ALMA Newsletter

February 2012

Dear readers of our ALMA Newsletter,

This ninth ALMA newsletter comes within the first ever period of ALMA observing. The good news is that the observatory is working well and is producing excellent data, and progress in constructing the full array continues on schedule. On the other hand, the rate of progress in completing the observations for the highest priority cycle 0 projects is lower than planned. As a result the cycle 0 observing period will be extended - see "ALMA Early Science Cycle 0 Status Report".

It is amazing how much has happened since the last newsletter, and the gap between newsletters is partly a reflection of how busy everyone in ALMA has been. Construction activities are resulting in around two completed "array articles" (as fully outfitted antennas are known) being added to the array every month. This is a great achievement and involves a complicated, world-wide supply chain culminating in the assembly of the antennas and systems in Chile and the final AIV (Assembly, Integration and Verification) and then CSV (Commissioning and Science Verification) activities undertaken by the JAO (Joint ALMA Observatory). The fact that ALMA vendors and JAO staff are delivering and commissioning two submillimeter antennas a month is astonishing – a timescale of around a year to commission a submillimeter antenna is more typical.

This newsletter contains an "ALMA in depth" article on calibration of the array, one of the most important, and challenging, issues for the ALMA science team. It also includes an interview with Neal Evans, Chair of the ALMA Proposal Review Committee, and introduces some of the 50 science assessors who participated in the process of ranking the 919 proposals to use ALMA in Cycle 0. The science assessors had a daunting task but they approached it very conscientiously and managed to maintain good humor throughout, and we deeply appreciate their assistance. The presence of the assessors in Santiago in mid August, and the job that they were there to do, was inspiring to the ALMA staff who have been working so hard and for so long to provide an observatory ready to do science. Finally, Jaap Baars provides a tribute to Albert Greve who had a long and distinguished career in radio astronomy, and we include a pointer to the many media stories about the start of ALMA science.

Lewis Ball
ALMA Deputy Director

The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership of Europe, North America and East Asia in cooperation with the Republic of Chile. ALMA is funded in Europe by the European Organization for Astronomical Research in the Southern Hemisphere (ESO), in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC) and the National Science Council of Taiwan (NSC) and in East Asia by the National Institutes of Natural Sciences (NINS) of Japan in cooperation with the Academia Sinica (AS) in Taiwan. ALMA construction and operations are led on behalf of Europe by ESO, on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI) and on behalf of East Asia by the National Astronomical Observatory of Japan (NAOJ). The Joint ALMA Observatory (JAO) provides the unified leadership and management of the construction, commissioning and operation of ALMA.

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Focus on...

"The feedback from the PIs who have already received their ALMA data is very positive and the data quality is extremely high"

Lewis Ball, ALMA Deputy Director and Lars-Åke Nyman, Head of Science Operations

ALMA Science Newsletter: Dear Lewis and Lars, first I suggest we take a step back. Almost a year ago, the observatory announced the plan for ALMA Early Science Cycle 0. As outlined in the plan, some months later ALMA invited the worldwide astronomical community to submit proposals for the first scientific observations. The enthusiasm among the scientists was tremendous and we received almost 1,000 proposals to observe with ALMA during Cycle 0. Was this a surprise for you?

Lewis Ball: It has taken nearly 30 years to get to this point, from the stage when ALMA was only a preliminary concept to being already the most capable millimeter radio telescope ever built even with only about a third of the total number of antennas, and astronomers have been waiting all that time for the first chance to use ALMA. So no, it wasn't really a surprise to get so many proposals. We were the astronomical community to demonstrate a lot of enthusiasm to start using the telescope. I'm not saying it wasn't a huge source of satisfaction of course!

Lars-Åke Nyman: Indeed, it was incredibly positive that there was so much interest. We'd gone through a process of asking for notices of intent from people who were considering submitting proposals. We did that both to help us gauge how many proposals we would likely get, and also to give us an indication of the likely spread across the different science categories and the demand for different receiver bands and configurations. We got 601 notices of intent and from that, we planned for around 1,000 proposals, which was pretty much what we got. It was a fantastic result and it represents a level of demand which is as high as that for any observatory, ever.

Focus on...

Lewis Ball
Deputy Director

Dr Lewis Ball joined ALMA in September 2010, as Deputy Director of the Joint ALMA Observatory, after working for 9 years at Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Lewis earned his PhD in Theoretical Physics from the University of Sydney. He spent 12 years as a researcher, first in Sweden and then in Australia, before moving into a research management role in CSIRO's Australia Telescope National Facility (ATNF) in 2001. While at CSIRO he was Deputy Officer in Charge of Parkes, then Deputy Director of the ATNF, then spent 2 years as Acting Director of ATNF and then Acting Chief of CSIRO's new division of Astronomy and Space Science (CASS) which operates the Australia Telescope Compact Array, the Mopro radiotelescope, the Parkes Observatory and NASA's Tidbinbilla DSN tracking station. Through his CSIRO roles Lewis has worked for many years as part of Australia's SKA efforts.

Lewis's research background is in the theory of shocks, particle acceleration, synchrotron emission and inverse Compton scattering and their application to supernovae, supernova remnants, pulsar winds and radio/X-ray transients. Lewis pioneered the theory of gamma-ray emission from the winds of binary radio pulsars.

Throughout his career, Lewis has pursued research emphasizing the link between theory and observation, first in magnetospheric physics and later in space physics and astrophysics.

Newsletter: Was there a fair balance across the different "ALMA" Regions in the proposals?

L.B.: Yes, the response from all the ALMA regions was tremendous. There was very high demand and over subscription from all of the ALMA Regions and also a substantial number of what we call "open skies" proposals, from Principal Investigators (PIs) from countries other than those that are contributing to ALMA.

L.N.: As Lewis says, ALMA is available to astronomers from anywhere in the world and that was great to get such a high demand not only from the ALMA Regions but from other countries too.

Newsletter: ALMA did a technical assessment of proposals before they were discussed by the science assessors. What was this assessment all about?

L.N.: Around 25 ALMA staff from across the project worked through the proposals. We needed to make sure that from a technical point of view the proposals were likely to be able to be done – or in other words that they were consistent with the technical capabilities of ALMA in this first science cycle. A side benefit was that it amounted to a first step of expert assessment of how would we set up the proposal so as to have the best possible likelihood of achieving the scientific goals of the astronomer who proposed it.

L.B.: In an ideal world, it shouldn't have been possible to submit a proposal that was not technically feasible because the ALMA Observing Tool (so-called OT) was designed to match the advertised capabilities. But because it was the first ever call for proposals and since ALMA is so complex, we had experts work through the proposals as a double check to make sure the proposals corresponded to the capabilities we advertised and the way the observatory would work, and also to make sure there was no disconnect between scientific goals and technical set up.

Newsletter: The proposals were divided into 4 science categories: Cosmology, Galaxies, the ISM and Stellar evolution. How were these categories defined in the first place?

L.N.: We took into account the original science goals for ALMA and natural fields of astronomical expertise in a way that we felt covered the range of science that ALMA was likely to do. Then we used the notices of intent to help us to estimate how many proposals would likely be submitted in each of these categories. Based on that we tried to make sure we appointed enough science assessors in each of these categories to be able to manage the expected workload.

Focus on...

Newsletter: In a separate article in this Newsletter we detail the selection process for these proposals so I don't want to go into that here, but very briefly, how were the assessors chosen and is 50 assessors enough to assess 919 proposals?

L.B.: Well we know by experience how many proposals you can ask an assessor to assess, how many proposals can sensibly be discussed in a face-to-face panel meeting, and how many assessments are needed per proposal in order to have sufficient robustness and fairness in the process. Some assessors are likely to have a conflict of interest with some proposals, so you need to account for that. The most obvious is that an assessor can't assess a proposal he or she is involved in, of course. We sought suggestions of possible assessors from a wide range of people: scientific staff within the JAO and the ALMA Regional Centers (ARCs), ALMA Board members, the ALMA Science Advisory Committee and Neal Evans of course, who was appointed as the Chair of the ALMA Proposal Review Committee pretty early in the process. We ended up with a list of hundreds of expert astronomers. From that, we did our best to balance the experience and expertise over the whole set of panels and then invited people to participate. One of the nicest things about the process was that most people we asked were really excited to participate, and many who couldn't accept this year stressed that they'd be happy to be assessors in future cycles.

Lars-Åke Nyman

Head, Department of Science Operations

Dr Lars-Åke Nyman joined the ALMA project in July 2007 as Head of Science Operations for the Joint ALMA Observatory. He received his Ph.D. at Onsala Space Observatory in Sweden, was in charge of operations of the SEST (Swedish- ESO Submm Telescope) on La Silla, and participated in the startup and later became the Station Manager of the APEX project (Atacama Pathfinder EXperiment), which operates a 12m submillimeter telescope on Chajnantor just next to ALMA. In the early 1990's, Lars-Åke was involved in the site testing for the LSA project (the Large Southern Array), and was later responsible for the European part of the ALMA site characterization. His main research interests are star formation and the study of circumstellar envelopes around evolved stars.

Newsletter: How do you extract the information from the proposals that is necessary to actually perform observations?

L.N.: Most of the information is already in the proposal itself because of the way the OT is structured. The OT is designed to help an astronomer plan his proposed observing and to capture all of the information that is necessary for ALMA staff to produce the scheduling blocks. These scheduling blocks create all the instructions that are necessary to configure and to control the array to collect the data required.

Newsletter: How do you organize the observations?

L.B.: At the moment, the highest priority for ALMA is to complete the construction of the array. Today, we have 27 antennas at the high site out of the final number of 66, and there is a huge amount activity that continues associated with the construction, assembly and verification of the array. The majority of the daylight hours are dedicated to engineering activities. Most of the evening and night time hours each day are what we call science time. During that period, we aim to use as much of the array as is available for Commissioning and Science Verification activities (associated with construction) or to collect data for the highest priority proposals (cycle 0 observing). To date, we've been using around a third of that science time to collect data for the PIs of cycle 0 projects, which corresponds to blocks of 4 or 5 nights of cycle 0 observing every 2 weeks. From early March onwards we'll be aiming to increase the fraction of ALMA time used for scientific operations.

