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MEMS-Based Beam Steering for Individual Addressing of Trapped Ions STEPHEN CRAIN, EMILY MOUNT, CALEB KNOERNSCHILD, TAEHYUN KIM, SOYOUNG BAEK, PETER MAUNZ, JUNGSANG KIM, Fitzpatrick Institute for Photonics, Electrical and Computer Engineering Department, Duke University — The ability to address individual ions in a long linear chain with multiple beams is necessary in order to realize scalable quantum information processing with trapped ions. Microelectromechanical systems (MEMS) technology allows one to design movable micromirrors to focus laser beams on individual ions and steer the focal point in two dimensions. This system provides low optical loss across a broad wavelength range and can easily scaled to multiple beams. Our current MEMS system is designed to steer a far-detuned UV pulsed laser beam to carry out single and two qubit Raman gates on a chain of Yb ions, with a waist of 1.5 μm across a 20 μm range. The crosstalk between neighboring ions can be used to characterize the individual addressing fidelity in this setup. We also present a MEMS-based optical shutter that utilizes the fast switching speeds of the MEMS devices without introducing thermal instability or frequency shifts of the beam. The shutter system is comprised of input and output UV fibers with collimating microlenses, a focusing lens, and a single MEMS mirror. By tiling the MEMS mirror, the beam is steered off the output fiber and the light is decoupled. We show a high extinction ratio of $>$50dB with a throughput of 53% and a switching speed of $\sim$2 μs.

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