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Scientific perspectives from Gaia data of Solar System objects

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Context

Gaia will collect asteroid observations over 5 years, with a limiting magnitude V~20 (>300,000 objects). Observations will include very precise astrometry and photometry, and low resolution spectra. Over the last few years, the Coordination Unit 4 of Gaia's Data Processing and Analysis Consortium has built the data reduction pipeline that will produce the expected products for Solar System science. We will outline the performances and limitations of these processing chains.

The implementation of the pipelines is mainly devoted to a general treatment for deriving the bulk properties of the largest possible sample of minor planets. The DPAC processing is based uniquely on Gaia data, in order to produce a homogeneous outcome independent from other surveys.

Data processing and releases

CU4 has implemented two different pipelines, respectively working on short (daily) or long time scales. The former pipeline is essentially designed to feed an alert stream, for diffusion to ground-based observers. The second will process data with the best calibrations, for deriving intermediate and final results.

As the raw data properties and the observation strategy are strictly peculiar to Gaia, specific algorithms have been developed.

The Gaia mission (ESA or DPAC) does not apply any embargo on the results, which will become available to the whole scientific community at the same time. Data releases will occur both for the alerts and for intermediate releases. A tentative scenario for data release of Solar System objects will be discussed.

Limitations and opportunities

A general understanding of the properties of Gaia data and the philosophy of the processing chains will be useful to planetary scientists willing to use Gaia data in the future. Also, it allows understanding the limitations of such processing and the areas where complementary observations are needed, both for enhancing the scientific exploitation of Gaia Solar System data, and for completing the inventory of dynamical and physical properties.

We will thus mention several fields to which ground-based observers can bring a valuable contribution both during and after the Gaia mission, including:

- Follow-up of newly discovered asteroids, both for orbit determination and physical characterization.
- Complementary photometry of objects whose Gaia observations alone don't permit the determination of shape and spin axis, or suspect binaries, etc.
- Physical characterization (light curves, NIR and thermal IR spectrophotometry…) of asteroids for which Gaia determines a mass.
- Occultation observations by using orbits and stellar positions measured by Gaia.

Of course, the best exploitation of the results obtained by Gaia will be obtained jointly to other data sources, such as other spectroscopic surveys or observations in other wavelength ranges.

For example, thermal IR fluxes measured by WISE concern 100,000 asteroids, the same order of the Gaia sample, and provide estimates of the object sizes that are not available by Gaia alone.

The joint exploitation of different data sources is currently at the core of the development of a new VO service, accessible by a web interface at http://mp3c.oca.eu/. This is the "Minor Planet Physical Properties Catalogue" (MP3C) implemented at Observatoire de la Côte d'Azur. In future, this service could be a candidate to allow simple and immediate access to asteroid properties issued from Gaia and other surveys, in a single integrated environment.