

# Measurement of neutral current cross sections at high Bjorken- $x$ with the ZEUS detector at HERA

ZEUS Collaboration

The study of nucleon structure at high Bjorken- $x$  has many fascinating aspects. The value of Bjorken- $x$  tells us how much of the proton momentum is carried by a quark or gluon. For  $x \rightarrow 1$ , we have a situation where the proton kinematics are dominated by a single quark (gluons at such high values of  $x$  are rare). The propensity for a nucleon to fluctuate into such a configuration is a challenge to calculate as well as to measure. On the theoretical side, such fluctuations represent fundamental non-perturbative aspects of the underlying theory, Quantum Chromodynamics. Calculations on the lattice have so far only been able to give moments of the  $x$ -distribution of quarks. New data could be a guide to understanding these fluctuations.

Phenomenologically, knowledge of the high- $x$  behavior of the parton densities is important in the search for physics beyond the current Standard Model. The production cross section for high-mass states are only reliable if the input parton densities are well known. However, little is known about the parton densities for Bjorken- $x \sim 1$ . The existing deep-inelastic scattering data ends at  $x = 0.75$ . There are data at higher  $x$ , but these are in the resonance production region (small hadronic invariant mass,  $W$ ), and require large corrections before they can be used to extract parton densities. The parton densities in common use today for extracting cross-sections from high- $x$  processes, e.g., in searches for new high-mass states, are constrained primarily from the form of the parametrization used, and not by data. An analysis of the ZEUS data was undertaken to push the cross-section measurements to the highest possible values of  $x$ . The main ideas behind the analysis are:

- Events can be selected easily at high  $Q^2$  independently of  $x$  because of the presence of a high-energy electron at large angle.
- The electron parameters cannot be used to reconstruct  $x$  at large  $x$  due to poor resolution. However, the hadronic system gives a precise determination of  $x$  when the hadronic system is well contained.

- For  $x \rightarrow 1$ , the hadronic system is partially or completely lost in the forward beam pipe. For these events an integrated cross section is measured for  $x_{\text{cut}} < x < 1$ , with  $x_{\text{cut}}$  ranging from 0.2 at lower  $Q^2$  to  $\approx 1$  at high  $Q^2$ .

A subset of the data is shown in the figure as the ratio of the observed cross section to the cross section predicted from a commonly used parton density set. The data show some excess at the highest values of Bjorken- $x$ . This should not be too surprising since little data existed previously in this kinematic region. The data will therefore be valuable in pinning down the parton densities at very high Bjorken- $x$ , and hopefully also in guiding theoretical calculations of these rare fluctuations of the proton.

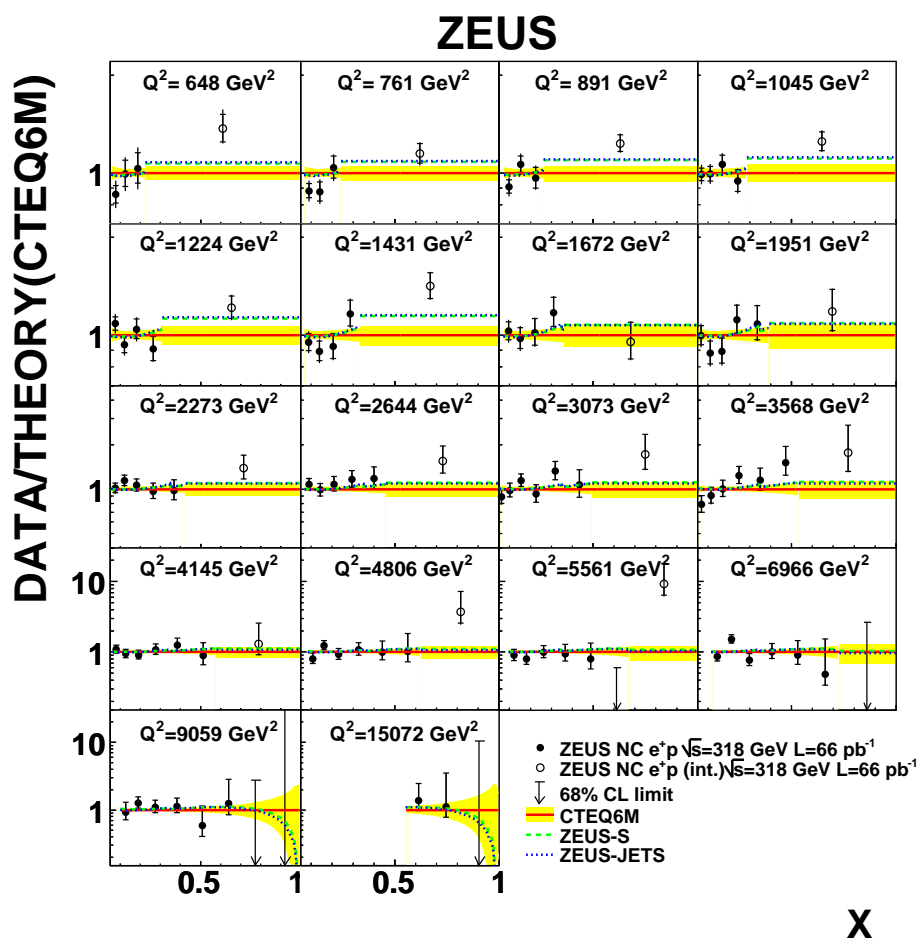


Figure 1: