Beyond all orders breakdown of the homoclinic connection to L_3 in the Restricted Planar Circular 3-Body Problem

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Abstract

The Restricted Planar Circular 3-Body Problem (RPC3BP), in synodic coordinates, can be modeled by a two degrees of freedom Hamiltonian. It has a critical point called L_3, collinear with the primaries and beyond the largest of the two, which is a saddle-center and possesses 1-dimensional stable and unstable manifolds. If the ratio between the masses of the primaries μ is small, the hyperbolic eigenvalues of L_3 are weaker, by a factor of order $\sqrt{\mu}$, than the elliptic ones.

In this talk, we present an asymptotic formula for the distance between the stable and unstable manifolds of L_3. Due to the rapidly rotating dynamics, this distance is exponentially small with respect to $\sqrt{\mu}$ and, as a result, classical perturbative methods (i.e the Melnikov-Poincaré method) can not be applied.

One of the main challenges of the proof is to obtain a good first order with an homoclinic connection and to analyze the complex singularities of its time parametrization. To obtain the the leading term of the difference, the perturbed manifolds have to be analyzed close to these singularities.

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