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11:00

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BACKGROUND

I have carried out research in laboratories worldwide including France, Belgium, Denmark, Australia, and Austria.
My research activities have mostly centered on the physics of nano-devices, and, in particular, on giving a direct and "local" understanding to a significant number of fundamental phenomena through experiments dealing with electron quantum interference and correlations, Coulomb blockade, and the quantum Hall regime. Over the last 6 years, my work has focused on implementing "spin qubits", i.e. units of quantum information represented by isolated spins confined in solid-state systems.

Coupling Atom-Like Spins in Semiconductors: Toward Scalable Quantum Computing

Abstract

In a world where the amount of data to process is steadily increasing, the quantum nature of matter offers new possibilities to develop concepts, which may overcome nowadays technologies. Implications are expected in research areas that can range from quantum computation, cryptography, and quantum simulation.
To be useful, a qubit (the elementary quantum unit of information) needs to be both isolated from its environment and precisely controllable, which places strict requirements on its physical realization. In particular, spins in solids are one of the most promising realizations due to their potential for scalability and miniaturization. Furthermore, in these systems, quantum control has been established and electron spin coherence times now exceed several seconds. Even so, a critical challenge in these systems consists of developing a robust two-qubit gate that can be scaled up to a larger network.
In this seminar, I will overview the first attempts to do two-qubit operations with spin qubits and I will introduce a new mechanism for "long-range" interaction. Making use of independent readout of two electron spins, we demonstrate coherent exchange interaction mediated by a multielectron quantum dot. This result provides a possible route to the realization of multi-qubit quantum circuits based on single spins.

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