HEASARC

https://heasarc.gsfc.nasa.gov/

Introduction and overview of services

by **Antara Basu-Zych** representing the team:

Director: (pending); **Project Scientist:** Lorella Angellini; **Chief Archive Scientist**: Tess Jaffe; **Data Scientist:** Brian Powell; **Archive Scientists:** Mike Corcoran, Keith Arnaud, Antara Basu-Zych, Abdu Zoghbi, Steve Sturner; **Database administrator:** Ed Sabol; **System and web administrator**: Mike Arida; **HEASoft lead:** Bryan Irby; **Web and analysis software developers**: Meredith Gibb, Michael Preciado, Kristin Rutkowski, Duy Nguyen, Craig Gordon, Pan Chai, Matt Elliot, Jesse Allen, James Runge, Kristen Killingsworth; **Bibliographer:** Doug van Orsow.

(Plus **LAMBDA team for CMB related data and tools**, Tom Essinger-Hileman, Science Lead)

How familiar are you with the HEASARC?

First time I am hearing about this

0%

I've heard of the HEASARC but not very sure what they do

0%

I'm pretty familiar with the HEASARC

0%

I use the HEASARC regularly

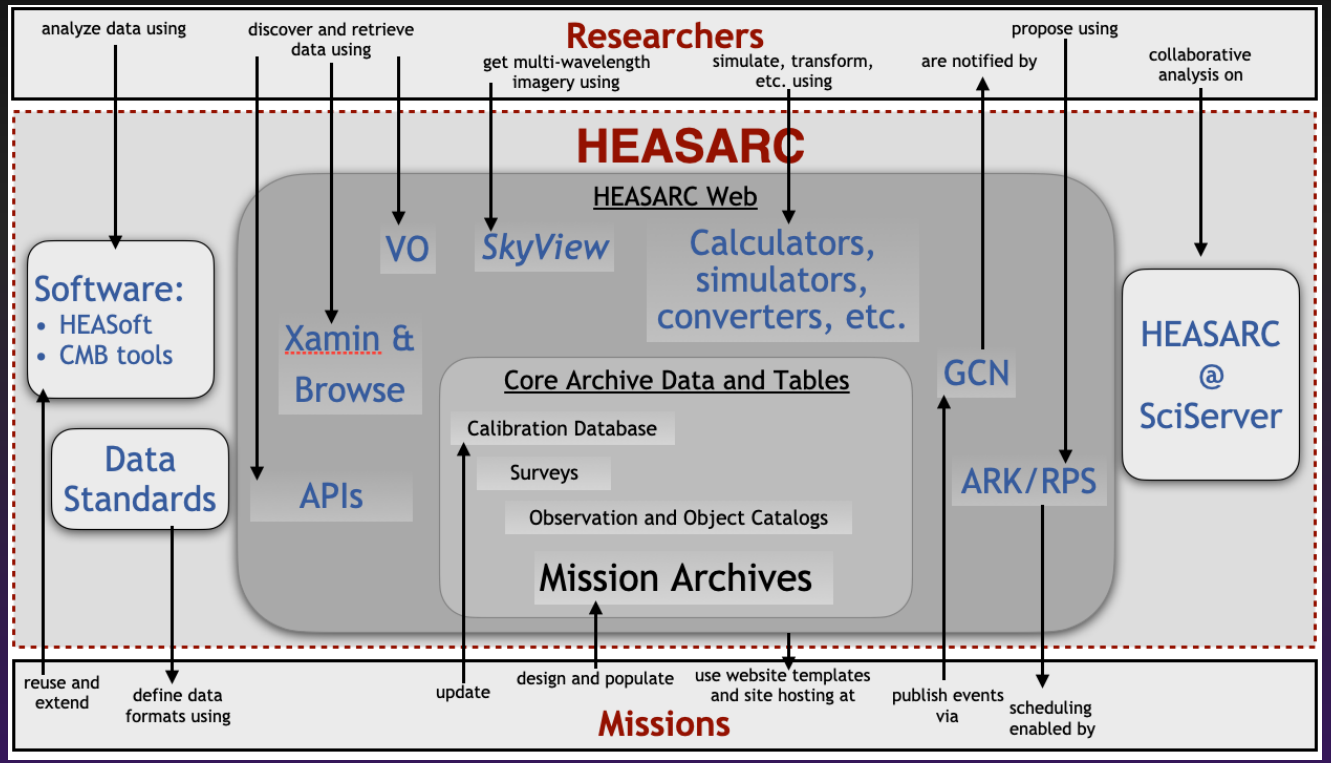
0%

HEASARC: High Energy Astrophysics Science Archive Research Center

- Overview
  - Tour of HEASARC for a scientist end user
- Data discovery
  - Live demo of a few science workflows
- SciServer and JS9
  - Demo of the environment and tools
- Heasoftpy
  - Intro to Ftools analysis through Python with NICER example

Overview

- Website
- Data archive
  - /FTP area
  - Xamin and Browse
  - Bibliographic data
  - APIs
- Software
  - HEASoft, Caldb
- Platforms
  - (past) Hera
  - (present) SciServer
  - (future) Fornax
- Proposal and science tools
  - ARK/RPS
  - WebPIMMS
  - SkyView
  - Viewing
- Community
  - News feed
  - Calendars
  - Helpdesks



