

MHD Simulation of Various Cross-Section Capillary Discharges

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Abstract: *The capillary discharges are widely used in experiments on the x-ray lasers and laser wakefield acceleration because of the emerging inside the capillary specific plasma density profile needed for these studies. The utilized capillaries typically have circular cross-section. Such configuration was thoroughly studied theoretically and using MHD computer simulations. Another possible capillary cross-section is a square one, which attracted less attention, but is more convenient for plasma diagnostics. Here we present the results of the MHD simulations of the square and circular capillary discharges and compare the established plasma density profiles.*

Many experiments on the laser based electron acceleration and on x-ray laser generation use capillary discharges as a simple and robust way to create plasma with required parameters. A majority of the experiments implement the capillaries with circular cross-section. Such capillary cross-section significantly simplifies the theoretical and computer simulations studies, reducing the dimensionality of the problem and allowing the use of 1D computer codes. On the other hand, the square cross-section capillaries, which attracted significantly smaller attention, are advantageous from the point of view of plasma diagnostics and fabrication. Here we present for the first time the results of the dissipative MHD simulation of the capillary discharges with various cross sections.

We use 3D RMHD code MARPLE (KIAM, RAS) for discharge simulation in the capillaries with different section. We present the simulation results showing the plasma dynamics and the electric current and magnetic field evolution in different capillaries.