



MSc AND PhD BURSARIES FOR 2019

CENTRE FOR RADIO COSMOLOGY

UNIVERSITY OF THE WESTERN CAPE

DEADLINE: 20 September 2018

The Centre for Radio Cosmology (CRC) at UWC is internationally recognized for its research on cosmology with the Square Kilometre Array (SKA), MeerKAT and other telescopes. CRC staff are closely involved in the South African and international SKA Projects. About 15 postdoctoral researchers and 15 PhD/MSc students are doing research at UWC. See <http://astro.uwc.ac.za> for further details.

The CRC is offering MSc and PhD bursaries for 2019. Successful applicants will be supervised by Prof Mario Santos, Prof Roy Maartens or Dr Ed Elson, on cutting-edge projects in cosmology with radio surveys. The available topics cover the Key Science goals of the SKA in cosmology – which have synergies with the science goals of the major upcoming optical/ infrared surveys, such as DESI, *Euclid* and LSST. Students also have the possibility to be co-supervised by visiting professors, Matt Jarvis (Oxford University), Romeel Davé (University of Edinburgh), Stefano Camera (University of Turin), Phil Bull and Alkistis Pourtsidou (Queen Mary London). Students will also have opportunities to spend time in institutions abroad, in particular the ones above.

The possible research topics are described below.

APPLICATIONS

Applicants should email the following PDF documents: CV + transcripts of all university-level results + a brief statement of research interests, related to the 8 topics below (1 page).

Applicants should also arrange for **2 reference letters** to be sent directly to us by referees, with the same closing date.

Email address: mgrsantos@uwc.ac.za

Deadline: 20 September 2018

Preference will be given to students who fit into the demographic guidelines provided by the NRF and SARAO.

BURSARY VALUES

CRC bursaries are at the same level as bursaries from the SKA South Africa Project. As guidance, the 2018 levels are:

- MSc:** 2 years at R119k per year
+ travel grant (up to R26.5k/year) + equipment grant (up to R24k for 2 years)
- PhD:** 3 years at R136k per year
+ travel grant (up to R32k/year) + equipment grant (up to R36k for 3 years)

In addition, tuition fees will be fully paid by the CRC.

BURSARY CONDITIONS

Bursaries are granted on a year by year basis - i.e. continuing into the next year depends on satisfactory progress.

MSc students will be required at the start of year 1 to complete the 6-month NASSP MSc course in Cape Town, and to obtain an average of at least 60%.

RESEARCH TOPICS

We offer a range of topics that tackle some of the fundamental questions in modern cosmology, with a focus on SKA and MeerKAT. Training in computation, simulations and data science will be provided.

1. Measuring neutral hydrogen (HI) across cosmic time with MeerKAT.

We will use MeerKAT observations to make statistical detections of neutral hydrogen intensity on cosmological scales. There are several projects, from more technical data analysis to simulations of the signal. These include the measurement of the power spectrum and detection of the elusive Baryon Acoustic Oscillations that can constrain Dark Matter and Dark Energy.

2. Measuring the properties of HI galaxies.

Using existing multi-wavelength observations and upcoming MeerKAT data, we will investigate the properties of HI galaxies, giving new information on the HI and Dark Matter content of the Universe. There are 2 possible projects. (a) Statistical techniques like 'stacking' will allow us to probe the mass function of HI galaxies down to low flux limits. (b) Using HI spectral line observations from current data, in particular MeerKAT, to study nearby HI galaxies and quantify their dynamics, mass distribution and star formation properties.

3. Probing the first galaxies in the Universe.

We will investigate the Epoch of Reionization and use HERA data to probe the HI 21cm signal from the early Universe. There are several projects, including simulations of the signal, the observation pipeline and data analysis techniques.

4. The radio continuum sky below the detection threshold.

We will develop and apply statistical techniques (e.g. stacking, P(D)) to radio continuum data from current surveys, in particular MeerKAT, to study the properties of radio galaxies below the detection threshold. This will allow to constrain their source counts, luminosity functions and even 2-point correlation function at very low flux limits.

5. Measuring Dark Energy.

DE is thought to be the source of the accelerating expansion of the Universe, and its properties can be accurately measured by using the probes extracted from HI and other surveys – such as the power spectrum, bispectrum, BAO, redshift-space distortions (RSD) and weak lensing. There are several possible projects, associated with different probes.

6. Testing Einstein's theory of General Relativity.

We will explore whether the acceleration of the Universe is not from DE, but instead from a modification of GR – again, using the probes from HI and other surveys (especially RSD). There are several possible projects, associated with different probes and different tests.

7. Extracting information from the very early Universe.

The properties of the initial fluctuations that provide the seeds for structure formation, leave imprints that are frozen in the large-scale distribution of matter. Using HI and other surveys, we can extract primordial information using some of the above probes. There are several possible projects, associated with different probes and different properties.

8. Testing the Cosmological Principle.

Cosmology is based on the Cosmological Principle – that on large scales, the Universe has no preferred directions and no preferred positions, when viewed from the rest-frame of the cosmic microwave background (CMB) radiation. Using continuum, HI and other surveys, we will develop various tests of this fundamental assumption. These include: measuring the dipole in galaxy surveys due to our motion relative to the CMB, and testing whether galaxy surveys are statistically isotropic and homogeneous.

We can also consider other topics on a case by case basis.