The synergy of polarimetry and photometry in the Gaia era

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Light scattering phenomena are responsible of some of the most important properties of the sunlight scattered by the surfaces of small solar system bodies. In particular, the observed variations of brightness and fraction of linear polarization as a function of phase angle are mostly the result of light-scattering processes, and are important to derive information about the properties of the scattering surfaces. The dependence of polarimetric properties upon the geometric albedo has been known and studied for decades, with some updated results having been published in very recent years[1]. It is known that also some properties of the phase – magnitude curves can be diagnostic of the albedo. It is urgent to reach robust and quantitative conclusions about this, because there are very important possible applications to the analysis of solar system body data produced by the Gaia space mission.

PREPARING A REVOLUTION

We are living the years which precede the expected Gaia revolution in asteroid science[2]. Gaia is building a huge data-base of astrometric, photometric and spectrophotometric observations of all astrophysical sources down to an apparent magnitude around 20.7[3]. Gaia observes minor solar system bodies a number of times of the order of 70 during 5 years of operations. The obtained data will drastically improve our knowledge of the dynamical and physical properties of these objects. However, Gaia does not carry aboard detectors suited to the determination of some important surface properties, including primarily the geometric albedo. For this reason, Gaia data reduction and interpretation will take profit of state-of-the-art knowledge coming from analysis of ground-based data, used as a complement to Gaia photometry and spectrophotometry[4,5]. As far as polarimetry is concerned, the major application will be the use of accurate geometric albedo values[1] to provide ancillary information needed to optimize a Gaia-based taxonomy, and to validate a relation between albedo and the morphology of the magnitude – phase relation. If such a relation is confirmed and properly calibrated, we will use Gaia photometric data to determine the albedo of tens of thousands of asteroids[4].

RECENT RESULTS IN ASTEROID POLARIMETRY

Apart from possible applications to the analysis of Gaia data, asteroid polarimetry is *per se* obtaining results of great interest, which deserve efforts of interpretation based on experimental and theoretical investigations. A brief list of topics includes (1) the existence of the so-called "Barbarian" asteroids, characterized by an anomalous morphology of the phase – polarization curve[4]. (2) The interpretation of a growing data-set of spectro-polarimetric data obtained using large telescopes[6]. (3) The possible evidence of a cometary origin of asteroids belonging to the so-called F taxonomic class[4]. (4) An analysis of the "ground-truth" in asteroid polarimetry obtained through an extensive study of the asteroid (4) Vesta[7]

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