CSIRO ASTRONOMY AND SPACE SCIENCE
www.csiro.au

ASKAP Commissioning Update, February 2019

In this issue, we report successful tests of fringe tracking per beam and frequency zoom modes. We also describe the first synchronisation of ASKAP's digital electronics across the full array and discuss plans to integrate the last 8 antennas.

Beginning the new year

This newsletter resumes the monthly commissioning update series for 2019 after the end-of-year holidays. We would like to wish all readers a happy new year, one which will see many exciting ASKAP results!

Towards the end of 2018, two major features were added to the telescope – fringe tracking per beam and zoom modes. The last newsletter discussed how these were identified as key requirements for pilot surveys and we can now report that they have been successfully integrated into the system.

Several bugs were introduced during the changes which impacted attempts to observe over the holidays, but these are mostly understood, and several have been fixed. We occasionally see instances of fringe rotator metadata getting stuck for one or more correlator cycles on its way to the ingest pipeline, but this is being actively worked on and until the cause is determined these cycles will be flagged so they do not impact the visibility data.

The commissioning team is on track to commence integration of the final eight antennas at the end of this month. We hope to have the entire array online during the integration work itself, but continued maintenance will likely keep the size of the array below the full 36 antenna complement during pilot surveys. We will aim to have at least 30 antennas (and hopefully more) operating at any given time.

Antenna integration work will be followed by full-scale pilot survey readiness tests and the shift to a new operations model for the Galaxy supercomputer.

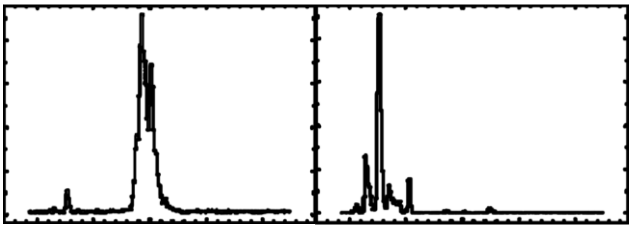
For the first time, ASKAP operators will run every scheduling block through the processing pipeline and share the results with the science teams. This means that most of the compute nodes can be dedicated to routine operations, hopefully improving the efficiency of both the data processing and software development efforts.

Fringe tracking individually per beam

Fringe tracking per beam involved significant changes to the way that meta-data are distributed from the telescope control system to the ingest pipeline. The measurement sets we write are now more compatible with the expectations of standard CASA tools, so it is no longer necessary to shift the phase centre of individual beams during image processing. This also corrects some of the bandwidth smearing seen in sources towards the edge of the field of view.

Zoom mode demonstration

Integration of zoom modes proved to be a challenge for the fringe rotator control system, since the distribution of frequency channels through the beam-former depends on the selected zoom mode. Once some additional information was added to the control system interface, we were able to capture visibility data in a zoom mode for the first time.



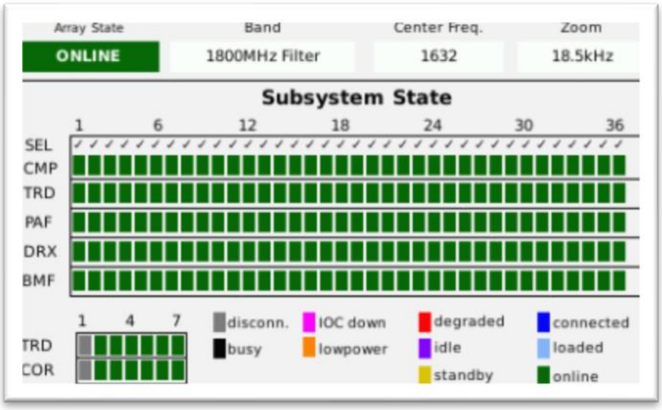
The spectra shown above are from Methanol masers detected in a single ASKAP beam with 1.157 kHz frequency resolution.

We are now planning to repeat the successful observation of the Small Magellanic Cloud from 2018 using more antennas and 1.157 kHz frequency resolution. This will verify the existing imaging pipeline with zoom mode data and provide an excellent test case for future development of joint deconvolution methods within ASKAPsoft.

Array integration and commissioning

Now that we have completed deployment and testing of the core features required for pilot surveys, attention returns to integration of the last few antennas and testing of the array as a whole.

We can report that all 36 antennas have been connected to the correlator and successfully synchronised. Several fibre cross-connect labelling errors and digital chassis faults were identified during testing, but these were fixed last month. The Murchison team is now working on gearbox replacements, antenna drive firmware updates and completion of the on-dish calibration system.



First synchronisation of digital systems across the full array

Replacement of failed gearboxes

Although it has taken several years to fully deploy the ASKAP PAFs and digital systems, the 12m antennas have been operational since 2012. In this time they have been driven as much as possible and we have developed procedures to monitor the drive system health by testing the load on the motors during standardised trajectories.

About a year ago, diagnostic data identified that two of the antennas were suffering from excessive gearbox wear and these were removed from the array.

Unfortunately, no spare gearboxes were available at the time, but a set of 11 replacements were ordered from the antenna manufacturer and these have now arrived at the observatory and are being installed.

Once the work is complete we will be able to drive all antennas again and have several spare gearboxes to use when maintenance is required in future.

On-dish calibration system completion

The on-dish calibration system consists of a low-power broad-band radiator at the vertex of each antenna, fed over optical fibre by a noise source located in the central building. Each antenna has an independent noise source and a reference copy is fed into the digitiser and beam-former alongside the signals returned from each phased array feed element. This allows the complex gain of each PAF element to be monitored, providing a way to determine when beam-former weights need to be refreshed, and a way to correct the weights without re-observing an astronomical reference source.

This provides a huge boost to operational efficiency, so it was decided that each antenna must have a functional ODC system to be included in the array. Since these were the last components to be installed, we are only just completing ODC acceptance tests now. Two of the antennas have yet to pass these tests and staff are working to identify the problematic hardware components.

Preparing for pilot surveys

Last year we published a detailed plan for pilot surveys. These will be short (100 hr) tests of the survey strategies that have been developed for ASKAP's multi-year science projects.

Upon completion of array integration, we will release a memo describing the performance of the system and its capabilities. Shortly thereafter, we will request a detailed description of the pilot survey strategy from each science team. There is no deadline on this request, but the operations team will begin to implement the strategies as soon as they are received.

We expect that data processing will be much more time consuming than observing in most cases, particularly while we test and refine the imaging parameters for each survey team.

The Rapid ASKAP Continuum Survey

Alongside pilot surveys we will begin the first ASKAP observatory project – a rapid continuum survey of the sky below +30 declination. With ASKAP's 30 square degree field of view and 10 minutes of integration time per field, RACS will take roughly one week to observe. However, tests show that the processing time will be significantly longer. The software development team is investigating ways to improve image processing efficiency for these short observations.

We hope to reach NVSS depth and therefore provide a comprehensive sky model for the Southern hemisphere. All images will be made freely available on the ASKAP science data archive.

CONTACT US
t 1300 363 400
+61 3 9545 2176
e csiroenquiries@csiro.au
w www.csiro.au

FOR FURTHER INFORMATION
CSIRO Astronomy and Space Science
Aidan Hotan
t +61 8 6436 8543
e aidan.hotan@csiro.au
w www.csiro.au/askap