On multi-particle equations in quark models

V.E. Rochev
Institute for High Energy Physics, Protvino, Russia

Abstract

Multi-particle equations are a traditional basis for a quantum-field description of bound states in particle physics. A well-known example of these equations is the two-particle Bethe-Salpeter equation (BSE) for the two-particle amplitude and for the two-particle bound state. The multi-particle (three or more particle) generalizations of the BSE have been also studied.

The investigations of multi-quark equations are of significant interest due to the much less model assumptions in this approach in comparison with the chiral-soliton models. The solutions of multi-quark equations will provide us almost exhaustive information about the structure of hadrons. There is the basic motivation of present work.

We shall investigate Nambu-Jona-Lasinio (NJL) model with quark content which is one of the most successful effective models of QCD in the non-perturbative region. In overwhelming majority of the investigations, the NJL model has been considered in the mean-field approximation or in the leading order of $1/n_c-$expansion. However, a number of perspective physical applications of NJL model is connected with multi-quark functions (for example: meson decays, pion-pion scattering, baryons, pentaquarks etc.). These multi-quark functions arise in higher orders of the mean-field expansion (MFE) for NJL model. In present report we review some preliminary results of investigation of higher orders of MFE for NJL model. To formulate MFE we have used an iteration scheme of solution of Schwinger-Dyson equation with fermion bilocal source. We have considered equations for Green functions of NJL model in MFE up to third order. The leading approximation and the first order of MFE maintain equations for the quark propagator and the two-particle function and also the first-order correction to the quark propagator. A consideration of these equations is the usual field of investigations of NJL model. The second order of MFE maintains the equations for four-particle and three-particle functions, and the third order maintains the equations for six-particle and five-particle functions. Here we discuss first results of investigation of these equations.