Chandra Users' Committee Meeting

October 8, 2024

CXC Manager's Status Report

Mark Weber, CXC Manager

Edward Mattison, CXC Deputy Manager

Topics

CXC

- High Level Overview
- **Program Management**
- Mission Operations
- Grants & Fellowships
- **Public Communication and Outreach**

High Level Overview (1/3)

CXC

- Spacecraft and instruments are performing well
  - With the primary exceptions of low-energy ACIS quantum efficiency and the restrictions imposed by the HRC power supply anomaly, Chandra continues to meet or exceed all other Level 1 requirements.
    - The pre-launch AXAF Level 1 requirements specify performance for a minimum of 3 years of mission operations. The Program has considerably exceeded that span.
  - HRC has been operating successfully with the new thermal and scheduling constraints.
  - Relaxation of thruster temperature limits and the increasing perigee altitude are allowing staff efforts to retain high efficiency planning.

- Senior Review 2025
  - Triennial NASA review of operating missions. One panel for APD.
  - **Budget guidelines are extremely low and challenging to propose to. Continuing mission plans will be submitted as "overguides".**
  - Proposals due 12 December 2024.
  - Panel questions in Jan–Feb. 2025.
  - Project presentations in Feb. 2025.

High Level Overview (2/3)

CXC

- Budget
  - The CXC budget for FY24 was reduced by $3M after the 2023 PPBE, due to budget constraints at NASA.
    - The FY24 budget reduction was achieved by cutting Cycle 25 by 30%, delaying new hires and equipment purchases, and minimal use of carryforward.
  - FY24 expenditures are projected to be in line with the FY24 Operating Plan.
  - The FY25 budget extends the existing workforce through 9/30/25, but reduces Cycle 26 Grants by 50%. New budget guidelines likely will not be provided to CXC for several months yet (i.e., President's Budget Request in March).

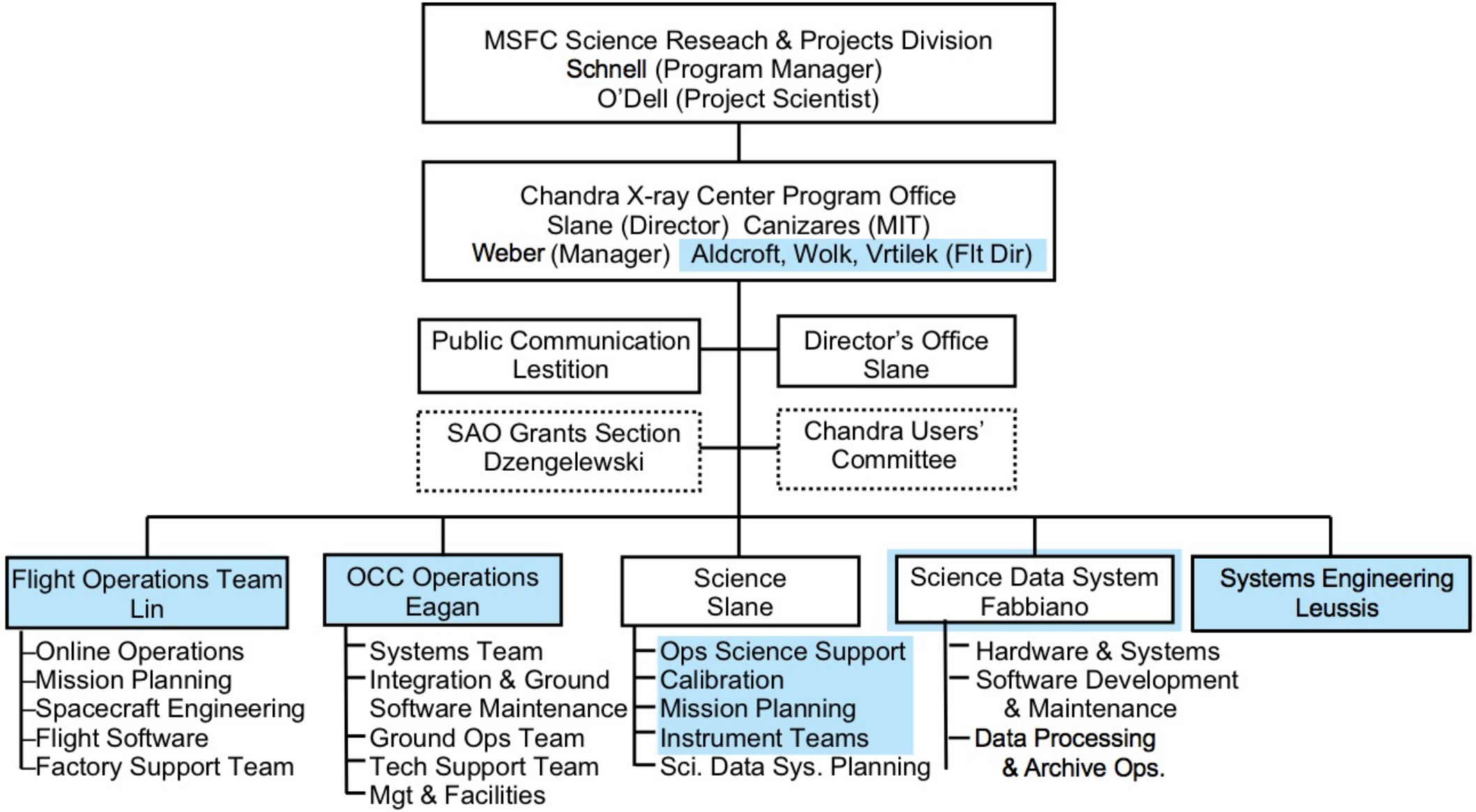
- Communications & Public Engagement
  - Chandra 25: Year-long campaign to highlight Chandra's 25th anniversary.
  - Chandra has been mentioned or featured in **>4k** popular news articles, including: ***The Washington Post, USA Today, The New York Times, NPR, CNN*** & many others.
  - Chandra science heavily spread across digital platforms.

High Level Overview (3/3)

