An Introduction to the ALMA Observing Tool



How to turn that great idea into an ALMA proposal...



Sixteenth Synthesis Imaging Workshop 16-23 May 2018













An Introduction to the ALMA ALMA **Observing Tool**



How to turn that great idea into an ALMA proposal...



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With thanks to Arielle Moullet & Harvey Liszt



What is ALMA?

- A global partnership to deliver a revolutionary millimeter/submillimeter telescope array by North America, Europe, East Asia, in collaboration with Chile
- 66 reconfigurable, high precision antennas
- $\lambda \sim 0.32 8.5$ mm
- Array configurations between 150 meters and >16 kilometers:
 - Main Array: 50 x 12m antennas
 - Total Power Array: 4 x 12m antennas
 - Atacama Compact Array (ACA): 12 x 7m antennas
 - ◆ TP + ACA (Morita Array)
- Array Operations Site is located at 5000m elevation in the Chilean Andes
- Provides unprecedented imaging* & spectroscopic capabilities at mm/submm λ





ALMA in a **Nutshell...**



- Angular resolution down to 0.015" (at 300 GHz)
- Sensitive, precision imaging 84 to 950 GHz (3 mm to 320 µm)
- State-of-the-art low-noise, wide-band receivers* (8 GHz bandwidth)
- Flexible correlator with high spectral resolution at wide bandwidth
- Full polarization capabilities including circular.
- Estimated 1 TB/day data rate
- All science data archived
- Pipeline processing



ALMA Current Status



- Construction Project ended in September 2014
- Science observing has been out to > 16 km baselines
 (C43-10) thanks to the highly successful Long Baseline
 Campaigns in 2014 and 2015
- All 66 antennas accepted
 - Currently all 66 antennas are at the high site (AOS), of which ~47 on average (up to max ~54) are being used for Cycle 5 observations
 - Some construction and verification items remain to be finished (e.g., wide-field polarization; various observing modes)
- The ACA (Atacama Compact Array) or Morita Array up to 12x7m antennas and 4x12m antennas for TP observations
 - currently being used for Cycle 5 observations

ALMA Capabilities



The Cycle 6 capabilities are fully described in Appendix A of the ALMA Proposers Guide available at:

https://almascience.nrao.edu/documents-and-tools

In summary:

Number of antennas

- At least forty-three (43) antennas in the 12-m Array
- At least ten (10) 7-m antennas (for short baselines) and three (3) 12-m antennas (for making single-dish maps) in the ACA

Receiver bands

Receiver Bands 3, 4, 5, 6, 7, 8, 9, and 10 (wavelengths of about 3.1, 2.1, 1.6, 1.3, 0.87, 0.74, 0.44, and 0.35 mm, respectively)

12-m Array Configurations

- Maximum baselines for the antenna configurations between 0.15 km and 16 km
- Maximum baselines of 3.6 km for Bands 8, 9 and 10
- Maximum baselines of 8.5 km for Band 7
- Maximum baselines of 16 km for Bands 3, 4, 5 and 6



ALMA Capabilities



• Spectral line, continuum, and mosaic observations

- Spectral line and continuum observations with the 12-m Array and the 7-m Array in all bands
- Single field interferometry (all bands) and mosaics (Bands 3 to 9) with the 12-m
 Array and the 7-m Array
- Single-dish spectral line observations in Bands 3 to 8

Polarization

 Single pointing, on axis, full (including circular) polarization for both continuum and full-spectral-resolution observations in Band 3, 4, 5, 6, and 7 are offered on the 12m Array. (min polarization percentage of 1.8% of the peak flux for circular polarization; only for sources that are on-axis with an angular size less than 10% of the FWHM primary beam).

Observing Time:

- 4000 hours for successful proposals of PI programs expected on the 12m Array (includes DDT, Cycle 4 Carryover and resubmissions)
- 3000 hours available on the ACA
 - ■3000 hours available on the Total Power Array

Proposal Checklist

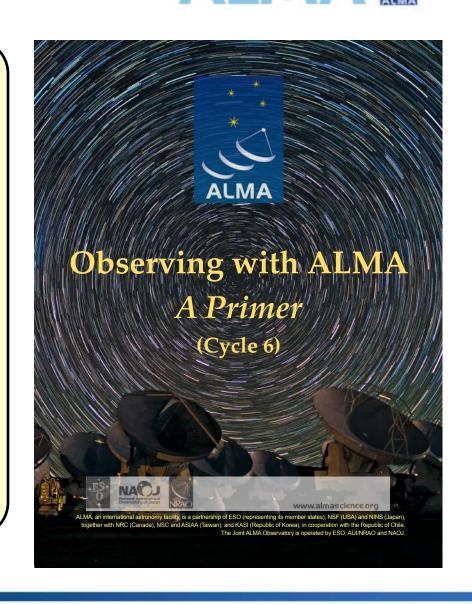


- Read relevant documentation (CfP Guide, Primer, etc.)
- Create an ALMA account by registering at the Science Portal (almascience.org)
- Download the Observing Tool (OT) & related guides
- Prepare the Science Case
 - Note the new capabilities for the current cycle!
- Prepare Science Goals (sources, frequency & correlator setup, integration times) within the OT
- Make use of the Helpdesk & the Knowledgebase



Cycle 6 Documentation & Timeline ALMA

- Call for Proposals
- Proposer's Guide
- ALMA Primer
- OT Guide
- ALMA Tech Handbook
- Timeline for Cycle 6
 - Mar. 20 Call for Proposals
 - Apr. 19 − Proposal Deadline
 - End July Results to Pls
 - Aug. 2018 Pls submit SBs
 - Oct. 2018 Start of Cycle 6
 - Sept. 2019 End of Cycle 6





Proposal Checklist



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Before you start the OT...



From your science case:

- Source(s):
 - single pointings or mosaics?
 - what angular resolution do you need?
 - what is the largest angular size of your source(s)?
- Spectral configuration:
 - continuum or spectral lines?
 - frequency: which band?
- Are you doing polarization?
 - what is the expected polarization fraction?
- Sensitivity:
 - what rms do you need to achieve your science goals?
 over what bandwidth? i.e., 3 km/s, or 1.875 GHz, etc.

