DUST ON OR IN SMALL BODIES, AS STUDIED BY POLARIMETRY TO PREPARE FUTURE SPACE MISSIONS TO NEOs. A.C. Levasseur-Regourd[1], S. Bagnulo[2], I. Belskaya[3], J. Berthier[4], H. Boehnhardt[5], A. Cellino[6], S. Fornasier[7], E. Hadamcik[8], J. Lasue[9], J.-B. Renard[10] and G.-P. Tozzi[11]. [1]UPMC-LATMOS, BC 102, 4 place Jussieu, 75005 Paris, France <aclr@aerov.jussieu.fr>; [2]Armagh Observatory, Armagh BT61 9DG, UK; [3]Institute of Astronomy, Kharkiv, Ukraine; [4]Observatoire Paris-IMCCE, 77 avenue Denfert-Rochereau, 75014 Paris, France; [5]MPI for Solar System Research, Max-Planck Str. 2, 37191 Katlenburg-Lindau, Germany; [6]INAF-Osservatorio Astronomico di Torino, 10025 Pino Torinese, Italy; [7]Observatoire Paris-LESIA, 5 pl. Jules Janssen, 92190 Meudon, France; [8]UPMC-LATMOS, 11 Bld d'Alembert, 78280 Guyancourt, France; [9]Observatoire Midi-Pyrenees-IRAP, 9 av. Colonel Roche, 31000 Toulouse, France; [10]LPC2E, 3 av. Recherche scientifique, 45071 Orléans Cedex, France; [11]INAF- Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, 50125 Firenze, Italy.

Introduction: Regolithic surfaces on small bodies (asteroids, cometary nuclei, KBOs) and cometary comae are both low-density dusty media. In-situ missions have revealed a huge variety in their properties, corresponding to a huge variety in structure, composition and evolution of small bodies. Such unique observations may be complemented by remote observations of the polarization of the sunlight scattered by such media, which tentatively provides clues to some of their properties. The linear polarization actually varies with the phase angle and wavelength of the observations and with the properties of the scattering medium, allowing different classes of objects to be defined with respect to their dust properties, e.g. [1], [2]. Polarimetry actually allows us to estimate bulk dust properties of asteroids and comets and to prepare future missions to small bodies of special interest.

Approaching Dust Properties from Polarimetric Observations: Polarimetric phase curves present a shallow negative branch for small phase angles and, after an inversion region (in a 18°-30° range for asteroidal regoliths and about 20° for cometary comae), a wide positive branch. The polarization at a given phase angle depends fairly linearly upon the wavelength. Various examples are found in [3-8].

Relations linking the phase angle at inversion or the minimum in polarization to the geometric albedo have been derived from laboratory measurements or from thermal radiometry, at least for surfaces of moderately bright asteroids [9]. The value of the albedo provides indications about the surface composition, its size distribution and its porosity.

Interpretation of polarization properties in terms of physical properties (geometric albedo, size distribution, porosity) stems from simulations with particles, the properties of which somehow agree with our present understanding of the corresponding scattering medium. Significant results have been obtained with series of particles chosen for experimental simulations in the laboratory and/or under reduced gravity conditions (during airplanes and rocket parabolic flights, and hopefully later on-board the ISS), as well as with series of virtual (compact and fluffy) irregular particles built for numerical simulations (see e.g. [10-11]).

Future Space Missions to NEOs: Some of the darkest asteroids (C-, D- and P-types) are considered amongst the most primitive bodies in the solar system; some of them could even be extinct cometary nuclei. Near-Earth objects (NEOs) being numerous (about 8500 of them already discovered) and corresponding to highly accessible targets, sample return missions to primitive asteroids have been considered by all the major space agencies, such as NASA with OSIRIS-REx, JAXA with Hayabusa II, ESA with MarcoPolo-R (see e.g. [12]). However, information about the taxonomic classification of many NEOs is still missing.

Remote polarimetric observations of NEOs can be obtained on a large range of phase angles, within not too long a time frame. They may provide an accurate classification, thus pointing out primitive objects of scientific interest. Systematic polarimetric observations with large telescopes, for which statistical estimations of the requirements will be presented, should allow us to efficiently search for multiple or back-up appropriate targets, for future space missions to primitive near-Earth asteroids.

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