# Chandra Users' Committee Meeting Preliminary Report

*Committee Meeting of 2017 September 27*

## Preamble

The CUC heard several presentations about the status and calibration of the telescope and instruments, operations, activities at the CXC, and a variety of other topics. The presentations, as usual, were of high quality and the CUC appreciates the time and effort that went into making them. We commend the CXC staff for their efforts in managing the telescope and the Center and we hope that they will continue performing at this level. We give below our more specific comments and recommendations. We begin here with a specific recommendation about reports in future CUC meetings.

*Recommendation:*

> *It would help new committee members as well as returning committee members if there was more continuity between one year and the next, and greater uniformity between the presentations. Likewise, it would be especially useful to new CUC members if the speakers would call out any topics on which the CXC is seeking CUC guidance. With the above in mind, we recommend adopting a format for CXC talks that specifically makes mention of past CUC recommendations and calls attention to specific issues in need of CUC feedback. A possible format for each topic could include:*
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> - *a summary of the activities from the last year*
> - *a summary of the actions taken (if any) from past CUC recommendations*
> - *identification any new issues and concerns, noting what CXC staff are doing to address them and whether you need CUC feedback*
> - *a short synopsis of the coming activities expected in the next 6 months.*

## Chandra Status Report

Dr. R. Brissenden reported on the status of all the mission items that were later discussed in detail in separate presentations.

a) The spacecraft is performing very well, despite a number of minor limitations due to aging. Last year the observatory experienced two solar radiation shutdowns, and two ACA bright star holds. The search box size was increased on star trackers to address gyro-bias issues.

b) Overall, science instruments are operating well. Contamination of the ACIS detector is being properly addressed and regularly re-evaluated.

c) NASA has asked for a proposal for a new contract extending through 2030. The contract extensions will be in 3 year installments up to 2027 followed by 3 years of closeout.

d) The Operation Control Center lease will end in September 2019. The CXC has engaged a realtor and engineering firm to identify a new building (three possibilities have been selected). Once the new center becomes operational, the old center will still be operated in parallel for a month or two to avoid major pitfalls. CXC staff have been involved in the process to understand needs and preferences, and so to minimize personnel loss and personnel unhappiness.

e) As far as mission planning goes, the main challenges arise from thermal constraints (more details are given in the Mission Planning section, below). Over the last cycle, 12 fast ToO and DDT observations required interrupting uploaded telescope command loads operations. The observing efficiency remains very good.

f) The preliminary version of the Chandra Source Catalog version 2 (CSC2) was released on 2017, September 18, with the full documented release expected in February 2018. Given the recent progress the CXC is optimistic that this schedule will hold.

**Director's Report**

The director, Dr. B Wilkes, summarized the use of director's discretionary time (DDT), and noted that the allocation has now risen to allow the director to award observations for non-transient objects that benefit from rapid follow-up, similar to the fast turnaround program at HST.

The committee was concerned about making sure that gravitational wave (GW) source follow-up does not become as contentious in the future as in the early days of gamma-ray burst afterglow follow-up. CUC encourages the CXC to continue to develop policies that ensure that backdoor triggering of TOOs does not take place (e.g., to ensure that proposals specifically aimed at GW sources are appropriately prioritized). The Director commented that the CXC is already aware of multiple possible conflicts within the Cycle 19 peer-review-approved ToO proposals. The Director's Office will set well-defined criteria to determine which proposal has priority to trigger for a variety of possible targets and triggering conditions. As different teams compete, the CXC will not "force marriages." If multiple teams are interested in a target from a DDT program, then there will be no proprietary rights for it.

The senior review by NASA will now take place every three years. The last senior review raised the issue of whether there should still be guaranteed time for Chandra given the age of the mission. In response to a request from NASA HQ, the CXC and GTO staff provided details on the staffing of each Instrument team. This report indicated that it would not be possible to retain the staff needed to support the mission without the GTO program funding to cover both their functional and their science time. NASA HQ decided to continue the GTO program as it now stands and requested that that the CXC develop a clear and effective succession plan for key instrument team staff supporting the Chandra mission. The senior review concurred with this request, and the CXC has developed and delivered the plan.

