CUC Report — 2024 Oct 09

CUC Members

In-person:
- David Pooley (Chair)
- Yvette Cendes
- Tesla Jeltema
- Silas Laycock
- Takanori Sakamoto
- Tea Temim

Remote:
- Marcella Brusa
- Adi Foord
- Frits Paerels
- Andreas Zezas

Meeting Summary

The Chandra Users Committee (CUC) meeting was held in-person at the Operations Control Center in Burlington, MA, on 2024 October 08 and 09 (half day). Six of the committee members were in person and four were remote. The agenda on the 8th with links to presentations is given below, and on the 9th the CUC discussed what was presented and deliberated on the recommendations.

Schedule

9:00	Introduction and Opening Remarks	Antonella Fruscione
9:15	Director's Report	Pat Slane
10:15	Chandra Status Report	Mark Weber
10:45	Morning Break	
11:15	Proposal Cycle and Future Plans	Rudy Montez
11:50	Mission Planning Updates	Scott Randall
12:30	Lunch	
13:30	Calibration: Goals, Priorities, and Plans	Akos Bogdan
14:10	CIAO Update	Jonathan McDowell
14:50	HRC Update	Dan Patnaude
15:30	Afternoon Break	
16:00	ACIS Update	Paul Plucinsky
16:40	Chandra Source Catalog & Data Systems Initiatives	Pepi Fabbiano
17:20	SDSS-V and NHFP Project Update	Paul Green
17:35	Final Discussion	

Executive Summary of Discussion and Recommendations

The presentations by the Chandra X-ray Center (CXC) to the CUC made it clear that the Chandra team has had a tumultuous year, full of uncertainty about the future of the mission. They have done an excellent job of continuing to ensure the health and safety of the observatory and carry out its scientific observations at high efficiency while, at the same time, undergoing three re-budgeting exercises in 15 months as mandated by NASA HQ (which changed guidelines several times during the process) and while also dealing with an accelerated timeline for the next Senior Review (SR). Prior to this meeting the CUC wrote a letter to NASA HQ that (1) was critical of both the process and

rationale that HQ has used and (2) expressed support for the full operation of Chandra and full funding of the mission and its General Observer (GO) program.

The re-budgeting exercises culminated in the Operating Paradigm Change Review (OPCR). Based on the OPCR findings, NASA seemed to pick an option in which there would be a vast reduction of the CXC scope, including 50% reductions in observing time with a commensurate 50% reduction in GO funding. After some negotiations, NASA agreed to add funding to restore the 50% of observing time but refused to restore GO funding. Further actions resulted in funding to eliminate layoffs at the CXC through FY25, allowing CXC activities to continue in much the same way as previously. Given the complexity and nuances of what has transpired, the CUC encourages the CXC to **have an online town hall to explain the budget situation and why the GO funding is at the current level.** Much of the community is in the dark about this, and that is leading to misunderstanding and resentment.

The CUC concurs that **suspending the archival and theory funding is prudent with the current GO funding levels**. We fully support archival and theory funding and suggest that the next archival and theory funding call happen independently than the Cycle 27 call for GO proposals. Pending results of the SR and future budgets, there could be a separate call for theory and archive later.

The CUC strongly encourages the CXC to **propose for full mission capabilities in the coming SR proposal**, i.e., full use of available observing time and continued TOO response capability along with restoration of GO funding to be commensurate with full observing time (back to ~$10M).

The CUC agrees that a distributed review is a good choice to mitigate the long-standing problem that far too few proposers share in the review process. The CUC feels that **the "N+1/additional" model (see below for details) would be a fair way to implement the distributed review** without placing an onerous burden on those who submit multiple proposals**.** There are several concerns about distributed review, especially about the quality of feedback given to proposers and the impact of the absence of discussion. The CUC would like to see the CXC develop an evaluation process that can measure the effectiveness and results of the distributed review model as well as a community poll to measure their sentiment. For future proposal calls, the CUC suggests that response files should be made available for warmer focal plane temperatures with a note explaining why they might be necessary.

