The ALMA Proposal Preparation Process

How to get started and what to expect

Danielle Lucero
ALMA Ambassador
Virginia Tech

This talk is for you if…

- You are new to ALMA and have not yet had experience with the relevant documentation…
- You have not downloaded the ALMA Observing Tool (OT) or even know where to get it.
- You have a fabulous science case that will be essential to follow-up with ALMA facilities.
- You are familiar with past Cycles and wonder what Cycle 8 capabilities are now available and what changes will be made before the Call for Proposals.

This talk will be available online for reference after this workshop.

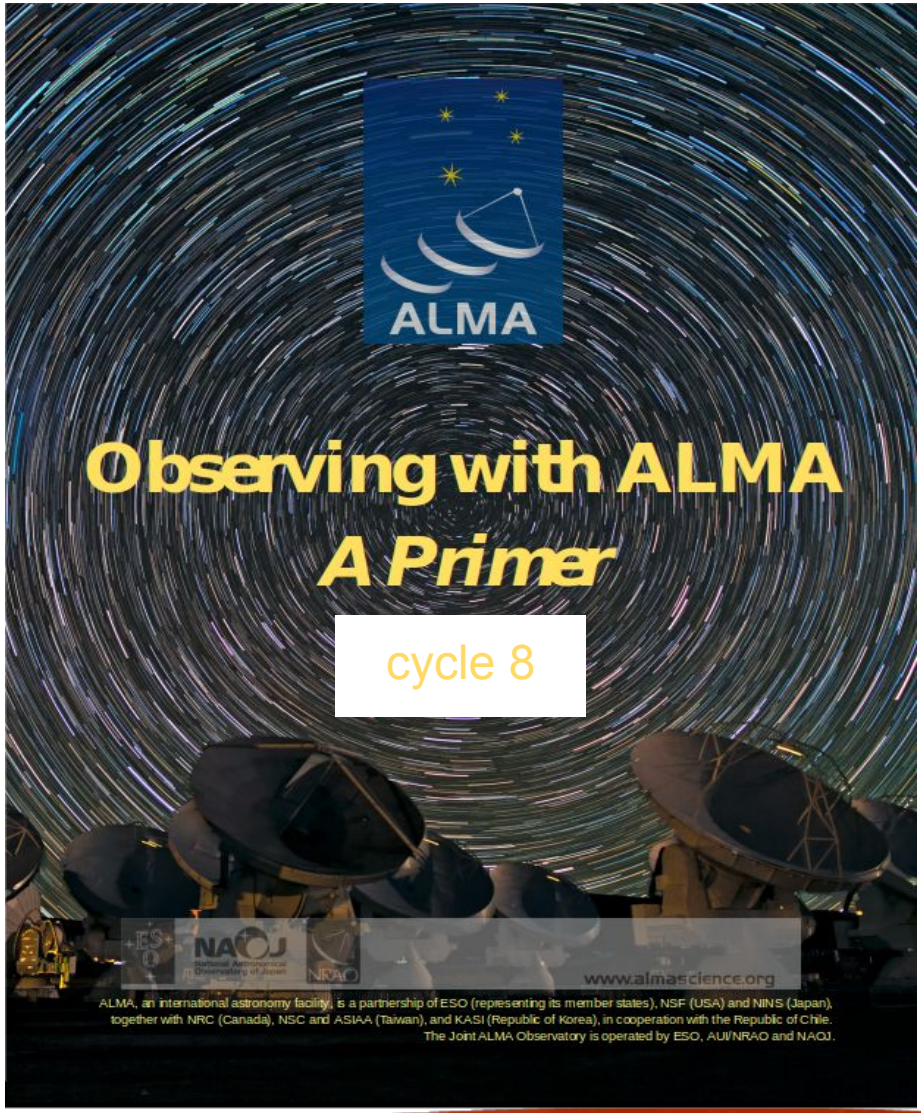
Proposal Checklist

- 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
  - New capabilities for Cycle 8!
- Prepare Science Goals (sources, frequency & correlator setup, integration times) within the OT.
- Make use of the Helpdesk & the Knowledgebase.

Cycle 8 Documentation & Timeline

- Call for Proposals
- Proposer's Guide
- ALMA Primer
- *OT Guide*
- *ALMA Technical Handbook*

- Timeline for Cycle 8
  - Mar. 17 – Call for Proposals
  - May. 19 – Proposal Deadline
  - End July – Results to PIs
  - Sept. 9 – Phase 2 submission
  - Oct. 2020 – Start of Cycle 8
  - Sept. 2021 – End of Cycle 8



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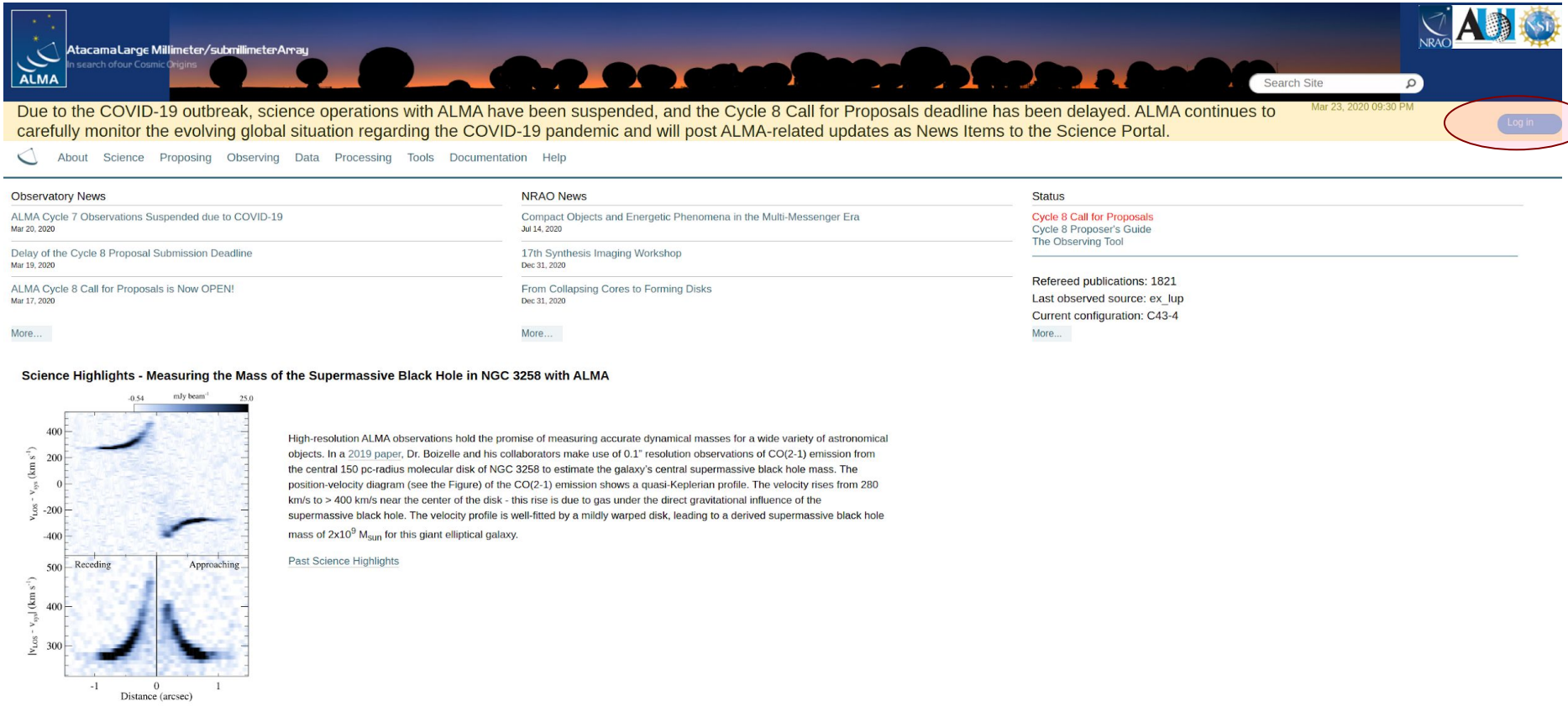
www.almascience.org



