

# HiPS – IVOA standard process

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Interop – may 2016 – Cape Town – South Africa

Presented by

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Daniel Durand [CADC]



# □ Plan

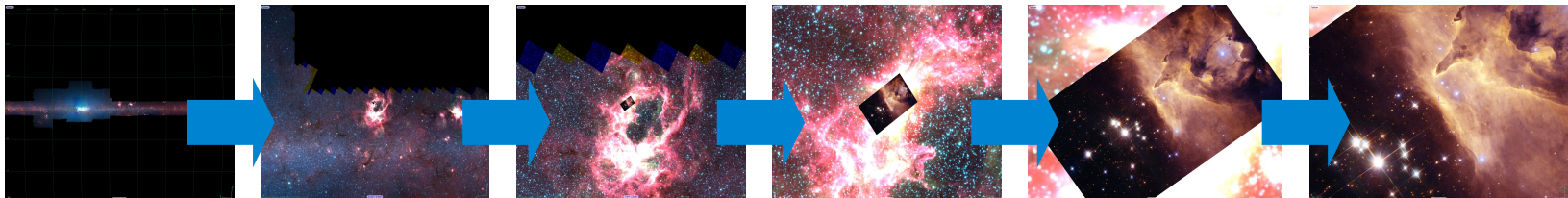
- 1) Recap on HiPS
- 2) State of the art
- 3) HiPS Network
- 4) Progress towards an IVOA standard
- 5) Next steps
- 6) Aladin Lite news and improvements

# □ HiPS – What is it?

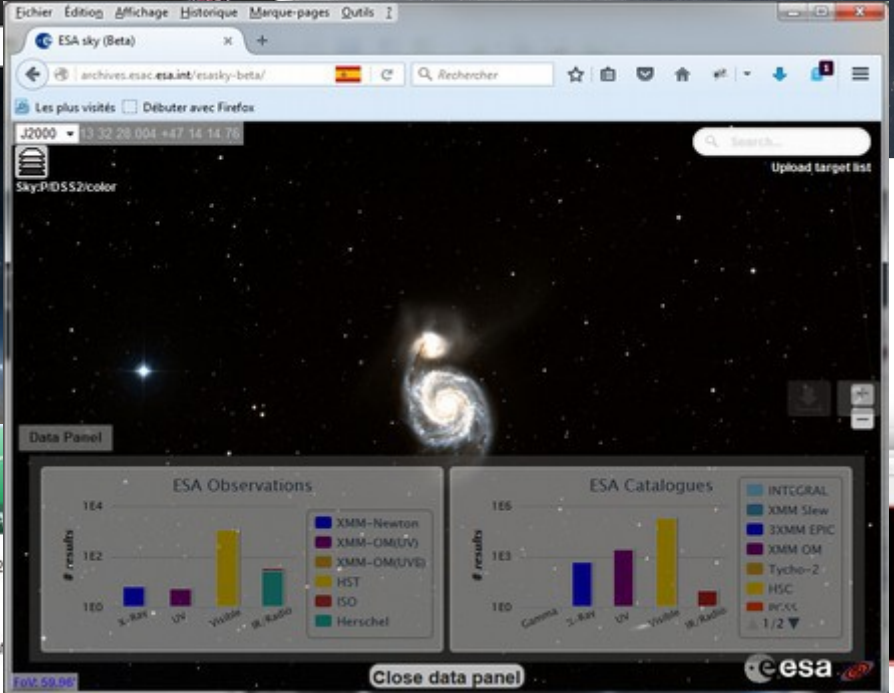
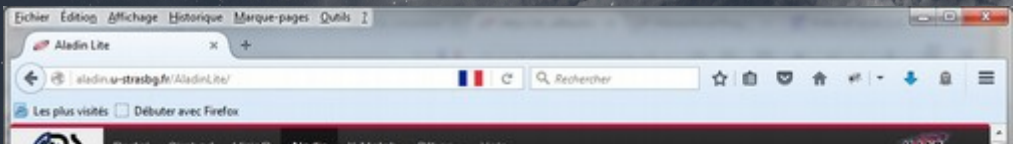
## Hierarchical Progressive Survey


“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, ...
- Keep scientific data properties
- Seamless multi-scale visualisation
- No databases or dedicated servers required, just HTTP upon a file hierarchy







**DARTS Labs Astrophysics** 

SUZAKU ASCA GINGA TENMA AKA

[Main](#)  
[About JUDO2](#)  
[Help](#)

longitude= 41.602719223504636 latitude= -21.561518193962  
 02h46m24s.65 -21d33'41".5  
 Constellation= Aquila  
   coordinate: galactic  Show Information

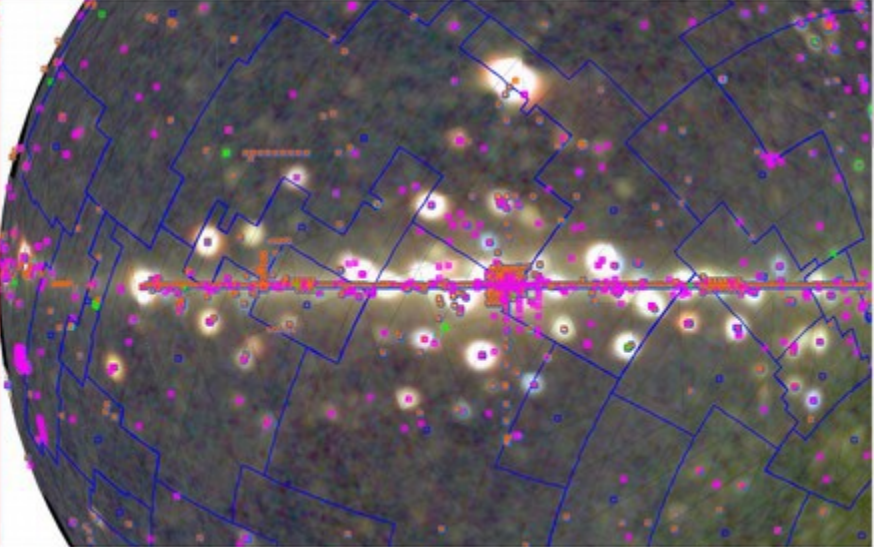
permlink

Name	Bottom	Top
SUZAKU	<input type="checkbox"/>	<input checked="" type="checkbox"/>
public image	<input type="checkbox"/>	<input checked="" type="checkbox"/>
public FOV	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
proprietary FOV	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ASCA SIS	<input type="checkbox"/>	<input type="checkbox"/>
public image	<input type="checkbox"/>	<input type="checkbox"/>
public FOV	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ASCA GIS	<input type="checkbox"/>	<input type="checkbox"/>
public image	<input type="checkbox"/>	<input type="checkbox"/>
public FOV	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ASCA GIS64	<input type="checkbox"/>	<input type="checkbox"/>

The position you are interested in.  
(Click to change on the image.)  
 pos=(96.337272, -60.188553)  
 coord=galactic

radius= 0.02 deg

Check with external services:  
[SDSS DR7 Navigate Tool](#)  
[NED](#)  
[SIMBAD](#)



IRIS colored-1  
 WISE W1 (3.40)  
 2MASS color2  
 GALEX color0  
 XMM-Newton0  
 Fermi color-0  
 Mellinger color2  
 SDSS9 color0  
 GASS  
 SHASSA-FL (B)  
 NVSS intensity  
 PLANCK-LFI 0  
 K DR4-23Ch0  
 IRAC color (11.3)  
 IRIS colored-0  
 WISE W1 (3.40)  
 2MASS color2  
 GALEX color0  
 XMM-Newton0  
 Fermi color-0  
 Mellinger color2  
 SDSS9 color0

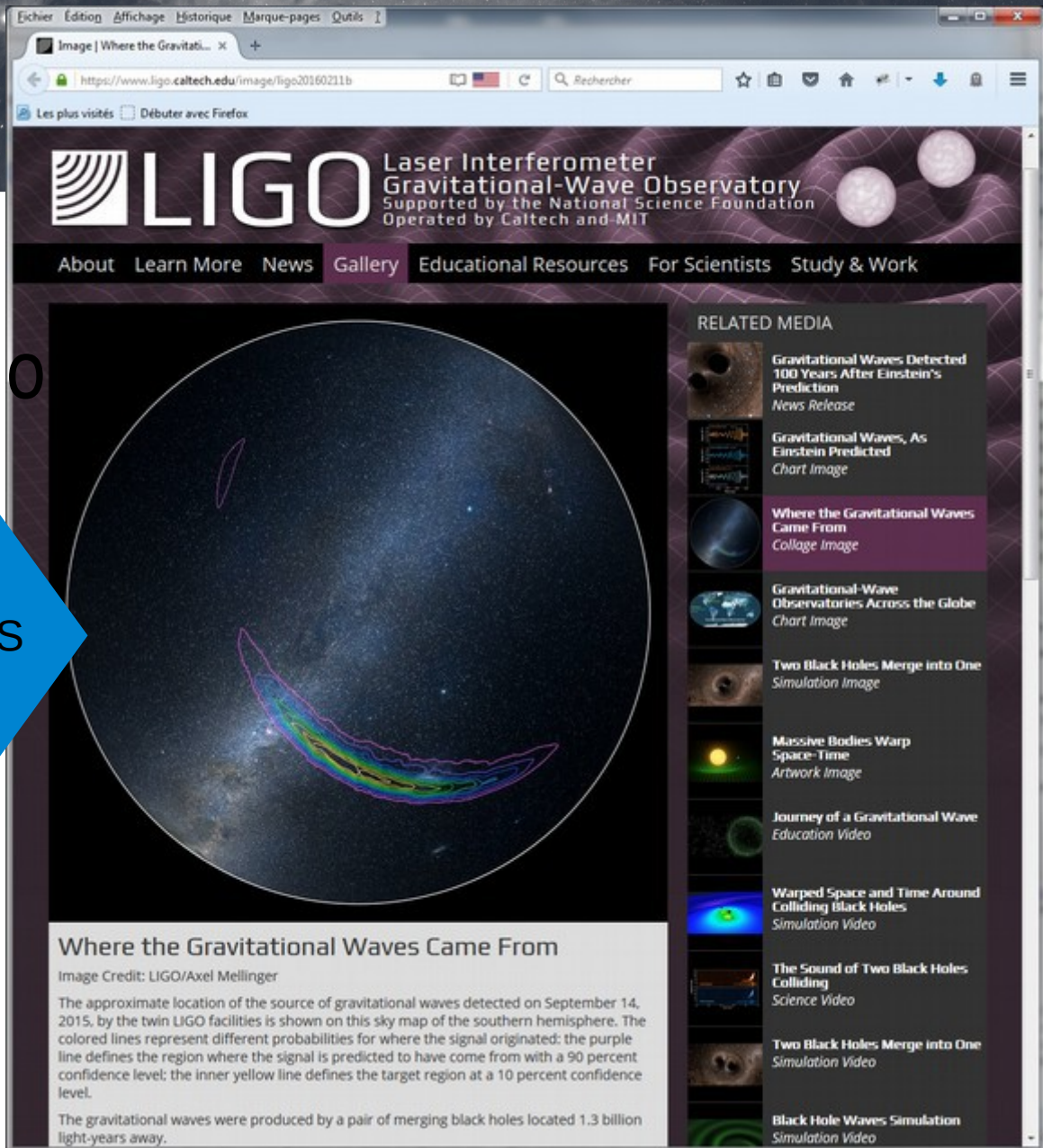
based under GTO GPL v1

0 sel / 0 int / 100px / 1000px



At the forefront of science

Yes ! it is a HiPS



The screenshot shows the LIGO website interface. The main header features the LIGO logo and the text "Laser Interferometer Gravitational-Wave Observatory Supported by the National Science Foundation Operated by Caltech and MIT". Below the header is a navigation menu with links: "About", "Learn More", "News", "Gallery", "Educational Resources", "For Scientists", and "Study & Work". The main content area is dominated by a large circular sky map of the southern hemisphere. A purple line outlines a region in the sky, and a yellow line outlines a smaller region within it. Below the sky map is a text box with the title "Where the Gravitational Waves Came From".

