

CDS

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SCIOPS Meeting, Garching, 24-27 November 2015

Centre de Données astronomique de Strasbourg



hosted at the Observatoire
astronomique de Strasbourg,
Université de Strasbourg

since 1972 ...

- Collect useful data on objects in electronic form
- Improve them by critical evaluation and combination
- Distribute the results to the international community
- Conduct research using the data

Status

- Supported as a French Research Infrastructure (via CNRS/INSU), plus international partners
 - *serving global community*
- ~30 staff: Scientists, Software Engineers, Documentalists, Admin
- Heavily used, VO-compliant, evolving fast
- Certification - Data Seal of Approval

Plans

- **Reinforcing the core of CDS**
 - Operations - ingesting data, providing services to the community
 - Underlying infrastructure updates
 - R&D, technical readiness, innovation, development and implementation of VO
- **Scientific Engagement**
 - making sure CDS continues to meet community needs + + +

Astronomy

- Publishing and Reference services must evolve because science is constantly changing
- Era of big surveys (but also detailed individual studies)
- Multi-wavelength astronomy, Time Domain astronomy, multi-messenger astronomy coming

Interconnected science

- Involves 'Big Data', Data Mining, VO
 - using multiple instruments/telescopes
 - combining data from multiple sources
- more Open and collaborative
 - using tools and services that fit the purpose
 - distributed teams/collaborations/projects

CDS services



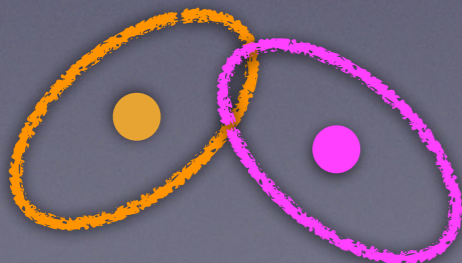
Astronomical Objects :
IDs, bibliography, measurements



Catalogue Service :
Catalogues, published tables, observation logs, surveys, associated data



Visualisation and integration :
images, catalogues, archives, VO portal, All-sky capabilities



X-Match : *Catalogue cross-match*

Reference data centre

- Qualified information = Scientific Value
 - Peer reviewed
 - Critically evaluated, professionally curated
- Science-driven to maintain relevance and quality
- Reliant on maintaining trust and support of community: *Journals, Authors, Archives, Data Centres, Observatories, Space Agencies*

Making information useable

- Add value - by homogeneous description of heterogeneous data
- Standardisation
 - Formats, conventions, V/O protocols
- Metadata
 - Encodes a level of 'meaning' to the data
- Connections - literature, archives, tools

Interoperability

CDS Portal

Portal [My data](#) [Help](#)

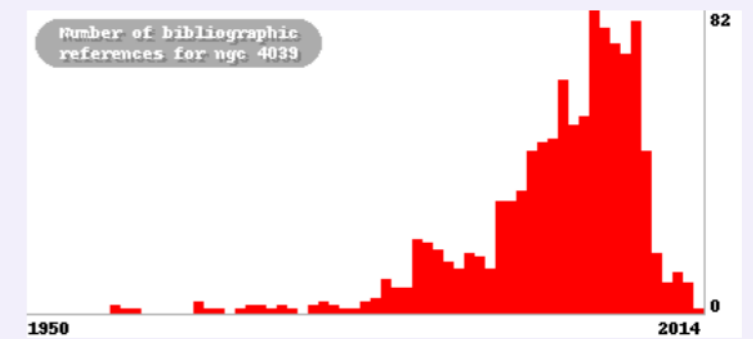
[Login](#) [Preferences](#) [Register](#)

Target:

J2000 position for ngc 4039: 12 01 53.7 -18 53 08

Object identifiers, measurements and bibliography for ngc 4039

- Object type: Galaxy in Pair of Galaxies
- Morphological type: Sc
- [More SIMBAD data for ngc 4039](#)
- [+ 1049 bibliographic references](#)
- [+ 360 objects within 2'](#)
- [Display map around ngc 4039](#)
- [Display SimPlay interactive map around ngc 4039](#)
- [+ Related objects in bibliography:](#)



Images for ngc 4039

- [Display region in Aladin \(Web Start\)](#)

Aladin images

Survey	Band	λ (μm)	Size	Epoch	Resolution	Download
2MASS	H	1.65	8.5' x 17.0'	1999-03-20	0.9" / pixel	FITS
2MASS	J	1.24	8.5' x 17.0'	1999-03-20	0.9" / pixel	FITS
DENIS	I	0.79	12.5' x 12.4'	1996-03-30	0.9" / pixel	FITS
DENIS	J	1.23	12.6' x 12.7'	1996-03-30	0.9" / pixel	FITS
DENIS	K	2.16	12.6' x 12.7'	1996-03-30	0.9" / pixel	FITS
IRAS-IRIS	25MU	25.0	12.5° x 12..	-	1.5' / pixel	FITS
IRAS-IRIS	12MU	12.0	12.5° x 12..	-	1.5' / pixel	FITS
IRAS-IRIS	60MU	60.0	12.5° x 12..	-	1.5' / pixel	FITS



[Display grayscale image](#)

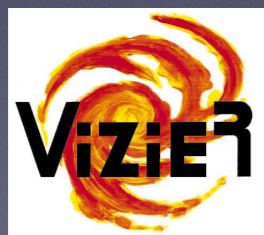
Catalogues for ngc 4039

- [10 catalogues with 'ngc 4039' keyword](#)
- [179 catalogues around ngc 4039:](#)

VizieR catalogues

Filter:

Name	Description	Local den...	Wavelength	Popula...	Coverage map
★ B/eso Query	ESO Science Archive Catalog (ESO, 1991-2014) [ReadMe]	74	optical	79	
★ I/297 Query	NOMAD Catalog (Zacharias+ 2005) [ReadMe]	53	optical,IR	89	
★ J/ApJS/1... Query	Chandra ACIS survey in 383 nearby galaxies. I. (Liu, 2011) [ReadMe]	52	X-ray	64	



SIMBAD

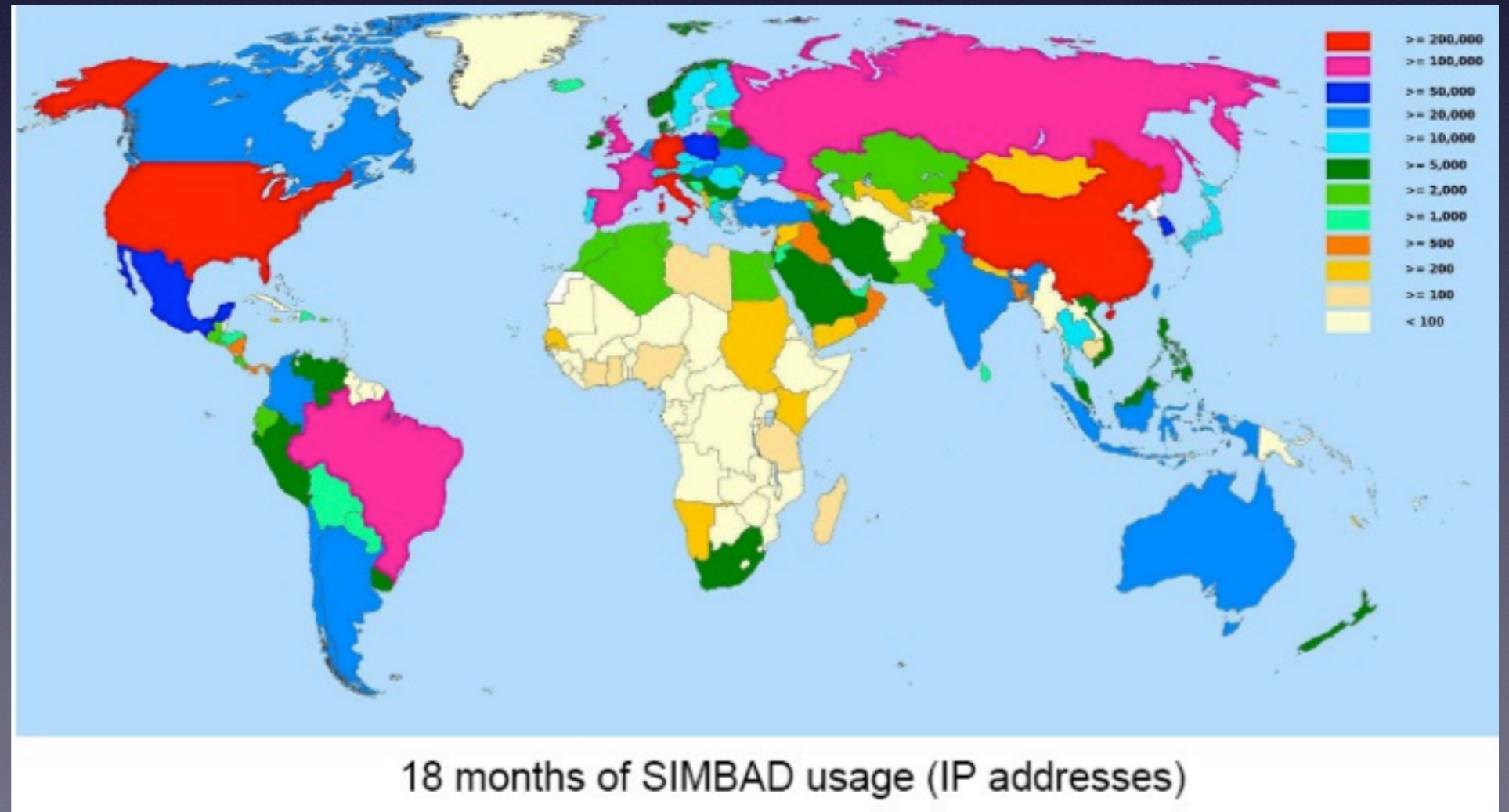


- Database of astronomical objects extracted and curated from the literature
- object types, coordinates, cross-identifications, citations, basic data
- 8×10^6 objects, 2×10^7 identifiers, 10^7 citation links
- $\sim 500,000$ queries per day

- well known via the ‘object name resolver’

Sombrero → 39 59.43185 -11 37 22.9954

- widely used:



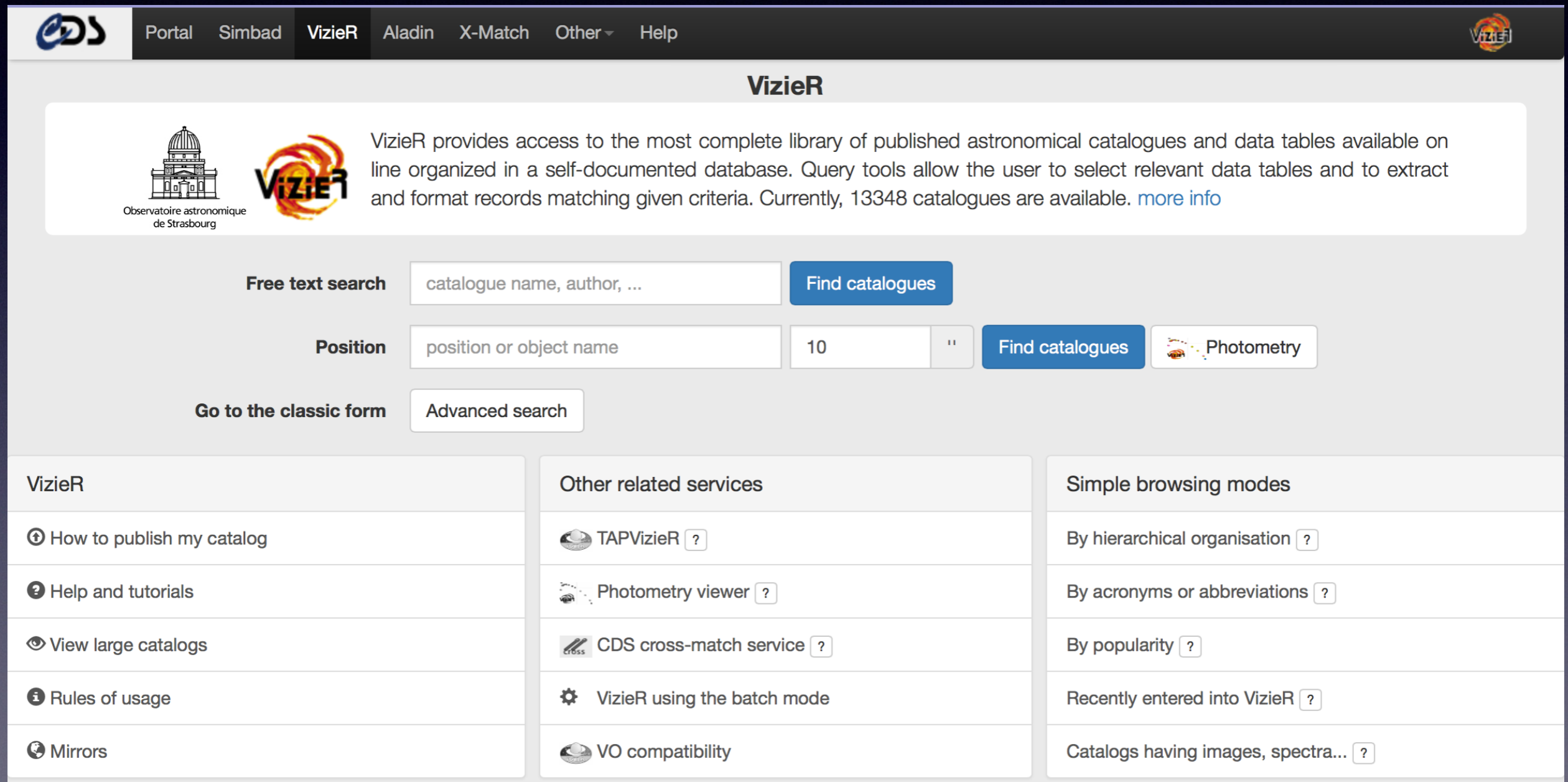
Vizier



Catalogues, published tables, observation logs, surveys, associated data

- Heterogeneous tables described by standardised metadata
- Curated by professional ‘documentalists’
- Cooperation with major journals
- Added value - interoperability, usability, services (e.g. X-Match, visualisation, complex

Renewed query interface



The screenshot displays the VizieR web interface. At the top, a navigation bar includes the CDS logo and links for Portal, Simbad, VizieR (selected), Aladin, X-Match, Other, and Help. The VizieR logo is also present in the top right corner.

The main header area features the VizieR logo and a descriptive paragraph: "VizieR provides access to the most complete library of published astronomical catalogues and data tables available on line organized in a self-documented database. Query tools allow the user to select relevant data tables and to extract and format records matching given criteria. Currently, 13348 catalogues are available. [more info](#)".

Below the header, there are three search methods:

- Free text search:** A text input field containing "catalogue name, author, ..." and a blue "Find catalogues" button.
- Position:** A text input field containing "position or object name", a numeric input field with "10", a quote button, a blue "Find catalogues" button, and a "Photometry" button with a corresponding icon.
- Go to the classic form:** A button labeled "Advanced search".

The bottom section is divided into three columns of links:

- VizieR:** How to publish my catalog, Help and tutorials, View large catalogs, Rules of usage, Mirrors.
- Other related services:** TAPVizieR, Photometry viewer, CDS cross-match service, VizieR using the batch mode, VO compatibility.
- Simple browsing modes:** By hierarchical organisation, By acronyms or abbreviations, By popularity, Recently entered into VizieR, Catalogs having images, spectra...

Advanced query interface

VizieR Service

Find catalogs among 11959 available

Clear Find...

Expand search

? *Catalog, author's name, word(s) from title, description, etc. e.g.: AGN, Veron, I/239, or bibcodes...*

- ▶ Search for catalogs by column descriptions (UCD) ?
- ▶ Search for catalogs containing additional data

Search by Position across 12558 tables

Target Name (resolved by [Sesame](#)) or Position: Clear J2000 Target dimension: 2 arcmin Go!

Radius Box size

Wavelength	Mission	Astronomy
Radio	AKARI	Abundances
IR	ANS	Ages
optical	ASCA	AGN
UV	BeppoSAX	Associations
EUV	CGRO	Atomic_Data
X-ray	Chandra	Binaries:cataclysmic
Gamma-ray	COBE	Binaries:eclipsing

[More about VizieR](#) ~ 0 matching catalogs

Browsing modes: [Designation](#), [Acronyms](#), [Favorites](#), [Dates](#), [Image spectra](#), [Kohonen](#)
Or list [the large surveys](#)

Tools related to VizieR

- **new** [Photometry viewer](#) : Plot photometry (sed) including all VizieR
- [TAP VizieR](#) : query VizieR using ADQL (a SQL extension dedicated for astronomy)
- [CDS cross-match service](#) : fast cross-identification between any 2 tables, including VizieR catalogues, SIMBAD

Query interface for single table

VizieR Search Page

Portal Simbad VizieR Aladin X-Match Other Help

[Fast Xmatch with large catalogs or Simbad](#)

Simple Target **List Of Targets**

Target Name (resolved by [Sesame](#)) or Position: J2000 2 arcmin

Radius Box size

1. J/ApJS/206/10/table3 CANDELS multiwavelength catalog (Galametz+, 2013) [2013ApJS...206...10G](#) [ReadMe+ftp](#)
[spectrum/SED](#) [Similar Catalogs](#)

1. J/ApJS/206/10/table3 [Post annotation](#)
 Multiwavelength catalog in the Ultra-Deep Field[spectrum/SED] (35932 rows)

Simple Constraint **List Of Constraints**

Query by **Constraints** applied on Columns (Output Order: + -)

Show	Sort	Column	Constraint	Explain (UCD)
<input type="checkbox"/>	<input type="radio"/>	recno	<input type="text"/>	Record number within the original table (starting from 1) (meta.record)
<input checked="" type="checkbox"/>	<input type="radio"/>	Seq	<input type="text"/>	[1/35932] Source identifier (Note 1) (meta.id)
<input checked="" type="checkbox"/>	<input type="radio"/>	RAJ2000	<input type="text"/> deg	Right Ascension in decimal degrees (J2000) (Note 2) (pos.eq.ra;meta.main)
<input checked="" type="checkbox"/>	<input type="radio"/>	DEJ2000	<input type="text"/> deg	Declination in decimal degrees (J2000) (Note 2) (pos.eq.dec;meta.main)
<input checked="" type="checkbox"/>	<input type="radio"/>	Hlim	<input type="text"/> mag ⁽ⁿ⁾	HST/WFC3 F160W limiting AB magnitude (Note 3) (phot.mag)
<input checked="" type="checkbox"/>	<input type="radio"/>	Q	<input type="text"/>	⁽ⁿ⁾ [0/3] Source reliability, 0=ok (Note 4) (meta.code.qual)
<input checked="" type="checkbox"/>	<input type="radio"/>	CStar	<input type="text"/>	[0/1] CLASS_STAR parameter (1=stellar) (Note 1) (src.class.starGalaxy)
<input checked="" type="checkbox"/>	<input type="radio"/>	SED	<input type="text"/> SED	SED plot from the photometry (meta.ref.url) spectrum/SED
<input checked="" type="checkbox"/>	<input type="radio"/>	uFlux	<input type="text"/> uJy ⁽ⁿ⁾	CFHT/Megacam u band flux density (Note 5) (phot.flux.density;em.opt.U)
<input type="checkbox"/>	<input type="radio"/>	e_uFlux	<input type="text"/> uJy ⁽ⁿ⁾	Uncertainty in uFlux (Note 5) (stat.error)
<input checked="" type="checkbox"/>	<input type="radio"/>	BFlux	<input type="text"/> uJy ⁽ⁿ⁾	Subaru B band flux density (Note 5) (phot.flux.density;em.opt.B)

ALL cols

⁽ⁿ⁾ indicates a possible blank or NULL column

Search Criteria
[Save in CDSportal](#)
 Keywords
 J/ApJS/206/10/ta...
 Tables
 J/ApJS/206/10
 ..table3

Preferences
 max: 50
 HTML Table
 All columns
 Compute
 Distance ρ
 Position angle θ
 Distance (x,y)
 Galactic
 J2000
 B1950
 Ecl. J2000
 default
 Sort by Distance
 + order -
 No sort
 Position in:
 Sexagesimal
 Decimal $^{\circ}$
 Mirrors

Query result

Portal Simbad **VizieR** Aladin X-Match Other Help

[Send to VO tools](#)

VizieR Result Page

Search Criteria
Save in CDSportal

Keywords

Tables

J/ApJS/206/10
..table3

Constraints

Preferences
max: 50

HTML Table

All columns

Compute

Distance ρ

Position angle θ

Distance (x,y)

Galactic

J2000

B1950

Ecl. J2000

default

Sort by Distance

+ order -

No sort

Position in:

Sexagesimal

Decimal $^\circ$

[Show the target form](#)

[Show constraint information](#)

The 3 columns in *color* are computed by VizieR, and are *not part of the original data*.

[J/ApJS/206/10/table3](#) [CANDELS multiwavelength catalog \(Galametz+, 2013\)](#) [2013ApJS...206...10G](#) [ReadMe+ftp](#)

[Post annotation](#) [Multiwavelength catalog in the Ultra-Deep Field \(35932 rows\)](#) [spectrum/SED](#)

