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Preserving photon qubits in an unknown quantum state with Knill Dynamical Decoupling – Towards an all optical quantum memory[1]

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The storage of quantum states and its distribution over long distances is essential for emerging quantum technologies such as quantum networks and long distance quantum cryptography. The implementation of polarization-based quantum communication is limited by signal loss and decoherence caused by the birefringence of a single-mode fiber. We investigate the Knill dynamical decoupling scheme, implemented using half-wave plates in a single mode fiber, to minimize decoherence of polarization qubit and show that a fidelity greater than 99% can be achieved in absence of rotation error and fidelity greater than 96% can be achieved in presence of rotation error. Such a scheme can be used to preserve any quantum state with high fidelity and has potential application for constructing all optical quantum memory, quantum delay line, and quantum repeater.

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