



# JWST Users Committee MIRI Instrument Status

Macarena Garcia Marin (ESA, STScI Branch Manager)  
on behalf of the MIRI Team



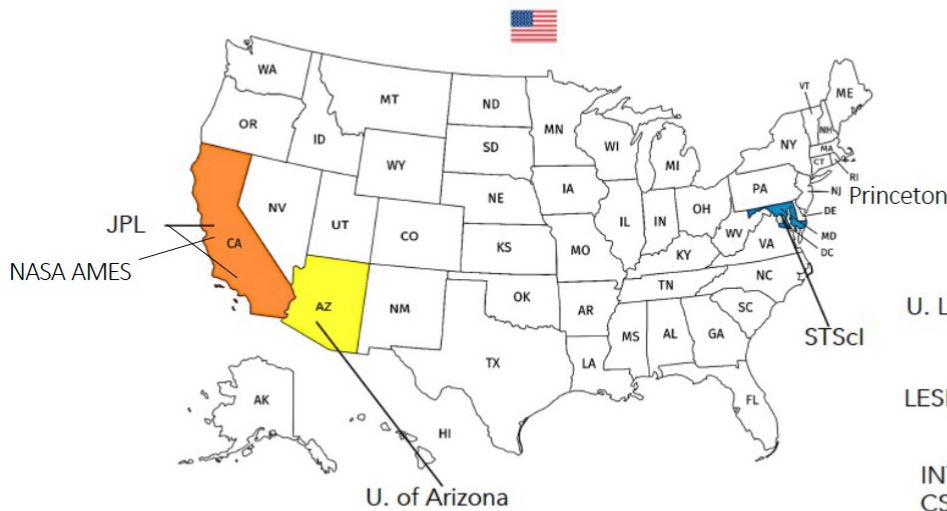
# Outline



- MIRI Team structure.
- Brief overview of MIRI modes.
- Detectors status.
- MIRI focus and pupil shear.
- Astrometry.
- Summary Straylight Glint Assessment.
- Other key results in all MIRI modes.
- MIRI in Cycle 1.



# The MIRI Team Structure



NASA/GFSC JWST Project Office

7/15/2020



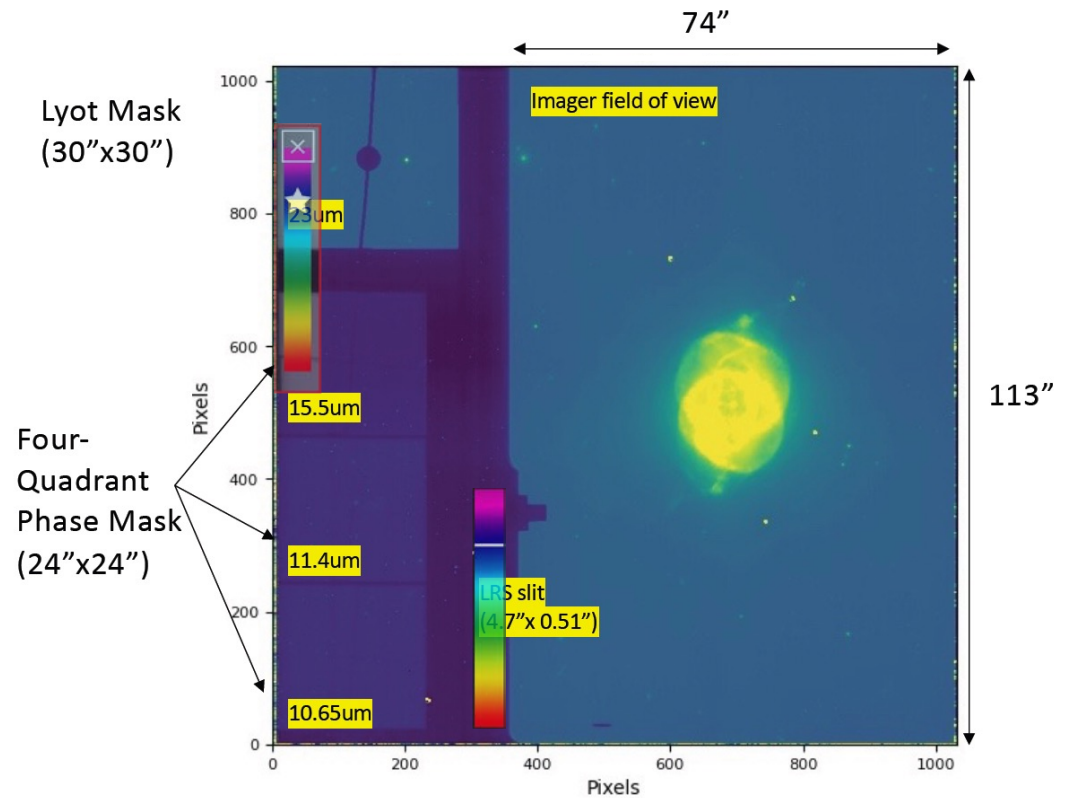
ESA/ESTEC JWST Project Office  
Prodex Office



