ACIS Update

Chandra Users Committee November 10, 2025

ACIS Overview

ACIS continues to function nominally and produce high quality data

Steiner (SAO)

- All 10 CCDs are fully functional
- Electronics are nominal, primary units are still in use
- Flight software is nominal, latest version installed on 15 August 2025
- ~90% of GO & GTO observations use ACIS

Cycle 25 GO & GTO Observing Statistics

Instrument	Grating	# of Obs	% of Obs	Time(ks)	% of Time
ACIS-I	NONE	366	36.5	6475	40.3
ACIS-S	NONE	450	44.9	7116	44.3
ACIS-S	HETG	41	4.1	837	5.2
Total			85.5		89.8

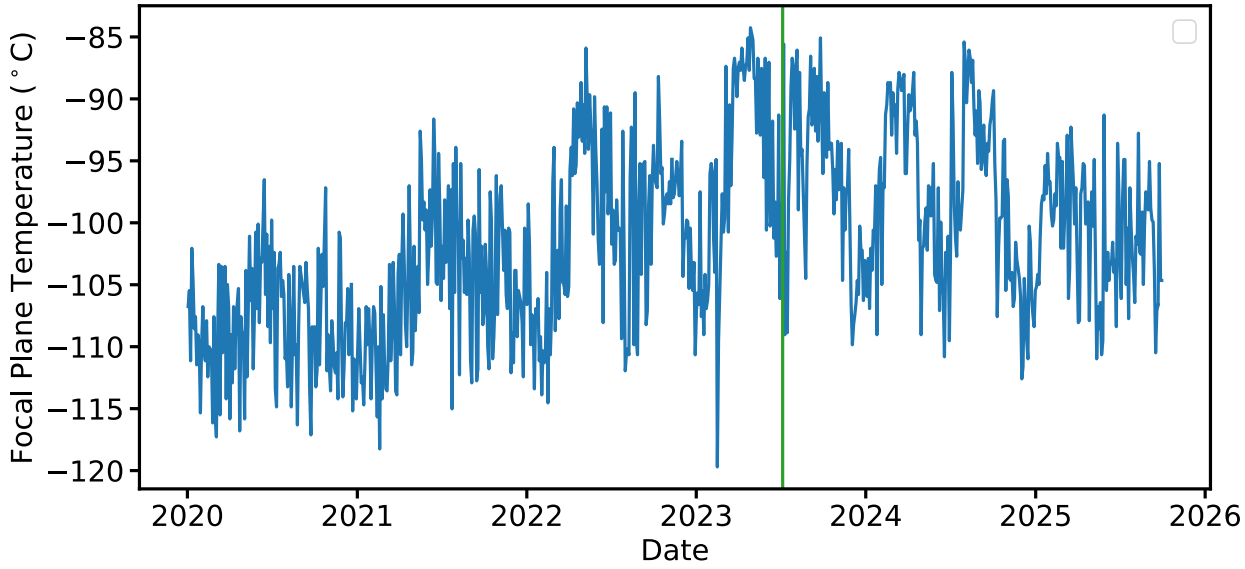
Highlights:

- No ACIS anomalies in the last year, operations has been smooth
- Minimal impact from perigee minimum during 2023, ACIS continues to function nominally
- FP temperature limits for observations have been easier to meet given relaxations of other spacecraft thermal limits
- ACIS is functioning as the radiation monitor for Chandra, a FI CCD is required to be on for every observation
- ACIS flight SW running without issue since update in August 2025

