CEBAF EXPERIMENT 89-008

Inclusive Scattering from Nuclei at $x > 1$ and High Q^2

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This experiment is an inclusive electron-nucleus scattering experiment in the domain of large x and Q^2 to study the A-dependence of the nuclear structure functions. Such studies can provide important constraints on the components of the nuclear wave function at large momentum and removal energy, and on non-nucleonic degrees of freedom.

In the past, inclusive scattering from nuclei has been studied in great detail in the region of the quasielastic peak (Bjorken scaling variable $x = 1$); the main issues have been the excess of transverse strength in the dip region, and the lack of longitudinal strength in the region of the peak. Inclusive scattering from nuclei has also been studied extensively at very large inelasticities ($x < 1$); here the main issues have been the determination of quark distribution functions in the nucleon, and their modification due to the nuclear environment. Inclusive scattering at `low' energy loss ($x > 1$) has been studied to a lesser degree, with data available only for a restricted set of Q^2, x-values; the main issues here have been the observation of y-scaling and the related study of high momentum components in the nucleus.

In the region of $x > 1$ and moderate Q^2, the dominant scattering process is one of quasielastic electron-nucleon scattering. In this region the data exhibit scaling in the variable y. The scaling function F(y) provides information on the nucleon momentum distribution. This information is of particular interest as $|y|$ increases ($x >> 1$); in the low energy-loss wing of the quasielastic peak the components of large initial-nucleon momentum and large removal energy play an important role. This region of kinematics thus is particularly interesting in studies of the role of nucleon-nucleon correlations. Information on the Q^2 dependence can also address questions regarding the importance of final-state effects.

In the region of very large x and Q^2, the fall-off of the nucleon form factors with Q^2 leads to a decrease in the contribution from quasielastic processes. Deep inelastic scattering from the quark constituents of the nucleus is expected to eventually dominate, as it does for $x < 1$. An interesting relation between the quasielastic and deep inelastic response has been discussed recently, where there are indications of a scaling behavior of the existing data in terms of the Nachtmann variable (a modification of the x variable made to account for target-mass effects).

Studies of this region at large x, Q^2 are also of particular interest in connection with the EMC effect. Values of $x = 2 - 3$ correspond to coherent scattering from a system that has 2 - 3 times the nucleon mass. Nuclear effects, such as 6 quark components of the wave function, have been predicted to lead to significant effects on the inclusive response at very large x, Q^2.

The limited amount of data available for $x > 1$ is largely due to the low cross sections in this region. The high luminosities expected from CEBAF should allow a significant extension in the region of x and Q^2 covered. It is the aim of this experiment to provide a more complete picture of the inclusive electromagnetic response.