A WAY TO INCREASE THE SPECTRAL-ANGULAR DENSITY OF DIFFRACTED TRANSITION RADIATION OF THE RELATIVISTIC ELECTRON IN SINGLE CRYSTAL

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Diffracted transition X-radiation (DTR) of relativistic electron crossing a single crystal plate of limited thickness is considered within the framework of x-ray diffraction dynamical theory in the geometry of Bragg. The analytical expression for spectral-angular characteristics of DTR is obtained with tacking to account the orientation of external surfaces relative to the diffracting atomic planes in the crystal. It is shown that under a fixed angle of electron incidence on the system of diffracting planes in the crystal the spectral-angular characteristics DTR significantly depend on the external surface orientation.
KEY WORDS: relativistic electron, transition radiation, dynamical diffraction, angle distribution, single crystal

The transition radiation originates [1] when a fast charged particle crosses a boundary between two different mediums. If one of the mediums is monocrystal the originated radiation can be diffracted on a system of parallel atomic planes in the crystal [2-4]. This radiation is named the diffracted transition radiation (DTR). Up to now DTR in dynamical approach was considered only in the case when crystals entrance surface is parallel to the system of the atomic planes. In the current work the expression for spectral-angular distribution of DTR is obtained on the base of the dynamical diffraction theory [5] with taking to account the angle between the entrance surface and the set of atomic planes in the crystal, as a parameter. It is shown that spectral-angular density of DTR substantially depends on this parameter. So by carving the crystal in different ways one can change the spectral-angular characteristics of DTR. The conditions of observation of DTR amplitude increase and decrease is shown in the work. The limit process to the case of the crystal entrance surface parallel to the atomic planes is specified.

THE BASIC FORMULAS

Let's consider the radiation of a fast charged particle crossing a monocrystal L thick with constant velocity **V** (Fig. 1). To describe this process we will use the equations for Fourier direct image of electromagnetic field

$$\mathbf{E}(\mathbf{k},\omega)=\int dt d^3r \mathbf{E}(\mathbf{r},t)\exp(i\omega t - i\mathbf{kr}). \quad (1)$$

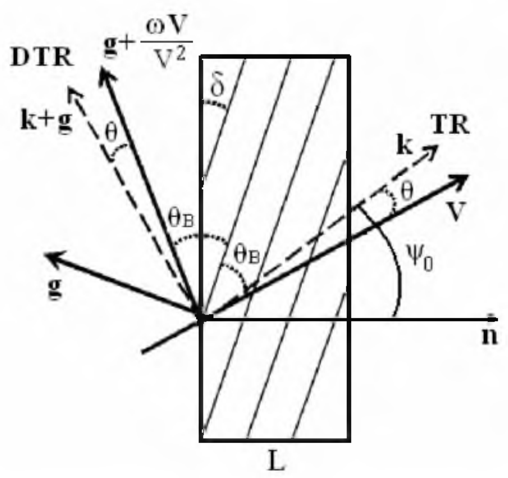

Fig.1. The radiation process geometry.

Since the Coulomb field of an ultrarelativistic particle in the close approximation is transverse, the incident $\mathbf{E}_0(\mathbf{k},\omega)$ and diffracted $\mathbf{E}_1(\mathbf{k},\omega)$ electromagnetic waves, can be defined by two components with different values of transverse polarization

$$\mathbf{E}_0(k,\omega)=E_0^{(1)}(\mathbf{k},\omega)\mathbf{e}_0^{(1)}+E_0^{(2)}(\mathbf{k},\omega)\mathbf{e}_0^{(2)},$$
$$\mathbf{E}_1(k,\omega)=E_1^{(1)}(\mathbf{k},\omega)\mathbf{e}_1^{(1)}+E_1^{(2)}(\mathbf{k},\omega)\mathbf{e}_1^{(2)}. \quad (2)$$

