# Five Years of Early Science with ALMA
## and
# the Activities of the Italian ARC.

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# Summary

Since 2011 ALMA has issued 4 Calls for Proposals[1] and completed 3 full observing cycles[2] in the framework of *Early Science*. We consider this a good time to look at what the Italian ALMA Regional Centre (ARC) has done to prepare the Italian community for the use of ALMA, and how this community is responding.

After a brief description of the Italian ARC and its various tasks and activities, we look at the performance of the Italian community with respect to ALMA. The main conclusions are:

– There is an increase in submitted proposals led by Italian PIs;

– There is an increase in accepted proposals with Italian PIs;

– There is an increase in the number of Italian PIs and Co-I's (i.e. there is increased participation of Italian researchers);

– There is an increased territorial distribution of submitted and accepted Italian proposals.

– Over the last three cycles the fraction of Italian-PI proposals (relative to submitted Italian-PI proposals) that are accepted increases with each cycle, and in the latest cycle they performed better than any other EU-country;

– Over 4 cycles, Italy "breaks even": proposals with Italian PIs account for about 8% of all submitted EU-executive proposals , as well as for about 8% of all accepted EU-executive proposals. These percentages are similar to those for the other ESO observing facilities;

– Averaged over 4 cycles, the countries that do better than Italy all already had strong mm-astronomy groups and/or privileged access to (sub)mm telescopes. But Italian astronomers are catching up fast.


[1] the $5^{th}$ Call was issued 22 March 2016; the results will not be known until Summer and thus cannot be included in the statistics presented here.

[2] Cycles 0,1,2 - Cycle 3 will be active until Sept. 2016

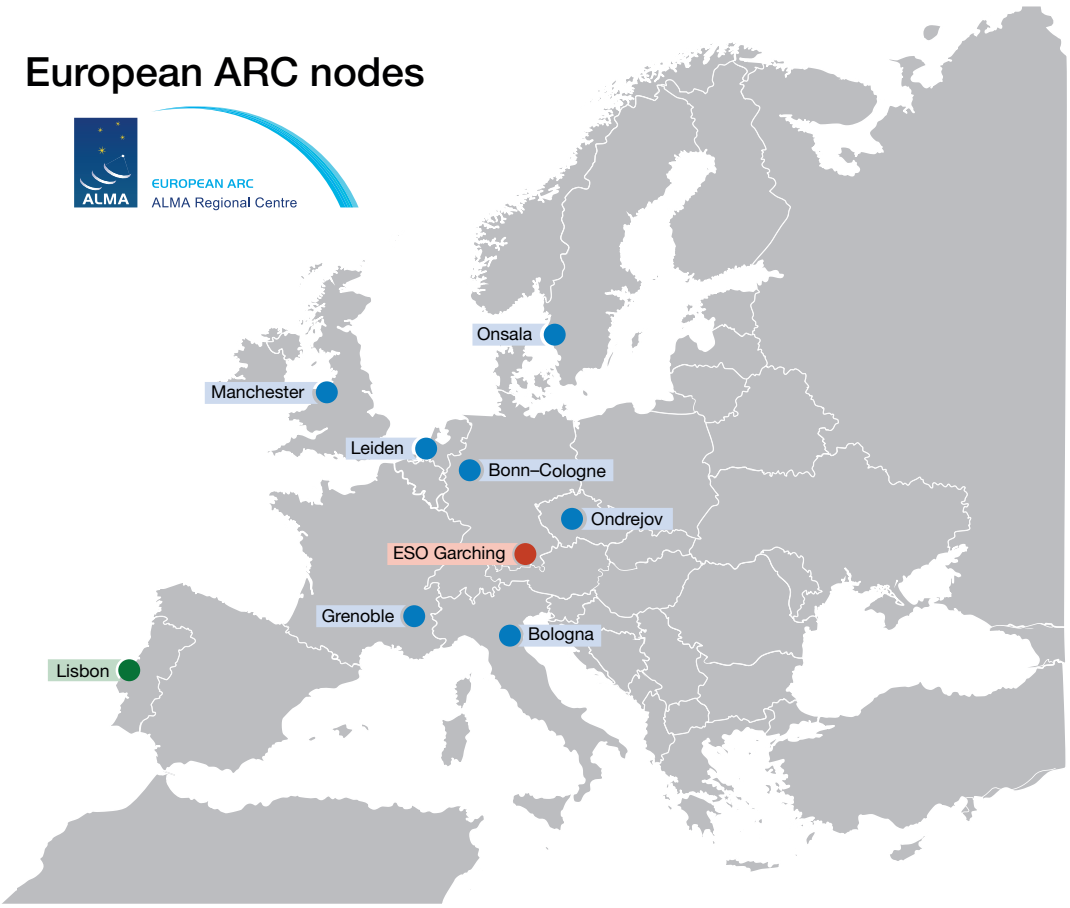


Figure 1: The European ARC network, coordinated by the central node at ESO, Garching. There are seven additional nodes, indicated in blue. In Lisbon is a 'Centre of Expertise', aspiring to become a full ARC-node.

