Geophysical Research Abstracts
Vol. 14, EGU2012-10778, 2012
EGU General Assembly 2012

Observations and experimental simulations of cometary and interplanetary dust by imaging polarimetry

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To interpret the physical properties of cometary and Interplanetary Dust Cloud (IDC) particles, we use remote light scattering observations. The scattered light is partially linearly polarized with a polarization degree depending on the physical properties of the dust, on the geometry (phase angle) and wavelength of observations. To interpret the results, numerical and experimental models are necessary.
Laboratory scattering measurements with the PROGRA2 experiment (in A300- CNES and ESA dedicated microgravity flights or on ground for low-density particles) offer an alternative to simulate the scattering properties of real particles particularly for structures too large or too complex for numerical simulations [1]. Experimental samples can present large size distributions (nanometers to hundreds of micrometers) and a large variety of structures and materials, similar to those suspected to compose cometary comae particles and interplanetary dust particles.
To optimize the choice of samples and size distributions, we consider the in-situ captured particles results [2,3] and previous experimental works with systematic studies of numerous samples underlying the characteristics of the polarimetric phase curves such as maximum and minimum polarization as a function of the properties of the particles (grains and particles size distribution, structure, refractive index) [4]. Numerical models can guide our choice of ratios of the different components and particles structures. For example, to fit the polarimetric observations of cometary comae, fluffy particles are numerically simulated by fractal aggregates and compact particles by ellipsoids [5]. Observations are fitted with two parameters: the particles size distribution and the ratio of low-absorbing silicates over high-absorbing organics. From the light scattering properties of the particles, their equilibrium temperature can be calculated for different structures and composition [6,7]. The variations in composition and in physical properties of IDC particles are correlated with their thermal degradation. Numerical simulations are used to interpret the changes of the solar light scattered by the particles observed with remote sensing. Real mixtures of particles, which may correspond to the composition of the IDC at different solar distances in the ecliptic plane and to the light they scatter are experimentally studied and their linear polarization compared with the polarimetric observations.
In this presentation we will present some cometary observations [8,9] and experimental simulations suggesting how particles physical properties change in the different coma regions and at different solar distances.

We acknowledge CNES and ESA support for the microgravity flights and experimental work

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