

# HiPS 3D implementation in Aladin Lite

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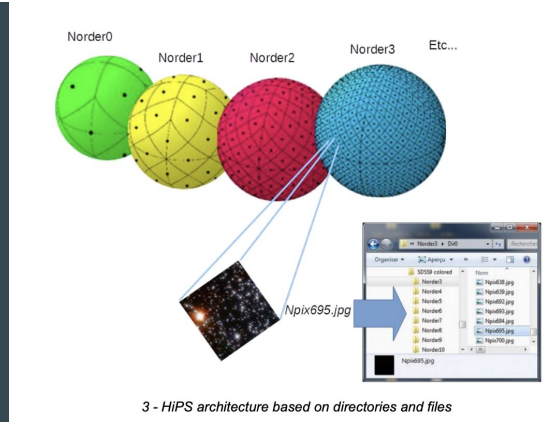
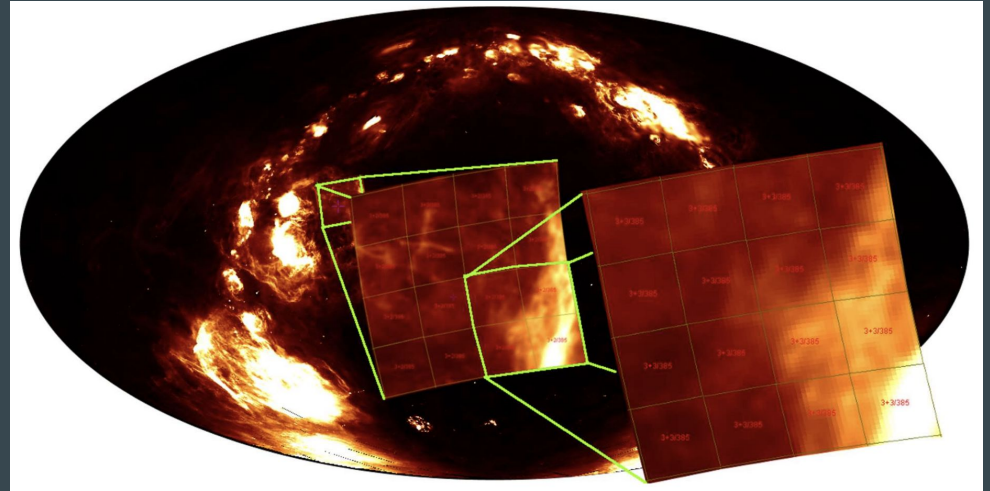
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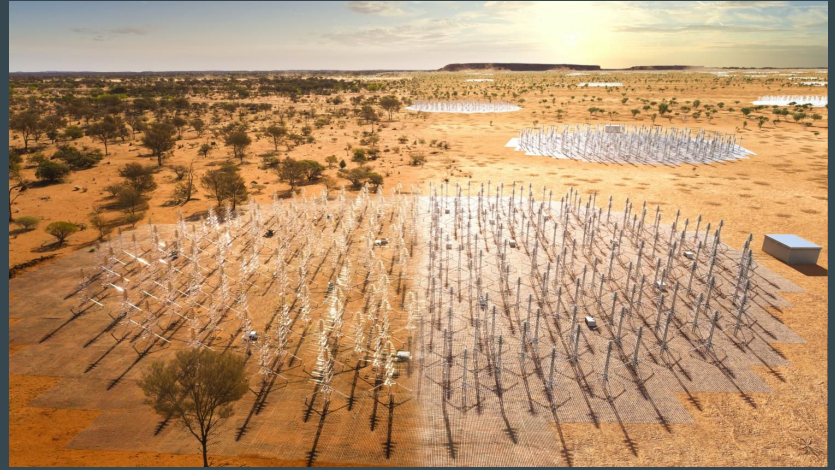
# 1. What is a HiPS (Hierarchical Progressive Survey) ?