ALMA Science Portal @ NRAO

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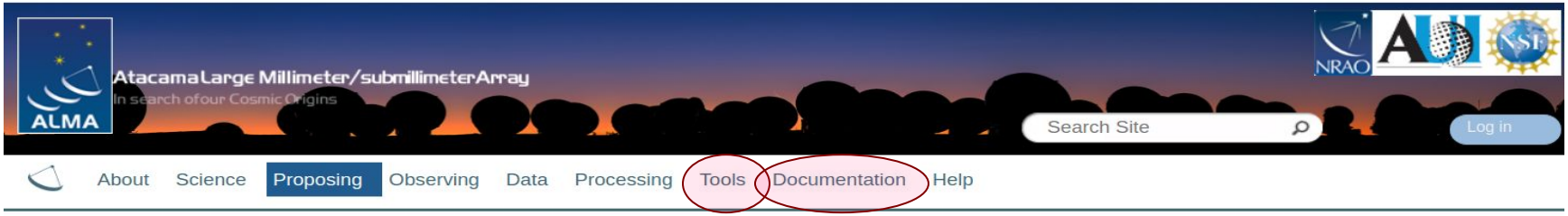
Downloading the ALMA OT



Observing Tool

The ALMA Observing Tool (OT) is a Java desktop application used for the preparation and submission of ALMA Phase 1 proposals and, for those which are accepted, Phase 2 materials (Scheduling Blocks). It is also used for preparing and submitting Director's Discretionary Time (DDT) proposals. The current *Cycle-8* release of the OT is configured for the present capabilities of ALMA as described in the Cycle 8 Call For Proposals. Note that in order to submit proposals you will have to register with the ALMA Science Portal beforehand.

Download & Installation

The OT should run on all common operating systems and depends on a version of Java being available. In previous releases of the OT it was the responsibility of the user to ensure that a suitable version of Java was installed, but the Cycle-8 version of the OT will come with its own version of Java 11 and thus the user need no longer worry about their local Java installation. Unfortunately, as Java 11 does not include Web Start, this version of the OT is no longer available. (Web Start remains available for the Cycle-7 OT currently used for the submission of DDT proposals.) The Cycle-8 OT can be installed in two different ways, either with a modern installer or manually with a tarball distribution.

It is recommended that the OT be installed using the ALMA **OT Installer**. This uses a modern graphical interface to report the progress of the installation and allows the user to change various settings from their defaults, including the amount of memory the OT may use. The installation will produce an executable file that can be used to start the OT. With the loss of Web Start, automatic updates of the tool are no longer possible, but the OT will detect if an update is available at start-up and inform the user. If problems are encountered with the installer, then the tarball must be used. **Due to issues with recently tightened security settings, users of Mac OS 10.15 (Catalina) must use the tarball.**

The **tarball** version must be installed manually and the instructions for doing this have not changed.

Installer Tarball

Documentation

Extensive documentation is available to help you work with the OT and optimally prepare your proposal:

- If you are a novice OT user you should start with the **OT Quickstart Guide**, which takes you through the basic steps of ALMA proposal preparation.
- 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

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

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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.

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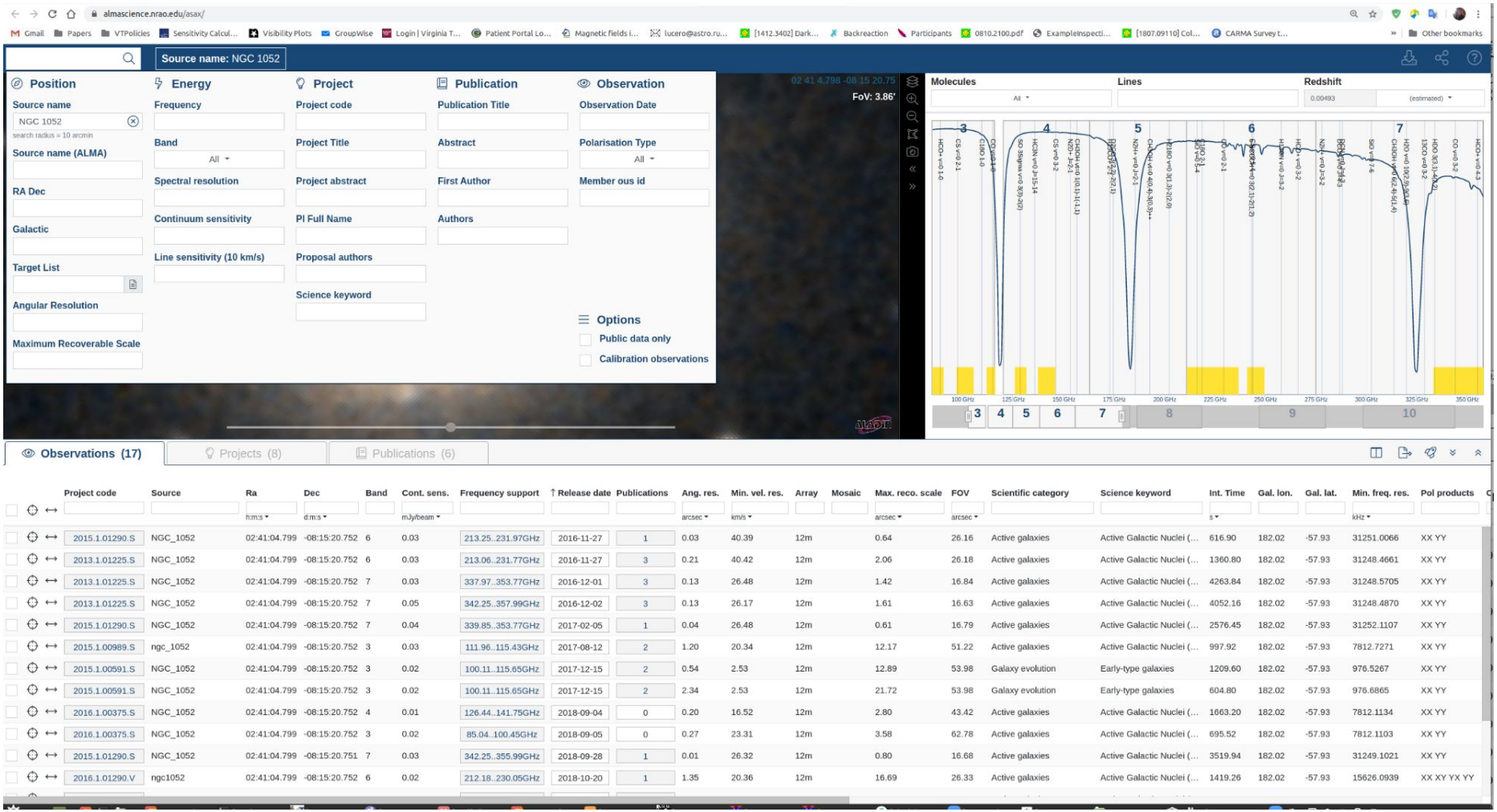
ALMA Archive: New Interface!