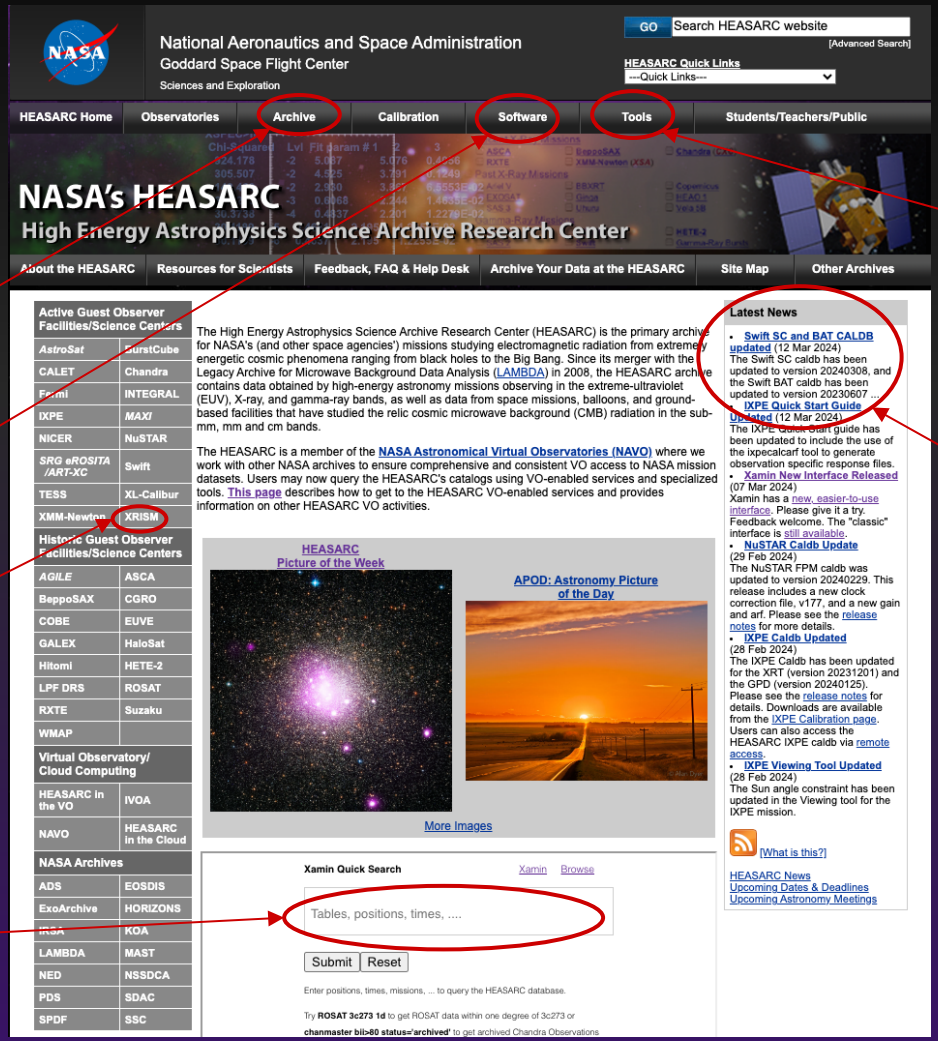
HEASARC home

Info on different ways to access the archive

Info on analysis software (HEASoft, PIMMS, etc.)

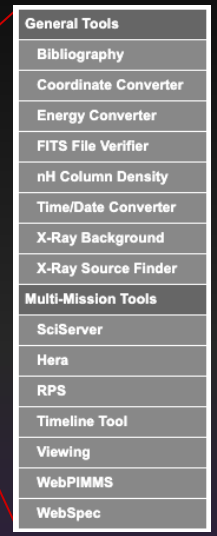
Go to mission support for XRISM

Quick archive search, e.g., “hitomi crab”



