Light-induced atomic desorption and single-photon generation in thermal micro-cells

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Micrometer-sized cells for atomic vapors are powerful devices in the realm of fundamental research and applied quantum technology. To reach significant optical densities along the short optical paths in such cells, temperatures exceeding 300°C have to be applied. This however is accompanied by stronger collisional effects, the excitation of surface-polaritons, and technical difficulties in the experimental setups due to large temperature gradients. We present an experimental approach exploiting the effect of light-induced atomic desorption (LIAD) [1, 2]. In this configuration, atoms are desorbed from the cell's glass surface by intense off-resonant nanosecond-pulses at 532 nm and provide a temporarily dense cloud of atoms. Using this technique, we locally increase the density to several hundreds of atoms per μm^3 on a nanosecond timescale. Besides, the LIAD effect is an essential building block for our approach towards a single-photon source. A promising candidate for the realization with room-temperature atoms in a micro-cell relies on the combination of four-wave mixing and the Rydberg blockade effect, as demonstrated in [3]. For the next generation single-photon source at high repetition rates, we can exploit the latest developments in laser technology by using a 1010 nm fiber amplifier [4] to reach the Rydberg state. At a repetition rate of 1 MHz we reach a peak pulse-power of 100 W for Fourier-limited nanosecond pulses.

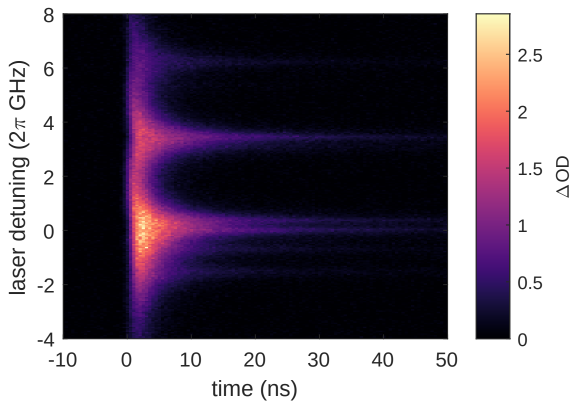

Figure 1. Detuning and time-resolved change of the optical depth (ΔOD) produced via the LIAD effect. The weak probe laser is scanned over the D1 transition (795 nm) of rubidium. After the LIAD pulse hits the cell at 0 ns the ΔOD increases.

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