MHD processes and FAC system during substorm deduced from data analysis and MHD simulation

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The magnetospheric substorm is the fundamental but the unsolved problem in the solar-terrestrial physics. In particular, the generation process of substorm-FAC, the heart of the substorm dynamics, is not fully discussed and understood in the context of the momentum/energy balance in the Magnetosphere-Ionosphere coupling system.

Based on the analysis of GOTAIL/MGF, LEP and EPIC data, we have suggested that MHD slow mode is the primary process as a non-Alfvenic (non-convective) motion in the earth's magnetotail. In the slow mode motion, the plasma fluid inside the flux tube move along the field line without causing any enhancement of total pressure profile. This resolving process of the pressure gradient and magnetic tension along the magnetic field is not included in the framework of the convective or the fast mode motion. So, the slow mode might have a key role in overall configuration change (redistribution of plasma and the reconfiguration of magnetic field) of the near-earth magnetotail.

In our previous study, we proposed a substorm scenario based on the slow mode interpretation mentioned above. However, we have not fully explained details, including the momentum/energy conversion at the site of plasma sheet and the stress/energy matching between the magnetosphere and ionosphere. In this study, we examine the scenario by comparing data analysis and MHD simulation. The MHD simulation and the analysis of its results are performed on an web-based operation system and an advanced visualization system that are introduced in NICT recently.

Also, we will report the progress of our MHD eigen-mode decomposition method, one of the new ideas that will be applied in global MHD simulations toward the understanding of the mechanics and energetics of substorm processes in the context of the Magnetosphere-Ionosphere coupling system.