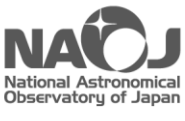
ALMA Cycle 0 Proposer's Guide



www.almascience.org

ALMA, an international astronomy facility, is a partnership of Europe, North America and East Asia in cooperation with the Republic of Chile.

User Support:

For further information or to comment on this document, please contact your regional Helpdesk through the ALMA User Portal at **www.almascience.org**. Helpdesk tickets will be redirected automatically to the nearest ALMA Regional Center at ESO, NAOJ or NRAO.

Revision History:

Version	Date	Editors
1.0	28 March 2011	Gautier Mathys
1.1	7 May 2011	Gautier Mathys

Contributors

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G. Mathys, 2011, ALMA Cycle 0 Proposer's Guide, Version 1.1, ALMA

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1 Executive Summary

The Joint ALMA Observatory invites proposals for ALMA Early Science observations (Cycle 0). The purpose of Early Science is to deliver scientifically useful results to the astronomy community and to facilitate the ongoing characterization of ALMA systems and instrumentation as the capability of the array continues to grow. Early Science will be conducted on a best-effort basis, so as to not unduly delay the construction of the full 66-antenna array, but nonetheless provides an important opportunity for first science from this cutting edge facility. Early Science will continue through Cycle 1 and until construction of ALMA is complete.

The ALMA Early Science Cycle 0 capabilities will comprise sixteen 12-m antennas, receiver bands 3, 6, 7 & 9 (wavelengths of about 3, 1.3, 0.8 and 0.45 mm), two array configurations (Compact and Extended), single field imaging and mosaics of up to 50 pointings, and a set of correlator modes that will allow both continuum and spectral line observations. Polarization and total power capabilities will not be available in Cycle 0, but are expected to be available from Cycle 1 onwards. The Compact configuration (baselines from 18 m to 125 m) is designed to provide good sensitivity for extended structures. The Extended configuration (baselines from 36 m to 400 m) will provide higher angular resolution and is more suited for compact structures.

ALMA Early Science Cycle 0 is expected to span 9 months. It is anticipated that 500-700 hours of array time will be available for Early Science projects. Any astronomer may submit a proposal in response to the ALMA Early Science Cycle 0 Call for Proposals. Preference will be given to proposals that best demonstrate and exploit the advertised ALMA Early Science Cycle 0 capabilities, producing scientifically worthwhile results from relatively short observations (averaging a few hours). Proposals will be assessed by peer review, and ranked strictly on the basis of scientific merit and feasibility with respect to the scientific capabilities offered in the formal Call for Proposals. Projects will not be carried over from Cycle 0 to later cycles (even if they have not been completed in Cycle 0), and will not establish proprietary rights beyond those provided by the ALMA data policy. Moreover, observations done in Cycle 0 will not constitute “Duplications” in subsequent Cycles.

Scientific observations for Early Science Cycle 0 successful proposals will be performed on a best effort basis. ALMA staff will conduct quality assurance on ALMA data, and will provide processed data products through the respective ALMA Regional Centers (ARCs). However, it cannot be guaranteed that the characterization and quality of the data and data reduction will meet the standards expected when ALMA becomes fully operational. Experience in radio (in particular, millimeter) interferometry will be an advantage in working with ALMA Early Science data products. PIs and observing teams should anticipate the need to invest their own time and expertise to assure the quality of the provided data products and to re-reduce the raw data if the quality of the former were not satisfactory. This may include the need to visit the relevant ARC or ARC node to get help and to assist with quality assurance and potential data re-reduction.

2 Invitation for ALMA Early Science Cycle 0 proposals

The Atacama Large Millimeter/submillimeter Array (ALMA) is an array of high-precision antennas operating at millimeter/submillimeter wavelengths, currently being assembled at a 5000 m high site in northern Chile. The Joint ALMA Observatory (JAO) invites members of the astronomical community to submit proposals for Early Science observations with ALMA. Successful projects are expected to be executed between September 30, 2011 and June 30, 2012. The Cycle 0 capabilities comprise sixteen 12-m antennas, receiver bands 3, 6, 7 and 9 (wavelengths of about 3, 1.3, 0.8 and 0.45 mm) and two antenna configurations with maximum baselines of 125 m and 400 m. The purpose of Early Science is to deliver scientifically useful data to the astronomical community and to facilitate the ongoing characterization of ALMA systems and instrumentation as the capability of the array continues to grow.

Proposals for ALMA are prepared and submitted using the ALMA Observing Tool (OT; Section 6.3). The OT is available for download from the ALMA Science Portal (*www.almascience.org*) starting on March 31, 2011, and can be used to start to prepare proposals and save them to a local disk. For planning purposes, prospective proposers are encouraged to submit a Notice of Intent (Section 6.1) by:

15:00 UT on April 29, 2011

The ALMA Archive will open for Cycle 0 proposal submission starting at:

15:00 UT on June 1, 2011

The Cycle 0 proposal submission deadline is:

15:00 UT on June 30, 2011

Table 1 summarizes the important dates and milestones of Cycle 0.

Date	Milestone
31 March 2011	Publication of the Cycle 0 Call for Proposals and related documents; ALMA Science Portal (www.almascience.org) open for registration; ALMA Helpdesk available for questions
29 April 2011 (15:00 UT)	Deadline for submission of the Notice of Intent
15 May 2011	Release of Cycle 0 Technical Handbook and of intended schedule of Compact and Extended configuration availability
1 June 2011 (15:00 UT)	Opening of the Archive for proposal submission
30 June 2011 (15:00 UT)	Proposal submission deadline
September 2011	Announcement of the outcome of the Proposal Review Process
30 September 2011	Expected start of ALMA Cycle 0 Science Observations
March/April 2012	Expected deadline for proposal submission for Cycle 1
30 June 2012	End of ALMA Cycle 0

Table 1. The ALMA Cycle 0 timeline.

3 Overview

3.1 ALMA

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

3.2 The ALMA telescope on Chajnantor

Upon completion, ALMA will be composed of 66 high-precision antennas. Fifty of these antennas will be 12-meter dishes used for sensitive, high-resolution imaging. Four additional 12-meter antennas will comprise the ALMA Total Power Array, which will be used for total power observations. Another twelve 7-meter antennas comprise the Atacama Compact Array, to enhance wide-field imaging.

For Cycle 0, ALMA will offer interferometric capabilities (no total power) with an array of sixteen 12-meter antennas, with two different array configurations (see Appendix A).

The Array is located on the Chajnantor plain of the Chilean Andes, a site that offers the exceptionally dry and clear sky required to operate at millimeter and sub-millimeter wavelengths. The ALMA antennas, weather stations, the two correlators and their computer interfaces, Local Oscillator generation hardware, timekeeping hardware, and the related Array Real-Time Machine computer are all located at the 5000 meter site referred to as the Array Operations Site. This site is connected via Gigabit fiber links to the Operation Support Facility (OSF), located near the town of San Pedro de Atacama at an altitude of 2900 meters. Science operations will be conducted from the OSF and coordinated from the JAO Central office in Santiago.

The quality of the Chajnantor observing site, combined with the unprecedented combination of sensitivity, angular resolution, spectral resolution and image fidelity made possible with ALMA, will enable astronomers to carry out transformational research in a wide variety of astronomical areas. At full operational capability, the wavelengths covered by ALMA range from 0.3 mm to 3.6 mm (frequency coverage of 84 GHz to 950 GHz) - this range is essential, for example, for probing the first stars and galaxies, directly imaging the disks in which planets are formed, and probing the energy output from active super-massive black holes.

ALMA is located at **latitude = –23.019283°**, **longitude = –67.753178°**. Targets as far north as declination +40°, corresponding to a maximum source elevation at Chajnantor of ~25°, can in principle be observed from the ALMA site, but shadowing by adjacent antennas becomes an increasing problem at low elevations. The shadowing depends on the current antenna configuration. As a reference, for the Cycle 0 compact

configuration, an 8-hour track on sources at DEC=+10° results in a loss of 10% of data due to shadowing; for sources at DEC=+30°, this loss increases to 30%. The imaging capability as well as the time on source will necessarily be limited for such northern sources. For more details, see the Technical Handbook.

Observing in the millimeter/submillimeter wavelength region is very dependent on the observing conditions, As such, the actual time to reach a given signal to noise on a target depends on when the project is executed. The ALMA OT is designed so that investigators request a given sensitivity to reach a particular science goal.

3.3 The Joint ALMA Observatory and the ALMA Regional Centers

The Joint ALMA Observatory (JAO) is responsible for the overall leadership and management of construction, commissioning and operations of ALMA in Chile. Its Santiago Central Office (SCO) houses the Director's Office and its associated functional units, as well as astronomers, technicians and administrative staff. The SCO also hosts the ALMA main archive (referred to in the rest of this document as the Archive). The JAO solicits research investigations through Calls for Proposals and organizes the peer review of the proposals by science experts. In addition, the JAO schedules all science observations and places the data in the electronically accessible ALMA Archive.

The three ALMA regional partners (Executives) maintain ALMA Regional Centers (ARCs) within their respective region. The ARCs provide the interface between the ALMA project and its user communities. The ARCs are responsible for user support to the community, mainly in the areas of proposal preparation, observation preparation, acquisition of data through the Archive, data reduction, data analysis, delivery of data, visitor support and workshops/schools. Each ARC will operate an archive that is a mirror of the SCO main archive. Browsing and data mining will be done through the ARC mirror archives.

The East Asian ARC (EA ARC) is based at the National Astronomical Observatory of Japan headquarters in Tokyo. It is operated in collaboration with Academia Sinica Institute of Astronomy and Astrophysics (Taiwan), and supports the astronomy communities of Japan and Taiwan.

