The Effect of Planetary Flybys on Singly Synchronous Binary Asteroids

Alex J Meyer, Daniel J Scheeres

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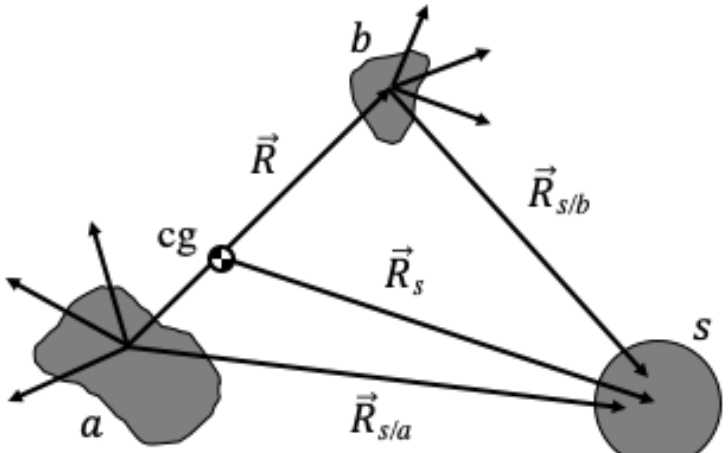
Equations of Motion



$$\ddot{\mathbf{R}} = -\frac{M_a + M_b}{M_a M_b}\frac{\partial U}{\partial \mathbf{R}} + \mu_s \left[\frac{\mathbf{R}_{s/b}}{R_{s/b}^3} - \frac{\mathbf{R}_{s/a}}{R_{s/a}^3}\right]$$

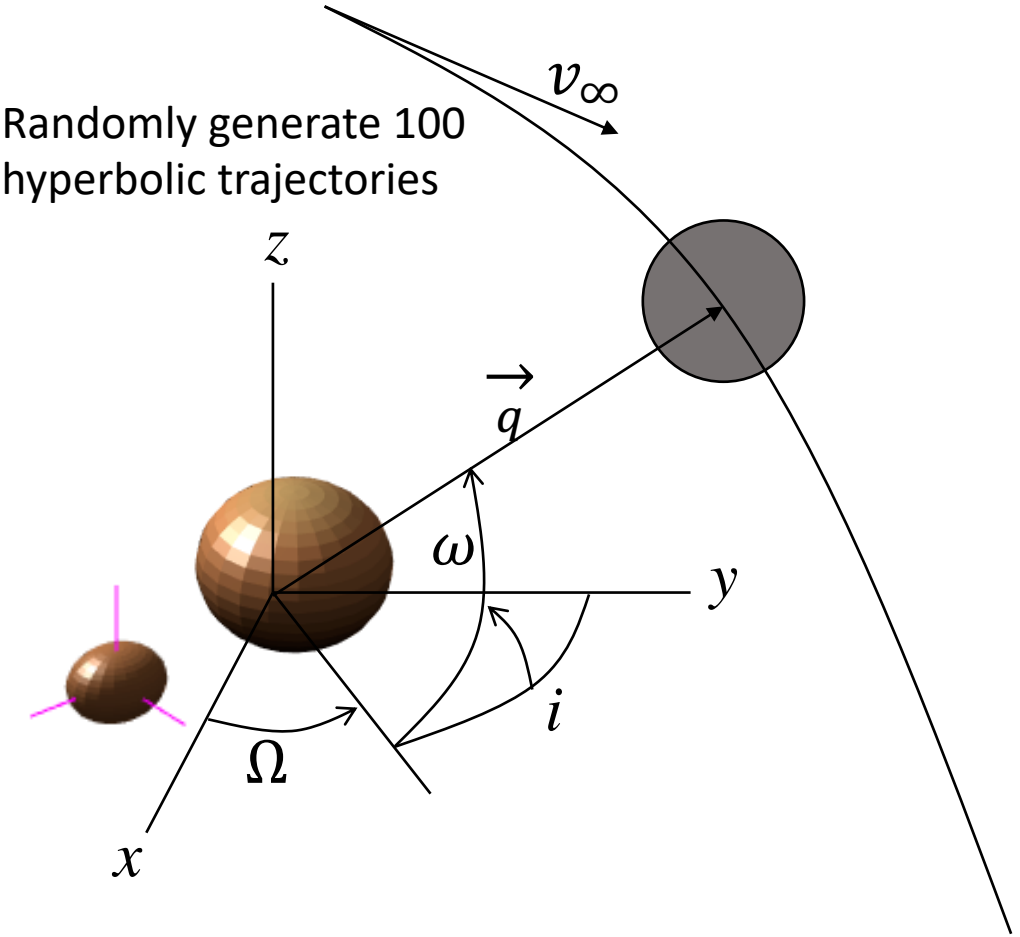
$$\dot{\mathbf{L}}_A = \mathbf{L}_A \times \Omega_A + \mathbf{M}_A + \mathbf{M}_{SA}$$

