Heat current and fluctuations of single-electron excitations: Fundamental properties and detection

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Nanoscale thermodynamics associated with few particles has attracted considerable attention in recent years. In nanoelectronics, single-electron excitations can be created by time-dependent driving of gate (bias) voltages. The heat current carried by these single-particle excitations as well as the associated heat current fluctuations carry information about the particles′ energetic properties. However, in contrast to charge currents, heat currents–both their average and their fluctuations–are difficult to access experimentally. Here, I will present our theoretical proposal for a setup for the detection of heat-currents emitted from single-electron sources (SES) as well as of their fluctuations [1]. Employing a Boltzmann-Langevin approach, we show that the measurement of the macroscopic, frequency-dependent temperature fluctuations in a probe reservoir gives access to the low-frequency heat-current noise from the source. Subtle differences are expected in the transport properties of different types of SESs [2], which could, e.g. be realized by a driven mesoscopic capacitor or a Lorentzian-shaped time-dependent bias voltage.

[1]N. Dashti, et al., Phy. Rev. App. **10(2)**, 024007 (2018).
[2]N. Dashti, et al., ArXiv: 1902.01209 (2019).