2022 MSc Project

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A new spectrograph: Characterization and early transient science

Different types of astrophysical objects display a range of extremely energetic events, including nova eruptions, supernova explosions, stellar mergers, and compact object mergers. Observing these transient events allow us to study the laws of physics operating in conditions unachievable in a laboratory. Many transient sources originate in interacting binary stars. The interest in these objects revolve around accretion and relativistic jets, the neutron star equation of state, strong-field gravity, the Galactic and extra-galactic X-ray and gamma-ray source populations, and the progenitors of type Ia supernovae.

Transient astronomy is already a rapidly expanding field, thanks to all-sky X-ray and γ-ray monitors, as well as a growing number of optical surveys. During the coming months and years several important surveys will be offering an opportunity to do science that was previously impossible, and to prepare for future larger surveys. Follow-up observations with optical telescopes such as SALT and the smaller SAAO telescopes will be key in many cases.

SAAO's newest telescope, Lesedi, is now nearing the end of commissioning. It is a 1-m telescope, which will allow robotic observations. One of its instruments is a low-resolution spectrograph called Mookodi, being built at the moment, and expected at the telescope in mid 2021. This telescope/instrument combination will enable a wide range of science, but the main driver is the rapid follow-up of transient sources. The brightest optical transients will therefore be prime targets for Mookodi.

This project will include both technical and science aspects, but the mix of the two will depend on your interests and on the status of the instrument when you start your degree.

Project goals You will work with a multidisciplinary team of engineers, technicians, astronomers and software developers to characterize the new instrument, create science software tools, and develop performance monitoring procedures. In addition, you will use the instrument to do some of the first science that it will enable.

Flexible scheduling of the telescope will be exploited to obtain data tracking the spectral evolution of bright transients from e.g. the ASAS-SN survey. The results will be used to trigger higher spectral/time resolution, or deeper, observations on SALT, making use of the existing large transients program.

Skills Basic programming skills and good knowledge of undergraduate physics or astrophysics are required. Observations using the new spectrograph will form an important part of this project, but prior experience in observational techniques is not required.

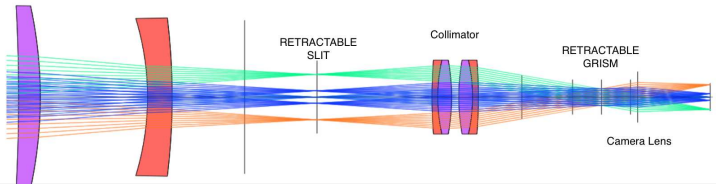

Figure 1. Layout of the optical design of the low-resolution spectrograph Mookodi.

Figure 2. Optical image of V838 Mon and its light echo. The red central object is likely the product of a stellar merger, and the bright emission from this event is sweeping through surrounding interstellar dust, illuminating it and creating the appearance of a shell.