

# SKA newsletter

Volume 24 - July 2012



## The Square Kilometre Array

Exploring the Universe with the world's largest radio telescope



[www.skatelescope.org](http://www.skatelescope.org)

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Project news

## > From the Office of the SKA Organisation

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**The SKA Project has taken some extremely important steps over the last six months, since publication of the previous newsletter. First off, on November 23rd at Heathrow Airport near London an agreement to set up the SKA Organisation was signed by the founding members from Australia, China, Italy, New Zealand, the Netherlands, South Africa and the UK. The SKA Organisation itself, a Company Limited by Guarantee, was set up a few weeks later on December 14th 2011. In recent months, both Canada and Sweden have become full members of the SKA Organisation and India has joined as an associate member (with the intention of upgrading to full member status soon).**

The members of the SKA Organisation (without Ltd. or Limited in the name, because it is a not-for-profit company) have pledged to contribute at least one million euros each to fund the central office for the four year pre-construction phase (2012-2015). In addition, they will also finance the local activities carried out by Work Package Consortia that are being formed at element (previously called sub-system) level.

The Office of the SKA Organisation, which has taken the place of the old SKA Program Development Office (SPDO) is to be led by the Director General and exercises management and system design authority over the whole project, as granted by the Board of Directors. Although recruitment for a permanent Director General started well before the organisation was set up, it was already clear that this process would only be

concluded after the site decision had been taken. The board therefore appointed me as Interim Director General, which is why I am writing this piece after eight years of introductions to the newsletters by Richard Schilizzi. I'd like to take this opportunity to once again thank Richard for his enormous contribution to the SKA over that period.

The second major step was taken on 25th May 2012, when the Members of the SKA Organisation announced the outcome of the site selection process. The SKA will be built in both Australia and Southern Africa - in phase one capitalising on the investments made in the precursors ASKAP and MeerKAT. This outcome will naturally have an impact on the project, but it is one that provides the possibility of building on the quite significant capability that both precursors represent.

The agreement means that in phase one, Australia will host the low frequency aperture arrays (AA\_low) and a survey instrument that incorporates the 36 ASKAP dishes and uses phased array feeds - still part of the advanced instrumentation programme (AIP) and therefore subject of course to a successful review of this technology. In phase one the SKA in South Africa will incorporate the 64 MeerKAT dishes (equipped with single pixel feeds) into an instrument that is optimised for deep observations. Indicative numbers for the size of both dish arrays are 96 in Australia and 254 in South Africa (including the precursors). The AA\_low array will have ~50 stations. All three arrays will operate independently as part of a single SKA Observatory. Compared with previous plans

this offers astronomers a new instrument: a survey telescope in Australia.

In phase two, the dish array in South Africa will be built out further, adding many dishes (reaching numbers of ~3000) and baselines up to ~3000 km, taking the SKA into the other partner countries in Southern Africa. The mid frequency aperture arrays, also part of the AIP programme, will be built in South Africa. The low frequency aperture array in Australia will see a major enhancement of stations in phase two (to ~250). There are no plans for expansion of the survey instrument.

The Office of the SKA Organisation will take the lead in assessment of the impact of the site agreement on the work to be done. Together with the host countries, plans for the incorporation of the precursors into SKA phase one are to be drawn up by the end of the year. The agreement certainly means that the work breakdown structure/statements of work (WBS/SOW), drawn up in close collaboration with the community over the last six months, have to be updated. The recent call for expressions of interest was issued as a way of identifying interest in participation in stage one of the preconstruction phase and generated over 130 responses. The need to update the WBS/SOW will mean a delay of at least three months before the next stage, the request for proposals to participate in stage one of the preconstruction phase, goes out.

The office needs to grow quickly if it is to take on the ambitious task of leading the SKA project into the next phase, especially in the light of the dual site agreement and with the increasing participation of organisations around the world. The project will also have to make the transition to a more formal and structured way of working. Providing structure is essential for an ambitious technical project

like the SKA, which depends on people working together closely despite being distributed all over the world. The first new members of staff have already arrived: Paul Furness, as ICT Officer on 28 May, Helen MacDonald as Finance Officer on 11 June and Andrew Taylor as HR Officer on 25 June. Recruitment is currently underway for project managers, system engineers, the project scientist and a communications officer. Check out [www.skatelescope.org/jobs](http://www.skatelescope.org/jobs) for details.

In April of this year construction started on the new building, provided by the University of Manchester at Jodrell Bank Observatory. Work is progressing rapidly and is expected to be completed in October 2012.

These new offices will provide an excellent and stimulating environment for staff with space for visitors, as well as facilities for video conferencing, essential for a modern and distributed project like the SKA. We hope to welcome many of you over the years to come.