Focus on...

Newsletter: What progress has been made so far with Early Science Observations?

L.N.: Progress is good and the quality of the data is excellent. By the end of January 2012, we have delivered datasets to 9 PIs which means that we have collected the data, processed the data and it has passed through the quality assurance process with the result that it meets the standard required.

L.B.: The feedback we got from the PIs who have already received their ALMA data is very positive and the data quality is extremely high, which is encouraging. Things have been going pretty well, but we are clearly not collecting data successfully at the rate that we had planned. As a result we have decided to extend Cycle 0 (more details page 7) to improve the efficiency of the observing and will implement a range of measures.

Newsletter: So why isn't the efficiency as high as planned?

L.B.: ALMA is very complex, and we are using the system for the first time ever so its not too surprising that we don't know everything about the system yet. One of the reasons for starting Early Science – which we've always said we would do on the basis of best efforts – is to get experience in using the system to do science. The overall efficiency is determined by the observing efficiency of the system itself in terms of how much time we can spend on a target source compared to the total execution time of each scheduling block, and the execution efficiency fraction of time set aside for cycle 0 that we can spend on the execution of scheduling blocks. That execution efficiency is a function of the technical downtime, our need to learn and gain expertise about the system and the weather. Of course the site has been chosen for its exceptional meteorological conditions, but from time to time we are not able to conduct observations because of weather, which is true for any observatory. Both have been lower than we expected and we are working hard to improve them.

Newsletter: Cycle 0 proposals envisaged using 16 antennas for observations. Now we have almost 30 antennas up at the Chajnantor plateau. Does this mean that some projects are observed by using more than 16 antennas?

L.N.: Yes, we use as many antennas as we have available to collect the scientific data at any given time. Nevertheless, six of the antennas at the site today are 7m antennas for the Atacama Compact Array and those aren't being used in Cycle 0. The maximum number that we've used so far is 18 and we are continually taking more antennas up to the 5,000m site. That has the advantage that we can get to the requested sensitivity more quickly as more antennas are added to the array, and it has an added benefit of better uv coverage for those projects for which that's important.

L.B.: It's also important to mention that this month (February), when the weather tends to be poorer at the site, we are having approximately a month when we don't conduct Cycle 0 observations. Actually, we concentrate on a range of engineering and construction activities. One of these is to reconfigure the array from the compact to the extended configuration, the second configuration offered for Cycle 0 with a maximum baseline of about up to 400 meters.

Focus on...

Newsletter: Do the PIs know when their proposal is likely to be observed?

L.B.: ALMA is a full service observatory, which means that it's ALMA staff who operate the array and are responsible for processing the data, ensuring that if passes various quality assurance tests and producing scientifically useful data products. The complexities of observing at ALMA's highest frequencies pushes us to undertake dynamic scheduling, meaning that ALMA staff choose the most suitable project and scheduling block to execute at any given time based on the condition of the array, the weather conditions and the scientific priorities. We don't know in advance what will be observed when, so it isn't really possible for us to let PIs know what is happening, but as soon as we have good data that we know has passed the quality assurance process we get it straight to the PI.

Newsletter: When can we expect the first science results with ALMA data?

L.B.: Results based on the publicly-released science verification data are already appearing, and a few astronomers have already got their data from their Cycle 0 projects. The feedback we have received is very positive and we think the data are beautiful, and the PIs have confirmed that. How soon that will result in publishable papers, I'm not sure. I wouldn't be surprised if we are seeing ALMA papers in the journals within a couple of months.

Newsletter: Do you have a final word to all the scientists whose proposals were not ranked in the highest priority group for cycle 0?

L.B.: About 2,500 astronomers participated in proposals for Cycle 0 as PIs and CoIs. Although only 112 out of 919 proposals were in the highest priority group, about 650 astronomers are a PI or a CoI on one of those projects. This means that about a quarter of the people who proposed to use ALMA in Cycle 0 are part of a group that will receive ALMA data. I think the most important message for all astronomers is that there will be many more opportunities to get ALMA data with an even more capable array, and I encourage everybody who has an interest in doing science with ALMA to continue to apply for time and to collaborate with other astronomers to maximize the chance of being part of the successful teams.

Night in Chajnantor. The ALMA antennas scrutinize the mysteries of the universe 24 hours a day. Credit: ALMA (ESO/NAOJ/NRAO), C. Padilla

Focus on...

ALMA Early Science Cycle 0 status report

ALMA started scientific operations on 30 September 2011. While the quality of the data being collected is excellent, the completion rate of projects is lower than planned. To increase the likelihood that most PIs of the highest priority Cycle 0 projects will receive scientifically valuable data sets, the Cycle 0 observing period will be extended until the end of 2012. This extension will not delay completion of the array.

The observatory plans to release information regarding the capabilities and timeline for ALMA Early Science Cycle 1 in April 2012. The proposal deadline is expected to be in July 2012 with the start of Cycle 1 observations at the beginning of 2013.

Background

Early Science Cycle 0 observations have been conducted in blocks of 4-5 days every two weeks. By the end of January 2012 approximately 50% of the anticipated observing time for Cycle 0 has been used and we estimate that roughly 25% of the highest priority observations have been completed. While consistent with the "best efforts" basis of ALMA Early Science this is lower than planned. Sixteen calibrated, quality assured datasets have been delivered to nine PIs (by the end of January 2012). The data clearly demonstrate the scientific potential of ALMA, and feedback from the PIs has been positive.

Measures are being implemented to increase the observing efficiency, and during the additional period of Cycle 0 observing the fraction of ALMA time used for scientific operations will increase from the current fraction of 33% to around 50%. This corresponds to the intended fraction of time planned for science operations if Cycle 1 had begun as planned. With the increasing number of antennas it will be possible to schedule observations using the extended or compact configuration during the latter part of Cycle 0. There is also an increased likelihood that "filler projects", particularly in band 3, will be observed.

Commissioning and science verification activities are being conducted in parallel with Cycle 0 observations. More ALMA "Science Verification" data has recently been posted to the Science Portal, and some has already started appearing on the astronomy abstract servers.

The highest priority of the ALMA project continues to be the completion of the full array, expected in the second half of 2013.

ALMA in-depth

How ALMA is calibrated:

I. Antenna-based pointing, focus and amplitude calibration

by T. van Kempen, S. Corder, R. Lucas and R. Mauersberger.

There are several good reasons to frequently calibrate ALMA and its data: First, good calibration is necessary to obtain good quality images and reliable intensities and coordinates of sources in the sky. Second, it helps to save observing time and makes sure the observations are as efficient as possible. And finally, frequent calibrations help to monitor the system as a whole and to detect any imperfections or failures. Some of the calibrations are explicitly requested by the PI during the observation of a scheduling block. These include the calibration of the amplitude, the focus, the pointing relative to a source in a certain region of the sky, and the phase of the different antennas in an array. Other types of calibrations are constantly being performed during an observation without the need to specify those in the instructions for a scheduling block. Examples are the correction of phase drifts in the system by line length correctors, the determination of atmospheric phase variations via the Water Vapor Radiometers (WVR), and finally the calibration of the pointing behavior of the antennas via a metrology system. Finally, there are calibrations of the whole system that are performed when an antenna is integrated into the array after it has been moved from one pad to another and also on a regular basis (at present every week) by ALMA staff in order to monitor the system. The latter calibrations include the determination of a global pointing model for each antenna and each band, the determination of the exact position of each antenna in the array (the baseline determination), a check of the focus for each antenna and band, as well as a check of the receiver temperatures.

Here we will discuss which calibrations are needed, how to perform them and how the calibration affect ALMA observations. This first part concentrates on aspects related to a single antenna, namely antenna pointing (including the antenna metrology), focusing, and the amplitude

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calibration, we also mention the bandpass calibration for single dish measurements. In a second part, we will explain those parts of the calibration that relate to the interferometer as a whole, and have to do with the phase stability of the system, namely the phase calibration, a more detailed description of the bandpass calibration and the baseline calibration. More exhaustive discussions can be found e.g. in Baars, (2007), Taylor, Carilly & Perley (1999), Thompson, Moran & Swenson (2001) and Wilson, Rohlfs & Hüttemeister (2008).

ANTENNA POINTING

In order to maximize the signal received from a source and to minimize the calibration uncertainties, we have to be able to accurately track its position in the sky. Unlike optical telescopes, we have no guide stars in the field of view, and often the source we want to observe is only detectable after a long integration time. At the highest frequencies ALMA will be able to observe, namely almost 1 THz, the 12 m antennas of the main array of ALMA each have a half power beamwidth of 7”. It is obvious that the blind pointing of the antennas should be much more accurate than such a beam size in order to find a source at such a high frequency. In fact, the specifications of the ALMA antennas require a “blind pointing” accuracy of 2” all over the sky. This specification is extremely challenging: after all, the antennas are not protected by a dome, and experience high wind and large temperature gradients by ambient temperature that can rapidly change and, during the day, from sunlight illuminating the antenna.

Each of the antenna vendors from the North American, European and East Asian Regions applied their own solutions to ensure such a high pointing accuracy. This includes a careful design, and modeling of the antennas’ behavior in response to temperature, gravitation and wind, and also metrology devices in the antenna such as sensors that measure the position of the antenna’s outer structure with respect to a reference frame inside an antenna. There are also thermal sensors and inclinometers which help to correct for wind gusts and thermal deformations. Still, this is not sufficient to guarantee that celestial sources can be pointed at with sufficient accuracy.

