EPSC Abstracts
Vol. 13, EPSC-DPS2019-1409-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Gaia-FUN-SSO: Tracking Gaia asteroid discoveries

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1. Introduction

The ESA Gaia mission continuously scans the entire sky from the Sun-Earth Lagrangian point L2. Any source brighter than V≈20.7 is recorded by the on-board processing units. Most are then later downloaded to the Earth. Among all the sources, Gaia is observing around 300,000 small bodies of our solar system, mainly asteroids from the Main Belt (Mignard et al., 2007).

A dedicated processing has been set in place within the Gaia Data Processing and Analysis Consortium (DPAC) to identify these moving objects, measure their astrometry, photometry, and low resolution spectroscopy (see Cellino et al., 2007; Delbo et al., 2012; Gaia Collaboration et al., 2018).

2. Daily processing

The vast majority of moving sources detected by Gaia are known small bodies. There are however every day moving sources that cannot be linked with any known comet, asteroid, or transneptunian. For these, a daily specific processing is conducted, described in details by Tanga et al. (2016) and Fedorets et al. (2018). The aim of this processing is to quickly provide estimates of region in the sky in which the object can be found, to alert a network of observers, the Gaia Follow-up Network for Solar System Objects (Gaia-FUN-SSO Thuillot et al., 2015).

Ground-based observations are indeed required to confirm the discovery and secure the orbit for follow-up. A dedicated Web site, https://gaiafunsso.imcce.fr/, provides all the information on each potential discovery, including the expected position, apparent magnitude, and velocity (Fig. 1).

Figure 1: Exemple of output of the daily pipeline, showing how the region to search is moving with time.

3. Over 120 confirmed candidates

In full operation since November 2017, the daily pipeline has published over 4500 potential discoveries on https://gaiafunsso.imcce.fr/.

Depending on the availability of the observatories in the network, on the expected coordinates and apparent magnitude of these potential discoveries, only a couple of hundreds were tracked from the ground. Of these, more than 120 were observed, and more than 50 have been successfully linked with the objects observed by Gaia. Starting from November 2018, the astrometry by both Gaia and the ground-based observers is submitted to the Minor Planet Center (MPC).

In most cases, previous observations had already been submitted to the MPC by other surveys, albeit without allowing an orbit to be determined.

Three objects, however, were first spotted by Gaia in December 2018, and later confirmed by follow-up observations performed by the Gaia-FUN-SSO team[1]

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at the Haute-Provence Observatory in France. These three objects, 2018 YK4, 2018 YL4, and 2018 YM4, are asteroids discovered by Gaia (Fig. 2).

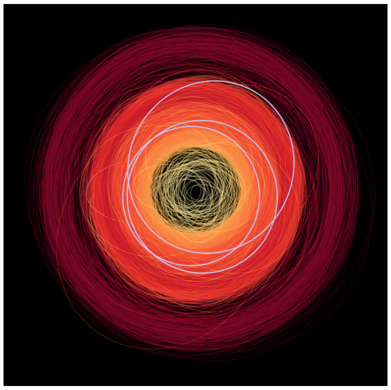

Figure 2: Orbits of Gaia's first asteroid discoveries (blue) and asteroids in the Gaia Data Release 2 (brown-orange, Gaia Collaboration et al., 2018).

4. Discovering bright asteroids?

It may appear surprising that Gaia is observing/discovering as-yet unknown (or poorly characterized) asteroids that are brighter than V≈20.7, given the discovery rate of the last decade in this magnitude range. It has, however, recently been shown that the current census of asteroids was biased toward low-inclination orbits (Mahlke et al., 2018). There are thus more objects remaining to be discovered in a given magnitude range at higher inclination than close to the ecliptic.

The objects processed by the Gaia daily pipeline and released as potential discovery have indeed statistically a high inclination (Fig. 3). We can therefore expect more discoveries by Gaia in its extended mission.

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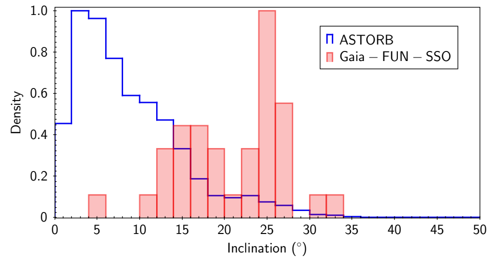

Figure 3: Distribution of the confirmed candidates (red) compared to the 800,000 known asteroids (blue).

Acknowledgements

This work has made use of data from the European Space Agency (ESA) mission Gaia (https://www.cosmos.esa.int/gaia), processed by the Gaia Data Processing and Analysis Consortium (DPAC, https://www.cosmos.esa.int/web/gaia/dpac/consortium). Funding for the DPAC has been provided by national institutions, in particular the institutions participating in the Gaia Multilateral Agreement.

References

Cellino, A., Tanga, P., Dell'Oro, A., & Hestroffer, D. 2007, Advances in Space Research, 40, 202

Delbo, M., Gayon-Markt, J., Busso, G., et al. 2012, Planet. Space Sci., 73, 86

Fedorets, G., Muinonen, K., Pauwels, T., et al. 2018, A&A, 620, A101

Gaia Collaboration, Spoto, F., Tanga, P., et al. 2018, A&A, 616, A13

Mahlke, M., Bouy, H., Altieri, B., et al. 2018, A&A, 610, A21

Mignard, F., Cellino, A., Muinonen, K., et al. 2007, Earth Moon and Planets, 101, 97

Tanga, P., Mignard, F., Dell'Oro, A., et al. 2016, Planet. Space Sci., 123, 87

Thuillot, W., Bancelin, D., Ivantsov, A., et al. 2015, A&A, 583, A59