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A Controlled-Phase Gate via Adiabatic Rydberg Dressing of Neutral Atoms TYLER KEATING, IVAN DEUTSCH, ROBERT COOK, University of New Mexico, GRANT BIEDERMAN, YUAN-YU JAU, Sandia National Labs — The dipole blockade effect between Rydberg atoms is a promising tool for quantum information processing in neutral atoms. So far, most efforts to perform a quantum logic gate with this effect have used resonant laser pulses to excite the atoms, which makes the system particularly susceptible to decoherence through thermal motional effects. We explore an alternative scheme in which the atomic ground states are adiabatically "dressed" by turning on an off-resonant laser. We analyze the implementation of a CPHASE gate using this mechanism and find that fidelities of >99% should be possible with current technology, owing primarily to the suppression of motional errors. We also discuss how such a scheme could be generalized to perform more complicated, multi-qubit gates; in particular, a simple generalization would allow us to perform a Toffoli gate in a single step.

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