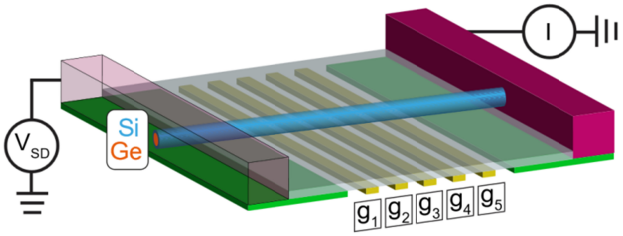
Spin-orbit interaction and dipole spin resonance in Ge-Si nanowire quantum dots

UNI BASEL

Open position available

*in the **Quantum Coherence Group (Zumbühl Group) in Basel:***



A set of narrow bottom gates is used to locally shape the potential landscape in Ge-Si core-shell nanowires. This allows us to form single, double and triple quantum dots [5] with controllable tunnel barriers. Using additional side gates (not shown), the spin-orbit strength could be tuned.

We are looking for a highly motivated and talented physicist for the investigation of **hole spin qubits** formed in **Ge-Si core-shell nanowire quantum dots**. The quantum dots are formed by local gating using bottom gates. Those wires offer **strong, electric field (gate) tunable spin-orbit interaction** [2] and **g-factor anisotropy** [3,4], which makes them suitable candidates for quantum computation experiments [1] using all electric control of the hole spin [6].

The suitable candidate fabricates the base structures (bottom gates) with electron beam lithography for later deposition of the Ge-Si nanowires, and performs quantum transport experiments in a dilution refrigerator to demonstrate tunable spin-orbit interaction and g-factor anisotropy. In a later stage, the project involves **electric – dipole spin resonance** measurements in a high frequency setup.

This project involves

- Working in a low temperature lab with a He-3/He-4 dilution refrigerator
- Nano fabrication in a clean room and subsequent quantum transport measurements in a high frequency measurement setup
- Physics of nanowires and gated quantum dots, hole spins, spin-orbit interaction, high frequency transmission and reflectometry measurements, electric – dipole spin resonance
- Analyzing complex experimental data and developing theoretical models
- Presentation of the results at international conferences and publication in high quality journals

References

[1] D. Loss et al., "*Quantum computation with quantum dots", Phys. Rev. A* **57,** 120 (1998)
[2] C. Kloeffel et al., "*Strong spin-orbit interaction and helical hole states in Ge/Si Nanowires", Phys. Rev. B* **84**, 195314 (2011)
[3] F. Maier et al., "*Tunable g factor and phonon-mediated hole spin relaxation in Ge/Si nanowire quantum dots*", Phys. Rev. B **87**, 161305(R) (2013
[4] M. Brauns et al., "*Electric field dependent g-factor anisotropy in Ge-Si core-shell nanowire quantum dots*", Phys. Rev. B **93**, 121408(R) (2016)
[5] F. N. M. Froning et al., *"Single, double and triple quantum dots in Ge/Si nanowires"*, arxiv:1805.02532 (2018)
[6] C. Kloeffel et al., "*Prospects for Spin-Based Quantum Computing in Quantum Dots", Annu. Rev. Condens. Matter Phys.* **4**, 51 (2013)

Contact

If you are interested to join our group, do not hesitate to send an email to *dominik.zumbuhl@unibas.ch* to initiate further discussions.