

# HEASARC

## NASA's High Energy Astrophysics Science Archive Research Center

### Site report by Tess Jaffe

on behalf of

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and

NASA's Astrophysical Virtual Observatories (NAVO)

presented to

IVOA Operations session at Interop October 2022

- HEASARC VO data services:
  - Catalogs
  - Images
  - Spectra
- NAVO/HEASARC Infrastructure Services:
  - Registry
  - Validation
  - Monitoring

# Data Services: catalogs

- Over 1000 catalogs served via Simple Cone Search and Table Access Protocol.

- Mission data in 23 “master” observation catalogs (pre-ObsCore, in progress).
  - Data products provided as DataLinks
- Others are mission or community products.
- Same backend database (Postgres) and code (java) for all.
- TAP service supports uploaded user tables

- Note:

- interested in PyVO for our science platform (SciServer) users to browse data from their Jupyter notebooks.

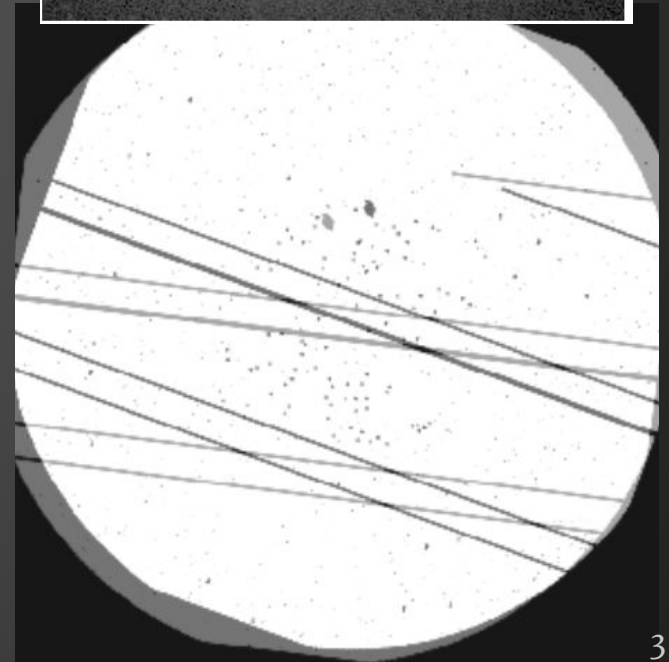
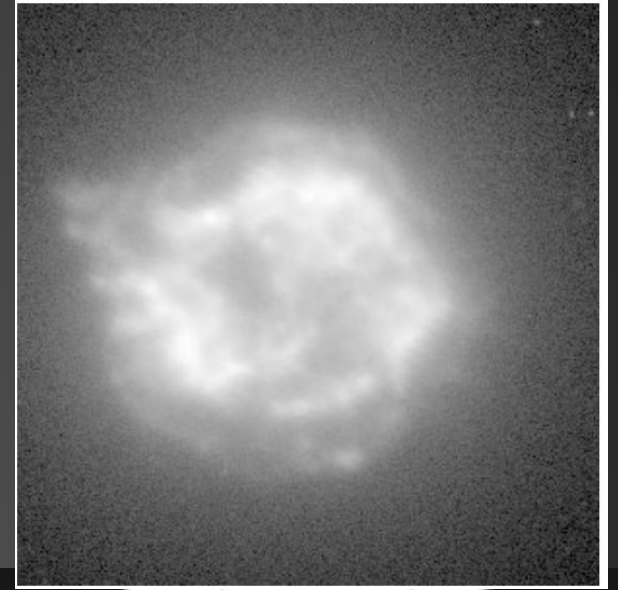
```
query="""
SELECT cat.ra, cat.dec, Radial Velocity, bmag, morph_type
FROM zcat cat, tap_upload.mysources mt
WHERE
contains(point('ICRS',cat.ra,cat.dec),circle('ICRS',mt.ra,mt.dec,0.01))=1
and Radial_Velocity > 0
ORDER by cat.ra"""
zcattable = heasarc.service.run_async(query, uploads={'mysources': 'data/my_sources.xml'})
#zcattable = heasarc.search(query, uploads={'mysources': 'data/my_sources.xml'})
mytable = zcattable.to_table()
mytable
```

