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A kinetic model for Alfvenic interactions in magnetosphere-ionosphere coupling

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Alfvenic interactions of the magnetosphere and the ionosphere (M-I) play a key role in spontaneous growth of quiet auroral arcs in the polar region. The feedback instability has been formulated in terms of the reduced magnetohydrodynamic (MHD) equations [1], and is recently investigated in detail in the dipole configuration with realistic Alfven velocity profiles [2]. Non-linear simulations of the feedback instability in the M-I coupling system also reveal that the secondary instability growth of the Kelvin-Helmholtz-like mode leads to deformation of vortex, current, and density profiles associated with auroral arcs [1].

A variety of non-MHD effects, however, appear in the magnetosphere with low-density and high-temperature plasma. The finite ion gyroradius effect is, for example, non-negligible in the vicinity of the magnetic equator region with the weak magnetic field and the high ion temperature. While some of the non-MHD effects can be incorporated in terms of extended fluid models, a kinetic model is still necessary for more complete description of the magnetospheric plasma dynamics.

In this study, we consider a gyrokinetic model of the magnetospheric plasma, where the finite gyroradius and other kinetic effects are preserved while deleting fast time-scales associated with gyro-motions. In the gyrokinetics, the kinetic Alfven waves are compactly formulated in terms of the polarization density of ion gyro-centers and the parallel electron current. We would discuss some basic properties of the kinetic model for Alvenic interactions in the M-I coupling system in comparison to the reduced MHD model.

[1] T.-H. Watanabe, "Feedback instability in the magnetosphere-ionosphere coupling system: Revisited", Phys. Plasmas, Vol.17, 022904-1 - 022904-8 (2010).
[2] Y. Hiraki, and T.-H. Watanabe, in preparation for submission (2011).

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