

This is one of a series of newsletters to keep interested parties informed about the progress of SKA-related activities in Australia and New Zealand. Previous newsletters are available from ► [www.ska.gov.au](http://www.ska.gov.au) ► [www.ska.govt.nz](http://www.ska.govt.nz)

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*The editors would like to warn Aboriginal and Torres Strait Islander people that this newsletter might contain images of people who are deceased.*

## Indigenous Land Use Agreement Complete

Construction will begin on the Australian Square Kilometre Array Pathfinder (ASKAP) radio telescope at the Murchison Radio-astronomy Observatory in Western Australia's Mid West region following an Indigenous Land Use Agreement (ILUA) signed with traditional owners, the Wajarri Yamatji People.

The ILUA between the Yamatji Marlpa Aboriginal Corporation, the Wajarri Yamatji People, the Government of Western Australia, Commonwealth Government and CSIRO was officially registered by the National Native Title Tribunal on 13 November 2009.

This important milestone was celebrated at a special event at Western Australia's Parliament House in Perth on 26 November 2009 attended by representatives of the Wajarri People, Western Australian State Ministers and Members of Parliament, the Australian Department of Innovation, Industry, Science and Research, and CSIRO.



*A special event was held at Western Australia's Parliament House in Perth on 26 November 2009 to celebrate registration of the ILUA. (From left) The Hon. Brendon Grylls (WA Minister for Lands), the Hon. Christian Porter (WA Attorney General), Anthony Dann (Chair, Wajarri Yamatji Working Group) and the Hon. Troy Buswell (WA Minister for Science and Innovation). Photo Credit: WA Department of Commerce.*

Registration of the ILUA means that CSIRO's lease over the Murchison Radio-astronomy Observatory has taken effect.

It also provides a range of practical and financial benefits to the Wajarri Yamatji People, including education and training opportunities.

Anthony Dann, Wajarri Traditional Owner, said of the agreement, "It's an exciting time for Wajarri People, the Mid West and Australia that such a major development will be happening in our country."

The ILUA was one of the fastest ever negotiated, due to the support of the Wajarri Yamatji People and all levels of government. It demonstrates the ongoing and successful development of ASKAP, as well as providing additional support for the Australia – New Zealand bid to host the SKA.



Representatives of the Wajarri Yamatji People, Yamatji Marlpa Aboriginal Corporation and CSIRO at Parliament House in Perth. (Front row, from left) Elizabeth Papertalk, Ike Simpson, Ross Boddington, Ron Simpson, Malcolm Ryan. (Second row, from left) Phillip Vincent (Barrister for Yamatji Marlpa Aboriginal Corporation), Pam Mongoo, Robin Boddington, Matthew Punch (Yamatji Marlpa Aboriginal Corporation), Janie Ronan. (Third row, from left) David DeBoer (CSIRO), Gloria Merry, Anthony Dann, Gavin Egan, Gordon Fraser. Photo Credit: WA Department of Commerce.

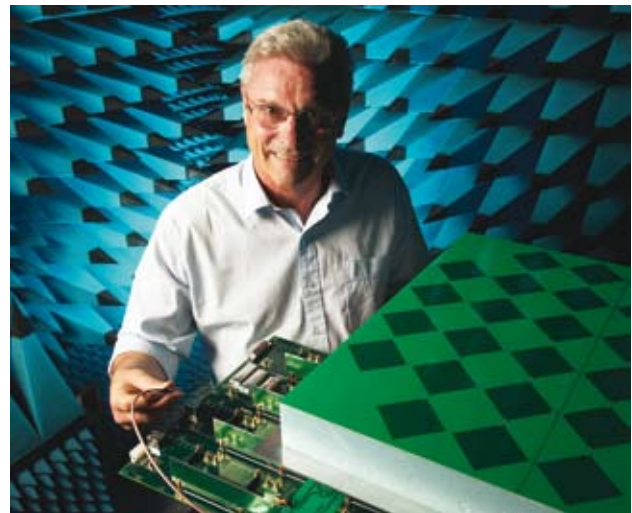
## ASKAP Engineer Receives Top Science Award

For his achievements in astronomy and wireless technologies, CSIRO's Dr John O'Sullivan has been recognised with Australia's pre-eminent science award – the 2009 Prime Minister's Prize for Science.

