ASKAP update for April 2023

This month we describe plans to resume survey operations and assess the performance of Setonix as the new data processing platform.

Towards resuming survey operations

Over the last two weeks we have been conducting maintenance on the high voltage switching gear at the observatory. Although complicated by heavy rain and associated road closures, this work concluded on the 14th of April, and most antennas are operational again. We successfully observed a VAST epoch on the 7th of April between maintenance sessions.

Pawsey have returned Phase 1 of the new Setonix supercomputer to service with configuration changes that resolved the most serious filesystem and job stability issues. We have now been able to run full-scale processing pipeline tests with only a small number of isolated failures. In its current form, we believe that Setonix is finally capable of supporting ASKAP operations.

With both the telescope and Setonix ready for integrated testing, our goal is to resume survey operations by the end of April.

SST	Observed	Processing	Awaiting Validation	Released	Rejected
EMU	43	0	0	36	7
WALLABY	10	0	0	5	5
POSSUM	53	0	53	0	0
VAST	559	0	0	529	30
FLASH	9	0	7	0	2

Table 1: Status of scheduling blocks observed since the start of the full survey trial. The first column shows the total number of fields observed per survey, the second column shows the number currently progressing through various stages of processing, the third column shows the number that have been deposited into CASDA, and the final two columns show the number released to the public or rejected. POSSUM products are derived from both EMU and WALLABY observations.

The first real test of Setonix as part of the telescope will be the planned VAST epoch due to begin after the 20th of April. This is a survey mode we have tested extensively on the previous supercomputer Galaxy and should therefore provide a good measure of readiness. We plan to run isolated tests on Setonix using live data in advance of the VAST epoch to ensure that everything is configured correctly. We will also conduct full tests of all currently available pipeline modes, using archived data as input. The Survey Science Teams should see no difference in data obtained from CASDA after the transition to Setonix, but as with any major change it will be important to check carefully and report any issues encountered.

Assuming the planned tests and VAST observations are successful, we will make every effort to resume survey operations using the established observing pool by late April. GASKAP-OH and GASKAP-HI will be added to the pool as soon as we have verified the new processing modes currently under development.

As with the previous full survey trial, we will closely monitor disk usage, processing and observing efficiency. If data throughput on Setonix proves to be sustainable, we will continue with survey operations into the future. If we are accumulating a backlog of unprocessed data, we may need to pause observations again and assess how to proceed. As table 1 shows, most of the Survey Science Teams have completed validation of their existing data backlog and are ready for new observations. We remind the remaining teams that ongoing observations are conditional upon prompt validation of previous data.

New ASKAPsoft release

The latest ASKAPsoft release was deployed to Setonix and Galaxy on the 7th of April. This release includes changes that increase compatibility with the Setonix environment, such as avoiding the use of MPI-based file access in specific circumstances. Survey Science Teams are reminded to check whether the latest version of their validation pipelines have been made available to the processing team for use at the end of a pipeline run. We may release another set of updates to the processing pipeline shortly, to optimise job distribution on Setonix.

Observing the April solar eclipse

Inyarrimanha Ilgari Bundara, our Murchison Radio-astronomy Observatory, will experience a partial solar eclipse on the 20th of April. We are planning to observe this event with ASKAP, capturing both imaging and high time resolution data for science goals which include investigating the scintillation of sources close to the Sun.

Fortunately, the path of the destructive Cyclone Ilsa kept it well north of mid-west WA, and the current forecast for April 20th is for some cloud, but no rain.

ASKAP astrometry investigation

Validation and quality control of RACS and other survey observations have shown that ASKAP currently exhibits semi-random astrometry errors at roughly the same scale as its image pixel size, i.e. about 2”. This is due to the fact that with our wide field of view, we currently do not phase reference in the same way that single-beam interferometers typically do. Regularly placing a phase reference source in each beam one by one would add significant overhead to ASKAP observations.

The astrometry errors are introduced during self-calibration, which acts to centre the brightest sources on the nearest pixel, potentially shifting the entire beam by roughly the pixel size in the worst cases. The issue is complicated by the interplay between multiple bright sources in a given beam, and the fact that each beam in a mosaicked field may exhibit a different error. Under these conditions, astrometric accuracy is not a function of signal-to-noise ratio. These errors are relatively small, but complicate the process of cross-matching against high-resolution catalogues with large source counts, especially at other wavelengths.

Using a phase-referenced sky model as the basis for calibration would solve this problem, but we need to obtain such a model first. RACS is the only survey with suitable sky coverage and resolution, but it was observed using the non-referenced approach and is therefore not a suitable ground truth without additional correction.

One option would be to observe another epoch of RACS with phase calibration (absorbing the observing overheads for this exercise only). We would need to develop a suitable workflow to conduct the additional calibration.

We have discussed a wide range of alternative approaches, including the construction of a much smaller sky model for a few select fields, specifically for the purpose of phase calibration. These fields would be chosen to avoid extended emission and would need to be observed repeatedly alongside other surveys, more frequently than bandpass calibration but with much less overhead since only a single, brief pointing would be needed. This would also require changes to the pipeline calibration workflow and would still incur a small survey efficiency penalty.

It may also be possible to measure phase corrections on a reference field and update the beamformer weights to compensate, rather than applying the corrections in the imaging pipeline. However, this requires close coordination and prompt feedback of processing outputs back into the telescope control system.

We will continue to deliberate on the best solution to this issue and keep the community informed of any developments.

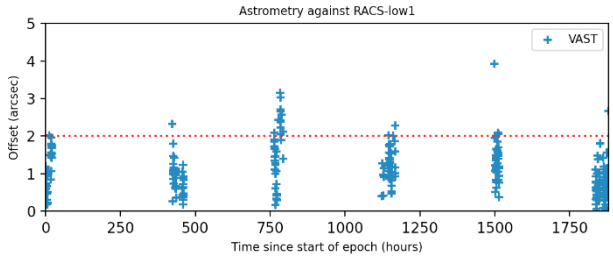

Figure 1: Plot showing average astrometric errors with respect to the RACS-low catalogue for a series of VAST epochs taken during full survey observations over the last few months. The offsets are usually less than the indicated 2" level, but poor weather conditions can cause more rapid departure from the phase solution of a given bandpass observation, leading to larger errors on occasion. Figure provided by Emil Lenc.

ASKAP’s antenna pointing model would also benefit from improvement, given that we only correct for bulk offsets and do not have a system capable of accurately measuring position-dependent parameters. This is likely responsible for slight changes in the measured flux of sources on either side of a roll axis unwrap, especially when pointing close to zenith. Once we have established routine survey operations and worked through the current development backlog, there should be more time to focus on improving the system. In the meantime, feedback from the Survey Science Teams is very useful as we triage issues and prioritise future development activities.

For further information

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