NONLINEAR DYNAMIC STRUCTURES IN MODIFIED IONOSPHERIC PLASMA

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Experimental and theoretical studies of dynamic effects arising in ionospheric plasma under action of powerful electromagnetic emission are presented.

The experimental results were obtained in the Nizhny Novgorod region at the heating facilities "Zimenki" and "Sura" by the method of sounding of artificially disturbed ionospheric plasma by probing radio pulses. This method is based on the scattering of pulses without plasma density perturbations and on the analysis of the characteristics of scattered signals. The specific feature of our facility is ionosphere sounding by intensive, but short, radio pulses on the frequency close to the heater one. The study of the characteristics and temporal evolution of different type signals scattered by modified ionosphere ("caviton" signal (CS), "plasma" signal (PS) and "aftereffect plasma" signal (AEPS) [1,2]), allowed us to reveal nonlinear dynamic processes in the vicinity of plasma resonance regions. The particular emphasis of this paper is made on the recent investigations of amplitude and phase characteristics of CS (analogue of narrow-band component (NC) of stimulated electromagnetic emission (SEE)) and phase behavior of the main signal of probing transmitter.

For theoretical interpretation of the characteristics of CS and AEPS the numerical solution of nonlinear Shrödinger equation (NSE) with driven extension were carried out in inhomogeneous plasma layer with linear electron density profile [3-5] and for the one with prescribed density depletion [6]. The simulation enables us to study spatial structures of electromagnetic field and plasma density, their time and spectrum characteristics at formation and relaxation states depending on heater intensity, density profile parameters.

Qualitative conformity of theoretical and experimental results is obtained. It was found that the observed evolution of phase characteristics of the main signal of probing transmitter and CS correspond to calculated phase dependencies of reflected wave and wave field at plasma resonance point accordingly, both demonstrating the powerful radio wave penetration into overdense plasma. The next observed characteristics of CS are proved theoretically [3-6] also: periodic generation of CS; the dependencies of CS period on the heating power and on the heater time; the travel of CS maximum height down the density gradient; aftereffect of CS

The obtained results demonstrate the excitation of strong turbulence and dynamics of solitary structures in the reflection region of powerful radio wave. They allow us to interpret as CS properties as such so far inexplicable phenomena like "spikes"[7].

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