STATUS OF THE SQUARE KILOMETRE ARRAY

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Abstract

The Square Kilometre Array (SKA) is a international project to build a number of multi-purpose radio telescopes, operating as a single observatory, that will play a major role in answering key questions in modern astrophysics and cosmology. It will be one of a small number of cornerstone observatories around the world that will provide astrophysicists and cosmologists with a transformational view of the Universe. Two major goals of the SKA is to study the history and role of neutral Hydrogen in the Universe from the dark ages to the present-day, and to employ pulsars as probes of fundamental physics. Since 2008, the global radio astronomy community has been engaged in the development of the SKA and is now nearing the end of the *Pre-Construction* phase. This talk provides an overview of the current status of the SKA and the plans for construction, focusing on the computing and software aspects of the project.

INTRODUCTION

The Square Kilometre Array (SKA) is an international project that has the aim of building multi-purposes radio telescopes, with an equivalent collecting area of at least one square kilometre, and thus unprecedented sensitivity, so that key questions in modern astrophysics and cosmology can be answered.

The original SKA Science book was published in 2004 [1]. In 2015, *Advancing Astrophysics with the Square Kilometre Array* [2] was published with an update to the SKA science book after a decade of development of the SKA concept, incorporating more than 130 scientific use cases that will be possible thanks to the SKA telescopes.

Those science cases cover Galaxy Evolution, Cosmology and Dark Energy[1] [3–5], Strong-Field Tests of Gravity[2] [6], Cosmic Magnetism[3] [7], The Cosmic Dawn and the Epoch of Reionisation[4] [8], and research on the Cradle of Life[5] [9]. The amount of physical disciplines foreseen to be encompassed by the SKA telescopes is one of the largest for any ground based facility to date.

The SKA project is currently in what is known as SKA Phase 1, or SKA1, in which two telescopes approximately with 10% of the target collecting area are being built, namely SKA1-Mid, and SKA1-Low, in order to prove the feasibility of the techniques and derisk the construction of the next phase of the project, SKA Phase 2, or SKA2.

The goal is to have a single observatory entity, that will construct and operate two SKA1 telescopes (SKA1-Mid and SKA1-Low), with presence in three sites: Australia (SKA1-Low), South Africa (SKA1-Mid), and United Kingdom (Headquarters and central operations).

This talk focuses on the progress and status of the SKA1 telescopes. It starts by describing the SKA Organisation itself (Sec.), the current SKA timeline (Sec.), and the overall project organisation (Sec. **??**).

SKA ORGANISATION

The organisation overseing the SKA1 project is the SKA Organisation (SKAO), currently a limited liability non-for-profit company registered in England and Wales.

The SKAO is in the process of the becoming an Inter-Govermental treaty Organisation (IGO), not unlike the European Southern Observatory (ESO) or the European Council for Nuclear Research (CERN). The timeline for that process will be detailed in Sec. .

Currently[6] there are ten countries as Full Members of the SKAO (in alfabetical order): Australia, Canada, China, India, Italy, New Zealand, South Africa, Sweden, The Netherlands, and United Kingdom. Other countries are involved in the design of the SKA1 telescopes, and it is estimated that $\tilde{2}0$ countries and more than 100 organisations are contributed to that effort.

SKAO's headquartes are located within the boundaries of the Jodrell Bank Observatory, in the middle of the Cheshire plain, under direct view of the 70m Lovell Telescope.

As part of the UK commitment as host country for the SKAO HQ, and the IGO, an expansion to the HQ is being constructed with the intention of becoming a nexus for radio astronomy. An artist rendition of the new building can be found in Fig. 1, while the current status of the work, as of September 2017, can be seen in Fig. 2.

The vision for the Square Kilometre Array

SKA1 TELESCOPES

As previously indicated, in this Phase 1 (SKA1) we intend to build two telescopes, SKA1-Mid, and SKA1-Low, within a cost cap for both telescopes of 674 MEur (2016 value).

The SKA1-Low will be located in Western Australia, within the Murchison Radio-astronomy Observatory (MRO), which defines a Radio Quiet Zone for the benefit of the SKA1-Low, but also the Australian SKA Pathfinder (ASKAP) and Murchison Widefield Array (MWA) precursor telescopes. Fig. 3 shows where the MRO is located, together with the positions of Geraldton (the designated Engineering

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[1] http://skatelescope.org/galaxyevolution/
[2] http://skatelescope.org/gravity-einstein-pulsars/
[3] http://skatelescope.org/magnetism/
[4] http://skatelescope.org/cosmicdawn/
[5] http://skatelescope.org/cradle-life/
[6] https://skatelescope.org/participating-countries/

Figure 1: Artist's view of the future SKAO HQ2, with the Council chamber in the foreground, and the Lovell telescope current Jodrell Bank Observatory building in the background.

Figure 2: Aerial view of the current status of the SKAO HQ2 building, after the steel structure has been erected, and concrete slabs installed. The current SKAO HQ is in the foreground, Council chamber can be seen raising to the right.

Operations Centre), and of the Pawsey Supercomputing Centre, currently the designated host for the Science Processing Facility.

SKA1-Low will consist of 131,072 log-frequency, dual polarisation dipole antennas, organised in 512 stations of 256 antennas each.

[10] defines the baseline design capabilities of the SKA1-Mid and SKA1-Low telescopes.

SKA1 CONSORTIA

TBD.

SKA1 TIMELINE

TBD.

SKA1 CONTROL HIERARCHY AND CONTROL SYSTEM GUIDELINES

SKA1 CENTRAL AND SCIENCE DATA PROCESSING

Challenge of processing, storage.

CERN-SKA agreement on extreme-scale computing[7].

[7] http://skatelescope.org/news/ska-signs-big-data-cooperation-agreement-cern/

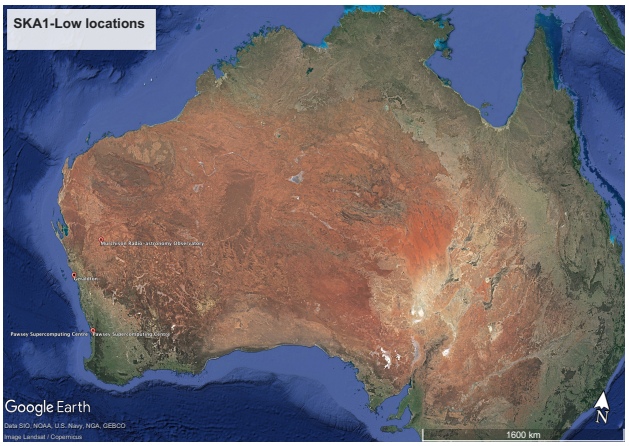

Figure 3: Relevant locations of SKA1-Low in Western Australia. The image shows the location of the Murchison Radio-astronomy Observatory, the Engineering Operations Centre in Geraldton, and the Pawsey Supercomputing Centre, where we expect the Science Data Processor for SKA1-Low to be located.

CONCLUSION

TBD. Any conclusions should be in a separate section directly preceding the **ACKNOWLEDGEMENT**, **APPENDIX**, or **REFERENCES** sections, in that order.

ACKNOWLEDGEMENT

TBD. Any acknowledgement should be in a separate section directly preceding the **REFERENCES** or **APPENDIX** section.

APPENDIX

TBD. Any appendix should be in a separate section directly preceding the **REFERENCES** section. If there is no **REFERENCES** section, this should be the last section of the paper.

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