High-Resolution Spectroscopy of Ultra-Hot Jupiter Atmospheres: Perspectives from the Roasting Marshmallows Program on Gemini South

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Ultra-hot Jupiters (dayside temperatures > 2200 K) are a class of gas-giant exoplanets subjected to extreme stellar irradiation which causes the onset of peculiar thermochemical properties including molecular dissociation, atomic ionization, inverted thermal structures, and large day to night temperature contrast. Atmospheric characterization of gas giants lying in the transitional regime between hot and ultra-hot Jupiters can help in understanding the physical mechanisms that cause this fundamental thermochemical transition in atmospheres between the two classes of hot gas giants. In particular, ground-based high-resolution spectroscopy (HRS) is particularly suited for this as it can resolve individual spectral lines from multiple species across a wide range of pressures, and measure signatures of atmospheric dynamics. Using the near-infrared (1.4 to 2.5 microns) high-resolution spectrograph IGRINS on Gemini South, I will present the near-infrared day-side spectrum of WASP-122b (T_day = 32258 +/- 54 K), a hot gas-giant situated at this transition. I will discuss the constraints we obtain on the atmospheric chemical abundance and the thermal structure of WASP-122b using state-of-the art Bayesian retrievals. In the context of these results, I will also discuss the importance of accurate and complete line-list data for atomic and molecular species especially TiO, VO, SiO, and metal hydrides which are relevant in the temperature regime spanned by the atmospheres of ultra-hot Jupiters. In summary, I will highlight the detailed information content of ground-based HRS data, their ability to constrain complex atmospheric thermal structures and compositions, and the line-list data needed for such high-precision atmospheric characterization of ultra-hot Jupiters.

Fundamental Parameters of Cool Brown Dwarfs with JWST

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Abstract

While great progress has been made over the last 20 years in determining the fundamental properties of brown dwarfs, the coolest brown dwarfs with $T_{\text{eff}} < 500$K have proven difficult to characterize because of their intrinsic faintness and the fact that their spectral energy distributions peak in the mid infrared. I will give a progress report on a Cycle 1 James Webb Space Telescope program to determine: 1) several fundamental properties of the coolest brown dwarfs including bolometric luminosity, effective temperature, and composition and 2) the brown dwarf mass function. Specifically I will present a spectral energy distributions of 20 brown dwarfs with $T_{\text{eff}} < 500$K covering the 1-22 micron wavelength range along with their effective temperatures and bolometric luminosities. I will also discuss the results of a uniform retrieval analysis of these spectra and how forward models seem to over predict the abundance of PH_3 and under predict the abundance of CO_2.