



**STScI** | SPACE TELESCOPE  
SCIENCE INSTITUTE

# Webb Mission and Science Operations Center Update

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(with contributions from many others)

January 15 2025





# Summary

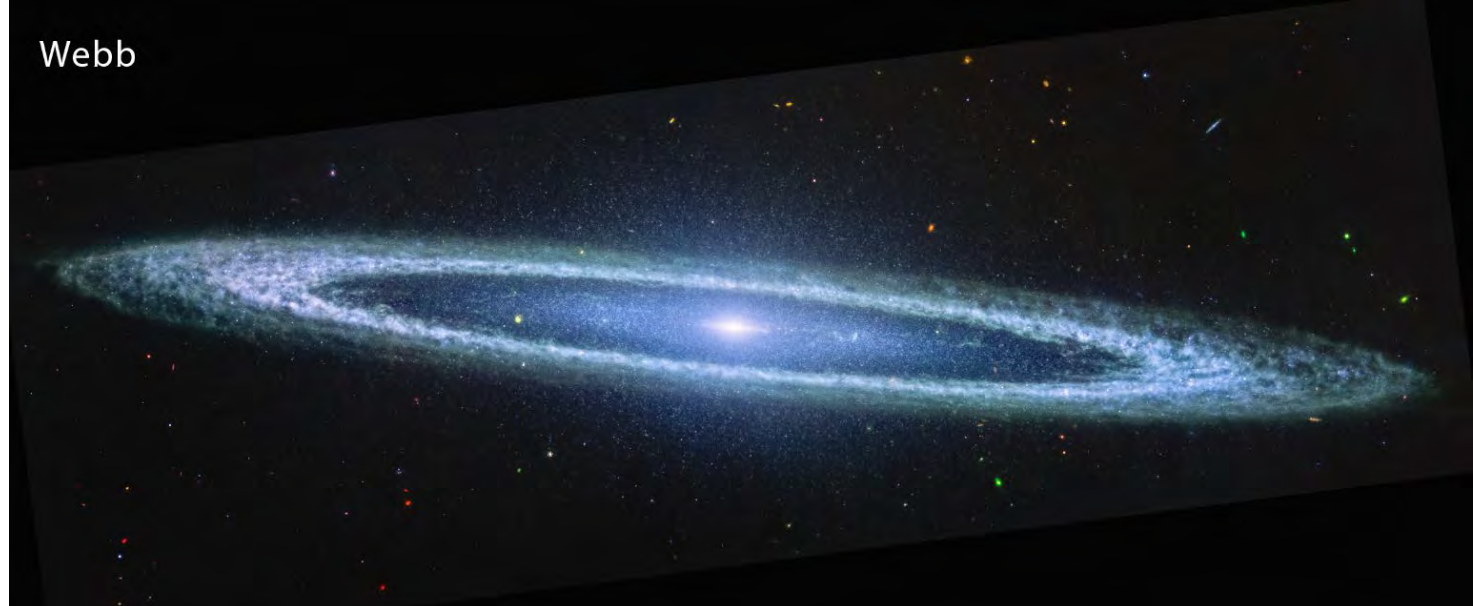
Sombrero Galaxy (M104) STScI PR 2024-137

- Spectacular science across all of astrophysics
  - *Expected to continue for 20+ years*
- Record response to Cycle 4 solicitation
  - 2,377 proposals for 78,000 hours
  - Results announced in mid March
  - 8,500 hours in Cycle 4 pool (increased from 5,500 hours)
  - Oversubscription still high (~9:1)
  - Cycle 4 ETC issues being addressed
- Observatory & instrument teams working to enhance mission's science productivity
- Major improvements to calibration
- Public enthralled by Webb's incredible discoveries
- Budget constraints broadly threaten NASA's missions, including Webb

Hubble



Webb

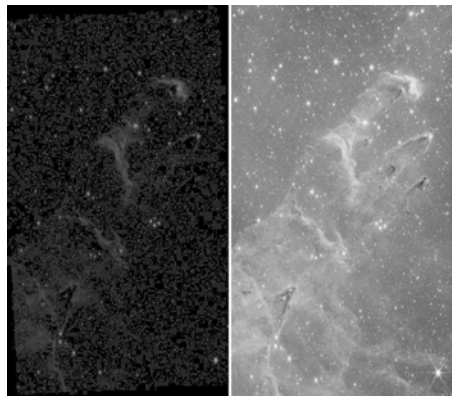




# Science Operations Highlights

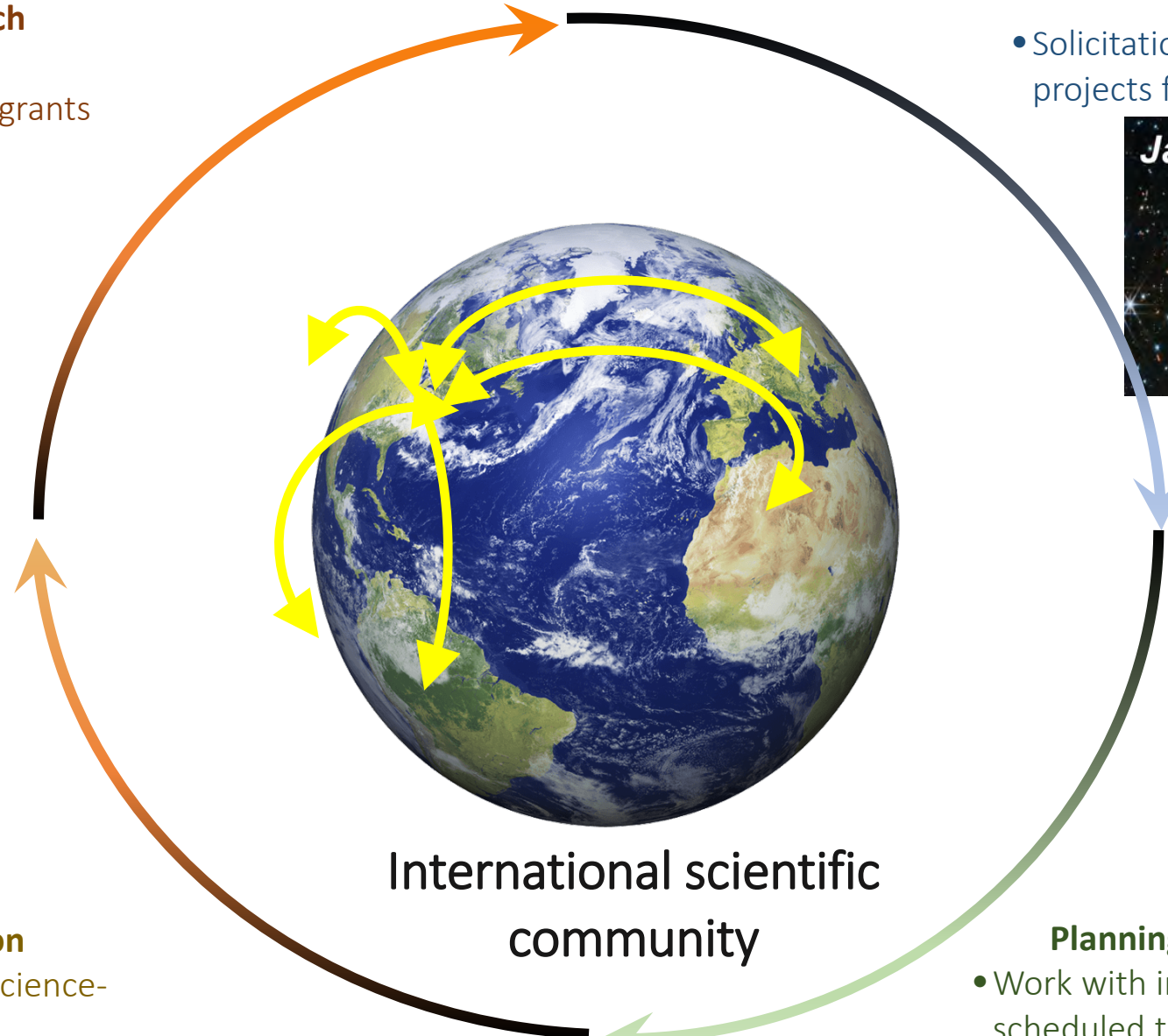
## Archive, Grants, & Outreach

- Maintenance of data archive
- Distribution and management of grants
- Scientific outreach to public & scientific community



