DOI: 10.34854/ICPAF.52.2025.1.1.122

STIMULATED RAMAN SCATTERING OF LASER RADIATION IN INHOMOGENEOS MAGNETIC FIELD *)

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The presence of a strong magnetic field during the interaction of powerful laser radiation with plasma has a significant impact on the development of parametric instabilities [1]. At the same time, under resonant conditions, a laser wave can transmit significant energy to plasma electrons [2]. A study of this interaction for radiation at the upper hybrid frequency was carried out in [3] using one-dimensional numerical modeling using the particle-in-cell method. It has been shown that a laser wave of extraordinary polarization when passing through the upper hybrid resonance region transforms into an electrostatic mode. In the future, such an electrostatic wave converts its energy into the kinetic energy of electrons. This report presents the results of a numerical simulation of the interaction of a laser wave with a plasma layer in the resonance region at twice the upper hybrid frequency. This heating method is often used in tokamacs and other plasma magnetic confinement systems. Parametric decay processes play a decisive role in such heating. However, due to the significant difference in radiation powers and frequencies, these processes for laser heating in a strong magnetic field can change due to the influence of nonlinear effects and relativism. For modeling, the electromagnetic relativistic PIC code 1D2V was used. Numerical experiments have shown that when a certain threshold value of the initial amplitude of the laser pulse is reached, stimulated Raman scattering is exited in the resonant region. It is shown thatwhen a pulse propagates from the side of a smaller magnetic field, a reflected electromagnetic wave appears in the vacuum region at the upper hybrid frequency. A similar process took place in the Textor tokamak when the plasma was heated at twice the upper hybrid frequency [4]. At the same time, a decrease in threshold values for tht radiation amplitude could be associated with the blocking of daughter waves in the resonance region. However, other mechanisms of reflected wave excitation are possible, as discussed in [5]. From the modeling results presented in this report, it follows that as the initial amplitude of the laser pulse increases, the energy of the electrostatic field of the upper hybrid plasmons increases. This leads to an increase in the efficiency of transmitting radiation energy to plasma electrons. It was shown that the energy gain by electrons is significant only if the cyclotron frequency is close to plasma frequency and slightly exceeds it. In the case of a large excess of the cyclotron frequency relative to the plasma frequency, the proportion of transmitted energy was significantly redused. With an increase in the gradient of the linearly increasing magnetic field, an increase in the threshold value of the radiation amplitude at which stimulated Raman scattering was excited was observed. .

References

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*) abstracts of this report in Russian