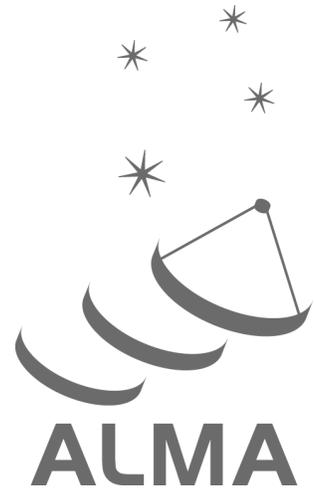


Guide to the European ALMA Regional Centre



www.almascience.org

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

User Support:

For further information or to comment on this document, please contact your regional Helpdesk through the ALMA Science Portal at www.almascience.org. Helpdesk tickets will be directed to the appropriate ALMA Regional Centre at ESO, NAOJ or NRAO.

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EUROPEAN ARC
ALMA Regional Centre

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Purpose of this document

The purpose of this document is to help users to find their way around the European ALMA Regional Centre (ARC). The European ARC is the 'one stop shop' for all European ALMA users. This document explains the ARC structure in Europe and how it can help users at the various stages of their ALMA observing project.

ALMA in a nutshell

The Atacama Large Millimetre/sub-millimetre Array (ALMA) is the leading observatory at millimetre and sub-millimetre wavelengths and will be for many decades to come. ALMA is a global collaboration involving East Asia, Europe, North America and the host country Chile. ALMA comprises 66 high-precision antennas equipped with receiver and digital electronics systems to observe in the frequency range from 30 GHz to 1 THz and at angular resolutions down to 6 milliarcsec. Using a fully dynamic scheduling system and innovative calibration strategies, the ALMA system allows observers to make the best use of the atmospheric conditions on the Chajnantor plateau at 5000 m altitude in the Atacama desert. The European contribution to ALMA is led by the European Organisation for Astronomical Research in the Southern Hemisphere (ESO) on behalf of its member states.

ALMA has performed scientific observations since September 2011, in addition to regular commissioning and science verification. Each observing period offers another opportunity for astronomers to propose science projects with ALMA. Details on the new capabilities in this cycle are given in the Proposer's Guide, available at the ALMA Science Portal at <https://almascience.org>. More information on ALMA can also be found on the Science Portal.

The ALMA Regional Centres (ARCs)

The interface between ALMA and the astronomical community is provided by the three partners through their respective ARCs. These are located at the National Astronomical Observatory of Japan (NAOJ) in Mitaka, Japan, for the East Asian partnership, at ESO in Garching, Germany, for the European partnership, and at the National Radio Astronomy Observatory (NRAO) in Charlottesville, USA, for the North American partnership. The ARCs are staffed by scientists with expertise in radio astronomy, millimetre and sub-millimetre astronomy, and interferometry, and their purpose is to work with the community of astronomers to maximise the scientific productivity of the telescope.

Organisation of the European ARC structure

The ARC structure in Europe supports the scientific use of ALMA by the European user community. The ARC forms the interface between the ALMA Observatory and the user community throughout the lifetime of a project, i.e., from proposal preparation to data analysis. In Europe, the services to the community are provided by a distributed network of ARC nodes at Bologna (the Italian ARC node), Bonn/Cologne (the German ARC node), Grenoble (the Institut de Radio-Astronomie Millimétrique (IRAM) ARC node), Leiden (the ALMA Local Expertise Group; Allegro), Manchester (the United Kingdom (UK) node), Ondřejov (the Czech node), and Onsala (the Nordic node), under the coordination of the ESO ARC in Garching.

