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# The Quest for the Ideal Quantum Light Source


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With the advent of the second quantum revolution, striving for real-world applications of quantum technologies, enormous efforts have been made to develop and optimize the necessary building blocks. For photonic quantum technologies, which uses light particles – photons – as quantum information carriers (qubits), one crucial technology are quantum light sources generating these qubits. In recent years, epitaxial semiconductor quantum dots have made substantial progress, bringing us closer to practical quantum light sources for photonic quantum technology applications. In particular, quantum dots exhibit the lowest multi-photon emission probability [1], strongly polarization entangled photon pairs at telecom frequencies [2], and two-photon interference raw visibility close to unity [3]. However, no ideal quantum light source has yet been developed, addressing all prerequisites at once. I will discuss our efforts improving source properties such as purity, brightness, indistinguishability, and on- demand entangled photon pair generation. I will put these achievements in relation to the different excitation methods used: resonant excitation of a quantum mechanical 2-level system and two-photon excitation of a 3-level quantum ladder system [4]. Finally, I will discuss solutions to overcome these fundamental challenges and show our recent efforts to simultaneously achieve high purity and indistinguishability from a quantum dot 3-level quantum ladder system [5].



[1] L. Schweickert et al., Appl. Phys. Lett. **112**, 093106 (2018).
[2] K.D. Zeuner at al., ACS Photonics **8**, 8, 2337–2344 (2021).
[3] E. Schöll et al., Nano Lett. **19(4)**, 2404–2410 (2019).
[4] E. Schöll et al., Phys. Rev. Lett. **125**, 233605 (2020).
[5] F. Sbresny et al., Phys. Rev. Lett. **128**, 093603 (2022).



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