The Research of the Dynamics of Charged Particles in a Quadrupole Paul Trap

Klimeshov, Kirill (School: Lyceum № 1511 Affiliated with MEPHI)
Shmyrkov, Leonid (School: University Lyceum No. 1511)

The aim of the project is to study the trajectories of charged particles in the Paul ion trap and develop a model for the ion trap. Ion traps are used to capture and contain microscopic particles. They can be used to study the parameters of the mass and charge of a particle, and keeping them in one region of space for a long time allows you to study extremely narrow spectral lines, without the limitation imposed by the finite time of interaction of the particle with the field. In addition, such traps can be used in quantum computers, the work of which is based on the capture of ions and the manipulation of their quantum states. Currently, many IT companies are developing projects to create quantum computers, the processing power of which will exceed those of ordinary computers. Assembled ring trap provides particle capture demonstration. The equation of motion of a particle in a two-dimensional quadrupole potential created by a system of four hyperbolic (force) electrodes and two end electrodes made it possible to construct particle trajectories using mathematical modeling methods. The parameters of the trap providing the stable trapping of the ion are estimated. As a result of the work, a system that allows trapping charged microparticles has been created; the study of the influence of external electric fields, friction force, and gravity on the trajectory of moving charged particles has been carried out.