Participants at the workshop with the smoking Volcán Villarrica in the background.

distribution — become much less efficient as one goes to greater distances. Nevertheless, a variety of techniques, including optical, infrared and X-ray surveys, as well as surveys based on the Sunyaev-Zel'dovich effect, have identified a growing number of clusters in the early Universe. Alternative methods, such as the use of powerful radio galaxies and quasars as beacons for locating high-redshift clusters, are also providing promising new ways to identify and study the most distant galaxy clusters.

With this motivation, ESO organised a workshop in the resort town of Pucón in Southern Chile with the goal of bringing together theoreticians and observational astronomers working at different wavelengths to summarise the current state of knowledge of galaxy clusters.

The conference was held over four days in the Gran Hotel Pucón, which is situated on the shore of the beautiful Lake Villarrica. A fifth day was kept free for participants to explore the region and to participate in some of the adventurous activities that are on offer in this part of Chile. Quite a few of the participants climbed Volcán Villarrica, an active volcano that dominates the Pucón skyline. The volcano can be seen behind the participants in the conference photo.

About 100 participants attended the workshop. Over the four days of the conference, there were about 60 talks, of which eight were invited reviews, and twenty posters. The presentations covered a broad range of cluster studies, from the theorist's view of galaxy evolution in galaxy clusters to detailed observations of individual clusters. Particularly impressive to the authors of this report, were the size and quality of the multi-wavelength datasets that were presented during the workshop. These datasets represent the result of many years of dedicated work and many hours of telescope time. Also presented were a few record-breaking high-redshift clusters. We look forward to learning more about these clusters at one of the cluster conferences being held during 2010.

In view of the rapid progress that has been made in this field and the number of cluster conferences that will be held during 2010, the proceedings will only be made available from the conference website[1]. By the time this *Messenger* report appears, all the presentations and some of the first papers will be available.

Acknowledgements

The workshop would not have been possible without the guidance of the scientific organising committee, the dedicated, efficient and friendly support of Daniel Asmus, María Eugenia Gómez, Paulina Jirón, Ricardo Salinas, and Jean Siefken, and of course the participants, who travelled such a long way to attend.

Links

[1] http://www.eso.org/sci/meetings/GCEU2009/

ALMA Achieves Closure Phase with Three Antennas on Chajnantor

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It is an exciting time for the Atacama Large Millimeter/submillimeter Array (ALMA). Following the shift of the focus of the testing activities from the ALMA Test Facility in Socorro, New Mexico (see *The Messenger*, 135, 61) to Chile at the end of 2008, the project has seen truly remarkable progress. Following conditional acceptance of the first antenna at the beginning of 2009, first fringes with two antennas were achieved at the Operations Support Facility (OSF at 2900 m altitude) after a few months (see *The Messenger*, 137, 17). Later in the year, three antennas were transported to the Array Operations Site (AOS, at 5000 m), where fringes were achieved with two antennas at submillimetre wavelengths. Finally, towards the end of the year three antennas were linked together and stable fringes and closure phase was achieved by the ALMA Assembly Integration and Verification (AIV) team (see ESO Press Release eso1001).

Following the successful checks on the three antenna interferometers and the deployment of the latest version of the ALMA software system, on 22 January 2010, the ALMA project has officially entered the Commissioning and Science Verification (CSV) phase. The goal for 2010 is to deliver the hardware, software

Figure 1 (above). The three ALMA antennas on Chajnantor working as an interferometer. The APEX telescope is also visible in the background.

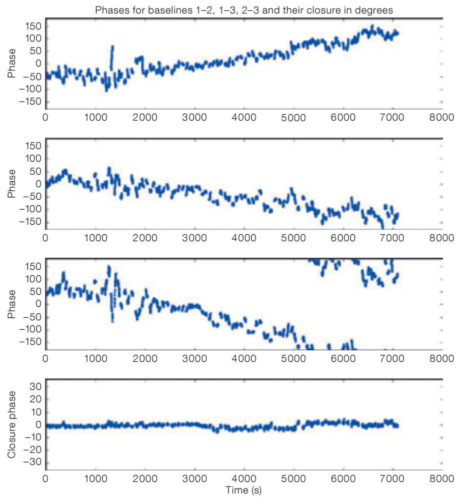

Figure 2 (right). Test of closure phase with three antennas at AOS. The upper three panels show the phase as measured on each of the three baselines and the bottom panel shows the closure phase.

and perform the necessary tests to allow a release of the first call for proposals for Early Science observations with ALMA.

This progress has been made possible by the many people intent on keeping to the schedule for the hardware and software deliveries for the closure phase and the start of CSV activities, as well as by the tireless efforts of the ALMA AIV and CSV teams led by Joe McMullin and Richard Hills.

Report on the Workshop

Data Needs for ALMA

From Data Cubes to Science: Ancillary Data and Advanced Tools for ALMA

held at the I. Physikalisches Institut, Universität zu Köln, Germany, 5–7 October 2009

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A summary of a workshop bringing together laboratory physicists, chemists and astronomers to discuss the needs and strategies for developing common approaches to data and models for ALMA is presented.

The Atacama Large Millimeter/submillimeter Array (ALMA) will revolutionise many scientific areas by providing an unprecedented quantity and quality of high spatial and spectral resolution (sub)millimetre wavelength spectral line data. These data will allow detailed observational tests of astronomical models of astrochemistry, star and planet formation, galaxy formation and evolution, and many others. The high quality ALMA data will allow much more stringent comparison between observations and models than has been possible with data from current instruments. Nevertheless, to achieve this, the models (e.g., chemical network models, radiative transfer programmes, etc.) need to be of commensurate quality. Additionally, given the expected ALMA data production rates, easy and perhaps innovative ways of comparing and visualising models and data must be available. The models need to have access to fundamental physical data, such as molecular and atomic line frequencies and strengths, collision rates, dust properties, etc. While producing the models themselves is a science activity, adapting them for use with ALMA data, and making them available to a larger community (including testing, documentation, etc.) is not. This latter is especially critical since one of the goals for ALMA is to be easily useable by the wider astronomical community and not to be restricted only to experts in millimetre and radio interferometry.

In order to optimise the science output from ALMA, there is therefore a need to produce and gather ancillary data and make them available to ALMA users, as well as adapting and making available scientific models for use by the ALMA community at large. While some efforts along these lines exist, such as the Cologne Database for Molecular Spectroscopy