Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Exact non-Markovian two-time correlation functions and current noise spectrum of electron transport through a quantum dot CHUNG-CHIN JIAN, HSI-SHENG GOAN, Department of Physics, National Taiwan University — Two-time correlation functions (CF's) of the electric currents through nanostructure devices are important in the study of the transport properties of current fluctuations and noise spectra. In the Markovian case, an extremely useful procedure to calculate the two-time (multiple-time) CF's is the so-called quantum regression theorem (QRT). For transport problems, a widely used method to calculate the steady-state current noise spectrum (i.e., Fourier transform of the steady-state current-current two-time CF's) is the MacDonald's formula which can be shown to be equivalent to QRT. However, similar to the QRT where only the evolution equations of the single-time expectation values are required to evaluate two-time CF's, the MacDonald's formula involves also only the single-time expectation values. Thus the MacDonald's formula, in our opinion, may not be applicable to calculate the current noise spectrum for transport problems that involves processes with non-Markovian (memory) effects. Here we develop a correct method to calculate the non-Markovian two-time CF's and finite-frequency noise power spectra based on the approach of the non-Markovian quantum state diffusion (NMQSD) or diffusive stochastic Schrodinger equation. This powerful NMQSD method allows us to calculate the exact current-current two-time CF and thus the exact current noise power spectrum for electron transport through a quantum dot. Our exact results reduce to those obtained by QRT or the MacDonald's formula in the Markovian limit.

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Date submitted: 14 Nov 2013 Electronic form version 1.4