



Report from the ALMA Scientific Advisory Committee

Face-to-Face meeting, Santiago de Chile

Feb. 28th & Mar. 1st 2011

Membership of the ALMA Scientific Advisory Committee

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Executive summary

Charge 1: (Preparation for Early Science)

Early Science will be the astronomical community's first in-depth interaction with ALMA and it thus it is extremely important that is deemed a success. The ASAC made the following recommendations available to the JAO before the final Cycle 0 capabilities were adopted. For completeness, they are repeated them here:

- All capabilities offered during Early Science should be expected to be successful and not still in a development stage.
- Small mosaics (e.g. ≤ 20 - 30 pointings) should be allowed.
- Offering polarization capabilities would entail a large degree of risk.
- No more than two array configurations should be offered in Cycle 0.
- The ASAC advises against including baselines of $>400\text{m}$ in Cycle 0 and/or planning to use specific configurations in Cycle 0 that depend on pads for which the power connection is not in place at the time of the call.
- Specifications on computing latency in mosaics should be defined.
- The current dearth of southern calibration sources should be rectified as soon as possible.
- The status of the archive continues to be a serious concern.

Charge 2: (Proposal Review Process)

The proposal review process is now in an advanced state of development, and the "Implementation Plan" is solid. The ASAC makes the following comments and recommendations:

- Clear guidelines for potential duplications need to be established.
- Requesting users to submit a Letter of Intent will not be effective.

- The identities of committee members should be protected and only made public (if at all) after the proposal review process, and only in a generic way that does not associate them with a unique panel.

Charge 3: (Path Toward Full Science)

Progress toward full science is continuing, and the ASAC commends the JAO on their balancing of near-term and longer-term priorities. However, the ASAC has several concerns for the transition of ALMA to full science:

- The JAO should maintain a high level of vigilance on antenna delivery.
- Insufficient contingency funds may require a prioritization of construction needs.
- The ASAC recommends the definition of an “Observatory Scientist” role in full operations.
- The ASAC would like the opportunity to review the “Development Principles” document when it becomes available, in particular with regard to “guaranteed time”.
- The ASAC is concerned that it has not been presented with an updated version of the Operations Plan and Budget, in which there are a number of issues that potentially have a strong scientific impact.

Informal Charge 1: (Community Expectations)

The expectations of the user community appear to be realistic and appropriate. The ASAC encourages the Project to maintain regular and transparent communication.

Informal Charge 2: (Power and Environmental Impact)

The ASAC remains committed to the recommendations made in previous reports. In particular:

- Negative publicity regarding the carbon footprint of ALMA could adversely affect the public's support.
- The investment in a combined-cycle power generator should be made as soon as possible, and every effort should be made to locate funding that could be moved forward in the budget.
- A working group should be established to investigate potential energy alternatives.
- Additional avenues for the capital investment in low carbon footprint energy generation should be investigated, including partnerships with providers and philanthropic organizations.

General:

- The weather at the AOS has been extremely detrimental to CVS progress and the schedule now has an extremely limited margin for slippage.

- The current level of activity at the JAO has resulted in late availability of documents and charges, which limits the ASAC's ability to provide appropriate and constructive feedback.

I. Introduction

The ASAC met in Santiago de Chile at the Central Office on February 28th and March 1st 2011. Prior to the meeting, two committee members visited the ALMA sites (OSF and AOS) in order to obtain a first-hand sense of detailed daily operations.

The ASAC would like to thank the JAO for coordinating this meeting during this hectic and exciting time and also express gratitude to the number of staff who presented material, provided information, and attended the face-to-face.

The ASAC was given three formal charges by the ALMA Board and two informal requests for input, which are discussed in turn in this document.

Finally, the ASAC proposes to hold its next face-to-face meeting (Sept/Oct 2011) in Charlottesville in order to continue the high level of interaction with the regional science centers. The ASAC unanimously agrees that the policy of holding alternate face-to-face meetings in Santiago and at the regional science centers (rotating between each in turn) is important to continue.

