CONTROLLING AND MEASURING QUANTUM TRANSPORT OF HEAT IN TRAPPED-ION CRYSTALS

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ABSTRACT

Measuring heat flow through nanoscale systems poses formidable practical difficulties as there is no `ampere meter' for heat. We propose to overcome this problem by realizing heat transport through a chain of trapped ions. Laser cooling the chain edges to different temperatures induces a current of local vibrations (vibrons). We show how to efficiently control and measure this current, including fluctuations, by coupling vibrons to internal ion states. This demonstrates that ion crystals provide a suitable platform for studying quantum transport, e.g., through thermal analogues of quantum wires and quantum dots. Notably, ion crystals may give access to measurements of the elusive large fluctuations of bosonic currents and the onset of Fourier's law. These results are supported by numerical simulations for a realistic implementation with specific ions and system parameters.