ALMA Early Science Cycle 2: Outcome of the Proposal Review Process

Proposal Review Process

In response to the Call for Proposals for Early Science Cycle 2, ALMA received 1381 valid proposals for scientific observations by the 5 December 2013 submission deadline. These proposals, referred to hereafter as "submitted proposals", were reviewed by 11 ALMA Review Panels (ARP), comprising each 7 Science Assessors. To ensure a fairly even workload between the different ARPs, they were distributed as follows across the 5 ALMA scientific categories:

1. Cosmology and the high redshift universe (2 panels);
2. Galaxies and galactic nuclei (3 panels);
3. ISM, star formation and astrochemistry (3 panels);
4. Circumstellar disks, exoplanets and the solar system (2 panels);
5. Stellar evolution and the Sun (1 panel).

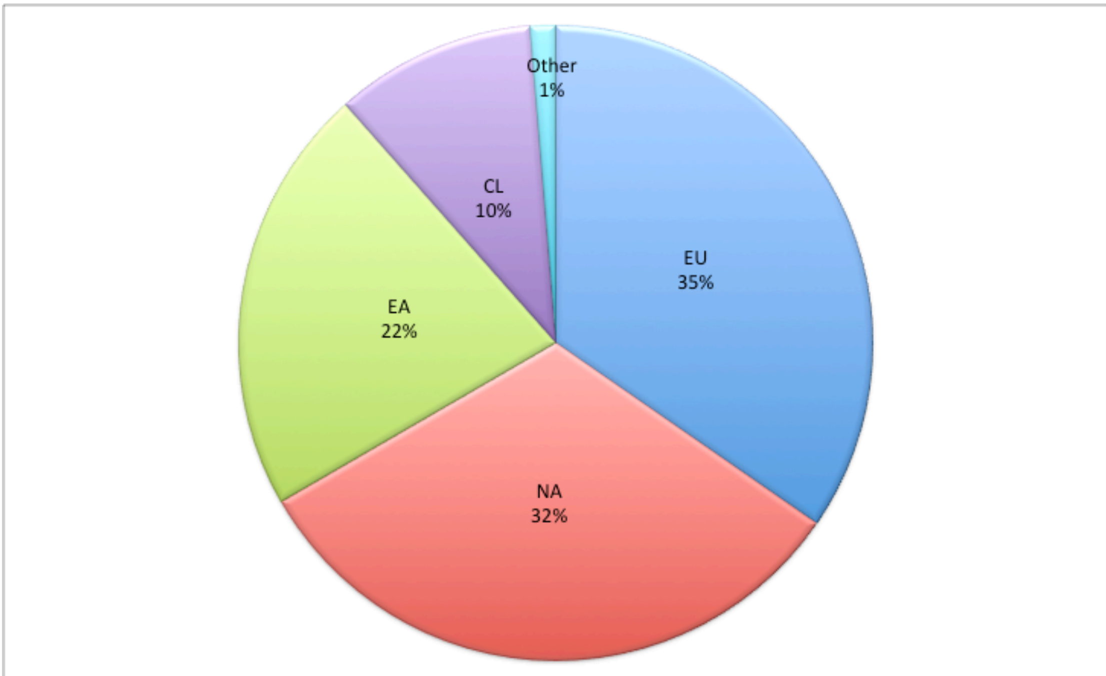

Figure 1. Regional distribution of the Science Assessors.

Table 1. Cycle 2 APRC and ARP members

APRC chair:	
Françoise Combes	Paris Observatory (France)
APRC and ARP members:	
Susanne Aalto	Chalmers University of Technology (Sweden)
Rachel Akeson	California Institute of Technology (USA)
Hector Arce	Yale University (USA)
Andrew Baker	Rutgers, The State University of New Jersey (USA)
John Bally	University of Colorado at Boulder (USA)
Felipe Barrientos	Pontificia Universidad Católica de Chile (Chile)
Maite Beltran	INAF (Italy)
Jacqueline Bergeron	Institut d'Astrophysique de Paris (France)
Michael Bietenholz	York University (Canada)
Andrew Blain	University of Leicester (UK)
Leonardo Bronfman	Universidad de Chile (Chile)
John Carpenter	California Institute of Technology (USA)
Cecilia Ceccarelli	Grenoble Observatory (France)
Jose Cernicharo	Centro de astrobiología (INTA-CSIC) (Spain)
Claire Chandler	National Radio Astronomy Observatory, Socorro (USA)
Cathie Clarke	University of Cambridge (UK)
Kristen Coppin	University of Hertfordshire (UK)
Leen Decin	Catholic University of Leuven (Belgium)
Therese Encrenaz	Paris Observatory (France)
Jayanne English	University of Manitoba (Canada)
Asunción Fuente	National Astronomical Observatory (Spain)
Yasuo Fukui	Nagoya University (Japan)
Guido Garay	Universidad de Chile (Chile)
Maryvonne Gerin	Paris Observatory (France)
Mark Gurwell	Harvard-Smithsonian Center for Astrophysics (USA)
Jorma Harju	Helsinki University (Finland)
Naomi Hirano	Academia Sinica Institute of Astronomy and Astrophysics (Taiwan)
Leslie Hunt	INAF (Italy)
Frank Israel	Leiden University (Netherlands)
Rob Ivison	University of Edinburgh (UK)
Andres Jordan	Pontificia Universidad Católica de Chile (Chile)
Sheila Kannappan	University of North Carolina at Chapel Hill (USA)
Hiroshi Karoji	The University of Tokyo (Japan)
Gillian Knapp	Princeton University (USA)
Kotaro Kohno	The University of Tokyo (Japan)
Nario Kuno	National Astronomical Observatory of Japan (Japan)
Ute Lisenfeld	Granada University (Spain)
Leslie Looney	University of Illinois at Urbana-Champaign (USA)
Lori Lubin	University of California, Davis (USA)
Dieter Lutz	Max-Planck-Institute for Extraterrestrial Physics (Germany)

Satoki Matsushita	Academia Sinica (Taiwan)
Akira Mizuno	Nagoya University (Japan)
Raffaella Morganti	Netherlands Institute for Radio Astronomy (ASTRON) (Netherlands)
Frédérique Motte	CEA Saclay (France)
Neil Nagar	Universidad de Concepción (Chile)
Fumitaka Nakamura	National Astronomical Observatory of Japan (Japan)
Hideko Nomura	Tokyo Institute of Technology (Japan)
Karin Oberg	Harvard-Smithsonian Center for Astrophysics (USA)
Nagayoshi Ohashi	Academia Sinica (Taiwan)
Tomoharu Oka	Keio University (Japan)
Sadanori Okamura	Hosei University (Japan)
Hans Olofsson	Chalmers University of Technology (Sweden)
Takashi Onaka	University of Tokyo (Japan)
Olja Panic	University of Cambridge (UK)
Ilaria Pascucci	University of Arizona (USA)
Alexandra Pope	University of Massachusetts at Amherst (USA)
Thomas Puzia	Pontificia Universidad Católica de Chile (Chile)
Erik Rosolowsky	University of Alberta (Canada)
Seiichi Sakamoto	Japan Aerospace Exploration Agency (Japan)
David Sanders	University of Hawaii at Manoa (USA)
Sho Sasaki	Osaka University (Japan)
Joachim Saur	University of Cologne (Germany)
Marc Sauvage	CEA Saclay (France)
Peter Schilke	University of Cologne (Germany)
Eva Schinnerer	Max-Planck-Institute for Astronomy (Germany)
Matthias Schreiber	Universidad de Valparaiso (Chile)
Nick Scoville	California Institute of Technology (USA)
Snezana Stanimirovic	University of Wisconsin at Madison (USA)
Lister Staveley-Smith	International Centre for Radio Astronomy Research (Australia)
Yoshiaki Taniguchi	Ehime University (Japan)
Ezequiel Treister	Universidad de Concepción (Chile)
Masato Tsuboi	Institute of Space and Astronautical Science (Japan)
Jean Turner	University of California at Los Angeles (USA)
Geronimo Villanueva	National Aeronautics and Space Administration (USA)
David Wilner	Harvard-Smithsonian Center for Astrophysics (USA)
Christine Wilson	McMaster University (Canada)
Liese van Zee	Indiana University (USA)

Science Assessors were selected on scientific expertise, taking into account regional balance. As can be seen in Figure 1, the regional distribution of the ARP members closely matches the nominal ALMA regional shares of the observing time. The 11 ARP Chairs served on the ALMA Proposal Review Committee (APRC), together with an ARP member acting as Chilean representative, and the APRC Chair, Françoise Combes, who did not belong to any ARP. The full list of Cycle 2 Science Assessors is given in Table 1.