Project code	Source	Ra	Dec	Band	Cont. sens.	Frequency support	Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.	Min. freq. res.	Pol products
		h:m:s	d:m:s		mJy/beam				arcsec	km/s			arcsec	arcsec			s			kHz	
2015.1.01290.S	NGC_1052	02:41:04.799	-08:15:20.752	6	0.03	213.25..231.97GHz	2016-11-27	1	0.03	40.39	12m		0.64	26.16	Active galaxies	Active Galactic Nuclei (...	616.90	182.02	-57.93	31251.0066	XX YY
2013.1.01225.S	NGC_1052	02:41:04.799	-08:15:20.752	6	0.03	213.06..231.77GHz	2016-11-27	3	0.21	40.42	12m		2.06	26.18	Active galaxies	Active Galactic Nuclei (...	1360.80	182.02	-57.93	31248.4661	XX YY
2013.1.01225.S	NGC_1052	02:41:04.799	-08:15:20.752	7	0.03	337.97..353.77GHz	2016-12-01	3	0.13	26.48	12m		1.42	16.84	Active galaxies	Active Galactic Nuclei (...	4263.84	182.02	-57.93	31248.5705	XX YY
2013.1.01225.S	NGC_1052	02:41:04.799	-08:15:20.752	7	0.05	342.25..357.99GHz	2016-12-02	3	0.13	26.17	12m		1.61	16.63	Active galaxies	Active Galactic Nuclei (...	4052.16	182.02	-57.93	31248.4870	XX YY
2015.1.01290.S	NGC_1052	02:41:04.799	-08:15:20.752	7	0.04	339.85..353.77GHz	2017-02-05	1	0.04	26.48	12m		0.61	16.79	Active galaxies	Active Galactic Nuclei (...	2576.45	182.02	-57.93	31252.1107	XX YY
2015.1.00989.S	ngc_1052	02:41:04.799	-08:15:20.752	3	0.03	111.96..115.43GHz	2017-08-12	2	1.20	20.34	12m		12.17	51.22	Active galaxies	Active Galactic Nuclei (...	997.92	182.02	-57.93	7812.7271	XX YY
2015.1.00591.S	NGC_1052	02:41:04.799	-08:15:20.752	3	0.02	100.11..115.65GHz	2017-12-15	2	0.54	2.53	12m		12.89	53.98	Galaxy evolution	Early-type galaxies	1209.60	182.02	-57.93	976.5267	XX YY
2015.1.00591.S	NGC_1052	02:41:04.799	-08:15:20.752	3	0.02	100.11..115.65GHz	2017-12-15	2	2.34	2.53	12m		21.72	53.98	Galaxy evolution	Early-type galaxies	604.80	182.02	-57.93	976.6865	XX YY
2016.1.00375.S	NGC_1052	02:41:04.799	-08:15:20.752	4	0.01	126.44..141.75GHz	2018-09-04	0	0.20	16.52	12m		2.80	43.42	Active galaxies	Active Galactic Nuclei (...	1663.20	182.02	-57.93	7812.1134	XX YY
2016.1.00375.S	NGC_1052	02:41:04.799	-08:15:20.752	3	0.02	85.04..100.45GHz	2018-09-05	0	0.27	23.31	12m		3.58	62.78	Active galaxies	Active Galactic Nuclei (...	695.52	182.02	-57.93	7812.1103	XX YY
2015.1.01290.S	NGC_1052	02:41:04.799	-08:15:20.751	7	0.03	342.25..355.99GHz	2018-09-28	1	0.01	26.32	12m		0.80	16.68	Active galaxies	Active Galactic Nuclei (...	3519.94	182.02	-57.93	31249.1021	XX YY
2016.1.01290.V	ngc1052	02:41:04.799	-08:15:20.752	6	0.02	212.18..230.05GHz	2018-10-20	1	1.35	20.36	12m		16.69	26.33	Active galaxies	Active Galactic Nuclei (...	1419.26	182.02	-57.93	15626.0939	XX XY YX YY

