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Phase-modulated spin-motional decoupling with trapped ions CLAIRE EDMUNDS, ALISTAIR MILNE, SANDEEP MAVADIA, TODD GREEN, MICHAEL BIERCUK, Univ of Sydney — We present a technique to minimize residual spin-motional entanglement after a phonon-mediated entangling gate in trapped $^{171}Yb^{+}$ ion qubits. Phonon-mediated gates, such as the Mlmer-Srensen gate, engineer spin-spin entanglement by coupling the qubits to their collective modes of motion. Consequently, a major experimental limitation is residual motional entanglement at the conclusion of the gate, resulting in a degradation of the final spin state purity. Our work utilizes phase-modulated pulse sequences to decouple the qubits from multiple motional modes simultaneously at a variable gate time. In addition, we extend this technique to the suppression of time-dependent noise using concatenated gate sequences, which allows for the recovery of a higher purity spin state. Using a single, experimentally controllable modulation parameter we are able to achieve more optimal quantum control in these gate sequences.

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