II. Response to Formal Charges

II.1) Charge 1

The Committee is requested to review and comment on the progress on preparing for Early Science. This should include: the status of the Construction project and progress with Commissioning and Science Verification; the scientific capabilities that are to be offered for Cycle 0; the preparations being made by the Department of Science Operations and by the ALMA Regional Centers, including the results of the integrated tests and progress on planning the activities needed to operate the facility. (Early Science readiness)

The ASAC is pleased that all the original baseline Early Science capabilities are sufficiently well understood that they can be offered as part of the Cycle 0 Call for Proposals. This is a major achievement for the ALMA Project and the CSV team.

The ASAC reiterates two important principles with respect to Early Science, and particularly Cycle 0. The first principle is that the number one goal of the Project is ALMA Full Operations. The second principle is that the Project should only offer those observing capabilities for which it is confident that it can deliver results in a way that will be seen positively by the community. Some might refer to this

as 'under promise and over deliver'.

The first principle strongly suggests that Early Science Operations should be designed to be as simple and regular as possible so as not to put an undue burden on CSV, DSO, or Engineering. Thus, Early Science operations should be scheduled in well-defined blocks of time, likely at night when the conditions are best and engineering is less likely to be affected. Along with minimizing the complexity of performing Early Science operations, while still evolving toward Full Operations, a regular schedule will also ensure that Early Science observations are completed in a fair and consistent manner. A further implication of this first principle is that the Project should minimize the offering of Cycle 0 capabilities that will be unavailable at the start of Early Science. Such complexities will unduly complicate the proposal submission, review, and scheduling. The Call for Proposals should clearly describe the expected impacts on observability (e.g., if a specific set of baselines is only available after the start of 2012 then the Call should note that observations requiring these baselines are more likely to be obtained for sources that are up at night in or after January 2012).

The second principle implies that all capabilities offered during Early Science should be expected to be successful and not still in a development stage or awaiting additional construction or verification. The ASAC concurs with the Project assessment that Early Science will commence on a 'Best Effort' basis and recognizes that during this phase the observations will likely not be as straightforward as expected during Full Operations. Early Science will, however, be the astronomical community's first in-depth interaction with ALMA and it thus it is extremely important that is deemed a success.

Scientific Capabilities to be Offered for Cycle 0

The ASAC was asked to comment on four additional "stretch" capabilities that might be provided during Cycle 0. Below are comments on each of these in turn.

(a) Mosaics - the ASAC was pleased to see a first mosaic presented by the Project Scientist and believes that there is little risk in making small mosaics available for Cycle 0. Given the reasonably large overheads associated with mosaics at present and the limited amount of observing time available, it is likely prudent to cap the size of allowed mosaics. The specific wording in the Call for Proposals should be extremely clear regarding the current and projected limitations of mosaicing - for example including the characterization of the primary beam and its affect on mosiacs.

(b) Polarization - the ASAC was shown some preliminary band 3 polarization data which appeared to show encouraging precision (0.1% rms polarization), at

least for continuum observations of a compact source at field center. However, there is evidence that the presence of standing waves within the optics, or some other mechanism, is producing variations as a function of frequency and position; moreover, no data have as yet been taken at bands 6, 7, or 9. There remains a great deal to be done in order to understand the instrumental polarization signature, and spectral line polarization should not be offered in Cycle 0. While continuum polarization may be possible, especially for point sources, since the instrument has not been calibrated off-axis, offering this mode in Cycle 0 is a significantly riskier proposition than other capabilities being made available and should not be offered in Cycle 0.

(c) Baselines beyond ~400 meters - The ASAC was presented with a draft plan for three 16-element Cycle 0 configurations, with respective FWHM baselines of 105m ("small"), 280m ("medium"), and 750m ("large"). Based on the careful analysis contained in this plan, the ASAC endorses the "small" and "medium" configurations for Cycle 0. The factor of 2.65 between resolutions provides a reasonable dynamic range in capabilities, and allows for observations that are roughly sensitivity and resolution matched over a significant frequency range. However, careful thought should be given to exactly how these two configurations are offered and implemented. For example, the Call for Proposals should specifically address whether *both* configurations or *either* configuration can be requested for a given science program.