***Michiel van Haarlem***  
***Interim Director***  
***General***



## > Industry participation

**As the project moves into the early stages of the preconstruction phase, the Office of the SKA Organisation continues to interact with industry on a number of levels. We are adding to the SKA mega-project knowledge bank through high level interactions with experienced multi-national firms and agencies. Meetings with industry representatives explore capability and technology pathways, as well as products and programmatic support.**

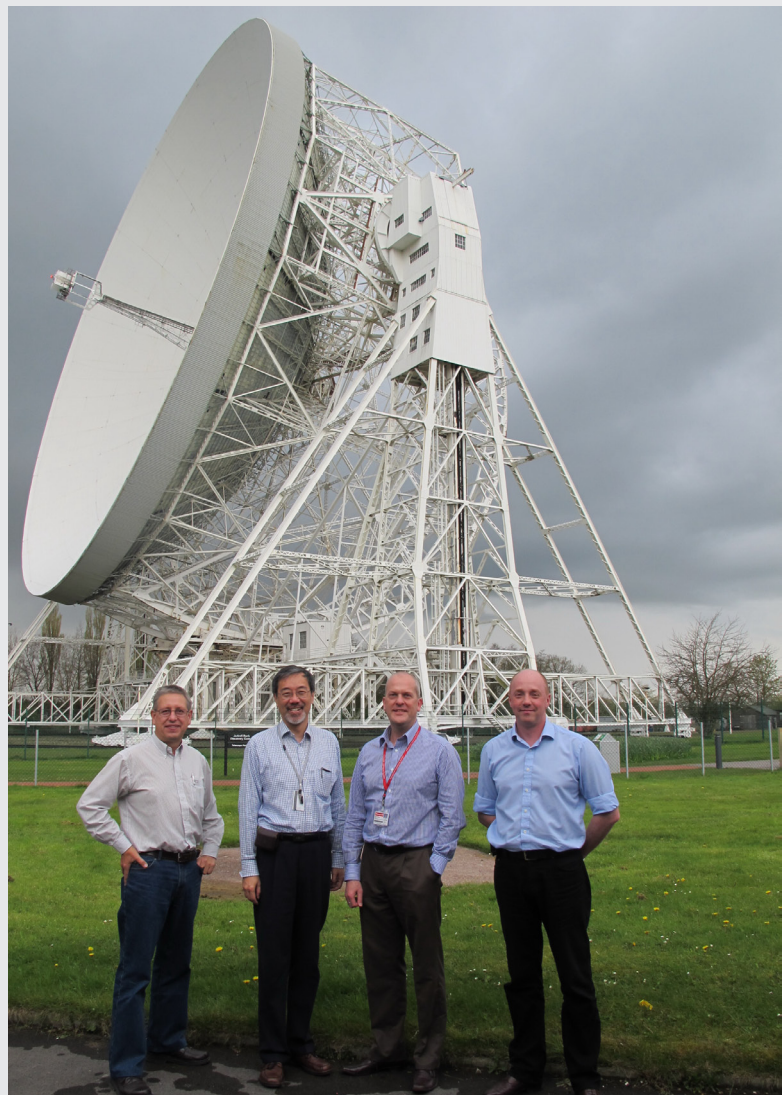
The Office of the SKA Organisation receives a constant level of enquiry from industry seeking information about the project. These enquiries are welcomed and are often referred to the relevant industry consortium leader. Industry groups are currently engaging with their regional participating organisations, especially as the expressions of interest (EoI) process for stage one of the preconstruction phase has now commenced. SKA precursor projects continue to let contracts for site engineering work and electronics fabrication. In Europe, several initiatives indicate growing engagement with SKA member institutes.

> *Phil Crosby, Manager - Industry Participation Strategy with HoneyWell engineers at Jodrell Bank Observatory. Credit: Georgina Harris, SKA Organisation.*

### Recent activities

SKA Office staff have recently met with industry representatives from companies including Ciena Inc. (US), Orbit Communications (Israel), and Vega Space (Telespazio) to explore capability and technology pathways.

Phil Crosby and Georgina Harris took advantage of the RTS 2012 gathering in



Manchester, UK in April 2012, to meet with large scale industrial project experts from Fluor Ltd, and Worley Parsons, as well as exploring new cryo-cooling technologies with engineers from Honeywell.

### Industry engagement strategy

A new version of the SKA industry engagement strategy is now available from the SKA website. This version contains updated information from the Office of the SKA Organisation, and more detail concerning practical industry participation in the next phase of the project. Find the link on this page <http://www.skatelescope.org/ska-industry/>.

### Mega-project management

We continue to add to the SKA Office mega-project knowledge bank through high level interactions with highly experienced multi-national firms and agencies. In March 2012, the International Centre for Complex Project Management (ICCPM) held its first 2012 Complex Project Management Roundtable in Australia. Phil Crosby joined around 40 other mega-project experts from across the spectrum of government and the private sector, including aerospace firms such as BAE Systems and Thales. David Pitchford, Executive Director Major Projects Authority U.K, gave the keynote address, and the day was summarised by Kim Gilles, Vice President Boeing Australia, who emphasised the value of lessons learned, and of recognising the driving schedule of big technology projects.

### Regional industry groups

The various industry groups associated with the SKA member countries remain active with their regional participating organisations, and the focus of recent meetings has been around practical arrangements for supporting

the proto-consortia in advance of the work package consortia request for proposals (RfPs) planned for later this year.

Both SKA precursor projects continue to engage with industry to support site engineering work and electronics fabrication.

In South Africa contracts are in place for the RF chain, dishes and receiver support. Tenders are being evaluated for antenna positioners, and partners evaluated for the digitiser, timing and frequency reference, and science processing. ACTOM are providing major power distribution components.

In Australia, the ASKAP dishes are now all on site. Workshops in Perth on SKA power and SKA networking attracted over 20 firms to review the known SKA requirements and preconstruction phase work. ICRAR ICT has established a number of industry collaborations including agreements with Data Direct Networks (DDN) and ThoughtWorks. Fremantle-based (WA) company, Poseidon Scientific Instruments was awarded a \$1.3 million contract to help deliver a key SKA precursor located at the Murchison Radioastronomy Observatory.

