Chandra X-ray Center

Science Data Systems

Jonathan McDowell

Chandra X-ray Center

Team: McDowell, Fruscione (1/2), Siemiginowska, Burke
(SAO scientists: CIAO, Sherpa, Docs, HRC, Catalog, User support)
Glotfelty, Lee, Joye, Cranmer (1/2)
(SAO computer specialists: Docs, User support, scripts, DS9)
Huenemoerder, Guenther, Principe, Nynka
(MIT scientists: Gratings, ACIS, PSF, V&V, Catalog, Sherpa, User support)

Overview:

Ensure the science community can turn data products into science papers:

Define, test and support CIAO - the Chandra user data analysis package
User support for data analysis
Maintain and improve science algorithms, data products
Simplify and codify evolving best practices for analysis (scripts, threads)

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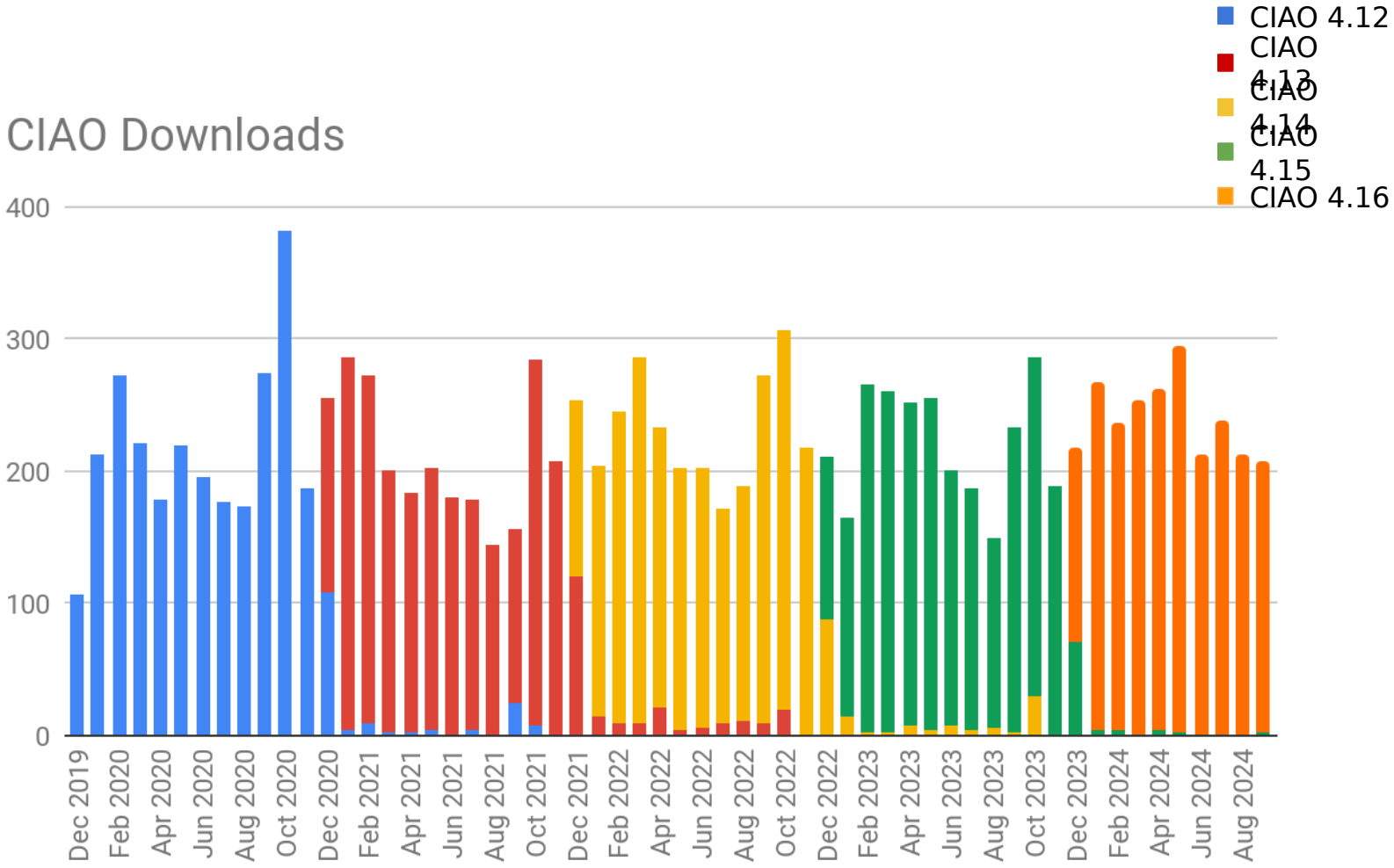
Community Support:

Downloads,
Documentation,
Helpdesk


CIAO Downloads
CIAO 4.12
CIAO 4.13
CIAO 4.14
CIAO 4.15
CIAO 4.16
400
300
200
100
0
Dec 2019
Feb 2020
Apr 2020
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Oct 2023
Dec 2023
Feb 2024
Apr 2024
Jun 2024
Aug 2024

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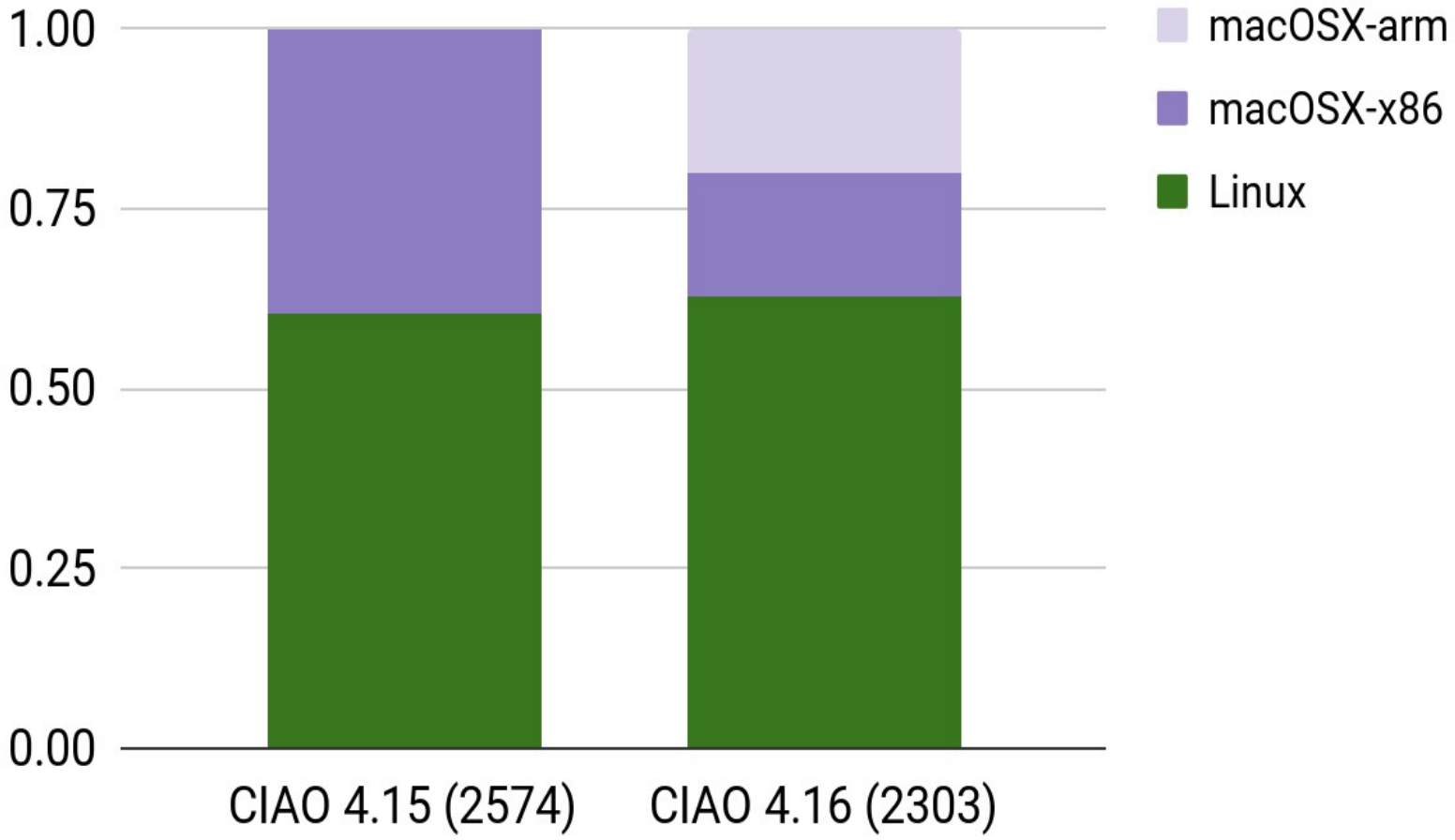
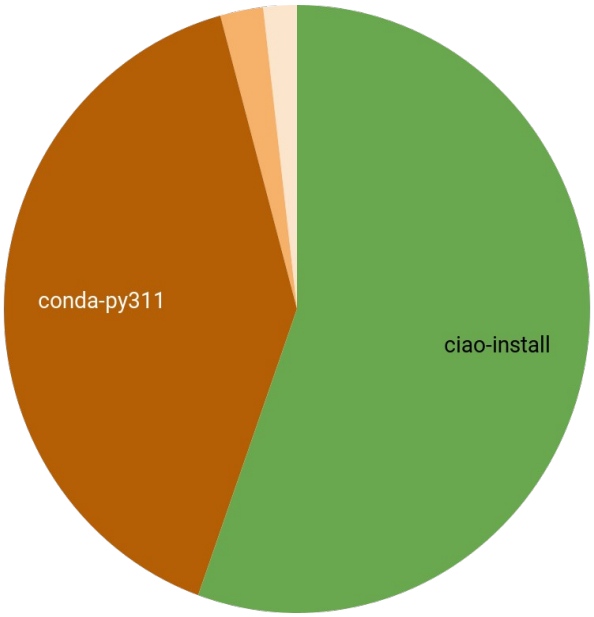
Downloads (lifetime)

OS	CIAO 4.15	CIAO 4.16
Linux	1558	1445
macOSX-x86	1016	401
macOSX-arm		457
	2574	2303
Source	6	24
Total	2580	2327

