Section A: Overview of the Research Project Proposal

1. Title: **Polarization calibration and imaging pipelines for MeerKAT**
2. Broad field of research: **Science**
3. Academic level of research project: **Masters**
4. Abstract: MeerKAT is providing a rich trove of polarization information with every observation. This can and should be exploited routinely, but this is currently hindered by the lack of standardized calibration procedures and software. This project aims to incorporate current (and novel) calibration techniques into a software pipeline, making MeerKAT polarization images routinely accessible.
5. Primary supervisor: **Prof Oleg Smirnov,** o.smirnov@ru.ac.za, Rhodes University

Section B: Research Project Proposal

Scientific merit: Standard (first-generation) polarization calibration for MeerKAT and other telescopes is fairly well-established. MeerKAT's extreme sensitivity provides for spectacular polarization images, and these should be produced routinely. That they are not is due to a number of factors: (a) good Southern polarisation calibrators are scarce, and some observations simply omit them; (b) legacy packages such as CASA have built-in assumptions from older telescopes that can hinder the process; (c) many science users do not fully understand polarization calibration and end up passing on the [considerable scientific!] opportunity.

The availability of standardized and easy-to-use polarization pipelines could change all this, and most of the software pieces are already in place. The CARACal pipeline already implements standard CASA-based polarimetric calibration. The CubiCal package (and its successor QuartiCal) provides a platform for implementing non-standard techniques. Work by Cotton & Mauch on MeerKAT shows how to derive polarization calibration solutions from the noise diode, alleviating the need for sky calibrators. A related PhD project aims to push these techniques further (but is not necessary for the success of this MSc project).

This project aims to pull together all the available tools into a standardized pipeline within CARACal, and to test it with a number of MeerKAT datasets from the first open time call (the latter means that the project will have immediate scientific spin-offs).

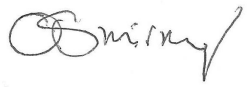
Feasibility: moist of the software pieces required to implement this project are already in place, and, in most cases, are maintained by the RATT group, so all the technical expertise is on hand.

Validation data is available from a number of MeerKAT open time projects within RATT.

Link to SARAO research priority areas for 2021: Any and all MeerKAT imaging observations will yield more science via better polarimetry.

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: Good coding skills and a good maths background. Familiarity with radio interferometry and observational radio astronomy would be an advantage but it is not strictly required.

Supervisor



Oleg Smirnov 24 February 2021