Project title: Investigating HI ram pressure stripping near the Virgo cluster with MeerKAT

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1. Project description

As part of the pilot survey of the Widefield ASKAP L-band Legacy All-sky Survey (WALLABY), a 57 kpc long bridge of gas has recently been discovered between the dwarf galaxies NGC 4532 and DDO 137. This is in addition to the extensive neutral hydrogen (HI) halo and the 0.5 Mpc tail previously discovered by the Arecibo telescope and implies that both tidal and ram pressure forces may play a role in the formation of this system. However, our study suggests that the origin of the ram pressure forces is probably the Virgo cluster, which is astonishing given the fact that the galaxies are well outside the virial radius of the cluster.

We therefore observed the NGC 4532/DDO 137 system with MeerKAT in 2023 at much better resolution and column density sensitivity than possible with WALLABY to look for detailed signatures of ram-pressure stripping. The MeerKAT data will be the focus of this MSc project.

2. Aims and Objectives

The aim of this project is to process and analyse the MeerKAT observations of the NGC 4532/DDO 137 system. The student will learn how to perform data reduction of MeerKAT HI data, feather the MeerKAT data with recently-obtained data from the new FAST telescope in China, and try to understand the origins of the enormous stripped HI tail.

3. Potential Impact

Confirmation of the ram pressure model would have important consequences for our understanding of the density of the IGM around dynamically young galaxy clusters such as Virgo, and for the pre-processing of galaxies well before infall.



Image: Left: a ROSAT All-Sky Survey image of the Virgo cluster (B.hringer et al. 1994) overlaid with ALFALFA HI contours of NGC 4532/DDO137 (Koopmann et al. 2008). Bottom centre: an expanded image showing the ALFALFA HI contours for NGC 4532/DDO 137 and the HI tail overlaid on the WALLABY HI image. Top centre: a further expanded showing the diffuse HI envelope around the about-to-be-released WALLABY image of NGC 4532/DDO 137 (Westmeier et al., in prep).

4. Alignment with national imperatives

This project aligns with the following national imperatives:

i) NRF Broad Category: Environmental, Material, Physical and Technology: Astronomy is a physical-technical discipline and strong usage will be made of cutting-edge technology in South Africa (MeerKAT telescope).

ii) National Priority: Transformation: the training of transformed, science-and-technology based researchers is the basis of South Africa's future in the Fourth Industrial Revolution.

iii) Grand Challenge: Astronomy: this project is astronomy, where usage is made of South Africa's cutting-edge technology to understand the Universe and our place in it.

iv) Sustainability Goals: Quality Education. Astronomy is a STEM-discipline that forms the basis of the future development of South Africa and an educated population.

5. National infrastructure platforms

SARAO/MeerKAT