Long-term evolution of the asteroid orbits at the 3:1 mean motion resonance with Jupiter (model problem)

V.V.Sidorenko[1]

1 Keldysh Institute of Applied Mathematics.
Miusskaya Sq. 4, 125047, Moscow (Russia).

Abstract

Under the scope of the non-planar restricted circular three-body problem (Sun-Jupiter-asteroid) we consider the asteroid's dynamics near 3:1 mean-motion resonance with Jupiter. The evolutionary equations, used to investigate the secular effects, are obtained through double averaging – over the orbital motions and over the rotations/oscillations of the resonant argument. In general such an averaging can be done only numerically.

The validity of the evolutionary equations over the large time span is closely connected with the conservation of the adiabatic invariant peculiar to the original system. The qualitative changes in the resonant angle behavior (transitions from the rotations to oscillations and vice versa) lead to violation of the adiabatic invariance. As a result the large region of chaotic motions appears in the system's phase space. In [1, 2] the adiabatic chaos at 3:1 mean-motion resonance was discussed in context of elliptic restricted three-body problem. We study the properties of the adiabatic chaos region in the phase space of non-planar circular problem under the same resonance conditions.

References

[1] J. Wisdom. A perturbative treatment of motion near the 3/1 commensurability. *ICARUS*, 63:272-286, 1985.

[2] A.I.Neishtadt, V.V.Sidorenko. Wisdom system: dynamics in the adiabatic approximation. *Celest. Mech. Dyn. Astron.*, 90:307-330, 2004.