



# IVOA standards for multiD access priority

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# PART 1

- ▶ **DATA ACCESS LAYER  
PROTOCOLS**

# TIME DOMAIN:

## Some lack of VO standardization

- ▶ Time Domain interest group
  - Focus on events (eg GRB → VoEvent protocols)
- ▶ Time Series
  - Light curve : standard discovery by spectral protocols
  - Cubes with time dimension : standard discovery by ObstAP or SIAV2
  - Actually: discovery by time, spectral, position and polarization ranges
  - Nothing about variation amplitude, symmetry, period
  - → Modeling first ? Then accessing ?

# DAL landscape

- ▶ DALI [VOTABLE]
- ▶ TAP ADQL
- ▶ ObsTAP ([Obscore])
- ▶ ConeSearch SIAV1 SSA1.1 SIAV2.0
- ▶ SODA (AccessData) DataLink
- ▶ ???????

# Protocol families in two words

- ▶ TAP = generic and interoperable relational DBMS interface. ADQL → extended SQL for Astronomy. IVOA Recommendations since 2008 and 2010
- ▶ « Simple » access protocols (ConeSearch, SIA, SSA ...) : mainly Parameter query interface for catalogues, images, cubes, spectra
- ▶ ObsTAP is dataset discovery based on a TAP service (2011)
- ▶ Newcomers : DALI, DataLink (2015), SIAV2.0, SODA = Server-side Operations for Data Access (previously AccessData – Working Draft)

# DAL landscape

- ▶ TAP,ADQL
- ▶ VOTABLE ConeSearch,SIAV1
- ▶ SSA1.1
- ▶ ObsTAP ([Obscore])
- ▶ DALI (common spec)
- ▶ SIAV2.0
- ▶ SODA (AccessData)
- ▶ DataLink (operation bounds)

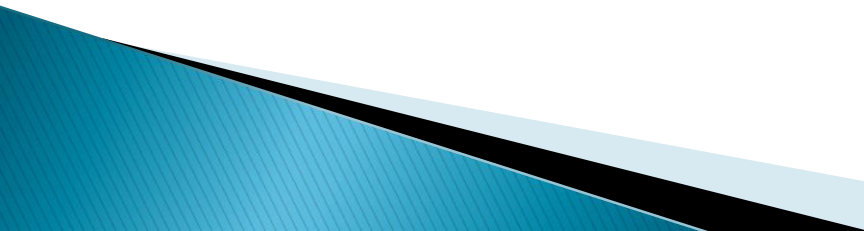
# Multi-dimensional Data Access

## minimal requirements from CSP:

- \* Data Discovery (Query)
  - \* A service shall be able to receive queries regarding its data collection(s) from a client, with the client placing one or more of the following constraints:
    - \* RA,Dec
    - \* Frequency/wavelength
    - \* Polarization states
    - \* Spatial size
    - \* Angular resolution
    - \* Integration time
    - \* Time of observation

# Multi-dimensional Data Access

## minimal requirements from CSP:

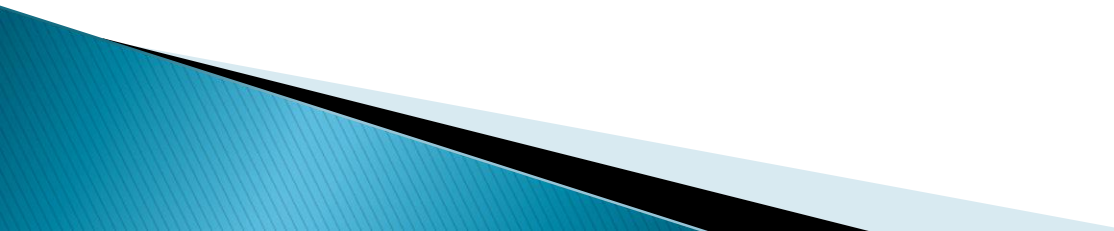
- \* Data Discovery (Query)
    - \* A service shall return to the client a list of observations, and the corresponding metadata for each observation, meeting the user-imposed constraints. In the event that the user places no constraints, the entire list of observations, and the corresponding metadata for each data set, shall be returned. In the event that no data meet the user's constraints, the service shall indicate the absence of any matches.
- 



