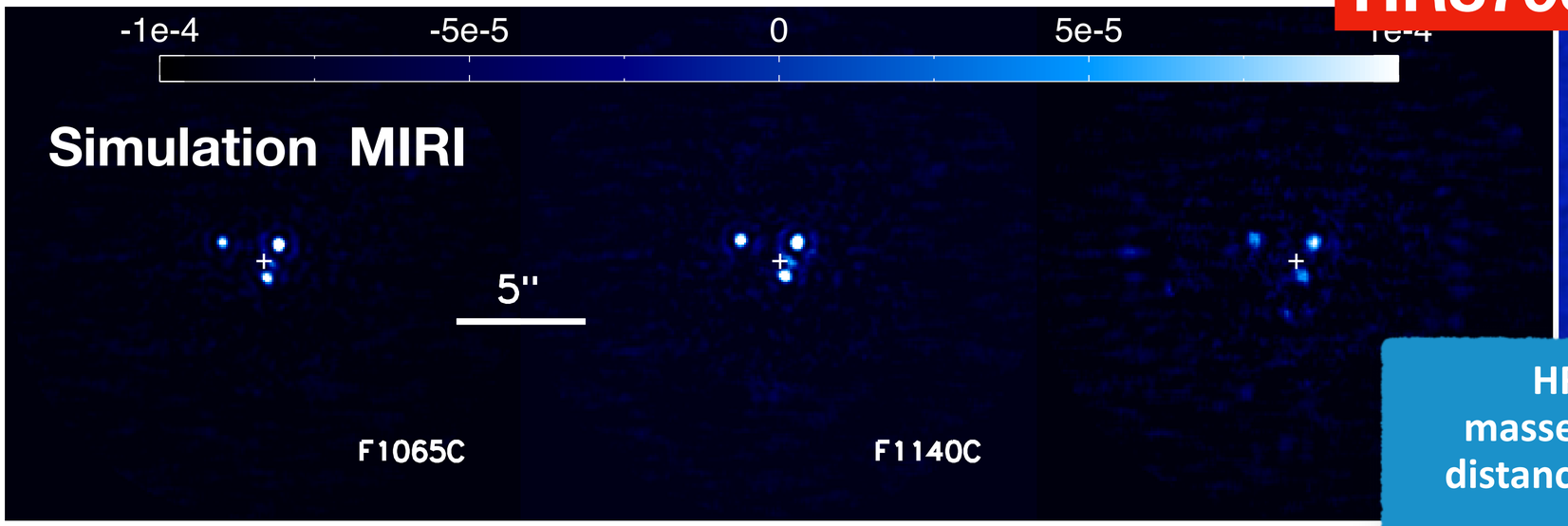


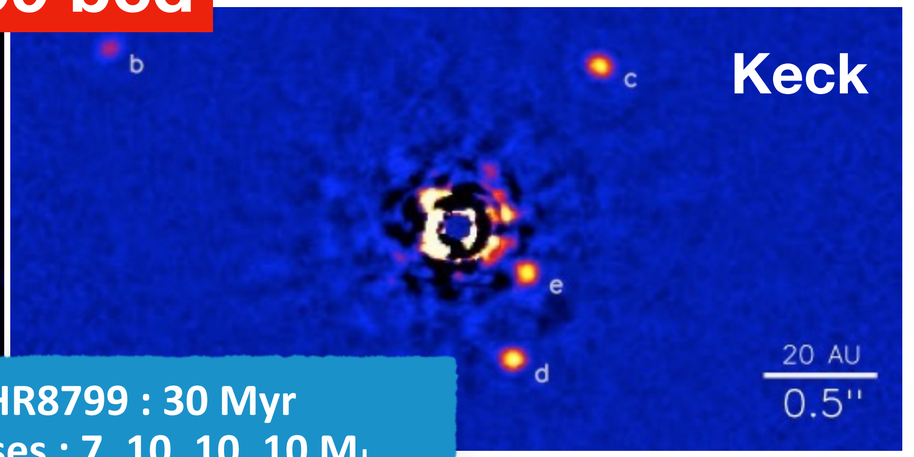
MIRI coronagraphs can detect very faint debris disks : η Crv

