

Hadron mass generation and the strong interaction

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Assuming a Lagrangian of the strong interaction slightly different from quantum chromodynamics - by replacing the non-Abelian Yang-Mills term by the coupling of two gluons to $J(\pi)=0+$ (the quantum numbers of the vacuum) with subsequent creation of quarks and/or antiquarks - the confinement of quarks is well understood. Further, hadron masses are generated by requiring "massless" quarks, which indicates that the vacuum of the strong interaction is close to the absolute vacuum. Consequently, new (Higgs) fields are not needed to explain quark masses.

Using self-consistency requirements, two-gluon and corresponding quark-antiquark densities have been deduced. There are only two self-consistent solutions, one which corresponds to mesons, the other which can be identified with baryons. For fundamental mesonic states this yields a predominant $q\bar{q}$ structure, whereas for baryons a strongly mixed $3q$ and $5q$ structure is obtained, with a nucleon density, which yields a good understanding of the hard electromagnetic form factors found experimentally.

The hadron masses are given by bound state energies in the $q\bar{q}$ potential and for excited states additionally by the binding in the self-induced 2-gluon binding potential, which corresponds to the confinement potential. This has a form for the nucleon, which explains that this system has the highest stability of hadrons.

In conclusion, a non-Abelian gluon-gluon coupling coupling has been assumed, which avoids the difficulties of quantum chromodynamics to explain the strong scalar fields found in hadrons and the coupling to the absolute vacuum. In the new Lagrangian chiral symmetry is not present, leading naturally to the sequence of hadronic states observed experimentally. Further, the dominance of the scalar part of hadron-nucleon potentials (given by Pomeron-exchange at high energy) is well understood.

Details as well as the resulting structure of the theory, which deviates appreciably from the present standard model, will be discussed.

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