

Section A: Overview of the Research Project Proposal

1. Title: **Galaxy evolution and galaxy cluster dynamics in the GCAV sample explored with MeerKAT and JWST**
2. Broad field of research: **Science**
3. Academic level of research project: **Doctoral**
4. **Abstract:** This project aims to explore the overlap between the MeerKAT Galaxy Cluster Legacy Survey, JWST observations, and the Galaxy Clusters At Vircam (GCAV) survey. This will allow for a very detailed study of the radio galaxy population down to the transition regime between AGN and starburst in elliptical galaxies, and to very faint star formation emission in late-type objects. Combined with ancillary data already available, this will open a window on galaxy evolution over a large, and largely unexplored, diversity of cluster environments.
5. Primary supervisor: **Prof Oleg Smirnov**, o.smirnov@ru.ac.za, Rhodes University & SARAO
6. Research supervisor: **Dr Tiziana Venturi**, INAF-IRA (Italy)

Section B: Research Project Proposal

Scientific merit: Galaxy Clusters At Vircam (GCAV) is an infrared, Y, J, Ks, 560 hrs survey (including overheads) for a sample of 20 clusters of galaxies, evenly distributed over the 0h-24h Right Ascension, and which aims to study galaxy evolution over a large, and largely unexplored, diversity of cluster environments. The clusters in the sample have already been observed by HST (ACS/WFC3-NIR) within the CLASH (Cluster Lensing And Supernovae Search with Hubble), HFF (Hubble Frontier Fields), Relics programmes. Furthermore a wealth of ground based ancillary data, from optical imaging and spectroscopy to radio observation, is available for most of the proposed clusters. A subset of the clusters in the GCAV sample has been observed as part of the MeerKAT GCLS, hence extremely sensitive images in L-Band, at the resolution of $\sim 7''$ and $15''$ are available and allow a very detailed study of the radio galaxy population down to the transition regime between AGN and starburst in elliptical galaxies and to very faint star formation emission in late-type objects. uGMRT observations are available from the archive, too, extending the radio information to frequencies of few hundred MHz. Some of the clusters in the sample have already been observed by JWST, and the data will be publicly available for the start of the PhD.

The study would initially focus on the wealth of optical information already available and on the MGCLS images (total intensity, polarization and spectral information) for A85, A2744 and A370. These clusters are very different in their overall properties (dynamics, environment and galaxy population). The study will extend to other clusters in the sample (MACSJ0416.1,

SMACSJ0723 and RXJ2129) during the PhD project, by means of MeerKAT proposals to be led by the candidate.

The potential candidate is expected to gain expertise in the reduction of optical as well as radio data, and to develop analysis tools, and in the interpretation of the results.

Collaborators: Dr. M. Nonino (INAF, Trieste Astronomical Observatory), Prof. D. Dallacasa (University of Bologna), Dr. K. Kolokythas (NWU), Dr. K. Knowles (Rhodes).

Feasibility: Most of the observational data for this project is already available (see above). JWST data is expected to be public by the start of this project.

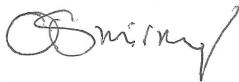
Storage and computing resources for this project will be provided by the compute cluster of the Rhodes Centre For Radio Astronomy Techniques & Technologies (RATT).

Scientific supervision of the project will be provided by Dr Venturi (INAF-IRA, Italy), and technical supervision by Prof Smirnov (Rhodes). The student is expected to spend some time in Italy at INAF-IRA and Dr Venturi will pay regular visits to South Africa. The supervisors will be able to provide further support for such visits.

Link to SRAO research priority areas for 2023: The proposed research project will exploit MeerKAT GCLS data.

Any particular qualifications, academic abilities, skills and/or experience that a student should have in order to successfully deliver on the objectives of the research proposed: familiarity with radio interferometry and observational radio astronomy would be an advantage but it is not strictly required.

Supervisor



Oleg Smirnov

22 February 2023