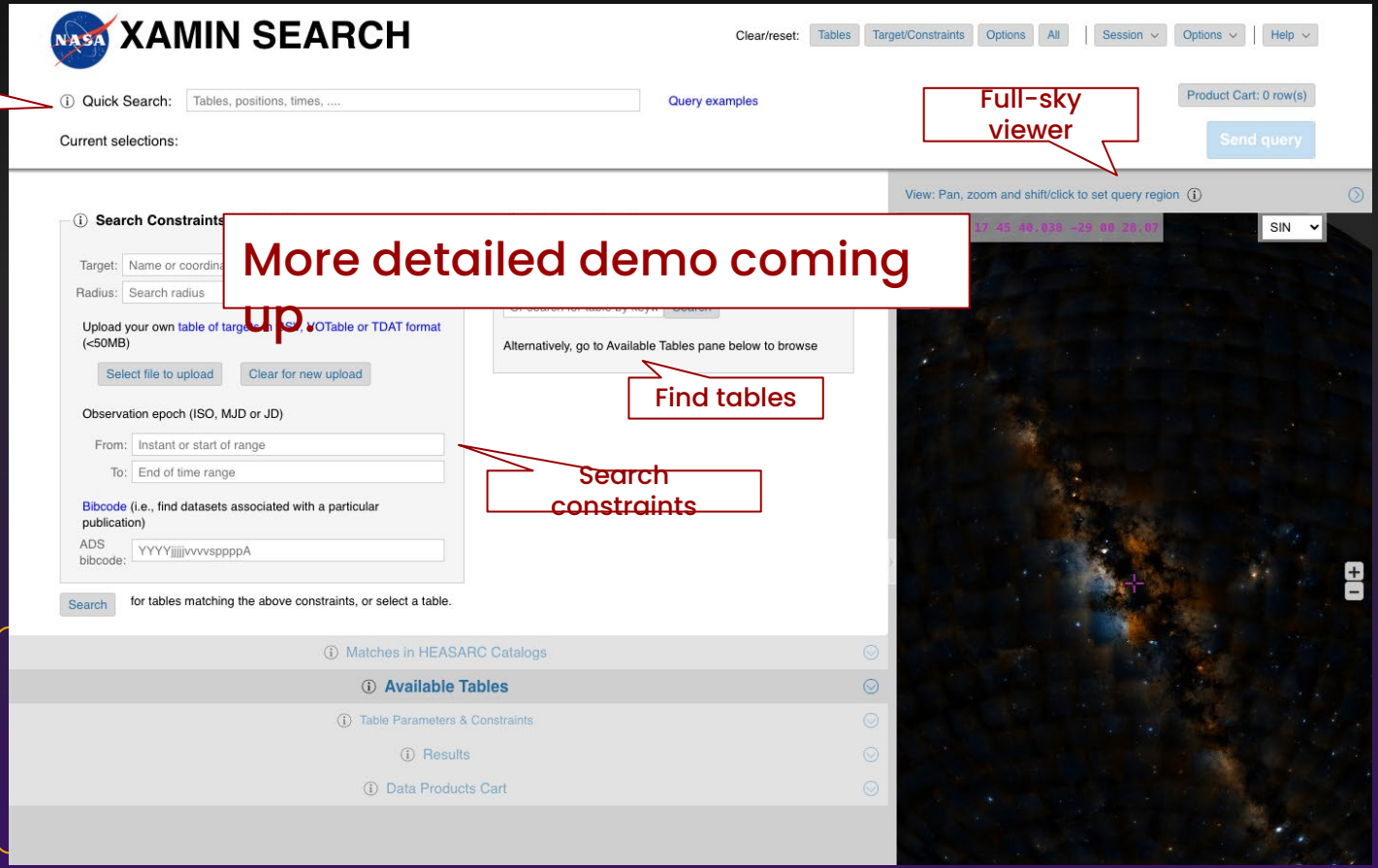
Info on web tools like calculators, converters, etc.

News items



Note: Currently working on redesign and modernization. Stay tuned!

Interactive portal: https://heasarc.gsfc.nasa.gov/xamin/



Quick search nicer 'cen a'

Full-sky viewer

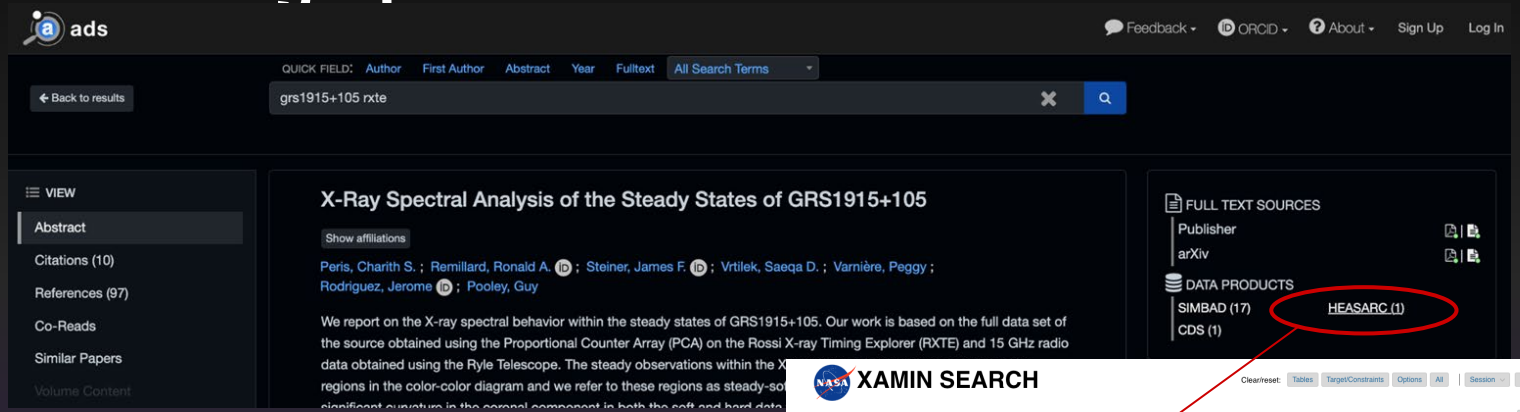
More detailed demo coming up.

