STScI | SPACE TELESCOPE SCIENCE INSTITUTE

EXPANDING THE FRONTIERS OF SPACE ASTRONOMY

JSTUC: JWST Mission Office Update

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Get to know (some) team members

JWST Mission Office

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Searching for a Deputy Project Scientist

Instrument teams

MIRI

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NIRISS

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Summary

- Current Cycle 2 LRP meets MAZ requirement
- MAZ constraints made it necessary to identify a pool of additional Cycle 2 GO programs to mitigate a time period when the LRP was underscheduled (Atacama)
- Survey programs useful to address Atacama as well
- Observatory efficiency is generally good, and we keep working on improvements (e.g. improvements to guide stars catalog, new bad pixel masks for FGS). During normal operations the observatory has spent about 55% of the time executing prime science and calibration exposures (i.e. detector time) and less than 7% of the time on failed visits
- DSN challenges mostly overcome so far, but may lead to some loss of science in the future
- Good progress on many approved enhancements, but work remains

Science and Operations Center in Cycle 2

After a successful commissioning period, the S&OC transitioned to *normal operations in July 2022. Cycle 2 officially started on July 2023*

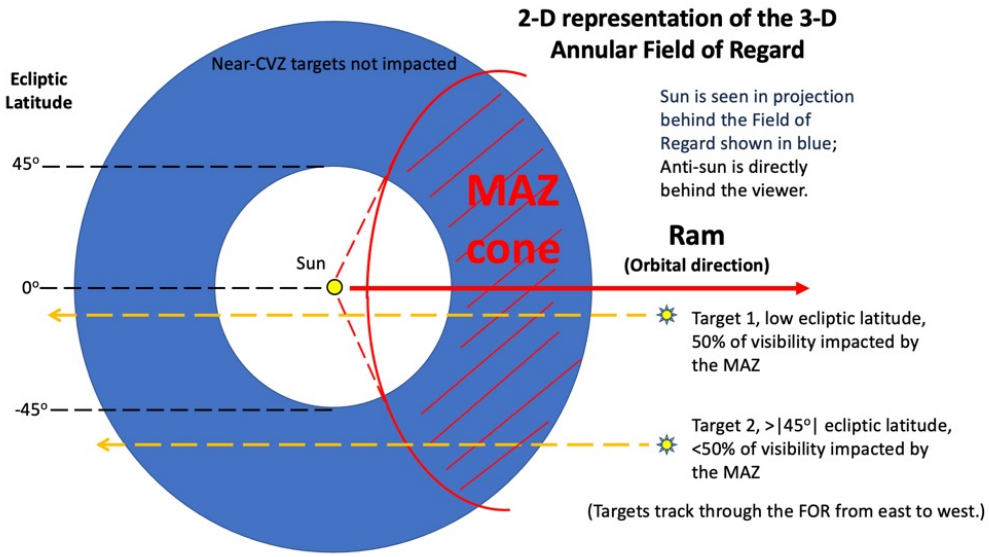
- In normal operations, the S&OC is:
  - Executing the approved science programs. We are currently into Cycle 2, with a tail of Cycle 1 programs
  - Improving instruments calibrations (see SI presentations)
  - Making necessary improvements to scheduling, operations, pipeline, and archive
  - Managing anomalies
  - Supporting calls for proposals (currently Cycle3)
  - Engaging the public in JWST science results
- Recent updates include:
  - Performance updates to support Cycle 3 call for proposals
  - Cycle 2 MAZ implementation
  - "Atacama" proposals
  - *Implementations of new features*
    - ***Since resources are limited,*** work must be prioritized based on health and safety, optimizing science return, community needs, etc.
- We are continuously working on improving communication with the community:
  - e.g. Data2Papers (D2P) initiative (see J. Valenti's presentation), improvements to pure parallels documentation
  - Open communication via JWST observer news items and email "blasts"

Micro-meteoroid update

- Because the telescope has an open design, micrometeroids impacts were expected
- JWST is designed to be resistant to these inevitable events
- On May 24 2022, the C3 mirror segment was struck by a micrometeoroid with higher-energy than expected
    - This impact did not significantly degrade the JWST performance, but the cumulative effect of many impacts will limit the diffraction limited lifetime
- Routine WFS is used to monitor the impact of micrometeroids: as of August 29th 2023 there have been tens of detectable events, but all of them are much smaller than the C3 impact
- Image quality continues to be excellent
- Current PSF metrics and overall WFE are below (but approaching) the correction threshold

Micro-meteoroid avoidance

- Cycle 2 implements a micrometeoroid avoidance zone (MAZ) to limit the degradation of the JWST wavefront error over the lifetime of the mission
- Several circumstances may force a target to be in MAZ
  - Time critical observations
  - PA limitations
  - Popular targets (e.g., specific transiting exoplanets)
- The requirement for Cycle 2 and beyond, defined by the Micrometeroid WG, is that the observatory should be in the MAZ no more than 20% of the time
  - The 20% averaged through a Cycle is considered a requirement
  - 15% or less is a desirable goal



MAZ implementation status

- The Planning and Scheduling team have done significant work to adhere to the MAZ requirement.
  - The MAZ constraint reduces scheduling efficiency
- Current sum of visit duration (hours) 'planned' in the current Long Range Plan (i.e. total hours that are planned but not yet executed)
  - 1st row is Cycle 2 hours
  - 2nd row is the remaining of Cycle 1 and 2 in the LRP.
  - There was no MAZ requirement for Cycle 1, hence the MAZ percentages are higher
  - To date no science program has required major revisions or cancellation due to MAZ implementation

Cycle	Sched_dur (hrs)	Sched_dur in MAZ (hrs)	Percentage in MAZ
2	4257.8	737.9	17.3%
All	5799.6	1501.0	25.9%

JWST additional Cycle 2 programs (or “Atacama” proposals) I

- Applying MAZ constraints led to 2 time periods with significant deficit on the scheduling rate
  - ~110 days around the Vernal Equinox,
  - ~2-months in the summer of 2024.
- The 2024 deficit should be covered with Cycle 3 proposals.
- For the vernal equinox we needed to identify a new set of suitable programs
- Selection:
  - Examine the ranked lists from the Cycle 2 TAC – oversubscription, 7:1
    - Review the five proposals immediate below the line for each panel
    - 20 panels, so 100 proposals
  - Criteria
    - At least 50% of the program targets must fall in the long-duration scheduling windows identified
    - In some cases, constraint requirements were applied to ensure scheduling in the first quarter of 2024

