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X-ray Emission by a High-Energy "Half-Bare" Electron in Ultra-Thin Crystals

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The process of coherent X-ray emission by a high-energy electron successively crossing two parallel targets –thick upstream amorphous and ultra-thin downstream crystalline ones, separated by a certain distance –is considered. Inside the thick target the electron's field becomes partially screened by the target polarization [1]. After crossing this target the electron still has suppressed electromagnetic field around itself, which lacks considerable part of virtual photons comparing to the Coulomb field in vacuum (which makes such electron "half-bare"[2,3]). It is shown that the process of the electron's field regeneration in the space between the targets dramatically modifies characteristics of radiation in the crystalline target. The discussed radiation is a superposition of parametric X-ray and diffracted transition radiations, which interfere with each other. It is demonstrated that in the considered case such characteristics of the radiation reflex as angular distribution and total yield significantly differ from the corresponding characteristics typical for thick (see, e.g. [4]) and for ultra-thin [5] crystals and depend on distance L between the targets. At sufficiently high energies of the electron (exceeding 10 GeV) such dependence takes place within macroscopically large values of L.
Special attention is drawn to the study of the influence of the crystalline target finite size upon radiation characteristics, which turns out to be noticeable in the considered process. It is shown that it leads to the change of the total radiation yield with the increase of L for macroscopically large values of this distance even for the electron energies lower than 1 GeV.

References
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Summary

The work deals with parametric X-ray (PXR) and diffracted transition radiation (DTR) emitted by an electron in ultra-thin crystalline target. The impinging electron is assumed to be "half-bare" in the result of preliminary penetration through an upstream thick amorphous target, separated by some distance from the crystalline one. It is shown that radiation characteristics in this case significantly differ from the well-known results for PXR and DTR and depend on distance between the targets.

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