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EXPANDING THE FRONTIERS OF SPACE ASTRONOMY

Webb Science Operations Center Update

Tom Brown
(with contributions from many staff noted within)

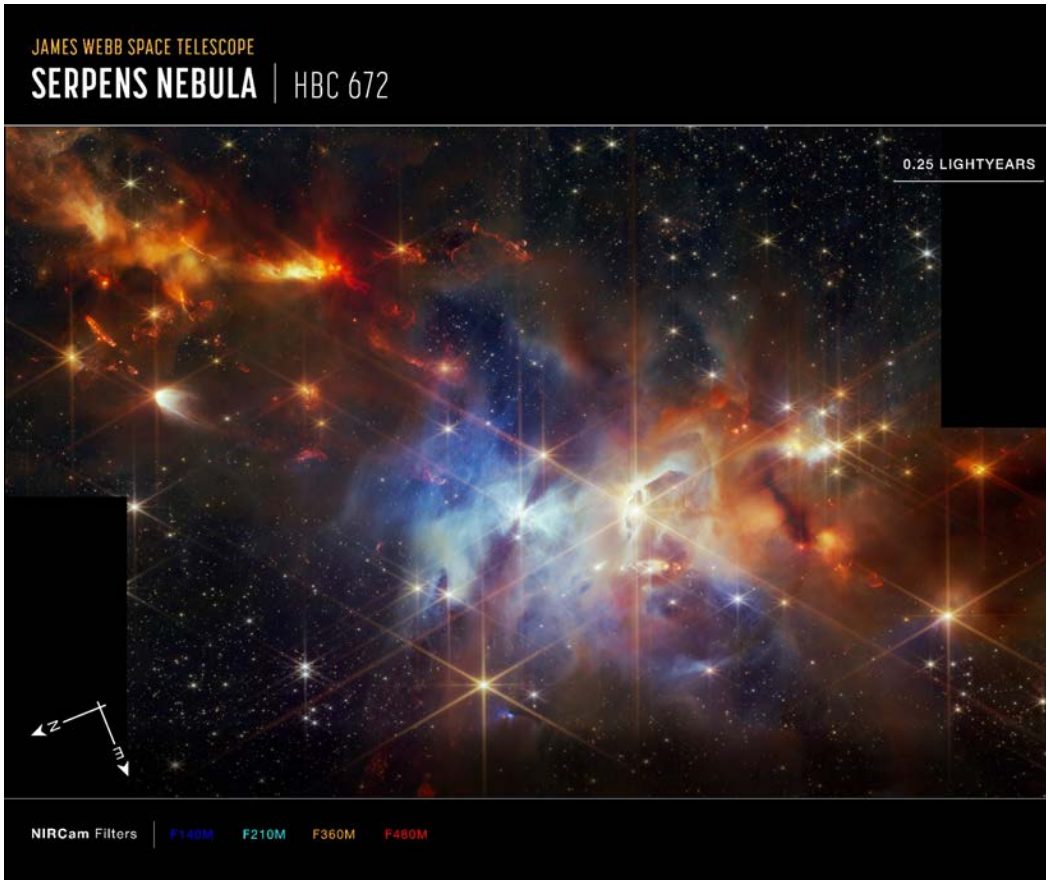
November 11, 2024

Summary

- Spectacular science across all of astrophysics
  - *Expected to continue for 20+ years*

- Record response to Cycle 4 solicitation
  - 2377 proposals for 78,000 hours
  - 8500 hours in Cycle 4 pool (increased from 5500 hours)
  - Oversubscription still high (~9:1)
  - ETC issues (being addressed)

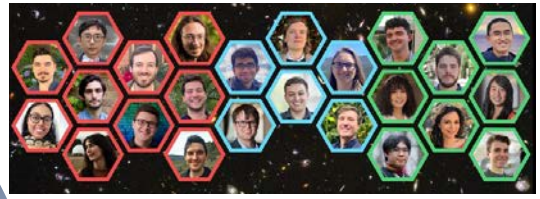
- Significant improvements to calibration (see David Law presentation)
- Observatory & instrument support improving mission's science productivity
- Adjusting flight ops to long-term sustainable posture
- New data analysis tools
- Public outreach drives support for mission & broader field
- New approach to grants review (see Ata Sarajedini presentation)

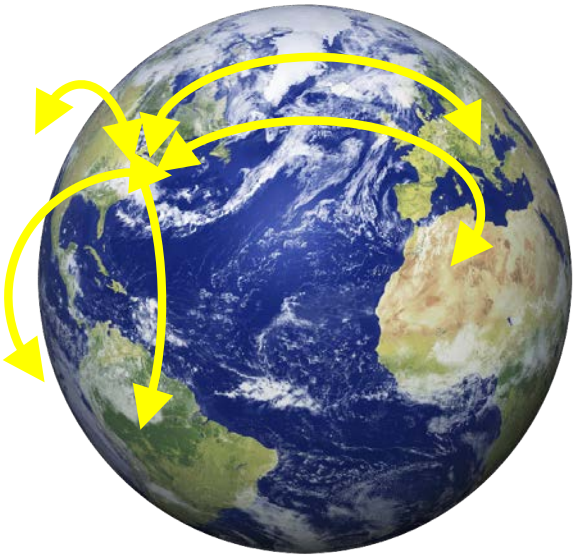


Science Operations Highlights

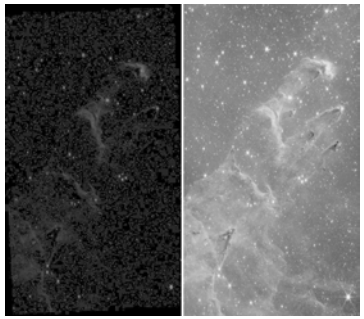
Archive, Grants, & Outreach
- Maintenance of data archive for researchers
- Distribution and management of research grants
- Scientific outreach to public & scientific community

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





International scientific community



Data Processing & Calibration
- Raw data into well-calibrated science-ready data products

Planning, Scheduling, & Commanding
- Work with investigators to turn projects into scheduled telescope operations

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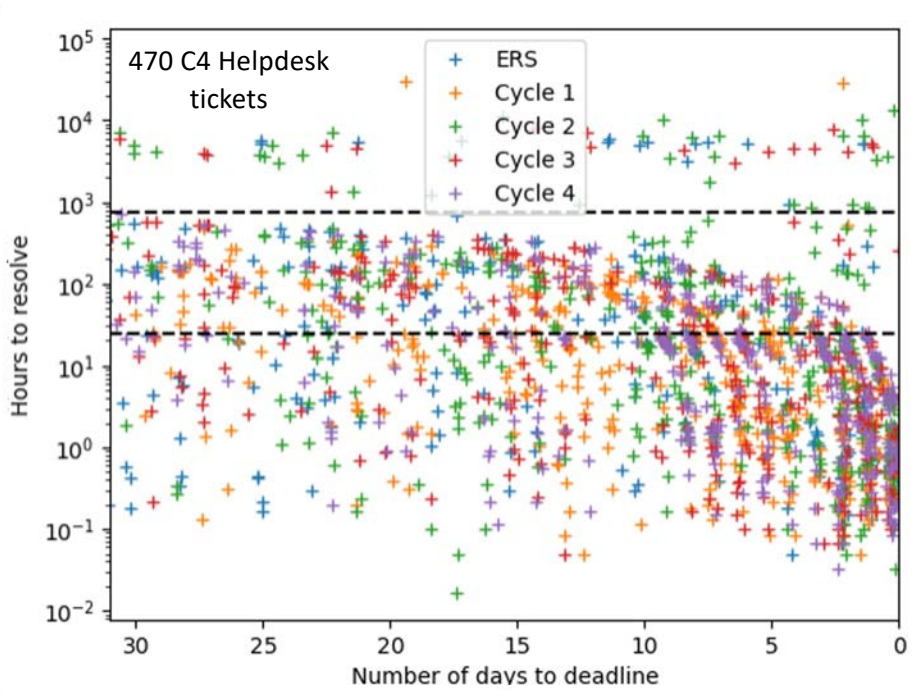
Science Selection

Thanks to Aleksandra Hamanowicz, Katey Alatalo, Chris Sontag, Vicki Laidler, Karla Peterson, Brian McLean, Nicolas Flagey, Maca Garcia Marin, Stacey Bright, Jeff Valenti, Neill Reid, Joseph Filippazo, and many others

Cycle 4: Record-breaking response (2377 proposals & 78 khrs) plus some issues

- 6% Solar System
- 16% exoplanet atmos
- 12% exoplanet systems
- 16% stars & stellar pops
- 9% gas, dust, & ISM
- 11% SMBH
- 11% nearby galaxies (0<z<2)
- 19% high-z galaxies (z>2)



Exposure Time Calculator issues

- Extreme slow-downs during last 48 hours
- Trouble logging in (delays of minutes to hours)
- Proactively increased capability of database server
- File server impacted by change in AWS network bandwidth limits – will upgrade server type
- Posted notice on JWST Helpdesk page
- Provided extensions to three investigators

Missing guide stars in some regions

- C4 proposals & C2/C3 MSA planning (5 tickets)
- Duplicate entries in GSC 3.0 → failed isolation test
- Addressed in November GSC 3.1 update (early access given to impacted users)
- Proactively ID'ed & informed programs w/MSA impacts
- Posted banner on JWST Helpdesk page

Webb Office Hours underutilized so far

- 18 sessions, 26 users (15 unique), 60 questions

Planning & Scheduling

Cycle Completion Status

Thanks to Bill Workman, Kristen Wymer, Brigette Hesman, Ian Jordan, Shelly Meyett, Alison Vick, Fawn Brewer, Anil Dosaj, and many others

As of Oct 30, 2024 –

- 4 months into Cycle 3
- Cycle 1: 98.7% complete
- Cycle 2: 95.3% complete
- Cycle 3: 17.5% complete

- SURVEY only used for undersubscribed calendar
- Cycle 2 SURVEY programs stopped at start of Cycle 3
- Cycle 3 SURVEY values reported for visits with assigned windows

Cycle	Cycle 1		Cycle 2		Cycle 3	
Category	Total Time [hrs]	Complete [hrs] (%)	Total Time [hrs]	Complete [hrs] (%)	Total Time [hrs]	Complete [hrs] (%)
GO	6223.4	6113.0 (98.2%)	5459.6	5186.7 (95.0%)	5967.2	840.5 (14.1%)
GTO	3806.7	3765.4 (98.9%)	175.3	153.3 (87.4%)	299.5	99.5 (33.2%)
DD	168.1	168.1 (100%)	220.3	210.1 (95.3%)	124.8	36.0 (28.8%)
CAL	706.8	706.8 (100%)	662.2	660.9 (99.8%)	645.1	258.6 (40.1%)
ERS	554.2	554.2 (100%)	-	-	-	-
SURVEY	-	-	308.0	308.0 (100%)	303.5	259.6 (85.5%)
Total	11,459.2	11,307.5 (98.7%)	6517.4 (w/o SURVEY)	6211.0 (95.3%)	7036.6 (w/o SURVEY)	1234.6 (17.5%)