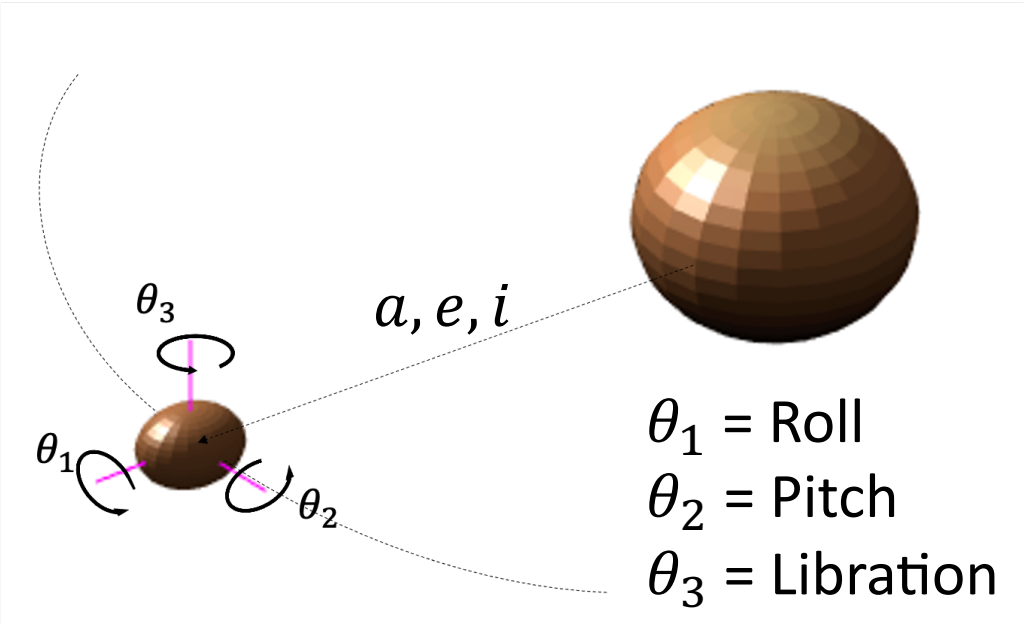
$$\dot{\mathbf{L}}_B = \mathbf{L}_B \times \Omega_A + \mathbf{M}_B + \mathbf{M}_{SB}$$

Hou, X., Scheeres, D. J., & Xin, X. 2017, Celestial Mechanics and Dynamical Astronomy, 127, 369

