physikalisches Kolloquium

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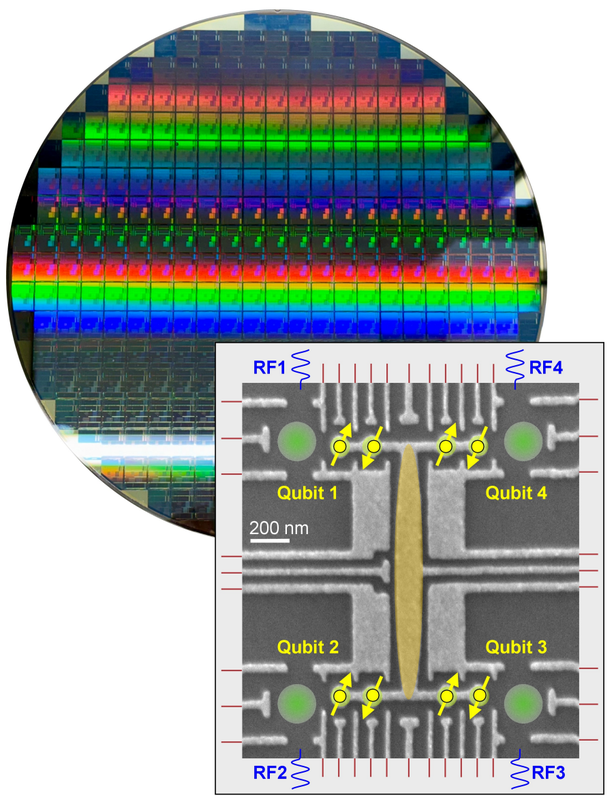
Spinful quantum dots – embracing interactions for quantum information processing

Mo. 27.10.25
16:00 Uhr
Ort: H34

Modern nanofabrication techniques in academic cleanrooms (and increasingly also industrial microelectronics foundries) enable transistor-like geometries that are so small that their charging energies dominate. Fabricated from various materials (GaAs, Si, Ge, Au, C), such quantum dots trap individual electrons at millikelvin temperatures and allow us to play with their different spin states.

Coupling spinful dots to each other and to readout resonators via tunnel barriers and capacitive couplings, reveals fundamental interactions such as Heisenberg exchange interaction, hyperfine coupling, spin-orbit coupling, etc. with nanoelectronvolt resolution. Controlling these interactions in gate-voltage-controlled quantum dots provides us with new ways of manipulating spin states in time domain.

From our lab I will show examples of control- and noise mitigation techniques inspired from NMR, machine-learning, and Bayesian Hamiltonian learning that have become powerful tools to reveal coherent dynamics of spin qubits and to establish them as attractive candidates for the pursuit of solid-state quantum computing.



Industrial 300-mm silicon wafer with thousands of transistors modified to function as single-electron quantum dots at subkelvin temperatures. Homebuilt GaAs quantum processor with four singlet-triplet spin qubits (Illustration credit: Federico Fedele).