Table gives charged hours, including all overheads

Planning & Scheduling

Thanks to Bill Workman, Kristen Wymer, Brigette Hesman, Ian Jordan, Shelly Meyett, Alison Vick, Fawn Brewer, Anil Dosaj, and many others

Cycle Completion Status

Total Cycle Completion History/Projections				
Cycle	Formal cycle end date	~50% Complete as of:	~90% Complete as of:	Current estimate of the last observation of cycle
1	6/30/23	4/6/23	12/13/23	12/9/25
2	6/30/24	4/15/24	9/12/24	11/24/25
3	6/30/25	3/4/25	7/31/25	2/23/26

Completion statistics for challenging exoplanet programs (those with period/phase special requirements for transits)

Cycle	Total Programs	Total Visits	Total Time [hrs]	Total Visits Complete	Complete [hrs] (%)
1	49	186	1633.92	179	1550.79 (94.9%)
2	29	115	915.88	106	852.41 (93.1%)
3	24	87	839.72	5	108.28 (12.9%)
Total	102	388	3389.52	290	2511.48 (74.1%)

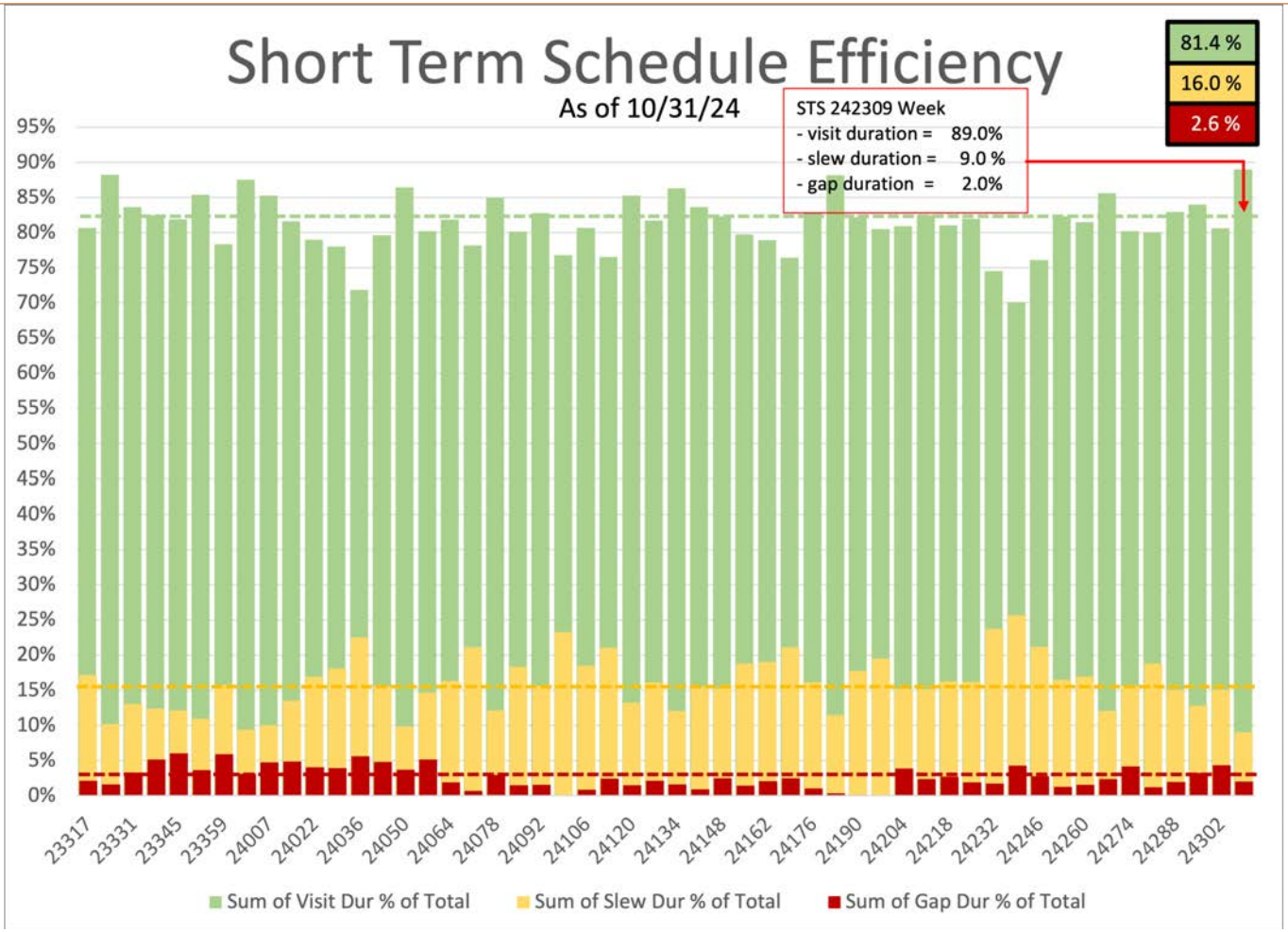
Highlight:
GO-6491 exoplanet program with 60-hour visit executed successfully Oct 24-27

Engineering staff have improved timing predictions for scheduling

Planning & Scheduling

Thanks to Bill Workman, Kristen Wymer, Brigette Hesman, Ian Jordan, Shelly Meyett, Alison Vick, Fawn Brewer, Anil Dosaj, and many others

Efficiency



Note:
Planned efficiency shown, which is close to execution efficiency

Thanks to Bill Workman, Kristen Wymer, Brigette Hesman, Ian Jordan, Shelly Meyett, Alison Vick, Fawn Brewer, Anil Dosaj, and many others

Micrometeoroid Avoidance Zone (MAZ) statistics

MAZ stats in plan (predictive):

LRP	Cycle 3 total time in LRP	Cycle 3 % of time observing in MAZ	Cycle 1-3 total time in LRP	Cycle 1 -3 % of time observing in MAZ
LRP generated on Sept 20, 2024 (Current)	4766.1 hrs	13.8%	5152.2	15.4%
LRP generated on May 24, 2024 (Cycle 3 plan window release)	4649.5 hrs	17.4%	6465.2	20.8%

MAZ stats since Nov 2022 (actual):

Cycle	Total time executed	% of time observing in MAZ
1	8967.2 hrs	38.7%
2	7409.8 hrs	12.9%
3	967.4 hrs	27.5% trending down
All	17399.4 hrs	27.2% trending down

- MAZ mitigation lowering overall time spent in MAZ
- No MAZ in Cycle 1
- MAZ is 37% of the sky
- Required to consider MAZ as new visits come into plan for Cycle 2+
- Time spent in MAZ will trend downward as Cycle 1 fraction decreases
- Cycle 3 front-loaded with more MAZ usage

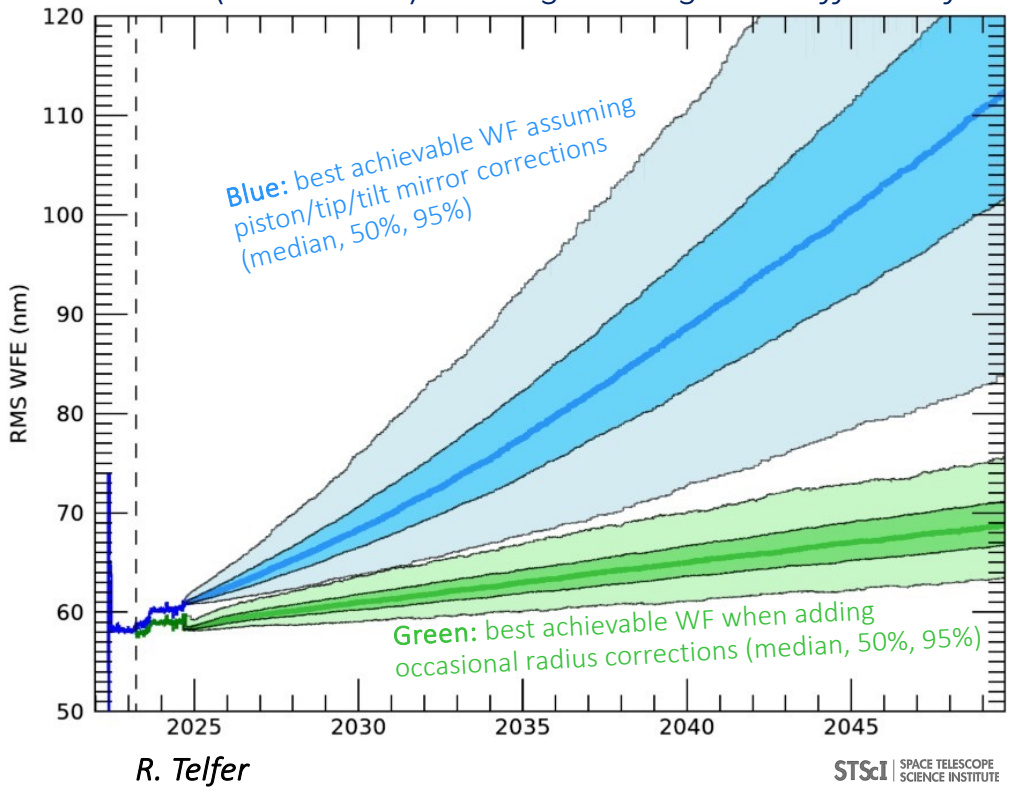
Thanks to Matt Lallo, Randal Telfer, Marshall Perrin, and others

JWST Optical & Pointing Performance

Mitigating micrometeoroids to *maximize mission life*

- STScI has measured, modeled, and performed special mirror control (last month) to *mitigate long-term effects of micrometeoroids on optical quality*

  - Micrometeoroid degradation driven by large outlier events and not routine events
  - By identifying and analyzing micrometeoroid effects, we obtain flash energies and induced figure error for entire observed population of micrometeoroid hits
  - Using observed event distribution and Monte Carlo sims, we project wavefront error (WFE) over expected mission lifetime
  - With normal WF control, after 25 years, total WFE increases by 50 nm to 112 nm (25% better than requirement)
  - **By adding Radius of Curvature corrections to mirror control (as we are doing ~once a year) we sustain only**
    ~3 nm of increased WFE after 10 years
    ~9 nm of increased WFE after 25 years



