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Demonstration and Characterization of Scalable Quantum Gate Operations with Trapped Ion Qubits CHAO FANG, STEPHEN CRAIN, JAMES JOSEPH, GEERT VRIJSEN, RACHEL NOEK, JUNGSANG KIM, Duke Univ, MULTIFUNCTIONAL INTEGRATED SYSTEMS TECHNOLOGY GROUP TEAM — The potential for trapped atomic ions to serve as a scalable quantum computing platform relies on the capability to individually address each ion in order to execute a complete set of single-qubit and fully connected two-qubit gates. In this work we perform quantum logic gates by addressing a linear chain of ^{171}Yb+ ions in a surface trap using two tightly focused laser beams and an elliptical global beam to drive Raman transitions. The two individual addressing beams can be independently steered in two dimensions using tilting microelectromechanical systems (MEMS) mirrors [1]. We present the demonstration of individually addressed single-qubit gates and progress towards Mølmer–Sørensen type two-qubit gates. The individual qubit addressing fidelity and crosstalk are characterized. We also present our work towards two-qubit gates between arbitrary pairs of ions in a chain. [1] S. Crain et al., Appl. Phys. Lett. 105, 181115 (2014)

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