ASKAP Commissioning Update, October 2018

In this issue, we report on the installation of the final hardware components needed to complete ASKAP's 36 antennas. We also describe recent antenna performance tests, observations with the 28-antenna array and preparations for pilot surveys in 2019.

Hardware installation complete

In the last issue, we reported that a shipment was on the way to the MRO, containing enough digital hardware to complete the digitisers and beamformers for all 36 antennas. This shipment arrived on schedule and the hardware was quickly installed by engineering and technical staff on site.

ASKAP's digital systems consist of hundreds of individual rack-mounted chassis and observatory staff have built considerable experience with the installation, configuration, maintenance and repair of these systems over the last few years. Seeing the final chassis installed and cabled into the system was a proud moment for the entire team, marking the beginning of a new phase in ASKAP's operational life, in which we will begin to see the full capability of the telescope.

Although all required ASKAP hardware is now in place, there will be another shipment of components before the end of the year to boost the number of available spares.

Commissioning and integration plans

The last 8 antennas must still be commissioned and integrated into the array before we can observe with the full system. The first stage of this process involves power-up and soak tests of the newly installed components, followed by synchronisation and signal mapping tests. Initial synchronisation tests last week revealed problems with the signal integrity from three of these new antennas which are currently being investigated as part of the commissioning process.

Once these issues are solved, we will begin observations to integrate the new antennas with the rest of the array.

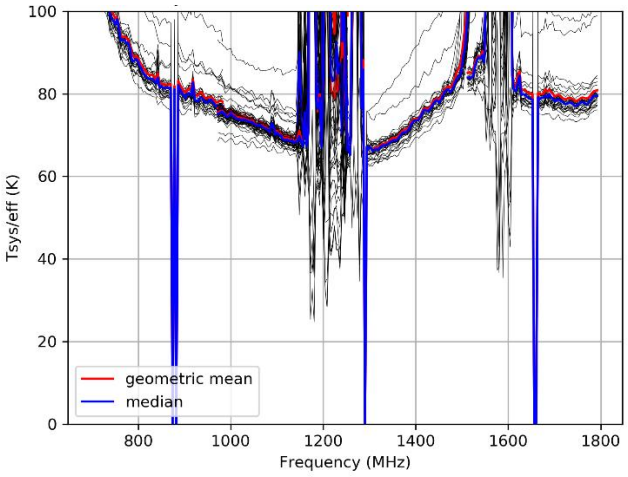
Performance measurements

One of the key parameters required to plan surveys with ASKAP is the sensitivity of the telescope at different wavelengths. This has been a difficult quantity to assess, since it is tied to the efficiency of the electronic beams that ASKAP forms using measurements of a bright reference source. Improvements in the configuration consistency of the array and our understanding of the beamforming algorithm's response to unusual circumstances have improved matters, but there is still more variation from one trial to the next and one antenna to the next than would be expected from a traditional mechanical feed.

Given the desire to begin pilot surveys in early 2019, we recently conducted a series of observations to measure the system temperature across the full spectrum using our best available methods.

In the most sensitive part of the band, ASKAP can achieve a Tsys/η of 65K, but this does not extend over the full frequency range and can vary by roughly 5K across different antennas. Unfortunately, radio frequency interference from global positioning satellites contaminates the most sensitive part of the band.

Other issues include several narrow drop-outs resulting from correlator de-synchronisation. This issue is currently being investigated by engineering staff.



ASKAP system temperature as a function of frequency for a single boresight beam, made using 5 different frequency tunings over the three available filters. Each antenna is shown as a thin back line, with the mean and median in red and blue.

Field of view determination

Additional observations are underway to extend previous measurements of ASKAP's field of view across all available frequency space. Initial measurements and simulations

can be found in ACES memo 15, which provides a basis for planning pilot surveys.

ASKAP community workshop

The next ASKAP community workshop will be held in Sydney on October 24-25, 2018. These events bring together members of all ASKAP survey science teams, along with observatory operations staff and the imaging software development team.