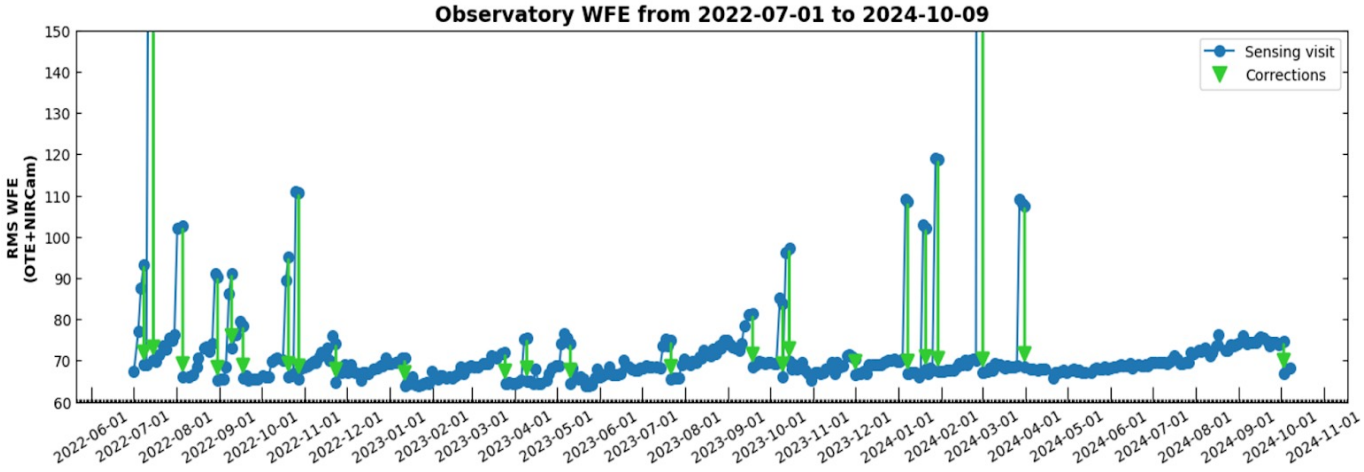
Observatory Characterization

Thanks to Matt Lallo, Telescope Branch, and others

JWST Optical & Pointing Performance

Wavefront Sensing & Control (WFS&C): *Giving time back to science*

- Excellent optical stability & low WFE mean less time spent correcting
- STScI proactively reduced WFS time and impact, resulting in *more (and better) science*
  - This month, with S&OC 7.1, we begin:
    - routine WFS&C at half cadence, every ~4 days vs. 2 days (releases ~80 hours per cycle)
    - sensing at new NIRCam field point (reduces persistence in science immediately following WF visits)
- Time spent maintaining the optics
  - WFS&C nominal conops was ~250 hrs/cycle
  - Early science ops reduced to ~160 hrs/cycle
  - Now reduced to *~80 hrs/cycle*
  - We are studying more savings & efficiencies for WFS&C that can achieve ≲60 hrs/cycle



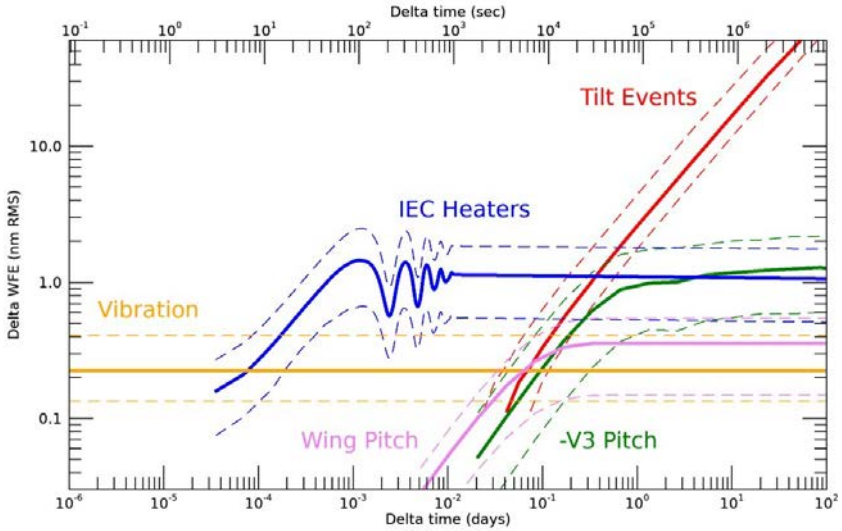
Primary mirror has become much more stable with time (just went 6 months without a correction)

Thanks to Matt Lallo, Telescope Branch, and others

JWST Optical & Pointing Performance

Optical characterization: We are *developing models to aid science*

STScI performed comprehensive analysis of observed optical behavior:
Empirical characterization of JWST wavefront error variations,
Telfer et al., SPIE 8/2024 http://dx.doi.org/10.1117/12.3020273

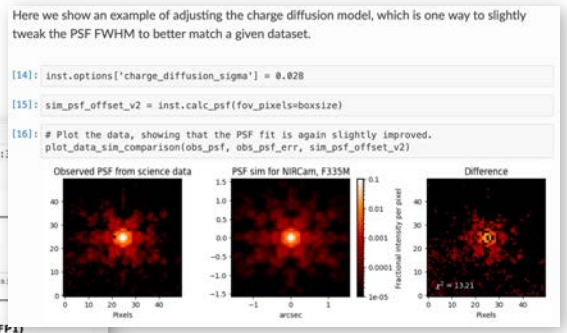


Magnitude of changes over a given time interval
(solid lines represent median, dashed lines represent 1st and 3rd quartiles)

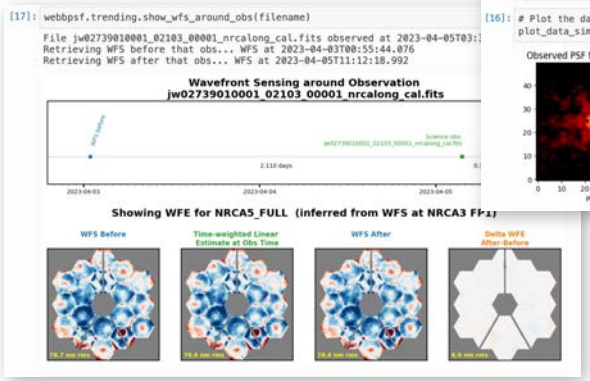
- At the shortest time scales, vibration dominates
- For intervals ≳10 sec, IEC heater oscillation dominates
- At time scales > few hours, tilt events had dominated, but over past 6 months, largely reversible thermal "pitch modes" and wing modes now dominate, and we have been able to characterize them in weak lens TSO data

STScI continues to improve fidelity of PSF simulator (*WebbPSF*), releasing versions 1.3 & 1.4

Enhancements include improved support for NIRSpec and MIRI IFU PSF calculations, improved MIRI Imager PSF fidelity, better trending tools, and ability to easily determine WFE and PSF best matching a particular science observation



NIRCam PSF with charge diffusion



Obtaining and using WF measurements bounding a given observation

Observatory Characterization

Thanks to Matt Lallo, Telescope Branch, and others

JWST Optical & Pointing Performance

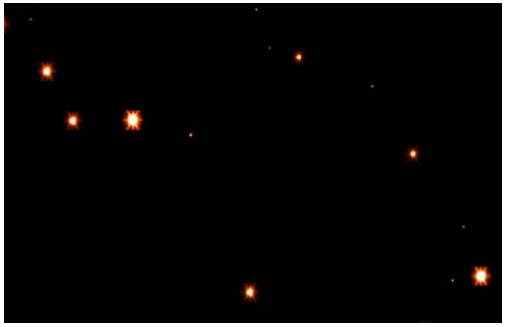
Guide-star acquisition success rate has improved to ~96%

We have *improved guiding performance in challenging fields*

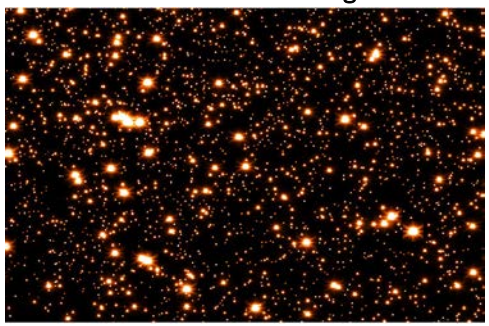
- Improved guiding success in crowded fields, particularly in Galactic plane, bulge, and region around SgrA*
  - Statistics across two SgrA* visibility windows indicate a ***~7-fold increase in guiding success***
  - See JWST Observer News article, *JWST Returns to the Galactic Center with Much Improved Success Rate*
- Also implemented "VVV" survey (ESO/VISTA) into GSC 3.1 to supplement regions of Galactic bulge and plane
  - Expect improvements in guiding success comparable to that achieved in SgrA*
  - GSC 3.1's release is imminent as of this fall 2024
- Additional wide-ranging improvements to guiding for variety of challenging regions and target types were are in progress

2MASS (dominates GSC 2.4.3)

Webb FGS simulation using GSC 2.4.3



Webb FGS simulation using GSC 3.0

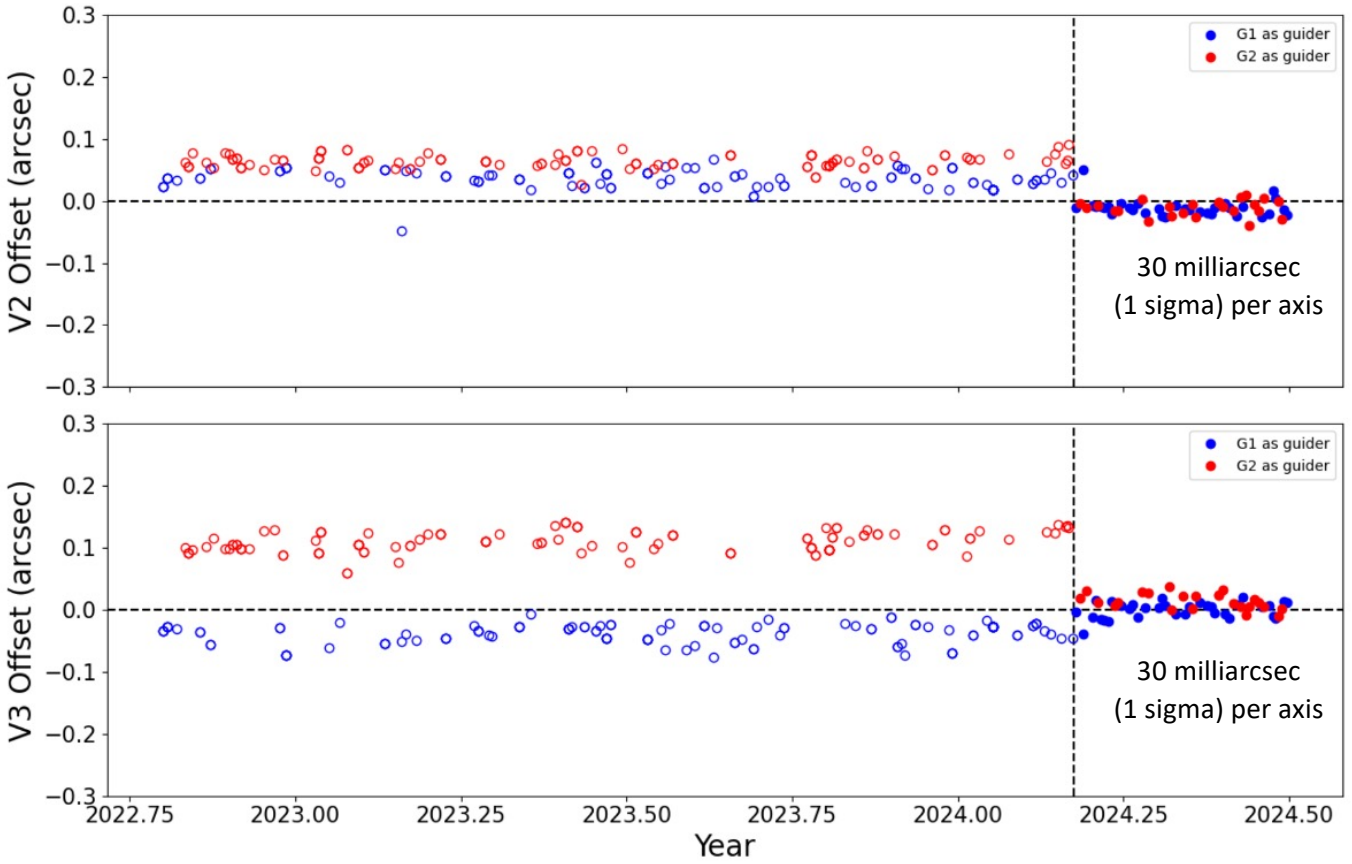


Actual Webb FGS image

Thanks to Matt Lallo, Tony Sohn, Telescope Branch, and others

JWST Optical & Pointing Performance

Smaller NIRCam TA corrections after updating FGS aperture location in focal plane