Table length=14

ra	dec	radial_velocity	bmag	morph_type
float64	float64	int32	float32	int16
136.0007	21.9679	3093	13.8	20
146.7033	22.0183	7446	14.6	-1
146.7033	22.0183	7597	15.0	-2
148.7781	14.2961	7194	15.1	2
175.0394	15.3273	3325	14.4	3
191.542	30.7323	6651	15.0	20
191.5474	30.7234	6517	14.7	-2
194.9129	28.8954	6093	15.0	0
200.5710	12.8505	2220	15.0	1

# Data Services: images

- 96 Simple Image Access services
  - Most generated by SkyView service (separate server and java code base) from full(ish)-sky surveys
    - Some SkyView surveys are in turn fetched via SIA from elsewhere.
    - Surveys composed of FITS images, HEALPix maps, or HiPS format.
    - Cutouts done on the fly as requested.
    - Highly processed, e.g., Swift XRT image of Cas A (from thousands of observations) in top image
  - The rest fetched from mission archives based on mission master tables
    - Registered as auxiliary services based on the master table's cone service.
    - Individual observations, not all of which are science-ready (see lower image, a single observation of Cas A by Swift XRT)



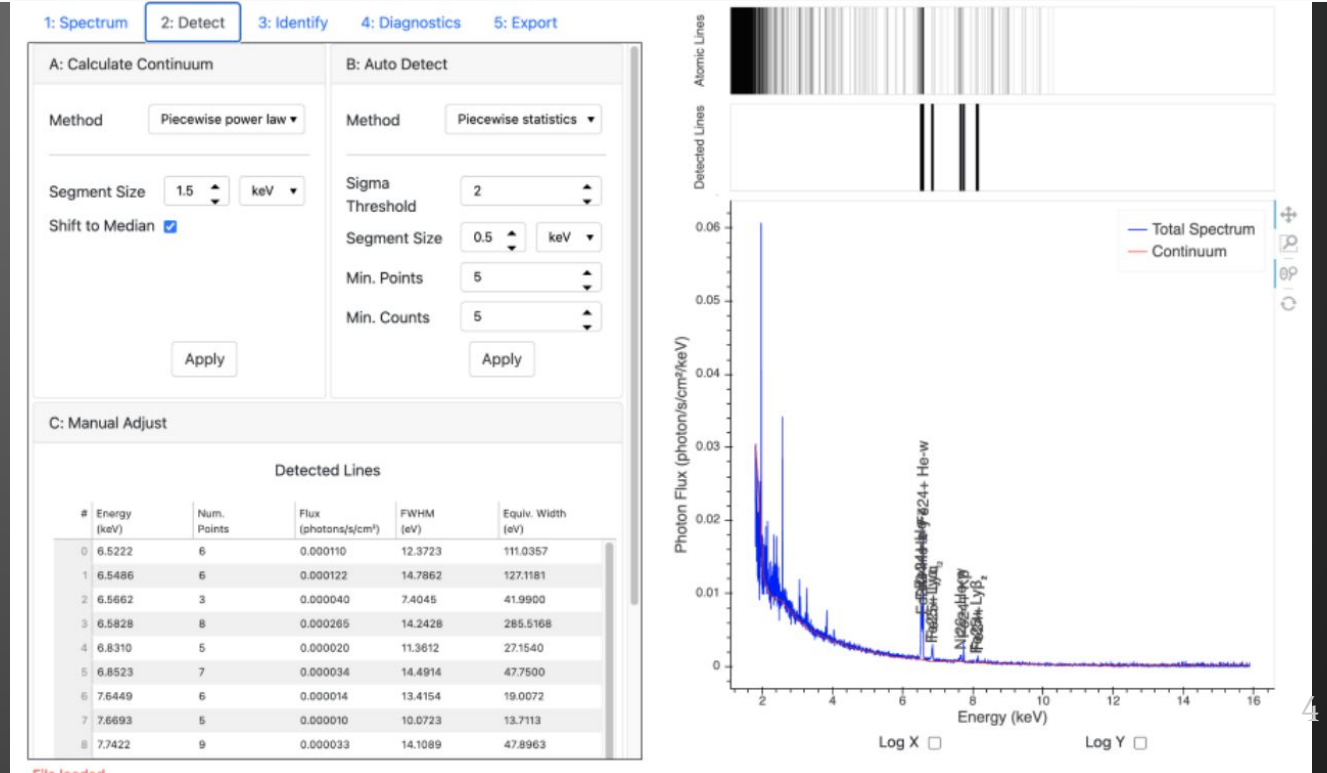
# Data Services: spectra

- 6 Simple Spectral Access services

- Fetched from mission archives based on mission master tables
  - Registered as auxiliary services based on the master table's cone service.
- DataLinks used to provide ancillary files necessary for x-ray spectral analysis.
  - background spectrum
  - energy response matrix
  - associated data products...
- SIA+DataLinks service is currently used in a new mission-specific spectral analysis web application.

```
In [5]: links=results[0].getdatalink()
links.to_table()
```

ID	access_url	service_def	error_message	description
object	object	object	object	object
129419:xte.prod.pca	https://heasarc.gsfc.nasa.gov/FTP/xte/data/archive/AO2/P20805//20805-01-01-00/stdprod/			RXTE PCA Products
129419:xte.prod.pca	https://heasarc.gsfc.nasa.gov/FTP/xte/data/archive/AO2/P20805//20805-01-01-00/stdprod/xp20805010100_s2.pha.gz			PCA Source Standard2 Spectra
129419:xte.prod.pca	https://heasarc.gsfc.nasa.gov/FTP/xte/data/archive/AO2/P20805//20805-01-01-00/stdprod/xp20805010100_b2.pha.gz			PCA Background Standard2 Spectra
