TUNNELING OF THE ULTRARELATIVISTIC DIRAC QUASIELECTRONS THROUGH THE STRUCTURE BASED ON THE DICE LATTICE

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The ballistic motion of the ultrarelativistic quasi-electrons in a structure based on a dice lattice is considered and studied. It is assumed that the barrier has a rectangular shape and is created by the external electrostatic potential. The transmission coefficient T is calculated in the continuous model by matching of the eigenfunctions at the interface of the barrier and out-of-barrier areas. The eigenfunctions, in turn, are found as a solution of the Dirac-type equation with the Hamiltonian, which takes into account the presence of a flat energy band. The difference in the values ​​of the Fermi velocity in the barrier and out-of-barrier regions (v1 and v2 respectively) is taken into account. It is also believed that the flat band is located halfway between the valence band and the conduction band and is separated from each of them by the energy gap . The detailed analysis of the tunneling spectra (dependences of the transmission coefficient Ton the quasielectron energy, incidence angle, Fermi velocity, electrostatic potential, energy gap ) is provided. Depending on the values ​​of the parameters of the considered structure, it is possible to implement a large number of different spectra. In particular, it is shown that: 1. Tunneling spectra have a pronounced angular dependence, i.e. the transmission coefficient T varies greatly when the angle of incidence of quasielectrons on the structure changes. 2. Spectra are highly sensitive to changes in the Fermi velocity (in the parameter =v2/v1). 3. At certain combinations of the parameter values, the phenomenon of supertunnelling is observed, which is that the transmission coefficient is equal to unity regardless of the angle of incidence of quasi-electrons on the structure. 4. The Klein tunneling can also be manifested in this structure. 5. For many parameter values ​​the Klein tunneling can be suppressed. 6. For certain values ​​of the parameters, there may be a wide plateau of incidence angles for which T is close to unity. This phenomenon can be called the limited supertunnelling. 7. For most parameter values, the spectra are characterized by three regions with T values ​​that differ significantly. This is due to the possibility of both intra and inter tunneling between the conduction and the valence bands of the considered structure.