STUDY OF LANGMUIR TURBULENCE GENERATED BY AN ELECTRON BEAM IN THE INHOMOGENEOUS PLASMA

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The interaction of a beam propagating in a inhomogeneous solar wind plasma is considered. The properties of the plasma waves are described by the one dimensional Zakharov's equation, the beam is modelled by means of particles moving in the electric fields of the Langmuir waves. We take into account the presence of high level density fluctuations that are known to be present in the solar wind. It is shown that when the level of density fluctuations is low, $\delta n/n_0 < 3k^2\lambda^2$, the regime of beam relaxation is very similar to that occurring in a homogeneous plasma and can be described by the quasilinear (QL) equations. In this case, the relaxation length is very short and corresponds to that obtained using the QL approximation. On the contrary, when the level of density fluctuations overcomes some limit, i.e. $1 \gg \delta n/n_0 > 3k^2\lambda^2$, the plasma inhomogeneities crucially influence the process of relaxation. First, the linear wave growth becomes localized and clearly identifiable wave packets/clumps dominate the wave spectrum; this is associated with the kinematic properties of the waves' propagation and the wave-particle resonant interactions. Most of the wave packets start to grow in the regions of density gradients.

The second important feature revealed by the beam relaxation consists in the generation of a tail of accelerated electrons with velocities $V > V_b$ exceeding the beam drift. The beam widens in both directions, toward lower velocities as well as higher velocities; the density of the accelerated electrons can reach more than $10 \div 20$ % of the beam density and the energy flux carried by this population can become as large as 40% of the initial energy flux of the beam.

Moreover, the waveforms, obtained in the results of simulations are copared with recent in-situ observations on the STEREO spacecraft and others, which reveal that large amplitude spatially localized Langmuir waves are frequent in the solar wind, and correlated with the presence of suprathermal electron beams during type III events or close to the electron foreshock. The problem of nonlinear parametric decay proccesses of Langmuir wave packets in inhomogeneous plasma is discussed on the basis of the simulations.