Quantum computing in silicon and the limits of silicon miniaturisation

Michelle Y Simmons

ARC Centre of Excellence for Quantum Computation and Communication Technology,
School of Physics, University of New South Wales, Sydney, NSW 2052, Australia
Tel: +62-2-93856313

michelle.simmons@unsw.edu.au

Down-scaling has been the leading paradigm of the semiconductor industry since the invention of the first transistor in 1947. However miniaturization will soon reach the ultimate limit, set by the discreteness of matter, leading to intensified research in alternative approaches for creating logic devices. One of the most exciting of these is quantum computation. We will present devices that address the ultimate limit of device miniaturization in silicon where we have patterned dopants in a crystalline environment with atomic precision to act as one dimensional leads, single electron transistors and control gates. In particular we demonstrate precision single atom transistors and spin-read-out in a silicon quantum computing architecture that is inherently scalable. We will discuss the benefits of donors as qubits and address some of the challenges to achieving truly atomically precise devices in all three spatial dimensions.