



Bringing Analysis to Petabytes of Scientific Data

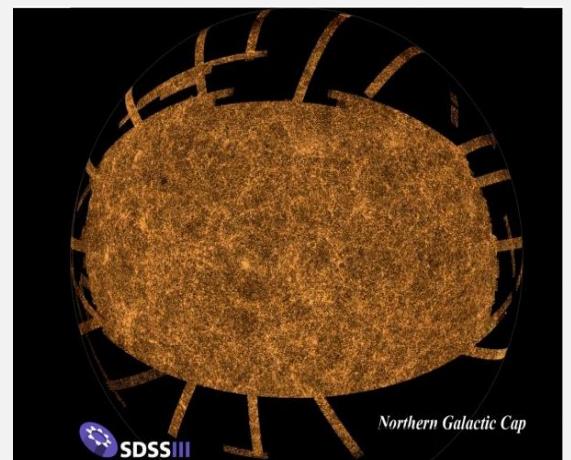
Data Mining 553.436
2019-11-20

Gerard Lemson, Manuchehr Taghizadeh-Popp
Johns Hopkins University
www.sciserver.org

Origin: Sloan Digital Sky Survey

Data:

- Galaxy/Star spectrum and 5-band photometry
- 1/4 Billion photometric objects
- 2.5 Terapixels of images
- Today: 35 TB MS SQL Server database,
100 TB processed data
- SDSS Data Archive developed and stored at JHU



SkyServer

Website for interactive access to SDSS

- Image Cutout Web service
- Scrolling sky map (like Google maps)
- Web-form & free-from synch SQL queries
- Extensive SQL help
- Integrated Database Schema Browser
- Cross-match between objects
- Rich educational projects section (K-12+)

SLOAN DIGITAL SKY SURVEY

SkyServer DR15

Home Data Schema Education Astronomy SDSS Contact Us Download Site Search Help History NEW!

DR15 Tools

SQL Search

This page allows you to directly submit a SQL (Structured Query Language) query to the SDSS database server. You can modify the default query as you wish, or cut and paste a query from the [SDSS Sample Queries page](#).

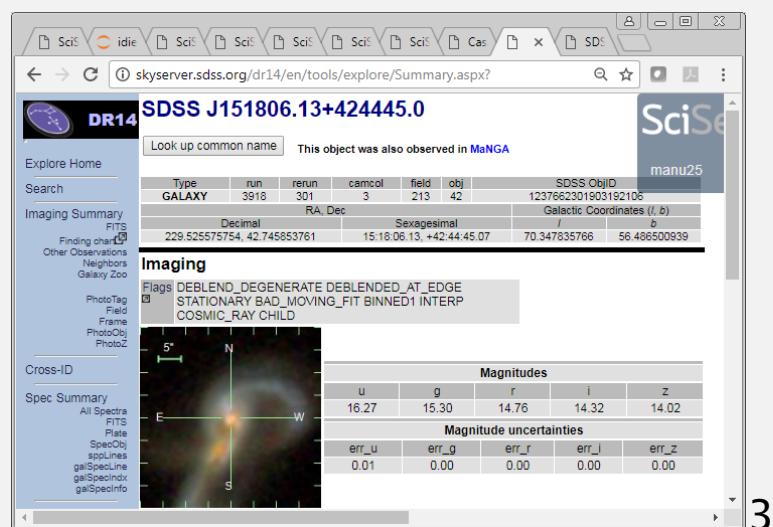
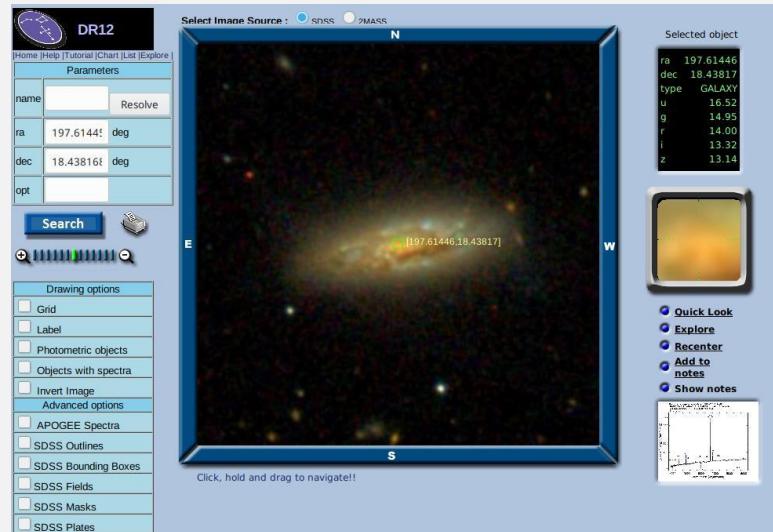
Please note: To be fair to other users, queries run from SkyServer search tools are restricted in how long they can run and how much output they return, by **timeouts** and **row limits**. Please see the [Query Limits help page](#). To run a query that is not restricted by a timeout or number of rows returned, please use the [CasJobs batch query service](#).

```
-- This query does a table JOIN between the imaging (PhotoObj) and spectra (SpecObj) tables and includes the necessary columns in the SELECT to upload the results to the SAS (Science Archive Server) for FITS file retrieval.  
SELECT TOP 10  
    p.objid, p.ra, p.dec, p.u, p.g, p.r, p.i, p.z,  
    p.run, p.rerun, p.camcol, p.field,  
    s.specobjid, s.class, s.z as redshift,  
    s_plate, s.mjdc, s.fiberid  
FROM PhotoObj AS p  
JOIN SpecObj AS s ON s.bestobjid = p.objid  
WHERE  
    p.u BETWEEN 0 AND 19.6  
    AND g BETWEEN 0 AND 20
```

Output Format: HTML XML CSV JSON VOTable FITS MyDB NEW!

Table name:

Check syntax **Submit query** **Reset**



CasJobs

-Website for running SQL queries as batch jobs

-Query results:

*Stored in personal MyDB database

*Searchable query history

-Table import, download

-Share personal tables with a Group

-7,000+ users, 44+ Million jobs

The screenshot shows the SDSS Query / CasJobs interface. At the top, there's a navigation bar with links for Help, Tools, Query, History, MyDB, Import, Groups, Output, Schema Browser, Queues, and SkyServer. Below the navigation bar, there's a search bar with dropdown menus for Status, Context, and Name Like, and an Apply button. A message says "Refresh this page to get latest info". The main area displays a table of executed queries. The columns are JobID, Name, Query, Context, Submitted, Time (hh:mm), Rows, and Status. Most rows have a status of "Finished". Some rows show errors like "Syntax error near 'as'". The table includes entries from various users and dates, such as "43347457 SoScript-R.CasJobs.executeQue" and "43347456 SoScript-R.CasJobs.executeQue".

The screenshot shows the SDSS Query / CasJobs interface after a query has been submitted. The URL is https://skyserver.sdss.org/CasJobs/SubmitJob.aspx. The main area displays the query results for "1 select top 10 * from specobjall". The results table has columns: specObjID, bestObjID, fluxObjID, targetObjID, plateID, sciencePrimary, sdssPrimary, ra, dec, and mag. There are 10 rows of data. Below the results, there are buttons for RESULTS, Plot, Save As, HTML, and Contact. The contact information is "sciworker-v1.10.3".

The screenshot shows the SDSS Query / CasJobs interface displaying a table definition for DR15:dbo.apogeeDesign. The table has columns: catalog, object_category, and object. The catalog is set to "DR15". The object category is "Tables" and the object is "dbo.apogeeDesign". Below this, there's a table titled "Table: DR15:dbo.apogeeDesign" with columns: Name, Type, Size/Content, Unit, and Key. The table contains 17 rows of design parameters for APOGEE plates, such as designid, ra, dec, location_id, radius, objid, comments, short_cohort_version, medium_cohort_version, long_cohort_version, number_of_short_fibers, number_of_medium_fibers, number_of_long_fibers, short_cohort_min_h, short_cohort_max_h, medium_cohort_min_h, medium_cohort_max_h, long_cohort_min_h, long_cohort_max_h, dereddened_min_l_k_s_color, number_of_visits, number_of_tellurics, number_of_sky, and number_of_science.

SciServer @ JHU

Web tools providing...

- 1) ...hosting of huge public/private datasets

File System + SQL Databases

- 2) ...data-intensive computing for everyone

Jupyter + Docker

- 3) ...personal data storage space/file system.

Disk Quotas + Temporary scratch space

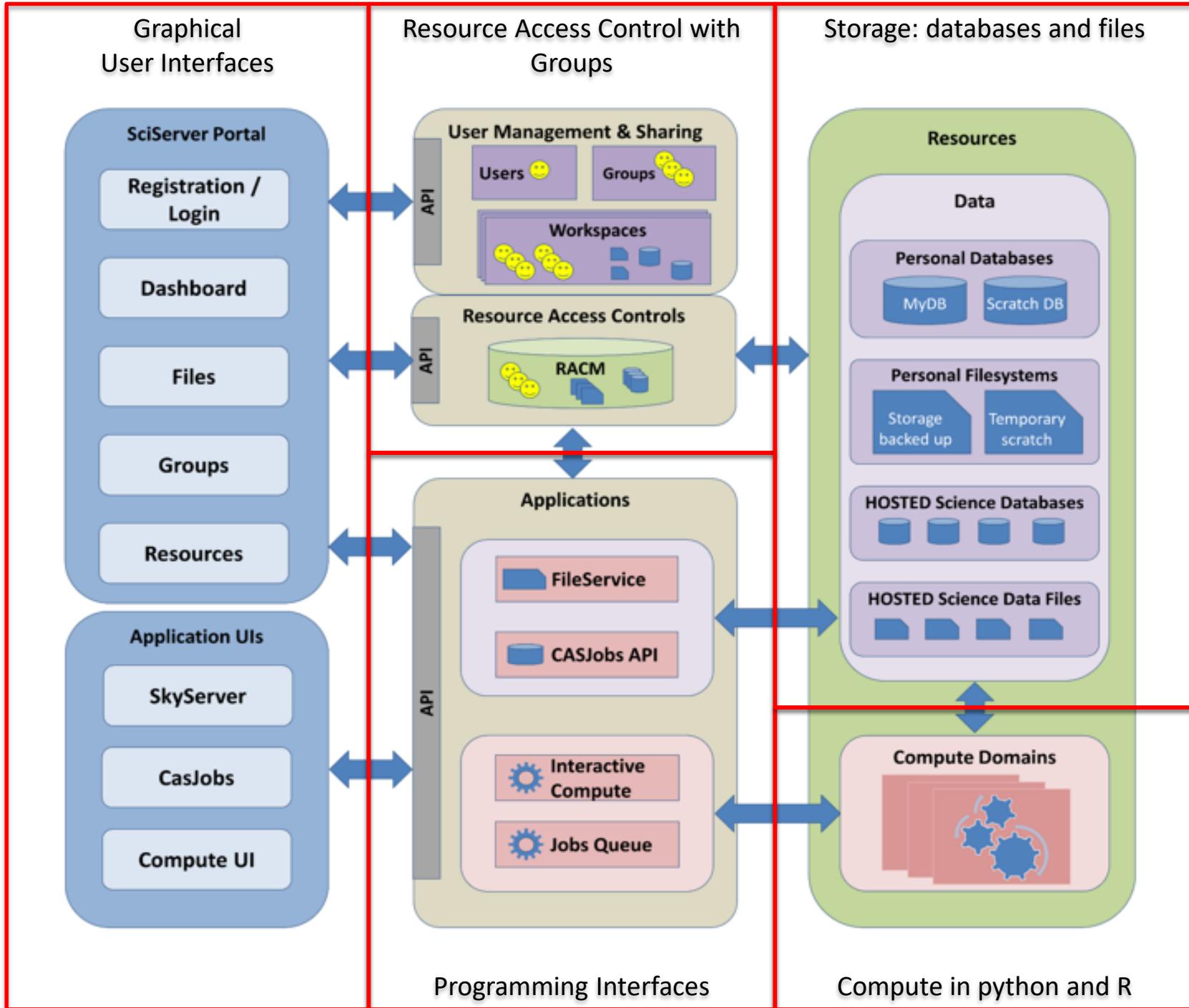
- 4) ...a workspace for sharing private data within a team.

