The destruction of inner planetary systems during the high-eccentricity migration of gas giants

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arXiv:1502.06971
Hot Jupiter formation pathways

I. Disc migration

Goldreich & Tremaine 80, Ward 97, ...

Rasio & Ford 96, Wu & Murray 03, Wu & Lithwick 11, ...

II. Dynamical delivery
Disc migration does not destroy/prevent formation of other planets

Fogg & Nelson 07
Hot Jupiters are (mostly) single
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Qualification: 72% may have long-period planet, BD, or stellar binary companion (Knutson+14, Ngo+15)
Never see hot J + low-mass planets
Take some representative Kepler triple-planet systems....

Testing effects of dynamical Hot Jupiter delivery on systems of low-mass planets

Example evolution I: Jupiter destroys inner planets


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Example evolution II: Jupiter ejected

J sent onto hyperbolic orbit

c & d collide

b & c collide

Destruction of inner planets or ejection of Jupiter?

Effects of Energy

- Chance of ejecting the Jupiter depends on relative orbital energies of the giant and the inner planets

Final orbital elements

Conclusion

• Dynamical delivery of hot Jupiters naturally explains the absence of close companions to them

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Disc migration does not destroy/prevent formation of other planets

Mandell+07

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Migration of embryos behind Hot Jupiter creates chains of low-mass planets

Ogihara+14
Example of tidal evolution

Matsumura+10

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Misaligning a primordial disc

Batygin 12

\[ m_{\text{disk}} = 10^{-2} M_* \]
\[ M_* = 1 M_\odot \]
\[ M' = 1 M_* \]
\[ a' = 500 \text{ AU} \]
\[ e' = 0.5 \]

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