



ALMA BOARD

ALMA EDM Document	AEDM 2021-010-O_Rev1
Distribution	Ordinary Session

Subject: ASAC April 2021 Report to the ALMA Board

AUTHOR(S): Kotaro Kohno & ASAC

Purpose of Document: To provide the ALMA Board with the April 2021 ASAC Report

Status: To be noted by the Board in its 14th – 16th 2021 Meeting

2021 April 2

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

Manuel Aravena, Anne Dutrey, Maryvonne Gerin, Meredith Hughes, Kotaro Kohno (chair), Alexandra Pope, Erik Rosolowsky, Nami Sakai, Kengo Tachihara, Mario Tafalla, Stephen White (NA vice-chair), & Paul van der Werf (EU vice-chair)

General considerations

The ASAC face-to-face meeting was held virtually on March 10-12, 2021 using zoom. ALMA Director Sean Dougherty, Observatory Scientist John Carpenter, and the three regional Program Scientists Daisuke Iono, Crystal Brogan, and Francisca Kemper participated. Rob Ivison also participated since he served as the European member on the IST for the few months preceding the ASAC meeting. James Di Francesco participated in the meeting as a liaison to the ALMA board science committee, which is very much appreciated. Liz Humphreys (DSO head), Satoko Takahashi (ObsMode lead), and Gie Han Tan (SCWG chair) were invited to present material on some of the charges. Felix Stoehr joined the discussion on charge 3 to help answer questions regarding the publication statistics. As usual, most of the documentation was provided in advance. The committee appreciates all these arrangements which help to make the ASAC meeting efficient and productive. No debrief session was arranged during the meeting due to limited availability of time at the virtual face-to-face meeting, where committee members joined across the globe. Instead, the ASAC chair met Sean Dougherty and John Carpenter (via zoom) on March 19 to debrief the initial outcomes of the ASAC meeting.

The committee applauds the observatory on the good progress on restarting ALMA and the positive outlook to resuming science operations soon, with excellent safety protocols and procedures for optimum working conditions of staff. Shortly following the ASAC meeting, the committee received fantastic news that limited cycle-7 science operations did indeed restart (March 17) on a best effort basis. ASAC thanks all who have made these achievements possible under the current extraordinary circumstances. ASAC wishes the team success in the recovery efforts including the reconfiguration of the array.

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

Recommendations/issues:

- ASAC appreciates the presentation and notices that the timing for the ObsMode2020/2021 is fine in spite of the difficult situation.
- ASAC is aware of the importance of improving flux calibration, particularly for higher frequencies. This is very important for projects which require both JWST and ALMA observations. ASAC recommends a detailed investigation of the flux error budgets, taking into account the recent study of atmospheric models at high frequencies.

ObsMode2020/2021: ASAC appreciates the presentation made by the observatory and notices that the timing for the ObsMode2020/2021 is fine in spite of the difficult situation. Some commissioning activities are not proceeding as quickly as originally envisioned, but this is understandable given the current operational status of the array. Some tasks require a minimum number of antennas and good weather conditions for commissioning, but the committee finds that prioritization and review processes are well-considered.

Flux calibration accuracy particularly for high-frequency bands: ASAC is aware of the importance of improving the flux calibration, particularly for higher frequencies. It is particularly important for projects which require both JWST and ALMA observations; in fact, many of the JWST GO-1 proposals (just recently evaluated) used ALMA results to justify the JWST request. An issue raised in the committee was that JWST is aiming at calibration accuracy of a few percent, while ALMA is claiming of order 10% (specifically 10% for Bands 6, 7, and 8; and 20% for Bands 9 and 10). The prominence of joint analyses in high-profile areas such as protoplanetary disk chemistry and kinematics argues that ALMA should investigate whether calibration accuracy can be improved. ASAC would like to know what the current plans are to investigate the error budget, and we recommend a detailed investigation of the flux error budgets, taking into account the recent study of atmospheric models at high frequencies.

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

Recommendations/issues:

- ASAC applauds the successful restart of the observatory after a long shutdown with excellent safety protocols and procedures for optimum working conditions of staff.
- We agree with the plan to perform the long-baseline observations with high priority.
- The committee encourages the observatory to make appropriate communication with PIs of cycle 7 programs to encourage resubmission to the cycle 8 proposal call.
- ASAC congratulates the observatory for the successful integration of CARTA into the ALMA archive.

