

HiPS for the ASTRODEEP portal

IVOA Interop meeting
Sydney, 30/10/2015

Sébastien Derriere



□ ASTRODEEP

- European project



- Exploit the deepest multi-frequency astronomical survey data
 - Data validation
 - Analysis
 - Sharing

Deep image surveys

		GOODS North	EGS CANDELS	UDS	UDS CANDELS	COSMOS	COSMOS CANDELS	GOODS South	HUDFs	Frontier Fields
	Area	150' ²	150' ²	1 ^{c2}	150' ²	1 ^{o2}	150' ²	150' ²	15' ²	
ALMA	1.3 mm								0.15mlv	

	GOODS North	EGS CANDELS	UDS	UDS CANDELS	COSMOS	COSMOS CANDELS	GOODS South	HUDFs
Area	150' ²	150' ²	1 ^{c2}	150' ²	1 ^{o2}	150' ²	150' ²	15' ²

	70 μm	70 μm	70 μm	70 μm	70 μm	70 μm	70 μm	70 μm	70 μm	70 μm
Spitzer	70 μm	2.4 mJy	3.5 mJy	18 mJy	18 mJy	10 mJy	10 mJy	3.1 mJy	3.1 mJy	
	24 μm	21 mJy	50 mJy	230 mJy	230 mJy	60 mJy	60 mJy	20 mJy	20 mJy	
	16 μm	32 mJy						52 mJy	52 mJy	
	8 μm	1.7 mJy	4.8 mJy	10.2 mJy	10.2 mJy	17.3 mJy	17.3 mJy	1.7 mJy	1.7 mJy	
	5.8 μm	1.4 mJy	3.9 mJy	8.3 mJy	8.3 mJy	13.4 mJy	13.4 mJy	1.4 mJy	1.4 mJy	
	4.5 μm	0.2 mJy	0.6 mJy	1.2 mJy	1.2 mJy	2.0 mJy	2.0 mJy	0.2 mJy	0.2 mJy	26mag
	3.6 μm	0.1 mJy	0.3 mJy	0.6 mJy	0.6 mJy	1.1 mJy	1.1 mJy	0.1 mJy	0.1 mJy	26.6 mag
VLT/VISTA/UKIDSS	2μm(K)	25.6	23.8	25.0	26.0	25.0	26.0	26.8	27.2	
HST-WFC3	1.6	27.8	26.7	---	26.7	---	26.7	27.8	29.9	
	1.4 (JW)								29.9	28.8
	1.2 μm(J)	27.8	26.7	---	26.7	---	26.7	27.8	29.9	28.8
	1 μm(Y)	28.0	---	---	---	---	---	28.0	30.0	28.8
VLT/VISTA	1μm(Y)	---	---	24.6	26.5	26.7	26.7	26.7	26.7	
HST-ACS	0.85μm(I)	27.6	---	---	---	---	---	27.6	29.4	28.8
	0.75	28.7	27.8	---	27.8	27.2	27.8	28.7	29.9	
	0.6	28.2	27.9	---	27.9	27.2	27.9	28.2	30.1	28.9
	0.45μm(B)	28.2	---	---	---	---	---	28.2	29.7	28.9
CFHT/VLT LBT	0.36μm(U)	28.2	27.0	27.5	27.5	27.7	27.7	28.0	28.0	
XMM	2-10 keV	1.5x10 ⁻¹⁵	---	3x10 ⁻¹⁵	3x10 ⁻¹⁵	3x10 ⁻¹⁵	3x10 ⁻¹⁵	4x10 ⁻¹⁶	4x10 ⁻¹⁶	
XMM	5-10 keV	4x10 ⁻¹⁵	---	1x10 ⁻¹⁴	1x10 ⁻¹⁴	1x10 ⁻¹⁴	1x10 ⁻¹⁴	7x10 ⁻¹⁶	7x10 ⁻¹⁶	
Chandra	0.5-2 keV	2x10 ⁻¹⁷	5x10 ⁻¹⁷ erg cm ² s ⁻¹	---	---	2x10 ⁻¹⁶	2x10 ⁻¹⁶	1x10 ⁻¹⁷	1x10 ⁻¹⁷	

