The effect of Jupiter's Mass Growth on Satellite's Capture

Othon Cabo Winter

Ernesto Vieira Neto

Tadashi Yokoyama

Grupo de Dinâmica Orbital & Planetologia

UNESP - Guaratinguetá and Rio Claro

Acknowledgments: FAPESP, CNPq and CAPES

Satellites

REGULAR

Equatorial : $i \approx 0$ (prograde)

Circular: $e \approx 0$

close to the planet : $a < 100 R_{planet}$

IRREGULAR

Inclined : $i >> 0$ (many are retrograde)

Elliptic: $e >> 0$

far from the planet : $a >> 100 R_{planet}$

Satellites

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==> Formed within a proto-planetary disc

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Satellites

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Equatorial : $i \approx 0$ (prograde)

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==> Formed within a proto-planetary disc

IRREGULAR

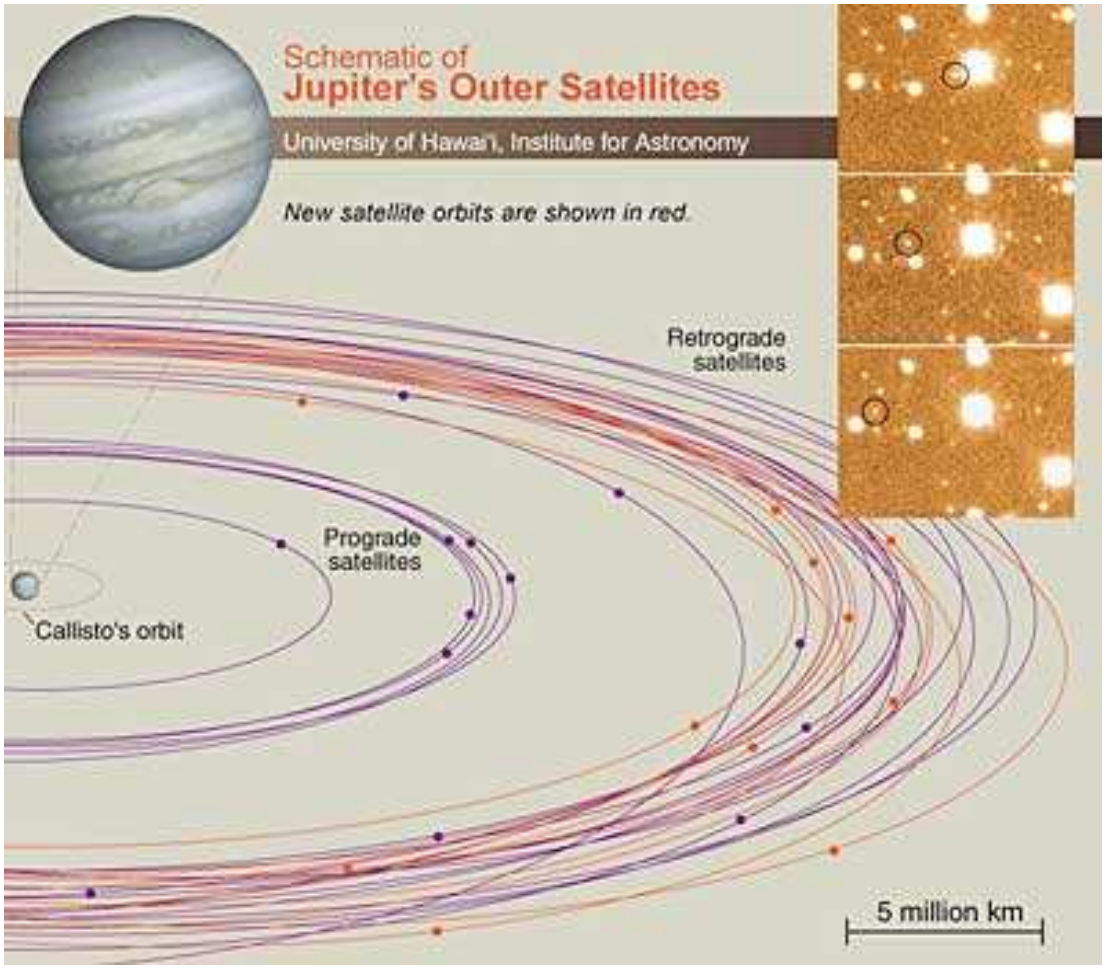
Inclined : $i >> 0$ (many are retrograde)

Elliptic: $e >> 0$

far from the planet : $a >> 100 R_{planet}$

==> Planetesimal captured by the planet

Irregular Satellites



Numerology

Planet	Regular	Prograde	Retrograde
Jupiter	8	7	50
Saturn	19	7	7
Uranus	18	1	8
Neptune	6	3	4

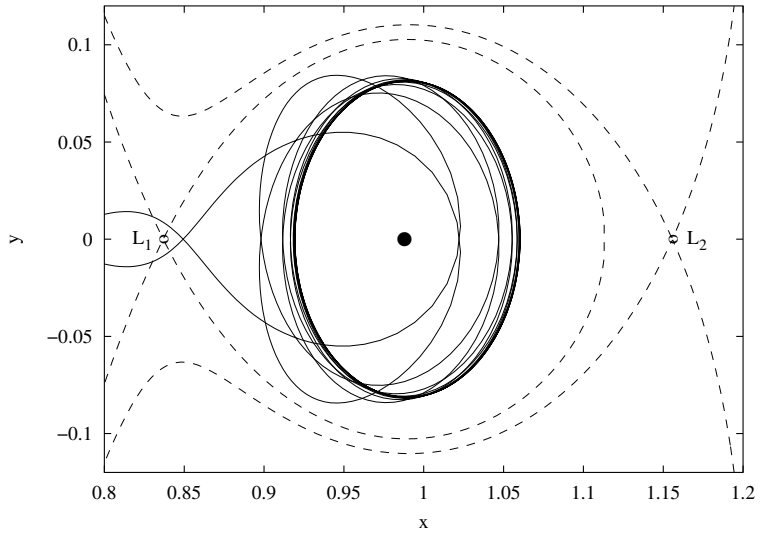
Capture Process

- First Stage:
  Temporary Gravitacional Capture

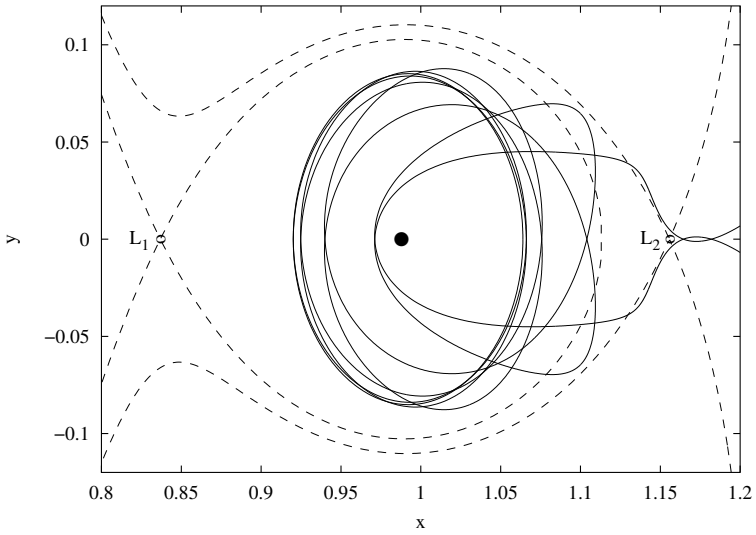
- Second Stage:
  Dissipative Effects: conversion of a temporary capture into a permanent one:
- gaseous drag,
- planetary migration,
- mass variation,

- ...

