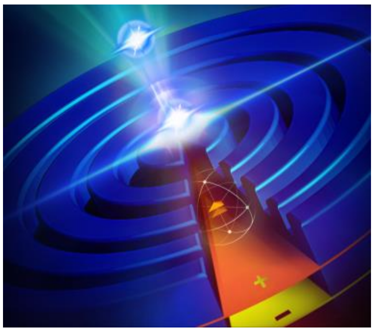
Development of electrically driven bullseye resonators

Background: Single-photon sources and spin-photon interfaces are elementary building blocks of future quantum networks. They emit single photons on demand and act as interfaces between flying qubits and stationary qubits. Semiconductor quantum dots are very attractive quantum emitters for realizing such quantum devices. To maximize the emission rate of these non-classical light sources, they are usually integrated into nanophotonic cavities, which enable increased light-matter interaction and associated intriguing effects such as the Purcell effect. Of particular interest in this context are quantum dot molecules that are integrated into so-called bullseye resonators[1].



Schematic view of a spin-photon interface based on a quantum dot molecule in a bullseye resonator.

The project:

In this master thesis, electrically contacted single-photon sources and spin-photon interfaces based on quantum dots and quantum dot molecules are to be developed. For this purpose, electrically operated bullyseye resonators are to be manufactured and electro-optically examined in detail. State-of-the-art nanoprocessing tools such as in-situ electron beam lithography and quantum-optical measurement methods are used for production and characterization.

Your tasks:

- Numerical design and optimization of electrically contacted bullseye resonators
- Device fabrication using in-situ electron beam lithography
- Optical and quantum optical experiments to evaluate the properties of the fabricated quantum devices, with a focus on demonstrating the emission of indistinguishable photons

What you can expect:

- Study a cutting-edge and exciting topic in quantum nanophotonics
- Deepen your knowledge of semiconductor materials, semiconductor quantum dots, optoelectronic components and modern simulation, nanotechnology and characterization methods of optoelectronic components.
- Deep insight into semiconductor nanotechnology by supporting fabrication of nanophotonic quantum light sources.
- Working in a friendly environment and discussing with other motivated and talented scientists daily
- We greatly value the importance of close training and support to students in all aspects.

Prerequisite:

- A strong ambition and passion to carry out a project.
- An open mind to learn new knowledges and tackle down the encountered problems.
- Having some basic knowledge in semiconductor quantum dots, optoelectronic components, and quantum optics is advantageous, but is however never as important as above!

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[1] J. Schall et al., Adv. Quantum Technol. 4, 210000 (2021)