CAREERS

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Artist's impression of the Australian Square Kilometre Array Pathfinder radio telescope to be built at the Murchison Radio-astronomy Observatory.

AUSTRALIA

Astronomy in the outback

A bid to host a major international radio telescope has created a demand for astronomers in Western Australia, and built a community that looks set to endure.

BY JAMES MITCHELL CROW

Very little happens in the outback of Western Australia — and that's how a growing group of astronomers likes it. The area is remote from urban centres and industry, so it is extremely radio-quiet: free of the 'noise' generated by cars, mobile phones and other trappings of civilization. That makes it an ideal spot in which to study radio waves from distant corners of the Universe, and is key to the nation's bid to host a prestigious international telescope, the Square Kilometre Array (SKA).

Five years ago, there was not a single astronomy researcher based in the state. Now, with the SKA on the horizon, two advanced pilot radio telescopes planned, high-level government

funding available and a fledgling astronomy community looking to add to its ranks, Western Australia has the potential to be a research hub for years to come. But to succeed, it will have to sustain funding and attract enough researchers to this remote corner of the world.

SKA BAND

The astronomy expansion was sparked in 2006, when an international committee announced that Australia was one of two nations bidding to host the SKA, picked from a shortlist of four. The €1.5-billion (US\$2.1-billion) SKA will be the world's most powerful radio telescope, a continent-spanning array of dishes with a total collecting area of one square kilometre that will combine to make an instrument 50 times

more sensitive than today's best. It is expected to help unlock some of the Universe's biggest mysteries, including the nature of dark energy and dark matter. Next year, the SKA selection panel will make its final decision on whether the telescope will be built on sites spanning Australia and New Zealand, or in South Africa.

Not every astronomer is convinced of the SKA's merits. Some wonder whether scientists and engineers can overcome technological, computing and energy-consumption challenges to maximize the array's effectiveness. "Any project of the scale that we are talking about has people who question whether this is the right way to spend the money," says Anton Zensus, director of the Max Planck Institute for Radio Astronomy in Bonn, Germany. ►

Hundreds of radio antennas could one day populate the outback, as in this artist's rendition.

► The SKA has ample support in Europe, but sentiment is mixed among US astronomers; some suggest that a large optical telescope should be the priority. The array's proponents are pushing ahead anyway, continuing with the site-selection process and developing technologies to enable it. Western Australia's astronomy community has already benefited.

INFRASTRUCTURE BUILD-UP

The University of Western Australia (UWA) and Curtin University, both in Perth, are working hard to bring astronomers to the state. In 2006, the state government awarded two Aus\$1-million (US\$1.1-million) Premier's fellowships to allow the UWA to hire radio astronomers. At the same time, Curtin established a high-profile position in radio astronomy, and another in astronomy engineering.

The academics who filled these posts came up with a plan to expand the local astronomy community. On 1 September 2009, they opened the International Centre for Radio Astronomy Research (ICRAR) in Perth — a joint venture between the UWA and Curtin, established with Aus\$100 million in funding from the universities and the state government to take it through to 2014. Planning for a grant-renewal application to form an expanded ICRAR 2 is already under way, says Peter Quinn, one of the Premier's fellows and the director of ICRAR. The university recruited him from the European Southern Observatory in Munich, Germany.

The centre already employs more than 60 staff members, 55 of whom are researchers in astronomy, engineering or information technology. More than half have been recruited from overseas. It also has 22 PhD students and 20 postdocs. "We aim to be a really strong part of the Australian bid for the SKA," says Quinn, "but we want also to be a major contributor to the international SKA project, independent of where the SKA is placed." The UWA and Curtin have already established seven permanent tenure-track positions at ICRAR.

Alan Duffy is a postdoctoral researcher who joined ICRAR in 2009. He came from one of the world's most prestigious astronomy research institutes, the Jodrell Bank Centre for Astrophysics in Manchester, UK. The culture difference is marked, says Duffy. "It's a lot more vibrant," he adds. "In ICRAR there's a real sense of a bit more adventure going on, as it is so new."

Two key attractions brought Duffy to ICRAR. "In the bigger institutes in Europe, often you're more of a cog in a machine, whereas at ICRAR I had the chance to really define my own research agenda," he says. Duffy runs computer simulations to test theories related to galaxy formation and dark matter.

The other attraction was the infrastructure being built nearby, including two 'pathfinder' radio telescopes that will test some of the technology to be used on the SKA. One is the Aus\$150-million Australian SKA Pathfinder (ASKAP), which will, for example, try out ways of viewing huge areas of the sky at once by combining the signals from multiple antennas. The other is the Murchison Widefield Array, which will consist of 512 antenna elements and will test some of the signal-processing systems to be deployed on the SKA. Both instruments will be located at the Murchison Radio-astronomy Observatory, opened in 2007 about 750 kilometres north of Perth. The observatory will be the base of the SKA if Western Australia's bid is successful.

The raw data from the telescopes will be stored and processed at the Pawsey Centre, an Aus\$80-million supercomputing facility in a

"There's a real sense of a bit more adventure going on, as it is so new."

Alan Duffy

suburb of Perth, which is expected to be among the top 20 fastest supercomputers in the world when it opens in 2013. Astronomy brought the Pawsey Centre to Western Australia, but other scientists will benefit from its presence, including geoscientists and biologists, says Andrew Rohl, executive director of iVEC, the joint venture that will build and run Pawsey.

The investment so far adds up to between Aus\$450 million and \$470 million. This is specially allocated money, notes Quinn, and it has not been taken from existing state or federal government astronomy funds or projects.

IS THE SKA THE LIMIT?

This year, six Australian universities, including the UWA and Curtin, joined together in the Australian Research Council Centre of Excellence for All-Sky Astrophysics (CAASTRO), a consortium aimed at training astronomers. It has Aus\$28 million of federal funding, which goes mainly towards employing postdocs, says Lister Staveley-Smith, deputy director of the consortium. The first recruits have already started work, and the centre will support close to 50 postdocs over the next seven years, with funding renewal possible.

If Australia wins the right to host the SKA, there will probably be another hiring surge. "If the SKA did come to Australia, then I could see ICRAR growing to a major science centre in the 100-plus staff range," says Quinn. Zensus predicts that there will be several hundred researchers affiliated with the SKA at any one time, first commissioning the site and then operating the central array, conducting experiments and running the computer centre.

Zensus notes that Western Australia's workforce and infrastructure are unlikely to "fizzle away", whether the bid is successful or not. The astronomy infrastructure elsewhere in Australia — such as SkyMapper, an optical survey telescope near Canberra — should complement the radio data from ASKAP. "From an academic point of view, there's a critical mass now — you don't notice any isolation because they've brought some of the best people in the world to you," says Duffy. Staveley-Smith agrees. "You wouldn't think that Perth would be the number-one spot for someone from Europe to apply for a job, but we've had some excellent applicants," he says. "I think the astronomy community worldwide recognizes that the government here is being very supportive to astronomy at the moment, coincidentally at a time when things are not quite so good in other places."

"If anything, I'm even more keen to stay in the country than when I first applied," says Duffy, who is a year away from the end of his postdoctoral contract and is applying for an Australian Research Council early-career award. "There's a sense that Australia really is this amazing place to be right now." ■

James Mitchell Crow is a science journalist based in Melbourne, Australia.