# 1. Introduction

Construction of The Atacama Large Millimetre Array (ALMA) is now complete and the Array is nearing the phase of full operation. It has been possible to observe with a limited, but ever increasing, number of antennas, receivers and configurations since 2011. In this period of *Early Science* there have been four calls for proposals; three observing cycles have been completed and the fourth has commenced on October 1, 2015. During these observing cycles the amount of time spent on commissioning, science verification and technical tests gradually decreased, while the amount of time available for scientific observations increased from $500 - 700$ hrs in Cycle 0 to 2100 hrs in Cycle 3.

## 1.1 ALMA Regional Centres

ALMA is an international partnership coordinated and operated by the Joint ALMA Observatory (JAO) on behalf of the three executives (Europe, North America and East Asia) in cooperation with Chile. The ALMA Regional Centres (ARCs) provide the interface between ALMA and the Science Communities of the three partners. The scientific communities of the ESO member states are supported by the European ARC, which consists of a network of nodes distributed throughout Europe (Fig. 1) that are coordinated by a central node located at ESO Garching. The Italian ARC-node is hosted by the Istituto di Radioastronomia (IRA) in Bologna, and currently employs 2 IRA staff members and 5 post-docs.

## 1.2 The Italian ARC - activities

The activities of the Italian ARC can be roughly catagorized as follows:

- Providing user support (proposal preparation, data reduction, archive mining)
- Building, maintaining and informing a community of potential ALMA users
- Raising the next generation of millimetre-wave astronomers
- Contributing to the ALMA project (participating in EOC, data quality assessment, software development, data archiving, development plan proposals)
- Developing our expertises (polarimetry, mm-VLBI)
- Science

These activities are outlined in some detail below.

### 1.2.1 User Support

The philosophy behind the Regional Centres is that *any* astronomer should be able to submit a successful proposal for ALMA *regardless* of their experience in mm-astronomy or interferometry. Therefore, one of the principal tasks of the ARC-node is to provide technical and scientific support to potential ALMA users with the preparation and submission of observing proposals, with the tracking of accepted ALMA projects (as Contact Scientist) up to the final data quality assessment, with data reduction assistance with the *Common Analysis Software Applications* (CASA), and with ALMA Science Archive mining.

### 1.2.2 Community Building

To familiarize the Italian astronomical community with ALMA we have held *ALMA Community Days* since 2007. The content of these meetings has varied over the years but usually involved lectures by experts on ALMA, on science, interferometric techniques, and tutorials on the various tools needed to write proposals. With time they evolved into the present *Proposal Preparation Days* when they became more focused on the capabilities of the upcoming cycle, the practical and technical side of the proposal tools and the possibility to get direct face-to-face support with one's proposal. Although these meetings are usually held at the host institute, IRA, we have experimented with visits to institutes and observatories throughout the country, and with video-conferences.

To help people with proposal writing and data reduction, we have given tutorials on the ALMA Observing Tool and the CASA software package, either stand-alone or as part of a School (see later).

Seminars on ALMA and *Early Science* have been presented at various institutes since 2008; in 2011 and 2013 the people from the Italian ARC-node have toured the country (8 cities) with a seminar presenting ALMA scientific results, and/or the capacities that would be available during the new observing cycle. After each seminar there was the opportunity to get proposal support. This allowed us to reach and individually help many astronomers. In 2016, 5 institutes are visited with a seminar on the present status of ALMA and an overview of scientific results in the 5 years since the first Call.

We have organized two workshops on millimetre astronomy in Italy (2012, 2015). These were occasions for the Italian community actively doing or interested in doing research in the field of (sub)mm astronomy to meet and discuss present or future ALMA projects, projects with other mm-instruments or synergies with instrumentations in other spectral bands.

In addition to this we publish a bi-monthly newsletter (as of Dec. 2015 absorbed in a newsletter for the entire European ARC-network), and we keep an up-to-date website (http://www.alma.inaf.it), where all our activities are listed and more detailed information can be obtained.

