ALMA Early Science Cycle 3: Outcome of the Proposal Review Process

Proposal Review Process

In response to the Call for Proposals for Early Science Cycle 3, ALMA received 1578 valid proposals by the 23 April 2015 submission deadline. These proposals, referred to hereafter as "submitted proposals", were reviewed by 12 ALMA Review Panels (ARPs), each comprising eight Science Assessors. To ensure a fairly even workload between the different ARPs, the proposals were distributed across the 5 ALMA scientific categories as follows:

1. Cosmology and the high redshift universe (3 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).

Science Assessors were selected on the basis of scientific specialization, 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 12 ARP Chairs served on the ALMA Proposal Review Committee (APRC), together with an ARP member acting as the Chile representative, and the APRC Chair, Anneila Sargent, who did not belong to any ARP. The full list of Cycle 3 Science Assessors is given in Table 1.

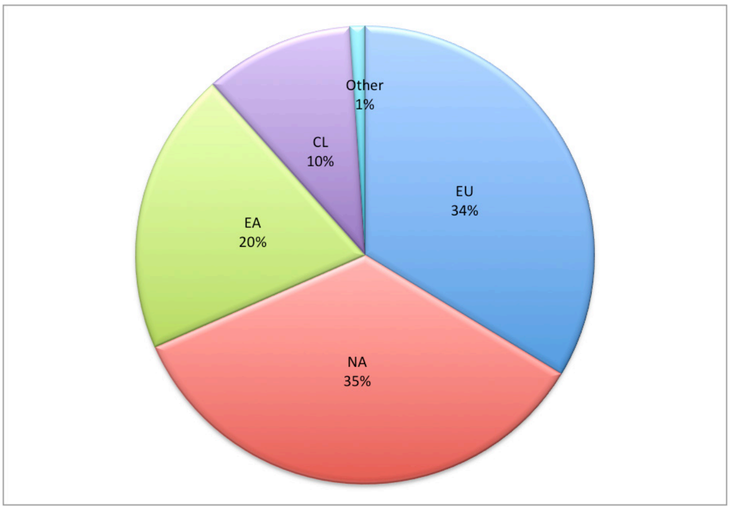

Figure 1. Regional distribution of the Science Assessors.

Table 1. Cycle 3 APRC and ARP members

APRC chair:	
Anneila Sargent	California Institute of Technology (USA)
APRC and ARP members:	
Susanne Aalto	Chalmers University of Technology (Sweden)
Jose Afonso	Instituto de Astrofísica e Ciências do Espaço (Portugal)
Hector Arce	Yale University (USA)
Maarten Baes	Ghent University (Belgium)
Beatriz Barbuy	Sao Paolo, University of (Brazil)
Felipe Barrientos	Catolica of Chile, Pontifica University (Chile)
Franz Bauer	Catolica of Chile, Pontifica University (Chile)
Amelia Bayo	Valparaiso, University of (Chile)
Henrik Beuther	Max-Planck-Institute for Astronomy (Germany)
Michael Bietenholz	York University (Canada)
Elias Brinks	Hertfordshire, University of (United Kingdom)
Simon Casassus	Chile, University of (Chile)
Paola Caselli	Max-Planck-Institute for Extraterrestrial Physics (Germany)
Caitlin Casey	California at Irvine, Univ of (USA)
Cecilia Ceccarelli	Grenoble Observatory (France)
Claire Chandler	National Radio Astronomy Observatory, Socorro (USA)
Ranga Chary	California Institute of Technology (USA)
Isabelle Cherchneff	Basel, University of (Switzerland)
Se-Hyung Cho	Korea Astronomy and Space Science Institute (South Korea)
Lucas Cieza	Universidad Diego Portales (Chile)
Miroslava Dessauges-Zavadsky	Geneva, University of (Switzerland)
Ana Duarte Cabral	Exeter, University of (United Kingdom)
Anne Dutrey	Bordeaux Observatory (France)
Jayanne English	Manitoba, University of (Canada)
Barbara Ercolano	Munich, University of (Germany)
Catherine Espaillat	Boston University (USA)
Duncan Farrah	Virginia Polytechnic Institute & State University (USA)
Yanga Fernandez	Central Florida, University of (USA)
Jacqueline Fischer	Naval Research Laboratory (USA)
Mark Gurwell	Harvard-Smithsonian Center for Astrophysics (USA)
Tomoya Hirota	National Astronomical Observatory of Japan (Japan)
Martin Houde	Western Ontario, University of (Canada)
Annie Hughes	Max-Planck-Institute for Astronomy (Germany)
Masatoshi Imanishi	National Astronomical Observatory of Japan (Japan)
Kelsey Johnson	Virginia, University of (USA)
Jes Jorgensen	Copenhagen, University of (Denmark)
Sheila Kannappan	North Carolina at Chapel Hill, University of (USA)
Stefan Kimeswenger	Catolica of the North, University (Chile)
Gillian Knapp	Princeton University (USA)

Tadayuki Kodama	National Astronomical Observatory of Japan (Japan)
Kotaro Kohno	The University of Tokyo (Japan)
Nario Kuno	University of Tsukuba (Japan)
Guilaine Lagache	Paris-Sud University (France)
Chang Won Lee	Korea Astronomy and Space Science Institute (South Korea)
Emmanuel Lellouch	Paris Observatory (France)
Paulina Lira	Chile, University of (Chile)
Ute Lisenfeld	Granada University (Spain)
Lori Lubin	California, Davis, University of (USA)
Sangeeta Malhotra	Arizona State University (USA)
Claudia Maraston	Portsmouth, University of (United Kingdom)
Diego Mardones	Chile, University of (Chile)
Dan Marrone	Arizona, University of (USA)
Satoki Matsushita	Academia Sinica (Taiwan)
Karin Menendez-Delmestre	Rio de Janeiro, Federal University of (Brazil)
Stefanie Milam	National Aeronautics and Space Administration (USA)
Kentaro Motohara	University of Tokyo (Japan)
Lee Mundy	Maryland, University of (USA)
Takayuki Muto	Kogakuin University (Japan)
Fumitaka Nakamura	National Astronomical Observatory of Japan (Japan)
Hiroyuki Nakanishi	Kagoshima University (Japan)
Hideko Nomura	Tokyo Institute of Technology (Japan)
Karin Oberg	Harvard-Smithsonian Center for Astrophysics (USA)
Nagayoshi Ohashi	Academia Sinica (Taiwan)
Masatoshi Ohishi	National Astronomical Observatory of Japan (Japan)
Tomoharu Oka	Keio University (Japan)
Masami Ouchi	The University of Tokyo (Japan)
Deborah Padgett	National Aeronautics and Space Administration (USA)
Jenny Patience	Arizona State University (USA)
Ismael Perez-Fournon	Astrophysical Institute of Canarias (Spain)
Ylva Pihlstrom	New Mexico, University of (USA)
Thomas Puzia	Pontifical Catholic University of Chile (Chile)
Jill Rathborne	Astronomy and Space Science (Australia)
Giulia Rodighiero	Padova, University of (Italy)
Erik Rosolowsky	Alberta, University of (Canada)
Huub Rottgering	Leiden University (Netherlands)
Joachim Saur	University of Cologne (Germany)
Marc Sauvage	CEA Saclay (France)
Claudia Scarlata	Minnesota, University of (USA)
Eva Schinnerer	Max-Planck-Institute for Astronomy (Germany)
Yoshiaki Taniguchi	Ehime University (Japan)
Nial Tanvir	Leicester, University of (United Kingdom)
Kim-Vy Tran	Texas A&M University (USA)
Ezequiel Treister	Concepcion, University of (Chile)
Esko Valtaoja	Turku, University of (Finland)
Hans Van Winckel	Leuven, Catholic University (Belgium)
Liese van Zee	Indiana University (USA)

Geronimo Villanueva	National Aeronautics and Space Administration (USA)
Serena Viti	London, University of (United Kingdom)
Keiichi Wada	Kagoshima University (Japan)
Natalie Webb	Institut de Recherche en Astrophysique et Planétologie (France)
Gillian Wilson	California at Riverside, University of (USA)
Sebastian Wolf	Kiel University (Germany)
Toru Yamada	Tohoku University (Japan)
Satoshi Yamamoto	The University of Tokyo (Japan)
Lisa Young	New Mexico Tech (USA)
Lucy Ziurys	Arizona, University of (USA)

The proposal review process was carried out as described in the ALMA Cycle 3 Proposer's Guide. At Stage 1, each proposal was evaluated by four 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 Osaka, Japan, on June 22-25, to discuss and rank all proposals assigned to them that were still under consideration, taking into account the technical assessments performed by ALMA staff members. On June 26, 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 104 scientifically outstanding proposals to be assigned Grade A, which makes them eligible for carry-over to Cycle 4 if they cannot be successfully completed by end of Cycle 3. Selection of those 104 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 298 Grade B proposals such that the estimated 12-m Array time allocated to both Grade A & B proposals summed to ~2100 hours. It also established a list of 236 Grade C proposals, to be used as “fillers”, to be scheduled when there are no Grade A or Grade B projects available that are appropriate for the prevailing conditions. The Grade C were assigned based on science rank and regional share, but considering also the observing pressure (number of hours requested vs. available, as a function of LST, 12-m Array configuration, and observing band; see below). 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 August 11.