- IVOA standard since 2017
- Based on HEALpix resampling
- Makes a sky survey **accessible**, **visualizable** and even manipulable, whatever the size of the survey, the quality of the network and the computing power available to the astronomer.
- A response to the big data challenge
- Implemented by several scientific, amateur and public visualization tools: Aladin, hips2fits, ESAsky, ESO portal, WWT, Firefly, DIGISTAR, RSACosmos, Stellarium...



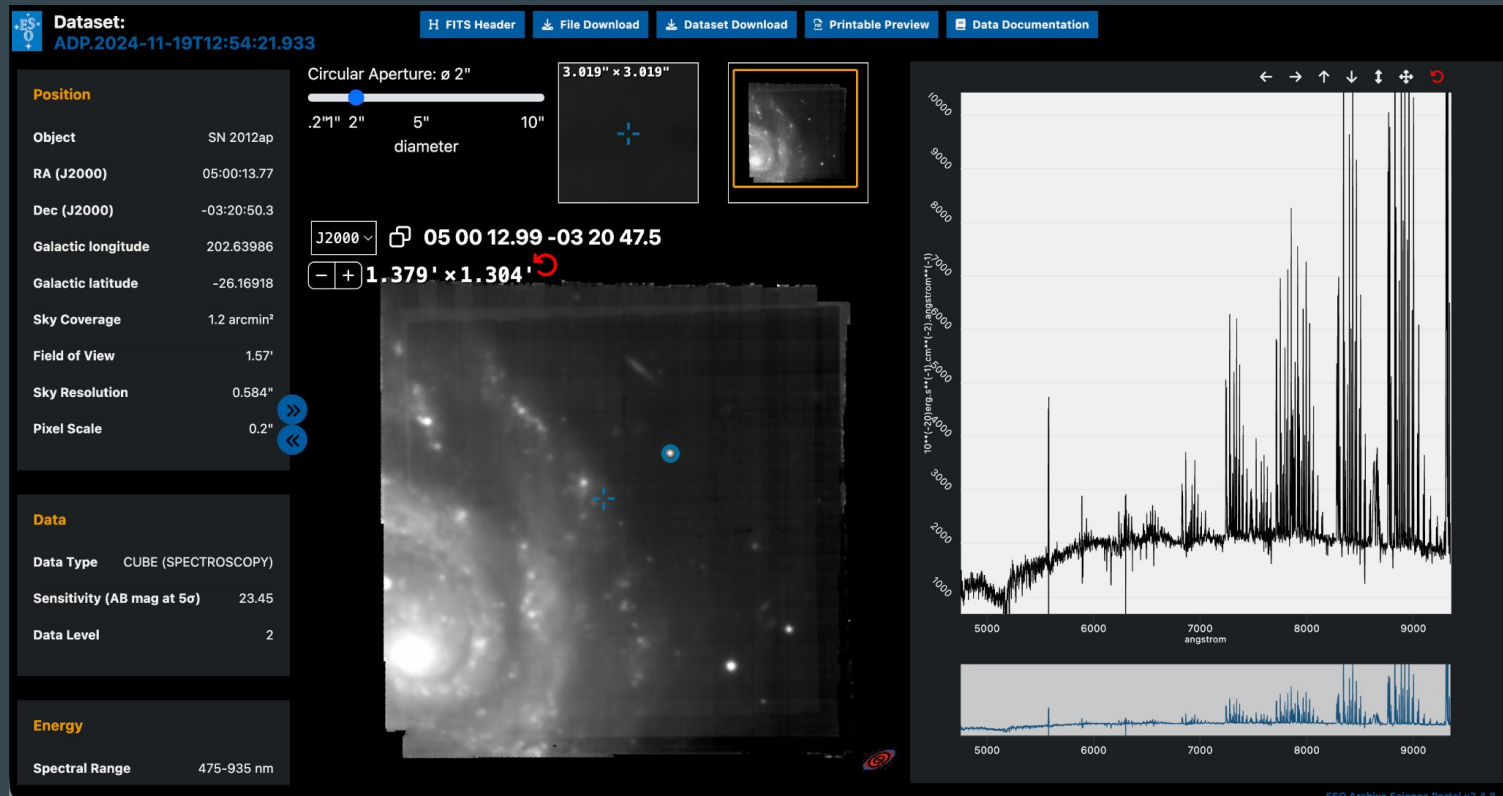
# New challenging surveys

- More and more already existing cubic data/surveys: MUSE, ASKAP
- SKA low/mid about to release in the years to come **PBs** of spectral cube data



