

Analysis of PR detector data from the GEn-RP experiment

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The GEn-RP experiment E12-17-004 is among various form factor experiments with the Super-Bigbite Spectrometer (SBS) setup at Hall-A, Jefferson Lab and aims to measure the ratio of electric to magnetic elastic form factors of the neutron, G_E^n/G_M^n using recoil polarimetry techniques at $Q^2 = 4.3 \left(\frac{\text{GeV}}{c}\right)^2$ in quasi-elastic electron-neutron scattering from a deuterium target. The ratio of these form factors is determined from the ratio of the transverse P_x and the longitudinal P_z components of the spin polarization, that is transferred to the recoiling neutron from the incident, longitudinally polarized electron beam. Both high-momentum, small-angle neutrons produced during $np \rightarrow np$ elastic scattering and high-momentum small-angle protons produced by $np \rightarrow pn$ (charge exchange) are used to analyze the neutron polarization components after precessing through known magnetic fields. In addition, low momentum, large-angle protons produced during $np \rightarrow np$ elastic scattering in an active analyzer are detected, as a proof-of-principle measurement of the analyzing power. Large-angle protons are detected in a side arm setup one pair of the GEMs, and a hodoscope. The Active Analyzer is located between the inline GEMs and the Hadron Calorimeter to detect the forward neutron.

This experiment will yield G_E^n/G_M^n at a momentum transfer nearly three times that of the highest published Q^2 point with recoil polarization. The charge exchange figure-of-merit is comparably higher than that of $np \rightarrow np$, then future recoil polarization at higher Q^2 becomes feasible. Ongoing work focuses on the analysis of large-angle recoil protons to extract the G_E^n and analyzing power. As part of this analysis, we have studied the hit correlation between both PR GEMs and the hit correlation between GEMs and the PR hodoscope to understand the detector response and improve event selection.

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