The primary aim of the European ARC is to maximise ALMA's scientific return for European users. Each ARC node is staffed with scientists providing a range of experience in interferometry, (sub-)millimetre observing and ALMA data reduction and interpretation, as well as a range in scientific interests. The staff at the ESO ARC and the ARC nodes work together to provide optimal support to users during the complete lifetime of a project from proposal preparation, validation of the Phase 2 material, delivery of the calibrated science products to the users, and, if required, additional data reduction support, advice regarding observing strategies and they can help with ALMA archival research. The ARC network organises community days, tutorials and workshops throughout Europe to reach out to the community and to train users in proposal preparation, data reduction and scientific exploitation of the ALMA Science Archive. Several ARC nodes also supervise Master's and PhD students and give university lectures on ALMA-related topics.

The central point of contact for current and prospective ALMA users is the ALMA Helpdesk, which is available to all registered users from the *ALMA Science Portal*. There is one Helpdesk for all ALMA users, but queries from European users will be primarily handled by the European ARC, either by scientists in Garching or by staff in one of the ARC nodes. The Helpdesk includes a library of “Knowledgebase” articles that address a number of common issues and questions. If the answer is not found in the suggested Knowledgebase articles, the user can submit a ticket. During normal operations, users can expect a response within two business days. During the week prior to a proposal deadline, extra staff are assigned to the Helpdesk and every effort is made to address time-critical questions in a rapid manner.

For all ALMA questions: use the [ALMA Helpdesk](#) to contact the ARC.

Role of the central ARC and the ARC nodes

The central ARC in Garching and the ARC nodes distributed throughout Europe work together to provide optimal support to European ALMA users. It is however important to realise that the roles that the central ARC and the nodes fulfil are very different. For example, all face-to-face support, one of the core functions of the ALMA project, takes place at the ARC nodes.

The different roles of the ARC and the ARC nodes are outlined below. Note that the typical ALMA user does not need to know the specifics of how tasks are divided between the central ARC and the ARC network: All initial contacts between the user and the ARC staff happen through the ALMA Helpdesk. The ARC staff may answer the user's question immediately, refer to documentation, or forward the query to an expert within the ARC network. The ARC may advise that face-to-face help is required, or the users may indicate themselves that they need to get in touch with their Contact Scientist (CS) or request face-to-face support.

The main tasks of the central ARC, of direct relevance to ALMA users, are:

- Phase 1 operations: distribution of the call for proposals to prospective European ALMA users and user support during proposal preparation.
- Manual generation and update of Scheduling Blocks when necessary, inspection of the automatically generated Scheduling Blocks and implementation of changes following successful change requests.
- Data product support: quality assurance (QA2) of science data sets and delivery of the final raw and reduced data to the PIs.
- Delivery of calibrated measurement sets.
- Archive operations: the ESO ARC node holds a complete synchronised copy of the ALMA archive.
- Staffing of the ALMA Helpdesk.

The relevant tasks of the ARC nodes are:

- User support with proposal preparation by means of face-to-face meetings, dedicated workshops and through the ALMA Helpdesk.
- Answering user questions on technical details pertaining the scheduling and execution of the proposed observations.
- Face-to-face help with data reduction, including expert support in data processing for specialised observing techniques.
- Help in archival research, including assistance to users of the ALMA archive in identifying and using the data products suitable for their scientific projects.
- Provision of computational support for ALMA data analysis
- Support to the QA process of science data sets.

- Close interaction with the community and regular updates on ALMA (Community Days and other events, newsletter, webpages), as well as community education through workshops, lectures, tutorials, and online material.
- Outreach to the general public.

The following section describes in more detail the kind of support to be expected throughout the lifetime of an ALMA project.

How the ARC can help with your ALMA observing project

For each scheduling period, a Call for Proposals for ALMA is issued and made available on the Science Portal (<http://almascience.org>), which is then distributed among the European user community by the ESO ARC. The call provides information about the available capabilities for each cycle, necessary information for the electronic submission of proposals as well as links to documentation such as the Proposer's Guide, the ALMA Technical Handbook and the ALMA Observing Tool (OT) User and Reference Manuals, as well as the [ALMA OT video tutorials](#). For the complete list of documentation, see the relevant section on the ALMA Science Portal.

