



ALMA BOARD

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ALMA Science Advisory Committee (ASAC) Report to the ALMA Board

Manuel Aravena, Anne Dutrey, Maryvonne Gerin, Kirsten Knudsen (EU vice-chair), Kotaro Kohno (EA vice-chair), Dan Marrone, Nami Sakai, Eva Schinnerer, Kengo Tachihara, Mario Tafalla, Stephen White (chair), & Christine Wilson

General considerations

The ASAC face-to-face meeting was held at the Joint ALMA Observatory in Santiago on March 5-6, 2020. We welcomed Maryvonne Gerin and Kengo Tachihara as new members of ASAC. A number of issues impacted travel for committee members, including the COVID-19 outbreak. As a result, only 5 members were able to attend in person, with the remaining 7 participating remotely by video. The “zoom” meeting application was used and was very effective, allowing all remote members to participate fully. Observatory Scientist John Carpenter and the three regional Project Scientists also participated (Franciska Kemper in person, Daisuke Iono and Crystal Brogan remotely). Local experts at JAO, including Liz Humphreys (DSO head) and Eric Villard (EOC head), presented material. Once again most of the documentation was provided early enough for the regional SACs to provide feedback, which is greatly appreciated. Logistics (transport, meals and communications) for the meeting were organized by Ann Edmunds, and ASAC is extremely grateful to Ann and the JAO staff for all their efforts. Late travel cancellations and remote committee members spread from Germany to Japan meant that the program for the meeting had to be reworked several times in the week leading up to the meeting, and it was moved to a 7am local start in order to avoid remote participants having to stay up all through the night (although Nami and Kotaro still stayed up until 5am on the last day). Ann Edmunds arranged for breakfast supplies to be available at JAO for the early-morning starts.

There were 4 new ad-hoc charges from the Board at this meeting, and the schedule was also modified from the usual balance in order to ensure enough discussion time for those charges as well as EOC prioritization. In particular, the Principles of the Proposal Review Process document was initially discussed in a telecon 1 month prior to the meeting and significant feedback was provided to the Observatory Scientist so that a more polished document addressing possible issues could be discussed at the face-to-face meeting.

As required by the ASAC Terms of Reference, an election was held to determine a new chair of ASAC starting after the April Board meeting. We nominate Kotaro Kohno (EA) for this position.

Permanent Charge #1. Assessment of the performance of ALMA scientific capabilities: ASAC shall indicate what information is required from the Joint ALMA Observatory (JAO) to perform this assessment.

Recommendations/issues:

- ASAC agrees with the Cycle 9 priorities for EOC as presented, except for an adjustment for solar commissioning.
- ASAC is pleased to see that implementation of ACA polarization observations is foreseen at highest priority for Cycle 9.
- We commend the project for the successful work in improving daytime focus models so that less time needs to be spent setting the focus, resulting in a savings in calibration overhead and a potential increase in time for science .

EOC priorities: ASAC appreciates the progress of EOC activities and the coordination provided by the commissioning team. ASAC has been presented with the new timeline foreseen for the ObsMode decisional process to implement new capabilities on ALMA. ASAC agrees that linking the ObsMode timeline to the OT software deadlines for specific observing cycles is sensible and should help to clarify the process.

JAO presented their Cycle 9 priorities for EOC and ASAC agrees with the plan, apart from one minor change. ASAC is pleased to see that implementation of ACA polarization observations is foreseen as the highest priority for Cycle 9, and we agree with putting circular polarization and spectral-line mosaicking next in line. A number of improvements for long-baseline and VLBI observations are being pursued and should improve performance. We are glad to hear that there is now significant in-house expertise for setting up VLBI observations. For solar commissioning, based on community input from the recent solar workshop in Oslo, ASAC suggests to give higher priority to fast-scan TP mapping of small regions of the solar disk in order to achieve higher time resolution (important for flares), rather than the planned spectral line capability. Solar polarization observations should stay at highest priority for implementing new solar capabilities.

ASAC has been also informed about the EOC plans for Cycle 10 and is prepared to provide input at a telecon in a suitable time frame according to the new ObsMode timeline. Further, ASAC recommends adding Band 8 and 9 continuum polarization observations as a potential Cycle 10 capability as the scientific merit is high. Recent developments have provided a strong science case for the value of comparing high-frequency polarization measurements with those at lower frequencies as crucial to constrain the magnetic field geometry in the hot and dense regions of proto-planetary disks and star-forming molecular clouds. There are conflicting reports on the quality of polarization measurements with the OMTs used in the Band 8 receivers, compared to the wire grids used in Band 9 where, however, the atmosphere is more problematic. This issue needs to be resolved in deciding which band should be commissioned first.

