ABSTRACT

We propose to measure the ratios F_2/F_1 and G_E/G_M in nuclei at low and high Q^2. The results, combined with concurrent high precision relative cross section measurements, will determine for the first time the hard scattering $\vec{e}p \rightarrow e\vec{p}$ scattering amplitude in nuclei. They will permit a high precision determination of possible effects of color transparency with essentially no model dependence. The low Q^2 results will provide a baseline for understanding the high Q^2 results. They will yield a measurement of G_E/G_M in nuclei with small systematic error. These values will be compared with previous values determined by Rosenbluth separation which are decreased by about 25% from free nucleon values.

The ratio of recoil proton polarization components P_t/P_l determines the ratios of form factors, G_E/G_M and F_2/F_1. The cross sections can be used to determine an A-dependent attenuation and an A-independent hard scattering amplitude in nuclei. The absolute magnitude of each form factor is determined from the ratio plus the scattering amplitude.

We propose to measure the $(\vec{e}, e'\vec{p})$ reaction on ^{12}C, ^{27}Al, ^{56}Fe, ^{90}Zr, and ^{197}Au in quasifree kinematics at two values of the four–momentum transfer, Q^2. The first phase of these measurements will determine the ratios G_E/G_M and F_2/F_1 to 10% for each target with 1.6 GeV beam energy at $Q^2 \approx 1$ (GeV/c)^2, in about two days of beam time per target. The second phase of these measurements will determine the ratios F_2/F_1 to 10% and G_E/G_M to 14% for the lighter targets with 5.1 GeV beam energy at $Q^2 = 4$ (GeV/c)^2, in about one week of beam time per target. Relative cross sections will be determined with a statistical precision much better than 1%, and systematic uncertainties of typically 2 – 3%, for both kinematics. The Q^2 evolution of the form factors will also be measured at additional kinematic points with the lightest target, ^{12}C.