Evidence for Comet Dust Evolution based on Microwave Analogue Experiments and Polarimetric Observations

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Cometary dust particles, most likely, can be represented as aggregates of grains with dimensions close to the wavelength of visible light or smaller. At the same time, the dimensions of each aggregate may span a broad range of size and sometimes be large compared to the wavelength. These circumstances make a theoretical study of light scattering by cometary dust and many other cosmic grains exceedingly difficult and, at least in part, beyond the capability of common numerical techniques. As a consequence, the interpretation of observational data is similarly difficult.

A basis for such an interpretation can be the laboratory simulation of light scattering by dust particles. Microwave analog experiments, which allow us to study particles of almost any combination of composition, size and shape, may be the most suitable. We have taken advantage of this ability and the broadband nature of the University of Florida microwave facility to obtain the intensity, polarization, color and polarimetric color for a range of particle types [1].

We selected aggregates made of acrylic and nylon for comparison to polarimetric CCD images for comets Hyakutake and Hale-Bopp [2,3]. These materials are, with their refractive indices near 1.605-0.003i and 1.74-0.005i, microwave analogues to silicates and organic materials expected in comet dust. Thus, the aggregates are among the most complicated for theoretical study, namely aggregates larger than the wavelength (circumference to wavelength ratio $X = 30$ to 100) with the constituent particles comparable to the wavelength $X \sim 1$. For each aggregate, we obtained the dependencies of intensity and polarization on the wavelength and on the scattering angle in the [0,165] degree range.

Based on these microwave data and on the polarimetric imaging by Jockers *et al.*, we present evidence for a change in scattering regime as particles transit the inner coma.

References:

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