Localization of charged particles in an electrodynamic trap with a charged thread

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The retention of localized systems of charged particles is necessary both for the creation and research of Coulomb systems, and for various devices and technologies. The possibility of retaining and additional stabilization of levitating charged particles in a linear electrodynamic quadrupole trap using an elastic charged thread was investigated. An electrodynamic trap with a length of 30 cm and four electrodes with a diameter of 4 mm was used. The electrodes of the trap were located at the vertices of a square with a side of 2 cm. Alternating electric potential with a frequency of 50 Hz was applied to the electrodes, with a phase shift of 180 degrees between the electrodes in adjacent corners. A nylon thread with a diameter of 30 μm was stretched along the axis of the trap. Polydisperse Al_2O_3 particles charged to $(4-6)\times 10^5$ units of elementary charge were introduced into the trap. The dynamics of microparticles and nylon thread was recorded by video camera. At an alternating voltage amplitude of $4-6$ kV, the thread began to bend and rotate. Due to the fact that the ends of the filament are fixed, the movement of the thread stabilizes and becomes like a standing wave with localized nodes and antinodes. The charged nylon thread, during its oscillatory-rotational movement, affects the charged microparticles trapped in the trap, as a result of which the microparticles gradually shift along the thread and concentrate in the antinodes of the oscillating thread. The use of such an additional trap makes it possible to create local areas of charged particles with a high concentration and a large volume charge.