SKA AFRICA
SQUARE KILOMETRE ARRAY

Newsletter

February 2011

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More info on the SKA South Africa Project at
www.ska.ac.za
E-mail marina@southernscience.co.za to subscribe to this quarterly newsletter of the SKA South Africa Project.

First HartRAO-KAT-7 VLBI fringes signal new capability

JASPER HORREL,
MEERKAT PROJECT OFFICE, CAPE TOWN

A milestone has been achieved in South Africa with the successful detection of "fringes" in a joint very long baseline interferometry (VLBI) observation performed using one of the seven 12 m dishes of the KAT-7 radio telescope, near Carnarvon in the Northern Cape, together with the 26 m dish of the Hartebeesthoek Radio Astronomy Observatory (HartRAO) near Pretoria.

VLBI is a well established technique, where the signals recorded by widely separated radio telescopes, simultaneously observing the same part of the sky, are brought together to produce a very high resolution radio picture of that region of the sky. While HartRAO has been involved in VLBI observations for many years with telescopes around the world, this is the first time that a KAT-7 antenna has been used and the first time that all the data processing has been done in South Africa.

Engineers and scientists at the MeerKAT site and HartRAO jointly observed a distant radio source known as 3C273, recorded the data and then correlated the signals in Cape Town to produce the successful fringe detection for the first time and at the first attempt. Fringe detection is a prerequisite for full VLBI operations, where the high resolution images are made from simultaneous observations using many telescopes.

In order to achieve the fringe detection, a number of significant technical challenges had to be overcome. For example, apart from being separated by 900 km and needing to be operated in tandem, the two telescopes used for the observations are completely different in design and construction, both in the mechanics and electronics. The HartRAO antenna recorded the data to a Mark5A VLBI recorder, while the KAT engineers constructed a new and flexible data recorder system (using ROACH-1; graphics processing units and other high-end PC components) to perform the job. The HartRAO antenna makes use of a hydrogen maser as the master clock, while a GPS-disciplined rubidium oscillator was used in the Karoo.

To produce the detection, the signals were jointly recorded, the data were transported to Cape Town and converted to the same format, a so-called "fringe stopping" correction was applied to the data (a correction for the earth's rotation, using the accurately known antenna and radio source positions) and the data were correlated to produce a "lag plot".

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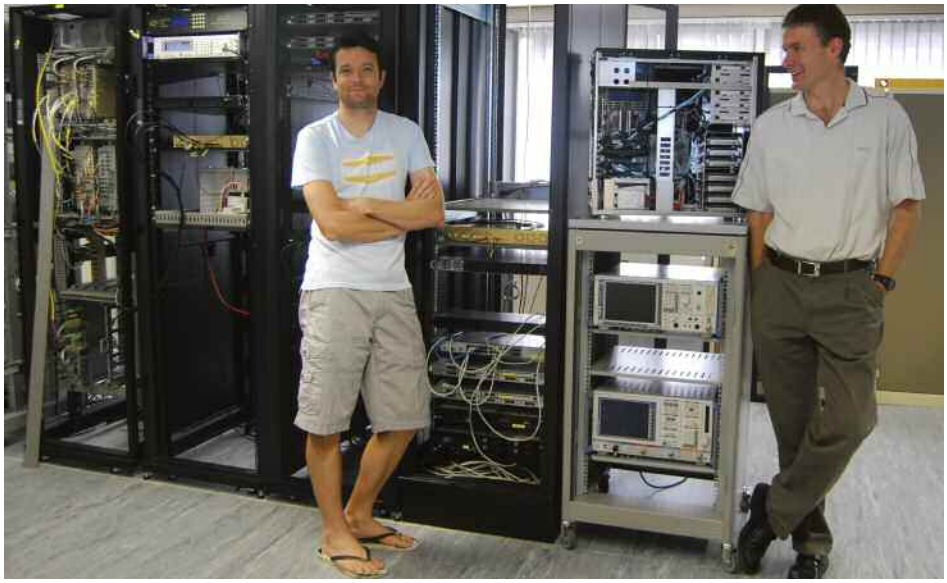
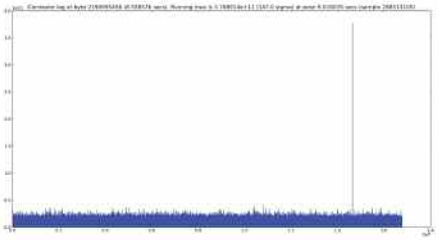
Desktop PC data recorder used in the VLBI experiment



Simon Ratcliffe and Jasper Horrell worked on the VLBI experiment from the MeerKAT office in Cape Town

A significant spike in the lag plot shows the point at which the two recorded signals are perfectly time-aligned and that the detected signal comes from the radio source on the sky (not from the inherent background noise of either of the two systems).

