ALMA Cycle 3 Capabilities & proposal preparation

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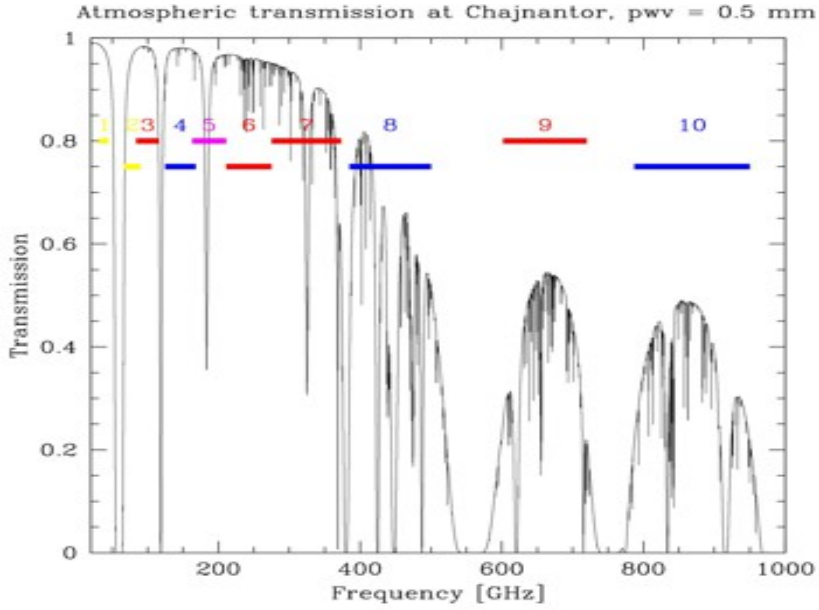
EUROPEAN ARC
ALMA Regional Centre || Italian

ALMA full array

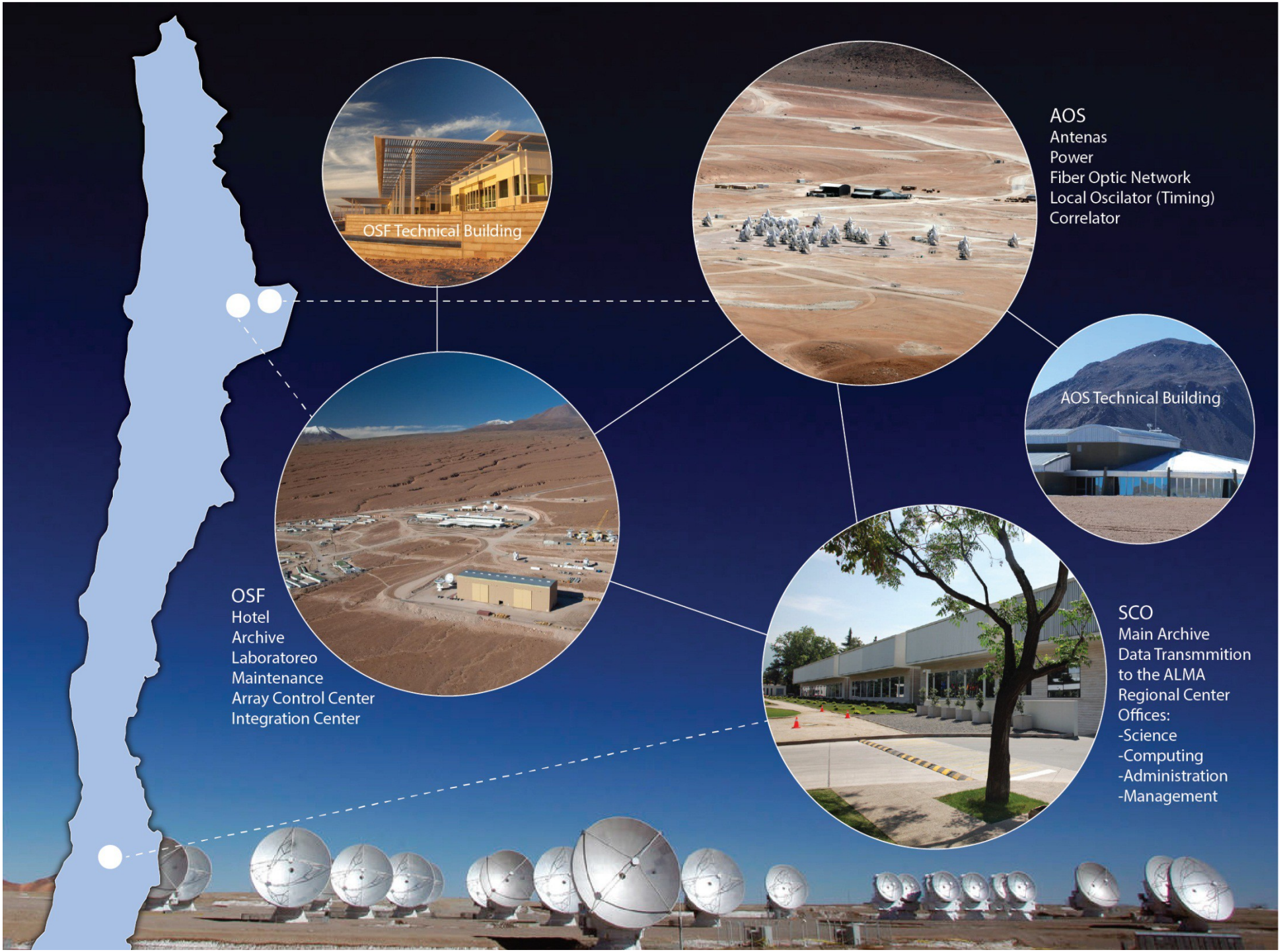
The Atacama Large Millimeter Array is a **mm-submm reconfigurable interferometer**