### 1.2.3 Training and education

To raise the next generation of mm-astronomers and potential users of ALMA, we are involved in various educational activities.

Where previously only occasional lectures were given for graduate students, we recently arranged to give lectures embedded in academic (Master's and PhD) courses. We started in the academic year 2013-14 to give lectures on radio astronomy (2 hrs; Bologna and Catania) and on ALMA and mm-astrophysics (4x2 hrs; SISSA, Trieste). At the Univ. of Bologna, members of the ARC give a 2-week "Astrophysics Laboratory" course, preceded by 4 hrs of lectures on ALMA and the theory of interferometry. Students learn to calibrate, image and analyze real ALMA data and their written reports are graded. These courses were carried out in the 2015-16 academic year for the third year in a row, and we have already been requested to continue next year. Furthermore we supervise ALMA-related Master's and PhD theses and support post-doc fellowships.

In 2007 we presented a series of lectures in the section "Science with ALMA" of the *Scuola Nazionale di Astrofisica*. In 2011 we have organized the "Astrochemistry with ALMA" training school, together with the Catania Observatory (and funded by the EU through ITN LASSIE Network and a COST Action), and in 2015 we participated in the "Francesco Lucchin" School of Astrophysics with a tutorial on Using the ALMA Science Archive data, in recognition of the fact that with the passing of time the ALMA archive becomes ever more important, as more and more data become public. In February 2016 we organized an ALMA data handling school/workshop with the aim to assist users in learning how to (re)process (archival) ALMA data, from raw data to the production of calibrated images and data analysis.

We have been giving tutorials on CASA and/or the ALMA Observing Tool since 2010, either as stand-alone (Bologna, Florence, Rome, ESO-Garching) or as part of a School (ERIS: Rimini 2011, ESO-Garching 2015).

The Italian ARC is co-proposer on the accepted merit (*"premiale"*) project *iALMA* (PI's Testi [ESO/Arcetri] and Villa [INAF-IASF Bologna]). (see Sect. 1.2.5).

### 1.2.4 Contributing to the ALMA project

The Italian ARC-node, like other nodes in the network, participates in various activities that are important to the ALMA project. This happens on a voluntary basis. Earlier we contributed to Science Verification data reduction. Presently we contribute to the polarisation Extension and Optimization of Capabilities (EOC) effort, to the long-baseline campaign, and to the weak calibrator survey. We also perform data reduction on observed ALMA projects, as the final step in the quality assurance (QA2), before the data are released to the PI.
The Italian ARC also develops new CASA tasks, a tool to improve archival research, and investigates new techniques of data reduction and handling.

Presently (June 2016) we are working on an ALMA upgrade proposal to investigate the feasibility of producing "science-ready" imaging products for the ALMA Science Archive.

### 1.2.5 Developing our expertises

As the user community matures, the role of the ARC nodes will change. In addition to mere user support we will be requested to focus our activities and skills on specific scientific or technological areas so that within the European ARC each node has its own expertises and contributes to the network not only on a geographical- but also on a scientific basis.

We are developing two main areas, as described below. We contributed to the writing of the Eu-

ropean white paper on future mm-VLBI observations with ALMA, we are Co-Is on the (accepted) ALMA upgrade proposal "Phased ALMA as element of the GMVA" (PI: Ros [MPIfR]), and on the national (accepted) merit proposal "Science and Technology in Italy for the upgraded ALMA Observatory - iALMA" (PIs: Testi; Villa), which aims to construct a solid infrastructure at INAF to support Italian involvement in ALMA. The project *iALMA* concerns science (ALMA bands 2-3), technology (laboratory, receivers), training (PhD students and post-docs) and outreach.

Our expertises are covered by working package WP3 of *iALMA* (Massardi WP-leader): "The evolution and development of the Italian ARC node". ARC personnel are also involved in the science and training WP's. We contributed to a white paper "Italian Science Case for ALMA Band 2+3".

Development 1: Polarimetry

Measuring the polarization properties of astronomical sources is an important aspect of ALMAs scientific programme. The Italian ARC-node intends to become the European expert for polarimetric observations with ALMA. We organized a workshop on this in June 2013 and are currently contributing to ALMA commissioning for polarization and the definition of pipeline procedures for polarization data reduction. A PhD student (funded by *iALMA*) has started at the ARC in Nov. 2014 on a project of multi-frequency polarimetric observations of radio sources.