Dr O'Sullivan was Project Leader of CSIRO's Wireless Local Area Network (LAN) Research Team, a group that developed wireless LAN technology that is used in most wireless communication systems. This technology is used by over 800 million people every day.

The wireless LAN story can be traced back to Dr O'Sullivan's work in astronomy and his application of mathematical equations called Fourier transforms to help eliminate the problems posed by multipath transmission in astronomical data.

Dr O'Sullivan's latest efforts are directed towards the development of an innovative radio camera or "phased array feed" with a uniquely wide field-of-view for the Australian Square Kilometre Array Pathfinder (ASKAP) radio telescope being built by CSIRO.



CSIRO's Dr John O'Sullivan with a prototype of the revolutionary phased array feed for the ASKAP radio telescope. Photo Credit: Chris Walsh, Patrick Jones Photo Studio.

By going back to first principles, Dr O'Sullivan has developed an innovative "chequerboard" design for the phased array feed, the prototype for which is already delivering world-leading performance.

Dr O'Sullivan's work has increased ASKAP's information gathering potential by more than an order of magnitude, which is central to achieving transformational science with the telescope, and also has the potential to influence the design of the SKA.

## Senator Carr Visits US, UK

Australia's Minister for Innovation, Industry, Science and Research, Senator the Hon. Kim Carr, visited the US and UK in October 2009 to promote the SKA and Australia and New Zealand's bid for the international telescope project. Senator Carr was accompanied by Mark Paterson (Secretary, Australian Department of Innovation, Industry, Science and Research) and Dr Brian Boyle (Chair, Australia – New Zealand SKA Coordination Committee).

Receptions held in Washington and London were attended by high-level representatives from government and industry. Keynote addresses included a presentation by Dr Boyle on "Blue Whales, Black Holes, and the White Heat of Astronomy".

While in the US, Senator Carr discussed the SKA with Representative Bart Gordon, Chairman of the US House Committee on Science and Technology, and with senior officials from the Department of State, Department of Energy, National Science Foundation, American Association for the Advancement of Science, and National Academies.

In the UK, Senator Carr met with the Rt. Hon. Lord Peter Mandelson (First Secretary of State, and Secretary of State for Business, Innovation and Skills) and with senior ministers and key research agencies involved with the SKA. Senator Carr also met Professor Richard Schilizzi (Director, SKA Program Development Office).



*Lord Peter Mandelson (at left) and Senator Kim Carr at their meeting to discuss the SKA. Photo Credit: Katharine Campbell, Australian Department of Foreign Affairs and Trade.*

There is a high level of awareness of the benefits the SKA can deliver in both the US and UK. For example, the UK is collaborating with CSIRO on ASKAP and developing a range of complementary activities such as a broadband network test-bed for long baselines to support the SKA.

## Australia, New Zealand Participate in SKA Planning

Australia and New Zealand were well represented at the latest international SKA meetings held in November 2009 in Manchester, UK. Staff from CSIRO, the International Centre for Radio Astronomy Research (ICRAR), and Auckland University of Technology participated in the European Union's Preparatory Phase Studies for the SKA (PrepSKA)

Work Package 2 (SKA Technology) meeting, which aimed to provide a snapshot of the world-wide progress towards the design of the SKA. In particular, there was considerable interest among participants in the performance and cost of ASKAP's antennas and prototype phased array feed.

While in Manchester staff also participated in a number of other related meetings, including those of the SKA Science and Engineering Committee, Power Infrastructure Task Force and Agencies SKA Group.

