O(e,e'p) meeting minutes
Larry Weinstein, 5 Dec 2007

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Kurnia presented the status of the analysis at ODU, starting with his August progress report (see ENOTE p80). He also showed his comparisons of reduced yields. There is still some disagreement between kin A and D. This disagreement also exists in the simulation. He looked more closely and found differences in the Q^2 and ω acceptances of the two kinematics (for the missing momenta where they overlap and disagree) and large differences in the ϕ acceptance. This indicates that much of the difference in the reduced cross section could well be due to R_{LT}. We then discussed exactly what needs to be done to extract A_{LT} from the data. This is a follow-up to the discussion with Kevin in October.

In general, we plan to bin the data in $\{Q^2, \omega, p_m, \phi\}$. We will calculate a radiatively corrected, reduced cross section for each bin and histogram the phase space (ie: the unweighted simulation results). We will then eliminate all bins where the phase space is less than some fraction of the maximum (nominal cut is 50%). (We know from Kurnia's analysis that bins with phase space less than 50% should not be used because the correction to the data is too large and too undetermined.)

There are at least two general approaches to extracting A_{LT} from the data. (1) we can fit a function of form $A + B\cos\phi + C\cos 2\phi$ to the data. Then $A_{LT} = B/(A+C)$. (2) Alternatively we can match acceptances for + and − kinematics and subtract. To do this, we have to restrict the acceptance so that for each bin in Q^2, ω, p_m we have matching acceptances in ϕ for + and − kinematics. For example, let's say we have 20 bins in ϕ. Then, if ϕ bins $\{1, 2, 3\}$ in the plus kinematics pass the phase space cut and bins $\{19, 20\}$ in the minus kinematics pass the phase space cut, then we will use the matching bins $\{1, 2, 19, 20\}$. We can then calculate A_{LT} for bin n of p_m, bin j of Q^2 and bin k of ω as

$$A_{LT}(Q_j^2, \omega_k, p_m^n) = \frac{\sum_{i=1}^{\phi_{max}} \left[\sigma_{red}(Q_j^2, \omega_k, p_m^n, \phi_i)/\cos\phi_i\right]}{\sum_{i=1}^{\phi_{max}} \left[\sigma_{red}(Q_j^2, \omega_k, p_m^n, \phi_i)/|\cos\phi_i|\right]}$$

By propagating uncertainties properly, we calculate $A_{LT}(Q_j^2, \omega_k, p_m^n) \pm \delta A_{LT}(Q_j^2, \omega_k, p_m^n)$.

We will want to check our results with the identical quantity calculated for the weighted simulation for each bin in Q^2, ω, p_m. For example, we can make a 2-D plot in Q^2 and ω of $A_{LT}^{data}/A_{LT}^{sim}$ for each p_m bin.

Then we need to average over Q^2, ω:

$$< A_{LT}(p_m^n) >= \frac{\sum_{j,k} \frac{A_{LT}(Q_j^2, \omega_k, p_m^n)}{\delta A_{LT}(Q_j^2, \omega_k, p_m^n)}}{\sum_{j,k} \frac{1}{\delta A_{LT}(Q_j^2, \omega_k, p_m^n)}}$$

We can do this for both experiment and simulation. However, when we do this for the simulation, we need to use the experimental uncertainties so that the simulation has the same $\{Q^2, \omega\}$ weighting as the data. Note also that we need to calculate the average $\{Q^2, \omega\}$ for the calculation so that we can then apply a bin-centering correction to bring the data to the central $\{Q^2, \omega\}$ of the experiment. [Tech note TN-07-068 shows how the simulation can vary when we do not apply a bin-centering correction.]

There are a number of systematic checks we need to do:

1 check how the calculated cross section varies as we vary the number of bins in Q^2, ω.
2 compare the two methods of calculating A_{LT}.
3 compare the effect of different ϕ_{max} on the calculation. This is needed to reduce the effect of R_{TT} on A_{LT}. Note that this applies to the subtraction, not to the fit method. Note that this effect is largest for the lower kinematics. For example, for kin A+, the ϕ-range is more than 1 radian. For kin D+, it is less than 0.5 radian.
4 check the effects of tighter R-function cuts.
5 check that these procedures, when applied to the simulation, recover the initial A_{LT}.

There are some other issues to check:

1 is energy loss treated correctly in the simulation? We currently do not apply energy loss to the simulated particles so there is no need to correct for it. Unless the energy loss of the particles is simulated stochastically, there is no gain in simulating and correcting the energy loss analytically. This only tests that the energy loss effect and the correction are applied identically.
2 radiative corrections: the Schwinger correction is easy and should be identical for plus and minus. The kinematic effects of low energy real photon radiation can only be calculated using the simulation.

Immediate tasks: We will first use one bin in $\{Q^2, \omega\}$ and no radiative corrections to calculate initial A_{LT} as a function of p_m for kinematics A and D.