

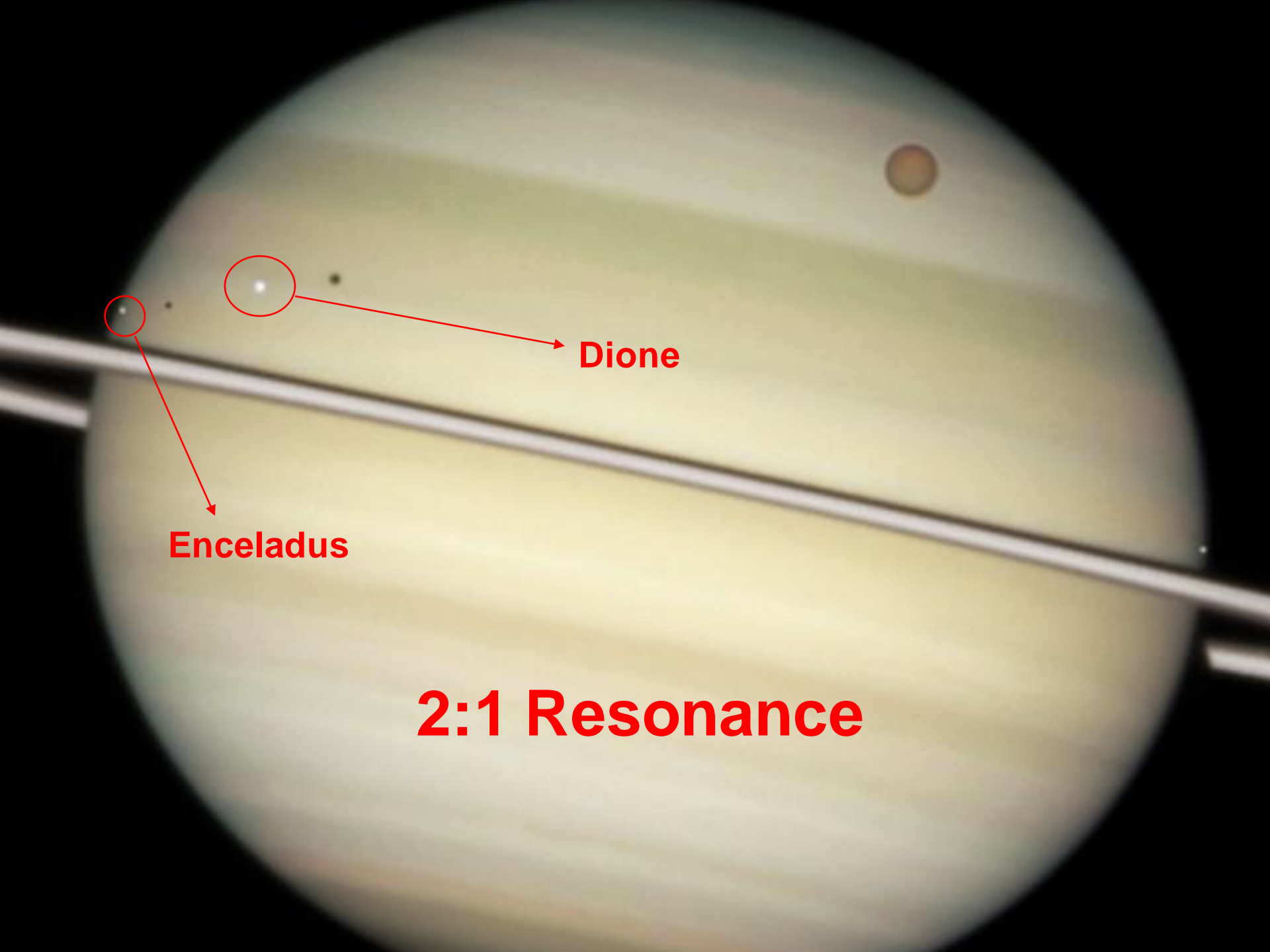
Approaching and Leaving of Resonance between Enceladus and Dione



