Photometry and spectroscopy of Solar System objects with Euclid

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The compositional structures of the asteroid main belt and the Kuiper belt result from the dynamical mixing they suffered in the early stages of planetary formation, in particular during planetary migrations. Revealing these structures, in link with the orbital distribution of these belts, is key in decoding the history of the Solar System [1].

Decades of targeted photometric and spectroscopic surveys of minor bodies have been the foundation of spectral classification and mineralogical analysis, leading to the first inventories of minerals in the main belt and ices in the Kuiper belt, links with meteorites, and description of their compositional structures [2,3]. However, with only a few thousands objects observed in the visible, and a few hundreds in the near-infrared, these targeted surveys have only glimpsed the tip of the iceberg [4].

A revolution was brought by large multi-filter imaging surveys, such as the Sloan Digital Sky Survey (SDSS), providing visible colors for hundreds of thousands of minor bodies [5]. Large imaging surveys are indeed goldmines to crudely characterize the surface properties of huge samples, inheriting the interpretation from the targeted surveys with higher spectral resolving power. For instance, the SDSS opened a new era in the study of asteroid families [6], space weathering [7], distribution of material in the inner solar system [8], and origin of the near-Earth asteroids [9].

In a few years, the current ESA Gaia mission will deliver low resolution visible spectra for 300,000 asteroids with an apparent magnitude $V<20$, increasing by two orders of magnitude the sample of minor bodies with visible spectra [10]. Starting its operations in 2021, the Large Synoptic Sky Survey (LSST) will provide colors in the visible for millions of minor bodies [11] in less than a decade. These will however remain limited to visible wavelengths.

The ESA Euclid mission, scheduled for a launch in 2021 and operating during six years from the Sun-Earth Lagrange L2 point, will carry out an imaging and spectroscopic survey of the extra-galactic sky of 15,000 deg^2 [12]. Euclid imaging detection limits are required at $m_{AB} = 24.5$ in the visible and $m_{AB} = 24$ in the near-infrared (Y, J, H filters). The access to the near-infrared sky, about 7 magnitudes fainter than 2MASS and 2–3 magnitudes fainter than current ESO VISTA VHS makes Euclid appealing for the surface characterization of minor bodies.

After presenting the main characteristics of the ESA Euclid mission, I will describe how the multi-filter images and spectra collected by Euclid in the visible and near-infrared will complement the ESA Gaia and LSST data sets to study the surface properties of minor bodies.

BIBLIOGRAPHY

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