The unit vectors $\mathbf{e}_0^{(1)}, \mathbf{e}_0^{(2)}, \mathbf{e}_1^{(1)}$ and $\mathbf{e}_1^{(2)}$ are chosen in the following way. Vectors $\mathbf{e}_0^{(1)}$ and $\mathbf{e}_0^{(2)}$ are perpendicular to vector $\mathbf{k}$, and vectors $\mathbf{e}_1^{(1)}$ and $\mathbf{e}_1^{(2)}$ are perpendicular to vector $\mathbf{k}+\mathbf{g}$. The vectors $\mathbf{e}_0^{(2)}$, $\mathbf{e}_1^{(2)}$ are situated on the plane of vector $\mathbf{k}$ и $\mathbf{k}+\mathbf{g}$ (π-polarization), and $\mathbf{e}_0^{(1)}$ и $\mathbf{e}_1^{(1)}$ are perpendicular to this plane (σ-polarization) ; It is obvious that $\mathbf{e}_0^{(1)}=\mathbf{e}_1^{(1)}$. The reciprocal lattice vector $\mathbf{g}$ defines a set of reflecting atomic planes. By the use of two-wave approximation of the dynamic theory of diffraction [5], we can write the well-known equation set for Fourier transform images of the incident wave and diffracted wave intensities [6]

$$\begin{cases}(\omega^2(1+\chi_0)-k^2)E_0^{(s)}+\omega^2\chi_{-\mathbf{g}}C^{(s)}E_1^{(s)}=8\pi^2 ie\omega\theta VP^{(s)}\delta(\omega-\mathbf{kV}),\\ \omega^2\chi_{\mathbf{g}}C^{(s)}E_0^{(s)}+(\omega^2(1+\chi_0)-(\mathbf{k}+\mathbf{g})^2)E_1^{(s)}=0,\end{cases}\qquad(3)$$

where $\chi_{\mathbf{g}}$, $\chi_{-\mathbf{g}}$ is Fourier coefficients of crystal dialectical susceptibility expansion in series by reciprocal vectors of the crystal lattice $\mathbf{g}$

$$\chi(\omega,\boldsymbol{r})=\sum_g \chi_g(\omega)e^{igr}=\sum_g\left(\chi'_g(\omega)+i\chi''_g(\omega)\right)e^{igr},\qquad(4)$$

Let's consider a crystal with symmetry $(\chi_{\mathbf{g}}=\chi_{-\mathbf{g}})$. The $\chi_{\mathbf{g}}$ is defined by expression

$$\chi_{\mathbf{g}}=\chi_0\left(F(g)/Z\right)\left(S(\mathbf{g})/N_0\right)\exp\left(-\frac{1}{2}g^2u_\tau^2\right),\qquad(5)$$

where $\chi_0=\chi'_0+i\chi''_0$ is the average dialectical susceptibility of the crystal medium, F(g)- form-factor of the atom containing Z electrons, $S(\mathbf{g})$ is the structure factor of the elementary crystal cell containing N_0 atoms, u_τ - mean-square amplitude of thermal oscillations of atoms in the crystal.

The quantities $C^{(s)}$ and $P^{(s)}$ in system (3) are defined in the following way

$$\begin{gathered}C^{(s)}=\mathbf{e}_0^{(s)}\mathbf{e}_1^{(s)},\ C^{(1)}=1,\ C^{(2)}=\cos 2\theta_B,\\ P^{(s)}=\mathbf{e}_0^{(s)}(\mathbf{c}/\rho),\ P^{(1)}=\sin\varphi,\ P^{(2)}=\cos\varphi,\end{gathered}\qquad(6)$$

where $\mathbf{c}=\mathbf{k}-\omega\mathbf{V}/V^2$ is the component of the virtual photon perpendicular to particle velocity $\mathbf{V}$ ($\rho=\omega\theta/V$, θ<<1 is the angle between $\mathbf{k}$ and $\mathbf{V}$), θ_B is the angle between the electron velocity and the set of crystallographic planes (Bragg angle). The azimuth angle φ is counted off from the plane made up by $\mathbf{V}$ and $\mathbf{g}$. The value of the crystal lattice reciprocal vector is defined as $g=2\omega_B\sin\theta_B/V$, where ω_B is Braggis frequency. The system (3) describes the field of σ -polarization if $s=1$ or the field of π -polarization if s=2.

In this work the case of Braggis geometry is under the consideration, when a diffracted field exits the entrance surface of the plate. The diffracted radiation is directed close to vector $\mathbf{g}+\omega\mathbf{V}/V^2$ (see Fig.1.).