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



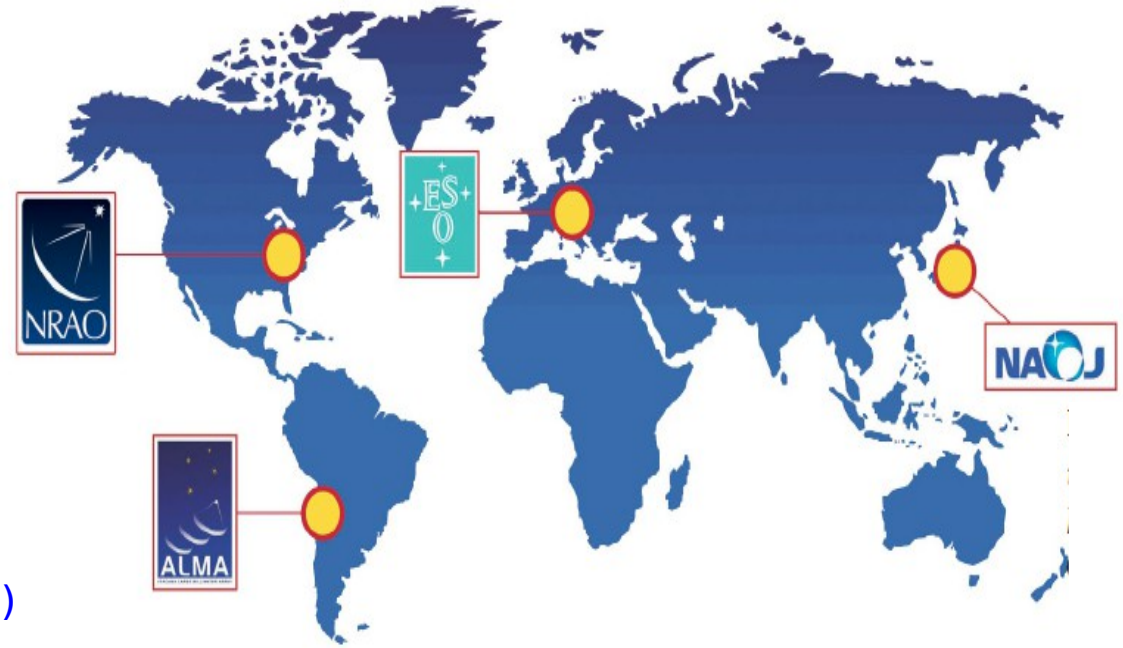
ALMA sites in Chile



ALMA organization

World wide collaboration

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

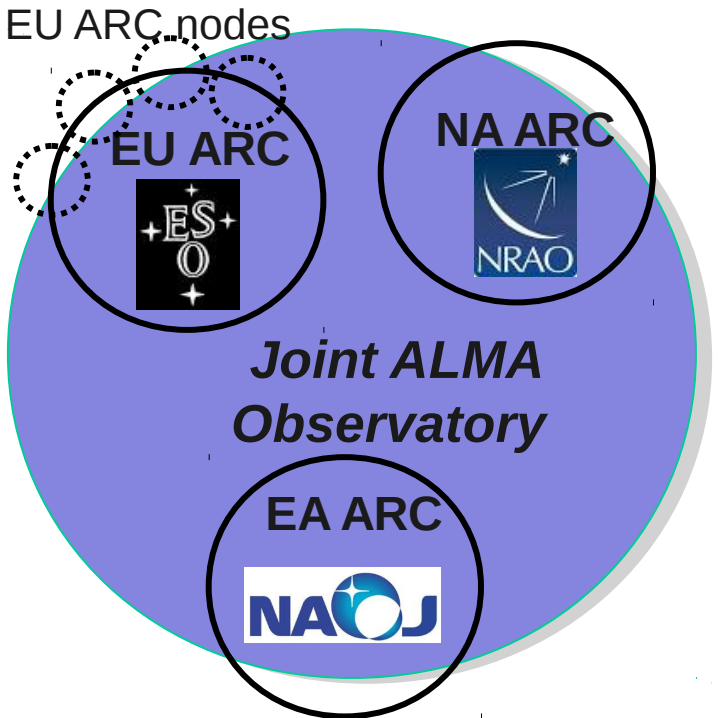


Contributors share the observing time

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

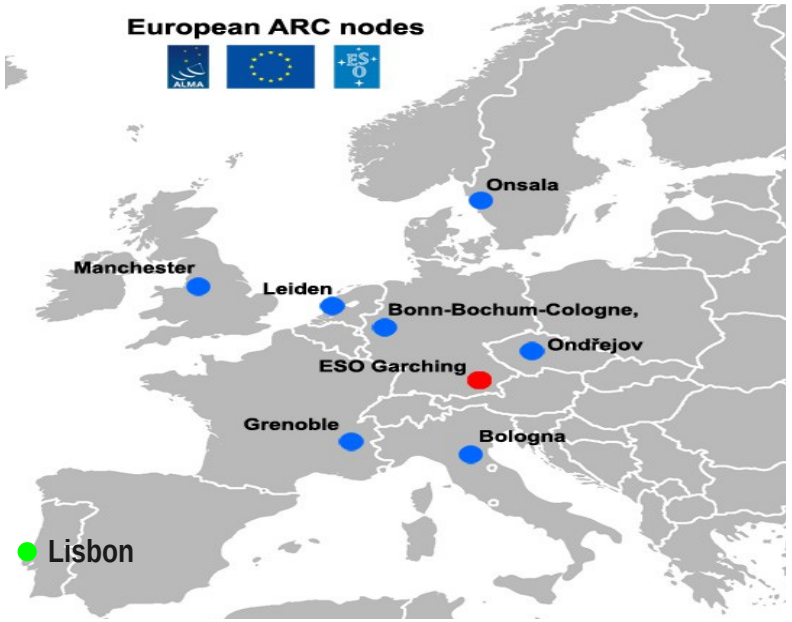


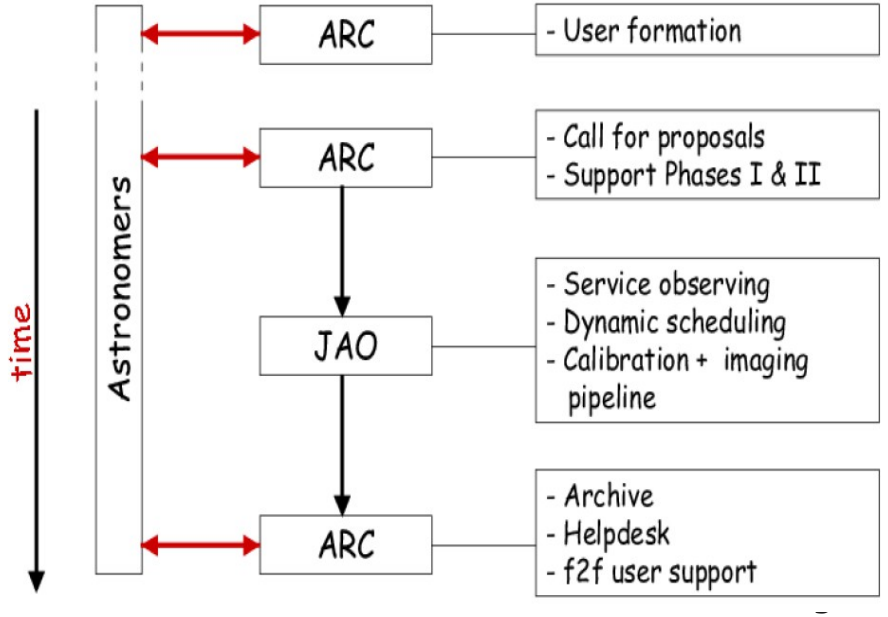
ALMA Regional Centres

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

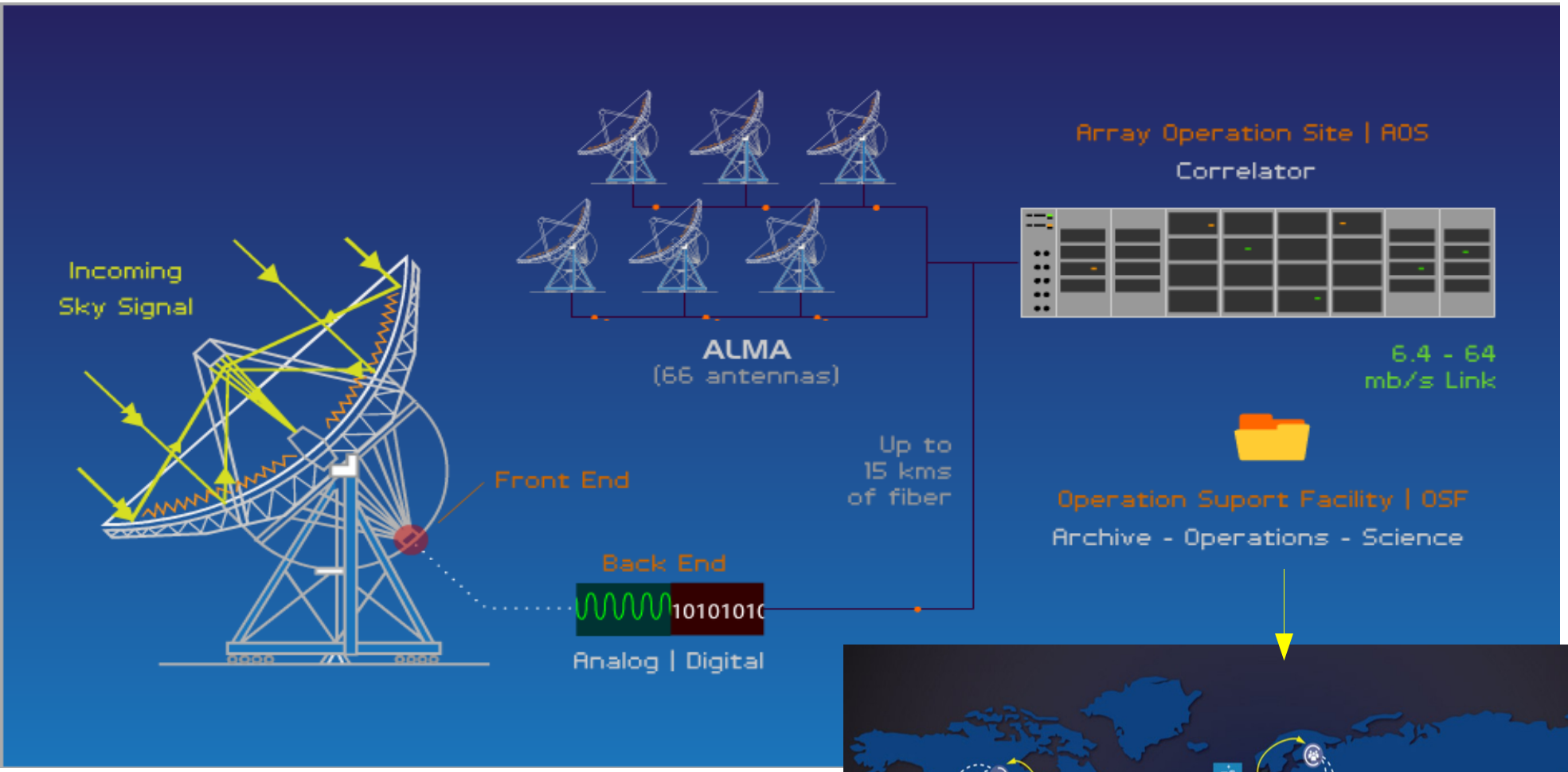
The ARCs

- **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

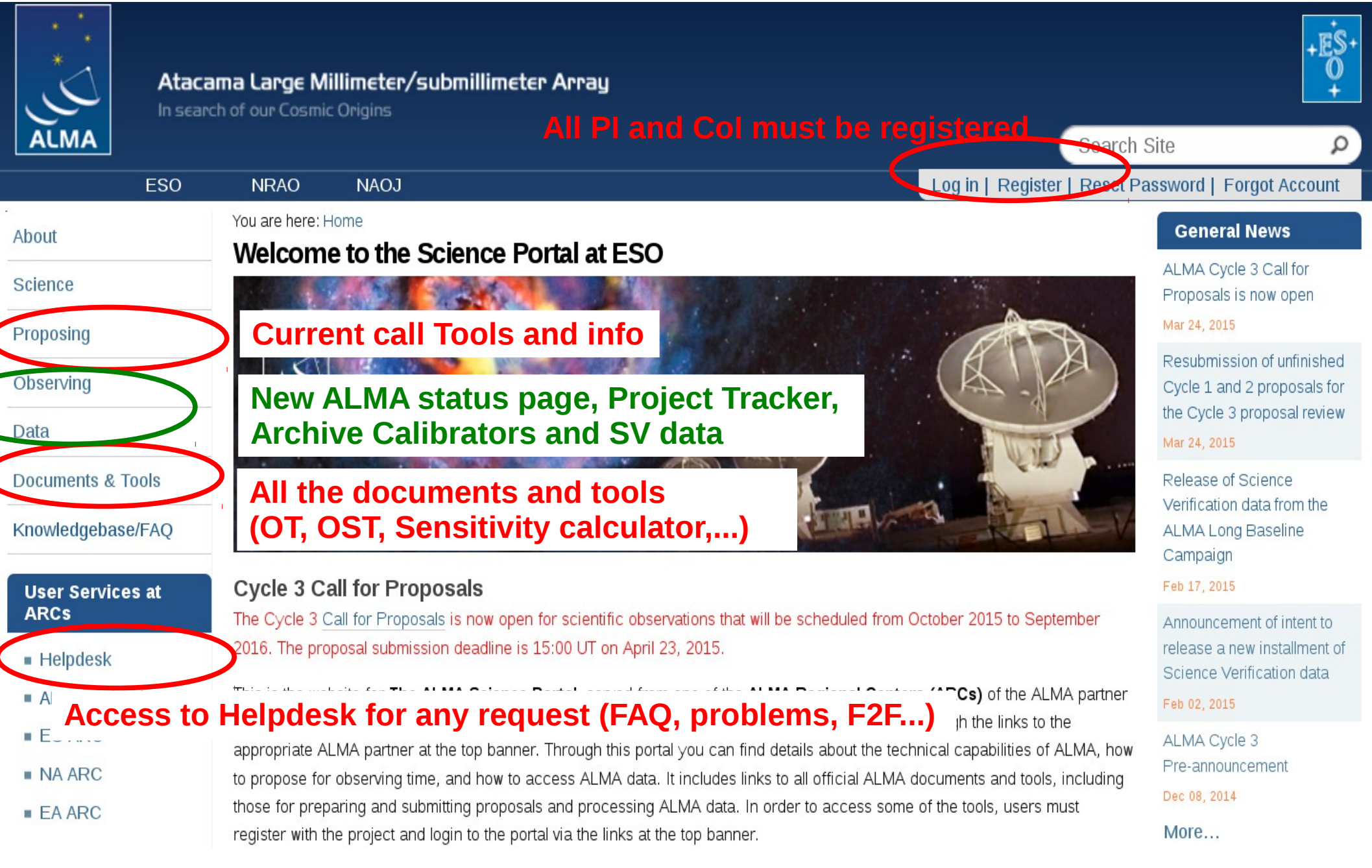


Data is collected, reduced and archived.
All the “almost” raw data is archived.

Each ARC hosts an archive mirror.

Enter the ALMA world through the ALMA Science Portal

http://almascience.eso.org/



A project lifetime: phase 1

PI has a good idea!	
PI estimates feasibility	Simulations are not compulsory (Sensitivity Calculator, OST, CASA)
PI splits project in Science Goals	**Minimum proposed observational unit including targets in the same sky region that roughly share the same calibration and spectral setup**
PI writes the science case in pdf and register to the Science Portal	Max 4 page, font no smaller than 12, all included (<20MB) www.almascience.org
PHASE I – Proposal submission	With the ALMA Observing Tool (OT) A copy of the project with the project ID must be saved and should be used for any resubmission within the deadline
