



Report from the ALMA Scientific Advisory Committee

Face to Face Meeting

ESO Garching, Germany

October 13th & 14th 2009

Membership of the ALMA Science Advisory Committee

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EXECUTIVE SUMMARY

The ASAC met at ESO Garching in Germany October 13th/14th 2009. Overall, ASAC is very pleased to see the progress with the project since we last met face-to-face in January 2009 in Chile. We remain confident that the Director, Project Scientists and their growing team are on track to commission ALMA as a transformational global observatory. We report in detail on the six charges sent to ASAC by the ALMA Board in Section III. Our greatest concern is the readiness of the ALMA software required for Early Science. Although we were generally impressed by the demonstration of the Observing Tool's functionality and user interface for the preparation of Phase 1 proposals, our understanding is that planning for some of the software packages is still at a rather early stage. ASAC would like to see a detailed overall schedule for the deployment of all core software packages for Early Science in the near future, and recommends that early versions of the OT be released to the ARCs and to the general community as soon as possible. It is also crucial that the ARC and ARC nodes generate and maintain a detailed schedule that includes clear deadlines, responsible individuals, and risk factors for all principal and shared responsibilities of the ARC since ARC readiness is a fundamental criterion for the decision point for Early Science. Our major non-charge concern for Early Science is that the schedule and cost are clearly under very significant pressure, with the current pacing item being the low rate of front-end deliveries. Regarding the Proposal Review Process, ASAC was disappointed that no draft was made available for the meeting, as this is an issue of great importance for the scientific potential for ALMA and for the establishment and testing of the necessary software and procedures. ASAC discussed the general principles we hope will be reflected in the final document, and look forward reviewing and commenting on this document when it is ready. ASAC continues a discussion on development, and we commend the idea of issuing a call for proposals for development work with some of the suitable areas identified.

I. INTRODUCTION

This report describes the discussions at the ALMA Science Advisory Committee (ASAC)'s face-to-face meeting held at the European Southern Observatory (ESO) Headquarters in Garching, Germany, for submission to the board at its meeting at the Operations Support Facility (OSF) in November 2009. The committee is grateful to European Project Scientist Leonardo Testi and his staff for organizing the ASAC meeting. We would also like to thank North American Project Scientist Al Wootten for organizing our bimonthly telecons, and to the workers throughout the project for their help in preparing and presenting documents and reports for our meeting.

The ALMA Board gave ASAC six 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 including additional questions raised about the project during our discussions of the charges. We would welcome future formal charges from the board on matters of concern highlighted in Section II.

II. GENERAL DISCUSSION

II.1) ASAC was happy to hear that the first antenna was successfully transferred from the OSF to the AOS and that continued effort, including the transfer of another two telescopes to the AOS and hard work by the project team at the high site, is being made towards a 3-element interferometer at the AOS.

II.2) ASAC appreciated the detailed project status report presented by Project Scientist Richard Hills. We heard that the start of CSV is forecast for Dec 2009 and that the first call for proposal for Early Science pleasingly remains scheduled for the end of 2010. ASAC will continue to follow closely the project's progress during the CSV phase with simultaneous efforts towards Early Science, as these are the critical steps for the success of ALMA.

II.3) ASAC learned that the project is reevaluating a cost-to-completion estimate that will be submitted to the Budget Committee of the ALMA Board after finalization. ASAC is ready to assist the project in safeguarding the scientific capabilities of ALMA in the light of possible cost-cutting measures.

II.4) Project Scientist Richard Hills draws our attention to the surface measurement of the 12m dishes now being carried out. We were pleased to see that the "best" surface rms error is now measured to be less than 10 micron. We support the continued effort of the project to minimize the thermal and gravitational deformation to meet to the ALMA specification. We also endorse a plan raised by Richard to install a radio transmitter on the Chajnantor ridge, to investigate smaller-scale surface errors than can be examined with astronomical holography and to calibrate polarization measurements, both of which goals are quite valuable to ensure ALMA's capability for scientific use.