## Data Processing & Calibration

- Raw data into well-calibrated science-ready data products



International scientific community

## Science Selection

- Solicitation, peer review, and selection of projects from scientific community



## Planning, Scheduling, & Commanding

- Work with investigators to turn projects into scheduled telescope operations





## Science Selection

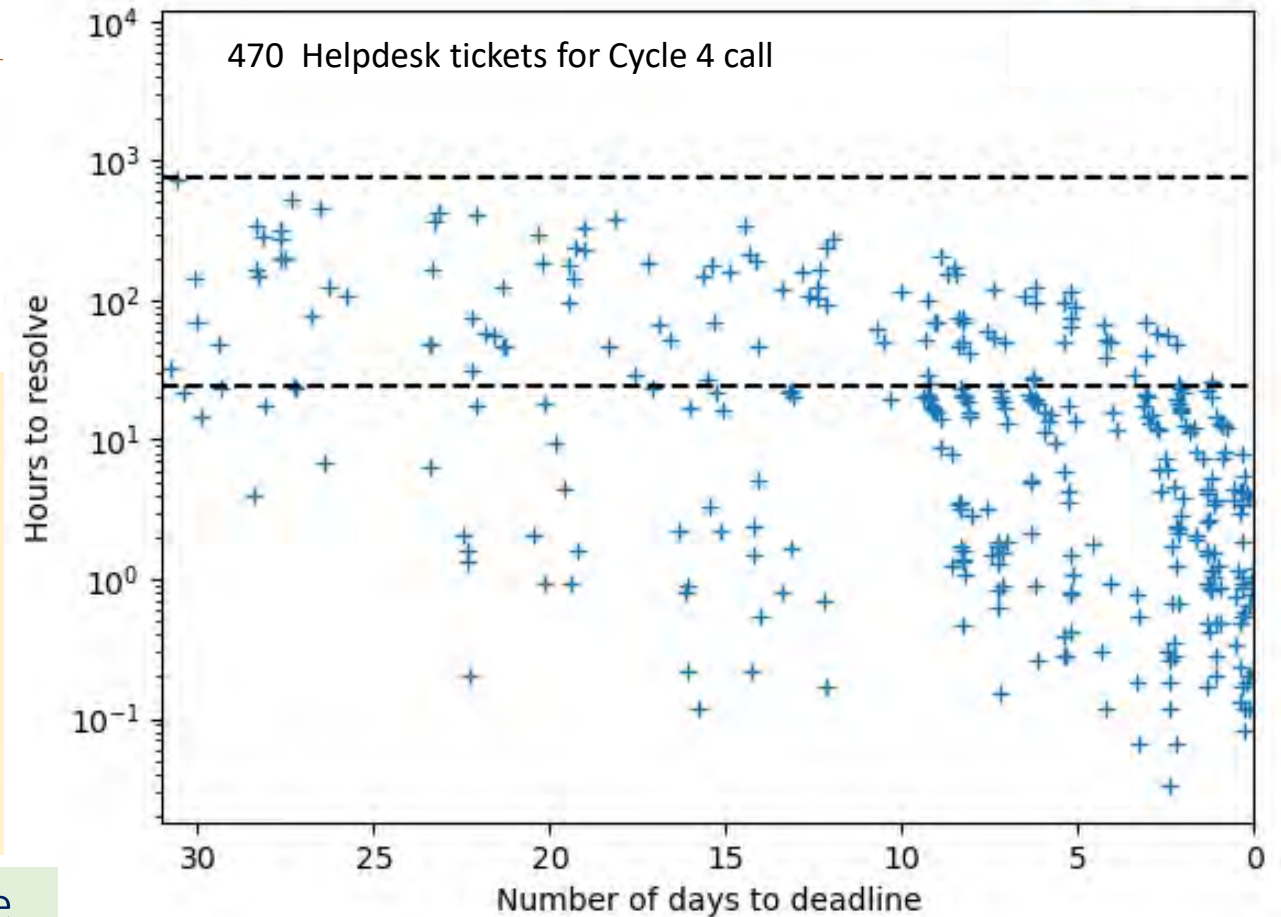
Cycle 4 had record-breaking response:  
2377 proposals and 78 khrs  
(plus some issues that are being addressed)

### Exposure Time Calculator issues

- Extreme slow-downs during last 48 hours
- Had already proactively increased database server capacity
- File server impacted by change in AWS network limits – will upgrade server type
- Posted notice on JWST Helpdesk page
- Provided extensions to three investigators

### Missing guide stars in some regions traced to GSC 3 issue

- Affected proposals (C4) and planning (C2/C3) for 5 programs
- Addressed in November update to GSC 3.1 – early access given to impacted users
- Proactively ID'ed & informed programs with impacts
- Posted banner on JWST Helpdesk page



### Webb Office Hours underutilized so far

- 20 sessions, 34 users (21 unique), 73 questions

We welcome feedback, esp. via user surveys and JWST Space Telescope Users Committee



# Planning & Scheduling

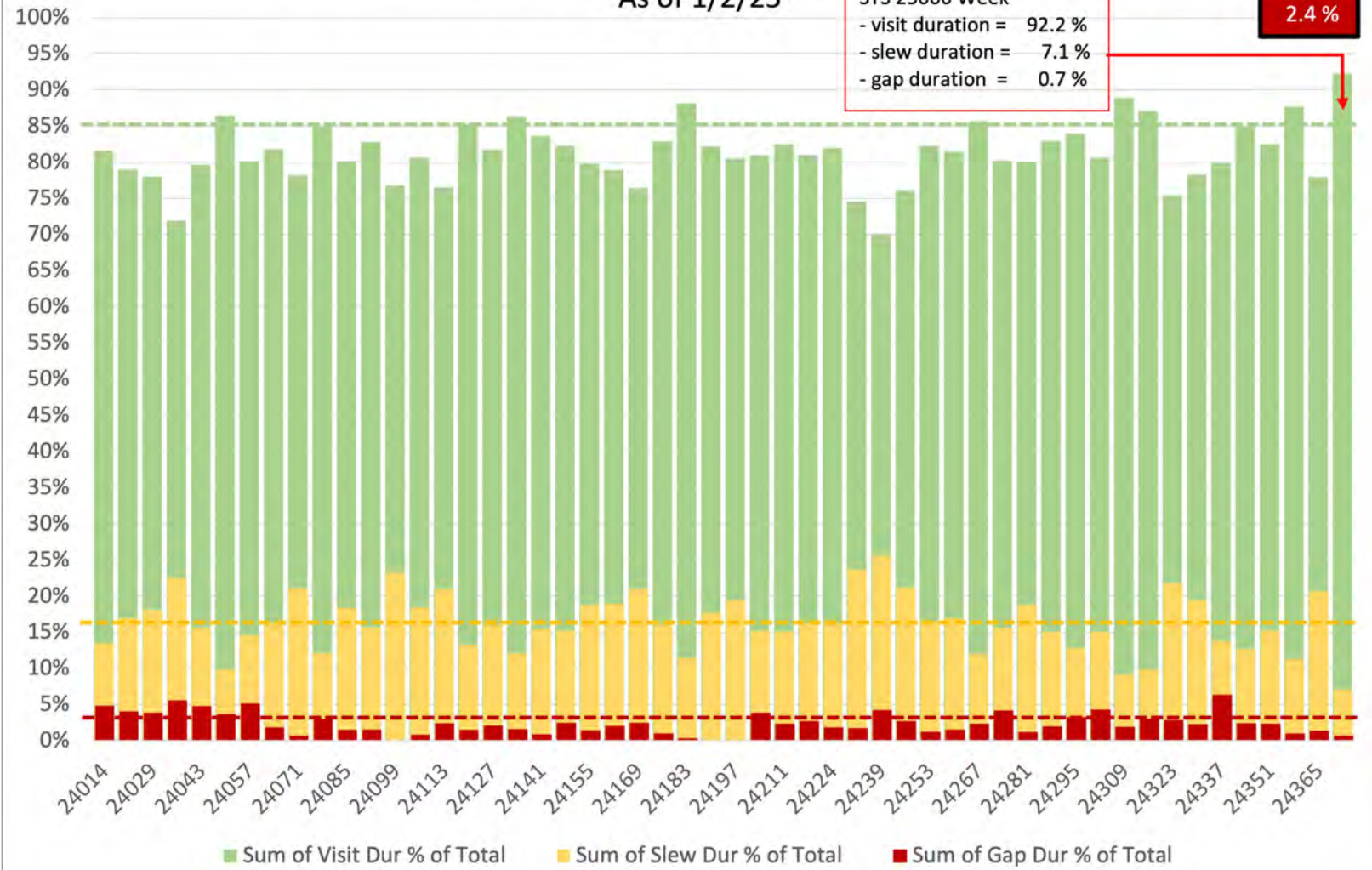
Thanks to B. Workman, K. Wymer, B. Hesman, I. Jordan, S. Meyett, A. Vick, F. Brewer, A. Dosaj, & others

