High e Jupiters

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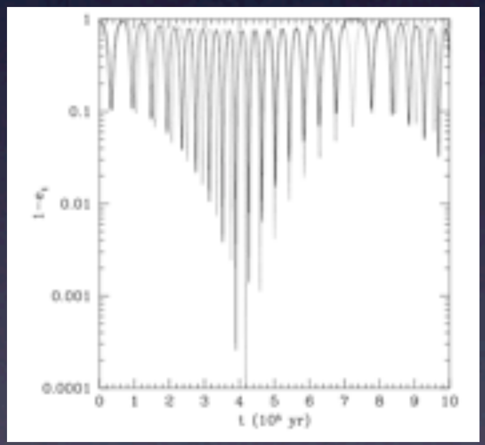
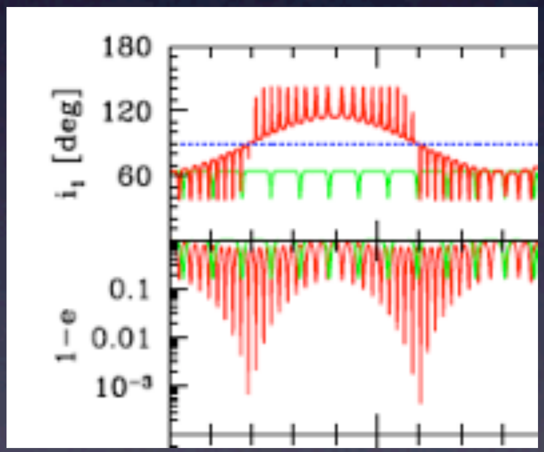
Generating high e: Kozai + octupole

