Entanglement and Specific Heat in an Open Quantum System with the Jeans-Cumming Interaction during Non-Markovian Processes

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Abstract

In this work, we consider the Jaynes-Cumming (J-C) interaction in which the particles of the system exposed to the bosonic bath. It is supposed that the system includes two spins 1/2 particles with the spin-exchange interaction. It also assumes that each of the particles is in a separate bosonic bath with the Cauchy-Lorentz distribution. By using the Liouville-von Neumann equation and applying the Born-approximation, we obtain the density matrix of the system as a function of both time and temperature during the Non-Markovian processes. Moreover, in order to calculate the specific heat, a new formula is presented by using the eigenvalues of the density matrix. Also, we consider the quantum entanglement (EN) as a function of time, temperature and the other parameters in Hamiltonian. The results obtained from these investigations show that, when the temperature of the system tends to zero, the state of system takes the maximum value of Entanglement (EN) and the specific heat diverges. The other result is the negative amount in specific heat at the moment of the system attached to the environment. These results play an important role in designing the solid quantum gates whose operations are based on the EN and thermal properties of the environment.

Keywords: Open Quantum System, Jaynes-Cumming Interaction, Born approximation, Entanglement, Specific Heat.

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