



Call 2017

Si-QuBus

Long-range quantum bus for electron spin qubits in silicon

Lars R. Schreiber, JARA IQI, Germany

<http://www.siqubus.rwth-aachen.de>



SUCCESS STORY (highlights)



Fully scalable quantum computing architecture with spin qubits in silicon:
to solve the signal fan-out problem



Shuttle electron spin qubits across 1 .. 10 μm distance



- Spin qubit entanglement by shuttling across 6 μm in GaAs (F= 89.5 %)
B. Jadot *et al.*, Nature Nanotechnology 16, 570 (2021)
- Shuttle without loss of spin projection across 80 μm in Si/SiGe
A. M. Zwerver *et al.*, arXiv:2209.00920 (2022)
- Shuttle 1 electron in Si/SiGe (conveyor) with only 4 input signals (F=99.42 %)
I. Seidler *et al.*, npj Quantum Information 8:100 (2022)
- Qubits made by advanced semiconductor manufacturing
A. M. Zwerver *et al.*, Nature Electronics 5, 184 (2022)
- 99.9% spin shuttle-fidelity possible in conveyor in Si/SiGe across 10 μm
V. Langrock, J. Kryzwda *et al.*, arXiv:220211793 (2022)
- Sparse „spiderweb array“ facilitates Millions of qubits in silicon
J. M. Boter *et al.*, Phys. Rev. Applied 18,024053 (2022)

total 18 publications (8 of them Nature family journals)

IMPACT (RRI aspects)



OPEN SCIENCE:

- All publication in open-access journals or journal repositories
- Measurement data available in repositories
- 34 international and 11 national conference contributions



SCIENCE EDUCATION:

- Quantum computing lessons for high school students (7 afternoons)
- Quantum shuttle as lab. experiment in Quantum technology Master track



PUBLIC ENGAGEMENT:

- Panel discussions, podcasts, radio interviews (Dr. Anne-Marije Zwerver)
- Newspaper articles
- Guest articles in specialised journals (artificial intelligence, crystal growth)
- Follow-up projects with industry engagement

IMPACT (potential users)



Semiconductor industry; software development



Towards universal quantum computer in silicon
(few qubit processor based on silicon as a first step)



EXISTING End Users:

- Intel Cooperation
- Infineon Technologies AG (Dresden, Germany)

POTENTIAL End Users:

- Planned German spinoff **ARQUE systems GmbH**



QUANTERA

ERA-NET Cofund in Quantum Technologies



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 731473.