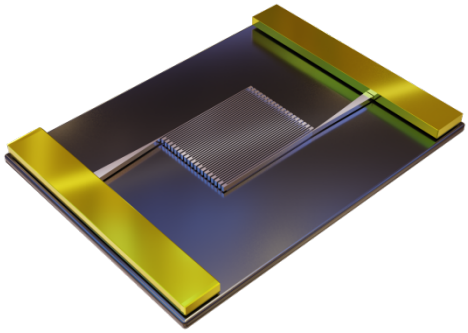
Master thesis on Superconducting Single Photon Detectors



A key requirement for almost any photonic quantum technology is the ability to detect single photons with high detection efficiencies, high count rates, low dark count rates, and high timing resolution. Within the last years, superconducting (nanowire) single photon detectors (SNSPDs) have proven to be one of the most versatile detectors for visible to infrared wavelengths. They outperform other single photon detectors in terms of detection efficiency (ca. 90%), timing resolution (<20ps), and dark count rate (<1cps) [1, 2]. Thus, these detectors have a wide range of applications such as general faint light detection in astronomy or integrated on-chip photonic circuits for future chip-based optical quantum applications.

We use established techniques to sputter NbTiN, MoSi, and WSi superconducting thin films in close collaboration with the Walther-Meißner-Institut (WMI) and pattern our detectors consisting of meandering nanowires (100 nm) using e-beam lithography. These detectors we then test and characterize in a cryogenic probe station. We are looking for a motivated student who complements our team by assisting us in

- designing and optimizing a distributed Bragg reflector and multi-layer anti-reflection coating to enhance device efficiency and wavelength selectivity for different superconducting detector types.
- developing a demonstrator experiment for application of SNSPDs in deep-space optical communication in close collaboration with the German Aerospace Center (DLR). For this project you would work both at WSI in Garching and the DLR site in Oberpfaffenhofen. See also the announcement on the DLR website: https://www.dlr.de/dlr/jobs/en/desktopdefault.aspx/tabid-10596/1003_read-45540/

In both projects you work closely together with a team of students and Ph.D. students, so teamwork is essential. Furthermore, some experience in the areas of optics, electronics, programming or cleanroom fabrication will be beneficial but secondary to your personal motivation and commitment to this fascinating project. You will gain skills, knowledge, and become an expert in various scientific research tasks, including but not limited to thin-film deposition techniques, nanoscale cleanroom fabrication (SEM, EBL, AFM, RIE, MLA, etc.), and electro-optical measurements at cryogenic temperatures.

If you want to contribute to the exciting and highly topical research on SNSPDs, we are looking forward to your application. Please send your CV, transcript of records and Bachelor thesis to Prof. Jonathan Finley (finley@wsi.tum.de) and Prof. Kai Müller (kai.mueller@wsi.tum.de), including Stefan Strohauer (stefan.strohauer@wsi.tum.de), Rasmus Flaschmann (rasmus.flaschmann@wsi.tum.de), and Lucio Zugliani (lucio.zugliani@wsi.tum.de) in cc.

[1] F. Natarajan et al., Supercond. Sci. Technol. **25,** 063001 (2012)

[2] I. Holzman et al., Advanced Quantum Technol. **2**, 1800058 (2019)

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