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Title :Full-counting statistics for molecular junctions: the fluctuation theorem and singularities

Abstract : We discuss the full-counting statistics of charges transmitted through a single-level quantum dot weakly coupled to a local Einstein phonon which causes fluctuations in the dot energy. An analytic expression for the cumulant generating-function, accurate up to second order in the electron-phonon coupling and valid for finite voltages and temperatures, is obtained in the extended wide-band limit. The result accounts for nonequilibrium phonon distributions induced by the source-drain bias voltage, and concomitantly satisfies the fluctuation theorem. Extending the counting field to the complex plane, we investigate the locations of possible singularities of the cumulant generating-function, and exploit them to identify regimes in which the electron transfer is affected differently by the coupling to the phonons. Within a large-deviation analysis, we find a kink in the probability distribution, analogous to a first-order phase transition in thermodynamics, which would be a unique hallmark of the electron-phonon correlations.
This kink reflects the fact that although inelastic scattering by the phonons once the voltage exceeds their frequency can scatter
electrons opposite to the bias, this will never generate current flowing against the bias at zero temperature, in accordance with the fluctuation theorem.