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FULL-WAVE MODELING OF ELECTRON CYCLOTRON RESONANCE HEATING AT THE SECOND HARMONIC FOR THE GDMT FACILITY *)

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The gas-dynamic multiple-mirror trap (GDMT) is a new-generation open trap for subthermonuclear plasma confinement being developed the Budker Institute (Novosibirsk). The aim of the project is to validate the possibility of using open traps as thermonuclear systems, such as high-power neutron source and fusion reactor. GDMT project should provide an opportunity for new plasma confinement studying methods and to show the significant increase in the efficiency of an open trap [1].

The main plasma heating method in a trap is the powerful neutral particles beams oblique injection, which are ionized in the plasma and captured in the trap as high-energy ions. As a result, two ion components are formed in the plasma: warm ions of the target plasma and an anisotropic population of fast ions. Fast ions ensure the occurrence of thermonuclear reactions in the plasma. In such systems with a two-component plasma, the energy lifetime of an anisotropic fraction of fast ions is determined by their collisions with electrons. Therefore the electron temperature increase is the key problem for an extending fast ions lifetime and, thereby, increasing the GDMT efficiency as a thermonuclear system. The electron cyclotron resonant (ECR) heating by powerful gyrotrons is the increasing electron temperature most direct method. Additional ECR plasma heating at the first harmonic in the previous generation facility GDT demonstrated the possibility of the reaching a stationary 1 keV electron temperature level in open magnetic trap [2].

Geometric-optical modeling has shown that effective ECR heating at the second harmonic is possible in the GDMT facility. This allows to increase plasma density compared to the GDT and to use ECR heating in the planned operating regime of the GDMT facility [1]. However, the resonant nature of the interaction of microwave radiation with subthermonuclear plasma can lead to violations of the WKB approximation, and as a consequence, to the appearance of a significant interaction of eigenmodes. Microwaves reflection from the resonant region is the most significant result of eigenmodes interaction, which can significantly change the heating efficiency assessment [3, 4]. In this work, full-wave modeling of the ECR interaction of a extraordinary wave at the second harmonic with a cylindrically inhomogeneous plasma with the parameters expected in a GDMT facility has been carried out. The dependencies of absorption efficency for various magnetic configurations on temperature and plasma concentration has been obtained.

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