

Shot noise in the absence of currents

Shot noise in mesoscopic conductors has since long been identified as a valuable tool to analyze the characteristics of conductors. The measurement of noise has for example been used to identify correlations between charge carriers, also the fractional charge of quasiparticles in strongly correlated systems has been extracted from charge current noise. Recently, there have been two interesting novel directions in this “noise spectroscopy”. On one hand, not only charge current noise, but also heat current noise and power fluctuations have started to raise interest. This additional observable increases the opportunities for spectroscopy, but is also of practical relevance in (quantum) thermoelectrics [1]. On the other hand, so called delta-T noise was experimentally observed, where charge current shot noise - also known as “partition noise” - arises despite the absence of an average charge current [2,3] when a pure thermal bias is applied across a conductor with an energy-independent transmission.

In this talk, I will present our recent results, which generalize these observations. I will discuss charge current shot noise in the absence of charge currents as well as heat shot noise in the absence of heat currents in generic two-terminal conductors under generic non-equilibrium conditions [4]. In thermoelectric conductors, these zero-current shot noises could correspond to the charge shot noise at the thermovoltage or the heat shot noise at the stopping voltage of a cooling device. In the case where the conductor’s transmission is energy-independent, I show that simple bounds can be found for both types of zero-current noises that cannot be exceeded under any non-equilibrium condition. In contrast, as soon as the conductors become energy dependent, these bounds are broken! While the zero-current charge shot noise can then still be shown to never exceed the coexisting thermal noise, the heat shot noise can become arbitrarily much larger than the heat thermal noise. I will show examples for specific conductors for which the shot noise in comparison to the thermal noise can be maximized and I will analyze their characteristics.

[1] S. Kheradsoud, N. Dashti, M. Misiorny, P. P. Potts, J. Splettstoesser, P. Samuelsson: Power, Efficiency and Fluctuations in a Quantum Point Contact as Steady-State Thermoelectric Heat Engine. *Entropy* 21, 777 (2019)

[2] E. V. Sukhorukov, D. Loss: Noise in multiterminal diffusive conductors: Universality, nonlocality, and exchange effects. *Phys. Rev. B* 59, 13054 (1999)

[3] O. S. Lumbroso, L. Simine, A. Nitzan, D. Segal, O. Tal: Electronic noise due to temperature differences in atomic-scale junctions. *Nature* 562, 240 (2018)

[4] J. Eriksson, M. Acciai, L. Tesser, J. Splettstoesser: Electronic shot noise in the absence of currents. arXiv:2102.12988 (2021)