

Co-evolution of water and organic compounds through surface reactions on interstellar grains

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Various kinds of molecules have been found in interstellar molecular clouds, which are the birthplace of stars and planets. Those molecules are mainly formed by the following two types of reactions: ion-molecule reactions in the gas phase and surface reactions on interstellar grains. Ion-molecule reactions have been well studied theoretically and experimentally for a long time, which resulted in a better understanding of chemical reactions in molecular clouds. However, since the observed abundance of major interstellar molecules such as H₂O, H₂CO, and CH₃OH cannot be explained by gas-phase synthesis only, it is now widely accepted that grain-surface reactions are essential for the formation of those interstellar molecules.

We have experimentally showed that quantum tunneling plays a significant role for chemical reactions to produce water and organic molecules on interstellar grains at as low as 10 K. In this talk, we will review recent progresses in the experimental studies on the formation of water and organic molecules through quantum-tunneling reactions on interstellar grains at very low temperatures.