地球磁気圏における境界層乱流とエネルギー輸送

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Boundary layer turbulence and energy transport in the earth's magnetosphere

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Anomalous energy transport, accumulation and release of three kinds of energy, namely energy budgets are important problems in interaction between the solar wind and earth's magnetosphere-ionosphere. We have studied distribution of three kinds of the kinetic, thermal and magnetic energies and three kinds of energy fluxes in the magnetosphere. Most dominant energy flux is Poynting flux in the magnetosphere which is main driver of magnetospheric convection. In the earth side of near-earth neutral line in plasma sheet, thermal energy flux is generally greater than kinetic energy flux, because thermal energy is large there and Much number is less than unity. The kinetic energy flux firstly becomes small and the thermal flux does secondly when plasma high speed flows come close to the earth from the neutral line by magnetic reconnection. Poynting flux survives finally and approaches very near the earth in the plasma sheet and then carries the energy from nightside to dayside magnetosphere.

At the same time, 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 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 visualization method of simulation results to discuss relationship between the currents and vortices in boundary layers. In particularly we will stress relationship among parallel and perpendikular components of vorticity and current, and also compressibility in order to understand the fundamental picture of magnetospheric physics.