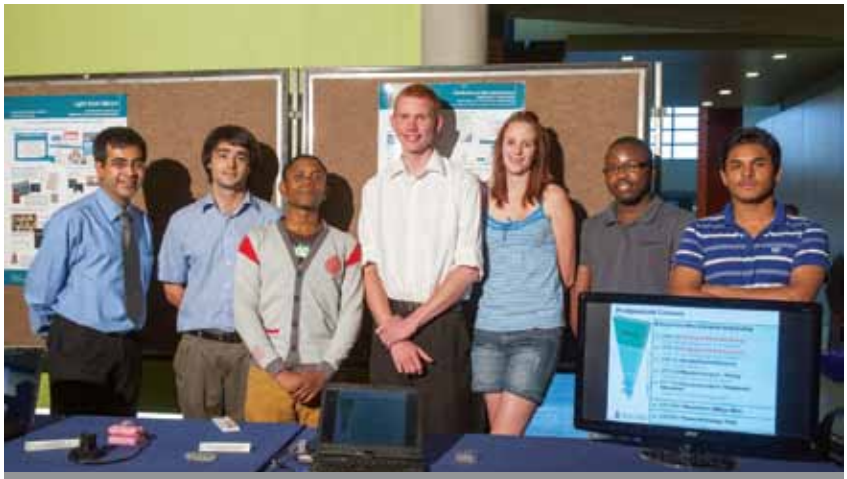
The MeerKAT is a radio telescope in development in South Africa and Australia. It uses radio waves instead of light waves to create a picture, and its ultimate goal is sensitivity to very small signals that originate in space.

Students develop solutions for the SKA project

The Carl and Emily Fuchs Institute for Microelectronics (CEFIM) in the Department of Electrical, Electronic and Computer Engineering at the University of Pretoria is doing remarkable work on the Square Kilometre Array (SKA) project, which is scheduled for construction in 2016. It allows for research to be done on all academic levels and the Department has launched various initiatives in relation to this exciting project.



The research team at the Carl and Emily Fuchs Institute for Microelectronics is developing solutions for the SKA project.

The SKA project involves the development of the MeerKAT radio telescope. It uses radio waves instead of light waves to make a picture and its ultimate goal is sensitivity to very small signals, originating from natural sources in space, which will enable physicists to gain an additional understanding into the origins and workings of the universe. It will have a total collecting area of approximately one square kilometre and will operate over a wide range of frequencies. Its size will make it 50 times more sensitive than any other radio instrument and this will enable it to survey the sky more than ten thousand times faster than ever before.

A principal factor affecting the sensitivity of radio telescopes is the noise figure (NF) in its receivers. The low-noise amplifier (LNA) is the first electronic subsystem in the receiver and it therefore plays the dominant role in determining the NF of the receiver as a whole, affected by both its own internal NF and its gain. It is therefore crucial to the scientific objectives of the SKA that its LNAs achieve excellent noise performance and reasonable gain. Researchers at CEFIM are working on developing human and technology capacity for this international project.

Undergraduate student James Smith recently concluded a project entitled “Design of a hybrid-integrated wideband low-noise amplifier in SiGe BiCMOS for the SKA”. He utilised the IBM 130 nm bipolar complementary metal-oxide semiconductor (BiCMOS), together with DuPont 951 low-temperature co-fired ceramic (LTCC) packaging to achieve a simulated NF of around 1 dB over the frequency range of 800 MHz to 1.4 GHz with an average gain of 27 dB.

Doctoral candidate Aba Bimana is conducting a project that looks at the wideband LNA for highly sensitive receivers using a differential architecture. A number of both theoretical and applied research outcomes are expected from this undertaking.

To encourage research that can benefit the development of the SKA, at least four undergraduate students, mainly from previously disadvantaged communities in South Africa, are supported in their studies through a scholarship and a mentorship programme. Various SKA student grants, managed through the National Research Foundation (NRF), support this research.