Development 2: mm-VLBI

The ALMA Development Plan, that sets the scientific context for transformational science with ALMA in 2020, considers as a key-point the use of the ALMA array as part of the global mm-VLBI array. The INAF-Istituto di Radioastronomia (now ORA) has long-standing expertise and collaborations in the VLBI network, and we consider ourselves to be in an excellent position to contribute to the VLBI with ALMA. In February 2015 a post-doc, expert in the field, started work at the ARC, funded by *iALMA*. We have contributed to the ALMA long baseline campaign, and organized an international workshop on mm-VLBI with ALMA in January 2015.

### 1.2.6 Science

Currently, the Italian ARC researchers are involved in several (sub-)mm scientific projects covering a variety of topics (from stars, galactic interstellar medium and local-Universe studies to high-redshift galaxies and cosmology), and offer general scientific support on their specific area of expertise. This meets the requirements of a community which is still evolving, and provides guidelines on how to properly interface with a new and complex instrument like ALMA. The large variety of skills of our staff allows us to successfully match the requests of the community.

Table 1: **Italian PI and Co-I proposals**

| | | submitted proposals | | | | accepted proposals | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | props | number of unique | | | PI props | | Co-I props | | unique |
| Cycle | Code | PI | PI | Co-I | PI/Co-I | top[a] | fill[b] | top[a] | fill[b] | Co-I |
| 0 | 2011.0 | 37 | 32 | 136 | 144 | 3 | 1 | 12 | 6 | 32 |
| 1 | 2012.1 | 38 | 33 | 151 | 158 | 3 | 0 | 16 | 10 | 32 |
| 2 | 2013.1 | 46 | 42 | 159 | 166 | 6 | 6 | 44 | 22 | 77 |
| 3 | 2015.1 | 56 | 47 | 171 | 183 | 15 | 8 | 51 | 37 | 117 |

[a] "top" means proposals accepted with highest priority (categories A, B).
[b] "fill" means a proposal of grade C, to be observed as "filler" when no higher-priority proposal is available at a certain time.

# 2. Early Science. Some statistics

After four Calls for Proposals we feel we have enough data to attempt a statistical analysis of the proposal meta data and of the performance of the ARC-node. Concerning the latter, over the 4 cycles of Early Science the ARC researchers (situation Oct. 2015 unless specified otherwise):

- are involved as PI or Co-I on 150 ALMA proposals, of which 51 (34%) are accepted [24 (16%) of top priority];
- are (co-)authors on 16 refereed ALMA papers + 3 White Papers (March 2016);
- supported ca. 165 proposals (est. 5 hrs average per proposal; $0.5 - 16$ hrs range);
- reached a few 100 astronomers (workshops, seminars, tutorials, proposal days, f2f);
- had 24 f2f visits at the ARC (21 proposal preparation, 3 data reduction) [Note: these are in addition to those we had during the organized events]

## 2.1 Italian proposals

Table 1 summarizes the situation of the Italian proposals and proposers for each of the 4 cycles. Columns 1 and 2 identify the cycle; Cols. $3 - 6$ concern submitted proposals: Col. 3 gives the number of proposals with an Italian PI, Cols. $4 - 5$ list the number of unique PIs and Co-Is, respectively, and Col. 6 says how many individuals appear on a proposal either as PI or Co-I. This is thus a measure of participation to ALMA. Columns $7 - 11$ concern accepted proposals, with Cols. $7 - 8$ giving the number of proposals with Italian PIs accepted with highest priority or as "filler" projects, respectively; Cols. $9 - 10$ give the same information, but for proposals with Italian Co-Is. Column 11 lists the number of unique Co-Is on accepted proposals. (In Cycle 1 we have not included an (accepted) DDT-proposal, which has 10 Italian Co-Is [4 of whom 'unique']).

There is a clear trend of increasing participation (e.g., Cols. 3 and 6) and success (Cols. $7 - 11$) of Italian researchers. Cycle 3 in particular has been very successful (also in comparison with other countries, see Table 4).

Table 2 shows that with each cycle there are more successful proposals from more cities and institutes: from 4 accepted proposals from 2 institutes in 2 cities in Cycle 0, to 23 accepted proposals from 9 institutes in 5 cities in Cycle 3. From which cities proposals were submitted and accepted is documented in Table 3.

Table 2: **Italian PI proposals – geographical distribution 1**

| Cycle | subm | cities | inst | top[a] | filler[b] | cities | inst |
|---|---|---|---|---|---|---|---|
| 0 | 37 | 9 | 15 | 3 | 1 | 2 | 2 |
| 1 | 38 | 10 | 16 | 3 | 0 | 2 | 2 |
| 2 | 46 | 10 | 15 | 6 | 6 | 4 | 7 |
| 3 | 56 | 7 | 14 | 15 | 8 | 5 | 9 |

[a] "top" means proposals accepted with highest priority (categories A, B).
[b] "filler" means a proposal of grade C, to be observed when no higher-priority proposal is available at a certain time.

