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.