By solving the dispersion equation following from system (3)

$$(\omega^2(1+\chi_0)-k^2)(\omega^2(1+\chi_0)-(\mathbf{k}+\mathbf{g})^2)-\omega^4\chi_{-\mathbf{g}}\chi_{\mathbf{g}}C^{(s)^2}=0,\qquad(7)$$

in standard methods of the dynamical theory [5] we will have obtained the expression for wave vectors of incident and diffracted waves

$$k^{(i,s)}=\omega\sqrt{1+\chi_0}+\frac{\omega\left|\chi'_{\mathbf{g}}\right|C^{(s)}}{2\varepsilon}\left(\xi^{(s)}-\frac{i\rho^{(s)}(1+\varepsilon)}{2}\mp K^{(s)}\right),\qquad(8a)$$

$$k_{\mathbf{g}}^{(i,s)}=\left|\mathbf{k}+\mathbf{g}\right|=\omega\sqrt{1+\chi_0}+\frac{\omega\left|\chi'_{\mathbf{g}}\right|C^{(s)}}{2}\left(\xi^{(s)}-\frac{i\rho^{(s)}(1+\varepsilon)}{2}\pm K^{(s)}\right),\qquad(8b)$$

here the following notations are inserted

$$K^{(s)}=\sqrt{\xi^{(s)2}-\varepsilon-\rho^{(s)}\left((1+\varepsilon)\xi^{(s)}+2\frac{\chi''_{\mathbf{g}}C^{(s)}}{\chi''_0}\frac{\left|\chi'_{\mathbf{g}}\right|}{\chi'_{\mathbf{g}}}\varepsilon\right)i-\rho^{(s)2}\left(\frac{(1+\varepsilon)^2}{4}-\frac{\chi''^2_{\mathbf{g}}C^{(s)^2}}{\chi''^2_0}\varepsilon\right)},$$

$$\xi^{(s)}=\eta^{(s)}(\omega)+\frac{\beta^{(s)}(1+\varepsilon)}{2},\ \zeta^{(s)}=\eta^{(s)}(\omega)+\frac{\left(\beta^{(s)}-i\rho^{(s)}\right)(1+\varepsilon)}{2},\ \rho^{(s)}=\frac{\chi''_0}{\left|\chi'_{\mathbf{g}}\right|C^{(s)}},\ \varepsilon=\frac{\sin(\theta_B-(\delta-\theta))}{\sin(\theta_B+(\delta-\theta))},\qquad(9)$$

$$\beta^{(s)}=\frac{1}{\left|\chi'_{\mathbf{g}}\right|C^{(s)}}\left(\theta^2+\gamma^{-2}-\chi'_0\right),\ \eta^{(s)}(\omega)=\frac{(\mathbf{k}+\mathbf{g})^2-k^2}{2\omega^2\left|\chi'_{\mathbf{g}}\right|C^{(s)}}=\frac{2\sin^2\theta_B}{V^2\left|\chi'_{\mathbf{g}}\right|C^{(s)}}\left(\frac{\omega_B(1+\theta\cos\varphi\cot\theta_B)}{\omega}-1\right),$$

δ is the angle between the entrance surface of the crystal target and the crystallographic plane of the crystal.

In expression (8) index $i = 1{,}2$ defines two branches of X-radiation waves passing through the crystal. Because the inequality $2\sin^2\theta_B / V^2 \left|\chi'_{\mathrm{g}}\right| C^{(s)} >> 1$ holds true in the range of X-radiation frequencies $\eta^{(s)}(\omega)$ is a very fast function, therefore it is convenient to use it as a spectral variable characterizing ω .