The ALMA Science Portal

All ALMA users need to register to the ALMA Science Portal. This is a single sign-on gateway to the various tools described below, the Helpdesk, the ALMA Science Archive, and other relevant information. Each astronomer who uses ALMA is assigned to a single ARC for user support at the time they register. ALMA users should have *one* ALMA account, that they should update in case any of their profile details changes (e.g. e-mail address, affiliation etc). A user's ALMA account should always reflect their current contact information. Users are furthermore expected to update their scientific expertise area, as this information is used for the distributed peer review process.

To submit a proposal, download ALMA software, or gain access to the Helpdesk, you will need an ALMA account that can be obtained by through the [ALMA Science Portal](#).

The proposal stage

The Phase 1 material of the proposals must be prepared with the ALMA OT, available from <http://almascience.org/proposing/observing-tool>. The ALMA OT requires the users to provide a scientific and technical justification, target specification, and sensitivity. The ALMA OT provides the users with time-on-target plus overhead specification, integration time estimation, transparency and atmospheric conditions, etc.

The ALMA Observation Support Tool (OST), hosted at the UK node (<http://almaost.ib.man.ac.uk/>) provides an easy web-based interface to preparing simulations. The user can upload a FITS image and 'observe' it with ALMA at different frequencies, bandwidths, configurations, integration times and weather conditions. The results are images as ALMA would produce them, together with point spread functions and maps of the *uv*-coverage. This information can help users in planning their ALMA observations.

Use the [ALMA OT](#) to prepare your proposal. Need help? Use the [Helpdesk](#) to contact the ARC.

More experienced users may want to use simulation capabilities included in the Common Astronomy Software Applications (CASA) data reduction package, which have more flexibility. For more details see <http://casaguides.nrao.edu>.

Staff at the European ARC network assist users with the preparation of their Phase 1 material. This assistance covers help with the ALMA OT, the ALMA exposure time calculator and the simulator. Staff are also available for consultation regarding observing strategies and the dual anonymous and distributed peer review procedure.

Need help with proposal submission? Use the [Helpdesk](#). Need face-to-face help for preparing a complicated proposal? Use the [Helpdesk](#) to coordinate a visit to an ARC node.

Users may also choose to visit an ARC node for face-to-face support during proposal preparation.

After the submission deadline, all proposals that request less than 50 hours on the 12-m Array and/or less than 150 hours on the Atacama Compact Array (ACA), also known as the Morita Array, will go through the distributed peer review process. Large programs will be reviewed by a panel of experts. A recommendation on the scheduling of ALMA projects for the coming period is made to the ALMA director by the ALMA Proposal Review Committee (APRC) based on the outcome of the distributed peer review process and the ranking of the Large Programs by the panels.

Phase 2 and the preparation of scheduling blocks

PIs are responsible for correctly providing all necessary information when submitting the proposal to successfully schedule the requested observations. PIs who are preparing a proposal and are unsure if they have listed all necessary information correctly are encouraged to get in contact with a node for support.

Immediately after the outcome of the proposal review process, the Scheduling Blocks (SBs) of accepted programs will be automatically generated by the observatory and will be placed in the observing queue for scheduling and eventual execution. The Phase 2 team will make sure all SBs will run smoothly at the telescope (e.g. check calibrator variability, target proper motion). In case a PI of an approved proposal realises that a change to the program is needed, they can consult with the CS whether a change request should be submitted or if a small change can be implemented by the Phase 2 team directly. PIs are encouraged to check, before their project can first be scheduled on the telescope, if any alterations are needed.

The SBs can be executed at any time without further intervention from users, CS or ARC staff. If a problem is found at run-time, execution of the SB is halted. The Phase 2 team at the ESO ARC will fix the problem and the affected SBs are put back in the queue for scheduling.

Tracking your project

The Snooping Project Interface (SnooPI) allows PIs, Co-Is and Data Delegates to follow the status of their ALMA observing projects. It allows users to search for their active projects and get an overview of the SBs that have been observed (including QA0+ reports), those in the queue, those that are under processing, etc.

