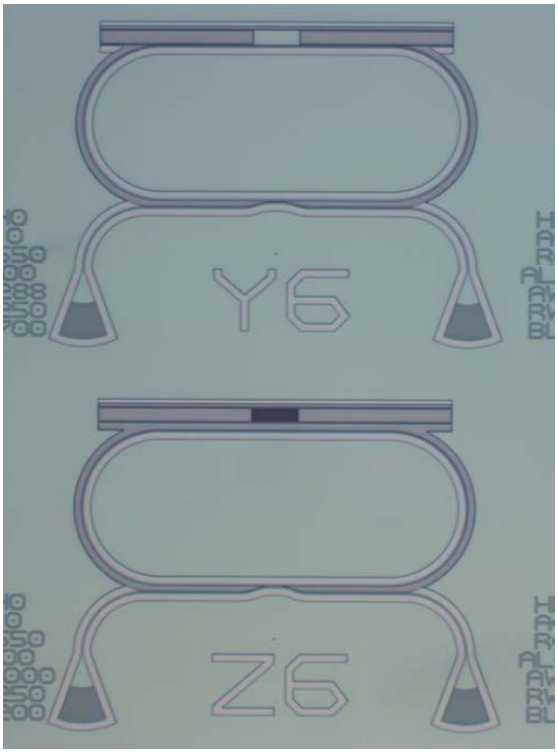
Quantum Technologies Lab
Physics Department
Technical University of Munich

Master's thesis project

Optomechanics with Single Photons

In optomechanics, light is used to measure and alter the dynamics of mechanical resonators. It is by far the most sensitive method to observe the tiny vibrations that nanomechanical devices perform: in one second one can determine their position with femtometer precision! Using light to measure the mechanics is not the only aspect of optomechanics. The same light can also be used to *change* the dynamics of the mechanical device through a process called cavity backaction. The photons exert a force on the resonator, the so-called radiation pressure. In this project we want to explore the ultimate limits to this force. The goal is to measure the force originating from a single photon! For this it is required that the photon interacts with the mechanical resonator as strongly as possible. For this we need to the design and make very low loss optical cavities, such as microring resonators. Also, the mechanical device should have a quality factor as high as possible. You will make both the optical and mechanical components from chips with highly-stressed silicon nitride using state-of-the-art nanofabrication in the cleanroom. Then the devices are placed in a vacuum chamber for their measurement. In our highly-automated setups you can very quickly characterize many of the devices on your chip. Then, with the perfect device you can start to explore the more advanced measurements. Initially we will measure the devices with pulsed light, but by using single photon sources, we want to explore the ultimate limits to optomechanical forces.



Project details

The project is primarily targeting students in Applied and Engineering Physics (AEP) and Condensed Matter Physics (KM). Still, if you follow another track or come from a different department (e.g. electrical engineering) we can always discuss if this project is a good match for you. Being curious and wanting to get a feeling for what doing *real* research is about is more important than your exact background. Hence, there are no formal requirements on courses taken. The project has the following components:

- Nanostructures (experimental) ~50%
- Optics (experimental) ~50%

What do we offer?

Our group works on experiments for quantum technology in the broadest sense. In particular, we focus on nano- and optomechanics, as well as on on-chip photonics for integrated quantum optics experiments. We are relatively small, so you will be working together with almost all group members. For more information about us, also look at our website: www.qtech.ph.tum.de.

Interested?

We love to hear from you and will be more than happy to answer any questions that you may have on this project. The first step is to contact us, so that we can discuss this (or other) projects with you in person; just come by in Rm. 3071 or send an e-mail to menno.poot@tum.de.

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