QPhysics AT QUEENS COLLEGE

Colloquium Notice

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Resonance phenomena in (Micro)Fluids and (Huge)Plasma

In my talk I discuss several aspects of transport phenomena in the near-integrable multiscale dynamical system. Multi-scale systems naturally arise when a small perturbation is added to an integrable base (or unperturbed) subsystem. Not only are such systems common in various applications, this is the only class of dynamical systems that generically affords a quantitative analytical treatment. Direct brute-force numerical simulation of such systems are possible, but usually are very challenging precisely due to a big separation of time scales. Approximate analytical tools represent an important alternative for studying such systems. An approach that greatly simplifies the description of the mixing dynamics in multi-scale systems is based on the method of averaging: in order to study long-time dynamics, the equations of motion for phase points are averaged over the fast time scale(s). In the present talk I illustrate the glory and the fall of the method of averaging by considering two examples: one from microfluidics and one from plasma physics. In the first part of the talk I consider mixing via resonances-induced chaotic advection in microdroplets. I show that proper characterization of the mixing quality requires introduction of two different metrics. The first metric determines the relative volumes of the domain of chaotic streamlines and the domain of regular streamlines. The second metric describes the time for homogenization inside the chaotic domain. In the second part of my talk, I describe the resonant interaction between monochromatic electromagnetic waves and magnetized electrons in configurations with magnetic field reversals (e.g. in the earth magnetotail). I discuss in two resonant phenomena occurring during slow passages of a particle through a resonance: capture into resonance and scattering on resonance. These processes result in destruction of adiabatic invariant, chaotization and almost free acceleration of particles. We calculate the characteristic times of mixing due to resonant effects and the rates of the acceleration.

Monday
October 28, 2013
Starts at 12:15 PM
Coffee at 12:00 PM
Physics Conference Room, SB B326