**Where the Gravitational Waves Came From**  
Image Credit: LIGO/Axel Mellinger

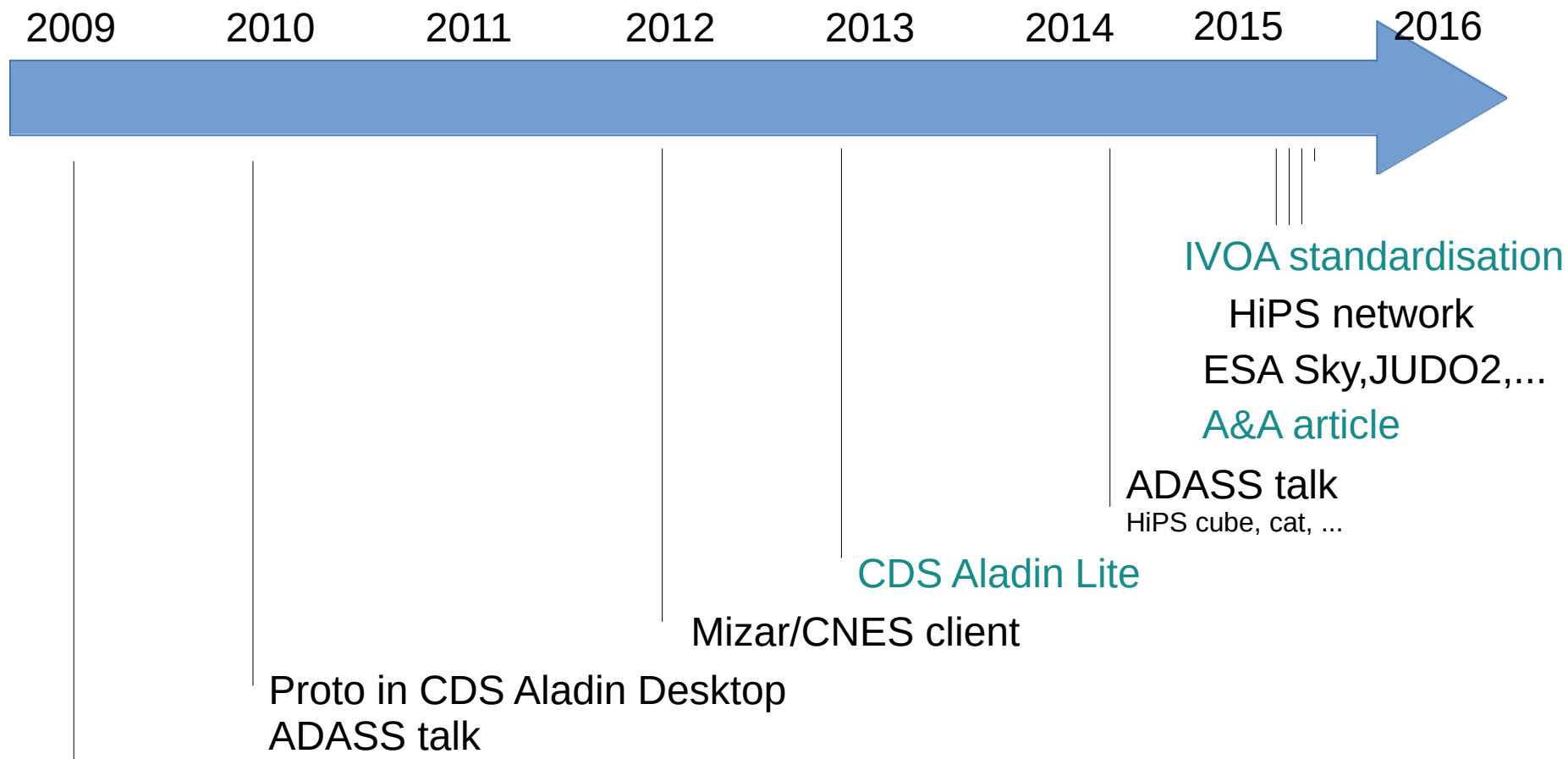
The approximate location of the source of gravitational waves detected on September 14, 2015, by the twin LIGO facilities is shown on this sky map of the southern hemisphere. The colored lines represent different probabilities for where the signal originated: the purple line defines the region where the signal is predicted to have come from with a 90 percent confidence level; the inner yellow line defines the target region at a 10 percent confidence level.

The gravitational waves were produced by a pair of merging black holes located 1.3 billion light-years away.

**RELATED MEDIA**

- Gravitational Waves Detected 100 Years After Einstein's Prediction  
*News Release*
- Gravitational Waves, As Einstein Predicted  
*Chart Image*
- Where the Gravitational Waves Came From  
*Collage Image*
- Gravitational-Wave Observatories Across the Globe  
*Chart Image*
- Two Black Holes Merge into One  
*Simulation Image*
- Massive Bodies Warp Space-Time  
*Artwork Image*
- Journey of a Gravitational Wave  
*Education Video*
- Warped Space and Time Around Colliding Black Holes  
*Simulation Video*
- The Sound of Two Black Holes Colliding  
*Science Video*
- Two Black Holes Merge into One  
*Simulation Video*
- Black Hole Waves Simulation  
*Simulation Video*

# □ HiPS timeline



Start of the story at CDS  
by A.Oberto, P.Fernique, T.Boch & Al.



# □ State of the art (May 2016)

- **300+ HiPS** for **85TB** data (CDS 92%, CADC 5%, ESAC 2%)
- **300 000+ HiPS tiles requested / day** (+40% in 1 year, CDS only)
- **More and more HiPS clients :**
  - Aladin Desktop (CDS), Aladin Lite (CDS), MIZAR (CNES)
  - + in dev: STScI **MAST portal** (NASA), **openWWT**, China-VO **proto**, ...
  - + Aladin Lite implementation: ESA Sky (ESAC), JUDO2 (JAXA), **SkyWatch**, ...
  - + Aladin Lite web page integration: Simbad, VizieR, GLIMPSE360, CADE, ADS AllSky, CASSIS, Akari-Viewer, **VistaOrion**, **ASTRODEEP**, **CDS portal v2**...
  - + Aladin Desktop Outreach usage: **ArchesWalker**

# □ State of the art (May 2016)

- **12+ HiPS nodes**

- CDS, SSC XMM-Newton, IAS, IRAP/CADE, IPAC, ADS, ESAC, JAXA, AMIGA, Spanish-VO, Vista-Orion, TGSSADR...

- **2 HiPS creation toolkits**

- Images & cubes: Aladin/Hipsgen (performance: 100Gpix/hour),
  - Catalogs: Hipsgen-cat

- **1 refereed paper** → 2015A&A...578A.114F

- **Documentation** → <http://aladin.unistra.fr/hips>  
(“*Make your HiPS in 10 steps*”, *Aladin Lite examples*, ...)



# □ HiPS in action – one example

- **HST & HLA : 48 HiPS**

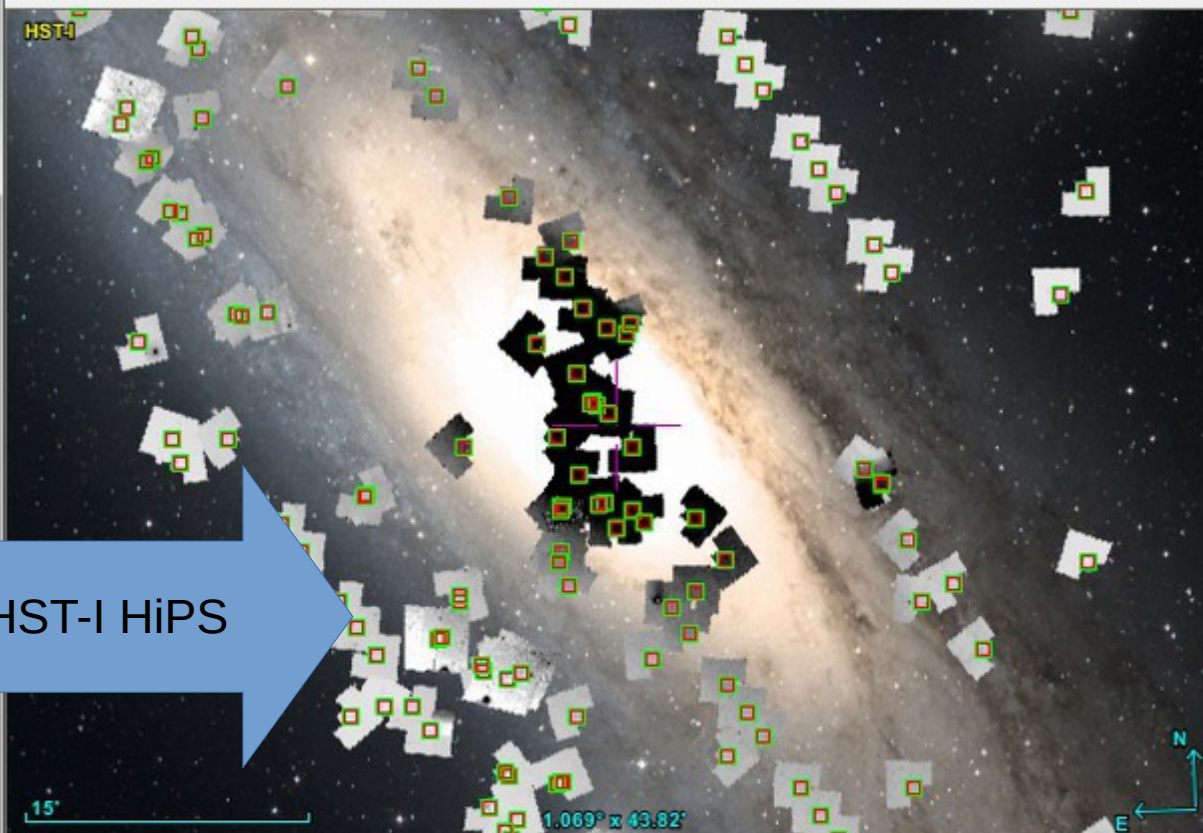
built by D.Durand/CADC – released in Feb 2016

