Title of Project: **A most enigmatic group of stars: R Coronae Borealis stars**

Project Number: **271**

University Project Leaders/Departments: Professor Peter Cottrell; Physics and Astronomy

Brief outline of project

Understanding the structure and evolution of stars is central to any investigation of the Universe. Thanks to intensive theoretical and observational studies in recent decades understanding of stars has advanced greatly in all but a few areas.

One area where progress has been limited concerns a rare group of chemically and physically peculiar objects that provide understanding of the final phase of the evolution of many millions of stars. These peculiar objects have a number of unusual properties, one being their hydrogen deficiency, in some objects up to a million times more deficient in hydrogen than in the Sun, and another being their unpredictable decline in light output. These objects are the R Coronae Borealis stars (RCB) stars. Several hundred of these objects are known in our Galaxy but their luminosities are imprecisely known due to their ill-determined distances. However, there are a group of RCB stars in our nearest neighbour galaxies, the Magellanic Clouds, for which we do have good distances and hence good luminosities, enabling astronomers to study these star's peculiar properties and relate them to specific evolutionary phases.

This project seeks to begin to investigate and analyse the decline phases of these objects through a collaboration between ourselves and Professor Udalski, Director Warsaw University Observatory and leader of the OGLE project, the well-established Polish microlensing experiment. The OGLE project records the brightness of many tens of millions of stars each night. The unusual decline behaviour of the RCB stars can be easily recognized and used to obtain target of opportunity spectroscopic observations on other telescopes. In this instance we will use the University of Canterbury's guaranteed access to data from the Southern African Large Telescope (SALT) to get the necessary target of opportunity spectroscopic data. The summer scholar will be involved in the analysis of the light output (photometric) data from OGLE-IV and any spectroscopic data that is acquired from SALT.

These decline phases involve the development of a dust (soot) cloud that gradually obscures the star – and reduces its brightness by about 100 times – changes the star's absorption spectrum into an emission line spectrum, like the chromospheric spectrum of the Sun. This happens over an interval of 10 to 30 days. The recovery of the photospheric spectrum and the star's maximum brightness occurs over a period of 200 to 500 days.

Specific student requirements:

Please indicate below any specific academic requirements you have for the summer scholarship student (e.g., specific level; specific courses, or equivalents, completed)

The ideal summer scholar would be a senior undergraduate or recently completed Honours student with an interest in applying their physics, chemistry, astronomy and/or mathematical skills to a research project. Specific requirements/preference:

- some astronomy/astrophysics knowledge through university courses, preferably at 3rd year
- good computational skills
- student who has completed BSc (or equivalent) would be preferred

Special condition:

n/a