# Handling ALMA data

Philippe Salomé (LERMA, Observatoire de Paris)

Credits : F. Stoer (ESO - ALMA Archive), ALMA European Science Portal, M. Massardi (Italian ARC-node) talks…

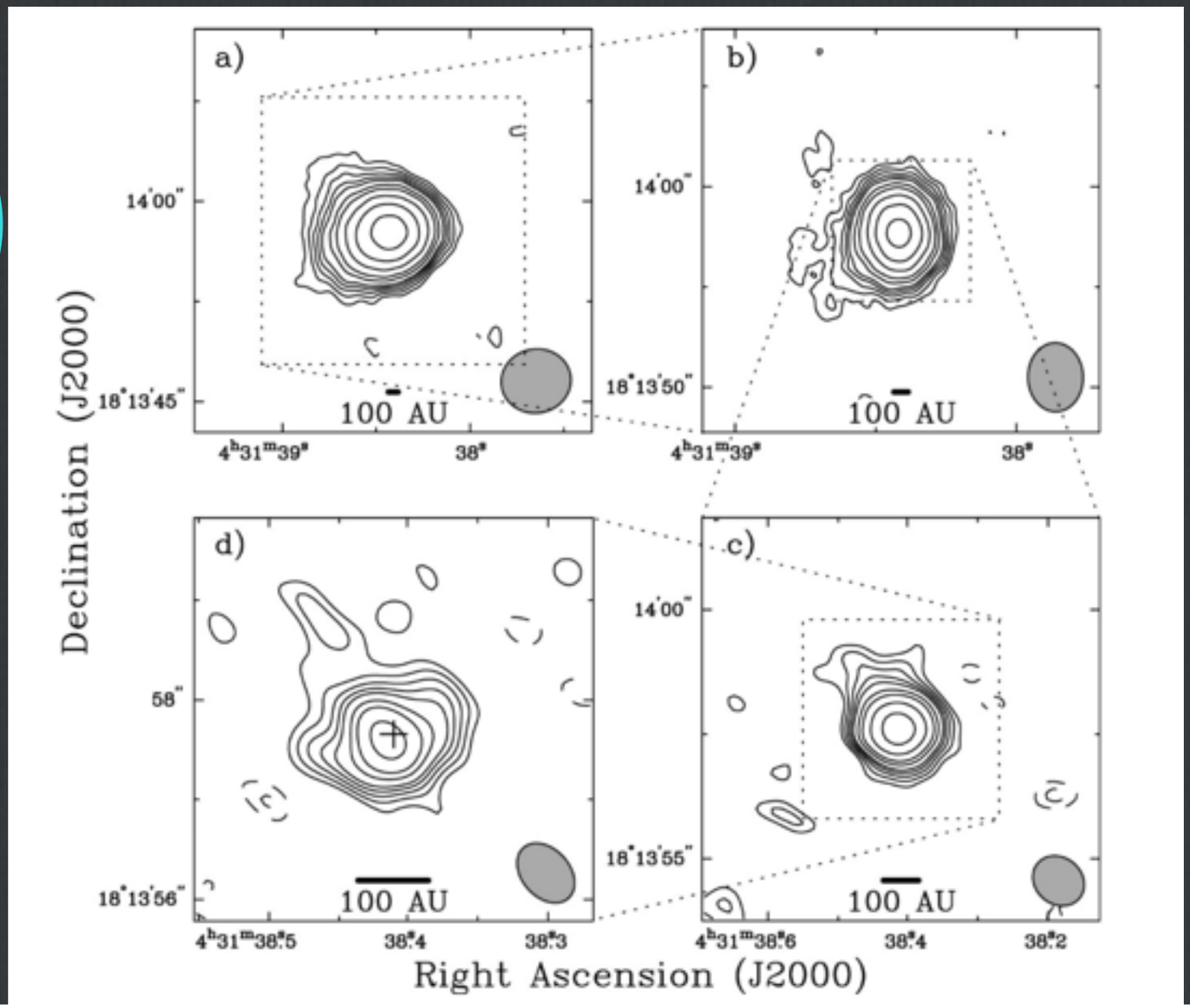
***Paris Workshop - MIS - ALMA/NOEMA/Herschel - CTA synergies***
***30/09/2015***

# « ALMA as a high spatial resolution instrument »

- First large baseline campaign -

# HL Tau

## A planet-forming disc around a young star



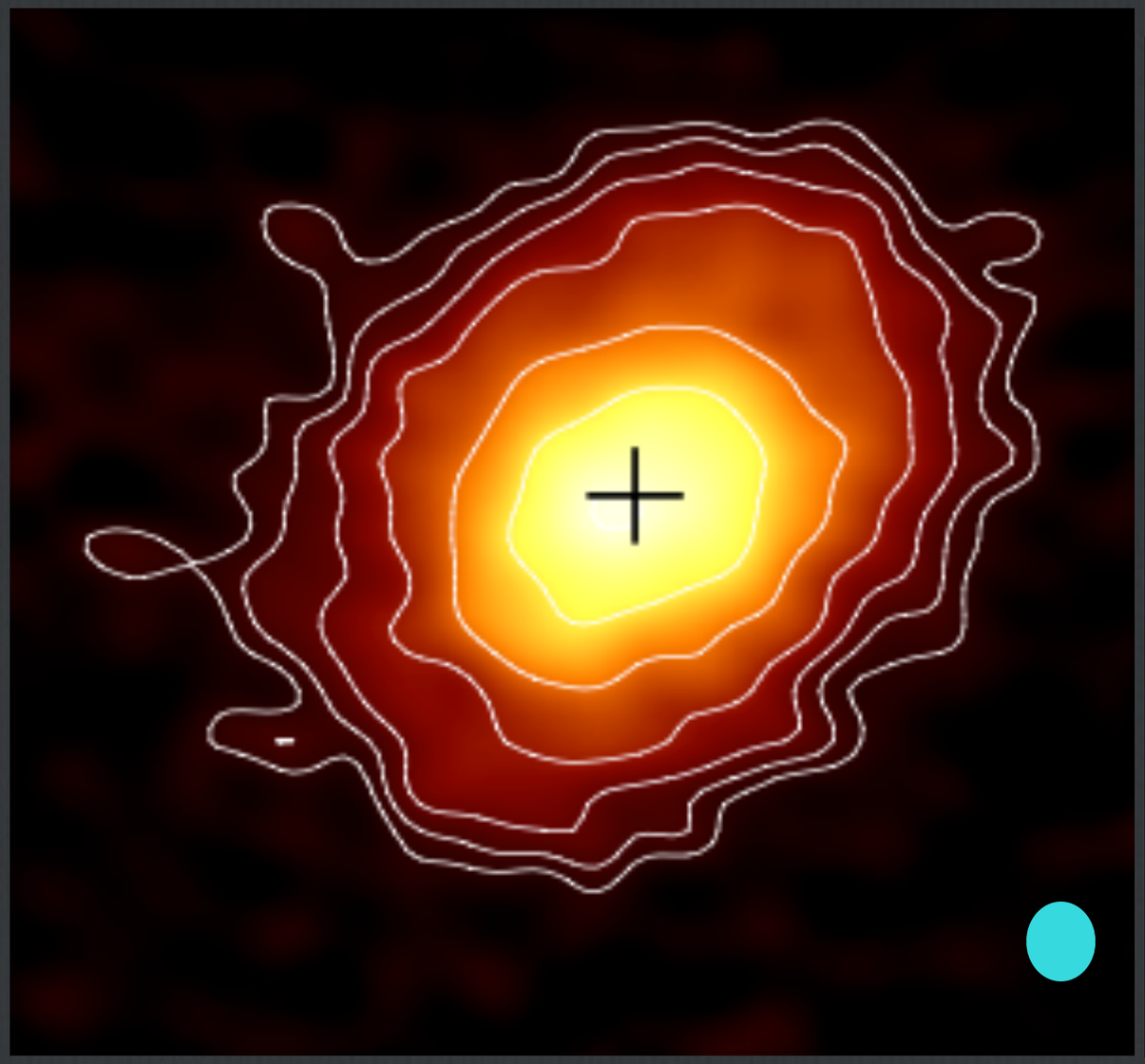

Looney et al (2000)

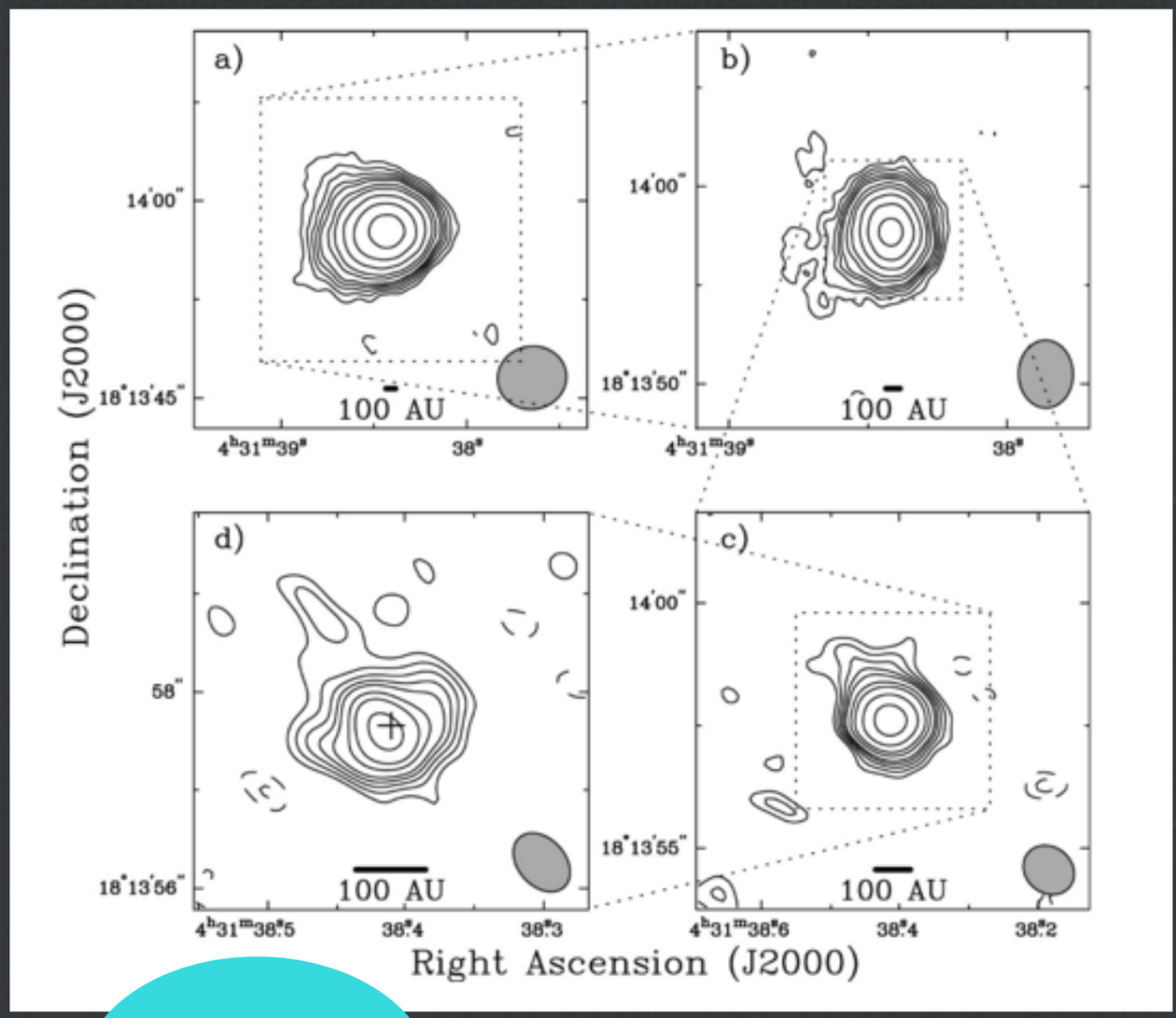
BIMA observations

FIG. 4.—HL Tauri maps of the $\lambda = 2.7$ mm continuum emission. All panels are contoured in steps of $(-4, -3, -2, 2, 3, 4, 5, 6, 8, 10, 14.14, 20, 28.28)$ times an rms noise of 2.9 mJy beam$^{-1}$. (*a*) $\sigma = 1.7$ mJy beam$^{-1}$; beam is $5''.31 \times 4''.79$ P.A. $= -81°$. (*b*) $\sigma = 1.7$ mJy beam$^{-1}$; beam is $3''.43 \times 2''.79$ P.A. $= 1°$. (*c*) $\sigma = 2.4$ mJy beam$^{-1}$; beam is $1''.11 \times 0''.94$ P.A. $= 53°$. (*d*) $\sigma = 2.9$ mJy beam$^{-1}$; beam is $0''.68 \times 0''.48$ P.A. $= 43°$. The cross in panel (*d*) is the $\lambda = 3.6$ cm peak from Rodríguez et al. 1994.

# HL Tau

## A planet-forming disc around a young star

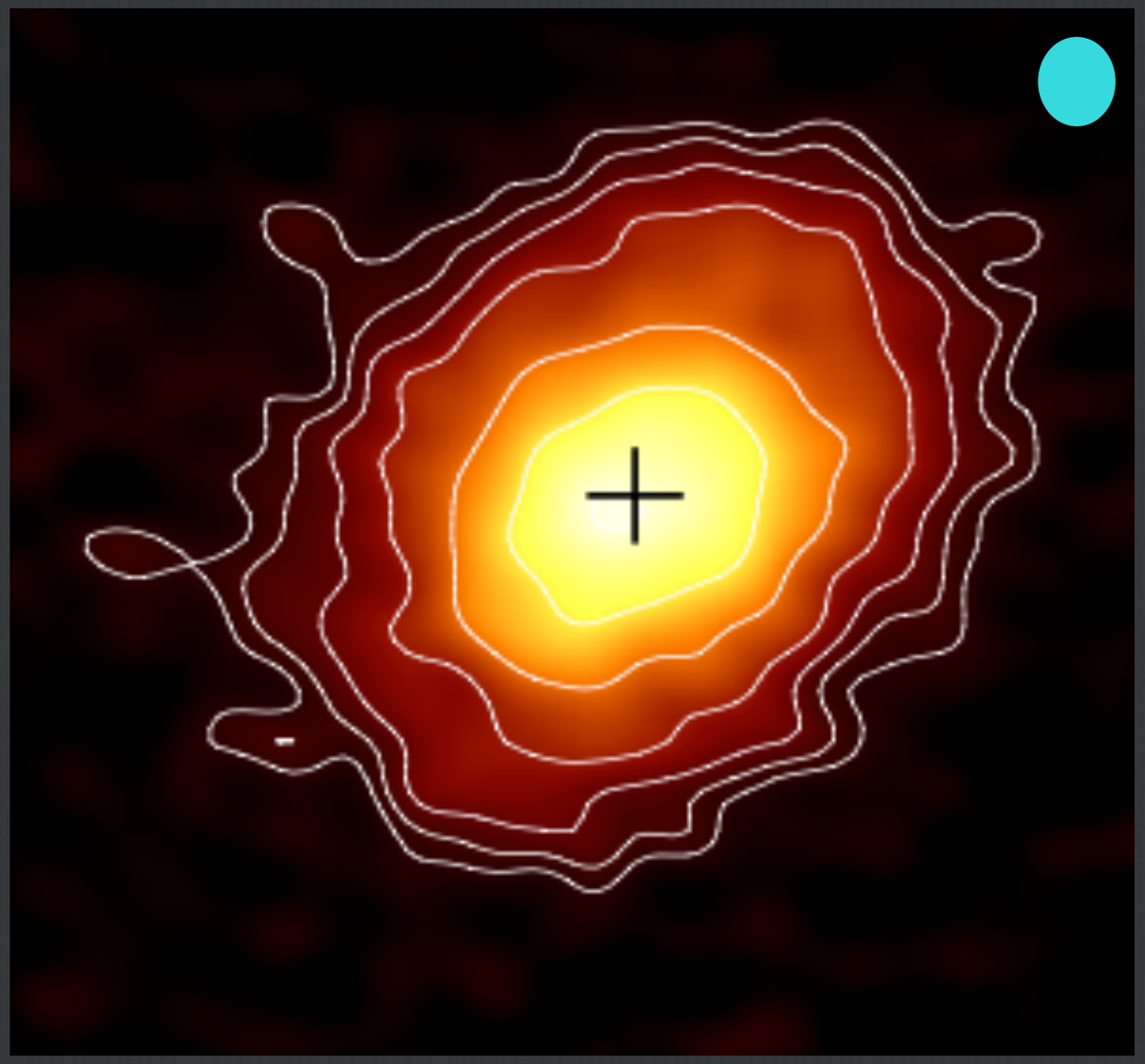




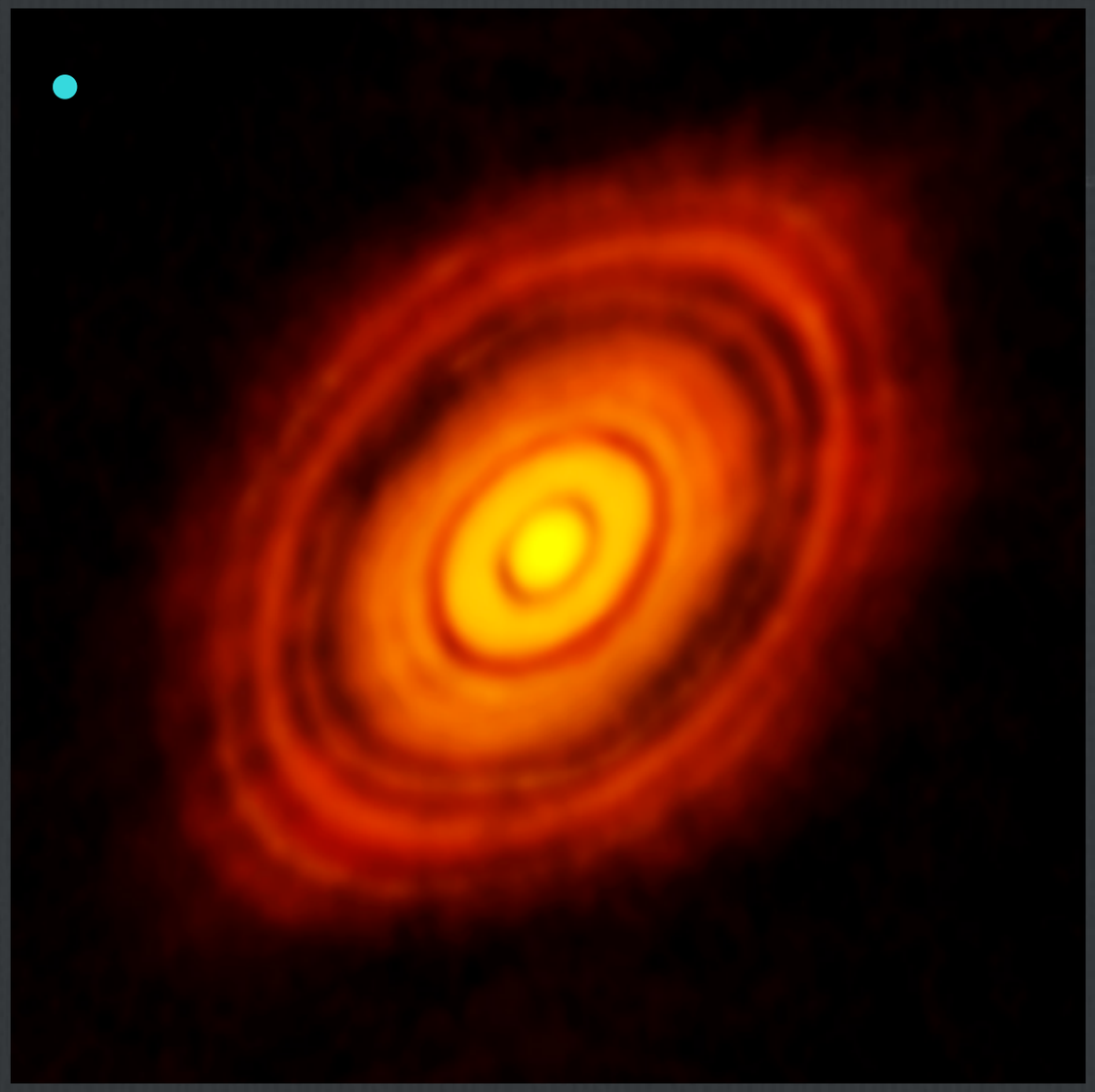

CARMA 2011: A,B,C configuration @ 230 GHz
—> 130 milli-arcsec. Kwon et al (2011)

