THE YARKOVSKY EFFECT ESTIMATION FOR SOME ASTEROID PAIRS WITH CLOSE ORBITS.

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Introduction: The mutual asteroid collisions and disruptions may be an important source of meteoritic flux on the Earth. In this aspect, studying very young asteroid families and pairs, which are originated in such events has a great interest. It is known, that non-gravity thermal effects play an important role in small bodies dynamics. The fundament of the Yarkovsky effect theory was established in Vokrouhlicky papers [1] and [2]. The Yarkovsky effect has still not been measured in the main belt. Thus Spoto et al. [3] used a calibration based on asteroid (101955) Bennu to compute the ages of more than 50 families in the main belt. In the present paper, we have calculated the values of maximal Yarkovsky acceleration for some pairs of asteroids with very close orbits and (potentially) very small ages.

Methods: According to Vokrouhlicky [1], it is possible to obtain:

$$\frac{da}{dt} = -\frac{8}{9}\frac{(1-A)\,\Phi}{n} W(K,R)\cos\phi \approx \frac{8}{45}\frac{(1-A)\,\Phi}{n}\cos\phi.$$

Here n is the mean motion; Φ is the standard radiation force factor, which is inversely proportional to the bulk density ρ, the diameter of asteroid D, and the square of the orbital distance r. The bond albedo A expressed through geometric albedo p_v as $A = 1/3\, p_v$. Function $W(K,R)$ is determined by the thermal parameters of the body and a frequency. Simple account of the Yarkovsky effect in the semimajor axis may be obtained by normalization using (101955) Bennu parameters, because it is known with the smallest errors [3]:

$$\dot{a} = \frac{da}{dt} = \left(\frac{da}{dt}\right)_B \frac{\sqrt{a_B}(1-e_B^2)D_B}{\sqrt{a}(1-e^2)D}\frac{\rho_B\cos\phi}{\rho\cos\phi_B}\frac{1-A}{1-A_B}.$$

The symbols with a "*B*" refer to asteroid (101955) Bennu. The value of $\dot{a}_B = (19 \pm 0.1)\cdot 10^{-4}$ au/Myr [4]. After the substitution of (101955) Bennu physical parameters [5], we obtain for the Yarkovsky semimajor axis drift (in au/Myr):

$$\dot{a} = \frac{da}{dt} = 12.09\cdot 10^{-4}\frac{\cos\phi}{\sqrt{a}(1-e^2)D}\frac{1-A}{\rho}.$$

Here diameter of asteroids is estimated by absolute magnitude H (in the assumption of equal albedo). The coefficient $(1-A)$ usually is very close to the unit. By acception for density value $\rho = 1.1$ g/cm^3 and for obliquity $\cos\phi = \pm 1$ we obtain the maximal value of modulus of semimajor axis drift for any studied asteroid. This value is slightly overestimated due to the underestimated value of density.

Results and discussions: As a result, we can estimate the most probable value of $|\dot{a}|$. As an example, we give results of our calculations for some famous asteroid pairs with a common origin (table 1). However, for more exact estimation, we must take into account the spectral type of studied asteroids.

Table 1. The estimations of the semimajor drift $|\dot{a}|$ due to the Yarkovsky effect for the asteroid pairs with a common origin

# pair	Asteroid	H [mag]	$D/2$ [km]	a [au]	$\lvert\dot{a}\rvert\cdot 10^{-4}$ [au/Myr]
1	(87887) 2000 SS_{286}	15.2	1.129	2.755	1.48
	(415992) 2002 AT_{49}	16.5	0.621	2.755	2.70
2	(6070) Rheinland	13.8	2.152	2.388	0.86
	(54827) Kurpfalz	15.4	1.043	2.388	1.78
3	(356713) 2011 UK_{160}	16.5	0.620	2.289	3.06
	2014 QX_{220}	18.7	0.225	2.289	8.44
4	(1741) Giclas	11.4	6.50	2.883	0.50
	(258640) 2002 ER_{36}	15.8	0.86	2.883	3.80
5	(2110) Moore-Sitterly	13.4	2.59	2.199	1.48
	(44612) 1999 RP_{27}	15.5	0.98	2.199	3.91
6	(5026) Martes	13.9	2.05	2.378	1.84
	2005 WW_{113}	17.8	0.34	2.378	11.10

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