Proposal statistics and regional distributions

The estimated 12-m Array time for all 1578 proposals summed to 8854 hours. The estimated execution time of the 402 Grade A and B projects amounts to 2133 hours of 12-m Array usage. The Grade C projects account for an additional 1360 hours of estimated execution time. Both groups of projects are proportioned between the ALMA partners by the agreed shares, with a small fraction assigned to highly ranked proposals from outside the ALMA partnership.

Among the 402 Grade A and B projects, 54 include observations with the Atacama Compact Array (ACA); such observations are also part of 42 of the 236 Grade C projects. According to current estimates, their execution should require respectively 699 hours (for Grade A and B projects) and 687 hours (for Grade C) of ACA time.

Three proposals that would have qualified for Grade A or B based on their scientific rank were rejected on technical grounds.

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 4.1. 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 6) is similar to that of all submitted proposals (Figure 5). In particular, both distributions have essentially the same median value: respectively, 4.5 and 4.6 hours, as per the Observing Tool (OT) estimate.

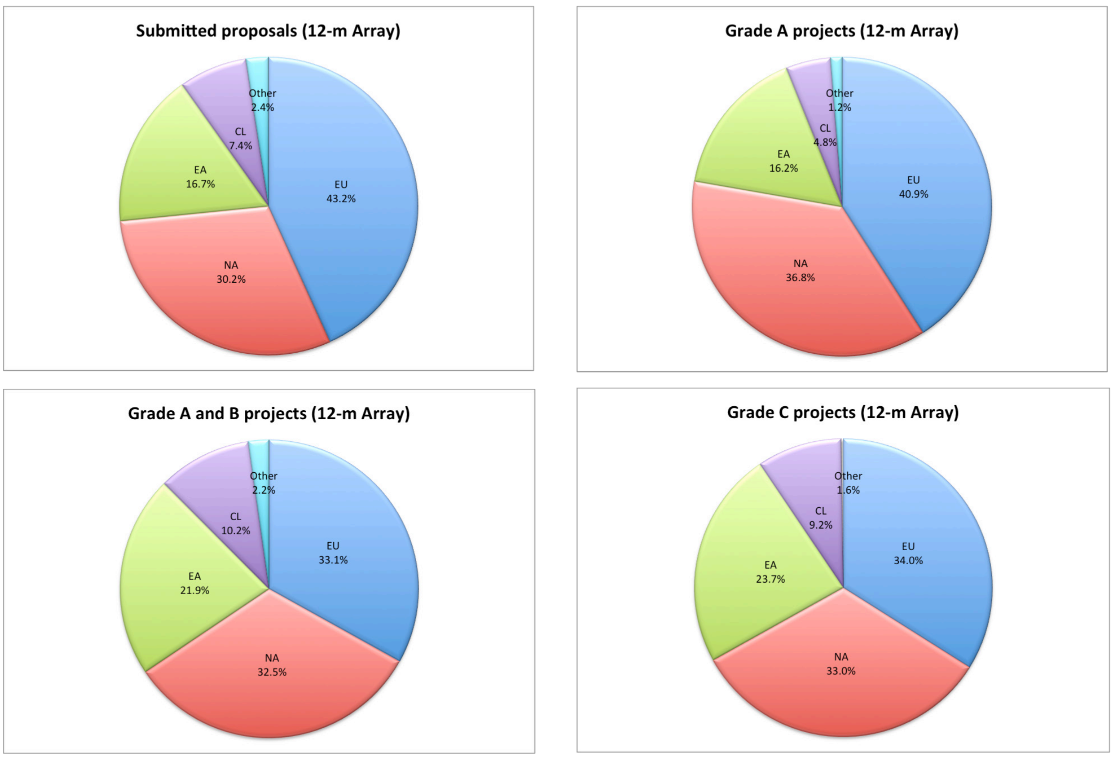

Figure 2. Regional share of 12-m Array time for all submitted proposals, and for the proposals recommended for scheduling with Grade A, Grades A and B, and Grade C.

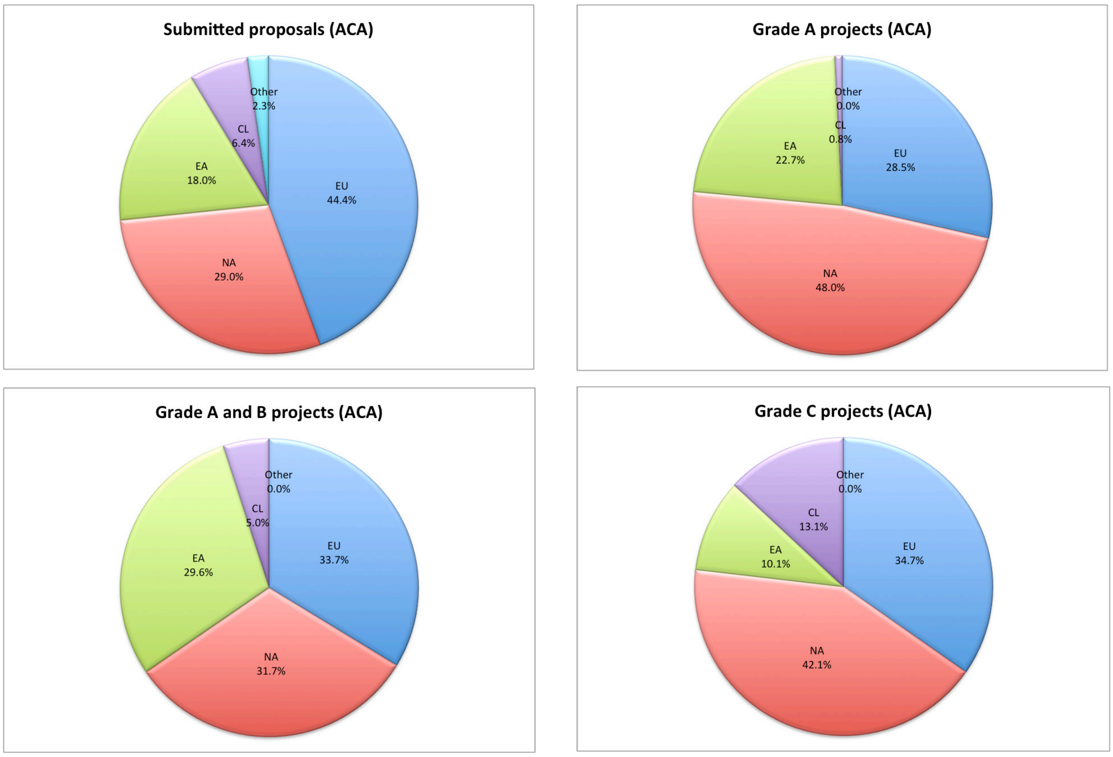

Figure 3. Regional share of ACA time for all submitted proposals, and for the proposals recommended for scheduling with Grade A, Grades A and B, and Grade C.

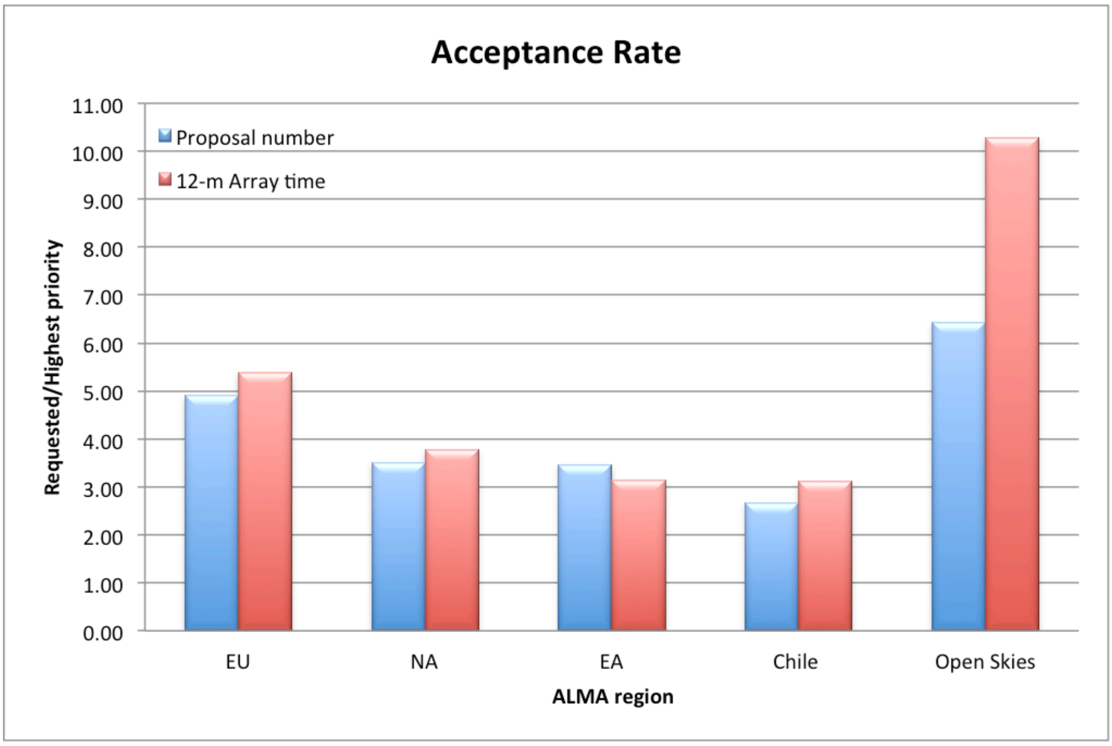

Figure 4. *Blue:* Ratio of the number of submitted proposals to the number of proposals assigned Grades A and B, by region. *Red:* Ratio of the estimated amount of 12-m Array time required for execution of all submitted proposals to that required for execution of the Grade A and B projects.