The solution of the first equation in set (3) for the Coulomb field of the relativistic electron in vacuum ($\chi_{-\mathrm{g}} = 0$) is as follows:

$$E_0^{(s)vac} = \frac{8\pi^2 ieV}{\omega} \frac{\theta P^{(s)}}{-\gamma^{-2} - \theta^2}. \tag{10}$$

The same for the Coulomb field in crystal is as

$$E_0^{(s)cr} = \frac{8\pi^2 ieV}{\omega} \frac{\theta P^{(s)}}{\chi_0 - \gamma^{-2} - \theta^2}. \tag{11}$$

So, the field of the radiation formed on the crystal entrance surface is

$$E_0^{(s)\,vac-cr} = \frac{8\pi^2 ieV}{\omega} \theta P^{(s)} \left(\frac{1}{-\gamma^{-2} - \theta^2} - \frac{1}{\chi_0 - \gamma^{-2} - \theta^2} \right). \tag{12}$$

By multiplying the amplitude of the radiation field formed on the entrance surface (12) by the reflection amplitude coefficient $Q^{(s)}$ which defines the reflection of the field in a crystal of limited thickness, we will obtain the amplitude of DTR

$$E_{Rad}^{(s)\ \mathrm{DTR}} = E_0^{(s)vac-cr} Q^{(s)} = \frac{8\pi^2 ieV}{\omega} \theta P^{(s)} \left(\frac{1}{-\gamma^{-2} - \theta^2} - \frac{1}{\chi_0 - \gamma^{-2} - \theta^2} \right) Q^{(s)}. \tag{13}$$

The reflection amplitude coefficient $Q^{(s)}$ is given as [5]

$$Q^{(s)} = \frac{C^{(s)}\chi_{\mathrm{g}}}{\varepsilon} \frac{e^{-\frac{i\omega L}{2\cos(\psi_0)}\sqrt{z^2+q^{(s)}}} - e^{\frac{i\omega L}{2\cos(\psi_0)}\sqrt{z^2+q^{(s)}}}}{\left(-z - \sqrt{z^2 + q^{(s)}}\right) e^{\frac{i\omega L}{2\cos(\psi_0)}\sqrt{z^2+q^{(s)}}} - \left(-z + \sqrt{z^2 + q^{(s)}}\right) e^{-\frac{i\omega L}{2\cos(\psi_0)}\sqrt{z^2+q^{(s)}}}}, \tag{14}$$

where the following notations are inserted $q^{(s)} = -C^{(s)^2}\chi_g^2 / \varepsilon$, $z = -\left(\alpha - (1+\varepsilon)\left(\chi_0 - \theta^2 - \gamma^{-2}\right)\right)/2\varepsilon$, $\pi/2 - (\theta_B + \delta) \approx \psi_0$ is the angle between the incident electron velocity and external normal to the target surface. The amplitude coefficient (14) reflects the existence of two branches in the solution (13) i.e. the existence of two branches of X-radiation waves in the crystal.

If we substitute (13) by expression [6]

$$\frac{d^2 W^{\mathrm{DTR}}}{d\omega d\Omega} = \omega^2 (2\pi)^{-6} \sum_{s=1}^{2} \left| E_{Rad}^{(s)\ DTR} \right|^2, \tag{15}$$

we will get the following formula for the spectral-angular density of the radiation

$$\omega \frac{d^2 N^{\mathrm{DTR}}}{d\omega d\Omega} = \frac{e^2}{\pi^2} \theta^2 \sum_{s=1}^{2} P^{(s)2} \left(\frac{1}{\gamma^{-2} + \theta^2} - \frac{1}{\gamma^{-2} + \theta^2 - \chi'_0} \right)^2 \left| Q^{(s)} \right|^2. \tag{16}$$

SPECTRAL-ANGULAR DISTRIBUTION OF DTR IN CASE OF A THIN CRYSTAL

With a thin crystal the absorption of radiation can be neglected and the reflection amplitude coefficient $Q^{(s)}$ can be given by

$$Q^{(s)} = \frac{e^{-ib^{(s)}\frac{\sqrt{\xi^{(s)^2} - \varepsilon}}{\varepsilon}} - e^{ib^{(s)}\frac{\sqrt{\xi^{(s)^2} - \varepsilon}}{\varepsilon}}}{\left(\xi^{(s)} - \sqrt{\xi^{(s)^2} - \varepsilon}\right) \exp\left(ib^{(s)} \frac{\sqrt{\xi^{(s)^2} - \varepsilon}}{\varepsilon} \right) - \left(\xi^{(s)} + \sqrt{\xi^{(s)^2} - \varepsilon}\right) \exp\left(-ib^{(s)} \frac{\sqrt{\xi^{(s)^2} - \varepsilon}}{\varepsilon} \right)}. \tag{17}$$

