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Probing the Atmospheres of the Hottest Planets

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Abstract

We present primary and secondary eclipse spectroscopic observations with LBT/LUCIFER1 of two of the hottest transiting extrasolar planets currently known, WASP-33b and XO-3b. The combination of their short orbital periods (1.2 and 3.2 days) and their bright, massive (A5V, F5V) host stars result in the two massive (4-$M_{\rm JUP}$, 12-$M_{\rm JUP}$) planets being highly irradiated. WASP-33b and XO-3b are estimated to be $\sim 0.1\%$ as bright as their host stars at ~ 1.5 μm, with resulting estimated equilibrium temperatures $\sim$ 3500 K and $\sim$ 3200 K. Such characteristics make WASP-33b and XO-3b similar to late M-dwarf stars. By observing the planets during primary transit and occultation, we can achieve a five-fold goal: a) evaluating how efficiently heat is re-distributed from the day-side to the night-side of the planets in the presence of (likely) pronounced photochemical, non-LTE processes due to their very high stellar irradiation; b) comparing WASP 33b and XO-3b to known late M dwarfs; c) gathering the highest resolution primary and secondary eclipse spectra ever obtained for exoplanetary atmospheres; d) further demonstrating the robustness of our new data analysis technique for ground-based near-IR spectroscopy of transiting planets, and e) assessing the feasibility for achieving high S/N ratio ground-based spectra of extrasolar planets with the LBT, turning our pioneering experiment into a strategic programme for the optimal exploitation of the unique capabilities of LBT/LUCIFER1 in MOS mode as applied to one of the 'hottest' fields of Astronomy.