Goddard Project Update

For the JSTUC on November 11, 2024

Jane Rigby, Mike Davis, Mike Menzel, Michael McElwain, Knicole Colón, Amber Straughn, Stefanie Milam, Susan Neff

For public release

New project managers

- Project Manager: Mike Davis
  - 42 years of combined industry and civil servant experience
  - 21 years on JWST; last 16 as JWST Deputy Mission Systems Engineer
  - Seeking to foster greater collaboration between GSFC and STScI while maintaining emphasis on JWST success
- Deputy Project Manager: Brandon Bethune
  - Civil servant since 2009
  - Previously served as DPM-Technical for NASAs Exploration Space Communication Division Near Space Network

NASA GSFC Project Science Team Updates

- Our Project Science team has streamlined for routine operations, adapted to retirements, and re-organized our roles.
- Team members who've moved on since the last JSTUC meeting:
  - Deputy Senior PS Jon Gardner moved to a new role in GSFC management
  - Deputy Observatory PS Chris Stark moved to a new role on HWO
  - Deputy Observatory PS Erin Smith moved to new roles in GSFC management and on HWO
  - We are so grateful for their contributions to JWST.

Jon Gardner

Chris Stark

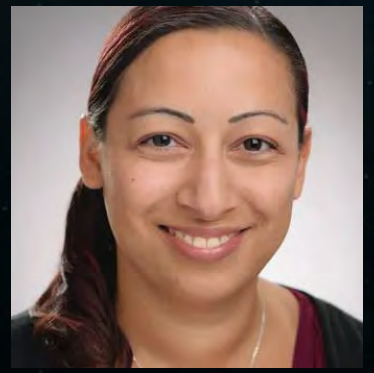
Erin Smith

NASA GSFC Project Science Team Updates

- Our team has streamlined for routine operations, adapted to retirements, and re-organized our roles.
- Since the last JSTUC meeting in March 2024:
  - Observatory PS Mike McElwain is now balancing new roles in GSFC management and on HWO
  - Deputy Operations PS Susan Neff is now balancing a new role on TESS
  - Knicole Colón became Operations PS, previously holding the role of Deputy PS for Exoplanet Science
  - Stefanie Milam became Policy & User Community PS, previously holding the role of Deputy PS for Planetary Science
  - Mic Bagley has joined the team in a new role as PS for Data, Pipeline, Calibration, and Archive

Mike McElwain

Susan Neff



Knicole Colón

Stefanie Milam

New Project Scientist for Data/Pipeline/Calibration/Archive

- Micaela (Mic) Bagley
  - Previously a Research Associate at University of Texas at Austin. Mic was the lead on the CEERS JWST/NIRCam imaging data reduction, a JWST Master Class grad, *JWebbinar* presenter, and overall JWST imaging data ninja.
  - RESEARCH INTERESTS: Early galaxy formation and evolution; the epoch of reionization; star formation efficiency and feedback physics; ionizing power in early galaxies; Lyman break galaxies; Lyman-α emitters; local analogs of high-redshift galaxies; Lyman continuum and Lyman-α photon escape; emission line galaxies; clustering and galaxy overdensities

James Webb Space Telescope

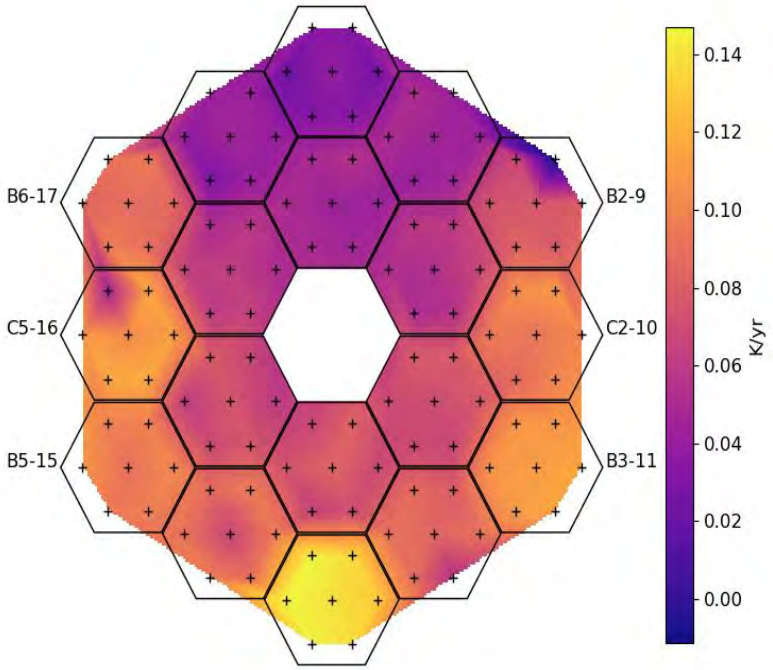
Observatory Performance Metrics – Mike Davis

