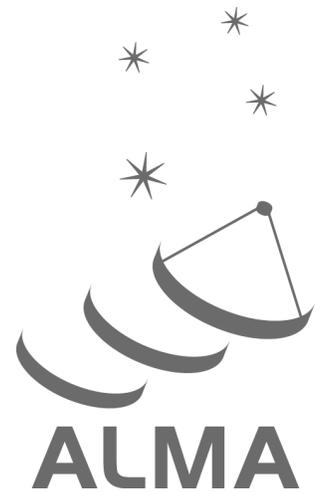


Guide to the European ALMA Regional Centre



www.almascience.org

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.

Revision History:

Version	Date	Editors
1.0	25 February 2011	Martin Zwaan
2.0	25 May 2012	Martin Zwaan, Evanthia Hatziminaoglou
3.0	14 October 2013	Martin Zwaan
3.1	23 July 2014	Martin Zwaan, Evanthia Hatziminaoglou
4.0	12 March 2015	Martin Zwaan, Evanthia Hatziminaoglou

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EUROPEAN ARC
ALMA Regional Centre

In publications, please refer to this document as:

Martin Zwaan & Evanthia Hatziminaoglou, 2015, Guide to the European ARC, Version 4.0, ALMA

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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 how the ARC structure works and how it can help users at the various stages of their ALMA observing project.

ALMA in a nutshell

The Atacama Large Millimetre/submillimetre Array (ALMA) is expected to be the leading observatory at millimetre and submillimetre wavelengths in the coming decades. ALMA is a global collaboration involving East Asia, Europe, North America and the host country Chile. When completed, ALMA will comprise at least 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 will allow 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 the ALMA project is led by ESO on behalf of its member states.

ALMA has performed scientific observations since September 2011 in the form of proposal-based "Early Science Projects", in addition to regular commissioning and science verification. The upcoming observing period now offers another opportunity for astronomers to propose science projects with ALMA. In the call for proposals for the current cycle the following capabilities are offered: thirty-six 12-m antennas in the 12-m main array and ten 7-m antennas in the Atacama Compact Array (ACA, also called the Morita Array) plus two 12-m antennas for single-dish observations; seven frequency bands (3,4,6,7,8, 9, and 10, covering wavelengths from about 3.1 to 0.35 mm) and maximum baselines from 160m to about 10km. The capabilities of ALMA will gradually improve during the next Cycles and we currently expect that the ALMA baseline project will be completed and in Full Science Operations by the second half of 2015. More details on the capabilities of ALMA during Early Science are given in the Proposer's Guide, available at the ALMA Science Portal at <http://almascience.org>. More information on the ALMA project 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 the ALMA Regional Centres (ARCs). These are located at NAOJ in Mitaka, Japan, for the East Asian partnership, at ESO in Garching, Germany, for the European partnership, and at NRAO in Charlottesville, USA, for the North American partnership. The ARCs are staffed by scientists with expertise in radio astronomy, millimetre and submillimetre 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, Bonn/Cologne, Grenoble, Leiden, Manchester, Ondrejov, and Onsala, as well as an ALMA Centre of Expertise (CoE) in Lisbon, 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-)mm observing and ALMA data reduction and interpretation, as well as a range in scientific interests. The staff at the ESO ARC, the ARC nodes and the CoE work together to provide optimal support to users during the complete lifetime of a project from proposal preparation, choice of observing modes, preparation of the scheduling blocks (SBs), delivery of the calibrated science products to the users, and, if required, additional data reduction support. Furthermore, the ARC can give advice regarding observing strategies and 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 and data reduction.

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 addressed by the European ARC, either by scientists in Garching or by staff in one of the ARC nodes. The Helpdesk includes a library of “Knowledge-base” articles that address a number of common issues and questions. If the answer is not found in the suggested knowledge-base 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 will be assigned to the Helpdesk and every effort will be made to address time-critical questions in a rapid manner.

For all ALMA questions: use the ALMA Helpdesk to contact the ARC. The Helpdesk is available through the [ALMA Science Portal](#).

Role of the central **ARC**, the **ARC nodes** and the **CoE**

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, the nodes and the CoE fulfil are very different. All face-to-face support, one of the core functions of the ALMA project, takes place at the ARC nodes and the CoE.

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 nodes.

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 nodes network. The ARC may advise that face-to-face help is required, or the users may indicate themselves that they need face-to-face support.

