

# A Guide to the North American ALMA Regional Center and the NAASC

Catherine Vlahakis (NAASC)



[www.almascience.org](http://www.almascience.org)

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ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada), NSTC and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ.

## User Support:

For further information or to comment on this document, please contact your regional Helpdesk through the ALMA Science Portal at [www.almascience.org](http://www.almascience.org). Helpdesk tickets will be directed to the appropriate ALMA Regional Center at ESO, NAOJ or NRAO.

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## Table of Contents

<b>1</b>	<b>Welcome</b>	<b>2</b>
<b>2</b>	<b>Highlights</b>	<b>2</b>
<b>3</b>	<b>About ALMA</b>	<b>3</b>
<b>4</b>	<b>About the NAASC</b>	<b>4</b>
<b>4.1</b>	<b>Organization and Role of the ARCs and the NAASC</b>	<b>4</b>
<b>4.2</b>	<b>Key Services provided by the NAASC</b>	<b>4</b>
<b>5</b>	<b>Essential Resources</b>	<b>6</b>
<b>5.1</b>	<b>The ALMA Science Portal</b>	<b>6</b>
<b>5.2</b>	<b>The NAASC Website</b>	<b>7</b>
<b>5.3</b>	<b>The ALMA Helpdesk</b>	<b>8</b>
<b>6</b>	<b>Getting Help from the NAASC at Each Step of Your Project</b>	<b>8</b>
<b>6.1</b>	<b>Large Program Support</b>	<b>8</b>
<b>6.2</b>	<b>Learning about ALMA: Documentation, Workshops, and Community Days</b>	<b>9</b>
<b>6.3</b>	<b>Proposal Preparation</b>	<b>9</b>
<b>6.4</b>	<b>Preparing Your Observations</b>	<b>11</b>
<b>6.5</b>	<b>Working with Your Delivered Data Products</b>	<b>11</b>
<b>6.6</b>	<b>Visiting the NAASC</b>	<b>12</b>
<b>6.7</b>	<b>Publishing Your Results</b>	<b>13</b>
<b>6.8</b>	<b>Getting Support for Conferences and Workshops</b>	<b>13</b>
<b>6.9</b>	<b>Promoting ALMA Science</b>	<b>14</b>
<b>7</b>	<b>Working with the Community to Improve ALMA</b>	<b>14</b>
<b>8</b>	<b>Student Support</b>	<b>14</b>
<b>9</b>	<b>ALMA Ambassador Program</b>	<b>15</b>
<b>10</b>	<b>NAASC Participation and Initiatives in the Office of Diversity and Inclusion (ODI)</b>	<b>15</b>
<b>11</b>	<b>Addresses for the NAASC, NRC-HAA, and ASIAA</b>	<b>17</b>
<b>12</b>	<b>Map of the Area near NRAO Headquarters and the NAASC</b>	<b>18</b>

# 1 Welcome

Welcome to the North American ALMA Regional Center (NA ARC) at the North American ALMA Science Center (NAASC), headquartered at 520 Edgemont Rd., Charlottesville, VA 22903, United States of America. The NAASC is a multinational institution that works to provide the scientific community of North America (NA) access to the Atacama Large Millimeter/submillimeter Array (ALMA). Through the NAASC, we provide support and outreach services to our peers including visiting scholars, graduate and undergraduate students and postdocs, underrepresented groups, and other inquisitive parties interested in ALMA science and outreach. The NAASC also facilitates many private and public training events to the international community. The NAASC welcomes you to visit and learn about what we do and what we have to offer to the scientific community. The NAASC is operated by the National Radio Astronomy Observatory (NRAO) in Charlottesville, Virginia, in collaboration with Canada's National Research Council Herzberg Astronomy and Astrophysics Research Centre (NRC Herzberg), and the National Science and Technology Council (NSTC) of Taiwan. The NAASC supports the science use of ALMA by astronomers in North America and Taiwan and supports research and development for future ALMA upgrades.

The following websites provide additional information on ALMA and the NAASC, and connect users to resources and tools they will need to use the ALMA observatory:

<b>ALMA Science Portal</b>	<a href="http://almascience.nrao.edu">http://almascience.nrao.edu</a>
<b>NAASC website</b>	<a href="http://science.nrao.edu/facilities/alma">http://science.nrao.edu/facilities/alma</a>
<b>ALMA Helpdesk (also linked from the ALMA Science Portal and the NAASC website)</b>	<a href="https://help.almascience.org">https://help.almascience.org</a>
<b>NRC ALMA website</b>	<a href="https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/herzberg-astronomy-astrophysics-research-centre">https://nrc.canada.ca/en/research-development/research-collaboration/research-centres/herzberg-astronomy-astrophysics-research-centre</a>
<b>Taiwan ALMA website</b>	<a href="http://alma.asiaa.sinica.edu.tw/">http://alma.asiaa.sinica.edu.tw/</a>

# 2 Highlights

Below is important information for the NA ALMA Community regarding services and operations at the North American ALMA Science Center (NAASC):

- **Get support for Large Programs!**  
Support services are available for PIs of any proposal type but Large Program PIs are particularly encouraged to review the support services that are available from the NAASC, ranging from assistance with proposal preparation to data delivery and analysis. Agreed-upon support can be included in the ALMA Large Program proposal's Management Plan. See Section 6.1 of this document – Large Program Support.
- **Visit us!**  
The NAASC offers face-to-face visits in both in-person and virtual formats. Through the face-to-face (f2f) department of the [ALMA Helpdesk](#), users may request an in-person visit (at NRAO headquarters

in Charlottesville, VA), a virtual visit, or a virtual “NAASC Chat”. NAASC Chats are an opportunity for a user to interact with NAASC staff members at a dedicated time without committing to a multi-day f2f visit but when they may need more assistance than is practical through a Helpdesk ticket. The f2f visitor program supports data reduction visits, visiting scientists, and sabbatical visits, including those who would like to come for archival research. If you need any help in preparing proposals, reducing data, or help finishing writing up an ALMA paper, consider signing up for a f2f visit to work closely with our data analysts and scientific staff. For more information and to request a visit, please see <https://science.nrao.edu/facilities/alma/visitors-shortterm> and submit a ticket to the face-to-face visits department of the [ALMA Helpdesk](#).

