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Space Digest

Prototype for the Karoo Array Telescope nears completion

The first phase, a one-dish prototype, has been constructed at the Hartebeesthoek Radio Astronomy Observatory (HartRAO) in Gauteng. The MeerKAT team has installed the last of the control system components on the MeerKAT prototype, and commissioned and tested the dish. A myriad tests were performed, the most important of which were related to proof of the surface (accuracy and efficiency) and the pointing/tracking capability of the dish.

The surface was measured making use of photogrammetry (the making of measurements or scale drawings from photographs) as well as theodolites (an optical instrument consisting of a rotating telescopic sight, used by a surveyor to measure horizontal and vertical angles). The results from these two methods were consistent and therefore resulted in a high degree of confidence in the measurements.

MeerKAT will be one of the world's premier mid-frequency radio astronomy facilities that will put South Africa at the cutting edge of radio astronomy.

The telescope will be constructed in phases to ensure the best value for money and sound technology choices.

- The first phase, a one-dish prototype, has already been constructed at HartRAO.
- KAT-7, a seven-dish engineering test bed and science instrument near Carnarvon in the Northern Cape Province, will be commissioned towards the end of 2009.
- The full array of 50 or more dishes should be ready by 2012. A high speed data transfer network will link the telescope site in the Karoo to a remote operations facility.

The terminology KAT and MeerKAT can be confusing. The "original" acronym "KAT" is for Karoo Array Telescope. From the beginning the South African team planned to build a telescope near Carnarvon consisting of about 12 dishes. Then about six months ago, the government increased the funding available for this project. The telescope will now be built in phases. First a seven-dish version (hence KAT-7) and then later a much bigger telescope (up to 35 or even more dishes, (the team is still working on specs) and hence the name became "MeerKAT" (meer being Afrikaans for more hence "more of KAT").

The eXperimental Development Model (XDM) is a 15-m diameter radio telescope antenna prototype for the Karoo Array Telescope (KAT located at HartRAO).

The Karoo region of the Northern Cape Province is ideal for radio astronomy, because it is remote and sparsely populated, with a very dry climate. There is minimal radio frequency interference from man-made sources such as cellular phones, broadcasting and air traffic.

MeerKAT science will explore celestial mysteries such as cosmic magnetism, the evolution of galaxies and large-scale structure in the universe, dark matter and the nature of transient radio sources. It will study pulsars and allow scientists to do novel astrophysics and astrobiology experiments.

South African engineers and astronomers are working closely with teams around the world on the cutting edge technology required to make MeerKAT work. In South Africa, the Hartebeesthoek Radio Astronomy Observatory and the South African Astronomical Observatory are participating in the MeerKAT project - the construction of the KAT-7 prototype array at the Karoo site. KAT-7 will primarily be an engineering test-bed, but it will also be capable of scientific observations and will be the first seven antennas of the full
MeerKAT array.

Astronomy Geographic Act - a step closer

South Africa's Astronomy Geographic Advantage (AGA) Bill took one step closer to being signed into law on 13 September 2007, as it was approved and adopted by the National Assembly. The last few months have seen a series of public hearings and stakeholder meetings to ensure that the Bill is given the appropriate powers to ensure the protection of Astronomy Advantage Areas in South Africa's Northern Cape Province. These meetings, which led to case studies being undertaken with a number of operators of wireless communications networks in the Northern Cape, were very fruitful. They sought to find feasible solutions to re-engineer existing wireless communication infrastructure to be compatible with the operation of a major radio astronomy facility, as well as prevent the establishment of further infrastructure and other activities that could be detrimental to astronomy.

The AGA Bill aims to protect astronomy facilities across a wide range of wavelengths, from radio to optical and gamma-ray. This could see the establishment of frequency dependent protection areas hundreds of kilometres in extent.

Some industry sectors, while recognising the necessity to protect sensitive astronomy areas, expressed concerns over the wide powers the Act will afford the minister.

Constellation of satellites to manage African resources – fact or fiction?

The Department of Science and Technology hosted the Second African Leadership Conference on Space Science and Technology for Sustainable Development at the CSIR International Convention Centre, Pretoria in early October. The theme of the conference was "Building partnerships in space".