**Mission Planning Updates**

The committee heard a report from Dr. P. Slane on the status of mission planning and the constraints that influence the schedule of observations. Dr. Slane noted that there are two regions in the sky where the spacecraft can observe with dwell times approaching 150 ks (approximately the available time between radiation zones) without primary components on the -Z side of the spacecraft overheating. Both of these regions result in the heating of other spacecraft components (indeed, there are no spacecraft pitch angles for which exposures are not limited by the heating of some spacecraft component), and both are geometrically small at any given moment, although the fraction of the sky that falls into these zones over the course of a year is substantial. Between these zones, uninterrupted exposures are limited to approximately 50-75 ks. Thus, over the course of a typical week the spacecraft must change pitch angle to allow various components to cool off after they have been exposed to the Sun for extended periods of time. The targets in the sky must be selected accordingly. In the zone around a pitch angle of $150^{o}$, observations with ACIS are challenging because the dwell time must be short. When observing with ACIS at this pitch angle, some of its CCDs must be kept off in order to manage the ACIS temperature. Updated, relevant requirements will be made known to observers in future calls for proposals. Luckily, thermal management is not yet so demanding as to create exclusion zones in the sky. Some challenging observations were carried out in Cycle 18 in which the spacecraft had to point at targets in "hot zones" and/or zones with many constraints (i.e., zones where some components heat up quickly), such as Venus, Sgr A*, and Jupiter. There will be similar challenges in cycle 19.

The mission planning team is continuing work to incorporate thermal constraints into efficient planning. The team is now using an updated and improved thermal model to predict subsystem temperatures while making the long-term observing schedule. Moreover, it has carried out a thermal feasibility study for the Cycle 19 targets. Many user preferences are still supported by the mission planning team but it may be difficult to continue that practice at the current level as the thermal shields of the spacecraft degrade.

There were no action items from the last year's CUC report. Post-IPPS (initial proposal parameter sign-off) review by the mission planning team is now carried out routinely, as endorsed by the CUC in its fall 2016 report.

During the ensuing question and answer session, Dr. Slane was asked if the mission planning team has any need for very short observations (exposure time of order 10 ks or less) that can be used as fillers to optimize the schedule. He noted that typical short observations (30 ks or less) without preferences or constraints already serve this purpose.

The CUC has no action items or specific new recommendations. Nonetheless, we re-iterate our recommendation from previous years that the CXC make sure that the mission planning team is properly staffed and has all the resources that it needs to continue performing as it has so far. We commend the team for its efforts and the excellent job that it has been doing.

**Proposal Cycle Update, Plans for Future Cycle**

Dr. A Prestwich provided a report on the most recent proposal Cycle. Chandra remains a very competitive telescope. Nearly 600 proposals were submitted in response to Cycle 19. The mean oversubscription rate for Cycle 19 was 5.8. The Very Large Proposal (VLP) category was particularly competitive with an oversubscription rate over 10. As requested by NASA, the CXC improved the time between submission of proposals and official notification to only 124 days. Acceptance rates for male and female PIs have been statistically indistinguishable in recent years. CXC has also carefully explored whether the present limits on time constraints and Targets of Opportunity are preventing important science. This appears to not be an issue except for Very Fast (VF) ToO triggers. Similarly, joint programs with NuStar do not appear to be limited by the current restrictions on time constraints. These statistics will be shared with future telescope allocation committees. CXO is recommending a time allocation by category for Cycle 20 similar to Cycle 19.

Recommendations:

1. *The committee recommends that the CXC studies the age demographics of proposers (or the years since PhD) and present this to the CUC next year.*

2. *The committee recommends that the CXC explores the option of adding a "snapshot" category to proposal submissions. This request is driven by the belief that such a category might allow interesting and unique scientific capabilities. For example, most Chandra targets are known to be X-ray sources from previous X-ray surveys. This category might allow proposers to explore a category of targets that has not been explored sufficiently with earlier missions. In particular, such a category might allow the exploration of targets selected at other wavelengths to be studied in X-rays without a large investment in observing time. We envision a process where the PI includes a large sample of targets and asks that some fraction be completed to allow an exploration of the class. We realize that this sort of program would not necessarily have the same sort of impact as HST snaps have in terms of filling "empty" time, but it might allow the TAC to take chances on observations that would otherwise be viewed as too risky, and, encouraging such a program now may turn out to be beneficial in the future if more such targets become necessary for thermal control of the satellite.*