CXC

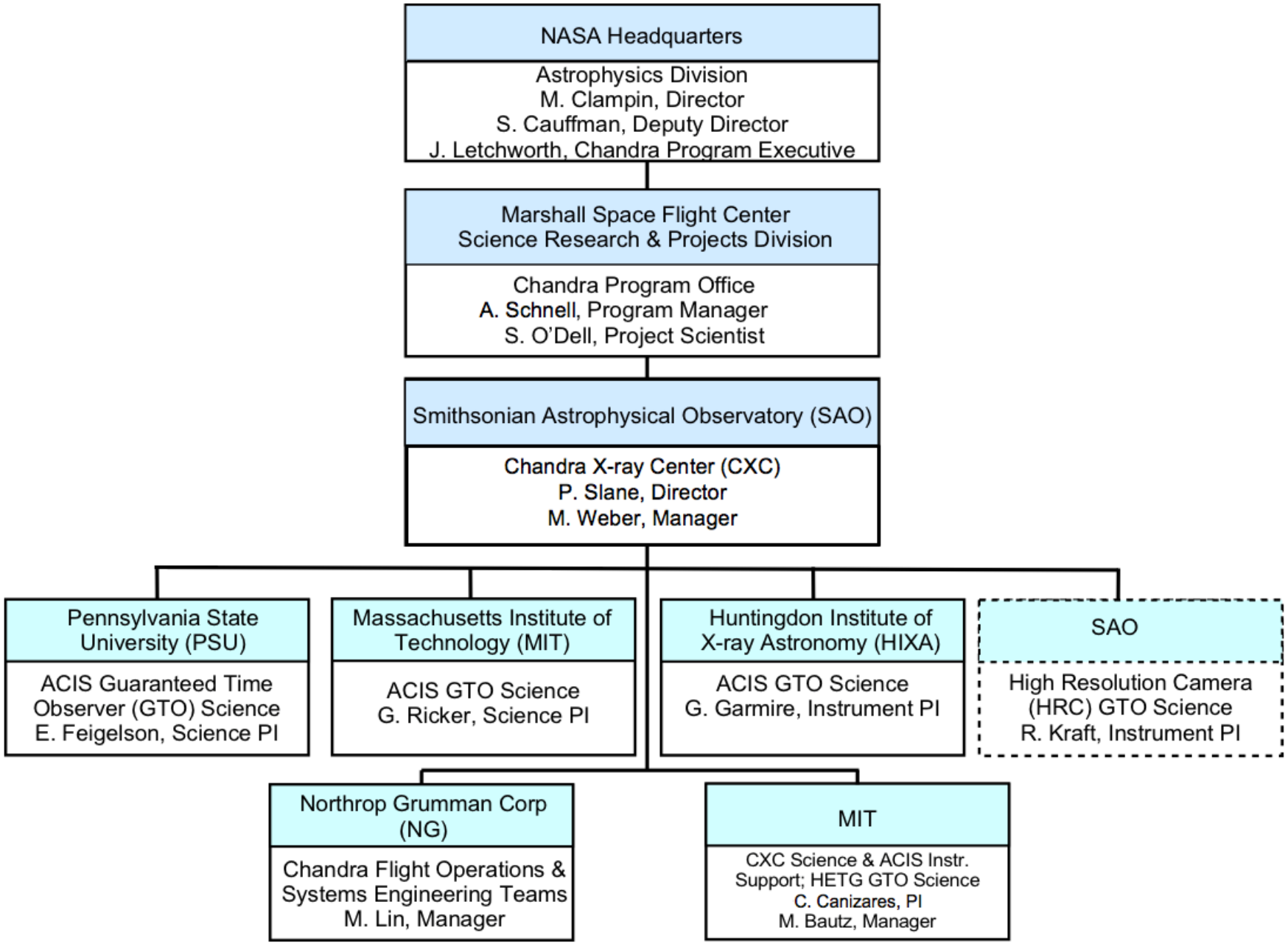
- Changes in Leadership Personnel
  - MSFC Chandra Project Manager:
    - **Helen Cole** retired on June 14, 2024. **Andrew Schnell** moved from Deputy PM to Acting PM.
  - MSFC Chandra Deputy Project Manager:
    - **Kevin Hix** is coming on as Acting Deputy PM.

Program Management (1/11)



Program Management (2/11)

CXC



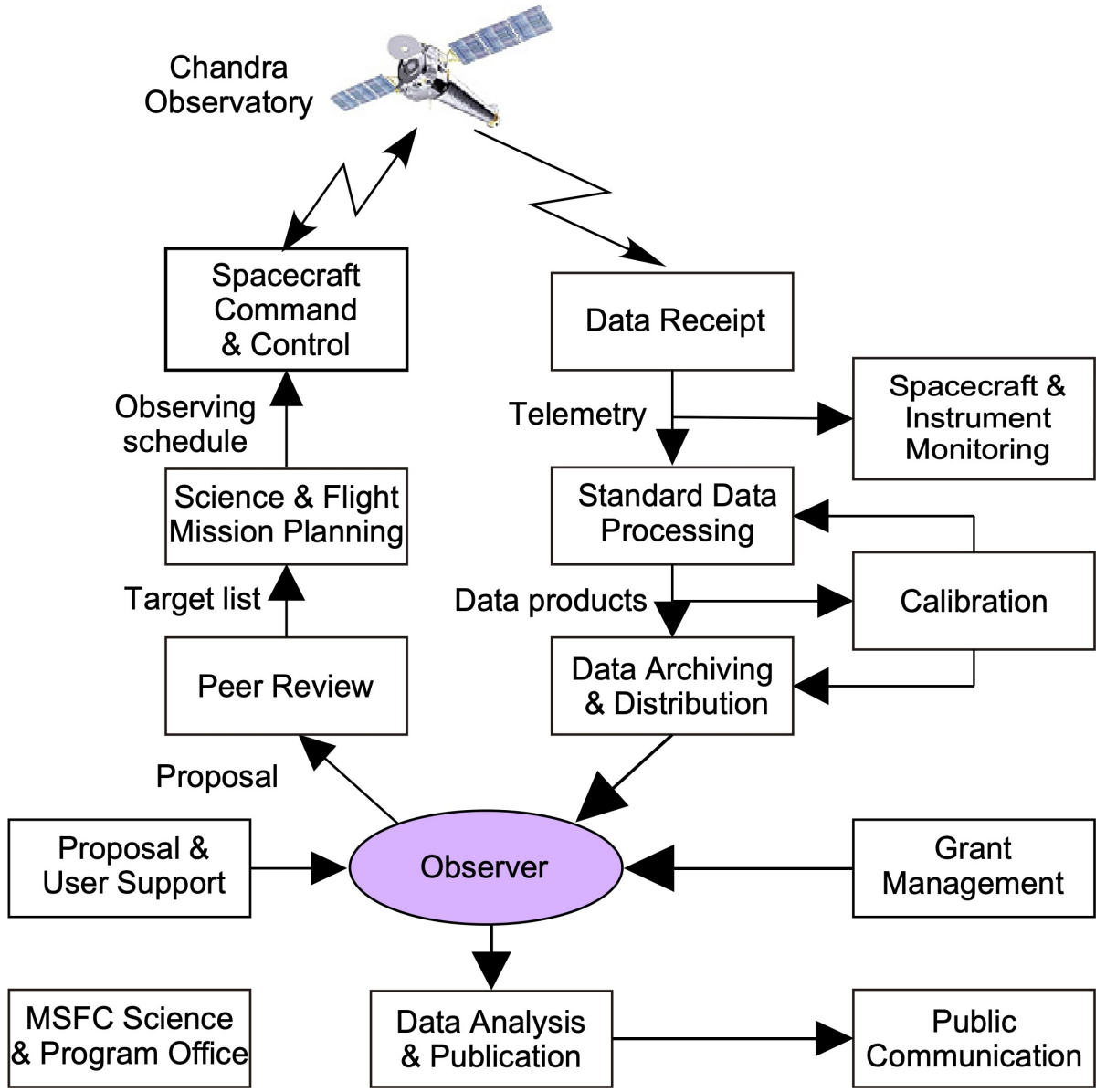
Program Management (3/11)

CXC

Chandra Task Thread

MSFC and the Chandra X-ray Center conduct all aspects of the Chandra X-ray Observatory program

- Science
- Spacecraft operations
- Data processing, archiving, & distribution
- General observer grants management
- Public communication



Program Management (4/11)

CXC

- CXC-organized Reviews and Conferences
  - Cycle 26 Dual Anonymous Peer Review
    - Was held 22 May – 27 June 2024 (conducted remotely and asynchronously).
  - Chandra Legacy Program
    - A portion of Cycle 26 observing time (1Ms) was reserved for the Chandra Legacy Program, which had a total allocation of 6 Ms from various sources (Cycle 26 & 27, DDT, and GTO time).
    - CLP was announced in November 2023 as a two-stage process, and completed in May 2024.
    - Two ~3 Ms programs selected.
  - Science conference: "25 Years of Chandra Symposium"
    - Scheduled for 2–6 December 2024, Boston.

- Programmatic Meetings
  - "State of Chandra" presentation to NASA HQ — 25 Oct 2023.
  - Quarterly #56 — 15 Nov 2023.
  - Quarterly #57 — 25 Jun 2024.

