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The Square Kilometre Array

Richard T. Schilizzi

International SKA Project Office,
c/o ASTRON, Postbus 2, NL-7990AA Dwingeloo, the Netherlands
email: schilizzi@skatelescope.org; url: www.skatelescope.org

Abstract. The Square Kilometre Array (SKA) is a global project to design and build a new generation radio telescope at metre to centimetre wavelengths.

1. Introduction

The Square Kilometre Array is under development by more than 50 institutes in 17 countries as one of the major observatories serving the global astronomical community for the coming decades. It will operate at metre and centimetre radio wavelengths with enormous sensitivity and wide field of view, and will have unprecedented surveying power. The range of key science to be tackled by the SKA (Carilli & Rawlings 2004) covers the epoch of re-ionization, galaxy evolution, dark energy, cosmic magnetism, strong field tests of gravity, gravitational wave detection, transients, proto-planetary disks, and the search for extra-terrestrial life. The major increase in performance compared to existing telescopes and the flexibility inherent in the telescope design allows us to predict that unexpected discoveries will be made with the SKA.

2. Telescope concept

The SKA is to be a radio telescope with

- the sensitivity to detect and image hydrogen in the early universe through its enormous collecting area of about 1 million square metres. This will make it about 50 times more sensitive than the EVLA, and able to reach an rms noise level of 10 nano-Jy in an 8 hr integration for a continuum observation;
- 50 % of the collecting area concentrated in the central 5 km diameter for optimal detection of hydrogen, pulsars, and magnetic fields;
- a fast surveying capability over the whole sky through its sensitivity and very large angle field of view of several tens of square degrees. The SKA will be 10000 times faster than the EVLA in surveying the sky;
- the capability for detailed imaging of compact objects like active galactic nuclei through its large physical extent of at least 3000 km;
- a frequency range from $\leqslant 100$ MHz to 25 GHz;
- data transport to the central data processor via very wide-band (terabit/sec) fibre links. Pflops/sec capacity is required for the central processor.

This combination of an enormous increase in sensitivity across the frequency range, a wide field of view, and the capability to sample the spatial, frequency, and time domains with high resolution will revolutionize many fields of astronomy.

The Reference Design for the SKA is an interferometer array capable of imaging the radio sky at frequencies from $\leqslant 100$ MHz to 25 GHz, and providing an all-sky monitoring capability at frequencies below 1 GHz. It covers the frequency band with three different

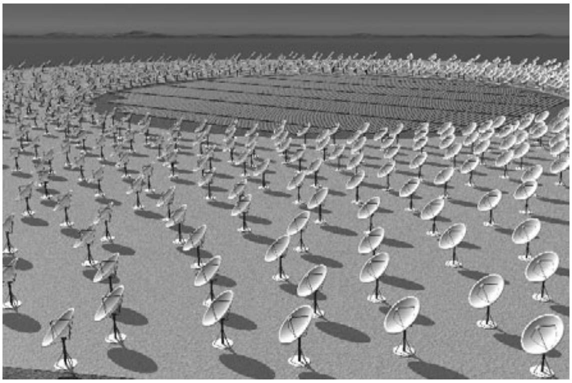

Figure 1. Artist's impression of the central 5 km of the SKA

kinds of receptors: (*i*) dipole arrays for ⩽100 - 300 MHz to observe the Epoch of Reionization; (*ii*) a small parabolic dish array, with phased focal plane arrays in the 300 MHz to 3 GHz range and broad-band single-pixel feeds above 3 GHz; and (*iii*) aperture array tiles in the core of the array for all-sky monitoring in the frequency range 0.3 - 1 GHz and multiple independent field observations. These three receptor components all make use of the same data transport, processing, and software infrastructure. An artist's impression of the central core of the array is shown in the figure.

Much of the required technology is being developed in the course of the construction of several 1 % SKA Pathfinder instruments. In Europe, a Design Study (SKADS) is underway, funded in part by the European Commission. The Low Frequency Array (LOFAR) is under construction in the Netherlands and Germany. The extended New Technology Demonstrator (xNTD) and the Mileura Wide-field Array-Low Frequency Demonstrator (MWA-LFD), are under construction in Western Australia, as is the Karoo Array Telescope (KAT) in South Africa, and the Allen Telescope Array (ATA) in the USA.

3. Location

Following an evaluation of proposals for four potential locations for the telescope by the International SKA Steering Committee (ISSC) and its advisory committees, the ISSC decided in August 2006 that the short-list of acceptable sites would comprise Australia and Southern Africa. A final choice is expected to be made late in this decade.

4. Timeline and cost

The major milestones foreseen in the project are the following:

2008	external review of concept design
2009-2011	costed system design completed, final site selection, agreement on funding
2012	start construction of the SKA
2014	science with 10 % SKA
2020	construction completed, full science operations

The target cost for the SKA is 1 billion Euro.

Reference

Carilli, C., & Rawlings, S. 2004, *New Astronomy Reviews*, 48, 979