# MIRI Imager Module (MIRIM)

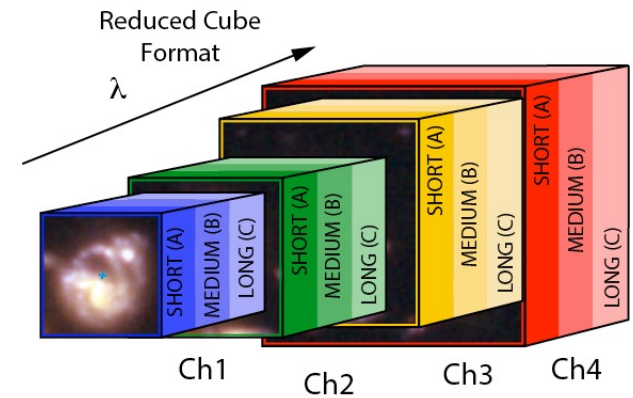
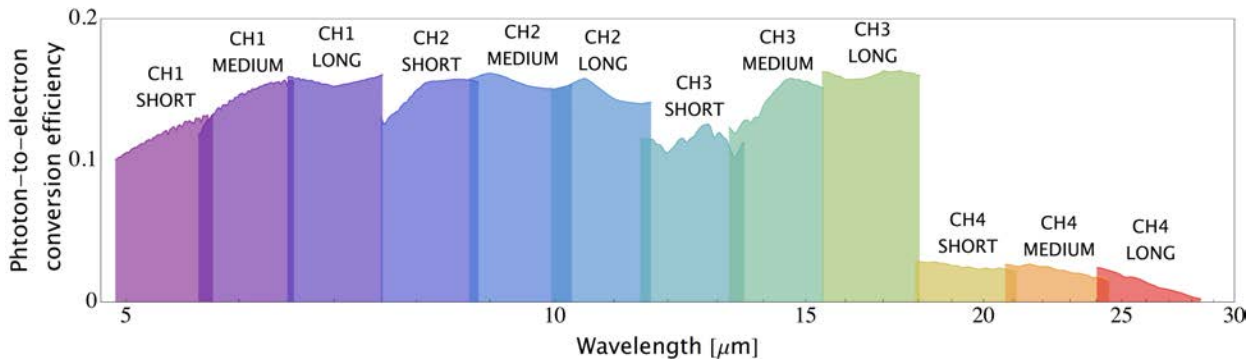
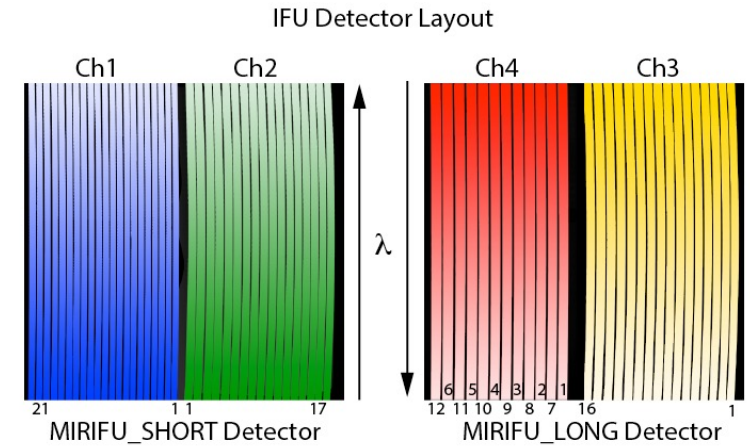
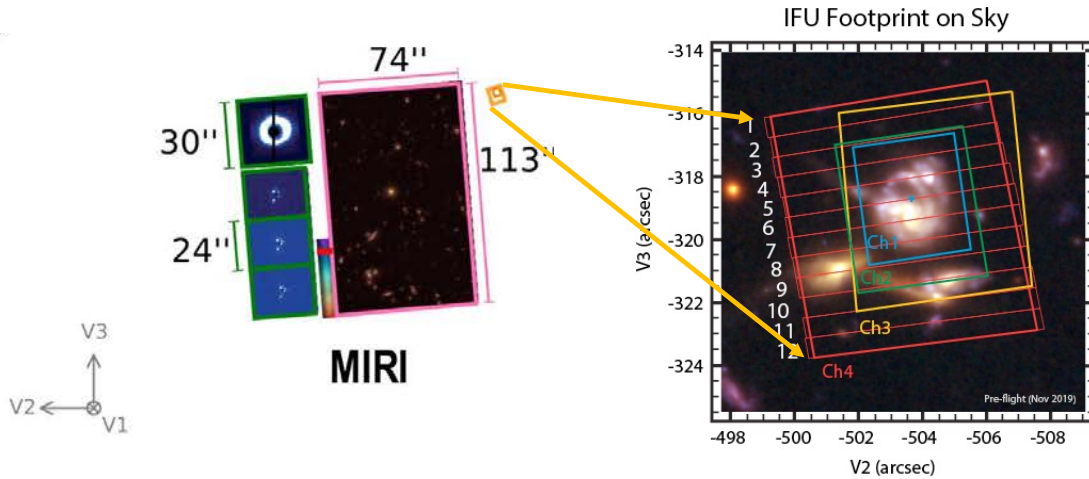