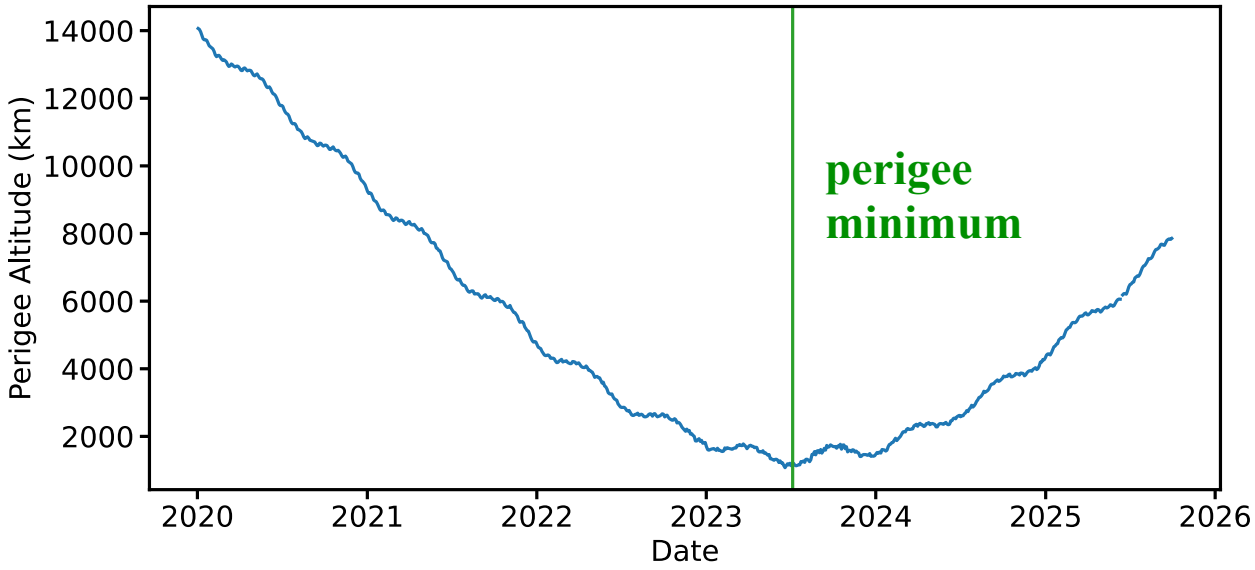
Chandra Low Perigee in 2023

- ACIS FP temperature warms during perigee passages
- FP temperature was kept below the Yellow High limit of -80 C for all perigee passages
- Maximum temperatures are expected to decrease in the coming years

Maximum FP temperature during perigee passages



ZuHone (SAO)



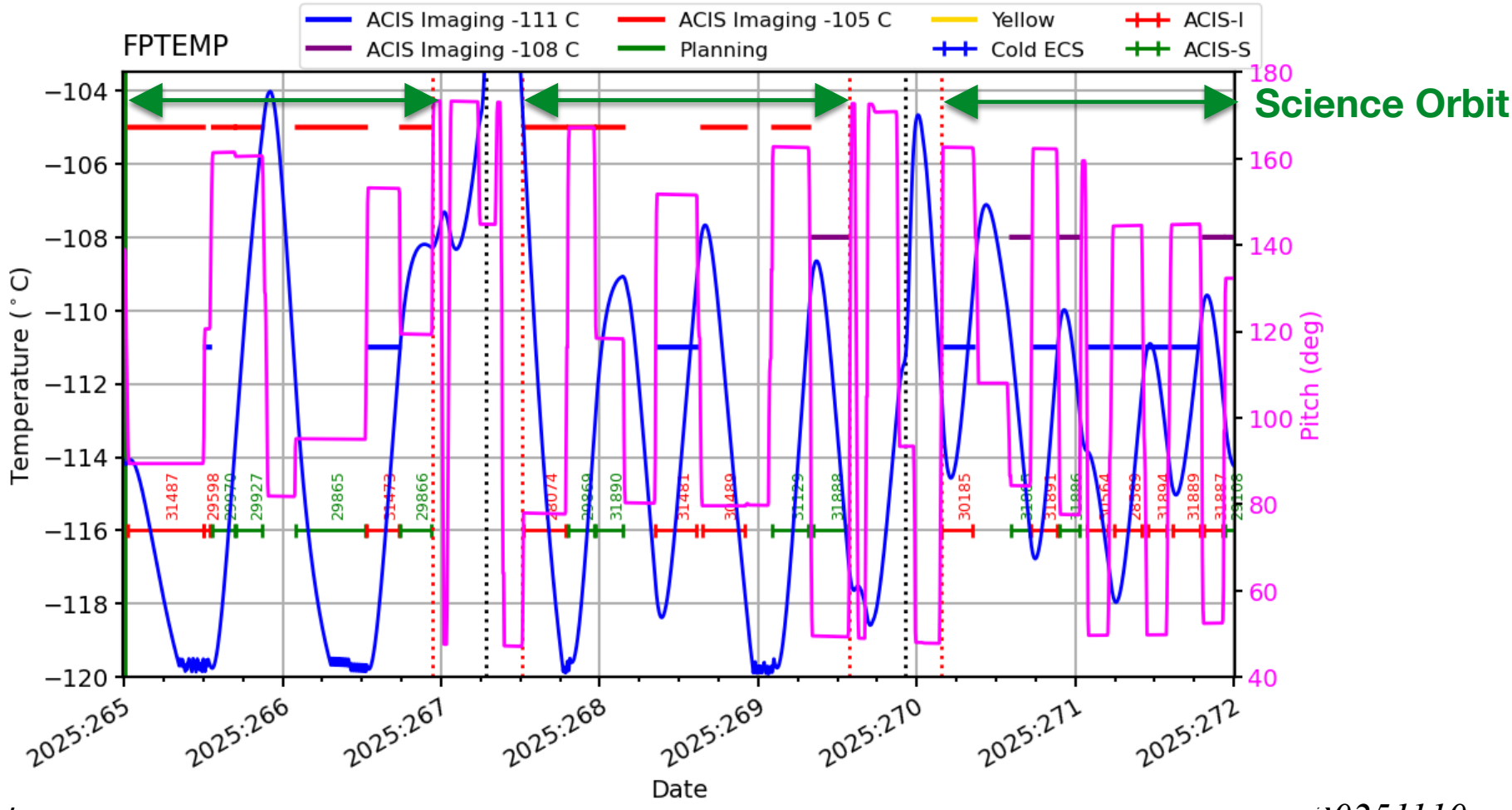
ACIS FP Temperature Limits for Observations

