Celestial Mechanics and Geometry

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It is proposed to apply Symplectic Geometry, as well as Symplectic Topology, to improve the standard windows and cones used in shadowing trajectories of Hamiltonian systems. This would provide efficient methods to find solutions for Celestial Mechanics, which could be effectively implemented to lead to computer-assisted proofs.

Since the beginning of Celestial Mechanics, Geometry has played a key role in its development, although not always explicitly. For example, Symplectic Geometry is of great help in the theory of perturbation through the Poisson brackets and the canonical transformations used to preserve Hamiltonian equations. However, close to singularities, such as collisions and infinity, the (singular) symplectic structure has often been abandoned, with the consequent loss of its benefits. It has not been until recently, within the Laboratory of Geometry and Dynamical Systems https://geodys.upc.edu/, that this type of singular symplectic structures have been and are being successfully applied [1-3] by senior and junior researchers. The interaction with all the other researchers working on similar problems will be of great help to carry out this project.

[1] Amadeu Delshams, Vadim Kaloshin, Abraham de la Rosa, Tere M. Seara, Global Instability in the Restricted Planar Elliptic Three Body Problem, Comm. Math. Phys., 1-56, 2018, https://doi.org/10.1007/s00220-018-3248-z

[2] Roisin Braddell, Amadeu Delshams, Eva Miranda, Cedric Oms and Arnau Planas, An invitation to singular symplectic geometry to appear at the International Journal of Geometric Methods in Modern Physics, April 2017, https://arxiv.org/abs/1705.03846.

[3] Amadeu Delshams, Anna Kiesenhofer and Eva Miranda, Examples of integrable and non integrable systems on singular symplectic manifolds, J. Geom. Phys. 115:89-97, 2017.

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