

# On the four-body limaçon trisectrix choreography: maximal superintegrability and choreographic fragmentation

**Adrian M. Escobar-Ruiz<sup>1</sup>**

(in collaboration with Manuel Fernández-Guasti)

<sup>1</sup>Departamento de Física, Universidad Autónoma Metropolitana-Iztapalapa, Rafael Atlixco 186, CDMX, 09340, Ciudad de México, México

## **Abstract:**

In this talk, we explore the dynamical and symmetry properties of a four-body system exhibiting choreographic motion along a limaçon trisectrix, building on recent results [Celest. Mech. Dyn. Astron. 137, 4 (2025)]. We demonstrate that the reduced Hamiltonian governing the motion in six-dimensional relative space is *maximally superintegrable*, admitting a complete set of eleven independent integrals of motion, which we indicate explicitly. We show that the system allows a complete separation of variables. The emergence of the observed choreography is not solely due to superintegrability. Instead, it arises from a subtler mechanism: the presence of *particular involution* and existence of *particular integrals*. Additionally, we describe how a more general four-body choreography can fragment into two distinct two-body choreographies, revealing a rich structure in the solution space.