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Multiqubit entangled channels for quantum communication in networks

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Multiqubit entangled states are an important resource for networked information processing and communication. Here, we explore the use of entangled channels for various controlled teleportation schemes. In controlled teleportation (CT), the teleportation can proceed only with the permission and participation of one or more controllers. Thus, the controller's role is of key importance in CT protocols. We present a quantifiable measure of the controller's power in N-qubit controlled teleportation. We apply our measure to evaluate the control power in several existing CT schemes. We also discuss the general rules that must be satisfied by controlled teleportation schemes to ensure both teleportation fidelity and control power. Our measure of control power is simple, practical and applicable to evaluate all CT schemes for teleporting N-qubit pure states. Practically feasible schemes for preparing multiqubit entangled states are required in order to implement large-scale quantum communication protocols.

Our results provide guidelines for developing robust teleportation schemes using both maximally entangled states as well as partially entangled channels.

Primary author: GHOSE, Shohini (Wilfrid Laurier University)

Co-author: Dr LI, Xihan (Wilfrid Laurier University)

Presenter: GHOSE, Shohini (Wilfrid Laurier University)

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