

Chandra Users Committee Report

Committee Meeting of September 30, 2015

Preamble

The consensus among the members of the CUC users committee was that the observatory is in good shape, the instruments are performing well, and the CXC is doing a good job taking care of business. We commend the CXC staff for the efforts and we hope that they will continue performing at this level. We give below our more specific comments and recommendations, focusing on areas where we feel some improvements can be made and on several topics where we feel we can make useful recommendations.

Overview and Manager's and Director's Reports

The Director's presentation included a discussion of efforts to coordinate large programs with other facilities. The CUC was very pleased to see that the Director's office is pursuing such initiatives. The CUC suggested the possibility that early proposals can be solicited for multi-observatory time-domain projects that require extensive coordination between a variety of different facilities. For example, the proposals can be submitted in advance of the cycle in which the data would be obtained (e.g. they could be submitted at the AO-18 call for implementation in AO-19), reviewed, and, if successful, they would be executed only if all the necessary facilities are participating. The Director was receptive to this idea. The Director is exploring a related initiative to put together a multi-facility observing program with its own call for proposals, allowing joint large programs, which would be appropriate for time-domain programs among others.

The CUC heard an update on the CXC's efforts in Education and Public Outreach. As one of NASA's Great Observatories, it is very important for Chandra to communicate the scientific return from this investment to the general public. Chandra is also in a great position to communicate to students the excitement of scientific discovery, and to illustrate the scientific process. We encourage the Mission to continue its efforts in Education and Public Outreach, and applaud them for the recent success of their proposal to support further efforts in Education.

Recommendations:

1. We recommend continuing the practice of exchanging time with other facilities, such as national observatories and space missions. We also encourage the director to continue to pursue new opportunities for such exchange programs. Specific examples include ASTROSAT, which was just launched successfully, and ASTRO-H which will launch in the not-so-distant future. If possible, we think it would be useful to have joint observations with these missions during their PV phases.

Chandra Source Catalog

The committee heard a report from Dr. Evans on the status of the work on version 2 of the source catalog. The production run for version 2 of the catalog started in April 2015 and about 70% of the stacks were processed by the second half of September 2015. The catalog at the moment includes both secure and marginal detections. Manual quality checks seem to be the critical step since they are slow and are holding up the production. To mitigate this situation a number of additional people have been recruited and are now being trained to help with this

labor-intensive task. The goal is to include many source properties in the final catalog (more than a thousand columns per source are anticipated). According to the current schedule for completion of the work, a few new steps will be carried out in winter 2015/16. The projected date of completion has been revised from May 2016 to summer 2016.

The committee thanks the CXC and the catalog team in particular for their Herculean efforts to produce a detailed, carefully checked and verified catalog with value-added products. We were glad to see that many of the technical problems, specifically hardware problems, that caused delays in the past have been overcome. However, we are concerned about the fact that the project is still slipping and that the projected completion date has been moved again. We feel it is imperative to finish the catalog as quickly as possible since it will be a tremendous resource for the community and since the community has been expecting this of the CXC for quite some time.

Recommendations:

1. The committee reiterates, and reinforces the recommendation from previous years that the catalog be completed as quickly as possible.
2. It would be extremely valuable, in our opinion, to release at least the basic properties of the sources quickly and continue to work on additional source properties after that. Therefore, we recommend very strongly that the release should not be delayed beyond summer 2016. The work should be prioritized so that the basic catalog can be ready by that time even if work on additional source properties and a thorough evaluation of the uncertainties has to be delayed. We recommend that the CSC team delay analysis of regions of the sky and/or particularly complex datasets that require a disproportionate amount of effort in the interests of an earlier release of the majority of the data.
3. We were concerned that a number of ancillary tasks, such as development of algorithms for Sherpa that are unrelated to the source catalog, seem to be interfering with the work on the catalog. We recommend that the work on the catalog remain focused on its primary goal, timely completion of at least the basic catalog. In this spirit, we recommend that algorithm development also be focused on those algorithms that are essential for the completion of the catalog and the development of other algorithms receive lower priority.
4. We suggest that the catalog team consider the *XMM-Newton* source catalog (now 3XMM) as a model for the basic version of the Chandra source catalog in terms of a reasonable level of sophistication of the analysis and complexity of the data products.
5. The CUC asks that a status report on the catalog production is presented at the intermediate CUC meeting next spring.