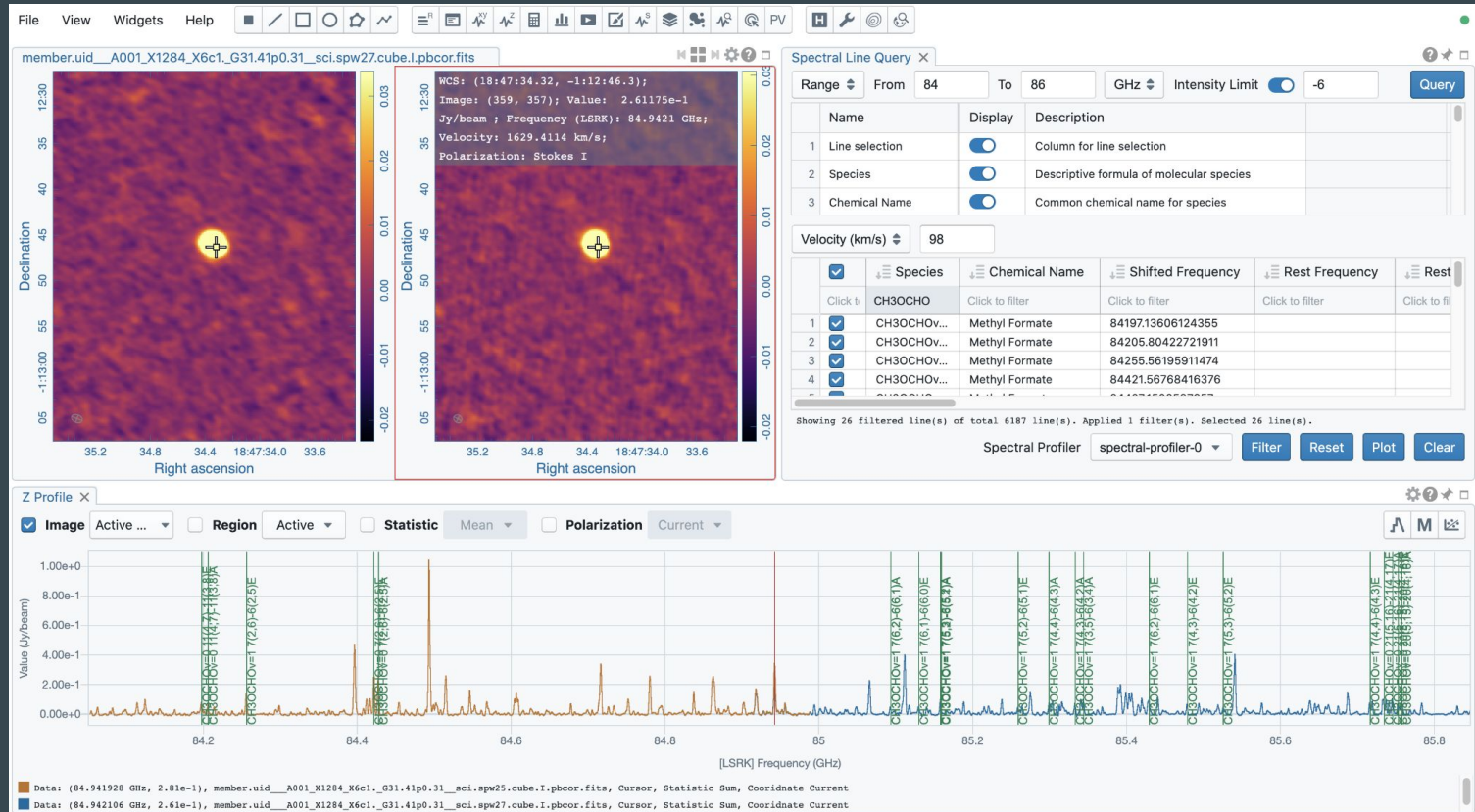
# How to visualize such a large amount of data ?