Share volumes, databases, Docker images, etc.

The SciServer Dashboard interface. At the top, there's a navigation bar with 'SciServer' logo, 'Home', 'Files', and 'Groups'. Below the header is a banner with the text 'SciServer Dashboard' and 'Data, Collaboration, Compute' over a background image of a star field. The main area has several cards: 'Files' (0 shared user volumes, 2 owned user volumes), 'Groups' (0 group invitations, 0 owned groups), 'Compute Jobs' (0 jobs running, 0 completed in 24 hours), and 'Activity Logs' (logged in on 12 Oct 2019 at 05:33:55 pm). Below these are 'SciServer Apps' cards for CasJobs, Compute, Compute Jobs, SciDrive, SkyServer, and SkyQuery.

The SciServer Files Service interface. It shows a list of files in a volume named 'turb1_persistent'. The table includes columns for Name, Last Modified, and Size. The files listed are:

Name	Last Modified	Size
ipython_checkpoints	2019-09-24 18:10:13	
jobs	2019-09-24 10:51:17	
MasterJobNotebook.ipynb	2019-09-24 18:07:26	2.5 KB
TurbCutout-beta.ipynb	2019-10-12 18:10:49	30.4 KB
datout_09-24-2019-22:08:20.837644.hdf5	2019-09-24 18:08:22	11.9 MB
outout_09-24-2019-22:08:20.837644.hdf5.xmf	2019-09-24 18:08:22	1.3 KB
outout_09-24-2019-23:01:46.517098.hdf5.h5	2019-09-24 19:01:47	11.9 MB
outout_09-24-2019-23:01:46.517098.hdf5.xmf	2019-09-24 19:01:47	1.3 KB
parameters.txt	2019-09-24 18:07:26	262 Bytes



SciServer Dashboard

Data, Collaboration, Compute



Files

You have 54 Shared User Volumes.

You have 35 Owned User Volumes.



Groups

You have 0 Group Invitations.

You have 47 Owned Groups.



Compute Jobs

You have 0 Jobs Running.

You have 0 Jobs Completed in 24 hours.



Activity Logs

You logged into the Dashboard on

18 Oct 2019 06:21:46 am.

SciServer Apps



CasJobs

Search online big relational databases collections, store the results online, and share them.



Compute

Analyze data with interactive Jupyter notebooks in Python, R and MATLAB.



Compute Jobs

Asynchronously run Jupyter notebooks in Python, R and MATLAB or commands.



SciDrive

Drag-and-drop file hosting and sharing services.



SkyServer

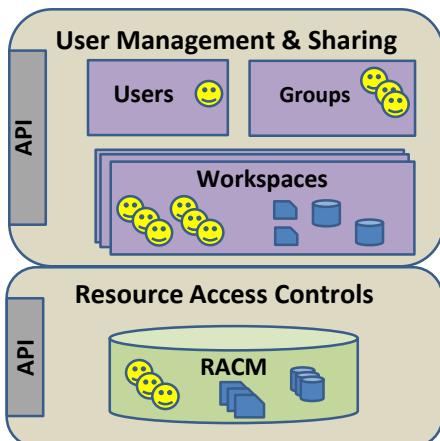
Access the Sloan Digital Sky Survey data, tutorials and educational materials.



SkyQuery

A scalable database system for cross-matching astronomical source catalogs.

Sharing: you decide who sees your data



- SciServer RACM: resource access control management
- **If you own** a resource (file store, database, compute environment, compute domain) **you decide** who can see (read/write) it
- May be public, groups, individuals
- Special: CourseWare
 - Use SciServer in the class room
 - Various classes at JHU
 - Astroinformatics 2018 (Penn State)
 - Turbulence Summer school 2018 (UM)
 - Astronomy course (St Andrews UK)



Resource Sharing

SciServer Home Files Groups Admin Resources

gerard

Groups

- as|
- ADASS2019Demo [Leave group](#)
- AS171d205
- AS4010_2018_S1
- Astroinformatics2018-Students
- baseball
- Baseball Collaboration
- GerardsDatabases
- HEASARC software user group
- Polybase
- TamasClas
- TamasTest

ADASS2019Demo

Shared Files

- ADASS2019Demo
- ADASS2019DemoD [ata](#)

Shared Data Volume

Share Data Volume with this group to see them here.

Shared Compute Images

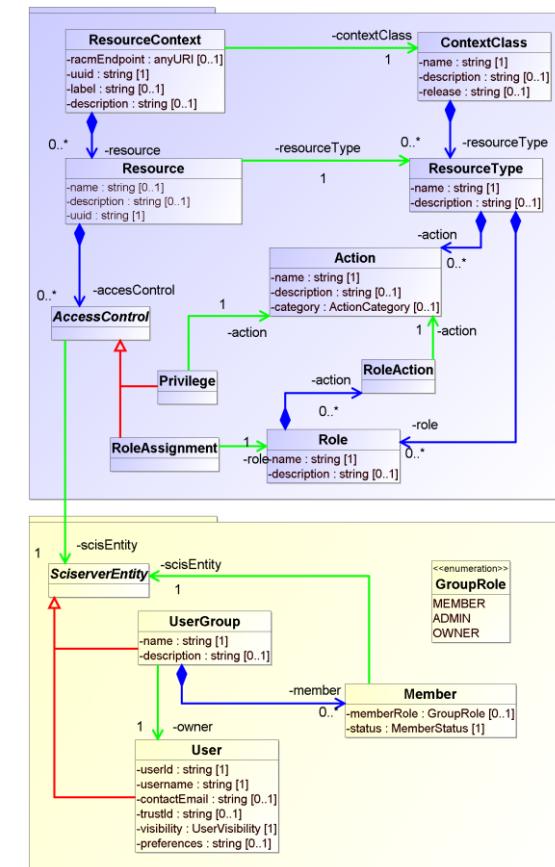
Share compute images with this group to see them here.

Shared Databases

Share database context with this group to see them here.

Powered by:

SciServer – 2.1.1 Dashboard - 2.1.2



Groups		
in		
admin		
Astroinformatics2018-Students		
Delete group		
ChinaMigration		
COMPMAdmin		
Eddies in Fluid		
FinTechAI-Group		
Indra Simulations Group		
Red Sequence in DECaLS		
SCISERVER_testing		
Streaming		
UCLA Machine Learning Group		
Working-MEDE		

Astroinformatics2018-Students

Participants in the 2018 Astroinformatics Summer School
<http://astrostatistics.psu.edu/su18/>

Shared Files

Lessons for Astroinformatics 2018 Shared Space for Astroinformatics 2018 Participants

Shared Data Volume

Share Data Volume with this group

Shared Compute Images

Share compute images with this group

Shared Databases

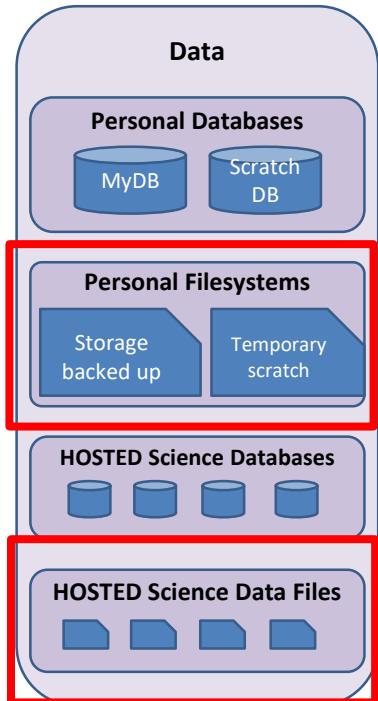
Share database context with this group

Astroinformatics 2018

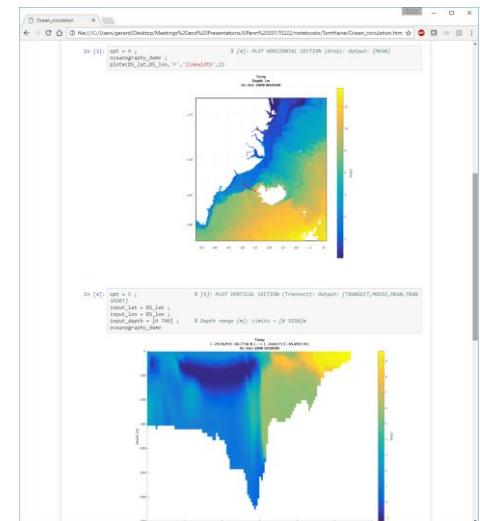
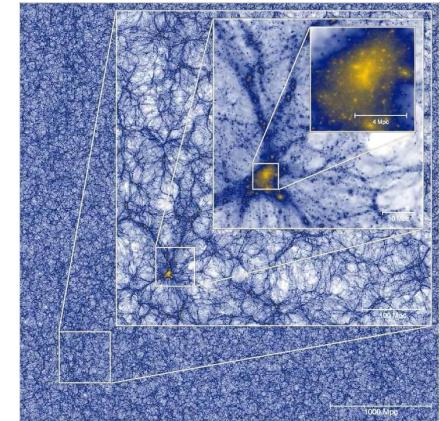
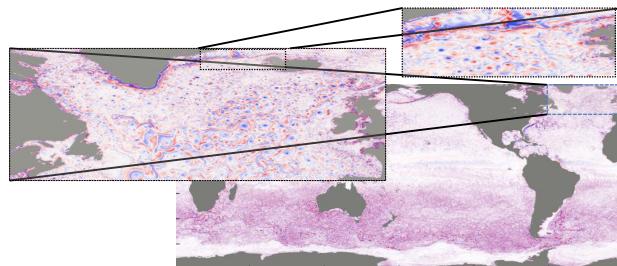
SciServer Home Files Groups Resources gerard