II.5) Information retrieval systems throughout the project make it difficult to search and find documents. We again suggest that the attentions of an archivist/librarian might be a useful way to claw back time spent searching unsuccessfully for information.

II.6) The schedule of next year's ASAC face-to-face meetings was discussed, especially in terms of the preparation for Early Science. A readiness review of Early Science will presumably be held in Chile during the latter half of 2010, and most of the actions for the decision point of Early Science will also be carried out in Chile at this time. This consideration motivates holding the second face-to-face meeting in 2010 in Chile around September so that

a large number of project staff will be able to attend the meeting, and so that ASAC members can fully engage with the decision making process for Early Science. The exact date of the meeting should be re-examined according to project progress at the time of the next meeting. As we stated in the last report, we would like to keep one face-to-face meeting in an executive per year, and so we propose that the next meeting (i.e., the first meeting in 2010) be held in East Asia.

III. RESPONSES TO BOARD CHARGES

III.1) Continue to monitor the readiness of the ALMA software system. Of special interest at present are: the archive, the interface between the observing tool and the archive, and the capture of necessary proposal information by the observing tool, in the context of ALMA operations planning.

ASAC thanks the project for its presentations on the status of the ALMA software system. In our response, we comment separately on the readiness of the software for AIV/CSV activities and for Early Science.

(i) AIV/CSV activities

ASAC is impressed by the close contact that has been established between the CIPT and the science team in Chile through the mediation of the eSSR (extended Science Software Requirements) committee. This arrangement has already paid clear dividends in the context of the control software, which (for example) now allows for the submission of customized test scripts at the command line by AIV/CSV scientists. ASAC welcomes plans by the project to build on this success by strengthening ties between the science team and the software groups responsible for (a) offline data reduction and (b) archive. Both of these areas offer potential gains in the efficiency of AIV/CSV work. As more single-dish functionality is built into CASA, the science team will need to spend less time rewriting its data reduction scripts; the summit between CASA developers and science team members scheduled for early December will spur progress on this front. As urgently needed query tools are developed for the temporary archives at the OSF, the science team will be able to exercise them (providing valuable feedback before the release of the full OSF science archive in January) and eventually dispense with its practice of laboriously recording each dataset's ID number by hand. ASAC notes as well that further gains in efficiency will come to the extent that software response and restart times are reduced, the goal of a new project requirement on software "latency" (see Charge 3 below).

(ii) Early Science

Well before our next face-to-face meeting, ASAC would like to see a detailed overall schedule for the deployment of all core software packages required for Early Science. This request is motivated by feedback from the recent review of the Science Operations Implementation Plan, and by our new appreciation for the fact that planning for some of these packages (e.g., the Phase 1 Manager) is still at a rather early stage. We are also concerned by the possibility that there may be other software efforts that remain critical for Early Science.

At this face-to-face meeting, ASAC concentrated its attention on the two elements of the software system with which Early Science proposers will interact most directly: the Helpdesk and the Observing Tool (OT). For the former, ASAC recommends that selection of the Helpdesk vendor be finalized as soon as possible, so as to minimize delays in installation and fine-tuning at the ARCs. For the latter, ASAC would like to express its particular gratitude to Andy Biggs and Alan Bridger for their status report and demonstration. Detailed comments on the OT follow below.

