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Dephasing due to electron interactions in inhomogeneous systems
MAXIMILIAN TREIBER, OLEG YEVTUSHENKO, JAN VON DELFT, Ludwig-Maximilians-University, Physics Department, ASC, CeNS, Theresienstrasse 37, D-80333 Munich, Germany — At sufficiently low temperatures, the dephasing time τ_φ of mesoscopic samples is governed by so-called Johnson-Nyquist (electronic) noise. We study the spatial dependence of the corresponding noise correlation function (NFC) in inhomogeneous systems. Using the fluctuation-dissipation theorem and the random-phase approximation, we derive a real-space integro-differential equation for the NCF and show that it reduces to a diffusion equation in the case of strong screening. In particular, using a method based on the spectral determinant, we evaluate the NCF for arbitrary networks of quasi-1D disordered wires with boundary conditions. As an application, we construct a realistic quantum dot model via a set of parallel wires connected at contacts to leads, and calculate the temperature dependence of τ_φ as well as the quantum corrections to the conductance. Furthermore, we analyze the observability of the elusive 0D regime (reached at $T < E_{\mathrm{Thouless}}$ with the characteristic $\tau_\varphi \propto T^{-2}$ behavior) in such systems, and discuss alternative scenarios of its observation.

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