CXC

- **-111 C ACIS-S & ACIS-I observations that benefit from the most accurate spectral response**
- **-108 C ACIS-S & ACIS-I observations that can achieve the objectives with reduced spectral response**
- **-105 C ACIS-S & ACIS-I observations that can achieve the science objectives with even more reduced spectral response**
- **-109 C All ACIS-S/LETG and ACIS-S/HETG observations with a SIM Z offset of -6.0 mm or more positive such that the dispersed spectrum is farther from the readout**
- **-105 C ACIS-S/HETG observations with a SIM Z offset of -6.0 mm or more negative such that the dispersed spectrum is closer to the readout**

SEP2225

ZuHone (SAO)



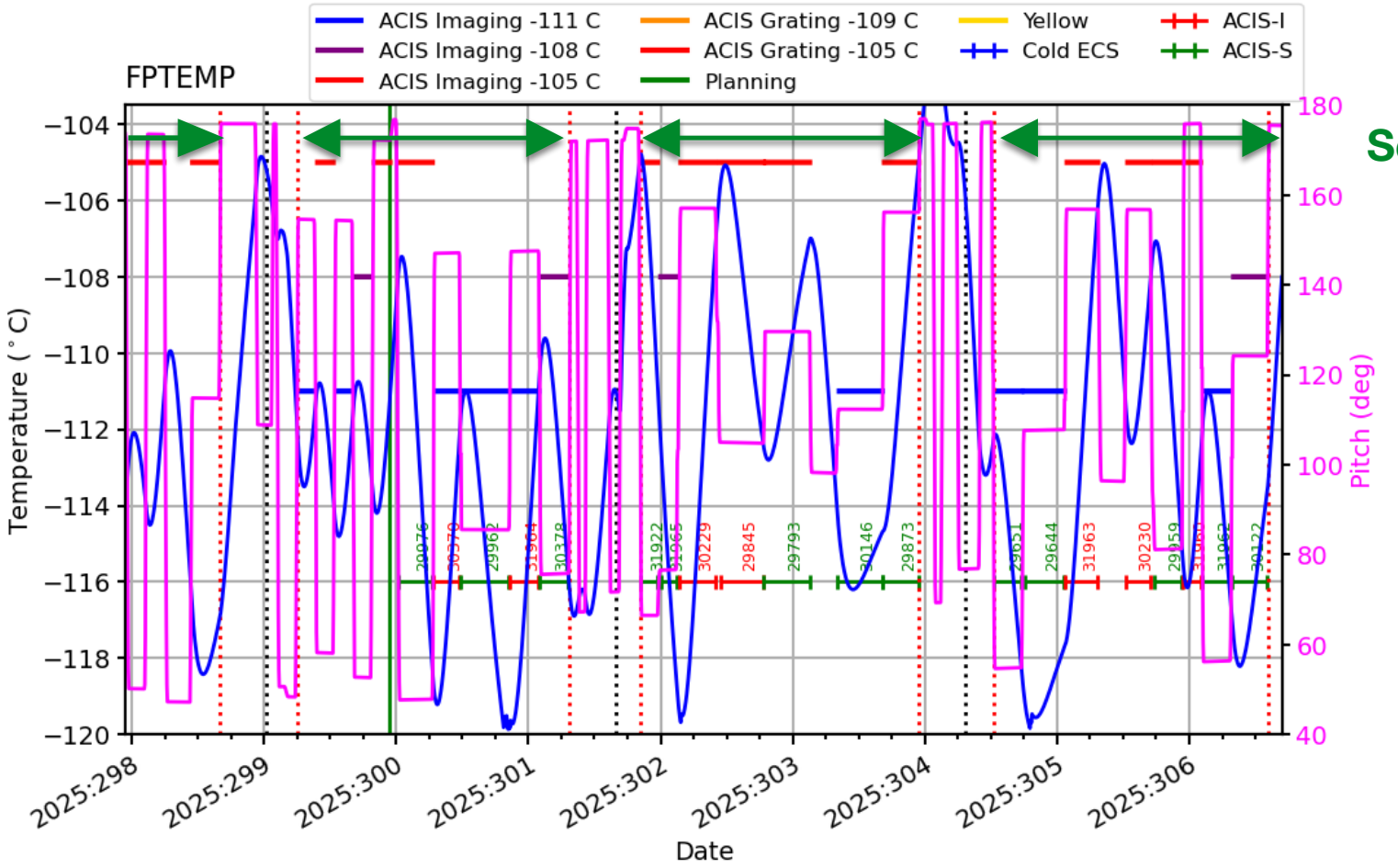
ACIS FP Temperature Limits for Observations