## Short Term Schedule Efficiency

As of 1/2/25

STS 25006 Week  
- visit duration = 92.2 %  
- slew duration = 7.1 %  
- gap duration = 0.7 %

81.3 %  
16.4 %  
2.4 %



### As of Dec 31, 2024 –

- 6 months into Cycle 3
- Cycle 1: 99.0% complete
- Cycle 2: 95.8% complete
- Cycle 3: 31.1% complete

### Micrometeoroid Avoidance Zone

- In place since Cycle 2
- Slows mirror degradation
- Statistically applied bias
  - Observe in MAZ <20% time
  - *Not a prohibition*

Note:  
Planned efficiency shown  
(close to execution efficiency)



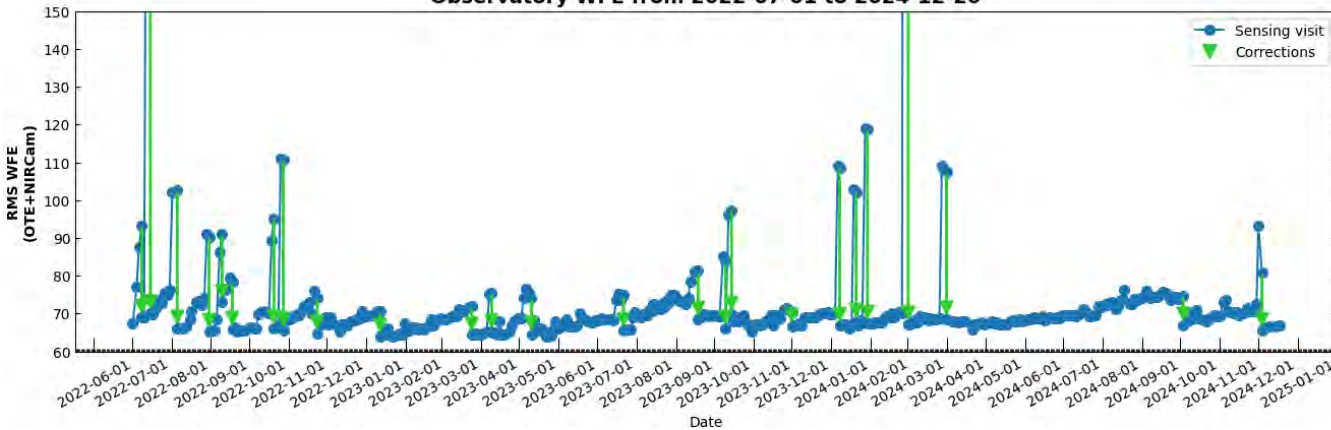


# JWST Optical & Pointing Performance

- Mirror corrections far less often than requirement
- Sensing cadence now halved to every 4 days
- Gives 80 hours/year back to science pool

- Optics team mitigating micrometeoroid degradation by adding radius-of-curvature corrections
- Only 9 nm of increased wavefront error after 25 yrs

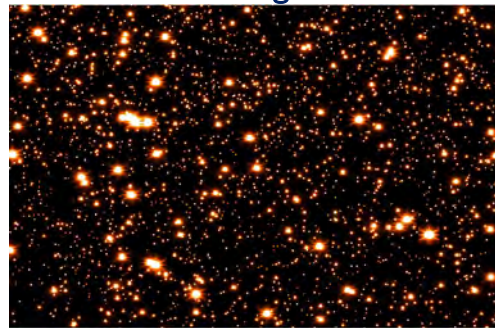
Observatory WFE from 2022-07-01 to 2024-12-20



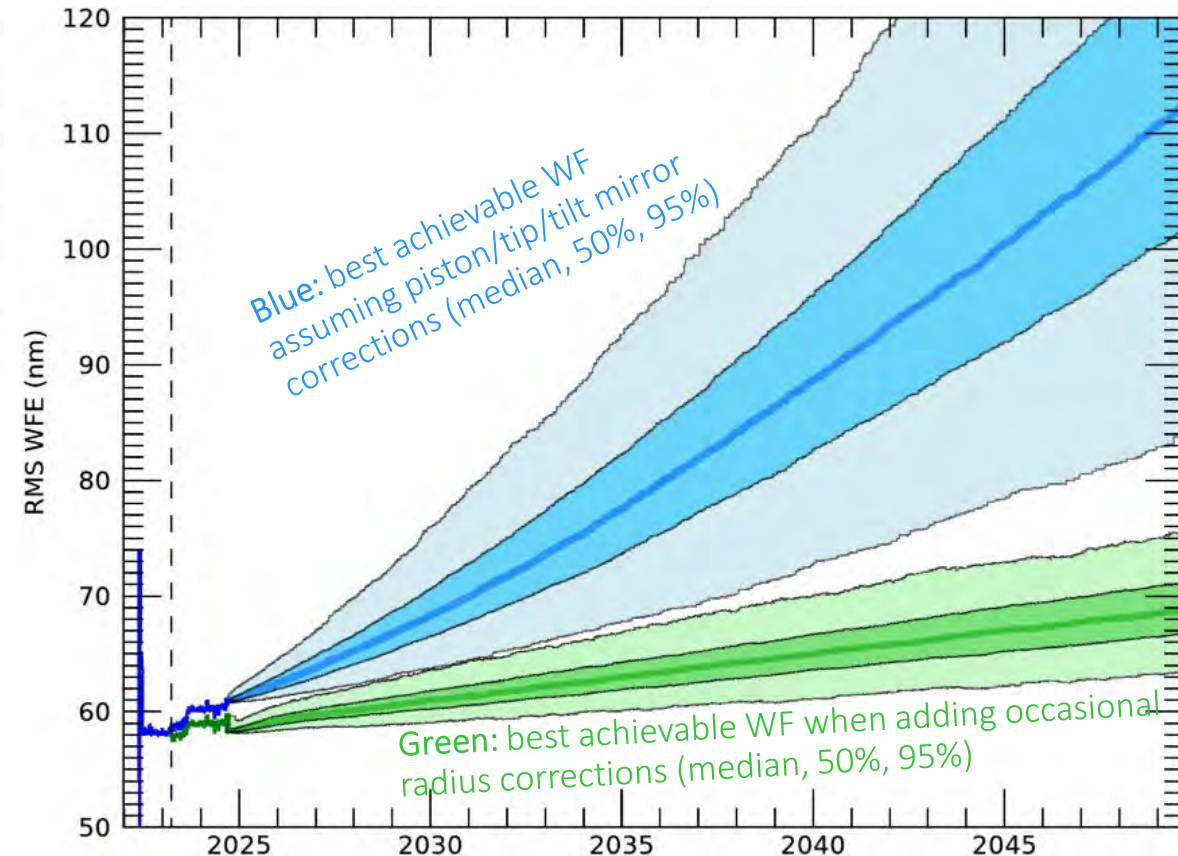
FGS sim using GSC 2.4.3



FGS sim using GSC 3



- Guide-star acquisition success improved to 96%
- Dramatic improvements in crowded fields (Sgr A)

