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Raman transition at motional sideband for a trapped ion using co-propagating pulsed lasers and a high NA lens[1] YEONG-DAE KWON, Quantum Tech. Lab., SK Telecom, SEOKJUN HONG, MINJAE LEE, DONGIL DAN CHO, ASRI/ISRC and Department of Electrical and Computer Engineering, Seoul National University, TAEHYUN KIM, Quantum Tech. Lab., SK Telecom — A pulsed laser is a great tool for coherent control of qubits based on trapped ions. Unlike microwave, it allows addressing individual ions among the string of ions stored in the same trap, and the high instantaneous power of the pulsed laser enables faster and more stable qubit operations [1]. The pulsed laser can also play a crucial role in the cooling process, as two-photon Raman process allows transitions between different motional states of an ion, which makes the sideband cooling possible [2]. Generally, however, for such a transition to occur, two beams traveling in different directions are needed to impart a sufficient momentum kick to the ion. In this research, we show that co-propagating pulsed lasers are also capable of driving such inter-motional-state transitions as long as they reach the ion through a high NA lens, from which the beams gain the extra momentum difference. Such a scheme can vastly simplify the optical setup, since the active matching and stabilization of the path lengths of the two pulsed lasers are no longer required when the lasers co-propagate. [1] D. Hayes et al., Phys. Rev. Lett. 104, 140501 (2010). [2] C. Monroe et al., Phys. Rev. Lett. 75, 4011 (1995).

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