

Abstract

We propose to measure the ratio of electromagnetic form factors of the proton, G_{Ep}/G_{Mp} , to $Q^2=9$ GeV² in elastic electron scattering from hydrogen in Hall C with the recoil polarization technique. The proton will be detected in the HMS and the electron in a large solid angle lead glass calorimeter. This experiment is an extension of experiment 99-007 which will measure G_{Ep}/G_{Mp} up to $Q^2=5.6$ GeV² later this year in Hall A. The data from JLab experiment 93-027 have shown an unexpected and significant difference between the electric and magnetic form factors, starting at $Q^2=1$ GeV², up to the maximum value of 3.5 GeV², revealing a different spatial distribution for charge and magnetization. These data also clearly demonstrated that we have not yet reached the perturbative QCD limit, which would be signaled by the ratio $Q^2 F_{2p}/F_{1p}$ becoming constant.

The proposed data, together with the existing G_{Mp} -data, will determine both F_{1p} and F_{2p} , the Dirac and Pauli form factors, separately. At large Q^2 , F_{1p} is already well determined from existing G_{Mp} data. This experiment will extend the knowledge of F_{2p} , which is equally sensitive to G_{Ep} and G_{Mp} , to a Q^2 region where, in the pQCD picture, helicity conservation should operate. For each one of these reasons, measurement of G_{Ep}/G_{Mp} up to 9 GeV² is of great interest. This Q^2 region is thought to be the one of transition between soft and hard scattering, and is the most challenging theoretically. Ultimately, understanding of this difficult region will be achieved from QCD, the theory of the strong interaction. The data from this experiment will provide a testing ground for theory.

This experiment requires 6 GeV incident electron energy, and thus is possible before the anticipated energy upgrade of the CEBAF accelerator.