Chandra X-ray Center

Science Data Systems

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Chandra X-ray Center

Science Data Systems:

- Really: Science Analysis User Support, supporting the users from data download to publication

- CDO supports users in the proposal phase, SDS supports them in the data analysis phase

- Software/algorithm requirements:
  - Support spacecraft-driven changes led by CaI and instruments/operations teams
  - Track and anticipate changing user requirements (new science questions, new algorithms, interoperability with new missions)
  - Grow the Chandra user base by making X-ray data analysis easier for newcomers

- Software testing and validation
- User support: helpdesk, documentation, face-to-face
- "Threads" - cookbook approaches to carrying out X-ray analysis
- Scripts - lowering the bar to entry for astronomers from other wavebands and making standard tasks easier for both newcomers and experts
- Helpdesk – direct support to users' analysis problems
- Workshops and booths – face-to-face software and analysis training for users
- Support for proposal planning tools

SDS Staffing

- Mike Nowak and Glenn Allen left MIT CXC in 2018
- MIT hired Dave Principe and Mel Nynka to replace them

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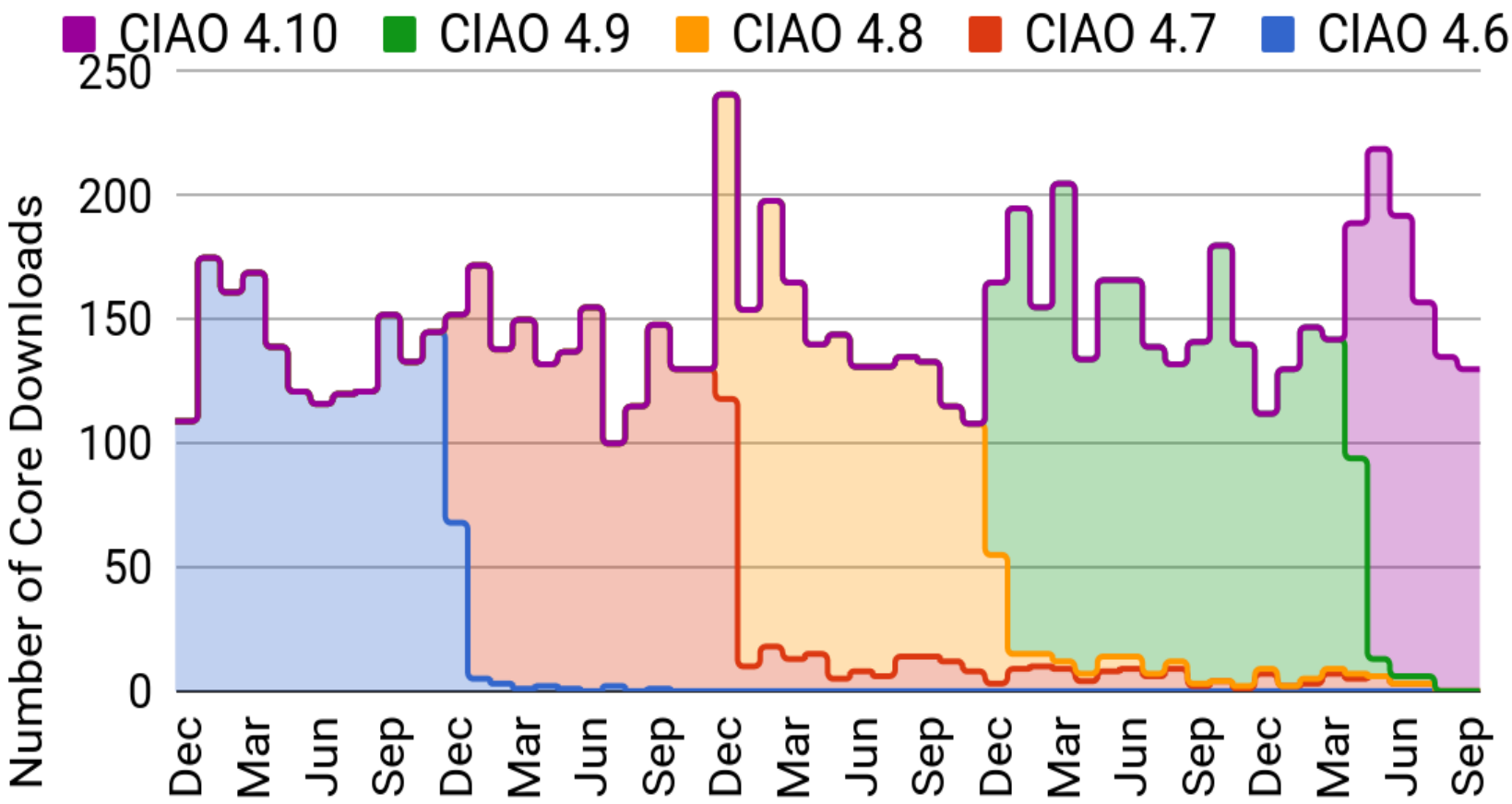
Community Support: Downloads, Documentation, Helpdesk