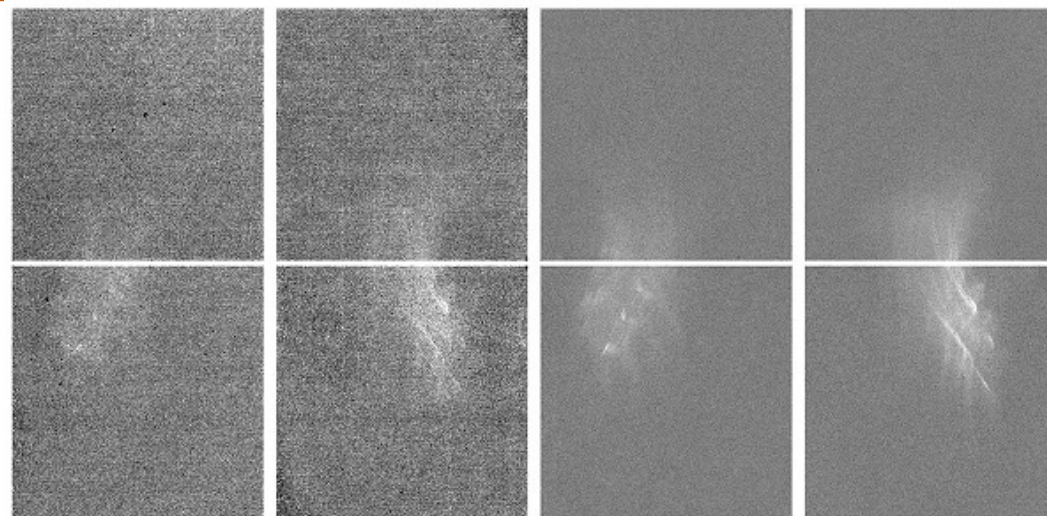




# NIRCam Highlights

- New short-wavelength grism time-series mode in Cycle 4
  - Dispersed Hartmann Sensor (DHS) previously used for mirror commissioning
  - Provides short-λ data simultaneously with extant long-λ grism to break exoplanet model degeneracies
- Additional calibration & characterization work underway
  - Brighter-fatter effect, wide-field slitless spectroscopy backgrounds, 1/f noise, updated flux calibration

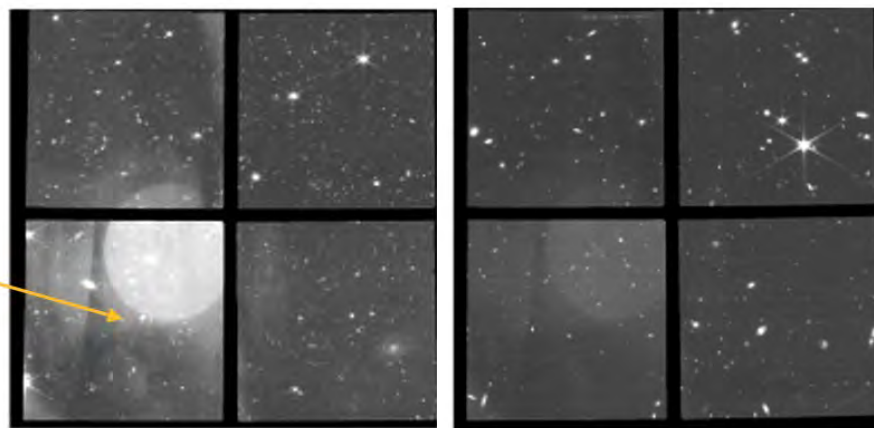
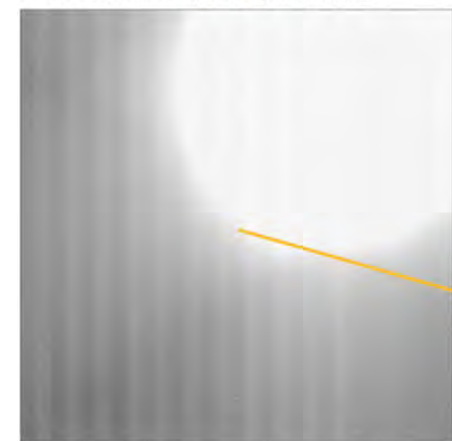
New Wisp templates & associated notebook  
 Old Template                      New Template



