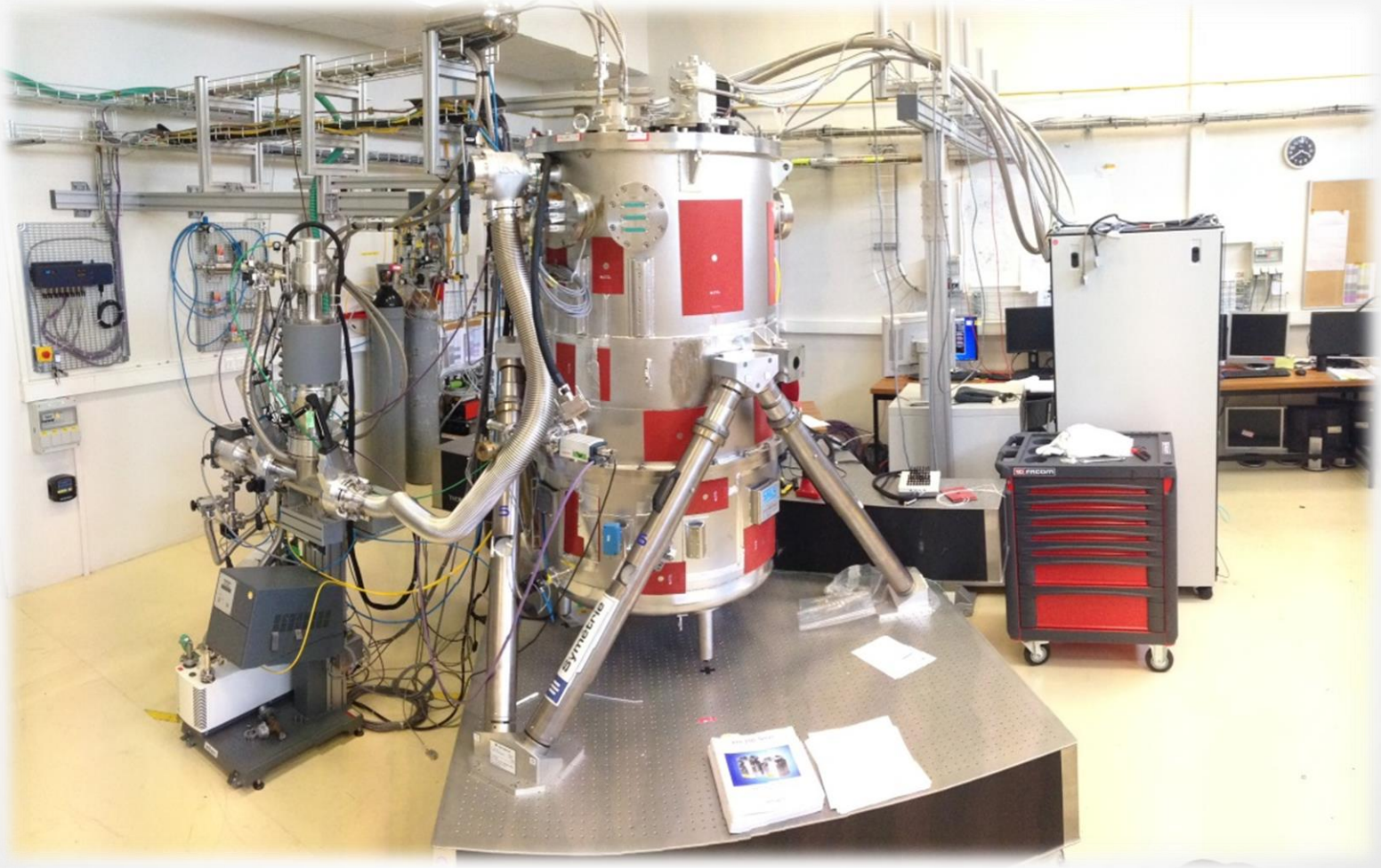
Upgrade and commissioning of the MIRIM cryogenic I/R test facility

Maxime MOTISI – IRFU SAp



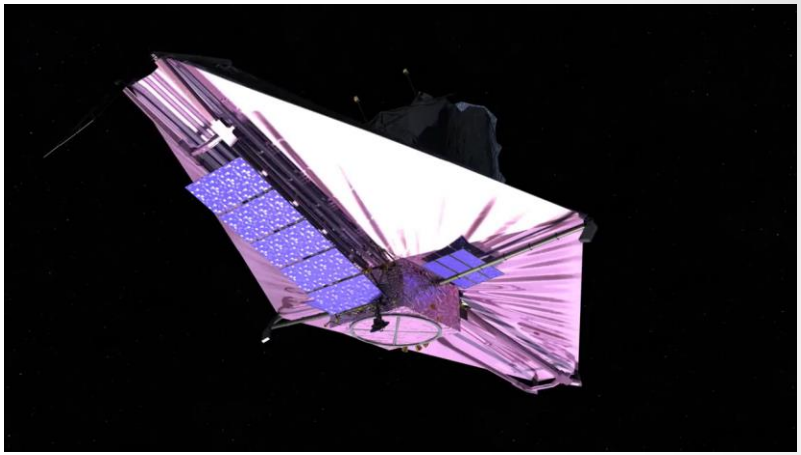
Summary

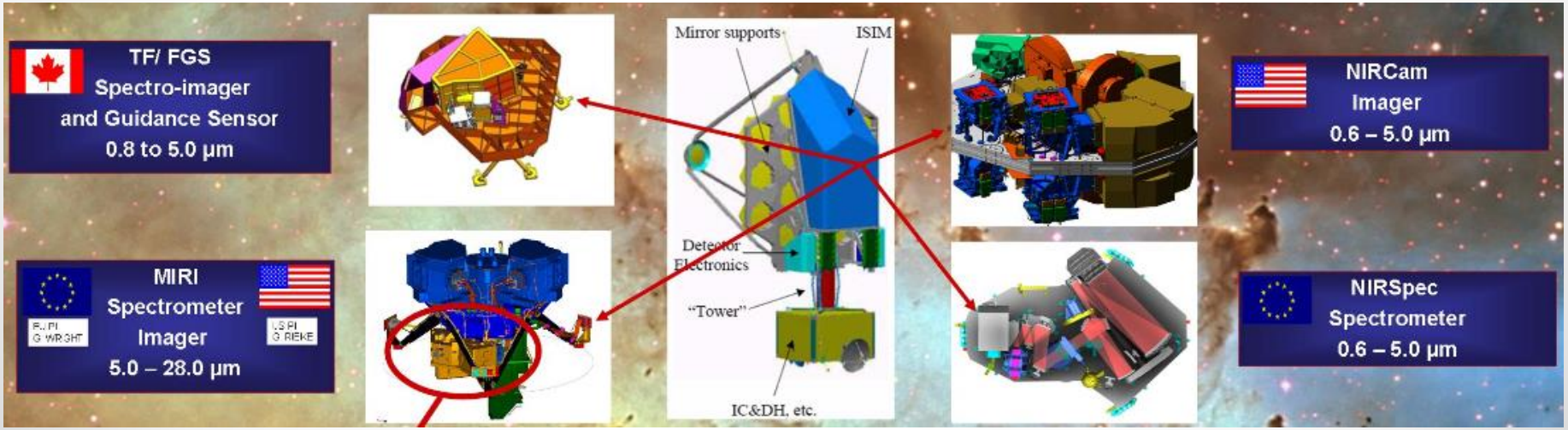
- Project presentation
- MIRIM test facility
- Commissioning
  - Cryogenics system & integration
  - Optical means
  - Validation & Tests

