A Systematic Approach to Studying Quark Energy Loss in Nuclear Matter Using positive pions

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Abstract

Our objective is to test published models of partonic energy loss, particularly those describing the energy loss mechanisms of quarks traversing nuclear matter, within the framework of DIS. Our methodological approach focuses on quantifying quark energy loss in cold matter by analyzing positive pions produced in various nuclear targets, including Deuterium, Carbon, Iron, and Lead. To achieve this, we define a kinematic variable that helps isolate positive pions produced outside the nucleus. Before normalization, we perform acceptance corrections to account for the detector's efficiency and ensure accurate comparison of the spectra. By normalizing the energy spectra of positive pions produced from these distinct targets, and based on the BDMPS theory, which posits that quark energy loss depends only on nuclear size, we assume that the energy distributions of the targets will exhibit similar behavior. For this normalization, we identify an energy shift between these distributions, corresponding to the quark energy loss. To ensure accuracy, we employ statistical techniques such as the Kolmogorov-Smirnov test. To validate our methods, we used a preliminary dataset collected using Jefferson Lab's CLAS detector.