- grouped by "usual filters": B, CO, H, H2O, Halpha, HBeta, I, J, NII, OII, OIII, Palpha, Palpha\_c, R, SDSSg, SDSSr, SDSSz, SIII, U, UV, V, Y, wideUV, wideV (rather than wavelength ranges)
- Tiles provided in both low and full dynamic range
- Access to "progenitors": direct links to original data archive images
- Incremental updates: supported by "-live" HiPSgen option

Location 

Frame ICRS

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



**Details HST-I**

HST-I

DSS colored

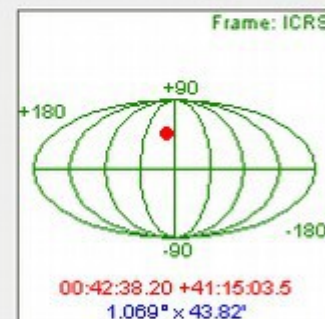
epoch -

size -

dens. -

cube -

zoom -

Search 

	RAJ2000	DEJ2000	id	Date	Target	FoV	Preview	Image	File	Inst...	Filter
<input type="checkbox"/>	10.72857	40.84745	<a href="#">18f101010</a>	2004-11-24	M32	FoV	Preview	Original image	File	ACS	F814W
<input type="checkbox"/>	10.86492	41.06215	<a href="#">18f102010</a>	2004-12-21	M32-CONTROL	FoV	Preview	Original image	File	ACS	F814W
<input type="checkbox"/>	10.72857	40.84745	<a href="#">18f103010</a>	2004-11-25	M32	FoV	Preview	Original image	File	ACS	F814W
<input type="checkbox"/>	10.86492	41.06215	<a href="#">18f104010</a>	2004-12-22	M32-CONTROL	FoV	Preview	Original image	File	ACS	F814W
<input type="checkbox"/>	10.72857	40.84745	<a href="#">18f105010</a>	2004-12-10	M32	FoV	Preview	Original image	File	ACS	F814W
<input type="checkbox"/>	10.86492	41.06215	<a href="#">18f106010</a>	2004-12-22	M32-CONTROL	FoV	Preview	Original image	File	ACS	F814W

# □ The HiPS philosophy

- **Universal:** Anybody should be able to generate HiPS (authors, projects, missions, archives, data centers...)
- **Scientific trust:** HiPS should be generated by the data curators (they know best their data).
- **Efficient:** HiPS should be distributed by several sites and mirrored/synchronized as much as possible
- **Simple:** from the user point of view: “click & play” !

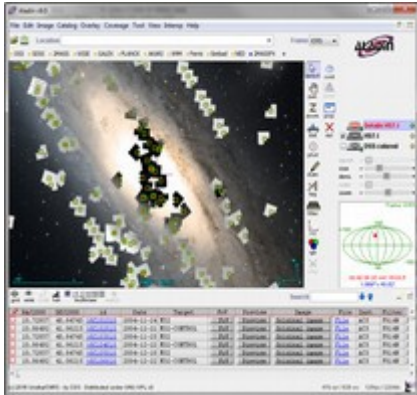


# □ How to build HiPS network

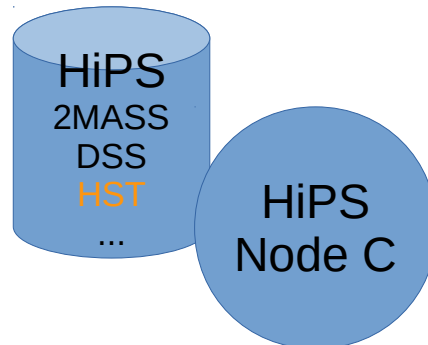
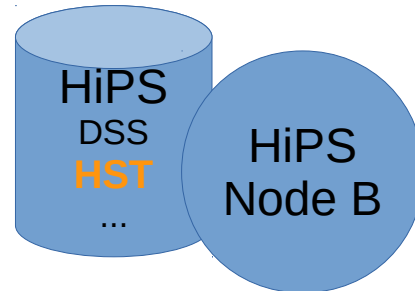
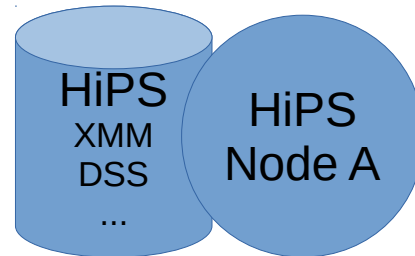
- **HiPS registry** = “registry” providing the list of HiPS nodes  
(CDS)
- **HiPS node** = HTTP server distributing HiPS and exposing its HiPS list  
(CDS, ESA, XMM-Newton, ...)
- **HiPS list** = list of the HiPS (with associated meta-data a la ObsCore) distributed by one HiPS node  
CDS: DSS2, SDSS, HST, ALLWISE, ...

# □ HiPS network

## HiPS clients



## HiPS nodes

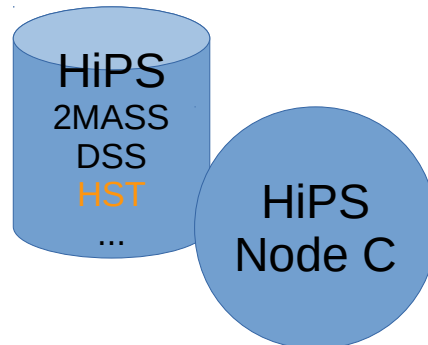
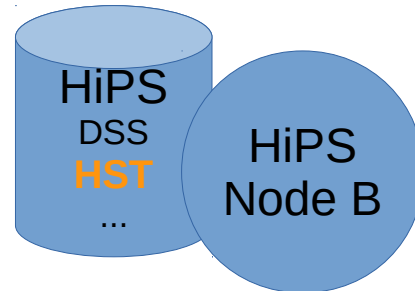
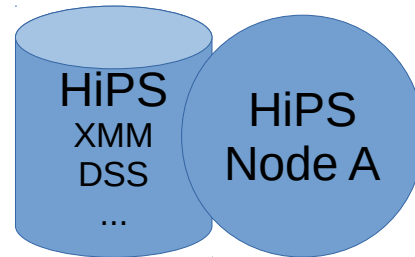


# □ HiPS network

## HiPS clients



## HiPS nodes



## HiPS registry

HiPS registry

- HiPS node A
- HiPS node B
- HiPS node C



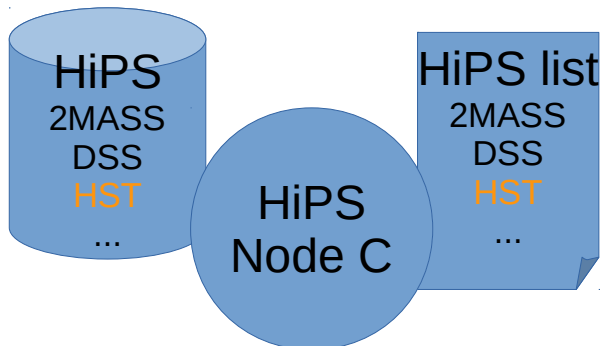
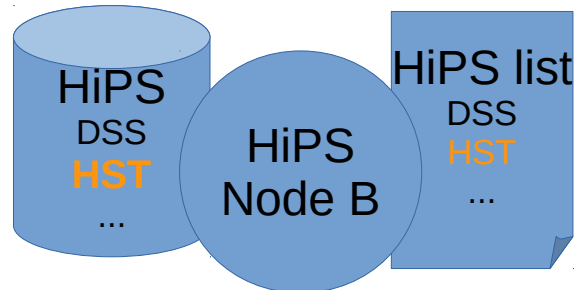
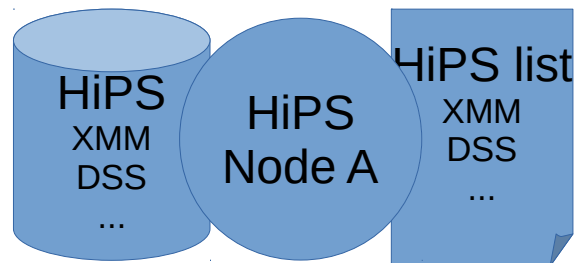


