Searching for merged stars in the white dwarf population

White dwarfs that underwent a merger event will have distinctive properties. The most notable of these are the acquisition of a magnetic field and fast rotation. One group of white dwarfs, the rare hot, carbon-rich white dwarfs (hot DQs), has an exceptionally high incidence of magnetism and fast rotation as compared to the general white dwarf population. These stars with their unusual atmospheric composition are also more massive than average white dwarfs, and all these properties suggest that they are products of merger events. Currently, only a small number of these stars are known, and they all have similarly hot effective temperatures. We do not know what their descendants are. Since white dwarfs are no longer burning any fuel, they are simply radiating out their internal heat and therefore they become cooler with age. Descendants of hot DQ stars will therefore have similar properties to hot DQs but will be much cooler.

Research Field
Stellar Astrophysics

Project Suitability
PhD
Honours

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The aim of this project will be to identify candidate white dwarfs that have carbon in their atmosphere but have lower temperatures. Such white dwarfs exist, but their properties such as mass and rotation are largely unknown and therefore, they cannot be evolutionarily linked to hot DQs. As part of this project you will analyse spectroscopic, spectropolarimetric and photometric data of these candidate descendants and determine their stellar properties such as their temperature, mass and atmospheric composition using the latest model atmosphere and spectral syntheses codes.

The European Southern Observatory (ESO) operates several 4m to 8m optical telescopes in the Chilean Atacama Desert which provides the best observing conditions on Earth. These telescopes are equipped with state-of-the-art instruments covering a vast range of the electromagnetic spectrum from the near ultraviolet and optical to the infrared. This project will also exploit data from the orbital observatory Gaia that is measuring accurate positions, distances and velocities of over 100 million stars in the Milky Way. Therefore, ESO and Gaia will provide the ideal tools to carry out detailed studies of these hot DQs and their descendants.

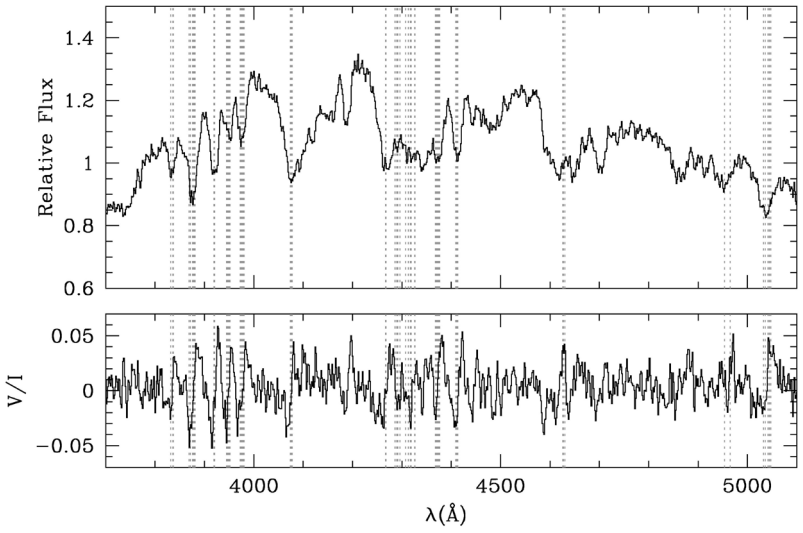

Figure 1: A spectrum of a carbon-rich white dwarf showing Zeeman broadened carbon lines representative of a magnetic field of 0.6 MG (top) and a circular polarization spectrum showing the characteristic choppy pattern of the Zeeman components of the carbon lines (bottom).