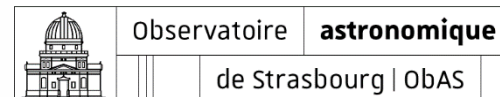


The IVOA HiPS network: Status and Evolutions

Interop Tucson – 10-13 November 2023

Pierre Fernique with all HiPS developers, contributors



□ HiPS numbers (nov 2023)



- Registered HiPS:
 - **1361** HiPS (including **74** HiPS cats (+24) , **25** HiPS cubes (+8), **62** planet HiPS (+3))
=> **+33%** (*)
=> **675 TB** of HiPS **+82%**
 - 5.34^{E14} pixels (~534 000 billions of pixels) +60%
 - 1.82^{E10} cat rows (~20 billions rows) +80%
 - **3281** instances (masters + mirrors)
- Unregistered HiPS:
 - **Thousands of hipsilized individual images** (e.g. ESO portal -> **800K** individual HiPS)
 - Dozens of project HiPS (e.g. ADASS: ESAC Euclid HiPS, VLASS HiPS, Tutorial T001,...)
- Usage:
 - No global statistics => too many clients and servers
 - **CDS usage : more than 1.8M** tile queries per day **(+125%)**

(*) Compared with the last HiPS network status talk (Gruningen nov 2020)

□ HiPS generation

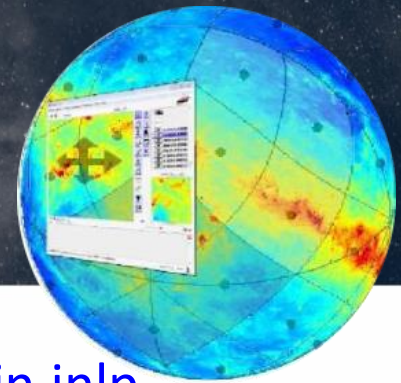
Existing tools available today for generating HiPS:

- Pixel HiPS:
 - CDS: Java code (*P. Fernique & A. Oberto*)
=> Aladin/**Hipsgen** => GUI/batch
 - IPAC: C lang
=> **Montage** (*G.B Berriman, J. Good & al*)
- Catalog HiPS
 - CDS: Java code: **Hipsgen-cat** (*FX Pineau*)

Other materials:

- HEASARC: HiPS tile generation (*Tom McGlynn*)
- Max Planck Institute : Python/Cython code => eROSITA HiPS generation (*Jeremy Sanders*)
=> https://github.com/jeremysanders/ero_hips_gen
- LSST/Rubin project (HiPS python lib + HiPScat lib -> see ADASS 2023 T002)
- CDS : Python code => HiPS color generation (*Thomas Boch*)

□ HiPS clients 2023 (partial list)

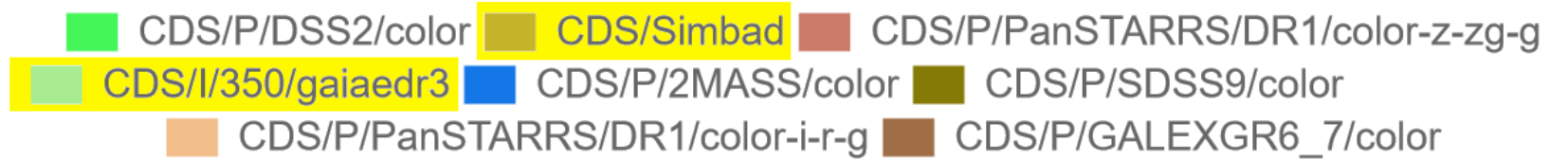


- **Aladin Desktop** – <http://aladin.cds.unistra.fr/java/Aladin.jnlp>
- **Aladin Lite** – <http://aladin.cds.unistra.fr/AladinLite>
- **WWT AAS** - <http://worldwidetelescope.org/home/>
- **ESASKY** - <http://sky.esa.int>
- **ESO science portal** - <http://archive.eso.org/scienceportal/home>
- **Stellarium Desktop** - <https://stellarium.org>
- **Stellarium Web** - <https://stellarium-web.org>
- **Firefly** - <https://github.com/Caltech-IPAC/firefly>
- **Kstar** - <https://edu.kde.org/kstars/>
- **Digistar** - <https://www.es.com/ips-2020-presentation/>
- **RSACosmos** - <https://www.rsacosmos.com/skyexplorer-open-planetary.html>
- **HscMap** - <https://hscmap.mtk.nao.ac.jp/hscMap4/app/>
- **MIZAR** - <http://sitools2.github.io/MIZAR/>

