Abstract Submitted
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Spin Dependent Forces and Entanglement of Atomic Qubits using Optical Frequency Combs[1] D. HUCUL, D. HAYES, D.N. MATSUKEVICH, P. MAUNZ, S. OLMSCHENK, Q. QURAISHI, W. CAMPBELL, J. MIZRAHI, C. SENKO, C. MONROE, University of Maryland Department of Physics and National Institute of Standards and Technology, College Park, MD 20742 — The spectral purity and large bandwidth of pulsed lasers makes them attractive candidates for precision control of multi-level atomic systems. We use a train of off resonant picosecond pulses from a mode-locked laser to drive stimulated Raman transitions between the hyperfine levels (∼10 GHz spacing) of trapped ytterbium ions and to cool to the quantum ground state of motion. By simultaneously addressing the spin and the motion of trapped ions using a train of laser pulses, we apply spin-dependent forces to create a single-ion Schrodinger cat state and implement a gate between two trapped ions to entangle their spins [1]. We also use high-intensity pulses to demonstrate fast (<10 ps) single qubit operations that can be used as the building blocks for fast multi-qubit entangling gates [2]. [1]. D. Hayes et al. arXiv:1001.2127v2 [2] García-Ripoll *et al.*, PRL **91**, 157901 (2003). Duan, PRL **93**, 100502 (2004).

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