地球磁気圏におけるプラズマ不安定の３次元グローバルMHDシミュレーション

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Three-Dimensional Global MHD simulation of Plasma Instability in Earth's Magnetosphere

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It is known that response of Earth's magnetosphere dominantly depend on north-south component of interplanetary magnetic field (IMF). For southward IMF, magnetic reconnection occurs in the dayside magnetopause and plasma sheet, and the processes play an important role on magnetospheric convection. However, magneticreconnection is not sufficiently understand as transport processes. For northward IMF, Kelvin-Helmholtz instability (KHI) can be excited due to velocity shear at magnetopause. In fact, there are several observations reported periodic wavy phenomena which can from KHI.Moreover, local simulations clearly show the vortex formation from the instability. However there is no clear global simulation to show occurrence of KHI for northward IMF condition. On the other hand, several global simulations show appearance of wavy phenomena and vortex formation during southward IMF. It is also needed to study relationship between magnetic reconnection and KHI.

Therefore, we have carried out a high-resolution three-dimensional global MHD simulation of interaction between solar wind and Earth's magnetosphere to study relationship between magnetic reconnection and plasma instability. For southward IMF, we found filamentary structure in plasma sheet due to patchy and intermittent reconnection. Moreover, irregular vortex train appears at the dayside magnetopause. Kelvin-Helmholtz instability is excited to generate wavy (or vortex) train rolled up in the low latitude boundary layer (LLBL), for northward IMF. On the other hand, for no uniform IMF condition, a dipole-like convective electric field Ey appeared at LLBL and propagated down the tale along the magnetopause. In this case, high latitude tail reconnection could not occures. In the present study, we discuss development of plasma instability and nonlinear evolution to a vortex train.