ACCURATE CALCULATION OF HIGH HARMONICS GENERATED BY INTERACTIONS BETWEEN VERY INTENSE LASER FIELDS AND ELECTRON PLASMAS*

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In a recent paper[1] we proved that the analytical expression of the intensity of the relativistic Thomson scattered field for a system composed of an electron interacting with a plane electromagnetic field can be written as a periodic function of only one variable, that is the phase of the incident field. This property was proved without using any approximation, except for neglecting the radiative corrections, in the most general case, in which the field is elliptically polarized, the initial phase of the incident field and the initial velocity of the electron are taken into consideration, and the direction in which the radiation is scattered is arbitrary. This property led to an exact method for calculating the angular and spectral distributions of the scattered field. We present the application of the method to the case of the interaction of very intense laser beams with electron plasmas resulted during the ionization of gas. We prove that the frequency of the fundamental scattered radiation does not depend on the relativistic parameters, this result being in very good agreement with the result of the Compton model approach. We calculate the shape of the spectrum of the scattered radiations and show that the number of the harmonics increases as the value of the relativistic parameter increases. The high harmonics spectrum has a maximum shifting to the shorter wavelengths. The method accurately predicts the angular distribution of the scattered radiations. All these properties are in good agreement with the experimental data from literature.

1. A. Popa, "Periodicity property of relativistic Thomson scattering, with application to exact calculation of angular and spectral distributions of scattered field", Physical Review A, 84, 2011, 023824.

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