Program Management (5/11)

- Current CXC Contract
  - Current contract carries mission ops through Sep-2027.
  - No remaining contract options for extending mission ops beyond Sep-2027. Further extension of mission operations will require a new proposal in coming 3 years.
  - Contract option for a 3-year closeout period follows the end of mission operations.

- Current Funding
  - Current CXC funding runs to 8-Mar-2025.
  - The Einstein program is funded through 2025.

Program Management (6/11)

CXC

- Budget Background: 2021
  - In 2021, the Chandra budget was insufficient to meet all costs. This was due to a number of things, but two were particularly important:
    1) The NASA budget for Chandra had been nominally flat (i.e., the same dollar value every year) for multiple years. Cost-of-living increases and advancement/promotions required more funding to maintain level capability for the program (staff, purchases, grants).
    2) COVID effects.
  - Chandra requested more funds to cover this in 2021, but got only half of that difference. As a result, we had to have a reduction in staff in 2022.

- Budget Background: 2022
  - In 2022, Chandra submitted the Senior Review proposal. It included a budget request for two additional FOT engineers to support increasing complexity of the spacecraft, and for yearly increases to account for inflation, cost-of-living, and advancement/promotion projections. The request also included some other “augmentations”.
  - Chandra received the highest scores in the Senior Review, and in the subsequent PPBE (Planning, Programming, Budgeting & Execution) budget process was awarded an amount that covered the engineers and rising costs, but not the augmentations.
  - However, for FY24 and beyond, while the guidelines included increases each year, they were not the full amount to maintain FY23 capability. NASA advised us to request in the 2023 budget cycle for the difference to be made up.

Program Management (7/11)

- Budget Background: 2023
  - In the 2023 PPBE process, the guidelines for FY24 carried over from the previous year, i.e., they showed a nominal increase over FY23, but not an amount sufficient to maintain “level capability”.
  - Chandra submitted an overguide request in the 2023 PPBE to be funded at level capability in FY24 and beyond.
  - The budgeting process between the White House and Congress resulted in delays and reductions to the Federal budget. Eventually, the CXC budget for FY24 was reduced by $3M after the PPBE.
  - The FY24 budget reduction was met by reducing Chandra Grant Cycle 25 by 30%, by delaying new hires and equipment purchases, and with some minimal use of carryforward.

Memorandum from Paul Hertz, 5 August 2022: NASA Response to the 2022 Astrophysics Senior Review of Operating Missions:

“The Chandra mission is provided additional funding to preserve operational capabilities and enhance Chandra’s ability to support time-domain science within the budget provided. **The guiding principle for the use of the funded overguide should be to maximize the science returns for the community by preserving mission infrastructure while maximizing General Observer program funding.**”

Program Management (8/11)

- Budget Background: 2024
  - **FY24 expenditures are in line with the FY24 Operating Plan, as updated after the NASA 2023 PPBE.**
  - The CXC Director presented to the CUC on 28 Aug 2024 regarding the OPCR results and FY25+ budget outlook.
    - OPCR Panel provided strong support for Chandra. Findings were that mission is operating well, that initial budget guidelines required decommissioning of observatory, and that reduced-funding options were faithful efforts at identifying minimal mission concepts (with and without GO funding), but that full operation of Chandra is desirable.
    - NASA announced budget plans to support Option III.
      - Vast reductions across entire CXC scope, including 50% reduction in observing time. GO funding included at levels scaled to reduced observing time.
    - "Bridge funding" provided to support CXC staff through Dec 2024 in order to enact transition to Option III and complete Senior Review proposal (12 December 2024).
    - Additional negotiations added "buy-back" funding to reclaim lost 50% observing time (but not GO funding).
    - Further efforts restored funding to eliminate layoffs through FY25. Current CXC staffing capacity maintained through Sep 2025.
    - All observing (including HRC) will continue as in past over this period, but GO funding is at reduced levels.

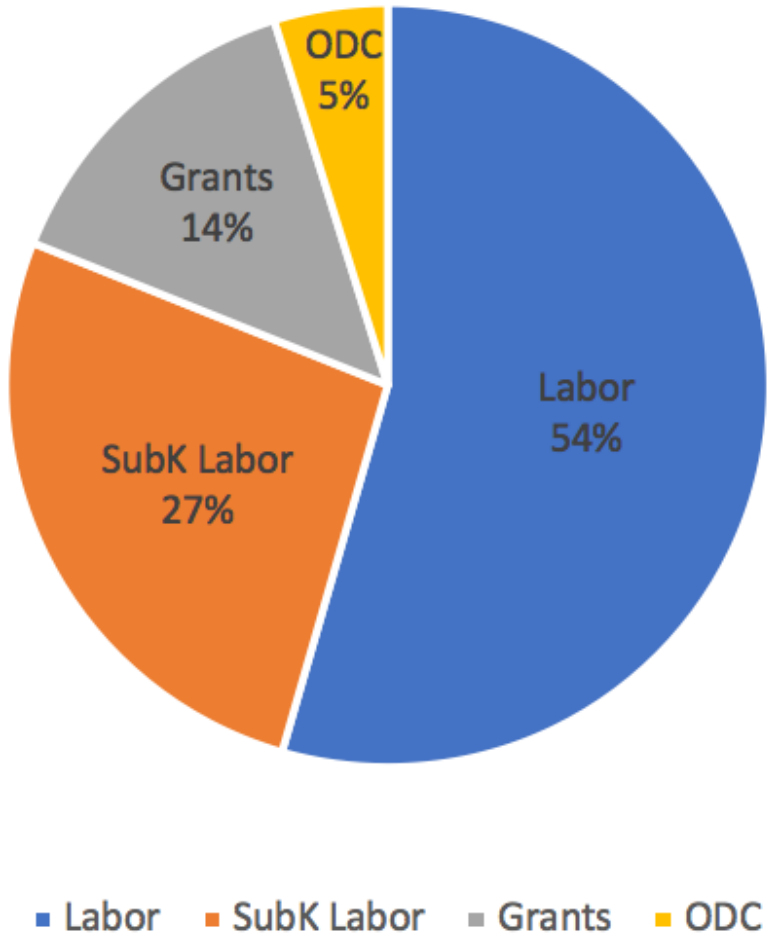
Program Management (9/11)

CXC

- Senior Review 2025
  - Triennial NASA review of operating missions. There is a single panel for APD missions.
  - **Budget guidelines are extremely low and challenging to propose to.**
    - In the absence of more concrete information about future years, and the uncertainties around FY25 Federal appropriations, NASA HQ has defaulted the guidelines to the President's Budget Request for FY25 (March 2024).
  - **Continuing mission plans will be submitted as "overguides".**
    - Overguide 1: A "mostly status quo" plan that seeks a few efficiencies.
    - Overguide 2: Retains most functions, utilizes all observing time, and fully funds Grants program. HRC off. Some software tools moved from development to maintenance-only.
  - **Proposals due 12 Dec 2024.**
  - Panel questions in Jan–Feb. 2025.
  - Project presentations in Feb 2025.

FY24 CXC Budget Structure

The CXC budget is dominated by labor and Chandra grants.



Program Management (11/11)

CXC

- Addressing a possible Federal shutdown
  - *How do Federal shutdowns potentially affect Chandra?*
  - There is only one Federal person on CXC staff, and none in the SAO Contracts & Procurement department. Effectively all SAO and subcontractor staff can continue working as long as we have funds. SAO can continue to fund, and work with, subcontractors.
  - MSFC Chandra project staff that are necessary for operation approvals and anomaly responses will be available as needed, so no impact to operations.
  - However, MSFC would not be able to issue funds to CXC, so existing funds would need to be stretched.
    - CXC can hold on some new obligations, such as purchases and funding to grants.
    - CXC has the option to seek emergency funds from SI. There is precedent for that action. But there is also elevated risk this year because SI itself faces potentially large budget cuts in FY25, and emergency funds have to paid back. After 3 months, these "loans" incur interest.
  - *A Federal shutdown is **NOT** an immediate concern for CXC.*
    - CXC is currently funded to Mar 8.
    - Current Continuing Resolution funds Federal government until Dec 20.

