ASKAP Update, January 2021

In this, the first issue of 2021, we report on observations conducted during the holidays, the status of data processing for Pilot Surveys Phase I and the path to test observations and quality gates for Pilot Surveys Phase II.

Observatory project update

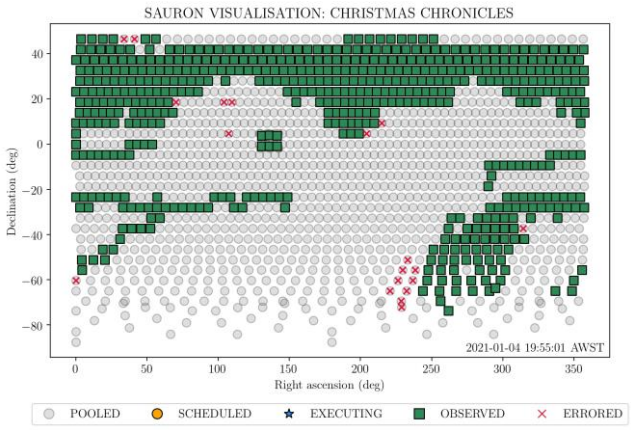
After finishing a 6-month period of consolidation work to improve many aspects of the telescope in the second half of 2020, we were very interested to see how the updated system would perform when conducting survey observations. As an extended test (and a chance to obtain data for the science community) we dedicated the time between December 20 and January 4 to existing ASKAP observatory projects.

The two observatory projects currently underway are SWAG-X (covering the GAMA-09 region) and RACS (an all-sky survey). For SWAG-X, we needed to complete observations to the specified depth in continuum and spectral line mode over 6 target fields. For RACS, we began observations in the second of three planned frequency bands, to complement the existing observations centred at 888 MHz (most of which are now available on CASDA).

These observations were scheduled using a new automated system called SAURON (Scheduling ASKAP Under Reactive Observational Needs) that links to the new array start-up mechanism configured via scheduling block parameters. In addition, the telescope now writes data to a fully independent disk array on the newly commissioned ingest cluster at the Pawsey supercomputing centre. This combination allows better observing efficiency through improved configuration flexibility and increases the ability of the telescope to correct small issues that arise on individual subsystems without human intervention.

The two different observatory projects test different aspects of the scheduling task, with SWAG-X involving a small number of fields with long integration times, and RACS involving roughly 1500 fields (more than the first band due to the smaller beam footprint at the new frequency of 1272 MHz) observed for 15 minutes each.

Compared with Pilot Surveys Phase I, the new automated system was able to achieve 80% attempted on-sky time (up from 50%), and an overall success rate of 95% (up from 70%). The fact that this holiday period corresponded to a planned maintenance hiatus also helped by maximising the available time, so these latest figures are likely an upper limit.



Completion status of the observational pool as covered by SAURON during the Christmas period. Grey circles indicate an observation which has not been observed, while green squares show successfully completed observations. Anything which was attempted but errored is marked as a red cross until the next attempt to observe it is successful. Figure provided by Vanessa Moss.

All SWAG-X observations were completed and about half of the total number of RACS band 2 fields have been observed, with the rest to be attempted throughout January alongside technical tests for Pilot Surveys Phase II.

Observatory reliability over summer

The observatory itself experienced two hardware faults over this period, the first being failure of an input high-voltage power filter which, with the support of local staff and contractors, was quickly replaced from spares, allowing operations to continue.

The second interruption involved switching over one of the fibre links servicing the MRO due to gradual degradation and increasing transmission errors. This work was done by AARNET staff just before the new year, with minimal disruption.

In previous years we have found that hot weather during the summer months can increase the stress on systems directly exposed to the environment, especially the Phased Array Feeds. This year, the automated start-up

system combined with the domino watchdog service seems to have kept everything running smoothly, with fewer interruptions due to trips.

Pilot Surveys Phase I Processing

As indicated in previous newsletters, our goal is to complete all processing associated with Pilot Survey Phase I before progressing to quality gate observations for Phase II. Technical tests may take place during the cross-over period, but these are expected to be few and relatively low-impact in terms of storage space and CPU hours.

Progress and outstanding tasks

Most of the survey science teams have received a large fraction of their Phase I data, although not all has passed the validation and release stage on CASDA. In some cases, we have had to deliver alternative data products or reduce the scope of the CASDA deposit while further research continues within the science teams.

Tasks such as joint deconvolution across multiple beams and off-axis polarisation leakage calibration are not yet compatible with or mature enough to conduct as part of a routine pipeline workflow. Where possible, we are providing access to suitable intermediate data products that will allow the required research and development to continue while allowing the observatory to clear disk space for future observations.

One of the major outstanding tasks is the imaging of FLASH spectral line data, with delays due primarily to the persistence of 1 MHz spectral jumps. Initial attempts to eliminate these jumps with wider beamforming intervals were not successful and subsequent changes have improved the situation but not eliminated the problem. Phase I FLASH data is being processed with calibration intervals of 1 MHz to make the most of the existing observations, while further tests will ensure the system is in better shape for Phase II.

Discussion of the optimal flagging and processing strategies for several teams is ongoing but reaching the point of diminishing returns, where changes make little impact on the final image quality. Some survey science teams are planning to continue their own research into optimal processing strategies using alternative software packages for comparison. Where feasible, this research will guide future ASKAPsoft development priorities.

Pilot Surveys Phase II preparation

Plans for Phase II were discussed at a meeting of Survey Science Team PIs and key representatives in December 2020. One of the discussion points was the need for commensality to ensure prompt returns from the overall survey strategy on a 5-year timescale. In 2021 there will be a review of the survey science project plans with the goal of allocating observing time. The terms of reference for this review will be circulated soon, and the degree of commensality that can be achieved will factor into the time allocation process.

In preparation for the review, all survey science teams are encouraged to evolve their plans for Pilot Surveys Phase II into something more closely resembling the full survey strategy they intend to employ. Timelines are tight but it is still our aim for most teams to have results from Phase II in good time for the review. In the meantime, we will continue to provide opportunities for feedback and iteration.

One major outstanding decision is whether or not to implement split-band mode in time for survey operations. The final decision will depend on how many teams require this mode and how much time it would save over the first 5 years compared with the time required to implement.

Technical test observation progress

Two technical tests are already underway, starting with verification of system-level changes by the observatory and concluding with on-sky science fields.

We have deployed software changes required to support a new beamformer firmware build that should fix issues with zoom mode fringe rotation. If observatory tests on calibrator sources pass this week, we will proceed to observations of a GASKAP-specified science test field.

We are also testing changes to the way wider beamforming intervals are implemented for FLASH. Once observatory tests have demonstrated a successful method, we will observe a FLASH science test field for final validation prior to Phase II.

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