- Drill into the cube to get a spectra



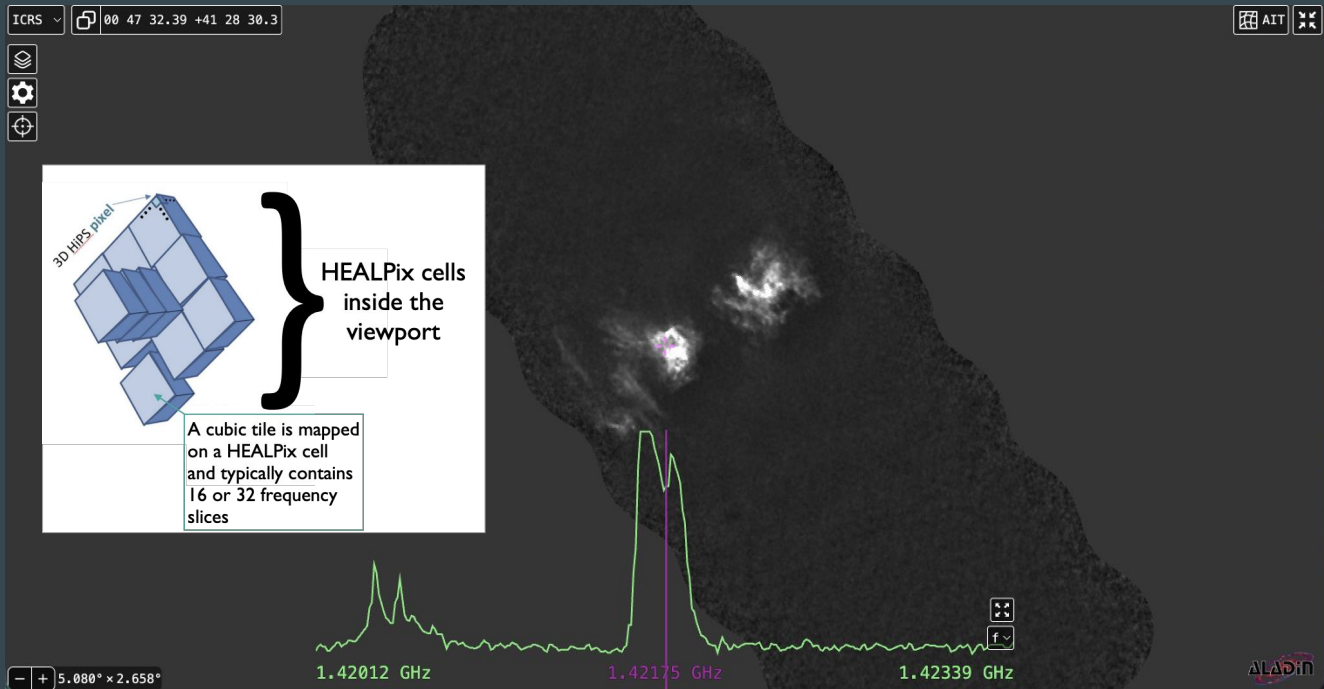
# How to visualize such a large amount of data ?

- Display frequency slice images



## 2. HiPS 3D extension proposal (see Pierre's ADASS talk)

- The memory layout has to be adapted for your use case!
- Extension of HiPS: enables navigation inside spectral “cubes” multiples observations
- Support navigation into both dimensions:
  - Spatial dimensions (As in classical HiPS)
  - Frequency space (New feature!)
- Independant from the size of your original data



# 3. Live demo

- Follow this tutorial for exploring HiPS3D datasets:  
<https://aladin.cds.unistra.fr/java/TutoHiPS3Den.pdf>

