CRITICALITY OF MAGNETOTAIL FIELD TOPOLOGY IN A THREE-DIMENSIONAL PARTICLE SIMULATION

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ABSTRACT

We have successfully visualized the magnetic field topology in the magnetotail using the numerical data sets obtained by the three-dimensional full electromagnetic particle simulation [1]. In our visualizations, the three-dimensional magnetic field topology in the magnetotail region is uniquely determined using our method [2]. We have presented the global and temporal changes of the magnetic field topology. It should be noted that the global changes of the magnetic field topology reveal the reconnection in plasma physics. Since the field topology is uniquely determined by the eigenvalues of the critical points, we have examined that the magnetic field topology has been globally changed and the IMF has been penetrated into the magnetotail. There are 4 step intervals between 1224 and 1228 steps and the global changes of the magnetic field have taken place between these two time steps. One step before the global change of the topology is important. Examining the magnetic field topology at time step 1224, the critical points are split into two isolated groups and form a trapezoidal-like region on the x-y plane at z = 0 in the GMS coordinate. All critical points are close at z = 0 plane and the point A is connected to the point C through the point B, which is corresponds to the so called ``neutral line." The important point here is that if the critical point at B or C vanishes or is split and the trapezoidal-like region is destroyed, the IMF or open magnetic field lines can penetrate and the reconnection can take place. We have also investigated the reconnection in the dayside magnetopause. We found the bifurcation with changing the strength of southward IMF B_z. The sudden occurrence of global reconnection is observed at the dayside magnetopause. Further investigations are necessary in order to clarify the topological changes associated with the magnetic reconnection and will be discussed using magnetic field data with better spatial and temporal resolutions.

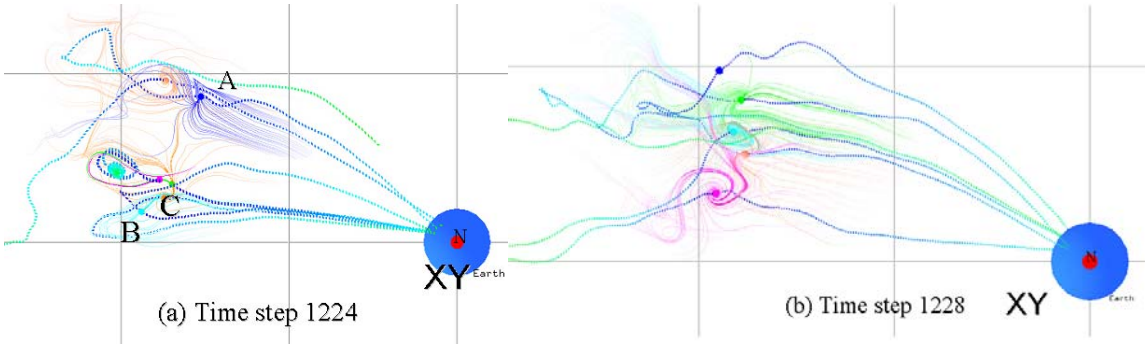

Fig. 1. Magnetic field topology projected onto the equator plane at time step (a) 1224 and (b) 1228.

REFERENCES

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