Daytime focus models. Efforts have been made for a better understanding of daytime focus performance and this has resulted in improvements in the focus models that now allow 4 to 5 hours between daytime

focus observations in the lower-frequency bands. This reduces the time required for calibration and thus increases the time available for science, which is always to be welcomed.

Permanent Charge #2. Assessment of the technical aspects of the ALMA system performance: ASAC shall indicate what information is required from the JAO to perform this assessment.

Recommendations/issues:

- ASAC commends JAO on the achievement of 1000 hours of QA0-pass observations in November + December, and on the improvements to observing efficiency.
- ASAC further commends JAO on their handling of the disruption due to civil unrest, and in particular on allowing new shift options to improve safety for staff.
- ASAC is glad to see that data delivery times continue to improve.
- The completion rate for A-ranked projects in any given Cycle can be lower than ideal, and since they can be carried over, this metric needs to be tracked for at least 2 years for each Cycle.

Observing efficiency: ALMA observed a total of over 1000 hours of QA0-pass time in November + December 2019, which is a remarkable achievement. At least part of this success can be attributed to efforts to allow for more flexible allocation of time between science observing and engineering/software maintenance and testing, which resulted in a net increase in the time available for science. ASAC commends JAO on their efforts to make these improvements. As it turned out, they were important for keeping Cycle 7 on track despite the halt in observing during civil unrest in Chile which limited travel to the site in October and November.

We note however that the completion rate for A-ranked projects could be improved, given that PIs of A-ranked projects expect that they will be completed. In Cycle 6, 57% were 100% completed, with 97% receiving some data. Completion rates were hampered by major snowstorms that disrupted observations and configuration moves, together with the onset of the insidious power dropouts. Carryover to Cycle 7 will improve the completion rate for some of these projects, but presumably not all. Failure to complete A-rated projects does not look good to the ALMA community: since A-ranked projects can be carried over into a second year, ASAC would like to see the progressive completion rate for A-ranked projects extending back at least 2 years, in order to track this issue.

Unrest in Chile: The civil unrest in Chile early in Cycle 7 caused problems with travel, raised safety issues focussed on night-time travel to and from airports and work sites, and caused staff concern about being away from their families during the unrest. JAO and the Director are to be commended for being proactive in addressing this concern, being flexible with staffing and for allowing new shift options that permitted safer daytime travel, thus helping with staff morale.

Data delivery: The current model for data analysis (pipeline processing at JAO followed by regionally distributed weblog analysis) seems to be working well and data delivery times continue to improve. 87% of pipeline-processed projects have been delivered within 30 days, and the number of overdue projects has been stable over recent months, rather than climbing steadily. We are pleased to see progress continuing in this area. We note that the mandated move from Python 2 to Python 3 continues to require

significant effort from the pipeline team.

Operations from SCO: The “SCO Control Room Extension” is now in place in the Santiago offices and is being tested. Astronomer-on-duty tasks have already been carried out from the extension. Array operators will continue to carry out their role from OSF (and indeed will presumably need to do so until their contracts, which specify OSF as their duty site, are changed). Testing for the large array of possible operation concepts utilizing the extension are anticipated to continue until at least 2021, with maintenance of current safety standards and ensuring robust communication between SCO and OSF/AOS being critical aspects. It is appropriate to be cautious about these issues during implementation testing. ASAC welcomes this development: in the longer term the savings due to minimizing travel to OSF will help to alleviate budget pressures, and the improvement in the ease of carrying out EOC test observations may speed future commissioning efforts. JAO is aware that in taking these steps, they have to ensure that the staff who will still need to be at AOS do not feel disconnected from the scientific staff at JAO, with whom they presently interact when on site.

Permanent Charge #3. Assessment of the science outcomes from ALMA: Statistics on publications, citations, press releases, web sites, etc. collected by the Executives shall be collated by the JAO, and analyzed by the ASAC.

Recommendations/issues:

- ASAC notes that publications using ALMA data continue to increase at an impressive rate.

