CAVITY RINGDOWN SPECTROSCOPY OF MOLECULAR IONS IN A FAST ION BEAM

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As described in the preceding talk, we are developing a new fast ion beam system called SCRIBES (Sensitive, Cooled, Resolved Ion BEam Spectroscopy) for high resolution spectroscopic studies of complex molecular ions. We are, for the first time, employing the highly sensitive technique of continous-wave cavity ringdown spectroscopy (cw-CRDS) to interrogate an ion beam. For the purposes of commissioning our ion beam instrument, we are studying the 1-0 vibronic band of the N_2^+ $A^2\Pi_u$-$X^2\Sigma_g^+$ system, using ions produced in an uncooled cold cathode dc discharge source and a tunable external cavity diode laser in the 925 nm region.

The next steps in the development of the SCRIBES system are the integration of a supersonic expansion discharge source and the construction of a difference frequency generation (DFG) system, which together will enable us to study rotationally cold molecular ions in the mid-infrared. The DFG system involves combining the outputs of a Ti:Sapph laser and a Nd:YAG laser in a periodically poled lithium niobate crystal to produce mid-infrared radiation. The infrared light will be tunable over the 2 – 5 μm region by scanning the output frequency of the Ti:Sapph laser.

In this talk, we will present the results of our commissioning experiment on N_2^+, and discuss the development of the supersonic source and the implementation of our DFG system. We will also describe the future prospects of the SCRIBES instrument, which include the spectroscopic study of complex molecular ions such as CH_5^+, $C_3H_3^+$, and $CH_3OH_2^+$, each of which is of great quantum-mechanical and astrochemical interest.