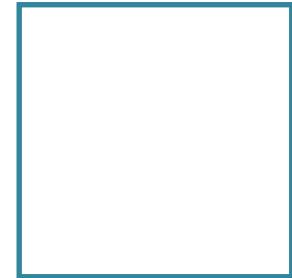


Description, Discovery, Access of Multi-Dimensional Data in the Virtual Observatory ASTERICS contributions



F.Bonnarel (CDS)

acknowledges extensive collaborative work with DAL WG, DM WG,
ASTERICS DADI collaborators, Strasbourg CDS and SVOM teams



Summary

- Data multi-D Discovery
 - ObsCore 1.1
 - SIAP 2.0
- Link Resource
 - DataLink 1.0
 - DataLink 1.1
- Cutouts
 - SODA 1.0
 - hints of virtual data generation
- HiPS
 - discovery, description and access
- Interface within Aladin, TOPCAT
 - SIAP ? DataLink, SODA interface
 - TAP interface
- Virtual data generation
 - New SODA parameters → SODA next
 - Direct access in SIAP2 or via DataLink (SIAP2 next)
 - Implemented thanks to HipS at CDS (HiPStoFITS)



Multi-dimensional data

IVOA science priority since 2013

- Radio datacubes (ALMA, LOFAR, ASKAP, -->SKA)
- Xray cubes
- Time dimensions (work in progress)
- Polarisation (tackled)
- Visibility data (?)



Data discovery : ObsTAP

- data discovery by selecting criteria on description attributes (metadata)
- ObsCore 1.1 (addition to ObsCore 1.0):
 - size in pixels
 - Polarisation
- Served by TAP → ObsTAP
- ObsTAP : allows to select datasets on criteria such as dataproduct_type= cube and characterisation of axes
- REC May 2017



Data Discovery : SIAP 2.0

- SIAP 2 : allows queries for images and cubes with PARAMETERS such as DPTYPE = cube
- POS = « some shape » BAND = 0.0005 0.0006 TIME = 52618 53700 etc.
- REC December 2015



SIAV2/ObsTAP response (ObsCore)

Aladin v9.0 *** BETA VERSION (based on v9.039) ***

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Location 344.57835 -55.91674

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

DSS colored

Server selector

Others HIPS File all-VO Watch FoV... CASDA Tools...

Image servers

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

Catalog servers

All VizieR Surveys Missions NED MOC TAP SkyBot Gaia Others...

POS: CIRCLE 340.4567 -64.4194 2
BAND: 0.25 0.30
TIME:
POL:
FOV:
SPATRES:
EXPTIME:
ID:
COLLECTION:

Reset Clear SUBMIT Close ?

grid wink north bar multiview match

9.707' x 4.352'

obs publ... access url target n... s_ra s_dec s_fov s_region t_min Observat... t_max Observat... t_exptime t_resolu... em_min Spectral... em_max Spectral... em_res p... o_ucd pol_stati

cube-24	https://...	344.6289...	-55.9409...	153.5149...	FoV	0.0	1858-11...	0.0	1858-11...	0.0	0.319074...	939,5931...	0.347154...	863,5912...	11.86275...	phot.flu...	/I/
cube-25	https://...	344.6230...	-55.9411...	158.5882...	FoV	0.0	1858-11...	0.0	1858-11...	0.0	0.347157...	863,5854...	0.380658...	787,5834...	10.86267...	phot.flu...	/I/
cube-26	https://...	344.6258...	-55.9394...	164.6950...	FoV	0.0	1858-11...	0.0	1858-11...	0.0	0.380660...	787,5776...	0.421318...	711,5757...	9.862602...	phot.flu...	/I/

Towards Access : SIAP 2.0 and ProvTAP - HiPS

- Full Data Retrieval via access_reference field
- Or access to DataLink and SODA (cutouts)
- Discovery , Representation and View via HiPS for cubes (see later)



DataLink

- {links} RESOURCE :

Link a list of RESOURCes (metadata, other formats, associated data, services...) to a DataSet via a small votable giving url, media type, semantics, etc..

