influence of the finite Larmor radius effects on the high pressure plasma equilibrium in the diamagnetic confinement mode in an axisymmetric open trap [[1]](#footnote-1)\*)

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The idea of diamagnetic confinement [1] is to create a “bubble” of plasma of the limiting pressure (β ≈ 1) in an open trap. Inside the “bubble”, the magnetic field vanishes, and diamagnetic current is concentrated in a thin transition layer at the plasma boundary. The diamagnetic confinement mode is designed to increase significantly the energy lifetime of the particles in the open trap by increasing the mirror ratio. Thus, this mode becomes attractive for a more detailed theoretical and experimental study. In particular, one of the goals of the GDMT project [2], the new generation open trap, is to verify the concept of diamagnetic confinement with β ≈ 1 experimentally. Also, in the near future, at the currently operating GDT facility the experimental campaign aimed at a local increasing in plasma energy density up to to β ~ 0.8 is planned.

Earlier, in the framework of single-fluid MHD the analytical theory of diamagnetic confinement in the cylindrical approximation was created [1], and the non-paraxial numerical model of the “bubble” equilibrium in the axisymmetric open trap [3] was also constructed. Nevertheless, the presence of a weak magnetic field region inside the “bubble” leads to the plasma not proved to be magnetized, and the MHD description is no more applicable. The need to create a theoretical model taking into account kinetic effects arises.

This work is devoted to the extension of the existing MHD model of the “bubble” equilibrium by taking into account corrections associated with the finite Larmor radius effects (FLR). For simplicity, it is believed that the plasma consists of two fractions. The first is the “cold” plasma in a state of thermodynamic equilibrium, which is still described by the MHD equations. The second fraction, the “hot” non-equilibrium plasma, is a consequence of the neutral injection of high-energy particles. This component is described in the framework of kinetic theory. The approximation of high-energy “hot” ions allows us to consider ion-ion collisions to be rare, and the collision integral corresponds to a weak friction with the “cold” electrons.

In this paper, we used the approach similar to one used in Ref. [4], namely, we assumed that the distribution function of “hot” particles could be represented as a function of the energy and the longitudinal component of the generalized angular momentum. As a result, the kinetic equation for the “hot” plasma was derived, and its analytical solution was found. Using the obtained distribution function, the expression for the “hot” ion current was calculated, which, together with the MHD equations for the “cold” plasma, was used to calculate the equilibrium of the diamagnetic “bubble” taking into account the FLR effects.

References

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