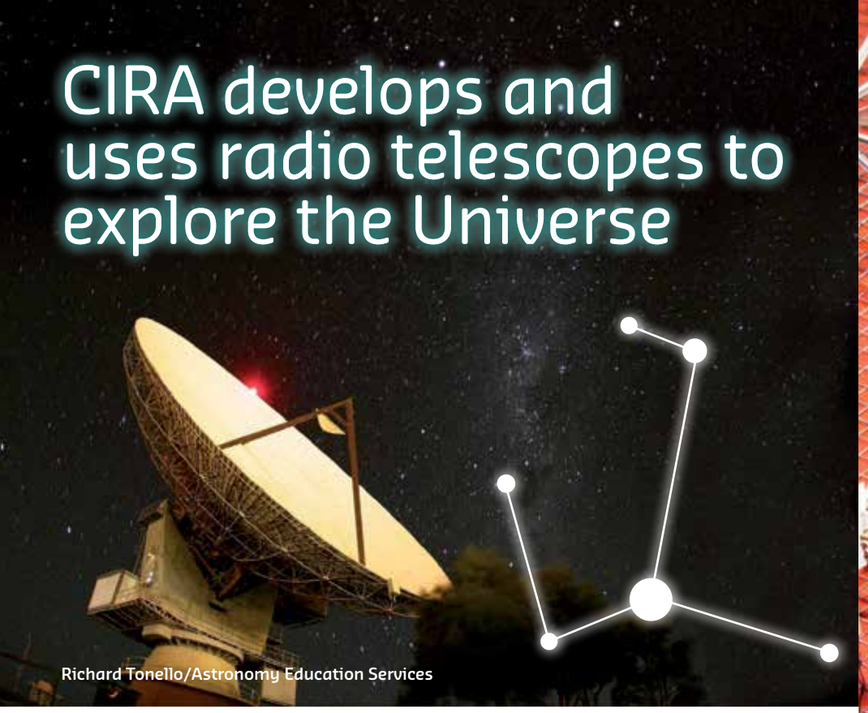
CIRA develops and uses radio telescopes to explore the Universe



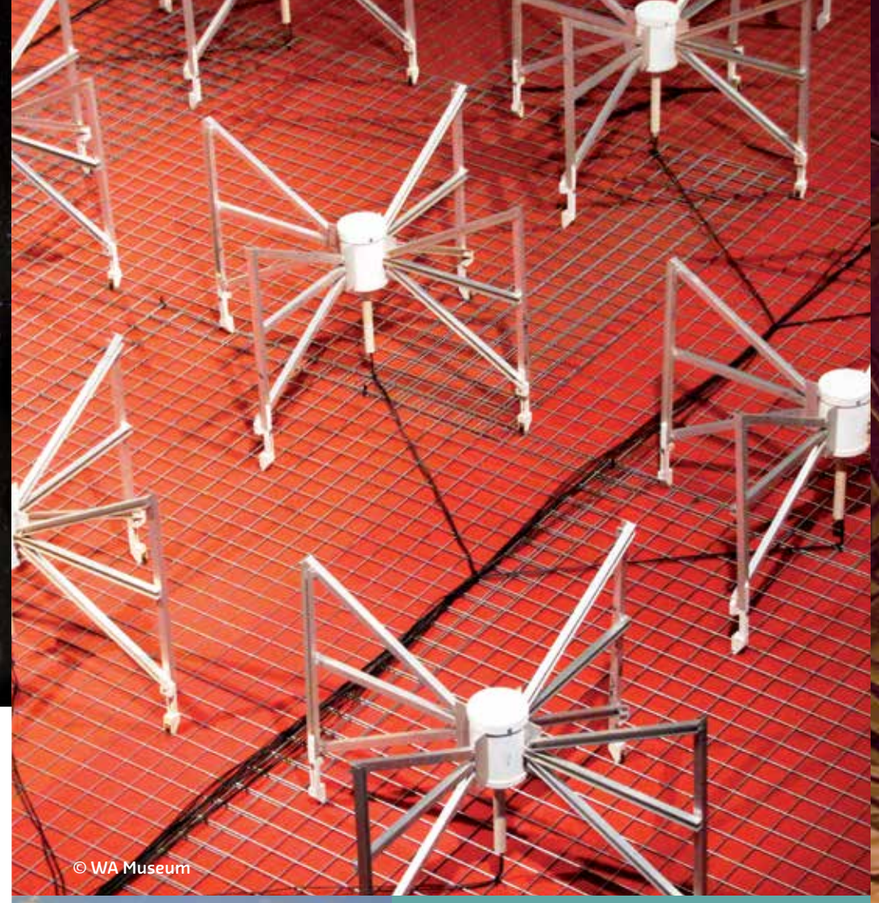
Richard Tonello/Astronomy Education Services

