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Studies of Ion Dynamics and RF Heating in Miniature Ion Traps

KEITH PELLETIER, JAMES RABCHUK, Western Illinois University — RF Paul ion traps have been an important tool in mass spectrometry and trapped ion quantum information processing. Arrays of ion traps have been proposed as the basis for a quantum information processor.[1] An important issue related to the use of these arrays is determining how difficult it will be to control ion heating as the traps are miniaturized and made less symmetric to accommodate the technological design needs of an actual quantum computer. Experiments performed recently have made important progress in measuring the heating rate of miniature ion traps as a function of the electrode distance from the ion position, which point to the existence of fluctuating patch potentials on the electrode surfaces as the main source of anomalous ion heating[2]. We will present results from numerical and analytical studies that identify and characterize the heating processes of ions in miniature ring and end-cap traps as functions of trap size and other variations in trap design. We will also explore the suitability of these traps for use in cavity QED experiments. [1] Kim, J., et al., "System design for large-scale ion trap quantum information processor," **QIC, 5 (7)**, 2005. [2] Deslauriers, L., et al., "Scaling and suppression of anomalous quantum decoherence in ion traps," ***Phys. Rev. Lett.*** **97**, 2006

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