

The history of the Square Kilometer Array

Home of clear skies and little pollution, South Africa is a forerunner in space technology

Science and technology in South Africa have taken an impressive leap forward over the past decade, particularly in astronomy-related fields. This is due, in no small part, to government efforts to secure the development of the Square Kilometer Array (SKA) project for South Africa.

When completed, the 3,000-dish Square Kilometer Array will feature the world's biggest radio telescope, and will be between 50 and 100 times more sensitive than any other radio telescope in existence.

Dishes in the SKA will be spread over 3,000 kilometers but will work together as one instrument, allowing astronomers to listen to electromagnetic radiation which travels at a fixed speed of about 1.08 billion kilometers/hour.

The SKA is a global collaboration of 20 countries that are aiming to provide answers to fundamental questions about the origin and evolution of the universe.

With a budget of 1.5 billion euro, construction of the SKA is scheduled to begin in 2016 for initial observations by 2019 and full operation by 2024.

South Africa has been preparing for this challenge for years and has reaped benefits already.

MILLER MATOLA
CEO OF THE INTERNATIONAL
MARKETING COUNCIL

At present, such high-powered tools are not available and the SKA will play a key role in furthering our understanding of the Milky Way and neighboring galaxies.

The success of the project depends on widespread cooperation. Some 70 institutions and 20 countries are now involved in the project.

While Australia is competing with South Africa to host the SKA, both



Minister of Science and Technology
Naledi Pandor

countries are collaborating on the development of radio telescopes, called pathfinders, which will contribute to the technology needed.

In May 2008, the preparatory phase of the SKA was launched with 5.5 million euro (\$7.9 million) in funding committed by the European Union. This preparatory phase finalized a detailed technical design and developed SKA's governance and legal framework.

In April, South Africa and eight other countries: Australia, China, France, Germany, Italy, the Netherlands, New Zealand, and the United Kingdom — signed a letter of intent, agreeing to work together to secure funding for the SKA and committing themselves to the project. Australia and South Africa trumped both Argentina and Chile who were ruled out as potential host nations.

"Though the host country will only be decided in 2012, with construction likely to be completed by 2022, South Africa has been preparing for this challenge for years, and has reaped considerable benefit already," says Miller Matola, CEO of the International Marketing Council (IMC).

"The SKA is already driving technology development in hi-tech

areas such as antennae, fiber networks, signal processing, software and computing in South Africa, and will also benefit other systems which process large volumes of data."

A wealth of experience

The SKA bid is not South Africa's first experience of advanced astronomical technology, as clear skies and relatively little pollution mean the country has always been a favorable location for space observation.

In 2005, the largest single optical telescope in the southern hemisphere, the Southern African Large Telescope, known as SALT, was inaugurated near Sutherland in the Karoo.

More recently, a precursor to SKA known as MeerKAT (Karoo Array Telescope) is being built near Carnarvon in the Karoo.

A seven-dish demonstrator project, called KAT-7, has been operational since last year. Work on MeerKAT's design, development and construction began in 2004.

Once completed, the 80-dish MeerKAT will be one of the most powerful instruments in the world, and demonstrates South Africa has the technical competence to build SKA.

Local researchers are already accessing a 10.4-million-euro ultra-high-speed broadband link between SALT, MeerKAT, and the South Africa National Research Network in Cape Town.

The proposed 10 gigabyte per second fiber-optic link demonstrates that South Africa can provide the bandwidth SKA would require and gives researchers near real-time access to the data collected by SALT and MeerKAT.

In order to support the SKA development, both as a potential host nation and as a collaborating partner to the overall project, South Africa launched the South African National Space Agency (SANSA) in December 2010 to oversee all



Meeting of African Partner Countries in Pretoria, June 2011

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of the country's space exploration programs and will work on the SKA bid, which will integrate existing science and technology institutions.

It will help develop a formal space program and will promote

astronomy, engineering and ICT have received 263 grants through government programs. The SKA is expected to provide practical work opportunities for these students and enhance uptake in science training programs.

Hosting the International Astronomical Union's Office for Astronomy Development gives us the opportunity to boost African astronomy and the economy through education and job creation.

NALEDI PANDOR
MINISTER OF SCIENCE AND TECHNOLOGY

research in areas of astronomy, earth observation, communications, navigation, and space physics, while also developing skills in these areas.

Since 2005, local training and skills development in astronomy-related subjects has received a major boost through support from SANSA. Students in physics,

Global support

Last year, South Africa beat 20 other countries to host the International Astronomical Union's Office for Astronomy Development, which promotes astronomy in developing countries and manages astronomy education.

Minister of Science and Technology Naledi Pandor hailed the

announcement as an opportunity to boost African astronomy and the economy through education and job creation.

In addition, the African Union has endorsed South Africa's bid, saying that it will help drive human capital development on the continent and boost its move to a knowledge-based economy.

The African bid for the SKA, though headed by South Africa, also involves Botswana, Mozambique, Namibia, Zambia, Kenya, Madagascar, Mauritius and Ghana.

"This collaboration is proof that regional integration and regional advancement is a reality," said Matola.