- DataLink service descriptor

A resource to describe a service (included in main DAL service or {links} resource response)

- REC June 2015
- DataLink 1.1 proposal (January 2019)= extending scope, better recognition, extended vocabulary etc



{links} response display

Aladin v9.0 *** BETA VERSION (based on v9.039) ***

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Location 12:29:37.78 +07:49:27.1 Frame ICRS

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

2001.0

1.79° x 0.9°

1.79° x 0.9°

obscore - target_name - Object a targeted observation targeted

TIP: Double click on the catalog name in the stack for selecting all its sources

grid wink north hdr multiview match

dataprod... obs title obs publ... obs crea... access url target n... target c... s ra s dec s fov s region t min Observat... t max Observat... t exptime

CALIFA V...	ivo://or...	http://											
CALIFA V...	ivo://or...	http://											

This cube in Data Release 2 medium resolution (V1200) (size 10000 bytes)
This cube in Data Release 2 low resolution (V500) (size 10000 bytes)
This cube in Data Release 1 medium resolution (V1200) (size 10000 bytes)
This cube in Data Release 1 low resolution (V500) (size 10000 bytes)
Retrieve data from this cube using the califadr3.fluxposv500 and califadr3.fluxposv1200 tables (size -1 bytes)
Metadata (size -1 bytes)
Metadata (size -1 bytes)

The full dataset. (size 147672000 bytes)
A preview for the dataset. (size -1 bytes)