Proposal Cycles: Update and Plans for Future Cycles

The committee was impressed that the proposal process continued to run smoothly in the most recent cycle, that the oversubscription rate remained high, and that there was no evidence of any gender equity problems with the proposal success rate. The committee had one concern with the time allocation process from this past year, which is that time was moved from the GO program to the LP program after proposals were submitted, in response to proposal pressure. While the committee believes that that was a sensible decision, it was concerned that the

decision changed the amount of time available in certain categories from what was stated in the call for proposals, after the call for proposals had already been issued.

There are concerns from the CDO that the number of large proposals being submitted leads to negative consequences at the peer review. The Big Project panel was asked to read 72 proposals this past cycle, a load which is barely manageable, and each of these proposals was also read by two subject-specific panels, further increasing the burden on the time allocation committees. Additionally, the conflict of interest rules for the Large Projects make it difficult to find reviewers for those projects. Dr. Prestwich also noted that the distribution of requested exposure times indicates that the requests are often engineered so they do not fall just below the level of a Large Project.

An analysis of the value of programs in different size ranges done by Ms. Winkelman showed more papers being published per unit time from smaller proposals than from larger ones. In the absence of results from the recent XVP programs, analysis of aggregates put together of both individual proposals, and cases where the same target had been observed in different cycles but in the same instrument configuration, were used to gauge the relative impact of different program sizes. At the Megasecond level, the trend started to reverse, with the most highly cited papers being disproportionately from the programs which used XVP levels of time. These high impact papers were predominantly from the deep fields rather than from other aggregates which used similar amounts of time.

Recommendations:

1. The committee recommends that specific criteria and procedures be laid out ahead of time in the call for proposals that discuss under what circumstances time may be moved among GO, LP and other classes of proposals.
2. Regarding the issue of too many LPs being submitted relative to what the peer review process can handle, the committee recommends implementing Dr. Prestwich's proposal to increase the threshold for LPs from 300 to 400 ksec. The committee additionally recommends that the CXC release detailed rates for probability of success of proposals as a function of the amount of time requested. This may lead to fewer proposals being engineered upward to exactly the threshold for an LP, as proposers realize that the proposals may have a better chance of being accepted as GO programs.
3. The committee recommends continuing publication analysis of different sizes of programs/aggregates before making a decision about whether the XVPs should return in Cycle 19. Waiting another year will allow the impact of the first actual XVP proposals to be considered which is important given that the large aggregates are mostly cases of proposals that amassed time over a long span, having shown strong intermediate results along the way, and they may not be reflective of the value of the bona fide new ideas that need at least 1 Msec immediately. A new discussion should take place one year from now about whether Cycle 19 should have an XVP component. The committee would also like to see the same type of weighted analysis on the citation data (i.e. citations per unit of time awarded) as on the publication data.

Mission Planning

Mission planning and scheduling are quite complex, and very ably handled by the mission in a manner that keeps their efforts almost completely transparent to users. This is particularly

impressive due to the continual introduction of new challenges as the spacecraft ages. These new challenges motivate the committee to emphasize the importance and value of maintaining staffing levels in these areas.

The CUC heard a summary of the continuing effect of overall heating of the observatory and the instruments. The gradual heating results in the mission planning becoming more complex with time in order to continue to shed heat successfully between observations. The implications for observing programs will eventually be that long integrations will become more difficult to fit into schedules in certain situations. It will also become more difficult to schedule time sensitive observations.

