ASKAP Update, July 2020

In this issue, we describe new features available in the latest update to ASKAP's science data archive. We also report on improvements to ASKAPsoft and the ASKAPpipeline that have been prioritised due to pilot survey phase I feedback.

Pilot survey phase I data processing

During the past month, the Galaxy supercomputer has been kept busy processing data from pilot survey phase I. This experience is leading to a better understanding of the end-to-end workflow required to produce science-ready data products. The later workflow stages are being exercised for the first time and we are working to improve several aspects in response to user feedback.

The development framework and pipeline integration of quality control software is under review and we will also investigate ways to conduct validation more efficiently when large numbers of scheduling blocks are involved.

Extensive analysis of released EMU and WALLABY data, alongside quality control for the Rapid ASKAP Continuum Survey (RACS), have led to the development of two high-priority image processing improvements which will be available in the next ASKAPsoft release.

Convolving to a common resolution

Ongoing analysis of ASKAP flux scales has led to several insights, described in detail last issue. One challenge we face with a wide-field telescope is the fact that the point spread function (PSF) can change significantly even within one field, especially when observing far from zenith.

Similarly, observations of fields at different hour angles can lead to different PSF properties between adjacent survey tiles. This makes measuring consistent integrated flux values challenging. In some cases, elongated PSFs have different alignment in the overlap region between two tiles, so the PSF of the combined mosaic is not well defined.

The simplest solution to this problem is to convolve an entire tile (or group of tiles) to a matching resolution before further analysis. The chosen resolution is typically set by the largest PSF present anywhere in the data.

The ASKAPpipeline has adopted a python tool developed by Alec Thomson to convolve the pipeline-produced continuum restored images to uniform resolution. In cases where this results in a significant resolution penalty, the original image can be saved along with the convolved version to cater for different science cases. Since the two types of image have different filenames, both can be archived on CASDA for future reference. We will be extending this capability to spectral cubes in future, though optimisations may be needed before the current tool is operationally viable on large cubes.

Improved continuum subtraction

Feedback from WALLABY, FLASH and DINGO has shown that ASKAPsoft's continuum subtraction approach was leaving significant residual flux around some sources. The initial scheme involved subtracting continuum flux from the visibility data using either CLEAN components derived from deconvolution, or model components derived from source finding. During analysis of pilot survey phase I data, the survey science teams found several examples where incomplete deconvolution, spatial complexities or instrumental artefacts prevented accurate continuum subtraction using this initial approach.

Experiments with other software packages showed that additional subtraction of a linear fit to the bandpass on frequency intervals matching the beamforming bandwidth could significantly reduce continuum residuals.

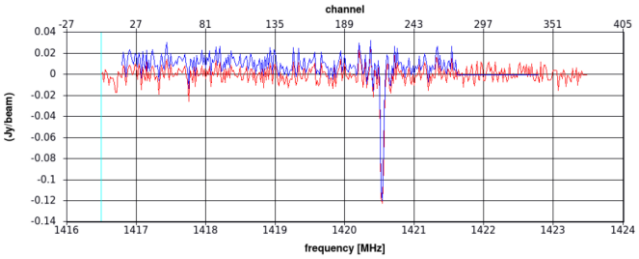

Figure 1: Improved continuum subtraction on the source MAXI J1348-630, showing remUVcont in red and the previous approach in blue. Figure provided by Wasim Raja.

The ASKAPsoft development team has developed a new continuum subtraction tool called remUVcont. This is similar to the one implemented in miriad's UVLIN task but using basis functions comprising polynomials and harmonics. remUVcont is built in python to facilitate quick testing and experimentation. The flexible features built into remUVcont and the related tuneable parameters

allow it to address several commonly encountered challenges in continuum subtraction of ASKAP data, like band discontinuities at the edge of beamforming intervals. Initial tests show that the use of this tool can significantly reduce continuum residuals (see Figure 1). Experiments are underway to derive the best parameters for specific science use cases.

CASDA major release features

On the 9th of July, a new version of the ASKAP science data archive (CASDA) was released, providing several features that should improve access to ASKAP data products.

