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Backaction Dephasing Induced by a Quantum Dot Detector
TOSHIHIRO KUBO, YASUHIRO TOKURA, University of Tsukuba — We theoretically investigate the backaction dephasing by a quantum dot detector (QDD) that couples to the quantum dot embedded in one arm of Aharonov-Bohm (AB) interferometer. We employ the nonequilibrium second-order perturbation theory and provide an analytical expression for the backaction dephasing rate, which characterizes the disturbance induced by coupling with an environment containing QDD. We show that the origin of backaction dephasing is a charge noise of QDD. In the linear transport regime through a QDD, this backaction dephasing induced by charge noise can be explained as a relaxation by an inelastic electron-electron scattering within the framework of Fermi liquid theory. In the low bias voltage regime, the increase or decrease of dephasing rate depends on the QDD energy level, the linewidth functions, and how to apply the bias voltage. Unlike quantum point contact detector, the dephasing rate would be insensitive to the bias voltage in a high bias voltage regime since the charge noise of a QDD is saturated. Moreover, such behaviors can be verified in terms of the visibility of AB oscillations by changing the bias voltage across the QDD.

Toshihiro Kubo
University of Tsukuba

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