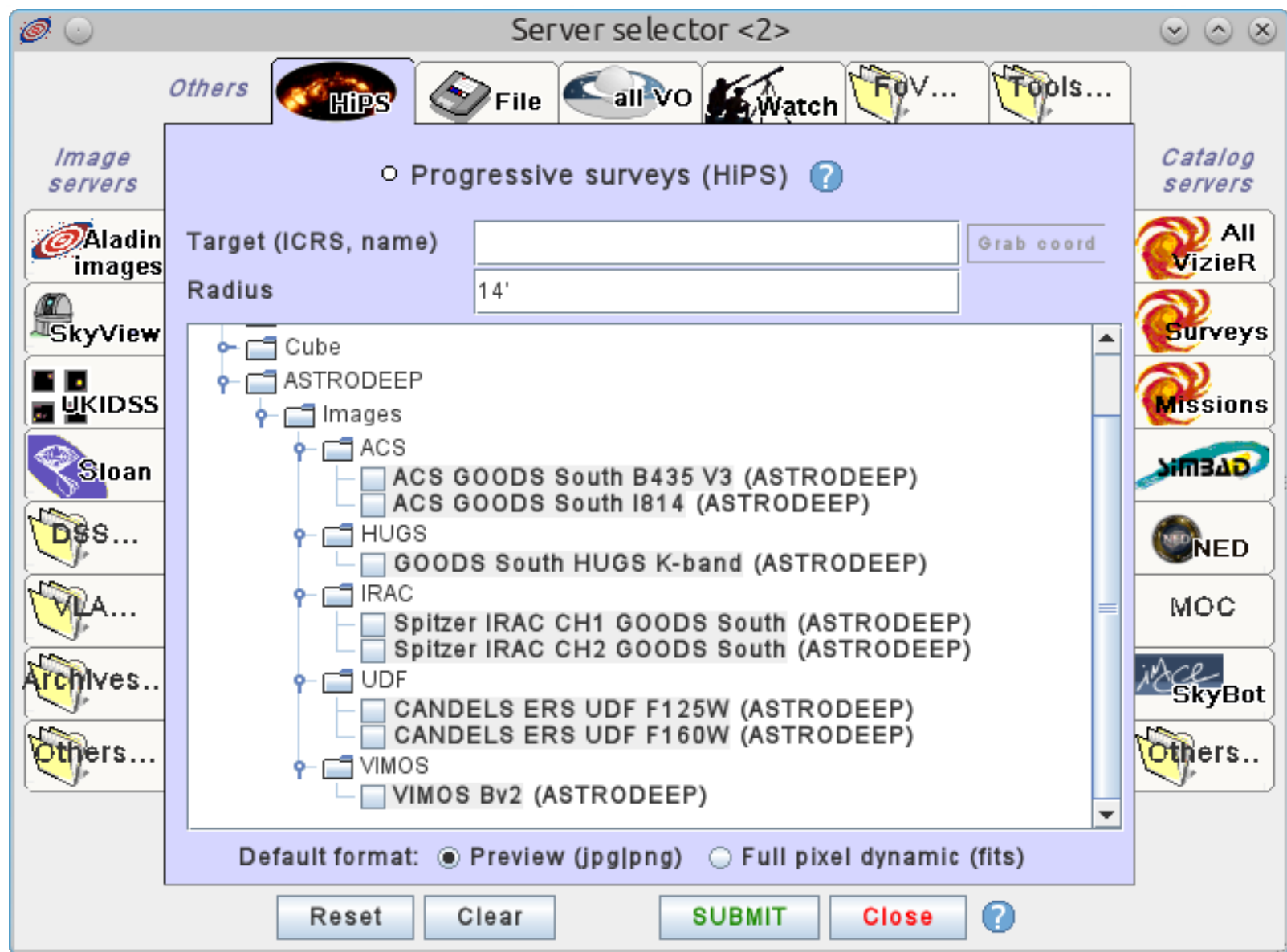
□ Image data

- Very deep !
- Small mosaics
 - covering a few fields in very different directions across the entire sky
- Several wavebands
 - with very different spatial resolution
- Not really Big Data

□ Conversion to HiPS

- Fast and easy to create within Aladin
- First application to 8 image bands in GOODS South
- Norder 10 to 13
- Allows to easily browse, pan, zoom, compare

Custom dictionary for Aladin



View in Aladin

The screenshot displays the Aladin v8.1 software interface, titled "Aladin v8.1 *** BETA VERSION (based on v8.128) ***". The interface includes a menu bar (File, Edit, Image, Catalog, Overlay, Coverage, Tool, View, Interop, Help) and a toolbar with various icons for navigation and analysis. A "Location" search bar is present, along with a "Frame" dropdown set to "ICRS".