Some of the improvements address issues with data upload and management, including easier removal of data products that do not pass quality control. Upload of survey data containing many small files has been significantly optimised based on experience with RACS and VAST observations. These surveys use comparatively short integration times but cover large areas of the sky.

Other improvements will be more visible, including the ability to display html-format data validation reports alongside the detailed description of a scheduling block's data products. Several improvements have been made to the user interface, including revised default parameter selection and separation of primary image data products (restored image cubes) from secondary products (noise maps, weights, higher order Taylor terms, etc.) in the tabular output of a search query. This makes it easier to find an item of interest quickly.

The CASDA team is also working on a series of improvements to the way value-added (level 7) data products are imported, managed, and displayed. These level 7 products are often uploaded by the science teams rather than the observatory. They represent high-level collections that combine ASKAP data in useful ways, such as catalogues covering multiple fields. The level 7 data deposit process now accepts images and catalogues at the same time, making it more efficient. Sources in a level 7 catalogue can also be linked to user-uploaded images, cubes, and spectra. This should encourage all science teams to upload final products representing pilot survey phase I once processing and analysis are complete.

In addition, level 7 catalogues will soon be selectable as layers on the ASKAP global sky map. Using this feature, survey science team members can explore their catalogue, click on a source to see its catalogue entry, and then download the level 7 image, cube or spectrum associated with that source. We will also be updating the sky map background with images from RACS when these are released over the next few months.

Finally, we have launched a new user access portal that contains documentation, examples, news related to data releases and ways to provide feedback and suggestions. This is the first port of call for users seeking more information about ASKAP data (see Figure 2).

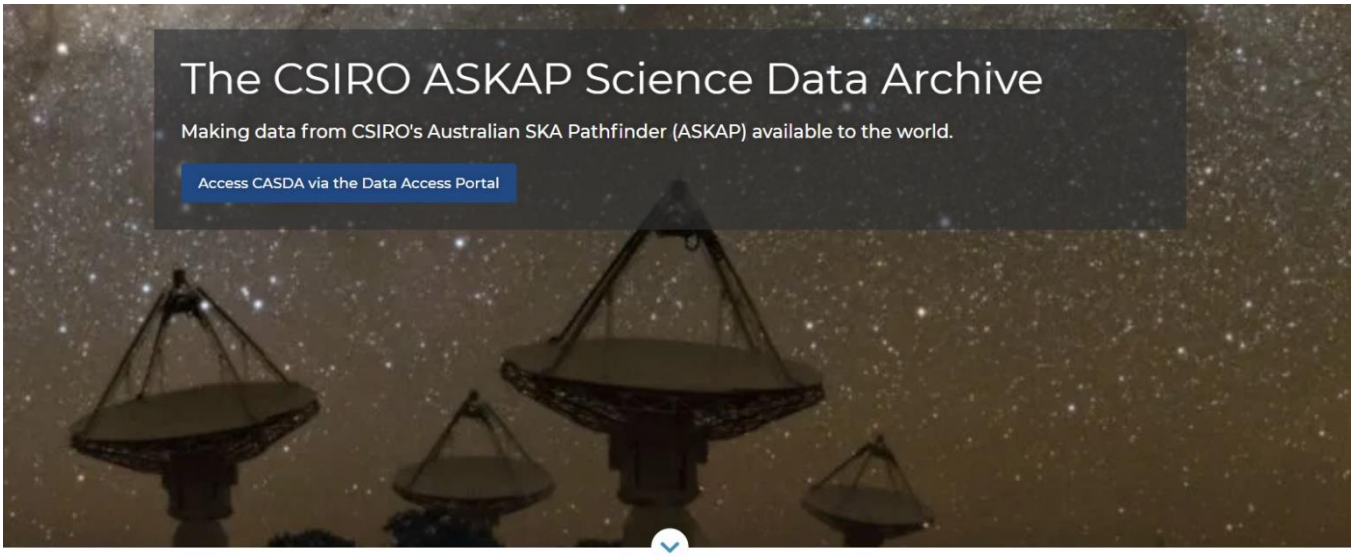

Figure 2: CASDA portal front page, which can be accessed at http://casda.csiro.au

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