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Scalable imaging of trapped ions with integrated diffractive mirrors[1] D. KIELPINSKI, V. BLUMS, M. GHADIMI, B.G. NORTON, Centre for Quantum Dynamics, Griffith University, Brisbane, Australia, H. HAYDEN, J.M. AMINI, C. VOLIN, Georgia Tech Research Institute, Atlanta, GA, USA, E.W. STREED, Centre for Quantum Dynamics and Institute for Glycomics, Griffith University, Southport, QLD, Australia — The standard roadmap to large-scale trapped-ion quantum information processing requires simultaneous fluorescence collection from ions at a large array of trap sites. We experimentally demonstrate scalable, monolithically integrated optics for fluorescence collection. We lithographically fabricate high-numerical-aperture diffractive mirrors directly on a microfabricated surface ion trap array, using the trap electrodes as the reflective element. These mirrors collimate the fluorescence from ions trapped at particular array sites. The collection efficiency of the diffractive mirrors exceeds 4%, on the order of standard bulk-optics collection systems. Since the diffractive mirrors are designed to be aberration-free, we anticipate that we will also achieve high-efficiency collection into single-mode fiber for quantum communications applications.

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