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Excitation of New Modes of the Global Weather Forming ULF Electromagnetic Waves and its Role in the Generation of the Traveling Ionospheric Disturbances

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In the present article the results of theoretical investigation of the dynamics of generation and propagation of planetary global weather forming ultra-low frequency (ULF) electromagnetic wave structures in the dissipative ionosphere are given. The physical mechanism of generation of the planetary electromagnetic waves is proposed. It is established, that the global factor, acting permanently in the ionosphere – inhomogeneity of the geomagnetic field and angular velocity of the earth's rotation – generates the fast and slow planetary ULF electromagnetic waves. The waves propagate along the parallels to the east as well as to the west. In E-region the fast waves have phase velocities (2÷20) km·s^{-1}and frequencies (10^{-1}÷10^{-4}) s^{-1}; the slow waves propagate with local winds velocities and have frequencies (10^{-4}÷10^{-6}) s^{-1}. In F-region the fast ULF electromagnetic waves propagate with phase velocities (5÷10) km s^{-1} and their frequencies are in the range of (10÷10^{-3}) s^{-1}. The slow mode is produced by the dynamo electric field, it represents a generalization of the ordinary Rossby type waves in the rotating ionosphere and is caused by the Hall effect in the E-layer. The fast disturbances are the new modes, which are associated with oscillations of the ionospheric electrons frozen in the geomagnetic field and are connected with the large –scale internal vortical electric field generation in the ionosphere. The large-scale waves are weakly damped. The waves generate the geomagnetic field from several tens to several hundreds nT and more. Nonlinear interaction of the considered waves with the local ionospheric zonal shear winds is studied. It is established, that planetary ULF electromagnetic waves, at their interaction with the local shear winds,

can self-localize in the form of nonlinear long-lived traveling ionospheric solitary vortices, moving along the latitude circles westward as well as eastward with velocity, different from phase velocity of corresponding linear waves. The vortex structures transfer the trapped particles of medium and also energy and heat. That is why such nonlinear vortex structures can be the structural elements of strong macroturbulence of the ionosphere.