Follow project progress with [SnooPI](#), which is available on the Science Portal under the 'Observing' menu.

After data have been taken

ALMA observing projects are dynamically scheduled, taking into account weather conditions, the configuration of the Array, the proposal ranking and other constraints. After the observations for a project have been completed, users are notified by email. Note that B- and C-rated projects will not be carried over to the next cycle when not completed, while A-rated projects will automatically be carried over, for one cycle. Accepted proposals under Director's Discretionary Time (DDT) will stay in the queue for the 365 days following their approval.

All data pass through a multi-tier quality assurance (QA) scheme before they are released to the user. ALMA data sets can vary enormously in size depending on correlator settings, averaging times and total integration time. Data size may range from tens of GB for the shortest observations to many TB for lengthy projects. Users can download the data from the ALMA archive. The download of data that are under proprietary time requires authentication by the PI or a data delegate.

It is important to realise that *all* ALMA data are kept in the archive. All requests for data of any observing program are handled through this archive. This [ALMA Science Archive](#) is accessible through the Science Portal.

PIs can request through the [ALMA Science Portal](#) ([Click on Data and then Request raw data](#)) that their QA0 raw data should be staged for download as soon as they are available (i.e. before the full QA2 products are ready). The proprietary period for the entire Member Observing Unit Set (MOUS) will start after the raw data from the first Execution Block (EB) in the MOUS have been made available to the PI. The release of raw data to the PIs will have no implications on the QA2 process. The access of QA0 raw data replaces the previous stale data and early release of target of opportunity (ToO) and time critical data policies, but with immediate start of the clock for the proprietary time of the respective MOUS the raw data belongs to.

The data reduction workflow

When a MOUS for a particular program has been observed, the observing mode is checked to confirm that the data can be reduced by the ALMA Data Reduction Pipeline and, if so, the ALMA Data Reduction Pipeline is activated. Note that, calibration is performed manually only for a few observing modes (e.g full polarization, solar data and very long baseline interferometry). The ALMA Pipeline runs on dedicated machines in Chile and in the ARCs and it uses a heuristics system to automatically flag, calibrate, and image data. The ALMA Pipeline heuristics have incorporated the acquired knowledge on ALMA data analysis for decision making into the reduction scheme. The output of the ALMA Pipeline is stored in the ALMA Science Archive. Before the reduced data of European projects are made available to the user, a quality assurance of the second level (QA2) is performed by staff at the European ARC or at Joint ALMA Observatory (JAO), including the review of the diagnostic information stored by the ALMA Pipeline (and subsequent triggering of reprocessing with additional flagging if necessary).

Data reduction support

The ALMA Pipeline produces high quality science products. Expert hands-on help with data reduction may be required however, especially when more complicated observing techniques are used. The ARC is the primary contact point for users who need assistance with data reduction. ARC staff provides basic data analysis support, ranging from simple advice, to providing appropriate data analysis documents and products, to detailed assistance for users who require it.

The primary responsibility of the ESO ARC is to ensure that the reduced data from all ALMA observing modes meet the requirements set by the approved observing proposal. The ARC nodes can provide further assistance to users who require it. A likely scenario may be the following: the ALMA Pipeline has processed a user's data set. If the data meet the requirements defined in the proposal, the data are delivered to the user. However, the user may wish to make images with a different weighting scheme to achieve a higher spatial resolution or higher sensitivity. The ARC nodes can help to reprocess the data, using different weighting schemes at the imaging stage. Another user may need higher dynamic range image cubes and can work with an ARC node to apply self-calibration to the data. For the use of non-standard analysis techniques and the utilisation of the advanced algorithms and software developed by a specific ARC node, ALMA users may also arrange a visit to this ARC node, where the best possible support can be provided.

