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 semi-inclusive deep inelastic scattering. Our methodological approach focuses on quantifying quark energy loss in cold matter by analyzing positive pions (Π^+) produced in various nuclear targets, including Deuterium, Carbon, Iron, and Lead. Before normalizing the pion energy distribution to unity to perform a shape analysis, acceptance corrections were performed to account for the detector's efficiency and ensure accurate comparison of the spectra. By normalizing the energy spectra of Π^+ produced from these distinct targets, and based on the Baier-Dokshitzer-Mueller-Peigné-Schiff (BDMPS) theory, which posits that quark energy loss depends only on nuclear size, it is assumed that the energy distributions of the targets will exhibit similar behavior. For this normalization, an energy shift between these distributions, corresponding to the quark energy loss, is identified. To ensure accuracy, statistical techniques such as the Kolmogorov-Smirnov test are employed. The data used for this analysis were from the CLAS6 EG2 dataset collected using Jefferson Lab's CLAS detector.