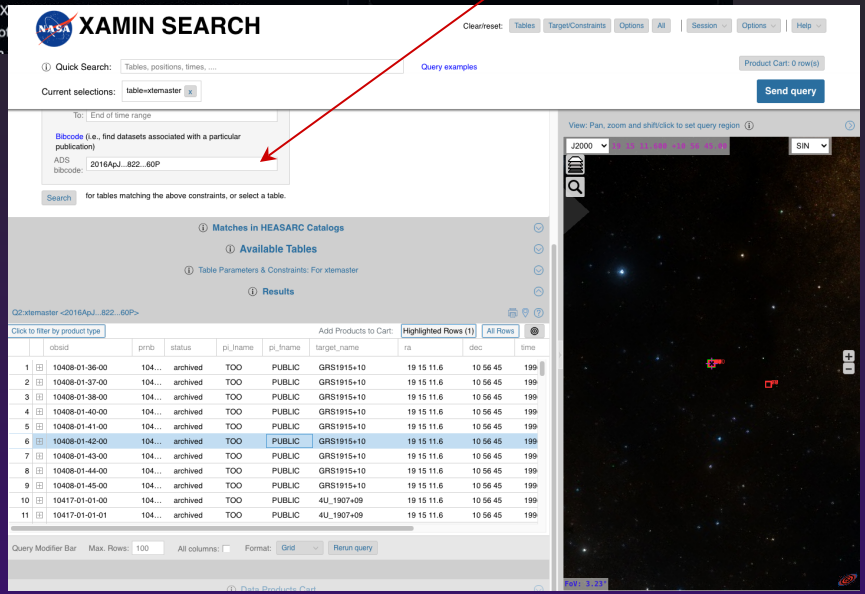
Find tables

Search constraints

Explore catalog contents, specify detailed constraints, browse results, select data products, download data....