ALMA configuration schedule



LST for best

~ 13h - 3h

~ 14h - 5h

~ 16h - 6h

~ 18h - 8h

~ 20h - 9h

- The configuration schedule may determine when an object will be observed
- In Cycle 6, for example:
 - C43-1,2 January, March
 - C43-3,4 December, April
 - C43–5 October only
 - C43-8..10 June, July
- Some combinations of object

 configuration may not be
 available for night-time
 observing

		baseline	observing conditions
2018 October 1	C43-6	2.5 km	~ 22h – 10h
2018 October 15	C43-5	1.4 km	~ 0h – 12h
2018 November 25	C43-4	0.78 km	~ 2h – 14h
2018 December 15	C43-3	0.50 km	~ 4h – 15h
2019 January 5	C43-2	0.31 km	~ 5h – 16h
2019 January 20	C43-1	0.16 km	~ 6h – 17h
2019 February 1-28	No observations due to February shutdown		
2019 March 1	C43-1	0.16 km	~ 8h - 21h
2019 March 15	C43-2	0.31 km	~ 8h – 22h
2019 April 1	C43-3	0.50 km	~ 9h – 23h
2019 April 15	C43-4	0.78 km	~ 10h – 0h
2019 May 1	No observations due to major antenna relocation		

Table 1: Cycle 6 configuration schedule

Longest

16.2 km

13.9 km

8.5 km

3.6 km

2.5 km

Configuration

C43-10

C43-9

C43-8

C43-7

C43-6

Start date

2019 June 1

2019 June 20

2019 July 10

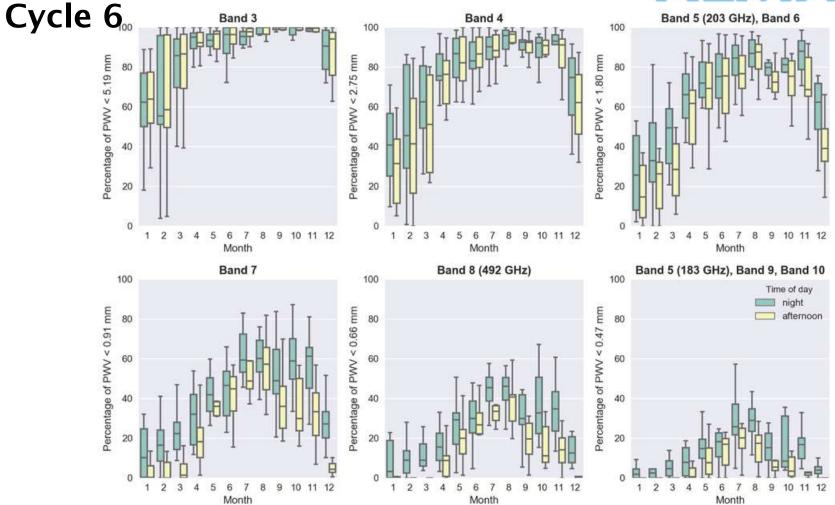
2019 August 1

2019 September 5



ALMA Observing Strategies





• Box and whisker plots of the percentage of time that the precipitable water vapor (PWV) is less than the thresholds adopted for the various ALMA bands versus the month of the year. Results are shown for both night time (green) and mid-afternoon (yellow), and assume a source elevation of 60 degrees. The horizontal line within a box indicates the median, the boundaries of a box indicate the 25th- and 75th -percentile of the distribution, and the whiskers indicate the highest and lowest values of the distribution. The PWV measurements were obtained by the APEX weather stations between 2007 and 2017.

Before you start the OT...



From your science case:

- Source(s):
 - single pointings or mosaics?
 - what angular resolution do you need?

On to the Observing Tool!

- Spectral configuration:
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Downloading the ALMA OT



https://almascience.nrao.edu



Observing Tool

The ALMA Observing Tool (OT) is a Java application used for the preparation and submission of ALMA Phase 1 (observing proposal) and Phase 2 (telescope runfiles for accepted proposals) materials. It is also used for preparing and submitting Director's Discretionary Time (DDT) proposals. The current Cycle 6 release of the OT is configured for the present capabilities of ALMA as described in the Cycle 6 Call For Proposals. Note that in order to submit proposals you will have to register with the ALMA Science Portal beforehand.

Note that preparation of Cycle 5 DDT proposals needs to be done using the Cycle 5 version of the Observing Tool. This version of the OT can be found in the DDT page, or the Phase 2 menu.

Download & Installation

The OT will run on most common operating systems, as long as a **64-bit version of Java 8** is installed (see the troubleshooting page if you are experiencing Java problems). The ALMA OT is available in two flavours: Web Start and tarball.

The **Web Start** application is the recommended way of using the OT. It has the advantage that the OT is automatically downloaded and installed on your computer and it will also automatically detect and install updates. There are some issues with Web Start, particularly that it does not work with the Open JDK versions of Java such as the "Iced Tea" flavour common on many modern Linux installations. The Oracle variant of Java should therefore be installed instead. If this is not possible, then the tarball installation of the OT is available.

The tarball version must be installed manually and will not automatically update itself, however there should be no installation issues. For Linux users, we also provide a download complete with a recognised version of the Java Runtime Environment. Please use this if you have any problems running the OT tarball with your default Java.

Webstart Tarball

Documentation

Extensive documentation is available to help you

Using webstart is easier and has the advantage that it checks for and will download a newer version at startup

- If you are a novice OT user you should start \(\lambda \)
- Audio-visual illustrations of different aspects of the OT can be found in the OT video tutorials. These are recommended for novices and advanced users alike.
- More in-depth information on the OT can be found in the User Manual, while concise explanations of all fields and menu items in the OT are given in the Reference Manual. These two documents are also available within the OT under the Help menu.

Troubleshooting

If you have problems with the installation and/or startup of the OT, please see the troubleshooting page. A list of currently known bugs, their status and possible workarounds can be found on the regularly updated known OT Issues page. A further source of information is the OT section of the ALMA Helpdesk Knowledgebase - this contains a number of articles that deal with frequently-asked questions. After exploring these resources, if confusion over some aspect of the OT remains, or if a previously unidentified bug has been uncovered, please file a Helpdesk ticket.

