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SQUARE KILOMETRE ARRAY (SKA) SOUTH AFRICA

Update SKA SA & KAT

SKA SOUTH AFRICA

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SA Science minister opens site for construction of Karoo Array Telescope (KAT) prototype

Astronomers, engineers, educators and journalists from around South Africa gathered at Hartebeesthoek Radio Astronomy Observatory on 2 November 2006 to celebrate the official kick-off of the construction of a prototype dish for the Karoo Array Telescope (KAT).

"Today is a significant step towards achieving our vision of providing another cutting edge window on the universe from the African continent," said Mr Mosibudi Mangena, South Africa's Minister for Science and Technology. He added that he was confident that the country's investment in a science instrument that could look back in time 14 billion years to the immediate aftermath of the Big Bang, would deliver Nobel Prize winners in future. "This dish is an example of mission-driven innovation and will be a proudly South African product", the Minister added. He congratulated the KAT team on what they had achieved so far and assured them of the full support of the Department of Science and Technology (DST).

Anita Loots, KAT project manager, thanked the Department for the confidence placed in her team of engineers and promised that they would not disappoint the Minister in the process of building one of the best telescopes in the world. She pointed out that the highly innovative approach that they are taking in building the KAT is not without risk, but added that the team was confident that this was the only way to deliver a cost-effective solution for the Square Kilometre Array (SKA). "We are optimising the cost all the time, and in the process driving down the cost all the time," she said.

The minister officially opened the site where a prototype of the Karoo Array Telescope (KAT) will be built by ceremoniously cutting a ribbon and unveiling a 1:50 scale model of the prototype dish.

The KAT engineering team will use the full size prototype dish, a single antenna 20m high and 15m in diameter, as the basis upon which to test all the components and systems of the KAT. The next phase will be to construct the twenty similar antennae of the KAT on a remote site near Carnarvon in the Northern Cape. The prototype dish structure will be finished by mid 2007, after which the receivers, computing and digital signal processing components will be added.

South Africa's Minister for Science & Technology, Mr Mosibudi Mangena, addresses a gathering of astronomers, engineers, educators and media representa-

Minister Mosibudi Mangena (left) with the Director-General of the Department of Science and Technology, Dr Phil Mjwara (right) at a 1:50 model of the Karoo Array

Minister Mangena cut a ribbon to officially open the site where the KAT prototype will be built at the Hartebeesthoek Radio Astronomy Observatory.

South Africa's Minister for Science and Technology, Mr Mosibudi Mangena, unveils a 1:50 model of the prototype dish of the Karoo Aray Telescope (KAT).

Once the KAT trials have been completed, the prototype dish will be used for ongoing radio astronomy research at HartRAO, including the study of pulsars.

Through building this prototype and the KAT, South Africa is demonstrating that it has the capacity and expertise to build high-tech radio astronomy instruments. This will bolster South Africa's chances in the bid to host the world's largest radio telescope ever, the SKA, in the country. South Africa and Australia are the only two countries still in the running to host this mega telescope that will cost more than a billion Euro.

"This prototype dish will not only be the test bed for all KAT components, but it will also strengthen our industry's capacity to design and construct large dishes," Anita Loots said. "This will make it possible for South African industry to compete for contracts on SKA, no matter where the telescope is ultimately built."

A consortium led by IST Dynamics Pty Ltd, a South African engineering company, has been awarded the contract to design and construct the KAT prototype dish. The Department of Science and Technology (DST) and the National Lotteries Board (NLB) are the joint funders of the first phase of the KAT, while the National Research Foundation (NRF) administers the project.

SKA Calibration and Imaging Workshop 2006

Delegates from the SKA Calibration and Imaging Workshop accepted the challenge to walk up Table Mountain.

The SKA Calibration and Imaging Workshop for 2006, held in Cape Town, South Africa from 4 to 6 December 2006, attracted 50 people, more than 30 of them experts from outside the country. The workshop was hosted by SKA South Africa at the South African Astronomical Observatory (SAAO) headquarters.

The workshop covered a number of radio astronomical calibration and imaging topics important for extending the capabilities of existing facilities, as well as for the next generation radio telescopes such as LOFAR, KAT, xNTD, MWA, and SKA itself. The workshop presentations were complemented by a number of excellent discussions, at the workshop and at a work-session at the KAT offices in Pinelands. A range of issues including, ionospheric calibration, primary beam effects, large-scale high-fidelity simulations and calibration/imaging pipelines to name but a few, were discussed. While it is clear that there is much work to be done in this area to support the new telescopes, good progress is being made in a number of areas.

