Full Counting Statistics of Electron Tunneling in Coulomb-Blockade Devices

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Abstract

Tunneling of electron into or out of Coulomb-blockade devices such as semiconductor quantum dots or metallic single-electron boxes is a stochastic process that gives rise to both thermal and shot noise. Recent progress in nanotechnology has made it possible to monitor the tunneling in and tunneling out events individually. This allows one to study the full counting statistics (FCS) of electron tunneling both in equilibrium and nonequilibrium and as a function of time. In this talk, we will show how the FCS can be used to acquire information about the system that is inaccessible from measuring the average transferred charge only. In particular, we will demonstrate how so-called generalized factorial cumulants indicate the presence of interaction [1]. In the limit of short measuring intervals, the factorial cumulants directly reveal correlated tunneling events of two electrons in Andreev-reflection processes [2]. They, furthermore, are suitable tools to detect violation of detailed balance in a stochastic system [3]. We also introduce the concept of inverse counting statistics [4] which seeks at identifying a stochastic system from a few measured factorial cumulants only. Finally, we present results of recent experiments that were successfully analyzed with the help of factorial cumulants.

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