CIAO Downloads



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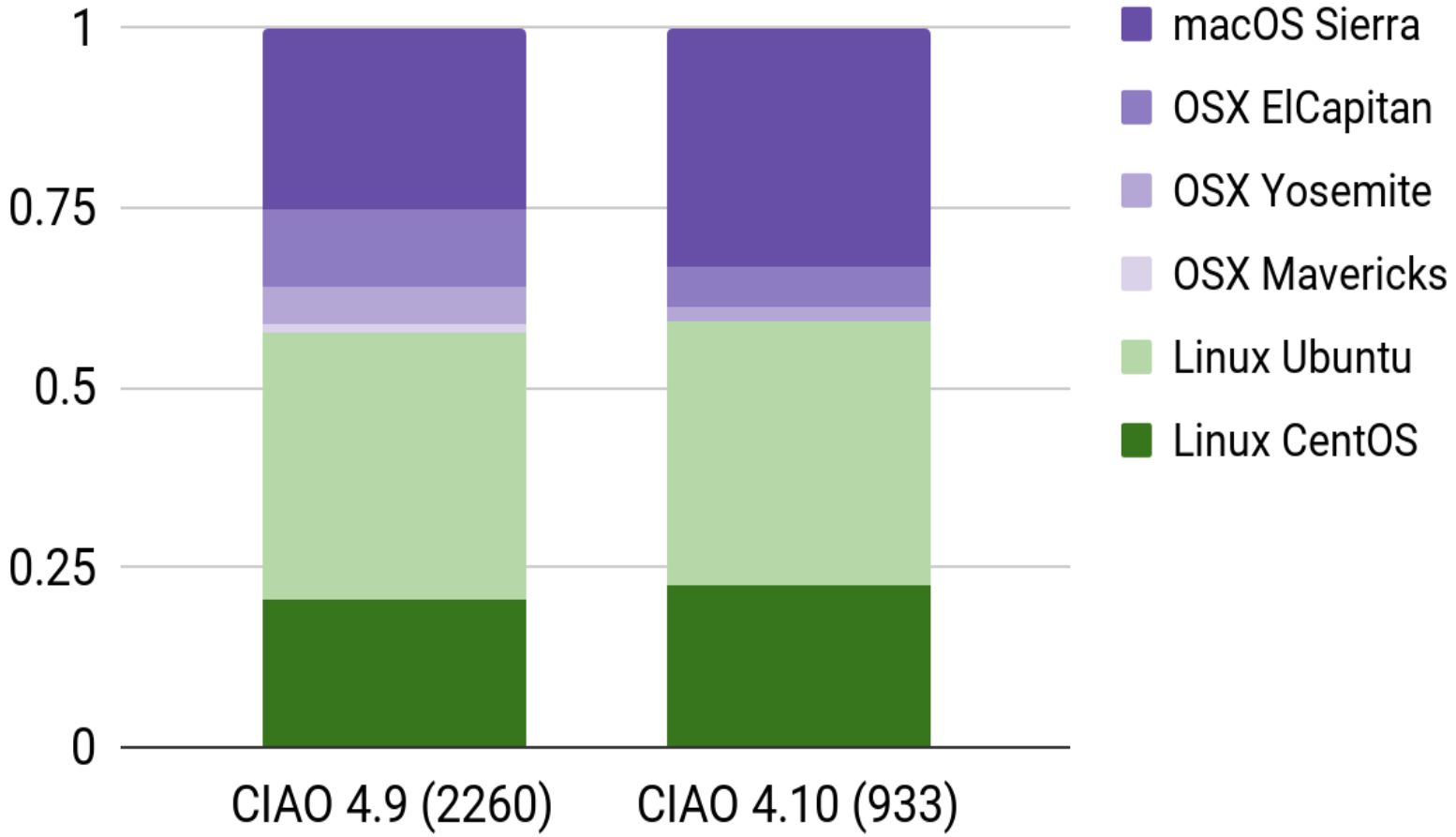
Download by OS



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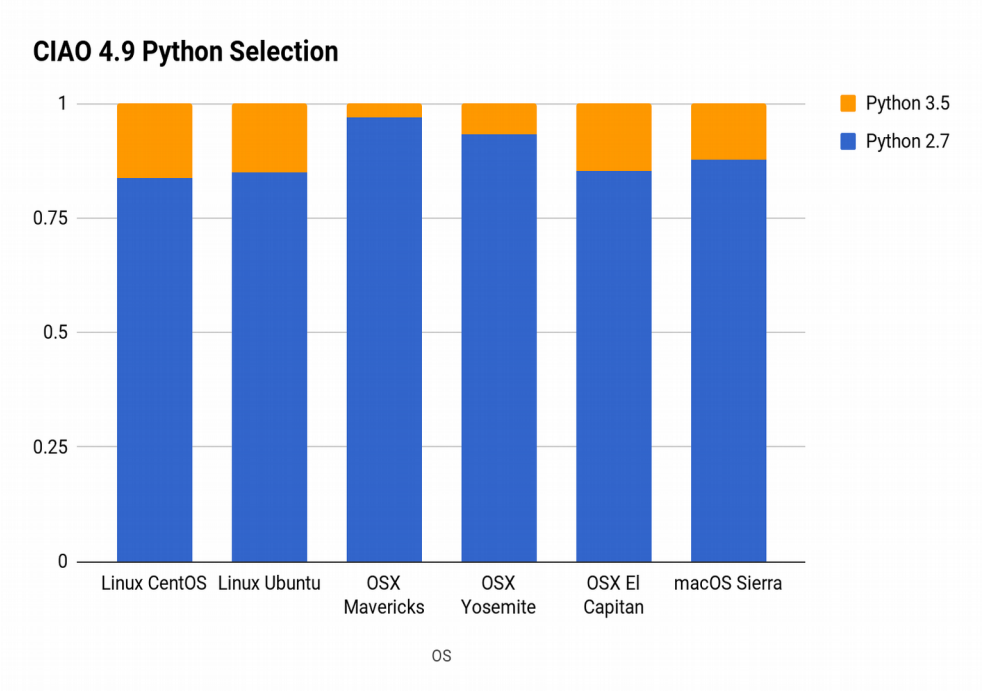
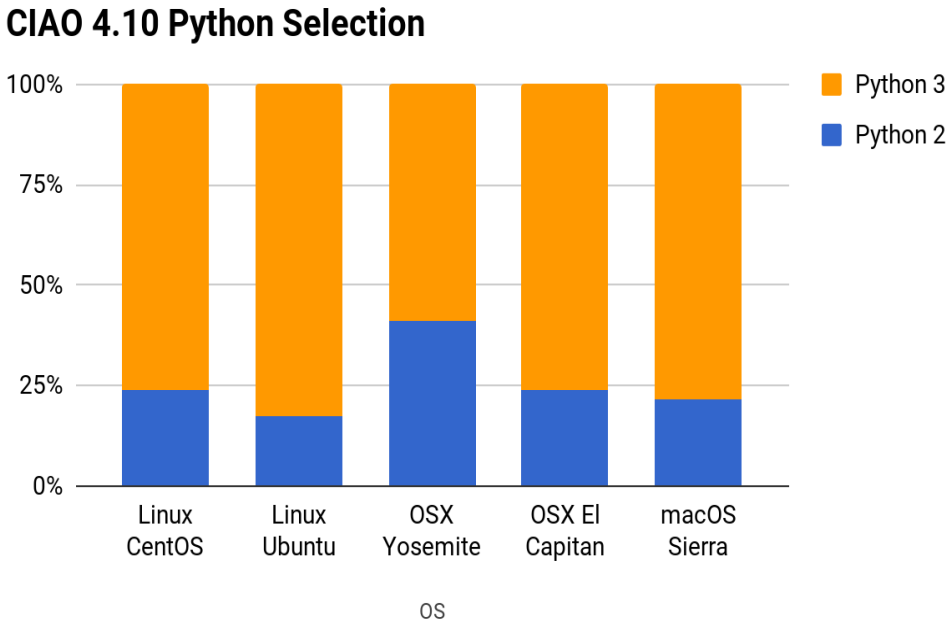
Downloads (lifetime)

