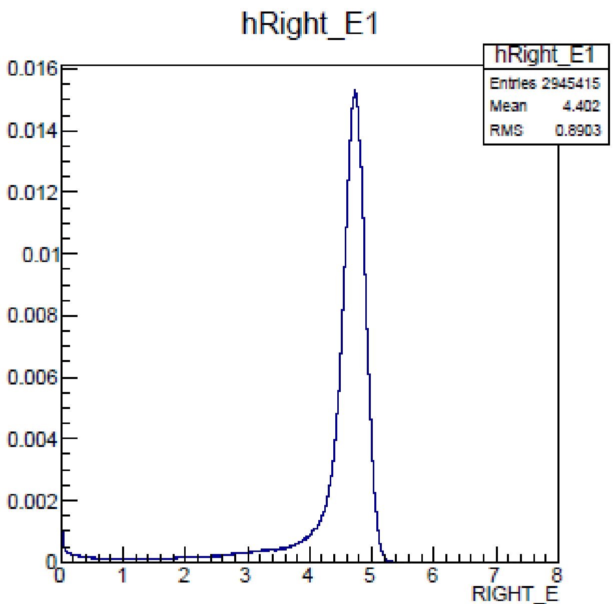
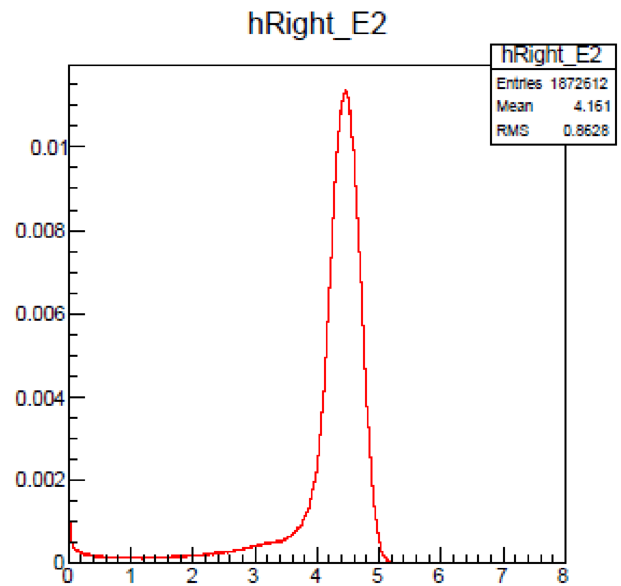
Determining Background in Mott Energy Spectra