The CXC has a philosophy of minimising the amount of information given to proposers about mission constraints, preferring to handle difficult constraints with manipulation of the schedule. To date it has not been a big problem to fit all approved programs into the schedule this way. CXC has urged proposers to contact them well ahead of the deadline for assistance with constraints but if proposers are not aware that their programs may have constraints, as noted by Dr. Slane, they do not follow this guidance. Dr. Slane indicated a concern that proposers may make incorrect assumptions about potential constraints on the one hand, and on the other they may make observing requests that are difficult to schedule without indicating what kind of flexibility might be acceptable at the scheduling stage.

As time goes on and the spacecraft heating continues to put pressure on the scheduling capabilities, it may be advisable for the CXC to consider involving the proposers in some simple aspects of the schedulability of their proposed observations. The CUC understands that this has been considered thoroughly before and that it is difficult to illustrate schedulability because it depends on the manner in which the schedule is actually built for prior observations.

Recommendations:

1. The Committee recommends that the scheduling team and the proposal review team work together to determine whether the proposal forms can be modified in a way that draws out more information from the proposers about what their real constraints are.
2. The Committee recommends that the CXC pay close attention to the staffing needs of the mission planning team. As the scheduling becomes more and more complex with the addition of constraints, the job of this team will become more demanding. Therefore, their staffing levels should be adequate for them to handle their difficult job.

Instrument Performance and Calibration

The CUC is pleased that instrument operations is running smoothly, and that no major issue related to instrument operations has affected the observation efficiency during the last 12 months. We express our appreciation to the teams in charge of instrument operations.

The CUC expresses also its congratulations to the calibration teams for their continuous efforts to monitor the instrument performance, and improve their calibration. The range of calibration activities covered by Dr. David in his presentation is truly impressive, and the outcome in terms of update of CALDB files outstanding. The new calibration files being released or soon to be released (ACIS Quantum Efficiency (QE), ACIS low energy gain, HCR-I gain, HRC QE, ACIS background files for the latest 3 years of the mission, empirical HRC-I PSF) will contribute to

improving the quality and fidelity of a broad range of *Chandra*-based scientific results, from grating spectral analysis of fainter sources to accurate image deconvolution.

Recommendations:

1. The CUC agrees that achieving a full characterization of the time evolution, spatial distribution, and chemical composition of the contaminant on the ACIS filter is the single most important calibration challenge facing the *Chandra* Project, and endorses the choice of investing a substantial fraction of the current in-flight calibration observation plan to understand it. The CUC acknowledges that the problem is complex. It applauds the release by the end of this year of a new contamination model that will allow proper characterization of its spatial-dependence. The CUC recommends continued monitoring of the time evolution, spatial dependence, and chemical characterisation of the contaminant layer on the ACIS filter as the highest-priority calibration objective.
2. The CUC is pleased that a discussion has started in the *Chandra* Project to evaluate the possibility of CCD annealing (baking-out) to ameliorate the contamination issue. It is understood that this option is not devoid of risks, and should be therefore carefully studied. The CUC endorses the ongoing study and asks that a report on the possible outcomes and risks of this operation are presented to the Committee as soon as the Project considers that a contribution from the community would be useful.
3. In some segments of the astronomical community concerns are expressed on the inter-calibration status among different observatories. Most notably in the galaxy cluster community a lively debate is on-going on how the current uncertainties in the cross-calibration of the effective area of instruments on different observatories (primarily *Chandra* ACIS vs. *XMM-Newton* EPIC) could limit the accuracy of cosmological parameters derived from the galaxy cluster mass function. The CUC acknowledges that the issue is complex, and is aware that efforts are on-going in the framework of the International Astronomical Consortium for High-Energy Calibration to address this issue. The CUC asks the Project to provide its own assessment on whether these discrepancies can be reconciled, and to indicate the paths it intends to follow to achieve this goal. The CUC asks for a short report on this assessment to be presented at the next intermediate CUC meeting in the spring of 2016.
4. The CUC thanks the *Chandra* project for their response to the recommendation on the “single entry point” calibration documentation raised at the prior meeting. The CUC asks the *Chandra* Project to implement the plan presented to address the “single entry point” CUC request (reported hereafter):
 - “1. Post a single web page that summarizes all calibration uncertainties. This will be a living document that presents the current (based on the latest released version of the CALDB) uncertainties in the effective area, gain and resolution for each detector/grating as appropriate.
 2. Add a link from each uncertainty to the relevant calibration memos, plots and presentations.
 3. Most of the work in generating a referred paper will be simultaneously completed during step 2, i.e., the compilation of all relevant materials to include in a paper.

