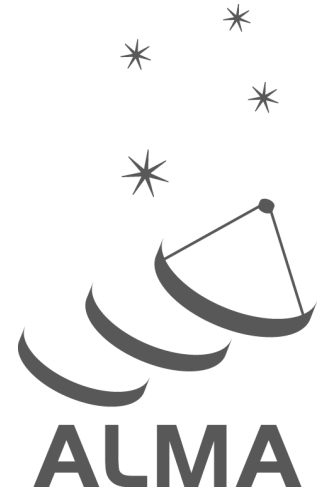


# A Guide to the North American ALMA Regional Center and the NAASC

Micheal Ivory (NAASC)



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

---

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.

<b>Revision History:</b>	<b>Version Date</b>	<b>Editors</b>
1.0	Mar 20, 2015	Jim Braatz
2.0	Jan 26, 2016	Micheal Ivory

---

## Contributors

**Anthony Remijan, NA ARC Manager**  
**Brian Mason, NAASC Executive**  
**Catherine Vlahakis, NAASC Executive**  
**Sabrina Stierwalt, NAASC Executive**  
**Mark Lacy, NAASC Executive**  
**Anand Crossley, Lead Data Analyst**

In publications, please refer to this document as:

**M.Ivory , 2016, "A Guide to the North American ALMA Science Center the ARC", v. 2.0, ALMA**

---

## Table of Contents

<b>1</b>	<b>WELCOME.....</b>	<b>2</b>
<b>2</b>	<b>About ALMA.....</b>	<b>2</b>
<b>3</b>	<b>Organization and Role of the ARCs and the NAASC.....</b>	<b>3</b>
<b>4</b>	<b>Essential Resources.....</b>	<b>4</b>
4.1	The ALMA Science Portal.....	4
4.2	The NAASC Website.....	5
4.3	The Helpdesk.....	5
<b>5</b>	<b>Getting Help from the NAASC at Each Step of Your Project.....</b>	<b>6</b>
5.1	Learning about ALMA: Documentation, Workshops, and Community Days.....	6
5.2	Proposal Preparation.....	7
5.3	Preparing Your Observations.....	8
5.4	Reducing Your Data.....	8
5.5	Visiting the NAASC.....	9
5.6	Publishing Your Results.....	10
5.7	Promoting ALMA Science.....	10
<b>6</b>	<b>Working with the Community to Improve ALMA.....</b>	<b>10</b>
<b>7</b>	<b>Student Support.....</b>	<b>11</b>
<b>8</b>	<b>Addresses for the NAASC, NRC-HIA, and ASIAA.....</b>	<b>11</b>
<b>9</b>	<b>Map of the Area near NRAO Headquarters and the NAASC.....</b>	<b>12</b>

# 1 WELCOME

Welcome to North America 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 North American (NA) scientific community 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 hosts and facilitates many private and public learning events to the international community. The NAASC welcomes you and encourages 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 (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 (JAO Systems Astronomer – 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

<http://almascience.nrao.edu>

The NAASC website

<http://science.nrao.edu/facilities/alma>

The ALMA Helpdesk, which is also linked from the Science Portal and the NAASC website

<http://help.almascience.org>

The NRC ALMA website

[www.nrc-cnrc.gc.ca/eng/solutions/facilities/alma.html](http://www.nrc-cnrc.gc.ca/eng/solutions/facilities/alma.html)

The Taiwanese ALMA website

<http://alma.asiaa.sinica.edu.tw>

## 2 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 plain 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 31 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>.

