Hadron Propagation and Color Transparency at 12 GeV

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Experiment E12-06-107 will measure the A(e,e'p) proton knockout cross sections to extract the proton nuclear transparency up to the highest Q^2 that can easily be reached at the 12-GeV JLab, using the HMS and SHMS spectrometers. We restrict the proton transparency measurement to just the ^{12}C nucleus with additional ^{1}H measurements (to determine the elementary process), over the range Q^2 = 8 - 16 (GeV/c)^2.

Measurements of proton and pion transparencies are fundamental in their own right, as they shed light on the propagation of protons and pions in nuclear matter, which is important for the interpretation of many experiments and phenomena. Further, a rise in the proton transparency as a function of Q^2 is predicted to be a signature of the onset of Color Transparency. Mapping the onset of any Color Transparency effects, uniquely points to the role of color in exclusive high-Q^2 processes.

Di-jet experiments have reported evidence for Color Transparency effects, corresponding to a Q^2 scale of $\simeq$ 10 (GeV/c)^2. An oscillation in nuclear transparency was found in A(p,2p) experiments, but no evidence of an energy dependence of transparency has been found in A(e,e'p) experiments to date. Onset of Color Transparency effects were reported at lower Q^2 in pion electro-production from nuclei. This is further corroborated by a series of ρ^0 production measurements at FermiLab, DESY and JLab. The occurrence of such effects in meson electroproduction experiments is an effective signature of the approach to the factorization regime, necessary for the access to Generalized Parton Distributions through high-Q^2 deep exclusive processes.

Nuclear transparencies provide a natural meeting ground between experiment and meson-nucleon as well as QCD inspired calculations of the propagation of highly energetic particles through the nuclear medium, which remains a very active area of study. The proton transparency experiment will unambiguously settle whether the oscillation noted in A(p,2p) experiments has any correlation with Color Transparency effects. The experiment will use 9 days of beamtime with beam currents of up to 80μA on a 15 cm liquid hydrogen target and a 2% r.l. carbon target. However, if a 10 cm liquid hydrogen target is used, the experiment will need 10 days of beamtime.