The committee was impressed with the presentations by the observatory that summarizes the sensible plan

of the ALMA Return to Operations with great enthusiasm of the staff. We appreciate the successful restart of the observatory after a long shutdown with excellent safety protocols and procedures for optimum working conditions of staff. ASAC supports the proposed plan to perform the long-baseline observations with high priority given the unavailability of long baselines in cycle 8. ASAC also agrees with the strategy of starting the PI observations with a threshold on antenna number low enough to enable cycle 7 projects and cycle 6 projects that would not have the opportunity to be carried forward to cycle 8 (because of e.g., configuration schedule).

Communication with PIs of unfinished cycle 7 programs: Although ASAC believes that it is important to balance priorities for cycle 8 preparation and cycle 7 observations, it is very likely that some cycle 7 programs will not get executed[#]. The observatory is encouraged to reach out the PIs of cycle 7 programs to discuss the likelihood their program will be observed and encourage them to resubmit to the cycle 8 proposal call. ALMA should not rely on individual PIs contacting the helpdesk.

CARTA new release: ASAC congratulates the observatory for the successful integration of CARTA into the ALMA archive. The committee believes that this advance is a significant improvement in archive capabilities, especially when combined with products from the ARI-L project. The observatory should ensure that this new functionality is communicated to the user community.

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

Recommendations/issues:

- ASAC is pleased with the effort made to collect the publication indicators requested last year.
- ASAC notes the strong record of ALMA publications in 2020 despite the pandemic.
- ASAC recommends to better understand the 10% publication drop of 2020 by comparing with similar facilities and the publication level of the main astronomy journals.

Publication statistics: The ASAC is very pleased to see that a significant effort has been made to collect the different statistical indicators of publications requested in last year's report. These indicators are crucial for ASAC to assess the scientific impact of ALMA, to evaluate the proposal review process, and to understand the use of ALMA by the community. ASAC also understands that the information needed to determine some of the indicators is not readily available, and that it may take some time to collect them from the literature. ASAC looks forward to seeing these additional indicators in future presentations.

The year 2020 represents an anomaly in the science outcome from ALMA since the covid-19 pandemic forced a shutdown of the instrument and a sudden cut in the flow of new data around mid-March. Previous analysis shows that the median delay between data availability and publication date is longer than 12 months,

[#] The committee recognizes that this issue is not new to cycle 7, since the observing queue is overloaded every year. There will likely be more projects that are not observed in cycle 7 than in a normal year.

so the effect of the ALMA shutdown is likely to have a similar delay and to be more noticeable over the next several years. Still, 2020 was a year in which a large part of the ALMA community had to work under difficult conditions, and this is likely to have affected its scientific productivity.

Despite the above caveats, the number of ALMA publications in 2020 exceeded 400, which represents a rate equivalent to that of other great observatories, such as HST, VLT, and XMM at a similar age. This publication rate is a clear indication of the high productivity of ALMA and its community. Noticeable in the statistics, however, is a 10% publication drop compared to 2019. While likely caused by the pandemic, this drop represents the first year-to-year publication decrease in the history of ALMA. For this reason, an effort should be made to understand its origin. The ASAC recommends comparing this drop with that of similar facilities and with the total rate of publication in the main astronomy journals.

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

Recommendations/issues:

- ASAC concludes that an earlier ALMA science meeting would be preferable for maintaining enthusiasm and momentum for ALMA science.
- ASAC recommends that this and future in-person meetings should be planned to include fully-supported remote participation, given the rapidly changing circumstances and a growing awareness on the environmental costs.
- We would like to remind that the first call for proposals for the JWST has been issued and it appears timely again to explore joint ALMA-JWST observations, following previous ASAC and JAO discussions.

ALMA Science Meetings: ASAC was informed that the next ALMA Science Meeting would nominally take place in Chile in late 2022. The committee affirmed the importance of a face-to-face meeting, if possible, but recognizes that travel restrictions may not have eased by that point. An in-person meeting presents invaluable networking opportunities to foster collaborations across the ALMA community and provides excellent exposure and experiences for junior scientists who are developing their careers around ALMA results. ASAC specifically considered whether it would be better to meet in late 2022 or delay until 2023 when travel is likely to be fully normalized. Given the COVID-19 shutdown, the committee concluded that an earlier meeting would be important for maintaining enthusiasm and momentum for ALMA science. The decision shall be made after the careful check of possible conflicting meetings that also discuss ALMA science.