SKA AND SKA-LOW

In May 2012 it was announced that Australia–New Zealand, together with South Africa, would share hosting of the SKA, the largest and most sensitive radio telescope ever built. The scientific and engineering effort required to create the SKA is truly global, involving 67 organisations in 20 countries.

The entire low-frequency SKA (SKA-low), consisting of aperture array antennas operating between 70 and 450 MHz, will be built in Western Australia at the Murchison Radio-astronomy Observatory (MRO). CIRA has been heavily involved in the development of the only low-frequency SKA precursor, the Murchison Widefield Array (MWA) pathfinder project, which was constructed at the MRO.

CIRA is also playing a lead role in the pre-construction of SKA-low, Phase 1, which is scheduled for construction in 2016. SKA-low will be an 'all electronic' telescope in which many stationary antennas are connected to programmable signal processors and computers. The full SKA-low will consist of several million antennas, capable of groundbreaking science, including observations of the early Universe.



© WA Museum

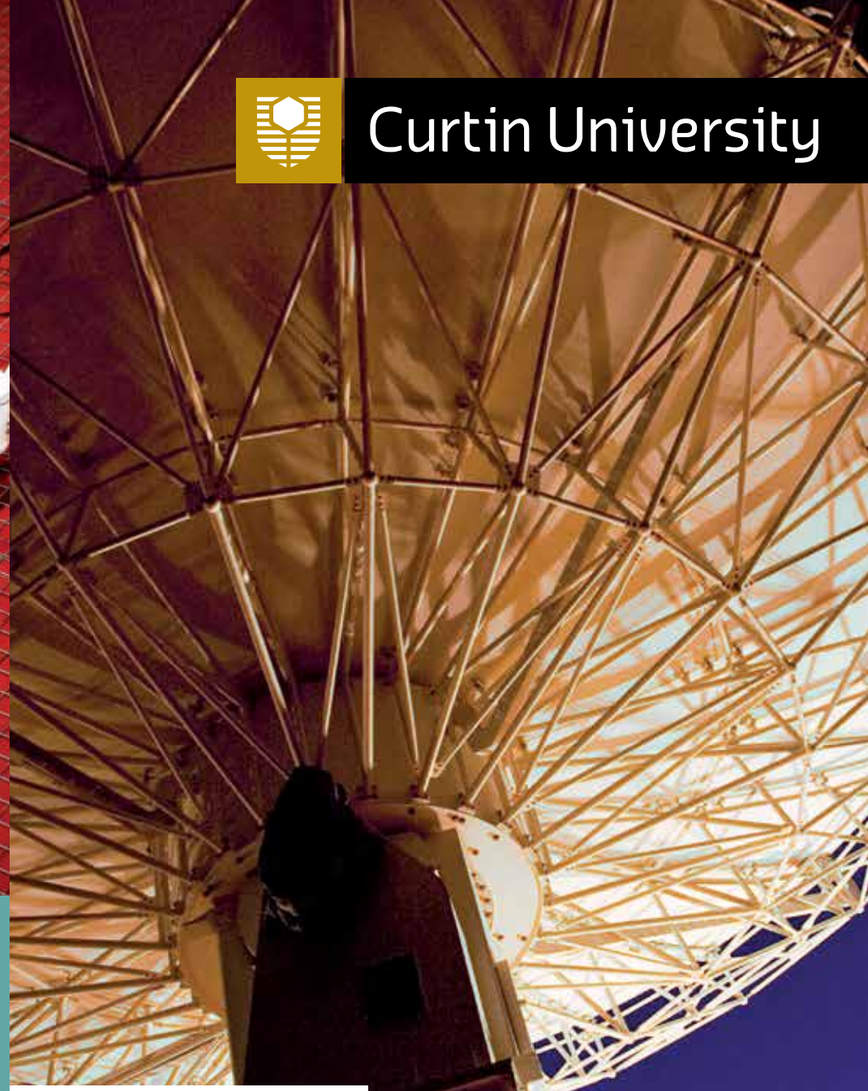
CONTACT

Curtin Institute of Radio Astronomy

Curtin University
Building 610, Brodie Hall
1 Turner Avenue, Technology Park
Bentley WA 6102
GPO Box U1987 Perth WA 6845

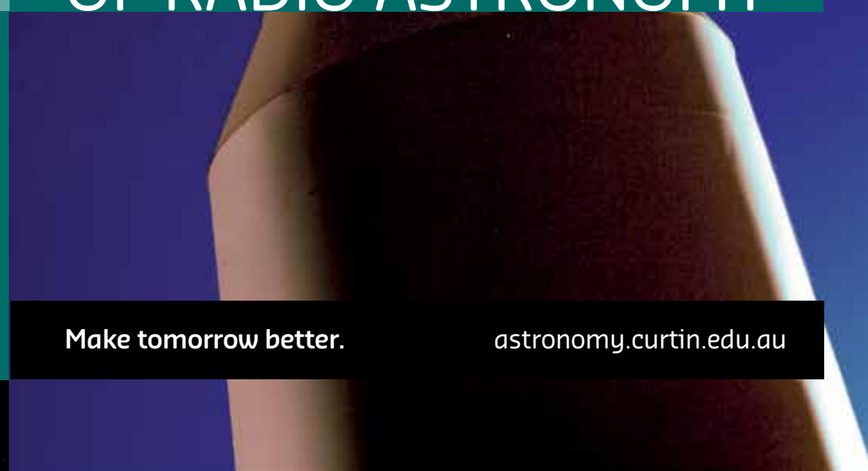
Tel: +61 8 9266 9899
Fax: +61 8 9266 9246
Email: cira@curtin.edu.au

Cover and image above: Department of Commerce WA



Curtin University

CIRA
THE CURTIN INSTITUTE OF RADIO ASTRONOMY



Make tomorrow better.

astronomy.curtin.edu.au

Curtin Institute of Radio Astronomy (CIRA) staff and students investigate the physics of stars and galaxies, and improve our understanding of high-energy and exotic physics, using a range of radio telescopes in Australia and around the world. They are at the forefront of international efforts to develop novel instrumentation and software to undertake this unique research.

CIRA is pivotal to the development of Australia's main component of the Square Kilometre Array (SKA), SKA-low, in Western Australia's Murchison region.