Temporary Capture

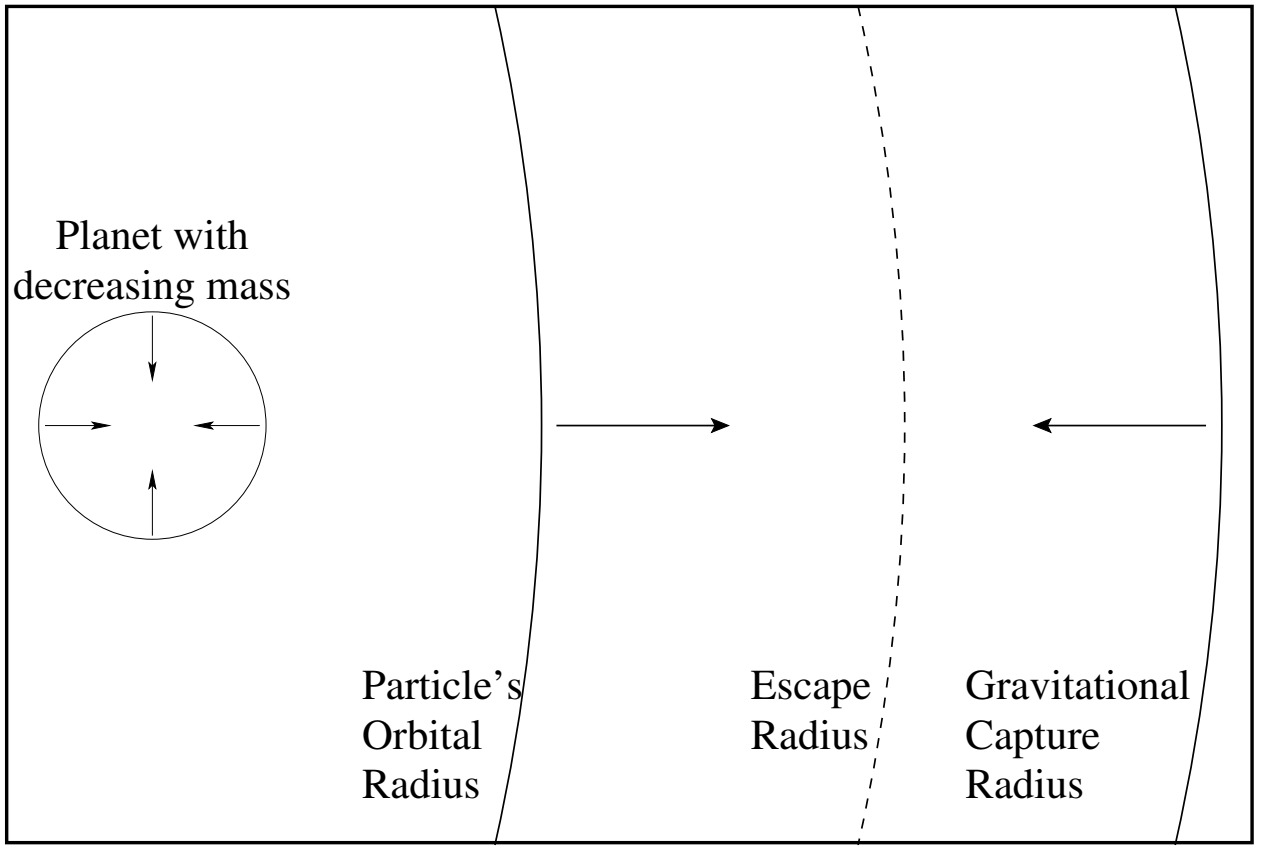


Capture by L_1

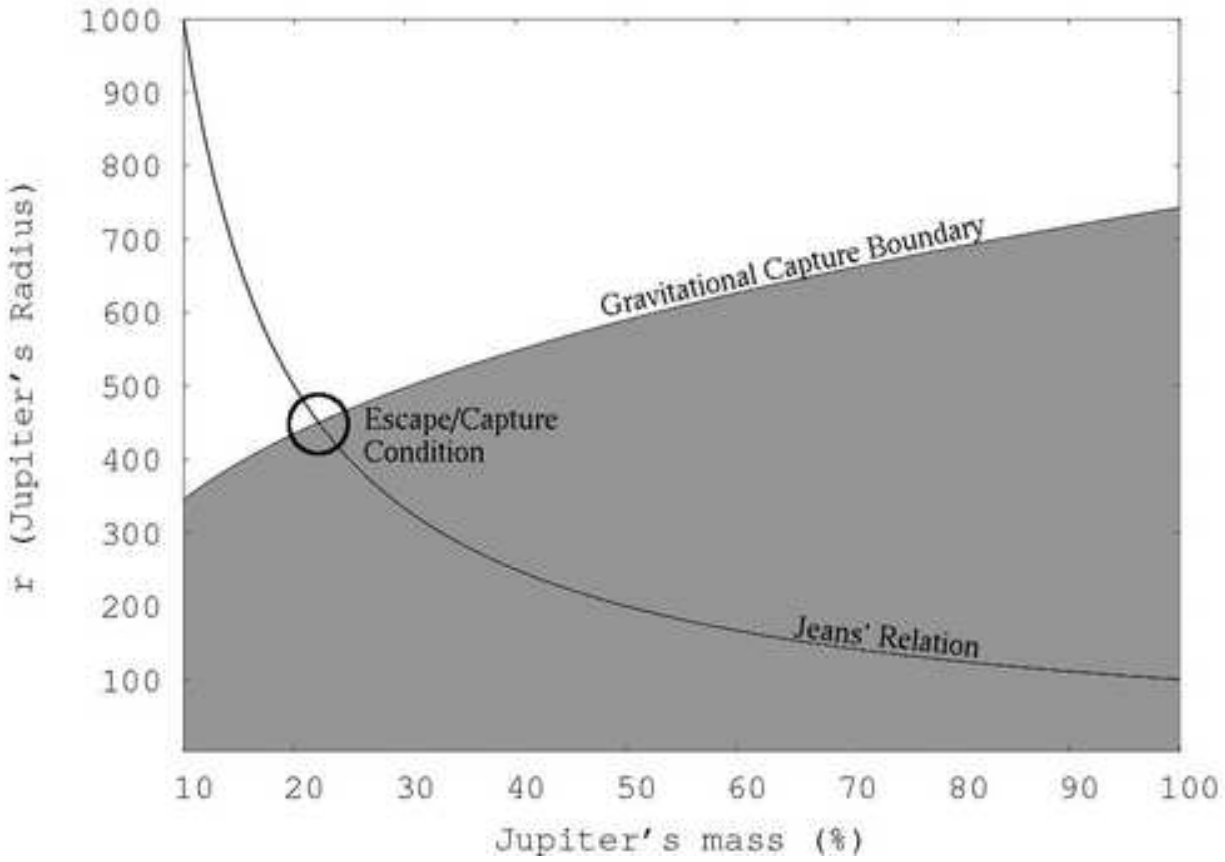


Capture by L_2

Mass Variation Effect

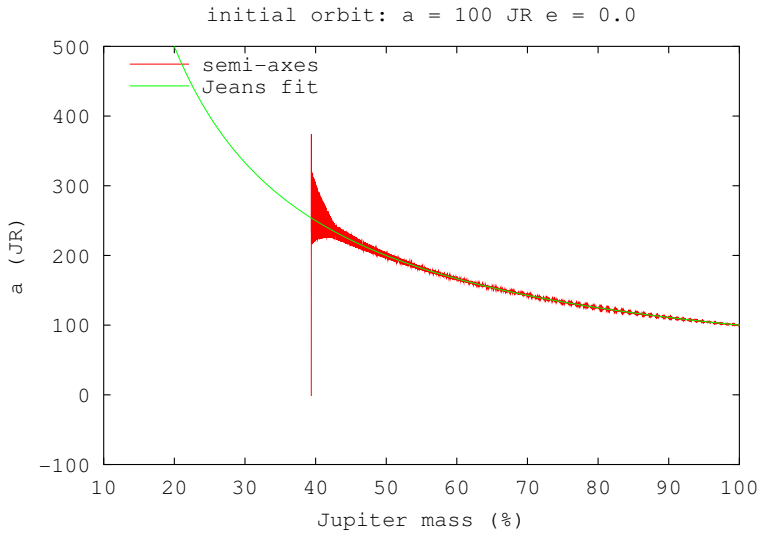


Escape/Capture Condition

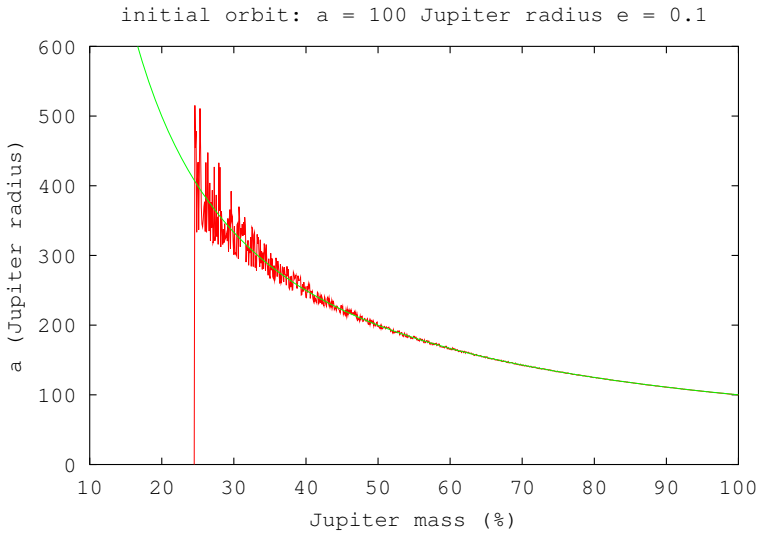