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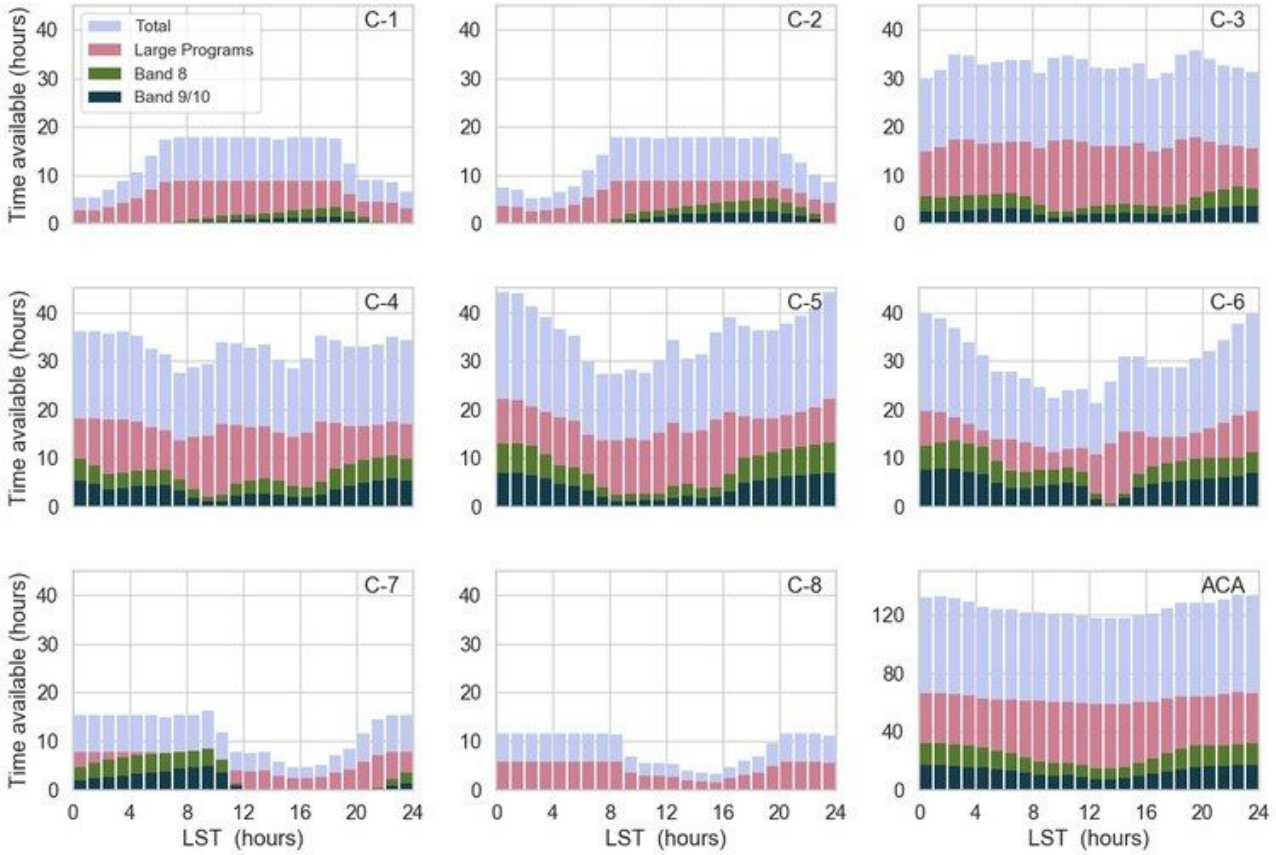
ALMA Array Configuration Schedule (Cycle 8)

- Antenna configurations for the main 12-m array will use a new nomenclature in Cycle 8.
  - Configurations will be called C-1, C-2, and so on up to C-10, with C-1 having similar characteristics to the C43-1 configuration of Cycle 7, and likewise for the others.
  - Cycle 8 will NOT include the two longest baseline 12-m array configurations, C-9 and C-10.
- Maximum baselines in Cycle 8 will therefore be 8.5 km in configuration C-8.
- Configurations C-9 and C-10 with maximum baselines of 13.9 km and 16.2 km, respectively, will again be available in Cycle 9.
- **NOTE: No PI observing takes place in Feb!**
- The forward-looking configuration schedule (through Cycle 9) can be found at: https://almascience.nrao.edu/observing/observing-configuration-schedule/long-term-configuration-schedule

Start date	Configuration	Longest baseline	LST for best observing conditions
2020 October 1	C-8	8.5 km	~ 22h – 10h
2020 October 20	C-7	3.6 km	~ 23h – 11h
2020 November 10	C-6	2.5 km	~ 1h – 13h
2020 December 01	C-5	1.4 km	~ 2h – 14h
2020 December 20	C-4	0.78 km	~ 4h – 15h
2021 January 10	C-3	0.50 km	~ 5h – 17h
2021 February 1-28	No observations due to February Maintenance		
2021 March 1	C-1	0.16 km	~ 8h – 21h
2021 March 26	C-2	0.31 km	~ 9h – 23h
2021 April 20	C-3	0.50 km	~ 11h – 1h
2021 May 10	C-4	0.78 km	~ 13h – 3h
2021 May 31	C-5	1.4 km	~ 15h – 5h
2021 June 23	C-6	2.5 km	~ 16h – 6h
2021 July 28	C-5	1.4 km	~ 17h – 7h
2021 August 18	C-4	0.78 km	~ 19h – 8h
2021 September 10	C-3	0.5 km	~ 20h – 9h

ALMA Observing Strategies (Cycle 8)



- Effective observing time available per configuration for executing PI projects. As an example, up to 36 hours are expected to be available in C-4 at LST=00 h for all observations and up to 18 h may be allocated to Large Programs. The total number of hours excludes time spent on observatory calibration, maintenance, reconfigurations, and other activities. The time available for Large Programs is shown in pink and time for high-frequency observations in green and dark blue. The configuration schedule and, consequently, the total number of hours available per configuration may change in response to proposal pressure. The data files containing these histograms are available here.

Science Justification

- Must include:
  - Astronomical Importance
  - Estimated intensity, S/N
- May include:
  - Figures
  - Tables
  - References
- Free-form PDF document
  - 12+ font, English only ** new: the OT will check font size and give an ERROR!
  - 20 MB file size
  - 4 pages (6 for Large Projects)

Tips for writing successful proposals

- Make sure ALMA is the best telescope to achieve your science goal and explicitly mention it.
- Justify your target selection well (this is always the weakest point in a proposal and the first thing reviewers use to take down your proposal in ranking).
- Explain the need for the setup you chose (e.g,. Band, angular and spectral resolution, SNR targeted (is it enough?), etc.) from a scientific perspective.
- Make sure your figures are readable and captions are self-explanatory and clear.
- If you have done an archive search, show you have done your homework.
- DO NOT SQUEEZE TEXT! This annoys your reviewer and you don't want that.
  - Stay within the guidelines outlined in the proposers guide
  - Use the provided template.
- Keep in mind your reviewers have to read ~100 proposals so make yours easy to read and clear.

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Cycle 8 Capabilities

- **Antennas:** At least 43 antennas in the 12-m Array, ten 7-m antennas (for short baselines) and three 12-m antennas (for single dish maps).
- **Receiver bands:** 3, 4, 5, 6, 7, 8, 9, & 10 (wavelengths of about 3.1, 2.1, 1.5, 1.3, 0.87, 0.74, 0.44, and 0.35 mm, respectively).
- **Baselines:** Maximum baselines for the antenna configurations will vary from 0.16 km to 8.5 km. Configurations C-9 and C-10 will not be offered in Cycle 8. Maximum baselines of 3.6 km for Bands 8, 9 and 10. Maximum baselines of 8.5 km for Bands 3 to 7.
- Spectral line, continuum, and mosaic observations.

