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Intrinsic phonon bands in high quality monolayer T' molybdenum ditelluride SHAO-YU CHEN, Univ of Mass - Amherst, Department of Physics, CARL NAYLOR, University of Pennsylvania, Department of Physics Astronomy, THOMAS GOLDSTEIN, Univ of Mass - Amherst, Department of Physics, CHARLIE JOHNSON, University of Pennsylvania, Department of Physics Astronomy, JUN YAN, Univ of Mass - Amherst, Department of Physics — Distorted octahedral (T') transition metal dichalcogenide (TMDC) is a type of layered semimetal that has attracted significant recent attention because of its fascination physical, chemical and nontrivial topological properties. Unlike its hexagonal counterpart, monolayer (1L) T'-TMDC is challenging to work with due to rapid sample degradation in air. In this talk, I will discuss well-protected 1L-$T'-MoTe_2$ that exhibits sharp and robust intrinsic Raman bands, with intensities about one order of magnitude stronger than those from bulk T'-$MoTe_2$. The high quality samples enable us to reveal for the first time the set of all nine even-parity zone-center optical phonons. Crystal angle and light polarization resolved measurements further indicate that all the intrinsic Raman modes belong to either z-mode (vibrating along the zigzag Mo atomic chain) or m-modes (vibrating in the mirror plane). Moreover, with the knowledge of vibrational symmetry, we can effectively distinguish the intrinsic modes from Te-metalloid-like modes with energy around 122 and 141 cm^{-1} which are associated to the sample degradation. Our studies offer a powerful non-destructive method for assessing sample quality, providing the fingerprint as well as key insights in understanding the fundamental properties of 1L T'-TMDCs.

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