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On the quantum master equation with nonhermitian operators
CHUN-FENG HUANG, National Measurement Laboratoy, Center for Measurement Standards, Industrial Technology Research Institue , K.-N. HUANG, Institute of Atomic and Molecular Sciences, Academia Sinica — A quantum master equation is derived for fermions by considering a relaxation term in addition to the mean-field Hamiltonian. [C. F. Huang and K.-N. Huang, Chinese J. Phys. **42**, 221 (2004); Ralph Gebauer and Roberto Car, Phys. Rev. B **70**, 125324 (2004).] The relaxation term is symmetric with respect to particles and holes, and its loss and gain factors can be obtained by incorporating nonhermitian parts to the Hamiltonian for the decays of particles and holes, respectively. Such an equation reduces to the Markoff master equation of the Lindblad form when the electrons or holes are of the low-density distribution. On the other hand, the derived equation reduces to the quasiclassical master equation in an incoherent limit. Both the loss and gain factors induce the decoherence. From Cauchy's inequality, we can see that the decoherence is important to keep both the density matrices for particles and holes as positive operators. The positivity of the density matrix for holes, in fact, indicates the validity of Pauli exclusion principle under the derived master equation. To further investigate the decoherence, we compare the master equation for fermion to that for bosons. The gain factor of the latter equation does not induce the decoherence, which is reasonable because bosons do not need to follow the Pauli exclusion principle.

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