The astrophysics and spectroscopy of molecular ions

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Atomic and molecular ions play a major role in astrophysics. The formation of molecules in cold environments is investigated in trap experiments. Higher order multipole traps are ideal instruments to simulate the cold conditions in space. Important examples such as the formation of small hydrocarbon molecules are discussed.

Ion trapping is also an interesting way to store ions for spectroscopy. The method of laser induced reactions (LIR) has been developed to record IR and FIR spectra of a few hundred(!) mass selected and cold ions. Recent results including the first pure rotational spectra of protonated hydrogen and their relevance to astrophysics will be discussed. The molecular collision is an intimate part of the LIR detection scheme. As a result the spectra also reveal information on state-to-state collision processes. Understanding molecular collisions is one future trend for LIR spectroscopy.