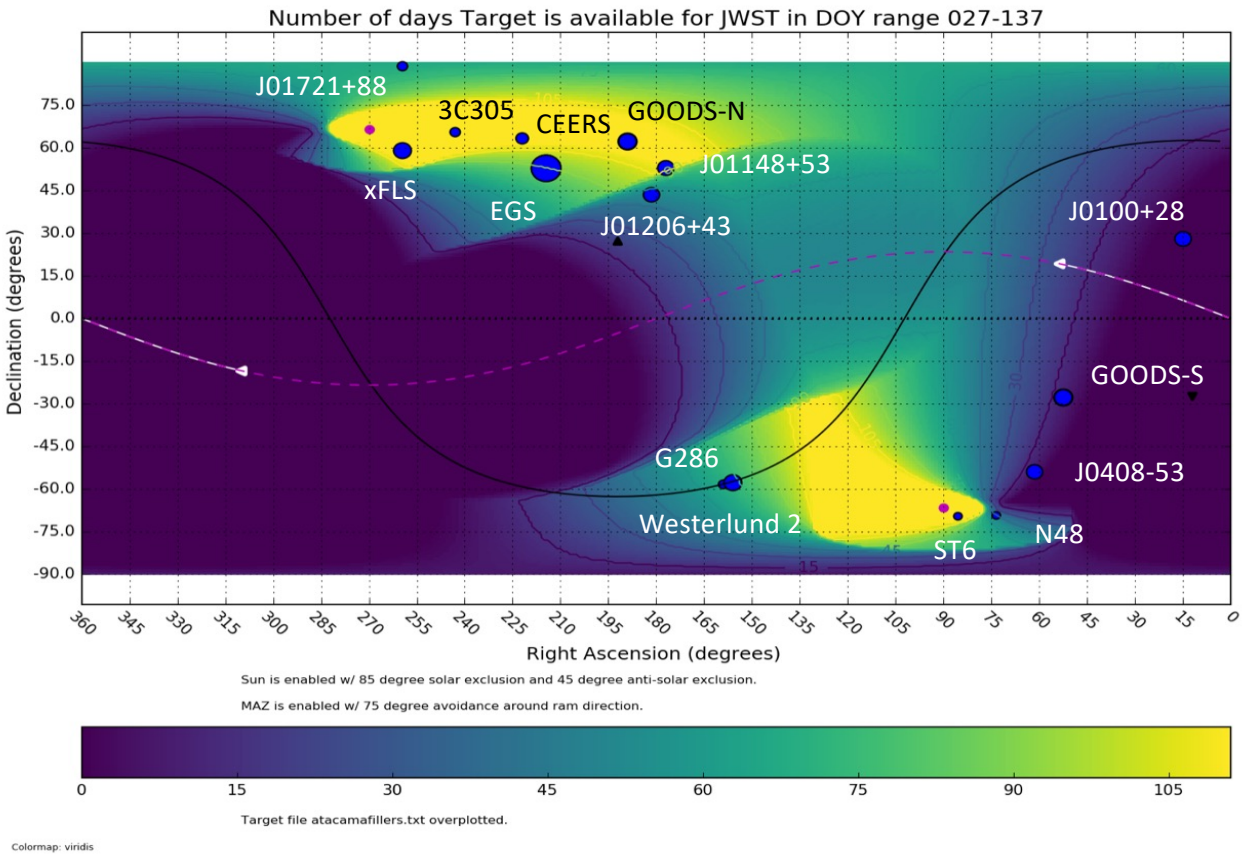
JWST additional Cycle 2 programs (or “Atacama” proposals) II

- 10 programs identified as matching requirements
  - 7 Extragalactic
  - 3 Galactic/stellar/ISM
  - Programs duration range from ~7 to ~70 hours

Total duration of 10 programs ~315 hours

These combined with survey observations should address the Atacama deficit

- Principal Investigators, teams and the community have been informed
- All teams have submitted budgets for consideration.



For additional information on the additional Cycle 2 programs see this JSTUC confluence page

GO Cycle 2 Survey and Pure Parallel programs

3 Survey programs with 989 targets for up to 1402 hours:

- 2 exoplanets and planets formation (1 MIRI LRS, 1 MIRI Imaging)
- 3 Stellar physics and stellar types (1 MIRI LRS, 2 MIRI Imaging)
- 2 SMBH and active galaxies (1 NIRSpec IFU, 1 NIRCam imaging)

2 Pure Parallel Programs in the Galaxies category:

- Up to 600 hours of NIRCam imaging
- Up to 615 hours of NIRISS WFSS
- Often these pure parallel programs are competing for the same slots

JWST Efficiency

- Observatory efficiency is evaluated monthly, using a series of metrics as agreed with NASA Goddard Project and Engineering teams. Example: July 2023 monthly report

Time Allocation across the Calendar

% Time by Visit Type: 2023 July	
Prime Science	89.16
Prime Calibration	3.84
WFS&C	0.39
Real-Time Engineering	0.49
Station Keeping	0.00
Momentum Unload	0.00
Idle Time	6.12

% Time by Idle Cause: 2023 July	
Failure (OPE exception)	0.00
OP Wait Time	3.62
OP Stopped Time	2.45
Residual Gap (remainder)	0.05

% Time Exposing: 2023 July	
Prime Science & Calibration	61.83
Parallel Science & Calibration	9.89

