

Physics & Astronomy PhD Project Proposal

Project Title: Discovering and characterising brown dwarfs in the brown dwarf desert

Project reference: STFC - Casewell

Groups: Astrophysics

Supervision Team:

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Three Key Points

- Discovering new transiting brown dwarfs using NGTS and TESS
- Understanding more about the brown dwarf desert and why transiting brown dwarfs are so rare
- Simulating the atmospheres of irradiated brown dwarfs in preparation for Ariel

Project Description

Brown dwarfs fill the gap in mass between planets and low mass stars, between 13 and 70 times that of Jupiter. However, since they do not fuse hydrogen into helium as a star would, once formed, they simply cool and fade. Brown dwarfs are relatively common in our solar neighbourhood as isolated objects, however, transiting brown dwarfs are much rarer than hot Jupiter exoplanets with only 40 known to date (a phenomenon known as the brown dwarf desert), and while we may expect their atmospheres to be similar to Jupiter-like planets, the effects of irradiation on a body that may be 100 times as dense is unknown. As such, these rare objects are fantastic comparisons to higher mass Hot Jupiter exoplanets and will allow us to understand the effects of irradiation on high and low mass objects.

In this PhD you will use data from the Next Generation Transit Survey based in Chile, and NASA's TESS mission to discover new, rare, transiting brown dwarfs, expanding our knowledge of the brown dwarf desert. Once launched in 2026 the ESA PLATO mission will observe transits of at least 6 of the known systems, and the ESA Ariel mission will characterise the atmospheres of some transiting, irradiated brown dwarfs using emission spectroscopy. You will simulate transiting brown dwarf emission spectra in preparation for observations from the ESA Ariel mission which is due to launch in 2029.

Further Reading:

- <https://ui.adsabs.harvard.edu/abs/2024MNRAS.tmp.1949H/abstract>
- Ariel mission: <https://arielmision.space>

Images/Graphics:



Credit ESO: An artist's impression of a brown dwarf transiting a star

Application advice: Please see web page

<https://le.ac.uk/study/research-degrees/funded-opportunities/stfc>