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Quantum Teleportation of Dynamics and Effective Interactions Between Remote Systems CHRISTINE MUSCHIK, ICFO - The Institute of Photonic Sciences, KLEMENS HAMMERER, Leibniz University Hannover, EUGENE POLZIK, Niels Bohr Institute, IGNACIO CIRAC, Max-Planck:institute for Quantum Optics — Most protocols in Quantum Information Science are discrete in the sense that they consist of a series of unitary operations and measurements which are applied sequentially. However, some implementations are intrinsically continuous. The most prominent example are atomic ensembles interacting with light, where schemes based on the continuous detection of quadrature operators are realized. In this system, protocols can be performed that are intrinsically deterministic and continuous in time. Here we address the question how this property can be exploited by designing primitives that take advantage of this fact. We introduce two protocols which achieve a qualitatively new goal - to control and transmit quantum evolutions between remote locations. We present two related protocols, where we consider two remote systems which evolve according to a given local dynamics. One scheme implements an effective non-local dynamics, where the two remote systems evolve as if they were interacting with each other. The other protocol realizes the quantum teleportation of a time evolution, which uses the dynamics of one system to steer the evolution of the other.

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