After much exercising of mind and the enjoyment of some good workshop fare over a couple of days, most of the participants enthusiastically participated in a walk up the front face of Table Mountain on one of the evenings and descended again via the cable car.

Presentations and more photos from the workshop and the Table Mountain excursion are available at: www.kat.ac.za/calim2006

CONRAD Milestone 1 for the SKA SA

Jasper Horrell, KAT

1 October 2006 saw the official end date of the Milestone 1 deliverable for the CONRAD software and computing collaboration. This collaboration was set up between the South African KAT- and the Australian xNTD computing teams.

Milestone 1 included work from a number of areas, including telescope monitor and control, data processing pipelines, array configuration, calibration and simulation, radio frequency interference mitigation, and system integration and testing frameworks. Some of the work delivered was in the form of working software and some involved paper studies.

The delivery of Milestone 1 is an important step for the collaboration since it demonstrates a working collaboration structure, concrete technical benefits and provides a basis for future work. Excellent progress has been made in a number of areas of joint interest to the teams. The deliverables for future milestones will build on the start made in Milestone 1, but will start aiming at more end-to-end software and computing systems to run the telescopes and process the data.

The launch of CONRAD (Convergent Radio Astronomy Demonstrator) was featured in a previous newsletter article (August 2006, No2).

Protecting the integrity of the KAT site

By Mike Inggs

The KAT site has been selected to provide an extremely low level of electromagnetic radiation from all sources, mostly man-made such as television, cell phones, car ignitions, and so on. This environment needs to be preserved, as one would a nature reserve. The South African government is currently working on legislation that will allow the authorities to enforce the quality of the electromagnetic environment in the area. The maintenance of these large geographic areas is integral to the Government strategy of attracting astronomy to South Africa, possibly even the SKA itself.

The KAT Project is working with engineers at Stellenbosch University, to establish very strict guidelines for all equipment to be located on site. These guidelines will be thoroughly evaluated and tested during 2007. All KAT equipment will then be tested to comply with the guidelines that have been established.

This rigorous regime will have to be enforced once the KAT is operational. This will almost certainly mean that site visits will not be possible, as it is very difficult ensure that visitors do not inadvertently create interference via their car ignitions, cell phones left on, and so on. Maintenance staff will be carefully trained. It is anticipated that only one or two maintenance staff will be on site at any time, and all science interaction will be remotely controlled.

KAT prototype update

By Willem Esterhuyse, KAT

Immediately after the November 2006 inauguration of the construction site for the KAT prototype, the teams started working on the site. The aim is to have the antenna structure ready for feed fitment by the end of July 2007. Track the progress of the KAT prototype at www.hartrao.ac.za/xdm.

By mid December, the concrete pedestal was in place and progress is becoming visible!

The manufacturing of the mould for the composite dish is progressing well and setup of the mould on site will start late January 2007.

Manufacturing of the other components is in process and is due to be completed at the end of February 2007.

Carnavon community outreach

As part of ongoing outreach projects to the Carnavon community in the Northern Cape, the KAT team organised a series of astronomy events during November 2006. Young children had the opportunity to get closer to the beauty of the southern sky with the aid of telescopes set up in the veld and the help of visiting astronomers. The team also distributed new solar system posters at various schools, while adults were introduced to the vast scale and mysteries of the universe at several popular talks in local community centres.

Upcoming events

Technical Challenges and the Science Potential of SKA Pathfinders
12 - 16 March 2007, Australia

17th meeting of the International SKA Steering Committee
26 - 31 March 2007, Argentina

SKA Pulsar Key Science Project meeting, "Pulsar Searching and Thai-ming 2007-SKA"
04 - 05 April 2007, Thailand

HI Survival through Cosmic Times
11 - 15 June 2007, Italy

Bursts, Pulses and Flickering: Wide-Field Monitoring of the Dynamic Radio Sky
12 - 15 June 2007, Greece

From Planets to Dark Energy: the Modern Radio Universe
01 - 05 October 2007, UK

New KAT project manager for Cape Town office

Kobus Cloete joined the Karoo Array Telescope team in December 2006 as the new project manager for the Cape Town office. Before joining the KAT team he worked for Reutech Radar Systems in Stellenbosch, a company that supplied some of the sub-systems and components for the Southern African Large Telescope (SALT).