New Capabilities

- Solar observations in Band 5
- VLBI observations of faint science targets (correlated flux density <500 mJy within an unresolved core on ALMA baselines up to 1 km). These observations will be done in passive phasing mode, where it is recommended to have a bright calibrator within 5 deg of the science target.
- High-frequency observations (Bands 9 and 10) with the stand-alone 7-m Array
- Mosaicking of continuum linear polarization observations (Bands 3 to 7)
- Spectral scans with the 7-m Array

Large Projects (started in Cycle 4)

- Any project >50 hours, or standalone ACA > 150 hours
- Limited observing modes
- Automatic 'A' grade
- +2 pages for Science Case
    - Data/Project Mgmt. Plans
    - Enhanced Data Products
- **For best results – WORK WITH YOUR ARC FOR SUPPORT!!**

ALMA Capabilities – NEW!!!

Dual-Anonymous Proposal Review

- Proposals in Cycle 8 will implement a dual-anonymous process for proposal reviews. While proposers will still enter their names and affiliations in the Observing Tool, their identities will be concealed from the reviewers.

- **It will be the responsibility of the investigators to write their proposals such that anonymity is preserved.**

- Guidelines on how to prepare such proposals will be presented in a forthcoming ALMA news item and, later, in the CfP.

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File Edit View Tool Search Help

Project Structure

Proposal | Program

Unsubmitted Proposal

- Project
  - Proposal
    - Planned Observing
      - ScienceGoal (Copy of B6 12CO (2-1): N
        - General
        - Field Setup
        - Spectral Setup
        - Calibration Setup
        - Control and Performance
        - Technical Justification

Template library. Turn the keys on the JTree below & r...

- Proposal
  - Planned Observing
    - ScienceGoal (B3 spectral sweep CO
    - ScienceGoal (B7 continuum: COSMO
    - ScienceGoal (B7 CO(9-8): Cosmic Ey
    - ScienceGoal (B9 continuum: Cosmic
    - ScienceGoal (B3 spectral sweep: PK
    - ScienceGoal (B3 continuum: GRB To
    - ScienceGoal (B6 continuum: GRB To
    - ScienceGoal (B7 continuum: GRB To
    - ScienceGoal (B6 continuum: GRB To
    - ScienceGoal (B3 continuum: GRB To
    - ScienceGoal (B6 12CO (2-1): NGC32
    - ScienceGoal (B6 13CO (2-1): NGC32
    - ScienceGoal (B6 spectral line: Massi
    - ScienceGoal (B9 spectral line: Massi
    - ScienceGoal (B3 continuum: Protoste
    - ScienceGoal (B6 continuum: Protoste

Editors

Spectral | Spatial | Field Setup

Source Name: NGC3256 — Resol

Choose a Solar System Object? — Name of object: Unspecified

Source Coordinates — System: J2000 — Sexagesimal display? ✔

RA: 10:27:51.6000

Dec: -43:54:18.000

Parallax: 0.00000 mas

PM RA: 0.00000 mas/yr

PM DEC: 0.00000 mas/yr

Source Radial Velocity: 0.000 km/s hel — z: 0.000000000 — Doppler Type: RELATIVISTIC

