Chandra X-ray Center

Science Data Systems

CIAO, Pipelines and Catalog

Jonathan McDowell

CIAO Update - Jonathan McDowell

- Chandra Source Catalog Release 1.0 is out
  - SDS support on analysis, characterization, documentation
  -
- CIAO 4.1 released on schedule in December
- CIAO 4.1.2 patch in April
  - More catalog tools
- CIAO 4.2 release in late 2009
  - More catalog tools
  - First batch of development from CUC input
  - Segmented release (separate Sherpa, Tools, etc)
- Catalog further work
  - Research effort: Coadd overlapping fields
  - Supporting HRC catalog processing.
  - No schedule yet (depends on review of release 1)
- L1 and L2 pipelines:
  - pipeline standard data processing (SDP) is stable; we will respond to any spacecraft issues but no major near-term science changes are expected.
  - "Summary pages" not much used, will stop making them in June 2009

Community support

- CUC input folded into CIAO 4.2 planning
- New computer specialist started Nov 08 – Nick Lee, replaces Nick Durham
  - Big load on computer specialist team during documentation of Catalog and CIAO4.1, all performed outstandingly
- Helpdesk: 90 new tickets (Oct 1 – Mar 18), 11 still open
  - median time to first (useful) answer 1.3 hours, longest time 10d (really a science question; science staff occupied with catalog release)
  - median time to close ticket 11 hours, average 4 days
  - some tickets take longer to close, e.g. waiting for feedback from user, or from internal specialist
  - 45 of 90 tickets handled by helpdesk staff without need for scientist support
- Gave catalog GUI (CSCview) demonstrations at Long Beach AAS meeting

CIAO 4.1

CIAO 4.1 was released in Dec 2008
CIAO 4.1.1 was released in Jan 2009 with updated proposal data files

Downloads since Oct 1 by user's platform: (total 731)

Linux	CIAO4.1 186,	CIAO4 113,	CIAO3.4 20
	- Most common: FC8, FC4,Debian		
	- Still a few FC2,3		
Solaris	CIAO4.1 14,	CIAO4 5,	CIAO3.4 0
Mac	CIAO4.1 166,	CIAO4 82,	CIAO3.4 17
	- 184 OS 10.5, 81 OS 10.4		
Unknown	CIAO4.1 75,	CIAO4 42,	CIAO3.4 9

Current platforms are
Fedora Core 4
Fedora Core 8
Mac PPC OS 10.4
Mac Intel OS 10.4, 10.5
Solaris 8

CIAO 4.1.2 will upgrade Solaris to 10, Mac PPC to 10.5, evaluate newer Fedora for CIAO 4.2 (successfully using CIAO on Fedora Core 10 with SELinux workaround)

CIAO 4.1

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CIAO 4.1 included the first batch of Catalog-derived tools

Reminder of CIAO 4.1 content (from last CUC):

- Sherpa
  - Release 1.0 of the new Sherpa, improved convergence and robustness, support for grating data, user models
- Science Tools
  - aprates Aperture photometry with confidence intervals (uses user-supplied PSF fraction)
  - eff2evt Calculates eff.area and 'flux' for each photon in event list
  - lc_clean Revised to use new ChIPS
  - mkpsfmap Gives image of approximate PSF size for use in detect apps (not for use in aperture corrections)
  - lim_sens Limiting sensitivity calculation (for catalog)
  - dmellipse Find ellipse containing given fraction of source
  - dmimgadapt New adaptive binning tool
  - Upgrades to wavedetect, acis_build_badpix
- Infrastructure
  - DataModel Ascii Kernel - cleaned up, no longer beta - “Release 1” status
    Image handling improved, can bin tables to images
    String handling in tables improved, fixed bugs with internal quotes and escape chars.
  - CALDB - new generation CALDB allows better internal organization
  - Prism file viewer improved
    new interface, better functionality and connection to plots
    Array columns expanded inline, not in popup; multiple files appear in tabs
  - GUIs (Prism, PEG, TaskMon) - changed out MOTIF for GNU compliant GTK
  - ardlib tools now accept data model filters

CIAO 4.1 Sherpa

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- Python and Slang environments
    - command line and script/batch mode
    - accessing and working with internal Data Structures
- Improved convergence and robustness with three optimization methods:
    - Levmar, Neldermead and Moncar methods
- Several statistics options
- Support for grating data
- Flexibility in adding user models and statistics functions
- Extensibility of the system for advanced users. Examples include:
    - Simulations to evaluate the confidence on derived parameters such as flux.
    - "Project" models that were developed and posted on the contrib pages by Tom Aldcroft:

http://cxc.harvard.edu/contrib/deproject

- Improved on line documentation includes many new threads - it is ongoing

CIAO 4.1.2

CIAO 4.1.2 development is complete and SDS science testing complete:
Completing regression testing and preparing for download testing
Release scheduled for Apr 15
CIAO 4.1.2 contains a set of Level 3 tools, plus bug fixes.