# Multi-dimensional Data Access

## minimal requirements from CSP:

- \* Data Access

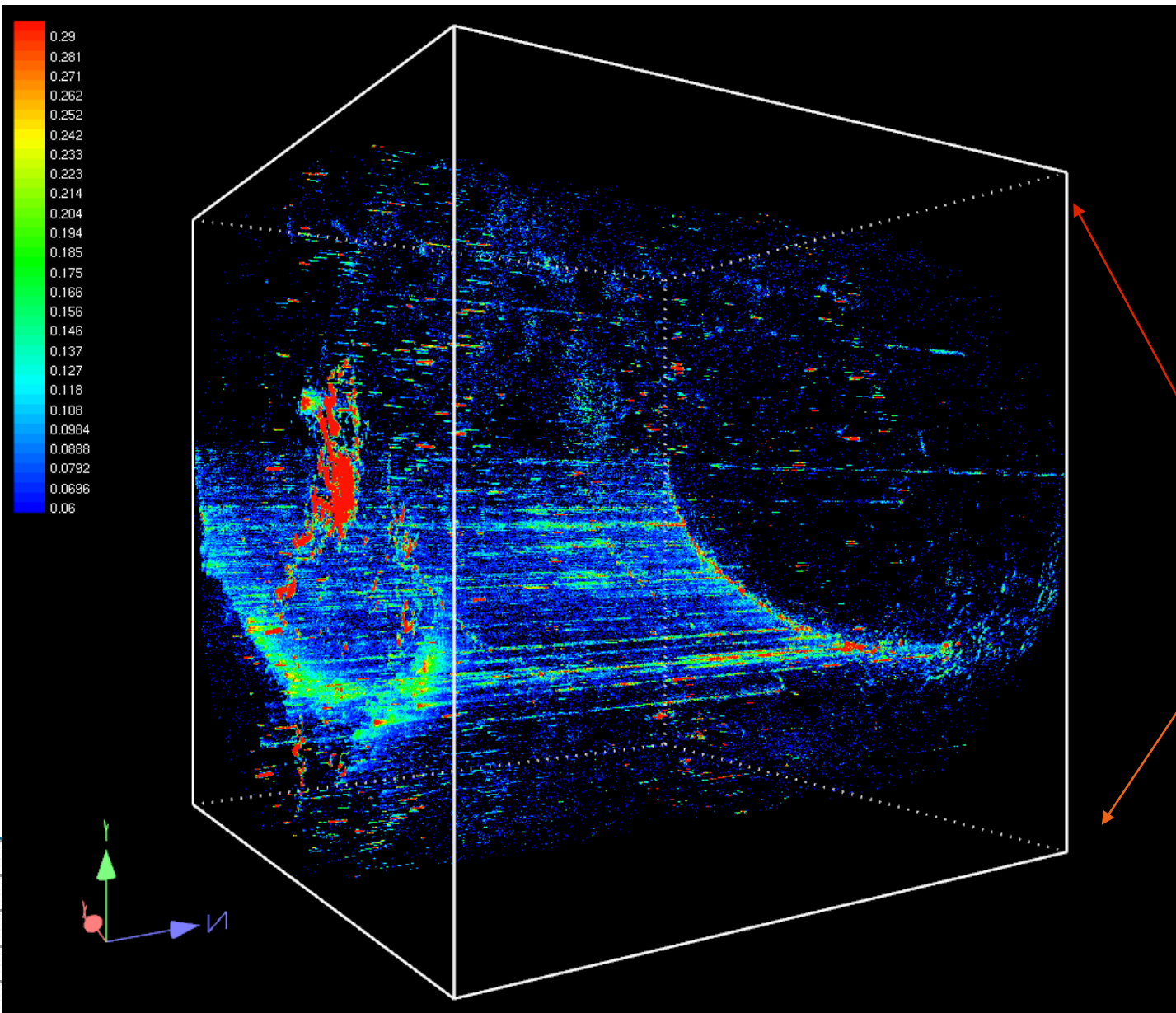
- \* Once a user has the list of observations that satisfy the constraints, they select all or a subset of the observations and:
    - \* Download the complete science data for each of the selected observations (the service shall return the complete multi-dimensional science data and metadata for each selected observation) or;
    - \* Download simple cutouts of the science data for each of the selected observations (the service shall be able to extract and return a user-specified subset of the complete multi-dimensional science data and metadata for each selected observation).
- 

# Multi-dimensional Data Access

## minimal requirements from CSP:

- \* Simple Cutout
  - \* For a simple cutout, the user-specified subset is restricted to be a contiguous interval within each dimension of the multi-dimensional science data. The user should *\*not\** be allowed to specify subsets with "gaps" or resampling or anything like that.
    - \* Spatial: a circle (a coordinate and a radius)
    - \* Energy: one interval (from energy1 to energy2)
    - \* Time: one interval (from time1 to time2)
    - \* Polarization: a list

# STEP 1 : Discovery



Radio data cube

*Green and red Axes*  
- *Spatial dimensions*  
*Blue Axis :*  
- *Wavelength dimension*

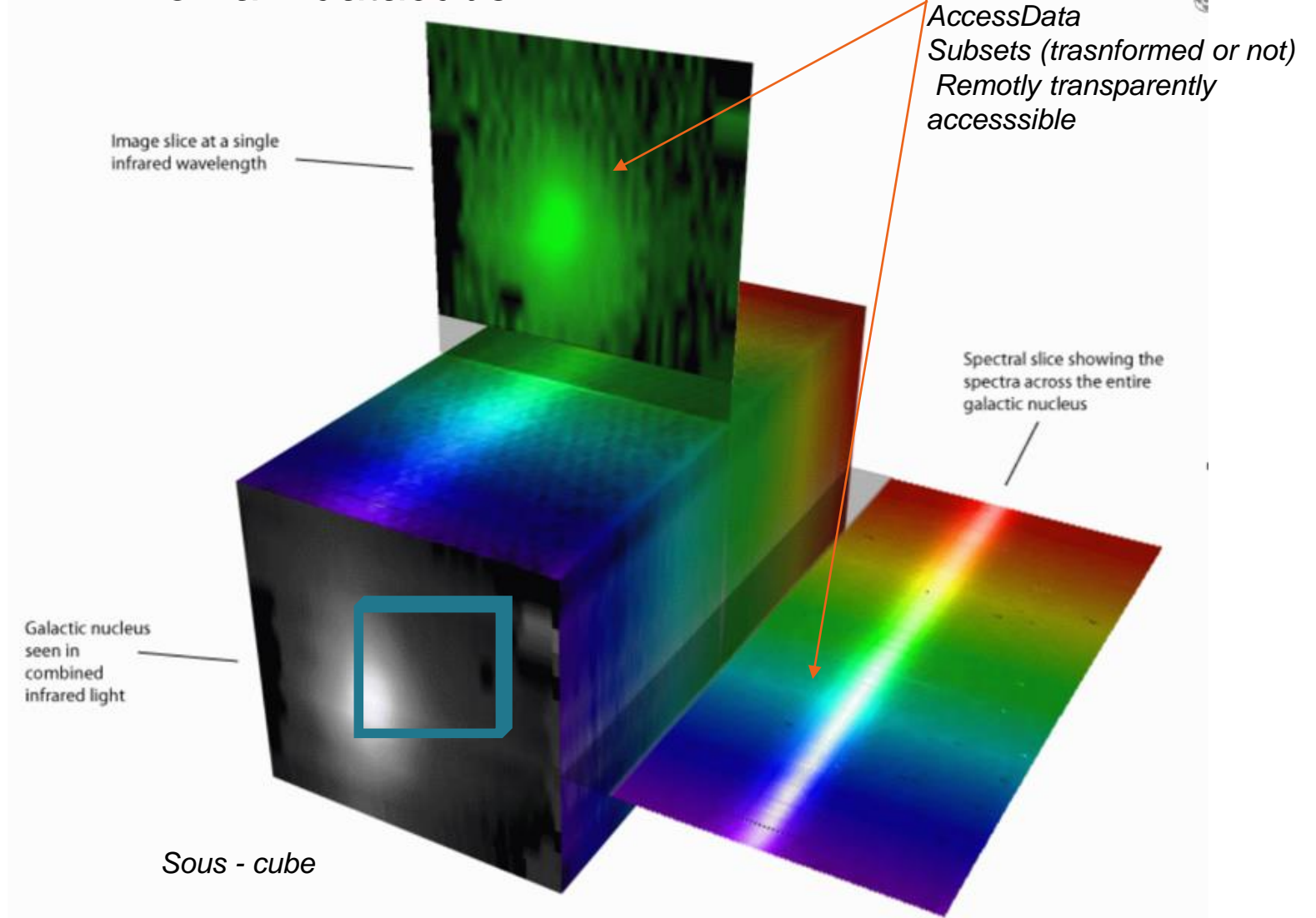
## STEP 2:

