RCs

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Abstract

Radiative are performed on the sane experiment to obtain the A1 and A2. Internal radiative corrections are calculated in polarization dependent way, while the external radiative corrections are calculated following the procedure of Mo and Tsai.

1 Introduction

2 Overview

The measured asymmetry includes external effects due to target thickness in addition to the internal radiative corrections.

The experimental asymmetry is

$$A^{r+t} = \frac{\sigma_{+}^{r+t} - \sigma_{-}^{r+t}}{\sigma_{+}^{r+t} + \sigma_{-}^{r+t}} \tag{1}$$

where $r+t$ denotes cross sections with internal (r) and external (t) radiation.

3 Background Contamination

Before subtracting the elastic radiative tail, the background of positrons, mostly produced from π^0 decays, must be subtracted. Here we will assume that all positrons are coming from pair production. The correction takes the form

$$A_{corr} = C_{pair} A_{raw}. \tag{2}$$

The resulting A_{corr} is the asymmetry of just the DIS electrons.

The correction for an experiment using a large magnetic spectrometer is

$$C_{pair} = \frac{1 - R A_{pair}/A_{raw}}{1 - R}, \tag{3}$$

where $R = n_{pair,e+}/n_{dis,e-}$ and A_{pair} is the positron asymmetry. Note that there is also the measured ratio, $r = n_{pair,e+}/n_{total,e-} = R/(1+R)$ which is often (incorrectly) interchanged with R.

3.1 BETA Background subtraction

The equations above are correct for an experiment which only detects electrons or high has a high positron rejection efficiency. However, for the case at hand, BETA was in an open configuration and detected both charges. Therefore, for each positron detected there is a corresponding electron, so a factor of two must be added to each R in the equation above. Thus the total rate would be

$$\begin{aligned} n_{total} &= n_{dis} + 2n_{pair} \\ &= n_{dis}(1 + 2R) \end{aligned}$$

or

$$\begin{aligned} n_{dis} &= n_{total}\frac{1}{1+2R} \\ n_{pair} &= n_{total}\frac{2R}{1+2R} \end{aligned}$$

It should be noted that due to the up-down symmetry of the target magnet, positron tracks are reconstructed the same as a positron track.

Using these definitions the correction can be split into a dilution correction and a contamination correction due to A_{pair}.

$$\begin{aligned} A_{corr} &= \left(\frac{1}{1-2R}\right) A_{raw} - \left(\frac{2RA_{pair}}{1-2R}\right) \\ &= \left(\frac{n_{dis}}{n_{dis}-2n_{pair}}\right) A_{raw} - \left(\frac{2n_{pair}A_{pair}}{n_{dis}-2n_{pair}}\right) \\ &= \left(\frac{1}{f_{bg}}\right) A_{raw} - (C_{A_{bg}}) \end{aligned}$$

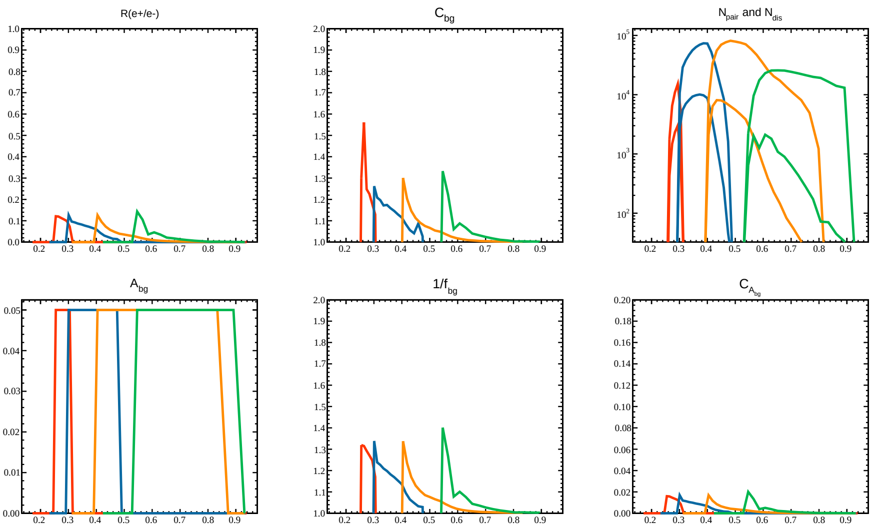

Figure 1: Corrections etc for different Q^2 bins.