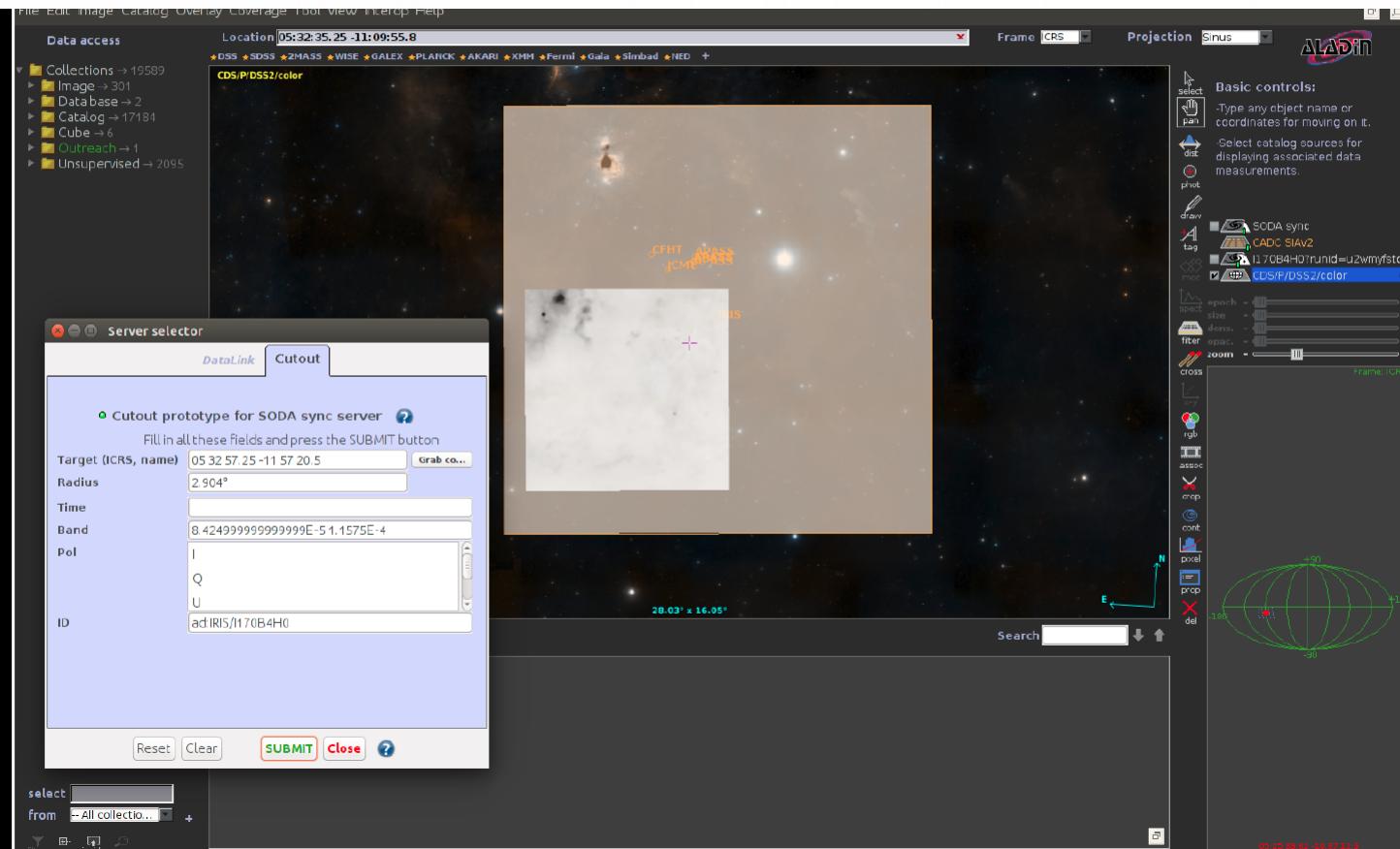
FR X 31/10/2016 15:30

Data access

- data access : extracting useful data from the datasets
 - full retrieval cumbersome
 - Cutouts : SODA 1.0 **REC May 2017**
 - eventually regridding, reprocessing ? SODA -next.
 - need for detailed data (metadata) representation further than ObsCore....

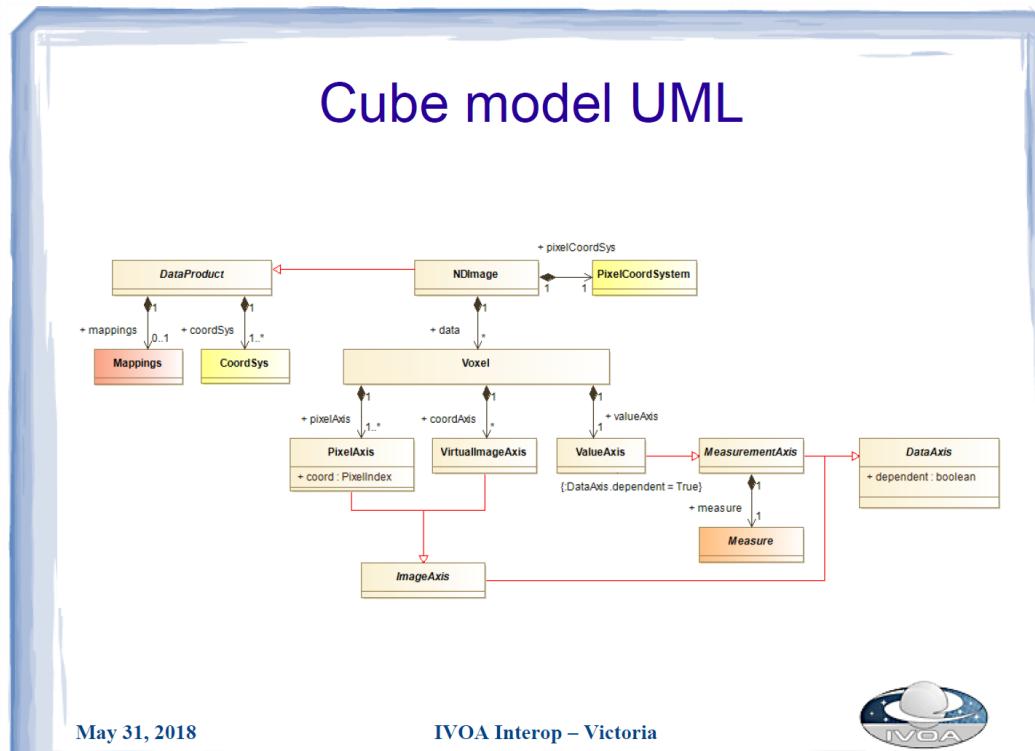


CADC example : « cutout » SODA service (in Aladin)



