

Quantum repeaters and computation by a single module

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We present a protocol of remote nondestructive parity measurement (RNPM) on a pair of quantum memories. The protocol works as a single module for key operations such as entanglement generation, Bell measurement, parity check measurement, and an elementary gate for extending one-dimensional cluster states. The RNPM protocol is achieved by a simple combination of devices such as lasers, optical fibers, beam splitters, and photon detectors. Despite its simplicity, a quantum repeater composed of RNPM protocols is shown to have a communication time that scales sub-exponentially with the channel length, and it can be further equipped with entanglement distillation. With a reduction in the internal losses, the RNPM protocol can also be used for generating cluster states toward measurement-based quantum communication.

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