When an antenna is assembled at the Operation Support Facility (OSF) its mechanical behavior is characterized by observing a large number of celestial sources distributed all over the sky using the radio receivers in single dish, and later in interferometric mode. For each of the sources, the telescope is pointed first toward the position where the telescope control system supposes the source to be and then at half beam offsets in either direction in azimuth and elevation. During this process, the signal from the radio source is recorded, and from a Gaussian fit to the signal one can determine how much the azimuth and elevation encoder readings of the telescope deviate from the predicted azimuth and elevation of the source in the sky (taking the atmospheric refraction properly into account). We can then relate the azimuth and elevation

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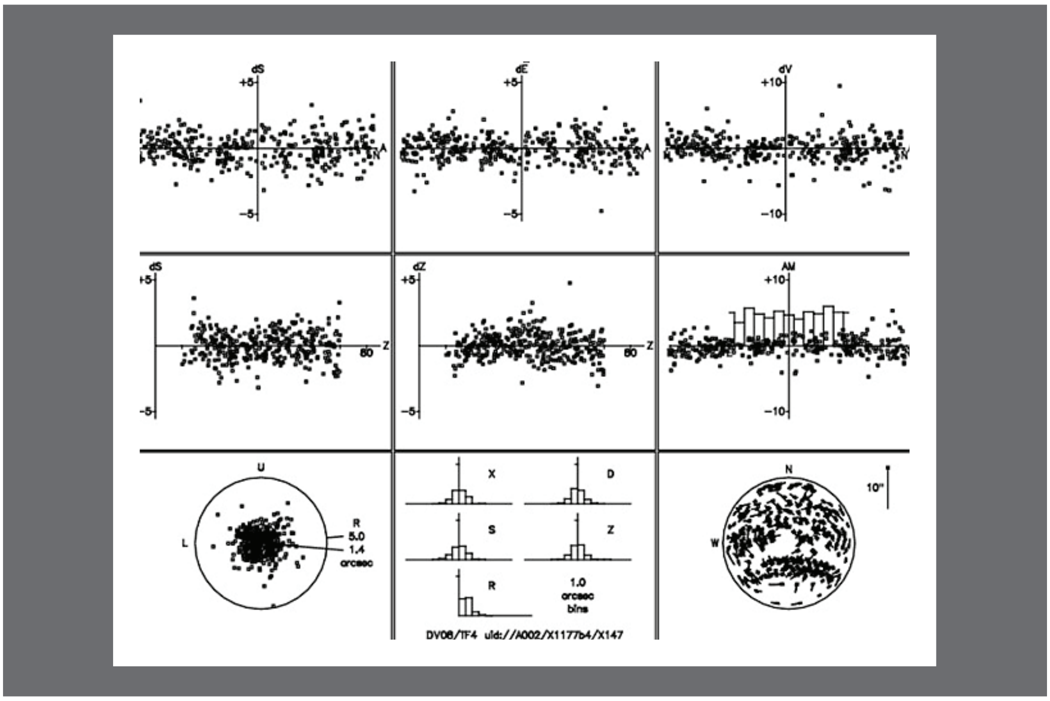
offsets Δaz(az, el), Δel(az, el), measured for hundreds of radio sources at different values of azimuth and elevation, to a model of the misalignments and imperfections any telescope has. This includes among others, the gravitational bending of the telescope as a function of elevation, the index errors in azimuth and elevation, the small tilt of the azimuth axis, and the fact that the neither the azimuth axis nor the line of sight are exactly perpendicular to the elevation axis.

This pointing model is then implemented into the control system of telescope in such a way that the antennas can now “blindly” find any source in the sky with an accuracy of 2” or better. Such a pointing model should be valid for several weeks before an upgrade of the pointing constants becomes necessary. A relatively short pointing run with 30-50 sources, spread evenly between 20 and 85 degrees elevation, is performed on a weekly basis to monitor the quality of the pointing model.

The antenna pointing model is sufficient to find any source in the sky, even at the highest frequencies. It is however not sufficiently well determined and stable to allow centering a source in the beam within 1/10 of the smallest beam width in order to optimize the calibration and sensitivity. Therefore, each scientific observation (Scheduling Block) is preceded by an offset pointing, i.e. a pointing observation on a strong point source close with well determined coordinates to the scientific target. Such an offset pointing allows to apply the small correction needed to track any source in the sky within the 0.6” specified in the ALMA requirements. This offset pointing can be performed at band 3 or 6 even if the actual science observations are performed. E.g. in band 9, where if is difficult to find suitable pointing sources.

After many celestial sources have been POINT is used to relate the offsets to about 15 pointing constants which determine the pointing model of an antenna. This pointing model predicts the imperfections in the aligment of an antenna such than any source in the sky can be pointed at with an rms precision of less than 2”



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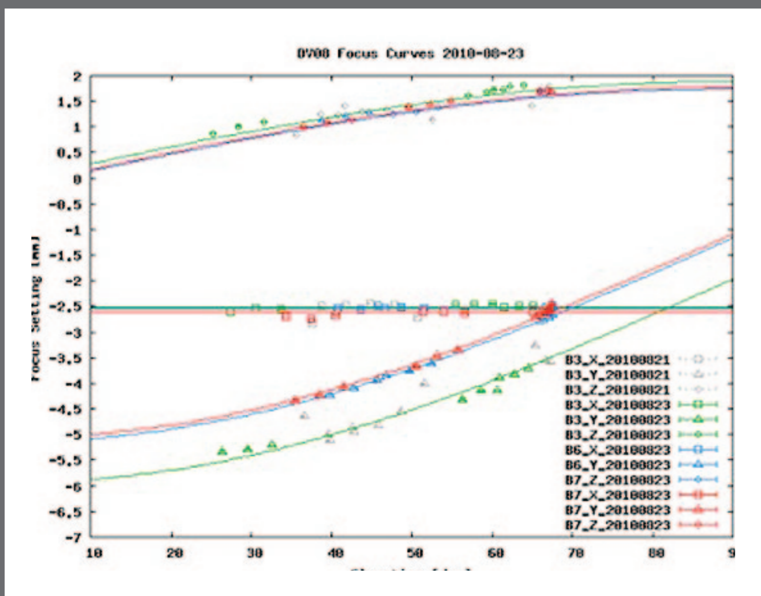
ANTENNA FOCUS

The ALMA dishes are deliberately constructed to change their shape as a function of elevation in such a way that the antenna always has the form of a paraboloid, however with varying focal length. This elegant principle of homologous deformation allows us to build large telescopes with a lighter structure, but it requires us to refocus the telescope as a function of elevation. This is taken care of by the part of the antenna control system that is in charge of the subreflector movement. In addition, the axial and lateral movement of the subreflector depend on the temperature of the antenna structure. After an antenna is assembled, ALMA astronomers determine the gravitational and temperature dependence of the axial and lateral focus by observations of strong radio sources at different elevations and temperatures. In a focus observation, we point the antenna toward such a radio source (e.g. a quasar or a planet) and then move the subreflector slightly inwards and outwards (and also toward lateral offsets) of the nominal focus position. From a Gaussian fit to the recorded intensities, we can predict the optimum focus position. As a result, we have a pretty accurate focus model for each antenna, which, however, does not predict effects of unequal illumination by the sun or large temperature gradients within the telescope structure. These residual affects can be corrected for during scheduling block by including a focus determination on a strong radio source and applying a small correction on top of our focus model.

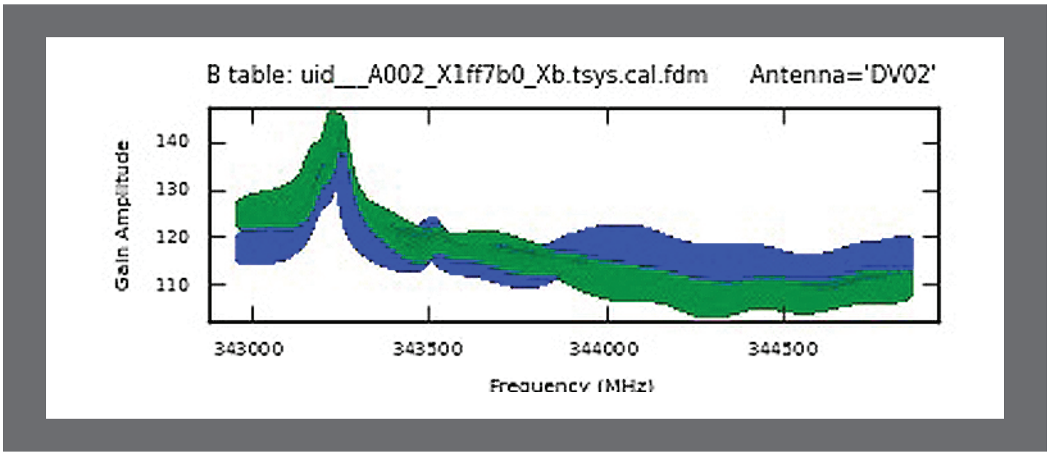


This is a compilation of optimum focus settings (in three different focus directions) for one antenna at various elevations. The results of these measurements are used by the ALMA control software to automatically refocus the antenna during observations.

ALMA in-depth

AMPLITUDE CALIBRATION

ALMA is designed to yield data with an unprecedented flux density calibration uncertainty of 1% (3% at the highest frequencies). Even if we have managed to point up our antennas and focus them following the steps described above, this is an extremely challenging task. The reason is that we have to include a plethora of effects that threaten to degrade the calibration of the radiation of celestial source on its way through the atmosphere, the antenna, and the receivers into the detecting system. Closely related to the calibration of ALMA data is the monitoring of the noise produced by the receivers and the system, including the atmosphere, in order to track the performance of the equipment and to decide on observing strategies.



The Figure shows a Tsys measurement on DV02 around 344 GHz. At 343.3 GHz, there is a known mesospheric line in the atmosphere. As such the system temperatures are about 20 to 30 K higher at these frequencies due to the lower transmission. Astronomical observations are consequently known to be less sensitive around 343.3 GHz.

The basis of the ALMA calibration is the Alma Calibration Device (ACD). The ACD consists of robotic arms that can place two microwave absorbers, the ambient and the hot load, at well defined temperatures in front of the receiver feed horns of any of the bands. These loads have to work in the entire frequency range of 30 to 950 GHz foreseen for ALMA. The ambient load is at 20° C and the hot load at 70° C. The response of the system V is proportional to the temperature of the ambient or hot load plus the equivalent noise temperature of the receiver: $V_1=g*(T_{amb}+T_{rec})$ and $V_2=g*(T_{hot}+T_{rec})$. Thus a set of measurements of the response to a measurement toward an ambient load and toward a hot load can be used to determine at the same time the "receiver gain" g, which is the basis of the intensity scale for all calibrations of the ALMA system and ALMA data, and the receiver temperature, T_{rec}. The receiver temperature is a measure of the sensitivity of a receiver and it is important to monitor that it always complies with the specifications (see the article in ALMA Newsletter 6 http://www.almaobservatory.org/outreach/newsletter/211-newsletter-no6#alma_in_depth) over the whole observable frequency band.