- ***Get support for your meeting!***

The NAASC also offers financial and logistical support to organize conferences and workshops hosted by the community to promote ALMA science. For proposals requesting more than \$10,000, the next call for applications will open in the summer of 2024. For other proposals, applications are accepted year-round while funds last. For more information and to request support for your conference or workshop, visit <https://science.nrao.edu/facilities/alma/facilities/alma/support-for-naasc-conferences-and-workshops>.

- ***Become an ALMA Ambassador or attend an Ambassador-led workshop!***

The ALMA Ambassador Program provides in-depth training and up to \$10,000 in research or travel grant to organize proposal preparation and data processing workshops at institutions across North America. See <https://science.nrao.edu/facilities/alma/ambassadors-program/> for details.

- ***Get calibrated data on demand!***

The NRAO Science Ready Data Products (SRDP) initiative now provides on-demand generation of calibrated measurement sets for data from Cycle 5 to present. It also provides the ability for users to request re-imaging of data products via the ALMA User-Defined Imaging (AUDI). More information on SRDP and AUDI can be found at: <https://science.nrao.edu/srdp>; requests for calibrated measurement sets and re-imaging can be made at: [data.nrao.edu](https://data.nrao.edu).

- ***Stay up-to-date!***

To stay informed about NAASC news and opportunities, subscribe to the [NRAO e-news](#) list and register with the [ALMA Science Portal](#) (NA ARC registered users are automatically added to the NA ALMA User mailing list). NRAO and the ALMA Observatory have Twitter feeds that provide news, updates and highlights – sign up on Twitter to follow @TheNRAO and @almaobs to receive these updates.

### 3 About ALMA

The Atacama Large Millimeter/submillimeter Array (ALMA) enables transformational research into the physics of the cold universe, where the sky is dark in the visible part of the spectrum but shines brightly at (sub)millimeter wavelengths. ALMA is a global collaboration involving partners in North America, Europe, and East Asia, in cooperation with the Republic of Chile. The telescope has 66 high-precision antennas located on the Chajnantor plateau of the Chilean Andes, 5000 m above sea level. ALMA operates at frequencies between 35 GHz and 950 GHz and can image the sky at resolutions as fine as 0.005” with unprecedented sensitivity. The capabilities of ALMA are outlined in the ALMA Proposer’s Guide and details on the telescope are given in the ALMA Technical Handbook. New users can learn about ALMA and get an introduction to radio interferometry in the ALMA Primer. These documents are available on the ALMA Science Portal at <https://almascience.nrao.edu/documents-and-tools>.

## 4 About the NAASC

### 4.1 Organization and Role of the ARCs and the NAASC

ALMA, an international facility, serves a worldwide community of astronomers, scientists, and other professionals. To interact with the geographically distributed user community, the three partners have established ALMA Regional Centers, or ARCs. These are the North American ARC (NA ARC), based in Charlottesville, VA; the East Asian ARC (EA ARC), based in Mitaka, Japan; and the European ARC (EU ARC), based in Garching, Germany. The ARCs are staffed by scientists with expertise in radio astronomy, millimeter/submillimeter astronomy, and interferometry, and their purpose is to work with the scientific community to maximize the productivity of the ALMA telescope. The NA ARC is part of the NAASC, concentrating on internationally agreed core ALMA functions.

Each astronomer who uses ALMA is assigned an ARC for user support at the time they register with the ALMA Science Portal and when they update their affiliation. Astronomers in North America, East Asia, or Europe are assigned to the ARC associated with their region. Astronomers from Taiwan can select either the NA ARC or the EA ARC. Astronomers elsewhere in the world can select any one of the three ARCs.



Stone Hall on the Campus of the University of Virginia and headquarters of the North American ALMA Science Center.

The NAASC is located in part at NRAO Headquarters, on the Grounds of the University of Virginia (UVa), a short walk from the UVa Department of Astronomy (Section 12). The NRAO and UVa Astronomy share colloquia, journal clubs, science group meetings and lunch talks. Several NAASC staff have joint or adjunct appointments at UVa. The NAASC is also located in part at NRC Herzberg Astronomy & Astrophysics, located in Victoria, BC, Canada. A list of NAASC staff, including research interests, is available here: <http://science.nrao.edu/facilities/alma/ALMApeople/>

### 4.2 Key Services provided by the NAASC

The key services provided by the NAASC to the North American astronomical community include:

- **Phase 2 Group (P2G)** – P2G staff assist users by preparing ALMA Scheduling Blocks (SBs) in anticipation of the upcoming observing cycle. This effort also includes follow-up on change requests reported during the course of the cycle and making the appropriate edits to the SBs before placement into the observing queue.
- **Contact Scientists** – ARC staff are assigned to each approved project to provide support and oversight of approved observing programs, and are the main point of contact between PIs and ALMA for approved projects.
- **Tool and algorithm development** – Includes calibration and imaging pipeline heuristics, [analysisUtils](#), [Splatalogue](#), [simalma](#), the QA2 reporting script for manual calibration, and algorithm research and development (see Section 6.3 of this guide for more information on *simalma* and Splatalogue).

