

MODELING C₂H₄O₂ ISOMERS IN COLD DARK CLOUDS

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Complex organic molecules (COMs) have been detected in a variety of interstellar sources. These sources allow for methods of production linked to increasing temperatures and densities, allowing for thermal chemical reactions to occur rapidly enough to produce observable amounts of COMs, both in the gas phase, and upon dust grains, which then become gaseous as the temperature increases to sublime the COMs off the grain. As more precursor molecules are detected in colder regions of interstellar space such as cold dark clouds, the same thermal methods of COM production are not efficient enough to produce observable amounts. Radiolysis chemistry is a possible non-thermal method of producing observable amounts of COMs in cold dark clouds. This new method greatly increases the modeled abundance of COMs upon the ice surface and within the ice mantle due to excitation and ionization events from cosmic ray bombardment. We examine three C₂H₄O₂ isomers, and a chemically similar molecule, dimethyl ether (CH₃OCH₃). The modeled abundances of methyl formate (HCOOCH₃) and glycolaldehyde (HCOCH₂OH) should be in the observable range, with fractional abundances of approximately 3.0×10^{-11} and 1.3×10^{-11} , respectively, with respect to hydrogen. Acetic acid (CH₃COOH) is greatly enhanced with the inclusion of radiolysis, with a modeled fractional abundance of 1.375×10^{-13} , but is not at observable abundances. Dimethyl ether, while detected in these regions is not greatly enhanced by radiolysis chemistry, with models with and without radiolysis chemistry show gas-phase fractional abundances of 2.5×10^{-10} and 2.4×10^{-10} , respectively.