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Enceladus

Dione

2:1 Resonance

Introduction

Tidal heating in Enceladus

(Wisdom & Meyer. 2007)

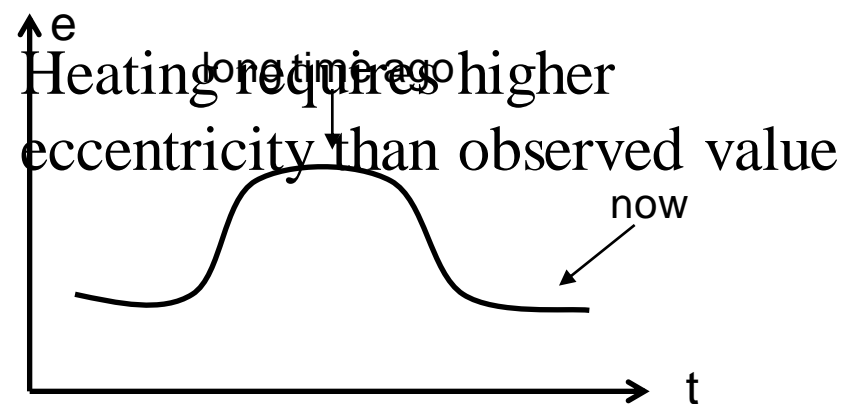
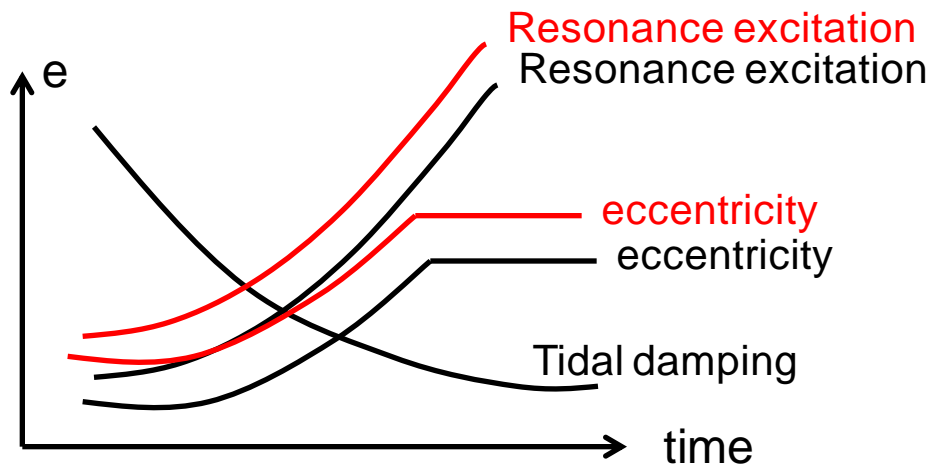
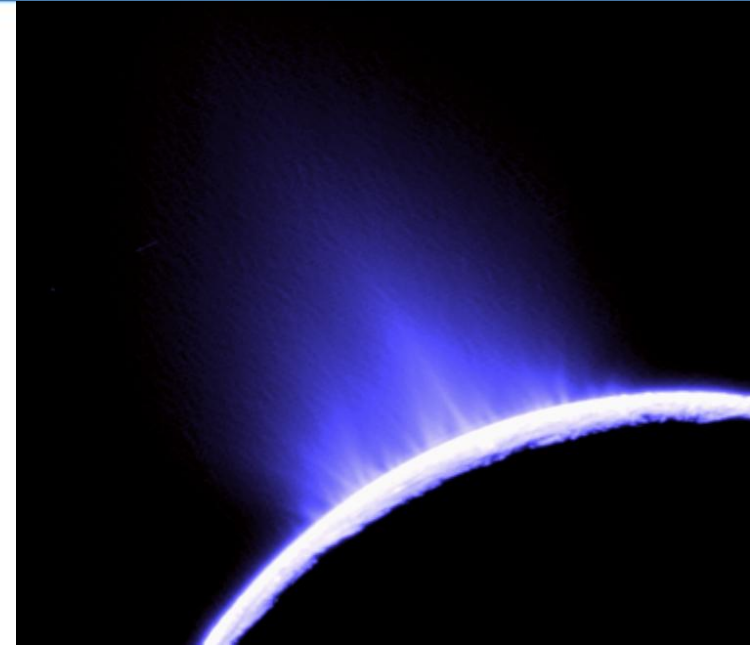
Resonance