- **Online data reduction guides for a range of ALMA observing modes** – These CASA guides can be found at <http://casaguides.nrao.edu/> and more information on CASA can be found at <http://casa.nrao.edu>.
- **Principal Investigator (PI) data reduction and imaging** – Includes Pipeline processing and coordinating and managing the calibration, imaging, and delivery of PI data products through the ALMA Archive and the delivery of calibrated measurement sets through the Labor-saving Added Value Automation (LAVA) service. We also provide ALMA Data Mining Toolkit (ADMIT) products for interferometric observations which offer a quick-look of data including line identification for well-known chemical species and moment maps. For more information about ADMIT products, see the [ADMIT CASA guide](#).
- **Re-generation of calibrated measurement sets** – The delivered calibrated data and ADMIT products are retained on disk for a period of **ONE** month. After that, users can request re-generation of calibrated measurement sets via the ALMA Helpdesk. Archival users can also request calibrated data from Cycles 1-4 via the ALMA Helpdesk. This service is restricted to projects whose PIs have NA designated as their ARC for support. If the user is not a PI or delegated co-I, and is requesting calibrated measurement sets for public data, there will be a limit of **FIVE** such requests per calendar year per requestor. For Cycles 5-present, users can request re-generation of calibration measurement sets at: [data.nrao.edu](http://data.nrao.edu) as part of NRAO's [Science Ready Data Products](#) initiative. This service is provided to all users worldwide, as long as the data is publicly available in the ALMA Archive. If the data is still proprietary, only the PI or delegated co-(P)Is may make the request.
- **NAASC Community Day events** – Training events, often hosted by ALMA Ambassadors (Section 9), which are part of the NAASC's mission to develop strategic plans and initiatives to grow and inform the ALMA user base through the use of schools, tutorials, and workshops.
- **ALMA Helpdesk** – Overall management of the ALMA Helpdesk activities including routine ticket reviews, enforcement of ticket service level agreements and formulation of new [Knowledgebase](#) articles based on user questions.
- **Documentation** – Review and assistance in the preparation of the ALMA documentation including the ALMA Call for proposals, Proposer's Guide, Users' Policies, Science Primer, Technical Handbook, Guide to the NA ARC and the NAASC, software user guides, and documentation on how to access NAASC services.
- **Face-to-face visitor program** – Visits (Section 6.6) can include proposal preparation and data reduction visits of PIs (or co-Is), or any scientist doing archival research. We also provide support for visiting scientists, and sabbatical visits.
- **Computing and archive infrastructure** – The NAASC operates a copy of the ALMA data archive including LUSTRE access and management of users to the NRAO cluster-processing pipeline.
- **Extension and optimization of ALMA capabilities** – NAASC staff interface with the JAO and the ALMA Science Advisory Committees on setting the priorities for expansion and improvement of ALMA's



**ALMA Ambassadors and NAASC Staff at the poster reception during the Ambassador training session – 2019 February**

capabilities for future cycles and support the JAO in carrying out related activities. In the next several cycles, work will focus on the [ALMA2030 Wideband Sensitivity Upgrade](#).

- **NA ALMA Development Program** – Aimed at keeping ALMA at the forefront of scientific discovery over the long-term. Over the next several years, this program will deliver a new wideband correlator and an upgraded Band 6 receiver as part of the [ALMA2030 Wideband Sensitivity Upgrade](#).
- **Funding support** – Providing opportunities for student funding (including archival research) and page charge support for U.S.-based investigators.
- **Science outreach events** – The NAASC works closely with the [NRAO Department of Diversity and Inclusion \(ODI\)](#) to promote STEM education through a wide range of initiatives.

## 5 Essential Resources

### 5.1 The ALMA Science Portal

The ALMA Science Portal is the primary access point to ALMA for all science users, and can be found at: <http://almascience.nrao.edu>

At the ALMA Science Portal, users can:

- Register as an ALMA user
- Access the ALMA Call for Proposals, the ALMA Proposer’s Guide, the ALMA Technical Handbook, the ALMA Primer, and other documentation
- Download the ALMA Observing Tool, the software used to prepare and submit ALMA proposals
- Search and access public data from the ALMA Archive
- Access Knowledgebase articles from the ALMA Helpdesk
- Access software tools and documentation, including a sensitivity calculator, the ALMA Observation Support Tool, and Splatalogue
- Get an overview of ALMA’s scientific capabilities.

Every astronomer who intends to submit an ALMA proposal as a PI, or appear on one as a co-PI or co-investigator (Co-I), must register with the ALMA Science Portal. Once registered and logged in, users will be able to:

- Submit an ALMA proposal as a PI
- Participate as a co-I or co-PI on ALMA proposals
- Manage their user profile and demographic information, including:
  - Updating user affiliation – Users are responsible for ensuring that their profile is correct throughout the cycle but it is particularly important (for proper observing time accounting across the Executives) that a user affiliation is correct if a proposal is being submitted. See details in the [ALMA Users’ Policies](#).
  - Updating personal information that is used to track proposal statistics as we continue to remove bias from the proposal review process.
  - Specifying areas of expertise and conflicts of interest, necessary for the proper dissemination of proposal review during the distributed peer review process.

- Setting an option to receive automatic email notifications of observing progress, delegate access to their data to other ALMA users or delegate the right to trigger Target of Opportunity observations to other ALMA users.
- Access SnooPI, the tool for PIs and collaborators to monitor the status of their observing programs
- Submit ALMA Helpdesk tickets
- Access their proprietary data through the ALMA Archive.

Once registered with the ALMA Science Portal, a user assigned to the NA ARC is automatically added to the NA ALMA User mailing list. This list is used by the NA ARC Manager and other designated NAASC staff to communicate news, events, science highlights and upcoming science conferences to the NA ALMA User community. These emails may be sent every 6-8 weeks (or more) depending on the urgency of information.

