Relativistic Field-Theoretical Formulation of the Three-Dimensional Equations for the Three Fermion System

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A new kind of the relativistic three-body equations for three fermion systems are suggested. These equations are derived in the framework of the standard field-theoretical S-matrix approach in a time-ordered three dimensional form. Therefore corresponding relativistic covariant equations are three-dimensional from the beginning and the considered formulation is free of the ambiguities which appear due to a three dimensional reduction of the four dimensional Bethe-Salpeter equations. The solutions of the considered equations satisfy automatically the unitarity condition and for the leptons these equations are exactly gauge invariant even after the truncation over the multiparticle ($n > 3$) intermediate states. Moreover, the form of these three-body equations does not depend on the choice of the model Lagrangian and it is the same for the formulations with and without quark degrees of freedom. The effective potential of the suggested equations is defined by the vertex functions with two on-mass shell particles. It is emphasized that these INPUT vertex functions can be constructed from experimental data.

Special attention is given to the comparison with the three-body Faddeev equations. Unlike to these equations, the suggested three-body equation has a form of the Lippmann-Schwinger-type equations with a connected potential. In addition, the microscopical potential of the suggested equations contains the contributions from the three-body forces and from the particle creation (annihilation) mechanism on the one external particles. The structure of the three-body forces, appearing in the considered field-theoretical formulation, is analyzed.

References

[1] A.I.Machavariani and Amand Faessler. Ann. Phys. 309(2004) 49.