Groot SARCHI Chair, Positions

Within the context of the NRF Funded SARChI project: *"Gravitational Wave Counterparts and Fast Transients"* the following positions are available. All positions will be based at the University of Cape Town (UCT), in close collaboration with SAAO, IDIA/Ilifu and SARAO. Candidates will be requested to spend extended periods of time abroad, specifically in the Netherlands and Chile. The postdoctoral and PhD positions are for three years, as per the usual regulations in the South African system. MSc bursary positions are to support the MSc student during the final-year project work. All selected candidates will be asked to spend part of their time on the day-to-day operations of the MeerLICHT and BlackGEM telescopes, located in, respectively, Sutherland, South Africa and ESO La Silla, Chile. Tasks can include monitoring data quality control, data processing control, preventive maintenance and transient vetting.

Selection of candidates will commence on February 28, 2019. Positions are available per direct. For applications and further questions please contact Prof. Paul Groot, pgroot@ast.uct.ac.za. Applications must include a clear reference to the position(s) applied for, a motivation letter, a Curriculum Vitae including an academic record, and the names of at least two people willing to write a reference letter. Reference letters do not have to be sent with the application but will be requested in a second stage.

1) Postdoctoral Fellow: Machine learning on Big Data for astrophysical transients

A postdoctoral fellowship position is available in collaboration with the Inter-University Institute for Data Intensive Astronomy (IDIA)/Ilifu and the BlackGEM Consortium. The candidate is expected to work on the combination of optical data from the MeerLICHT telescope, radio data from the MeerKAT telescope, in particular in the context of the ThunderKAT Legacy Survey Project, and the BlackGEM array of telescopes, for the detection, identification and characterisation of astrophysical transients, with an emphasis on the machine learning aspects of identification and characterisation. Astrophysically the focus will be on transients in the nearby (<100 Mpc) Universe on timescales ranging from minutes to months. On the computational, machine learning side, the emphasis will be on the use of machine learning techniques across wavelengths and telescopes, aiming for an early classification of transients while suppressing false positives and interlopers in Big Data sets, and on Google BigQuery-type configurations.

Requirements are a PhD in astronomy, physics or computer science, with a shown interest and experience in either astronomy, for physics and computer science PhDs, or machine learning, for astrononomy and physics PhDs. The annual value of the fellowship is R390000 per annum, fully taxfree. Equipment and travel funding is also available.

2) PhD positions

Two PhD positions are available. Requirements for a PhD position are a finished MSc degree in astronomy and/or physics. The annual value of a PhD fellowship is R155000 annum, fully taxfree. Equipment and travel funding is also available.

PhD 1: Gravitational wave counterparts

A PhD graduate position is available for the identification and characterisation of optical gravitational wave counterparts to aLIGO/aVirgo events. Usage will be made of the MeerLICHT optical telescope, the BlackGEM array of telescopes for gravitational wave counterparts, the 10m SALT telescope within its Transients Large Program and the ESO VLT telescope within the ENGRAVE program. Following the detection of a gravitational wave event, the MeerLICHT and BlackGEM telescopes will scan the sky localization regions for new astrophysical transients (kilonovae), making use of reference frames of these sky areas made earlier. After a positive identification follow-up spectroscopy will be obtained with the SALT and VLT telescopes to follow the evolution and fading of the 'golden glow' of these events. After the event has faded in the optical, VLT+MUSE observations will be used to characterize the host environment of the gravitational wave merger.

PhD2: Local Universe fast transients

Complementary to the gravitational wave merger events program, the MeerLICHT+MeerKAT, BlackGEM array, SALT/SAAO and VLT combinations will be used to discover and characterize Local Universe transients. The emphasis will be on fast transients that rise and fade on a timescale of ≤1 day, requiring immediate follow-up for spectroscopic identification and characterization. Both MeerLICHT and BlackGEM will run a Twilight Program targeting nearby (<10 Mpc) major mass concentrations, including the Galactic Center/Bulge, the Magellanic Clouds and local galaxies such as Centaurus A, Sculptor and the Southern Pinwheel Galaxy M83. Source classes can involve novae, luminous red novae, supernovae, but also more speculative classes such as

supernovae Type .Ia. The project is aimed to systematically explore the fast time scale transient Universe. BlackGEM will also run a Local Transient Survey program aimed at the major mass concentrations within 100 Mpc, including the Fornax and (southern part of) the Virgo clusters, and the Norma and Centaurus galaxy clusters.

3) MSc bursaries

Within the UCT Masters program in Astronomy, two bursaries are available to support MSc projects. MSc students must have completed their Honours year in physics and/or astronomy. The value of the bursary is R134000 per annum.

MSc1: Fast Transients

The MSc student will work in coordination with PhD1 and PhD2 to characterize the multi-colour evolution of transients, to establish a better framework for the identification of kilonova gravitational wave counterparts. Despite many years of transient work, multi-colour optical light curves are still rare. The unique aspect of the BlackGEM and MeerLICHT telescopes is their ability to rapidly switch filters for wide-field observations. All data will therefore be obtained in 3-6 filters contemporaneously. Using SALT/SAAO optical spectroscopy and SAAO Lesedi and LCO optical photometric follow to identify and characterize the transients, the student will work towards a complete multi-colour understanding of the time evolution of transients, including dwarf novae, novae, supernovae and flare stars.

MSc2: The radio-optical-X-ray luminosity correlation of X-ray binaries in the Galactic Bulge

The Galactic Bulge Survey used the Chandra X-ray satellite to survey two strips of sky, each 1x6 degrees across, in the Bulge of the Milky Way Galaxy to chart the population of low-luminosity X-ray binaries. It has detected over 1000 X-ray sources in this region, consisting of a mix of binaries located in the Bulge and foreground objects such as Cataclysmic Variables and X-ray emitting active stars. The newly commissioned MeerKAT radio array has surveyed a part of the Galactic Bulge Survey area to very deep levels. The aim of the MSc project is to cross-correlate the GBS catalog with the MeerKAT radio data and a) identify which of the targets follow the radio-X-ray correlation of X-ray binaries, and b) if an optical counterpart is visible, obtain spectroscopic confirmation of the X-ray binary nature