In Europe, the VIA-SKA project - a viability study of the Spanish industrial participation



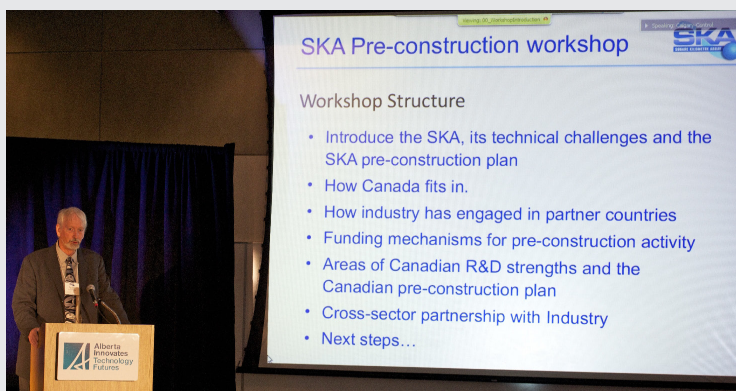
▶ *The Canadian SKA workshop, Calgary, Canada (Credit: Luke Tymowski, CYBERA, Calgary).*

in the SKA - has produced a first survey of the capacities of Spanish industry. More than 40 companies have shown their specific interest in areas ranging from the design and manufacture of antennas and aperture arrays to data processing and signal transport and synchronisation. Special emphasis has been placed in the area of green power supply. Discussions in Portugal, Spain, Germany and the Netherlands on sustainable power for the SKA led to a two day seminar in June 2012 which reviewed current R&D trends, industry forecasts for solar energy options and green energy experiences, with a focus on applications to the SKA.

In March 2012, UK Trade & Investment hosted a meeting for UK companies to learn about the overall structure of the SKA pre-construction phase. Nearly 60 organisations were represented - from major international companies to SMEs and specialist firms.

Finally, in Canada, the University of Calgary, hosted a workshop in April 2012, with the purpose of communicating the processes and timelines of the SKA preconstruction phase. The aim was to foster international links as well as national collaborations between Canadian industry, government and university R&D labs in preparation for Canadian participation in the pre-construction phase of the SKA.

***Phil Crosby, Manager – Industrial Participation Strategy***



➤ *Russ Taylor presents at the Canadian SKA workshop, Calgary, Canada (Credit: Luke Tymowski, CYBERA, Calgary).*



## ➤ Outreach update

The third issue of the SKAnimals comic series is here and it is also available in Dutch.

The results of the outreach evaluation exercise carried out in November 2011 are now available and, to make sure that you are aware of all outreach materials, we have published a full list at the end of this article.

The recent site agreement means that our printed materials now need to be revised. Once the revision has been completed, a print run will be carried out and the newly revised material distributed.



- *The latest adventures of SKAnimals comic is now available to download from the SKA website.*

## The adventures of SKAnimals No. 3

We are very pleased to announce that the third issue in the SKAnimals comic series is now available to download from the SKA website: [www.skatelescope.org/mediaoutreach/ska-comic/](http://www.skatelescope.org/mediaoutreach/ska-comic/). In this issue the SKAnimals fear an alien invasion but end up floating high over part of the newly constructed SKA telescope in a hot air balloon. The comic series is designed to give 9-14 year olds an introduction to the SKA, show what the telescope will look like, what it will do and what the benefits will be.

## SKAnimals in Dutch

The complete SKAnimals comic series is now also available in Dutch. Kindly provided by ASTRON, you can check them out and download them here: <http://www.skatelescope.org/media-outreach/ska-comic/>. If you would like to translate the comic into your own language, please get in touch.



