numerical simulation of transition to regime of diamagnetic confinement in an axisymmetric mirror machine [[1]](#footnote-1)\*)

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Possibility of confinement of thermonuclear plasma with a high pressure comparable to the pressure of magnetic field is an important advantage of linear magnetic traps. Increasing of plasma pressure to ultimate pressure (equal to pressure of the magnetic field) is accompanied by transformation of the magnetic field: an region with dense plasma and extruded field (so called diamagnetic bubble) arises [1, 2]. Plasma pressure and magnetic field changes sharply in transiting layer on the bubble boundary. Magneto-hydrodynamic models [1, 2] predict that the plasma lifetime increases essentially in this regime. Experimental demonstration of the regime of diamagnetic confinement is planned on CAT device in BINP SB RAS [3].

Numerical supercomputer simulations can be useful for investigating the diamagnetic confinement in addition to theoretical analysis and experiments. An 2D3V (two coordinates and three component of velocities) particle-in-cell numerical code aimed to simulation of high-beta plasma confinement in axi-symmetric mirror machines is developed in ICMMG SB RAS [4]. Simulation of electron dynamic at long times (several hundreds of cyclotron periods of ions) is too difficult so a hybrid model is used (electrons are described as a mass-less charged fluid). So-called null collisions method [5] is used for simulation of Coulomb collisions instead binary collisions (as in Takizuka-Abe model [6]).

Results of simulation of the regime of diamagnetic confinement in an axi-symmetric mirror machine with neutral beam injection are presented in this report. Structure of magnetic field and electrostatic potential at stationary stage, formation of sheared azimuthal flows in the transition layer, trajectories of individual ions and influence of distribution function of injected atoms on shape of the diamagnetic bubble are discussed.

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/Mu/ru/AT-Chernoshtanov.docx) [↑](#footnote-ref-1)