Bibliographic links: from ADS to HEASARC





Go straight from ADS to browse the data products on HEASARC

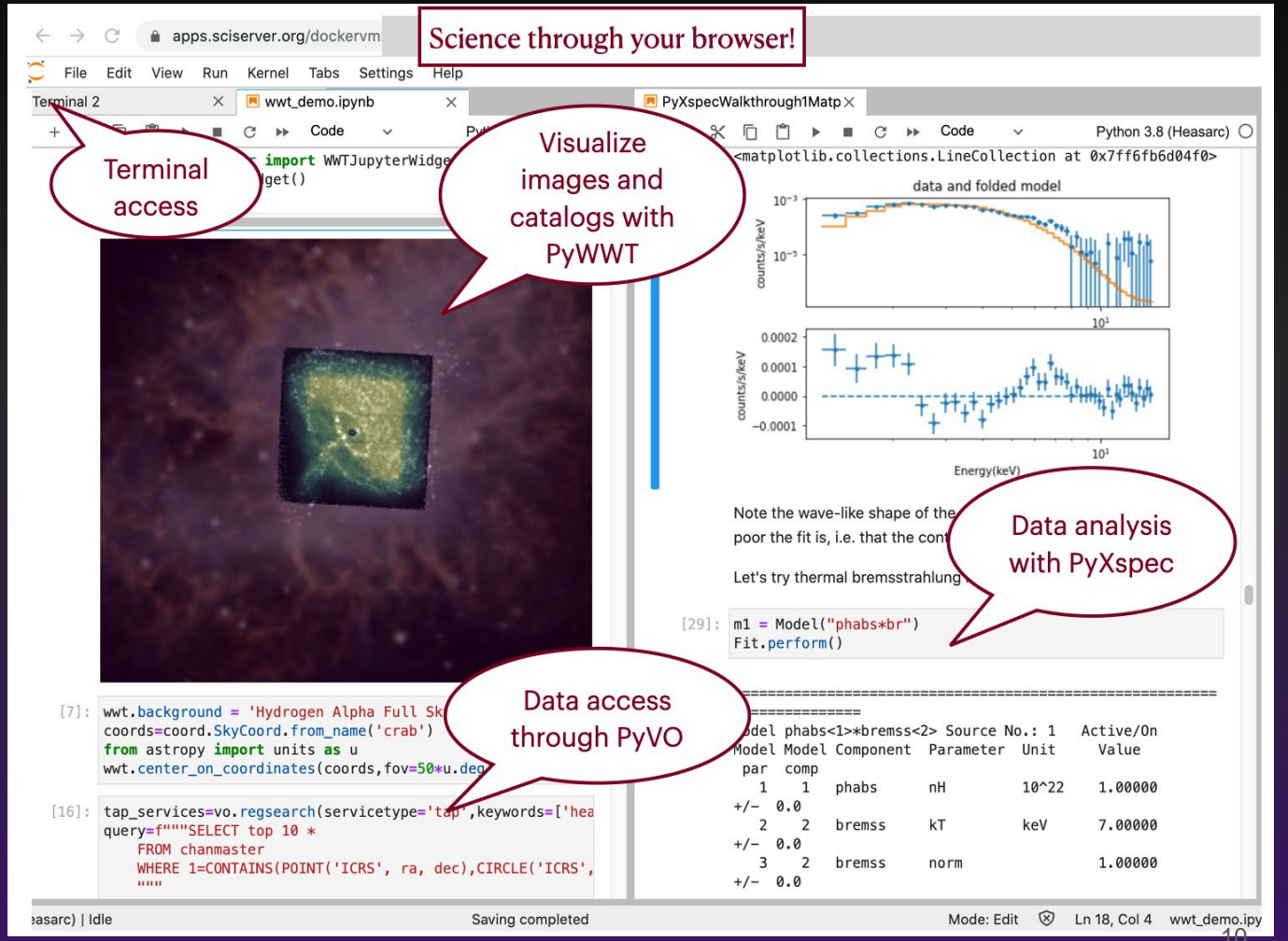
Software

- HEASoft
  - Generic and mission-specific tools for high energy astrophysics data analysis.
  - Use our Dockerfile
  - Or use our science platforms (see below)
- Heasoftpy
  - Script in Python
  - Share as Jupyter notebooks
  - Start from tutorials
- Caldb
  - Keep up-to-date with the latest calibration

```python
import heasoftpy as hsp
hsp.fdump(infile='input.fits', outfile='STDOUT', ...)

# or
params = {
    'infile': 'input.fits',
    'outfile': 'STDOUT',
    ...
}
hsp.fdump(params)

# or
fdump_task = hsp.HSPTask('fdump')
fdump_task(infile='input2.fits', outfile='STDOUT', ...)
hsp.fdump(fdump_task)

# or
fdump_task = hsp.HSPTask('fdump')
fdump_task.infile = 'input2.fits'
fdump_task.outfile = 'STDOUT'
... # other parameters
fdump_task()
```

Science platform: SciServer

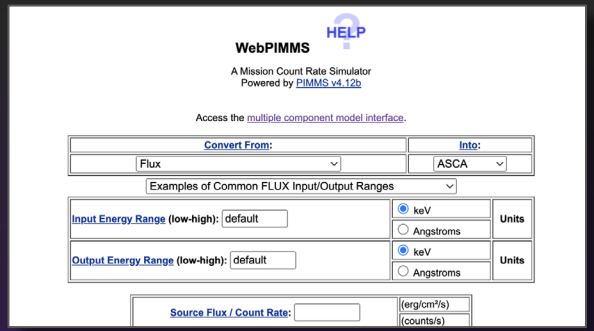
- Do science through your browser
  - No data downloads
  - No software builds
  - Just create an account and go.
- Replaces existing Hera interface.
- Coming soon to Amazon Web Services with more available data from beyond HEASARC.

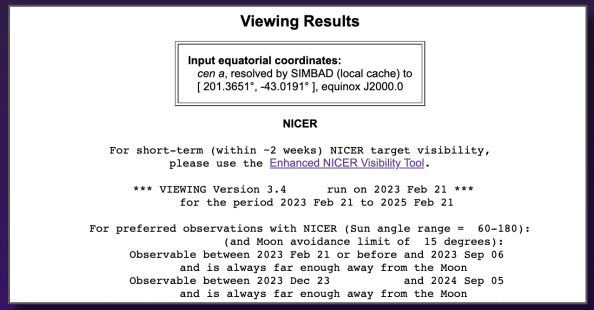


https://heasarc.gsfc.nasa.gov/docs/sciserver/

Mission proposal support

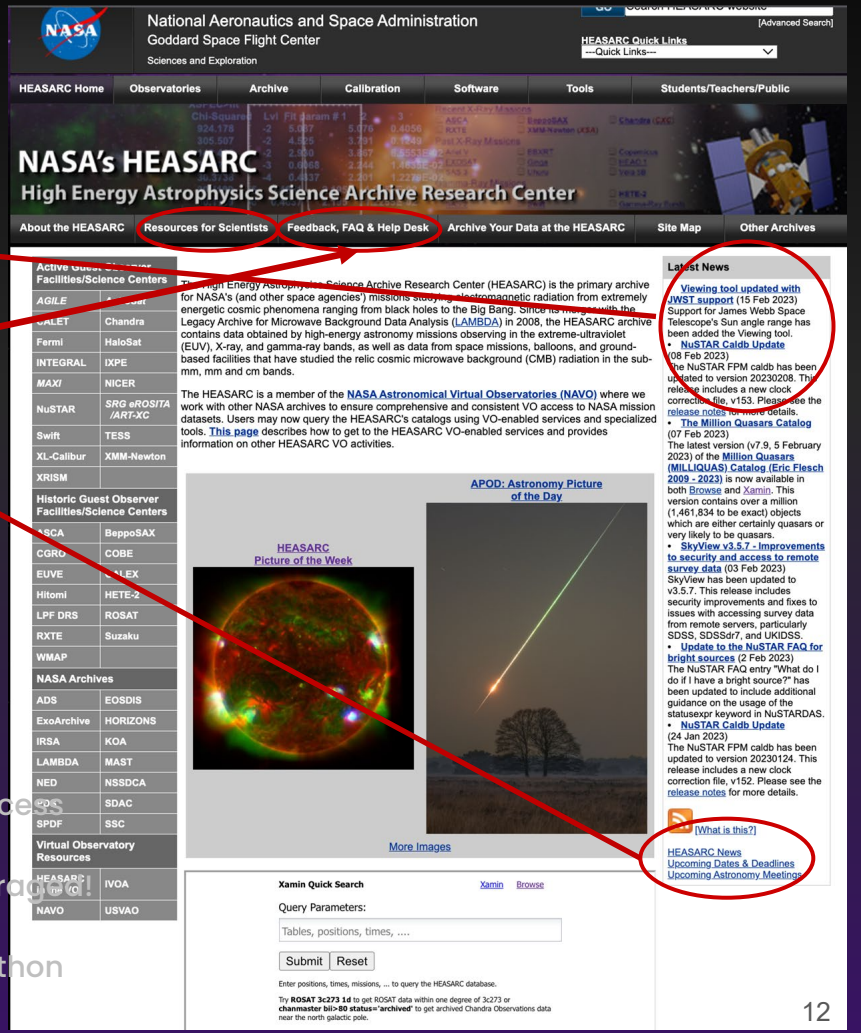
- ARK/RPS
  - Standard proposal submission system for HEA missions
- (Web)PIMMS
  - Portable, Interactive, Multi-Mission Simulator
  - i.e., what S/N will I get for my source?
- Viewing
  - When can which instruments see my source?





