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ASKAP Update, October 2020

In this issue, we report the first release of continuum SWAG-X data, recent consolidation development progress, and further preparations for Pilot Surveys Phase II.

SWAG-X continuum data release

On Monday the 12th of October we announced the first data release from the Survey With ASKAP of GAMA-09 + X-ray (SWAG-X). This is an Observatory Project organised in collaboration with the eROSITA team as part of the AAL/eROSITA MoU, providing radio data to complement X-ray performance verification observations.

This first data release is continuum-only, centred at 888 MHz with a bandwidth of 288 MHz. 6 ASKAP tiles were observed in October 2019 for 8 hours each, reaching an RMS noise limit of 50 μJy/beam.

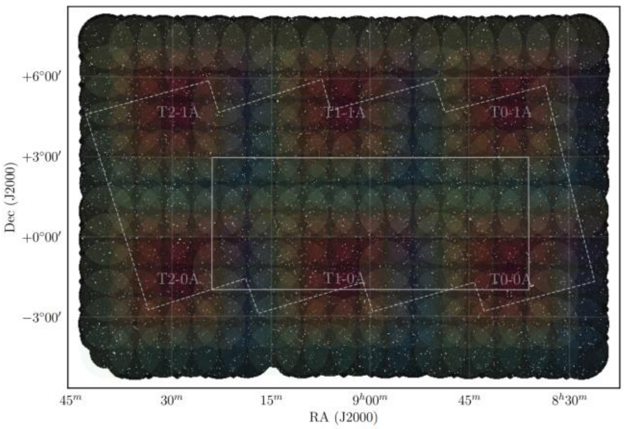

Figure 1: Combined mosaic of 6 ASKAP tiles covering the GAMA-09 field, with individual beams colour coded. eROSITA coverage is shown as diagonal tiles within the ASKAP region. Figure provided by Vanessa Moss.

Images, catalogues and calibrated visibility data are now available on CASDA. Full spectral resolution observations of the same region are ongoing, in the original band at 888 MHz and an additional band centred on 1296 MHz.

One of the goals of SWAG-X was to demonstrate commensality by observing with the smallest number of modes that could provide data of interest to all Survey Science Teams. We welcome feedback from all ASKAP SSTs on SWAG-X data so far.

Consolidation development update

While Pilot Surveys Phase I data processing continues, we are working to improve the efficiency of the telescope itself, the reliability of observing procedures, and overall science data quality.

Automation of array start-up procedures

Now that most of the core ASKAP systems are in place, we are working to link everything together. For Pilot Surveys Phase I, it was necessary to configure the telescope's digital systems by hand in advance of an observing run. For Pilots Phase II, we will use an automatic configuration procedure that reads key parameters such as sky frequency, filter band and zoom mode from the scheduling block parameters and reconfigures the hardware to match. Once commissioned, this will greatly increase the efficiency and flexibility of ASKAP.

This automatic configuration system will detect common faults and react accordingly (usually with a re-try), which should increase the chances of a clean configuration swap and reduce potential for human error. Automatic configuration works side-by-side with the beam weights service, which is now in operational use. This service automatically matches beamformer weights to a requested footprint and manages associated files.

The first release of the automatic configuration system was deployed to the array on the 12th of October and it is currently undergoing tests.

Trial of a new on-dish calibration antenna

During Pilots Phase I we discovered a problem with the reliability of the on-dish calibration system used to refresh beamformer weights. On some occasions, several antennas would report gain corrections outside of the expected (small) range. Further investigation showed time-variable narrow-band features in the on-dish calibration reference signal. The impact of these was greatly reduced by restricting the update to a median-level correction across the entire band.

Further investigation isolated the narrow-band features to the small reference antenna installed at the vertex of each 12-m dish, designed to illuminate the PAF. The existing antennas are susceptible to gain changes likely induced by mechanical deflections when the dish moves. Trials of a sturdier test antenna reduced the variations significantly on the worst-affected dish. We will now investigate whether it is possible to upgrade all the reference antennas in time for Pilots Phase II.