The receiver is not the only part of the system that adds noise to the observations. The antenna and the atmosphere also contribute to the noise budget. The contribution of the atmosphere depends on the precipitable water vapor (PWV) toward the zenith, the elevation, and most importantly, the frequency. In particular, observations at the highest ALMA frequencies are only

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possible if the PWV content is small. Knowing the receiver temperature T_{rec} and the gain g, we just have to point the antenna toward the sky to obtain the effective noise temperature of the atmosphere in the observing direction: $V_3=g*(T_{sky}+T_{rec})$. In fact, the ALMA calibration software also accounts for the fact that a small percentage of the telescope beam is directed not toward the sky but toward the ground, and also for the contribution of the cosmic background radiation. It is important to know the noise temperature of the sky since, together with an atmospheric model, it can be related to the optical depth, τ, of the atmosphere in the observing direction and at the observing frequency. The optical depth of the atmosphere not only determines the contribution of the sky to our noise budget but also the atmospheric absorption of the incoming radiation from a celestial source. The above mentioned calibrations also serve to calculate the system temperature during an observation. Since the system temperature contains a correction for the atmospheric absorption it can be related to a black body outside the atmosphere, and can therefore be used in the radiometer formula to estimate the integration time necessary to obtain a certain signal to noise ratio at a given frequency and elevation.

During a scientific observation, sky and receiver temperatures are measured every 10 to 20 minutes (depending on the observing band and weather conditions), and whenever one observes in a different direction of the sky (in practice >15° away). Results are stored together with the observed data and are used to apply corresponding corrections due to the atmospheric absorption, as one of the first steps in the data reduction process.

For a perfect antenna, this would already be sufficient to exactly calibrate all of our measurements. Since, however, the ALMA antennas do not perfectly couple to the sky, and since there might be still a residual mis-pointing and defocus, a thorough calibration requires sources in the sky for which we know the flux at any given frequency. Among the best such calibrators are solar system objects especially those for which we know the size and the temperature. In particular for Neptune, Uranus and Mars there is a good understanding of their fluxes as a function of frequency and time. Minor planets and the moons of the giant planets can also be used in particular Ganymede and Callisto around Jupiter, and Titan around Saturn.

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ALMA is designed to observe regularly at baselines longer than 1 km and as long as 16 km apart. At such baselines most solar system objects, including asteroids and moons, are resolved out at any frequency, making amplitude calibration difficult. One can use models of the coupling of the synthesized beam of the array to an extended sources, but this is dependent on the configuration of the array relative to the location of such an object in the sky at the time of the observations and may not always give the best results. Another obvious problem is that solar system object are unevenly distributed over the sky.

This is why ALMA uses quasars as secondary calibrators: they are point like and distributed all over the sky. A disadvantage of quasars is, however, that their fluxes may vary with time and that the frequency distribution of the flux, the spectral energy distribution, is not known a priori. Almost all known quasars spend significant amounts of time in a flaring state with brightnesses that can vary day by day. This is why ALMA is carrying out a monitoring program of 40 of the brightest visible quasars distributed all over the sky. The fluxes of the calibrators are calibrated against the fluxes of solar system objects, which serve as ALMA's primary calibrators. The cross calibration is performed using telescope pairs that are at a short distance of each other in order to capture all the flux from the primary calibrators. During the scientific observations, however, these quasars can be used at all baselines since they are compact.

The monitoring program is also not limited to a single frequency, but these quasars are observed at low frequency (currently 92 GHz) and high frequency (352 GHz) to determine the frequency dependency of the flux. With observations at multiple wavelengths, it is possible to estimate fluxes of these quasars at any frequency.

BACKGROUND REMOVAL FOR SINGLE DISH MEASUREMENTS

ALMA will also be used for single dish measurements, in order to map structures that are "resolved out" by the interferometer. For spectral line measurements, the correlator will then be used in the autocorrelation mode with bandwidths of up to several GHz. The signal from a celestial source is typically hundreds or thousands time weaker that the contribution of the atmosphere. Since the atmospheric contribution to the signal varies with frequency (in fact there are many atmospheric absorption lines) and time, one has to frequently measure a blank portion of the sky in order to determine the contribution of the atmosphere to the observed signal. In practice one either observes a reference position close to the source observed every minute or so, or one uses emission free regions of a map when performing an on-the-fly map of a source.

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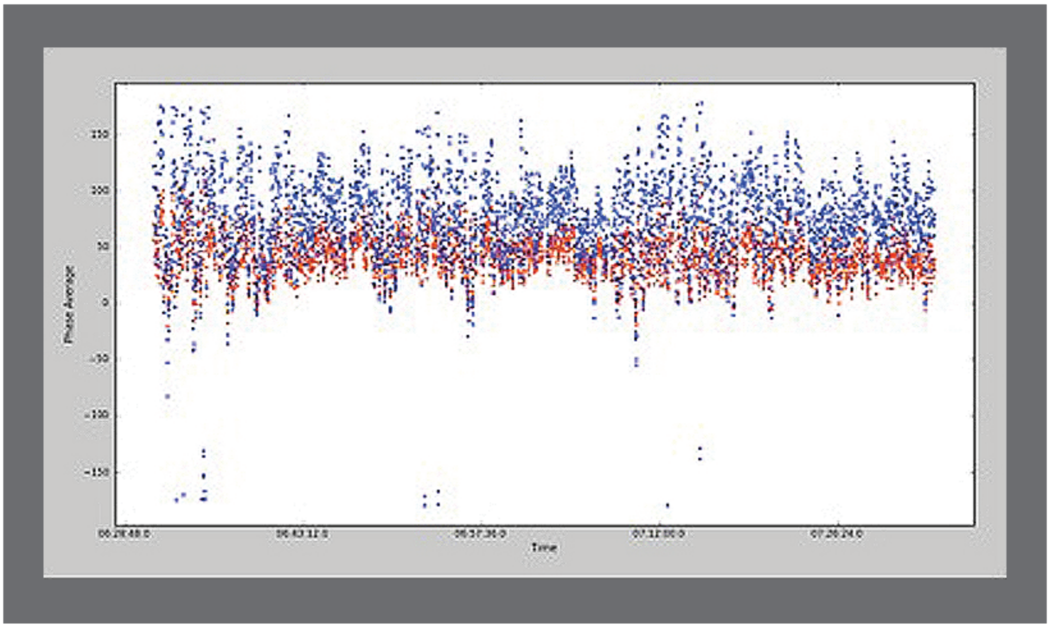
ALMA in-depth

WATER VAPOUR RADIOMETRY



Comparison between the phase stability of a quasar before correction of the WVR is applied (blue) and after (red). As can be seen the variation in phase is significantly reduced.

ALMA's 12-meter antennas are equipped with water vapor radiometers (WVR; for a detailed description, see Newsletter http://www.almaobservatory.org/outreach/newsletter/211-newsletter-no6#focus_on). These are receivers which, in parallel to the receivers used for astronomy, look towards the sky and record the atmospheric emission at 183 GHz and neighboring frequencies. At this frequency, there is a strong atmospheric emission line of a rotational transition of water vapor. By measuring the intensity of that line emission in its central frequency and its line wings, one can calculate the amount of water vapor in the line of sight and the delay this water vapor causes to an incoming signal. This delay is used to correct for the phase fluctuations caused by atmospheric water vapor. These predicted phase corrections are continously recorded and can be used at a later stage of data reduction to reduce the phase variations between different antennas. This makes interferometric observations possible even for large baselines, high frequencies and less optimum weather conditions. The WVRs are also used in order to decide whether certain projects that require specially low water vapor in the atmosphere can be observed. The astronomers and telescope operators can see a display on the console showing the evolution of the water vapour in the atmosphere as a fuction of time.

ALMA in-depth

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Who's who

Neal Evans, Chair of ALMA Proposal Review Committee for Cycle 0:

"Panelists worked as a team, having checked their institutional affiliations at the door"

Although ALMA will still be under construction until 2013, the capabilities of the 16-antenna array that became available for Early Science observations at the end of September 2011 already exceed those of all other telescopes of this kind. It is thus no surprise that 919 proposals were submitted by astronomers from all over the world. This level of demand for observing time with ALMA corresponds to about nine times the number of observations that are expected be carried out during the first phase of Early Science. This demand demonstrates how excited researchers are to use ALMA, even at this early stage. Professor Neal Evans, Chair of the ALMA Proposal Review Committee (APRC), answered our questions regarding the selection process.

ALMA: Professor Evans, 49 astronomers from around the world joined you at the ALMA Office in Santiago in mid-August to complete the review of the almost 1,000 proposals for Cycle 0 Early Science with ALMA. Could you please tell us something about who these APRC panelists were?

Top: ALMA Cycle 0 science assessors in Vitacura, Chile at the entrance to the ALMA Santiago Central Office building. Credit: ALMA (ESO/NAOJ/NRAO), I. Lemus (ALMA)

Neal Evans: The composition of the review panels reflected the worldwide nature of the project, together with our attempt to provide balance among areas of expertise, gender, and experience (1). Both senior astronomers and younger astronomers served on panels. Also, consistent with the goal of making ALMA accessible to all astronomers, panelists were not limited to those with extensive experience with interferometry at millimeter/submillimeter wavelengths. Based on the Notices of Intent, we anticipated the number of proposals in each of four science categories: cosmology and high-z galaxies, extragalactic observations (low-z), star formation, and a broad

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category that included solar system objects and evolved stars. Panels were added to keep the workload "reasonable" (about 115 proposals per panel), resulting in two cosmology panels, two extragalactic panels, three star formation panels, and one solar system/stellar panel. Each panel had 6 members (7 for the solar system/stellar panel). Together with the APRC Chair, that made 50 people. Francoise Combes did double duty as a Panel Chair and the Deputy Chair of the APRC. Proposals were assigned to panels to minimize conflicts of interest.

