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Probabilistic model of beam-plasma interaction in randomly inhomogeneous plasma

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We study beam-plasma interaction in the presence of random density fluctuations. The level of fluctuations is supposed to be high but Langmuir waves generated by the beam instability are supposed to be not trapped inside the density depletions. This system can be considered as a good approximation of beam-plasma interaction in the solar wind. We describe the system in terms of probability density for the density fluctuations that determines the probability density for wave phase velocities during wave propagation. We suppose that at each moment of time an electron can interact only with one single wave having the phase velocity equal to its velocity or do not interact at all. We suppose that the amplitudes and electron distribution functions vary slowly with respect to single wave-particle interaction that allows one to average over a large number of interactions. This allows one to write Smoluhovsky equation for probability for particle having velocity V0 at time t0 to have velocity V at time t. From this description one can obtain Kolmogorov-Feller equation for slow variations of electron distribution function similar to the diffusion equation in quasilinear approximation. This probabilistic approach allows finding out the dependence of diffusion coefficients on statistical distribution of plasma density fluctuations. We use Liouville equation to describe the evolution of the Langmuir wave's spectral power, for each single wave. To describe slow evolution of the wave power we use averaged wave growth rate. It is obtained from the probability for the wave to have the resonant velocity on the interval. The equations obtained are solved numerically. We evaluate the influence of the density inhomogeneities on the beam relaxation time. As a result the length of relaxation of the electron beam in such inhomogeneous plasma is much longer than in homogeneous case and our goal is to determine the dependence of this length on characteristics of the statistical properties of density fluctuations.