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Handling of Planar Channeling of Particle in Crystals Depending on Their Parameters

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Consideration of moving of the fast charged particle in crystals within the classical theory framework is possible for protons, ions and other heavy particles of a specific range of energies, whereas for positrons and especially for electrons due to the presence of diffraction effects it is necessary the quantum description.
Redistribution of density of electrons and positrons during their moving and penetration deep into the crystal is considered in presented work in the regime of planar channeling, within the framework of quantum-mechanical theory.
Consequent quantum theory of channeling effect based on the usage of the density matrix formalism is developed in a series of works of Yu.M. Kagan and Yu.V. Kononets. This method allows to take into account the coherent nature of diffraction in the regular medium and inelastic processes accompanying the motion of fast particle in the crystal. As part of this formalism, all the observed phenomena can be explained in a unified way.
The behaviour of reflection coefficient both for rectangular potential barriers and potential holes is investigated for the nearest above-barrier and below-barrier states, as well as the influence of this behaviour on the different physical phenomena arising at planar channeling of electrons and positrons with energies in the MeV-region has been studied.
In the channeling effect of electrons we have established a special role of the above-barrier states, which are placed in close proximity to a potential barrier that, by the way, has allowed to explain the anomalous passage of the above-barrier electrons in crystals, which experimentally was observed at the Nuclear Physics SRI of Tomsk Polytechnic Institute.
Investigation of specificity of the energy spectrum and properties of the Bloch wave functions of the various states arising from the interaction of particles with a regular medium, revealed a special role in the phenomenon of channeling of negatively charged particles of the above-barrier states, manifested in the existence of a fraction of the electrons, which relatively weakly interact with the crystal atoms. As it turned out as a result of our investigations, just these states are responsible for the abnormally deep penetration of the electrons into the crystal under the channeling conditions.
So, realizing the conditions, under which the coherent phenomena have not damped (small thickness of a crystal), and, having measured the yield of inelastic processes on the crystal lattice nuclei, or interstitial impurity atoms, it is possible to find experimentally the periods of appropriate oscillations that will give the information about the energy band structure in case of particles moving in crystal.

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