### Description :

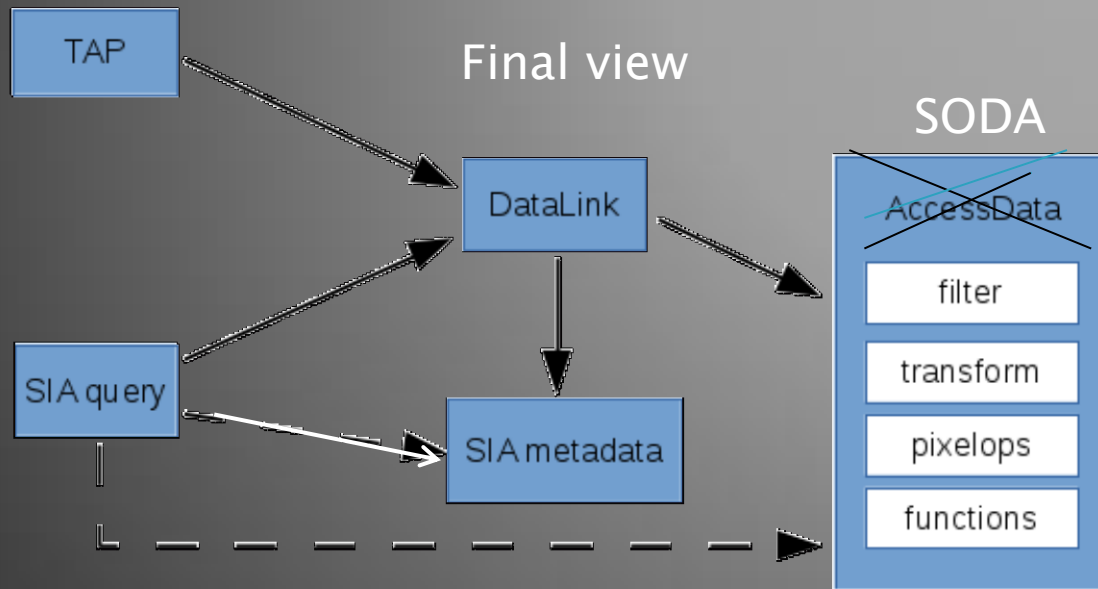
- *Axes type*
- *Extension*
- *Typical value*
- *Date*
- *Data producer,*
- *Data curator*

