

SCHOOL OF PHYSICS

UNIVERSITY OF NEW SOUTH WALES



COLLOQUIUM

4-5 p.m., Thursday, 22 October 2009
(Please note change of day)

School of Physics Common Room
Room 64, Old Main Building

Professor Sven Rogge
Kavli Institute of NanoScience, Delft University of Technology

“Transport Through a Single Dopant Atom in a Nano MOSFET”

CMOS technology reached such a level that we can realize transport through a single dopant atom in a transistor. Such transport spectroscopy can probe the atomic orbitals and the interaction of the atom with the environment. This interaction can consist of hybridization with other localized states and coupling to the leads. A dopant in a nano device has different properties than those known in the bulk such as the level spectrum and the charging energy. The system discussed is a gated donor where the donor-bound electron is partly pulled towards the interface by the gate electric field. Electronic control over the wavefunction of dopants is one of the key elements of Si quantum electronics. In this talk we focus on the role of the valley-orbit coupling and on the spin configuration of the two-electron state. The six valleys of the conduction band play an essential role for charge carriers in Si confined to the nanometer scale. For a dopant this effect is most dramatic and reaches a large fraction of the binding energy. We discuss the valley-orbit coupling for a CMOS quantum dot, a dopant, and their combination experimentally and compare it to tight-binding simulations. For the negatively charged donor we observe a reduced charging energy and bound singlet and triplet excited states. The existence of a bound triplet state is the basis for spin-to-charge conversion in donor-based quantum electronics. Besides the gate control of the orbital degree of freedom of the dopant, data that link to the spin degree of freedom by the Kondo effect will be discussed.

The audience is invited to meet the speaker beforehand at 3.45 p.m. over coffee and biscuits in the Common Room.

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