High-performance quantum memory based on electromagnetically-induced transparency

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We report our advancement on the development of high-performance quantum memory (QM) based on electromagnetically induced transparency (EIT) during the past few years. Using optically dense cold atomic media, we have achieved EIT optical memory with a record-high efficiency of 92 % [1]. By increasing the intensity of the control field, we also extend the bandwidth of EIT memory to 31 MHz with an efficiency of larger than 50 %, limited by the available control power [2]. We also report the application of EIT memory to photonic polarization (or frequency) converter [3]. To realize the quantum storage, we developed a bright heralded single-photon source based on cavity-enhanced spontaneous parametric downconversion that can be locked to atomic transition [4]. We interface this solid-state photon source with the atomic memories by demonstrating the quantum storage and manipulation of heralded single photons [5]. In addition, we encode the polarization qubits into the single photons and realize the EIT-based quantum memory of polarization qubits with an efficiency of larger than 70% and a fidelity of larger than 96% [6].

References:

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