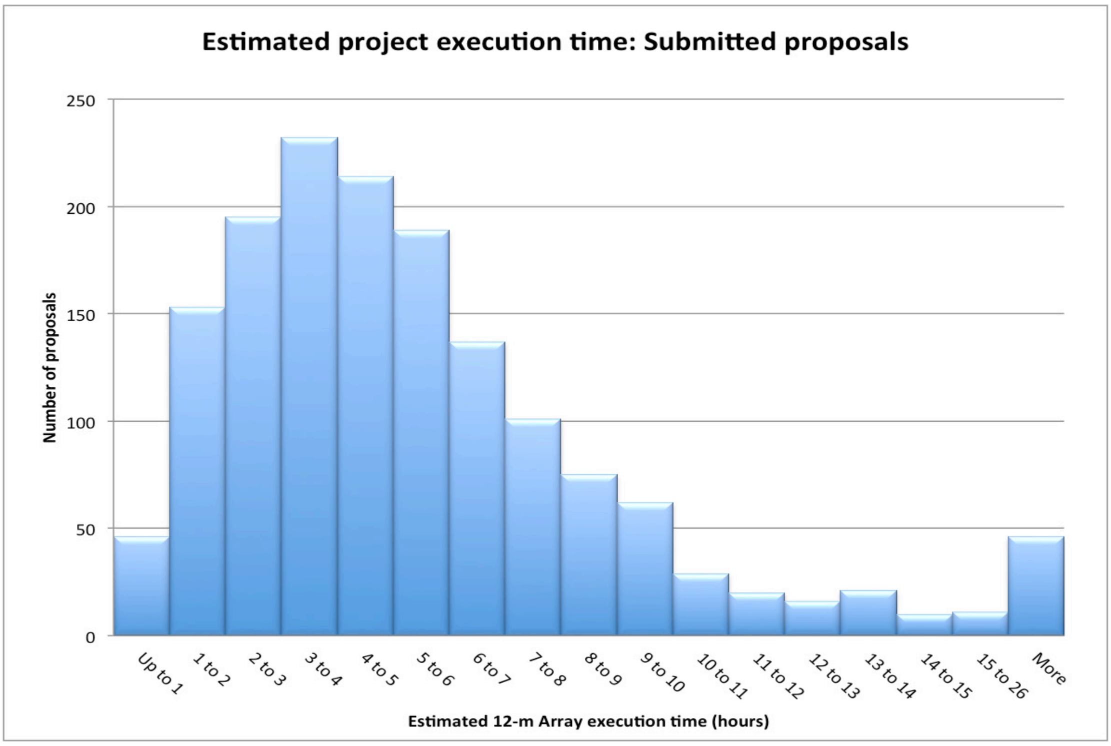

Figure 5. Distribution of the amount of 12-m Array observing time per proposal (as per the OT estimate), for the 1578 Cycle 3 proposals considered in the review process. The maximum amount of requested 12-m Array observing time was 62.9 hrs.

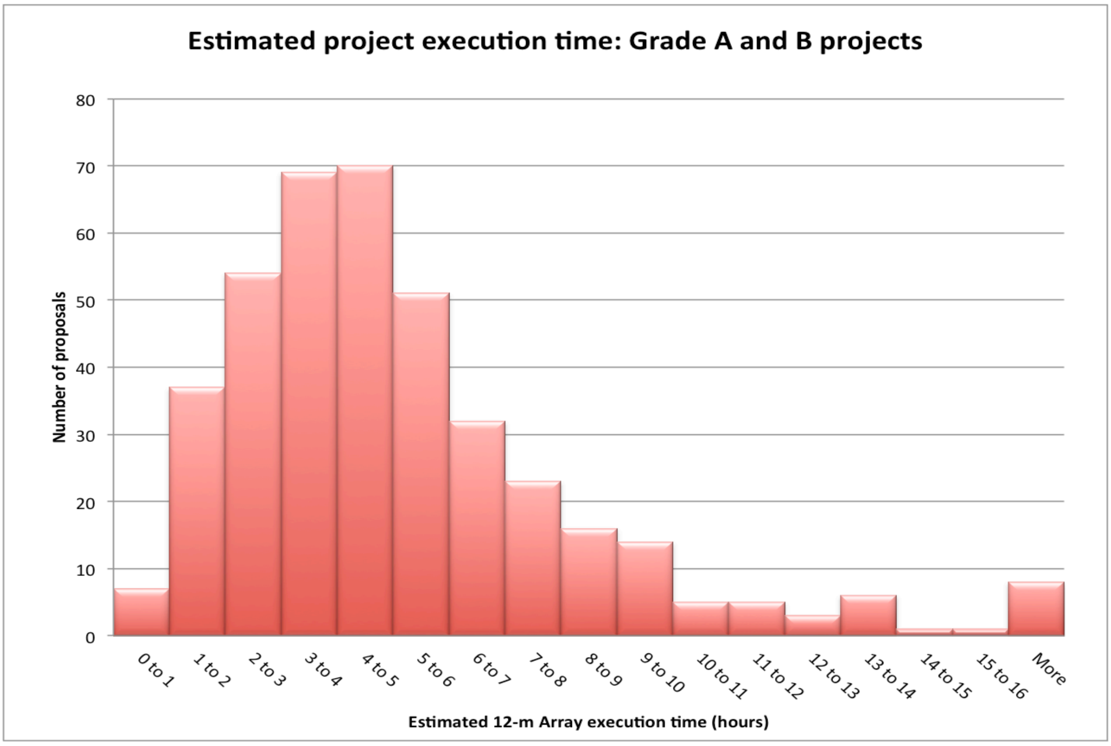

Figure 6. Distribution of the amount of 12-m Array observing time per proposal (as per the OT estimate), for the 402 Cycle 3 proposals assigned Grades A and B. The maximum amount of requested 12-m Array observing time was 44.4 hrs.

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

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

	EU	NA	EA	Chile	Open Skies	Total
Submitted Proposals						
Number of proposals	657	465.5	295.5	115	45	1578
Fraction of submitted proposals	41.6%	29.5%	18.7%	7.3%	2.9%	100%
Number of requested 12-m Array time (hr)	3817.2	2677.7	1487.1	655.6	216.0	8853.7
Subscription rate	5.4	3.8	3.1	3.1	10.3	4.2
Grade A & B projects						
Number of proposals	134	132.5	85.5	43	7	402
Fraction of grade A and B projects	33.3%	33.0%	21.3%	10.7%	1.7%	100%
Number of requested 12-m Array time (hr)	704.2	694.0	469.5	218.1	47.5	2133.4
Fraction of available 12-m Array time	33.5%	33.0%	22.4%	10.4%	2.3%	101.6%
Grade C projects						
Number of proposals	87	71	54	21	3	236
Fraction of grade C projects	36.9%	30.1%	22.9%	8.9%	1.3%	100%
Number of requested 12-m Array time (hr)	462.0	448.3	321.8	125.0	3.4	1360.5
Fraction of available 12-m Array time	22.0%	21.3%	15.3%	6.0%	0.2%	64.8%

User statistics

A total of 3605 unique users participated in the Cycle 3 Call, as either PI or Co-Investigator (Co-I) on a proposal. The 402 Grade A and B proposals involve 1749 unique users and 345 unique PIs. Of the 331 users who were PIs on more than one proposal, 51 had more than one project assigned Grade A or B.

The project codes, titles, investigators, and abstracts of the Grade A and B projects are available from the ALMA Science Portal (under the Observing – High Priority Projects menu item).

The composition of the proposing teams of both the submitted proposals and of Grade A and B selected projects ranged from one single PI to 68 proposers (see Figures 7 and 8, respectively). The mean number of proposers per submitted project was 9.2 and per Grade A or B project was 10.1.

