

BigBite

Pair-Production Correction

Matthew Posik

¹Temple University
Philadelphia, PA 19122

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1 Pair-Production Correction Methods

- Method 1: Asymmetry Correction
- Method 2: Counting Correction
- Method Comparison

2 To Do

Pair-Production Correction Methods

There are **two** methods by which to correct for pair production contamination

1 **Asymmetry Correction**

- Form positron asymmetry and dilution factor
- Correct measured asymmetry by subtracting positron asymmetry

2 **Counting Correction**

- Correct measured helicity counts by subtracting positron counts

Positron Asymmetry Correction

$$A_m = \frac{N_e^- - N_e^+ + N_p^- - N_p^+}{N_e^- + N_e^+ + N_p^- + N_p^+} = \frac{\Delta N_e + \Delta N_p}{N_e + N_p}$$

where e = electron, p = positron and $-(+)$ is negative (positive) helicity
 ΔN is $N^- - N^+$ and N is $N^- + N^+$

$$A_m = \frac{\frac{\Delta N_e}{N_e} + \frac{\Delta N_p}{N_p}}{1 + \frac{N_p}{N_e}} = \frac{A_e + \frac{\Delta N_p}{N_e} \frac{N_p}{N_p}}{1 + \frac{N_p}{N_e}} = \frac{A_e + R A_p}{1 + R}$$

$$A_e = A_m (1 + R) - A_p R$$

$$\delta A_e = \sqrt{(1 + R)^2 \delta A_m^2 + R^2 \delta A_p^2 + (A_m - A_p) \delta R^2}$$

where:

- A_m = measured asymmetry
- A_e = clean electron asymmetry
- A_p = positron asymmetry
- $R = e^+/e^-$ ratio (assume $\delta R = 0$ for now)

4.74 GeV e^+/e^- Ratios

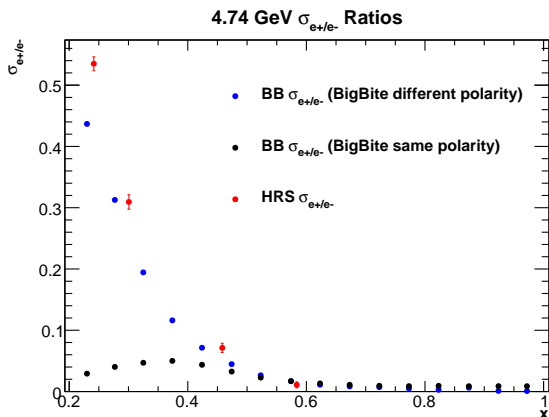


Figure: Ratios of positron and electrons from the LHRs and BigBite.

Positron Count Correction

$$N_m^+ = N_e^+ + \frac{N_p^+}{R}$$

$$N_m^- = N_e^- + \frac{N_p^-}{R}$$

$$\delta N_e^{-/+} = \sqrt{\left(\delta N_m^{-/+}\right)^2 + \left(\frac{\delta N_p^{-/+}}{R}\right)^2 + \left(\frac{N_p^{-/+}}{R^2} \delta R\right)^2}$$

where e = electron, p = positron and $-(+)$ is negative (positive) helicity

$$A_e = \frac{N_e^- - N_e^+}{N_e^- + N_e^+}$$

$$\delta A_e = \frac{2N_e^- N_e^+}{(N_e^- + N_e^+)^2} \sqrt{\left(\frac{\delta N_e^-}{N_e^-}\right)^2 + \left(\frac{\delta N_e^+}{N_e^+}\right)^2}$$

where:

- N_m = measured counts
- A_e = clean electron asymmetry
- $R = (e^+)_{\text{bend-down}} / (e^+)_{\text{bend-up}}$ ratio (only stat.)

4.74 GeV e^+/e^+ Ratio

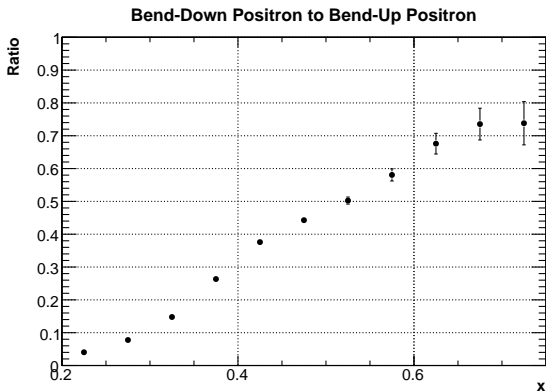


Figure: Ratios of **bend-down** positron to **bend-up** positrons.

Contributions to Uncertainties

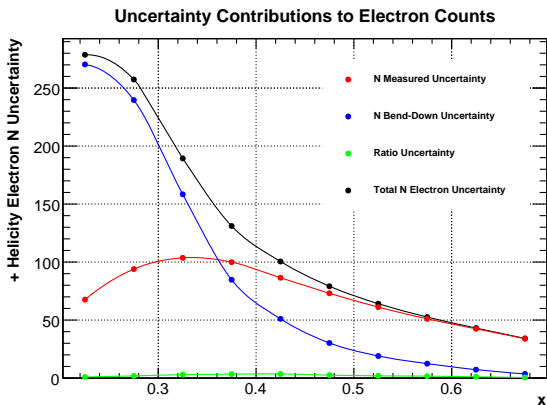


Figure: Contributions of each uncertainty to total uncertainty of corrected electron asymmetry. Plot shows the results for one run.