# HL Tau

## A planet-forming disc around a young star

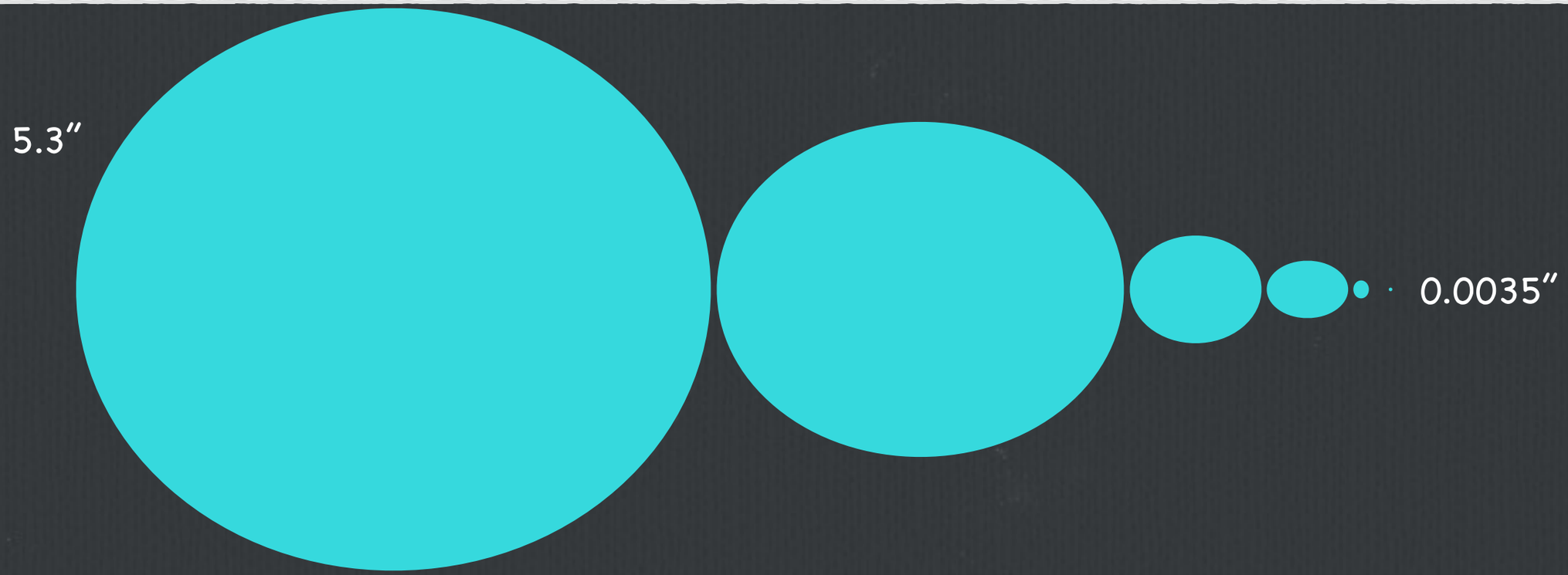


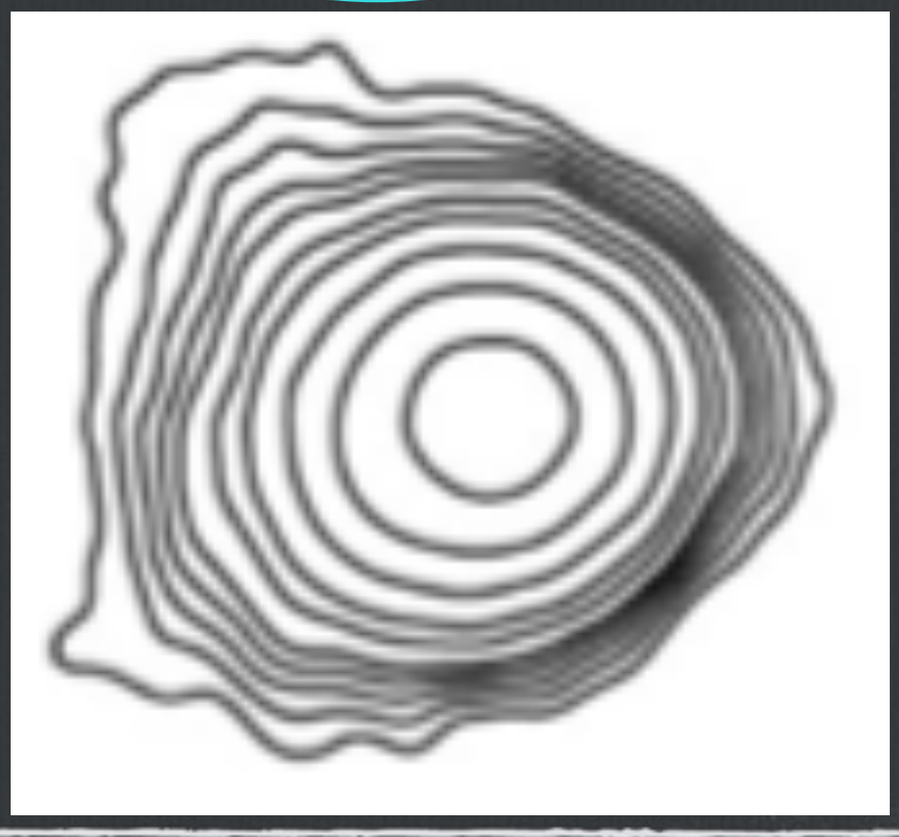
CARMA 2011: A,B,C configuration @ 230 GHz
—> 130 milli-arcsec. Kwon et al (2011)

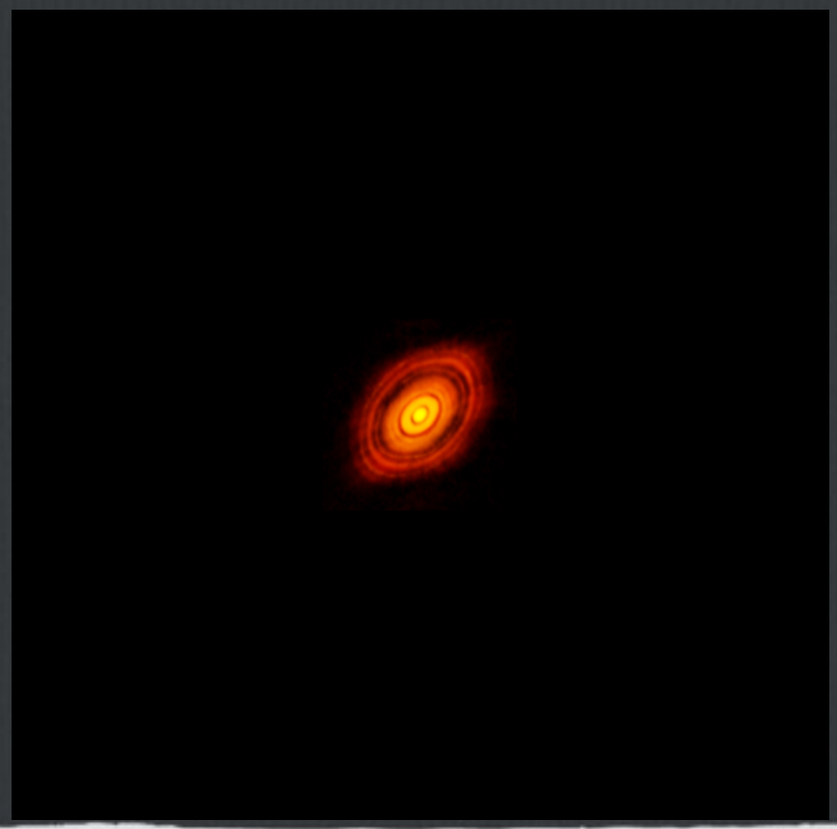


ALMA 2014: 15 km-baseline @ 233 GHz 4.5 hours —>35 milli-arcsec

# HL Tau





# HL Tau

Good imaging capability needs :

- if necessary : spatial resolution (and good weather)
- uv-coverage (sampling of the equivalent larger telescope area by the collection of smaller apertures)
- sensitivity

# Data and publications

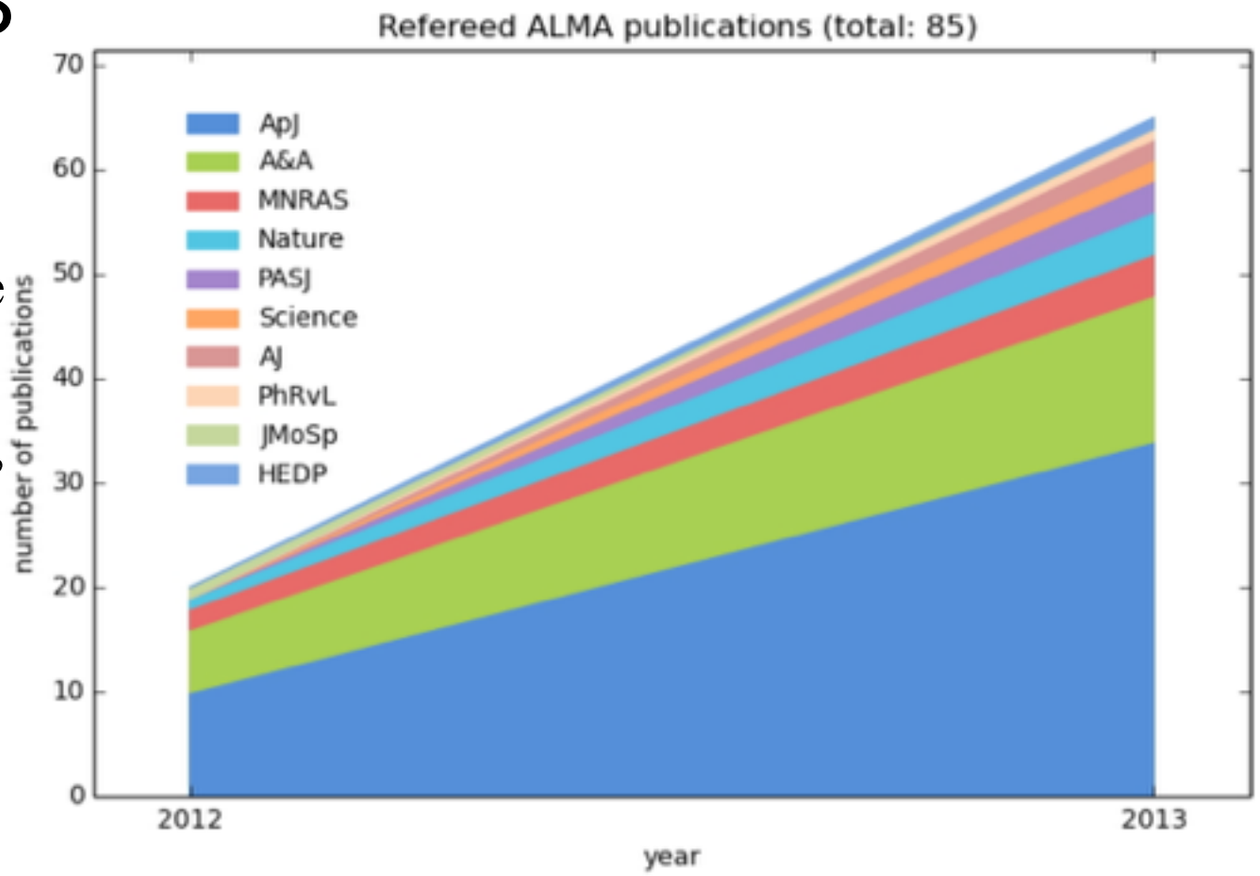
**Proprietary :**

- Once data have been taken, they are made available to the PI
- A proprietary period of 12 months is applied, starting at the time when data is delivered to the PI
- Director's Discretionary Time project : 6 months

**By the end of 2013 :**

- 85 refereed papers were published using ALMA data (2012: 20; 2013: 65).
- ALMA publications typically experience a delay of less than a year.
- The fraction of published data is around 70%.
- Fraction of papers appeared in *ApJ* (almost 52%), *A&A* (approx. 24%) and *MNRAS* (more than 7%). High number of publications (8%) have been published in the high-impact journals *Nature* and *Science*

**Meakins et al. (2014)**



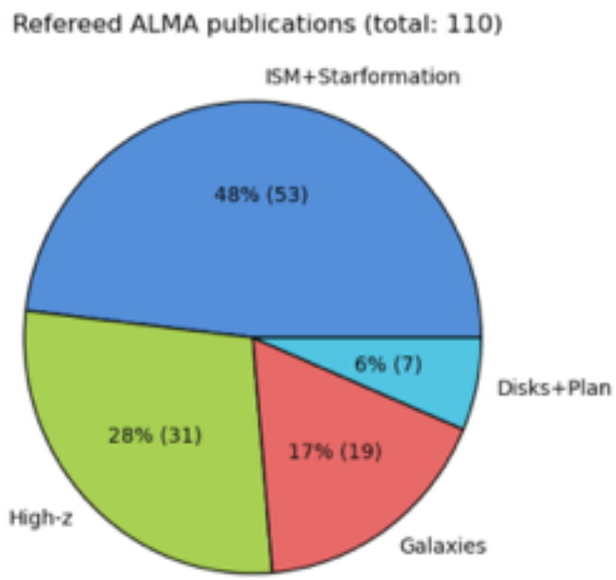



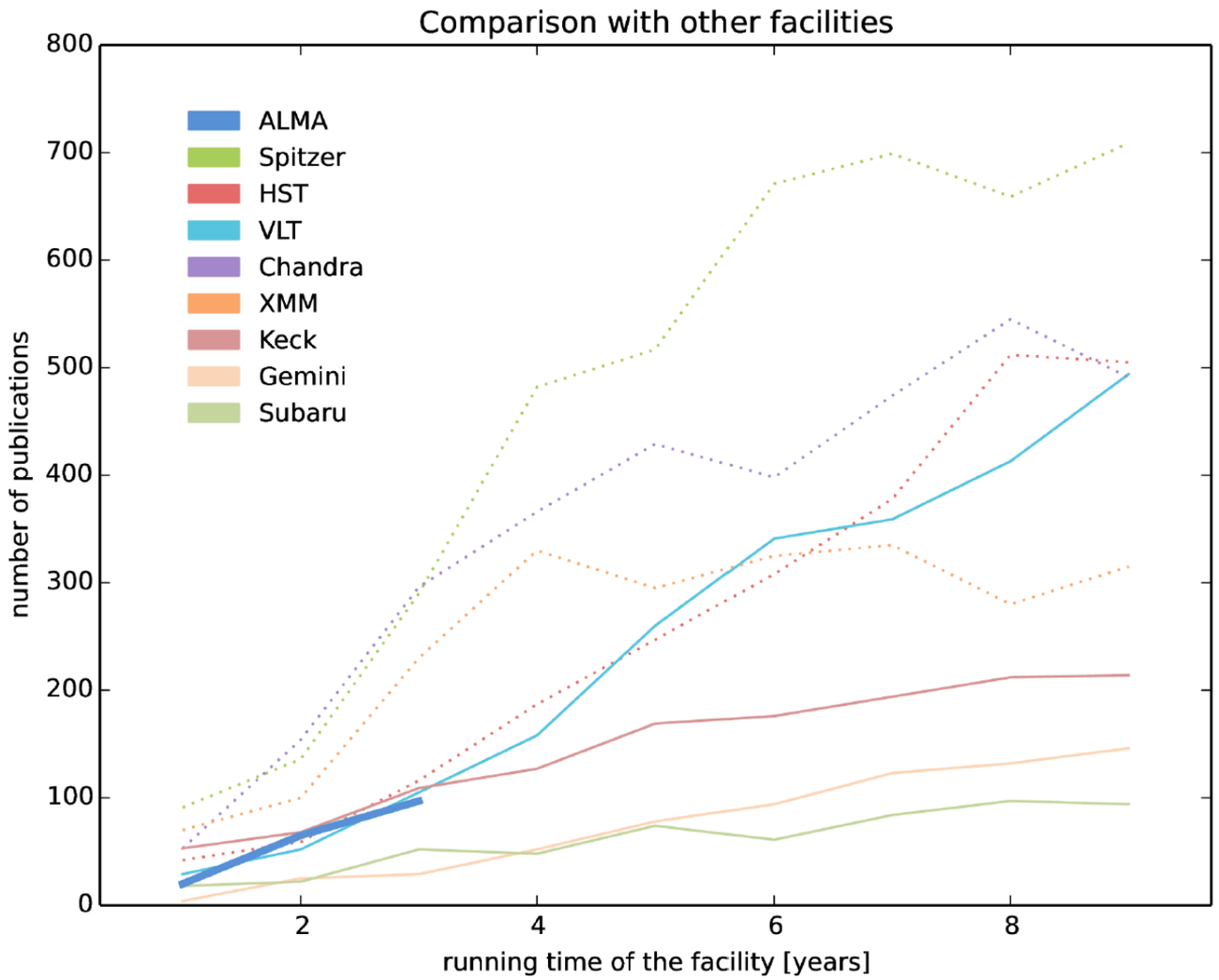

Figure 3. Number of papers by scientific category of the data they used. Publication years: 2012 – Apr 2014. See text for an explanation of the categories.

# The ALMA Archive
# https://almascience.eso.org/alma-data/archive

About 1/3 of the ALMA referred publications made use of ALMA archive data

Use of archival data is Increasing for science cases

It is useful to check before proposing!



# The ALMA Archive

## Articles & Publications

ESO Telescope Bibliography

REFINE

Results **1 - 25** of **280** found for
instrument:ALMA_Bands

« Previous Next »

| YEAR ▼ | AUTHOR | TITLE | INSTRUMENTS | ACCESS TO DATA | FULLTEXT ADS |
|---|---|---|---|---|---|
| 2015 | Viikinkoski, M. et al. | VLT/SPHERE- and ALMA-based shape reconstruction of asteroid (3) Juno | ***ALMA_Bands***, NACO, SPHERE | 086.C-0785, 2011.0.00013.SV, 60.A-9379 | 2015A&A...581L...3V |
| 2015 | Öberg, Karin I. et al. | Double DCO+ Rings Reveal CO Ice Desorption in the Outer Disk Around IM Lup | ***ALMA_Bands*** | 2013.1.00226.S | 2015ApJ...810..112O |
| 2015 | Tadaki, Ken-ichi et al. | SXDF-ALMA 1.5 arcmin2 Deep Survey: A Compact Dusty Star-forming | ***ALMA_Bands*** | 2012.1.00756.S | 2015ApJ...811L...3T |

# Intro thoughts

- Example of the **HST** archive where the total number of **archival papers even outnumbers the PI papers**
- Larger data rates of individual observatories, AND multi-wavelength science. Astronomers have **"less time" for the analysis of data of a given wavelength range**.
- Very large data size : **visual inspection is impossible** for future facilities
- « Future **observatories will compete for astronomers to work with their data** that observatories will have to reorient themselves from providing good data only to providing an excellent end-to-end user-experience » F. Stoer et al. (2015) arXiv:1504.07354

**—> Need of Data Mining Tools ( + analysis)**

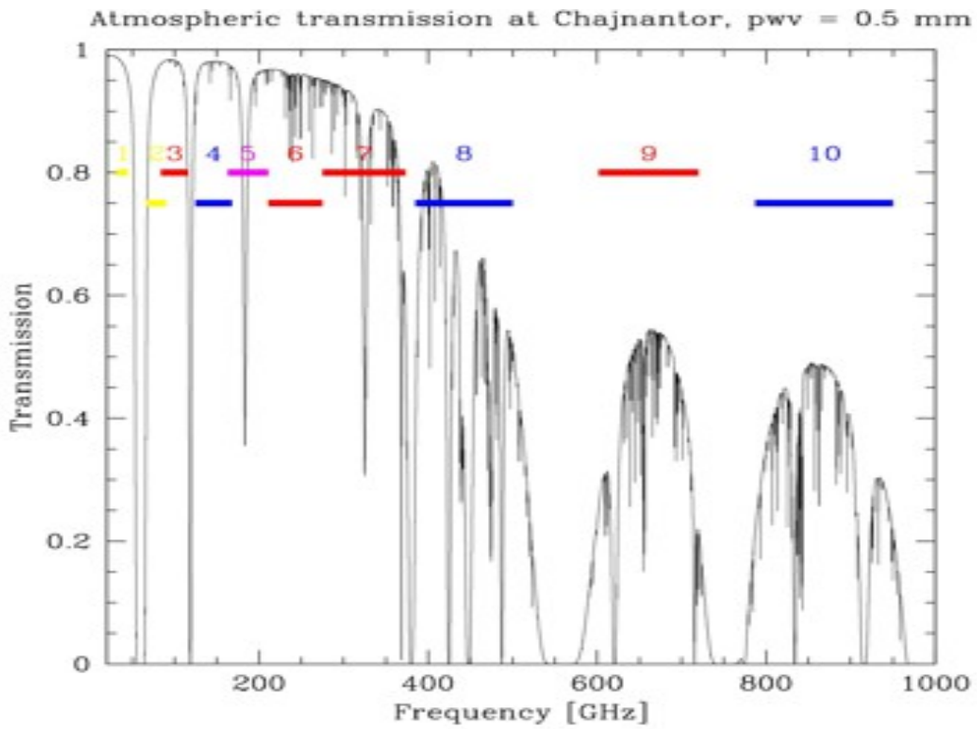
- The ALMA Archive is designed to manage the **200 TB of data that will be taken each year** (full operations) with short-term peak data-rates of ten times as much
- Typical project size **~200 Go. But ~To** with data reduction products, i.e. need of temporary large disk space
- Operating for 30 to 50 years will have to follow the general hardware evolution. Over such large timescales, **scalability and flexibility in hardware and software** solutions are mandatory