In the attached correlator lag plot, the big spike near the right, towering above the noise floor of the observations, is the detection of a correlated signal from the 3C273 radio source using a 16 MHz frequency band, centered at 1704.49 MHz. The x-axis represents a correlation interval of 0.524 secs (167 77 216 samples at 32 Msps). The very narrow peak (approx 1 sample) shows where the two signals match (correlate) or, in other words, indicates the common signal from the radio source simultaneously detected by the two widely separated antennas.

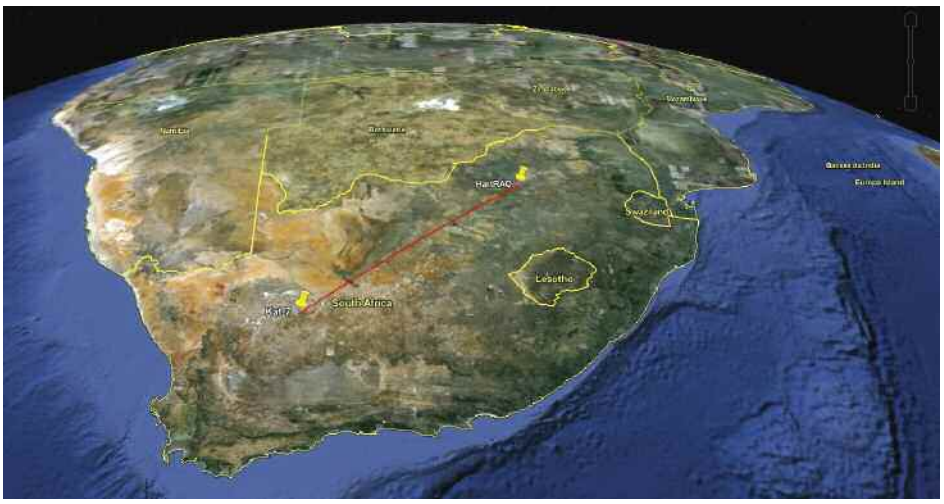


Correlated signal from the 3C273 radio source

This result is a signal of things to come not only for South Africa, but for Africa in general. A proposed new initiative for a VLBI network composed of dishes stationed around Africa, known as the African Telescope Array, is gaining momentum. Such cutting-edge science collaboration brings together countries in ways which not only foster closer collaborations and spread new expertise and technology, but also remind us in a concrete and practical way that together we can do more.

Jonathan Quick coordinated the VLBI experiment from HartRAO

The VLBI baseline between KAT-7 and HartRAO



MeerKAT engineers launch new ROACH board

South African engineers at the MeerKAT project office in Cape Town are taking the lead in the development of new generation astronomy tools such as the ROACH (reconfigurable open architecture computing hardware) boards in a collaboration with UC Berkeley, the NRAO and others. The ROACH board is a primary building block for digital signal processing systems in many next-generation radio telescopes. It is a cutting-edge innovation that enables highly specialised and high-performance computing.

Designed mainly in South Africa, about 300 of the ROACH-1 boards are already in use at high-tech facilities around the globe. The prototypes of a much faster and more powerful board – ROACH-2 – have now been manufactured. This provides a highly compatible upgrade path for all these facilities and opens up many more possibilities for new installations.

ROACH-2 has five times the processing capacity of its predecessor, four times the memory bandwidth, twice the memory capacity and twice the I/O bandwidth. This is made possible by using the latest advances in FPGA (field-programmable gate array) technology. "We try to take the best possible advantage of the reduced cost of computation by developing new hardware that can be programmed using common software tools," says Francois Kapp, DBE sub-system manager at the MeerKAT project office in Cape Town. "Progress in FPGAs is forecast to hold for at least another four generations, so we should at least see ROACH-3, -4, -5 and -6 in the coming years."