Mission Operations (1/9)

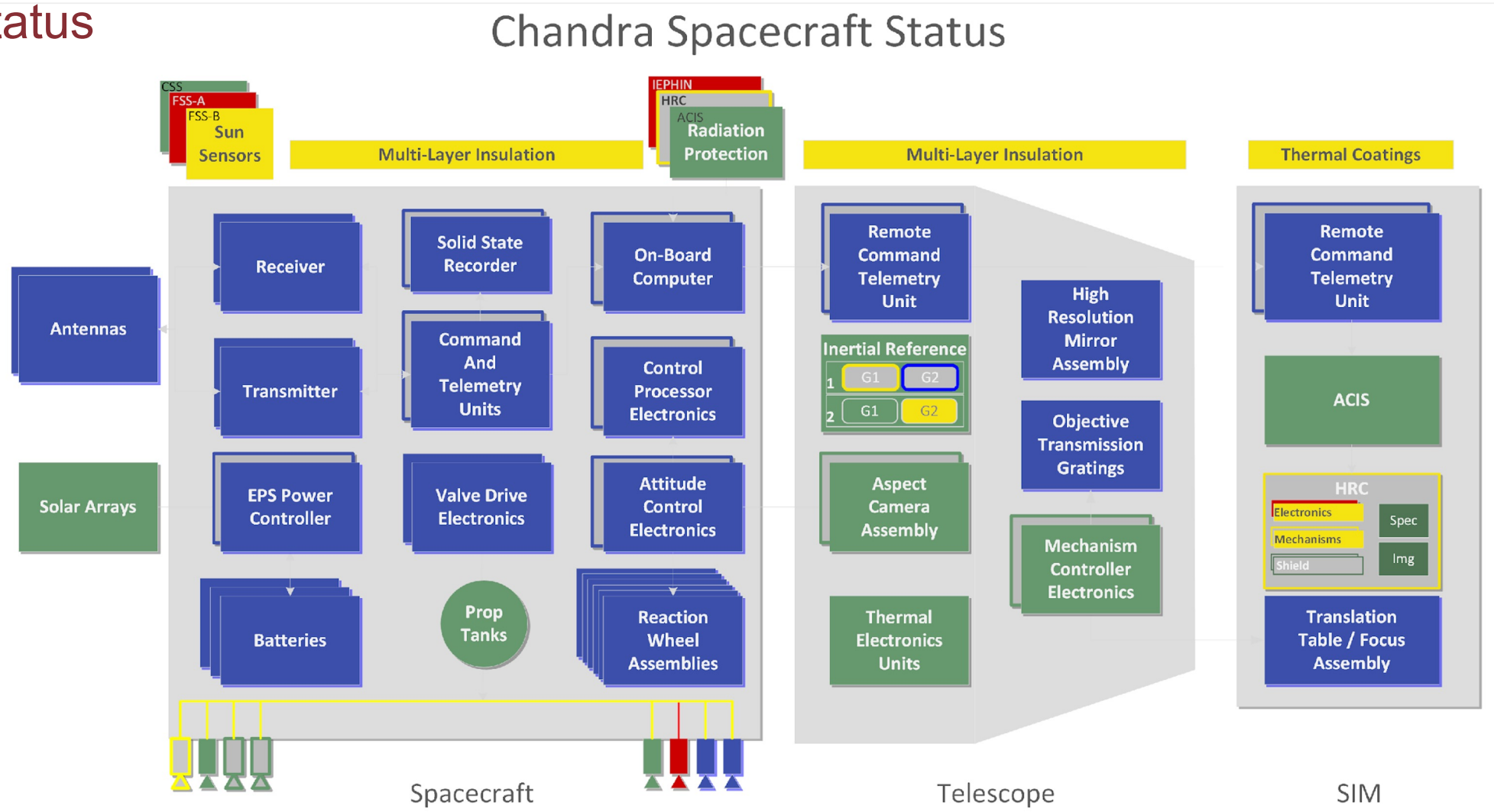
CXC

- Spacecraft — Overall status
  - **The spacecraft continues to operate extremely well.**
  - Increases to the MUPS thruster thermal limits and ground tool improvements have increased max dwell durations and provided relief to mission planning complexity.
  - Gravity-gradient and ionizing radiation concerns due to 2022-2024 low-perigee are reduced. We expect to retire all low-perigee constraints by early to mid-2025.
  - Capability to offset point to a "cool" attitude following a safing action has been approved and used twice. This provides a safe thermal configuration for extended safing events and reduces time and complexity for returning to science.

- Science Operations
  - **ACIS continues to operate well.**
    - A new ACIS flight software version was developed and uplinked on 19 September 2023.
    - ACIS FP and electronics temperatures have been lower (on average) due to longer dwelltimes at pitch angles around 90 degrees.
  - **HRC A-side electronics have functioned nominally in over 100 observations since the restart in Apr 2023.**
    - The team is working on improving the accuracy of the thermal model for the HRC electronics.

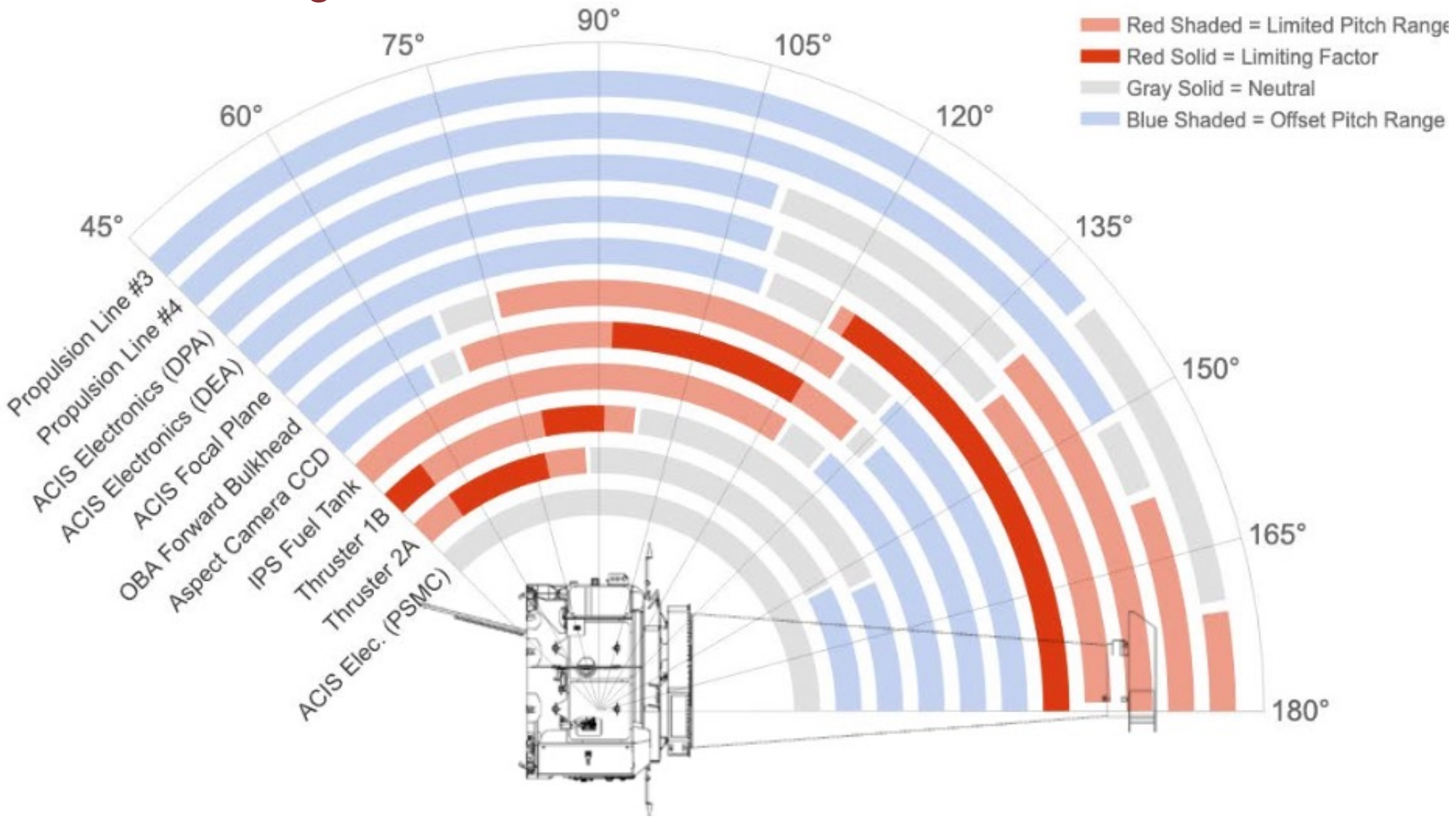
Mission Operations (2/9)