To stay informed about NAASC news and opportunities, we also recommend that you subscribe to the [NRAO e-news](#) list. Also, NRAO and the ALMA Observatory have Twitter feeds that provide news, updates and highlights. If you haven't already done so, sign up on Twitter to follow @TheNRAO and @almaobs to receive these updates.

## 5.2 The NAASC Website

The NAASC website provides up-to-date news and information of particular use to North American ALMA users, and can be found at: <https://science.nrao.edu/facilities/alma>.

At the NAASC website, users get information on:

- ALMA and NAASC news and events
- ALMA development activities, including updates on the Wideband Sensitivity Upgrade
- Data reduction and analysis support including instructional videos on interferometry and CASA
- Financial support for visiting the NAASC, publications, and organizing conferences and workshops
- Student and postdoc programs
- Scientific and training activities, including workshops on ALMA proposal preparation, data processing and analysis
- NAASC staff, contacts, and feedback avenues



**NAASC Staff members Adele Plunkett (Left) and Andy Lipnicky (2<sup>nd</sup> from Right) at the high site with ALMA engineer Pablo Carrillo (2<sup>nd</sup> from Left) and an ABC Nightline correspondent (Right) – 2019 March.**

## 5.3 The ALMA Helpdesk

The ALMA Helpdesk is the main user resource for getting help. The ALMA Helpdesk is a website that can be accessed from the ALMA Science Portal, from the NAASC website, or directly at: <https://help.almascience.org>.

The ALMA Helpdesk includes a library of [Knowledgebase](#) articles that address a number of common issues and questions. As the user types a question, Knowledgebase articles are searched in real time and relevant articles are presented as the question is being typed. If the user does not find an answer in the articles or documentation suggested, the user can submit a ticket. While it is necessary to log in before submitting a ticket, users can browse and search the Knowledgebase articles and ALMA Science Portal documentation without logging in.

The ALMA Helpdesk has the following departments in order to direct tickets to the appropriate people at the user's affiliated ARC:

- General Queries (NA) – Science Portal/Registration, Documentation, Webpages, Proposal reviews and assessment, Project tracking, other
- Project Planning (NA) – Available Capabilities, Call for Proposals, Sensitivity Calculator, Simulators, Splatalogue, other
- Observing Tool (NA) – Proposal Preparation, Proposal Submission (general), Phase2 process
- Proprietary Period Extension Requests (NA)
- Data Reduction (NA) – CASA, pipeline processing, etc.
- Proposal Change Requests (NA) – request for a change to a submitted proposal or accepted project
- Archive and Data Retrieval (NA) – archive access and queries, obtaining your ALMA data, archival research
- Face to Face Support (NA) – Data reduction, science, short term, other

ALMA Helpdesk staff will make every effort to respond to tickets promptly. During normal operations, users can expect a response within two business days. During the last week before the Call for Proposals, a single department called “Proposal Submission Emergency” is set up across all ARCs that will answer urgent tickets concerning proposal submission. Triage for this department will start 72 hours before the deadline with 24-hour coverage by Europe (EU), North America (NA), and East Asia (EA).

## 6 Getting Help from the NAASC at Each Step of Your Project

The NAASC provides user support through all stages of an ALMA project, from learning the observatory's capabilities to the publication of results.

### 6.1 Large Program Support

All ARCs provide support for ALMA Large Programs. As stated in the ALMA Proposer's Guide, prospective PIs of Large Programs are **strongly encouraged** to contact their ARC for support in order to better prepare for submitting a Large Program proposal – especially when preparing the Management Plan. The sections below describe the services that are available to all PIs that may be especially relevant to Large Program PIs, both when preparing an ALMA proposal and to help with data processing and analysis. Large Program PIs should review these services carefully and decide if any/all of the services are relevant for their program. It is strongly recommended that Large Program PIs reach out to the NA ARC well ahead of submitting their proposal to get

agreement on the services that will be provided by the NA ARC such that they can be included in the proposal Management Plan. Such service can include, but are not limited to:

1. Access to computing resources (e.g. NA ARC high speed computing system, disk space, or server areas (e.g. ftp) where data can be staged and shared with members of the proposal team). Any NA ALMA user can request access to the NA ARC computing systems, but Large Programs are particularly encouraged to secure access to disk space and the high speed computing system prior to proposal submission, to help with data processing and analysis.
2. Support in optimizing observing strategy and OT setup.
3. Dedicated data analyst support throughout the QA2 Process including incremental checks of the data to ensure the final quality of the delivered data.
4. Face-to-face or virtual visits to the ARC for proposal preparation or data processing support.
5. Other support provided on request (e.g. help with press releases, page charges, limited travel support).

Additional services may be available upon request and Large Program PIs should contact the NA ARC early in the proposal preparation process to discuss their needs.

## 6.2 Learning about ALMA: Documentation, Workshops, and Community Days

Preparing for an ALMA project begins with learning about the observatory's capabilities and the tools needed to design observations, prepare proposals, and submit proposals. The NAASC provides user documentation, including [Observing with ALMA: A Primer](#), at the ALMA Science Portal.

The NAASC helps to organize NRAO Community Days and other regional workshops in the USA and Canada to promote ALMA to the astronomical community, describe the tools needed to write proposals, and provide training on techniques for PI and archival data processing. These workshops feature talks on the observatory's capabilities, mm/submm interferometry observing techniques, the tools required to design effective ALMA projects, data processing, and data visualization. Attendees learn to use the ALMA Observing Tool (OT), the software used to prepare and submit observing proposals. The workshops may include a hands-on session to introduce attendees to imaging ALMA data with CASA. At the request of the hosts, the workshops may also include talks and information on CASA tasks for simulating ALMA observations. Future workshops are arranged in response to the level of interest from the user community. NRAO Community Days and ALMA workshops can be organized and hosted by university groups or research institutes, or can be tied to other scientific meetings or workshops.

