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Precise measurement of the 0-1 R(0) vibrational transition in HD
SAMUEL MEEK, ARTHUR FAST, Max Planck Institute for Biophysical Chemistry — Precise measurements of vibrational transition frequencies in the isotopes of molecular hydrogen can provide a sensitive probe of fundamental physics. Because these transitions can be predicted with high precision using ab-initio theory, comparisons between theory and experiment can be used to test quantum electrodynamics, search for new physics, and determine the proton-electron mass ratio more precisely. We report a measurement of the 0-1 R(0) vibrational transition frequency in deuterium hydride (HD) made using infrared-ultraviolet double resonance spectroscopy in a pulsed supersonic molecular beam. Molecules in the $v = 0$, $J = 0$ state are excited to $v = 1$, $J = 1$ using a tunable infrared laser stabilized to an optical frequency comb, and the excitation efficiency is determined using state-selective ionization of the vibrationally excited molecules. Based on the measured infrared spectra, we have determined the transition frequency with an uncertainty of less than 20 kHz ($2 \cdot 10^{-10}$ fractional uncertainty), which is limited primarily by the residual first-order Doppler shift.

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