MHD Simulation of the Solar Wind-Magnetosphere Interaction on Substorm and Magnetospheric Storm Events

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There are typical two kinds of interplanetary disturbances in the solar wind, which are called as ICME (Interplanetary Coronal Mass Ejection) and CIR (Corotating Interaction Region). Generally the former is frequently associated with occurrences of magnetospheric storms and the latter does not usually induce large magnetospheric storms but has often big chance of generation of high energy particles in the radiation belts. Thus it becomes important to simulate responses of the earth's magnetosphere by ICME and CIR to compare the effects. A three-dimensional global MHD simulation of the interaction between the solar wind and the earth's magnetosphere has been executed to study the magnetospheric storm event on space weather problem in October, 2003, when an abnormal operation happened in a satellite for Environment Observation Technology, ADEOS-II (Midori-II) and also to study the CIR event in September, 2005.

Characteristic features of the magnetospheric storm event in 2003 are the long duration of southward IMF, arrival of a strong shock wave, then large variation of IMF By from negative to positive for about 15 minutes duration. In the simulation, the shock wave compresses the magnetosphere for southward IMF and a hot plasma was injected around the geosynchronous orbit from plasma sheet. During the interval when IMF By changes from negative to positive, the magnitude of IMF extremely decreases to bring attenuation of magnetic reconnection at the dayside magnetopause. The open-closed boundary shrinks in the polar cap and the transient expansion of the magnetic field lines occurs to imply enhancement of particle precipitation. The reconnection site moves form dawn to dusk at the dayside magnetopause and a narrow cockscomb closed field region is formed in the high latitude tail when the IMF turned from dawn to dusk during northward IMF. Characteristic features of the CIR event in 2005 are characterized by fluctuations of the IMF Bz component and high speed of the solar wind. We will compare the difference of magnetotail dynamics from the global MHD simulation in connection with magnetic reconnection.