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Numerical Simulations of Light Scattering by Cometary Dust

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Cometary dust shows common characteristics in optical observational data:
The albedo is a smooth function of scattering angle with a strong broad forwardscattering peak and a weak backscattering enhancement; The dependence of albedo on wavelength exhibits a red color relative to the solar continuum without significant variations at different scattering angles; The degree of linear polarization in relation to scattering angle shows a bell-shaped curve with its maximum around a scattering angle of 90° and a negative branch at scattering angles larger than 150–160°; The wavelength dependence of linear polarization is red, while it gradually approaches neutral toward backscattering region. Numerica simulations of these optical properties provide clue to understand the nature of cometary dust.
First we will review previous studies that attempted to numerically reproduce the common optical properties of cometary dust. Second we will present a model of cometary dust: fractal aggregates of submicrometer-size grains with a core-mantle structure consisting of magnesium-rich silicates and iron-bearing sulfides in the core and of amorphous carbon and organic refractory materials in the mantle. In this model, not only all the common optical properties of cometary dust are simultaneously reproduced by numerical simulations but also the composition of the aggregates is consistent with the element abundances of cometary dust derived from in-situ measurements. Finally we will discuss the applicability of the model to interpret observational data in the near- and midinfrared wavelengths. We expect that the model provides link to interstellar and interplanetary dust, and thus insight into the evolution of cosmic dust.

Keywords: Cometary dust; light scattering; numerical simulation.