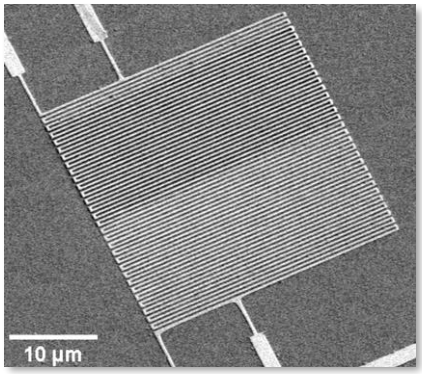
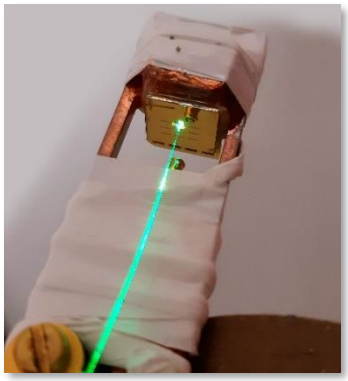
BSc/MSc Thesis: Plasmonically Enhanced Superconducting Nanowire Single Photon Detectors



Single-photon based applications in quantum technologies such as quantum computing require photon detection with high precision and near-unity efficiency. To achieve this goal, we are using Superconducting Nanowire Single Photon Detectors. Plasmonic resonances represent an effective way to increase the absorption efficiency of such detectors. In order to have optimum detection efficiency we integrate a so-called plasmonic perfect absorber structure to enhance the performance even further to reach almost 100% absorption with our detector. To ensure the perfect coupling, we utilize directly coupled single mode fibers in combination with high NA micro optics, which are printed onto the fibers.



So far, we have demonstrated that the basic principle of our detectors works and are working on the optimization of the detectors and the measurement setup.

Available tasks for you:

- Optimization of the electrical connections of our samples to obtain a better signal to noise ratio so that the time-dependent quantities of our detectors can be determined.
- Development of new detector designs for different applications, e.g., polarization independent structures, as well as integration of pixelated detectors on a planar substrate, for quantum imaging and multi-photon detection

Required skills:

- Interest in optics, experimental and low-temperature physics
- Interest in the design of electronic circuits
- Hands-on and practical attitude

You gain:

- Handling of ultra-cold liquids nitrogen and helium
- Know-how about superconductors, lasers, and measurement techniques for quantum technologies
- Experience in designing and building high-speed electrical circuits

Contact:

- M.Sc. Sandra Mennle (sandra.mennle@pi4.uni-stuttgart.de)
- Dr. Philipp Karl (philipp.karl@pi4.uni-stuttgart.de)
- Prof. Harald Giessen (h.giessen@pi4.uni-stuttgart.de)

Literature:

- Philipp Karl et al., “Niobium nitride plasmonic perfect absorbers for tunable infrared superconducting nanowire photodetection,“ Opt. Express **29**, 17087 (2021).
- Philipp Karl et al., "Tunable infrared high absorbing polarization independent niobium nitride plasmonic perfect absorber nanowire photodetectors," Opt. Mater. Express **12**, 2453-2461 (2022).