Quantum Memory

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The upcoming quantum revolution relies on a successful implementation of a new network based on quantum mechanics, allowing for fundamentally secure transfer of information as well as enabling the connection of future quantum computation nodes. To realize such a quantum network, the information transmitted via single photons, as qubits, need to be stored in a coherent way. Hot rubidium vapor cells are capable of performing such a storage with high efficiency, making them ideal candidates for scalable quantum memories.

In this project the student will work together with a PhD student and researcher to optimize and characterize the storage efficiency of a novel and compact quantum memory based on rubidium vapor. The total efficiency not only depends on the quantum memory itself but also on the quantum optical properties of the photons stored. The first tests will be performed with attenuated coherent light to generate write and read pulses for the memory operation and finally true single photons emitted from a resonantly exited semiconductor quantum dot will be interfaced with the memory. If the quantum memory efficiency is sufficiently optimized the students will have the opportunity to store for the first time a true single-photon, a milestone for the realization of quantum networks.

This cutting-edge science project combines classical optics, electronics, atom and semiconductor physics, as well as quantum optics. The motivated students will learn how to build and characterize complex optical setups working at the quantum mechanical fundamental limit of single photons as well as the theory behind the working principle of quantum memories based on atomic vapor cells. Since the overarching goal is a team effort, several groups of students can apply and tailor-made tasks per group can be formulated.

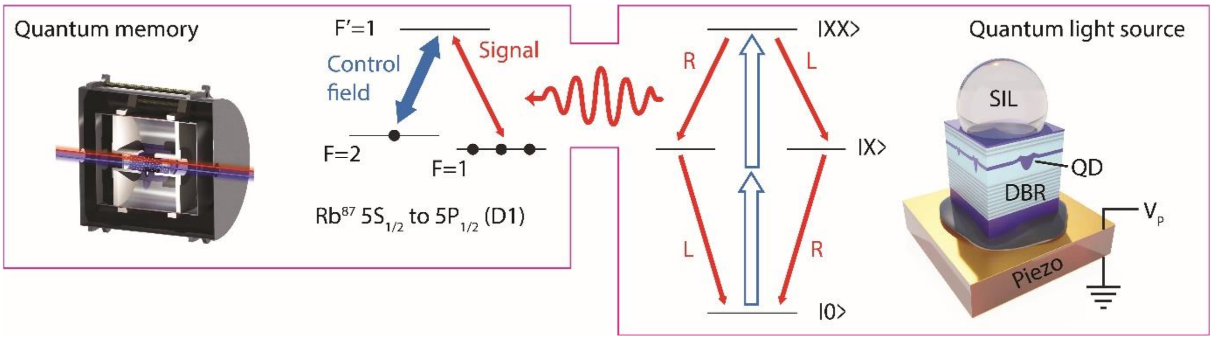

Figure 1: Hybrid quantum network interfacing a rubidium quantum memory with on-demand generated photons from a quantum dot non-classical light source.