Parabolic ejection & collision orbits for the restricted planar circular three body problem

A. Marcel Guàrdia Munárriz[*] B. José Lamas Rodríguez[†]
C. Tere M-Seara [‡]

Abstract

We consider the restricted planar circular three body problem (RPCTBP), 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 RPCTBP called *ejection-collision orbits*, i.e., solutions that depart from the big primary at some time t_0 and collide with it at some instant t_1. In particular, we will study the case when such orbits go arbitrarily far away for small values of the mass ratio.

To obtain them, we show that, for small values of the mass ratio and the Jacobi constant, there exist transversal intersections between the stable (unstable) manifold of *infinity* and the unstable (stable) manifold of collision.

Close to such transversal 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.

[*]Departament de Matemàtiques, Universitat de Barcelona; Centre de Recerca Matemàtica, Campus de Bellaterra, Edifici C. Email: guardia@ub.edu

[†]Departament de Matemàtiques, Universitat Politècnica de Catalunya Email: jose.lamas.rodriguez@upc.edu

[‡]Departament de Matemàtiques, Universitat Politècnica de Catalunya; Centre de Recerca Matemàtica, Campus de Bellaterra, Edifici C. Email: tere.m-seara@upc.edu