- Sherpa
  - CIAO 4.1.2 Sherpa updated to the latest XSPEC12.5 models
- Science Tools
  - **evalpos** Simple script to get image pixel value at a celestial position (e.g. for sensitivity file values)
  - **glvary** - Variability tool developed for catalog
  - **modelflux** – New tool based on catalog script, to convert between flux and rate for arbitrary Sherpa model
  - **srcextent** – Modified from catalog tool for better user interaction; measures effective size of source and PSF and estimates intrinsic size.
  - **streakmap** - Modified from catalog tool to accept more general user inputs; calculates streak background map due to CCD readout 'out-of-time' events.
  - **pileup_map** - Simple script to estimate pileup based on frame count rates.

TESTING CIAO 4.1.2

CIAO 4.1.2 is undergoing science testing and regression testing by SDS.

For each tool the assigned scientist prepares a worksheet giving several test cases and results. The test team uses them to prepare scripts for portable regression testing.

CIAO 4.1.2 SDS carries out regression testing on multiple platforms. We have upgraded our testing scripts and machines, and we now test on

- Fedora Core 8,
- Mac OS 10.4 PPC,
- Mac OS 10.4 Intel,
- Solaris 8,

and are beginning tests on Solaris 10. For Mac Intel testing we have been borrowing a scientist's desktop, but we are now getting a dedicated machine whose configuration can be more easily controlled.

CIAO 4.1.2 Gratings Documentation

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New: Grating Analysis Guide
Links together existing threads for ACIS/HETG and ACIS/LETG work

New Line fitting thread

ANALYSIS GUIDES (for HETG/ACIS-S, LETG/ACIS-S, LETG/HRC-S) http://cxc.harvard.edu/ciao/guides/

- Roadmap of the CIAO threads for grating data analysis (high resolution spectroscopy)
- Takes the user through the analysis of a single source from a single observation.

There is also a: *High Resolution Spectroscopy - Detailed Overview* (by Dave Huenemoerder)
good comprehensive overview of grating processing and analysis (old, needs some updating).

CIAO 4.1.2 Gratings Documentation

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New: Grating threads for Sherpa

CIAO/SHERPA DATA ANALYSIS THREADS:

Grating spectroscopy section: http://cxc.harvard.edu/ciao/threads/gspec.html

Include about 30 threads for all grating combinations (including LETG/HRC-I!) that explain how to examine pha2 files, create color spectra, correct zero-order source position, create grating ARFs and RMFs, group and coadd spectra.

Modeling & Fitting Grating Data with Sherpa: http://cxc.harvard.edu/sherpa/threads/fitting.html

Fitting Grating Data: General introduction to fitting grating data in Sherpa. Loading and filtering data are covered, as well as defining instrument responses and source models.

Fitting Multiple Orders of HRC-S/LETG Data: Explains how to model overlapping orders in Sherpa by defining the instrument response as a composite of the interesting orders. The thread uses response files (gRMFs and gARFs) created with CIAO to model and fit the first three +/- orders of the spectra.

Measuring Line Parameters: After you have a set of PHA2 and response files from TGCAT (for an HETG/ACIS-S observation), perform a simple fit to one of the line features present in the spectrum.

Simulating an ACIS/HETG emission-line grating data set: using responses and backgrounds from an observed data set

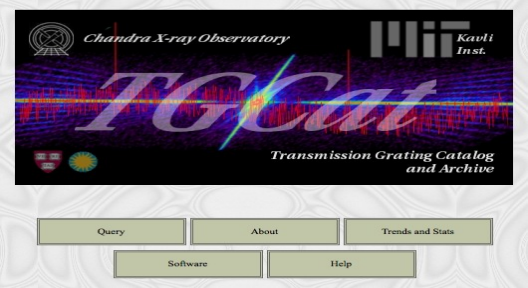
TGCAT SOFTWARE MANUAL: http://space.mit.edu/cxc/analysis/tgcat/tgcat_man.pdf