Target Type: ○ Individual Pointing(s) ◉ 1 Rectangular Field

Expected Source Properties

Peak Continuum Flux Density per Beam: 0.17400 Jy

Continuum Polarization Percentage: 0.0 %

Peak Line Flux Density per Beam: 0.00000 Jy

Line Width: 0.00000 km/s

Line Polarization Percentage: 0.0 %

Rectangle

Coords Type ○ ABSOLUTE ◉ RELATIVE

Field Center Coordinates — System: J2000

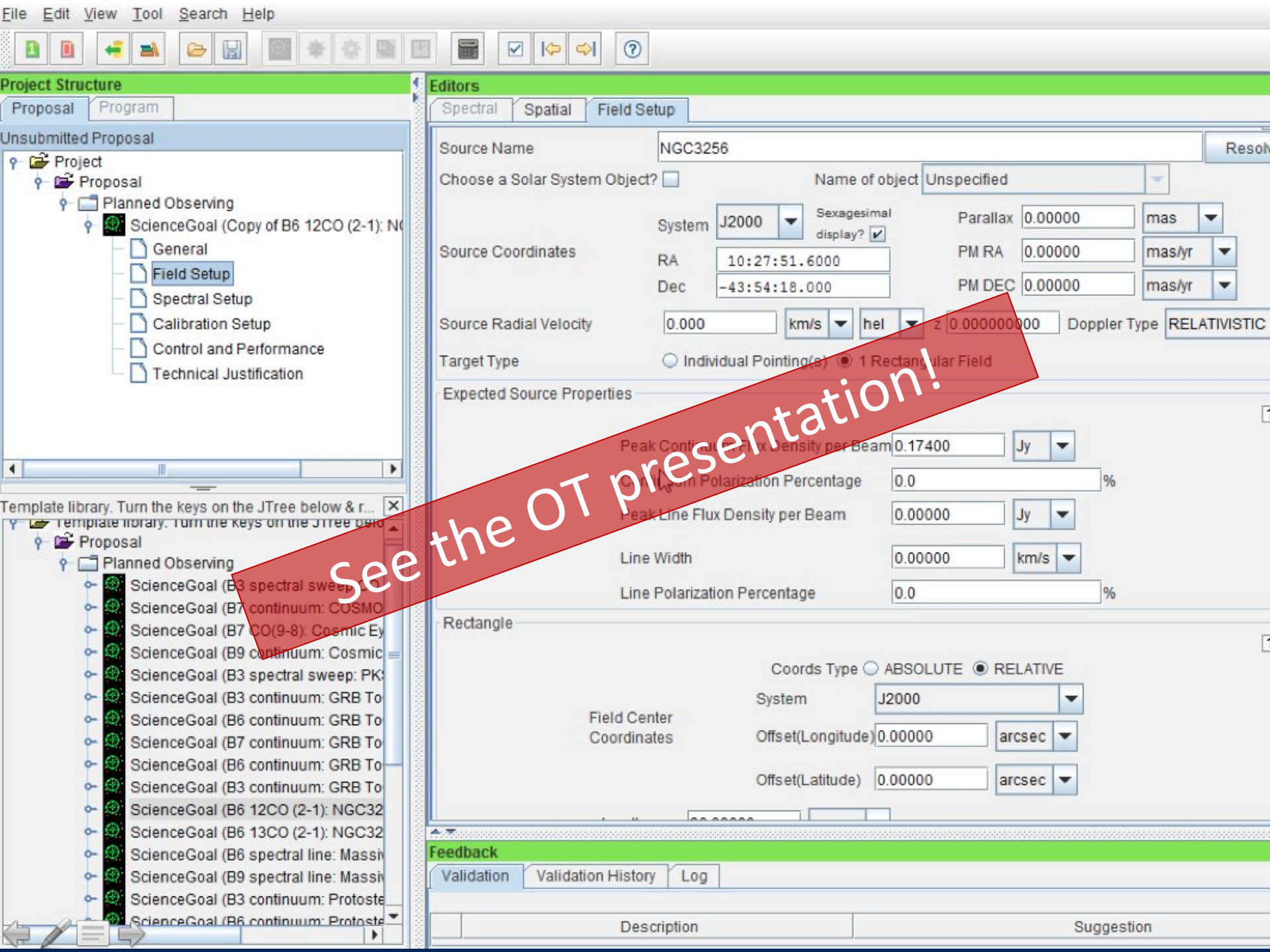
Offset(Longitude): 0.00000 arcsec

Offset(Latitude): 0.00000 arcsec

Feedback

Validation | Validation History | Log

Description	Suggestion


File Edit View Tool Search Help
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Template library. Turn the keys on the JTree below & r...
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ScienceGoal (B3 spectral sweep
ScienceGoal (B7 continuum: COSMO
ScienceGoal (B7 CO(9-8): Cosmic Ey
ScienceGoal (B9 continuum: Cosmic
ScienceGoal (B3 spectral sweep: PK
ScienceGoal (B3 continuum: GRB To
ScienceGoal (B6 continuum: GRB To
ScienceGoal (B7 continuum: GRB To
ScienceGoal (B6 continuum: GRB To
ScienceGoal (B3 continuum: GRB To
ScienceGoal (B6 12CO (2-1): NGC32
ScienceGoal (B6 13CO (2-1): NGC32
ScienceGoal (B6 spectral line: Massi
ScienceGoal (B9 spectral line: Massi
ScienceGoal (B3 continuum: Protoste
ScienceGoal (B6 continuum: Protoste
Editors
Spectral Spatial Field Setup
Source Name NGC3256
Resol
Choose a Solar System Object?
Name of object Unspecified
System J2000
Sexagesimal display?
Source Coordinates
RA 10:27:51.6000
Dec -43:54:18.000
Parallax 0.00000 mas
PM RA 0.00000 mas/yr
PM DEC 0.00000 mas/yr
Source Radial Velocity 0.000 km/s hel z 0.000000000 Doppler Type RELATIVISTIC
Target Type Individual Pointing(s) 1 Rectangular Field
Expected Source Properties
Peak Continuum Flux Density per Beam 0.17400 Jy
Continuum Polarization Percentage 0.0 %
Peak Line Flux Density per Beam 0.00000 Jy
Line Width 0.00000 km/s
Line Polarization Percentage 0.0 %
Rectangle
Coords Type ABSOLUTE RELATIVE
System J2000
Field Center Coordinates
Offset(Longitude) 0.00000 arcsec
Offset(Latitude) 0.00000 arcsec
Feedback
Validation Validation History Log
Description
Suggestion
See the OT presentation!

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Observatory News

Announcement of 3mm VLBI in Cycle 7
Jan 07, 2019

ALMA Cycle 7 Pre-Announcement
Dec 19, 2018

Job Opening: Head of ALMA Department of Science Operations
Dec 05, 2018

More...

NRAO News

Multi-Messenger Astrophysics: Insights from Combining Gravity and Radio Waves
Feb 16, 2019

ALMA Data Reduction Party
Mar 13, 2019

New Horizons in Planetary Systems
May 13, 2019

More...

Status

Configuration Schedule
Cycle 6 Highest Priority Projects

Refereed publications: 1300
Last observed source:
Northeast_Section_of_NGC6334
Current configuration: C43-1

More...

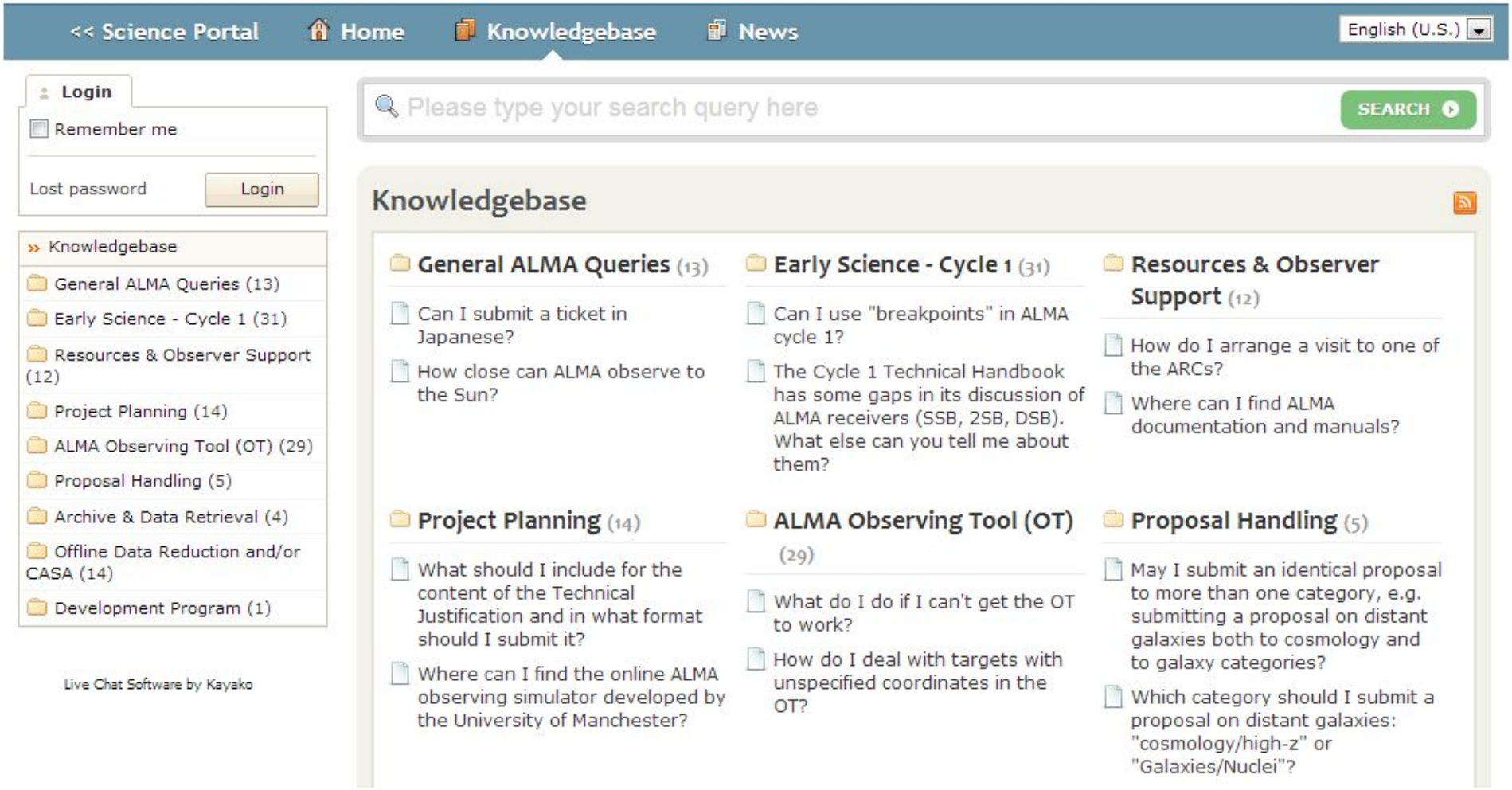
Science Highlights - An ALMA Detection of the Radioactive Molecule 26AlF in a Stellar Merger Remnant.