- Perspectives

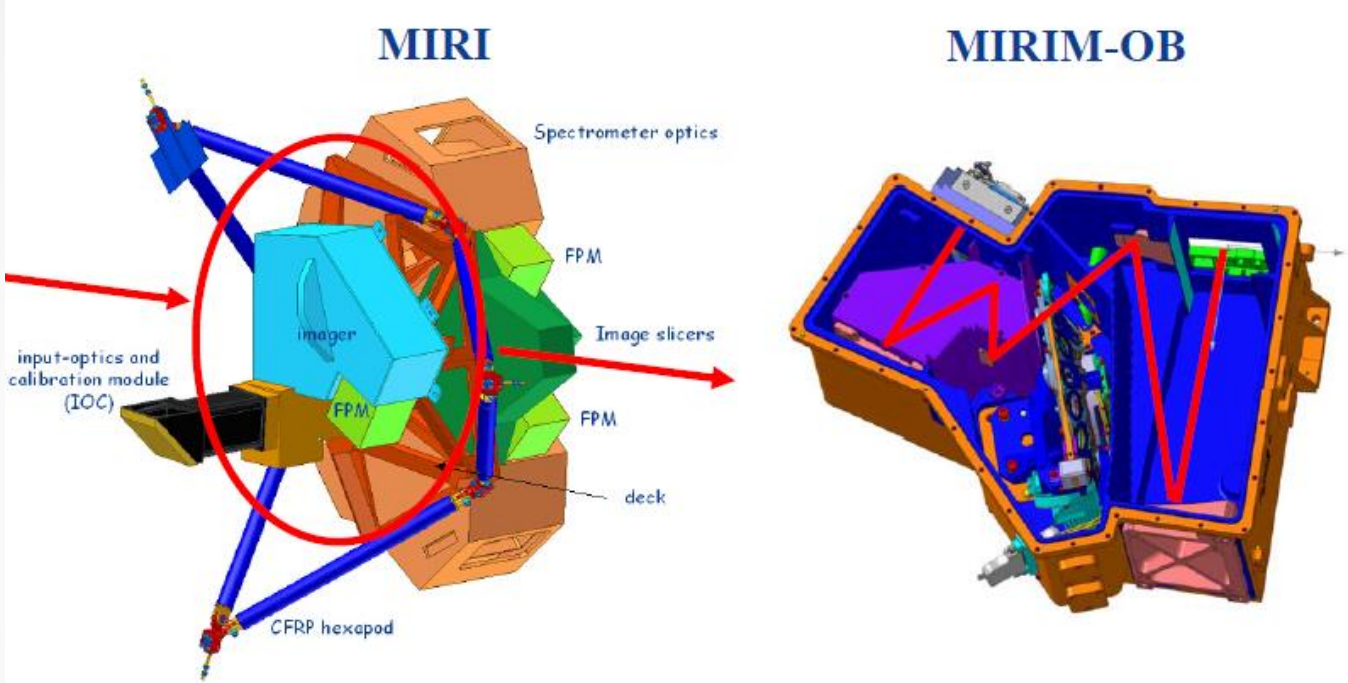
Presentation - The JWST Instruments

- JWST is a NASA mission Mission is dedicated to I/R Space observation.
- Expected to be launched in 2018 it will embark 4 instruments.
- One of them is the Spectro- Imager MIRI.



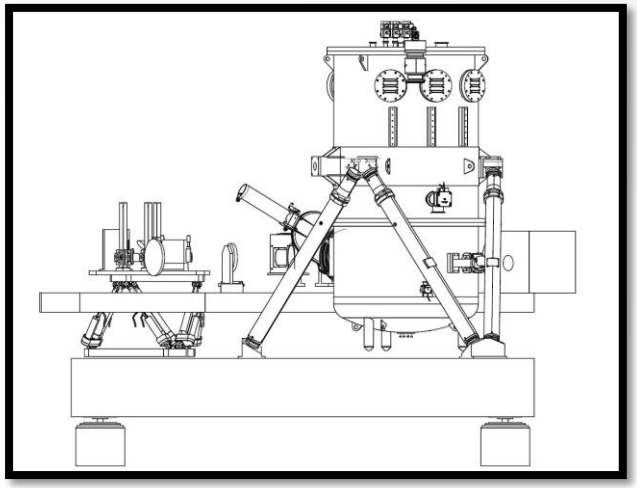


Presentation - MIRI & MIRIM



- The MIRI Imager (MIRIM) is a multi-wave Imager operating in the 5µm-25µm range.
- MIRIM has been designed, built and tested at CEA under the supervision of IRFU/SAp in the framework of the MIRI Consortium.
- The flight model has been successfully delivered in 2009.

