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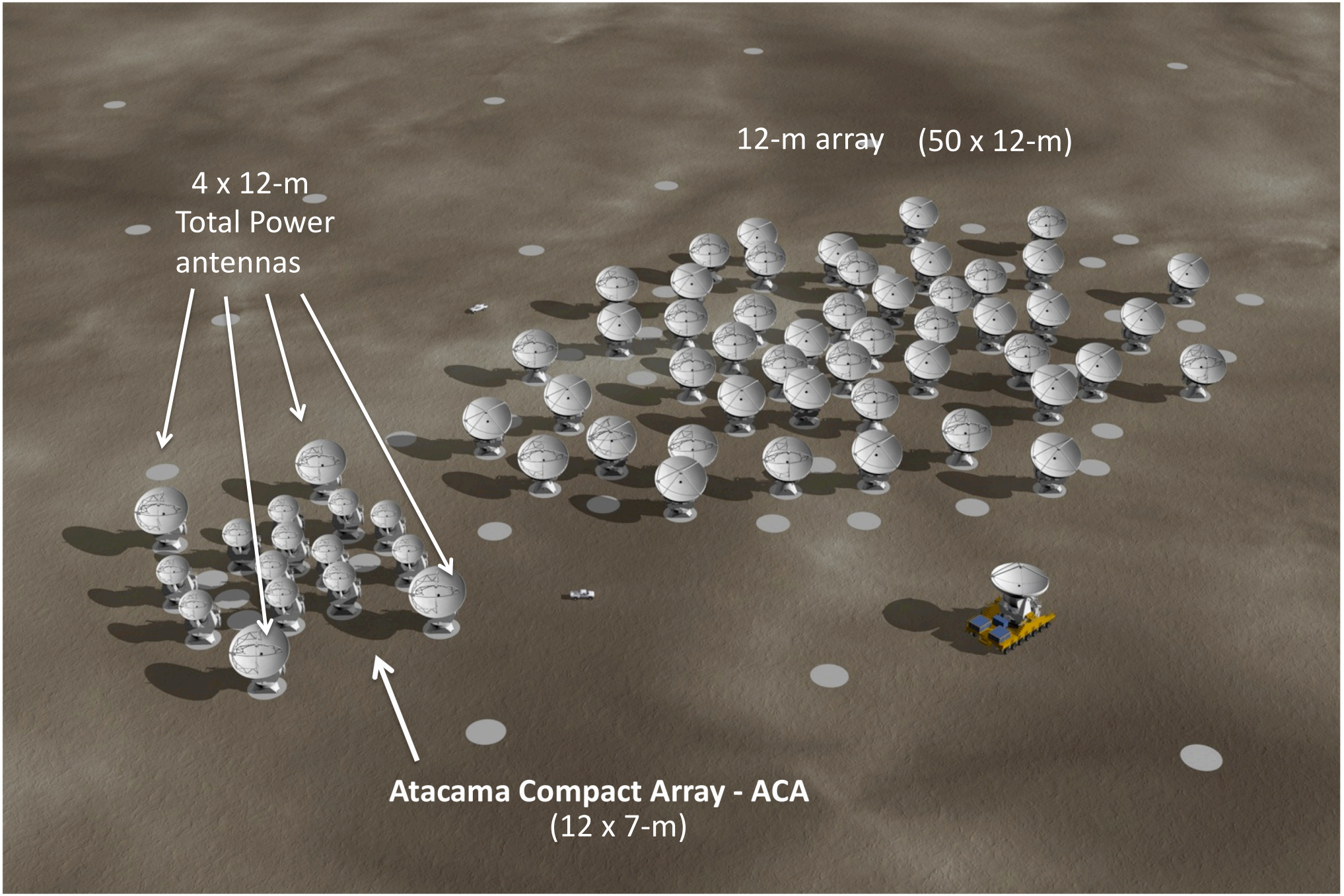
ALMA REGIONAL CENTRE ITALY
is Bologna

The Italian ALMA Regional Centre

Jan Brand, INAF-Istituto di Radioastronomia

ALMA: Atacama Large Millimeter/submillimeter Array @ 5km alt. Chajnantor plateau, Chile