TAC evaluation	**A**=high ranked pass to Cycle 4 if not finished **B**=high ranked but not passed over **C**=maybe filler (depends on time shares and ranking)

A project lifetime: phase 2

PHASE II – Observing process	Each SG is converted into a **Scheduling Block**
SB generation	Interacting with a Contact Scientist the PI checks the SB and finally approves them
Observations	**Projects are dynamically scheduled according to telescope configuration, weather, ranking, project status...**
Quality assessment	**QA0 and 1 = telescope conditions** **QA2 = Check for PI sensitivity requests** **Performed by ARC staff**
Data archival and delivery	**1 yr of proprietary period before data are public through the archive**

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 Sep. 2011 – Jan. 2013	Cycle 1 Jan. 2013 – May. 2014	Cycle 2 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

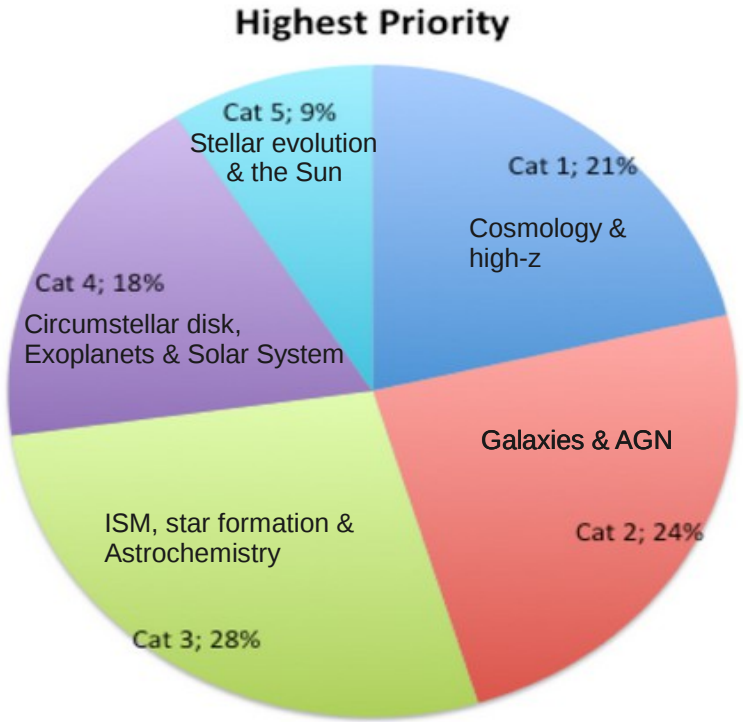
FAQ

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"



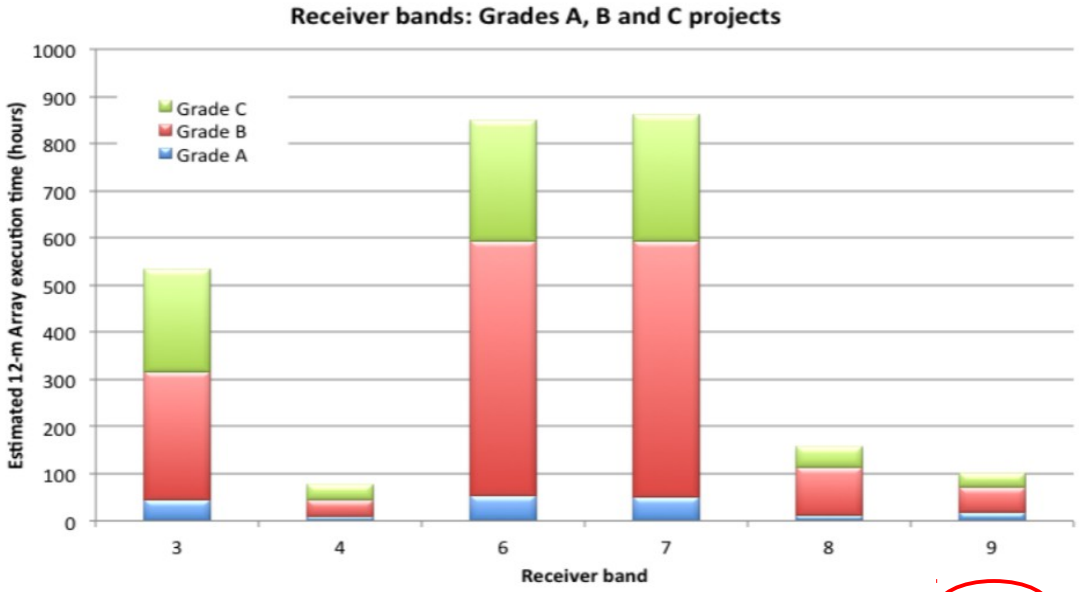


Table 2: Estimated maximum fraction of observing time suitable for observations in each band in Cycle 3

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 **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

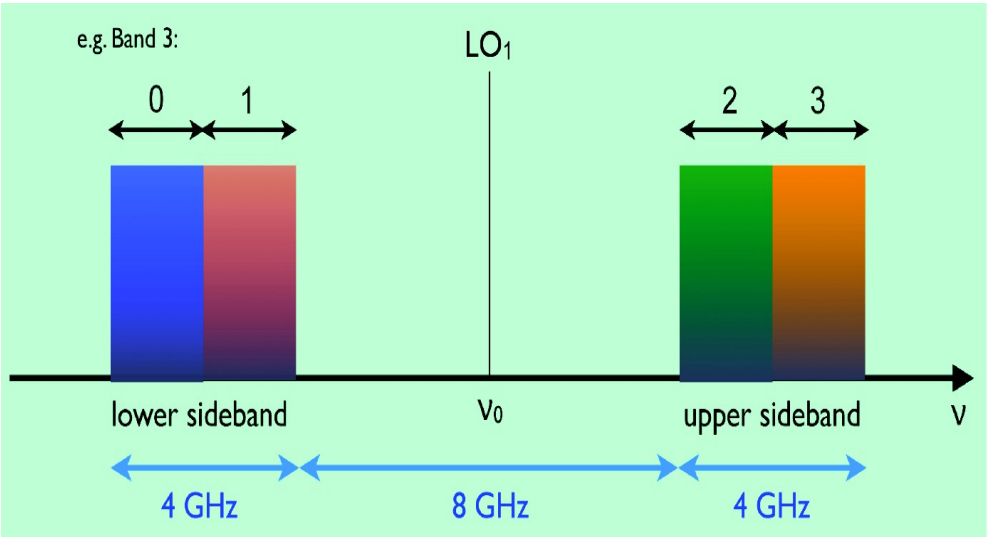
Main array and ACA use separate correlators that offer the same setups.