OT Video Tutorials



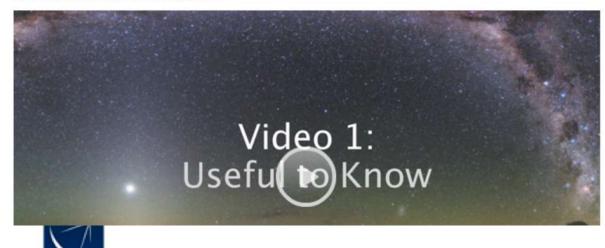


OT Video Tutorials

The OT video tutorials provide an audio-visual demonstration of different aspects of proposal preparation in the OT. Novice users should start with the first video and work their way down, while more experienced users may want to jump straight to one of the specialised videos.

OT Video Tutorial 1: Useful to Know

This video will help you get started with the OT and introduce you to some handy tips and tricks. Topics covered include navigating the OT, using the help function, the template library, time estimation, validation, opening & submitting projects including re-submissions, and the concept of non-standard modes. **Note**: this video is from Cycle 4, some things have changed slightly in Cycle 5. In particular, time constraints can now also include simultaneous 12-m and 7-m observations, and re-submissions are no longer defined by the user. Also, the time estimate interface has changed a bit.

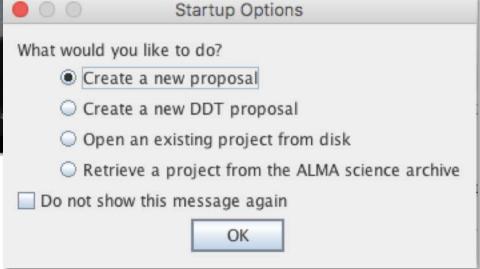


When the ALMA OT starts





Then you see this



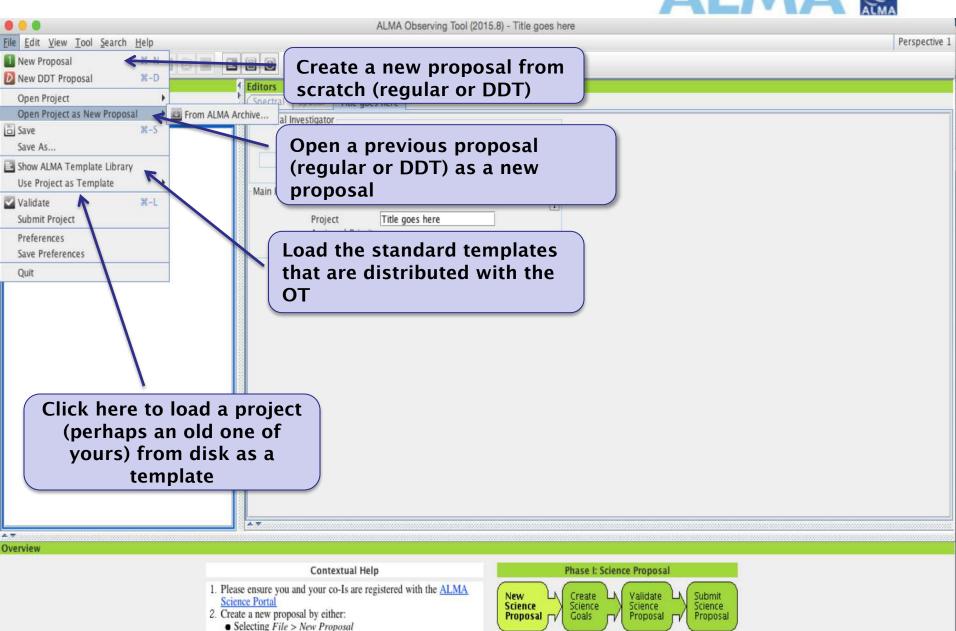


Creating a new proposal

Clicking on the licon in the toolbar

Or clicking on this link

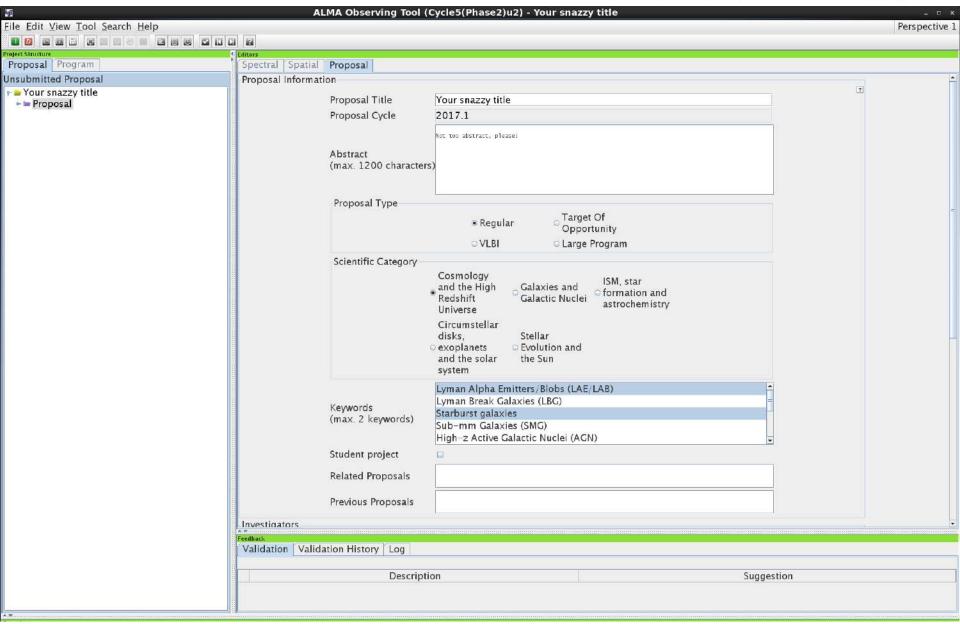




Click on the overview steps to view the contextual help

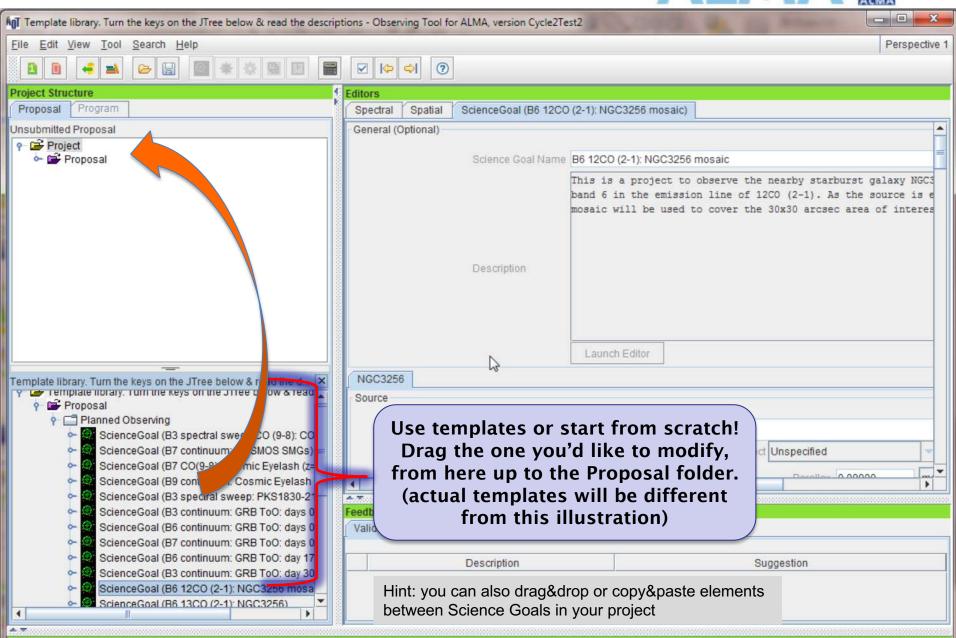
Proposal front page





Next: Add science goals





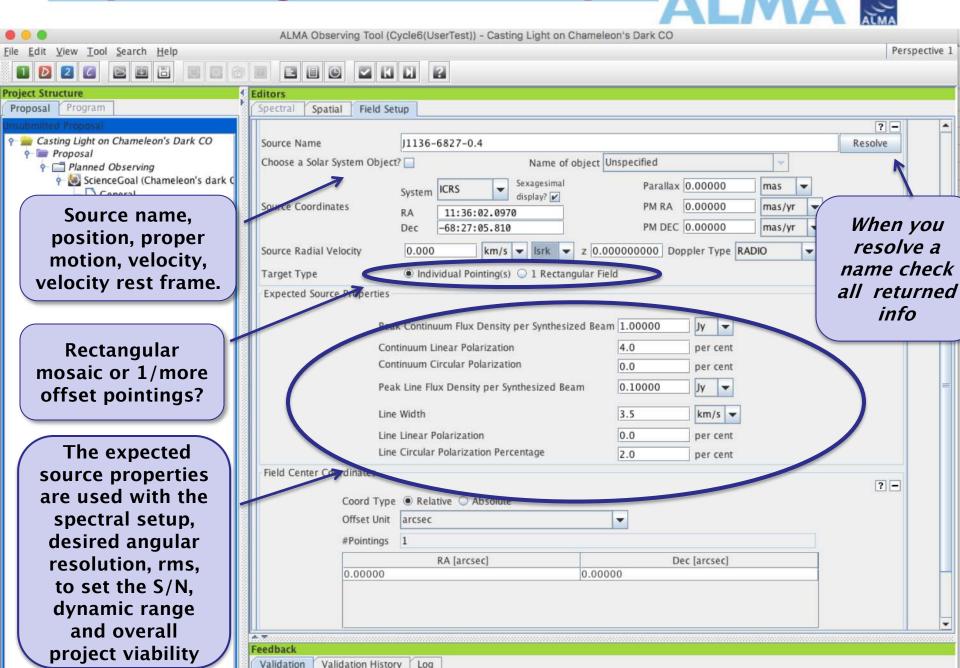
Before you start the OT...



From your science case:

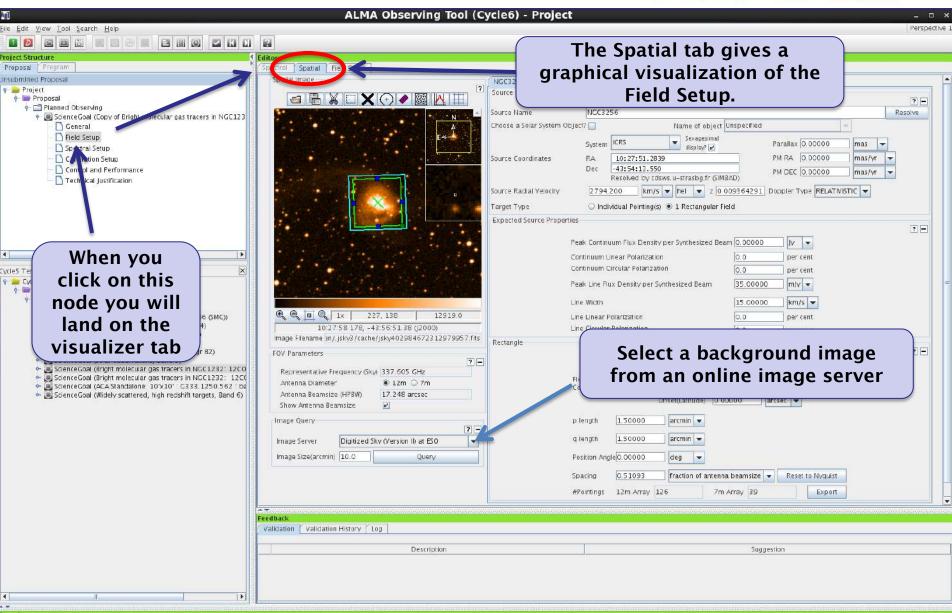
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- Sensitivity:
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Set your targets: Field Setup



