Report from the
ALMA Scientific Advisory Committee
Face-To-Face Meeting
NAOJ Japan
March 9th & 10th 2010

Membership of the ALMA Science Advisory Committee

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EXECUTIVE SUMMARY

The ASAC met at NAOJ in Japan March 9th/10th 2010. Overall, ASAC is very pleased to see the progress with the project since we last met face-to-face in October 2010 at ESO Garching. We remain confident that the Director, Project Scientists, and their growing team are on track to commission ALMA as a transformational global observatory. ASAC believes that an Early Science call by the end of this year remains within reach but notes that this is an exceptionally tight schedule which will require all aspects of the Project to work effectively and at a very high level. ASAC emphasizes that the technical requirements for Early Science should not be compromised in order to meet this pre-determined deadline. We report in detail on the seven charges sent to ASAC by the ALMA Board in Section III. A draft description of the ALMA Proposal Review Process provided by the ALMA TAC subcommittee was actively discussed, and ASAC agrees with most of the contents of the document. In considering areas of possible improvement, we have provided comments on top-level issues, which should definitely be addressed in a Board-approved document, as well as on low-level issues, which we feel could be usefully incorporated in an Implementation Plan written by the DSO. We see continued progress in software development, but some areas remain critical for Early Science. It is encouraging to see that the AIV/CSV teams are maintaining a high level of activity focused on Early Science, but a major concern is the slow delivery of front end units. ASAC recommends that a first call for ALMA Development be issued within this calendar year, with input on community interest and costing from the regional Project Scientists. The cost savings issues were also extensively discussed from the point of view of protecting science.

I. INTRODUCTION

We received a report at the meeting about the recent earthquake in Chile, noting that there were no casualties among the project staff, but that most of the staff and their families were affected in one way or another. We were relieved to hear that there were no injuries and wish the project team all the

best in recovering from the damages. ASAC was very much pleased to see the Project Scientist Richard Hills in person at NAOJ and many other staff via video from Chile for the meeting.

This report describes the discussions at the ALMA Science Advisory Committee (ASAC)'s face-to-face meeting held in March 2010 at the National Astronomical Observatory of Japan in Mitaka, Japan, for submission to the board at its meeting in Santiago in April 2010. The committee is grateful to the East Asian Project Scientist Koh-ichiro Morita and his staff for organizing the ASAC meeting, including a receiver laboratory tour at the NAOJ during the meeting. We would also like to thank the North American Project Scientist Al Wootten for organizing our bimonthly telecons, and the ALMA project team for their help in preparing and presenting documents and reports for our meeting.

The ALMA Board gave ASAC seven specific charges. Our reports on the charges can be found in Section III.

We start our report with a general overview of the discussions at our meeting.

II. GENERAL DISCUSSION

II.1) ASAC was pleased to hear that CSV started in January, with commissioning now underway with three antennas at the AOS and the test interferometer operational at the OSF. ASAC would like to continue to follow closely the project's progress in the context of CSV activities and other efforts towards Early Science, as these are critical steps for the success of ALMA.

II.2) The committee spent considerable time discussing issues related to Early Science. Since the next face-to-face meeting will be held shortly before the decision point for Early Science, the present meeting offers a good opportunity for us to provide constructive comments for achieving a successful start of Early Science. We discussed the Proposal Review Process at length, since its proper implementation is important for maximizing the scientific output of ALMA. Software system issues still require attention; some parts of the software are advancing well, while others still remain on the critical path to the call for proposals. We are pleased to see the recent progress on antenna preparation, with the steady resolution of many problems, but the slow delivery of the frontend units may be a major blocker for Early Science in the current situation. Cost cutting issues were also major subjects at the meeting, and we discussed them from the point of view of protecting ALMA's science. ASAC continues to stand ready and willing to advise the board on any issues relating to the scientific effectiveness of ALMA.

II.3) As described in our last report, we propose that our next meeting be held in Chile, so that ASAC members can fully engage in the decision making process for Early Science. The exact date of the meeting will be determined according to the schedule of the readiness review for Early Science and the Board meeting.

We propose as the next ASAC chair Frédéric Gueth from the European partner.

III. RESPONSES TO BOARD CHARGES

III.1) Review the draft document describing the ALMA Proposal Review Process and provide comments to the Board.

ASAC was pleased to see a well thought through draft description of the ALMA Proposal Review Process and thanks the ALMA TAC subcommittee for its hard work. In its broad lines, and also in many of its details, ASAC agrees with the contents of the document. In considering possible areas of improvement, however, ASAC concluded that it might be advantageous to separate top-level issues related to the distribution of time among different partners and different proposal categories (regular, director's discretionary, "Open Skies", etc.), which clearly must be in a Board-approved document, from lower-level details that could be more naturally worked out in an Implementation Plan prepared by the Department of Science Operations (DSO). There are two reasons for this conclusion. First, ASAC feels that many of the latter details are likely to evolve with time (e.g., between Early Science and full operations), a process most easily accommodated if small changes do not require Board approval. Second, during the course of our meeting and subsequent discussions, ASAC came to realize that there is a complex web of issues-- centering on how to define when a project is "finished" as a function of its requested observations, its rank, and the time remaining in the queue(s) from which it may draw-- that is deeply connected to the goal of making ALMA just as easy to use for single-partner as for cross-partner teams, that needs to be clearly explained to prospective Early Science proposers, that is not adequately described in the current Board draft, and that (crucially) will require close contact with the proposal handling and scheduling software groups to untangle. Further work on this front would be most naturally led by DSO, with continuing input from the Board and ASAC.

