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On the rotation of co-orbital bodies

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Abstract

The rotation of asymmetric bodies in eccentric Keplerian orbits may be chaotic. As it is the case for Hyperion [1], this phenomenon is due to the overlapping of spin-orbit resonances. For a Keplerian motion with small eccentricity, the only relevant spin-orbit resonance is the synchronous one (when the orbital frequency is equal to the rotation frequency as it is the case for the Moon). As a consequence, the rotation is generally regular.

Here we are interested in the rotation of a body whose orbital motion is perturbed by a third one. The situation in which the rotator and the perturbing body are in co-orbital resonance (1:1 orbital resonance) is particularly interesting. We demonstrate that, even when the eccentricities of the trajectories are small, stable non-synchronous rotation is possible for a wide range of mass ratios and body shapes [2]. We further show that the rotation becomes chaotic when the natural rotational libration frequency, due to the axial asymmetry, is of the same order of magnitude than the orbital libration frequency inside the co-orbital resonance. When the co-orbital bodies evolve on elliptic orbits with significant eccentricities, case in which non-synchronous spin-orbit resonances are possible on Keplerian orbits, a new kind of spin-orbit resonance appears.

References

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