CIAO and its help pages continue to be a model of clarity and usefulness among all NASA missions. The CUC feels **the consolidation of CIAO threads into umbrella topics is a helpful improvement and should continue, along with pruning of overlapping threads**. The CIAO team should continue their focus on documentation improvement and bug fixes instead of development of new tools. We support their continued efforts to secure external support for SAOImage ds9 and beyond and suggest they improve messaging to the larger astronomy community that ds9 was developed and has been maintained with funding from the CXC.

The Chandra Source Catalog (CSC) is a tremendous resource for the community, and the CUC feels that **new CSC efforts should be paused until more stable budget times** (we assume that there will be a final CSC produced at the end of the mission). Perhaps incremental additions to the source catalog could be done using only new observations (not remaking stacks) as these would be useful and might take far less effort.

The CUC is concerned that usage of and publications resulting from the CXC's SDSS-V buy-in have not been tracked yet, which makes it difficult to assess the value to the community. The CUC encourages the CXC to **make its SDSS-V access more visible** and to **implement tracking of community usage of its SDSS-V access and resulting publications**, perhaps through DOIs or through a boilerplate sentence for users to put in their acknowledgements.

Detailed Summaries and Reports on Presentations

Director's Report — Pat Slane

A high-level overview indicates the observatory is functioning well, and the HRC has been re-engaged with > 300 HRC segments carried out since then. Data processing is functioning nominally, and the CSC 2.1 was released. Target of Opportunity Observations and Director's Discretionary Time observations continue at nominal pace (see presentation slides for review of DDT observations). The Legacy Program was enacted with two programs selected. The Cycle 26 Peer Review was completed successfully with continued high oversubscription. Several operational changes (details in later presentations) were implemented to ease scheduling, increase dwell times, and reduce safe mode recovery times. The 25th Anniversary activities will continue, with a symposium in December.

Budget issues have become central and have impacted the CXC. The FY24 (2023 Oct 01 to 2024 Sep 30) budget cuts reduced GO funding by 30% for Cycle 25, following written direction from NASA to address FY24 shortfalls by "preserving mission infrastructure while maximizing General Observer program funding." Additional savings were made through hiring freezes for some vacated positions.

The FY25 (and beyond) budget guidelines were at close-out levels for the observatory, and the OPCR was carried out to assess options. The CXC presented three overguide options (Option I was the initial budget guidance, i.e., closeout). Option IV was the full mission. Option III was a vast reduction across the entire CXC scope including 50% reductions in observing time with GO funding scaled back proportionally. Option II was Option III without any GO funding.

The OPCR provided strong support for Chandra, and NASA suggested budget plans to support Option III (vast reductions across the entire CXC, including a 50% reduction in observing time and GO funding scaled back) with some additional bridge funding through 2024 Dec to help with the transition. Additional negotiations added "buy-back" funding to reclaim the lost 50% observing time but not GO funding. Further efforts restored funding to eliminate layoffs at the CXC through FY25, i.e., current CXC capacity is maintained through 2025 Sep.

The end result is that, over this period until 2025 Sep, all observing will continue as it has in the past, but GO funding is at reduced levels, which will impact Cycle 26 proposals, which will have reduced funding for accepted observing proposals and no funding for archival or theory proposals. Funding for DDT observations has been eliminated.

Although plans were in place to transition archive and theory proposals to ADAP and ATP, respectively, the latest update from NASA HQ is that that will not happen, which will impact the Cycle 27 Call for Proposals, which could solicit archive and theory proposals but with an uncertain ability to fund them. This has several downstream implications for proposers seeking other sources of support, and the CUC recommends to not solicit such proposals in the next Call for Proposals; instead the archive and theory proposals could be solicited later if the FY26 budget after the SR allows for it.

