Numerical simulation of regime of diamagnetic confinement by particle-in-cell method [[1]](#footnote-1)\*)

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The idea of newly proposed regime of diamagnetic confinement in the mirror machines is formation and maintaining of plasma with extremely high pressure which is equal to the pressure of magnetic field of the trap [1]. Transition to the regime of diamagnetic confinement is accompanied by formation of region with hot dense plasma and extruded magnetic field (so-called diamagnetic “bubble”) in central section of the trap. Effective mirror ratio inside the “bubble” is extremely high, so in the frame of MHD approximation losses of particles and energy essentially decrease after transition to the regime of diamagnetic confinement [1, 2].

The kinetic effects are neglected in the MHD models, but these effects are important if plasma have thermonuclear parameters. Self-consistent solution of the Maxwell equations and kinetic equations with collision integral for ions and electrons is needed for modeling of regime of diamagnetic confinement in the frame of kinetic model. This system is too sophisticated for analytical treatment, so using numerical simulation by Particle-in-Cell (PIC) method is seems to be suitable.

The two-dimension (with axial symmetry) hybrid (PIC for ions and model of charged mass-less fluid) numerical code for modeling regime of diamagnetic confinement is presented in this report. Modeling continuous injection of ion-electron pairs in a mirror machine was carried out. A set of ions distribution functions is used: the Maxwellian distribution with non-zero mean azimuthal velocity (so-called rigid-rotor distribution [3]), beam distribution etc. Accumulation of fast ions, extrusion of magnetic field and formation of stationary “bubble”-like configuration are demonstrated. Dependences of radius of the “bubble” on injection and magnetic field parameters are investigated. Agreement of these dependences with analytical estimations is demonstrated.

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References

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