大規模磁気嵐の３次元MHDシミュレーション

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Three dimensional MHD simulation of super magnetic storms

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It is important to study super magnetic storms like the Carrington storm in 1859 for good understandings of space weather. As the solar wind and IMF becomes abnormal conditions, plasma turbulence are strongly excited near boundary layers in the magnetosphere. In the plasma sheet magnetic reconnection occurs in patchy and intermittent manner to produce streamer-like structure. At the magnetopause, more regular vortex train is formed for northward IMF. It is because velocity shear created between the magnetosheath fast flow and magnetopause slow flow. On the other hand, sunward fast flow is produced by tail reconnection for southward IMF. Therefore two types of velocity shears created outside and inside of the magnetopause to strongly excite Kelvin-Helmholtz instabilities in both sides. Moreover dayside reconnection occurs in patchy and intermittent manner to give seeds of plasma turbulence. As the results, complicated and strong vortex turbulence appears in flank magnetopause.

We will demonstrate those phenomena from 3-dimensional global MHD simulation of interaction between the solar wind and magnetosphere to discuss relationship between the currents and vortices in boundary layers for extreme conditions on the solar wind and IMF. In particular we will stress relationship among parallel and perpendicular components of vorticity and current, their influence to the global structure of magnetosphere and also compressibility in order to understand the fundamental picture of super magnetic storms in the magnetosphere.