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A Hell of a Phase Curve: Mapping the Surface and Atmosphere of a Lava Planet

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Lava planets are ultra-short-period planets with bulk densities consistent with terrestrial composition, but dayside temperatures hot enough to melt—and vaporize—rock. Of these planets, the most favorable candidate for atmospheric and surface characterization is the super-Earth, K2-141b with a density of 8 g/cm^3 and an orbital period of 6.7 hrs around a J = 9 star. Near-Infrared Spitzer and optical K2 photometric phase curves of K2-141b hints at a tenuous rock vapor atmosphere. The combination of the strong signal expected from K2-141b and the large contrast at long wavelengths makes mid-IR phase curve observations of K2-141b ideal for imposing the most stringent constraint on the dayside and nightside temperature of a lava planet. We present the full-orbit spectroscopic MIRI/LRS (5-12 um) phase curve of K2-141b to map the planet's thermal emission as a function of longitude. In addition to constraints on the phase offset, Bond albedo, and heat recirculation efficiency from the phase curve, the emission and transmission spectrum provide further evidence into the presence, or lack-of a global atmosphere on a lava planet. Our observations shed light on an extreme outcome of planet formation and provide insights into atmosphere-interior interactions on a rocky planet under extreme irradiation.