- Imaging: 9 filter from 5.6 to 25.5 microns.
  - Full and subarrays
- Coronagraphic imaging:
  - 1 Lyot, 3 4QPM.
- Low resolution spectroscopy (LRS) slit and slitless (5-12 microns).
  - Common disperser.
  - LRS slit in FULL array only.
  - LRS slitless: TSO, subarray only.





# MIRI Medium Resolution Spectroscopy (MRS)



7/25/22

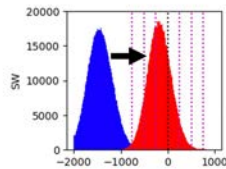


# MIRI Detectors Status

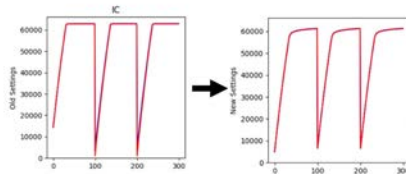


## Successful Post-Flight Tuning

Odd-Even row offset from ~1500 DN to ~100 DN

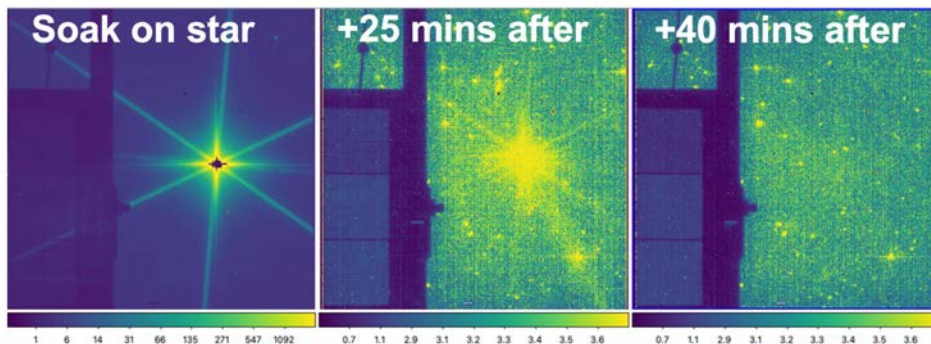


Saturation no longer clipped by readouts. Better zeropoints



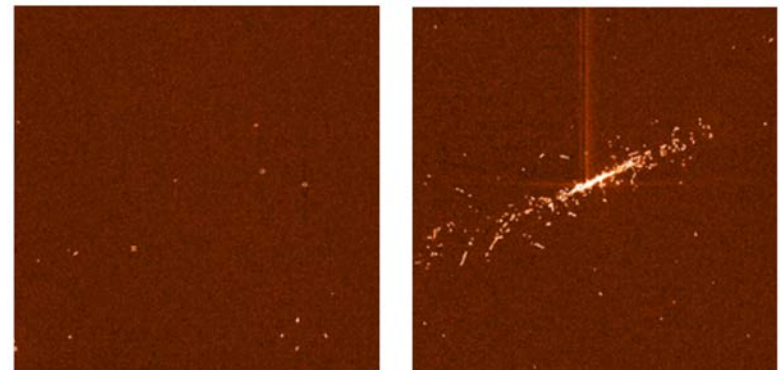
## Excellent image latent recovery

Latent signal is << 0.01% of soak signal after 30 minutes.



