Planetesimal migration and evaporation caused by Jovian resonances near the snowline

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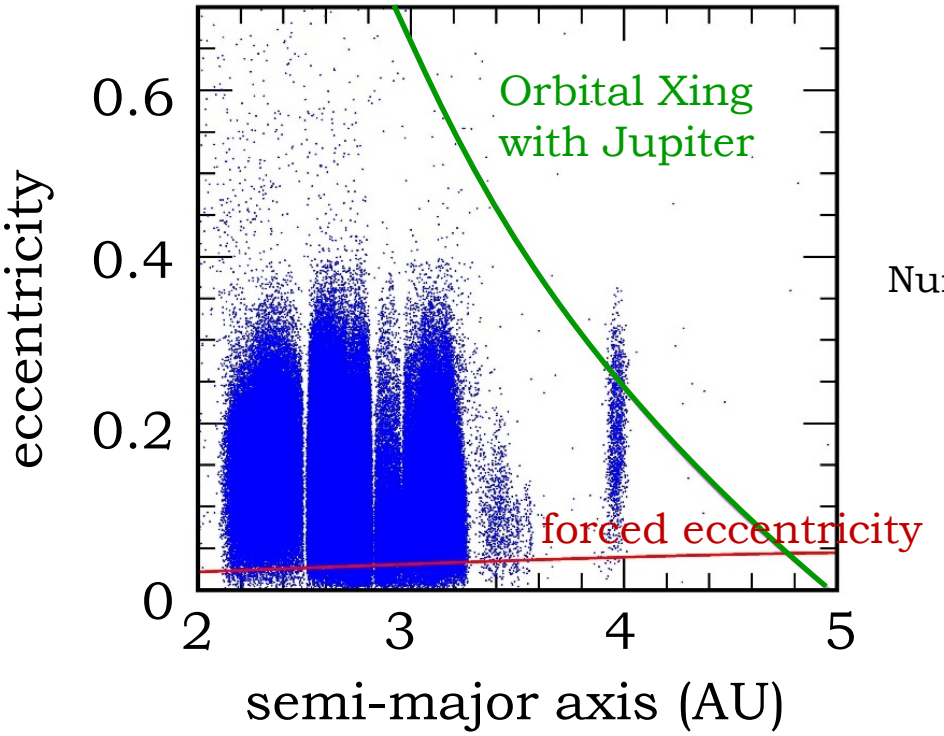
Depletion of asteroids

Jovian formation in the gas disk

→ depletion of nearby planetesimals

(e.g., Ida & Lin 1996)



Planetesimals evolution by Jupiter is a promising mechanism

Evaporation beyond snow line → a clue for Giant planet ?

Planetesimal evaporation

High speed planetesimals travel in the gas

Shock heating

short lived materials which do not normally exist in a cold disk

Required velocity for evaporation:

in the case of solar system parameters

> 3-7 km/s @ 4AU

> 7-15 km/s @10AU

What kind of planet is required?

