

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

Anthony Remijan (NAASC)



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

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ALMA, an international astronomy facility, is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada), NSC 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.

For further information or to comment on this document, please contact your regional Helpdesk through the ALMA User 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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# 1 Welcome

Welcome to North America ALMA Regional Science Center 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 outreach services to our peers including visiting scholars, graduate, and undergraduate students and postdocs, underrepresented minorities, 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 Council (NSC) 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.



Anthony Remijan (NA ARC Manager – right) and Neil Phillips (ESO – left) at the AOS.

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

The ALMA Science Portal	<a href="http://almascience.nrao.edu">http://almascience.nrao.edu</a>
The NAASC website	<a href="http://science.nrao.edu/facilities/alma">http://science.nrao.edu/facilities/alma</a>
The ALMA Helpdesk, which is also linked from the Science Portal and the NAASC website	<a href="https://help.almascience.org">https://help.almascience.org</a>
The NRC ALMA website	<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>
The Taiwanese ALMA website	<a href="http://alma.asiaa.sinica.edu.tw">http://alma.asiaa.sinica.edu.tw</a>

## 2 What's New at the NAASC?

Below is new information for NA ALMA Community regarding Operations at the North American ALMA Science Center (NAASC):

- In addition to delivering calibrated measurement sets (ms), we now 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. More information about ADMIT products can be found at: <http://admit.astro.umd.edu/admit/>.

- The face-to-face visitor program supports data reduction visits, visiting scientist, and sabbatical visits, including those who would like to come for archival research.
- Once registered with the ALMA Science Portal, a user is automatically added to the NA ALMA User mailing list. This list is used by the 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 are sent every 6-8 weeks (or more) depending on the urgency of information.
- NRAO has a Twitter feed that provides news, updates and highlights from all NRAO instrumentation. Updates and news from ALMA and the NAASC are also included in this Twitter feed. If you haven't already done so, sign up on Twitter to follow @TheNRAO to receive these updates.
- The NAASC also offers financial and logistical support to organize conferences and workshops hosted by the community to promote ALMA science. This support is done twice a year. For more information and to request support for your conference or workshop, please visit <https://science.nrao.edu/facilities/alma/community1/NAASC-Conference-and-Workshop-Support>.

**Multiphase Gas in Galaxy Groups**

**June 23-25, 2020** **NRAO Headquarters**  
520 Edgemont Rd  
Charlottesville, VA 22903, USA

**Invited Speakers**

- Sanchayeeta Borthakur (Arizona State University)
- Charlotte Christensen (Grinnell College)
- Massimo Gaspari (Princeton University)
- Erika Hamden (University of Arizona)
- Nikole Nielsen (Swinburne University)
- Ewan O'Sullivan (Harvard-Smithsonian Center for Astrophysics)
- Celine Peroux (Laboratoire Astronomique de Marseille)
- David V. Stark (Haverford College)
- Jing Wang (Kavli Institute, Peking University)

**Local Organizing Committee**

- Anthony Riejan, Co-Chair (NRAO)
- Loreto Barcos Muñoz, Co-Chair (NRAO)
- John Hibbard (NRAO)

**Scientific Organizing Committee**

- Sheila Kannappan, Chair (University of North Carolina, Chapel Hill)
- Rongmon Bordoloi (North Carolina State University)
- John Hibbard (NRAO)
- Laura Parker (McMaster University)
- Ming Sun (University of Alabama in Huntsville)

<https://go.nrao.edu/gasingroups2020>  
gasingroups2020@nrao.edu

NRAO ALMA NAASC  
ALMA SCIENCE CENTER

### 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. In Full Operations, ALMA will image the sky at resolutions as fine as 0.005" with unprecedented sensitivity, and will operate at frequencies between 35 GHz and 950 GHz. The capabilities of ALMA are outlined in the Proposer's Guide and details on the telescope are given in the Technical Handbook. New users can learn about ALMA and get an introduction to radio interferometry in the ALMA Primer. These documents are available at the ALMA Science Portal website, found at <http://almascience.nrao.edu>.