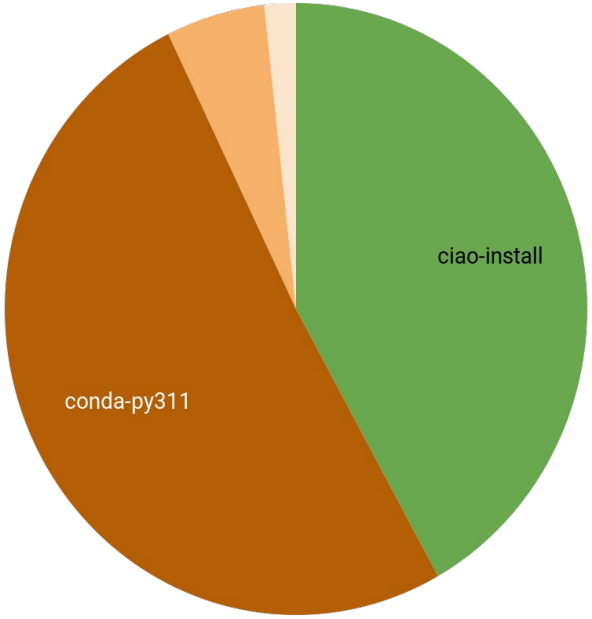
Download by OS



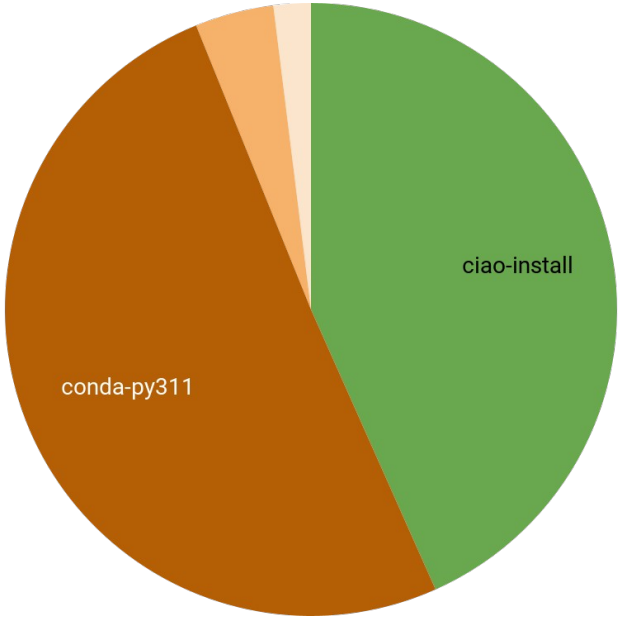
CIAO 4.16 Installation Options



Linux



macOS-intel



macOS-arm

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Documentation

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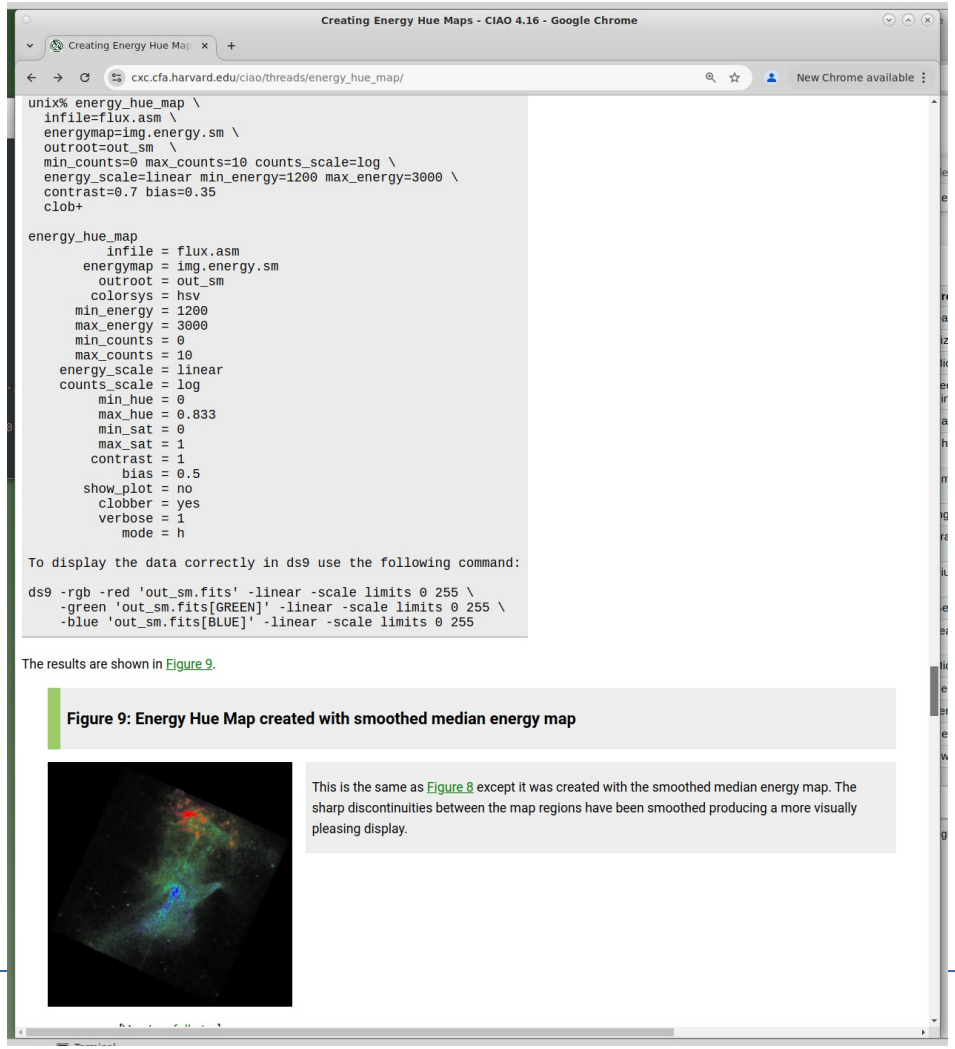
Docs

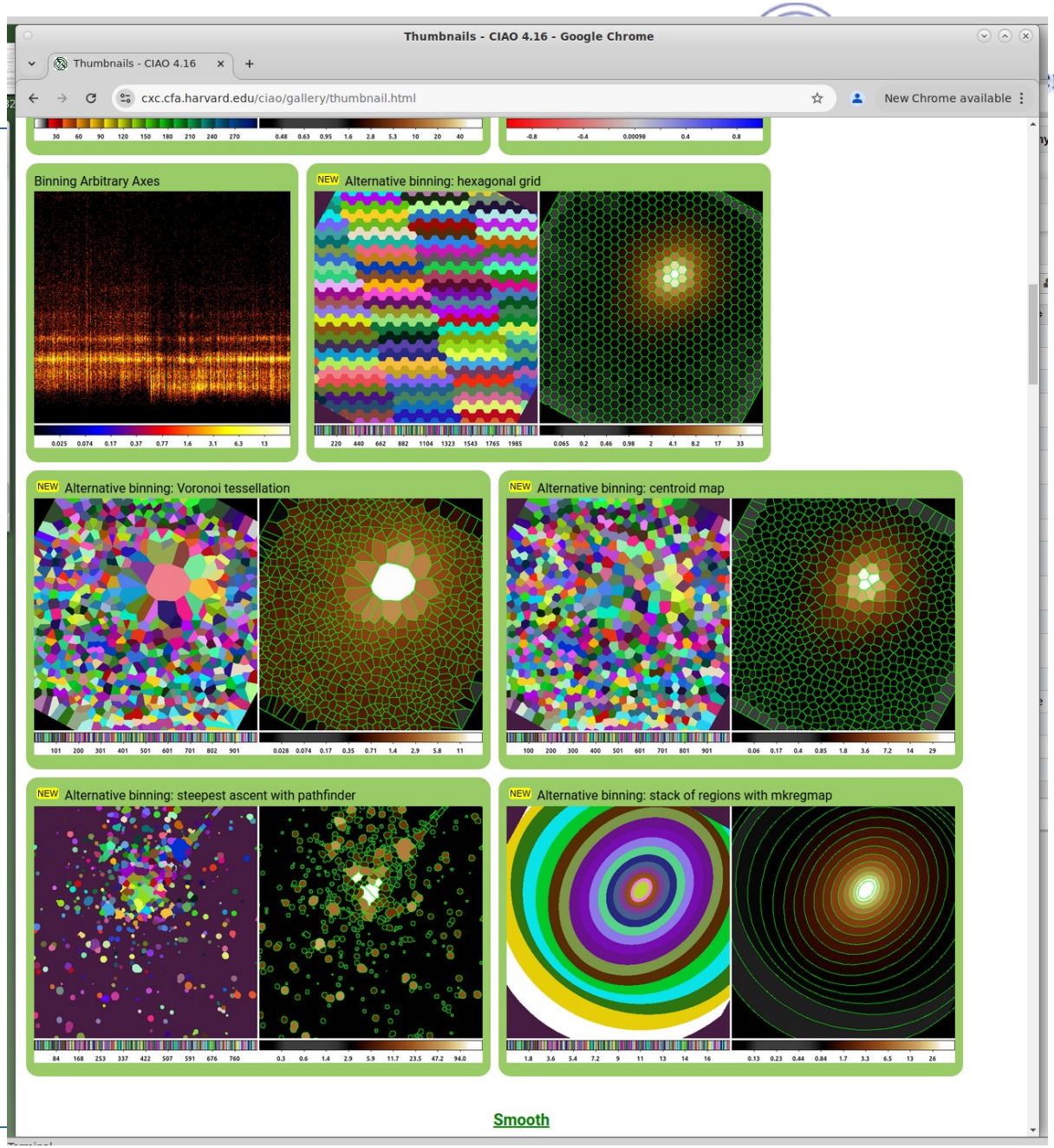
- Routine roll-out of CIAO 4.16 site; CIAO 4.14 site retired.
  - Significant updates related to conda-only / new ciao-install script. Advocate using miniforge due to Anaconda licensing.
  - Overhaul of source build threads going from Makefile's to CMake system
  - Major scrub of bugs pages
  - Updated threads to clarify tcsh shell vs. bash/zsh shell syntax
- New Energy Hue Map thread
- New Gallery examples
  - New adaptive binning scripts
  - New apertures scripts (PSF based region creation)
  - Region logic example
- Updated Create L2 thread to show how to use OBC aspect solution to process Earth and Moon observations (no guide stars).
- Updated publishing code to check for HTML5 compliance; updated many pages (>150) to fix compatibility issues.
- Reprocessing of circa 1999 data lead to need to update several threads which uses early datasets.
- Replaced potentially insecure CGI download script with static file download

energy_hue_map thread



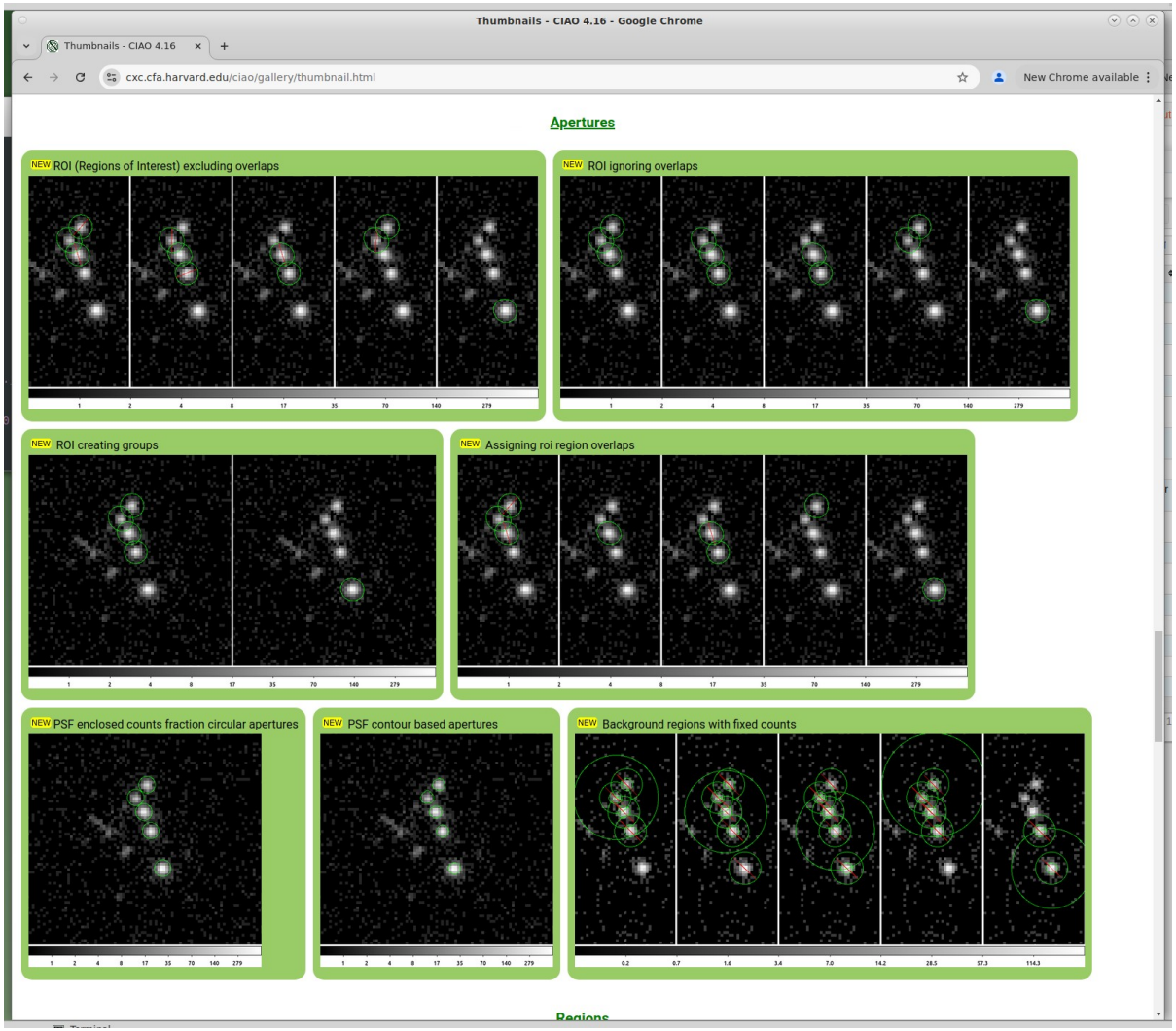
Gallery: alternative binning

Demonstrates several examples of the new adaptive/alternative binning tools that were released in the CIAO 4.16 contributed scripts package.



