Separation of Microparticles in a Quadrupole Trap with Variable Pulse Fill Factor

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An experimental study and numerical calculation of the separation of microparticles in a quadrupole electrodynamic trap with rectangular voltage, operating in air at atmospheric pressure, have been conducted.

The experimental study was performed at various fill factors K_p in the range of 30–50%. For each K_p, experiments on particle release were carried out, and particle size distributions were measured. In parallel, numerical calculations of stable retention regions were performed for particles with diameters of 5, 10, 20, and 50 μm.

It is shown that at $K_p = 50\%$, the calculated retention regions for particles of different diameters overlap, forming a single continuous q/m range. This explains the experimentally observed simultaneous presence of particles of all sizes in the trap. As K_p decreases to 45%, 40%, 35%, and 30%, the stability regions narrow and shift, leading to the selective release of particles of specific sizes. The experimental particle distributions at each change in K_p qualitatively agree with the calculated retention regions.