



Title of Project : Evolution of molecules in space: from interstellar clouds to proto-planetary nebulae

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【Purpose of the Research Project】

So far, our understanding of the origin and evolution of planetary systems has been mostly limited to the dynamics. Although the importance of chemistry has been emphasized, systematic studies about chemical evolution have not yet been performed.

We focus our attention on the most abundant solid materials in space: ices and organic materials. How do these molecules evolve in space? We aim at answering this question by interdisciplinary approaches including laboratory and theoretical studies about surface processes, observation of young stellar objects, modeling of molecular cloud and protoplanetary-disk chemistry, and analyses of extraterrestrial materials.

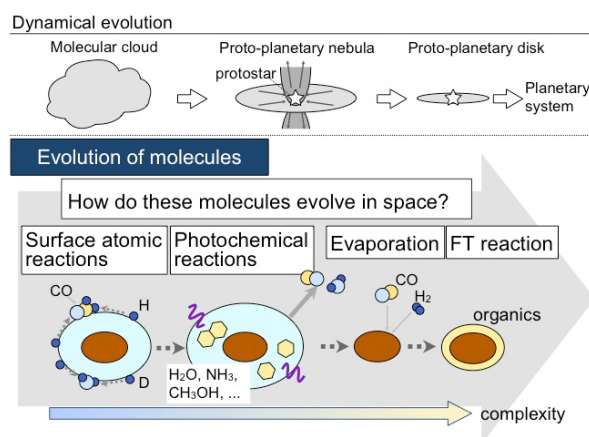


Fig.1 Evolution of molecules from interstellar molecular cloud to protoplanetary nebula

【Content of the Research Project】

We will investigate the evolution of molecules in space by physicochemical method:
(1) Experimental studies about surface reactions of atoms and molecules and photochemical reactions of solids at low temperatures to mimic phenomena occurring in molecular clouds
(2) Heating experiments of molecular-cloud organics and Fischer-Tropsch type surface

reaction experiments to mimic phenomena occurring in proto-planetary nebulae
(3) Observation of young stellar objects by radio telescopes (ALMA, ASTRON etc.) to understand the evolution and variety of organic molecules. From these studies, we will establish a new criterion to clarify the origin of molecules and their isotope fractionation in space.

We will make a scenario on the evolution of molecules by

(4) Chemical network model using above results
(5) Analyses of chemical and isotopic composition of organic molecules in meteorites and cometary dust.

In addition to (1)-(3), these approaches clarify the evolution of organic molecules in our proto-solar nebula.

【Expected Research Achievements and Scientific Significance】

Evolution of molecules (ices and organics) from molecular clouds to proto-planetary nebulae will be clarified systematically by an interdisciplinary study. This will certainly contribute not only origin and evolution of planetary systems but also origin and evolution of life. We will be also dedicated to outreach and educational activities.

【Key Words】

Ice, organic materials, evolution of molecules, molecular clouds, proto-planetary nebulae.

【Term of Project】 FY2013-2017

【Budget Allocation】 891, 300 Thousand Yen

【Homepage Address and Other Contact Information】

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