## Cosmic rays at expected rate

- A “few” per cm<sup>2</sup> per second in quiescent times (left)
- No “snowballs”, but plenty of secondary blasts (right)
- Data benefits from dithering
- Pipeline eliminates almost all events very well



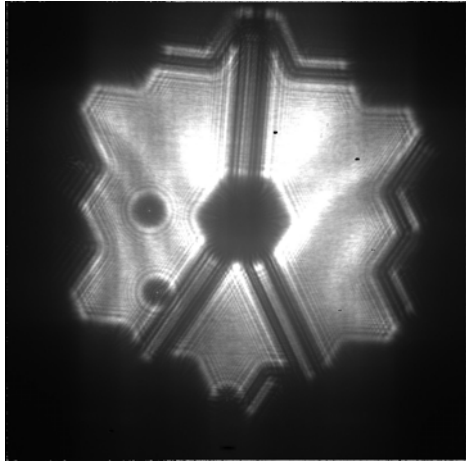
Each panel is the difference between 2 imager successive groups

**Dark current is consistent with pre-flight tests**

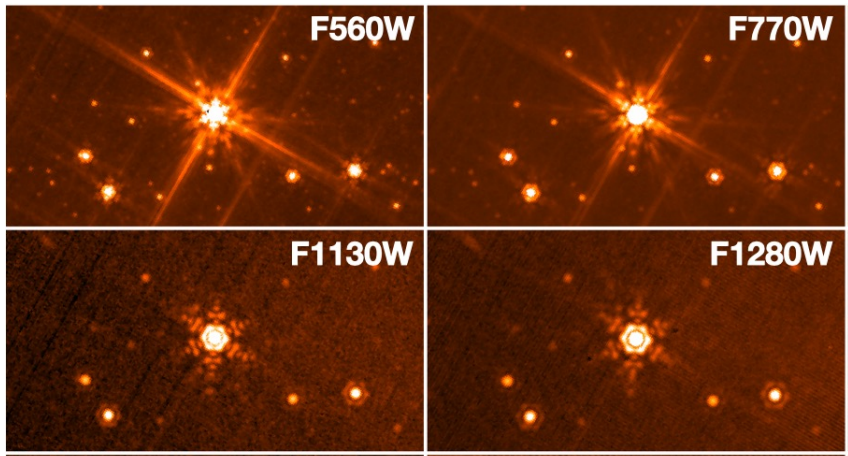
**Bad pixels:** 0.7% in imager are bad, similar for spectrometer arrays



# MIRI Focus and Pupil Shear



This animated gif shows the MIRI pupil from CV3 testing compared with the one measured on flight. The images are very well coaligned.