Growing eccentricity



Heating



Introduction

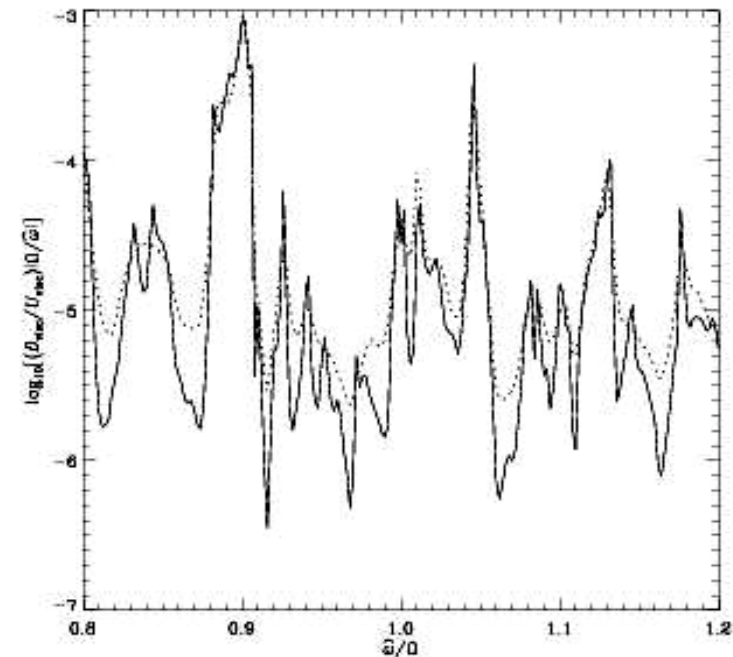
Meaning of Q :

- Parameterize the efficiency of tidal dissipation
- Influence the change in resonance state
- Planet to Satellite

(Ogilvie & Lin 2003)

Q is dependent on:

- Tidal forcing frequency
- Structure parameters of planet



Introduction



Target:

