ALMA user support in EU

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Spanish ALMA Days 18-20 February 2025, La laguna, Spain

ALMA

Open to non-expert users

- 100% service mode observation
- Data quality assessment, calibration and reduction done by observatory
- Open archive
- Help from experts thanks to the ARCs (ALMA Regional Centers)

ALMA

World-wide collaboration: 3 mains partners + Chile

- Europe (**ESO**)

- North America (USA, Canada, Taiwan)

- Eastern Asia (Japan, Taiwan, South Korea)

- Chile

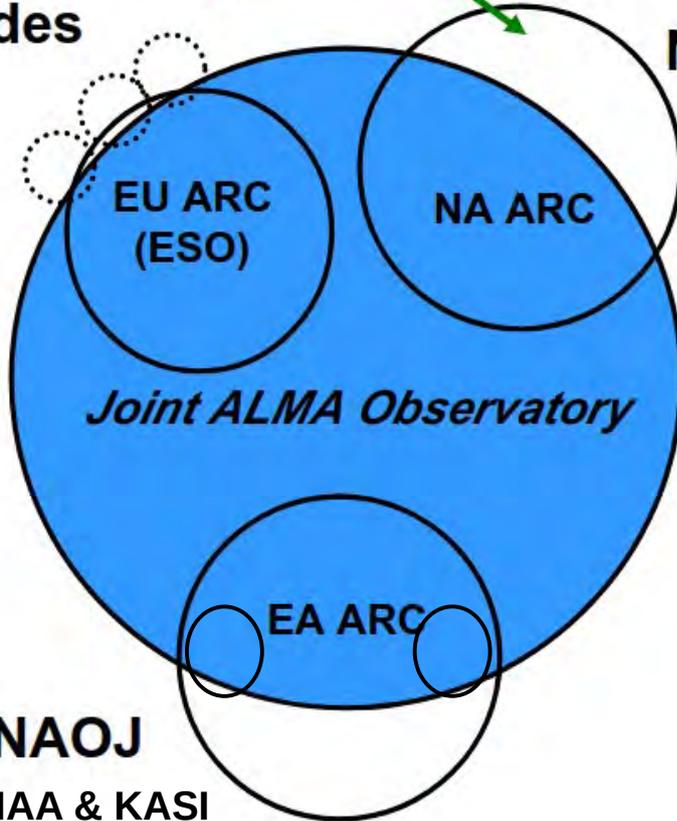Observing time : EU 33.75%, NA 33.75%, EA 22.5%, Chile 10% and open sky
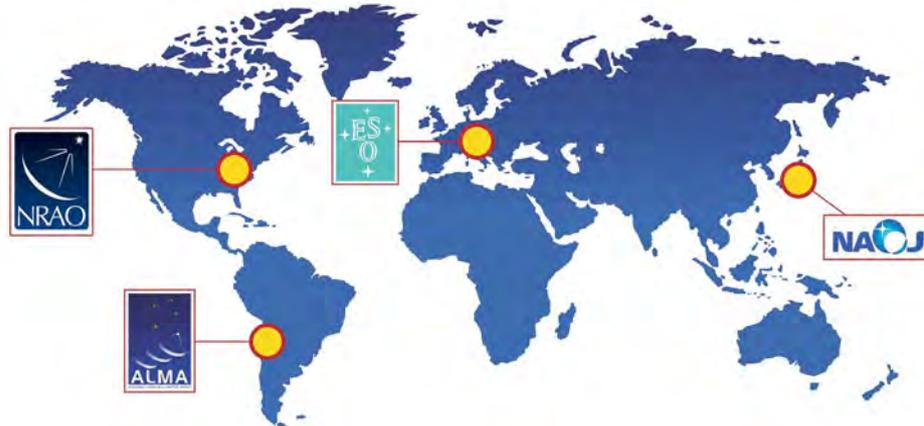
ARC organization