IMPACT AND APPLICATION

Radio astronomy provides fundamental information on the make-up and history of our Universe, including the birth and evolution of galaxies, stars and individual planets. It also contributes significantly to our knowledge of high-energy and exotic physics.

Radio astronomy demands leading-edge engineering science and technology in areas such as high-performance computing, signal processing, radio frequency systems and high-speed communications. Technology development often transfers to a wide range of down-to-earth applications.

CAPABILITIES AND ACTIVITIES

CIRA is headed by Professor Steven Tingay (astrophysics research) and Professor Peter Hall (engineering research). This multidisciplinary institute works at the nexus of engineering, science and computing, and tackles challenging research problems on the path to the SKA. Expertise includes:

- development and production of custom hardware and software
- communications technology and high-performance computing
- data collection and storage
- algorithm development
- data processing and analysis
- theoretical astrophysics.

Collaboration

CIRA is a major contributor to the **International Centre for Radio Astronomy Research (ICRAR),** an equal joint venture between Curtin University and The University of Western Australia. CIRA and ICRAR played a key role in Australia's bid to host the SKA, and will continue contributing to the development and scientific success of the SKA, particularly through the development of SKA-low.

CIRA staff contribute to the Australian Research Council **Centre of Excellence for All-sky Astrophysics (CAASTRO)**, formed in 2011. CAASTRO is led by the University of Sydney, in conjunction with the Australian National University, the University of Melbourne, The University of Western Australia, Curtin University and Swinburne University of Technology. CAASTRO aims to become the world leader in widefield astronomy, building unique expertise and research capability to position Australia to lead the science programs planned for the SKA.