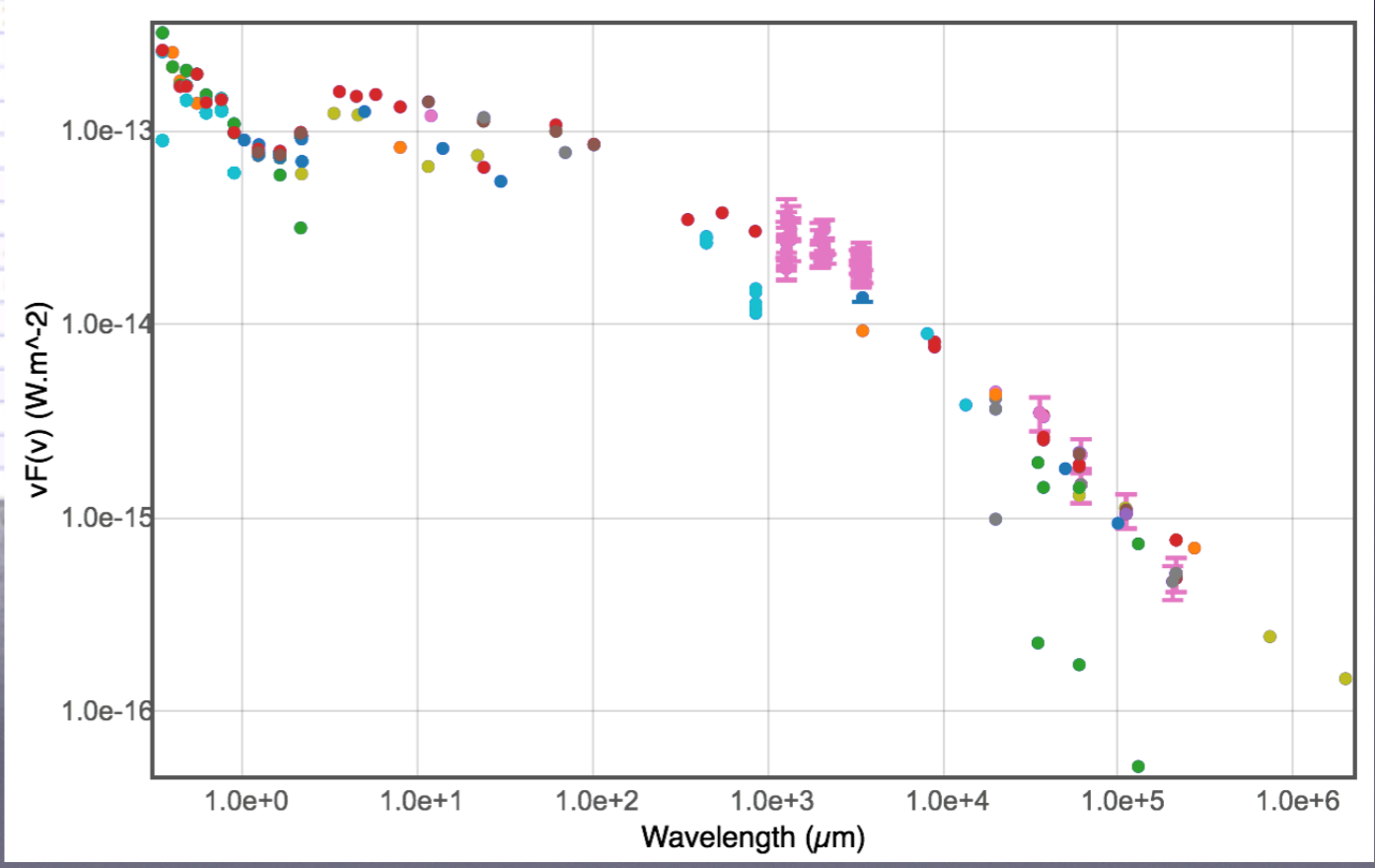
<i>Full</i>	<i>RAJ2000</i>	<i>DEJ2000</i>	recno	Seq	RAJ2000	DEJ2000	Hlim	Q	CStar	SED	uFlux	e	BFlux	e	VFlux	e	RFlux
	"h:m:s"	"d:m:s"			deg	deg	mag				uJy	uJy	uJy	uJy	uJy	uJy	uJy
1	02 16 53.703	-05 16 40.99	1	1	034.2237643	-05.2780530	27.3495	2	0.520	SED	0.0253	0.0079	0.1071	0.0051	0.1962	0.0079	0.2803
2	02 16 53.737	-05 16 40.62	2	2	034.2239039	-05.2779490	27.4093	2	0.600	SED	-0.0163	0.0081	0.0273	0.0053	0.0505	0.0081	0.0624
3	02 16 53.638	-05 16 40.63	3	3	034.2234901	-05.2779525	27.4355	0	0.000	SED	0.0532	0.0065	0.2287	0.0046	0.3859	0.0071	0.5439
4	02 17 03.625	-05 16 39.90	4	4	034.2651053	-05.2777490	27.3034	2	0.010	SED	0.0134	0.0069	0.0613	0.0040	0.0916	0.0077	0.1152
5	02 17 10.888	-05 16 39.53	5	5	034.2953666	-05.2776482	27.2547	0	0.000	SED	6.8024	0.0078	11.7075	0.0047	18.3565	0.0087	25.0891
6	02 17 02.959	-05 16 39.50	6	6	034.2623285	-05.2776390	27.6433	0	0.990	SED	0.1916	0.0062	0.4718	0.0035	0.8439	0.0069	1.0121
7	02 17 05.645	-05 16 38.86	7	7	034.2735198	-05.2774614	27.3550	0	0.000	SED	0.0740	0.0069	0.0789	0.0041	0.0889	0.0075	0.1051
8	02 16 53.877	-05 16 38.58	8	8	034.2244858	-05.2773846	27.7858	1	0.360	SED	-0.0033	0.0063	0.0219	0.0044	0.0398	0.0066	0.0411
9	02 17 09.414	-05 16 38.59	9	9	034.2892250	-05.2773859	27.2079	2	0.910	SED	0.0674	0.0063	0.0898	0.0030	0.0936	0.0054	0.0761
10	02 16 56.187	-05 16 38.52	10	10	034.2341120	-05.2773670	27.7893	0	0.000	SED	0.0418	0.0065	0.1074	0.0030	0.1502	0.0046	0.1491
11	02 16 57.568	-05 16 39.02	11	11	034.2398666	-05.2775057	27.7778	0	0.000	SED	0.0485	0.0064	0.0701	0.0032	0.0826	0.0049	0.1161
12	02 17 08.427	-05 16 38.21	12	12	034.2851117	-05.2772799	27.3177	0	0.000	SED	0.3300	0.0069	0.3761	0.0032	0.3142	0.0070	0.2721
13	02 16 53.647	-05 16 38.11	13	13	034.2235310	-05.2772525	27.8098	0	0.000	SED	-0.0011	0.0072	0.0882	0.0048	0.1671	0.0074	0.2011
14	02 17 19.015	-05 16 38.14	14	14	034.3292298	-05.2772620	27.6179	0	0.080	SED	0.1564	0.0071	0.1824	0.0040	0.1997	0.0074	0.2291
15	02 17 07.748	-05 16 38.46	15	15	034.2822842	-05.2773499	27.3130	0	0.000	SED	0.6138	0.0080	0.7718	0.0037	0.8846	0.0070	0.8031
16	02 16 57.962	-05 16 38.06	16	16	034.2415067	-05.2772375	27.7839	0	0.000	SED	0.1609	0.0065	0.1845	0.0035	0.1899	0.0049	0.1891
17	02 17 10.963	-05 16 39.47	17	17	034.2956798	-05.2776302	27.3381	2	0.010	SED	3.5312	0.0078	6.0261	0.0049	10.3968	0.0092	12.9821
18	02 17 28.040	-05 16 37.73	18	18	034.3668318	-05.2771468	27.3898	2	0.020	SED	-0.0001	0.0063	0.0077	0.0031	0.0017	0.0049	0.0021
19	02 16 54.134	-05 16 37.65	19	19	034.2255569	-05.2771244	27.9561	0	0.010	SED	0.1361	0.0063	0.1382	0.0042	0.0981	0.0062	0.1350
20	02 17 17.256	-05 16 37.55	20	20	034.3219019	-05.2770976	27.2060	2	0.050	SED	0.1590	0.0063	0.2295	0.0031	0.2846	0.0057	0.2741
21	02 17 08.837	-05 16 37.94	21	21	034.2868189	-05.2772051	27.4361	0	0.080	SED	0.1811	0.0077	0.3102	0.0038	0.4060	0.0070	0.3941
22	02 17 26.714	-05 16 37.83	22	22	034.3613081	-05.2771756	27.3226	2	0.400	SED	0.2465	0.0070	0.3366	0.0040	0.3986	0.0066	0.3831
23	02 17 09.849	-05 16 37.60	23	23	034.2910377	-05.2771121	27.7011	0	0.050	SED	0.0243	0.0070	0.0350	0.0034	0.0408	0.0059	0.0431
24	02 16 53.683	-05 16 37.54	24	24	034.2236773	-05.2770947	27.9998	0	0.000	SED	0.0131	0.0072	0.0276	0.0046	0.0504	0.0071	0.0771
25	02 17 20.489	-05 16 37.43	25	25	034.3353705	-05.2770628	27.7102	2	0.530	SED	0.0487	0.0067	0.0612	0.0035	0.0648	0.0058	0.0571
26	02 17 03.703	-05 16 39.29	26	26	034.2654298	-05.2775807	27.6767	2	0.030	SED	0.0155	0.0072	0.0381	0.0042	0.1007	0.0081	0.1481

Vizier: Multiple Interfaces

Vizier web page, Aladin interface,
CDS Portal, direct URL queries,
Topcat interface, DS9, VO TAP, VO
Cone Search, VizQuery

Photometry in catalogues

Full	2UCAC	RAJ2000	e	DEJ2000	e	UCmag	No	Nc	pmRA	pmDE	2MASS	Jmag	Kmag
		deg	mas	deg	mas	mag			mas/yr	mas/yr	Jmag	Kmag	
1	32373958	187.2463827	15	+01.9468434	15	12.43	4	2	-15.7	-7.6	855626345	10.915	10.167
2	32373967	187.3425680	12	+01.9778012	13	10.20	4	8	-3.3	-3.7	855626394	9.533	9.319
3	32543380	187.1322115	15	+02.0783695	15	15.87	2	2	-11.9	-25.0	855619179	13.731	13.435
4	32543381	187.1521298	15	+02.0176656	15	14.90	2	2	-6.6	-3.5	855619179	13.731	13.435
5	32543385	187.1763859	22	+02.0937712	42	15.64	3	2	-10.1	17.1	855619047	13.940	13.168
6	32543388	187.1912221	15	+02.0374417	17								



VizieR Photometry viewer

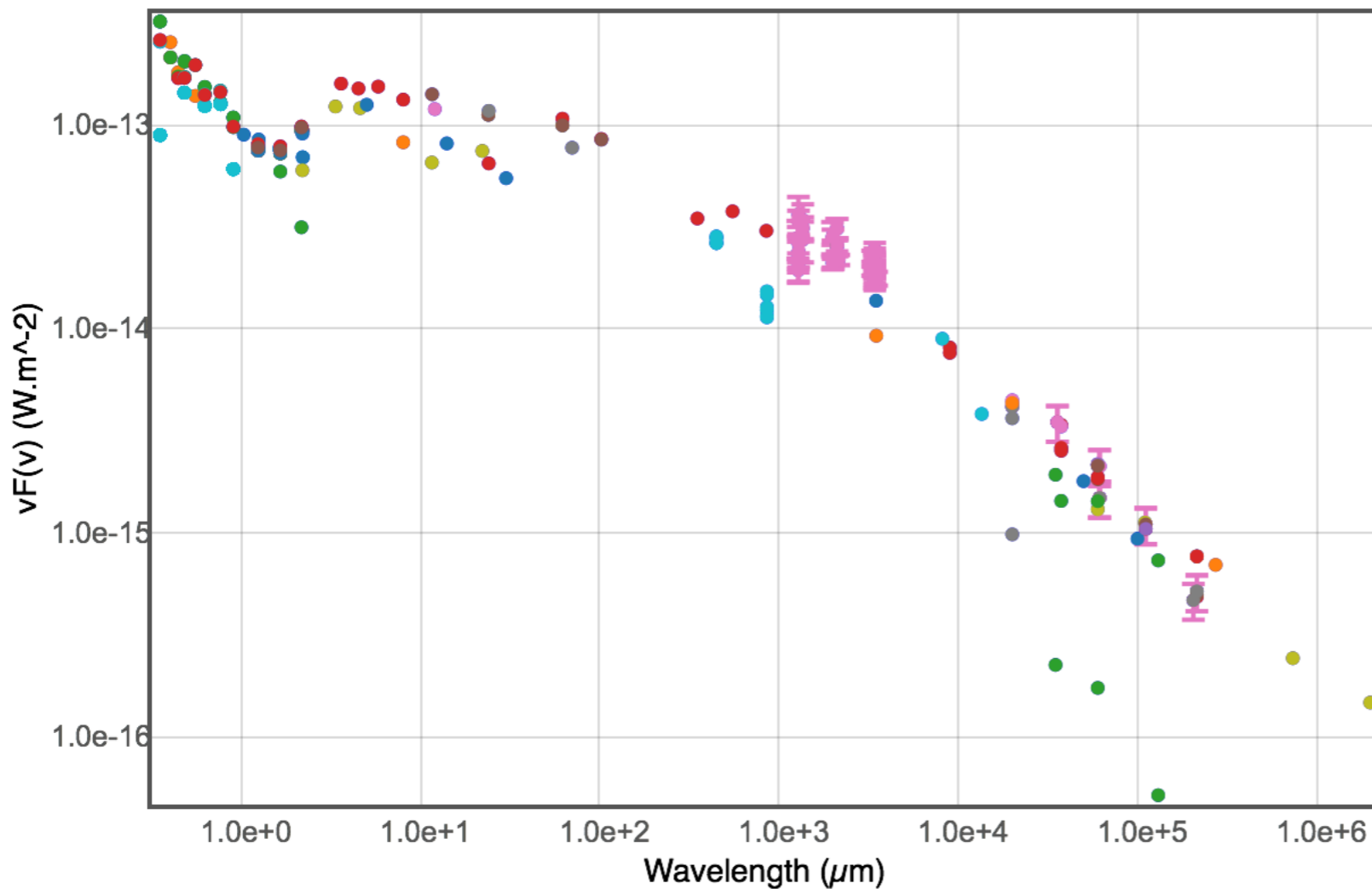
[share +](#)