3. *The committee recommends that the "stars" category be explicitly re-named "stars and exoplanets" to ensure that exoplanet proposals are properly considered both in setting committee composition and in evaluating the proposals.*

4. *Since the topic of proposals always generates lots of discussion and tends to run over its allocated time, the committee recommends that more time be allocated for the presentation and discussion of this topic next year.*

5. *The committee endorses VLPs for another year.*

**Instrument Calibration: Goals, Priorities and Plans**

The CUC received a detailed presentation from Dr. L. David regarding the multiple current calibration activities being performed by the CXC, and their future plans to extend this effort. While many aspects of the mission calibration and performance are stable, (e.g. imaging capabilities) a number are time-dependent and require moderately frequent monitoring, notably detector gain, quantum efficiency, and the optical depth and composition of the contamination known to be building up on the detector surfaces. Methods to characterize these changes with time have been established, and are being continued as necessary. Furthermore, significant effort is now being made to map the spatial dependence of these issues across the various detectors. In particular, ~75% of the total calibration time available is being used to study the evolution and spatial dependence of the detector contaminants. The systematic errors on the effective areas of the different onboard detectors are of order ~3%, and the agreement between them is also < 5%. Calibration is known to be a highly complex issue, particularly for missions with multiple detector configurations, and so the CUC would once again like to commend the CXC calibration team on their impressive efforts in this regard. The CUC was particularly pleased to see that a short (~1-page) web-based summary of the key systematic calibration uncertainties (e.g. gain, effective area, spectral resolution) has now been made available online[1] following a previous recommendation from this Committee, and would like to thank the CXC calibration team for compiling this information.

The CUC was also happy to note that issues related to future calibration procedures are already being anticipated. In particular, the gain of the detectors is currently assessed through the use of an external calibration source, but this is approaching the end of its usable lifetime. Beyond this point (anticipated to be in ~3 years time), one or more astrophysical calibration sources will be required to continue monitoring this key parameter, and discussions over source selection for this effort have already begun. Plans for future updates to the contamination model, encompassing new information regarding the time/spatial dependence of this material, are also well established.

*Recommendations:*

*In light of the future calibration plans presented, the CUC did not have many detailed recommendations at the current time. However, some broader points were noted:*

1. *The CUC strongly recommends that the current calibration efforts are continued at the same level of commitment. The complex long-term trends seen in many of the key detector parameters (e.g. gain, contamination) will continue to require frequent monitoring to ensure the continued success of the mission. The CUC therefore again asks the CXC to continue providing regular updates with the latest data on the evolution of these properties at future CUC meetings.*

[1] http://cxc.harvard.edu/cal/summary/Calibration_Status_Report.html

2. *The CUC also recommends that the CXC calibration team continues to play an active role in the IACHEC collaboration in order to maintain efforts to characterize and understand the cross-calibration uncertainties between the various X-ray missions currently active (e.g. XMM-Newton, NuSTAR, Swift). With the recent launch of NICER, continuing such efforts will be of particular importance.*

3. *Although these plans were not actively discussed this year, it is well known that there is an ongoing discussion within the Chandra project regarding the possibility of attempting to 'bake' off the contaminants building up on the ACIS detectors. This is understood to be a risky endeavor, which requires careful study before any decision is made. The CUC therefore also wishes to reiterate its previous recommendation that a report on the possible outcomes and risks of this operation is presented to the Committee as soon as the CXC considers that a contribution from the community would be useful.*

**Chandra Source Catalog**

The production of an official Chandra Source Catalog (with both point and extended sources) has been a key priority of the CXC. The CXC also aims to provide high-level data products to the community in a user-friendly environment that will effectively contribute to the legacy of the Chandra Observatory. Over the past few years, the generation of this catalog has been an important issue to the CUC that has been addressed extensively during past meetings primarily due to the delays in the release, and the increasing complexity of the analysis resulting from the desire to produce a high-quality product. The CUC is very happy to see that the catalog effort is approaching a successful conclusion and thanks the catalog team for its work.

