P212c Radical Production via UV Irradiation of Protoplanetary Disks

I. J. Manoraj, S. Okuzumi, K. Homma (Institute of Science Tokyo)

Planets are thought to form in protoplanetary disks from micron-sized dust grains that coagulate and grow into full-sized planets. The beginning stages of planet formation is inefficient in the outer parts of the disk, where the grains are mantled by an ice layer that contains simple molecules. When exposed to UV radiation, photoproducts are formed within the ice mantle. Once the grains drift inside the snow line, the warming and sublimation of ices can trigger organic synthesis on the grains. In addition to interstellar medium (ISM) radiation, radiation from the disk's central star and nearby massive stars play an important role in facilitating organic synthesis. We perform a vertical dust size evolution simulation and calculate the abundance of photoproducts inside icy grains produced by UV irradiation, and its dependence on disk parameters such as fragmentation velocity and turbulence. We consider the effects of the central star's FUV continuum emission and Lyman-alpha emission separately. We find that, due to the enhancement in flux via additional radiation sources, photoproducts are formed both at a higher quantity and faster rate. Additionally, we find that the cycle of fragmentation and mixing due to turbulence help homogenize the distribution of irradiated grains through the depth of the disk. However, the impact of disk parameters on photoproduct abundance depends on the availability of the starting materials in the ice, limiting the total amount of photoproduct. Our results suggest that, given high enough initial abundances of starting molecules, there could be more organics formed once grains drift inward than previously thought, contributing to rapid growth in the inner disk.