Technical status and prospects of our GHz-bandwidth thermal four-wave mixing single-photon source

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Our concept for an on-demand single-photon source based on the Rydberg blockade of room-temperature rubidium atoms in a wedged micro-cell (Fig. 1) requires a unique combination of pulsed lasers with minimal jitter, kW-power, GHz-bandwidth, yet kHz-linewidth. To fulfill these conventionally contradicting requirements, we employ state-of-the-art 1010 nm pulsed fiber amplifiers and electronics with highly tunable pulse sequences to drive a Rydberg excitation via the 6P intermediate state.

Here, we report on the current state, technical milestones, and challenges in the current daily operation phase. Using an improved electrical pulse generation system and upgraded detectors we can increase photon generation and detection efficiency. We also explore fabrication concepts and aging of our µm wedge vapor cells as observed during the past years in addition to novel concepts. The MHz repetition rate and excitation timescales pave the way towards fast optimal control methods for single-photon generation, Hong-Ou-Mandel interference, and high fidelity Rydberg logic gates.

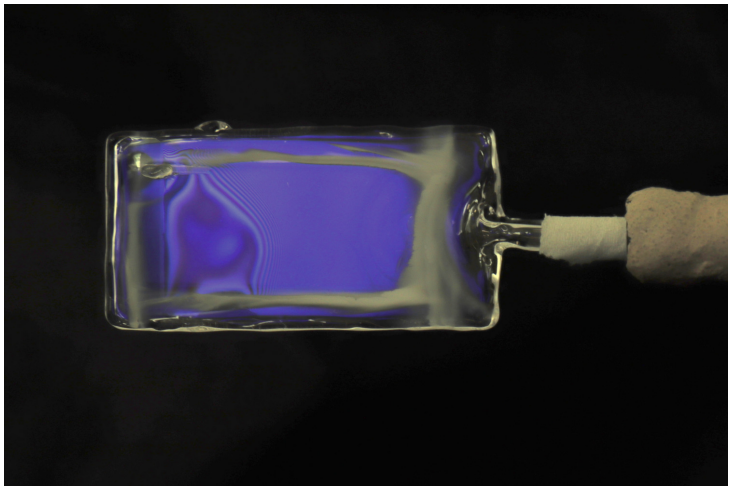

Figure 1. A photograph of the wedge cell currently used in our experiment with visible interference fringes around a touching point.