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.

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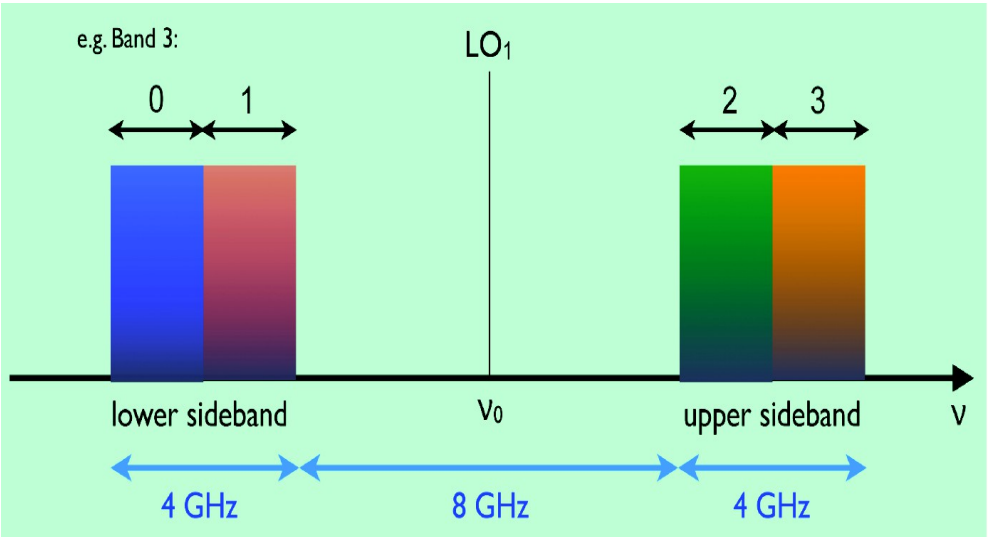


(see Kazi's talk)

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)

Cycle 3 standard vs non-standard modes

Standard modes are pipeline-calibrated and imaged and quality is guaranteed
Non-standard mode observations are conducted on a best effort basis.
Up to 25% of time will be assigned to non-standard mode projects:

- **Bands 8,9 and 10** - only day-time in summer
  - discarded if requires more than 2h of good weather continuously
- **Baselines >2km**
- **Polarization**
  - **only main Array, continuum, B3, B6, B7,**
  - **no ACA, no mosaics, no spectral line, no circular polarization**
  - Sources must have angular scale < 1/3 primary beam $_{\text{main array}}$
  - min 3hr/SG observations for calibration issues
- **Spectral Scans** **automatic setting of spectral windows to cover a frequency range**
  - <5 spectral windows per band,
  - only 1 pointing/target (no mosaic or offset)
  - targets * tunings <150
  - no ACA, no polarization
- **Spectral setups with only narrow band spectral window**
  - aggregate bandwidth <934MHz
- **User-defined calibration**

Proposals with SG in non-standard modes outside the 25% of time will be graded C

Cycle 2: Limitations & time available

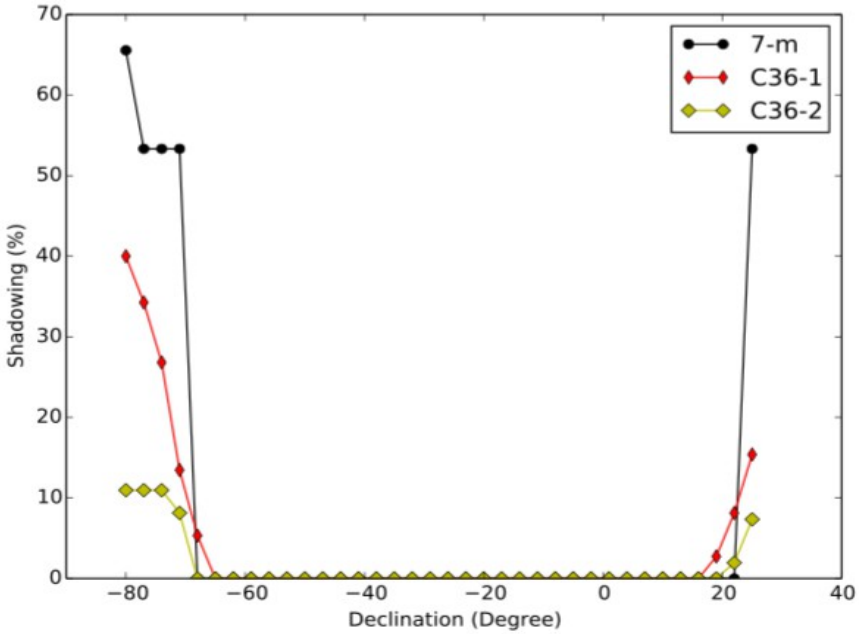
Pointing: **≤ 150 pointings in the same Science Goal** (single pointings or mosaic pointings).
Individual pointings separated <10° and with the same spectral setup

Observing Time: **≤ 100 hrs per proposal** as estimated by Observing Tool (sum of all the array used)

Declination: Shadowing Problem:

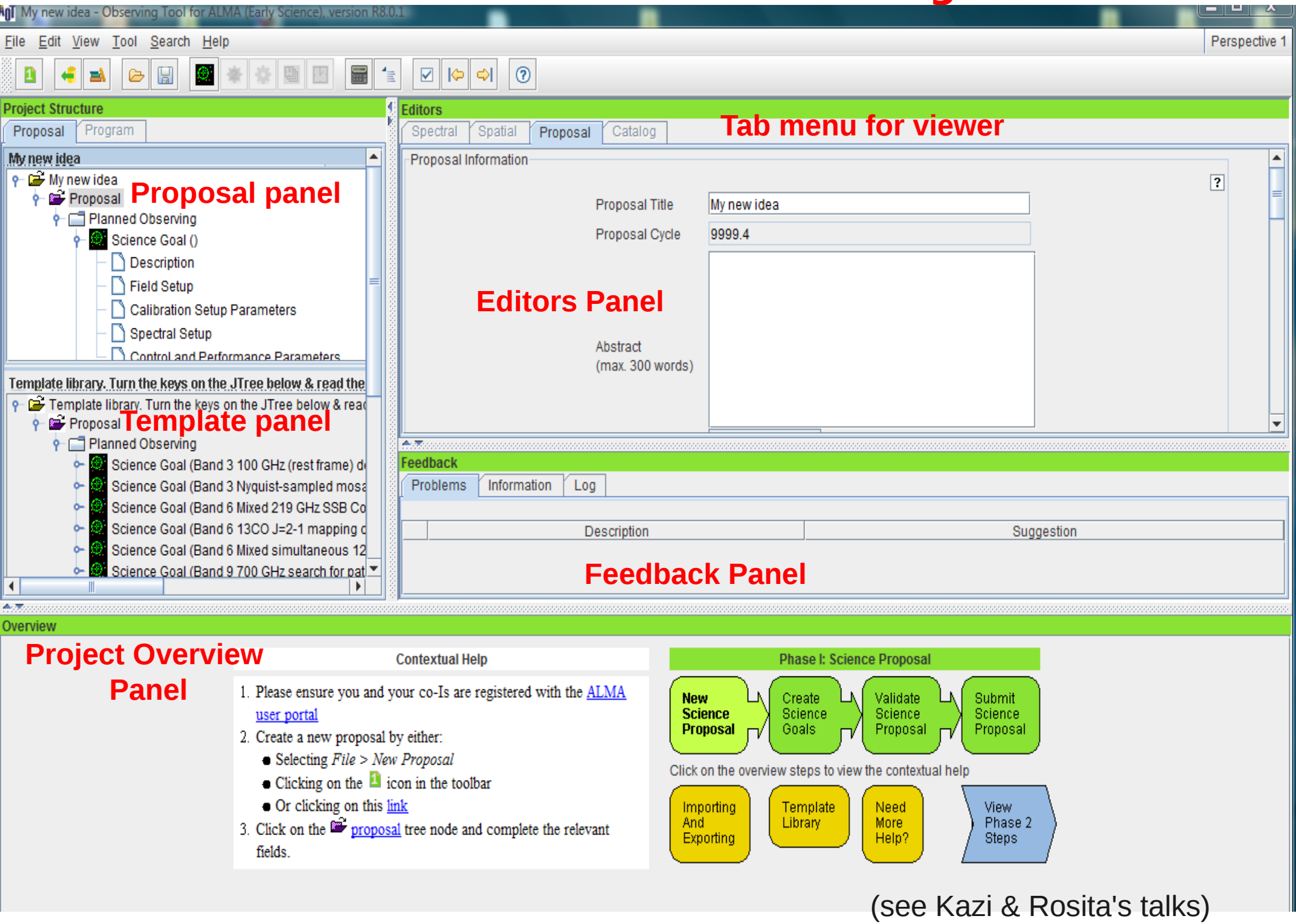
Main Array: **NO Dec < -75 deg, Dec > +25 deg (in compact config.)**
ACA: **NO Dec < -70 deg, Dec > +20 deg**

Moving Targets allowed
No solar observations



Array: **ACA and TP antennas are available only to complement 12m array observations of extended emissions** according to the OT suggestions
(the OT estimates also the time needed as sum of the time on each array)

Submit with the ALMA Observing Tool



(see Kazi & Rosita's talks)

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

The science case & the duplications

Science categories used to distribute the proposals for review to the most qualified assessors:

- Cosmology and high z universe
- Galaxies and galactic nuclei
- ISM, star formation and astrochemistry
- Circumstellar disks, exoplanets and Solar system
- Stellar evolution and the Sun

Science case is limited to 4 pdf pages (A4, font size no smaller than 12 points) including:

- science case (recommended 2 pages)
  - describe the astronomical importance
  - include a clear statement of its immediate observing goals
  - explain how the expected intensity of the target source(s) was estimated
  - justify requested snr and angular scales
- figures and tables
- potential for publicity

Proposals must be self-contained. Use the latex template available on the SP!

