

Scientific Area	Developing quantum hardware
Topic title	Optimizing the spin qubit control in novel industrial semiconductor spin qubit devices
Main host institution	IQMT, KIT https://www.iqmt.kit.edu/
Supervisor/institution	Prof. Wolfgang Wernsdorfer, PHI and IQMT, KIT https://www.phi.kit.edu/wernsdorfer.php
Co-Supervisor/institution	Guido Pupillo, University of Strasbourg: https://isis.unistra.fr/cesq/pupillo-physique-quantique/
Mentor¹/institution	Prof. D. Zumbühl, Uni Basel : https://physik.unibas.ch/en/persons/dominik-zumbuehl/
Secondment institution	Interuniversity Microelectronics Centre (imec) https://www.imec-int.com/en
Topic description	
<p>Why is universal quantum computing still out of reach – despite its revolutionizing potential e.g. in chemistry, medicine and cryptography? While high-fidelity operations of single- and multi-qubit gates have been demonstrated across various physical qubit platforms, achieving universally useful quantum processors requires the integration and control of millions of qubits. This scalability challenge is one of the biggest technological hurdles of the 21st century.</p> <p>Industrial semiconductor manufacturing has already reached the capability to produce classical processors with billions to trillions of transistors. Interestingly, qubits in semiconductor quantum dot devices share many similarities with classical transistor structures. Leveraging industrial fabrication techniques to produce large-scale semiconductor spin qubit processors makes the semiconductor qubit platform one of the most promising candidates for realizing universal quantum computing.</p> <p>In collaboration with the Interuniversity Microelectronics Centre (imec) in Belgium, we have successfully demonstrated first qubit operations in a device fully fabricated using industrial techniques [1]. Building on this, the next phase involves fabricating and studying larger-scale qubit devices, with a focus on developing and refining strategies for scaling up these qubit devices.</p> <p>As part of this project, you will utilize an optimized and fast dilution refrigerator to study and characterize spin qubits in semiconductor heterostructures. Your work will include the optimization of qubit control and readout schemes, and contributing to the design of advanced architectures that pave the way for large scale semiconductor-based quantum processors.</p> <p>[1] T. Koch et al., Industrial 300 mm wafer processed spin qubits in natural silicon/silicon-germanium, arXiv. https://arxiv.org/abs/2409. (2023)</p>	
Recommended applicant's profile	
Master degree of physics with background in nanoscience, lithography, programing, and quantum technologies. Proficiency in English are required.	

¹ Mentor: The primary role of the mentors will be to identify and facilitate specific training objectives, advise on any problems faced by the DC, including career matters with an external perspective and provide mediation in the case of disputes.