

Local Approximation for Contour Dynamics in Effectively 2D Electron-Magnetohydrodynamic Flows

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In the present paper we consider a special class of vortical flows in plasma that correspond to the model of Ideal Electron Magnetohydrodynamics (EMHD). The EMHD model approximately describes macroscopic motion of the low-inertial electron component of plasma on sufficiently short spatial scales (i.e. below the ion inertial length). We perform an analytical investigation of the model by the Hamiltonian method adapted for fluids. We consider the dynamics of piecewise constant distributions of a conserved quantity related to the frozen-in canonical vorticity in effectively two-dimensional (2D) incompressible ideal EMHD flows. We consider both the axisymmetric flows with zero azimuthal velocity component and the flows with the helical symmetry of vortex lines. For sufficiently large size of a patch of the conserved quantity, we suggest a local approximation for the patch boundary dynamics, based on the possibility to represent the total energy as the sum of area and boundary terms. We show that only the boundary energy term determines the time evolution of the flow shape. Finally, in this local approximation we analytically describe possible stationary moving configurations of the vortex structures. The results are published at <http://xxx.lanl.gov/abs/physics/0204087>.