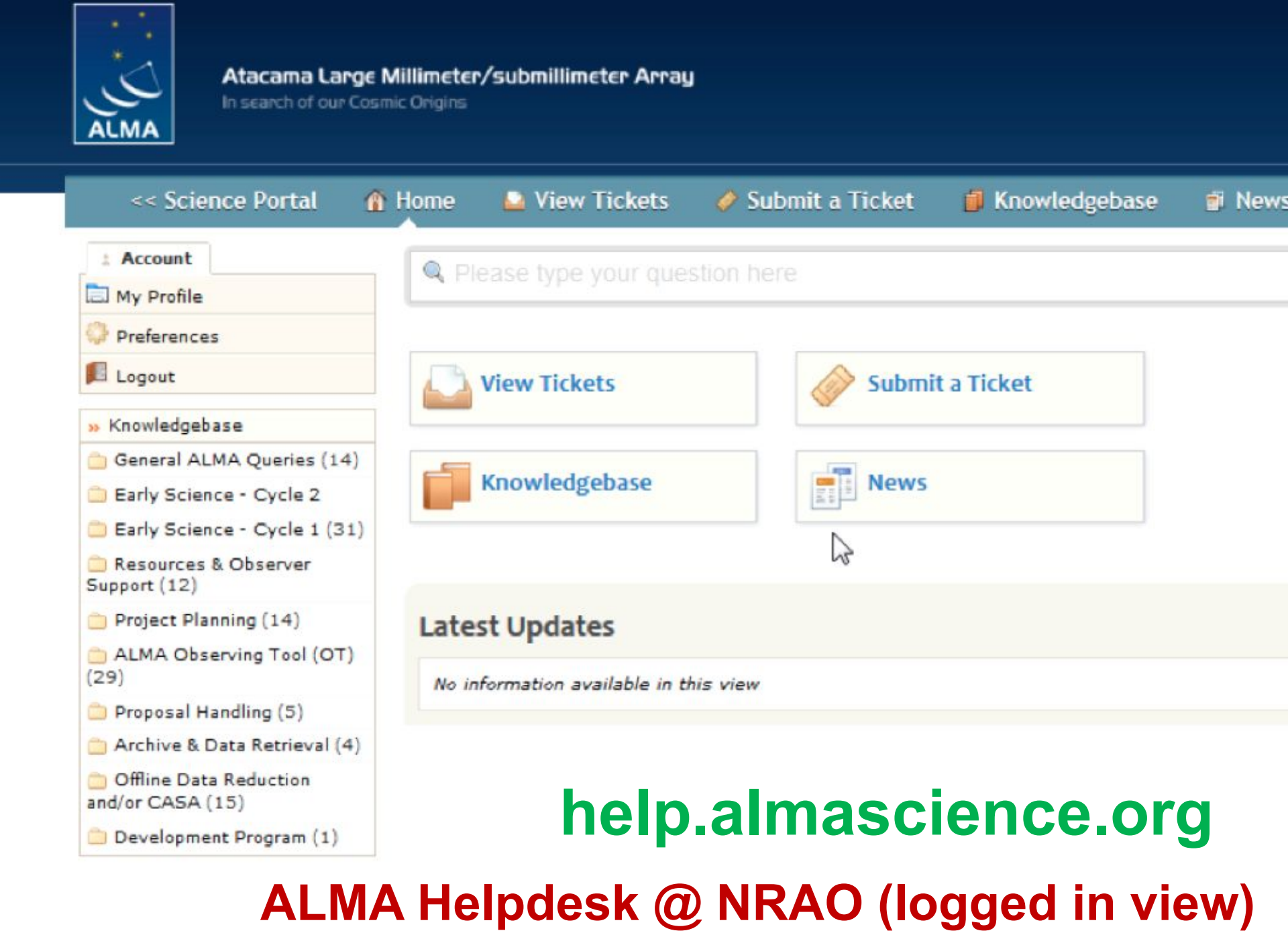
Although diffuse Galactic gamma-ray emission from the isotope of aluminum, ^{26}Al, was first detected in the 1980s, the identification of the source of emission has been hard to pinpoint due to the poor spatial resolution of gamma-ray observations. In a recent Nature paper, a team led by Dr. Kaminski has made use of sensitive, high-