Community

- News
  - Subscribe via RSS
- Conference listings
- Proposal deadlines
  - Subscribe to our calendar!
- HEACIT
  - Community-run, HEASARC-supported
  - HEACIT is on openastronomy.org
- Helpdesks
  - Mission-specific
  - Tool-specific
  - HEASoft
  - General
- APOD and ……
- Social
  - Facebook for Xspec
  - Astropy.slack.com channel 'pyvo' for Pythonic data access
  - GitHub (HEASARC and NASA-NAVO organizations)
    - Jupyter notebook tutorials Contributions encouraged!
- Workshops
  - Regular AAS workshops on accessing data through Python
  - HEAD meeting special session/workshop on HEASARC.



What are HEASARC services that you have used before? Or if you are new to HEASARC, what services might you be interested in using in future?

Nobody has responded yet.

Hang tight! Responses are coming in.

Xamin data discovery

- Let's do a live demo of https://heasarc.gsfc.nasa.gov/xamin/
- Can also do via Python
- Then same in https://heasarc.gsfc.nasa.gov/xamin/QueryServlet?help
  - https://heasarc.gsfc.nasa.gov/xamin/QueryServlet?
  - position='229.7375,-57.3633'
  - &radius=1
  - &table=nicermastr
  - &time=2024-03-01..2024-04-01
  - &constraint='exposure>5000'

Programmatic data access

- If you know what you want and where it is already (e.g., from the web portal), you can use our download script

```
download_wget.pl https://heasarc.gsfc.nasa.gov/FTP/nicer/data/obs/2018_01/1050020180/
```

- To find things on the command line, you can use the Xamin java tool (which calls the API) to run queries:

```
> runquery position='cen a' table=chanmaster time=2018-01-01..2019-01-01 products
filterstring='*/*evt*'
```

- For API access, you can use
  - the Xamin API: https://heasarc.gsfc.nasa.gov/xamin/QueryServlet?help
  - The VO APIs: https://heasarc.gsfc.nasa.gov/navo/summary/navo_services.html
    - A good Python VO client is PyVO: https://nasa-navo.github.io/navo-workshop/

HEASARC data in the cloud

Most HEASARC data now on AWS in a free S3 bucket

- E.g., a file that on HEASARC is available at
  - `https://heasarc.gsfc.nasa.gov/FTP/chandra/data/byobsid/5/4475/`
- can also be found at
  - `s3://nasa-heasarc/chandra/data/byobsid/5/4475/`
- Or
  - `https://nasa-heasarc.s3.amazonaws.com/chandra/data/byobsid/5/4475/`
- Access via HTTPS or AWS CLI or Python boto3 library etc. See our Python tutorial for some access options. It looks a bit like this:

```
s3_url = url.replace("https://heasarc.gsfc.nasa.gov/FTP/",
                     "https://nasa-heasarc.s3.amazonaws.com/")
hdul = fits.open(s3_url)
```

(FYI: each mission is currently sync'd to AWS weekly. Let us know if you need things faster and we'll see what we can do.)

SciServer and JS9

Go to live demo. If internet not cooperative, go to backup SciServer video.

HEASARC @ Sciserver

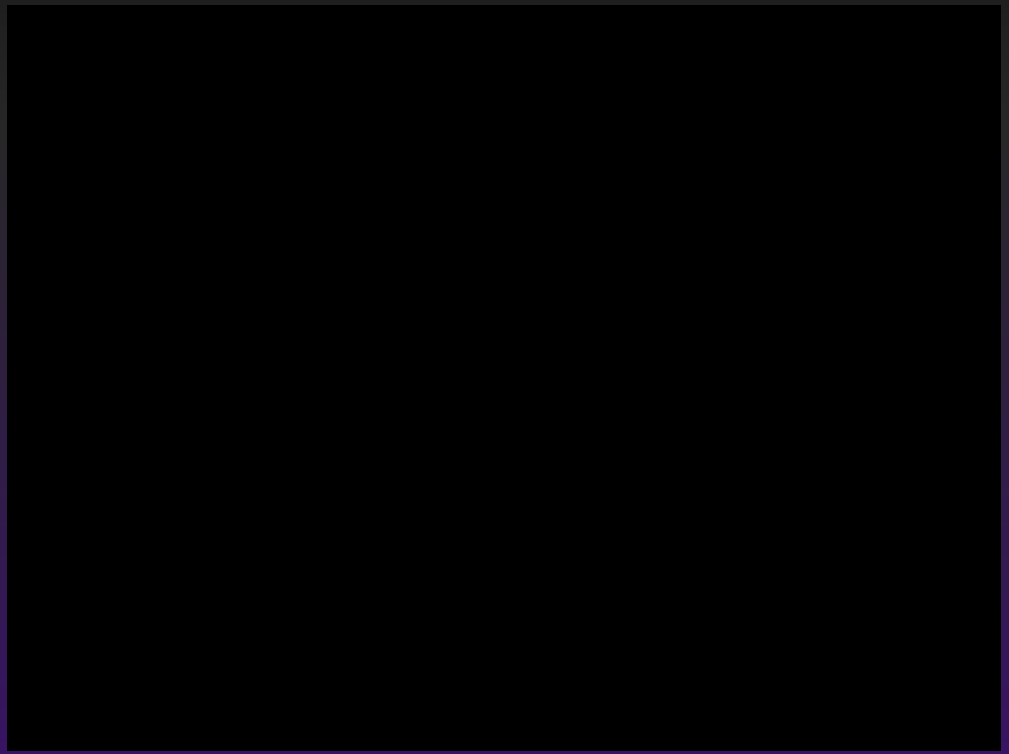
- Sciserver is a jupyter-based science platform hosted at JHU.
- Open to anyone.
- Heasoft and all of HEASARC archive is available ‘locally’.
- No need to install anything
- No need to download anything
- Also includes: XMM SAS, Chandra CIAO, and Fermitools.
- Tutorials. Also on github.com/HEASARC/sciserver_cookbooks
- File-sharing.
- Run Batch jobs.
- Great for students too (data+software ready to go and easy to share code, etc)