Files Service View Quotas		
	Name ↓	Last Modified
	.ipynb_checkpoints	2018-06-04 23:15:39
	Day_2-Data_Mining	2018-06-04 08:16:09
	Day_2-Machine_Learning	2018-07-16 13:07:44
	Day_3-Bayesian_Computing	2018-06-06 17:25:59
	Day_4-Approximate_Bayesian_Computing	2018-06-06 15:20:38
	Day_4-Gaussian_Processes_Emulation	2018-06-07 16:09:05
	Day_4-Hierarchical_Bayesian_Modeling	2018-06-07 07:27:54
	Day_5-Neural_Networks	2018-06-27 14:35:18
	setup	2018-06-08 12:00:38
	Day_3-Machine_Learning	2018-06-04 23:14:25 22 Bytes

Storage: File System

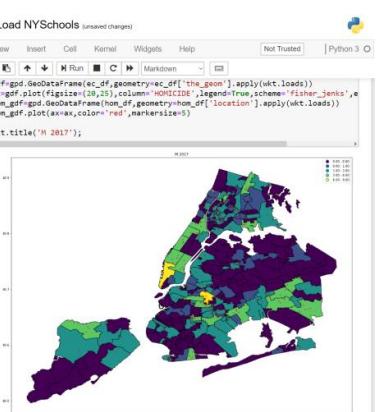
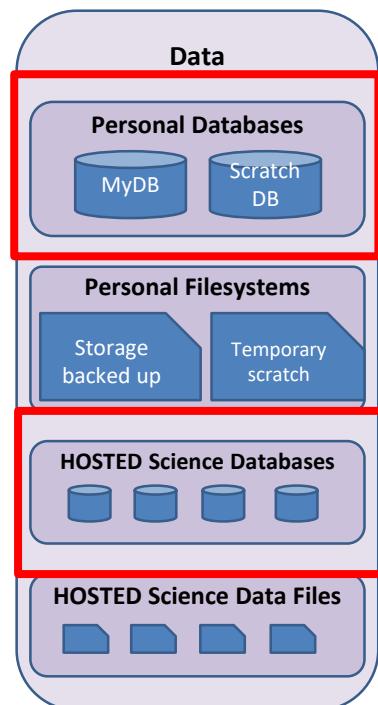


- “Flat file” storage
 - Public data sets: SDSS images, Recount, Ocean and Cosmology simulations
 - Personal: backed up storage and scratch



Storage: Database

- Databases
 - Public project databases: SDSS, Turbulence, Cosmology
 - Personal (MyDB, MyScratch)
 - **Option: build your own, on Datascope or SciServer DB**
 - Introduce scientists to new technology
 - Easy to teach to students
 - Greatly facilitates many analysis tasks
 - Advanced functions, e.g. GIS
 - Direct access to DB servers, often on Datascope
 - **Bring your own:**
 - Millennium Run mirror



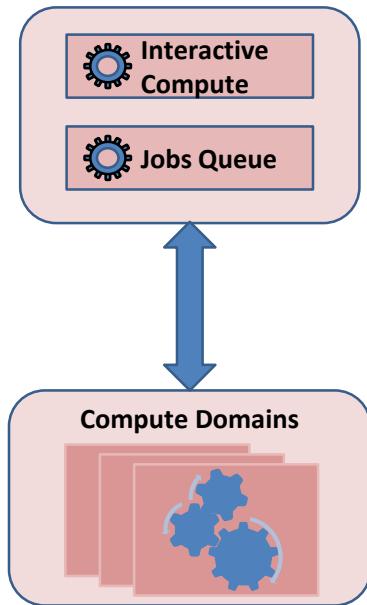


The screenshot shows the Microsoft SQL Server Management Studio interface. The left pane displays the Object Explorer with a tree view of the database structure. The right pane contains a query editor window with the following T-SQL code:

```
SELECT TOP (100) [id],[name],[description],[location],[last_update],[parent],[category],[category_id],[category_name],[category_level],[category_order],[category_type],[category_value],[category_weight],[category_x],[category_y],[category_z],[category_x2],[category_y2],[category_z2],[category_x3],[category_y3],[category_z3],[category_x4],[category_y4],[category_z4],[category_x5],[category_y5],[category_z5],[category_x6],[category_y6],[category_z6],[category_x7],[category_y7],[category_z7],[category_x8],[category_y8],[category_z8],[category_x9],[category_y9],[category_z9],[category_x10],[category_y10],[category_z10],[category_x11],[category_y11],[category_z11],[category_x12],[category_y12],[category_z12],[category_x13],[category_y13],[category_z13],[category_x14],[category_y14],[category_z14],[category_x15],[category_y15],[category_z15],[category_x16],[category_y16],[category_z16],[category_x17],[category_y17],[category_z17],[category_x18],[category_y18],[category_z18],[category_x19],[category_y19],[category_z19],[category_x20],[category_y20],[category_z20],[category_x21],[category_y21],[category_z21],[category_x22],[category_y22],[category_z22],[category_x23],[category_y23],[category_z23],[category_x24],[category_y24],[category_z24],[category_x25],[category_y25],[category_z25],[category_x26],[category_y26],[category_z26],[category_x27],[category_y27],[category_z27],[category_x28],[category_y28],[category_z28],[category_x29],[category_y29],[category_z29],[category_x30],[category_y30],[category_z30],[category_x31],[category_y31],[category_z31],[category_x32],[category_y32],[category_z32],[category_x33],[category_y33],[category_z33],[category_x34],[category_y34],[category_z34],[category_x35],[category_y35],[category_z35],[category_x36],[category_y36],[category_z36],[category_x37],[category_y37],[category_z37],[category_x38],[category_y38],[category_z38],[category_x39],[category_y39],[category_z39],[category_x40],[category_y40],[category_z40],[category_x41],[category_y41],[category_z41],[category_x42],[category_y42],[category_z42],[category_x43],[category_y43],[category_z43],[category_x44],[category_y44],[category_z44],[category_x45],[category_y45],[category_z45],[category_x46],[category_y46],[category_z46],[category_x47],[category_y47],[category_z47],[category_x48],[category_y48],[category_z48],[category_x49],[category_y49],[category_z49],[category_x50],[category_y50],[category_z50],[category_x51],[category_y51],[category_z51],[category_x52],[category_y52],[category_z52],[category_x53],[category_y53],[category_z53],[category_x54],[category_y54],[category_z54],[category_x55],[category_y55],[category_z55],[category_x56],[category_y56],[category_z56],[category_x57],[category_y57],[category_z57],[category_x58],[category_y58],[category_z58],[category_x59],[category_y59],[category_z59],[category_x60],[category_y60],[category_z60],[category_x61],[category_y61],[category_z61],[category_x62],[category_y62],[category_z62],[category_x63],[category_y63],[category_z63],[category_x64],[category_y64],[category_z64],[category_x65],[category_y65],[category_z65],[category_x66],[category_y66],[category_z66],[category_x67],[category_y67],[category_z67],[category_x68],[category_y68],[category_z68],[category_x69],[category_y69],[category_z69],[category_x70],[category_y70],[category_z70],[category_x71],[category_y71],[category_z71],[category_x72],[category_y72],[category_z72],[category_x73],[category_y73],[category_z73],[category_x74],[category_y74],[category_z74],[category_x75],[category_y75],[category_z75],[category_x76],[category_y76],[category_z76],[category_x77],[category_y77],[category_z77],[category_x78],[category_y78],[category_z78],[category_x79],[category_y79],[category_z79],[category_x80],[category_y80],[category_z80],[category_x81],[category_y81],[category_z81],[category_x82],[category_y82],[category_z82],[category_x83],[category_y83],[category_z83],[category_x84],[category_y84],[category_z84],[category_x85],[category_y85],[category_z85],[category_x86],[category_y86],[category_z86],[category_x87],[category_y87],[category_z87],[category_x88],[category_y88],[category_z88],[category_x89],[category_y89],[category_z89],[category_x90],[category_y90],[category_z90],[category_x91],[category_y91],[category_z91],[category_x92],[category_y92],[category_z92],[category_x93],[category_y93],[category_z93],[category_x94],[category_y94],[category_z94],[category_x95],[category_y95],[category_z95],[category_x96],[category_y96],[category_z96],[category_x97],[category_y97],[category_z97],[category_x98],[category_y98],[category_z98],[category_x99],[category_y99],[category_z99],[category_x100],[category_y100],[category_z100]
```

The results grid below the query editor shows 100 rows of data, each corresponding to a category entry from category_id 1 to category_id 100. The columns include id, name, description, location, last_update, parent, category, category_id, category_name, category_level, category_order, category_type, category_value, category_weight, and various x, y, z coordinates.

Compute



- Software
 - Private containerized environment
 - Public set of compute *images*:
 - python, R, Julia
 - machine learning libraries, e.g. TensorFlow
 - Run python/R/Matlab/... notebooks interactively
 - Submit larger jobs to batch queue
 - **Option: design your own image**
- Hardware
 - Bunch of SciServer provided servers
 - Up to 256GB RAM, 32 cores per job
 - Soon: GPUs and connecting with MARCC

SciServer Compute

SciServer Compute

Interactive Notebooks | Jobs

Now Available: JupyterLab and Classical Jupyter images are now combined. Containers default to the classical interface and will remember the last interface used.

