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Fine Structure of the Axial Channeling Particles Quantum States and Electromagnetic Radiation at Low Energies

The transversal motion of charged particles (electrons or positrons) in axial channeling regime can be characterized by 2 main quantum numbers: n –defining the energy level of the particle transversal motion and l – defining its momentum, which always is directed along the channel axis OZ. The transitions between different energy levels would result in electromagnetic radiation –the same way as transitions between energy levels in atoms. At low energies (nonrelativistic case) the number of the allowed quantum states for electrons and positrons is limited (1-3 for electrons[1-3]) The distance between energy levels is comparable with Bohr energy and the transitions between them must result in emerging of discrete spectrum lines in optical range. In relativistic case there can be many energy levels with different, but close transition energies, and the Doppler effect shifts radiation into x-ray or gamma-range [4-5]. In this report we want to consider the fine structure of the axial channeling particles quantum states influence on the radiation spectrum of the channeling particles. Additionally to orbital momentum each electron (positron) has its own immanent spin momentum. And the interaction between spin and orbital momentum would result in splitting the energy levels, the same way as it happens with energy levels of atomic electrons. Thus spectrum lines of electromagnetic radiation must also split into multiplets and additionally the low energy radiation (radio range) shall be observed, associated with transitions between splitted sub-levels. The estimations of the characteristic radiation energies associated with the fine structure of transversal motion energy levels at axial channeling are proposed.

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Summary

The fine structure of the axial channeling particles quantum states? arrising from spin-orbital interraction, is considered. It influence on the radiation spectrum of the channeling particles is analized.

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