The terahertz wave emission at an oblique incidence of the laser pulse on the rarefied plasma [[1]](#footnote-1)\*)

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The terahertz (THz) wave packet emission theory is constructed when an *s*-polarized laser pulse is incident on a semi-infinite plasma whose density is much lower than the critical value. The angular, spectral and energy characteristics of a THz pulse are studied as a function of the plasma density, the angle of incidence and the duration of laser radiation. It is shown that the energy of the THz signal has the maximum value at the fall of the laser pulse at grazing angles, when the effect of total reflection of the laser radiation from the plasma boundary takes place [1].

The boundary value problem for the *s*-polarized laser pulse at oblique incidence onto the boundary of rarefied plasma occupying a half-space is considered. It is shown that for a plasma density significantly less than the critical value, a total reflection of laser radiation is possible at grazing angles. On the basis of the Maxwell's equations averaged over high-frequency oscillations and the equations of motion for plasma electrons, taking into account the ponderomotive action of laser radiation, we consider the excitation of THz fields in plasma and in vacuum. The physical characteristics of THz waves emitted in a vacuum are studied. It is shown that THz wave packet propagates in the direction of a laser pulse reflected from the plasma boundary. The THz radiation spectrum was studied and it was shown that it substantially depends on the plasma density, the incidence angle and the duration of the laser pulse. At small angles of incidence, a line near the plasma frequency is present in the emission spectrum if the laser pulse duration  is comparable to the reciprocal plasma frequency. As the angle of incidence increases, the line at the plasma frequency gradually disappears, and if  noticeably exceeds the period of plasma oscillations, a broad maximum appears at a frequency comparable to  - the reciprocal duration of the laser pulse. It was found that the height of this broad spectral maximum has the greatest value at grazing angles, when the effect of total reflection of laser radiation takes place. By integrating over the spectrum, the total energy density (fluence) of the THz radiation was calculated. It was shown that of the THz pulse fluence has a maximum value when laser pulse falls onto the plasma boundary at an angle of total reflection. The conditions for the applicability of the presented theory are discussed and estimates for the characteristics of THz wave packet are given for the conditions of modern laser-plasma experiments. These estimates demonstrate the possibility of the generation high-intensity THz pulses at laser action on rarefied plasma at grazing angles, when the effect of total reflection *s*-polarized laser radiation takes place.

References

1. Frolov A. A*.,* Plasma Phys. Control. Fusion, 2020, V. 62,P. 0950020.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/It/ru/DD-Frolov.docx) [↑](#footnote-ref-1)