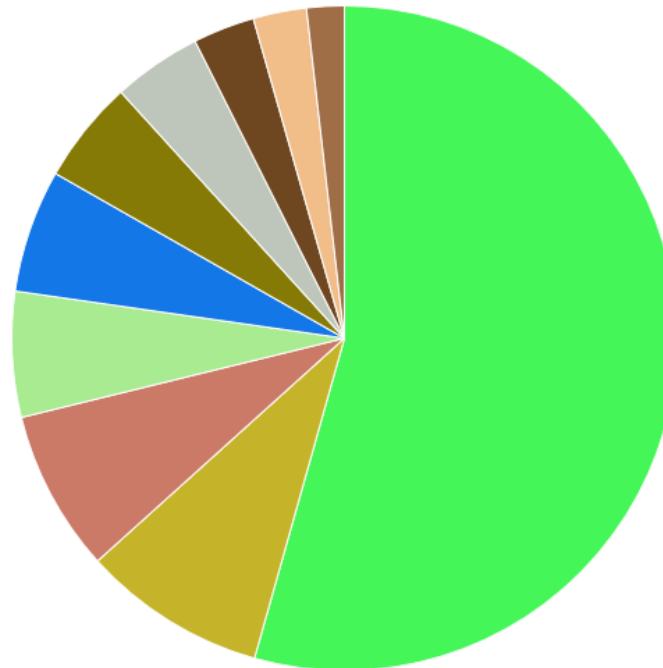
HiPS top 10 (2023)

A partial stats based on Aladin Desktop

Top10 HiPS loaded in Aladin Desktop



HiPS catalogs

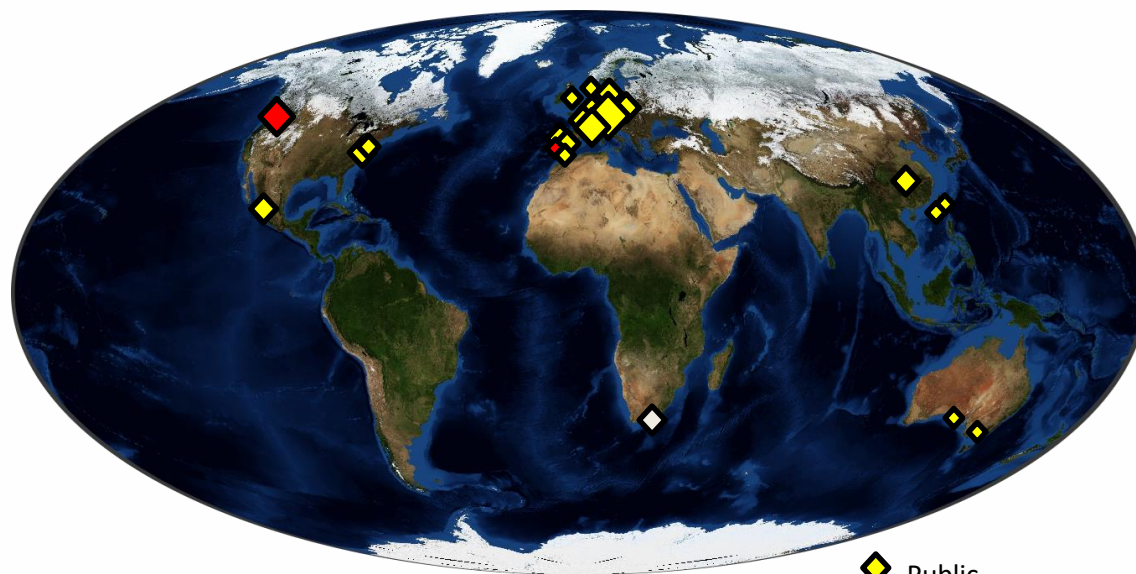


□ HiPS nodes (= HiPS servers)