Evolution of the semi-major axis

Jeans Relation



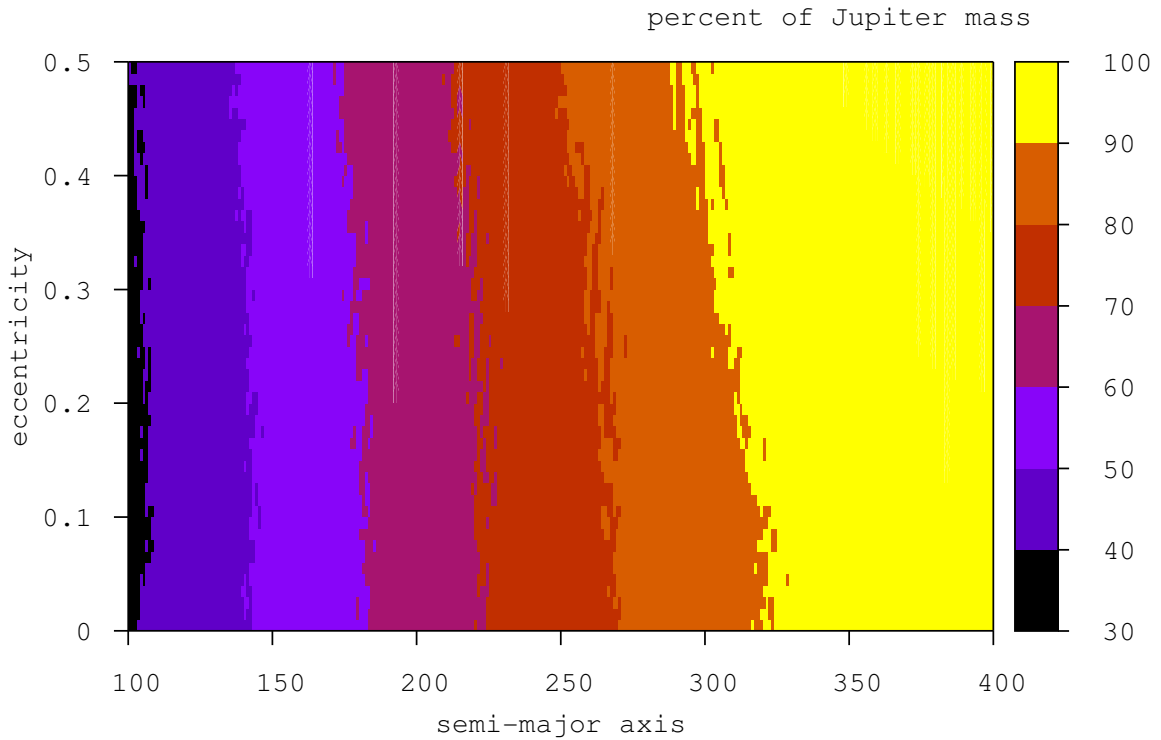
Prograde



Retrograde

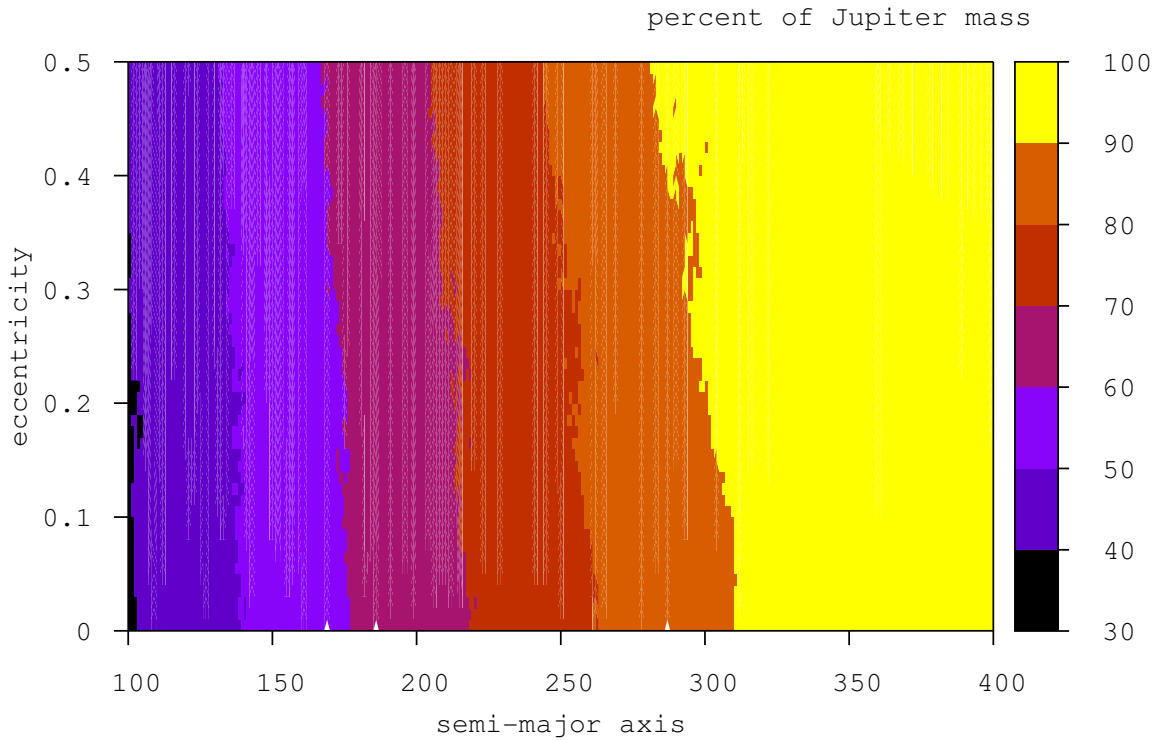
Escape/Capture Time

10^3 years - Prograde



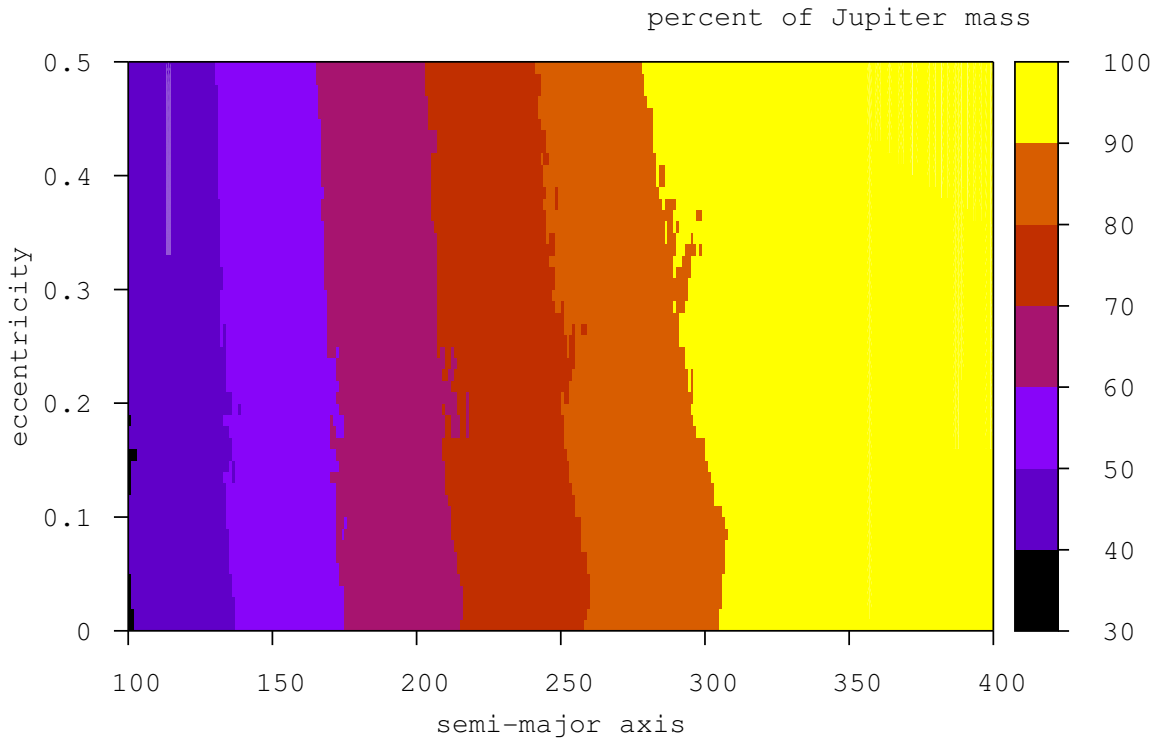
Escape/Capture Time

10^4 years - Prograde