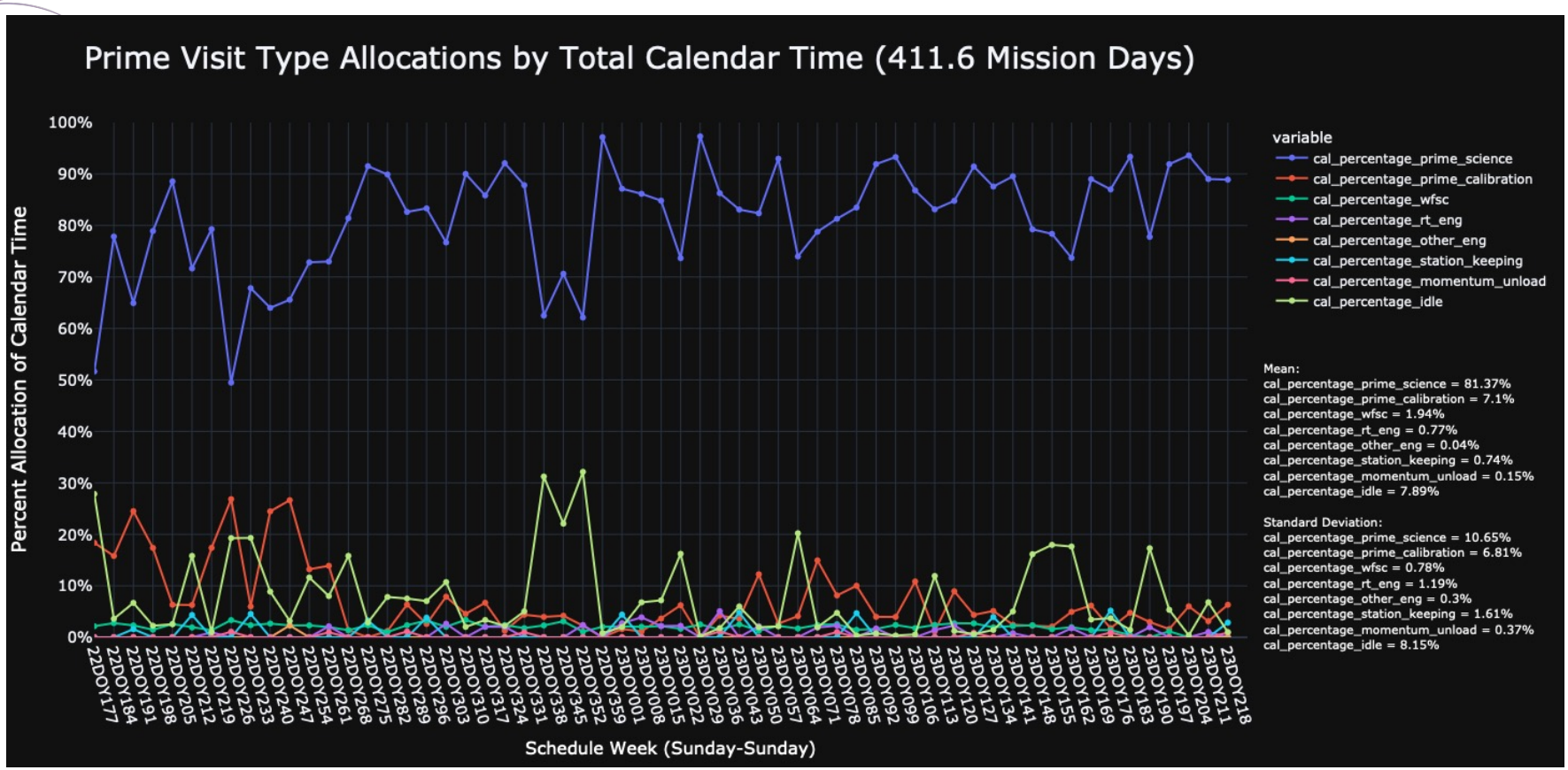
Time Allocation within a Science Visit

% Time for Overheads: 2023 July	
Slew	16.72
GS Acq (Fixed & Moving Target)	3.04
Target Acq	2.51
SAM	1.67
Wait (internal to visit)	0.63
NIRCam Subarray	0.09
OSS overheads	2.32
TOTAL overheads	26.98

% Time for Prime Science: 2023 July	
Prime Science (SI_MAIN)	70.98
Prime Calibration (SI_MAIN)	2.04

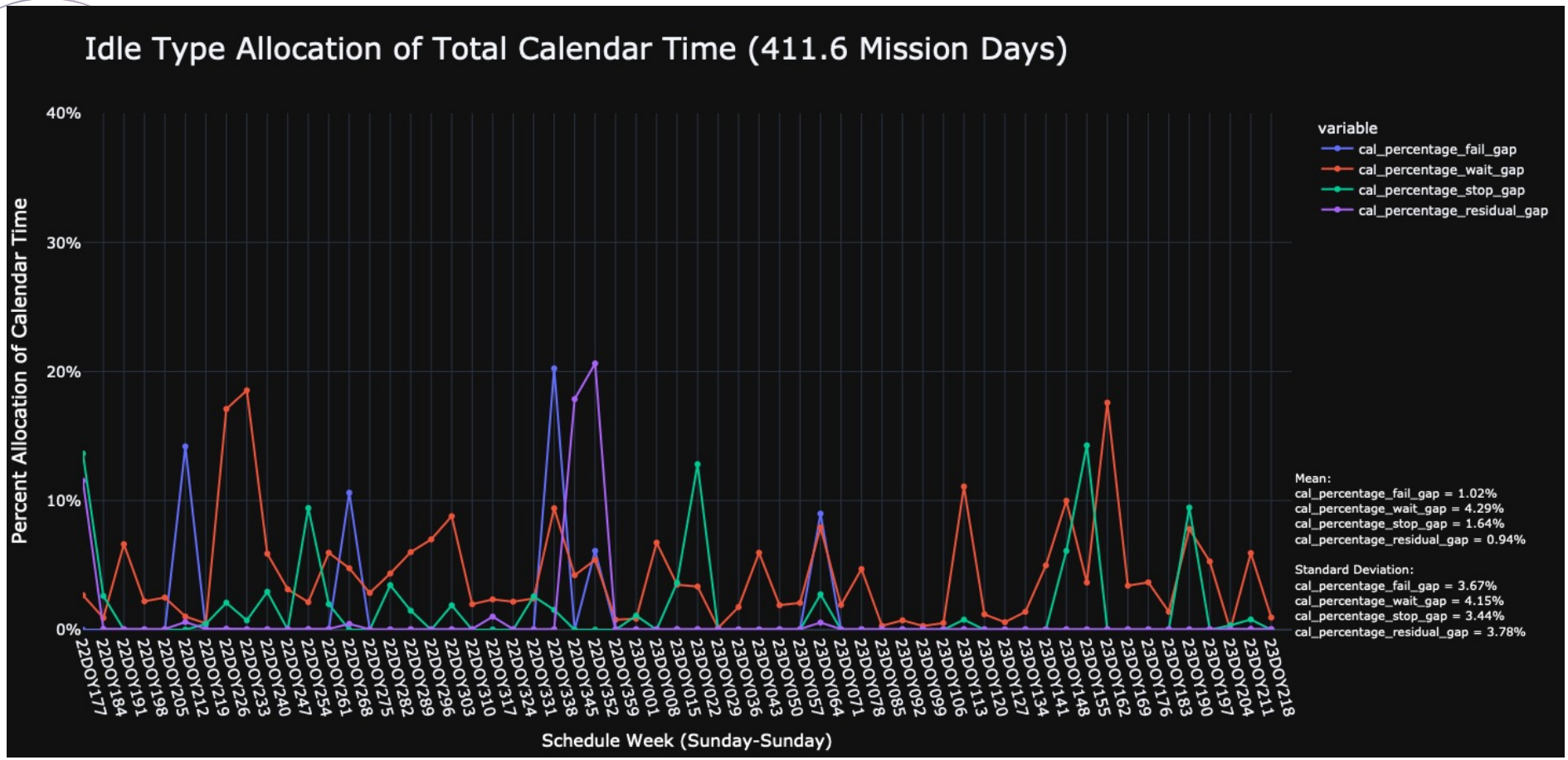
% Time for Parallel Science: 2023 July	
Parallel Science (SI_MAIN)	12.85
Parallel Calibration (SI_MAIN)	1.06

JWST Efficiency: Mission-to-date % time dedicated to different types of visits (prime science, prime calibration, station keeping…)