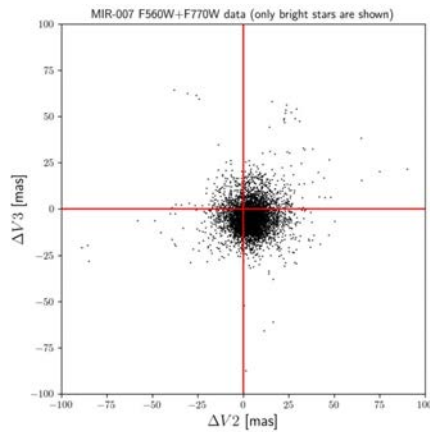
MIRI does not have an internal focus or alignment mechanism. Following MIMF, MIRI is in focus and aligned to the telescope, image quality meets requirements, pupil shear as expected



# MIRI Astrometry and Target Acquisition



## MIRI Imager



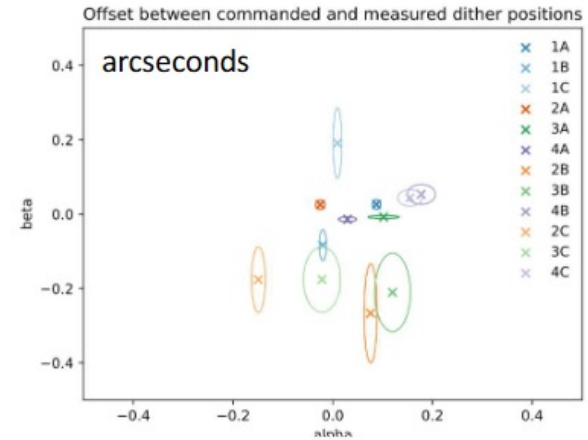
Residual errors  
8.9, 8.6 ( $1\sigma$ ) mas  
across the MIRI  
imager SCA.  
(reqt 10mas)

## Coronagraph

Nulls located with 10 mas accuracy (20 mas for the Lyot mask.)

## MIRI MRS

Astrometric calibration currently accurate to  $\sim 0.25$  pixels, with some improvements planned for Cycle 1.

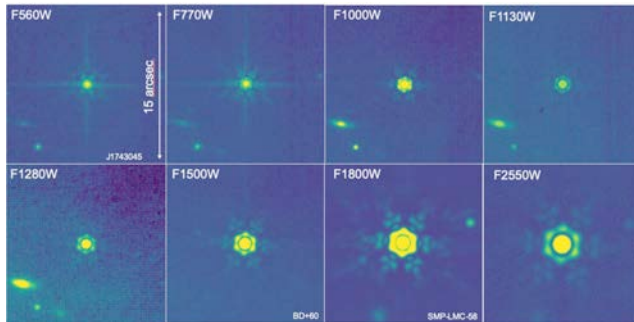


## MIRI LRS

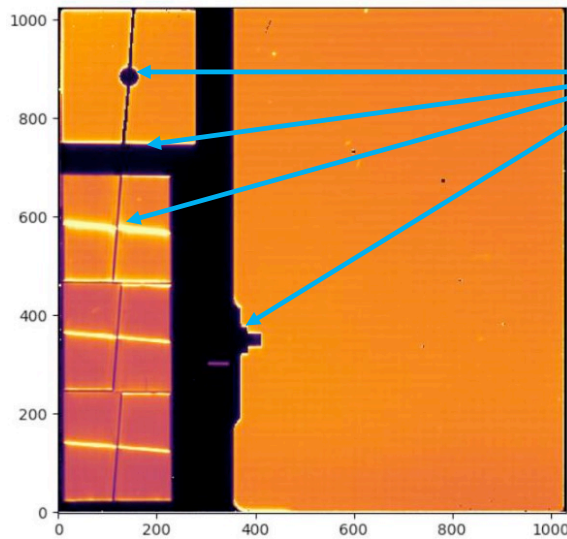
Slit location and size known/measured ( $\sim 5'' \times 0.5''$ ).  
TA sufficiently accurate for science



# Summary Straylight/Glint Assessment



Optical ghosts and glints are consistent with ground measurements (none seen/found) for Imager field of view and MRS



Anomalous illumination glow-stick straylight features seen at the position of edges in the MIRIM focal plane mask.

