COSMIC RAY-DRIVEN RADIATION CHEMISTRY IN COLD INTERSTELLAR ENVIRONMENTS

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The physiochemical impact of cosmic rays on interstellar regions is widely known to be significant [a]. Indeed, the cosmic ray-driven formation of H_3^+ via the ionization of H_2 was shown to be of key importance in even the first astrochemical models [b]. Later, cosmic rays were implicated in the collisional excitation of H_2, which leads to the production of internally produced UV photons that also have profound effects on the chemistry of molecular clouds [c]. Despite these key findings, though, attempts at a more complete consideration of interstellar radiation chemistry have been stymied by the lack of a general method suitable for use in astrochemical models and capable of preserving the salient macroscopic phenomena that emerge from a large number of discrete microscopic events.

Recently, we have developed a theoretical framework which meets these criteria and allows for the estimation of the decomposition pathways, yields, and rate coefficients of radiation-chemical reactions [d]. In this talk, we present preliminary results illustrating the effect of solid-phase radiation chemistry on models of TMC-1 in which we consider the radiolysis of the primary ice-mantle constituents of dust grains. We further discuss how the inclusion of this non-thermal chemistry can lead to the formation of complex organic molecules from simpler ice-mantle constituents, even under cold core conditions.

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[a] Indriolo, N. & McCall, B. J.,*Chem. Soc. Rev.*, 42, 7763-7773, 2013
[b] Herbst, E. & Klemperer, W., *Ap.J.*, 185, 505-534, 1973
[c] Prasad, S. S. & Tarafdar, S. P.,*Ap.J.*, 267, 603-609, 1983
[d] Shingledecker, C. N. & Herbst, E., *Phys. Chem. Chem. Phys.*, 20, 5359-5367, 2018