JWST Update

Astrophysics Advisory Committee
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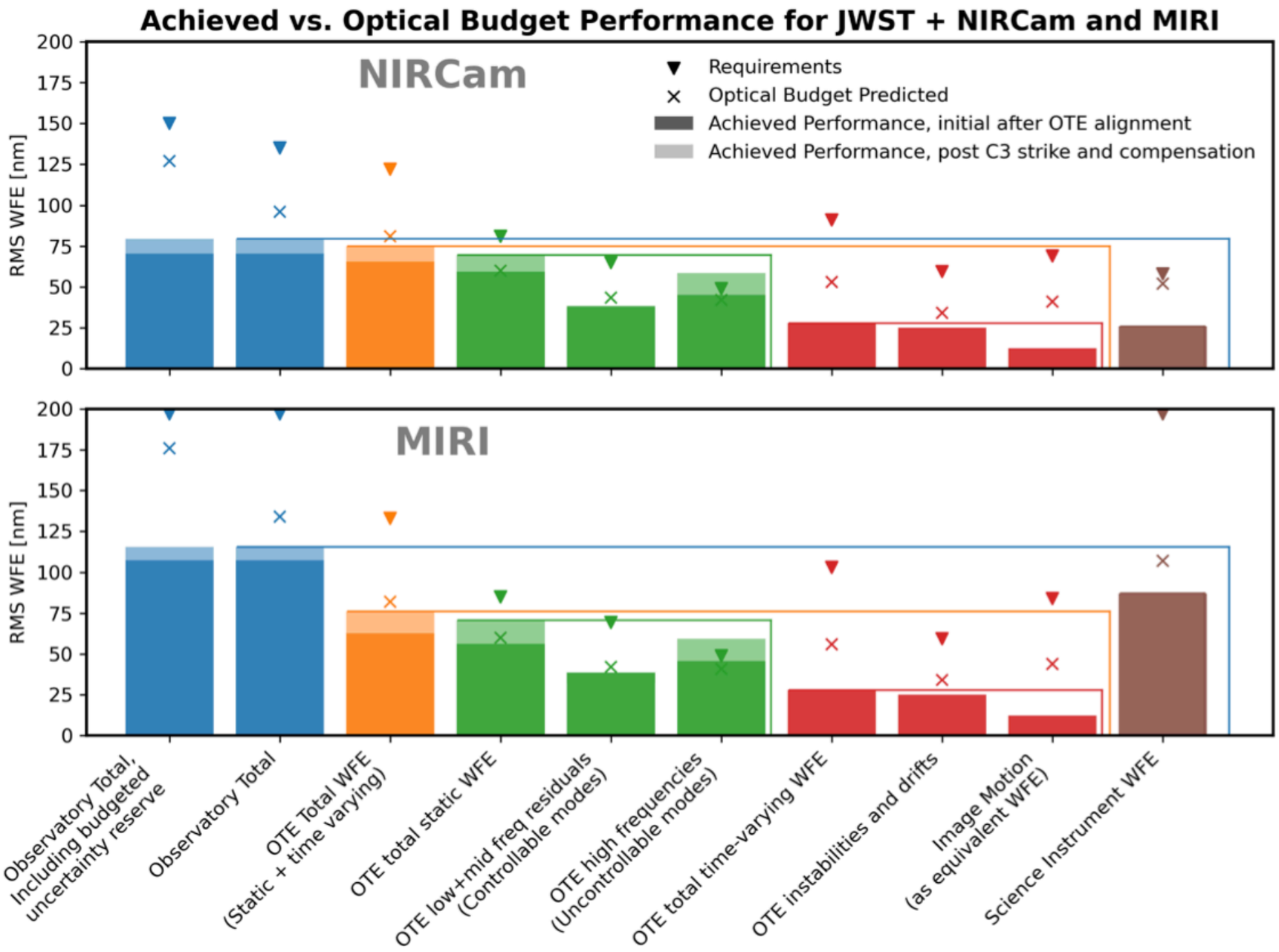
Cycle 1 Performance

- Lifetime: > 2x initial goal, 4x requirement
- Diffraction limit: 1.1 μm vs 2 μm requirement
- Sensitivity: ~35/20% better than requirement (NIRCam/NIRISS)
- Pointing Stability: Factor of ~6-7 better than requirement
- Photometric Stability: better than 1%
- Thermal Stability: within 40mK noise of the sensors
- Moving Target Tracking: > 3x required rate (req:30 mas/sec)
- Backgrounds: NIR (lower than predicted), MIR (as predicted)