How the SKA will look, and where it is to be located, are among the many questions that need to be addressed before construction can begin. The PrepSKA program is the framework within which this decision making is taking place. Seven PrepSKA working groups have been established:

- ▶ Work Package 1: Project Management
- ▶ Work Package 2: SKA Technology
- ▶ Work Package 3: Site Characterisation and Selection
- ▶ Work Package 4: Governance
- ▶ Work Package 5: Procurement/Industry
- ▶ Work Package 6: Funding
- ▶ Work Package 7: Implementation Plan

Through the Australian Department of Innovation, Industry, Science and Research, CSIRO and New Zealand's Ministry of Economic Development, Australia and New Zealand are active participants in planning for the SKA.

## CSIRO, IBM to Collaborate on Single Digital Backend

CSIRO and IBM have agreed to enter into a collaborative research and development agreement to develop a prototype single digital backend as a strategic SKA activity in Australia.

The sheer scale of the SKA demands a flexible, adaptable and low-cost processing system for the massive digital data stream that will be created by the telescope. An option being investigated by CSIRO's ASKAP team for the SKA is to base this on a supercomputer running a standard operating system called the "single digital backend" (SDB). The SDB has the potential to significantly augment the scientific capabilities of the SKA.

In March 2009, CSIRO issued an open call for Expressions of Interest (EOI) to seek collaborator(s) to develop a prototype SDB system. The detailed evaluation of the EOI proposals has been completed, with IBM selected as the preferred collaborator. CSIRO and IBM are now working towards developing a project plan for their proposed collaboration.

The SDB system development will be completed in three project phases led by Dr Tim Cornwell (CSIRO) and Glenn Wightwick (IBM Australia).



Brian Boyle (CSIRO SKA Director) and Steve Bond (IBM Australia General Manager, Public Sector) signed a statement of intent to work together on developing a prototype single digital backend for the SKA. Photo Credit: Tony Crawshaw, CSIRO.

## Science News

### Australian SKA Pathfinder (ASKAP) Update

#### First ASKAP Antenna Passes Factory Tests

CSIRO staff travelled to China at the end of September 2009 to undertake factory acceptance testing of the first ASKAP 12-metre antenna.

It was in November 2008, after an international tendering process, that CSIRO awarded the contract for construction of ASKAP's 36 antennas to Chinese company CETC54.

During their busy seven-day visit to CETC54's test range in Shijiazhuang, the ASKAP team worked through the antenna's factory acceptance tests, which were all successfully completed.

"Our visit was the first opportunity the ASKAP team has had to see the antenna's unique three-axis movement in action, and it was great to see all our plans come to life," said Dr Carole Jackson, ASKAP Antenna Project Leader.

The antenna has now been disassembled, painted and is on its way to the Murchison Radio-astronomy Observatory in Western Australia where construction will commence in December 2009. ASKAP's antennas, and their technical systems, will be completed by 2013. Once built,

ASKAP will operate as part of CSIRO's radio-astronomy facility for use by Australian and international scientists.

### Survey Science Project Teams Meet

Representatives of the ten Survey Science Projects that will use ASKAP in its first five years of operation (see anzSKA Newsletter 24) held their first meeting with CSIRO staff on 21 October 2009. More than 20 people attended, either in person or by phone, and heard about development of the telescope, its computing system, and how CSIRO will provide support to the teams.



Some of the participants in the SSP kick-off meeting. (Front row, from left) Ray Norris, Tara Murphy, Ilana Feain, Naomi McClure-Griffiths, Baerbel Koribalski, Lisa Harvey-Smith, John Dickey, Martin Meyer. (Back row, from left) Lewis Ball, Jean-Pierre Macquart, Tobias Westmeier, Bryan Gaensler, George Hobbs, Steven Tingay, Simon Johnston, Helen Johnston, Andrew Hopkins. Photo Credit: Gabby Russell, CSIRO.

"The meeting was very positive and there was a good sense of everyone wanting to work together to achieve the best science outcomes possible from ASKAP," said Dr Simon Johnston, ASKAP Project Scientist.