	CIAO 4.9 (2016-12-15)			CIAO 4.10 (2018-04-15)		
OS	**Python 2**	**Python 3**	**Total**	**Python 2**	**Python 3**	**Total**
Linux CentOS	389	76	1302	56	154	552
Linux Ubuntu	709	128		58	284	
OSX Mavericks	30	1	959	0	0	381
OSX Yosemite	107	8		9	10	
OSX El Capitan	205	35		12	41	
macOS Sierra	504	69		69	240	
Source			95			26
Total			2356			959


CIAO 4.9 Python Selection
1
0.75
0.5
0.25
0
Python 3.5
Python 2.7
Linux CentOS
Linux Ubuntu
OSX Mavericks
OSX Yosemite
OSX El Capitan
macOS Sierra
OS


CIAO 4.10 Python Selection
100%
75%
50%
25%
0%
Python 3
Python 2
Linux CentOS
Linux Ubuntu
OSX Yosemite
OSX El Capitan
macOS Sierra
OS

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Website statistics: 2018-03-15 to 2018-09-30

	CIAO	Sherpa	Chips
Sessions	36,664	10,017	2,202
Users	12,470	4,235	1,699
Page Views	112,657	26,328	3,801
Duration	5:29	4:17	1:39

Helpdesk Stats

	Fall 2017	Spring 2018	Fall 2018
Number of TIckets	139	158	168
Median time to 1st contact [hrs]	0.95	1.53	0.68
Median time to close [hrs]	10.07	7.54	5.97
Maximum time to close [hrs]	1918.1	722.5	1201.9
% handled by techs	93.5	81.6	88.1

Maximum time was for a student trying to run chandra_repro on dataset with multiple evt1 files. Routine ticket just that user took long time to respond.

Common helpdesk topics

- Increase in number of users reporting download problems (md5sum mismatch for largest files)
- Users requesting 3rd party package integration with CIAO
  - astropy, scipy, pygsl, matplotlib, spyder, jupyter
- Several (unrelated) questions about radial profiles
  - extracting, fitting (including PSF), errors, etc
- Multi-mission usage
  - NuSTAR, XMM/Newton, use MARX with N-body simulation, use dmfilth with radio data, wavdetect on Swift/XRT + Athena/WFI, dmimg2jpg CTIO 4.0m telescope

Examples of Bugs

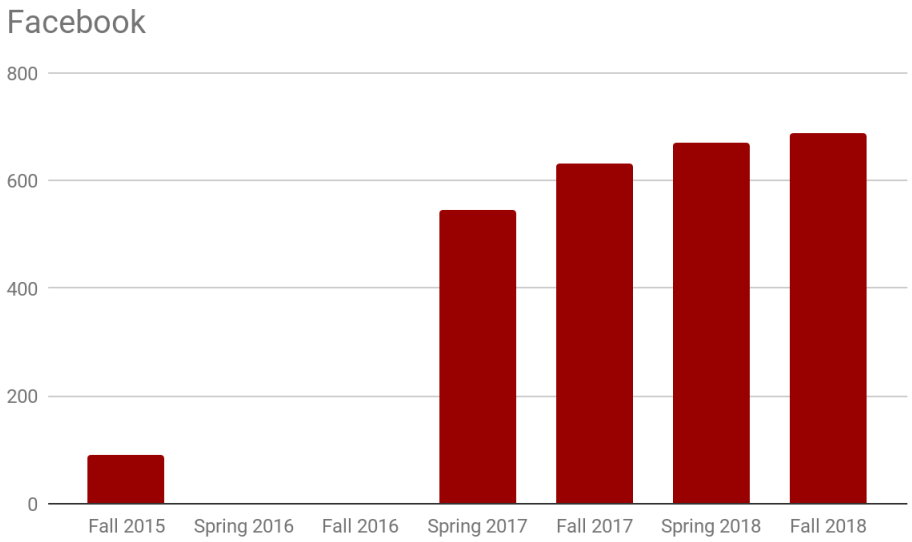
- ciao_install internationalization problem (output from 'df' command in Spanish)
- sherpa sample_flux problem clipping values at 0 when computing median
- addresp problem with SAS (XMM/Newton) response files
- problem downloading all rows and most columns from CSC2 (increased memory)
- mktgresp failing to create both HEG and MEG responses (python3 issue)
- smoke tests on systems without 'make' command installed failing due to PATH issue.