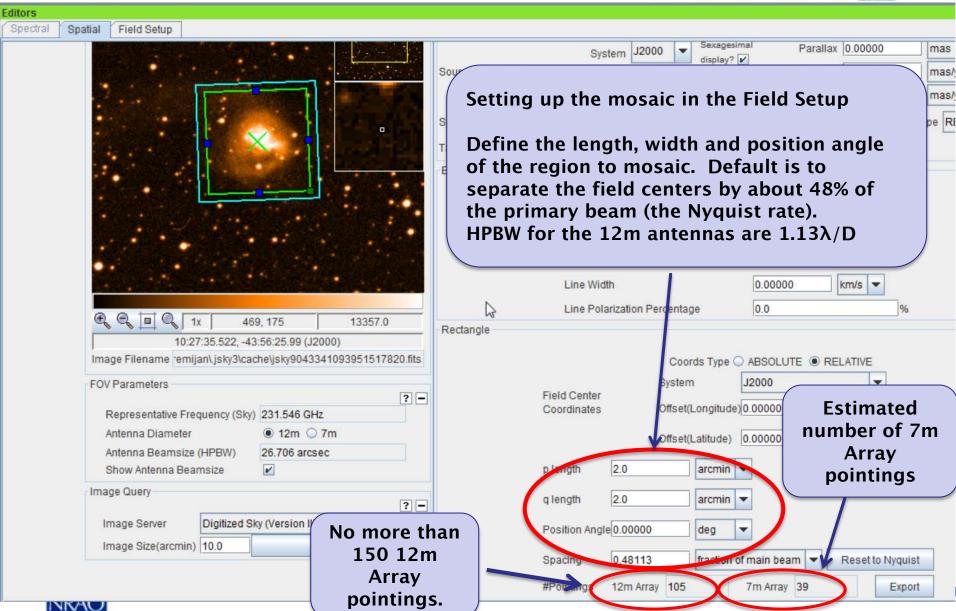
Set your targets: Mosaics





Set your targets: Mosaics





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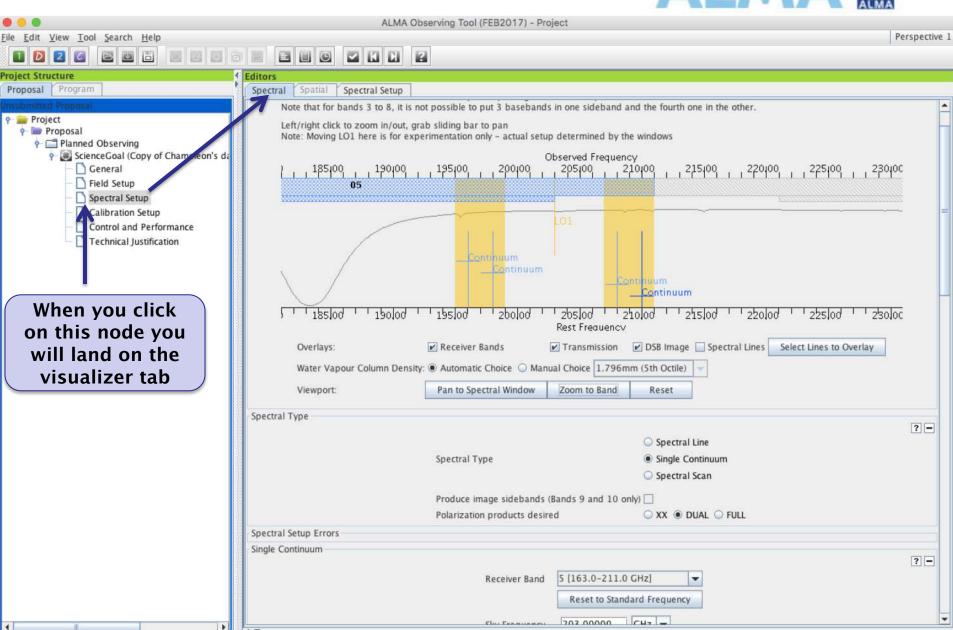


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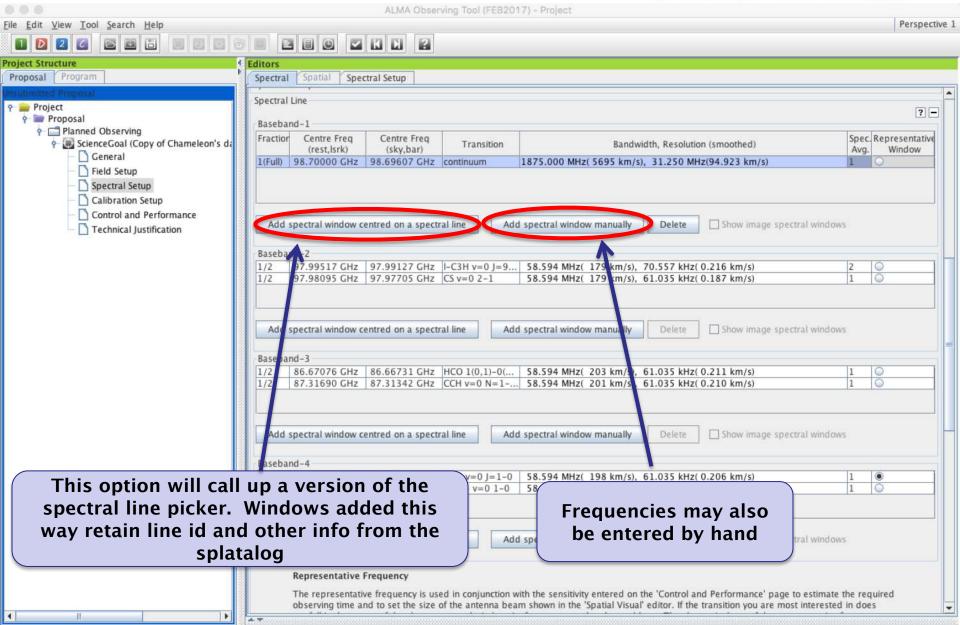
Spectral setup