The main viewing area is a 3x3 grid of panels, each showing a different astronomical image of the same field. The panels are labeled as follows:

- Top-left: VIMOS Bv2
- Top-middle: ACS GOODS South B495 V3
- Top-right: ACS GOODS South I814
- Middle-left: CANDELS ERS UDF F125W
- Middle-middle: CANDELS ERS UDF F160W
- Middle-right: GOODS South HUGS K-band
- Bottom-left: Spitzer IRAC CH1 GOODS South
- Bottom-middle: Spitzer IRAC CH2 GOODS South
- Bottom-right: (Empty panel)

Each panel features a central crosshair and a red box indicating the field boundaries. The dimensions for each panel are shown as $49.91'' \times 49.91''$. A toolbar on the right side provides interactive tools such as "select", "pan", "dist", "phot", "draw", "tag", "filter", "cross", "xy", "rgb", "assoc", "crop", "cont", "pixel", "epoch", "size", "prop", "dens.", "opa.", "zoom", and "del".

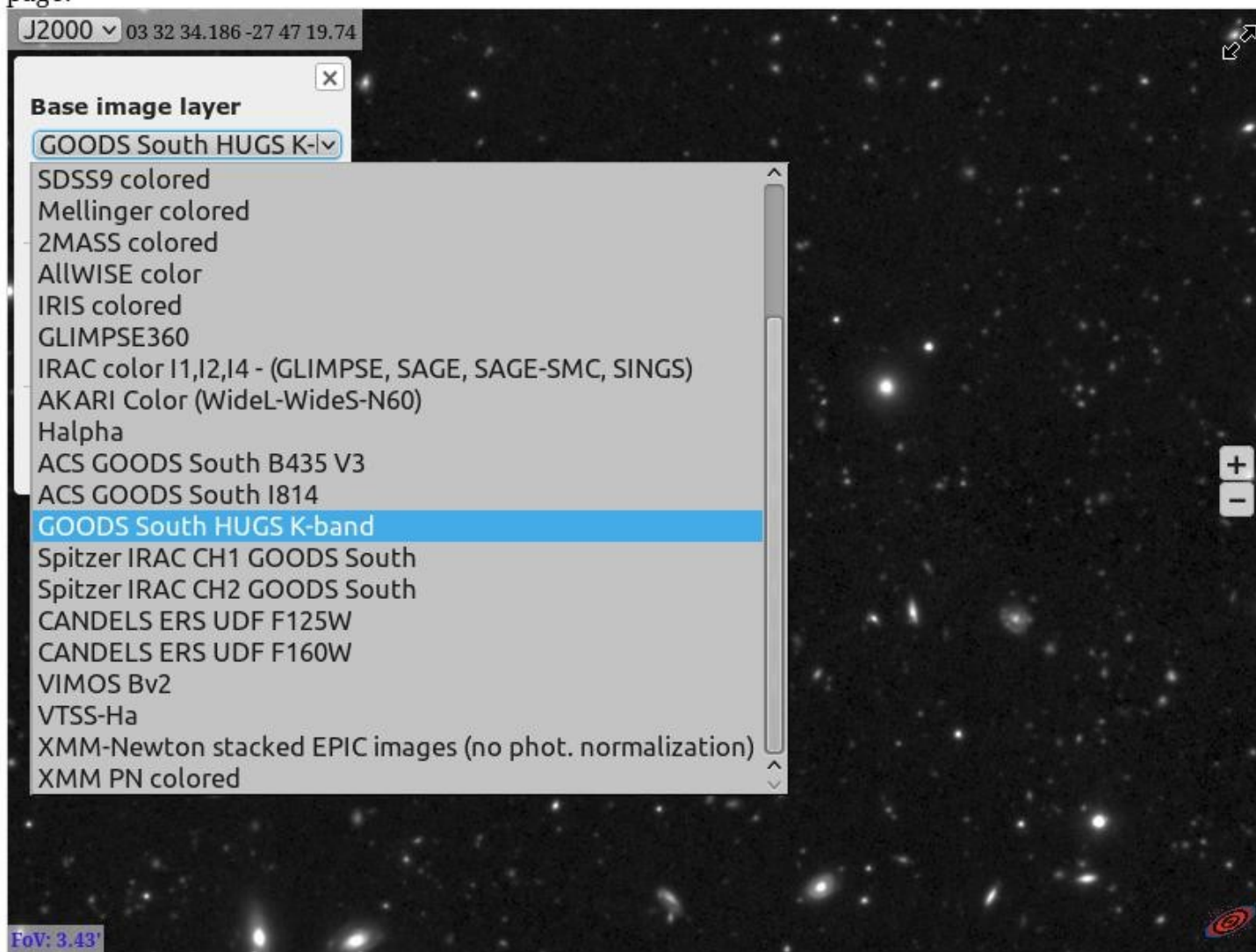
Below the toolbar is a "Frame: ICRS" section with a celestial coordinate diagram showing a red dot at the field location. The coordinates are given as $03:32:28.39 -27:44:19.2$ and $49.01'' \times 49.01''$.