- Vehicle Status



Mission Operations (3/9)

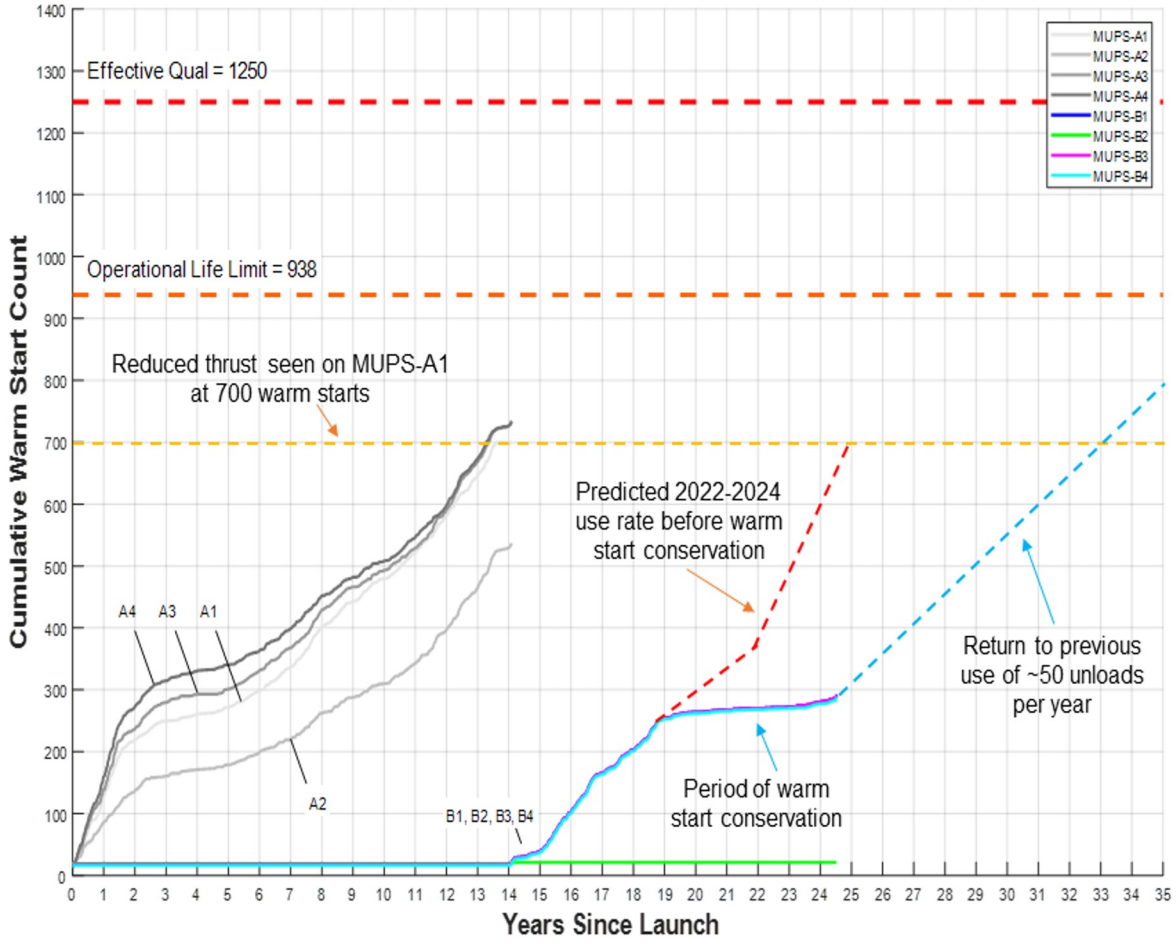
- Spacecraft — Heating versus Pitch



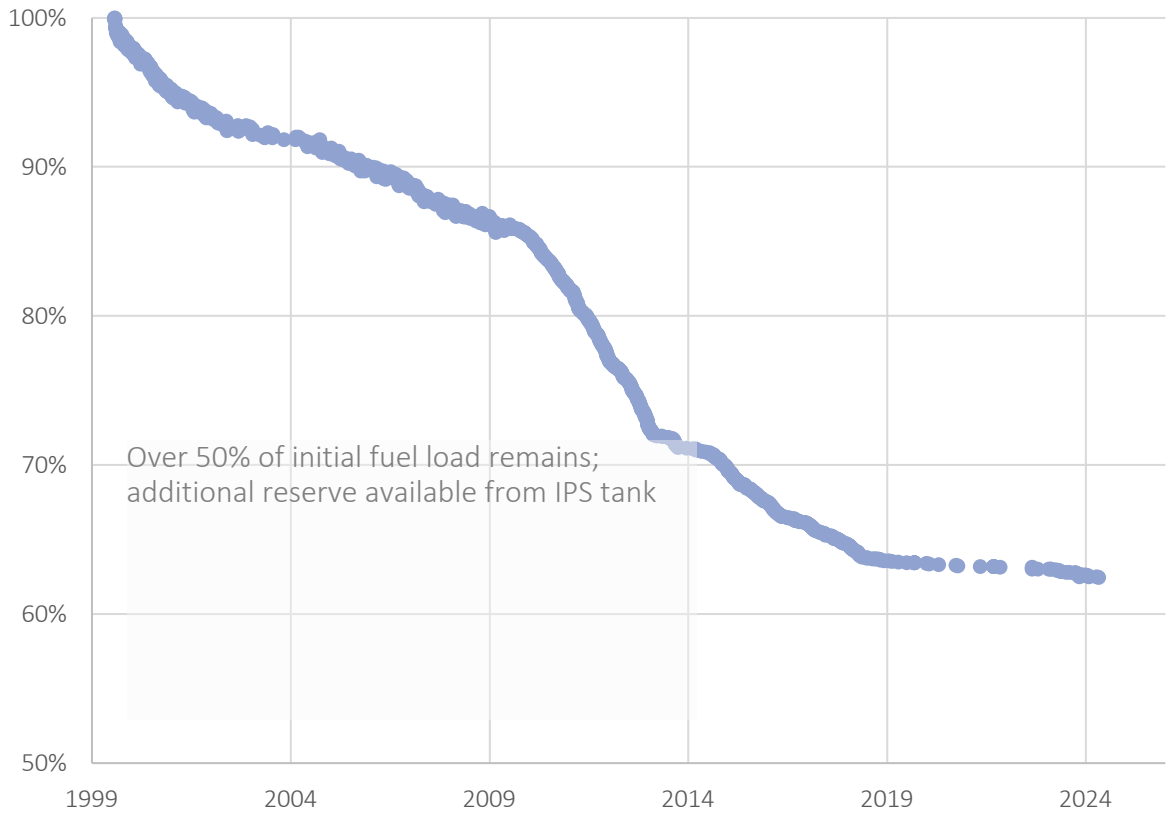
Mission Operations (4/9)

