

South African Square Kilometre Array Project Postgraduate Bursary Programme

MEng Research Project Proposal to be considered for Bursary Funding to Commence in 2020

1. Title of Research Project: Reverberation Chamber Optimization for EMC Pre-compliance Testing

2. Academic Level: M Eng

3. Supervisor's Title and Full Name: Dr Pieter Gideon Wiid

4. Co-supervisor's title and full name:

5. Supervisor's University: Stellenbosch University

6. Overview and Aims of the Research Project:

Pre-Compliance testing requirements for Electromagnetic Compatibility (EMC) of individual components for the Square Kilometre Array (SKA) is ever-increasing. Reverberation chambers are often used for this type of testing due to their simplicity in measuring worst-case total radiated power emissions. This project will investigate methods to optimize bandwidth, quality factor, time constant and statistical uniformity of reverberation chambers through practical changes to chamber surfaces and angles, stirring paddle designs and antennas used in these chambers.

7. Relevance of the research proposed to the priority areas of MeerKAT / SKA:

Multiple feed components of MeerKAT as well as future SKA-MID1 components still need to go through testing before they can be installed to site. The early detecting of RFI from these components through reverberation chamber testing is essential, due to their close proximity to other telescopes and adjacent components on the index feed system. This falls in priority area 4.2.3 Hardware and data analysis systems for detecting, monitoring and identifying Radio Frequency Interference (RFI), including the use of telescope data (e.g. using MeerKAT visibilities to locate RFI sources)..

8. Research work breakdown:

- a. Year 1: The student will conduct an in-depth literature study in the first semester of current state-of-the-art of reverberation chamber designs, methods, instruments, antennas and stirrers as well as the chamber performance parameters, how to evaluate them and which design changes will improve on it. The second semester will include the performance evaluation of the currently installed reverberation chamber at Stellenbosch University to use as baseline. The work will then involve incremental

proposed design changes in computational electromagnetic (CEM) software simulation, with practical suggestions for improvement.

- b. Year 2: The first semester of year 2 will include the implementation of these improvement and optimization strategies and testing of their performance criteria compared to initial chamber designs. Iterative changes can be applied to analyse which changes provides the best improvement. The dissertation writing will be done during the second semester, and work will include the final analysis and evaluation of the suggested improvements.

9. Availability of required data / access to required equipment /availability of research facilities and other resources required:

The Stellenbosch University has a shielded reverberation chamber, an anechoic chamber, a Rohde and Schwarz 8 GHz network analyser, as well as a Rohde and Schwarz 40 GHz Spectrum Analyser and soon a Tektronix 2.5 GHz oscilloscope for testing purposes. A 3D-printer as well as numerous fine-mechanic and large-scale machinery and materials are available at the E&E Department workshops, for prototype container parts. A PCB milling facility is also available in the department. Electronic components for filters and other system hardware components can be sourced through the university as well.