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The modified dispersion relation for ionacoustic instabilities of ionospheric plasma at 80-200 km altitudes and its usage for interpretation of 150km equatorial radioecho

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Ionacoustic instabilities of the ionospheric plasma and corresponding small-scale irregularities of the electron density significantly affect to the HF and UHF radiowaves propagation. Due to this an investigation of their characteristics is the important task staying on the border of the radiowaves propagation theory, geophysics and plasmaphysics.

The theory of these instabilities in the E-layer, that are qualitatively divided into the two-stream and gradient-drift ones, is under development for a long time. The most part of the linear theories replaces investigation of the irregularities by analysis of the dispersion relation for the plasma irregularities. This dispersion relation connects oscillation frequency of the irregularities with their wave vector and defines conditions for the growth of the irregularities and their spectral characteristics in terms of plane waves approximation.

There are two traditional limitations of such theories, limiting their region of applicability:

1)Magnetized electrons and unmagnetized ions requirement;

2)Low oscillation frequency of irregularities in comparison with ion-neutral and electron-neutral collision frequencies.

In the paper within the approximation of the two-fluid magnetohydrodynamics and geometrooptical approximation the dispersion relation without noted limitations was obtained. The relation describes ionacoustic instabilities of the ionospheric plasma at 80-200km altitudes in three-dimensional weakly irregular ionosphere.

The dispersion relation obtained has a form of the 6-th order polynomial for the oscillation frequency. Within limitations 1,2 the obtained relation has approximate solutions, close to the traditional ones for two-stream and gradient-drift instabilities.

The difference between obtained and standard dispersion relation becomes significant at altitudes above 140 km. For this situation, in some special cases this new dispersion relation can be significantly simplified and some analytical solutions of the dispersion relation can be found. As the analysis shown at these altitudes a solution exists that growth with time. One of the conditions for existence of such solution is the presence of line-of-sight electron density gradients and electron drifts and perpendicularity of line-of-sight to the magnetic field. The necessary conditions regularly exist at magnetic equator. Detailed analysis has shown that peculiarities of the obtained solutions allow us to interpret 150 km equatorial radioecho.

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