Target
Radius (in arcsec)

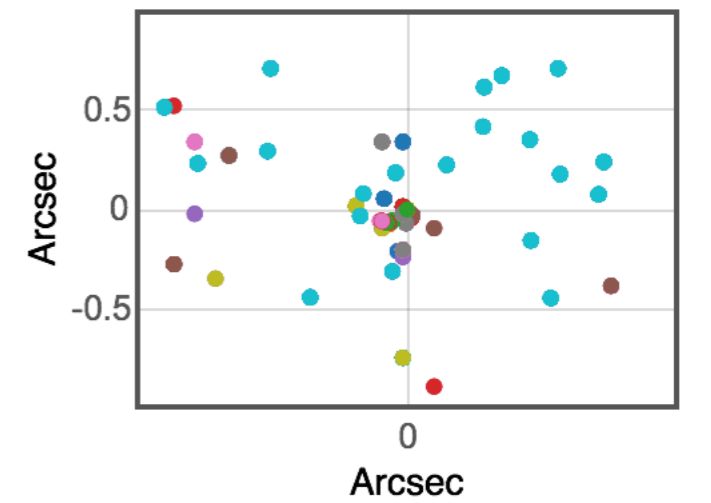
submit



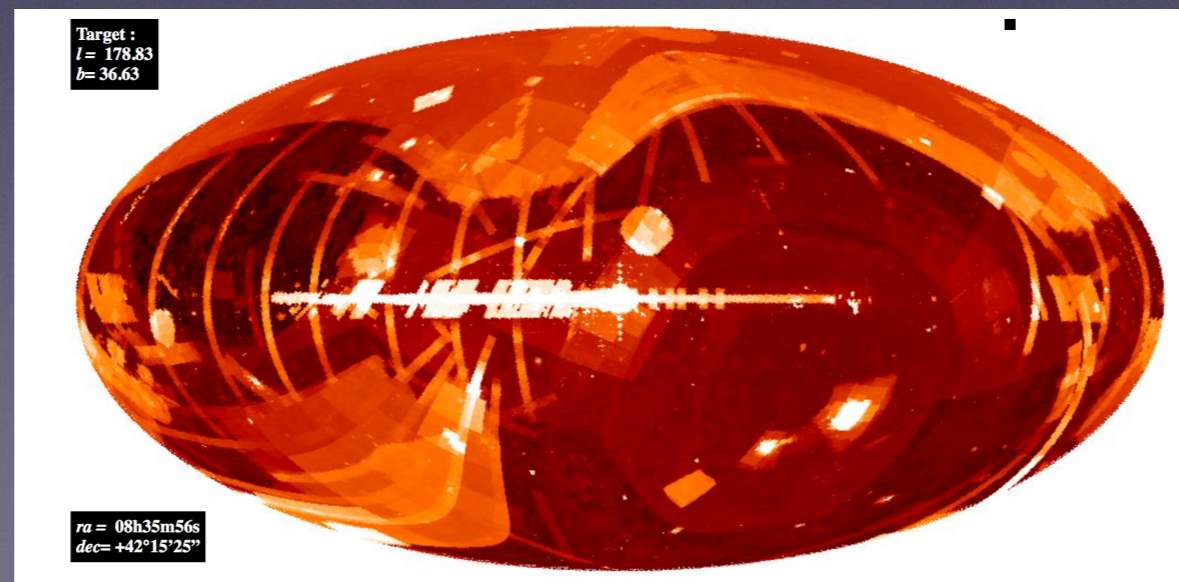
3c273 (12 29 6.695+02 03 8.662),
radius : 1 arcsec



Mouse position:
Wavelength :
2.96e+3 μm
Frequency :
1.01e+2 GHz
Energy :
4.18e-4 eV
Flux density or F(ν) :
5.70e+2 Jy
νF(ν) :
5.77e-13 W.m⁻²
F(λ) :
1.95e+4 erg.s⁻¹.cm⁻².μm⁻¹




- 14,000 catalogues, containing 30,000 tables
- ~1200 new catalogues per year
- total of ~17 billion rows
- ~280,000 queries per day (working to decrease this by making queries 'smarter')









Vizier 'associated data'

- Science ready data 'associated' with a journal publication
- Catalogues/tables
 - Time-series
 - Spectra
 - Images

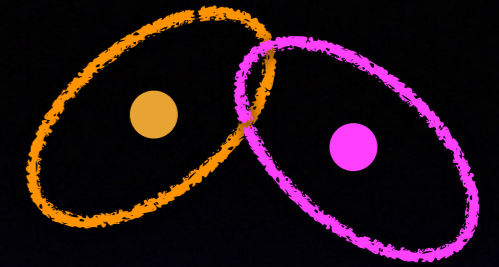
[B/corot/astero](#) [CoRoT observation log Release 13 \(CoRoT, 2009-2014\)](#)
[Post annotation](#) Stars observed in the bright star mode (155 rows)

 start AladinLite

<u>Full</u>	<u>RAJ2000</u> "h:m:s"	<u>DEJ2000</u> "d:m:s"	<u>Img</u>	<u>date1</u> s	<u>date2</u> s	<u>CoRoT</u>
<u>1</u>	06 54 24.72	-01 07 37.1		2007-01-31	2007-04-02	1
<u>2</u>	06 55 54.24	-01 35 07.3		2007-01-31	2007-04-02	2
<u>3</u>	06 51 51.84	-02 10 33.7		2007-01-31	2007-04-02	2
<u>4</u>	06 50 49.92	-00 32 27.2		2007-01-31	2007-04-02	
<u>5</u>	06 54 44.64	-02 07 23.2		2007-02-06	2007-04-02	2
<u>6</u>	06 53 02.88	-01 53 01.1		2007-02-06	2007-04-02	1

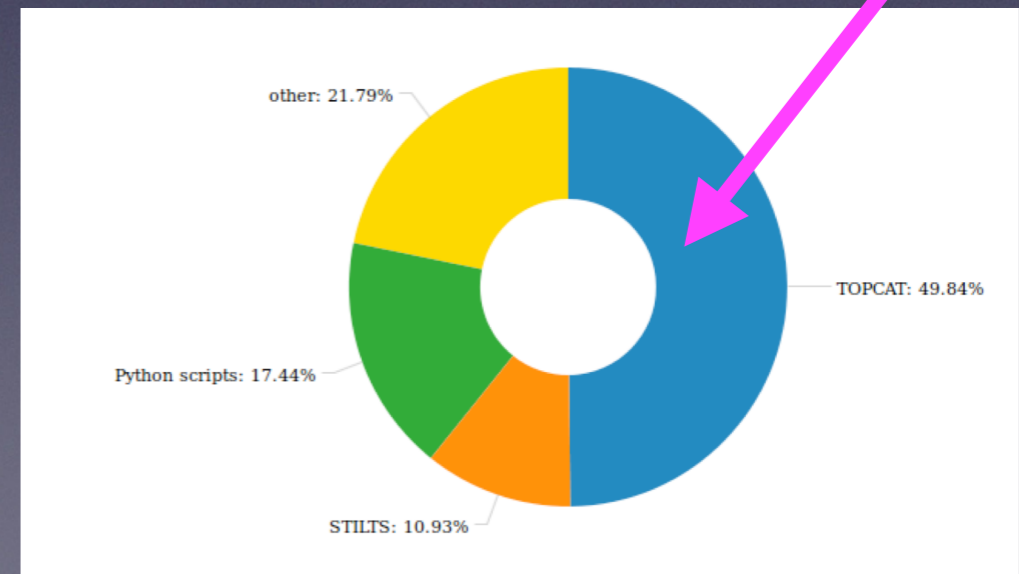
evolving very quickly with '*data publication*' efforts

CDS X-Match



- Positional 2 table cross-match
- 14,000 Vizier cats, & SIMBAD, & upload
- Fast big catalogue matching:
 - *SDSS vs. 2MASS in 20 minutes*
- Web interface
- HTTP API

TOPCAT



Aladin & Aladin Lite

Aladin v7.0

Location Clear Frame ICRSd

Allsky opt Allsky IR DSS Simbad NED PPMX 2MASS

SDSS colored Chandra/Hubble/Spitzer X-ray/Visible/Infrared Image of M82

select pan zoom dist phot draw tag filter cross rgb assoc crop cont mglss pixel prop del

FoV_U3NK0201
FoV_bandpass_
All
Simbad
Chandra/Hubb
Fold
Filter4
Simbad~1
FoV_hst_0644
The Heart Sta
SDSS colored

om 1/8x

10.74' x 8.72'

grid north multiview match

[View A1] - SDSS colored

Search

(c) 2010 UDS/CNRS - by CDS - Distributed under GNU GPL v3

0 sel / 1082 src 823Mb



Aladin Lite

Target:

J2000 05 45 30.655 -01 29 5.16

Surveys:

DSS2

Fermi

GALEXGR6/AIS

DSS2/red

DSS2/blue

SDSS9

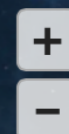
Mellinger

2MASS

allWISE



FoV: 3°



Aladin Lite API example

AAS225 demonstration

[Aladin Lite](#) / [Documentation](#) / [API](#) / [Examples](#) / AAS225 demonstration

SDSS DR9 band r image of APG 240 pair of galaxies, with an overlaid HST image and a WFPC2 footprint.