ALMA: What were the main criteria used to establish the ranking of the proposals?

NE: Because ALMA will be a dynamically scheduled telescope, the project selected for observation at any given time will depend on weather conditions, equipment availability (e.g., configuration of the antennas), and partner share, as well as the scientific quality. Consequently, the job of the proposal review was to assess only the scientific quality, within the capabilities offered in the call for proposals. Secondary considerations included whether the project provided a good demonstration of ALMA scientific capabilities and "efficiency" in the sense of excellent science for a small investment of time. The product of our work was a single, rank-ordered list that ignored the affiliation of the proposers entirely. From this single list, rank-ordered lists for each of the three partners and the host country were generated by going down the single list until each partner's nominal time share was filled. Open skies proposals (2) were grouped with North American proposals for this purpose. The total time available in Cycle 0 was uncertain, and the efficiency of actual operations was unknown. Indeed, one of the purposes of Cycle 0 is to test the efficiency under actual observing conditions. While a nominal estimate that 500 hours would be available was used, a high ranking is not a guarantee that any proposal will actually be observed. The APRC is NOT a Time Assignment Committee; it is a Proposal Review Committee.

Françoise Combes
Professor at Paris Observatory,
France

The ALMA-Cycle 0 proposals were of exceptional quality, and written such as to draw the best science out of a small amount of time, only 5 hours on average. Our panel considered before all scientific merit, and also the adequacy to the first-science goals and constraints. The experience was enriching!

ALMA: The proposal submission deadline was at the end of June. What happened between this date and mid-August, when you all met in our Offices in Santiago?

NE: The panelists arrived in Santiago having already done a great deal of work. Every proposal was read by at least 4 members of the relevant panel (different members for each proposal) and assigned a score. Based on these scores, 30% of proposals were triaged unless they had large dispersions in the scores. The remaining 70% were sent through a technical review process to ensure feasibility. The fact that only 27 proposals were determined to be infeasible is a testimony to the effectiveness of the Observing Tool and the support provided by the ALMA Regional Centers (ARCs). Those proposals that were neither triaged nor determined to be technically infeasible were then read and graded by all remaining non-conflicted members of the panel to which they were assigned. These grades were averaged to produce a rank-ordered list of all

Who's who

proposals in that panel by the time the panelists assembled in Santiago. In addition, a primary and, in many cases a secondary reviewer, provided preliminary comments.

ALMA: Could you describe the process after panelists arrived in Santiago, including the ways that conflicts of interest were dealt with?

NE: The first two days of the meeting primarily involved the review and discussion of the proposals within the panels, followed by a re-vote on the scores. Triaged proposals could be revived for discussion upon (un-conflicted) request. About 600 proposals (about 75 per panel) were thus discussed. The result of these discussions was a rank-ordered list within each panel. For science areas with multiple panels, there was some effort to compare lists of highly ranked proposals and to make adjustments to avoid duplication of effort and produce a well-balanced portfolio of proposals. This cross-panel discussion was ad hoc in Cycle 0, but we are considering the idea of formalizing it for Cycle 1, with due regard for the additional conflicts of interest that may be introduced. Much of the third day was devoted to writing, checking, and agreeing on the comments to the proposers. On the fourth day, the APRC (Chairs and Deputy Chairs of the panels) met with me to examine the merged list of ranked proposals (in principle 1 to 919 with 1 the best). The rankings were merged in round-robin fashion, using the ranking divided by the number of proposals in that panel, so that proposals in each panel had an equal chance to emerge with a low number (good) ranking. The APRC then examined the list and commented on the distribution over right ascension and receiver bands. In principle, the APRC could have changed the rankings, but the members preferred to honor the judgments of the full panels. The effect of these procedures is that the distribution of science rankings over science areas reflects the distribution of proposals; all science areas were considered equally important. Finally, the total ranked list was broken into ranked lists for each partner and the host country. Responsibility for monitoring shares as observing proceeds lies with ALMA Department of Science Operations.

ALMA: Were all the proposers informed about the outcomes of the selection process?

NE: Yes, they were. Feedback to the proposers included the consensus comments on the proposal and guidance as to how the proposal ranked, both in the overall list and in the lists for

Leen Decin
Professor at Leuven University, Belgium

Ranking the ALMA proposals was a challenging task, not only due to the high number of proposals, but also due to the high quality of the proposals meanwhile realising that only ~12% could be accepted. We realise that many good proposals will not be observed during ALMA Cycle 0, reason not being that the scientific idea was not valid or not spelled out clearly, but just since these proposals were just below the cut-off.

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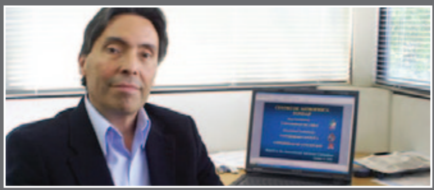

Guido Garay
Professor at Universidad de Chile, Chile

In my panel most of the proposals were of great scientific quality, thoroughly prepared and involved the collaboration from several researchers, usually from different regions of the world. The job of ranking the Cycle 0 proposals was, therefore, one of the most difficult that I have experienced as a member of a Proposal Allocation Committee, particularly knowing that about 90% of the proposals were not going to receive observing time. In any case, the panel members discussed each of the proposals very carefully and we made the best of our efforts in producing a final ranking based purely on scientific merit and impact.

each partner and the host country. The guidance was within bands of percentile ranking: top 10%, 10-20%, 20-40%, 40-70%, and 70-100%. Proposals that were rejected as technically infeasible were identified as such. The top range of percentile rankings approximately filled the expected available time in Cycle 0, so the proposers also received the message that their project had the highest priority to be observed. The next hightest ranked proposals will be treated as filler projects. They will be observed only if conditions did not permit observation of a project in the first group.

ALMA: Being the very first round of Science Observations for ALMA, Cycle 0 is a learning process for ALMA operations. Did the Cycle 0 proposal review also represent a test that can provide lessons for future reviews?

NE: It certainly did. For instance, in future cycles, we will ask proposers to list key words that describe the science to assist panels in grouping similar proposals for discussion. To this end, panels collected key words for each area, and proposers to Cycle 1 will see a request to check those that apply. We are also considering the following changes. Since the technical review demanded substantial human resources to identify only 27 proposals that eluded the checks in the observing tool, it may be more efficient to confine technical review to those proposals that have made it to the top percentile groups. In this case, it would be done after the scientific review and would be focused on detailed analysis in preparation for scheduling. Also, we are considering the idea of an intermediate merge of proposals in the same science category, with an extra day for the panels to consider these, essentially formalizing the ad hoc process described above for Cycle 0. We will again ask for Notices of Intent as we expect to need to add panels, and we need guidance to keep the number of proposals balanced between panels.

Christine Wilson
Professor at McMaster University, Canada

I found it pretty sobering to look at the over-subscription rate and the roughly 100 proposals that my committee had to review, and to realize even before starting to read that only 10 of the proposals would likely be accepted. I would say that many of the proposals that didn't get time were scientifically excellent and made their case well. This made the committee's job quite hard, as we had to identify what we thought were the most outstanding proposals from a very strong pool.

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Yoshi Taniguchi
Professor at Ehime University,
Japan

We found many high-quality proposals in our Panel. However, this is not surprising because many active radio astronomers were rushing into the ALMA Cycle 0; and non radio astronomers as well! Compared to some other calls for observing on other telescopes, I have the impression that proposals were written in more extended collaborations.

ALMA: To conclude, what was your general impression as Chair of this whole process?

NE: As Chair of the APRC, I did not review proposals. Instead I observed the panels in action, answered questions about the process, and occasionally free-lanced to adjust procedures to reality. My impression is that the panelists were extremely conscientious and hard working. They worked as a team, having checked their institutional affiliations at the door. The resulting list of highly ranked proposals provides an outstanding mix of innovative and important science projects. I would like to recognize all the panelists got their hard work, as well as the local support staff, which was excellent and flexible in responding "on the fly" to needed changes.

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(1) Vignettes of a few of the panelists that accompany this interview illustrate these points

(2) Open skies proposals are the proposals submitted by astronomers who are not affiliated to an institution belonging to one of the ALMA funding countries. These scientists also have the possibility to make observations with ALMA.

Progress at the ALMA site

Lots of progress has been made and important milestones for the project were reached during the last months and the following is only a non-exhaustive selection of some of these, which barely reflect the intense activity on site to complete the construction of the most advanced radio observatory.

Of course, the major milestone lately was the successful start of ALMA Cycle 0 Early Science Observations at the end of September and the subsequent delivery of the first data packages to principal investigators. Considering that this topic is largely covered in the "Focus on" and "Who's who" section of this Newsletter, no further details are provided here.

With stationing of the sixth 7-m diameter antenna at the 5,000 meter Chajnantor plateau mid-January the array grew to 27 antennas in total.

ALMA antennas at the 5,000 meters Chajnantor plateau. In the background, the Chajnantor mountain, culminating at a bit more than 5,600 meters. Credit: ALMA (ESO/NAOJ/NRAO), W. Garnier (ALMA)

Progress at the ALMA site

Top picture: The final three 7m antenna parts on their way to the OSF

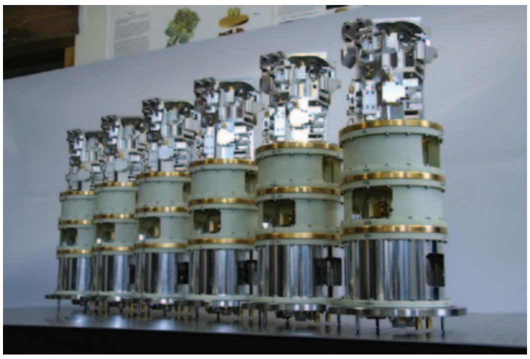
Bottom picture: North American antennas being assembled in the Vertex hangar

In addition, seven antennas are going through their Integration and Verification tests at the Operations Support Facility (OSF), located at 2,900 meter altitude, and are being readied for transport to the AOS in the coming weeks. In the meantime, the antenna manufacturers continue working very hard on the construction and assembly of their respective deliverables. The final three 7m antenna parts arrived from Osaka via Kobe in October, completing delivery to the site of the entire Japanese complement of 16 antennas. Of these 16, already 11 have been delivered to ALMA. Also, 7 European antennas have been handed over to the Project since April 2011, 2 are fully assembled and close to acceptance phase, 2 others are fully assembled and in pre-commissioning phase and 2 others are in assembly phase at the European assembly site. On the North American side, a total of 19 antennas have already been accepted and delivered to ALMA and four others are in various stages of integration and commissioning work.

