Si-QuBus

Long-range quantum bus for electron spin qubits in silicon

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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

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