

## Section A: Overview of the Research Project Proposal

1. Title: **Quantifying multiscale feedback in star forming regions in the Galactic Plane with MeerKAT**
2. Broad field of research: **Science**
3. Academic level of research project: **Doctoral**
4. **Abstract:** This project aims to explore the free-free radio continuum emission observed with the MeerKAT facility in a portion of our Galaxy rich in newly formed massive star-forming regions. The free-free emission is critical to understanding the impact of the feedback in such regions, providing us unique insights into the star formation mechanisms. In combination with ancillary data available from facilities such as APEX and ALMA we will be able to investigate all the mechanisms that allow the multiscale formation of massive stars, from the parent molecular clouds down to the innermost cores.
5. Primary supervisor: **Prof Oleg Smirnov**, [o.smirnov@ru.ac.za](mailto:o.smirnov@ru.ac.za), Rhodes University & SARAO
6. Research supervisor: **Dr Alessio Traficante**, INAF-IAPS (Italy)

## Section B: Research Project Proposal

**Scientific merit:** The Galactic Plane hosts the majority of intermediate and high-mass starforming regions, where clusters of stars at all masses are born. The fragmentation and protostellar accretion process in crowded regions is governed by the interplay of actors such as gravity and turbulence. The system becomes strongly influenced by the most massive protostars of the clusters when they reach the main sequence, generating HII regions with strong ionised winds and UV radiation that constitute a source of strong radiative and dynamical feedback into the system.

The free-free radio continuum is the ideal tracer for this ionised component, and the novel ability of MeerKAT to map at 3GHz (S-band) its properties over large areas in the Galactic Plane enables the study over multiple spatial scales, from the smallest hypercompact HII regions to the large filamentary structures marking shock fronts at the scale of tens of parsecs.

The goal of this PhD project is to work with a new 3 GHz MeerKAT 5 square degree pilot survey of a region of the Galactic Plane that is rich with tens of newly forming massive regions. The PhD candidate will learn how to process interferometric data and how to interpret the results in the context of the various star formation theories available today. To this end, the candidate will also have the opportunity to combine the new MeerKAT data with ancillary datasets obtained from various single-dish surveys, aimed at understanding the large-scales gravo-turbulent properties of these star-forming regions, as well as newly available data obtained from the

ALMA interferometry in the context of the ALMAGAL large survey, led by the Catania group, to investigate the feedback mechanisms at the sub-pc scales of the star-forming clusters.

Collaborators: Dr. S. Molinari (INAF-IAPS, Rome), Dr. G. Umana (University of Catania), Dr. F. Cavallaro (University of Catania), Dr. A. Ingallinera (University of Catania).

**Feasibility:** Most of the observational data for this project is already available.

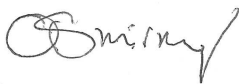
Storage and computing resources for this project will be provided by the compute cluster of the Rhodes Centre For Radio Astronomy Techniques & Technologies (RATT). Additional support by the INAF facilities in Rome and Trieste may be allocated for data analysis and data storage if needed.

Scientific supervision of the project will be provided by Dr Traficante (INAF-IAPS, Italy), and technical supervision by Prof Smirnov (Rhodes). The student is expected to spend some time in Italy at INAF-IAPS and Dr Traficante will pay regular visits to South Africa. The supervisors will be able to provide further support for such visits.

**Link to SARA0 research priority areas for 2024:** The proposed research project will exploit MeerKAT Galactic Plane data at 3GHz.

**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

26 February 2024