"It is an incredible opportunity to get involved in a high-tech, high-profile project such as the KAT and I look forward to the challenges ahead," says Kobus. "Our most immediate focus is to have the KAT prototype functional by the end of 2007."

Away from the high-tech environment at the office, Kobus is a keen hiker and thoroughly enjoys the mountains around Cape Town and Stellenbosch.

Students excel at first SKA/KAT Bursars Conference

More than 20 students who study with bursaries from the South African SKA/KAT project had the opportunity to present their work to fellow students and local and international SKA leaders at the first annual SKA Bursary Conference. The conference took place from 28 November to 1 December 2006 at the South African Astronomical Observatory (SAAO) in Cape Town.

Attended by several SKA leaders from abroad, the conference also provided an opportunity to showcase South Africa's progress with developing the people, skills and technology required for the SKA. At the end of the event Prof Peter Wilkinson, a pioneer of the SKA project and Associate Director at Jodrell Bank Observatory in the UK, remarked that he was "amazingly impressed" by what South Africa has achieved with its SKA effort over the last few years. "With this quality of people, science and engineering work, you have taken a major step forward in a very short time and achieved a remarkable turnaround in radio astronomy in South Africa to put the country on the international stage," he said. He added that he was also inspired by the students' talks on topics ranging from abstract cosmology to practical SKA applications.

More praise came from Prof Steve Rawlings, Head of Department of Astrophysics Oxford University, UK. "I am really awfully impressed by what I have seen at this conference and how things have exploded on the science and engineering side in such a short time scale," he said. "South Africa is doing all the right things for the SKA!"

The conference provided a very successful networking opportunity between SKA/KAT bursars from all over Southern Africa, and helped to strengthen the community of participants and stakeholders around the SKA and KAT projects. "We're building Team South Africa for the SKA and KAT," said Dr Bernie Fanaroff, South Africa's SKA project manager. He added that a series of workshops and networking events would follow in 2007 to build on the synergy between team members and give more opportunities for "sparking off each others' bright ideas!" In addition to current and future bursars and their supervisors, delegates from four of the SA SKA partner counties also attended. Discussions with these delegates from Mauritius, Madagascar, Mozambique and Ghana lead to the initiation of a collaboration between the African universities, University of Cape Town and SKA. Four students from Madagascar and Mozambique have been enrolled into South Africa's NASSP (National Astrophysics and Space Science Programme) to begin with a customized honours/masters' degree in astrophysics in January 2007. The SKA Project has also awarded a bursary to a PhD student from Mauritius.

Excellent talks were given by the local and international guest speakers including topics such as;

- The SKA: Past, present and future by Prof Wilkinson;
- The science of SKA by Prof Rawlings;
- Sky simulations for KAT and SKA by Dr Matt Jarvis and Dr Hans Reiner-Kloek, both postdoctoral researchers at the Department of Astrophysics, Oxford University, UK;
- SALT - The first year by Prof Phil Charles, Director of the SAAO;
- The ALMA Telescope by Prof Roy Booth, Director of the Hartebeesthoek Radio Astronomy Observatory.

Supervisors from local universities presented on their research and Ms Anita Loots (KAT project engineer) gave a comprehensive talk on the development of the KAT. Prof Justin Jonas (KAT project scientist) presented an inspiring talk about his discovery of radio astronomy from an early age and entertained the delegates with sound bites from British radio and David Bowie's Star Man.

The conference included a half-day student workshop on popular science communication and media skills to encourage the bursars to share their passion for engineering and astronomy with public audiences.

Prize winning students

The students' presentations were excellent. Initially only three prizes were set aside; one for the best MSc presentation, one for the best PhD presentation and one for the best overall presentation. However the judges (Prof Fabio Frescura, Dr Sharmila Goedhart and Ms Tabisa Fiko) and the SKA team found it very difficult to select only three winners and in the end seven prizes in all were awarded as follows:

In the MSc category, the following students received prizes:

Mr. Gregory McDonald (MSc - UoJ) *Glitch mechanisms in pulsars*

Mr. Richard Stupart (MSc - WITS) *Investigating the effect of reduced TCP back off delay on throughput in Beowulf class computational clusters*

Mr. Andile Mngadi (MSc - UCT) *Prototype Radio Telescope Receiver*

Ms. Monica Wu (MSc - UCT) *KAT receiver design*

In the PhD category, the following students received prizes:

Mr. Attie Combrink (PhD - HARTRAO) *Radiometer - and GNSS - derived water vapour estimates for application in centimetre - wavelength radio astronomy and VLBI*

Mr. Ryan Warne (PhD - UKZN) *Radio pulsar science*

Overall winner

Mr. Marten Lodewijks (MSc-UoJ) *Testing general relativity in binary pulsars using KAT*

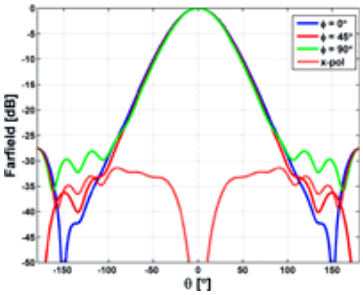
Prototype feed horn design update

LJ du Toit, EMSS Antennas

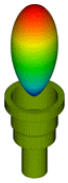
To allow the KAT engineering team to integrate and test various subsystems in the immediate future, the XDM prototype dish will employ a cluster of seven feed horns, of classical design. The emphasis was placed on overall design fidelity rather than maximising frequency bandwidth, and as such will also serve to illustrate a sound understanding of radio astronomy dish illumination principles.

The responsibility for the design, development, integration and evaluation of the cluster was allocated to EMSS Antennas, a small Stellenbosch-based company contracted into the KAT team. Since the frequency bandwidth of the XDM was chosen to be moderate (18% centered around 1535MHz), we decided to develop a generic stepped-circular horn, excited with a dual-polarised quad-ridge feed segment. The design phase involved many simulation iterations, and our in-house CEM software package FEKO proved to be invaluable in the design of both the horn and the feed structure.

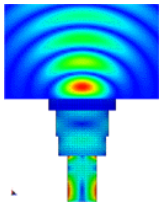
A fundamental requirement of such a horn is to exhibit a rotationally-symmetric pattern with precise control over the spatial extend, to balance the amount of wanted energy received from the dish up to its edge, compared to the unwanted noise received from the ground visible immediately outside that edge. We are quite satisfied that our design satisfies these two requirements, and a typical set of cuts through the simulated horn pattern is shown to illustrate this. It is perhaps worthwhile to note the low level of cross-polarisation, and also the low levels of unwanted stray radiation present in the horn radiation.



Within the next two months, this design will be manufactured and evaluated for compliance to design parameters. However, previous experience with simulations of this nature lead us to expect no surprises, and we are confident that the XDM prototype feed cluster will behave exactly as planned.



A 3-D simulation of the horn radiation pattern. Note that stray radiation below -25dBr are artificially suppressed.



A FEKO illustration of RF currents flowing on the inner surface of the horn, and an instantaneous snapshot of the electric fields immediately outside the horn aperture.

Minister Mangena visits KAT office

Mr Mosibudi Mangena, Minister for Science and Technology, and officials from his department, visited the KAT offices on 10 January 2007 for an update on progress with the Karoo Array Telescope.

Simon Ratcliffe (KAT computing architect) demonstrating the KAT control software to Thomas Kusel (KAT system engineer), Anita Loots (KAT project manager), Dr Philemon Mjwara (Director-General, Department of Science and Technology), Ms Pontsho Maruping (General Manager: Frontier Programmes and CSI), Mr Mosibudi Mangena (Minister of Science and Technology).

Mr Ncedo Mkondweni (KAT computing specialist) discussing receivers for PED with Ms Pontsho Maruping and Mr Mosibudi Mangena.

SKA online gets facelift

By Vene Muskett, SKA SA webmaster

The SKA web site [www.ska.ac.za] has been redesigned to improve speed and give the site a fresh new 'look' and additional content. The site has also proved very popular both locally and internationally with increasing monthly visits and reciprocal links to the site. The top performing areas of the site, apart from the homepage and SKA pages, are the newsletter and the Karoo Array Telescope (KAT) sections.

Additional areas to the site have been launched to ensure that it continues to add value to the SKA community. Be sure to visit and view our KAT animation, find out who is involved in the SKA and KAT projects in our Who's who directory, and read more about the SKA key science projects and timeline. Our Education Zone offers easy to understand information about radio-astronomy for learners as well as a section to download related educational resources.

Other valuable sources of online information include easy access to the latest news in our SKA South Africa - KAT Update newsletter and downloadable online resources including bid documents.

Join the SKAnet Community!
SKAnet is an email list which keeps subscribers updated on news and latest developments about the Square Kilometre Array South Africa project. Join the list today!