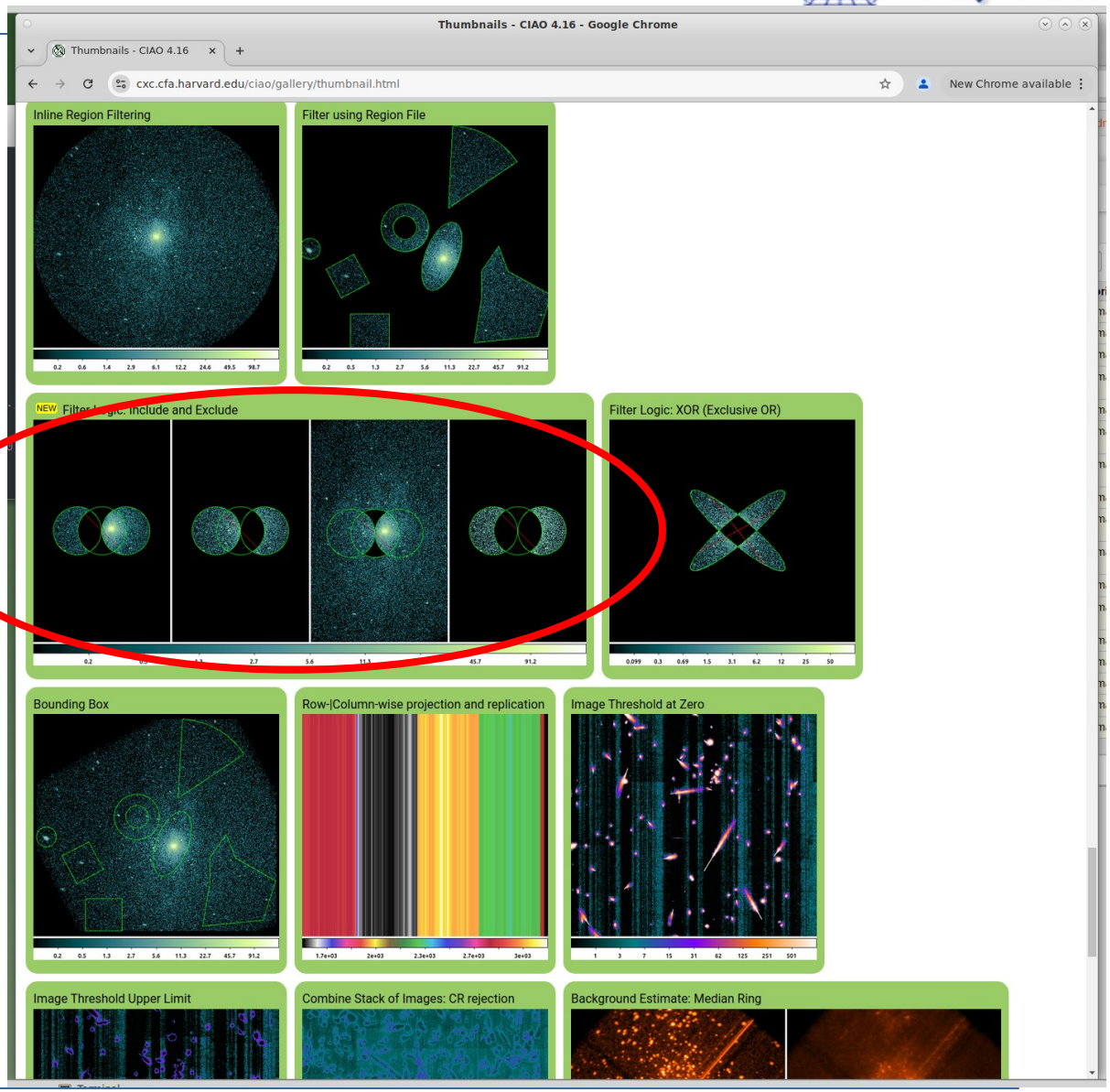
Gallery: Apertures

CIAO has several tools to help automate the creation of source and background regions. This new Gallery section provides examples of how these various tools work and the kinds of outputs they create.



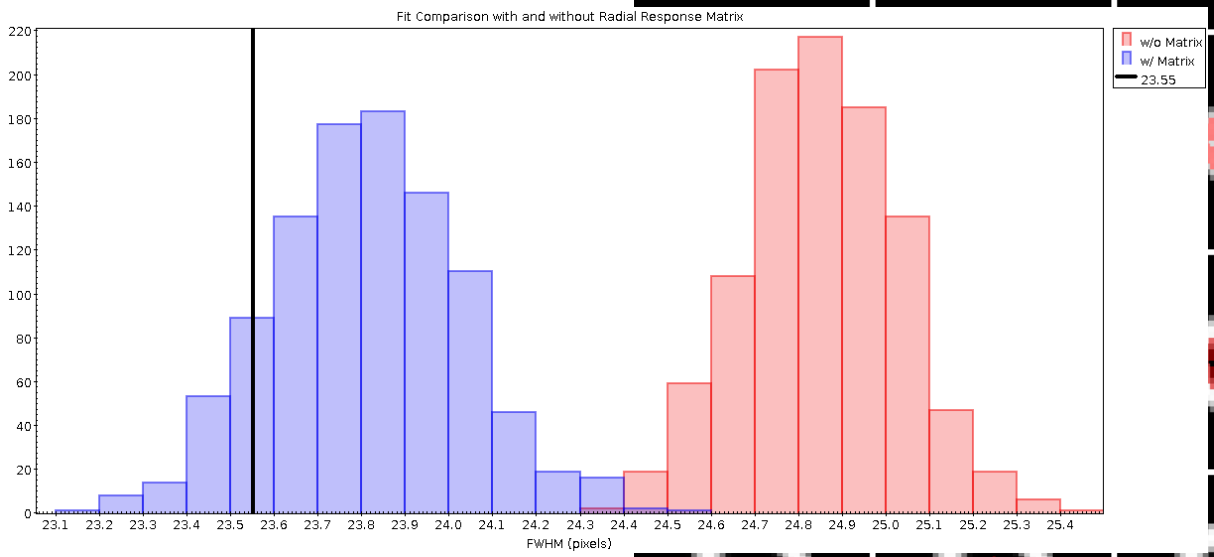
Gallery: include and exclude logic

A common question from new users is how CIAO's region syntax treats included and excluded shapes. This new example illustrates how order matters when using "-" to exclude shapes.

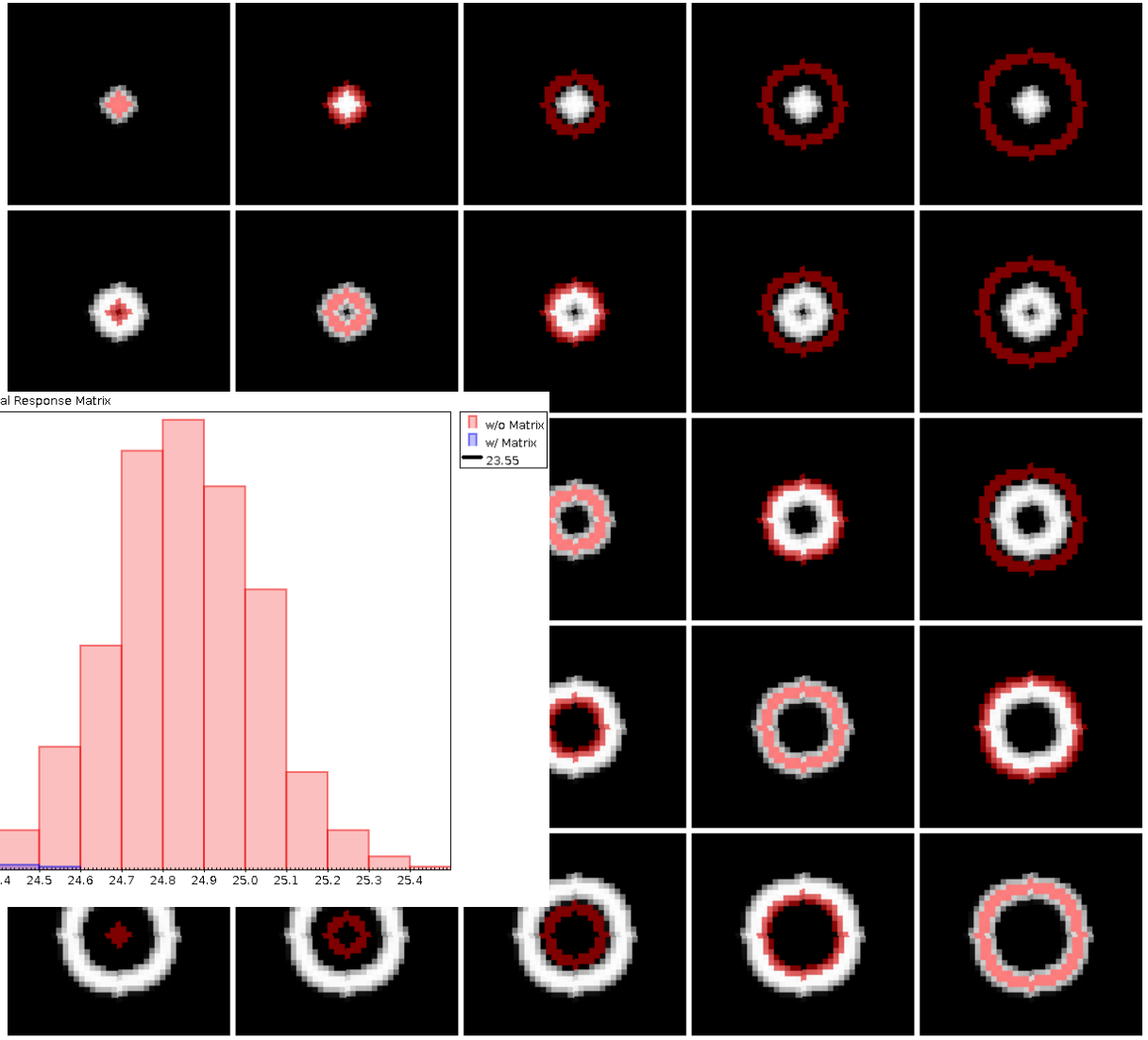


Radial Profile Response Matrix

We are working on a new *Why?* topic and script to help users evaluate the effects the PSF has on radial profiles.



1000 simulations of a radial profile fit to Gaussian emission 5' off-axis with FWHM=23.55 (solid black vertical line) without including response (red) and with including response (blue)



The grey scale images are each annulus convolved with the PSF. The red mask shows what fraction is imaged in each annulus. We can see that the annulii are not strictly independent.

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cxc.harvard.edu/ciao/merging/ (Nick Lee, Katie Cranmer, Antonella Fruscione)

Merging Central

Introduction to Merging *Chandra* Data

Spatial/Imaging Analysis | Spectral Analysis | Timing Analysis

Chandra observations can be split in segments or can cover different time spans for two main reasons:

1. **Scientific reasons**: the same target or patch of the sky has been observed many times during the course of the mission
2. **Engineering reasons**: because of spacecraft thermal restrictions, long observations are broken into shorter exposures. As of late 2021, observations longer than about 60ks are usually broken up into 30ks segments for planning purposes, and observations of these segments may be separated by significant periods of time Proposers' Observatory Guide §3.3.3.

Whatever the reasons, observers may want to merge the various observations for example to:

- detect faint sources
- study variability across time
- cover a large area
- recover the unsplit exposure time

The direction in which to go when merging observations is strongly dependent on several factors. The main ones are:

- the scientific goal
- the instrument used
- the time separation between observations
- the spatial separation between observations

It is also crucial to understand what is possible or is not possible to do with the merged output once observations are combined and the limitations therein.

The aim of this website is to provide instructions and guidance in all aspects of merging observations.

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Merging Central

- A comprehensive project designed to guide Chandra observers around the problems of merging datasets for spatial, spectral, and temporal analyses.
- Draws from existing documentation and previously undocumented discussions from Helpdesk
- Organizes information more coherently by focusing on different analysis themes.
- Addresses when merging data can enhance scientific analysis and when it should be avoided due to intrinsic limitations.
- Provides examples and counter-examples of combining data sets

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Merging Central

Organized by theme:

Spatial Analysis:

- Fine-tune astrometric corrections with CIAO tools.
- Ensure proper event reprojection to a common sky system.
- Caveats: handling PSF maps, exposure maps, and source detection.

