Thermal conductivity in one-dimensional lattices

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We study the thermal conductivity of two models of one-dimensional monoatomic lattice of anharmonic oscillators with Langevin thermostats at temperatures T_L and T_R attached to its left and right boudaries. The first model [1] is a Toda lattice perturbed by a stochastic dynamics preserving energy and momentum. The strength of the stochastic noise is controlled by a parameter γ, and the left and right ends temperatures are constant and $T_L > T_R$. We show that heat transport is anomalous, and that the thermal conductivity diverges with the length n of the chain according to $\kappa(n) \sim n^{\alpha}$, with $0 < \alpha \leq 1/2$. In particular, the ballistic heat conduction of the unperturbed Toda chain is destroyed. Besides, the exponent α of the divergence depends on γ.

The second model [2] is a chain of rotors coupled by the potential $V(q) = 1 - \cos(q)$ where q is each rotor's angle with its nearest neighbours. The left end of the system is considered fixed (attached to a wall) while its right end is subject to a constant mechanical forcing τ. We consider different (T_L, T_R) configurations: when T_R is fixed the behaviour of the mean current is qualitatively equivalent to the case in which $\tau = 0$, that is the effect of the thermal and mechanical forcing are somewhat addictive. On the other hand, when T_L is fixed, we obtain a surprising and counterintuitive result: an increase in the positive temperature gradient yields an increase of the negative heat current.

Références

[1] Iacobucci, A., F. Legoll, S. Olla, G. Stoltz, *Thermal Conductivity of the Toda Lattice with Conservative Noise*, J. Stat. Phys. , $140 : 336 - 348$, (2010).

[2] Iacobucci, A., F. Legoll, S. Olla, G. Stoltz, *Negative thermal conductivity of oscillators chains with mechanical forcing*, (in preparation).

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