# « Integral Field Unit » optical Domain datacube

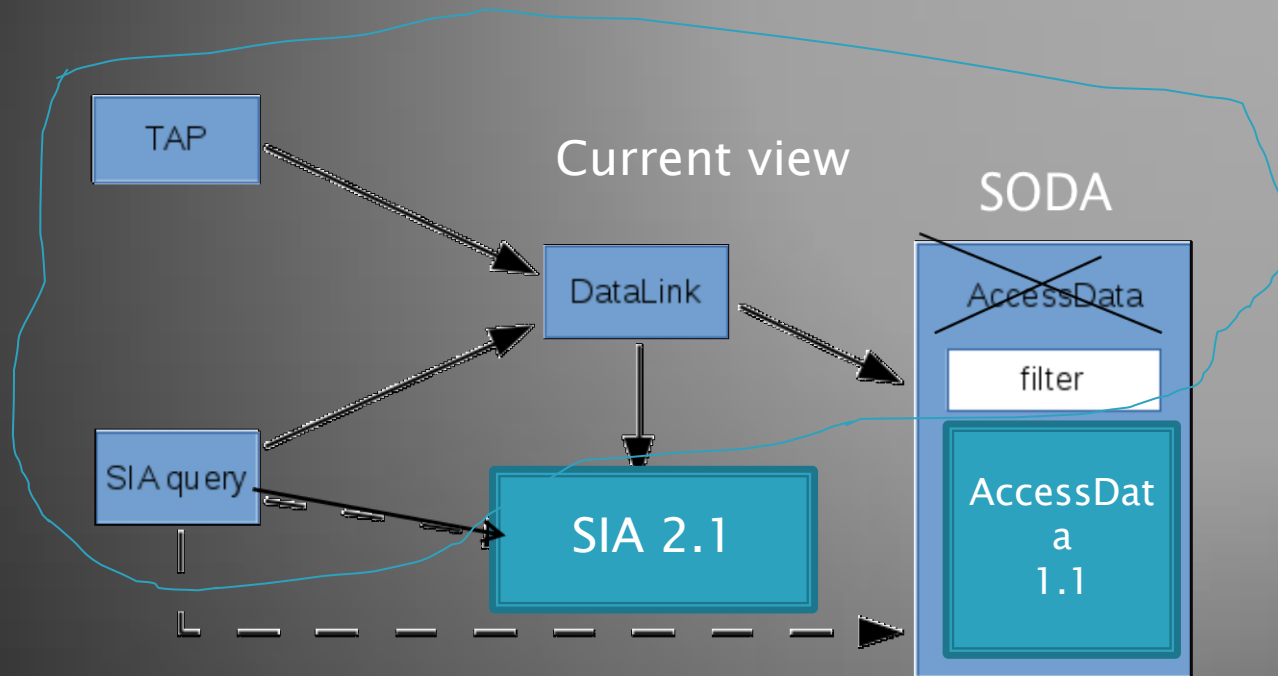
**STEP 3**



# Multidimensional data protocol Caravane



# Multidimensional data protocol Caravane



# Cube Access scenario: basic (first version of protocols, end 2015)

- **I ) find out cube services from registry.**

- Obstap (generic, ADQL)

or

- SIAV2 (cube-oriented, parameterQuery)

- **II ) Query from an ObsCore service**

- « select \* from Obscore where dataproduct\_type = cube »

- **II bis ) Query from a SIAV2 service**

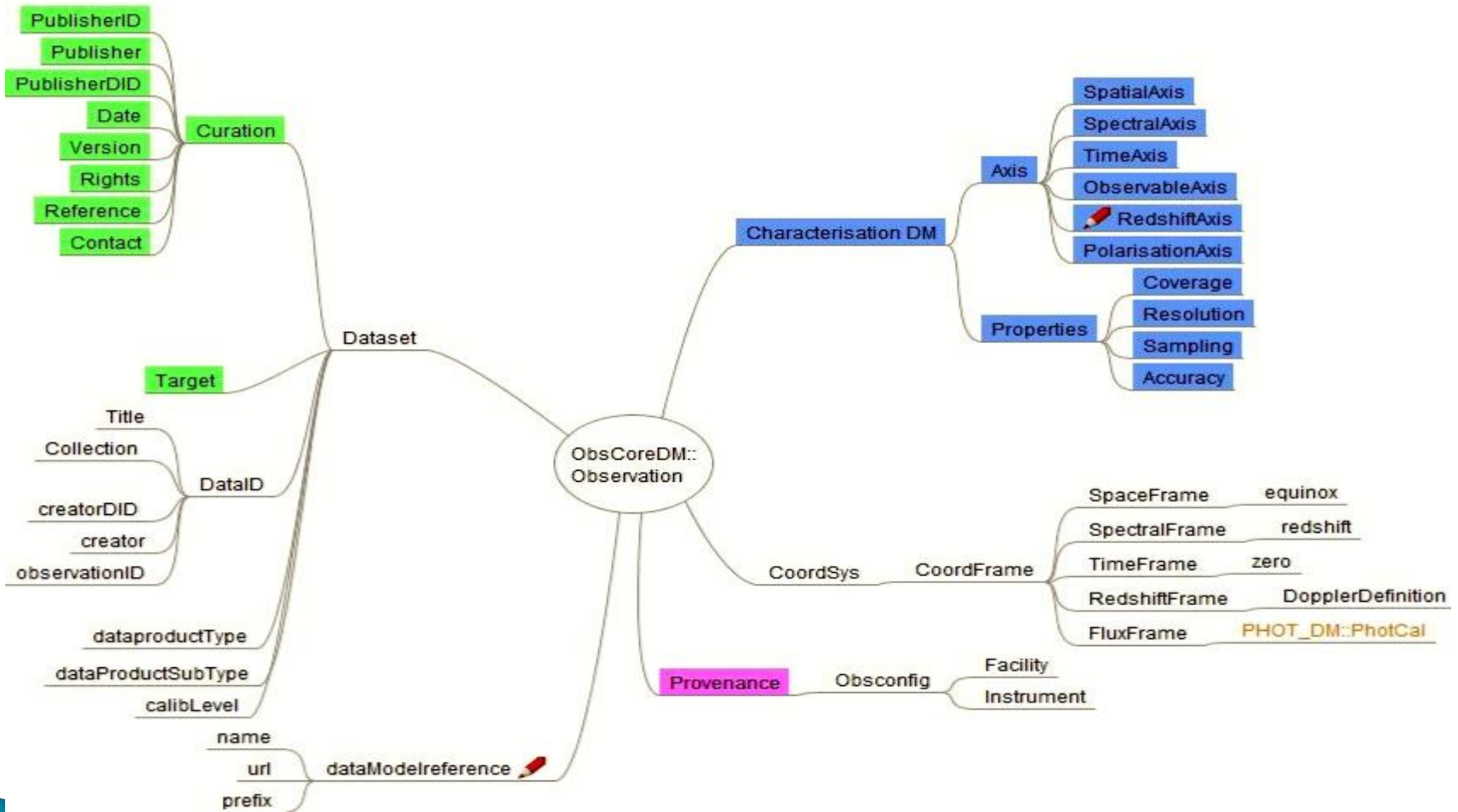
- « http://.....?request=query&pos=circle 3.0 2.0 1.0&band=0.001 0.003 »

