Quantum Measurement using a Short Pulse in a Multipurpose Interferometer

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This paper presents the overview of update technology in quantum measurement. A multipurpose quantum interferometer used for measurement below the quantum limit, and for quantum communication known as Mach-Zehnder interferometer (MZI) is described. The first beam splitter of MZI separates the short pulse, i.e., laser beams into two arms, according to the phase of light pulse φ is properly adjusted. The quantum correlation within the interferometer allows one to resolve the small modulations of phase θ below the quantum limit. The combination of the interferometer with phase and amplitude modulations is formed in a setup for quantum dense coding by continuous variables. Continuous variable dense coding refers to the ability to read amplitude and phase modulations with a precision below the limit given by Heisenberg uncertainty relation. For large photon numbers, the channel capacity of the scheme approaches twice that classical coherent-state communication.

In practice, MZI may also be used to generate a single photon for quantum communication, where the important protocols of quantum communication over realistic noisy channels with the continuous variable quantum teleportation and entanglement swapping can be investigated. Quantum teleportation uses entangled beams as a quantum resource to transfer the unknown quantum sate from one destination to another without exposing it to the distortions that occur if one just sends it along a noise communication line. Where one can also teleport an entangled sate, the procedure is referred to as entanglement swapping that its entangles two distant part of the two pairs.

The need for this comes about as the quantum resource for teleportaion, i.e., entangled beams, must firs be distributed over a noisy channel to make quantum communication possible. Entanglement swapping operates as a quantum repeater to provide a possibly perfect entanglement link between some remote station. The application of the intense light field, i.e., soliton pulses allows for particularly simple experimental implementation of these protocols by use of the quantum interference setup.

In Conclusion, quantum interferometry with a short pulse/soliton covers a wide range of applications from high precision measurements to quantum information processing by use of continuous variables. Quantum interferometry has emerged as an alternative approach to quantum information with single photons and atoms described discrete variables. The main motivation for this new approach is the availability of controlled sources, efficient detection systems where the APD is proposed for such a system, and easy-to-handle processing by use of linear elements. Alternatively, nonlinear coupling can also be efficiently implemented with intense soliton pulses.

REFERENCES

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