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

Being an international facility, ALMA serves a worldwide community of Astronomers, Scientist, and other Scientific Professionals. To interface 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 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. Astronomers in North America, East Asia, or Europe are assigned to that region's ARC. Astronomers from Taiwan can select to use 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 at NRAO Headquarters, on the Grounds of the University of Virginia (UVA), and a short walk from the UVA Department of Astronomy (Section 9). The NRAO and UVA Astronomy share colloquia, journal clubs, and lunch talks. Several NAASC staff have joint or adjunct appointments at UVA. 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:

- Assisting users with the preparation and submission of ALMA proposals including the episodic though intense preparation of Phase 2 Scheduling Blocks in anticipation of the upcoming observing Cycle. This also includes follow-up on any change requests reported during the course of the cycle and making the appropriate edits to the scheduling block before scheduling.
- Contact scientist support and oversight including a thorough review of all the NA projects to ensure PIs have reviewed and approved the projects for scheduling. Contact scientists will be responsible for the final data reduction of their observing programs with the support of the data analysts.
- Tools and Algorithm development including the QA2 reporting script for manual calibration, analysisUtils, Splatalogue, simdata, calibration and imaging pipeline heuristics & algorithm research and development.

- Coordinating the testing of the end user software for ALMA including the ALMA Observing Tool (OT), the ALMA Archive, AQUA, Dynamic Scheduler, Observer Support Tool (OST), and other software tools.
- 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.
- NAASC Community Day events 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. In addition, enhancing the use of the NRAO forums so users can discuss questions on a peer-to-peer level.
- Review and assist in the preparation of the ALMA end user documentation including the Call for proposals, Proposers Guide, Users Guide, ALMA Primer, Technical Handbook, Guide to the NA ARC, software user guides and additional documentation on how to access NAASC services.
- Face-to-face visitor support including data reduction visitors, visiting scientists and sabbatical visits.
- Operating a copy of the ALMA data 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 Joint ALMA Observatory (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

## 4 Essential Resources

### 4.1 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

Astronomers can also register with the Science Portal. Indeed, every astronomer who intends to submit an ALMA proposal, or appear on one as a co-investigator, must register. Once registered and logged in, users at the Science Portal will be able to:

- Submit a proposal as Principal Investigator (PI)
- Participate as a co-Investigator (co-I) or co-Principal Investigator (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 to other ALMA users
- Access SnooPI, the tool for PIs to monitor the status of their scheduled observing programs.
- Submit Helpdesk tickets
- Access their proprietary data through the science archive

## 4.2 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 travel and publications
- Visiting the NAASC
- Student and postdoc programs
- Education and outreach activities
- NAASC staff

## 4.3 The 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: <http://help.almascience.org>

The Helpdesk includes a library of "Knowledgebase" articles that address a number of common issues and questions. To submit a ticket, users must first log in. 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 viewable by a user to send tickets to the user's affiliated ARC:

- General Queries (Science Portal/Registration, Documentation, Webpages, Proposal reviews and assessment, Project tracking, other)
- Project Planning (Available Capabilities, Call for Proposals, Sensitivity Calculator, Simulators, Splatalogue, other)
- Observing Tool (Proposal Preparation, Proposal Submission (general), Phase 2 process)
- Data Reduction (Common Astronomy Software Applications [CASA], pipeline processing)
- Archive and Data Retrieval (archive access and queries, obtaining your ALMA data)
- Face to Face Support (Data reduction, sabbatical, science, short term, other)

Helpdesk staff will make every effort to respond to tickets promptly. During normal operations, users can expect a response within 2 business days. During the last week before the Call for Proposals, a single department called “Proposal Submission Emergency” is set up across ARCs that will answer urgent tickets concerning proposal submission. Triage for this department will start 36 hours before the deadline with 24-hour coverage by Europe (EU), North America (NA) and East Asia (EA).

## 5 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 telescope’s capabilities through the publication of results.

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

Preparing for an ALMA project begins with learning the telescope’s capabilities and learning the tools needed to design observations, prepare proposals, and submit proposals. The NAASC provides user documentation, including the ALMA Primer -

<http://almascience.nrao.edu/documents-and-tools/cycle4/alma-early-science-primer>,

at the ALMA Science Portal.

The NAASC helps to organize and support 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 telescope’s capabilities, mm/submm interferometry observing techniques, and the tools required to design effective ALMA observations. 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 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 describes 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 process archival data.

To request a community day event at your institution or for an up-to-date 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.

## 5.2 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 4.1). These documents describe the capabilities of the telescope 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 in order 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 used not only used to assemble and submit the scientific and technical justifications, but also to design and fully specify the observations, so users are encouraged to become familiar with the Observing Tool well in advance of the proposal deadline. The Helpdesk (Section 4.3) 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 5.5).