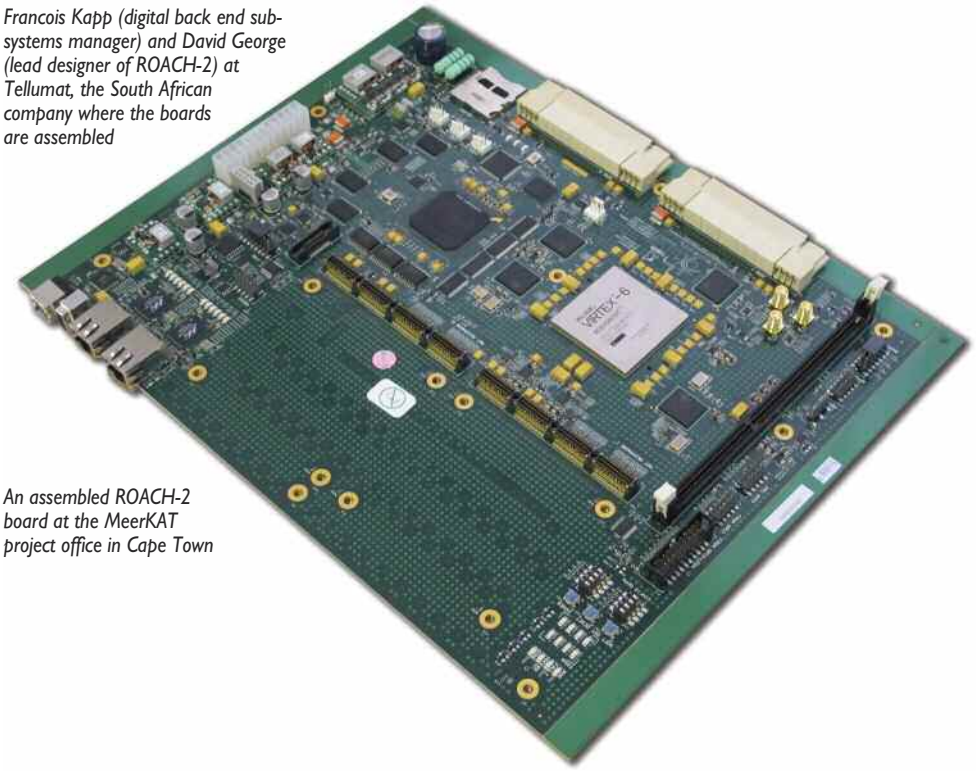
The design of ROACH-2 (like ROACH-1) was led from conception to production by engineers from the SKA South Africa Project, with collaboration from many international experts, especially the Centre for Astronomy Signal Processing and Electronics Research (CASPER) at the University of California, Berkeley.

Based on their experience with the KAT-7 array and fringe finder, the local team now takes the lead in specifying the ROACH boards, with the design process being led by David George, a member of the MeerKAT DBE team. Local content in the project is further boosted by Tellumat, a South African company assembling these complex boards. "While we are taking the lead with ROACH innovations, our international collaborations have been invaluable in the development of these and other cutting edge radio astronomy tools," Francois adds.

David George with the latest reconfigurable open architecture computing hardware board – ROACH-2

Francois Kapp (digital back end sub-systems manager) and David George (lead designer of ROACH-2) at Tellumat, the South African company where the boards are assembled

"Tellumat has always been associated with the manufacture of leading technology, but having the opportunity to produce components for an internationally significant project like the SKA is something we're particularly proud of," says Eugene van der Watt, business development manager at Tellumat Electronic Manufacturing. "We've gained valuable experience about which devices work in an open radio astronomy environment," says Marc Welz, software architect of the DBE team. "Testing of the ROACH board has been changed significantly and is now based on a unified JTAG (joint test action group) chain, accessible via USB, making it much easier and more affordable to produce." "ROACH-2 prepares us for the wide band processing systems needed for MeerKAT," says Andrew Martens, signal processing specialist. "ROACH-2 addresses the signal processing needs of many upcoming radio astronomy instruments and that is why the radio astronomy facilities around the globe are so interested in our ROACH-2 innovation."