The CUC reported to the director that there is community frustration with the reduced funding and suggested that the CXC clear up any misunderstandings with the community. For example, the community needs to understand that it was very close to not having any Cycle 26 observations happen (which could have been the case under Option III).

The CXC is also preparing for the next SR, which is due months earlier than previous SRs, and which will have all missions reviewed by a single panel (a change from previous SRs). The budget guidance given to the Chandra mission is at FY25 PBR levels, which is below the first-year closeout cost, i.e., not a continuing mission. To continue

the mission in any form will result in likely what is the largest overguide request in SR history. The CUC strongly encourages the CXC to propose for full mission capabilities in the coming SR proposal, i.e., full use of available observing time and continued TOO response capability along with restoration of GO funding to be commensurate with full observing time (back to ~$10M).

Chandra Status Report — Mark Weber

Spacecraft and instruments are stable and performing well. ACIS continues its loss of efficiency due to contamination buildup, and the HRC power supply anomaly imposes some thermal and scheduling constraints, but both issues are understood and under control. Both instruments are in good condition otherwise.

The spacecraft status is very good. The effects of the slow thermal evolution on the observing program and efficiency have been addressed with multiple new procedures, and by cautiously raising temperature limits. The effect of this concerted effort has been a much improved efficiency, effectively reversing a lot of the scheduling limits and complexity that had built up over the last few years. Over 50% of the fuel remains to date.

The last GO cycle (26) was oversubscribed in time by a factor 3.9, which has held steady or only slightly decreased over the last few cycles.

The next major event in the project will be the Senior Review in 2025. Operations continue for FY25 with the existing workforce and reduced funding for guest observers, and with the HRC in operation. A budget will be submitted to the Senior Review which will be well over the budget guidance provided, based on maintaining a full observing program and maintaining CXC strength.

Proposal Cycle and Future Plans — Rudy Montez

After a short overview of the CDO staff/personnel and past CDO activities (including newsletter activities and staff changes), the output of the Chandra Legacy Program (CLP, with time shares from GO, DDT and GTO over cycle 26 and cycle 27) was presented: two CLP programs were awarded for a total of ~6 Ms.

The Cycle 26 peer review was completed and saw very little change in user demand compared to last Cycle (as measured by number of proposals, where Cycle 25 received 408 proposals and Cycle 26 received 406 proposals). However, the amount of time requested did decrease, and some of this decrease was attributed to the CLP, which fielded many large programs competing for the CLP allocation. In addition, due to unexpected and one-off shuffling of selection and announcement timelines by some Joint Partner Observatories (JPOs), there was a larger than anticipated amount of unused JPO time. As a result, the overall oversubscription rate by time reduced slightly to 3.9. Under Chandra's most recent funding guidelines, the CXC was unable to award any of the highly-ranked Archive and Theory programs, despite the request and oversubscription rates being in line with the previous Cycles.

In Cycle 27, expected to be announced in December 2024, the Chandra Peer Review will transition to a distributed peer review (DPR). In a distributed peer review, a member of every proposing team will be required to review ~10 other proposals (with a strong recommendation to avoid over-commitment for multiple PIs). This team member is called the “Designated Reviewer” and will be identified at the time of proposal submission by the PI. Keywords will be associated with each designated reviewer in order to match the assigned proposals. The DPR should also mitigate problems with conflicts of interests and availability of expert reviewers. Selections of non-TOO and non-LP/VLP programs will be based on aggregate scoring and relative balance of the science program (proportional to the requested time in a given category). TOO, LP, and VLP proposals will also enter the DPR but undergo an additional traditional review composed of experts drawn from the astrophysical community (total allocated time ~4 Ms). The recommendation is to keep at least 1 Ms VLP program approved.

Mission Planning Updates — Scott Randall

The overall temperature increase as Chandra ages continues to limit the length of observations at any given pitch angle, owing to the thermal limits of the various spacecraft subsystems. This complicates construction of the long term schedule and weekly planning, but the CXC continues to work to mitigate the impact of heating and other scheduling issues through proactive software, procedure, and policy changes.