Spectral Analysis:

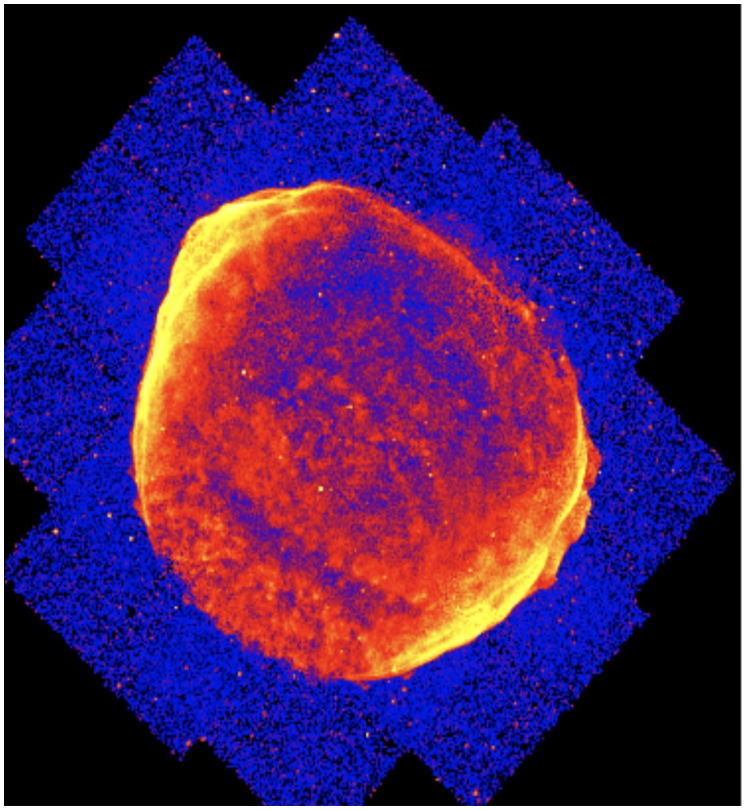
- Avoid direct merging of spectra due to response file limitations.
- Address background spectra merging issues; model separately if background rates differ.
- Advises about fitting simultaneously.

Temporal Analysis:

- Merging light curves requires correct time ordering.
- Address challenges with gaps in time between observations.

Merging Central

- we need feedback from you and the users!



And in the the future …

- ➢ **Grating Central**
- ➢ **Extended Source Central**

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Helpdesk

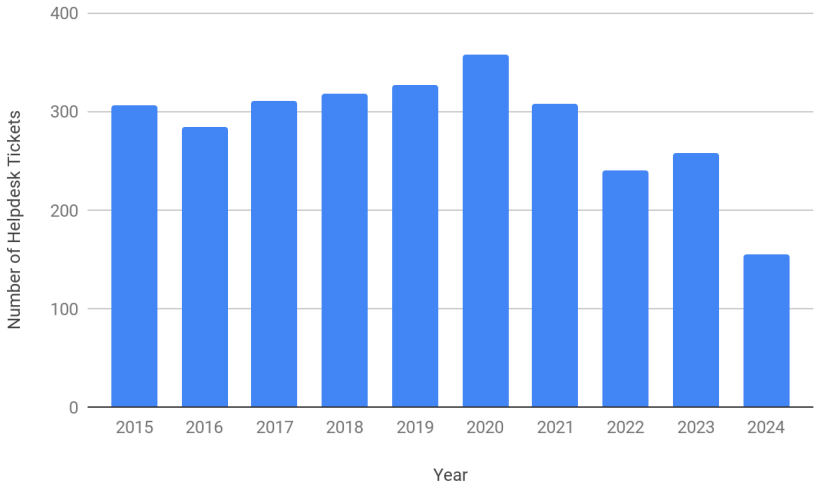
Helpdesk Stats

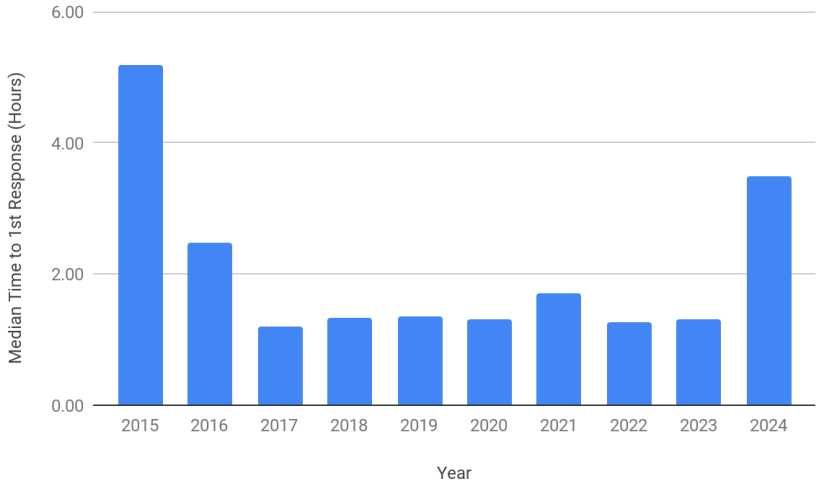
	2022-10-01 to 2023-09-30	2023-10-01 to 2024-09-30
Time period [months]	12	12
Number of TIckets	261	208
Median time to 1st contact [hrs]	1.42	2.17
Median time to close [hrs]	13.67	19.77
Maximum time to close [hrs]	1346.4	786.6

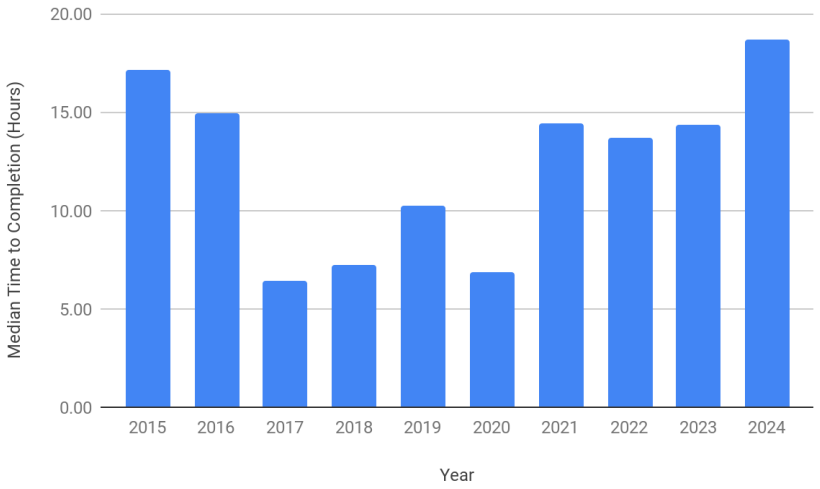
Longest ticket was for user who was unable to download CIAO due to network timeout problems. Previously we were able to point users to alternative download site (Google Drive folder); however, with conda/new ciao-install this required intervention by DS to provide instructions on how to download and install manually.

This information is now part of the ciao-install thread.

Long Term Helpdesk Trends







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Bugs from Helpdesk

- new ciao-install setting LD_LIBRARY_PATH messes up user's environment
- srcflux
  - problem computing optimized regions for off-chip positions
  - getting coordinates from an input file with coordinates in sexagesimal format
  - combining observations with 0th order gratings
- specextract failure when creating weighted responses but region contains 0 counts in energy range.
- merge_too_small treating 0 counts like 0 area
- combine_grating_spectra when type:II pha does not contain background
- install on unsupported platform (no warning)
- dmimghull crash when all pixels are Null/outside-of-subspace

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Community

Community

- Jan AAS: Various staff supported

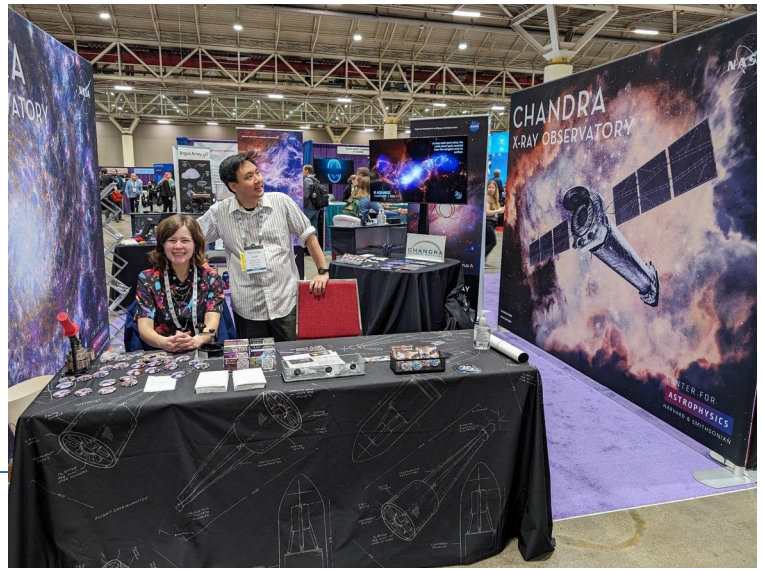
Chandra booth as part of new CfA megabooth

- Katie Cranmer supported June AAS

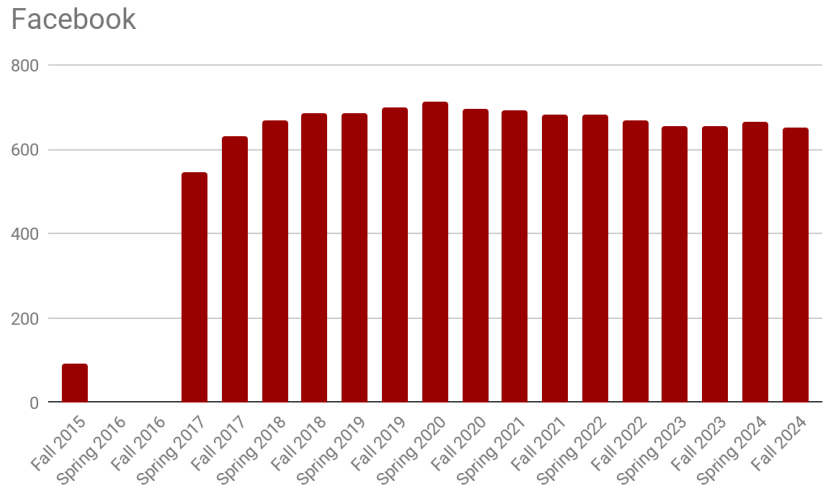
- Chandra Newsletter, Issue 34,

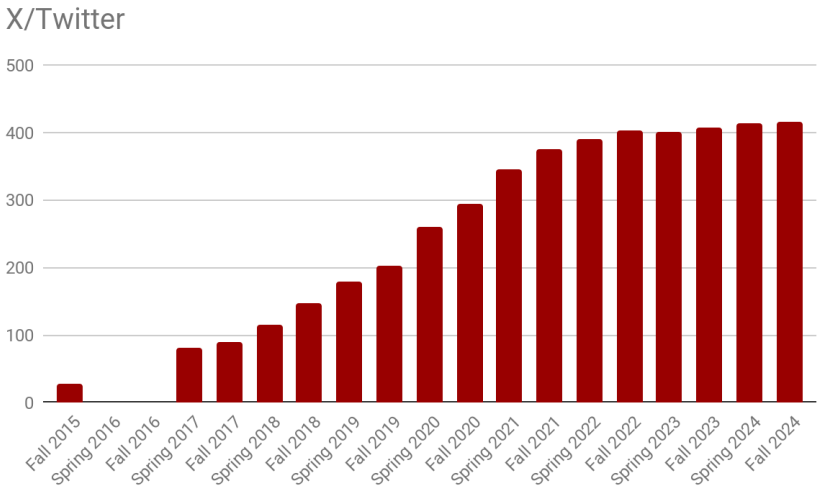
The CIAO Contributed Scripts: Always Improving, Fruscione, Glotfelty, Lee for the CIAO team

- CfA Demofest



Social Media





Facebook	651 (-13)
X	415 (+2)

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CIAO 4.16 and Scripts Overview

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CIAO 4.16 - December 12, 2023

Highlights

- Native support for macOS-arm processors (M1/M2/M3)
- New ciao-install script to support conda-only installation method
- a_p_e improved temperature dependent CTI corrections (requires CALDB 4.11)
- tgextract and mkgrmf updates for higher order EEFrac corrections when using non-standard extraction regions.
- dmextract (and others) now copy WCS from input image to output tables.

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CIAO 4.17

Drop support for multiple versions of Python; will only support 3.11.

Bug Fixes

- Fix setup script to omit (DY)LD_LIBRARY_PATH
- wcs_update when infile and wcsfile are same file (quietly yields no update)
- wcs_match crash when 0 matching sources
- pixlib issues causing truncation when casting negative numbers
- aconvolve fix for byte type images

Maintenance

- Python changes: pytransform update for deprecated "imp" module
- Updates to support newer compilers: vtpdetect, h_p_e, pixlib, etc
- Changes related to CFITSIO updates to support longer keyword descriptions/comments

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Contributed Scripts

4.16.0 - 12 December 2023

- new energy_hue_map script to create true-color images
- assortment of new adaptive binning routines and utilities to support energy_hue_map script
- srcflux now has option to create point-source optimized regions akin to acis_extract
- spectract improved support for MARX event files.
- blank sky scripts use the new CHKVFPHA keyword (if present) to determine of very-faint mode background filtering applied.

