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Extending Dynamical Activity in Quantum Coherent Transport

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Kinetic Uncertainty Relations (KURs) impose fundamental limits on the precision of quantum transport observables by linking signal-to-noise ratios to system activity, a measure of the rate of particle exchange between the system and its environment. While KURs are well-defined in weak coupling regimes, where particle-like behavior dominates, extending these relations to strong coupling regimes remains a challenge due to coherent electron transport effects. Here, we develop a generalized definition of activity for strong coupling using the Heisenberg equations of motion and scattering theory, adapting KURs to the generic quantum coherent mesoscopic conductors . Our findings reveal potential KUR violations in mesoscopic systems under strong coupling, providing new insights into how coherence influences transport precision in multi-terminal setups.

Theme

Theme 2. Quantum effects in energy processes and materials

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