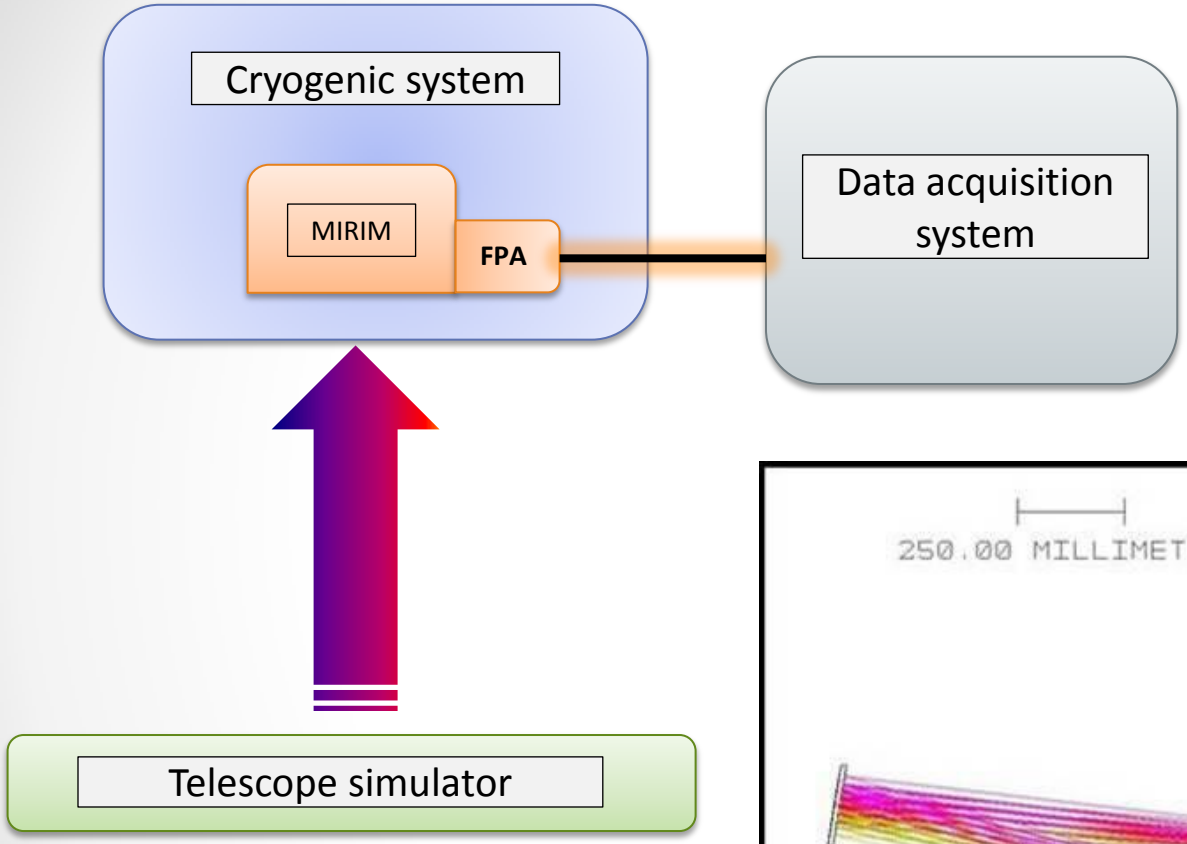
The MIRIM cryogenic test facility

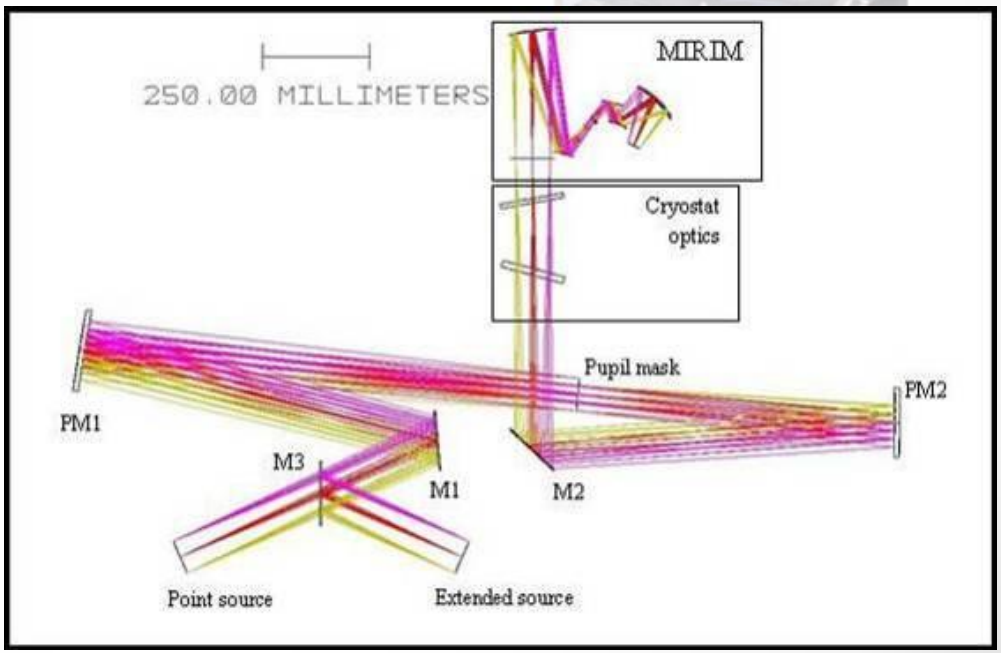


- The MIRIM cryogenic InfraRed test facility has been developed at IRFU to test and characterize MIRIM prior to its delivery.
- After MIRIM delivery, it has been decided to take advantage of this test facility equipped with the existing MIRIM Engineering and Thermal Model (ETM) used as a **Space performance imaging system**

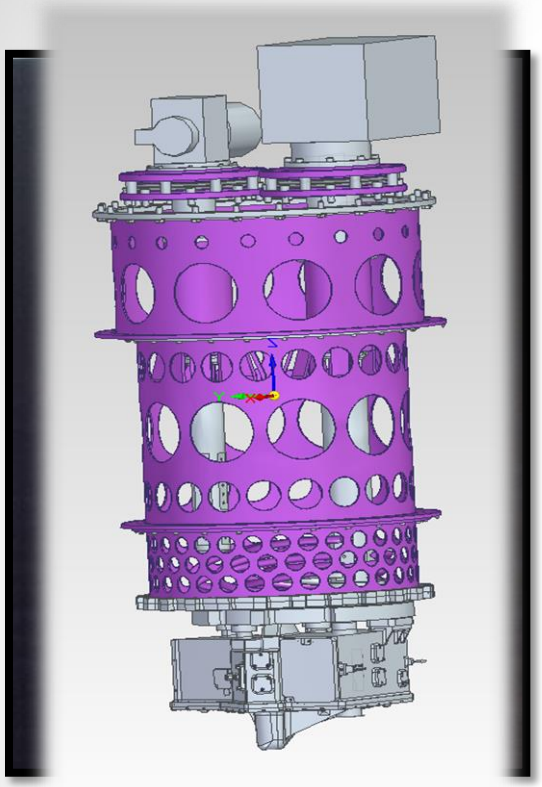
- The goals are the following:
  - **To maintain the MIRIM test facility operational for further MIRIM characterizations.**
  - **To have at our disposal a cryogenic test facility to characterize I/R detectors.**

MIRIM cryogenic test facility





Refurbishment of the cryogenic system



Liquid Helium tank

↓ ↓

(2x) 4 Kelvin Refrigerators (Dry Cryostat)

Vaccum in vessel:
1,0.10-7 mbar (expected):

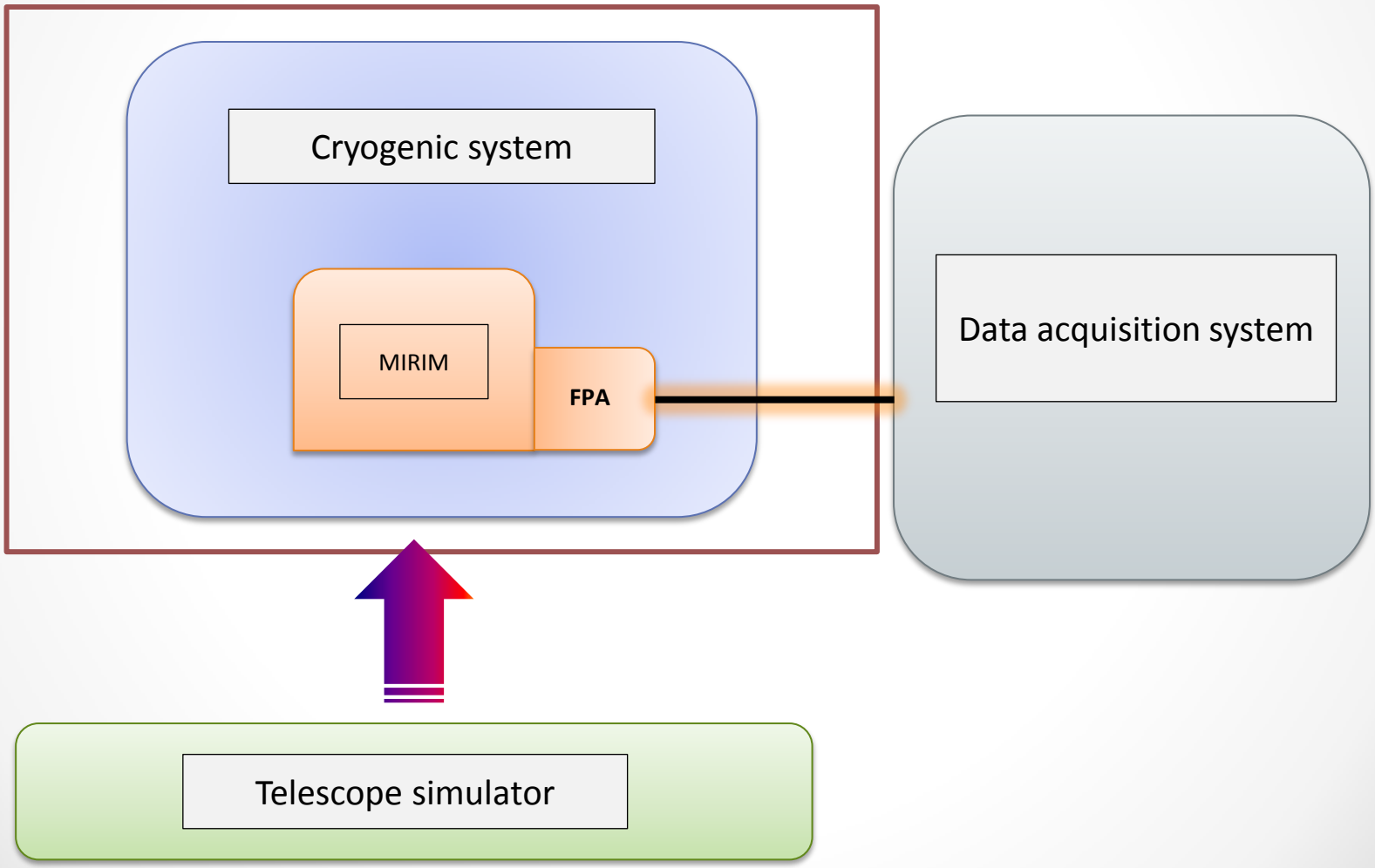
Temperature on detector:
6 to 4 Kelvin (expected):