Fringe rotation in zoom modes

Since commissioning ASKAP's high frequency resolution zoom modes, we have found that imaging experiments (especially at the highest 32x resolution) tend to produce poor-quality results. Detailed analysis of GASKAP-OH data from Pilots Phase I revealed that the self-calibration solutions could diverge on some baselines, pointing to an issue with fringe rotation. Further dedicated test observations of a calibrator source in 16x and 32x modes confirmed that for large phase rates (i.e. the longest baselines, around source transit) the array loses phase coherence. CASS engineers are currently investigating this problem while the science teams are working to determine whether existing data can be recovered by flagging only the corrupted baselines.

Once the exact cause of the problem has been identified and resolved, we will repeat calibrator test observations before proceeding with science tests in these modes.

Pilot Surveys Phase II planning

Previously we reported a community workshop designed to consider how we might merge some of the different observing modes used in Pilot Surveys Phase I to improve efficiency. The Survey Science Teams are now considering future strategies and planning test observations required to make key decisions.

The observatory also has important goals for Pilot Surveys Phase II, primarily to reduce the time between observation and access to processed data products. Increasing data throughput will be essential to demonstrate readiness for extended survey operations. We are currently investigating several approaches to this goal including software automation and efficiency enhancements, as well as procedural changes.

To approach the conditions required for sustainable survey operations, end users will only receive data through CASDA with no option for reprocessing, as per the original ASKAP data processing model.

Achieving science quality data with a single processing pass will require extensive verification prior to commencement of Pilots Phase II. Quality gates based on release of test data will be established to ensure that survey mode outputs meet expectations.

Holography and polarisation leakage

One of the best opportunities for survey commensality is combining the POSSUM polarisation project with EMU continuum observations. During Pilots Phase I, POSSUM used a compact beam footprint, trading a smaller field of view for reduced off-axis polarisation leakage in the outer beams. Since this would slow down survey speed, it may be more efficient to correct the larger footprint during imaging if it can be accurately characterised. POSSUM has developed a method for using holography observations to measure leakage from Stokes I into the other parameters Q, U, and V. The challenge that remains is to turn these measurements into a robust correction. Comparison of RACS observations to NVSS and SUMSS has already shown that holography-derived primary beam information provides a more reliable flux scale than assuming circular Gaussian beam shapes.

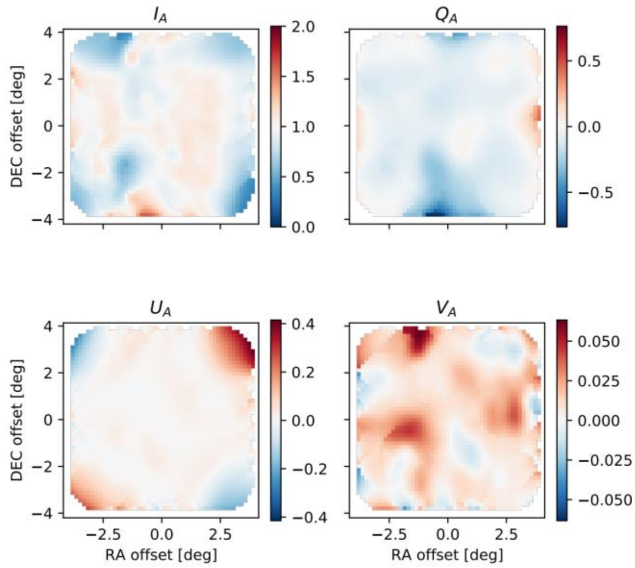

Figure 2: Widefield leakage patterns from the RACS beam footprint after linear mosaicking. In the Stokes I panel; we can see the systematic error imposed by assuming a Gaussian primary beam model on the measured flux. In the Q, U, and V panels, we see the effect of off-axis leakage as averaged over each beam and frequency. These patterns are also observed in broadband VAST images, which have the same footprint as RACS. Figure provided by Alec Thomson.

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