EFFECTIVE ELECTROSTATIC PLASMA LENS FOR FOCUSSING OF HIGH-CURRENT ION BEAMS

V.I.Maslov, A.A.Goncharov*, I.N.Onishchenko

**Institute of Physics NASU, 252650 Kiev;*
NSC Kharkov Institute of Physics and Technology, Kharkov 61108, Ukraine

Optimum plasma lens realized in experiments [1] at weak magnetic fields, when the Larmor radius of electrons is comparable with radius of the lens, has been theoretically researched. The optimum lens is lens, in which the vortical perturbations are not excited and particle density in which is uniform in space. Three possible reasons not excitation of vortices in near axis area of the high-current plasma lens have been researched: namely, finite time of ion movement through the plasma lens, finite time of electron renovating in it, proximity of the plasma lens parameters to optimum ones. It has been shown, that the vortical perturbations are not excited in the plasma lens, if the overbalance of ions by electrons is close to limiting one, determined from a condition of balance upset of radial forces retaining rotated electrons in the region of finite radius: magnetic retaining, centrifugal and electrical scattering forces. At an overbalance of ions by electrons, close to limiting one, the vortical perturbations are not excited in the plasma lens. Also it has been shown that the spatial uniformity of electron density is easier supported in the optimum plasma lens.

The possibility of supression of instability development of collective field excitation in near wall area of the plasma lens due to electron density increase on radius in this area has been considered. The influence of such electron distribution in the plasma lens on focussing of ion beam has been estimated and simulated numerically. It has been shown, that the aberrations, called by such electron density distribution on radius, are small.

References

1. A.A.Goncharov, S.M.Gubarev, I.M.Protsenko and I. Brown. Influence of magnetic field strength on the focusing properties of a high-current plasma lens. Problems of Atomic Science and Technology. Kharkov. 2001.