ELECTRON-PROTON SCATTERING AT 900 Mev AND 135° *

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Recently a 900-Mev electron beam became available on the linear accelerator at Stanford. This paper reports the results of electron-proton scattering measurements at values of $q^2 > 20$ f^{-2} taken during the adjustment runs of the accelerator. The results, with only statistical errors quoted, are given in Fig. 1 and Tables I and II.

The three points shown on Fig. 1 were obtained with a liquid hydrogen target at $q^2 = 23.9$, 25.1, 26.7 f^{-2} and a scattering angle of 135°. Incident electron energies were 825 Mev, 856 Mev, and 896 Mev. The data were taken with a double-focusing, zero-dispersion spectrometer designed by Alvarez, Brown, Panofsky, and Rockhold,[1] which had installed in it a mask designed to make $\Delta p/p$ independent of angular deviations from the central ray. The nominal $\Delta p/p$ for this experiment was 4%, while $\Delta p/p$ for the incident beam was 1%. The beam was monitored by a Faraday cup known to contain better than 99% of a 600-Mev shower. Detection of the scattered electrons was accomplished by a 10-in. long water Čerenkov counter which makes it possible to reject essentially all the background pulses, while retaining an estimated better than 90% efficiency for real electrons.

We normalized our results with two points at 45°, thus keeping constant the geometry, the recoil kinematic variation over the acceptance aperture, and the momentum of the scattered electron. Only the angle and the incident beam energy were varied. Relative accuracy of the latter was ≤0.1%. The two normalization points were $E_0 = 381$ Mev, $q^2 = 1.95$ f^{-2} and $E_0 = 374$ Mev, $q^2 = 1.88$ f^{-2}. Scattering by the liquid hydrogen caused a possible ≤4% loss in Faraday cup effi-

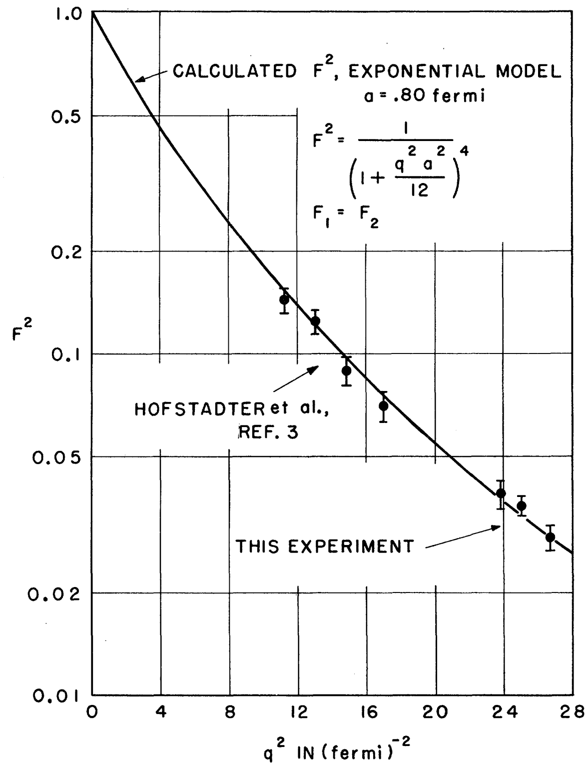

FIG. 1. Ratio of proton elastic scattering to Rosenbluth formula at 135°. (These values of F^2 correspond to those of Table II.)

Table I. Absolute cross sections.

θ	q^2 (f^{-2})	E_0 (Mev)	Physical radiator correction	Schwinger correction	Measured absolute cross sections with corrections (cm^2/sr)	Statistical errors in measured cross sections and in absolute values of F^2	Measured absolute F^2	Calculated[a] F^2
135°	26.7	896	+19%	+31%	0.44×10^{-33}	8%	0.031	0.029
135°	25.1	856	+19%	+31%	0.57×10^{-33}	4%	0.038	0.0335
135°	23.9	825	+19%	+31%	0.61×10^{-33}	9%	0.039	0.0375
45°	1.95	381	+19%	+25%	1.03×10^{-30}	4%	0.72	0.673
45°	1.88	374	+19%	+25%	1.07×10^{-30}	5%	0.72	0.683
45°	1.72	357	+19%	+25%	1.26×10^{-30}	4%	0.78	0.70

[a]Calculated F^2 assumes $F_1 = F_2$ and exponential model.

Table II. Cross-section ratios.

q^2 (f^{-2})		F^2 from measured cross section ratios[a]	Calculated[b] F^2
26.7	$\frac{d\sigma/d\Omega \text{ at } 896 \text{ Mev}, 135°}{d\sigma/d\Omega \text{ at } 381 \text{ Mev}, 45°} = 0.43\times10^{-3}$ (±9%)	0.029 (±9%)	0.029
25.1	$\frac{d\sigma/d\Omega \text{ at } 856 \text{ Mev}, 135°}{d\sigma/d\Omega \text{ at } 374 \text{ Mev}, 45°} = 0.53\times10^{-3}$ (±6%)	0.036 (±6%)	0.0335
23.9	$\frac{d\sigma/d\Omega \text{ at } 825 \text{ Mev}, 135°}{d\sigma/d\Omega \text{ at } 374 \text{ Mev}, 45°} = 0.57\times10^{-3}$ (±10%)	0.039 (±10%)	0.0375

[a] $F(q^2)$ is calculated from exponential model, $F_1=F_2$ for 45° points.
[b] See footnote (a) of Table I.

ciency at the lower energies, and, of course, we do not know the Faraday cup efficiency at 900 Mev, but more than a 10% shower loss at 900 Mev is not likely.

We calculated absolute cross sections for six points, assuming 100% Faraday cup beam collection and 100% counter efficiency. The absolute normalization was based on the reaction $\gamma+p \rightarrow \pi^+ + n$ with[2] $(d\sigma/d\Omega)_{\gamma-\pi^+} = 16.5$ μb/sr at $k=250$ Mev and $\theta_{\text{lab}} = 83.8°$ plus some current data with the same spectrometer mentioned above taken by R. Alvarez of this laboratory (experiment in progress). The principal limitation is probably in the accuracy to which the absolute π^+ cross section is known. The Schwinger correction was quite large (little affecting the ratios, however), because we are taking a peak height with poor resolution $\langle \ln(E/\Delta E)\rangle_{\text{av}} \sim 4$ rather than integrating a curve with good resolution as in the measurements of Hofstadter et al.[3] at lower q^2. The absolute values were taken as a cross-check only.

Probably the principal error in the ratio determination is caused by slight differences in the setting of the spectrometer at the two points, although work at 896 and 856 Mev with high resolution showed that we were within 1/2% of the peak.

Further discussion will have to await more data; however, it appears clear that in the $q^2 = 25$ f^{-2} region, at an angle dominated largely by scattering from the proton's magnetic moment, no structure other than that seen in earlier experiments at lower values of q^2 has appeared.

I wish to thank the accelerator crew for their cooperation in helping to make these measurements possible.

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[2] A. J. Lazarus, W. K. H. Panofsky, and F. R. Tangherlini, Phys. Rev. 113, 1330 (1959).
[3] R. Hofstadter, F. Bumiller, and M. R. Yearian, Revs. Modern Phys. 30, 482 (1958); E. E. Chambers and R. Hofstadter, Phys. Rev. 103, 1454 (1956).