Table 3: **Italian PI proposals – geographical distribution 2**

| Cycle | cities with submitted and/or accepted proposals | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | BO | CA | CT | FI | MI | | PD | PI | RM | TS |
| 1 | BO | CA | CT | FI | MI | PA | PD | PI | RM | TS |
| 2 | BO | CA | CT | FI | MI | PA | PD | PI | RM | TS |
| 3 | BO | | | FI | MI | | PD | PI | RM | TS |

Black: proposals were submitted; Red: proposals were accepted (all priorities).

## 2.2 Comparison with other EU countries

Italian researchers are doing better (in terms of participation in ALMA and successful proposals) with each cycle. In Table 4 we compare Italy with other countries and the ARC-nodes they refer to, for the most recent cycle (Cycle 3) only. Numbers are given for PI-proposals from the countries listed in Col. 1. We have not included countries from which a proposal was submitted only sporadically, such as Ireland (referring to the UK-node in Manchester) or Iceland, Norway and the Baltic states (Nordic-node at Onsala). The other columns report the following information: number of submitted proposals (Col. 2); absolute number of proposals accepted with highest priority (Col. 3) and the percentage w.r.t. the number of submitted proposals (Col. 4). Cols. 5 and 6 give those numbers for accepted proposals of all rankings, i.e. including "fillers". In Cols. $7-9$ we give the percentages of submitted and accepted proposals relative to the European totals. For example, Italy's 56 submitted proposals constitute 8.5% of the 657 proposals that were submitted to the EU-executive, and the 23 accepted proposals are 10.5% of the 220 accepted EU proposals (of all rankings). From this table we see that in Cycle 3 Italian astronomers have the greatest return on their proposals: 41% of the proposals with an Italian PI was accepted in some form, the highest percentage of all.
Figure 2 shows the success rate for Italian-PI proposals for each cycle. These rates are compared with those for all European proposals. After lagging somewhat behind the EU averages in the first cycles, in the most recent cycle Italian-PI proposals are performing well above the European average; better than anyone else, in fact - as seen in Table 4.

Also Table 5 compares countries with each other, but with numbers averaged over 4 cycles. In this case, Cols. $7-9$ give percentages relative to *all* proposals pertaining to the EU-executive. This table shows that so far for Italy the percentage of accepted proposals is roughly the same as the percentage of submitted proposals, relative to the EU-executive total.

With the current average of 8% of submitted and accepted EU-proposals, the performance of

Table 4: **Cycle 3: comparison between countries / ARC-nodes**

| Selected Countries (nodes) | PI-proposals subm | top[b] | % | top+fil[c] | % | w.r.t. EU-EX totals[a] % subm | % top[b] | % top+fil[c] |
|---|---|---|---|---|---|---|---|---|
| NL+B (Leiden) | 68 | 14 | 20.6 | 19 | 27.9 | 10.4 | 10.5 | 8.6 |
| S+DK+FIN (Onsala) | 49 | 13 | 26.5 | 19 | 38.8 | 7.5 | 9.8 | 8.6 |
| UK (Manchester) | 135 | 20 | 14.8 | 44 | 32.6 | 20.5 | 15.0 | 20.0 |
| I (Bologna) | 56 | 15 | 26.8 | 23 | 41.1 | 8.5 | 11.3 | 10.5 |
| F+E+D[MPG][d] (Grenoble) | 205 | 52 | 25.4 | 80 | 39.0 | 31.2 | 39.1 | 36.4 |
| D[e]+A+CH (Bonn-Cologne) | 51 | 9 | 17.6 | 16 | 31.4 | 7.8 | 6.8 | 7.3 |

[a] For the EU executive in Cycle 3: 657 proposals submitted, 133 (20.2%) accepted with top priority, 220 (33.5%) accepted including fillers.
[b] "top" means proposals accepted with highest priority (categories A, B).
[c] "fil" means a proposal of grade C, to be used as "filler" (when no higher-priority proposal is available at a certain time).
[d] The German institutes belonging to the Max-Planck-Gesellschaft are counted with IRAM
[e] German institutes, excluding the MPG-institutes.