At the bottom of the window, there is a status bar with the text "(c) 2014 UDS/CNRS - by CDS - Distributed under GNU GPL v3" on the left, "Search" with a search bar in the center, and "0 sel / 0 src 833fps / 227Mb" on the right.

Access in AladinLite

Aladin Lite view

Images of the GOODS South field in 8 different bands have been computed in HiPS, you can click the stack icon in the upper left to change the image base layer. Other surveys are also available for comparison. Higher resolution images are retrieved as you zoom in. Such AladinLite view can be easily embedded in any web page.



Re-use in SAADA

- Create thumbnails centered on catalogue sources



workingDB GOODS_South>ENTRY>candels_3dhstEntry



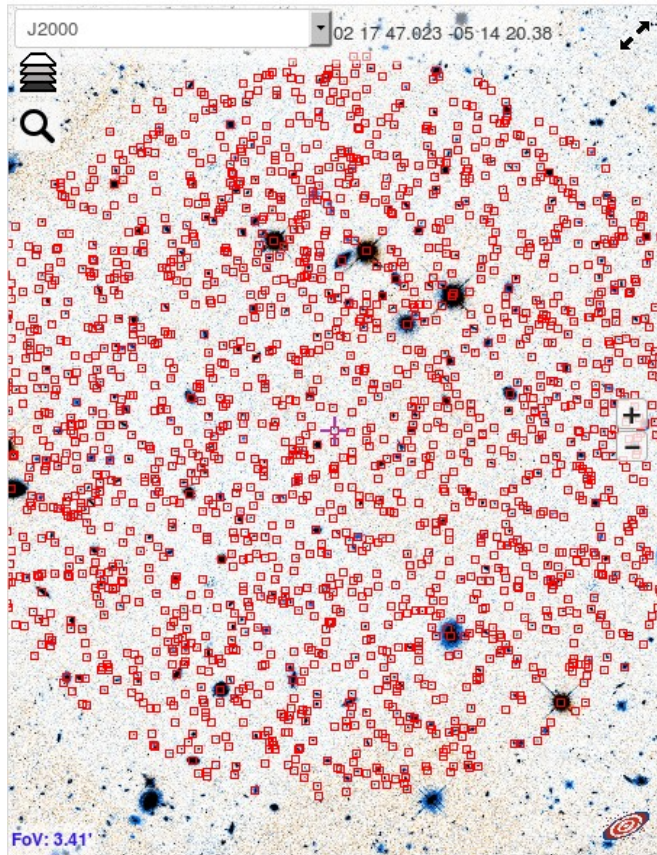
GOODS_South

- TABLE
 - candels_3dhst
 - match_GS
 - match_VUDS_GS
- ENTRY
- SPECTRUM
- MISC
- FLATFILE