With this arrangement in mind, ASAC has provided its additional comments in two sets. The second set can be viewed as suggested guidelines for the DSO as it prepares an Implementation Plan, or (if the Board prefers not to separate top-level from lower-level material) as suggested changes for a single, unified document.

Recommendations on top-level issues

(1) ASAC strongly recommends that communities of proposers with access to ALMA through more than one region not be allowed to choose which region their proposals are attributed to, but that attribution be automatic and in proportion to the contributions made through the respective regions to construction and operations, however those contributions are defined by the Board. Adopting this policy would remove an element of chance from the attribution of time and make it easy to adjust to any future changes in the relative contributions made through different regions. ASAC notes that Taiwan is currently the only nation with access to ALMA through two regions, and makes the further suggestion that as soon as either the East Asian or the North American queue for a particular season is drained, the scheduling and time charge of all remaining Taiwanese proposals should be tagged to the region whose queue has not yet been drained. These recommendations have the support of ASAC and of the Taiwanese members of ANASAC and EASAC.

(2) On the attribution of time in general, ASAC concurs that small programs are best attributed to regions based on the affiliation of the (single) PI. This rule is simple, offers no incentive for "strategic" inclusion of Co-Is on a proposal to exploit a particular queue, makes it clear to reviewers who is taking responsibility for the proposed work, and gives the clearest "credit" for a project to the Executive who pays for the "honor" by spending time from its queue.

For large, ambitious programs, ASAC suggests that it be possible for proposing teams to designate a limited number (N = 3-4) of Co-PIs on a proposal, with a fraction 1/N of the time then being attributed to the region with which each Co-PI is affiliated. Co-PIs could be from the same or different regions (with one possible limitation; see (5) below). This rule is again simple, offers no incentive for strategic inclusion of *Co-Is* on a proposal, makes it clear to reviewers who is taking responsibility for the proposed work, and gives the clearest credit for a project to the appropriate Executive(s). ASAC notes that the distinction made here between "Co-PIs" and "Co-Is" is blurred in the terminology used by the current draft document.

ASAC concurs that 100 hours is a realistic, albeit arbitrary, boundary between small and large programs. However, it became clear during discussion that at the time of Phase 1 submission, a project's total time request is not a well-defined quantity within the Observing Tool. ASAC therefore suggests that the DSO (in cooperation with the Observing Tool team) develop a metric that can actually be calculated at the time of Phase 1 submission, and that corresponds to about 100 hours of integration time. For a Board-approved document, "the equivalent of 100 hours" would be a useful description.

(3) ASAC concurs that the ALMA science return would be enhanced by reserving a small (no more than about 5%) fraction of director's discretionary time (DDT). As noted in the last report, the Executives are answerable to their communities and their funding agencies about the allocation of DDT. To ensure a close connection between the JAO and the scientific output of ALMA, and to avoid unnecessary duplication, a leadership role for the JAO in the DDT review process is essential, but clear input from the Executives (and the Chilean community) and reporting back to the Executives (and the Chilean community) are equally essential. Appointment of representatives to a standing DDT review panel by the Executives would address this concern.

(4) ASAC agrees with the wording of the draft document on the fraction and attribution of "Open Skies" time.

(5) ASAC sincerely hopes that the Chilean community will participate fully in the unified proposal review that is outlined in the document. A decision to do so would streamline the resolution of duplications and facilitate Chilean astronomers' ability to propose for ALMA time on an equal footing with astronomers elsewhere. (ASAC notes that the attribution of time for large programs based on Co-PI affiliations, as suggested in (2) above, would protect Chilean time against "palo blanco" additions of Chilean Co-Is to non-Chilean PIs' proposals; however, it would also likely prevent Chilean astronomers from serving as Co-PIs on cross-partner proposals if the Chilean community does not join the unified proposal review.)

(6) ASAC feels that a description of the Proposal Review Process should at this stage not contain language about "Key" or "Legacy" projects. Without clear definitions of these terms, and with no blocks of time set aside for these categories while ALMA's capabilities are still evolving, their inclusion is misleading and might raise expectations in the community that the project cannot deliver on in the immediate future. The most appropriate statement to include at this point may be that these categories do not exist for now, that they may be established in the future, and that in the mean time there is no upper limit on the amount of time that can be requested in a regular proposal.

(7) ASAC agrees that at this time, language about balancing fixed shares among weather bands should be excluded from any description of the Proposal Review Process. The degree to which the various queues get their "fair shares" of each weather band can be evaluated as Early Science proceeds, with consideration of further balancing postponed until later.