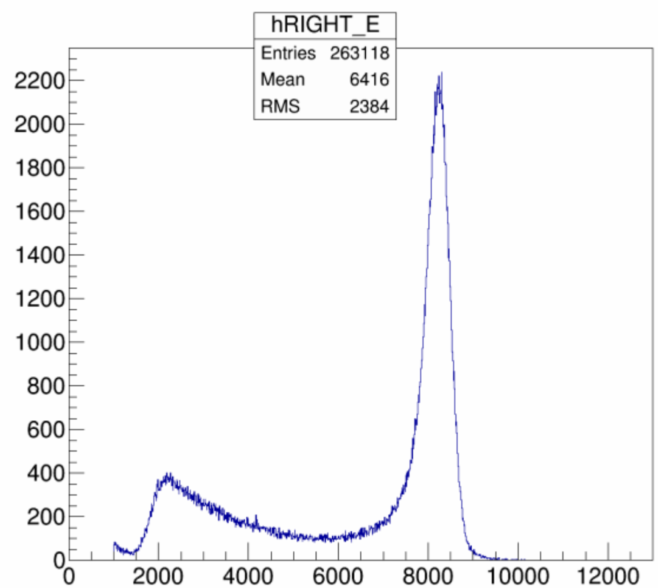


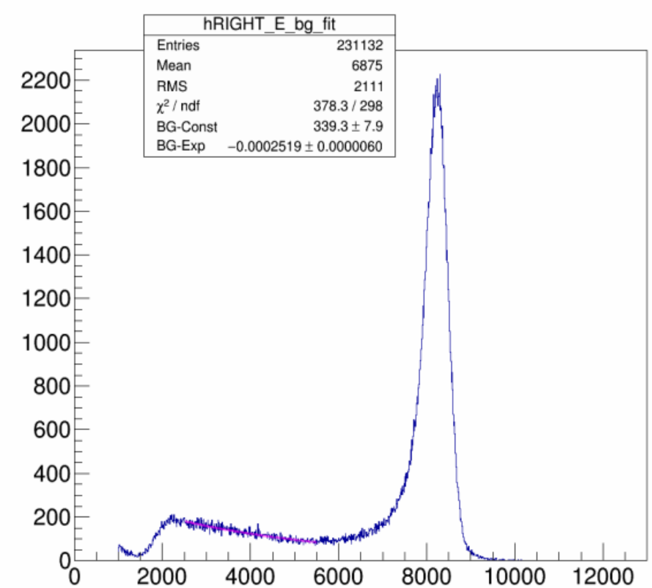
GEANT4 Simulation Mott energy spectra

blue single-scattering, red double-scattering

Run 8545 from Run II, on 350nm Foil, with Hardware ToF-veto

Left, energy spectra before ToF software cut
Right, energy spectra after ToF Software cut





Determining Background in Mott Energy Spectra

$$\varepsilon = \frac{N^+ - N^-}{N^+ + N^-} \rightarrow \left\{ \varepsilon = \frac{N^+ - N^-}{N^+ + N^-} \right\}_{LRUD} \longrightarrow \left\{ \varepsilon_i = \frac{N_i^+ - N_i^-}{N_i^+ + N_i^-} \right\}_{LRUD}$$

Looking at one detector...

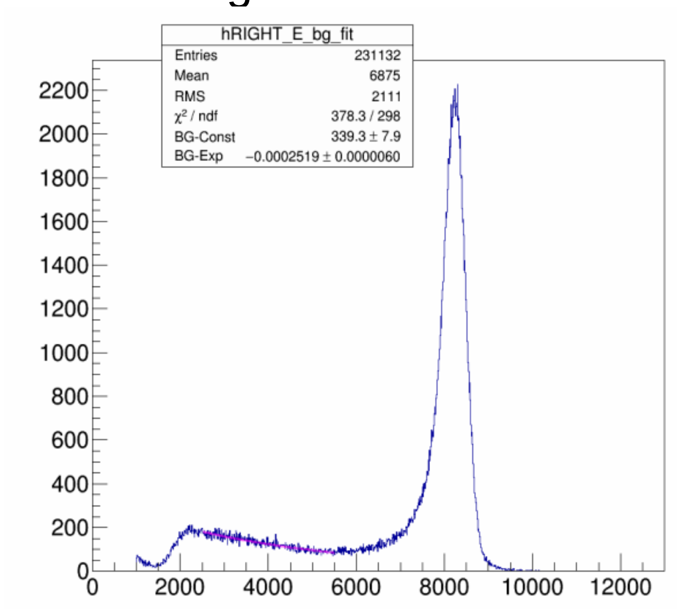
Assume $\forall i$, $\varepsilon_c = \dfrac{n_i^+ - n_i^-}{n_i^+ + n_i^-}$ $\quad b_i^\pm \rightarrow b_i \quad N_i^\pm = n_i^\pm + b_i$