Important milestones for the project were reached with the final deliveries of assembled cartridges for two of the ALMA receiver bands. The ALMA Band 3 Receiver (3mm) team at the National Research Council's Herzberg Institute of Astrophysics in Victoria, BC, Canada assembled the 73rd and final, receiver. The Band 3 project has been a ten-year effort and is reaching completion on-time and on-budget (see more details in "ALMA events/News from the Regions" section). Meanwhile, in Europe, the final Band 9 (450µm) production cartridge was delivered from NOVA (the Netherlands Research School for Astronomy), and it completed verification at the end of November 2011. This delivery completed the 73 item production run for Band 9 -enough for all the ALMA antennas, plus spares (more details on ALMA website). Each of the ALMA antennas must be equipped with an arsenal of detectors, like highly sensitive radio receivers, operating in different wavelength bands. These receivers are being made by institutes in Europe, North America, and Japan and are subsequently integrated into the Front-End.

Some of the 73 Band 9 receiver cartridges delivered by NOVA (the Netherlands Research School for Astronomy) under contract to ESO, for the Atacama Large Millimeter/submillimeter Array project. The so-called "Band 9" receivers are the second-shortest wavelength ALMA detectors, measuring light with wavelengths as short as 420µm (0.42 millimeters). The design and manufacture of receivers that can operate at these short wavelengths is particularly challenging. Credit: ESO/NOVA

The three Front End Integrations Centers delivered 25 new Front Ends, or receiver packages, to outfit the antennas. The units in the antenna cabin through which the Front Ends communicate with the equipment in the Array Operations Site Technical Building (AOS TB) are called Antenna Articles, and 66 of these were delivered by the end of last year, one for each of the planned ALMA antennas. The Central Local Oscillator was also delivered and installed during 2011. It forms an important part of the ALMA nervous system, distributing and synchronizing signals across the array. The last of the four correlator quadrants was also accepted. Two correlator quadrants were deployed at the AOS TB and a third was installed, while the fourth remained at NRAO labs in Charlottesville, West Virginia, USA, for software testing.



Progress at the ALMA site

The Front End Servicing Vehicle reaching the high altitude Chajnantor plateau

Until now, servicing of receiver electronics - which must be cooled to temperatures of 4K- has generally meant that an antenna, with its front end, has had to be transported from the Array Operations Site (AOS) at 5,000 meters altitude to the lower elevation OSF. With the recent arrival of the Front End Servicing Vehicle, a North American deliverable fitted for ALMA service in Taiwan, ALMA has the ability to change out receiver directly at the antenna.

Also worthwhile being mentioned is that the new electricity generation and distribution system that power equipment distributed throughout the ALMA site is now in its final stage.

The unified generation plant has a capacity of 14 MW and is comprised of three 4-MW turbines and a starter generator. The observatory is currently using close to 3MW and the demand will continue to increase as more of the final total of 66 ALMA antennas are brought on line.

"The new system will be extremely reliable and we hope it will end the blackout problems we have had recently," says Massimiliano Camuri, the engineer in charge of the ALMA Multi-fuel Power Generation System project. The turbines are now being tested and their combustion characteristics, efficiency, and electric circuit protection checked.

Building the generation system was challenging as it is both large and complex. Although not required, ALMA voluntarily submitted the project voluntarily to Chile's Environmental Impact Assessment System to demonstrate that the plant meets all the requirements of Chilean environmental law.

"I am very pleased because we have achieved a great deal with this project, which required 40 million Euros -- close to US$ 50 million -- which is a significant budget for a generation and transmission project," says Camuri.

One of the advantages of the new plant is that it can run on diesel, liquid petroleum gas (LPG) or natural gas, which means that at any given time the system has the potential to use the fuel that is priced lowest in the market. The new system is expected to begin operating in early 2012. By mid-year it will operate primarily on LPG with diesel as a backup fuel source.

General view of the brand new electricity generation plant. The OSF can be seen below.

Progress at the ALMA site

ALMA will soon have its own "hotel" for the astronomers, engineers, and other staff working at the observatory. The contract for the detailed design of this European deliverable has just been signed with the Finnish architects Kouvo & Partanen. The hotel residence will be built at the OSF and the buildings' architectural design will be integrated into the landscape by using local materials such as stone, copper and volcanic rock. Their facades and structures will use the colors and tones of the surroundings, and the natural landscape will be preserved as much as possible. The buildings are designed for energy efficiency, using natural light wherever possible, and collecting solar energy for hot water and heating. The design phase is planned to last six months, followed by the procurement actions for the construction. Completion of construction is expected in 2014. (more details on ALMA Website)

The ALMA science team also continues to make observations for Science Verification purposes using new capabilities and an ever increasing number of antennas. We are pleased to be able to provide further Science Verification datasets to the astronomy community.

The new data sets are:

- Spiral galaxy, M100, a mosaic at Band 3;

- Interacting galaxy pair, The Antennae, a mosaic at Band 6;

- Our Galactic Center, SgrA*, recombination lines at Band 6;

- Proof of Concept of Response to Targets of Opportunity, the GRB 110715A datum.

The data products released here contain raw, uncalibrated data together with the necessary calibration tables to allow users to try their hands at a complete data reduction. CASA data reduction scripts are included in the release as well. Calibrated versions of the data are also provided, as are reference images in FITS format.

These products are the result of a great deal of work by many people from all over the world, including the Science Team responsible for Commissioning and Science Verification, and the teams responsible for Science Operations at the ALMA Regional Centers and at the Joint ALMA Observatory (JAO).

These and future datasets listed in the Science Verification pages will be released through the ALMA Science Portal, so please continue to check under the ALMA Data -> Science Verification link for news.

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New Staff in ALMA

MICHAEL THORBURN TOOK UP DUTY AS HEAD OF THE ALMA DEPARTMENT OF ENGINEERING IN AUGUST.

Michael brings to ALMA over 25 years of engineering and engineering management experience from the space science and aerospace engineering sectors in the United States. In the 1990s he spent seven years with the Jet Propulsion Laboratory (JPL) in California where he managed a succession of organizations and research projects for NASA's Deep Space Network spanning space telecommunications, radio science and radio astronomy. Beginning in January 2000, he spent over ten years with Space Systems/Loral in California where he led several satellite design projects and managed organizations in communications systems engineering and antenna engineering. His technical interests and expertise span both microwave electronics technology and antenna technology and his management experience spans both large projects and large functional organizations. Michael earned his PhD in Electrical and Computer Engineering from Oregon State University in the United States. He has published many scientific and technical papers and conference papers and has held several leadership positions within the Institute of Electrical and Electronic Engineers (IEEE).

GARY PARKS TOOK OVER AS THE ALMA PROJECT MANAGER IN OCTOBER.

Gary comes to ALMA with thirty-five years experience at NASA's Jet Propulsion Laboratory (NASA/JPL) in Pasadena, California (USA). His project management experience includes space projects such as NASA's contribution to the international Herschel and Planck space observatories and the spacecraft for the successful Phoenix Mars Lander that confirmed existence of subsurface water/ice. He also managed technical organizations within JPL including the Optical Interferometer Section and the Microwave Observational Systems Section. Other pursuits include technical contributions to Very Long Baseline Interferometry (VLBI), millimeter-wave imaging, downward-looking radar for detection of precipitation, water vapor radiometry and lightweight segmented replicated silicon-carbide optics for large space telescopes. Gary graduated with a BS in Electrical Engineering from California State Polytechnic University in the United States.

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ALMA Events

Recent events from East Asia

NAOJ National Astronomical Observatory of Japan

EA ALMA DEVELOPMENT WORKSHOP IN MITAKA, TOKYO, JAPAN.

On September 8th, 40 scientists and engineers from Japan, Taiwan, and Korea attended the ALMA development workshop held in Mitaka campus of NAOJ. Both scientific and technology talks were presented for developing new capabilities, which makes ALMA as a cutting edge facility in future.

ALMA SPECIAL SESSION IN THE ANNUAL MEETING OF ASTRONOMICAL SOCIETY JAPAN IN KAGOSHIMA, JAPAN.

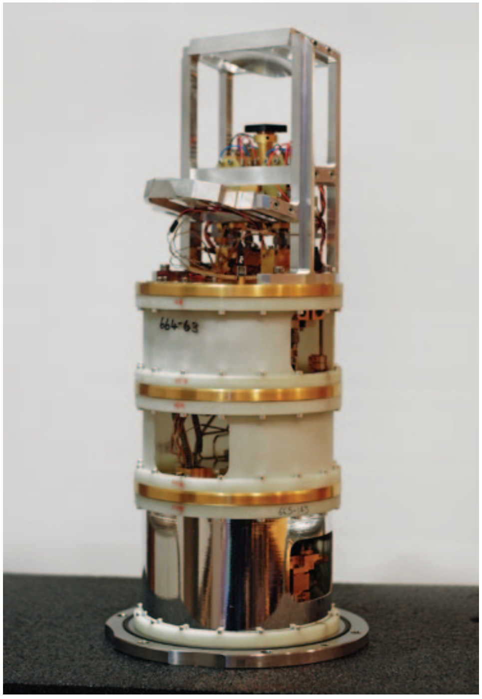
On September 19th, the ALMA special session was held in the annual meeting of Astronomical Society of Japan in Kagoshima, Japan. Since the time was just after the consensus reports were sent to all the cycle 0 proposers, more than 150 researchers and students participated in the meeting from all over Japan. We reported the status of ALMA construction, preparation of cycle 0 observations, and the status of Early Science observations. It was a good opportunity to reach potential ALMA users and to listen to their opinions about ALMA and its user support.