129419:xte.prod.pca	https://heasarc.gsfc.nasa.gov/FTP/xte/data/archive/AO2/P20805//20805-01-01-00/stdprod/xp20805010100.rsp.gz			PCA Response Matrix



# Infrastructure Services: <https://heasarc.gsfc.nasa.gov/navo/summary/> (click on Developers)

- Funded through NASA Astronomical Virtual Observatories (NAVO)
  - collaboration among HEASARC, IRSA, NED, and MAST.
- Publishing Registry
  - 3rd party OAI software.
  - Records auto-generated and published weekly.
  - Transient and including deleted records (recently).
- Monitoring of VO services' uptime
  - worldwide, subset of each site's services, spanning DAL types
  - hourly
  - opt-in for notification
- Validation of VO services' results
  - worldwide, everything
  - automatic, roughly monthly
  - also available as a web tool, i.e., put in your URL and request immediate validation
- Performance monitoring for NAVO services
  - open source infrastructure

# Infrastructure Services: monitoring VO services worldwide

## NAVO: NASA Astronomical Virtual Observatories

[Astronomers](#)[Developers](#)[About NAVO](#)[NAVO Internal](#)[Feedback](#)

### VO Monitor ?

VO Data Services (2022/10/04 15:40:09- 2022/10/04 15:53:04)

Site	Status	% Passed tests	% All Up	Site	Status	% Passed tests	% All Up	Site	Status	% Passed tests	% All Up
3CR Snapshots	Fail	0	0	Harvard ADS *	OK	100	100	NRAO	Fail	0	0
AIP	OK	100	100	Harvard CXC *	OK	100	100	OCA	OK	100	100
ARCHES	Fail	66.6	0	Heidelberg	OK	100	100	OSUG	OK	100	100
ARVO	Fail	0	0	Helio VO	OK	100	100	OVGSO	OK	100	100
ASTRON	OK	100	100	IAA	OK	100	100	Obs Haute Provence	OK	100	100
ASU	OK	100	100	IACVO	OK	100	100	Obs Lyon	OK	100	100
ArVO Byu	OK	100	100	IAP CZ	OK	100	100	PADCC	OK	100	100
BIRA	OK	100	100	IDOC	OK	100	100	PDS	OK	100	100
BSDC	OK	100	100	INAF	OK	100	100	ROE Astrogrid	OK	100	100
CADC	OK	100	100	IRSA *	OK	100	100	SAO RAS	Fail	33.3	0
CDPP	OK	100	100	IVOA	OK	100	100	SAO TDC	OK	100	100
CDS	OK	100	100	IVOA RofR	OK	100	100				

- Current status summary
- Organized by site
- Can specify a date range to compile stats

# Infrastructure Services: monitoring details, re-run buttons, etc.

## NAVO: NASA Astronomical Virtual Observatories

[Astronomers](#) [Developers](#) [About NAVO](#) [NAVO Internal](#) [Feedback](#)

