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High fidelity universal quantum gates using non-adiabatic rapid passage FRANK GAITAN, RAN LI, Southern Illinois University — Simulation results are presented which suggest that a class of non-adiabatic rapid passage sweeps known from NMR should be able to implement one-qubit Hadamard, phase, and $\pi/8$ gates as well as the two-qubit controlled-phase gate. This set of gates is known to be universal for quantum computation. For each of the gates in this set, sweep parameter values are provided which simulations indicate yield: (i) one-qubit gates that operate with gate error probability $P_e < 10^{-4}$; and (ii) a controlled-phase gate for which $P_e < 2.65 \times 10^{-3}$. These sweeps are non-composite and generate controllable quantum interference effects which allow the gates to operate non-adiabatically while maintaining high fidelity. The simulations suggest that the gates produced by these sweeps show promise as possible elements of a fault-tolerant scheme for quantum computing.

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