Automated Station:
- Vacuum & cryogenics processes
- Automatic heat control

- The original cryo system was based on the use of a liquid Helium cryostat
- The drawbacks of the helium based system were the complexity of the setup and the running cost
- The new cryogenic system is based on cryogenics refrigerators dramatically simplifying the cryogenics scheme and the operation

- IRFU Institute involved in the project
  - SACM: Cryogenics design, realisation
    - Bertrand HERVIEU
  - SIS: Electrical, command and automatism
    - Yannick DROUEN
    - Dominique EPPELE
    - Nicolas SOLENNE
    - Michael MASSINGER
    - Romain BERTHIER
  - SAp: System coordination, integration, commissioning
    - Jean-Louis AUGUERES
    - Pierre-Olivier LAGAGE
    - *Maxime MOTISI*
    - Thierry ORDUNA
    - Samuel RONAYETTE

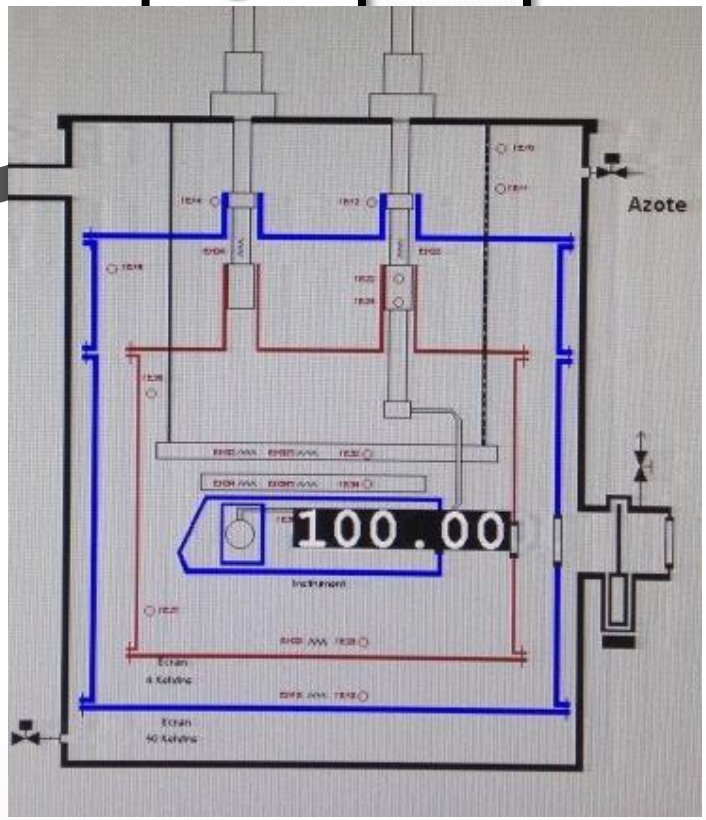
The cryogenic system



The cryogenic system

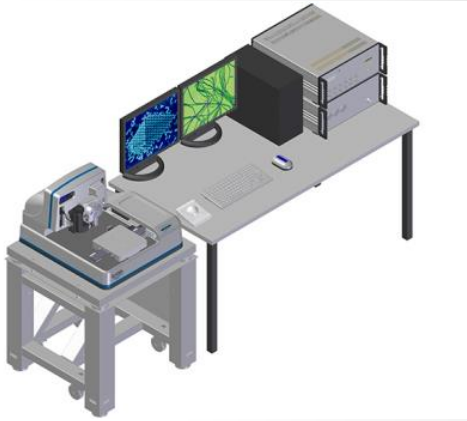
Helium Compressors

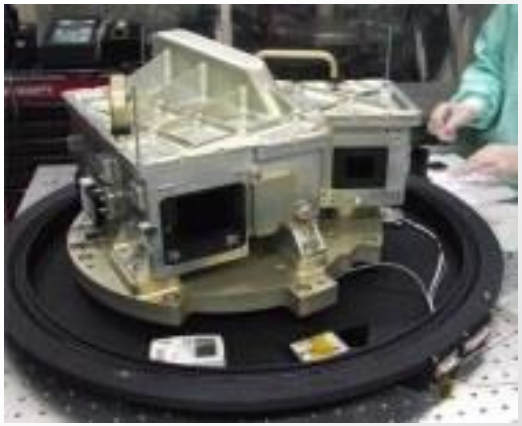
Watercooling system



Vacuum group

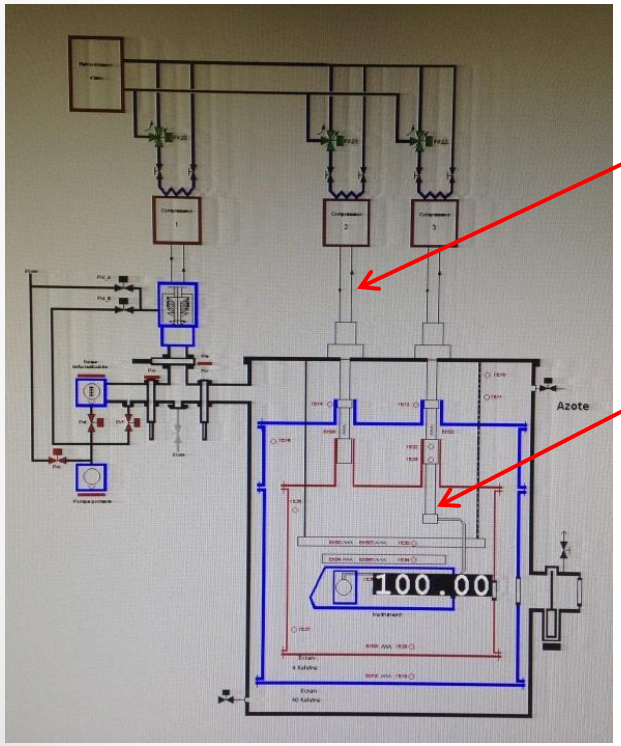
Control Station

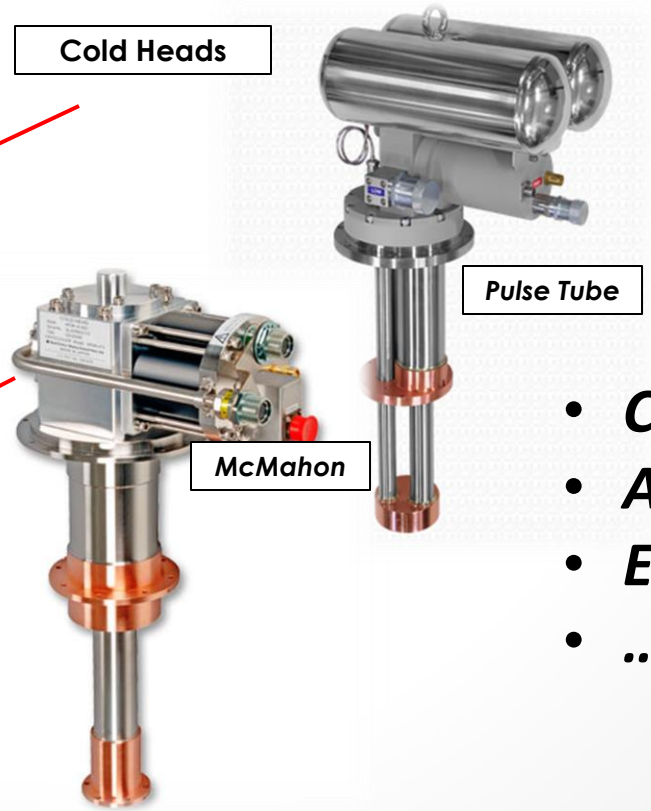




Updating cryogenics means

- New cryogenics refrigerators
  - 2 Refrigerators ensuring the cold (4 Kelvin), all by conduction.
  - 1 ***McMahon*** (1,5W @4,2K) and 1 ***PulseTube*** (1,0W @4,2K)
  - The process manages the cold heads and the **heat regulation**.