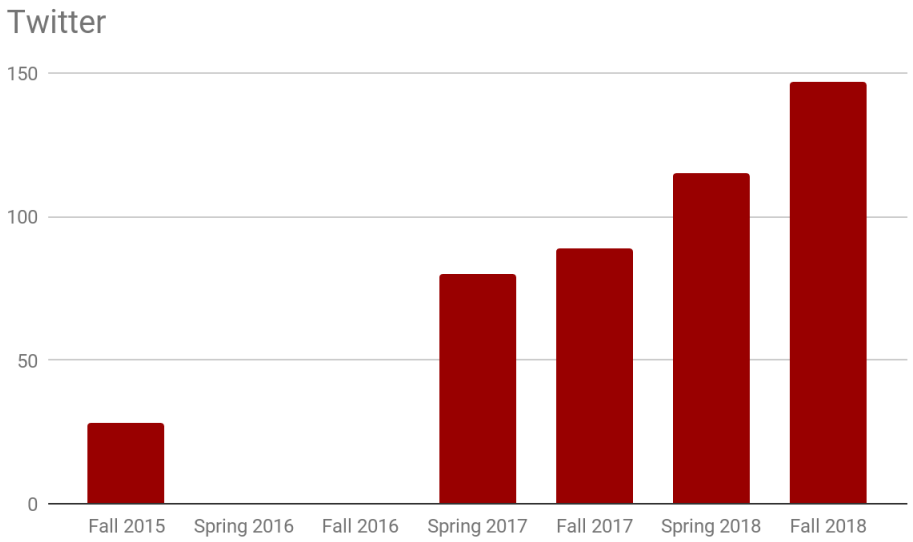
Community

Social Media

Facebook	ChandraCIAO	685 followers
Twitter	@chandraCIAO	148 followers
Google+	Chandra CIAO	15 followers

Long Term Social Media Trends





Community Support

- June 2018, AAS, Denver, CO
- August 2018, Chandra/CIAO workshop, Cambridge, MA
- August 2018, IAU, Vienna, Austria

Planned:

- January 2019 - AAS/Seattle First Chandra/CIAO AAS Workshop
- April 2019 – Possible Chandra/CIAO regional workshop in Crete

2018 Winter AAS, Washington, DC

2018 Summer AAS, Denver, CO

2018 Chandra/CIAO Workshop,
Cambridge, MA

Docs

- CSC2 catalog documentation – major effort
- CIAO pages: mostly routine updates
  - Bug pages updated as issues are identified
  - Sundry thread and help file edits based on user feedback
- New caveat for ACIS-5 FP_TEMP dependent badpixel
- New thread to showcase Pixel Mask functionality to be released with CIAO 4.10
- New thread to showcase aimpoint drift correction for long observations with bright point sources. http://cxc.cfa.harvard.edu/ciao/threads/periscope_drift/
- AAS handout
- Pune workshop
  - New Exercises workbook for students to follow.

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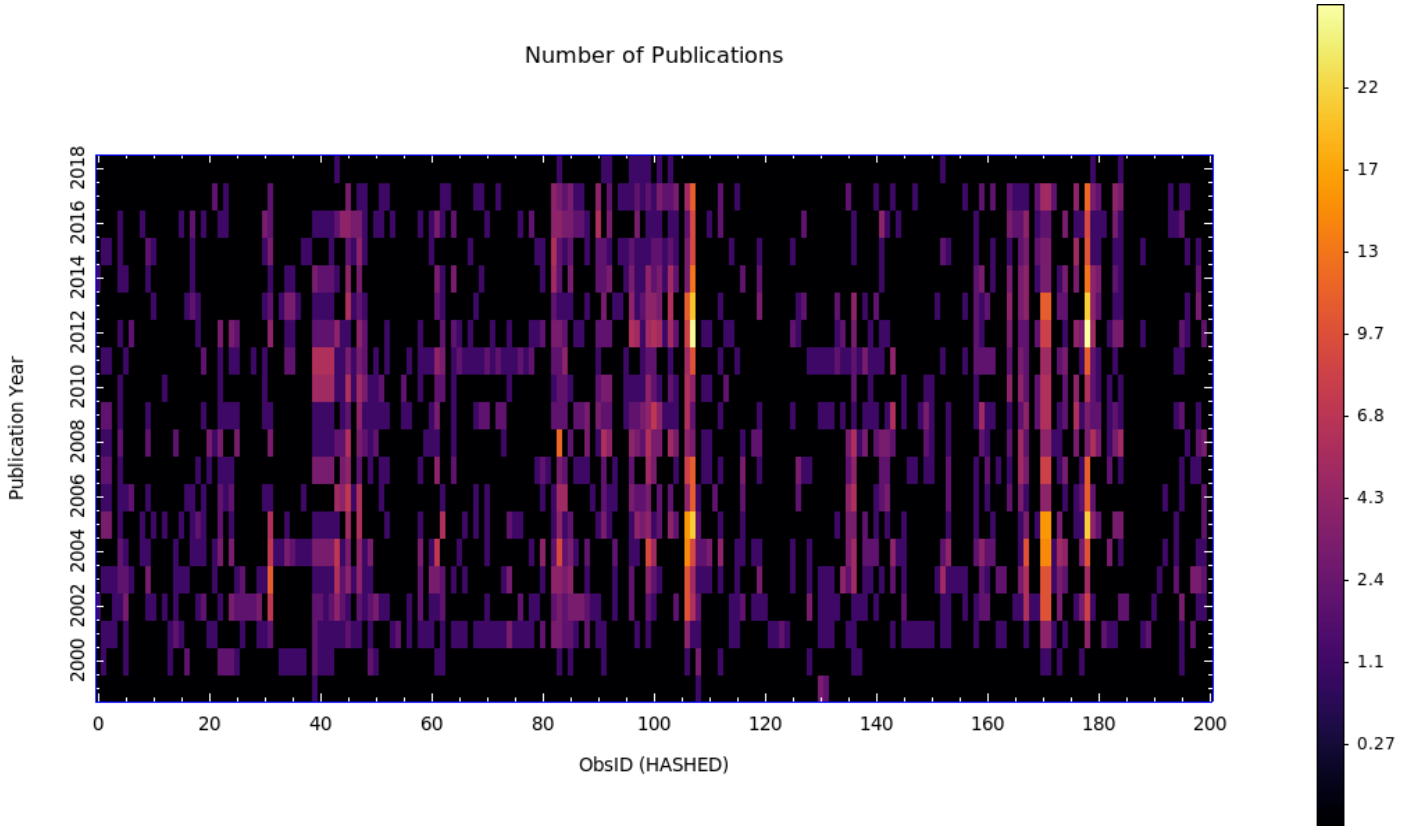
CIAO 4.11 and Scripts Overview