### VO Services Monitor ?

Tests of JVO Services (Most Recent Test Results: Last test at: 2022/10/04 15:43:29)						
Site	Test Name	Status	Contact	Test	Raw Test Results	Service URL
JVO	<a href="#">JVO SIAP V2 FITS</a>	pass		<a href="#">Test</a>	<a href="#">Run</a>	<a href="#">URL</a>
JVO	<a href="#">JVO SSA FITS</a>	pass		<a href="#">Test</a>	<a href="#">Run</a>	<a href="#">URL</a>
JVO	<a href="#">JVO TAP</a>	pass		<a href="#">Test</a>	<a href="#">Run</a>	<a href="#">URL</a>
JVO	<a href="#">JVO SIAP</a>	pass		<a href="#">Test</a>	<a href="#">Run</a>	<a href="#">URL</a>
JVO	<a href="#">JVO SIAP V2</a>	pass		<a href="#">Test</a>	<a href="#">Run</a>	<a href="#">URL</a>
JVO	<a href="#">JVO SSA</a>	pass		<a href="#">Test</a>	<a href="#">Run</a>	<a href="#">URL</a>
JVO	<a href="#">JVO SIAP FITS</a>	pass		<a href="#">Test</a>	<a href="#">Run</a>	<a href="#">URL</a>
JVO	<a href="#">JVO Registry</a>	pass		<a href="#">Test</a>	<a href="#">Run</a>	<a href="#">URL</a>

Click Contact icon to retrieve contact information for service  
Click Test link to run a test on the service in real time  
Click Run link to get the service's response at a default position  
Click URL link to return the service's base URL and the positional information in a popup

Earlier Tests on Site's Services (2022/10/04 15:43:29 - 2022/10/04 03:43:06)			
Name	Test Name	Status	Time
JVO	JVO SIAP V2 FITS	pass	2022/10/04 15:43:29
JVO	JVO SSA FITS	pass	2022/10/04 15:43:23
JVO	JVO TAP	pass	2022/10/04 15:43:22
JVO	JVO SIAP	pass	2022/10/04 15:43:17
JVO	JVO SIAP V2	pass	2022/10/04 15:43:11
JVO	JVO SSA	pass	2022/10/04 15:43:09
JVO	JVO SIAP FITS	pass	2022/10/04 15:43:03

- Details for a given site
- This can take a noticeable time to open.
- Top panel shows most recent results
- Lower panel shows history.

# Infrastructure Services: averaging uptime history by year

Center	Tested	Total #Services	2014-01-01 2014-12-31	2015-01-01 2015-12-31	2016-01-01 2016-12-31	2017-01-01 2017-12-31	2018-01-01 2018-12-31	2019-01-01 2019-12-31	2020-01-01 2020-12-31	2021-01-01 2021-12-31	2022-01-01 2022-10-02
3CR Snapshots	1	1	96.3	98.9	99.8	99.5	99.7	97.8	85.4	31.4	30.3
ARCHES	2	2	0	0	97.0	96.7	86.7	96.7	93.8	97.0	86.7
ARVO	1	1	0	95.6	98.1	92.4	92.3	93.4	39.6	0	0
ASDC	1	1	99.3	98.8	99.9	97.9	99.8	99.4	99.0	100	0
ASU	4	17	99.0	99.7	98.4	0	92.6	98.3	99.6	99.5	88.8
Astronet	2	30	49.1	88.9	75.1	25.7	95.4	96.5	44.4	0	0
BIRA	2	2	0	0	0	0	100	100	99.9	99.9	98.5
BSDC	3	8	0	84.7	98.8	98.6	99.3	95.6	98.5	99.9	99.8
CADC	4	6	98.6	93.8	97.0	96.1	98.2	98.9	96.8	95.8	93.4
CDPP	1	5	0	97.4	99.6	97.7	99.6	88.2	99.3	99.9	99.8
CDS	7	20773	99.7	99.5	99.4	99.0	98.9	98.9	99.1	99.3	99.0
CDS SIMBAD	2	2	99.1	98.9	99.2	99.6	99.2	98.5	99.6	99.5	99.7
CESAM	2	11	0	0	0	0	0	0	0	99.9	99.8
CSIRO	5	15	98.7	98.9	99.0	98.1	72.5	95.3	91.4	97.2	91.6
ChiVO	4	4	0	0	0	0	87.9	90.8	90.3	85.3	50.7
China VO	3	4	95.1	87.6	98.2	99.1	99.8	99.8	88.3	97.4	96.9
DAME	1	2	0	81.5	98.3	84.4	86.2	0	0	0	0
ESA VO	5	27	99.5	98.8	98.3	99.4	97.1	98.3	97.6	94.8	96.9
ESO ORG	3	4	59.9	99.7	99.0	99.9	95.5	99.6	99.7	99.7	99.9
FU-Berlin	2	2	0	0	0	0	100	97.1	99.9	99.9	99.9
GAVO	6	71	99.3	99.4	99.7	98.3	99.0	99.6	99.5	99.8	99.9

