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Towards Nanofiber-Based Quantum Networks — •Jakob Hinney, Christoph Clausen, Adarsh Prasad, Philipp Schneeweiss, Jürgen Volz, and Arno Rauschenbeutel — VCQ, TU Wien – Atominstitut, Stadionallee 2, 1020 Wien, Austria

In a new project, we plan to establish nanofiber-based atom-light interfaces as quantum-enabled fiber-optical components for quantum information processing and communication. The key ingredient is a nanofiber-based optical dipole trap which stores cold atoms in the evanescent field around the nanofiber [1,2]. In this evanescently coupled atom-waveguide-system, even a few hundred atoms are already optically dense for near-resonant photons propagating through the nanofiber. The first goal of this project is to realize efficient quantum memories which allow one to directly store and retrieve the quantum state of fiber-guided photons. Furthermore, nanofiber-coupled atoms can provide a strong optical non-linearity. The second goal of this project is to explore and to maximize this non-linearity until it prevails down to the single photon level. This would then enable optical quantum switches and photon-photon quantum gates which are essential for implementing deterministic optical quantum computation. The final goal is to interconnect these components in order to demonstrate different quantum network applications, such as highly efficient photon counting, heralded entanglement of two fiber-coupled quantum memories, and a non-linear interaction between two single-photon pulses.

[1] E. Vetsch *et al.*, Phys. Rev. Lett. **104**, 203603 (2010).
[2] D. Reitz *et al.*, Phys. Rev. Lett. **110**, 243603 (2013).

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