Global MHD simulation study of the vortex at the magnetopause boundary for the southward IMF and steady solar wind conditions

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We have used a high-resolution and three-dimensional global magnetohydrodynamic (MHD) simulation to study the interaction between the steady solar wind and Earth's magnetosphere during the weak southward IMF. The simulation results show that the vortex like is generated at about = 11.7R_E region (1600LT-1700LT) with a vortex size of about 2.9 R_E at the inner boundary of magnetosphere. The vortices are propagating tailward with a velocity of 55 km/s up to 86 km/s. Moreover, the quasi-periodic fluctuations of magnetic field and plasma properties clearly show 8-10 min variations across the vortex. The total magnetic field and density are enhanced in center of the vortex with a bipolar magnetic field perturbation in the field component normal to the magnetopause. Also the velocity is low in the center of the vortex and V_x and V_y components have an opposite polarity across the vortex. Magnetic reconnection favorably occurs in anti-parallel field region with slower shear velocity in the magnetosheath. The magnetic field lines are highly bent by parallel vorticity in the flanks of the magnetopause boundary. We suggest that the reconnection is a mechanism of generating vortex with a periodicity in the dayside during the southward IMF.

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