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Searching for 3D effects in the optical, high spectral resolution emission spectrum of KELT-9b

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Ultra-hot Jupiters (UHJs; $T_{eq} \geq 2500$ K) are the hottest gaseous giants known. They emerged as ideal laboratories to test theories of atmospheric structure and its link to planet formation. Indeed, because of their high temperatures, (1) they likely host atmospheres in chemical equilibrium and (2) clouds do not form in their day-side. Their continuum, which can be measured with space-facilities, can be mostly attributed to H- opacity, an indicator of metallicity. From the ground, the high spectral resolution emission spectra of UHJs contains thousands of lines of refractory (Fe, Ti, TiO, …) and volatile species (OH, CO, …), whose combined atmospheric abundances could track planet formation history in a unique way. In this talk, we take a deeper look to the optical emission spectrum of KELT-9b covering planetary phases 0.25 - 0.75 (i.e. between secondary eclipse and quadrature), and search for the effect of atmospheric dynamics and three-dimensionality of the planet atmosphere on the resolved line profiles, in the context of a consolidated statistical framework. We discuss the suitability of the traditionally adopted 1D models to interprete phase-resolved observations of ultra-hot Jupiters, and the potential of this kind of observations to probe their 3D atmospheric structure and dynamics. Ultimately, understanding which factors affect the line-shape in UHJs will also lead to more accurate and more precise abundance measurements, opening a new window on exoplanet formation and evolution.