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Revealing the nature of small-planet atmospheres: JWST tests the water world hypothesis for GJ 9827d

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GJ 9827d is a small (2 Earth radii) warm (680K) K dwarf planet that lies in the degenerate wedge of the mass-radius diagram where it could either be a hydrogen-rich “mini-Neptune” at the cusp of losing its atmosphere, or a stable volatile-rich “water world” with a high-mean-molecular weight atmosphere. I will present the detailed characterization of the atmosphere of GJ 9827d from four JWST transits with NIRISS SOSS and NIRSpec G395H. Initial results from the already-observed NIRISS SOSS transits already favor a water-rich atmosphere scenario. Our deep observational program has the unprecedented potential to unambiguously identify candidate water worlds as such, and characterize their composition. Alternatively, for a hydrogen-rich atmosphere, our observations will open a new window into the short-lived late stages of complete atmosphere stripping and the evolution of small planet atmospheres. This unique dataset provides, for the first time, insights into the composition and building blocks of the new class of volatile-rich atmospheres, and showcases the potential for JWST to definitively test the water world hypothesis for promising candidates.