A Geometric and Dynamical Review of the Spin-Orbit Problem

Brayan Guerra

June 3, 2025

Abstract

The spin-orbit problem arises in celestial mechanics as a model for the rotational dynamics of a satellite orbiting a central body, particularly when the satellite has an asymmetric mass distribution. Historically motivated by the synchronous rotation of the Moon, the model provides a rich framework for understanding resonance phenomena in finite-dimensional dynamical systems. This poster offers a review of the origin and mathematical formulation of the conservative spin-orbit model, emphasizing its Hamiltonian structure and its relation to symplectic geometry. We also examine the dissipative version of the model, where energy loss due to internal friction or tidal forces leads to the emergence of attractors and modifies the qualitative dynamics. By comparing these two settings, we highlight how the spin-orbit problem serves as a foundational example in the study of geometric and dynamical structures in celestial mechanics.