- **21** HiPS nodes (-2 compared to 2020)

CFA, WFAU, CASDA, PADC, IPAC, ANU, LEIDEN, IRAP, SSC, CDS, AMIGA, SVO, IAS, ESAC, JAXA, HEASARC, China-VO...

=> 1 removed (AMIGA), 1 out-of-order (CADC)

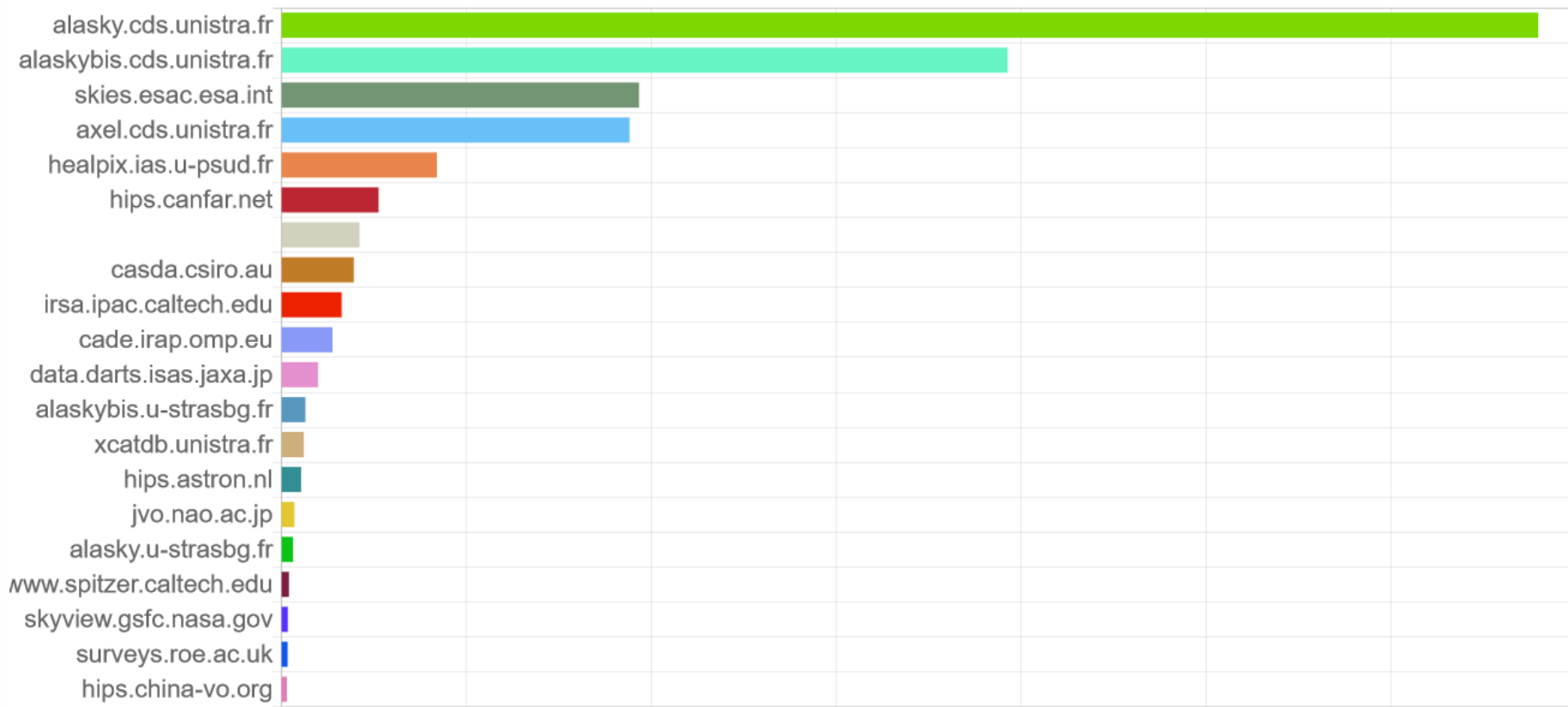


- ◆ Public
- ◆ Removed / Out of order
- ◆ In project

HiPS nodes stats 2023

A partial usage stats based on Aladin Desktop

Repartition of hips nodes used by Aladin Desktop



State of the HiPS network (26 oct 2023)

