Infrared Cavity Ring-Down Measurements of Astronomically Relevant Cations

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Interstellar cations play a role in ion-molecule interactions, and can be used a tracers for centrosymmetric molecules, e.g. HO_2^+ or CH_5^+, as well as tracers of the formation pathways of larger species. For example, current astronomical models predict that hydrocarbon cations, e.g. $C_2H_3^+$, act as key intermediates in the formation pathways of larger species, such as those for long carbon chains or polycyclic aromatic hydrocarbons (PAHs). However, currently many key cations have yet to be observed in space. While new astronomical flagship facilities, e.g. ALMA (Atacama Large Millimeter Array), can now probe even trace molecules (abundances of $\sim 10^{-6}$ - 10^{-10} with respect to H_2), a shortage of accurate laboratory spectroscopic data complicates the identification of such species. We present new high resolution infrared (IR) spectra in the C-H stretch region obtained using ultra-sensitive and highly precise IR continuous wave cavity ring-down spectroscopy (cw-CRDS), combined with supersonic plasma expansions[a]. In particular, we show recent studies of cations, including the first gas phase detection of the smallest aromatic molecule[b], c-$C_3H_3^+$, which have yield molecular parameters accurate enough for astronomical applications.

References
a. D. Zhao, J. Guss, A. Walsh, H. Linnartz, Chem. Phys. Lett., 565, 132 (2013)
b. D. Zhao, K.D. Doney, H. Linnartz, ApJ, 791, L28 (2014)