On diagnostic of energy spectrum of accelerated electron bunches by their synchrotron radiation spectrum

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Analytic model for optical diagnostics of the energy spectrum of electron bucnhes accelerated in ion channel formed in a near-critical density plasma under the action of a powerful laser pulse is proposed. The model is based on the analysis of the spectrum of the synchrotron radiation of electrons which perform betatron oscillations during their acceleration [1, 2].

It is shown that the electrons energy spectrum can be described by combination of exponential curves with two characteristic temperatures. The temperature $T_{\rm sp}$ of super-ponderomotive electrons and the maximum energy $E_{\rm max}$ of the electron beam can be determined from the high-frequency branch of the synchrotron radiation spectrum. The absolute value of the maximum of the synchrotron radiation spectrum $N_{0.1\%BW}(\omega)$ can be used to estimate the total number of electrons accelerated to energies up to $E_{\rm max}$ in the ion channel.

The temperature T_p and the number $N_{\rm p}$ of ponderomotive electrons can be estimated using low-frequency branch of the synchrotron radiation spectrum of an electron beam. The use of both branches of the spectrum of synchrotron radiation is useful for refining the parameters of electrons energy spectrum.

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[1] Esarey E, Shadwick B A, Catravas P and Leemans W P 2002 *Phys. Rev. E* **65** 056505

[2] Veysman M 2021 *Laser and Particle Beams* **2021** 6655499