Report on the Workshop

ALMA Community Days: Towards Early Science

held at ESO Headquarters, Garching, Germany, 6–7 April 2011

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ALMA is rapidly approaching Early Science operations, and is scheduled to start the first observing projects for the astronomical community in the autumn of 2011. The Call for Proposals for ALMA Early Science Cycle 0 was published on 30 March, inviting the community to submit observing proposals by the deadline of 30 June 2011. Held just after the Call for Proposals was issued, the ALMA Community Days were designed to optimally prepare the European ALMA Community for Cycle 0 proposal submission. The workshop included a broad range of scientific and technical presentations as well as hands-on software tutorials for the ALMA simulators and the Observing Tool.

ALMA, the Atacama Large Millimeter/submillimeter Array, is expected to be the world's leading observatory at millimetre and submillimetre (sub-mm) wavelengths over the coming decades. A global collaboration involving Europe, North America, East Asia as well as the host country Chile, ALMA will comprise at least 66 high-precision antennas equipped with receiver and digital electronics systems to observe in the frequency range from 30 GHz to 1 THz at angular resolutions as high as 5 milliarcseconds. Dynamic scheduling and innovative calibration strategies will ensure the most efficient use of the unique atmospheric qualities encountered at the 5000-metre-high site on the Chajnantor plateau in the northern Chilean Andes.

While Full Science operations are scheduled to begin in 2013, the increasing capabilities of the growing array will become available to the astronomical community following the start of Early Science operations in the autumn of 2011. Early Science operations will be divided into two observing periods, Cycle 0 and Cycle 1, each planned to last between nine and twelve months. It is expected that the capabilities of the array offered to the community will substantially increase from Cycle 0 to Cycle 1, and then again for Full Science operations.

The aim of this two-day workshop was to optimally prepare the European astronomical community for ALMA Early Science. The first day was dedicated to a series of technical and scientific presentations on the status of ALMA and the capabilities offered in Early Science, while the second day was taken up by hands-on tutorials on the two most important pieces of software for ALMA proposal preparation — the ALMA Observing Tool and the ALMA simulators. The ALMA Community Days were very well received by the European astronomical community, and the maximum capacity of 100 participants was easily reached (see Figure 1). The Community Days were followed by a dedicated workshop on massive star formation with the ALMA Early Science capabilities (see Longmore et al. p. 41). Interestingly, a large fraction (~40%) of the workshop participants described themselves as novices in radio/sub-mm interferometry, indicating that ALMA is eagerly awaited not only by radio/sub-mm astronomers, but also by the wider astronomical community.

ALMA Early Science and commissioning/science verification

The presentations on the first day were kicked off by L. Testi, who reported on the current status of ALMA and the capabilities offered during Early Science. In Cycle 0, a minimum of 16 antennas will be working together in two configurations with baselines up to 125 metres and 400 metres. Four receiver bands will be offered, covering the frequency ranges 84–116 GHz (around 3 mm; Band 3), 211–275 GHz (around 1.3 mm; Band 6), 275–373 GHz (around 850 μm; Band 7) and 602–720 GHz (around 450 μm; Band 9). One major limitation in Cycle 0 is the time available for scientific observations: accepted programmes will be scheduled for up to one third of the time

Figure 1. The participants at the 2011 ALMA Community Days gathered outside the ESO Headquarters.

on a best-effort basis, while the completion of the array is given priority. Single dish observations, polarisation measurements and solar observations are not yet offered, but are planned for Cycle 1.

The audience was given a first-hand impression of the current commissioning and science verification activities at the ALMA site in Chile by T. van Kempen and L. Humphreys. While some remarkable commissioning data had been obtained in the second half of 2010, progress slowed during the first quarter of 2011 due to a particularly severe altiplanic winter and the deployment of a major software upgrade. However, the situation has now improved, and the first science verification data (focussing on TW Hya and NGC 3256) will be released to the public at the beginning of June.

The European ALMA Regional Centre

User support for the European ALMA community is handled by the European ALMA Regional Centre (ARC), which currently consists of seven ARC nodes distributed across Europe and a central coordinating node hosted at ESO. The European ARC, its staff and the services offered to the scientific community were introduced by P. Andreani, while the individual nodes and the face-to-face support offered there were presented by M. Zwaan. An overview of the proposal review process was given by G. Mathys. In Cycle 0, it is expected that around 100 proposals will be accepted, with an average execution time of 5–10 hours each. Projects not completed will not be carried over to Cycle 1, therefore the ideal Cycle 0 project will produce immediately publishable results, highlighting the unique capabilities of Early Science ALMA with only a few hours of observations.

