Heat transport: effect of the range of the interactions

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Heat conduction is usually described by the Fourier’s law, however this law fails in many one-dimensional systems, where the temperature profile and the conductivity are anomalous. These anomalies depend on the type of interactions between the elements that compose the system. On the other hand, it is well known in the literature that the range of the interactions changes considerably the dynamic and thermodynamic properties of a system, appearing features such as negative specific heat, ensemble inequivalence, and quasi-stationary states. This motivates the present study to analyze the effects of the range of interactions in the context of heat transport. We consider a paradigmatic Hamiltonian system known in the literature as $\alpha$-XY model. It consists of a one-dimensional lattice of classical rotators with attractive couplings that decrease with distance as $r^{\alpha}$, with $\alpha \geq 0$. The ends of the chain are in contact with Brownian heat reservoirs at different temperatures with mean value $T$. In the limit $\alpha \to \infty$, only nearest neighbors interact, and the system satisfies Fourier’s law. In the opposite case $\alpha = 0$, interactions are global and the system behaves thermally as an insulator in the thermodynamic limit. For intermediate ranges, we establish different regimes for the behavior of the conductivity with system size, depending on $\alpha$ and the average temperature $T$. 