Gas Flows and the ISM in NGC1672 using SALT IFUs, JWST and MeerKAT

Level: MSc

Supervisor: Dr Moses Mogotsi
Institution: SALT/SAAO, UCT
Supervisor Contact: moses@saao.ac.za

Background:
The interstellar medium (ISM) of galaxies plays an important part in the baryon cycle and star formation in nearby galaxies. The presence of cold gas that is unstable leads to star formation, and this star formation can itself result in ionization, removal or prevention of cold gas from forming new stars; or it can trigger more star formation. Understanding the motion and properties of the different phases of the ISM and the distribution of star formation are key to understanding all of this and how it affects the evolution of galaxies.

Optical spectroscopic observations allow us to characterize the ionized and neutral ISM, the star formation and stellar properties of galaxies. The new SALT Slitmask Integral Field Unit (SMI) is a powerful addition to SALT capabilities and it allows us to perform optical spectroscopy over an extended field of view rather than along a slit. It consists 0.9 arcsec diameter fibres spread across a 22.3 x 17.6 arcsec hexagonal field of view, see Fig. 1.

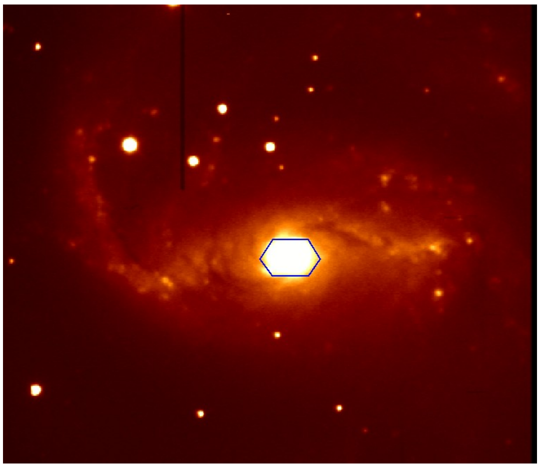

Figure 2: Overlay of the SMI field of view on an optical image of NGC1672.

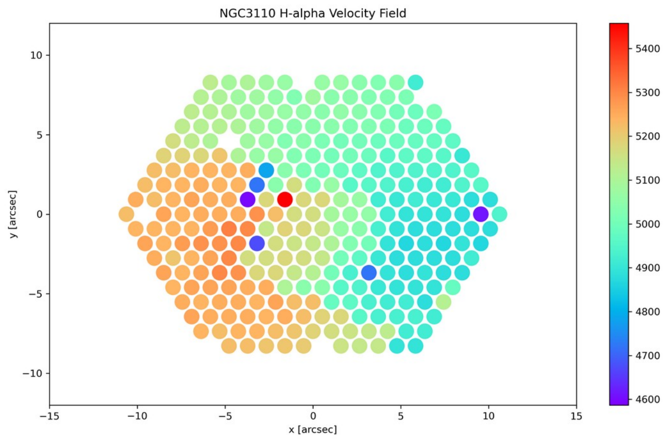

Figure 1: The Hα velocity field determined from SMI observations of NGC3110

The instrument became available for the first time during this current observing semester and we are testing its performance and capabilities. In order to test its capabilities we have taken data of some nearby star forming galaxies which have been observed with MeerKAT as a part of the MHONGOOSE survey, therefore these galaxies have corresponding deep HI observations, that can be used to study the neutral gas in unprecedented combinations of sensitivity and resolution. The HI observations will allow us to study the neutral gas that is the fuel that can be turned into molecular gas that stars eventually form from. We can use these datasets to trace and study the atomic and ionized gas kinematics and how they relate to star formation. One of the key galaxies that we have data for is NGC1672, which also has JWST data (see Fig. 3) . From the JWST data we can study and trace the star formation, the dust and old stellar populations with better sensitivity than ground facilities. The student will be able to work on this or other galaxies in our sample.

Figure 3: NASA, ESA, CSA, STScI, J. Lee (STScI), T. Williams (Oxford), PHANGS Team

Project Description:
In this project the student will analyze SALT SMI data and produce velocity fields (e.g., see Fig. 2) and flux maps of different emission lines. These data will be used to characterize the performance of the instrument. They will also utilize similar principles to produce velocity fields of the HI data and then compare the HI and ionized gas kinematics to each other and to the star formation and gas densities in order to study how the kinematics of the gas relates to the star formation. These will be used to study various star formation laws and measures of disc stability in galaxies.

Most of the data has been taken and the student can focus on the analysis, however, there student may have to reduce some reduce optical IFU and longslit data, but recipes exist for doing so. The HI data has been fully reduced. The project is relatively flexible and can be tailored towards the student's interests and strengths. The JWST part of the analysis is optional. The project will enable the student to be involved in various collaboration, and this project has the potential to be expanded into a PhD project in the future. The project will also open up opportunities for the student to collaborate with the wider MHONGOOSE, SUNBIRD and MeerChoirs collaborations.

Requirements: The student needs to be very comfortable with Python coding, handling fits files and be able to produce and optimize line fitting code.