MONTE CARLO SIMULATIONS ON THE FORMATION OF INTERSTELLAR ICE

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Formation and destruction of ice mantles play an important role in many astrophysical environments including regions where new stars and planets are born and on icy bodies in our own solar system such as comets. Although we have a general picture about how the mantles form and desorb again, little is known about the basic physical processes. Even the formation of the most abundant ice – H_2O – is not fully understood. Observations indicate that in dense clouds dust particles are covered by several to hundreds of monolayers of water ice. In diffuse clouds, however, the water ice mantles constitute less than one monolayer, the current detection limit.
We studied the formation of ice mantles under several conditions, both in diffuse and dense regions using the continuous-time, random-walk Monte Carlo method. We considered a set of surface reactions with reactants that either accrete onto a grain surface or are products of other surface reactions that remain on the grain. We further considered photodissociation processes for surface species caused by ultra-violet photons. In diffuse areas, these photons are mainly those of the external radiation field and photodissociation is the main destruction route for ice. In dense sources, the much smaller flux of photons arises indirectly from cosmic ray bombardment of H_2, which produces ions and electrons. We will present our results and comment on how they relate to current observations.