CUI//SP-EXPT

Status as of 10/31/2024

Observatory Performance Metrics	
FGS Performance Past Month	--
Total Visits	292
Success	93.8%
Skipped	6.2%
Micrometeoroid Impacts	76 (+3)
Wavefront Error [nm] Requirement: < 150 nm	68 (-9) WFSC correct 10/4
Propellant End of Life [Calendar Year] Requirement: 2034	2042-2063 (was 2046-2057)
Power (mean load) [W]	1386 (-14)
Power Capability [W]	2659 - 3051
# of DSN Issues (between DOY 245-274)	5
Solid State Recorder Hard Error Count	11
NIRCam Photometric Stability	<1%
MIRI Imager Throughput Reduction [@10 um] (relative to beginning of life)	1.5%
NIRISS Flux Ratio (1.0-2.5 um)	1
NIRSpec Count Constancy	1%

Mirror Delta T due to linear slope over time



The linear trend is due to some effect for which line-of-sight to the back of the wings is relevant, such as aging of the sunshield

REDUNDANCY STATUS

Attitude Control Subsystem (ACS)																
Wheel Drive Electronics (WDE)	1	2	3	4	5	6										
Valve Drive Electronics (VDE)	A	B														
Star Tracker Assy (STA)	1	2	3													
Inertial Reference Unit (IRU)	1A	1B	2A	2B												
Fine Sun Sensor (FSS)	A	B														
Command and Data Handling (CDH)																
Configuration Control Unit (CCU)	1															
Command & Telem Processor (CTP)	1	2														
Solid State Recorder (SSR)	A	B														
1553 Bus	A	B														
Communication (COMM)																
x-Band Transponder	1	2														
KA-Modulator	1	2														
Receivers	1	2														
Traveling Wave Tube Assy (TWTA)	1	2														
Deployment Control Subsystem (DCS)																
Deployment Electronics Unit (DEU)	A	B														
Bi-Axial Gimbal Assy (BAGA)	A	B														
Propulsion Subsystem (PROP)																
Monopropellant Rocket Engine (MRE)	1	2	3	4	5	6	7	8								
	9	10	11	12	13	14	15	16								
Secondary Combustion Augmented Thruster (SCAT)	1	2	3	4												
Electrical Power Subsystem (EPS)																
Power Control Unit (PCU)	A	B														
Telemetry Acquisition Unit (TAU)	A	B														
Solar Array Regulator Array Regulator Module (SAR ARM)	1_1	1_2	1_3	1_4	2_1	2_2	2_3	2_4								
Integrated SI Module (ISIM)																
ISIM Command & Data Handling	A	B														
ISIM Remote Services Unit (IRSU)	A	B														
Optical Telescope Element (OTE)																
Actuator Drive Unit (ADU)	A	B														
Cold Junction Box (CJB)	A	B														
Cryo Multiplexer Unit (CMU)	A1	A2	A3	A4	A5	A6										
	B1	B2	B3	B4	B5	B6										
	C1	C2	C3	C4	C5	C6										
	SMA		-V2 WG		+V2 WG											
Differential Impedence Transducer Control Electronics (DITCE)	A	B														