Less time than usual was spent considering this charge at this meeting due to competing questions, particularly the ad hoc charge on publication statistics. ASAC is pleased to see that the ALMA publication rate continues to grow, and continues to be competitive with the publication rates of other leading ground and space facilities (such as HST) in their early years. Archival PI data that has become public continues to grow as a major source of publications, as anticipated. ALMA papers form a significant fraction of the 30 highest-citation papers from the 2018-2019 period, led by the EHT results and the D-SHARP Large-program papers.

One minor anomaly is that NA and CL papers did not grow as much as EU and EA publications in the past year. One possible explanation is that EU authors tend to publish in smaller units, rather than submitting more comprehensive papers, at least in part because some popular journals are imposing page charges only if articles exceed a certain length. Preparations for the decadal review in the US may have also affected publication rates there. Citations are an alternative measure of science outcomes, but there is necessarily a delay between a paper’s publication and its citations that complicates the interpretation of citations.

In response to ad hoc charge #2, below, we discuss the science questions that we would like to see addressed by the publication statistics plots in the future.

Permanent Charge #4. Recommendations of ways to maximize ALMA’s scientific impact: This includes review of the scientific effectiveness of the Proposal Review Process after each Proposal cycle.

Recommendations/issues:

- ASAC commends JAO for the success of the ACA Supplemental Call and the subsequent review.
- We note the findings of the surveys of the PIs and reviewers regarding the DPR review process, and the fact that, despite mixed responses, there was not a strong sense of opposition to its use, at least for small proposals, going forward.
- Due to the worsening COVID-19 situation in the weeks since the ASAC meeting, ASAC welcomes the decision to delay the Cycle 8 proposal deadline, in order to be fair to the community.

ACA supplemental results and Distributed Peer Review. ASAC is glad that the implementation of the DPR process went smoothly during the ACA supplemental call for proposals, and congratulates JAO and the regions for their efforts in this regard. The high return rate on the poll of the reviewers and PIs allows for a good evaluation of their opinions. The feedback from the reviewers shows that overall the instructions and tools were sufficient for an efficient reviewing process. The number of proposals per reviewer of 10 was deemed appropriate by a large fraction of reviewers and suggests that a significant increase in this number should be avoided. Not surprisingly, the reviewers were more comfortable ranking proposals close to their area of expertise, confirming that assignment of proposals close to reviewers’ expertise should continue to be an emphasis.

ASAC notes that PIs appeared overall to be satisfied with the DPR system: in particular, PI satisfaction with the comments provided by the reviewers, which has been a concern, was similar to that of the consensus reports sent out in the main call. The majority of the PIs supported the DPR for small proposals (61%) and supplemental calls (71%), yet only 46% of the reviewers of DPR proposals believe that this method is suitable for regular proposals. This is curious since essentially the PIs and reviewers are the same group of people. The relevant questions posed to reviewers and PIs were apparently not identical (“all or none” on regular proposals in the first case, broken down into proposal size in the second case), which may have affected the outcomes. Another possibility is that the statistics may be influenced by the fact that the PI survey was carried out when PIs already knew their proposal outcomes, whereas as reviewers (immediately following review submission) they did not. Since the over-subscription rate of the ACA Supplemental Call was relatively low (~2-3x), and considering that the reviewers and PIs are the same population, apparently the fraction of PI/reviewers with a good impression of the DPR model increased considerably between the review and the announcement of outcomes. While it is certainly not clear that the majority of PIs would prefer this model over the current proposal panel system, a majority of those involved in the ACA supplemental call were not opposed to the use of DPR in the main call, at least for small proposals. PIs did express more concern about confidentiality in the DPR review than in the panel review.

ASAC discussed a number of possible improvements to the current model, in addition to the issues already detected by JAO (i.e., a better proposal assignment algorithm, additional documentation on how

to rank proposals, improved mathematical methods on scores). These include: (1) creation of mechanisms to easily spot duplications; (2) provision of detailed information to the community about the new DPR system, including information on the ranking method; (3) proactively seeking ways to ameliorate possible biases towards underrepresented scientific areas (e.g. Stars, Solar), which, due to the lower number of PI/reviewers, might end up being evaluated by experts in other areas who might not necessarily give good scores on the proposed topics. Additionally, ASAC thinks that it is essential to conduct continued monitoring of the DPR system in the future, with particular focus on the scientific outcomes (e.g. number and quality of publications, types of projects selected in A, B and C categories) in addition to scrutinizing the perceptions of PIs/reviewers. Another possible implication of DPR could be an imbalance in the regional distribution of reviewers, since in DPR that depends on how many proposals are submitted from each region, rather than having imposed regionally-balanced (relative to the nominal distribution of observing time) panel composition. In turn, differences in regional composition can lead to other biases, since different regions typically have different scientific foci. This issue should be tracked going forward.

