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Fachbereich Physik, Universität Stuttgart
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Entanglement-based quantum communication with artificial atoms

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Abstract

The prospect of using the quantum nature of light for secure communication keeps spurring the search and investigation of suitable sources of entangled photons. Semiconductor quantum dots (QDs), also dubbed “artificial atoms”, are arguably one of the most attractive, as they can generate pairs of polarization-entangled photons with high efficiency and near-unity degree of entanglement. Despite recent advances, however, the exploitation of photons from QDs in real-world quantum networks remains a major open challenge.

In this talk, I will first discuss how GaAs quantum dots can generate entangled photons with high brightness and degree of entanglement [1-3]. Then, I will show how they can be used to implement advanced quantum communication protocols, such as quantum state teleportation and entanglement swapping [4, 5]. Finally, I will present our first steps towards the construction of a QD-based quantum network for secure communication within the University campus [6, 7]. A discussion on future challenges and perspectives will conclude the talk.

[1] D. Huber et al., Phys. Rev. Lett. 121, 033902 (2018)
[2] M. B. Rota et al., Elight 4, 13 (2024)
[3] A. Laneve et al., arXiv:2409.07875 (2024)
[4] F. Basso Basset et al., Phys. Rev. Lett. 123,160501 (2019)
[5] F. Basso Basset et al., npj Quantum Inf. 7, 7 (2021)
[6] F. Basso Basset et al., Science adv. 7, eabe6379 (2021)
[7] A. Laneve et al., in preparation (2024)