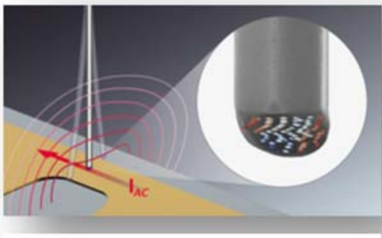
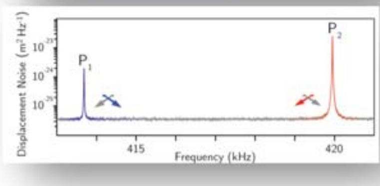
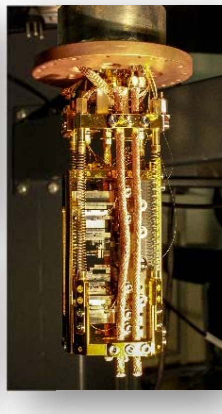
POGGIO LAB

Nano-mechanics, Nano-magnetism, Nano-imaging







Ph.D. Position Available

Department of Physics
University of Basel

We seek a talented and ambitious **Ph.D. Student** interested in using nanomagnetic scanning probe sensors based on nanowires (NWs) to image current flow and nanomagnetism in 2D van der Waals (vdW) systems. The research is supported by the Swiss Nanoscience Institute (SNI) Ph.D. Program. **The position is available starting in January 2020.**

Recent years have seen rapid progress in nanometer-scale magnetic imaging technology, with scanning probe microscopy driving remarkable improvements in both sensitivity and resolution. Among the most successful tools are magnetic force microscopy (MFM), spin-polarized scanning tunneling microscopy, as well as scanning magnetometers based on nitrogen-vacancy centers in diamond, Hall-bars, and superconducting quantum interference devices. Here, we propose the development and application of recently developed NW force sensors as MFM probes. Using NWs functionalized with magnetic tips, we will realize MFM capable of mapping magnetic fields and dissipation with enhanced sensitivity and resolution compared to the state of the art. With these new capabilities, we will image mesoscopic current flow, magnetism, and dissipation in 2D vdW heterostructures with well-defined twist angles, which allow for control over strong electronic correlations. These structures include 'magic-angle' twisted bilayer graphene, which – in a major breakthrough – recently showed gate-controllable superconductivity.

Although MFM is already applied to a wide array of samples for its ability to work at various temperatures, some materials remain out of reach because of limitations in resolution and due to the perturbative effect of conventional tips. High force sensitivity coupled with small tip size should allow magnetic NW sensors to work both close to a sample, maximizing spatial resolution, and in a regime of weak interaction, remaining noninvasive. These characteristics will allow NW MFM to provide magnetic contrast, which has not been available through existing techniques. These include spatial maps of Biot-Savart fields, magnetic stray fields, and dissipation tied to the various strongly correlated states, which have recently been discovered within of 2D vdW materials.

Our relevant work in the field:

1. F. R. Braakman and M. Poggio, *Nanotechnology* **30**, 332001 (2019).
2. N. Rossi, et al., *Nano Lett.* **19**, 930 (2019).
3. N. Rossi, et al., *Nat. Nanotechnol.* **12**, 150 (2017).

The Department of Physics at the University of Basel offers a stimulating and collaborative environment with internationally recognized research groups active in both experimental and theoretical condensed matter physics. Our group is part of the **Swiss Nanoscience Institute** (nanoscience.ch) and the **NCCR: Quantum Science and Technology (QSIT)** (nccr-qsit.ethz.ch). More information is available at poggiolab.unibas.ch and www.physik.unibas.ch.

Candidates with previous experimental physics or scanning probe microscopy experience are preferred. A Masters in physics or a related field is required. Applications should include the candidate's CV, copies of his/her diplomas, and 2 letters of reference. **Applications should be submitted at https://biped2.sni.unibas.ch/apply/sni-phd-program-2019 specifying interest in project P1905: Magnetic force microscopy with nanowire transducers.**

poggiolab.unibas.ch www.physik.unibas.ch nanoscience.ch/en/research/phd-program

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