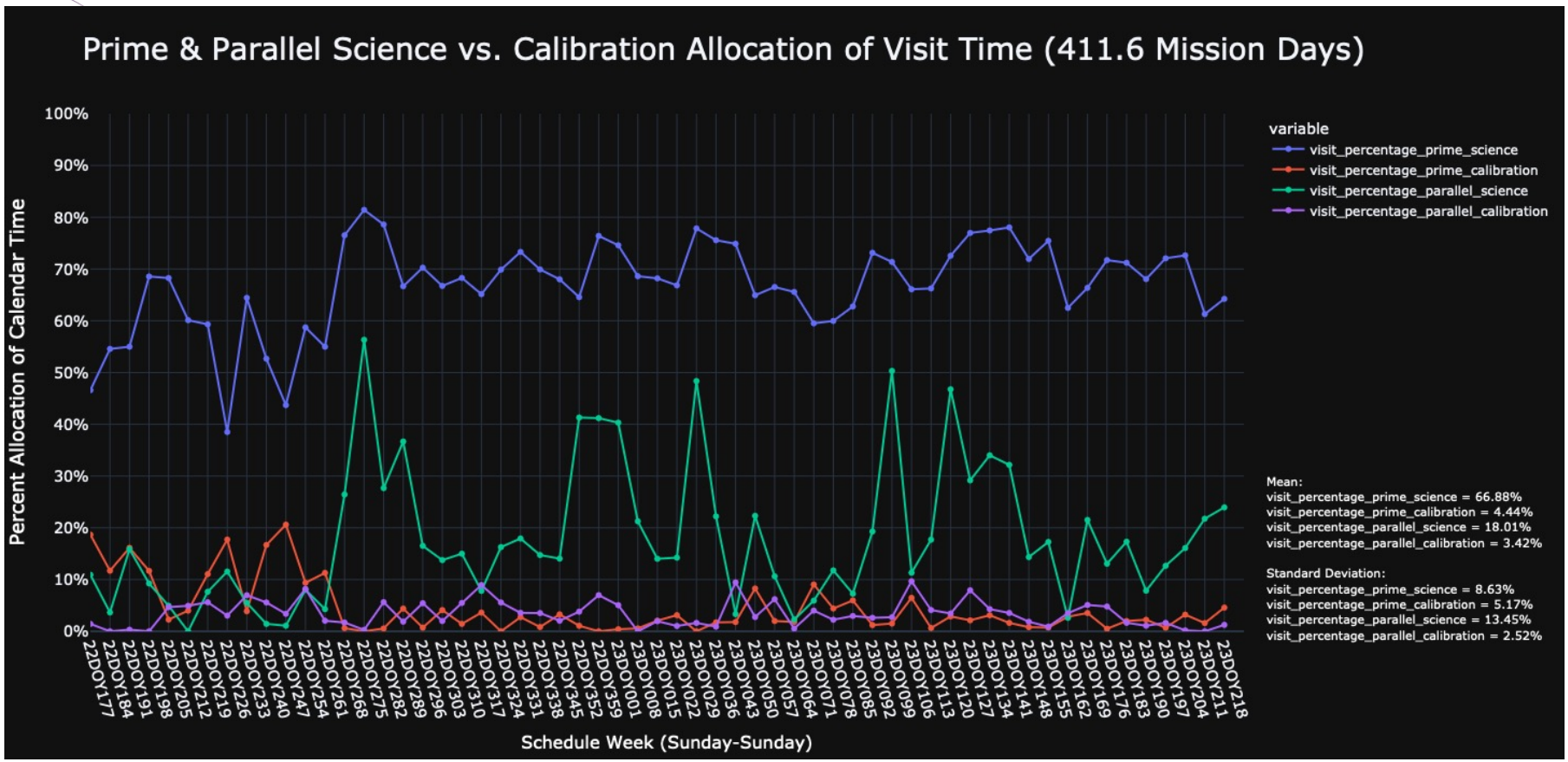


Data is sampled and plotted on a weekly basis – where a week is split between months, the week is shown as part of the month where the majority of days for that week lie. All time is covered, with no overlaps in data samples. This approach applies to all plots in this package.

JWST Efficiency: Mission-to-date % Observatory Idle Time

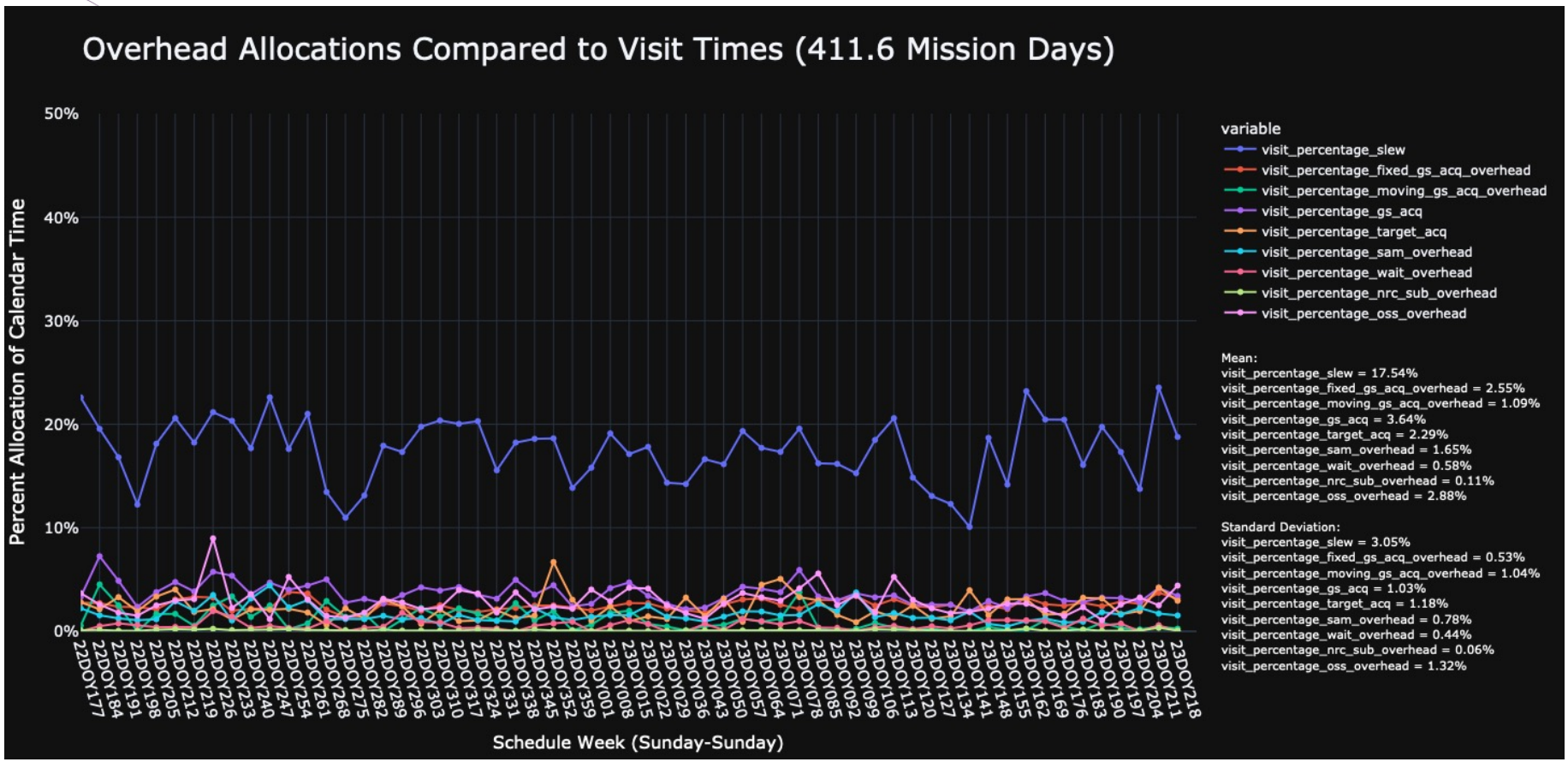


JWST Efficiency: Visit percentage for science and calibration (includes science instruments overheads)

