Density Matrix for Mesoscopic Distributed Parameter Circuits

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Abstract: Under the Born-von-Karmann periodic boundary condition, we propose a quantization scheme for non-dissipative distributed parameter circuits (i.e. a uniform periodic transmission line). We find the unitary operator for diagonalizing the Hamiltonian of the uniform periodic transmission line. The unitary operator is expressed in a coordinate representation that brings convenience to deriving the density matrix $\rho(q,q',\beta)$. The quantum fluctuations of charge and current at a definite temperature have been studied. It is shown that quantum fluctuations of distributed parameter circuits, which also have distributed properties, are related to both the circuit parameters and the positions and the mode of signals and temperature T. The higher the temperature is, the stronger quantum noise the circuit exhibits.

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