The proposal review process was carried out as described in the ALMA Cycle 2 Proposer's Guide. At Stage 1, each proposal was evaluated by 4 Science Assessors. A ranked list of all proposals was built on the basis of the scores that they assigned. The top 70% of this ranking proceeded to Stage 2, as did those proposals with a large dispersion of the Stage 1 scores. At Stage 2, the ARPs met face-to-face in London, Ontario (Canada), on March 10–13, to discuss all proposals assigned to them that were still under consideration, taking into account the technical assessments performed by ALMA staff members, and to rank them. On March 14, the APRC reviewed the single ranked list resulting from the merging of the individual ARP rankings, paying particular attention to the handling of proposals involving duplicated observations. It identified a set of 35 proposals to be assigned Grade A, which makes them eligible for carry-over to Cycle 3 if they cannot be successfully completed by end of Cycle 2. Selection of these 35 Grade A projects was based exclusively on their scientific merits. Going down the APRC ranked list, and factoring in the regional shares, the Joint ALMA Observatory (JAO) built a list of 318 Grade B proposals. It also established a list of 160 Grade C proposals, to be used as "fillers", for observation when the conditions do not allow any Grade A or Grade B projects to be carried out. The Directors' Council and the Chilean representative endorsed this scientific program, which is summarized in the present document. Notifications on individual proposals were emailed to the Principal Investigators (PI) on April 9.

Proposal statistics and regional distributions

The estimated execution time of the 353 Grade A and B projects amounts to 1700 hours of 12-m Array usage.[1] The Grade C projects account for an additional 800 hours of estimated execution time. Both groups of projects are shared across the regions in the agreed proportions of 12-m Array time based on the shares of the partners' and of the host country.

Among the 353 Grade A and B projects, 53 include observations with the Atacama Compact Array (ACA); such observations are also part of 27 of the 160 Grade C projects. According to current estimates, their execution should require respectively 812 hours (for Grade A and B projects) and 495 hours (for Grade C) of ACA time.

[1] An additional 470 hours are expected to be needed for the completion of carried-over Cycle 1 projects. See the June 06, 2014 News Item in the ALMA Science Portal.

Twenty proposals that would have qualified for scheduling based on their scientific rank were rejected on technical grounds.

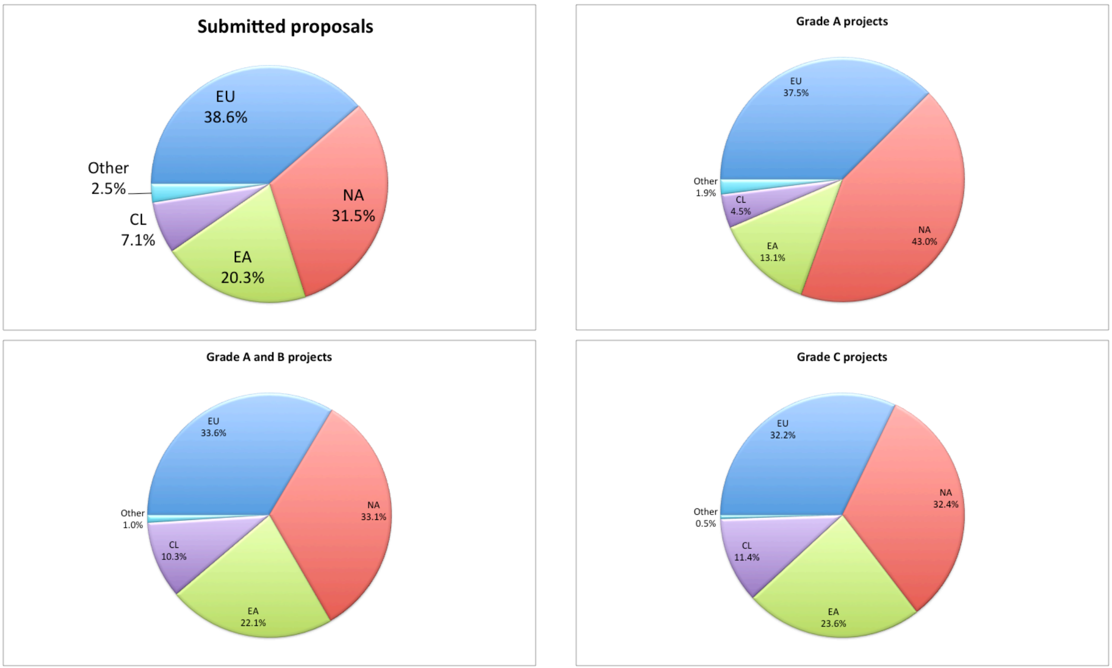

Figure 2. Regional share of 12-m Array time for all submitted proposals, and for the proposals recommended for scheduling with Grade A, Grades A and B, and Grade C.

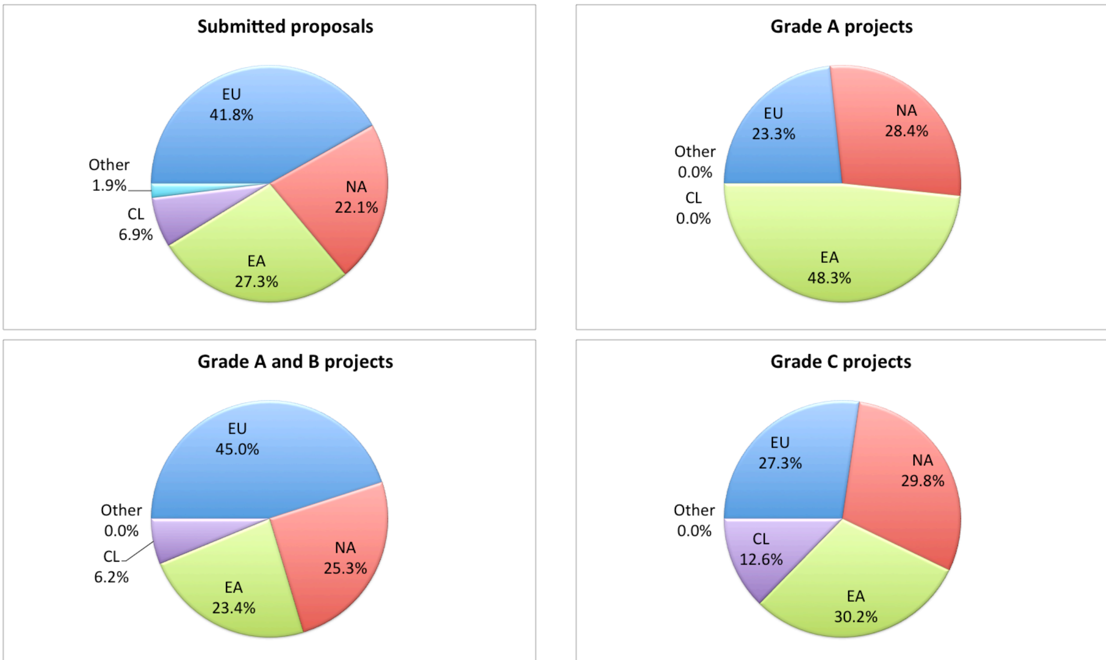

Figure 3. Regional share of ACA time for all submitted proposals, and for the proposals recommended for scheduling with Grade A, Grades A and B, and Grade C.