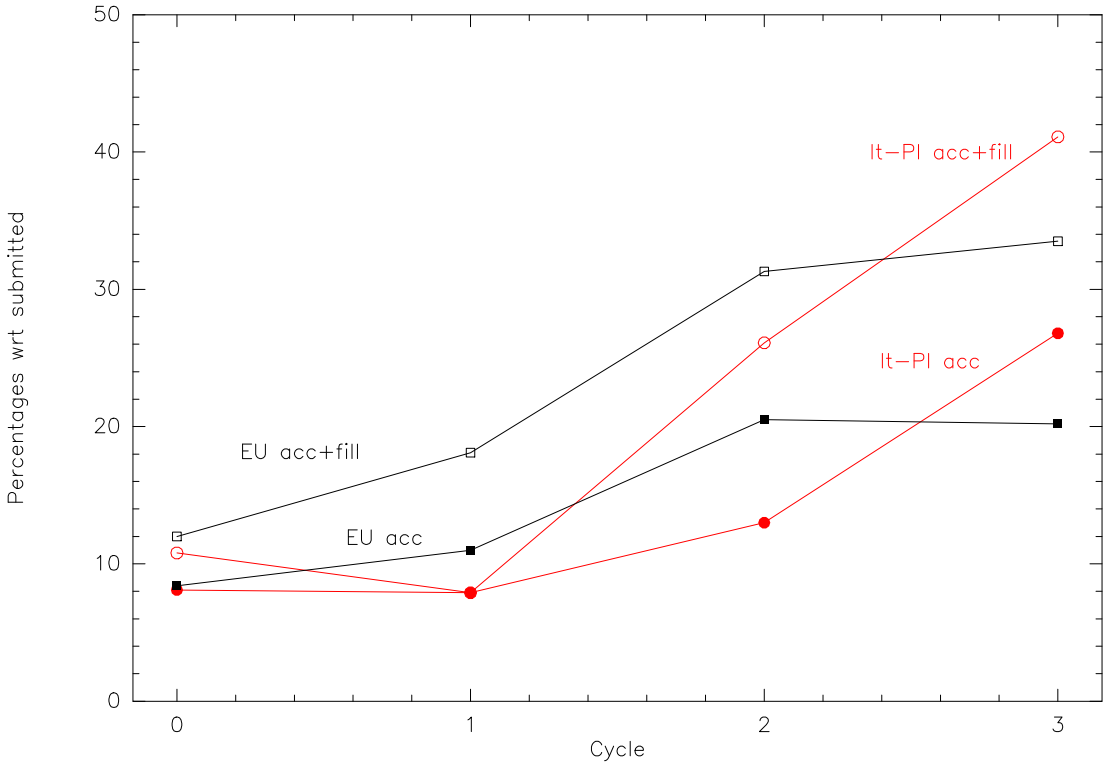


Figure 2: Performance of proposals with Italian PI (red) compared to all European (black) proposals, in terms of percentage of accepted proposals (all priority categories), for each of the 4 Cycles.

Table 5: **Comparison between countries / ARC-nodes: all cycles**

| Selected Countries (nodes) | PI-proposals subm | top[b] | % | top+fil[c] | % | w.r.t. EU-EX totals[a] % subm | % top[b] | % top+fil[c] |
|---|---|---|---|---|---|---|---|---|
| NL+B (Leiden) | 200 | 35 | 17.5 | 53 | 26.5 | 9.5 | 10.4 | 9.9 |
| S+DK+FIN (Onsala) | 163 | 30 | 18.4 | 50 | 30.7 | 7.7 | 8.9 | 9.4 |
| UK (Manchester) | 393 | 50 | 12.7 | 95 | 24.2 | 18.6 | 14.9 | 17.8 |
| I (Bologna) | 172 | 25 | 14.5 | 40 | 23.3 | 8.1 | 7.4 | 7.5 |
| F+E+D[MPG][d] (Grenoble) | 681 | 142 | 20.9 | 203 | 29.8 | 32.2 | 42.3 | 38.1 |
| D[e]+A+CH (Bonn-Cologne) | 195 | 22 | 11.3 | 35 | 17.9 | 9.2 | 6.5 | 6.6 |

[a] For the EU executive in Cycles $0-3$: 2115 proposals submitted, 336 (15.9%) accepted with top priority, 533 (25.2%) accepted including fillers.
[b] "top" means proposals accepted with highest priority (categories A, B).
[c] "fil" means a proposal of grade C, to be used as "filler" (when no higher-priority proposal is available at a certain time).
[d] The German institutes belonging to the Max-Planck-Gesellschaft are counted with IRAM.
[e] German institutes, excluding the MPG-institutes.

