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ASKAP update for December 2024

This month we report on survey progress and plans for continued observations across the end of 2024 and into 2025.

Survey science progress update

Our focus on mid-band spectral line observations continued throughout November and the first half of December, nearly doubling the number of released WALLABY scheduling blocks and providing enough data for GASKAP-HI to begin verifying their full survey processing strategy at the required depth over a few representative fields.

Throughout this intensive period of spectral line observing, we have been able to process data at the rate required to avoid filling the ingest buffer and deliver science-ready data products promptly to CASDA, averaging a few days between observation and upload. This is the first time we have been able to run at ASKAP's full data rate for an extended period, providing evidence that we will be able to make good progress on all surveys in 2025 if no further issues arise.

SST	Deposited	Awaiting Validation	Released	Rejected
EMU	318	0	254	67
WALLABY	86	8	42	40
POSSUM	403	11	276	121
VAST	4585	5	4539	42
FLASH	265	0	146	119
GASKAP-HI	7	6	1	0
GASKAP-OH	1	1	0	0
DINGO	24	2	19	3

Table 1: Survey progress as of 9-12-2024

Although we began the first full survey trial in November 2022, we were forced to pause almost immediately and only resumed continuum observations in May 2023. It has taken two years to reach a point where data can flow smoothly in all science modes. This has been accomplished with optimisations to many aspects of ASKAP, as well as the Pawsey Supercomputing Research Centre's improvements to Setonix and related systems. The extra time needed to meet performance requirements on Setonix will of course have an impact on the expected completion date for all ASKAP surveys. We remain committed to the time allocations set out in the international independent Review of ASKAP Survey Science Proposals.

Highlights from 2024

As a key SKA precursor, our goal has been to support all required operational modes and supply data to all Survey Science Teams promptly. We have worked with the Survey Science Teams to refine observing and processing strategies based on direct experience with ASKAP data. This approach allows everyone to remain engaged with development efforts, prepare post-processing pipelines and work with the Australian SKA regional centre to develop value-added processing strategies and tools.

ASKAP's autonomous operations model has allowed it to run tirelessly and as efficiently as possible, managing a plethora of observing and technical constraints. Our open-access data policy ensures prompt, global availability of data products, with quality assessment provided by the Survey Science Team validators. Each ASKAP field covers 30 square degrees, and most observations provide the best view of the sky currently available at ASKAP's wavelengths. Alongside several key discoveries and over 50 refereed publications this year, ASKAP is meeting new milestones and delivering new capabilities regularly.

Meanwhile, we have released several epochs of the Rapid ASKAP Continuum Survey (RACS) across three frequency bands, providing a new radio astronomy reference including images and catalogues. In addition, RACS can now be used to initialise ASKAP's self-calibration scheme, providing a significant improvement to image quality in some circumstances (see Figure 1). RACS data have also been processed for polarisation science as part of the

SPICE-RACS project, which will soon provide the most extensive rotation measure catalogue available.

Conducting large-scale survey projects with a newly commissioned telescope that utilises advanced and innovative technology at unprecedented data scales has been extremely challenging. However, we are beginning to see the rewards of this effort and look forward to the discoveries that 2025 will bring.

Survey progress simulations

One of the questions most frequently asked by the community is how quickly we expect to progress the Survey Science Projects that are currently underway. It has been difficult to give a meaningful answer to this question while working through early issues with Setonix and continuing to improve our understanding of ASKAP's data quality. With many issues now resolved, we expect to make improved progress for all Survey Science Projects in 2025, demonstrating the way forward.

To address the need for timeline estimates based on the best available information, we have been further developing the existing simulation mode in ASKAP's autonomous scheduler, SAURON. While currently limited to idealised technical and environmental constraints, projections made by SAURON will take the complexity of jointly scheduling all the Survey Science Projects into account, providing the most realistic estimates possible. We expect to share these with the community in 2025.

Holiday observing plans

Across the end of year holidays, both the Murchison Support Facility and the Pawsey Supercomputing Research Centre have limited capacity to support ongoing ASKAP operations, with intervention generally limited to safety-critical situations. ASKAP will continue to run throughout this period, but we will restrict the observing pool to minimise configuration changes and data rates. This increases the chance that ASKAP can successfully run with no human intervention for the duration of the shutdown.

The current plan is to continue our mid-band spectral line focus session until a few days before the end of year shutdown period officially begins on the 20th of December. Around this time, we will switch to low-band exclusive observations with EMU, VAST and FLASH in the observing pool until the 13th of January. After this time, we will resume full survey operations with all Survey Science Projects active and expect to make steady progress throughout 2025.

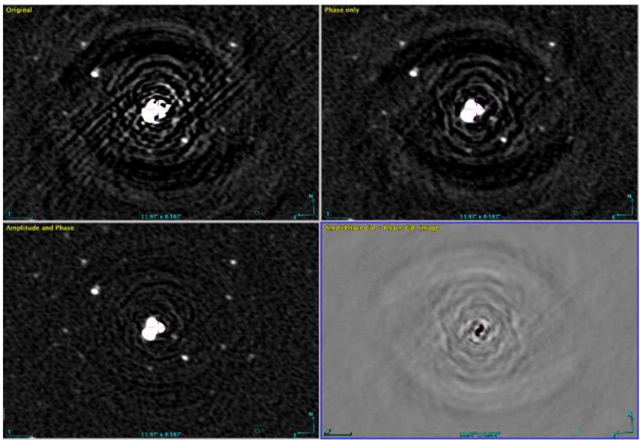

Figure 1: In some science observations, we see significant departure from calibration solutions based on daily bandpass observations of PKS B1934-638. In these cases, priming ASKAP's self-calibration process with information from RACS allows better adaption than using the observed data alone. We tested this approach for DINGO previously and are now testing the same method on WALLABY data, including the field shown above, from scheduling block 68760. In this image, standard self-calibration results are shown in the upper left panel, while phase-only calibration against the RACS model prior to self-calibration improves image quality as seen in the upper right panel. The addition of an amplitude self-calibration step improves image quality even further as shown in the bottom left panel, with only a ~2% change in the flux scale. After additional testing we plan to expand the use of this method to other Survey Science Teams in 2025. Image credit: Emil Lenc.

Priorities for 2025

Although we will start 2025 with ASKAP in its best operational state since surveys began, there are several additional improvements on the way. These focus on addressing data quality concerns raised by the community, especially the presence of artifacts around bright sources. Fundamental research into improving ASKAP's beam models, calibration, pointing and overall gain stability will continue, but we hope to make the most impactful improvements in a few relatively simple ways:

- Provide traditional weighting as an alternative to preconditioning
- Use full-band continuum model information when cleaning individual frequency channels
- Imaging small regions outside the observed field to allow deconvolution of bright exterior sources
- Expand use of RACS-based calibration to all processing modes (see Figure 1).

These features are in the final stages of development and testing and should be available for use in early 2025.

For further information

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