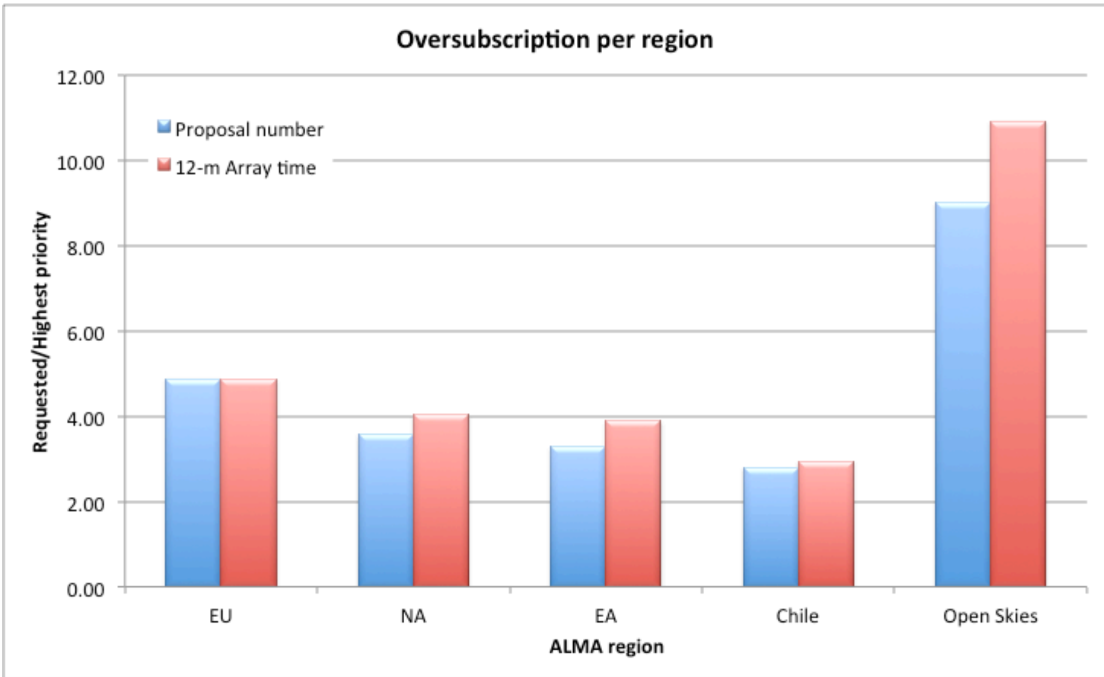

Figure 4. *Blue:* Ratio of the number of submitted proposals to the number of proposals assigned Grades A and B, by region. *Red:* Ratio of the estimated amount of 12-m Array time required for execution of all submitted proposals to that required for execution of the Grade A and B projects.

Figure 2 shows the distribution across the ALMA regions of the estimated amount of 12-m Array time required for execution (i) of all the submitted proposals, (ii) of the Grade A projects, (iii) of the Grade A and B projects, and (iv) of the Grade C projects. Figure 3 is similar, but with respect to ACA time.

The estimated total amount of 12-m Array time that would be required for execution of all submitted proposals exceeds the 12-m Array execution time of the Grade A and B proposals by a factor of 4.2. This is similar to the ratio of the number of submitted proposals to that of Grade A and B proposals, 3.9.

As can be seen in Figure 4, the similarity between the oversubscription factor in terms of number of proposals, on the one hand, and in terms of execution time, on the other hand, also stands when one considers the proposals region-by-region.

The distribution of the 12-m Array execution time of the Grade A and B proposals (see Figure 5) is similar to that of all submitted proposals (Figure 6). In particular, both distributions have essentially the same median value: respectively, 4.32 and 4.47 hours, as per the Observing Tool (OT) estimate.

Table 2 summarizes the main elements of information on the distribution of the proposals across the ALMA regions.

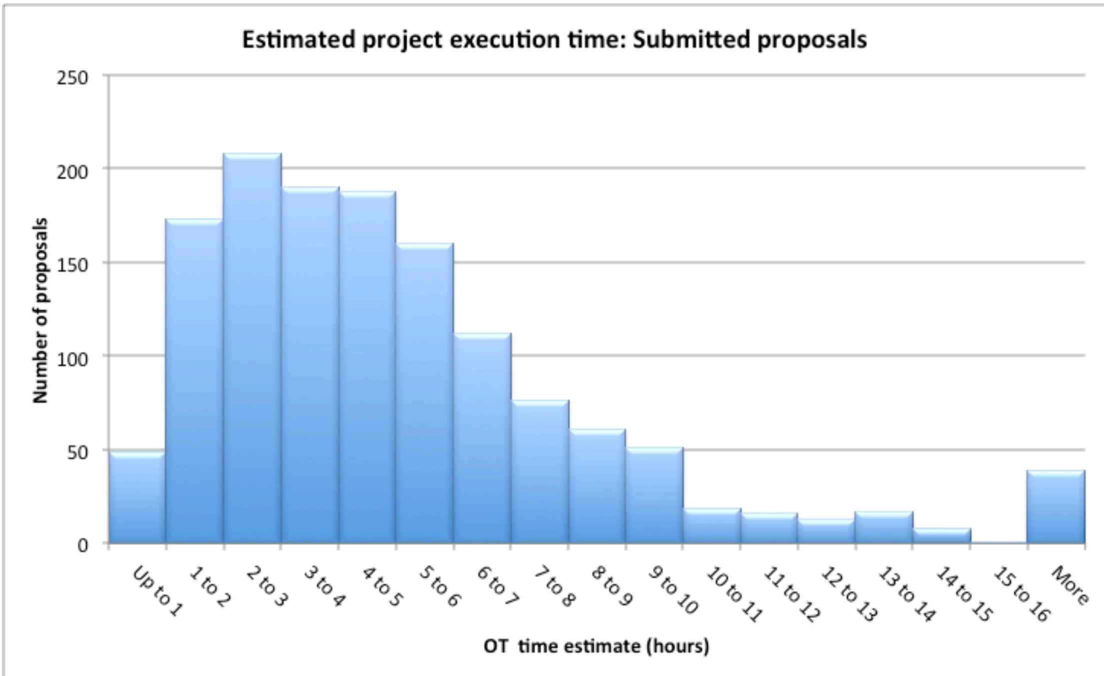

Figure 5. Distribution of the amount of 12-m Array observing time per proposal (as per the OT estimate), for the 1381 Cycle 2 proposals considered in the review process.

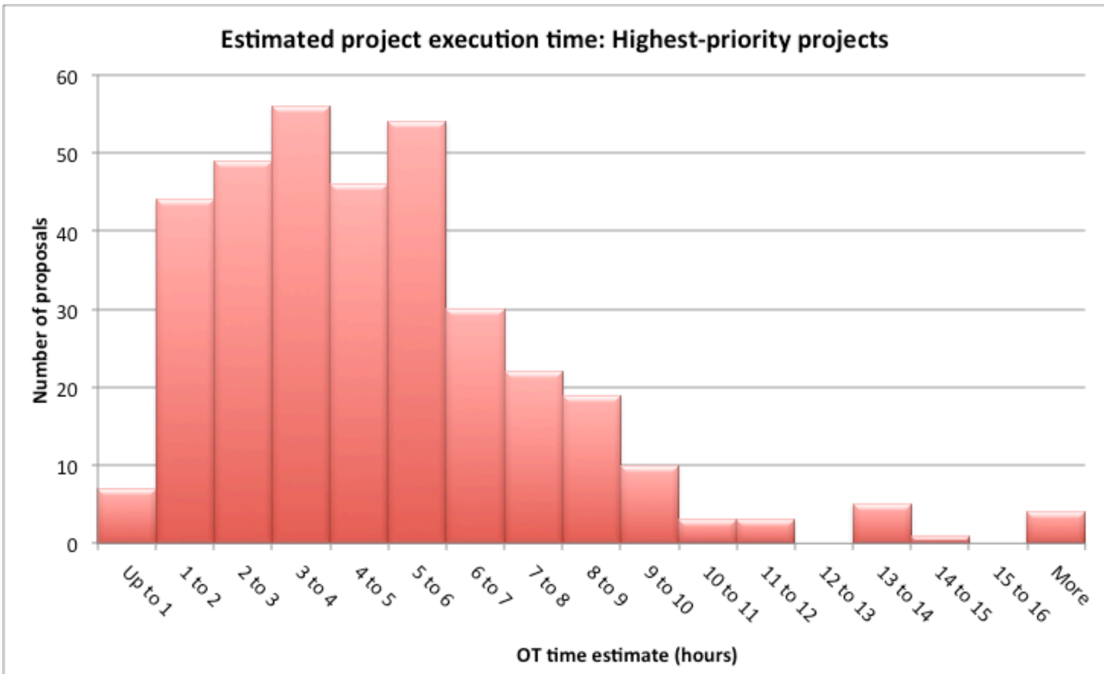

Figure 6. Distribution of the amount of 12-m Array observing time per proposal (as per the OT estimate), for the 353 Cycle 2 proposals assigned Grades A and B.

Table 2. Regional distribution of all submitted proposals, of the Grade A and B projects, and of the Grade C projects.