New mitigation of bad-actor persistence via insertion of buffer wait-time period

**ERS-1373**  
 "Observations of the **Jovian System** as a demonstration of JWST capabilities for Solar System science"

**GTO-1305**  
 And I

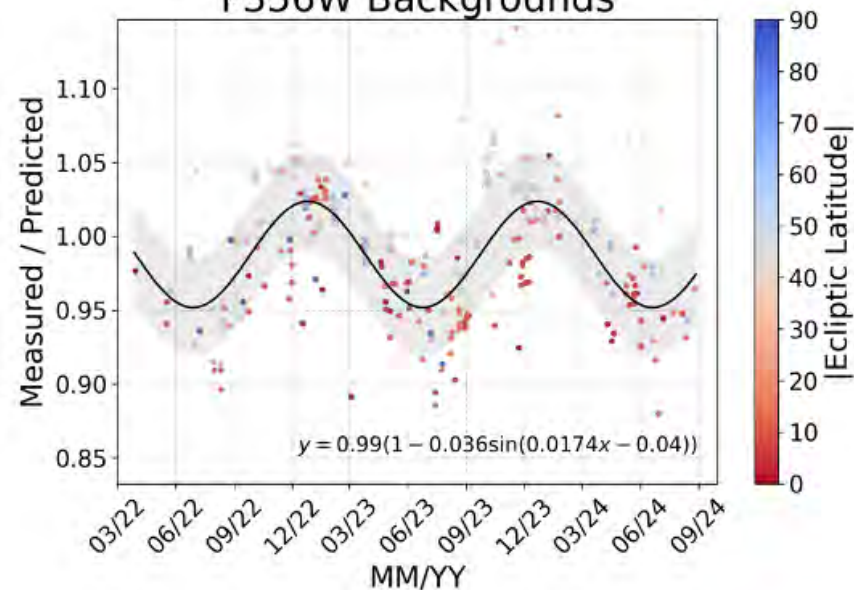


End of exp. = 2022-07-28 21:16:31

Start of exp. = 2022-07-28 21:57:00

40.5 min after ERS-1373 → +3 hr

## F356W Backgrounds



New analysis on seasonal variations (~4%) in backgrounds

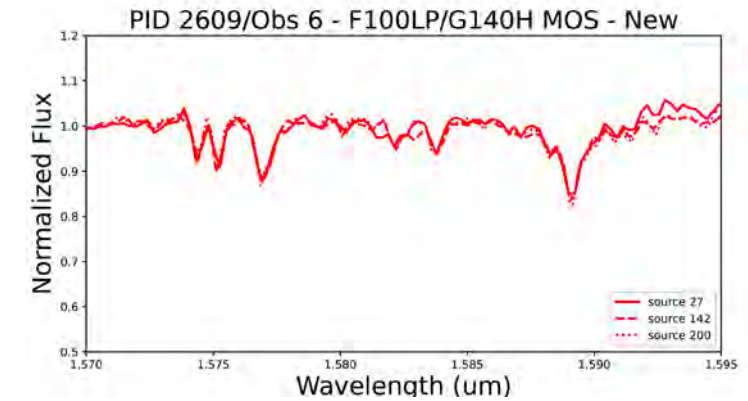
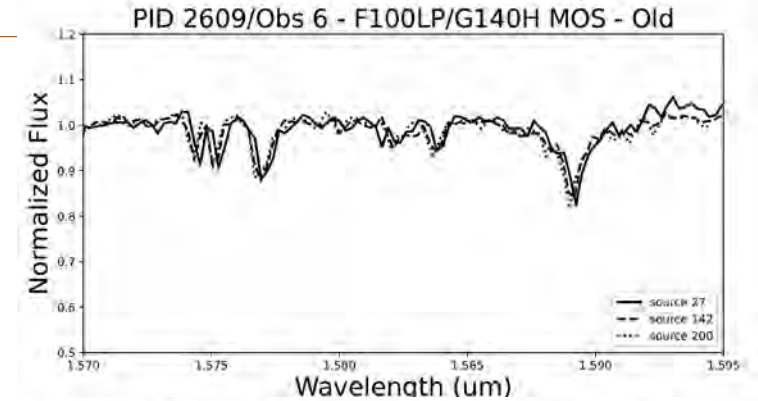
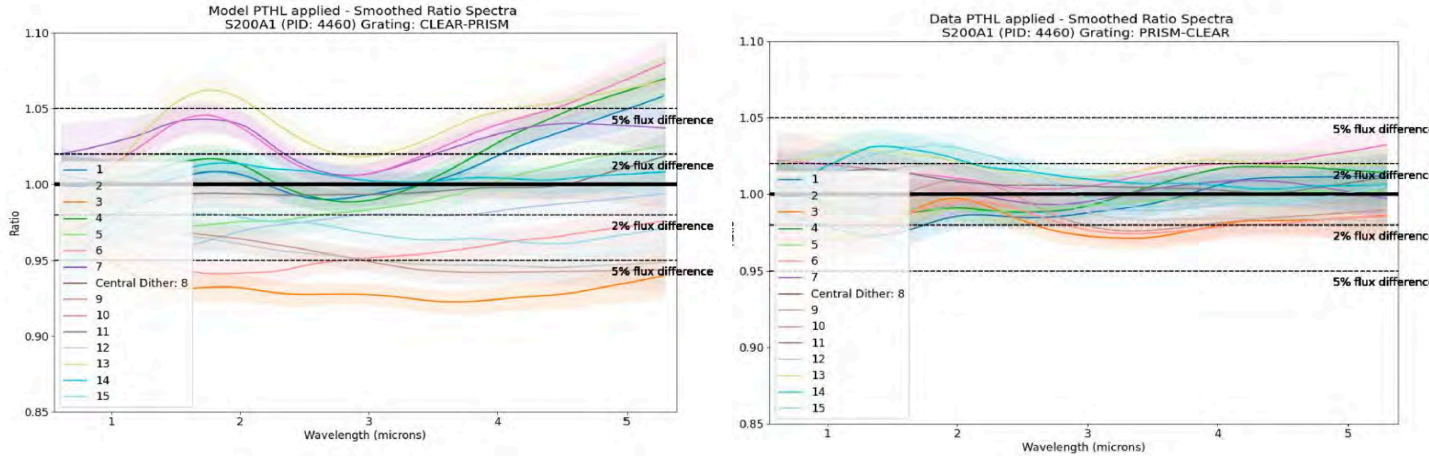




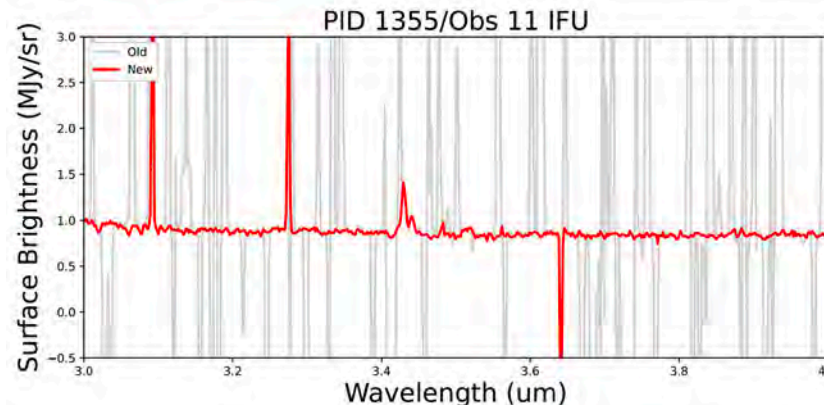
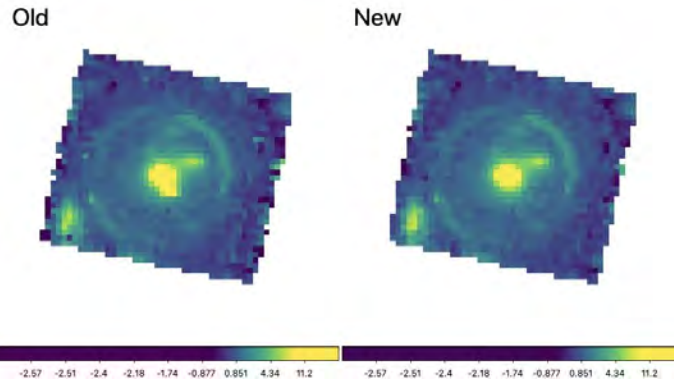
# NIRSpec Highlights

## Fixed slit (FS)

Revised FS path-loss reference files reduce systematic error to 2-3%



**Multi-object spectroscopy**  
 New wavelength correction for sources offset in slits improves relative wavelengths to  $\sim 0.1$  pix



## Integral field unit

**New outlier detection:** Lensed galaxy example showing new treatment of group-2 saturation in data with NRSIRS2 readout. New spatial & wavelength distortion corrections in progress.

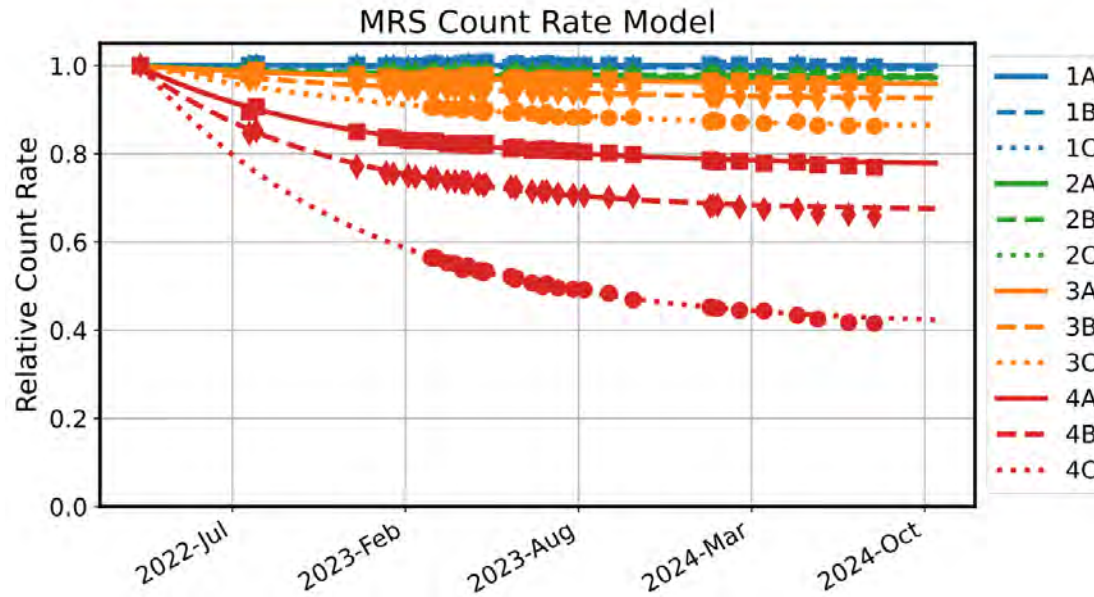




# MIRI Highlights

- Calibration

- Flux calibration updates and continued monitoring of trends
- Low-resolution slitless: update to  $\lambda$  calibration, accuracy now  $\leq 10$  nm at 6-13  $\mu$ m
- LRS slit + slitless: updates to flux calibration & aperture correction, uncertainty of  $\sim 1\%$
- MRS, imager, and coronagraphs all have updated flux calibration
- Improved bad pixel masks & darks