Parameter $\varepsilon \approx \sin(\theta_B - \delta)/\sin(\theta_B + \delta)$ defines the orientation of the crystal plate entrance surface. If $\varepsilon > 0$ the crystal is oriented according to Bragg's geometry. In this case the part of TR formed on the entrance surface is diffracted on the set of the atomic planes and exits the crystal through its entrance surface. Under the fixed value of Bragg's angle θ_B parameter δ becomes negative and its absolute value grows when the electron incident angle $(\theta_B + \delta)$ decreases (in the limit case $\delta \to -\theta_B$) which consequently leads to the increase of ε. On the contrary, if the electron incident angle increases ε decreases (the limit value of ε is reached in the case of $\delta \to \theta_B$).

A very interesting expression is given for the square module of the reflection amplitude coefficient $\left|Q^{(s)}\right|^2$, describing the DTR spectrum as the function of the orientation of the crystal plate entrance surface

$$\left|Q^{(s)}\right|^2 = \frac{\sin^2\left(b^{(s)}\frac{\sqrt{\xi^{(s)^2}-\varepsilon}}{\varepsilon}\right)}{\xi^{(s)^2} - \varepsilon + \varepsilon\sin^2\left(b^{(s)}\frac{\sqrt{\xi^{(s)^2}-\varepsilon}}{\varepsilon}\right)}, \tag{18}$$

where $\xi^{(s)} = \eta^{(s)} + \beta^{(s)}(1+\varepsilon)/2$, $\eta^{(s)} = \frac{\alpha}{2\left|\chi'_g\right|C^{(s)}} = \frac{2\sin^2\theta_B}{V^2\left|\chi'_g\right|C^{(s)}}\left(\frac{\omega_B(1+\theta\cos\varphi\cot\theta_B)}{\omega} - 1\right)$, $\beta^{(s)} = \frac{1}{\left|\chi'_g\right|C^{(s)}}\left(\theta^2 + \gamma^{-2} - \chi'_0\right)$.

The curves describing the spectrum of DTR built up on formula (18) are presented in Fig.2 for different values of parameter ε. One can see that under the increasing of ε the DTR spectrum becomes narrower, which signifies the decreasing of the frequency region of the TR total reflection in the crystal. The total reflection region (anomalous dispersion region) is the frequency region where the wave vector $k^{(i,s)}$ of the incident wave (see (8a)) acquires a complex value in the absence of absorption $\left(\rho^{(s)} = 0\right)$, the waves radiated on the entrance surface are completely reflected in the crystal by the atomic planes and do not move worward.

This region is defined in accordance with the expression for $K^{(s)}$ (8) can be presented as

$$-\sqrt{\varepsilon} - \beta^{(s)}(1+\varepsilon)/2 < \eta^{(s)} < \sqrt{\varepsilon} - \beta^{(s)}(1+\varepsilon)/2, \tag{19a}$$

or by

$$-\sqrt{\varepsilon}\left|\chi'_g\right|C^{(s)} - \beta_0 < \frac{2\sin^2\theta_B}{V^2}\left(\frac{\omega_B(1+\theta\cos\varphi\cot\theta_B)}{\omega} - 1\right) < \sqrt{\varepsilon}\left|\chi'_g\right|C^{(s)} - \beta_0, \tag{19b}$$

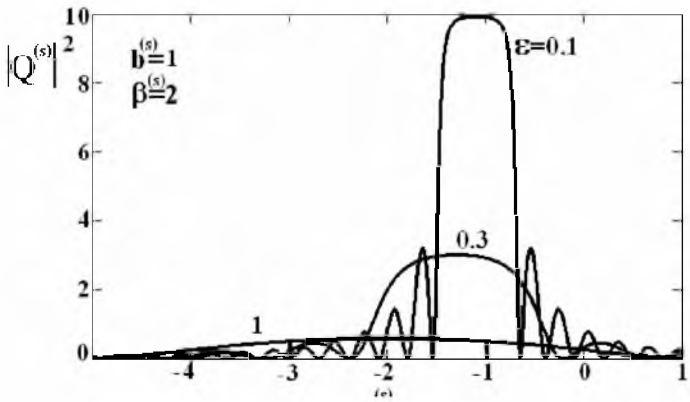

Fig.2. Influence of the crystal plate entrance surface orientation on the DTR spectra.

where $\beta_0 = \frac{(1+\varepsilon)}{2}\left(\theta^2 + \gamma^{-2} - \chi'_0\right)$.