The NAASC also supports NRAO special sessions, splinter sessions, webinars and training events at AAS meetings and other meetings of the astronomical community throughout the year.

Finally, the NAASC hosts periodic "Data Reduction Parties" – workshops that focus specifically on data calibration and imaging. These workshops are aimed at helping users process their own ALMA data or archival data.

To request a community day event at your institution and/or see a list of workshops, Community Days, and training events, visit the workshops page at: <https://science.nrao.edu/facilities/alma/community>

## 6.3 Proposal Preparation

A Call for Proposals is issued prior to each scheduling period, or "Cycle". The Call and supporting documents are made available on the ALMA Science Portal (see Section 5.1). These documents describe the capabilities of the observatory for the upcoming cycle and the policies and procedures for submitting proposals.

ALMA proposals are prepared using the ALMA Observing Tool (ALMA OT), an application that can be downloaded from the ALMA Science Portal. Proposals must include a scientific and technical justification, a list of targets and frequencies to be observed, and details such as the sensitivity and angular resolution required to meet the science goals. The ALMA OT includes a sensitivity and exposure time calculator. Users must be registered with the ALMA Science Portal to be able to submit proposals using the ALMA OT.

NAASC staff are available to help users learn how to use the ALMA OT and prepare proposals. We emphasize here that the ALMA OT is not only used to assemble and submit the scientific and technical justifications, but also to design and specify fully the observations, so users are encouraged to become familiar with the ALMA OT well in advance of the proposal deadline. The ALMA Helpdesk (see Section 5.3 of this guide) is the primary resource for those seeking assistance. It may be possible to arrange face-to-face assistance at the NAASC for particularly challenging proposals (Section 6.6).

The [CASA Simulator](#) using the task *simalma*, and the lower-level tasks *simobserve* and *simanalyze*, allow users to simulate an ALMA observation of a target based on a model with a given source position, structure and brightness. These tasks also help potential ALMA users visualize how different antenna configurations and track durations affect an observation. More information on simulating ALMA observations is available at: [http://casaguides.nrao.edu/index.php?title=Guide To Simulating ALMA Data](http://casaguides.nrao.edu/index.php?title=Guide%20To%20Simulating%20ALMA%20Data).

The [ALMA Observation Support Tool](#) (OST) provides another method of simulating ALMA observations. The OST provides a web interface to the CASA simulation code through which the user can specify observing parameters and upload a FITS file with a model image, or select a model image from a pre-existing library. The OST is available from the ALMA Science Portal at <https://almascience.nrao.edu/tools>.

The NAASC is also responsible for providing the ALMA user community with a complete, up-to-date spectral line catalog – [Splatalogue](#). Splatalogue is an effort to collate and rationally organize existing spectroscopic catalogues into a single resource for the astronomical community. The focus is on pure rotational and ro-vibrational transitions of astronomically relevant molecules for observations in the microwave and millimeter wave regions using telescopic infrastructure such as ALMA, JVLA, and the GBT, amongst many others. As of July 2022, Splatalogue contains over 11.4 million transitions from 1333 species and is updated regularly. Splatalogue also features an interface that is Virtual Astronomical Observatory (VAO) compliant for interfacing with external software or websites.

New starting in February 2024, the main page for Splatalogue features options for Basic or Advanced search capabilities for the Splatalogue database. Use of the Basic search is limited to:

- Common astronomically detected molecules and vibrational states, such as CO, H<sub>2</sub>O, methanol, hydrogen cyanide, and others.
- Pre-defined “filtered” sets of molecules, such as those relevant to diffuse clouds, comets, planetary atmospheres, etc.

Search criteria including user defined frequency ranges, as well as ALMA Bands 3-9 and the primary GBT bands, and lower state energy bounds.

In all cases, the only frequencies shown are those which are NRAO recommended. These are typically selected as the most recently updated line list from either JPL, CDMS, or SLAIM. Observed astronomical intensities for transitions found in the Lovas/NIST database are also included along with the NRAO recommended frequencies. For more information about Splatalogue and its use and functionality, visit <http://splatalogue.online>.

## 6.4 Preparing Your Observations

ALMA proposals are reviewed on their scientific and technical merit, and PIs are informed of the outcome of the review process by email from the JAO. Programs eligible for scheduling are assigned a Contact Scientist, a member of the NAASC staff who provides a single point of contact for program support. NAASC staff and the Contact Scientist work with the PI to review observing strategies and prepare Scheduling Blocks. After the observations are made, the Contact Scientist can assist with questions related to data reduction. The main means of interaction between PIs and NAASC staff is via the ALMA Helpdesk. For particularly complex observations, however, users may arrange a visit to the NAASC to prepare the observations (Section 6.6).

Observers do not travel to Chile or elsewhere to take part in the ALMA observations. Observatory staff dynamically schedule ALMA observations, taking into account the weather conditions, instrument status, availability of the targets, and proposal ranking.

## 6.5 Working with Your Delivered Data Products

The primary software package used to process ALMA data is CASA (Section 6.3 - <http://casa.nrao.edu>). A set of *CASA Guides* – a collection of data reduction and imaging tutorials and step-by-step processing and analysis examples, including scripts for processing Science Verification data – is available at <https://casaguides.nrao.edu/index.php?title=ALMAGuides>.

The challenge posed by storing and processing ALMA data is formidable. The NAASC hosts a copy of the ALMA data archive and the NAASC site serves as the primary data access point for North American users, and provides a backup of the archive in Santiago. Upon completion of the observations and initial data processing, PIs are notified and given instructions on how to download their data.

