STIMULATED MANDELSTAM-BRILLOUIN SCATTERING IN LONG PLASMA slaB

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Interest in the problems of stimulated Mandelstam-Brillouin scattering is maintained for a long time in connection with the tasks of accelerating electrons by laser beam [1], plasma heating and laser fusion [2], compression and amplification of laser pulses [3], plasma diagnostics [4] and others. The paper deals with absolute instability of stimulated Mandelstam-Brillouin scattering in long plasma slab with size –L/2 < y <L/2. Pump wave, polarized along the z-axis, propagates along x direction. Plasma is considered to be infinite in x and z directions. Surface waves in this polarization are absent, so the scattered field can be represented as a sum of leaky waves as well as the continuous spectrum [5, 6]. Without loss of generality we can assume that the initial perturbation is concentrated in the plane x = 0.

Leaky waves are not considered as plasma eigenmodes; however, in the vicinity and within the slab, the field of certain leaky waves can be distinguished from the continuous-wave spectrum [5]. In this paper we calculate the spectra of electromagnetic and acoustic leaking waves. The calculation showed that the number of leaky waves, which can be separated from the continuous spectrum increases with the size of the plasma slab and the electron density in the plasma. An algebraic dispersion equation for leaky waves, converging to the wave with a given number n is found.

From the viewpoint of instability development, leaking wave differ from the natural waves of the dielectric waveguide only by additional attenuation associated with the energy flux from the slab. Besides using these waves we can consider plasma with an arbitrary ratio of the pump wavelength λ and cross slab size L.

For large transverse dimensions of the plasma slab L >> λ greatest instability growth rate observed in those cases when the resulting acoustic and electromagnetic waves run in synchronism conditions not only along the longitudinal axis X, but also along the axis Y. Increment of absolute instability can be calculated using standard formulas [7] for backward scattering, taking into account the attenuation of leaky waves associated with radiation and difference of normalizing Y integral along the axis differences from unity.

Finite length of the plasma slab influence on threshold and increment of absolute instability can also be taken into account.

References

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