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Contributed Scripts - continued

4.16.1 - April 2024

- updated search_csc and obsid_search_csc to default to CSC2.1
- srcflux fix problem using method=optimized for positions outside the field-of-view.
- sherpa_contrib.notebook_plotter module: provides interactive control over Sherpa model settings within a Jupyter notebook

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Contributed Scripts - continued

4.16.2 - August 2024

- chandra_repro
  - fix for early, pre repro-4 data
  - add support for OBC mode (Earth and Moon obs)
- specextract : fix for 0 counts in region when creating weighted responses
- srcflux
  - fix for combining 0th order grating observations
  - fix for long/complex region expressions
  - fix when pos=filename, which contains RA and DEC values in sexagesimal format (ie strings) rather than decimal degrees.
- download_chandra_obsid: fix to support mirror archives
- sherpa_contrib helper module to create diagonal responses matching a variety of X-ray instruments.

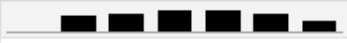
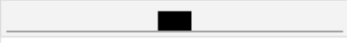
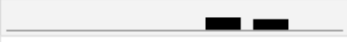
Post Apocalypse Planning

Documentation: ensure pages can be downloaded and still maintain internal links

- ensure relative links
- make explicit links to default pages (eg index.html)

Reviewed Standard Data Processing issue

- Identified most common processing issues in the past few years and what would be needed to support users (Docs, Scripts, etc.).

Issue Number	Summary	Total	Class	2018 through 2024 (log scale)	Notes
95	Corrupted ACIS bias value	336	bias		**Needs script/thread**
9	Error in aspect image reconstruction	204	aspect		**Needs eval**
183	ACIS bad pixels	87	badpix		warm temps, more badpix, review thread (needs new example)
190	Incorrect SAMP values in HRC-I event files	36	data		Fixed in DS release
55	Incorrect 0th-order position in grating obs	33	grating		Have thread
129	Inaccurate coordinate in star catalog	16	aspect		**Needs eval** (bad pos leads to poor aspect solution)
187	Incorrect DELTPHA in ACIS T-GAIN	14	caldb		Fixed in CALDB

Started cross training on ds9 maintenance; submitted 2 proposals for non-CXC support.

Docs: Toward end of mission

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We are beginning to adjust our docs with long term archiving in mind.

We use the same code and approach for the CIAO, Sherpa, CALDB, and CSC web pages on the CXC site:

- a "versioned" URL (e.g. ..... /ciao4.16)

as the primary storage location and

- a "version-free" URL (e.g. ...../ciao)

which is the one users normally go to.

Internal links generally are relative links rather than absolute ones, including links to css style files

This lets us make a tar or zip file of the site that can be transferred to a local directory on a user's computer to be viewed
in a web browser locally, even if cxc.harvard.edu is not available

We are making some minor changes (explicitly link to .../index.html, adapt header and footer text etc.) to ensure this will now work robustly

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Sherpa

Sherpa Development 2024

Sherpa Releases:

- 4.16 December 12, 2023 - in CIAO - include the 2023 Sherpa development
- 4.16.1 May 21, 2024 - standalone Python release

Sherpa 4.16 and 4.16.1 Highlights:

- Enhancements:
  - New plotting backend Bokeh (for web display, interactive display) - users have a choice of matplotlib or bokeh
  - Several plotting changes:
    i. support for splitting model expression into additive components and plot the results;
    ii. support of log scale axes for confidence plots;
    iii. improved error messages for unavailable plot backends
    iv. improved RMF plot display to allow choice of energy units
- Documentation changes:
  - Improved documentation for fake_pha, fixing links, and ReadTheDocs pages to match the code.
- Infrastructure changes:
  - revamp of plotting backends from modules to classes and adding support for multiple backends
  - changes to use the NumPy random generator API
  - support of Python 3.11 and continue to support 3.9 and 3.10
  - supported versions of Xspec are 12.12.0 - 12.13.1e
- Several bug fixes:
  - various updates to notice/ignore and group/ungroup code
  - fixed issue with show_bkg, binning in 1D histogram, cache errors in TableModel class, multi-panel plots

- *85 (46+39) Sherpa Pull Requests (PR) in these two releases*

Full Release Notes:

- *https://github.com/sherpa/sherpa/releases*

Sherpa Development 2024

Sherpa 4.17.0 Release - October 8, 2024

Python standalone release to be included in the CIAO 4.17 in December 2024.
CIAO release will contain 4.16.1 and 4.17 updates.

4.17.0 Highlights:

- Enhancements:
  - add calc_model() and calc_source() functions to return an evaluated model/source arrays
  - added wstat to plot_pvalue for the likelihood ratio test
  - Xspec updates:
    i. support models in Xspec 12.14.0
    ii. changed model interface to use C++ instead of Fortran
    iii. Added show_xsabund, get_xsabundances, and set_xsabundances
  - reviewed and improved support for PHA data starting at channel 0
  - improved guess for complex models
  - several updates to enhance plotting capabilities and layout
- Documentation changes:
  - added references to the new ApJSuppl paper Sherpa: an Open Source Python Fitting Package
- Infrastructure changes:
  - Experimental support for Python 3.12 and continue to support 3.10 and 3.11
  - supported versions of Xspec are 12.12.0 - 12.14.0
- Several bug fixes:
  - fixed an issue with plotting 1D data with asymmetric errs after filter
  - Include the default identifier in save_all output if it has been changed

- *68 Sherpa Pull Requests (PR) in this release*

Full Release Notes (on the day of the release):

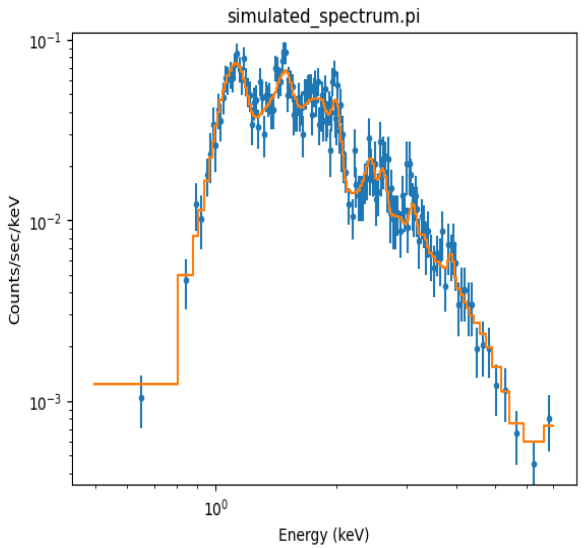
- *https://github.com/sherpa/sherpa/releases*

Sherpa Visualization

Two Plotting Backends

Matplotlib - default

```
[7]: ui.set_plot_backend("pylab")

[8]: ui.plot_fit(xlog=True, ylog=True)
```



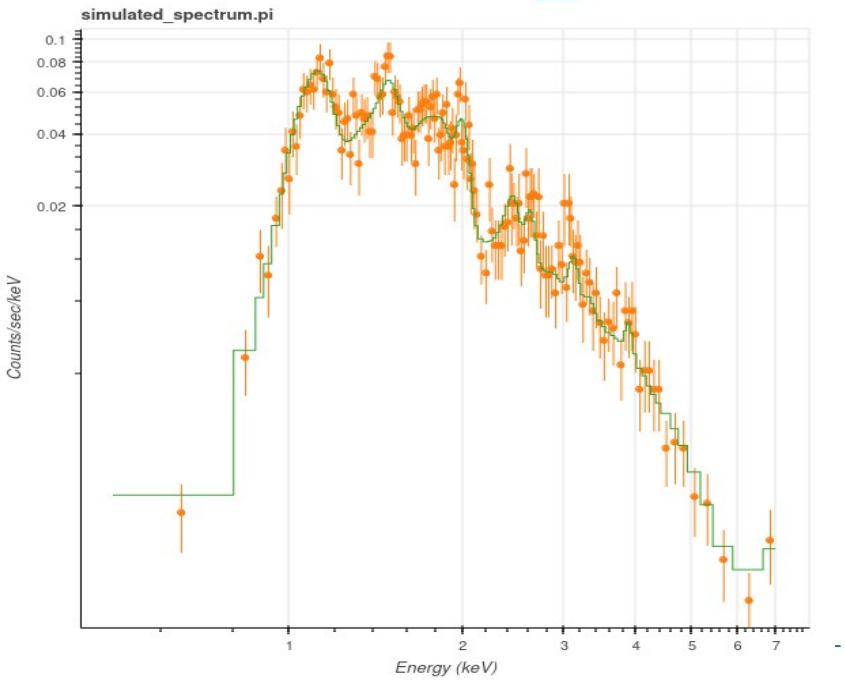
Bokeh - experimental

```
[9]: ui.set_plot_backend("BokehBackend")

[10]: from bokeh.io import output_notebook
      from bokeh.plotting import show
      output_notebook()
```

BokehJS 3.4.1 successfully loaded.

```
[11]: from sherpa import plot

[12]: ui.plot_fit(xlog=True, ylog=True)
      show(plot.backend.current_fig)
```

Interaction options



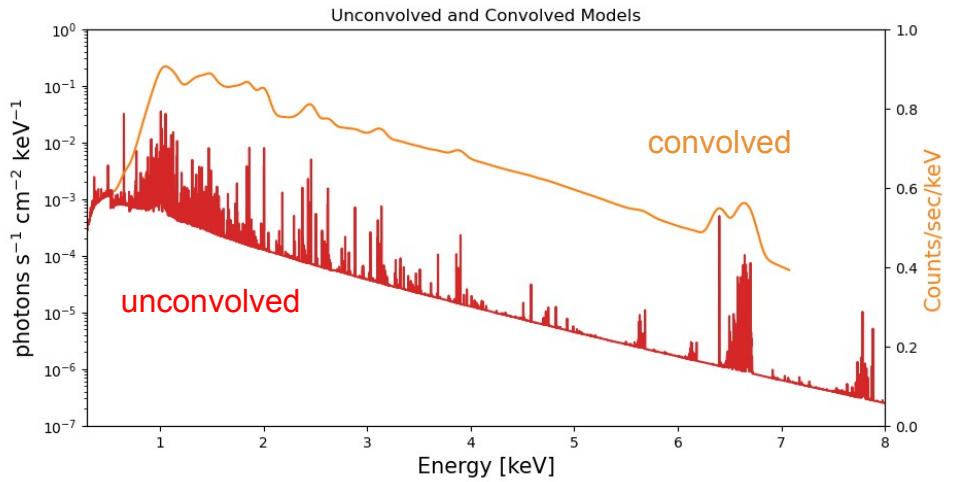
Sherpa Visualization

Interactive Analysis Model Spectra

Python module added to the CIAO contributed scripts in April, 4.16.1 release to interactively edit model parameters when using a Jupyter notebook.

This code was written taking advantage of Sherpa's capabilities but did not require any changes to Sherpa itself. This is an example of a contribution to Sherpa that users can provide.

```
set_source(test_model_4)

notebook_plotter(test_model_4, log_axis = 'ylog', autoscale = 'none',  plot_type = 'both_models', xlim_low = 0.3, xlim_
```



Plotting Options

resolution	0.001
autoscale	none
xlim_low	0.3
xlim_high	8
ylim_low	1e-7
ylim_high	1
log_axis	ylog
plot_type	both_models
figsize_x	10.00
figsize_y	5.00

Model Parameters

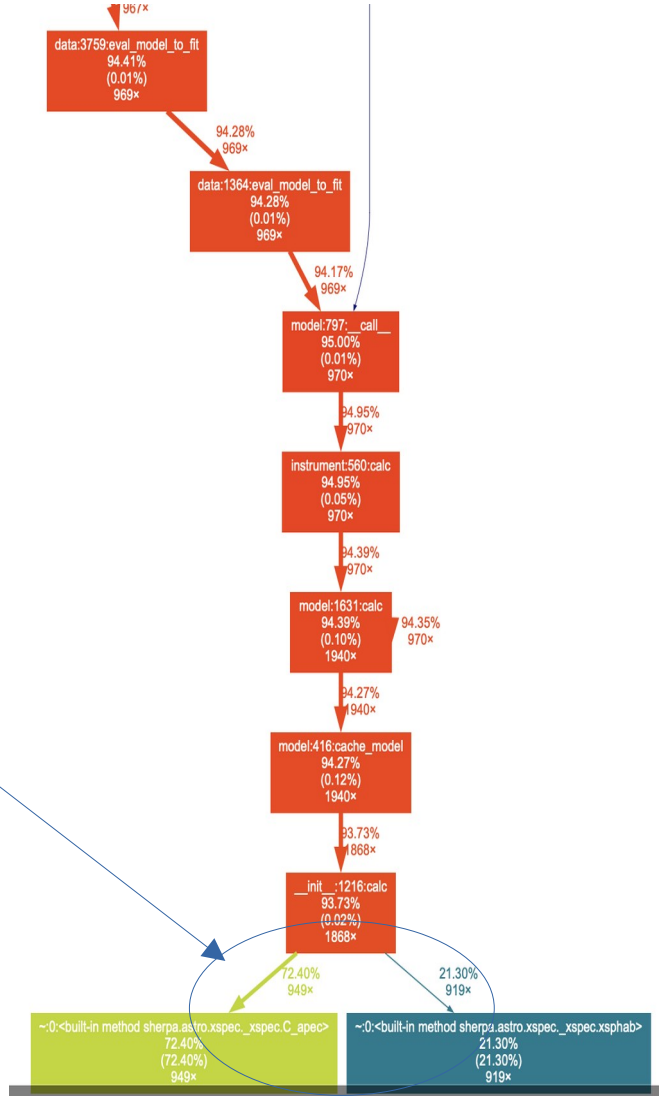
ma4.nH	0.10
p4.kT	1.30
p4.Abundanc	0.50
p4.redshift	0.00
p4.norm	0.003
g4.LineE	6.40
g4.Sigma	0.00
g4.norm	5e-7

Absorbed APEC model

Change parameters to visualize models

Sherpa performance

- Benchmarking of common X-ray fitting shows that Sherpa fits spend >90% of the time in XSPEC model calls.
- The one and only way to speed up sherpa is to call XSPEC less, by making better use of caching.