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

Being an international facility, ALMA 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. They 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 sanctioned 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. 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.

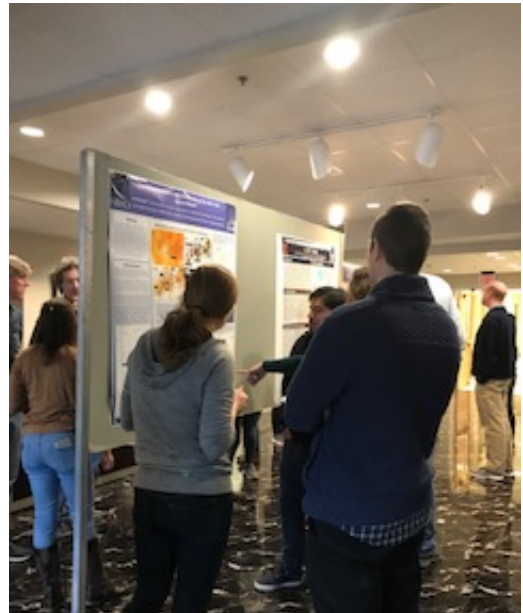
The NAASC is located in part at NRAO Headquarters, on the Grounds of the University of Virginia (UVa), and a short walk from the UVa Department of Astronomy (Section 12). The NRAO and UVa Astronomy share colloquia, journal clubs, science group meetings and lunch talks. Several NAASC staff have joint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

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

- The Phase 2 Group (P2G) assists users by preparing ALMA Scheduling Blocks 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 scheduling block before placement into the queue.
- Contact scientists provide support and oversight including a thorough review of all the NA projects to ensure PIs have approved their Phase 2 material (or Scheduling Blocks) prior to placement into the queue.
- Tools and algorithm development including the QA2 reporting script for manual calibration, analysisUtils, Splatalogue, simdata, calibration and imaging pipeline heuristics, and algorithm research and development (See Section 6.2 of this guide for more information on simdata and Splatalogue.).
- Coordinating the testing of the end-user software for ALMA including the ALMA Observing Tool (OT), the ALMA Archive, AQUA, the Dynamic Scheduler, the Observer Support Tool (OST), and other software tools.
- Providing online data reduction guides for a range of ALMA observing modes. These CASA guides can be found here: <http://casaguides.nrao.edu> and more information on CASA can be found here: <http://casa.nrao.edu>.
- Principal Investigator (PI) data reduction and imaging, including 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 htaccess. Also starting in Cycle 6, we now 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. More information about ADMIT products can be found at: <http://admit.astro.umd.edu/admit/>.
- The calibrated data and ADMIT products are retained on disk for a period of **ONE** month. After that, they can be re-generated upon request by the PI or delegated co-PI or co-I. The PI or delegated co-

(P)Is may also request calibrated measurement sets for data calibrated at the Joint ALMA Observatory (JAO) or another ARC. This service is restricted to projects whose PIs have NA designated as their ARC for support. If the requestor 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.

- NAASC Community Day events, often hosted by ALMA Ambassadors (Section 9), including the development of the strategic plans and initiatives to grow and educate the ALMA user base through the use of schools, tutorials, and workshops.
- 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.
- Review and assistance in the preparation of the ALMA documentation including the Call for proposals, Proposer's Guide, Users' Policies, ALMA Primer, Technical Handbook, Guide to the NA ARC and the NAASC, software user guides, and additional documentation on how to access NAASC services.
- Face-to-face visitor program including data reduction visits of principal investigators (or co-I), or any scientist doing archival research. We also provide support for visiting scientists, and sabbatical visits.
- Operating a copy of the ALMA data archive including LUSTRE access and management of users to the NRAO cluster-processing pipeline.
- Extension and Optimization of Capabilities (EOC) work and activities. There are still many EOC activities remaining and NAASC staff interface with the JAO and the ALMA Science Advisory Committees on setting the priorities of ongoing EOC work as needed for the completion of these activities for future Cycles.
- Providing opportunities for student funding and page charge support for U.S. investigators.
- Science outreach events, especially working very closely with the NRAO Department of Diversity and Inclusion (ODI) to promote STEM education through a wide range of initiatives.