The ASAC advises against including the "large" array in the Cycle 0 Call given that power to the necessary antenna pads will only become available well into Cycle 0, after the planned February 2012 'shut down'. While the ASAC is very keen to see ALMA deliver long baselines, it was unanimously agreed that three arguments argue against including such long baselines in the Cycle 0 Call:

1. The availability of the requisite power to the "large" array pads cannot be entirely assured ahead of time. Thus there is the potential risk that a significant number of accepted Cycle 0 proposals will not be completed, over and above the nominal "shared risk" caveats.

2. Scheduling successful proposals on ALMA would be significantly complicated by the many changes in array configuration over less than 8 months of observing, especially if there is a high demand for long baselines, which the ASAC expects if they are included in the Call. Allowing for long baselines effectively produces a two-tiered Call, where short baselines are available for the first part of the observing session and extended baselines for the second session. This approach was rejected at the previous ASAC meeting as being too hard to deal with during proposal review process and scheduling. With respect to scheduling, assuming that most Cycle 0 observations are carried out during the nighttime, the RA range observable with long baselines is extremely restricted

(as are the RA ranges observable for the now-abbreviated compact arrays). Splitting Cycle 0 into two configurations ("low" and "medium" resolution) appears feasible; splitting into three configurations and desiring to finish RA-restricted proposals threatens to put undue pressure on the CSV team's schedule of its high-priority work to complete the full array.

3. At best the long baselines will be available after February, only four months before the beginning of Cycle 1. Since the proposal deadline for Cycle 1 will take place before many large baseline proposals can possibly be observed, and since there is no carry-over from Cycle 0 to Cycle 1, these proposals are likely to be re-submitted in Cycle 1 anyway (with Cycle 1 proposals being additionally able to use a much more powerful array!).

(d) Single-dish observing. The ASAC concurs with the project scientist that for reasons of readiness, this capability should be deferred to Cycle 1.

Status of Construction and CSV

The ASAC was very pleased to see the two early results from the Science Verification process, and congratulates the CSV team on this milestone. It is clear that weather has been extremely detrimental to CSV progress and that there is now very little room in the schedule for further slippage. The ASAC was pleased to hear that progress on the roll-out of the R8 software has been aided by a 'simulation mode' which can be utilized during poor weather at the high site, but concerned that there have again been a large number of compatibility issues with the new software. The ASAC agrees with CIPT that the testing plan for future revisions of the software must be revised, include more rigorous regression tests, and involve CSV more. It is also important to note that computing latency remains a serious concern, as it is currently a limiting factor in the ability to efficiently carry out mosaic observations; in light of this it would be prudent to set a specification on the tolerable amount of computing overhead, which is not currently defined. In addition, the current capabilities of the OT do not allow for sensible mosaic patterns, and this should be rectified as soon as possible.

The ASAC is concerned that the calibration of observations is not yet fully determined, although the preliminary amplitude calibration tests are very encouraging. The ASAC is specifically concerned about the shortage of southern calibrator sources and supports the CSV efforts to identify and monitor further sources as part of the CSV activities.

The ASAC continues to have serious concerns about the status of the archive, which were not allayed by the CIPT presentation at the face-to-face meeting.

First, the schedule for opening the archive for proposal submission on June 1 is apparently rather tight. Second, while progress in solving bulk data transmission problems has been substantial since our October face-to-face meeting, progress in implementing multi-parameter (i.e., realistic) queries appears to be negligible. In particular, our recommendation for immediate deployment of even rudimentary multi-parameter query functionality at the OSF (to improve the CSV team's efficiency) has not been followed, and the archive interface seems to have been completely unavailable to the CSV team during the IT3 exercise. Recognizing its importance and public visibility as part of ALMA, the ASAC again highlights the archive as requiring adequate deployment of personnel within Computing, as well as active monitoring and supervision by project management.