4. *Generate a paper to be submitted to A&A.*

5. *One question which we can discuss at the next CUC meeting, is whether to resubmit the Chandra calibration paper to A&A every few years as the calibration changes, or just keep a living paper on the Chandra web pages.”*

As far as Point#5 is concerned, the CUC recommends that the A&A calibration paper, once accepted, is kept as a living document on the Chandra web pages. A second, and final, version of the calibration paper should be published only after the end of science operations.

CIAO Update

Dr. McDowell presented updates on CIAO, which is a well-documented and sophisticated suite of analysis software tools for *Chandra*. The CIAO team continues to add new useful tools to the suite, further enhancing the capabilities of CIAO; e.g., subpixel simulations are largely improved, a new tool can model the background due to readout streaks, and support for CC grating data is improved. The CUC is pleased with the efforts to improve the PSF-related threads.

Dr. McDowell also provided an update on community support efforts, which include the helpdesk, various workshops, and participation in major meetings. These activities are great avenues to introduce new scientists to Chandra and X-ray astronomy, and help to maintain the vitality of the mission and field. We commend this continued outreach, engagement, and support of the astronomical community.

Last year the CUC recommended that the CXC “consider reallocating resources to scientifically higher priority tasks (e.g., the source catalog)”. Dr. McDowell’s presentation shows that higher priority is given to the source catalog by the CXC software teams.

The Sherpa team plans to improve documentation and characterization of the MCMC tools, which make Sherpa very powerful for X-ray spectral analysis with complex systematic errors.

Recommendations:

1. The CUC recommends that the CXC software teams continue to assign the highest priority to the timely release of the source catalog.
2. The CUC recommends that Sherpa run PyBlocks as the default mode for ACIS spectral analysis, outputting the confidence intervals on the spectral model parameters due to the systematic calibration uncertainties on the effective area besides the purely statistical uncertainties. This innovation should trigger users to ask if calibration systematic uncertainties affect their science, and to be aware of the associated - and very good - PyBlocks-related refereed papers and on-line documentation. However, to adhere to the spirit of the previous recommendation, we also recommend that implementing this recommendation be prioritized so that it does not interfere with the timely completion of the source catalog.
3. We recommend continuing the effort towards community support through workshops and other means, as outlined in the presentation.

Einstein Fellowship program

The Einstein Fellowship program continues to be a valuable resource for talented young scientists in NASA's Physics of the Cosmos research areas, and CDO's stewardship of this program is commendable. The oversubscription rate of factors of ten and higher demonstrate the high desirability of such positions. Efforts underway by the CDO to produce a guide of practical information for fellows, and move the institutional endorsement letter to after the acceptance phase, are good steps in keeping the focus on the excellent science projects while minimizing worries and reducing work for applicants and sponsors. The committee was especially pleased to hear about the fellowship changing to accommodate life situations in relaxing the strict 3 year upper limit since PhD to include an additional year (with justification). Efforts to make NASA fellowships more uniform with respect to employment status are also good steps. Specifically, the fellows will have the option of having either employ or stipendary status at their host institution. This is mandated by NASA and is intended to provide more flexibility to the fellows regarding benefits, taxes, visa status, travel regulations, etc.

The committee was pleased to hear about efforts to collect information on alumni and their current status, as well as to connect current Einstein fellows with alumni through an informal mentoring network.

Recommendations:

1. The committee recommends a couple of possible ways to strengthen the alumni-fellow connection, either by inviting one or more alumni to the symposia, possibly in keynote speaker roles, or to move the symposium to different locations for a larger interaction cross section with the alumni community.