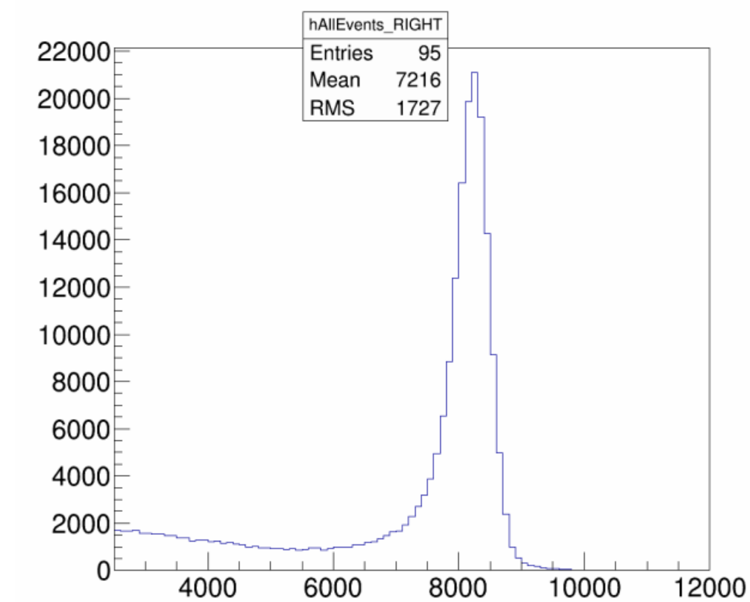
then,

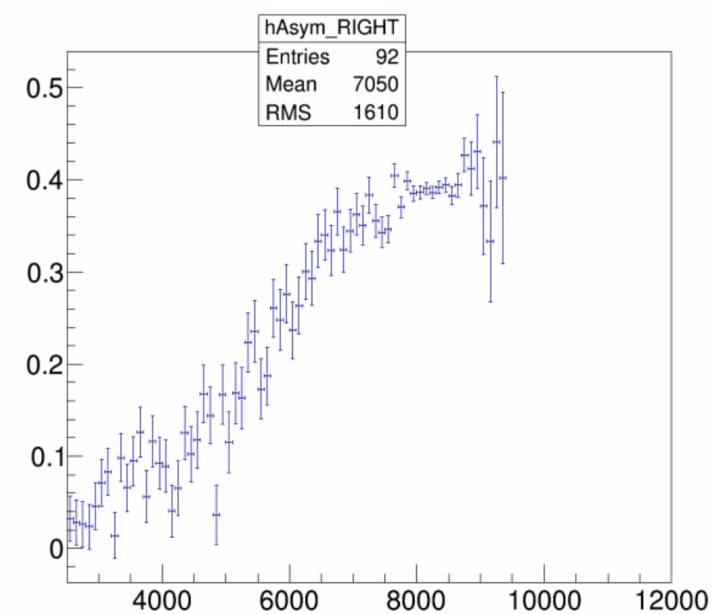
$$\varepsilon_c = \frac{(N_i^+ - b_i) - (N_i^- - b_i)}{(N_i^+ - b_i) + (N_i^- - b_i)} \Rightarrow \quad b_i = \frac{1}{2}\left[(N_i^+ + N_i^-) - (\frac{N_i^+ - N_i^-}{\varepsilon_c}) \right]$$

Determining Background in Mott Energy Spectra

Taking a bin size of 100 channels (from fits, sigma ~250 channels)







