COMPILATION AND EVALUATION OF THE LABORATORY SPECTROSCOPY OF H_3^+

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Over the past 2 decades, there have been 17 individual spectroscopic studies of the ro-vibrational states of H_3^+, reporting over 800 unique transitions from a variety of fundamental, overtone, combination, and hot bands. The results of these works are an important tool for computational and astronomical chemistry. As the simplest polyatomic molecule, H_3^+ is computationally tractable from first principles, and its spectrum serves as a benchmark for ro-vibrational calculations of other molecules. Astronomically, the spectrum of H_3^+ is an important probe of the conditions of ionized environments such as planetary ionospheres and dense and diffuse interstellar clouds. Due to the difficulty of the laboratory measurements and the complexity of the H_3^+ spectrum, the literature on the laboratory data is riddled with transition frequency measurement errors, misassignments (and reassignments), inconsistent labelings of states, and underestimates of the experimental uncertainties—all of which make the data difficult to use reliably. In the last few years the accuracy of theoretical calculations and the resolution of astronomical infrared spectrometers has become very close to the accuracy of the laboratory data, increasing the importance of sorting out these problems.

In this talk, we describe our effort to alleviate the confusion and compile all of the data into a single source. Every reported transition of H_3^+ has been reviewed for reliability in frequency measurement and compared to the latest theoretical calculations for assignment. We will discuss the confusion in assigning labels to ro-vibrational states at moderate energy and present a labeling scheme for every state below 9000 cm^{-1}. Once reviewed, the experimental transition frequencies, uncertainties, and assignments were tabulated and used to determine 526 energy levels. We present these results and discuss their application to theoretical and astronomical spectroscopy.