Cycle 3 proposals will be checked for duplication against Cycle 1 and 2 projects that have archived data at the time of the Cycle 3 proposal deadline. Duplication is checked on SG basis. Check the Duplication page on the Science Portal (link in “Proposing”) to check for your targets and the duplication conditions on the User policies (“Documents & Tools”).

Observations are considered duplicates if **all** the following conditions are met:

- Target field location (or less than 50% overlap of a mosaic region)
- The highest angular resolution differ by a factor <2.
- Spectral windows overlaps by more than 50% (in TDM) or >50% of the lines overlaps (in FDM)
- Spectral resolution in overlapping spectral windows differ by a factor <2.
- The requested rms differ by a factor <2.

Repetition of SG proposed by the same group, if deemed necessary, must be scientifically justified.

The technical justification

The Technical Justification for each SG is entered in text box in a dedicated OT panel divided in:

- **sensitivity**
- **imaging**
- **correlator setup**

The OT automatically identifies user choices that should be justified in dedicated text boxes to be filled:

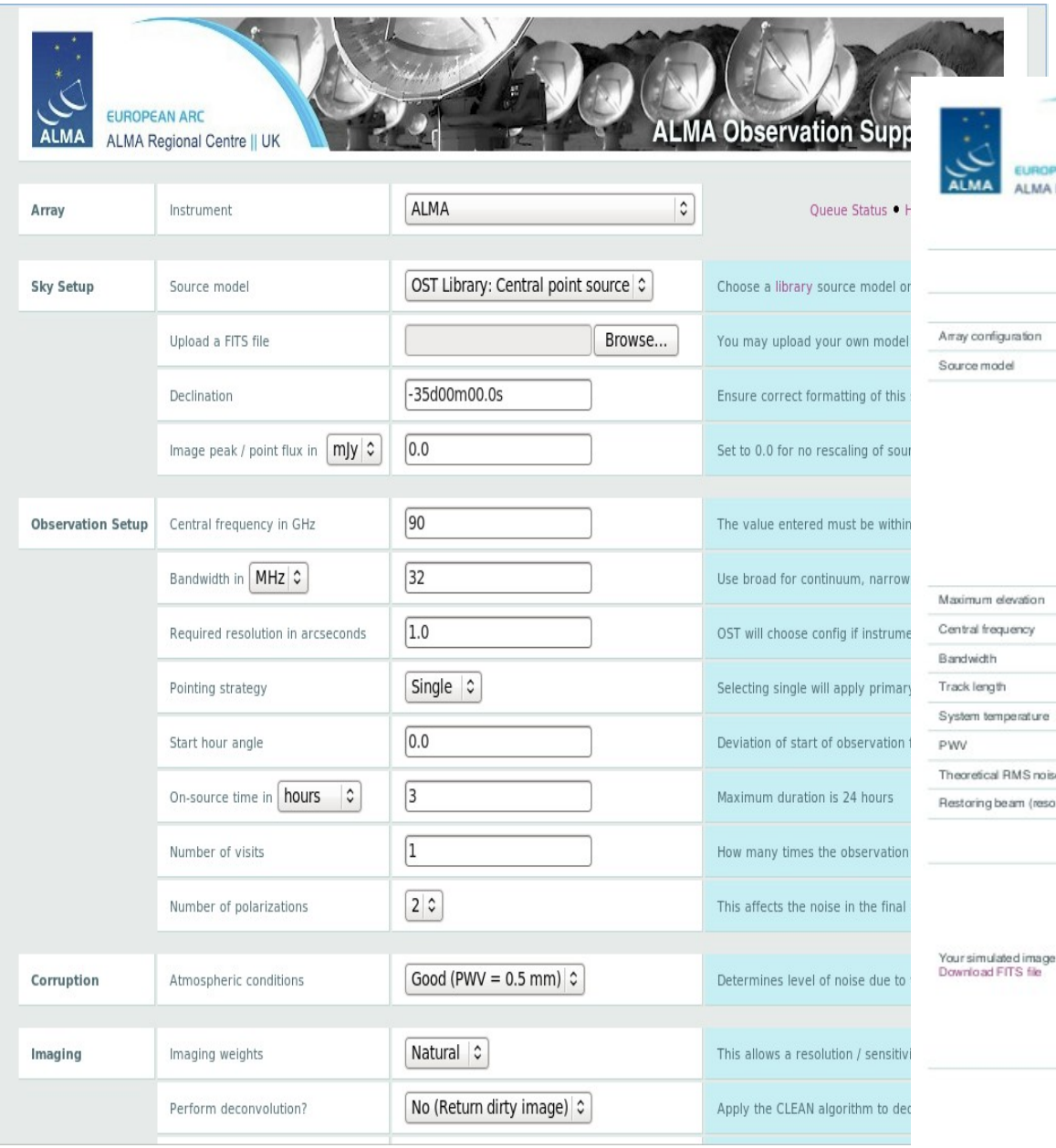
- data rate
- Override of OT time estimate
- scheduling/time constraints
- user-defined calibration
- low elevation
- single polarisation
- non-Nyquist mosaic sampling

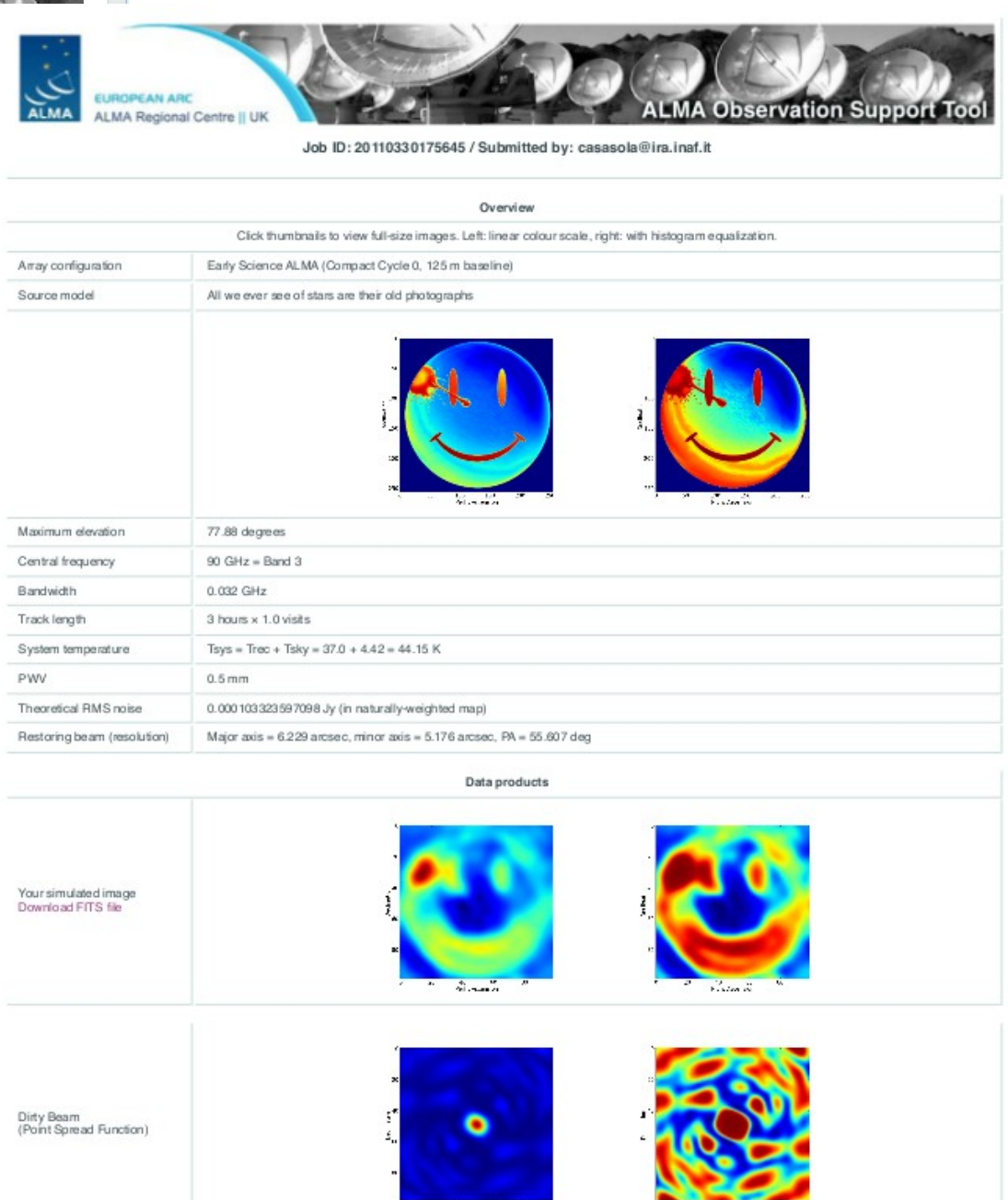
Make your ALMA simulations (Observation Support Tool)