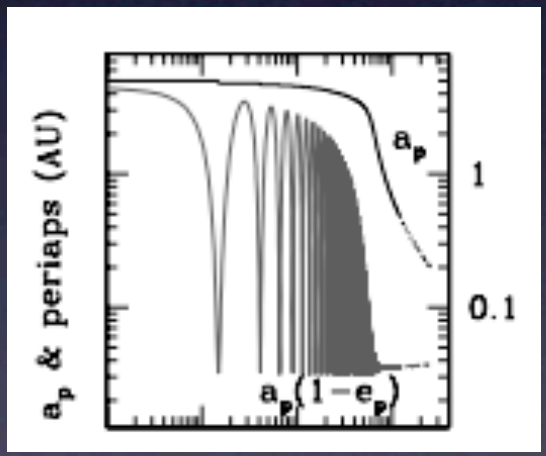
Migrating at high e: Tidal dissipation



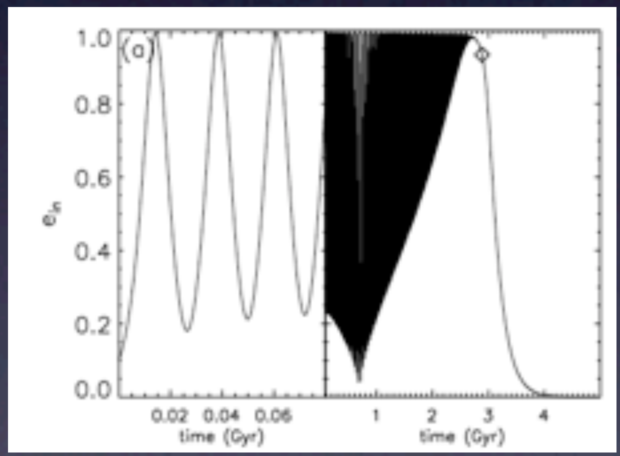
e.g. Ford et al. 2000



Naoz et al. 2011



e.g. Wu & Murray 2003



Fabrycky & Tremaine 2007

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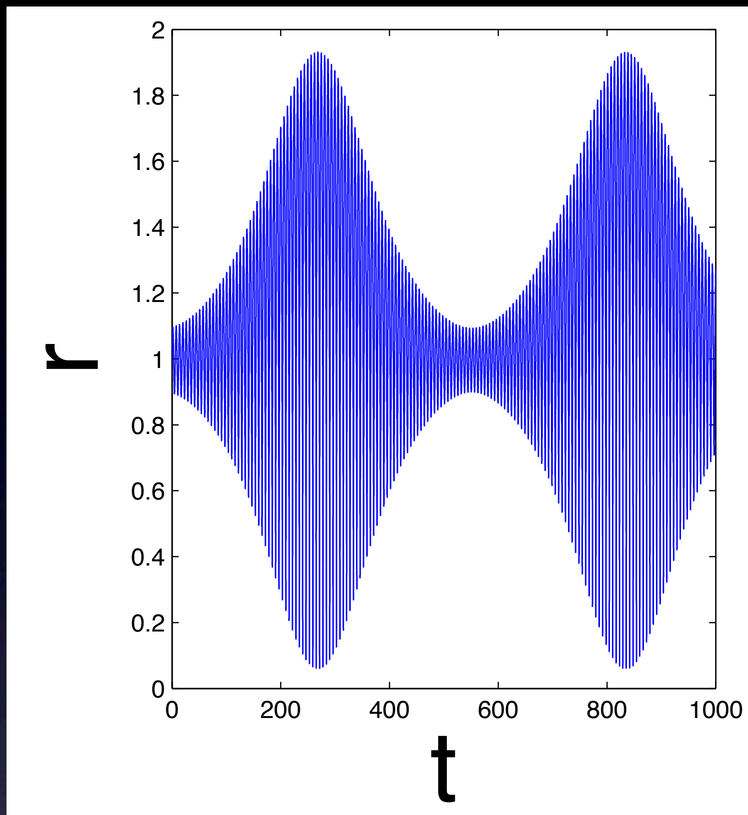
Katz, Dong & Malhotra 2011

