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Fast and Robust Phase Gates with Trapped-Ion Hyperfine Qubits

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I will present a proposal for generating fast and robust quantum phase gates between two microwave-driven hyperfine ions, making use of a pulsed dynamical decoupling protocol. The scheme consists of a series of pi-pulses that are applied individually to each ion, whose internal level act as a qubit. Unlike previous proposals, this gate uses both axial vibrational modes as the quantum bus between both qubits. In this way, we are able to achieve a higher gate speed. In addition, I will argue that the proposed gate is robust against most harmful noise sources, related with fluctuations of the Rabi frequency or the magnetic field. Our numerical simulations show that with state-of-the-art ion trap technology, entangling gates with fidelities above 99.9% can be produced in tens of microseconds.

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