CXC

- FP temperature is almost always increasing or decreasing
- **KEY POINT:** almost all of a GO observation will be executed with a FP temperature *less* than the limit providing higher quality data
- Calibration files account for this variable FP temperature
- Staying below these limits has gotten *easier* in the last year given the relaxation of other spacecraft thermal limits
- FP temperature model updated this year by J. ZuHone to maintain required accuracy

OCT2724

ZuHone (SAO)



Science Orbit

Optional CCD Usage

- Chandra GOs request “required” and “optional” CCDs for their observations
- A maximum of 4 required CCDs is allowed, a maximum of 6 total CCDs is allowed where total equals required + optional
- Limiting the number of active CCDs helps to keep the ACIS FP and electronics within limits

POG Example: ACIS-I Imaging

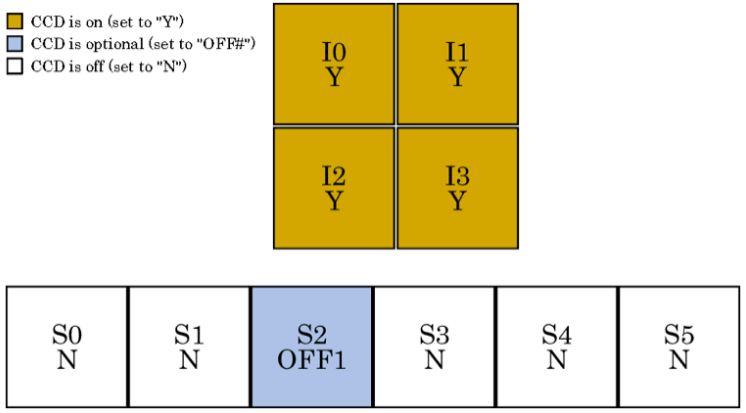


Figure 6.39: ACIS-I imaging, nominal I3 aimpoint (4 Required CCDs, 1 Optional CCD)