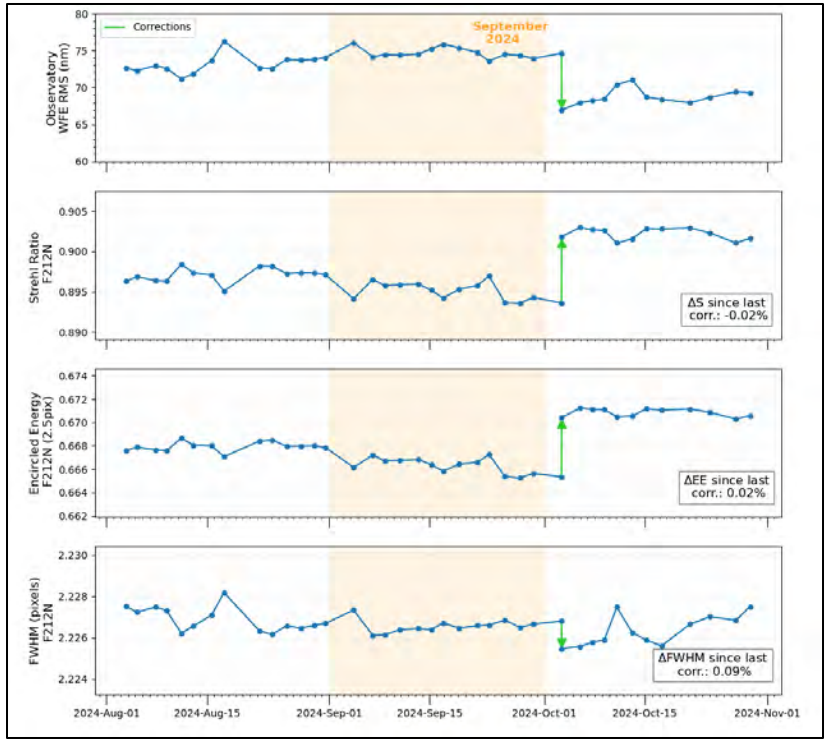
LEGEND

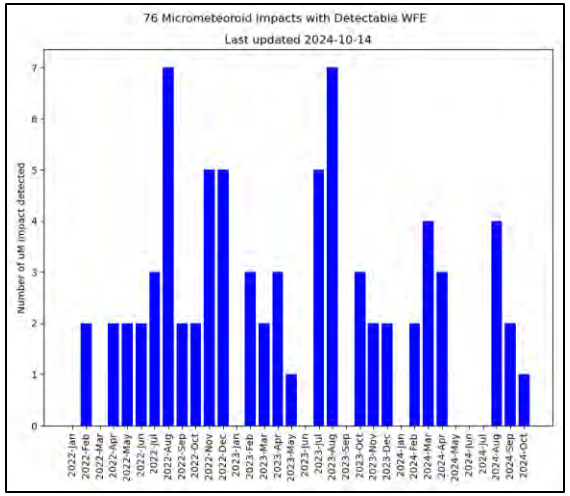
- All Redundancy In Place
- Some Loss of Redundancy
- No Redundancy Remaining

As of 10/31/24

Observatory Status – Mike Menzel

- **Observatory status is nominal, with full redundancy capability available.**
- **Observatory performance metrics summarized on previous chart**
- **Optical Performance:**
  - Wavefront Error (WFE), Strehl, Encircled Energy, and Full Width at Half Max (FWHM) trends are shown on the upper right.
  - The observatory maintained an optical stability for over 180 days without the need for corrective action.
- **Micrometeoroid impacts remain at expected levels in terms of frequency (impacts per month) and wavefront error**
  - Recorded impact statistics shown on the lower right
  - As of 10-31-24, there have been 76 recorded impacts
- **The Flight Operations Team (FOT) executes station keeping maneuvers on roughly 6 week intervals.**
  - Successfully conducted Station Keeping Maneuver #30 on 10-30-24.
- **Current estimates for propellant life remain greater than 20 years.**





Key MSE Activities (1 of 2)

- **Mission Systems Engineering (MSE) reviewed and approved work to develop Fine Guidance Sensor (FGS) software patch to modify Guide Star (GS) Identification (ID) and Acquisition (ACQ) to reduce ID / ACQ failures in bright crowed fields.**
  - The patch will essentially modify the methodology to measure the brightness of objects in order for them to be included on the “Bright Object List, used by FGS to identify and acquire Guide Stars.
  - Current methodology performs 3 x 3 pixel measurement of the first brightest pixel identified within an 8 x 8 pixel scanning window.
    - This is has led to situations where a bright star with saturate pixels can be excluded from the Bright Object List leading to failure of GS ID or ACQ.
  - Revised candidate methodologies will modify this sample box and its application to pixels in the 8 x 8 scanning window to remedy this.
  - Patch is expected for delivery in time for the up-coming Sag-A observation season in the March 2025 timeframe.

Key MSE Activities (2 of 2)

- **MSE reviewed and approved a change the communication uplink conops baseline to a date rate of 2 Kbps.**
  - This change addresses DSN's decision to reduce uplink power on their back-up antenna transmitters by 3 dB.
  - It avoids reconfiguring the observatory back and forth from 16 K to 2K depending on the ground antennas.
  - The 2 Kbps rate assessed to have no impact to ranging and no significant impact to science or flight ops.
  - MSE cited the caveat that these assessments apply only to normal operations, and not to scenarios where DSN coverage compromised to do other missions such as Artemis.