	Node	# HiPS Masters	Delta master since 2020	# HiPS	Delta HiPS since 2020	Mirrors OutOfDate	Masters with errors	Compliant with HiPS 1.0
1	<i>CDS/hipsmaster</i>	523	+132	1181	+264	84	3	99%
2	<i>CDS/hipsslave</i>			1181	+266			
3	<i>CDS/hipscat</i>	55	+14	55	+14		1	98%
4	<i>hips.astro.nl</i>	6	+6	6	+6			100%
5	<i>jvo</i>	14		14			14	0%
6	<i>CEFCA</i>	8	+2	8	+2			100%
7	<i>cfa.harvard.edu</i>	1		1				100%
8	<i>wfau.roe.ac.uk</i>	13		13			1	92%
9	<i>CASDA/hipsserver</i>	2	+2	9	+2			100%
10	<i>PADC/hipsserver</i>	57	+15	67	+25	7	51	11%
11	<i>IPAC/hipsserver</i>			23		5		
12	<i>ANU/hipsserver</i>			1				
13	<i>- AMIGA/hipsserver</i>		-2		-2			
14	<i>Leiden/hipsserver</i>	2		2			1	50%
15	<i>IRAP/hipsserver</i>	523	+93	523	+93	1	10	98%
16	<i>SSC/hipsserver</i>	4		4				100%
17	<i>svo.cab/hipsserver</i>	1		1			1	0%
18	<i>IAS/hipsserver</i>	13		27			7	46%
19	<i>ESAC/hipsserver</i>	71	+5	87	+5	2	28	61%
20	<i>JAXA/hipsserver</i>	34	+6	34	+6		24	29%
21	<i>HEASARC/hipsserver</i>	26		26			11	58%
22	<i>- CADC/hips</i>				-166			
23	<i>China-VO/hipsserver</i>	8		18		10	8	0%
	TOTAL	1361	+273	3281	+515	109	160	

□ Hips network scanning method

- A simple perl script using **Hipslint.jar** (v12.105) and the list of HiPS nodes maintained by CDS
- ~1 hour for scanning the 3281 HiPS instances