Interferometer, 66 antennas; main array: baselines 0.15 – 16 km

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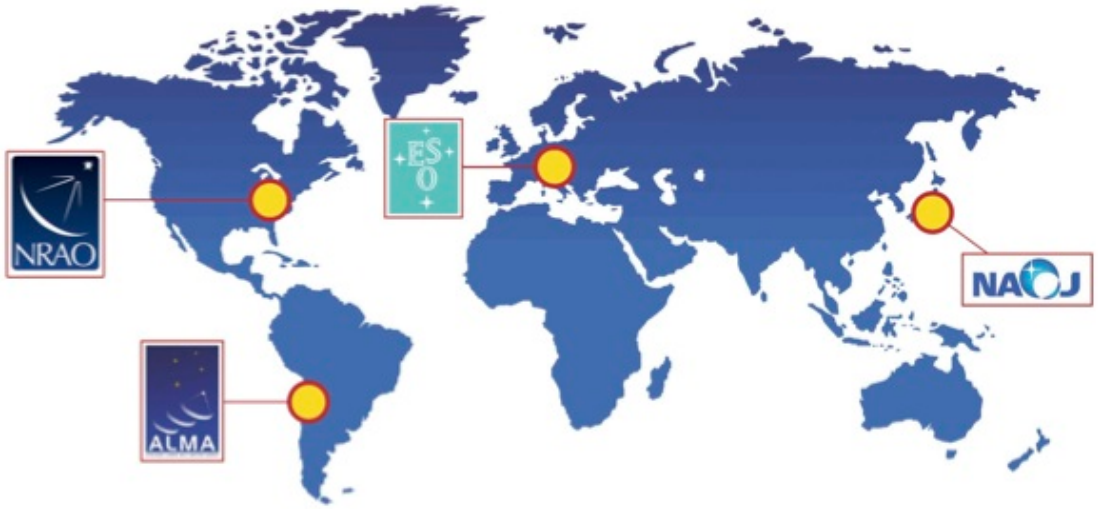
OUTLINE

!. Introduction
2. Our tasks and results
3. The team and their expertise
4. Using our expertise: projects and developments
5. Outlook
6. Critical issues

#1. ORGANIZATIONAL STRUCTURE



Joint ALMA Observatory:

Europe (ESO): 33.75%
North America (NRAO): 33.75%
East Asia (NAOJ): 22.5%
Chile: 10%

A user-support network for ALMA was set up, based on the philosophy that:

Every astronomer, regardless of field or spectral range of research, should be able to succesfully apply for observing time with ALMA.

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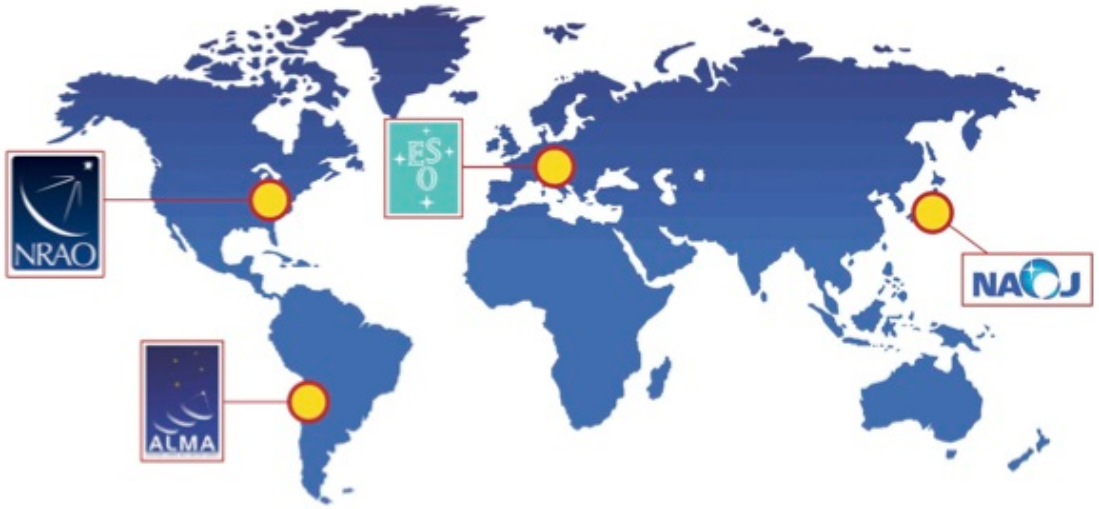

