

Radiation Spectrum of Electrons Moving Along a Spiral in Medium

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The time-averaged radiation power \bar{P}^{rad} of sequence of electrons moving one by one along a spiral in transparent medium can be calculated by the instrumentality of spectral distribution $W(\omega)$ [1]

$$\bar{P}^{rad} = \int_0^{\infty} W(\omega) d\omega,$$

$$W(\omega) = \frac{2e^2}{\pi c^2} \int_0^{\infty} dx \mu(\omega) S_N(\omega) \omega \frac{\sin\left\{\frac{n(\omega)}{c} \omega \eta(x)\right\}}{\eta(x)} \cos \omega x \left[V_{\perp}^2 \cos(\omega_0 x) + V_{\parallel}^2 - \frac{c^2}{n^2(\omega)} \right],$$

where $\eta(x) = \sqrt{V_{\parallel}^2 x^2 + 4 \frac{V_{\perp}^2}{\omega_0^2} \sin^2\left(\frac{\omega_0}{2} x\right)}$, ω is the cyclic frequency, $r_0 = V_{\perp} \omega_0^{-1}$,

$\omega_0 = ec^2 B^{ext} \tilde{E}^{-1}$, $\tilde{E} = c \sqrt{p^2 + m_0^2 c^2}$, the magnetic induction vector $\vec{B}^{ext} \parallel OZ$, V_{\perp} and V_{\parallel} are the components of the velocity, \vec{p} and \tilde{E} are the momentum and energy of the electron, e and m_0 are its charge and rest mass, respectively, Δt_l is the time shift of the l^{th} electron, c is the velocity of light in vacuum.

In the case of sequence of electrons moving one by one along a spiral the coherence factor $S_N(\omega)$ takes the form:

$$S_N(\omega) = \sum_{l,j=1}^N \cos\{\omega(\Delta t_l - \Delta t_j)\}.$$

The oscillations [1] in the spectral distribution of radiation power of the one, two, three, and four electrons are founded and studied for the case when the transversal component of velocity (perpendicular to the magnetic induction vector) is bigger than the light phase velocity ($V_{\perp} > c/n(\omega)$) in the medium.

For the small time shifts between electrons, in radiation spectra of two, three, and four electrons moving along the spiral in vacuum and in transparent medium we have found the existence of the coherent radiation of harmonics with $S_N(\omega) = N^2$ ($S_N(\omega)$ is the coherence factor of N electrons). The conditions at which the radiation power for these systems tends to zero are analyzed [1].

1. Konstantinovich A.V., Konstantinovich I.A. Fine Structure of Radiation Spectrum of System of Electrons Moving in Spiral in Medium // Romanian Reports in Physics. – 2014. – V. 66, No 2. – P. 307–318.