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Depth oscillations of electronuclear reactions caused by relativistic planar channelled electrons: quantum versus classical calculations

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Depth oscillations of electronuclear reactions were observed in original experiment in [1].

The computer simulation of the depth oscillations effect of the electronuclear reactions yield was performed in [2] for 700 MeV electrons at <111> axial channelling in silicon crystal.

In this work the oscillations effect is investigated for (220) planar channelled electrons in silicon crystal in the framework of quantum and classical theories using the modern computer code BCM-1.0 [3], which was successfully applied to explain recent experiments on relativistic electrons scattering in the crystals [4-5].

Within quantum approach the flux density was obtained using numerically calculated wave functions [6] of transverse states of channelled electrons. The convolution of the atomic thermal vibrations distribution function in the crystal with the flux density depending on the penetration depth is thus proportional to the electronuclear reaction yield.

In the classical approach the flux density of electrons in a crystal is calculated using simulated trajectories of channeled electrons. Then this function also was convoluted with atomic thermal vibrations distribution function.

Both approaches revealed the oscillations of the electronuclear reactions yield initiated by planar channeled electrons, depending on the beam energy and beam-crystal alignment. The comparison of quantum and classical calculations is performed.

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