- Percent uptime by site
- Average over each year



# Infrastructure Services: validation

- Validation tools
  - Statistics updated daily
  - Rotating subset of 1000 services tested per day, each service hit roughly monthly.
  - Tools for browsing, re-testing, viewing errors, etc.
- We use:
  - VO Paris to validate SSA and SIAP V2 service
  - the NCSA validators to validate Cone and SIAP services.
  - UK Bristol's taplint to validate TAP services
  - OVAL, a 3rd party validator, to validate Registry services.
- Home page shows
  - the pass rate for the VO as a whole
  - a search box so that users can get the current validation status of individual services at their site.
  - buttons to see the validation results by 'center' or by 'type'
  - a button is provided to validate the service in real-time

Validation Statistics for All VO Services ⓘ		
Total Number of Active Services	27075	
In Validation Queue	0	
Validated	27075	
Deprecated	13	
Status	Total	Percent
Passed	23930	88.3
Failed	2953	10.9
Skipped Validation ⓘ	0	0
Aborted	192	0.70

[View Results By Center](#)

[View Results By Type](#)

[View Most Recent Test Results](#)

[View Most Recent Test Stats](#)

Query by identifier or string. Any identifiers containing this string will be matched

Last Validation Occurred	2022/10/07 03:25:00 ET
Next Scheduled Validation	2022/10/08 06:00:00 ET
Services Tested Daily ⓘ	1000

Do you need to test a service URL? (Cone,SIA,SSA,and TAP services only)

Examples:

<http://dc.zah.uni-heidelberg.de/rave/q/cone/scs.xml?> (Cone)

[http://voparis-srv.obspm.fr/srv/ssa-hess\\_spectrum.php?](http://voparis-srv.obspm.fr/srv/ssa-hess_spectrum.php?) (SSA)

<http://casjobs.sdss.org/vo/DR3SIAP/SIAP.asmx/getSiapInfo?&FORMAT=image/fits&BANDPASS=g&> (SIAP)

<https://heasarc.gsfc.nasa.gov/xamin/vo/tap> (TAP)

URL:

DAL Type:  RA:  Dec:  SR:

*\*The Cone and SIA validators were originally provided by NCSA and are currently maintained by the HEASARC*

