Supersymmetry and stable Dirac sea in carbon nanotubes

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We consider the construction of exactly solvable models of twisted carbon nanotubes by applying Darboux transformation to the square of the Dirac-like Hamiltonian, describing the low-energy dynamics of charge carriers. It is shown that obtained two pseudo-Schrodinger expressions are intertwined, demonstrating supersymmetry structure. It is proved, that for the considered class of pseudo-scalar external perturbations, the unitary disentanglement of negative/positive states as within Foldy-Wouthuysen (FW) approach, so by Eriksen or SU(2) methods, can be carried out exactly, thus demonstrating the stability of the Dirac-sea. The necessity of introduction of the probability density operator into the theory, while considering the problem in FW representation, is underlined.

Keywords: supersymmetry; carbon nanotubes; probability density.

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