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Executive Summary

Colour Transparency and Hadronization

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Colour transparency is one of the intriguing predictions of quantum chromodynamics (QCD) for a nuclear physics phenomenon (CT). On a nuclear target, initial particle production is projected to occur as point-like configurations (PLC) with extremely small transverse dimensions and, thus, extremely small cross sections with the surrounding medium. Meson generation on nuclear targets has been the main strategy used in experimental searches for CT. The target radius then offers a time scale for hadronization for a particularly produced particle velocity. Due to the requirement for a reference cross-section for a process without CT, one of the challenges in determining CT in such studies is the lack of such a cross-section. By combining hard scattering amplitude with the t-channel amplitude which alone supplied most of the longitudinal strength—the mystery of the enormous transverse cross-section at high Q2 was finally resolved. A string fragmentation model can explain the decline of various DIS setups. The authors hold the view that these hard transverse occurrences are what CT is principally related to in the research of CT and cross-section evolution. The goal of the current work was to review the outcomes of such an approach. As a result, these outcomes are compared to fresh information, and what is discovered regarding the temporal evolution of newly generated hadrons is highlighted. Any description of CT must include a trustworthy account of the freshly created hadron's final state interactions with the nearby nuclear target. To this goal, the nuclear process is described here using a quantum-kinetic transport model based on the Kadanoff-Baym equations. Hadrons' creation period and the interaction cross section up until the hadron is fully formed determine what happens to them in a hard photonuclear reaction on a nuclear target. The times used in computations are taken directly from the PYTHIA algorithm for each particle and each event; they are not free parameters. This study reviews and summarizes prior findings on the hadronization process in deep inelastic collisions. Nuclear targets' semi-inclusive deep-inelastic scattering (SIDIS) events are sensitive to the length (and time delays) of the hadronization process and hence offer important insights into its workings. It is important to note that any time delays of this nature are only associated with extreme, DIS-like occurrences that necessitate a significant rearrangement of the impacted nucleon and the partons in the reaction product. A string-fragmentation model, as it is done in PYTHIA, is used to handle the real deterioration. In contrast to other methods, the production and formation periods are directly derived from this string-breaking procedure rather than being free parameters or informed guesses.

JOURNAL REFERENCE

Gallmeister K, Mosel U. Hadronization and Color Transparency. Physics. 2022; 4(2):440-450.

KEYWORDS

Hadronization, colour transparency, deep inelastic scattering (DIS)