Please find Figures 1 & 2 of Tanaka et al. 2013, ApJ 764:120

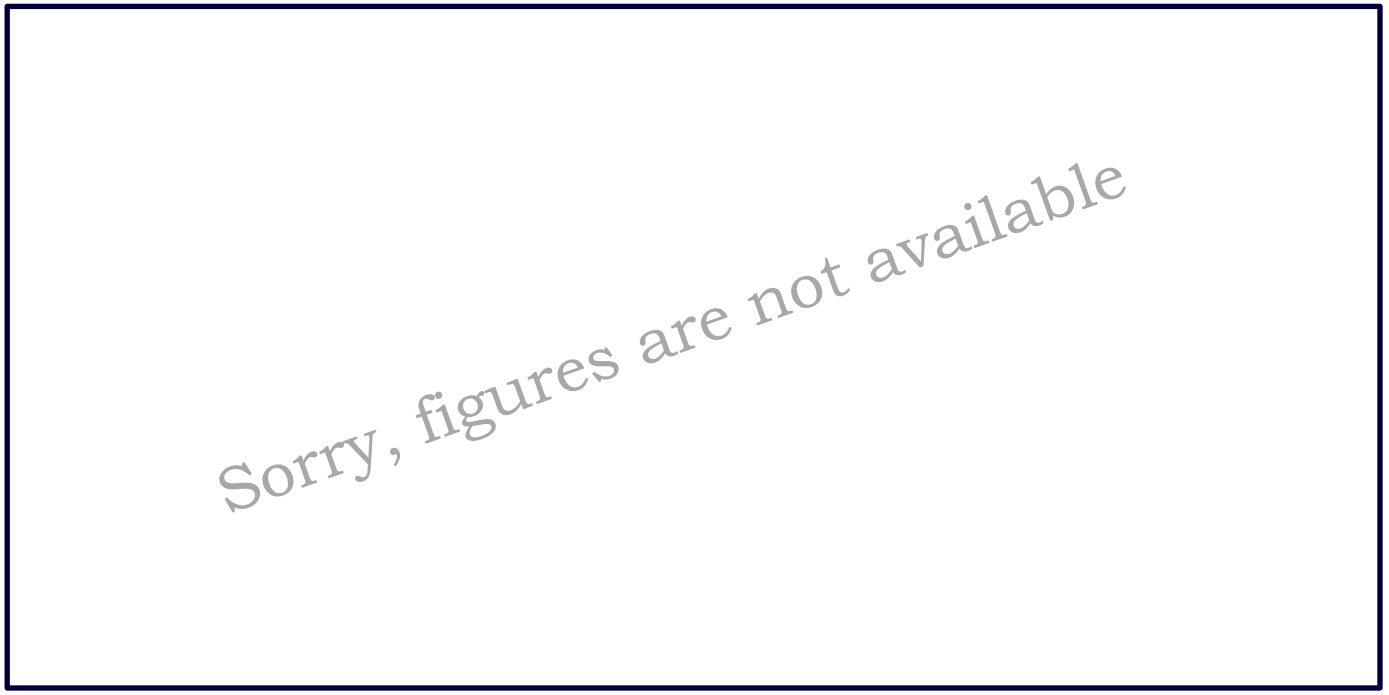
Typical evolution

Please find Figures 1(a) of
Nagasawa et al. 2014, ApJL 794:L7

- Planetesimals to be affected:
  between the 2:1 and gas giants ($0.6a_p$~$1a_p$)
- Peak eccentricity is @ the 3:1 (~$0.48a_p$) , v_{rel}~10 km/s

Maximum $v_{\rm rel}$

- maximum speed depends on $M_{\rm p}$ and $a_{\rm P}$

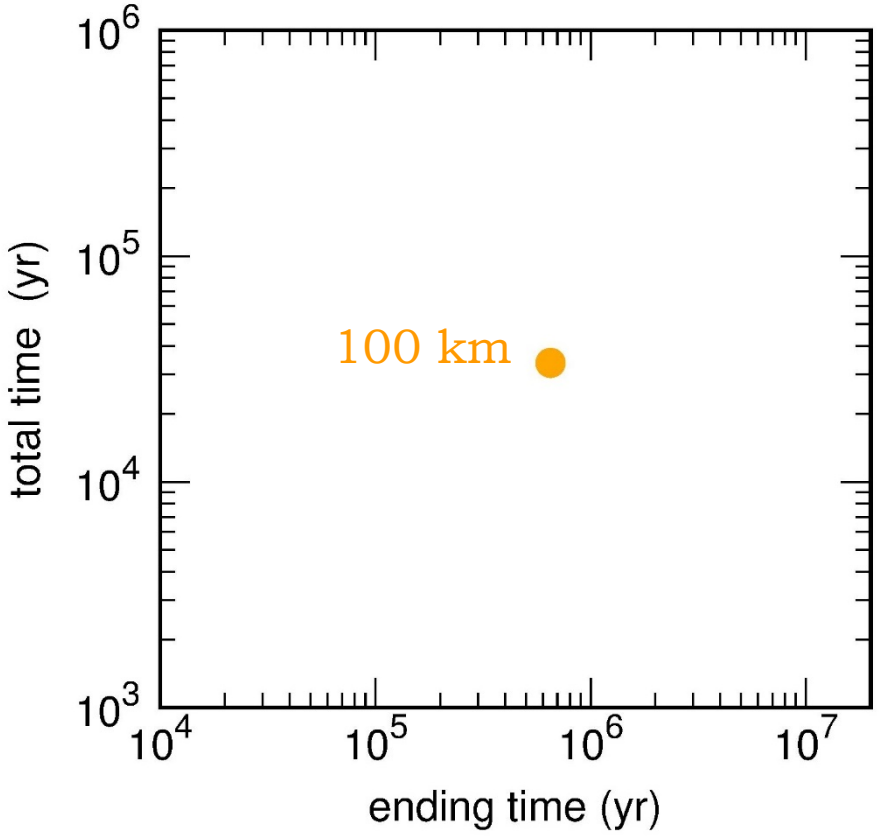


If $M_{\rm p} \gtrsim 0.1 M_{\rm J\ at\ 5AU}$, planetesimals evaporate

If $a_{\rm p} \lesssim 15{\rm AU}$, planetesimals evaporate

Duration of evaporation

average time of $v_{rel} > v_{evap}$ of 30 planetesimals



assuming
Jovian parameters
MMSN disk
100km planetesimal

each planetesimal has high v for $\lesssim 10^5$ yr
event continues during ~10^5 -10^6 yr

(size halves in ~10^7 yr)

Summary

We studied the condition of planetesimal evaporation

← evaporated materials (e.g., SO, H_2S) are observable by ALMA

requirements (Jupiter is assumed for other parameters)

- Mass of gas planet > 0.1 M_J
- Location of the planet < 15 AU
- planetesimals @ $0.6a_p$-$1a_p$

evaporation continues ~10^6 yr