ASAC notes that a significant spread is present in the grades of individual reviewers, which in the current panel system can be discussed and re-voted in the ALMA APR face-to-face meetings. To alleviate this issue, ASAC suggests making the DPR system a two-step process in which, after submitting their initial scores and comments (first step), reviewers can have the opportunity to revise their scores and comments after seeing the comments (but not scores) from other reviewers. This may also ameliorate possible biases due to differences in experience level by PI/reviewers.

Contingency planning for the Cycle 8 APCR Meeting: In view of the COVID-19 health crisis, at the time of the ASAC face-to-face the project was already exploring alternatives in the likely case that the ALMA Review Panel meeting scheduled for June in Atlanta needed to be cancelled. Delaying the meeting causes issues, since some of the current panel members will likely not be available at different dates than those already committed. Alternatives to the Atlanta meeting range from having the subpanels meet remotely to moving the evaluation process to a distributed peer review (DPR) mode.

ASAC understands that these are extreme circumstances, and commends the proactive attitude of JAO in exploring possible alternatives to the Atlanta meeting well in advance of a decision point. Moving to DPR seems premature, and may compromise the view that the community holds of this still-poorly-known evaluation process. ASAC prefers an alternative that involves virtual panel meetings. The JAO plan (as of the ASAC meeting) consisted of holding a single virtual meeting of 4 hours per panel to discuss a small number of selected proposals (e.g., those with large ratings dispersion) due to time-zone limitations and the concern that holding ~25 simultaneous virtual meetings may run into technical difficulties. ASAC is worried that having such a reduced discussion time of a limited number of proposals may be too restrictive and preclude a proper evaluation of the proposals, damaging the credibility of the review process. We are less concerned that there will be technical difficulties, since plenty of large university departments successfully carry out multiple simultaneous meetings on a routine basis. ASAC thus recommends extending the discussion time and holding two virtual meeting sessions in two consecutive days. Using the regional centers to support this more complex operation could help enable this alternative, and it can be tested in advance to ensure that it is technically feasible.

In the weeks since the ASAC face-to-face meeting, the situation with travel has worsened dramatically. Many members of the ALMA community are currently confined at home, without access to the institutional resources normally used to prepare ALMA proposals. ALMA has announced a halt to science observations, which will impact the completion of Cycle 7 and likely the schedule for Cycle 8. In view of these difficulties, ASAC supports the decision to delay the Cycle 8 proposal deadline in fairness to the community, while recognizing that this will complicate the review process further.

Permanent Charge #5. Reporting on operational or scientific issues raised by the wider community as communicated by the three regional Science Advisory Committees (ANASAC, ESAC and EASAC).

Recommendations:

- ASAC encourages JAO to consider allowing PIs the choice of whether their OUSs are delivered in order as they are processed, or whether they wait for the whole dataset to be completed before receiving any data.

Programs having multiple observing unit sets (Multiple OUSs): ASAC suggests to re-open the discussion about when proprietary time should start in view of the scattered data delivery times for some projects. Specifically, ASAC suggests re-consideration of the possibility that PIs be allowed to choose whether they wait for the whole dataset to be ready before receiving any data, or receive OUSs piecemeal with the corresponding mix of proprietary periods across a single program.