Averaging over Cycles

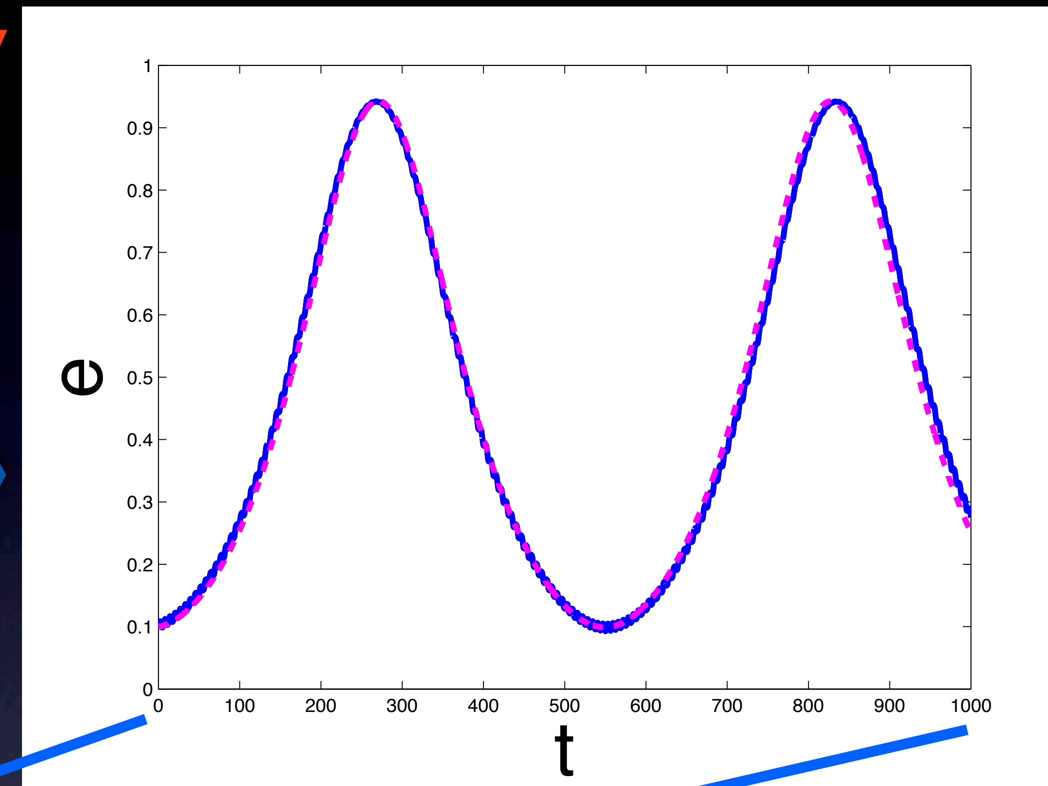


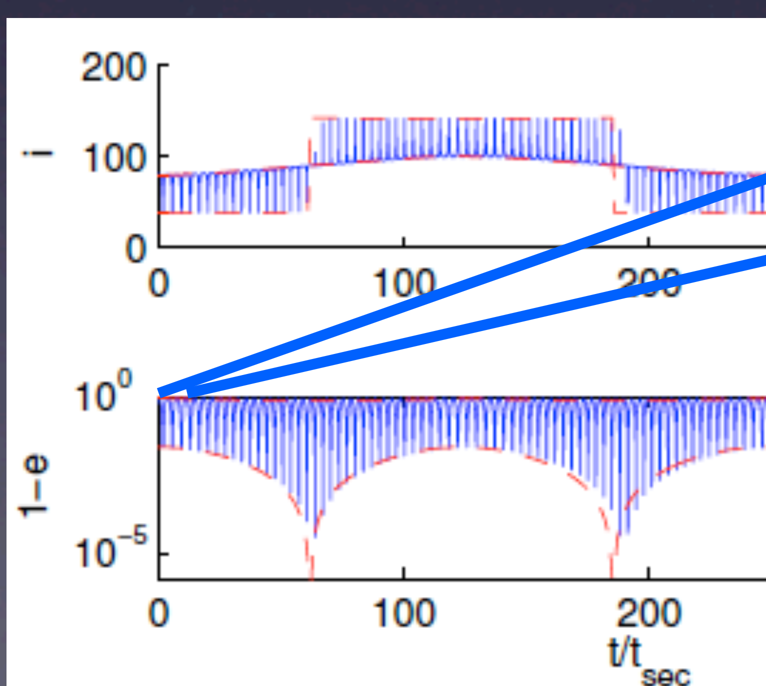
Kozai Lidov

Study e, i, ω, Ω

Kozai=Kepler + small quadrupole perturber

Average Eqs.





