Looking back to beginning of time

Giant MeerKAT will bring hi-tech astronomy to Karoo, and scientists hope R15bn Square Kilometre Array will follow.

By Kelvin Kemm

How many people know of the big KAT of the Karoo? Not many, because this sleek giant is a major astronomical telescope, which has been developed locally.

The MeerKAT, a giant astronomical eye on the sky, is part of an endeavour to see the start of time. And there is big money involved, billions of rands.

The telescope concept was initially named the Karoo Array Telescope (KAT). Such a telescope monitors radio waves rather than light.

People are used to seeing astronomical pictures created from light images, but few realise that astronomers can generate accurate "pictures" built up from radio waves. The waves that astronomers want to view have been travelling through space since the birth of the universe, so when they get a "snapshot" of these waves, scientists will actually see a picture that was created at the beginning of time.

Major astronomical events, such as exploding stars, do not ONLY emit light, they emit energy covering the entire electromagnetic spectrum, including radio waves, X-rays and gamma rays. Radio waves travel much further, with less disturbance, than does light. So to see back to the beginning of time, it is best to use radio waves.

An array telescope is constructed from a group of individual radio dish receivers, all electrically interconnected. All the individual dishes, interconnected in this way, act as one single telescope with a large collecting area.

The initial South African KAT design team was putting planning blocks in place when team members concluded that they wanted to expand the original concept extensively, by adding more dishes, so the expanded project became MeerKAT. This expanded project will consist of 80 or more dishes. Each radio dish unit will consist of a three-storey-high assembly supporting a 12m diameter dish.

Out of the way

Foundations for the first dishes are now being poured at the 14 000ha site 100km from Carnarvon in the Northern Cape. This remote site has been chosen because there is nothing much there: most importantly, no stray radio waves to interfere with the operation of the telescope. Recent legislation also enables astronomers to ensure that no future unwanted radio waves impinge on the area.

South Africa also has its eye on an even larger international project, the Square Kilometre Array (SKA). This radio telescope array will have a collecting area of 1km² and a project price tag of R15 billion. There is very big money involved in looking for the beginning of time.

Some years ago, when the international community announced the objectives for the SKA, countries were invited to bid to host the telescope. The two countries still in the running are South Africa and Australia. The winner should be announced in 2011.

Winning the SKA bid will not only bring a large financial input into South Africa, but will bring the country considerable prestige in the challenging fields of science and

technology.

Both SKA and MeerKAT are major projects, demanding only the best in terms of the science and technology required to design, construct and operate the facilities. South Africans are considered world leaders in this respect.

The project now under construction is known as KAT 7. It will install the first seven dishes of MeerKAT, to become operational this year, with the full 80 dishes expected to be up by 2012. An experimental demonstration model dish assembly has already been built at the Hartebeeshoek Radio Astronomy Observatory near Pretoria.

Building KAT 7 is not just a case of building the seven complex dish assemblies. These seven, and eventually all 80 dishes, have to be interconnected to act as one. This entails developing a system of very high-precision fibreoptic links, integrated into fancy high-speed computing systems. Continuous adjustments and fine-tuning will take place, with scientists tweaking here and there all the time as the final configuration takes shape.

Running MeerKAT will be very similar to operating a Formula One racing car in a Grand Prix, where track or atmospheric changes require rapid expert adjustments.

The fibreoptic cables will be buried, and will undergo extensive testing to ensure that temperature changes in the Karoo do not affect the signal quality.

The South African digital signal processing team can be justly proud of what they have already achieved. The local team has been working with the University of California and the US National Radio Astronomy Laboratory on developing the computing architecture.

They have developed reconfigurable open-architecture computer hardware (Roach) boards. This technology uses very fast hardware to carry out specialised computing applications in parallel.

South Africa is already building Roach boards for India and Australia. The team has also started getting interesting inquiries from the local telecoms industry. So this big science, aimed at looking back in time, will also produce valuable technology for business applications.

Show the world

South African scientists, designers and high-precision construction teams want to show the world what can be achieved in the dramatic dry Karoo.

The SKA is projected to be one hundred times more powerful than MeerKAT. South Africa possesses the skill to build this super system.

The SKA will attract a constant stream of visitors, scientists and astronomers. This has already been demonstrated by the hugely successful Southern African Large Telescope (Salt) at Sutherland.

Salt is the largest optical telescope in the southern hemisphere. It attracts a constant stream of international astronomers and it operates 24 hours a day. It works round the clock because during daylight hours it streams information internationally via the internet. So, in effect, the stars never set on Salt.

The SKA project now involves 55 scientific institutions from 19 countries. It is expected that 40 percent of the cost will be borne by the US, 40 percent shared by eight European countries, and 20 percent contributed by the remaining

participants. The South African government has committed R860 million to the SKA effort, including the design and construction of MeerKAT.

The international SKA office is run by the University of Manchester, which operates the famous Jodrell Bank radio observatory in the UK. The South African SKA office is in Rosebank, Johannesburg.

The successful implementation of the KAT 7 phase of MeerKAT will hopefully ensure that the stars of fortune shine on South Africa in the form of the R15bn SKA project.

Who would have thought that the open arid Karoo, where time seems to stand still, could potentially earn so much money from peering back to the origins of the timeless stars?

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