

Measurement of the Ratio G_{Ep}/G_{Mp} to large Q^2 , Interesting New results form Jefferson Lab

Vina Punjabi[†]

Norfolk State University, Norfolk, VA 23504

[†] E-mail: punjabi@jlab.org

In experiments 93-027 and 99-007 the ratio of the electromagnetic elastic form factors of the proton, G_{Ep}/G_{Mp} , was measured with high precision, up to four momentum transfer Q^2 of 3.5 GeV² [1, 2] and 5.6 GeV² [3], respectively, with the recoil polarization technique; the great strength of this method is the tight control of systematics it affords. Double spin experiments measure the product $G_{Ep}G_p$ as well as $(G_{Mp})^2$, and are more sensitive to small values of G_{Ep} than cross section measurements because of the interference nature of the observables.

The data from the two JLab experiments have shown an unexpected and significantly different Q^2 -dependence for G_{Ep} and G_{Mp} , revealing a definite difference between the spatial distributions of charge and magnetization at short distances. The polarization results from the two JLab experiments were surprising as they disagree with the ratios $\mu_p G_{Ep}/G_{Mp}$ obtained by measuring cross sections (Rosenbluth method), which appear to be near unity up to about 6 GeV², whereas the polarization results show a ratio value of 0.29 at Q^2 of 5.6 GeV².

The large discrepancy between the ratios obtained with the Rosenbluth and the recoil polarization method is currently the subject of intense debate. Recent precision measurements of G_{Ep}/G_{Mp} in Hall A using the Rosenbluth method are in agreement with earlier Rosenbluth results; it appears increasingly difficult to explain the difference away by methodological or systematic errors. A likely explanation is the two-photon exchange process, which affects both cross section and polarization transfer components at the level of a few percent; however, the two-photon effects have drastic impact on the results from a Rosenbluth separation method, but modify the ratios obtained with polarization method by a few percent only.

We are currently preparing a third experiment to measure the ratio G_{Ep}/G_{Mp} to Q^2 of 9 GeV² [4], this time in Hall C at JLab. This high priority experiment requires a new polarimeter to measure the polarization of recoil protons, and a large acceptance calorimeter to detect the scattered electrons. Both instruments are now in an advanced stage of construction. The experiment will run in 2007.

References

- [1] M.K. Jones *et al.* (2000) Phys. Rev. Lett. **84** 1398.
- [2] v. Punjabi *et al.* (2005) Phys.Rev. C **71** 055202; Erratum-(2005) Phys.Rev. C **71** 069902.
- [3] O. Gayou *et al.* (2002) Phys. Rev. Lett. **88** 092301.
- [4] C.F. Perdrisat, V. Punjabi, M.K. Jones and E. Brash, "Measurement of G_{Ep}/G_{Mp} to $Q^2=9$ GeV² via recoil polarization". exp 04-108