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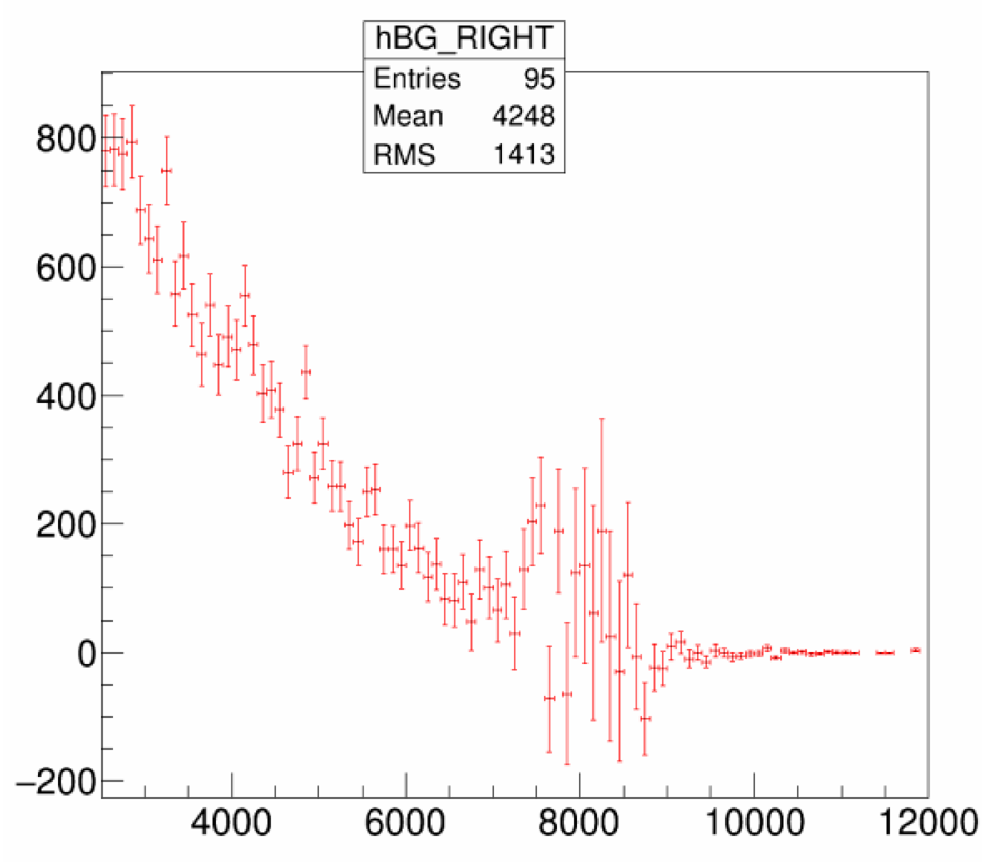
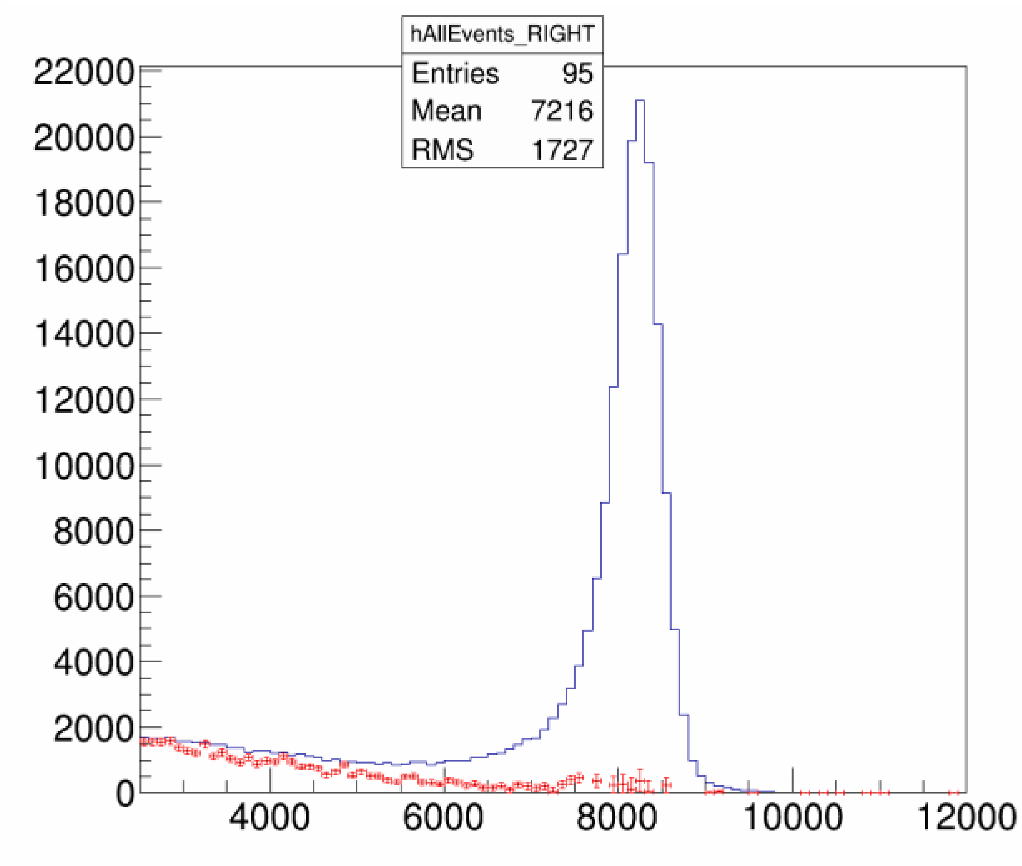