(8) ASAC recommends that the system of queue-draining be set up in a such a way that no (or as few as possible) A-ranked proposals are left stranded because a queue has been used up on B-ranked observations (i.e., the scheduler should stop executing B-ranked proposals when there is still enough time to execute a region's remaining A-rated proposals), and so that the cost of accruing a slight imbalance in regions' allocations does not outweigh the efficiency loss incurred by leaving a large number of projects at any rank half-finished.

(9) ASAC suggests that a Board-approved document not contain a specific reference to the number of calls per year. Instead, it can describe policies in the context of a single cycle of unspecified length. Due to coupling with the exact format (and therefore cost) of a single proposal review, the optimal number of calls per year may well evolve with time, and therefore seems more appropriately reserved for an Implementation Plan (for a current ASAC consensus, see (12) below).

(10) ASAC recommends that the Board explicitly define policy on attribution of time for proposals led by JAO staff members. A sensible approach may be to charge the region whose Executive is paying a given staff member's salary.

Recommendations on lower-level details

(11) ASAC notes that proposal submission will proceed through the central archive in Santiago, not "through one of the ARCs." The statement that "ARC staff will work directly with the proposers of problematic proposals in order to get the technical details right" suggests a very high level of support; more realistic wording might be "ARC staff can help proposers resolve technical difficulties that preclude proper submission of the proposal, and offer general help with preparing proposals and/or understanding ALMA capabilities."

(12) ASAC feels that a proposal review format that allows discussion among review panelists (as opposed to one that relies heavily on anonymous external reviews) is the most scientifically beneficial and appropriate implementation for at least the initial proposal cycles, when expertise within the pool of

prospective reviewers will be limited. Recognizing that this format is more expensive than the alternative, as well as the heavy pressure on the operations budget, ASAC endorses the draft plan for one proposal cycle per year in the immediate future, with the expectation that this issue can be revisited in future years.

(13) ASAC feels that a refereeing load of 125 proposals per person is too high. This load is already painful for experienced millimeter interferometrists (e.g., on the IRAM Program Committee), but if ALMA wants to include novice users and scientists from other fields in review panels (and ASAC thinks it should), 125 proposals will be unworkable. Using external referees to triage proposals before discussion is also not preferred by ASAC, especially in the first calls when community expertise will be limited, due to the complex interactions between triage strategy and scheduling (i.e., a poorly ranked proposal can still have a high proposal execution likelihood). One way to decrease the effective amount of work is to have only one secondary referee in addition to the primary referee. The exact ranking procedure (use of external referees, number of assessors per proposal, etc.) may evolve with time, as experience grows and expertise in the community increases.

(14) ASAC recommends that individual referees' grades be rescaled for identical mean and variance before they are fed into panel discussions, and that the amount of time allocated to each of the four "themes" be roughly proportional to the requested amount of time in each theme. This system effectively equalizes the oversubscription rates of the four themes, although it requires that some adjustments be made if certain themes attract a disproportionate share of very poor-quality proposals asking for very large amounts of time.

(15) ASAC suggests as a guideline that the Implementation Plan specify that a proposed observation be considered a "duplication" if for that observation and data from the archive or another proposal, *all* of the following are true:

(a) positions differ by less than half the primary beam,
(b) respective longest and shortest baselines differ by factors of less than 1.5 (or an equivalent statement about synthesized beam sizes and largest scales recovered that is appropriate for ALMA's configurations),
(c) spectral bands overlap by more than 50%,
(d) spectral resolutions differ by less than a factor of 4,
(e) sensitivities (fixing all other parameters) differ by less than a factor of 2.

Observers should always be allowed to request a waiver during Phase 1 or later to obtain duplicate observations; standard waiver categories should be defined for time-monitoring and astrometry/proper

motion observations that would violate (a), and for new spectral line tunings that would violate (c). Duplication criteria should be defined in the Implementation Plan in a non-ambiguous way. The ALMA software should then eventually make it possible to identify duplications, so that Phase 1 proposers can be asked to justify duplications of archival data before submitting, and institutional memory in the PRC does not rest entirely on the shoulders of returning panelists. Policy on duplications must be shared with proposers before the Phase 1 deadline, not just with members of the review panels before they meet.

(16) ASAC suggests that the Implementation Plan include a description of how duplications, overlaps, and descopes will be *resolved* that is more detailed than "taking into account regional preferences," since it is important for this information to be conveyed to proposers before the Phase 1 deadline.

(17) ASAC notes that panels will need to be informed about which targets/proposals are implicated in duplications extending outside the proposals they themselves are reviewing (e.g., so that they can comment on whether the scientific goals of a given proposal would be irreparably damaged by dropping one of several targets).

(18) ASAC suggests that with regard to Target-of-Opportunity proposals in the "can reasonably be anticipated" category, the Implementation Plan should make specific commitments on how rapidly observations will take place after a trigger, and on the level of disruption they will be allowed to cause to other programs in the queue.