Italian-led ALMA projects is very similar to that of Italian-PI proposals for other ESO observing facilities. Averaged over the past 10 years, PI's affiliated to Italian institutes requested 9.4% of the total time on the VLT/VLTI , and obtained 9.8% of the total allocated time. For the other ESO-telescopes (3.6-m, NTT, 2.2-m, APEX) these numbers are 7.2% (requested) and 7.8% (allocated), respectively. Proposals with Italian Co-Is show similar percentages: 8.9% vs. 9.3% (VLT/VLTI; requested vs. allocated) and 7.4% vs. 6.5% (the other telescopes; requested vs. allocated. All numbers kindly provided by F. Patat, Head Observing Programmes Office, ESO). The only difference is that while the percentages of the other ESO facilities are averages over 10 years (ca. 20 periods), those for ALMA are averages over only 4 cycles (ca. 4 years) and they are showing a strong upward trend (an increasingly higher success rate) over the last 3 years.

## 2.3 Comparison with other executives

In Table 6 we compare the success rates of proposals for each executive, over 4 cycles. A graphical representation of the results is shown in Figure 3. There are some interesting points to be noted here. For instance, compared to the other executives there are not many proposals with a Chilean PI, yet Chile gets 10% of the ALMA time; therefore, more than half of the Chilean-led proposals are accepted in order to fill their allocated observing time. In stark contrast with this, an order of magnitude more European proposals are submitted, and although their time allotment is almost 34%, only about a quarter of all EU-proposals are accepted (in all rankings). The North American executive has the same 34% slice of ALMA time as the EU, but more than a third of their proposals make it through (almost the same absolute numbers of accepted proposals, but more than 600 fewer proposals submitted). As shown in Fig. 3 the EU-proposal success rate is even below the percentages for *all* proposals together (regardless of the executive). Relative to the other partners, obtaining ALMA time with an EU-affiliation is much more difficult, and one might be forgiven to hand PI-ship over to a Co-I with a NA- or (preferably) CL-affiliation.

Table 6: **Comparison between Executives: all cycles**

| EXEC[a] | subm | top[b] | % | top+fil[c] | % |
|---|---|---|---|---|---|
| CL | 308 | 111 | 36.0 | 160 | 51.9 |
| EA | 927 | 236 | 25.5 | 348 | 37.5 |
| EU | 2115 | 336 | 15.9 | 533 | 25.5 |
| NA | 1502 | 355 | 23.6 | 522 | 34.8 |
| NA_EA | 50 | 10 | 20.0 | 17 | 34.0 |
| OTHER | 128 | 14 | 10.9 | 19 | 14.8 |

[a] Time shares for the executives: CL 10%, EA 22.5%, EU and NA 33.75%. OTHER-proposals (from non-member countries) are shared among the executives according to their time share percentages. NA_EA (proposals from Taiwan) are assigned to either NA or EA.
[b] "top" means proposals accepted with highest priority (categories A, B)
[c] "fil" means a proposal of grade C, to be used as "filler" (when no higher-priority proposal is available at a certain time)