# Cube Access scenario: basic (first version of protocols, end2015)

- **III ) query response :**
  - votable, ObsCore/consistent
- **IV ) DataLink :**
  - fixed links, metadata services, SODA (access data)
- **IV bis ) direct SODA (AccessData)**



# ObsCore Heuristic Map



# Discovery

Cette page est en anglais Voulez-vous la traduire ? Traduire Non Toujours traduire les pages en anglais Options

**VAO** Search All Virtual Observatory Collections:  Radius:  Arcmin

[User Guide](#) | [Discovery Tool v1.5 \(6846\)](#) Examples: [M101](#), [14.03.12.6](#) + [54.20.56.7](#), [more...](#)

Start Page  NGC 6946 (RA: 20:34:52.322, Dec: +60:09:14.08), radius: 0.01667°

Displaying 46 of 358 Total Rows

**Filters**

Clear Filters Edit Facets... Help...

Filter All Record Fields

**Type**

- Catalog (0 of 307)
- Image (46 of 46)
- Spectra (0 of 5)

**Waveband**

- EUV (2 of 5)
- Gamma-ray (3 of 12)
- Infrared (20 of 104)
- Millimeter (2 of 5)
- Optical (14 of 154)
- Radio (2 of 71)
- UV (11 of 39)
- X-ray (9 of 66)

**Publisher**


- Canadian Astronomy Data Centre (2 of 2)
- CDS (0 of 205)
- Chandra X-ray Observatory (2 of 4)
- ESO (1 of 1)
- European Space Agency (1 of 1)
- German Astrophysical Virtual Observatory (1 of 2)
- MAST (5 of 6)
- NASA/GSFC HEASARC (15 of 82)
- NASA/HEASARC (1 of 1)
- NASA/IPAC Infrared Science Archive (10 of 12)
- National Optical Astrono (0 of 2)
- Observatory of Strasbourg, SSC Team (1 of 1)





Actions	Short Name	Type	Title	Waveband	Records Found
	Spitzer Level 1		Spitzer Level 1 / Basic Calibrated Data	Infrared	3127
	CADC		CADC Image Search	Millimeter, Infra...	869
	CADC/SIAv1		CADC Image Search (SIA)		869
	Spitzer Level 2		Spitzer Level 2 / post Basic Calibrated Data	Infrared	546
	WISE All-Sky L1B		WISE All-Sky 4-band Single-Exposure Images	Infrared	177
	ST-ECF/HLA/SIA		ST-ECF Hubble Legacy Archive Images		89
	hdap_siap [1]		HDAP -- Heidelberg Digitized Astronomical Plates	Optical	63
	SkyView		SkyView Virtual Observatory	Radio, Infrared,...	58
	NED(images)		The NASA/IPAC Extragalactic Database Image Data Atlas	Radio, Millimeter...	47
	HLA [1]		Hubble Legacy Archive	Optical, Infrare...	40
	ST-ECF/HST/SIA		ST-ECF Hubble Space Telescope Images		35
	HST Previews		Hubble Space Telescope Preview Images	Optical	29
	MAST-Scrapbook		The MAST Image Scrapbook	Infrared, Optica...	28
	IRTS		The Infrared Telescope in Space Data Atlas	Infrared	26
	ROSAT SIA		SIA Service for ROSAT Archive	X-ray	22
	2MASS QL		2MASS All-Sky Quicklook Image Service	Infrared	18
	2MASS ASKY AT		2MASS All-Sky Atlas Image Service	Infrared	18
	DSS ESO		Digitized Sky Survey		16

**AstroView**

20:35:44.469 +60:25:47.943  
20:34:52.322 +60:09:14.076 **RA DEC**  
hhmmss/deg











# Discovery


 TAPHandle  Node Selector @ b

    **cadc>ivoa>ObsCore>w/wclxqkwx29g5jq**

Tap Nodes

- cadc
  - TAP\_SCHEMA
    - ivoa
      - ivoa.ObsCore
        - cfht
        - caom2
        - caom
- Goodies

	access_estsize	target_name	s_ra	s_dec	s_fov	s_region	s_resolution	t_min	t_max	t_exptime	t_resolution	em_min
nk	null	M31	10.684280	41.268274	0.75172824		NaN	54349.349	54349.380	13.858047	NaN	0.00086506567
nk	null	M31	10.684280	41.268274	0.75172824		NaN	54349.349	54349.380	13.878724	NaN	0.00086497792
nk	null	M31	10.684942	41.268232	1.0513781		NaN	54349.348	54349.380	2720.0000	NaN	0.00086497865
nk	null	M31	10.684652	41.268042	0.75315870		NaN	54349.384	54349.415	13.912904	NaN	0.00086505104
nk	null	M31	10.684943	41.268233	1.0513813		NaN	54349.384	54349.415	2737.0000	NaN	0.00086497865
nk	null	M31	10.684615	41.268007	0.75315870		NaN	54349.384	54349.415	13.931988	NaN	0.00086497792
nk	null	M31	10.685881	41.269388	0.75173089		NaN	54382.325	54382.357	11.208046	NaN	0.00086504622
nk	null	M31	10.685057	41.268589	0.75315870		NaN	54382.325	54382.357	13.994818	NaN	0.00086497797
nk	null	M31	10.685161	41.269028	1.0527622		NaN	54382.325	54382.357	2755.0000	NaN	0.00086497870
nk	null	M31	18.854066	35.020254	1.4872042		0.82000000	52966.227	55567.244	4170.0000	NaN	4.0780000e-7

 **Select What** **Where** **Plain Text Query** **Job Control**

Set up the SELECT clause of the query

```
SELECT TOP 100 *
FROM ivoa.ObsCore
WHERE ivoa.ObsCore.target_name = 'M31'
```

Result Limit

saada.u-strasbg.fr/taphandle/#tapselect

# INTERFACE TO AMIGA SIAV2 service

Aladin v8.1 \*\*\* BETA VERSION (based on v8.155) \*\*\*

Fichier Edition Image Catalogue Graphique Couverture Outil Vue Interop Aide

Position: 022.24521 -29.83011 Référentiel: ICRSd

DSS SDSS 2MASS WISE GALEX PLANCK AKARI XMM Fermi Simbad NED +

DSS colored

Contrôle par la souris:

- Gauche: sélection des sources.
- Milieu: déplacement du champ.
- Droite: ajustement du contraste.

