

Coherent Vortex Structures in Magnetosphere in 3D Global MHD Simulation

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The Kelvin-Helmholtz (K-H) instability and its vortices generated by the velocity shears have long been considered to be a key to understand the mass, momentum, and energy transfers from the solar wind to the magnetosphere. However, the large Reynolds number of the magnetosphere also suggests that these vortices may have a key structure called a coherent structure. The K-H vortices generated by the shear sooner or later will leave the shear layer, magnetopause boundary, and form the Karman vortex street with the counter rotating vortices generated by the wake flow (see Figure. The white line is the vortex core and the magenta line is B field) These “Karman vortices” originated from the shear layer (magnetopause) stretch and elongate in the stream-wise direction, and become the so-called Hairpin vortices. One part of Hairpin vortex that is transverse to the flow will breakdown (vortex-breakdown) and, thus, the flow becomes to be turbulent by a nonlinear process. At the same time, another part of the Hairpin vortex that is the longitudinal vortex survives and to be the nucleus of the broken vortices. These longitudinal vortices originated from the Hairpin vortex will survive until $X \sim 150 R_E$ and form the coherent structure of the magnetosphere.

Keywords: coherent structure, vortex

