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Project Title: Development of South African Multi-Object Spectroscopic Array (SAMOSA)

1. Background

The existing instrument capabilities of the SAAO operated and hosted telescopes including the Southern African Large Telescope (SALT) has been unable to cater to some of the demands of the astronomical community. Scientific questions, especially those requiring a survey level observation of several fainter extended objects to understand statistical properties, have been difficult to approach for the community. Answering such scientific questions requires wide-field integral field spectroscopic instruments which would provide deployable multi-object capability, something which is not only absent in the African continent, but also in the entire globe.

The SAAO Astro-photonics laboratory is aiming to develop South African Multi Object Spectroscopic Array (SAMOSA), to alleviate the above observational shortcomings. SAMOSA will have two spectrographs fed by optical fiber made integral field units (IFUs). Four IFUs, deployed over a field of 30 arcmin diameter, would each sample 1 arcmin wide patch of sky at 2.5 arcsec spatial resolution and provide 1200 sampling pixels (spaxels) in total. Half of the IFUs would feed a single channel wideband spectrograph covering a 370-740 nm window at a spectral resolution of 2000. The other fibers would feed a dual channel narrow band spectrograph which has two bandpasses of 460-510 nm and 630-690 nm, both channels capable of delivering significantly higher resolution of 15000. The wavelength windows and resolutions are strategically chosen to cover key spectral features useful for astronomers working in different fields of study.

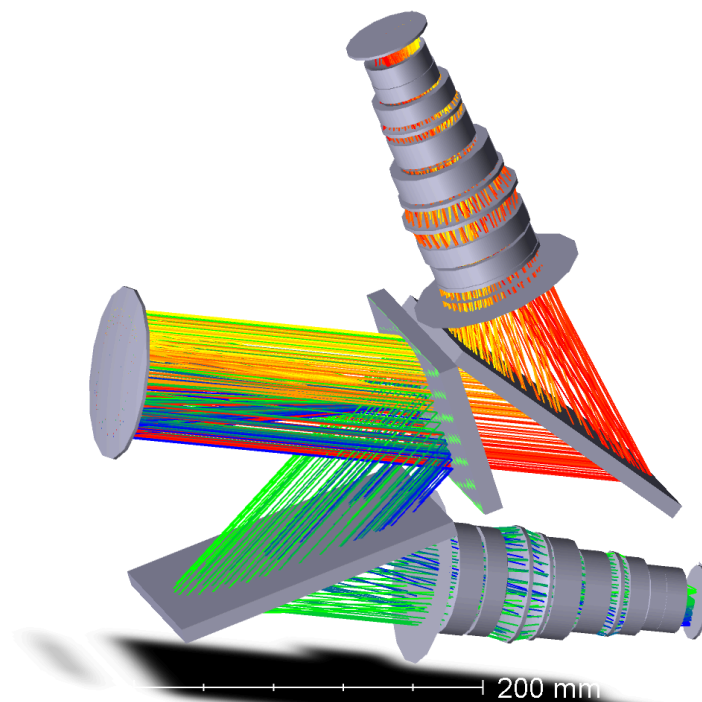


Figure: Optical design of the two channel narrow band high resolution AMASE spectrographs. SAMOSA would use the same spectrograph as well as a single channel lower resolution wide band spectrograph.

2. Aims and objectives of the project

The higher resolution narrow band spectrograph of SAMOSA is going to be an exact replica of the AMASE spectrograph. Thus the development path for the same is expected to be less complicated. The lower resolution wide band spectrograph needs minor modification from the AMASE. This section would involve minor optical design study, component procurement, communicating with opto-mechanical component vendors and finally lab assembly.

In addition, the instrument would require a fiber cable assembly, and associated optics to adjust the telescope supplied optical beam to be acceptable into the AMASE spectrographs. Although effort intensive, the existing effort towards building fiber instrument cable for AMASE at the Astro-photonics lab would pave for a smoother transition to develop a similar fiber system for SAMOSA.

The key challenge in SAMOSA development is expected in the integral field unit (IFU) deployment system. This would involve design, development and implementation of an algorithm to position IFUs using off-the-shelf components at the telescope focal plane ensuring fast deployment and safety of the instrument while meeting the required optical specifications.

3. Potential impacts of the project

Several astronomical research bodies including ESO, NASA are encouraging large dedicated surveys to use niche capabilities of instrumentation development to bridge the gap in our understanding of the universe. Along this line of exploration, SAMOSA would enable our capability to perform astronomical surveys. Some of the scientific impacts would include:

- 3.1. Advancement of deployable wide-field spectrograph
- 3.2. Demonstration of small multi-mode fiber application in astronomy
- 3.3. Demonstration of CMOS detector application in astronomy
- 3.4. Training of future generation of instrument developers as the in house go to expertise

4. Requirements

The student would require a basic grasp of any software language. Understanding of photonics or optical fiber is not necessary and will be built over the duration of the project. However, a keen interest and willingness to learn and apply the knowledge for solving practical problems would be important.