

The equation between 3-body mean motion resonances and Yarkovsky drift speeds on eccentricities in the range (0.2, 0.3)

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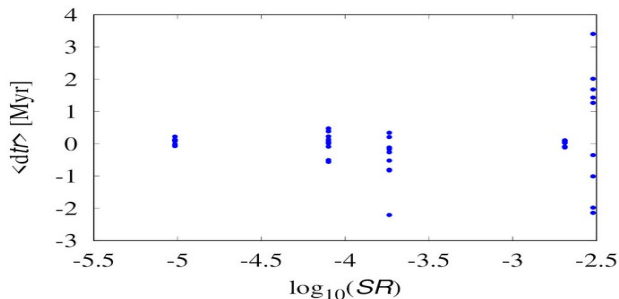
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Summary: We studied the motion of asteroids across the 3-body mean motion resonances with Jupiter and Saturn and with the Yarkovsky drift speed in the semimajor axis of the asteroids. The research was conducted using numerical integrations performed using the ORBIT9 integrator with 72,000 test asteroids. We calculated time delays, dtr , caused by the six 3-body resonances on the mobility of test asteroids with 10 positive and 10 negative Yarkovsky drift speeds, which are reliable for main belt asteroids. We devised equations that approximately describe the functional relation between the average time spent in the resonance, the strength of the resonance, and the semimajor axis drifts (positive and negative) with the orbital eccentricities of asteroids in the range (0.2, 0.3). Finally, this study shows that the functional relation we obtain for 3-body MMRs for orbital eccentricities of asteroids in the range (0.2, 0.3) is analogous to that previously obtained for orbital eccentricities of asteroids in the ranges (0, 0.1) and (0.1, 0.2) in Milić Žitnik (2021, 2024), respectively.

Results:

Table: The properties of the 6 selected 3-body resonances. In the first column there are names of 3-body MMRs. In the second column it is showed their nominal semimajor axis. The widths of the 6 selected 3-body resonances for $e = 0.3$ are in the third column, propagated by the numerical method with the ORBIT9. The last two columns contain their strengths SR , in cases of negative and positive da/dt , calculated with the numerical method given by Gallardo (2014).

MMR	a_{res} [au]	width($e = 0.3$) [au]	SR $da/dt < 0$	SR $da/dt > 0$
1:-3J:1S	2.75180	0.00620	0.00288159	0.00301936
2:-7J:3S	2.55896	0.00428	0.00230629	0.00204820
2:-7J:2S	2.44715	0.00304	0.00033580	/
3:-6J:-1S	3.13787	0.00246	0.00018175	0.00018345
3:-8J:1S	2.79909	0.00138	0.00010307	0.00007959
1:-5J:6S	2.75761	0.00184	0.00000954	0.00000965



$$\langle dtr \rangle = (0.5 + da) \log_{10}(SR) + (db - 1.0) \log_{10}\left(\frac{da}{dt}\right) + (dc + 5.0) \quad (1)$$

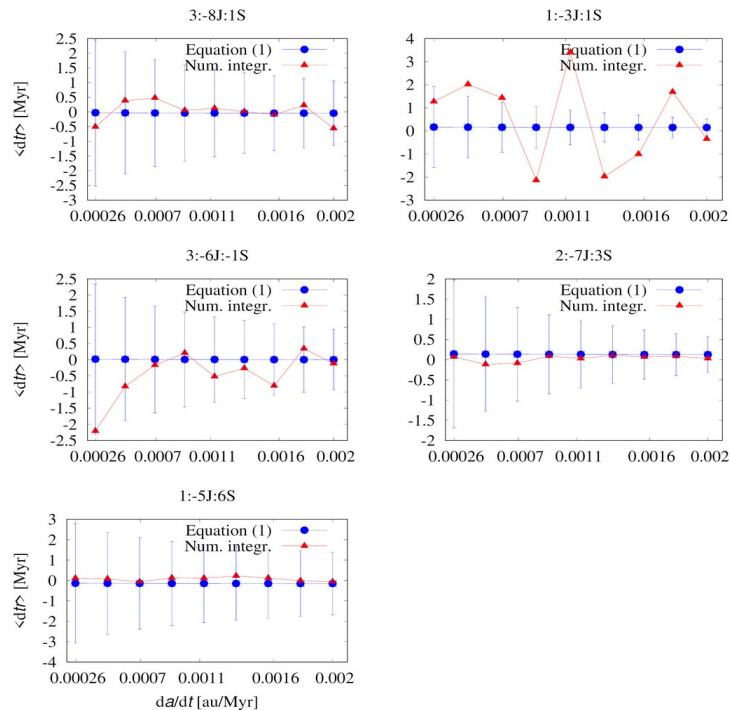
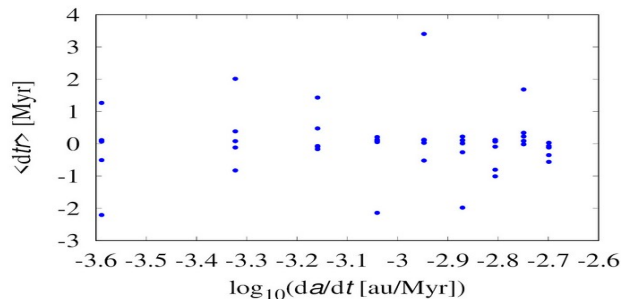
Coefficients for negative Yarkovsky drift speeds:
 $da = -0.685 \pm 0.134$, $db = 0.867 \pm 0.409$, $dc = -5.984 \pm 1.329$

Coefficients for positive Yarkovsky drift speeds:
 $da = -0.381 \pm 0.156$, $db = 0.980 \pm 0.522$, $dc = -4.605 \pm 1.679$

Average time was expressed in Myr and the Yarkovsky drift speed was expressed in au/Myr.

The range of Equation 1:

$$\sigma(\langle dtr \rangle) = \sigma(da) \log_{10}(SR) + \sigma(db) \log_{10}\left(\frac{da}{dt}\right) + \sigma(dc) \quad (2)$$



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