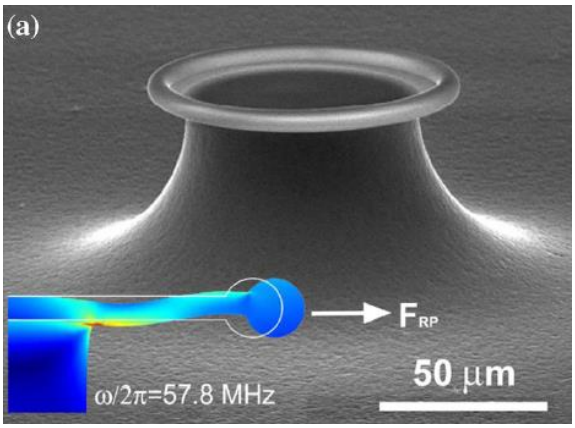
Master Thesis Scholarships on nanophotonics and quantum optics at the Swiss Federal Institute of Technology Lausanne (EPFL)

The „Laboratory of Photonics and Quantum Measurement“ (k-lab.epfl.ch) at the Swiss Federal Institute of Technology Lausanne (Ecole Polytechnique Fédérale de Lausanne, EPFL) offers scholarships for master's theses of up to twelve months. The Master thesis can be joint with a home institution in Germany or elsewhere. Research in our group at EPFL is focused on novel applications of chip based ultra high Q optical microresonators for quantum optomechanics and optical frequency comb generation. The topics which we work on are broadly defined as:

- **"Quantum Optomechanics"** is a novel field of research, where the radiation pressure induced coupling between an optical and mechanical degree of freedom is explored.[1,2] We are particularly interested in the possibility to cool a mechanical degree of freedom to its quantum mechanical ground state[1,3,4], which literally gives access to "quantum mechanics" experiments. This multifaceted project involves micro fabrication, laser physics, quantum optics and cryogenics. The objective of this research is to extend quantum control from atoms, molecules and ions to mechanical systems.



Optical microresonators

- Our second line of research topic is on a novel method of **optical frequency-comb generation** using chip-based micro cavities[6,7]. Frequency combs – the Nobel prize in 2005 has been awarded to Hänsch and Hall for its development – are of widespread interest in physics and are used in the fields of metrology, laser spectroscopy, sensing, telecommunications as well as the calibration of astrophysical instruments. Recently, our group developed a method permitting to generate these frequency combs on-chip.

Our experiments are at the interface of nanophysics and quantum optics closely linking experiment and theory, and thus allow acquiring a broad knowledge in several fields and of experimental techniques.

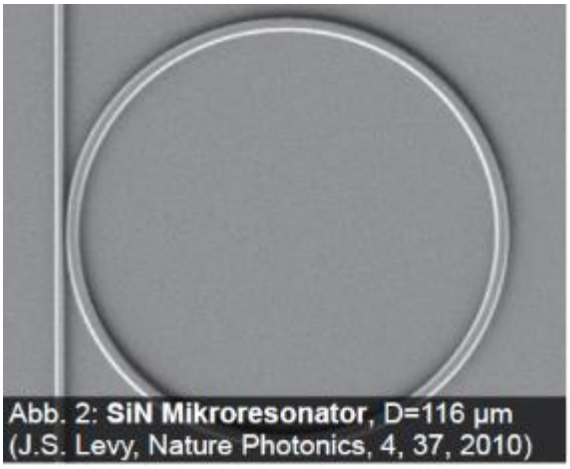


Abb. 2: **SiN Mikroresonator**, D=116 µm
(J.S. Levy, Nature Photonics, 4, 37, 2010)

Being one of the two Swiss Federal Institutes, EPFL is known for its high international reputation and outstanding equipment. Access to unique 1500 square meter cleanroom facilities for nano-fabrication is available http://cmi.epfl.ch/ in for the Master thesis project. EPFL campus in Lausanne is only at a few steps from Lake Geneva (see photo). As a major city in the French-speaking part of Switzerland, surrounded by Montreux and Geneva and the nearby Alps, Lausanne provides an attractive environment.

This scholarship addresses physicists or students of neighboring subjects (e.g. electrical engineering) interested in doing cutting-edge research on one of the aforementioned exciting and challenging projects.

A major asset of EPFL is its extensive cleanroom environment that is used for a number of advanced micro- and nanofabrication projects. Master students can gain access to the premier facility.

For further information please contact Prof. Dr. Tobias J. Kippenberg (jobs-klab@epfl.ch) or consult our webpage k-lab.epfl.ch.

The scholarship offered amounts to 1600 CHF/month, such that the stay in Lausanne is self-financing.

Literature:

1. Kippenberg & Vahala "Cavity Optomechanics: Backaction at the mesoscale" *Science* **321**, 1172 (2008).
2. Kippenberg & Vahala "Cavity opto-mechanics" *Optics Express* **15**, 17172 (2007).
3. Schliesser, Del'Haye, Nooshi, Vahala & Kippenberg "Radiation pressure cooling of a micromechanical oscillator using dynamical backaction" *PRL* **97**, 243905 (2006).
4. Verhagen, Deléglise, Weis, Schliesser & Kippenberg "Quantum-coherent coupling of a mechanical oscillator to an optical cavity mode" *Nature* **482**, 63-67 (2012)
5. Schroeter, Reich, Arcizet, Raedler, Nickel & Kippenberg "Chip based, lipid bilayer functionalized microresonators for label-free, ultra-sensitive and time-resolved molecular detection" Submitted (cf. arxiv) (2008).
6. Del'Haye, Schliesser, Arcizet, Wilken, Holzwarth & Kippenberg. "Optical frequency comb generation from a monolithic microresonator" *Nature* **450**, 1214 (2007).
7. Kippenberg, Holzwarth & Diddams "Microresonator Based Frequency Combs" *Science* **322**, 555 (2011)