	EU	NA	EA	CL	Other	Total
Submitted Proposals						
Number of proposals	561	417	272	95	36	1381
Fraction of submitted proposals	40.6%	30.2%	19.7%	6.9%	2.6%	100%
Subscription rate	4.9	4.0	3.9	2.9	10.9	4.2
Grade A & B projects						
Number of proposals	115	117	83	34	4	353
Fraction of high priority proposals	32.6%	33.1%	23.5%	9.6%	1.1%	100%
Fraction of available 12-m Array time	34.2%	33.7%	22.5%	10.4%	1.0%	102%
Grade C projects						
Number of proposals	61	50	33	15	1	160
Fraction of filler projects	38.1%	31.3%	20.6%	9.4%	0.6%	100%
Fraction of available 12-m Array time	16.1%	16.2%	11.8%	5.7%	0.2%	50%

User statistics

A total of 3405 unique users participated in the Cycle 2 Call, as either PI or Co-Investigator (Co-I) on a proposal. The 353 Grade A and B proposals involve 1584 unique users and 302 unique PIs. Of the 253 users who were PIs on more than one proposal, 12 had more than one project assigned Grade A or B. The list of the Grade A and B projects was published in a previous News article.

The composition of the proposing teams of the submitted proposals ranged from one single PI to 61 proposers; Grade A and B projects involve between 1 and 35 authors per proposal. The mean number of proposers per submitted project was 8.5; the mean number of proposers per Grade A or B project is 9.4. The distribution of the number of proposers per proposal is shown in Figure 7 for all submitted projects, and in Figure 8 for those assigned Grades A and B.

Table 3 shows the distribution of the country or executive of affiliation of PIs and Co-Is of submitted, Grade A and B, and Grade C proposals. Note that the total number of unique PIs is lower than the sum of the number of unique PIs per country or executive because some PIs from Taiwan submitted proposals on account of both EA and NA. For the statistics of all unique proposers (PIs and Co-Is), for Taiwan, a 50/50 executive split between EA and NA was arbitrarily adopted, since Co-Is do not have the option to select their proposal submission executive.

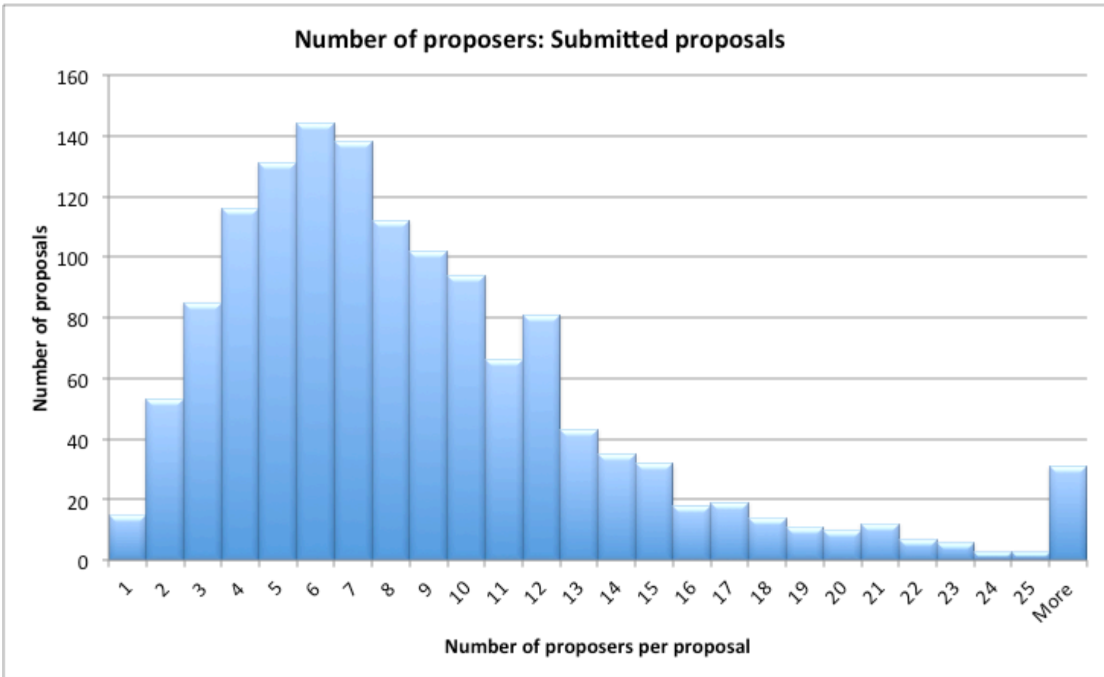

Figure 7. Distribution of the total number of proposers (PI + Co-Is) per proposal, for all submitted Cycle 2 proposals.

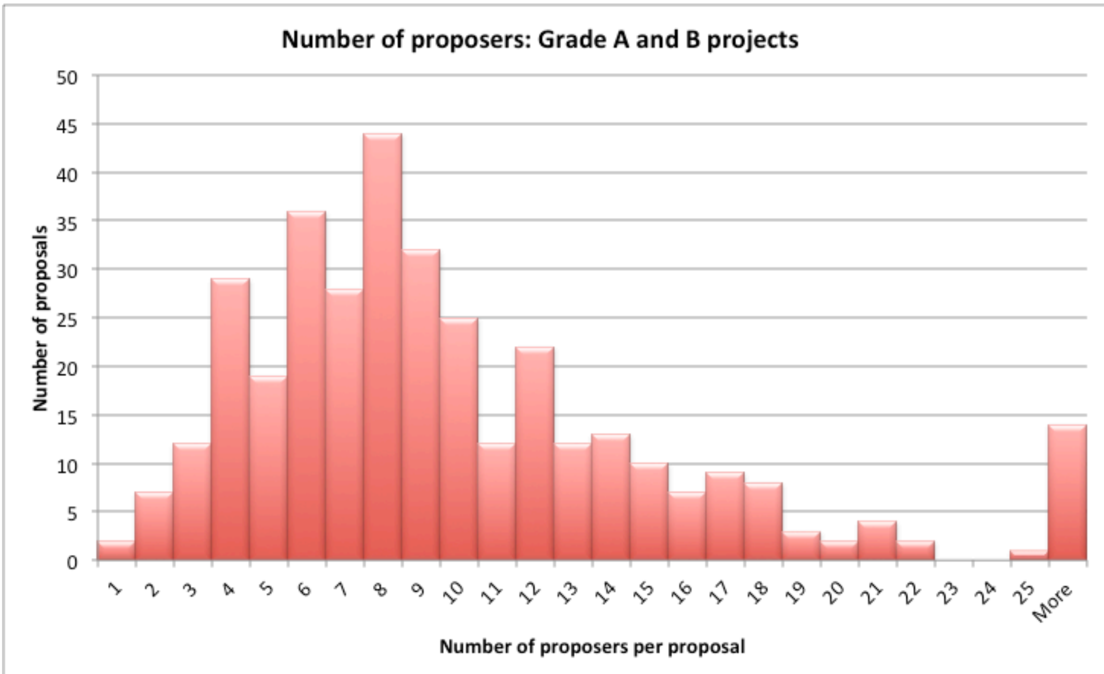

Figure 8. Distribution of the total number of proposers (PI + Co-Is) per proposal, for the Cycle 2 proposals assigned Grade A or B.

Table 3. Distribution of the country or executive of affiliation of PIs and Co-Is or submitted, Grade A and B, and Grade C proposals.

Country/ Executive	Number of submitted proposals	Number of Grade A and B projects	Number of Grade C projects	Number of unique Pis	Number of unique investigators
Canada	30	5	8	25	74
Chile	97	35	15	62	103
ESO countries	562	116	61	449	1521
Japan	188	62	26	129	328
South Korea	22	4	0	17	51
Taiwan (via EA)	62	17	7	46	44
Taiwan (via NA)	8	3	0	8	44
USA	374	106	42	283	956
Open Skies	38	5	1	34	284
Total	1381	353	160	1053	3405

Science categories

Figure 9 and Figure 10 show the distribution of the number of proposals per science category, respectively for all submitted proposals, and for Grade A, B, and C proposals.

Although the overall proposal ranked list was built in such a way that the fraction of proposals per category in any (large enough) range of ranks is proportional to the fraction of proposals per category for the full set of submitted proposals, departures from this proportionality are introduced when this ranked list is folded with the regional time shares so as to define the groups of proposals assigned highest priority and filler status. Their origin can be understood from consideration of Figure 11, which illustrates the differences between the scientific interests of the ALMA communities of the different regions, as reflected by their Cycle 2 proposals.