- Spacecraft — Trends on Resources

Cumulative Thruster Warm Starts



% Fuel Remaining



Mission Operations (5/9)

CXC

- Major Operational Improvements
  - Significant improvements allowed for increases to the MUPS thruster planning limits which substantially constrain planning and dwell times.
    - Added capability to block hot thrusters, preventing a hot firing in the event of an OBC auto-unload. This allows elimination of a significant 15F margin in the MUPS planning limit.
    - Performed an important technical study allowing for increasing the MUPS compatibility limit from 240F to 260F. This limit had previously been viewed as unchangeable.

    ➥ **Decreases planning complexity and increases dwell durations, rolls back the clock ~5years**

  - Updated HRMA thermistors to wide-range readout

    ➥ **Provides key visibility of thermal state during Safe Mode Events .**

  - Similar to the offset pointing capability for Normal Sun Mode events, a Safe Sun Mode offset patch was developed and deployed to autonomously offset the vehicle to a cooling attitude after a Safe Mode.

    ➥ **Keeps ACA cooler, enabling faster recoveries from some Safe Mode anomalies and mitigating thermal risks.**

Mission Operations (6/9)

CXC

- Major Operational Improvements (continued)
  - A new "sky balance" metric has been developed, which is used for laying out the schedule.
    - ➥ **This drastically reduces the amount of time that FOT Mission Planning has to drop during detailed weekly planning.**
  - Calibration and analysis efforts have enabled the warm end of the ACIS focal plane temperature range to be raised to -105 C for a significant fraction of ACIS observations.
    - ➥ **This reduces contraints on the Mission Planning scheduling, and enables use of ACIS under a wider range of conditions.**
  - Changed format of ORL to a YAML-based machine readable format.
    - ➥ **This allows more automated handling of constraints by FOT Mission Planning during weekly planning, and sets the groundwork for the potential development of an assistive scheduler by FOT-MP.**

Mission Operations (7/9)

CXC

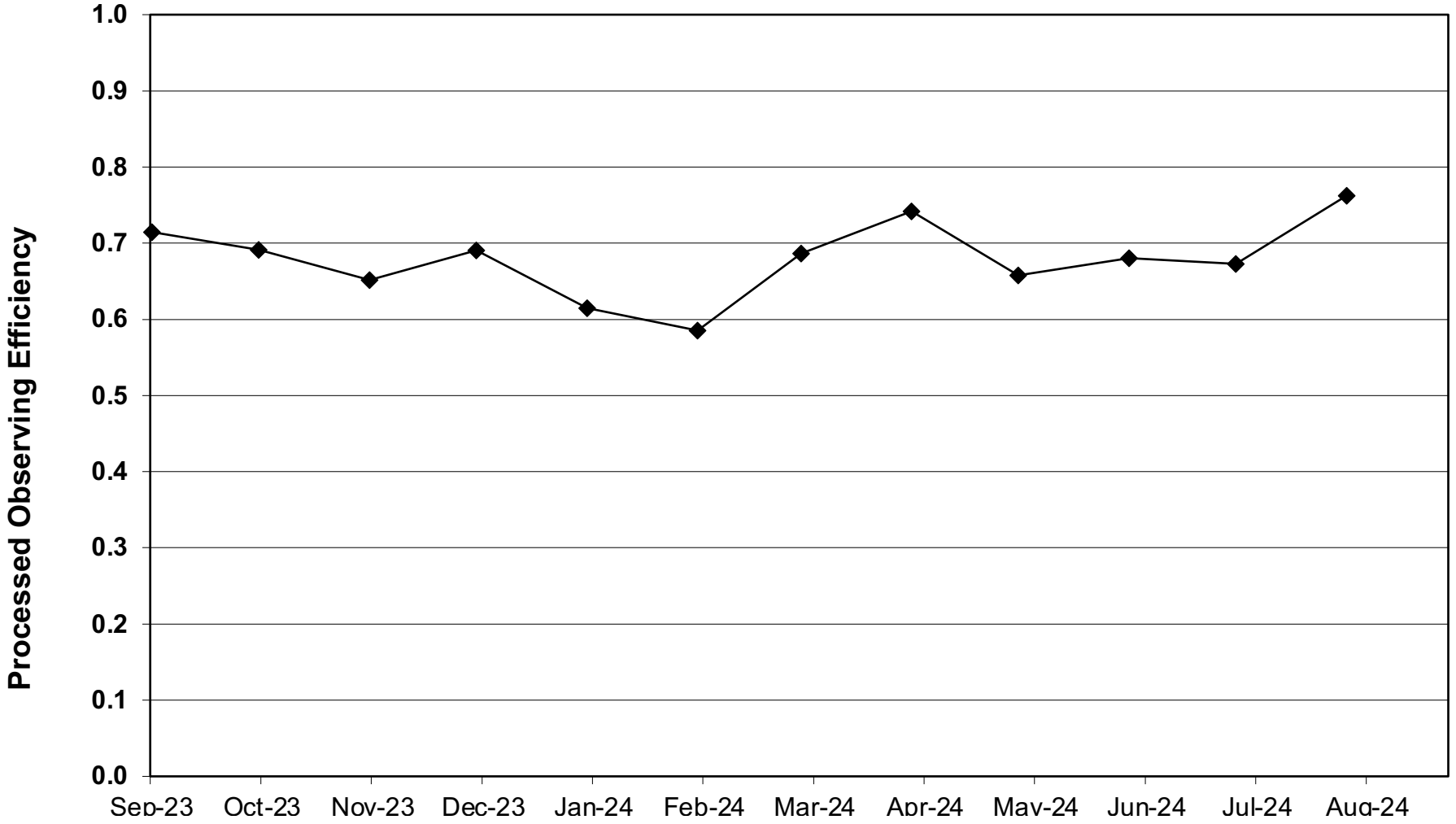
- Spacecraft — Interruptive events
  - (Jan 24) Normal Sun Mode following a Maneuver
    - Failed star acquisition after maneuver due to sparse star field and instance of ACA “wrong box” recurring anomaly.
    - Science time lost = 154 ks.
  - (Feb 4) Normal Sun Mode due to loss of guide stars
    - Stars lost due to extended duration ACA High Background recurring anomaly.
    - Science time lost = 172 ks.
  - **Both of the NSM events took advantage of the offset pointing capability to cool the ACA and facilitate timely return to science.**

Pauses from radiation monitoring:

- (Nov 5) “SCS 107” manually triggered
  - Science time lost = 95 ks.
- (Jan 22) “SCS 107” manually triggered
  - Science time lost = 72 ks.
- (Feb 10) “SCS 107” manually triggered
  - Science time lost = 75 ks.
- (Mar 24) “SCS 107” ACIS TXings
  - Science time lost = 94 ks.
- (May 20) “SCS 107” manually triggered
  - Science time lost = 246 ks.
- (Jun 8) “SCS 107” ACIS TXings
  - Science time lost = 198 ks.
- (Jul 23) “SCS 107” ACIS TXings
  - Science time lost = 203 ks.