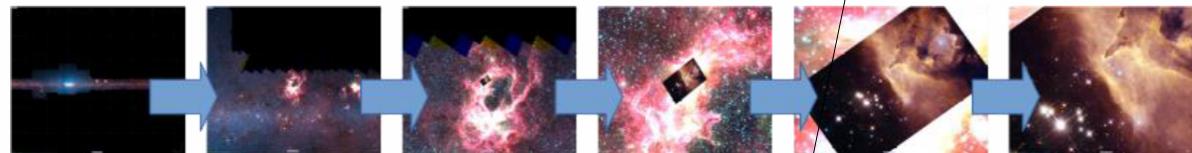
Data representation

- Cube data model → serialisation : still in discussion
- in the meantime FITS or native format



□ HiPS ? What is it ?

- Hierarchical Progressive Survey
“The more you zoom in on a particular area, the more details show up”
- Multi-resolution HEALPix data structure
- for Images, Catalogues, 3-dimensional data cubes, ...
- Conserves scientific data properties alongside visualisation considerations
- No databases or dedicated servers are required, just http

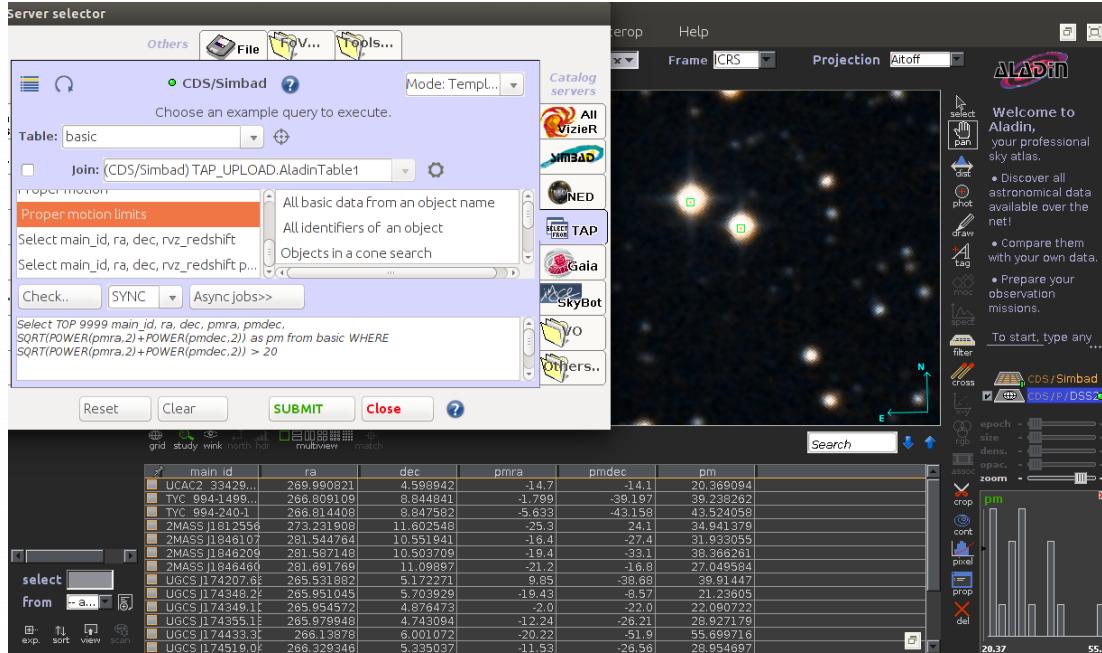


3

View, Access, Discovery of DataCube

Interface : Aladin

- ASTERICS developments : discovery tree, SIA interface, DataLink interface and SODA interface (see above)
- ASTERICS development :
 - TAP interface
 - ADQL control and assistance
 - Synchronous, asynchronous
 - JOIN
 - UPLOAD