# □ HiPS network

## HiPS clients



## HiPS nodes



## HiPS registry

HiPS registry

- HiPS node A
- HiPS node B
- HiPS node C

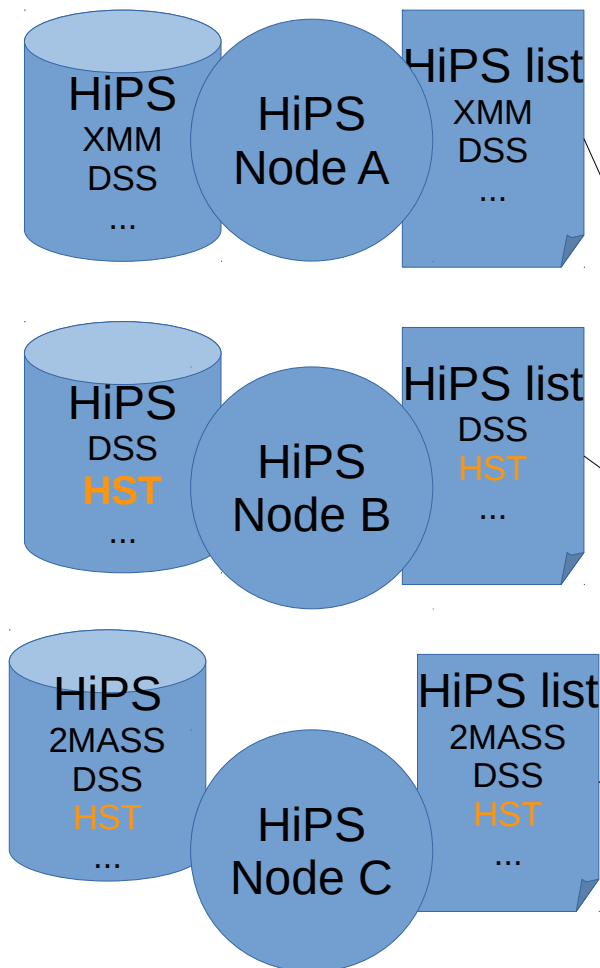


# HiPS network

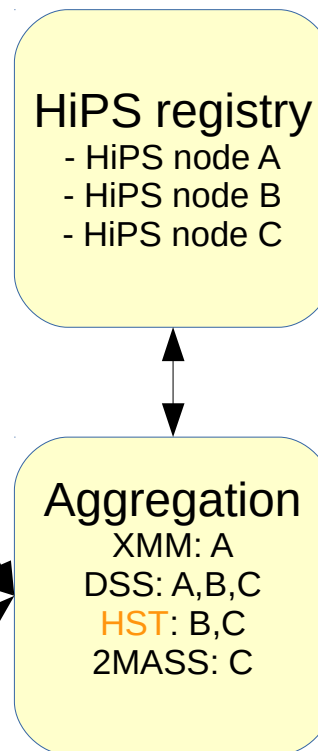
## HiPS clients



## HiPS nodes



## HiPS registry

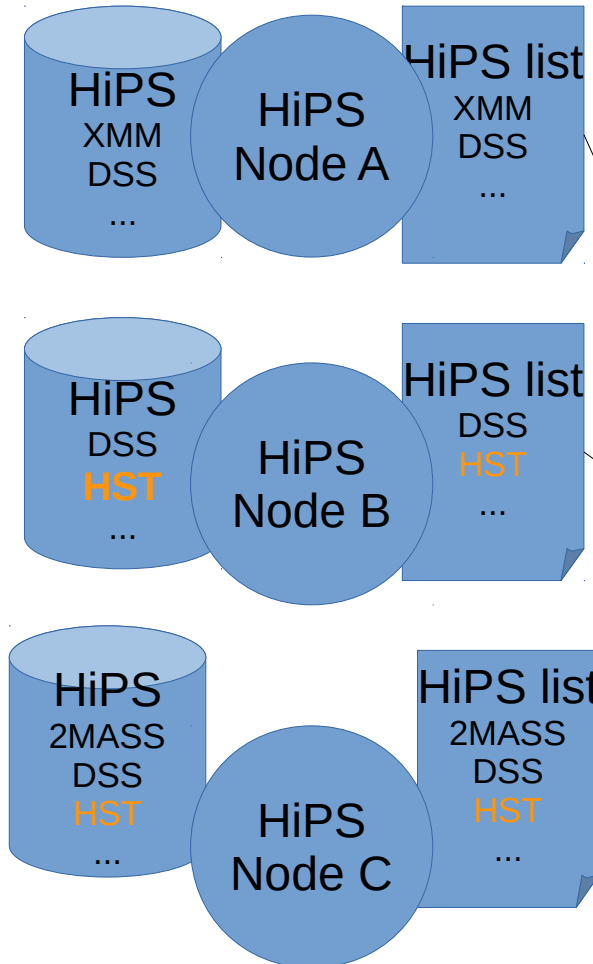


# HiPS network

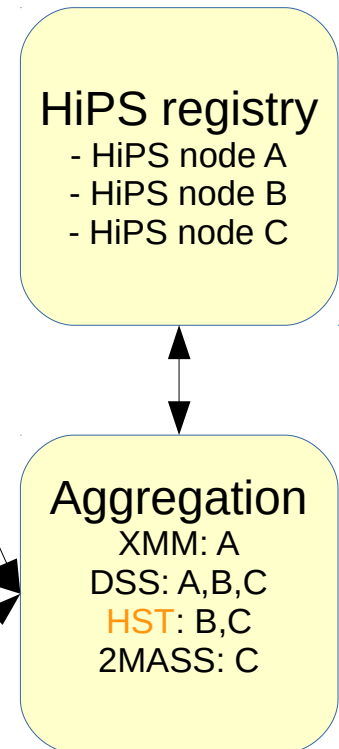
## HiPS clients



## HiPS nodes



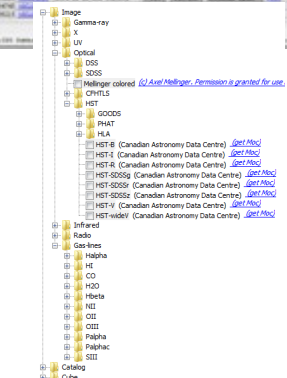
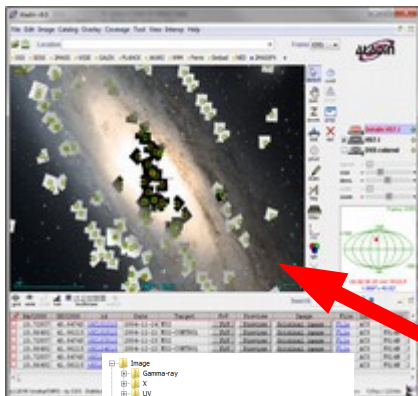
## HiPS registry



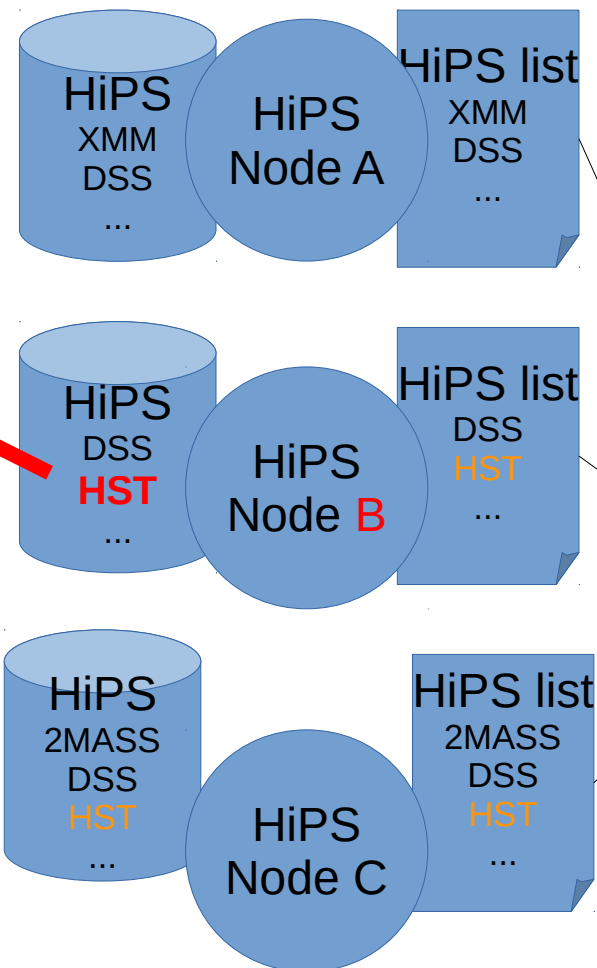


# HiPS network

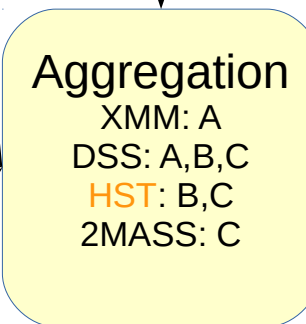
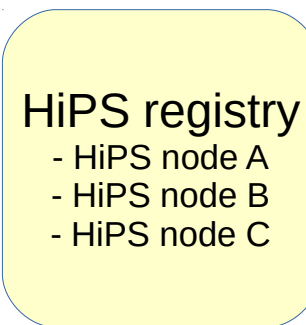
## HiPS clients



## HiPS nodes

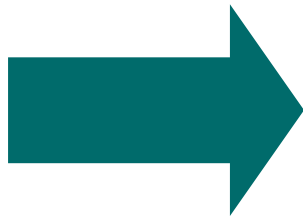


## HiPS registry



# □ HiPS metadata

Properties  
file provided  
with each  
HiPS



```
creator_id = ivo://CDS/P/DSS2/color
obs_collection = DSS colored
obs_title = DSS2 optical HEALPix survey, color (R=red[~0.6um]/G
obs_description = Color composition generated by CDS. This HiPS survey
obs_copyright = Digitized Sky Survey - STScI/NASA, Colored & Healpi
obs_copyright_url = http://archive.stsci.edu/dss/acknowledging.html
client_category = Image/Optical/DSS
client_sort_key = 03-00
hips_builder = Aladin/HipsGen v8.149
hips_builder = Aladin/HipsGen v8.133
hips_creation_date = 2010-05-01T19:05Z
hips_release_date = 2015-05-11T08:45Z
hips_publisher = CDS (A.Oberto, P.Fernique)
hips_version = 1.3
hips_order = 9
hips_frame = equatorial
hips_tile_width = 512
hips_tile_format = jpeg
dataprodtype = image
dataprodsubtype = color
hips_glu_tag = P-DSS2-color.hpx
client_application = AladinLite
client_application = MediaDesktop
moc_access_url = http://alasky.u-strasbg.fr/DSS/DSSColor
hips_service_url =
hips_status =
hips_rgb_red = public master clonable [Linear]
hips_rgb_blue = DSS2-blue-XJ-S [4286.0 12122.5 19959.0 Linear]
hips_hierarchy = median
hips_pixel_scale = 2.236E-4
moc_sky_fraction = 1
hips_service_url_1 = http://alaskybis.u-strasbg.fr/DSS/DSSColor
hips_status_1 = public mirror clonable
moc_order = 9
obs_initial_ra = 0
obs_initial_dec = +0
obs_initial_fov = 0.11451621372724685
```

# □ CDS MocServer: HiPS list aggregator

→ <http://alasky.unistra.fr/MocServer/query> →  
<http://aladin.unistra.fr/hips/list>

## HiPS list aggregator

List of Hierarchical Progressive Surveys provided by all public HiPS nodes

*This page provides the list of all public [HiPS](#) sorted by categories, plus the list of the public HiPS nodes.  
It is based on the CDS [MocServer](#) used to aggregate HiPS lists.*

### HiPS nodes (list of HiPS servers - will required a VO registration in a near future)

<http://aladin.unistra.fr/hips/registry>

#	Origin	Type	HiPS list URL
1	IRAP-CADE	<i>mixed</i>	<a href="http://cade.irap.omp.eu/documents/Ancillary/4Aladin/hipslist-IRAP.txt">http://cade.irap.omp.eu/documents/Ancillary/4Aladin/hipslist-IRAP.txt</a>
2	SSC-Strasbourg	<i>mixed</i>	<a href="http://saada.unistra.fr/cgi-bin/hipslist">http://saada.unistra.fr/cgi-bin/hipslist</a>
3	CDS	<i>mixed</i>	<a href="http://alasky.u-strasbg.fr/hipslist">http://alasky.u-strasbg.fr/hipslist</a>
4	CDS	<i>mixed</i>	<a href="http://alaskybis.u-strasbg.fr/hipslist">http://alaskybis.u-strasbg.fr/hipslist</a>
5	CDS	catalog	<a href="http://axel.u-strasbg.fr/HiPSCatService/hiplist">http://axel.u-strasbg.fr/HiPSCatService/hiplist</a>
6	AMIGA	<i>mixed</i>	<a href="http://amiga.iaa.es/hipslist">http://amiga.iaa.es/hipslist</a>
7	svo.cab	<i>mixed</i>	<a href="http://gtc.sdc.cab.inta-csic.es/hips/hipslist">http://gtc.sdc.cab.inta-csic.es/hips/hipslist</a>



# □ IVOA HiPS standardisation

- **IVOA note** (oct 2015) → <http://www.ivoa.net/documents/Notes/HiPS/>
- **IVOA Sydney agreement** (nov 2015) :  
IVOA endorsement of HiPS
- **Discussion** (in progress)
- **Identification & VO registration** → agreement !
- **HiPS standards** (protocols+metadata) → WD in progress..
- **IVOA WD in progress** (ready for Trieste)  
Authors aff.: CDS, CADDC, SSC, ESAC, ALMA, NASA

