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# A space-time analysis of semi-inclusive deep inelastic scattering on nuclei

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A new analysis of published experimental data from the HERMES experiment has been performed. This analysis extracts new information on the space-time properties of color propagation through fitting to a geometric model of the interaction with a realistic nuclear density distribution. Our approach uses a simultaneous fit to the transverse momentum broadening observable and the hadronic multiplicity ratio; the simultaneous fit to two different observables strongly constrains the outcome. We extract the color lifetime, or production time, for the first time. We also extract estimates for the $\hat{q}$ transport coefficient characterizing the strength of the interaction between the quark and the cold nuclear medium transverse to the direction of the quark. With a three-parameter model we obtain satisfactory fits to the data for the kinematic conditions approximately corresponding to the current fragmentation region. Quark energy loss was also parametrized using a 4-parameter variant of the model, and it was found not to play a significant role in describing the data. We note the important impact of the functional form of the distribution of production lengths on present and future data. Using simple kinematic arguments, we use these results to predict the color lifetime for typical kinematic conditions for 5 GeV measurements at Jefferson lab, for 11 GeV beam at the upgraded Jefferson Lab, and at the energies of the future Electron-Ion Collider.

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