Seminario de análisis matemático y aplicaciones
Analisi matematikoa eta aplikazioak mintegia

Kinetic models of particles interacting with their environment

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ABSTRACT:

The goal of this talk is to study a generalization of an Hamiltonian model describing the interaction between a single particle and its environment. In the first model, The state of the environment is represented by a vibrating scalar field which exchanges energy with the particle. In large time, it has been proved that the particle behave as if it was subjected to a friction force driven by the environment while the global energy stay constant.

After a short introduction, we will consider an infinite number of particles represented by their distribution function and suppose that they all interact with the environment as in the first model. The evolution of the system is driven by two equations (one for the particles and one for the environment) which can be summarize in a single Vlasov-like equation. The physical validity of these equations is established by a mean-field limit on the initial model, the solutions always exist and are unique under a strong integrability condition on the initial distribution function. Making the wave velocity in the medium going to infinity, we will connect our model with a regular Vlasov equation and also with the attractive Vlasov-Poisson equation. We will then care about some large time asymptotic issues. First, adding a diffusion term which can be interpreted as the consequence of a Brownian agitation and a friction driven by the environment, some hypocoercivity estimates allow us to prove the relaxation to the unique equilibrium of the new system. Then, coming back to our previous model we will discuss the stability of a large family of equilibrium states. The question of whether or not the solutions converge is not fixed yet, we will end by presenting some new qualitative results which allow us to get an idea of what can happen.

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