(19) ASAC feels that any endorsement of "coordinated" (in the sense of inter-observatory) proposals is premature, given uncertainties in how these would work when access to a particular facility is partly or wholly conditioned on a proposer's institutional affiliation.

(20) ASAC would welcome opportunities to interact with the DSO on the development of an implementation plan, and to consider in more depth issues that have come up in its own discussions and those of the regional SACs (e.g., how queue draining will work for cross-partner proposals, the merits of establishing a joint proposal mechanism, the possibility of offering special consideration to student Ph.D. thesis projects, and the appropriate latitude to give panels to rewrite or descope proposals).

III.2) The Project is investigating how to make cost savings that would restore the contingency funding to a satisfactory level. Reductions in operating costs are also being considered. In the event that these savings turn out to have implications for either the scientific performance or the operational efficiency of ALMA, the ASAC will be asked to make recommendations on the relative priorities and cost-effectiveness of the proposals.

ASAC received a short but clear presentation from Richard Hills on the status of construction and is pleased to learn that the potential crisis in the construction budget has been averted. ASAC would like to congratulate the many individuals involved in the budgetary process for their efforts. ASAC does have some concern that some cost savings items in the construction budget may increase costs later, during operations, and that these might in turn have implications for the level of science. Such items include the decision to not surface the roads, and the reduction in purchasing of some spare parts.

ASAC also received a detailed report from Lars-Åke Nyman on the Operations Budget, which is clearly under significant pressure. According to the report, the initial operations plan was 20%, or $12 Million, over-budget without accounting for the likely increased cost of power. Obviously significant budgetary cuts will be necessary, including some which may impact directly the science operations. ASAC, however, was disappointed that the only detailed cost savings presented were those that directly impacted science operations, especially since only modest savings were found from the cumulative efforts. Most of the savings were found in areas that were not clearly detailed, such as maintenance of the telescope. ASAC stresses that these budgetary savings may have a much larger impact on the science than those accounted for directly through science operations. Thus, ASAC recommends that a more careful analysis of these items be undertaken. Finally, ASAC had difficulty placing the science operations cost savings in context with the overall Operations budget. It is not clear if cuts to science operations reflect similar cuts in other areas of the project. For example, the scientific manpower is severely reduced within the science operations staff while it is not clear the extent to which management and administration positions have been reduced.

ASAC was shown three specific reductions to the science operations:

(1) a reduction from two to one proposal reviews per year provides a marginal savings of about $0.5 Million. As discussed in III.1 (12), ASAC endorses the draft plan for one call per year in the immediate future.

(2) a reduction in the number of array configurations provides a marginal savings of about $0.5 Million.

ASAC awaits the detailed report based on simulations but agrees that this reduction is likely to have an acceptable impact on the quality of the science.

(3) a significant reduction in the science staff provides a moderate savings of about $1.0 Million. ASAC recognizes that there may be a solid case for data analysts performing effectively and efficiently many of the required tasks and thus the change of some astronomer positions to data analysts may be appropriate. ASAC believes, however, that ALMA benefits from having active scientists engaged in operations in Chile. In particular, ASAC does not recommend the deep cuts to the Fellows program. The suggestion that these positions might be supported from the individual Executives was not seen as viable either.

ASAC was also shown two recommendations that were NOT presently implemented:

(1) a reduction in operations during Altiplanic winter. ASAC believes that ALMA is capable of excellent science during the Altiplanic winter as long as the configuration and instrumentation is appropriate (short baselines and low frequency receiver accessibility). The Operations Plan must take this into account when devising the configuration schedule and planning any instrumentation maintenance. Beyond this, ASAC recommends no further reduction in science operations during the Altiplanic winter.

(2) a reduction in the number of archives, explicitly removing the ARC archives. In principle, ASAC recognizes that there should be no scientific impact as long as access to data is secure and fast. ASAC notes, however, that reducing the archives may have a strong negative impact on the operation of the ARCs and data re-processing. This is especially true if the entire pipeline needs to be rerun on the archived data. It is also to be noted that removing the ARC archives may require tripling the network bandwidth, which imposes extra costs, and that having only one archive system introduces the risk of a single point of failure. Further, the cost savings from archive reduction appears to be minimal and thus does not justify the loss.

ASAC recognizes that the Operations Plan must address the budgetary issues and recognizes that science output is likely to be affected due to necessary revisions. ASAC stresses that the purpose of the observatory is to conduct science and thus every effort should be made to minimize the scientific losses. ASAC expects to be further involved in reviewing these plans over the next year and hopes to gain a clearer understanding of the relative budgetary cuts within all areas of Operations. Again, ASAC stresses that the savings found in the science operations has been marginal considering the overall budget situation. The significant decreases required in other parts of the Operations budget are likely to have

even more profound effects on the scientific capability of ALMA.

III.3) Discuss the revisions to Scientific Requirements and Specifications, which are in preparation, and make a recommendation to the Board on approval.

