Project Manager's Report

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Chandra has marked over 15 years of successful mission operations with continued excellent operational and scientific performance. Telescope time remained in high demand, with significant oversubscription in the Cycle 16 peer review, held in June 2014. The Cycle 16 review approved 190 proposals, out of 634 submitted by researchers worldwide who requested 108 Msec of observing time, ~ 4.8 times greater than the time available. Among the approved proposals are three X-ray Visionary Projects (XVPs), which were allocated a total of 5.4 Msec. XVPs are longer observing programs intended to address major questions in astrophysics and to produce data sets of lasting value.

In the Fall, the observing program transitioned from Cycle 15 to Cycle 16. Due to the gradual evolution of *Chandra*'s orbit, which has reduced the nonproductive time spent in Earth's radiation belts, *Chandra*'s overall observing efficiency has generally been near the highest level of the mission, resulting in higher than average allocated observing time. However, with continued orbit evolution the available time will slowly decrease in future years. We released the Call for Proposals for Cycle 17 in December, with proposals due in March 2015 and the peer review in June 2015.

In response to NASA's request for proposals for the 2014 Senior Review of operating missions, *Chandra* X-ray Center (CXC) and Marshall Space Flight Center program staff submitted the *Chandra* proposal January 2014. The NASA review committee held a site visit at the CXC in March. In their final report, the committee recognized *Chandra*'s capabilities and scientific productivity, saying "The prospects for further compelling science return in the future are excellent. This panel enthusiastically endorses the extension of the *Chandra* mission….The staff and infrastructure of the *Chandra* Project are most effective at enabling new science….*Chandra* discoveries continue to have an extraordinarily high impact on both the scientific and public understanding of our universe." The committee recommended that "mission operations and the ground system should be examined by senior engineers from other NASA projects for new ideas that may result in cost efficiencies." The CXC will host an operations review for this purpose in May 2015.

In October, the CXC hosted the annual symposium for the Einstein Fellowship program. A CXC workshop, "The X-ray View of Galaxy Ecosystems," originally planned for the summer of 2013 but cancelled due to NASA restrictions on conferences and travel, was held in July 2014. As part of the CXC's regular reviews and consultations with outside organizations, NASA reviewed the CXC's operations in April and October, and the *Chandra* Users' Committee met at the CXC in October.

After several years of very low solar radiation, the sun has become more active, resulting in *Chandra* observing being interrupted three times during the year to protect the instruments from solar particles. In addition, seven requests to observe targets of opportunity required the mission planning and flight teams to interrupt and revise on-board command loads. *Chandra* passed through the 2014 spring and fall eclipse seasons with nominal power and thermal performance.

In May of 2014, *Chandra* encountered a new meteor shower, the Camelopardalids, when the Earth crossed the path of comet 209P/LINEAR. To prepare for this passage, the CXC flight team developed and implemented procedures to point the observatory in the anti-radiant direction and partially feather the solar arrays to reduce their cross section. *Chandra* passed the shower successfully, with no known damage.

Engineers from the flight team and other experts completed a detailed review of *Chandra*'s systems to assess its expected operational lifetime. The group concluded that, "Taking into account all presently known equipment conditions and trends, it is very promising that all *Chandra* hardware and consumables will last for 25 years of mission activity."

Chandra's focal plane instruments, the Advanced CCD Imaging Spectrometer and the High Resolution Camera, have continued to operate well and have had no significant problems. The observatory has continued to warm gradually due to slow degradation of the spacecraft's multi-layer thermal insulation. This warming results in added complications in scheduling observations, but no significant decrease in observing efficiency. All systems at the *Chandra* Operations Control Center continued to perform well in supporting flight operations. *Chandra* data processing proceeded smoothly and data distribution continued to be rapid, with the time from observation to receipt by the observer averaging ~ 30 hours.

The CXC's Data System team released software to support *Chandra* users with Cycle 16 observation proposal submissions, the Cycle 16 Peer Review, and

the Cycle 17 Call for Proposals. In addition, in June the team released a major upgrade to the data system that migrates the *Chandra* Data System's archive server from Solaris to 64-bit Linux. The *Chandra* Source Catalog (CSC) currently includes about 107,000 individual sources. The CXC is in the process of developing a major new release, expected to triple its size, that will co-add multiple observations and use new source detection and background algorithms to include the faintest (~ 5 net counts) sources.

The CXC Communications and Public Engagement (CPE) group created 11 *Chandra* science press releases, 3 additional in conjunction with other telescopes, 2 non-science press releases (including announcement of the appointment of Belinda Wilkes as the new CXC Director), and 26 image releases (some with multiple images) resulting in 3350 articles in print and electronic news outlets. *Chandra* images were used in 21 releases of HEASARC Picture of the Week, 6 Astronomy Pictures of the Day, and 9 NASA Pictures of the Week. The group produced 48 podcasts on *Chandra* results as well as special series for children, fundamental science topics related to astrophysics, and the 15th anniversary of the *Chandra* launch. In addition, 62 blog entries were posted, including additions to "Meet the Astronomer" profiles of Principal Investigators of *Chandra* science observations, and a series related to the *Chandra* 15th anniversary. Team members presented 10 workshops at conferences and clinics sponsored by the National Science Teacher Association and 3 additional for the National Science Olympiad. The training video to support the 2015 Science Olympiad Coaches was updated.

At the request of NASA, the CPE team developed a 32-image exhibit to commemorate *Chandra*'s 15th anniversary. It was exhibited during July at NASA headquarters and was then moved to the Christa Corrigan McAuliffe Center in Framingham, Massachusetts, where it is being used in education programming.

The "Here, There and Everywhere" (HTE) traveling exhibit continued its national tour of one site per month at public libraries and museums. A grant from the Smithsonian Women's Committee funded Braille/tactile panels to expand the audience for the exhibit, and the US State Department commissioned a modified version of the panels for its overseas "American Spaces" program. Staff developed a new exhibit for the International Year of Light, which will be shown at the Seattle meeting of the American Astronomical Association before touring widely.

Staff produced a *Chandra* image application for mobile devices that is available through the iTunes store. The CXC team created a series of astronomy-related coding exercises, graded from simple to more advanced, for the "Hour of Code" project (http://event.pencilcode.net/home/hoc2014/), which is aimed at encouraging students' use of Pencil Code.

We look forward to a new year of continued smooth operations and exciting science results.