Sherpa performance

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- Benchmarking of common X-ray fitting shows that Sherpa fits spend >90% of the time in XSPEC model calls.
- The one and only way to speed up sherpa is to call XSPEC less, by making better use of caching.
- Example: XSPEC model phabs calculates:
  M(E) = exp (-N_H sigma(E))
  evaluating sigma(E) is expensive, but we can evaluate it just once for a fiducial value of N_H, cache the result and use Python for exp(-N_H * cached_value).
  That way, the XSPEC model is called only one.
- Status: Implementation ongoing, need to carefully select fiducial N_H
- Other example include: Changes in normalization or partial covering factor.

Using Sherpa in Astronomy Research

1683 publications in ApJ, AJ, MNRAS, A&A and others use Sherpa (since 2001 and including astro-ph abstracts)
https://ui.adsabs.harvard.edu/public-libraries/X6orMXwpRtSPy8x1uiiRMg

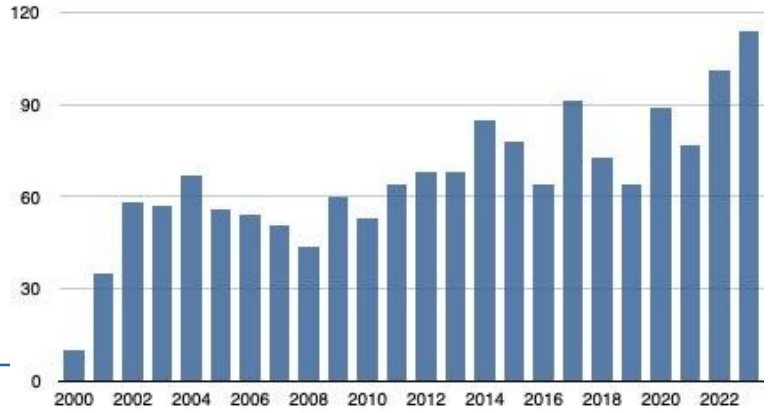
463 citations to Freeman et al 2001 SPIE paper
90 citations to Doe et al 2007 ADASS paper on Python implementation

50 citations to zenodo releases: DOI: *10.5281/zenodo.593753*

105 research papers published in 2024

7 PhD theses listed in ADS that used Sherpa

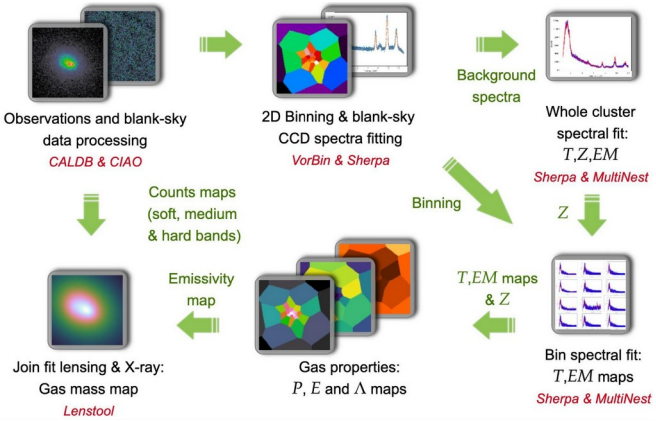
2001-2023 Statistics from ADS



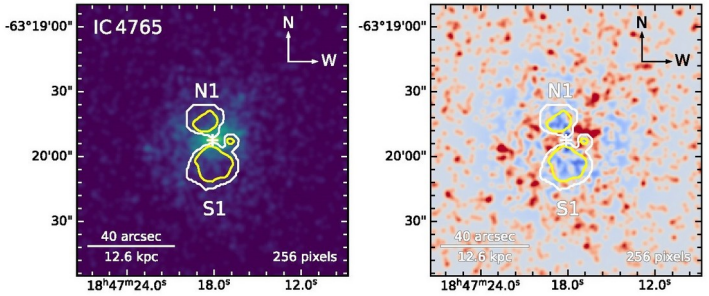
Using Sherpa in Astronomy Research

Recent Examples:

Sherpa incorporated into a **pipeline for modeling a mass of a gravitational lens** with X-ray, lens and galaxy kinematics data
in application to the analysis of Hubble Frontier Field Cluster Abell S1063.
(Beauchesne et al (2024) doi: 10.1093/mnras/stad3308)

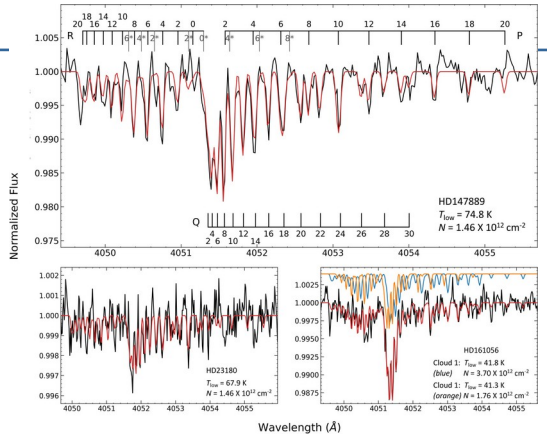


X-ray image of a galaxy IC4765. The image of the residuals from a Sherpa **2D-beta-model fit to the image**. The contours mark the deficit in the surface brightness detected by CaDeT a new ML algorithm.
(Plsek et al (2024) doi: 10.1093/mnras/stad3371)

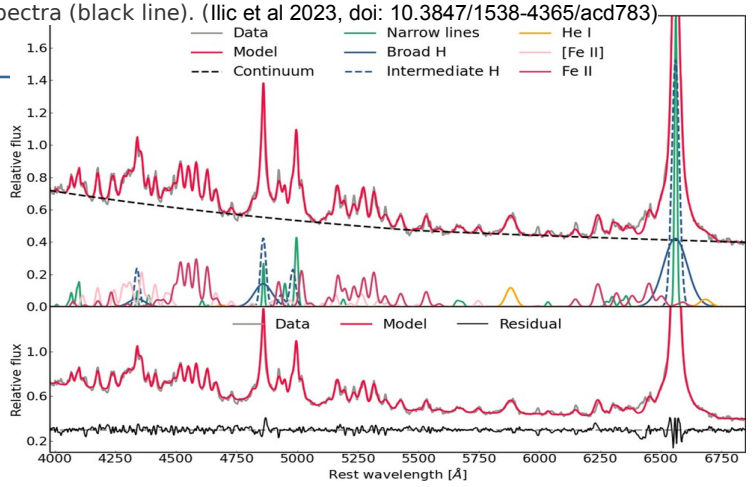


EDIBLES Survey: Sherpa used to fit spectra to study molecular lines C2 and C3 in ISM clouds. (Fan et al (2024) doi: 10.1051/0004-6361/202243910)

C3 in three representative sightlines. Top panel: HD 147889 - The transitions are all labelled, including those to the original and the perturbed upper energy levels Bottom panels: The C3 is tentatively detected towards HD 23180. The sightline of HD 161056 contains two velocity components, plotted with a positive offset in different colours.



Multicomponent fitting with the **fantasy** (includes Sherpa) of the I Zw 1 **SDSS spectrum** (gray line) The model (red line) consists of a broken power law (black dashed line), narrow lines (green solid line), broad (blue solid line) and intermediate (blue dashed line) components of the Balmer lines (Hα, Hβ, and Hδ) and He I lines (yellow line), intermediate components of [O III] (blue dashed line), the Fe II model (dark red line), and [Fe II] lines (light red line). The bottom panel shows a zoomed-in view of the observed (gray line), model (red line), and residual spectra (black line). (Ilic et al 2023, doi: 10.3847/1538-4365/acd783)



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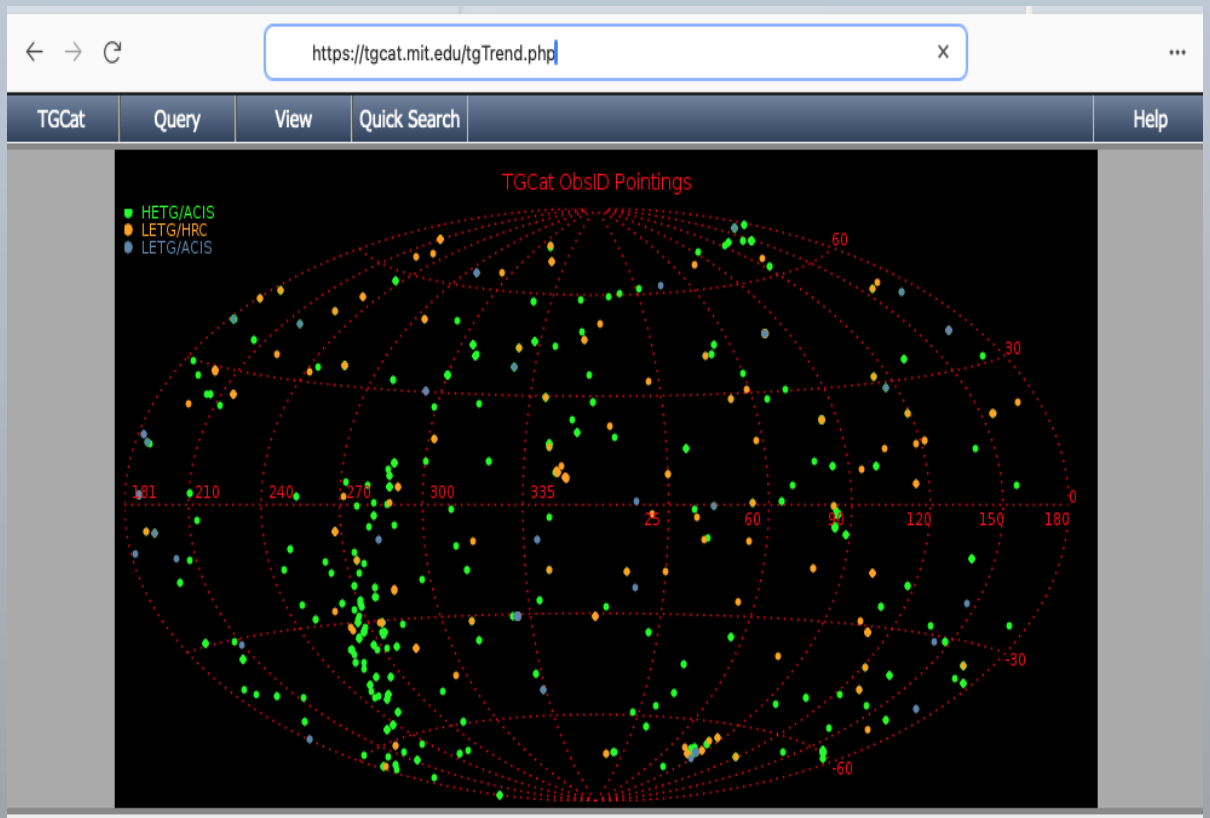
Instruments/ Gratings

HRC: We are working on a script to fix the HRC secondary science corruption (SSC) --- basic algorithm looks OK as per HRC team review.
Next step is to make it look like a tool in our contrib area, and have it for application during V&V, and eventually in the pipeline.
(SSC makes it look like there are big data dropouts, but the data are there and one just needs to identify the times and update the GTI info)

High-T observations (mostly with gratings): modified the V&V statement (reviewed decision tree from Cal).