POG Example: ACIS-S Imaging

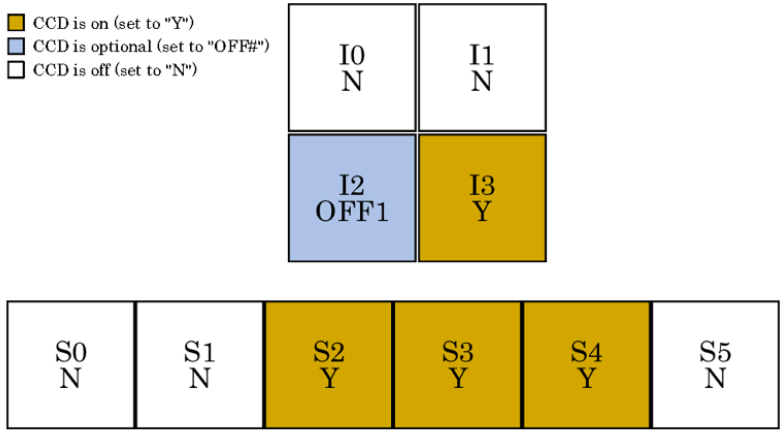


Figure 6.45: ACIS-S imaging, nominal S3 aimpoint (4 Required CCDs, 1 Optional CCD)

CCD Utilization for Cycles 23, 24, & 25

Steiner (SAO)

# of CCDs	AO23 (%)	AO24 (%)	AO25 (%)
1	7.7	1.3	1.6
2	24.1	26.9	27.0
3	9.2	8.4	2.6
4	33.9	38.3	48.7
5	15.4	14.9	15.1
6	9.8	10.3	4.9

Dropped CCD Statistics for Cycles 23, 24, & 25

AO	Mean Total CCDs	Mean Active CCDs	Mean Dropped CCDs	% of Obs with dropped CCD
23	3.95	3.54	0.98	43.1
24	4.08	3.69	1.00	40.2
25	4.04	3.76	0.80	35.9

FI CCD Requirement for all observations

- **ACIS is the *only* radiation monitor on Chandra now**
- **FI and BI CCDs respond differently to high particles, the ACIS radiation monitor is more likely to trigger if at least one FI CCD is active during an observation**
- **The CXC now requires at least one FI CCD to be on for GO observations**

Subarray frame times assuming the subarray is in the middle of the CCD:

subarray	1 CCD	2 CCD	3 CCD
128 rows	0.4 s	0.5 s	0.6 s
256 rows	0.8 s	0.9 s	0.9 s
512 rows	1.5 s	1.6 s	1.6 s

Total background rates (0.3-13.0 keV), all telemetered grades.
VF mode telemetry limit is 68.8 cts/s, F mode telemetry limit is 170.2 cts/s

S3 (cts/s)	S3+S2 (cts/s)	S3+S2+S1 (cts/s)
6.0	10.5	22.1

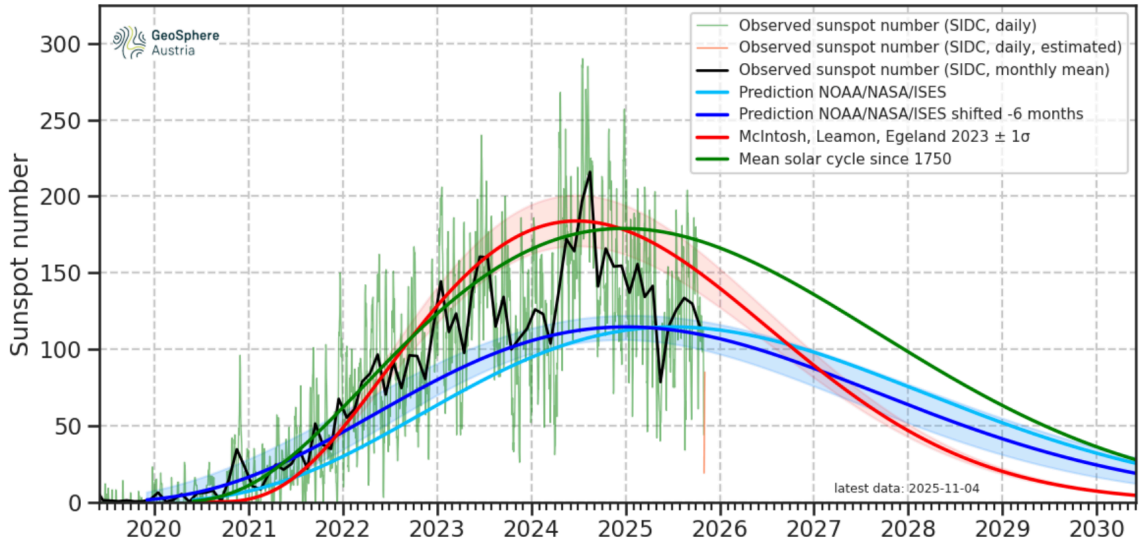
ACIS Radiation Safing and Solar Cycle Progression