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

## 5 Essential Resources

### 5.1 The ALMA Science Portal

The Science Portal is the primary access point to ALMA for all science users. The website is: <http://almascience.nrao.edu>

At the Science Portal, users can:

- Access the Call for Proposals, the Proposer's Guide, the Technical Handbook, the Primer, and other documentation
- Download the Observing Tool, the software used to prepare and submit ALMA proposals
- Search and access public data from the ALMA science data archive
- Access Knowledgebase articles from the 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 during Full Operations

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

- Submit a proposal as a PI
- Participate as a co-I or co-PI on ALMA proposals
- Manage their user profile and demographic information, including the option to receive automatic email notifications of observing progress or delegate their data rights, Phase 2 submission or ToO triggers to other ALMA users
- Access SnooPI, the tool for PIs and collaborators to monitor the status of their observing programs
- Submit Helpdesk tickets
- Access their proprietary data through the ALMA science data archive

Once registered with the ALMA Science Portal, a user is automatically added to the NA ALMA User mailing list. This list is used by the 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 sent every 6-8 weeks (or more) depending on the urgency of information.

Also, NRAO has a Twitter feed that provides news, updates and highlights from all NRAO instrumentation. Updates and news from ALMA and the North American ALMA Science Center are also included in this Twitter feed. If you haven't already done so, sign up on Twitter to follow @TheNRAO 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. The website is: <https://science.nrao.edu/facilities/alma>.

At the NAASC website, users get information on:

- ALMA and NAASC news and events
- Tutorials on ALMA's capabilities and proposal preparation
- Data reduction and analysis support
- Workshops on ALMA data processing and analysis
- Financial support for visiting the NAASC, publications and for organizing conferences and workshops
- Student and postdoc programs
- Education and outreach activities
- NAASC staff



NAASC Staff members Adele Plunkett (Left) and Andy Lipnicky (2<sup>nd</sup> from Right) at the high site with ALMA engineer Pablo Carillo (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 Helpdesk is a website that can be accessed from the Science Portal, from the NAASC website, or directly at: <https://help.almascience.org>.



The 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. In addition, the Knowledgebase query also accesses the documentation in the ALMA science portal and suggests parts of the ALMA documentation that may be relevant to a user's question. 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 science portal documentation without logging in.

The ALMA Helpdesk has the following departments set up as viewable by a user 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

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 Learning about ALMA: Documentation, Workshops, and Community Days

Preparing for an ALMA project begins with learning 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* - <https://almascience.nrao.edu/documents-and-tools/cycle8/alma-early-science-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 and describe the tools needed to write proposals. These workshops focus on preparation of proposals and observations, and feature talks on the observatory's capabilities, mm/submm interferometry observing techniques, and the tools required to design effective ALMA projects. 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 and training events at AAS meetings and other meetings of the astronomical community throughout the year. These events promote all NRAO observing facilities, and include a focus on the tools needed to prepare effective proposals. NAASC staff describe ALMA capabilities, NAASC support services, ALMA user tools, and CASA data reduction and analysis techniques.

Finally, the NAASC hosts periodic 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 directly at: <https://science.nrao.edu/facilities/alma/community1>

Registration is required for workshops and Community Days, and is available on the website.

## 6.2 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 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, an application that can be downloaded from the 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 Observing Tool includes a sensitivity and exposure time calculator. Users must be registered with the Science Portal to be able to submit proposals using the Observing Tool.

NAASC staff are available to help users learn how to use the Observing Tool and prepare proposals. We emphasize here that the Observing Tool 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 Observing Tool well in advance of the proposal deadline. The 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 6.5).

The CASA 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_To_Simulating_ALMA_Data).

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 Science Portal.

