ASKAP update for July 2023

This month we report on survey operations, maintenance activities, data quality and the SMART Observatory Project designed to characterise ASKAP's RFI environment.

Ongoing survey operations

Survey operations continued throughout the last month, with a few interruptions described in more detail below. EMU and POSSUM are now receiving data at the rate of several fields per week on average. WALLABY and FLASH are also receiving new data regularly, but at a slower rate due to our limited observing disk buffer and the time it takes for spectral line observations to propagate through the full processing workflow. Although we still experience job failures that require parts of the pipeline to be re-run, we have been more successful processing several scheduling blocks in parallel using the scratch disk on Setonix, which helps keep the backlog down.

Over the last month we observed and processed the first full set of 275 VAST extra-galactic dedicated survey fields using a new scheduling mode. Each field will be repeated on a specific cadence, measured individually with respect to the most recent observation of that field. This removes the need for dedicated VAST epochs and should intersperse short VAST observations between longer observations required for deeper surveys, increasing ASKAP's overall observing efficiency.

We are in the final stages of preparing to add both GASKAP-OH and GASKAP-HI into the observing pool, pending decisions on the velocity correction strategy and Sun avoidance constraints respectively. CRAFT are operating commensally during most survey observations and continue to work on commissioning the coherent fast transient detection system (CRACO).

Maintenance activities

ASKAP's digital systems were shut down for a few days in the middle of June so that a small water leak in the central cooling system could be fixed. The Pawsey Supercomputing Research Centre also conducted maintenance at the beginning of July, necessitating a pause in observations, data processing and archiving.

July 10th and 11th were dedicated to system tests and software releases. During these two days we updated the antenna drive firmware and multiple python packages on the control system servers.

We are expecting some short outages on the external network to ASKAP over the next month as fibre upgrades take place between the site and Geraldton, but these should have minimal impact on survey operations.

The Pawsey Supercomputing Research Centre is also planning an upgrade of Setonix in conjunction with the platform vendor. While plans are still being discussed, the upgrade is likely to happen over the next month. We are hoping to minimise ASKAP's downtime using a rolling upgrade of individual compute nodes. Some downtime will be necessary during the subsequent upgrade of core services, which may take approximately one week.

Data processing and quality

Several WALLABY scheduling blocks were recently rejected due to the presence of imaging artifacts. The science observations in question share a common calibrator observation, and although investigations did not show anything out of the ordinary in the calibration data, we did uncover a bug in the pre-flagging workflow.

Due to the large number of antennas in the ASKAP array, there are often one or two that are out for maintenance or otherwise producing unusable data. These are flagged in the first instance by the control system, and as a backup, by a data-driven pre-flagging routine that checks for nominal signal characteristics. Data from some of the antennas in the WALLABY calibrator observation mentioned above were marked as anomalous by the pre-flagger, but these flags were not carried over to the science field, leading to contamination of the visibilities. This issue has been rectified and should not happen again.

The SSPs have noted several other data quality issues, ranging from low-level continuum artefacts in spectral line observations to solar interference and systematic off-axis polarisation leakage in observations within the polar cap.

We are currently determining whether imaging and primary beam correction manage the feed angle of offset beams properly, since this can diverge from the central feed angle when observing towards the pole.

We are conducting investigations in conjunction with the SSP working groups and the AKVET team. The volume of data we routinely process is now much higher than any previous Pilot Survey, so it is reasonable to expect that new issues will arise. We are also enforcing the single-pass processing model to manage disk space more effectively, and this makes it more likely for issues to remain hidden until CASDA validation.

Solar interference

The AKVET team continues to investigate the issue of solar interference in ASKAP data. Due to the varied nature of emission regions on the Sun and their strength (especially during active times), we can expect to see significant power from the Sun whenever it is above the horizon, over a range of predominantly short baseline lengths. We would need to flag too much data to remove this effect, causing significant loss of extended emission. Instead, we have been investigating whether it is possible to model and remove only the solar emission.

