RIKEN QUANTUM COMPUTING

https://rqc.riken.jp/

46th RQC Colloquium

Scalability with conveyor-belt spin-qubit shuttling in Si/SiGe

Dr. Lars Schreiber

RWTH Aachen University

June 15, 2026(Mon.) **16:00–17:00** (JST)

This colloquium will be held in **HYBRID format**.

On-site Venue: Wako C61 Wako Welfare and Conf. 2F Large Meeting Room

Online Venue: Zoom. To receive the link, register in advance at https://krs2.riken.jp/m/rqc_registration_form

Conveyor-belt shuttling transports single electron spin qubits adiabatically in a propagating sinusoidal potential defined by gate electrodes in a Si/SiGe quan-tum channel. This approach relies on purely electrical control with only a few tunable signals and is compatible with industrial fabrication processes. Im-portantly, the electron spin state can be preserved during transport in Si/SiGe devices. Mobile spin qubits enable new approaches to qubit manipulation, re-duce cross-talk and might enhance the spin qubit connectivity.

I discuss integrating mobile qubits into sparse quantum-computing architectures compatible with cryogenic electronics. To fully exploit spin-qubit shuttling, linear shuttle lanes must be extended into two-dimensional grids with controllable electron routing. I show how T-junctions between shuttle lanes can be realized without additional control lines. I further present how conveyor-mode shuttling can generate two-dimensional maps of local material properties, including elec-trostatic disorder, valley splitting, and complex intervalley coupling, providing feedback for mitigation strategies and benchmarking material improvements.