Chandra HETG and LETG Spectra on TGCat

TGCat trends (as reported by tgcat.mit.edu):



Observations		Exposure (s)		ZO method		Archive	
Total Obsids:	2858	Min Exposure:	40	tgdetect2:	141	Total Archived Files:	97467
Distinct Sources:	582	Max Exposure:	189,255	tgdetect:	1323	Total Archive Size (GB):	534.93
ACIS HETG Observations:	1962	Mean Exposure:	38,322	none:	1081	Space per Obsid (MB):	191.66
ACIS LETG Observations:	321	Cumulative Exposure:	109,522,873	findzo:	313	Ave File size (MB):	5.62
HRC LETG Observations:	575					Number Distinct File Type:	8
ACIS CONTINUOUS Mode	176						
ACIS TIMED Mode	2107						

TGCat Merging and Unfolding of Spectra:

23 HETG observations of NGC 4051 (1 Ms): merged,unfolded

tgcat.mit.edu

TGCat | Query | View | Actions | Help Topics

---- currently viewing extr

+/-	Links	obsid	object	instrument	grating	ra (h:m:s)
☑	opvs	17105	NGC 4051	ACIS	HETG	12:03:09.619
☑	opvs	17102	NGC 4051	ACIS	HETG	12:03:09.605
☑	opvs	18768	NGC 4051	ACIS	HETG	12:03:09.636
☑	opvs	859	NGC 4051	ACIS	HETG	12:03:09.612
☑	opvs	18769	NGC 4051	ACIS	HETG	12:03:09.612
☑	opvs	18785	NGC 4051	ACIS	HETG	12:03:09.596
☑	opvs	18786	NGC 4051	ACIS	HETG	12:03:09.628
☑	opvs	17103	NGC 4051	ACIS	HETG	12:03:09.646
☑	opvs	17104	NGC 4051	ACIS	HETG	12:03:09.602
☑	opvs	10403	NGC 4051	ACIS	HETG	12:03:09.619
☑	opvs	10778	NGC 4051	ACIS	HETG	12:03:09.619
☑	opvs	10775	NGC 4051	ACIS	HETG	12:03:09.636
☑	opvs	10777	NGC 4051	ACIS	HETG	12:03:09.624
☑	opvs	10779	NGC 4051	ACIS	HETG	12:03:09.612
☑	opvs	10801	NGC 4051	ACIS	HETG	12:03:09.617
+/-	Links	obsid	object	instrument	grating	ra (h:m:s)
☑	opvs	10780	NGC 4051	ACIS	HETG	12:03:09.619
☑	opvs	18787	NGC 4051	ACIS	HETG	12:03:09.629
☑	opvs	10776	NGC 4051	ACIS	HETG	12:03:09.617
☑	opvs	10781	NGC 4051	ACIS	HETG	12:03:09.619
☑	opvs	10782	NGC 4051	ACIS	HETG	12:03:09.617
☑	opvs	18823	NGC 4051	ACIS	HETG	12:03:09.653
☑	opvs	10404	NGC 4051	ACIS	HETG	12:03:09.612	+44:31:52.752	2008-11-12 16:45:46	19989.9
☑	opvs	10824	NGC 4051	ACIS	HETG	12:03:09.624	+44:31:52.932	2008-11-30 04:20:59	9162.39

Set primary sort ; Loaded extractions table: 23 rows; selection limited

tgcat.mit.edu

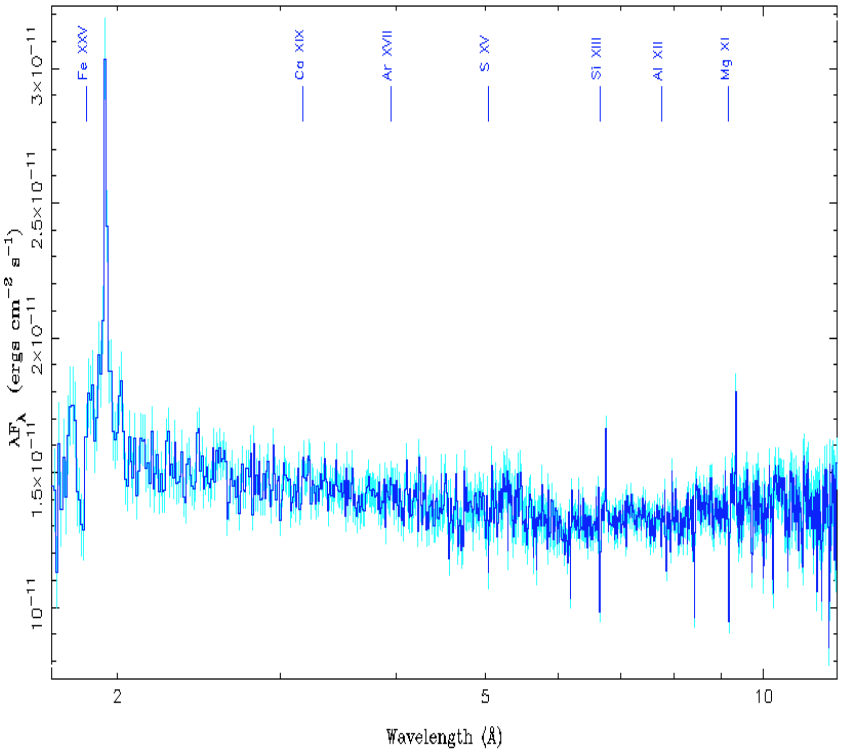
TGCat | Query | View | Help Topics | Help

Multi Preview

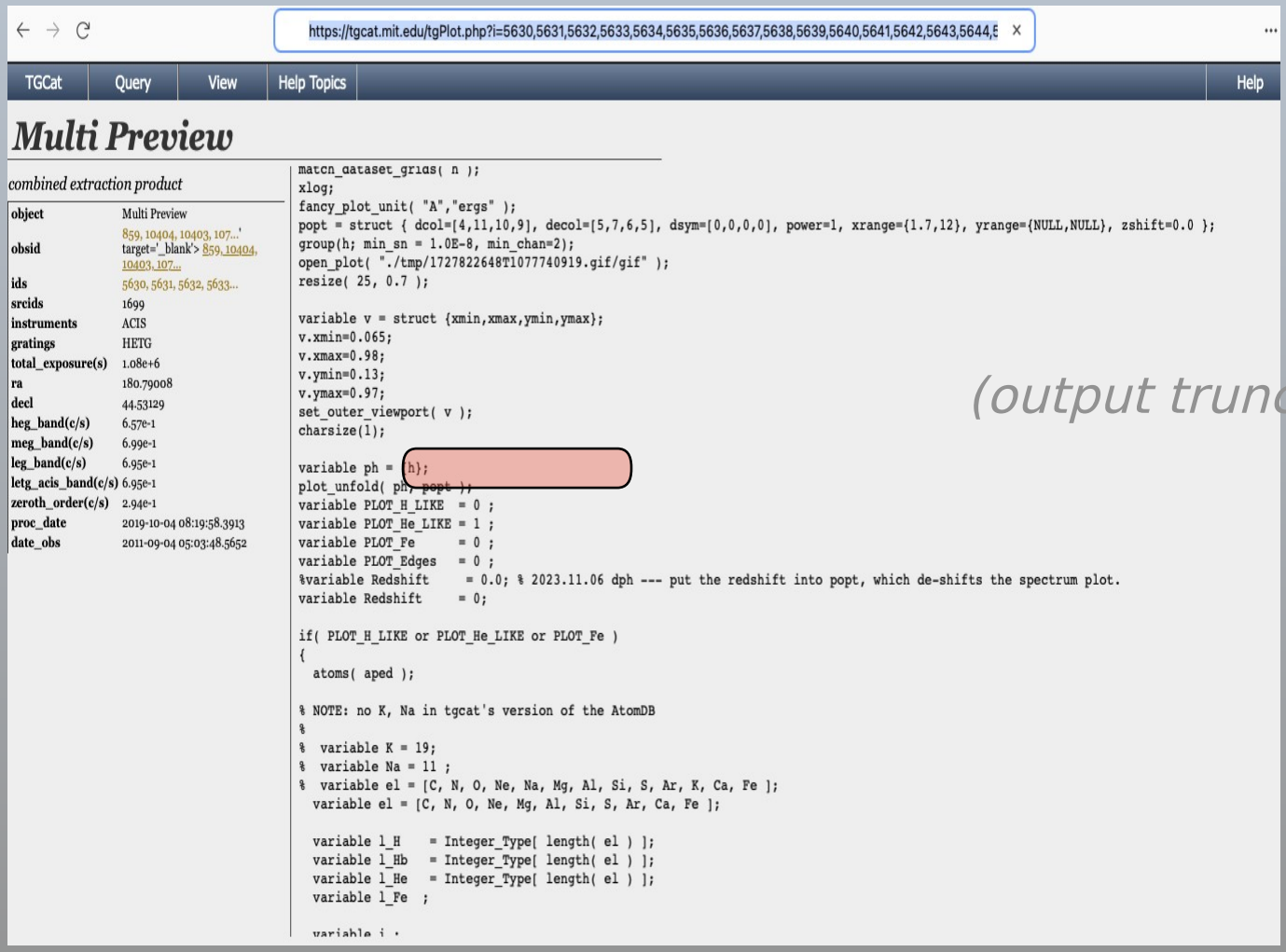
combined extraction product

object	Multi Preview
obsid	859, 10404, 10403, 107...' target='_blank'> 859, 10404, 10403, 107...
ids	5630, 5631, 5632, 5633...
srcids	1699
instruments	ACIS
gratings	HETG
total_exposure(s)	1.08e+6
ra	180.79008
decl	44.53129
heg_band(c/s)	6.57e-1
meg_band(c/s)	6.99e-1
leg_band(c/s)	6.95e-1
letg_acis_band(c/s)	6.95e-1
zeroth_order(c/s)	2.94e-1
proc_date	2019-10-04 08:19:58.3913
date_obs	2011-09-04 05:03:48.5652

PLOTTING CONTROLS



Pro tips: behind the scenes: *tgcat* optionally provides the ISIS script used to plot the merged, unfolded spectra (View -> Custom Plotting -> ISIS Command File). You can also download the plot as an ASCII table (View -> Custom Plotting -> ASCII Dump) .



(output truncated)

How/Why Unfold?

Example case using XMM/RGS data,
via ISIS' plot_unfold on 800 ks of 18 merged RGS-1 spectra of ζ Puppis (a O-star with wind-shocked emission lines):

Unfolding details coming soon…

Draft version October 1, 2024
Typeset using LaTeX **twocolumn** style in AASTeX631

Unfolding X-ray Spectral Data: Conditions and Applications

Sean Gunderson [1, *] and David P. Huenemoerder [1]

[1] *Kavli Institute for Astrophysics and Space Research, Massachusetts Institute of Technology , 77 Massachusetts Ave., Cambridge, MA 02139, USA*

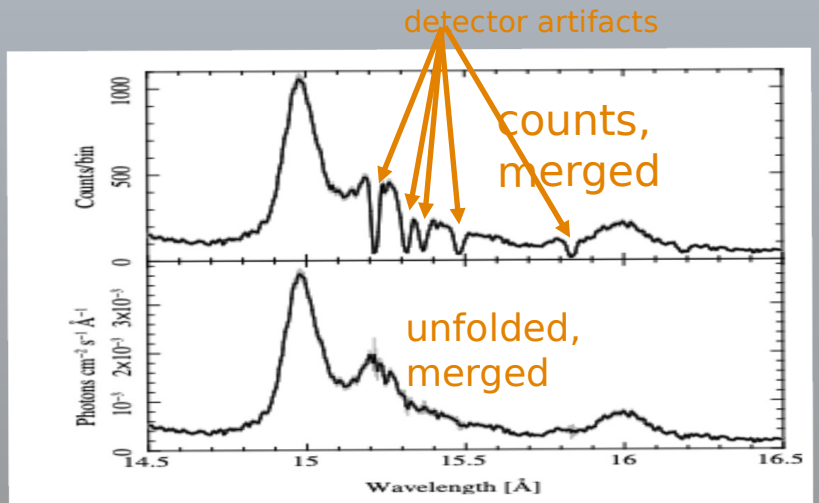
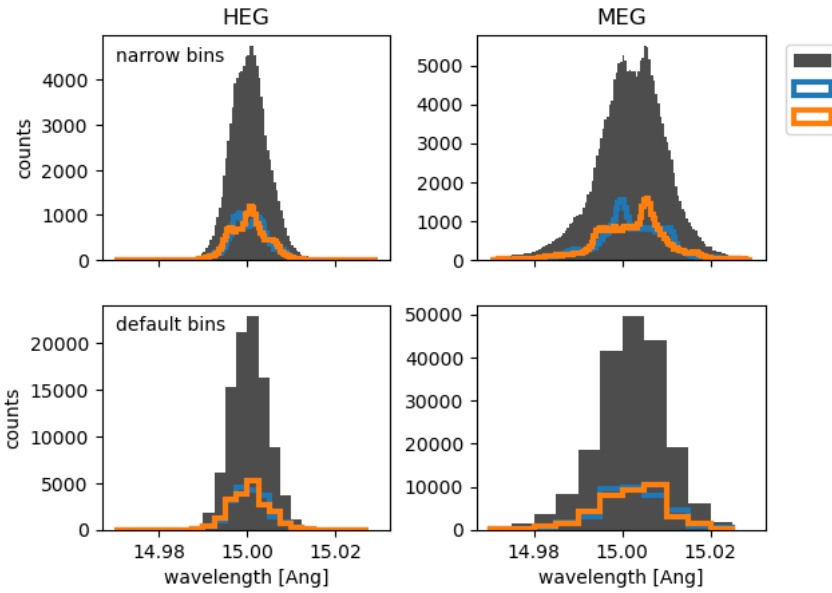


Figure 8. *XMM* This combination of 18 RGS-1 observations, nearly 1 Ms exposure of ζ Puppis, demonstrates how drop-outs in the count spectrum—the prominent dips in the upper panel—which are due to sharp features in the effective area function, are corrected by unfolding (bottom). Statistical errorbars are plotted in gray, but are hard to see, except in the regions of very low counts. The bottom panel is thus an accurate representation of the intrinsic source spectrum.