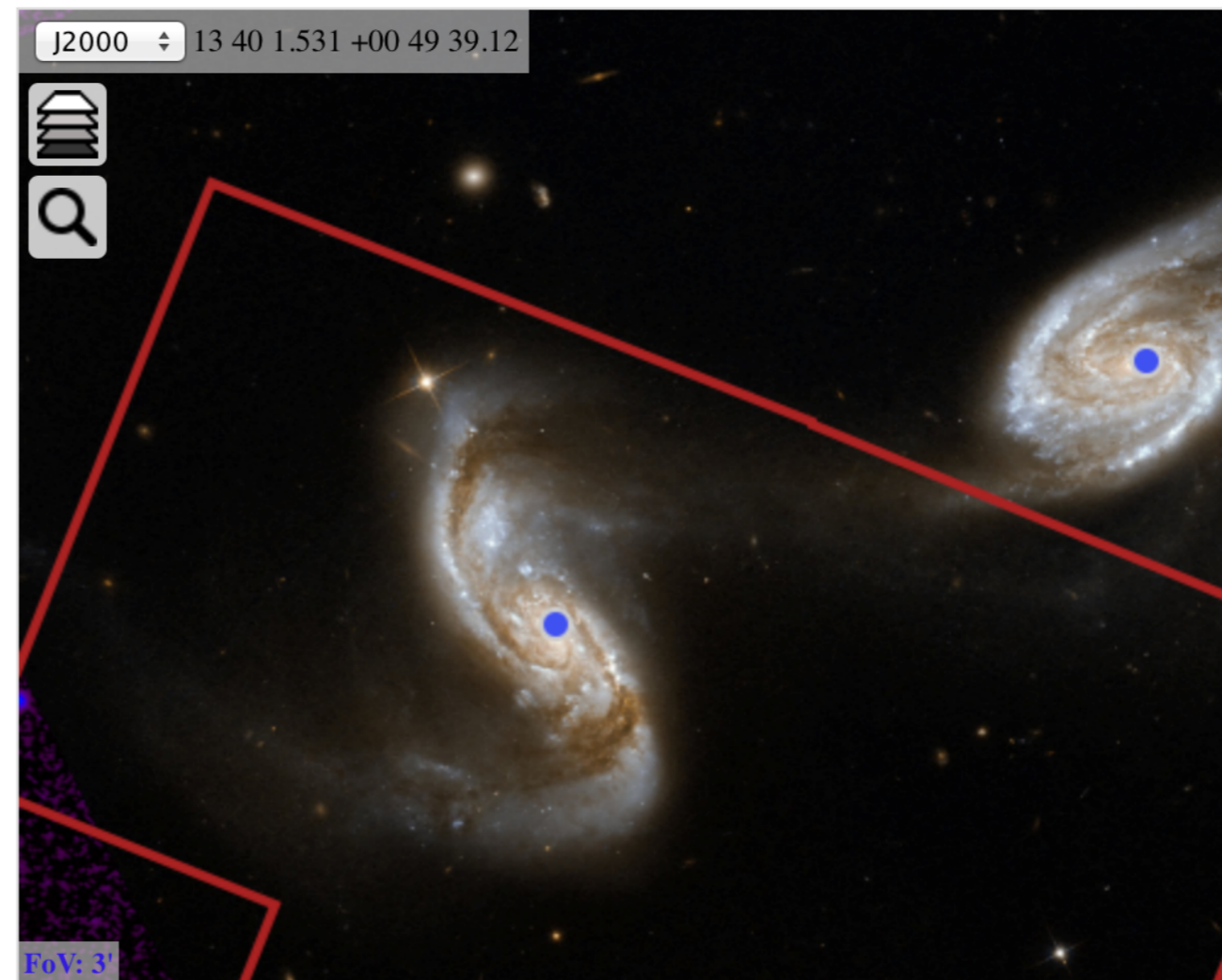
Javascript

```
var aladin = A.aladin('#aladin-lite-div', {fov:0.15, tar
aladin.setBaseImageLayer(aladin.createImageSurvey('SDSS-
aladin.getBaseImageLayer().getColorMap().update('rainbow
var simbad = A.catalog({name: 'Simbad', sourceSize: 16,
aladin.addCatalog(simbad);
simbad.addSources([A.marker(204.97010833333336, 0.840016

var overlay = A.graphicOverlay({color: '#aa2222', lineW
aladin.addOverlay(overlay);

overlay.addFootprints(A.polygon([[204.970214, 0.81206],
aladin.displayJPG('http://images.ipac.caltech.edu/stsci/
```

Result

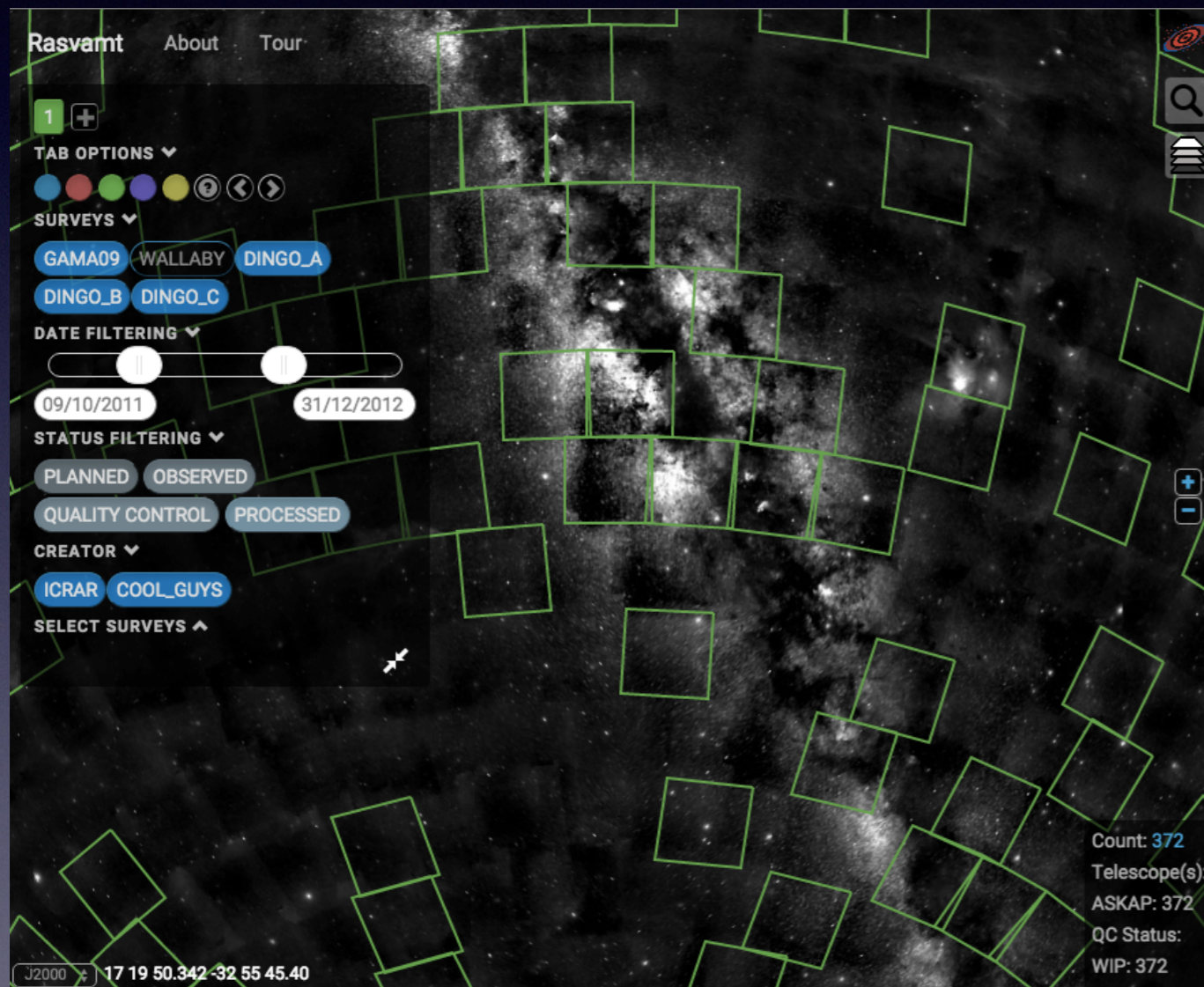


ESA sky - built on Aladin Lite

The screenshot displays the ESA sky interface, which is built on Aladin Lite. The main view shows a star field with various observation footprints overlaid in different colors (blue, red, yellow, cyan). The interface includes several key components:

- Top Left:** J2000 coordinates: 14 03 48.935 +54 17 25.47
- Top Right:** Search bar and "Upload target list" button.
- Left Panel:** "Skies" dropdown menu with options like INTEGRAL, XMM-Newton, HST, ISO, AKARI, Herschel, Planck, and Others. Below it is the "Colour Map" section with "Native" selected and a "Reverse" checkbox.
- Right Panel:** A list of target names including M33, M51, M83, M91, M95, M99, M100, M101 (highlighted), NGC 300, NGC 1300, NGC 1365, NGC 2997, NGC 3184, NGC 4013, NGC 4725, NGC 6744, NGC 6946, and NGC 7479.
- Bottom Left:** "Data Panel" with tabs for HST, XMM-OM(UV), XMM-Newton, Herschel, and ISO.
- Bottom Center:** Two bar charts:
 - ESA Observations:** Shows the number of results for different observation types. The Y-axis is logarithmic, ranging from 1E0 to 1E4. The X-axis categories are X-Ray, UV, Visible, and IR/Radio. The legend includes XMM-Newton, XMM-OM(UVB), HST, ISO, and Herschel.
 - ESA Catalogues:** Shows the number of results for different catalogues. The Y-axis is logarithmic, ranging from 1E0 to 1E6. The X-axis categories are Gamma, X-Ray, UV, Visible, and IR/Radio. The legend includes INTEGRAL, XMM Slew, 3XMM EPIC, XMM OM, Tycho-2, HSC, PGSS, PCSS, and PSZ.
- Bottom Right:** "Open data" button and the ESA logo.

Radio Astronomy Survey Visualisation Monitoring Tool (ICRAR)