Astrometric Performance:
We Improved pointing through focal plane calibrations

OTE Science Performance Memo
FGS2-to-FGS1 Alignment Offset and Correction (Sohn, 8/2024)

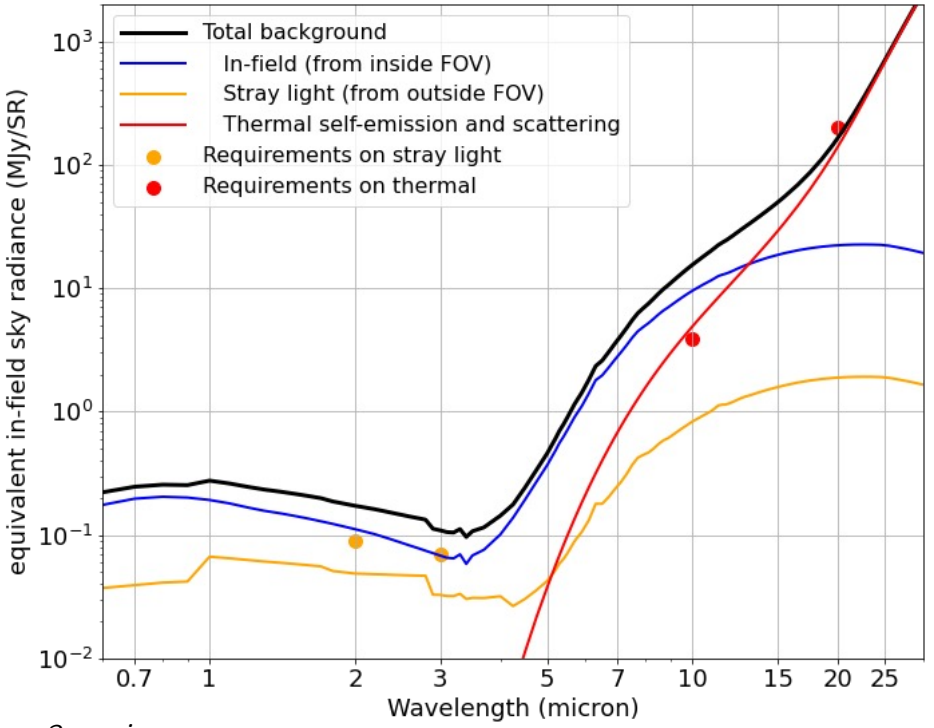
We are working to assess and better document astrometric accuracies across wide variety of modes

Observatory Characterization

Thanks to Kate Rowlands, Ben Sunnquist, Misty Cracraft, Marshall Perrin, Jane Rigby, Mike McElwain, and many others

Improving knowledge of JWST Observatory Backgrounds

- Background often a limiting factor for deep observations
- Background depends upon both astrophysics (zodiacal dust, ISM) and observatory (thermal emission, stray light)
- Commissioning measurements (Rigby+2023) show superb performance but some discrepancies with models, depending on wavelength
- At long wavelengths, background is slowly rising with time (~2%/yr – next slide), as expected due to space weathering
- Cross-instrument monitoring & analysis has allowed improved characterization of
  - observed background compared to models
  - changes over time in background (e.g., seasonal NIRCam variations)
- Includes dedicated monitor program using MIRI imager & MRS, plus measuring backgrounds in MIRI + NIRCam science data



3 regimes:

< 4 µm: Usually* dominated by Solar System dust scattered sunlight	4 - 12 µm: Solar System dust thermal emission	> 12 µm: Sunshield & telescope thermal emission

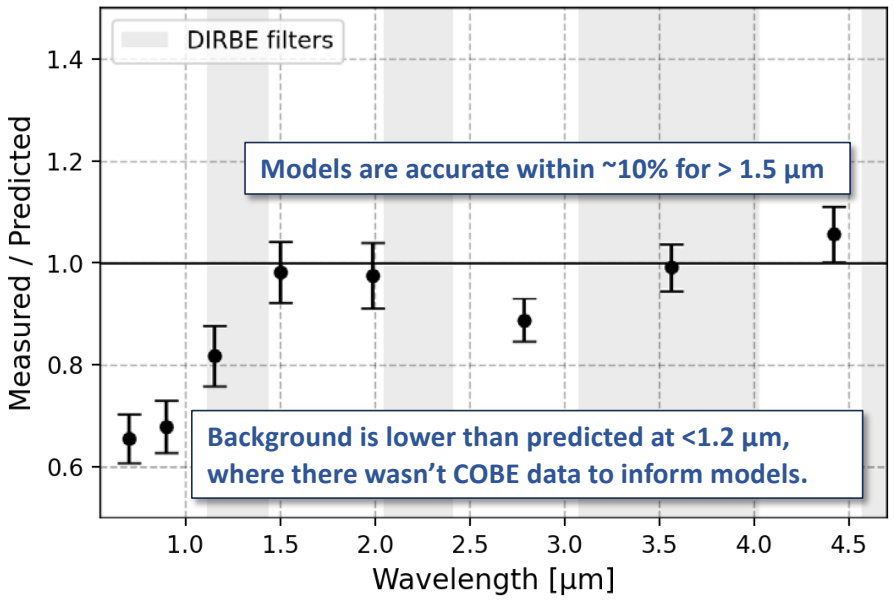
** With some variations depending on particular line of sight and date*

Thanks to Kate Rowlands, Ben Sunnquist, Misty Cracraft, Marshall Perrin, Jane Rigby, Mike McElwain, and many others

Results from ongoing backgrounds monitoring

< 12 µm: no long-term trend with time, but small average offsets

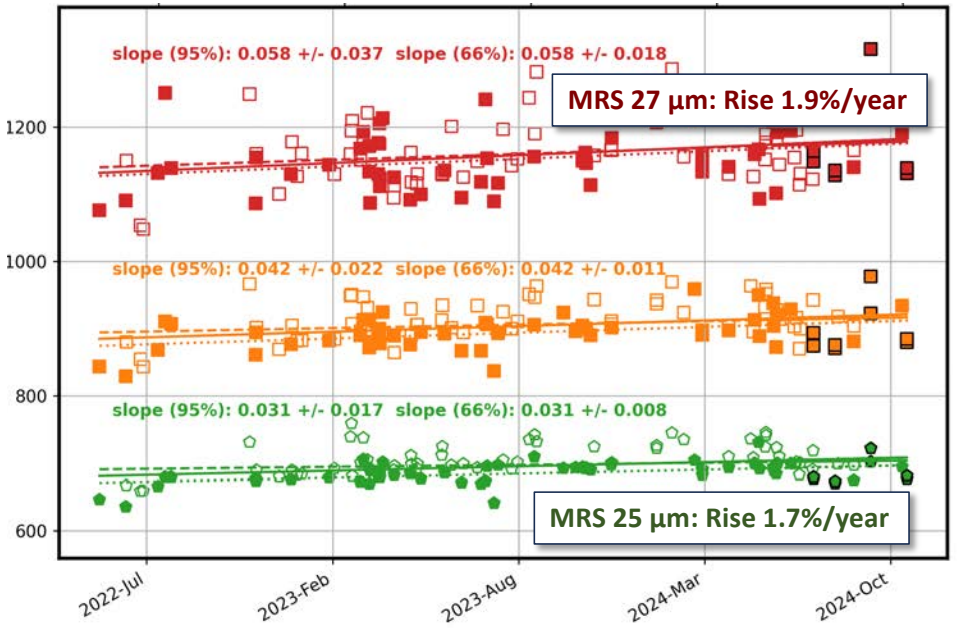
Small discrepancies between models and data are from imperfect knowledge of Solar System dust. Spitzer saw very similar offsets.



NIRCam background analyses by B. Sunnquist et al. 2024

> 15 µm: slow increase, ~2% per year

Likely due to space weathering and gradual temperature increases. Measurable, but a small effect compared to changes in MIRI sensitivity.



MIRI MRS background analyses by K. Rowlands et al.

Thanks to Amanda Arvai, Tim Johnson, Ron Jones, Kenny McKenzie, Margaret Jordan, Flight Ops Branch, and many others

Flight Operations Update

Updated communications schedule

- On Aug 23, Deep Space Network (DSN) reduced backup antenna power (250W to 150W)
- Extends antenna amplifier lifetime and keep parts within warranty
- At 150W, backup stations unable to maintain lock at 16Kbps near apogee
- Flight ops team mitigated by making new baseline of 2Kbps uplink beginning Oct 8
- Minimal impacts to operations and ***no impacts to science***
  - Most activities are single commands – can be performed at any rate
  - Observation Plan uplinks take ~2x longer (up to ~2 hrs) but still fit in most contacts
- Team will manually switch to 16Kbps as needed and when possible

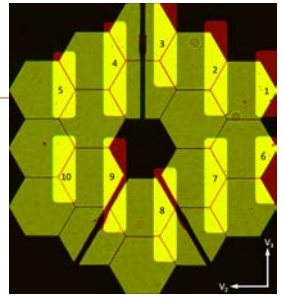
DSN blackout period 12am-6am beginning Feb 2

- Coincides with DSN-requested decrease in coverage from 12 hrs/day to 10 hrs/day
- Closer to the 8 hrs/day expected pre-launch
- Improves work/life balance and staff retention, reduces costs
- Maintains daytime contact saturation rate for special activities and recoveries
- On-call and contingency staff onsite as needed (e.g., anomalies, DSN scheduling issues)
- Flight ops reduced from 3 to 2 staff on nights and weekends
- No significant operational impacts expected, but begins with 2-month trial period

Instrument Support

Thanks to Martha Boyer, Mario Gennaro, John Stansberry, Jeff Valenti, Nestor Espinoza, and many others