Previous experiments[**?**] have measured and fit the ratio of positrons to electrons (at least just for the parallel configuration). There they use the fit

4 Subtracting Elastic Tail

First we want to get the inelastic radiated asymmetry from the total asymmetry.

$$A_{Exp} = \frac{\Delta^{total}_{r+t}}{\Sigma^{total}_{r+t}} = \frac{\Delta^{in}_{r+t} + \Delta^{el}_{r+t}}{\Sigma^{in}_{r+t} + \Sigma^{el}_{r+t}} \tag{4}$$

where A_{Exp} is the measured radiated asymmetry, the Δs are polarized cross section differences and Σs are unpolarized cross sections. The subscript denotes inelastic or elastic processes. The born asymmetry is calculated as

$$A_{in} = \frac{\Delta_{in}}{\Sigma_{in}} \tag{5}$$

$$= \frac{\Delta_T - \Delta_{el}}{\Sigma_{in}} \tag{6}$$

$$= \frac{\Sigma_T A_{Exp} - \Delta_{el}}{\Sigma_{in}} \tag{7}$$

$$= \frac{1}{f_{el}} A_{Exp} - C_{el} \tag{8}$$

where

$$\frac{1}{f_{el}} = \frac{\Sigma_T}{\Sigma_{in}} \tag{9}$$

and

$$C_{el} = \frac{\Delta_{el}}{\Sigma_{in}} \tag{10}$$

In order to subtract the elastic tail we need the fully radiated cross section difference Δ_{el}, and the ratiated cross section sums Σ_{in} and Σ_{el}

Figure 2: Image (`A1p.tex`) generated thanks to `TTeXDump`

5 Calculating the Radiative Tails

5.1 Elastic Radiative Tail

Mo and Tsai do not provide a way of calculating the polarized elastic radiative tail, however, it does provide a method for calculating the external radiative tail, which we treat as an unpolarized effect. The polarized elastic radiative tail, σ^{ERT}_r calculated using the formalism of [**?**]. Using the born level, polarized elastic cross section, the external component of the radiative tail, σ^{ERT}_t, is calculated following equation A.16 of Mo and Tsai. The totally radiated elastic radiative tail is then simply

$$\sigma^{ERT}_{t+r}(E_s, E_p, T/2) = \sigma^{ERT}_t(E_s, E_p, T/2) + \sigma^{ERT}_r(E_s, E_p). \tag{11}$$

5.2 Inelastic Radiative Tail

Following equation A.22 of Mo and Tsai [**?**], the inelastic external radiative corrections to the interanlly radiated cross section difference (or sum) can be written using the "strip" approximation as

$$\begin{aligned}
&\Delta\sigma_{t+r}(E_s, E_p, T/2) = \\
&\quad e^{\delta_s+\delta_p}\Delta\sigma_r(E_s, E_p, T/2) \\
&\quad + e^{\delta_s/2}\int_{E_{smin(E_p)}}^{E_s-\Delta}\{1 - D(E_s, E_s', Z)\}\, I_e(E_s, E_s', T/2)\Delta\sigma_r(E_s', E_p, T/2)dE_s' \\
&\quad + e^{\delta_p/2}\int_{E_p+\Delta}^{E_{pmax(E_s)}} I_e(E_p', E_p, T/2)\Delta\sigma_r(E_s, E_p', T/2)dE_p'.
\end{aligned}$$

6 Iterative Procedure

Figure 3: Image (`A1ppdf.tex`) generated thanks to `TTeXDump`