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**Ultrafast Manipulation of Trapped Ion Qubits**[1] WES CAMPBELL, QUDSIA QURAISHI, JONATHAN MIZRAHI, CHRIS MONROE, University of Maryland and JQI — Ultrashort light pulses are an attractive tool for trapped ion quantum information processing. High pulse intensity permits far-detuned (>10 nm) operation, where decoherence from differential AC Stark shifts and spontaneous emission is suppressed. Short pulse duration allows interaction times shorter than a trap oscillation, circumventing the need for cooling to the Lamb-Dicke limit. We describe an experiment with trapped $^{171}Yb^{+}$ using a vanadate laser (∼10 ps pulses at 355 nm). Since the single pulse bandwidth exceeds the $S_{1/2}$ hyperfine splitting, coherent Raman transitions between qubit states should be possible. This is in contrast to our previous work [1] with near-resonant pulses that coherently transfer population to the P-state. It should also be possible to use a series of multiple pulses to impart spin-dependent forces. By controlling the pulse timing and phase we could then entangle multiple ions in a temperature insensitive manner [2,3]. [1] Madsen *et al.*, PRL **97**, 040505 (2006). [2] García-Ripoll *et al.*, PRL **91**, 157901 (2003). [3] Duan, PRL **93**, 100502 (2004).

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[X] Prefer Oral Session
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