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Gaia DR2 and shape models

In addition to stellar data, Gaia Data Release 2 (DR2) also contains accurate astrometry and photometry of about 14000 asteroids covering 22 months of observations. From these data, the Gaia team is able to derive shape models from numerous asteroids. The great thing about this is that the amateur astronomers will be able to combine their occultation results with all these shape models to get accurate measurements of the diameter – provided they have at least two well-timed and spaced chords to fit to the shape model.

Abstract:

In addition to stellar data, Gaia Data Release 2 (DR2) also contains accurate astrometry and photometry of about 14000 asteroids covering 22 months of observations.

We used Gaia asteroid photometry to reconstruct rotation periods, spin axis directions, and the coarse shapes of a subset of asteroids with enough observations. One of our aims was to test the reliability of the models with respect to the number of data points and to check the consistency of these models with independent data. Another aim was to produce new asteroid models to enlarge the sample of asteroids with known spin and shape.

We used the lightcurve inversion method to scan the period and pole parameter space to create final shape models that best reproduce the observed data. To search for the sidereal rotation period, we also used a simpler model of a geometrically scattering triaxial ellipsoid.

By processing about 5400 asteroids with at least ten observations in DR2, we derived models for 173 asteroids, 129 of which are new. Models of the remaining asteroids were already known from the inversion of independent data, and we used them for verification and error estimation. We also compared the formally best rotation periods based on Gaia data with those derived from dense lightcurves.

We show that a correct rotation period can be determined even when the number of observations N is less than 20, but the rate of false solutions is high. For N>30, the solution of the inverse problem is often successful and the parameters are likely to be correct in most cases. These results are very promising because the final Gaia catalogue should contain photometry for hundreds of thousands of asteroids, typically with several tens of data points per object, which should be sufficient for reliable spin reconstruction.