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THE CHAPMAN-FERRARO CURRENT STRUCTURE IN RESPONSE TO THE IMF BY

Ramon Lopez, relopez@uta.edu

University of Texas at Arlington, Arlington, Texas, United States

Walter Gonzalez, walter.gonzalez@inpe.br

Instituto Nacional de Pesquisas Espaciais, São José Dos Campos, Brazil

Pauline Dredger, pauline.dredger@mavs.uta.edu

University of Texas at Arlington, Arlington, United States

Paul Cassak, pacassak@mail.wvu.edu

West Virginia University, United States

Vitor Moura, vitormoura21@gmail.com

National Institute for Space Research (INPE), SÃO JOSÉ DOS CAMPOS, Brazil

The classical Chapman-Ferraro current flows on the boundary of the magnetosphere just Earthward of the magnetopause, which defines the transition from the magnetosphere to the magnetosheath. For southward magnetic field this simple picture must be modified to include a current in the magnetosheath that flows on open field lines in the same direction as the Chapman-Ferraro current, and which is known as the external Chapman-Ferraro current. This current is of the correct orientation to help close the bow shock current. When an east-west component is present in the IMF, the picture is further modified. Using THEMIS observations of magnetopause crossings near noon and near the magnetic equator, we demonstrate that for northward IMF, the Chapman-Ferraro current retains its basic, classical form, flowing entirely on closed field lines, but it is inclined to provide a smooth rotation of the magnetic field from the magnetosheath values to the magnetospheric values. For southward IMF the picture is more complicated. There is no evidence of a component in the external Chapman-Ferraro current associated with a rotation of B_y toward the magnetospheric value, which means that the bow shock current associated with the compression of the IMF B_y component across the shock must close elsewhere in the system. Moreover, the rotation of the magnetic field in the Chapman-Ferraro current flowing on closed field lines is in different places for B_y and B_z , in contrast to the relatively uniform inclined current seen for positive B_z . The rotation of B_y is primarily accomplished by a vertical current at the Earthward edge of the current layer, implying a north-south, unipolar current. One possible closure path for that current would be to close bow shock current flowing into (or out of) the polar cap that would connect to the Chapman-Ferraro current via meridional ionospheric currents.