



PhD Student Scholarship: Vera C. Rubin Observatory LSST



The South African Astronomical Observatory (SAAO) invites applications for a 3 year PhD scholarship position related to the Vera C. Rubin Observatory's Legacy Survey of Space and Time (LSST).

The student will join the research group led by Professor David Buckley, who is a South African LSST Principal Investigator involved in optical transient follow-up as is affiliated with both the University of Cape Town and University of the Free State. The student will be enrolled at one of these institutions and will be co-supervised by an appropriate staff member, but will be based at the SAAO in Cape Town.

The activities proposed for this programme involve supporting the follow-up studies of optical transients discovered by the Rubin Observatory Legacy Survey of Space and Time (LSST). When this 8.4-m telescope, with its ~ 10 square degree field and 3.2 gigapixel camera, is completed and commissioned in Chile in 2024, it will embark on a 10 year mission to continuously survey the southern sky, in multiple filters, every few days: the so-called Deep, Wide, Fast survey. This will be supplemented by smaller scale targeted surveys, some at a higher cadence. The science from RO-LSST will be a game-changer in terms of the number of transient or variable objects discovered, leading to the identification of new types of objects and phenomena. South Africa will be heavily involved in the follow-up of LSST-discovered transients using its own suite of optical, infrared and radio facilities.

The potential topics for the PhD study within this programme are outlined below, with the final choice depending on the student's interests and the requirements of the programme at the time.

The annual stipend for this three year scholarship is R180,430, with an additional R36,000 available for research and study related expenses (e.g. IT costs, travel, etc). The position will be filled once a viable candidate is identified and ideally taken up before 31 March 2022. Preference will be given to suitable South African citizens or permanent residents, particularly those from previously disadvantaged backgrounds.

Enquiries may be directed to Professor David Buckley (DAH.Buckley@sao.nrf.ac.za).

Description of the aims and objectives of the study

These are focused on activities associated with the South African involvement in the Rubin Observatory's Legacy Survey of Space and Time (LSST), with an emphasis on the study of newly identified transient and variable objects. Some of the activities within this programme, for which a graduate student could potentially become involved, cover the following areas:

- planning for follow-up studies of LSST optical transients using simulation software, including Machine Learning and utilizing Data Preview releases, including simulated and early commissioning data.
- developing optimal cadencing strategies for transients from simulations of various compact binaries populations in the Galaxy and Magellanic Clouds.
- participation in existing SALT and MeerKAT (i.e. ThunderKAT) transient programmes, focusing on specific object classes of interest and utilizing other multi-wavelength facilities (e.g. X-ray telescopes).
- multi-wavelength and multi-messenger transient follow-up of gravitational wave and neutrino events.
- Helping to develop automatic follow-up systems at SAAO/SALT within the Intelligent Observatory project to react to triggers from LSST alert brokers.
- Participation in the BRICS Intelligent Telescope and Data Network, a BRICS astronomy flagship programme.
- Involvement in projects involving local transient detection and follow-up facilities like MASTER, MeerLICHT, MONET-South, KMTNet and PRIME.

Some of the science questions being addressed, which a student may become involved in, include:

- what strategies to employ in real time decision making when it comes to decide what is worth following up what is not
- how well Machine Learning techniques based on characterizing light curves actually perform by testing predictions with actual observations
- the nature of accretion in high amplitude out-bursting compact binaries such as cataclysmic variables and X-ray binaries and specifically how the spectral and timing behaviour vary during an outbursts (e.g. development of QPOs, spectral line behaviour, etc.)
- correlation of optical/X-ray variations in X-ray transients with the soft/hard state of the source and how these relate to the non-thermal emission detected at radio wavelengths (e.g. by MeerKAT)

The student will participate as a Junior Affiliate of the South African RO-LSST transients team, who are all members of the Rubin Observatory's Transients and Variable Stars (TVS) and Stars, Milky Way and Local Volume (SMWLV) Science Collaborations.