HEASARC @ Sciserver

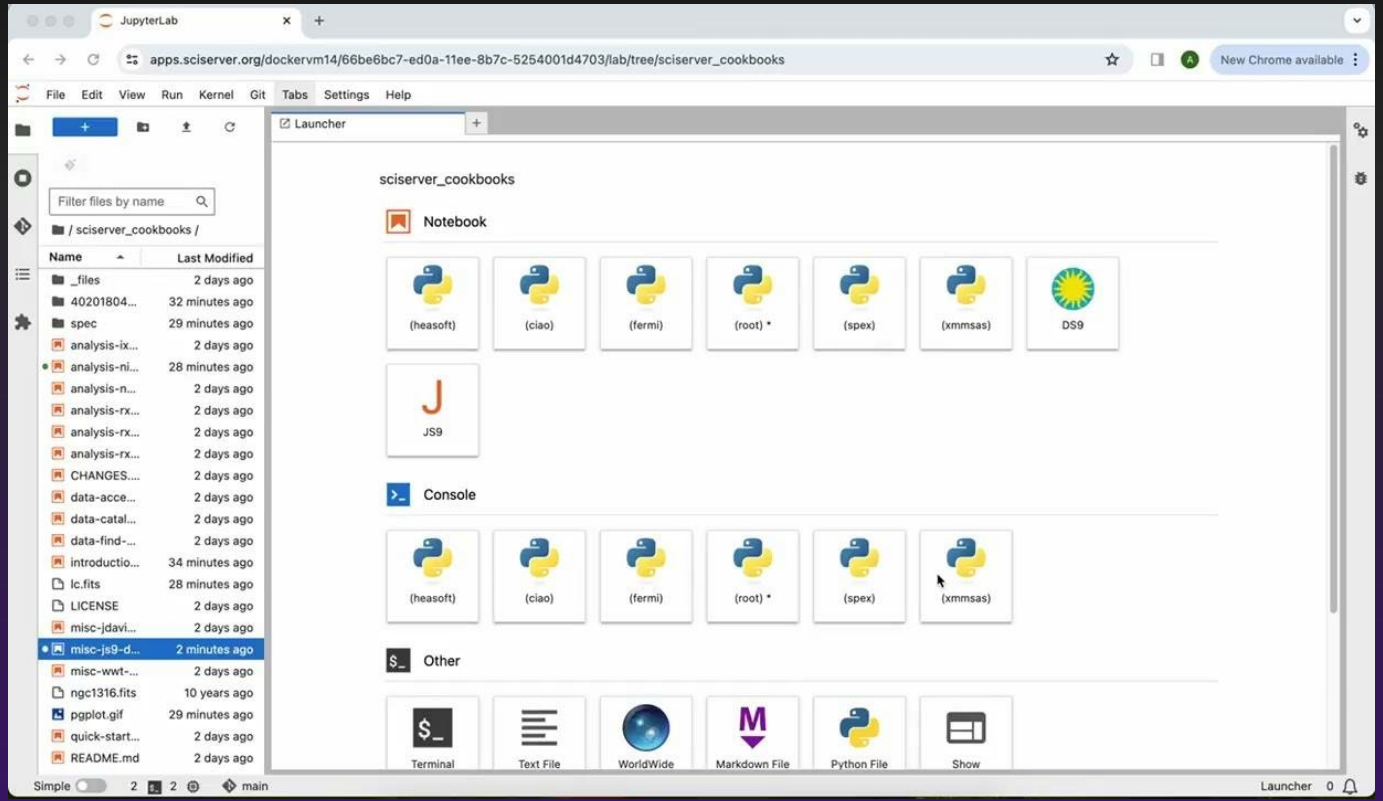
- Getting started with Sciserver:
  - Login
  - Create a container
  - Choose a software image
  - Select the data to be mounted (all of HEASARC data)
  - Access the Jupyter environment.