- $T \sim 120\text{K}$  warm emission straylight path most likely from the sunshield/bib region - Appears stable
- Caused complications in determination of coronagraph nulls during commissioning
- Small impact on noise in glow stick region

The glow-stick straylight is expected to not have a significant impact in the coronagraph performance.

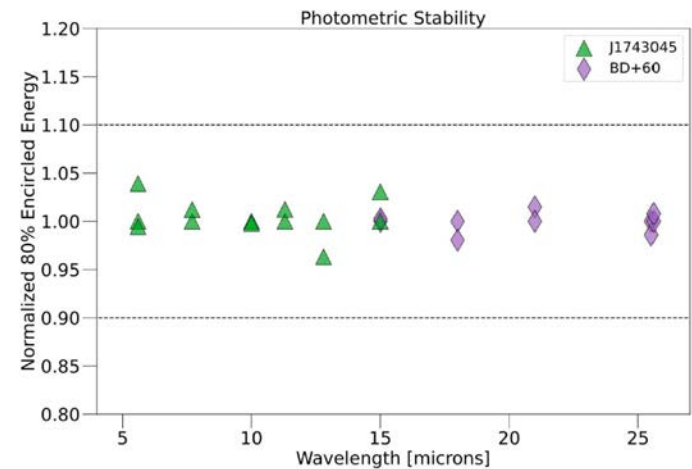
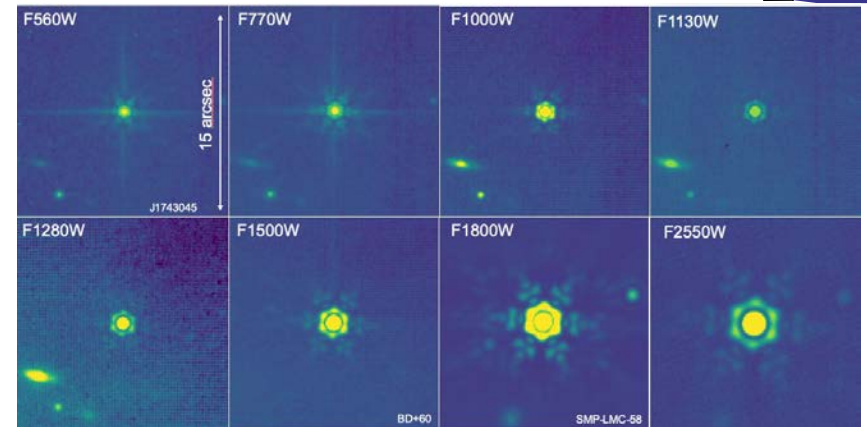
No other straylight issues have been found



# MIRI Imager Key Results



- The on-sky measured sensitivity exceeds predictions by typically 10% for all filters.
  - The ETC is adequate for Cycle 1 for Sensitivity and Saturation.
- The measured FWHM and encircled energies are within a few percent of predictions for all filters and field positions.
- Good photometric stability (repeat about 12 days apart) – all measurements are within 5%



Science Readiness Review Passed 17<sup>th</sup> June 2022  
Performance Exceeds expectations.  
Additional calibration work will continue in Cycle 1.



