ALMA Status and Science Verification Data

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ALMA is rapidly progressing towards the end of the construction phase. At the beginning of August 2011, 17 antennas were interferometrically linked on the Chajnantor plateau at an altitude of 5000 metres. Twelve-metre antennas from all the vendors were used in this experiment, which is a major milestone towards the first Early Science guest observer observations, currently planned to begin soon. In the meantime, ALMA Science Verification datasets are becoming available on the ALMA webpages for users to download and gain familiarity with ALMA data reduction and analysis procedures.

The Atacama Large Millimeter/submillimeter Array (ALMA) is at an advanced stage of construction with 17 fully equipped antennas at the high site at the time of writing (see Figure 1). The current array consists of 12-metre antennas of different designs from all three providers (AEM, MELCO and Vertex); all have been tested, fully equipped with the ALMA components and linked together to work as an interferometer. Following the achievement of closure phase at the beginning of 2010 (Testi, 2010) and the collection of test datasets on astronomical sources with the array consisting of a few antennas during the second half of 2010 (Testi et al., 2010; Randall & Testi, 2011), the successful execution of the first Science Verification test projects (see below) have been completed. These early demonstrations are an important step towards the scientific validation of the ALMA observatory for Early Science operation.

The ALMA Early Science Cycle 0 Call for Proposals was issued in March 2011 with deadline 30 June 2011. The array has been offered with very preliminary capabilities (sixteen antennas, four frequency bands, limited correlator flexibility and without either the full polarisation option or the solar observations), and for a small fraction of the time, as construction and commissioning efforts towards full science operations are still a priority. Nevertheless, the response from the community worldwide was phenomenal: 919 observing proposals were received, resulting in an over-subscription rate of approximately a factor of nine as compared to the expected time available for science during Cycle 0 of ALMA Early Science. The review process is in progress at the time of writing, and the expectation is that proposers will be notified in early September; the observations for the scheduled proposals will then start in the autumn.

In the meantime, the Commissioning and Science Verification team, headed by Richard Hills and Alison Peck at the Joint ALMA Office in close collaboration with the ALMA Regional Centres (ARCs) in Europe, Japan and the USA and the ALMA science teams at ESO, National Astronomical Observatory of Japan (NAOJ) and the US National Radio Astronomy Observatory (NRAO), are testing the end-to-end system by taking Science Verification (SV) observations. The SV targets were chosen from a long list of suggestions provided by the community at the beginning of 2011. The current list of SV targets, along with a detailed description of the goals and constraints of the programme are posted on the ALMA observatory webpages[1]. The SV test data, once validated, are released publicly in raw and reduced format along with CASA scripts and tutorials to fully explain the data reduction procedures. The goal is to allow future users to look at scientifically validated ALMA data for sources already well known from previous (sub)millimetre observations. Astronomers from the community are encouraged to look at the data to learn the details of the data reduction and to publish any interesting scientific results that may come out of their analysis of the released datasets.

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Figure 1. Seventeen ALMA antennas on the Chajnantor plateau, when fringes on 136 baselines (between the 17 antennas) were obtained for the first time. The first antenna to the high site produced by the AEM consortium was included in the array and is visible near the centre left of the picture.

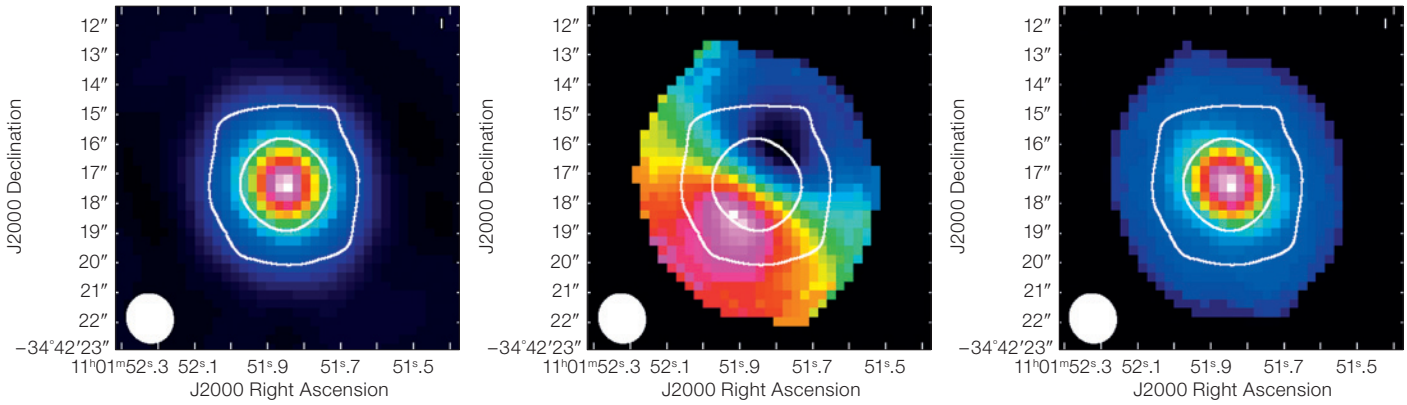

Figure 2. ALMA CO(3-2) and continuum SV test observations of the TW Hydrae protoplanetary disc. From left to right the colour-coded map of the molecular line total intensity, mean velocity and velocity dispersion respectively, with the contour plot of the continuum emission overlaid.