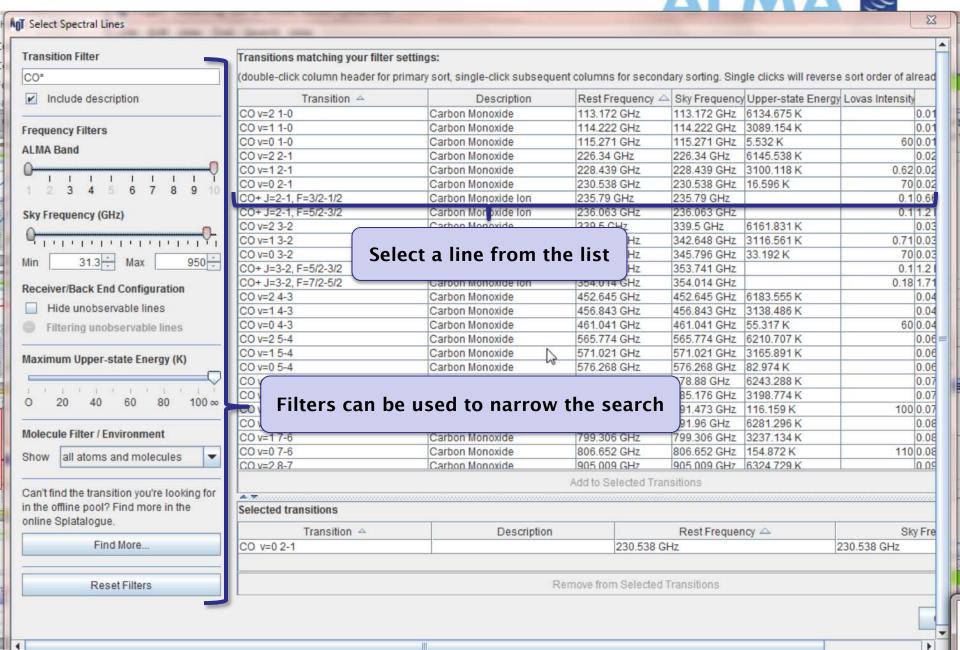


Adding spectral windows





Using the spectral line catalog AIMA



Before you start the OT...

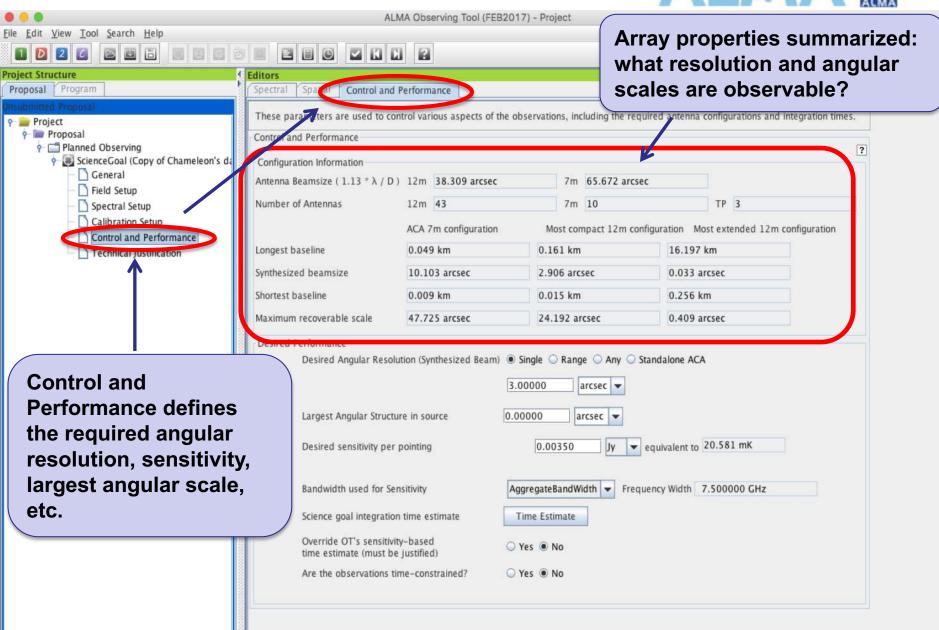


From your science case:

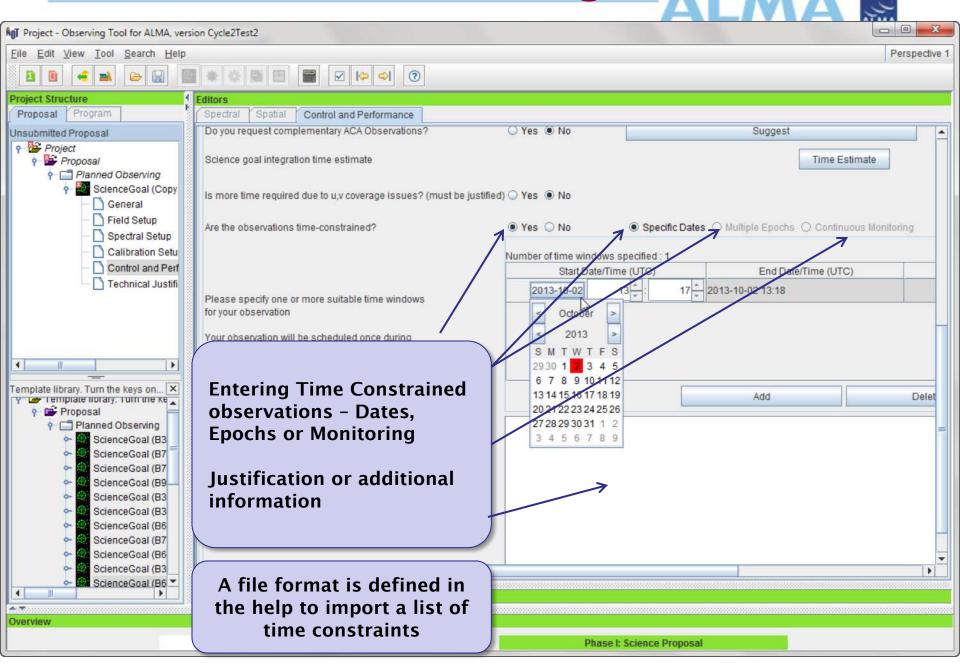
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Control & Performance