Both for all submitted proposals, and for those assigned Grade A, B or C, the distribution of the estimated 12-m Array time per category differs significantly from their distributions in number (compare Figure 13 and Figure 14 with, respectively, Figure 9 and Figure 10). This is primarily due to differences in the mean 12-m Array time per proposal between the different categories, and especially, the greater amount of observing time per Category 1 proposal, and the lower amount of observing time per Category 3 proposal, compared to Categories 2, 4 and 5 (see Figure 12).

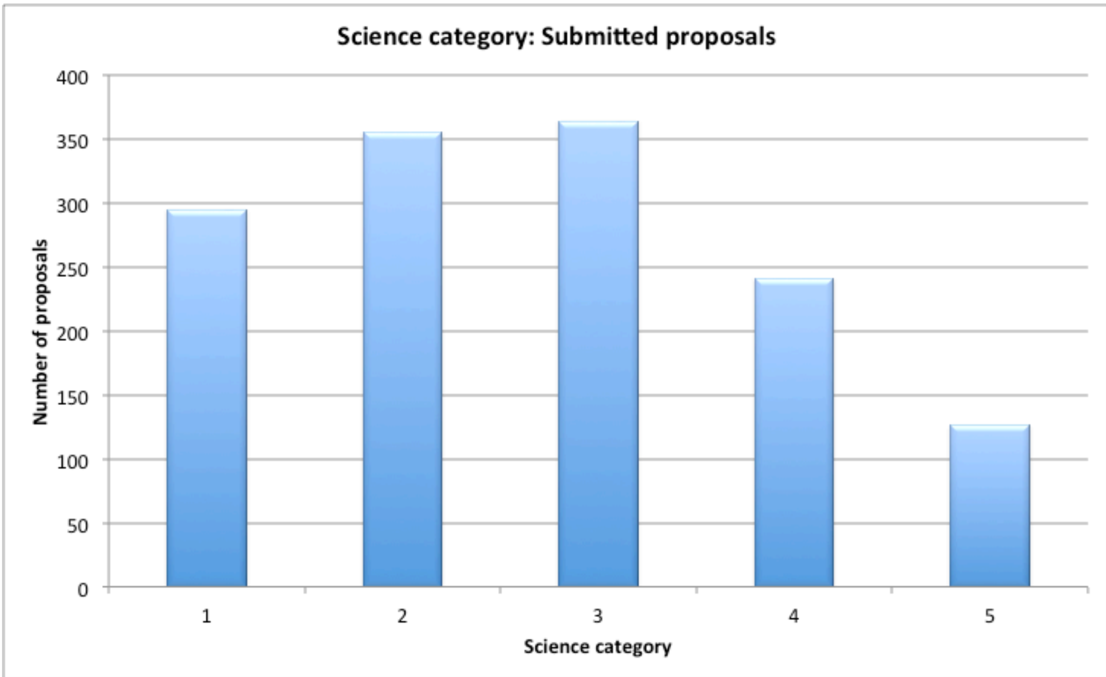

Figure 9. Distribution of the number of submitted proposals per science category.

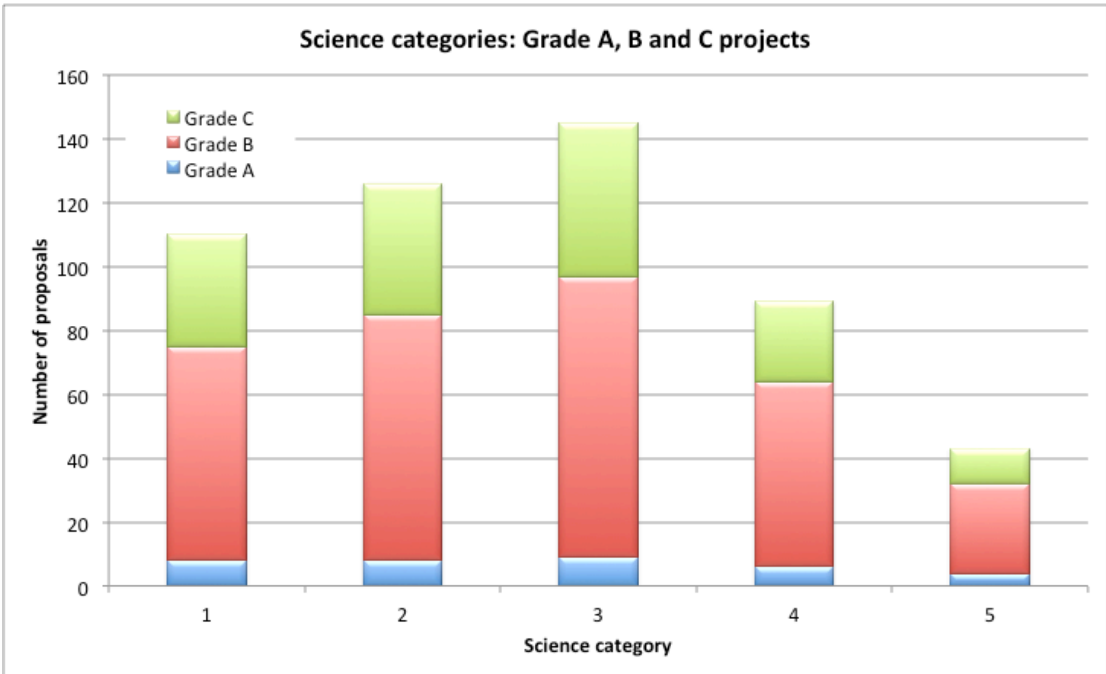

Figure 10. Distribution of the number of proposals per science category for Grade, A, B and C projects.

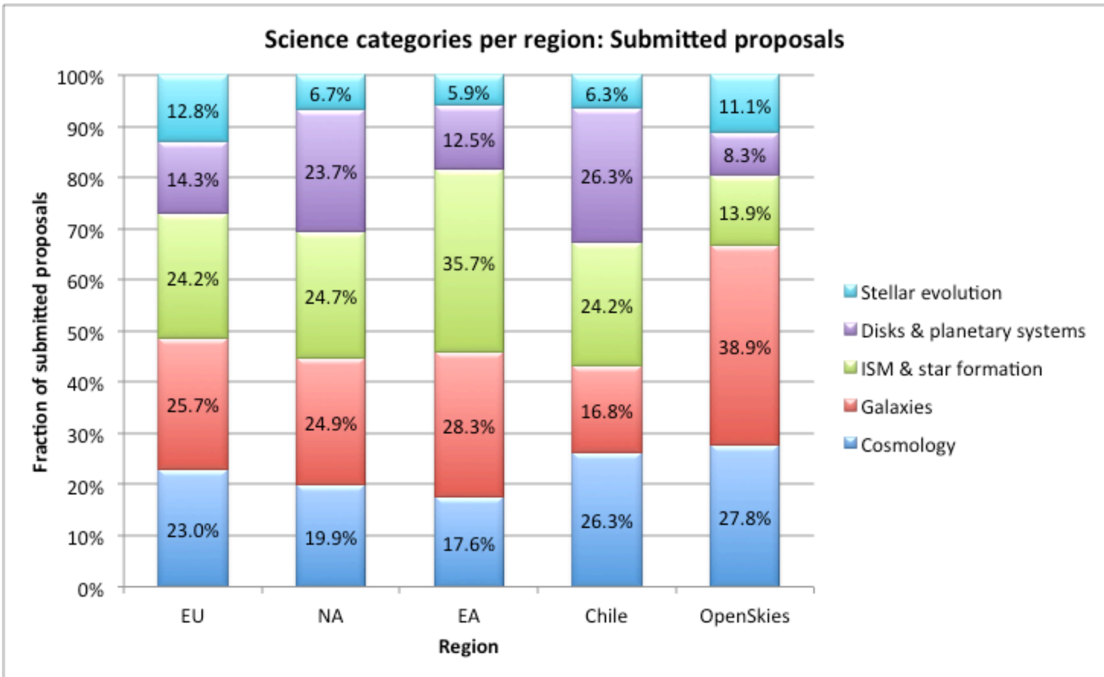

Figure 11. Distribution of submitted proposals across science categories, for each ALMA region.