Containers

Created At	Name	Domain	Image	Status
2019-10-06 07:35:21.0	ADASS 2019 interactive GPU domain	GPU Interactive	TensorFlow	running
2019-10-02 08:36:11.0	heasoft	Interactive	Heasarc	stopped
2019-10-01 16:24:04.0	montage	Interactive	Montage	stopped
	2019-pytorch	Interactive	PyTorch	running
	edb	Interactive	Python + R	stopped
	and aris	Interactive	Python + R	stopped
	sh	Interactive	BeakerX	stopped
	y + III + ukbiobank	Interactive	WFIRST-Archive SIT	stopped

jupyter 2. Stripe82-coadd-Copy1 Last Checkpoint: a minute ago (autosaved)

File Edit View Insert Cell Kernel Help

In [340]:

```
gdf=gpd.GeoDataFrame(ec_df[geometry=ec_df['the_geom'].apply(wkt.loads)])
ax=gdf.plot(figsize=(20,20),column='HOMICIDE',legend=True,scheme='fisher_jenks',cmap='viridis')
hom_gdf=gpd.GeoDataFrame(hom_df[geometry=hom_df['location'].apply(wkt.loads)])
hom_gdf.plot(ax=ax,color='red',markersize=5)
plt.title('M 2017');
```

Container File Storage

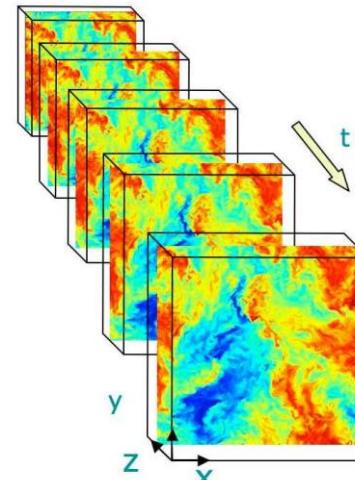
Jupyter notebooks in a Container's file system should not be used to store your files. Your initial container view is of /home/idies/workspace, which

File Edit View Insert Cell Kernel Widgets Help Not Trusted Python 3 O

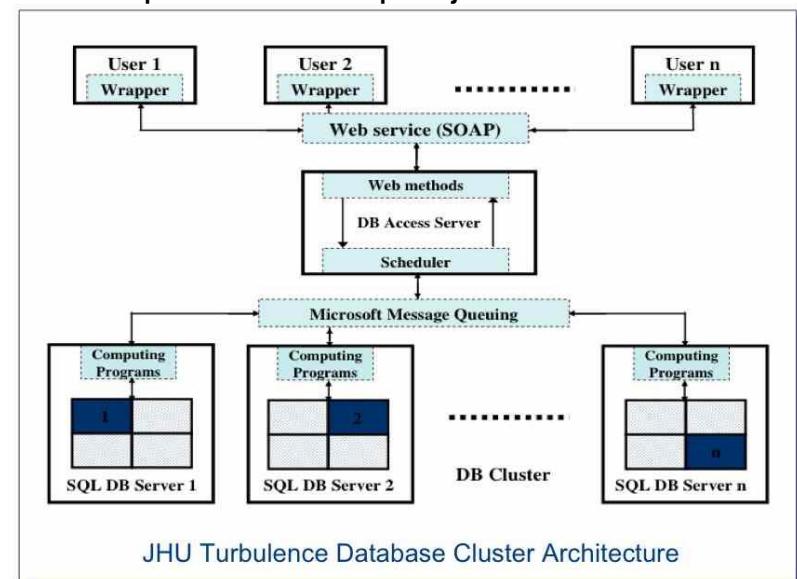
Intro demo

Immersive Turbulence

- Website exposing Fluid dynamic simulations
- MS SQL Server Databases
- 100TB+ of data
- Spatial cutout webservice
- Fast Fourier transforms in DB
- Shoot test particles (sensors) from Laptop into simulation (like the movie “Twister”)
- 77 Trillion “sensors” queried by public



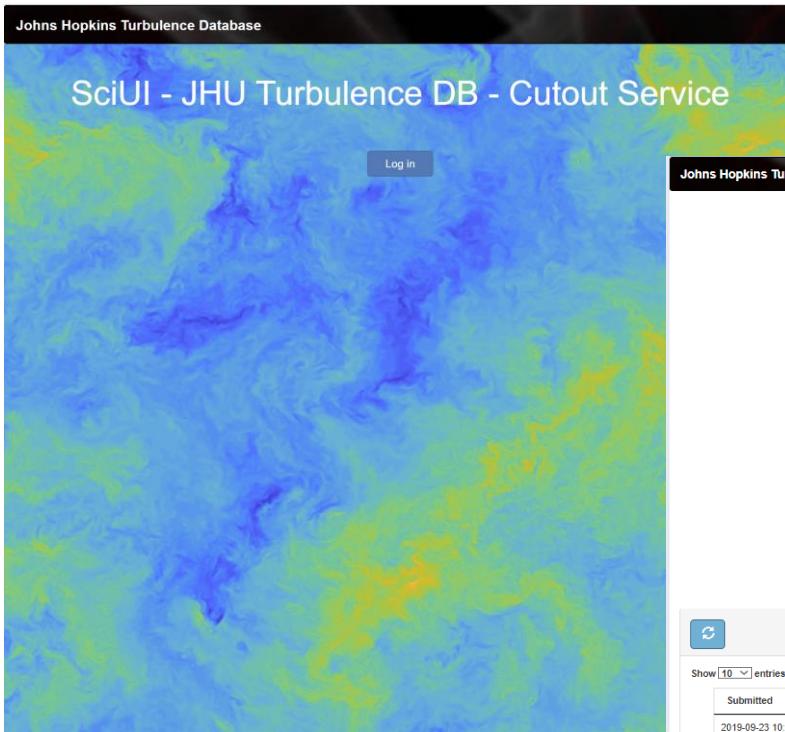
<http://turbulence.pha.jhu.edu/>



JHU Turbulence Database Cluster Architecture



SciUI for TurbCutout



Johns Hopkins Turbulence Database

SciUI - JHU Turbulence DB - Cutout Service

Log in

Johns Hopkins Turbulence Database

Instructions:

- Enter your turbulence token and select your desired cutout parameters.
- Note, if you keep the default token you cannot create cutouts larger than 4096 cells.
- Click on the submit button to start a new cutout job.
- Links to the results can be found in the jobs list below.

Job Name :

(optional)

Token :

edu.jhu.pha.turbulence.testing-201406

Enter your personal turbulence token here.

Dataset :

Channel

Function :

Velocity

	Start:	End:	Stride:
T [1-4000]	1	1	1
X [1-2048]	1	10	1
Y [1-512]	1	10	1
Z [1-1536]	1	10	1

Submit Cutout

Jobs List

Submitted	Runtime Info	Input	Results
2019-09-23 10:31:17	Job name: __turbcutout__concurrent 2 Status: SUCCESS Job Id: 56883 Duration: 4m, 53.659s.	{"dataset": "isotropic1024fine", "filter_width": 1, "function": "u", "output_filename": "isotropic1024fine", "stride": 1, "stridex": 1, "stridey": 1, "stridez": 1, "te": 4, "token": "uk.ac.manchester.zhao.wu-ea658424", "ts": 4, "xe": 512, "xs": 1, "ye": 1024, "ys": 1, "ze": 512, "zs": 1}	Job Folder isotropic1024fine.h5 isotropic1024fine.xmf notebook
2019-09-23 10:31:12	Job name: __turbcutout__concurrent 2 Status: SUCCESS Job Id: 56880 Duration: 4m, 45.757s.	{"dataset": "isotropic1024fine", "filter_width": 1, "function": "u", "output_filename": "isotropic1024fine", "stride": 1, "stridex": 1, "stridey": 1, "stridez": 1, "te": 4, "token": "uk.ac.manchester.zhao.wu-ea658424", "ts": 4, "xe": 512, "xs": 1, "ye": 1024, "ys": 1, "ze": 512, "zs": 1}	Job Folder isotropic1024fine.h5 isotropic1024fine.xmf notebook
2019-09-23 10:31:06	Job name: __turbcutout__concurrent 2	{"dataset": "isotropic1024fine", "filter_width": 1, "function": "u", "output_filename": "isotropic1024fine", "stride": 1, "stridex": 1, "stridey": 1, "stridez": 1, "te": 4, "token": "uk.ac.manchester.zhao.wu-ea658424", "ts": 4, "xe": 512, "xs": 1, "ye": 1024, "ys": 1, "ze": 512, "zs": 1}	Job Folder isotropic1024fine.h5

Show 10 entries

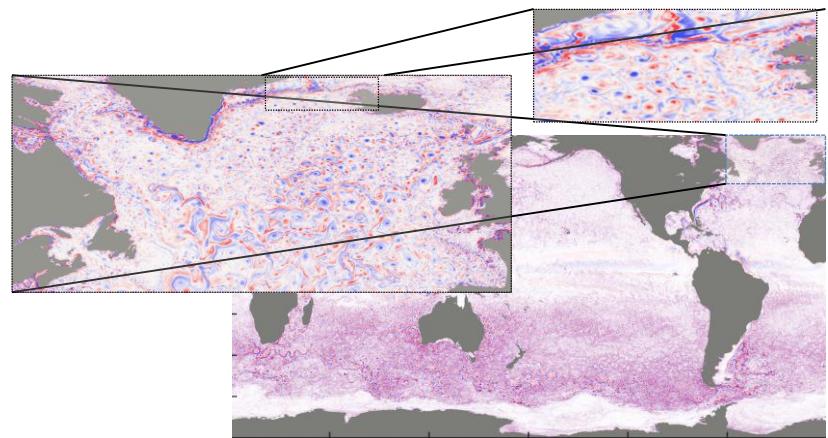
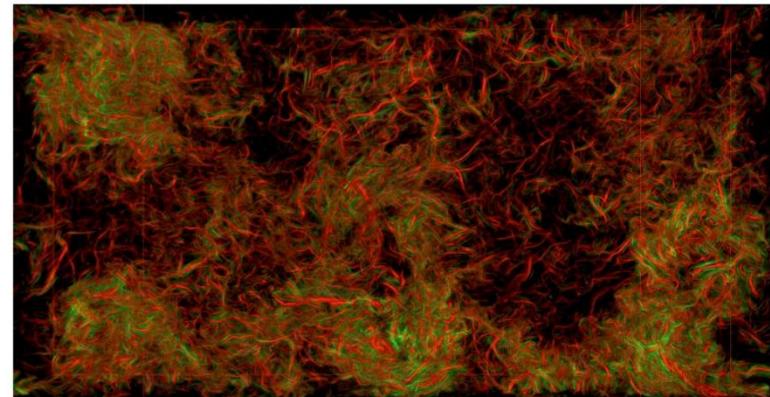
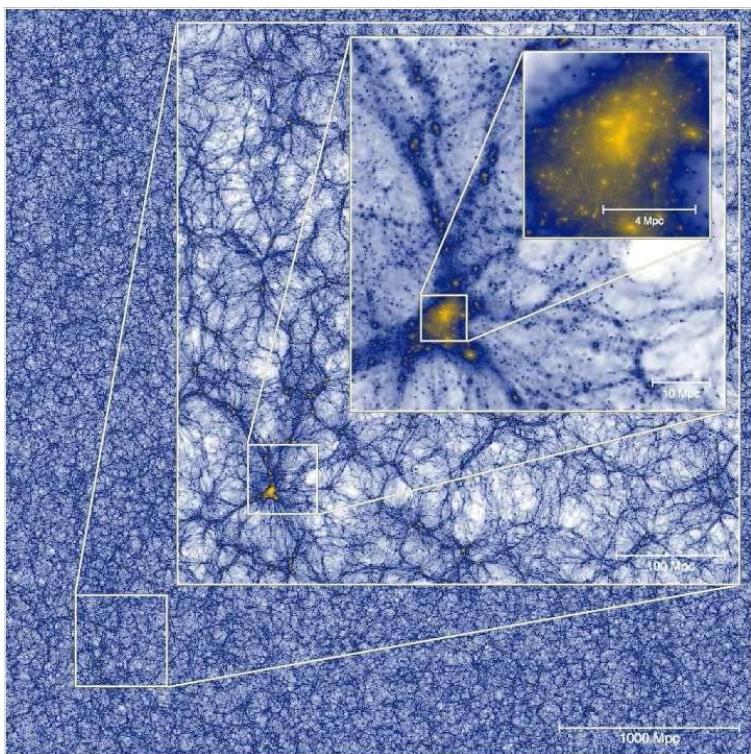
Search:

