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Radiation spectra of electrons with the energy 200 MeV in diamond crystal at axial orientation

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Characteristics of the radiation of relativistic electrons in a crystal depend on their motion in the crystal lattice. Character of the movement is determined by the orientation of the crystal axes relatively the particle momentum and can have both regular and random features, and in connection with these features of the motion both coherent and interference is possible, as well as different non-coherent effects in the radiation. Character of the movement can change due to interaction of the electron with the atoms of the crystal that leads to a change of the radiation emission mechanisms at different part of the particle path in the crystal.
In experiments, the radiation spectra averaged over different types of the particles motion are usually observed, but in many cases it is important to know what mechanisms give the main contribution in radiation at certain motion conditions. For this purpose, a series of theoretical and experimental studies of electron radiation process in a diamond crystal has been performed at electron energies of 200 MeV, using the MAX-lab experimental facility [1] and theoretical model [2], based on numerical simulation of electron emission process in the crystal, taking into account both coherent and incoherent effectiveness in scattering and radiation, as well as the phenomena of channeling, dechannelling and rechanneling particles in the crystal.
Some results of this study are presented in this report relating to the radiation of electrons incident on the crystal at different angles to the axis <100> of the 0.1 mm diamond crystal. The simulation results are in good agreement with the experiment that indicates that the proposed model reflects a real picture of the interaction of electrons with the crystal in this energy range.
The results of the research show that at the axial orientation of the diamond crystal there is a significant increase in radiation intensity spectrum in the energy range of several MeV, more than 15 times in relation to radiation of electrons in the same amorphous target. The main contribution to the radiation in this case makes above barrier particles, and the contribution of the particles moving in the axial channeling mode is significant only at a distance of a few microns in the beginning of the electron path in the crystal.

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References

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