The first edition of a new publication, *ASKAP Science Update*, has been published to keep the international science community updated about the progress of ASKAP and the Survey Science Projects. It is available online at [www.atnf.csiro.au/projects/askap](http://www.atnf.csiro.au/projects/askap).

### Geothermal Cooling Trial Starts

Keeping ASKAP's electronic systems at a constant, cool temperature is an important design consideration, particularly as the telescope will require power 24 hours a day, every day of the year. CSIRO has started trialling a prototype geothermal cooling system that will be used to assess whether this offers an efficient and cost-effective option for cooling ASKAP's electronics and reducing the telescope's overall demand on power.

Installation of the prototype system commenced at CSIRO's Marsfield site in late July 2009. It uses cool water to transfer heat energy away from ASKAP's prototype electronics cabinets. Subsequently, the heated water is cooled by using high pressure/temperature refrigerant gas in reticulated copper pipes buried to a depth of 30 metres in the surrounding lower-temperature earth. The refrigerant gas condenses in the copper pipes and returns to a compressor in its liquid state.



*A prototype geothermal cooling system is being trialled at CSIRO's Marsfield site. Photo Credit: Grant Hampson, CSIRO.*

By measuring the system temperatures using thermocouples attached along the length of the buried copper pipes and internal water pipes, the ASKAP team will be closely monitoring the performance of the system over coming months. A "passive" air cooling option for ASKAP has already been trialled at CSIRO's Parkes Testbed Facility.

## Murchison Widefield Array (MWA) Update

The MWA team is in the process of integrating and demonstrating the prototype 32-antenna system at the Murchison Radio-astronomy Observatory (MRO). In November 2009 several MWA team members from across Australia, the US and India gathered at Curtin University of Technology's node of the International Centre for Radio Astronomy Research (ICRAR) in Perth in order to integrate and test the hardware correlation system for the 32-antenna prototype under the watchful eyes of MWA Project Manager Wayne Arcus (ICRAR) and MWA Project Engineer Dr Bob Goeke (MIT).

Initially, the integration took place on the bench in the lab followed by a visit to the MRO to integrate the correlator with the rest of the system. A second site visit is scheduled for

December 2009, when further data will be collected for the 32-antenna system test and verification program. Analysis of the data collected will take place in preparation for a review of the system in February 2010.

*Steven Tingay, ICRAR and Curtin University of Technology for the MWA team*

## EDGES Deploys at the MRO

In August 2009 a single low-frequency dipole antenna was deployed at the Murchison Radio-astronomy Observatory (MRO), Australia and New Zealand's candidate core site for the SKA, for a three-month automated observing campaign. The antenna and an accompanying digital receiver constitute the Experiment to Detect the Global EoR Signature (EDGES).



*The EDGES antenna (in the foreground) at the MRO. Under the antenna, in a white protective envelope, is an analog receiver chain with internal comparison-switched calibration noise sources. The cable leads back 70 metres to the CSIRO trailer, which houses a direct-sample digitiser. Photo Credit: Judd Bowman, Caltech.*

EDGES is a collaboration between Caltech and MIT/Haystack Observatory, funded by the US National Science Foundation, that aims to develop a high dynamic-range radio spectrometer capable of detecting the cosmological epoch of reionization (EoR), a significant but poorly understood period in the history of the Universe.

The experiment measures the all-sky spectrum between 100 and 200 MHz in order to probe the global evolution of 21-cm emission from neutral hydrogen gas at high redshift. In this type of measurement, reionization should produce a faint, step-like contribution to the all-sky spectrum that is superimposed on the much brighter Galactic synchrotron foreground. The observed frequency of the "step" and its sharpness encode both the redshift and duration of the reionization epoch.

With one month of observations analysed from the current MRO deployment, the campaign is yielding the first-ever constraints on reionization from redshifted 21-cm measurements.

The deep, clean spectrum obtained so far by EDGES rules out very rapid reionization histories. But it also points the way to needed future improvements. The instrument is presently limited from detecting histories with longer time scales by systematic errors that change slowly with frequency.