PIs may have multiple OUSs in a single project, such as 12m array + ACA + TP. In the current situation, each OUS will be delivered to the PI once QA2 finishes, and the proprietary-period clock on that OUS will immediately start. Thus, some OUSs, particularly those taken early in the Cycle, may become public in the archive before the PI has received all datasets. For some cases, this can risk reducing the science impact of the approved program, which will have been carefully designed to produce results from the full set of data and reviewed on that basis. However, an archive user who thinks 3.5 sigma is enough for publication, or that a lower-resolution or less complete image suffices for a quick result, may use a portion of the data that has early release and write a paper. If the PIs argued that for an optimal scientific outcome they needed a complete data set (e.g., a 5 sigma result, or multiple configurations for suitable u, v coverage) and that was approved by the APR, they will want to wait for the whole dataset. But, in the current system, the archive user can publish a quick detection before the PI receives the full dataset. This will have a negative impact on the original science proposed by the PIs, since, e.g., the quick result may not be complete enough to be considered for prestige journals such as Nature/Science and/or letters, but preempts the PI's analysis. Thus, the current system may make the science impact significantly lower than originally proposed. Achieving the *best* science outcomes with ALMA data may require the proprietary period to be set based on the last component of the data to be received. However, currently some PIs are forced to take the risk described above, despite having no control over when individual OUSs are delivered. ASAC thus recommends that PIs be offered the option to choose to wait until all datasets are ready (or the possibility of further data acquisition for the program has expired, such as the end of possible configurations in the cycle for B- or C-rated projects) before receiving any data.

Permanent Charge #6. Assessment of the scientific impacts of the ALMA Development Program, and particularly of new projects that are proposed.

Recommendations:

- ASAC endorses the OT Redesign project proposal.
- ASAC welcomes the preparations for an organized path to achieving the ALMA 2030 Roadmap goals.
- ASAC notes good progress on the Band 1 receivers and looks forward to their installation.

OT redesign project. ASAC has reviewed the proposal for a redesign of the ALMA OT and fully endorses it, providing a reliable platform for future ALMA needs. We have previously expressed some concerns about the limitations of a cloud-based OT, and the proposing team has sought to address those. As the OT redesign begins, we urge the team to pay special attention to the limitations of poor or unstable internet connections and to ensure that projects can easily be saved locally during their preparation. We note that it is anticipated that the old and the new OTs will both be running in parallel during Cycle 11, with the old OT still being used for Phase 2 of proposal submission. This should help to smooth the transition to the new OT.

ALMA 2030 preparations. ASAC welcomes the recent ALMA initiatives to define the path to ALMA2030. We find the formation of working groups around the front-end, correlator, and digitization/transport topics to be welcome developments, and the involvement of the global technical community through workshops has already shown itself to be a valuable exercise. We hope that this process will enhance coordination between the regional development programs and ensure that the limited project resources can efficiently be used to enhance ALMA. Of course, the overall engineering for such significant upgrades will be essential to the success of ALMA2030 and so we await the hiring of the system engineer. We look forward to seeing a coherent plan for major ALMA upgrades, which are becoming urgently needed.

EU activities: We welcome the progress on finalizing the design for the Band 2 receiver, and the efforts to find the optimal components needed irrespective of regional source. The ARI-L reprocessing of images from Cycles 3-5 is progressing satisfactorily.

EA activities: There is good progress in the construction of the Band 1 receivers, with the acceptance review pending after successful cryogenic tests at the site. The current schedule anticipates commissioning to start as soon as early in 2021. NAOJ is providing the optics for the Band 2 receivers. The beacon transmitter is in place and being tested. Other efforts involve testing methods for frequency transfer on long baselines, and multibeam receivers.

NA activities: We note the success of the ALMA Correlator Workshop held in Charlottesville, which resulted in excellent discussions and presentation of several options for a correlator meeting the ALMA 2030 needs. The correlator working group has developed strawman requirements for the new correlator. Phased-array capabilities continue to be improved, although testing was hampered in 2019 by poor weather. A new, more capable and efficient version of the Sumitomo He compressor will be tested in

2020, and studies of a new Band 6 receiver with wider IF bandwidth continue.

Ad-hoc Charge #1. ASAC should consider means by which ALMA could both solicit and identify high risk/high reward proposals as part of future calls for proposals and the ensuing proposal evaluation process.

Recommendations:

- ASAC supports implementing mechanisms to encourage more high risk/high reward observing programs with ALMA.
- However, there is a difficulty in defining exactly what constitutes a high-risk, high-reward proposal.
- ASAC notes the importance of clarifying the types of proposals that would be seen as high risk/high reward, and in particular drawing a distinction between HR/HR proposals, Large and Medium Proposals, and observations that are more properly part of EOC.