Though the success of South Africa's SKA bid will only be known in 2012, it is clear that, if successful, the country — and the continent — will reap benefits far beyond a deeper knowledge of our galaxy and universe. The sky may not be the limit after all.

Building the case for South Africa

Winning the bid would present opportunities for global R&D and future investment

Staring at the stars could be one of South Africa's smartest investments, if the country's bid to host the world's largest radio telescope, the Square Kilometer Array (SKA), is successful.

Securing the SKA for South Africa would provide not only a significant financial investment from international organizations, but it would significantly increase South Africa's research and development skills and boost the scientific capacity of universities all over the continent.

The potential impact of the project is already being compared to the

my. The SKA project will help foster talent and skills not only here in South Africa, but across the globe as well. Growing South Africa's scientific capacity is a government priority, and while the country is growing as an industrialized economy the SKA will spur investment and accelerate talent development."

Once built, the SKA will be the world's largest radio telescope, and will be between 50 and 100 times faster than any existing radio imaging telescope.

Radio telescopes enable astronomers to listen to electromagnetic

project, but both contenders are lobbying hard as the capital investment is estimated to be worth 1.5 billion euro (\$2.18 billion).

To cover the operating costs, a further 100-150 million euro will be spent every year, of which a significant portion would be spent in the host country. Construction is planned to start in 2016 and finish by 2022.

Location is key, as the SKA requires an area of at least 100 km surrounding the project which is free from radio interference.

In addition, the 3,000-km surrounding the project needs to be silent from all interference, including radio signals.

South Africa is able to offer at least 150 km of land free from interference in an area near Carnarvon in the Karoo. With its partners, South Africa would have substantial research capacity.

Outlying stations will be located in Botswana, Mozambique, Namibia, Zambia, Kenya and Ghana. Madagascar and Mauritius are also supporting South Africa's bid and the African Union has acknowledged the importance of the bid for capacity building across the continent. "This is truly an African bid and project," says Matola.

South Africa is already reaping the benefits of the SKA through a comprehensive skills development program to support students in physics, astronomy, engineering and ICT.

To date, 263 academic grants have been awarded since 2005. In addition, the University of Botswana, Madagascar's University of Anta-



Karoo Array Telescope (KAT-7) is already operational in the Northern Cape Province, South Africa.

marivo, and Mozambique's Eduardo Mondlane University have introduced courses in astronomy and astrophysics.

Minister of Science and Technology Naledi Pandor said the SKA will provide practical work opportunities for these students and will enhance the uptake of science training programs.

Bilateral agreements have been established with some of the key institutions in the SKA consortium, including the Universities of Oxford and Cambridge, the University of California at Berkeley and Caltech, the National Radio Astronomy Observatory of the US, the National Radio Astronomy Center in India and three radio astronomy institutes in Italy.

Last year, South Africa beat 20 other countries in its bid to host

the International Astronomical Union Office, which, among other objectives, promotes astronomical research and education in developing countries.

This development signals the prestige South Africa has already gained in astronomy. If South Africa is chosen to host the SKA, the facility will pave the way for Africa to contribute significantly to the global technology economy.

The Karoo, a vast desert area in western South Africa, is already a favored location for astronomy, and the Karoo Array Telescope (MeerKAT), a powerful 80-dish radio telescope in its own right, is being built as part of South Africa's bid.

MeerKAT will be commissioned in 2014 at the earliest but is already in demand, with more than 43,000 hours of radio observation time

already allocated. MeerKAT's precursor, a seven-dish demonstrator project known as KAT-7 is already operational.

In a further boost to South Africa's bid, a 10.4-million-euro ultra-high-speed broadband link now connects the Southern African Large Telescope (SALT) — the largest single optical telescope in the southern hemisphere, in Sutherland — and the MeerKAT site with the South Africa National Research Network in Cape Town.

The 10 gigabyte fiber-optic link demonstrates that South Africa can provide the bandwidth SKA would require, and gives researchers real-time access to the data collected by SALT and MeerKAT. SALT, MeerKAT and similar projects demonstrate that South Africa already has the capacity to successfully host the SKA.

We are just touching the surface of China and we have the potential to attract many more visitors. We want to increase the numbers by 15 percent within five years."

ALBERTO LIM
SECRETARY OF TOURISM AT THE DEPARTMENT OF TOURISM

World Cup, and with good reason.

Just like the FIFA 2010 Soccer World Cup, the Square Kilometer Array (SKA) will place South Africa firmly on the world stage and leave a lasting infrastructural legacy which will benefit both the world's scientific and research communities, as well as the people of South Africa and the African continent through economic growth and education and skills development.

According to Miller Matola, CEO of the International Marketing Council of South Africa (IMC), custodians of Brand South Africa, "knowledge is the most important commodity in the modern econo-

radiation, which travels at a fixed speed of about 1.08 billion km/h.

The SKA will enable astronomers to observe objects in the outer edges of the universe, and help researchers better understand the universe's origins. At present, these tools are not available, so the SKA will have a considerable impact on world scientific knowledge.

Both South Africa — supported by eight other African countries — and Australia (allied with New Zealand) are bidding for the right to host the SKA project, having already beaten Argentina and Chile.

The final decision will be made in 2012 by those countries funding the