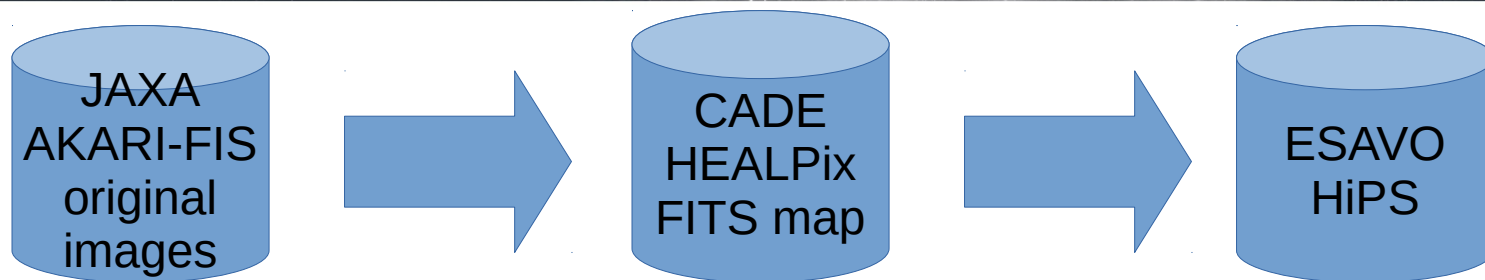
9 months

# □ HiPS standardisation status

- 1) The IVOA HiPS standard will recommend to **use a valid IVOID identifier** for any generated HiPS, for instance **ivo://authority\_id?obs\_id** (ex: ivo://CDS?P/DSS2/color) with the constraint to declare ASAP the authority\_id in the VO registry if it is not yet the case;
- 2) This identifier will be stored in the HiPS properties file under the **creator\_did** keyword;
- 3) **In addition**, any provider can **declare his HiPS in the VO registry**:
  - as **individual entries** in the VO Registry
  - **through a HiPS node** which should be present in the VO Registry

# □ Properties file

## Provenance/acknowledgement example

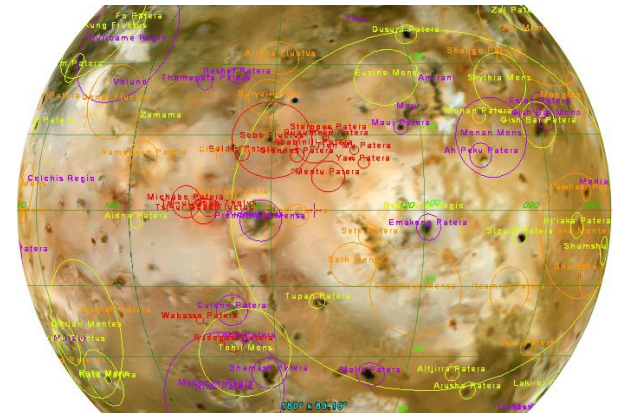


```
creator_id      = ivo://ESAVO/P/AKARI/color
obs_title       = AKARI-FIS color
obs_collection  = AKARI
obs_description = AKARI FIS All-Sky Survey HEALPIX map produced by the
Centre d'Analyse de Donnees Etendues (CADE) with the original processed
data from ISAS/JAXA.
obs_ack         = CADE/IRAP
obs_ack         = ISAS/JAXA
prov_progenitor = CADE
prov_id         = ivo://CADE/AKARI
bib_reference   = 2007PASJ...59S.389K
hips_creator    = ESAC
hips_copyright  = public
obs_copyright   = (c) JAXA - public
hips_service_url = http://skies.esac.esa.int/AKARI/color/
hips_status     = public master clonable
```



# □ Next steps

- Finalize the **IVOA WD**
- Pursue the **HiPS** implementation  
eg: **HiPS catalogs** (~15 000 HiPS)
- Start the **VO** registry declarations



- Look for a **usage statistics report protocol**
- Improve/validate HiPS “live” survey (HST, DES HiPS)
- HiPS **extension to planetary data** (EuroPlanet project)

# Aladin Lite news & improvements

- Major improvement: fixing astrometry offsets
  - For strong-distorted tiles, affine transformation not good enough
  - Need to subdivide until deformation is acceptable (same algorithm as Aladin Desktop)
  - Challenges: keep performances compatible with interactivity
  - Limitations: current version of Javascript HEALPix library limited to `NORDER=13`
  - Improvement available in beta version  
Released in public version by end of month

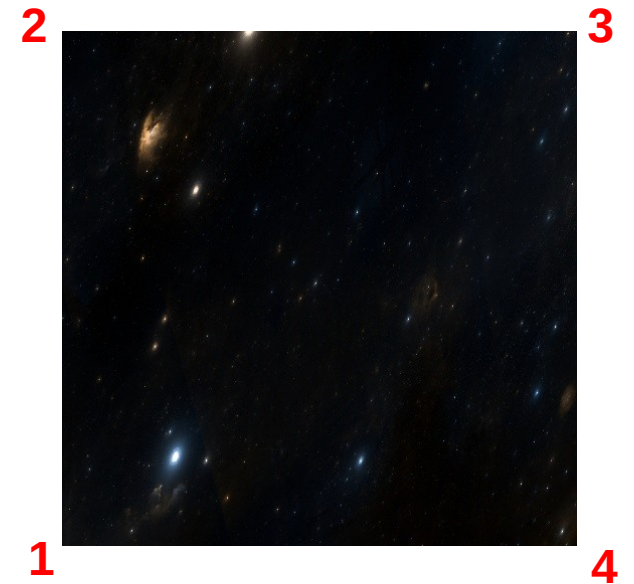
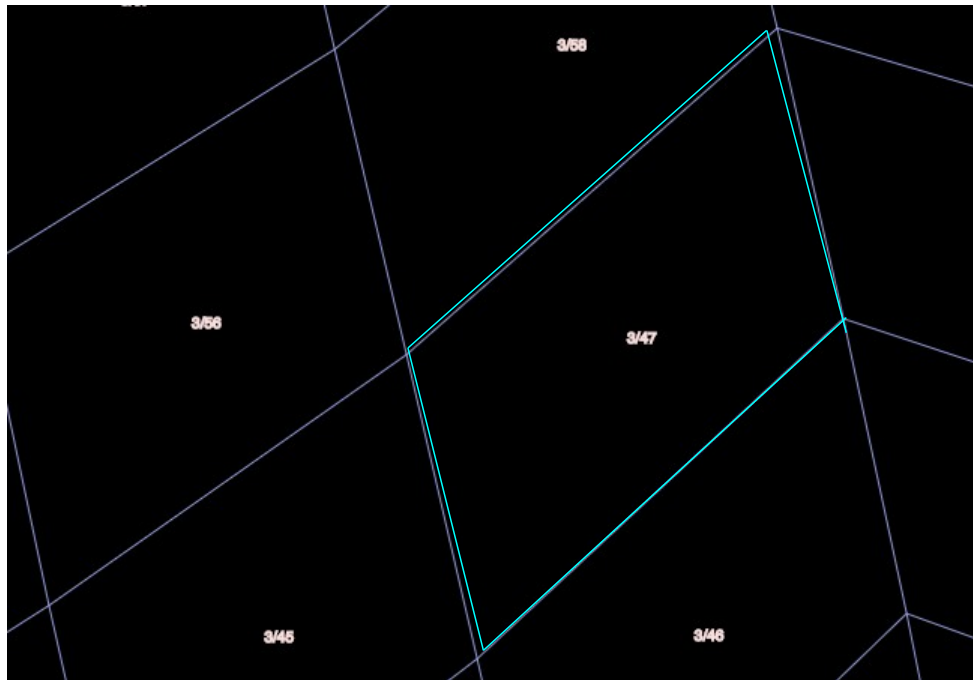


# Tile drawing algorithm

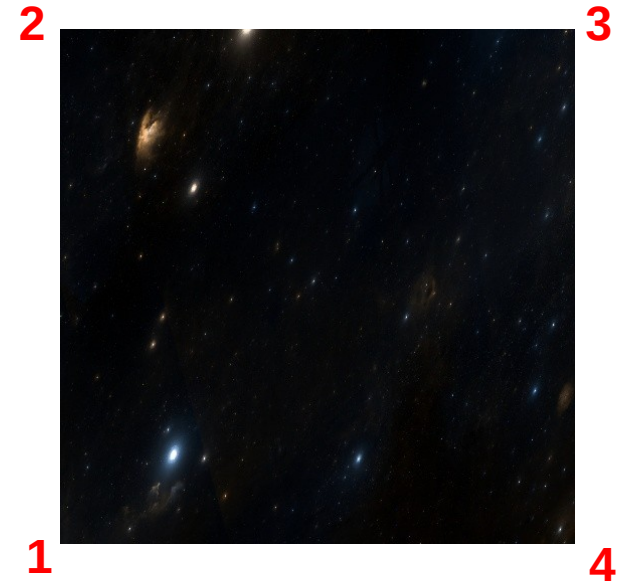
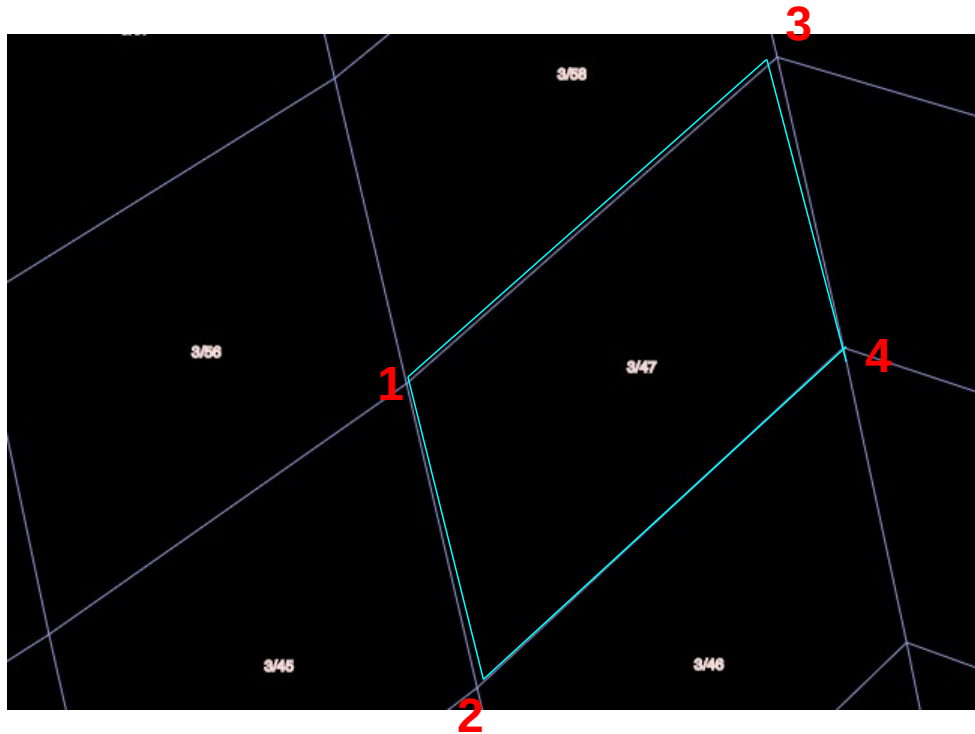




