THE EMISSON OF TERAHERTZ WAVES AT THE INTERACTION OF COUNTERPROPAGATING LASER PULSES IN UNDERDENSE PLASMA [[1]](#footnote-1)\*)

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The effective scheme for generating THz waves is proposed, when two counterpropagating laser pulses interact in a rarefied plasma. The theory of radiation developed at the doubled plasma frequency during the interaction of pulses with identical frequencies [1] is generalized here to the case of laser pulses with differing frequencies. As in the publication [1], the generation of THz electromagnetic radiation in the scheme under consideration is due to the excitation of small-scale wake plasma fields and their interaction in the region of overlap of laser pulses. That is, an electromagnetic wave appears as a result of the fusion of two plasma waves, or in other words, the generation of THz radiation is associated with an elementary nonlinear process of fusion of two plasmons with the generation of a photon.Spectral, angular and energy characteristics of THz waves are investigated. The spectrum of THz radiation is analyzed and it is established that it essentially depends on the frequency difference between laser pulses. It is shown that even with a small difference in the pulse frequencies a maximum in the emission spectrum appears near the plasma frequency together with the line at the doubled plasma frequency. The height of this maximum increases with increasing frequency difference and reaches its maximum when the frequency difference coincides with the plasma frequency. The angular distribution of the THz waves was studied under conditions of radiation dominance at the plasma frequency. It is shown that with tightly focusing of laser pulses, radiation occurs in the transverse direction relative to the axis of propagation of pulses. The increase in the size of the focal spot of pulses leads to the fact that the radiation is gradually pressed to the axis of propagation of pulses and for very wide pulses is directed practically along this axis. The time profile of THz waves in the far zone at large distances from the region of interaction of pulses was investigated. It is shown that when the resonance condition is fulfilled, the field oscillations in a THz pulse occur at a plasma frequency and have many periods, so that its duration is significantly longer than the duration of laser pulses. The total energy of the THz pulse is calculated and a condition is found under which the radiation at the plasma frequency dominates. It is shown that the radiation energy at the plasma frequency has maximum when the difference in the frequency of the pulses coincides with the plasma frequency. Estimates show that at the interaction of two counterpropagating laser pulses in a rarefied plasma can generate THz radiation with a fairly high conversion coefficient.

References

1. Gorbunov L.M., Frolov A.A., JETP, 2004, 125, 598
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/It/ru/CM-Frolov.docx) [↑](#footnote-ref-1)