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, VLA, and the GBT, amongst many others. As of February 2016, Splatalogue contains over 8.1 million transitions from 1233 species and is updated regularly. Splatalogue also features an interface that is Virtual Observatory (VO) compliant for interfacing with external software or websites.

The main page for Splatalogue features the Basic 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.
- Single molecules in the Splatalogue database outside those in the pre-defined categories.
- User-defined frequency ranges as well as ALMA Bands 3-10 and lower state energy ranges.

In all cases, the only frequencies shown are those that are NRAO recommended. These frequencies are typically selected from the most recently updated line list. 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>.

### 6.3 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 Helpdesk. For particularly complex observations, however, users may arrange a visit to the NAASC to prepare the observations (Section 6.5).

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.

### 6.4 Working with Your Delivered Data Products

The primary software package used to process ALMA data is CASA (Section 6.2 - <http://casa.nrao.edu>). Note in particular the *CASA Guides* link available from that site. The *CASA Guides* site provides a collection of data reduction and imaging tutorials and step-by-step processing and analysis examples, including scripts for processing Science Verification data.

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 Americans, and will provide a backup of the archive in Santiago. Upon completion of the observations and initial data processing, investigators 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 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:

- README file which contains 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.nrao.edu/processing/documents-and-tools>.

The fully-calibrated measurement set (ms) which includes only the science target data has been 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. In a rare number of 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, they can be re-generated upon request by the PI or delegated co-PI or co-I. The PI or delegated co-(P)Is may also request calibrated measurement sets for data calibrated at the JAO or another ARC. This service is restricted to projects whose PIs have NA designated as their ARC for support. If the requestor 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.

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 website <http://admit.astro.umd.edu/admit/>.

Users are encouraged to visit the NAASC to get help with their data processing (Section 6.5). 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 helpdesk. To request remote access to the cluster, visit: <https://science.nrao.edu/facilities/alma/docs/manuals/computing-resources/overview>.

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

## 6.5 Visiting the NAASC

The NAASC welcomes short-term visits to Charlottesville or Victoria, British Columbia from North American investigators of successful ALMA programs or archival researchers for expert assistance with processing and analyzing ALMA data. Visits for data reduction have to be requested at least one month in advance, and are expected to last about a week. Novice visitors are required to be accompanied by an experienced investigator, e.g., a collaborator. Visitors will have access to an office and a computer to process their data. Investigators who are requesting a short data reduction visit can apply to the NAASC for assistance with travel expenses.

To request a visit, send a ticket to the ALMA Helpdesk using the “Face-to-Face Support” category. More details are available at: <https://science.nrao.edu/facilities/alma/visitors-shortterm>.

The NAASC also hosts approximately two Data Reduction Parties each year during which a group of 10-12 PIs and their students visit the NAASC at the same time for assistance in data reduction and analysis. These parties are similar to individual “face-to-face” support visits except that they also include lectures on ALMA data packaging, the ALMA calibration and imaging pipelines, and advanced imaging analysis techniques, 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 are negotiable but can last between a few weeks to a year. Visit support can range from paying 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>.

## 6.6 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), MOST 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>.

## 6.7 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 the following site: <https://science.nrao.edu/facilities/alma/workshops>.

The NAASC also offers financial and logistical support to organize conferences and workshops hosted by the community to promote ALMA science. This support is done twice a year. For more information and to request support for your conference or workshop, please visit <https://science.nrao.edu/facilities/alma/community1/NAASC-Conference-and-Workshop-Support>

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 sessions 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 Iris Nijman at ALMA Public Relations ([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/alma-develop/>

## 8 Student Support

The NAASC supports student involvement in ALMA through the NRAO student programs. NRAO has a Summer Student Program aimed at introducing undergraduate and graduate students to cutting-edge research. In addition, a Student Observing Support Program funds graduate students working on eligible ALMA proposals. Finally, a graduate Pre-Doctoral Program is available to give students the opportunity to conduct thesis research at NRAO sites under the supervision of an NRAO scientist. Details on the student programs are available at: <http://science.nrao.edu/opportunities/studentprograms.shtml>.