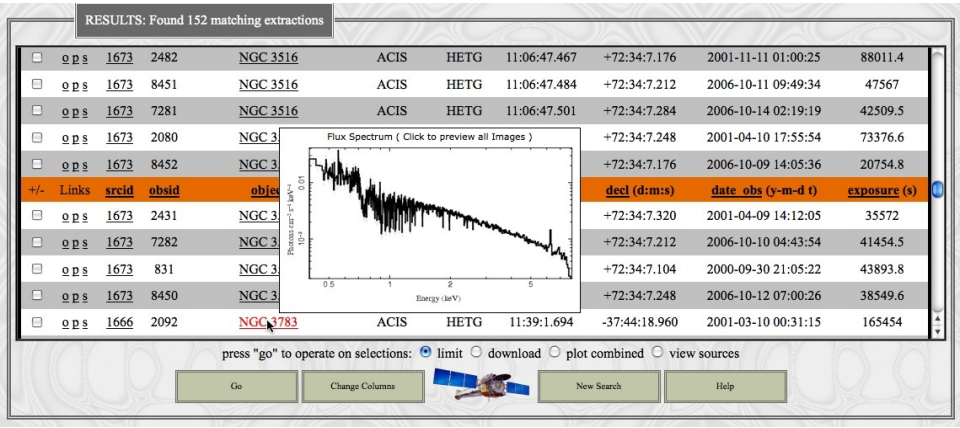
Explains how to run the reprocessing scripts to obtain pha2 files, grating ARFs and RMFs, light curves, and quick-look summary plots

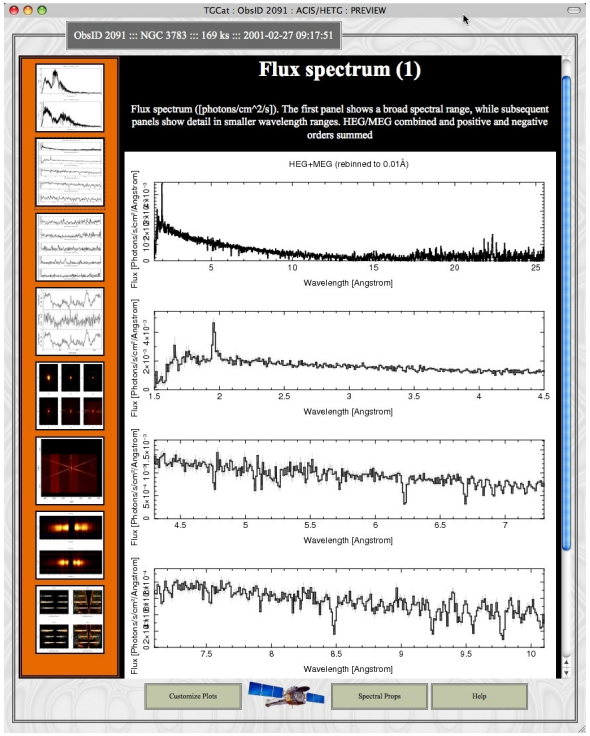
TGCat

The gratings team at MIT has reprocessed HETG data and released products at

http://tgcat.mit.edu







CIAO 4.2

CIAO 4.2 (Dec 2009) planning well underway

Focus is point source analysis, and more catalog-derived tools
Below I list examples of SDS development work for 2009

- Candidate Science Tools for CIAO 4.2 - catalog
  - BEHR BEHR algorithm for hardness ratios
  - flux_eval Use eff2evt to make flux estimate, add confidence intervals
  - background map tool
  - error ellipse combination tool
- Candidate Science Tools for CIAO 4.2 – enhancing existing tools
  - acis_build_badpix Tool to make bad pixel files for your observation, adding user-requested improved abilities to customize
  - acis_process_events support for graded CTI [request from Cal team]
  - acis_process_events support for sub-pixel resolution
  - hrc_process_events support for new gain files
  - sherpa Enhance user interface
- R&D work
  - MARX/ChaRT comparison and characterization; PSF aperture correction for ARF

CIAO 4.2

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CIAO 4.2 scripts, GUIs and threads

- Restore ChIPS plotting functionality to user scripts (lost in CIAO3.4-4.0 upgrade) and improve interface
- Work on scripts for merging observations
- Add statistical error analysis scripts based on CHASC astrostatistics collaboration
- Simple user data-reprocessing scripts
- Investigate simple GUIs for Sherpa (long lead)

CIAO 4.2 and beyond: user interface

- We are currently supporting two advanced scripting languages in Sherpa/Chips: S-lang and python
- This is a major support headache – the documentation is OK (mostly automated) but science testing of two versions of each function is too much work
- python is working well in our system after an initial learning curve
- Following CUC recommendation in Sep 07, we are considering phasing out S-lang in the Sherpa/Chips environment and reviewing the status of S-lang modules in CIAO
- S-lang would still be packaged with CIAO and users can continue scripting in it outside of Sherpa/Chips
- However, we are concerned about impact to existing users – welcome CUC feedback. Will keep CUC informed as we evaluate options.
- Also considering additional user interface work following feedback from some users who prefer a command line interface and find the functional style confusing.