ALMA data are processed in two steps: first they are calibrated, and then imaged. Most ALMA data are now calibrated and imaged using the ALMA Data Reduction and Imaging Pipeline. In some rare cases, observatory or NA ARC staff may prepare CASA scripts for calibration or imaging. Access to these data products are primarily available through the ALMA Archive. The archive products include the raw data written in ALMA Science Data Model (ASDM) format and processed data products. The processed data includes:

- QA0 and QA2 report files which contain important information about your data including how your data were processed.
- FITS images
- Calibration and imaging scripts (either pipeline- or manually-produced)
- Calibration tables
- Quality Assurance (QA) plots or the weblog if any part was processed by the ALMA pipeline
  - The weblog is an html-formatted collection of web pages containing diagnostic information describing the pipeline run.
  - A more detailed description of the pipeline and weblog can be found under the section ALMA Science Data Tracking, Data Processing and Pipeline, Archive and QA2 Data Products at: <https://almascience.org/documents-and-tools#datatrack>.

The fully-calibrated measurement set (MS) which includes only the science target data is provided as an additional "Added Value" service to North American PIs. Calibrated measurement sets are supplied with all NA-processed deliveries to the PI and (on request) to delegated co-PI or co-Is. Generally, calibrated data provided to users are ready for science imaging using the ALMA Imaging Pipeline or directly with CASA tasks. Visit [https://casaguides.nrao.edu/index.php?title=ALMA\\_Imaging\\_Pipeline\\_Reprocessing](https://casaguides.nrao.edu/index.php?title=ALMA_Imaging_Pipeline_Reprocessing) for imaging

examples. In rare cases, however, users may get best results by refining the calibration themselves, with assistance from NAASC staff (if desired).

The calibrated data are retained on disk for a period of **ONE** month. After that, for Cycles 1-4, users can request re-generation of calibrated measurement sets via the ALMA Helpdesk. This service is restricted to projects whose PIs have NA designated as their ARC for support. If the user is not a PI or delegated co-I, and is requesting calibrated measurement sets for public data, there will be a limit of **FIVE** such requests per calendar year per requestor. For Cycles 5-present, users can request re-generation of calibrated measurement sets at: [data.nrao.edu](http://data.nrao.edu). This service is provided to all users as long as the data is out of proprietary period. If the data is still proprietary, only the PI or delegated co-(P)Is may make the request.

In addition to the calibrated target MS and QA2 information, we also provide the ADMIT products for interferometric observations. ADMIT is an experimental ALMA development project which is designed to look through science images and automatically provide line identification, moment maps, position-velocity diagrams, etc. Please note that ADMIT products are **not** Quality Assured and line identification is only performed for well-known chemical species. For more information about installing and using ADMIT on your data, please see the [ADMIT CASA guide](#)

Users are encouraged to visit the NAASC to get help with their data processing (Section 6.6). The NAASC has computers with ample resources to reduce ALMA data, including powerful desktops and a cluster machine connected to a high-speed LUSTRE file system. The NAASC also supports remote access to its cluster machine, which can be obtained by submitting a ticket to the ALMA Helpdesk.

Short term or data reduction visitors will be assigned a temporary login and password to work on their data. This short term visitor account can be used for a couple of days up to a few (2-3) weeks. If additional time is necessary, one extension can be made for this short term account for up to a few (2-3) weeks. After that, if the user still needs additional substantial time to work on their data, they will be directed to request a long-term NRAO account. This long-term account can be open for up to a year before renewal. To qualify for a long-term NRAO account, the user must have the support of an NRAO scientific staff member. NAASC staff will be more than willing to support long-term users working on their data on the NAASC cluster. *Note – NAASC resources are NOT the place for long term curation of user data products. Users will need to make other arrangements for the long term storage of their data.* For information about the cluster, visit: <https://info.nrao.edu/computing/guide/cluster-processing>. To request remote access to the cluster, submit a ticket to the ALMA Helpdesk.

On the CASA website, there are recommendations for computing hardware required to process ALMA data outside of the NAASC (visit <https://casa.nrao.edu/casa硬件-requirements.shtml>).

## 6.6 Visiting the NAASC

The NAASC welcomes short-term visits to Charlottesville, VA, or Victoria, British Columbia from North American investigators of successful ALMA programs or archival researchers for expert assistance with processing and analyzing ALMA data (including archival data), or with setting up technical aspects of ALMA observing proposals including Large Programs (see Section 6.1).

The NAASC offers face-to-face (f2f) visits in both in-person and virtual formats. Users may request an in-person visit (at NRAO headquarters in Charlottesville, VA), a virtual visit, or a virtual “NAASC Chat”. NAASC Chats are an opportunity for a user to interact with NAASC staff members at a dedicated time without committing to a multi-day f2f visit but when they may need more assistance than is practical through a Helpdesk ticket. In-person visits are expected to last about a week. Virtual visits can vary from a few hours up to a few days

depending on the purpose and type of visit. NAASC Chats last 1-2 hours. Up to three visitors can be supported for each scheduled or observed project.

Visitors will have access to office space and high-end computing facilities to process their data, plus support from NAASC staff. Novice visitors, new to radio interferometry, are required to be accompanied by an experienced investigator. Investigators who are requesting a short data reduction visit can apply to the NAASC for assistance with travel expenses for 1-2 members of their team.

To request a visit, send a ticket to the ALMA Helpdesk using the "Face-to-Face Support" department. In-person f2f visits reduction should be requested *at least one month in advance*. Virtual f2f visits should be requested at least two weeks in advance. NAASC Chats should be requested at least one week in advance. More details about visiting the NAASC are available at: <https://science.nrao.edu/facilities/alma/visitors-shortterm>.

