Non-post-selection entanglement concentration, quantum error correction and event-ready EPR state production with linear optics

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This talk includes 3 parts.

Part 1: Non-post-selection entanglement concentration with linear optics. Two remote parties, Alice and Bob initially share some non-maximally entangled states. Through the entanglement concentration by local operation and classical communication(LOCC), they may obtain an outcome of maximally entangled states in the price of decreasing the number of pairs shared by them. Recently, entanglement concentrations have been experimently demonstrated by post-selection (T. Yamamoto et al, Nature, 421, 343(2003) and Z. Zhao et al, quant-ph/0301118). Here we give a modified scheme which can be used for the entanglement concentration without any post selection by using only practically existing linear optical devices. In particular, a sophisticated photon detector to distinguish one photon or two photons is not required. Our scheme can be used to really produce the event-ready maximally entangled pairs through LOCC provided that the requested raw pairs are supplied deterministically. A detailed experimental plan with spontaneous parametric down conversion(SPDC) is shown.

Part 2: Quantum error correction with linear optics. We propose a feasible scheme to test the fault tolerance property of of quantum error correction code with S'DC process. To transmit an unknown qubit robustly through the noisy channel, one may first encode it into a certain quantum error correction code and then transmit it. The remote party decodes it and stores it. Sending a qubit in such a way can significantly reduces the error rate compared with directly sending the qubit itself. Here we show how to realize such a scheme by linear optics.

Part 3: Producing the event ready two photon polarization entangled state with normal photon detectors. We propose a scheme to produce the maximally two photon polarization entangled state(EPR state) with single photon sources and the passive linear optics devices. In particular, our scheme only requires the normal photon detectors which distinguish the vacuum and non-vacuum Fock number states. A sophisticated photon detector distinguishing one-photon state and two-photon state is unnecessary in the scheme.

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[1] The talk is based on the following 3 papers: 1. Wang X. B. and Fan H, quant-oh/0302105, Non-post-selection entanglement concentration with linear optics. 2. quant-ph/0302015, Quantum error correction with linear optics. 3. quant-ph/0208166, Producing the event ready two photon polarization entangled state with normal photon detectors.
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