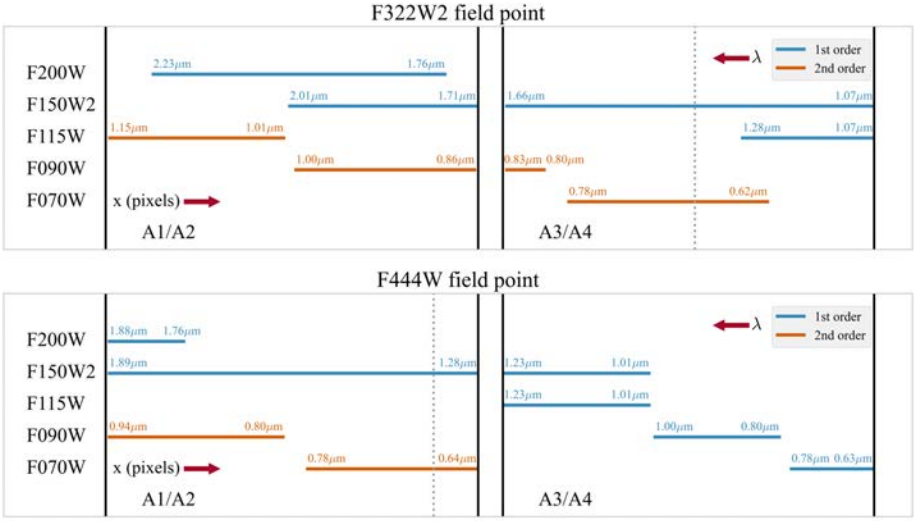
New NIRCam Shortwave (SW) Grism Time-Series Mode



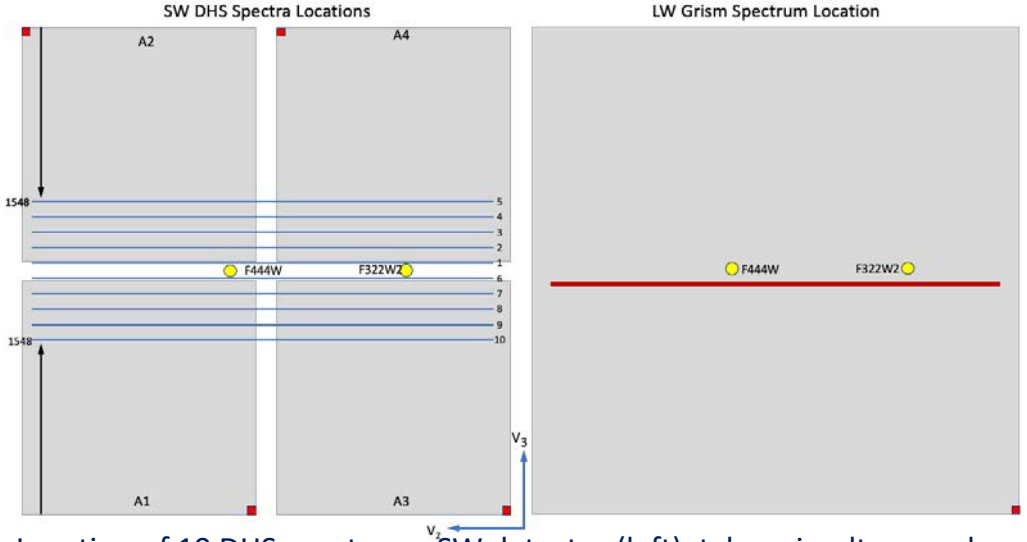
For Cycle 4, we are enabling Dispersed Hartmann Sensor (DHS) for SW grism (0.6-2.3 μm) time-series observations (TSO) taken simultaneously with extant LW (2.4-5 μm) TSO – ***broader wavelength coverage helps break exoplanet model degeneracies***

ETC/APT did not have new DHS readout patterns in term for Cycle 4 call, so provided workaround to users

DHS used for mirror phasing in commissioning – 10 grisms in rectangular sub-apertures (right)



Wavelength coverage of 1st (blue) and 2nd (red) order spectra on detector, depending on field point used in LW channel



Location of 10 DHS spectra on SW detector (left), taken simultaneously with LW spectrum on right

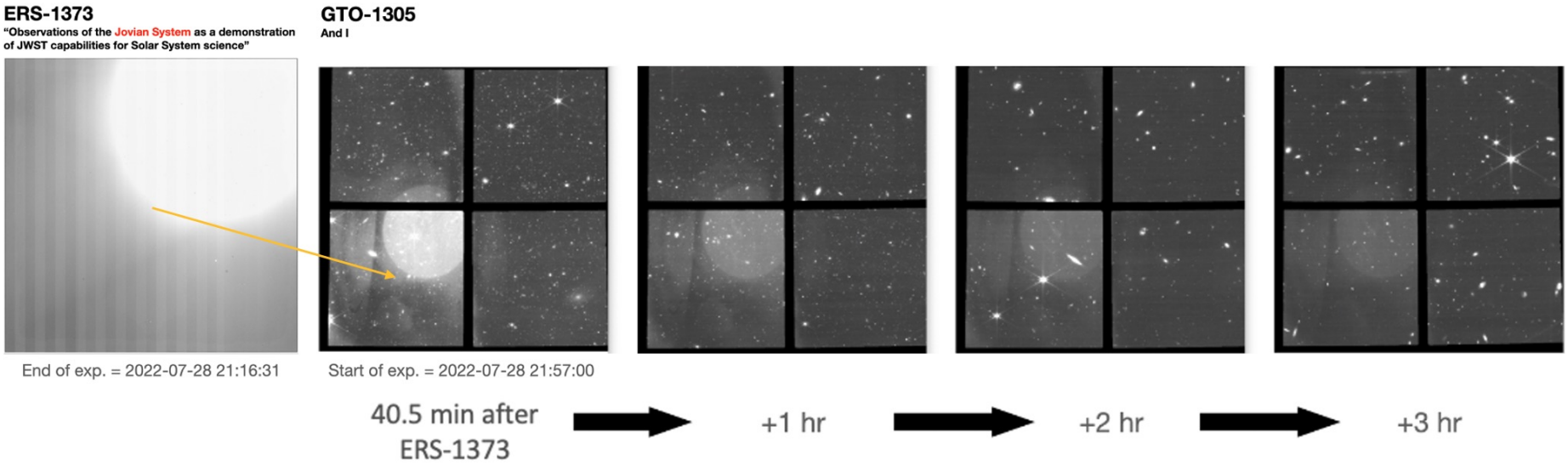
All SW spectra can be read in separate subarrays using new multistripe readout mode

Thanks to Martha Boyer, David Golimowski, and many others

New NIRCam Persistence Mitigation

New Special Requirement to mitigate bright "bad actors" identified by instrument scientists

- Inserts a buffer wait time period, followed by a short dark image after bright observations
  - Buffers are 3 hrs to 1 day, depending on the brightness of the target
  - Other instruments can observe during these buffers
- Instrument scientists and/or PCs insert the buffers/darks in APT, allowing for automatic scheduling

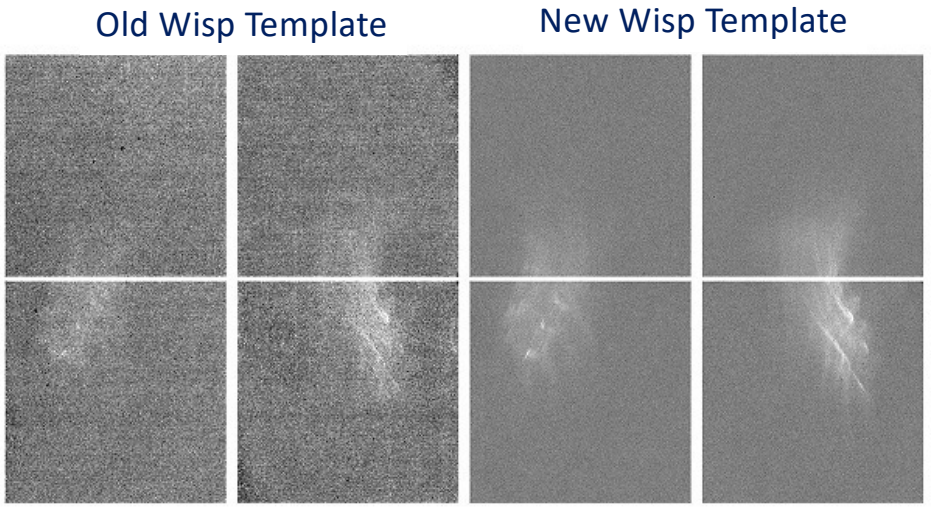


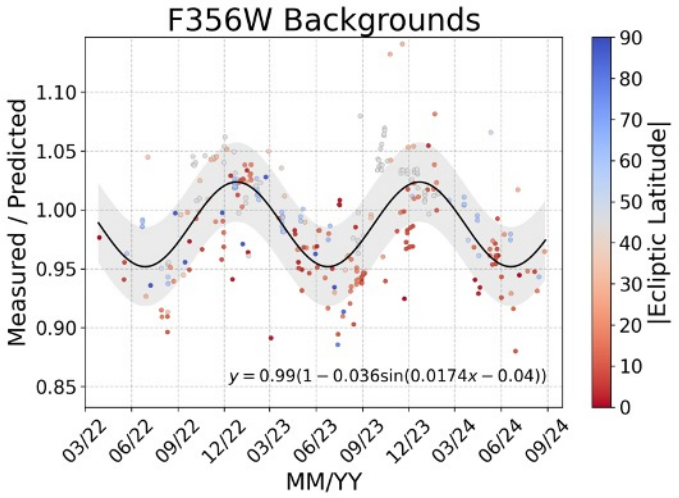
Example of long-term persistence, here due to a Jupiter observation on a short-wavelength detector still visible 3 hrs later

Thanks to Martha Boyer, Ben Sunnquist, and many others

Other NIRCam Updates

- New Wisp templates, and a notebook demonstrating how to use them (*right*)
- New analysis on NIRCam backgrounds (*lower right*)
  - Seasonal offset from JWST background model prediction (~4%), with general agreement at 5-10%
- Lots of additional calibration & characterization work underway
  - Brighter-fatter effect
  - WFSS backgrounds
  - 1/f noise
  - Updated flux calibration
  - And more!