An assembled ROACH-2 board at the MeerKAT project office in Cape Town

MeerKAT Science – the Large Survey Projects

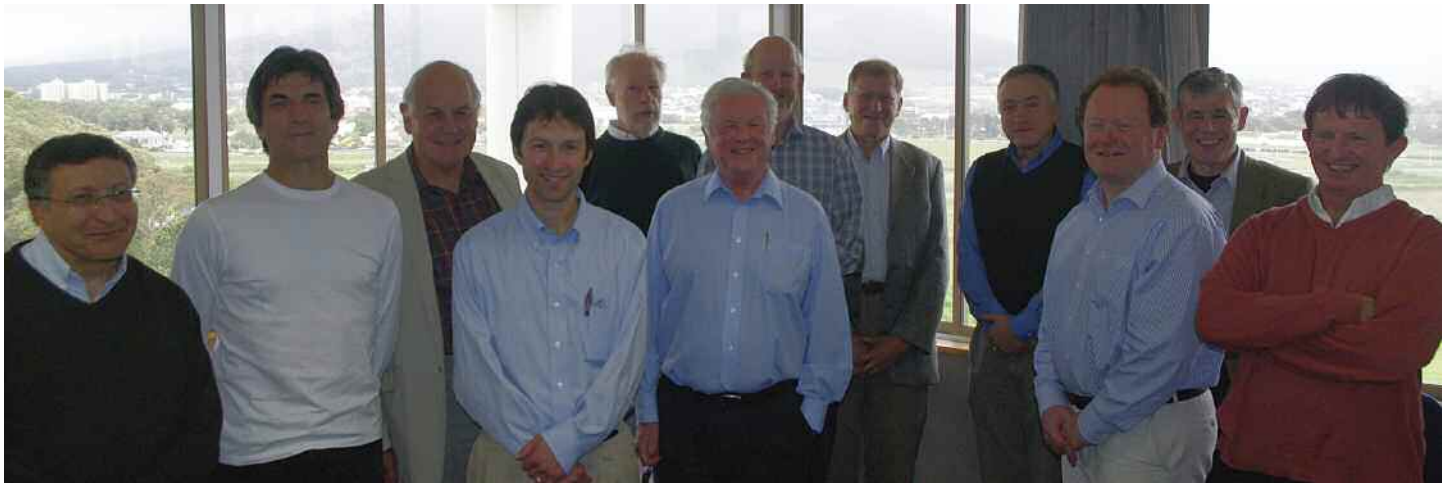
PROFESSOR ROY BOOTH, SKA SOUTH AFRICA PROJECT

The first science that the MeerKAT will do is encompassed by the large survey projects which were approved by an international Time Allocation Committee in 2010. Five years of observing time have already been allocated to these projects. They cover a wide range of astrophysics, from the evolution of galaxies after their formation in the early universe to nearby exotic objects like pulsating radio sources, neutron stars and even complex molecules in the interstellar medium of our galaxy. The two top priority projects are a deep survey of neutral hydrogen and a pulsar timing survey.

The excitation of the hydrogen gas formed as the universe cooled after the Big Bang gives the spectroscopic signature which several of the projects will use to make the deepest studies of the earliest (high red-shift) galaxies. Atomic hydrogen (HI) will be used in the ultra-deep Laduma survey, which is expected to detect the HI content of galaxies from the present time back to when the universe was less than half its current age. The Mesmer survey will search for molecular hydrogen through its surrogate, carbon monoxide (which is easier to detect). Spectral lines of CO will be used to detect denser gas in galactic centres and star-forming clouds. The Doppler effect in the expanding universe shifts the wavelengths of these spectral lines to longer wavelengths and their red-shift, z, gives a measure of the look-back time to the galaxy from which they come.

The atomic hydrogen line is used in several other extragalactic studies: the MeerKAT Absorption Line Survey will detect HI lines and even hydroxyl (OH) in absorption against the continuum emission of distant galaxies; a hydrogen survey of the Fornax cluster will study the assembly of clusters, the effect of clustering on galaxies (tidal effects and stripping of gas from galaxies as they fall into the cluster); and the Mhongoose survey of nearby galaxies will make very sensitive measurements of galaxies and their environments, and may have the potential to detect the cosmic web, the filamentary structure or 'skeleton' of the universe along which the galaxies are believed to form.

Experience shows that when there is a significant improvement in sensitivity in a radio telescope, there is a good chance of detecting new kinds of galaxies. The Mightee survey is a deep survey of continuum emission and polarization which exploits MeerKAT's sensitivity to the full with this hope in mind, as well as making more detailed studies of faint objects and making a



comparison of their properties from multi-wavelength studies.

MeerGal is a high frequency survey of our own Milky Way galaxy. MeerGal will exploit the upper frequency band of MeerKAT in a survey of the interstellar medium of our galaxy for ionized hydrogen/star formation regions, cold molecular clouds, complex molecules, masers and other interstellar matter. The wide-band receivers of MeerKAT will be ideal for such studies. MeerGal will even cover the investigation of a potential new radio emission mechanism due to spinning dust.

