Australian Square Kilometre Array Pathfinder – Fast Facts

The Australian Square Kilometre Array Pathfinder (ASKAP) is a world-class radio telescope currently being developed by CSIRO in the Mid West region of Western Australia. Once completed, it will be one of the most powerful survey radio astronomy instruments in existence.

A phased array feed (PAF) receiver installed on an ASKAP antenna at the Murchison Radio-astronomy Observatory. Credit: Barry Turner, CSIRO.

What is ASKAP?

ASKAP is a next-generation radio telescope incorporating novel receiver technologies and leading-edge ICT systems. It is made up of 36 antennas, each 12 metres in diameter, working together as a single instrument. When completed, it will be capable of high dynamic wide-field imaging using novel phased array feeds that will provide a unique new capability within radio astronomy.

ASKAP, as well as being a world leading telescope itself, also provides an important test-bed for Square Kilometre Array (SKA) technology.

What is the SKA?

The SKA is an international project to develop a future radio telescope that will have capabilities far in excess of even ASKAP. The SKA will be 50 times as sensitive and have a discovery potential 10,000 times greater than the best present-day instruments. It will be one of the largest and most ambitious international science projects ever realised.

It will help to answer some of the most fundamental questions of 21st Century astronomy and physics involving dark matter, dark energy, the nature of gravity, the origins of the first stars and galaxies and the generation of magnetic fields in space.

The CSIRO-run Murchison Radio-astronomy Observatory is in the region where SKA telescope infrastructure and components of SKA Phase One, SKA1-low, will be built in Australia. SKA telescope infrastructure will also be deployed in southern Africa.

As part of SKA pre-construction, CSIRO is taking a lead role in a number of R&D consortia involved in the design and validation process of the SKA, including 'Dish', 'Infrastructure-Australia' and 'Assembly, Integration and Verification'. The CSIRO SKA Centre has also been established to coordinate and guide SKA activities within the organisation

Why build ASKAP?

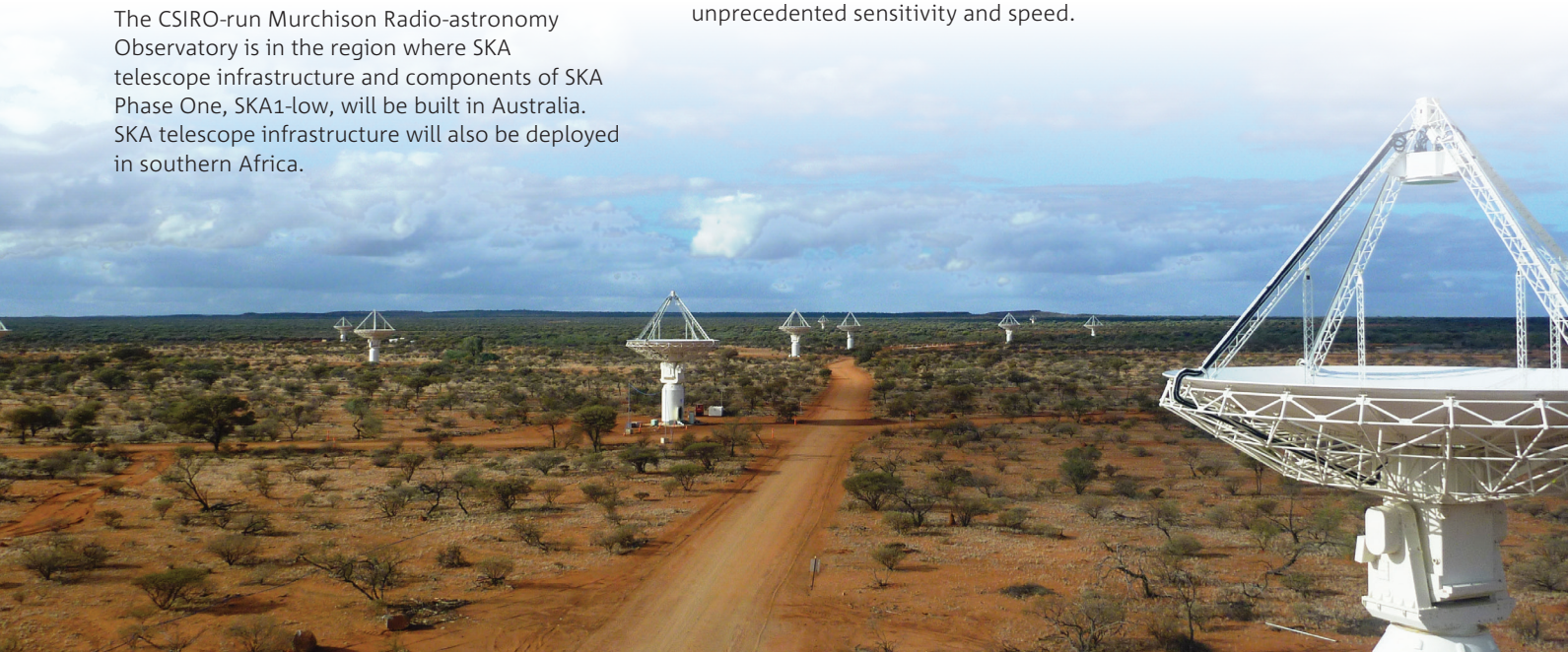
The ASKAP telescope will be able to detect hundreds of times more galaxies than current radio telescopes, helping us to understand how galaxies have formed and evolved. It will help us to understand how our own Galaxy has developed, and its current structure.