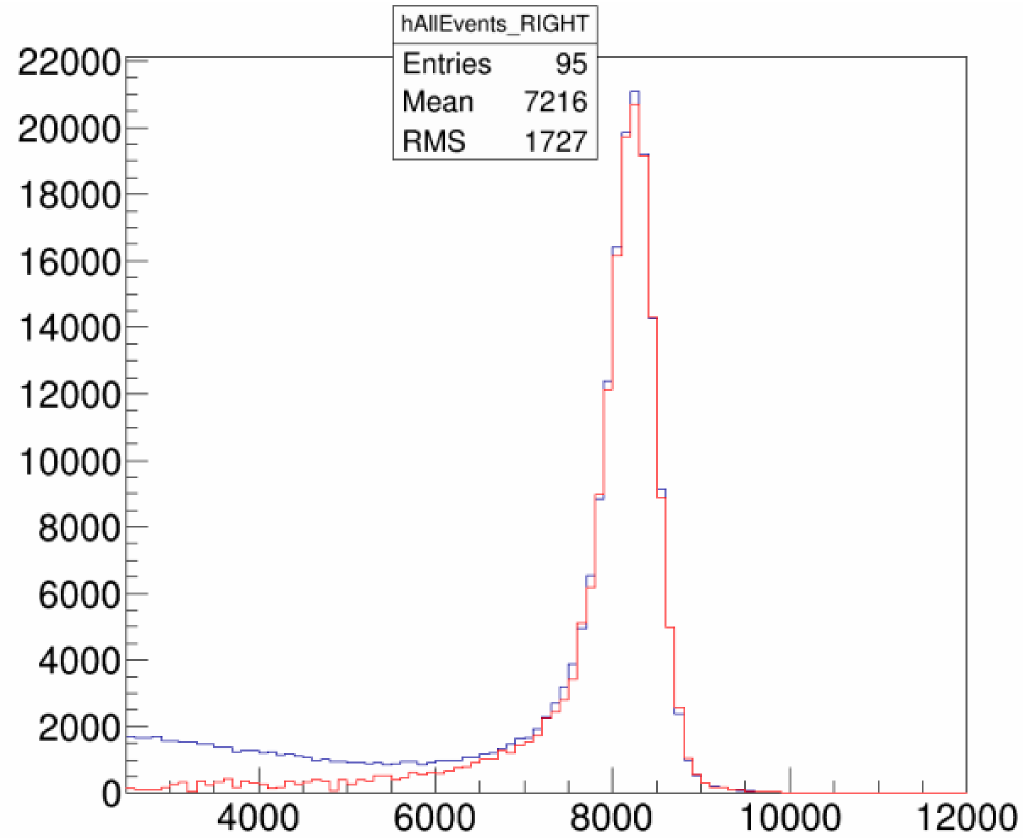
Bin-by-bin Calculated Background



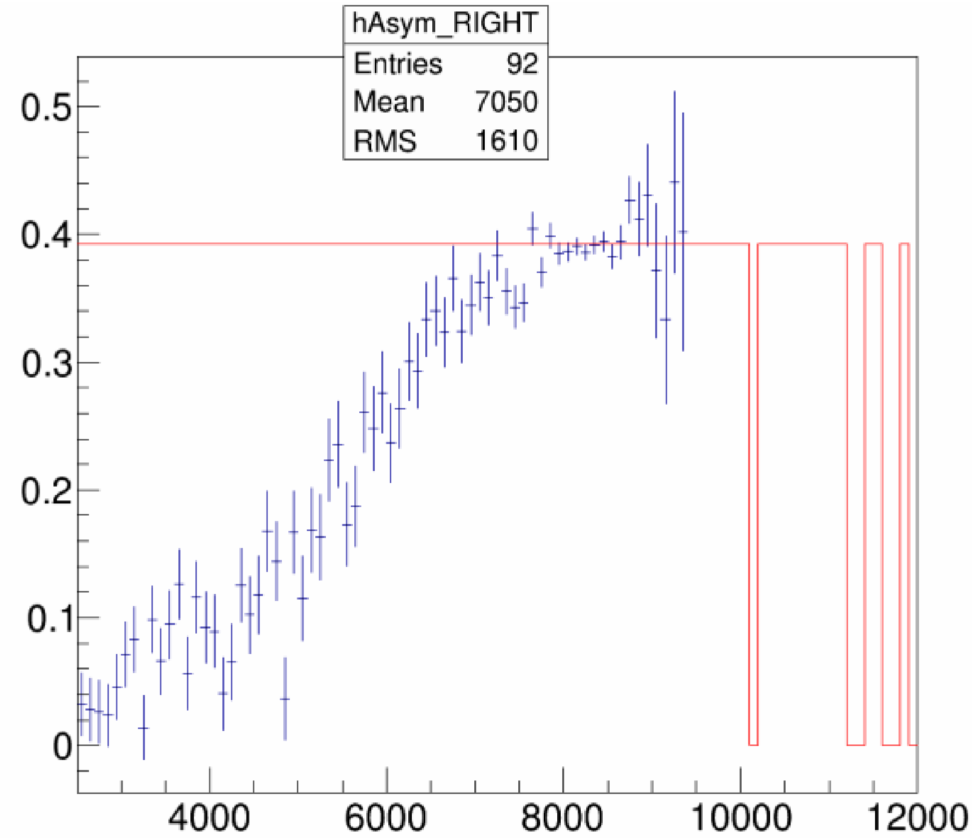
Calculated Background and Energy Spectra

