

Monte Carlo calculation of organic synthesis by the matrix-based bond model: Toward reproduction of sugar synthesis experiment on interstellar particles

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Because organic molecules are essential materials for life, their synthesis in a prebiotic environment is an important topic for the origin of life. Of the many organic molecules, because ribose is the component of RNA, sugar is a key prebiotic material. Meinert et al. (2016) reported that many kinds of sugar, including ribose, were detected from interstellar ice analogs radiating UV in a high vacuum chamber. They suggested that formose reaction may have occurred to form ribose and related sugars. However, it is not easy from laboratory experiments to know what kind of synthesis path actually occurred and when sugars were formed.

In order to know the details of sugar synthesis reaction in Meinert's experiment, we performed numerical simulations based on the classical Dugundji-Ugi algebraic model.

We started the simulations from H₂O and CH₃OH, corresponding to the condition of Meinert's experiment. For simplicity, we simulated the condition of UV irradiation by setting the temperature at T=10⁵ K, which corresponds to ~10 eV of UV energy.

From the simulation results, we found that the amount of sugar production increased when we warmed up to room temperature. In addition, we got some different reaction paths from formose reaction and we can suggest that sugar may be produced by a different kind of reaction in Meinert's experiment.