Prestellar chemical fingerprint in protoplanetary disks and comets

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The chemical evolution of volatiles in protoplanetary disks begins in the earliest prestellar phase of star formation. Under the dark, cold conditions of cores the initial icy mantles of grains are built up. Already at this point, grain-surface chemistry starts to set the composition of these icy layers. Once collapse is initiated, the central protostars can boost chemical processing of the ices by serving as a source of additional UV photons, thereby enhancing photochemistry in both phases, and by heating the dust grains, which allows higher mobility of radicals in the solid phase. Regionally, the heating is sufficient to thermally desorb the ice mantles entirely. In such regions, the chemistry is set via gas-phase reactions. Protoplanetary disks are built up from the collapsing core materials, which are exposed to variable intensities of UV irradiation and heating. In this talk, the history of the protoplanetary disk composition will be unraveled with the help of sophisticated physicochemical models. The results can be substantiated observationally by comparing the modelled midplane volatiles with the chemical composition of comets. Comets are thought to trace the chemical contents of the innate protosolar disk. The unique in situ measurements from the Rosetta mission on comet 67P/ChuryumovGerasimenko will be highlighted in this talk in the context of such models. Additionally, a connection will be made with extrasolar protostellar sources, as ALMA observations are revealing similar chemically complexity between young low-mass protostars, such as IRAS 16293-2422, and the molecular inventory of comets. Such comparative studies give hints on the uniqueness of the ingredients to life.