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Resonant interaction of high-power laser radiation with plasma in a strong magnetic field (a review)

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The review is presented on investigations on the resonance plasma heating by a powerful laser radiation in a strong magnetic field. It is shown that for small amplitude impulse propagation along the magnetic field in the underdense plasma with ECR conditions the modulation instability takes place with modulation period equal to the exited plasma wave length. With an increase in the amplitude of the pulse, a strong amplification of the excited longitudinal electric field occurs. The energy of laser radiation gained by plasma electrons increases several times in comparison with the case of isotropic plasma. The physical reason for such a strong heating of electrons is the transition of the modulation instability at large amplitudes to the stochastic regime. In the case of transverse propagation with respect to the magnetic field, the process of the extraordinary laser wave propagation in the region of parametric resonance at a doubled upper hybrid frequency is considered. In such an interaction, significant additional heating of electrons also occurs. It is caused by the decay of the laser wave into upper hybrid plasmons and the excitation of Bernstein waves. From the distributions of the electric field at the moment when the laser pulse reaches the right boundary of the plasma layer, it follows that in the resonance region there is a strong absorption of the transverse electric field of the laser pulse and an increase in the longitudinal field. It is shown that in this case a reflected electromagnetic wave occurs at the upper hybrid frequency.

Keywords: laser radiation, parametric resonance, inhomogeneous plasma, strong magnetic field, upper hybrid frequency, Bernstein modes.

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