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

- Phase I operations: distribution of the call for proposals to prospective European ALMA users, user support during proposal preparation as well as assistance in coordinating the refereeing process and in assessing the technical feasibility of the proposals.
- Phase II operations: assisting users with the preparation of the technical details required to schedule and execute the proposed observations, and validation of Phase II material.
- Data product support: delivery of the final raw and reduced data to the PIs.
- Archive operations: the ESO ARC node holds a complete synchronised copy of the ALMA archive.
- Running the ALMA Helpdesk.
- Community development and outreach.

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.
- Phase II operations: one-on-one advice by a contact scientist for each ALMA project.
- 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.
- facilitate science coordination between ALMA users, i.e. providing space for small meetings, putting people with similar interests in contact if mutually desired etc.
- Community preparation through lectures, tutorials, etc.
- Close interaction with the community and regular updates on ALMA (Community Days and other events, newsletter, webpages).
- Outreach to the general public.

The ALMA Centres of Expertise:

European ALMA Centres of Expertise are a recent addition to the European ALMA support structure. A CoE has a temporary status and will eventually acquire the status of full ARC node, once the local ALMA expertise has matured. The tasks of the CoEs are similar to those of the ARC nodes, with the exception that they do not provide contact scientists or face-to-face support for data reduction. Once a CoE becomes an ARC node, its role and responsibilities will fully align with those of the other ARC nodes.

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. The ESO ARC distributes this call among the European user community by email and makes it available on the ALMA Science Portal (<http://almascience.org>). The call provides information about the available capabilities for each Cycle and necessary information for the submission of electronic proposals.

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 a single ARC for user support at the time they register.

To submit a proposal, download ALMA software, or gain access to the Helpdesk, you will need to register with the [ALMA Science Portal \(almascience.eso.org/\)](http://almascience.eso.org/).

The proposal stage

The Phase I material of the proposals must be prepared with the ALMA Observing Tool (OT) which is provided by the Joint ALMA Office (JAO) in Chile and is available from the ALMA Science Portal, section "Documents & Tools". The OT allows the users to provide a scientific and technical justification, target specification, time-on-target plus overhead specification, sensitivity and integration time estimation, transparency and atmospheric conditions, etc.

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

The ALMA Observing Support Tool (OST), hosted at the UK node (<http://almaost.jb.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.

More experienced users may want to use simulation capabilities included in the CASA data reduction package, which allow for more flexibility. For more details see <http://casaguides.nrao.edu>.

Staff at the ESO ARC and the ARC nodes assist users with the preparation of their Phase I material. This assistance covers help with the Observing Tool, help with the ALMA exposure time calculator and simulator. Staff are also available for consultation regarding observing strategies.

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 are ranked by the Proposal Review Committee (PRC), which makes a recommendation to the ALMA director on the scheduling of ALMA projects for the coming period. Note that there is only one international proposal review committee for all ALMA proposals.

The preparation of Scheduling Blocks (SBs)

Users with newly approved observing projects are notified by email and assigned to a Contact Scientist (CS) from an ARC node, who will open a Helpdesk ticket on behalf of the PI. The CS will work with the PI and the Phase II team at the ESO ARC in Garching to create the Scheduling Blocks (SBs), which are required to execute observations and to make sure they are in agreement with the science goals and are technically feasible. The SB is the smallest (indivisible) unit in ALMA observing that can be scheduled independently, and contains a full description of how the science and the calibration targets are to be observed, and how sets of the data from executions of linked sets of SBs can be combined. SBs also ensure that information required for the processing of data after observation is passed to the pipeline, ultimately providing images.

For each scheduling batch there will be a Phase II completion deadline communicated to the PIs. Phase II projects not successfully submitted before this deadline will not be executed. There are multiple scheduling batches within each observing cycle; projects not completed in the batch for which they are first listed are still eligible for the rest of the observing cycle, depending on configuration.

At present, the Phase II team prepare SBs, incorporating any stipulations from the Time Allocation Committee, using current best practice for observing (since array performance is still improving during each observing cycle). The PI is notified when SBs are ready for approval and the CS will draw attention to (and, if necessary, explain) any significant issues so that the PI can check the SBs and the requested positions, velocities and frequencies. Minor mistakes can be corrected or improvements implemented if the ARC review process reveals a better way to execute the program. Major changes, which might change the scientific content of the program, need special permission and should be requested via a special Helpdesk ticket.

Once all Phase II material is approved by the PI and technically validated, it will be passed for release to ALMA operations in Chile for scheduling and eventual execution. No further alterations can be made without special approval, obtained via Helpdesk in consultation with the CS. Note that observers do not travel to Chile or elsewhere to take part in the observations - all ALMA observations are scheduled dynamically.

