Collision leading to chaos in the Restricted Planar Circular 3-Body Problem

Authors:

- Marcel Guàrdia Munarriz, Departament de Matemàtiques i Informàtica, UB & CRM, Barcelona (marcel.guardia@upc.edu)
- José Lamas Rodríguez, Departament de Matemàtiques & IMTECH, UPC (jose.lamas.rodriguez@upc.edu)
- Tere M-Seara, Departament de Matemàtiques & IMTECH, UPC & CRM, Barcelona (Tere.M-Seara@upc.edu)

Abstract:

We consider the restricted planar circular three body problem (RPC3BP), which describes the motion of a massless body under the attraction of other two bodies, the primaries, which describe circular orbits around their common center of mass located at the origin.

In a suitable system of coordinates, this system is Hamiltonian with two degrees of freedom, whose conserved energy is usually called the Jacobi constant. In such system, we are interested in solutions of the RPC3BP called ejection-collision orbits, i.e., solutions that depart from the big primary at some time t_0 and collide with it at some time t_1.

In this talk, I will explain how to construct arbitrarily large ejection-collision orbits for small values of the mass ratio. To this end, we show that, for small values of the mass ratio and the Jacobi constant, there exist transverse intersections between the stable (unstable) manifold of infinity and the unstable (stable) manifold of collision.

Close to such transverse intersections, we prove the existence of a sequence of ejection-collision orbits that travel arbitrarily far away. Moreover, using a similar argument, we prove the existence of a sequence of forward and backward periodic parabolic orbits that travel close to collision too. Finally, we also prove the existence of periodic orbits that travel close to collision and arbitrarily far away.