Mission Operations (8/9)

- Observation Efficiency



Mission Operations (9/9)

CXC

- Operations Control Center (OCC)
  - The OCC has maintained smooth operations.
  - Started hardware refresh for systems purchased in 2017–18. Transitioned to new VMware environment. Replacement of flight operations servers continues.
  - Telemetry Database P017 built, tested, and transitioned to operations on 31 May 2024.
  - Developing OFLS v13 (Offline System, primarily for mission planning and scheduling, command load management, attitude determination, and spacecraft clock correlation calculations), with delivery expected in Oct 2024.
  - ONLS v4.2 (Online System, primarily for real-time spacecraft command and communications) delivered in Jul 2024. System test finish will be end of Oct 2024. Testing of a new telemetry display client will continue into 2025.
  - The Backup OCC is fully capable to support science operations.

- Science Data Systems
  - Software development and deliveries have stayed on schedule.
  - Standard data processing and archive operations are proceeding smoothly.
  - Chandra Source Catalog v2.1 processing is complete, and the catalog was released on 2 Apr 2024.
  - Repro V (a data reprocessing across the mission) is nearly complete. Some edge cases remain.
  - We delivered data to observers within ~ 1.0 day of the observation.

Grants & Fellowships (1/2)

CXC

- Data Delivery
  - We continue to deliver data to observers within ~1.5 days of observation.

- Grant Issuance
  - We continue to issue grants typically within 2–3 weeks of initial observation.
  - Grants <$30k are issued for total award amount.
  - Grants ≥$30k and <$100k are initially issued for 50% of total award; remaining amount is awarded when 75% of initial award has been invoiced.
  - Grants ≥$100k are initially issued for 33% of total award; remaining amount is awarded in multiple increments when 75% of previously awarded funds have been invoiced.

Grants & Fellowships (2/2)

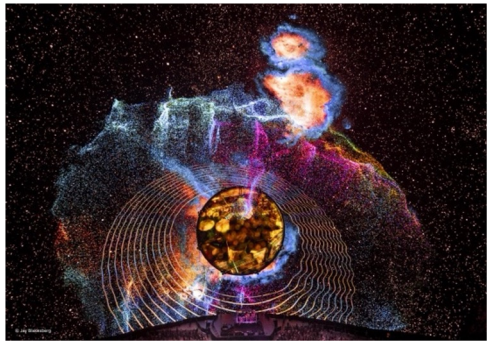
CXC

- General Observer Program
  - The Observing Cycle 26 Call for Proposals was issued 14 Dec 2023.
  - There were 406 proposals submitted (324 general observer, 23 theory, 58 archive).
  - Total time available: ~13.8Ms.
  - Oversubscription in time: 3.9x.
  - Dual anonymous peer review was held remotely, 22 May – 27 June 2024, with several session occurring asynchronously.

- Einstein Fellows Program
  - NASA Hubble Fellowship Program (NHFP, administered by STScI) retains Hubble, Einstein, and Sagan science-based categories and their lead project scientists.
  - Current fellows class had 521 applications, with 29 offers made, yielding 24 new fellows.
  - P. Green (SAO) continues to provide scientific and policy leadership to NHFP Einstein fellows.
  - SAO supported the NHFP Symposium in Pasadena, on 16–20 Sep 2024.

Communications & Public Engagement (1/3)

- Overview
  - Chandra Communications & Public Engagement team remains highly productive and influential with particular skill and success in accessibility.
- Chandra 25: Year-long campaign to highlight Chandra's 25th: multi-generational, audience-driven, accessible & partner based. Highlights include:
  - Chandra/NASA+ documentary "Listen to the Universe" (Feb) a "top NASA+ performer" each week, lauded by NASA+ leadership. Premiered at SI Hirshhorn to sold-out audience; won award at NYC's Raw Science Film Festival.
  - Chandra featured as a question on "Jeopardy!" (Jun): potential audience **9M**
  - Data-driven augmented reality experiences launched on Instagram (Apr-): >**2M**
  - Low-tech Chandra activities/info in *USA Today*/Smithsonian insert (Apr): >**1.3M**
  - Apple Maps Guides (location-based storytelling) featured by Apple (Feb-): >**1M**
  - Chandra images on large screens in 6 DC Metro stations (Jul-Oct): >**500k**
  - Collab w/Mickey Hart (Dead & Company), Chandra sonifications & images for Las Vegas Sphere (May-Aug): >**500k**
  - Plus: New vinyl album of Chandra sonifications produced (Mar); Live recorded symphony album dedicated to Chandra (Jul); Yo-Yo Ma/Amir Siraj piece accompanied by Chandra images at SI DC event (Sep); Upcoming world premiere of Chandra sonification composition at Hirshhorn (Nov).



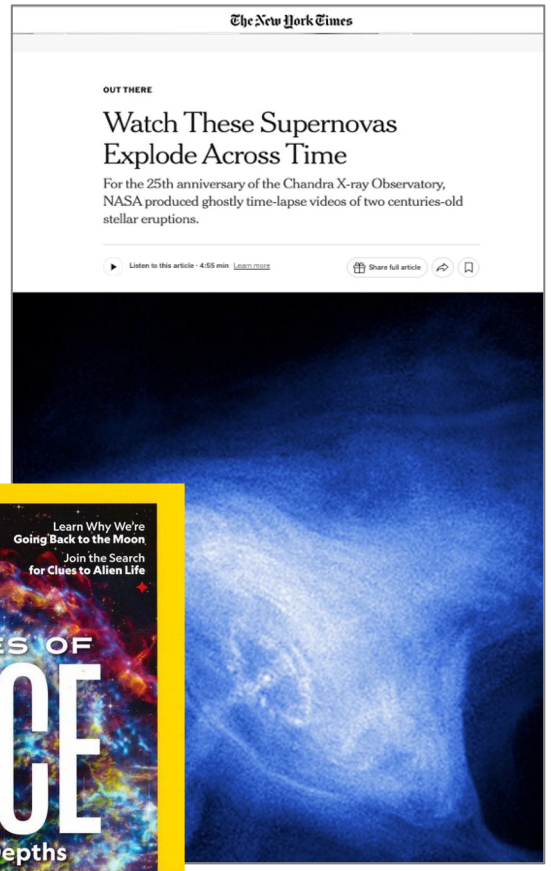
Communications & Public Engagement (2/3)

CXC

Chandra science made the news – a lot of it!

- Press Releases Oct 2023 – Oct 2024
  - **18** science press releases.
  - **8** additional image features including image galleries, with sonifications or 3D filters.
  - **62** Chandra images released overall
- Press Results
  - Since Oct 1, 2023, Chandra has been mentioned or featured in **>4k** popular news articles.
  - Those outlets include: ***The Washington Post, USA Today, The New York Times, NPR, CNN*** & many others.
  - Potential viewership that = **15.5B** people over the year; or average of **~1.3B** people each month.*

** Like STScI, the CXC uses Meltwater media monitoring services to track # of articles & potential audience reached from the articles.*

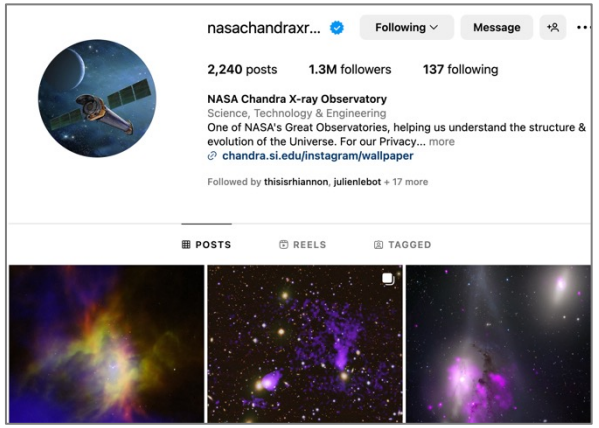


Communications & Public Engagement (3/3)