Spitzer GLIMPSE 360



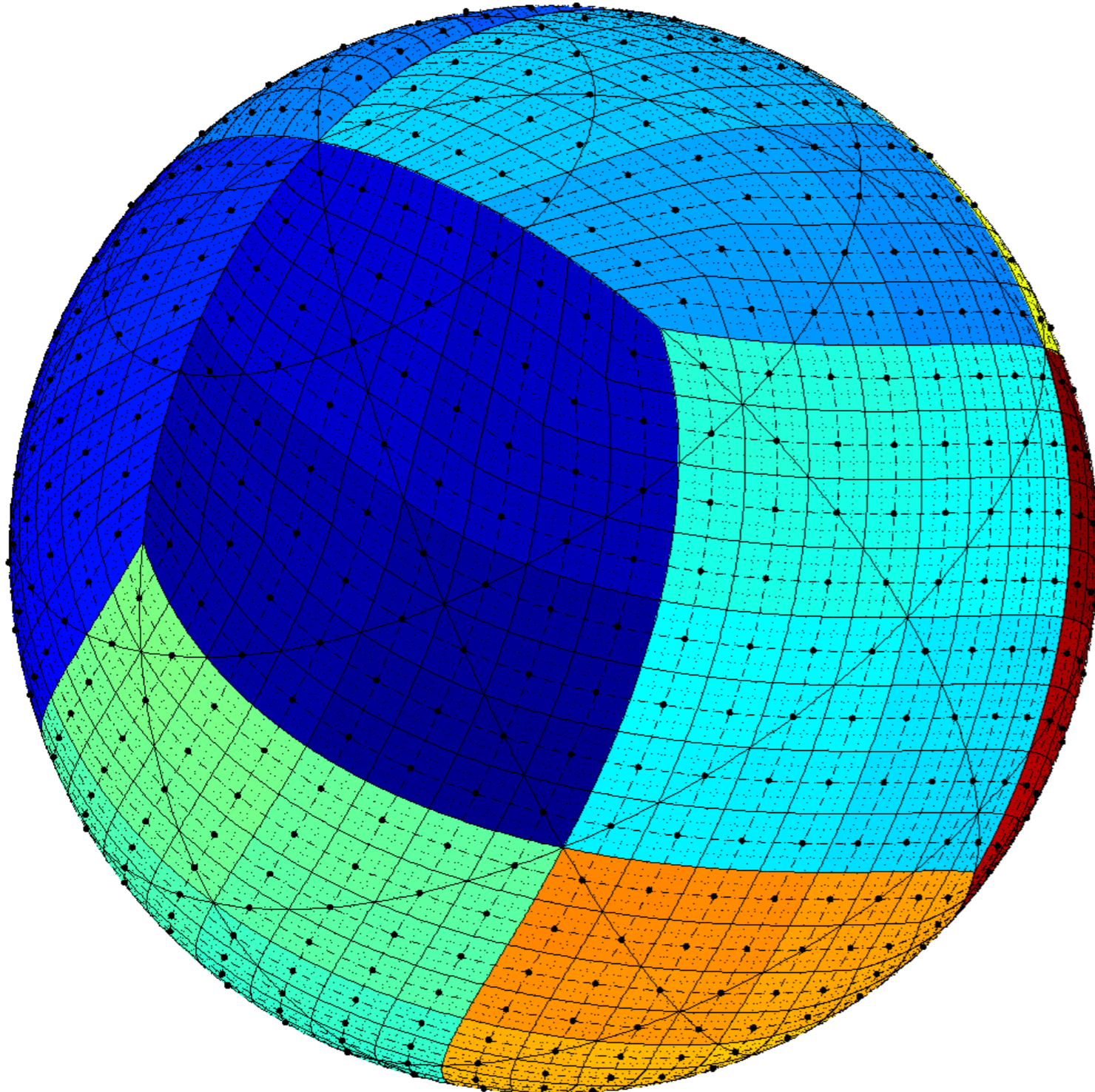
Recent developments

- **Hierarchical representation** of large image surveys, catalogues and cubes - **a structuring development at CDS**
- **Coverage maps** open up new possibilities for manipulating surveys and catalogues
 - new interactions between images, cubes and catalogues
- **HiPS and Aladin Lite fostering collaboration**

HiPS: Hierarchical Progressive Surveys

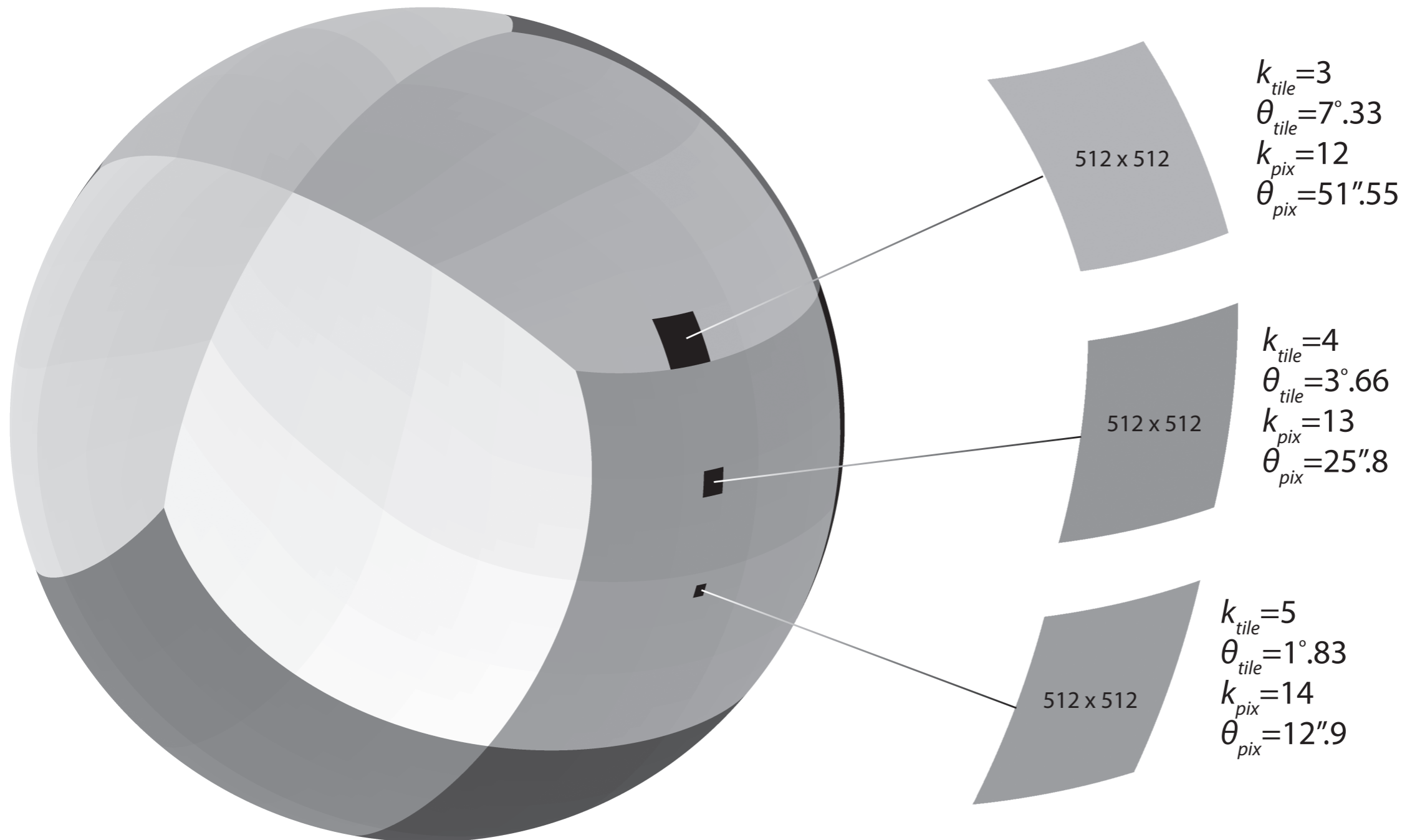
- Multi-resolution HEALPix data structure for
 - *Images*
 - *Catalogues*
 - *3-dimensional data cubes*
- Conserves scientific data properties alongside visualisation considerations (*FITS & png/jpeg*)
- Mechanisms for links to original data
- Implemented for ~250 data sets and growing

□ HEALPix*



- 12 quadrilateral pixels
- 2x2 division at each level
- Equal area
- Iso-latitude
- Nested index scheme encodes inheritance
- Libraries

HiPS – Tiles and Pixels



k	$N_{side} = 2^k$	N_{pix}	θ_{pix}	$k_{tile,512}$	$N_{tile,512}$	$\theta_{tile,512}$	
0	1	12	58°6				
1	2	48	29°3				
2	4	192	14°7				
3	8	768	7°33				
4	16	3072	3°66				
5	32	12,288	1°83				
6	64	49,152	55'0				
7	128	196,608	27'5				
8	256	786,432	13'7				
9	512	3,145,728	6'87	0	12	58°6	- WMAP
10	1024	12,582,912	3'44	1	48	29°3	
11	2048	50,331,648	1'72	2	192	14°7	- PLANCK HFI
12	4096	201,326,592	51''5	3	768	7°33	- IRAS
13	8192	805,306,368	25''8	4	3072	3°66	
14	2^{14}	3.22×10^9	12''9	5	12288	1°83	- NVSS
15	2^{15}	1.29×10^{10}	6''44	6	49152	55'0	
16	2^{16}	5.15×10^{10}	3''22	7	196608	27'5	- SCUBA
17	2^{17}	2.06×10^{11}	1''61	8	786432	13'7	
18	2^{18}	8.25×10^{11}	0''81	9	3,145,728	6'87	- DSS
19	2^{19}	3.30×10^{12}	0''40	10	12,582,912	3'44	- SDSS
20	2^{20}	1.32×10^{13}	0''20	11	50,331,648	1'72	
21	2^{21}	5.28×10^{13}	0''10	12	201,326,592	51''5	- CFHTLS
22	2^{22}	2.11×10^{14}	50.3 mas	13	805,306,368	25''8	
23	2^{23}	8.44×10^{14}	25.1 mas	14	3.22×10^9	12''9	- HST ACS
24	2^{24}	3.38×10^{15}	12.6 mas	15	1.29×10^{10}	6''44	
25	2^{25}	1.35×10^{16}	6.30 mas	16	5.15×10^{10}	3''22	



----- Tiles -----

Aladin v8.1 *** BETA VERSION (based on v8.162) ***

Location Frame

IRIS colored

14:00 12:00 10:00

-30:00 -30:00

15° 134° x 108.6°

grid wink north multiview match

select pan zoom dist phot draw tag filter

rgb HST-F606W r3
 IRIS colored
 AIIWISE W1 (3.4u)
 AIIWISE color
 PHAT F475W
 HST-F555W r3

epoch -
size -
dens. -
opac. -
zoom -

Frame: ICRS

+180 +90 -180
-90

05:38:03.22 -69:14:27.9
134° x 108.6°

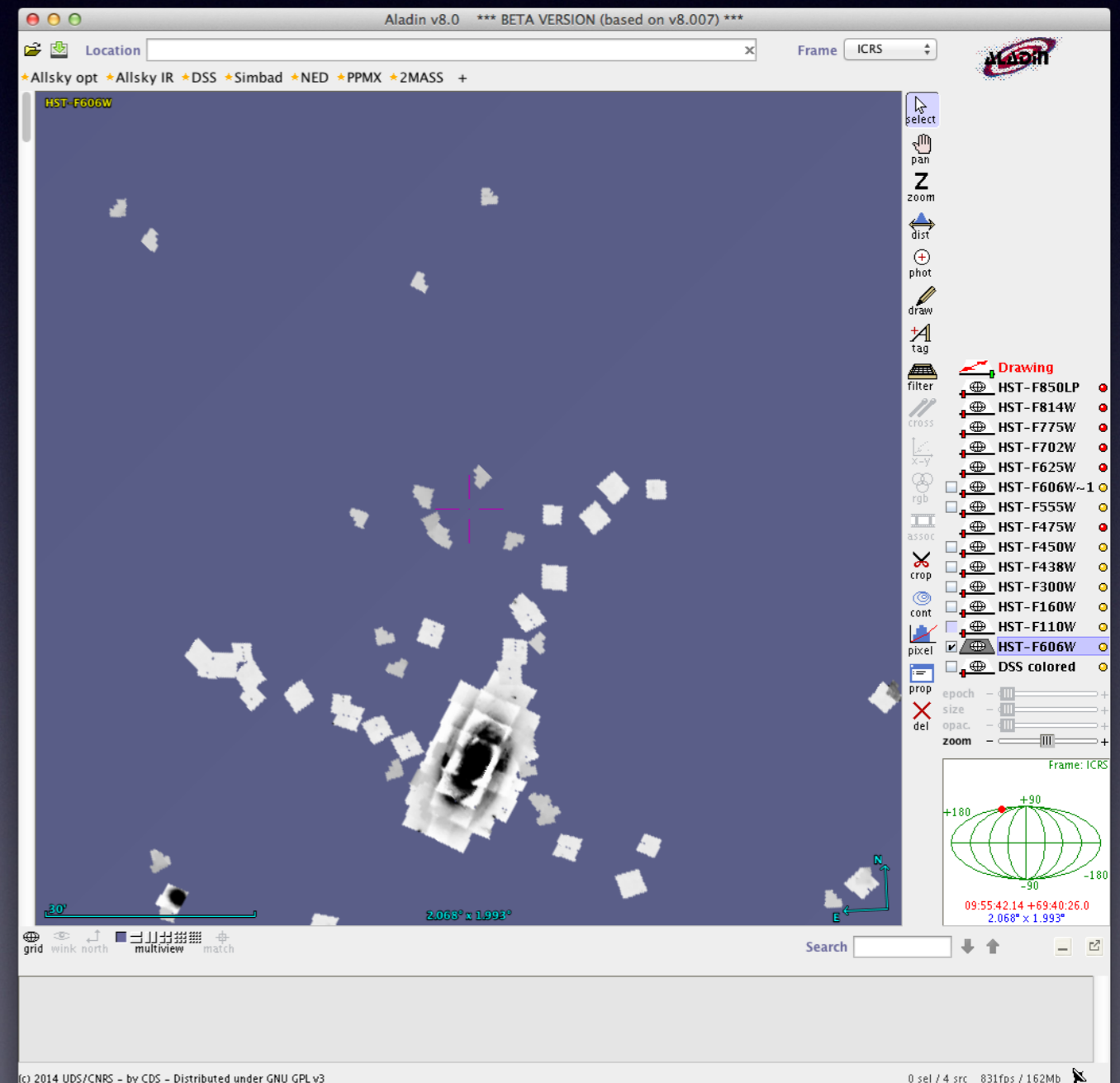
Search

0 sel / 0 src 66fps / 288Mb

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Use an archive as a survey

- HiPS of the WFPC2 HST archive images (filter by filter)