CADC SIAV2  
Amiga SIAV2  
DSS colored

Sélecteur de serveurs

Autres: RIPS File all VO Watch FoV... Amiga CAD SIAV2 Tools...

Serveurs d'images:

- Aladin images
- SkyView
- UKIDSS
- Sloan
- DSS...
- VLA...
- Archives...
- Others...

Serveurs de tables:

- All Vizier
- Surveys
- Missions
- Simbad
- NED
- MOC
- SkyBot
- Others..

Cadc SIAV2 archive prototype ?

POS: CIRCLE 23.5 -29.4 0.2

BAND:

TIME:

POL:

FOV:

SPATRES:

EXPTIME:

ID:

COLLECTION:

Réinit. Effacer CHERCHER Fermer ?

dataproduct	calib le...	obs coll...	facility	instrume...	obs id	obs rele...	access url	access f...	acces
<input type="checkbox"/> image	2	HST	HST	WFPC2	u6ead504m	2001-08-...	http://w...	applicat...	
<input type="checkbox"/> image	2	HST	HST	WFPC2	u6ead506m	2001-08-...	http://w...	applicat...	
<input type="checkbox"/> image	2	HST	HST	WFPC2	u6ead505m	2001-08-...	http://w...	applicat...	
<input type="checkbox"/> image	2	HST	HST	WFPC2	u6ead502m	2001-08-...	http://w...	applicat...	
<input type="checkbox"/> image	2	HST	HST	WFPC2	u6ead501m	2001-08-...	http://w...	applicat...	
<input type="checkbox"/> image	2	JCMT	JCMT	SCUBA	19970909...	1999-02-...	http://w...	applicat...	
<input type="checkbox"/> image	2	JCMT	JCMT	SCUBA	19970909...	1999-02-...	http://w...	applicat...	
<input type="checkbox"/> image	3	HSTLA	HST	WFPC2	hst 0904...	2001-08-...	http://w...	applicat...	
<input type="checkbox"/> image	3	HSTLA	HST	WFPC2	hst 0904...	2001-08-...	http://w...	applicat...	
<input type="checkbox"/> image	3	HSTLA	HST	WFPC2	hst 0904...	2001-08-...	http://w...	applicat...	
<input type="checkbox"/> image	3	HSTLA	HST	WFPC2	hst 0904...	2001-08-...	http://w...	applicat...	

grille onlign nord multivues univ

12:48  
18/06/2015

# AMIGA response for NGC 613

Aladin v8.1 \*\*\* BETA VERSION (based on v8.155) \*\*\*

Fichier Edition Image Catalogue Graphique Couverture Outil Vue Interop Aide

Position 01:34:38.92 -29:19:51.0 Référentiel ICRS

DSS colored

30° 3.11° x 1.257°

Chercher

access url	access f...	access e...	obs publ...	obs title	obs coll...	dataproduct	target n...	s ra	s dec	s fov	s resolu...	em min	em max	o stat e...	o unit	o ucd	pol states	fa
http://a...	applicat...	6412	ivo://sv...	NGC613	BODEGA	bodega.c...	NGC613	23.5758	-29.4183	0.0106667	4.6129			0.0207632	Jy/Beam	phot.fux		MK

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1 sel / 63 src 115Mo

FR 12:42 18/06/2015

# NGC 613 cube in movie mode channel 4

Aladin v8.1 \*\*\* BETA VERSION (based on v8.155) \*\*\*

Fichier Edition Image Catalogue Graphique Couverture Outil Vue Interop Aide

Position 023.57437 -29.41528 Référentiel ICRSd

DSS SDSS 2MASS WISE GALEX PLANCK AKARI XMM Fermi Simbad NED +

1310070.222 0.01006

004 / 025

1.503" x 07.16"

Amiga SIAv2  
Simbad  
<http://amiga.iaa.es>  
DSS colored

époque -  
taille -  
opac. -  
zoom -

Chercher

TIP: Saviez-vous que vous pouvez calibrer des images JPEG ou PNG ? => Image>Calibrer

0 sel / 9148 src 321ps / 91Mo

FR 18:29 12/06/2015

# NGC 613 cube in movie mode channel 11

Aladin v8.1 \*\*\* BETA VERSION (based on v8.155) \*\*\*

Fichier Edition Image Catalogue Graphique Couverture Outil Vue Interop Aide

Position  Référentiel

DSS 
  SDSS 
  2MASS 
  WISE 
  GALEX 
  PLANCK 
  AKARI 
  XMM 
  Fermi 
  Simbad 
  NED 
 +

1.030077.881 011 / 025 -0.04177

1.030° x 47.16° 1.28° x 1.28°

grille cligne nord multivues unif. Blink control: Change the current frame Chercher

access url	access f...	access e...	obs publ...	obs title	obs coll...	dataproduct	target n...	s ra	s dec	s fov	s resolu...	em min	em max	o stat e...	o unit	o ucd	pol states	fa
<input type="checkbox"/> http://a...	applicat...	6412	ivo://sv...	NGC613	BODEGA	bodega.c...	NGC613	23.5758	-29.4183	0.0106667	4.6129			0.0207632	Jy/Beam	phot.fux		MK
<input type="checkbox"/> NGC_613		EMG	01 34 18.235	-29 25 06.56					10.77	10.03	9.5	7.916	7.381	7.031	4....	2....	120	230