A detailed set of revisions to the Scientific Requirements and Specifications was not available at the time of the face-to-face meeting. Although disappointed, ASAC understands this is a consequence of the fact that the project is currently very busy with AIV and CSV activities. We have expressed, as at our last face-to-face meeting, our interest in interacting with the project scientist on the key revisions to the requirements. One ASAC member, Andrew Baker, in collaboration with project team members, is working on a revision of one of the Level-1 Scientific Requirements, "the ability to detect spectral line emission from CO or C II in a normal galaxy like the Milky Way at a redshift of z=3, in less than 24 hours of observation". The present status of this effort was summarized in a report and was distributed to the other ASAC members for comment. ASAC is willing to continue such efforts and to keep close contact with the project scientist on key revisions to the requirements. We note that the astronomical community's current expectations are based on the statements in the Level-1 Scientific Requirements for ALMA because they have long been publicly available. In line with this, changes to the Requirements, if any, should be finalized very soon and disseminated through the community.

III.4) Comment on the analysis that is being prepared on the Development Fund items and on which of these might be considered for a first Call for Proposals.

ASAC underlines the importance of a sufficient development budget for the long-term viability of ALMA. Even though at the moment the project's priorities are the CSV process and preparation for Early Science, ASAC stresses that initial work in some key development areas already needs to start now. ASAC recognizes the efforts ongoing in the executives to identify various development items and obtain cost estimates. ASAC feels that project-wide coordination is vital, and foresees a role for JAO to guide this process with ASAC input. In ASAC's opinion a draft call for first proposals is timely, and we recommend that a call is issued within this calendar year. The best way forward for this, in ASAC's opinion, is for the JAO to ask the regional Project Scientists to obtain rough cost estimates for development items of interest to their regions. On the basis of these numbers, the project can then draft a call with further input from ASAC. ASAC stresses that the entire procedure should be set up such that

any demands on the time of AIV CSV staff is minimized.

We attach the updated matrix of development items as the last part of this document. At this stage, ASAC suggests the consideration of development items that have a relatively short time line and modest price tag, and which clearly fill a 'gap' in ALMA's current capabilities. Seed money for long-term developments that can have a wide-ranging impact on ALMA's future capabilities should also be considered. Improving components that have not yet been fully tested in real science observations, such as the calibration devices, software, WVRs, etc., should, at this stage, not be considered.

III.5) Continue to monitor the readiness of the ALMA software system. In view of the ASAC's most recent report it is clear that the observing tool and the archive continue to be important topics and that the ASAC will also have comments on the overall schedule for the release of the core software packages that the Project is going to deliver to them. The data analysis software deserves particular attention: ASAC should examine the capabilities of the latest release of CASA, and review what further enhancements are planned before the start of Early Science.

ASAC was given reports on ALMA software and computing readiness from Brian Glendenning and Crystal Brogan. These presentations were very informative and candid, and we would like to express our thanks to Crystal and Brian for their participation in the ASAC meeting. We also wish to express our gratitude to the entire CIPT group for their commitment to the ALMA project and the substantial effort that continues to be put into the ALMA software. The ALMA software will be the "face" of ALMA to the outside world, and therefore it should be appropriately available in time for Early Science. Releases of the OT should no longer be locked to the 6-month release cycle, but to calls for proposals. We expect that CIPT's planning, including, but not limited to, the OT, will build in time to prepare for Early Science.

The committee notes the important recent progress on the development of the Observing Tool (OT). The OT will be one of the first points of contact for general ALMA users and it constitutes a potential single point failure. ASAC is concerned that the OT remains on the "critical path" for the ALMA project. CIPT must continue their level of dedication to ensure that the OT is ready for the ES Call with no significant bugs or flaws and with full documentation available.

At the time of the ASAC meeting, the OT has been through at least one in-depth test with a small group of potential users, and we endorse the current plan for a general community release in the 2nd-3rd quarter of 2010 -- well in advance of the Early Science Call. We strongly support plans for at

least one further round of extensive user testing. In addition, we support the idea of limiting the scope of the released OT to the observing modes and configurations that will effectively be used for ES in order to proactively mitigate potential confusion in the community, and possible channel resources to the current critical development areas. It should also be noted that the release of the OT cannot be delayed from its present planned date (October 10). The buffer between this date and the ES proposal application deadline is already very small, and time for last-hour fixes and/or improvements must be planned for. We also note that the OT is a "customer" to numerous other ALMA software products, such as the archive and splatalogue; the ASAC is anxious to see further development of the OT interfaces with these tools. We encourage the CIPT to take a careful look at functionality that is formally listed as part of "phase 2", but which might be required by proposers to adequately carrying out phase 1. Indeed, given that phase 2 requirements will need to be met only shortly after those of phase 1, we support the effort the CIPT is making to keep an eye on the near horizon.