## 9 ALMA Ambassadors Postdoctoral Fellows Program



The 2020 Cycle 8 ALMA Ambassadors from the NAASC

The ALMA Ambassadors Postdoctoral Program provides training (and up to a \$10,000 research grant if based in the U.S.) to postdoctoral researchers interested in expanding their ALMA/interferometry expertise and sharing that knowledge with their home institutions through the organization of ALMA proposal writing workshops. Each year beginning in Cycle 5, the NAASC sponsors a group of selected postdocs 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) as well as guidance with speaking on these topics.

The postdocs then return to their home institutions or an agreed upon location to host 1-2 days proposal preparation workshops in advance of the ALMA proposal deadline. More information on the ALMA Ambassadors program, including upcoming deadlines, can be found here:

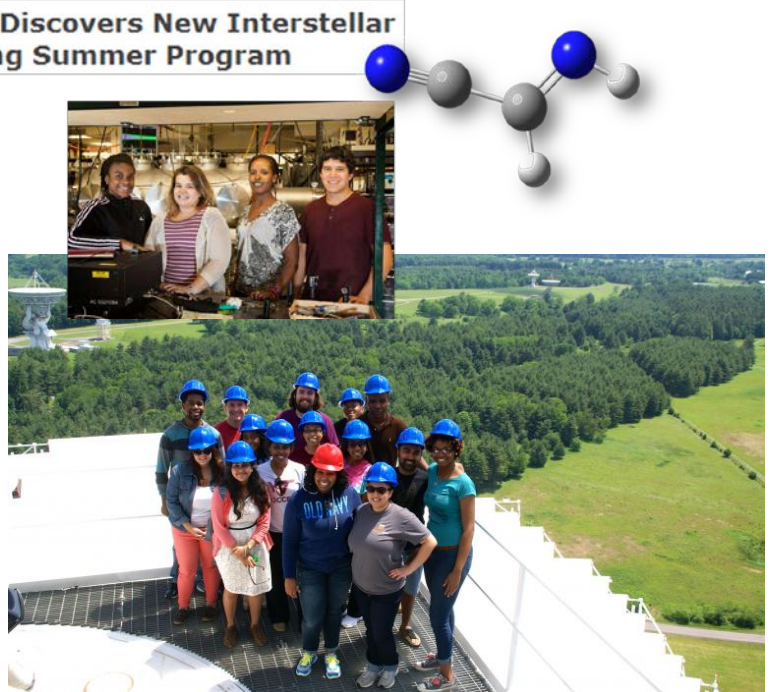
<https://science.nrao.edu/facilities/alma/ambassadors-program>

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

The ODI 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 NAC Project Scientist position is held by NAASC staff and handles most of the summer program development including organizing the weekly meetings and activities. The National and International Non-Traditional Exchange (NINE - [go.nrao.edu/NINE](http://go.nrao.edu/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. Finally, NAASC staff actively participate in mentoring students participating in the Louis Stokes Alliance for Minority Participation (LSAMP - <https://lsamp.virginia.edu/>) program. The LSAMP program consists of 12 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 LSAMP program targets early career undergraduates and work with staff on learning how to do scientific research, especially involving synergistic research between astronomy and chemistry, in an eight week summer program. The NAASC provides financial support for the NAC and NINE programs and supports NINE hubs around the world. The NAASC works very closely with ODI on best practice for inclusion of all staff and in supporting safe spaces (<http://www.nrao.edu/policy/diversity.shtml>). NAASC management and leadership all have “open door” policies especially when it comes to personnel issues. Finally, the NAASC is 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

