Publicacions més rellevants de la línia de recerca:
Astrodinàmica

Referència: Romero-Gómez, M., Masdemont, J.J., Athanassoula, E. and García-Gómez, C. The formation of spiral arms and rings in barred galaxies. *Astron. Astrophys.*, **472** (2007), pp.:63–75.

Abstract:

In this and in a previous paper (Romero-Gómez et al. 2006) we propose a theory to explain the formation of both spirals and rings in barred galaxies using a common dynamical framework. It is based on the orbital motion driven by the unstable equilibrium points of the rotating bar potential. Thus, spirals, rings and pseudo-rings are related to the invariant manifolds associated to the periodic orbits around these equilibrium points. We examine the parameter space of three barred galaxy models and discuss the formation of the different morphological structures according to the properties of the bar model. We also study the influence of the shape of the rotation curve in the outer parts, by making families of models with rising, flat, or falling rotation curves in the outer parts. The differences between spiral and ringed structures arise from differences in the dynamical parameters of the host galaxies. The results presented here will be discussed and compared with observations in a forthcoming paper.

Referència: Delshams, A., Masdemont, J. and Roldán, P. Computing the scattering map in the spatial Hill's problem. *Discrete Contin. Dyn. Syst. Ser. B*, **10(2-3)** (2008), pp. 455-483.

Abstract: Let Λ_1 and Λ_2 be two normally hyperbolic invariant manifolds for a flow, such that the stable manifold of Λ_1 intersects the unstable manifold of Λ_2 transversally along a manifold Γ. The scattering map from Λ_2 to Λ_1 is the map that, given an asymptotic orbit in the past, associates the corresponding asymptotic orbit in the future through a heteroclinic orbit. It was originally introduced to prove the existence of orbits of unbounded energy in a perturbed Hamiltonian problem using a geometric approach. We recently computed the scattering map in the planar restricted three body problem using non-perturbative techniques, and we showed that it is a (non-trivial) integrable twist map. In the present paper, we compute the scattering map in a problem with three degrees of freedom using also non-perturbative techniques. Specifically, we compute the scattering map between the normally hyperbolic invariant manifolds Λ_1 and Λ_2 associated to the equilibrium points L_1 and L_2 in the spatial Hills problem. In the planar problem, for each energy level (in a certain range) there is a unique Lyapunov periodic orbit around $L_{1,2}$. In the spatial problem, this periodic orbit is replaced by a three-dimensional invariant manifold practically full

of invariant $2D$ tori. There are heteroclinic orbits between Λ_1 and Λ_2 connecting these invariant tori in rich combinations. Hence the scattering map in the spatial problem is more complicated, and it allows nontrivial transition chains. Scattering maps have application to e.g. mission design in Astrodynamics, and to the construction of diffusion orbits in the spatial Hills problem.

Referència: Canalias, E. and Masdemont, J.J. Computing natural transfers between Sun-Earth and Earth-Moon Lissajous libration point orbits. *Acta Astronaut.*, **63(1-4)** (2008), pp.238–248.

Abstract: The four body problem SunEarthMoonspacecraft can be decoupled, in a raw first approximation, in two restricted three body problems (RTBPs): the SunEarth+Moon (SE) and the EarthMoon (EM). Using the hyperbolic manifolds of the libration orbits of both problems and intersecting them in an adequate way, trajectories joining the solar and lunar libration regions can be found. Unfortunately, however, the coupling of two different RTBPs does not correspond to the physical reality of the Sun, Earth and Moon relative motions. Therefore, the initial trajectories obtained in the simplified model have to be refined to more realistic models. The present work introduces a way to compute connecting trajectories between EM and SE L_2 Lissajous type orbits, starting from a simple model which couples two RTBP and refining them to JPL ephemeris. Furthermore, the refinement of the trajectories is tackled in such a way that the cost of the coupling is iteratively reduced, while the trajectory is kept similar to the original one in the coupled RTBPs. As a result, zero cost or natural connecting trajectories are obtained when possible. For less favourable cases, the outcome of the method are connecting trajectories which need a maneuver at the coupling point, always below 100 m/s of total Δv.