ASAC was impressed by the presentation on CASA, and we congratulate the CASA team on their developments and the pace at which CASA advancing. The committee endorses the roughly 6-months release cycle for major versions of CASA, and notes the progress on the smoothness of the process. We endorse the efforts that have been made to solicit and respond to input from scientifically active radio interferometry experts, so that required tasks and facilities may be more efficiently implemented, and we encourage the CASA team to continue in this way. The committee is pleased to note the new CASA helpdesk based on 'kayako', and the implementation of a CASA knowledge base, which will be of high value. However, this new facility relies on manual intervention by CASA Scientists, which we anticipate will be difficult amid other issues during Early Science. We support the idea of out-sourcing ("crowd-sourcing") this functionality or alternatively allowing for some level of automation. ASAC also discussed the extent to which it will be necessary and/or appropriate for individual desktop users to be able to run their data through a designer pipeline. While this will be feasible with small computer clusters, it will not (in general) be realistic for users to run the entire pipeline on desktops in the near future. However, we believe that re-imaging of data at a user's home institution should be allowed for. We anticipate computer abilities for desktop environments will continue to increase making a full pipeline reduction more tractable in the future, and we encourage the CIPT to revisit this issue in the coming years.

The readiness of the software for ongoing AIV/CSV activities in Chile remains an important focus of CIPT's efforts. The December 2009 visit of CASA developers to Santiago was a very useful exercise in guiding work to meet current commissioning needs and facilitate future scientific operations. ASAC encourages CIPT to arrange a similar summit for archive and logging tool (e.g., ShiftLog) developers, so

that the manual logging burden on AIV/CSV scientists can be reduced, and key archive functionality (e.g., the ability to search automatically for duplications; see III.1.15) will be in place on appropriate timescales.

III.6) Continue to review the progress and schedule of the AIV/CSV process, with particular attention to the risks, risk mitigation, and prioritization.

ASAC received clear and thorough reports by Alison Peck and Richard Hills on the AIV/CSV process. We congratulate the team on the progress to date including, in particular, phase closure at the AOS and the formal beginning of commissioning.

It is encouraging to see that the AIV/CSV staff levels in Chile are at the desired levels. The scheduling and allotment of personnel is very well organized and attention is paid to training of new personnel.
The wiki pages and JIRA tickets make it possible to follow progress and allow for continuity during team switches at the OSF.

Although the poor weather has limited some astronomical tests, there has been substantial and impressive progress particularly in regard to antenna pointing, tracking, holography and WVR phase correction. Yet there remain some problems with amplitude calibration, including problems with moving the loads and receiver non-linearity issue. More testing is required and contingency plans should be put in place.

It is encouraging to see that the overall CDR has been completed for the front ends but their slow delivery is currently the limiting factor to the scheduled acceptance of 16 antennas and start of Early Science. There is some room for mitigation by moving the OSF interferometer to the AOS as long as this does not conflict with the schedule for major software releases.

Single dish total power measurements are at risk from the delay in delivery of the nutating secondary. A viable mitigation procedure is fast scanning of the primary.

ASAC notes that the aggressive timeline for Early Science requires that the Site and Facilities groups perform at the same high level as the rest of the project. In particular, the timely deliveries of fully functional pads at the AOS and a higher-bandwidth data link between the AOS and OSF have a high

scientific priority, as does the elimination of power interruptions at the AOS and the OSF, which reduce the efficiency of AIV/CSV efforts and damage staff morale.

AIV/CSV is on track for an operations readiness review with 8 antennas in October 2010 and Early Science in July 2011. Noting that the consequences of any delay in Early Science are severe, ASAC nevertheless emphasizes that the technical requirements for Early Science should not be compromised in order to meet a pre-determined deadline. Further, ASAC recommends that an end-to-end demonstration of the science verification array with ~8 antennas occur before the call for Early Science is made.

III.7) Review the plans for carrying out the initial processing (e.g. calibration, map-making and quality checking) of the Early Science data and delivering it to the user community. Of particular interest are the questions of a) whether there will be sufficient resources (especially staffing) to cover this in the period before the pipeline is ready and b) what level of quality assurance is appropriate.

The ASAC was given a presentation by Alison Peck on the plans for initial processing of Early Science Data. The observatory will have the responsibility of performing quality and assurance up to QA2 (image fidelity checking) with a level close to that the pipeline will produce. The QA2 data will then be ingested into the archive and become available to the user at the regional ARCs. After examining the imaging products, if the user believes there is a problem with the data that indicates a problem with the array performance, calibration procedures, or reduction process they then contact the ARC via the helpdesk, and the ARC is tasked with investigating the problem. If it is a problem with the observatory science operations, a "QA3" report is filed so that the JAO is aware of and tracks the problem.

A major continuing concern of the ASAC regarding the processing of Early Science data is the likelihood that unanticipated issues with instrument performance, pipeline software glitches, and/or requests from Early Science PIs will require substantial trouble-shooting. If the QA2 process does not initially work as expected, this could lead to significant time investment at the ARC level during early science, and appropriate human resources must be available in the regional ARCs to be able to perform this work. In addition, we are concerned that such problems could overload the CSV staff, risking slowing down or even stopping CSV activities, something that cannot be allowed to happen. We underscore the importance of good logging during data acquisition and reduction stages, so that re-reduction can be performed and preliminary processes understood. Given the importance of the QA2 procedures, the

ASAC would like to see, within the next year, a practical example of the scripts (soon-to-be-pipeline) using real data (CARMA, IRAM, or, ideally, ALMA CSV data).

