Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM30-P17 Room:Convention Hall Time:May 24 10:45-12:15

Global magnetic flux circulation in the magnetosphere during obliquely northward interplanetary magnetic field periods

WATANABE, Masakazu[1*], FUJITA, Shigeru[2], KUBOTA, Yasubumi[3], SHINAGAWA, Hiroyuki[3], TANAKA, Takashi[1], MURATA, Ken T.[3]

[1]Kyushu University, [2]Meteorological College, [3]National Institute of Information and Communications Technology

The structure of the magnetosphere during northward interplanetary magnetic field (IMF) periods is less well known than is generally thought. For example, few people recognize that because open field lines drape over the dayside magnetosphere (the so-called overdraped lobe), the low-latitude boundary layer is located on open field lines. Also, as for the steady-state magnetic flux circulation resulting from reconnection, only the circulation mode that is completed within the lobe [Russell, 1972] has been considered in the past. Consequently, the convection cell that appears in in the ionosphere has been interpreted as the so-called lobe cell for all cases. However, Watanabe and Sofko [2009] has pointed out that considering the magnetic topology, the lobe circulation view is not necessarily true, and in fact another mode of magnetic flux circulation is dominant during northward IMF periods. In that new idea, IMF-lobe reconnection and lobe-closed reconnection occur sequentially in both hemispheres to maintain steady-state flux circulation by reciprocating magnetic flux between the two reconnection processes. This new idea has not been accepted widely, however. One reason is the difficulty in visualizing the three-dimensional topology of the magnetic field, with the result that the discussion stops at the most rudimentary level. The authors previously showed that the outcome of numerical magnetohydrodynamic simulation was consistent with the aforementioned circulation mode. When the IMF clock angle points about 20 degrees from due north, the convection patterns in the ionosphere exhibit those expected from the theoretical prediction. In the current study, we further advance the analysis of the simulation results, and confirm that the magnetic flux circulation mode is in fact that predicted. In addition, we visualize the circulation mode using computer graphics techniques so that everyone can understand the reconnection processes involved. For this purpose, we first determine and visualize magnetic nulls, separatrices, and separators, which are essential in understanding the three-dimensional structure of the magnetosphere. We next show the existence of a streamline that crosses separatrices sequentially in the following order: IMF-lobe-closed-lobe-IMF. This proves the above-mentioned magnetic flux circulation mode. In the presentation, we will also refer to observations that are relevant to the circulation mode.

References

Watanabe, M., and G. J. Sofko (2009), Role of interchange reconnection in convection at small interplanetary magnetic field clock angles and in transpolar arc motion, J. Geophys. Res., 114, A01209, doi:10.1029/2008JA013426.

Russell, C. T. (1972), The configuration of the magnetosphere, in Critical Problems of Magnetospheric Physics, edited by E. R. Dyer, pp. 1-16, Inter-Union Commission on Solar-Terrestrial Physics Secretariat, Natl. Acad. of Sci., Washington, D. C.

Keywords: magnetic topology, magnetic reconnection, magnetic null, separatrix, separator