*Basic data reduction support: use the [Helpdesk](#).
Advanced data reduction support: visit an ARC node (use the [Helpdesk](#) to coordinate a visit).*

The ARC nodes provide the latest (or any relevant) version of CASA, installed on high performance workstations with ample disk space. For any first line CASA support, please visit the CASA Guides website at <https://casaguides.nrao.edu>.

Calibrated measurement sets

Scientists can request calibrated data products, that will be generated using the calibration scripts in the ALMA Science Archive. These requests are done through the ALMA Helpdesk: select Archive and Data Retrieval department followed by the "Data request" sub-category. Per ticket, scientists can request the calibrated data for up to 10 datasets (MOUSs), after which scientists in the ARC will stage the calibrated data products for download for a period of up to 21 days. The service is open both for ALMA PIs or Delegees with proprietary ALMA data and for archival users wanting to use datasets for which the proprietary time has expired. More information is provided at [this link](#).

Calibrated measurement sets can be requested through the [Helpdesk](#). More information is given at [this link](#).

Additional help from the European ARC

Archive research support

A complete, synchronised mirror of the ALMA archive is kept at ESO and is a valuable resource for data mining. Assistance for archive research encourages broader approaches to scientific investigations. Therefore, scientists in the ARC nodes offer support for astronomers accessing the ALMA science archive. The ALMA Science Archive is available through the User Portal.

*Basic archive research support: use the [Helpdesk](#).
Advanced archive exploitation support: visit an ARC node (use the [Helpdesk](#) to coordinate a visit).*

Prospective ALMA users are likely to want to consult the Archive when planning observations as well as for data mining. To ensure that the archive (and ALMA) is exploited to its full potential, ARC network staff can assist users in using the archive. This includes face-to-face visits. Note that only PIs and Data Delegates can access data from projects that are still within their proprietary period.

The ARC network can also help users extract information effectively (such as potential calibration source properties, or whether there are public domain data matching the required criteria) as well as assist with analysis of archive data.

Users can inspect data in the archive directly from their browser using CARTA (Cube Analysis and Rendering Tool for Astronomy), a next generation image visualization and analysis tool designed among others for ALMA. All image products ingested into the archive are directly accessible for investigation with CARTA through the ALMA request handler.

Need training?

The European ARC regularly organises workshops, tutorials and schools related to ALMA. Dedicated CASA data reduction tutorials are held throughout Europe, as well as sessions describing the ALMA OT and more general workshops explaining the current ALMA capabilities. These general workshops include for instance the [ALMA Archive school](#) and [ALMA school](#) organized by the European ARC network. Additionally, the European ARC network offers online video tutorials and training sessions such as the regular series of Interactive Training in Reduction and Analysis of Interferometric data ([I-TRAIN](#)) and the [ALMA explained](#) series of 3-minute videos with the purpose of introducing and explaining ALMA and basic interferometry principles to non-experts.

Need information on upcoming ALMA related tutorials and workshops? Check the [European ARC announcements](#) or subscribe to the mailing list of your local ARC node.

Promotion of ALMA science in Europe

The European ARC network organizes several events to promote ALMA science in Europe and stimulate the communication between European ALMA users. These events include for example science days and workshops organized by individual nodes and network-wide activities such as the '[Unveiling ALMA Band 2 workshop](#)'.

The European ALMA newsletter and announcements provide a list of all scheduled training and science activities and the mailing lists of the ESO ARC and the local nodes are used to disseminate this information.

General questions

For any general questions related to ALMA capabilities, availability of observing modes, or other relevant topics, please use the Helpdesk.

Any questions related to ALMA: use the [Helpdesk](#)

How to organise a face-to-face visit

The preferred way to obtaining any type of support is through the ALMA Helpdesk: select “Face to Face Visit”. To easily identify the requested support and make the most of the face-to-face visit the user should give as much information as possible on the purpose of the visit and the proposed node and dates when submitting the ticket.

Support staff at this node are responsible for arranging the details of the visit. Each visitor is assigned a dedicated member of staff for support purposes and can expect that this support person will be able to respond as quickly as possible to their requests for help, within reason.