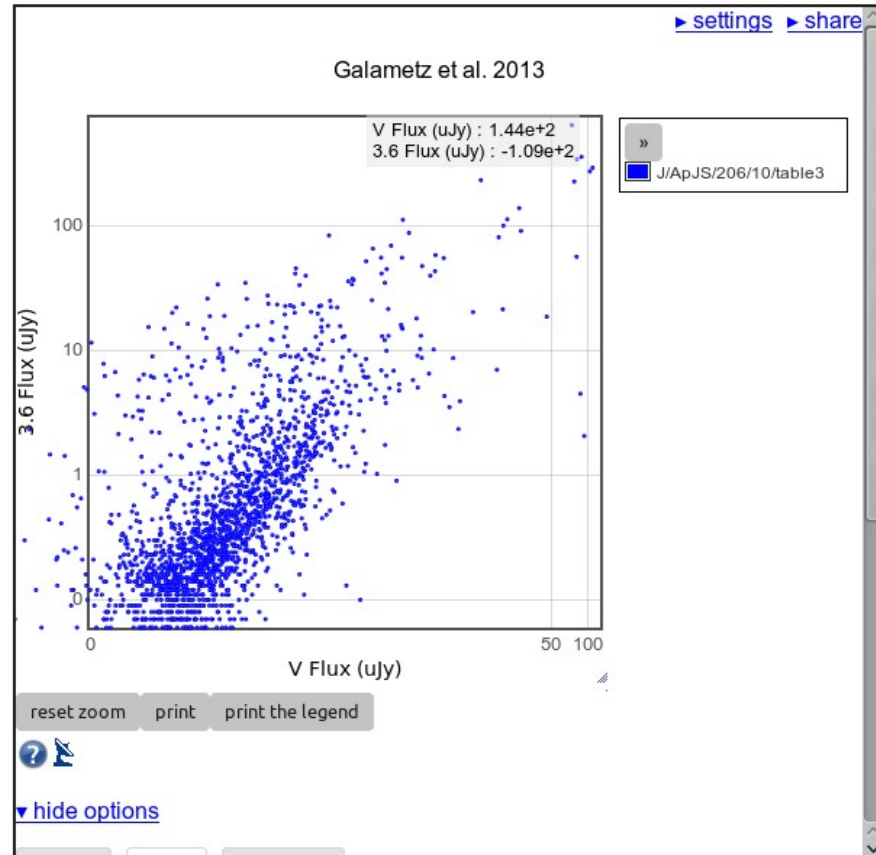
Show 10 entries | Showing 1 to 10 of 160 entries

Position	Error (arcsec)	Name	Rel : ToThumbnail	Rel : ToSED	Rel : ToPZ	Rel : ToSpectr
03:32:24.41-27:57:30.4 (s)	Not Set	GOODS_South-candels_3dhstEntry03 32 24.4-27 57 30		1 links	No index!!	4 links
03:32:19.70-27:57:13.2 (s)	Not Set	GOODS_South-candels_3dhstEntry03 32 19.7-27 57 13		1 links	No index!!	4 links
03:32:17.87-27:56:58.3 (s)	Not Set	GOODS_South-candels_3dhstEntry03 32 17.9-27 56 58		1 links	No index!!	4 links
03:32:20.57-27:56:56.3 (s)	Not Set	GOODS_South-candels_3dhstEntry03 32 20.6-27 56 56		No link	No index!!	4 links
03:32:29.28-27:56:19.4 (s)	Not Set	GOODS_South-candels_3dhstEntry03 32 29.3-27 56 19		No link	No index!!	4 links