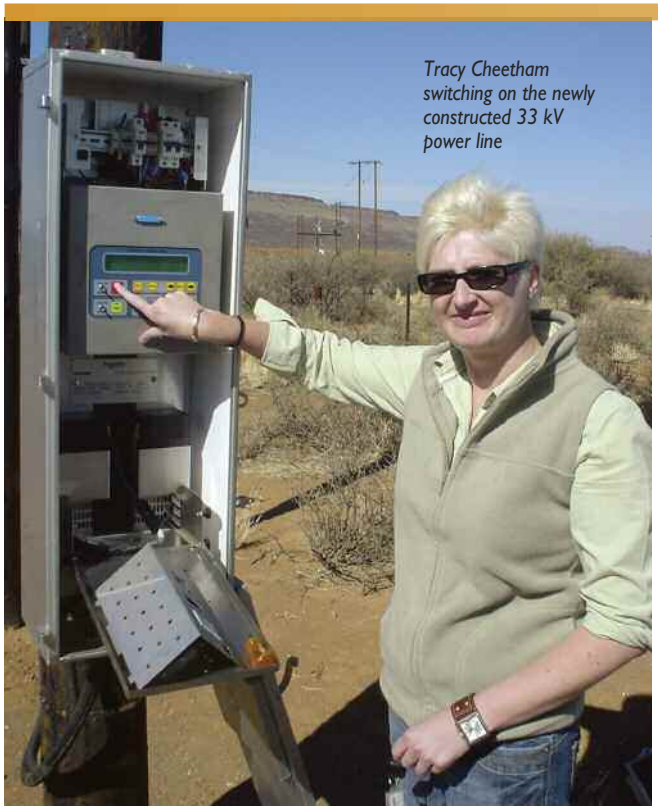
There are two major projects which will investigate the exotic pulsating radio sources, pulsars. The first, and one of the two highest rated projects among the large survey proposals, concentrates on Pulsar Timing, partly in the hope of detecting changes in pulsar periods caused by gravitational waves in order to investigate theories of gravity. MeerKAT's high frequency band facilitates observations through the ionized medium towards the Galactic Centre – a probable source of gravitational waves. The second pulsar study, Trapum, is a search for new types of pulsars and fast transient sources, some of which have been shown to behave like pulsars for short intervals of time but 'switch off' for long periods, without detectable emission. These enigmatic sources remain a puzzle.

Finally, slow (several seconds) transients are the topic of the Thunderkat project. The team expect to detect and study radio emission associated with high-energy gamma ray bursts, radio supernovae and other types of explosive event, in both the nearby and the more distant Universe.

All three of the timing/transient projects are data-hungry and want to sample all data streams from all other projects. Although this will be a headache for our engineers, these surveys hold out a serious promise of very exciting results.

The MeerKAT Large Survey Proposal Review Committee, with SKA Project hosts (fltr) Bernie Fanaroff (South African SKA Project); Roy Maartens (University of the Western Cape); Andrew Lyne (Jodrell Bank); Joseph Lazio (Jet Propulsion Laboratory) (Chair); Frank Briggs (Australian National University, Mount Stromlo Observatory); Roy Booth (SA SKA Project), Simon Johnston (Australia Telescope National Facility); Jay Lockman (National Radio Astronomy Observatory), Athol Kembal (University of Illinois), Robert Laing (European Southern Observatory), Thijs van der Hulst (University of Groningen), Justin Jonas (SA SKA Project).

All of the project teams are beginning to ramp up for a meeting of principal investigators in mid-April 2011 in Cape Town, when an exchange of ideas with our MeerKAT engineers will help to refine the MeerKAT systems. We will call for input by the survey teams, especially on aspects of MeerKAT software and the organisation of the data products. Some teams have offered special hardware and are very experienced in organization and even pre-processing of the data in the pipeline output. Their input will help to ensure efficient data processing across the MeerKAT science projects.



Tracy Cheetham switching on the newly constructed 33 kV power line

More power and connectivity milestones for Karoo astronomy reserve

BY TRACY CHEETHAM, SKA SA INFRASTRUCTURE MANAGER

GRID power to the MeerKAT site

The new 33 kV power line constructed between the Karoo sub-station and the MeerKAT site was switched on for the first time at the end of September 2010, to allow for testing and commissioning of the line from the substation to the Klerefontein support base, the MeerKAT site complex at Losberg and the KAT-7 radio telescope.

The KAT-7 telescope is now powered by the new grid power line, which is currently being operated at 22 kV. This will be switched over to 33 kV once the upgrade to the Karoo sub-station has been completed in March 2012. Back-up power is also provided to the radio telescope and buildings on site and at Klerefontein.

Once the voltage regulators have been installed, final Eskom acceptance testing will take place to verify that the design conforms to all Eskom standards and SKA SA radio frequency interference requirements, which were defined by the project in the grid design report.

The first flight arrived at Carnarvon on Wednesday 12 January 2011. The passengers were (fltr) Tony Foley (MeerKAT science operations); Andrew Martin (DBE team member); Frank Curtolo (projects process manager); Darrel Liebenberg (logistics engineer); Dawie Fourie (SKA SA site manager); Thembinkosi Nfiwezi (student); and Execujet pilots - Mark and Anton

MeerKAT Karoo Express – flying to the MeerKAT site

A new weekly charter flight, departing every Wednesday at 07:30 from Cape Town and returning the same day, leaving at17:30 from Carnarvon, cuts the seven-hour road trip between the MeerKAT project office and the telescope site near Carnarvon in the Karoo to just more than an hour.