Catalog publications

- SDS catalog posters presented at Long Beach AAS:
  - Chandra Source Catalog:Algorithms (McDowell et al)
  - Chandra Source Catalog: Source Variability (Nowak et al)
  - Chandra Source Catalog: X-ray Aperture Photometry (Kashyap, Primini et al)
  - Chandra Source Catalog: Statistical Characterization (Primini et al)
  - Chandra Source Catalog: User Interface (Bonaventura et al)

in addition to posters authored by software team (I Evans et al, overview; J Evans et al, processing; S Doe et al, spectra; R Hain et al, merging)

and by archive team (A Rots et al, source properties; M McCollough et al, backgrounds)

Catalog documentation

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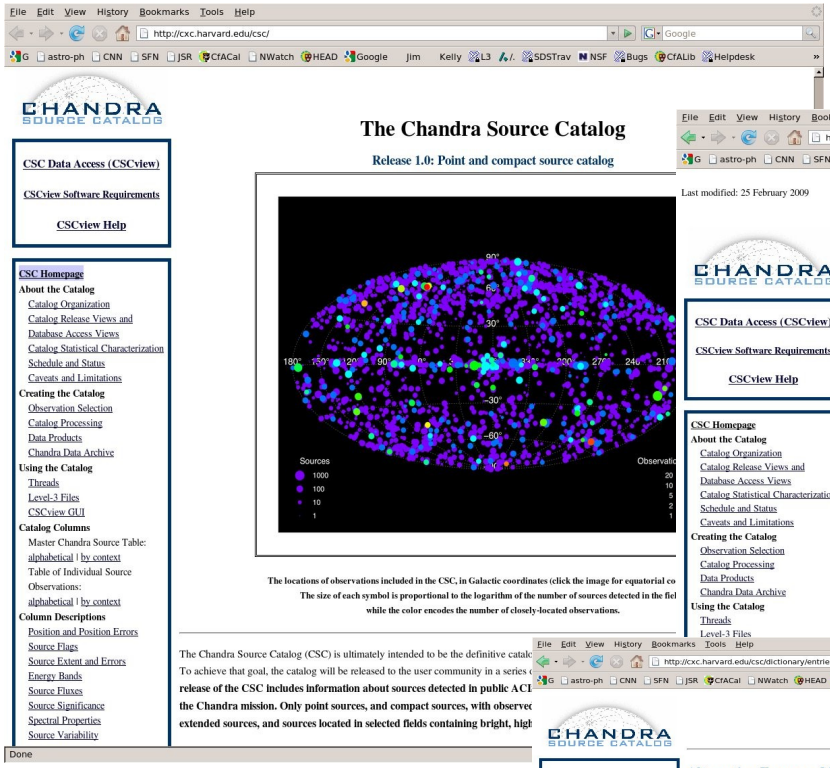

