

Research Project

QUSTEC PhD fellowship - Hybrid quantum networks with atomic memories and quantum dot single-photon sources

Third-party funded project

Project title QUSTEC PhD fellowship - Hybrid quantum networks with atomic memories and quantum dot single-photon sources

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Organisation / Research unit

Departement Physik / Experimentelle Nanophysik (Treutlein)

Department

Departement Physik

Project start 01.03.2021

Probable end 14.05.2024

Status Active

This project aims at combining the high purity and large bandwidth of quantum dot single photons with the high efficiency and long storage times of atomic quantum memories into a hybrid quantum network architecture with advantageous properties. We already demonstrated that GaAs/AlGaAs quantum dots can emit transform-limited single photons tuned into resonance with rubidium atoms and that the temporal waveform of these photons can be controlled. In parallel, we realized a rubidium atomic quantum memory with a bandwidth of 660 MHz operating on the single-photon level.

The goal of this project is to develop the two systems further and to interface them through an optical fiber link. Several improvements will be implemented to achieve low-noise operation: controlling the charge state of the dot and enhancing the photon collection efficiency with an optical cavity, as well as controlling the spin state of the atoms to suppress four-wave mixing noise by selection rules. After demonstrating storage and retrieval of quantum dot single photons in the atomic memory, we intend to perform basic quantum networking tasks with this hybrid system.

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