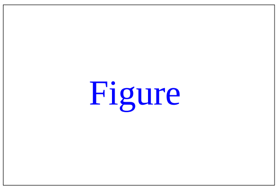

Figure 1: Radiative corrections to the measured asymmetries.

Orientation	T_b	T_a
parallel	0.0246	0.0253
perpendicular	0.0256	0.0294

Table 1: Material thickness in radiation lengths before and after the scattering for both target orientations.

0.1 Proton Radiative Corrections

An incident electron loses some fraction of its energy as it passes through the materials before and after scattering, as well as during the interaction itself. The procedure to account for these effects are known as external and internal radiative corrections, respectively. The internal radiative corrections include corrections to the leading order Feynman diagram and can be spin-dependent. The external corrections are spin-independent (as long as the non-target material is unpolarized) and are dominated by the emission of brehmsstrahlung, with a small contribution arising from the Landau straggling of the electron.

The external radiative correction were applied following the formalism of Mo and Tsai [1], using the peaking approximation procedure of Ref. [2]. The internal radiative corrections utilized the Fortran based POLRAD [3] code which was updated to include a model of the RSS polarized data.

0.1.1 Elastic Tail Subtraction

The elastic peak has the lowest possible invariant mass and can radiate events to all higher mass states. It must therefore be subtracted before the inelastic radiative corrections are applied. The measured asymmetry contains a contribution from elastic tail as follows:

$$A_T^{\mathrm{r}} = \frac{\Delta_T^{\mathrm{r}}}{\Sigma_T^{\mathrm{r}}} = \frac{\Delta_{\mathrm{in}}^{\mathrm{r}} + \Delta_{\mathrm{el}}^{\mathrm{r}}}{\Sigma_{\mathrm{in}}^{\mathrm{r}} + \Sigma_{\mathrm{el}}^{\mathrm{r}}} \quad (1)$$

where the subscripts T,el and in refer to the total measured quantity, elastic and inelastic contributions respectively. The superscript r implies the the quantity is radiated. For example, A_T^{r} represents the measured asymmetry.

Because the asymmetries are not additive, we perform the tail subtraction on the polarized cross section $\Delta = \Sigma A$:

$$\Delta_{\mathrm{in}}^{\mathrm{r}} = \Delta_T^{\mathrm{r}} - \Delta_{\mathrm{el}}^{\mathrm{r}} \tag{2}$$

The measured asymmetry is related to the polarized cross section via:

$$\begin{aligned}
A_{\mathrm{in}}^{\mathrm{r}} &= \frac{\Delta_{\mathrm{in}}^{\mathrm{r}}}{\Sigma_{\mathrm{in}}^{\mathrm{r}}} && (3)\\
&= \frac{\Delta_T^{\mathrm{r}} - \Delta_{\mathrm{el}}^{\mathrm{r}}}{\Sigma_{\mathrm{in}}^{\mathrm{r}}} && (4)\\
&= \frac{\Sigma_T^{\mathrm{r}} A_T^{\mathrm{r}} - \Delta_{\mathrm{el}}^{\mathrm{r}}}{\Sigma_{\mathrm{in}}^{\mathrm{r}}} && (5)\\
&= \left(\frac{\Sigma_T^{\mathrm{r}}}{\Sigma_{\mathrm{in}}^{\mathrm{r}}}\right) A_T^{\mathrm{r}} - \frac{\Delta_{\mathrm{el}}^{\mathrm{r}}}{\Sigma_{\mathrm{in}}^{\mathrm{r}}} && (6)\\
&= \frac{1}{f} A_T^{\mathrm{r}} - Cel && (7)
\end{aligned}$$

where we have made the following definitions:

$$f = \frac{\Sigma_{\mathrm{in}}^{\mathrm{r}}}{\Sigma_T^{\mathrm{r}}} \tag{8}$$

$$C_{el} = \frac{\Delta_{\mathrm{el}}^{\mathrm{r}}}{\Sigma_{\mathrm{in}}^{\mathrm{r}}} \tag{9}$$

The radiative dilution factor f is completely determined by the model [5] of the unpolarized cross section Σ, and is the only part of the radiative correction to affect the statistical errors. C_{el} requires both the unpolarized model and knowledge of the elastic asymmetry [6] to form $\Delta_{\mathrm{el}}^{\mathrm{r}}$.

0.1.2 Inelastic Radiative Correction

The external material thickness was modeled as two radiators of thickness T_b and T_a placed before and after the target respectively. The relevent radiation lengths of RSS are listed in Table 1.

After the elastic tail is subtracted, a fit was made to the RSS A_1 and A_2 data. A global model [5] of the unpolarized proton data was used to transform these fits directly into polarized cross sections as needed for the radiative corrections. The polarized cross section model was radiated and then compared to the measured data. An iterative procedure was used to adjust this model until the final radiated cross section agreed with the measured data. The difference between the Born and radiated asymmetry models was then applied directly to the measured inelastic data and is defined as C_{in}.

So the total radiative correction is given explictly by

$$A = \frac{A_{raw}}{f} + C \tag{10}$$

where C has both an elastic and inelastic contribution.

0.1.3 Systematic Uncertainties

The elastic form factors contributed 5% uncertainty to the tail subtraction, while the model-dependence of the inelastic radiative corrections was evaluated by performing the procedure with several different inelastic models, varying the A_1 and A_2 models independently. The additional models were the JLab Hall B fit [8] to world data excluding, and then including Eg1a [7] data, along with the AO [10], and the DMT [9] models.

0.1.4 Total Radiative Correction

The size of the radiative corrections and the related systematic uncertainy can be seen in Fig. 1.

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