"This is a major time saver for our project team," explains Willem Esterhuyse, who heads the MeerKAT project office in Cape Town. "It is now possible to travel to site, do a significant amount of work there and get back to Cape Town the same day." Most of those travelling stay on site for a week and return with the next flight.

Once construction starts on the MeerKAT infrastructure later this year, a similar service may be implemented between the SKA South Africa office in Johannesburg and the Karoo site.

Carnarvon from the air

Data connectivity boosted with interim link

The interim 10 Mbps data link between the MeerKAT project office in Cape Town and the KAT-7/MeerKAT site outside Carnarvon in the Northern Cape went live for the first time on Wednesday, 19 January 2011. The 10 Mbps link was commissioned by the South African National Research Network (SANReN) on behalf of the SKA SA project and will be managed by the Tertiary Education and Research Network of South Africa (Tenet).

This interim link is an important milestone for the SKA SA project, as some of the commissioning and operation activities of the KAT-7 radio telescope – an engineering prototype for MeerKAT – can now take place from the project's engineering headquarters in Cape Town. This will reduce travelling time considerably for the engineering and commissioning team from Cape Town to the Karoo in future. During its operations/science lifetime, the MeerKAT telescope will be operated from the Cape Town facility.

The data link is comprised of a 48-fibre cable from the MeerKAT site complex to the SKA SA point of presence (POP) station in Carnarvon, which then interfaces with 5x1984 Mbps bonded links to Cape Town.

SANReN recently awarded the provision of the long-term MeerKAT and Southern Africa Large Telescope (SALT) 10 Gbps data link to InfraCO/Neotel. The first stakeholders' meeting was held on Friday, 21 January 2011 to discuss the implementation of the long-term link, which is expected to be completed by the end of June 2011 for both the MeerKAT site and SALT in

SKA SA Carnarvon point of presence (POP) station

Supply of grid power to the MeerKAT Site Complex and KAT-7 radio telescope

Sutherland. The shared 10 Gbps link will cater for the full MeerKAT bandwidth requirements in future.

Commenting on these milestones, the Minister of Science and Technology, Naledi Pandor, said: "This demonstrates South Africa's commitment to ensuring that the SKA becomes a major catalyst for scientific development in Africa".

SKA South Africa and NRAO to deepen collaboration in 2011

BY DEBRA SHEPHERD, MEERKAT PROJECT OFFICE, CAPE TOWN

The SKA South Africa Project and the USA's National Radio Astronomy Observatory (NRAO) have agreed to expand their collaboration on radio astronomy research and development. This follows a visit by engineers and scientists from the South African SKA Project Office to the NRAO headquarters in Charlottesville and the Green Bank Telescope facility. The topics of collaboration range from technical and scientific through to outreach.

Jasper Horrel and Justin Jonas (SKA South Africa Project) talk to John Ford (NRAO engineer) about instrumentation for the NANOGrav project.

The NRAO Green Bank visitor centre, reaching out to the community to engage young minds in the excitement of science and discovery. NRAO staff will collaborate with SKA South Africa staff to design a visitor centre in the Northern Cape that will attract people from all over southern Africa and provide unique learning opportunities for young people in primary and secondary schools.

On 17 September 2008, the South African SKA Project Office (SASPO) signed a formal collaboration agreement with the USA National Radio Astronomy Observatory (NRAO) with the shared goal of collaborating and cooperating to develop radio astronomy projects of common interest. In that memorandum of understanding, SASPO and NRAO resolved to collaborate on software development, data processing capabilities and joint scientific research, and to develop an active student and staff exchange program that would benefit both sides.

The SKA South Africa Project and NRAO have worked together with the Centre for Astronomy Signal Processing and Electronics Research (CASPER) group at the University of California, Berkeley on a reconfigurable open architecture computing hardware (ROACH) integrated circuit board that can be configured to do different computing tasks. This ROACH board has found ubiquitous applications in radio astronomy instrumentation, including the Green Bank Telescope and the Very Long Baseline Array (VLBA) facilities operated by NRAO. The ROACH board is also the basis for the computer correlators used by the South African Karoo Array Telescope precursor (KAT-7) and the "Epoch of Re-ionization" (PAPER) experiment. In the software collaboration, the SKA South Africa Project is using the NRAO-developed CASA data processing software, and South African developers will provide critical software needed for both the MeerKAT and NRAO radio telescopes. The NRAO has sent astronomers and engineers to help with the commissioning of the KAT-7 and MeerKAT telescopes and NRAO scientists and engineers have participated in MeerKAT review panels, including the Science Advisory Committee, the Time Allocation Committee, and the Concept Design Review panel. The southern hemisphere PAPER experiment, which has both NRAO and SKA South Africa involvement, has been set up and successfully operates on the protected Karoo radio astronomy site in the Northern Cape Province of South Africa.

