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Cesium-filled hollow-core fibres for light storage and manipulation

Established for quantum metrology and quantum communication applications, photonics has also recently become a very promising platform for quantum computing. And a crucial component of optical quantum computing schemes are quantum memories. For "practical" quantum memories we require on-demand read-in and read-out of ideally ultrashort light pulses at room temperature. Indeed, our group was able to demonstrate a broadband quantum memory based on stimulated Raman scattering in warm cesium vapours in a bulk cell [1]. For scalability of the memory, however, we also require it to be power-efficient and integratable with other photonic architectures. To this end, we have successfully implemented the Raman memory scheme for weak coherent states in warm Cs vapours confined to a hollow-core photonic crystal fibre [2]. The Raman memory efficiency strongly depends on the optical depth (OD) of the storage medium. Unluckily, alkali-filled hollow-core fibres provide low ambient optical depths due to the reactive metal's absorbance to the fibre walls. However, it has been shown to be possible to increase these ODs by several orders of magnitude through Light-Induced Atomic Desorption. Using this phenomenon we are currently able to maintain quasi-continuously high ODs in our Cs-filled fibres at room temperature. We are currently investigating whether this translates into long-term high memory efficiency, which would make further light storage and manipulation experiments at the single-photon level feasible. [1] Michelberger, P. S. et al., arXiv:1405.1470. [2] Sprague, M. R. et al., Nature Photonics 8, 287–291 (2014)

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