ALMA Events

Recent events from Europe

ALMA BAND 5 RECEIVERS

An international team led by GARD from Onsala in Sweden has recently completed the construction of the last of a set of six ALMA Band 5 receiver cartridges. While the last cartridge is undergoing the acceptance tests before being delivered to the Front-end Integration Centre, the first produced cartridge has already been installed in one of the ALMA front-ends and delivered to OSF. Commissioning tests have started on this first cartridge, while the other five will follow in the coming months.



The Band 5 receiver cartridges will allow ALMA to observe in the 163-211~GHz frequency range and have been developed in the framework of the European Commission FP6 ALMA Enhancement project. The possibility of performing a full production run of Band 5 cartridge to equip all the ALMA antennas with this capability is currently being investigated as part of an ALMA Development Plan Study by NOVA, in collaboration with the EC-FP6 project team. Observations in Band 5 will allow ALMA to explore the emission from ionized Carbon, the main cooling line in star forming galaxies, in the deep Universe (z~8-10) and to study the emission from water and its isotopes in the local Universe.

EUROPEAN RADIO ASTRONOMY LEAPS INTO FUTURE WITH RADIONET3

On 1 January 2012, European radio astronomy entered a new era with the implementation of RadioNet3, the third iteration of RadioNet, the European radio astronomy collaboration. As the recognized European body for radio astronomy, RadioNet aims at facilitating access to leading radio astronomy facilities around the world for European radio astronomers.

The European Commission recently secured the project by granting it 9.5 million euros for the period 2012 to 2015. The Max-Planck Institute for Radio Astronomy (MPIfR) will work with 24 European partner institutions (including ESO), as well as South Korea, Australia and South Africa, to offer access to all 18 existing radio astronomy facilities in Europe. The project will also take full

ALMA Events

advantage of the APEX telescope operated by ESO, as well as the Atacama Large Millimeter/submillimeter Array (ALMA) of which ESO is a partner, both located in Chile.

ALMA activities feature prominently in RadioNet3, especially in all the Joint Research Activities and in the Networking Activities. The JRAs will deliver key R&D in the areas of digital electronics for radio astronomy, millimeter-wave broad band receivers, high performance computing algorithms for radio astronomy and key technology for VLBI applications. The NAs will support training or young researchers, science workshops and

have a dedicated activity to support ALMA users that wish to make the best possible use of the European ARC network.

For more details on RadioNet3, see: http://www.radionet-eu.org/

COMMUNITY EVENTS AND WORKSHOPS IN EUROPE

A number of workshops were organized by the European ARC network in the period November 2011 to January 2012. These events were mostly focused on keeping the community updated with the ALMA progress, preparing for Cycle 1 and providing tutorial for data reduction with CASA. These events will continue during the first part of 2012 (see also the "Upcoming events" section). Particularly relevant was the data reduction tutorial for Cycle 0 ESO PIs. The tutorial was organized in Garching on January 19-20, 2012 (http://www.eso.org/projects/alma/arc/tw/bin/view/External/EUARCCASATutorialJan2012). In addition, smaller scale community events were held for the Dutch and French ALMA communities in Leiden on December 12 to 14 and in Grenoble on November 28 and 29.

ALMA Band 3 receivers covering 84-116 GHz are currently available on ALMA. The lower frequency part of the 3mm window, from 65-90 GHz, will be covered by receivers for Band 2. This frequency range covers the J=1-0 transitions of several important deuterated species as well as the J=1-0 and 2-1 transitions for galaxies in the redshift range 0.3 to 0.7 and 1.5 to 2.4 respectively. A workshop dedicated to science opportunities with ALMA Band 2 was held in Manchester on 14-16 December 2011. Approximately 30 participants from various European institutes participated in the workshop and contributed with ideas for the ALMA Band 2 science case. The workshop was the initial step for a more extensive activity focused on Band 2 science and technology to be carried out in the 2012-2013 timeframe.

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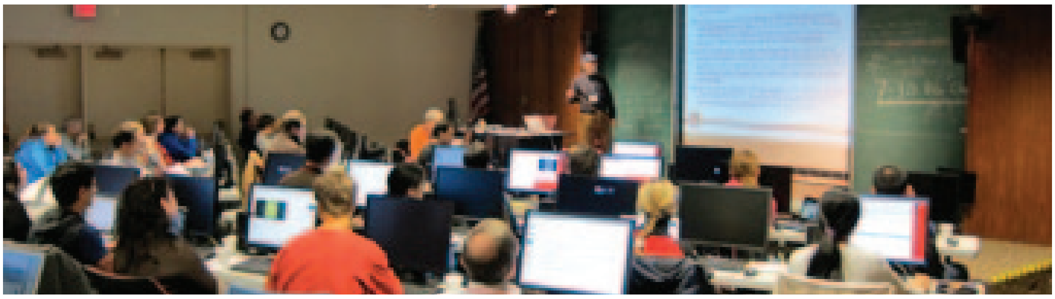
Recent events from North America



Ed Fomalont explains the mysteries of self-calibration at the Data Reduction Workshop

ALMA DATA REDUCTION WORKSHOP

The North American ALMA Science Center (NAASC) invited investigators from the highest rated North American Community ALMA Cycle 0 programs to a Data Reduction Workshop in Charlottesville 2011 December 1-2 (organized by Adam Leroy and Carol Lonsdale of the User Services Group). NRAO staff outfitted the Edgemont Road auditorium with terminals and 29 visiting investigators used the new NAASC data reduction cluster to work through training material built around ALMA science verification data. NAASC staff presented background material on ALMA and CASA to the local attendees and several remote participants. Then the local attendees worked hands-on with actual ALMA data sets, learning how to use CASA for calibration, imaging, and self-calibration. During the hands on sessions, NAASC staff provided one on one assistance. The first ALMA datasets were delivered the following week. One of the PIs who attended the workshop received his ALMA data in this distribution.

The workshop Program with presentations is available here

ALMA AT THE ANNUAL MEETING OF THE USNC-IRSI

US National Committee of the International Union of Radio Science held its annual meeting in Boulder, Colorado on 2012 January 4-7. Activities of the radio astronomy section were concerned with observation and interpretation of all radio emissions and reflections from celestial objects. Emphasis was placed on the promotion of technical means for making radio-astronomical observations and data analysis as well as the support of activities to protect radio-astronomical observations from harmful interference. At the meeting, Mark Gordon presented a historical perspective on the world's first Millimeter-Wave Radio Telescope, the 36 foot telescopes at Kitt Peak, Arizona, at which emission from the carbon monoxide molecule was first detected just over forty years ago. ALMA was discussed at session J2 Wednesday on New Telescopes, Techniques and Tutorials, chaired by Richard Prestage.

ALMA Events

AMERICAN ASTRONOMICAL SOCIETY 219TH MEETING

ALMA Cycle 0 Early Science and Capabilities for Cycle 1 Science Special Session organized by the North American ALMA Science Center 219th American Astronomical Society Meeting | Austin, TX Wednesday, January 11, 2012.

A major goal of this special session was to convey ALMA's initial capabilities and the nature of the support offered to the community by the North American ALMA Science Center (NAASC) at the NRAO for the second call for proposals, ("Cycle 1") due in spring 2012.

Our speakers updated the status of ALMA through its first Early Science observations (Alison Peck, Joint ALMA Observatory) and described the opportunities and capabilities associated with the Cycle 1 call for proposals (Al Wootten, National Radio Astronomy Observatory). Three speakers presented first observations and near-term prospects for science with ALMA in the fields of planet formation and disks (Meredith Hughes, University of California-Berkeley), Galactic star formation (Yancey Shirley, University of Arizona), and galaxies across cosmic time (Carol Lonsdale, National Radio Astronomy Observatory).

COMMUNITY DAY EVENTS

NRAO held two community days in December 2011-January 2012. The first, designed to serve astronomers in the northeast U.S., was hosted by the University of Maryland on 15 December 2011. The second Community Day was designed to serve astronomers in the western states, especially California, and was hosted by UC, Berkeley on 13 January 2012. The goal was to showcase the NRAO instruments and provide information regarding how to propose and observe with ALMA, EVLA, VLBA, and GBT.

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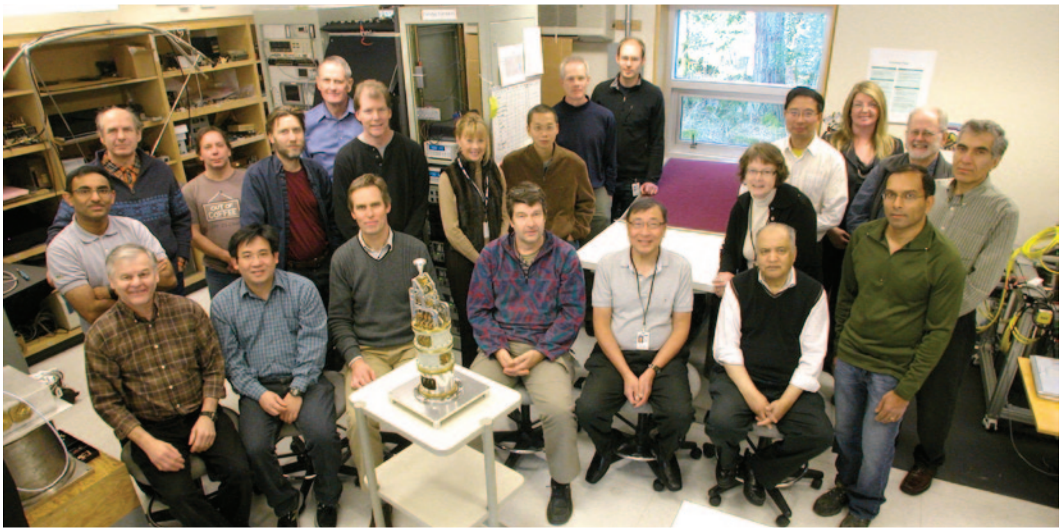
ALMA Events

ALMA BAND 3 PROJECT SUCCESSFULLY COMPLETED



The ALMA Band 3 Receiver team at the National Research Council's Herzberg Institute of Astrophysics in Victoria, BC, Canada celebrate the assembly of the the seventy-third, and final, receiver as it begins in-house testing ahead of shipment to an ALMA Front End Facility. The Band 3 project has been a ten year effort, has fostered significant interaction between NRC-HIA and Canadian industry, and is reaching completion on-time and on-budget.