The width of the area is $\Delta\eta^{(s)} = 2\sqrt{\varepsilon}$. It is important to note that the magnitude of this area depends on the orientation of the crystal. From (19) one can see that the presence of the total reflection area is a dynamical effect, in cinematic approach, when $\chi'_g = 0$, this area turns into the point of exact Bragg resonance for the pseudo photon of the relativistic electron Coulomb field

$$\omega'_B = \omega_B\left(1 + \theta\cos\varphi\cot\theta_B + \frac{(1+\varepsilon)V^2}{4\sin^2\theta_B}\left(\theta^2 + \gamma^{-2} - \chi'_0\right)\right). \tag{20}$$

The middle point of the maximum is defined from (18) by

$$\eta^{(s)}{}_{\max} = -\frac{1}{\left|\chi'_g\right|C^{(s)}}\left(\theta^2 + \gamma^{-2} - \chi'_0\right)(1+\varepsilon)/2, \tag{21}$$

$$\omega_{\max} = \omega'_B . \tag{22}$$

In accordance with (21) the total reflection area shifts to the left with increasing parameter ε (see Fig. 2) and the midband frequency $\omega_{\max}$ grows (20). This effect is not connected with dynamic scattering because $\omega_{\max}$ does not depend on parameter $\chi_{\mathbf{g}}$. With decreasing ε the amplitude of DTR spectrum is on a considerable increase, which is connected with the decreasing cross direction dimensions of the reflected photon beam.

The cause of the formation of subordinate maxima (see Fig.2) in DTR spectrum is the interference between the second wave field penetrating the crystal and the first wave field originateng on the input crystal surface passing backward inside the crystal.

If we substitute (18) for (16) we will get the general expression for the spectral-angular distribution of DTR.

$$\omega \frac{d^2 N^{\mathrm{DTR}}}{d\omega d\Omega} = \frac{e^2}{\pi^2}\theta^2 \sum_{s=1}^{2} P^{(s)2} \left(\frac{1}{\gamma^{-2}+\theta^2} - \frac{1}{\gamma^{-2}+\theta^2-\chi'_0} \right)^2 \frac{\sin^2\left(b^{(s)} \frac{\sqrt{\xi^{(s)^2}-\varepsilon}}{\varepsilon} \right)}{\xi^{(s)^2} - \varepsilon + \varepsilon \sin^2\left(b^{(s)} \frac{\sqrt{\xi^{(s)^2}-\varepsilon}}{\varepsilon} \right)} . \tag{23}$$

It is necessary to note that in the particular case of entrance crystal surface parallel to a crystallographic plane ($\delta = 0$ or $\varepsilon = 1$) the expression (23) turns into the expression for DTR obtained in [7].

ANGULAR DENSITY OF DTR

In order to study the dependence of the angular density of DTR on parameter ε let's integrate (20) with the frequency function $\xi^{(s)}(\omega)$

$$\frac{dN^{\mathrm{DTR}}}{d\Omega} = \int \frac{d^2 N^{\mathrm{DTR}}}{d\omega d\Omega} d\omega = \int \frac{d^2 N^{\mathrm{DTR}}}{d\omega d\Omega} \frac{\omega \left|\chi'_{\mathbf{g}}\right| C^{(s)}}{2\sin^2\theta_B} d\xi . \tag{24}$$