<https://aladin.cds.unistra.fr/hips/registry>

<https://aladin.cds.unistra.fr/hips/Hipslint.jar>

```
check-2023-10-26.txt - Notepad2
File Edit View Settings ?
1488 . 60 idoc/P/omega/emissivite_5-07mic Mirror
1489 . 61 idoc/P/omega/emissivite_5-09mic Mirror
1490 . 62 idoc/P/omega/ferric_bd530 Mirror
1491 . 63 idoc/P/omega/ferric_nnphs Mirror
1492 . 64 idoc/P/omega/olivine_osp1 Master 6warn
1493 . 65 idoc/P/omega/olivine_osp2 Master 6warn
1494 . 66 idoc/P/omega/olivine_osp3 Master 6warn
1495 . 67 idoc/P/omega/pyroxene_bd2000 Mirror
1496
1497 Scanning IPAC/hipserver [url=http://irsa.ipac.caltech.edu/data/hips/list]...
1498 . 1 ESAVO/P/HERSCHEL/PACS-color Mirror
1499 . 2 CDS/P/2MASS/color Mirror
1500 . 3 CDS/P/2MASS/J Mirror
1501 . 4 CDS/P/2MASS/H Mirror
1502 . 5 CDS/P/2MASS/K Mirror
1503 . 6 CDS/P/allWISE/color Mirror
1504 . 7 CDS/P/allWISE/w1 Mirror
1505 . 8 CDS/P/allWISE/w2 Mirror
1506 . 9 CDS/P/allWISE/w3 Mirror
1507 . 10 CDS/P/allWISE/w4 Mirror
1508 . 11 CDS/P/GALEXGR6/AIS/color Mirror
1509 . 12 CDS/P/GALEXGR6/AIS/FUV Mirror
1510 . 13 CDS/P/GALEXGR6/AIS/NUV Mirror
1511 . 14 CDS/P/SDSS9/color Mirror
1512 . 15 CDS/P/SPITZER/IRAC1 Mirror
1513 . 16 CDS/P/SPITZER/IRAC2 Mirror
1514 . 17 CDS/P/SPITZER/IRAC3 Mirror
1515 . 18 CDS/P/SPITZER/IRAC4 Mirror
1516 . 19 CDS/P/IRIS/color Mirror
1517 . 20 CDS/P/DSS2/color Mirror
1518 . 21 CDS/P/DSS2/red Mirror
1519 . 22 CDS/P/PLANCK/R2/LFI/color Mirror
1520 . 23 CDS/P/PLANCK/R2/HFI/color Mirror
1521
1522 Scanning ANU/hipserver [url=http://skymapper.anu.edu.au/_HiPS/hipslist.txt]...
1523 . 1 CDS/P/skymapper-color Mirror
1524
1525 Scanning Leiden/hipserver [url=http://tgssadr.strw.leidenuniv.nl/hips_list]...
1526 . 1 Leiden/P/TGSSADR Master 6warn
1527 . 2 Leiden/TGSSADR/7sigma Master 3err 7warn
1528
1529 Scanning IRAP/hipserver
[ur]l=http://cade.irap.omp.eu/documents/Ancillary/4Aladin/hipslist-IRAP.txt]...
1530 . 1 ov-gso/P/Abell1763/irac1 Master 2warn
1531 . 2 ov-gso/P/Abell1763/irac1/SIGMA Master 2warn
1532 . 3 ov-gso/P/Abell1763/irac2 Master 2warn
Ln 5939: 6164 Col 7 Sel 0 474 Ko ANSI CR+LF INS Default Text
```

□ Most current errors



1. Mirrors out of date
 2. Hipslist incoherency compared to properties
-



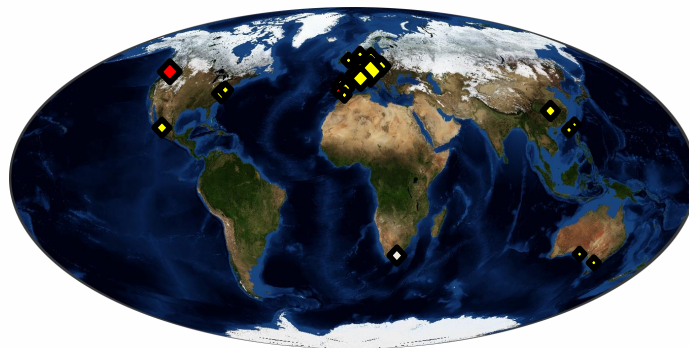
3. Mandatory keyword missing (`creator_id`, `hips_service_url`, `hips_order`, `obs_title`, ...)
 4. Not ISO date
 5. Properties file missing
-



6. Tile width not conform to `hips_tile` width
7. `Hips_order_min` not conform

□ HiPS challenges

1. Continuing to **improve HiPS declarations**
2. Better **sharing of HiPS distribution effort**



3. **Avoid duplicate HiPS generation** efforts
4. **Enhance HiPS** solution to support large data **cube surveys** (SKA, ...)

