

PHYSIKALISCHES KOLLOQUIUM

Wintersemester 2023/24

Das Kolloquium findet (soweit unten nicht anders angegeben) jeweils montags **jeweils montags um 17:15 Uhr online via Zoom** statt.

(Der jeweilige Link wird noch zur Verfügung gestellt.).

13.11.2023

Vorstellungsvortrag im Rahmen des Habilitationsverfahrens

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Let there be (quantum) light: single-photon sources as a tool for engineers and scientists

Abstract

Quantum technologies are posed to have a transformative impact on our society. They are expected to be a driving technology of the 21st century.^{1,2} This is especially true for quantum computing which exploits quantum entanglement for the computation of tasks that cannot otherwise be performed with a classical computer.³ There is a plethora of platforms currently being pursued with the common goal of realizing a fault-tolerant and universal quantum computer.⁴ However, up to this point, only two of these platforms – superconducting and photonic qubits – have demonstrated quantum advantage.^{5,6} Indeed, optical quantum computing is a leading contender amongst the different quantum computing platforms,⁷ and unique in the sense that photons are the only known qubits that can be used to exchange quantum information in networks over macroscopic distances. Yet, quantum photonics will only meet its expectations as a game-changing technology if it can be integrated in a scalable way.

In this context, I will discuss epitaxial quantum dots as high-performant sources of single photons that can be considered as a semiconductor launchpad for quantum photonic technologies.⁸ This talk will cover the physical principles of semiconductor quantum dot single-photon sources, and provide an overview on the state-of the art. I will furthermore present recent progress on quantum dot single-photon sources *made-in-Würzburg* and show how our sources can drive progress in quantum computing and the exploration of fundamental science.



References

1. Dowling, J. P. & Milburn, G. J. Quantum technology: the second quantum revolution. *Philos. Trans. R. Soc. London. Ser. A Math. Phys. Eng. Sci.* **361**, 1655–1674 (2003).
2. Acín, A. *et al.* The quantum technologies roadmap: a European community view. *New J. Phys.* **20**, 080201 (2018).
3. Cardozo, R. & Corbett, R. *Quantum Computing*. (National Academies Press, 2019). doi:10.17226/25196.
4. Ladd, T. D. *et al.* Quantum computers. *Nature* **464**, 45–53 (2010).
5. Arute, F. *et al.* Quantum supremacy using a programmable superconducting processor. *Nature* **574**, 505–510 (2019).
6. Zhong, H.-S. *et al.* Quantum computational advantage using photons. *Science (80-.)*. **1463**, 1460–1463 (2020).
7. O'Brien, J. L. Optical Quantum Computing. *Science (80-.)*. **318**, 1567–1570 (2007).
8. Zhou, X., Zhai, L. & Liu, J. Epitaxial quantum dots: a semiconductor launchpad for photonic quantum technologies. *Photonics Insights* **1**, R07 (2022).

Für die Dozentinnen bzw. Dozenten der Fakultät

Prof. Dr. Assaad, Prof. Dr. Hinrichsen, Prof. Dr. Pflaum und Hr. Kuhr