*Judd Bowman, California Institute of Technology for the EDGES team*

## SKA Molonglo Prototype (SKAMP) Update

A highly successful two-day meeting, *Science with SKAMP: Widefield Spectroscopy of the Southern Radio Sky*, was held at Molonglo Observatory on 16 and 17 September 2009. Approximately 40 astronomers participated in the meeting, including international speakers from the US, Canada and India.

Topics covered included:

- ▶ The status of SKAMP instrumentation
- ▶ Surveys for redshifted 21-cm and OH absorption systems
- ▶ Searches for variables and transients
- ▶ Studies of radio recombination lines in the interstellar medium
- ▶ Mapping of non-thermal emission and magnetic fields in the Milky Way and other galaxies
- ▶ Synergies with other upcoming wide-field surveys with the MWA, SkyMapper and ASKAP

Various upcoming challenges for SKAMP surveys were discussed, including the development of a real-time pipeline needed to handle the large data rate, the hostile radio interference environment resulting from SKAMP's proximity to Canberra and source confusion in deep integrations.

On the other hand, it was clear that SKAMP has some unique capabilities amongst SKA pathfinders: it has a large collecting area already in place, offers continuous and highly redundant u-v coverage, is a university instrument that can be dedicated to large projects, and already has all-sky reference images in hand from previous sky surveys. The presentations and ensuing discussion at this stimulating workshop made clear that there is broad community interest in the exciting scientific opportunities that SKAMP will soon be offering.

More information on SKAMP and the workshop are available at <http://www.physics.usyd.edu.au/sifa/Main/SKAMP>.

*Bryan Gaensler, University of Sydney for the SKAMP team*

## New Zealand Science Update

The growth of radio astronomy research in New Zealand has continued with the recent completion of two postgraduate theses related to the SKA.

Stuart Weston's Master of Philosophy thesis on very long baseline interferometry techniques led to the development of radio image synthesis software, new approaches to the assessment of image quality, and a novel "phased" approach to SKA construction. Stuart's work, with an emphasis on New Zealand participation in the SKA, was conducted in close collaboration with researchers in Australia at Swinburne University of Technology and the new International Centre for Radio Astronomy Research.

A methodology for the measurement of radio frequency interference in New Zealand, which has the potential to be used for the assessment of possible SKA sites, was the subject of Paul Banks' thesis. This research was sponsored by New Zealand's Ministry for Economic Development and ASTRON in The Netherlands, and was conducted in close collaboration with CSIRO.

*Sergei Gulyaev, Auckland University of Technology*

## VLBI and GNSS: New Zealand and Australian Perspectives

Very long baseline interferometry (VLBI) and global navigation satellite system (GNSS) techniques are essential parts of modern space geodesy, and both have the potential to play a vital role in the SKA.

In conjunction with the conference *Pathways to SKA Science in Australasia* (see anzSKA Newsletter 24) a workshop on VLBI and GNSS, and integration of the two techniques, will be held on 15 February 2010.

**Where:** Auckland University of Technology, New Zealand

**When:** 15 February 2010

**Registration:** Now open

**More information:** Visit [www.aut.ac.nz/skanz2010](http://www.aut.ac.nz/skanz2010) for details of the conference program and to register.

## Industry News

### ASKAP Industry Engagement Update

CSIRO recently hosted the third in its special technical ASKAP/SKA industry discussion series, "Developing sensitive,

ultra-wideband phased array receivers for radio astronomy". Held on 23 October 2009, 15 industry representatives from 10 companies participated in the session, which included discussion on the challenges faced in the development of receivers for ASKAP and the SKA, building the world's first "chequerboard" phased array feed receivers, and the next-generation receiver – an L-band "system on a chip". CSIRO is now discussing how to progress the phased array feed's design for manufacture, and the development of an integrated system on a chip receiver, with a number of interested parties.