Lebreton et al. 2016

Exoplanetary systems to be observed in GTO

HR8799 bcd

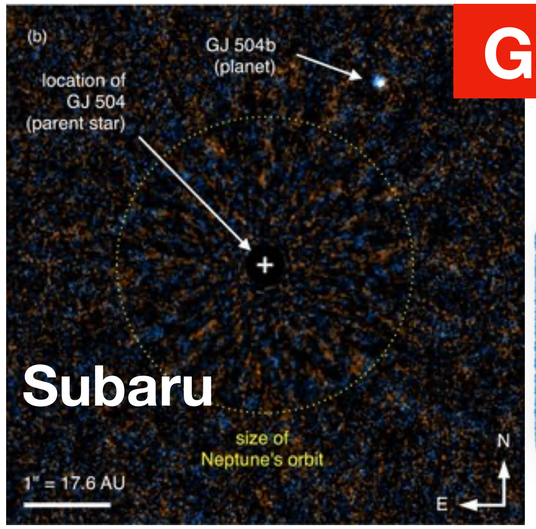




Marois et al. 2010

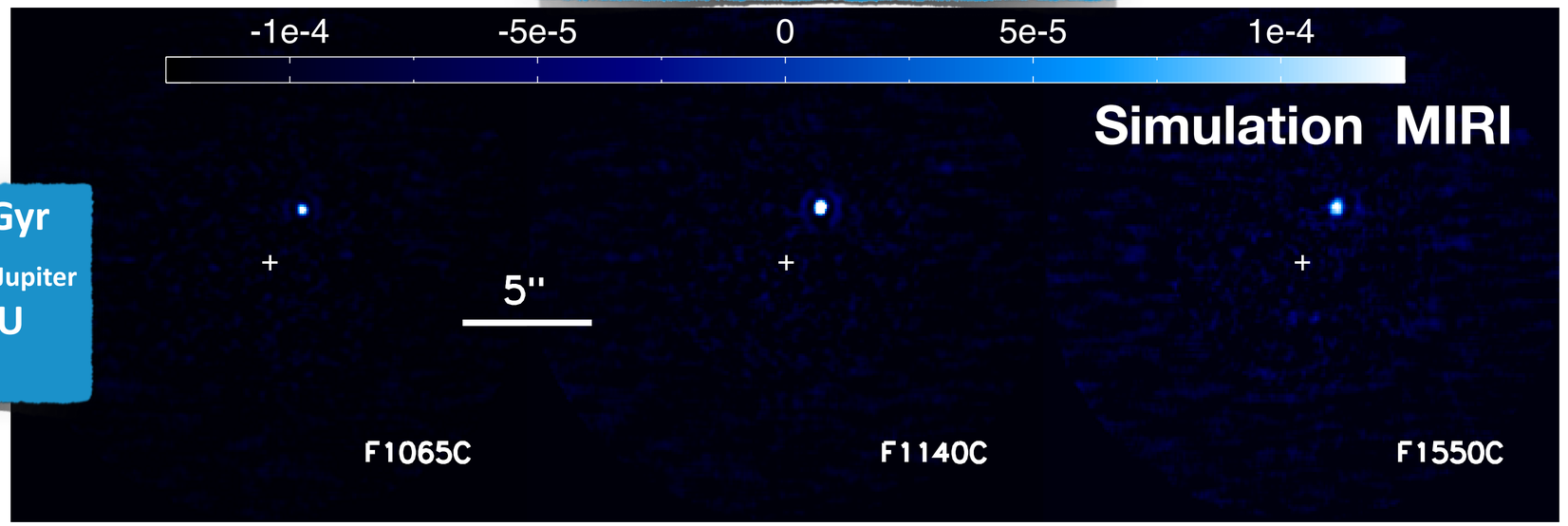
HR8799 : 30 Myr
masses : 7, 10, 10, 10 M_J
distance : 16, 24, 38, 68 AU
900 - 1000 K
Marois et al. 2008, 2010

