2021 MSc Project

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Student must be registered at UCT.

Disc variability in Be/X-ray binaries

Project context

Be/X-ray binaries are one of the largest known groups of interacting binary star system and are thought to be direct progenitors of double-compact object binaries that emit gravitational wave radiation at the end of their lives, making these systems hugely important in our understanding of stellar and binary evolution. The donor Be stars in these systems are rapidly rotating, such that a "decretion" disc is formed as part of the stellar photosphere approaches the escape velocity of the star. Very little is known about these discs, though they are key in fully understanding how this large population of binaries form, interact and evolve, and how they feedback into the local galactic environment.

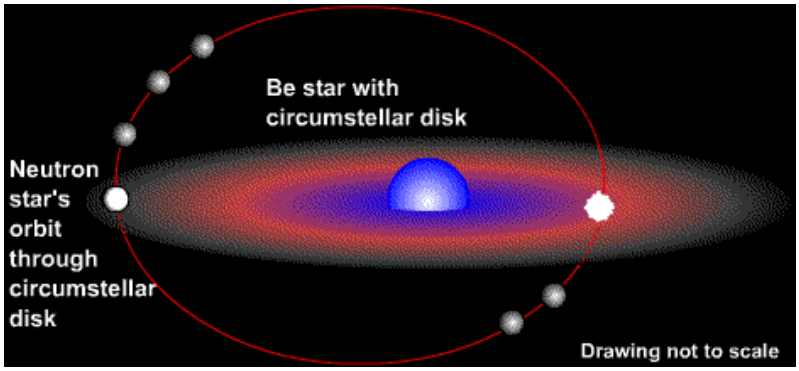

Figure 1: *A simple artist impression of a Be/X-ray binary. The neutron star orbits the Be star, interacting with the circumstellar disc.*

Project Description

The compact object (mostly a neutron star in these systems) orbits the Be star, often interacting with the decretion disc as it passes through or close by. This interaction produces X-rays, as material is accreted from the disc onto the compact object. However, this is not the only interesting result of the interaction. Being cooler than the stellar photosphere itself, decretion discs in Be/X-ray binaries emit strongly in the red and infrared. The proximity of the compact object causes material in the disc to be disturbed, resulting in flaring in the red and infrared. A large amount of information can be gained by studying this optical and infrared variability.

This project will focus on the analysis of data obtained from the IRSF and 1.9m telescopes in Sutherland. These data consist of optical spectra, infrared photometry and infrared polarimetry. By looking at these excellent and extensive datasets, we hope to significantly advance our knowledge of the physics governing the interaction and evolution of one of the largest groups of binary star systems. Interested students should have a strong interest in observational astronomy, as this project is data intensive. They should also have a basic understanding of Python and IRAF, to allow efficient reduction and analysis of the spectra and images. Previous experience with optical/NIR data reduction is advantageous.