- (a) ASAC was generally impressed by the demonstration of the OT's functionality and user interface for the preparation of Phase 1 proposals. The contextual help tabs, which provide a road map through the Phase 1 process, will be especially appreciated by novice proposers.
- (b) As might be expected from a group of eager prospective ALMA users, ASAC members offered an enthusiastic barrage of suggestions for improving the OT during the course of the demonstration. Rather than summarize this discussion, we recommend in general that OT beta testers include not only "naive users" with no background in (sub)millimeter astronomy, but also a healthy number of experts whose interests span a wide range of Galactic and extragalactic science. A number of ASAC members would be pleased to participate in this effort. ASAC also endorses the OT team's desire for greater participation by the science team in exercising the current version of the OT at the OSF.
- (c) ASAC recommends that early versions of the OT be released to the ARCs, and (separately, and preferably limited to Phase 1 functionality) to the general community, as soon as possible. ARC staff need early access to the OT so that they can begin to prepare user documentation and tutorial materials; a limited version suitable for public release is desirable to generate community enthusiasm for (and confidence in) the promise of Early Science. ASAC is very favorably disposed to the July 2010 target for a limited public release that was proposed at the face-to-face meeting by the OT team.
- (d) ASAC is concerned by the degree to which the OT is a "customer" of other elements of the software system that are less well developed at this point in time (e.g., the user portal, the calibrator database, the spectral line database, and the archive). In some cases, it was not clear even after discussion where responsibility for these elements lies. (On a related note, the immediate establishment and self-population of the user database would seem to be an excellent means of increasing community interest in ALMA well before Early Science; however, the project does not appear poised to capitalize on such an opportunity.) To make sure that the OT works as well with other parts of the system as it does in isolation, ASAC recommends that the project designate a single "OT czar" who will have a broad overview of all elements of the system to which the OT links, and who will be empowered to drive development of those elements as necessary. (Although such a designation may not have an obvious precedent within the project's software effort, ASAC feels it is justified by the unique "front line" role of the OT during Early Science.)
- (e) ASAC was pleased to hear of the upcoming meeting between NAASC scientist H. Liszt and the OT team to discuss how the OT will factor into the technical review of Phase 1 proposals. ASAC would like to receive a brief report on the outcome(s) of this meeting as soon as possible after it takes place, from the "OT czar" (if one is identified) or another participant.
- (f) ASAC would also like to see a current audit of the OT with respect to its scientific requirements, to get a full sense of its status in areas we did not see demonstrated. This could conveniently be implemented by the "OT czar" or another team member as an update of the spreadsheet that was provided as input to the June 2009 science software requirements review.

III.2) Continue to review the progress and schedule of the AIV/CSV process, especially with respect to readiness for Early Science. The Board would appreciate a report on the status of plans for Commissioning and Science Verification and for obtaining “ALMA Public Images”, and commentary on the outcome of the Review of CSV plans which will take place in September.

The ASAC was given a thorough overview of the current state of AIV/CSV process by Richard Hills and Alison Peck. We continue to be impressed by the hard work and diligence of the project scientists and engineers and their teams in carrying out this work in what is still a relatively austere environment. AIV/CSV continues to progress well, with staffing levels now close to those required in the plans, and with progress at a rate that is within a small margin of that foreseen almost 9 months ago at our last meeting. While he was not present at our meeting, we would like to commend Joe McMullin and his team; we were very impressed by the power of the recently released movie of the first antenna moving to the AOS.

However, we note that the schedule and cost are under very significant pressure, with the current pacing item being the low rate of front-end deliveries. This is currently the greatest threat to enabling Early Science. The necessary delivery rates of a range of items resemble ‘hockey sticks’, with the recent delivery rate requiring rapid increase in order to maintain the schedule. Assuring the delivery of hardware to Chile requires the continued urgent attention of the executives. The low delivery rate of key components has required a significant number of items to be accepted conditionally. This is storing up potential problems for future CSV and operations.

The testing effort is still typically in the ‘design verification’ mode, rather than in ‘quality assurance’ mode. As a result, there is still a burdensome series of acceptance tests for each item.

The reliability of a wide range of ALMA components is currently a large factor less than it needs to be to ensure a count of 1-2 inoperable antennas. While it is too soon to be able to assess the likely failure rate in the operational array, it is clear that action may need to be taken within two years to ensure that ALMA keeps at least 48 12-m antenna in routine service.