WEBB
SPACE TELESCOPE

Optical Performance



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WEBB SPACE TELESCOPE

NIR Sensitivity

Wavelength (µm)	2	3.5
Requirement (nJy)	11.4	13.8
ETC prediction (nJy)	10	14.1
Actual (nJy)	7.3	8.8

Table 3: NIRCam limiting point source sensitivity. *What is quoted is the faintest flux density that can be detected at SNR=10 in 10,000s. Values are for wide-band filters. Smaller numbers are better.*

Wavelength (µm)	1.15	2	3.5	4.4
ETC prediction (nJy)	13	10.2	14.5	22.8
Actual (nJy)	10.0	8.4	11.8	17.9

Table 5: NIRISS limiting point source sensitivity. *What is quoted is the faintest flux density that can be detected at SNR=10 in 10,000s. Values are for wide-band filters. Smaller numbers are better. The requirement level was set at 13 nJy for the 3.5 µm filter.*

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Commissioning Moving Targets

Moving target	Apparent Rate of Motion (mas/s)	Program ID	Instrument/Mode
Jupiter	3.3	1022	NIRCam Imaging, NIRISS Imaging, NIRSpec fixed slits and IFU, MIRI MRS and imaging
2516 Roman	4.7	1449	MIRI/Imaging
118 Peitho	4.9	1449	MIRI/ LRS and MRS
6481 Tenzing	5	1021	NIRCam/Imaging
1773 Rumpelstilz	6.6	1021	NIRISS/AMI
216 Kleopatra	11	1444	NIRSpec/ IFU and MOS longslit
2035 Stearns	24	1021	NIRCam/Imaging
4015 Wilson-Harrington	40	1021	NIRCam/Imaging
2004 JX20	67	1021	NIRCam/Imaging

Table 1: Moving targets tested during commissioning. *Targets are sorted by apparent rate of motion.*

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Early Science

Early Release Observations (EROs), Early Release Science (ERS), Guaranteed Time Observers (GTOs), General Observers

- Over 2000 hours of data in these categories has zero exclusive use period

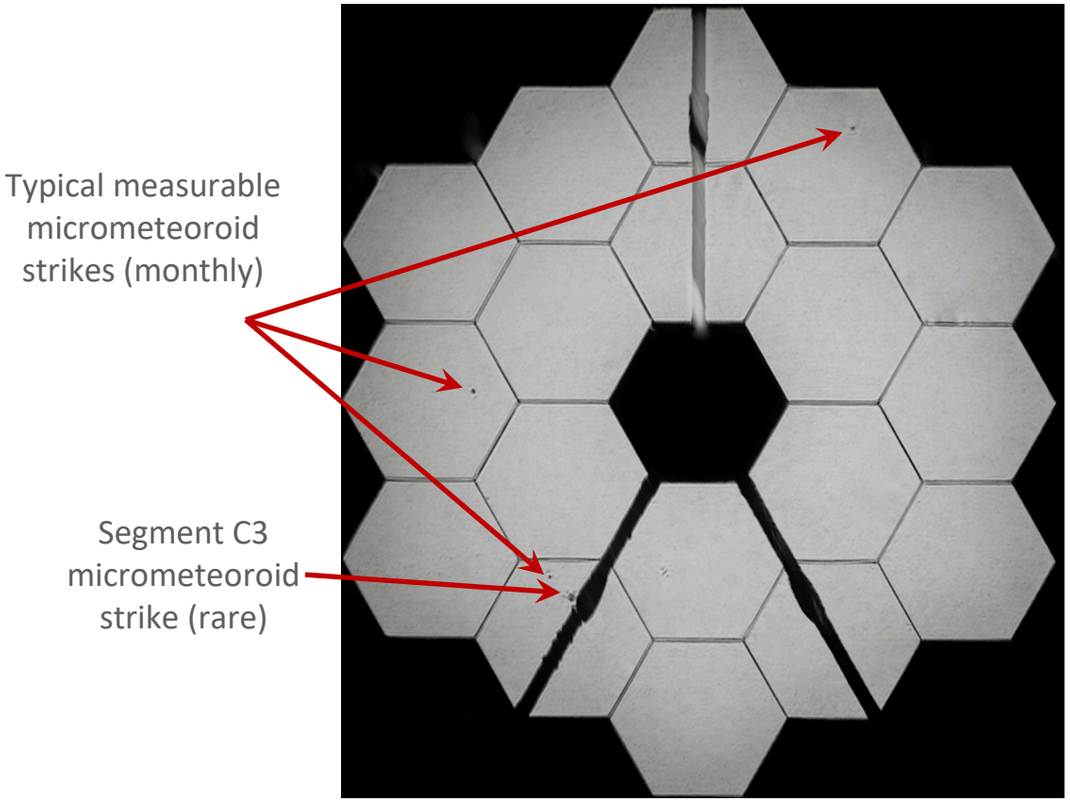
- >120 Preprints in arXiv as of 9/30/2022 (averaging about 3-4/day)

