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Type: Masters

Project Title: Study of warm/diffiused ionized gas using SALT

1. Background

The Wisconsin Hα Mapper (WHAM) mapped the Milky Way in Hα wavelengths, uncovering areas of star formation as well as warm, diffuse ionized gas (DIG), referred to as the Reynolds Layer. The DIG is distributed in a much thicker layer compared to the star-forming disc. Such distribution is found to be typical, as seen in several edge-on late type galaxies. DIG regions have emission-line flux ratios that are distinct from star forming regions as well as AGN. While the gas itself likely comes from a confluence of star-formation-region fountains (outflows) from disc midplanes, in-situ mass-loss from evolved stars in thick discs, and infall from high-velocity clouds, the ionization mechanisms are debated. Leakage of ionizing photons from mid-plane star-formation is one possibility, while in situ photo-ionization from hot evolved stars (metal-poor blue horizontal-branch or pAGB stars) is another. Shocks may be another ionization source.

2. Aims and objectives of the project

One way to probe these ionization sources is by targeting DIG regions at (i) varying distances from star-forming regions and at (ii) varying heights about the mid-plane with known gradients in evolved stellar populations. These lines of sight will be carefully chosen to be outside the solar circle where velocity information yields unique velocity-to-distance transformation. By examining the trends in ionization conditions in the DIG with HII region distance and mid-plane height, including line diagnostics sensitive to shock heating, we will be able to determine uniquely the contributions from different sources of DIG ionization.

The first version of the Slit Mask Integral Field Unit (SMI-200) has recently gone through a successful engineering commissioning run on the Southern African Large Telescope. The SMI-200 is a front end module for the visible arm or Robert Stobie Spectrograph (RSS) on board SALT. The module reformats an 18”x23” sky patch sampled at 0.9” onto the spectrograph slit input using optical fibers. The elongated hexagonal shape of SMI is ideal for observing galaxies over a range of inclination angles, and can be used to map more extended objects from Galactic HII regions. Using the proprietary SALT data for SMI-200, we aim to probe the source of ionization of DIG regions from emission line identifiers.

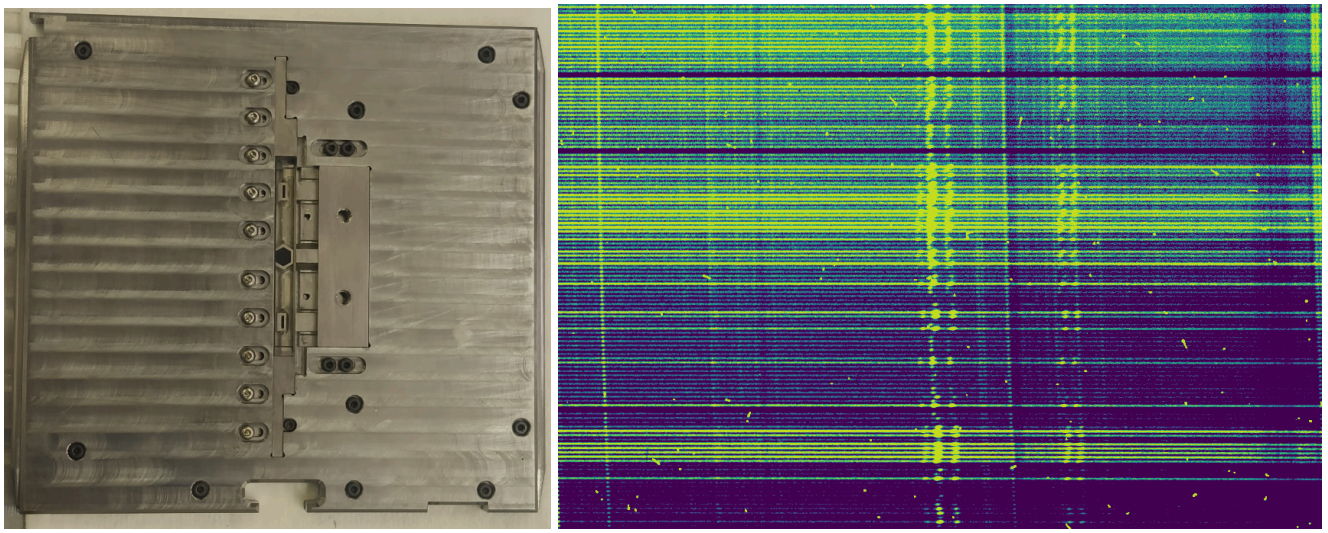

Figure: Left: The fully assembled SMI-200 instrument. Right: Spectra of a star-forming galaxy through several fibers of SMI (each individual horizontal trace is spectra from a fiber). The vertically misaligned zig zag blobs are Hydrogen-alpha (brightest), doubly ionized Nitrogen and Sulphur emission lines.

3. Potential impacts of the project

The origin of diffused ionized gas around the star forming disk has drawn many theoretical models for prediction of its observable state. These models have been able to provide an heuristic understanding of the forming processes behind DIG. We aim to use observation to validate these models. SMI-200 would provide the avenue to observe edge-on disk galaxies where the baryon cycle of fall and ejection of matter from the galaxy star forming disk can be caught in action to validate the existing models. In addition, the project would provide validation of an SMI-200 application in astronomy.

4. Requirements

The student would require a basic grasp of any software language. Having taken a course on galaxy evolution and basics of astronomy is desired but not necessary. However, a keen interest and willingness to learn and apply the knowledge for solving practical problems would be important.