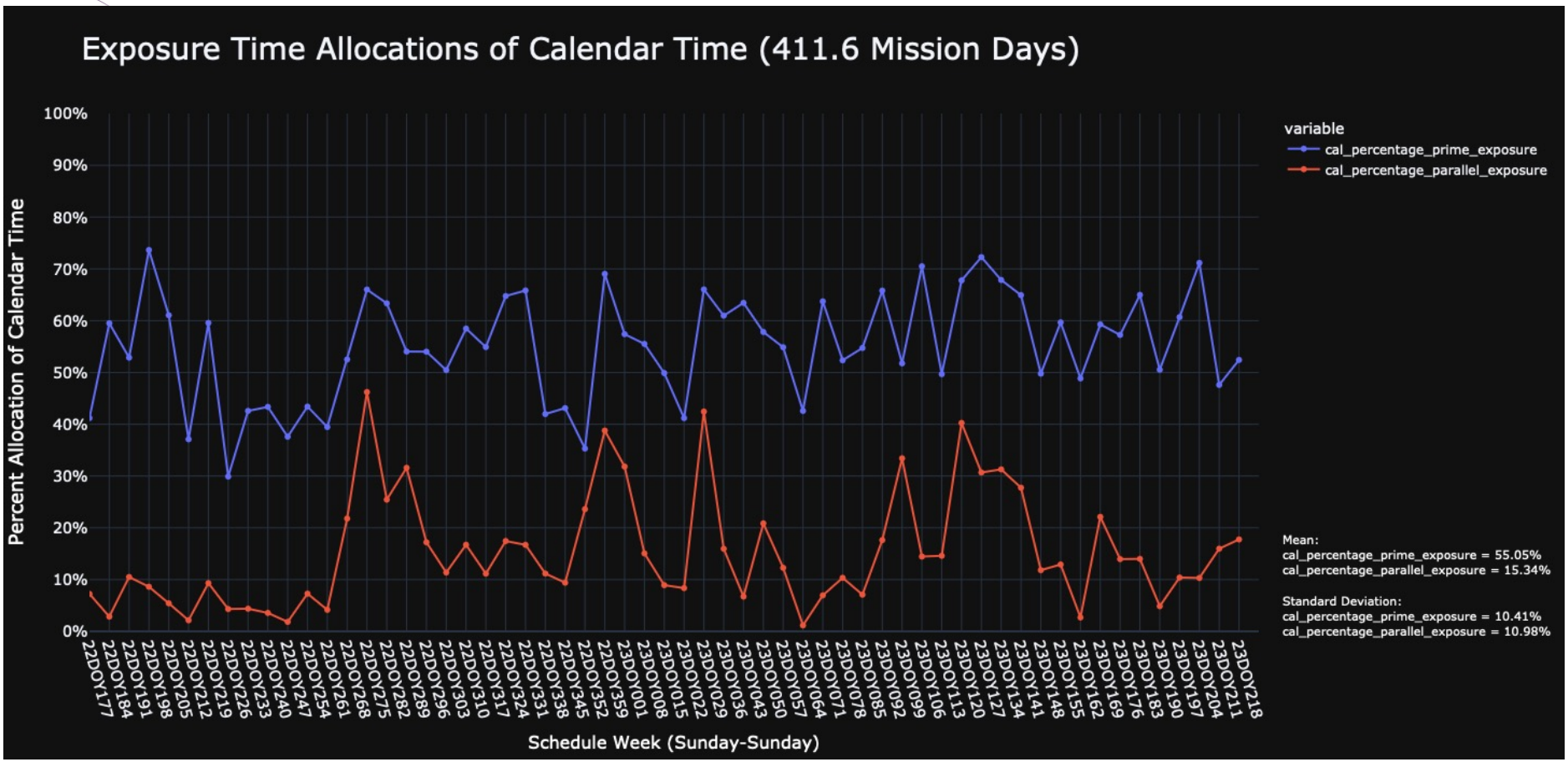


*This is activity time "overlaid" on top of the activities on the timeline – this is an indicator of the additional science "throughput" parallel visits add to observing operations. This metric includes both coordinated and pure parallel science observations.

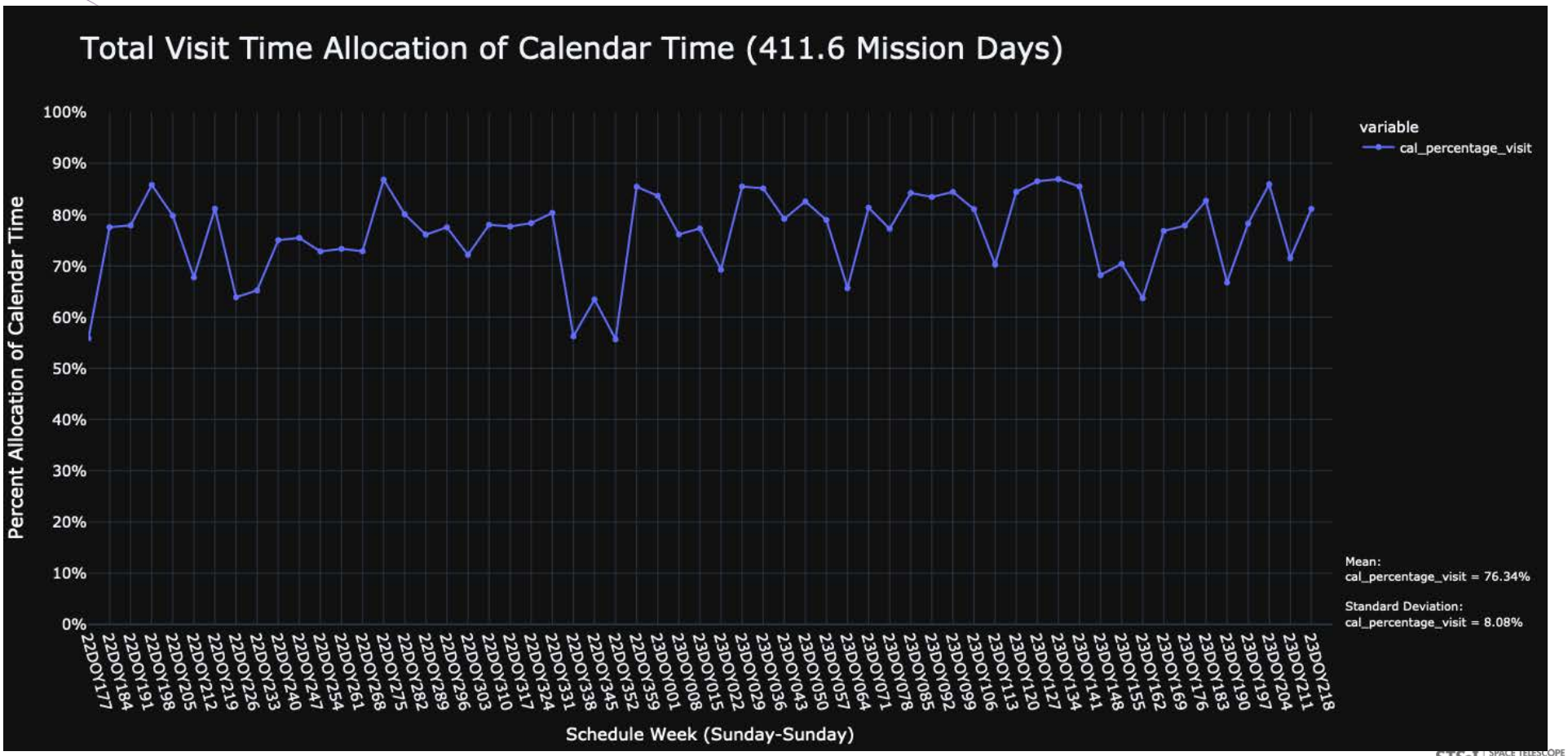
JWST Efficiency: Time setting up for science (i.e. all visits overheads)