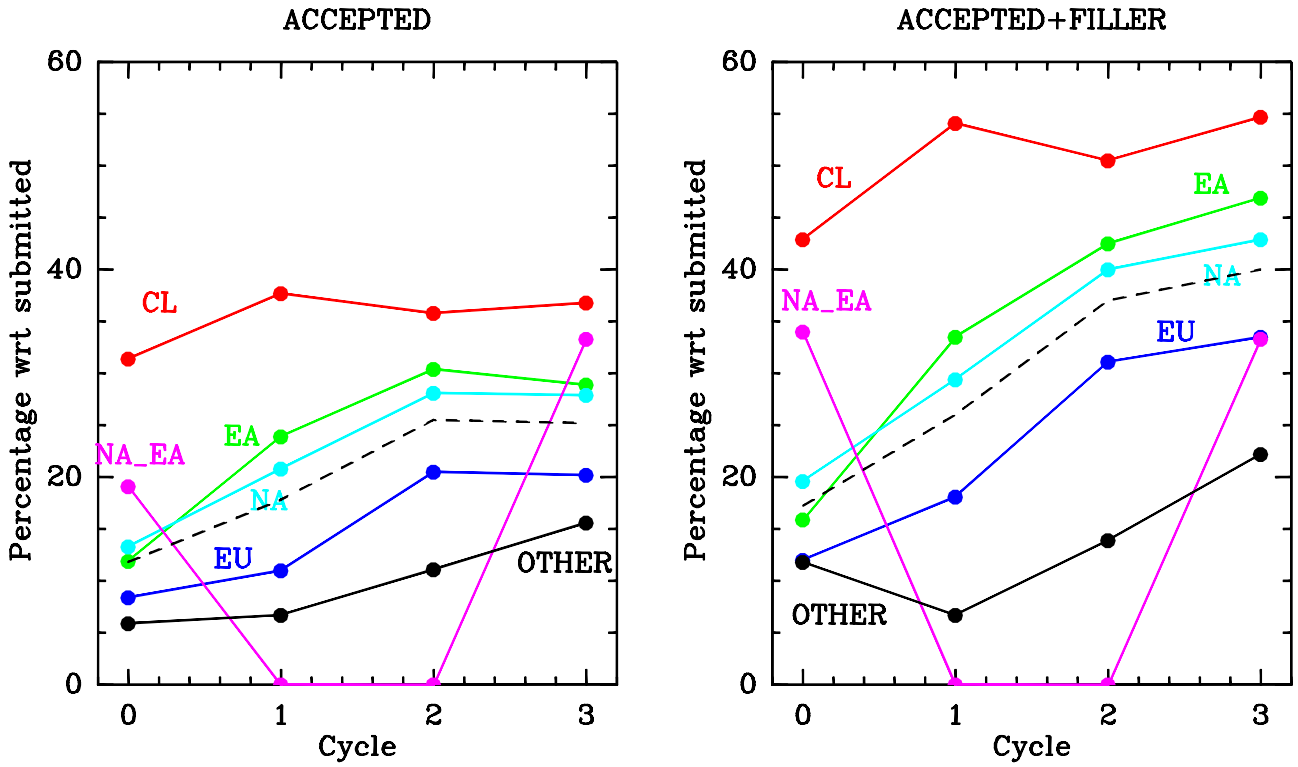


Figure 3: **left:** Comparison of percentage of accepted proposals (top priorities) per executive. The executives are colour-coded and indicated by their acronym (see Table 6). The dashed line indicates the percentages for *all* proposals, regardless of executive. **right:** As left panel, but including "filler" proposals.

# 3. Conclusions

After analyzing data on the proposal submission and acceptance over the first 4 *Early Science* proposal cycles, we come to the conclusion that the Italian community is performing quite well and doing better with each cycle, in terms of number of proposals submitted and accepted, the number of researchers involved in the proposals, and the number and geographical distribution of institutes from which successful proposals were submitted.

When looking at the numbers, and particularly when comparing countries, it should be kept in mind that ALMA is not yet in full operational mode, and that a limited number of hours was (and still is) available for science observations; this was especially so in the earlier cycles. This tends to favour proposals that require little time and/or that build on previous observations with similar instruments, and this in turn tends to favour researchers with easier access to such instruments, such as those from IRAM-countries or, to some extent, Sweden. From this point of view, most Italian applicants for ALMA time therefore started with a disadvantage, and that may explain the slow start. However, Italian-led proposals show an increased success rate with each cycle, and the initial lag with respect to other countries is rapidly disappearing. Furthermore it is clear from a comparison between the executives, that **the proposal pressure for the EU-executive is considerably larger than for the others.** The numbers show that it is much more difficult to get a proposal accepted under EU-flag than any other.

The Italian ALMA Regional Centre has been very active throughout the *Early Science* cycles, and has started well before that with bringing ALMA to the attention of the community. The ARC has reached out, informing and forming a growing group of potential ALMA users, in many different ways, as described in Section 1 of this document. It seems clear that the increased participation of the Italian astronomical community and the increasingly positive performance of Italian proposals, is at least in part due to these efforts.

Having said that, the main conclusions can be summarized as follows:

– There is an increase in submitted proposals led by Italian PIs;

– There is an increase in accepted proposals with Italian PIs;

– There is an increase in the number of Italian PIs and Co-I's (i.e. there is increased participation of Italian researchers);

– There is an increased territorial distribution of submitted and accepted Italian proposals.

– Over the last three cycles the fraction of Italian-led proposals (relative to submitted Italian-PI proposals) that are accepted increases with each cycle, and in the latest cycle they performed better than any other EU-country;

– Over 4 cycles, Italy "breaks even": Italian PI-led proposals constitute about 8% of all submitted EU-executive proposals, and also about 8% of all accepted EU-executive proposals. These percentages are already similar to those for the other ESO observing facilities, established over a longer time;

– Averaged over 4 cycles, the countries that do better than Italy all already have a strong tradition in mm-astronomy with strong groups and/or privileged access to (sub)mm telescopes. But Italian astronomers are clearly catching up.