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Yarkovsky drift detectability using the Gaia DR2 asteroid astrometry

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The orbital motion of small bodies is affected by the Yarkovsky effect (semiminor axes change in time (da/dt)). The first direct detection was only made in 2003 thanks to radar observations. Nowadays there are over a hundred detections for NEAs and only a few for Main-Belt objects, however, the Yarkovsky effect remains difficult to detect for a large group of asteroids.

The ESA Gaia mission was claimed to provide extremely precise astrometry of asteroids. Gaia observations were expected to lead to new Yarkovsky detections. In this work, we present the results for the most promising Yarkovsky candidates indexed before the start of the mission.

We converted all available data (ground-based optical astrometry, satellite astrometry measurements, radar observations and GAIA DR2 data) to ADES format and then used it for orbit determination. We included the standard error of right ascension (RA), declination (Dec) and correlation of Ra and Dec errors for Gaia astrometry. We found a reliable detection of the Yarkovsky effect with a signal-to-noise ratio (SNR) greater than 3 for 21 asteroids, including 7 confirmations and 14 new detections. In 10 cases the resulting da/dt parameter SNR increased with the usage of the DR2 catalogue data, but no reliable detection can yet be claimed. Furthermore, we present a comparison of our empirical results with expected values estimated using physical and orbital parameters of studied objects. GAIA DR2 asteroids astrometry impacts positively the Yarkovsky drift determination. GAIA DR3 will elongate the observational arc, therefore, contribute to A2 parameter determination.