BEAM-PLASMA INTERACTION IN RANDOMLY INHOMOGENEOUS PLASMAS

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We consider a linear instability of a weak electron beam in randomly inhomogeneous plasma. Plasma density fluctuations result in several physical effects that we take into account:

(1) k-vectors of waves propagating towards smaller densities increase and the wave phase velocities decrease, leading to damping of the wave energy due to the resonance with thermal particles;

(2) k-vectors of waves propagating towards larger densities decrease, the wave reflects from the density gradient and turns back propagating towards larger k-vectors to the region of the strong damping;

(3) the presence of density fluctuations having smaller scales and small amplitudes gives rise to the angular diffusion of the wave vector and thereby shifts wave vectors from the resonance with beam particles to the damping region.

We present a theoretical model describing statistical properties of wave amplitudes where these three effects are taken into account. We calculate the probability distribution functions that characterize statistical properties of such a system. It is shown that they are close to the so-called beta distributions. The theoretical results are compared with experimental observations from the Cluster satellites and it is found that the agreement with the observations is very good.