- *The SKAnimals series is now also in Dutch!*

## Results of the outreach evaluation

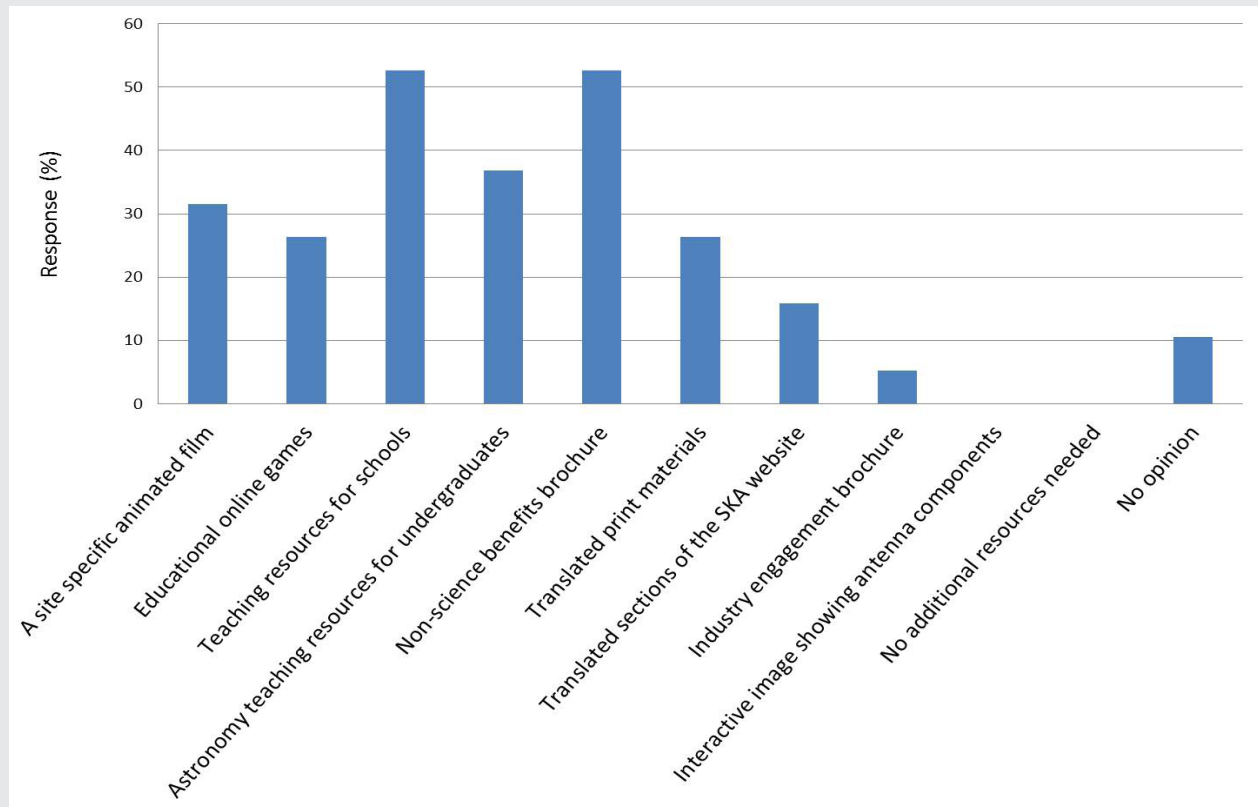
Thank you to those of you who participated in our outreach evaluation survey featured in the last newsletter. We wanted to find out what you thought of SKA outreach so far and we also wanted to gauge perceptions and attitudes towards the SKA project. Importantly, we also found out what resources you would like to see in the future.

You gave very encouraging responses to questions about the usefulness and quality of materials produced by the SKA office.

The poll of your perceived attitudes towards the project in the media, among policy makers, and your colleagues indicated that you think there is a positive attitude towards the project as a whole.



➤ *Outreach in numbers. An overview of SKA outreach from 4th quarter 2010 to 2nd quarter 2012.*



➤ *Plans for the future. You told us you would find teaching resources and a brochure detailing the non-science benefits of the SKA most useful.*

The survey showed that all resources are used but indicated that the newsletter and website have proved the most popular over the past year.

You told us that in the future you would find teaching resources for use in schools and a brochure detailing the non-science benefits of the SKA most useful. We'll see what we can do!

Your responses show that you generally find out about outreach resources from the newsletter and the website. So we have provided a full list of the current outreach resources at the bottom of this article and please continue to check the [outreach section of the website](#) for new additions.

## What outreach materials are available and how do I find them?

We want to make sure that everyone knows what outreach resources exist and how to get hold of them. Here is the complete list. *Please note that some of these materials may be temporarily unavailable while revisions regarding the new site agreement are carried out.*

### Available to download from the [media and outreach](#) page of the SKA website:

- SKA science animation
- General SKA animation (showing antenna close-ups)
- Images
- Factsheets
- Brochure
- Leaflet with poster on reverse
- SKA comic in English and Dutch
- SKA posters (timeline, science or general overview)
- Newsletter
- Brand guidelines

### Available on request from the Office of the SKA Organisation:

- Conference stand and individual banner stands
- Interactive touch screen iTable
- Large cardboard cutout SKA antennas
- Electronic pdf of the comics with blank speech bubbles for translation
- Print copies of the brochures
- Print copies of the leaflet with poster on reverse
- Print copies of the factsheets
- SKA document folders

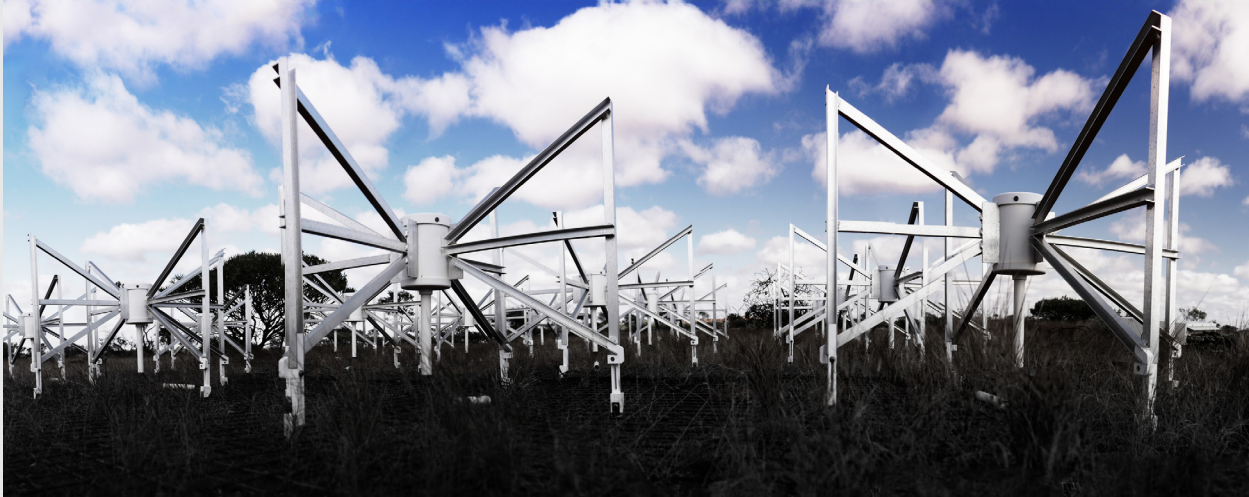
### Available elsewhere online:

- [Flickr image library](#)
- [Facebook](#)
- [Twitter](#)
- [YouTube channel - SKA TV](#)

News from  
around the world



## > Australia and New Zealand



> *The Murchison Widefield Array. Image credit: Dr Natasha Hurley-Walker, ICRAR.*

While the dual SKA site agreement has dominated recent news, other highlights include the Australia and New Zealand membership of the SKA Organisation, successful installation and testing of the first PAF receivers for ASKAP, and the ongoing development of a new supercomputer at the iVEC Pawsey Centre. The MRO infrastructure approaches completion, all ASKAP antennas are on site, the MWA progresses quickly and the EDGES project is generating data at the MRO.

### **Australia and New Zealand welcome SKA site announcement**

Representatives of Australia–New Zealand SKA (anzSKA) welcomed the SKA Organisation’s announcement that the telescope will be shared between the Australia–New Zealand (A–NZ) and southern African sites.

anzSKA Project Director Dr. Brian Boyle welcomed the decision, seeing it as building

on A–NZ’s extensive infrastructure investment and scientific strengths.

**“A great outcome for the project – we look forward to working closely with South Africa and the rest of the world to build the world’s largest telescope.”**

The Australian component of SKA phase one will build on CSIRO’s development of phased array feed receiver technology and Australia’s significant experience in low frequency astronomy.

The decision to award the hosting rights to both candidate sites is seen by Australians and New Zealanders as a great outcome for



► *The first ASKAP antenna to be installed with a PAF, an innovative receiver with many separate, simultaneous beams that will provide ASKAP with a wide field-of-view, allowing it to map the sky more quickly than alternative technologies. Credit: Barry Turner, CSIRO.*

the project and we look forward to working closely with South Africa and the rest of the world to build the world's largest telescope.

## A–NZ signs up to SKA Organisation

Australia and New Zealand were proud to become founding members of the SKA Organisation in November 2011.

Australia–New Zealand SKA (anzSKA) Project Director Dr Brian Boyle commented, “the establishment of the SKA Organisation is a key step in the global partnership to build the world's biggest telescope and we are very proud to be a part of it.”

## MRO infrastructure approaches completion

Support infrastructure works at the Murchison Radio-astronomy Observatory (MRO) in Western Australia, home to CSIRO's ASKAP telescope and the international Murchison Widefield Array (MWA) project, are almost complete.

Support works include the construction of 36 km of access roads and tracks, power and data infrastructure, accommodation facilities, a central control building and antenna foundations. Commissioning and final testing of key infrastructure is currently underway.

High-speed internet connections provide links from the MRO to its support facility 370 km to the west in Geraldton, and on to iVEC's Pawsey Centre supercomputers (450 km to the southwest in Perth). The link currently operates at 1 Gb/s and will progressively increase to 40 Gb/s this year.

## ASKAP antenna construction complete

All 36 of CSIRO's ASKAP antennas are now on site at the MRO. This significant milestone paves the way for implementation of the remaining high-tech components of the telescope and full operation in 2013. The first full-sized phased array feed (PAF) receiver was installed on an ASKAP antenna late in 2011, and end-to-end system tests are underway.

Additionally, first test results of PAF receiver technology from the Parkes Testbed Facility [successfully demonstrated the expected performance of the system](#), further validating chequerboard PAFs as rapid imaging devices appropriate for radio astronomy.

[Read more about ASKAP construction and end-to-end system tests.](#)

## MWA in final construction phase

The MWA project recently transitioned into the final construction stage of the 128 antenna array, which will be commissioned from mid 2012 onwards.

Already the equipment is producing results, with astronomers from MIT using the MWA to image an area of the sky 20,000 times larger than the full moon. The MWA will search for the very first stars and galaxies to have formed soon after the Big Bang.

[Read more about the Murchison Widefield Array.](#)

## EDGES goes live

Late in 2011, the Experiment to Detect the Global EoR Signature (EDGES) project underwent an upgrade which allows outputs to be viewed in real-time. The equipment now records 65 536 channel calibrated spectrum of the sky below 200 MHz once every minute at a data rate of 1.2 GB per day.

The data are transferred nightly from the MRO in Western Australia to the EDGES research lab at Arizona State University, where data is processed daily to track the progress of the observations. Examples of daily measurements are posted at: <http://loco.lab.asu.edu/edges>.

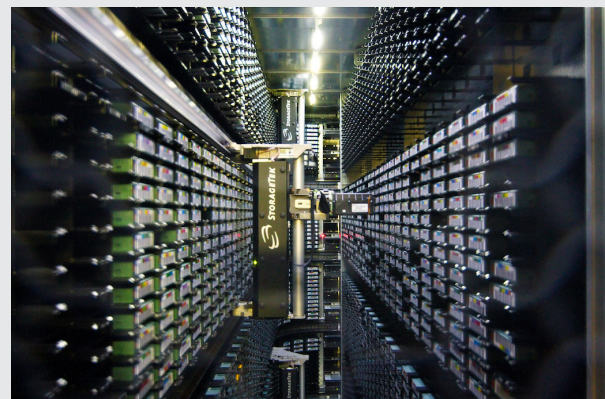
## Preparing for the data deluge

Storing, accessing and processing the data volumes expected from the next generation of radio telescopes are challenges which must be addressed well in advance of the telescopes themselves.