2018 Priorities

- Catalog 2 support
- Planning and support for future archive reprocessing
- CIAO 4.11
  - Planned for December 2018
  - Dropping Python 2
  - Support for retaining HISTORY in scripts via the crates module
  - Various bug fixes and enhancements
  - HRC coordinate tweaks

Repro Early Datasets



Publication rate for 202 datasets taken before January 2000 (aka 'warm datasets') not included in Repro-4.

Script releases

4.10.1

- Bug fixes
- list_datasetid withdrawn

4.10.2

- Workaround to support footprint server move to https://
- specextract bug fix for HRC grids

Packaging and Distribution

Based on numerous user requests, and building on our experience with the standalone Sherpa, CXC is planning to improve CIAO's integration with python and make other packaging enhancements:

1) Move to python3

2) Support for external python packages in CIAO environments.

3) Move from ChiPS to matplotlib

Packaging and Distribution

1) Support for Python 2.7 is being dropped for major scientific packages in the coming years (CIAO 4.10 uses NumPy and IPython). We are dropping Python2.7 support in this year's release.

CIAO 4.9 (December 2016) provided a beta release with Python 3.5 support (users had to explicitly choose to install this version).

CIAO 4.10 (April 2018) made Python 3.5 the default (so users have to explicitly choose Python 2.7 now). There have been very few, if any, HelpDesk tickets about users having problems with changes in Python 3.5, and ~ 75% of the downloads are Python 3.5.

CXC announced 26 June 2018 that CIAO 4.11 would only support Python 3.5. The only reaction we have had is "why not Python 3.6?" (Answer: we haven't had resources to update further at this time).

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Packaging and Distribution

2) A common HelpDesk question is of the form “Can I use CIAO and <insert favorite Python package>?”.

In CIAO 4.11 we are aiming to simplify the installation of Python packages into the CIAO installation area, using standard tools (pip/setuptools). This is somewhat possible in CIAO 4.10 but it depends on the OS and Python version that is being used (the need to access a web service via SSL/https).

Longer term we are investigating how to enable the use case of “Can I use my version of Python with CIAO packages?” by improving the source build and tracking options such as the Conda package/environment management system.

Packaging and Distribution

3) Plotting in CIAO

We have made the decision to end further active development of ChiPS and focus on matplotlib support.

ChiPS already doesn't work well on recent MacOS releases, and depends on VTK which is hard to support.

For CIAO 4.11, ChIPS will be included in CIAO (but with limited support for macOS Sierra and later.)

The matplotlib Python plotting package will be included in CIAO for the first time.

- We already use matplotlib for the standalone Sherpa backend, so basic Sherpa plotting with matplotlib in the CIAO enviroment doesn't require new work.

- matplotlib is one of the packages we often get asked by users to include in CIAO.

- in future releases we will focus on using matplolib for plotting, and will not put further resources into ChiPS

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Catalog Support

SDS Support for Catalog

SDS supports the catalog at 2.0 FTE level (Primini, Burke, Siemiginowska, Lee, with some additional relevant work by others)

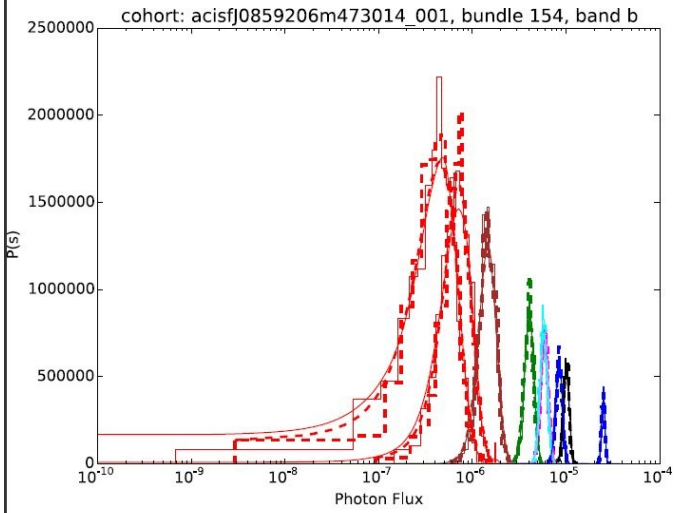
Details of progress in I Evans presentation