Depending on the exact request for support, users either visit their local ARC node or the node that has the best specialist knowledge to support the user (to be determined by the user and the ARC (node) staff). Users can request a face-to-face visit regardless of the existence or not of a local node.

ALMA data reduction will normally be performed using dedicated computing facilities such as those provided by the ARC nodes. The data volumes are too large for laptops in most cases, except for the later stages of image or spectral analysis, possibly using subsets of the data. Please consult ARC staff if you want to use your laptop.

To organise a face-to-face visit: use the [Helpdesk](#)

To ensure data are downloaded locally and ready for the PI, the PI must give explicit permission for processed and raw data to be downloaded from the ALMA Science Archive by the ARC node staff via the “Project delegation” tab in their ALMA Science Portal User Profile. ARC nodes provide facilities for the user to copy data onto a hard disk drive. Data backup should be discussed prior to the visit, so that the user can bring appropriate storage devices. Some nodes can also support ftp of data provided the link at the user's home institute is fast enough.

ARC nodes keep a copy of the data the user has been working on for at least a few weeks after the end of the user's visit. This enables the node staff to address any post-visit questions which may arise.

The ARC nodes

Each node has its own area(s) of expertise. Users are encouraged to visit the individual ARC node web pages to obtain the most up-to-date information. Most ARC nodes also maintain email lists that are used to inform their local communities about activities and region-specific news items.

The Italian node in Bologna

The Italian ARC node is hosted by the INAF-Istituto di Radioastronomia in Bologna. Support is offered with proposal preparation and submission, tracking of accepted ALMA projects, data reduction with CASA, and with ALMA archive mining, polarimetry and VLBI with ALMA, our three areas of expertise.

Visit the Italian ARC node at <https://arc.ira.inaf.it>

The Italian ARC node also investigates new techniques of data reduction and handling and is heavily involved in the development of the ALMA science data archive. It organizes seminars, tutorials and workshops to inform and train the Italian community and to stimulate scientific discussion and collaborations. ARC personnel are involved in teaching and supervising students.

Multi-wavelength research, especially through the use of archives, is becoming more and more requested. The Italian ARC node therefore also offers assistance with reduction and analysis of data taken with other interferometers.

The Italian ARC node researchers are involved in several (sub-)millimetre scientific projects covering different topics (from galactic and local-Universe studies to high-redshift galaxies and cosmology) and offer general scientific support on their specific area of expertise for continuum and spectroscopic observations.

At the host institute, the ARC node can accommodate visitors for face-to-face support and visits. Visitors can connect to a dedicated computer server, to access the data and run the CASA data reduction software.

The ARC node is connected to the outside world through a high-speed optical fibre network, allowing fast data transfer (10 Gbit/sec). Outside users of ALMA and CASA can access the ARC node cluster facilities for a certain period of time.

The Dutch node in Leiden: Allegro

Allegro, the ARC node in the Netherlands, is located at Leiden Observatory. The node employs approximately six postdocs and staff members who coordinate the node's activities. Allegro provides general user support for the ALMA community and offers expert help on high-frequency and long-baseline ALMA observations, mm-VLBI observations, and science analysis tools.

Visit the Dutch ARC node at www.alma-allegro.nl

The Allegro node supports users in all the steps, from ALMA proposal preparation through data delivery and data analysis. We offer assistance tailored to the needs of the user and organise activities for our user community. Allegro has guest desks available for visitors, who can make use of the dedicated high-performance computing facilities and connected fast-access storage system. Computing and data storage facilities can also be accessed remotely from users' home institutes.