Table 3 shows the distribution of the country or region 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 region because PIs from Taiwan could be affiliated with either EA and NA. For the statistics of all unique proposers (PIs and Co-Is), a 50/50 region split between EA and NA was adopted for Taiwan Co-Is (since Co-Is do not have the option to select their proposal submission region).

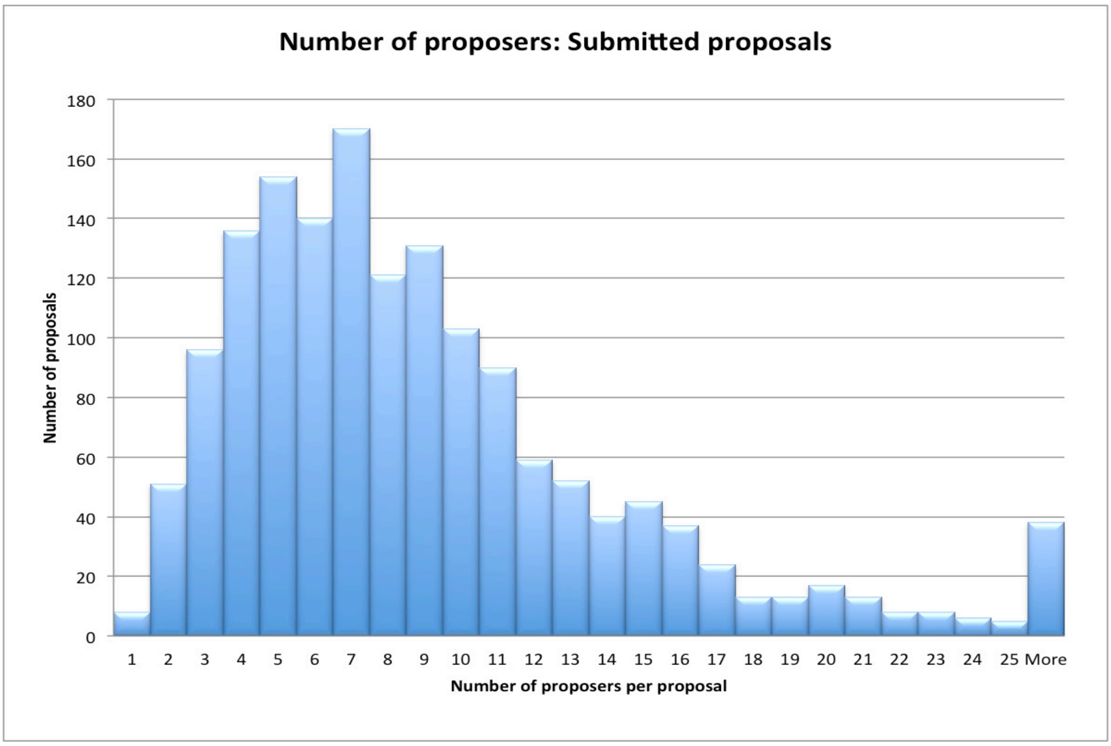

Figure 7. Distribution of the total number of proposers (PI + Co-Is) per proposal, for all submitted Cycle 3 proposals. The maximum number of proposers was 68.

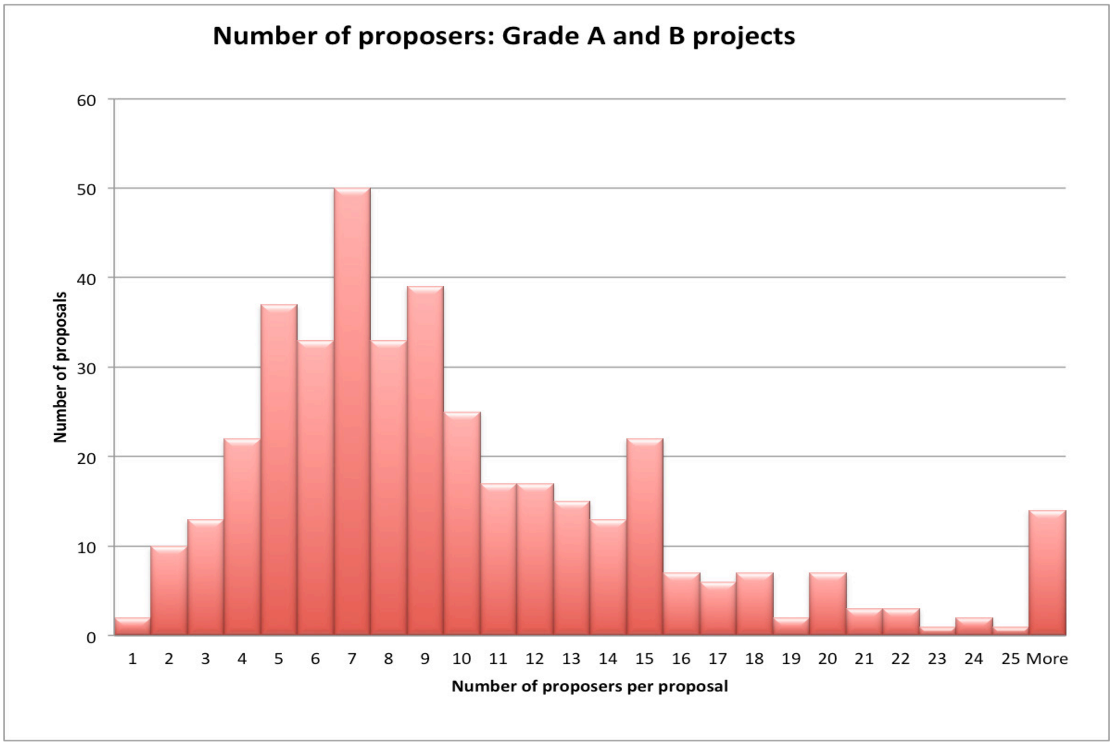

Figure 8. Distribution of the total number of proposers (PI + Co-Is) per proposal, for the Cycle 3 proposals assigned Grade A or B,. The maximum number of proposers was 68.

Table 3. Distribution of the country or region of affiliation of PIs and Co-Is of 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	36	6	6	23	79
Chile	115	43	21	70	122
ESO countries	658	134	87	497	1588
Japan	202	65	36	141	374
South Korea	25	2	4	18	43
Taiwan (via EA)	67.5	18.5	14	42.5	43
Taiwan (via NA)	10.5	4.5	0	10.5	43
USA	417	122	65	284	1006
Open Skies	47	7	3	41	307
Total	1578	402	236	1127	3605

Science categories

Figures 9 and 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 different grades. 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 3 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 somewhat differs 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 and 2 proposal, compared to Categories 3, 4 and 5 (see Figure 12).

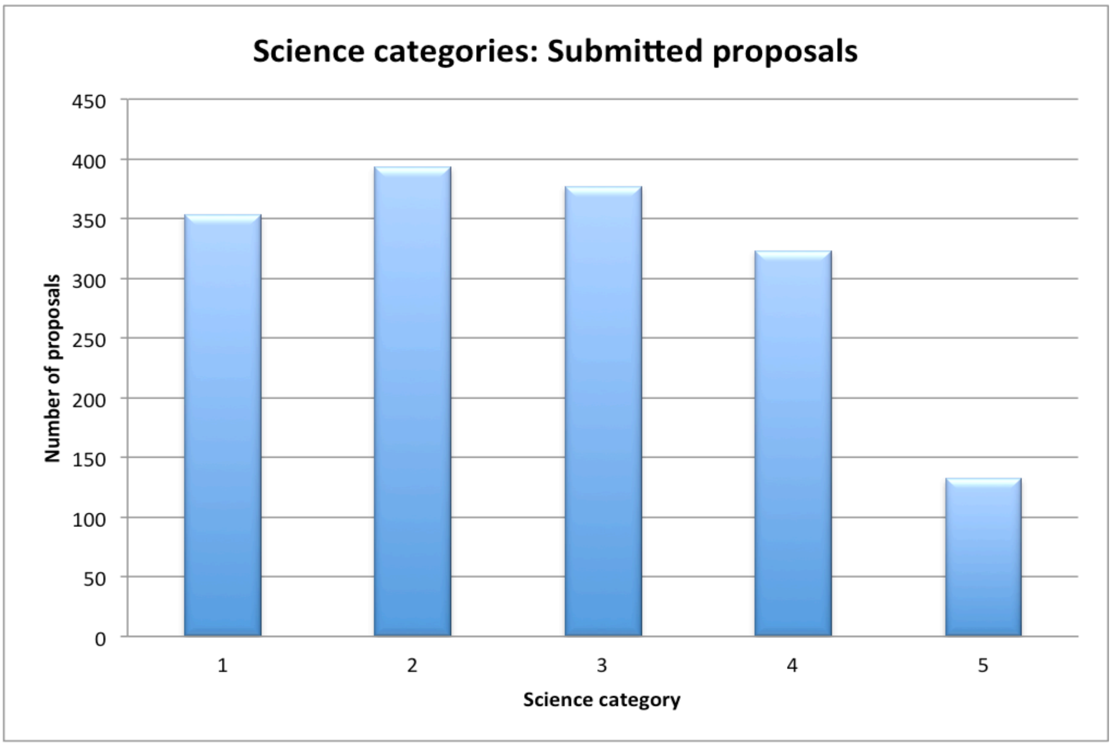

Figure 9. Distribution of the number of submitted proposals per science category (1=Cosmology & high redshift, 2=Galaxies & galactic nuclei, 3=ISM, star formation and astrochemistry, 4=Circumstellar disks, exoplanets & solar system, 5=Stellar evolution and the Sun).

