Quantum Computation using Photons

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1. Introduction

Among many candidates for quantum bits, photons are the only quanta whose quantum state can be transmitted over long distances. It has been thought that devices for direct entanglement manipulation such as quantum phase gates (QPGs) are indispensable for quantum computation. However, they are difficult to develop. Recently it has been reported that quantum teleportation can also be used to generate entanglement between non-interacting photons. Toward a future realization of large scale quantum circuits, we are now trying to perform receiver's feedback free quantum teleportation (RFFQT) using single photons as the first stage, and to establish basic theories for estimating errors.

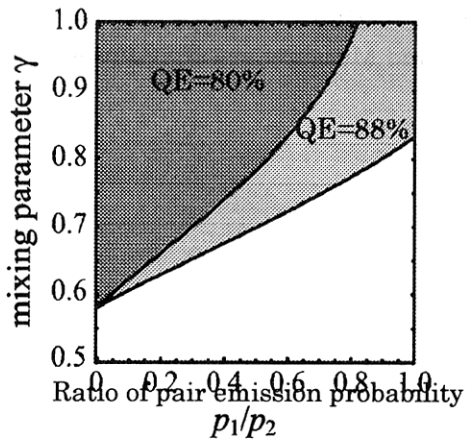

Fig1. Experimental condition for RFFQT using VLPC.

2. Receiver's feedback free teleportation: Detailed analysis of the fidelity [1]

We investigate the condition for performing a high fidelity teleportation without receiver's feed back. We found that it is possible to demonstrate an experiment of RFFQT within a reasonable time (27 hours) using a visible light photon counter and conventional entangled photon sources (Visibility 85%).

3. Effects of noisy entangled state transmission on q-teleportation [2]

Quantum teleportation requires the transmission of entangled pairs to Alice and Bob. Transmission errors modify the entangled state before the teleportation can be performed. We determine the changes in the output state caused by such transmission errors. It is shown that the errors caused by entanglement transmission are equivalent to the errors caused in a direct transmission of a quantum state from Alice to Bob.

[1] K.Tsujino and S. Takeuchi, in Proceedings of ISQM'01-Tokyo, 2001
[2] H. F. Hofmann, K.Tsujino and S. Takeuchi, submitted to QIT5, 2001.