Sciserver Set up and Orientation:

Live demonstration: https://apps.sciserver.org/dashboard/



Sciserver: JS9



Heasoftpy and NICER analysis

https://docs.google.com/presentation/d/16lt_2e4z-Bh6dECGJJC4tKl8Qh-dzpZ4/edit?usp=drive_link&ouid=115044030236622835103&rtpof=true&sd=true

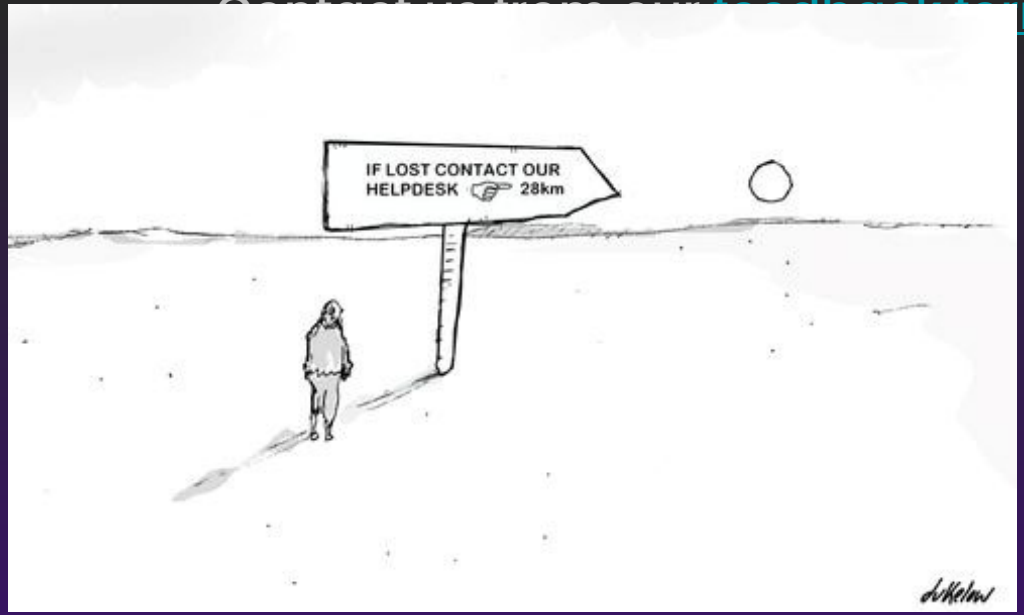
Future:

- Website refresh
  - Incremental improvements for easier navigation.
  - Mobile friendly and more accessible!
- Platforms
  - More Python notebook tutorials for SciServer
  - AWS-based Fornax platform in the works.
- Cross-archive data discovery
  - See ESASky for example. Plan to make it easier in Xamin and other archives' portals.
  - NASA-wide cross-disciplinary metadata effort, TBD.
- Software sustainability
  - Make Heasoft more flexible to install and modernize older code.
  - Interoperate with other open-source software projects, e.g., new gamma-ray development by CTA et al.
  - Modern methods of installing software, e.g., conda.
  - Open source and collaborative development. Complicated but starting with https://github.com/HEASARC/cfitsio
  - Working on updating astroquery.heasarc and astroquery.skyview.
- Community outreach
  - Community surveys.
  - Workshops.
  - Social media? Where? HEACIT is on openastronomy.org

what else?

To follow up:

- Give us feedback on anything!
- Try out Xamin, SciServer, heasoftpy, etc. if you haven't already.
- Contact us from our feedback forum



Find us at AAS
(Jan 2025: Washington D.C.):
demos and Q&A within the NASA booth

antara.r.basu-zych@nasa.gov

Thank You!

backup

Storage and files on SciServer

- **Exists outside container, backed up, quota'd**
- Exists outside container, not backed up, not quota'd, may disappear
- *Exists only inside container, saved with stopped container but dies when container deleted*

Storage (file system)

```
user1
   persistent
   my_usr1_vol_X
mloewenstein
   persistent
   XRISM-wkshp
user3
…
…
```

Temporary (file system)

```
user1
   scratch
   jobXtempSpace
user2
   scratch
user3
…
```

Container 1

```
/home/idies/
   file1.txt
   miniconda3
      fooPy v X.x
   workspace
      sciserver_cookbooks
      Storage
         user1
            persistent/foo/bar
         mloewenstein
            XRISM-wkshp
      Temporary
         user 1
            scratch
```

User1 created a container

- chose to mount XRISM-wkshp
- chose *not* to mount my_usr1_vol_X;
- pip installs version X.x inside container;
- creates foo/bar under persistent
- creates file1.txt in $HOME inside container;

- ***Copy files from XRISM-wkshp into foo/bar to work on your own copy!***

Storage and files on SciServer

- **Exists outside container, backed up, quota'd**
- Exists outside container, not backed up, not quota'd, may disappear
- *Exists only inside container, saved with stopped container but dies when container deleted*

Storage (file system)

```
user1
   Persistent
   my_usr1_vol_X
user2
   persistent
   project_Y_shared_space
user3
…
…
```

Temporary (file system)

```
user1
   scratch
   jobXtempSpace
user2
   scratch
user3
…
```

Container 2

```
/home/idies/
   miniconda3
      fooPy v Y.y
   workspace
      sciserver_cookbooks
      Storage
         user1
            persistent/foo/bar
            my_usr1_vol_X
      Temporary
         user1
            scratch
            jobXtempSpace
```

User1 creates a container

- (maybe from the same base image, maybe not);
- chose to mount my_usr1_vol_X;
- chose to mount jobXtempSpace;
- pip installs version Y.y;
- note that file1.txt created in container 1 is NOT in HOME of container 2 because it was not put in the storage area.