Verified 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 and all associated SBs (i.e., the whole project) is halted. The ESO ARC and the CS then work with the user to fix the problem. Once the problem is resolved, the SBs are re-released for scheduling.

Need help with Scheduling Block preparation? Contact the ARC through the [Helpdesk](#). Need face-to-face help for preparing Scheduling Blocks? Use the [Helpdesk](#) to coordinate a visit to an ARC node.

Please note that in general the CS and PI should check the SBs as rapidly as possible to avoid any delays. The PI can ask for Helpdesk tickets to be copied to a Co-I if they are likely to be unavailable at the required time. However, if for example the weather changes, there may be a delay before conditions are suitable for observations. The Phase II staff and CS are responsible for checking for potential problems (e.g. calibrator variability, target proper motion).

Tracking your project

The online Project Tracker allows PIs and those authorised by them to follow the status of their ALMA observing projects after the project is accepted and scheduled for observing. The project tracker allows the PI and Co-Is to search for their active projects and get an overview of the SBs that have been observed, those in the queue, those needing additional work, etc. When problems arise during the execution of scheduling blocks, users are notified by email after QA2 (see below), and problems are logged in the Project Tracker as well. Note that the Project Tracker is not functional for Cycle 0 projects.

Follow project progress with the [Project Tracker](#) tool, 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 possibly other constraints. Short projects may be observed within one day,

whereas others may take several weeks or months to complete. After the observations for a project have been completed, users are notified by email. Note that during Early Science projects will not be carried over to the next cycle when not completed.

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 many Tb for lengthy projects to tens of Gb for the shortest observations. Depending on the data volume, users can download the data from the ALMA archive, or may request to receive the data on hard disk drives.

The ALMA Science Archive is available through the [Science Portal](#).

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.

The data reduction pipeline

When a block of data for a particular program has been observed, the ALMA data reduction pipeline is activated. This pipeline runs on dedicated machines in Chile and uses a heuristics system to automatically edit, calibrate, and image data taken with the standard observing modes. The pipeline heuristics have captured the knowledge of experienced radio interferometer users and incorporated it into the reduction scheme. The output of the data reduction pipeline is stored in the ALMA Science Archive and is subject to a final Quality Assurance test (QA2) before the reduced data are made available to the user. The Project Tracker can be used to explore which parts of your observing program have been fully pipeline processed.

Pipeline calibration has been fully commissioned for most observing modes employed in previous cycles but about 25% of observing time will still be calibrated manually using standard scripts (e.g., high frequency bands, long baselines, full polarisation). Pipeline imaging will still be under commissioning for Cycle 3. The data processing will be done using a combination of the pipeline and by-hand analysis using CASA.

Data reduction support

The data reduction pipeline produces high quality science products for most standard observing modes. 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 provide 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 ESO ARC's primary responsibility is to ensure that the reduced data from all standard ALMA observing modes meet the requirements set by the approved observing proposal and those specified by the Quality Assurance procedure.

The ARC nodes can provide further assistance to users who require it. A likely scenario may be the following: The ALMA data reduction pipeline has processed a user's data. In order for the user to reach their specific science goals however, they may need images with higher spatial resolution or higher sensitivity. The ARC nodes can help to reprocess the data, using different weighting schemes in 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 nonstandard 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. For any first line CASA support, please visit the CASA Guides website at <http://casaguides.nrao.edu>.

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 ARCs provide support for astronomers accessing the ALMA science archive. The ALMA Science Archive is available through the User Portal.

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 node or CoE staff can assist users in exploiting the archive. This includes face-to-face visits. Note that only PIs and Co-Is can access projects completed within the last 12 months.

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

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

Users are encouraged to contribute advanced data products back to the archive; such requests for ingestion are coordinated by ESO.

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 Observing Tool and more general workshops explaining the current ALMA capabilities. The ESO ALMA webpages provide a list of all scheduled activities and the mailing lists of the ESO ARC and the local nodes are used to disseminate this information.

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

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 “Submit a Ticket”, then “Face to Face Support (EU)”). In the Helpdesk ticket and in order to make the most of the visit to an ARC node or CoE, the user should give as much information as possible on the purpose of the visit and the proposed node and dates.

Together with the staff at the ARC network, it is decided which node the user should visit and on which dates. 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.

Users normally visit their local node. If there is no ARC node associated with the country where the user is working, or if the user and the ARC (node) staff decide that specialist support is best provided by another node, or if there are other compelling reasons, a visit to another node can be organised.

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 data. Please consult ARC staff if you want to use your laptop.

To organize 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. 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 providing 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.

