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Quantum Error Correction and the Future of Solid State Quantum Computing[1]

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Quantum error correction (QEC) theory has provided a very challenging but well defined goal for the further development of solid state qubit systems: achieve high enough fidelity so that fault-tolerant, error-corrected quantum computation in networks of these qubits becomes possible. I will begin by touching on some historical points: initial work on QEC is actually more than 20 years old, and the landmark work of Kitaev in 1996 which established 2D lattice structures as a suitable host for effective error correction, has its roots in theoretical work in many-body theory from Wegner in the 1970s. I will give some perspective on current developments in the implementation of small fragments of the surface code. The surface-code concept has driven a number of distinct requirements, beyond the reduction of error rates below the 1% range, that are actively considered as experiments are scaled beyond the 10-qubit level.

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