In the past year, these have included: (i) the creation and implementation of a new "sky balance" metric, to quantify the difficulty associated with maneuvering between a collection of targets during detailed planning; (ii) the implementation of machine-readable observation record lists (ORLs), used to codify constraints for weekly planning, and laying the groundwork for the potential development of assistive scheduling software; (iii) a new maintainable GUI, used for weekly planning and maintenance of the long term scheduled, to replace the previous obsolete GUI; and (iv) a new thermal database, which can be used to pre-calculate the thermal impact of all observations in every planning week, greatly improving the speed and efficiency of weekly planning activities.

In addition, the unanticipated ability to raise the planning limit for the momentum unloading and propulsion system (MUPS) has allowed longer dwell times at forward-sun solar pitch angles, and ongoing calibration work now allows over 30% of ACIS observations to be done with a focal plane temperature of up to −105 C.

Despite the increasing difficulty of scheduling, observing metrics remain favorable, with observing efficiency, TOO/DDT response, and science constraint compliance on par with mission history.

Calibration: Goals, Priorities, and Plans — Akos Bogdan

The continuing accumulation of the contaminant on the ACIS blocking filter required further monitoring and modeling of its buildup. Analysis of the calibration data showed that the buildup continues at a linear rate that is well described by the current model in the CALDB. As a result there is no need for an update to the contamination model.

The dependence of the CTI on the detector temperature results in varying detector gain and energy resolution. Given the wider range of the focal-plane temperature under which observations are taken, there is a need for updated temperature-dependent CTI calibration products. Such products were released for ACIS-I, S3 and S2 in January 2024. To account for the temperature-dependent energy resolution, the calibration team is developing a new set of RMFs for different detector temperatures. These RMFs will be included in the CALDB. A shift of the ACIS-I gain has been observed since 2022 and has continued through 2024. The calibration team developed a new time-dependent gain correction that accounts for this shift.

The calibration team will release new HRC-S and HRC-I QE files to account for the change in the QE as a result of the voltage increase.

Monitoring of the PSF showed indication for a slight degradation of ~0.01”/year in the last 4 years. This degradation is attributed to instrumental effects rather than actual degradation of the telescope performance: the declining HRC gain results in an increase of the low-amplitude events which appear to have broader PSF.

CIAO Update — Jonathan McDowell

The number of CIAO downloads remains stable. CIAO 4.16 includes several tool updates and support for macOS-arm processors (M1/M2/M3) and now handles installation through conda under the hood when running ciao-install. Starting with 4.17 in December, CIAO will only be built with the most recent version of python.

Updates in CIAO documentation include a new Energy Hue Map thread and a new page, Merging Central, that provides structured guidance for merging spatial, spectral, and temporal data, addressing when merging improves analysis and when it should be avoided. The CUC encourages efforts like this which consolidate the threads into umbrella topics, and encourages future pruning/merging of threads to improve clarity and allow for a more linear path through the threads for common analyses. The CUC also encourages a continued focus on documentation improvement and bug fixes rather than new tools. Thought and development is being put into preparation for eventual mission end. These include readying the documentation to be easily tarred and moved to a new location, and compiling a list of tasks to replace V&V so users can do this themselves.

Sherpa has seen several important improvements including work underway to improve performance for X-ray fitting by caching model values, and a paper presenting Sherpa has been accepted to the Astrophysical Journal Supplement Series. Ds9 continues to be incredibly popular with 36,000 downloads, and it won the ADASS 2024 software prize. New functionality was added including support for hue-saturation-value (HSV) three-color images and improvements to allow ds9 to be called more easily in python notebooks. Without new funding support for ds9 going forward will only be to keep it running. Efforts have and will be made to get external funding, which the CUC fully supports. The CUC notes that ds9 is an incredibly useful and used tool across astronomy, not limited to X-ray, and is an enabling tool for new researchers including undergraduates.