Delegates from 14 African countries gathered to discuss Africa's involvement in space. One of the major issues on the agenda was African Resource Management (ARM) - the proposal to launch a constellation of low earth orbiting satellites to enhance the ability of Africa to manage its resources more effectively. The constellation supports the determination of African leaders to make a significant contribution to the world body of knowledge from an appropriate commitment in a space programme.

The ARM concept was first introduced as a proactive approach with Resource Management through remote sensing as an alternative to disaster management in Africa at the Addis Ababa United Nations workshop on disaster management in July 2002. The concept was further developed by Prof. Robert Boroffice (head of Nigeria Space Agency), Prof. Sias Mostert of South Africa and Azzedine Oussedik (head of Algerian Space Agency). During the next three years South Africa and Kenya joined the initiative while Canada and Germany have shown some interest in supporting the project.

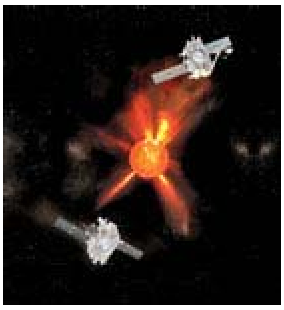
In parallel to the formulation of the constellation concept, the development of a next generation imager started at SunSpace in Stellenbosch in collaboration with the Catholic University in Leuven, Belgium and funded by the Innovation Fund. The multi-sensor micro-sat imager (MSMI) combines high spatial (multi-spectral) and spectral (hyper-spectral) resolution detectors on the same focal plane using a telescope with a focal length of 1744 mm. In addition, an array of detectors provides live video feed and geometrically accurate image capability.

While each satellite will be owned and operated by one of the participating countries, the constellation works as one system, providing the participating nations will much-needed information at a local economic level.

The constellation will provide information for environmental impact assessment, farmer settlement, housing, urban planning, border control, disaster monitoring, land use and cover mapping, water resources management, mineral, oil and gas exploration and peace-keeping missions.

The development of the constellation of satellites will support technology enhancement in the participating countries and will be a further catalyst in establishing a space industry on the African continent.

The development of the MSMI camera is progressing well at the SunSpace facilities in the Western Cape. Testing of the first model was recently completed and engineers are pleased with the results. The Department of Science and Technology has committed to the building of an actual qualification model and expects to have the unit completed during 2008.



Comet Encke never knew what hit it!

On 20 April, 2007, the comet had just dipped inside the orbit of Mercury, perilously close to the sun, when a solar eruption struck and literally tore the comet's tail off. This surely has happened to comets before, but for the first time in history a spacecraft was watching.

Angelos Vourlidas at the Naval Research Lab in Washington DC, was speechless - he kept playing the movie over and over. He is part of a team of NRC researchers who built the heliospheric imager telescope onboard STEREO-A that recorded the event.

The eruption that hit Encke was a CME or "coronal mass ejection". Sky watchers on Earth are familiar with CMEs because of the auroras they create when they occasionally hit our planet. CMEs are fast-moving and massive, packing billions of tons of solar gas and magnetism into billowing clouds travelling a million-plus miles per hour.

Actually, it is a little surprising that a CME succeeded in ripping off a comet's tail. For all their mass and power, CMEs are spread over a large volume of space. The impact of a gossamer CME exerts little more than a few nano Pascal of mechanical pressure - softer than a baby's breath.

The ripping action must have been something else.

Vourlidas believes the explanation is 'magnetic reconnection'. Magnetic fields around the comet bumped into oppositely directed magnetic fields in the CME. Suddenly, these fields linked together - they "reconnected" - releasing a burst of energy that tore off the comet's tail. A similar process takes place in Earth's magnetosphere during geomagnetic storms powering, among other things, the aurora borealis.

"In a sense, the comet experienced a geomagnetic storm," says Vourlidas. "It is the first time we've ever witnessed such an event on another cosmic body."

Although STEREO is primarily designed to study CMEs and their impact on Earth, scientist hope that this CME strike on Encke will provide insights into studying comets.