Chandra Source Catalog

Ian Evans, for the CSC team

In the last newsletter, we described many of the enhancements that will be included in the upcoming release 2.0 of the *Chandra* Source Catalog (CSC). The updated catalog will include observations released publicly through the end of 2014, co-adds multiple observations of the same field (pointings co-located within 60 arcsec and obtained using the same instrument) prior to source detection, and uses an improved source detection method that allows us to detect on-axis point sources reliably down to roughly 5 net counts for exposures shorter than the median *Chandra* observation duration (13 ks). Similar to the current catalog release, the updated catalog will tabulate numerous properties (with their associated confidence intervals) for each source, and provide extensive FITS data products for each field and source region that can be used directly for scientific analyses. When complete, the catalog should include information for approximately 400,000 source detections from roughly 10,000 *Chandra* ACIS and HRC-I imaging observations.

Production of release 2.0 is well underway, with almost all of the observed sky having completed the initial source detection phase at the time of writing. The candidate source detections are then analyzed with a new maximum likelihood estimator (MLE) tool that uses Sherpa to fit a model of the local point spread function (PSF) plus underlying background to the observed photon counts distribution to evaluate the likelihood that the candidate source is real. A second model of the local PSF convolved with an elliptical Gaussian (plus background) is also fitted to the data to simulate sources with some inherent extent. In addition to determining source likelihood, fitting with the local PSF also improves source astrometry, particularly for large off-axis angles where PSF asymmetries can bias position centroids.

Roughly ⅔ of the observed sky had been processed through the MLE step as of (Northern) autumn 2015 when we discovered that a few percent of the candidate source detections had poor MLE fits. In some cases, the source positions derived from these fits were in error by several times the local PSF radius (and several times the reported position uncertainties). Such errors would be unacceptable in the final released catalog, so processing was suspended to allow for a detailed investigation and resolution. In many cases, the root cause of the error was that the candidate source detection position was displaced from the actual source position, and therefore the region in which the MLE fit was performed did not properly enclose the source counts (the region is intentionally kept small to avoid confusion between nearby sources in crowded fields). To resolve the problem we have developed a two-stage MLE fitting process where a preliminary fit in an expanded region is used to re-center the final fit region on the counts distribution of the candidate source detection. Several automated quality assurance steps were added to identify cases where the MLE fit may not have completed successfully and send them for human review. A few additional pipeline and quality assurance enhancements were also developed to resolve other minor issues identified during this investigation.

Release 2.0 catalog production with the updated pipelines was restarted in March 2016 and production should be completely caught up by late spring. The remaining steps required to complete the official catalog release include merging detections from multiple overlapping fields, extracting source properties, generating limiting sensitivity maps, and populating the final catalog database. These steps should require roughly an additional 6 months. Once they are completed, release 2.0 will become the default official catalog release accessed by all of our standard catalog interfaces.

Key data for the subset of detections that completed processing through the end of July 2015 were

---

Reminder on the Naming of Sources Detected with Chandra

We want to remind our users of the recomendations regarding the naming of sources detected in *Chandra* observations:

Either register your own acronym with the IAU Task Group on Astronomical Designations:
http://cdsarc.u-strasbg.fr/viz-bin/DicForm

or use the general purpose designation
CXOU Jhhmmss.s±ddmmss
http://cdsarc.u-strasbg.fr/viz-bin/Dic?/2880906

Do not use the acronyms CXO or nCXO (where n is a number). These are reserved for use by the CSC which is a project of the CXC:
http://cdsarc.u-strasbg.fr/viz-bin/Dic?/2812380

For complete recommendations, please refer to:
http://cxc.cfa.harvard.edu/cdo/scipubs.html#NAME

made available to the community in early August as a "preliminary detections list" in FITS binary table format. The preliminary detections list can be accessed through the CSC release 2.0 website (*http://cxc.cfa.harvard.edu/csc2/*). For each detection, this table includes position, likelihood, and intensity estimates (a proxy for aperture photometry) in multiple energy bands for ACIS observations and a single energy band for HRC-I observations, together with their associated confidence intervals.

Although the original version of the preliminary detections list does include a few percent of detections impacted by the poor MLE fits issue described above, the vast majority of isolated brighter sources (≳10 counts on-axis) are unaffected. The preliminary detections list will be updated on the website once the data are reprocessed through the two-step MLE process. Readers interested in using the preliminary detections list should understand that these data may undergo revisions and have not received the complete quality assurance assessments that will apply to the final catalog release, and are therefore urged to review the caveats listed on the website carefully.

The current version of the catalog (release 1.1) as well as extensive user documentation, may be accessed through the CSC website (*http://cxc.cfa.harvard.edu/csc/*). The documentation describes the content and organization of the catalog in detail and lists important caveats and limitations that should be reviewed prior to using the catalog data. The various user interfaces are described along with several examples and user threads that demonstrate the use of these tools to access the catalog. Updates to the preliminary detections list and news about release 2.0 of the catalog will continue to be added to the website (*http://cxc.cfa.harvard.edu/csc2/*) as production proceeds. ∎