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Fault-tolerant quantum computation in multiqubit block codes: performance and overhead[1] TODD BRUN, Univ of Southern California — Fault-tolerant quantum computation requires that quantum information remain encoded in a quantum error-correcting code at all times; that a universal set of logical unitary gates and measurements is available; and that the probability of an uncorrectable error is low for the duration of the computation. Quantum computation can in principle be scaled up to unlimited size if the rate of decoherence is below a threshold. The main constructions that have been studied involve encoding each logical qubit in a separate block (either a concatenated code or a block of the surface code), which typically requires thousands of physical qubits per logical qubit, if not more. To reduce this overhead, we consider using multiqubit codes to achieve much higher storage rates. We estimate performance and overhead for certain families of codes, and ask: how large a quantum computation can be done as a function of the decoherence rate for a fixed size code block? Finally, we consider remaining open questions and limitations to this approach.

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