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Sequre quantum teleportation of a squeezed thermal state

Secure quantum teleportation is essential for reliable transfer of quantum information across distant locations. It paves the way for future quantum networks and quantum communication systems. Consideration of an input squeezed thermal state is more realistic and appropriate for many applications because of losses caused by interaction with environment. The secure teleportation is conditioned by presence of two-way steering between the two parties and fidelity of teleportation being higher than the threshold value.

In this work, we deduce using the characteristic function approach, the analytical expression for fidelity of teleportation of an input squeezed thermal state using as a resource state an initially entangled bimodal Gaussian state. The resource is a two-mode Gaussian state.State modes are put in contact with a general Gaussian environment. As an example, we investigate secure quantum teleportation when the two modes are embedded each in its own thermal bath.

We use the Markovian Kossakowski-Lindblad master equation for describing the time evolution of the open system, quantum steering and quantum fidelity of teleportation. The studies are implemented in the framework of the theory of open systems based on completely positive quantum dynamical semigroups.

Moreover, we study the dependence of fidelity of teleportation and steering on time, bath parameters, and resource state properties. In most cases, the success of teleportation is defined by the steering presence during the experiment, because the fidelity is greater than the threshold value when the steering disappears.

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