Finally the ASAC is impressed that the CSV team received over 80 submissions for science verification targets and looks forward to the release of many SV data sets before the opening of the ALMA archive for proposal submission (June 1). The ASAC recommends that a diversity of science verification projects be observed, specifically taking into account the four proposal science categories. Careful thought should be given to *how* the SV data will be publically distributed, in particular what the path will be if the necessary archive functionality is not in place and tested.

Preparations by the DSOs and by the ARCs

The ASAC is pleased to hear that there has been significant progress at the DSO in defining the policies and implementations for the ALMA Project. The ASAC offers its assistance in reading and commenting on these documents as they become available and understands that the deadlines are very tight. The (partial) results available from the IT3 test are encouraging although there appear to be significant issues around the technical assessment phase. The ASAC agrees that guidelines for the technical assessment should be produced and that a clear explanation of what is expected in the technical justification should be available before the Cycle 0 Call. The Call for Proposals should clearly state how the technical assessment will be used in the proposal review. The ASAC would appreciate having the opportunity to review this document as well.

The ASAC agrees that there are significant advantages to an unannounced opening of the User Portal (UP) and offers assistance in early tests of the UP availability and usability. The ASAC remains concerned about the availability of the archive for ingesting proposals on June 1 and recognizes that any delay would be very public and prominent. The ASAC therefore recommends that a backup plan be in place for accepting proposals in the case that the full archive is not ready.

II.2) Charge 2

A final version of the document “Principles of ALMA Proposal Review Process” has been approved by the Board. A draft of the Implementation plan (for full Operations) and a plan specifically for Cycle 0 will be provided to the ASAC, together with a report on progress in setting up the ALMA Proposal Review committees. The Committee is requested to comment on the implementation plan and the plans for Cycle 0.

The Principles of the ALMA Proposal Review Process is very good but lacks specifics on the handling of duplications, a gap that the implementation plan needs to fill. While some level of judgment clearly will be required on a case-by-case basis for potential duplications, it is important to establish guidelines to aid proposers in determining reasonable requests. The implementation plan is also thorough and there were no major concerns. In regard to Appendix B on workload reduction, the consensus (not only in the ASAC) is that there will be substantially more than 320 proposals and the ASAC recommend triage along the lines proposed in Appendix B.

The ASAC favors the triage system proposed as “Alternative 3” due to its relative simplicity and transparency. “Alternative 2” is viewed as too complex and unlikely to be satisfactory. The ASAC further recommends that proposals in all science areas be read by the same minimum number of panelists, regardless of the proposal pressure in different areas.

It was suggested that proposers submit a brief letter of intent at the Cycle 0 call for proposals. While the rationale is clear, the ASAC uniformly doubts its utility or effectiveness. As an alternative, ASAC committee members (PdBI: Hogerheijde; CARMA, SMA: Williams) have volunteered to look into the proposal statistics for the existing interferometers and use these to produce an estimate for the ALMA call. For example, recent statistics for PdBI alone are as follows: 2008: 230, 2009: 218, 2010: 202, 2011, winter only: 138.

The ASAC was encouraged by the rapid and positive response to the invitations to be members of the Proposal Review Committees. However there is some concern that not all of the invitees have actively used an interferometer in recent years. The plan to invite future Cycle 1 referees to act as “standby” referees provides an important safety valve that the ASAC strongly endorses.

The ASAC is *not* in agreement with the suggestion that the committee members be made public at this stage as the single panel in each science category and small size of the committees in Cycle 0 effectively means that most proposers will know who evaluated their proposals. For comparison, note that other proposal review committees (HST, Spitzer, Herschel) do not generally reveal the names of the committee members. If committee names are to be released, the ASAC

recommend either that this be restricted to the panel chairs (as is done in Japan) or that it be delayed to be post-review and only in Cycle 1+ once there are 2 panels per category.

Finally, there should be a clear plan for how the Call for Proposals will be written and reviewed, and the ASAC would like the opportunity to review this document.