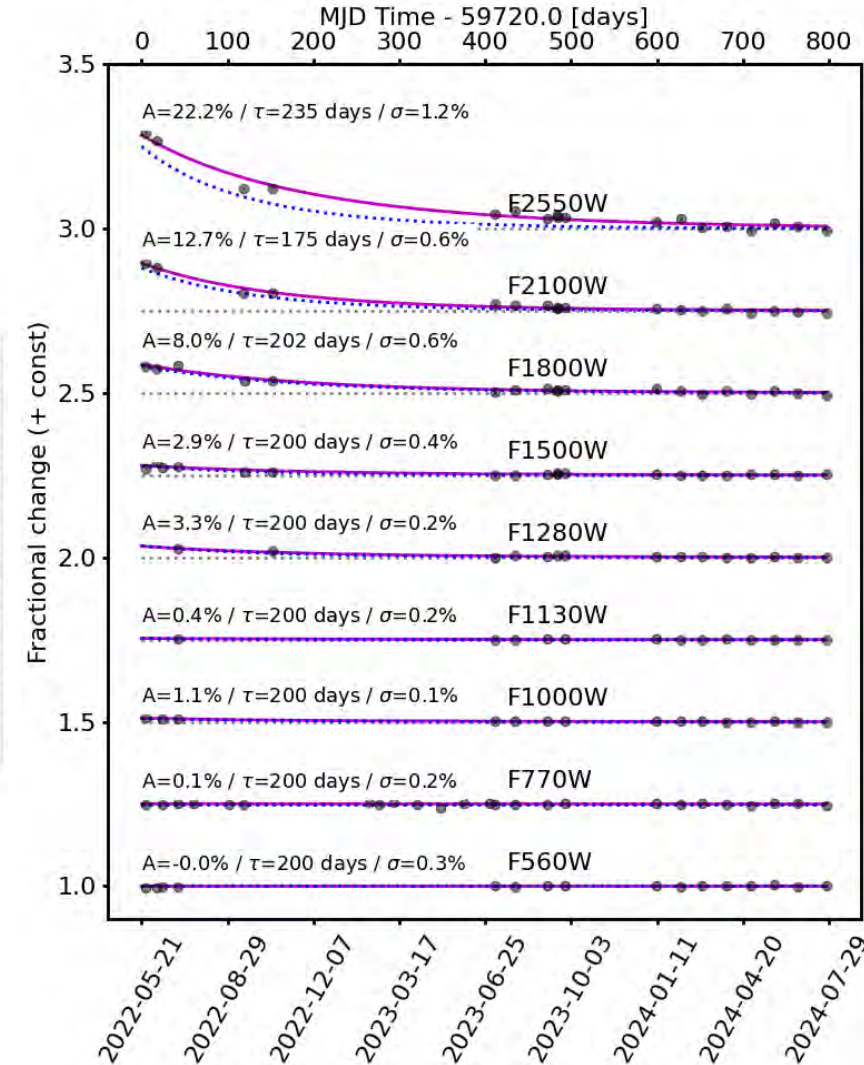


- Exposure Time Calculator

- Imager calculations now include count-rate loss
- ETC v4.0 projects losses to end of Cycle 4
- Background model updated based on MIRI trending

- Coronagraphy in FULL array fully tested & available

- MIRI Wide-Field Slitless Spectroscopy in development for future availability



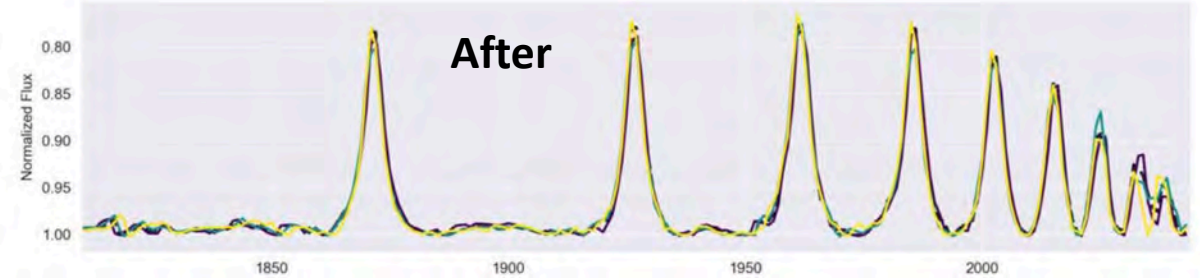
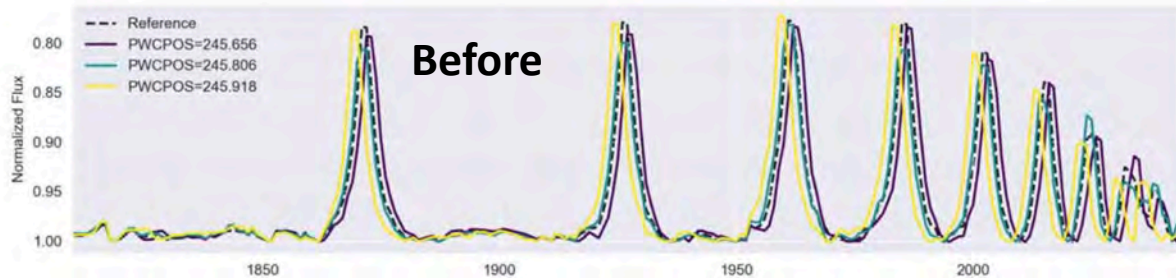


# NIRISS Highlights

## Single Object Slitless Spectroscopy (SOSS)

Improved aperture extraction and wavelength accuracy (from 4 pix to 0.5 pix) in pipeline-extracted spectra as of build 11.1

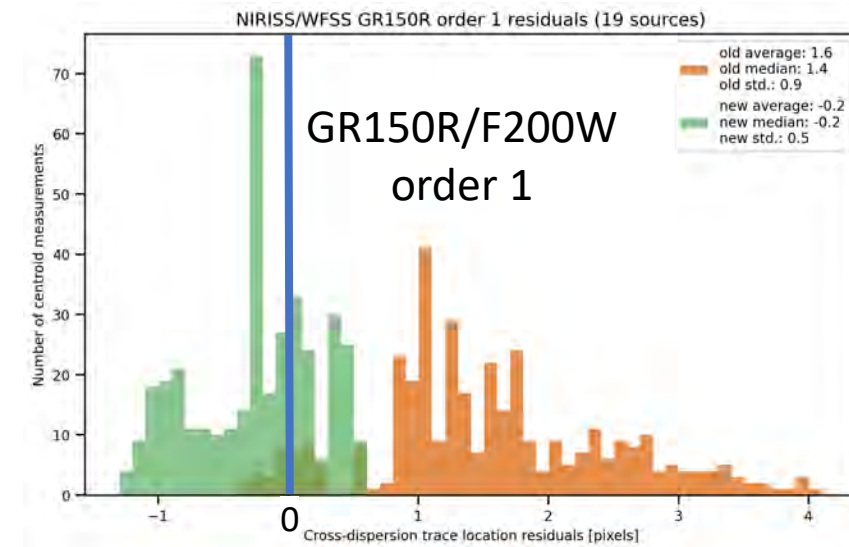
- Users no longer need to run PASTASOSS (Baines et al. 2023a, 2023b) separately to achieve this accuracy