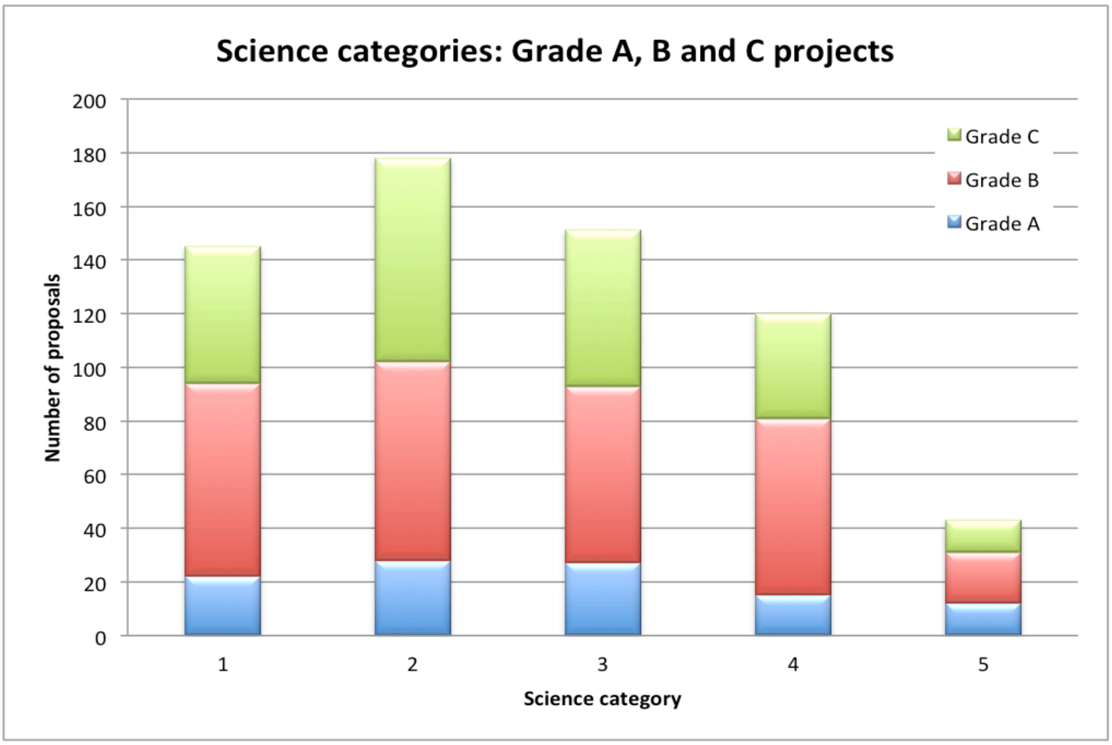

Figure 10. Distribution of the number of proposals per science category for Grade A, B and C projects.

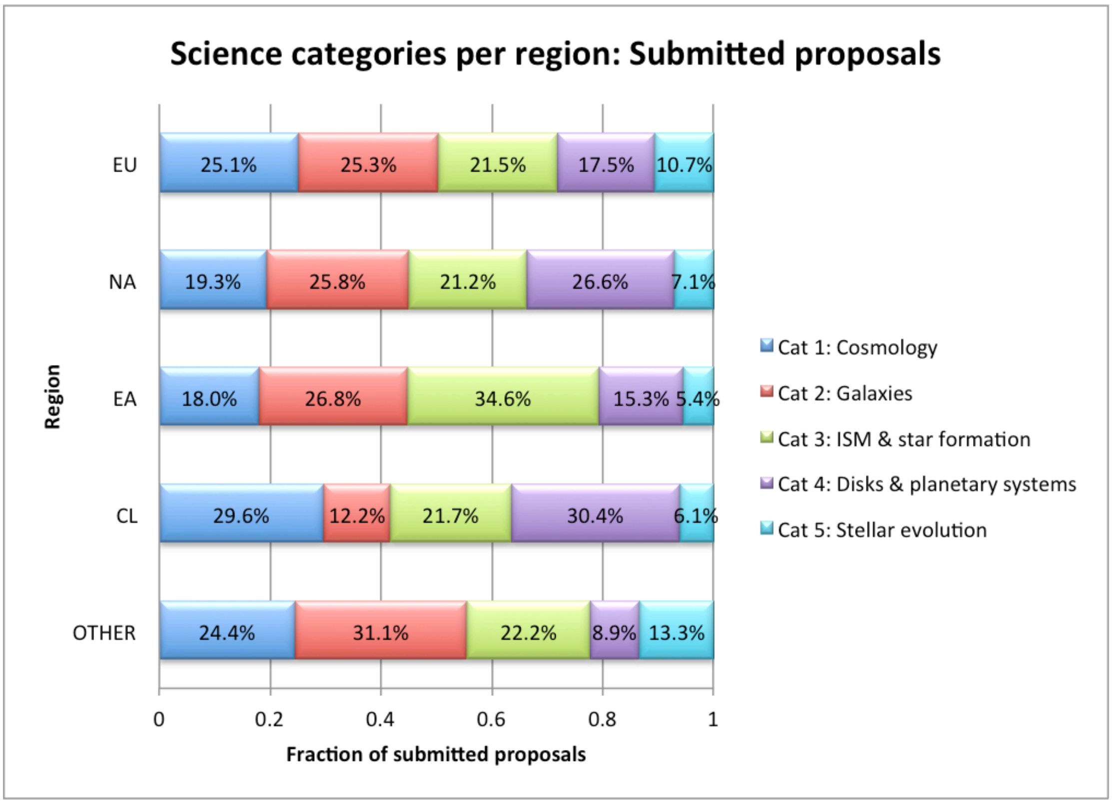

Figure 11. Distribution of submitted proposals across science categories, for each ALMA region.

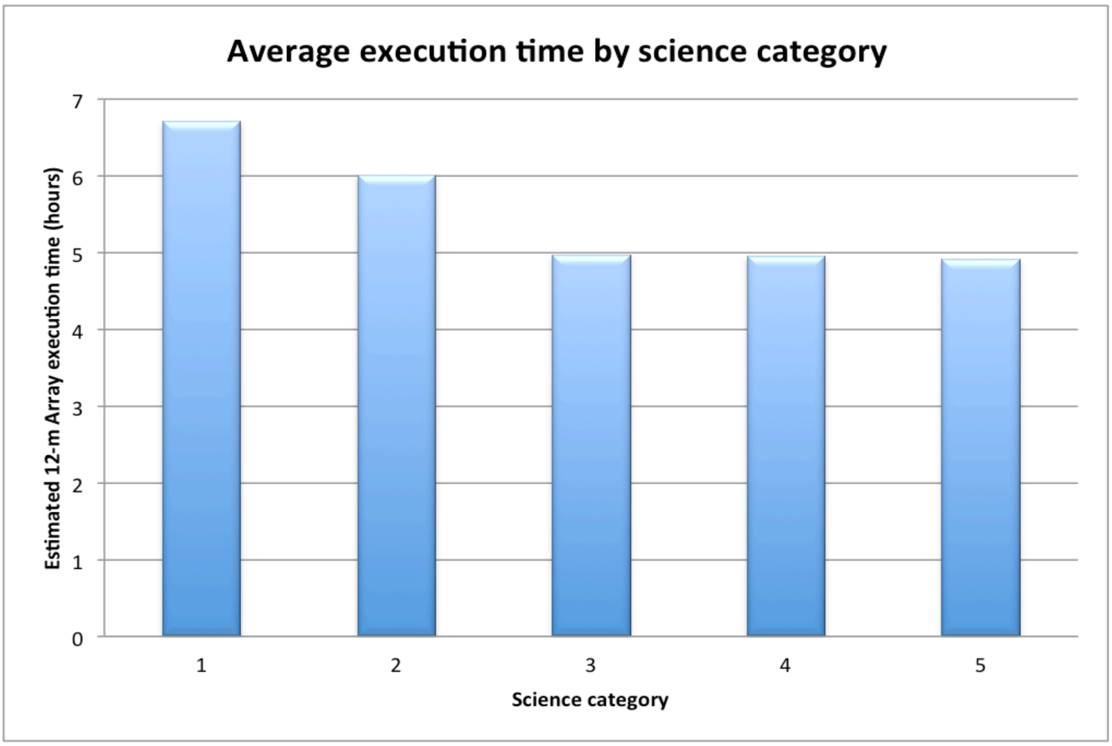

Figure 12. Distribution of the average proposal length of 12-m Array time per science category for all submitted proposals. The science categories are: 1=Cosmology & high redshift, 2=Galaxies & galactic nuclei, 3=ISM, star formation and astrochemistry, 4=Circumstellar disks, exoplanets & solar system, 5=Stellar evolution and the Sun.

