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Abstract for invited presentation at AVS 66th International Symposium in Columbus, OH, USA from 10/20/2019 -10/25/2019

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Title: Surface Ion Trap Device Fabrication for Experiments in Quantum Information Science

Abstract: Radio-frequency (rf) surface ion traps offer important advantages for realizing precise control of the spatial positioning, as well as motional and electronic states, of trapped ions. The control of ions provided by micro-fabricating planar trap electrodes on a silicon device surface has allowed ion trapping to be at the forefront of experiments in quantum sensing, simulation, and information processing. Engineered surface traps offer the ability to extend the performance of their macroscopic equivalents and can even allow new concepts to be explored in both classical and quantum trapped-ion physics and chemistry. The ability to fabricate complex and arbitrarily arranged 2-D and 2.5-D trap electrode geometries is critical for numerous trapped ion quantum information science experiments. Surface electrode ion traps [1] have enabled the Kielpinski ion trap CCD (charge coupled device) architecture [2], whereby ions can be shuttled between linear trapping regions via junctions, as well as trap designs, for example triangles [3] or rings [4], optimized for different experimental objectives. The ability to design and fabricate precision through-chip holes for ion loading and photon collection/delivery and to arbitrarily shape trap chips for increased optical access to ions is also critical for rendering a highly evolved ion trap chip technology. As well, micro ion trap chip technologies are beginning to integrate passive and active electronic and photonic capabilities for enhanced performance, including trench capacitors, optical waveguides, and avalanche photodiodes. Aspects of the “micro-systems” approach to the design and integration of surface electrode ion trap devices will be presented.

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[2] D Kielpinski, *et al.*, *Nature*, 709, 417 (2002)

[3] M Mielenz, *et al.*, *Nature Communications*, 7 (2016) 11839

[4] B Tabakov, *et al.*, *Physical Review Applied*, 4 (2015) 31001