European researchers are supported by the European ARC (EU ARC). It is organized as a coordinated network of scientific support nodes distributed across Europe. The EU ARC is located at ESO Headquarters in Garching bei München (Germany) and carries the responsibility for all core ARC activities and their coordination with additional support provided by the regional nodes. There are currently seven regional nodes: Bonn-Bochum-Cologne (Germany), Bologna (Italy), Onsala (Sweden), IRAM, Grenoble (France), Allegro, Leiden (The Netherlands), Manchester (United Kingdom) and Ondřejov (Czech Republic).

The North American ALMA Science Center (NAASC) is based at NRAO headquarters in Charlottesville, VA, USA. It is operated in collaboration with the National Research Council of Canada, Herzberg Institute of Astrophysics (Canada) and Academia Sinica Institute of Astronomy and Astrophysics (Taiwan), and supports the astronomical communities of North American and Taiwan.

3.4 ALMA observing time allocation

ALMA proposals may be submitted by investigators of any nationality or affiliation. Each proposal must identify a single individual who will serve as Principal Investigator (PI). The PI will act as the official contact

between ALMA and the proposing team for all correspondence related to the proposal. By submitting a proposal, the PI takes full responsibility for its contents, in particular with regard to the names of the Co-Investigators (Co-Is) and the agreement to act according to the ALMA policies and rules, including the conditions specified in the present Proposer's Guide. The PI will be responsible for the scientific and administrative conduct of the project. There is no limit to the number of Co-Is that may appear on a proposal.

Graduate students and post-doctoral scholars can apply for ALMA time as Principal Investigators. All PIs and Co-Is must be registered with ALMA (see Section 6.2).

The main guiding principle of the assignment of observing time with ALMA is to optimize its scientific impact. Proposal selection will be based on scientific merit, while attempting to ensure that each region receives its share of the time, that is:

- 22.5% for East Asia (EA);
- 33.75% for Europe (EU);
- 33.75% for North America (NA);
- 10% for Chile.

Successful projects will have their observing time assigned to the region of the PI. The latter is defined as the region to which the organization that employs the PI belongs, or as the region of residence for unaffiliated PIs.

ALMA will strive to reach the sensitivity requested by the PIs. Projects will be considered complete when (a) the observations that have been obtained are within 10% of the sensitivity goal or (b) the observing time has reached twice the value estimated by the OT (with a maximum of 100 hours). For projects that require high imaging quality, the necessary extended Hour Angle coverage will be scheduled.

If a PI has access to ALMA through two regions (e.g. due to a joint appointment at two organizations or as a member of an organization in Taiwan), the PI will have the option to submit proposals affiliated with either of the regions (see Section 6.2).

ALMA proposals may also be submitted by PIs whose affiliation does not lie within any ALMA Executive's region.

ALMA policies prohibit the same proposal to be submitted with different Executive affiliations. If such proposals are detected, the first will be considered and the remaining proposals ignored.

4 Resources

4.1 Documentation

The following documents are relevant for Early Science and submission of Cycle 0 proposals. All of them can be accessed via the ALMA Science Portal at *http://www.almascience.org*.

4.1.1 The Call for Proposals

The Call for Proposals documents are:

- **The ALMA Cycle 0 Announcement**: This is a short overview of the Call for Proposals for Cycle 0. It contains a short description of the ALMA capabilities, deadlines and limitations specific to Cycle 0.
- **The ALMA Cycle 0 Proposer's Guide** (this document): This document defines the Proposal preparation and review procedures, ALMA Capabilities, and Cycle 0 Policies.
- **The ALMA Cycle 0 Technical Handbook**: This handbook describes the more technical aspects of ALMA during Cycle 0, including calibration strategies and UV-coverage. Users may also find technical information in the Science Portal web pages (see Section 4.2).

In addition, users may find the following document useful:

- **Observing with ALMA: A Primer for Early Science**: brief introduction to ALMA observing and examples of ALMA Early Science projects. It also presents an introduction to (sub)millimeter terminology, which should prove useful for investigators who are new to radio astronomy.

4.1.2 The Observing Tool documentation

The ALMA Observing Tool is the proposal preparation and submission (Phase 1) and observation preparation (Phase 2) software application. The OT-related documents are:

- The **OT Phase I Quickstart Guide**: A guide to proposal preparation for the novice ALMA OT user. It takes the reader through all the necessary steps to create an ALMA Observing Proposal, without including large amounts of detail.
- The **OT Video Tutorial**: A visual demonstration of proposal preparation and submission with the OT.
- The **OT User Manual**: This manual is intended for all ALMA users, from novices to experienced users. It provides comprehensive information about how to create valid Phase 1 proposals and Phase 2 programs for observing astronomical objects. It is also included as part of the "Help" documentation within the OT application itself.
- The **OT Reference Manual**: This manual provides a more concise explanation for all the fields and menu items in the OT. It is also included as part of the "Help" documentation within the OT application itself.

OT installation requirements and access to "known issues" are available from the OT trouble-shooting page, accessed from the ALMA Science Portal.

4.1.3 The ALMA Regional Center Guides

The ARC Guides contain user support details specific to each ALMA regional partner. They are:

- The **East-Asian ARC Guide**
- The **European ARC Guide**
- The **North American ARC Guide**

4.1.4 The data processing documentation

CASA, the Common Astronomy Software Applications, is the offline data reduction and analysis tool for ALMA data. For CASA downloads and documentation, see *http://casa.nrao.edu/*. The "Obtaining CASA" link provides access to system requirements, release notes, and installation instructions. ALMA-related CASA tutorials are available on-line at *http://casaguides.nrao.edu/index.php?title=ALMAguides*.

CASA contains **Simdata**, which is a simulator task built into the CASA data reduction package. It includes files of the ALMA array configurations so that investigators can simulate ALMA observations. For Simdata documentation, see *http://casaguides.nrao.edu/index.php?title=Simulating_Observations_in_CASA*.

4.1.5 Other documents

Splatalogue (*www.splatalogue.net*) is a database containing frequencies of atomic and molecular transitions which emit in the radio through sub-millimeter wavelength range, and which is used by the ALMA OT. To learn more about it, see the Splatalogue QuickStart Guide on the Science Portal.

The ALMA Observation Support Tool (OST) simulates ALMA observations. Users submit jobs to the OST via a standard web interface. They specify the parameters of an observation and either supply an arbitrary source model (by uploading a FITS image) or selecting a model from the pre-existing library. When the simulation is complete, the user receives by automated e-mail an hyperlink to a web page containing among others a simulated image, an image of the PSF, and some other information and figures. The OST documentation is available at *almaost.jb.man.ac.uk/help*.

4.2 The ALMA Science Portal

The ALMA Science Portal is the primary access point for science users to ALMA. It is intended to provide a one-stop access gateway to all ALMA web resources, documents and tools relevant to users for proposal preparation, proposal assessment, project tracking, project data access and data retrieval as well as to the ALMA Helpdesk (see Section 4.3).

All non-proprietary content is accessible anonymously. User registration and authentication is available in order to submit tickets to the Helpdesk and to submit proposals via the ALMA Observing Tool.

Material available to any user at all times includes:

- User registration
- Call for Proposals
- Tables explaining ALMA technical capabilities (sensitivity, frequency coverage, available observing modes, etc)
- Download of the OT
- Helpdesk "knowledgebase" articles listing solutions to common problems
- Archive access to non-proprietary data (once available)
- All official ALMA user documentation and some software tools, including the ALMA Sensitivity Calculator, simulators, etc.

The following additional material is available to registered users after authentication:

- User profile and password management
- Ability to submit Helpdesk tickets
- Archive access to proprietary data (when available)

In addition, some subgroups of users have access to material related to their specific role. For instance, in the future, users with approved proposals will be able to use the Project Tracker to obtain the status of their scheduled observing projects. Authentication will also allow PIs to access their proprietary ALMA data. Users must also register in order to be able to act as a PI or Co-I on a proposal.

There are three instances of the Science Portal available, one at each ARC. There is a common entry point to the ALMA Science Portal at *www.almascience.org*, from which users are able to select the regional instance that they wish to visit (see Figure 1), and a direct entry point served from each ARC. These may be accessed directly via *almascience.nao.ac.jp*, *almascience.eso.org*, or *almascience.nrao.edu*. Links on the portal also allow users to switch to an instance running at a different ARC (green arrow in Figure 2). The multiple instances ensure that the Science Portal is always available even if one instance is temporarily down.

The Science Portal also includes links to the local ARC webpages, from which users can access local information and specific services of its ARC, such as local visitor and student programs, schools, workshops, and public outreach activities (red arrow in Figure 2).

4.3 The ALMA Helpdesk

The ALMA Helpdesk is accessed from the ALMA Science Portal (red arrow in Figure 2), or directly at the East Asian, European, or North American ARC via the links *https://alma-help.nao.ac.jp*, *https://alma-help.eso.org*, or *https://alma-help.nrao.edu*. The Helpdesk provides a mechanism for keeping track of user queries, thus ensuring that all tickets are answered in a timely and professional manner. Submitted tickets are directed to support staff at one of the ARCs, who are available to answer any question relating to ALMA, including ALMA policies, capabilities, documentation, proposal preparation, the OT, Splatalogue, CASA, etc. Users may also request information on workshops, tutorials, or about visiting an ARC or ARC node for assistance with data reduction and analysis. Users must be registered through the ALMA Science Portal in order to submit a Helpdesk ticket.

The Helpdesk is similar to those used in a number of other astronomical environments such as Spitzer, Herschel, Euro-VO and NRAO. It has a “knowledgebase feature”, which is a database of answered questions or “articles” on all aspects of ALMA (see Figure 3). The knowledgebase is also available to unauthenticated users, and may be searched to find answers to common queries without the need to send in a Helpdesk ticket. It is also used when a user creates a Helpdesk ticket, whereby matching knowledgebase articles are suggested to a user as they type in a query.

