Interaction of a single photon with a single quantum system in ambient conditions

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In our work a simple, room temperature, cavity- and vacuum-free interface for photon-matter interaction is implemented [1]. Here we report an ambient-conditions experiment in which a heralded single photon [2] is absorbed by a single atom-like system, which is an NV center in diamond. The experimental setup is shown in Fig. 1. The NV center is pumped with a 532 nm quantum light and subsequently the fluorescence signal, registered on a single photon detector, is compared with the idler photon detection signal and fluorescence decay is collected (Fig. 2). This scheme shows a simple platform for investigating light-matter interaction with a good control on both, the number of atom-like systems and the number of photons. More control over the optical illumination can provide additional information about the interrogated sample. This can be envisioned when considering an ensemble of absorbers located at distances below the diffraction limit. After laser excitation the number of emitted photons can enable to indirectly determine the number of absorbers. However, typical single photon detectors are not photon-number-resolved, which makes this task more difficult. Illumination with a photon number state, which is well defined, could help to overcome some of these limitations.

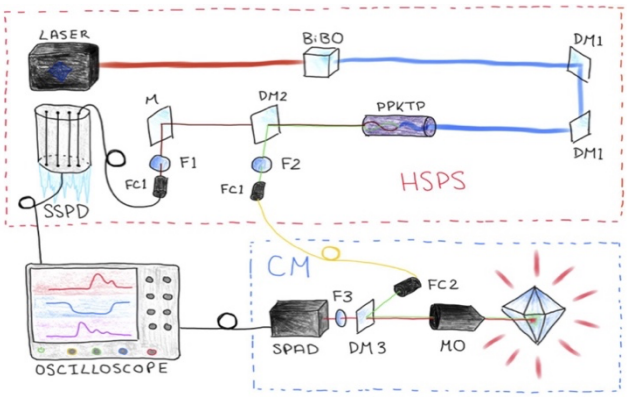

Fig. 1. Experimental setup.

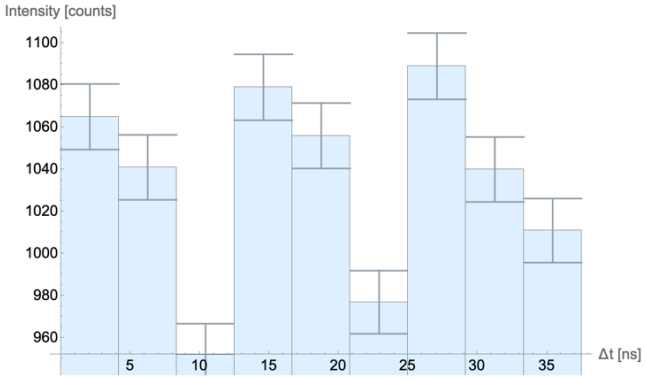

Fig. 2. Fluorescence decay histogram for a single photon interacting with a single NV centre.

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References

[1] M. Gieysztor, M. Misiaszek, J. van der Veen, W. Gawlik, F. Jelezko, and P. Kolenderski, Optics Express, 29, 564 (2021).

[2] A. Divochiy, M. Misiaszek, Y. Vakhtomin, P. Morozov, K. Smirnov, P. Zolotov, and P. Kolenderski, Opt. Lett. 43, 6085 (2018).