Arnold diffusion in the elliptic restricted three body problem

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The restricted planar elliptic three body problem (RPETBP) describes the motion of a massless particle (a comet) under the gravitational field of two massive bodies (the primaries, say the Sun and Jupiter) revolving around their center of mass on elliptic orbits with some positive eccentricity. The aim of this talk is to show the existence of orbits whose angular momentum performs arbitrary excursions in a large region. In particular, there exist diffusive orbits, that is, with a large variation of angular momentum.

The leading idea of the proof consists in analyzing parabolic motions of the comet. By a well-known result of McGehee, the union of future (resp. past) parabolic orbits is an analytic manifold. In a properly chosen coordinate system these manifolds are stable (resp. unstable) manifolds of a manifold at infinity, which turns out to be topologically equivalent to a normally hyperbolic invariant manifold (TNHIM).

On this TNHIM, it is possible to define two scattering maps, which contain the map structure of the homoclinic trajectories to it, i.e., orbits parabolic both in the future and the past. A non-canonical symplectic structure still persists close this TNHIM and extends naturally to a b^3-symplectic structure. Such singular structures appear also in other problems of Celestial Mechanics.

Since the inner dynamics inside the TNHIM is trivial, two different scattering maps are used. The combination of these two scattering maps permits the design of the desired diffusive pseudo-orbits. Using shadowing techniques and these pseudo orbits we show the existence of true trajectories of the RPETBP whose angular momentum varies in any predetermined fashion.

This is a joint work with Vadim Kaloshin, Abraham de la Rosa, and Tere M. Seara (`arXiv:1501.01214`).