# ALMA full array

The Atacama Large Millimeter Array is a **mm-submm reconfigurable interferometer**

Inaugurated in March 2013 on the Chajinantor plain (**5000m**, Chile)

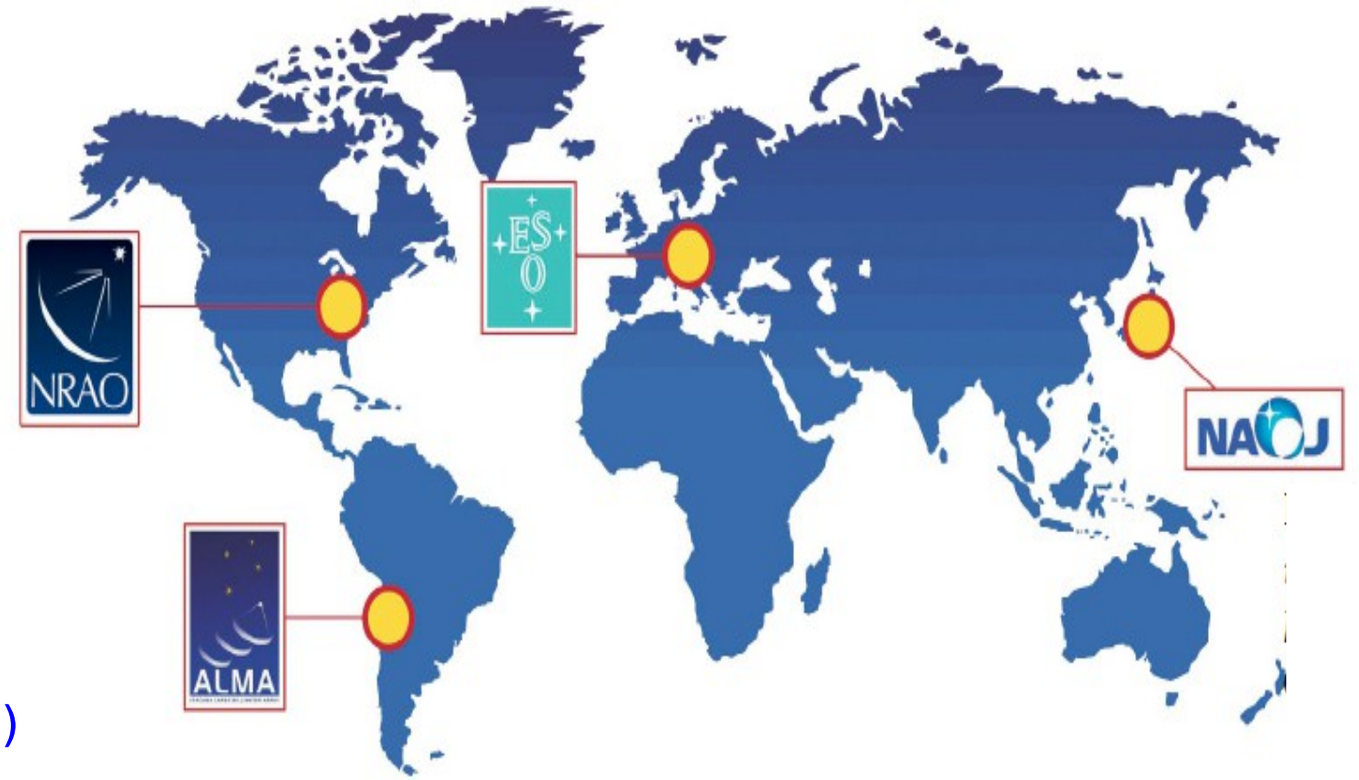
- Frequency range: **10 bands between 30-900 GHz** (0.3-10 mm)
- Antennas: **50x12m** main array + **12x7m** ACA **+ 4x12m** Total Power
- Baselines length: **15m ->150m-16km** + **9m->50m**
- Bandwidth: **2 GHz x 4 basebands**
- Polarimetry: Full Stokes capability
- Angular Resolution: **0.2" x (300/freq_GHz)x(1km/max_baseline)**
  40 mas @ 100 GHz, 5 mas @ 950 GHz
- Velocity resolution: **As narrow as 0.008 × (Freq/300GHz) km/s**
  ~0.003 km/s @ 100 GHz, ~0.03 km/s @ 950 GHz
- High instantaneous imaging capabilities & setup flexibility

# ALMA organization

## World wide collaboration

- Europe: **ESO** (33.75%)
- North America: **NRAO** (33.75%)
- East Asia: **NAOJ** (22.5%)
- Chile (10%)

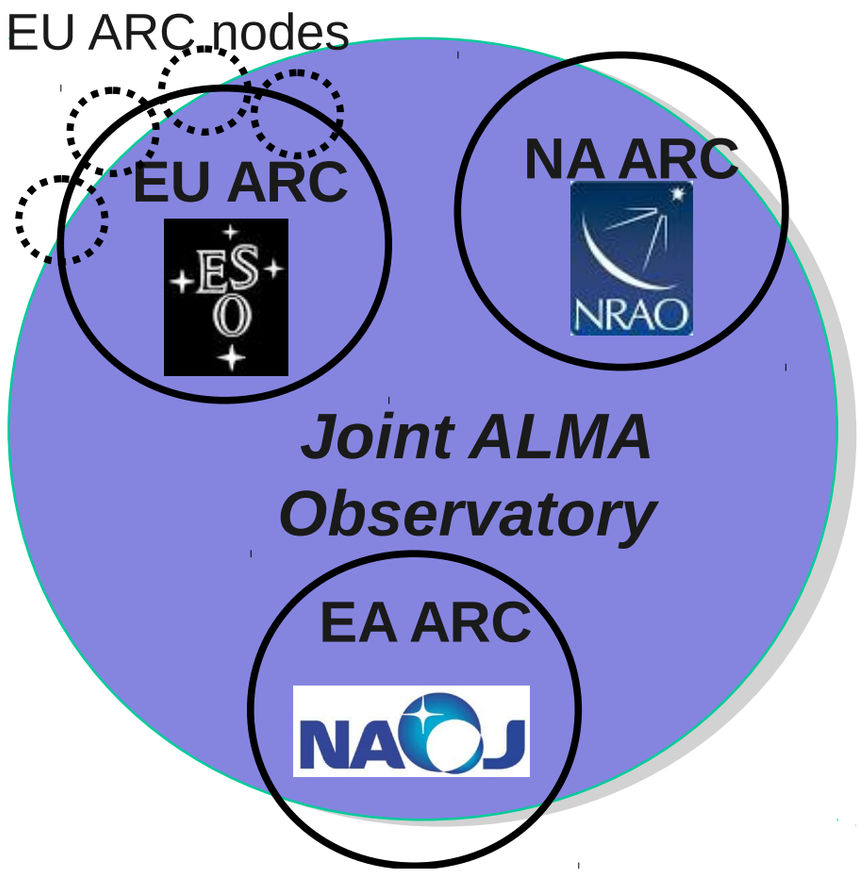



**Contributors share the observing time**

**PI affiliation defines the time share on which the project is executed**
(Chilean have additional rules from Cycle 3 on)

## Joint ALMA Observatory

- Execution of observations
- Array operations
- Scheduling of projects
- Data quality assurance and trend analysis
- Calibration plan maintenance
- Delivery of data to the archives
- Archive operations
- Pipeline operations

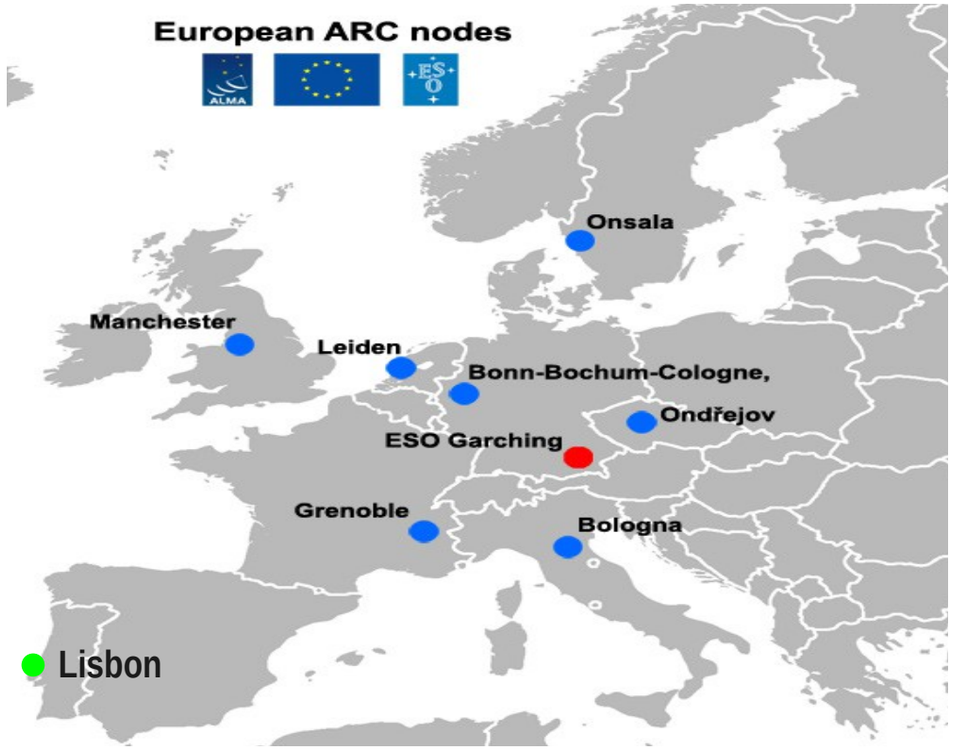


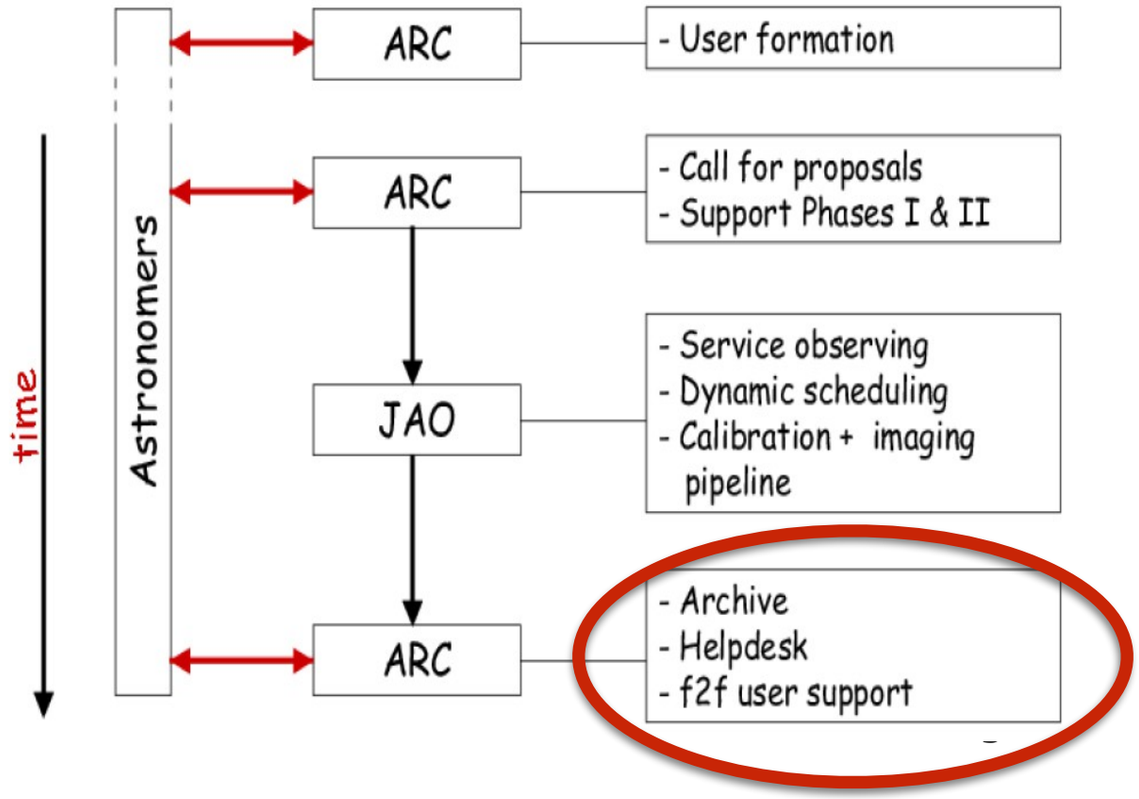

## ALMA Regional Centres

- User interface
- User support (via helpdesk and f2f)
- Data delivery to the PIs
- Mirror archive operations
- Software tools
- Astronomers on duty
- Data quality assurance

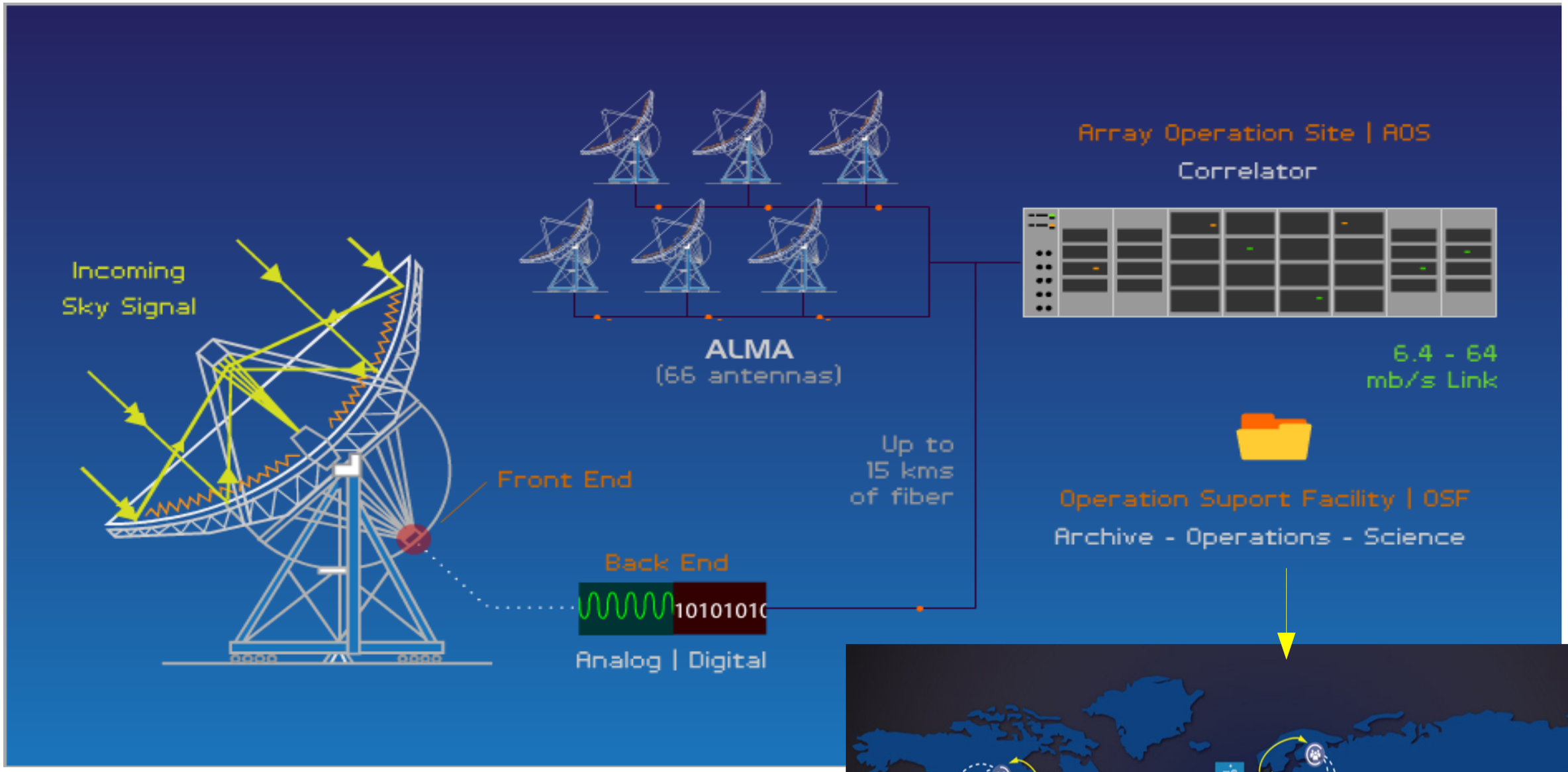
# The ARCs

- **Interface between JAO and users**
- 1 ARC per Partner:
  - NRAO for North America
  - NAOJ for East Asia
  - **ESO for Europe (split in 7 nodes)**
- Operation support
  - Archive replication
  - Astronomer on duty
  - Software tools
- **User support**
  - **Community formation and outreach (schools, workshops, tutorials, ...)**
  - **Phase 1 (proposal preparation)**
  - **Phase 2 (scheduling block preparation)**
  - **Data analysis, Archive mining**
  - **F2F user support, Helpdesk**



# ALMA data flow




Data is collected, reduced and archived.
All the “almost” raw data is archived.