# MIRI MRS Key Results

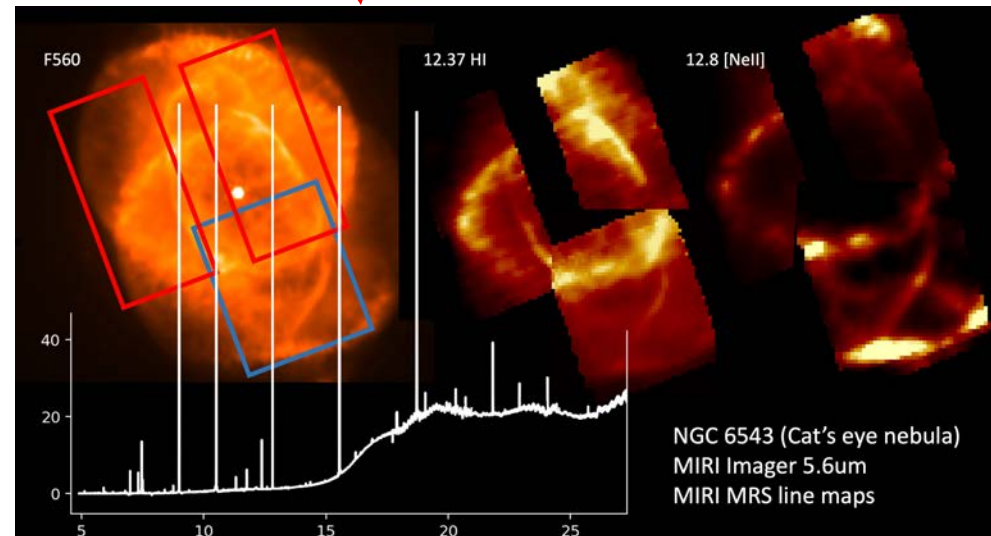
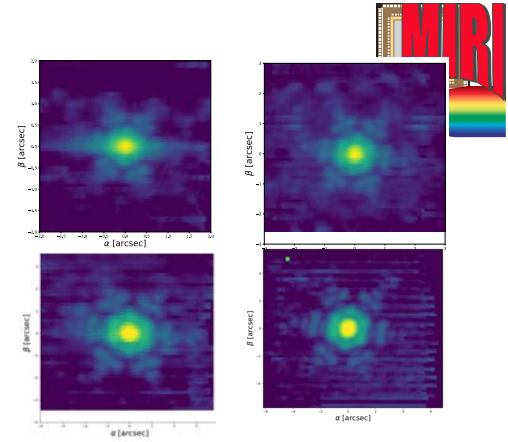
## Key results:

- Measured Sensitivity exceeds predictions
  - ETC is adequate for cycle 1.
  - Photometric response repeatable to better than 10%.
- Following commissioning SLOWR1 detector mode calibration is prioritized. Data has already been obtained.
- Image quality, spectral resolution and fringe removal in pipeline processed data is excellent.

Science Readiness Review Passed 24<sup>th</sup> June 2022  
Performance exceeds expectations. Additional calibration work will continue in Cycle 1.

Image quality retrieved from dithered data is good

Narrow spectral features with good spectro-photometry

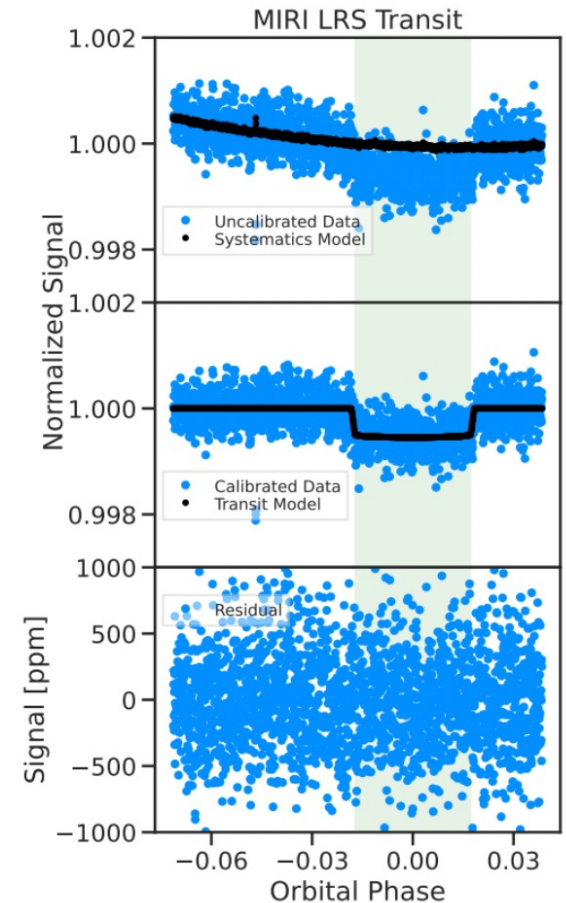
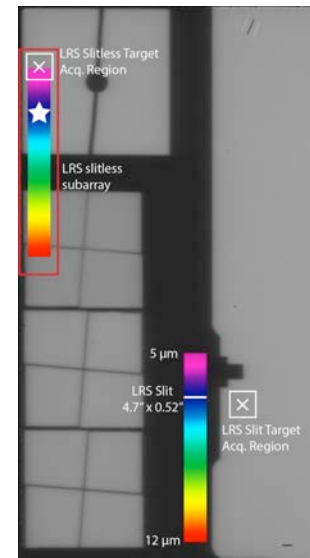