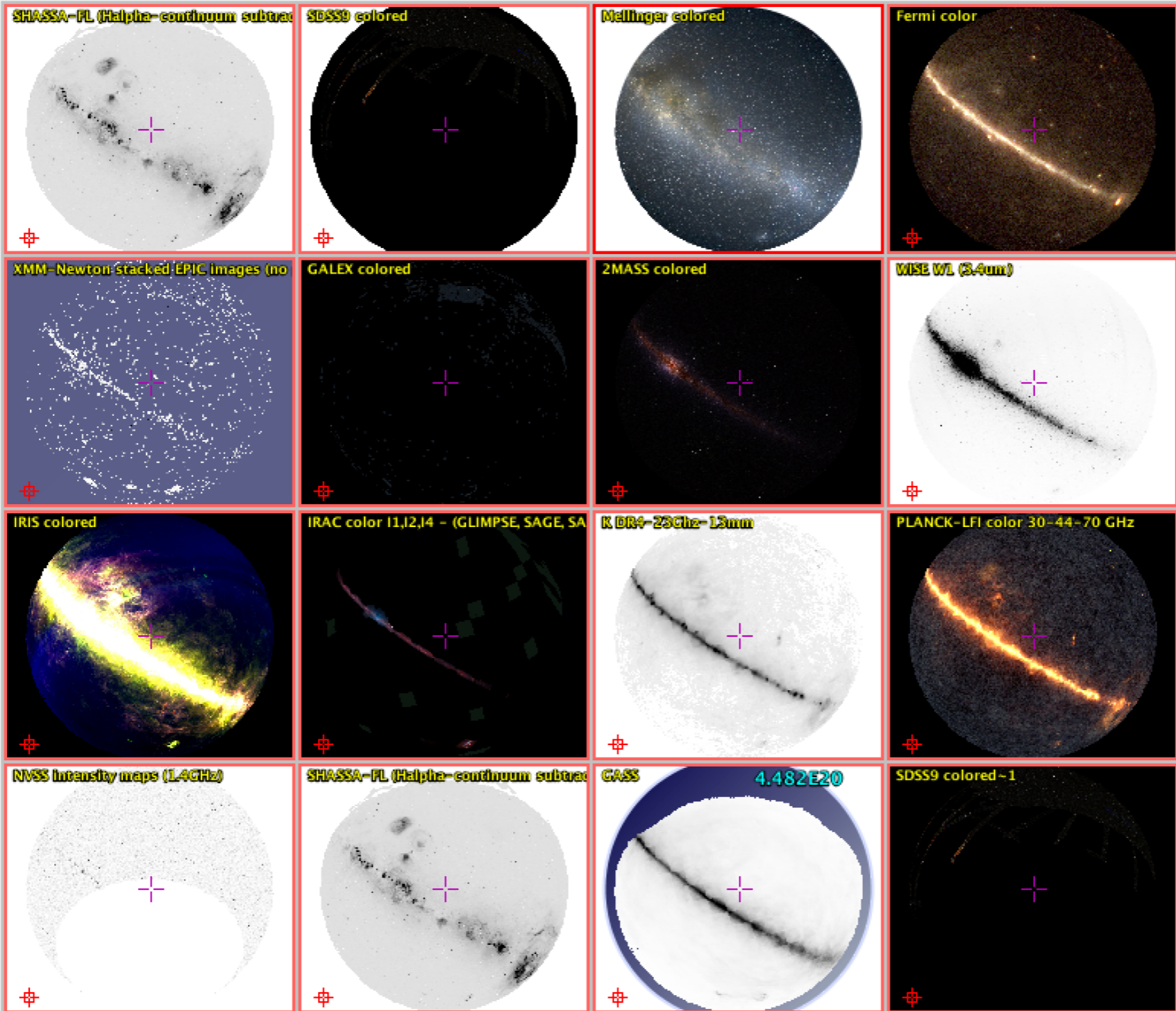


Location

Frame ICRS



★ Allsky opt ★ Allsky IR ★ DSS ★ Simbad ★ NED ★ PPMX ★ 2MASS +



select
pan
zoom
dist
phot
draw
tag
filter
cross
x-y
rgb
assoc
crop
cont
pixel
prop
del

- IRIS colored
- WISE W1 (3.4um)
- 2MASS colored
- GALEX colored
- XMM-Newton
- Fermi color
- Mellinger colored
- SDSS9 colored
- GASS
- SHASSA-FL (Alpha-continuum subtracted)
- NVSS intensity maps (1.4GHz)
- PLANCK-LFI color 30-44-70 GHz
- K DR4-23GHz-15mm
- IRAC color I1,I2,I4 - (GLIMPSE, SAGE, SAGE)
- IRIS colored
- WISE WL (3.4um)
- 2MASS colored
- GALEX colored
- XMM-Newton
- Fermi color
- Mellinger colored
- SDSS9 colored

epoch

size

opac.

zoom

Frame: ICRS

15:13:19.48 -44:40:43.2
180° x 180°

grid wink north multiview match

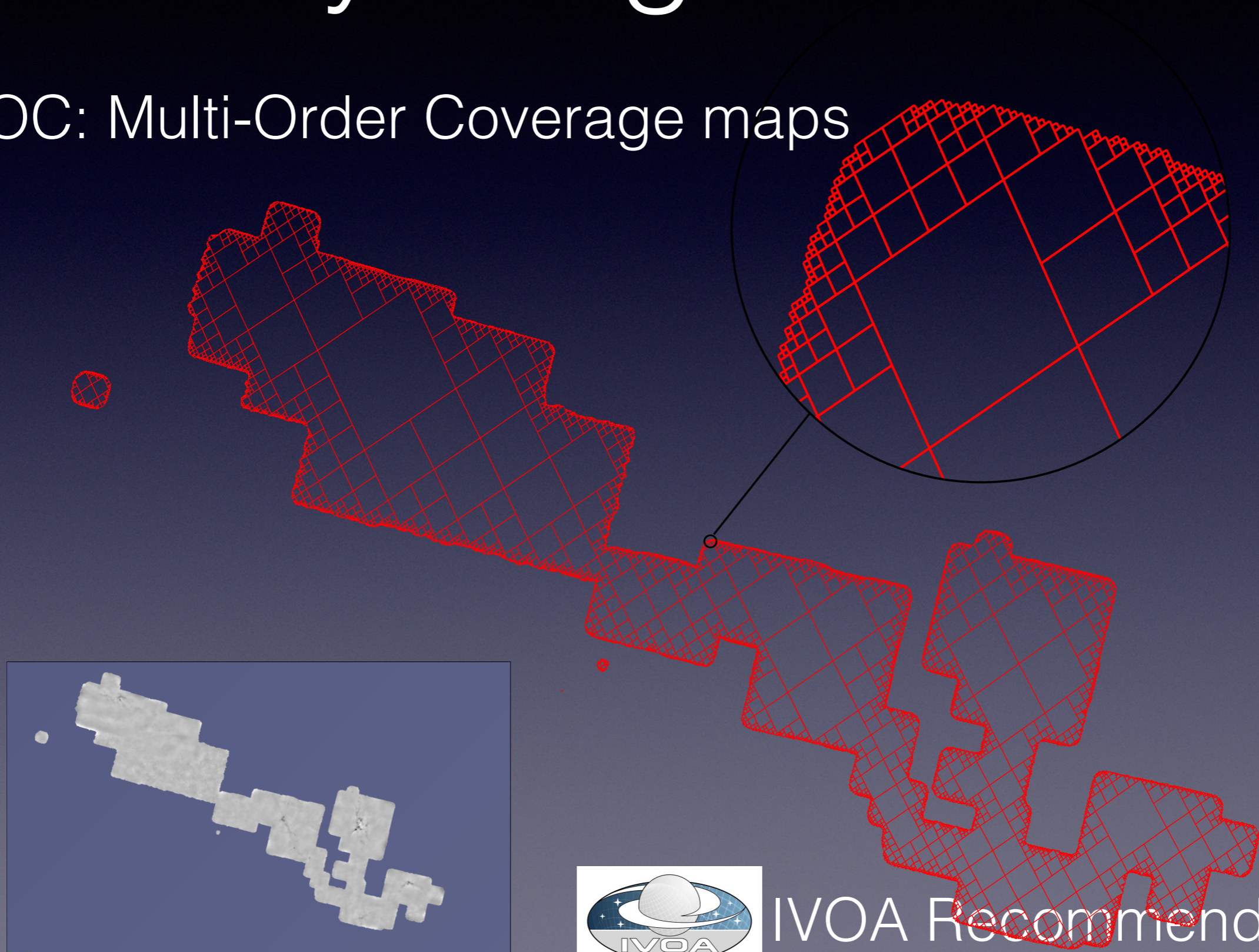
[View B2] - GALEX colored

Search

- Fermi
- EGRET
- XMM
- INTEGRAL
- RASS
- GALEX
- DSS
- SDSS
- CFHTLS
- HST
- 2MASS
- ULTRAVISTA
- WISE
- ALLWISE
- DIRBE
- IRIS
- GLIMPSE360
- SPITZER
- AKARI
- SCUBA
- BGPS
- WMAP
- PLANCK
- NVSS
- CHIPASS
- SUMSS
- DWINGELOO
- HASLAM408
- VLSSR
- WENSS
- SHS
- SHASSA
- VTSS
- GASS
- CGPS
- GALFA
- CALIFA
- MUSE
- HARP/JCMT
- Gaia GUMS
- SIMBAD
- GOODS
- PHAT