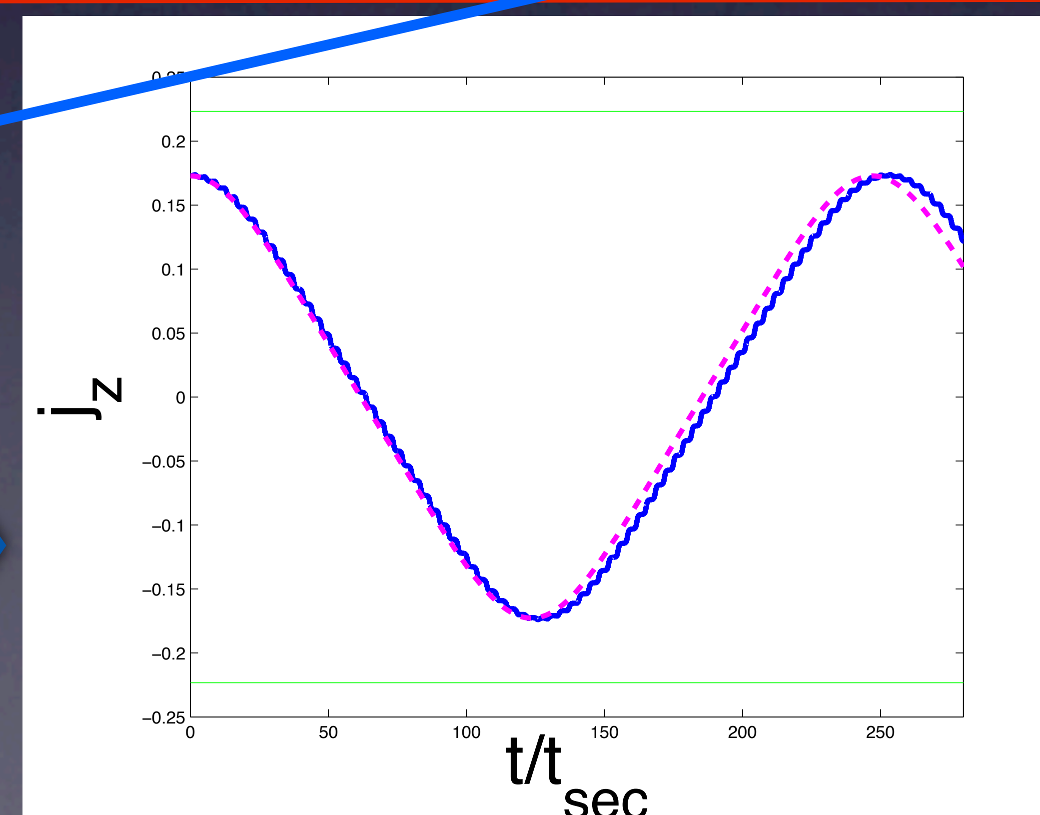
a la Naoz et al. 2011

+octupole

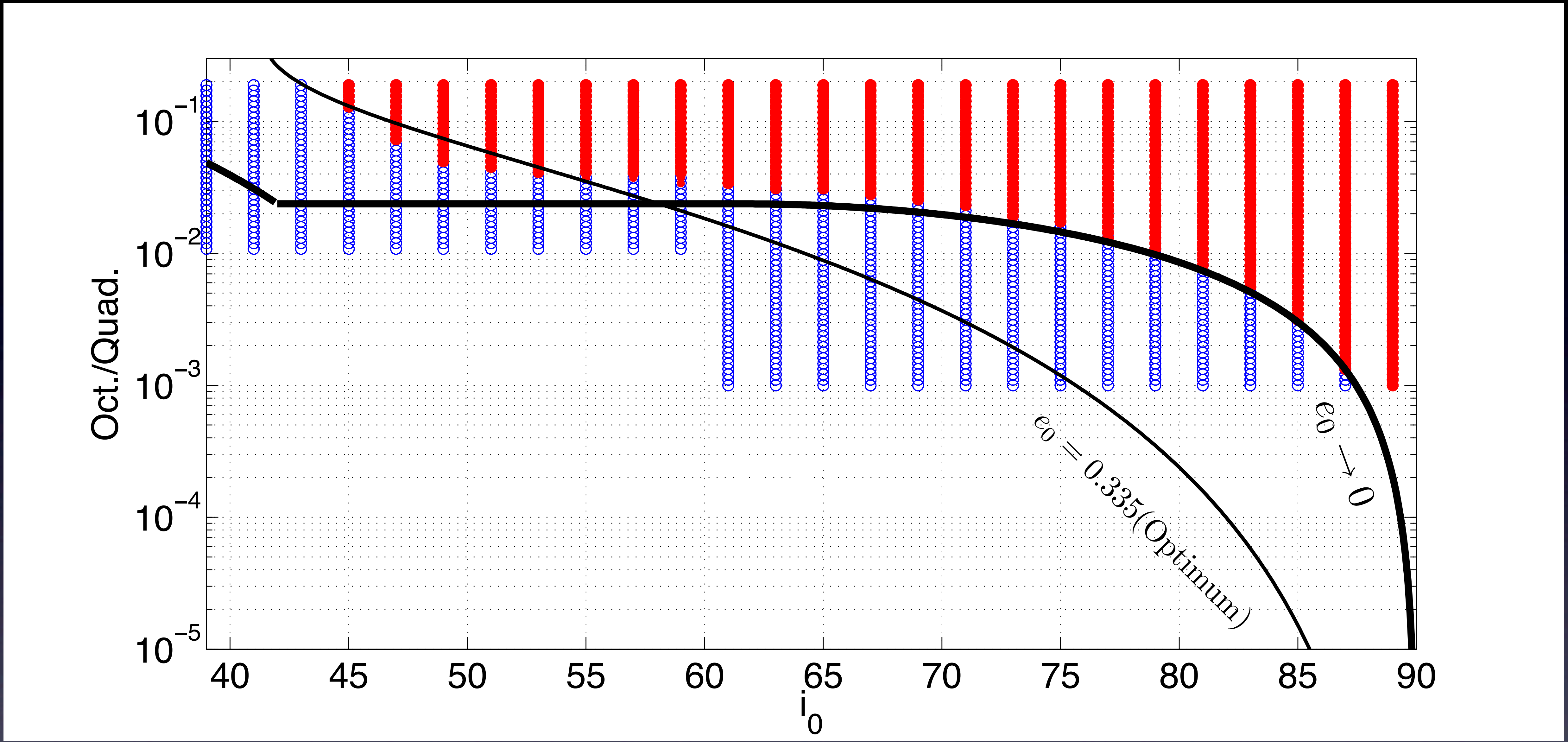
Study j_z, C_K, Ω_e

Kozai + small octupole

Average Eqs.



Binaries make retrogrades



Katz, Dong & Malhorata 2011

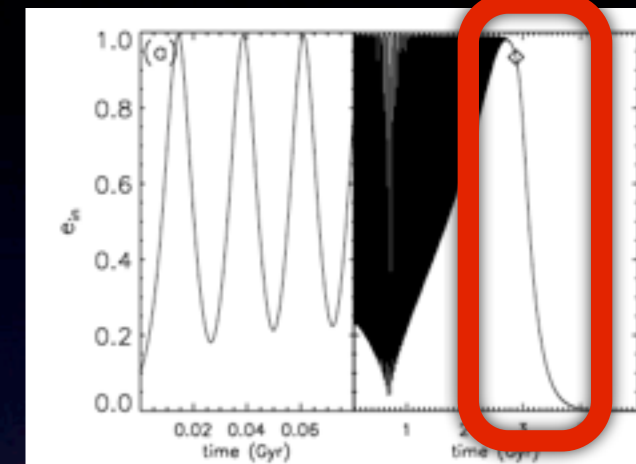
$$\text{Flip at } \frac{a_{\rm per}}{a} \sim 100!$$

