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Non-Markovian dynamics of a nanomechanical resonator measured by a quantum point contact P. CHEN, C.-C. JIAN, Department of Physics, Center for Quantum Science and Engineering, and Center for Theoretical Sciences, National Taiwan University, Taiwan, H.-S. GOAN[1] — We study the dynamics of a nanomechanical resonator (NR) subjected to a measurement by a low-transparency quantum point contact (QPC) or tunneling junction in the non-Markovian domain. By partially taking trace over the microscopic degree of freedom of the QPC reservoir and keeping track of the number n of electrons that have tunneled through the QPC during the time period (0,t), we obtain the non-Markovian n-resolved (conditional) master equation valid to second order in the tunneling Hamiltonian. In our derivation, we do not make the rotating-wave approximation and the Markovian approximation, generally made in quantum optics systems. Our non-Markovian master equation reduces, in appropriate limits, to various Markovian versions of master equations in the literature. We find considerable difference in dynamics betweem the non-Markovian case and its Markovian counterpart. We also calculate the time-dependent transport current through the QPC which contains information about the measured NR system. We find an extra transient current term proportional to the expectation value of the symmetrized product of the position and momentum operators of the NR. This extra term, with a coefficient coming from the combination of the imaginary parts of the QPC reservoir correlation functions, was generally ignored in the study of the same problem in the literature. But we find that it has a substantial contribution to the total transient current in both the Markovian and Non-Markovian cases.

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