- **The Project developed, tested and uploaded the flight software patch to ignore corrupted time tags from the Star Tracker Assemblies due pointing transients during station keeping maneuvers.**
  - Such transients encountered during station keeping caused an entry into a Safe Haven on 12-14-23.
  - The patch was uploaded in time Station Keeping #28 conducted on 8-8-24 and performed nominally.
  - Patch performance during Station Keeping #29 and #30 was also nominal.

Observatory Risk Posture

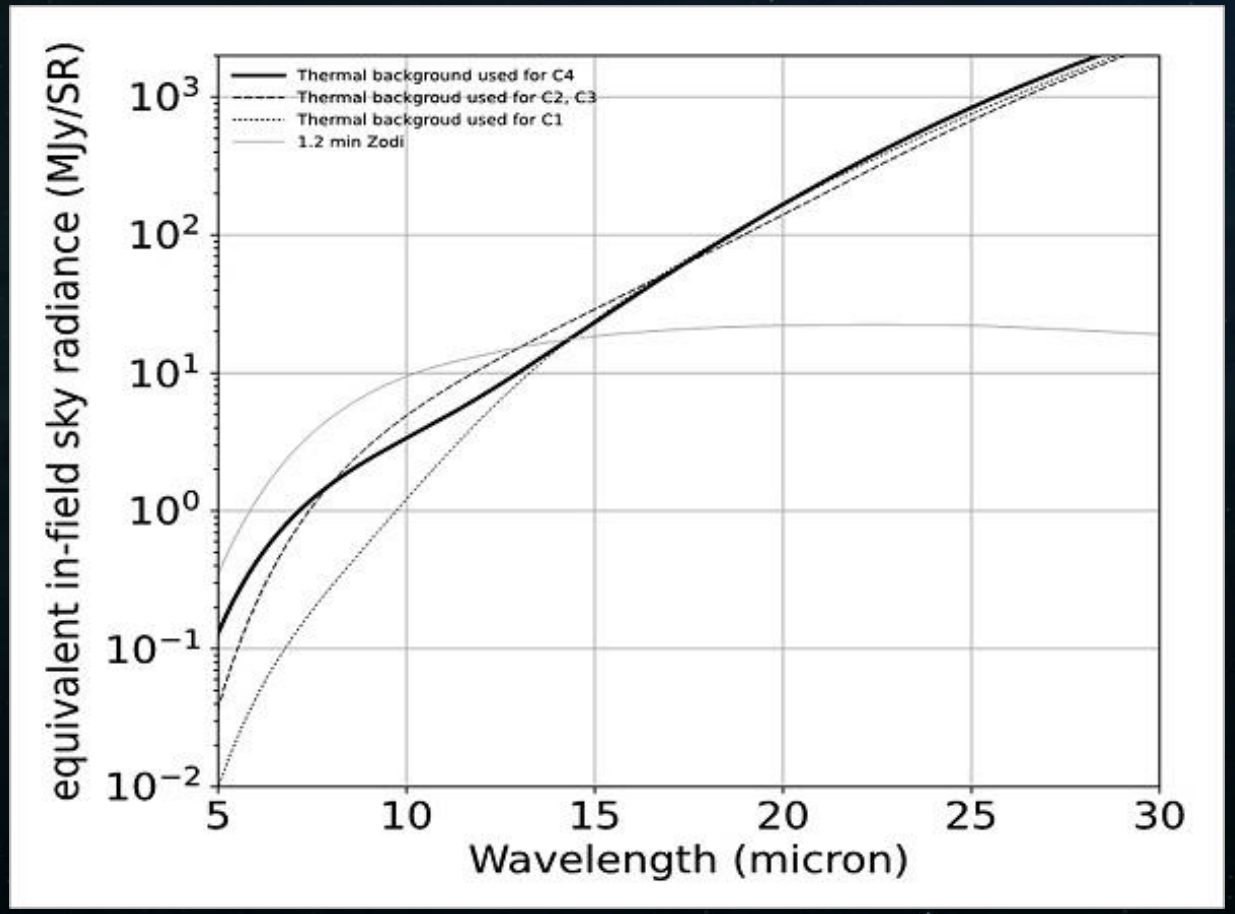
- **Project Risk (5 x 5) matrix shown on the upper right.**
  - 20 risks in the Project Database, No Red risks, 4 Yellow Risks, 16 Green Risks
- **New risks 757 and 758 address the potential reduction in DSN communication coverage during the Artemis II and III missions.**
  - 757: Addresses the reduction in Observatory Command and Telemetry as it relates to Health and Safety
  - 758: Addresses the reduction in science during these periods.
- **Project MSE has formulated mitigation plans that includes:**
  - Coordination with HQ to find alternate Ground Assets for these periods.
  - Repartitioning of Solid State Recorder to avoid losing engineering telemetry during these periods.
  - Definition of the characteristics of science programs during these periods to lower risk of entry into contingency modes.