After a visit, the user is requested to submit a feedback form on the service received, indicating, among other things, whether the goals of the visit were met.

Funding for visits

It is foreseen that most users will apply for funding from their local agencies for travel to one of the ARC nodes or CoE. Some ARC nodes have access to funds for visiting scientists. Please check the details in the next section, or visit the ARC node web pages. Funding is also available through the RadioNet3 MARCUs (Mobility for ARC Users) networking activity, until the end of 2015. Requests for MARCUs funding should be sent via [this form](#).

Need funding to travel to an ARC node? You may be eligible for funding through the RadioNet program MARCUs.

The ARC nodes and CoEs

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 is hosted by the Istituto di Radioastronomia in Bologna. The node currently employs two staff members and five postdocs, experts in mm-astronomy and/or interferometry, and has the support of a dedicated system manager. Support is offered with the use of ALMA tools for proposal preparation and submission, tracking of accepted ALMA projects, data reduction with CASA, ALMA archive mining, and the special areas of polarimetry and the handling of large datasets. This is mostly done via face-to-face visits or Helpdesk tickets.

The Italian ARC is also developing new CASA tasks, and investigates new techniques of data reduction and handling. It publishes a bimonthly newsletter and organises seminars, tutorials and workshops to inform and train the Italian community and to stimulate scientific discussion and collaborations. ARC personnel is involved in teaching and supervising students.

The Italian ARC researchers are involved in several (sub-)mm 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.

Visit the Italian ARC node at www.alma.inaf.it

At the host institute, the ARC node offers fully equipped office space where it can simultaneously accommodate two (or more) visitors for face-to-face support and visits. Visitors are provided with desktop computers (or laptop sockets), directly connected 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). The node exploits 80 Tb of disk space, one 12-blade cluster (96x2.1-GHz cores and 8Gb

RAM) and an additional 1-blade unit (4x2.8-GHz cores and 16Gb RAM), dedicated to its activities. ALMA and CASA users can access the ARC node cluster facilities and 1 Tb of disk space for a period of three months after their face-to-face visit. On request, access can be extended to longer periods.

No local funding is available for visitors but eligible visitors can apply for MARCUs support.

The Dutch node in Leiden: Allegro

Allegro, the ARC node in the Netherlands, is located at Leiden Observatory. The node employs 2-3 postdocs and two staff members who coordinate the node's activities.

Allegro provides general face-to-face support. Allegro also offers expert advice on high-frequency observing (roughly speaking bands 8, 9, and 10) including proposal planning, setup of observations and calibration strategies, reduction techniques, and data analysis. In addition, Allegro offers help in using radio-techniques for wide-field imaging, and hosts a large suite of data analysis tools that can be consulted on-line or in person.

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

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 also close to the University of Cologne. Six staff and five postdocs are associated with the ARC node, working on various support tasks. Areas of special expertise are the combination of interferometric data with single-dish data, polarimetry, and advanced data analysis and modelling. The latter includes work with the Cologne Database for Molecular Spectroscopy and a number of tools developed in-house. In close collaboration with the Max-Planck-Institut für Radioastronomie, the node also contributes to the efforts towards integrating ALMA into global mm-VLBI networks.

The ARC node provides an ARC visitors' room equipped with workstations, switches for laptops and a conference phone. The workstations are connected to a dedicated local high-performance server that runs all the latest ALMA software necessary for the proposal stage, data reduction and ALMA archive search. Up to two visitors can be accommodated simultaneously and the visitors' office is located next to a dedicated parent-child office.

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

In addition to user support and technical work, the German ARC node reaches out to the local community with community meetings, a monthly newsletter and talks at seminars and conferences. ARC node members are also active in teaching the fundamentals of radio interferometry, in ALMA-OT and CASA tutorials and in public outreach.

No local funding is available for visitors but eligible visitors can apply for MARCUs support.

The IRAM node in Grenoble

IRAM (Institut de Radio-Astronomie Millimétrique) is an international institute supported by the Max Planck Society (Germany), the CNRS (France), and the IGN (Spain). The institute is operating the 30-m Pico-Veleta antenna and the Plateau de Bure mm-interferometer. The construction of NOEMA, the successor to the Plateau de Bure observatory, has now started. 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 (in particular the development of the ALMA real-time Telescope Calibration software).

The face-to-face support for ALMA will use the same procedures and infrastructures as those used for the Plateau de Bure support. A computer room dedicated to data reduction is available and each project is assigned a local contact. A total of six astronomers are associated with the ARC node.

