Towards a fiber coupled organic molecule as a single-photon source

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A single-photon source is an essential tool for the developing field of quantum technologies. Ideally, it should be spectraly compatible with other photonic devices while providing a high flux of narrowband photons. The single organic dye molecule dibenzanthantherene (DBATT) embedded into a n-tetradecane Spol'skii matrix under cryogenic conditions possesses the given characteristics, thus constitutes a prominent single-photon source [1]. Nevertheless, the implementation of such a single-photon source requires a complex experimental setup involving a cryostat with a confocal microscope for the effective collection of the molecule's emission. Another approach is to use a single emitter coupled to an optical fiber. This approach has the potential to transfer a single-photon source from a proof-of- principle type of setup to a scalable plug and play device. Here we present the first steps towards the fiber-coupled organic molecule single- photon source. To conveniently couple the molecules to the fiber the solution of the DBATT molecule in the a n-tetradecane was deposited inside a glass capillary. The fiber end was immersed inside the capillary to collect the molecule emission. This simplistic approach already enabled the detection of single molecules and collection of up to 40 thousands photons per second with anti-bunching at zero reaching the value of 0.35 [2]. Nonetheless, the obtained emission is significantly influenced by the Raman scattering inside the fiber. The spectrum of the molecule was filtered to minimize the presence of the Raman scattered light in the emission of the molecule. However, spectral filtering cuts off 70 % of the molecular emission. Additionally, a time filtering in the pulsed excitation scheme is examined, which holds a promise to avoid the disadvantages introduced by the spectral filtering.

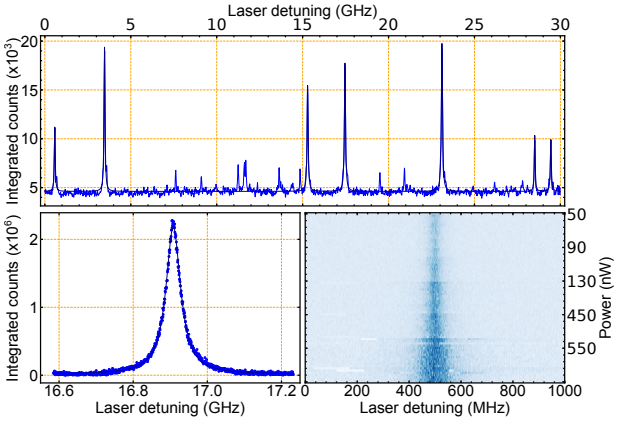

Figure 1: The detected with a fiber single DBATT molecules.

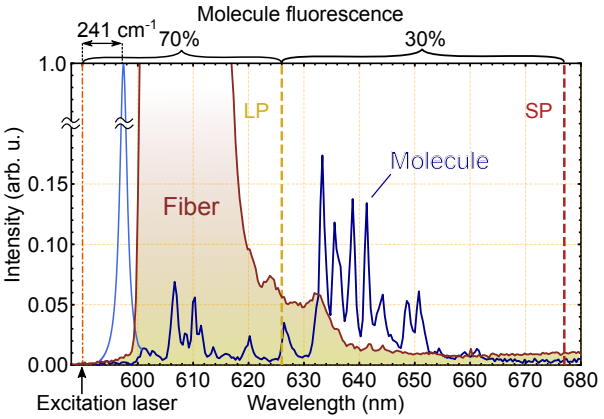

Figure 2: The spectral picture of the emission og the DBATT molecule coupled to the fiber.

[1] Rezai, M., Wrachtrup, J. & Gerhardt, I. Coherence Properties of Molecular Single Photons for Quantum Networks. *Phys. Rev. X* **8,** 031026 (3 2018).

[2] Stein, G., Bushmakin, V., Wang, Y., Schell, A. W. & Gerhardt, I. Narrow-Band Fiber-Coupled Single-Photon Source. *Phys. Rev. Applied* **13,** 054042 (5 2020).