# ASKAP Update, November 2020

In this, the last issue of 2020, we summarise key achievements and outline the expected path to full survey operations in 2021.

## The year in review

2020 has been a tumultuous year in many ways. Even so, we concluded observations for Pilot Surveys Phase I and have made good progress towards finishing the associated data processing. We have released initial data from the SWAG-X observatory project (6 fields covering the GAMA 09 region) and are set to announce the release of ASKAP's first all-sky survey, RACS, at the end of this month.

Our engineering and technical teams have been using the time between pilot surveys to improve the telescope. We have updated the beamformer weights management software, drives control firmware, and many other components. A new automated telescope configuration system was developed and deployed, which will improve operational efficiency.

Many improvements to the data processing pipeline have been made in response to survey science team feedback, including the ability to convolve images to a common resolution, improved continuum subtraction and the use of holography to improve primary beam correction.

The last major upgrade of 2020 will be ASKAP's new ingest cluster, which includes a 0.5 PB extremely fast SSD storage array. This should fully isolate data recording from image processing and allow us to develop a sustainable survey workflow.

In December, our focus will be on preparing for holiday operations, so we will not host a science forum or publish a newsletter. The first science forum of 2021 will be on January 19th, where we will provide an update on readiness for Pilot Surveys Phase II.

### Planning for 2021

2021 should be the year in in which ASKAP begins its full survey projects. We are planning one more cycle of Pilot Surveys to test commensal modes, and an external review of survey project time allocation.

The Pawsey centre plans to commission a new supercomputer in 2021, which will be used for ASKAP operations. While the transition from Galaxy may involve some disruption, the new machine should be significantly more powerful and may help improve ASKAP's efficiency.

## Consolidation development update

As we wind up the year, our goal is to deploy all outstanding updates and verify the telescope's stability in advance of an extended holiday observing campaign.

### Ingest cluster commissioning

The new ingest cluster has been installed and is currently being commissioned. Software that simulates the distributed processing and file writing load of a typical observation shows that the new cluster performs well and should have more headroom in both CPU power and storage access than previous hardware.

We plan to switch the MRO network over to the new ingest cluster on or before the 23rd of November, at which point we can begin tests of the full system with real data.

### Beam weights frequency interval

The beam weights database service that we introduced earlier this year has been updated to include the frequency interval with which weights were formed as a key parameter. Previously, this option could be passed to the weights calculator but was not stored in the database, making it impossible to automatically select weights with a specific frequency interval. The change means that automatic weight selection can now be used for surveys requiring wider beamforming intervals, such as FLASH.

We are still investigating unexpected bandpass features that appear in beams formed with wider intervals.

### Zoom mode register overflow identified

Last issue we reported that a problem with fringe rotation in zoom modes had been identified, but not understood. Since then, our engineering team has determined that the registers used for the fringe rate parameter in the beamformer firmware are not wide enough to accommodate the values needed for the two highest zoom factors, x16 and x32. This means that numerical overflow can occur, corrupting the rate term on the longer baselines around transit. Since the required rate is also frequency-dependent, this problem is most apparent in the high-frequency part of ASKAP's band.

We are now investigating whether the FPGAs in the beamformer have sufficient internal resources to widen the registers or whether we can scale the parameters in some way to increase headroom. It may take some time to find a solution to this problem, but we hope to have a fix in place before that start of Pilot Surveys Phase II.

### Spectral ripple due to ODC cross-talk

One of the outstanding issues with Pilot Survey Phase I data is the presence of low-level sinusoidal ripples in the image and frequency domain, most prominently in beams near the corners of a given footprint. Test observations last week revealed that although the on-dish calibration system reference signal has very low power, it can correlate weakly between nearby antennas, which introduces bandpass ripple on short baselines with the same period as seen in some of the science data.

We will update the control system to keep the calibration signal switched off outside of beamforming and weights update observations, where it is needed.

## Pilot Surveys Phase II update

Alongside this newsletter we are releasing an updated plan for Pilot Surveys Phase II. This plan includes a revised timeline with test observations beginning as soon as possible in 2021, followed by quality gate observations and the pilots themselves in late February. This is still dependent on prompt commissioning of the new ingest cluster and completion of data processing for Pilot Surveys Phase I.

Since Pilot Surveys Phase II is expected to be the final pilot before full surveys, it should test the final survey strategies that will be used. We will be hosting a survey science team PI meeting in early December 2020 to discuss, among other things, the degree of commensality required to complete the all-sky survey projects in a reasonable time. The outcome of this discussion may impact the choice of observing strategies.

The updated plan also describes the observation specification scheme that will be used for Pilot Surveys Phase II. This is evolving towards a machine-readable format that will ultimately be passed to an automatic scheduler.

## Holiday operations plan

To keep the telescope operating with minimal intervention over the holidays, we will be making full use of recent automation enhancements. The current plan is to spend two to three weeks completing a mid-band pass of the Rapid ASKAP Continuum Survey, with a bandwidth of 288 MHz and a centre frequency around 1296 MHz. RACS is a good test of extended, automated survey operations since it consists of a large number of fields covering the observable sky, with a relatively short integration time (15 minutes was used in the low band) and relatively small disk space requirements due to the use of online continuum averaging.

A recent weekend observing run tested two possible survey tiling schemes and beam footprints (which need to have a smaller spacing than was used in the low band) and the automatic system configuration logic. To ensure the automatic configuration was triggered, we shifted the centre frequency by a small amount every few hours. The plot below shows the location of each field observed and outlines fields where the frequency changed. Blocks that failed are crossed out.

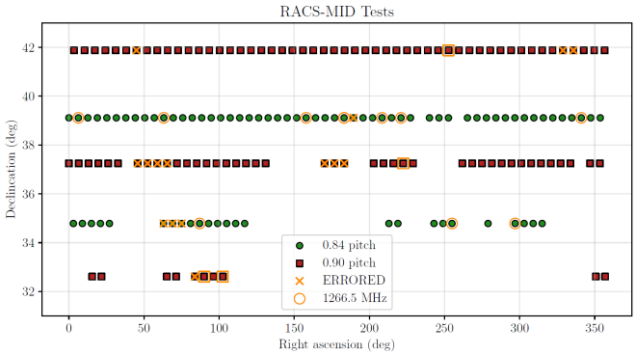


**Figure 1: RACS test run. Figure provided by Vanessa Moss**

Although a few groups of blocks did fail, human intervention was required only once to address an issue with complicated recovery logic. The automatic configuration system managed to recover a few less complicated faults on its own.

We also intend to finish observations of GAMA 09 for the SWAG-X observatory project in 2020, but these involve spectral line mode and must be coordinated with other activities requiring significant disk space.

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