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Online feature

Array for Australia?

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by Carmelo Amalfi
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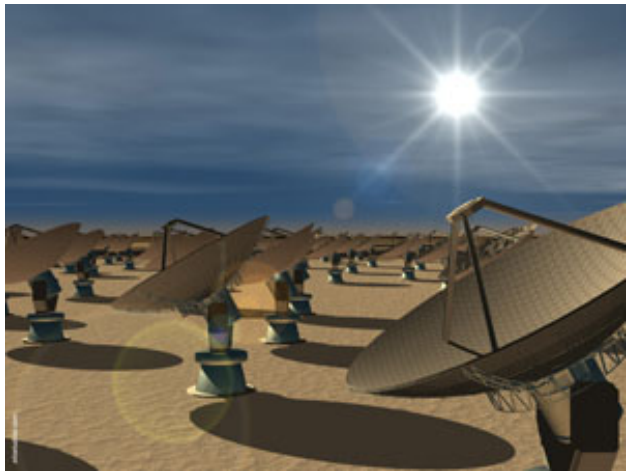

An artist's impression of the small dishes and focal plane arrays used in design of the Square Kilometre Array.
Image: XiloStudios

It might shed light on the origins of our universe or lead us to alien civilizations. The Square Kilometre Array will be the biggest radio telescope in the world - and it might call Australia home.

Astronomers across Australia are breaking open the champagne to celebrate one of the biggest announcements in astrophysics: that Australia was one of the two finalists to host the world's largest radio telescope.

The International Square Kilometre Array Steering Committee announced on September 28 that Australia and South Africa had made the shortlist to host the planet's most powerful array. Bids by China and Argentina were unsuccessful, failing to meet the strict site requirements. A final decision will be made in 2008.

The Square Kilometre Array (SKA) will cost A$1 billion to build and is expected to be operational by 2020. The

advanced array would consist of thousands of radio dish antennas spread across the continent to create a 'virtual' dish thousands of kilometres in diameter. Though spread over more than 3,000 km, half of the antennas in the Australian SKA would be in a central 5 km by 5 km region in outback Western Australia.

The bigger the collecting area, the better scientists can see distant objects, including black holes, dark matter and other distant radio sources – including alien civilisations, whose faint radio transmissions might be leaking into space but are too weak to be detected with current instruments.

Instead of being able to tune into one point-source in the sky, SKA's very wide field of view allows the study of multiple targets at the same time - and in unprecedented detail and speed. And that's just the science.

A new industry is also emerging, with collaborative projects already under development by members of the international SKA consortium consisting of 17 nations, including the United States, Britain, France, The Netherlands, Sweden and India.

In Australia, a core consortium of about a dozen companies and institutions was formed in 2005 to drive industry involvement in the SKA project.

For Patrick Walsh and his family, the decision to shortlist the remote Australian cattle station they live on will go a long way to attracting new developments in the Murchison and Mid-West regions of Western Australia. In 2004 they sold Mileura station, which had been in their family for 119 years, to the state government, but stayed on as managers.

"We believe the SKA represents an excellent opportunity for the Murchison, for Western Australia and Australia," Walsh said. "Anything this big will only attract a lot more science and industry because it is cutting edge. Winning SKA is like winning the Olympics."

Bringing optic fibre and power generation would benefit outback communities, he said, as well as his own children who will be able to access the Internet and have communications infrastructure taken for granted by those in towns and cities.

His family's interest in the SKA project was linked to their love of the night sky at Mileura – a station named by an Aboriginal tracker and meaning, "see a long way", he said. The tracker was helping provide local knowledge to visiting scientists from around the world so that they could identify the best sites to conduct experiments in the lead up to the final SKA decision in 2008.

"I always say there is no reason why you can't have the cows and telescopes on the same site," he said. "Our cows are very friendly and very quiet, and they are feeding Australia."

