

Grain Surface Pathways to Complex Organic Molecule Formation

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Complex organic molecules (COMs) have been identified in a number of distinct interstellar environments, characterized by radically different physical conditions, e.g., hot cores of low- and high-mass protostars as well as cold dense molecular clouds [1]. Although gas-phase COM formation channels may be particularly important in hot cores, they cannot fully explain the presence of complex species in cold regions. Recent laboratory studies showed that COMs form effectively at low temperatures (10-30 K) in the solid state, i.e., on icy grains, typically following a non-energetic (atom-addition) or energetic (X-rays, VUV photons, ions, and electrons) trigger. So far, such studies have been mostly performed for one of the two processes. For decades, surface complex molecule formation has been thought to be induced largely by energetic processing. Very recently, my co-workers and I gave the first laboratory evidence that the building blocks of sugars, fats, and proteins can be formed through non-energetic surface reactions under dark molecular cloud conditions [2, 3]. During my talk, I will review the most recent laboratory work carried out at the Sackler Laboratory for Astrophysics in Leiden (Netherlands). Particularly, I will qualitatively and quantitatively discuss both the relative importance and the cumulative effect of atom-addition and VUV irradiation on the surface formation of complex species at 15 K [4, 5]. Results will be linked to current astronomical observations.

References

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