Studies of Hadronization Mechanisms using Pion Electroproduction in Deep Inelastic Scattering from Nuclei

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Atomic nuclei can be used as spatial analyzers of the hadronization process in semi-inclusive deep inelastic scattering. The study of this process using fully-identified final state hadrons began with the HERMES program in the late 1990s, and is now continuing at Jefferson Lab with a number of different final state hadrons. In the measurement described here, electrons and positive pions were measured from a 5 GeV electron beam incident on targets of liquid deuterium, carbon, iron, and lead using the CLAS large-acceptance detector in Hall B. A high-precision comparison of the heavier targets to deuterium was facilitated by having a two-target system that allowed the liquid deuterium cryotarget to be located in the beam simultaneously with the solid targets, separated by 5 cm, thus minimizing accepance differences and eliminating time-dependent corrections to the comparisons of the two targets. The broadening of the transverse momentum of positive pions has been studied in detail as a function of multiple kinematic variables, and interpreted in terms of the transport of the struck quark through the nuclear systems. New insights are being obtained into the hadronization process from these studies, as well as new constraints on the interpretation of such experiments, which will be extended with the 12 GeV Upgrade of Jefferson Lab in approved experiment E12-06-117 and at the future Electron-Ion Collider.

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Primary relevance: Quarks and Gluons in Hadrons
Secondary relevance: Quarks and Gluons in Hot and Dense Matter