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Ion Motion Stability in Asymmetric Surface Electrode Ion Traps[1]

FAYAZ SHAIKH, ARKADAS OZAKIN, Georgia Tech Research Institute — Many recently developed designs of the surface electrode ion traps for quantum information processing have asymmetry built into their geometries. The asymmetry helps rotate the trap axes to angles with respect to electrode surface that facilitate laser cooling of ions but introduces a relative angle between the RF and DC fields and invalidates the classical stability analysis of the symmetric case for which the equations of motion are decoupled. For asymmetric case the classical motion of a single ion is given by a coupled, multi-dimensional version of Mathieu's equation. In this poster we discuss the stability diagram of asymmetric surface traps by performing an approximate multiple scale perturbation analysis of the coupled Mathieu equations, and validate the results with numerical simulations. After obtaining the stability diagram for the linear fields, we simulate the motion of an ion in a given asymmetric surface trap, utilizing a method-of-moments calculation of the electrode fields. We obtain the stability diagram and compare it with the ideal case to find the region of validity. Finally, we compare the results of our stability analysis to experiments conducted on a microfabricated asymmetric surface trap.

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