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COLLISIONLESS KELVIN - HELMHOLTZ INSTABILITY AND VORTEX INDUCED RECONNECTION IN THE EXTERNAL REGION OF THE EARTH MAGNETOTAIL

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Abstract. In plasma configurations, such as those produced by the onset of the Kelvin-Helmholtz instability in a plasma with a velocity shear, qualitatively different magnetic structures are produced depending on how fast the reconnection process develops and competes with the pairing process of the vortices produced by the Kelvin-Helmholtz instability.

In a magnetized plasma streaming with a nonuniform velocity, the Kelvin-Helmholtz (K-H) instability plays a major role in mixing different plasma regions and in stretching the magnetic field lines leading to the formation of layers with a sheared magnetic field where magnetic field line reconnection can take place. A relevant example is provided by the formation of a mixing layer between the Earth's magnetosphere and the solar wind at low latitudes during northward periods. In the considered configuration, in the presence of a magnetic field nearly perpendicular to the plane defined by the velocity field and its inhomogeneity direction, velocity shear drives a K-H instability which advects and distorts the magnetic field configuration. If the Alfvén velocity associated to the in-plane magnetic field is sufficiently weak with respect to the variation of the fluid velocity in the plasma, the K-H instability generates fully rolled-up vortices which advect the magnetic field lines into a complex configuration, causing the formation of current layers along the inversion curves of the in-plane magnetic field component. Pairing of the vortices generated by the K-H instability is a well know phenomenon in 2-D hydrodynamics Here we investigate the development of magnetic reconnection during the vortex pairing process and show that completely different magnetic structures are produced depending on how fast the reconnection process develops on the time scale set by the pairing process.

References

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