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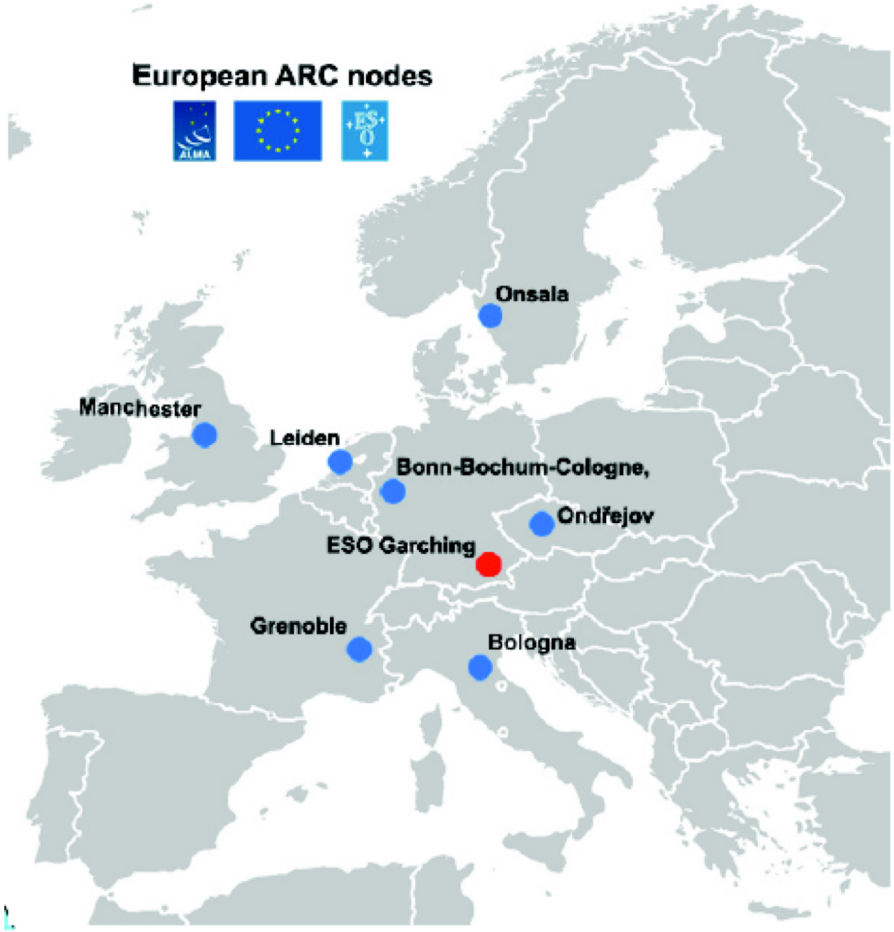
#1.

In Europe

A network of 7 ARC-nodes, coordinated by the central node at ESO.

Bound by an MoU, signed by all

Italian node EU-ARC Network hosted by INAF-Istituto di Radioastronomia (>2005)



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Support tasks in a nutshell:

Support to and development of user community

- Teach potential users what is needed to successfully access the facility, to reduce and analyse the data.
- Create platform for meeting, exchanging ideas and finding collaborations.
- Expand the community by attracting and training new generation

Support to the ALMA Project

- Contribute to the functioning and development of ALMA user tools and facilities.

#2. SUPPORT TO THE COMMUNITY

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- Organise Community Event around Call for Proposals.
  various formats, and durations. Practical & educational information and science presentations
- Contact Scientist for Italian projects
  follow and support accepted projects throughout their lifetime
- face-to-face support; Helpdesk Available always!
  proposal preparation, data reduction (calibration, imaging), and analysis
- Tutorials
  on software tools for proposing and analysing data, e.g. AOT, CASA, ALMA simulators
- Provide computing facilities (see also scheda IRA-DC)
  13 servers, 64-256 GB RAM, 318TB storage; high-speed connection 10Gbit/s

COMMUNITY DEVELOPMENT

- Organise scientific conferences and workshops
- Tutorials on advanced topics of data analysis
  e.g. on self-calibration, calibration polarimetric observations, scientific exploitation of the archive
- University courses and supervising students
  longest running (7 years): Laboratory Astrophysics (ALMA) @ UniBo [Paladino, ass. Brand]
  Mm science with ALMA @SISSA [Massardi]
- Involvement in Training Networks, Schools, seminars, lectures for PhD students

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#2. SUPPORT TO THE ALMA PROJECT

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Important to remain up-to-date, use our expertise and improve our skills and guarantee best service to community

Variegated activities, always aimed towards an improved operability of the array, assurance of fast delivery of reliable data to the PI's and creating new opportunities for users to make scientific use of ALMA.