Because of rapidly changing circumstances and ongoing uncertainty around the state of travel in 2022, ASAC strongly recommends that this and future in-person meetings should be planned to include fully-supported remote participation. If circumstances limit or prohibit in-person attendance, the meeting would then be able to shift entirely to a virtual format, which is preferable to a delayed meeting or no meeting at all. Travel restrictions may also vary with region. Thus, the meeting should be structured so that people who are unable to or uncomfortable with international travel will be able to engage with this and future ALMA science meetings.

ASAC reports that there is a growing awareness and concern within our communities about the carbon footprint of our professional travel. The environmental costs for our scientific meetings need to be weighed against the benefits to ALMA science. We clearly recognize the importance of in-person contact at science meetings, but future ALMA science events should be planned with good options for participation that will not necessitate participant travel. These concerns are primarily centered around the pandemic now, but the environmental concerns will continue to become more important. Improving remote participation in ALMA events will also make the community more inclusive since travel can impose a burden on caregivers or people with positions that have inflexible professional commitments (e.g., heavy teaching duties). Thus, this and future ALMA science meetings should include options for vibrant remote participation.

Joint Proposals with Other Facilities: Finally, the ASAC would like to remind that the first call for proposals for the JWST has been issued and proposals are under review. ASAC is aware that implementing joint projects has become more difficult due to the pandemic. However, it appears timely again to explore joint ALMA-JWST observations, following previous ASAC and JAO discussions.

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

Recommendations/issues:

- ASAC appreciates the detailed analysis performed by IST, which finds that the incidence of “scooping” is low and concludes that there is no need for further extension of the proprietary time at this stage.
- The committee notes that the analysis presented is limited to the published record and the widespread feeling that “scooping” may happen remains an issue.
- ASAC notes that aiming at removing proprietary time completely would not give any advantage to the current ALMA partner researchers over ‘open sky’ researchers.
- There is overall support among the different regions for providing more protection for students needing ALMA data for their theses. ASAC recognizes that finding a way to better support student use of ALMA will not be straightforward, but it should be investigated.

Extension of proprietary period and IST study: ASAC welcomes the detailed analysis performed by IST in order to understand quantitatively the possibility of extension of proprietary time. The current analysis suggests that the incidence of “scooping” is low and concludes that there is no need for further extension of the proprietary time. However, ASAC notes that the analysis presented is limited to the published record and might need further investigation. For example, ASAC members know of students who feel that they were scooped by other groups, validating the widespread feeling that “scooping” may happen.

The IST report discusses several options for proprietary time, one of which is the possibility of doing away with it altogether, and notes that other observatories are moving in this direction. ASAC noted that under DPR, ALMA PIs are carrying out a service for ALMA (reviewing 10 proposals) without compensation. If successful ALMA PIs are not given the advantage of proprietary time, they would seem to have less incentive to propose obvious targets themselves when they can just wait for someone else to do so and

avoid the burden of reviews. ASAC notes that aiming at removing proprietary time completely would not give any advantage to the current ALMA partner researchers over ‘open sky’ researchers.

A possible support for student programs: There is widespread support among the different regions for providing more protection for students needing ALMA data for their theses. It is recognized that regional differences in typical thesis lengths is relevant here: longer theses are likely to require more data for completion, and thus are more susceptible to being scooped. There are different potential options for providing stronger support for students, and it will not be straightforward to implement. It is felt that this is an important issue and deserves more investigation.

An issue for student support is the increasing role of undergraduate research in science. Since such students cannot easily be identified in advance, it is important that a solution allows flexibility for cases where the students are identified after proposal submission. At the end of the proprietary period, PIs could request an extension based on the needs of students related to the project.

