On the problems of magnetohydrodynamics in multi-connected domains

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Abstract

We analyze the problem of motion of a viscous incompressible electrically conducting liquid contained in a vessel Ω_1 in the presence of magnetic field. The motion of the liquid is governed by the Navier-Stokes equations. For the magnetic field we have the Maxwell equations with excluded displacement current. The magnetic field should be determined not only in Ω_1 but also in the surrounding vacuum region Ω_2. On the boundary of Ω_1 no-slip condition for the velocity of the liquid, as well as standard jump conditions for the magnetic field are prescribed. We prove that the problem is well-posed, i.e, that it has a unique local solution for arbitrary initial data satisfying only natural compatibility conditions. It is shown that in the case of small initial data the solution can be extended in the infinite time interval $t > 0$. Especial attention is given to the case where the domains Ω_1 and $\bar{\Omega}_1 \cup \Omega_2$ are multi-connected.