Abstract Submitted
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**High-Fidelity Laser-Free Trapped-Ion Entangling Gates with an RF Oscillating Magnetic Field Gradient**[1] H.M. KNAACK, R. SRINIVAS, S.C. BURD, NIST, CU Boulder, R.T. SUTHERLAND, S.B. LIBBY, LLNL, D.J. WINELAND, University of Oregon, D. LEIBFRIED, A.C. WILSON, NIST, D.T.C. ALLCOCK, University of Oregon, D.H. SLICHTER, NIST — Trapped-ion entangling gates typically rely on laser-induced coupling of the ions internal qubit states to their motion. Laser-free entangling gates, which eliminate photon scattering errors and may offer benefits for scalability, have been implemented using either static magnetic field gradients or magnetic field gradients oscillating at GHz frequencies. We demonstrate a recently proposed trapped-ion entangling gate based on a radiofrequency oscillating magnetic field gradient and two microwave magnetic fields symmetrically detuned about the qubit frequency [1]. Our implementation offers reduced sensitivity to qubit and motional frequency errors, enabling the generation of a symmetric Bell state of two $^{25}Mg^{+}$ hyperfine qubits with fidelity 0.998(2) in 700 $\mu$s. This gate scheme also allows us to incorporate laser-free single-ion addressing to prepare an antisymmetric Bell state. [1] R.T. Sutherland et al., New J Phys 21, 033033 (2019)

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