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Experimental evidence of the loading-unloading substorm scheme

M. Shukhtina (1), N. Dmitrieva (1), N. Popova (1), A. Yahnin (2), I. Despirak (2)

Saint - Petersburg State University, Saint- Petersburg, Russia (mshukht@geo.phys.spbu.ru),
Polar Geophysical Institute, Apatity, Russia

The aim of the work is to compare the magnetotail magnetic flux F at substorm onset with the magnetic flux through the auroral bulge F_{bulge} at substorm maximum . The quantity F was calculated for 200 substorms observed by Geotail spacecraft in 1995-1998 using our empirical model, expressing the lobe magnetic field and tail radius at substorm onset via the solar wind dynamic pressure, one hour - averaged merging electric field E_m and spacecraft position. It turned out that the F value depends only on the merging electric field value and so may be calculated using only E_m measurements. Thus computed F values were compared with the quantity F_{bulge} , calculated from Polar UVI images. The study of 40 substorms showed good correspondence of the magnetic flux stored during the substorm growth phase with the magnetic flux through the corresponding auroral bulge. We conclude:

1. The total magnetotail magnetic flux at substorm onset is not constant, but linearly depends on the merging solar wind electric field. An empirical formula linking F and E_m quantities is obtained.

2. For individual substorms the flux through the auroral bulge F_{bulge} almost equals the flux stored during the growth phase ΔF , being $\sim 85\%$ of its value. This result quantitatively confirms the loading - unloading substorm concept.

3. Correspondence of the quantities F_{bulge} and ΔF confirms that the auroral bulge is the ionospheric projection of the reconnection region.