ALMA Science Portal @ NRAO

ALMA

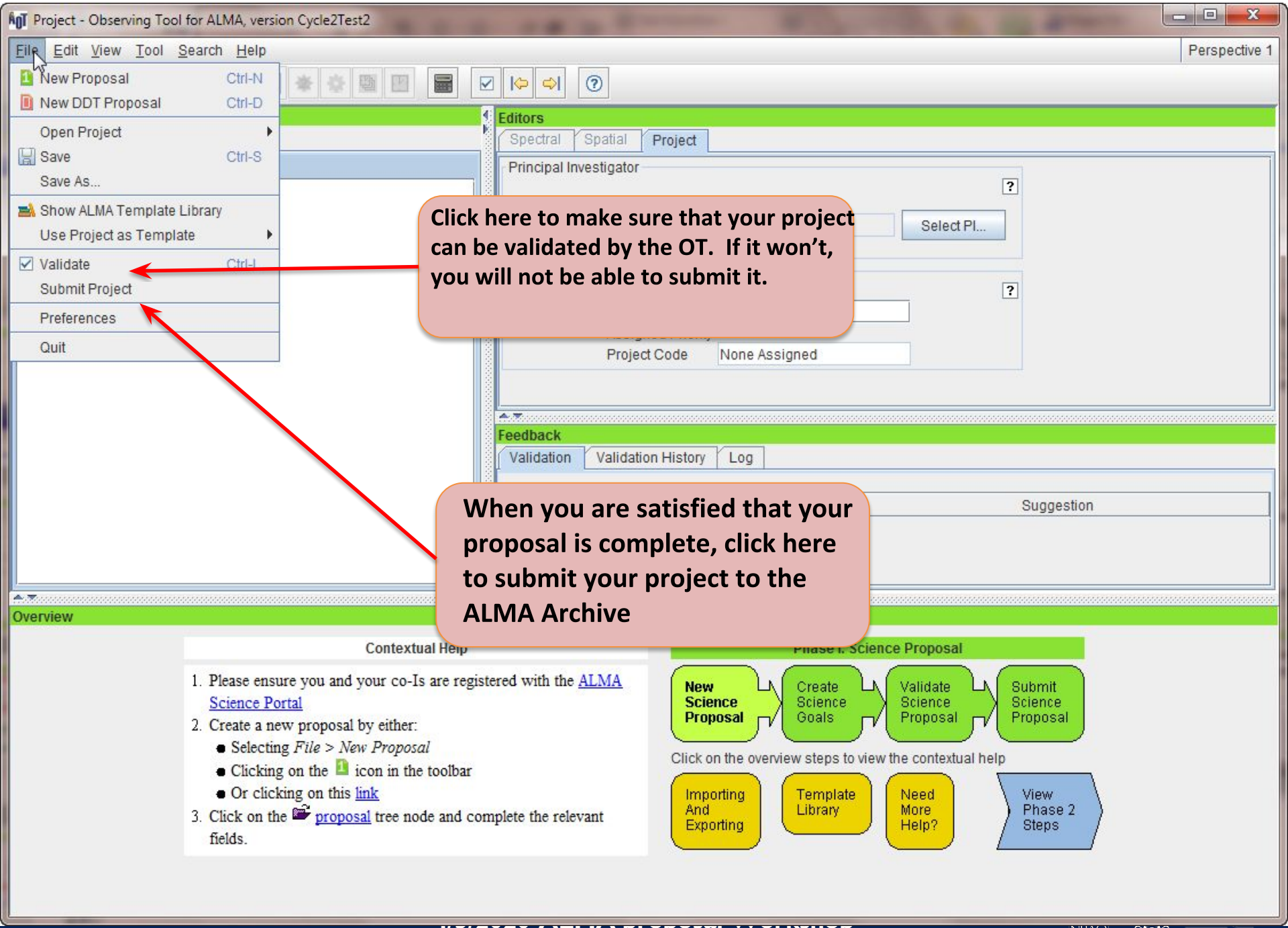
Have no fear, the ALMA Helpdesk is here…





help.almascience.org

ALMA Helpdesk @ NRAO (logged in view)


Project - Observing Tool for ALMA, version Cycle2Test2
File Edit View Tool Search Help
Perspective 1
New Proposal Ctrl-N
New DDT Proposal Ctrl-D
Open Project
Save Ctrl-S
Save As...
Show ALMA Template Library
Use Project as Template
Validate Ctrl-I
Submit Project
Preferences
Quit
Editors
Spectral Spatial Project
Principal Investigator
Select PI...
Project Code None Assigned
Feedback
Validation Validation History Log
Suggestion
Click here to make sure that your project can be validated by the OT. If it won't, you will not be able to submit it.
When you are satisfied that your proposal is complete, click here to submit your project to the ALMA Archive
Overview
Contextual Help
1. Please ensure you and your co-Is are registered with the ALMA Science Portal
2. Create a new proposal by either:
Selecting File > New Proposal
Clicking on the icon in the toolbar
Or clicking on this link
3. Click on the proposal tree node and complete the relevant fields.
Phase I: Science Proposal
New Science Proposal
Create Science Goals
Validate Science Proposal
Submit Science Proposal
Click on the overview steps to view the contextual help
Importing And Exporting
Template Library
Need More Help?
View Phase 2 Steps

After submission

- Remember, you can re-submit as often as needed, but keep in mind that the server is quite busy right before the deadline
- Standard and ToO proposals will be reviewed by the ALMA Proposal Review Committee (APRC) and the ALMA Review Panels (ARP).
- All proposals will be subject to Technical Assessment by a selected group of JAO and ARC experts.
- Proposals will be assessed on the basis of the overall scientific merit of the proposed investigation and its potential contribution to the advancement of scientific knowledge.
- Following approval by the Directors Council, the outcome of the Proposal Review Process will be communicated to the PIs of all valid submitted proposals, expected at the end of July 2020.

Systematics in the ALMA Proposal Review Rankings

- https://arxiv.org/abs/1908.09639

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Systematics in the ALMA Proposal Review Rankings

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ABSTRACT

The results from the ALMA proposal peer review process in Cycles 0–6 are analyzed to identify any systematics in the scientific rankings that may signify bias. Proposal rankings are analyzed with respect to the experience level of a Principal Investigator (PI) in submitting ALMA proposals, regional affiliation (Chile, East Asia, Europe, North America, or Other), and gender. The analysis was conducted for both the Stage 1 rankings, which are based on the preliminary scores from the reviewers, and the Stage 2 rankings, which are based on the final scores from the reviewers after participating in a face-to-face panel discussion. Analysis of the Stage 1 results shows that PIs who submit an ALMA proposal in multiple cycles have systematically better proposal ranks than PIs who have submitted proposals for the first time. In terms of regional affiliation, PIs from Europe and North America have better Stage 1 rankings than PIs from Chile and East Asia. Consistent with Lonsdale et al. (2016), proposals led by men have better Stage 1 rankings than women when averaged over all cycles. This trend was most noticeably present in Cycle 3, but no discernible differences in the Stage 1 rankings are present in recent cycles. Nonetheless, in each cycle to date, women have had a lower proposal acceptance rate than men even after differences in demographics are considered. Comparison of the Stage 1 and Stage 2 rankings reveal no significant changes in the distribution of proposal ranks by experience level, regional affiliation, or gender as a result of the panel discussions, although the proposal ranks for East Asian PIs show a marginally significant improvement from Stage 1 to Stage 2 when averaged over all cycles. Thus any systematics in the proposal rankings are introduced primarily in the Stage 1 process and not from the face-to-face discussions. These results are discussed in the context of potential language and cultural biases, but any conclusions on the origin of the observed systematics remain speculative.

1. INTRODUCTION

The Atacama Large Millimeter/Submillimeter Array (ALMA) is an international astronomical facility operated in a partnership of the European Organisation for Astronomical Research in the

After submission

- Phase II (Creating and Queuing Scheduling Blocks)
  - PIs ***review*** their scheduling blocks by Sept. 9, 2020!
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  - PIs ***review*** their scheduling blocks by Sept. 9, 2020!!!
    - ***You don't submit your SGs, your proposal will be downgraded!***
  - Any change requests need to go to the Helpdesk, and possibly a formal change request
  - Being prompt helps ensure your project can be observed!

dates may change!

- Then wait – dynamic scheduling means your Contact Scientist doesn't know when your project will run. As observations are made, updates are shown in the SnooPI tool on the Science Portal:

  https://almascience.nrao.edu/observing/snoopi

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.

www.nrao.edu
science.nrao.edu
public.nrao.edu

The National Radio Astronomy Observatory is a facility of the National Science Foundation
operated under cooperative agreement by Associated Universities, Inc.