INITIAL DEVELOPMENT OF HIGH PRECISION, HIGH RESOLUTION ION BEAM SPECTROMETER IN THE NEAR-INFRARED

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Interest in molecular ions stretches across many fields, from combustion to astrochemistry. These ions can be difficult to study spectroscopically in the laboratory, however. Obstacles include the relatively small density of ions produced in samples compared to neutral molecules and high rotational temperatures of the ions (which lead to dilution of the energy levels). To overcome some of these challenges of molecular ion spectroscopy, we are developing a fast ion beam spectrometer system we call Sensitive, Cooled, Resolved Ion BEam Spectroscopy (SCRIBES). This setup will enable the sensitive study of a supersonically cooled ion beam, taking advantage of narrow linewidths, a mass-dependent Doppler shift for mass identification of each spectral line, and on-line mass spectrometry for beam composition studies. Presently, the spectrometer contains an ion beam source that produces ions at high rotational temperature. We have characterized the spectrometer using the near-infrared rovibronic transitions of N_2^+, optimizing the sensitivity of the instrument. Furthermore, we have used an optical frequency comb for highly accurate frequency calibration, measuring a N_2^+ transition to within an accuracy of 8 MHz. This work in the near-infrared has laid the foundation for mid-infrared and indirect THz ion beam spectroscopy of many interesting molecular ions at a high level of precision, accuracy, and resolution.

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