Outcomes of Generating Planetary Obliquities Through a Dissipating Disk

Group Meeting, Sep 13, 2019

Yubo Su

September 13, 2019

Background
Problem Setup

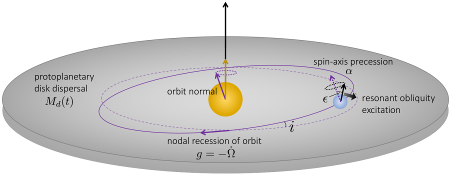


Figure: Millholland & Batygin, 2019. Three vectors $\hat{s}(t), \hat{l}, \hat{l}_d$.

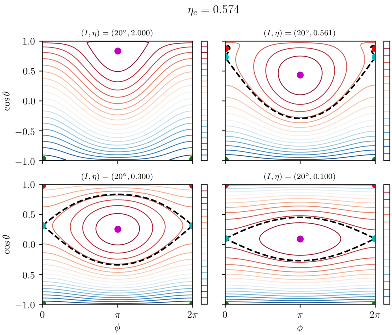
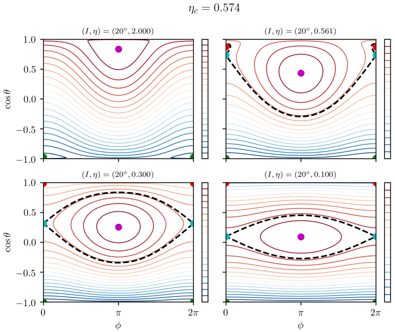


Figure: $H(\hat{s})$, where $\eta = -\frac{g}{\alpha}$.



$$\cos I = \hat{l} \cdot \hat{l}_d, \qquad \theta_{sd,i} = \hat{s}(t=0) \cdot \hat{l}_d,$$
$$\theta_{sl,f} = \hat{s}(t = t_f) \cdot \hat{l}.$$

- Let $\dot{\eta} = -\epsilon\alpha\eta$.
- What is $\theta_{sd,f}(\theta_{sd,i}, \epsilon)$?
- Millholland & Batygin 2019: ϵ dependence, adiabatic vs non-adiabatic regime. No $\theta_{sd,i}$ variation.

Results
Adiabatic

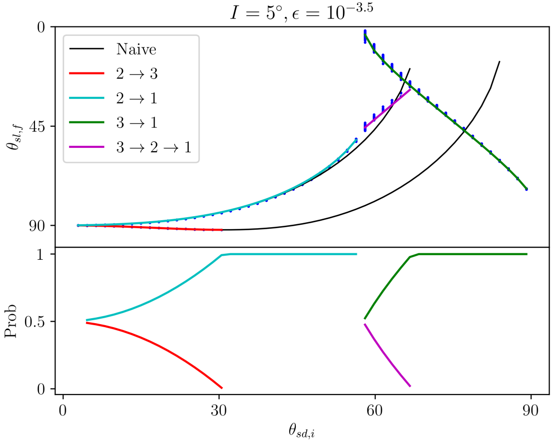


Figure: $\cos\theta_{sl,f} \approx \pm\frac{\sin^2\theta_{sd,i}}{4}$

Results

Non-Adiabatic

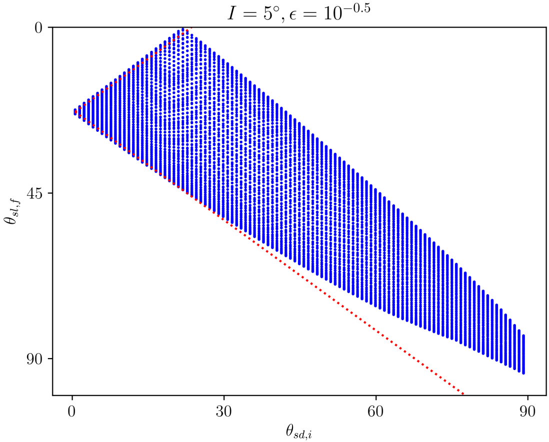


Figure: $\theta_{sl,f} \approx \sqrt{2\pi/\alpha\epsilon}\tan I \pm \theta_{sd,i}$.

Results

Transition between Adiabaticity/Non-Adiabaticity