

# NEAR-RECTILINEAR MOTIONS IN THE SPATIAL THREE-BODY PROBLEM

**Jesús F. Palacián, Flora Sayas and Patricia Yanguas**

Departamento de Ingeniería Matemática e Informática  
Universidad Pública de Navarra  
Campus de Arrosadía, 31006 Pamplona (Navarra) Spain  
palacian@unavarra.es, flora.sayas@unavarra.es and yanguas@unavarra.es

## Abstract

In the context of KAM theory and the spatial three-body problem, specifically in the regime where the Hamiltonian is split as the sum of two Keplerian systems plus a small perturbation, we deal with the quasiperiodic solutions of the three bodies such that the two inner particles describe near-collision orbits. More precisely the inner particles never collide, they follow orbits that are close to bounded straight lines. These solutions fill in invariant 5-tori and their motions occur either near the plane perpendicular to the invariable plane or near the invariable plane. The orbit of the outer particle has an eccentricity varying between zero and a value upper bounded by  $e_{2\max} < 1$  and lies near the invariable plane. These solutions have been studied for the first time by Lei Zhao in his PhD thesis. Our approach is different and consists of a combination of a regularisation process based on the construction of the reduced spaces at different levels and the explicit determination of sets of symplectic coordinates that allow us to calculate the torsions in the various possible cases. Moreover we use a theorem by Han, Li and Yi on the existence of quasiperiodic solutions for Hamiltonian systems with high-order proper degeneracy.