Enhanced User Services

EU ARC nodes

ESO + 7 nodes
User support

NAASC

NRAO

EU ARC (ESO)

NA ARC

Joint ALMA Observatory

Difference between ARCS:

- NA: concentrated in Charlottesville
- Europe: distributed in different ARC nodes.
- East Asia: concentrated in Mitaka. Taiwan and Korea nodes

EA ARC

NAOJ

ASIAA & KASI

EU ARC nodes network

- Allegro (NL)
- Bologna (IT)
- Bonn-Cologne (German Uni.)
- IRAM (FR, ES, MPG)
- Ondrejov (Cz)
- Nordic (SE, NO, DK)
- UK

Headquarter / coordination at ESO

Goal : maximize scientific return
Nodes provide services beyond critical
operational activities

No guaranty time for ARC and ARC nodes
members

EU ARC nodes network

- No "signed contract" but MoU
- 2 types of task : core and additional
- On **good will (and best effort)**

- No funding from ESO
- Each node has its own funding scheme
    - ► different funding agency's requirement
    - ►Very **inhomogeneous** network
        - But you **can go** where the expertise you need is !

- Some nodes have specific area of expertise, e.g.
    - VLBI at Bonn,
    - Solar observation at Ondrejov,
    - ...

Overview of the nodes

Some of the node's areas of expertise

- Dutch: High frequency, long baseline, VLBI, tool: ARTIST/LIME

- Italian: Archive mining, polarization, VLBI

- German: VLBI, annual community meeting

- IRAM: synergy with NOEMA / 30m, imagery/uv analysis software (MAPPING, IMAGER)

- Onsala: astrometry, polarization, imaging, Tools : data analysis package

- UK: Archive mining. Multi-instrument tools: ALMA observation support tool https://almaost.jb.man.ac.uk/

- Czech: Solar observation

Central ARC main tasks

Observatory support

e.g.
- Astronomer on Duty shifts
- Development/ maintenance of tools (e.g. the Observing Tool…)
- Maintain a copy of the ALMA Archive
- Quality assessment
- And others...

Central ARC main tasks

Users support

- Run the helpdesk

- Phase 1 operations:

  - distribution of the call for proposals

  - documentation

  - assistance in coordinating the proposal reviewing process.

- Phase 2

  - Generation and update of Scheduling Blocks

  - Implementation of successful change requests

- Data product support:

  - quality assurance (QA2) of science data sets

  - delivery of the final raw and reduced data

  - Delivery of calibrated measurement sets on demand

- Archive operations:

  - ESO ARC node holds a complete synchronized copy of the ALMA archive

- ALMA science portal

- CASA support

ARC nodes main tasks

- **Core task specific to nodes :**
  - **Personalized user support thanks to Face-to-face visits**
  - **Contact scientist** follow project life and assist PI
  - **Scientific community development**

- Interface between user and ESO/Observatory
- Help from proposal preparation to project life and data reduction
- Additional help like archive search, combination with other data
- Community development and outreach (school, workshop...)
- Involved in helpdesk and support user, QA2, QA3 (feed back from user after data delivery

Very dependent as a function of the funding scheme of the nodes

Additional

On top of F2F and CS duties, many nodes are involved in a lot of tasks on best effort

- AoD shift
- QA2
- Science verification data reduction
- Commissioning
- participation to software testing
- participation to documentation review
- interaction with technical groups
- others
    - recalibration of early science dataset (Italian ARC node ARI-L)
    - Phase RMS database (ALLEGRO)
        https://library.nrao.edu/public/memos/alma/main/memo624.pdf
- development of their own tools

In practice

- Contact point is the **Helpdesk**

    ESO will assigned your ticket to the best person (available) in the network

- Proposal preparation :

    - do not hesitate to ask for help / double check technical feasibility. The sooner the better

    - ALMA documentation could be intimidating, but is very well written.