ASAC held an extensive discussion of high risk/high reward (HR/HR) proposals. This discussion focused around two main themes: how to define a HR/HR proposal, and what steps could be taken to encourage more successful HR/HR proposals. The general consensus within ASAC is that, although there is no hard evidence that HR/HR proposals are disadvantaged in the current proposal process, there is also no evidence that they are not disadvantaged, and it is easy to think of factors that could disadvantage such proposals. Therefore ASAC agrees that it is worth taking steps to encourage HR/HR proposals. We note further that the conclusions will differ, depending on whether a panel or DPR is used in the review.

What is a high-risk, high-reward (HR/HR) program? ASAC found it difficult to come up with a unique definition of HR/HR proposals. Risk occurs both as observational risk (difficult to carry out) and as scientific risk (e.g., possibility of no detection). In the latter case, both long and short integrations on a single source might be viewed as HR/HR by different ALMA communities. For example, proposal statistics show that requested on-source integration times tend to be significantly larger for extragalactic observations (Categories 1 and 2) than for observations of stars (Category 5). High-frequency observations or long-baseline observations might by definition be viewed as high risk because of the difficulty in obtaining the weather conditions required to carry out such programs.

ASAC came up with the following list of possible examples of HR/HR proposals; this list is neither exhaustive nor complete:

- (1) A deep integration (e.g. 20 hrs on source) on a single spectral tuning for, e.g., kinematics in a protoplanetary disk, detection of a rare molecule in a dense core (or any source), or detection of a critical line in a high-redshift galaxy;
- (2) an observation of a target for which the predictions of the expected line flux are very uncertain, e.g., the integration time required for a detection could be between 2 and 40 hours;
- (3) an unlikely but important signature, such as a biosignature or an unexpected molecule in a protoplanetary disk or evolved star;

- (4) confirmation of an unlikely but important signature (e.g. unlikely 2-3 sigma distribution, unlikely kinematic components, which is found by ~ 10 hrs or less integration.);
- (5) polarization observations of a source that is not a standard polarization target (e.g., a starburst galaxy) or of a molecular line for which no previous polarization measurements have been recorded;
- (6) searching for an atmosphere around a small solar system object such as a distant Kuiper Belt Object (KBO).

On the other hand, ASAC did not feel that proposals using experimental observing modes or demonstrating new or soon-to-be-released capabilities should be considered as HR/HR proposals. Such proposals and observing programs are more suitable for EOC or science verification observations.

How can it be made easier for high risk/high reward proposals to be successfully observed? ASAC identified a number of mechanisms that could be used to identify HR/HR proposals. One concrete example is as follows

- (a) For each proposal, ask the reviewer “are you concerned that the risk in this proposal is causing its rank to be worse than it otherwise would be?” and ask them to tick Yes/No
- (b) Allow each reviewer to identify up to one of their 10 proposals as HR/HR
- (c) Identify all proposals receiving at least 3 HR/HR ticks for further review by a committee such as the APRC or the DDT committee

A second possibility that was discussed was to encourage HR/HR proposals through the DDT process, without any changes to the main proposal review. In this approach, it would be necessary to review and update the guidelines for DDT. For example, it would need to be made explicit that long duration programs (20-30 hours) can be submitted to DDT, and that a proposal that has been rejected in a regular ALMA review can be resubmitted as a DDT proposal. In the DDT option, the guidelines could ask the proposers to make the case that this is a HR/HR program.

ASAC feels that there needs to be some kind of incentive or reward for some of the HR/HR proposals that are identified via these processes. Such rewards could include (1) being scheduled to be observed as part of (strategic) DDT time (2) receiving an increase in proposal ranking (e.g. unscheduled to C or B grade; C grade to B grade; B grade to A grade). Ideally at least a few HR/HR proposals would always be scheduled for observations, regardless of their rank.

Other points. Improvements to identify HR/HR programs could be made as part of a general update of the proposal review process. For example, the comments from DPR reviewers in Cycle 7 requested more guidelines on how to review proposals. One suggestion would be to have a clear, single page “cheat sheet” guiding reviewers on what questions to consider and what the evaluation criteria to use; this cheat sheet could also include specific language on and possibly examples of HR/HR proposals. Another alternative would be to have the reviewers answer a series of more structured questions in the review form, either as Yes/No boxes or Strongly Agree/Agree/Neutral/Disagree/Strongly Disagree choices. An interesting experiment would be to have proposers tick a box to identify a proposal as HR/HR, but not to

pass this information along to the reviewers. This would allow a comparison of how the writers and the reviewers judge the HR/HR nature of the proposal

ASAC wishes to highlight the difficulty in defining HR/HR programs. Ultimately, a suitable definition is a question for the ALMA Board. We note that the discussion of HR/HR programs addresses issues (and types of observations) that are distinct from those that the IVC's recommendation of Medium and Large programs are intended to help with.

