Hollow-core light cage waveguides for atomic vapor quantum memories

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Quantum memories play a fundamental role in the goal of long-distance communications via entanglement swapping in quantum repeaters [1]. Using hot atomic vapors as quantum memories, employing electromagnetically induced transparency (EIT), provides easy-to-handle systems capable of storing light up to seconds [2] and even down to the single photon level [3]. Recently we have shown that a novel photonic structure, an on-chip hollow-core light cage (LC), can enhance the effects of EIT when placed inside a hot vapor Cs environment, with the advantage of fast diffusion of atoms inside the core compared to other hollow-core structures [4].

In this work we show for the first time storage of faint coherent light pulses in the atomic medium confined within the core of the LC for hundreds of nanoseconds. The intrinsic efficiency of the memory was optimized by performing a parameter scan on the signal bandwidth and control power driving the memory. This paves a way towards an on-chip integrated module for quantum memories and as a platform for coherent interaction of light and warm atomic vapors.

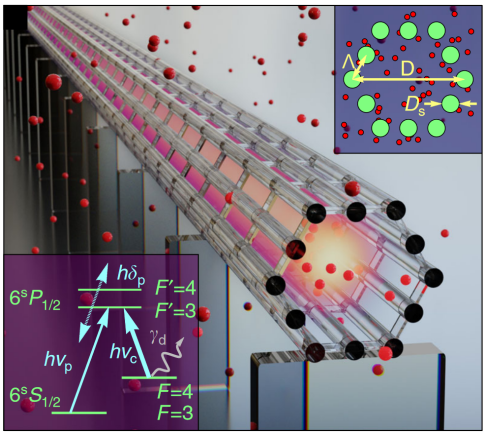

Figure 1. Render of a hollow-core light cage, formed by 12 parallel polymer strands arranged in a hexagonal shape. The side-wise access provided by the strands allows for fast diffusion of atomic vapors inside the core. Top inset: the lattice constant Λ, strand diameter D_s, and core diameter D are adjusted to have an anti-resonance window at the Cs D1 line wavelength. Bottom inset: Addressed levels of the Cs D1 line to create EIT for storage of light. Figure from Ref. [4]

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