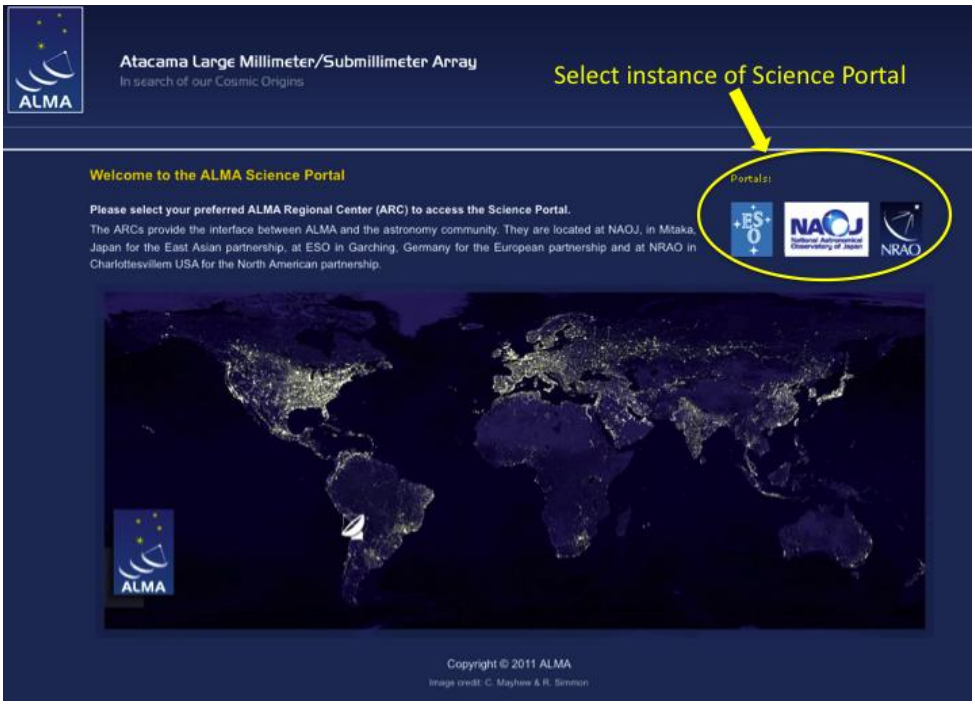

Figure 1: ALMA Science Portal gateway at www.almascience.org

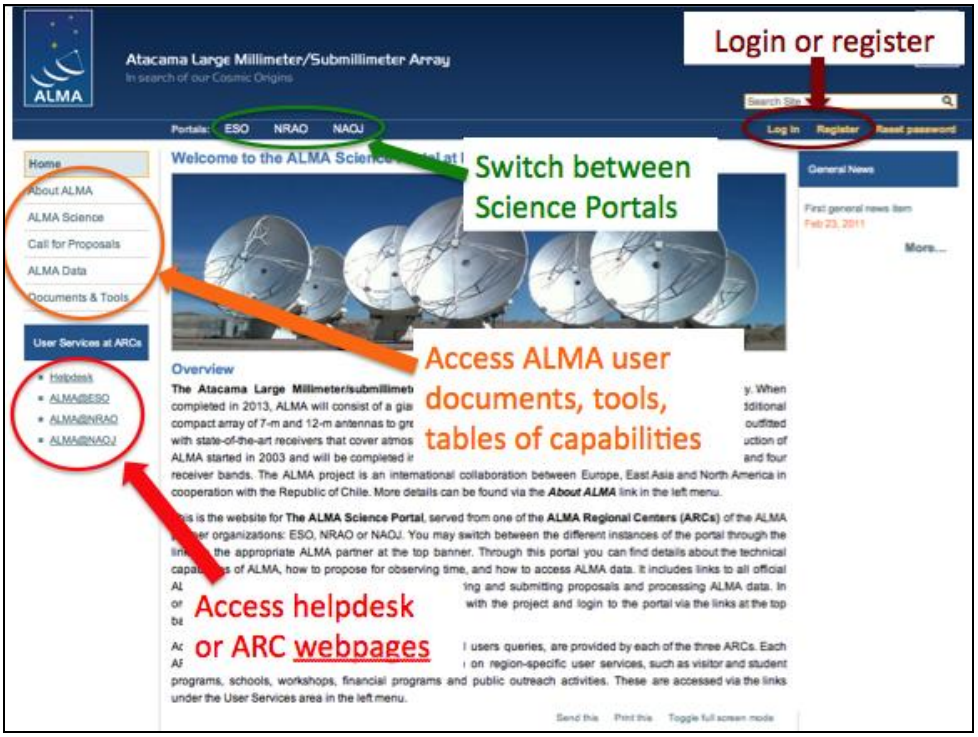

Figure 2: ALMA Science Portal instance at one of the ARCs

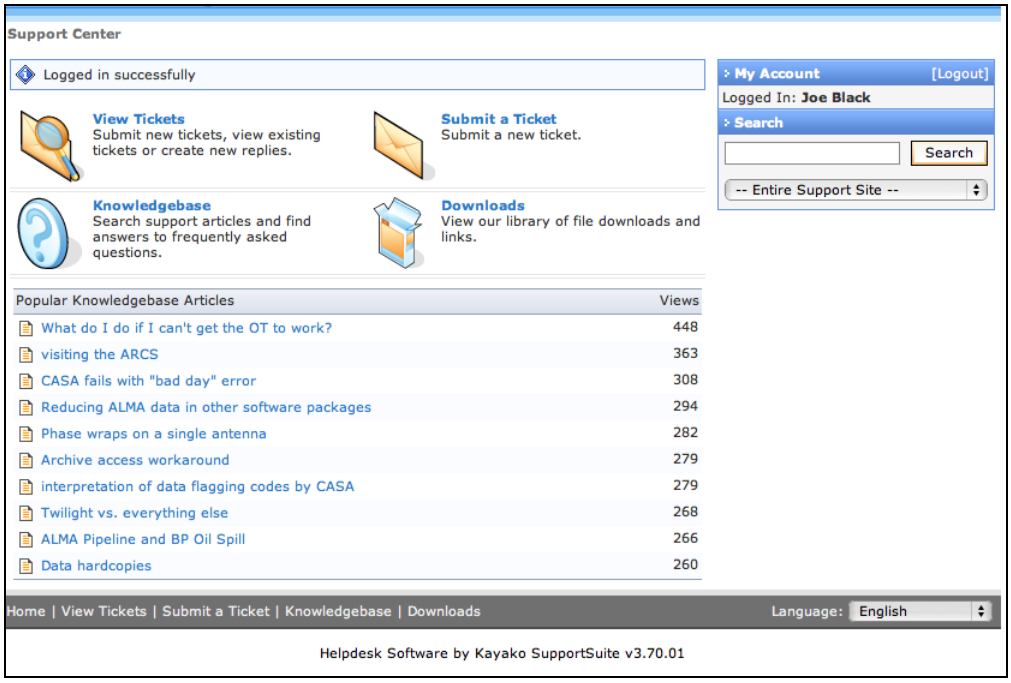

Figure 3: Helpdesk landing page, showing knowledgebase articles

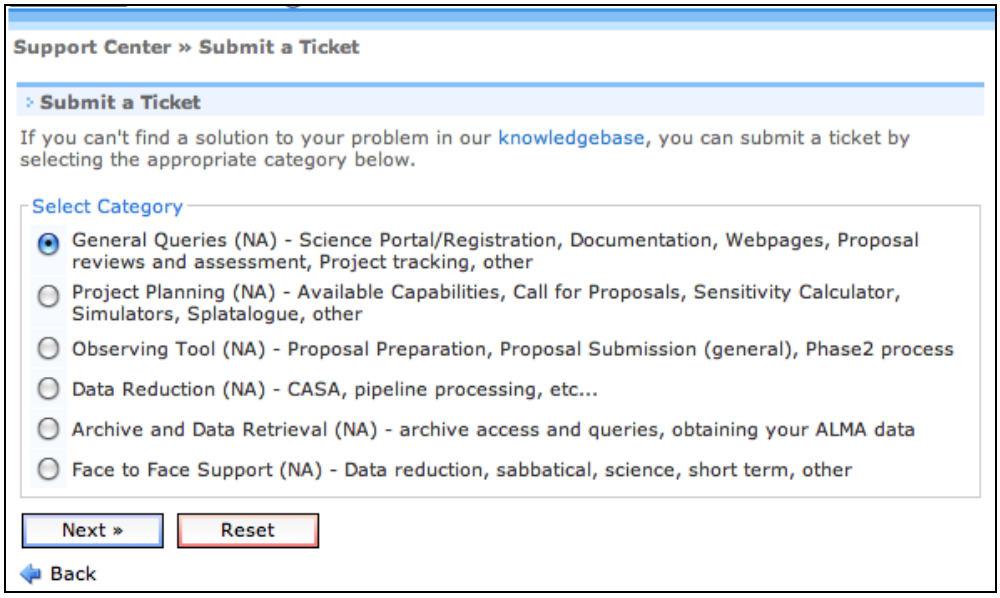

Figure 4: Available Helpdesk departments

The current ALMA Helpdesk consists of the following departments (see Figure 4): General Queries, Project Planning, OT, Data Reduction, Archive and Data Retrieval, and Face-to-Face Support. In addition, a new department called Proposal Submission Emergencies, will appear 72 hours before the proposal submission deadline to handle immediate connectivity issues users may have submitting proposals.

Helpdesk tickets will primarily be answered by the support staff at the receiving ARC. However, if the ticket can be better addressed by an expert at another ARC it may be transferred; the user will be notified accordingly. This model ensures that the support staff are responsive to their user community, but also that all users benefit from the expertise available at any of the ARCs or ARC nodes. Solutions to queries that are not too specific to a particular user or project are published as knowledgebase articles, which are available to all users regardless of the originating ARC.

5 Cycle 0 general information and policies

5.1 Introduction and policies

Cycle 0 will have a duration of 9 months including a one month engineering shutdown, leaving 8 months for science operations. It is expected to start on September 30, 2011 and finish on June 30, 2012. The engineering shutdown is expected to take place during February 2012.