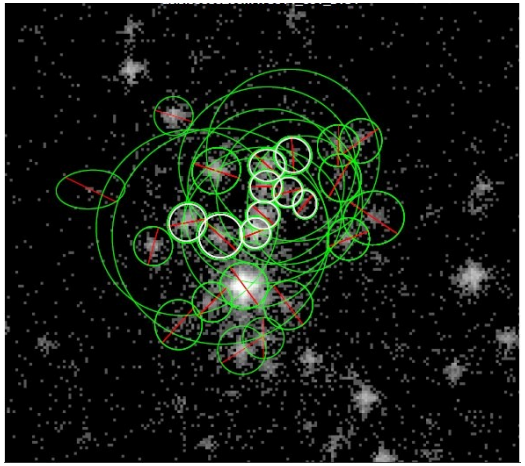
Primini:
- Quality assurance and reviews on data, detect list and data products
-Testing of aperture-photometry tool
- Work on limiting sensitivity

Burke
- Master match support, convex hull support, visualization

Siemiginowska
- Fitting

Burke, McDowell, Lee
- Documentation.





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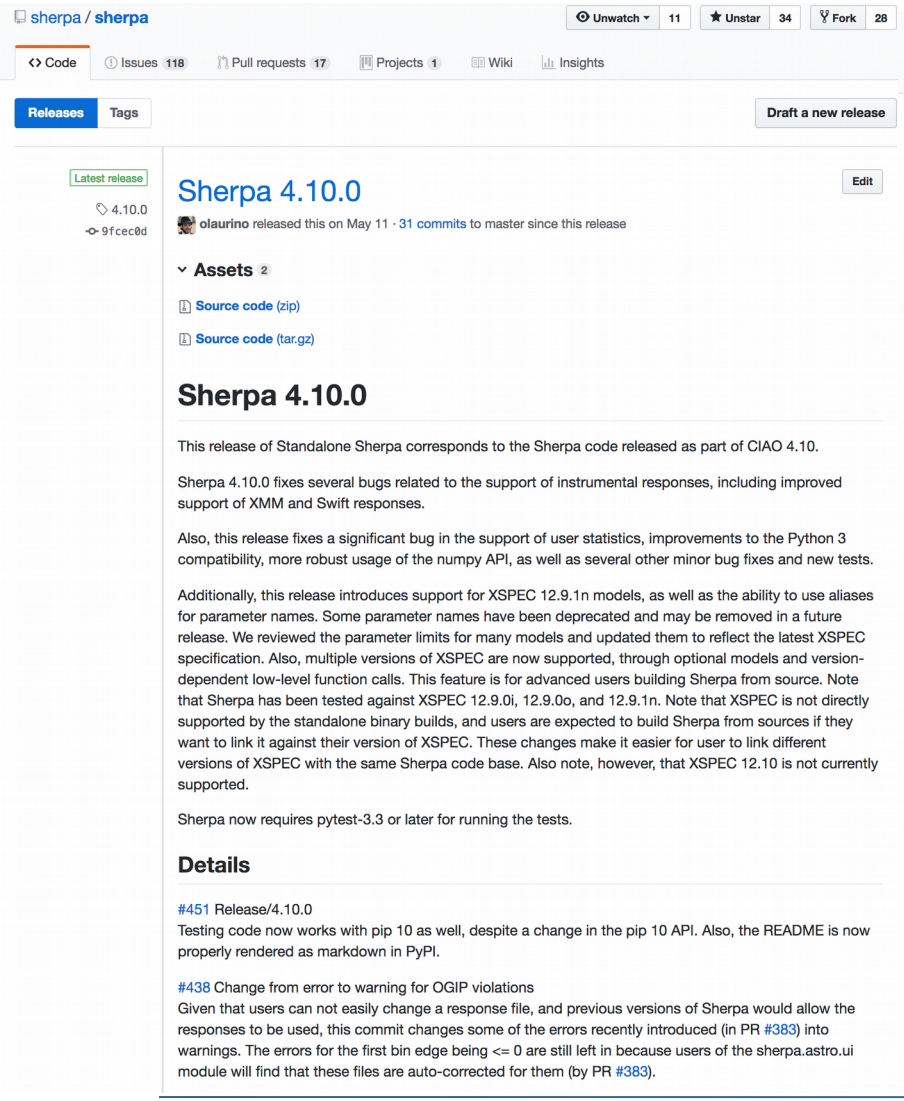
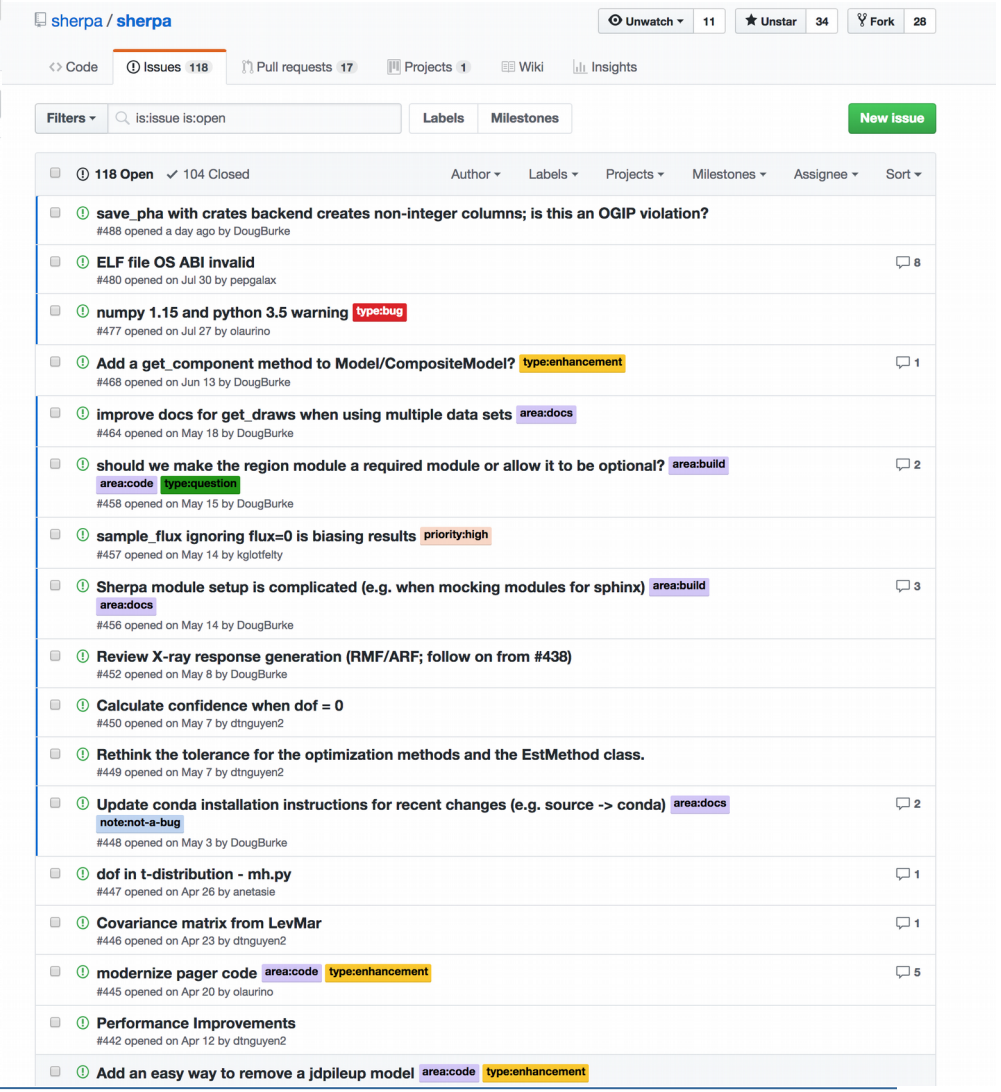
Sherpa