Examples:

- Participation in science verification observations and data reduction campaigns
- Long baseline campaign: calibration & high-quality images at longest baselines
- Quality assurance (QA2); weblogreview
- Software tests (Observing Tool)
- Updating ALMA documentation (Technical Handbook, User Manuals, guide to EU ARC)
- Astronomer on Duty
- **Contributions to expert working groups: on polarisation, on mm-VLBI**
- **Archive mining (various projects)**

#2.

MOST TANGIBLE RESULTS USER SUPPORT

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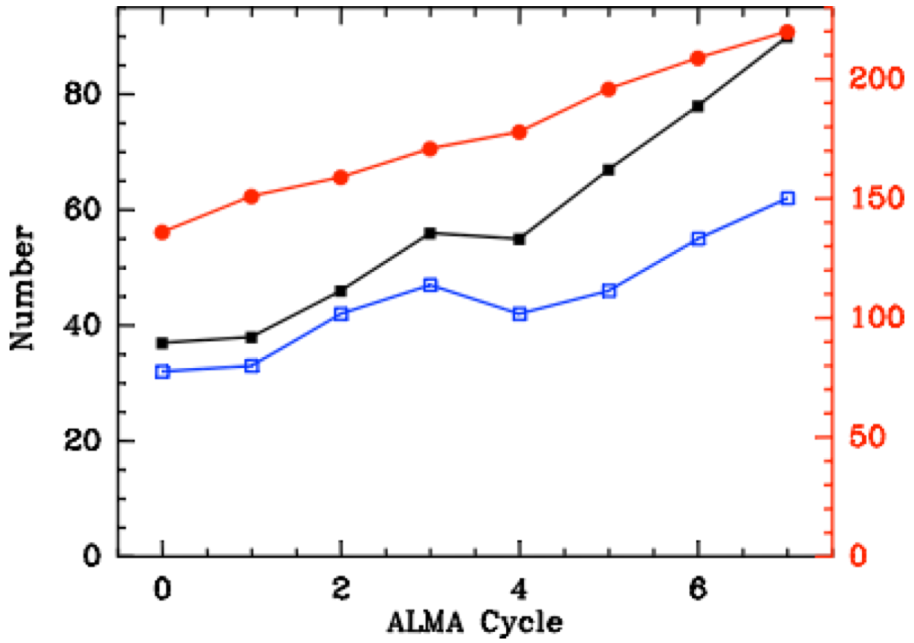
Considerably increased interest in ALMA, also in institutes with historically not a radioastronomical background.

Cycle 0 to 7: from 37 proposals by 32 PI's to 90 proposals by 62 PI's

PI's, Co-I's and Proposals

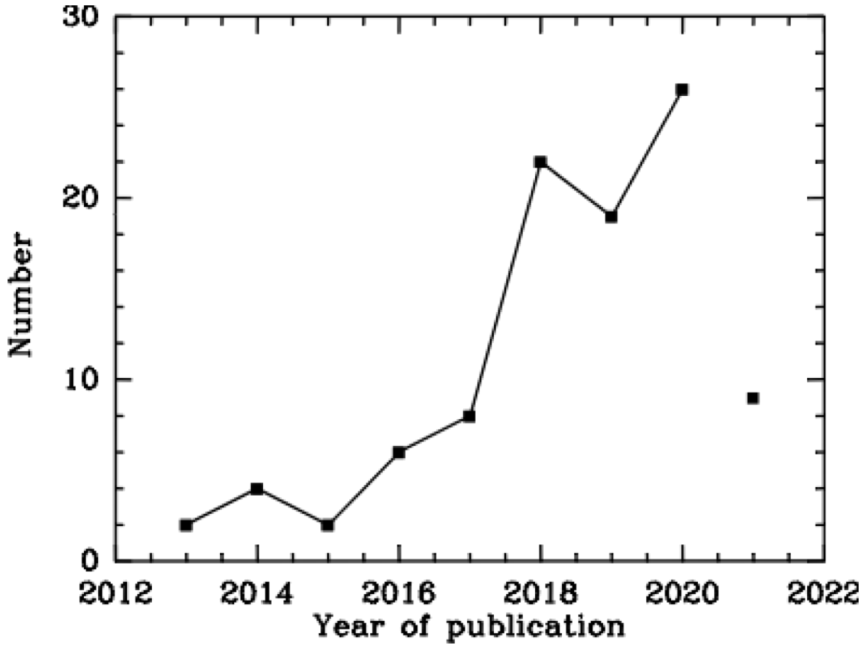


Submitted Italian-led proposals [left axis]

Unique Italian PI's [left axis]

Unique Italian Co-I's [right axis]

Publications Italian PI's



Refereed publications, first author Italian affiliation

2013-2021: N=98

#2.

