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Finite-time Lyapunov exponents in zones of magnetic reconnection in Earth's magneto-tail

Christoph Lhotka (1), Philippe Bourdin (1), and Elke Pilat-Lohinger (2)

(1) Space Research Institute, Austrian Academy of Sciences, Graz, Austria (christoph.lhotka@oeaw.ac.at), (2) Institute for Astrophysics, University of Vienna, Vienna, Austria

Lyapunov exponents have widely been used in literature to investigate dynamical problems, that can be found in various research fields ranging from quantum to space physics. From a mathematical point of view the Lyapunov characteristic exponent is a quantity that characterizes the rate of separation of nearby solutions in a dynamical system. In the field of celestial mechanics the theory has most often been used to distinguish between regular and chaotic orbits in nonlinear dynamics. However, it may also safely be used just to investigate the behaviour of nearby trajectories of particles in generic dynamical problems. The motion of atomic particles close to regimes of magnetic reconnection is non-trivial as a result of the sudden change of connectivity within magnetic field topologies. The evolution of the magnetic field far away from the reconnection site may well be described on fluid scales. However, plasma-kinetic scales are necessary to understand the physics taking place close to the reconnection site itself. In this talk we investigate the different kinds of possible motions of individual electrons in regions of phase in the vicinity of magnetic reconnection. We describe the possibility to investigate the orbital motions together with the the variational equations of the problem derived from Lorentz force equations. Using the theory of finite time approximations of Lyapunov exponents we present first results based on numerical simulations that reveal the topology of the phase space close to the reconnection center from a dynamical systems point of view. The results are going to be discussed in the context of plasma physics, i.e. open problems, and possible applications to space missions.