Master Thesis Proposal

University of Basel, Quantum Sensing Group (Switzerland)

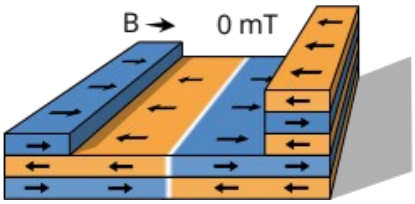
Title: Domain walls in layered magnetic materials.

Keywords: condensed matter physics**,** 2D materials, magnetism, domain walls, excitons, scanning probe instrumentation.

Scientific description:

Heterostructures built from atomically thin two-dimensional (2D) materials form a rapidly advancing frontier of condensed matter physics. Within this family, several compounds exhibit intrinsic magnetic order. A prominent example is CrSBr, where spins align ferromagnetically within each layer but antiferromagnetically between layers.

Recently, our team developed a technique to write magnetic domain walls between regions of opposite Néel vectors [arXiv:2503.04922]. Building on this result, we aim to investigate (i) the optical properties of these domain walls and (ii) their response to external electric and magnetic fields. Key open questions include: What is the characteristic size and internal structure of the domain walls? Do they couple to optically injected excitons? Can domain walls be manipulated with electric or magnetic fields?



Schematic of an domain wall in a layered antiferromagnet.

As a Master's student, you will join our team to explore these questions. Depending on project needs and your personal interests, you could contribute to:

- Fabrication of layered magnetic heterostructures
- Optical spectroscopy at cryogenic temperatures
- Scanning magnetometry experiments

Techniques/methods in use: nanofabrication, optical spectroscopy, scanning probe methods (nitrogen vacancy magnetometry).

Applicant skills: We welcome students with experience or interest in experimental work in connection with condensed matter physics, optics, two-dimensional materials and scanning probe instrumentation.

Industrial partnership: No.

Internship supervisors: Prof. Dr. Patrick Maletinsky (group leader), with direct supervision by Dr. Patrick Knüppel and Dr. Clément Pellet-Mary.

Internship location: Quantum Sensing Group. University of Basel, Klingelbergstrasse 82, 4056 Basel, Switzerland.

Possibility for a Doctoral thesis: Yes, fully funded. See also: https://quantum-sensing.physik.unibas.ch/en/open-positions/