# MIRI LRS Key Results



- Slit and slitless spectroscopy performance
  - Dispersion and resolution as expected.
  - Sensitivity exceeds predictions by about 5%.
  - Excellent photometric stability.
  - Transit spectroscopy exceeds expectations, spectro-photometric precision  $\sim 50$  ppm at a spectral resolution of  $R \sim 50$  at  $7.5 \mu\text{m}$ .



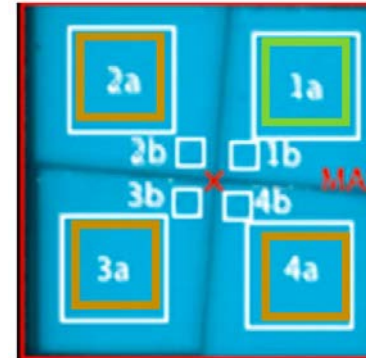
Science Readiness Review Passed 24<sup>th</sup> June 2022 Performance exceeds expectations. Additional calibration work will continue in Cycle 1.



# MIRI Coronagraphy Key Results



- Working well, sensitivity exceeds predictions similar to other MIRI modes
- Revised Null Location Procedures due to the glowstick straylight
- Target acquisition (TA) in quadrant one (1) and the neutral density filter successfully demonstrated for each four-quadrant phase mask (4QPM) to a precision of 10 mas, 20 mas for the Lyot.
  - *Other filters and quadrants require calibration during cycle 1. Data for Q4 and FND already obtained.*



- TA Filters
- FND
  - F560W
  - F1000W
  - F1500W

## Measured performance

Coronagraph	MASK1065	MASK1140	MASK1550	MASKLYOT
Raw contrast (6λ/D)	10,570 ± 240	12,700 ± 330	14,700 ± 480	10,260
Rejection (3λ/D)	108.1 ± 8.8	108.8 ± 5.6	135.8 ± 7.1	233.5
Star subtraction (3σ at 6λ/D)	61,800	47,300	24,100	N/A

- The rejection measurements exceed the modelled performance for the pre-launch telescope by factors of 10-20

Science Readiness Review Passed 29 June 2022  
 Performance exceeds expectations. Additional characterization and calibration work will continue in Cycle 1.



## MIRI Cycle 1 Activities



All MIRI modes have been successfully exercised in Cycle 1.

- ERS, GO, GTO and Calibration programs have been executed.
  - Commissioning-based reference files have been delivered.
- Several commissioning liens are managed:
  - Subarrays leave an imprint which will decay after FULL frame is selected. A permanent fix to switch to FULL array implemented in OSS 8.4.12 (not on-board yet). In the mean time an operationally workaround is used.
  - Imager backgrounds recommended at 25.5 microns (communication with PIs).
  - MRS backgrounds are recommended for extended and semi-extended sources (communication with PIs).
  - MRS programs that require high precision (sub-%) photometry/fringe correction recommended to be executed after an upcoming distortion update (communication with PIs).
  - SLOWR1 calibration has been prioritized, relevant data (e.g. darks) has been obtained and generation of reference files is underway.
- More recently we have identified an issue with two imager dithers that, depending on the number of filters and their order, shifts the placing of the source and in subarrays may partially leave it out of the FOV. The root cause is identified and a ticket is in place to fix it (<https://jtar.stsci.edu/browse/PPSDR-5723>).
  - We are also identifying affected programs.



## In conclusion



- MIRI is in good health, performing beyond expectations and ready for science.
- We are all looking forward to the discoveries to come!