Sherpa Development 2018

- Sherpa 4.10 for CIAO was released on April 18, 2018 (May 11, 2018 on GitHub).
  - This Sherpa for CIAO contains the code introduced in the Sherpa standalone during 2017 development year.
    - Sherpa now runs under Python 2.7, 3.5 and 3.6.
    - The main updates include:
      - the XSPEC models in the version 12.9.1n and modifications to model parameters names and limits to reflect changes introduced by XSPEC.
      - Many bug fixes related to handling instrument responses, Python 3 support.
      - Details on *https://github.com/sherpa/sherpa/releases*
- Development in 2018 focused on a few specific issues:
  - Model evaluation on arbitrary grid – allowing the size of the PSF bins to be independent of the data bins.
  - Function to define a diagonal matrix (e.g. RMFs).
  - Function to calculate uncertainties on line equivalent width using sampling
  - Performance updates to simultaneous fitting of multiple data sets.
  - Documentation changes – use *sphinx* for building web documents

Sherpa github page





Using Sherpa in Astronomy Research

1111 publications in ApJ, AJ, MNRAS and A&A use Sherpa (since 2001 and including astro-ph abstracts)

229 citations to Freeman et al 2001 SPIE paper

68 research papers in Jan-Sep 2018, 87 papers in 2017

7 PhD theses listed in ADS that used Sherpa

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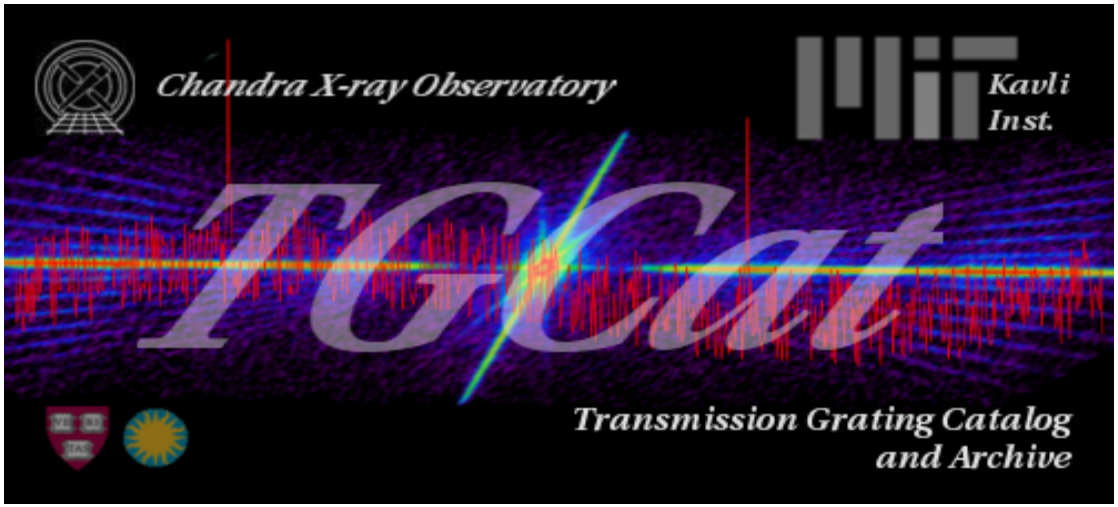
Instruments
Gratings