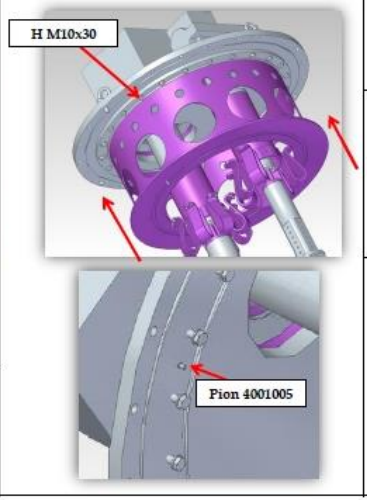


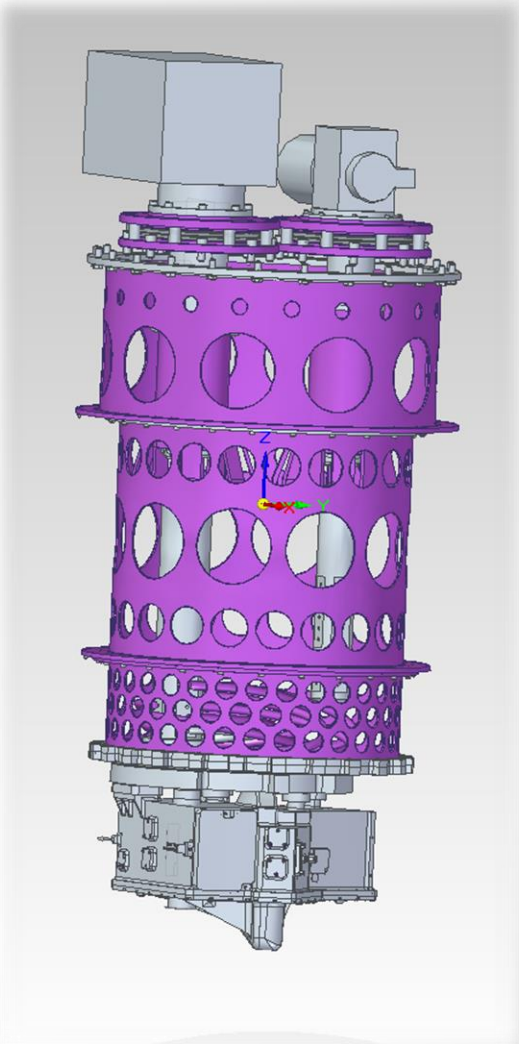


- ***CAMISTIC***
- ***ARTEMIS***
- ***EUCLID***
- ***…***

Integration

Irfu	MIRIM Renovation	Ref: Issue: 2.0 Date: Novembre 2013

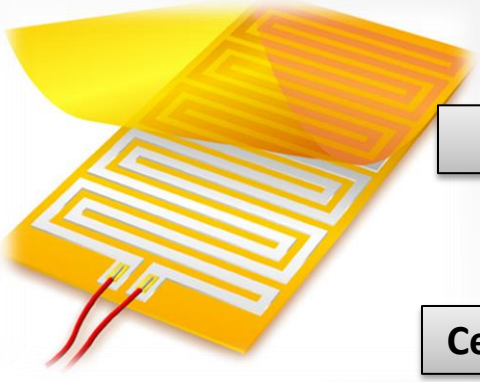
	Description	Outillage / Instructions	Illustration / Photo	Check
	Phase 5 : Montage du 1er étage de la virole sur la bride supérieure de l'enceinte à vide			
2.	**Montage du premier étage de la virole**	Placer le premier étage de la virole **4001001** sur le plateau support. Insérer le pion d'indexage **4001005** sur la bride supérieure. A l'aide d'un moyen de levage, placer la virole sous la bride supérieure **5001001**. A l'aide de 24 rondelles et vis **H M10x30**, Visser la virole **4001001** sur la bride supérieure.		
	Note :			



Integration

New Vessel, new instrumentation

(Heaters, probes, Cryogenic wires)