CIRA leads an international consortium of 13 institutions involved in the **MWA pathfinder project,** the only low-frequency SKA precursor, which was constructed at the MRO. CIRA will continue to lead the operations and early data analysis from the full 128-tile telescope.

CIRA staff have direct links with the **International SKA Program Development Office** and are undertaking key design work for the SKA. Nationally, staff work closely with CSIRO to advance the design and deployment of the Australian SKA Pathfinder – a dish-based instrument being constructed at the MRO.

In collaboration with **CSIRO, the University of Tasmania and a number of international research groups,** CIRA plays a leading role in the enhancement of Very Long Baseline Interferometry (VLBI) capabilities in the Asia-Pacific region.

CIRA also makes use of the **iVEC** supercomputing, data storage and high-speed network facilities. An iVEC joint venture including Curtin University manages the $80 million Pawsey Centre Project, creating a world-class supercomputing facility to support the needs of the Australian radio astronomy research community, as well as researchers in other areas of computational and data-intensive science.

Research and education

RESEARCH AREAS

CIRA concentrates its research effort on several projects, including:

- construction and use of the MWA: science goals cover a range of cutting-edge Galactic and extragalactic astrophysics, including possible detection of the Epoch of Reionisation, when the first stars and galaxies formed in the early Universe; a survey of the dynamic radio sky; and solar physics
- development of new 'sparse array' antenna and related technologies for SKA-low
- key inputs – including development of advanced cost and performance modelling tools – to the international SKA system design now underway as a global engineering project
- the transient and variable Universe: studies of transient radio sources from distant objects, allowing investigation of physics under extreme conditions and the properties of the interstellar propagation medium. This includes development of novel instrumentation and algorithms for detecting transient and variable sources
- high angular resolution radio astronomy: investigations of the structure and motion of compact, energetic radio sources such as jets formed by black holes, and exploding or collapsing stars. This includes development of techniques for VLBI, such as more efficient data transport and processing.

OUTREACH AND EDUCATION

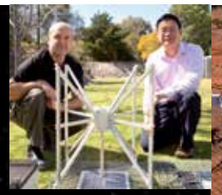
CIRA educates the next generation of radio astronomers and uses astronomy as a vehicle for raising awareness of physics, engineering and general science in the broader community. Outreach and education activities for teachers, high school students and the general public are ongoing.

Curtin offers an undergraduate degree with a full range of units in astronomy, astrophysics and data analysis. Undergraduate engineering project work is also available, and students can undertake science–engineering double degree programs with a radio astronomy focus. Practical involvement of undergraduates in real research projects is encouraged, and postgraduate projects in science and engineering are available in a variety of radio astronomy research areas.

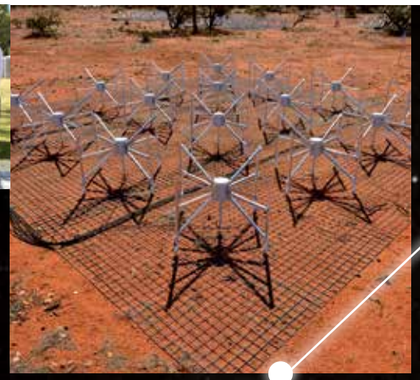
CIRA's radio astronomy engineering laboratory contains a full suite of fabrication and testing equipment for developing innovative ideas in radio astronomy. The laboratory allows development from concept stage through to prototyping and final operational experiments. It has become a focal point for Western Australian industry involved in collaborations with radio astronomers, providing physical facilities, high-level expertise, education through master classes, and seminars for exchanging ideas between collaborators.

The laboratory underlines CIRA's commitment to novel engineering and technology as a way of facilitating new science and CIRA's support of MWA and SKA-low development activities.

CIRA engages industry partners to bring concepts and services from radio astronomy to commercial viability, and its laboratories provide another mechanism for small and medium-sized enterprises to enter and support the radio astronomy industry in Western Australia.



Courtesy of ICRAR



Courtesy of ICRAR