MOLECULAR IONS IN THE LABORATORY AND IN SPACE

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Molecular ions play a central role in the gas-phase chemistry of the interstellar medium; they also provide information on the physical conditions in astronomical sources (e.g., fractional ionization), and in some cases can be used to infer the abundance of nonpolar molecules such as N_2 and CO_2 which can not be observed in the radio band. Until fairly recently, only positive molecular ions — most protonated forms of abundant interstellar molecules — had been detected in space. Despite numerous predictions either on general grounds or on the basis of chemical models, no negative molecular ions had been found in the interstellar gas. During the past three years the rotational spectra of six carbon-chain anions have been detected in this laboratory, and on the basis of precise laboratory rest frequencies, four have now been identified in rich astronomical sources, including cold dust clouds and the circumstellar shell of the evolved carbon star IRC+10216; there is almost certainly evidence for a fifth anion, C_5N^-, in IRC+10216, although the rotational spectrum of this anion has not yet been detected in the laboratory. More generally, these discoveries have stimulated interest in laboratory, observational, and astrochemical studies of molecular anions.
This talk will provide a brief overview of our recent work, including laboratory detection of two distinct isomeric forms of HSO_2^+, protonated isocyanic acid H_2NCO^+, and the cyanate anion NCO^-. Efforts now underway to better understand the distribution of anions in space and their formation in IRC+10216 will also be presented.