Measured receiver non-linearity is going to demand a more complex calibration plan. This must be implemented and documented in time for Early Science.

ASAC continues to stand ready and willing to advise the board on any issues relating to the scientific effectiveness of the almost established ALMA. We stress that community expectations are high for Early Science. The project must ensure that pressure on the schedule is managed, but Early Science must be started based on ALMA’s capability, and not by target date.

The concept of ALMA public images must now be viewed in the context of the challenging schedule. At the announcement of Early Science it is necessary to have science verification (SV) images for release to the astronomical community, even if they are not as spectacular as the final “Public Images” that ALMA can eventually produce. We believe that as the AIV/CSV process is under pressure, a requirement to produce specific images for EPO in the short term must not be imposed.

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

ASAC endorses the adoption of the new software latency requirement, with a view to the efficiency of both science operations and AIV/CSV activities (see Charge 1 above), as well as the relocation of the northernmost pad to a site less visible from the international road. Although a detailed set of revisions to the Scientific Requirements and Specifications was not available at the time of the face-to-face meeting, ASAC is broadly supportive of the philosophy outlined by the project scientist, in which realistic science goals are to drive specific and challenging technical requirements for ALMA's performance. We look forward to interacting with the project scientist on the key revisions to the requirements, and anticipate reviewing a complete set of revisions at our next face-to-face meeting.

III.4) Report on the status of the plans for the proposal review process and on what is being done to ensure that all the necessary software and procedures will be established and tested in readiness for the Call for Proposals for Early Science.

ASAC was disappointed that no draft of the Proposal Review Process was made available for our face-to-face meeting, as this is an issue of great importance for the scientific potential of ALMA. We look forward to reviewing and commenting on this document when it is ready.

With respect to the second part of the charge, ASAC stresses that establishment and testing of the necessary software and procedures cannot proceed without definition of the Proposal Review Process. The lack of a defined Proposal Review Process is threatening to negatively impact the project's readiness for Early Science.

In the absence of a detailed plan for the Proposal Review Process, ASAC discussed the general principles that considers desirable in the final proposal process. The most important of these is that ALMA's science output should come first. A few examples of how this should influence the proposal process are:

- (a) ALMA's scientific output is maximized if all proposals are in principle reviewed by the proposal review panels. Any discretionary time - and there are arguments why a small fraction of discretionary time (DT) should be aside for such - should be focused on exceptional cases that are very timely or that need rapid follow-up, and that cannot be dealt with through the regular review process. There was strong recognition that the Executives are answerable about the allocation of DT, both toward their communities and their funding agencies. 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 DT review process is beneficial for the scientific output of ALMA; clear input from the Executives (and the Chilean community) and reporting back to the Executives (and the Chilean community) are equally essential.
- (b) ALMA science benefits from a limited fraction of observing time being available to proposals entirely from non-partner countries. These proposals should be reviewed together with the proposals from the three executives and from Chile. The review process should proceed without regard to nationality, and the proposals ranked accordingly. This limited fraction of non-partner proposals should be attributed to the different Executives in proportion to their respective shares.
- (c) Attribution of time from successful proposals to the individual Executives should not make it harder to have a proposal accepted with collaborators from different Executives (or non-member countries) than it is to have a proposal accepted with collaborators from a single Executive only.

ASAC continues to have real concerns about the specifics of the Proposal Review process, including worries about handling duplications and filling different weather bands. Finally, ASAC recommends that any adopted Proposal Review Process be regularly monitored to check for fairness and efficacy, especially during the first years of the project.

III.5) Report on the readiness of the ARC's to support early science proposals and the of the ALMA helpdesk, and on the plans to reach out to the communities to encourage early science proposals, and to inform the communities about realistic capabilities and performance.

The ASAC met personnel from the European ARC and received a presentation on the European ARC functions and progress. Progress at the North American and East Asian ARCs was reviewed using the presentations and reports made by the ARCs at the Science Operations Review in early October 2009. Verbal feedback of the Review Panel at the Science Operations Review was also taken into account.