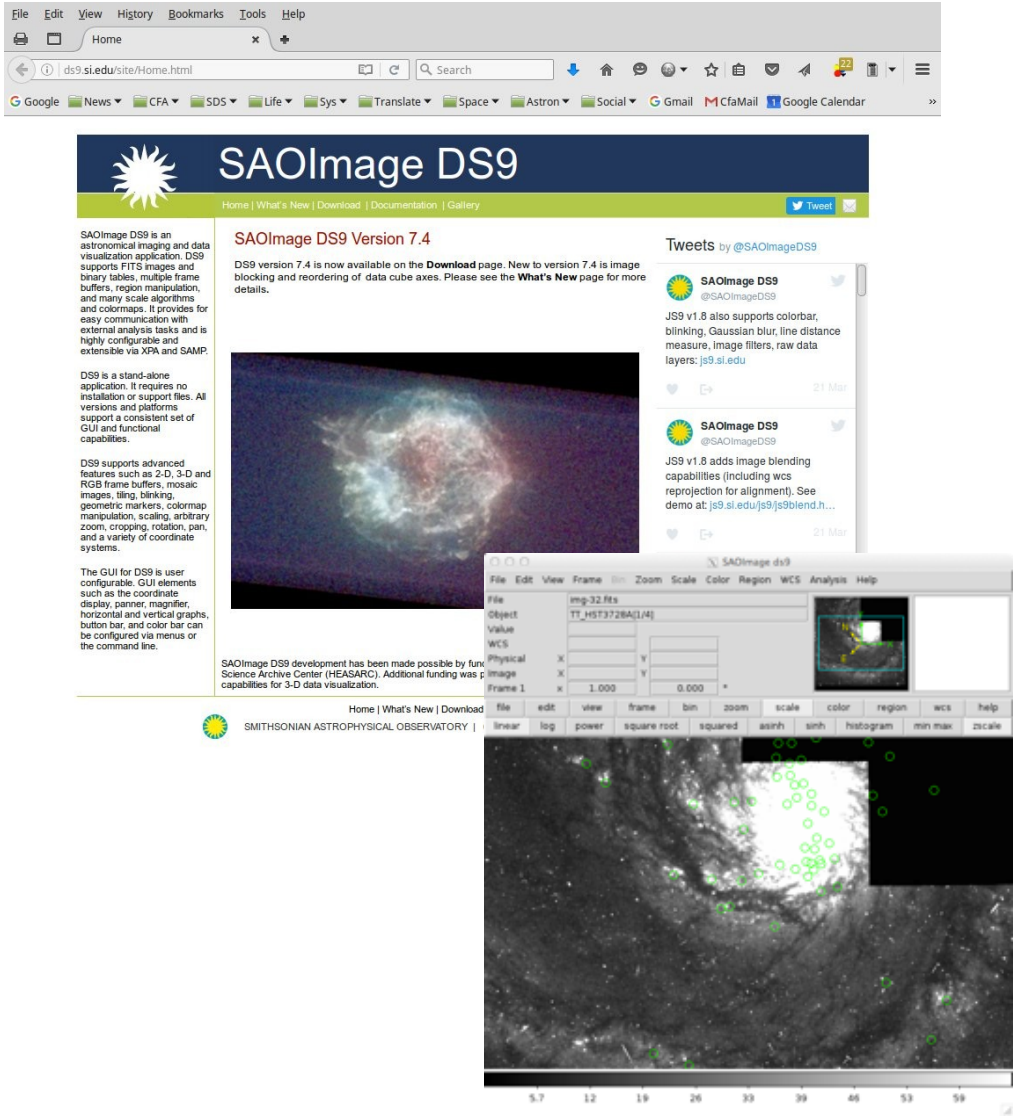
TGCAT updates continue
- Must be ported to modern OS to maintain service
- Scoping future archive needs

Grating work
- Revised HRC-S PI computation, improves LETG background (Cal data pending)
- Prelim analysis of HETG/HRC-I test data (provides high spectral res at low energy)

ACIS work
- CTI temperature dependence
- ACIS-S1 L-shaped hot pixel area

Visualization

ds9 imaging



ds9 is an imaging program widely used in the astronomical community, well beyond X-ray astronomy. It was the successor to the earlier, also widely adopted, SAOImage program

ds9 is a key part of the Chandra data analysis infrastructure – it directly supports X-ray event files.

ds9 status

- ds9 Version 7.6 – release coordinated with CIAO 4.10 on April 15
  - Support for improved precision in coordinates (needed for HETG wavelengths but generally useful)
  - 10 bug fixes (in compression, GUI, catalog-support areas)

- ds9 Version 8.0 – anticipated release Dec 2018, with release candidate currently available for test
- Infrastructure updates in 8.0:
  - Revised FITS WCS support, including spectral standards (Paper II-IV)
  - Uses AST library (D. Berry, Starlink); includes support for 3D cube WCS from IFS, VLBI
  - Revised parser/API design. New formal parser system will give consistent API, rigorous syntax, parameter verification, error detection.
  - The new parser provides an API that is completely backward compatible and won't affect either scripting or interactive users.

Help requests: 165 (79 CXC helpdesk, 57 direct to ds9, 29 internal SAO)
ADS citations – 175
Twitter followers @SAOImageDS9 401