Section A: Overview of the Research Project Proposal

1. **Title:** Localization of stationary Radio Frequency Interference (RFI) sources in MeerKAT observations of the Proxima Centauri field.

2. **Broad field of research:** Science

3. **Academic level of research project:** Masters

4. **Abstract:** Radio Frequency Interference (RFI) is one of the major challenges in MeerKAT data analysis. Current techniques for RFI mitigation (AOFlagger, tricolour, etc.) are based on identifying and flagging outliers in visibility data based on some sort of statistical criteria, without exploiting the physical nature of the underlying RFI.

   This project aims to localize nearby stationary RFI sources, using existing MeerKAT observations of the Proxima Centauri field. We intend to use near field Electromagnetic equations and interferometric techniques to measure the location of these active RFI sources, and to determine their statistical properties.

5. **Primary supervisor:** Prof Oleg Smirnov, o.smirnov@ru.ac.za, Rhodes University

6. **Research supervisor:** Dr. S. K. Sirothia, sirothia@ska.ac.za, SARAO

Section B: Details of Research Project

1. **Scientific merit:** site surveys, as well as recent studies by the SARAO Data Science team (see *MeerKAT HPRFI -- Known RFI impact*, report by N. Oozeer) confirm three major groups of known strong RFI sources that can be detected at the MeerKAT site: Global System for Mobile Communication (GSM), Distance Measurement Equipment (DME) and Global Positioning System (GPS) satellites. Strong RFI sources are routinely flagged and, and data affected by them is excised.

   Low-power RFI, while considerably more difficult to locate and characterize, can also have an adverse effect on observations. We propose to explore the use of near-field interferometric techniques to localize nearby stationary low-power RFI emitters. The project proposed here will use MeerKAT data from the observations of the Proxima Centauri field.

   We will be developing this technique using near-field Electromagnetic equations, and applying them to interferometric visibilities in order to measure the location of these active RFI sources and determine their statistical properties.

The techniques developed here will have application to many MeerKAT observations, as they could mitigate the effect of low-level RFI that is not detected by traditional flaggers.

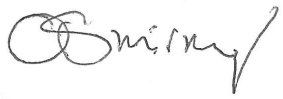
2. **Feasibility:** Multi-epoch data of the Proxima Centauri field from the MeerKAT open time call will be used. Computing resources already available with the Radio Research group (RARG, SARAO) will be used for the project.

   Scientific supervision of the project will be provided by Dr S.K.Sirothia (SARAO), and technical supervision by Prof Smirnov (Rhodes).

3. **Link to SARAO research priority areas for 2021:** The proposed research project will exploit MeerKAT data awarded in the Open Time call for proposals issued in December 2018 and July 2020. It is therefore directly linked to the highest priority area of the call. The results of the project can have direct application to most MeerKAT observations.

4. **Any particular qualifications, academic abilities, skills and/or experience that a student should have in order to successfully deliver on the objectives of the research proposed:** Familiarity with radio interferometry and observational radio astronomy would be an advantage but it is not strictly required.

Supervisor



Oleg Smirnov
23 February 2021