Retardation effects from quark confinement on hadron dynamics

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Study of the effects of quarks and gluons confined within hadrons on nucleon dynamics is of fundamental importance in understanding the strong interaction. The quark-gluon retardation effects are important for describing the short-range (SR) part of the NN interactions. They can also be very important for describing the dynamics of dense nucleon matter especially at large densities [1]. We investigate the effects of quark-gluon retardation on low-energy nucleon dynamics within the generalized quantum dynamics (GQD) developed in [2]. The GQD allows one to describe the evolution of systems of hadrons whose interaction is nonlocal in time due to quark-gluon retardation effects [2,3]. We consider the dynamics of the system of nucleons whose interaction is described by an interaction operator constructed with in relativistic quark model. It is shown that quark-gluon retardation effects give rise to an anomalous off-shell behavior of the two-nucleon amplitudes. The elements of the two-nucleon T matrix as functions of momenta have the large-momentum behavior which within Hamiltonian dynamics leads to the ultraviolet divergences. Since the off-shell properties of two-particle amplitudes are crucial for the three- and many-body results, the anomalous off-shell behavior of the two-nucleon amplitudes can have substantial effects on the dynamics of few-nucleon systems, and on the properties of nuclear matter.

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