

## Section A: Overview of the Research Project Proposal

1. **Title:** Variable sources in MeerKAT observations of the Proxima Centauri field
2. **Broad field of research:** Science
3. **Academic level of research project:** Masters
4. **Abstract:** The presence of variable sources in any field impacts calibration solutions and therefore the dynamic range of map. The causes of variability could be instrumental (antenna primary beam, ionosphere) or could be intrinsic to the source. This project aims to identify variable sources in the Proxima Centauri field.

Existing multi-epoch MeerKAT data of the Proxima Centauri field will be used to derive flux density and time series, and to establish and quantify the effect of variability. This will potentially reveal extragalactic variable sources, such as blazars, and galactic variable sources, such as pulsars, within the field itself.

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:** During the course of the project, methods will be developed to identify variable sources. Flux density, time series related study of extragalactic variable sources, such as blazars and galactic variable sources such as pulsars, using the existing multi-epoch data of the Proxima Centauri field, will be used to establish and quantify the effect. This will require use of standard calibration and imaging packages such as CASA, as well as packages developed within the group (CARACal, CubiCal). The project aims to quantify the variation in the flux density due to intrinsic source variability and differentiate with the flux density variations due instrumental effects. The aim is therefore primarily technical, and the primary outcome will be an improvement to techniques and pipelines, however, there is a possibility for science payoffs if unusual types of variability are discovered.

Current approaches to source variability revolve around direction-dependent gain solutions. These approaches can yield undesired results, whereby possible intrinsic source variability is attributed to instrumental and beam related errors; this can also

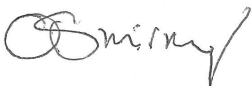
impact the flux density measurements of sources in the immediate vicinity of such variable sources. The project attempts to do a preliminary technical study of these issues. The study will help to improve the flux density accuracy and dynamic range of the images from MeerKAT.

2. **Feasibility:** Multi-epoch data of the Proxima Centauri field from the MeerKAT open time call is available. No new observations and proposals are required. 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 2023:** 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.
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**  
**22 February 2023**