JWST Ops Project Open Risk Matrix						Status as of: 09-23-24
Likelihood	5	17 758	10	6	3	1
	4	19	13	8	4	2
	3	22 749 754	16	11	7	5
	2	24 750 759 760	20	15 761	12 762	9
	1	25 688 692	23 711 642 643	21 753 752	18 587 570 751	14 756 757
		1	2	3	4	5
		Consequence				

- **Highest Risk Items:**
  - 756: A technical risk of FSS-2 locking onto a False Sun following a switch-over from FSS-1 while out of ground contact.
  - 757: A technical risk that during a time with no Cmd / Tlm during the Artemis Mission there could be an externally generated condition that required timely correction.

Observatory - McElwain

- Overall, science performance continues to be excellent.
- Enhanced background trending and characterization underway to improve observation planning and predict performance in future cycles.
- Micrometeoroid impacts have been infrequent and of low consequence to image quality, benefitted from the implementation of the MAZ.



JWST background tool model used for each JWST Cycle.

Science Operations Updates and Highlights (1) - Knicole Colón

- Cycle 3 successfully began July 1, 2024. With science operations first starting in July 2022, we are nearing the halfway mark of the 5 year prime mission!
- The few anomalies that occurred since March were handled quickly, resulting in only brief periods of down time for the observatory, with schedules quickly re-planned. Observing efficiency remains high: typically around 80% or higher of time spent on science.
- Extensive work was done to execute challenging or extremely-time-critical observations, for example:
  - a direct imaging search for planets around Alpha Centauri with MIRI
  - a 60 hour visit to catch a transit of the 1000 day period planet Kepler-167e – the longest single visit executed to date
- There has been increased success for observations of extremely crowded fields near the Galactic Center, thanks in large part to the use of a new version of the Guide Star Catalog and to the practice of performing quick test observations to validate guide stars in some of these fields.
- There continue to be major improvements to calibrations and pipelines and soliciting and incorporating direct user feedback ***(see David Law's talk)***, including implementing a new data release model on a quarterly basis to provide stable and complete builds to the community and make data reprocessing (when needed) more efficient.
- All public science data are now in the AWS cloud.

Science Operations Updates and Highlights (2) - Knicole Colón

- The Cycle 4 call for proposals offered an increased number of hours for the GO community, which should help improve the long-range planning of the observatory schedule, and in particular more efficient use of the Micrometeoroid Avoidance Zone (MAZ).
- Cycle 4 stressed the ETC, resulting in some unexpected down time. Mitigations are being explored for future cycles.
- Work is being done to enable the use of the Dispersed Hartmann Sensor (DHS), which will allow NIRCam observations at short and long wavelengths simultaneously. This work involves implementing and testing a new SIDECAR ASIC capability (multistripe subarray operations). The community had their first opportunity to propose to use this new DHS mode in Cycle 4, with detailed guidance given in a JWebbinar and in JDox.

Science Operations Concerns - Knicole Colón

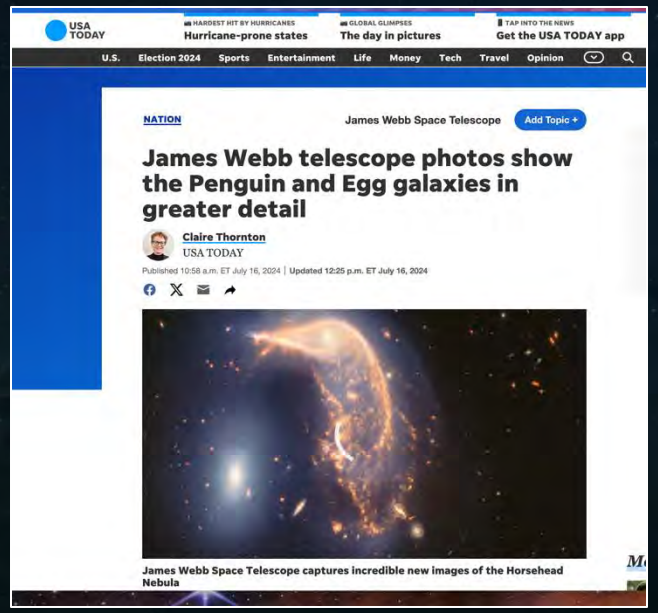
- DSN operations and availability remains a project concern, especially in the era of Artemis launches.
- The level of support for the extended mission (Cycle 6 and beyond) has not been determined. If it is less than the current level, then this would affect operations, for example:
  - Sufficient resources may not always be available to both maintain existing activities and to fully calibrate and implement new observing capabilities (like the NIRCam DHS mode) or to develop new analysis tools for the community (like for cloud-based computing and analysis).