Change in Asymmetry

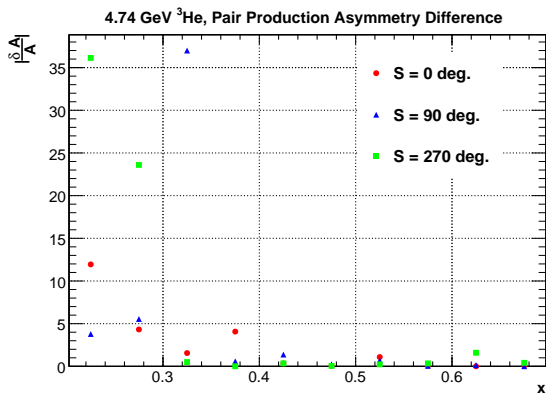


Figure: plot shows the Difference of the pair production and raw asymmetry, normalized by the raw asymmetry.

4.74 GeV Asymmetry Comparison

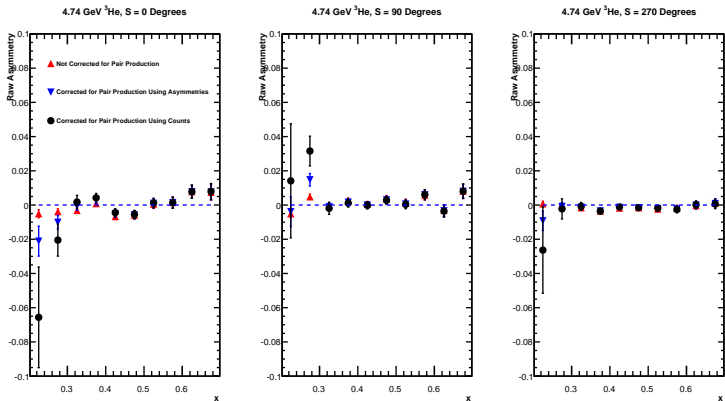


Figure: Plot shows the raw asymmetry in red, the asymmetry corrected for pair production by the asymmetry method in blue and the counts method in black.

4.74 GeV Asymmetry Uncertainty Comparison

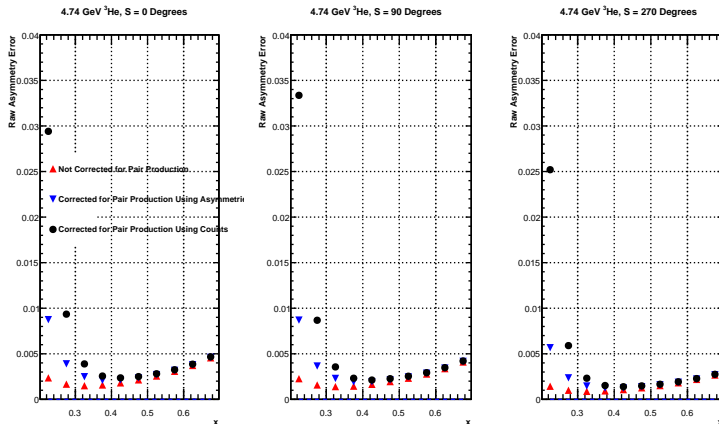


Figure: Plot shows the raw asymmetry uncertainty in red, the asymmetry uncertainty corrected for pair production by the asymmetry method in blue and the counts method in black.

TO Do

- Meet with Zein-Eddine to discuss radiative corrections

4.74 GeV Asymmetry Comparison (Zoom-In)

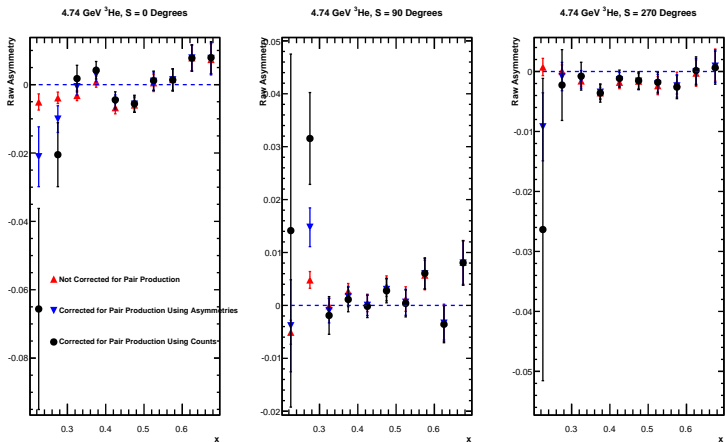


Figure: Plot shows the raw asymmetry in red, the asymmetry corrected for pair production by the asymmetry method in blue and the counts method in black.