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Executive Summary

Hadrons with A Perturbative Qcd Core and Colour Transparency Phenomena

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The suppression of the final and/or initial state interaction for the small wave packet of quarks and gluons generated in the hard processes and transported via a nucleus is what causes the colour transparency phenomenon. In the quantitative approach, the cross-section of the interaction of a tiny wave packet scattering off a target is calculated, and some bound state hadron characteristics peculiar to quantum chromodynamics are described (QCD).

A hadron in QCD is made up of three overlapping layers that represent the two different phases of the QCD substance. The pion cloud of a hadron creates the outer layer. Inter-nucleon attraction in low-energy nuclear events is only produced by this layer. Quarks interacting with chiral and gluon condensates create the following layer.

The two-pion exchange potential is computed using the chiral QCD dynamics modified by the inclusion of isobars, as can be seen. This is an illustration of how nuclear theory incorporates the inner structure of a nucleon. The type of inter-nucleon contact can be limited by observing the high momentum tail of the nucleon momentum distribution.

A pion is a pseudo-Goldstone boson of QCD, not an elementary particle. Because there are no pseudo-Goldstone bosons in the pQCD phase, an interacting nucleon loses its pion cloud as nuclear density rises. The exchange of component quarks between nucleons is the cause of intermediate-range inter-nucleon forces. This is so because a quark's instanton field mostly contributes to the chiral condensate, which gives light quarks their mass.

According to the authors, a nucleon in quantum chromodynamics (QCD) comprises three layers made up of two QCD phases that coexist with one another. The pion cloud of a nucleon creates an outer layer that dominates low-energy nuclear phenomena due to the nucleon-nucleon interaction's attraction potential.

As per the idea of QCD factorization theorems, the perturbative QCD (pQCD) core of nucleon results in the existence of a sizable group of hard processes off nuclear targets where the beginning of the colour transparency (CT) phenomena is quick. The gradual beginning of CT phenomena for quasi-elastic processes off nuclear targets discloses the non-perturbative phase of spontaneously broken chiral symmetry surrounding the pQCD core of a nucleon.

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KEYWORDS

quantum chromodynamics (QCD); exclusive processes; color transparency; nucleon structure