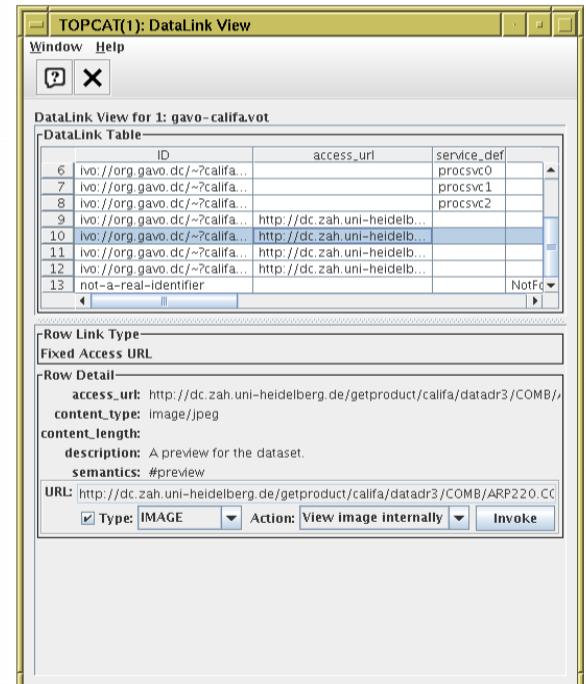


Interface : TOPCAT

- TOPCAT is an interface to ObsTAP
 - Discovery, SAMP to other Tools
- TOPCAT takes into account

DataLink

- Feedback
- Improvement proposals



Virtual data: why give access to standalone FITS and JPEG images in the age of HiPS ?

Rationale of virtual standalone images distribution :

- Mosaics
- Comparison with external standard image servers (with same WCS)
- CDS : Follow-ups of previous functionalities for non HiPS clients
 - JPEG thumbnails for CDS portal (replacing Aladin preview..)
 - Local usage for XMM ACDS cross identification pipe-line (originally done with legacy Aladin image server)
- Etc...



How to give access to standard FITS and JPEG images in the age of HiPS ?