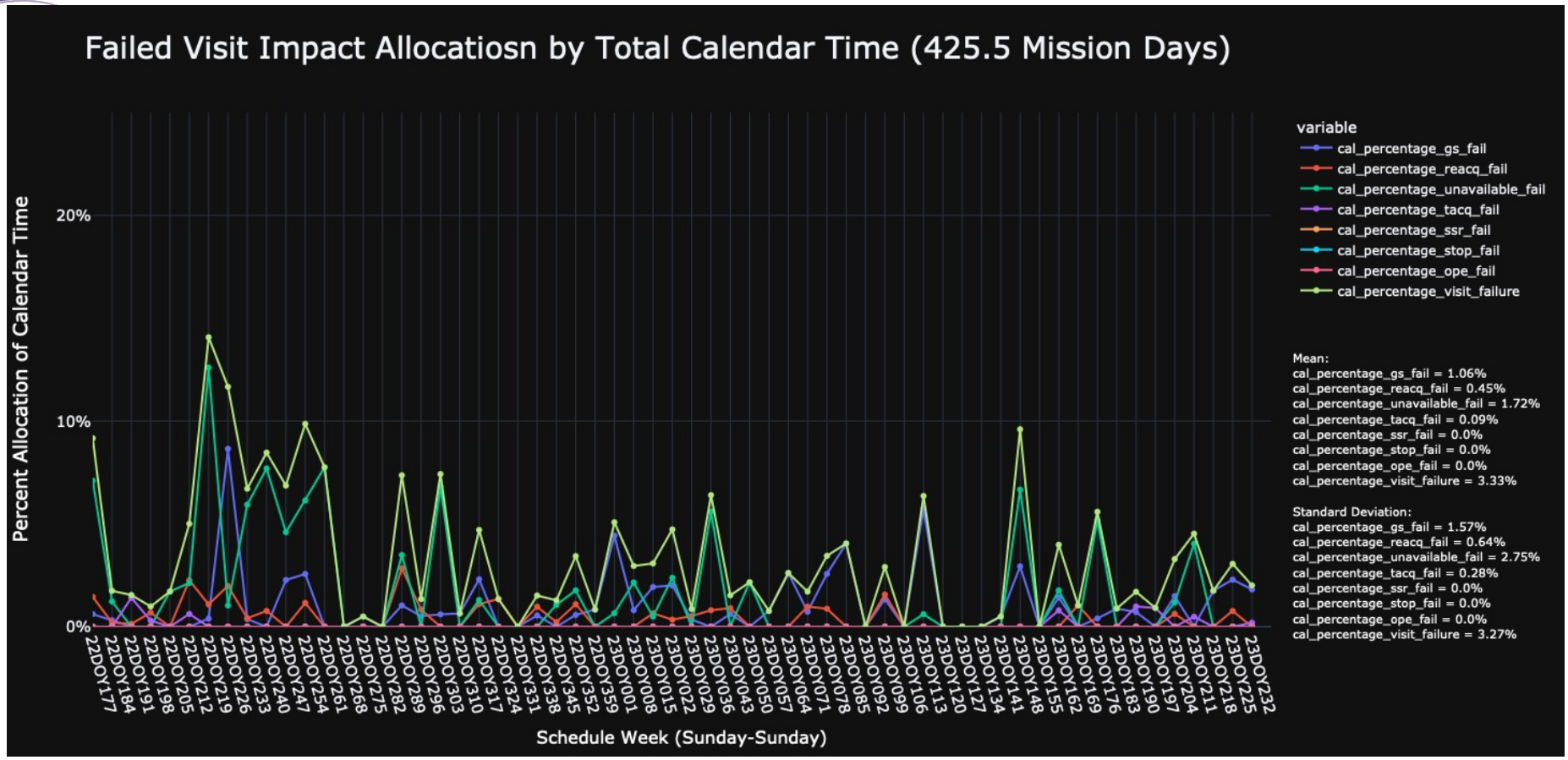
JWST Efficiency: Prime and parallel exposure times (i.e. detector time)



JWST Efficiency: Time for all non-slew visit time (similar to HST metric)



JWST Efficiency: Failed Visit Impact Allocation



JWST Efficiency: High-Level Mission Life Summary

Time Allocation across the Calendar (mean ± stddev)

% Time by Visit Type: June 2022- Aug2023	
Prime Science	81.37±10.65
Prime Calibration	7.1±6.81
WFS&C	1.94±0.78
Real-Time Engineering	0.77±1.19
Station Keeping	0.74±1.61
Momentum Unload	0.15±0.37
Idle Time	7.89±8.15

% Time by Idle Cause: June 2022- Aug2023	
Failure (OPE exception)	1.02±3.67
OP Wait Time	4.29±4.15
OP Stopped Time	1.64±3.44
Residual Gap (remainder)	0.94±3.78

% Time Exposing: June 2022- Aug2023	
Prime Science & Calibration	55.05±10.41
Parallel Science & Calibration	15.34±10.98

Time Allocation within a Science Visit (mean ± stddev)

% Time for Overheads: June 2022- Aug2023	
Slew	17.54±3.05
GS Acq (Fixed & Moving Target)	3.64±1.03
Target Acq	2.29±1.18
SAM	1.65±0.78
Wait (internal to visit)	0.58±0.44
NIRCam Subarray	0.11±0.06
OSS overheads	2.88±1.32
TOTAL overheads	28.69%

% Time for Prime Science: June 2022- Aug2023	
Prime Science (SI_MAIN)	66.88±8.63
Prime Calibration (SI_MAIN)	4.44±5.17

% Time for Parallel Science: June 2022- Aug2023	
Parallel Science (SI_MAIN)	18.01±13.45
Parallel Calibration (SI_MAIN)	3.42±2.52

Failed visits and WOPRs

Time Allocation across the Calendar (mean ± stddev)

% Failed Visits time: June 2022- Aug2023	
GS Acq	1.06±1.57
GC Re-acq	0.45±0.64
Unavailable	1.72±2.75
Target Acq	0.09±0.28
SSR	0.0
Stop	0.0
OPE fail	0.0
Visit fail	3.33±3.27

