Title: A microscopic mechanism for increasing thermoelectric efficiency

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Abstract:

Thermoelectricity is an old field: The Seebeck effect, that is, the conversion of temperature differences into electricity, was discovered in 1821. In the last decade there has been an increasing pressure to find better thermoelectric materials with higher efficiency. The reason is the strong environmental concern about chlorofluorocarbons used in most compressorbased refrigerators. Also the possibility to generate electric power from waste heat using thermoelectric effect is becoming more and more interesting.

In my talk, I will talk on theoretical approach for increasing thermoelectric efficiency with microscopic models. At moment without taking account of experimental relevance, we are classifying the mechanism for the high efficiency. (Eventually we aim to apply them to experiments.) To this end, we consider several microscopic (toy) models.

We first study the coupled particle and energy transport in a prototype model of interacting one-dimensional system: the disordered hard-point gas, for which numerical data suggest that the thermoelectric figure of merit ZT diverges with the system size.

We next show that for systems with broken time-reversal symmetry the maximum efficiency and the efficiency at maximum power are both determined by two parameters: a "figure of merit" and an asymmetry parameter. In contrast to the time-symmetric case, the figure of merit is bounded from above; nevertheless the Carnot efficiency can be reached at lower and lower values of the figure of merit and far from the so-called strong coupling condition as the asymmetry parameter increases. We demonstrate an asymmetric Seebeck coefficient for toy electric systems.

References:

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