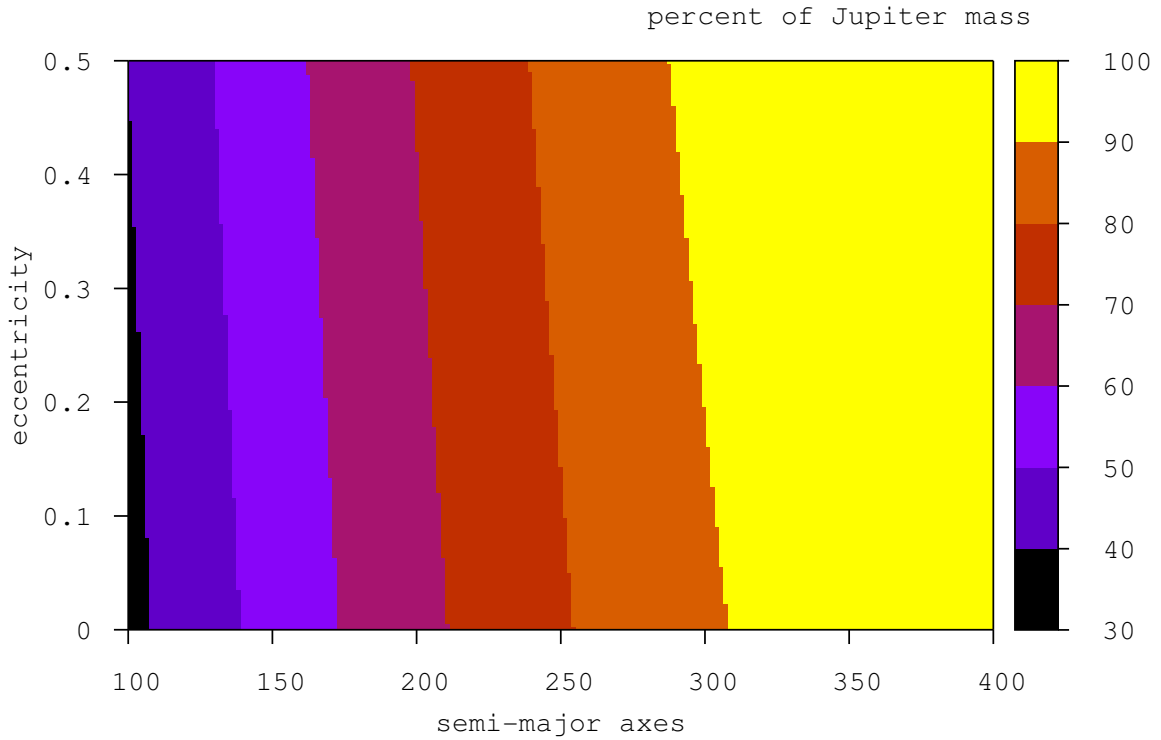
Escape/Capture Time

10^5 years - Prograde

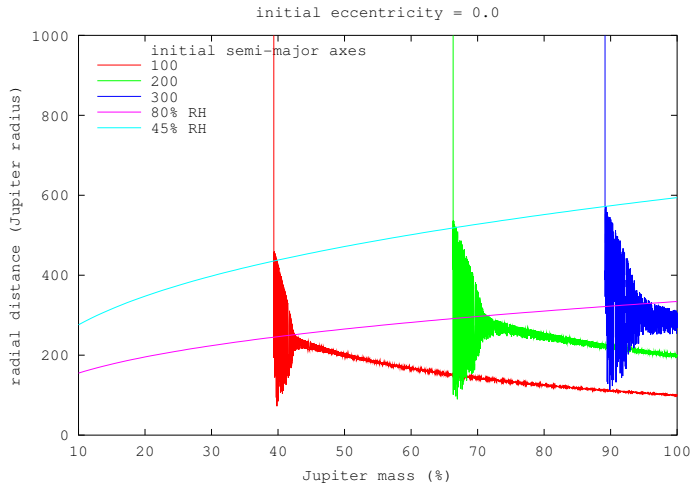


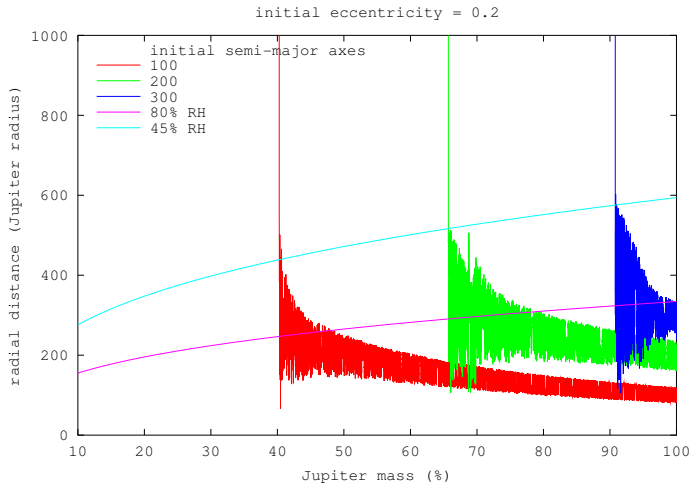
Escape/Capture Time

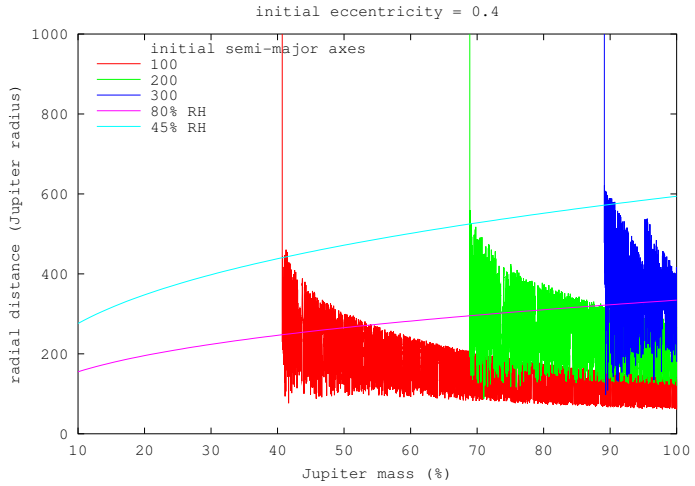
$$M(a,e) = k_0 + k_1 a + k_2 e + k_3 a^2$$ – Prograde



