The Square Kilometre Array

fact sheet for scientists and engineers

Exploring the Universe with the world's largest radio telescope

What is the SKA?

The SKA will be a revolutionary radio telescope with about one square kilometre of collecting area, giving 50 times the sensitivity and 10,000 times the survey speed of the best current day telescopes.

It will give astronomers insight into the formation of the first stars and galaxies after the Big Bang, how galaxies have evolved since then, the role of magnetism in the cosmos, the nature of gravity, and studies in astro-biology. And, if history is any guide, the SKA will raise more questions about the Universe than answer old ones.

The SKA is a global project in which astronomers and engineers from more than 70 institutes in 20 countries, together with industry partners, are participating in the scientific and technical design of the telescope through development programs, design studies, and pathfinder telescopes.

Where will it be located?

Two candidate locations are under consideration: Australia – New Zealand and Southern Africa.

In the first case, the core region would be in Western Australia with remote stations stretching across Australia to New Zealand.

In Southern Africa, the core would be in the Northern Cape Province in South Africa with remote stations scattered throughout the rest of South Africa and several countries in the region including the Indian Ocean islands.

The core region in either location will have to accommodate up to three sub-cores, each approximately 5 km in diameter - one for the dishes, one for sparse aperture array dipoles, and one for dense aperture array tiles.

Major site selection criteria include the current and future radio quietness of the sites, and the infrastructure capital and operations costs. Ongoing site characterisation includes measurement of the radio-quietness of the core regions and representative remote stations, as well as measurement or modelling of tropospheric and ionospheric stability.

What will it look like?

The SKA will employ antenna systems to cover, initially, the frequency range from 70 MHz to 10 GHz (4 m to 3 cm wavelength), with a later extension to 25 GHz or more. Fifty percent of the total antenna collecting area will be concentrated in the core region, 15-20 km across, with the remainder in outlier stations at distances of up to at least 3000 km to provide very detailed images of the cosmos.

In the higher part of the frequency band, the antennas will comprise up to 3000 dishes each of about 15 m diameter and carrying low noise innovative feed and receiving systems. In the lower part of the band, the antennas will be fields of aperture array tiles and dipole arrays, with no moving parts, able to observe a number of large areas of the sky simultaneously.

Signals received by the antennas will be transferred to a central signal processing system and high performance computer by optical fibre links carrying up to 420 gigabits/sec per dish and 16 terabits/sec per aperture array.

The special purpose central processing system will process as much as 1 petabyte of astronomical data every 20 seconds, so that exascale computing and exabyte data storage will be required.

A sophisticated data archive and distribution system will provide access to the data by astronomers and physicists anywhere in the world.

Timeline and cost

Five stages of development of the SKA are planned:

2008-2012 Preparatory Phase in which the system design and cost are determined, and the site decision and initial construction funds are ratified by the participating governments.

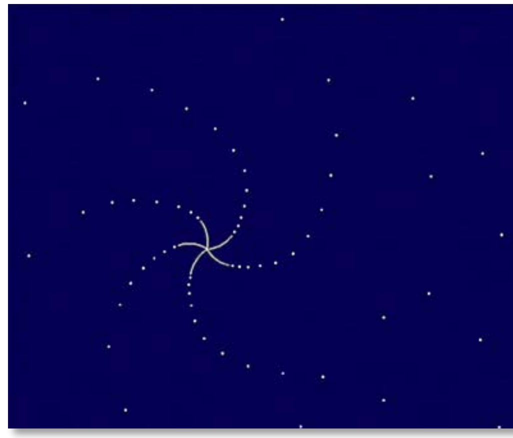
2013-2015 Detailed design, production engineering and tooling.

2016-2019 Initial construction (10%), commissioning, acceptance, integration and first science. Ratification by governments of funds for the full SKA.

2020-2023 Completion of construction, commissioning, acceptance, integration, and shared-risk science.

2024 Science operations.

The target cost for the SKA construction is €1,500 million.



The spiral arms of the SKA will extend more than 3,000 km from the centre of the array.

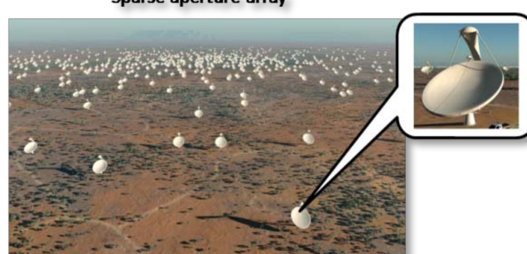
Artist's impression of the three arrays of receptors

The **sparse aperture arrays**, for the lowest frequencies of observation, are shown as arrays of "droopy dipoles", one for each polarisation. The sparse aperture arrays are arranged into stations.

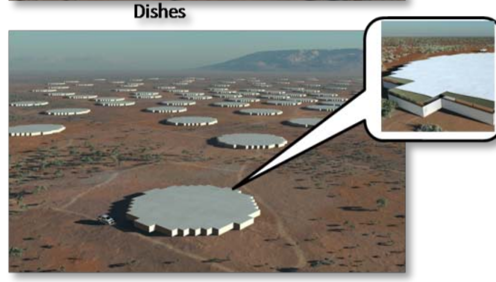
At mid-frequencies the **dense aperture arrays** are closely packed antennas arranged in tiles within stations. The size of the dense aperture array stations is likely to be about 60 m diameter.

Parabolic dishes are used for high frequencies. These are arranged into stations at distances beyond about 180 km from the core regions. Each dish is approximately 15 m in diameter.

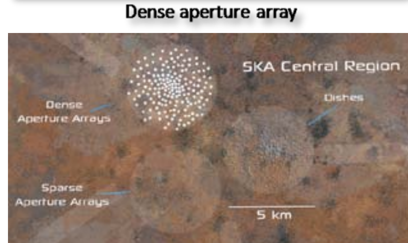
Sparse aperture array



Dishes



Dense aperture array



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