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Surface ion trap structures with excellent optical access for quantum information processing P. MAUNZ, M. BLAIN, F. BENITO, C. CHOU, C. CLARK, M. DESCOUR, R. ELLIS, R. HALTLI, E. HELLER, S. KEMME, J. STERK, B. TABAKOV, C. TIGGES, D. STICK, Sandia National Laboratories —
Microfabricated surface electrode ion traps are necessary for the advancement of trapped ion quantum information processing as it offers a scalable way for realizing complex trap structures capable of storing and controlling many ions. The most promising way of performing two-qubit quantum gates in a chain of trapped ions is to focus laser beams on individual ions of the chain to drive gates. However, in surface ion traps the close proximity of the ions to the surface and the size of the chips usually cannot accommodate the tightly focused laser beams necessary to address individual ions parallel to the chip surface. Here we present a surface electrode ion trap monolithically fabricated in standard silicon technology that implements a linear quadrupole trap on a bowtie shaped chip with a narrow section that is only 1.2mm wide. Laser beams parallel to the surface can be focused down to a waist of 4μm with enough separation from the trap chip to prevent light scattering. The trap structure incorporates two Y-junctions for reordering ions and is optimized for quantum information processing. This work was supported by the Intelligence Advanced Research Projects Activity (IARPA). Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the US Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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