CXC

- **ACIS is the *only* radiation monitor on Chandra.**
- **Autonomous safing actions are initiated by the ACIS process called "TXings".**
- **The peak of Solar Cycle 25 has passed. The possibility of strong storms remains.**
- **Observations are suspended during strong storms and ACIS is moved to a safe position.**
- **There have been 6 radiation safings in the past year (2 manual, 4 autonomous)**
- **Safing actions have been more effective in the last year due to fortuitous timing.**

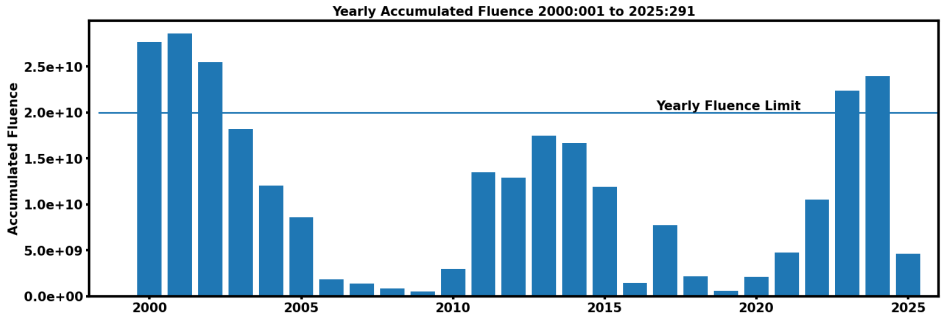
Solar Cycle Progression

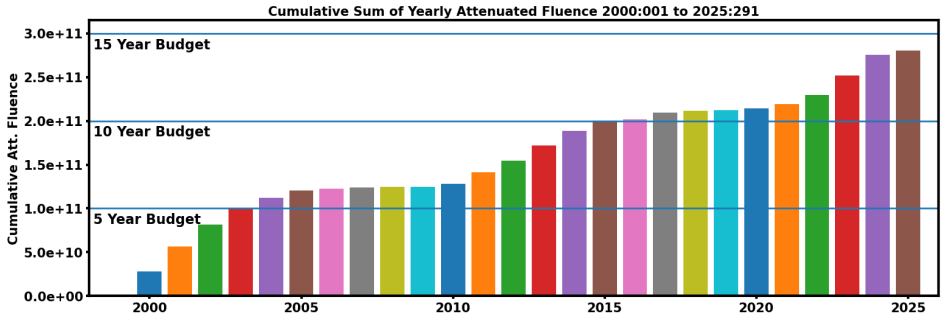
https://helioforecast.space/solarcycle

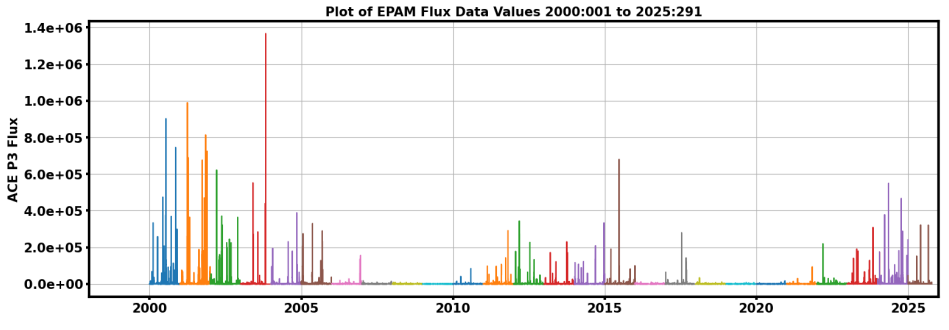


Fluence of low energy protons on ACIS

Germain (SAO)