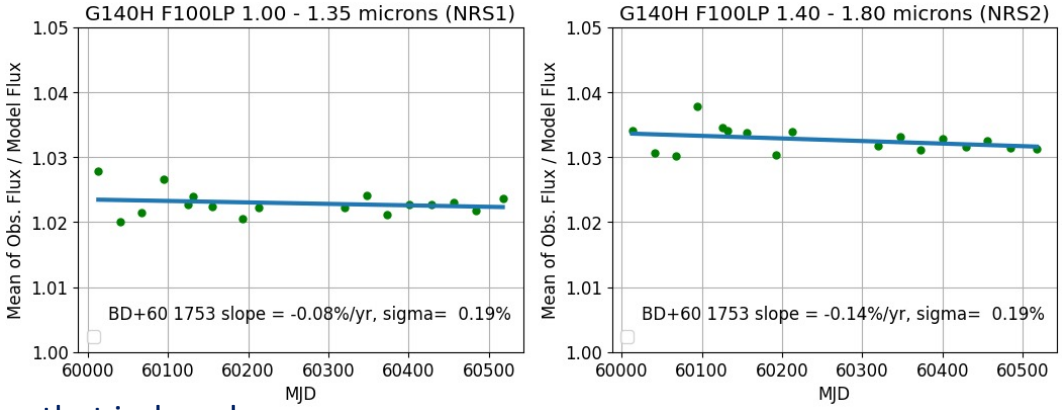
Backgrounds have a ~4% seasonal offset from the JWST background model, similar in all filters

Instrument Support

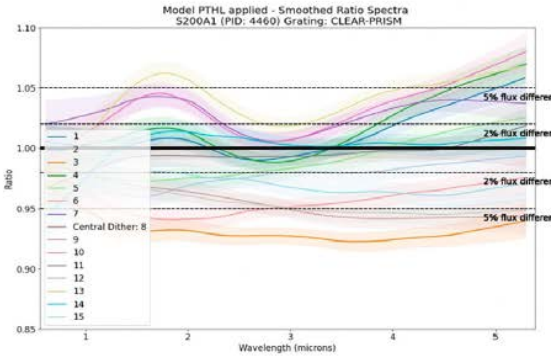
Thanks to James Muzerolle, NIRSpec branch members noted below, and many others

NIRSpec Calibration Highlights

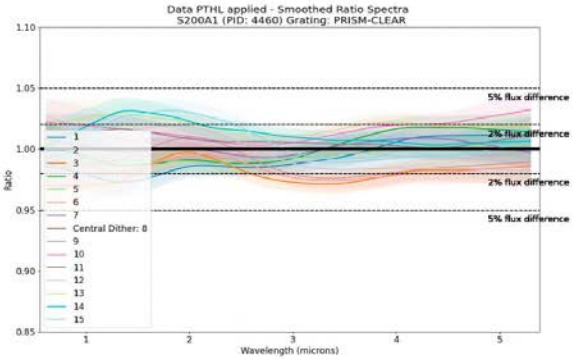
- Monitoring stability with internal lamps & spectrophotometric standard ***(Charles Proffitt)***
  - relative repeatability within ~0.2%
- Analysis of instrument model verification data from Cycle 2 ***(Peter Zeidler)***
  - WCS and wavelength calibration stable since launch



- Updated MOS S-flat files to correct unexpected NRS2 feature that induced ~20% flux inaccuracy at some wavelengths, now down to ~5% ***(Charles Proffitt)***
- Revised F-flat reference files for MOS and fixed slit (FS) modes to align with pipeline flux conservation fix ***(Fluxcal WG: Peter Zeidler, Alex Fullerton, Elaine Frazer, Charles Proffitt)***
- Revised FS path-loss reference files ***(Elena Manjavacas)***
  - data-based correction for S200A1 & A2 slits reduced systematic errors to 2-3%



FS nodded spectra (normalized to central nod), corrected with original model-based pathloss reference file



Same, corrected with new data-based reference file

Calibration lead: Nimisha Kumari

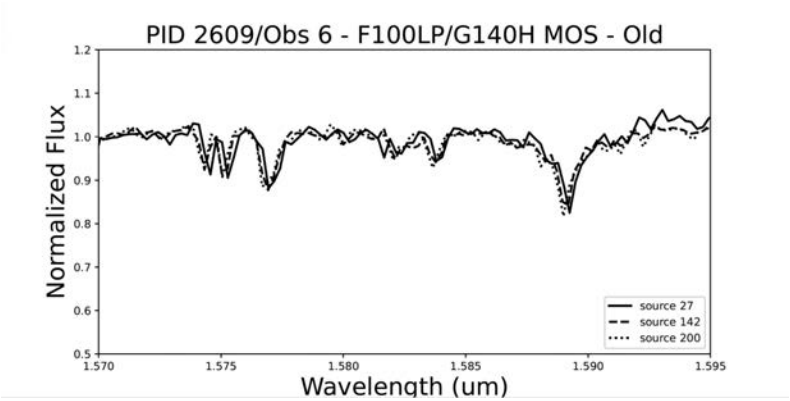
Instrument Support

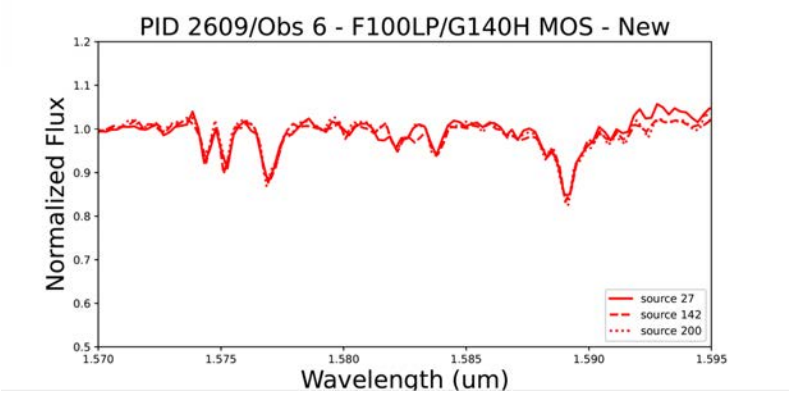
Thanks to James Muzerolle, NIRSpec Branch members noted below, and many others

NIRSpec Pipeline Highlights

Wavelength correction for offset point sources:

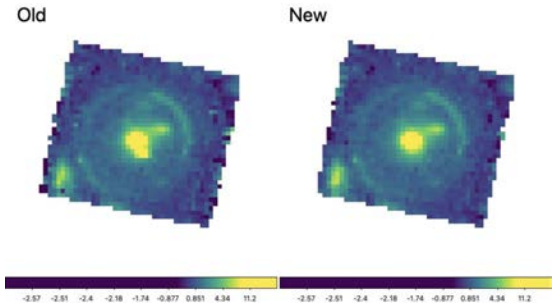
MOS spectra of three stars at different positions within shutters; bug fix significantly improves relative wavelengths (to ~0.1 pix)

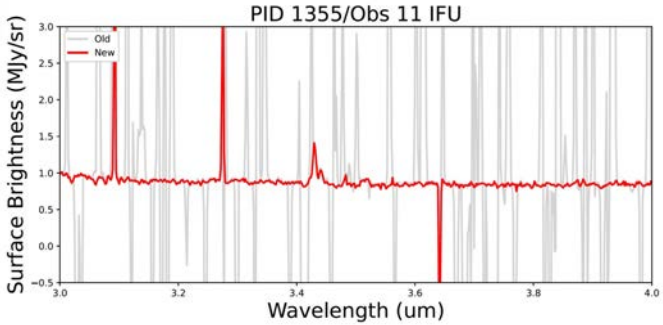




IFU outlier detection:

Lensed galaxy example showing new treatment of group-2 saturation in data with NRSIRS2 readout





Other highlights:

- Developed & presented MOS data processing Jwebbinar ***(Dan Coe, Kayli Glidic)***
- Completed & tested new code for dark/bias creation ***(Diane Karakla, Kayli Glidic, Christian Hayes, Torsten Boeker)***

Pipeline technical lead: Christian Hayes
Mode leads: Dan Coe (MOS), Bethan James (IFU), Elena Manjavacas (FS), Nikolay Nikolov (BOTS)

Thanks to James Muzerolle, NIRSpec Branch, and many others

NIRSpec: Ongoing & planned work

Calibration

- improved characterization of IFU spatial and wavelength distortions
- complete investigations of time-dependent effects and backgrounds relevant to bright-object time series
- constraining MOS flux calibration field dependence
- analyzing expanded sample of spectrophotometric calibrators for all modes
- observations to characterize MOS FOV wavelength calibration accuracy coming this winter

Pipeline

- testing & optimizing different 1/f corrections
- implementing correction for oversubtraction of nodded data
- possible revisions to 1D extraction from unrectified data
- investigating improvements to MOS master background subtraction

Operations and user support

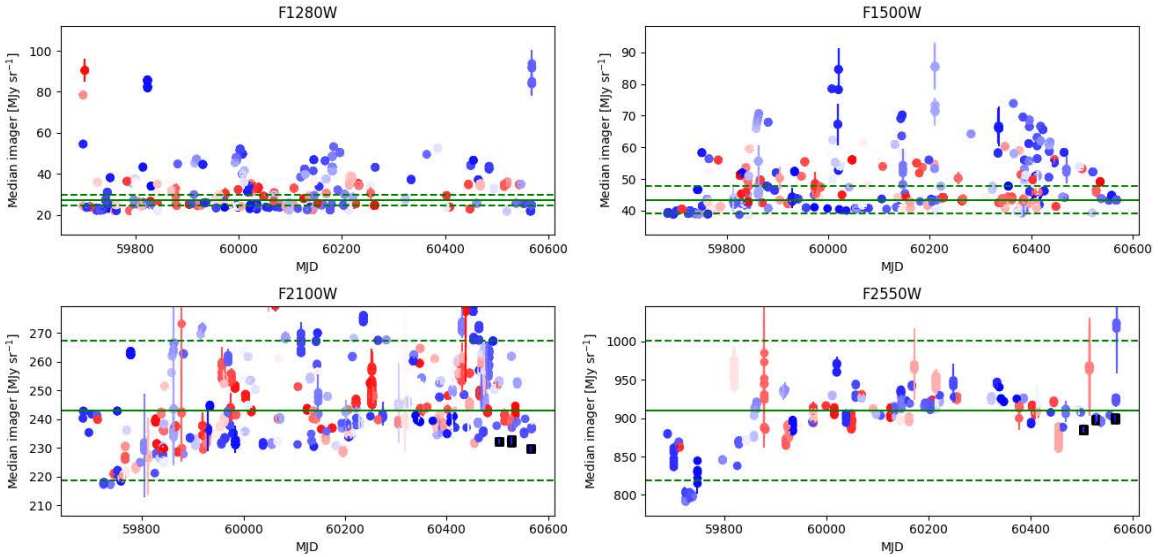
- program reviews for all accepted programs
- monitoring TA performance
- new “hybrid full frame” mode for MSA TA exposures
  (to minimize thermal transients from readout mode switching)

Instrument Support

Thanks to Sarah Kendrew, MIRI Branch members noted below, and many others

MIRI: Major milestones

- Important calibration updates
  - LRS slitless: update to wavelength calibration, accuracy now ≤ 10 nm in 6-13 μm range (Greg Sloan)
  - LRS slit + slitless: updates to flux calibration & aperture correction, uncertainty of ~1% (Ian Wong, Andreea Petric, Greg Sloan)
  - MRS flux calibration: updated to use average of multiple calibrator types (see Law et al 2024)
  - Imager + coronagraphs flux calibration (see Gordon et al 2024)
  - Improved bad pixel masks, darks (Mike Engesser, Boris Trahin)