Tribute

Jaap Baars, Max-Planck-Institut für Radioastronomie

Remembering Albert Greve (1938-2011)

With the sudden death of Albert Greve on 13 June 2011, caused by a massive heart attack, the radio astronomy community lost a remarkable member, and many of us a very good friend. The career of Albert was characterized by a broad array of activities, all performed at a high level of professionalism and an enduring wit. At the most difficult moments in, for instance, the commissioning of a new telescope Albert would always cheer us with an uplifting little poem by the german poet Wilhelm Busch. Such instances were not rare, for he was prone to choose to work on unusual and hard problems. These ranged from optical instrument making, early satellite astronomy, measuring radio telescopes to highest accuracy, analyzing their thermal behaviour, establishing mm-wavelength VLBI in Europe, writing a dissertation on "High Resolution UV Observations and the Formation of the Solar Mg II Resonance Lines" to serving as the "Company Astronomer" for the Carl-Zeiss company. In that last position he once advised the Saudi Government in the acquisition of an optical telescope that could always see the moon, when above the horizon, for the precise determination of Ramadan periods. If such dignitaries visited Zeiss, Albert was even allowed to use the "director's lift" up to the executive offices!

I met Albert in the mid sixties when he was still a student at Leiden Observatory. In 1975 we became close collaborators at the MPIfR in Bonn, where he had already made his marks with his work on the accurate setting of the surface of the 100-m telescope. In his spare time he finished his doctoral dissertation, which he successfully defended at the University of Utrecht on 13 September 1978. Now we embarked on the siting, the design and later the construction of the 30-m mm-telescope for the new institute IRAM. Albert organized and analysed site testing campaigns on Plateau de Bure and Pico Veleta, while also establishing first contacts with Spanish authorities. He and Wolfgang Harth developed in Bonn a first version of a "laser

Tribute

ranger" for the surface measurement of the 30-m telescope, well ahead of the availability of such instruments on the market. He was, of course, the man who made the first accurate setting of the 30-m telescope with this instrument.

When IRAM became established in 1980, Albert joined the institute and moved to Grenoble, where he continued to contribute to the development of both IRAM instruments. In 1990 he was promoted to station manager of the 30-m telescope in Granada, Spain. Here he intensified his studies of the thermal behaviour of telescope structures in which he was joined by Michael Bremer of IRAM. He became an expert in this area, which led to participation in the designs of several radio telescopes, be it on the side of the institutes or the contractors, as the HHT on Mt. Graham, LMT in Mexico and lastly ALMA. At the time of his retirement he was an active member of the evaluation team for the ALMA prototype antennas at the VLA site in New Mexico.

Albert Greve was born on 30 December 1938 in Hamburg, Germany. He followed the in Germany widely used "zweiten Bildungsweg" (secondary education track), combining practical education in an optical components factory with evening studies leading to the "Abitur", allowing him to attend university. In 1960 he started astronomy studies at Leiden University and obtained his master's degree in 1967. After stints in the Cosmic Ray Group in Leiden, an ESRO scholarship at UKAE in Culham, UK and Carl-Zeiss, he joined the Max-Planck-Institut fur Radioastronomie in Bonn. In 1980 he switched to IRAM where he remained to the end of his career.

Next to his duties in the area of technology and administration, Albert managed to remain active in astronomical research covering a wide area from studies of the Sun, optical spectra of galaxies and VLBI studies of galaxies and quasars at mm-wavelengths. He published about 175 articles, the last one posthumously. In his retirement he found the time to summarize his enormous knowledge of the thermal behaviour of antenna structures in a book, written with Michael Bremer and published by Springer.

No story about Albert Greve should conclude without an example of his wit and sense of humor. I borrow the following one from Jeff Mangum. Once Jeff told Albert he was going to Germany for the first time in his life and he was anxious to meet someone who would greet him at the airport with "Ich bin ein Frankfurter" (which translates in the USA to "I am a hotdog") to which Albert retorted "Ich bin ein Hamburger" (another product of the American cuisine)!

Albert Greve combined a high scientific and technical talent with an irresistible fine and honest personality. All who have known him will miss him, but will cherish their fine memories of him.

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Press Review

The World Lays Its Eyes on ALMA / A Hundred Media Glances About Early Science

In order to mark the start of Early Science Observations with ALMA at the end of September 2011, the EPO Teams at the JAO, at ESO, at NAOJ and at NRAO joined their efforts to produce a powerful communication plan, which resulted in an extremely high media interest around the globe. Hundreds of articles, video and audio features were published in a variety of media worldwide.

A purpose-made animation showing a list of media and highlighting the corresponding ALMA Early Science-related article in the central part was implemented and is available at: http://www.almaobservatory.org/multimedia/media_coverage/

We invite you to browse the articles you might be interested in either by country (by simply clicking on the map) or by the name of the media.

Enjoy !

Joint ALMA Observatory EPO Team

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Upcoming events

ALMA WINTER SCHOOL

2012
- feb -
28/29

The ALMA Winter School will take place at the Astronomical Institute of the Academy of Sciences in Prague (Czech Republic) on 28 to 29 February 2012. The purpose of this ALMA Winter School is to prepare the European astronomical community for ALMA Early Science operations. The program includes many introductory talks on ALMA and ALMA-related science, as well as hands-on sessions on proposal preparation and data reduction.

See http://www.asu.cas.cz/alma-school

THE 6TH ANNUAL NAASC SCIENCE WORKSHOP: "OUTFLOWS, WINDS AND JETS: FROM YOUNG STARS TO SUPERMASSIVE BLACK HOLES"

2012
- mar -
3/6

The North American ALMA Science Center will host its 6th annual science workshop in Charlottesville, Virginia, March 3-6, 2012. This workshop is an exciting opportunity to bring together active researchers interested in outflow-bearing systems spanning a wide range of mass and size scales for a refreshing view of the spectacular phenomena.

Workshop focus items include:

- Probing the driving engines deep with the upgraded facilities
- Emission and absorption properties of outflows, winds, and jets
- Structures and chemistry of the outflow systems on various scales
- Cross-talk among the participating communities
- Synergy programs with the featured facilities and other large telescopes

The approach adopted by this workshop is interdisciplinary. Science from different mass and size scales will be naturally blended. We hope to promote interactions among the various communities from young stars to active galactic nuclei, and to facilitate mutual exchanges and joint efforts.

Upcoming events

ALMA SPECIAL SESSION IN THE ANNUAL MEETING OF ASTRONOMICAL SOCIETY JAPAN IN KYOTO, JAPAN

2012
- mar -
19/22

On March 19 – 22 2012, the ASJ meeting will be held in Ryukoku University in Kyoto, Japan. The ALMA Special Session to report Cycle 0 Early Science and Capabilities for Cycle 1 will be conducted for the period of this meeting. Confirmed speakers are Satoru Iguchi, Masao Saito and Daniel Espada. They will update the status of ALMA project (Satoru Iguchi) and describe the opportunities and capabilities associated with the Cycle 1 call for proposals (Masao Saito), and present the latest science verification results of Early Science observations (Daniel Espada).

NATIONAL ASTRONOMY MEETING

2012
- mar -
27/30

The UK ARC node, in collaboration with the German ARC node and ESO, organizes a session on "Evolution with ALMA - first science results on the cool universe", as part of the Germany-UK National Astronomy Meeting. There will be talks by Richard Hills, ALMA Project Scientist, and prospective ALMA users as well as presentations of the first ALMA science results. The ALMA session and also a lunchtime meeting will update the astronomical community on ALMA construction progress and the support available for prospective ALMA users including preparation for the Cycle 1 deadline. Location: Manchester, dates: March 27-30.

See: http://www.jb.man.ac.uk/nam.

MEETING ON MM-ASTRONOMY IN BOLOGNA

2012
- apr -
2/3

The Italian ARC node organizes a workshop on mm- and submm-astronomy in Bologna on 2-3 April 2012. The workshop is intended to bring together the Italian community working in this field to discuss recent results obtained with the various new instruments operating in these bands, with particular attention to ALMA.

See http://www.alma.inaf.it/.

GERMAN ALMA COMMUNITY DAYS

2012
apr

The German ARC node is planning an ALMA Community Day in April. More information will be available soon on the webpages of the German ARC node:

http://www.astro.uni-bonn.de/ARC/

Upcoming events

ONSALA CYCLE 1 WORKSHOP

2012
jun

The Nordic ARC node will organize a workshop in preparation of ALMA Cycle 1 in early June. More information will be available soon on the webpages of the Nordic ARC node:

http://www.chalmers.se/rss/oso-en/observations/alma-regional-centre

FIRST SCIENCE WITH ALMA

2012
- dic -
12-15

The Joint ALMA Observatory in collaboration with all the ALMA partners is organizing an international conference to be held in Chile in mid December 2012 focused on the first science results from the ALMA Observatory.

ALMA Early Science Cycle 0 observations started at the end of September 2011 with over 100 high profile science projects selected by an international Program Review Committee. The conference will take place after one year of ALMA Early Science Operations and will be the ideal forum to present the highlights of the first year of ALMA operations. We do expect that many exciting new science results will be presented and the conference, which will also cover a discussion of the scientific priorities for ALMA in the future.

More detailed information on the details of the organization and the conference website will be distributed shortly.

Contacts:

- ***Gautier Mathys,*** LOC Chair at gmathys@alma.cl
- ***Leonardo Testi,*** SOC Chair at ltesti@eso.org
- ***Email account for the conference:*** asc2012@alma.cl

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Credit: ALMA (ESO/NAOJ/NRAO)

If you wish to receive email announcements when new editions become available, please send an email to almanewsletter@alma.cl with *"subscribe ALMA newsletter"* in the body.

To find out if you are already on the email list, send an email to almanewsletter@alma.cl, with *"which"* in the body.

This newsletter is also available here.

Regional Newsletter ESO

Regional Newsletter NRAO

Regional Newsletter NAOJ

Comments on the newsletter or suggestions for articles and announcements are welcome.

More information on ALMA and contact details can be found on the ALMA homepage www.almaobservatory.org