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Electronic structure of graphene wormhole and graphitic nanocone

Jan Smotlacha

Joint Institute for Nuclear Research, Russia

The graphene nanostructures are the materials derived from the hexagonal carbon lattice. In our research of the graphene nanoparticles we are concerned with two kinds of them: The graphene wormhole and the graphitic nanocone. Due to extremely curved geometry of the graphene wormhole, the relativistic effects could be observed here: The mass of the electrons appearing close to the wormhole center can be much higher than the invariant mass. This fact together with the effect of the spin-orbit interaction can cause the appearance of the chiral massive fermions. The calculations show that on the wormhole bridge the density of the corresponding zero states should be very high, so it could be used to detect the wormhole centers during the production. The geometric structure we acquire by the connection of 2 graphene sheets with the help of 12 heptagonal defects. In addition to the theoretical calculations, we carried out the numerical simulations. The graphitic nanocone is the structure which arises by the addition of one or more pentagonal defects into the original graphene structure. In the numerical simulations, the calculations of the electronic structure are based on the exact atomic structure, in the continuum approximation we work with different approximations: Either we suppose the pure conical geometry or we simulate the smooth geometry close to the tip by different supplementary effects like the placement of the charge into the place of the tip. Next significant effect influencing the electronic structure of the nanocone is the spin-orbit interaction.

Biography

Jan Smotlacha has completed his PhD from Czech Technical University. Now he works as the Senior Research Scientist in the Bogoliubov Laboratory of Theoretical Physics in the Joint Institute for Nuclear Research in Dubna. He has published about 13 papers in reputed journals or conference proceedings.

smota@centrum.cz

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