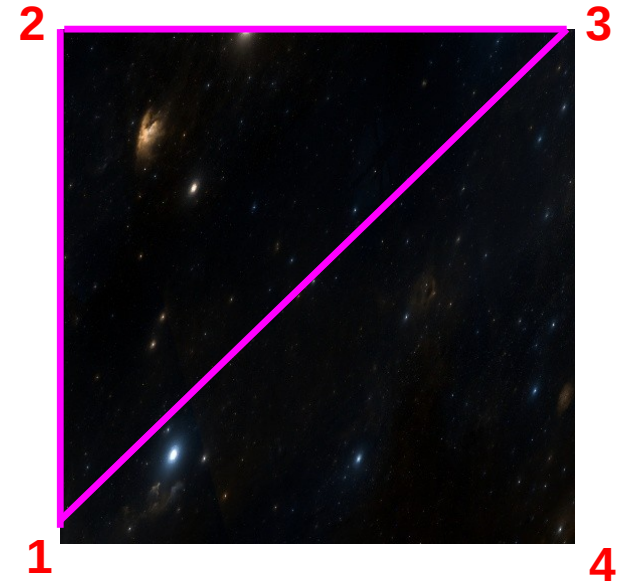
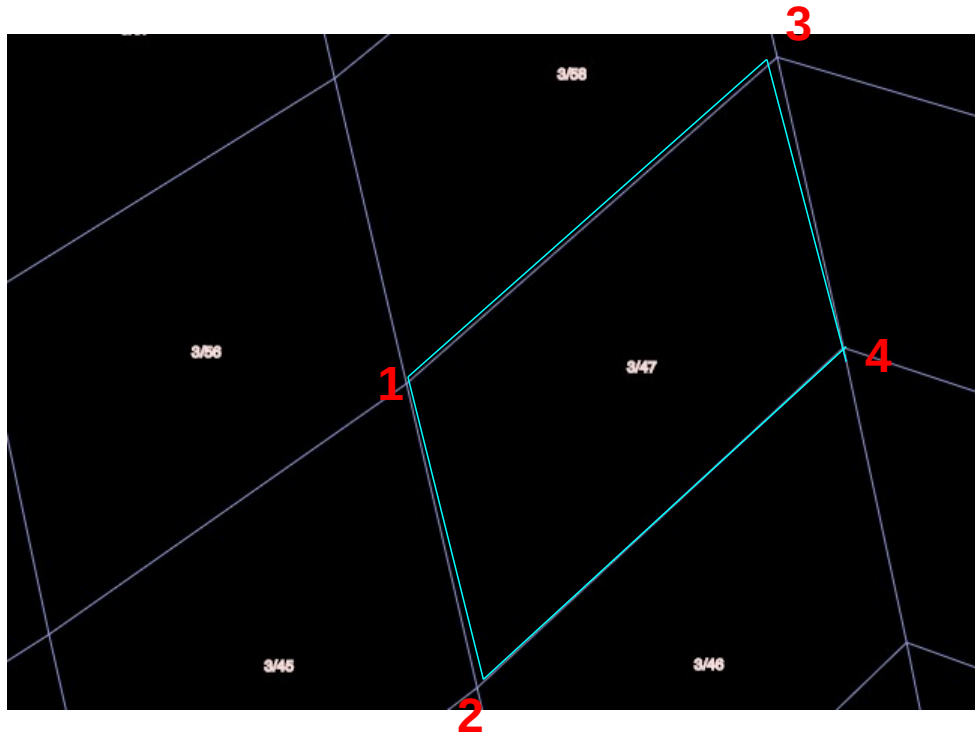
# Tile drawing algorithm



# Tile drawing algorithm

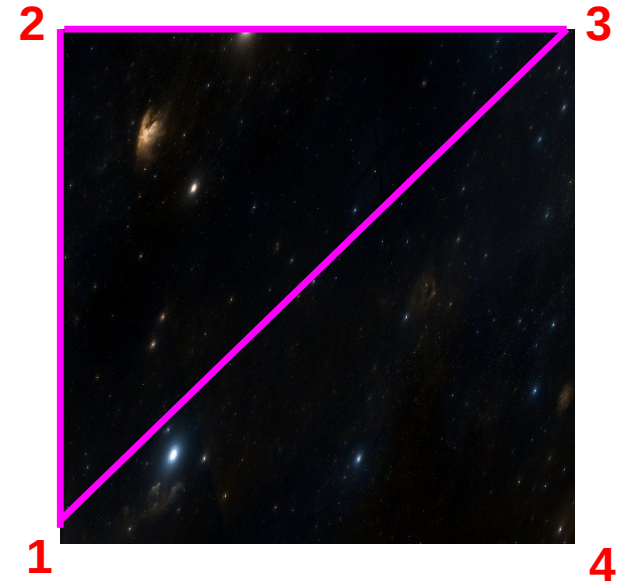
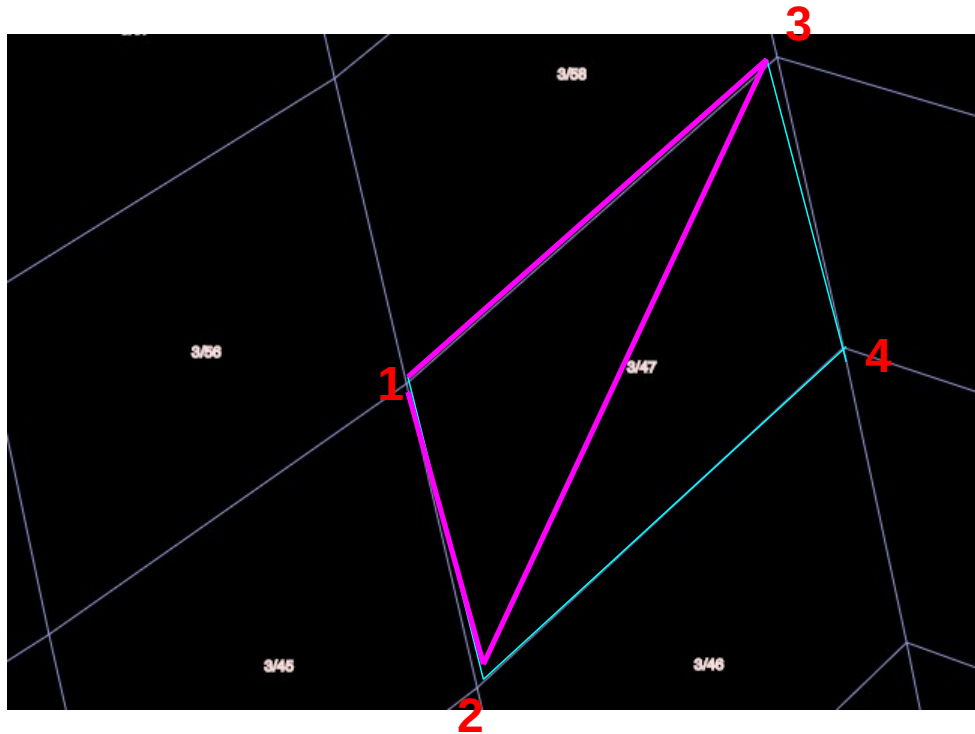


# Tile drawing algorithm

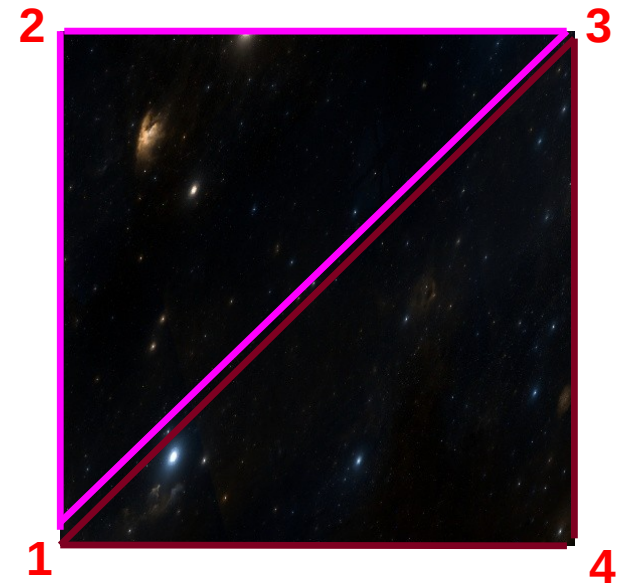
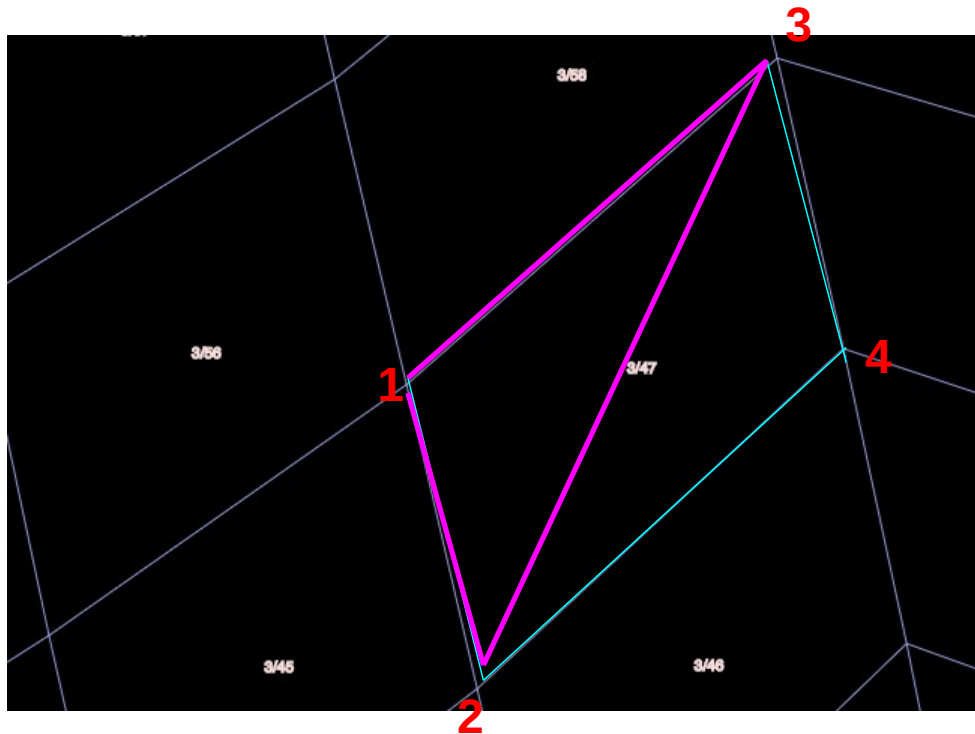