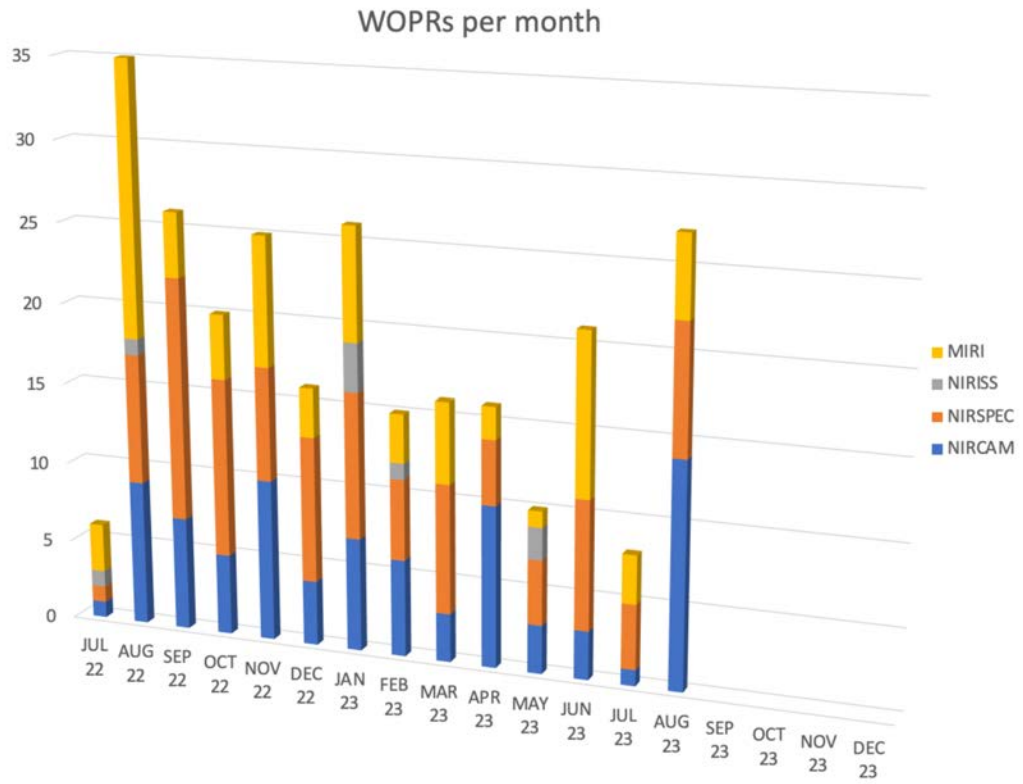
- When a visit fails the proposal PI receives a notification.
- They can submit a WOPR (Webb Observation Problem Report) asking for a repeat.
- The TTRB (Telescope Time Review Board) is the arbiter that decides whether the repeat is granted.
- There are additional reasons that can trigger a TTRB (e.g. MRS reduced count rate, low data quality due to persistence from previous visit)

TTRB Activities Summary: WOPRS since June 2022

Total number of WOPRs submitted: 267 (for 1184.50 hrs of JWST time)

approved: 234 (for 742.59 hrs of JWST time)