Micrometeoroids: Summary

- The rates of micrometeoroids hitting the primary mirror are consistent with pre-launch predictions
  - Total of 14 micrometeoroid impacts that had a measurable change in wavefront error since launch
  - Total of 33 smaller particles detectable in pupil image but no change to wavefront error

- Of those measurable, all but one are consistent with error budget allocations for micrometeoroid effects over expected prime lifetime

- Between May 22nd-24th we had a larger than expected strike on segment C3, increased system wavefront from 50 to 59 nanometers rms, versus a requirement of 150nm

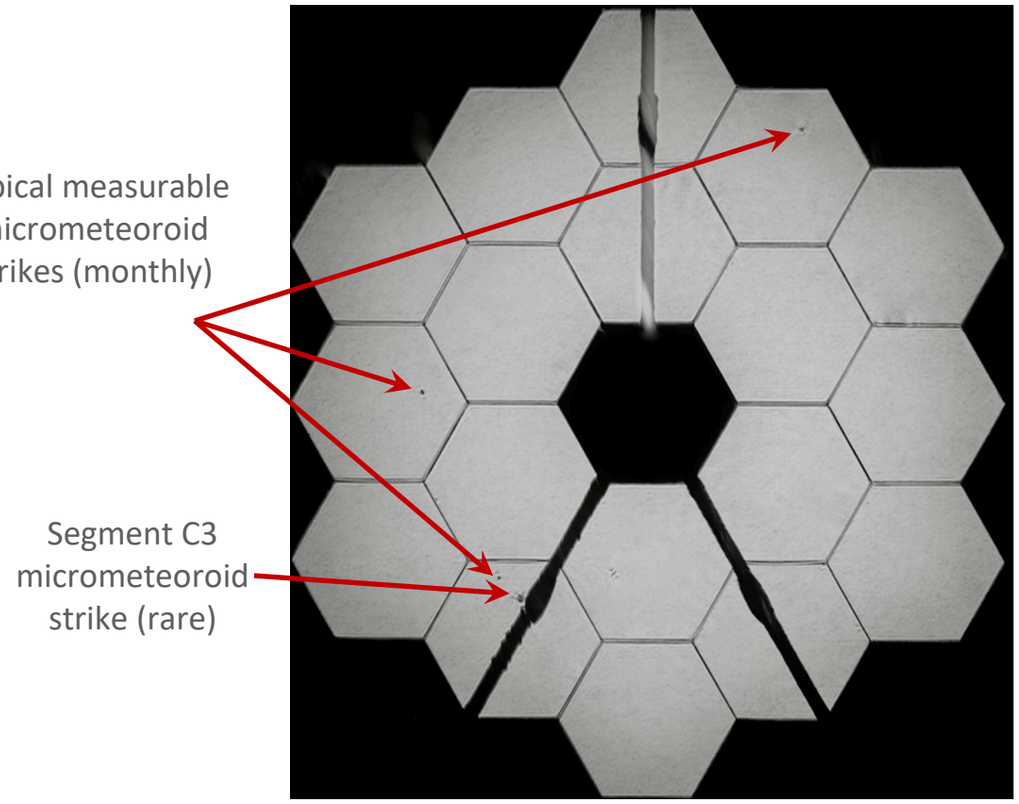


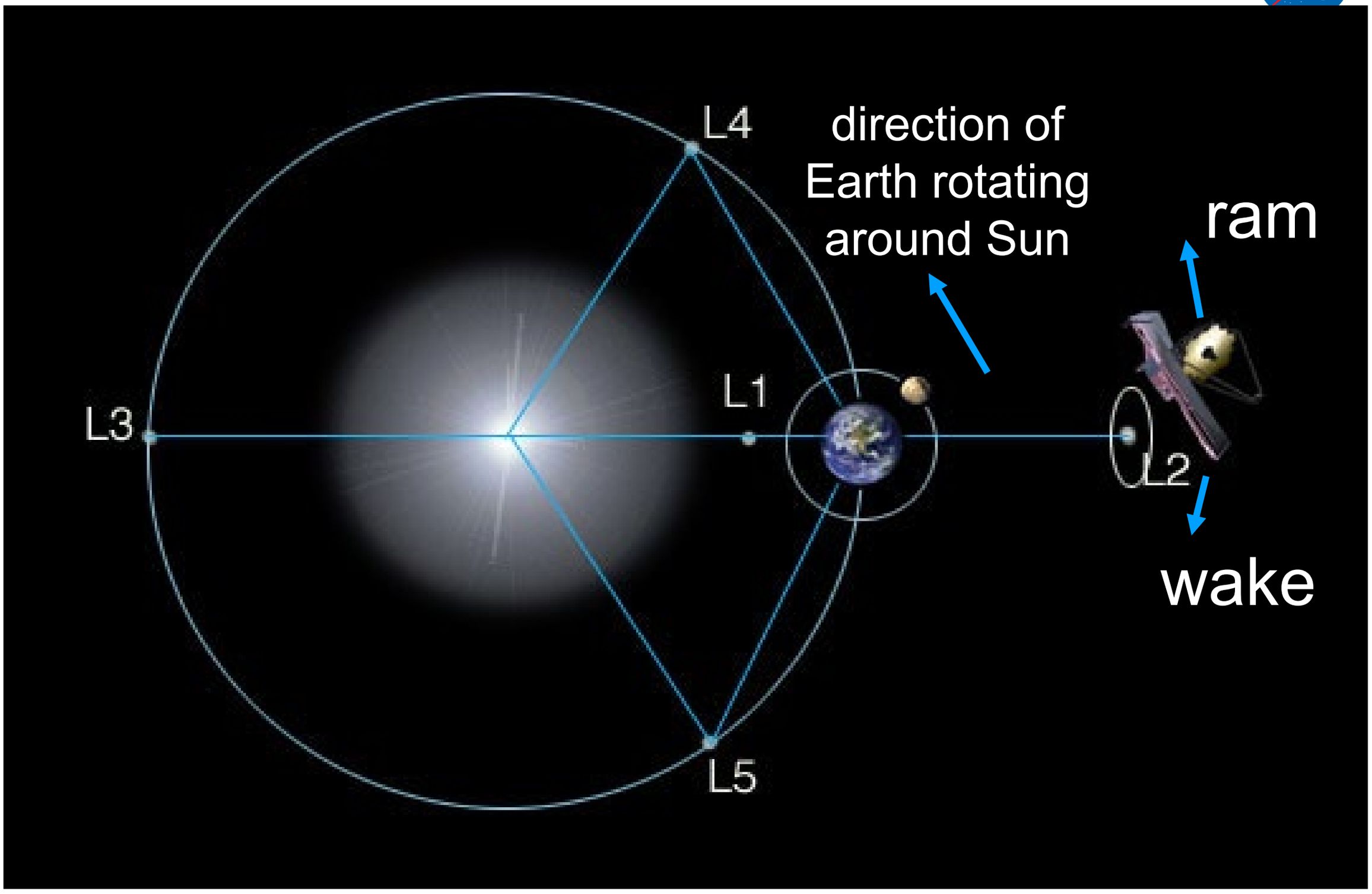
Micrometeoroids: Analysis

- Team used the measured and detected micrometeoroid rate data and pointing history to assess the statistically likely energy of the C3 strike

- Team performed 3D hydrodynamics impact and finite element modeling of cryogenic mirror using the statistically likely energy

- Best explanation is the C3 micrometeoroid was a higher energy particle (statistically unlikely) and hit a particularly sensitive part of the mirror and structure. Based on this, strikes like C3 can occur but will be infrequent (and at a statistical distribution)



