



## All set for a Big Bang in the Karoo

By John Yeld

The Copernican revolution, named for Polish astronomer Nicolaus Copernicus, who described the movements of the planets around the Sun in 1543, shook the religious world to the core and fundamentally changed the way people think.

Now we're on the cusp of a second Copernican revolution that could be just as profound, suggests Bernie Fanaroff, a world-renowned South African radio-astronomer.

And surprising as it may seem, that revolution could be fomented on an isolated sheep farm deep in the heart of the Great Karoo, with some support from the leafy Cape Town suburb of Pinelands, among other places.

This farm is Blouputs, a 3 800ha property 94km west of Carnarvon that is the preferred site in South Africa's bid to build the €1-billion (about R8,3-billion) Square Kilometre Array (SKA).

### Examine how galaxies first formed

South Africa is one of four nations bidding to host the array, an international project funded by the European Union, the United States, China and a number of other countries.

The other contenders seeking to be awarded the host site are Australia, Argentina and China.

The SKA will be by far the world's largest radio-telescope, allowing astronomers to see back in time to soon after the "Big Bang" that began the universe around 14 billion years ago, and to examine how stars and galaxies first formed and how they and the universe have evolved since then.

It is also intended to assist astronomers in the quest to find and describe the unknown material that forms 96 percent of the universe: the mysterious "dark matter" (26 percent) and the equally mysterious "dark energy" (70 percent) that astronomers know is there but cannot detect or describe.

The Pinelands connection relates to the KAT project - an acronym for the Karoo Array Telescope - a much smaller but extremely powerful radio-telescope.

### Huge data-processing machine

Work on this project, which is one of a pair of so-called "one percent telescopes" which form the first phase of SKA - the other is the Extended New Technology Demonstrator in Australia - is already under way.

A team of about 30 of South Africa's brightest young engineers and software designers, based in a Pinelands office block, is working on the project, with a prototype 15m parabolic dish antenna being built by a Pretoria company.

The two one percent telescopes will start observations in 2010, and will be followed by the building of the 10 percent SKA Pathfinder between 2010 and 2014, using lessons learned from the one percent telescopes.

Construction of the full SKA array will only start in 2014 and it should be fully operational by 2020.

The SKA will consist of 2 500 dish antennae, each between 12m and 15m in diameter, at its core site, and another 2 000 at remote stations as much as 3 000km or even further away.

If South Africa wins the right to host the SKA, these remote stations will be built in Ghana, Namibia, Botswana, Mozambique, Kenya, Madagascar and Mauritius.

The antennae will all be linked by a new fibre-optic cable network and high-speed Internet connections faster than anything yet available anywhere in the world.

In effect, SKA will be a huge data-processing machine, with information arriving in terabits.

Fanaroff heads the project team which will be making a final presentation to the international SKA steering committee next month.

This committee will announce a short-list of sites in September, with a final decision to be announced in 2008.

"What's happening now is that we're going through another Copernican revolution," says Fanaroff.

"At this point we only understand four percent of what's in the universe. Dark matter and dark energy are really strange."

The Carnarvon farm has not been confirmed as South Africa's chosen venue, but it's definitely the preferred option. Many modern appliances emit radiation - including aircraft, televisions, cellphones and vehicles - which interferes with a radio-telescope.

Although Blouputs is not completely "radio-quiet", there is significantly less radio noise there than elsewhere in the country, and the scientists say they will be able to manage with this interference.

And new legislation likely to be adopted this year will prohibit any new radiation emission in demarcated areas.

The KAT project, which currently has a R300m budget, is already producing cutting-edge technology, ranging from highly sophisticated engineering software and data-processing protocols to high-speed data transfer networks and high-performance, low-noise amplifiers.

"The Pinelands team are really doing fantastic work that is being recognised internationally... In less than a year, we've caught up with European and American teams," Fanaroff says. "What we're building now (for KAT) is likely to be close to the final technology for SKA."

When complete, KAT will consist of 20 dishes, each 15m in diameter, which will be operated remotely from Cape Town.

Among its key experiments will be a search for thousands of pulsars: compact, spinning celestial objects that shoot out radio energy in pulses like a lighthouse, so regularly that they are even more stable than atomic clocks.

Science and Technology Minister Mosibudi Mangena, who visited the Carnarvon farm earlier this week, was extremely optimistic about the two projects.

"I've been reading and getting reports about what the SKA and KAT teams are doing, but coming to see it with my own eyes has been a wonderful experience.

"We are making progress, and I'm happy with that."

Dr Adi Paterson, deputy director-general in Mangena's department with responsibility for expert services, says radio-telescopes have always been

considered something of a stepchild of astronomy, but that their time has now arrived.

"There's some serious science here," he says.

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