approval rate: 87.6%

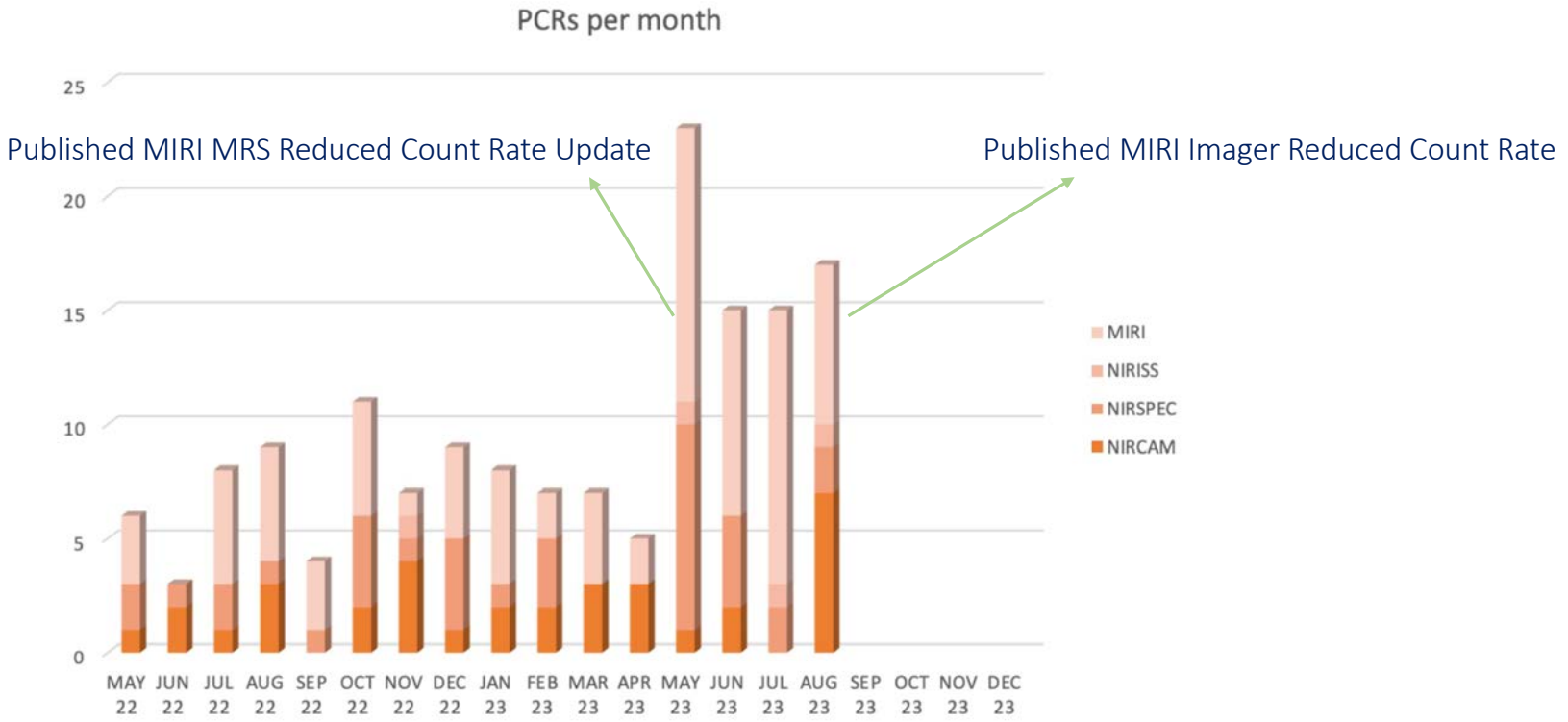


TTRB Activities Summary: PCRs since June 2022

Total number of Program Change Requests submitted: 154

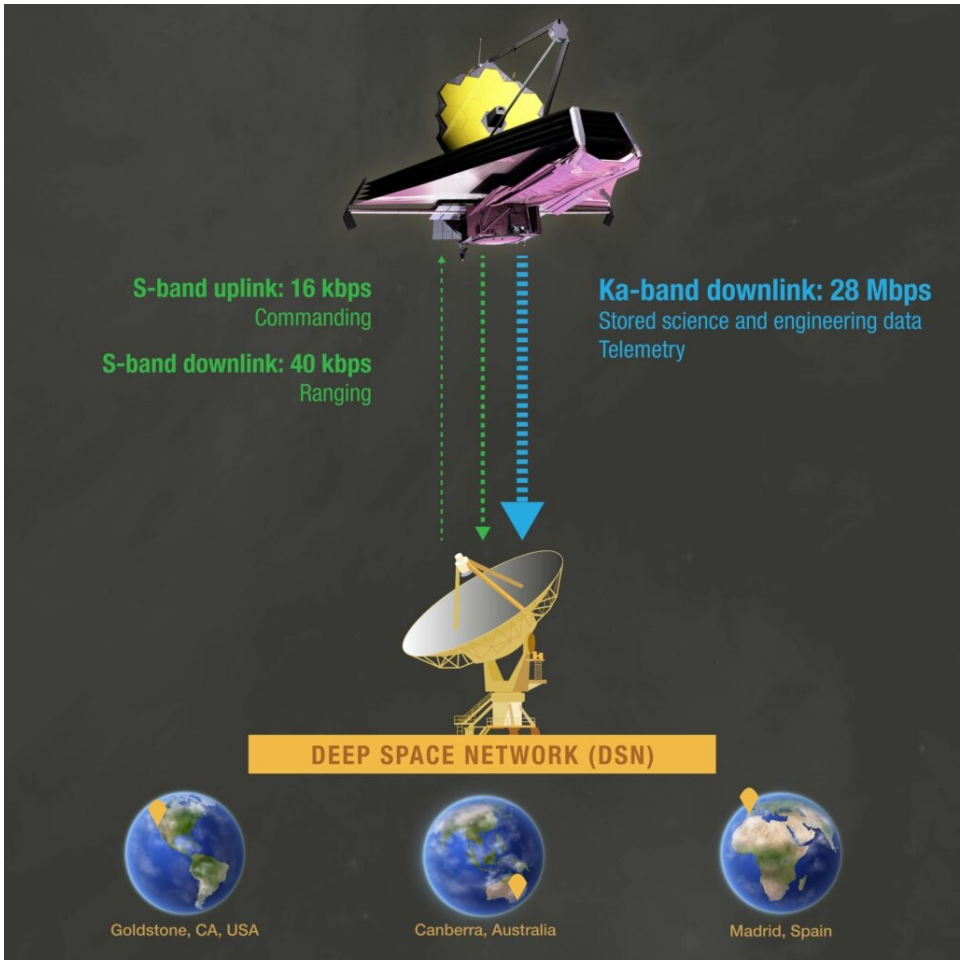
approved: 123

approval rate: 79.9 %



JWST and the Deep Space Network: Normal Operations

- Nominal Ops Concept calls for 2 contacts/day for 8 hours of total contacts.
- The Ops concept is that a missed contact would be recovered in up to 3 successive contacts.
- The data volume of approved programs is higher than expected. During the first 55 weeks of Normal Ops the average daily downlink data volume for scheduled visits is 65 GB and it exceeds the original design data volume (56 GB).
- ~10 hours of contact/day are more adequate. DSN is normally able to provide these contacts .
- During times when ~10 hours of contacts are not available over an extended time period (e.g. certain Artemis launch dates, Typhoon on Guam, maintenance of DSN Antennas) we need to manage data volume when preparing the schedule up to and including not scheduling pure parallels if the expected SSR utilization exceeds 80%.
- Any unexpected unavailability places us in a vulnerable situation and the on-board OP will stop further observations in order to avoid over-writing data.
- High demands and strains in the DSN have been captured in a Science article



JWST and the Deep Space Network: An example of contingency impact

- During the month of July we had 6 DSN contacts without commanding due to DSN hardware issues, these led to loss of downlink capability (downlink could not be commanded).
  - 5 of these events were absorbed without an impact thanks to a schedule that happened to have low data volume.
  - The sixth event led to filling the SSR and stopping observations. Luckily, a contact was scheduled soon after filling the SSR that enabled us to recover the OP with the loss of only ~1 hour of science. If we didn't have this contact, the loss of science could have been much longer.
  - The lack of downlink also slowed down data ingestion in the archive, by 24 hours in one instance (i.e. users received their data with a delay of more than 24 hours).
- During August 2023 we had several days with long planned DSN contact gaps and one day with a gap of 22hours 45min. In addition to a major impact on data volume that we could plan for, any unexpected contingency occurring after the contact would have not been found and corrected for potentially more than 20 hours.
- One day in August the total DSN contact time was 1hour 45min of DSN coverage against the 8 hours of nominal daily contact duration.

JWST and the Deep Space Network: Summary

- Downlink capacity is currently the limiting resource for execution of science observing on JWST.
  - We have the capability to adapt the short term schedule to DSN availability on an occasional/contingency basis by scheduling lower data volume science.
  - If this were to extend to a prolonged period, science observing would be seriously impacted by degraded downlink capacity.
- Normal Ops experience has shown us that margin beyond 8 hours/day is needed for the contact allocation, as the daily data volume can vary significantly from day to day, and there are unexpected DSN outages that must be accommodated.
  - Where we haven't had contact margin, the unexpected DSN unavailability has led to science observing inefficiency. Data already taken are not lost but observations stop and pure-parallel science observations will not be carried out. For time-critical observations this is impactful, and could lead to pushing observations that need to be rescheduled, out beyond the current Cycle.
- In order to ensure that all TAC-approved science in Cycle 2 can be accommodated, we would like to have an average of 10 hours of daily contact allocated for JWST.
- This may be relevant for (future) execution of 3 instruments science parallels

Science planning board enhancements - Completed

ID	Enhancement	Status
411	Reduce overhead when changing NIRSpec detector mode	2022-09-20: Operational
694	Make end-of-plan slew optional (improve efficiency)	2022-11-17: Operational
640	Allow parallels with NIRCam coronagraphy	2022-12-17: Operational
121	Require (not just allow) NAIF ID for moving targets	2023-01-30: Withdrawn, not needed
681	Show NIRISS stray light susceptibility region in APT	2023-02-23: Operational
682	Implement micrometeoroid avoidance zone (risk mitigation)	2023-02-23: Operational
453	Define additional target locations for NIRCam observers	2023-02-23: Operational
143	Enable NIRCam SW+LW coronagraphy simultaneously	2023-05-30: Operational
510	Continue parallel, if prime fails? (currently, parallel continues)	2023-08-11: Withdrawn, no change
9	Add flexible mosaic capability (only APT tile placement tool)	2023-08-11: Withdrawn, not needed
540	Improve workflow for uploading MOS pre-images	2023-08-11: Withdrawn, not used
723	Update example science programs as needed for Cycle 3	2023-08-15: Operational

Science planning board enhancements – Completed (some partially)

ID	Enhancement	Status
203	Allow science observations during MIRI anneal	2023-08-24: Operational
728	Improve efficiency of NIRSpec MSA short detection, Part 1	2023-08-24: Operational
614	Allow use of full detector for MIRI coronagraphy	2023-08-24: Operational
736	Enhance simultaneous MIRI imaging with MRS	2023-08-24: Partially operational
732	Allocate number of targets rather than time for Survey proposals	2023-08-24: Partially operational
757	Improve MPT (bug fixes, enhancements)	2023-08-24: Partially operational
389	Reuse NIRSpec detector configuration (improve efficiency)	2023-09-05: Operational

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Science planning board enhancements – Not yet completed

ID	Enhancement	Status
264	Enable DHS use in NIRCam grism time series template	2023-03-30: Wait for 733 (stripe mode)
282	Enable moving target shadow observations (need FSW update)	2023-05-22: On hold. Alternatives?
302	Determine maximum feasible duration for time series visit	2023-06-12: Identified some soft limits
618	Enable use of NIRSpec fixed slit with MSA (big change for DMS)	2023-09-01: DMS work pending
644	Improve duplication checking tool (harder than expected)	2023-08-14: Notebook released
721	Allow NIRCam WFSS as a pure parallel option	2023-09-01: In progress, many steps
729	Improve efficiency of NIRSpec MSA short detection, Part 2	2023-09-01: Expected in Nov 2023
733	Implement stripe modes for NIR detectors (ASIC microcode)	2023-07-26: FSSE held design review