

South African Radio Astronomy Observatory

Research Project Proposals for Masters and Doctoral Research in 2019

- 1. All research project proposals must be submitted by a primary supervisor (see the definition of a primary supervisor in Section 1 of the Application Guide). In the case where the primary supervisor is not the research supervisor, the details of the co-supervisor, who will be responsible for supervising the research, must also be provided (as requested below).**
- 2. Please provide the information requested below, in the order requested, and please use the same numbering, and “headings”, as below.**
- 3. As requested in the online application form, upload the research project proposal as a PDF document.**

Information Required

Section A: Overview of the Research Project Proposal

1. Academic level of research project: Masters
2. Broad field of research: Astrophysics
3. Title of the research project: *Studying giant pulses in eclipsing binaries of Southerly millisecond pulsars using MeerKAT.*
4. Research project abstract/summary (max 250 words)

Project Abstract

Millisecond pulsars (MSPs) are rapidly spinning neutron stars that emit beams of radio emission from its magnetic poles. With the correct alignment, these radio beams will cross our line of sight periodically as the pulsar spins around its own axis. Sensitive radio telescopes, such as MeerKAT, can pick up pulses from MSPs and measure their time of arrival (TOAs) at the telescope with incredible precision.

Of the several hundred MSPs discovered to date, the majority of them are found in binary systems, orbiting a companion such as a main sequence star, a white dwarf or even another pulsar. Such binary systems can appear as eclipsing systems from our vantage point: as the pulsar moves behind its companion its emission disappears.

Recently it was found that the radiation of MSPs are greatly amplified by the stellar winds of their companions as they enter and leave the eclipse. Until now the Southern hemisphere has not had a telescope sensitive enough to detect these flux changes. Commissioning the MeerKAT telescope changes this. For the first time there is a telescope with enough sensitivity to detect giant pulses from the eclipsing

pulsars in the Southern hemisphere.

This MSc project will use data from the MeerTIME MSP census to search for giant pulses in eclipsing pulsar systems. First we will investigate which are the most suitable eclipsing MSPs by updating relevant observational parameters and studying for which systems MeerKAT achieves the best data. Once a target list is finalised, we will learn whether all eclipses in these systems amplify pulsar emission or not. In systems where the pulsar emission is amplified, the atmosphere of the companion star will act as a lens allowing us to probe the magnetosphere and emission mechanisms of these MSPs in more detail.