## Other available HiPS3D:

### GalfaHI full survey

<https://alasky.cds.unistra.fr/HIPS3D/GalfaHI>

### SKA Data Challenge 2

<https://alasky.cds.unistra.fr/HIPS3D/SKADC2>

### MUSE test 2800 fields

<https://alasky.cds.unistra.fr/HIPS3D/MUSE-test>

### LGLBSHI: The Local Group L-Band Survey

<https://alasky.cds.unistra.fr/HIPS3D/LGLBSHI16>

### DHIGLS: DRAO H I Intermediate Galactic Latitude Survey

<https://alasky.cds.unistra.fr/HIPS3D/DHIGLS>

Explore some HiPS3D yourself:

- [GALFAH1](#)
- [M31](#)
- [MUSE](#)

## 4. Insights on the HiPS3D time generation/volume

Worst case, no overlapping of input data, no sub sampling:

- HiPS2D: 4 pixels merged into 1  $\rightarrow$   $\sim$ x1.3 (30% more) for the whole pyramid (HiPS + original data)
- HiPS3D: 8 voxels merged into 1  $\rightarrow$   **$\sim$ x1.15 (15% more, only)** for the original data + HiPS.

## 4. Insights on the HiPS3D time generation/volume

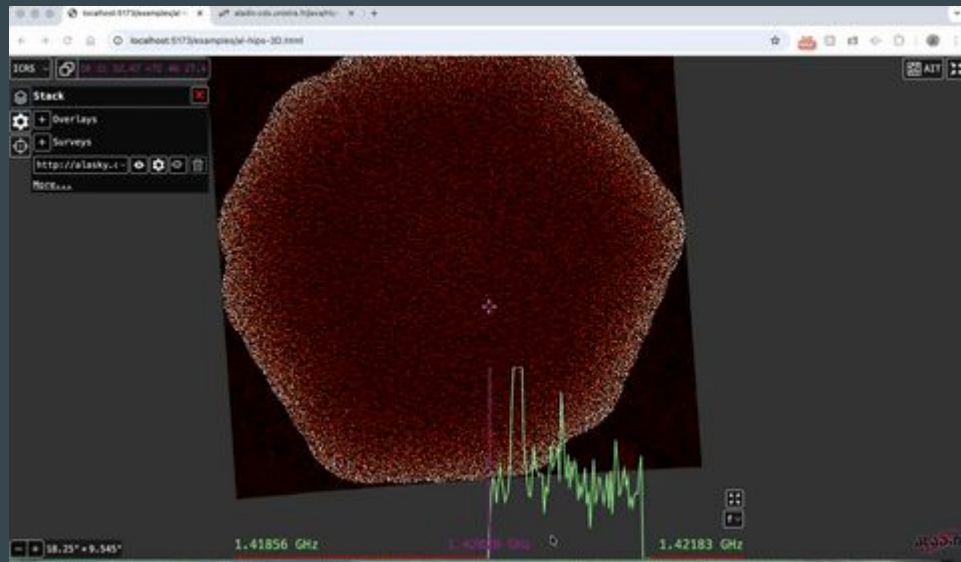
Input data	HiPS processing	Nb. files / tiles	Generation time	Final volume
ALMA MUSE cube samples (88 cubes, 675 GB)	HiPS3D FITS (256×256×32)	10,060	53 min (64 threads, NFS)	28.3 GB (/20)
	HiPS3D PNG (256×256×32)	10,060	+ 1 min 21 s	3.3 GB
GALFAHI (225 cubes, 225 GB)	HiPS3D FITS (trim)	140,502	32 min 5 s	250 GB
	HiPS3D PNG (checkerboard)	140,502	+ 2 min 48 s	7.8 GB
	HiPS3D JPEG (checkerboard)	140,502	+ 1 min 25 s	4.2 GB

**Reality:** less volume due to overlapping of cubes, subsampling

# 4. HiPS3D use of compression techniques

Several ideas has been explored (cf work done by Thomas Boch and Pierre Fernique, CDS).