Policy and Community – Stefanie Milam

- Cycle 4 call – Signed, sealed, delivered. Excellent input from JSTUC on improvements and process. The community delivered another record breaking number of proposals and looking forward to results.
  - Any word from the community on the “improvements”?
  - Will be good to follow-up post-TAC to see how reviewers faired with shorter proposals and still larger number of proposals.
- Grants Working Group – Great job on delivering their report to NASA and STScI on recommendations for Cycle 4!
  - More on this later today
  - Will be good to follow-up after the Cy 4 Phase 2 grants are completed, to see how the process may be revised or updated. Are there further efficiencies to gain (e.g., AR having allocated funding levels; are appeals working and/or necessary; does the formula need revisiting?).

Communications – Amber Straughn

- Goddard and STScI (in collaboration with HQ, ESA, CSA) work together for communications & outreach
  - Products/activities: news releases, social media, multimedia assets, public events, WebbVR, media interviews, tours, website work, exhibits support
  - STScI selects & writes news releases; NASA reviews and posts online and to social media accounts (led by GSFC)
  - STScI creates graphics and visualizations for news releases; GSFC produces science videos for some releases
  - GSFC & STScI work together for public engagement events
  - GSFC & STScI both support requests from the media for interviews



Senior Project Scientist – Jane Rigby (1)

- **Enviable problems:** Our problems are great ones to have. JWST is the most powerful, the most in-demand telescope the world has ever seen. Let's take a moment and savor that.
- A new team: Despite a lot of turnover and new roles at GSFC and at STScI (see early slides), a more collaborative relationship is emerging. We all need to work together.
- **How to make JWST even better?** How can we make a great observatory even better, and accelerate the pace of discovery? How can we expand access and lower barriers to using JWST data?
- **Community-driven discovery:** The community's discoveries drive JWST's success. How can we better empower the community?
- **A symbol:** JWST has become a symbol of scientific discovery, and what's best about humanity. How should we tap into that public connection?

Senior Project Scientist – Jane Rigby (2)

- **The Budget:** NASA's Science and Astrophysics budgets are down (see Eric Smith's talk.) While JWST's flat budget is healthier that many, we all know that inflation erodes the purchasing power of a flat budget.
- **Extended mission**: JWST's prime mission is 5 years. As users, you know that JWST's scientific powers are transformative, absolutely unique, will not be eclipsed for decades, and as excellent as in Cycle 1. Rates of papers and discoveries are accelerating, and we have propellant for decades. I know in my bones that Cycles 6, 7, etc. should be at least as productive as early cycles. I want to be sure we make that happen. Funding usually drops in "extended mission", but often the main science has been accomplished and/or capabilities are reduced – neither true for JWST. For operations, it's reasonable for a mature observatory to find efficiencies, but past a certain point, the science suffer. I see all this as a big part of my job to "maximize the scientific productivity of JWST".

Questions for JSTUC

- What difficulties were encountered by the community in submitting Cycle 4 proposals? Was information sufficiently available within JDox or elsewhere? What improvements can be made for future cycles?
- How are STScI <--> user interactions? Helpdesk, surveys?
- You are power users. How do we expand access, to a broader community? MSIs, PUIs, etc
- What are the community's opinions on balancing and prioritizing different activities, e.g., developing new observing modes vs frequency of pipeline updates?
- Where should the pipeline and calibrations be, at the end of cycle 5?
- What work should be done and in place before the extended mission begins (C6+)? If resources were reduced in the extended mission (Cycles 6 and beyond), what work would the community want prioritized?
- Scientifically, are we focusing on the right things? Is there science that needs non-GO approaches? Large v small balance?