ASKAP Commissioning Update, October 2019

In this issue, we report on the availability of a new disk storage buffer for ASKAP data capture and processing, progress on pilot surveys and the first detection of a Fast Radio Burst in commensal mode during an EMU pilot observation.

ASKAP pilot survey progress

Pilot survey observations continued this month with observations for POSSUM in the mid-band. The target fields cover the same area recently observed for EMU's pilot survey, but with a centre frequency of 1296 MHz and a more compact footprint to reduce the impact of off-axis polarisation leakage in the final mosaic. This will test the viability of POSSUM running as a completely commensal survey using EMU and WALLABY data, depending on EMU's selection of observing band for their full survey.

POSSUM have also requested a simple form of leakage calibration based on the same bandpass calibration data used to set the flux scale. Tests have shown that this provides a small but significant improvement in the quality of the Stokes products. An implementation of this method now exists in the ASKAP data processing pipeline. POSSUM requires full Stokes cubes with 1 MHz resolution, making the disk space requirements a few times larger than EMU's continuum mode. This will be the next priority after work on the WALLABY pilot and GASKAP test fields.

First commensal Fast Radio Burst

Earlier this month we re-observed two of the EMU pilot survey fields due to data quality issues found prior to release. During one of these re-observations, the CRAFT team detected their first commensal Fast Radio Burst, also the first FRB detected with ASKAP at a centre frequency of 944 MHz (previous bursts were found at 1296 MHz). This exciting event suggests that the commensal nature of CRAFT can be realised.

EMU pilot survey data processing

The EMU pilot survey has now been fully processed using the parameters nominated by the science team. Aside from 2 out of 10 blocks that failed quality control (and one block that was used as a test of the first processing parameters), the data have all been released to the public on CASDA. They can be found under project code AS101.

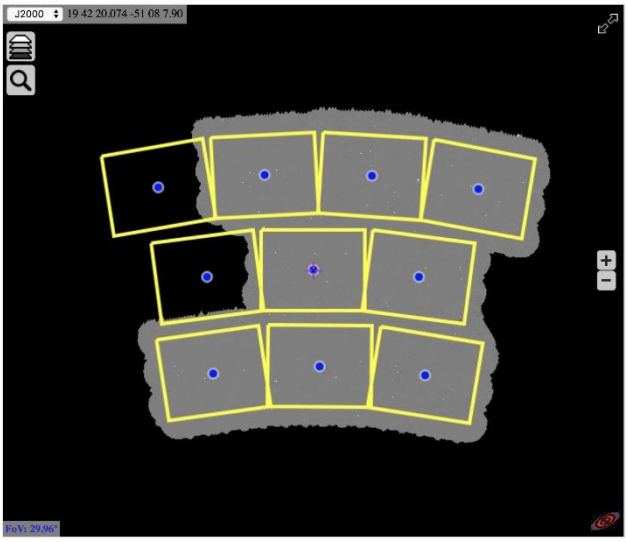

Image of a mosaic containing all released EMU pilot survey data, made by Josh Marvil during a recent busy week

WALLABY pilot survey data processing

Processing of the WALLABY Eridanus test field is complete, and the result should be available on CASDA very soon. Preliminary analysis of the NGC4636 pilot survey field observed last month shows promising results, despite the presence of missing channels due to a known problem with correlator synchronisation (see the ASKAP-X section below). We will likely we-observe this field to improve data quality.

ASKAP-X work underway

The first Program Increment (PI) of the ASKAP extended modes project is now underway and the first two-week iteration has already led to significant enhancements and improved understanding of several long-term issues.

Investigation into the cause of delay jumps that invalidate beam-former weights on a system reset has found several issues with the digitiser firmware. These have mostly been rectified in the firmware itself and improved operational procedures will allow us to avoid the problem in all but a few cases (such as band changes that involve a different sampler clock). This upgrade will be deployed as a joint

firmware/software patch in the coming month and should reduce operational overheads and the amount of time needed to recover from other system issues.

Another focus of the first iteration was investigating the cause of correlator channel loss that has been impacting all observations. This problem causes reduced sensitivity in continuum mode but is particularly damaging to spectral line observations, since the lost channels may contain line emission.

Investigation of existing diagnostic information suggested that the problem is not in the correlator, but in the output from the beam-formers. To further narrow down the cause, a new version of the beam-former firmware was created with additional diagnostic outputs. This new build was deployed to the array and has unexpectedly reduced the frequency of channel loss greatly.

Although this is good for our short-term need to conduct spectral line pilot surveys, the problem may come back in future firmware builds as it is not yet understood. The situation will be monitored and if the problem does return, we should at least have enough information to track down the cause.

Another stability issue that will be addressed during this increment is the occasional loss of array covariance matrix data during download. This greatly increases the operational overhead of forming new beam weights.

Alongside the excellent work being done on the firmware and control system, the science data processing team have been working on polarisation leakage calibration (as mentioned above) and the capture of roll axis metadata in the measurement sets to keep an accurate record of feed orientation on the sky.

New disk storage buffer online

In order to assist with the development of survey processing strategies, we have found it necessary to store visibility data for re-processing during pilot surveys. The strategy has been to process the first nominated field for each pilot survey several times, until achieving a reasonable level of quality and verifying all required data products for the given science case.

This need to re-process means that data must be retained for some time, placing considerable strain on our disk resources. Until now, we have been working with a 1 PB data ingest buffer and a 300 TB processing buffer.

Recently, the Pawsey supercomputing centre installed a new disk array specifically for use as an ASKAP data buffer. This has the benefit of being much larger and providing two independent partitions that are isolated from other storage infrastructure. The isolation should ensure that processing activities and other users of the supercomputers cannot create load that impacts our ability to observe.

The new disk array offers the same amount of space for ingest of new data (1 PB) and a significantly expanded (3 PB) area for processing. New data will be copied to the processing buffer for short to medium term storage and this area should provide plenty of space for expansion of intermediate imaging products.

We are conducting processing tests on the new disk array now and expect to record the first science data very soon.

eROSITA collaboration

In support of the MoU being finalised between Astronomy Australia Limited (AAL) and the eROSITA-DE collaboration, ASKAP is currently planning to observe the GAMA-09 equatorial field, the main target field for eROSITA performance verification. Based on widespread interest in this field from the ASKAP survey science teams, the observations will be carried out as an observatory project. Observing and processing parameters will be selected to meet as many science criteria as possible via consultation with the science teams. These observations will provide a valuable standalone dataset, as well as forming a useful multi-wavelength resource alongside the X-ray data within the scope of joint Australian/eROSITA-DE projects.

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