**Each ARC hosts an archive mirror**.

# Before the end of Obs…

- Project tracker (follow you proposals)
- Highest priority projects (schedule)
- Real time observations
- ToO

# ALMA Project Tracker

**ALMA Project Tracker** User Manual Alma Portal Log out **57 Projects found**

| Project Code | PI Userid | Executives | Project Name | State | Time C | Time of Creation | Timed Out | Project UID |
|---|---|---|---|---|---|---|---|---|
| 2015.1.01198.S | slh23 | EU | Detection and mapping of molecular filaments in galaxy cluster cores | Reviewed | | 2015-04-23 10:47:18 | | uid://A001/X1ee/Xe16 |
| 2015.1.01155.S | ggentile | EU | Molecular gas in the central parts of the Fornax cluster: fueling the AGN | Reviewed | | 2015-04-23 09:55:5( | | uid://A001/X1ee/Xd6d |
| 2015.1.01120.S | guillard | EU | The role of cosmic rays regulating star formation in AGN | Reviewed | | 2015-04-23 09:27:2: | | uid://A001/X1ed/Xcd9 |
| 2015.1.01019.S | qsalome | EU | Star formation efficiency in the outer filament of Centaurus A | Reviewed | | 2015-04-23 06:44:0: | | uid://A001/X1ed/Xb4d |
| 2015.1.00740.S | brmcnamara | NA | Molecular Gas Flows and Star Formation in Cluster Cores | Reviewed | | 2015-04-22 22:19:1: | | uid://A001/X1ee/X791 |
| 2015.1.00695.S | freundlich | EU | Star-forming clumps after the peak epoch of star formation | Reviewed | | 2015-04-22 20:42:0( | | uid://A001/X1ed/X6cd |
| 2015.1.00644.S | yfujita | EA | Nuclear outflow and inflow in the strongest X-ray cool core of nearby galaxy groups | Reviewed | | 2015-04-22 18:53:0( | | uid://A001/X1ee/X649 |
| 2015.1.00628.S | afabian | EU | ALMA observations of the 40 billion solar masses of molecular gas in the heart of the ne | Reviewed | | 2015-04-22 18:22:5( | | uid://A001/X1ed/X5e2 |

**2013.1.01267.S - Using ALMA to look into galaxy cluster cool cores at high-z**

| Entity | Status |
|---|---|
| 2013.1.01267.S | InProgress |
| Proposal | |
| ObsUnitSet | FullyObserved |
| SG OUS (Cluster cool cores with ALMA) | FullyObserved |
| Group OUS | ReadyForProcessing |
| Member OUS (XMMU_J2235-2557) | Delivered |
| XMMU_J22_a_03_TE | FullyObserved |
| Member OUS (XMMU_J2235-2557) | Delivered |
| XMMU_J22_a_03_7M | FullyObserved |

| | | | |
|---|---|---|---|
| Code | 2013.1.01267.S | Cycle | 2013.1 |
| PI | Kaustuv Basu (kmbasu) | Project UID | uid://A001/X112/X330 |
| Email | kbasu@astro.uni-bonn.de | Creation date | 2013-12-05 14:13:46 |
| Priority Flag | C | Executives | EU |

Project Report PDF HTML

APRC Consensus report

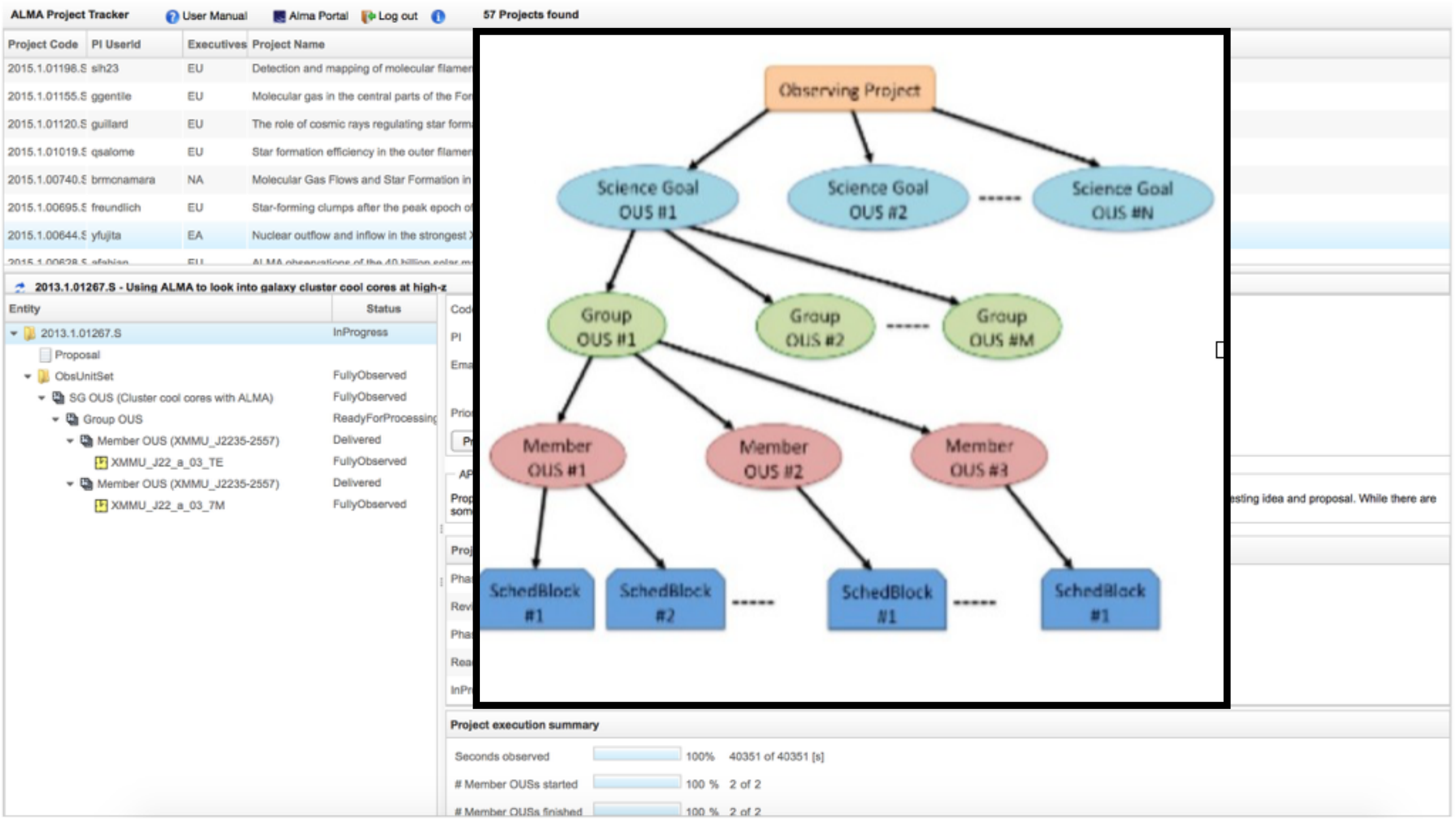
Proposal for measuring the temperature profile in the central regions of a cluster of galaxies at z=1.4. This is done by combining SZ and Xray imaging.Interesting idea and proposal. While there are some simulations included in the proposal, this should include a deeper discussion on the method itself and possible problems.

| Project status history | Timestamp |
|---|---|
| Phase1Submitted | Thu, 05 Dec 2013 14:13:47 GMT |
| Reviewed | Wed, 09 Apr 2014 15:13:24 GMT |
| Phase2Submitted | Wed, 10 Dec 2014 14:17:42 GMT |
| Ready | Wed, 10 Dec 2014 14:20:31 GMT |
| InProgress | Tue, 16 Dec 2014 00:09:49 GMT |

**Project execution summary**

| | | |
|---|---|---|
| Seconds observed | 100% | 40351 of 40351 [s] |
| # Member OUSs started | 100 % | 2 of 2 |
| # Member OUSs finished | 100 % | 2 of 2 |

# ALMA Project Tracker



# Highest priority projects

Atacama Large Millimeter/submillimeter Array
In search of our Cosmic Origins

Search Site

ESO NRAO NAOJ

Log in | Register | Reset Password | Forgot Account





## High Priority Projects



The table below lists ALMA Cycle 3 projects with public metadata, including all Cycle 3 A- and B-graded proposals, any Cycle 3 C-graded proposals with archived observations. The public metadata includes the ALMA Project Code, program title and abstract, investigator names and institutes, the Executive to which the project is assigned (CL=Chile, EA=East Asia, EU=Europe, NA=North America, or OTHER), and the proposal science category (Category 10=Cosmology and the high redshift universe; Category 20=Galaxies and galactic nuclei; Category 31=Interstellar medium, star formation and astrochemistry; Category 41=Circumstellar disks, exoplanets and the solar system; Category 50=Stellar evolution and the Sun).

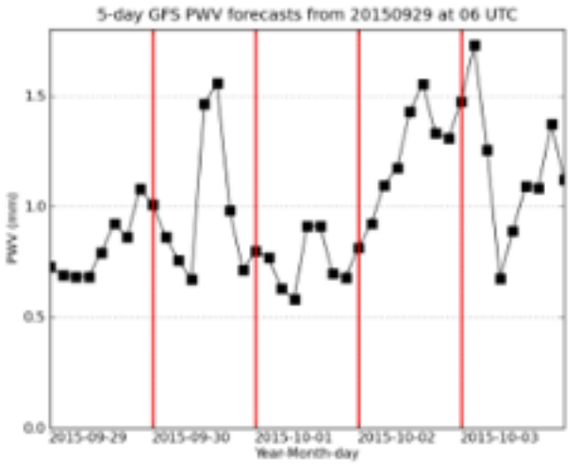
Clicking on ALMA "Project Code" will spawn an ALMA Science Archive query for the project (if the link returns an empty table, then no archived data exists). Clicking on the "Abstracts" or "CoIs" links will open additional fields in the table with the corresponding metadata.

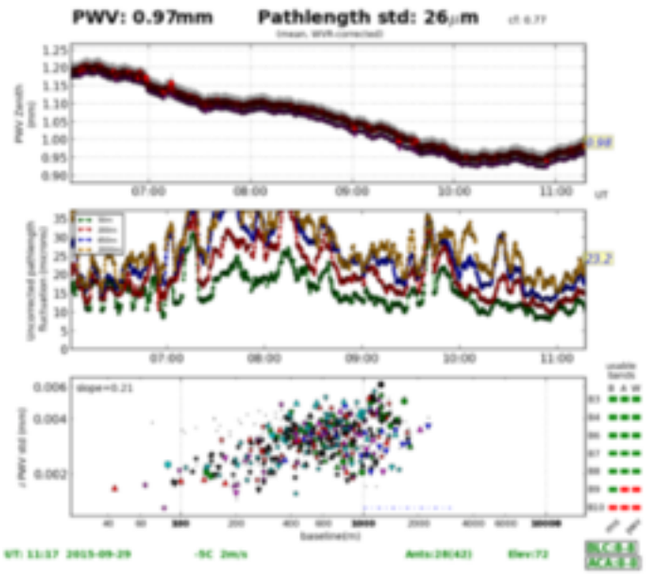
| Project Code | Title (Abstracts) | PI (COIs) | Exec | Category |
|---|---|---|---|---|
| 2015.1.00007.S | Not alone?: Solving the complex mass loss puzzle of U Ant | Franz F. Kerschbaum | EU | 50 |
| 2015.1.00009.S | High Resolution mm-Interferometry of a Highly Magnified Lyman Break Galaxy at z=3.07 | Kristen E K Coppin | EU | 10 |
| 2015.1.00016.S | A search for extragalactic argonium, ArH+, a probe of the very atomic diffuse interstellar medium | Holger S.P. Müller | EU | 31 |
| 2015.1.00019.S | Resolving the star-forming ISM at z~2-3 | Jacqueline A. Hodge | NA | 10 |

# Real time ALMA Status

## Weather

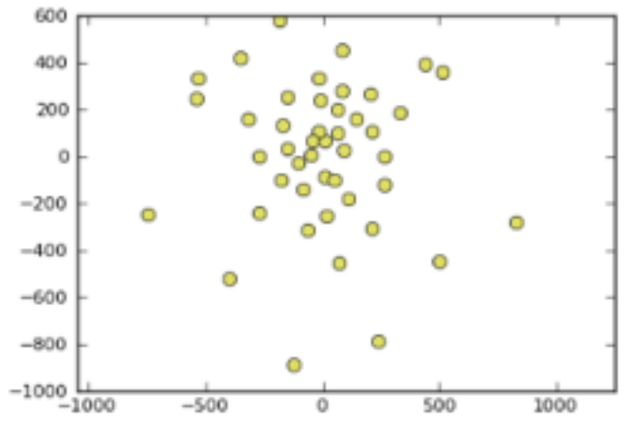
| Current Data | | | |
|---|---|---|---|
| Radiometer | [mm] | : | 1.0 |
| Temperature | [C] | : | -0.21 |
| Dewpoint | [C] | : | -20.75 |
| Humidity | [%] | : | 15.94 |
| Pressure | [hPa] | : | 553.1 |
| Wind Speed | [m/s] | : | 4.49 |
| Wind Direction | [deg] | : | 279.0 |
| Wind Chill | [C] | : | -7.83 |
| Last update | | : | Tue Sep 29 15:12:00 2015 |



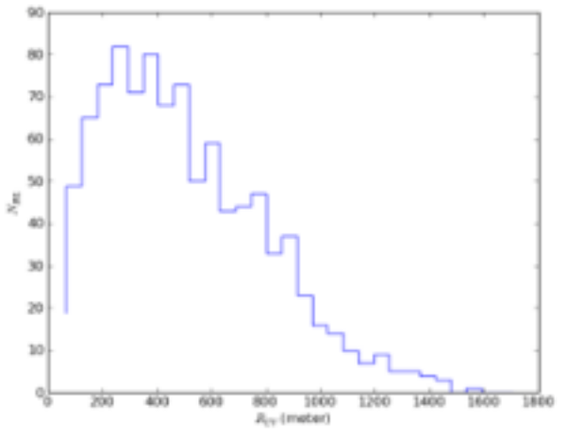




APEX Weather Monitor | Chajnantor PWV Forecast | Current ALMA PWV & phase stability

## Most Recent ES Configuration (from June 23 2015)



12m Array Configuration (config file)



12m Array Baseline Radial UV Density

| Array | 7m | 12m |
|---|---|---|
| min BLs | 8.9 m | 42 m |
| max BLs | 32.1 m | 1466 m |
| RMS BL | 19.5 m | 556 m |
| beam (@100 GHz) | 19.3" | 0.49" |
| max recoverable scale (@100 GHz) | 41.7" | 8.8" |

# Trigger accepted ToO

too.almascience.org

elcome to the Science Portal at ESO | Target of Observation

ToO | Home

If you need to submit a ToO trigger for Cycle 1 please click here

## ALMA Cycle 2 Target of Opportunity

### PI Information

Name

Salome, Philippe

Email

philippe.salome@obspm.fr

### Project Information

ToO Projects

Select...

### Target/Scheduling block information

Ephemeris File (2MB Max., .TXT files only)

Choisir le fichier aucun fichier sél.

Additional Strategy Comments

# ALMA Archive

The ALMA archive is a combined database and binary data storage system that is accessed by the different software subsystems through the same software layer. It is divided in 2 parts

- The ALMA Frontend archive (AFA), which provides the core persistence functionality
- The ALMA Science Archive (ASA) that holds a tiny subset of metadata of the AFA and provides access to external interfaces like the Archive Query interface and Virtual Observatory (VO) tools.

The ALMA archive has operational parts at 1- the Operations Support Facility (OSF), 2- the Santiago Central office and 3- the three ALMA Regional Centres (ARCs).

Main archive at the SCO, holding (all science data, commissioning, operations data, monitoring data)

Full copies of the main archive are stored at the three ARCs. Off-site backup copies of the main archive and ALMA staff local user support (quality control QA3)

From the archives at the ARCs data is distributed to PIs and archival researchers.

# ALMA Science Archive

**Goal**
Provide a Science Archive with web access and programmatic access to metadata and data. This Science Archive should understand queries by physical concepts and should be intuitively usable by non-radio astronomers and expert radio-astronomers alike.

**Status**
Currently the ALMA Science Archive only queries on the raw metadata → many rows for a single source may be returned.

The user interface, although it has improved a lot recently, is still under heavy development.

**Future**
Abstracts, Previews, metadata of publications, previews, visualization, access to individual science-grade products.

# ALMA Archive

The ASA consists of 4 building blocks.

1) **The Harvester** extracts a small subset of the metadata from the AFA and writes a into the ASA database. This software is written in Java and runs twice a day.

2) **The Archive Query interface** is built using Java Server Pages (JSP) and JavaScript and provides a classical form-based search interface to selected columns of the ASA database. Once the user hits the search button, the query is transformed into the Astronomy Data Query Language (ADQL) a dialect of SQL and passed to the

3) **Query Backend** is a generic Java code allowing to query Relational Databases and return results in VO format. The result of this query is then passed back to the query interface for display. Thus, internally, all ASA queries are VO queries which also means that all user-services querying the archive will use the same query backend. This reduces cost, simplifies the the set-up, allows for easy maintenance and uses existing standards. Once the user has selected data and, the user will be sent to the ALMA Request Handler (RH)

4) **The Request Handler** manages user requests for the download of data or for the processing of data. It stores the users' requests under the user's account and provides the access control on a file level and allows for different download methods.

a) The standard method is a download manager (Java applet) which allows the user to download several files in parallel in order to optimize the use of the available bandwidth. Paused or broken downloads can be resumed.

b) It also offers a download script which is meant for users who want to download the ALMA data directly onto a processing environment without having to use a web browser.

The RH logs data access to be able to generate download statistics.

# ALMA Archive

**ALMA archive data is made of the following;**

- Raw data (in form of ALMA science data model [ASDM], and measurement set [MS]), which can be re-processed with CASA.
- Processed image files (in .fits format), science-ready **(not the full data cube but slices of science goals)**
- CASA data reduction script used for producing the processed image files. *Note that the script and the resulting FITS are not optimized to the best quality image possible, but adopts standard procedures. For example, point-like sources are not self-calibrated.*

**Reprocess ALMA datasets**

- Install CASA (http://casa.nrao.edu/casa_obtaining.shtml), knowledge of python (script code) is advantageous
- Redo the full calibration : scripts available in the archive tarball. Contact your local ARC-node (IRAM)
- **Redo the imaging** (i) within casa (ii) use the GILDAS filler (either from fits images or even directly from uvfits in order to **get GILDAS uv-table**). See Documentation on IRAM website.

# ALMA Science Archive

## ALMA Science Archive Query

Query Form | Results Table

Search | Reset

Query Help

### Position

Source name (Resolver)

Cen A

Source name (ALMA)

RA Dec

Spatial resolution

### Energy

Frequency

### Time

Observation date

### Polarisation

Polarisation type

### Observation

Water vapour

### Options

View: raw data project

public data only

science observations only

**Source name (Resolver)**
Case-insensitive search for source name, to be resolved with Sesame. Wildcard matching is disabled.

**Usage.**
Use Sesame (via. NED, Simbad and VizieR) to parse names commonly found throughout literature. A green tick indicates a successful search, otherwise, a red cross is returned.

**Example**
Cen A
NGC3375
ARP220

**Source**
NAME CENTAURUS A

**Coordinates (RA Dec)**
13:25:27.61 -43:01:08.8

**Object type**
Sy2 (Seyfert 2 Galaxy)

**Morphology Type**
S0pec

**Resolver**
Sesame using Simbad

# ALMA Science Archive

## ALMA Science Archive Query

Query Form | Results Table

Search | Reset

Query Help

### Position

Source name (Resolver)

Cen A

Source name (ALMA)

RA Dec

Spatial resolution

### Energy

Frequency

Bandwidth

Spectral resolution

Band

### Time

Observation date

Integration time

### Polarisation

Polarisation type

### Observation

Water vapour

### Project

Project code

Project title

PI name

co

Cicone, Claudia

Codella, Claudio

Colina, Luis

Combes, Francoise

Conley, Alexander

Coppin, Kristen

Corder, Stuartt

Cordiner, Martin

Cortes, Paulo

**PI Full Name**
ALMA PI name

**Description**
case-insensitive partial match over the full PI name. Wildcards can be used

**Example**
Smith, Fred
SMI*
fr?d

### Options

View: raw data | project

public data only

science observations only

# ALMA Science Archive

## ALMA Science Archive Query

Query Form | Results Table

Search | Reset

Query Help

### Position

Source name (Resolver)
Source name (ALMA)
RA Dec
Spatial resolution

### Energy

Frequency
100 .. 300 | 600 .. 900
Bandwidth
Spectral resolution
2e6 .. 3e6
Band

### Time

Observation date
Integration time

### Polarisation

Polarisation type

### Observation

Water vapour

### Project

Project code
Project title
PI name

### Options

View: (•) raw data ( ) project

[x] public data only

[x] science observations only

# ALMA Science Archive

## ALMA Science Archive Query

Query Form | Results Table

Query Help

### Query Help

The tooltips that appear when you hover over the search boxes will give examples of searches, and show the unit in which to enter numerical quantities. The name resolver (SESAME) will resolve names of non-solar system objects using the SIMBAD, NED, and Vizier databases.

By default, the results of a search will be a list of publically available, raw observations of science targets. To see a project-level view, and/or prorietary data, choose the appropriate options in the lower-right box. In order to see also data from calibrator observations, select the appropriate entries from the "Scan Intent" field.

