ABSTRACT

Exclusive processes in QCD can be considered in a Fock state expansion of the nucleon wave function projected onto the basis of free quark and gluon Fock states. At large momentum transfer the lowest particle-number 'valence' Fock component with all the quarks within an impact distance $b_\perp \leq \frac{1}{Q}$ controls the form-factor at large Q^2. Such a Fock state component has a small color dipole moment, and thus interacts only weakly with nuclear matter. Hence, in quasielastic electron scattering inside a nucleus one predicts negligible final-state interactions in the target as Q becomes large. This effect is called 'color transparency'. In the limit of complete transparency the cross section per nucleon should be independent of A. From elastic scattering on the proton, we know that above Q^2 of ~ 5 $(\mathrm{GeV/c})^2$ (proton recoil momentum of 3.5 GeV/c) the data is consistent with quark counting rule behaviour. In addition, a recent quantum mechanical treatment of high momentum transfer nuclear processes indicates that complete color transparency arises if the recoil proton energy is much greater than 1.2 $A^{\frac{1}{3}}$ GeV.

We propose to use the nucleus as a laboratory to study this prediction of QCD by measurement of the A dependence and Q^2 dependence of the cross section at the quasielastic peak up to the highest attainable Q^2 in Hall C at CEBAF. The proposal is based on previously submitted Letters of Intent #LOI46 (September 1987) and an updated version CEBAF 88-09 (February 1988). The Short Orbit Spectrometer (SOS) will be used for electron detection and the High Momentum Spectrometer (HMS) used for recoil proton detection. With the 4 GeV CEBAF beam and Hall C spectrometers, the quasielastic (e,e′p) cross-section can be measured up to $Q^2 = 6.2$ $(\mathrm{GeV/c})^2$. At this momentum transfer the struck proton recoils with a momentum of 4.1 GeV/c and hence is significantly relativistic. The advantages of CEBAF over existing facilities are its high duty factor, high intensity beam currents, and large solid angle, high resolution spectrometers. The experiment will provide important information on the approach to perturbative QCD in exclusive processes. It provides the possibility of directly studying the underlying theory of the strong interaction in the nucleus using the electromagnetic interaction as a probe.