Quantum work statistics in chaotic and disordered Fermi liquids

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We present a theory of work statistics in generic chaotic, disordered Fermi liquid systems within a driven random matrix formalism. We extend Phil Anderson's orthogonality determinant formula [1] to compute the full distribution of quantum work [2]. The evolution of quantum work distribution is found to be universal, and characterized by just two parameters: the temperature in units of mean level spacing (giving the energy scale), and a dimensionless velocity, characterizing the frequency of avoided level crossings [3].

At zero temperature, the energy absorbed increases linearly with time, while its variance exhibits a superdiffusive behavior [2], reflecting Pauli's exclusion principle, and a non-Gaussian statistics is observed [3]. In slowly driven systems, quantum work can be well described in terms of a purely classical Markovian symmetric exclusion process in energy space, as generated by Landau-Zener transitions, and accurate analytical expressions can be derived for it.

Our random matrix predictions are compared to and validated by numerical simulations performed on realistic 2D quantum dot models. We propose to verify them experimentally by calorimetric measurements on nanoscale circuits [3].

[1] P. W. Anderson, Phys. Rev. Lett. 18, 1049 (1967).

[2] I. Lovas, A. Grabarits, M. Kormos, and G. Zaránd, Phys. Rev. Research 2, 023224 (2020).

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