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Registration: Student will be expected to register at the University of Cape Town (UCT)
Project Title: **Modelling system parameters of Galactic Compact binaries**
Type: **MSc**, within the UCT/SAAO-based SARChI group of Paul Groot

Project Description

1 Problem Statement
The vast majority of all stars reside in binary and/or higher-order systems. A large fraction of these systems will interact with each other during the course of their evolution, leading to very compact binary settings where a stellar remnant (white dwarf, neutron star or black hole) is accompanied by a low-mass star and/or another stellar remnant. Such compact systems are the host of the strongest X-ray sources in a Milky Way Galaxy, as well as the progenitors of low-frequency gravitational wave emission, to be detected by the LISA satellite constellation.

Through a number of wide-field synoptic surveys our knowledge of the Galactic population of short period binaries is expanding rapidly. The MeerLICHT/BlackGEM set of telescopes, in combination with the Gaia satellite and the ATLAS set of telescopes has been providing a growing set of high quality, multi-colour observations of hundreds of compact binary systems, most of them in the pre-interaction phase, or after the first common-envelope phase. However, many of these systems remain ‘anonymous’ as they are not used for extracting system parameters through light curve modelling where this is needed to better understand the overall population of binary systems in their entirety in the Milky Way.

2 Aims and Objectives
Using the multi-colour multi-telescope dataset we will construct a better understanding of the Galactic population of eclipsing systems, in particular those that are currently post-main-sequence. Usage will be made of publicly available light curve modeling programs such as *ellc*, to model the light curve of eclipsing systems and derive their system parameters and place them in the Galactic context of binary systems. Hundreds of binary light curves are currently already available so attention will be paid to the scalability of the modeling routines to large samples. The innovative aspect of our approach is in the number of systems, in combination with the multi-colour light curves available from wide-field synoptic surveys. This is a largely numerical study, using the facilities at IDIA/Ilifu to model the light curves already obtained with (inter)national facilities.

3. Potential Impact
The impact of this study is to understand extreme products of binary evolution, such as ultracompact systems, gravitational wave merger systems, supernovae type Ias and merging binaries, we also need a better understanding of their progenitor populations. Eclipsing systems are ideal for the wealth of information they provide, and their well-understood selection biases. The results of this study will feed into binary evolution models of the population of binaries in our Milky Way Galaxy.

4. Alignment with National Imperatives
This project aligns with the following national imperatives:
i) NRF Broad Category: Environmental, Material, Physical and Technology: Astronomy is a physical-technical discipline and strong usage will be made of cutting-edge technology in South Africa (MeerKAT, MeerLICHT, SALT, SAAO telescopes).

ii) National Priority: Transformation: the training of transformed, science-and-technology based researchers is the basis of South Africa's future in the Fourth Industrial Revolution.
iii) Grand Challenge: Astronomy: this project is astronomy, where usage is made of South Africa's cutting-edge technology to understand the Universe and our place in it.
iv) Sustainability Goals: Quality Education. Astronomy is a STEM-discipline that forms the basis of the future development of South Africa and an educated population.

5. National Infrastructure Platforms:
SAAO, SARAO/MeerKAT, SALT, MeerLICHT, IDIA/Ilifu