Ad-hoc Charge #2. ASAC should list the science questions they would like to see addressed by publication statistics.

Recommendations:

- ASAC notes the importance of publication statistics in assessing ALMA's scientific impact, and recognizes that a significant effort is made to collect them.
- ASAC also notes that publication statistics can help identify areas where ALMA users need additional help or resources to efficiently produce high-quality papers from ALMA observations.

ASAC is charged to assess the science outcomes from ALMA, and for this, it needs publication statistics. Trends in such statistics are revealing of issues that may need to be addressed, and these may differ from one region to another. Low publication rates for specific types of observation may reveal difficulties in data analysis or observing properties that the project can help with. Over the longer term, the publication statistics help to show how people use the telescope, and how this usage fits with ALMA's strategic vision. To help prepare the material that is presented to ASAC to perform this task, we have selected what we think are the main questions that these statistics should answer, and we present them below, grouped by themes. We are aware that answering different questions may involve different degrees of complexity, and that JAO may not be able to fully address all of them. There are subtleties such as the need to ensure, when comparing different telescopes, that the comparison is fair, in the sense that the reported statistics use the same definitions, and the project already pays attention to such questions. We note that much of the assignment of papers by region is based solely on the first author's affiliation, and this often does not reflect the true regional distribution of credit for a given paper. It was pointed out that it may be possible to use the features of the Astrophysics Data System (ADS) to help in quantifying the distribution of multiple co-authors for ALMA papers.

1. Evaluation of the impact of ALMA

1a. What is the publication and citation record of ALMA projects by category, region, configuration, and band?

1b. What is the publication and citation record of ALMA compared with other equivalent facilities (HST, VLT, VLA)?

1c. What is its rate of publication in high-impact journals (e.g., Nature, Science, letters)?

2. Evaluation of the proposal review process:

2a. Does the proposal review process rate higher those projects that later have the greatest impact?

2b. Does the change to double-blind or DPR modify the effectiveness of the evaluation process?

3. Use of ALMA by the community

3a. How long does it take to publish ALMA data?

3b. What fraction of projects does not lead to any publication (by cycle, category, band, and configuration)?

3c. What is the use of the archive (alone and combined with PI projects)?

3d. How often do observers use multiple ALMA projects, or multi-line/multi-wavelength continuum, and how does it compare between the different regions?

3e. How much scientific collaboration is there between the different regions and how does it evolve with time?

3f. Do large programs have a larger impact (globally and by number of hours)?

Ad-hoc Charge #3. ASAC should comment on the draft revised Principles of the ALMA Proposal Review Process, especially on the concept and the extension to Medium and Large Programs.

Recommendations:

- ASAC endorses the introduction of the category of Medium proposals.
- ASAC supports the opportunity for "Strategic projects" under DDT assuming that this would enable new scientific opportunities for the wider community. ASAC strongly encourages that the selection of projects be done in consultation with the community.
- ASAC endorses the concept of a lower limit ("a floor") for time allocated to Large and Medium proposals, but feels the effect of this floor will need to be evaluated every few years.

ASAC has provided comments and suggestions on the draft version of the revised "Principles for the Proposal Review Process" and appreciates the thoughtful discussions with the Observatory Scientist on this topic. We recognize the importance of making sure that the Principles are sufficiently flexible to permit logical modifications to the review process while maintaining the overall high standards. There was some confusion about the current need for "co-PIs", as described in the document, that was not really resolved by the discussion, but we see no need to remove this option. The project recognizes that a double-anonymous review places the primary role of assessing conflicts of interest on the project, since reviewers are no longer able to be sure if they are conflicted. Following the detailed discussion during the ASAC meeting, we highlight the following further issues for consideration.

ASAC appreciates the efforts to introduce a "Medium" category, which is seen as a positive opportunity to establish a category that can deliberately encourage either deeper observations on individual targets, or larger samples, and thus hopefully weaken the community's apparent psychological barrier in the 20-50 hour range. The exact limits for the Medium category should be based on reasonable analysis of past experience and revisited at every cycle. The current suggestion of a Short-Medium boundary around 35h seems reasonable for the next cycle. We note that at the lower end of Medium there may be situations where the same science is proposed in Small and Medium proposals, but their review processes will be different if DPR is used for one and a panel for the other. ASAC feels that the Medium-Large boundary

presently should be about 70-75 hours, rather than 100 hours, but agrees that this decision needs to be informed by an analysis of how this might impact the queue-building exercise.