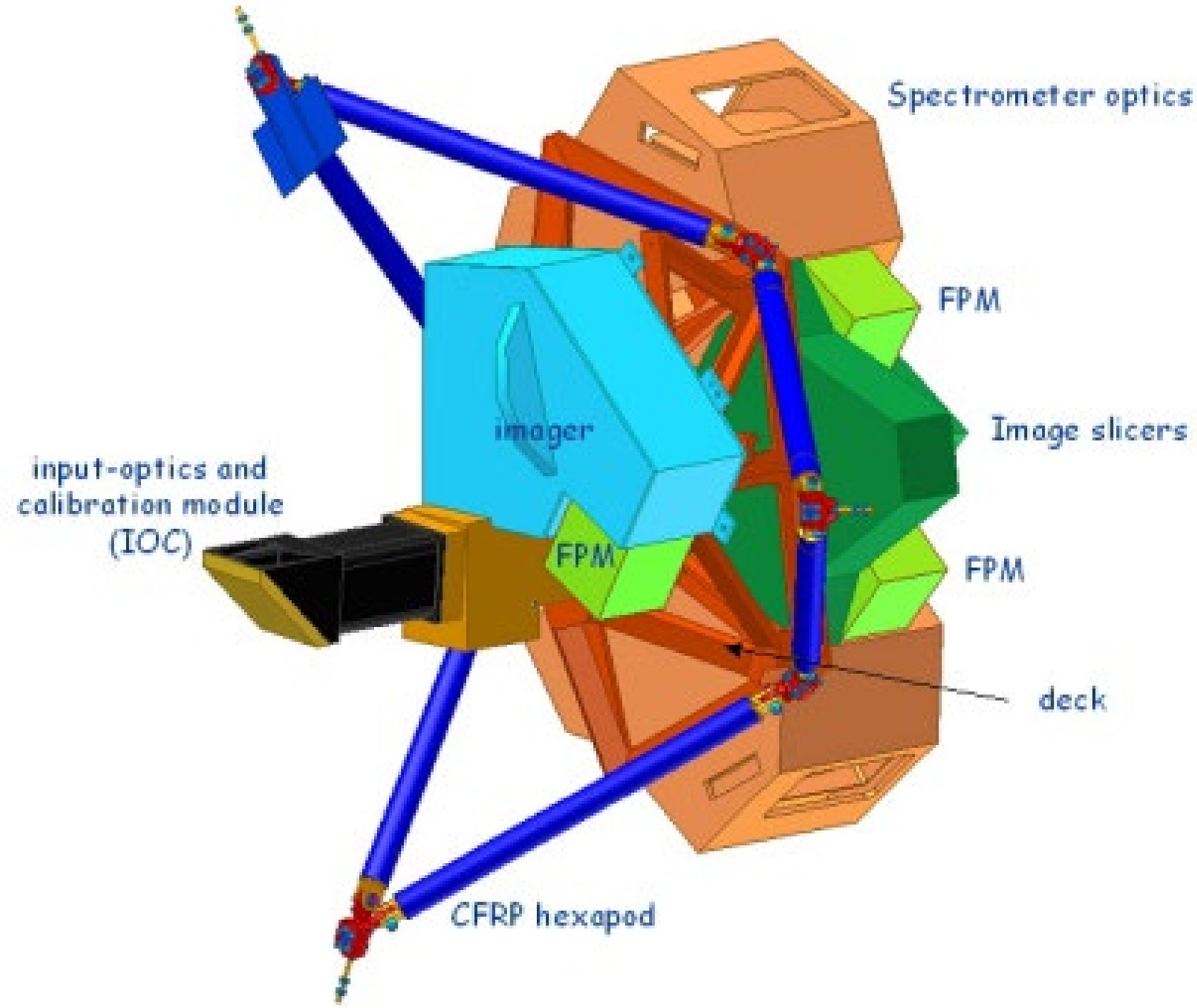

L4
direction of
Earth rotating
around Sun
ram
L1
L3
L2
wake
L5

MIRI
Grating Wheel Mechanism

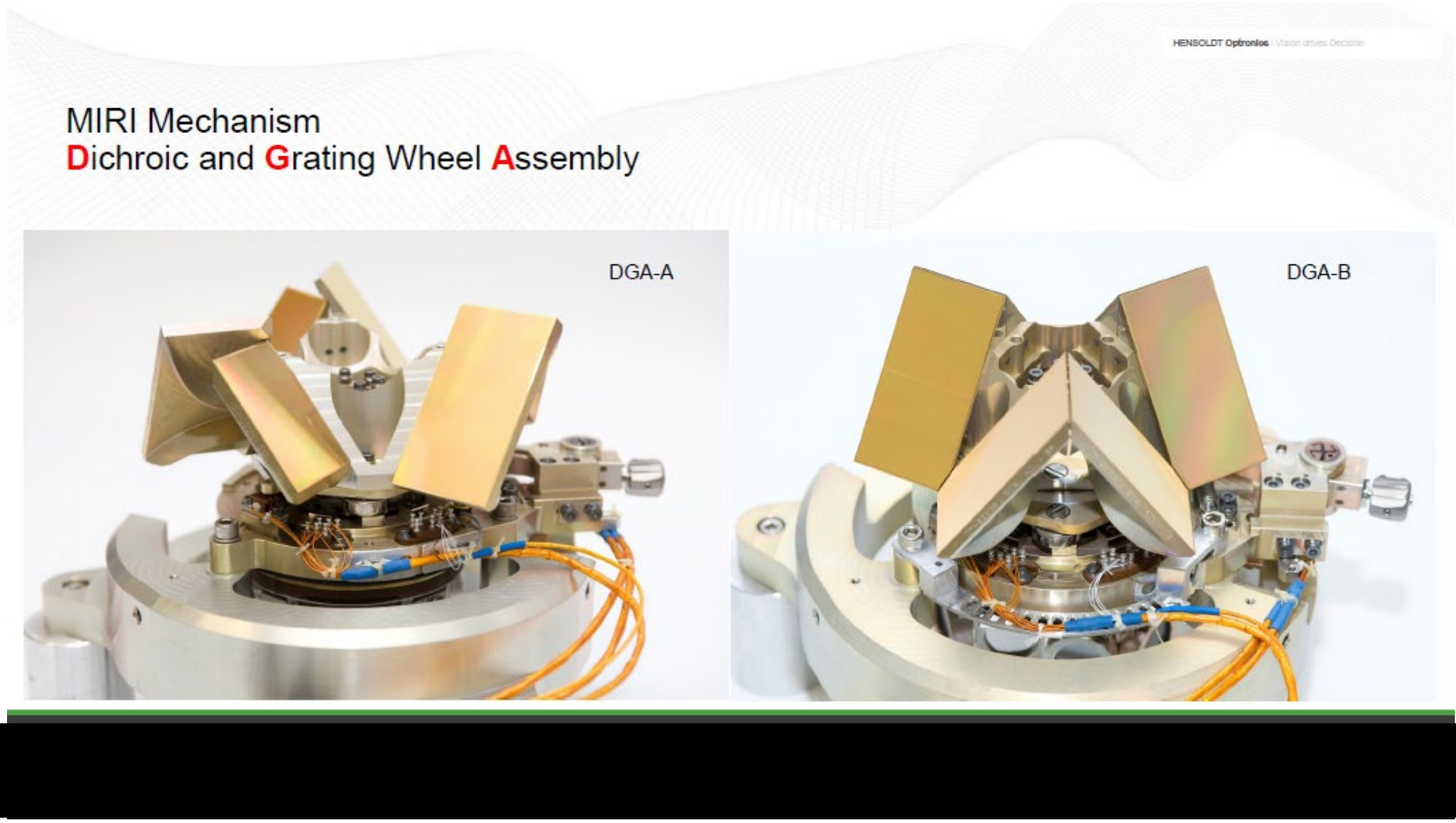
The James Webb Space Telescope's Mid-Infrared Instrument (MIRI) has four observing modes. On Aug. 24, a mechanism that supports one of these modes, known as medium-resolution spectroscopy (MRS), exhibited what appears to be increased friction during setup for a science observation. This mechanism is a grating wheel that allows scientists to select between short, medium, and longer wavelengths when making observations using the MRS mode. Following preliminary health checks and investigations into the issue, an anomaly review board was convened to assess the best path forward.

The Webb team has paused in scheduling observations using this particular observing mode while they continue to analyze its behavior and are currently developing strategies to resume MRS observations as soon as possible. The observatory is in good health, and MIRI's other three observing modes – imaging, low-resolution spectroscopy, and coronagraphy – are operating normally and remain available for science observations.

MIRI Instrument Diagram



MIRI “DGA” Mechanism



Summary

- Webb performance exceeds requirements in nearly every measure
- Observatory health is good with the MIRI MRS mode expected to be reactivated any day now
- Open data is enabling rapid publication of scientific results
- Cycle 2 Call for proposals, mid-November