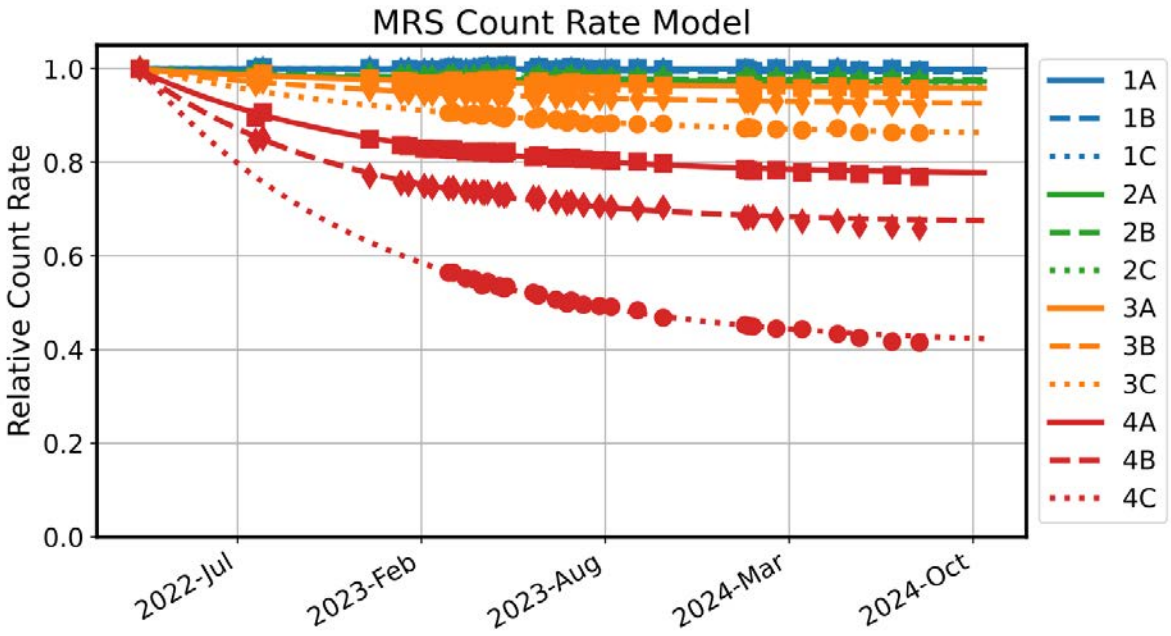
Imager background trending (Misty Cracraft)

- Exposure Time Calculator
  - Imager calculations now include impact of count rate loss
  - ETC v4.0 projects imager & MRS loss values to Cycle 4 end
  - Background model updated based on MIRI trending data (News article)
- Coronagraphy in FULL array config fully tested & available (Jonathan Aguilar, Bryony Nickson, Dean Hines)
- MIRI Wide-Field Slitless Spectroscopy mode approved!
  - MIRI lead for implementation: Andreea Petric

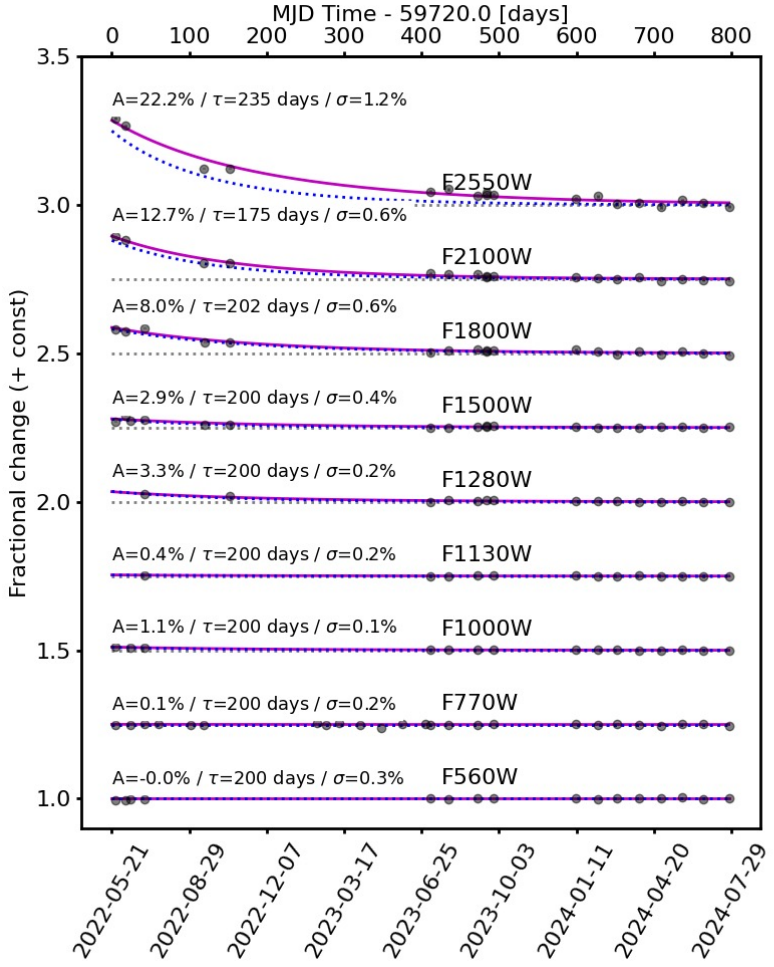
Instrument Support

Thanks to Sarah Kendrew, MIRI Branch members noted below, and many others

MIRI Imager + MRS count rate loss



Law et al 2024 + JDocs



Gordon et al 2024

- Flux calibration program continues to monitor trend
- No deviations observed from model
- Root cause remains under investigation

Thanks to Sarah Kendrew, MIRI Branch members, and many others

MIRI: Priorities for the next 6-12 months

- Implementation of the WFSS mode:
  - Prioritizing front-end tools (APT, ETC)
  - Defining calibration/pipeline requirements & planning for future calibration observations
  - Hoping to offer this mode in a future cycle

- Calibration priorities:
  - Improve flat fields for all modes
  - Improvements to darks calibration strategy
  - Analysis of persistence effects in time-series observations
  - Supporting algorithmic improvements with pipeline developers

- Continuing with monitoring backgrounds in Imager & MRS (see also M. Perrin's talk)

- Support to the Rocky Worlds DDT program: 500 hrs of MIRI time
  - MIRI has good transiting exoplanets expertise; program co-led by MIRI's Hannah Diamond-Lowe

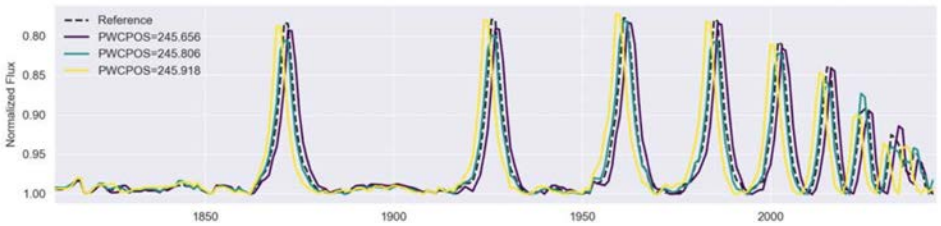
Instrument Support

Thanks to Stephanie LaMassa, NIRISS Branch members noted below, and many others

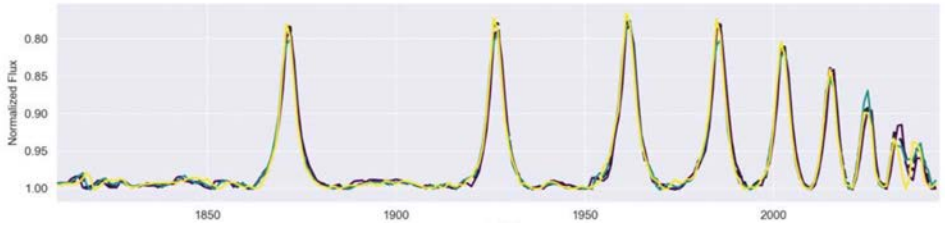
NIRISS Single Object Slitless Spectroscopy (SOSS) Calibration Improvements

✅ 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 package (Baines et al. 2023a, Baines et al. 2023b) separately to achieve this accuracy



Before



After

credit: Tyler Baines, Joe Filippazzo; SOSS team leadership Aarynn Carter

Implement background subtraction for SOSS mode

Work in progress

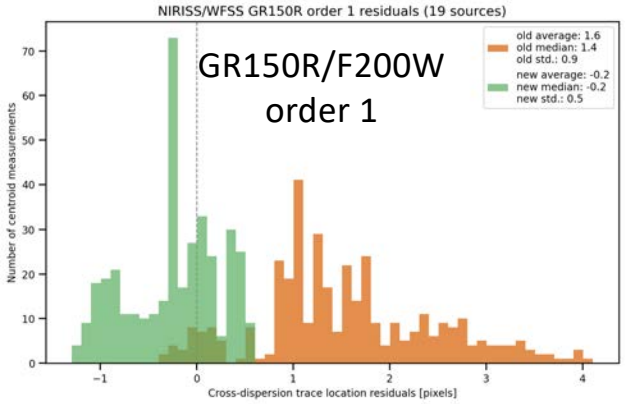
- Understand cause of background variations & determine optimal removal
- Implement pipeline capability to subtract background
- Users are currently advised to take their own background measurements, but can we provide useful templates for subtraction instead?

