I think this talk will nicely summaryze several results in two important hot topics of exoplanet atmospheres.

404.04 — Unlocking the Hidden Secrets of Hot Jupiter Atmospheres through Near-Ultraviolet Spectroscopy: A Case Study of HAT-P-41b

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Near-Ultraviolet (NUV, 200-400 nm) spectra of planets hold rich information about the chemistry and physics at work in their upper atmospheres. In the solar system, NUV spectroscopy has been critical in identifying and measuring the abundances of a variety of hydrocarbon and sulfur-bearing species, produced via photochemical mechanisms, as well as oxygen and ozone. To date, less than 20 exoplanets have been probed in this critical wavelength range, with mixed results, limited by the wavelength coverage and sensitivity of the workhorse instrument for such studies, HST's STIS G430L and E230M gratings. In HST Cycle 25, our team embarked on a journey to explore the potential of HST's WFC3/UVIS G280 grism, which offers the highest throughput of all HST's instruments in the NUV and is up to 25 times more sensitive than its STIS counterparts at 350 nm. The WFC3/UVIS G280 grism does offer one challenge, the presence of overlapping spectral orders similar to those of JWST's NIRISS instrument, which required us to develop new data reduction and analysis techniques. The first target to be explored with this newly unlocked mode on HST was the hot Jupiter HAT-P-41b, which had been previously observed with HST's STIS G430L grism. Our high-precision spectrum of HAT-P-41b, which combines information from both the positive and negative spectral orders, has revealed features in the NUV that cannot be explained by standard equilibrium chemical models, the presence of aerosols, or stellar activity. Drawing on solar system and stellar studies, we considered dozens chemical species that are known to absorb strongly at NUV wavelengths. Through detailed atmospheric modeling and retrieval analyses we have uncovered not yet considered chemistry and physics at work in the atmosphere of HAT-P-41b, which is likely present in many exoplanet atmospheres. In this talk I will detail the opportunities that have been opened up with the HST WFC3/UVIS G280 grism in the exploration of exoplanet atmospheres and reveal the once hidden secrets of HAT-P- 41b's atmosphere.

404.05 — New Theoretical Models for Cloudy Substellar Atmospheres

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Ample evidence suggests that exoplanets of all kinds have clouds, likely made of many different materials from refractory minerals, to silicate dust, to salts, to volatile ices. Clouds are complex to model and challenging to understand from limited observations of exoplanets. Fortunately, planet-mass free-floating objects provide a key venue for understanding cloud formation in substellar atmospheres. These objects have the temperatures of planets but, critically, lack a nearby star, making high signal-to-noise, high precision measurements possible. To understand the physics and chemistry of these atmospheres, we need to compare these high fidelity observed spectra to state-of-the-art models. Recent improvements to the ingredients in substellar atmosphere models include new line lists for various important species (methane, alkali metals, water, etc.), as well as updated chemistry calculations for a range of metallicities and carbon-to-oxygen ratios. Here, we present a new set of substellar atmosphere models for objects warmer than 1000 K including clouds. We show how these models differ from previous cloudy brown dwarf models (Saumon & Marley 2008), and demonstrate how metallicity affects cloudy substellar spectra. We present results comparing these models to field brown dwarfs, free-floating planets, and directly-imaged companions, demonstrating how gravity changes cloud properties and emergent spectra. Finally, we present a new technique for understanding the compositions and mineralogy of clouds in brown dwarfs using mid-infrared spectroscopic time-series measurements with JWST. These models will publicly available and provide a critical