The NAASC also hosts ALMA Data Reduction Parties during which a group of 10-12 researchers visit the NAASC at the same time for assistance in data reduction and analysis. These events are similar to individual f2f support visits except that they also include lectures and can be focused on a specific technique or application, depending on interest. The dates for these events are announced via the NAASC webpage and the NRAO eNews newsletter.

Long-term visitors to the NAASC are also strongly encouraged, especially those interested in extending and optimizing the capabilities of ALMA or improving the data reduction and imaging strategies. The length of such visits is negotiable but they typically last between a few weeks to a year. Visit support can range from funding for accommodation, per diem or travel costs, to salary supplements, as needed. More details are available at: <https://science.nrao.edu/facilities/alma/community1/opportunities/visitorsprogram>.

## 6.7 Publishing Your Results

Upon request, NRAO provides financial support for page charges to authors at U.S. scientific or educational institutions. The paper may report either original data obtained with an NRAO facility, including ALMA, or original research made with NRAO archival data.

All publications that are funded by NRAO page charges **must** include the following statement as a footnote or acknowledgement: "The National Radio Astronomy Observatory is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc." and, for ALMA data, the additional acknowledgment: "This paper makes use of the following ALMA data: ADS/JAO.ALMA#2011.0.01234.S. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada), NSTC and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ."

Details on the page charge support policy are here: <http://library.nrao.edu/pubsup.shtml>.

## 6.8 Getting Support for Conferences and Workshops

The NAASC offers support for inclusive conferences and workshops which encourage the participation of students, postdocs, and early career researchers. There is no restriction on the size of the meeting, and any wavelength and/or topic with a connection to ALMA science, technology, or broader impact objectives will be considered. The NAASC will provide monetary funding (up to \$25,000) and provide certain logistical support.

For proposals requesting more than \$10,000, we will open the next call for applications in the summer of 2024. For other proposals, we will accept applications year-long while funds last. For more information and

to request support for your conference or workshop, please visit <https://science.nrao.edu/facilities/alma/facilities/alma/support-for-naasc-conferences-and-workshops>.

## 6.9 Promoting ALMA Science

The NAASC sponsors ALMA-themed science conferences on roughly an annual basis. A listing of previous ALMA conferences and information on upcoming conferences is available at: <https://science.nrao.edu/facilities/alma/naasc-workshops>.

NAASC activities and ALMA results are publicized in the NRAO eNews: <http://science.nrao.edu/enews>.

The NAASC is also involved in community outreach through special ALMA special sessions and other events at American Astronomical Society and Canadian Astronomical Society meetings. At these sessions, we provide attendees with highlights of recent ALMA science, describe the current status of ALMA, and give updates on the proposal submission and data processing tools.

The Education and Public Outreach (EPO) team at NRAO works with investigators to publicize newsworthy ALMA projects via news releases, videos, and other outreach products. In addition to providing expertise and advice on outreach activities, the EPO team can develop images, graphics, and other visuals to promote science results. To recommend a potentially newsworthy result or for questions, contact the NRAO Department for Public Relations for ALMA ([alma-pr@nrao.edu](mailto:alma-pr@nrao.edu)).

## 7 Working with the Community to Improve ALMA

The NAASC encourages involvement from the user community to develop and improve ALMA. The NAASC periodically invites proposals from North American entities for studies or projects for potential inclusion in the ALMA Development Plan. The primary aims are:

- To give groups in North America the opportunity to propose ALMA upgrades that may later be implemented as part of the ALMA Development Plan
- To support the development of conceptual and detailed designs for ALMA upgrades, and
- To encourage relevant long-term research and development.

Development proposal calls are announced at:

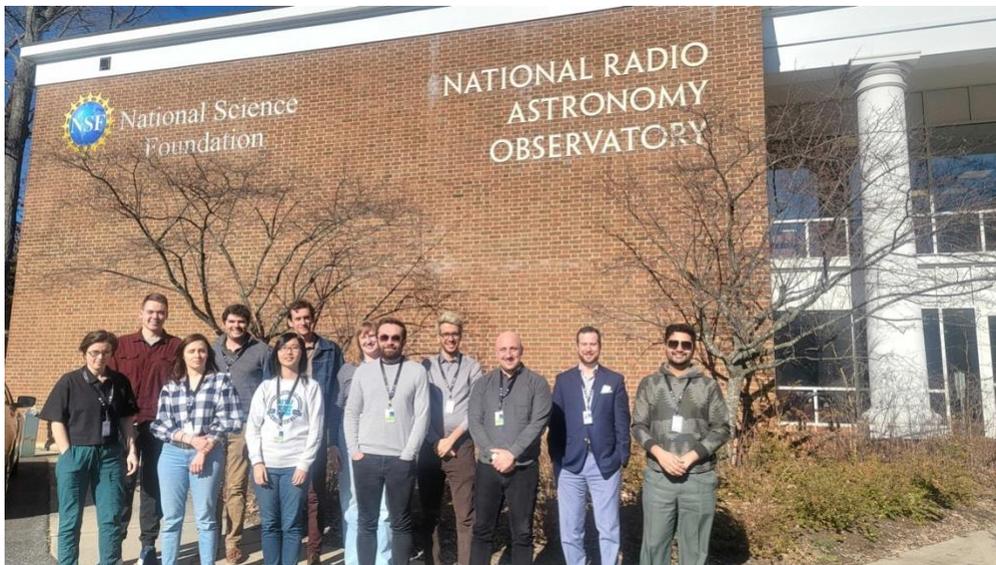
[https://science.nrao.edu/facilities/alma/facilities/alma/science\\_sustainability/NADevelopmentProgram](https://science.nrao.edu/facilities/alma/facilities/alma/science_sustainability/NADevelopmentProgram).