TIP: Affichez la table des couleurs avec l'image => Graphique>Table des couleurs

2 sel / 9148 src 32fps / 307Mo

FR 18:28 12/06/2015

# NGC 613 cube in movie mode channel 20

The screenshot displays the Aladin v8.1 software interface, which is a BETA VERSION based on v8.155. The main window shows a grayscale image of NGC 613 in movie mode channel 20. The interface includes a menu bar (Fichier, Edition, Image, Catalogue, Graphique, Couverture, Outil, Vue, Interop, Aide), a position field (023.57646 -29.41274), and a reference system dropdown (Référentiel: ICRSd). A toolbar on the right contains various tools such as select, dépl., zoom, dist, phot, dessin, matq, filtre, nvb, coupe, cont, époque, pibrel, opac., zoom, and suppr. The bottom status bar shows the copyright information (© 2014 UDS/CNRS - by CDS - Distributed under GNU GPL v3), the current selection (0 sel / 9148 src), frame rate (32fps / 305Mo), and the date and time (18:29 12/06/2015).

Aladin v8.1 \*\*\* BETA VERSION (based on v8.155) \*\*\*

Fichier Edition Image Catalogue Graphique Couverture Outil Vue Interop Aide

Position 023.57646 -29.41274 Référentiel ICRSd

DSS SDSS 2MASS WISE GALEX PLANCK AKARI XMM Fermi Simbad NED +

1060067.22 020 / 025 -0.04201

1.368" x 47.16"

1.28" x 1.28"

Chercher

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FR 18:29 12/06/2015



# DataLink

Two mechanisms to bound resources (others datasets, descriptions, services) to « discovered » datasets = resource descriptor and links services

The list of links that is returned by the {links} resource can be represented as a table with the following columns:

name	description	required	UCD
ID	Input identifier	yes	meta.id;meta.main
access_url	link to data or service	one only	meta.ref.url
error_message	error if an accessURL cannot be created		meta.code.error
service_def	reference to the description of a service at <a href="#">access_url</a>	no	meta.ref
description	human-readable text describing this link	no	meta.note
semantics	limited vocabulary describing this link	no	meta.code
content_type	mime-type of file the link returns	no	meta.code.mime
content_length	size of download the link returns	no	phys.size;meta.file

□ Cube average (fixed links), accesdata, (*custom services*)

# SODA

- Cutout driven by parameters identical to Query
  - POS=CIRCLE 12 34 0.5
  - POS=RANGE 12.014.0 34.0 36.0
  - BAND=500 550
  - TIME= 55000.0 56000.0
  - POL=Q,POL=.....

# DataLink and « SODA » combination

- ▶ Client implementation : TapHandle :

The screenshot displays the TapHandle web application interface. The main window shows a table of data entries with columns: **dataproduit\_type**, **calib\_level**, **obs\_collection**, **facility\_name**, and **in**. The table contains 10 entries, with the first few rows showing 'image' data from 'CFHT' facilities. Below the table, there are controls for 'Showing 1 to 10 of 100 entries' and navigation buttons.

A 'Link Browser' window is open, displaying a 'Link #this' section with a description: 'the primary (as opposed to related) data of the identified resource'. Below this, there is a 'Link #cutout' section with a description: 'Cutout a subsection of the primary data'. The 'uri' field contains 'ad:CFHT/1247354s'. The 'cutout' field contains a polygon ICRS coordinate string: 'polygon ICRS 31.991146 -4.112172 31.991146 -3.605686 32.497632 -3.605686 32.497632 -4.112172 31.991146 -4.112172'. Below the coordinates is a small image of a star field with a red rectangular cutout and a crosshair. The 'FoV: 1.01°' is indicated. At the bottom of the window are buttons: 'Browse', 'Edit', 'Center', 'clear', and 'Accept'.

The interface also includes a 'Tap Nodes' tree on the left, a 'SUBMIT' button, and a 'List of UWS jobs' section at the bottom. The browser's address bar shows 'saada.unistra.fr/taphandle/#'.

# Current protocol status

- ▶ TAP 1.1 and ADQL 2.1 are discussed Drafts
- ▶ DataLink 1.0 is a recommendation since June 2015
- ▶ SIAV2.0 is a proposed recommendation with a very long stay in TCG review phase.

All main issues have been solved and it is in the hands of the Exec  
**CASDA group succeeded in implementing it**

- ▶ SODA1.0 :

new version of WD after Sydney. Should be fast because it's very dependant on SIAV2. → recommendation well before May 2016 interop

