



DYNAMICAL STABILITY OF PLASMA IRREGULARITIES PRODUCED BY POWERFUL RADIO WAVE IN THE F REGION OF THE IONOSPHERE

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ABSTRACT

The paper demonstrates that the artificial plasma irregularities in the F region of the ionosphere are dynamical structures caused by the component of temperature gradient parallel with gravitational field. The concept is justified by theoretical estimates of critical parameters of thermal convection in the heated ionospheric volume. Presented results of radar observations of small-scale irregularities are explained by the thermal convection.

INCOMPLETENESS OF LOCAL DESCRIPTION OF IONOSPHERIC PLASMA

The heated volume produced by a powerful radio wave has been investigated as a radio physical object rather fully. However, optical and radio physical methods being used give the static pattern of the disturbed ionospheric volume. At the same time, analysis of dynamics of the plasma system involves fundamental difficulties, as cooperative processes have a dominant role in plasma physics. Nowadays, the analysis of plasma motions leans upon hydrodynamic equations which refer to a local type of model. The notion is not adequate for description of global cooperative phenomena. In particular, in differential equations, the term descriptive of gravitational force, as a rule, is omitted. This is reasonable to a local approximation, because weight of a differential element of material is negligibly small in comparison with other forces on it. However, contrary to others forces, the gravitational pull acts on all elements similarly and, hence, the combined effect of gravity on macro irregularity may be of basic importance. In the gravitational field, the heated macro irregularities do have high free energy transforming to kinetic energy.

The disturbed volume may be adequately conceived as an open system with the structure formed by a external energy flux. At present, an acceptable description for the open system is not found. We can make some qualitative conclusions based on general physical principles. For the region of the ionosphere modified by a powerful radio wave, the flux of heat caused by temperature gradient is most pronounced. Consequently, the structure of the heated region may be dictated by the thermal convection.

THEORETICAL ESTIMATIONS OF POSSIBILITY OF THERMAL CONVECTION

The analysis will be followed on the macro level lest global effects will be overlooked. The parameter essential to the dynamics regime in nonhomogeneous medium is Rayleigh number. Let us next construct an equivalent to the number for ionospheric plasma in the volume heated by powerful radio wave. The geomagnetic field is the crucial factor for the F region of the ionosphere. The plasma may be decompose into a longitudinal system and a cross system about the field lines. The longitudinal system serves as