Build web portal with widgets



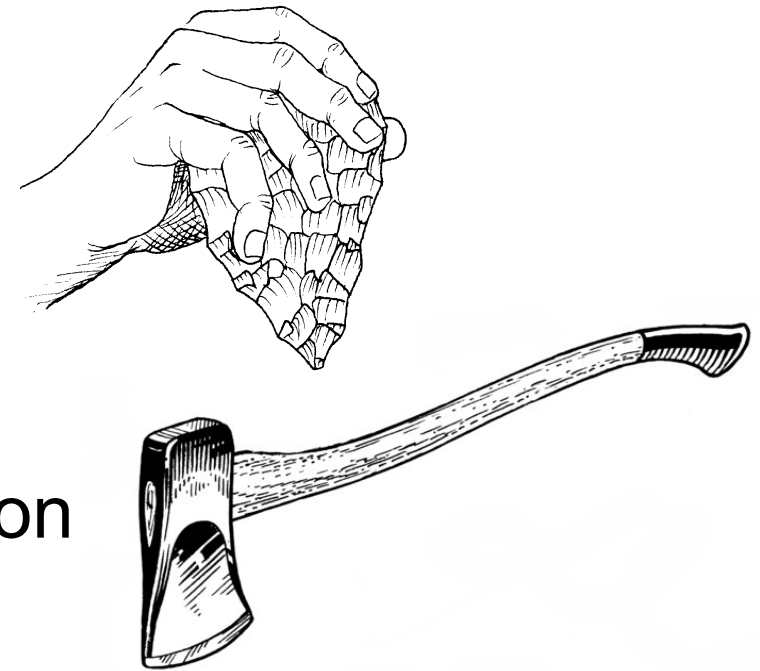
Various image surveys can be displayed as [HIPS surveys](#). Higher resolution details get downloaded as we zoom in on the view.



Full	_r arcmin	_RAJ2000 deg	_DEJ2000 deg	recno	Seq	RAJ2000 deg	DEJ2000 deg	Hlim mag	QCStar	SED	uFlux uJy	e_ uJy	BFlux uJy	e_ uJy	V	
✓1	0.0180	034.445931	-05.237783	6762	6762	034.4459305	-05.2377832	28.2217	0	0.070	SED	0.1082	0.0076	0.1232	0.0040	0.13
✓2	0.0802	034.445896	-05.238835	6652	6652	034.4458960	-05.2388351	28.3169	0	0.000	SED	0.3953	0.0077	0.5218	0.0040	0.56
✓3	0.0878	034.444457	-05.238012	6684	6684	034.4444573	-05.2380124	28.3090	0	0.370	SED	0.0025	0.0066	0.0486	0.0033	0.07
✓4	0.1022	034.446013	-05.235807	7112	7112	034.4460129	-05.2358069	28.0995	0	0.880	SED	0.0118	0.0066	0.0208	0.0035	0.03
✓5	0.1184	034.444349	-05.236194	29497	29497	034.4443489	-05.2361940	28.0896	0	0.110	SED	0.0173	0.0068	0.0364	0.0034	0.04
✓6	0.1259	034.447940	-05.237492	29411	29411	034.4479398	-05.2374915	28.1403	0	0.570	SED	0.0131	0.0068	0.0254	0.0035	0.02
✓7	0.1327	034.447116	-05.235694	29520	29520	034.4471156	-05.2356944	28.1068	0	0.200	SED	0.0504	0.0066	0.0473	0.0034	0.09
✓8	0.1353	034.447360	-05.239166	6745	6745	034.4473598	-05.2391663	28.1528	0	0.030	SED	1.1860	0.0083	1.7875	0.0045	3.14
✓9	0.1595	034.448387	-05.238274	6641	6641	034.4483869	-05.2382744	28.2387	0	0.070	SED	0.0323	0.0068	0.0605	0.0037	0.05

□ Side-project : create large posters !

- « Do you know where I can find very large astronomical images to make large prints for outreach ? »
- Could HiPS help do that ?
 - The astronomer's approach
 - The computer scientist's solution
 - The guru's solution



□ Brute force

- Create a web page with HUGE AladinLite instance
- Wait for all the tiles to load
- Make screenshot of the browser contents

```
<html>
<body>
  <!-- include Aladin Lite CSS file in the head section of your page -->
  <link rel="stylesheet" href="http://aladin.u-strasbg.fr/AladinLite/api/v2/latest/aladin.min.css" />

  <!-- you can skip the following line if your page already integrates the jQuery library -->
  <script type="text/javascript" src="http://code.jquery.com/jquery-1.9.1.min.js" charset="utf-8"></script>

  <!-- insert this snippet where you want Aladin Lite viewer to appear and after the loading of jQuery -->
  <div id="aladin-lite-div" style="width:8000px;height:8000px;"></div>
  <script type="text/javascript" src="http://aladin.u-strasbg.fr/AladinLite/api/v2/latest/aladin.min.js" charset="utf-8"></script>
  <script type="text/javascript">
    var aladin = A.aladin('#aladin-lite-div', {survey: "P/GLIMPSE360", cooFrame:"galactic", fov:8, target: "0 +0"});
  </script>
</body>
</html>
```