ICRAR is working with DataDirect Networks and the Canadian Astronomical Data Centre to perform data storage solutions and assess systems requirements for handling the

'data deluge' that will be produced by large telescope projects such as the SKA ([read more here](#)).

Across the Tasman, New Zealand's Institute for Radio Astronomy and Space Research, in collaboration with the IBM TJ Watson Research Centre, have developed a streaming spectrometer and correlator for radio astronomy that aims to combine and exploit the next generation of high performance stream-based parallelisation middleware to work with large volumes of data streaming from any number of data sources ([read more here](#)).



► Astronomers will need a top-ranking supercomputer to process the data deluge from the SKA.  
Credit: ICRAR.

Top ranking supercomputers will be vital to the system requirements of data storage and handling, and Australia is one step closer to positioning itself in the top ranks of global supercomputing following the installation of iVEC's 'Fornax' supercomputer at the University of Western Australia. Fornax will provide data-intensive computing solutions to various research communities, particularly in astronomy and geosciences.

Along with its sister machine 'Epic', Fornax is

already being used by early adopters such as CSIRO and ICRAR to prepare for the launch of the full Pawsey Supercomputing Centre in 2013–14.

### Soaring with *theSkyNet*

*theSkyNet*, a distributed computing project launched by ICRAR in September 2011 continues to grow with over 7 000 members providing enough processing power to put the project among the top 500 supercomputers in the world, if it were a single machine.

*theSkyNet*, aims to build a global network of privately owned computers that process astronomical data for radio astronomers.

Recently, *theSkyNet* joined forces with the Pan-STARRS1 Science Consortium to probe galaxies beyond our Milky Way. By ‘donating’ computer power to Pan-STARRS1, an optical telescope based in Hawaii, *theSkyNet* expects to be able to process telescope data at speeds [more than 500 times faster than possible with an ordinary computer](#).

### Korean connection ‘creates’ gigantic telescope

Early in 2012 Australian and Korean radio telescopes were linked for the first time to form a system equivalent to a telescope more than 8,000 km across. The linkup included three Australian telescopes: two CSIRO dishes and one from the University of Tasmania, and two telescopes operated by the Korean Astronomy and Space Science Institute. After five hours of simultaneous observation, data was streamed at a rate of 64 MB/s in real time over optical fibre links to Curtin University in Perth, where it was processed ‘on the fly’ at the International Centre for Radio Astronomy Research (ICRAR). The long distance linkup reflects Australia’s years of experience with VLBI, and anzSKA’s commitment to scientific

partnerships with countries in the region and elsewhere.



## ➤ South Africa

In addition to the dual SKA site agreement, which has been the focus of recent news, work has been continuing on South Africa's KAT-7 array which is performing well as a science instrument. While commissioning and science verification of KAT-7 are nearing completion, bulk infrastructure development for the 64-dish MeerKAT has started in the Karoo. The team expects to pour the first MeerKAT dish foundations before the end of 2012.

### Agreement on SKA location

The Members of the SKA Organisation announced on 25th May 2012 that South Africa, along with its eight SKA partner countries in Africa, will host the phase two SKA dish array and the mid frequency aperture arrays of the SKA telescope. The MeerKAT telescope will supplement the sensitive SKA phase one dish array, providing a quarter of the collection area of what will be the most sensitive radio telescope in the world until the construction of SKA phase two.

"We've been waiting for this decision for a very long time – it has been a long, hard road at times," said Prof Justin Jonas, Associate Director: Science and Engineering, SKA South Africa. "I think that this is an excellent outcome for the global SKA project, and now we can move into the really exciting phase – the detailed design and building of the SKA."

"I am ecstatic! I'm happy for our scientists, I'm happy for our country, I'm happy for Africa!" said Ms Naledi Pandor, South Africa's Minister of Science and Technology. Her comments coincided with the celebration of Africa Day. The African SKA site proposal had

been endorsed by the African Union, both in 2010 and earlier this year.

"This is an excellent outcome for the global SKA project, and now we can move into the really exciting phase – the detailed design and building of the SKA."



➤ *Ms Naledi Pandor, South Africa's Minister of Science and Technology at the media briefing on 25 May 2012 in Pretoria, South Africa.*

President Jacob Zuma added "South Africa is confident that the country will deliver on the expectations of the continent and world".



► *Prof Andrew Baker (Rutgers University, left) and Dr Sarah Blyth (University of Cape Town, right) reported on their impressive schools outreach programme that forms an integral part of their MeerKAT science project (LADUMA).*

## MeerKAT scientists and engineers meet to plot the way forward

The principal investigators (PIs) of the MeerKAT survey teams, SKA SA Research Chairs and the MeerKAT science and engineering team met in Cape Town on 10th and 11th of May 2012. Discussions included plans for MeerKAT science, and the possibility of observations during MeerKAT construction, once 16 or more of the antennas are ready. The PIs are keen to start using MeerKAT for early science. They agreed, however, that this should not delay the delivery of the full instrument in any way. Dr Ian Heywood of Oxford University, and Prof Rob Fender from Southampton University and the University of Cape Town, agreed that the survey teams, and other radio astronomers around the world, need MeerKAT for revolutionary headline science. “The facts that MeerKAT will be extremely sensitive and is situated in the southern hemisphere fit in perfectly with our science objectives,” Fender said.