## 8 Student Support

The NAASC supports student involvement in ALMA research through the NRAO student programs. NRAO has a Summer Student Program aimed at introducing undergraduate and beginning graduate students to cutting-edge radio astronomy research and engineering. In addition, the Student Observing Support Program funds undergraduate and graduate students working on eligible ALMA observations, including support for research with ALMA archival data. The Reber Pre-Doctoral Program and the Post-Bacc Program offer the opportunity for students to conduct research at NRAO sites under the mentorship of an NRAO scientist. Details on the student programs are available at: <http://science.nrao.edu/opportunities/studentprograms.shtml>.

## 9 ALMA Ambassador Program

The ALMA Ambassador Program provides training (and up to a \$10,000 research or travel grant) to early career researchers (including graduate students and postdocs) interested in expanding their ALMA/interferometry expertise and sharing that knowledge with their home institutions through the organization community workshops. Each year the NAASC sponsors a group of selected Ambassadors to travel to Charlottesville, Virginia, to receive in-depth training in topics related to ALMA proposal writing (including interferometry basics, ALMA science capabilities, recent ALMA headlines, and use of the Observing Tool), ALMA data processing (including imaging, self-calibration, NRAO's Science Ready Data Products, and CARTA visualization), as well as guidance with speaking on these topics. The Ambassadors then return to their home institutions or an agreed upon location to host 1-2 day proposal preparation workshops in advance of the ALMA proposal deadline and 1-2 day data processing workshops later in the year. More information on the ALMA Ambassadors program, including upcoming deadlines, can be found here: <https://science.nrao.edu/facilities/alma/ambassadors-program>.



Members of the Cycle 11 ALMA Ambassador cohort visited the NRAO Headquarters and the NAASC in Charlottesville, VA, for training in February 2024.

## 10 NAASC Participation and Initiatives in the Office of Diversity and Inclusion (ODI)

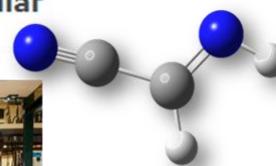
The [Office of Diversity and Inclusion \(ODI\)](https://science.nrao.edu/opportunities/student-programs/nac) National Astronomy Consortium (NAC - <https://science.nrao.edu/opportunities/student-programs/nac>) is a program that had its roots in the NAASC and is led by the National Radio Astronomy Observatory (NRAO) and Associated Universities Inc., (AUI) in partnership with the National Society of Black Physicists (NSBP), and a number of minority and majority universities to increase the numbers of students from underrepresented and underserved groups and those otherwise overlooked by the traditional academic pipeline into STEM or STEM-related careers. The National and International Non-Traditional Exchange (NINE - [go.nrao.edu/NINE](https://science.nrao.edu/opportunities/student-programs/nine)) Program is geared towards enticing the best and brightest, both nationally and internationally, into high quality programs designed to benefit the

participant, each partnering location, and the radio astronomy community as a whole. The NAASC provides financial support for the NAC and NINE programs and supports NINE hubs around the world.

The NAASC supports, where possible, the Louis Stokes Alliance for Minority Participation (LSAMP - <https://lsamp.virginia.edu/>) program activities. The LSAMP program consists of 11 partner institutions, including the University of Virginia, and strives for diversification of the Science, Technology, Engineering, and Mathematics (STEM) workforce, with an emphasis on increasing the number of underrepresented minority students earning baccalaureate degrees and matriculating to graduate school.

The NAASC works very closely with ODI on best practice for inclusion of all staff and in supporting safe spaces (<https://public.nrao.edu/odi/>). The NAASC is also a major corporate sponsor of the International Symposium on Molecular Spectroscopy and sponsors new initiatives including the LGBTQIA+ reception.

### Student Team Discovers New Interstellar Molecule During Summer Program



## 11 Addresses for the NAASC, NRC-HAA, and ASIAA

### **North American ALMA Science Center**

520 Edgemont Rd.  
Charlottesville, VA 22903  
USA

Phone: 434-296-0308

Directions: <https://science.nrao.edu/facilities/alma/>

### **National Research Council**

#### **Herzberg Astronomy and Astrophysics**

5071 West Saanich Road  
Victoria, BC V9E 2E7  
Canada

Phone: 250-363-6919

Directions: <http://www.nrc-cnrc.gc.ca/eng/about/directions/victoria.html>

### **Institute of Astronomy and Astrophysics, Academia Sinica**

11F of Astronomy-Mathematics Building, National Taiwan University  
No.1, Roosevelt Rd, Sec. 4 Taipei 10617, Taiwan, R.O.C.

Phone: +886-2-3365-2200

Directions: <http://www.asiaa.sinica.edu.tw/guide/transport.php>

## 12 Map of the Area near NRAO Headquarters and the NAASC



NRAO headquarters and the NAASC are located by the red marker labeled "A"



The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership of the European Organisation for Astronomical Research in the Southern Hemisphere (ESO), the U.S. National Science Foundation (NSF) and the National Institutes of Natural Sciences (NINS) of Japan in cooperation with the Republic of Chile. ALMA is funded by ESO on behalf of its Member States, by NSF in cooperation with the National Research Council of Canada (NRC) and the National Science and Technology Council (NSTC) in Taiwan and by NINS in cooperation with the Academia Sinica (AS) in Taiwan and the Korea Astronomy and Space Science Institute (KASI).

ALMA construction and operations are led by ESO on behalf of its Member States; by the National Radio Astronomy Observatory (NRAO), managed by Associated Universities, Inc. (AUI), on behalf of North America; and by the National Astronomical Observatory of Japan (NAOJ) on behalf of East Asia. The Joint ALMA Observatory (JAO) provides the unified leadership and management of the construction, commissioning and operation of ALMA.

