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Non-Markovian dynamics of a solid-state charge qubit measured by a quantum point contact CHUNG-CHIN JIAN, PO-WEN CHEN, HSI-SHENG GOAN, Department of Physics, National Taiwan University, NTU TEAM
— We study a system of a charge qubit consisting of an electron in two coupled quantum dots (CQD's) detected by a quantum point contact (QPC). We derive perturbatively the non-Markovian quantum master equation for the CQD's system and calculate the transport current through the QPC (considered as a reservoir) to second order in the system-reservoir interaction. The non-Markovianity of the whole system comes from the energy-dependent tunneling amplitudes and energy-dependent densities of states of the QPC, which are modeled as a spectral density with a Lorentzian shape. In the non-Markovian case, the decay coefficients in the derived master equation and transport current are time-dependent and involve the real and imaginary parts of the contributions from the QPC reservoir correlation functions. In the wide-band limit (WBL), the various Markovian master equations in different parameter regimes are recovered, and the contributions of the imaginary parts are found to vanish. However, in the non-Markovian regime, the contributions of the imaginary parts significantly influence the dynamics of the charge qubit and thus the transport current. Especially, the non-Markovian transient currents through QPC differ significantly from the WBL Markovian counterparts and thus may serve as a witness for the non-Markovian behavior in the QPC-qubit system.

Chung-Chin Jian
Department of Physics, National Taiwan University

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