Curriculum Vitae

Leon C. Camenzind

leon.camenzind@riken.jp

Current affiliation

Quantum Functional System Research Group (QFSRG) at

Center for Emergent Matter Science (CEMS) RIKEN

Orcid ID 0000-0002-2278-1915

Academic Career

Research Scientist, Quantum Functional System Research Group, RIKEN **(4/2023 – now)**

As a research scientist, I focus on scaling and advancing high-fidelity spin qubit systems. We achieved a record single-qubit gate fidelity approaching 99.999% and developed a scalable calibration protocol for simultaneous multi-qubit operation using a shared control line, offering a clear advantage for large-scale quantum architectures. I also led efforts to investigate performance, noise and correlated noise across a range of devices, including a detailed comparative study of spin qubit platforms fabricated by Intel Corporation and those produced in our academic cleanroom at RIKEN, providing key insights into performance of state-of-the art industrial devices. More recently, we have ramped up efforts to investigate larger-scale devices, aiming to operate systems with around ten qubits within this year and to scale up to one hundred qubits over the next three years.

Visiting researcher, Quantum Functional System Research Group, RIKEN **(3/2022– 3/2023)**

As a visiting researcher supported by the Swiss National Science Foundation at the Quantum Functional Systems Research Group, I worked on high-fidelity spin qubits in isotopically enriched silicon quantum wells. In a three-qubit Silicon/Silicon-Germanium device, we demonstrated a robust and scalable calibration protocol for a controlled-rotation gate in an exchange-coupled silicon quantum processor. The uncalibrated gate was limited by coherent phase errors, which we quantified and corrected using a simple phase compensation scheme. This allowed us to reliably tune up two-qubit gates above the quantum error correction threshold of 99%, as verified by randomized benchmarking and gate-set tomography.

Postdoctoral researcher, Quantum Coherence Lab, University of Basel **(5/2019 – 3/2022)**

During my postdoctoral research in Basel, I investigated spin qubits in silicon, germanium–silicon core–shell nanowires, and gallium arsenide. In germanium–silicon nanowires, we achieved coherent control of the fastest spin qubit demonstrated to date and reported the first experimental evidence of the gate-tunable direct Rashba effect—an important mechanism for electrically controlling hole spin qubits. In parallel, we established a hot spin qubit in a silicon fin field-effect transistor, enabling coherent operation above 4 Kelvin—marking a significant milestone in the development of thermally robust spin qubits.

PhD in Nanoscience graduated with 'suma cum laude', University of Basel **(3/2014 - 4/2019)**

Quantum Coherence Group, Department of Physics

Title of PhD thesis: "Spin and Orbits in Semiconductor Quantum Dots".

Studied spin and orbital dynamics in quantum dots across three distinct semiconductor platforms, all relevant for scalable quantum computing. This included gallium arsenide devices with lateral quantum dots, hole double quantum dots formed in germanium–silicon core–shell nanowires, and ambipolar quantum dots using holes and electrons in silicon fin field-effect transistors fabricated with industry-compatible processes. This work aimed to understand material-dependent properties and inform future qubit design.

Date of defence: April 11, 2019. Committee: Prof. D. Zumbühl, Prof. S. Tarucha and Prof. D. Loss.

MSc. in Nanoscience majoring in Nanophysics (grade of 6/6), University of Basel **(8/2010 - 10/2012)**

Experimental focus on two dimensional GaAs spintronic systems and atomic force microscopy (AFM) in biological tissue.

Master thesis: "Quantum Transport Signatures of Electric Dipole Spin Resonance near the Persistent Spin Helix in GaAs Quantum Wells".

(8/2007 - 7/2010)

BSc. in Nanoscience (grade of 5.2/6), University of Basel

Education in Physics, Biology, Chemistry and Mathematics.

Higher School Certificate, Gymnasium Kirchenfeld, Bern **(8/2002 - 6/2006)**

Majoring in Physics and Mathematical Applications.

Awarded prizes

Camille- and Henry-Dreyfus scholarship in Physics 2019 for PhD thesis, Camille- and Henry-Dreyfus-Foundation.

NCCR SPIN Excellent Paper Award 2022 for "A hole spin qubit in a fin field-effect transistor above 4 Kelvin".

NCCR SPIN Excellent Paper Award 2023 for "Phase-Driving Hole Spin Qubits".

Swiss NSF mobility fellowship (P2BSP2_200127).

Selected Publications

1. L.C. Camenzind*, L. Yu*, P. Stano, J.D. Zimmerman, A.C. Gossard, D. Loss, and D.M. Zumbühl. Hyperfine-phonon spin relaxation in a single-electron GaAs quantum dot. Nat. Commun. 9 (2018)
2. F.N.M. Froning*, L.C. Camenzind*, O.v.d. Molen, F. A. Zwanenburg, A. Li, E.P.A.M. Bakkers, D.M. Zumbühl, and F.R. Braakman. Ultrafast hole spin qubit with gate-tunable spin–orbit switch functionality. Nat. Nanotechnol. 16, 308-312 (2021).
3. L.C. Camenzind*, S. Geyer*, A. Fuhrer, R.J. Warburton, D.M. Zumbühl, and A.V. Kuhlmann. A hole spin qubit in a fin field-effect transistor above 4 Kelvin. Nature Electronics 5, 178–183 (2022).
4. S. Geyer, B. Hetenyi, S. Bosco, L. C. Camenzind, R. Eggli, A. Fuhrer, D. Loss, R.J. Warburton, D.M. Zumbühl. Anisotropic exchange interaction of two hole-spin qubits. Nature Physics 20, 1152-1157 (2024).
5. Y.-H. Wu, L. C. Camenzind, A. Noiri, K. Takeda, T. Nakajima, T. Kobayashi, C.-Y. Chang, A. Sammak, G. Scappucci, H.-S. Goan, S. Tarucha. Hamiltonian phase error in resonantly driven CNOT gate above the fault-tolerant threshold. npj Quantum Information 10, 8 (2024).