Study on a Disseminable Single-Photon Emitter for Quantum Radiometry

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In quantum radiometry, single-photon sources (SPSs) are promising candidates for standard light sources in the low-photon-flux regime due to their sub-Poissonian emission statistics, complementing blackbody and synchrotron radiation sources. This has motivated National Metrology Institutes (NMIs) to develop and metrologically characterize SPSs with narrow spectral bandwidth, high single-photon purity, high photon flux and high stability. Consequently, NMIs are advancing measurement procedures and improving the uncertainty analysis to enable future intercomparisons and establish best practices.
We present a metrological characterization of a disseminable SPS based on a deterministically fabricated InGaAs quantum dot (QD) micromesa, performed at two NMIs [1, 2]. This disseminable source consists of a QD chip and compact spectral filters, that have been shipped from PTB, the German NMI to NIST, the NMI of the United States of America. The characterization includes measurements of emission wavelength, absolute photon flux and second-order correlation function $g^{(2)}(\tau)$ of the same QD (see Fig. 1). The consistent results in terms of $g^{(2)}(0)$ in two different laboratory environments and the demonstrated robustness of the quantum emitter show its potential to be used as a standard source for quantum radiometry and related fields in quantum science and technology.

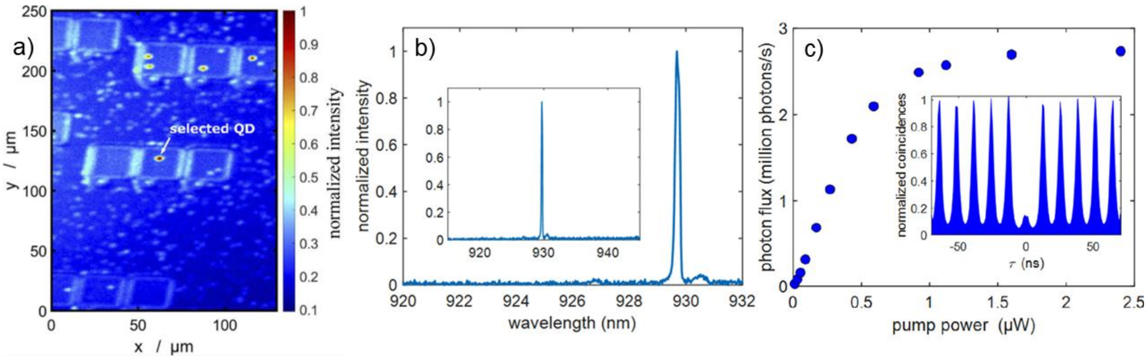

Fig. 1: *a) Micro-photoluminescence scan of the sample emission showing the selected QD-micromesa used for the characterization [1]. b) Microluminscence spectrum of the selected excitonic state [2]. c) Saturation curve. The QD emission reaches a maximum incident photon flux of 2.8 million photons/s at the SPAD's active area. Inset: Second-order correlation function* $g^{(2)}(\tau)$ *for an excitation power close to saturation [2].*

References

[1] H. Georgieva, et al., Opt. Express 29, pp. 23500–23507 (2021).
[2] H. Georgieva et al., Appl. Phys. Lett. 125, 264002 (2024).