

Singular background in a model of material plane interacting with Dirac particles

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A method is proposed [1] for constructing a model for the interaction of fields of quantum electrodynamics (QED) with two-dimensional materials in the framework of the Symanzik approach [2]. It is based on the modification of the QED Lagrangian by adding to it an additional contribution (the Lagrangian of the defect) concentrated in a two-dimensional region of space. The requirement to comply with the basic principles of QED (renormalization, locality, gauge invariance) makes significant restrictions on the type of defect Lagrangian. As a result of the modification of QED, a small number of new dimensionless parameters appear in the model which describe the material properties of defect. The Dirac spinor fields in this approach can be used to describe the processes of interaction of spin $\frac{1}{2}$ particles (electrons, protons, neutrons) with two-dimensional objects. The talk presents the results of the study of the scattering of Dirac particles on a homogeneous isotropic plane, as well as properties of bound states arising from the interaction of the spinor field with the plane [3-8]. It is shown that the choice of specific values of the seven dimensionless parameters in the model can achieve significant differences in the quantitative characteristics of the studied physical effects. Theoretical investigations within the framework of the proposed approach may be useful both for improving the methodology of experiments with two-dimensional materials, and for analyzing the possibilities of technical devices created on their basis.

References

- [1] V.N. Markov, Yu.M. Pis'mak, Casimir effect for thin films in QED // Journal of Physics A: Mathematical and General, 2006. –Vol. 39,– P. 6525-6532; arXiv: hep-th/0505218v3, 2005; D.Yu. Pis'mak, Yu.M. Pis'mak, Modeling the interaction of a material plane with a spinor field in the framework of Symanzik's approach // Theoretical and Mathematical Physics, 2015. –Vol.184,–№ 3.– P. 505–519.
- [2] K. Symanzik, Schrödinger representation and Casimir effect in renormalizable quantum field theory//Nucl.Phys. B, 1981– Vol. 190, P. 1-44.
- [3] Yu.M. Pismak, O.Yu. Shakhova, Symanzik approach in modeling the interaction of quantum fields with extended objects: scattering of Dirac particles on material plane// Phys. Part. Nucl. Lett., 2019 –Vol. 16, –P. 441-444.
- [4] Yu.M. Pismak, Modelling of Bound States of Dirac Particles in Singular Background in Framework of Symanzik Approach. // Phys. Part. Nucl. Lett. , 2018—Vol. 15, 4, —P. 380-383.
- [5] Yu. Pismak, F. Wegner, Dispersion relations and dynamic characteristics of bound states in the model of a Dirac field interacting with a material plane //EPJ Web of Conferences, 2018 —Vol. 191, —P. 06015.
- [6] Yu.M. Pismak and D.Yu. Shukhobodskaya Symanzik approach in modeling of bound states of Dirac particle in singular background // EPJ Web of Conferences, 2017. —Vol. 158, —P. 07005.
- [7] Yu.M. Pismak and D.Yu. Shukhobodskaya, Bound states in a model of interaction of Dirac field with material plane // EPJ Web of Conferences, 2016. —Vol. 125, —P. 0522.
- [8] Yu.M. Pis'mak, D.Yu. Shukhobodskaya, Model of Dirac field interacting with material plane within Symanzik's approach, // EPJ Web of Conferences, 2016. —Vol. 126, —P. 05012.

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