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

Findings/issues:

- ASAC was provided with the reports from the Correlator and Front-End working groups, a presentation from the Signal Chain working group, and commends the project for the progress and the coordinated approach to planning for the implementation of the ALMA 2030 recommendations that they demonstrate.
- We welcome the finding from the Signal Chain working group that a new correlator can be located at OSF, since that option will minimize the disruption and loss of science observing time to be anticipated during the necessary testing and transition phase of a new correlator.
- We are encouraged that NA expects to receive proposals for a full new correlator, addressing the ALMA 2030 requirements from the Correlator Working Group document, at the next NA Development Project proposal deadline in April.
- ASAC notes the comment that the control software aspect of the upgrade seems to have received less attention than the hardware aspects, and expects that more resources will be needed in this area to ensure that the full capabilities of the upgrade can be exploited as soon as they are ready.
- The Covid pandemic has unfortunately delayed installation of the Band 1 receivers and the ACA spectrometer. We hope for speedy commissioning of these capabilities once they are installed in order for the community to benefit from them.
- The regional Development studies and projects continue to demonstrate impressive technical advances, many of which will find application in the 2030 upgrades, while others will improve the analysis resources available to ALMA observers. ASAC commends the Observatory for the continuing success of these efforts.

ASAC was provided with reports/presentation from the three working groups set up to plan for the ALMA 2030 recommendations and lay out requirements. The reports/presentation from the Correlator, Front-End and Signal Chain working groups, and the recognition of the need for coordination that they demonstrate,

is an encouraging sign that a full-system approach to ALMA 2030, needed to ensure success, is being taken, and ASAC commends the progress that has been made towards ALMA 2030 despite the pandemic.

A separate presentation was provided on the results of the Signal Chain working group, charged with ensuring that the infrastructure for data transfer and control matches the capabilities in the front end and the correlator. One of the findings is that the current fiber connection from AOS to OSF may be capable of handling the data rates needed to site the next-generation correlator at OSF. This would be a very welcome outcome, since maintenance of the correlator should be much easier at the lower site, and being able to install and test a new correlator at OSF without dismantling the current correlator at AOS will minimize disruption and the ensuing loss of science observing time during the necessary testing and transition phase.

Verifying that the current fiber can indeed handle the required data rate should be a priority, but it must also be recognized that future developments may increase the required data rate to the correlator. The Signal Chain Working Group recognizes that the one-time resources needed to trench new fiber, etc, suggest that there is value in providing capabilities that address data rates beyond those anticipated for ALMA 2030. Serious consideration should be given to the trade-off of over-specifying some aspects of the signal chain during the 2030 upgrade in order to avoid more expense beyond 2030.

We note the recommendation that more attention needs to be paid to the control-system software. The extent of the changes planned for the hardware mean that creation of a new control system will be far from trivial, and it is important that this be addressed and appropriate resources be allocated in conjunction with all the hardware developments, in order that the control software be ready to handle the new hardware once it becomes available for use. Failure to provide sufficient resources to develop the software may delay the commissioning and thus observer use of new hardware.

We are encouraged that NA expects to receive proposals for a full new correlator, addressing the ALMA 2030 requirements from the Correlator Working Group document, at the next Development proposal deadline in April. The expectation that all the ALMA 2030 upgrades will have to be covered by the (finite) regional development funding has the consequence that the effort will need to be spread over many years, and thus early starts to major components are desirable, despite the fact that this locks the project into current technology rather than technologies that will be available in the late 2020s. We note that a timely start to the correlator upgrade will place pressure on other developments, particularly the signal chain, in order to be ready to take advantage of the capabilities of the new correlator as soon as it is ready.

An issue of future importance for ALMA is the likelihood of increased RFI in Bands 1 and 2 due to commercial (and military) interest in W and V bands for satellite communications and high-bandwidth applications. This may influence the number of sample bits that need to be designed into the signal chain and correlator upgrades.

The regional Development studies and projects continue to demonstrate impressive technical advances, many of which will find application in the 2030 upgrades, while others will improve the analysis resources available to ALMA observers. ASAC commends the Observatory for the continuing success of these efforts. The Covid pandemic has unfortunately delayed installation of the Band 1 receivers and the ACA spectrometer. We look forward to speedy commissioning of these capabilities once they are installed in

order for the community to benefit from them. We note that there are wideband-RF projects in both EA (Band 7+8) and EU (Band 6+7) regions that may overlap at some level. It is appropriate to continue developing both as a mean to prepare the future architecture of ALMA.