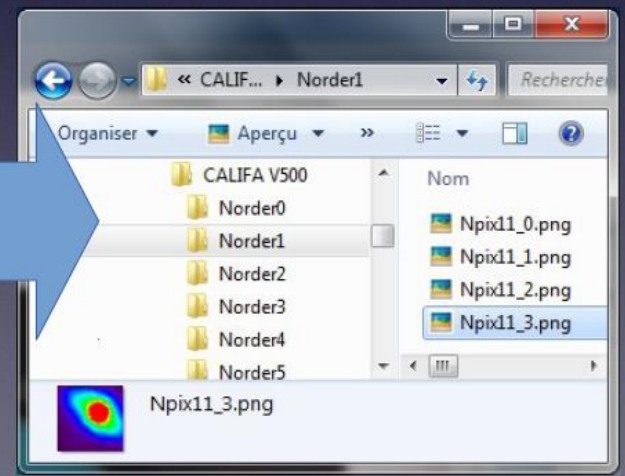
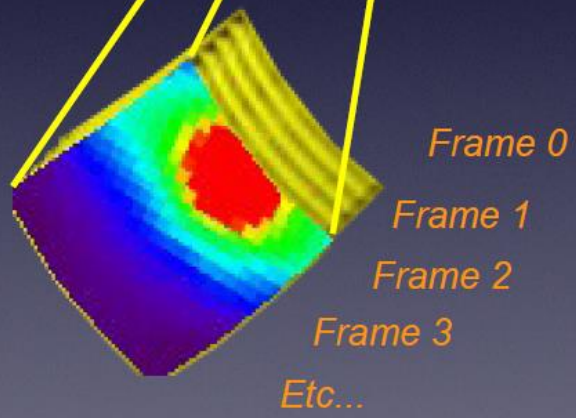
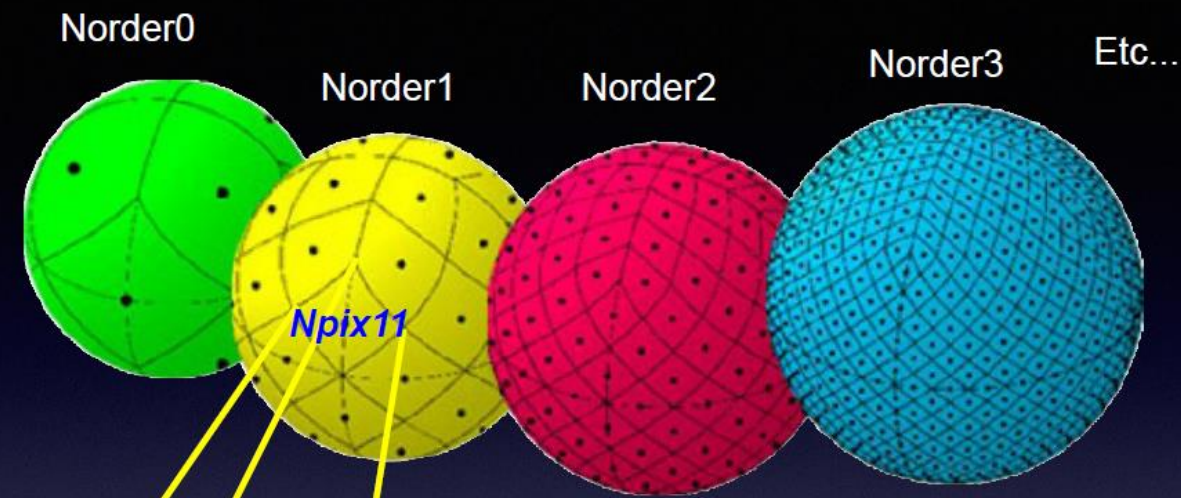
- ▶ Improvements discussion / implementation feedbacks up to May 2016
- ▶ upgrade of DataLink/SIAV2/SODA after the May interop.

# PART 2

- ▶ **HIPS EMERGING STANDARD  
(APPLICATION)**

# HiPS in two words

- ▶ From all sky views to high resolution pixels
- ▶ Based on Healpix sky projection and tessellation.
- ▶ Hierarchical organisation of pixel (or voxel) data
- ▶ First developed at CDS, but other partners now
- ▶ No server : http + directory organisation
- ▶ Several clients : Aladin Desktop + AladinLite + Mizar + etc...
- ▶ Several hundreds of Hips collections (CDS, CADAC, ESA, etc...)



# HIPS cube viewer

Server selector

Others File Watch Tools...

image servers

Progressive surveys (HIPS) ?

Target (Gal. name) 120.9777 +12.0000

Radius 180°

Aladin v8.1

Image Progressive catalog

- WISE cube WISE acknowledgment
- CALIFA V500 from Calar Alto Arc
- CGPS from CADC
- GOODS cube NASA/ESA/AURA
- HST cube from CADC
- IRAS cube

Default format: Preview (jpg)

Reset Clear

Aladin v8.1 \*\*\* BETA VERSION (based on v8.103) \*\*\*

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Location 057.48176 +85.58532

DSS + SDSS + 2MASS + WISE + GALEX + PLANCK + XMM + Fermi + Simbad + NEI + ...

CALIFA V500

Mouse controls:

- Left: source selection
- Middle: quick panning
- Right: scrollbar adjustment
- Wheel: quick zoom in the palette
- Simple click: move the palette
- Double click: re-center

CALIFA V500 PROCS

CGPS

Frame: Gal

100 xel / 103 arc 101 view 1 type/ 22288

RAJ2000	DEC2000	id	access	FoV
142.54233	7.90358	200540	original cube	FoV
154.76215	8.85726	200796	original cube	FoV
207.87804	14.98353	200944	original cube	FoV

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CGPS

DSS colored

apoc - [slider]

sta - [slider]

den - [slider]

cube - [slider]

cont - [slider]

zoom - [slider]

pixel

prop

del

Frame: Gal

110.66480 +00.02630  
151.7° x 100.0°

Adjust the visible area (click drag + mouse wheel)

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# Standardization relationship to DAL protocols

- ▶ De facto standard already
- ▶ IVOA Note published in October 2015
- ▶ Upgraded to Working Draft status
- ▶ Towards a fast recommendation
  
- ▶ HIPS : already usefull to do science
- ▶ But is Not providing the original pixels  
( regridting and or interpolation)
- ▶ HIPS as discovery tool for progenitors and  
DataLinks → DAL services bounding
- ▶ Special Kind of advanced « SODA » mode