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Engineering qubits in silicon with atomic precision

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Abstract

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. This will cover the use of atomic precision lithography to achieve fast, controllable exchange coupling, qubit initialisation and read-out; high quality epitaxial growth to create all epitaxial gate structures allowing for highly stable qubits; and unique imaging and modelling techniques that provide a deep understanding of the impact of the solid state environment on qubit designs and operation.