TOWARDS HIGH RESOLUTION CAVITY ENHANCED SPECTROSCOPY WITH FAST ION BEAMS

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The spectroscopic study of gas phase molecular ions has been recognized as an important subject for many fields ranging from combustion to the chemistry of the interstellar medium. In order to perform high resolution spectroscopy with molecular ions, several challenges have to be overcome, including low sample densities and spectral congestion caused by neutral species. For many years, velocity-modulated AC plasmas have been used successfully to provide ion-neutral discrimination; however, they suffer from Doppler broadened line widths and high rotational temperatures. Furthermore, spectroscopy in an AC discharge is often burdened with an inherent uncertainty as to which species are actually present in the plasma.

To address these issues we are developing a new spectroscopic technique called SCRIBES (Sensitive, Cooled, Resolved Ion BEam Spectroscopy) that employs molecular ion beams to reduce Doppler line widths by kinematic compression. A time-of-flight mass spectrometer allows for exact identification of the ion beam composition during the measurements. The use of a supersonic ion source will reduce the rotational temperature and eliminate spectral congestion. In order to achieve the required spectroscopic sensitivity we utilize cavity-enhanced techniques, which require a high degree of mechanical stability. We will describe improvements made to our instrument to increase the mechanical stability of the cavity, and allow for simultaneous spectroscopy and mass analysis. We will also describe progress made towards integrating the cavity enhanced velocity modulation spectroscopy (CEVMS) method described in the previous talk with an uncooled fast ion beam.