Instrument Support

Thanks to Stephanie LaMassa, NIRISS Branch members noted below, and many others

NIRISS Wide Field Slitless Spectroscopy (WFSS) Calibration Improvements

- Calibrated change in trace shape as function of detector position: updated specwcs reference file for both grisms and F200W filter (jwst_1228.pmap), F115W Filter (jwst_1525.pmap), F150W filter (jwst_1263.pmap)



- Residual = Predicted trace centroid – measured trace centroid
- Orange: old specwcs reference file
- Green: updated specwcs reference file

- Residuals more closely centered around 0, smaller spread
- Credit: Jo Taylor (lead), Rachel Plesha

Work in progress

- Improve trace calibration further:
  - Aim for residuals centered around 0 with < 0.1 pix residuals
- Deliver new background calibration files (almost done, files created, testing on-going; credit: Gaël Noirot)

Instrument Support

Thanks to Stephanie LaMassa, NIRISS Branch members noted below, and many others

NIRISS Calibration Improvements

Aperture Masking Interferometry (AMI):

- Major overhaul to AMI3 stage of pipeline released in build 10.2: Implemented bad pixel correction well suited for interferometry, updated algorithm to calculate interferometric observables, serve data in oifits format (interferometry standard)
  - Credit: Rachel Cooper (lead), Anand Sivaramakrishnan, Deepashri Thatte
- Pipeline updates to push to deeper contrast ratios are being investigated
  - Credit: Anand Sivaramakrishnan

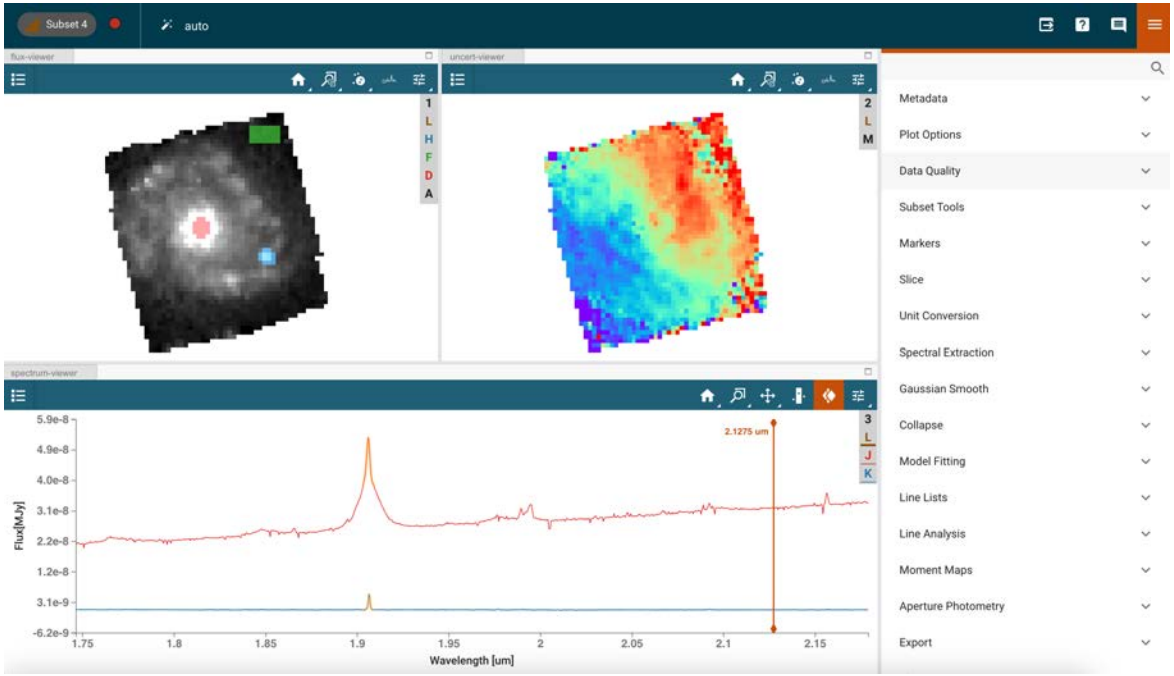
Imaging:

- Implemented IRAFStarFinder as default source finding algorithm for NIRISS in pipeline build 10.2, which works optimally for NIRISS's undersampled PSFs (see Goudfrooij 2022)
  - Credit: Paul Goudfrooij
- Verified no updates needed to geometric distortion in Cycles 1 – 2
  - Credit: Tony Sohn
- Cross-calibration between NIRISS and NIRCam on-going
  - Credit: Kevin Volk (lead), Paul Goudfrooij

Thanks to Camilla Pacifici, Data Analysis and Instrument branch staff noted below, and many others

JWST Data Analysis Tools

- Visualization (Jdaviz) – Release of stable version 4.0
  - Fully featured **spectral extraction in Cubeviz** (with fractional pixels, background subtraction, and optional conical extraction)
  - **Unit conversion** to properly deal with surface brightness and flux
  - Improvements to **stand-alone** version with ability to **export** everything calculated or generated in app (e.g., aperture photometry results in table format, generated spectra/maps in fits format)
  - New configuration for visualization of raw data (ramps) - **Rampviz**
  - Performance improvements and bug fixes



Cubeviz: cube of NGC7469 from program 1328. The top left viewer shows the flux cube at 2.13 micron and the three spatial subsets used for the analysis. The top right viewer shows the calculated velocity map of the Paschen-alpha line obtained with the Moment Map plugin. The bottom viewer shows the spectra extracted in the center (red spectrum) and in the outskirt clump (blue spectrum) using the newly updated Spectral Extraction plugin. To the right, the plugin tray is open, showing all the visualization and analysis plugins available in the tool.

Team: Brett Morris, Clare Shanahan, Hatice Karatay, Gilbert Green, Jenn Kotler, Jesse Averbukh, Kyle Conroy, Ricky O'Steen, Pey Lian Lim, Cami Pacifici

Thanks to Camilla Pacifici, Data Analysis and Instrument branch staff noted below, and many others

JWST Data Analysis Tools

- Libraries
  - Specutils: received more community input and interest; addressed requests and fixed bugs; working towards next stable version 2.0 – *Ricky O'Steen*
  - Photutils: improvements and performance enhancements to methods to calculate photometry (both aperture photometry and PSF photometry); release of stable version 2.0 – *Larry Bradley*
- Notebooks
  - New set of notebooks to demonstrate how to run JWST calibration pipeline: 2 notebooks done (MIRI MRS and NIRISS imaging), 5 in review – *David Law, Steph LaMassa*
  - New analysis notebooks (how to deal with 1/f noise in NIRSpec and how to deal with NIRCam wisps) and updated notebooks with real JWST data (NIRISS WFSS) - *Melanie Clarke, Kayli Glidic, Ben Sunnquist, Rachel Plesha, Jo Taylor, Cami Pacifici*
  - Technical and scientific notebook reviews – *Hatice Karatay, Gilbert Green, Rosa Diaz, Bryan Hilbert, Roeland van der Marel*

Future plans

- Jdaviz will undergo a data menu redesign following feedback in last user testing campaign
  - More intuitive place to find data and regions
  - Interactive legend in each viewer
  - More intuitive interaction with footprint and RGB tools
- Subset tool (i.e., to define regions of interest) in Jdaviz will be accessible from notebook in a more straightforward way to make workflows easy to reproduce
- Continue collaboration between MAST and Jdaviz to offer most up-to-date tool in web visualizer
- Updates of existing notebooks and creation of new ones to use inflight data and to demonstrate latest developments in libraries

Outreach

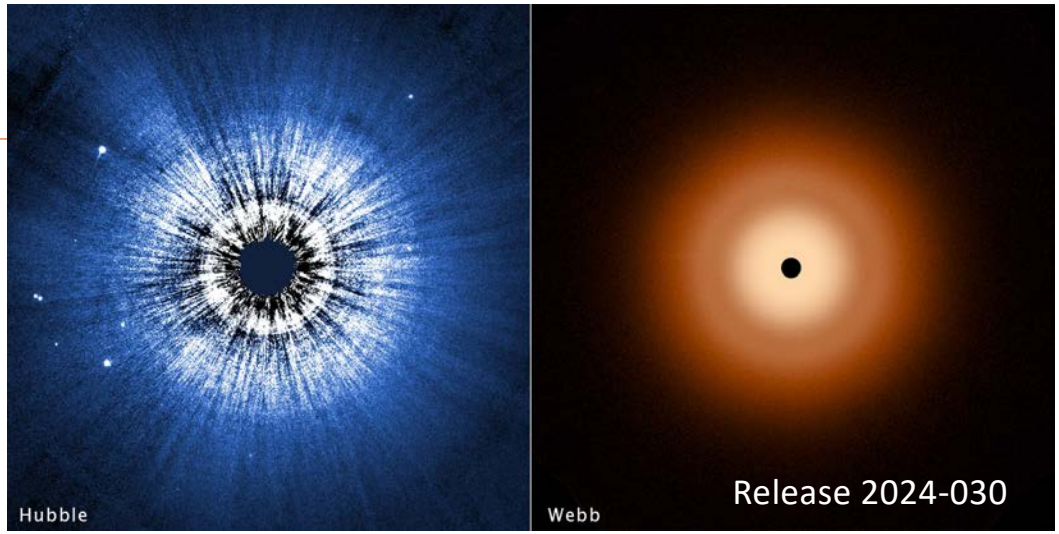
Thanks to Hussein Jirdeh, Christine Pullium, OPO division, and many others

Recent News Releases

Webb outreach has tremendous impact

- 48 Webb news releases in 2023 resulted in 35,000+ online mentions & articles with a total potential audience of 121 billion

- Highlights of recent releases:
  - 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 (*3rd slide*) – Jul 24
  - Morning and evening exoplanet atmosphere – Jul 15
  - Penguin & Egg 2nd anniversary (*2nd slide*) – Jul 1
  - Celestial fireworks around forming star – Jul 2
  - Pillars of Creation visualization – Jun 26
  - Detection of stellar bipolar jets (*2nd slide*) – Jun 20
  - Investigating Crab Nebula origins – Jun 17
  - New window on supernova science – Jun 10
  - Carbon molecules around young star – Jun 6



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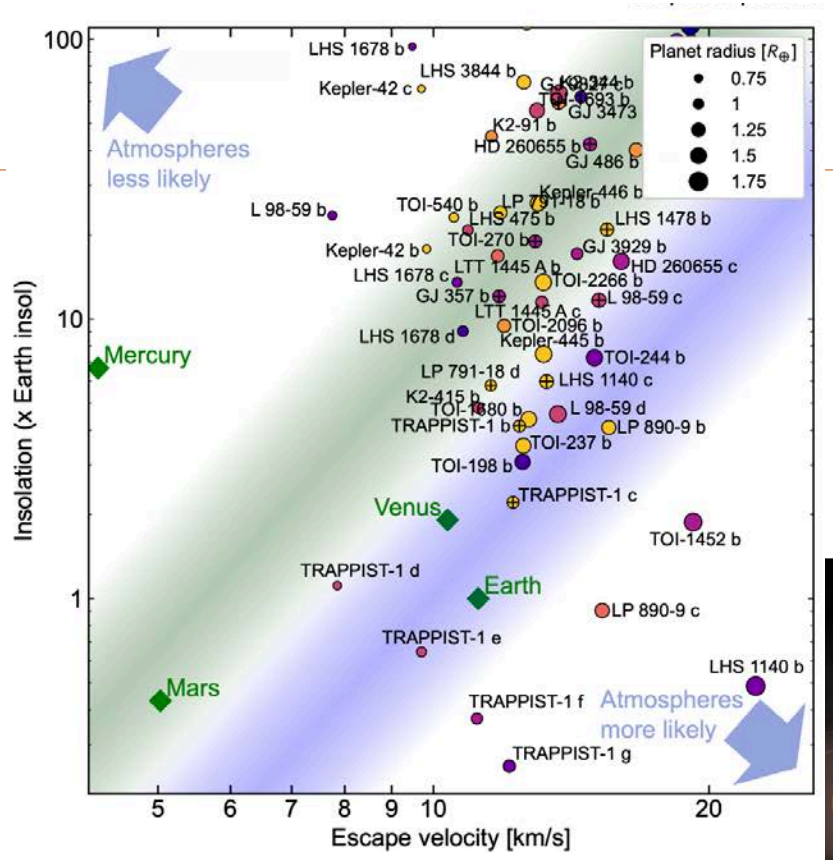
Summary

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

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



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