

NEW HIGH PRECISION LINELIST OF H_3^+

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As the simplest polyatomic molecule, H_3^+ serves as an ideal benchmark for theoretical predictions of rovibrational energy levels. By strictly *ab initio* methods, the current accuracy of theoretical predictions is limited to an impressive one hundredth of a wavenumber,^a which has been accomplished by consideration of relativistic, adiabatic, and non-adiabatic corrections to the Born-Oppenheimer PES. More accurate predictions rely on a treatment of quantum electrodynamic effects, which have improved the accuracies of vibrational transitions in molecular hydrogen to a few MHz.^b High precision spectroscopy is of the utmost importance for extending the frontiers of *ab initio* calculations, as improved precision and accuracy enable more rigorous testing of calculations. Additionally, measuring rovibrational transitions of H_3^+ can be used to predict its forbidden rotational spectrum. Though the existing data can be used to determine rotational transition frequencies, the uncertainties are prohibitively large.^c Acquisition of rovibrational spectra with smaller experimental uncertainty would enable a spectroscopic search for the rotational transitions.

The technique Noise Immune Cavity Enhanced Optical Heterodyne Velocity Modulation Spectroscopy, or NICE-OHVMS has been previously used to precisely and accurately measure transitions of H_3^+ , CH_5^+ , and HCO^+ to sub-MHz uncertainty.^d A second module for our optical parametric oscillator has extended our instrument's frequency coverage from 3.2-3.9 μm to 2.5-3.9 μm . With extended coverage, we have improved our previous linelist by measuring additional transitions.

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^cC. M. Lindsay, B. J. McCall, *J. Mol. Spectrosc.* (2001), **210**, 66–83.

^dJ. N. Hodges, *et al. J. Chem. Phys.* (2013), **139**, 164201.