HiPS declarations

- The good solution => the **VO registry**, but...
 - **11 HiPS node** declarations, **+4**, at least **10** missing
 - **560 individual HiPS** declarations, **+551**, (but **801** undeclared)

```
SELECT TOP 10000 * FROM
rr.resource NATURAL JOIN
rr.interface NATURAL JOIN
rr.capability WHERE standard_id
LIKE '%hips%'
```

void	res_type	created	short_name	res_file	updated
1	vs.catalogservice	2020-05-11T08:35:51	WISE4	WIRAC: The WISE Infrared Astronomical Catalogue	2023-10-24T09:01:03
2	vs.catalogservice	2004-10-02T09:00:00	CGA	Chandra X-ray Observatory Data Archive	2018-01-18T00:00:00
3	vs.service	2019-07-08T00:00:00	CXC hips service	Chandra HiPS Service	2019-07-18T00:00:00
4	vs.catalogservice	2021-03-24T10:17:51	W137	GalSim Universe Model Snapshot	2023-10-09T10:54:25
5	vs.catalogservice	2019-12-02T08:30:00	MNLIPASFOR201912	MNLIPAS FOR201912 Catalogue (December, 2019)	2023-09-20T06:30:00
6	vs.catalogservice	2019-12-02T08:30:00	MNLIPASFOR201912	MNLIPAS FOR201912 Catalogue (December, 2019)	2023-09-20T06:30:00
7	vs.catalogservice	2022-10-13T09:00:00	J-PLUS-DR3	J-PLUS DR3 Catalogue (July, 2022)	2023-09-20T06:30:00
8	vs.catalogservice	2022-10-13T09:00:00	J-PLUS-DR3	J-PLUS DR3 Catalogue (July, 2022)	2023-09-20T06:30:00
9	vs.catalogservice	2020-07-28T09:00:00	J-PLUS-DR2	J-PLUS DR2 Catalogue (July, 2020)	2023-09-20T06:30:00
10	vs.catalogservice	2020-07-28T09:00:00	J-PLUS-DR2	J-PLUS DR2 Catalogue (July, 2020)	2023-09-20T06:30:00
11	vs.catalogservice	2018-07-17T09:00:00	J-PLUS-DR1	J-PLUS DR1 Catalogue (July, 2018)	2023-09-20T06:30:00
12	vs.catalogservice	2018-07-17T09:00:00	J-PLUS-DR1	J-PLUS DR1 Catalogue (July, 2018)	2023-09-20T06:30:00
13	vs.service	2018-06-01T04:18:52	CSIRO HiPS	CSIRO HiPS Mirror Service	2018-06-01T04:18:52
14	vs.service	2018-06-05T09:18:24	CSIRO HiPS	CSIRO HiPS Mirror Service	2018-06-15T21:15:18
15	vs.service	2017-10-18T14:00:00	CDS hips slave	CDS imagecube HiPS service (slave server)	2017-10-20T13:00:00
16	vs.service	2017-10-18T14:00:00	CDS hips slave	CDS imagecube HiPS service (slave server)	2017-10-20T13:00:00
17	vs.service	2017-10-18T14:00:00	CDS hips master	CDS imagecube HiPS service (master server)	2017-10-20T13:00:00
18	vs.service	2017-10-18T14:00:00	CDS catalog HiPS	CDS catalog HiPS Service	2018-03-29T16:00:00
19	vs.catalogservice	2018-01-18T19:00:00	Planck HiPS	Planck HiPS Service	2023-04-25T11:30:47
20	vs.catalogservice	2014-04-15T08:59:00	allWISE color	allWISE color: Red (W4), Green (W2), Blue (W1), R6	2023-04-25T11:30:47
21	vs.catalogservice	2022-11-04T16:44:00	PLANCK R3 CMB	PLANCK R3 CMB	2023-04-25T11:30:47
22	vs.catalogservice	2020-03-04T07:22:00	THOR continuum 1950	THOR continuum 1950 linc survey collection	2023-04-25T11:30:47
23	vs.catalogservice	2016-02-09T15:40:00	ROSAT WFC F1	ROSAT Wide Field Camera F1 (15-27 Phz) survey col.	2023-04-25T11:30:47
24	vs.catalogservice	2012-04-23T15:02:00	2MASX K	2MASX K (z 16um) survey collection	2023-04-25T11:30:47
25	vs.catalogservice	2014-03-25T19:31:00	HST GOODS 2	GOODS 2 survey collection	2023-04-25T11:30:47
26	vs.catalogservice	2018-12-18T13:22:00	unWISE color-W2-W1W2-W1	unWISE color: from W2 and W1 bands survey collect.	2023-04-25T11:30:47
27	vs.catalogservice	2023-01-30T07:57:00	DM simbad-biblio-pub-dates 1995	Simbad heatmap - 1995 survey collection	2023-04-25T11:30:46
28	vs.catalogservice	2015-02-08T12:38:00	HST PHAT F475W	HST PHAT F475W - ACS/WFC survey collection	2023-04-25T11:30:46
29	vs.catalogservice	2011-07-05T08:45:00	SPITZER IRAC4	IRAC4 survey in HiPSa survey collection	2023-04-25T11:30:47
30	vs.catalogservice	2018-11-25T18:05:00	HST I8	HST I8 includes the following filters: F430W, F438W	2023-04-25T11:30:46
31	vs.catalogservice	2020-05-03T09:23:00	THOR continuum 1950	THOR continuum 1950 linc survey collection	2023-04-25T11:30:47
32	vs.catalogservice	2023-01-30T08:04:00	DM simbad-biblio-pub-dates 2018	Simbad heatmap - 2018 survey collection	2023-04-25T11:30:46
33	vs.catalogservice	2018-11-05T20:21:00	HST I7W	HST I7W includes the following filters: F127W survey C.	2023-04-25T11:30:46
34	vs.catalogservice	2022-10-26T13:18:00	PLANCK R3 LF144	PLANCK R3 frequency LF1 map 44 GHz survey collect.	2023-04-25T11:30:47
35	vs.catalogservice	2023-01-30T08:02:00	DM simbad-biblio-pub-dates 2012	Simbad heatmap - 2012 survey collection	2023-04-25T11:30:46
4					