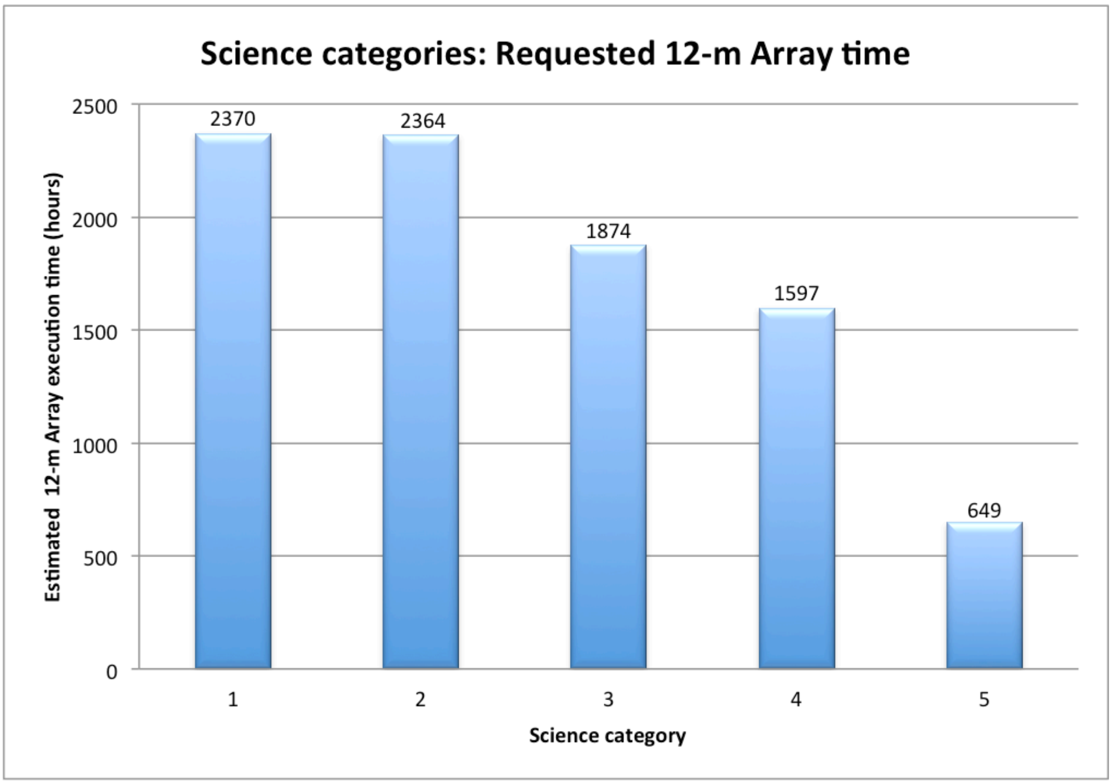

Figure 13. Total requested 12-m Array time for each scientific category (1=Cosmology & high redshift, 2=Galaxies & galactic nuclei, 3=ISM, star formation and astrochemistry, 4=Circumstellar disks, exoplanets & solar system, 5=Stellar evolution and the Sun).

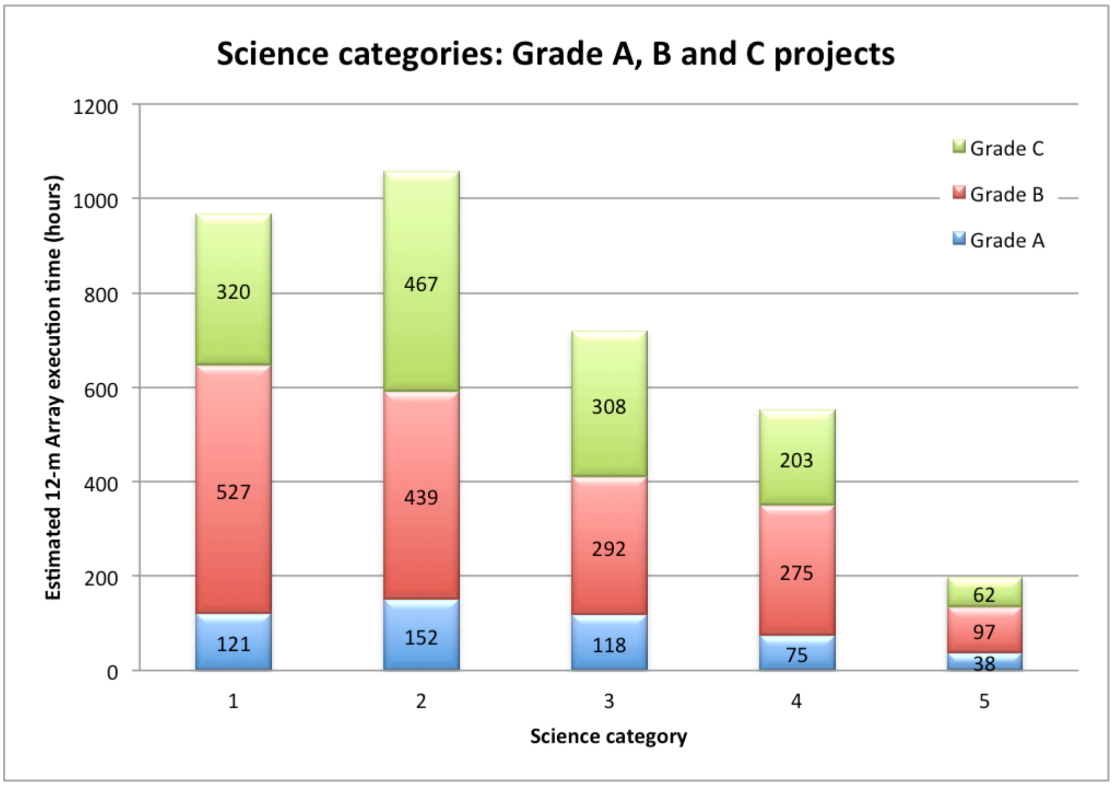

Figure 14. Distribution of the amount of 12-m Array time per science category for Grade A, B and C projects.

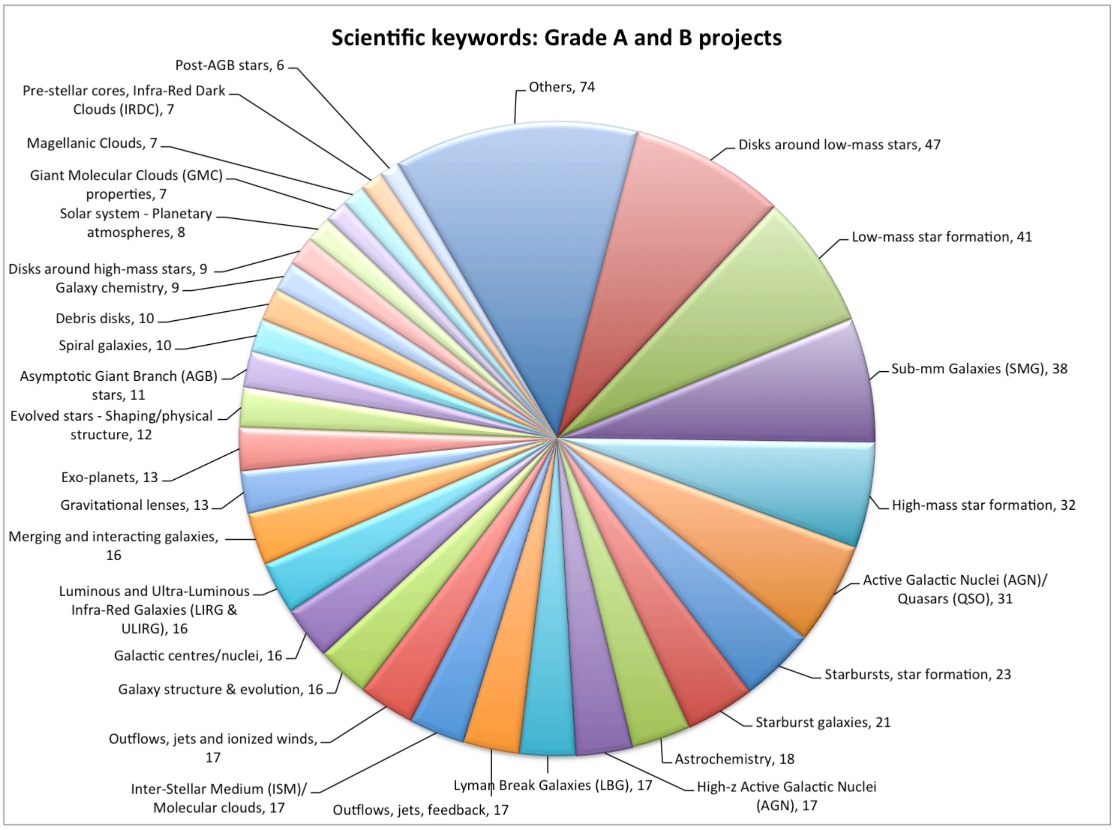

Figure 15. Breakdown of the Grade A and B projects by scientific keyword, across all ALMA scientific categories. For each science keyword, the number of proposals in which it is selected is indicated.