GJ 504 b

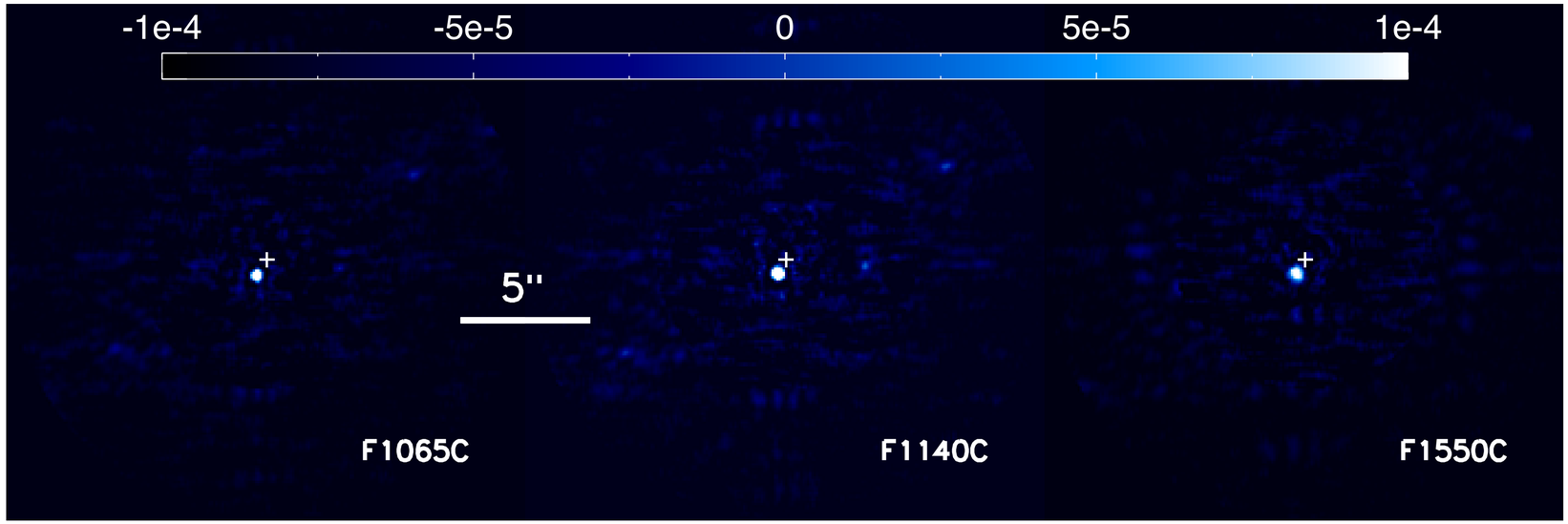


Kuzuhara et al. 2013

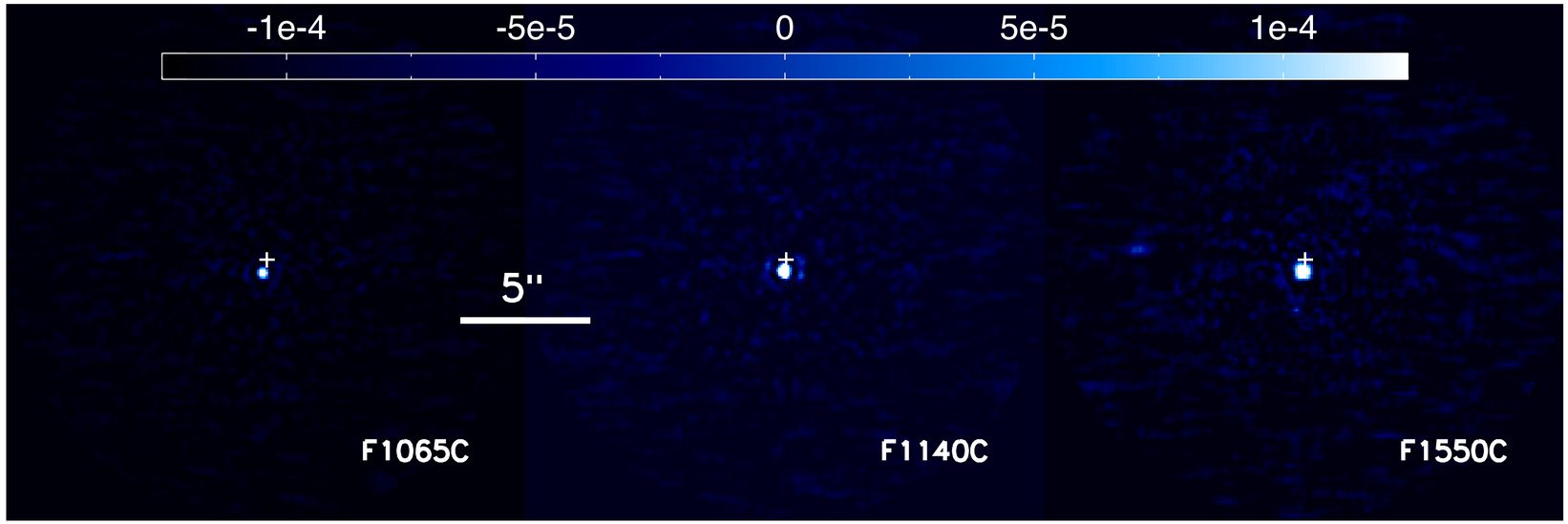
age : 20 Myr - 4 Gyr
masse : ~ 1 - 23 $M_{Jupiter}$
distance : 45 AU
550 K



Exoplanetary systems to be observed in GTO



HD 95086 b



51 Eri b