The capabilities during Cycle 0 will be limited compared to those of the completed array, and the highest priority for ALMA will be the completion of the entire array without undue delay.

The time available after engineering and integration activities will be shared between Science Operations and Commissioning and Science Verification (CSV, which has priority). Observations will be executed by JAO staff, taking into account the weather conditions, the configuration of the array, the proposal ranking and other constraints.

Cycle 0 observations will be scheduled during blocks of time of 8-12h, mainly during nighttime, up to an expected maximum of 500-700h. Scheduling of the blocks will be reviewed on a weekly basis.

ALMA staff will conduct quality assurance on ALMA data, and will provide processed data products through the respective ARCs. However, it cannot be guaranteed that the characterization and quality of the data and data reduction will meet the standards expected when ALMA becomes fully operational. Experience in radio (in particular, millimeter) interferometry will be an advantage in working with ALMA Early Science data products. PIs and observing teams should anticipate the need to invest their own time and expertise to assure the quality of the provided data products and to re-reduce the raw data if the quality of the former were not satisfactory. This may include the need to visit the relevant ARC or ARC node to get help and to assist with quality assurance and potential data re-reduction.

All Cycle 0 Early Science observing will be conducted on a best effort basis.

The ALMA proposal review process for Cycle 1 will ignore the outcome of Cycle 0, in the sense that Cycle 0 projects will not establish proprietary rights to sources, fields or science goals, beyond the 12 months proprietary rights that apply to all ALMA data. Cycle 0 observations that have not been completed by the end of the cycle will not be carried over to Cycle 1.

5.2 Capabilities and limitations

The Cycle 0 capabilities are described in Appendix A.

The following limitations in capabilities and types of observations should be noted:

- UV coverage will be limited compared to the completed array;
- The characterization and quality of the data and data reduction may not meet the standards expected when ALMA is in full scientific operations;
- The characterization of the instrumentation may not be complete.

There will be limitations in observing time per project:

- A maximum of 500-700 hours array time will be available for observations;
- About 100 proposals are expected to be accepted;
- The average observing time per proposal is likely to be 5-7 hours (with a wide range). Only a small number of scientifically compelling proposals requiring substantially more time may be accepted, provided that the need for above average project execution time is scientifically compelling;
- There is no guarantee that a project will be completed.

5.3 Proposal types

Only Standard and Target of Opportunity (ToO) Proposals will be accepted for Cycle 0.

Proposals shall require no more than 100 hours of observing time, as given by the larger of: (1) the estimated total time for the project by the OT and listed on the first page of the "printable summary of proposal", or (2) the total time requested in the Science case. Proposals that are estimated to require more than 100 hours to complete will not be accepted during Cycle 0.

ToO proposals should be used to observe targets that can be anticipated but not specified in detail. Like standard proposals, these proposals must be submitted by the Cycle 0 proposal deadline. While the target list may be left unspecified, observing modes and sensitivity requests must be specified in detail for ToO observations.

Only a few ToO proposals are likely to be accepted for Cycle 0. Those that are will have to meet the following criteria:

- They are estimated to require no more than 100 hours of observing time;
- The observations will be assigned a maximum time allocation;
- Execution of ToO observations will be restricted to the Cycle 0 blocks of observing time. As a rule, CSV activities will not be interrupted to carry out ToO observations.

Triggering of observations from accepted ToO proposals will be done through a web form available via the ALMA Science Portal.

Time-critical and monitoring observations may be possible, but will be restricted to the Cycle 0 blocks of observing time. Therefore proposals with an execution time tolerance of less than 3 weeks will not be accepted. Time-critical observations can be part of either Standard or ToO proposals.

5.4 Science categories

Cycle 0 proposals will be assigned to one of four science categories:

1. Cosmology and the high redshift universe
2. Galaxies and galactic nuclei
3. ISM, star formation/protoplanetary disks and their astrochemistry, exoplanets
4. Stellar evolution, the Sun and the solar system

Category information is used to distribute the proposals for review to the most qualified assessors. The assignment of a proposal to a category is made by the proposers, but it may be modified by the JAO if another category is judged to better describe the science of the proposal.

6 Proposal preparation and submission: Phase 1

6.1 Notice of intent

To help ensure that the Cycle 0 review process is set up in a way that allows proper handling of the set of proposals to be assessed, and to assist the JAO to schedule the two configurations offered, prospective Principle Investigators are strongly encouraged to submit a notice of intent ahead of actual proposal submission. This should be done using the notice of intent web form, accessible via the Science Portal. One such form should be completed and submitted for each planned Cycle 0 proposal. This should not require more than a few minutes, since the information to be provided has been deliberately kept to a minimum: PI's name and affiliation, science category, observing bands and configuration(s) to be used.

The submission deadline for notices of intent is

15:00 UT on April 29, 2011

Notices of intent are neither mandatory nor binding. That is, a proposal may be submitted even if it was not announced via such a notice. Conversely, sending a notice of intent does not represent an obligation to submit the corresponding proposal. Nevertheless, users are strongly encouraged to submit a notice of intent.

6.2 Registering with ALMA

User registration is provided via the "register" button on the Science Portal (magenta arrow in Figure 2). During registration, users provide contact information, specify their primary institutional affiliation, and choose a password (see Figure 5). The primary institutional affiliation is selected from a drop-down menu based on country and (in some cases, state). If a user's institute does not appear in the drop-down list, a text field is provided to add it manually.

A user's institutional affiliation defines if his/her proposals will be accounted to one of the four ALMA regions (East Asia, Europe, North America or Chile), or if they will be non-ALMA member ("Open-skies") proposals. It also constrains which ARC a user's Helpdesk tickets are initially sent to. Users affiliated with one of the ALMA regions will have their tickets sent to the corresponding ARC, while all other users may select which ARC their tickets are directed to. Even though Helpdesk tickets go to a specific ARC, the support staff at the ARCs will consult each other or transfer tickets as needed in order to ensure all tickets are answered appropriately (see Section 4.3).

For Cycle 0, if users from Taiwan (which is affiliated with both EA and NA) wish to submit proposals under both affiliations, they must register with ALMA **twice**: once with the initials for one region appended to their surname (e.g. Smith-EA), and again with the initials of the other region appended to their surname (e.g. Smith-NA). Different e-mail addresses must be used for these two user identities. Within the OT, users will select the PI identity that is associated with the region they wish the proposal to be affiliated with. **This is a special case for Cycle 0; multiple affiliations will be handled properly in future cycles.**

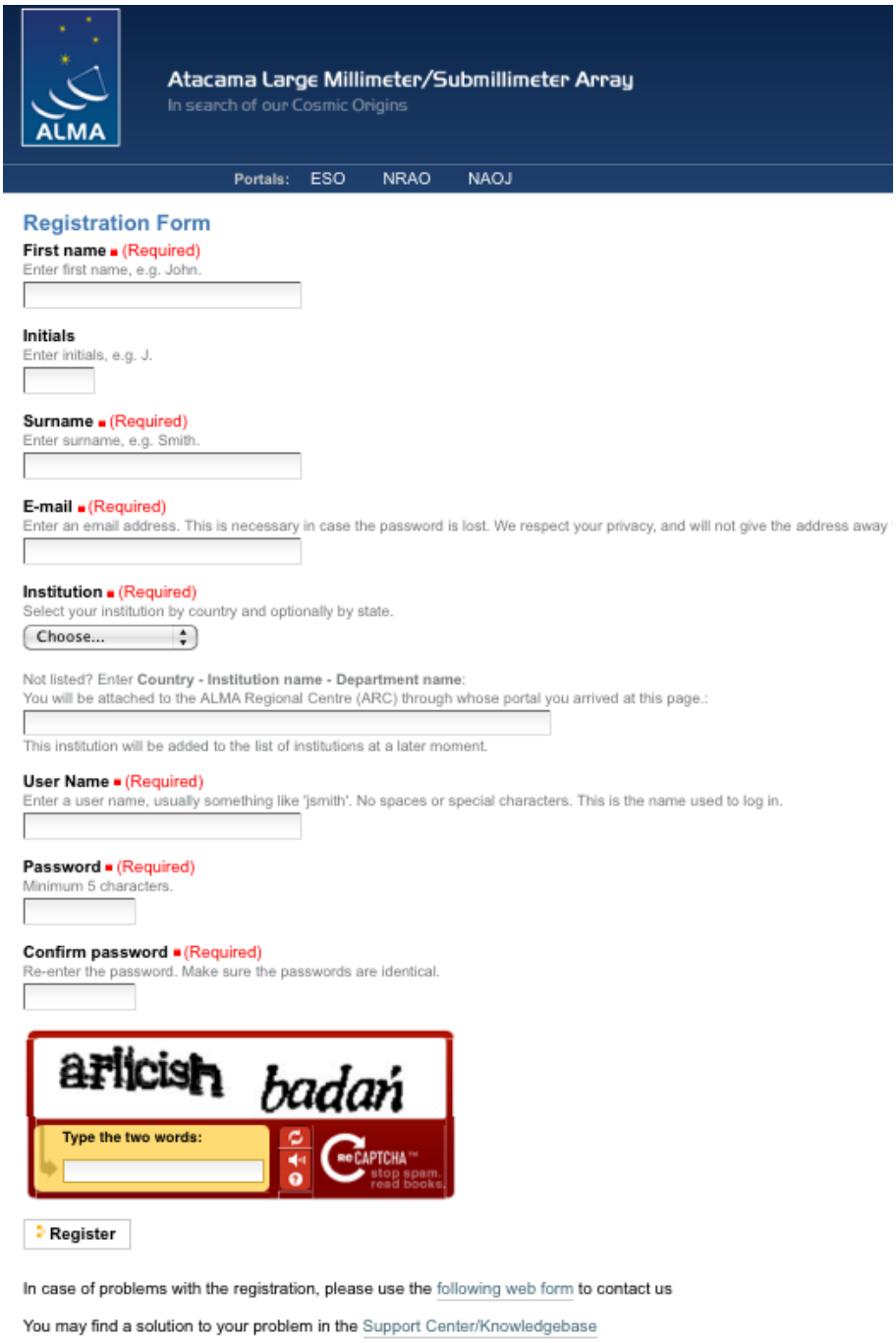

Figure 5: Registration screen from ALMA Science Portal

6.3 The Observing Tool

The ALMA Observing Tool is used for proposal preparation and submission (Phase 1) and later for detailed planning of observations on the telescope (Phase 2). The OT is a Java-based application (client) that resides and runs on the user's computer and interacts with the ALMA Archive and other databases over the Internet while active. Anyone will be able to download and use the OT, but only registered ALMA users will be able to submit proposals. Users should consult the OT trouble-shooting page for system requirements and "known issues" (cf. Section 4.1.2).