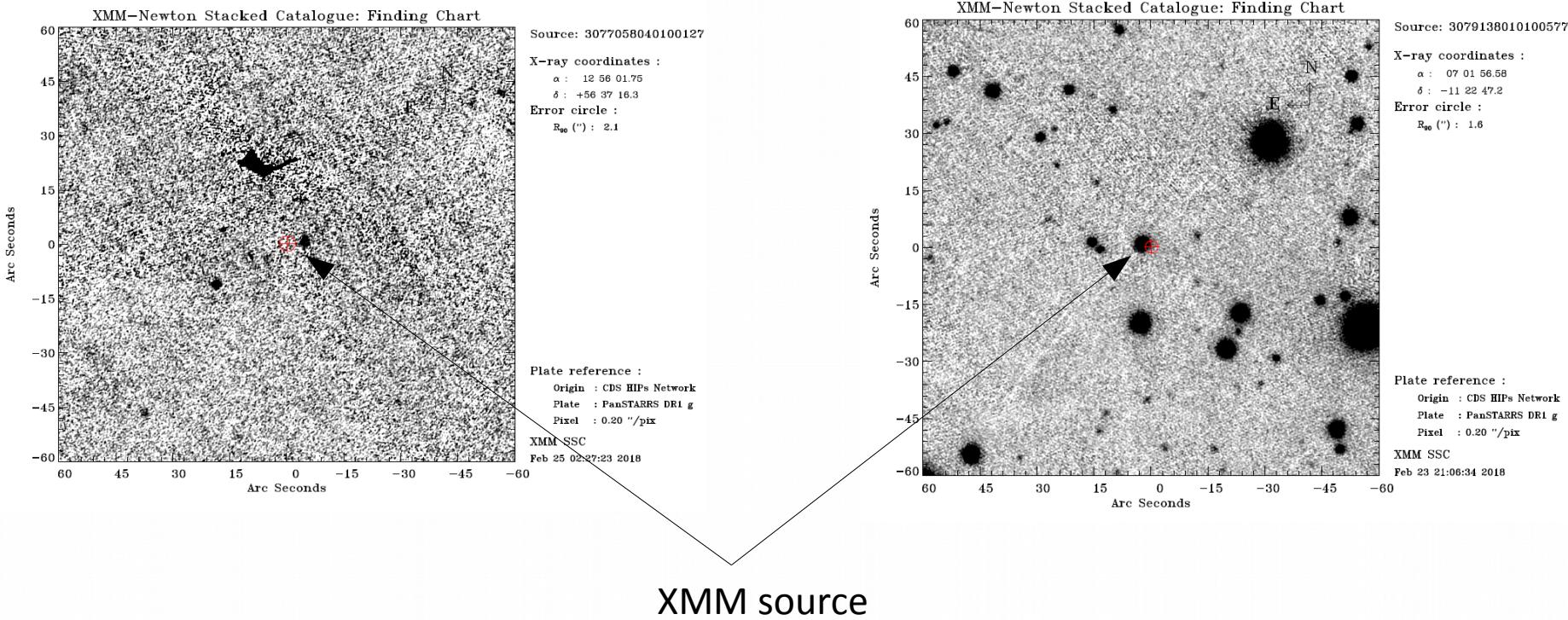
- HiPS-based solution : create images on the fly by reprojecting HiPS pixels on a 2D grid of pixels
→ HiPSToFITS !!



HiPStoFITS for XMM ACDS (Chaitra+Laurent Michel + Pierre

- Based on an extension of Aladin java code
 - Web Server = servlet technolog.
 - Generates FITS images from HiPS for a preselected list of HiPS
 - All WCS projections available
 - flexibility in the interface parameters (Polygon, Circle, resolution...)
 - Works for any spatial extent by adapting resolution
 - Force output via input WCS
 - HiPStoFITS becomes a testbed fo IVOA protocol prototype for virtual data generation (« SODA »)
- Operational in SSC XMM since 2018 January

HiPStoFITS for XMM ACDS (Laurent Michel)



Pan-Starrs finding charts for Stacked XMM Catalogue (3XMMdr7s catalogue, Iris Traulsen et al. A&A submitted)



Proposal for SODA-next interface parameters, access modes

- Proposal based on HiPStoFITS experience
 - Non spatial parameters as in SODA1.0 (selection on the axis)
 - ID = may be an image identifier or a HiPS identifier/url
 - POS = as in SODA1.0 .
 - SPATRES = spatial resolution (or HiPS order as non standard parameter)
 - PROJECTION = sky projection
 - PA = position angle of the North direction
- OR alternatively to above
 - WCS = wcs fits header keywords list
- Can be accessed in several ways :
 - direct URL in SIAP2.0 consistent with SIAP2.0 Parameters (POS, SPATRES, etc ...)
 - Or via DataLink and a dedicated interface



Mode 1 : SIAP2 HiPStoFITS Pan-STARRS retrieved image

Aladin v10.0 *** BETA VERSION (based on v10.098) ***

File Edit Image Catalog Overlay Coverage Tool View Interop Help

Available data → 22055 / 22059
 • in view • out view

Command 20:34:52.80000 +60:09:00.0000 Frame ICRS Projection Aitoff

Collections → 22055
 • Image → 376
 • Data base → 5
 • Catalog → 22055

Server selector

Others File FOV... HIPS Tools...

HiPS CDS SIAv2 virtual data prototype ?
 Fill in all these fields and press the SUBMIT button

POS 308.72 60.15 0.1
 BAND
 TIME
 FORMAT application/fits
 RESPONSEFORMAT VOTable

Aladin images SkyView Sloan DSS... VLA... Archives... Se Others...

