ERGODIC PROPERTIES OF SOME OPEN MECHANICAL PARTICLE SYSTEMS

Tatiana Yarmola
Department of Mathematics, University of Geneva

Rigorous derivations of macroscopic heat conduction laws from microscopic dynamics of mechanical particle systems coupled to heat reservoirs require good mixing properties of the stationary distributions. For many such systems in non-equilibrium, i.e. with two or more unequal heat reservoirs, pure existence of stationary distributions is a nontrivial question due to the non-compactness of the phase space. One of the main technical difficulties is related to a possible overheating of a moving particle. We consider a class of mechanical particle systems interacting with thermostats. Particles move freely between collisions with disk-shaped thermostats arranged periodically on the torus. Upon collision, an energy exchange occurs, in which a particle exchanges its tangential component of the velocity for a randomly drawn one from the Gaussian distribution with the variance proportional to the temperature of the thermostat; the normal component of the velocity changes sign. We show that in the stationary distribution exists, is unique, and absolutely continuous. Moreover under rather mild conditions initial distributions converge to the equilibrium. The rates of convergence, however, are sub-exponential due to an effect of slow particles. Similar methods can be applied to several generalizations of the above class of systems.