サブストーム開始時におけるグローバル磁場トポロジー変遷

吉岡 大樹 [1]; 渡辺 正和 [2]; 田中 高史 [3]; 藤田 茂 [4]
[1] 九大・理・地惑; [2] 九大・理・地惑; [3] 九大・宙空センター; [4] 気象大

Transition of Global Magnetospheric Topology at Substorm Onset

Daiki Yoshioka[1]; Masakazu Watanabe[2]; Takashi Tanaka[3]; Shigeru Fujita[4]
[1] Earth and Planetary Science, Kyushu Univ.; [2] Earth & planetary Sci., Kyushu Univ.; [3] SERC, Kyushu Univ.; [4] Meteorological College

Recent magnetohydrodynamic (MHD) simulations indicate that the magnetic field topology of the magnetosphere is basically described by a torus representing the open-closed filed line boundary and a cylinder representing the open-interplanetary field line boundary. The torus is inscribed in the cylinder with a tangent topologically equivalent to a circle. The circle consists of two separators (which are also field lines) connecting two magnetic nulls on the circle. The torus surface consists of two separatrices, namely the separatrix northward of the separator circle and the separatrix southward of the separator circle. Similarly, the cylinder surface is divided into two separatrices by the separator circle. We call such structure of the magnetosphere the null-separator topology. When the interplanetary magnetic field (IMF) is northward, the null-separator topology almost always persists. For southward IMF, however, the null-separator topology is locally modified, sometimes drastically, although the global null-separator topology is basically retained. In this paper, we investigate the magnetic topology change at the onset of substorms simulated by global MHD modeling. In our simulation, a nonzero dawn-dusk component of the IMF was included in the upstream conditions. We found the following. Just before the onset, at x = -20 ˜-30 Re on the nightside, the torus surface northward of the separator circle and the torus surface southward of the separator circle are in contact with each other and reconnect. As a result, unconnected (IMF) lines produced by reconnection pierce the closed field line region, making another hole on the torus (i.e., a 2-fold torus or a double torus). We discuss how the 2-fold torus is formed at the substorm onset by analyzing the simulation data in detail.