Below are a list of operators and wildcards that may be used in the search fields (apart from the name resolver field, which accepts no operators).

| **Numerical Operators** | | **String Operators** | | **String Wildcards** | | **Logical Operators** | |
|---|---|---|---|---|---|---|---|
| Equal | = | Equal | ~ | Any text | * | Or | \| |
| Not Equal | != | Exactly equal (case sensitive) | = | Any single character | ? | | |
| Less than | < | Exactly equal (no wild cards) | == | | | | |
| Less than or equal | ≤ | Not equal | !~ | | | | |
| Greater than | > | Not exactly equal (no wildcards) | != | | | | |
| Greater than or equal | ≥ | | | | | | |

# ALMA Science Archive

## ALMA Science Archive Query

Query Form | Results Table

Search | Reset

Query Help

### Position

Source name (Resolver)

Cen A

Source name (ALMA)

RA Dec

Spatial resolution

### Energy

Frequency

Bandwidth

Spectral resolution

Band

### Time

Observation date

Integration time

### Polarisation

Polarisation type

### Observation

Water vapour

### Project

Project code

Project title

PI name

### Options

View: raw data | project

public data only

science observations only

# ALMA Science Archive

## ALMA Science Archive Query

Query Form | Results Table

Submit download request

Results Bookmark | Export Table | Results Help

Showing 1000 rows (1000 before filtering). More columns

| | Project code | *Source name* | RA | Dec | Band | Integration | Release date | Velocity resolution | Frequency support |
|---|---|---|---|---|---|---|---|---|---|
| Filter: | | | | | | | | m/s | |
| | 2011.0.00010.S | CenA | 13:25:27.62 | -43:01:08.8 | 3 | 516.403 | 2015-02-12 | 415.31 | 87.05..89.14GHz |
| | 2011.0.00010.S | CenA | 13:25:27.62 | -43:01:08.8 | 3 | 516.546 | 2015-02-12 | 415.31 | 87.05..89.14GHz |
| | 2011.0.00010.S | CenA | 13:25:27.62 | -43:01:08.8 | 6 | 692.215 | 2015-02-12 | 667.58 | 217.61..220.48GHz |
| | 2011.0.00454.S | CenA - CO knot S1 | 13:26:16.10 | -42:46:55.7 | 6 | 57.255 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| | 2011.0.00454.S | CenA - Xray N1 | 13:27:25.30 | -42:40:17.5 | 6 | 57.218 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| | 2011.0.00454.S | CenA - Xray N2 | 13:26:56.80 | -42:41:37.4 | 6 | 57.226 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| | 2011.0.00454.S | CenA - Xray N3 | 13:26:40.50 | -42:43:50.6 | 6 | 57.225 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| | 2011.0.00454.S | CenA - Xray N4 | 13:26:34.20 | -42:46:19.8 | 6 | 57.237 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:27.62 | -43:01:08.8 | 7 | 32.534 | 2015-06-30 | 848.45 | 332.20..347.95GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:14.85 | -43:00:26.8 | 3 | 8.559 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:16.90 | -43:00:13.9 | 3 | 8.559 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:16.90 | -43:00:39.7 | 3 | 8.559 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:16.90 | -42:59:48.0 | 3 | 8.606 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:18.94 | -43:00:00.9 | 3 | 8.606 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:18.94 | -43:00:52.6 | 3 | 8.559 | In Progress | 1269.75 | 112.30..115.30GHz |

public

proprietary

has not yet been delivered to the PI

# ALMA Science Archive

## ALMA Science Archive Query

Query Form | Results Table

Submit download request

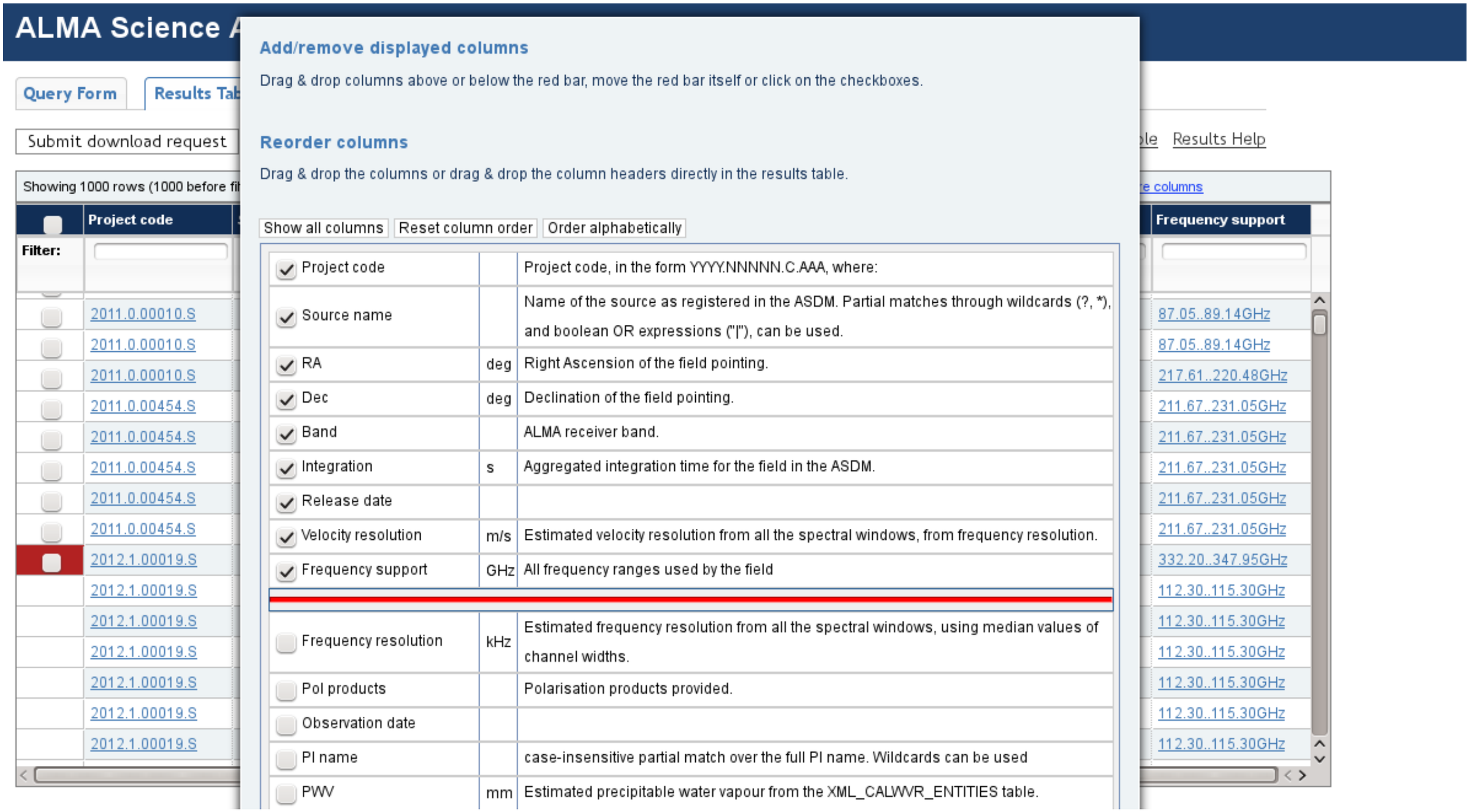
Results Bookmark | Export Table | Results Help

Showing 1000 rows (1000 before filtering). More columns

| | Project code | *Source name* | RA | Dec | Band | Integration | Release date | Velocity resolution | Frequency support |
|---|---|---|---|---|---|---|---|---|---|
| Filter: | | | | | | | | m/s | |
| | 2011.0.00010.S | CenA | 13:25:27.62 | -43:01:08.8 | 3 | 516 | | | 87.05..89.14GHz |
| | 2011.0.00010.S | CenA | 13:25:27.62 | -43:01:08.8 | 3 | 516 | | | 87.05..89.14GHz |
| | 2011.0.00010.S | CenA | 13:25:27.62 | -43:01:08.8 | 6 | 692 | | | 217.61..220.48GHz |
| | 2011.0.00454.S | CenA - CO knot S1 | 13:26:16.10 | -42:46:55.7 | 6 | 57.1 | | | 211.67..231.05GHz |
| | 2011.0.00454.S | CenA - Xray N1 | 13:27:25.30 | -42:40:17.5 | 6 | 57.1 | | | 211.67..231.05GHz |
| | 2011.0.00454.S | CenA - Xray N2 | 13:26:56.80 | -42:41:37.4 | 6 | 57.1 | | | 211.67..231.05GHz |
| | 2011.0.00454.S | CenA - Xray N3 | 13:26:40.50 | -42:43:50.6 | 6 | 57.1 | | | 211.67..231.05GHz |
| | 2011.0.00454.S | CenA - Xray N4 | 13:26:34.20 | -42:46:19.8 | 6 | 57.237 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:27.62 | -43:01:08.8 | 7 | 32.534 | 2015-06-30 | 848.45 | 332.20..347.95GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:14.85 | -43:00:26.8 | 3 | 8.559 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:16.90 | -43:00:13.9 | 3 | 8.559 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:16.90 | -43:00:39.7 | 3 | 8.559 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:16.90 | -42:59:48.0 | 3 | 8.606 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:18.94 | -43:00:00.9 | 3 | 8.606 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:18.94 | -43:00:52.6 | 3 | 8.559 | In Progress | 1269.75 | 112.30..115.30GHz |

| Frequency | Resolution | Polarization |
|---|---|---|
| 211.67..213.55GHz | 976.56kHz | XX YY |
| 213.67..215.54GHz | 976.56kHz | XX YY |
| 226.66..228.53GHz | 976.56kHz | XX YY |
| 229.18..231.05GHz | 976.56kHz | XX YY |

# ALMA Science Archive



# ALMA Science Archive

## ALMA Science Archive Query

Query Form | Results Table

Results Bookmark | Export Table | Results Help

### Export Table

To download the results table, click on one of the links below:

- VOTable (XML Format)
- CSV (Comma Separated Values)
- TSV (Tab Separated Values)

Submit download request

Showing 1000 rows (1000 before filtering). More columns

| Project code | *Source name* | RA | Dec | Band | Integration | Release date | Velocity resolution | Frequency support |
|---|---|---|---|---|---|---|---|---|
| Filter: | | | | | | | m/s | |
| 2011.0.00010.S | CenA | 13:25:27.62 | -43:01:08.8 | 3 | 516.403 | 2015-02-12 | 415.31 | 87.05..89.14GHz |
| 2011.0.00010.S | CenA | 13:25:27.62 | -43:01:08.8 | 3 | 516.546 | 2015-02-12 | 415.31 | 87.05..89.14GHz |
| 2011.0.00010.S | CenA | 13:25:27.62 | -43:01:08.8 | 6 | 692.215 | 2015-02-12 | 667.58 | 217.61..220.48GHz |
| 2011.0.00454.S | CenA - CO knot S1 | 13:26:16.10 | -42:46:55.7 | 6 | 57.255 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| 2011.0.00454.S | CenA - Xray N1 | 13:27:25.30 | -42:40:17.5 | 6 | 57.218 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| 2011.0.00454.S | CenA - Xray N2 | 13:26:56.80 | -42:41:37.4 | 6 | 57.226 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| 2011.0.00454.S | CenA - Xray N3 | 13:26:40.50 | -42:43:50.6 | 6 | 57.225 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| 2011.0.00454.S | CenA - Xray N4 | 13:26:34.20 | -42:46:19.8 | 6 | 57.237 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| 2012.1.00019.S | Centaurus_A | 13:25:27.62 | -43:01:08.8 | 7 | 32.534 | 2015-06-30 | 848.45 | 332.20..347.95GHz |

# ALMA Science Archive

## ALMA Science Archive Query

Query Form | Results Table

Submit download request

Results Bookmark | Export Table | Results Help

Showing 1000 rows (1000 before filtering). More columns

| | Project code | *Source name* ▲ | RA | Dec | Band | Integration | Release date | Velocity resolution | Frequency support |
|---|---|---|---|---|---|---|---|---|---|
| Filter: | | | | | | | | m/s | |
| | 2011.0.00010.S | CenA | 13:25:27.62 | -43:01:08.8 | 3 | 516.403 | 2015-02-12 | 415.31 | 87.05..89.14GHz |
| | 2011.0.00010.S | CenA | 13:25:27.62 | -43:01:08.8 | 3 | 516.546 | 2015-02-12 | 415.31 | 87.05..89.14GHz |
| | 2011.0.00010.S | CenA | 13:25:27.62 | -43:01:08.8 | 6 | 692.215 | 2015-02-12 | 667.58 | 217.61..220.48GHz |
| | 2011.0.00454.S | CenA - CO knot S1 | 13:26:16.10 | -42:46:55.7 | 6 | 57.255 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| | 2011.0.00454.S | CenA - Xray N1 | 13:27:25.30 | -42:40:17.5 | 6 | 57.218 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| | 2011.0.00454.S | CenA - Xray N2 | 13:26:56.80 | -42:41:37.4 | 6 | 57.226 | 2013-02-14 | 1324.13 | 211.67..231.05GHz |
| | 2011.0.00454.S | CenA - Xray N3 | 13:26:40.50 | -42:43:50.6 | | | 013-02-14 | 1324.13 | 211.67..231.05GHz |
| | 2011.0.00454.S | CenA - Xray N4 | 13:26:34.20 | -42:46:19.8 | | | 013-02-14 | 1324.13 | 211.67..231.05GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:27.62 | -43:01:08.8 | | | 015-06-30 | 848.45 | 332.20..347.95GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:14.85 | -43:00:26.8 | | | n Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:16.90 | -43:00:13.9 | | | n Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:16.90 | -43:00:39.7 | 3 | 8.559 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:16.90 | -42:59:48.0 | 3 | 8.606 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:18.94 | -43:00:00.9 | 3 | 8.606 | In Progress | 1269.75 | 112.30..115.30GHz |
| | 2012.1.00019.S | Centaurus_A | 13:25:18.94 | -43:00:52.6 | 3 | 8.559 | In Progress | 1269.75 | 112.30..115.30GHz |

Add to Google Calendar
Add to Live Calendar
Add to Yahoo! Calendar
iCal
vCalendar

# ALMA Science Archive

Atacama Large Millimeter/Submillimeter Array
In search of our Cosmic Origins

Request Handler | Login

Archive Requests | Req #848,936,240

## Request #848936240 by Anonymous User ✔

Click to edit

Include raw | Select All | Deselect All | Download Selected

Requested Projects / OUSets / Executionblocks

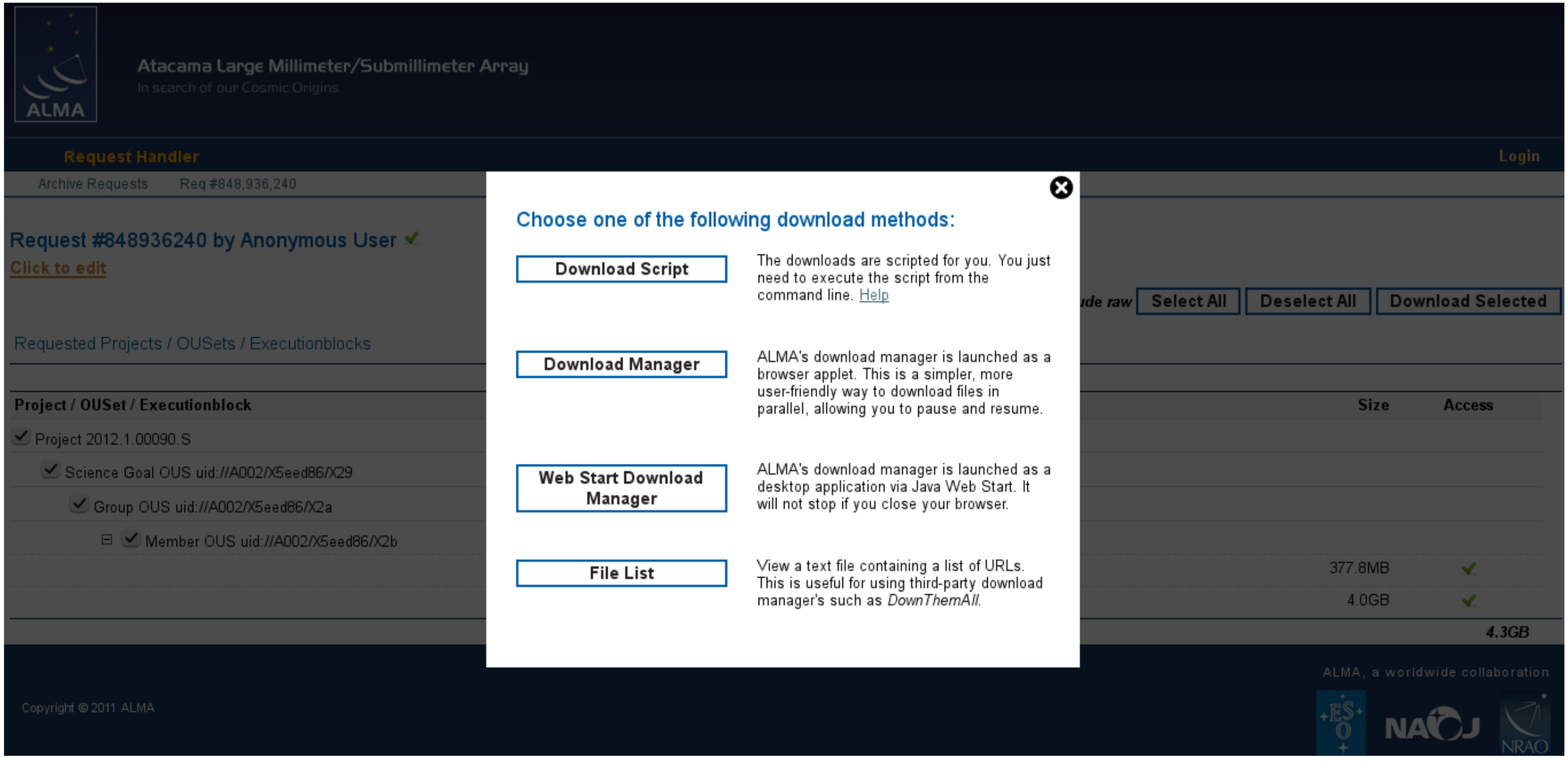
*Data entities 1-4 of 4*

| Project / OUSet / Executionblock | File | Size | Access |
|---|---|---|---|
| Project 2012.1.00090.S | | | |
| Science Goal OUS uid://A002/X5eed86/X29 | | | |
| Group OUS uid://A002/X5eed86/X2a | | | |
| Member OUS uid://A002/X5eed86/X2b | | | |
| | 2012.1.00090.S_uid___A002_X5eed86_X2b_001_of_001.tar | 377.8MB | ✔ |
| | 2012.1.00090.S_uid___A002_X7143f6_Xf9b.asdm.sdm.tar | 4.0GB | ✔ |
| | *Data entities 1-4 of 4* | | *4.3GB* |



ALMA, a worldwide collaboration

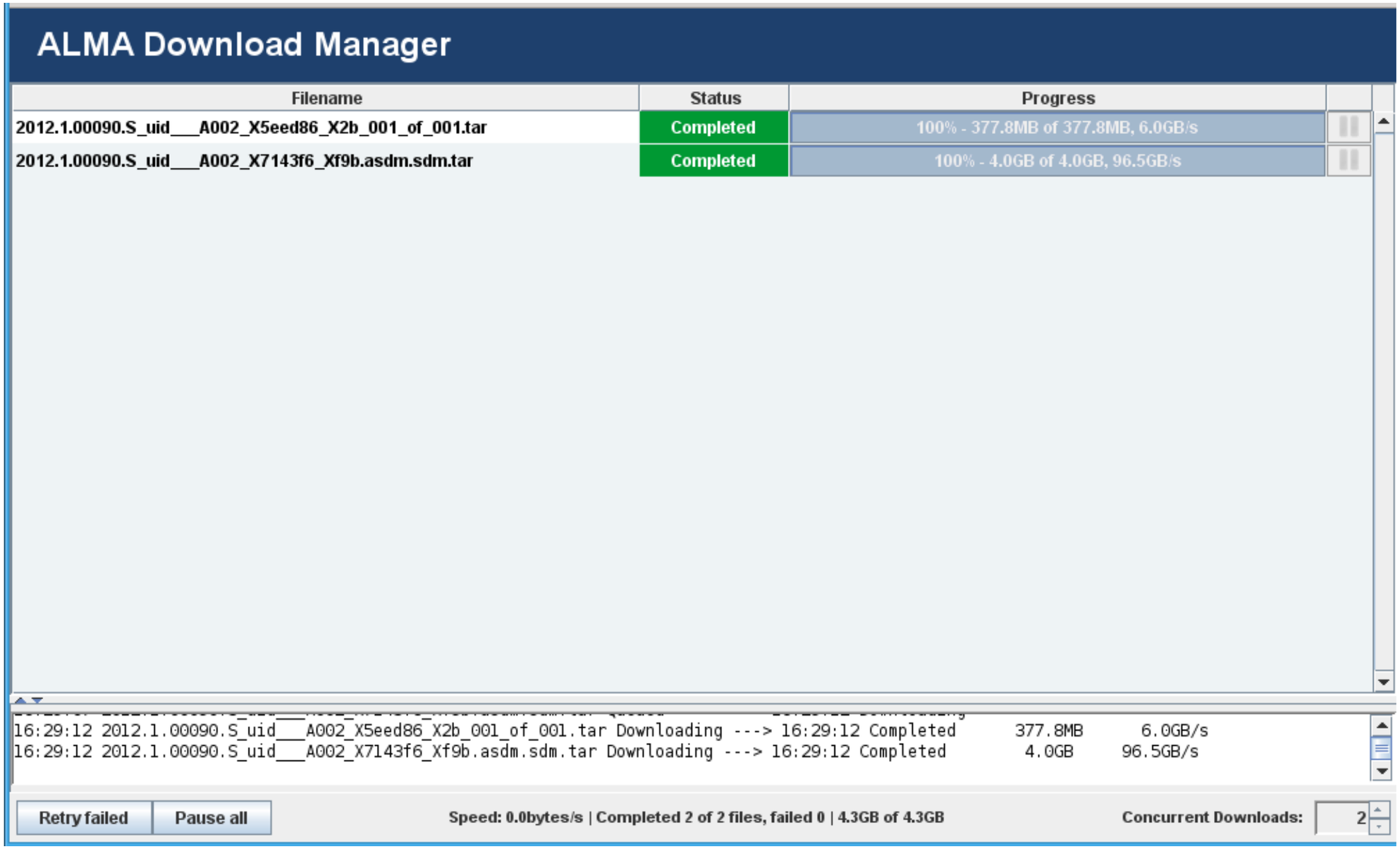
# ALMA Science Archive



# Download script

```
Downloading

https://almascience.eso.org/dataPortal/requests/anonymous/848936240/ALMA/2012.1.00090.
S_uid___A002_X5eed86_X2b_001_of_001.tar/2012.1.00090.S_uid___A002_X5eed86_X2b_001_of_0
01.tar

https://almascience.eso.org/dataPortal/requests/anonymous/848936240/ALMA/uid___A002_X7
143f6_Xf9b/2012.1.00090.S_uid___A002_X7143f6_Xf9b.asdm.sdm.tar

 in up to 5 parallel streams. Total size is 4.3GB. This may take a while ...

starting download of 2012.1.00090.S_uid___A002_X7143f6_Xf9b.asdm.sdm.tar

starting download of 2012.1.00090.S_uid___A002_X5eed86_X2b_001_of_001.tar
```

# ALMA Science Archive



# ALMA Science Archive

# File list

## Request 848936240

total size of files: 4.3GB

PLEASE do not attempt to chop a single download into pieces to make it faster. This places a significant load on our servers and may result in your downloads being throttled. For example, in the Firefox plugin ***DownThemAll***, make sure that the property "Max. Number of Segments Per Downloads" is set to 1. Likewise, it's easy to download more than 5 files in parallel. Please don't.