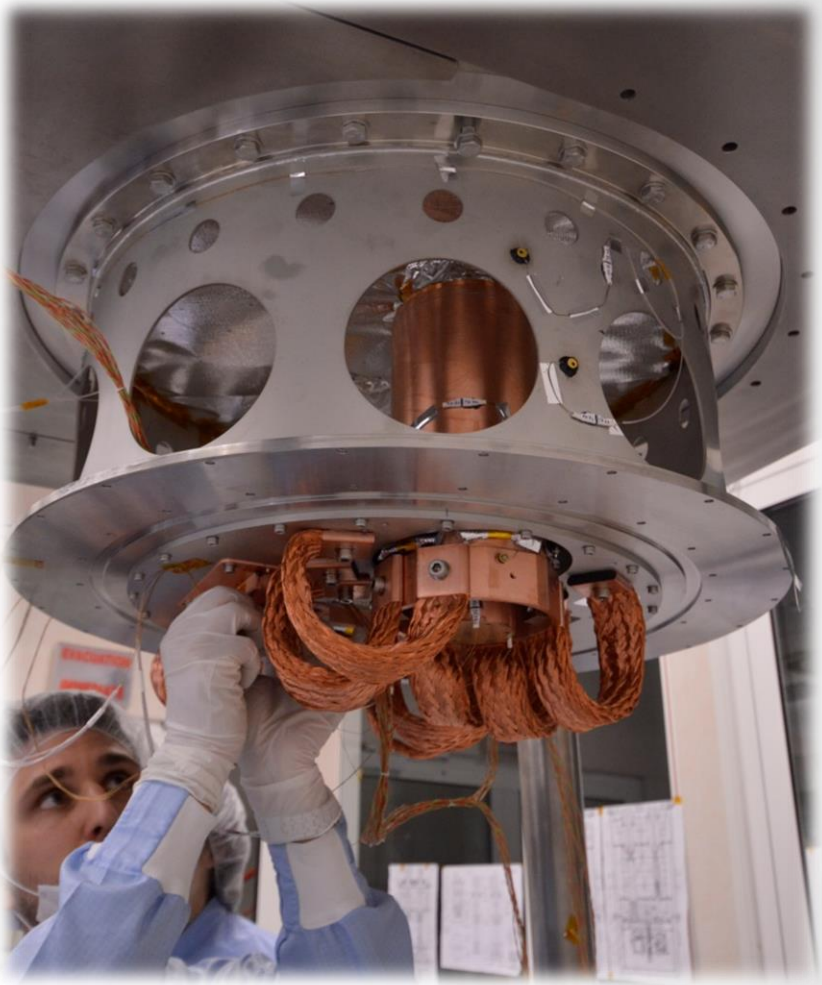
Heating mat

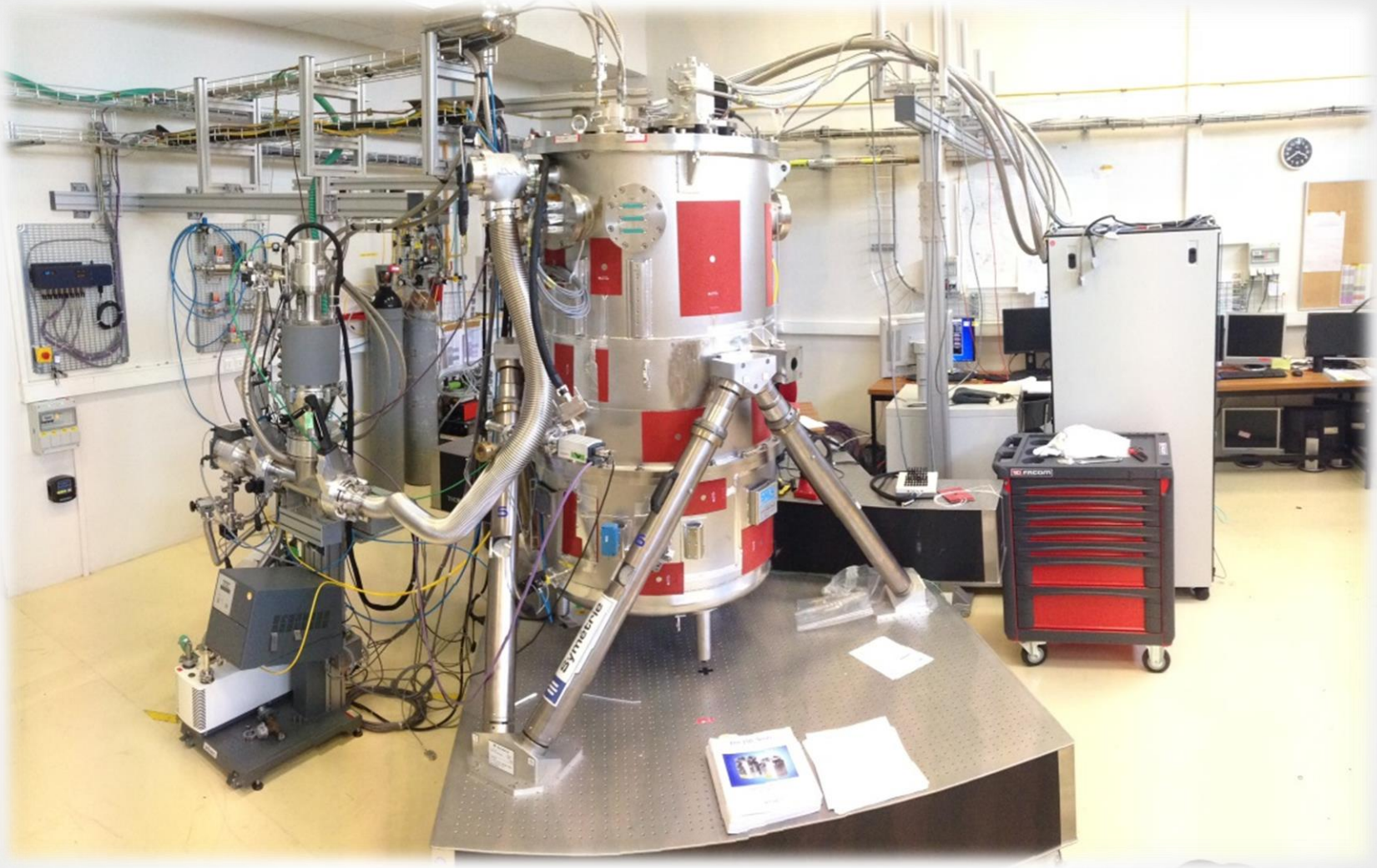
Cernox probes

New mechanics:

- Efficient thermal links
- Looking for the best conductivity
- Oxygen-free Copper is used

Inner pieces of the cryostat




Symmetric

Validation & tests

The commissioning plan of MIRIM I/R test station includes the following steps:

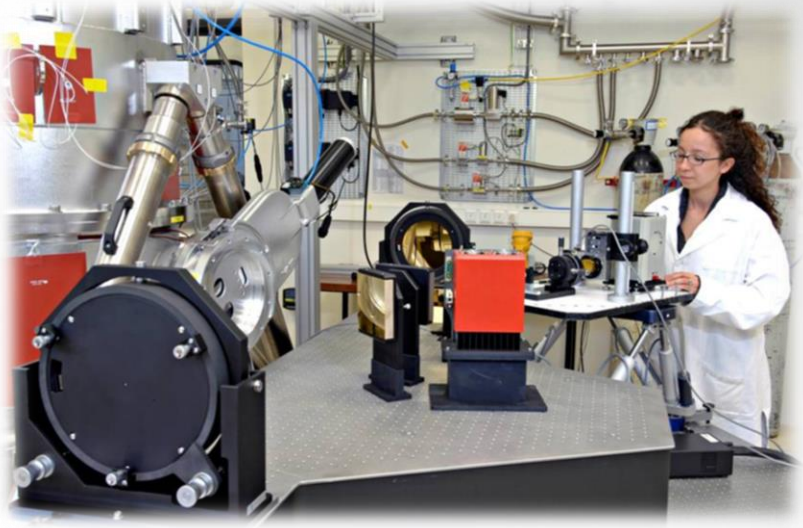
- Check the individiual functions (colds heads, probes, heaters…)
- Proceed to vacuum test with the mass model of MIRIM

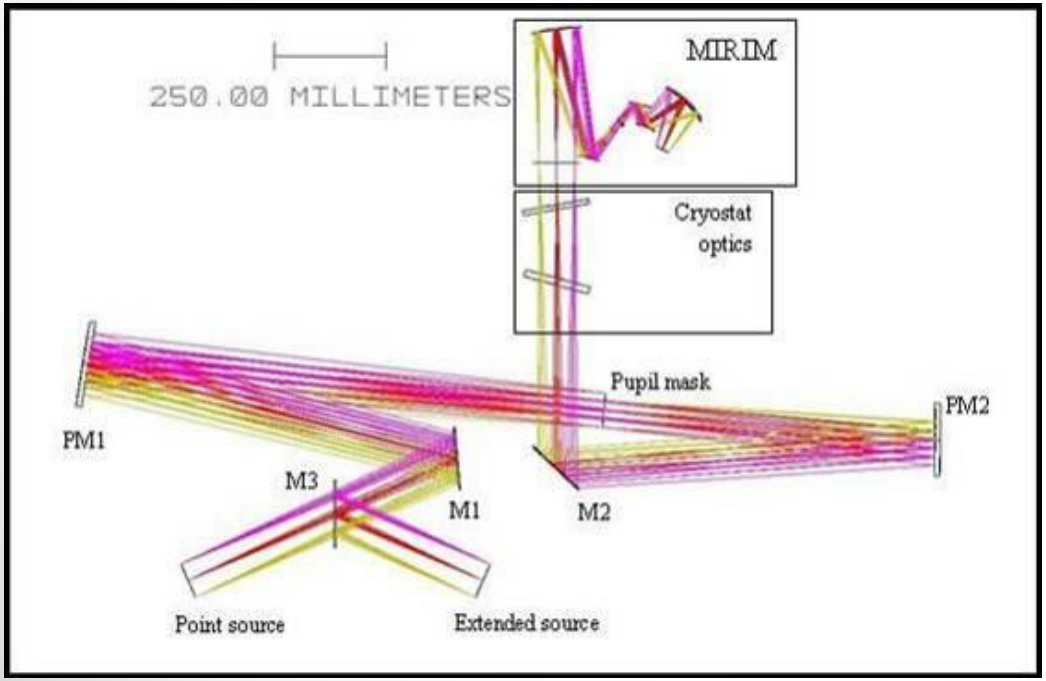
- 1st cooling run with mass model
  - Define limit Temperature
  - Define time to reach working temperature

- 2nd run with actual MIRIM model + Detector
  - Check MIRIM functionalities
  - Find the result of the previous version

