High-Efficiency Photonic Memory based on Electromagnetically Induced Transparency and Progress Towards its Quantum Demonstration

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Quantum memory is a device which could store and replay a photonic quantum state on demand. In the long-distance quantum communication based on the quantum repeater protocol, quantum memory is a crucial component which requires a high fidelity, a high efficiency and a long storage time. In this talk, I will present our work to achieve a storage efficiency (SE) of 92% for a photonic memory based on the electromagnetically induced transparency (EIT) in cold atomic media with an optical depth of nearly 1000. In a memory application, the time-bandwidth product, defined as the ratio of the storage time at 50% SE to the input pulse duration, is an important figure of merit which evaluates how many operations that a memory can provide. We have achieved a time-bandwidth product of 1200. Both the achieved SE and the time-bandwidth product are the best records to date. I will also report our progress towards the demonstration of a true quantum memory. Specifically, I will present our development of an ultrabight, narrowband photon pair source with a detection and generation rate of 6142 and 7.24×10^5 pairs/(s·mW), respectively and a bandwidth of 6.6 MHz.