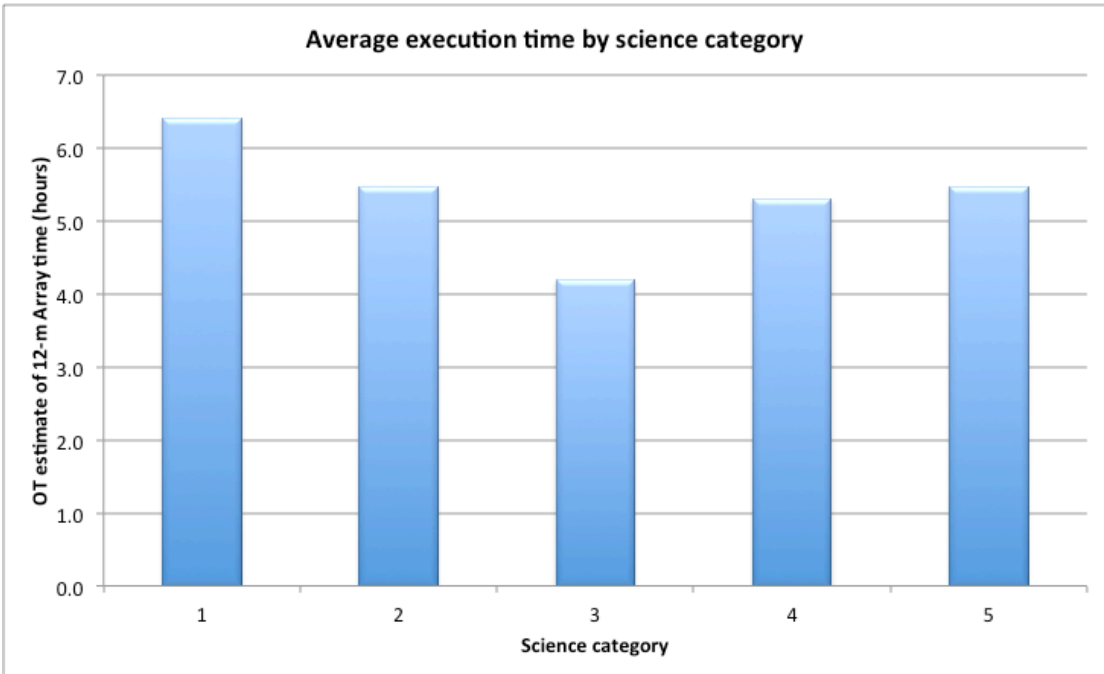

Figure 12. Distribution of the average proposal length of 12-m Array time per science category for all submitted proposals.

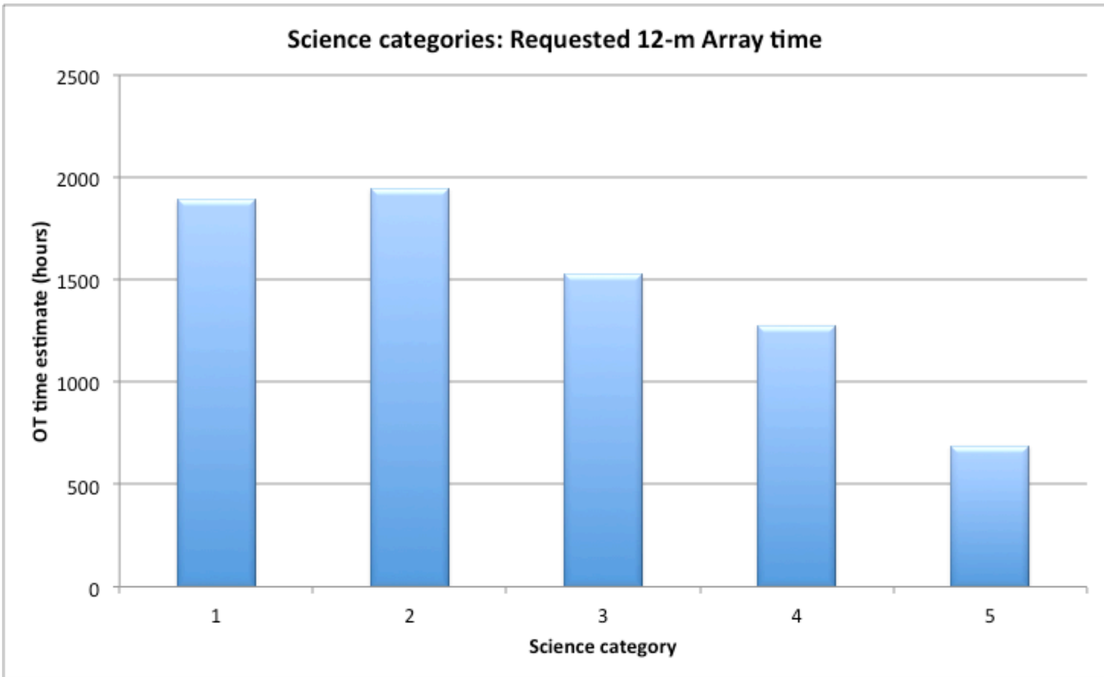

Figure 13. Total requested 12-m Array time for each scientific category.

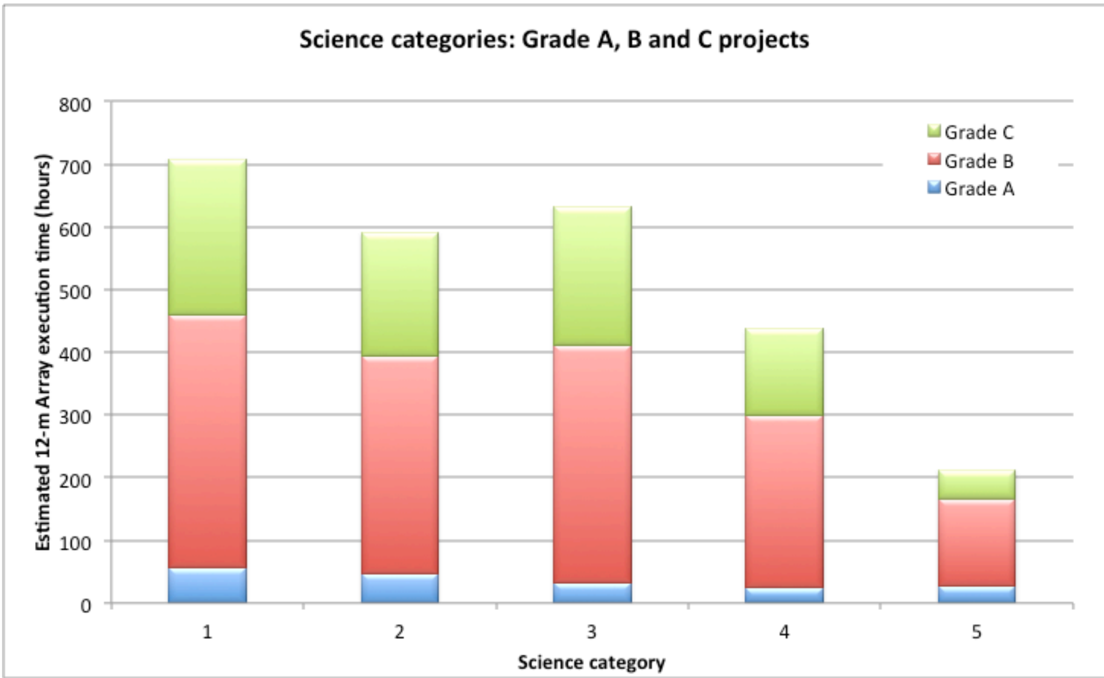

Figure 14. Distribution of the amount of 12-m Array time per science category for Grade A, B and C projects.

