2021 MSc Project

Project Title: Optical Kinematics in a subsample of MHONGOOSE Galaxies

Supervisor: Dr Moses Mogotsi
Institution: SAAO
Email: moses@saao.ac.za

Co-Supervisor: Prof Petri Vaisanen
Institution: SAAO

Student can register at any South African university

Introduction:
MHONGOOSE is a deep HI galaxy survey of 30 nearby (D<30Mpc) star forming galaxies covering a wide range of galaxy properties that has been allocated time on MeerKAT. Two of the key science goals are to study the baryon cycle and how gas relates to star formation within galaxies in order to understand how galaxies assemble and evolve with time. MHONGOOSE will study the HI in the outskirts of such a large sample of galaxies at unprecedented sensitivity and resolution. However the interstellar medium (ISM) consists of multiple phases and in order to obtain a complete picture of the interplay between gas and star formation, the star formation history, gas kinematics, and other aspects of the baryon cycle and gas flow in galaxies in the inner and outer parts of galaxies we require multi-wavelength observations. We observed a subsample of MHONGOOSE galaxies with the Robert Stobie Spectrograph (RSS) on the Southern African Large Telescope (SALT), and with the Wide Field Spectrograph (WiFeS) on the 2.3m ANU telescope in Siding Spring, Australia. These optical spectroscopic observations are complementary to MHONGOOSE because they allow us to probe the inner parts of galaxies at higher spatial resolution than MeerKAT can do and to simultaneously study multiple optical spectral lines, which allow us to probe the ionized, neutral gas and stars.

Project Goals:
The aim of this project is to study the relationship between star formation and gas kinematics and to characterize the multi-phase ISM in a subsample of MHONGOOSE galaxies that have been observed with WiFeS. This is essential because it will be combined with the lower spatial resolution HI data when the MeerKAT observations take place to provide a complete characterization of the kinematics and interstellar medium of galaxies in the MHONGOOSE sample. The student will be expected to learn how to handle optical spectroscopic data, write and use software to fit spectral features and to model the kinematics using different emission lines detected in the optical data.

I will work with the candidate to focus on a specific theme in line with their mutual interests and capabilities. They will get to select from the following analyses:
a) For galaxies with SALT spectroscopic observations above and below the disc, the student will investigate whether there are galactic winds and extraplanar gas and how this gas relates to the gas properties of the main galaxy disc.
b) In a nearby galaxy they can identify the HII regions and star forming clumps, identify winds and diffuse ionized gas structures, study the kinematics in these regions and how they relate to the star formation.

c) For some of the galaxies in the sample there is multi-wavelength data available and the student will have the opportunity to compare the results of the WiFeS analysis with other wavelength data such as HI or near-infrared data for a selected galaxy.
d) Another possible extension of the work is to use line ratios to create diagnostic diagrams that will better characterize the ISM and to study the resolved metallicity distributions within galaxies.

Requirements:
The project will mainly focus on analysis of spectroscopic data, so the student must have some basic programming skills, be comfortable with working in Python and be eager to learn how to use new software.