Estimate of the Yarkovsky effect influence on the motion of the simulation particles of the Quadrantid meteor stream

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It is well known that nongravitational forces should be considered for the overall understanding evolution of small bodies of Solar system (Vokrouhlicky et al., 2000; Bottke et al., 2006). One of the most important nongravitational perturbations is the Yarkovsky effect, which is due to radiative recoil of anisotropic thermal emission and causes asteroids to undergo a secular semi major axis drift $\langle da/dt \rangle$. Over the past decade the understanding has increased that the Yarkovsky effect plays an important role in the evolution of asteroid orbits and the delivery of meteorites to the Earth (Bottke et al., 2006). Some authors have published definitions of the Yarkovsky effect for dozens of asteroids (Chesley S. R. et al., 2008; Nugent C. R. et al., 2012). The largest collection of Yarkovsky's definitions is presented in (Greenberg A. H. et al., 2017).

The probabilistic evolution of the orbits was numerically simulated with the IDA software package (Bykova et al., 2012). During the implementation of this study, the possibility of accounting for the Yarkovsky effect using the transverse acceleration coefficient A_2 was added. We used the following force model which takes into account the influence of the Sun, the planets, Pluto, the Moon, Ceres, Pallas, Vesta solar radiation pressure, the Yarkovsky effect, the Earth, the Sun, and Jupiter oblateness, relativistic effects of the Sun, the planets and the Moon.

The probabilistic orbital evolution was analyzed by numerical integration of the differential equations of motion for the 500 simulation particles of the Quadrantid meteor stream. We investigated the orbital evolution of each ejection particle from the moment of ejection to the present 5000 AD. Knowing the dependence of the diameter of the object and the transverse acceleration coefficient A_2, it is possible to conduct a model experiment. We tried to estimate the influence of the Yarkovsky effect on the simulation particles of meteor stream using different A_2 values. But the Yarkovsky effect depends on several physical quantities such as spin state, size, mass, shape, and thermal properties, which often unknown.

References:

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