The CASA task *simalma*, and the lower-level tasks *sim\_observe* and *sim\_analyze*, allow users to simulate an ALMA observation of a target based on a model with a given source structure and brightness. These tasks also help one to understand 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)

More information on CASA and CASA guides is available at these websites:

<http://casa.nrao.edu>

<http://casaguides.nrao.edu>

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 off the Science Portal.

The NAASC is also responsible for providing ALMA 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, 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.
- Predefined “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 predefined categories
- User defined frequency as well as ALMA bands 3-9 and lower state energy ranges.

In all cases, the only shown frequencies are those which are NRAO recommended. These are typically selected as the most recently updated linelist. 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 [www.splatalogue.net](http://www.splatalogue.net).

### 5.3 Preparing Your Observations

ALMA proposals are reviewed on their scientific and technical merit, and Principal Investigators (PIs) are informed of the outcome of the review process by email. 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 5.5).

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

### 5.4 Reducing Your Data

The primary software package used to process ALMA data is CASA (Section 5.2 - <http://casa.nrao.edu>). Note in particular the *CASA Guides* link available from this site. The *CASA Guides* site provides a collection of data reduction 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 is processed in two steps: first it is calibrated, and then imaged. Most ALMA data are calibrated using the pipeline, but in some cases the observatory staff may prepare CASA scripts for the calibration. Calibrated measurement sets are supplied with all NA processed deliveries to the PI and (on request) to delegated co-Is. The calibrated data are retained on disk for a period of two months. After that, they will be regenerated upon request by the PI or delegated co-I. The PI or delegated co-I 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.

NAASC staff also prepare and provide imaging scripts and a set of reference images to the PI as part of the delivered data package. Starting with these scripts, users generally will complete the imaging of the full data set independently. Generally, calibrated data provided to users are ready for science imaging. In some cases, though, users may get best results by refining the calibration themselves, with assistance from NAASC staff, if desired.

Users are encouraged to visit the NAASC to get help with their data processing (Section 5.5). 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. For more information about how to request remote access to the NAASC 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. See: <http://almascience.nrao.edu/alma-data/data-processing>.

## 5.5 Visiting the NAASC

The NAASC welcomes short term visits to Charlottesville from investigators of successful ALMA programs or archival researchers for expert assistance with processing and analyzing ALMA data. Visits for data reduction are expected to last about a week. Student visitors must be accompanied by an experienced investigator, usually their academic advisor. 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>.

Long term visitors to the NAASC are also strongly encouraged especially to 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 anywhere from a few weeks up to a year. Support for these visits can range from paying for accommodation, per diem or travel costs, to providing summer or sabbatical salary supplements, according to need. More details are available at:

<https://science.nrao.edu/facilities/alma/community1/opportunities/visitorsprogram>.

To request a visit, send a ticket to the ALMA Helpdesk using the “Face to Face Support” category.

## 5.6 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 observations made with an NRAO telescope, or original research made with NRAO archival data.

All publications must include, as a footnote or acknowledgement, the following statement: "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 acknowledgment: "This paper makes use of the following ALMA data: ADS/JAO.ALMA# [Project code]. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada) and NSC and ASIAA (Taiwan), 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>

## 5.7 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>.

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 Charles Blue at [cblue@nrao.edu](mailto:cblue@nrao.edu).

## 6 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

Calls for development proposals will be announced on the NAASC web site at:

<https://science.nrao.edu/facilities/alma/alma-development-2015/alma-development/alma-development-north-america>

## 7 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 forefront research. A Student Observing Support Program funds graduate students working on eligible ALMA proposals. Additionally, 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>

## 8 Addresses for the NAASC, NRC-HIA, and ASIAA

The North American ALMA Science Center  
520 Edgemont Rd.  
Charlottesville, VA 22903  
USA

Phone: 434-296-0211

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

National Research Council  
Herzberg Institute of Astrophysics  
5071 West Saanich Road  
Victoria, BC V9E 2E7  
Canada