    - You can participate to any event or visit any nodes (different funding)

In practice

- If you get a successful proposal (congratulation!)
  - you will be assigned a **"Contact Scientist"** at a node that is defined by your affiliation, and a "Phase 2 Generator" (P2G) member of the ESO ARC.
  - A dedicated **helpdesk ticket** will be open
  - You can follow your project on **SnooPI**
  - You can ask any question on your project status (much preferentially in the dedicated helpdesk ticket)

- During phase 2 (observation preparation)
  - the **P2G** will generate the SBs
  - **CS** will do the interface between PI and P2G (e.g. correction of source coordinates)

In practice

- During observation
  - CS will follow the life cycle of the project
  - You can ask question (preferentially on the dedicated helpdesk ticket)
  - You can follow the status on SnooPI
  - QA2 is done either by JAO, ESO or some nodes
  - The reduced data will be delivered to the PI
  - The PI can go and search for additional help (imaging, data combination….) in any node
  - Some nodes have specific funding for F2F visit, some other funding (like ORP)

    (e.g. IRAM could pay for 1 visit for 1 PI from the IRAM community per project)

Useful links and tools

- ALMA science portal
    https://almascience.eso.org/
- helpdesk
    https://help.almascience.org/
- knowledge database
     https://help.almascience.org/kb
- Antenna configuration schedule
    https://almascience.eso.org/observing/observing-configuration-schedule
- SnooPI (project's status)
    https://almascience.eso.org/observing/snoopi
- ALMA status page
    https://almascience.eso.org/observing/alma-status-pag
- ALMA archive
    https://almascience.eso.org/aq/

- EU ARC Newsletter and annoncements
   https://www.eso.org/sci/facilities/alma/news

Useful links and tools

- Events
  - schools
    - ALMA archive school
      https://www.eso.org/sci/facilities/alma/arc/alma-archive-school2022.html
    - Maya (Meeting of ALMA Young Astronomers 2023)
      https://www.eso.org/sci/facilities/alma/arc/maya2023.html
    - ALMA interferometry school 2024
      https://sites.google.com/view/eu-alma-school-2024

  Check also IRAM interferometry schools and ERIS (European Radio Interferometry School)

- Youtube videos I-train
  - https://www.youtube.com/@europeanalmaregionalcentre2068/featured

- Some tools developed by the community are listed here
  https://almascience.eso.org/tools/eu-arc-network/tools

Tools list

ARTIST	Allegro	Adaptable Radiative Transfer Innovations for Submillimeter Telescopes - a set of two CASA tools
ALminer	Allegro	ALMA Archive Mining & Visualization Toolkit
ALMA FITS Keywords filler	Italian	Generate and ingest in the headers new FITS keywords useful for a generic ALMA archive miner
MAPPING (for GILDAS)	IRAM	ALMA imaging simulator for GILDAS, with CASA->GILDAS filler
ASTRO (for GILDAS)	IRAM	Software for GILDAS, including UV_TRACKS (used with ALMA configurations), FREQUENCY, BASEBAND, SPWINDOW, PLOT to create/test correlator setups
SD2vis	Nordic	CASA task to compute synthetic visibilities from a single-dish image or image cube
STACKER	Nordic	Library for stacking sources in interferometric data (averaging emission from different sources)
UVMULTIFIT	Nordic	Versatile library for fitting models directly to visibility data in CASA
FAKEOBS	Nordic	CASA task to generate model visibilities from already-existing measurement sets
CLOSURES	Nordic	CASA task for (early) checks of data quality, even before beginning with any calibration
APSYNSIM	Nordic	Aperture Synthesis Simulator for Radio Astronomy, based on python/matplotlib
CASAIRING	Nordic	Simple CASA task to compute radial profiles of images and image cubes
POLCONVERT	Nordic	CASA task for conversion of ALMA-VLBI visibilities from linear-circular into circular-circular polarization basis
CHECKRES	Nordic	Interactive CASA task for a quick check of image residuals in Fourier space
POLSIMULATE	Nordic	Basic CASA simulator of ALMA full polarization observations
MEMOIR	UK	Molecular EMissiOn IdentifieR - tool to detect and identify molecular lines in the spectra of protoplanetary disks

