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Differential Stark shift measurement of clock states of Yb+ using an optical frequency comb QUDSIA QURAISHI*, DAVID HAYES, DAVID HUCUL, DZMITRY MATSUKEVICH, SHANTANU DEBNATH, SUSAN CLARK, CHRIS MONROE, JQI, Univ of Maryland Dept of Physics and NIST — Quantum information processing with trapped ions has traditionally involved state preparation, manipulation (eg. quantum gates) and detection using CW lasers. Quantum gates implemented with ions typically involve optical Raman transitions between two atomic levels. An optical frequency comb, emitted by a pulsed laser, is an excellent tool for bridging atomic frequency differences. Previously, we demonstrated quantum gates and separately, ultrafast spin manipulation, using pulsed lasers [1,2]. Unlike the CW case, employing pulsed lasers has the marked advantage of both low spontaneous emission and low AC Stark shifts, because the high powers available from pulsed lasers allow for larger detunings from optical resonance. Here, we show both experimentally and theoretically the scaling of the differential Stark shift with detuning (6 THz to 20 THz) of the Raman fields, achieving values of 10^{-3} of the Rabi frequency. [1] D. Hayes, et al., Phys. Rev. Lett. 104, 140501 (2010) [2] W. C. Campbell, et al., Phys. Rev. Lett. 105, 090502 (2010). *Currently NRC postdoc with SEDD, ARL, Adelphi, MD. Support: DARPA OLE under ARO contract, IARPA under ARO contract, NSF PIF Program, NSF PFC at JQI and *IC Postdoc administered by the NGA.

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