We anticipate that during the initial period ARC staff will be under high pressure and all effort should be made to alleviate other demands on them during this time period. We also support the involvement of the ARC staff during the development of all procedures in order to maximize the efficiency and communication during Early Science.

ALMA development plan: comparison matrix

ASAC report: March 9th & 10th 2010

performance to be improved	development item	degree of improvement	speed/technical difficulties	cost	beneficial for	Note
sensitivity	more antenna	add 5 antenna ==> 10%	quick	expensive	all science	
	new digital system/2GC	10%	moderate	expensive	all science	
	2SB for Band 9	a factor of 2	moderate?	moderate?	all science	
	Widening the IF Bandwidth of Band 6	a factor of 2 in a certain case	moderate	moderate($1.6M?)	All science	Three CO isotopes simultanuously
	receiver development (lower noise): Especially at band 3	10 - 20%?	moderate?	moderate?	all science	
angular resolution	longer baseline	a factor of a few	easy/quick but phase stability issues (including atmospheric and LO reference) should be improved as well	expensive?	limited brightest sources	
	VLBI	orders of magnitude	easy/quick? LO reference should be improved. A lot of software efforts needed	cheap ($5M?)	Black hole: Sgr A* and very limited sources, 200GHz or higher frequencies AGN Jets at 86GHz and above	
field of view	multi-beam receiver	a factor of a few?	long/tough? Enhance correlator power is also required?	expensive?	almost all science (but for compact sources)	
	under-illuminated feed	a factor of a few	moderate?	moderate	Solar obs only	
spectral coverage	band 1		medium-term	moderate ($4M for the first five sets)	SZ, redshifted lines, protoplanetary disks, solar	Q band (31-50GHz)
	band 2		medium-term	moderate	SZ, redshifted lines, protoplanetary disks, solar	
	band 5		medium-term	moderate	redshifted lines, planetary atmosphere	163-211GHz European deliverable (6 cartriges)
	band 11		long-term/difficult	moderate?	redshifted atomic lines, galaxies?	
simultaneous frequency coverage	multi-frequency feed	a factor of a few	moderate? Enhance correlator power is also required (for narrow band observations BLC can accommodate?)	moderate?	almost all science?	
	receiver development (wider frquency coverage)	a factor of a few?	moderate? Enhance correlator power is also required to cover whole wide freq. range?	moderate?	ISM, galaxies?	
	new digital system/2GC	an order of magnitude? (at high spectral resolution mode)	moderate	expensive	ISM, galaxies?	
imaging quality	more antenna	add 5 antennas ==> 2 times fidelity	quick	expensive	targets with extended structures	
	more 7m antenna	?	moderate?	expensive?	targets with extended structures	
	software development	??	all	moderate?	all science	
accuracy of amplitude	improved calibration device	???	difficult?	??	ISM?	
accuracy of phase	improved atmospheric correction	???	difficult?	??	almost all science which requires high angular resolution	
accuracy of polarization	improved calibration device	???	difficult?	??	star formation, ISM	
flexibility	more subarrays (two more LO reference systems)	a factor of a few?	moderate	moderate($620k?)	transient objects(gamma ray bursts, cometary ejection events, solar flares)	
usability	software development	??	long term	moderate	all science	

ALMA BOARD

ALMA EDM Document	AEDM 2010-080-O
Distribution	**Ordinary Session**

Subject: Response to ASAC

AUTHOR(S): R. Hills

Purpose of Document: To provide the Board with the project's response to the ASAC report

Status: For approval at the June 24th 2010 telecon

DRAFT Response to the March 2010 ASAC Report

The Board and the Project would like to thank the ASAC for an outstandingly clear and well thought out report which contains very many helpful comments and recommendations. For simplicity, the appropriate sections of the ASAC report are quoted here in italics with the responses following.

II.1) ASAC was pleased to hear that CSV started in January, with commissioning now underway with three antennas at the AOS and the test interferometer operational at the OSF. ASAC would like to continue to follow closely the project's progress in the context of CSV activities and other efforts towards Early Science, as these are critical steps for the success of ALMA.

We welcome the suggestion that ASAC keeps in close touch with the Project's progress over the coming months. Arrangements are being made for ASAC members to join some of the regular telecons where progress and problems are discussed and to attend the readiness reviews that are planned to take place in October.

II.3) As described in our last report, we propose that our next meeting be held in Chile, so that ASAC members can fully engage in the decision-making process for Early Science. The exact date of the meeting will be determined according to the schedule of the readiness review for Early Science and the Board meeting.

The face to face meeting is planned for 13th and 14th Oct in Santiago with reviews on CSV status and on Operations preparations immediately before that (7/8th & 11/12th Oct respectively).

