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Langmuir waves exited by an electron beam in plasma with density fluctuations

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Usually solar radio bursts of the III type are related to propagation of superthermal electron beams in solar wind plasma and it is supposed that the key role is played by the Langmuir waves generated by these beams. The existing theoretical explanations of this process are based on the theory of weak langmuir turbulence in plasma with small and large scale inhomogeinety. On the other hand it is known that solar wind plasma is not homogeneous, in it there are fluctuations of a density of plasma which are caused by propagation of magnetohydrodynamic waves and other reasons. The influence of a density fluctuation on a relaxation of an electron beam and spectrums of generated by it Langmuir turbulence also was considered before, nevertheless the full clearness of is not present. The long-wave and slowly varying density fluctuations, which amplitudes satisfy to a requirement dn/n0 > Te/Ebeam, are of the special interest here. In the given report we present results of theoretical investigations and the one dimensional numerical simulations of influence of such long-wave fluctuations of a plasma density on generation of Langmuir waves by a warm electron beam. To simulate Langmuir turbulence in this situation the Zakharov equation with terms, which take into account resonant interaction of waves with beam electrons, is solved for plasma with external random density inhomogeneities. It is shown, that owing to a competition of processes of wave amplification by an electron beam and the wave vector evolutions under the influence of inhomogeneity, a formation of the localized wave packets occurs. The profiles of these packets asymptotically became nearer to Gaussian one with growth of waves amplitudes during the linear stage of instability. Thus the width of a spectrum of waves is determined by typical depth of holes of a density and plasma oscillations with the phase velocity exceeding medial velocity of a beam appears at a spectrum of waves. Thereof as a result of back influence of waves on a beam electron distribution there is an acceleration of a part of electrons of a beam. On the other hand, presence of fluctuations of a density restricts wave's growth in short-wave region what in turn slows down losses of energy of a beam electrons and decrease a deceleration of its main part due to resonant interaction with waves. As a result intensity and a spectrum of Langmuir waves, and also an electron beam deceleration appear depending on depth of fluctuations of a density. Taking into account results of simulations and, in the assumption of small losses of energy of electrons during the pass through one hole, the theoretical description of a relaxation of beam electron distribution function is offered at averaging on random fluctuations of a plasma density.