Tool example: data mining

It is our pleasure to announce the release of **ALminer: ALMA archive mining and visualization toolkit!**

ALminer is a novel Python-based code that enables users to efficiently query, analyse, and visualize the ALMA Science Archive. Users can programmatically query the archive for positions, target names, or any other keywords in the archive metadata (e.g. proposal title, abstract, scientific category) in a simple way. ALminer's plotting routines allow the query results to be visualised, and its analysis functions allow users to filter the results and check whether certain frequencies of interest are covered in the queried observations. The code also allows users to directly download ALMA data products in FITS format and/or the raw data that can be used for manual image processing. ALminer has been designed to make mining the ALMA archive as simple as possible, while being flexible to be customised according to the user's scientific interests. The code is released with a detailed tutorial Jupyter notebook, introducing ALminer's common functions as well as some of its more advanced options.

Developed by ALLEGRO   https://www.alma-allegro.nl/alminer

ARTEMIX - ALMA RemoTE MIning eXperiment

▶️ A demo of Artemix and Yafits web applications

The ALMA data mining experiment (ARTEMIX) is supported by the LERMA from the Paris Observatory, its aim is to provide astronomers with a webservice that enables to quickly explore the ALMA scientific archive (ASA) content.

If you make use of ARTEMIX for your work, please add the following reference : « This work made use of ARTEMIX (http://artemix.obspm.fr), a service from the Paris Observatory (2019ASPC, 521, 421S) ».

If you have any question or request, please contact us (artemix.lerma at obspm.fr).
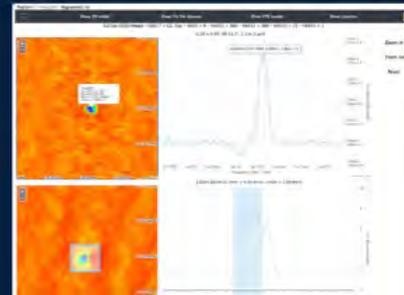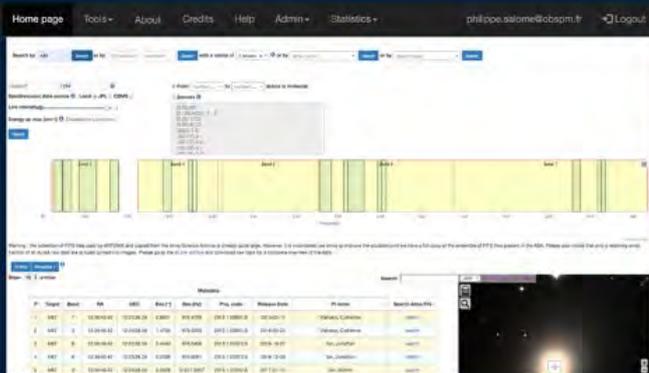
Click here to search for sources

- Search Tool
- Spectral display / Line catalogues
- Download on-demand
- Remote viewer 2D and 3D

Click here to visit Fits files

- Browse filesystem
- No search / No filter
- No download on-demand
- Remote viewer 2D and 3D

All *pbcor.fits (up to 2017)
All *pbcor < 3GB for 2018 and after
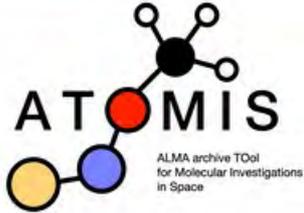For larger files : use download on-demand (login access)

- Fast remote viewer
- Interactive
- Interoperable

Allow efficient source search and visualization of the image cubes without downloading the dataset

Developed in Paris observatory

https://artemix.obspm.fr/

ATOMIS

ALMA archive TOol
for Molecular Investigations
in Space

ALMA archive TOol for Molecular Investigations in Space

Overview

ATOMIS is a web application that aims to search for observations in the ALMA archive for a given list of sources and species. The users can specify different filters on observations (angular and spectral resolutions, sensitivity, ...) and on species (minimum and maximum E_{up}, A_{ij}, maximum frequency uncertainty).