e.g. Jupiter 5AU, binary 500AU

High e Jupiter Migration in Steady State

Socrates et al. 2011 in prep

$$N \propto t$$

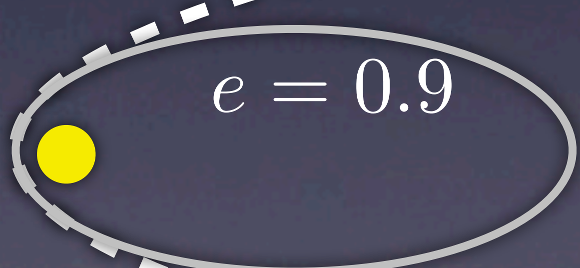


e.g. Fabrycky & Tremaine 2007
HD 80606b

$$J = \text{const} \Rightarrow r_p \approx \text{const}$$

$$\frac{\Delta E}{\text{Orbit}} \approx \text{const}$$

$e = 0.99$



$$\Rightarrow \frac{dN}{d\log P} \propto P^{1/3}$$

$$\text{High}{-}P \Leftrightarrow \text{High} - e$$

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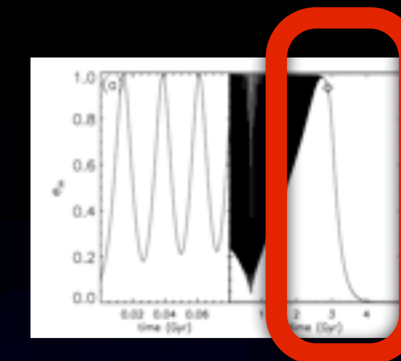
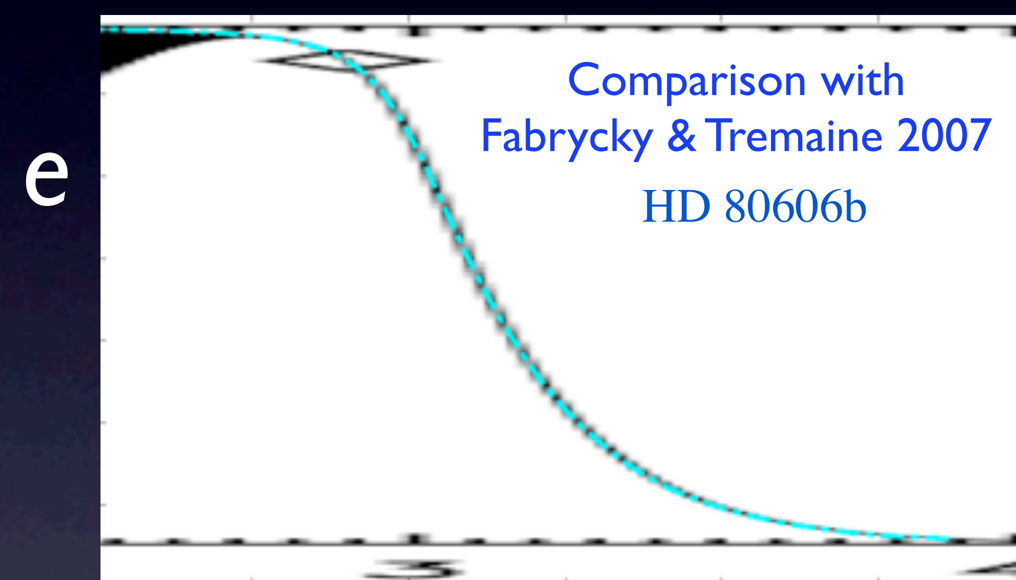
High e Migrating Jupiters: Analytics works

Socrates et al., Katz et al. 2011 in prep





- Pseudosynch
- Equilibrium tides

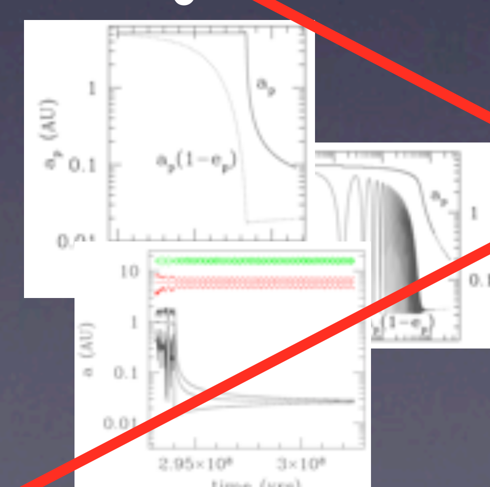
(Hut 81 = Eggleton et al 98 = everyone)

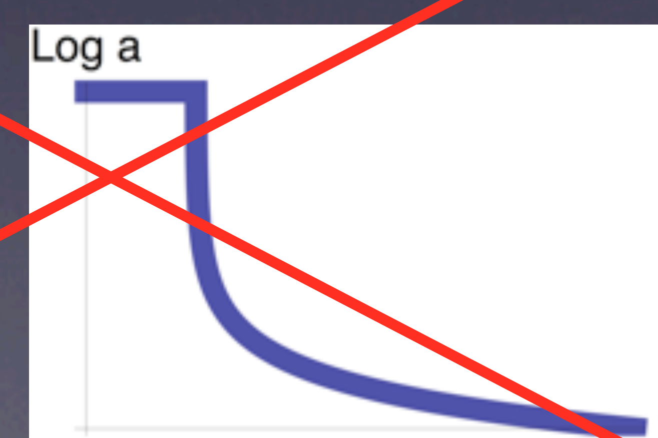
$$\frac{de}{dt} \propto \underbrace{e(1-e^2)^{3/2}}(2.33 + 6.12e^3)$$

