Quantum measurement of work in mesoscopic systems

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Heat and work in thermodynamics refer to the measurement of changes in energy content of external bodies (baths and agents). We discuss the implications of quantum mechanics on the possibility to measure work in a mesoscopic context [1]. The agent is a quantum entity (say an oscillator) that is used to drive the system [2]. An obvious limitation is related to back-reaction [3], leading to a classical-like restriction. We furthermore find that in order to resolve fingerprints of interference an additional quantum uncertainty limitation should be taken into account in the design of the agent [1]. The quantum limitation is fundamental, not merely noise-like blurring.

[1] A.V. Varma, D. Cohen, arXiv:2507.09977 (2026).

[2] D. Cohen, Y. Imry, Phys. Rev. E 86, 011111 (2012).

[3] C. Han, D. Cohen, E. Sela, Phys. Rev. B 110, 115153 (2024).