Classical and quantum chaos and understanding and control of heat flow

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The understanding of the underlying dynamical mechanisms which determines the macroscopic laws of heat conduction is a long standing task of non-equilibrium statistical mechanics. A better understanding of such mechanism may also lead to potentially interesting applications based on the possibility to control the heat flow. Indeed, the possibility to build a thermal rectifier is discussed, in which heat can flow preferentially in one direction. Although a prototype realization is far away, the underlying mechanisms are of very general nature and, as such, are suitable of improvement and may eventually lead to real applications. Of particular interest is the problem, almost completely unexplored, of the derivation of Fourier law from quantum dynamics. To this end we discuss heat transport in a model of a quantum interacting spin chain and we provide clear numerical evidence that Fourier law sets in above the transition to quantum chaos. Finally the problem of thermoelectric efficiency is briefly discussed.