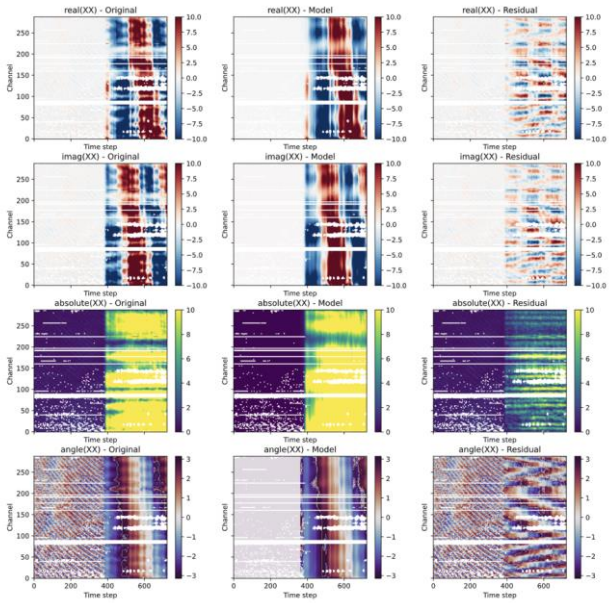

Figure 1: The first column shows visibility data from the shortest ASKAP baseline during a recent observation as a function of frequency channel and time. The Sun rises about halfway through and dominates the data when above the horizon. The second column is a polynomial model of the solar emission made with ASKAPsoft tools, and the third column shows the residual after subtracting the model from the data. Images made by Alec Thomson.

While the technique shows promise, it involves directly modifying the raw visibility data and will therefore need to be tested over a wide range of scenarios to ensure it does not have unintended side effects. We would also need to conduct benchmarking on all data types to ensure the method does not cause significant processing delays.

The SMART RFI Observatory Project

As part of an effort to quantify ASKAP's RFI environment and monitor changes during SKA construction, we recently carried out a first trial epoch of SMART – Survey and routine Monitoring of ASKAP's RFI environment and Trends. This survey records 20 minutes of full-resolution data while tracking celestial coordinates chosen to cross specific azimuth and elevation locations, covering a wide range of angles on the sky. Each pointing in a given frequency band is observed three times over the course of 24 hours with the goal being to assess RFI at different times of the day. These observations will be processed by software designed to gather RFI statistics from ASKAP flagging tables and will augment the dedicated RFI monitoring systems with more sensitive data from the telescope itself.

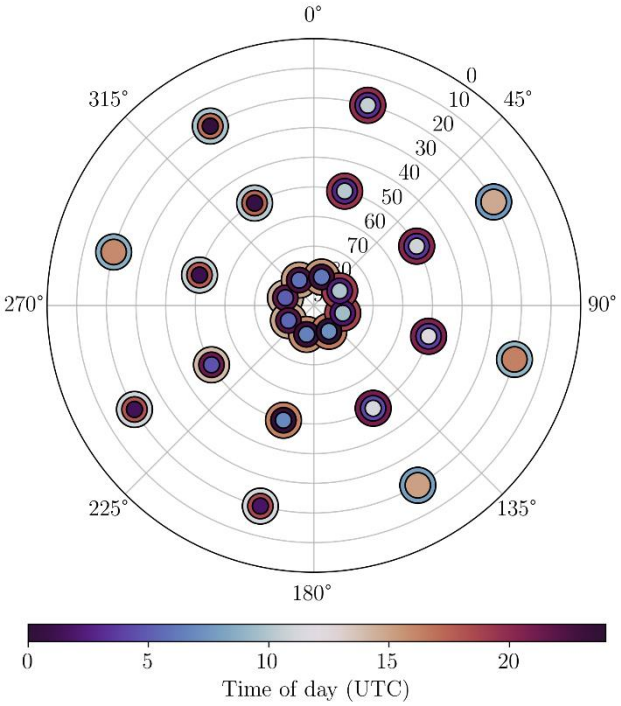

Figure 2: Locations in Az/El coordinates and times (colour coded by time of day as concentric rings per observation) for the SMART observations. The survey was designed to map a wide range of directions across the full frequency range observable with ASKAP. Image made by Vanessa Moss.

For further information

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