Amazing Grains - The nature of interstellar dust as revealed by light scattering

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Dust grains are formed in several types of near-stellar environment. However, once they enter the interstellar medium these grains will be modified in size, shape and even composition by a variety of physical processes. These modifying processes may continue to act throughout the lifetime of a grain. Thus, we should consider the possibility that grains evolve in the interstellar medium.

In the diffuse medium, some materials will be affected by starlight or by cosmic rays, and some may be modified by chemical reactions with gas phase species. All grains will be eroded and possibly reduced to atoms or small molecular fragments in the intermittent passage of interstellar shock waves, with some materials (such as silicates) being more resistant to this kind of erosion than others (such as hydrocarbon polymers). The response of dust to local conditions may be reflected in the variations in interstellar extinction curves along different lines of sight in the Milky Way, and in other galaxies.

Starting from the mathematical techniques that enable the optical properties of spherical grains and clusters of spheres to be computed, I'll present a dust model specifically constructed on the assumption that dust grains evolve in space, and discuss it in the context of current approaches to modelling the properties of interstellar dust. The model is inherently time-dependent with its properties modified by the interaction with the environments in which grains are embedded. Timescales are set by the deposition time of carbon in a hydrogen-rich gas (mainly aliphatic), and the time for its conversion to aromatic carbon by the local ultraviolet radiation field. Another timescale is associated with the occasional swift ablation of the carbon layers and their recycling in the gas-phase when a shock, or other impulsive phenomena occur.

Finally, I'll consider possible limitations, and suggest revisions that may be required to take account of these concerns.