Department of Materials Science

Seminar Room, 1st Floor

November 30, 13:30

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Using atom-like spins in semiconductors toward scalable quantum computing

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 some of the challenges of this field and 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.