HRC Update — Dan Patnaude

The HRC continues to operate nominally. In early December, 2023, the CEA temperature deviated from the thermal model that is used for planning. The CXC halted HRC observations for about 1.5 months while the model was evaluated and refit with a larger dataset. Since that time, the thermal model has been accurate to better than ±1.7 C. Additionally, the CAL team requested an update to both the HRC-I and HRC-S high voltage settings, to account for continued drop in the detector gain due to the characteristics of MCPs. These updates were recently completed. Updates to the thermal model are underway. Additionally, the on-board flight software update for HRC thermal and voltage monitor to enable autonomous safing is planned. This is one of the highest flight software tasks, and expected to be uploaded this December.

Although there is a limit of 15 ks observing time for HRC in the proposal guide of cycle 26, there is no penalty for the proposer to request more than 15 ks observing time.

ACIS Update — Paul Plucinsky

ACIS is doing very well. It continues to function nominally and produce high quality data. All 10 CCDs are fully functional, electronics are nominal, and primary units are still in use. Flight software is nominal, latest version has been running for over a year with no issues. Cycle 24 GO & GTO observing statistics show that over 90% of observations use ACIS. To date, there have been no light leaks or damage due to micrometeorite impacts. The additional absorption due to the contamination layer is well-modeled. ACIS should continue as the workhorse instrument for Chandra for years to come.

Chandra achieved a minimum perigee altitude of 1045 km in July 2023 with a minimal impact on ACIS. Solar arrays degrade during low perigees times, and spacecraft bus voltage decreases. ACIS Digital Processor Assembly (DPA) & Detector Electronic Assembly (DEA) input voltages on side A decreased below the Yellow Low limit of +24.5 V for short periods of time during some perigee passages; this was caused by the spacecraft bus voltage decreasing when

the solar arrays warmed due to heating by the Earth. The ACIS electronics functioned nominally during all of these periods and there is significant margin against the Red Low limit of +22.0 C. ACIS focal plane (FP) temperatures warm during perigee passages. However, FP temperature was kept below the 'Yellow High' limit (−80 C) for all perigees passages, due to careful monitoring and planning. Perigee altitude is now increasing (currently ~4000 km) and no further impacts are expected.

The ACIS FP, DEA & DPA temperatures during science observations have become easier to manage due to the relaxation of the MUPS constraint that allows longer dwell times at forward Sun attitudes, and the relaxation of the ACA constraint that allows longer dwell times at normal Sun attitudes. The FP temperature limits for science observations have been expanded to include higher temperatures given that the calibration team has released calibration products appropriate for those higher temperatures. Some ACIS observations may be executed with a temperature limit of −105 C if the science objectives do not require the best spectral response. Additional limits of −108 C, −109 C, and −111 C apply depending on the science objectives and instrument configurations (grating or no grating, SIM position). These multiple limits provide more flexibility in scheduling observations.

The ACIS Flight Software (SW) was updated on September 19, 2023; it was the 8th modification since launch. Four 'patch loads' were included: (1) Alternating Exposure Mode bias computation bug fix (GO impact); (2) SW will report that science is idle when all video boards are powered off (minimal/no GO impact); (3) SW will report more diagnostic information when the BEP reboots due to a a bus error (minimal/no GO impact); (4) SW forces a new bias map computation when a FEP has been powered off before the current science run (minimal/no GO impact). This flight SW version has run for over a year without any issues.

Solar Cycle 25 is close to its peak, and this cycle has been stronger than predictions. Observations are suspended during strong storms, and ACIS is moved to a safe position. 'Safing' ACIS reduces the rate at which the CTI increases. So far, there have been 7 radiation shutdowns in the past year (4 manual, 3 autonomous). The autonomous shutdowns are initiated by the ACIS radiation monitor called "txings." Autonomous shutdowns have helped keep down the amount of fluence that ACIS experiences. The txings threshold must be adjusted as the ACIS background rate varies. The threshold has been adjusted 9 times during the Solar Cycle.