<http://turbulence.idies.jhu.edu/cutout>

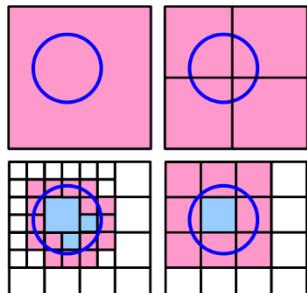
SciServer



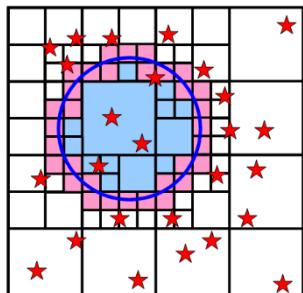
FileDB



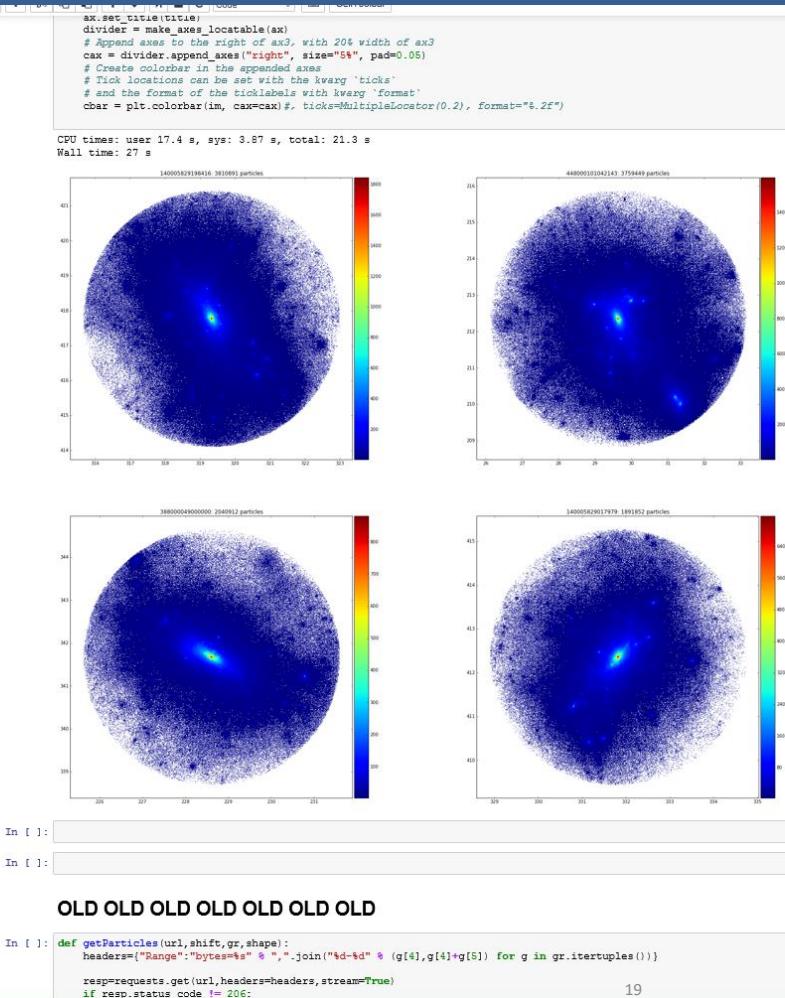
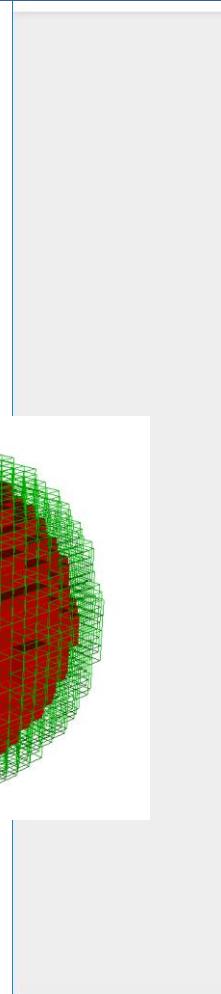
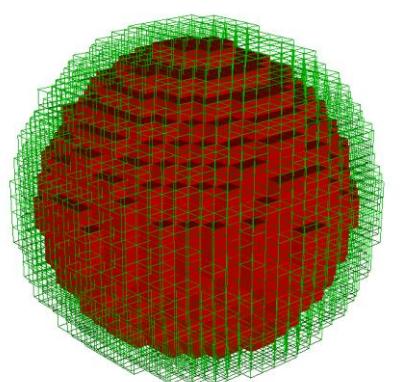
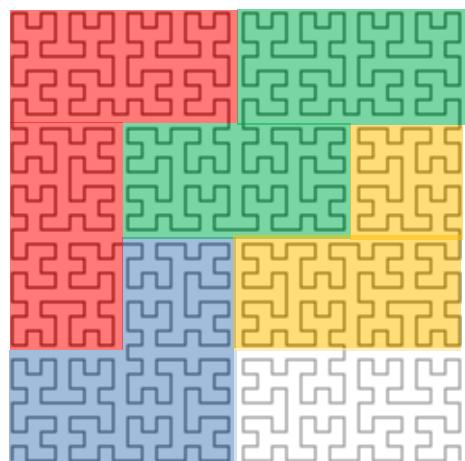
3D Spatial querying

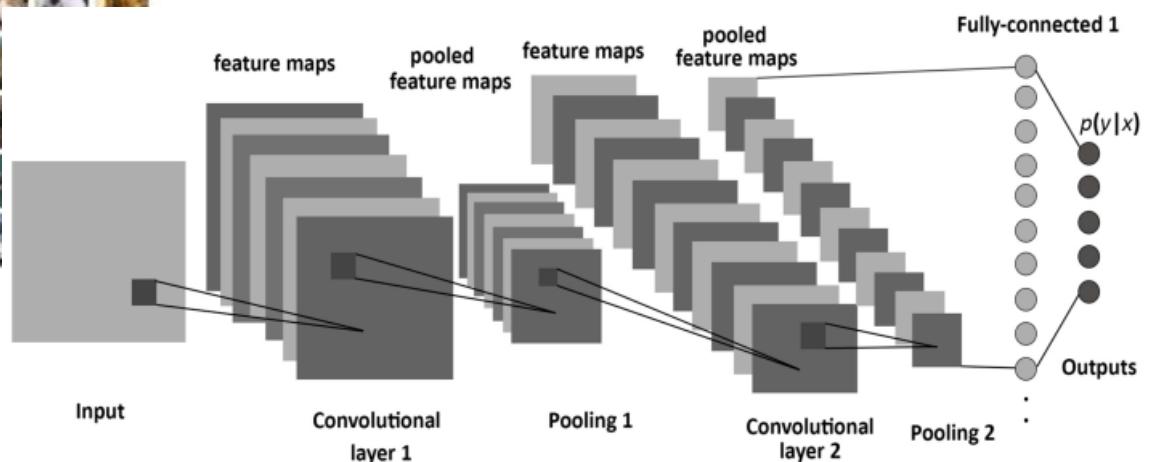


(a)



(b)





Thanks to Adi Devarakonda



Share trained models

SciServer Home Files Groups Admin Resources

Groups + ad ADASS2019Demo Leave group admin BARReader COMPMAdmin NYSchoolsAdmin PARADIM paradigm_data_modeling RACMAdmins Tornados

SciServer Home Files Groups Admin Resources

Volumes User Volumes Data Volumes

Files Service View Quotas

Temporary / gerard / ADASS2019DemoData / CNN

Name	Last Modified	Size
cifar-10-batches-py	2009-06-04 22:47:42	
cifar-10-python.tar.gz	2019-09-30 20:51:35	162.6 MB
model_chkpt.pth	2019-10-03 22:47:38	74.5 MB
model_chkpt_test.pth	2019-10-02 18:17:22	74.4 MB

Use pre-calculated pytorch model for classification

Jupyter PyTorch CNN Inference - CPU Last Checkpoint: 42 minutes ago (unsaved)

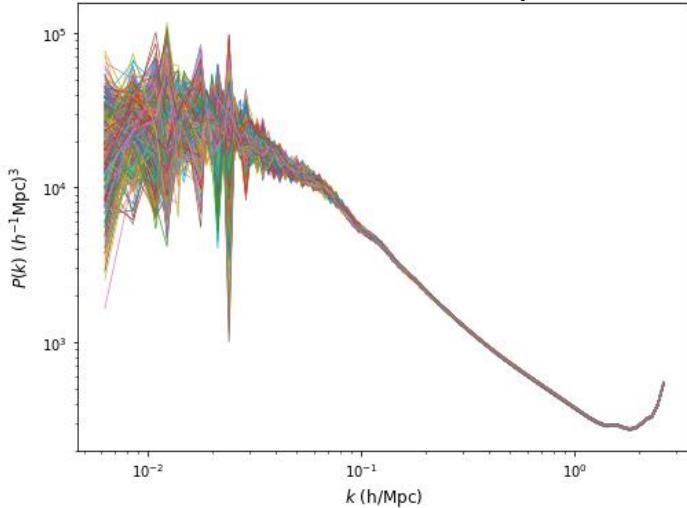
File Edit View Insert Cell Kernel Widgets Help

Restoring Model... Restored Model from [Epoch: 126, Iteration: 0] Loss: 0.001 Performing inference...