The user can either choose species on the CASSIS spectroscopic database (JPL[1], CDMS[2] and VASTEL) or upload spectroscopic files. It also allows the users to download the corresponding ALMA data products such as fits files and to visualize them with ALADIN[3] and CASSIS[4].

In order to search for ALMA observations, ATOMIS uses the Astropy package[5] and some features of the Alminer tool[6] (ALMA Archive Mining & Visualization Toolkit).

Developed in IRAP (Toulouse, Fr, Audrey Coutens et al.
https://atomis.ovgso.fr/

Tool example: imaging

Imaging 100 000 channels with ALMA & NOEMA
The IMAGER program in GILDAS

S. Guilloteau, E. Chapillon, E. Di Folco & T. Jacq
(LAB/OASU, *IMAGER was developed as part of the INSU SNO ALMA/IRAM*)

Abstract

IMAGER is an interferometric imaging package in the GILDAS environment, tailored for usage simplicity and efficiency for multi-spectral data sets. It is optimized for ALMA and NOEMA data sets. Efficiency is obtained through Parallel programming and extensive use of Memory. IMAGER comes with a powerful PIPELINE, which simplifies mutliple spectral line processing. IMAGER is distributed as a standalone precompiled LINUX container, and as a MacPorts package for MacOs.

IMAGER Features
Designed for speed and simplicity

- **User friendly**
- **Integrated viewer**
- **Automation** with sensible defaults
- Automatic spectral line identification
- **Fast**: parallelization, limited I/O
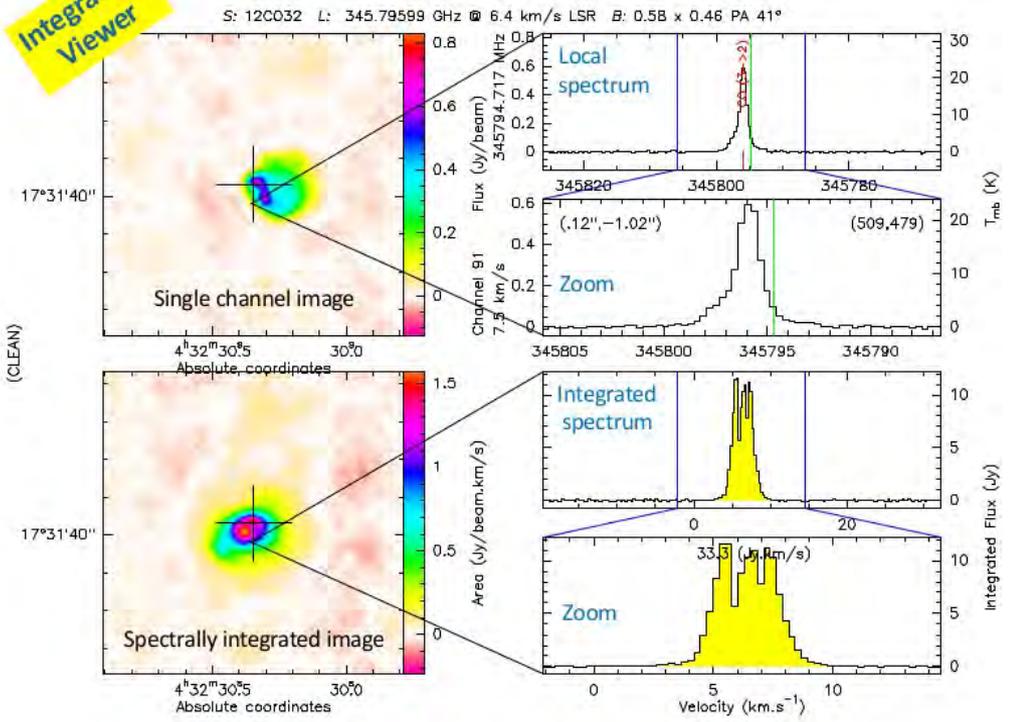- **Fully documented**:
  HELP, WebSite, demos and video tutorials

