The configuration of the magnetosphere as a function of dipole tilt andIMF orientation

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The configuration of magnetic field lines in the earth's magnetosphere is determined by magnetic reconnection between the interplanetary magnetic field (IMF) and the geomagnetic field. That is, the IMF determines where magnetic reconnection occurs, and how the reconnected field lines move. Two conditions determine where magnetic reconnection occurs at the magnetopause: The extent to which the antiparallel field condition is satisfied and the relative velocity of the reconnected field lines in the direction perpendicular to the magnetic field. The IMF lines flow radially from the subsolar point in the magnetosheath.

Their velocity can easily exceed the local Alfven speed. Therefore, magnetopause reconnection occurs in regions where the antiparallel field condition is well satisfied and magnetosheath plasma flow is relatively small (closest areas to the subsolar point).

For purely northward IMF the magnetosphere can become nearly closed because high atitude reconnection occurs simultaneously in both the northern and southern hemispheres. If the IMF has a finite IMF By component, the earth's magnetosphere becomes open. For instance when the IMF has a small duskward component (positive Bz and positive By), reconnection occurs in the dusk side, high-latitude magnetopause region in the northern hemisphere. Then open field lines that have convected from the dusk side are found in the dawn polar region.

If the dipole tilt is non-zero, the earth's magnetosphere becomes open again, even for purely northward IMF, and a north-south asymmetry appears.

When non-zero dipole tilt and finite IMF By and Bz exist simultaneously, complicated structures form in the magnetosphere. We demonstrate this complicated magnetic field line configuration and magnetospheric dynamics by using a 3-dimensional global MHD simulation. Moreover, we show energy distribution and energy transfer in the magnetosphere depending on the dipole tilt and IMF orientation.