Escape/Capture Condition - PROGRADE

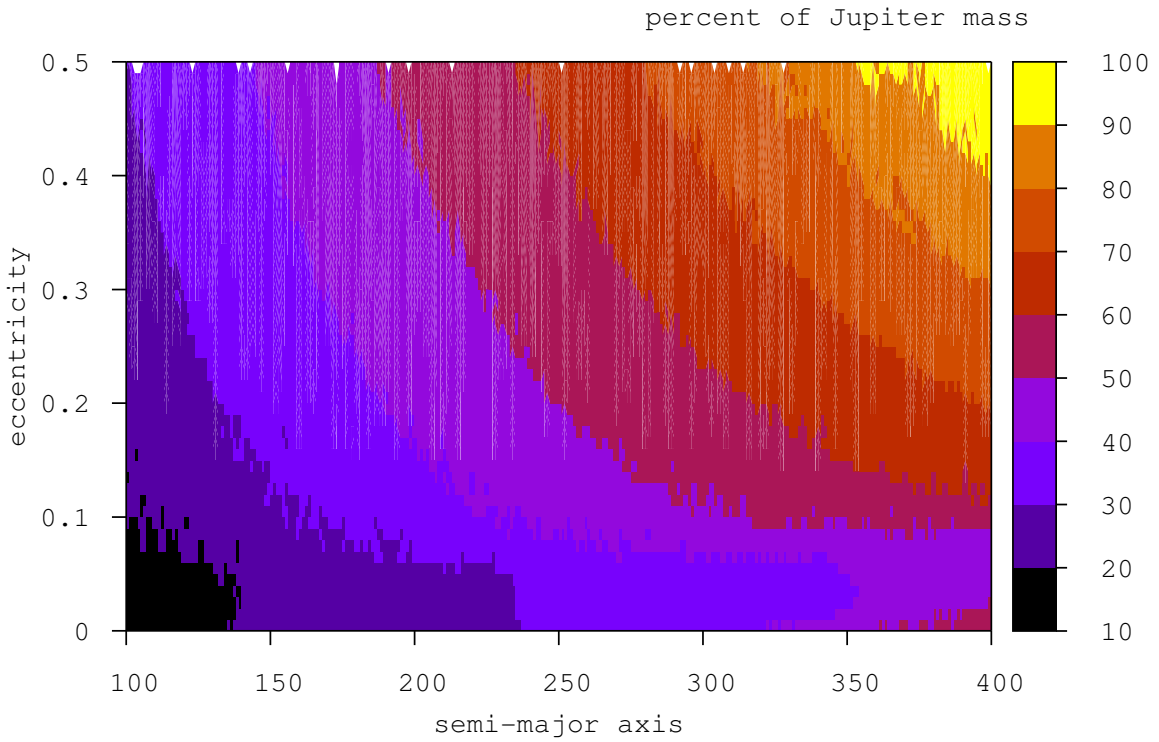






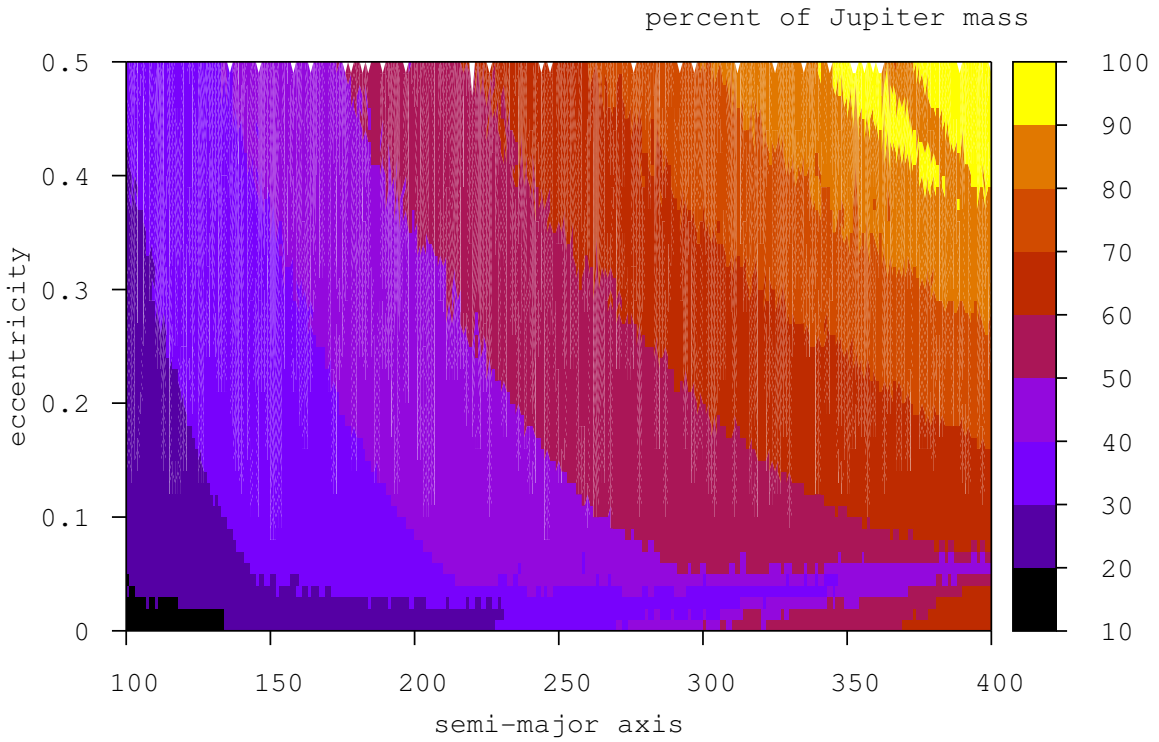
Escape/Capture Time

10^3 years - Retrograde



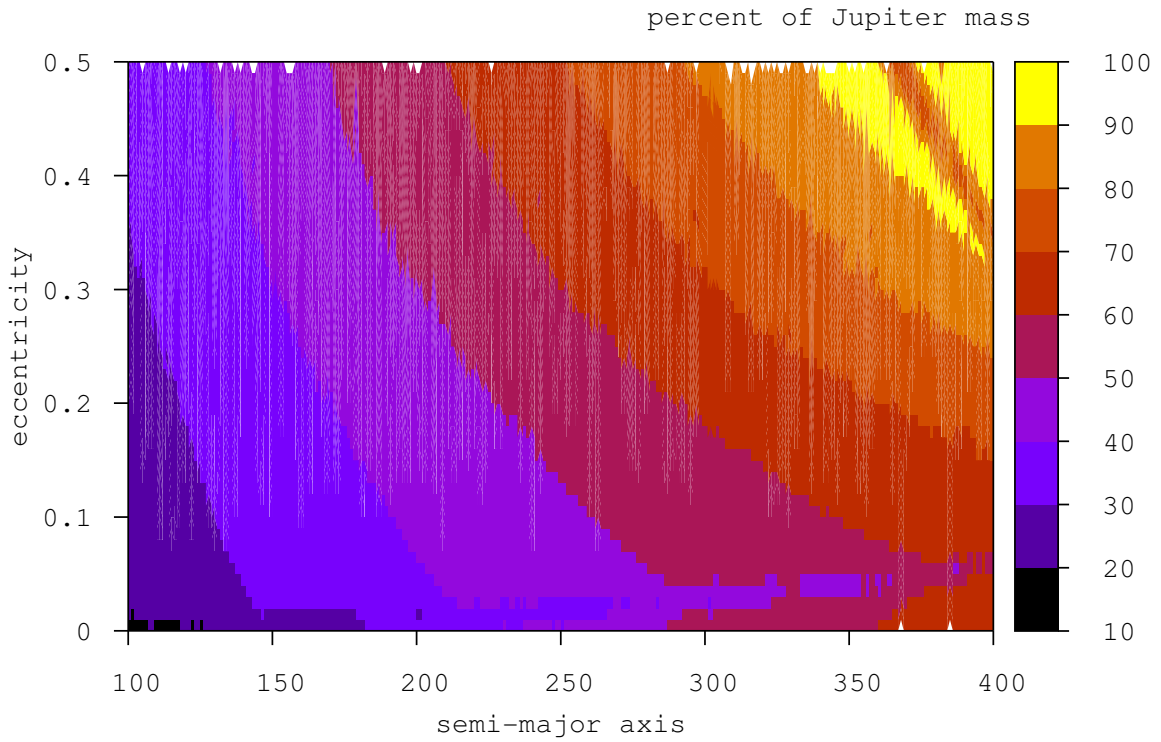
Escape/Capture Time

10^4 years - Retrograde



