AN APPLICATION OF THE MELNIKOV INTEGRAL TO A RESTRICTED THREE BODY PROBLEM

JAUME LLIBRE

Departament de Matemàtiques, Universitat Autònoma de Barcelona, 08193 – Bellaterra, Barcelona, Spain. E-mail: jllibre@mat.uab.es

ERNESTO PEREZ-CHAVELA

Departamento de Matemáticas, Universidad Autónoma Metropolitana–Iztapalapa, Av. San Rafael Atlixco 186, México D.F. 09340, México. E-mail: epc@xanum.uam.mx

Using the variational method introduced by Melnikov, we prove the existence of transversal homoclinic orbits in a particular collinear restricted three body problem. As a consequence we can embed a Bernoulli shift on a suitable cross section of the flow, showing that this problem possesses chaotic dynamics.

1. Introduction and equations of motion

The classical restricted three body problem studies the motion of a massless particle $m_3 = 0$, under the gravitational attraction of two masses m_1 and m_2 called the primaries; they move uniformly in circular Kepler orbits around their center of mass.

In this paper we consider another restricted three body problem, where the primaries are in a degenerate elliptic collision orbit, and the massless particle moves in the same line that m_1 and m_2. We must emphasize that this model does not correspond to the usual collinear restricted three body problem, here we avoid the rotation effect of the primaries, our goal is to show in this simple model, how the Melnikov integral method can be used to avoid long and tedious computations, even in models with singularities due to collisions, where of course, these singularities must be previously regularized. The classical restricted collinear three body problem, including the rotating effect of the primaries has been studied by the same authors in [5].

We consider three point masses $m_1 = \mu$, $m_2 = 1 - \mu$ and $m_3 = 0$ with μ