Recent Progress at the ALMA Test Facility

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Recent developments at the ALMA Test Facility are presented. Many aspects of the hardware and software needed for operation in Chile have now been tested and the Facility continues to demonstrate its value as a test-bed. The first high-resolution interferometric spectra of astronomical sources have now been obtained.

The ALMA Test Facilty (ATF) is located at the site of the National Radio Astronomy Observatory (NRAO) Very Large Array near Socorro, New Mexico, USA. It was used initially to test the three prototype antennas developed by Vertex RSI (North America), the AEC consortium (Europe) and MELCO (Japan). A photograph of the three antennas at the ATF appeared on the cover of The Messenger 128. The MELCO prototype has since been dismantled and some of its structure re-used for one of the production antennas currently under test in Chile. The remaining two antennas (Figure 1) have been used to develop and test much of the hardware and software required for ALMA to operate in Chile.

Until September 2007, the emphasis at the ATF was primarily on Prototype System Integration – the process of integrating and testing the ALMA electronics. Since then, the Facility has been managed by the Computing Group. The emphasis is much more on software development, with considerable input from astronomers, although testing of production electronics in advance of deployment to Chile continues to be important. The major milestone of *dynamic interferometry* was achieved in November 2007. This meant that the antennas could be pointed at an astronomical source, with the receivers tuned and the correlator under computer control, so that stable interferometric fringes were obtained. We showed an example of an interferometric spectrum of the Orion Hot Core region obtained in January 2008 in a recent Messenger article (Hunter & Laing, 2008). ALMA does not differentiate between continuum and spectroscopic configurations: all ALMA observations will have multiple spectral channels, and the correlator can be configured in many different ways. The published spectrum was an example of ALMA's *lowest* resolution mode, in which spectral channels cover a total frequency range of 2 GHz. This would be used with the final array to obtain the widest possible bandwidth and hence the highest sensitivity.

Photo: R. Avles, Joint ALMA Office

Figure 1. The two ALMA prototype antennas during an interferometric observation. The European and North American antennas are on the left and right, respectively.

In January, many of the operations needed to set up the interferometer had to be performed using separate pieces of software. Over the last few months, there has been steady progress towards the goal of automated operation. A science project can now be created using the ALMA Observing tool, archived and then executed using the scheduler. The results are stored in the format of the ALMA Science Data Model, exported to the CASA data reduction package and reduced. As an example, we show a higher-resolution spectrum of the Orion Hot Core (Figure 2). In this observation, the Tunable Filter Bank cards developed at the University of Bordeaux were used to increase the resolution of the correlator. Figure 2 shows three portions of a spectrum with 2048 channels across the 2 GHz band from 100–102 GHz. Many astrophysically important molecular lines can already be identified on this spectrum.

The ATF is managed by NRAO and a substantial part of its support involves staff based in Socorro, but it is very much an international operation. Software engineers from ESO and its partner institutes in Europe are frequent visitors, as are their counterparts from East Asia. ESO astronomers from Garching and Santiago participate in science operations, again in collaboration with colleagues from elsewhere in the project. Finally, astronomers, array operators, hardware and software engineers from the Joint ALMA Office are spending substantial periods of time at the ATF, training to support ALMA in Chile but also contributing greatly to development, testing and debugging. The work at the ATF is recognised as vital to ALMA's success, and is likely to continue to 1 September 2008, when some of the equipment will be required for interferometry in Chile.

References

Hunter, T. & Laing, R. A. 2008, The Messenger, 131, 47

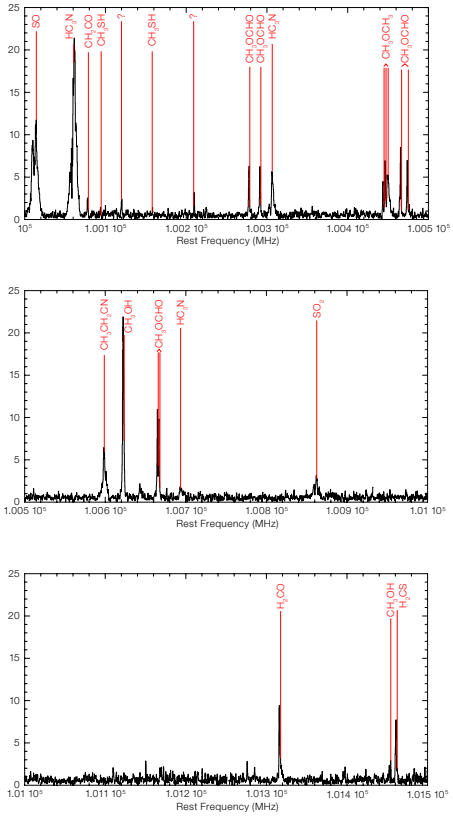

Figure 2. A spectrum of the Orion Hot Core region obtained with the prototype interferometer at the ATF by Al Wootten. There are 2048 spectral channels over a total bandwidth of 2 GHz. Prominent lines of astrophysical interest are labelled. (Credit: A. Wootten, NRAO)