Quantum fluctuations of thermodynamic variables

Dmitri V. Averin

Department of Physics and Astronomy, Stony Brook University, SUNY

Equilibrium fluctuations of thermodynamic functions like internal energy, temperature, or pressure, are usually calculated from the statistical distribution of the thermodynamic system over its states [1]. This approach, however, does not give full magnitude of the equilibrium fluctuations of these quantities, which can also be produced by other mechanisms. Several years ago, we have shown with Prof. Pekola [2] that the heat flux should exhibit quantum fluctuations, which are physically associated with the finite relaxation energy terms required for the heat flow, and which violate fluctuation-dissipation theorem for the thermal conductance. So far, these fluctuations have not been observed experimentally. In the talk, I will discuss how the quantum heat fluctuations can be transformed into fluctuations of internal energy and temperature which should in principle be observable. I will also discuss possible quantum fluctuations of other thermodynamic quantities.

[1] L.D. Landau and E.M. Lifshitz, Statistical Physics, Part I, Sec. 112.
[2] D.V. Averin and J.P. Pekola, Phys. Rev. Lett. **104**, 220601 (2010).