It will also be a world leader in the study of pulsars, transient radio sources, and magnetic fields in space, helping to cast light on fundamental physics and processes at work in the Universe.

Why is ASKAP special?

The design of ASKAP is unique among radio telescopes. Its antennas feature three-axis movement and will use 'phased array feeds' (or 'radio cameras') rather than 'single pixel feeds' to detect and amplify radio waves, a development being pioneered by CSIRO especially for ASKAP with application to the SKA. These attributes mean that the telescope will survey large areas of sky with unprecedented sensitivity and speed.

Antennas of CSIRO's Australian SKA Pathfinder at the Murchison Radio-astronomy Observatory in Western Australia. Credit: Steve Barker, CSIRO.



Where is ASKAP located?

The cluster (or array) of ASKAP antennas are located at the Murchison Radio-astronomy Observatory (MRO), a remote outback region about 350 km northeast from Geraldton in Western Australia. This follows the signing of an Indigenous Land Use Agreement (ILUA) with the Wajarri Yamatji Claimant Group.

This region is ideal for a new radio observatory because the population density is very low and there is a lack of man-made radio signals that would otherwise interfere with weak astronomical signals.

CSIRO acknowledge the Wajarri Yamatji people as the traditional owners of the Murchison Radio-astronomy Observatory site.

Building ASKAP

Construction of ASKAP began in early 2010, and all 36 antennas, as well as site infrastructure, were completed in mid-2012. ASKAP is currently undergoing the fit-out of its complex PAF receiver systems and electronics, as well as commissioning.

Engaging with industry

As CSIRO has moved through the design, development and construction phases of ASKAP, industry has played a crucial role in the delivery and ongoing support of technologies and infrastructure.

Industry collaborations enabled significant progress in technical areas such as computing architecture, low noise amplifier design, and geo-exchange cooling systems.

Powering ASKAP

CSIRO is working with partners to develop full scale, clean energy technologies for the MRO and for ASKAP's support computing facility, the Pawsey Supercomputing Centre, based in Perth. Solar power generation technology will help power the Murchison site, and an efficient geo-exchange cooling system has been employed to cool the digital signal processing equipment. The nation's largest direct heat geothermal demonstrator is being developed to help cool the Pawsey Centre supercomputer.

As both sites will have high electricity demands, the implementation of these renewable technologies will provide multiple benefits including a reduction in energy costs and a reduction in carbon emissions.

What is a PAF?

Phased array feeds (PAFs) are receivers or 'cameras' with many separate, simultaneous beams for detecting radio waves. They allow telescopes to have a much wider field-of-view, and to scan the sky more quickly, than existing receiver technologies.

Development is currently underway by CSIRO to develop PAFs as rapid imaging devices for the SKA and for wider use throughout the world's leading radio astronomy observatories. CSIRO is also investigating the use of PAFs in other domains where radio-imaging is required, including geophysics and medical imaging.

Past, present and future

CSIRO is a pioneer and world leader in radio astronomy research with a long and illustrious history backed up by the development of novel and ground-breaking instrumentation at radio, microwave and optical wavelengths.

CSIRO's division of Astronomy and Space Science currently operates radio telescopes at three observatories near the towns of Parkes, Coonabarabran and Narrabri in New South Wales. These radio telescopes are known collectively as the Australia Telescope National Facility. The facility is used by Australian and international scientists to conduct outstanding astronomical research.

ASKAP will provide Australian and international astronomers with another world-leading radio astronomy observatory. It will be operated by CSIRO as part of its National Facility.

The bulk of the first five years of ASKAP's operation have already been allocated to ten major international projects looking for pulsars, measuring cosmic magnetic fields and studying millions of galaxies.

CSIRO's Murchison Radio-astronomy Observatory (MRO) in Western Australia. Credit: Steve Barker, CSIRO.

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