When *Cosmos* learned of the shortlisting through its own sources - a week before the official announcement - approaches were made to the CSIRO (a key partner in the project) for comment. But Australia's national science agency declined to discuss the matter ahead of the official announcement lest it jeopardise Australia's chances of winning the project.

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The announcement had originally been due to be made on October 5. But following enquiries from *Cosmos*, a decision was made to go public on September 28.

The Australian site at Mileura station, 130 km west of Meekatharra in Western Australia, was always expected to make the shortlist of SKA contenders following a number of favourable technical reports of the radio-quiet Mid-West region.

Results of CSIRO studies at Mileura station also have found, "the spectral occupancy is extremely low, even in the region of the spectrum below 1600MHz, which is, internationally, the most crowded."

A final decision on which one of the shortlisted countries will host the SKA project will be made in 2008. Construction is due to begin by 2012, the phased development of the spiral-shaped array including 10,000 km of fibre-optic cable and super-fast computers yet to be invented for the next generation of radio astronomy science.

While lobbying is expected to intensify now the shortlist has been announced, researchers at Mileura station have already been busy developing a low-frequency array telescope which is due to be completed by 2010 as part of the SKA-generation suite of technologies.

Such projects would continue to be developed whether or not Australia is chosen to host the SKA project. Operating at 80 to 300 megahertz, the Mileura widefield array - low frequency demonstrator (LFD) will be able to detect radio sources in space with unprecedented sensitivity and versatility. It is a scaled down version of the SKA network.

The preferred configuration for the real SKA is a five-arm, symmetrical, log-spiral arrangement of array stations out to a distance of 350 km from the core or central station. The core SKA station had to be at least 550 km from urban centres where there are high densities of transmitters that can affect arrays operating at low to mid frequencies.

"The Mileura site achieves this; the closest major urban centre is Perth, 620 km away," according to a special issue of the September Australian SKA Planning Office newsletter updating SKA-related activities in Australia and New Zealand. "The Mileura site also has excellent sky coverage, a stable ionosphere and low precipitable water vapour."

Unlike South Africa, which is lobbying strongly for SKA, Australia's sparsely populated interior allowed it, "enormous freedom in selecting the final SKA shape," it added. "All array stations for the principal configuration lie within Australia, greatly simplifying administrative arrangements for establishing and managing the SKA."

South African bid leader Bernie Faneroff has said that most of the science could be done using only South African stations, though current designs include spin-off stations in Botswana, Namibia, Kenya, Madagascar, Mauritius, Mozambique and Ghana.

He has said there was not a lot to choose between South Africa and Australia on scientific grounds, with South

Africa having cheaper electricity costs and a "geographical upper hand" over Australia, whose remoteness Faneroff claimed would add significantly to SKA's costs.

The formal proposal to host the SKA project in Australia was submitted in December 2005, with the state and federal governments investing time and funding to build up a physical and 'political' presence at Mileura.

"Australia's strategy is to identify the best site and put on it technologies needed to develop the SKA," astronomer Peter Quinn told *Cosmos*. The acclaimed astronomer has just moved to Perth from the European Southern Observatory in Germany, where he was a senior official.

The technologies being developed at Mileura station and overseas promise to advance understanding of the behaviour and impact of solar storms by measuring the thousands of bright radio sources which change as they pass through the ejected plasma. The changes, which depend on magnetic field strength and direction, allow astronomers to analyse accurately the properties of coronal mass ejections and their impact on Earth.

Regardless of which country is chosen to host the world's most important telescope, the SKA promises to take science back to the first stars and galaxies to form after the Big Bang, detect pulsars and discover the elusive gravity waves Einstein theorised rippled throughout space-time at the speed of light.

"Perth will become a major centre of science if Western Australia wins the SKA project," Quinn said. "The astronomy community is already aware of the potential at Mileura and is planning and investing in projects now."

Carmelo Amalfi is a science writer in Perth, Western Australia.