Optical means

Telescope simulator can provide the instrument several light sources



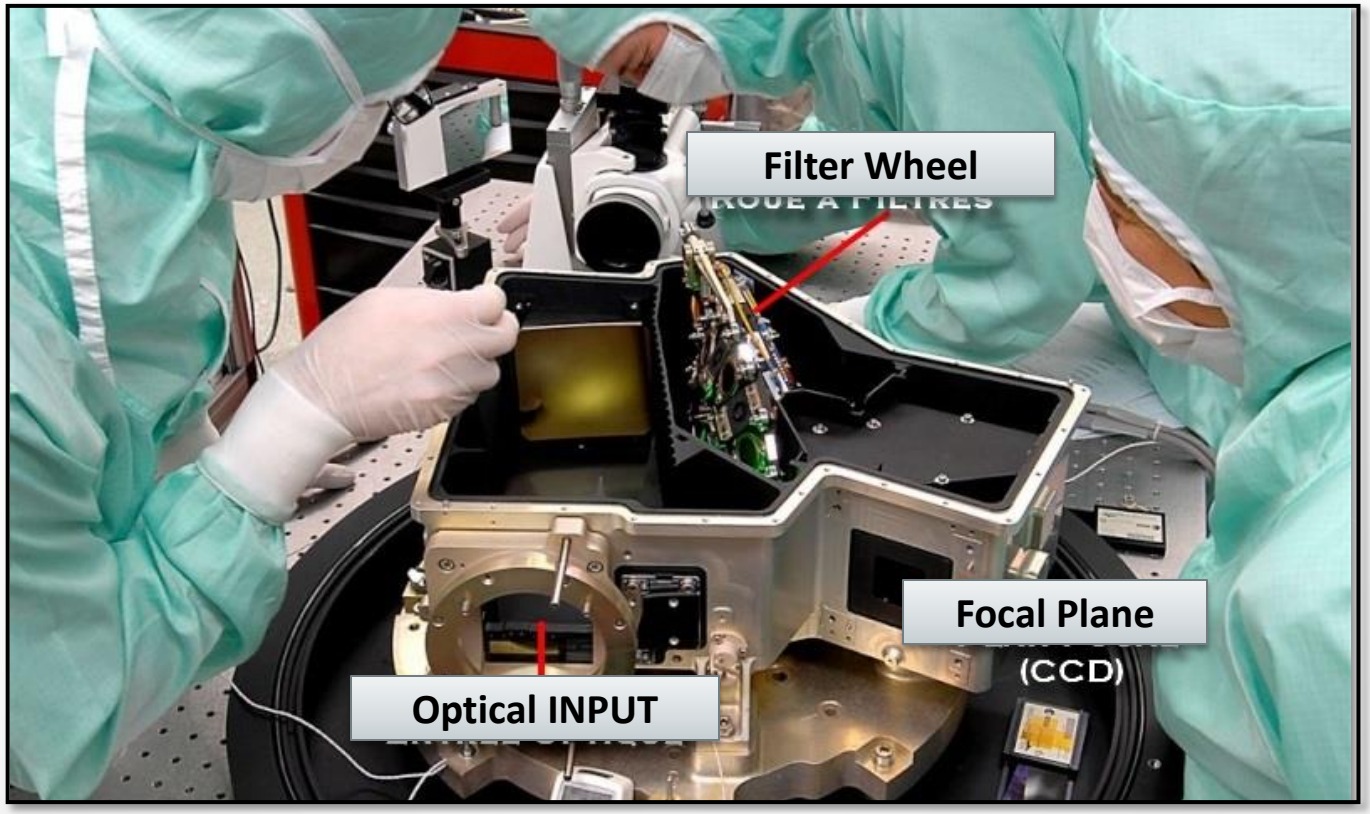


- Point-like source
  2000K Ceramic + 30µm hole
- Extended source
  Flat black body (-5°C - +100°C)

Optical means

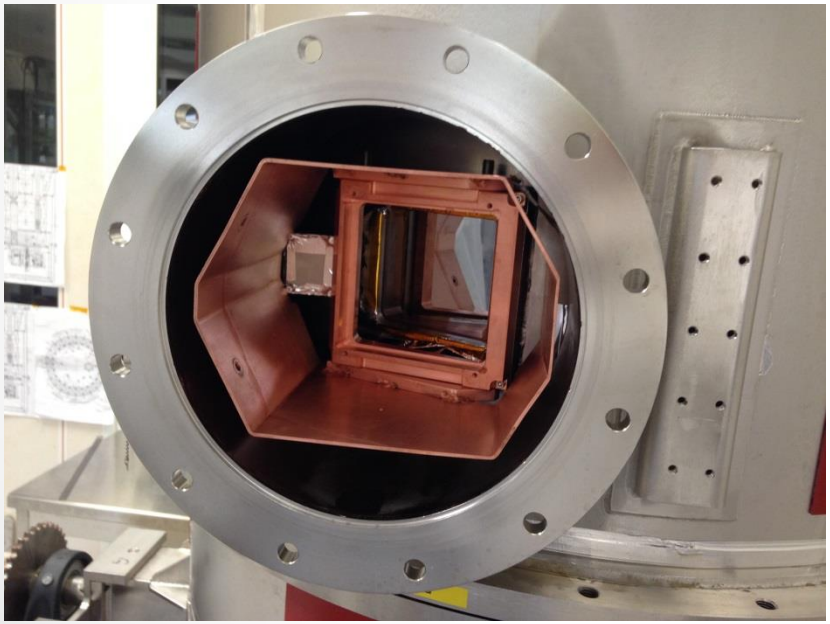
- MIRIM can image on 5 – 25,5 µm IR detector

- The detector benefits the fully equiped filter-wheel and high quality imaging of JWST's MIRIM.

