EPFL Physics Colloquium

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Silicon-based quantum computing:
The path from the laboratory to industrial manufacture

In this talk I will give an overview of the development of **silicon-based quantum computing (QC**), from the basic science through to its prospects for industrial-scale commercialization based on CMOS manufacturing. I begin with Kane's original proposal for a silicon quantum computer, conceived at UNSW in 1998, based on single donor atoms in silicon, and will review the first demonstrations of such qubits, using both electron spins and nuclear spins. I then discuss the development of SiMOS **quantum dot qubits**, including the demonstration of single-electron occupancy, high-fidelity single-qubit gates, and the first demonstration of a two-qubit logic gate in silicon, together with the most recent assessments of silicon qubit fidelities. I will also explore the technical issues related to scaling a silicon-CMOS based **quantum processor** up to the millions of qubits that will be required for fault-tolerant QC, including the prospects for operating silicon qubits at temperatures above 1K, which would open a path to the integration of conventional CMOS control electronics with the qubit system.

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