$$\Updownarrow$$

$$\text{high } e + \frac{\Delta E}{\text{Orbit}} \approx \text{const}$$

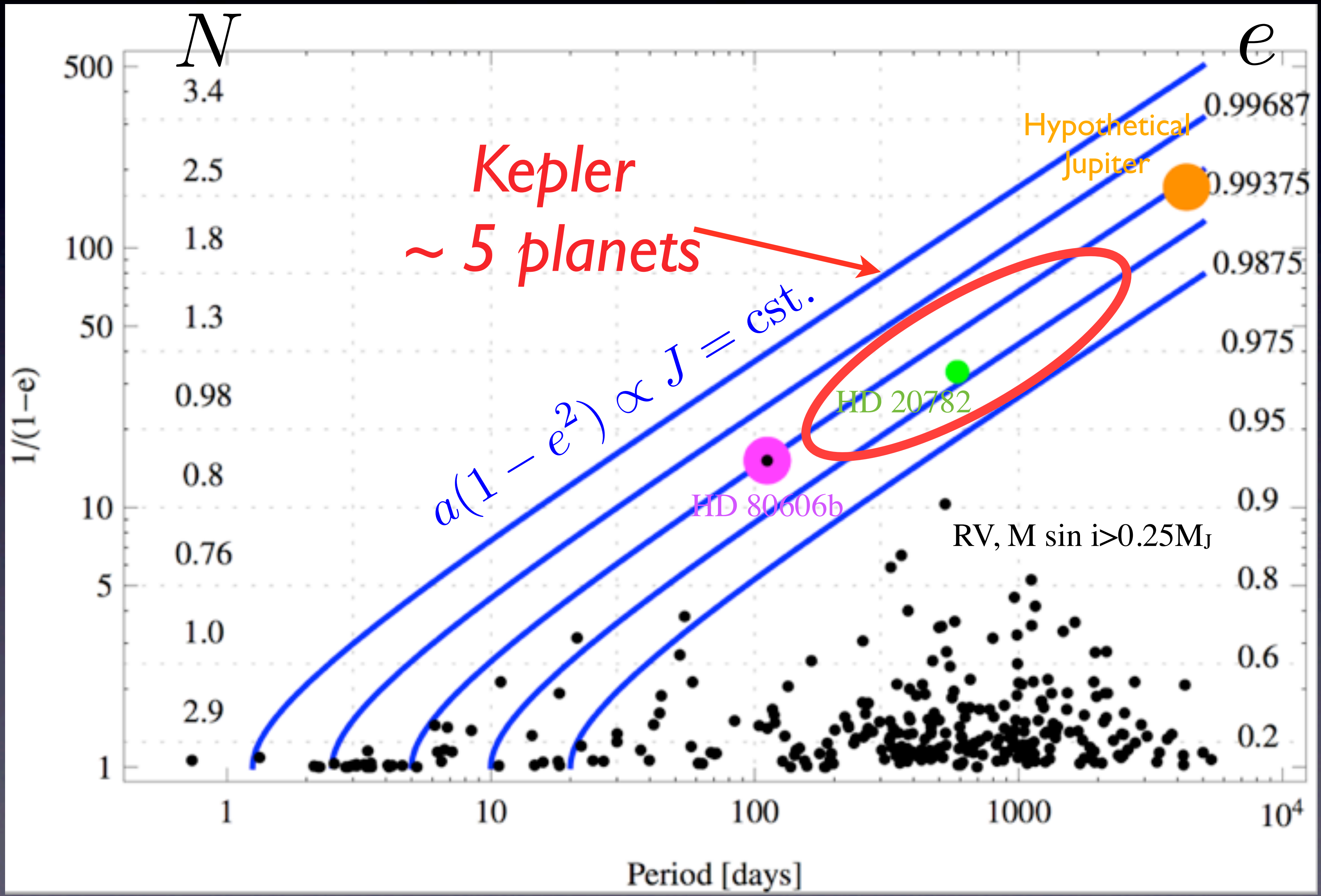
$$Q = \text{cst.} \Rightarrow \dot{E} = \text{cst.}$$





Kepler - Expect extreme e record breakers!

Socrates et al. 2011 in prep



e=0.98