Abstract Submitted
for the PSF16 Meeting of
The American Physical Society

Observation of Interlayer Phonons in Transition Metal Dichalcogenide Atomic Layers and Heterostructures YE GAIHUA, ZHIPENG YE, Univ of Northern Iowa, CHUN HUNG LUI, University of California, Riverside, RUI HE, Univ of Northern Iowa — Interlayer phonon modes in atomically thin transition metal dichalcogenide (TMD) heterostructures were observed for the first time. We measured the low-frequency Raman response of MoS2/WSe2 and MoSe2/MoS2 heterobilayers. We discovered a distinctive Raman mode (30 - 35 cm-1) and identified this new Raman mode as the layer breathing mode (LBM) arising from the perpendicular vibration between the two TMD layers. We also investigated the ultralow-frequency Raman response of atomically thin ReS2, a special type of TMD with unique distorted 1T structure. We found that the two shear modes in bilayer ReS2 are nondegenerate and clearly resolved in the Raman spectrum, in contrast to the doubly degenerate shear modes in other two-dimensional materials. By carrying out comprehensive first-principles calculations, we can account for the frequency and Raman intensity of the interlayer modes and determine the stacking order in bilayer ReS2.

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Date submitted: 29 Sep 2016 Electronic form version 1.4