The DPA Minus-Z temperature (1DPAMZT) is used to protect the ACIS electronics from getting hot. The Minus-Y (1DPAMYT) temperature tracks 1DPAMZT closely; a new model has been developed for 1DPAMYT that could be quickly substituted for 1DPAMZT in case that sensor fails.

Chandra Source Catalog & Data Systems Initiatives — Pepi Fabbiano

The Chandra Source Catalog (CSC) version 2.1, released on April 2, 2024, includes around 408,000 X-ray sources from Chandra observations up to 2021. Key improvements include astrometric accuracy aligned with Gaia-CRF3, better detection positions, improved aperture photometry for low-count detections, and added APEC spectral models for bright sources. CSC2.1 data products are now tagged with DOIs. Although a few issues were found with the release, a patch CSC2.1.1 is planned for October 2024. The CSC saw significant use with about 900,000 downloads and 1.5 million searches over the past year. Other activities include upcoming Sherpa and CIAO updates, and the Cycle 27 review and updates in preparation for the Dec 19 proposal planning release. Data processing is nearly complete for early mission data, with Chandra Data Collection DOIs improving citation tracking. The archival data now totals 71 TB, with 10,129 Chandra Science Papers published to date, contributing to the mission's H-index of 247. The Chandra Source Catalog has generated 167 papers since 2022.

SDSS-V & NHFP Project Update — Paul Green

SDSS-V is an all-sky optical/IR spectroscopy program being conducted between 2020 - 2027. Telescopes in both N and S hemispheres are equipped with robotic fiber positioners which can place 500 fibers per 3 deg^2 field, with each spectrum spanning 3650 - 9500AA. The survey targets OIR counterparts to the CSC 2.1 catalog, generated by cross-matching with the GAIA, PansSTARS, 2MASS, and other legacy catalogs using the NWAY algorithm (Solvadao+2020). Some 50% of CSC2.1 sources have a positional match down to V<21 mag giving a total target list of 188K objects of which SDSS will ultimately get spectra for 40K. Survey targets are sub-selected in three science themes: Black hole mapper (QSOs with repeat visits), Milky Way Mapper (stars), and Local Volume Mapper (IFU observations of nearby galaxies). About 16k optical spectra have so far been obtained during SDSS-V. Combining with previous generations of SDSS, there are now about 24.5k optical spectra of CSC2.1 counterparts. About 70% are spectroscopically classified as AGN and for these redshifts are generated out to z=4, while stars get an RV measurement, 5K objects have more than one spectrum. Fully reduced calibrated spectra are released to users.

SAO is an SDSS-V member, with CXC providing half of the $1,150,000 dues, made in a series of five annual payments of $230,000 in 2020, 2021, 2022, 2023, and 2024. Once this payment plan is complete, the CXC are SDSS-V full members until the end of the survey in 2027. The CUC recommends that usage and publication statistics be compiled and disseminated to establish the value of the SDSS-V membership to the Chandra community.

The NASA Hubble Fellowship Program, (which includes the Hubble, Einstein, and Sagan programs, each focusing on a different topic) has seen a huge jump in applicants in recent years, with last year's oversubscription reaching about 22X. Dual anonymous review is not planned, as the current system enables points for overcoming challenges, and facilitates the selection of high-potential individuals over a simple review of science goals alone. The process is demonstrably equitable, at least in regard to gender. Some 34% of applicants are female and the rate of female awardees lies in the 40-50% range, and has been as high as 58%.

The weeklong NHFP annual symposium just completed in Pasadena was a big success. New initiatives include expansion of host eligibility to include NASA centers as well as institutions based in US territories. An exciting addition to the fellowship starting in 2025 is the availability of up to $250k annual funding mentorship and outreach, and to enable the fellows to hire students, initially as summer interns.