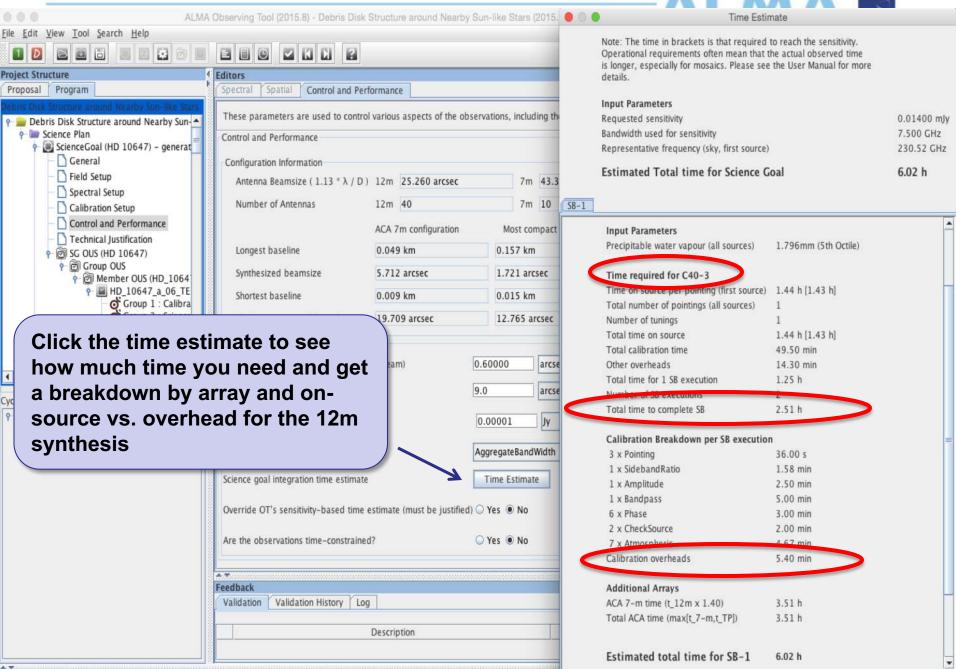


Time-constrained observing



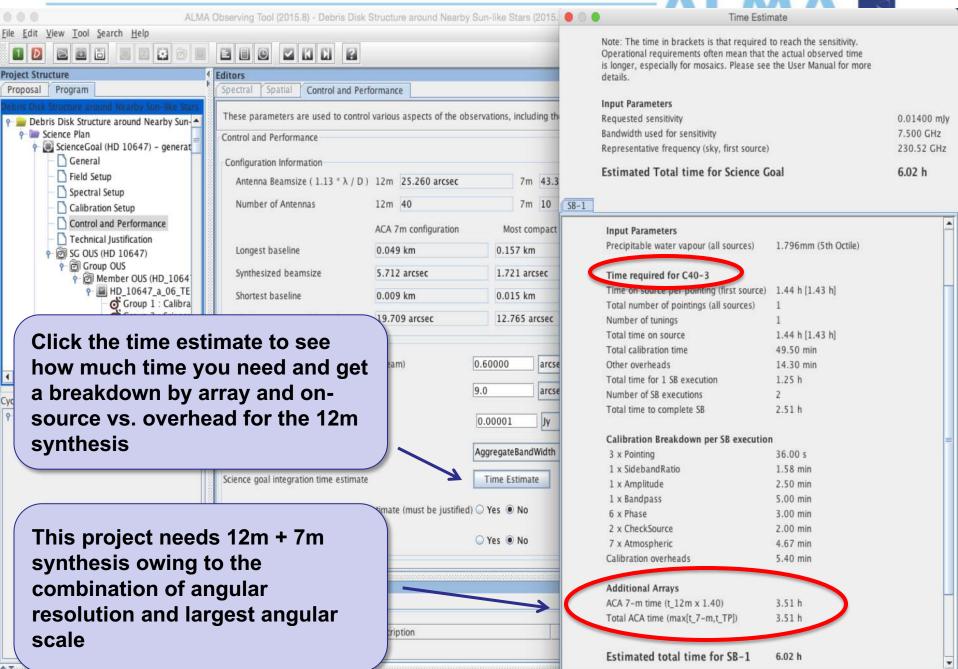
Science Goal time estimates



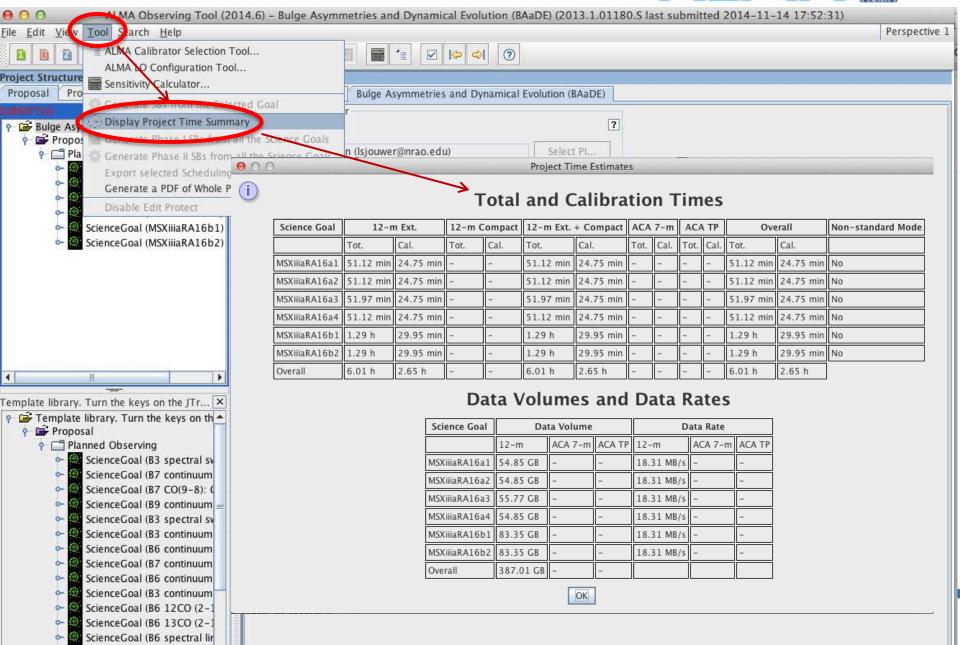


Science Goal time estimates



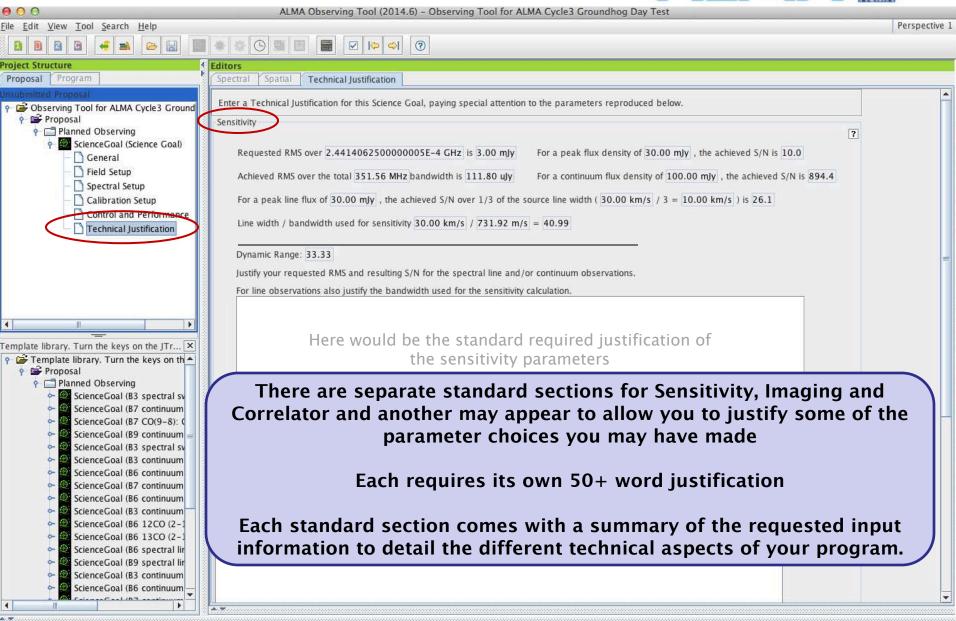


View the project time summary LMA

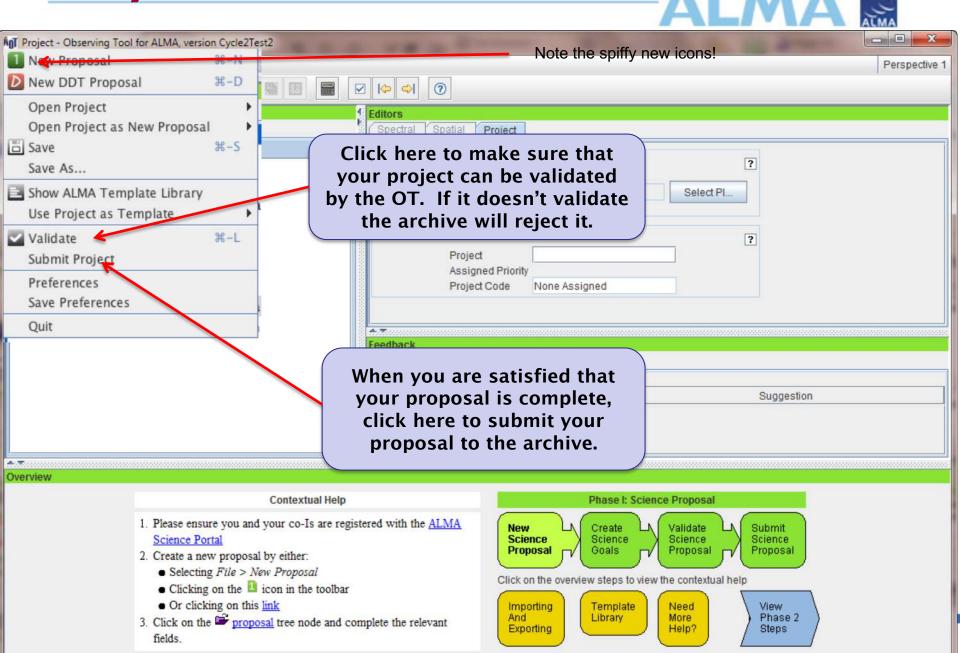


Technical justification





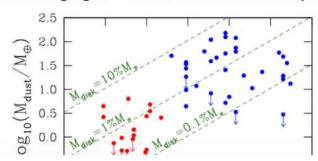
Ready? Validate & submit!



User support



Science Highlights - Possible Disk Truncation in Ophiuchus Brown Dwarfs



The sensitivity, resolution and the wavelength coverage of ALMA makes it an ideal tool for studying the properties of the cold outer disks of young stars and low mass objects. Such observations can aid us in understanding the formation of their central objects and their likelihood of ultimately hosting planets. In a recent Astronomy & Astrophysics paper, Dr. Testi and his collaborators made use of ALMA Band 7 to observe an unbiased sample of spectroscopically confirmed Ophiuchus brown dwarfs with infrared excesses.



