Hybrid Quantum Information Processing; A Way for Large-scale Optical Quantum Information Processing

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We are working on hybrid quantum information processing, which combines two methodologies of quantum information processing – qubit and continuous variable (CV) [1]. More precisely, we encode logical qubits by using CV methodology and utilize CV quantum processors for the realization of a fault-tolerant large-scale universal optical quantum computer. The advantage of this methodology is that we can have both high-fidelity nature of qubits and determinisity of CV quantum processors. In other words, we can enjoy both particle- and wave-nature of quantum mechanics. Towards this goal we performed various things, which include quantum error correction with nine-party CV entanglement [2], teleportation of Schrödinger's cat state [3], adaptive homodyne measurement with phase-squeezed states [4], deterministic teleportation of time-bin qubits [5], creation of ultra-large-scale CV cluster states [6], generation and measurement of CV entanglement on a chip [7], and synchronization of photons with cavity-based quantum memories [8].

References

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