Experiment 01-113

Deeply Virtual Compton Scattering at 6 GeV with CLAS

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This experiment aims at measuring the exclusive electroproduction of photons ($\vec{e}p \to ep\gamma$) in the Bjorken regime (Q^2 large), using the CEBAF 6 GeV polarized electron beam and the CLAS detector at Jefferson Lab. The subprocess of interest $\gamma^* p \to \gamma p$ is characterized by the "mass" $-Q^2$ of the incident virtual photon and a large enough energy for the system $\gamma^* p$. It is referred to as Deeply Virtual Compton Scattering (DVCS). In these kinematical conditions, the virtual photon may be viewed as scattering off a quark in the proton.

Such a process is calculable through perturbative QCD (pQCD) and gives access to new structure functions of the nucleon, called "Generalized Parton Distributions" (GPD's). These structure functions are generalizations of the parton distributions usually measured in inclusive Deeply Inelastic Scattering. They are also connected to elastic form factors and to the angular momentum of the quarks inside the nucleon. Not only do they provide an attractive unifying scheme for all the present knowledge on the nucleon structure, but their determination would give new insight in this structure, through a "femto-photography". For example, the longitudinal momentum of a quark, that is along the direction of the proton, could be determined simultaneously with its transverse position; whereas in the "ordinary" parton distributions, one averages over this transverse position.

The main focus of the experiment will be the measurement of the beam spin asymmetry in the reaction $\vec{e}p \to ep\gamma$. This asymmetry is directly proportional to the imaginary part of the DVCS amplitude and gives access to a given combination of the GPD's.

The first goal of the experiment will be to test whether the underlying picture of the process is valid. This is characterized by a given Q^2 dependence as well as a given shape for the asymmetry. The recent observation of such an asymmetry [1] is very encouraging in this respect.

If these conditions are fullfilled, the large kinematical coverage of CLAS will allow a first systematic exploration of the GPD's, i.e. their variation as functions of kinematical variables x_B and t.

The experiment necessitates the addition, close to the target point of the CLAS detector, of a calorimeter to detect the photons emitted at small angles and of a superconducting solenoid to trap background particles emitted in the interaction of the beam with the target. This new equipement is to be built in 2002-2003, so that the experiment would be ready by the fall of 2003.

Related JLab experiments: E99-105 and E00-110.

[1] S. Stepanyan *et al.* (CLAS collaboration), Phys. Rev. Lett. **87**, 182002 (2001).