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Coherent Vortex Dynamics and Turbulent Structures in Magnetosphere in 3D Global MHD Simulation

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The Kelvin-Helmholtz instability and the associated 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 be shed-off from the magnetopause boundary sooner or later, and become to be free vortices and align to be the so-called “Karman Vortex Street” [Von Karman, 1963]. These “Karman vortices” sooner or later will breakdown (vortex-breakdown) and, thus, the flow becomes to be turbulent by a nonlinear process. At the same time, these free vortices that are the transverse vortices disappears and the new stream-wise or longitudinal vortices are gradually formed. These stream-wise vortices survive for a long time that is much longer than the periods of vortex rotations and constitute to the coherent structure that recently considered playing an important role in mixing the masses, momentum, energies between the solar wind and the magnetosphere. In the present report, we show these magnetospheric coherent vortex structures and dynamics using 3D large-scale global MHD simulations. These vortices should be able to be observed and identified in the tetrahedrally-configured satellites set like MMS.