http://almaost.jb.man.ac.uk/

Submit a request for a full simulation of ALMA capabilities for your target

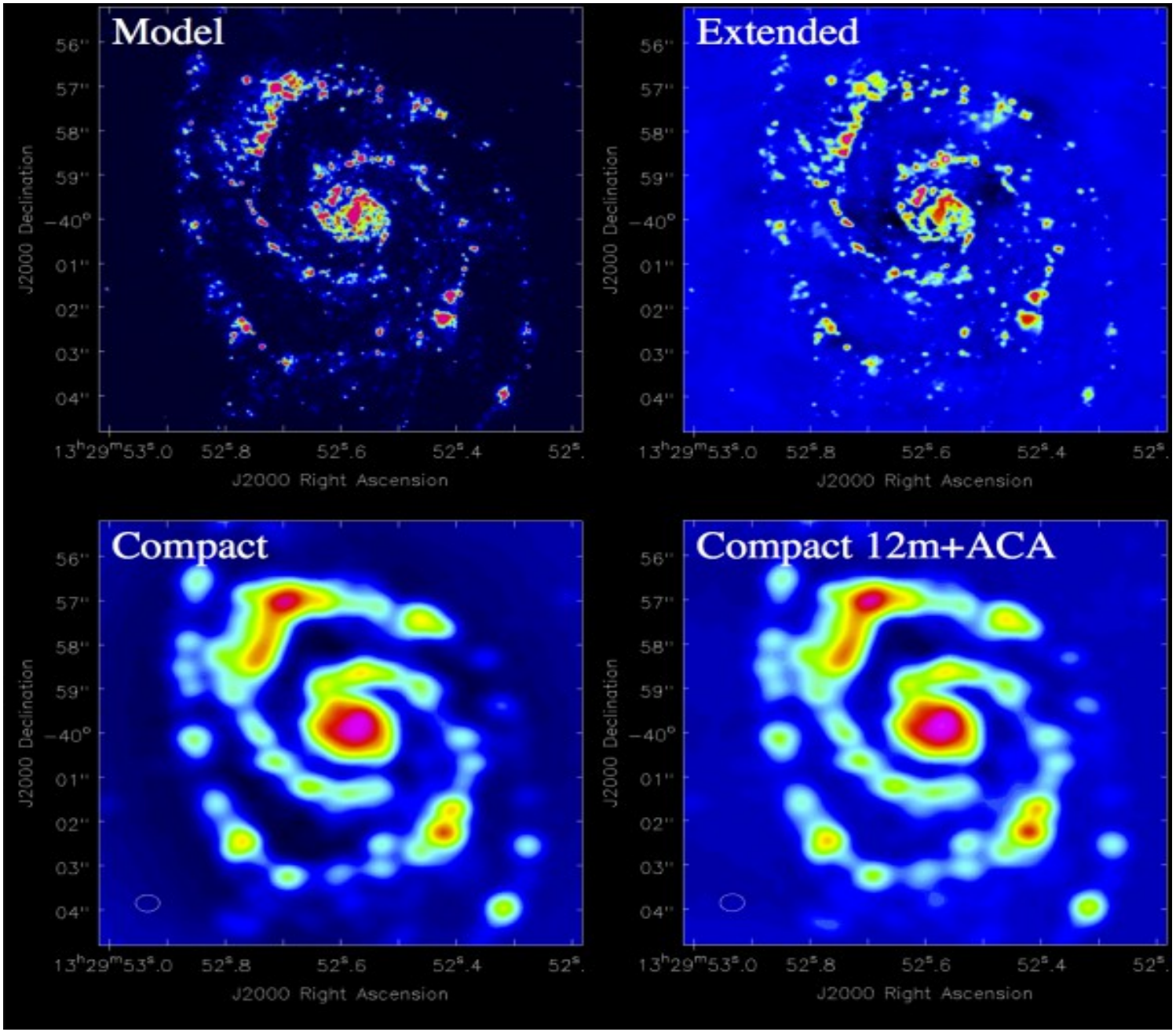
Receive the results via e-mai





(see Rosita's talk)

Make your ALMA simulations (CASA simalma, simobserve, and simanalyze)



The task **simobserve** generates a data set with simulated visibilities based on an input model image.

The task **simanalyze** produces a cleaned image based on the simulated visibilities, and it generates some diagnostic images.

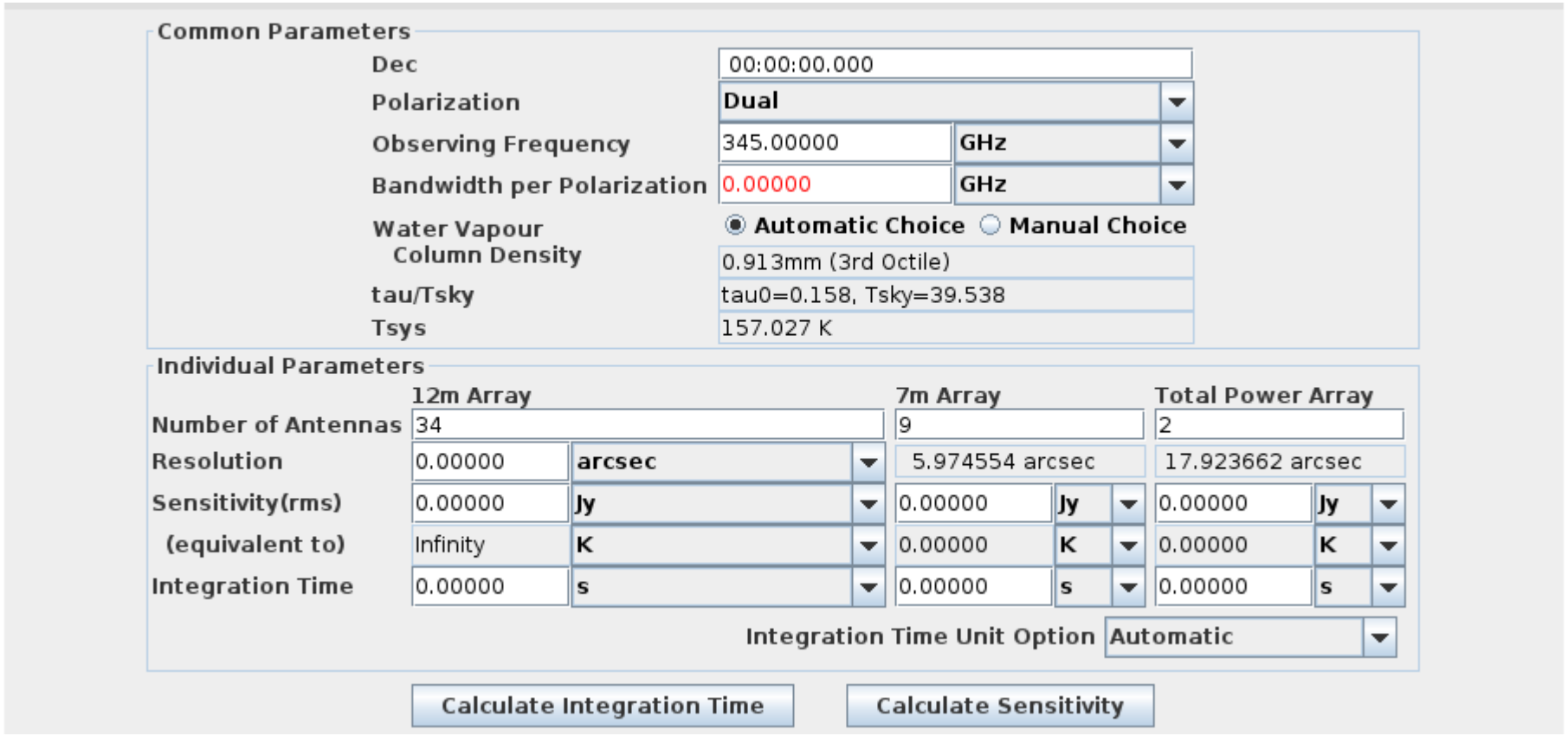
CASA also provides the task **simalma** that simplifies the steps needed to simulate ALMA observations that combine data from multiple arrays or multiple configurations.