## New Zealand SKA Industry Consortium (NZSKAIC) Update

In September 2009, NZSKAIC hosted a strategy workshop with research and government stakeholders to develop a cohesive strategy for participation in Australia and New Zealand's bid for the SKA. The workshop, facilitated by IBM New Zealand, focused on participants describing the "end" state (vision and desired results) they aspired to achieve, as well as describing the "means" (the course of action) to get to that destination.

Stakeholders found the session extremely useful, and a very positive contribution towards defining how New Zealand will collectively work to assist the joint bid. A further session is planned for early December 2009 to further define the strategy and tactics to achieve the group's vision.

This strategy work also allows NZSKAIC to "plug in" the existing capability framework it has developed working with the New Zealand SKA Research and Development Consortium, providing a comprehensive and coordinated plan for developing New Zealand SKA-related capability.

*Dougal Watt, New Zealand SKA Industry Consortium*

## Education and Outreach

### Outreach Ideas Go Global

PULSE@Parkes, a remote-observing outreach activity that CSIRO plans to extend to ASKAP and later the SKA (see anzSKA Newsletter 24), was shared with participants at the recent Astronomical Society of the Pacific's *Science Education and Outreach: Forging a Path to the Future* conference.

CSIRO Education Officer Rob Hollow delivered a presentation "Building Educational Programs for the Australian Square Kilometre Array Pathfinder" at the meeting held in San Francisco in September 2009.

"The conference provided a valuable opportunity to meet with US outreach groups and plan future collaborations," said Rob.

In addition to attending the conference, Rob also visited staff at the SETI Institute and Sonoma State University to learn more about their outreach activities and share ideas about future programs.

## Roadshows Raise Astronomy Awareness in WA

Recent International Year of Astronomy activities in Western Australia provided a great opportunity to raise the profile of astronomy, as well as ASKAP and the SKA, with local communities.

In October 2009, more than 5000 people hit the "space trail". A self-drive guided tour, the trail was designed to raise awareness of ten space-related facilities and features in and around Perth including observatories, discovery centres, museums, and a nearby meteorite impact site. During the course of one week, participants collected stamps from each of the sites they visited in their trail "passport".

Viewing nights and day time astronomy presentations, including a multimedia introduction to the SKA, have been held throughout regional Western Australia. Scitech's Peter Birch and Alecia Jongewald visited centres including Broome, Pia Wadjari, Geraldton, Karratha, Port Headland, Exmouth, Carnarvon, Kalgoorlie, Gingin and Darlington where they engaged more than 5500 people in the wonders of the Universe and the future of astronomy.

As well as events for the general public, Scitech has also recently run mobile planetarium shows for primary schools in regional communities including Badgingarra, Dandaragan, Eneabba, Leeman and Mingenew.

*Paul Nicholls, Scitech*

## Ilgarijiri Exhibition Moves to Canberra

The highly successful exhibition *Ilgarijiri – Things Belonging to the Sky* was launched in Canberra at the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) on 27 November 2009. The exhibition opening was part of a one-day symposium on Indigenous astronomy that included speakers Wardaman Elder Bill Yidumduma Harney from the Northern Territory, Yamatji artist Charmaine Green, and CSIRO astronomer Ray Norris.



*Some of the works from the exhibition Ilgarijiri – Things Belonging to the Sky on display at the Australian Institute of Aboriginal and Torres Strait Islander Studies in Canberra. Photo Credit: John Goldsmith.*

*Ilgarijiri* is an exhibition of Indigenous art based on a cross-cultural exchange between artists from Yamaji Art in Geraldton and astronomers from the International Centre for Radio Astronomy Research (ICRAR), with a focus on the country where the Murchison Radio-astronomy Observatory is sited (see also auSKA Newsletter 23). The exhibition has previously run in Geraldton and in Perth, and will be open to the public in Canberra from 30 November. In March 2010 the exhibition will be featured at a conference, *Communicating Astronomy to the Public*, in Cape Town, South Africa. The *Ilgarijiri* project blog can be found at <http://ilgarijiri.wordpress.com>.

*Steven Tingay, on behalf of the Yamaji Art and ICRAR collaboration*

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