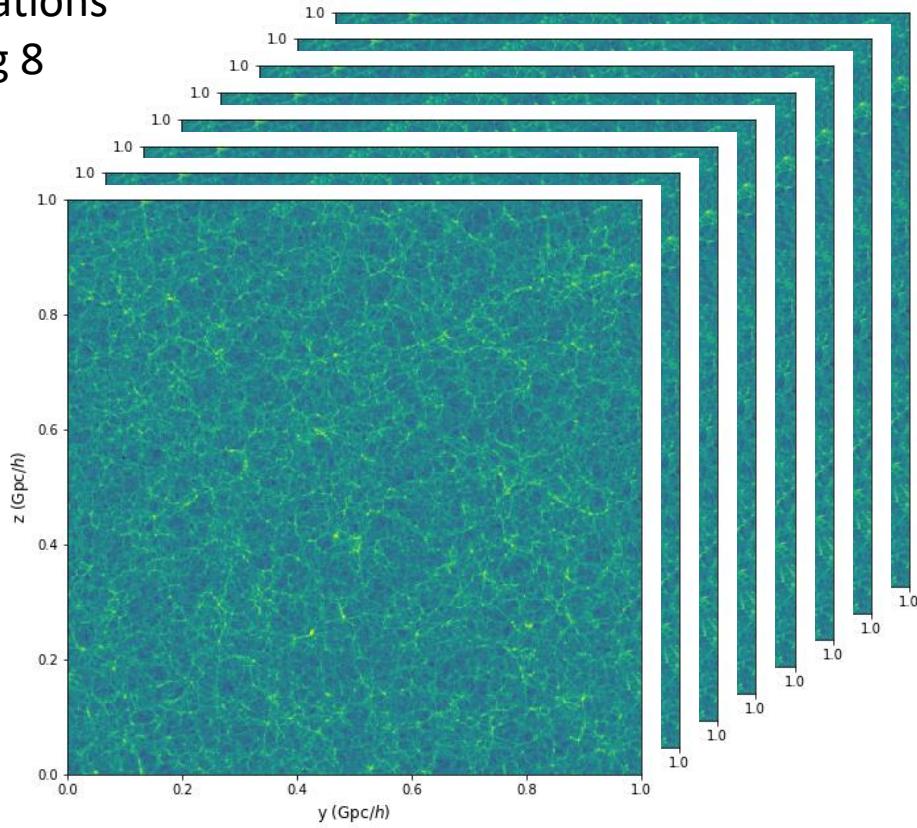
dog ship ship bird
truck truck deer car
cat deer plane deer

Massive parallel analysis of cosmological simulations
448 Cloud-In-Cell density grids in 2 hours, using 8
DASK workers on distributed file system

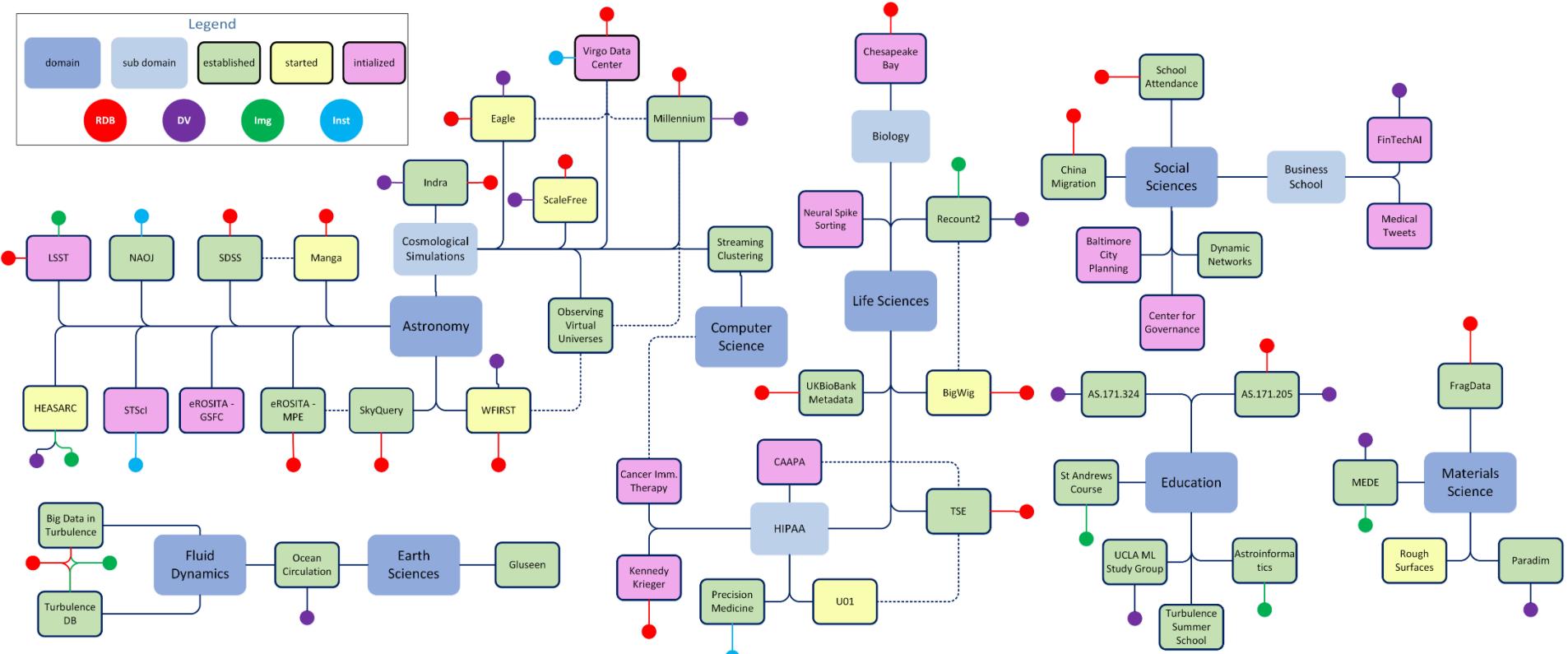
Each simulation has 1 billion particles



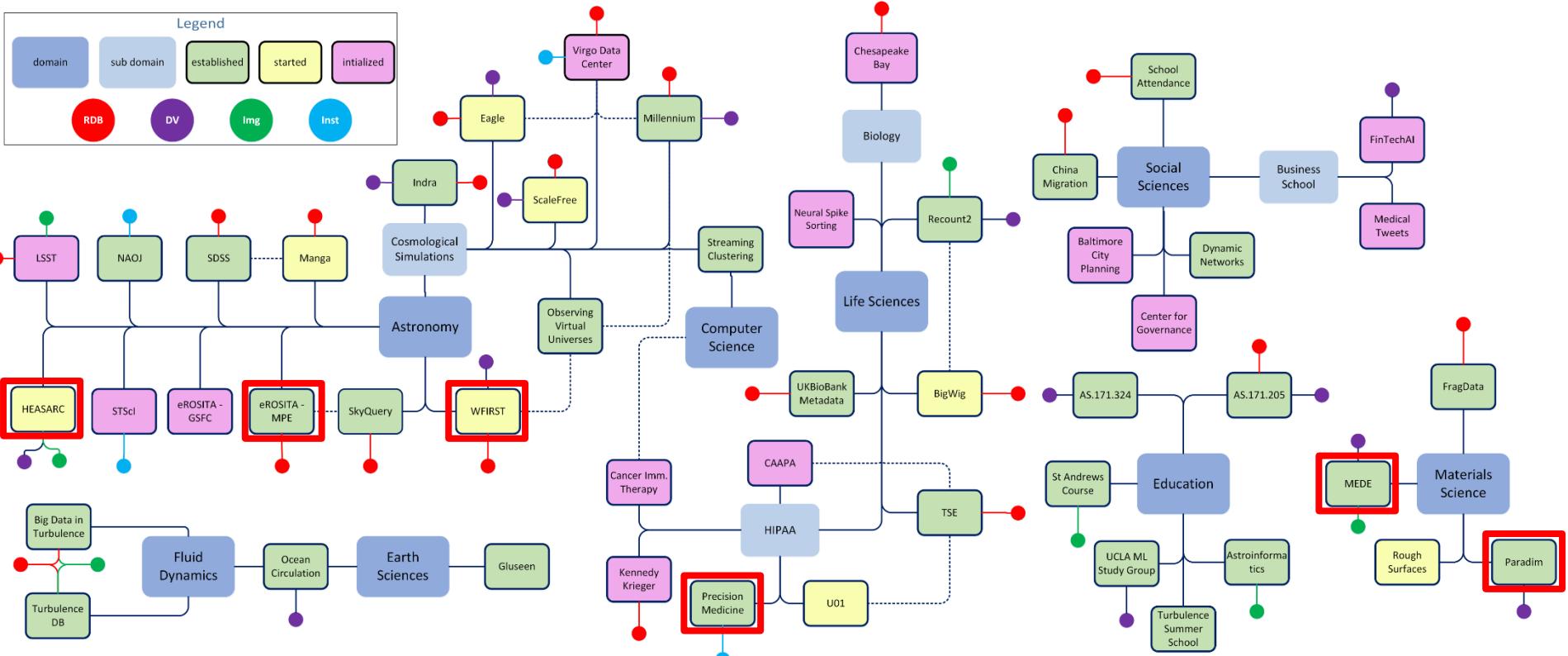
Thanks to Bridget Falck



SciServer Projects



SciServer Projects





PMAP: crunchr

The image shows a Windows desktop environment. On the left, there is a vertical sidebar with various icons and links:

- Recycle Bin
- Hopkins Applications
- SAFE Applications
- CORUS
- Disconnect
- IT@JH Remo...
- PMAP Tools
- MyJH
- Microsoft Office

JOHNS HOPKINS UNIVERSITY & MEDICINE

In the center, there is a large window titled "WELCOME TO SAFE". The title "SAFE" is in large yellow letters, with "SECURE ANALYTIC FRAMEWORK ENVIRONMENT" stacked below it. A teal-colored gear-like graphic surrounds the text. At the bottom of this window, there is a note about the SAFE desktop's purpose and how to contact the steering committee.

