Quantum networking with microfabricated atomic vapor cells

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Quantum memories are building blocks of quantum networks. Hot alkali vapors are an attractive platform for such basic components, as they operate without cryogenics or ultra-high vacuum systems. We demonstrated single-photon storage and retrieval therein, mapping 370 MHz broad single photons from a spontaneous parametric down conversion source to long lived spinwave excitations between rubidium ground states [1]. A schematic illustration is shown in Figure 1. Moreover, we implemented such a memory in a MEMS cell compatible with wafer-scale fabrication, marking a crucial step towards scalability [2]. Following these proof of principle demonstrations, we formed a collaboration to interface these atomic memories with single photons from rubidium-like quantum dots, studied in the Warburton group, into hybrid quantum network interconnects, and to adapt already scaled atomic clock cell manufacturing processes, pioneered at CSEM Neuchâtel, to yield mass producible vapor cells truly suited for memory applications.

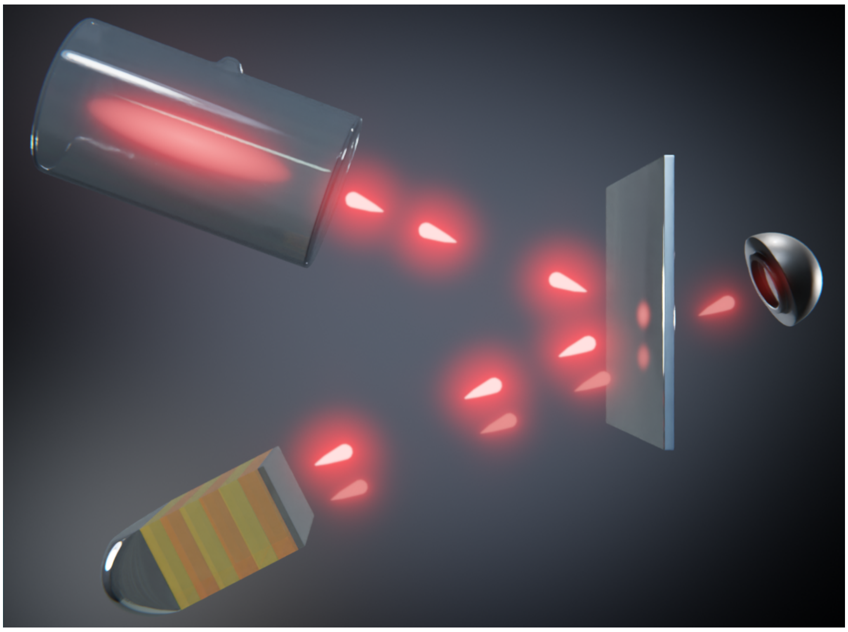

Figure 1. Contrary to long-circulating malignant rumors, hot atomic vapors are, in-fact, not intrinsically too noisy to store single photons.

[1] G. Buser, R. Mottola, B. Cotting, J. Wolters, and P. Treutlein, Single-photon storage in a ground-state vapor cell quantum memory, PRX Quantum **3**, 020349 (2022).
[2] G. Buser, R. Mottola, and P. Treutlein, Optical memory in a microfabricated rubidium vapor cell, Physical Review Letters **131**, 260801 (2023).