IMAGER Concept: 7 basic commands
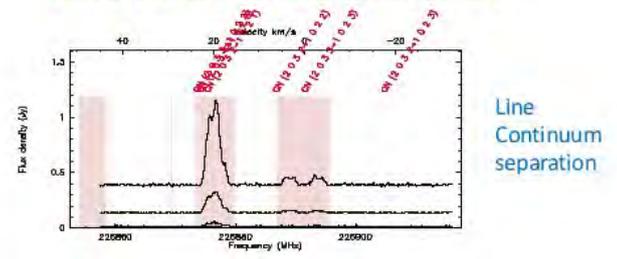**Treats Single-fields or Mosaics alike**

READ	read your data only once
(UV_SHORT)	short-spacings inclusion (if needed)
SELFCAL	(self-calibration, if possible and needed)
UV_MAP	imaging
CLEAN	deconvolution
VIEW	synthetic visualization
WRITE	save your result only when satisfied

https://imager.oasu.u-bordeaux.fr/

S: 12CO32 L: 345.79599 GHz @ 6.4 km/s LSR B: 0.5B x 0.46 PA 41°

Single channel image

Local spectrum

Zoom

(.12'',−1.02'')   (509,479)

Spectrally integrated image

Integrated spectrum

Zoom

33.3 (Jy.km/s)

Fast preview with line identification

Line Continuum separation

IMAGER Capabilities

Imaging
- **UV_MAP**   Basic dirty image construction
- **CLEAN**   Deconvolution (Cleaning) tools
- **SELFCAL**   Self calibration
- **UV_SHORT**   Short-spacings inclusion in UV data

Integrated Viewer
- Offers a **synthetic view**
- Can also **Compare 2 data cubes or maps** side by side

UV_Handling: **UV-oriented commands** to handle UV data time averaging, spectral resampling, line and continuum identification and separation, flagging, re-weighting, azimuthal averaging, etc.

MAP_Handling: **Image-oriented commands** to resample (in frequency), to compress (by channels), to compute integrated intensity maps, etc.

Spectral Lines identification: CATALOG command

PIPELINE: contains all processing steps for high fidelity imaging.

SIMULATE: simulates an observation from a given model and a list of array configurations (includes thermal noise addition).

HOW_TO   IMAGER has an "HOW TO" facility, where simple questions can be typed, and answers are searched for in a database.

The automatic PIPELINE

- Easy data import from CASA (casagildas() tool) and CLIC (@ all-tables)
- 1 command for all spectral windows: **PIPELINE**
  o Derives and **applies Self-calibration**
  o **4 pipeline MODES**: Continuum, Survey, All, Split
  o **Identifies spectral lines** from a user-defined Catalogue
  o **Modes All and Split** extract channels around identified spectral lines
- Easy control from the **Widget**
- **Dazzling fast**: a full track from NOEMA / PolyFIX in < 5 min

IRAM ARC node

NOEMA , south of Grenoble, France

- Support France, Spain, Max Planck communities

- Very small group (~1 FTE)

- Focus on user support

  visits (F2F or remote) and Contact Scientist, helpdesk

- All staff also involved in NOEMA operation (12 x 15m dishes, up to 1.8km baseline interferometer)

- Synergy with NOEMA (3-1mm) and 30m (3-0.8mm)

- Members

IRAM-30m single dish,
near Granada, Spain

  - Frédéric Gueth (representative, IRAM deputy director)

  - Edwige Chapillon (manager, staff) F2F CS

  - Ana Lopez Sepulcre (staff) limited CS

  - Giuliana Cosentino (postdoc, to start in March 2025)

(most)
EU ARC
network
members