



An existing 64-dish array in South Africa is set to become part of the Square Kilometre Array.

WORLD'S LARGEST RADIO TELESCOPE NEEDS TO HIT US\$1-BILLION TARGET

Countries won't say how much they have pledged to the Square Kilometre Array in Australia and South Africa.

By Sarah Wild

An independent panel of reviewers has approved the design of what will be the world's largest telescope – the Square Kilometre Array (SKA). But the final design and construction timetable depend on whether the SKA collaboration can raise its first €940 million (US\$1 billion).

The amount that countries have already committed to the SKA is confidential, but it is understood to be less than is needed for construction to begin on schedule in 2021. When asked, SKA director-general Philip Diamond would not say how much money the project expects to have in the bank when building starts, but SKA officials say that pledges must be confirmed by the middle of 2020.

The design was agreed by the review panel last month. “We are aggressively seeking the full funding commitment,” Diamond says. But he adds that if sufficient funds are not pledged in time, the collaboration will turn to a scaled-back design costing €691 million. This design has reduced computing power, and its dishes and antennas are squeezed closer together.

If the full plan is achieved, the SKA will be able to create images 50 times more detailed than those produced by current instruments,

such as the Hubble Space Telescope, and will shed light on some of the most enigmatic problems in astronomy and science, such as the nature of dark matter and how galaxies form.

The gigantic telescope will be able to detect signals from the ‘epoch of reionization’, when the first stars and galaxies began to give off light, says Francisco Colomer, director of the Joint Institute for Very Long Baseline Interferometry European Research Infrastructure Consortium in Dwingeloo, the Netherlands, which coordinates a network of radio telescopes in 13 countries.

Budgetary barriers

The SKA will be built in stages, but once complete, it will include around 2,000 radio dishes in 9 African countries and up to one million antennas in Australia. The array will have a total signal-collecting area of roughly 1 square kilometre, hence its name. Designs for the first phase – known as SKA1 – account for roughly 10% of the finished project, and will include 194 dishes in South Africa, along with about 130,000 antennas in Australia.

The project is being coordinated by ten member governments: those of Australia, Canada, China, India, Italy, Spain, South Africa, Sweden, the Netherlands and the United Kingdom, as

well as a group of French research organizations and Germany's Max Planck Society.

But it's not clear how much of the \$1-billion construction cost has already been raised. The United Kingdom – which houses the project's headquarters at the Jodrell Bank Observatory near Manchester – has contributed £119 million (\$154 million) to the SKA project so far, and other countries have also provided funds.

Around 100 organizations from 20 countries have worked on prototype dish and antenna designs, as well as the information-technology infrastructure needed to collect data. SKA spokesperson William Garnier says the amounts that these countries have contributed are confidential for now, but he confirms that the construction funds will need to be banked before the collaboration can award building contracts.

Costs of cutbacks

Astronomers have voiced concerns that – if the project cannot raise its first \$1 billion – the scaled-back plan would reduce the telescope's sensitivity. But Diamond told *Nature* that this design can be upgraded if more money comes through – or if more countries become part of the consortium.

Extra countries have joined the project since it officially kicked off in 2013. But of the founding partners, the German government left the project in 2014 and New Zealand pulled out in July last year, the latter because officials were not convinced that its researchers would gain enough benefits from the project to justify the membership cost, estimated at NZ\$40 million (US\$26 million) over 10 years.

The telescope's budget and its start date have changed before, and it is possible that the 2021 target might be revised again. This is because SKA member countries have not yet finished creating the intergovernmental SKA Observatory, which will be the legal entity responsible for managing the project and collecting and spending funds.

The SKA Observatory must be established before governments can formally begin depositing project funds. For this to happen, at least five member countries – including Australia, South Africa and the United Kingdom, which all host parts of the project – must each pass a law pledging that the country will become part of the body. Australia, China, Italy, the Netherlands, Portugal, South Africa and the United Kingdom have all agreed to enact relevant legislation, but so far only the Netherlands has done so.

A source who has knowledge of the project, but who asked not to be named, is confident that the SKA will be built despite delays and fluctuating costs, and that it will be an impressive instrument irrespective of the chosen design. “SKA is too big to fail: there's too much involvement at a senior level, too much money,” they say.