Freie Universität Berlin

Colloquium
Dahlem Center for Complex Quantum Systems

Spins in quantum nanostructures: What they do, and what we want them to do

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Time: Thursday, February, 14th, 14:00 c.t.

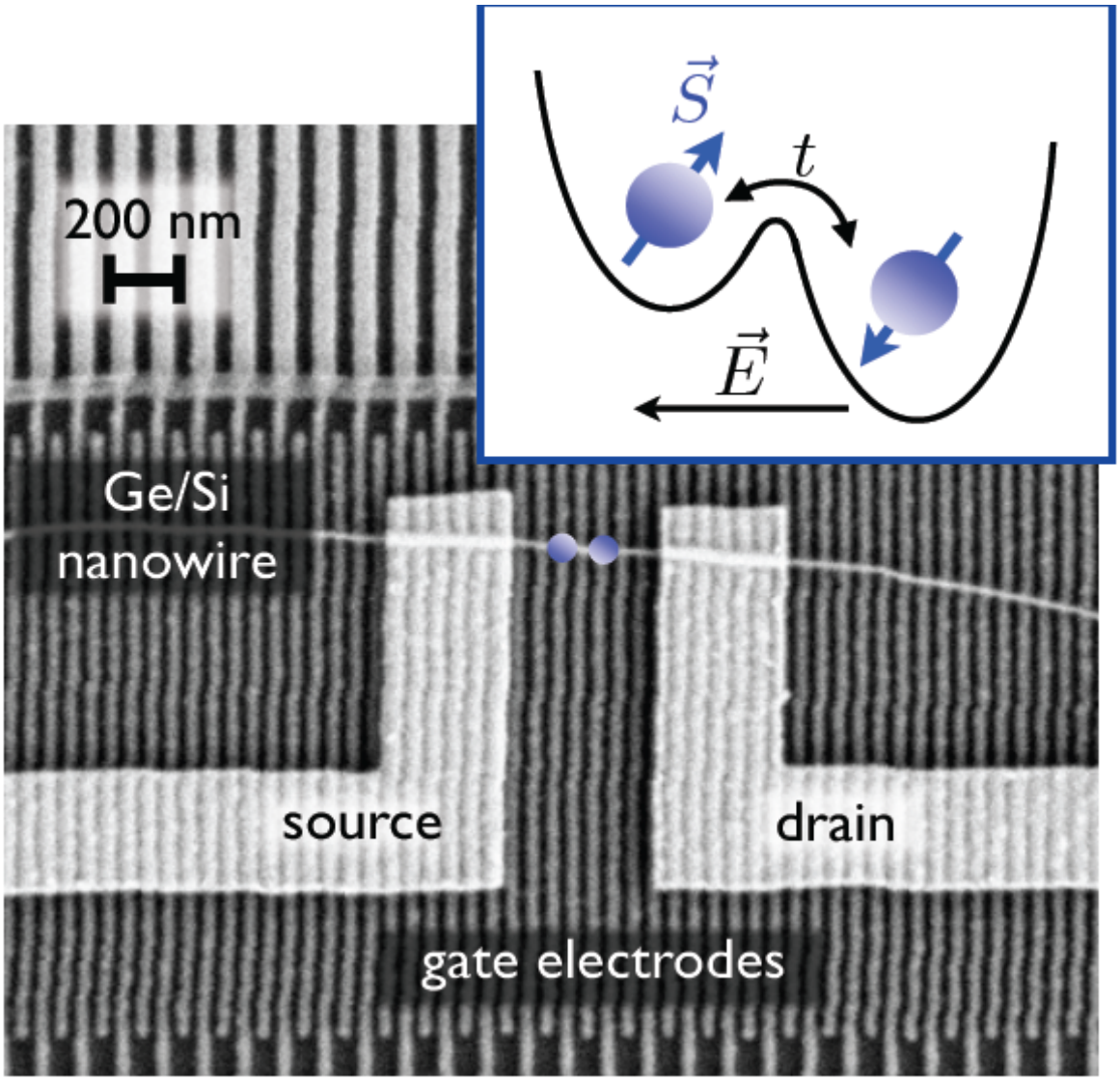
Location: Hörsaal A (1.3.14)

Abstract:

Spin is a curious property of many quantum mechanical particles. In the context of nano-electronic devices its coherent properties can be considered a technological resource. As we pursue different spin-based devices we encounter a variety of fundamental interactions. Many of these interactions such as relativistic, spin-spin, and electron-electron interactions are not easily accessible in nature, but can be studied in great detail at low temperatures.

In particular, I will explain how the interplay of these effects can be studied and controlled in quantum dot nanostructures. For example, tunneling spectroscopy at subKelvin temperature accurately determines discrete quantum states in carbon nanotube "artificial atoms". Their magnetic fingerprints reveal an electronic regime that is dominated by relativistic (spin-orbit) interactions and electron-electron interactions, in striking contrast to natural atoms. Ten years ago the controllable coupling of one-electron quantum dots seemed a formidable experimental challenge. Today, we can coherently manipulate spin states in tunable double quantum dots on a sub-nanoscecond timescale. I will show how charge sensing and microwave measurement techniques allow the operation of such devices as qubits, or as sensitive electro- or magnetometers that interact with their local environment on energy scales as small as nano-eV.

As new materials and nanofabrication techniques become available, new questions arise, such as spin dynamics of holes, and the nature of exotic particles that are neither electrons nor holes. Our curiosity continues.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