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 Grade A and B proposals. Of the 402 Grade A and B projects, 208 include a single scientific keyword, and 194 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 3, 3 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	47
Low-mass star formation	41
Sub-mm Galaxies (SMG)	38
High-mass star formation	32
Active Galactic Nuclei (AGN)/Quasars (QSO)	31
Starbursts, star formation	23
Starburst galaxies	21
Astrochemistry	18
High-z Active Galactic Nuclei (AGN)	17
Lyman Break Galaxies (LBG)	17
Outflows, jets, feedback	17
Inter-Stellar Medium (ISM)/Molecular clouds	17
Outflows, jets and ionized winds	17
Galaxy structure & evolution	16
Galactic centres/nuclei	16
Luminous and Ultra-Luminous Infra-Red Galaxies (LIRG & ULIRG)	16
Merging and interacting galaxies	16
Gravitational lenses	13
Exo-planets	13
Evolved stars - Shaping/physical structure	12
Asymptotic Giant Branch (AGB) stars	11
Spiral galaxies	10
Debris disks	10

Observing Pressure

Comparison of Figure 17 with Figure 16 shows that the distribution of the 12-m Array time between the available observing frequency bands as part of Grade A or B projects is roughly similar to its distribution in all submitted proposals. In particular, Grade A and B Bands 8, 9 and 10 projects 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 3 Proposer's Guide). Projects proposing observations in Bands 3, 4, 6 and, to a lesser extent, Band 7 have by design been privileged in the selection of Grade C projects, so as to ensure that they can be executed as "fillers" when the conditions are too poor for any Grade A or B observation. The Band 7 projects were assigned Grade C only if there was a deficit of Grade A or B projects at the corresponding right ascension for a given 12-m Array configuration. High-frequency Grade C observations stand a low probability of being prepared and executed.

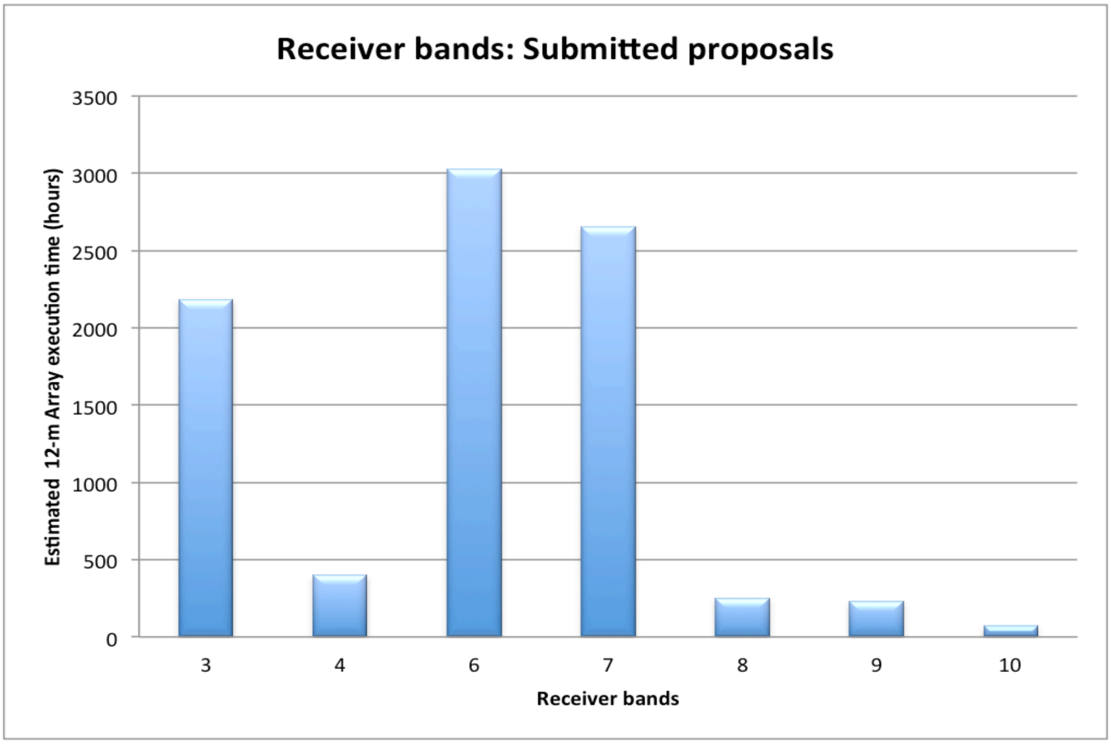

Figure 16. Distribution of the amount of 12-m Array time per receiver band for all submitted proposals.

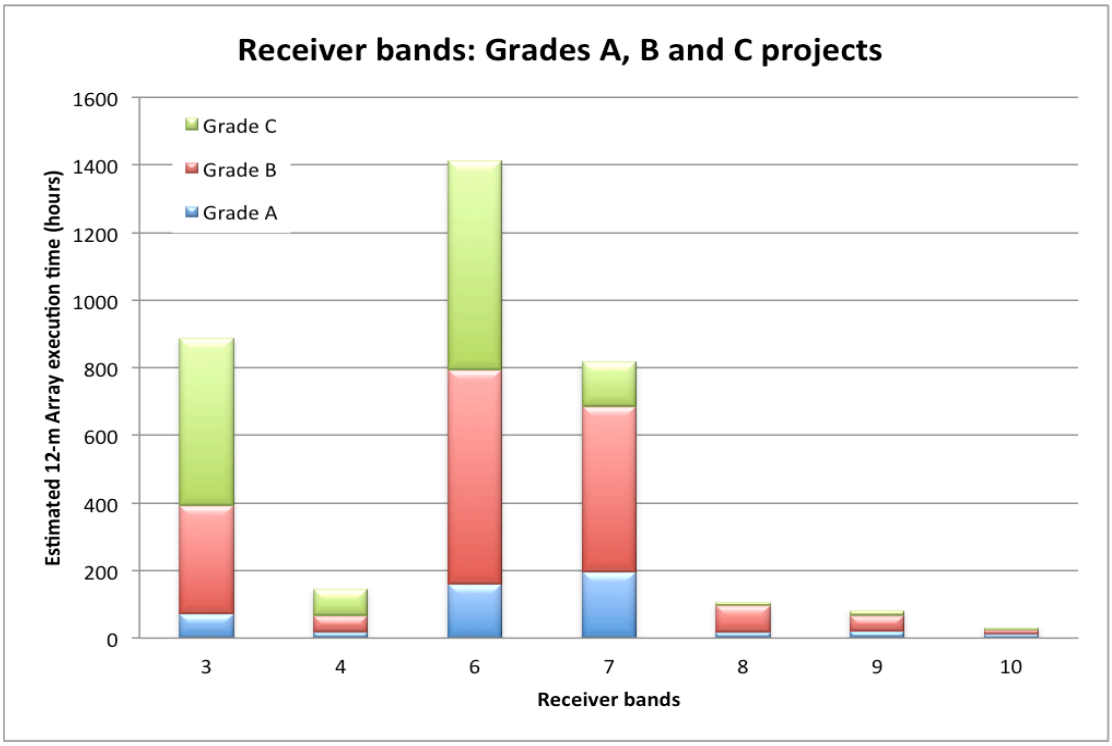

Figure 17. Distribution of the amount of 12-m Array time per receiver band for Grade A, B and C projects.