To the right of the desktop, a web browser window is open to the URL <https://crunchr-dev.pm.jh.edu>. The browser title bar says "crunchr User". The main page of the website is displayed, featuring the word "crunchr" in large white letters. Below it is a navigation menu with "Home", "Files", "Groups", and "Compute" tabs. The "Home" tab is currently selected. Below the menu, there are four cards: "Files" (with a folder icon), "Groups" (with a user icon), "Compute" (with a server icon), and "Jobs" (with a document icon). The status bar at the bottom of the browser window shows "Powered by: SciServer idies JOHNS HOPKINS".



SciServer @ MPE

eROSITA is funded by the German Aerospace Centre DLR and the Max Planck Society. The Max Planck Institute for Extraterrestrial Physics (MPE) is the leading institute for the project, which is carried out in close collaboration with other German research institutes and the IKI in Moscow.

Important academic and industry partners:

Max Planck Institute for Extraterrestrial Physics, Garching, Germany

Max Planck Institute for Astrophysics, Garching, Germany

German Aerospace Centre DLR, Bonn, Germany

ROSKOSMOS, Moscow, Russia

Space Research Institute (IKI), Moscow, Russia

Dr. Remeis Observatory Bamberg, University Erlangen-Nürnberg, Germany

Hamburg Observatory, University Hamburg, Germany

Institute for Astronomy and Astrophysics (IAA), University Tübingen, Germany

Leibniz Institute for Astrophysics Potsdam (AIP), Germany

University Observatory Munich, Germany

Argelander Institute, University Bonn, Germany

Excellence Cluster Universe, Munich, Germany

RUAG Space GmbH, Vienna, Austria

Carl Zeiss AG, Oberkochen, Germany

Lavochkin Association, Moscow, Russia

Invent GmbH, Braunschweig, Germany

Kayser-Threde GmbH, Munich, Germany

HPS GmbH, Munich, Germany

Media Lario Technologies, Bosso Parini, Italy

Tecnotron GmbH, Weißensberg, Germany

pnSensor GmbH, Munich, Germany

iABG mbH, Ottobrunn, Germany

LaserJob GmbH, Fürstenfeldbruck, Germany

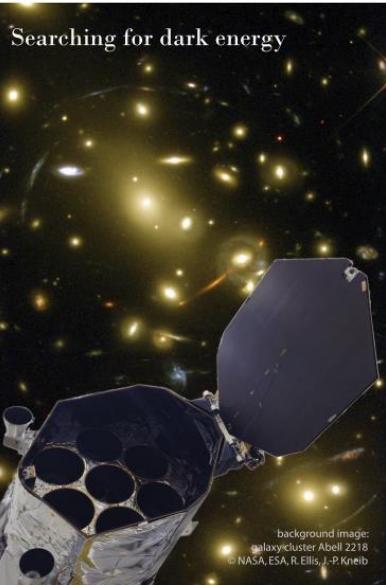
IberEspacio, Madrid, Spain



eROSITA

the whole sky in X-rays

Searching for dark energy



Hobby-Eberly Telescope [Martin Harris/McDonald Observatory]

National Aeronautics and Space Administration
Goddard Space Flight Center
Sciences and Exploration

GO Search HEASARC website [Advanced Search]

HEASARC Quick Links
---Quick Links---

HEASARC Home Observatories Archive Calibration Software Tools Students/Teachers/Public

NASA's HEASARC
High Energy Astrophysics Science Archive Research Center

About the HEASARC Resources for Scientists Feedback, FAQ & Help Desk Site Map Other Archives

Active Guest Observer Facilities/Science Centers

AGILE	AstroSat
Chandra	Fermi
Hitomi	INTEGRAL
MAXI	NICER
NuSTAR	SRG/eROSITA
Swift	TESS
XMM-Newton	XRISM

The High Energy Astrophysics Science Archive Research Center (HEASARC) is the primary archive for NASA's (and other space agencies') missions studying electromagnetic radiation from extremely energetic cosmic phenomena ranging from black holes to the Big Bang. Since its merger with the Legacy Archive for Microwave Background Data Analysis ([LAMBDA](#)) in 2008, the HEASARC archive contains data obtained by high-energy astronomy missions observing in the extreme-ultraviolet (EUV), X-ray, and gamma-ray bands, as well as data from space missions, balloons, and ground-based facilities that have studied the relic cosmic microwave background (CMB) radiation in the sub-mm, mm and cm bands.

The HEASARC is a member of the [NASA Astronomical Virtual Observatories \(NAVO\)](#) where we work with other NASA archives to ensure comprehensive and consistent VO access to NASA mission datasets. Users may now query the HEASARC's catalogs using VO-enabled services and specialized tools. [This page](#) describes how to get to the HEASARC VO-enabled services and provides information on other HEASARC VO activities.

Recent X-Ray Missions

- ARCA**
- BeppoSAX**
- RXTE**
- XMM-Newton (XSA)**
- Chandra (CXO)**
- Past X-Ray Missions**
- BIXRT**
- Copernicus**
- Ginga**
- Uwits**
- HETE-2**
- Gamma-Ray Bursts**

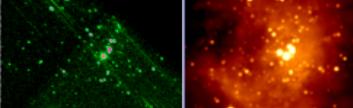
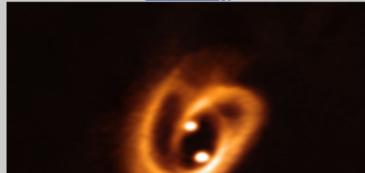
Other Archives

Historic Guest Observer Facilities/Science Centers

ASCA	BeppoSAX
CGRO	COBE
EUVE	GALEX
HETE-2	LPF DRS
ROSAT	RXTE
Suzaku	WMAP

APOD: Astronomy Picture of the Day

HEASARC Picture of the Week

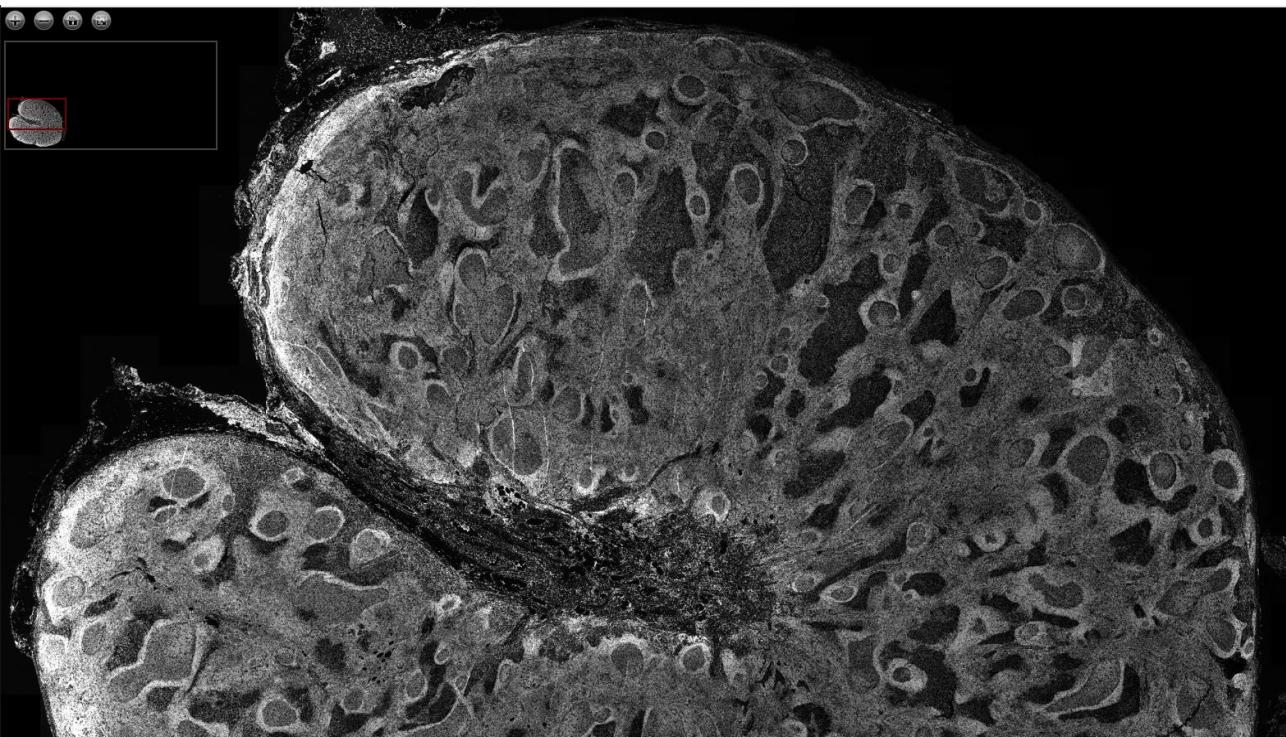



Latest News

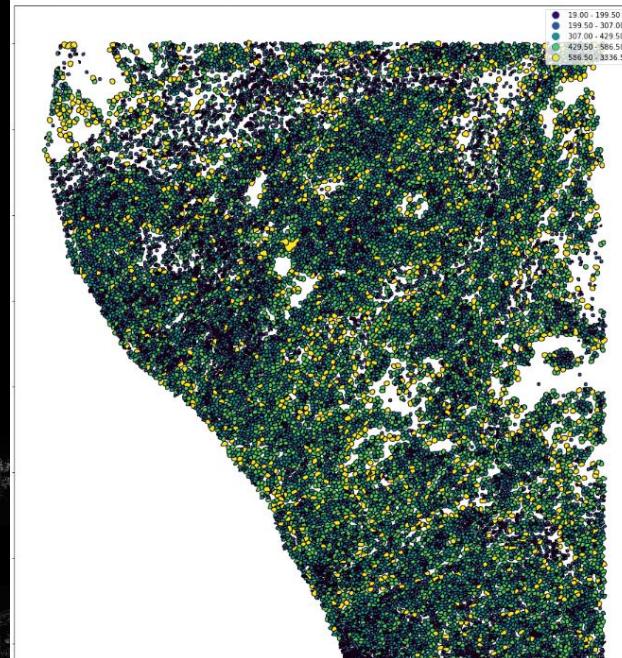
- [NuSTAR CALDB Update](#) (16 Oct 2019)
The NuSTAR CALibration DataBase was updated on October 16, 2019 (CALDB version 20191008). This updates the NuSTAR clock correction file to version 96, valid through 2019-10-08.
- [NICER Stowed Due to ISS Operations](#) (15 Oct 2019)
In support of ISS operations, NICER has been stowed since Sunday, October 13. As a result, NICER is not currently taking requests for Target of Opportunity observations. We anticipate that NICER observations will resume as soon as the ISS operations are completed.
- [NICER observations of the X-ray transient MAXI J1807+132: flaring activity](#) (08 Oct 2019)
NICER has been monitoring the X-ray transient MAXI J1807+132 regularly since September 16. During this time, NICER detected brief, sudden episodes of X-ray brightening which may be analogous to similar flaring behavior seen near the end of the 2017 outburst of the source.
- [Fermi Science Tools Updated](#) (07 Oct 2019)



