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Three-dimensional MHD simulation of MHD-scale Kelvin-Helmholtz vortices modeling the magnetospheric boundary layer

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The Kelvin-Helmholtz instability (KHI), which is a hydrodynamic instability exited by the velocity shear, has been considered as one of the most notable processes at the planet's magnetospheric boundary existing between the stagnant magnetospheric plasma and the solar wind plasma. At the Earth's low-latitude magnetospheric boundary, in-situ observations have shown the existence of MHD-scale vortex-like flow patterns which are believed to be produced by the non-linear development of the KHI. These results strongly indicate that the KH vortex plays an important role in the local entry of the solar wind plasma. To really understand the developmental process of the KH vortex at the magnetospheric boundary, it is necessary to take into account the three-dimensional structure of the boundary where the plasma sheet (KH-unstable), the north and south lobes (KH-stable) and the magnetosheath (KH-unstable) are adjoined. Recently, Takagi et al. (2006) performed three-dimensional MHD simulations modeling such a magnetospheric boundary situation, and found that the growth of KHI is strongly affected by the plasma sheet thickness. In their study, however, only one KH vortex is allowed to grow in the simulation. On the other hand, several two-dimensional numerical studies have confirmed that the vortex coalescence process can lead to the large-scale development of vortices observed at the Earth's magnetospheric boundary. Thus, in this study, to investigate the large-scale development process of KH vortices at the three-dimensional magnetospheric boundary, we perform three-dimensional MHD simulations considering the vortex coalescence in the boundary model as Takagi et al., (2006).

In this presentation, we will show the results of the parameter survey of the plasma sheet thickness and the number of vortices, and discuss how large the KH vortex can grow at the magnetospheric boundary.