Allegro also contributes to the progress of the field within its own expertise areas. The node hosts expert knowledge in high-frequency and long-baseline observations with ALMA. By investigating techniques to overcome the impact of atmospheric effects, such as water vapour fluctuations, we drive ALMA towards reaching its full potential at the highest possible resolution and frequencies. The team has also partnered with the mm-VLBI group at Radboud University to develop Very Long Baseline Interferometry with ALMA, offered since Cycle 4 with the Global Millimetre VLBI Array (3 mm) and the Event Horizon Telescope (1 mm). In addition, Allegro develops science analysis tools, like ARTIST/LIME, to assist scientists in the analysis and interpretation of their observations.

The German node in Bonn/Cologne

The German ARC node is a collaboration between the astronomical institutes at the universities of Bonn and Cologne. The node's main facilities are located at the Argelander-Institut für Astronomie in Bonn, right next to the Max-Planck-Institut für Radioastronomie and a 30-minute commute from the University of Cologne. A number of staff members and postdocs are associated with the ARC node, working on various support tasks. The node maintains and continuously extends the Cologne Database for Molecular Spectroscopy and offers a number of advanced data analysis and modelling tools developed in-house.

Visit the German ARC node at astro.uni-bonn.de/ARC

Visitors to the German ARC node are welcome to use the spacious ARC node visitors' room equipped with workstations, switches for laptops and video conference equipment, and a parent-child office, located next to the ARC node visitors' room. Three high-performance compute servers dedicated to ALMA-related work run all the latest ALMA software necessary for the proposal stage, data calibration and imaging and analysis, and for ALMA archive searches.

In addition to user support, development projects and services to ALMA operations, the German ARC node reaches out to the local community with annual community meetings, a local newsletter and talks at seminars and conferences. The node's training opportunities include an annual comprehensive (remote) lecture series on radio astronomy, a self-study hands-on CASA tutorial and ALMA OT tutorials. In addition, some members of the ARC node participate actively in general public outreach and education.

The IRAM node in Grenoble

IRAM (Institut de Radio-Astronomie Millimétrique) is an international institute supported by the Max Planck Society (Germany), the Centre National de la Recherche Scientifique (CNRS, France), and the Instituto Geográfico Nacional (IGN, Spain). The institute operates the 30-m Pico-Veleta antenna and the Northern Extended Millimeter Array (NOEMA) mm-interferometer.

Visit the IRAM ARC node at <https://iram-institute.org/science-portal/arc-node/>

The IRAM ARC node activities are built on the in-house experience with user support and on the involvement of the institute in the ALMA design and construction phases (e.g. the development of the ALMA real-time Telescope Calibration software). The face-to-face support for ALMA uses the same procedures and infrastructures as those used for the NOEMA support. A computer room dedicated to data reduction is available and each project is assigned to a local contact. The IRAM ARC node provides a good opportunity to use synergies between the IRAM instruments and ALMA, as, e.g. an access to the full sky for interferometric observations or to large-scale surveys with the 30-m antenna.

Funding is available for travel and accommodation, with the usual IRAM rules: one mission/one person per project. Funding is however limited to astronomers affiliated to one of the IRAM funding agencies.

The Nordic node in Onsala

The main mission of the Nordic ARC node is to provide full support for ALMA users in Sweden and other Nordic and Baltic countries. The Nordic node employs experienced millimetre wave observers and IT support. The node is physically located at Onsala Space Observatory (OSO) near Gothenburg, Sweden. OSO is the Swedish National facility for Radio Astronomy and is hosted by Chalmers University of Technology. OSO has a long history in millimetre/sub-millimetre astronomy and presently runs the 20-m single-dish telescope at Onsala and is a collaborator of the Atacama Pathfinder Experiment (APEX) sub-millimetre single-dish telescope at the ALMA site in Chile.

Visit the Nordic ARC node at www.oso.nordic-alma.se

Nordic ARC node services include e.g. face-to-face support for ALMA proposal preparation, project follow-up, data reduction and analysis as well as access to archives. The node has expertise in the areas of astrometry, self-calibration, multi-frequency synthesis, deconvolution algorithms, visibility fitting and polarisation. The node also maintains several advanced data analysis packages. The Nordic node is also active in community outreach and organises meetings and training events for the whole Nordic community.