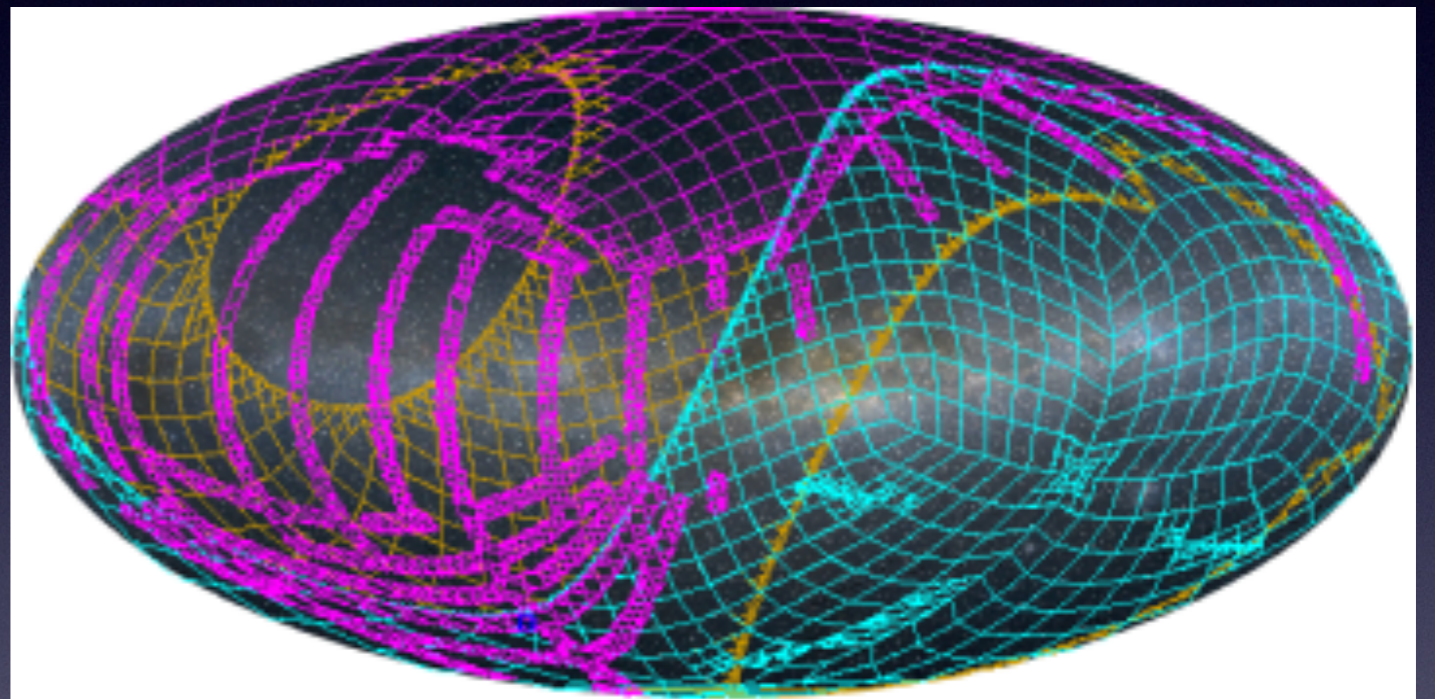
Survey/image outlines

- MOC: Multi-Order Coverage maps



IVOA Recommendation

- Comparing coverage of 100s of large data sets
- Intersection/union/complement trivial
- Catalogue coverage
 - 1000s (Vizier)



- Queries based on coverage and catalogues
 - e.g. Veron quasars in HST, XMM and SDSS images

Hierarchical views of Catalogues

- Same idea: *HiPS Catalogue*. Important when dealing with/visualizing 10^6 , 10^7 , 10^8 + catalogues
- Allows zooming into large or deep catalogue
- HiPS catalogues - provide progenitor links to HiPS images
- Hierarchy can be defined in different ways - brightness, parallax, local density
- e.g. SIMBAD progressive Survey (hierarchy based on size of object and number of citations)

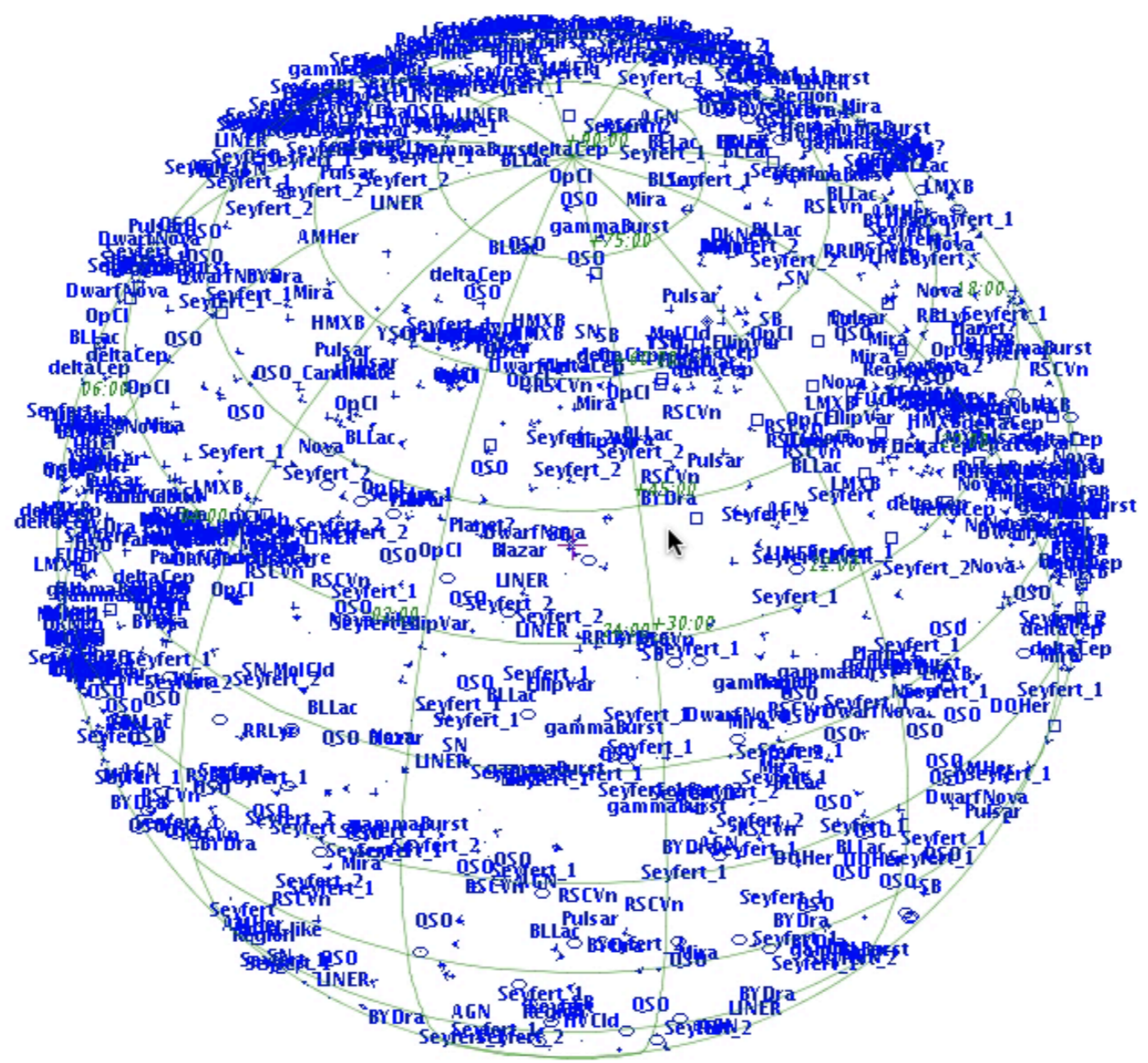
Location

Frame ICRS



Allsky opt Allsky IR DSS Simbad NED PPMX 2MASS +

Simbad



select
pan
zoom
dist
phot
draw
tag
filter
cross
x-y
rgb
assoc
J2000
size
opac.
zoom
cont
pixel
prop
del

Frame: ICRS

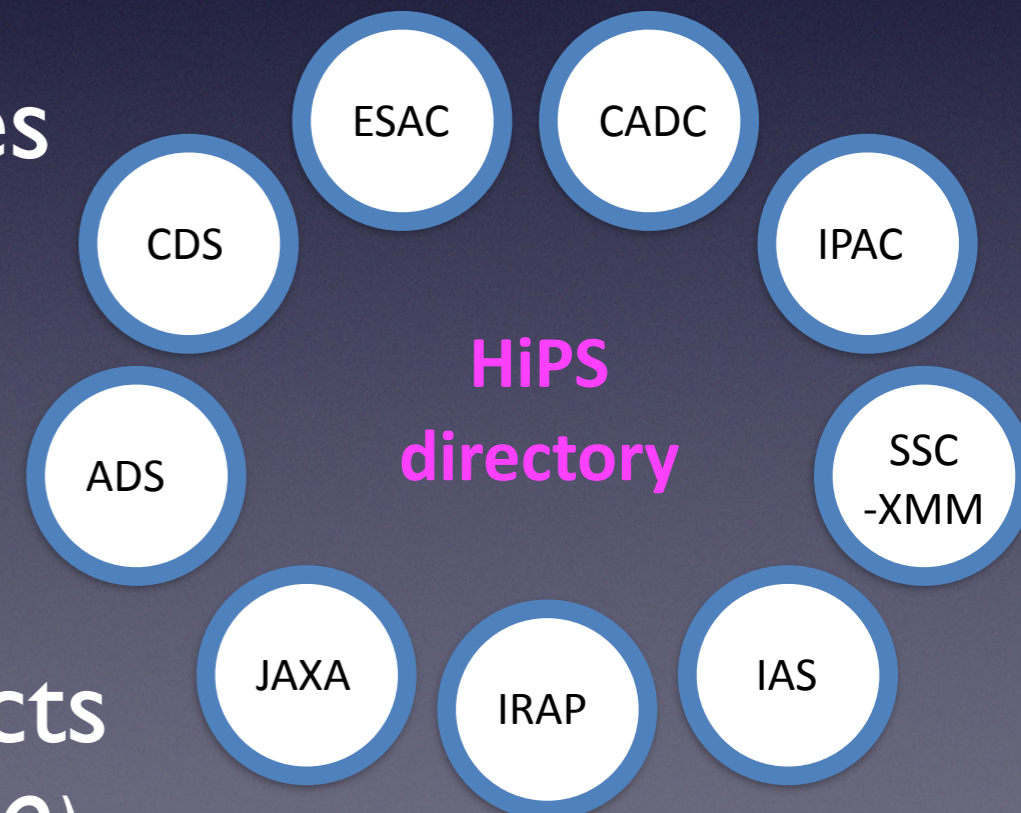
00:42:44.33 +41:16:07.5
180° x 180°

grid wink north multiview match

Search

Interactions and collaboration with agencies and observatories

- Reference data centre role of CDS
- Catalogues of surveys
- HiPS images, catalogues, cubes
- Support of Aladin Lite
- VO interoperability
- Involvement in specific projects and missions (e.g. *Gaia* via *CU9*)



Plans

- **Reinforcing the core of CDS**
 - Making services work and grow according to needs
 - quality, integrity and relevance
- **Scientific Engagement**
 - Astronomers, Projects, Missions, Observatories, Agencies, Journals, Data Centres

Challenges

- Big Data and small data
- Keeping up with feature demands and fixes
- Quickly evolving publication landscape
- Recognition of Data Science roles
- Performance indicators

Conclusions

- CDS Reference data centre supports science
- HiPS & Aladin Lite proving to be good model for collaboration, sharing software components, innovation and interoperability
- Interaction at SCIOPS very helpful

thanks

Links

- Hierarchical Progressive Surveys
 - *Fernique et al. 2015, A&A 578, 114*
 - HiPS on CDS web pages: <http://aladin.u-strasbg.fr/hips>
- Aladin <http://aladin.u-strasbg.fr/AladinDesktop/>
- Aladin Lite <http://aladin.u-strasbg.fr/AladinLite/>
- HiPS generation tools: <http://aladin.u-strasbg.fr/hips/#tools>