Telecom single photon source based on nonlinear photon transport in hot atomic vapor

Inna Kviatkovsky[1], Martin Cordier[1], Lucas Pache[1], Leonid Yatsenko [2], Philipp Schneeweiss[1], Jürgen Volz[1], Arno Rauschenbeutel[1]

[1] Institut für Physik, Humboldt-Universität zu Berlin, Berlin, Germany
[2] Institute of Physics, National Academy of Sciences of Ukraine, Kyiv, Ukraine

The generation of single photons is essential for quantum communication and cryptography. However, the efficient generation of Fourier-limited single photons often requires complex and demanding experimental conditions. In this work, we present a novel method for generating single photons using so-called nonlinear photon transport in Rubidium vapor. Our approach leverages the 1529-nm transition between excited states in ^{87}Rb to produce single photons in the telecom C-band, making it compatible with existing communication infrastructure.

The single-photon source is based on a two-photon interference technique. The atoms scatter the photons in two ways, typically referred to as coherent and incoherent scattering. In the case of resonant scattering, the two-photon probability amplitudes of the coherent and incoherent components have opposite signs. For a specific atom number, the probability amplitudes then interfere fully destructively, resulting in photon antibunching of the transmitted light [1,2]. In order to implement this scheme in hot atomic vapor in ^{87}Rb, we use a three-level ladder system, where a strong pump that drives the D2 transition is used to prepare atoms at the intermediate state. This facilitates the generation of single photons at the telecom C-Band upon the transport of laser light at 1529 nm. In this way, we realize a technologically relevant nonlinear filter, generating narrow-band single photons, compatible with atomic transitions.

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