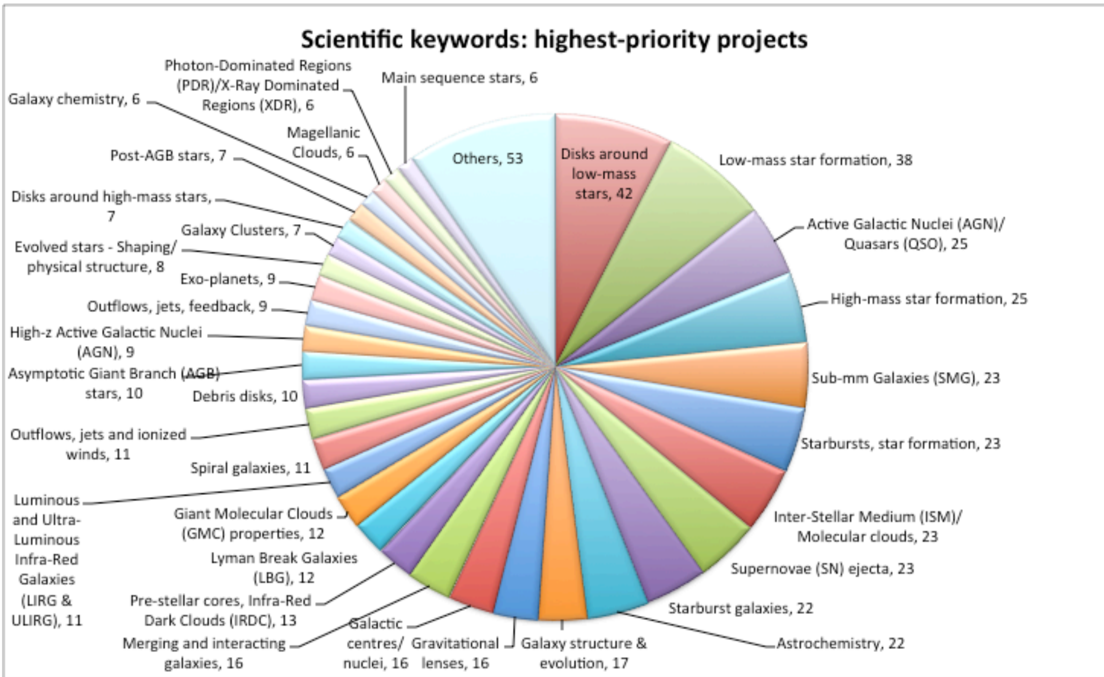

Figure 15. Breakdown of the Grade A and B projects by scientific keyword, across all ALMA scientific categories. For each science keyword, the number of proposals in which it is selected is indicated.

Figure 15 illustrates the wide range of scientific topics covered by the Grade A and B projects. It is based on the ALMA scientific keywords specified in the proposals, counting the number of occurrences of each in the highest-priority proposals. Of the 353 Grade A and B projects, 173 include a single scientific keyword, and 180 include two. The latter are counted twice (once for each keyword) in Figure 15. Keywords that are specified in less than 6 Grade A and B proposals appear under “Others”. Of the 58 scientific keywords available for Cycle 2, 5 do not feature in any Grade A or B proposal. Table 4 gives a list of the scientific keywords most frequently occurring in the Grade A and B proposals.

Table 4. Scientific keywords occurring in more than 9 Grade A or B proposals

Scientific keyword	Number of occurrences
Disks around low-mass stars	42
Low-mass star formation	38
Active Galactic Nuclei (AGN)/Quasars (QSO)	25
High-mass star formation	25
Sub-mm Galaxies (SMG)	23
Starbursts, star formation	23
Inter-Stellar Medium (ISM)/Molecular clouds	23
Supernovae (SN) ejecta	23
Starburst galaxies	22
Astrochemistry	22
Galaxy structure & evolution	17
Gravitational lenses	16
Galactic centres/nuclei	16
Merging and interacting galaxies	16
Pre-stellar cores, Infra-Red Dark Clouds (IRDC)	13
Lyman Break Galaxies (LBG)	12
Giant Molecular Clouds (GMC) properties	12
Luminous and Ultra-Luminous Infra-Red Galaxies (LIRG & ULIRG)	11
Spiral galaxies	11
Outflows, jets and ionized winds	11
Debris disks	10
Asymptotic Giant Branch (AGB) stars	10

Scheduling Pressure by Receiver band, LST and Configuration

The next two figures show the requested number of hours per ALMA receiver band for all submitted proposals (Figure 16), and for projects receiving A, B or C grades (Figure 17). The distribution of the 12-m Array time between the different bands as part of Grade A, B or C projects is roughly similar to its distribution in all submitted proposals. In particular, Grade A and B projects requesting Bands 8 and 9 require close to 10% of the total available 12-m Array time: this represents a good match with the fraction of the time when observing conditions are suitable for science observations in these bands (see Figure 1 of the ALMA Cycle 2 Proposer's Guide).

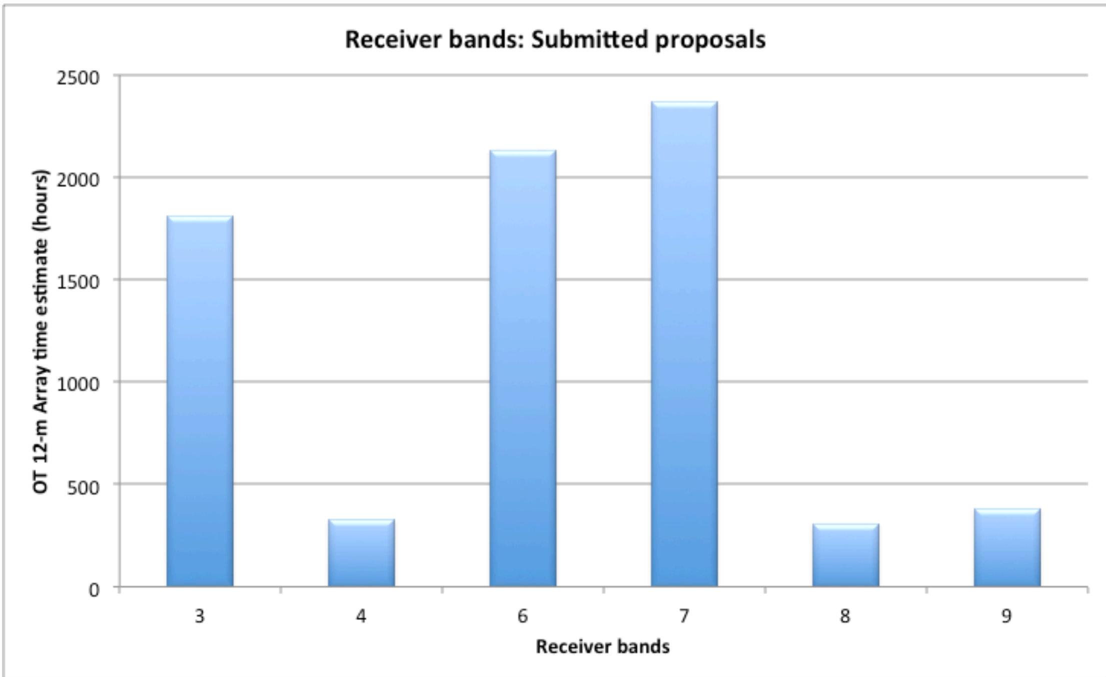

Figure 16. Distribution of the amount of 12-m Array time per receiver bands for all submitted proposals.

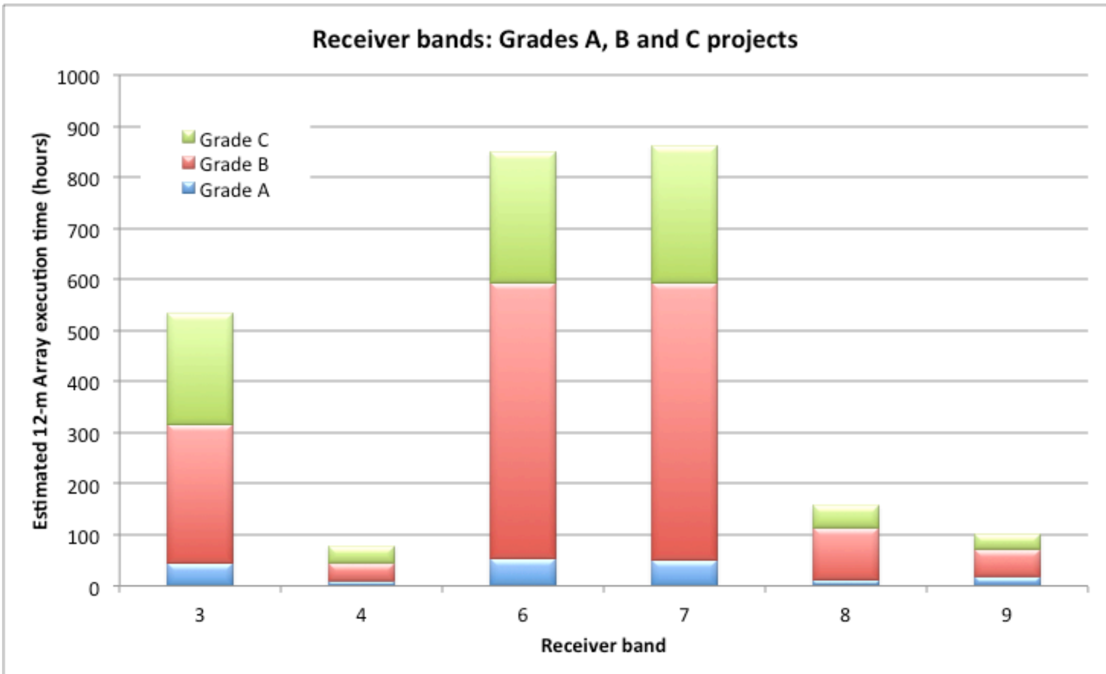

Figure 17. Distribution of the amount of 12-m Array time per receiver band for Grade A, B and C projects.

