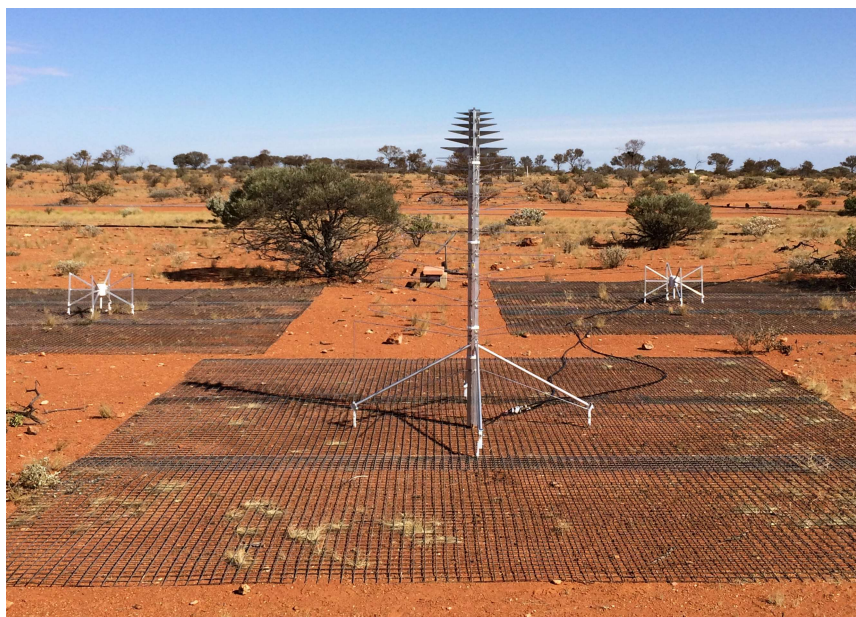


The SKALA4-AL antenna: implementation, prototyping and experimental verification



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1. Introduction

The SKA1-LOW is the low-frequency instrument of the Square Kilometre Array (SKA). SKA1-LOW is a Low Frequency Aperture Array (LFAA) exploiting a digital beamforming to steer the array beams towards the celestial sources. In order to have enough collecting area and high angular resolution, the SKA1-LOW is composed by a multitude (more than 130.000) of fixed antennas spread over large distances in the Murchison area in Western Australia.

The functional electromagnetic performance and the harsh environment pose challenging requirements to the antenna design. After an intensive work, a dual-polarized 16-elements Log Periodic Dipole Antenna, called SKALA4, has been proposed as a possible antenna candidate to match the specifications of the SKA project. This antenna has been designed by the Work Package “Antenna and LNA” (led by Dr. Eloy de Lera Acedo from the University of Cambridge and with the participation of members from INAF and CNR-IEIT) of the AADC (Aperture Array Design and Construction) Consortium¹ and is based on the experience gathered over several years of research and development activity. In September 2017, an antenna selection panel appointed by the SKA Organization identified this antenna as the most appropriate solution for the SKA project.

Starting from the conceptual design of the SKALA4 antenna, several mechanical and electrical solutions need to be applied to transform such an ideal design to a real antenna. In this perspective, the authors of this report proposed an antenna solution called SKALA4-AL. This antenna solution is based on the experience present at INAF and CNR-IEIT. Furthermore, several suggestions especially in the fabrication process come from the industrial partner Sirio Antenne. Sirio Antenne is a company established in 1972, which earned a reputation of a reliable and high quality supplier in the field of communication and especially wire antennas.

Besides the antenna, the Italian team worked also on developing a low noise amplifier (LNA) to be installed on top of the antenna to amplify the signal before transmitting it to the front-end module. Also on this side, a collaboration with an industrial partner was established.

Several experimental verifications of the SKALA4-AL antenna were conducted on individual antenna parts, like corrosion resistance and tensile tests. Furthermore, two antenna prototypes were built allowing the possibility to perform electromagnetic measurements, which were conducted both in Italy and in Australia. These tests showed good results in terms of EM performance and reliability.

This report describes the various activities that have been conducted on the SKALA4-AL antenna in the period September 2017 – August 2018. The mechanical design is presented together with some considerations on the grounding, material selection, packaging and shipment. Some preliminary environmental tests on the corrosion resistance and robustness are showed. The report includes also results from full-wave electromagnetic simulations as well as from experimental measurements on two prototypes of the SKALA4-AL antenna. Two sections of the report are addressed to the description of the LNA and to some preliminary budget estimation. Finally, future activities to further optimize and test the SKALA4-AL antenna are reported.

¹ <https://www.skatelescope.org/lfaa/>

*The full technical report
is available only on
request to one of the
authors*