□ Brute force result

- It works (surprisingly) !
- Generate 8000 pixel * 8000 pixel image in a few minutes
- Makes 2m * 2m 100dpi print





☐ Smarter way

- Create JS script and load it with
 - PhantomJS is a headless WebKit



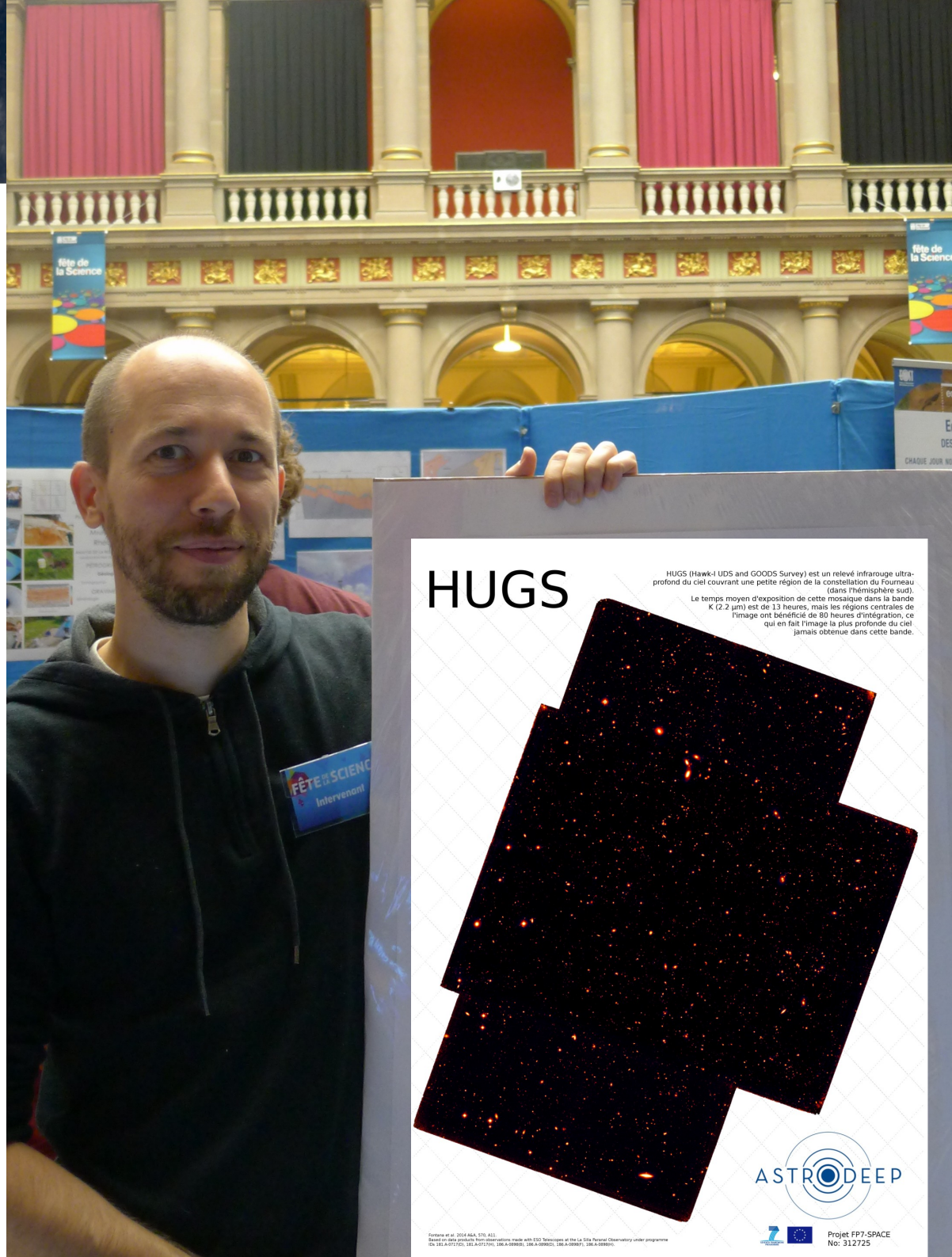
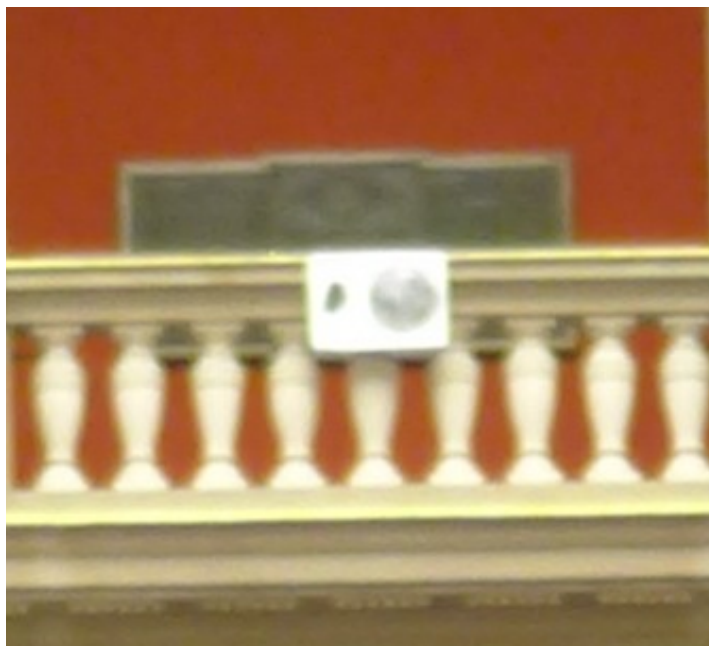
- Wait for the data to load
- Make screenshot of AladinLite canvas