All Vizier SIMBAD SELECT TAP Gaia SkyBot NED O Others...

Reset Clear SUBMIT Close ?

Selected image

grid study wink north star multiview search

access url dataproduct type calib level obs collect... Δ obs id obs publisher ... access format access estsize target name sra sd epoch ... dens ... opacity ... zoom ...

access url	dataproduct type	calib	level	obs collect... Δ	obs id	obs publisher ...	access format	access estsize	target name	sra	sd
http://localhost	image	ε	ε	1	PLANCK R2 HFL...	CDS/P/PLANCKR2 iwo/CDSP/PLAN...	image/fits	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	PLANCK R2 HFL...	CDS/P/PLANCKR2 iwo/CDSP/PLAN...	image/fits	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	PLANCK R2 HFL...	CDS/P/PLANCKR2 iwo/CDSP/PLAN...	image/fits	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	PLANCK R2 HFL...	CDS/P/PLANCKR2 iwo/CDSP/PLAN...	image/fits	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	PLANCK R2 LFI...	CDS/P/PLANCKR2 iwo/CDSP/PLAN...	image/fits	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	PLANCK R2 LFI...	CDS/P/PLANCKR2 iwo/CDSP/PLAN...	image/fits	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	PLANCK R2 LFI...	CDS/P/PLANCKR2 iwo/CDSP/PLAN...	image/fits	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	PLANCK R2 LFI...	CDS/P/PLANCKR2 iwo/CDSP/PLAN...	image/fits	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	PLANCK R2 LFI...	CDS/P/PLANCKR2 iwo/CDSP/PLAN...	image/fits	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	PanSTARRS DR...	CDS/P/PanSTAR... iwo/CDSP/Pan...	image/fits	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	Planck HFI 100	ESAVO/P/PLANCKi...	ESAVO/P/PL...	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	Planck HFI 143	ESAVO/P/PLANCKi...	ESAVO/P/PL...	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	Planck HFI 143	ESAVO/P/PLANCKi...	ESAVO/P/PL...	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	Planck HFI 217	ESAVO/P/PLANCKi...	ESAVO/P/PL...	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	Planck HFI 545	ESAVO/P/PLANCKi...	ESAVO/P/PL...	-32768	308.72000000...	60.1499	
http://localhost	image	ε	ε	1	Planck HFI 545	ESAVO/P/PLANCKi...	ESAVO/P/PL...	-32768	308.72000000...	60.1499	

Search ↓

grid study wink north star multiview search

epoch ... dens ... opacity ... zoom ...

location 20:34:52.68749 +60:09:00.0000

180° -90° +90° +180°

16.04' x 8.658'

