ABSTRACT

TITLE: Experimental Study of the Dissociative Recombination of Molecular Ions at Temperatures Relevant to Cold Interstellar Plasma (30 – 300 K)

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ABSTRACT: The dissociative recombination process of N_2H^+ ions with electrons was investigated using a stationary afterglow combined with a Cavity Ring-Down Spectrometer. We conducted real-time observations of the changes over time in the population densities of various rotational and vibrational states of recombining N_2H^+ ions. Based on these observations, we determined the rate coefficients for thermal recombination of N_2H^+ within a temperature range of 80 – 350 K. By employing newly calculated vibrational transition moments of N_2H^+, we provided an explanation for the discrepancies observed in previous studies regarding the recombination rate coefficients. Furthermore, our findings indicate that the measured recombination rate coefficient does not exhibit a statistically significant correlation with the number density of the buffer gas. We also conducted a study on the dissociative recombination of H_3^+ ions with electrons in neon gas at a temperature of 110 K. To perform this investigation, we utilized a new Cryogenic Stationary Afterglow apparatus equipped with a Cavity Ring-Down Spectrometer and an electron number density measurement system. Our results revealed that the ternary recombination rate coefficient, denoted as $K_{Ne}(110\ K)$, closely resembles the value obtained in a helium buffered plasma.

KEYWORDS: dissociative recombination, afterglow plasma, CRDS, low temperature plasma, astrochemistry, molecular ions, electrons, recombination rate coefficient