□ Better way

- Have a dedicated jar access the HiPS and build the image directly
 - ask Pierre Fernique !
- 5min to generate 12k x 12k PNG image (including data transfer)
- Without data transfer : 26s to generate 15k x 15k JPG image (but you need enough RAM !)

Application

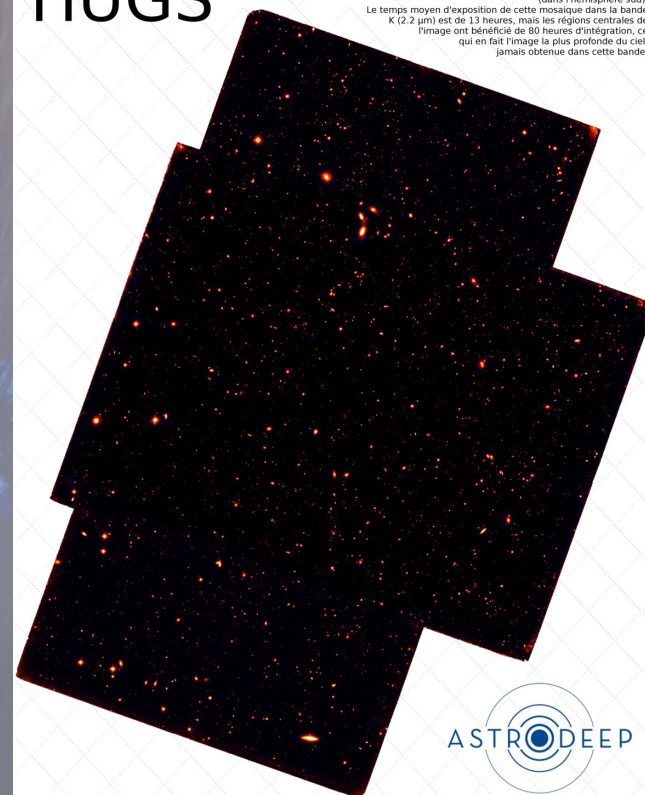
- Fête de la science 2015



HUGS

HUGS (Hawk-I UDS and GOODS Survey) est un relevé infrarouge ultra-profond du ciel couvrant une petite région de la constellation du Fourneau (dans l'hémisphère sud).

Le temps moyen d'exposition de cette mosaïque dans la bande K ($2.2 \mu\text{m}$) est de 13 heures, mais les régions centrales de l'image ont bénéficié de 80 heures d'intégration, ce qui en fait l'image la plus profonde du ciel jamais obtenue dans cette bande.



ASTRODEEP