It was positive to meet European ARC personnel, to see the ramp up of new ARC hires, and to learn that ARC personnel have commenced their AIV+CSV support activities in Chile. ASAC also would like to congratulate the East Asian ARC on the deployment of its archive, which was underway at the time of the face-to-face meeting. We look forward to the purchase and deployment of the remaining archives over the next year. The ARCs are a critical component of the users' interaction with ALMA. Their overall readiness - in archive support, user tools and documentation, and trained personnel - is a fundamental criterion for the decision point for early science.

The planning documents demonstrate that the ARCs are very clear on their requirements; however the roadmap towards achieving these goals is difficult to evaluate. The ASAC supports the findings of the Science Operations Review Panel, i.e., it is critical that the ARCs and ARC nodes generate and maintain a detailed schedule that includes clear deadlines, responsible individuals, and risk factors for all principal and shared responsibilities of the ARC (also see Charge 1 above). These include archive installation, user tool development and integration, helpdesk, and user-friendly documentation - all of which are currently seen as crucial but delayed. ASAC is concerned that the (potentially abundant) requests from Early Science users for support, alongside the still very pressing CSV requirements on the ARCs at this stage, may be beyond the available human resources and capabilities available. The coordination between ARCs in maintaining a common knowledge base to avoid duplications is also seen as a concern. ASAC also feels concern about what Early Science data product will be delivered to end-users by the project. We understand that the pipeline for science data processing will not be ready at Early Science, and the data quality will be assured by DSO and ARCs. We would like to ask the project to demonstrate what can be delivered in a timely fashion with the projected level of staffing at the DSO and ARCs. We also discussed the fact that one of the most crucial functions to be implemented is to track the pipeline modification history in order for end-users to trace back the reduction.

The ASAC supports the ARCs' efforts to disseminate ALMA capabilities to a wide astronomical community, especially novice users. Given the tight ALMA schedule and the delay in delivery and integration of user software and documentation, the ASAC feels that it is important to avoid too high expectations, especially among novice users, during the initial call for proposals. This requires a delicate balance in the Early Science outreach message to the astronomical community.

III.6) Provide further commentary on the prioritization of the items that are being considered for funding from the Development Budget, in particular those that might be considered for the first call for proposals.

The ASAC was able to revisit its previous reports on development, while new members have brought new experience and ideas. The list of possibilities from our report in February 2009, and their different properties in cost, timescale and risk remains a useful reference. We commend the idea of issuing a call for proposals for development work, although we note that there needs to be some means by which the JAO can secure funding for those projects that should clearly be executed or coordinated in Chile (e.g., baseline extension).

Some of the most suitable areas identified are:

- VLBI phasing of the array. A recent proposal was turned down owing to a considerable demand on ALMA project staff time. Possible alternative routes to VLBI capability using the ACA correlator have been discussed.
- Receiver developments offer a potentially valuable increase in the efficiency of ALMA. Possibilities include the implementation of single-sideband mixers in Band-9.
- Ongoing research work to develop new and better detector technologies could be a rich seam of efficiency improvement for ALMA. The implementation of a complete Band-5 receiver suite, new or revised receivers in Bands 1, 2 & 3 and a Band-11 are all exciting possibilities, although we agree that we should investigate science done by Band-10 and Herschel before going forward to Band-11. It might be appropriate to modify the boundaries between Bands 1, 2 & 3 in light of developments in HEMT amplifiers.
- A variety of software tools could be very important: for data visualization, reduction and compiling, maintaining and extending spectroscopic catalogues.

ASAC also believes strongly that the proposal of other, perhaps unforeseen, possibilities by the community should be encouraged in any such call. ASAC looks forward to helping the project and the board in formulating a call and in reviewing the received proposals. This report highlighted in Section II.