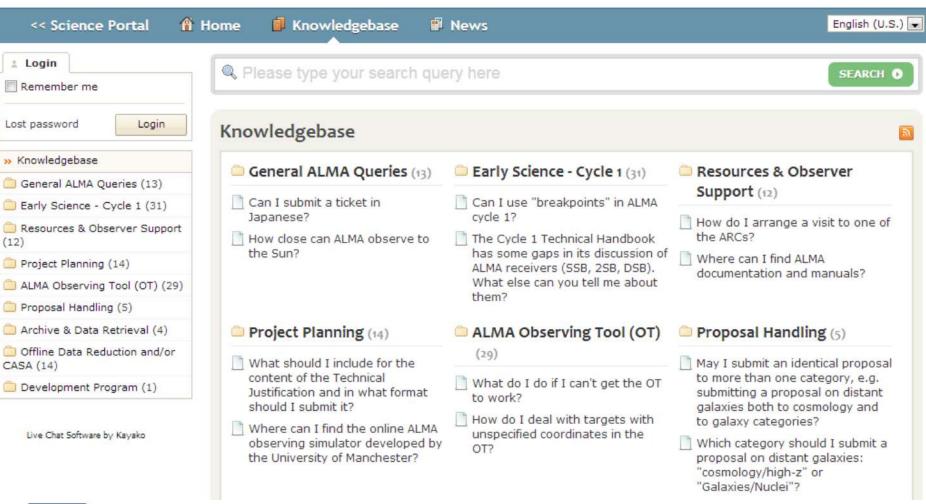
www.almascience.org ALMA Science Portal @ NRAO

I could use a hand...





Have no fear, the ALMA Helpdesk is here...









For more info:

https://almascience.nrao.edu/

The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership of Europe, North America and East Asia in cooperation with the Republic of Chile. ALMA is funded in Europe by the European Organization for Astronomical Research in the Southern Hemisphere (ESO), in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC) and the National Science Council of Taiwan (NSC), and in East Asia by the National Institutes of Natural Sciences (NINS) of Japan in cooperation with the Academia Sinica (AS) in Taiwan. ALMA construction and operations are led on behalf of Europe by ESO, on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI), and on behalf of East Asia by the National Astronomical Observatory of Japan (NAOJ). The Joint ALMA Observatory (JAO) provides the unified leadership and management of the construction and operation of ALMA.