Australian Government

SEARCHING THE SOUTHERN SKY, AND UNCHAINING THE INTERNET

Through their unique view of the southern sky, Australian researchers are unraveling the secrets of the cosmos—and they're doing it with a huge helping hand from the US. In return, Australian astronomer engineers have helped change the world via discoveries that have unchained notebook computers, made flight safer, improved CT scans, and delivered clearer sound. **Now, Australia and the US are working together to design the next generation of telescopes: the Giant Magellan optical telescope to be constructed in Chile; the gravitational observatories looking for echoes from the Big Bang; and what will be the world's largest radio telescope—the Square Kilometre Array.**

From hunting bombers to hunting galaxies—the birth of radio astronomy

Australia was one of the pioneers of radio astronomy, literally turning its World War II radar stations to the stars, developing techniques in processing radio signals and making the important discovery of the first radio galaxies outside the Milky Way. The mathematical techniques Australian pioneers used at this time went on to underpin the development of CT and MRI medical imaging as well as modern radio astronomy.

Transmitting the first lunar landing

America took heed of Australia's growing expertise in radio astronomy and contributed to the construction of the Parkes radio telescope in southern New South Wales, which found the first quasar (quasi-stellar radio source). The telescope later helped to track the first lunar landing, delivering pictures of the first moon walk to US television audiences.

Unchaining the computer

Using techniques he developed to clean up the radio waves from exploding black holes, astronomer engineer Dr John O'Sullivan and his team at CSIRO invented the tools needed for fast, reliable wireless computing in the home and office. Their patented ideas are built into almost every modern notebook and smart phone.

From similar origins came: the technology for Interscan, the first microwave-based aircraft landing system to be approved and deployed at US airports; some of the signal processing technology behind the bionic ear; and the consumer sound technology, Dolby Headphone, which was developed in Sydney by Lake Technologies.

Looking over the horizon

Australia's expertise with radio is also demonstrated in the over-the-horizon radar that guards the country's northern approaches—the Jindalee Operational Radar Network—developed over 40 years by DSTO with American support.

Creating tomorrow's telescopes

American and Australian astronomers and engineers are working closely on the development of a new generation of telescopes.

Guiding stars for Gemini

Australia and the US are among the seven national partners involved in building the Gemini Observatory, the world's largest publicly funded optical/infrared telescopes. The twin 8.1-meter telescopes, located at high altitude in Chile and Hawaii, can collectively access the whole sky. Researchers at the Australian National University have built a near infra-red spectrometer for the Hawaii telescope and an adaptive optics imaging system for the Chile telescope which will provide distortion-free images of the sky using natural and artificial guide stars. Other instruments are on the drawing board.

Assisting with the design of the adaptive optics system is Electro Optics Systems (EOS), one of the world's largest installers of medium-sized optical telescopes, which has built telescopes for the Universities of California and Hawaii. The company is also a world leader in laser ranging and targeting, remote weapons systems and the surveillance of space for debris. In 2005, it formed a strategic alliance with global defense company Northrop Grumman.

Starbugs and the Giant Magellan Telescope

Australia, along with seven US research institutions and Korea, is a founding partner in the international Giant Magellan Telescope (GMT) project to be constructed in Chile by about 2018. Of revolutionary design, it will be far larger than any existing optical telescope. Australian technology to be provided to the GMT may well include a light-capturing system incorporating novel robots known as 'Starbugs', being developed at the Australian Astronomical Observatory.

Starbugs will move optical fiber light receivers precisely to locations of interest in the telescope's focal plane. The fibers themselves are an outgrowth of astrophotonics, a field pioneered by Professor Joss Bland-Hawthorn of the University of Sydney. These fibers can selectively absorb unwanted parts of the spectrum to improve the analysis of astronomical objects.

Square Kilometre Array

Australian radio astronomers are working closely with their US counterparts in developing technology to be used in the Square Kilometre Array (SKA), the world's largest radio telescope, to be constructed either in Australia and New Zealand or in southern Africa from about 2016.

The SKA will comprise thousands of separate radio dishes and other antennae in a focal square kilometer, with additional detectors spread across an area the size of a continent. Combining the radio signals received by each of the sensors will effectively create one giant antenna thousands of kilometers across, to provide the sharpest ever radio images of the sky, with incredible sensitivity to faint signals.

Already, two facilities to test technology are underway at Western Australia's radio-quiet Murchison Radio-Astronomy Observatory, Australia and New Zealand's proposed core site for the SKA. The Murchison Widefield Array is being built by an international consortium of US, Australian and Indian research institutions. It has no moving parts, being made up of tile-like detectors that are tuned electronically, and is already collecting data on low frequency radio emissions. The second facility, the 36-dish Australian SKA Pathfinder, is under construction and due to start operating in 2013. It will combine high-speed surveillance of the sky with sensitivity in a search for pulsars, magnetic fields and galaxies.

Quantum computing

In 2010, a team of physicists and engineers at the University of New South Wales in Sydney led by Dr Andrea Morello and Professor Andrew Dzurak announced in the journal *Nature* they had developed one of the key building blocks needed to make a quantum computer using silicon—a 'single electron reader'.

Their work, and research at the Universities of Queensland and Melbourne, have put Australia at the forefront of development of the quantum computer, which promises exponential increases in processing speed over today's computers for tasks including database searches and encryption.

Chief Scientist for Australia

Professor Penny Sackett, a dual US-Australian citizen formerly of the Australian National University, is an authority on the discovery of planets outside Earth's Solar System. In her role as Chief Scientist, Professor Sackett advises the Australian Prime Minister on matters relating to science, technology and innovation.

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