Quantum computing using electron spins in silicon

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Remarkably, the techniques used to make classical silicon CMOS devices can be used to make qubits with excellent performance. The operation of these devices, on the other hand – from the required temperatures to the number of electrons comprising a typical qubit – is very different from what is found in even the most advanced classical integrated circuits. In this talk I will present both a short historical overview of how quantum computing in silicon has developed, as well as the latest results from both our group at Wisconsin and from around the world. I will emphasize the role of integration, including 3D integration, which enables readout of qubits formed in a Si/SiGe by measuring the microwave transmission of a superconducting resonator on a separate substrate, flip-chip bonded to the first. And I will discuss very recent results demonstrating the remarkable properties of silicon quantum wells containing short wavelength oscillations in the concentration of added germanium atoms. Advances like these have, in just the last few years, demonstrated that a future quantum computing technology in silicon will likely integrate sophisticated techniques and knowledge cutting across many difference academic departments, from electrical engineering to materials science, computer science, and physics – a feature that makes it an incredibly dynamic (and fun!) field of science and technology.

Bio

Mark A. Eriksson is the John Bardeen Professor of Physics and Physics Department Chair at the University of Wisconsin-Madison. Prior to joining the University of Wisconsin in 1999 he received his Ph.D. from Harvard University in 1997 and was a postdoctoral member of technical staff at Bell Labs for two years from 1997-1999. Eriksson leads a team studying semiconductor-based quantum computing and focusing on the development of spin qubits in silicon/silicon-germanium gate-defined quantum dots. He also leads the Materials & Integration science and technology thrust area within the DOE-funded Q-NEXT center led by Argonne National Laboratory. Eriksson is a fellow of the American Physical Society and the American Association for the Advancement of Science.