During proposal preparation, the OT is used to collate the proposal science case and technical justification, and capture other information needed to specify the details of the proposed observations. The user uploads the Science Case and Technical Justification through the OT interface. The user also expresses intended scientific goals as a series of specialized OT constructs called Science Goals, and employs various specialized editors to specify target coordinates and mapping field parameters, line frequencies and correlator bandwidths, desired sensitivities, etc. The user's inputs are interpreted by the OT to establish which resources of ALMA (configurations or antennas, etc) are required, and to make an estimate of how much observing time (including calibration and observing overheads) is needed.

In simple cases, a single Science Goal may encompass the entire scientific purpose of a proposal. However, most proposals will contain multiple Science Goals. More than one Science Goal is needed in the following cases:

- Proposals requiring more than one ALMA band;
- Proposals for observations of multiple lines that are spread sufficiently across a band so that they cannot be observed with a single tuning;
- Proposals for observations of several target sources requiring different sensitivities, angular resolutions, etc.

The Cycle 0 capabilities of the ALMA instrumentation are embedded within the OT as selectable options. Visual editors allow sky viewing of target positions and mapping regions, and spectral editors display the available spectral region against the backdrop of the atmospheric opacity. While a proposal is being prepared, it can be exported to and recalled from the local disk. Once the ALMA Archive is available (June 1, 2011 15:00 UT) and the proposal is validated within the OT, it can be submitted to the ALMA Archive. Note that the proposal can be resubmitted by the Principal Investigator as many times as needed before the proposal deadline.

6.4 General guidelines for writing a proposal

ALMA Cycle 0 proposals must be written in English and include the following sections:

1. Science case (mandatory), not exceeding 2 pages
2. Technical justification (mandatory)
3. Figures, tables and references (optional)

4. A brief statement on the likely potential for publicity (e.g. images, press releases etc.) arising from the proposed scientific observations

These sections shall be submitted as a single PDF document. **The total length of this document is limited to 5 pages** (A4 or US Letter format), with a font size no smaller than 11 points. A file size limit of 20 MB will be enforced at submission. Accordingly, extremely large or complex color figures may not be acceptable. Proposals must be self-contained. Their assessment will be based solely on their explicit contents, to the exclusion of external references such as personal webpages, etc. Reference can be made to published papers (including astro-ph preprints), as per standard practice in the scientific literature. Consultation of those references should not, however, be required for understanding of the proposal.

Additional information about the intended schedule of availability of the Compact and Extended configurations will be published on May 15, 2011.

6.4.1 Science case

Each proposal must describe the astronomical importance of the proposed project and include a clear statement of its immediate observing goals. Since the proposal review panels will be told to give preference to proposals that best demonstrate and exploit the advertised ALMA Early Science Cycle 0 capabilities, producing scientifically worthwhile results from relatively short observations (averaging a few hours), the science case should address this aspect. Additionally, it should explain how the expected intensity of the target source(s) was estimated and justify the Signal-to-Noise (S/N) ratio required to achieve the scientific objectives of the project as well as, when appropriate, the size of the target sample.

Proposers should keep in mind that the topical ALMA Review Panels span a wide range of scientific areas. Therefore, proposals should be written for an expert, but broad-based, astronomy audience.

The science case is mandatory and **should not exceed two typeset pages**.

6.4.2 Technical justification

A mandatory part of each proposal is the Technical Justification. The Technical Justification should be as long as necessary to fully justify the requested observations, with particular attention paid to those parameters that most directly affect the total time request. There is no specific limit to its length, as long as the total proposal limits are not exceeded. For most proposals, it should fit within one typeset page.

PIs should provide a sound basis for the following parameters that are set in the OT:

- Requested Sensitivity (including quantities this is based on, such as desired signal to noise, expected flux and line width, etc)
- Correlator Setup (bandwidth and spectral resolutions, number and placement of spectral windows, single or dual polarization)
- Imaging requirements (angular resolution, largest angular scale of interest, arrangement of pointings)

Some proposers may need to justify additional aspects of the proposal, especially any aspects that result in a longer total observing time than given by the OT time estimate. These may include:

- Imaging performance (especially if the ratio of the expected peak flux density to the required sensitivity is higher than about 50)
- User-defined calibrators (if appropriate – see Section A.6)
- Calibration accuracy
- Special weather requirements or considerations
- Organization of Science Goals (if this results in a longer time request)
- Other requirements not fully captured by OT, such as time critical aspects.

The imaging performance requirement is particularly important for ALMA Early Science because the "snapshot" performance of ALMA is greatly reduced compared to that of the final array.

PIs should also consider if their observations are better suited to one or other of the two available Cycle 0 configurations. As detailed in Appendix A, there will be two configurations available for Cycle 0 – a Compact configuration (baselines of 18-125 m) and an Extended configuration (baselines of 36-400m). The Compact configuration is designed to provide good sensitivity for extended structures. The Extended configuration will provide higher angular resolution and is more suited for compact structures. Appendix A includes tables of the corresponding angular scales.

Except in special cases, a PI will not explicitly request an observing time in the OT. Instead, users specify the *desired sensitivity* for each science goal. The ALMA OT will then use the requested sensitivity together with estimates of weather and system performance and calibration overheads to calculate a total estimated observing time. The estimated time for each Science Goal is reported in the OT time estimator (accessed from the “Control and Performance Parameters” pane of the OT), and the total time for the project is reported on the first page of the printable summary of the proposal produced by the OT. If a user wishes to request a time that is not based on the time to reach a given sensitivity (e.g., to cover a range of hour angles in order to improve imaging fidelity), the PI must select the corresponding button within the OT “Control and Performance Parameters” pane (see Figure 6), and clearly indicate this request in the Technical Justification.

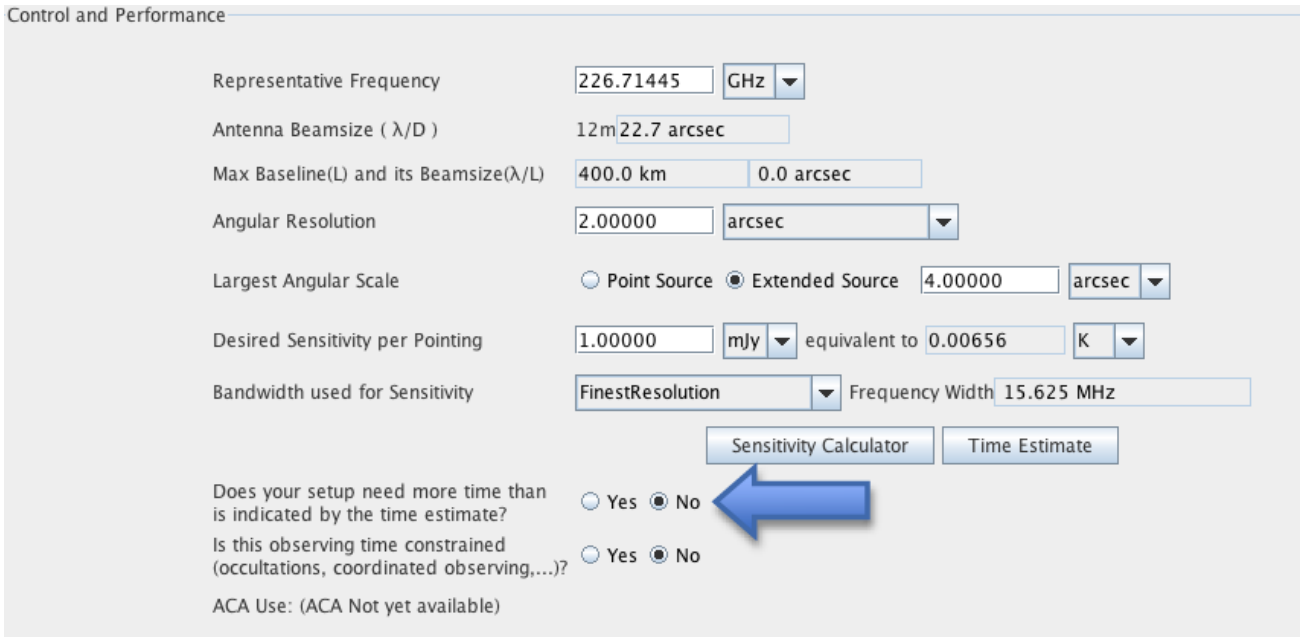

Figure 6: Snapshot of the OT "Control and Performance" pane, with the button selected indicating the proposal requires more time than given by the OT sensitivity calculator

The technical justification also provides an opportunity to describe any special scheduling requirements. In general, PIs do not specify observing sequences, and observations may be broken up and observed independently. If an observation must be executed in a specific sequence (e.g., near-simultaneous observations at two different frequencies), or if the observations should be distributed over a range of hour angles (e.g., to improve imaging fidelity), the PI should also clearly indicate this request in the Technical Justification, as there is currently no other way to do so in the OT.

The observational parameters may differ for the different science goals in the proposal; each set of parameters should be separately justified.