After two successful years of the collaboration, SASPO and NRAO have agreed to expand the scope of their collaboration. NRAO Director Fred Lo and Associate Director Phil Jewell met with SKA Africa Project Director Bernie Fanaroff and Associate Director for Science and Engineering Justin Jonas, together with assistant directors and division leads from both sides, at the NRAO offices in Charlottesville and Green Bank in November 2010. They agreed to collaborate on the development of new software, MeerKAT receivers and new instruments designed to detect gravitational waves using pulsar signals (in cooperation with the NANOGrav consortium) and the faint signals from the first stars in the "epoch of re-ionization" (PAPER). NRAO and the SKA South Africa Project will also expand their staff exchange program and will work together to design a visitor centre and outreach program to be associated with the Karroo radio astronomy reserve. The details of the collaboration will be finalized in the coming months, with the goal of signing an expanded memorandum of understanding in March 2011.

Technician team deployed at KAT-7 in Karoo

A team of technicians will be permanently on site at the KAT-7 telescope in the Karoo from 1 March 2011 to provide technical support during the roll-out and commissioning of the instrument. They are (fltr) Sibusiso Wakhaba, André Walker, Matthys Maree and Siyabulela Tshongweni. "This is a great opportunity and we really look forward to helping to get the first seven dishes fully operational and then working with the team who will be constructing the new look MeerKAT dishes," says Matthys. "Seeing how busy we are with the maintenance of KAT-7, it is clear that the 64-dish MeerKAT will be a challenge and I can't even image what it will be like if we were to build and operate several thousand dishes for the SKA – what an exciting prospect!"

Postdoctoral opportunities at SKA South Africa

BY KIM DE BOER, SKA SA HUMAN CAPACITY DEVELOPMENT PROGRAMME

The postdoctoral fellowship programme at the SKA South Africa provides talented postdoctoral scientists from around the world an opportunity to engage in ongoing research projects related to the mission of the project.

Interested individuals have until 15 March 2011 to apply for postdoctoral fellowships in fields ranging from galactic astronomy to cosmology, including:

1. Transients, Compact Mass-transferring Binaries (AAS ID 27191), working with Prof Patrick Woudt (pwoudt@ast.uct.ac.za) at the University of Cape Town;
2. Extragalactic Nearby/Deep HI Studies (AAS ID 27193), working with Prof Erwin de Blok (edeblok@ast.uct.ac.za) and Dr Sarah Blyth (sarblyth@ast.uct.ac.za) at the University of Cape Town;
3. Extragalactic High-redshift Molecular Gas Studies, working with Dr Lerothodi Leeuw (lleeuw@uj.ac.za) at the University of Johannesburg;
4. Galaxy Evolution and Observational Cosmology (two fellowships), working with Profs Roy Maartens (rmaartens@uwc.ac.za), Matt Jarvis (M.J.Jarvis@herts.ac.uk) and Catherine Cress (ccress@uwc.ac.za) at the University of the Western Cape;
5. General Cosmology, working with Prof Bruce Bassett (cosmoaims.wordpress.com). This fellowship is held jointly between the African Institute for Mathematical Sciences and the South African Astronomical Observatory.

The SA SKA postdoctoral fellowships are awarded for a period of two years (plus one additional year if agreed to by the host institution, the candidate and the SA SKA Project). The fellowships are renewable every six months based on progress. The value of a postdoctoral fellowship is R300 000 per annum (non-taxable), excluding travel and equipment grants. Write to the research leaders listed above or Kim de Boer (kdeboer@ska.ac.za) for more information.

Students supported by SKA South Africa doing a "spiral galaxy activity" with children at a school in Carnarvon

MeerKAT advances cutting-edge expertise

South Africa's MeerKAT project – and the prospect that the continent could possibly also host the SKA – is becoming a major catalyst for developing new skills and expertise around the globe, and to support development in Africa in particular.

"MeerKAT attracts and excites talented young scientists and engineers because it is something entirely new and extremely ambitious and challenging," explains Dr Bernie Fanaroff, Director of SKA South Africa. "The young people working on this project, both in our MeerKAT team and in the universities, are becoming experts in next-generation technologies that will be in high demand around the globe."