Created with: Yearly_Fluence_Stats_Plots_Table.py

ACIS Flight SW Update

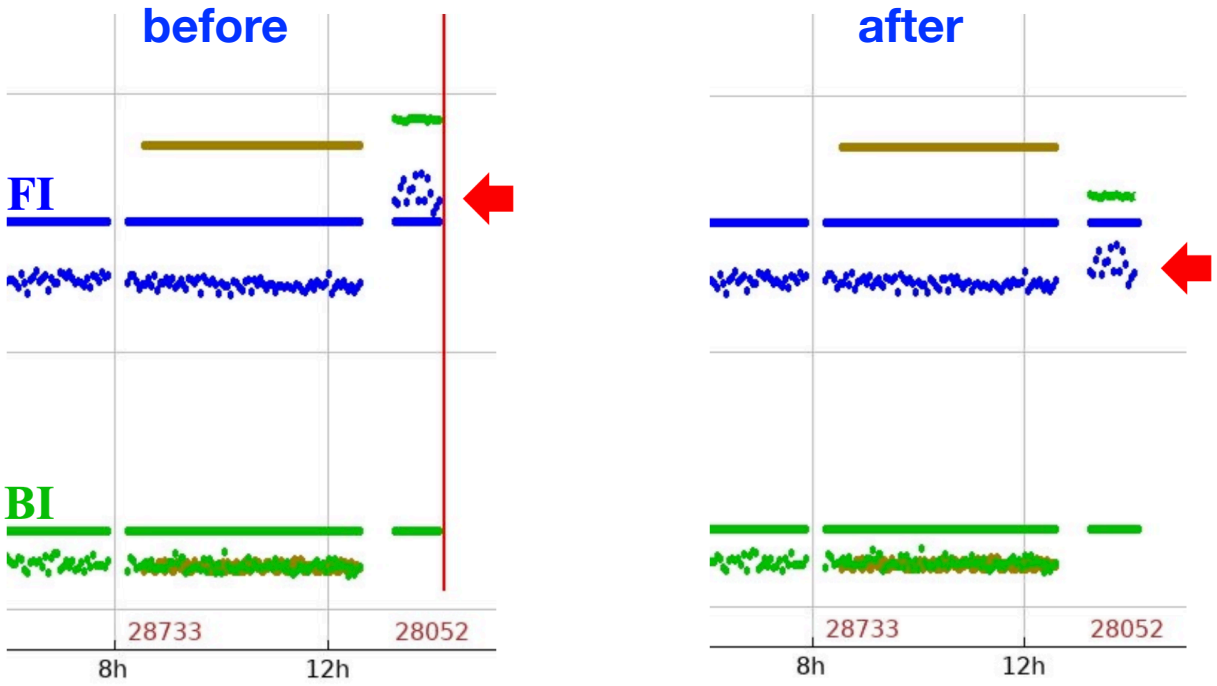
- Flight SW updated on 15 August 2025, 9th modification since launch
- Smallest patch yet in the mission, one "patch load" was included in this update:

  1. Subarray with dead time TXings computation bug fix → *minimal GO impact*

- Subarray configurations with a dead time are extremely rare, an observation of the Crab Nebula in October 2024 with S3 and S0 on inadvertently triggered TXings
- Lamarr & Ford (MIT) quickly diagnosed the bug that only affects subarray configurations with a dead time and developed a patch to fix the bug.
- Flight SW version 61 (HKL) was successfully uplinked at the 6:45am EDT on 2025:227, 15 August 2025

TXings rates before and after the patch for the Crab Observation OBSID 28052

Ford & Grant (MIT)



Flight SW version 61 has run for over two months without any issues.

ACIS Summary

ACIS continues to function nominally and produce high quality data

- All 10 CCDs are fully functional
- Electronics are nominal, primary units are still in use
- No light leaks or damage due to micrometeorite impacts
- Additional absorption due to the contamination layer is well-modeled, an update is planned in the coming months
- FP temperature is maintained within limits depending on the science objectives of the observation
- Flight software is nominal, latest version running for two months with no issues
- ~90% of GO & GTO observations use ACIS

Future Prospects:

- No ACIS anomalies in the last year, flight SW updates have minimized the impact of future anomalies depending on the anomaly
- Minimal impact from perigee minimum during 2023, impacts are decreasing as the perigee altitude increases
- FP temperature limits for observations are easier to accommodate given relaxation of other constraints
- ACIS is functioning successfully as the radiation monitor for Chandra

ACIS should continue as the workhorse instrument for Chandra for years to come