How to estimate sizes, morphologies and composition of cosmic dust particles from light scattering observations

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Some key parameters to the properties of cometary comae (e.g. size distribution, morphology, silicates to organics ratio) can be estimated from versatile models computing the light scattering properties of a given size distributions of compact grains and fractal aggregates; the parameters are constrained through polarization observations performed over a significant range of colours and phase angles [1]. For comet Hale-Bopp, observations in two colours from about 5° to 50° provide results in good agreement with those derived from other observations (see e.g. [2]).

Main trends in the linear polarization of small bodies in the solar system, with emphasis on recent polarimetric observations of comets and asteroids (e.g. C/2004 Q2 Machholz, 9P/Tempel 1) will first be summarized. Results about the properties to be derived for media that are less constrained by observations, such as the interplanetary dust cloud, will also be presented. Finally, we will mention the results obtained through laboratory measurements [3], as well as comparisons (already undertaken) between numerical simulations and laboratory measurements under microgravity conditions.

This approach, which could also take into account local changes in the scattering properties (as revealed from imaging polarimetry), should provide more constraints to the problem of the determination of the morphology, size distribution, and silicates to organics ratio of dust in cometary comae and asteroidal regoliths from their light scattering properties. It will be of interest to optimize the strategy of future space missions to comets (e.g. Rosetta) and possibly asteroids.

[1] J. Lasue and A.C. Levasseur-Regourd, Porous irregular aggregates of sub-micron sized grains to reproduce cometary dust light scattering observations, J. Quant. Spectros. Radiat. Transfer, On line, December 2005. [2] L. Kolokolova et al., Physical properties of cometary dust, obtained using their light scattering and emission, Comets II, M. Festou, et al., Univ. Arizona Press, 577-604, 2004. [3] E. Hadamcik et al., Light scattering by fluffy particles with the PROGRA2 experiment: Mixtures of materials, J. Quant. Spectros. Radiat. Transfer, On line, December 2005.