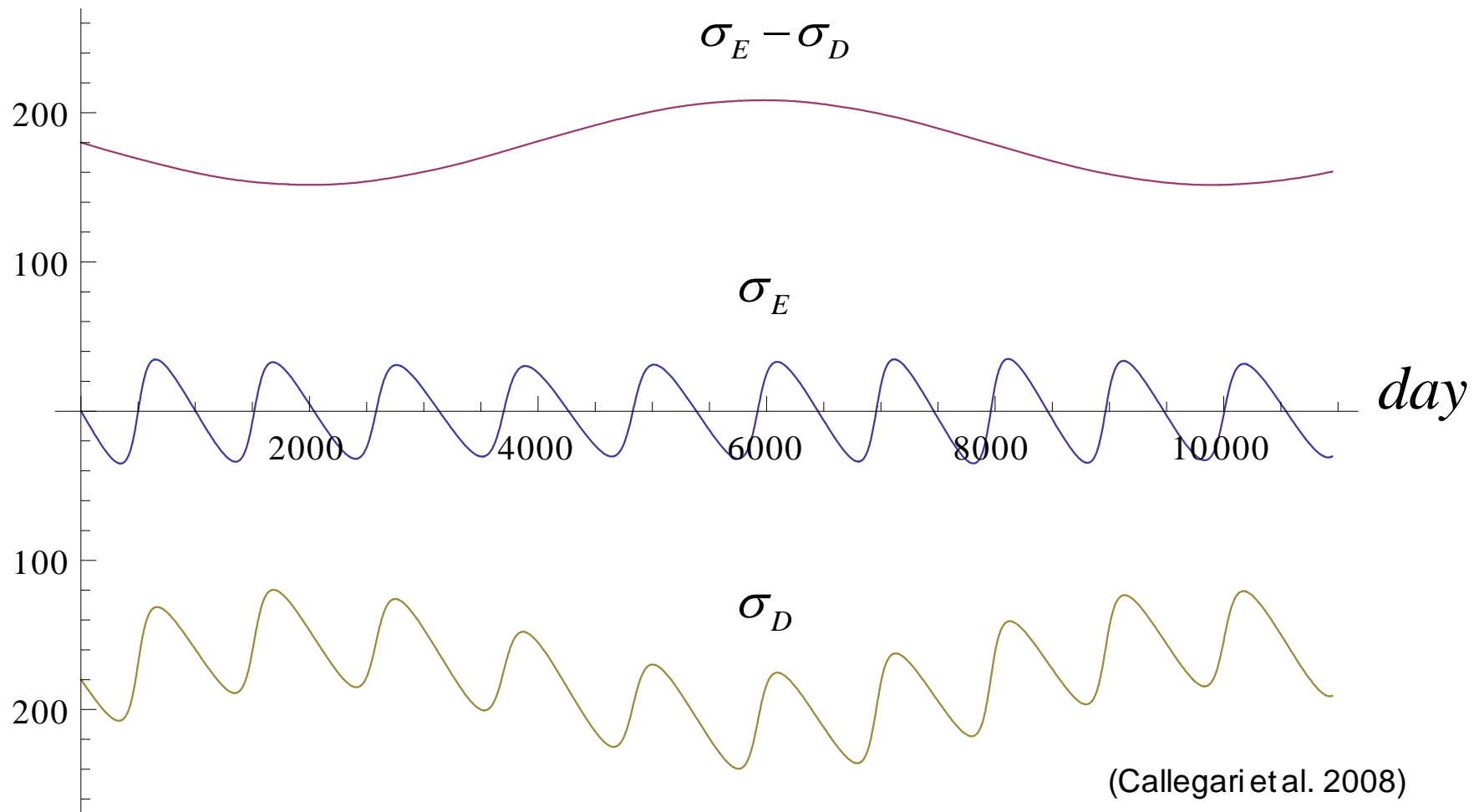
- Relate Q value with tidal forcing frequency

Method:

- Numerically solve Hamiltonian Equations for Enceladus and Dione
- Change Q and see the change in resonance

Without Tides

Hamiltonian equations related with σ_E and σ_D



Method



To see the effect of tidal evolution:

- Resonance amplitude and period become less important
- Combine Hamiltonian equations with tidal dissipation
- Need longer time scale for simulation

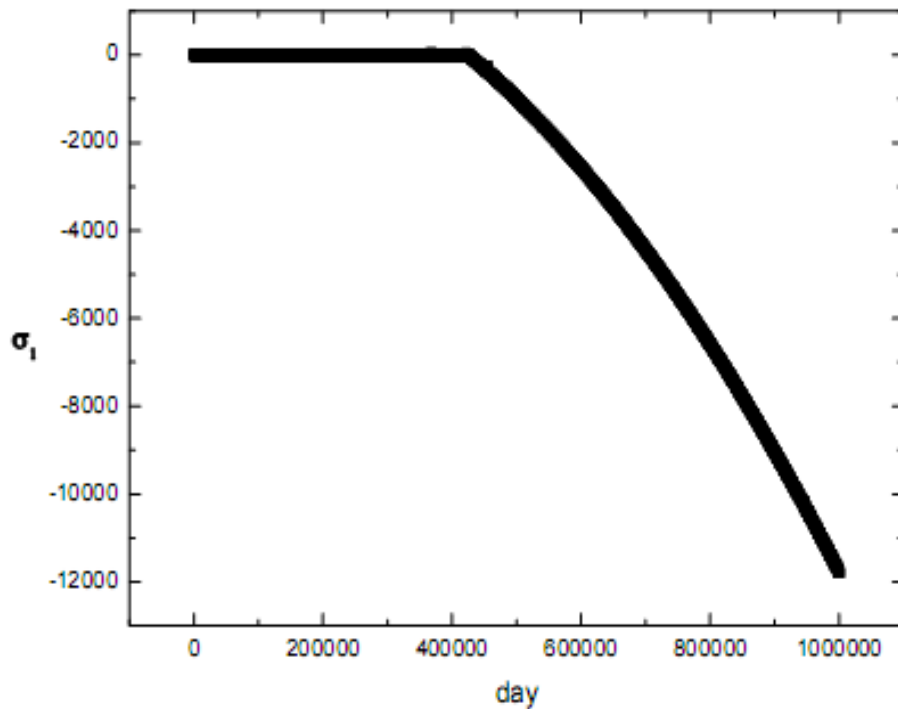
$$10^3 \text{ days} \Rightarrow 10^{7\sim 8} \text{ days}$$

