ASKAP update for October 2024

This month we report on survey progress, the return of Nyarluwarri (ak30) to the array, the use of RACS-based self-calibration and a new observing mode designed to study Coronal Mass Ejection (CME) events.

Survey science progress update

As we gain confidence in the performance of ASKAP's processing workflow on Setonix after recent platform upgrades, we have been adding more Survey Science Projects to the active observing pool. This has highlighted the time pressure caused by overlapping observing constraints, especially the desire to do most spectral line observations at night.

Whenever the Sun is above the horizon, we observe long-period ripples in ASKAP spectra due to strong, extended and sometimes highly variable radio emission from the Sun itself. Although a minimum (u,v) distance cut corresponding to a projected baseline of about 40m is sufficient to remove most of these artifacts, such a cut also prevents ASKAP from detecting extended emission at scales of scientific interest. We are currently observing with a night-only constraint active for several Survey Science Projects and will assess ASKAP's observing efficiency over the next month to see whether these Survey Science Teams receive data at an acceptable rate.

SST	Deposited	Awaiting Validation	Released	Rejected
EMU	314	1	251	65
WALLABY	66	12	26	28
POSSUM	379	14	264	106
VAST	4248	15	4193	42
FLASH	257	3	136	117
GASKAP-HI	1	0	1	0
GASKAP-OH	1	1	0	0
DINGO	22	20	0	2

Table 1: Survey progress as of 10-10-2024

We would like to remind all Survey Science Teams that prompt validation of CASDA deposits is a condition of continued observations. This is to ensure that we do not build up a large backlog of observations that may not meet science requirements.

We have also started observing a second epoch of the RACS-mid observatory project, since the first epoch had incomplete holography beam measurements. As with RACS-low3, RACS-mid2 will be processed using the standard ASKAPsoft pipeline and data products for each field will be made available promptly in CASDA. These images and catalogues will be openly available.

Nyarluwarri back in action

For several months we have been observing without Nyarluwarri (also known as ak30, named after the Wajarri word for the Pleiades cluster), one of ASKAP's 36 antennas, in the array. This was due to a persistent inability to update its beam weights using our standard calibration scheme. After checking every part of the associated hardware and data products without finding the source of the issue, we started looking at other aspects of the system. After much investigation, our electronics team found evidence of a rare problem we'd seen only once before.

Although it is not currently used, ASKAP's Phased Array Feeds include the ability to insert a 180-degree phase jump into the signal from each output port on command. In the case of Nyarluwarri, spurious control signals were causing this phase switch to activate unintentionally. When a similar issue occurred on Bundara (ak03) in 2017 it manifested as reduced visibility amplitudes on all baselines to that antenna. This time, the spurious phase switching was occurring at a much slower rate and the problem manifested as an inconsistency in the beam weight update process instead.

The spurious control signals were successfully eliminated by replacing the PAF controller module on the 20th of September. With this problem solved, it will be easier to meet minimum antenna constraints alongside routine maintenance efforts.

RACS-based self-calibration

To improve the consistency of ASKAP's astrometry over all mosaicked beams and increase the quality of our self-calibration results (while retaining a small number of iterations for operational efficiency) we have been testing the use of RACS as an initial model for the self-calibration process. Both DINGO and GASKAP-OH have seen significant improvements in image cube quality using this approach (see Figure 1).

Although we do not yet have a global sky model covering ASKAP's full frequency range, we do have at least one epoch of RACS in each of the three bands typically used for science observations. Using these single-band epochs as an initial model helps test the software services needed for sky model calibration and has been shown to provide a significant improvement over starting from scratch.

Using RACS as the starting model for each beam also ties the astrometry to the corresponding RACS catalogue. Although each beam is independently calibrated and imaged, a common initial condition ensures consistency of source positions across all beams and makes combination of multi-epoch science observations easier. There may still be astrometric offsets present in the RACS catalogues, but these are being carefully studied and corrected during post-processing efforts to ensure the best possible compatibility with surveys performed by other telescopes.