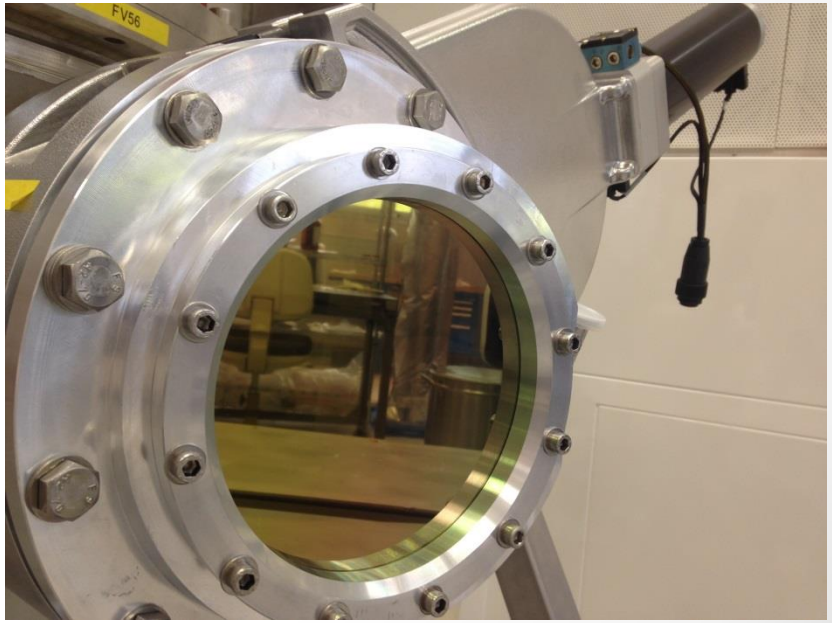


Optical means

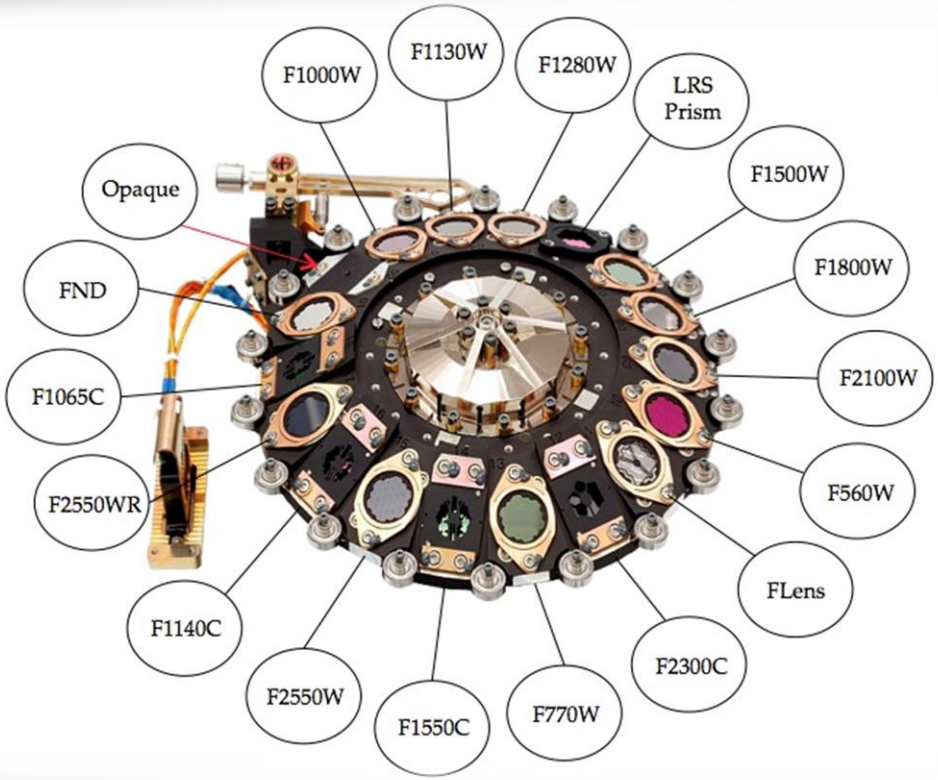
- The whole station can be versatile
- It includes a removable neutral density in the Optical Input
  - 10^3 and 10^5 available
  - *Ge* or visible window available



Removable Neutral Density



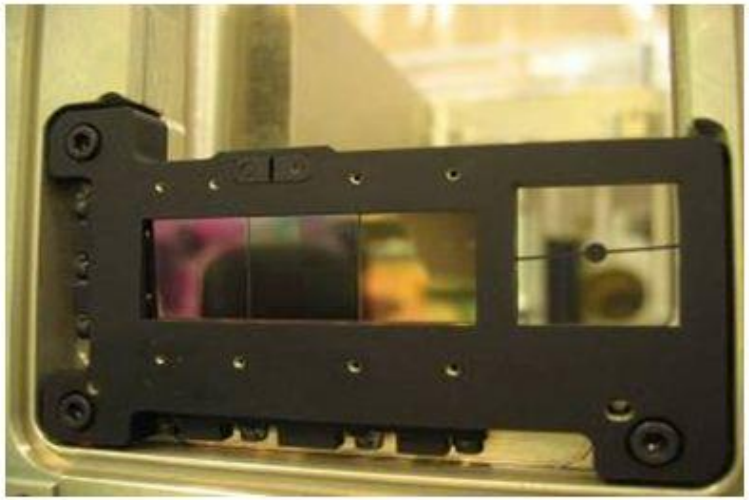
Interchangeable input window

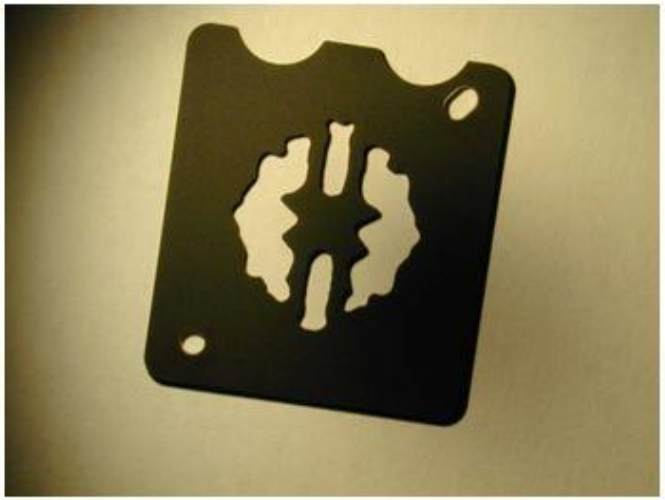


Imaging mode (5 -25,5µm)
At various wavelenghts with 12 interchangeable filters.

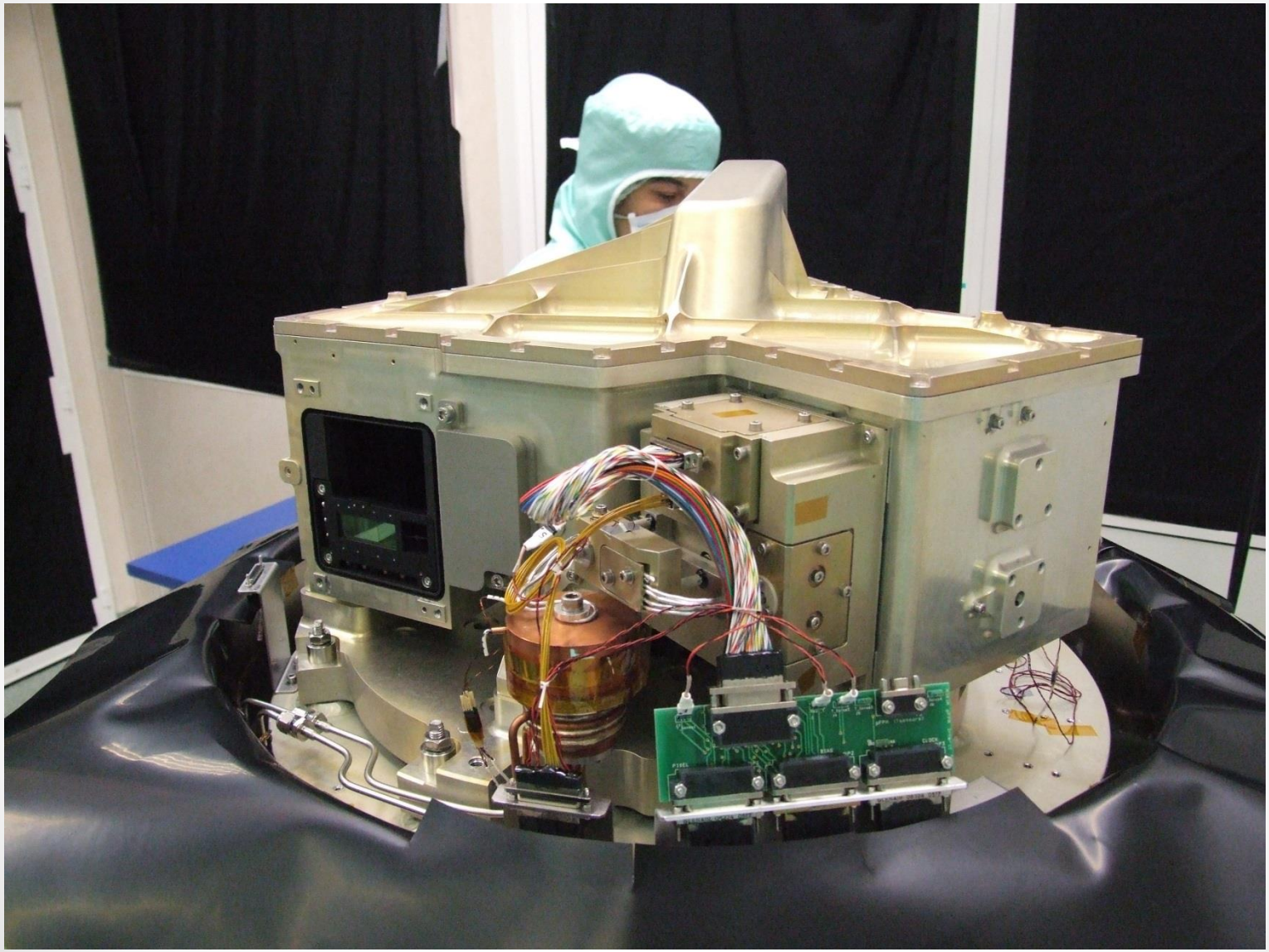
Coronographic Mode

Low resolution Spectroscopic mode (LRS)





Final step: Real Imager



Thank you for your attention