The excitation conditions of magnetospheric convection by the electric current generated in the Bow Shock

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The solar wind undergoes the greatest change of its parameters during the passage through the shock wave front. Its density in this case increases by a factor of four, and gas and magnetic pressures increase more than an order of magnitude.

In this paper we re-examine the consequences of the fact of generation of electric current at the Bow Shock (BS) front that we considered at an earlier date, and the dependence of the direction of this current on the sign of IMF B_z. The first consequence is the closure of the aforementioned current through the body of the magnetosphere. It was found that this process is a two-stage one. Initially, the electric field penetrates and establishes in the medium a new convective regime. After that, depending on the degree of flow inhomogeneity, a plasma density distribution can be established, which corresponds to the electric current equal to the external current.

The new steady state, to which the new convection velocity field and the new plasma pressure field correspond, is established within a time on the order of the transit time taken by the magnetosonic wave to propagate through the entire system. To understand the dependence of the convection configuration on the direction of the external current, that is, on the sign of the IMF B_z-component, an idealization of the magnetosphere in the form of a spatially bounded magnetic dipole is used. The question of the validity range of the model is discussed. A linkage between the power dissipated inside such a model magnetosphere and the parameters of plasma convection existing therein is shown. It is shown, in particular, that with the southward directed IMF B_z, the convection must be a two-vortex one, while in the case of a sufficiently long persistence of the northward IMF B_z the magnetospheric convection must acquire a four-vortex character.

An estimate of the time of such a passage is made.