*\*The SSA Validator is provided and supported by VO Paris*

*\*The TAP Validator is 'taplint'. It is provided and maintained by UK Bristol.*

# Infrastructure Services: validation results by center

Last Updated (UTC): 2022-10-04T13:00:11

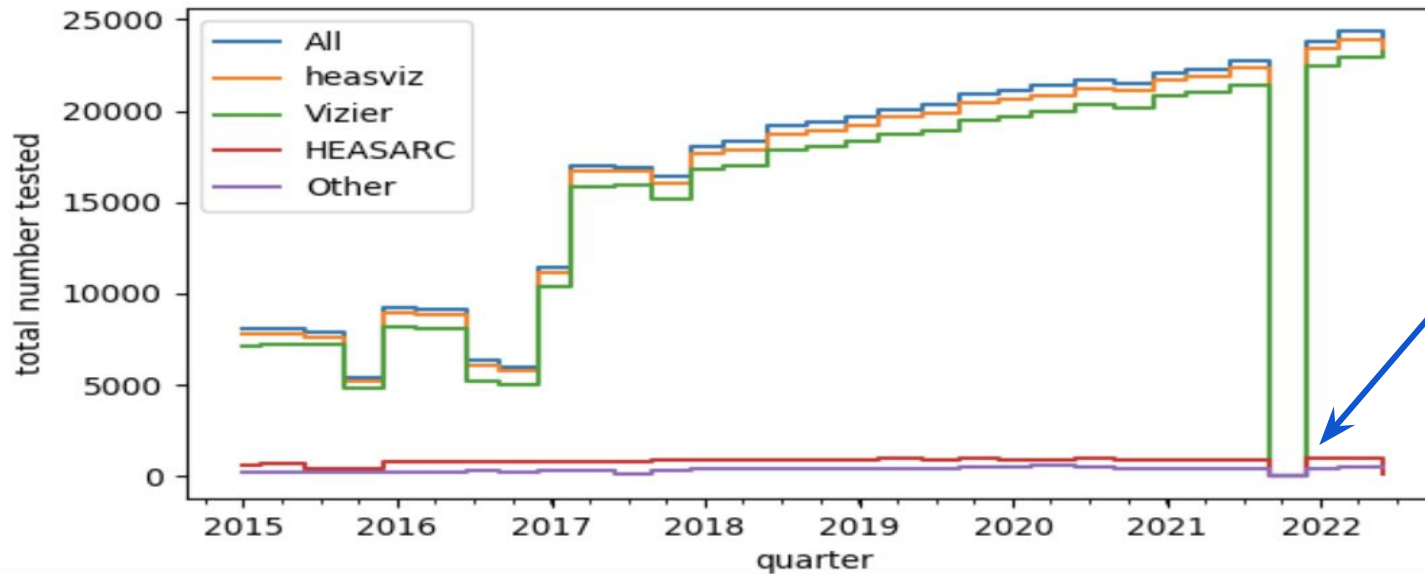
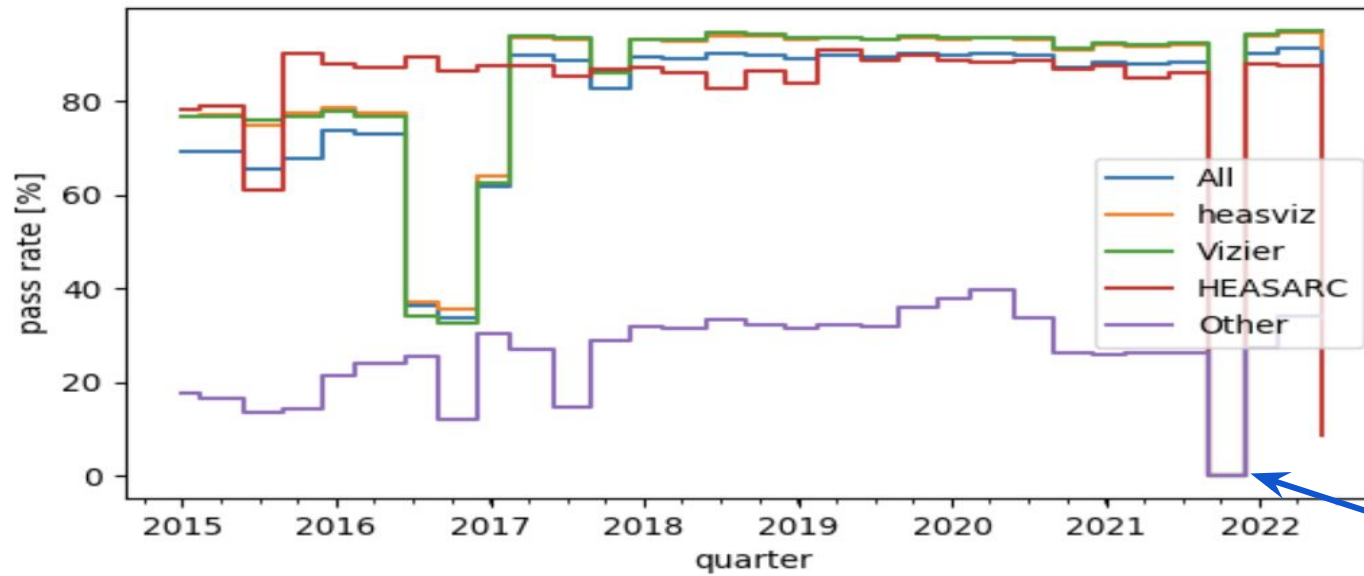
Center <sup>i</sup>	Active Services	Total Validated	Not Validated	Pass Rate % <sup>i</sup>	Passed	Skipped	Deprecated	Failed	Aborted	Error Types per Center <sup>i</sup>
3CRSnapshots	1	1	0	0	0	0	0	1	0	<a href="#">View List</a>
ARCHES	2	2	0	0	0	0	0	2	0	<a href="#">View List</a>
ARVO	1	1	0	0	0	0	0	1	0	<a href="#">View List</a>
ASTRON	23	23	0	56.5	13	0	0	10	0	<a href="#">View List</a>
ASU	16	16	0	100	16	0	0	0	0	<a href="#">View List</a>
Astronet	30	30	0	100	30	0	0	0	0	<a href="#">View List</a>
BIRA	2	2	0	100	2	0	0	0	0	<a href="#">View List</a>
BSDC	8	8	0	100	8	0	0	0	0	<a href="#">View List</a>
BYU ArVO	4	4	0	100	4	0	0	0	0	<a href="#">View List</a>
CADC	6	6	0	33.3	2	0	0	4	0	<a href="#">View List</a>
CDPP	3	3	0	100	3	0	0	0	0	<a href="#">View List</a>
CDS SIMBAD	1	1	0	100	1	0	0	0	0	<a href="#">View List</a>
CDS VizieR	24433	24433	0	100	24433	0	0	0	0	<a href="#">View List</a>
CEFCa	26	26	0	100	26	0	0	0	0	<a href="#">View List</a>
CESAM	3	3	0	100	3	0	0	0	0	<a href="#">View List</a>