Comprehensive technical information on ALMA capabilities, proposal preparation and relevant software is available online via the ALMA Science Portal[1], as was explained by F. Stoehr. Any technical or scientific questions/comments relating to ALMA should be addressed to the ALMA Helpdesk, which was presented by S. Randall. Accessible via the ALMA Science Portal, the Helpdesk contains a regularly updated knowledge base with answers to frequently asked questions and allows registered users to submit tickets that will receive a customised reply.

The ALMA Science Portal gives access to a suite of ALMA-related software. During the first stages of proposal preparation, the ALMA simulators, introduced by E. van Kampen, can be used to estimate the image fidelity achieved in a given observing time for the Cycle 0 array configurations. Similarly, the sensitivity calculator can be used to estimate the integration time needed to achieve a given sensitivity goal. Proposals must be prepared and submitted with the ALMA Observing Tool (OT), which was presented by A. Biggs. Finally, the data obtained in Cycle 0 will be reduced using CASA scripts, while in the future an automatic ALMA data reduction pipeline will become available, as outlined by D. Petry.

Science with ALMA

Observations obtained with ALMA are expected to have a significant impact on a broad range of current research topics in astronomy. As convincingly demonstrated by A. Rushton, even Galactic high-energy astrophysics, normally associated with much higher or lower frequency observations, can benefit from the unique capabilities of ALMA. ALMA test data for Sgr A*, obtained with five antennas during commissioning as part of a self-calibration test, reveal a number of molecular absorption and hydrogen recombination lines and are already comparable or superior in quality to spectroscopy taken with existing facilities, such as Owens Valley Radio Observatory. ALMA will also be a powerful tool for studying asymptotic giant branch stars, in particular their envelopes, as explained by M. Maercker. Spectroscopy taken as part of commissioning on the evolved star R Dor showed a far lower noise level than equivalent data obtained with a higher integration time with HIFI/Herschel. ALMA band 3 test data were also successfully used to detect a detached shell around R Scl (see Figure 2).

Extragalactic astrophysics and cosmology has always been one of the main scientific drivers behind ALMA. L. Cortese showed beautiful commissioning data on NGC 253 (see the image in *The Messenger* 142, p. 17), which was observed in all the four bands that will be available in Cycle 0. These data were used for continuum mapping at different wavelengths as well as velocity mapping from a number of the strong transition lines detected. ALMA test data on extragalactic sources also include NGC 3256, PKS 1830-211, BRI 0952, and the Cosmic Eyelash. In all cases, the ALMA test data obtained with just 4–8 antennas are comparable or superior in quality to those obtained with existing facilities, such as the Sub-Millimeter Array (SMA) or the Plateau de Bure Interferometer. The potential of

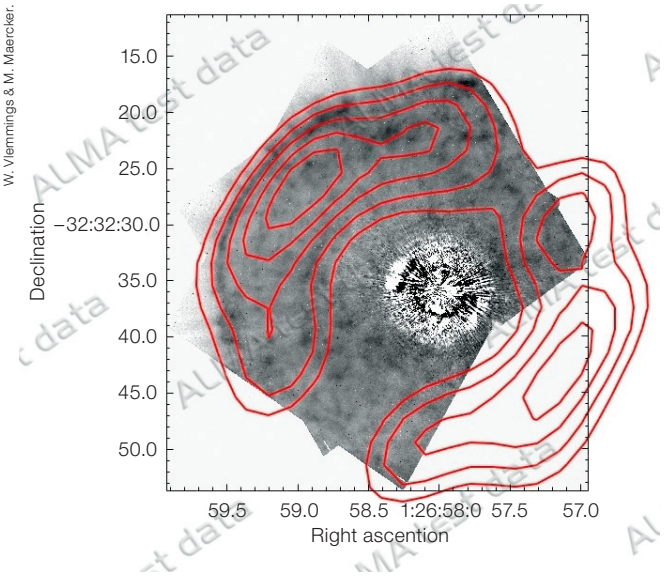

Figure 2. CO(1-0) test data of the detached shell around R Scl observed with ALMA with five antennas (red contours). The grey-scale image shows stellar light scattered by dust particles in the detached shell observed with the ACS on HST (Olofsson et al., 2010).

