Dynamics of single and multiple asteroids based on Gaia observations

D. Hestroffer[1]

[1]IMCCE/Paris Observatory, CNRS, UPMC, univ. Lille1

The Gaia mission from the European Space Agency (ESA) has been launched in December 2013, and is currently under commissioning phase. Gaia is expected to provide huge improvements in the science of Solar System Objects (SSO) [1]. Indeed, depending on the actual limiting magnitude that will be achieved by the telescope (mag. $V < 20$ nominally) about 300,000 asteroids will be observed (mostly known). These include near-Earth objects (NEOs), main-belt bodies, Trojans, as well as bright Centaurs and transneptunian objects (TNOs), and, moreover, several comets and a few planetary satellites.

The Gaia telescope will regularly scan the sky during its 5 years operation, down to the solar elongation of 45°, providing one of the largest systematic surveys of such bodies. The observation and data reduction for Solar System Objects is specifically included in the data-reduction pipeline, and the final Gaia catalogue will contain very important data for planetary science. After resuming the general aspects of Gaia observations of SSOs, and some of their limitations, we will focus on the astrometric information, dynamics, orbit determination, and improvements that can be performed on asteroids. The direct outcome from Gaia astrometric measurements (orbit improvement, binary-asteroid and multiple-system orbits, mass and bulk density determination for a significant number of large asteroids, local test of general relativity, detection of non-gravitational effects, etc.) will be presented, as well as their link to imaging and photometric measurements (size, shape, spin rate and spin direction, albedo, taxonomy, etc.). A ground-based network Gaia-FUN-SSO dedicated to the follow-up of critical objects such as newly discovered NEOs has been set up. Detection of new objects, computation of orbits, and ground- based follow-up will also be addressed.

At the end of its mission, Gaia will provide a much broader view of the dynamical and physical characteristics of the Small Bodies of the Solar System. Gaia will also, indirectly, enhance our knowledge of the Solar System based on the use of the stellar catalogue itself. It will generally improve the astrometry of these bodies (from new CCD measurements or old photographic plate rereduction) or prediction and observation of stellar occultations, opening again the way to new developments in the studies of Solar System bodies. Beyond the mission itself, the scientific exploitation of the collected data and the use of complementary observations (larger time span, higher spatial resolution, time frequency, etc.) will also bring major contributions to the study of Small Bodies of the Solar System.

Acknowledgements: The DPAC/CU4 members, Action Spécifique Gaia, and CNES.

References: [1] Mignard F. et al. (2007) EM&P, 101, 97–125.