- Mathematica \rightarrow Burlisch Stoer Integrator

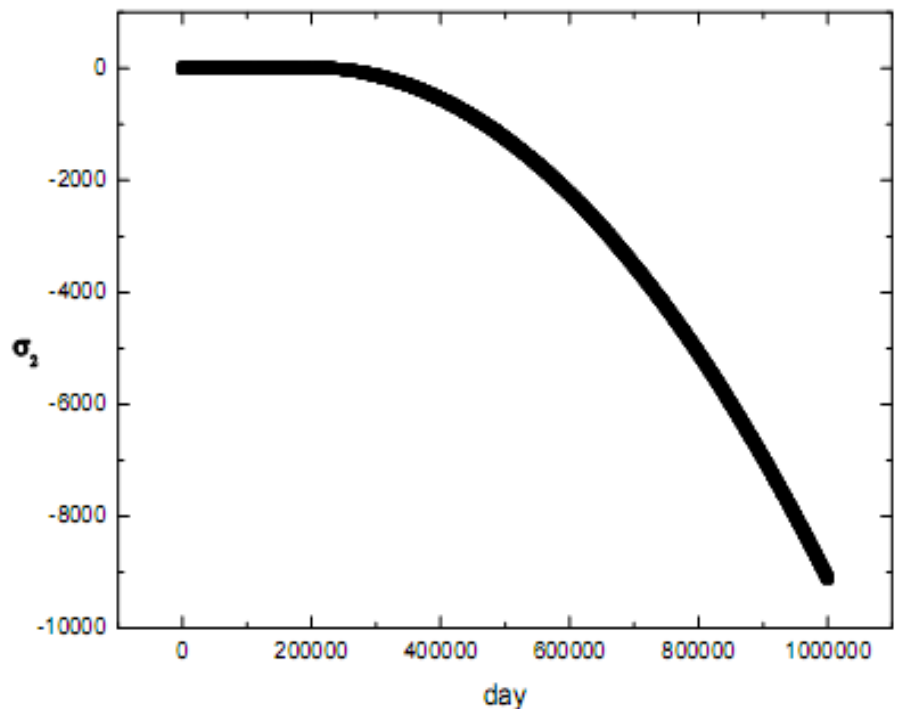
Leaving Resonance

$$Q_{SE}=0.34, Q_{SD}=0.34$$

Enceladus



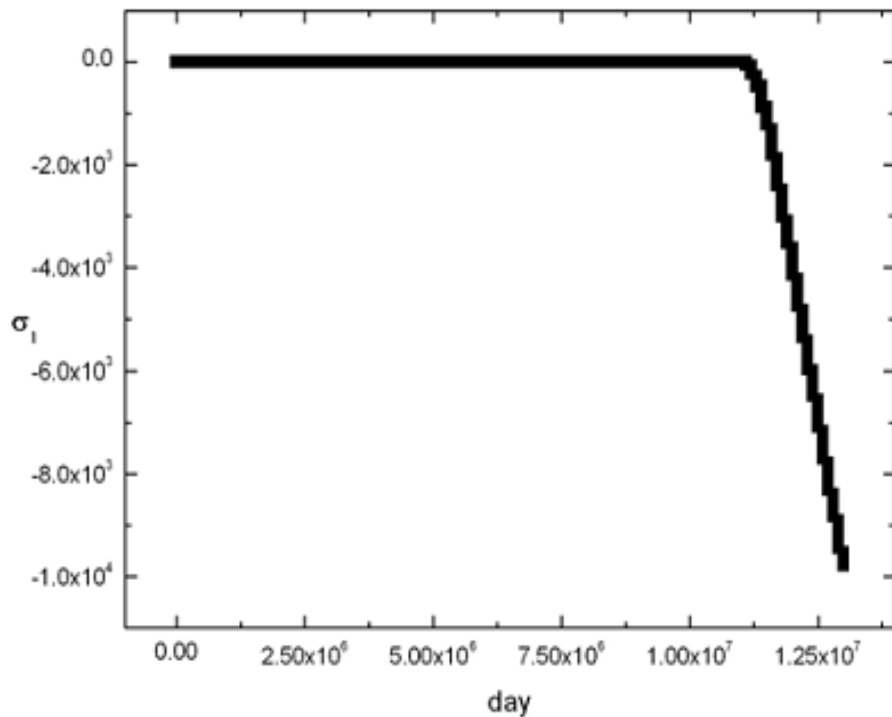
Dione



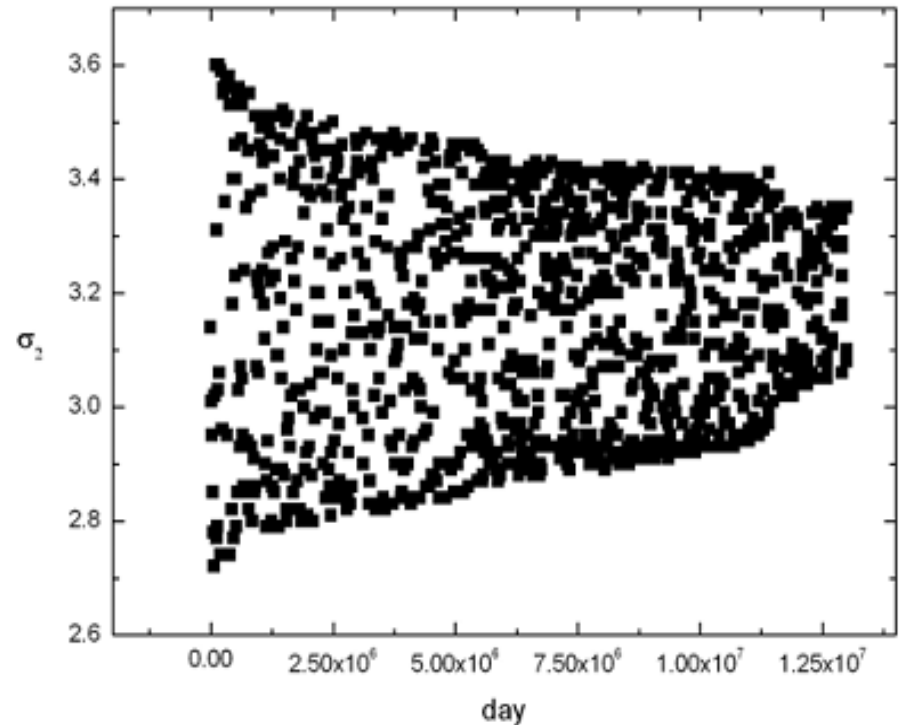
Leaving Resonance