Most Recent Validation Results for: CADC

<sup>i</sup>	<sup>i</sup> Shortname	<sup>i</sup> IVOA Identifier	<sup>i</sup> Status	<sup>i</sup> Time ▲	<sup>i</sup> Service URL	Run Test	<sup>i</sup> Type	<sup>i</sup> Query Information
	Description	Registry Entry	Last Test Status	Start Time of Test	Base URL of Service		DAL Service Type	Right Ascension, Declination Search Radius
1	null	ivo://cadc.nrc.ca/registry	Fail	2022/10/02 03:19:03	URL	<a href="#">Test</a>	RegistryHarvest	RA=0.0000&DEC=0.0000&SF00
2	null	ivo://cadc.nrc.ca/registry	Pass	2022/10/02 03:17:53	URL	<a href="#">Test</a>	RegistryHarvest	RA=0.0000&DEC=0.0000&SF00
3	YouCat	ivo://cadc.nrc.ca/youcat	Fail	2022/09/30 02:40:14	URL	<a href="#">Test</a>	TAP	
4	null	ivo://cadc.nrc.ca/sia	Fail	2022/09/25 02:55:52	URL	<a href="#">Test</a>	SIA	POS=0.0000,0.0000&SIZE=0
5	null	ivo://cadc.nrc.ca/argus	Pass	2022/09/16 02:52:27	URL	<a href="#">Test</a>	TAP	
6	null	ivo://cadc.nrc.ca/sia	Fail	2022/09/12 02:46:01	URL	<a href="#">Test</a>	SIAV2	POS=0.0000,0.0000&SIZE=0

Subtestid	Error
ID of the Subtest	Error Message
	Test of Registry Service Using Oval BASE OAI-PMH Validator
OAI.63507	ERROR: Identify response well-formed but invalid: Element '{http://www.ivoa.net/xml/RegistryInterface/v1.0}Resource', attribute '{http://www.w3.org/2001/XMLSchema-instance}type': The QName value '{http://www.ivoa.net/xml/VORegistry/v1.0}Registry' of the xsi:type attribute does not resolve to a type