- https://almascience.eso.org/dataPortal/requests/anonymous/848936240/ALMA/2012.1.00090.S_uid___A002_X5eed86_X2b_001_of_001.tar/2012.1.00090.S_uid___A002_X5eed86_X2b_001_of_001.tar
- https://almascience.eso.org/dataPortal/requests/anonymous/848936240/ALMA/uid___A002_X7143f6_Xf9b/2012.1.00090.S_uid___A002_X7143f6_Xf9b.asdm.sdm.tar

# astroquery

- ALMA provides programmatic access to metadata and data
- Astroquery, an externally developed python package (Adam Ginsburg), makes use of this functionality
- https://astroquery.readthedocs.org/en/latest/alma/alma.html
- Documentation: http://goo.gl/21QQnI

# astroquery

Example

```
from astroquery.alma import Alma
import numpy as np

m83_data = Alma.query_object('M83')
print(m83_data)

myAlma = Alma()
myAlma.cache_location = '/big/external/drive/'
myAlma.retrieve_data_from_uid(uids[0])
```

# Calibrator Source Catalogue

Atacama Large Millimeter/submillimeter Array
In search of our Cosmic Origins

Search Site

ESO NRAO NAOJ

Log in | Register | Reset Password | Forgot Account





## ALMA Data

### The ALMA Archive

The first ALMA Science data are now public. These data are accessible through the Science Portal without user registration.

Data still within its proprietary period is only accessible to PIs as authenticated users. The data proprietary period is 12 months, starting at the time when data is delivered to the PI. A single project may be divided into more than one delivery and in these cases a unique 12 month proprietary period is defined for each delivered data set.

Access is provided through the Archive link in the left side-bar.

The ALMA Archive is under development and will eventually provide access to all data obtained by the ALMA observatory. This includes: raw science data from the correlators, calibration data, processed and quality assured data, including image data cubes as well as logs and reports on project execution and quality assurance.

### The ALMA Calibrator Source Catalogue

A web-based user interface to the calibrator database is provided through the Calibrator Catalogue link in the left side-bar.

The intention is to provide a more complex, public search tool for calibrator sources, which can also be accessed through the Observing Tool and included into the Scheduling Blocks. The principles of the calibrator selection during observation are described in the ALMA Cycle 2 Technical Handbook, A.8 'Calibration source selection'

The data comprise ALMA calibrator measurements of the flux density for sources drawn from seed catalogues such as ATCA, SMA and VLA, and use updated coordinates from VLBI. Stated flux density uncertainties do not in all cases fully account for uncertainties in the planetary models used for the primary amplitude calibration. Structure information, expressed as the acceptable uv range, is available for sources where relevant for past and current ranges of ALMA baseline. Polarization information will be added during Cycle 2. For further details on the Calibrator Source Catalogue, see Fomalont, E., et al., 2014, "The Calibration of ALMA using Radio Sources', The Messenger, 155, 19"

# Calibrator Source Catalogue

## ALMA Calibrator Source Catalogue

Query Form | Result Table | Result Plot

Search | Reset

### Position

Source name

RA

Dec

Search radius

### Energy

Band

Frequency Min

Frequency Max

Flux Density Min

Flux Density Max

### Time

After

Before

# Calibrator Catalogue

## ALMA Calibrator Source Catalogue

Query Form | Result Table | Result Plot

Download csv

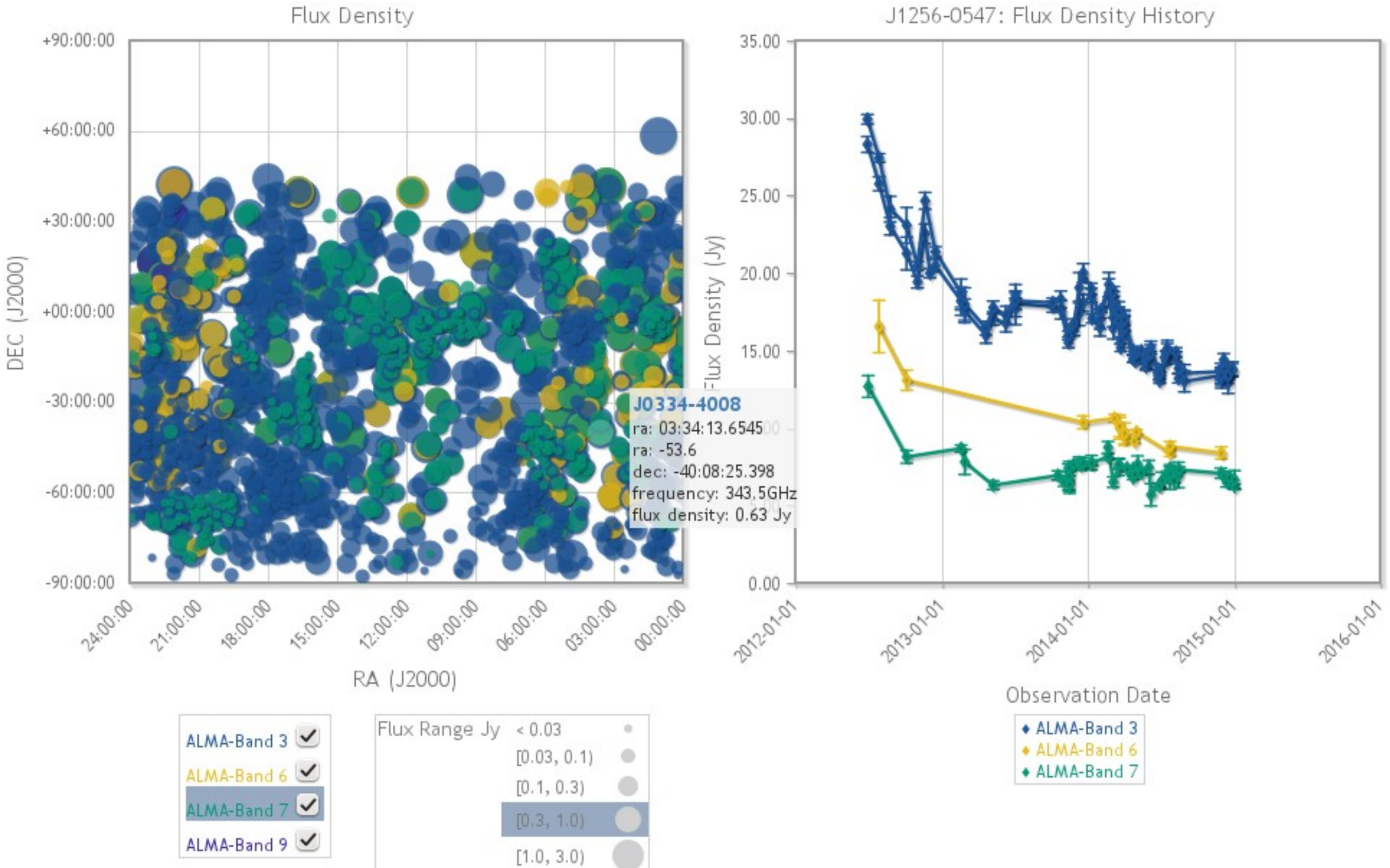
Note:
- hover over the column headers for more information
- click on the column headers to sort
- right-click on the column headers to display columns

| Name | RA | RA Err. | DEC | DEC Err. | Freq. | Band | *Flux* | Flux Err. | UvMin | UvMax | Observed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| J0319+4130 J03... | 03:19:48.1601 | ±0.0001 | +41:30:42.106 | ±0.0001 | 91.5 | 3 | 19.28 | ±0.95 | | > 508.6 | 2015-01-13 |
| J0319+4130 J03... | 03:19:48.1601 | ±0.0001 | +41:30:42.106 | ±0.0001 | 103.5 | 3 | 18.05 | ±0.80 | | > 508.6 | 2015-01-13 |
| J2253+1608 J22... | 22:53:57.7479 | ±0.0001 | +16:08:53.561 | ±0.0001 | 91.5 | 3 | 17.43 | ±0.42 | | > 343.6 | 2015-01-04 |
| J2253+1608 J22... | 22:53:57.7479 | ±0.0001 | +16:08:53.561 | ±0.0001 | 103.5 | 3 | 17.31 | ±0.36 | | > 343.6 | 2015-01-04 |
| J1256-0547 J125... | 12:56:11.1666 | ±0.0001 | -05:47:21.525 | ±0.0001 | 91.5 | 3 | 13.81 | ±0.45 | | > 1160.7 | 2014-12-29 |
| J1256-0547 J125... | 12:56:11.1666 | ±0.0001 | -05:47:21.525 | ±0.0001 | 91.5 | 3 | 13.72 | ±0.43 | | > 1160.7 | 2014-12-28 |
| J2253+1608 J22... | 22:53:57.7479 | ±0.0001 | +16:08:53.561 | ±0.0001 | 233.0 | 6 | 12.87 | ±0.80 | | > 343.6 | 2015-01-03 |
| J1229+0203 J12... | 12:29:06.7000 | ±0.0001 | +02:03:08.598 | ±0.0001 | 91.5 | 3 | 12.64 | ±0.57 | 20.0 | > 1196.6 | 2014-12-29 |
| J2253+1608 J22... | 22:53:57.7479 | ±0.0001 | +16:08:53.561 | ±0.0001 | 343.5 | 7 | 12.38 | ±0.73 | | > 343.6 | 2014-10-05 |
| J1229+0203 J12... | 12:29:06.7000 | ±0.0001 | +02:03:08.598 | ±0.0001 | 91.5 | 3 | 12.29 | ±0.77 | 20.0 | > 1196.6 | 2014-12-28 |
| J0319+4130 J03... | 03:19:48.1601 | ±0.0001 | +41:30:42.106 | ±0.0001 | 233.0 | 6 | 11.3 | ±0.89 | | > 508.6 | 2014-10-12 |
| J2202+4216 J22... | 22:02:43.2914 | ±0.0001 | +42:16:39.980 | ±0.0001 | 97.7 | 3 | 8.96 | ±0.45 | | > 64.4 | 2011-10-31 |
| J2202+4216 J22... | 22:02:43.2914 | ±0.0001 | +42:16:39.980 | ±0.0001 | 109.8 | 3 | 8.91 | ±0.45 | | > 72.4 | 2011-10-31 |
| J1256-0547 J125... | 12:56:11.1666 | ±0.0001 | -05:47:21.525 | ±0.0001 | 233.0 | 6 | 8.38 | ±0.39 | | > 1160.7 | 2014-12-01 |
| J0319+4130 J03... | 03:19:48.1601 | ±0.0001 | +41:30:42.106 | ±0.0001 | 343.5 | 7 | 7.68 | ±1.00 | | > 508.6 | 2015-01-01 |
| J1256-0547 J125... | 12:56:11.1666 | ±0.0001 | -05:47:21.525 | ±0.0001 | 343.5 | 7 | 6.64 | ±0.60 | | > 1160.7 | 2015-01-03 |
| J1229+0203 J12... | 12:29:06.7000 | ±0.0001 | +02:03:08.598 | ±0.0001 | 233.0 | 6 | 5.71 | ±0.28 | 20.0 | > 1196.6 | 2014-12-01 |
| J0522-3627 J052... | 05:22:57.9846 | ±0.0001 | -36:27:30.851 | ±0.0001 | 91.5 | 3 | 5.34 | ±0.21 | 20.0 | > 656.6 | 2014-12-28 |
| J0522-3627 J052... | 05:22:57.9846 | ±0.0001 | -36:27:30.851 | ±0.0001 | 103.5 | 3 | 5.26 | ±0.21 | 20.0 | > 656.6 | 2014-12-28 |
| J0854+2006 J08... | 08:54:48.8749 | ±0.0001 | +20:06:30.641 | ±0.0001 | 91.5 | 3 | 5.13 | ±0.17 | | > 1470.4 | 2014-12-16 |
| J0854+2006 J08... | 08:54:48.8749 | ±0.0001 | +20:06:30.641 | ±0.0001 | 103.5 | 3 | 5.05 | ±0.18 | | > 1470.4 | 2014-12-16 |

# Calibrator Catalogue

## ALMA Calibrator Source Catalogue

Query Form | Result Table | Result Plot



# NEXT

**NEED of a robust PIPELINE** : once the ALMA pipeline is running in full production mode

- science products can be ingested into the ASA directly
- search can be based on products instead of raw-data.
- ALMA can offer previews
- users will be able to access individual data cubes directly

**Further developments of externally developed software tools**

- A powerful server-side visualization tool (PI: Erik Rosolowsky) which allows users to browse and manipulate the very large ALMA data cubes without having to download them to disk first.
- The second of such tools is a a post-pipeline science-analysis tool (PI: Lee Mundy). This tool will run at JAO directly after the ALMA pipeline and will do source extraction, line-finding and science analysis : **ADMIT**
- Japanese Virtual Observatory (JVO) science-ready ALMA images (JVO portal (http://jvo.nao.ac.jp/index-e.html)

# Concluding remarks

- **Success** = maximizing the **end-to-end user experience**
- **Astronomers** not data will be the rare resource
- More **work and responsibility** will shift **to observatories**
- science-grade data reduction **pipelines** will be the norm
- All this will have a deep impact on how we do science
- Parallelism will be increasingly required

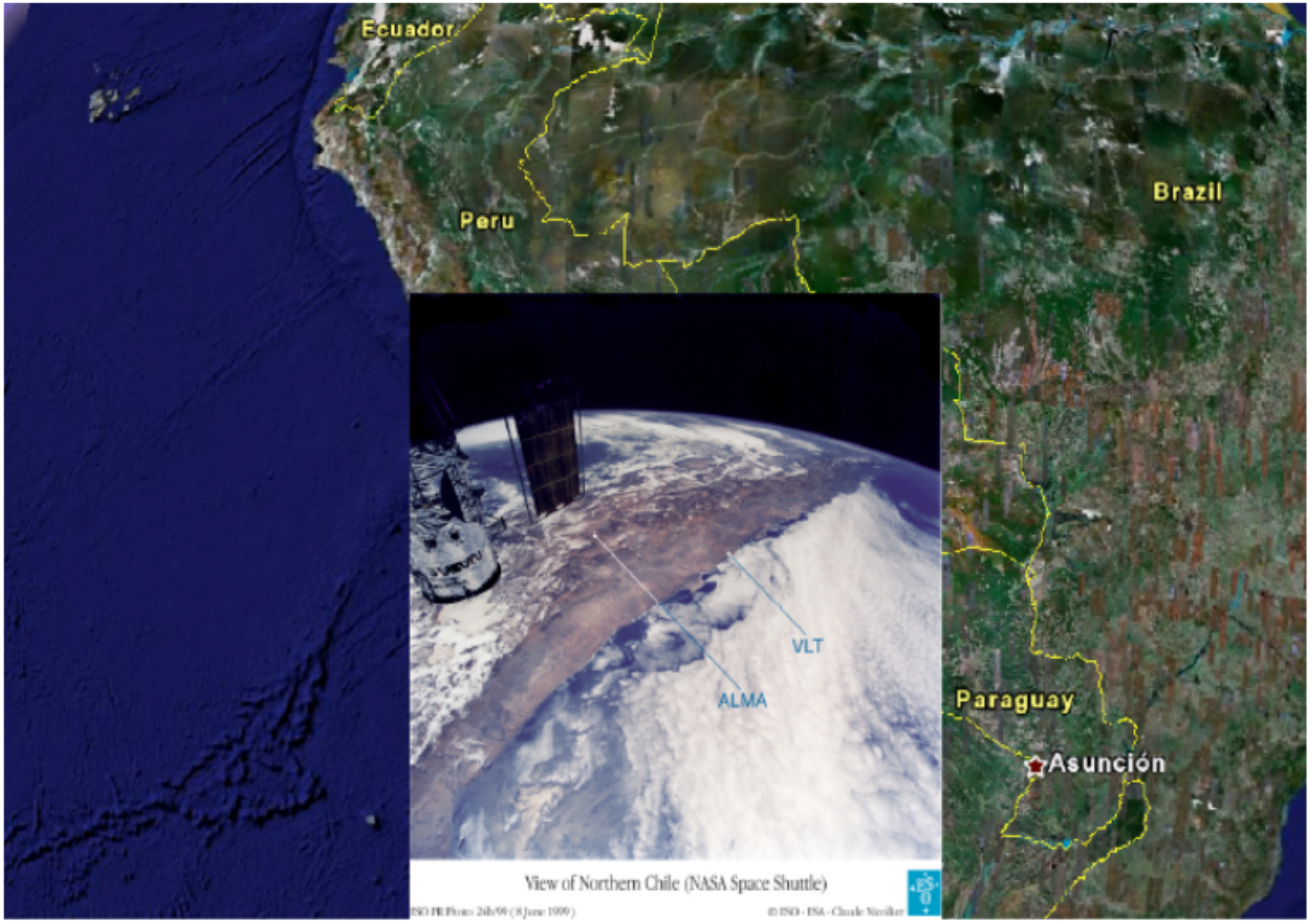
- The **Science Archive** follows that paradigm
  - Queries on physical concepts, focus on relevant information, programmatic access, parallel downloads ...
  - Future: previews, first science-analysis ADMIT (P2.17), pipeline user-reprocessing (O7.8), visualization (O5.2), VO

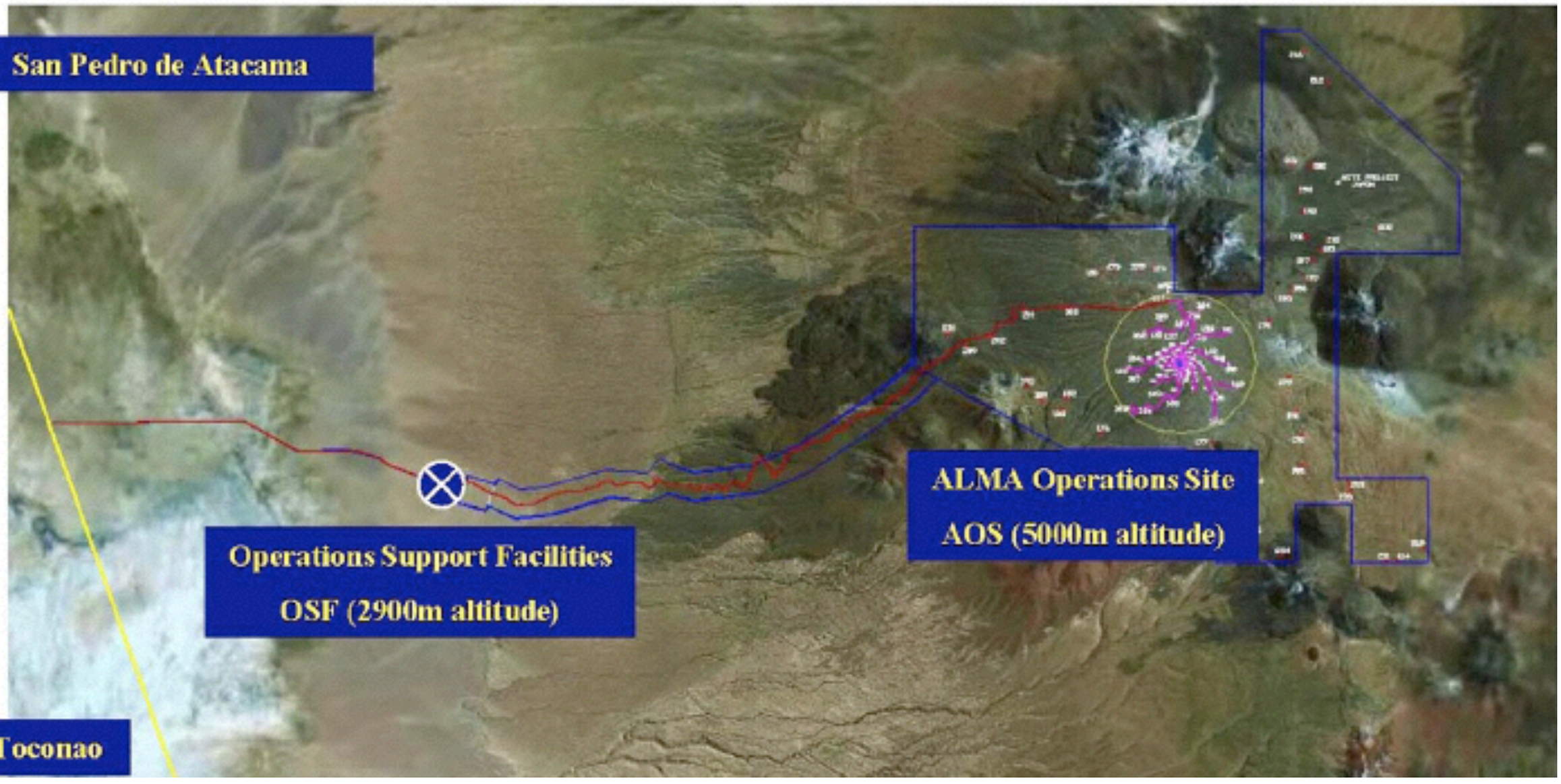
- This will be **golden times for astronomers**