Phone: 250-363-0001

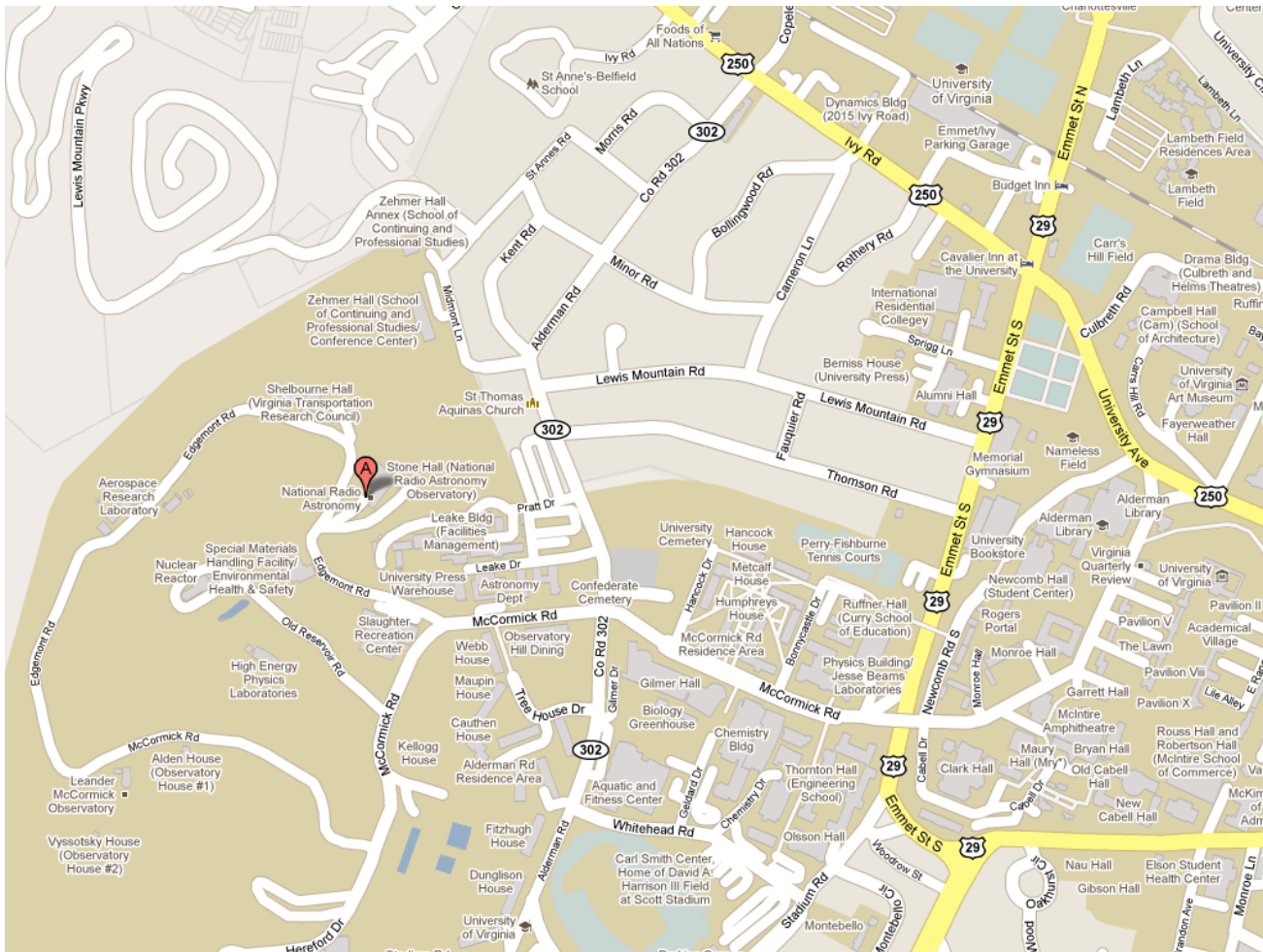
Directions: <http://www.nrc-cnrc.gc.ca/eng/about/directions/victoria.html>

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>

## 9 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 Organization 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 Council of Taiwan (NSC) 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.

