

SUB-DOPPLER SPECTROSCOPY OF H_3^+

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Spectroscopy of H_3^+ is of fundamental interest for advancing *ab initio* efforts to calculate spectra with high precision and accuracy. H_3^+ is the simplest polyatomic ion, which is why it is an excellent benchmark for theory. In order to perform calculations with spectroscopic accuracy, relativistic and non-adiabatic corrections to the Born-Oppenheimer approximation must be included; calculations with these considerations agree to within hundredths of a wavenumber.^a Increasing the precision of the calculations further will require a treatment of quantum electrodynamic effects, as has already been implemented for the diatomic case,^b and testing these calculations will require higher-precision experimental data to guide *ab initio* calculations.

Noise Immune Cavity Enhanced Optical Heterodyne Velocity Modulation Spectroscopy, or NICE-OHVMS^{cd}, is a highly sensitive, highly precise technique that we have employed to observe transitions in the ν_2 fundamental band of H_3^+ . It combines the advantages of cavity enhancement and heterodyne detection with the ion-neutral discrimination afforded by velocity modulation. Combining a cavity with a high power mid-infrared light source, we can saturate rovibrational transitions. The resulting Lamb dips may be fit in order to determine line centers to a much higher precision than is possible for ordinary Doppler broadened profiles. Additionally, a frequency comb is used to surpass the limited accuracy and precision of a wavemeter. Here we present the results from comb calibrated H_3^+ transitions observed via NICE-OHVMS. Precision and accuracy of ~ 1 MHz were achieved representing the most accurate and precise H_3^+ line list that has been obtained to date.

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