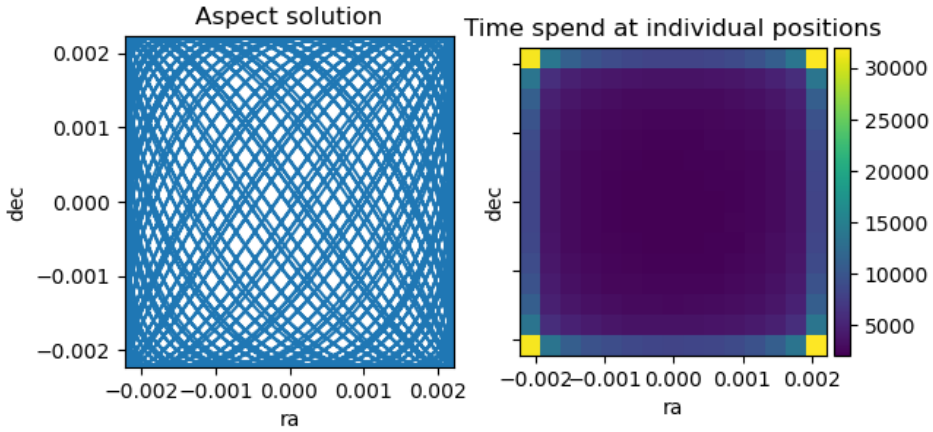
HETG line-spread function

- HETG LSF last updated in 2004 and only for on-axis sources
- Doing marx simulations for off-axis sources
- Noticed that MEG LSF looks double peaked
- MARX simulation at 15A

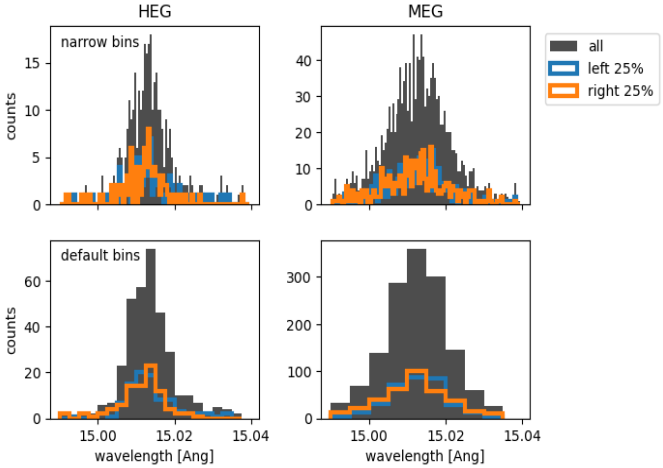


HETG line-spread function

Why double peaked?



We see hints of this in real data, too.



But needs more analysis to confirm.

HETG – MEG LSF

- Double peaks comes from pixelization effect because dither dwell time peaks at very specific locations.
- tg_extract currently used integer pixel positions.
- If using EDSER, could increase R of MEG by ~20%.

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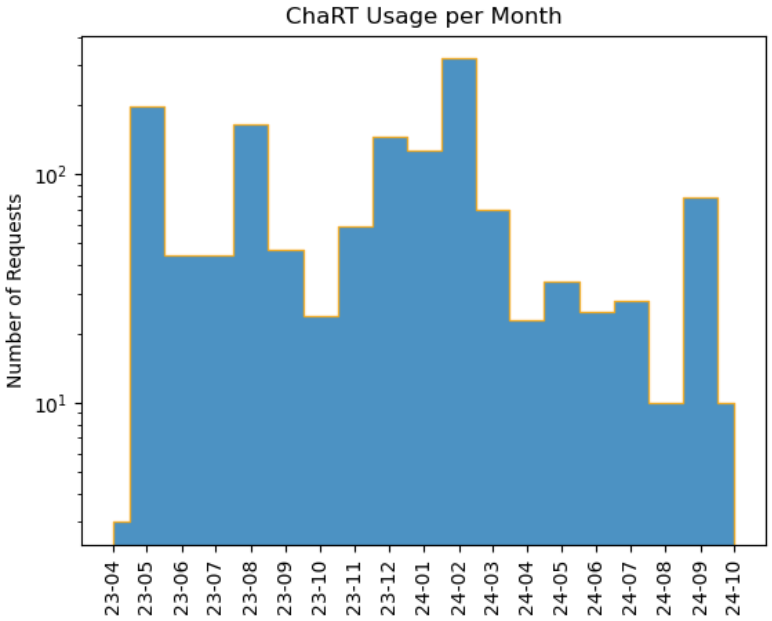
PSF

ChaRT



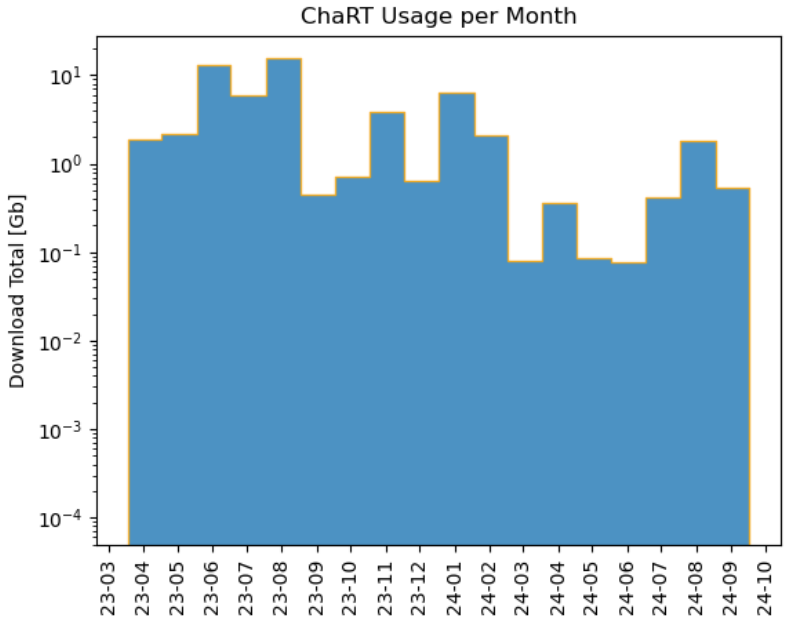


ChaRT updated to CIAO 4.16 with Python 3.11. The cgi module was dropped in Python 3.11 and had to be replaced with custom code.

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Visualization

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SAOImageDS9

Releases

- 03.25.2024 RELEASE version 8.6b1
- 07.01.2024 RELEASE version 8.6b2
- 08.15.2024 RELEASE version 8.6

New Features

- All new reimplementation SAMP HUB and SAMP WEB HUB support which is fully compatible with JSAMP
- New HSV (Hue, Saturation, Value) and HLS (Hue, Lightness, Saturation) color mode

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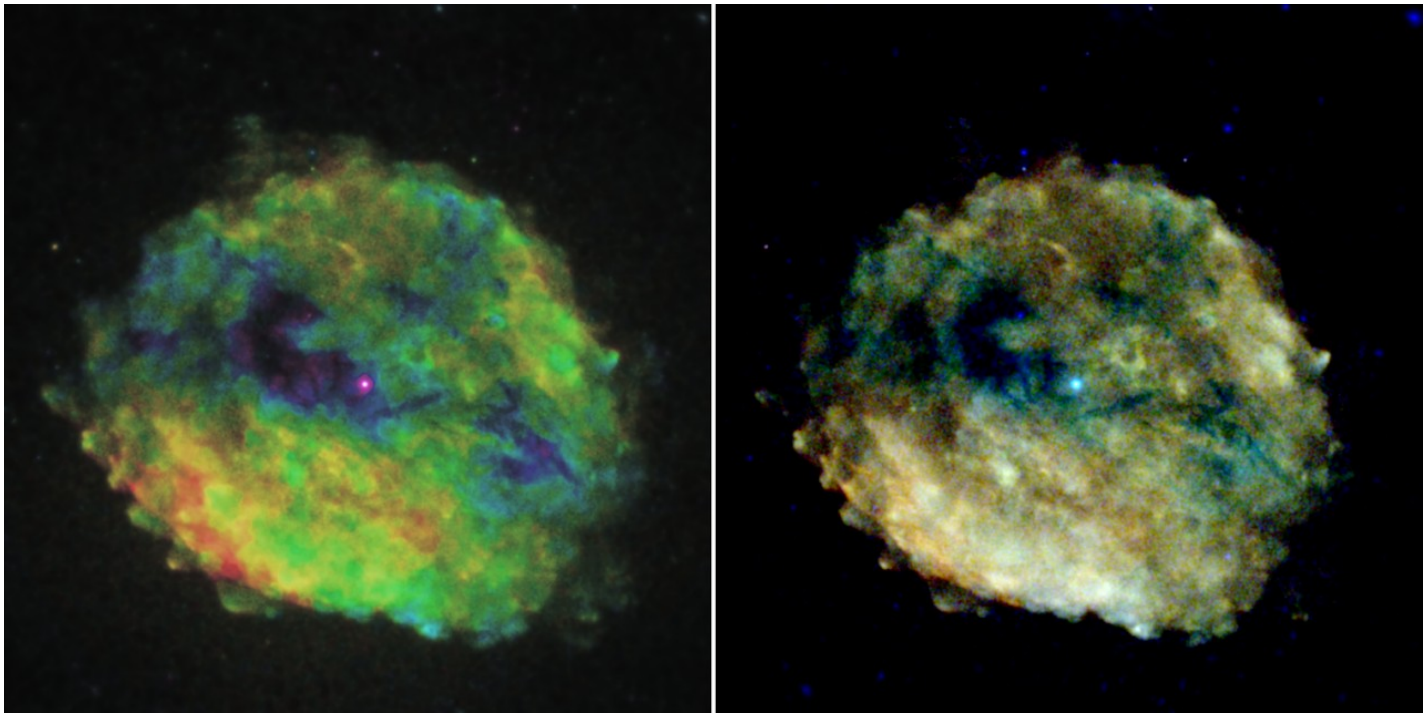
SAOImageDS9

New HSV (Hue, Saturation, Value) and HLS (Hue, Lightness, Saturation) color mode. Fully compatible to RGB mode, user specifies a FITS image for each layer, Hue, Saturation, Lightness, Value.



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SAOImageDS9

DS9 + Astropy Interoperability using SAMP
Control DS9 directly from Astropy using Python
Example: Interactive IMEXAMINE

```
from astropy.samp import SAMPIntegratedClient
ds9 = SAMPIntegratedClient()
ds9.connect()
ds9.ecall_and_wait("c1","ds9.set","10",cmd="url http://ds9.si.edu/download/data/img.fits")
ds9.ecall_and_wait("c1","ds9.set","10",cmd="zscale")
print('Click anywhere in image:')
coord = ds9.ecall_and_wait("c1","ds9.get","10",cmd="imexam wcs icrs")
print('Coordinate is ', coord['samp.result']['value'])
ds9.disconnect()
```

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SAOImageDS9

GitHub Activity

- 65 Release Notes Entries
- 418 Commits

Help Desk

- 106 CXC HelpDesk Requests

Downloads

- 36158 Unique IP addresses

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SAOImageDS9

ADASS 2024 Software Prize Winner

The ADASS Program Organizing Committee is pleased to announce the winner of the annual ADASS Prize for an Outstanding Contribution to Astronomical Software. The 2024 recipients of the prize are:

William Joye and Eric Mandel for their contributions to SAOImageDS9