Planetary Flyby

1. Randomly generate 100 hyperbolic trajectories



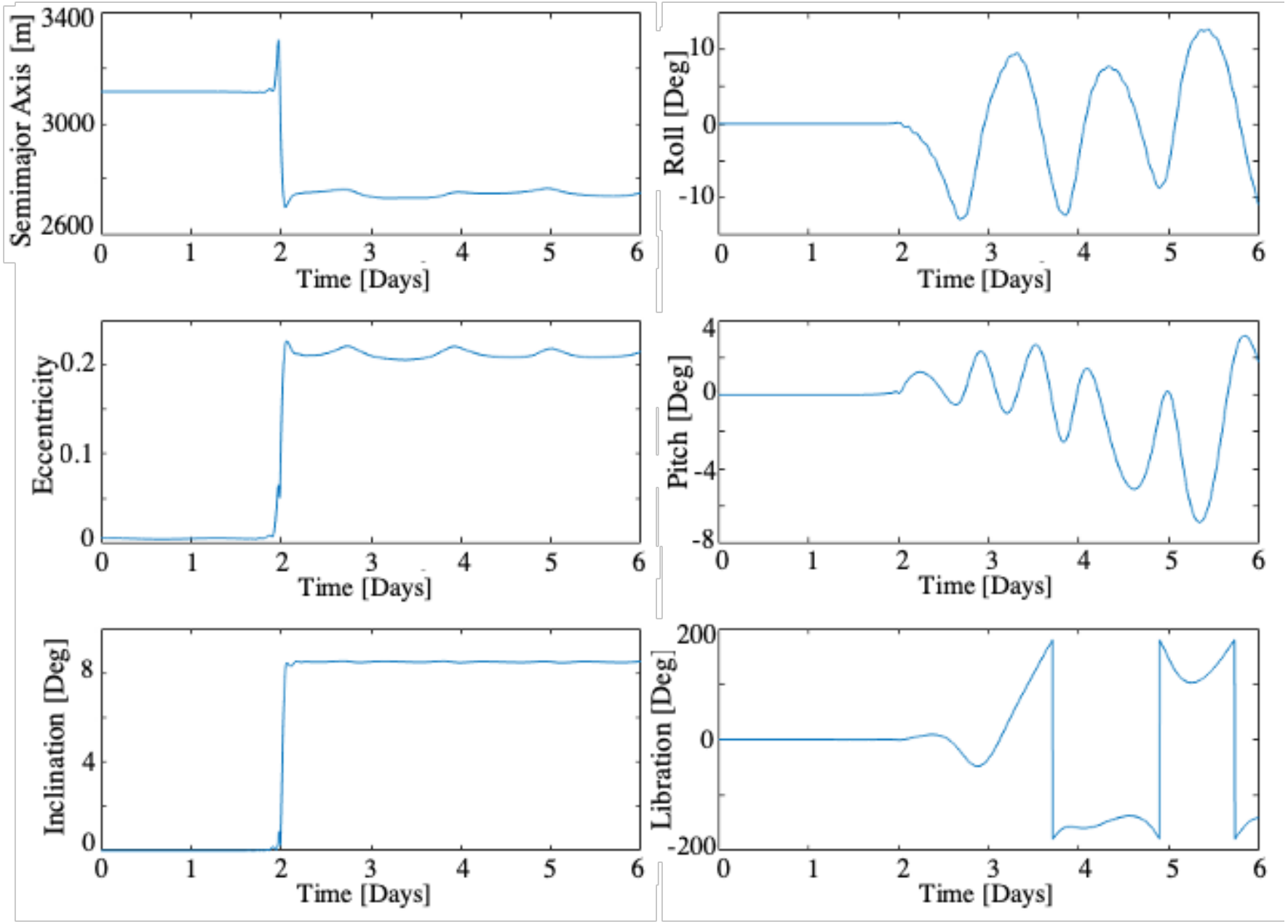


Results

50,000 km flyby

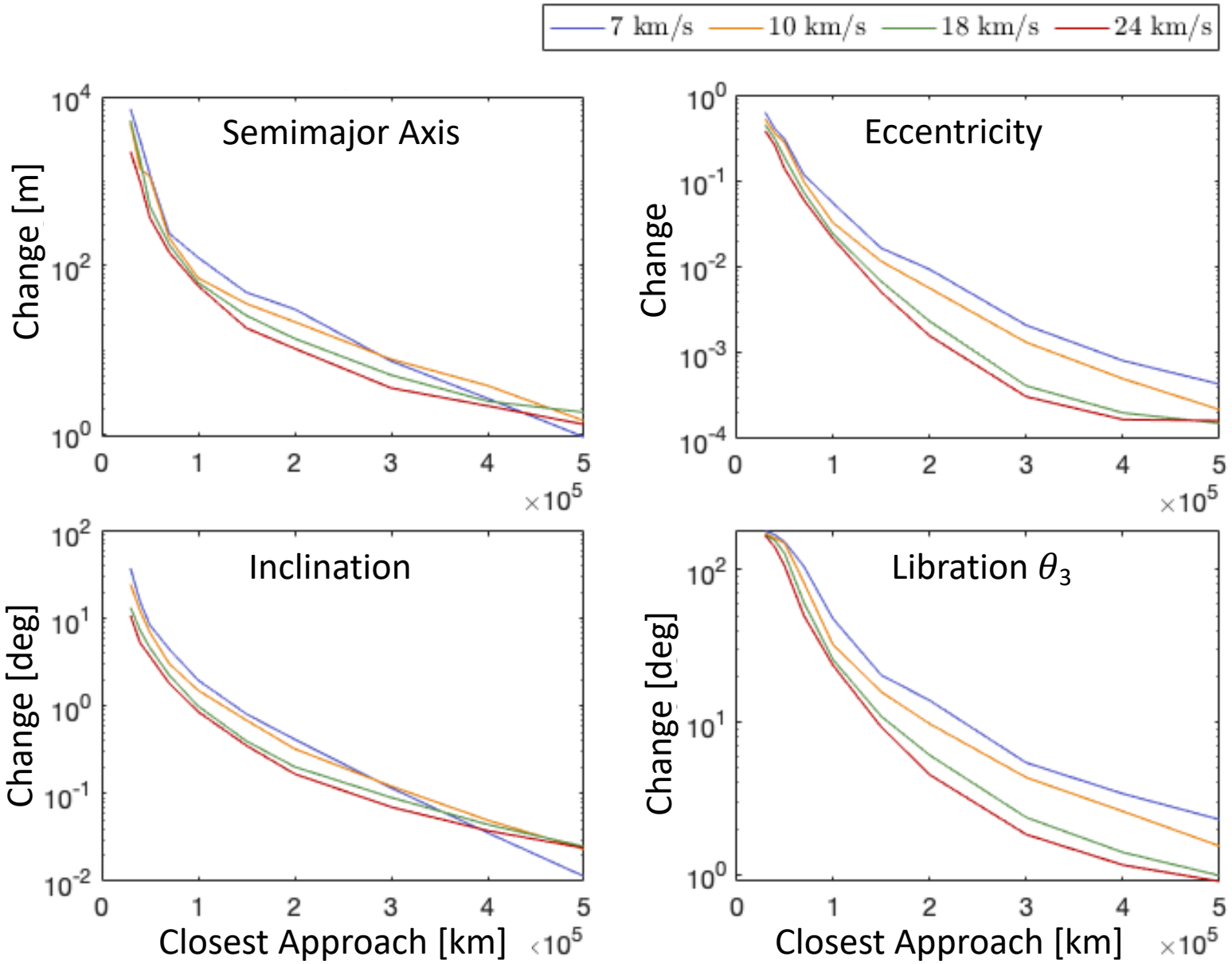
1. Randomly generate 100 hyperbolic trajectories