- WebP compression: PNG tiles compressed with *convert* (-quality 98 -define webp:method=6). Size reduced from **3 GB** → **1.3 GB** with no visible quality loss.  
*Already supported*
- RICE compression: FITS tiles compressed with *fpack* (default options). Size reduced from **13 GB** → **2.9 GB**.  
*Soon to be implemented*



DHIGLS: DRAO H I Intermediate Galactic Latitude Survey converted into a HiPS3D

# Creating a HiPS3D from your own data!

**HiPSgen** (included with *Aladin Desktop*) lets you generate HiPS3Ds directly.

## Command example:

```
java -Xmx2G -jar AladinBeta.jar -hipsgen -hips3D \  
  in=YourCube.fits out=YourHips3D id=AUTH/C/xxx INDEX TILES PNG
```

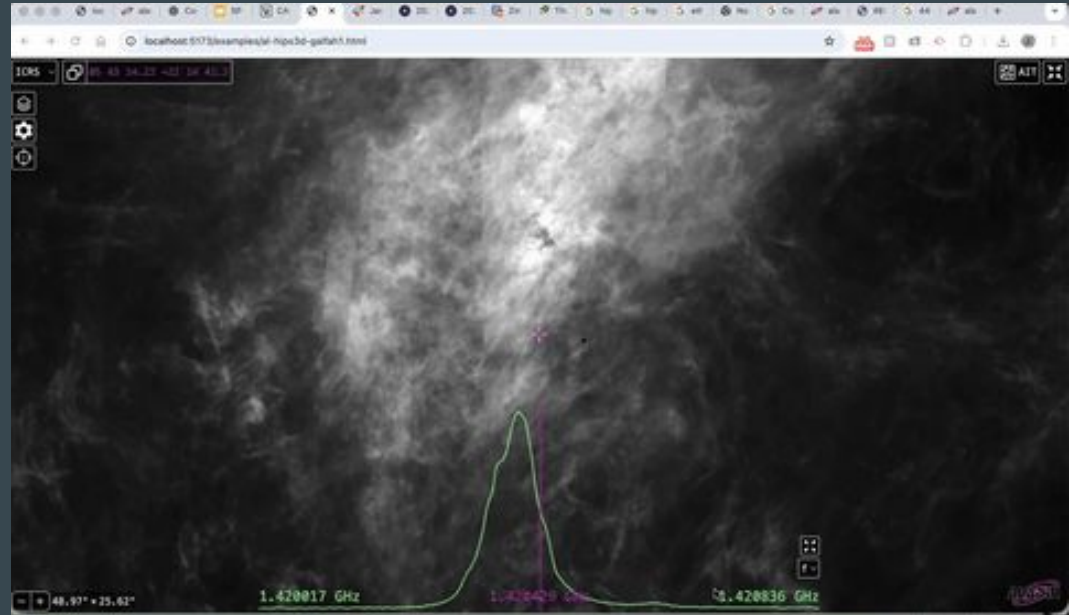
## Key options:

- `YourCube.fits` → FITS cube (or directory of cubes) with spatial & frequency calibration
- `YourHips3D` → output directory for the HiPS3D product
- `AUTH/C/xxx` → identifier of your choice
- `INDEX TILES PNG` → actions to build HiPS3D with FITS + PNG tiles
- `-hips3D` → enables HiPS3D generation
- `-Xmx2G` → reserves 2 GB RAM

More options (resolution, overlays, etc.): [HiPSgen Manual](#)

# Conclusion & next steps:

- HiPS3D impl in Aladin Lite: a way to render sized-agnostic spectral cubes
- Future ideas to implement:
  - **Zoom in/out** in the **spectra** independently from the spatial zoom level
  - Extract a **full resolution spectra** at a coordinate/cone
  - **Display** the image of a **thick bandwidth** (not one slice only)
  - **Compose many spectral slices/band** to make a color rendering



# Thank you!

- Looking for feedback:
  - Try our tutorial: <https://aladin.cds.unistra.fr/java/TutoHiPS3Den.pdf>
  - Try our examples:
    - [GALFAH1](#)
    - [M31](#)
    - [MUSE](#)
- Contacts:
  - GitHub: <https://github.com/cds-astro/aladin-lite>
  - email: [cds-question@astro.unistra.fr](mailto:cds-question@astro.unistra.fr)



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