Before final submission, PIs should double check that the parameters referred in the Technical Justification agree with those entered into the OT and are consistent with the advertised Cycle 0 capabilities, as detailed in Appendix A. More details on the meaning of the parameters specified in the OT are available from the help facilities within the OT. If users have any questions about technical justification, they should consult the ALMA Helpdesk. Additional considerations for ALMA Early Science observing are included in the ALMA Early Science Primer.

6.4.3 Figures, tables, and references

Figures, tables, and references that support the Science Case and the Technical Justification may be included. Figure captions, tables and references may be listed in 10-point font. Color figures or tables may be included.

Figures, tables, and references are optional. Together with the science case and the technical justification, they must fit within the overall 5-page length limit of the PDF proposal.

6.4.4 Opportunities for public promotion of ALMA

Opportunities for public and media interest in ALMA science will be very important during Early Science Cycle 0. Proposers are requested to consider the potential media appeal of proposed observations, with regard to scientific content and/or the quality of the visuals that could be produced. Each Proposal should include a brief statement on the likely potential for publicity arising from the proposed scientific observations. This information will not be used in the assessment of the proposal, which will be based solely on scientific merit and technical feasibility. The statement must fit within the overall 5-page limit of the PDF proposal.

In the event that a Cycle 0 proposal is successful and is selected for publicity activities, the ALMA Education and Public Outreach (EPO) team will work with the PI to develop the material for presentation to the media and the public (e.g. press releases), including support in the preparation of visuals if relevant. EPO may ask for co-operation on the scientific content and for the PI to be available for possible interviews. Furthermore, the PI will be asked to agree to inform the ALMA EPO team if he/she is planning a press release or similar media interaction (for example through the PIs own institution's press office). ALMA requests that PIs do this at the start of the process, in order to allow for sufficient time to assess the news story and provide assistance to PIs as appropriate. The contact e-mail address for all liaison with the ALMA EPO team is *alma-epo-ipt@alma.cl*.

6.5 Proposal validation and submission

All proposals must validate in the OT before they can be submitted (via the use of the “Validate” option under the “File” menu item). If the proposal fails to validate, the non-validating parts will be listed in the “Feedback” pane, and clicking on each message will direct the user to the corresponding error (see Figure 7).

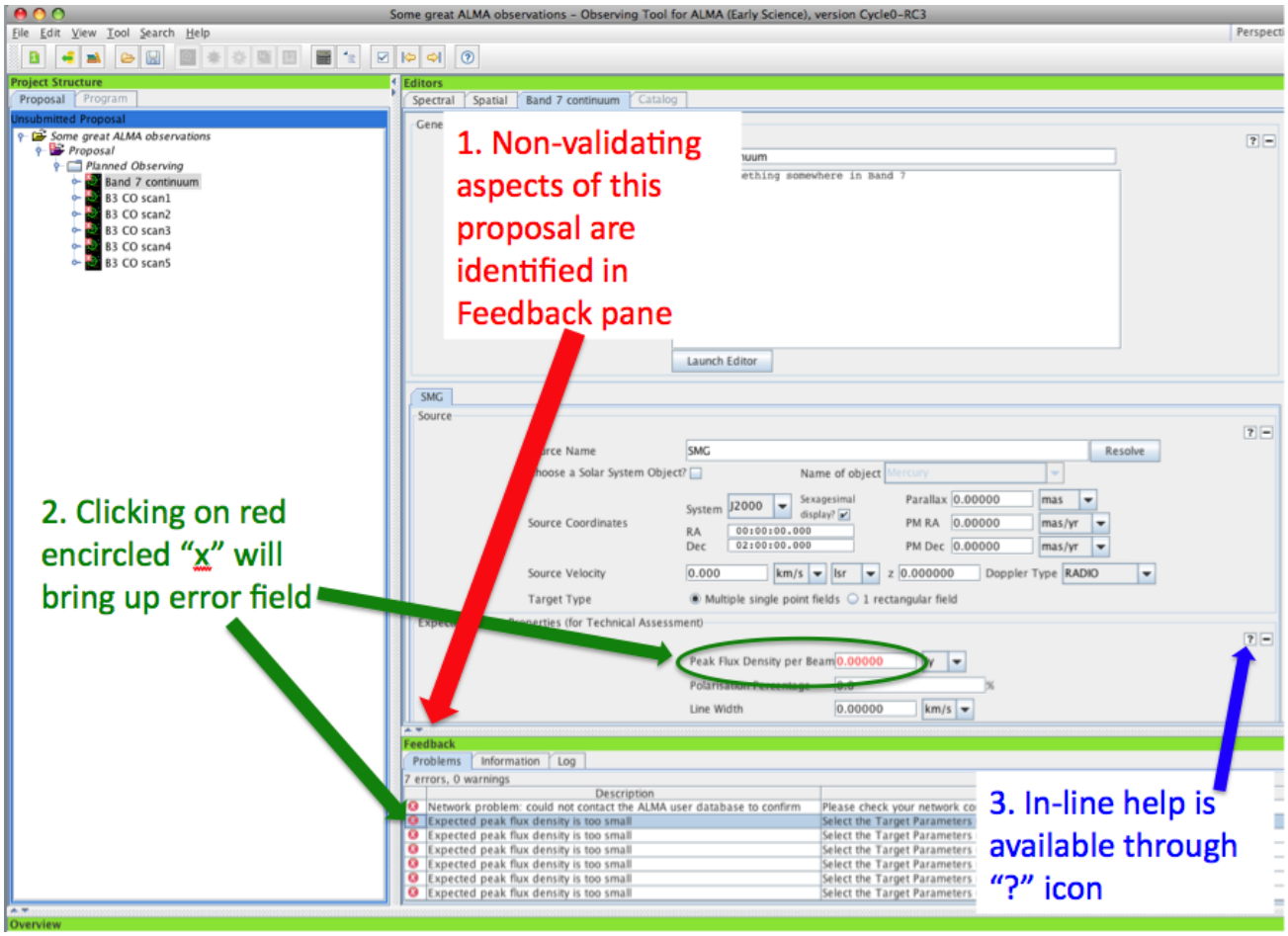

Figure 7. Validation error reporting in the ALMA Observing Tool

Validated proposals must be submitted to the ALMA Archive using the OT (via the "Submit Project" option under the "File" menu item). Upon submission, the science case, technical justification and any other materials uploaded to the OT as a PDF file (Section 6.4) together with the observing specifications entered into the OT are electronically transmitted to the ALMA Archive. Prior to this, PIs should save the proposal as a local file on their computer ("Save" or "Save as" option under the "File" menu item), so as to leave open the possibility of resubmission of the proposal until the deadline. A detailed PDF summary of the whole proposal may also be generated and saved locally by the user (option listed under the "Tool" menu item).

Proposal submission to the Archive will be available from 15:00 UT on June 1, 2011.

The proposal submission deadline is:

15:00 UT on June 30, 2011

Proposals must be submitted prior to this deadline. The proposal submission deadline is firm: proposals received after the deadline will not be considered.

If successfully submitted, a proposal receives a unique code adhering to a standard format. This code incorporates the submission year, the proposal submission cycle, a running number and an indicator of the proposal type (Standard, ToO). The format of the proposal code is as follows: YYYY.C.NNNNN.T. Here, "YYYY" denotes the year, "C" is the cycle number, "NNNNN" is the five-digit running number and "T" denotes the proposal type. For example, the code 2011.0.00156.S indicates a Standard proposal that is the 156th ALMA proposal submitted during Cycle 0 in 2011.

A proposal can be submitted and resubmitted until the submission deadline. Modifications of submitted proposals will not be permitted after the deadline. Co-Is can retrieve proposals from the Archive before the deadline, but only the PI can submit a proposal.

Previously submitted proposals are identified by the fact that, contrary to original submissions, they already contain a submission code. This code is assigned by the proposal handling system when the proposal is submitted for the first time. Accordingly, it is essential that, after submitting a proposal, users save a copy of it to their local disk, complete with the proposal submission code. Any subsequent submissions intended to update a previously submitted proposal should be derived from that saved, post-submission copy, in order to ensure that the same submission code is used. *Attempts to update a previously submitted proposal using the local copy without a code should always be avoided, as this will result in a new (duplicate) submission that will be assigned a new code.*

A Helpdesk ticket should be submitted in order to withdraw a proposal after a code has been assigned.

7 The ALMA Proposal Review Process

7.1 Description

ALMA proposals will be subject to peer review. This review will be conducted by the ALMA Review Panels (ARP). There will be at least one ARP per science category, comprising experts in the range of scientific topics covered by this category. The primary criterion for selection of the ARP members will be scientific competence. ARP membership will ensure appropriate representation of the ALMA regions.

Each ARP will build a ranked list of the proposals, and assign each a grade. The ARPs will assess proposals on the basis of their scientific merits. They will base their judgment on the following criteria:

- The overall scientific merit of the proposed investigation and its potential contribution to the advancement of scientific knowledge;
- The extent to which the proposed investigation is well suited to the ALMA Cycle 0 capabilities;
- The technical feasibility of the proposed observations.

The ARPs will base the technical component of their assessments on input from Technical Assessors, who are JAO and ARC astronomers selected on the basis of their technical expertise.

It will be the responsibility of the ALMA Proposal Review Committee (APRC) to merge the outputs of the individual ARPs into a single ranked list, and to consolidate the proposal grades across categories. In this process, the APRC will take into account the distribution of observations across Right Ascension, frequency band, required weather conditions, etc. For Cycle 0, the APRC will comprise the APRC chair (who is not a member of any of the ARPs) as well as the ARP chairs and deputy-chairs. Dr Neal Evans, from the University of Texas, has been appointed APRC chair for three years, effectively covering Cycles 0, 1 and 2 of ALMA science operations.

At the end of the process, each proposal will have been assigned one of the following four grades:

- Grade A: highest priority proposals;
- Grade B: high priority proposals which will be scheduled at a lower priority than grade A proposals;
- Grade C: scientifically fruitful proposals which will be observed only as filler projects, only if a higher grade proposal is not available for the current conditions;
- Grade D: proposals that shall not be observed.

