

Co-orbital quasi-periodic solutions in the planar three-body problem

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Within the framework of the planar three-body problem we establish the existence of quasi-periodic motions and KAM 4-tori related to the co-orbital motion of two small moons around a large planet in such a way that the moons move in nearly circular orbits with almost equal radii. The approach is based on a combination of normal form and symplectic reduction theories and the application of a KAM theorem for high-order degenerate systems. To accomplish our results we expand the Hamiltonian of the three-body problem as a perturbation of two uncoupled Kepler systems and perform further suitable symplectic changes of coordinates. The resulting transformed Hamiltonian represents a system in 1:1 resonance corresponding to the mean-motion resonance of the Kepler problems plus the perturbing higher-order terms. This approximation is valid in the region of phase space where co-orbital solutions occur. In the application of KAM theory we distinguish between big and moderate-to-small values of an angular-momentum-like action. For the latter case we need to execute an extra transformation that requires the introduction of a pair of action-angle coordinates by means of elliptic functions.

This is a joint work with J.M. Cors and J.F. Palacián.