Effect of anomalous resistance on the formation of a geomagnetic cavity in an expanding jet

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Anomalous plasma transfer during the injection of high-speed plasma jets in laboratory plasma and active ionospheric experiments is the focus of many studies. Modeling of jet dynamics is limited by the difficulty of adequately taking into account the anomalous transfer and heating of electrons and plasma ions. Often, models with arbitrary free parameters are used for this in an attempt to achieve agreement with experimental data. Based on a physical model of electron and ion turbulence, an attempt was made to give a magnetohydrodynamic description of the formation of a geomagnetic cavity during the expansion of a plasma jet in the collisionless plasma of the Earth's upper ionosphere. It was assumed that anomalous resistance arises in regions where large electron drift currents arise. Small-scale fluctuations of electrons form into nonlinear wave structures, which, in contrast to linear waves, transport electrons along the direction of a large-scale electric field, leading to their heating. The electron temperature balance is determined by the level of turbulence and the concentration of neutrals, on which electrons are scattered, accompanied by excitation and additional ionization. Electronic turbulence becomes a source of anomalous scattering of ions and determines their anomalous transfer with the formation of ionic nonlinear wave structures that accelerate and heat ions. An attempt was made to formalize the results of microstructural modeling and introduce them in the form of transport coefficients into a large-scale calculation of plasma jet expansion in the framework of magnetohydrodynamics. It is found that the considered processes significantly affect the position of the boundary of the geomagnetic cavity both at the leading and trailing fronts of the jet and change the lifetime of the cavity.