

SIEF Special Research Program: Australian Square Kilometre Array Pathfinder (ASKAP)

The Australian Square Kilometer Array Pathfinder (ASKAP)

ASKAP is an innovative radio telescope being built at the Murchison Radio-astronomy Observatory (MRO) in Western Australia (WA). When fully commissioned, ASKAP will be world's largest, most sensitive survey radio telescope. ASKAP is made up of 36 steerable 12-metre antennas that will each be fitted with one of CSIRO's multi-award winning Phased Array Feed (PAF) receivers. PAFs allow ASKAP to take snapshots of the sky over 100 times the size of the full moon (conventional radio astronomy images are assembled one small region of the sky at a time).



The ASKAP radio telescope with its innovative phased array feed receives (at apex of antennas). Photo credit: CSIRO

This SIEF Project aimed to enhance and extend ASKAP through the construction of 12 second generation (Mk II) PAFs, bringing the number of ASKAP antennas to be fitted with Mk II PAFs up to 30. Having 30 Mk II PAFs helps ensure delivery of this revolutionary telescope at close to the scientific capability required to ensure optimum scientific impact and lasting benefit to Australia and will make possible significant advances in areas of SKA science such as: cosmology, galaxy evolution, cosmic magnetic fields and the nature of gravity, continuing Australia's role as a research hub of world-class radio survey science.

BETA testing of exceptional first generation PAFs

Over the life of the SIEF Project, the broader ASKAP Program has come a long way, with the success of ASKAP's 'BETA' test array of six antennas fitted with first generation (Mk I) PAFs being a major outcome. For two years BETA proved itself a critical development instrument for the new era of view astronomy that PAFs have enabled and BETA demonstrated performance beyond that of any other

radio telescope. To date, nine papers have been published describing scientific discoveries made with BETA and more are in the pipeline as BETA observational data, available on the web, is proving to be a rich source of novel findings for astronomers. BETA was decommissioned in February 2016 to make way for the installation of Mk II PAFs.

ASKAP and second generation PAFs

The prototype Mk II PAF was installed on an ASKAP antenna in September 2014. It operated reliably through the heat of summer and heavy rain and, more importantly, demonstrated the expected significant improvement over the Mk I PAFs. With these results in hand, the PAF production line at CSIRO's astronomy headquarters in Sydney got into full swing.

The first 'production' Mk II PAFs were installed in June 2015 and the first image was made just three months later. By May 2016, 12 Mk II PAFs were installed and in October 2016 ASKAP Early Science had commenced with these 12 PAFs. At time of writing, there are 24 Mk II PAFs installed: the aim is to have all 30 installed by the end of 2016.

In an exciting next step, CSIRO has sourced sufficient funds to upgrade ASKAP and fit all 36 antennas with Mk II PAFs, allowing ASKAP to reach its full potential. ASKAP will be the world's pre-eminent survey instrument for at least the next decade and will complement the planned telescopes of the international SKA project.

Exciting next steps

Over the life of the SIEF Project, the rate of PAF production improved markedly. This is a significant achievement resulting from streamlining production processes and cross-skilling the workforce to ensure a steady production rate was maintained. CSIRO was also able to slot into its production line, the manufacture of a PAF for Germany's Max Planck Institute for Radio Astronomy and have secured a contract to make another PAF for Jodrell Bank Observatory in the UK.

A number of Australian suppliers have been considerably upskilled by their involvement with ASKAP. High end electronics assembly supplier, Puzzle Precision, for example, expanded into premises ten times the size of its old factory and has grown its workforce by a similar factor. The company reports a sustained increase in business and now boasts a suite of clients from Australia and around the world.