Professor Andrew Baker of Rutgers University commented that the meeting was a valuable opportunity to strengthen ties between the survey teams. “There are several projects

that will run concurrently and use each other’s data,” he explained.

Heywood agreed with the importance of close collaboration between the survey teams and the project engineers in order to get the most out of the telescope, and avoid unnecessary overlap. “Telescope time, manpower and money are all precious resources, and we always have more ideas than the means to deliver them.”

Prof Andrew Baker and Dr Sarah Blyth reported on their impressive schools outreach programme that forms an integral part of their MeerKAT science project (LADUMA). By involving visiting scientists, they have taken top scientists to 20 schools around Cape Town this year. “You have to be really well prepared and organised to make the science relevant and exciting and achieve impact with



► *Progress with new landing strip. Photo credit: Dawie Fourie, SKA SA Karoo site manager, 21 April 2012.*

a school visit,” Blyth elaborated. “The SKA SA outreach materials – especially the Mission MeerKAT comics and bright astronomy posters – are very well received and make a huge difference in science classrooms.”

These resources are available online at [www.ska.ac.za/learn](http://www.ska.ac.za/learn)



▶ *A recent site inspection by the SKA SA team, along with some of its industrial and engineering partners.*

## MeerKAT infrastructure and construction update

The extension and upgrade to the power infrastructure for MeerKAT, including new transformers, substations and power lines, are nearing completion. Work has also started on additional roads and the new landing strip, as well as on the electrical and fibre reticulation, and the construction camps. Following the conclusion of the required tender procedures, additional contractors will be appointed to construct new buildings, deliver a building management system, and an RFI-shielding system for the processor building. Detailed design processes are also now underway for the MeerKAT local area network and antenna foundations.

## Early science with KAT-7

South Africa's KAT-7 telescope began observing the binary star system Circinus X-1 towards the end of 2011, and has to date completed up to 80 observations. "We now have enough new data to prepare the first KAT-7 science publication", explained Prof Rob Fender. "We are excited about continuing work with KAT-7, which will include simultaneous observations with the Southern African Large Telescope."

Early in 2012, astronomers also used KAT-7 successfully to observe the radio emission

of neutral hydrogen in a nearby galaxy, NGC 3109. KAT-7's correlator – the first step in processing and computing the incoming radio waves – currently allows measurement of the gas velocity to an accuracy of 10 km/s. Further upgrades during 2012 will enable astronomers to study this galaxy with a velocity resolution of 1 km/s.

"The engineers who delivered KAT-7 need to pat themselves on the back," was the view expressed by Dr Ian Heywood. "They have managed the project with tenacity and purpose, and have been tremendously successful."

"These results achieved by KAT-7, and the positive feedback from the scientific community, have given us confidence in our ability to deliver a cutting-edge radio telescope and do frontier science on a very tight schedule", says Dr Bernie Fanaroff, Project Director of SKA South Africa.

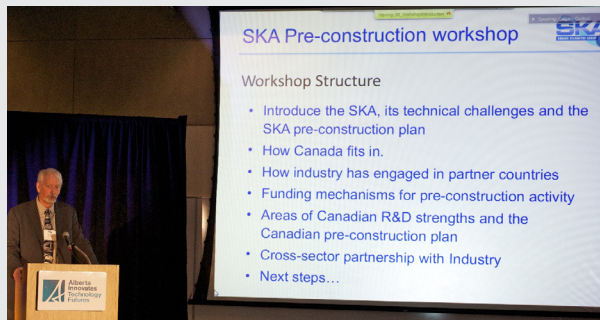
Visit SKA South Africa's new public web site focused on science and engineering issues (including KAT-7 data and images) at <http://public.ska.ac.za> or find out more about KAT-7 and MeerKAT at [www.ska.ac.za](http://www.ska.ac.za)

## > Canada

On 19 March 2012 Canada formally joined the SKA Organisation and preparations to participate in stage one of the SKA preconstruction phase are underway. R&D work continues to advance in composite reflectors, advanced receptor technologies and digital systems. A preconstruction networking workshop was held in Calgary in April 2012 to formulate Canada's involvement in stage one.

### Preconstruction Workshop

Canadian industry, university and government stakeholders participated in a preconstruction phase workshop in Calgary on the 27 April 2012. SKA Interim Director General Michiel van Haarlem, Canadian SKA Chair Russ Taylor, NRC Vice President Dan Wayner and others spoke about the SKA project, the Canadian SKA programme, industrial opportunities and next steps for participation in SKA activities. The workshop was very successful and attracted roughly around 100 participants, about half from industry.



> *Calgary Preconstruction Workshop.*

### Composite Reflectors

National Research Council Canada (NRC) and the US Technology Development Programme (TDP) collaborators at Cornell, Berkeley and Socorro continue to make



> *Dish Verification Antenna (DVA-1) for the SKA.*

progress on a high performance cost effective 15 m Dish Verification Antenna (DVA-1) for the SKA. The shaped Gregorian design aims to provide a stable clear aperture with low far-out sidelobes, as well as maintaining a large effective area / system temperature. The DVA-1 will be located at the DRAO near Penticton, BC and leadership of the project will shift to NRC for the construction and test phases.