II.3) Charge 3

The ASAC will receive updates on matters related to the completion of the full construction program of ALMA, including schedule, budget and the build-up of operational capabilities. Progress on establishing the principles that will govern the ALMA Development process will also be reported. The ASAC is requested to comment on these topics and bring any concerns to the attention of the Board.

Progress toward full science is continuing, and the ASAC commends the JAO on their balancing of near-term and longer-term priorities. Front ends are now well into production, but remain on the critical path in the near term. However, antennas are projected to drive the critical path in the mid- to long-term, and the ASAC encourages the JAO to maintain a high level of vigilance on antenna delivery.

The ASAC has not seen a revised operations plan or budget and therefore cannot comment on it, which is a source of concern because it is not clear how science operations will be affected. In terms of the construction budget, the limited amount of funding now available in contingency may result in a prioritization of additional construction needs. Should this prioritization be necessary, the ASAC would like to have the opportunity to provide feedback.

As ALMA nears the transition from construction to operations, the transition of people and skills will become increasingly important and complicated. The ASAC recognizes that the talented and dedicated staff are at the core of ALMA, and will continue to be the most precious resource. The ASAC supports the efforts of the JAO to optimize staff transitions during this period. There is also concern that an "Observatory Scientist" position is not currently planned for full operations.

The Development Principles document is currently being drafted and was not made available to the ASAC at the time of the face-to-face meeting. The ASAC agree with the general framework as presented at the face-to-face that future development should be driven by enhancing the scientific productivity of the observatory, although the ASAC stresses that specific investments in infrastructure that would result (either directly or indirectly) in additional science capabilities should not be excluded.

The ASAC supports the plan for the JAO to oversee development with counsel from the executives and guidance from the ASAC on scientific priorities. While the ASAC is not opposed *a priori* to the possibility of external contributions resulting in guaranteed time, this would require careful consideration and a sounding of community expectations. The ASAC hopes to have the opportunity to review and comment on the Development Principles document when it becomes available.

III. Response to Informal Charges

III.1) Informal Charge 1

Community sounding on expectations for early science, and ALMA information resources for the general community.

Recent announcements concerning the time and likely core capabilities available during Cycle 0 have ensured that the expectations of the user community remain realistic. To this end, it may be prudent to announce that a large number of proposals were received for SV - nearly an order of magnitude more than the perhaps naive expectations. This will both dampen expectations concerning the likely completion rate of SV projects and signal that the over-subscription rate for Cycle 0 is likely to be high.

The community is content with the level of information available to aid preparation of proposals, and believes that a reasonably good balance has been achieved between “in-depth”- and “how-to”-style resources. The ASAC believes that regular transparent communication is important to maintain the bond between ALMA and its community, and foster the feeling that a truly significant development is taking place as ALMA move towards operations.

III.2) Informal Charge 2

ASAC will continue to look for ways in which ALMA construction and operations might be more environmentally friendly, especially in terms of energy use (without compromising science).

The ASAC remains committed to our previous recommendations, including those most recently presented in the face-to-face report of November 2010. In particular, the ASAC unanimously supports increasing the efficiency of power generation at the site as a high-priority issue. The ASAC recommends that the investment in a combined cycle power generator be made as soon as possible. The projected mid- and long-term savings far out weigh the initial expense, and every effort should be made to locate funding that could be moved forward in the project to make this investment. Not capitalizing on these guaranteed savings

amounts to wasting resources and money, and will sooner or later negatively impact ALMA's science output.

The ASAC also reiterates the recommendation that a working group be established under the purview of the Board/JAO to investigate potential energy alternatives, and to define the terms under which a contribution to capital investment from outside the project could be used to enhance the efficiency of ALMA's power generation. The ASAC recognizes that one of the fundamental obstacles for such changes is the initial capital investment. However, there may be multiple options for meeting this expense, including (but not limited to) partnerships with providers, philanthropic organizations, or funds for infrastructure development within the ALMA project. Some of these solutions may be "unorthodox" in the strict organization of ALMA as a partnership among three executives, but the ASAC feels that such considerations do not outweigh the significant positive impact of increasing the energy efficiency and sustainability of ALMA.