Hendrik Bluhm

RWTH Aachen

Semiconductor spin qubits - from proof of principle demonstrations to high fidelity quantum gates

Qubits based on electron spins trapped in fabricated semiconductor nanostructures such as gate controlled quantum dots or individual donors are considered promising candidates for scalable solid state quantum computing, which promises an exponential speedup for certain computational tasks.

Starting from an outline of the development of key concepts, I will give a (selective) overview of the current state of the art of GaAs and Si based spin qubit devices. Key results include single shot readout, high fidelity single-qubit manipulation, and first demonstrations of two-qubit gates. One particular focus of my talk will be effects from the hyperfine interaction of nuclear spins with the electron spin qubit, which is a source of strong decoherence when present and unavoidable in GaAs devices. The intricate physics emerging from hyperfine coupling is now rather well understood and we have developed effective methods to reduce the associated dephasing and achieve high fidelity qubit control.