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Engineering qubits in silicon with atomic precision

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Making a large-scale error-corrected quantum computer requires reproducibly manufactured qubits that are fast, highly coherent, controllable and stable. Evidence to date suggests that atomic qubits in silicon provide an especially promising and highly manufacturable platform. In this talk, I will demonstrate our progress in engineering every aspect of device behaviour at the atomic level. I will cover the use of atomic precision lithography to achieve fast, controllable exchange coupling, qubit initialisation and read-out. I will show how we use high quality epitaxial growth to create all epitaxial gate structures, allowing for highly stable qubits. I will also present unique imaging and modelling techniques that provide a deep understanding of the impact of the solid state environment on qubit designs and operation. Above all, I will try to give you an understanding of the materials issues that impact device operation.