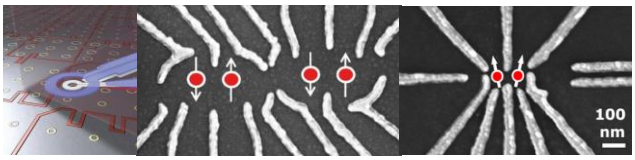


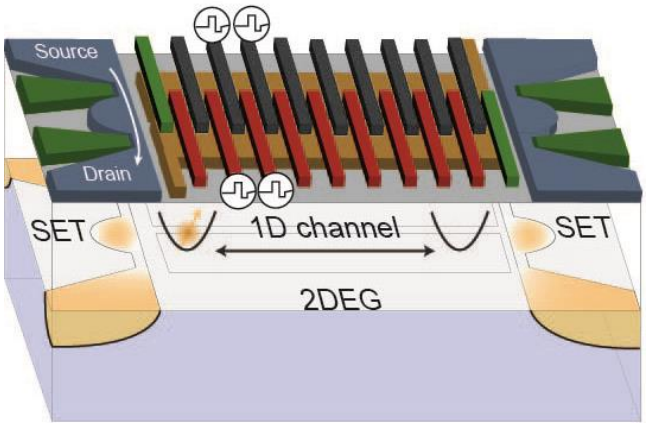
Quantum Technology Group

RWTH AACHEN UNIVERSITY

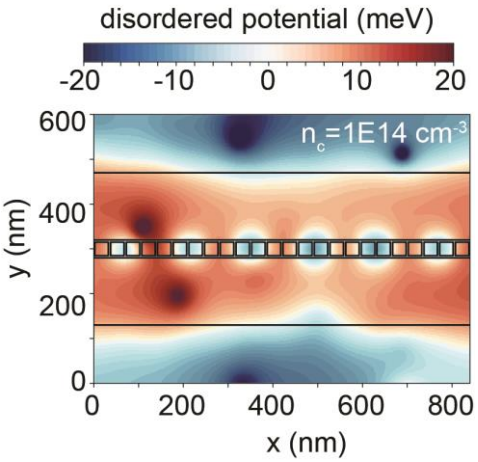
Impacts of Charged Defects in Si/SiGe on Quantum Bus

Bachelor's project starting 2021

Scientific background To achieve long range coupling of a qubit over a few microns, a **quantum bus (QuBus)** has been proved to be a promising architecture implemented by laterally defined quantum dot on Si/SiGe heterostructure. Ideally a qubit could be shuttled along an 1D channel by moving potential minima adiabatically with high fidelity. However, either charge defects introduced by imperfect oxides during fabrication or those intrinsically located defects in Si/SiGe heterostructure will scatter the shuttled electron and have an impact on the qubit fidelity consequently.



Research goal By including defects as an electrostatic perturbation, you will model their influence on the moving potential, e.g. the single electron gets trapped by the impurity. Within our electrostatic model, we take different distances between defect and QuBus into account and solve the Schrödiger equation for the transfer potential. As a result a critical density of charged defects in Si/SiGe heterostructure should be predicted and serving as a parameter to benchmark the quality of substrates provided by our suppliers.



Top: Schematic of the single electron spin QuBus. Metallic top-gates induce charges (yellow) in the Si/SiGe 2DEG. Bottom: Impacts of charge impurities on electric fields that sees by 2DEG.

Your task You will learn about the QuBus concept and about solving Schrödinger equation numerically for a realistic quantum device. You will gain experience in

- Solid background of semiconductor physics.
- Numerical simulations using COMSOL physics and matlab.
- Simulating dynamics of a spin qubit.

Furthermore, you will attend group seminars and journal clubs to learn about new developments in quantum computing.

Cooperation partners (QuantERA project):

http://www.siqubus.rwth-aachen.de/?page_id=149&lang=de

Contact:

M.Sc. Ran Xue, Physikgebäude 26A301, ran.xue@rwth-aachen.de

Dr. Lars Schreiber, Physikgebäude 28A327, lars.schreiber@physik.rwth-aachen.de