2. Calculate average change in element through each flyby



Results

1. Randomly generate 100 hyperbolic trajectories
2. Calculate average change in element through each flyby
3. Average all 100 simulations for each combination of flyby distance and speed



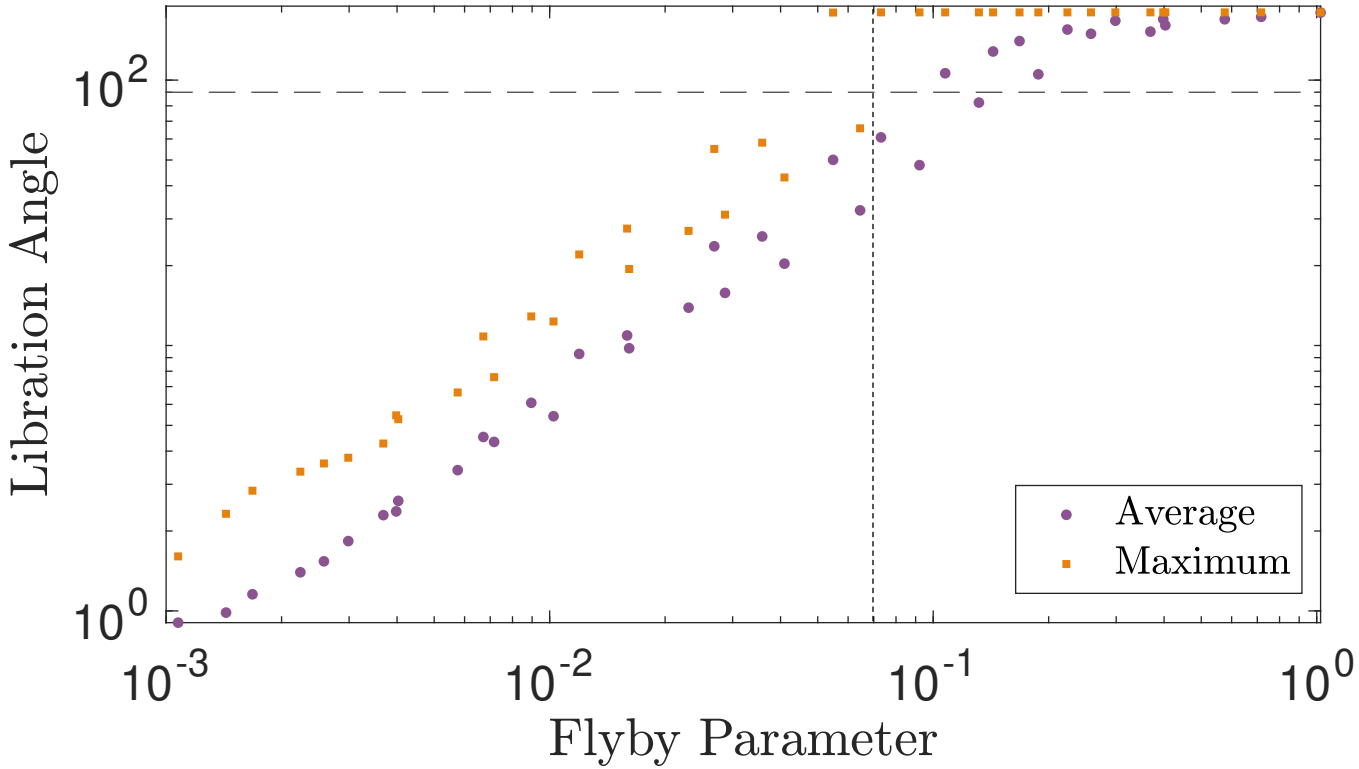
Loss of Lock

Flyby Parameter:

$$P = \sqrt{\frac{G}{M}} \frac{M_{\oplus} a^{3/2}}{v_{\infty} q^2}$$

Analytic prediction:

Change in free energy provides sufficient condition for circulation; circulation starts at P ≈ 0.07



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