ALMA for Solar System science was briefly outlined by M. Zwaan. Since solar observations will not be offered in Cycle 0, the current focus is expected to lie in observations of the atmospheres of planets and their moons, Kuiper Belt and trans-Neptunian objects, and the study of comets. Ironically, the only ALMA test data currently available for a Solar System body are single-dish observations of the Sun taken during a period of particularly bad weather, when the thick cloud cover effectively acted as a solar filter!

Star formation, both at low- and high-mass, is another research area that will benefit extensively from ALMA's unique capabilities, as shown by J. Pineda and P. Klaassen. ALMA band 7 test data have already revealed outflows for a number of molecular species in NGC 1333 IRAS4B, and the unprecedented sensitivity achievable even during Early Science is expected to have a strong impact on our understanding of core formation, fragmentation, disc and planet formation, to give just a few examples. A 14.7 GHz wide band 7 spectral sweep of the Orion Kleinmann–Low region, taken during ALMA commissioning as part of a spectral scan test, impressively illustrates the potential of ALMA for spectral line detection. With the large bandwidth covered and the high sensitivity achieved, the ALMA test observations already entirely surpass SMA data (see Figure 1 of Longmore et al. p. 42).

Hands-on software tutorials

The second and last day of the workshop was devoted entirely to hands-on software tutorials. Around 80 interested participants were split into two groups depending on their previous experience in radio/sub-mm interferometry. Each group was given a hands-on tutorial on the two major pieces of software relevant to ALMA proposal preparation: the OT and the ALMA simulators. While the tutorials were held simultaneously for the two groups, those for the novice users were slightly longer and included an introduction to radio/sub-mm concepts (presented by A. Biggs) and interferometry basics (given by A. Richards) in the OT and the simulator sessions respectively. Both groups were given software-specific presentations and live demonstration sessions (with presenters A. Avison, A. Biggs, E. van Kampen and S. Randall), followed by a few hours in which tutees could experiment with the software, with the help of a number of tutors (see upper figure on p. 38).

The enthusiastic response of the European astronomical community to this workshop and the lively discussions among the participants indicate that the groups specialising in the radio/sub-mm, and other wavelength regimes, are eagerly awaiting ALMA and Early Science operations. We look forward to a flood of excellent observing proposals and some spectacular scientific results during Cycle 0 — and beyond!

The presentations and most of the tutorial material are available in electronic form from the conference website: http://www.eso.org/sci/meetings/2011/alma_es_2011.html.

Acknowledgements

The organisation of the ALMA Community Days would not have been possible without the help of C. Stoffer, who took care of many of the practical aspects of the workshop and kept an overview at all times. We would also like to thank the members of the Organising Committee, S. Longmore, the entire ESO ARC staff and the ESO Garching IT Helpdesk staff for their help. The tutorials on the second day could not have taken place without the tutors: A. Biggs, A. Bridger, V. Casasola, B. Dabrowski, L. Humphreys, A. Kospal, S. Muller, S. Randall (OT) ; A. Avison, A. Richards, A. Rushton, E. van Kampen, M. Zwaan (Simulators). Finally, we would like to thank all the speakers for putting so much work into their presentations. The workshop was sponsored by ESO and Radionet, which provided travel support to a number of speakers and tutors.

References

Olofsson, H. et al. 2010, A&A, 515, 270

Links

[1] ALMA Science Portal: www.almascience.org

Report on the

ALMA Early Science Massive Star Formation Workshop

held at ESO Headquarters, Garching Germany, 8 April 2011

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With the deadline for ALMA Early Science Cycle 0 proposals fast approaching, a workshop was held for members of the European massive star formation community to discuss ideas for potential ALMA Early Science projects. The workshop began with short summary talks on the ALMA Early Science capabilities, the multi-wavelength large-area survey data available as ALMA source-finder charts and the modelling/analysis tools that are available to help interpret future ALMA data. The rest of the meeting was spent discussing science ideas and proposal strategies. There was general agreement on the main science questions to be addressed, the basic observing strategies required to achieve the goals and the future steps needed to develop the ideas into proposals.