Key topics for the next workshop include establishing survey strategies for pilot observations in 2019 and assessing their technical feasibility, which will set the priority of ASKAPsoft feature development.

28-antenna observations and images

The ASKAP operations plan provides a window of several months during which observations will be made with 28 antennas to test performance and specific aspects of pilot survey strategies before the full array is commissioned. Initial observations with the 28-antenna array are now underway, using early science target fields.

These observations can be compared to data from the 12 and 16-antenna arrays to see how performance and image quality have improved with the latest increases in sensitivity and UV coverage.

The GAMA23 field

One of the most widely requested ASKAP early science fields has been the region covered by the Galaxy And Mass Assembly (GAMA) survey conducted at optical wavelengths. The goal of this survey was to study cosmology and galaxy evolution, making it a very good match for ASKAP's key science goals. Detailed radio imagery of this region will allow cross-matching with optical sources, leading to a wealth of additional science.

Initial observations of the GAMA23 field were conducted in December 2016 and results will be published shortly. These observations were repeated in September 2017 and this month we have added a set of 28-antenna data.

Initial imaging of the 28-antenna observations shows that they are of exceptional quality, revealing many sources with extended structure.

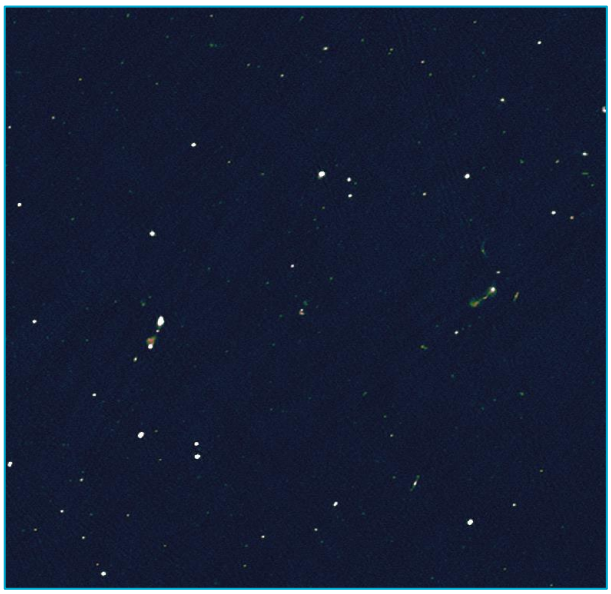
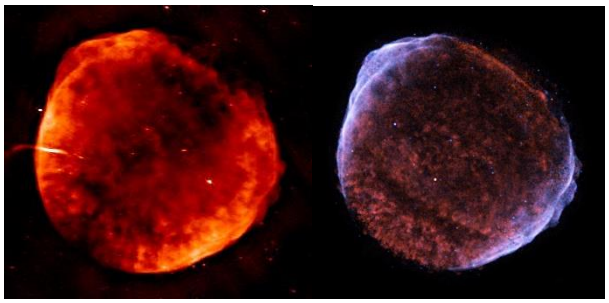


Image cut-out from recent 11-hr observations of a field in the GAMA23 region, using 28 antennas and 288 MHz of bandwidth. Processing was done by Andrew O'Brien using a combination of ASKAPsoft and other tools. The RMS noise is 52 µJy/beam.

SN 1006

While the GAMA23 field is an excellent test of ASKAP's ability to image small-scale structure, the supernova remnant SN 1006 provides a test of ASKAP's ability to detect diffuse and polarised emission. The supernova remnant's radio shell fits neatly into one ASKAP beam and is known to exhibit interesting polarisation characteristics in observations made with the Very Large Array.

Recent 28-antenna observations with ASKAP show structures very similar to the Chandra X-ray image. Efforts are underway to calibrate the polarisation data.



SN 1006 imaged with ASKAP at 912 MHz (left) and the Chandra X-ray observatory (right). Aside from what is likely a background radio galaxy jet on the left of the ASKAP image, the two show remarkably similar structures. The ASKAP image was made by Emil Lenc.

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