Who needs CASA for simulations today and wants to access to our cluster can ask for an account

(see Rosita's talk)

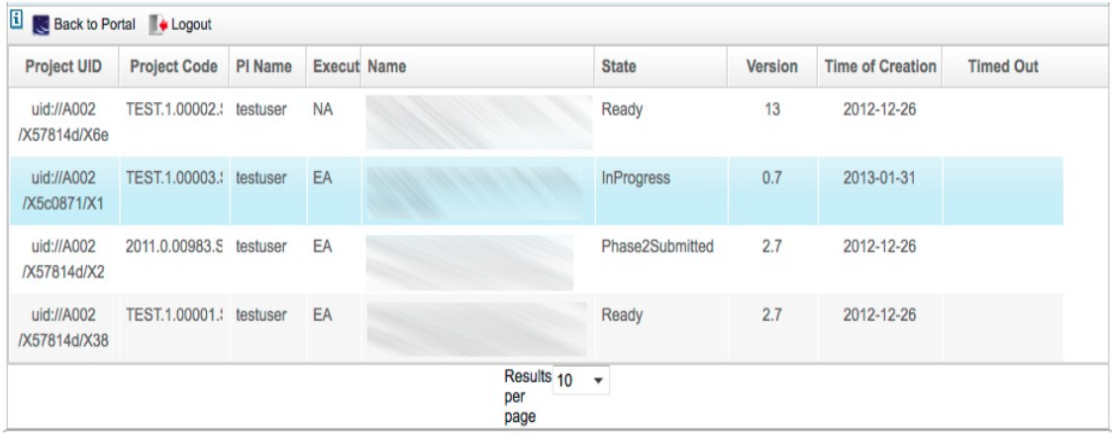
The Science Goal: Sensitivity Calculator

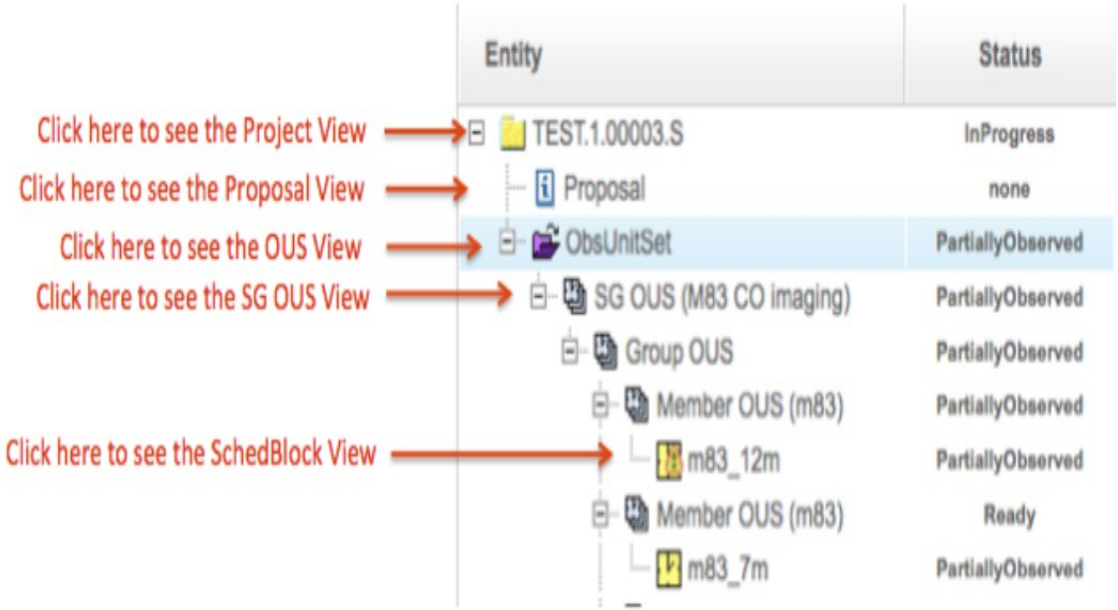
http://almascience.eso.org/call-for-proposals/sensitivity-calculator

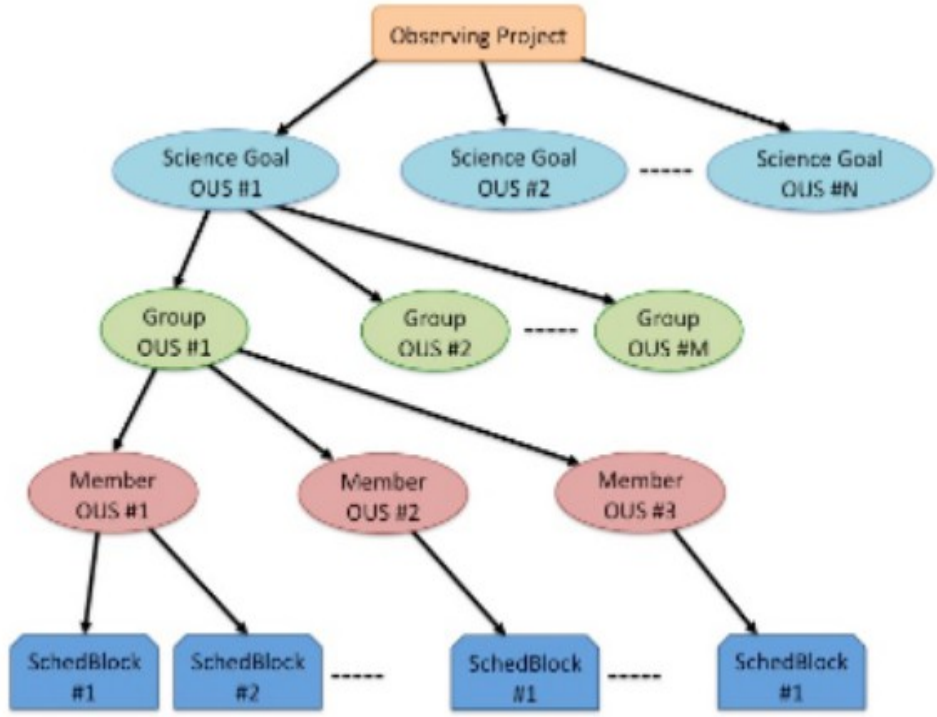


The Project Tracker
https://almascience.eso.org/observing/project-tracker

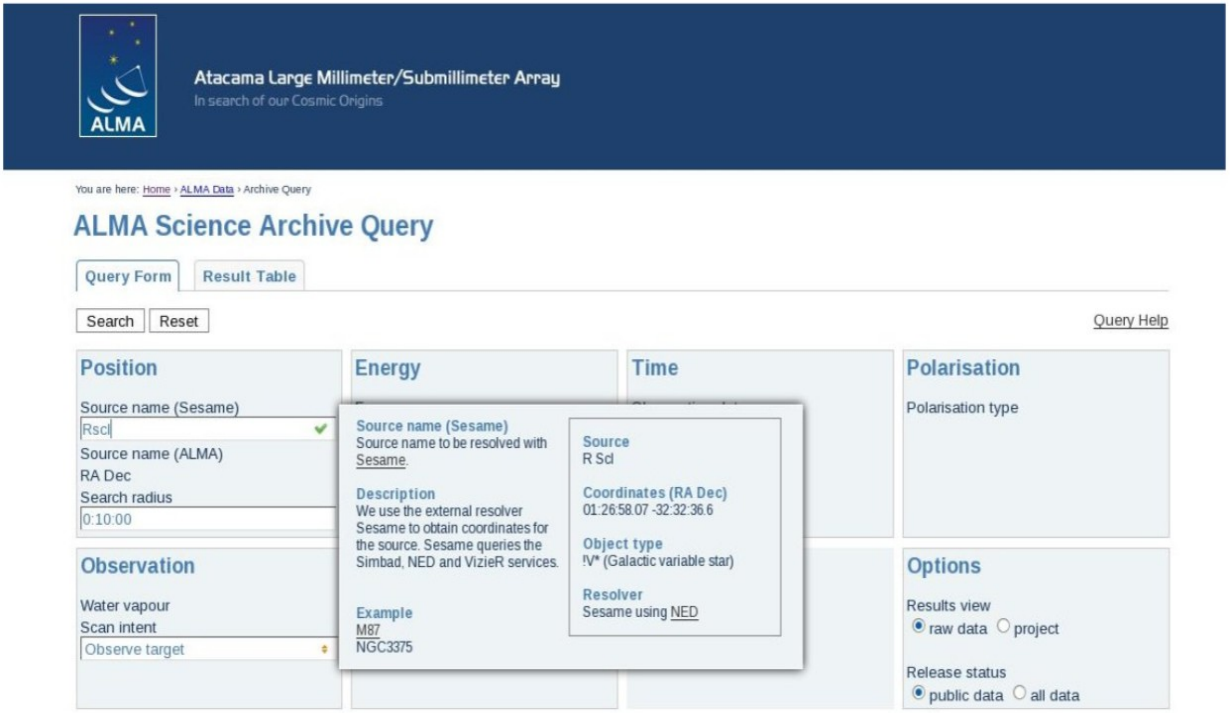
The Project Tracker (PT) is a software tool that allows Principal Investigators to track the observational and processing status of their ALMA science projects.