$$Q_{SE}=0.34, Q_{SD}=0.034$$

Enceladus



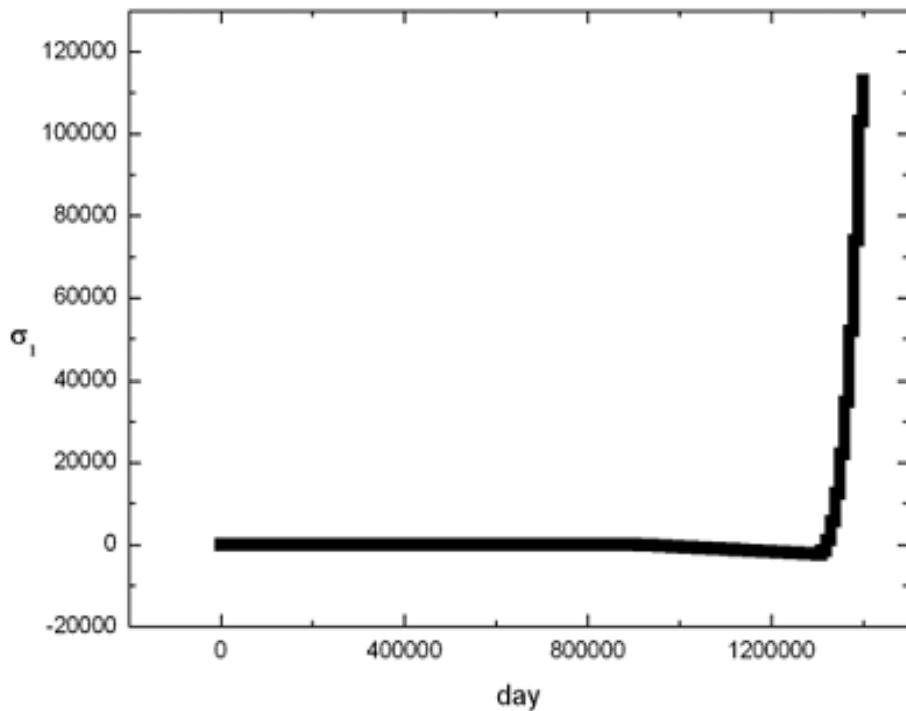
Dione



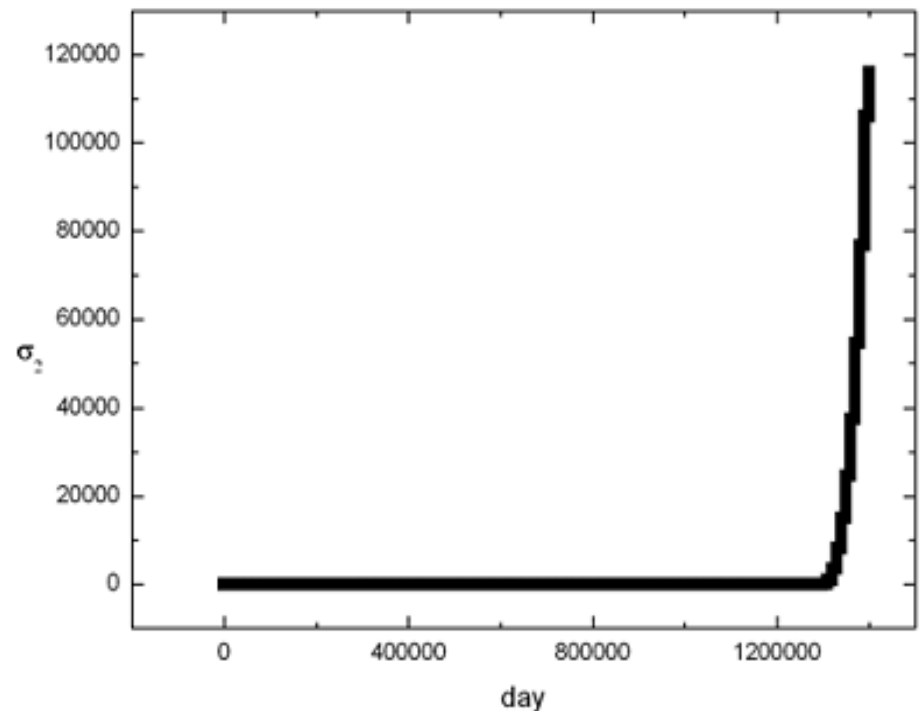
Leaving Resonance

$$Q_{SE}=0.34, Q_{SD}=0.0034$$

Enceladus



Dione



Summary



- Q value depends on tidal forcing frequency
- Method: Numerically solve Hamiltonian equations, without tides and with tides
- Preliminary Results: The time they stay in resonance grows as Qs^2 decreases
- Future work: Study approaching resonance, Let Q vary with frequency

Thank you!