Stoer (ADASS 2014)

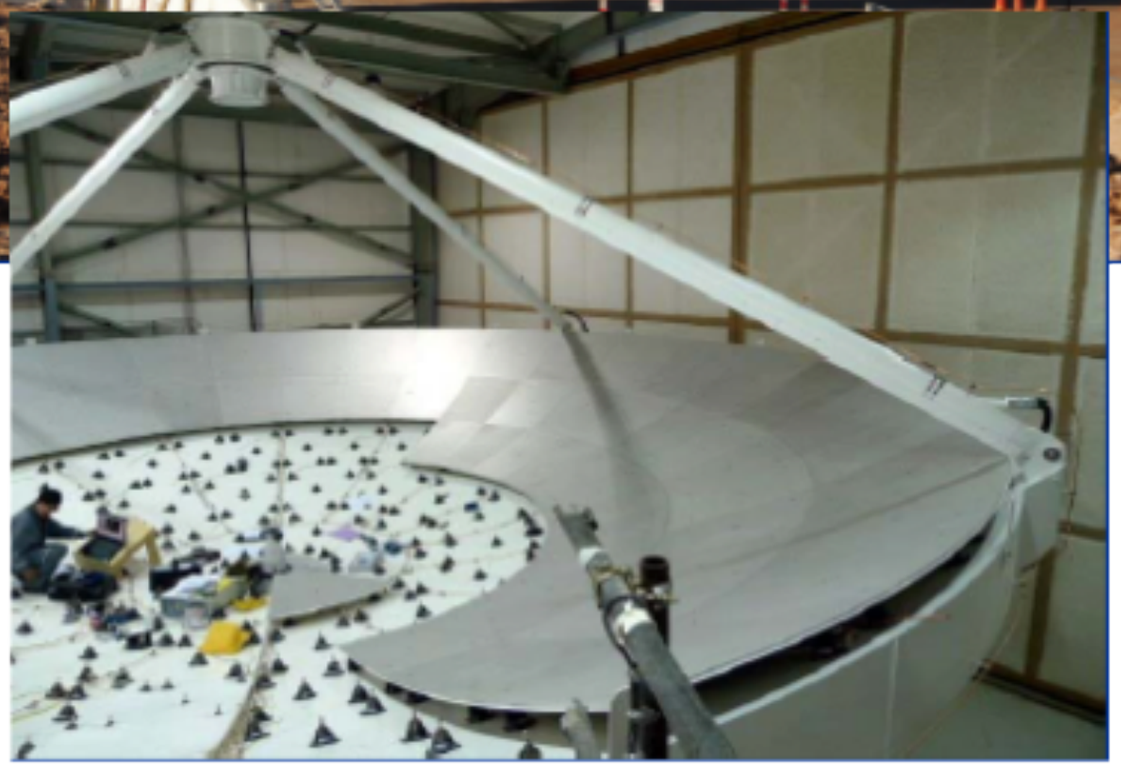
END

# Le site


Ecuador
Peru
Brazil
VLT
ALMA
Paraguay
Asunción
View of Northern Chile (NASA Space Shuttle)
ESO PR Photo 24b/99 ( 8 June 1999 )
© ESO - ESA - Claude Nicollier

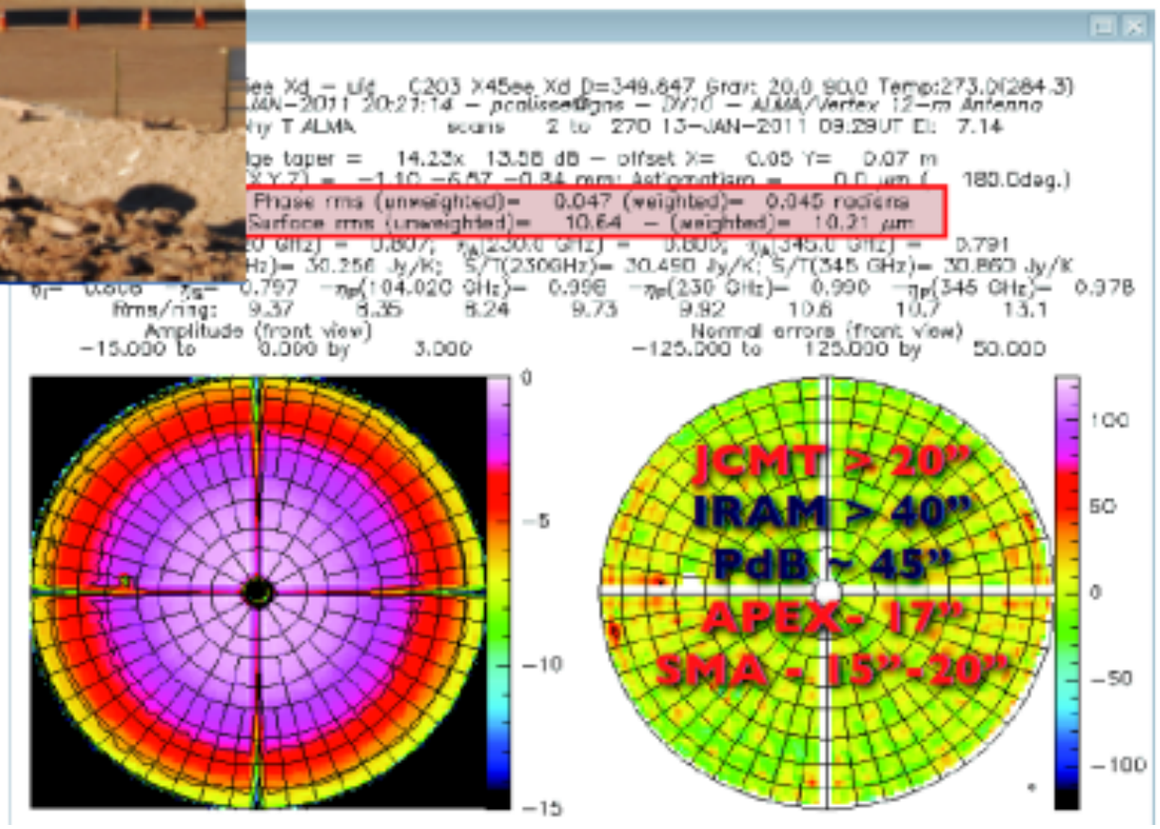

San Pedro de Atacama
Operations Support Facilities
OSF (2900m altitude)
ALMA Operations Site
AOS (5000m altitude)
Toconao

# Les antennes



Précision de surface <25μm

Précision de pointage 0.6”avec du vent à 9m/s



# Transporteurs

# L'OSF (Operation Site Facility)

# Early Science Cycles

**Early Science observations are conducted on a best effort basis to allows community to observe with incomplete, but already superior array, with priority given to the completion of the full ALMA capabilities**

## Past & current ALMA Early Science cycles:

| | Cycle 0<br>Sep. 2011 – Jan. 2013 | Cycle 1<br>Jan. 2013 – May. 2014 | Cycle 2<br>Jun. 2014 – Oct. 2015 |
|---|---|---|---|
| **Telescope** | | | |
| Hours dedicated to Science | **800** | **800** | **2000** (incl. some Cycle 1) |
| Antennas | **> 12x12-m no ACA** | **> 32x12-m+9x7m+2TP** | **> 34x12-m+9x7m+2TP** |
| Receiver bands | 3, 6, 7, 9 | 3, 6, 7, 9 | **+4, 8** |
| Wavelengths [mm] | 3, 1.3, 0.8, 0.45 | 3, 1.3, 0.8  0.45 | +2, 0.7 |
| Baselines | up to 400 m | **up to 1000 m** | **up to 1500** |
| Polarisation | single-dual | single dual | **+full (with limitations)** |
| **Proposal outcome** | | | |
| Submitted | 917 | 1133 | 1381 |
| Highest priority | 112 | 198 | 354 (35A, 319B) |
| Filler | 51 | 93 | 159 |
| Success rate | 12% (18%) | 17% (25%) | 26% (37%) |

## Pressure factors (highest priority projects)

- Cycle 1: Europe: 9.1 (global ALMA: 5.8)
- Cycle 2: Europe: 4.9 (global ALMA: 3.9)

# Early Science Cycle 2 projects

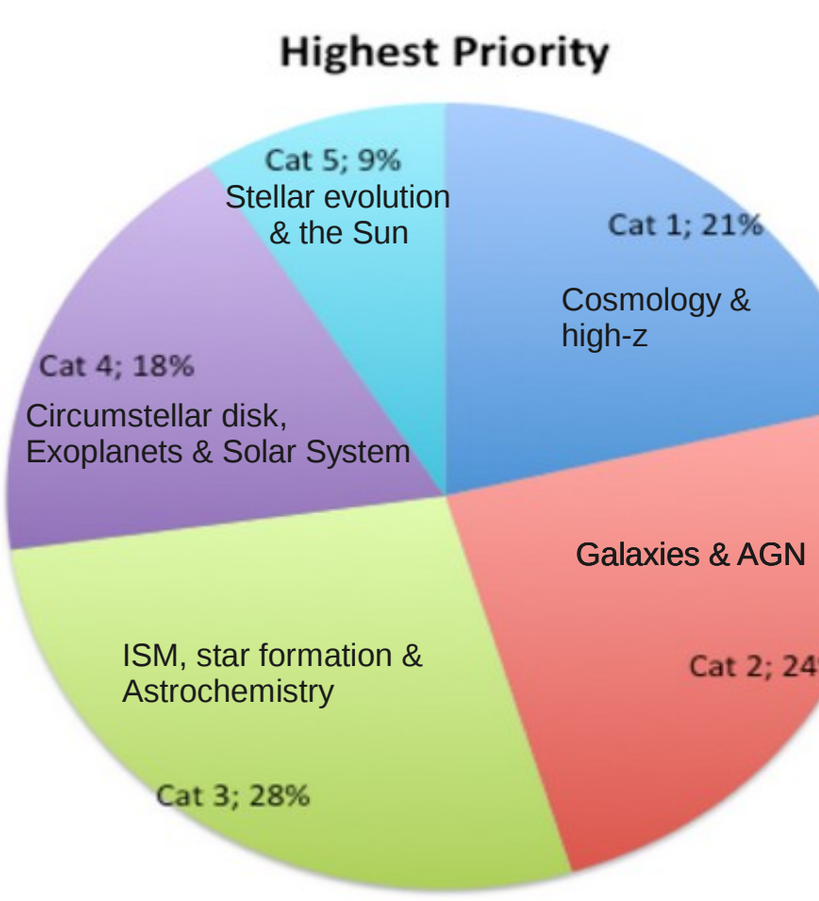

**FAQ**

PI - "How much time can I request?"

ARC -"In ALMA **you request to reach a certain sensitivity** justified by your science case. However..."

PI – Which band?

ARC - "The one you need, but high frequency bands are more weather dependent"



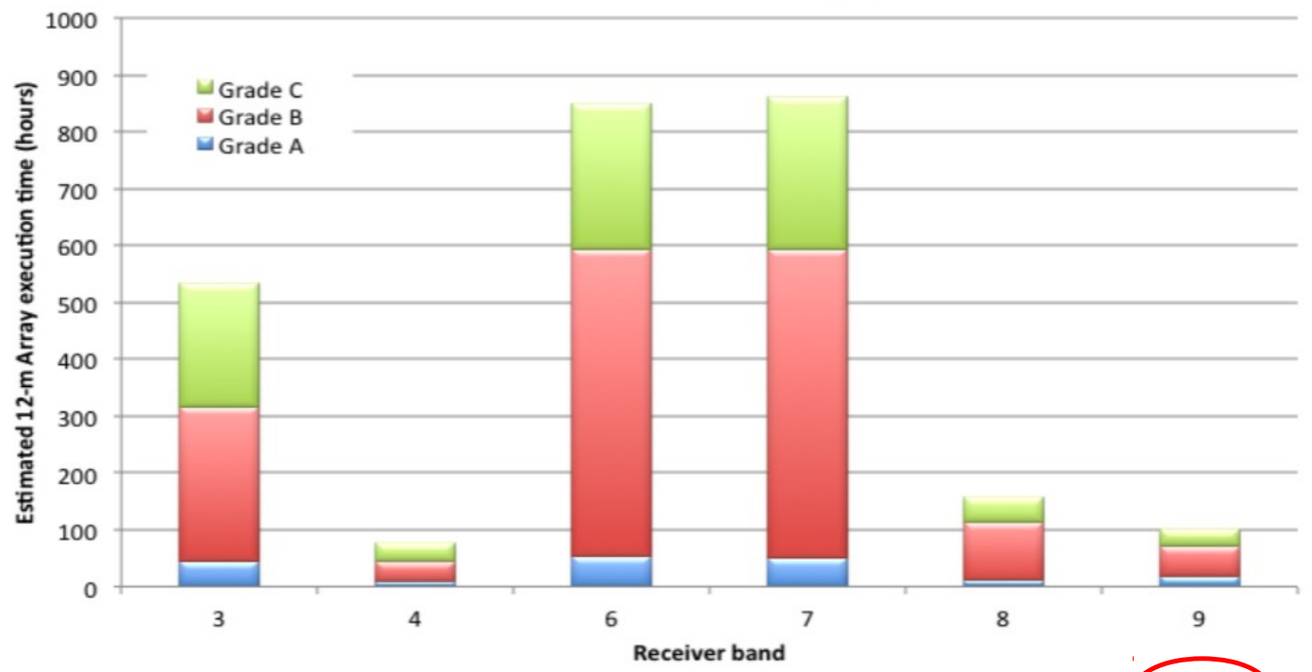




**Table 2: Estimated maximum fraction of observing time suitable for observations in each band in Cycle 3**

| ALMA Band | Band 3 | Band 4 | Band 6 | Band 7 | Band 8 | Band 9 | Band 10 |
|---|---|---|---|---|---|---|---|
| Fraction of time | 100% | 90% | 70% | 40% | 20% | 10% | 10% |

Unlikely executed in day-time and winter

# Early Science Cycle 3

| | | | | |
|---|---|---|---|---|
| **Hours dedicated to Science** | **2100 hours** | | | |
| **Antennas** | **> 36x12m main array + 10x7m+2TP ACA** | | | |
| **Receiver bands** | 3, 4, 6, | 7, | 8, 9, | **+ 10** |
| **Wavelengths [mm]** | 3.1, 2.1, 1.3, | 0.87, | 0.74, 0.44 | **+0.35** |
| **Baselines** | **up to 10 km** | **up to 5 km** | **up to 2 km** | |
| **Polarisation** | Single + Dual in all Bands<br>**Full Stokes** (with limitations) | | | |
| **Single dish** | **only spectral line in bands<8** | | | |
| **Correlator modes** | **mixed (simultaneous high and low resolution)** | | | |

| Date | Milestone |
|---|---|
| 24 March 2015 | Release of Cycle 3 Call for Proposals, Observing Tool & supporting documents |
| 24 March 2015 | Opening of the Archive for proposal submission |
| 23 April 2015 (15:00 UT) | Proposal submission deadline |
| August 2015 | Announcement of the outcome of the Proposal Review Process |
| 1 October 2015 | Start of ALMA Cycle 3 Science Observations |
| 30 September 2016 | End of ALMA Cycle 3 |

**15:00 UT = 17:00 CEST**

# Cycle 3 capabilities: receivers and spectral setup

**Table A-4: Properties of ALMA Cycle 3 Receiver Bands**

| Band | Frequency range[1] (GHz) | Wavelength range (mm) | IF range | Type |
|---|---|---|---|---|
| 3 | 84 – 116 | 3.6 – 2.6 | 4 – 8 | 2SB |
| 4 | 125 – 163 | 2.4 – 1.8 | 4 – 8 | 2SB |
| 6 | 211 – 275 | 1.4 – 1.1 | 5 – 10 | 2SB |
| 7 | 275 – 373 | 1.1 – 0.8 | 4 – 8 | 2SB |
| 8 | 385 – 500 | 0.78 – 0.60 | 4 – 8 | 2SB |
| 9 | 602 – 720 | 0.50 – 0.42 | 4 – 12 | DSB |
| 10 | 787 – 950 | 0.38 – 0.32 | 4-12 | DSB |

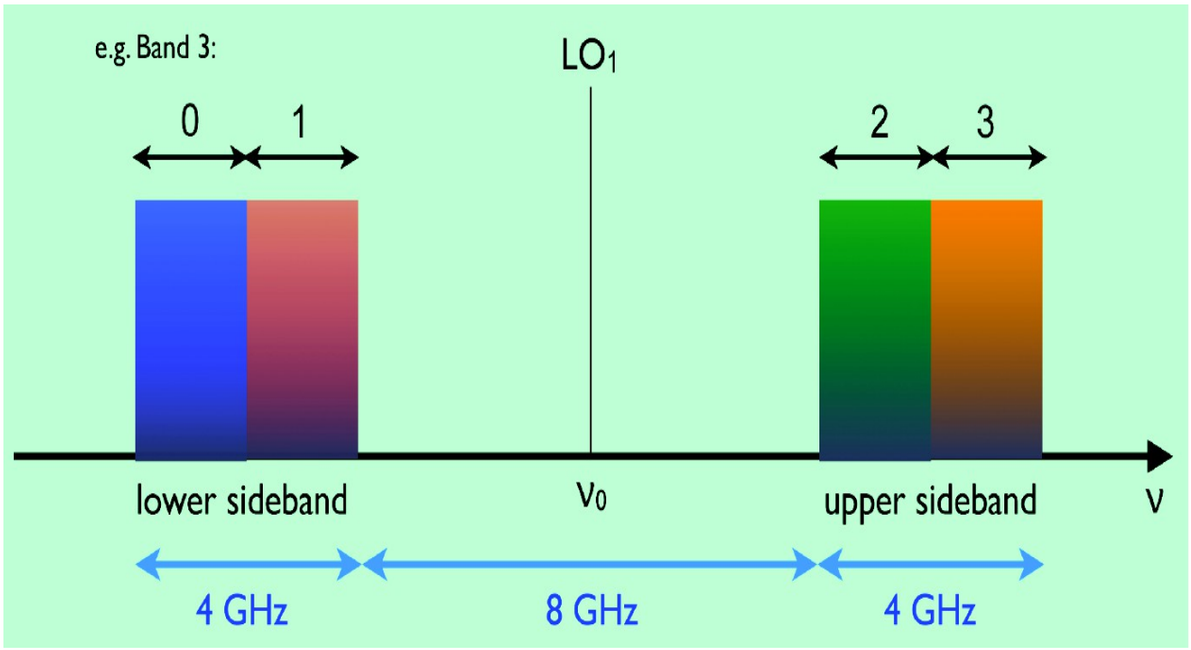
**Main array and ACA use separate correlators that offer the same setups.**

Time Division Mode (high sensitivity low spectral resolution) and Frequency Division Mode (Low sensitivity high spectral resolution) are available.

For each receiver 2 sidebands separated by 8-10 GHz
and up to 4 basebands per sideband are allowed.
Different correlator modes can be specified for each baseband

Up to 4 independent spectral windows (with up to 3840 channels) per baseband are allowed.
All spws within a given baseband must use the same correlator mode

Many channels observed at the same time imply high data rate.
**Maximum data rate allowed is 60MB/s,**
**but data rate above 6 MB/s must be technically justified.**
Data can be binned to reduce data rate at correlator stage.




