Three dimensional MHD simulations of Kelvin-Helmholtz instability in a tail-flank of Magnetosphere

Ken Takagi[1]; Ryoji Tandokoro[2]; Takuma Nakamura[3]; Masaki Fujimoto[4]; Hiroshi Hasegawa[5]

[1] Dept. Earth and Planetary Sci., Tokyo Inst. Tech.; [2] Dept.Earth and Planetary Sci.,TIT; [3] Earth and Planetary Sci., TITech; [4] DEPS, TITECH; [5] TITECH

We have performed three-dimensional MHD simulations to investigate the Kelvin-Helmholtz vortices at the interface between tail-flank of Magnetosphere and magnetosheath. The simulation domains are divided into three regions; plasmasheet (K-H unstable), tail lobe region(K-H stable) and magnetosheath (K-H unstable). The one of the interesting results from our simulation runs is that the K-H instability can be excited and the vortex is rolled up distinctly in the plasma sheet even in the situation when the plasma sheet thickness (unstable layer thickness) is as small as 1.3 times the wavelength of the K-H instability. Having obtained this result under the condition that the orientation of the magnetic field is due north, we have then conducted several more simulations and found that if the deviation of the magnetic field direction from northward is less than 20 degrees, the K-H vortex can be highly rolled up. Furthermore, when the K-H vortex is rolled up, we found the tailward plasma flow velocity exceeds the speed of the solar wind in the region within the vortex where the magnetospheric plasma (low density) penetrates into the magnetosheath region (high density). From this result, we can consider the overshoot tailward flow of the magnetospheric plasma penetrating the magnetsheath as the smoking gun evidence of a rolled up K-H vortex in single spacecraft observations. We have performed virtual spacecraft observations through the center of a simulated rolled-up vortex to set up the robust indicator for a rolled-up K-H vortex. This result can be a steppingstone for future data analyses using already exiting numerous single spacecraft observations that would firmly reveal the existing of, and may further show the occurrence condition of, rolled-up K-H vortices at the interface between the tail-flank and the magnetosheath.