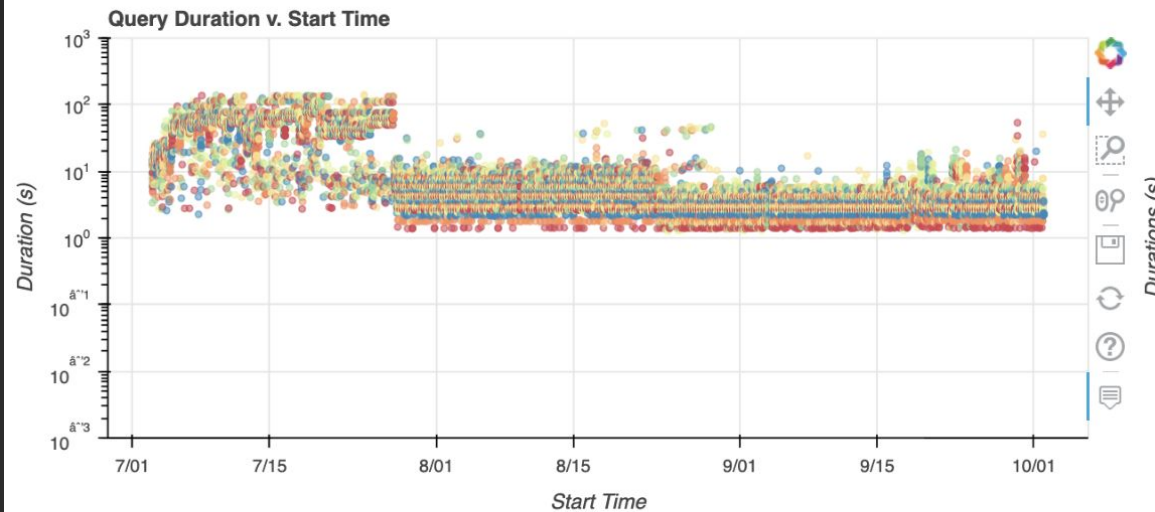
# Infrastructure Services: validation history



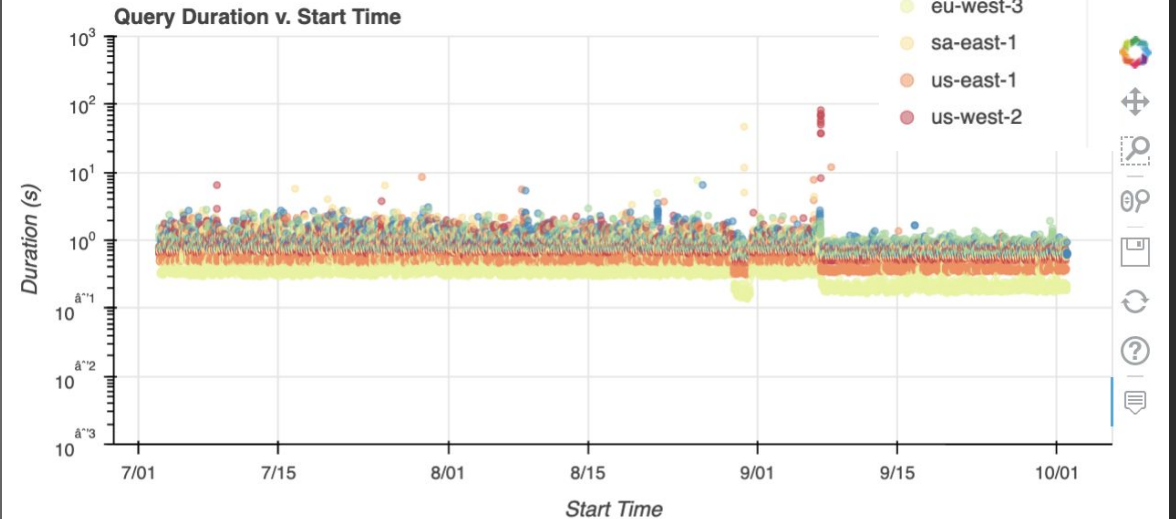
Database transition issue

# Infrastructure Services: performance monitoring for NAVO

## IPAC\_2MASS tap



## CDS\_2MASS cone



- Can see effects such as service overloading (IPAC in July) followed by server configuration change to fix it.
- Has proved useful for NAVO.
- Currently including one CDS service and one CXC service as well.
- (Tools by IRSA and MAST, deployed on AWS, web page hosted at HEASARC.)

# Resources

- HEASARC:
  - <https://heasarc.gsfc.nasa.gov>
  - Portal (VO under the hood): <https://heasarc.gsfc.nasa.gov/xamin/>
  - Science platform: <https://heasarc.gsfc.nasa.gov/docs/sciserver/> and <https://sciserver.org>
- NAVO:
  - [https://heasarc.gsfc.nasa.gov/navo/summary/navo\\_intro.html](https://heasarc.gsfc.nasa.gov/navo/summary/navo_intro.html)
  - Monitoring and Validation information under Developers