- Actual alternative:
 - => **CDS HiPS list agregator**
 - <https://aladin.cds.unistra.fr/hips/list>
 - http://alasky.cds.unistra.fr/MocServer/query?hips_service_url=*&get=record
- But still (mis)use observed:
 - => direct access to a unique big HiPS node (alasky.cds.unistra.fr)
 - <https://alasky.cds.unistra.fr/hipslist>

□ HiPS network evolution

- **Growth speed**: Usage: x2 in 2 years - Size: x2 in 4 years
- Number of **clients** : exploding (Aladin Lite, Stellarium, ...)
- Number of **servers** : stable, but...
 - A little bit Europe centric
 - The HiPS node project in South Africa seems dormant (no news)
 - HiPS cadanian nodes to be recommissioned (down for months)

=> A robust HiPS node on North and/or South America would be welcome



□ HiPS synchronisation

3 methods available today for copying/synchronizing HiPS:

- Via regular copy (rsync, ...) (*)
 - Via HTTP copy (wget, curl, ...) (*)
 - Via dedicated tools :
 - CDS: java code (*P. Fernique*) => dedicated to image and cube HiPS
=> Aladin/**Hipsgen MIRROR**
- ⇒ Regular use (1x per year?) of Hipsgen MIRROR would be highly desirable (updates HiPS and/or properties if required)
- ⇒ Automatic warning system to alert HiPS managers in case of out of date mirror?

(*) + manual properties file update (master-> mirror)

□ HiPS 3D for future cube surveys

Several ideas are “on the desk”:

- Managing **cubic tiles** => prototype ready - T.Boch
- Optimizing tile size:
 - **Removing unobserved areas**
=> available in Hipsgen/Aladin - P.Fernique (-trim option)
=> only supported by Aladin Desktop client
 - Using **FITS compression**
=> Rice reduces FITS tiles by a factor of 3 to 4 => study in progress - T.Boch
=> But significant compression time + much slower random pixel access
 - Studying **video-codec tiles** => not tested
- Considering **non-spatial resampled HiPS** => not tested
=> dedicated to a single observation



Questions ? Remarks ? Ideas ?