

National Committee for Astronomy

A committee of the Australian Academy of Science

Inquiry to examine the Convention establishing the Square Kilometre Array Observatory

The Australian Academy of Science is writing in support of the proposed *Convention establishing the Square Kilometre Array Observatory*, tabled in the Senate on 9 September 2019 and currently under consideration by the Joint Standing Committee on Treaties. This is in support of astronomy, which has historical significance to Australia, plays a vital role in current scientific discoveries and has future prospects for advancing astronomical discoveries.

Historically, Australians have observed the sky for centuries. An Aboriginal archaeological discovery in Kakadu suggests that the earliest Australians, dating back to 65 000 years ago, were both technologically and culturally adept¹, and careful observers of astronomical phenomena. This is engraved in the Australian Aboriginal people who trace their cultural heritage back to the Dreamtime – the astronomical phenomena observed by the first Aboriginal and Torres Strait Islander people informed navigation, calendars, laws, social structure and predicted weather, and continues to do so in the present.

Astronomy has grown in Australia from the construction of the first government observatories in Sydney, Melbourne and Adelaide in the 19th century, through the advent of radio astronomy at the end of the Second World War and optical astronomy in the 1960s, to today's leading role in radio astronomy, especially low frequency studies. Australia's outback interior provides an excellent location for low radio frequency reception and is now the selected location for the Australian component of the Square Kilometre Array (SKA) telescope.

Brief overview of the Square Kilometre Array

The Square Kilometre Array (SKA) is an international “big science” project to build the world's largest radio telescope, which will eventually have over a square kilometre of collecting area at some radio frequencies. This will make SKA the most sensitive radio telescope ever built, and represent a huge advancement in engineering and scientific research and development. At the same time, it will address a wide range of questions in astrophysics, fundamental physics, cosmology and particle astrophysics. The project was originally conceived in 1991 with an international working group established in 1993. The

¹ <https://www.smh.com.au/technology/aboriginal-archaeological-discovery-in-kakadu-rewrites-the-history-of-australia-20170719-gxe3qy.html>

first Memorandum of Agreement was signed in 2000, followed by a series of early developments leading to its conceptual design in 2012. The SKA project is proposed to be built in the Murchison area of Western Australia and Carnarvon in Northern Cape in South Africa, where radio quiet zones have been established. The first phase will commence in 2021, involving the construction of an operational array capable of carrying out the first studies, and is slated to be completed in 2027.

The design and site quality will enable SKA to survey the sky many times faster than previous telescopes and provide radio imaging capabilities greater than what is currently available worldwide. The SKA established its headquarters at the Jodrell Bank Observatory in the UK. On 12 March 2019 in Rome, seven countries signed an international treaty to establish the Square Kilometre Array Observatory (SKAO). The seven initial member countries include Australia, China, Italy, the Netherlands, Portugal, South Africa and the United Kingdom. India and Sweden are expected to follow shortly, and eight other countries have expressed interest to join in the future. The intergovernmental organisation (i.e. SKAO) has the responsibility of building and operating the facility. The Australian SKA Office (ASKAO) sits within the Department of Industry, Innovation and Science, coordinates the government's national and international involvement in the SKA project. The ASKAO also engages Australian industry and the science community, supports community involvement near the project sites and provides opportunities for the design and development of the SKA while delivering public awareness².

Major benefits of the SKA project to Australia

The SKA will enhance our knowledge of the Universe, explore technology options and advance Australia's innovative capabilities³. The SKA will enable studies over a wide range of science, including the cosmic dawn, from the appearance of the first stars; cosmology, including the nature of dark matter and dark energy; probing galaxy formation and evolution; monitoring the sun's activity; looking for gravitational waves; mapping the thousands of pulsars in our galaxy; tracing cosmic magnetic fields; and the search for life elsewhere in the Universe.

² <https://www.industry.gov.au/about-us/what-we-do/australian-ska-office>

³ <https://www.skatelescope.org/wp-content/uploads/2018/08/COST-Workshop-Summary-SPDO-version-1.6.pdf>

Beyond the quest for astronomical discoveries, the SKA represents a model for global information and computing technology. This can be a major driver for developing and exploiting worldwide data transfer infrastructure that links industry, academia and society. The SKA project will push IT boundaries to innovate efficient, low cost, low power and effective receivers, electronics, data transfer networks, data processing capability, and data storage technologies. The result will be the development of new software and hardware systems that will power the SKA and set global standards for IT engineering and construction. Technological innovations from the SKA can be applied to other areas that process and store large volumes of data, including geoscience, meteorology, remote sensing, communications, environmental monitoring and the industrial and financial sectors.

The SKA infrastructure energy needs are expected to be around 50-100 MW and much of the demand will be concentrated in off-grid areas. In the era of global climate change and fluctuating fossil fuel prices, renewable energy offers a low-cost sustainable energy solution. The SKA infrastructure will take advantage of renewable energy technology that offers scalable energy generation, storage, distribution, efficiency and zero-carbon emission power supply. This will be a global model for 100% renewable energy system. The SKA project presents an opportunity for Australia and other participating nations to lead in the development of new techniques for an effective global research collaboration. The project will unite individuals, research groups, industry partners and governments in a global scientific fellowship that will have a long-term benefit to Australia.

The SKA project will have a positive impact on research, training and employment as this will breed a new generation of astrophysicists, engineers and data scientists, while creating job opportunities in a wide range of associated fields. Astrophysics links to other fields of science and technology and the SKA project will increase Australia's capabilities in aerospace, engineering, mathematics and the natural sciences.

Finally, the SKA project can improve tourism and other non-technology spin-offs. For example, a visitor centre may be located near the SKA support facility in Geraldton and create job opportunities for the local community. Indigenous artists and astrophysicists can work together to develop exhibitions or periodical workshops that connect Indigenous astronomy with modern astrophysics. This will give the Indigenous land-owners hosting the SKA project a sense of ownership of the telescope and its astronomy. Therefore, investment into the SKA project will provide long lasting benefits to Australia as

its construction and operation will increase local and regional skill development in science, engineering, technology and non-industry activities such as tourism and job opportunities.

Recommended Course of Action

While this submission supports the proposed Convention, the Academy makes the following recommendations based on its Decadal plan for Astronomy:

- We encourage graduate training programs that will ensure skills transfer and build highly skilled graduates for roles to be created in the SKAO project and the wider society.
- We recommend the establishment of a central body to promote and facilitate individual-research group-industry-government engagement and linkages with the SKA project.
- Adopt principles and practices of diversity at all phases of the SKA project and within the SKAO.
- The SKA project should ensure it minimises environmental impact by adopting green energy technologies
- Ensure the participation of Indigenous community in all phases of the SKA project.
- Ensure the availability of world-class high-performance data centres, computing facilities, hardware and software systems essential for SKA operation and global use.

For more information see the Academy's Decadal Plan for Astronomy at

<https://www.science.org.au/supporting-science/science-sector-analysis/reports-and-publications/decadal-plan-australian>.

For more information on this submission, or to arrange an appearance before the Treaties Committee, please contact the National Committees for Science Office <nc@science.org.au>.