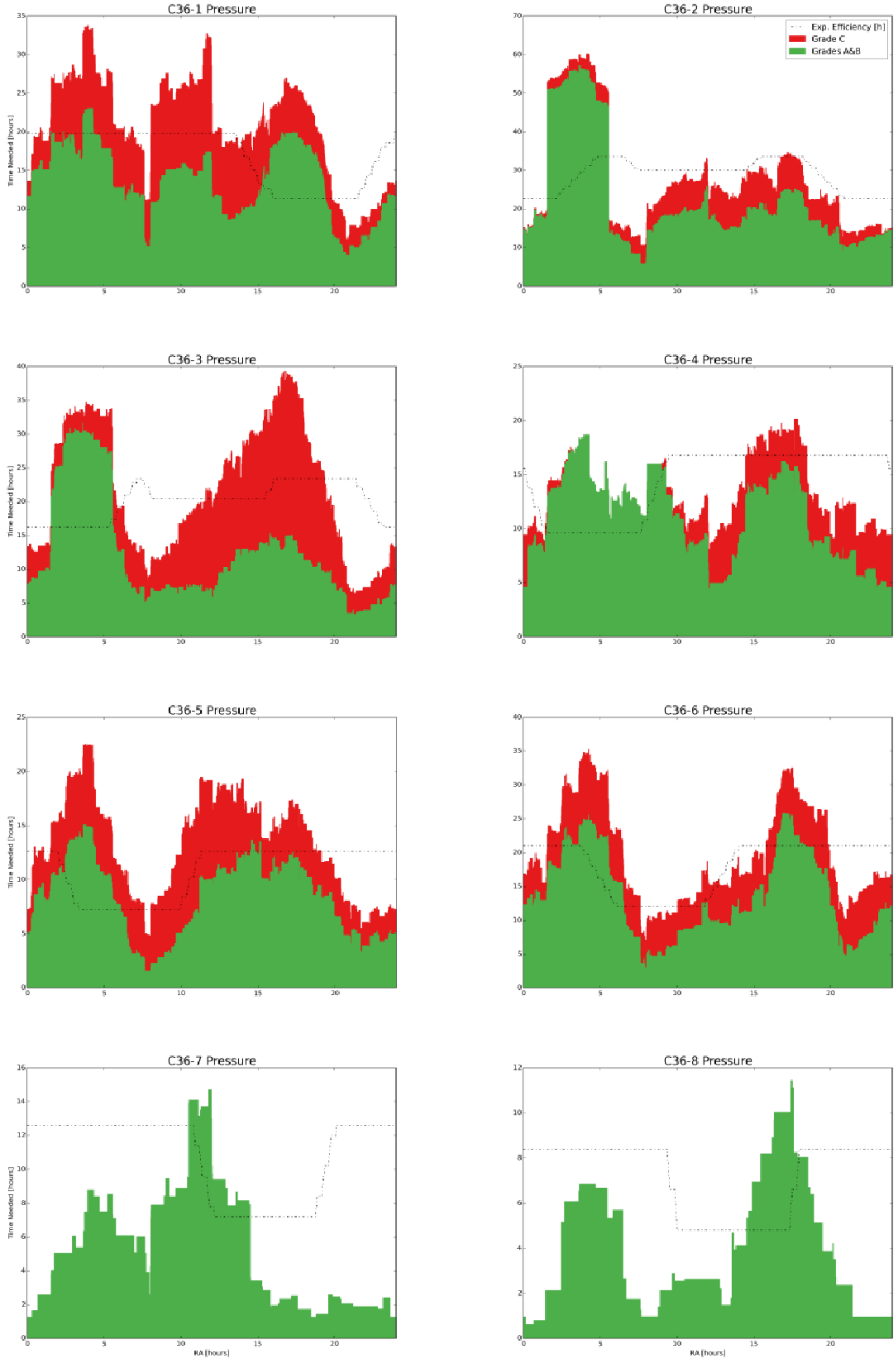

Figure 18. Distribution of the amount of 12-m Array time as a function of right ascension (RA), for each of the array configurations offered in Cycle 3. The green part of the histograms corresponds to the Grade A and B proposals, and the red part, to Grade C. The dotted line in each panel shows the expected amount of available observing time in the considered configuration, according to the planned configuration schedule and adopting an observing efficiency of 60 %.

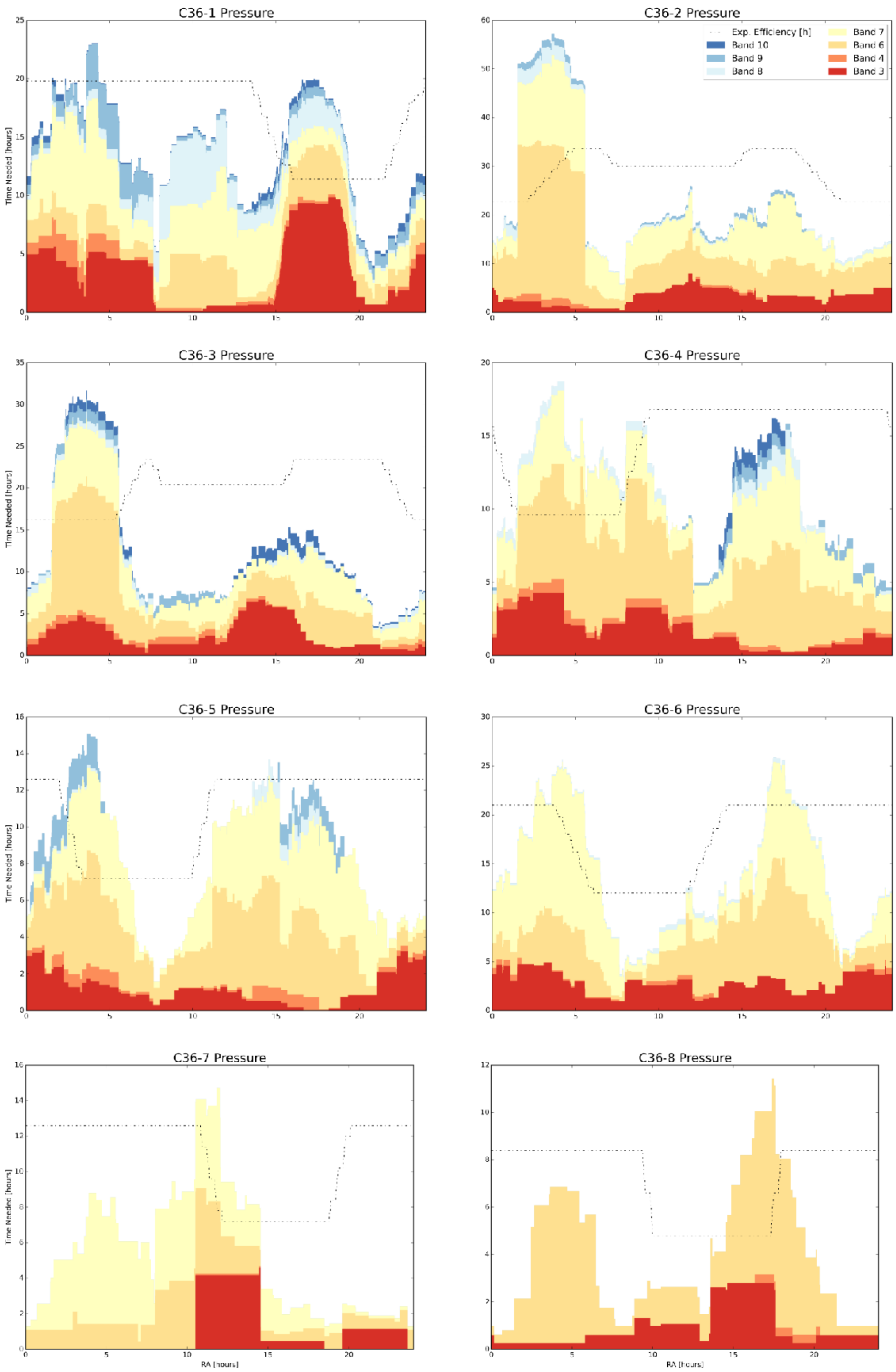

Figure 19. Distribution of the amount of 12-m Array time for the Grade A and B proposals as a function of right ascension (RA), for each of the array configurations offered in Cycle 3. The colors used in the histograms distinguish the various receiver bands. The dotted line in each panel shows the expected amount of available observing time in the considered configuration, according to the planned configuration schedule and adopting an observing efficiency of 60%.

Observing pressure plots (number of hours requested compared to the number available, as a function of required LST, observing frequency band, and inferred array configuration) were produced based on the individual Science Goals (SGs) of the Grade A, B, and C proposals. The number of available hours for each configuration was taken based on a slightly revised version of the 12-m Array configuration schedule published in the Cycle 3 Proposers Guide, and adopting an observing efficiency of 60%. The RA of the target and observing frequency were taken directly from each SG, and the required configuration was inferred from the requested observing frequency, desired angular resolution, and source declination. The resulting observing pressure plots are presented in Figure 18 (color coded by overall proposal grade) and Figure 19 (for Grade A and B proposals only, color coded by frequency band). **Figure 19 shows that the most scientific demand for observations in the 2-6 h and 12-19 h LST ranges for most configurations, with low demand for observations in the 7-9 h and 22-1 h LST ranges. Note that A and B grades were assigned primarily on the basis of the scientific ranking of proposals and executive share, rather than on observing pressure.**

As mentioned earlier, the assignment of Grade C to proposals was made in consideration of the distribution of the Grade A and B proposals (green histograms in Figure 18). However, no fillers were assigned for proposal requesting observations in the long baseline configurations (C36-7 and C36-8, maximum baselines > 5 km), because a long baseline campaign will happen in parallel in order to turn long baselines into a standard observing mode and to further test high frequency observations in long baselines.