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RESULTS EDUCATIONAL EFFORTS

Raised visibility of the ARC and ALMA and attracted students to do their Master and PhD theses with us.

So far we (co-)supervised 8 Master and 8 PhD projects

In the past 15 years **16 young scientists passed through the ARC as post-docs** learning, often also teaching and sharing expertise in mm-interferometry. Because of them there was always enough manpower to provide high-level support to the community. **11 are still in astronomy, 8 in permanent positions (7 at 4 different INAF institutes).**

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#3.

Current team

Jan Brand

Marcella Massardi

Rosita Paladino

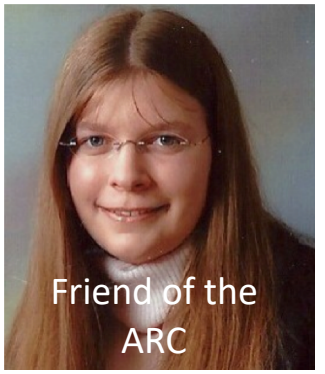
Elisabetta Liuzzo

Kazi Rygl

Giovanni Sabatini

Nicola Marchili

Matteo Bonato



Sandra Burkutean

#3.

THE TEAM

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5 permanent staff, 3 postdocs, 1 Friend of the ARC:

Brand: coordinator, responsible for finances and personnel; principal contact with ESO
Massardi: manager, responsible for day-to-day running of ARC. Expert in archive mining and PI of ARI-L project (see scheda figlia)
Liuzzo: expert on mm-VLBI; archive exploitation
Paladino: expert on polarisation
Rygl: expert on mm-VLBI; archive exploitation
Bonato: expert on galaxy modeling; archive
Marchili: expert on mm-VLBI; archive (BHC postdoc)
Sabatini: expert in chemical modeling; observational astrochemistry
Burkutean: expert on array combination; machine learning ('Friend of ARC' since 1/4/21)
New postdoc to be hired soon, to work on line polarisation

All user support tasks and community events are carried out by all, as are many of the more ALMA-related contributions. Contribution to more specialised activities and workgroups according to individual expertise.

#3.

OUR SPECIFIC EXPERTISES

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By design of the network, any of our activities are also done at other nodes.
Some are more node-specific. These are our areas of expertise:

1. mm-VLBI. Phased ALMA array as part of global mm-VLBI array. Long-standing experience IRA with radio VLBI, noblesse oblige. Involved in development from start and developed competence. This led to invitation to become partners in BHC/EHT project and to making significant contribution to that.

2. polarisation. Contribute to the ALMA extension of polarisation capabilities since 2015, participating in the observational and data reduction campaign leading to the capabilities currently offered. We contribute to the data reduction scripts, the quality assurance and to the training of analysts. Work on more efficient calibration and extension FoV of polarisation observations.

3. archive mining. Science archive continuously expanding and its scientific exploitation becomes increasingly important in research. Fraction of publications making use of ALMA archival data increases. From early on we contribute to make ASA more accessible and containing more complete and higher quality products, and to explore ASA in connection with other archives and catalogues.

#4.

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USING OUR EXPERTISES:

PROJECTS, DEVELOPMENTS #1: ALMA Archive-related

ARI-L: Additional Representative Images for Legacy

Massardi PI. ALMA Development Plan. Produce and ingest into the ALMA archive a set of additional image products representative of the whole data content for more than 70% of the 3476 observing projects in cycles 2-4 that can be processed through the ALMA Imaging Pipeline. Started officially: 7 June 2019. Funding (ESO) for 2 FTE for 2 yrs. **See scheda figlia.**

BREAKFASTwithALMA

Burkutean PI. A highly versatile non-telescope specific image analysis package. Combines automated image analysis with machine learning techniques to explore ASA with other public data repositories.

