

PEM005-31

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Catapult current sheet relaxation model for substorm onset

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Based on the results of our superposed epoch analysis of Geotail data, we have proposed a catapult (slingshot) current sheet relaxation model in which earthward flows are produced in the central plasma sheet (CPS) due to the catapult current sheet relaxation, together with the rapid enhancement of Poynting flux toward the CPS in the lobe around $X \sim -15 R_E$ about 4 min before the substorm onset. These earthward flows are characterized by plasma pressure decrease and large amplitude magnetic field fluctuations. When these flows reach $X \sim 12 R_E$ in the magnetotail, they give significant disturbances to the inner magnetosphere to initiate some instability such as a ballooning instability, and the substorm starts. The occurrence of the magnetic reconnection is a natural consequence of the initial convective earthward flows, because the relaxation of a highly stretched catapult current sheet produces a very thin current at its tailward edge. Recently, Nishimura et al. [2010] reported that the substorm onset begins when a North-South (N-S) arc reaches equatorward quiet arcs. The region of earthward convective flows correlatively moves earthward prior to the onset. Thus, this region of the earthward convective flows seems to correspond to the N-S arc.

Keywords: magnetosphere, substorm, magnetic reconnection, current disruption, aurora, plasma sheet