

## Evolution of phase space densities in the Earth's magnetosphere during a prolonged northward-IMF period: CLUSTER, GEOTAIL, LANL-MPA comparison

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It is observationally known that the plasma sheet becomes much cooler and denser than usual under prolonged northward interplanetary magnetic field (IMF) conditions [1]. However, the mechanism responsible for the formation of the cold dense plasma sheet (CDPS) is still far from understood. The Kelvin-Helmholtz (K-H) instability driven by the velocity shear at the magnetopause has been proposed as a possible mechanism of magnetosheath plasma entry through the LLBL [2]. “Double lobe reconnection”, i.e., reconnection of magnetosheath flux tubes with lobe field at the high-latitude magnetopause in both hemispheres is also an important candidate process for the dense, thick LLBL formation during northward IMF periods [3]. In order to examine roles of the K-H instability and “double lobe reconnection” for formation of CDPS in the Earth’s magnetotail, evolution of electron and ion phase space densities (PSDs) from the dayside to the nightside magnetosphere is investigated by comparing simultaneous observations by CLUSTER, GEOTAIL, and LANL-MPA at three different regions in the magnetosphere. The observations are also compared with results from full-particle simulation of the K-H instability in the magnetized plasma with a density gradient. Results shows:

1. Heated electron signature observed by CLUSTER around dayside magnetopause indicates the “double lobe reconnection” indeed took place during the event.
2. Comparison of PSDs in the newly closed flux tube and the dusk-flank LLBL indicates that double lobe reconnection is responsible for formation of the outer-LLBL in the dusk flank.
3. GEOTAIL observed wavy structures in the dusk LLBL, which is consistent with the non-linear phase of K-H vortices.
4. Comparison between PSDs from full-particle simulation and observations in the LLBL suggests that the K-H instability is responsible for the selective plasma entry into the inner-LLBL.
5. Comparison between PSDs at GEOTAIL and LANL-MPA indicates that CDPS material can be injected into inner magnetosphere after southward turning of IMF. However, the magnetic drift may be not negligible and further study is needed.

### References

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- [2] H. Hasegawa et al.: *Nature*, 430, 755 (2004).
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