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The Development of the Astrophysical Laboratory for the Study of Interstellar Surface Chemistry

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Interstellar complex molecules can be formed in interstellar molecular clouds during the process of star formation. Those complex molecules can be later delivered to planets to serve the role of the building blocks of life. Therefore, understanding the interaction and formation processes of those complex molecules in interstellar conditions is crucial to the understanding of the origin of life. Interstellar complex molecules are thought to be formed in a solid phase, on a surface of icy dust grains in molecular clouds. The regions where the formation of the complex molecules occurs are generally cold with temperatures below 100 K and pressure of 10^{-10} mbar. Here we present the development of the astrophysical laboratory to study interstellar surface chemistry. The laboratory includes an experimental station to mimic the extreme conditions of interstellar molecular clouds and computational modeling of the chemical processes that occur in the interested physical conditions. The experimental station will be located at the PBP-CMU Electron Linac Laboratory, with the collaboration between NARIT, CMU, SUT, and SLRI. The setup includes an ultra-high vacuum chamber pumped to 10^{-10} mbar as the main chamber for the experiments. Connected to the sample holder in the main chamber is a liquid nitrogen dewar to maintain the temperature of around 80 K. The water and the interested molecules are injected through the gas injection unit onto the cold surface of the substrate to form an interstellar ice analog. The chemical products will be probed with mid-IR and far-IR from the FTIR spectrometer by the MCT detector connected to the chamber. Finally, we present examples of the experiments that can be done with this experimental setup. The experiments will allow us to understand the structures, intermolecular interactions, and formation processes of the complex molecules in interstellar cloud environments.

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