ALMACAL

Use the ALMA calibrator observations to study calibrators and serendipitous sources. Bonato, local PI. Create database and study properties of ALMA calibrator sources.

#4.

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USING OUR EXPERTISES:
PROJECTS, DEVELOPMENTS #2

AENEAS: Advanced European Network of E-infrastructures for Astronomy with the SKA (a H2020 project)

INAF-IRA (Massardi) was leader of WP5, which focused on design of user interaction model that could be implemented for the European SKA Data Centre (ESDC). Involved people from It-ARC and from other nodes (UK, Nordic). Funding for 2 FTE. Ended 9/2020.

BHC: BlackHoleCam (a H2020 project)

INAF-IRA/ARC official partners. Funding for 2 FTE + hardware.
Liuzzo and Rygl work on CASA pipeline for mm-VLBI data. Ends 2021.
See separate scheda.

Liuzzo and Rygl with M87 in 2019

First SKA Data challenge

Burkutean PI, leader of IRA/ARC effort. Finding, extracting and characterizing radio sources. Competitive project.

#5. OUTLOOK: ARC EVOLUTION I

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Premise:
ALMA is continuously being upgraded and improved; both new and experienced PI's continue to need support with new observing modes and capabilities. New generation continues to need training and students need supervising.
We guarantee continued support, including all new features.

Experienced users may request we focus activities and skills on specific scientific and technological areas (advanced data analysis). Multi-wavelength research, especially through the use of archives, is becoming more and more requested. To match ALMA data, high-angular resolution data are desirable. One may thus expect increasing demand for support with data reduction/analysis of observations taken with other interferometers (incl. in near future SKA).

Many ARC nodes nodes already expand their role to become the central point for synergy among many imaging facilities (collaboration across disciplines, cross-matching of datasets and linking communities) and we too
evolve towards a national center of expertise for radio and mm-interferometry.

We are undertaking steps to organize this on a transnational level and create a
N-ICE: Network of Interferometry Centres of Expertise
Of course while recognising and sharing expertise with groups outside the ARC-node network.

#5. OUTLOOK: ARC EVOLUTION II

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The skills we have matured naturally drive us towards involvement in other projects and open up new and exciting directions both in terms of user support and science and we could play a significant role in their development.

Our involvement in AENEAS allows us to make significant contributions to the SKA Regional Center working groups, of which we are in the steering committee.
Because of our expertise in interferometry and data reduction we are part of BHC, and contribute to the EHT project.

#6.

REQUIREMENTS and PROBLEMS

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- We need to maintain high level of support and diversity in scientific interests. Thus it is essential to conserve the expertise of carefully trained temp staff, who need to be able to apply for permanent positions, where their support role is taken into account in the *bando* and the emphasis is not on publication record.

- To remain faithful to task of training a new generation, giving them an opportunity to acquire skills and apply them on ALMA science projects, the continued possibility of hiring postdocs under attractive conditions (in terms of duration and salary) is important, as is the possibility to finance PhD positions on a regular basis.

- We need a reduction of bureaucracy in the job application process for postdocs, a simplification of the text of the *bando,* and templates in Italian AND English.

- Lack of manpower at the IRA Centro Calcolo – leading to have to 'autogestire' the cluster; Clearly not ideal and something that needs to be resolved.

