# Recent developments in quantum error correction with few qubits

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Quantum error correction and the theory of fault-tolerance are the principal tools that we imagine using to perform quantum computations with noisy devices. Recent experiments have demonstrated simple error correcting codes to reduce the effects of noise, and theoretical results show that in principle large quantum computers can function very accurately if operations have sufficiently low noise and are implemented *fault tolerantly.*

Unfortunately, current approaches such as those based on the surface code have a prohibitively large overhead; they are very costly to build as the required level of redundancy is astronomical. Motivated by this practical limitation, theorists have been working to characterise the range of approaches to fault tolerant quantum computation and to use this understanding to substantially reduce this overhead. One aspect of this approach is to use more realistic and structured descriptions of the noise environment, and to take advantage of the structure of the noise.

I'll present some recent results from the theory literature that suggest ways to execute quantum error correction without an astronomical overhead. I'll focus on results that have implications for spin qubit quantum computing in the near future.

[1] "Ultra-high error threshold for surface codes with biased noise," David K. Tuckett, Stephen D. Bartlett, Steven T. Flammia, arXiv:1708.08474.
[2] "Tailored codes for small quantum memories," Alan Robertson, Christopher Granade, Stephen D. Bartlett, Steven T. Flammia, arXiv:1703.08179.