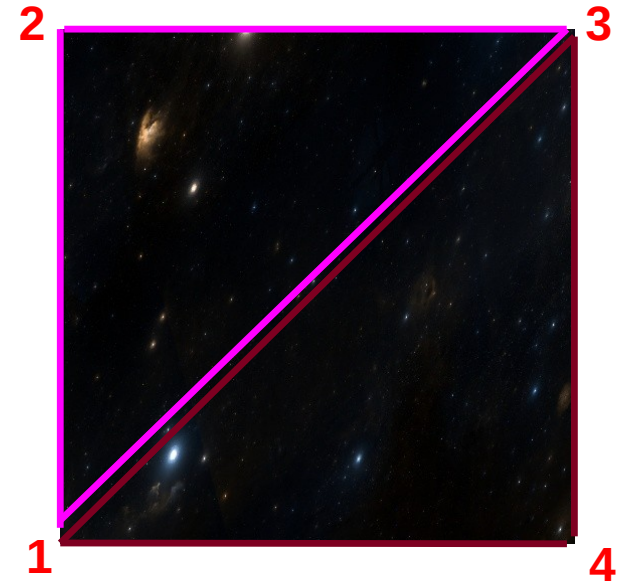
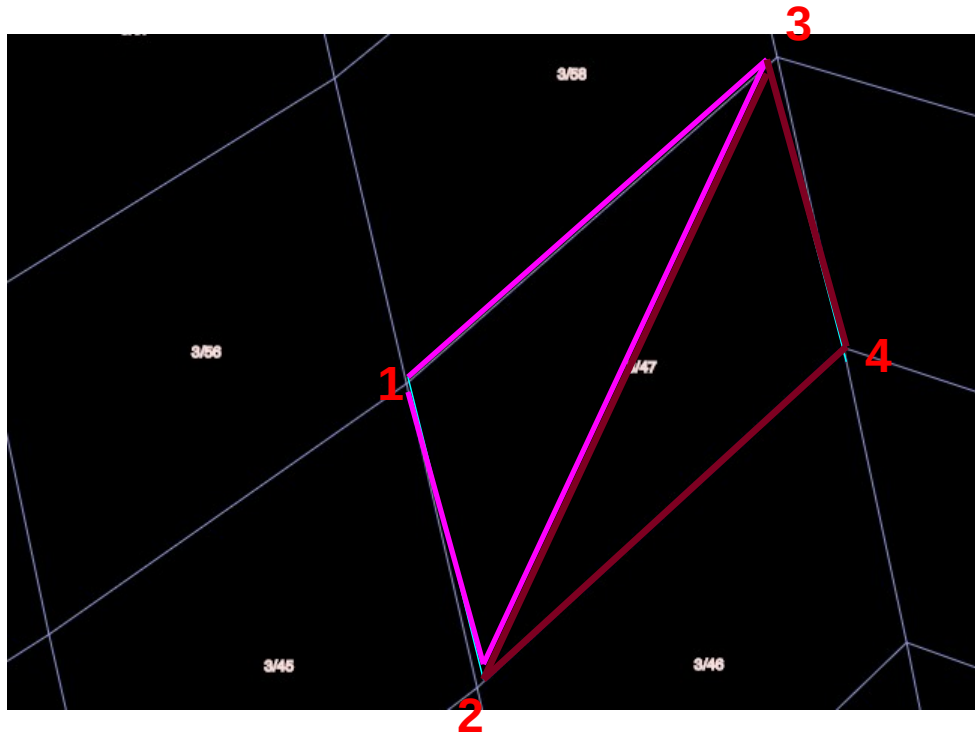
# Tile drawing algorithm



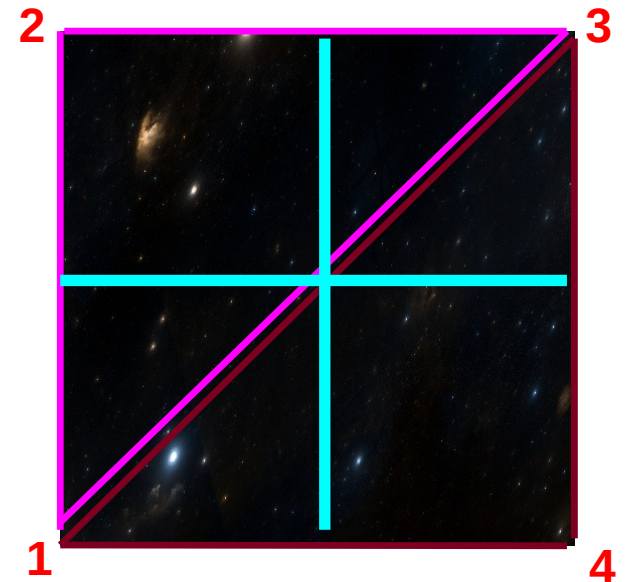
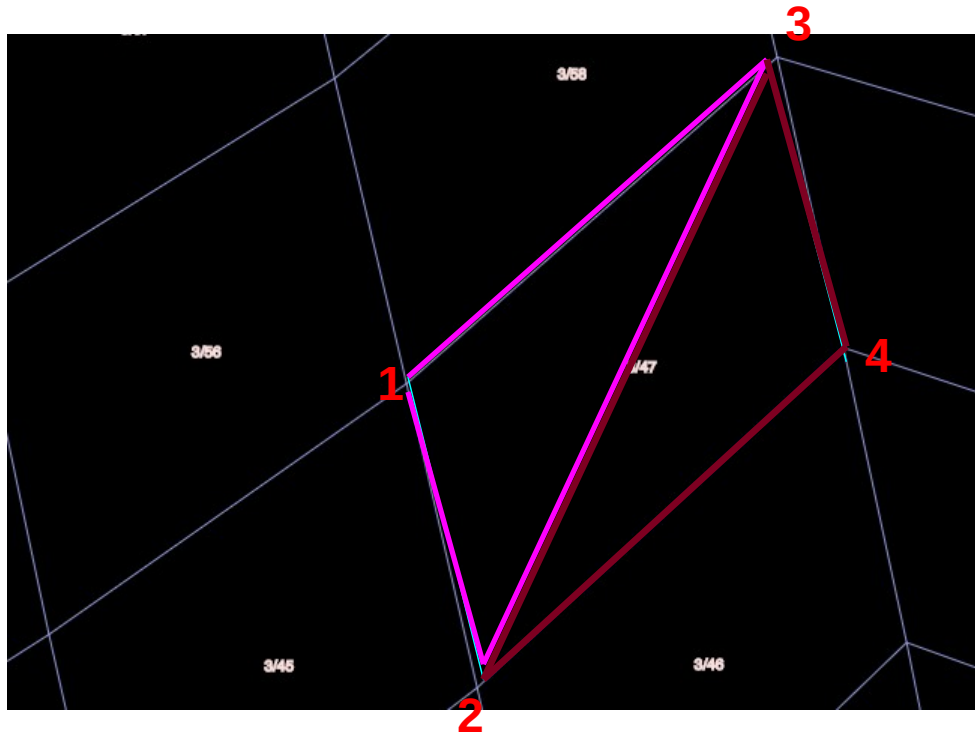
# Tile drawing algorithm



# Tile drawing algorithm

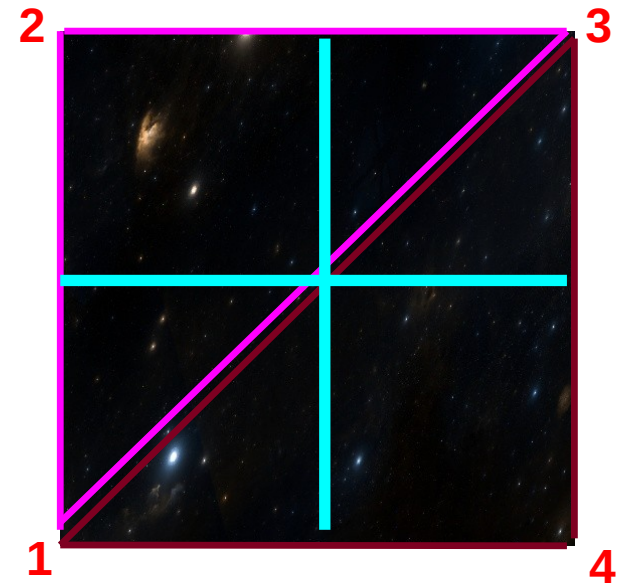
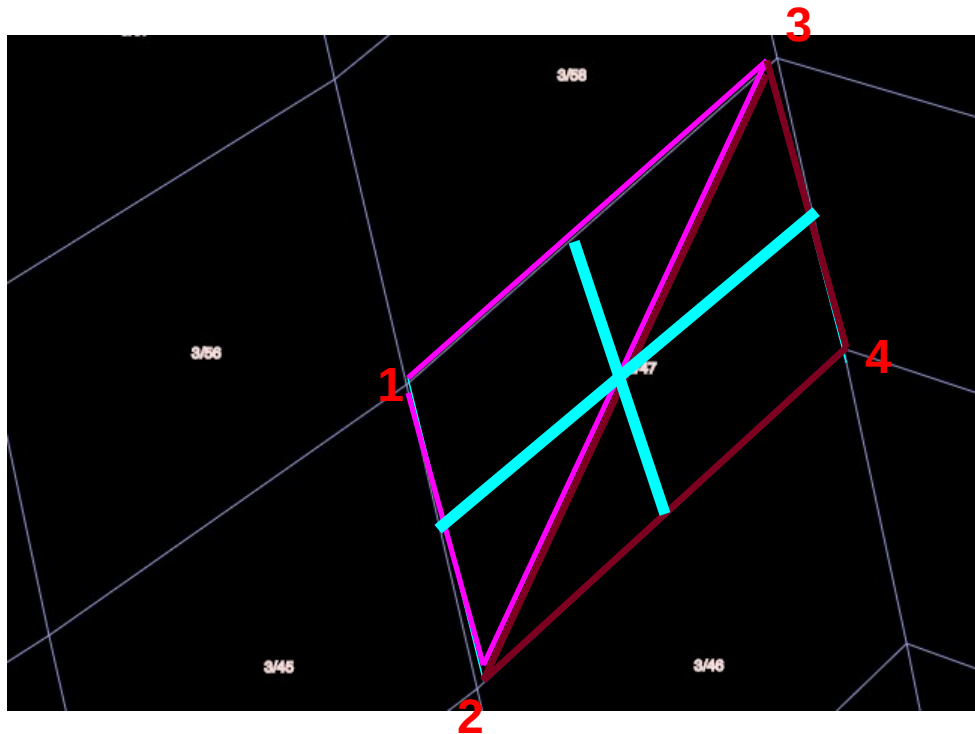


