Evolution of the magnetic field generated by the Kelvin-Helmholtz instability

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The Kelvin-Helmholtz (KH) instability in ionized plasma is studied with a focus on the magnetic field generation via the Biermann battery (baroclinic) mechanism. The problem is solved by using direct numerical simulations of two counter-directed flows in 2D geometry. In contrast to general belief and previous studies of the Rayleigh-Taylor instability [1], we have demonstrated that the KH instability generates magnetic field with significantly different structure from the vorticity field, see Fig. 1. This distinction originates from intrinsically different initial conditions for vorticity and magnetic fields, which are supposed to be rather common for the KH plasma experiments [2].

Another important finding of the present work is that the magnetic field keeps growing even after the hydrodynamic vortex strength has reached its maximum and started decaying due to viscous dissipation. The pressure distribution has local minimum in the centre of the vortex while density becomes practically constant along the flow with a certain profile across the flow. It produces finite Biermann battery term which leads to almost linear growth of magnetic field at the later stage of the instability.

![Fig. 1. Vorticity and magnetic field structures during earlier stage of KH vortex evolution.](image1)

![Fig. 2. Time evolution of the scaled averaged quantities representing magnetic field, baroclinic term and vertical velocity.](image2)