Specifying an upper or lower limit to the total amount of observing time pre-allocated to the Medium and Large categories will likely impact the design of proposals. A lower limit for the total time for Medium and Large proposals could be introduced as a guideline that is reconsidered for future cycles, for which ASAC is happy to provide advice. Currently it would be meaningful to aim for a lower limit similar to the present allocation for Large Proposals (about 10%) to signal that Medium proposals are encouraged. Introducing an upper limit on the total time allocated to Medium and Large proposals should also be revisited after the first cycle that has both categories. ASAC suggests to initially either give a generous upper limit, or no limit, followed by an analysis. However, it will be important to have clear instructions as to how much time can be allocated by LST-range-per-configuration, e.g. a maximum of 50% allocated to Medium and Large proposals.

ASAC supports the suggestion to have different proposal lengths for Short, Medium and Large proposals, as well as the change in number of cycles a proposal can remain active (1 vs 2). It was noted that in the present draft of the revised principles that the Medium category does not have an option for "C"-grade. ASAC suggests that this be reconsidered, understanding that there are pros and cons for this. An example where this would be relevant are for Medium proposals of large samples with a wide RA-distribution that could function as a filler program. Proposals for lower frequency bands (Band 3 for instance) that can take advantage of long periods with less-than-ideal observing conditions could also make sense.

ASAC is in favor of the proposal to continue to review Medium and Large programs by a panel while small programs can be evaluated through DPR. The method on how the final queue of proposals is to be built remains to be discussed, and ASAC is happy to be involved in those discussions. This specifically pertains to the question of the relative priority between Short and Medium projects in queue-building. The algorithm used to address this question is important, since the project does not want to be seen in the community as being unfair to either class of proposal. Thus the means by which Short and Medium projects are placed in the queue should be well thought-out and clearly described to the community.

ASAC supports the suggestion of allowing DDT time to be used for "strategic" projects. ASAC notes that this provides a good opportunity to do demonstration programs of capabilities. However, ASAC also comments that "strategic DDT" should not be used for projects that are close to "normal" proposals, risking duplication of proposals that have previously been submitted but possibly rejected in the normal review process. It is again important here that ALMA not act in a way that might give the perception of unfairly favoring particular groups or individuals. ASAC strongly recommends that such projects are initiated only after consulting the wider community (e.g. through a committee that represents the community widely beyond the observatory).

Ad hoc Charge #4. ASAC should summarize the science observations feasible with the Total Power Array given its expected sensitivities in this mode.

Recommendations:

- ASAC finds that the science cases for solar system objects justify ALMA total-power continuum observations. No feasible cases were found for other objects.

Science cases for total-power continuum observations: ASAC thanks the JAO staff for the work which has been done to provide relevant reports on this capability. ASAC has discussed the recent analysis of total power continuum observations. The last report, “Sensitivity estimation for the Total Power Array continuum mapping”, confirms that the initial sensitivity anticipated cannot be reached. However, ASAC notes that it is not a problem to observe bright sources with well-defined angular extents, such as solar system targets. For many of these sources it is also important to get simultaneous TP and interferometric observations due to the need to see the same rotational phases in the same state. No plausible science cases for objects beyond the solar system have been suggested, given the limited sensitivity of ALMA’s TP observations. There continues to be progress in combining ALMA interferometric data with much more sensitive bolometer TP observations from other observatories (e.g., Band 3 with GBT), and this seems to be a more efficient way to match TP continuum data to ALMA visibilities. ASAC therefore recommends that the TP continuum mode be made available for Solar System objects including the Sun, but otherwise not be offered.

ASAC notes the comments from JAO that functioning nutators could improve the TP continuum map sensitivity by factors of 1.5 (at band 3) to more than 3 at the higher frequency bands. However, TP continuum mapping would still not achieve the nominal expected sensitivity with these improvements, and in particular it would not significantly improve sensitivity in the most popular bands (3 and 6) with the current suite of receivers. Therefore ASAC does not consider the development of new nutators to be a high priority at this time.