B006-17 会場: C 時間: 9月30日 9:00-9:15

磁気圏グローバルMHDシミュレーションによるケルビン・ヘルムホルツ不安定の再現

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The Kelvin-Helmholtz instability at the magnetopause : A global MHD simulation

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Since 1980's the magnetohydrodynamic (MHD) simulation has been a powerful tool for modeling an interaction of the supersonic solar wind plasma with the terrestrial magnetosphere. Increasing computational capability enables us to predict the geospace environment in response to transient solar activities such as the coronal mass ejection (CME), that is, Space Weather forecast. Nowadays, a number of global MHD models have been developed. However, due to restricted CPU time and a memory capacity, even the modern global MHD models of the magnetosphere solve limited area in the magnetosphere and physical processes. Despite the great progresses on the global MHD simulations, some issues are remained to be solved for the future high performance computing. Recent numerical simulations and in-situ observations have shown that turbulence is of particular importance in discussing plasma transport and acceleration in the magnetosphere. For example, the turbulent transport of the solar wind plasma via Kelvin-Helmholtz instability (KHI) has been proposed by the local numerical simulations [Matsumoto and Hoshino, 2006]. Despite its importance, little has been understood by the global MHD simulations.

To show importance of turbulence in the context of energy and mass transports at the magnetopause, we have developed a new global MHD simulation model of the magnetosphere. The model implements the CIP algorithm [Yabe et al., 2001] which enables us to solve the advection equation stably with a low numerical dissipation [Matsumoto and Seki, 2008]. With the newly developed model, we aim at reproducing the growth of the KHI at the magnetopause under a northward IMF condition as a first step. As a result, we have successfully reproduced the vortex formation at the magnetopause under the typical solar wind conditions of $|V_x|$=400km/s, N=4/cc, B_z=+5nT, and the plasma beta=1.0. The vortical motion starts at 16 MLT and subsequently evolves to larger scale vortices. The unstable region extends in 3D space whose vertical scale ranges +- 5 R_E, which is consistent with the recent statistical study of the KH vortex obseravations [Hasegawa et al., 2006]. In this talk, we present details of our newly developed global MHD simulation model and an interaction of the solar wind with the magnetosphere for a northward IMF case. We also compare the obtained vortex evolution with the linear theory of the KHI to justfy the obtained vortical motions as a result of the KHI.