To build the curves describing the angular density for σ -polarization let's write (24) as

$$\frac{dN_{\sigma}^{\mathrm{DTR}}}{d\Omega} = \frac{e^2}{\pi^2} \frac{\left|\chi'_{\mathbf{g}}\right| C^{(1)}}{2\sin^2\theta_B} \frac{\omega_0^4}{\omega^4} F ,$$

$$F = \frac{\theta_\perp^2}{(\gamma^{-2}+\theta_\perp^2)^2 \left(\gamma^{-2} + \theta_\perp^2 + \frac{\omega_0^2}{\omega^2} \right)^2} \int_{-\infty}^{+\infty} \frac{\sin^2\left(b^{(1)} \frac{\sqrt{\xi^{(1)^2}-\varepsilon}}{\varepsilon} \right)}{\xi^{(1)^2} - \varepsilon + \varepsilon \sin^2\left(b^{(1)} \frac{\sqrt{\xi^{(1)^2}-\varepsilon}}{\varepsilon} \right)} d\xi , \tag{25}$$

where $\theta_\perp = \theta \sin\varphi$.

The curves of the angular density of DTR is calculated by formula (25) presented in Fig.3. The curves are built for different value of parameter ε and fixed values of other parameters shown in the figure. Fig.3 shows that with the increasing of the incidence angle of the electron on target (with decreasing ε) the angular density of radiation rises steeply, which is important from the point of view of creating alternative quasimonochromatic sources of X-radiation.

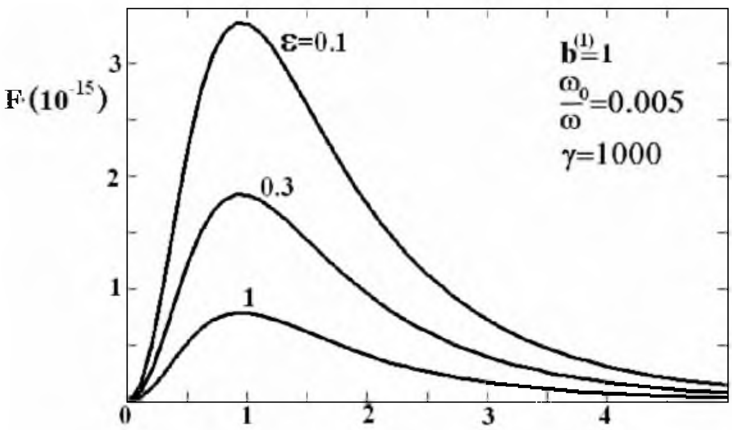

Fig.3. Influence of orientation of the crystal plate on angular density of DTR.

CONCLUSION

The detailed theoretical analysis of relativistic electron DTR in crystal is carried out in Bragg's scattering geometry. On the base of the dynamical theory of x-ray diffraction the analytical expression for spectral-angular characteristics of DTR is obtained by taking into account the orientation of external surfaces relative to the diffracting atomic planes in the crystal. It is shown that under a fixed angle of electron incidence on the set of reflecting atomic planes the spectral-angular characteristics of DTR depend substantially on the orientation of the entrance surface of the crystal. The abrupt increase of the angular density of DTR with the increasing of parameter ε we explain by the decreasing of cross dimensions of the reflected photon beam under increasing the angle of electron incidence on the entrance crystal surface. And for all that the total reflection area will narrow and its middle frequency shifts downward (η shifts upward). This effect can be used for intensity enhancement of x-radiation source built on a basis of DTR mechanism.

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МЕТОД УВЕЛИЧЕНИЯ СПЕКТРАЛЬНО-УГЛОВОЙ ПЛОТНОСТИ ДИФРАГИРОВАННОГО ПЕРЕХОДНОГО ИЗЛУЧЕНИЯ РЕЛЯТИВИСТСКОГО ЭЛЕКТРОНА В МОНОКРИСТАЛЛЕ

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В рамках динамической теории дифракции рассматривается дифрагированное переходное излучение (ДПИ) релятивистского электрона, пересекающего монокристаллическую пластинку конечной толщины в геометрии Брэгга. Получены аналитические выражения для спектрально-угловых характеристик ДПИ с учетом различных ориентаций входной поверхности относительно дифрагирующих атомных плоскостей кристалла. Показано, что при фиксированном угле падения электрона на систему дифрагирующих плоскостей кристалла, спектрально-угловые характеристики ДПИ существенно зависят от ориентации входной поверхности.
КЛЮЧЕВЫЕ СЛОВА: релятивистский электрон, переходное излучение, динамическая дифракция, угловое распределение, монокристалл