Figure 18 shows the distribution of project components (science goals) as a function of the mean LST for the science goal, color-coded by project grade. The histogram labeled SSO/ToO is for projects observing Solar System Objects or Targets of Opportunity, for which an average LST is not relevant.

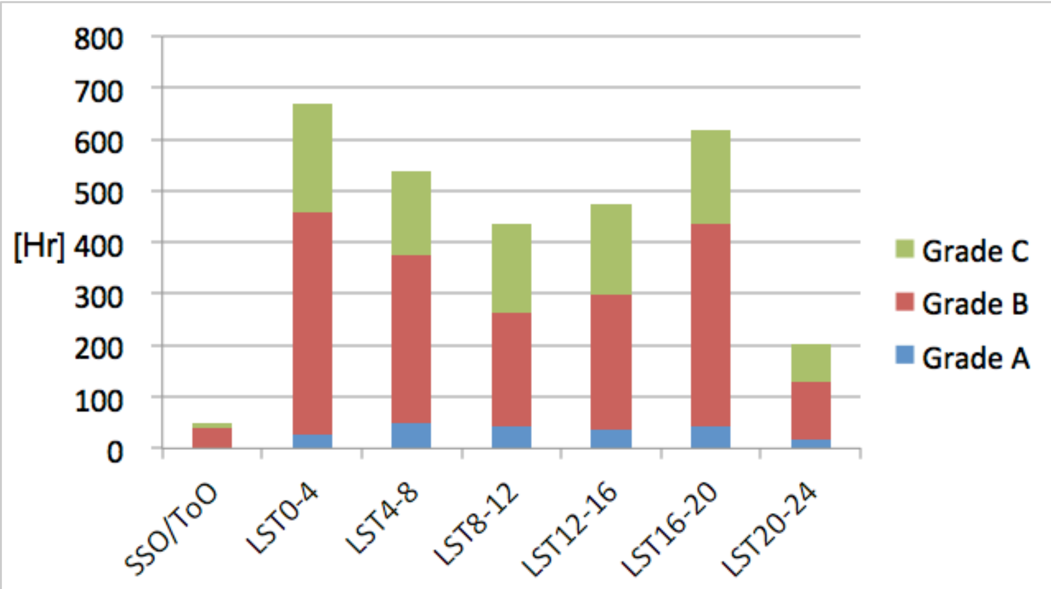

Figure 18. Distribution of the amount of 12-m Array time as a function of LST (calculated from average of each science goal), color-coded by project grade. The left-most bar is for science goals observing Solar System Objects or Targets of Opportunity.

Figure 19 shows again the scheduling pressure as a function of the mean LST of each science goal, but this time only for Grade A or B proposals, and color-coded by the 12-m Array configuration appropriate for the angular resolution and frequency specified in the science goal.

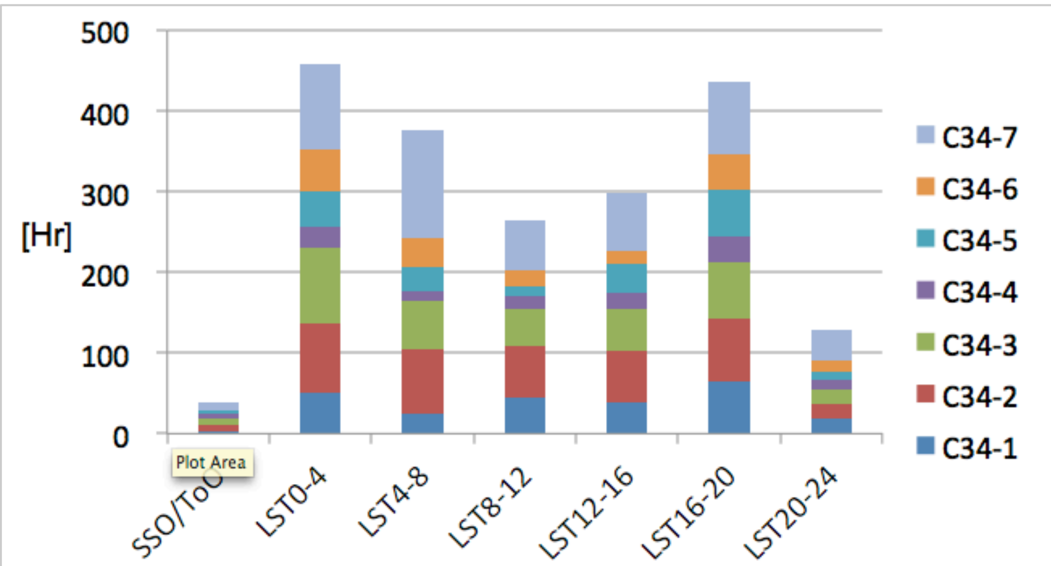

Figure 19. Distribution of the amount of 12-m Array time as a function of LST (calculated from average of each science goal) for Grade A and B projects, color-coded by the 12-m Array configuration (see text). The left-most bar is for science goals observing Solar System Objects or Targets of Opportunity.

Finally, in Figure 20 we show the scheduling pressure as a function of the 12-m Array configuration (as inferred from the angular resolution and observing frequency specified in the science goal), color-coded by requested receiver band. As can be seen, the scheduling pressure is bimodal, with the highest demand for the most extended configuration (C34-7, maximum baseline ~1.5 km), and the largest aggregate demand for the three most compact configurations (C34-1, -2, -3, maximum baselines ~130-190 m). The overall scheduling demand will be impacted by the ~470 hours of unfinished Cycle 1 High Priority projects that transfer into Cycle 2, two-thirds of which require observations in C34-5 and C34-6, and the remaining one-third need observations in the more compact configurations.

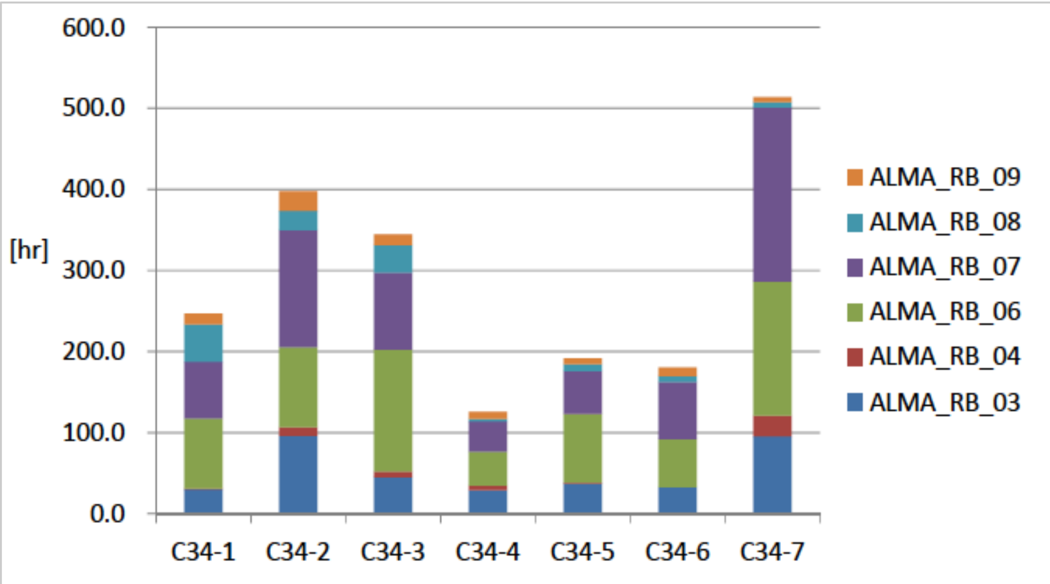

Figure 20. Distribution of the amount of 12-m Array time for Grade A and B projects as a function of the inferred 12-m Array configuration (see text), color-coded by requested receiver band.