The new approach offers the most benefit in imaging modes that have reduced continuum sensitivity, such as spectral line zoom bands. However, we expect it will be a significant improvement when used in any imaging mode and are planning to offer it as a standard pipeline feature soon. Please discuss with the Operations team if you would like to make use of this feature.

New CME observing mode

On the 4th of October we conducted the first successful test of a new observing mode designed in collaboration with a Guest Science Project team. The new mode will capture Coronal Mass Ejections, which involve the large-scale release of magnetised plasma from the Sun. This mode is triggered when a suitable CME is detected by other telescopes and is designed to observe a set of positions in an arc following the leading edge of the CME close to ASKAP's minimum allowed distance from the Sun under normal operating conditions. The data will be processed using Rotation Measure Synthesis to study changes in the Faraday rotation of background sources, with the goal of measuring the CME's magnetic field. Accurate measurements at about 10 to 15 degrees from the Sun could help improve space weather predictions on Earth. This new observing mode will also be useful for studies of interplanetary scintillation.

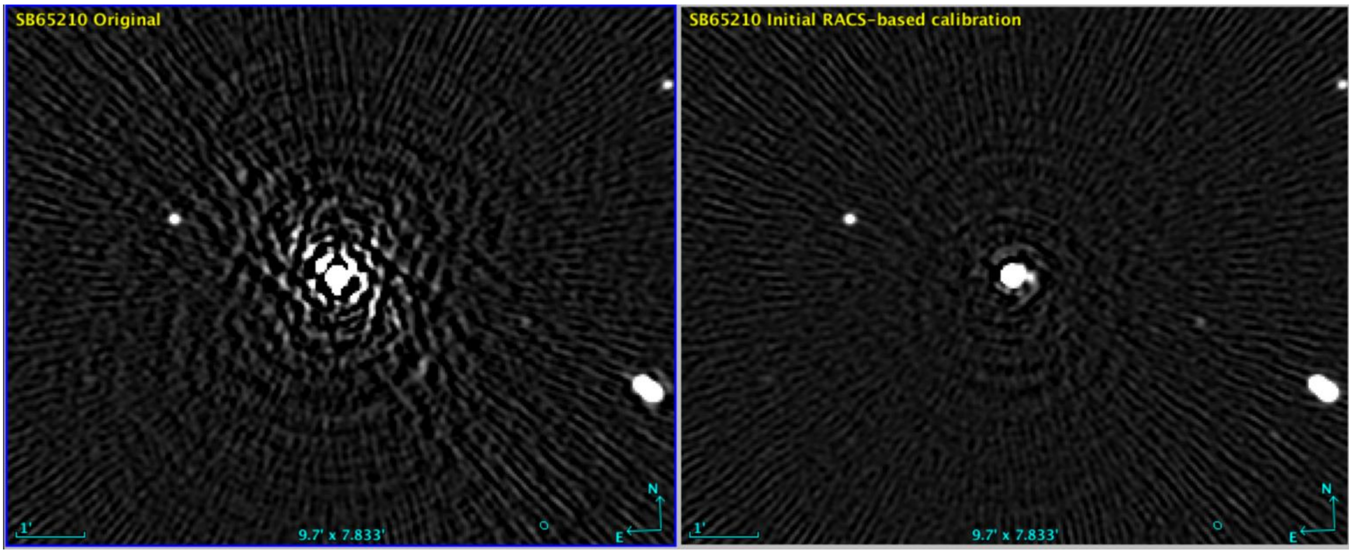

Figure 1: Example from a recent DINGO observation of the difference between self-calibration based on the observed data alone (left) and a new approach of beginning with a model based on RACS (right). For the new approach, phase-only self-calibration was done on time intervals of 200s, followed by one final round of amplitude self-calibration.

For further information

CSIRO Space & Astronomy
Aidan Hotan
+61 8 6436 8543
aidan.hotan@csiro.au
csiro.au/astronomy