PROBING MOLECULES WITH LASER-COOLED ATOMIC IONS

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Trapped, laser-cooled atomic ions can be controlled with unprecedented precision and accuracy as demonstrated by both atomic ion clocks and prototype quantum computing devices. By trapping a mixture of laser-cooled atomic and molecular ions, the molecular ions will be sympathetically cooled to millikelvin temperatures. The reaction dynamics and spectroscopy of the molecular ion can then be observed without the thermal distribution of ion motion. Furthermore, the bright fluorescence of the atomic ion can be used as a signal for obtaining information about the molecular ion via the Coulombic interaction. In this talk, I will present our work towards performing single molecular ion spectroscopy on an atomic ion - molecular ion pair. I will discuss fundamental limits and applications of the technique for astrochemistry and the direct laser-cooling of molecular ions.