Ion separation in a Paul trap in the presence of damping force

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Abstract
Dynamical behavior of particles in a Paul trap has been investigated by solving the set of differential equations considering the effect of damping force. Positions of the trapped ions as a function of time, ion trajectories and the phase space curves in the first stability region have been obtained in the presence of the damping force. The region of stability for $r$ and $z$ components as well as the first stability region with and without the damping force have been computed using the fourth-order Runge-Kutta method. Furthermore, for a Paul trap with specified dimensions and a typical RF frequency, the first stability region for $3\text{H}^+$ and $\text{H}^+$ ions has been determined in the $V_{dc} - V_{ac}$ plane. It is worthwhile to note that computation of the stability region in the presence of damping force through the use of this method has been reported for the first time.

Keywords: Paul trap, damping force, fourth-order Runge-Kutta method, Mathieu equation, stability region

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