(see Kazi's talk)

# Cycle 3 capabilities: receivers and spectral setup

**Table A-5: Properties of ALMA Cycle 3 Correlator Modes, dual-polarization operation [1,2]**

| Bandwidth[(3)] (MHz) | Channel spacing[(4)] (MHz) | Spectral resolution (MHz) | Number of channels | Correlator mode[(5)] |
|---|---|---|---|---|
| $2000^3$ | 15.6 | 31.2 | $128^3$ | TDM |
| 1875 | 0.488 | 0.976 | 3840 | FDM |
| 938 | 0.244 | 0.488 | 3840 | FDM |
| 469 | 0.122 | 0.244 | 3840 | FDM |
| 234 | 0.061 | 0.122 | 3840 | FDM |
| 117 | 0.0305 | 0.061 | 3840 | FDM |
| 58.6 | 0.0153 | 0.0305 | 3840 | FDM |

Continuum

Spectral lines

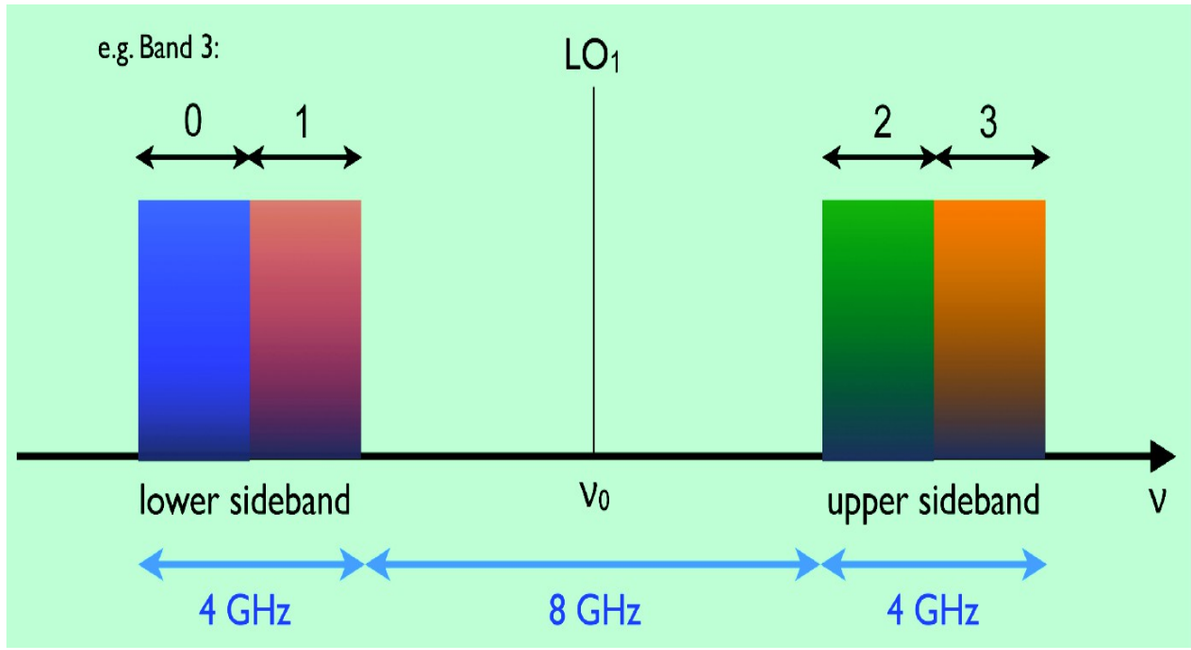
**Main array and ACA use separate correlators that offer the same setups.**

Time Division Mode (high sensitivity low spectral resolution) and Frequency Division Mode (Low sensitivity high spectral resolution) are available.

For each receiver 2 sidebands separated by 8-10 GHz
and up to 4 basebands per sideband are allowed.
Different correlator modes can be specified for each baseband

Up to 4 independent spectral windows (with up to 3840 channels) per baseband are allowed.
All spws within a given baseband must use the same correlator mode

Many channels observed at the same time imply high data rate.
**Maximum data rate allowed is 60MB/s,**
**but data rate above 6 MB/s must be technically justified.**
Data can be binned to reduce data rate at correlator stage.




(see Kazi's talk)

# Cycle 3 capabilities: angular scales

**Maximum Recoverable Scale[1] and Coarsest and Finest Angular Resolutions[1] for the Cycle 3 12-m Array configurations**

| Frequency | Maximum Recoverable Scale without ACA[2,3] | Coarsest allowed angular resolution[2,3,4] | Finest achievable angular resolution[2,3,5] |
|---|---|---|---|
| (GHz) | (arcsec) | (arcsec) | (arcsec) |
| 100 | 25.3 | 6.8 | 0.075 |
| 150 | 16.9 | 4.6 | 0.050 |
| 230 | 11.0 | 3.0 | 0.030 |
| 345 | 7.3 | 2.0 | 0.034 |
| 460 | 5.5 | 1.4 | 0.060 |
| 650 | 3.9 | 1.0 | 0.040 |
| 870 | 2.9 | 0.8 | 0.030 |

**Maximum Recoverable Scales for ACA 7-m**

| Frequency (GHz) | Maximum Recoverable Scale[1,2] (arcsec) |
|---|---|
| 100 | 42.8 |
| 150 | 28.5 |
| 230 | 18.6 |
| 345 | 12.4 |
| 460 | 9.3 |
| 650 | 6.6 |
| 870 | 4.9 |

(see Rosita's talk)

## News

- ALMA WebQL and Vissage are open to the public (2012-11-14)
- IVOA Newsletter Vol.9 (2012-10-30)
- JVOSky updated (2012-06-30)
- ALMA SV data archive is now available (2012-05-26)
- IVOA Newsletter Vol.8 (2012-05-26)
- Suprime-Cam archive is updated (2012-03-15)
- Registered user login is now available (2011-12-16)
- HDS archive is updated (2011-12-16)
- IVOA Newsletter Vol.7 (2011-12-16)
- Data of photometric calibration with standard stars are added in the Suprime-Cam page (2011-09-17)

## Registration

- Read "about

# Service Contents Help(J)

### Data Search

- Quick Search
- Single VO Service
- Multiple VO Services
- JVO Sky
- JVOQL Search

### Subaru

- Suprime-Cam
- HDS
- MOIRCS

### ALMA

- ALMA SV Data
- ALMA Archive

### Surveys

- Subaru Deep Survey
- IRSF Survey

### Service Search

- Keyword Search
- Category Search (Auto)
- Category Search (Manual)
- Advanced Search

### JVO Space

- Home
- Work

### Astro Tools

- Source Extractor
- HyperZ

### Bookmark

- Bookmark of VOService
- Bookmark of JVOSpace

Quick Look System for ALMA VO Service - Mozilla Firefox

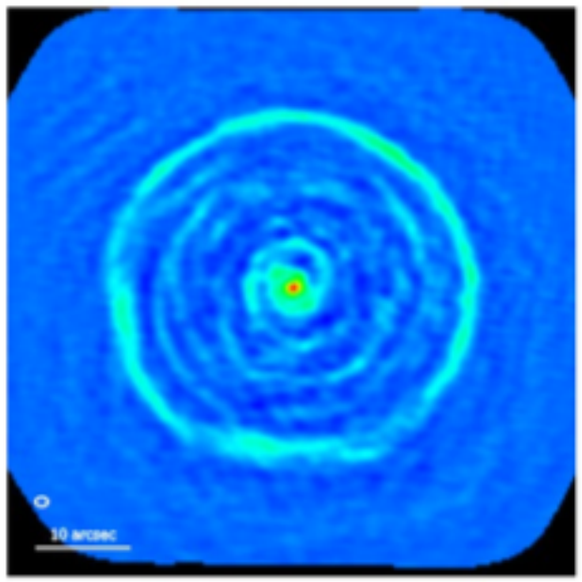
Quick Look System for ALMA VO Se...

jvo.nao.ac.jp/almawebql/ALMAWebQL.html?path=http%3A%2F%2Flocalhost%3A8060%2Fskynode%2Fdo%2Ftap%2Falma_int%2Fsync%3FREQUEST%3DdoQ

ADS | Web of Science | サイボウズ | NAOJ | ALMA | ALMA-J | TwikiICT | TwikiChile | TwikiNAOJ | JiraICT | JiraChile | JiraNRAO | JiraNAOJ | User

**File Information**

| • Title | • Data Set ID | • Observation Date (UT) | • File Size |
|---|---|---|---|
| R Scl | ALMA01000003 | 2011/11/03 10:21:50 | 100.42 MB |




Resolution :

Enumerate...

Zoom :

Enumerate...

Log Scale

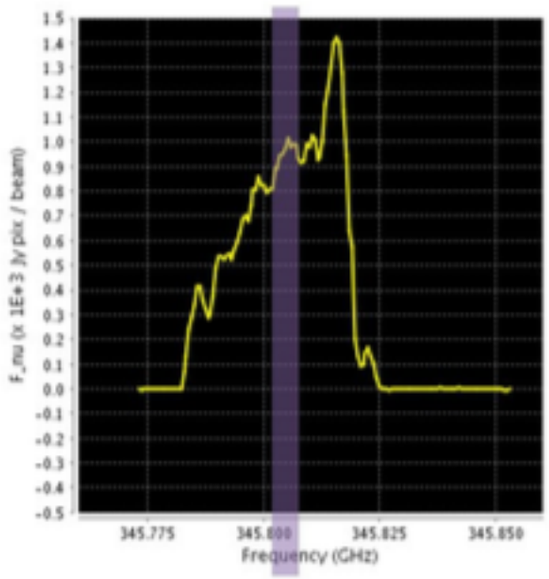
Res. : 300.0 mas/pix

Zoom : x2

R.A. : 01h26m57.98s

Dec. : -32d33m05.904s

Select Sub-region




Resolution :

Enumerate...

Temperature

Log Scale

Res. : 576.726 kHz/ch

345.744 GHz

Back to Pan Mode

Force Reload | Print | Download Viewing FITS | Back to Information Page

ready.

# ALMA, c'est quoi ?

- 50 antennes de 12m de diamètre à 5000m d'altitude

- Observant à des fréquences entre 30-1000 GHz (cad 0.3-10mm) grâce à 10 récepteurs

- Distance min/max entre 2 antennes (ligne de base) : 150m-16km (diamètre de la télescope synthétisé):

Pouvoir de résolution <10 mas (détails (pixel) de l'ordre de 10m sur la Lune depuis la Terre). Distinguer 2 pièces de 1 centime à Orleans

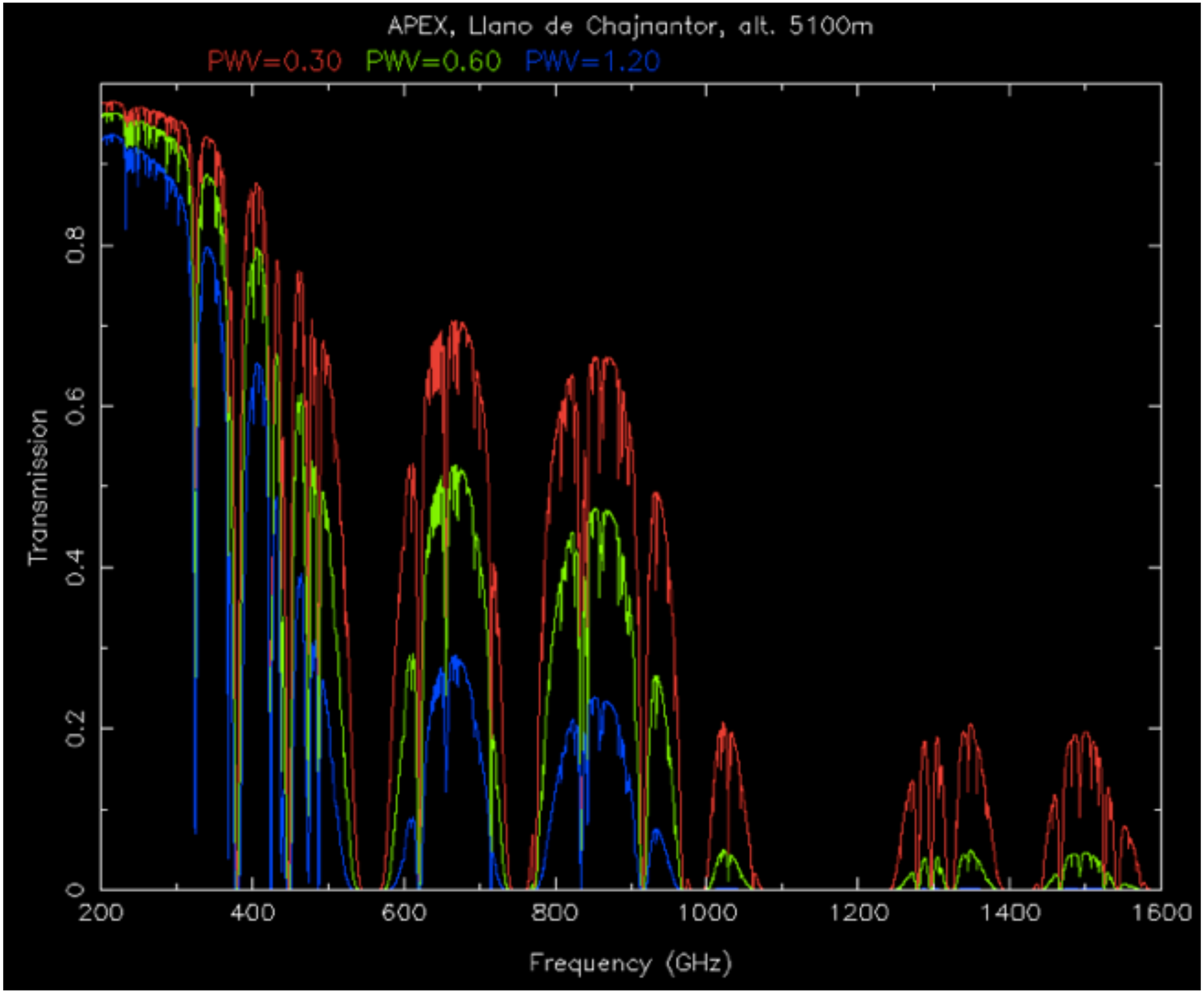
- ALMA Réseau Compact: 4 antennes de 12m + 12 antennes de 7m

# ALMA, c'est quoi ?

ALMA est une collaboration internationale entre:

ESO – Europe (14 états membres)
NRAO – Amerique du Nord (USA, Canada)
NAOJ – Asie (Japon, Taiwan),

Et en collaboration avec le Chili où est construit l'instrument (désert de Chajnantor). Coût: ~1.2 milliard €, partagé par l'ensemble des partenaires


APEX, Llano de Chajnantor, alt. 5100m
PWV=0.30
PWV=0.60
PWV=1.20
Transmission
0
0.2
0.4
0.6
0.8
200
400
600
800
1000
1200
1400
1600
Frequency (GHz)

# Cycle 3 Proposal Types

- **Standard** (including also time-critical, multiple-epoch observations, and continuous monitoring of a target over a fixed time interval within Cycle 3).

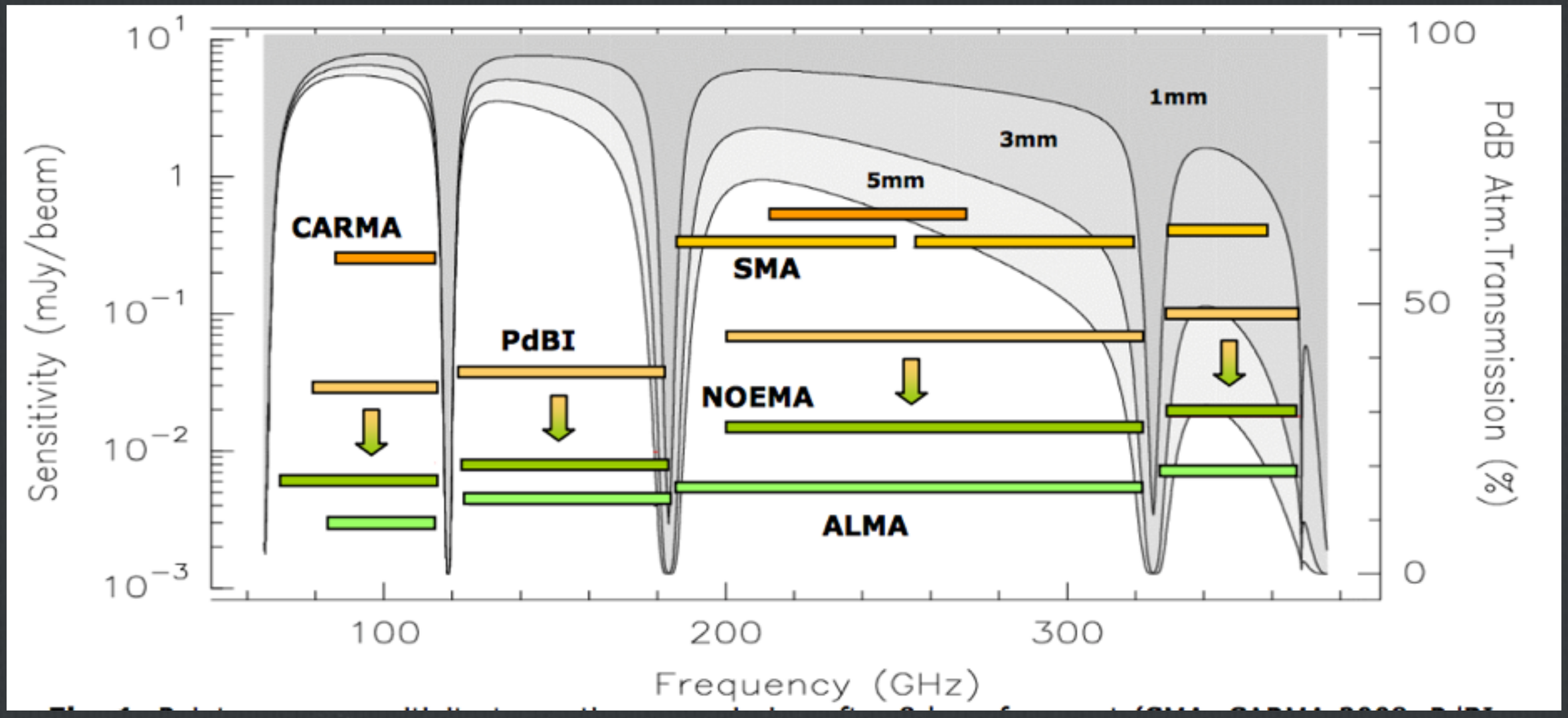
- **Target of Opportunity (ToO)**: to observe targets that can be anticipated but not specified in detail.

  ToO and time-constrained projects requiring a time window smaller than 14 days will not be guaranteed but attempted on a best effort basis

- **Director's Discretionary Time (DDT)** proposals may be submitted at any time during Cycle 3

  - Proposals requiring the immediate (within 2 weeks) observation of an unexpected astronomical event
  - Proposals requesting observations on a highly competitive scientific topic
  - Follow-up observations of a program recently conducted with ALMA or any other observing facility, where a quick implementation is expected to provide breakthrough results

| | Altitude (m) | $N_{ANT}$ | Diameter (m) | Coll.Area ($m^2$) |
|---|---|---|---|---|
| IRAM PDBI | 2550 | 6 | 15 | 1060 |
| CARMA | 2200 | 15 | 6/10 | 772 |
| SMA+CSO+JCMT | 4080 | 10 | 6/10/15 | 481 |
| NMA | 1340 | 6 | 10 | 471 |
| IRAM NOEMA | 2550 | 12 | 15 | 2120 |
| ALMA | 5060 | 50 | 12 | 5652 |



# ALMA sites in Chile


AOS
Antenas
Power
Fiber Optic Network
Local Oscilator (Timing)
Correlator


OSF
Hotel
Archive
Laboratoreo
Maintenance
Array Control Center
Integration Center

SCO
Main Archive
Data Transmmition
to the ALMA
Regional Center
Offices:
-Science
-Computing
-Administration
-Management

| | Altitude (m) | $N_{ANT}$ | Diameter (m) | Coll.Area ($m^2$) |
|---|---|---|---|---|
| IRAM PDBI | 2550 | 6 | 15 | 1060 |
| CARMA | 2200 | 15 | 6/10 | 772 |
| SMA+CSO+JCMT | 4080 | 10 | 6/10/15 | 481 |
| NMA | 1340 | 6 | 10 | 471 |
| | | | | |
| IRAM NOEMA | 2550 | 12 | 15 | 2120 |
| ALMA | 5060 | 50 | 12 | 5652 |