筑波大学
University of Tsukuba

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Spin qubits in semiconductor heterostructures

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Research on the physical implementation of quantum computing has made dramatic progress over the past decade, spearheaded by superconducting qubits and trapped ion qubits, to the degree that small-scale quantum information processors are now within reach. Studies of semiconductor spin qubits, which have often been considered one of the most promising in the long term from the perspective of scalability, have also yielded some important results in the past decade, demonstrating exceptional coherence properties for single spins confined in quantum dots and donors and high-fidelity single-qubit gates. Over the past year, high-fidelity single- and two-qubit gates have been demonstrated in a variety of Si nanostructures, indicating that spin qubits in Si are close to the quantum error correction threshold.

In this talk I will first introduce the basic properties of spin qubits, and discuss what makes spin qubits promising building blocks for a scalable quantum computer. I will give a recap of what have been achieved, and present a general discussion of the current status of spin qubit research, with particular focus on potential bottlenecks for spin qubits, and possible solutions to the problems. Lastly, I will discuss our studies of spin communications on chip, through spin shuttling or using surface acoustic waves.

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