The preliminary design review (PDR) held in October 2011 was successful and detailed design is nearing completion. Procurement of long lead time components is underway. A critical design review of the project is planned for 2012.

## Digital Systems

Our main development focus is design of a general purpose FPGA board (Kermode Board) that has application commercially as well as in adaptive optics real time control and radio astronomy. A board that is aligned with an existing product line is attractive to industry as investments made in board support package software and firmware can be leveraged to yield a new product that fits within an existing product portfolio.

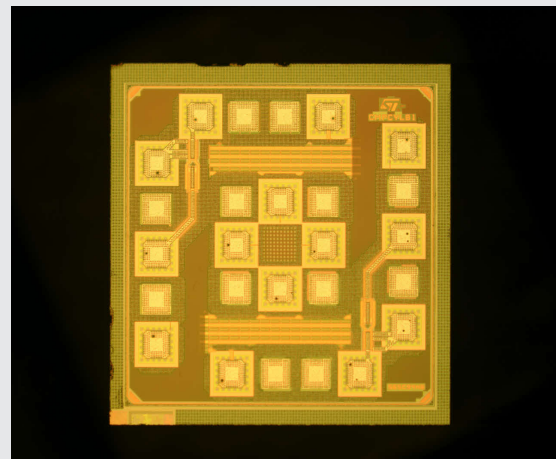
Lyrtech RD, Quebec, is adapting their



▶ *The DVA-1 pedestal mount*

standard Board Support Development Kit (BSDK) to the Kermode Board. The Kermode design is purposely aligned to an existing Lyrtech board permitting the BSDK to be readily ported. The BSDK provides a commercial development environment 'out of the box' that integrates with Mathworks MatLab/Simulink so that FPGA firmware can be developed and tested in a high or low level HDL in a consistently supported environment. With the BSDK, users can concentrate on the application firmware development without

concern for the bitstream programming, network monitor and control details, and supervisory functions. The Kermode board and BSDK system will be available for purchase as a supported commercial off-the-shelf (COTS) product with preferred pricing for NRC partners/collaborators. An advantage of this development model is that it marries the advantages of a custom hardware solution with an established commercial software/firmware development environment, manufacturing and support channel. The general purpose design of the board has sparked investigations into topologies applicable to SKA signal processing. Its high performance and high density make it a platform suited to all SKA signal processing requirements with perhaps the exception of non-image processing, which is being investigated. An initial version of the BSDK is nearly complete as is layout of the board. First prototypes are expected in the summer of 2012.



▶ *65 nm CMOS LNA die*

## University of Calgary

The devices group at the University of Calgary continues work on high performance low noise amplifiers (LNAs) and analog-to-digital converters (ADCs), with the ultimate

goal of developing a highly integrated LNA and ADC with an optical link output.

### Gain Stages and LNAs

Two new TSMC 65 nm GP CMOS receiver integrated circuits (ICs) are now undergoing tests. Preliminary results show less than 30 K of noise temperature with ~55 dB of gain 700 MHz to 1.4 GHz. This is short of simulated ~10 K of noise temperature and >70 dB of gain. The shortcoming is attributed to coupling on the test PCB, which is now being redesigned.

Two ST Microelectronics 65 nm CMOS otherwise identical LNAs fabricated in GP and LP processes have been measured.

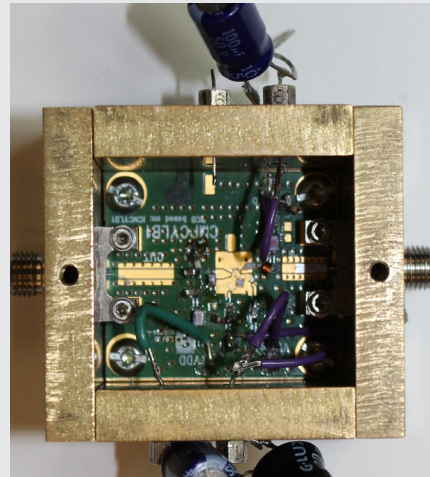
Measurements show that both LNAs achieve approximately 20 K of noise temperature and could be used as an SKA receiver front-end LNA. These results have been published at [https://www.jstage.jst.go.jp/article/elex/9/7/9\\_7\\_636/\\_pdf](https://www.jstage.jst.go.jp/article/elex/9/7/9_7_636/_pdf)

### Analog to Digital Converters

A 5 GS/s time-based ADC is undergoing measurements. Initial results show that the two parts of the ADC, voltage-to-time converter (VTC), and the time-to-digital converter (TDC), are working as expected. Work on measuring the complete ADC has recently commenced and show that the ADC is operational even when the VTC and TDC are physically separated by cables. A key advantage of this design is that the digital data transport is inherently serial and does not need additional SerDes circuitry.

A 4-bit 10 GS/s non-interleaved flash ADC has been measured and is shown to achieve 3.2 effective bits when operating with a 10 GHz clock. With a least significant bit of 12.5 mV it consuming only 120 mW of power

and presents only 60 fF of input capacitance to the preceding circuit making it extremely wideband. The ADC has been redesigned and submitted for fabrication in February 2012 to improve its calibration and reduce the power consumption to 45 mW.



▶ Packaged 65 nm CMOS LNA

# Future meetings and events

Visit the meetings calendar page to find out what SKA-related meeting are coming up. [More details](#)

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