University of Victoria

PHYSICS AND ASTRONOMY SEMINAR (In Person)

Dr. Megan Tannock

University of Western Ontario

"Brown Dwarf Atmospheres at High Cadence and Spectral Resolution"

Abstract

"Brown dwarfs are sub-stellar objects that form like stars but are not sufficiently massive to sustain hydrogen fusion in their cores. Characterized by cool, molecule-rich atmospheres, brown dwarfs demonstrate great diversity in spectroscopic appearance and share many properties with giant exoplanets. In this talk I will present two of my recent projects: the first is a detailed photometric and spectroscopic study of the three most rapidly rotating brown dwarfs. The second examines a spectrum of a cool brown dwarf at unprecedented spectral resolution and signal-to-noise ratio to study the accuracy of theoretical model photospheres.

Photometric monitoring of brown dwarfs has revealed that periodic variability is common and that brown dwarf atmospheres are composed of patchy, multi-layer clouds of varying thicknesses and compositions. In the first half of my talk, I will present my discovery of rapid photometric variability in three brown dwarfs from long-duration photometric monitoring with the Spitzer Space Telescope. Using moderate-resolution infrared spectroscopy I find a large degree of rotational broadening in each of these brown dwarfs, confirming that the rapid variability is due to fast rotation. These three brown dwarfs have the shortest rotation periods ever measured, between 1.08 and 1.23 hours. When put in context with the entire sample of brown dwarfs with known rotation periods, the clustering near the short-period end suggests that brown dwarfs are unlikely to spin much faster than once an hour.

In the second half of my talk, I will examine the atmospheric composition of a cold 1050 +- 50 K (T6-type) brown dwarf. Even the most up-to-date theoretical model photospheres do not completely reproduce observed spectroscopic features in cold brown dwarfs, limiting our ability to constrain their fundamental properties. I compare the observed data to these models to assess their accuracy and completeness. I draw conclusions about which models are the most reliable and which spectroscopic regions should be used to estimate physical parameters of cold brown dwarfs and, by extension, exoplanets. Additionally, I will present the first detections of absorption features by hydrogen sulfide and molecular hydrogen in an extra-solar atmosphere. These data comprise the most detailed atlas of spectroscopic lines in a cold brown dwarf available to date."

Thursday, September 22, 2022

2:30 p.m. PDT

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