It is expected that Grade A proposals will not constitute more than 20% of the anticipated available time in each observing period. Together, Grade A and B proposals will account for 100% of the available time over the observing cycle. Grade C proposals will oversubscribe this time by 50%.

In its final recommendation, the APRC will make allowance for the need to ensure that each ALMA region receives its nominal share of observing time.

At the end of the review process, PIs will be informed of the outcome of the assessment. This notification will specify the grade assigned and will include a short feedback report on the assessment, as well as on possible technical issues that it may raise.

7.2 Proposal Review Process Policies

7.2.1 Confidentiality

Proposals submitted in response to this Call for Proposals will be kept confidential to the extent allowed by the review process. The PI name, proposal code, scientific category and title of accepted proposals will be made publicly available as soon as the first data of a project have been archived. The abstracts of successful proposals will also become public, when the proprietary period of the last dataset of the corresponding project is over. Unsuccessful proposals and more detailed information regarding the successful proposals shall remain confidential.

7.2.2 Duplication

A high-level principle of ALMA is that identical data should not be taken twice unless scientifically necessary. The term “Duplication” is used to refer to projects that may potentially replicate the data or results obtained in another proposal.

In Cycle 0, potential duplication of proposals may occur in the following cases:

- When more than one team applies to observe the same objects in the same observing mode (frequency, configuration, area, depth, etc);
- When different teams propose to try to answer similar science questions with different observations.

In case of potential duplications, the relevant proposals shall be directly compared with each other, so as to ensure that their relative ranks shall duly reflect their respective scientific merits. The assessors will determine if the considered duplicate proposals are mutually exclusive or if it would be scientifically meaningful for more than one to be approved. The final verdict will be rendered by the APRC.

7.2.3 Descoping

The ARPs and the APRC will be strongly advised against recommending descoping or other modifications of proposals. Nevertheless, the ARP/APRC may recommend the descoping of a project. Descoping of projects shall only arise as a result of the review process, and will be made only for compelling scientific and/or technical reasons.

Descoping rulings will be communicated to the PIs as part of the APRC feedback report. They will include:

- A clear and rigorous description of the justification of the descoping decision;
- A detailed description of the specific manner in which the intended descoping should be implemented; number and, if needed, identification of the targets to be omitted; observing modes or configurations not to be used, etc.

Notwithstanding the general descoping rules, for approved ToO proposals, an upper limit will be set by the APRC to the number of events that may be observed in the period, and/or on the number of times observations (at different epochs) of these events that may be triggered over the period.

8 Preparation and Submission of Observations: Phase 2

The Phase 2 process may be quite involved for complex projects. It will be more fully described in separate documentation provided closer to the start of the Cycle 0 observing period. The general process is outlined briefly below.

If a proposal receives a grade “C” or better as a result of the review process, then its state will be changed to “Accepted” and it will be available for the Observation preparation stage, Phase 2. For Cycle 0, this stage will proceed as follows:

The PI will receive notification from the Observatory that his/her proposal has been accepted for scheduling on ALMA. The PI shall then use the OT to retrieve the project from the ALMA Archive, and it will open as a new Phase 2 project. The specific details of any mandated changes will also be noted in the appropriate text field sections of the project itself. Then the PI should select the “Generate Phase 2 SBs from all the Science Goals” option from the “Tools” drop-down menu. This will generate one or more ObsUnitSet items (with a white “stack of clocks” icon in the OT), each containing one or more Scheduling Blocks (SBs; each of which

has a single yellow clock icon in the OT). These SBs are the atomic structural units that will actually be selected and run at the telescope. When a full set of all of the SBs within a given ObsUnitSet have been successfully executed an appropriate number of times each, all of the data associated with the completed ObsUnitSet will undergo full reduction. The PI should check that the breakdown of the project into ObsUnitSets and SBs reflects the intended Science Goals. More detailed instructions will be provided to PIs of successful proposals.

Note that the time window for Phase 2 submission is about a month. The ARCs will work closely with successful PIs regarding any problems with SB generation. The Helpdesk "Observing Tool" department should be used for any problems encountered during Phase 2.

8.1 Changes to submitted projects

Changes to a submitted project prior to the completion of the review process will not be permitted. Changes to a project accepted for admission to the ALMA observing queue will not normally be permitted. However, should a PI wish to request a change to a project (e.g. to correct a mistake in a field source list, or in response to later additional information obtained that may seriously affect the scientific case of the project), this will be done via a standard change request form accessed from the Helpdesk. To be considered by the Observatory, such change requests must include a very clear description of the proposed change along with a clear, substantive justification for the change. All such change requests will be considered by the Observatory on a case-by-case basis. Approved changes will be implemented by ARC staff, in consultation with the PI.

8.2 Project Withdrawals, Completion and Carryovers

Should a PI wish to withdraw his/her project before completion for some reason, then a Helpdesk ticket should be filed to this effect, and no further observations will be performed for that project.

All projects, whether completed or not, will end at the conclusion of Cycle 0 and will not be carried over to Cycle 1.

9 Data processing and data delivery

More details of the data processing plans will be made available towards the start of Cycle 0 observations. The anticipated process is outlined briefly below.

Once an ObsUnitSet is completed, the corresponding data will be processed by the JAO pipeline and/or ALMA staff astronomers.

When a set of data has been processed and has passed quality control, it will be made available to the PI of the project via the ARC he/she has registered with. The PI will be notified accordingly. Data will become available are either for the full project, or, if the project contains several ObsUnitSets, the data of each ObsUnitSet will be provided separately. Depending on the size of the dataset, it will be offered for download over the Internet (preferred) or shipped on storage media. All storage media deliveries will need to be requested by the user, with the policies regarding shipping of media to be determined by the individual

ARCs. Especially during Cycle 0, PIs are strongly encouraged to visit the ARCs or ARC nodes to obtain their data directly, this will also allow them to analyze and (if necessary) reprocess it with the help of local experts

By default, data obtained as part of an ALMA science program are subject to a proprietary period of 12 months, starting for each dataset at the time when the ARC sends the notification to the PI that this dataset is ready for delivery.

Data taken by the ALMA observatory will be kept confidential for the duration of the proprietary period, to the extent allowed by the quality assurance and face-to-face support processes. All ARC and ARC nodes personnel involved in the quality assurance of the data and/or reduced data products as part of the user support will be fully informed of this. They will be required to treat the raw data and the associated data products as confidential and not to disclose them or use them in any way beyond that needed for the quality assurance and face-to-face support processes themselves.

10 ALMA Cycle 0 Checklist

1. Read the summary of ALMA Cycle 0 capabilities (Appendix A).
2. Both (sub)millimeter astronomy experts and novices are encouraged to download and read Observing with *ALMA: A Primer for Early Science*. **This document, and all Cycle 0 documentation, is available through http://www.almascience.org.**
3. Create an ALMA account by registering on the Science Portal (http://www.almascience.org). This step is necessary to submit proposals and Helpdesk tickets, and to access proprietary data (note that access to the Helpdesk knowledgebase does not require registration).
4. Download the OT from the link provided on the Science Portal (under “Documents and Tools”) and install it on your computer.
5. Download and read the *OT Quickstart Guide*.
6. Start up the OT and select “Create new Proposal”.
7. Select the correct Proposal Type (either **Standard** or **Target Of Opportunity**).
8. Note the evaluation criteria listed in Section 7.1 of this Guide.
9. Prepare your observing proposal according to the guidelines listed in Section 6.4 of this Guide. The Science Case and Supporting Documents should be attached as a PDF document of 5 pages or less and no more than 20 MB.
10. After June 1, 2011: follow the steps described in Section 6.5 to electronically submit your proposal, cover sheet, and Science Goals. Note that you can resubmit the proposal as many times as you like before the proposal deadline (**June 30, 2011 at 15:00 UT**).

11. If you experience difficulties when trying to submit your proposal just prior to the deadline, immediately contact the ALMA Project through Proposal Submission Emergencies, a Helpdesk department available for the 72 hours before the proposal deadline.

Appendix A Capabilities for Cycle 0

A.1 Antennas

All proposers should assume that observations in Cycle 0 will utilize **sixteen fully operational antennas**.

It may be that, due to problems with the equipment or other reasons, the number of antennas available will sometimes be less than 16. In that case the ALMA support staff will endeavor to carry out observations that they believe will not be seriously affected having a slightly smaller number of antennas. The integration times or UV coverage might be increased to compensate where that is practical.

A.2 Receivers

Bands 3, 6, 7 and 9 will be available on all antennas. For all bands both linear polarizations of the astronomical signals are received and processed separately.

The receivers are based on SIS mixers and there are two types - dual-sideband (2SB), where the upper and lower sidebands are separated in the receiver and then processed separately, and double-sideband (DSB), where the sidebands are super-imposed coming out of the receiver but are separated in later processing.

The frequency ranges and receiver types are shown in Table A 1.

Band	Lower frequency [GHz]	Upper frequency [GHz]	Type
3	84	116	2SB
6	211	275	2SB
7	275	373	2SB
9	602	720	DSB

Table A 1. Properties of ALMA Cycle 0 Receiver Bands

These are the nominal frequency ranges for continuum observations. Observations of spectral lines that are within about 0.2 GHz of a band edge are not possible at present.

Water Vapor Radiometers will also be available on all antennas. Correction for phase errors due to fluctuations in atmospheric water vapor will be applied when it improves the coherence.

A.3 Array Configurations

There will be two array configurations available for Cycle 0: Compact and Extended. The Compact configuration is designed to have high brightness-temperature sensitivity and should be used for observations where extended structure is important. The Extended configuration has higher angular resolution and is more suited for the study of objects with higher surface brightness features. These configurations correspond to the following baselines:

- Compact Configuration:

    - Minimum baselines: ~18m
    - Maximum baselines: ~125m
- Extended Configuration:
    - Minimum baselines: ~36m
    - Maximum baselines: ~400m

The Cycle 0 antenna configuration files (Cyc0_comp.cfg and Cyc0_ext.cfg) can be used when simulating ALMA Cycle 0 observations with the CASA Simulator. These configuration files are already incorporated in the web-based Observation Support Tool.

