Gaia Observations of Solar System Bodies. P. Tanga¹, D. Hestroffer², J. Berthier², A. Cellino³, M. Delbô¹, A. Dell’Oro⁴, F. Mignard¹, K. Muinonen⁵, T. Pauwels⁶, J.-M. Petit⁷, W. Thuillot² and DPAC-CU4-SSO team.

¹Laboratoire Lagrange, UMR7293, Université de Nice Sophia-Antipolis, CNRS, Observatoire de la Côte d'Azur, F-06304 NICE, France, tanga@oca.eu, ²IMCCE/Observatoire de Paris, UPMC, CNRS, 77 av. Denfert-Rochereau F-75014 PARIS hestro@imcce.fr, ³INAF/OATo, str. Osservatorio 20, I-10025 Pino Torinese (TO), ⁴INAF/OAA, Largo Enrico Fermi 5, I-50125 Firenze (FI), ⁵Department of Physics, University of Helsinki, Gustaf Hällströminkatu 2a, P.O. Box 64, FI-00014 U. Helsinki, and Finnish Geodetic Institute, Geodeetinrinne 2, P.O. Box 15, FI-02431 Masala, Finland, ⁶Observatoire Royal de Belgique, Ringlaan 3, B-1180 BRUSSEL, ⁷Observatoire de Besançon, OSU THETA, UFC, 41bis av. De l’Observatoire, F-25010 BESANCON.

The Gaia mission will be launched in mid-2013 by the European Space Agency (ESA). Gaia is expected to produce major contributions in several branches of astrophysics, including a collection of distances and kinematics of stars in our Galaxy, the establishment of a new kinematically non-rotating reference frame and a dense astrometric catalogue of unprecedented quality. Solar System science is also well covered by the mission and has been included since the early stages of its concept and development [1]. Observation and data reduction of Solar System Objects (SSO) is hence specifically included in the data-reduction pipeline which is now under development, and the final Gaia catalogue will contain very important data for planetary science. One Coordination Unit of the Gaia DPAC consortium for data analysis and processing is in charge of the task of SSO observations including astrometry, photometry, identification and cross matching, orbit computation and light curve inversion.

The Gaia observing strategy is based on a scanning telescope observing simultaneously two regions of the sky. It will survey the whole celestial sphere down to magnitude V ≤ 20 and down to solar elongation as low as 45°. Several 100,000’s small bodies (comets, natural satellites, and mostly asteroids in addition to the brightest Centaurs and TNOs) will be observed repeatedly during 5 years, the nominal operational lifetime of the mission. A single whole-sky instrument will perform astrometry and low-resolution spectrometry to very high accuracy (at sub-mas level for astrometry and milli-mag for colour-photometry).

We will present the main characteristics of the Gaia mission focusing on the expected results of Gaia observations of SSOs including discussion of some critical aspects related to the expected radiation damage modelling, as well as the expected role played by ground telescopes as a support to the mission. Data reduction and workflow will be presented with the estimated accuracy for the basic on-board detectors. The direct outcome from Gaia astrometric measurements (orbit improvement, 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 those from imaging and photometric measurements (size, shape, spin rate and spin direction, albedo, taxonomy, etc.). 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 re-reduction) 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.

References: