Universität Basel

# Research Project

# Q-AFM / Quantum Limited Atomic Force Microscopy

**Third-party funded project**

**Project title** Q-AFM / Quantum Limited Atomic Force Microscopy
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**Organisation / Research unit**
Departement Physik / Nanomechanik (Meyer)
**Department**
**Project Website** www.qafm.eu
**Project start** 01.01.2019
**Probable end** 31.12.2023
**Status** Completed

We aim to make a radical improvement in the speed of acquisition and information content of Scanning Probe Microscopy (SPM) images by developing a new type of resonant mechanical force sensor. By the end of the project we realize a Quantum-limited Atomic Force Microscope (Q-AFM), where the force sensor is working at the fundamental limit of action and reaction set by quantum physics. Achieving this limit will result in three orders of magnitude improvement in force sensitivity and five orders of magnitude in measurement bandwidth, beyond the current state-of-the-art. This huge gain in performance will translate to a radical increase in imaging speed and in the information content of images. Our sensor will lead to a revolution in SPM, where multi-dimensional data sets are acquired in seconds, as opposed to several days as is the current practice. The key to reaching quantum-limited sensitivity lies in the the electro-mechanical coupling between the resonant mechanical force transducer and the readout circuit. While our ideas are based on well-established theories and some proof-of-concept measurements, but there is still a high risk that we can not reach the desired strong-coupling regime with an appropriate SPM sensor design. To mitigate this high risk we will pursue two different sensor designs, one based on electrostatic coupling and the other based on piezoelectric coupling. Our work plan includes medium and low risk stages of development, each of will result in major gains in performance SPM. The project brings together three university research groups from KTH, Uni Basel and TU Wien, with one SME Intermodulation Products. Together they bring the diverse and complementary expertise necessary to carry out this project such as: superconducting quantum circuits, low temperature AFM, piezoelectric MEMS, and advanced analog and digital electronic design and low-level programming.

**Financed by**
Commission of the European Union

**Add publication**

**Add documents**

**Specify cooperation partners**