Advantage of using 5 GeV beam for G_e^N

There are well known advantages to higher incident energies in electron scattering. In our recent beam request to TJNAF, we presented our desire to have beam energies greater than 4 GeV. Here we compare the Mott cross sections for two cases: a) the original proposal, and b) energies up to 4.85 GeV. We have limited ourselves to electron scattering angles $> 13°$ and have required clear access for the incident and outgoing particles through the magnet. Tables 1 and 2 represent, respectively, the old ($E_o \leq 4GeV$) and new ($E_o \leq 5GeV$) optimal kinematic parameters associated with the four different Q^2 values; the final columns of these tables lists the Mott cross sections (σ_{enMott}) associated with the corresponding kinematic parameters.

Table 1: old (nucleon) kinematic quantities and Mott cross sections

Q^2 $(GeV/c)^2$	E_o GeV	θ_e	ν_{qe} GeV	q GeV/c	θ_q	θ_B	T'_n GeV	σ_{enMott} nb/sr
0.50	2.85	14.97°	0.266	0.756	62.05°	27.95°	0.266	2178
1.00	3.97	15.56°	0.533	1.133	54.45°	35.55°	0.533	963
1.50	3.97	19.88°	0.799	1.463	47.49°	42.51°	0.799	360
2.00	3.97	24.04°	1.066	1.771	41.92°	48.08°	1.066	167

Table 2: new (nucleon) kinematic quantities and Mott cross sections

Q^2 $(GeV/c)^2$	E_o GeV	θ_e	ν_{qe} GeV	q GeV/c	θ_q	θ_B	T'_n GeV	σ_{enMott} nb/sr
0.50	3.26	13.00°	0.266	0.756	62.99°	27.01°	0.266	2937
1.00	4.69	13.00°	0.533	1.133	55.64°	34.36°	0.533	1416
1.50	4.82	15.99°	0.799	1.463	49.24°	40.76°	0.799	585
2.00	4.85	19.00°	1.066	1.771	44.09°	45.91°	1.066	289

Comparing the values of the old and new σ_{enMott} (see table 3), one can readily see that the higher incident electron energies will provide a significant increase in cross sections. These larger cross sections translate into higher count rates which correspond to an overall shorter running time (at each Q^2) and/or higher precision in the measurement.

Table 3: % increase in σ_{enMott}

Q^2 $(GeV/c)^2$	$\sigma_{oldMott}$ nb/sr	$\sigma_{newMott}$ nb/sr	% increase
0.50	2178	2937	34.8
1.00	963	1416	47.0
1.50	360	585	62.5
2.00	167	289	73.1