LOW-TEMPERATURE KINETICS MEASUREMENTS OF THE GAS-PHASE REACTIONS BETWEEN AROMATIC SPECIES AND THE CN RADICAL

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It remains an open question as to whether polycyclic aromatic hydrocarbons (PAHs) can be efficiently formed in the ISM by bottom-up mechanisms involving growth from small aromatic precursors like benzene. However, the lack of dipole moment renders benzene invisible in the radio regime making estimation of the abundance of benzene in the ISM difficult. The recent detection of benzonitrile in the Taurus Molecular Cloud (TMC)-1 has caused excitement in the astrochemical community as it is the first aromatic molecule detected in the interstellar medium (ISM) using radio astronomy. Benzonitrile is thought to form via the neutral-neutral reaction between the CN radical and benzene, and therefore may serve as a chemical proxy to determine the abundance of benzene. The abundances of aromatic species in ISM environments are not well understood, in part due to a lack of experimental kinetics data. Both rate constants and product-branching ratios for the reactions of aromatic molecules must be measured at low temperature in order to input these reactions into astrochemical models and accurately predict abundances. Benzene and toluene are two of the aromatic species detected in the atmosphere of Titan and their reactions with the CN radical have been studied down to 105 K by Trevitt et al. Here, we have extended this study down to 15 K to approach dense cloud conditions and have measured the rate constants of the reactions of benzene and toluene with the CN radical using the well-established CRESU technique (Cinétique de Réaction en Ecoulement Supersonique Uniforme, or Reaction Kinetics in Uniform Supersonic Flow) combined with the Pulsed Laser Photolysis-Laser-Induced Fluorescence method. I will also discuss our recent progress in combining chirped-pulse micro/mm-wave spectroscopy with the CRESU method and how we plan to employ this technique to measure product branching ratios for reactions of the CN radical with aromatics at low temperatures.