## Wide Field Slitless Spectroscopy (WFSS)

Calibrated trace shape as function of detector position, and updated reference file for grisms and filters

- Residual = Predicted – measured trace
- Orange: old reference file
- Green: updated reference file
- Residuals more closely centered around 0, with smaller spread



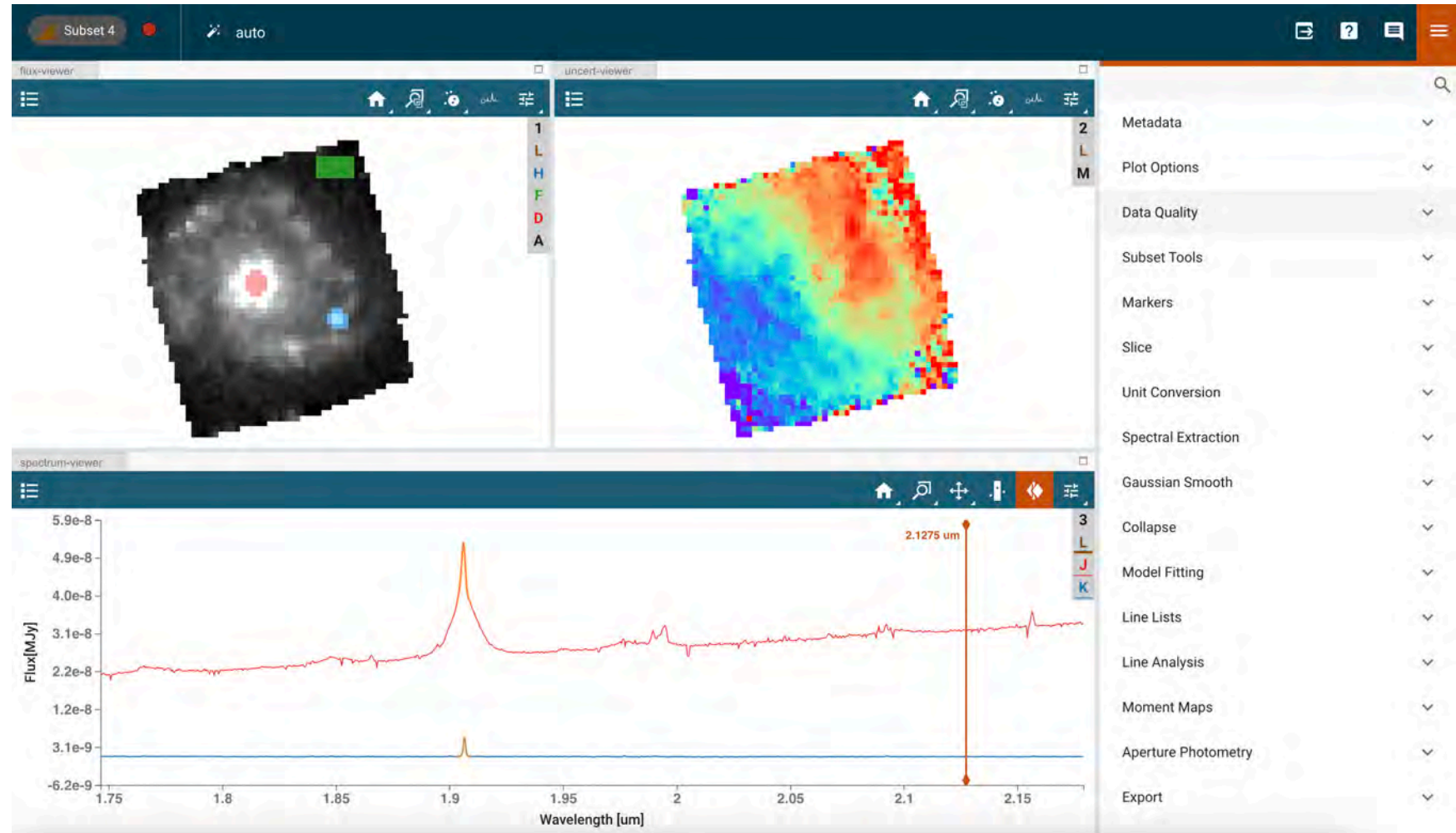
Pipeline build 10.2 also included major overhaul to aperture masking interferometry (AMI) and imaging source detection





# JWST Data Analysis Tools

- Visualization ([Jdaviz](#)) – Release of stable version 4.0
  - Fully featured spectral extraction in Cubeviz
  - Unit conversion to properly handle surface brightness and flux
  - Improvements to stand-alone version with export abilities
  - New configuration for visualization of raw data (ramps) - Rampviz
  - Performance improvements and bug fixes



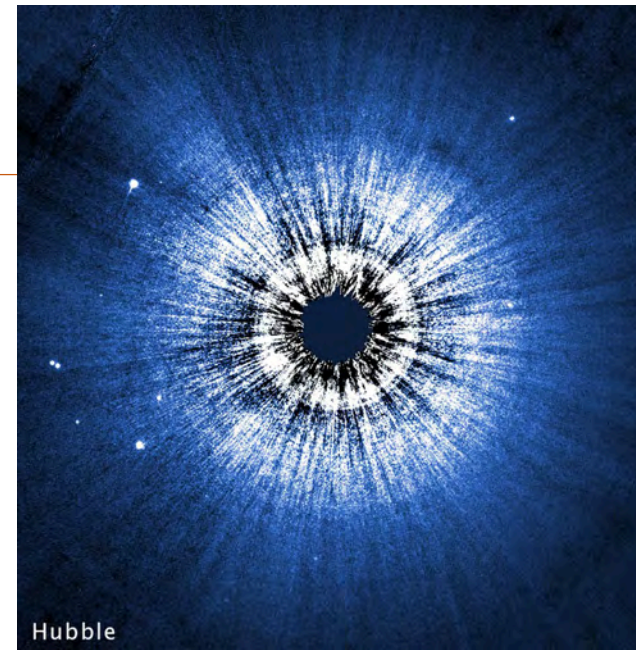
Cubeviz: cube of NGC7469 from Program 1328