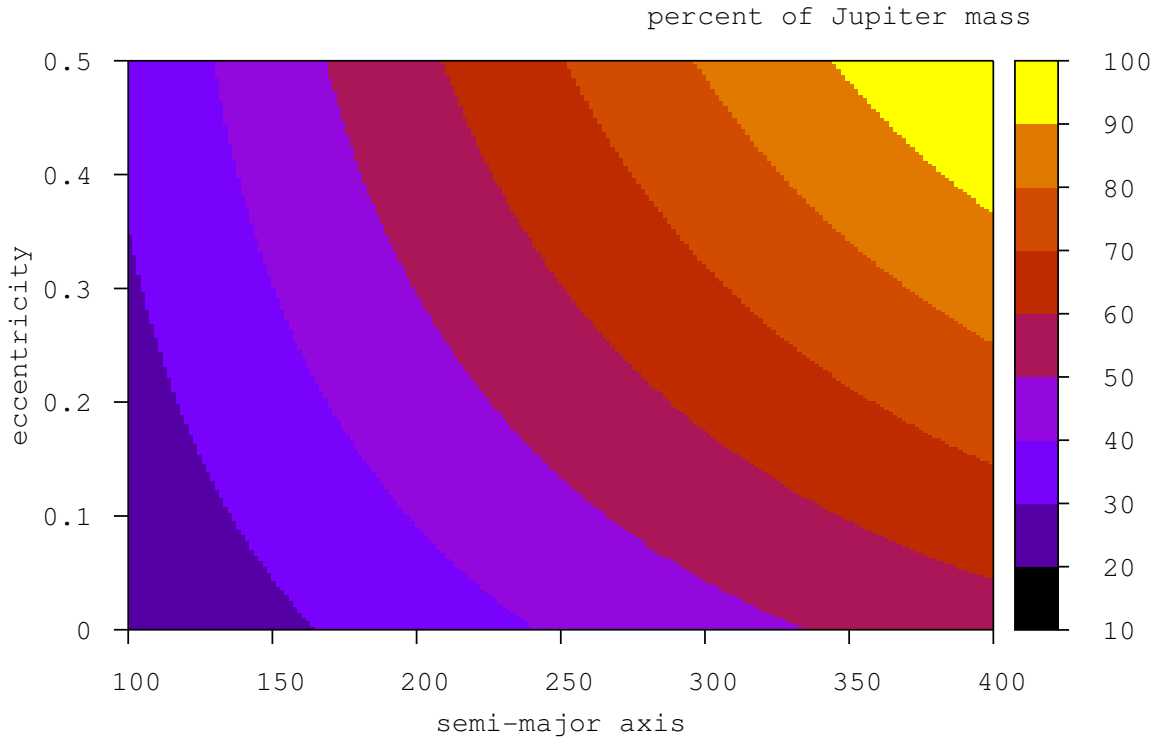
Escape/Capture Time

10^5 years - Retrograde

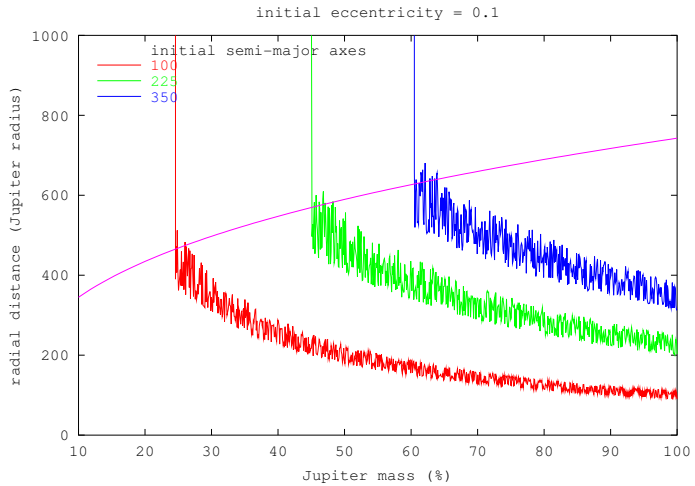


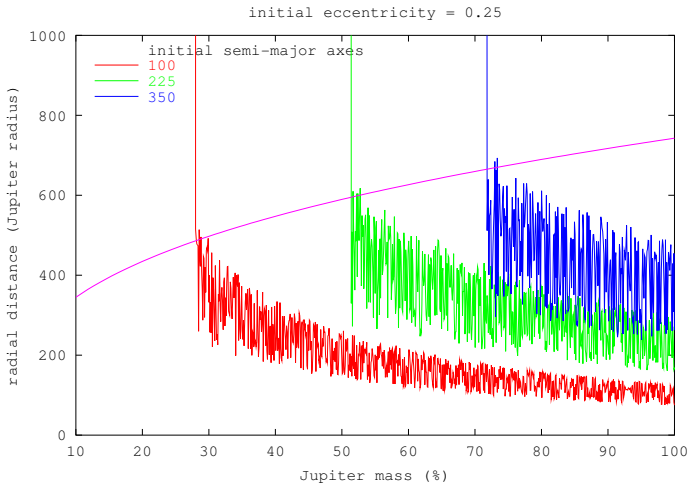
Escape/Capture Time

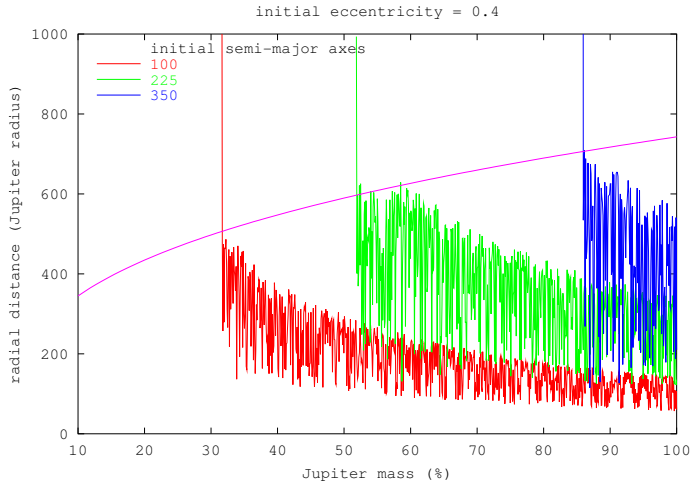
$$M(a,e) = k_0 + k_1 a + k_2 e + k_3 a^2 + k_4 e^2$$ Retrograde



