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EXPERIMENTAL STUDIES OF THE NEUTRON AND PROTON ELECTROMAGNETIC STRUCTURE FUNCTIONS*

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Abstract

We have carried out an experimental study of the neutron and proton deep-inelastic electromagnetic structure functions. The structure functions were extracted from electron-proton and electron-deuteron differential cross sections measured in three experiments spanning the angles 6^{o}, 10^{o}, 15^{o}, 18^{o}, 19^{o}, 26^{o}, and 34^{o}. We report primarily on the large angle (15^{o}-34^{o}) measurements. Neutron cross sections were extracted from the deuteron data using an impulse approximation. Our results are consistent with the hypothesis that the nucleon is composed of point-like constituents. The variation of the cross section with angle suggests that the hypothetical constituents have spin 1/2. The data for σ_n/σ_p, the ratio of the neutron and proton differential cross sections, are in the range 0.25 to 1.0, and are within the limits imposed by the quark model. Detailed studies of the structure functions were made for a range of the scaling variable ω from $\omega = 1.3$ to $\omega = 10.0$, and for a range of invariant four-momentum transfer, Q^2, from 1.0 GeV^2 to 20.0 GeV^2. These studies indicate that the structure functions approximately scale in the variable ω, although significant deviations from scaling in ω are apparent in the region $1.3 < \omega < 3.3$. These deviations from scaling are in the same direction and of similar magnitude for both neutron and proton. The interpretation of the data in terms of various theoretical models is discussed.

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