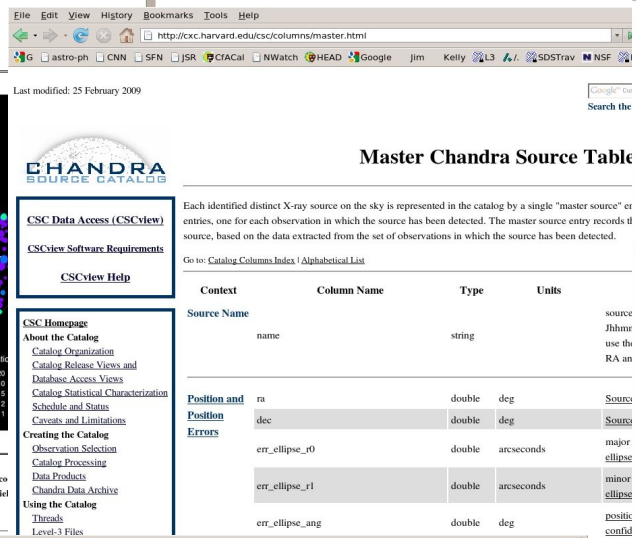

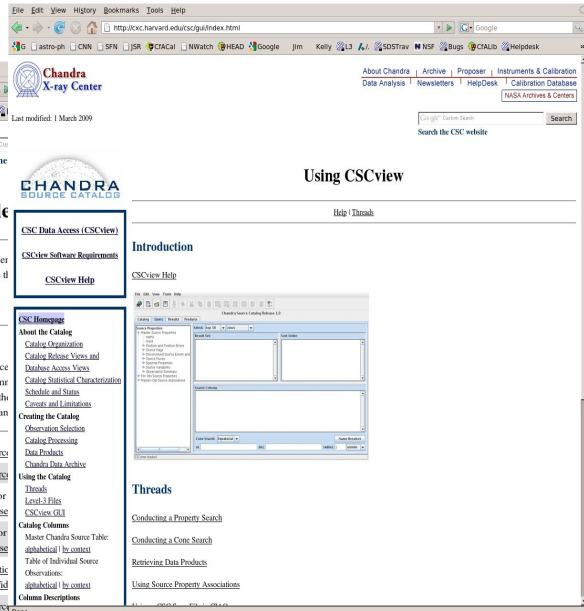

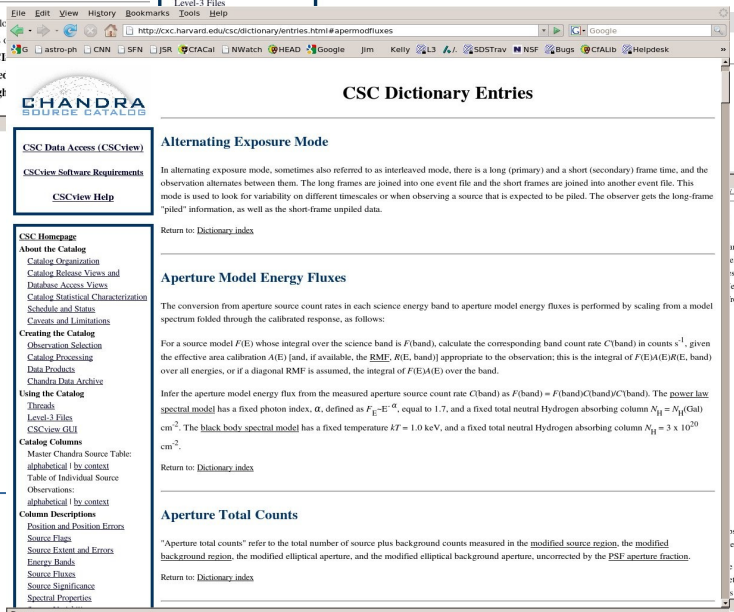

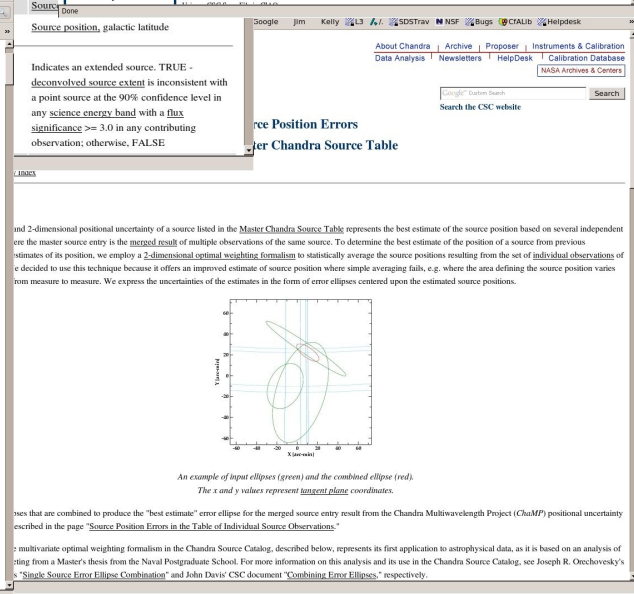

Main page
column descriptions
GUI usage
dictionary
special topics
etc...

CUC meeting Apr 2009

Catalog – Release 1.0 support

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Catalog release process involved significant work by SDS team in support of DS software release effort

Documentation updated

Example science thread for users

User testing of CSCView GUI interface

Web site infrastructure and release

Science support for last-minute data migrations following discovery of minor bugs in the data
found by science characterization review