Kolloquium

Prof. Dr. John Morton
UCL

Spins qubits using donor spins in silicon

physikalisches

Mo. 18.01.16
16:00 Uhr
Ort: H34

Quantum computers have the capability to radically change the way we are able to process information, with impacts ranging from quantum chemistry and materials modelling to machine learning and optimisation. A wide range of different systems are being explored to represent the most basic unit of quantum information: the quantum bit.

Electron and nuclear spins of donor atoms in silicon are exceptional candidates for representing quantum bits, with quantum coherence liftetimes of up to 3 seconds for the electron spin, up to 3 minutes for the neutral donor nuclear spin, and 3 hours for the ionized donor nuclear spin. Furthermore, single-shot readout of both the electron spin and nuclear spin have been demonstrated, with measurement fidelities of up to 99.8%.

I will first discuss how the Stark shift caused by DC electric fields can be used to locally tune different donor spins in- and out- of resonance, and to coherently control them. I will then show how optically-driven donor-bound exciton transitions can be used to electrically detect the donor electron spin resonance and discuss how this could provide a fruitful route to single-spin measurement at low magnetic fields using simple nanodevice structures. Finally, I will examine strategies for scaling up to arrays of multiple coupled dopant spins qubits, including the strong coupling of spins to high-Q superconducting resonators.