The 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>

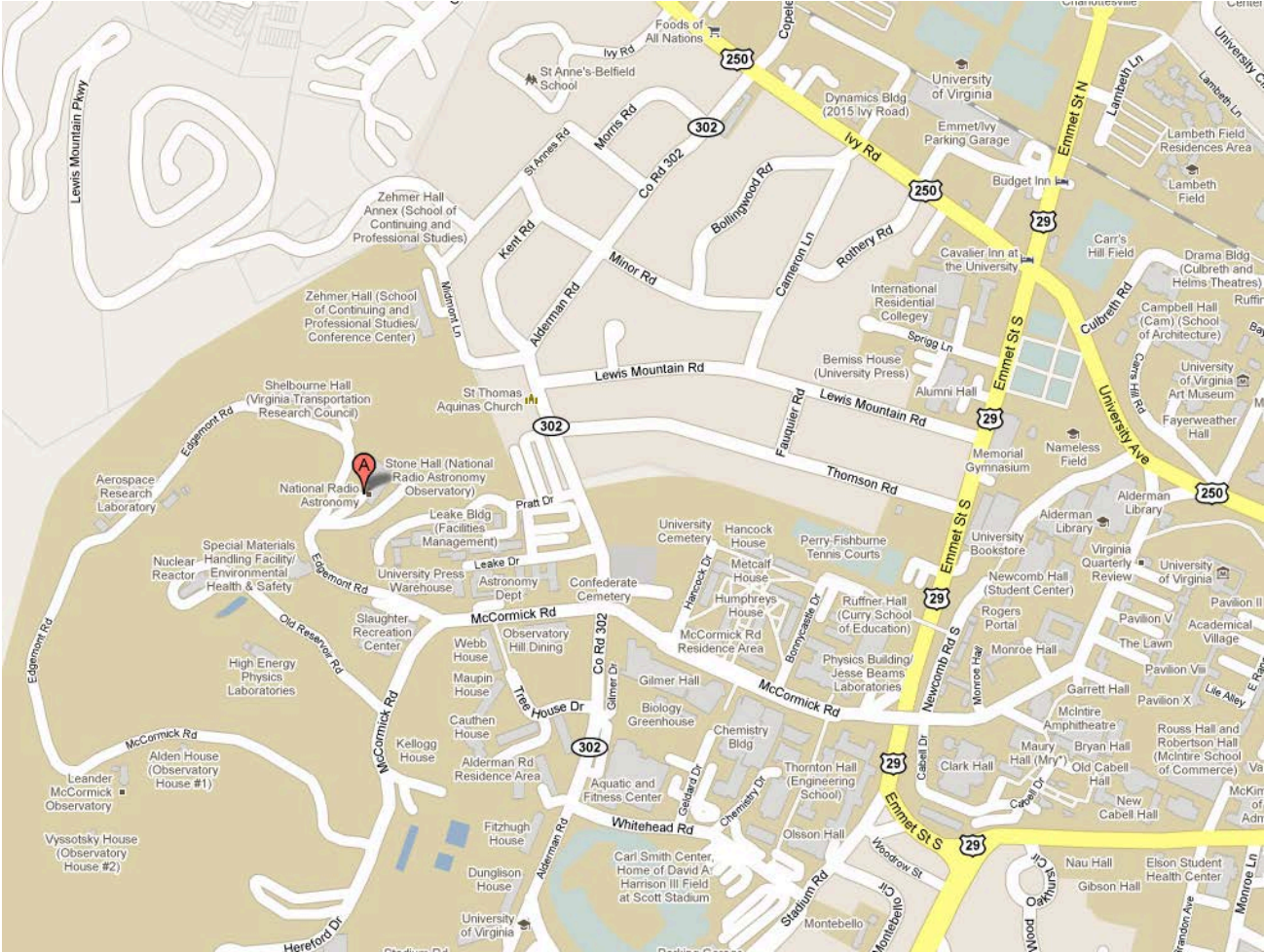
Institute of Astronomy and Astrophysics, Academia Sinica.  
11F of Astronomy-Mathematics Building, National Taiwan University  
No.1, Roosevelt Rd, Sec. 4 Taipei 10617, Taiwan, R.O.C.

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 Ministry of Science and Technology (MOST) 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.