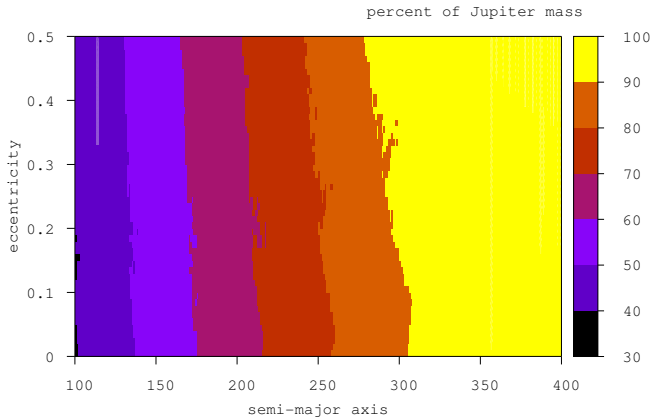
Escape/Capture Condition -RETROGRADE

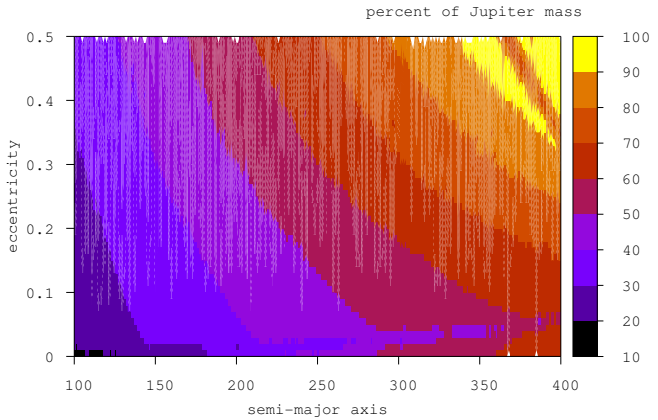


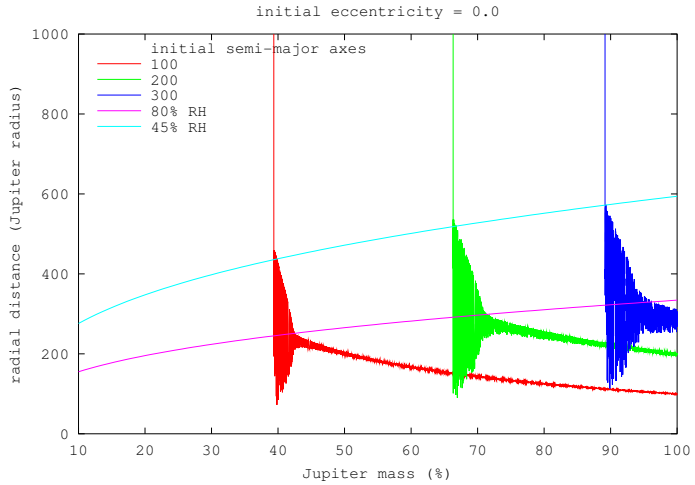


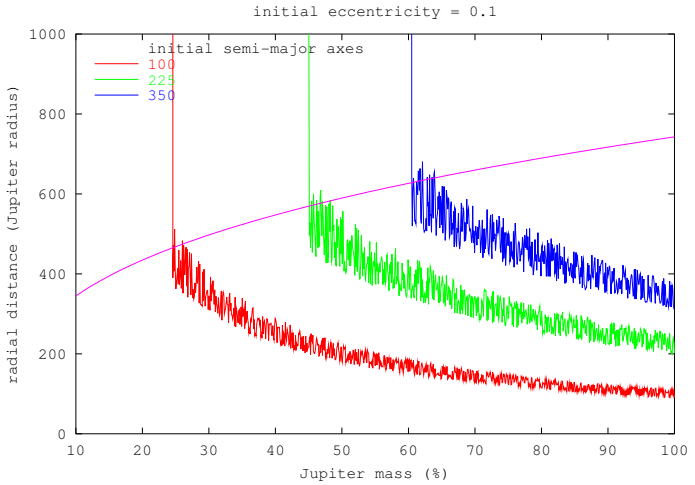


