PRECISE MEASUREMENT OF A FUNDAMENTAL VIBRATIONAL TRANSITION FREQUENCY IN HD

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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-level *ab-initio* theory, comparisons between theory and experiment can be used to test quantum electrodynamics, search for new physics, and determine the nucleon-electron mass ratios more precisely. In this talk, I will present our measurement of the $0 - 1$ R(0) transition frequency in hydrogen deuteride (HD) using infrared-ultraviolet double resonance spectroscopy in a pulsed supersonic molecular beam.[a] HD 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 by state-selectively ionizing the vibrationally-excited molecules using a pulsed UV laser. We have determined the absolute frequency of the transition with an uncertainty of 13 kHz (0.12 ppb relative uncertainty), limited primarily by the first order Doppler shift. Improvements in the compensation of this shift should make it possible to reduce the uncertainty by another order of magnitude.

[a] Fast et al., arXiv:2002.09333