## Public Outreach

Thanks to H. Jirdeh,  
C. Pullium, and others

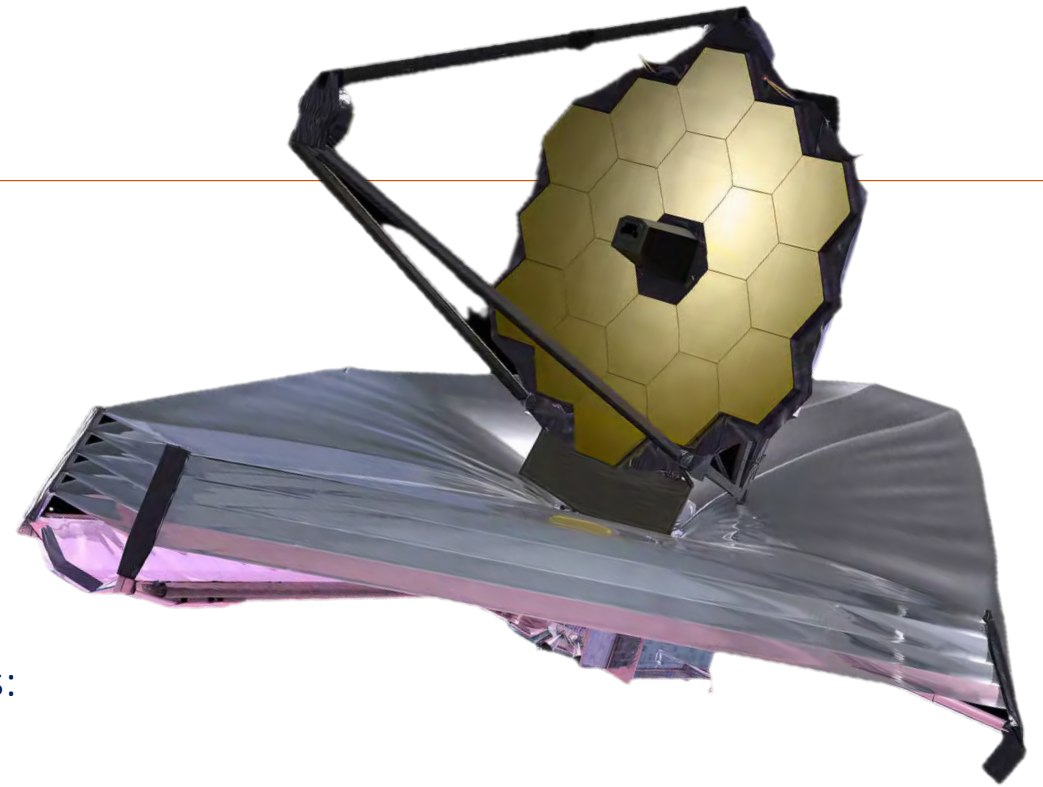
- 36 Webb news releases in 2024 resulted in 13,000+ online mentions & articles with a total potential audience of 48 billion
- Highlights of recent releases:
  - Planet-forming disks lived longer in early universe – Dec 16
  - Actively-forming galaxy as lightweight as Milky Way – Dec 11
  - Hubble and Webb probe Vega disk (*right*) – Nov 1
  - Webb reveals jets from icy centaur 29P – Oct 2
  - Webb peers into extreme outer Galaxy (*right*) – Sep 12
  - JADES GOODS South fly-through – Aug 8
  - Directly imaged cold exoplanet – Jul 24
  - Morning and evening exoplanet atmosphere – Jul 15
  - Penguin & Egg 2<sup>nd</sup> anniversary – Jul 1
  - Celestial fireworks around forming star – Jul 2
  - Pillars of Creation visualization – Jun 26
  - Detection of stellar bipolar jets – Jun 20
  - Investigating Crab Nebula origins – Jun 17
  - New window on supernova science – Jun 10
  - Carbon molecules around young star – Jun 6







# NASA Science Budget Concerns



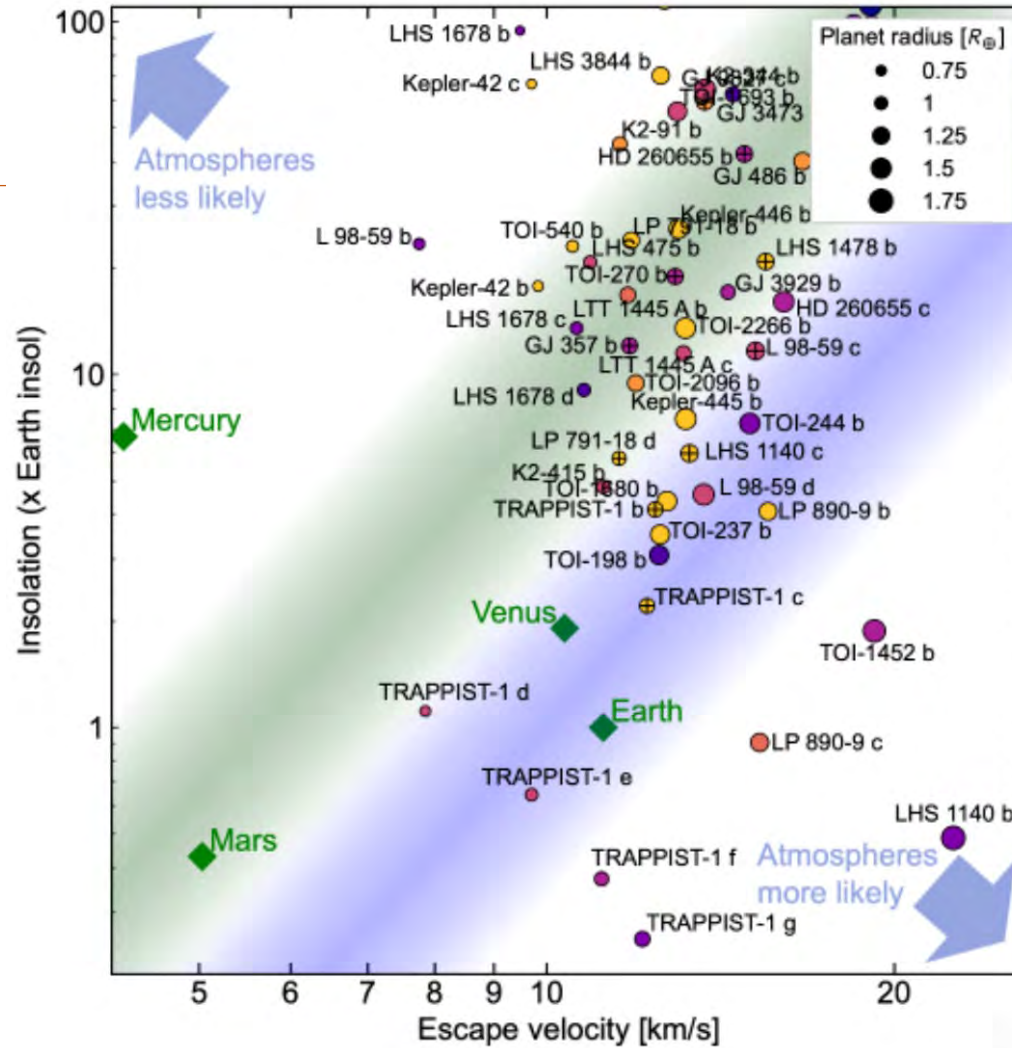
- Webb is pursuing amazing science across the entire field
- Demand continues to break records:  
2,377 proposals, 78 khrs, and 9:1 oversubscription
- 350+ grants/yr for \$60M/yr made to 100+ institutions
  - \$90M+ requested by community in Cycle 3
  - 3000 additional hours but no additional funding available in Cycle 4
  - Grants via formula in Cycle 4 (see K. Alatalo's presentation)
- Webb's performance and projected longevity exceed all expectations:
  - Expected mission of 20+ years enables long-term strategic science
  - Possible overlap with Habitable Worlds Observatory (HWO)
- Even with flat top-level funding, Webb faces a major potential shortfall starting in October 2025 (Cycle 4)
  - Webb ops costs set idealistically low in 2011
  - Subsequent inflation much higher than expected
  - Less flexibility in NASA budget
  - STScI is being asked to consider significant (~20%) cuts to science and mission ops in prime mission
- Despite Webb's incredible capabilities, its science productivity may be diminished in Cycle 4 and beyond
  - Areas potentially impacted include:
    - Observing program reviews and support
    - Cadence of calibration updates and improvements
    - High-level science products
    - Data analysis tools
    - Observatory efficiency
    - Timely resolution of anomalies and system problems
    - Engagement with scientific community and public
    - Support of current observing modes
    - Number of observing modes



# Summary

We are working to optimize Webb's science productivity and impact over its entire expected mission of 20+ years

Hubble + Webb exoplanet investigations will inform Habitable Worlds Observatory, and these missions may be operating simultaneously



Thanks to  
N. Espinoza, H. Diamond-Lowe,  
N. Batalha, K. France, L. Kreidberg,  
N. Reid, M. Lopez-Morales, and others

Rocky Worlds DDT program will invest 500 Webb hours and 250 Hubble orbits to investigate the cosmic shoreline delineating worlds with atmospheres