The Notices of Intent for Cycle 0 indicate roughly equal levels of demand for the compact and extended array configurations offered.

The schedule that is currently foreseen for the compact and extended configurations offered for Early Science Cycle 0 is as follows:

- 30 September - 30 November 2011: Extended configuration
- 1 December 2011 - 30 January 2012: Compact configuration
- 1 February - 29 February 2012: Science shutdown over altiplanic winter
- 1 March - 30 April 2012: Compact configuration
- 1 May - 30 June: Extended configuration

This schedule takes into account scientific, engineering and operational factors. It will allow observations in all Right Ascensions for each configuration, and as a result PIs preparing Cycle 0 proposals need not be overly concerned about RA availability.

Prospective PIs are asked to note that this schedule is indicative only, and that Early Science Cycle 0 observing is being offered on a "Best Efforts" basis. The dates and even the approach may be adjusted as necessary, particularly if required to maintain progress towards the completion of the full ALMA observatory.

The properties of the two offered configurations are summarized in Table A 2.

Band	Frequency [GHz]	Angular Resolution ["]	Maximum Scale ["]	T_{bc} [mK]	Flux [mJy]	T_{bl} [K]	Field of View ["]
Properties of the Compact Configuration (baselines of ~18 m to ~125 m)							
3	100	5.3	21	0.65	0.14	0.030	62
6	230	2.3	9	1.0	0.20	0.029	27
7	345	1.55	6	1.8	0.37	0.043	18
9	675	0.80	3	15	3.2	0.27	9
Properties of the Extended Configuration (baselines of ~36 m to ~400 m)							
3	100	1.56	10.5	7.6	0.14	0.35	62
6	230	0.68	4.5	11	0.20	0.34	27
7	345	0.45	3.0	20	0.37	0.50	18
9	675	0.23	1.5	175	3.2	3.1	9

Table A 2. Properties of ALMA Cycle 0 Array Configurations

In Table A 2:

- It is important to note that all these figures are estimates based on simulations and modeling together with test data on individual sub-systems. It has not yet been possible to confirm these figures by testing at system level and until this has been done there remains some uncertainty, especially on the sensitivity values.
- "Angular Resolution" is the FWHM of the synthesized "dirty" beam for a source in the declination range 0° to -40° (outside this range of declination the beam will become somewhat elongated in the North-South direction).
- "Maximum Scale" is the largest angular scale that can be observed effectively. If the objects contain smoothly varying structures that are larger than this in both dimensions those components will be "resolved out". This is the well known "missing flux" problem intrinsic to interferometry. The limit is taken to be 0.6 x (wavelength/min_baseline) but this is only a guideline. The ALMA Compact Array and single-dish observing modes, which will be used to measure these larger scales in the future, are not available for Cycle 0.
- "T_{bc}" is the five-sigma continuum brightness-temperature sensitivity in milli-Kelvin for a 1-hour observation using the full bandwidth (i.e. 8GHz per polarization) in dual polarization mode.
- "Flux" is the five-sigma flux sensitivity in milli-Janskys per beam again for 1-hour of observing with the full continuum bandwidth in dual polarization mode.
- "T_{bl}" is the three-sigma spectral-line brightness-temperature sensitivity in Kelvin for a 4-hour observation with a 1 km/s spectral resolution in dual polarization mode.
- "Field Of View" is the nominal field of view for single-field interferometry. It is taken to be 1.2 × (wavelength/dish diameter) and is therefore close to the FWHM of the primary beam.

A.4 Correlator Capabilities

The correlator provides a set of spectral "windows" which can be used simultaneously.

For Cycle 0, up to four simultaneous spectral windows are available. The spectral windows must all have the same bandwidth and resolution.

A.4.1. Polarization

The correlator can process both polarizations or all the resources can be used to analyze a single polarization.

When a **Dual Polarization** setup is used, separate spectra are obtained for each linear polarization of the input signal. This will give two largely independent estimates of the source spectrum that can be combined to improve sensitivity.

In **Single Polarization** mode, only a single input polarization ("pol-X") is analyzed. For a given resolution, this provides $\sqrt{2}$ poorer sensitivity than the Dual Polarization case, but one can use either a factor two more bandwidth for the same spectral resolution or a factor of two better spectral resolution for the same bandwidth. Single polarization should therefore be used in cases where having a large number of spectral channels is more important than having the best sensitivity.

A.4.2. Bandwidth and Resolution

The correlator operates in two main modes - **Time Domain Mode** (TDM) or **Frequency Division Mode** (FDM).

TDM provides modest frequency resolution and produces a relatively compact data set. It should be used for continuum observations or for spectral line observations that do not require high spectral resolution.

FDM gives high spectral resolution and produces much larger data sets. It should be used for observations of spectral lines in all sources except those with very wide lines. Six FDM set-ups will be available with different bandwidths and resolutions as set out in Table A3.

A.4.3. Overview

The correlator modes offered for Cycle 0 are summarized in Table A 3.

Bandwidth (MHz)	Channel Spacing (MHz)	Number of Channels	Correlator Mode
Correlator Mode properties for Dual Polarization			
2000	15.6	128	TDM
58.6	0.0153	3840	FDM
117	0.0305	3840	FDM
234	0.061	3840	FDM
469	0.122	3840	FDM
938	0.244	3840	FDM
1875	0.488	3840	FDM
Correlator Mode properties for Single Polarization			
2000	7.8	256	TDM
58.6	0.0076	7680	FDM
117	0.0153	7680	FDM
234	0.0305	7680	FDM
469	0.061	7680	FDM
938	0.122	7680	FDM
1875	0.244	7680	FDM

Table A 3. Properties of ALMA Cycle 0 Correlator Modes

Notes for Table A 3:

- These are the figures for each spectral window and, in the case of dual polarization, for each polarization.
- The "Bandwidth" given here is width of the spectrum processed by the digital correlator. The usable bandwidth is limited to about 1875 MHz by the anti-aliasing filter, which is ahead of the digitizer in the signal path.
- The "Channel Spacing" is the separation between data points in the output spectrum. The spectral resolution - i.e. the FWHM of the spectral response function - is larger than this by a factor that depends on the "window function" that is applied to the data in order to control the ringing in the spectrum. For the default function - the "Hanning" window - this factor is 2, i.e. the effective spectral resolution will be twice the channel spacing given in Table A 3.

A.5 Observational Modes

Two observational modes are offered in Cycle 0: single field interferometry and pointed mosaics.

A.5.1. Single field interferometry

Single field Interferometry is the standard observing mode in which the antennas track a single pointing position. Observations of phase and amplitude calibrators are included as part of the observing sequence. In addition to objects with fixed RA and Dec, moving targets (including the planets, their major moons, asteroids and comets) can be observed. Observations of the Sun will, however, not be supported in Cycle 0.

A.5.2. Pointed mosaics

When observing pointed mosaics, the antennas cycle around a series of pointing positions and the interferometric data are combined in post-processing to produce a "mosaic" image. The spatial resolution and largest angular scale will be about the same as for a single field interferometry, i.e. as given in Table A 2 and Table A 3, but the mosaic image will cover a larger area. In rough terms, the field of view will be increased by a factor equal to the number of pointing positions divided by four. Since the observing time is split between the different pointing positions, the time required to reach a given sensitivity scales with the size of the field of view. There are also some overheads associated with changing the pointing positions that cause a further loss of sensitivity. In Cycle 0 this additional loss is expect to amount to about 10% for 25 points and 20% for 50 points. Mosaics with larger than 50 pointing positions will not be supported in Cycle 0.

The OT will provide the capability to set up suitable patterns of pointing positions.

A.6 Calibration

Phase calibration is essential for all interferometric observations. It is accomplished by observing suitable sources - i.e. objects that have very small angular sizes and accurately known positions. Positional accuracy of better than $1/10^{th}$ of a synthesized beam-width should be possible on sufficiently bright objects.

Absolute amplitude calibration will be based on observations of objects of known flux, principally solar system objects. It is expected that the accuracy of the absolute amplitude calibration relative to these objects will be better than 5% for Band 3. Calibration in the higher frequency bands is likely to be less accurate. The goals are: better than 10% in bands 6 and 7, and better than 20% in band 9.

The ALMA Observatory has adopted a set of strategies to achieve good calibration of the data. Requests for changes in these strategies will only be granted in exceptional circumstances and must be fully justified by the requester. Some flexibility exists in choosing the actual calibrator sources. The default option is automatic calibrator selection by the system. If users opt for providing their own calibrators, justification will be needed. This may result in decreased observing efficiency and/or calibration accuracy.

Appendix B Acronyms and Abbreviations

ALMA	Atacama Large Millimeter Array
ARC	ALMA Regional Center
ARP	ALMA Review Panel
APRC	ALMA Proposal Review Committee
AS	Academia Sinica
AUI	Associated Universities, Inc.
CASA	Common Astronomy Software Applications
Co-I	Co-investigator
EA-ARC	East Asian ALMA Regional Center
ESO	European Southern Observatory
EU-ARC	European ALMA Regional Center
JAO	Joint ALMA Observatory
NAASC	North American ALMA Science Center
NAOJ	National Astronomical Observatory of Japan
NINS	National Institutes of Natural Sciences
NRAO	National Radio Astronomy Observatory
NRC	National Research Council of Canada
NSC	National Science Council of Taiwan
NSF	National Science Foundation
OSF	Operation Support Facility
OST	Observation Support Tool
OT	Observing Tool
PDF	Portable Document Format
PI	Principal Investigator
SB	Scheduling Blocks
SCO	Santiago Central Office
ToO	Target of Opportunity

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