The CUC heard a report from Dr. G. Fabbiano on the highly significant progress achieved since the last meeting, primarily the result of the considerable allocation of personnel to this effort. Preliminary detections of the CSC were released on September 18, 2017 based on 7287 observations that contain 374,365 unique detections. The data products are substantially improved due to the following: (a) the source amplitude is now given as a good approximation of the photon flux, (b) the detection algorithm is compared with simulation data, (c) deblending in crowded fields is optimized, and (d) a probabilistic approach is applied to source detection. A pre-release source list of 298,273 master match sources is being compiled with expected completion in three weeks from the CUC meeting; this list includes source positions and amplitudes in different photometric bands for unique sources. A "go"/"no-go" decision on running the source properties pipeline will be made October 6th, and production will begin on October 17th if a "go" decision is reached. If a "no go" decision is reached, a workaround that will minimize delays will be designed.

The complete version (work in progress) of the catalog will include the following and be available in about 3 months' time: (a) improved model and photon-based fluxes down to $10^{-15}$ erg/s/cm$^2$ (a factor of 10 fainter than CSC1), (b) removal of spurious sources and detection of variable sources based on multiple observations, (c) completion of quality assurance, and (d) use

with CSC view, a graphical interface for the community. Work proceeds on the inclusion of the extended emission and a measure of source extent. Any further delays will be mitigated by excluding certain measured properties that are not yet optimal. A full release of the catalog with full documentation is expected to occur in February 2018. A published paper will be produced and possibly coincide with the release; there will be a presentation for the community of the catalog at the January 2018 AAS meeting.

*Recommendations:*

1. *The CUC recommends the go/no-go decision on October 6th be discussed with the special committee members, Mike Watson and Andy Lawrence.*

2. *The CUC recommends that future releases should prioritize a comprehensive measurement set for sky fields that are not troublesome. Any challenging fields can be flagged and delayed from inclusion in the catalog. This will enable future releases to maximize the amount of years of observations being released.*

3. *The CUC recommends that the CXC make yearly incremental releases of the catalog that require processing only new data and adding the new sources to the existing catalog.*

4. *The CUC recommends that a paper describing the February 2018 release of the CSC be submitted to a peer reviewed journal so as to give proper credit to the team.*

5. *The CUC recommends developing a mechanism for community feedback that will inform future work required to enhance the usefulness of the CSC to the broader astronomical community.*

**CIAO Update**

Dr. J. McDowell provided an update on CIAO development and usage. CIAO downloads have been stable over the last 5 years; various OS platforms are being supported (Linux and OSX). A Python 3 version of CIAO v4.9 is available as of December 2016, with few minor bugs that are in the process of being fixed; it should become the standard with the next release (see below).

Recent upgrades include updated help files as well as an increased number of threads, most notably CIAO gallery, an intuitive, image based gallery of tools with links to related threads.

Helpdesk statistics have also been stable over the last five years; the median contact time for a ticket is 1.28 hr. Helpdesk keeps track of the number of iterations, closing times, and “hot” topics (such as dynamic libraries, PSF generation, openGL enabled environment for Chips, bugs and smoketest fails).

The team is engaged in a series of community work initiatives and CXO data analysis workshops, e.g. during the 2017 Summer AAS and HEAD meeting and an upcoming invited workshop in Pune, India.

Current developments and activities include: (a) Supporting the release of the Chandra Source Catalog v2, (b) CIAO version 4.9.1. *patch* release, hoping to integrate Chips and Sherpa on Sierra and High Sierra, which currently have plotting issues, and (c) Version 4.10 release is planned for April 2018 (High Sierra build).

There were no major issues arising. CIAO is widely recognized as an important resource to the community and we thank the CIAO team for providing helpful and sustained support.