Through its human capacity development programme, SKA South Africa funds students across a wide range of study levels, including artisan apprentice, technicians, undergraduates, MSc and PhD students and postdoctoral fellows.

To date, 293 students have benefited from SKA South Africa bursaries and scholarships, including many students from other African countries. Bursaries go to physics and engineering students and a special effort is made to attract women and black students to these fields. Support for artisan training focuses on bringing students from the towns around the MeerKAT/SKA site to study at the Northern Cape Further Education and Training Urban College in Kimberley, the capital city of South Africa's Northern Cape Province.

Throughout their studies, students are involved in workshops and site visits, often accompanied by foreign collaborators. The postgraduate students and some of the undergraduates participate in the annual bursary holders' conference, where they get the opportunity to interact with world leaders in the development of the science and instrumentation of the SKA. There are also summer and winter schools for the undergraduates.

During site visits to the Northern Cape, the undergraduate students get the opportunity to participate in educational outreach activities designed to excite the learners of the Northern Cape about the leading role that their province is playing in the future of astronomy – in South Africa, Africa and the world.

Delegates at the 2010 SA SKA postgraduate conference

Students star at SA SKA postgraduate conference

The annual South African SKA postgraduate conference, now in its fifth year, is not only an excellent showcase for the high level of South African science students, but is fast becoming an extremely valuable meeting place for local and international researchers and students working together in fields such as astronomy, electrical engineering, astrophysics, applied mathematics and cosmology.

The 2010 conference was held from 29 November to 3 December at the Wallenberg Research Centre in Stellenbosch. It attracted 164 attendees from across South Africa and African countries such as Madagascar, Mauritius, Kenya and Botswana, which are part of the African SKA Working Group, as well as a speakers from leading research groups such as Chalmers University of Technology (Sweden), the USA SKA Consortium, the University of Southampton (UK), the Netherlands Institute for Radio Astronomy (ASTRON) and Oxford University (UK).

"We invite international speakers to motivate our students and this year no-one declined," Prof Justin Jonas, associate director of science for the SKA South Africa Project, said. "We see in this that people realise the value in coming here, that they are attracted to South Africa through work on MeerKAT and other instruments, by our good students and by the opportunity to network with their peers."

Of the 72 talks presented, relating to topics such as radio astronomy, digital signal processing, antenna development and radio telescopes, 36 were given by doctoral and senior year masters degree students, based on their current research.

Dr Huib Jan van Langevelde, director and associate professor: Joint Institute for Very Long Baseline Interferometry in Europe (JIVE) described the conference concept as "clever". "It not only exposes your postdoctoral students and students to international scientists, but also exposes the international community to what is being done here. This is a sound approach."

Prof Patrick Woudt (associate professor at the University of Cape Town's Department of Astronomy), Prof Rob Fender (professor in astronomy at the University of Southampton) and Prof Erwin de Blok (SARChI Research Chair in the Department of Astronomy, University of Cape Town)

Dr Paul Ho, director of the Academia Sinica Institute of Astronomy and Astrophysics in Taiwan and associate of the Smithsonian Astrophysical Observatory (USA), stressed the important role conferences such as these have to motivate students to pursue a career in astronomy and related fields. "It is good for them to see what the future will look like, and that it is not only their own professors that are interested in the field, but a much larger community from outside this country."

According to Prof Patricia Henning, director of the Institute of Astrophysics of the University of New Mexico and vice-chair of the USA SKA Consortium, she was impressed by the student representativity shown. "I really don't think there is something similar being done elsewhere in the world relating to SKA, which brings so many students together," she said. Astronomer Dr Dinesh Somanah of the University of Mauritius described the conference format as "pioneering" because it brings many disciplines within the African scientific community together. "SKA isn't just a South African project anymore, it's an African project," he noted.
The international visitors to the conference were thoroughly impressed by the very high standard of work and findings presented by the students. "Some of these talks have been fantastic and have been comparable if not better than those given by European students of the same age," said Prof Rob Fender, professor of Astronomy at the University of Southampton (UK).

Dr Oleg Smirnov, a researcher at the Netherlands Institute for Radio Astronomy (ASTRON), was impressed by the amount of work done in South Africa since the SA SKA project started in 2006. "The diversity of topics being studied has impressed me at the conference," he said. "With new technology comes new problems, and these will always attract bright young people."

Prof Steve Rawlings, professor in astrophysics at Oxford University, believes SA SKA is uniformly attracting high quality people. "Several significant findings have been presented at the conference," he said. Prof Rawlings added that he has been struck by the general desire of South African students studying at Oxford to at some stage return to their country to plough back into local science.