

## Teleportations of Mixed States and Multipartite Quantum States

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(Received: 2006-6-26; Revised: 2006-9-22)

**Abstract:** In this paper, we propose a protocol to deterministically teleport an unknown mixed state of qubit by utilizing a maximally bipartite entangled state of qubits as quantum channel. If a non-maximally entangled bipartite pure state is employed as quantum channel, the unknown mixed quantum state of qubit can be teleported with  $1-(1-C^2)^{1/2}$  probability, where  $C$  is the concurrence of the quantum channel. The protocol can also be generalized to teleport a mixed state of qudit or a multipartite mixed state. More important purpose is that, on the basis of the protocol, the teleportation of an arbitrary multipartite (pure or mixed) quantum state can be decomposed into the teleportation of each subsystem by employing separate entangled states as quantum channels. In the case of deterministic teleportation, Bob only needs to perform unitary transformations on his single particles in order to recover the initial teleported multipartite quantum state.

PACS: 03.67.Hk, 03.65.Ud

Key words: teleportation, mixed state, multipartite quantum state

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