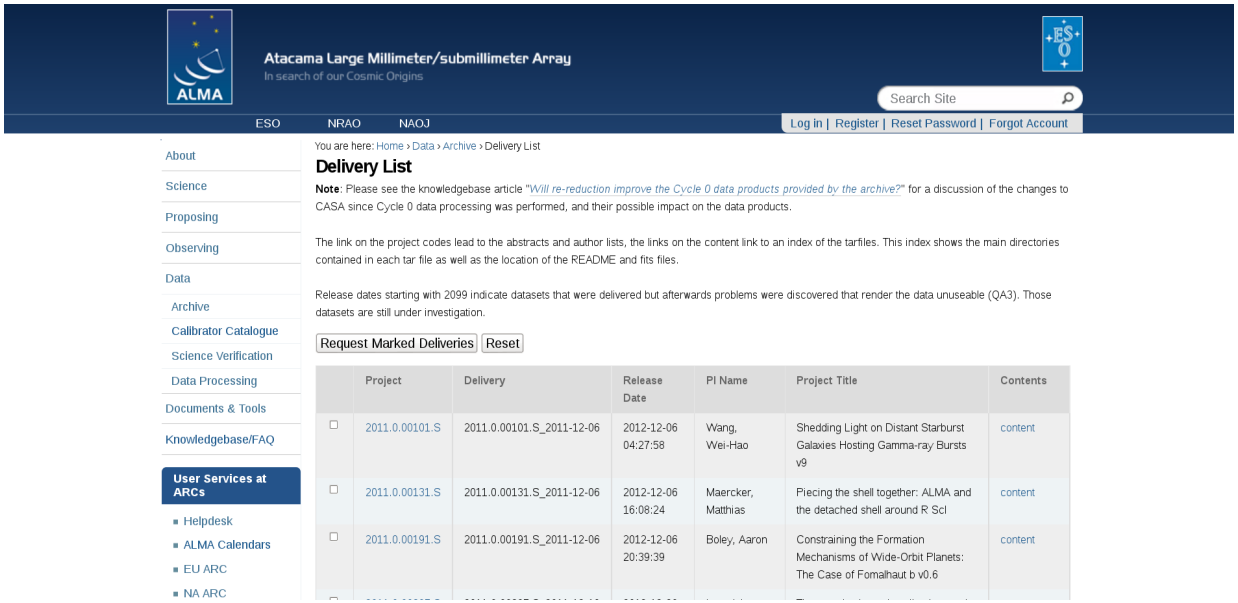


The ALMA Archive
https://almascience.eso.org/alma-data/archive



Archive query:
allows users to identify observations that match given search constraints and to select observations of interest from the results table

Delivery List:
Full data related to a project.
Available only for Cycle 0 projects!



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

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

Request Handler | Login

Archive Requests | Req #834,275,790

Request #834275790 by Anonymous User ✓

Click to edit

Include raw | Select All | Deselect All | Download Selected

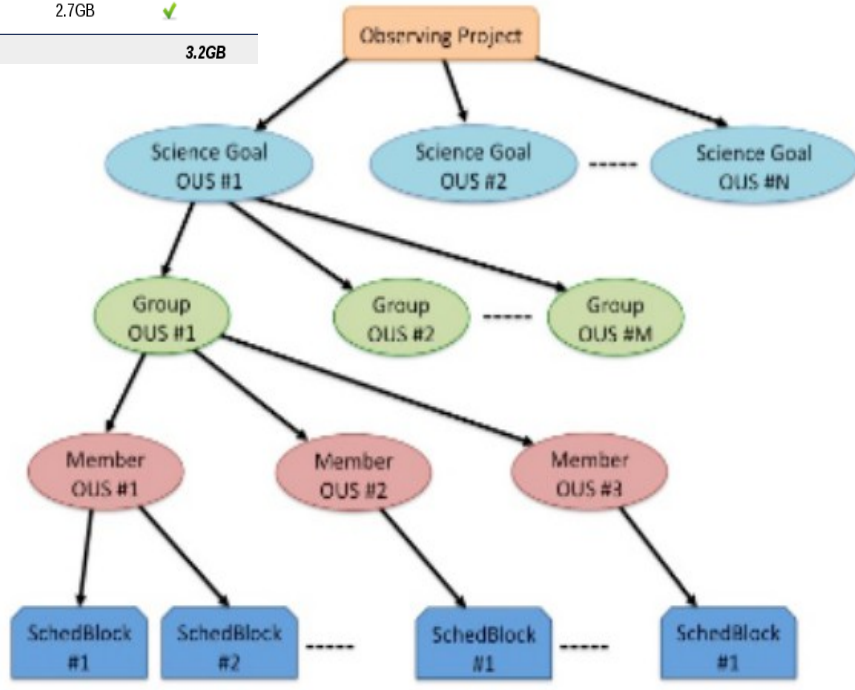
Requested Projects / OUSets / Executionblocks

Data entities 1-4 of 4

Project / OUSet / Executionblock	File	Size	Access
Project 2012.1.01080.S			
Science Goal OUS uid://A002/X75fbd6/X87			
Group OUS uid://A002/X75fbd6/X88			
Member OUS uid://A002/X75fbd6/X89			
	2012.1.01080.S_uid___A002_X75fbd6_X89_001_of_001.tar	543.8MB	✓
	2012.1.01080.S_uid___A002_X77da97_Xba7.asdm.sdm.tar	2.7GB	✓
Data entities 1-4 of 4			*3.2GB*

Choose one of the following download methods:

Download Script	The downloads are scripted for you. You just need to execute the script from the command line. Help
Download Manager	The Java plugin is required. Either use the scripts, a third-party download manager, or install the Java plugin in your browser and reload this page. Get Java here: https://java.com
Web Start Download Manager	The Java plugin is required. Either use the scripts, a third-party download manager, or install the Java plugin in your browser and reload this page. Get Java here: https://java.com
File List	View a text file containing a list of URLs. This is useful for using third-party download manager's such as *DownThemAll*.

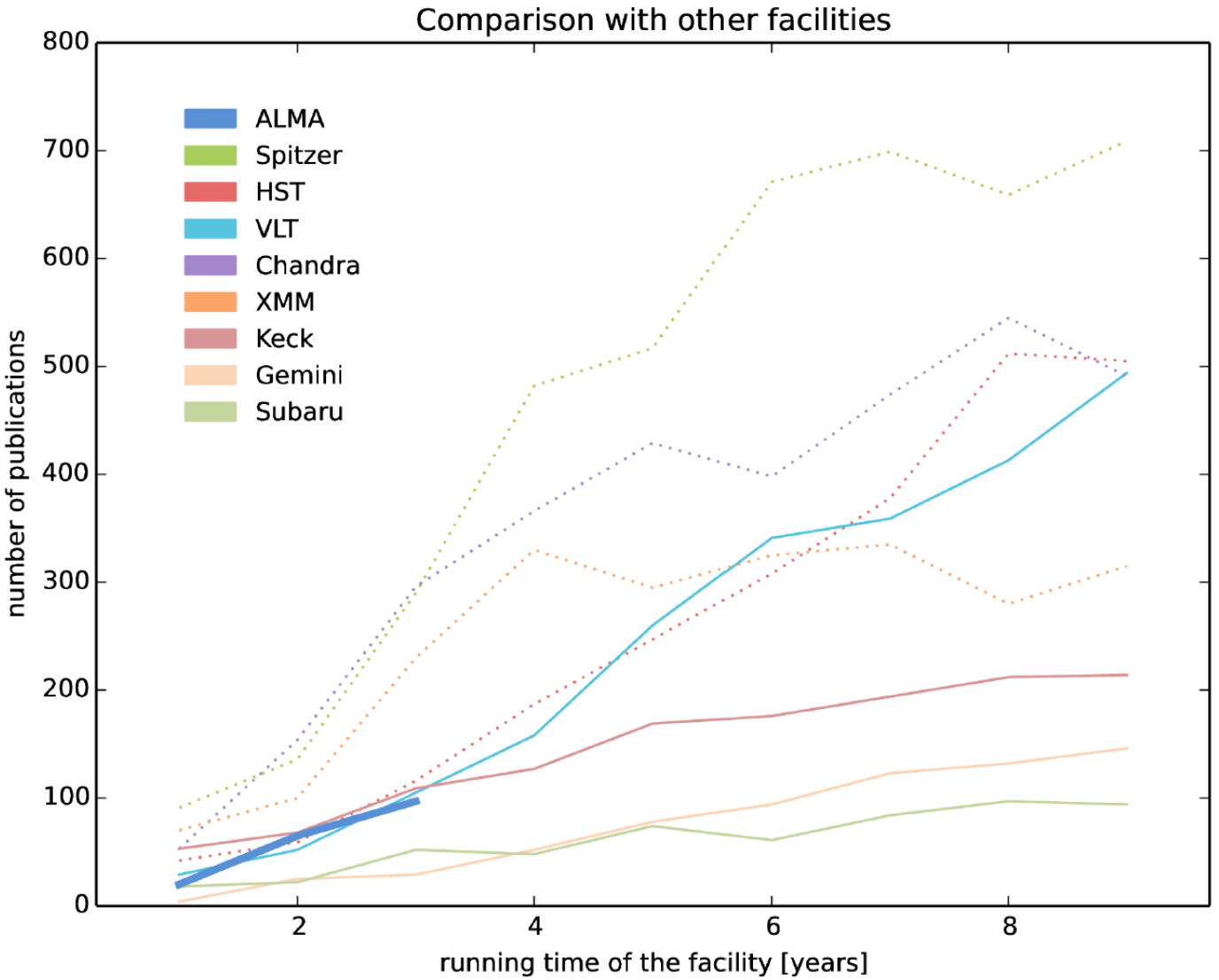


The ALMA Archive
https://almascience.eso.org/alma-data/archive

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!



Get support for Cycle 3 from the Italian node!

In any stage of your ALMA projects,

for any data reduction with CASA,

for ALMA related stuff

contact us and/or organize your visit to the Italian ARC node!

Enjoy your ALMA Cycle 3 proposal!

Deadline: 15:00 UT on April 23, 2015