Engineering qubits in silicon with atomic precision

Michelle Y. Simmons
Silicon Quantum Computing, Sydney, Australia

The realisation of a large-scale error corrected quantum computer relies on our ability to reproducibly manufacture qubits that are fast, highly coherent, controllable and stable. The promise of achieving this in a highly manufacturable platform such as silicon requires a deep understanding of the materials issues that impact device operation. In this talk I will demonstrate our progress to engineer every aspect of device behaviour in atomic qubits in silicon for fast, controllable exchange coupling [1], fast, high fidelity qubit initialisation and read-out [2]; low noise all epitaxial gates allowing for highly stable qubits [3]; and qubit control [4,5] that provide a deep understanding of the impact of the solid-state environment [6] on qubit designs and operation. I will also discuss our latest results in quantum machine learning [7], analogue simulation [8,9] and demonstration of the highest efficiency Grover's algorithm to date [10].

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