Prograde versus Retrograde

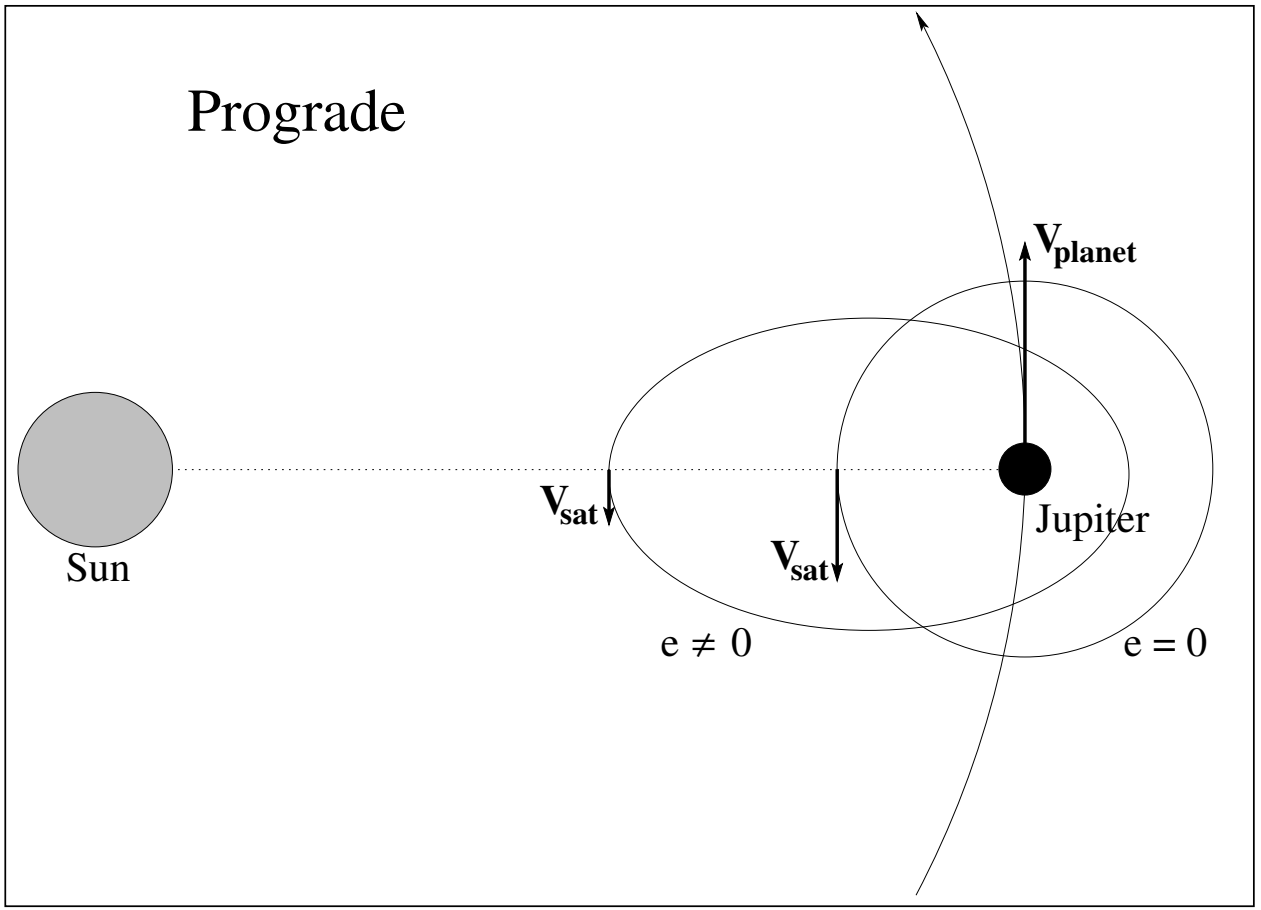
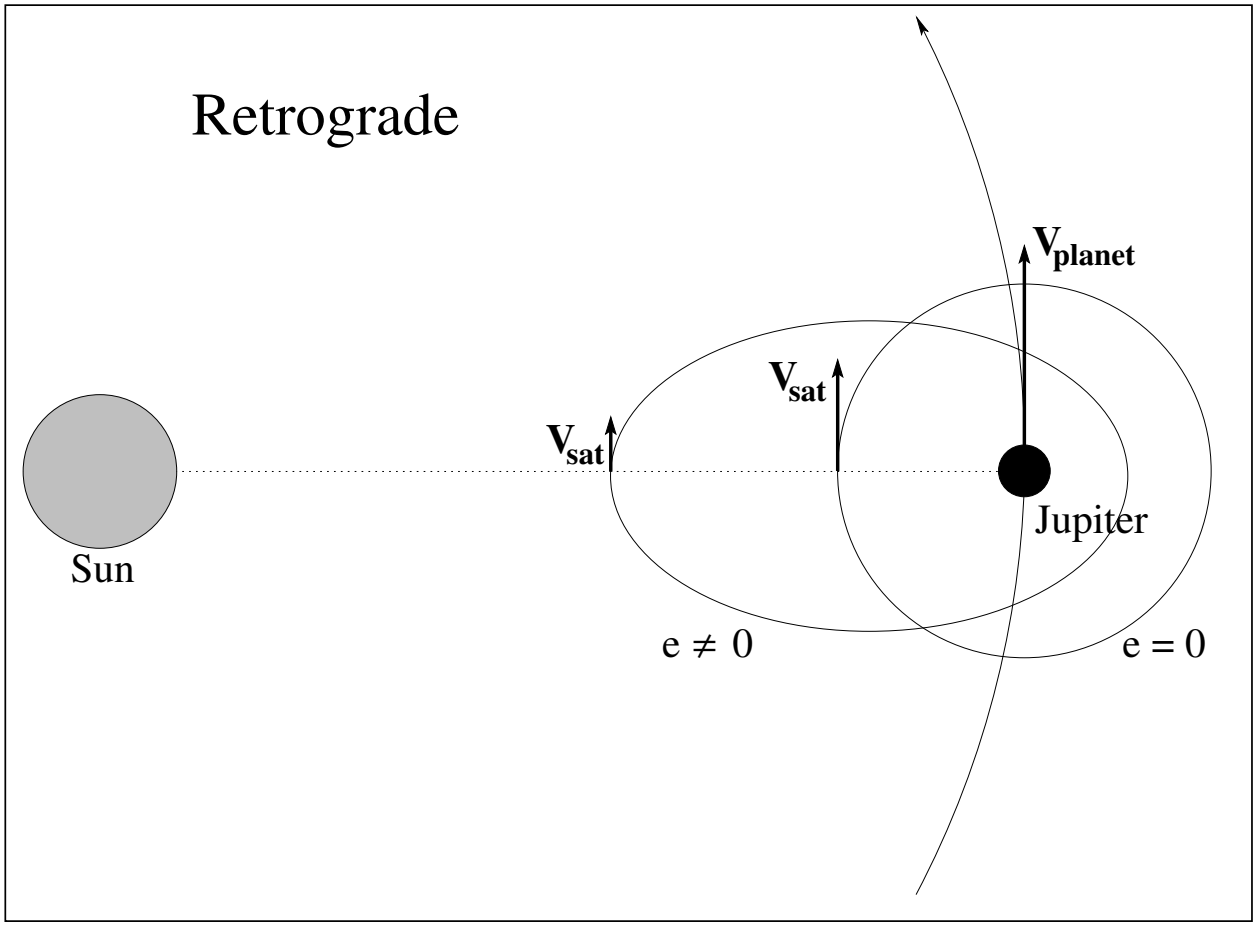








Prograde versus Retrograde



Prograde versus Retrograde