Abstract Submitted
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Pulsed laser gates for trapped atomic qubits[1] CRYSTAL SENKO, WESLEY C. CAMPBELL, JONATHAN MIZRAHI, CHRIS MONROE, Joint Quantum Institute, University of Maryland Department of Physics and National Institute of Standards and Technology, College Park, Maryland 20742 — Current experimental techniques for entangling multiple trapped ion qubits via the quantized modes of motion are inherently limited in speed and thus sensitive to many sources of noise. We use high power mode-locked lasers to perform ultrafast qubit operations via stimulated Raman transitions. We show that complete control over the spin state of a single qubit can be accomplished in tens of picoseconds by splitting a single pulse and varying the delay [1]. We also investigate improvements to the fidelity of current protocols using a weak pulse train at a large (33 THz) detuning [2]. Future work will focus on generating entangling gates on timescales faster than a motional period, by tailoring the ions' motional evolution with pulse sequences of varying Rabi frequency [3] or using spin-dependent momentum kicks fashioned from a few strong pulses [4,5]. [1] W.C. Campbell et al., PRL 105, 090502 (2010) [2] D. Hayes et al., PRL 104, 140501 (2010) [3] S.-L. Zhu et al., Europhys. Letters 73, 485 (2006) [4] J.J. Garcia-Ripoll et al., PRL 91, 157901 (2003) [5] L.-M. Duan, PRL 93, 100502 (2004).

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