For more info on all items presented and more: http://www.alma.inaf.it

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SCHEDA FIGLIA: ARI-L

Marcella Massardi, INAF-Istituto di Radioastronomia

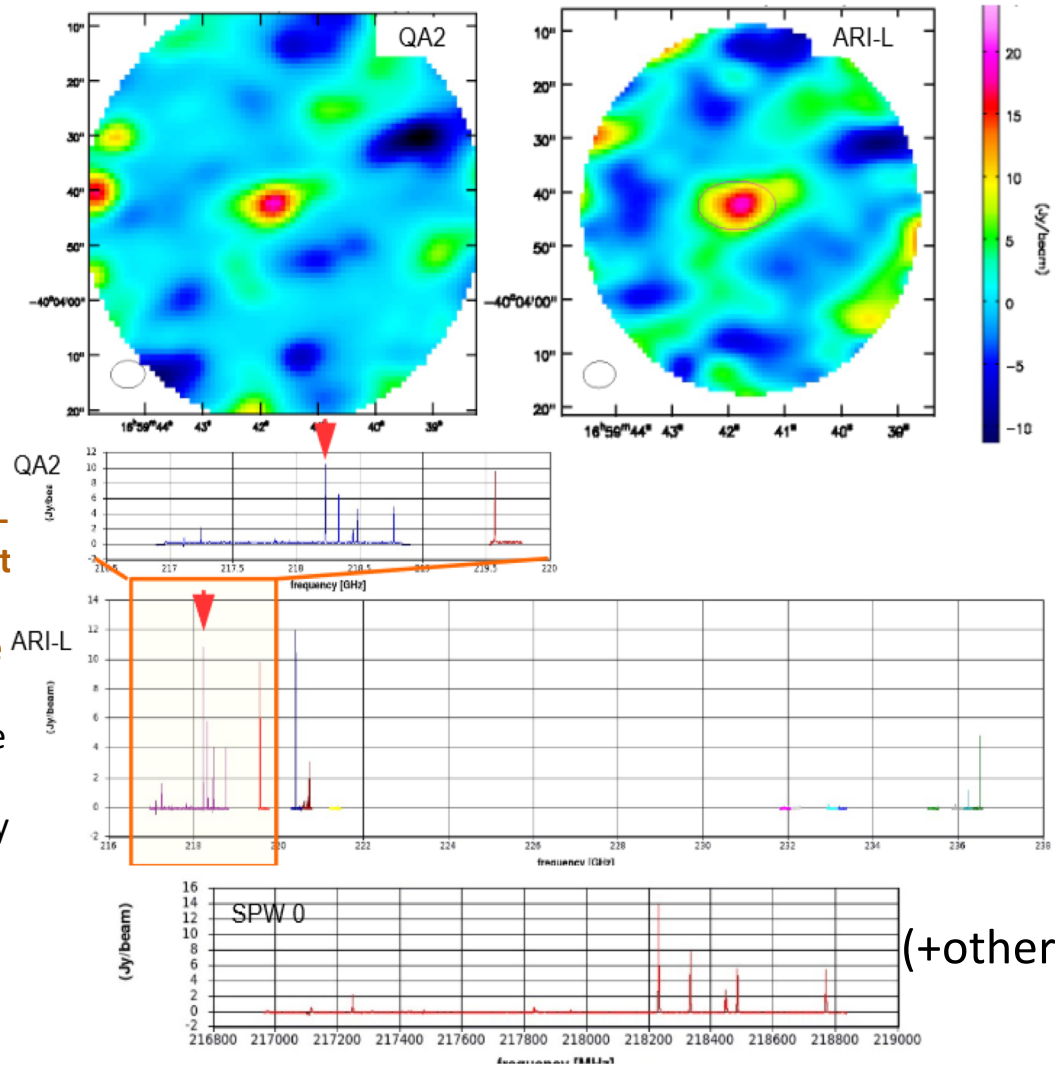
ARI-L: Additional Representative Images for Legacy

ALMA was the first radiotelescope to pledge that the fundamental data products will be calibrated, deconvolved images and data cubes.

In the first years an indicative product was manually generated via QA2. Only after the 4th cycle a pipeline was used to generate images.

QA2-generated products cover only a small (<10%) fraction of the available data of each project.

The "Additional Representative Images for Legacy (ARI-L, pi: Massardi) in the ASA" ALMA development project will produce and ingest into the ALMA archive a set of additional image products representative of the whole data content for more than 70% of the 3476 observing projects in cycles 2-4 that can be processed through the ALMA Imaging Pipeline, to complement the manually produced ones and generate legacy value in consistency with later cycles.