N E

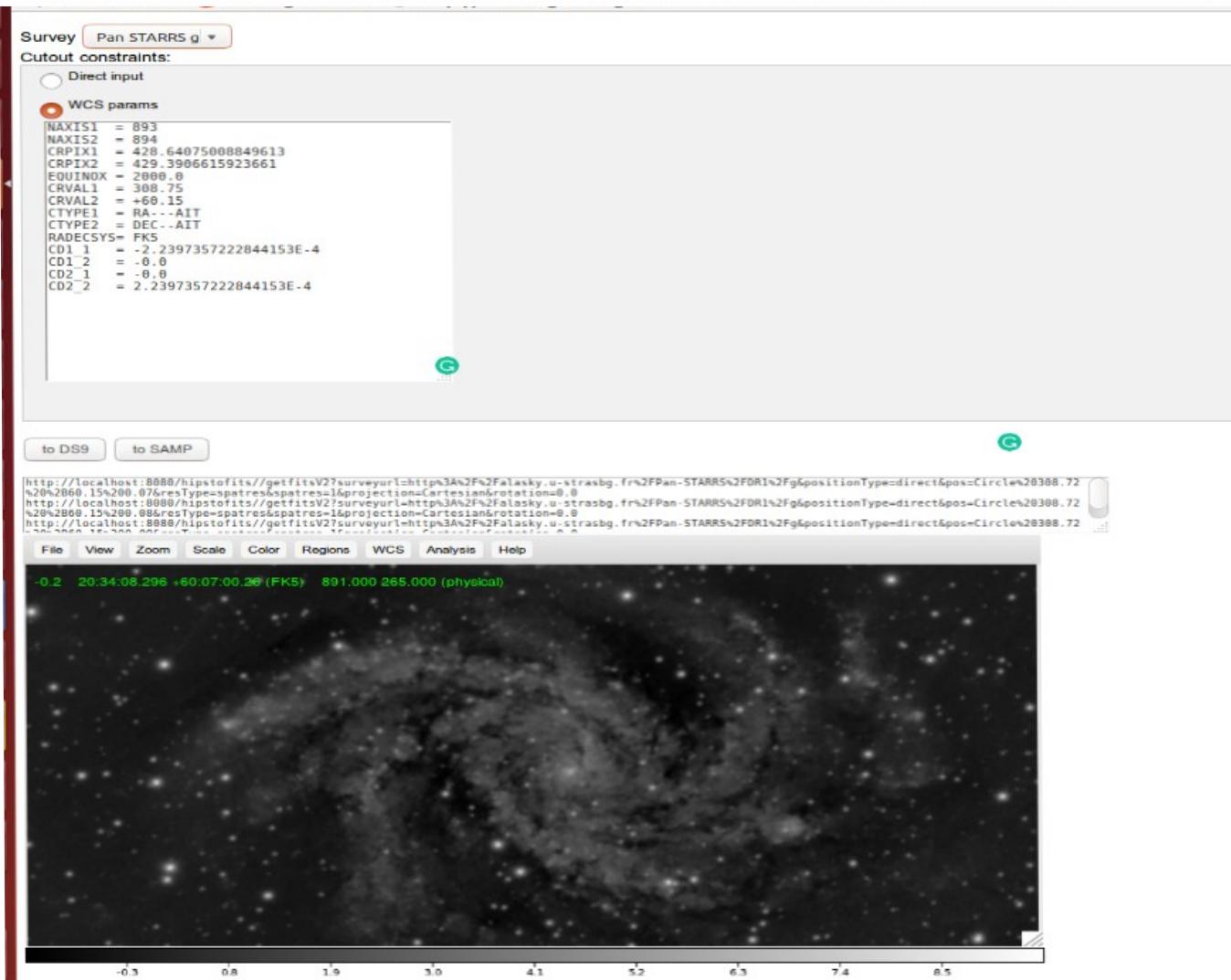
Aladin

Welcome to Aladin, your professional sky atlas.

- Discover all astronomical data available over the net!
- Compare them with your own data.
- Prepare your observation missions.
- To start, type any object name, such as M1, and press ENTER...
- Or easier, clic in the main frame and enjoy the sky...

filter cross assoc crop cont pixel prop del

Same interface, Pan-STARRS, driven by WCS header



HiPStoFITS version 2 and SIAP2 next steps

- Complete integration in SIAP2 CDS service
- Release SIAP2 and HiPStoFITS external access next year (before next interop)



Further discussion. Acknowledgments

Hackathon late today (after provenance)?

TimeDomain is reusing a lot of Multi-D : hackathon today

Radio data in the VO : workshop on Thursday.

Contributors in ASTERICS context : a major involvement of europeans

(not all of them funded by ASTERICS, but they all discuss in ASTERICS meetings)

M.Demleitner (SODA, DataLink, services)

M.Louys, A.Micol ; C.Rodrigo (Obscore, feedback, use cases)

Chaitra, P.Fernique, L.Michel, T.Boch (development)

M.Taylor (TOPCAT development, feedback)

M.Molinaro, F.Bonnarel (miscellaneous inputs as DAL WG vice-chair, chair, ex-chair)

+ CADC (Canada), CFA SAO (USA), CASDA (ASKAP Australia)

