# MSc AND PhD BURSARIES FOR 2020

# CENTRE FOR RADIO COSMOLOGY

# UNIVERSITY OF THE WESTERN CAPE

## DEADLINE: 30 September 2019

The Centre for Radio Cosmology (CRC) at UWC is internationally recognized for its research on cosmology with MeerKAT, the Square Kilometre Array (SKA) and other telescopes. CRC staff are closely involved in the South African and international SKA Projects. In 2019 there are 17 PhD/ MSc students and 15 postdoctoral researchers doing research at UWC. See http://astro.uwc.ac.za for further details.

The CRC is offering MSc and PhD bursaries for 2020. Successful applicants will be supervised by Prof Mario Santos, Prof Roy Maartens or Dr Ed Elson, on cutting-edge projects described briefly below. The available topics cover the Key Science goals of the SKA in cosmology and galaxy evolution – 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 mentioned.

### APPLICATIONS

Applicants should email a single PDF document containing the following:

- a CV
- transcripts of all university-level results
- a brief statement of research interests, related to the 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**: 30 September 2019

Preference will be given to students who fit into the demographic guidelines provided by the NRF and SARAO (SA Radio Astronomy Observatory).

## BURSARY VALUES

CRC bursaries are at the same level as bursaries from the SARAO. As guidance, the 2019 levels are:

**MSc**: 2 years at R134k per year
+ travel grant (up to R28k/year) + equipment grant (up to R26k for 2 years)
**PhD**: 3 years at R155k per year
+ travel grant (up to R34k/year) + equipment grant (up to R38k 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 big questions at the forefront of international cosmology and galaxy evolution. Research students in South Africa have a historic opportunity provided by MeerKAT and the future SKA. In each topic below, there is a focus on MeerKAT and SKA, and their synergy with other surveys.

Training in cutting-edge theory, 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 in 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. Probing Dark Energy.**
Dark Energy 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 scale, 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 possibly not from Dark Energy, but instead from a modification of General Relativity – 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 'fossil' information from the very early Universe.**
The primordial fluctuations generated in the first instants of the Universe provide the seeds for the formation of CMB anisotropies and large-scale structure. Imprints of the primordial Universe are 'frozen' in the large-scale distribution of matter. Using HI and other surveys, we can extract this 'fossil' information using some of the probes listed in Topic 5. There are several possible projects, associated with different probes and different properties.

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