Simulation of Neutron Detection Efficiency in the CLAS12 detector[1]

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The neutron magnetic form factor is a fundamental observable that will be measured with the CLAS12 detector at Jefferson Lab. This measurement requires precise knowledge of the CLAS12 neutron detection efficiency(NDE). We determine the NDE by measuring the ratio of neutrons detected versus how many neutrons are expected. We use the nuclear reaction ($ep \rightarrow e'n\pi^+$) - electron beam(e) on a proton target(p) producing an electron(e'), neutron(n), and a pion(π^+). We apply momentum conservation to the $e'\pi^+$ system to predict the neutron trajectory. We swim the neutron track to see if it strikes the fiducial volume of CLAS12. If it hits, we increment the NDE denominator for that neutron momentum. Otherwise the event is thrown out. For good events we then search for a neutron hit near the predicted position. If it is found, we add it to the NDE numerator. We generated events using Pythia, simulated them in CLAS12 with the physics-based Monte Carlo code GEMC, and reconstructed them using the CLAS12 Common Tools. We added background events to study their effect on the NDE ratio. We wrote a groovy script to analyze the data and extract the NDE. The NDE is small at low momenta and at a momentum of approximately 0.5 GeV it rises to a plateau at an efficiency of about 70%.

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