CXC

Chandra science heavily spread across digital platforms

- Chandra public website
  - Attracted average of **~27M** hits/month (Oct 23-Sep 24).
  - Largest month of traffic ever recorded: **46M** hits in Dec 2023, primarily from sonification coding app, and images.
  - Posted **29** release videos, **40** blog posts.
- Social media growth across platforms
  - Instagram: **1.4M** followers; highly active follower engagement.
    - 3 Reels each reached an audience of >**1.5M** people.
    - AR 3D Experiences reached **~2M** people.
  - YouTube: > **1.2M** video views.
  - X (Twitter): 407k → **415k** followers.
    - Chandra 25th anniversary day post: **3k** likes
    - Multiwavelength image posts with Webb and/or Hubble, high engagement throughout the year.
  - Facebook: Gained **5.4k** followers.



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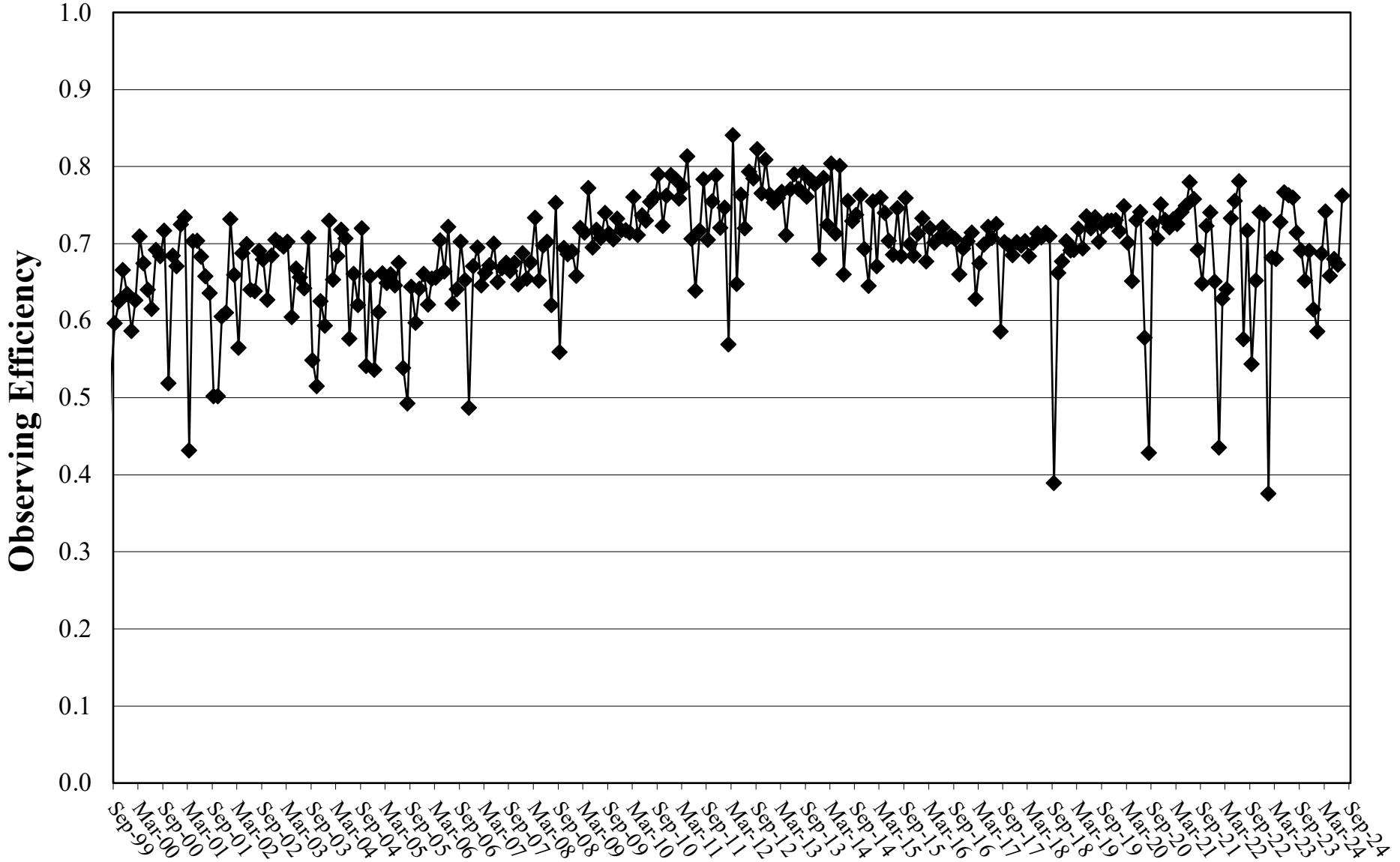
Supplementary Information

Observing Efficiency — Launch through Aug-2023



Mission Metric: Data Delivery Effectiveness

CXC

As of middle of following month							As of 9/6/24		
Month	Number of Obs	Days to Data Delivery			Number Deliv	Number Outstanding	Number Deliv	Number Outstanding	Comments
		Min	Avg	Max					
Sep-23	103	0.2	0.9	4	103	0	103	0	
Oct-23	136	0.2	0.9	30	136	0	136	0	
Nov-23	111	0.2	0.7	3	111	0	111	0	
Dec-23	129	0.2	0.9	8	129	0	129	0	
Jan-24	121	0.2	1.0	8	121	0	121	0	
Feb-24	105	0.2	0.8	3	105	0	105	0	
Mar-24	124	0.2	0.8	5	124	0	124	0	
Apr-24	124	0.2	0.8	7	124	0	124	0	
May-24	92	0.2	0.8	6	92	0	92	0	
Jun-24	92	0.2	0.7	6	92	0	92	0	
Jul-24	87	0.2	0.9	7	87	0	87	0	
Aug-24	83	0.3	0.9	5	83	0	83	0	

Mission Metric: Science Observation Summary

CXC

	Total Mission through 8/31/24	
	No. ObsIDs	Total Msec
Cal ER	1,362	N/A
Cal	3,370	27.8
DDT	840	17.1
GO	15,929	402.3
GTO	3,244	66.9
TOO	1071	26.0
CCT	515	7.0
Total	26,331	547.1
Time since first light (Ms)		790.2
Mission average efficiency		69.2%

Program Management

CXC

- Senior Review 2022
  - SR22 proposal was submitted to NASA Feb 11. Virtual site visit by SR panel was Apr 4.
  - Chandra received highest achievable marks:
    - The Chandra Panel rated Chandra **'Excellent' overall.**
    - The Astrophysics Advisory Committee (APAC) ranked Chandra **'Tier 1'**.
  - We proposed an Overguide budget and augmentations.
    - The Overguide budget maintains current capabilities:
      - Compensates for inflation
      - Funds 2 additional Flight Operations engineers to meet rising challenges of planning and operations
    - Augmentations:
      - Diversity, Equity, and Inclusion: CFaSt Minority Internship Initiative
      - Time domain science: enhance data processing pipelines to identify varying targets
      - Chandra grants: increase funding for added observing time in FY23–25 and to restore purchasing power lost to inflation during mission
  - The SR22 APAC report recommended the following ranking of funding priorities:
    1) Completely fund the Overguide, reducing GO (General Observer) funds if necessary
    2) Time-domain science
    3) Increase GO program funding