# Tile drawing algorithm



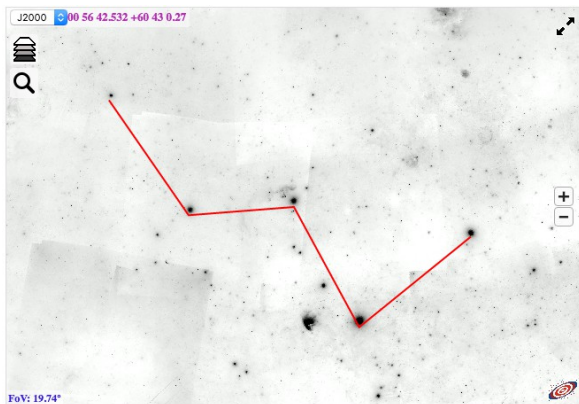
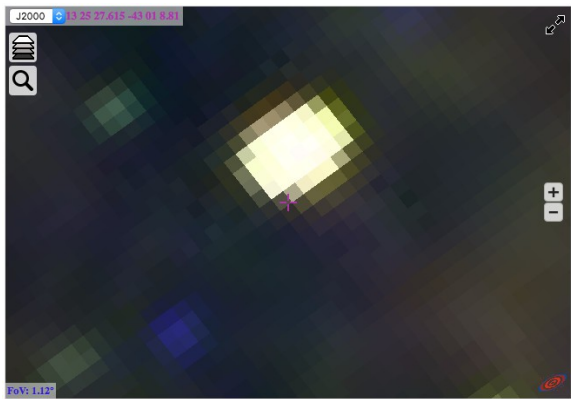


# Tile drawing algorithm

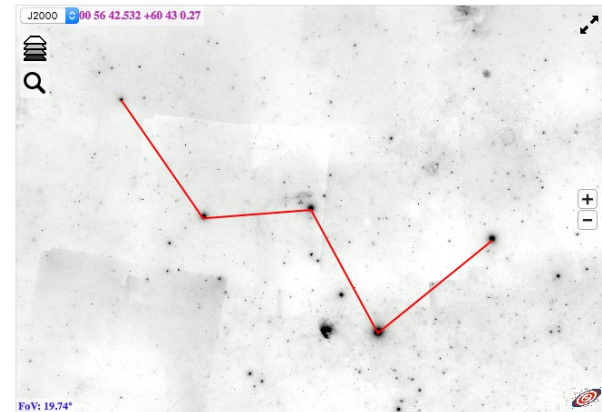
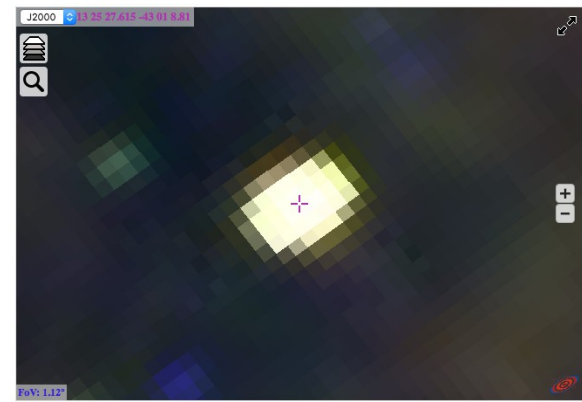


# Aladin Lite news & improvements

Old algorithm



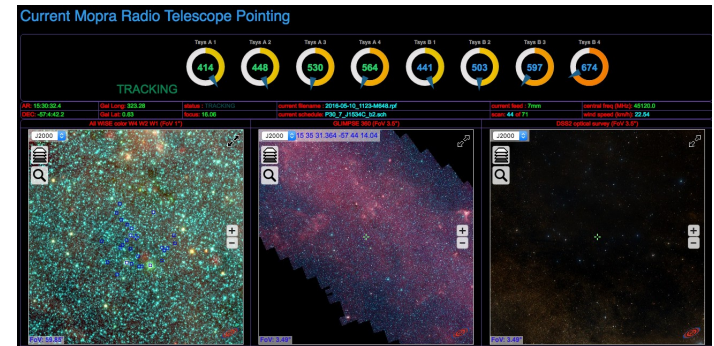
Updated algorithm



# Aladin Lite news & improvements

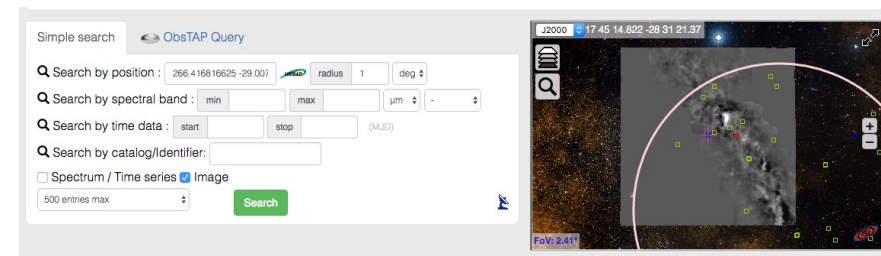
- New sites integrating Aladin Lite

- Visualization of Mopra Radio telescope pointing [developed by D. Romano]



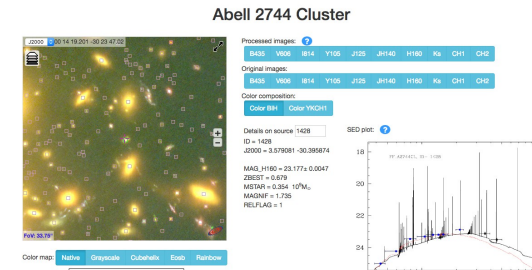
[hologhost.altevista.org/pointing/mopra.html](http://hologhost.altevista.org/pointing/mopra.html)

- VizieR associated data interface (preview of FITS image)



[cdsarc.u-strasbg.fr/assocdata/](http://cdsarc.u-strasbg.fr/assocdata/)

- ASTRODEEP portal (Frontier Fields visualisation + interaction with ASTRODEEP catalogue)



[astrodeep.u-strasbg.fr/ff/](http://astrodeep.u-strasbg.fr/ff/)



# Aladin Lite news & improvements

And also:

- eHST [ESAC]

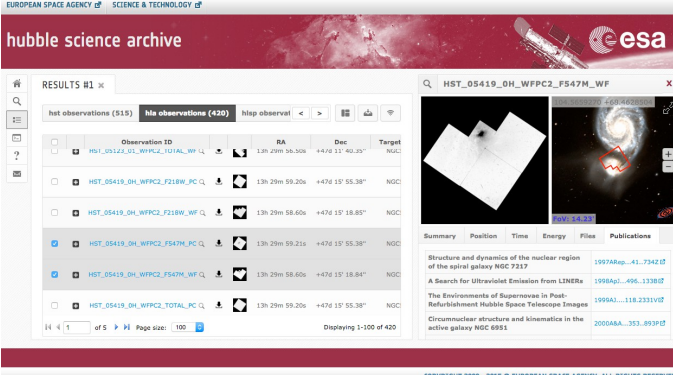
[archives.esac.esa.int/ehst/](http://archives.esac.esa.int/ehst/)

- Gaia Photometric Science Alerts

[gsaweb.ast.cam.ac.uk/alerts/home](http://gsaweb.ast.cam.ac.uk/alerts/home)

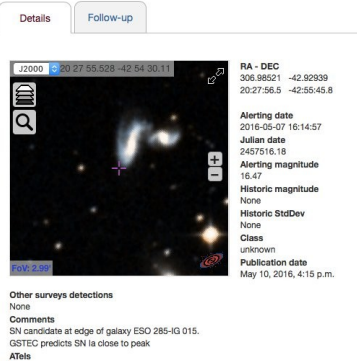
- Skywatch

[app.skywatch.co/](http://app.skywatch.co/)



The screenshot shows the 'hubble science archive' interface. At the top, there's a search bar with 'HST\_05419\_OH\_WFPC2\_F547M\_WF' entered. Below the search bar is a table of results with columns for Observation ID, RA, Dec, and Target. The table lists several observations, including HST\_05419\_OH\_WFPC2\_F218W\_PC and HST\_05419\_OH\_WFPC2\_F547M\_PC. To the right of the table, there are two image thumbnails: one showing a white rectangular field of view and another showing a spiral galaxy with a red circle around a specific region. Below the images, there are tabs for 'Summary', 'Position', 'Time', 'Energy', 'Files', and 'Publications'. The 'Summary' tab is active, displaying text about the 'Structure and dynamics of the nuclear region of the spiral galaxy NGC 7317' and other related research.

## Gaia16ang



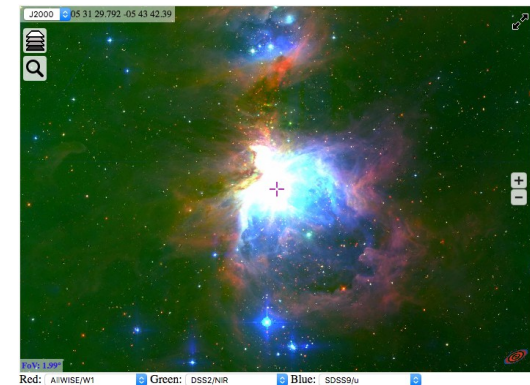
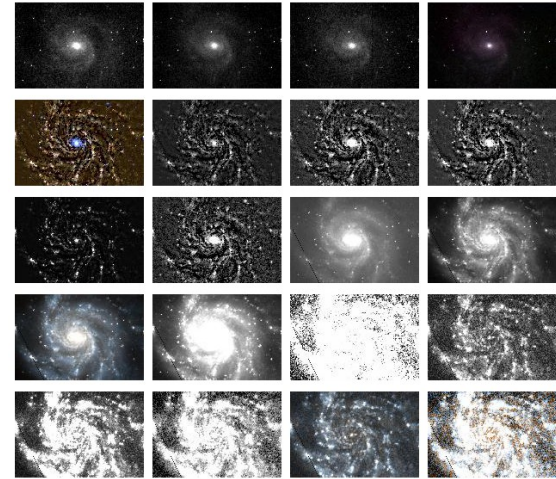
The screenshot shows the 'Gaia16ang' website interface. At the top, there are two tabs: 'Details' and 'Follow-up'. The 'Details' tab is active. On the left, there is a small image of a star field with a red crosshair marking a specific star. To the right of the image, there is a table of data for the star. The data includes RA-DEC coordinates (308.98521, -42.90939), Alerting date (2018-05-07 16:14:57), Julian date (2457516.18), Alerting magnitude (16.47), Historic magnitude (None), Historic StdDev (None), Class (unknown), and Publication date (May 10, 2016, 4:15 p.m.). Below the table, there are sections for 'Other surveys detections' (None), 'Comments' (SN candidate at edge of galaxy ESO 285-IG 015, GSTEC predicts SN Ia close to peak), and 'Alerts' (None).





# Other HiPS experiments

- **cutout generation from HiPS**  
(existing Java code, internship to develop a Python library)
- On-the-fly **generation of RGB HiPS** from user-selected **existing HiPS tiles**



Thanks !  
Questions ?