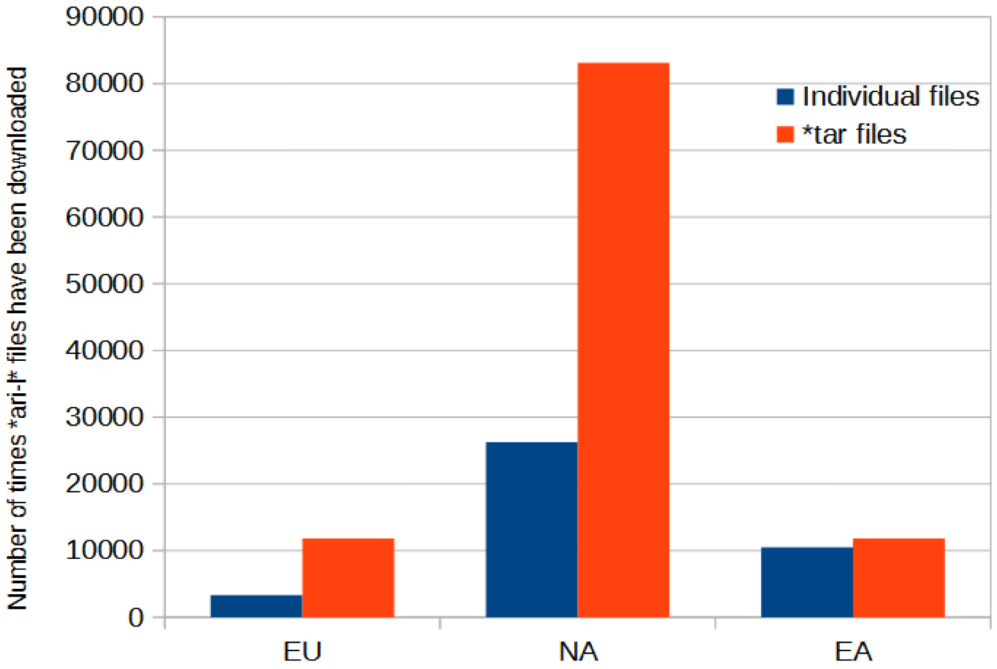


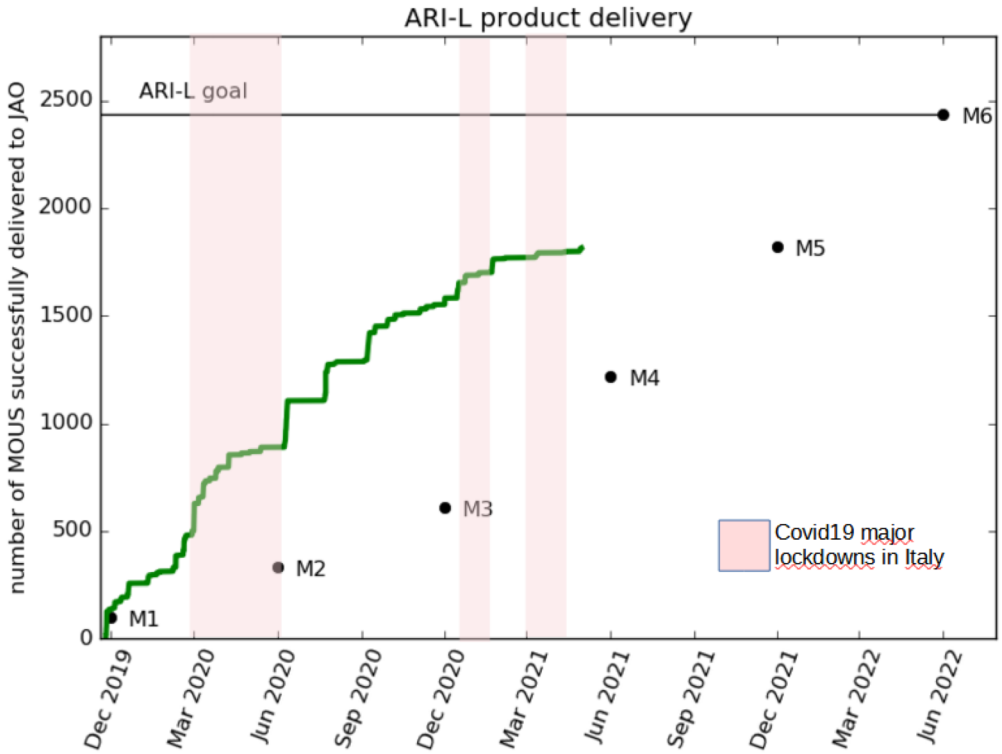
(+other 12)

(Massardi et al.submitted)

ARI-L: Additional Representative Images for Legacy

Thanks to the contribution of all the parties (INAF ARC-It & IA2, ESO, UMan, JAO) more than *243073* files tagged *ari-l* (including readme's, masks, and fits files) for a total size of 40.8 TB are now available to ALMA Science Archive users to download





The project is currently facing the second year review in full swing and 6 months ahead of expected goals

At the completion of the project goals in 2022 ESO will complete the payment of the agreed 228 kEuro.

A 6 months extension will be asked to further investigate future perspectives of application of ARI-L approach to other ALMA dataset classes.

(Massardi et al.ARI-L Second Year Report)