Cell view: Taube group



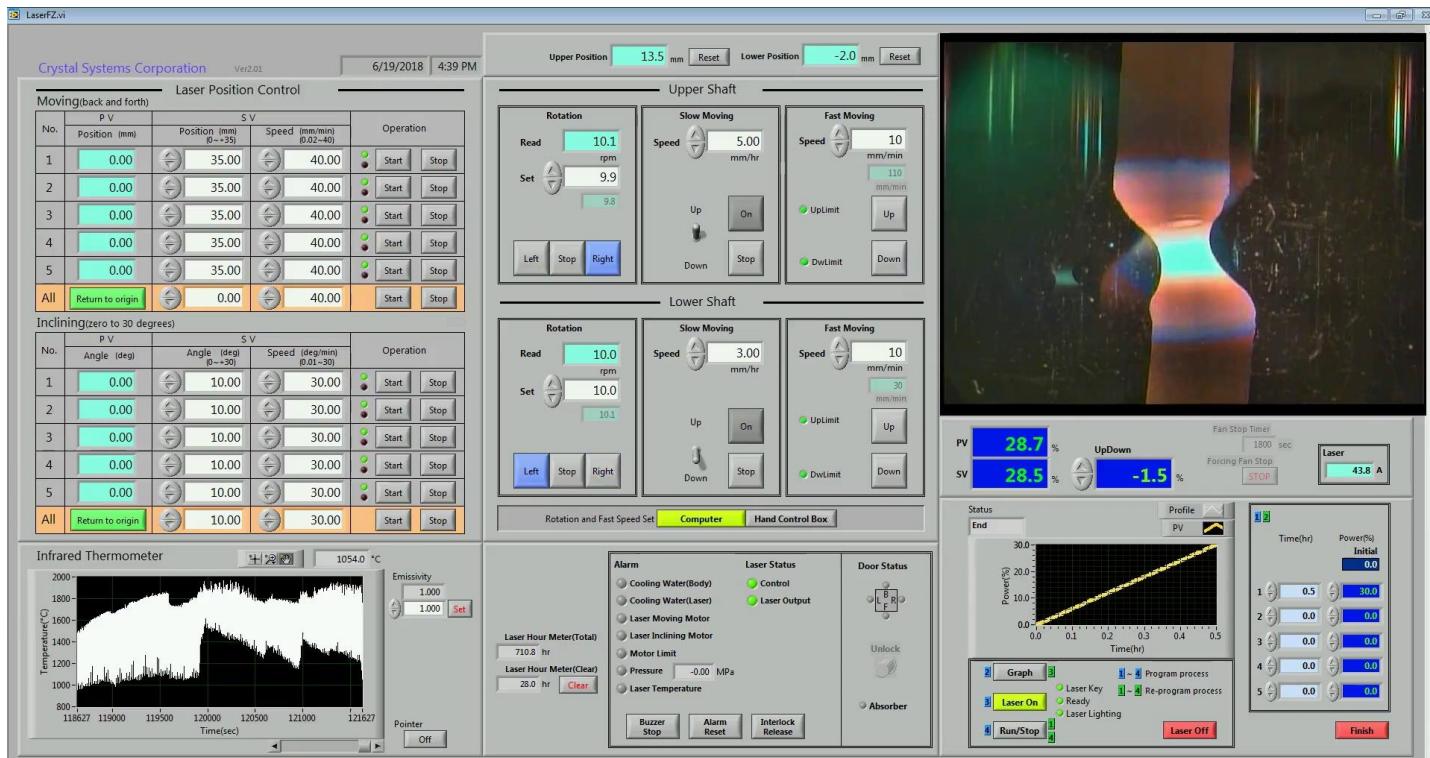
```
transform to GeoPandas dataframe, translating the 'wkt' column
pd.read_csv('path_to_your_file.csv')
gdf = pd.read_csv('path_to_your_file.csv')
gdf['geometry'] = gdf['wkt'].apply(wkt.loads)
gdf.plot(figsize=(20,20),column='area',label=gdf['cellid'],legend=True,scheme='fisher_jenks',edgecolor='black')
gdf.plot(figsize=(20,25),color='white',edgecolor='black');
```



SciServer



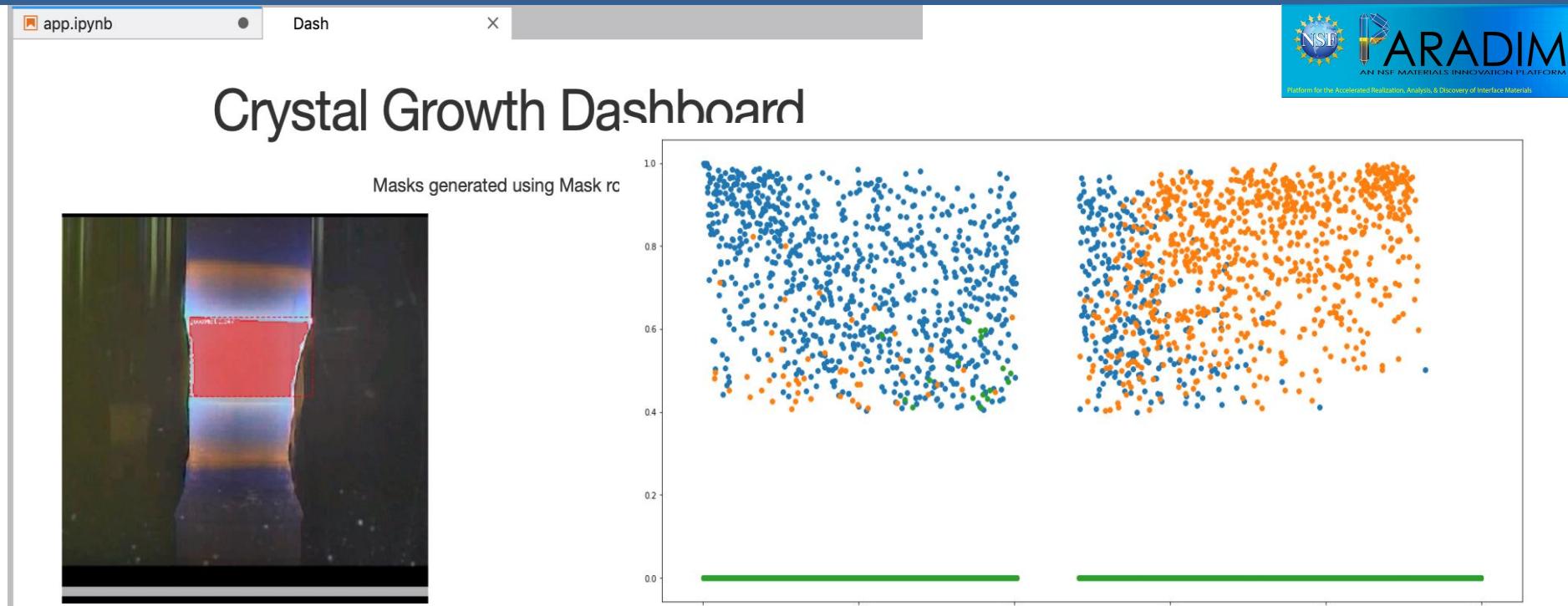
Platform for the Accelerated Realization, Analysis, & Discovery of Interface Materials



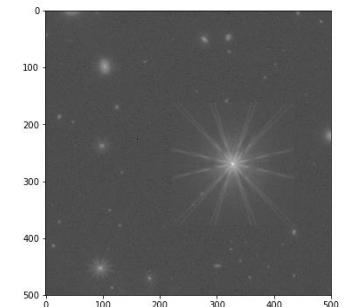
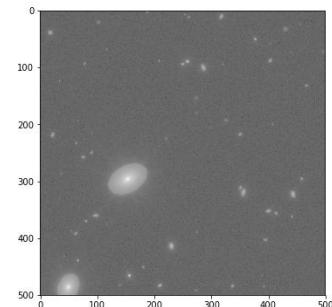
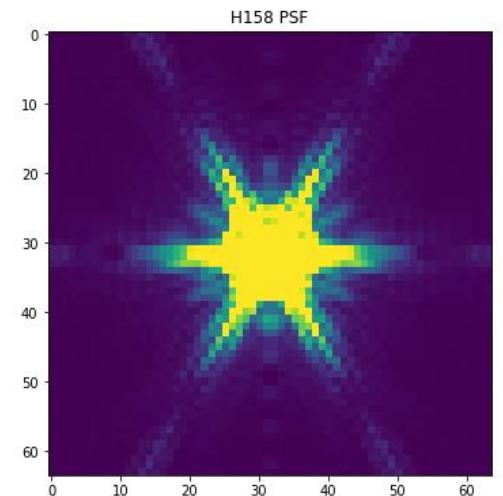
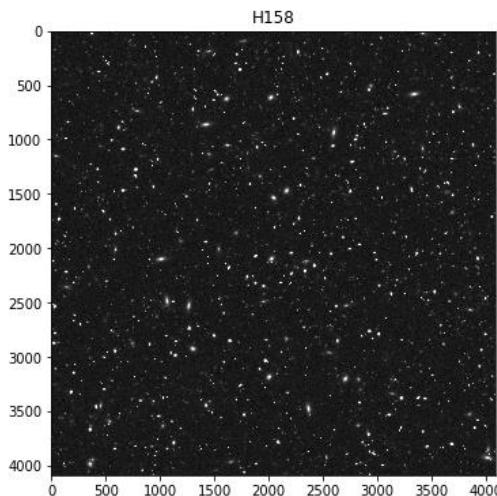
Thanks to Nick Carey, David Elbert, Adam Phelan



Real time tracking



-Floating zone data harvest, storage, classification, and dashboard rendering all execute on the SciServer



Simulate WFI images with *GalSim* or *STIPS*
Pre-installed in WFIRST Compute image

Thanks to Bridget Falck