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 or to large-scale surveys with the 30-m. In addition to general face-to-face support, specific

Visit the IRAM ARC node at www.iram.fr/IRAMFR/ARC

domains of expertise at IRAM include the calibration of (sub-)mm interferometric data or wide-field imaging and the inclusion of short-spacings.

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 Nordic ARC node's main mission is to support ALMA users in Denmark, Finland, Sweden and other Nordic and Baltic countries. 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 mm/submm astronomy and presently runs the 20 m single dish telescope at Onsala and is a partner in the APEX submillimetre single dish telescope at the ALMA site in Chile.

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

The ARC node has high capacity data links for downloading archive data and high performance computer facilities to support ALMA data reduction. There is ample dormitory and guest room accommodation on site to support data reduction visits and small workshops. The ARC node currently employs three permanent staff members, two postdocs and IT support. The ARC node includes experienced millimetre wave observers, and specialists in interferometry algorithm development.

The node is active in community outreach to promote ALMA in the Nordic countries. The node also organises meetings for the whole Nordic community to explain the science that can be done with ALMA and train users to plan, submit, and reduce ALMA projects. As well as giving general face-to-face support, the node has expertise in the areas of astrometry, robust phase self-calibration, multi-frequency synthesis, deconvolution algorithms and polarisation. The node is also involved in the study for phasing up ALMA for VLBI and maintains several advanced data analysis packages. In collaboration with academic staff at Chalmers, there is also extensive scientific expertise on-site in the areas of radiative transfer and astrochemistry.

No local funding for travel and accommodation is available. Eligible visitors can further apply for MARCUs support.

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. Six ARC staff (plus IT and administrative support) divide their time between face to face user support and related research and development. Facilities for visiting astronomers include a large, dedicated room with ample desk space and powerful computing facilities, which can also be used for small meetings and tutorials. The node has very fast internet links (enhanced due to Manchester participation in real-time VLBI) for communication with the ESO-based ALMA Archive. Staff can also provide guidance for users wanting to install ALMA software on their laptops, where appropriate.

Visit the UK ARC node at <http://almadev.jb.man.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. Herschel, JCMT, e-MERLIN, EVN) combining ALMA and compatible data, and interoperability between CASA and AIPS.
- 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 (<http://almaost.jb.man.ac.uk/>) or inside CASA: choosing suitable input images, estimating the brightness on ALMA scales and so on.

STFC PATT funds can now be used to fund visits from UK institutes to the UK ARC Node. If your institute does not hold a PATT linked grant, you can apply for support through the usual PATT process, see <http://www.stfc.ac.uk/1506.aspx>

The Czech node in Ondrejov

The Czech node is located at Ondrejov Observatory near Prague. The node has available an office for three visitors equipped with computers dedicated to ALMA. Affordable accommodation in the guest rooms of the Astronomical Institute at Ondrejov can be offered. The node's duties are currently distributed over two staff members, two postdocs, and one technician.

The team is ready to provide support in preparation and submission of proposals to ALMA, with interpretation of observations, with some numerical modelling of the observed processes, and interstellar molecular line identification. The expertise areas of the Czech node are:

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

- Solar radio spectroscopy in dm-range, non-LTE radiative transfer, physics of the solar chromosphere, prominences and filaments, and solar flare plasma astrophysics.
- Galaxy evolution in clusters and groups, triggered star formation, proto-planetary disks, galactic centre and AGN.
- High resolution microwave laboratory spectroscopy of small molecules with a focus on hyperfine effects, spectroscopy of unstable transient molecular species, theoretical analyses of molecular energies, and transition (dipole) moment measurements.

No local funding is available for visitors but eligible visitors can apply for MARCUs support.

The Portuguese CoE in Lisbon: PACE

The Portuguese ALMA Centre of Expertise (PACE), operating since July 2014, is hosted by the Institute of Astrophysics and Space Sciences and located at the Astronomical Observatory of Lisbon. Two staff members and six postdocs devote part of their time to PACE duties, such as providing QA2 analysts, organisation of events for community support, or face-to-face user support on proposal preparation and submission, as well as archival research.

Dedicated workstations, including access to the Nonius Cluster, are available to visitors.

Visit the Portuguese CoE at <http://pace.oal.ul.pt>

The PACE astronomers have experience in mm-to-radio science. The topics of galaxy formation and evolution, planetary atmospheres and archival research are of particular interest to PACE astronomers and will be enhanced in order to improve the capabilities of the EU ARC network user support.

PACE also maintains a strong outreach team through which it educates the national community on mm-to-radio astronomy.

Visitors can apply for MARCUs support.



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

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