III.1) ASAC was pleased to see a well thought through draft description of the ALMA Proposal Review Process and thanks the ALMA TAC subcommittee for its hard work. In its broad lines, and also in many of its details, ASAC agrees with the contents of the document. In considering possible areas of improvement, however, ASAC concluded that it might be advantageous to separate top-level issues related to the distribution of time among different partners and different proposal categories (regular, director's discretionary, "Open Skies", etc.), which clearly must be in a Board-approved document, from lower-level details that could be more naturally worked out in an Implementation Plan prepared by the Department of Science Operations (DSO).

The Board agreed with this suggestion and a new Board-level document "Principles of the ALMA Proposal Review Process" is in preparation and plans for the detailed implementation are being drawn up. The Board and the Project were also very appreciative of the ASAC's detailed suggestions and comments on the draft document and will be taking those into account in refining the process.

On the issue of cost savings, the summary comment was as follows. *III.2)… ASAC recognizes that the Operations Plan must address the budgetary issues and recognizes that science output is likely to be affected due to necessary revisions. ASAC stresses that the purpose of the observatory is to conduct science and thus every effort should be made to minimize the scientific losses. ASAC expects to be further involved in reviewing these plans over the next year and hopes to gain a clearer understanding of the relative budgetary cuts within all areas of Operations. Again, ASAC stresses that*

the savings found in the science operations has been marginal considering the overall budget situation. The significant decreases required in other parts of the Operations budget are likely to have even more profound effects on the scientific capability of ALMA.

Work on refining the budget is continuing and the need to find ways of making savings that minimize the impact on the scientific impact of ALMA is very much in the forefront of the minds of the people wrestling with these issues. ASAC will continue to be informed about the process and consulted on any trade-offs which involve scientific questions. Since the Project is under great pressure to meet goals on performance, budget and schedule simultaneously, the Board has issued the following statement: *The Board agrees that budget and schedule are the highest priorities for ALMA. Putting performance in the third place in no way suggests that descoping can be accepted without a careful and open assessment of scientific losses. The Board stresses the importance of quality and reliability.*

On the Development Fund, ASAC proposed that, "*III.4)… The best way forward for this is for the JAO to ask the regional Project Scientists to obtain rough cost estimates for development items of interest to their regions. On the basis of these numbers, the project can then draft a call with further input from ASAC."*

Work on this is going on in all three regions with the goal of giving the ASAC a picture, at their October meeting, of the range of costs and effort involved in the items that are presently being discussed.

The ASAC made extensive comments *(III.5)* on the readiness of the ALMA software system, with emphasis on the Observing Tool (OT) and CASA and mentioning the archive and logging tools such as ShiftLog. All these continue to be very much at the focus of CIPT activities and were discussed in detail at the recent software CDR#8. In particular we recognize the criticality of ensuring that the OT is well-matched to the requirements for the Call for Early Science Proposals, both in its implementation and by thorough testing. The plan calls for intensive tests of the operations software relevant for ES proposal preparation (the OT and other parts of ObsPrep) during the month of August and we will ensure that ASAC members are involved in those.

On progress with AIV/CSV, the ASAC commented that, "*III.6)… timely deliveries of fully functional pads at the AOS and a higher-bandwidth data link between the AOS and OSF have a high scientific priority, as does the elimination of power interruptions at the AOS and the OSF, which reduce the efficiency of AIV/CSV efforts and damage staff morale."*

It has already been reported to the ASAC that the pads needed to enable us to move to the compact ("phase 2") configuration were eventually brought into operation by the end of March. We can also report that the improvements already made to the microwave link have been providing adequate bandwidth and good reliability in AOS-OSF communications and that the installation of the fiber has been brought forward and is in now in progress. Unfortunately the problem of power interruptions is still with us and this has become a significant threat to the commissioning schedule.

ASAC also made the recommendations that *"III.6)… Noting that the consequences of any delay in Early Science are severe, ASAC nevertheless emphasizes that the technical requirements for Early Science should not be compromised in order to meet a pre-determined deadline. Further, ASAC recommends that an end-to-end demonstration of the science verification array with ~8 antennas occur before the call for Early Science is made."*

With respect to the first of these, we agree and would point out that (in response to earlier advice from ASAC) we already have in place a set of Minimum Requirements for Early Science and a more ambitious set of Goals. We are at present still striving to reach all the Goals and are certainly not expecting to have to compromise on any of the Minimum Requirements. In response to the second, we set a target of having 8 antennas operational at the high site by mid-August. On present plans we will miss this, but only by a week or two. Delays to deliveries of antennas, front-ends, and calibration devices mean that this can only be done by moving up the antennas in the OSF interferometer: the ASAC already noted that this was undesirable but should be done if necessary.

Finally, on the issue of plans for data processing during Early Science, the ASAC noted that there was a danger that the science staff would become overloaded during this period and made a number of helpful suggestions to mitigate this, in particular spreading the load as widely and in as efficient a manner as possible, which we will certainly work into our plans. The specific request to see (with the next year) examples of the scripts for the QA2 procedures is noted.