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Efficient recurrence quantum entanglement distillation algorithm for quantum channels impaired by fiber birefringence LIANGZHONG RUAN, Massachusetts Inst of Tech-MIT, BRIAN T. KIRBY, MICHAEL BRODSKY, U.S. Army Research Laboratory, MOE Z. WIN, Massachusetts Inst of Tech-MIT — Distributing entangled states with high fidelity via fiber optic routes is challenging due to the various decoherence mechanisms in fibers. In particular, one of the primary polarization decoherence mechanism in optical fibers is polarization mode dispersion (PMD), which is the distortion of optical pulses by random birefringences in the system. Among quantum entanglement distillation (QED) algorithms proposed to mitigate decoherence, the recurrence QED algorithms require the smallest size of quantum circuits, and are most robust against severe decoherence. On the other hand, the yield of recurrence QED algorithms drops exponentially with respect to the rounds of distillation, and hence it is critical to minimize the required rounds of distillation. We present a recurrence QED algorithm, which is capable of achieving maximum fidelity in every round of distillation when each photonic qubit individually traverses a PMD-degraded channel. The attainment of optimal fidelity in every round of distillation implies that our algorithm reaches the fastest possible convergence speed and hence requires the minimum rounds of distillation. Therefore, the proposed algorithm provides an efficient method to distribute entangled states with high fidelity via optic fibers.

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