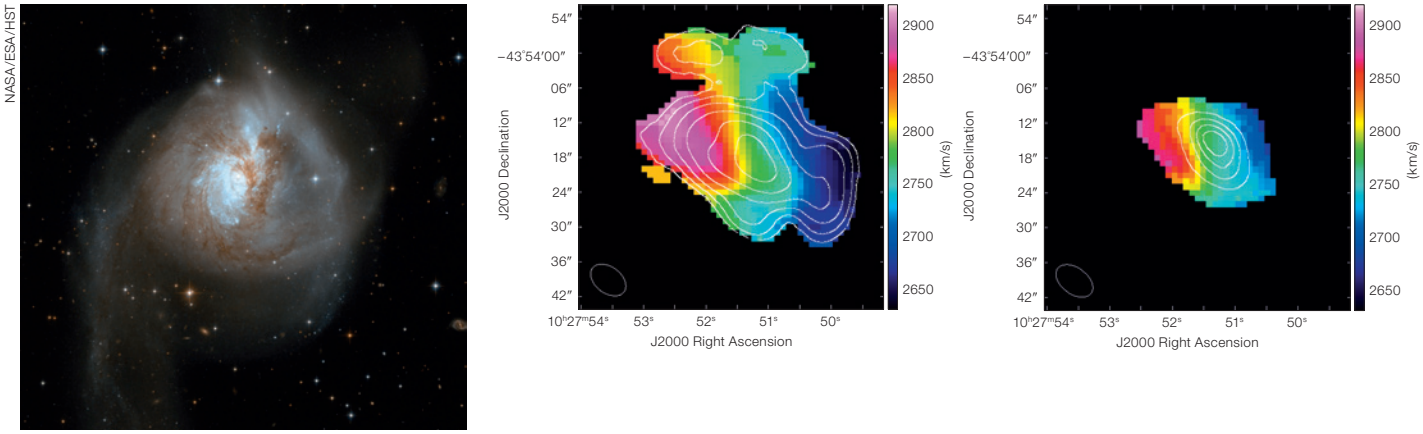

Figure 3. ALMA SV test observations of the luminous infrared galaxy NGC 3256. Left panel: optical HST image of the galaxy; Centre panel: contours of the CO(1-0) total intensity overlaid on the molecular gas mean velocity map; right panel: as the central panel but for the CN(1-0) line.

At the time of writing, on the ALMA Science Verification webpages[1], users can download data released in June 2011 for the protoplanetary disc surrounding the young star TW Hydrae (see Figure 2) and for the luminous infrared galaxy NGC 3256 (Figure 3). The TW Hydrae dataset[2], shown by the maps in Figure 2, includes continuum and spectral line observations in the molecular lines of CO(3-2) and HCO^+(4-3) using ALMA Band 7. These data can be compared with published Sub-Millimeter Array (SMA) data for the continuum by Hughes et al. (2011) and for CO(3-2) by Qi et al. (2008), who also presented HCO^+(3-2) observations at a similar angular and spectral resolution as the ALMA SV data. The NGC 3256 dataset[3] consists of continuum data and CO(1-0) and CN(1-0) molecular line data obtained using ALMA Band 3, and is shown in Figure 3. No other high angular resolution observations of this galaxy are available in the CO(1-0) line, but the CO(2-1) line was observed with the SMA by Sakamoto, Ho & Peck (2006).

Additional data on TW Hya and on the NGC 4038/4039 (the Antennae) merging galaxies system are scheduled to be released in August 2011. The Antennae dataset will demonstrate the ALMA mosaicking capabilities that will be available during Early Science Cycle 0. Additional datasets are currently being worked on and will also be released soon.

References

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Randall, S. & Testi, L. 2011, The Messenger, 144, 39
Sakamoto, K., Ho, P. T. P. & Peck, A. B. 2006, ApJ, 644, 862
Testi, L. 2010, The Messenger, 139, 52
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Links

[1] ALMA Science Verification: http://almascience.eso.org/alma-data/science-verification
[2] Access to TW Hydrae Science Verification data: http://almascience.eso.org/alma-data/science-verification/tw-hya
[3] Access to NGC 3256 Science Verification data: http://almascience.eso.org/alma-data/science-verification/ngc3256