*Recommendation:*

> *The committee recommends the CXC assesses accessibility and W3C/WAI compliance for data releases, web presence, and user interfaces. This recommendation applies to the CSC, CIAO, and RPS. The AAS Working Group on Accessibility and Disability could be a resource to the CXC in this endeavor.*

**Einstein Fellowship Program Update**

The Einstein Postdoctoral Fellowship program has been one of the cornerstones for maintaining and growing a vibrant community of high energy astrophysicists. The Einstein Fellowship has propelled the careers of not only high energy observers but also instrumentalists and theorists. A large fraction of these Fellows (> 65%) have gone on to obtain faculty positions and are now educating the next generation of Chandra (as well as Fermi, LIGO, etc) users.

In the fall 2016 meeting, the CUC was informed of the pending action by NASA to descope the funding and consolidate the three NASA prize postdoctoral fellowship programs (Einstein, Sagan, and Hubble). At this meeting Dr. P. Green reported on how this consolidation process will actually be carried out. CXC's stewardship of the Einstein Fellowship has been commendable and the committee hopes, for the sake of the high energy community, that the Einstein Fellowship office at the CXC will have a strong say in the evolution of this program going forward. To ensure that, the CUC makes the following recommendations.

*Recommendations:*

1. *The CUC recommends that the current Einstein Postdoctoral Fellowship coordinator, Dr. Green, actively participate in selecting a diverse committee to fill out the science panels. This step should not be left solely to STScI. To this end, several members of the CUC volunteered to serve on this NASA Hubble Fellowship Program. The CXC should be active in recruiting panel members. The CUC considers it important to maintain scientific breadth among the members of the selection panels so as to cover all the research areas under NASA Astrophysics, including areas related to current and future missions.*

2. *The CUC requests a report at the spring 2018 telecon on how the selection process went, and how the high energy community fared in the final candidate list.*

3. *There was some support on the CUC for improving the interaction of Einstein Fellows with the broader astronomical community and with other NASA Fellows. We recommend that the Fellowship office explore ideas to make this possible. Members of the CUC would be happy to exchange ideas with the CXC.*

**Chandra Proposal Submission Software - the replacement for RPS**

Dr. A. Fruscione provided a rationale for the replacement of the current Chandra Remote Proposal Submission (RPS) system and informed the CUC about the status of this undertaking. The current RPS system dates back to 1995 (Richmond et al. 1995), with several revisions. The software has been used by a number of missions and is well known by experienced X-ray astronomers. However, the RPS has aged and it must be replaced because it has a number of limitations. For example, one feature of the current RPS software is that users cannot see verification of their submission and commonly query the helpdesk about its status. Re-submission of proposals before the deadline is not a streamlined process and requires intervention by the helpdesk, increasing the risk of errors, and placing an additional burden on the CXC staff. The software is non-intuitive (especially for new users or those who use it only occasionally), not flexible for dynamic changes (for example, number of co-Is, number of monitoring observations), and some simple mistakes in the proposal form can lead to an unforeseen stream of complications (e.g., a typo in email address of the PI). Furthermore, it is cumbersome to re-submit a proposal from one cycle to the next. These shortcomings of the current RPS provide strong motivation for the development of a more modern and better integrated proposal submission system, which (a) addresses modern security concerns, (b) is easier to maintain and (c) is more straightforward to operate on both the user and CXC side.

In light of the above, the CXC has commissioned the same team that developed the well received Einstein Fellowship Application software to work on the new Chandra Proposal System (CPS) in order to replace RPS. The development started in January 2017. The new software has already undergone several internal releases, followed by rapid testing and collection of feedback. The next internal release is planned for October 3, 2017, before the software is released to outside beta testers. The aim is to have the CPS implemented and, if ready, released on December 15, 2017 with the Call for Proposals for Cycle 20. If the CPS is not ready by the time of the Cycle 20 call for proposals, the CXC will fall back to the RPS and postpone release of the CPS until Cycle 21.

Some of the desired features that will be developed in Phase 1 will address the shortcomings of the earlier version of RPS, e.g., make it a more user-friendly web form, keep the same proposal number on resubmission, make it easy to submit large target lists online, and share common files (CV and previous experience) between proposals. All other requirements that cannot be developed ahead of the Cycle 20 will be implemented in Phase 2, in future cycles. The CUC

noted that the RPS replacement process is well planned and commends the team for good project management, looking forward to user feedback.