The ARC node has high capacity data links for downloading archival data and high performance computer facilities to support ALMA data reduction. The node offers flexible face-to-face support in any combination of on-site visits and remote support. There is ample dormitory and guest room accommodation on-site to support data reduction visits and small workshops. No local funding for travel and accommodation is available.

The UK node in Manchester

The UK ARC Node is centrally located at the University of Manchester, Jodrell Bank Centre for Astrophysics, conveniently placed for all national and international transport links and high-speed internet connectivity. UK ARC node staff (plus IT support) divide their time between face-to-face user support and related research and development. Facilities for visiting astronomers include desk space and workstations for short- or long-term visitors. Absolute beginners or experts are welcome and resources can be made available by arrangement for teams working on ALMA projects with demanding computational and skills requirements.

Visit the UK ARC node at <http://www.alma.ac.uk>

The UK ARC Node draws on local and national expertise to offer specialised assistance in a number of areas:

- Interferometry skills, in particular advanced calibration, extended array configurations (high resolution), wide-band high-sensitivity continuum imaging (multi-frequency synthesis), mosaicing and wide-field imaging (including combining ALMA configurations to improve image fidelity), and polarimetry.
- Multi-instrument research, in particular comparing data from different telescopes, (e.g. JCMT, e-MERLIN, EVN, JVLA, NOEMA, SMA and JVLA) combining ALMA and compatible data, and interoperability between CASA and other software. The UK ARC Node is part of the Centre of Excellence for Radio Astronomy (CERA) which provides support for these instruments, others such as LOFAR and prospective SKA users.
- Data management, in particular data mining the ALMA Archive, development of pipelines and scripts for large projects, standards and documentation for data publication.
- Simulations using the OST (<https://almaost.jb.man.ac.uk/>) or inside CASA: choosing suitable input images, estimating the brightness on ALMA scales and so on.

The Czech node in Ondřejov

The Czech node is hosted by the Astronomical Institute of the Czech Academy of Sciences, which is based at the Ondřejov Observatory and in Prague. Its primary mission is to provide user support to the ALMA community in Central and Eastern Europe. In addition, the node has unique expertise in solar observations with ALMA and therefore offers specialized support for solar projects to users across all of Europe.

Visit the Czech ARC node at www.asu.cas.cz/alma

The node team provides both face-to-face and remote support covering all stages of ALMA projects and related (sub-)millimetre and radio facilities. This includes assistance with proposal preparation and submission, ALMA Archive mining, data calibration and imaging, data combination and visualization, and interpretation of observations. In parallel with user support, the team actively contributes to the technical development of ALMA.

Both the Ondřejov and Prague sites offer visitor offices and access to a high-performance computing cluster, as well as possibilities for on-site accommodation. A dedicated ARC office equipped with workstations is located in Ondřejov, hosting the solar section of the node. Visitors may apply for local support for travel and accommodation.

Expertise Areas of the Czech Node include:

- Solar ALMA Observing Mode and Solar Physics: Advanced manual calibration and time-domain imaging of solar data, including self-calibration and imaging of time-series visibilities; high-resolution solar interferometry; interferometric/total-power data combination; and development of solar observing modes. Solar science expertise includes non-local thermodynamic equilibrium radiative transfer and the physics of prominences, filaments, and flares.
- Galactic and Extragalactic Astrophysics: Galaxy evolution in the field, groups, and clusters; star formation; active galactic nuclei; and studies of the Galactic Centre.
- Laboratory Astrophysics and Molecular Spectroscopy: High-resolution microwave laboratory spectroscopy of small molecules, in collaboration with the University of Chemistry and Technology in Prague.



The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership of the European Organisation for Astronomical Research in the Southern Hemisphere (ESO), the U.S. National Science Foundation (NSF) and the National Institutes of Natural Sciences (NINS) of Japan in cooperation with the Republic of Chile.

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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.

