Optical information processing with hot atoms – From classical to quantum

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Hot atoms are ideal for enabling the processing and transportation of classical as well as quantum information. In the classical domain, hot atoms acting as saturated absorbers can act as non-linearity in optical neural networks. Moreover, optical coherent memories based on electromagnetically induced transparency (EIT) in vapor cells can enable versatile all-photonic computing platforms. Both are highly promising model systems to study and develope optical hardware for energy efficient machine learning [1]. In the quantum case atomic memories for single photons [2] may enable technological simple quantum repeaters operating even in remote locations, e.g. under sea or in space [3]. Similar, such memories are promising for synchronizing probabilistic processes like photon generation by parametric conversion [4] or all-optical quantum gates.

I will present our recent results towards realizing the aforementioned applications with hot Cesium atoms. These include a scheme for optical reservoir computers with atomic memory, an optical convolutional neural network with atomic non-linearity, our efforts towards multi-rail optical memories and satellite-suited noise-free quantum memories.

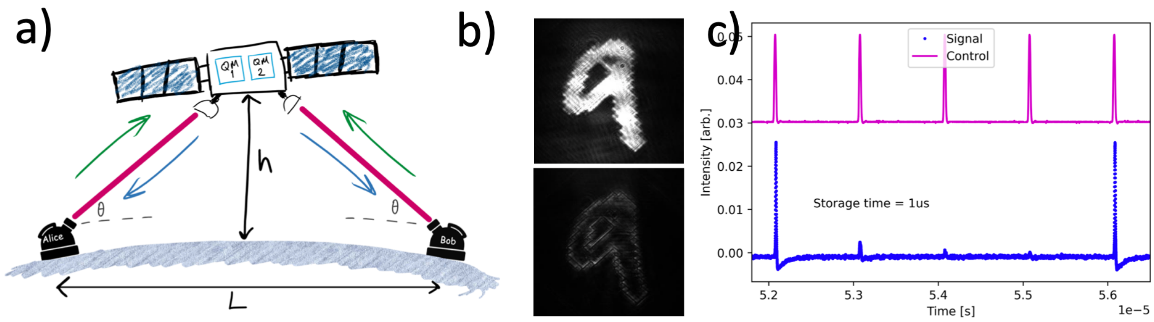

Figure 1. a) A memory assisted quantum communication scenario with atomic quantum memories (QM) onboard of a satellite. b) Processing a member of the MNIST dataset (handwritten number 9) by an optical convolutional neural network with atomic non-linearity. c) Storage of attenuate laser pulses in a Cs vapor memory.

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