Run 8545, 350nm Foil
Right Detector

Determining Background in Mott Energy Spectra



Energy Spectra



Asymmetry

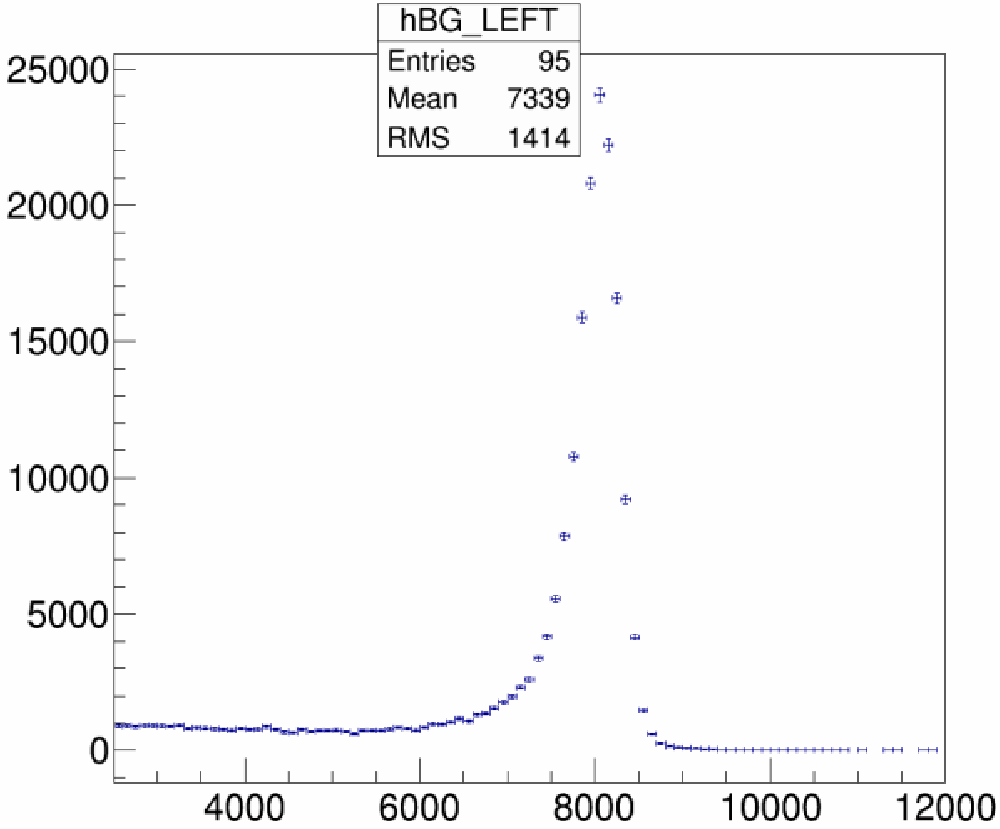
Blue : Before Background subtraction
Red : After Background Subtratction

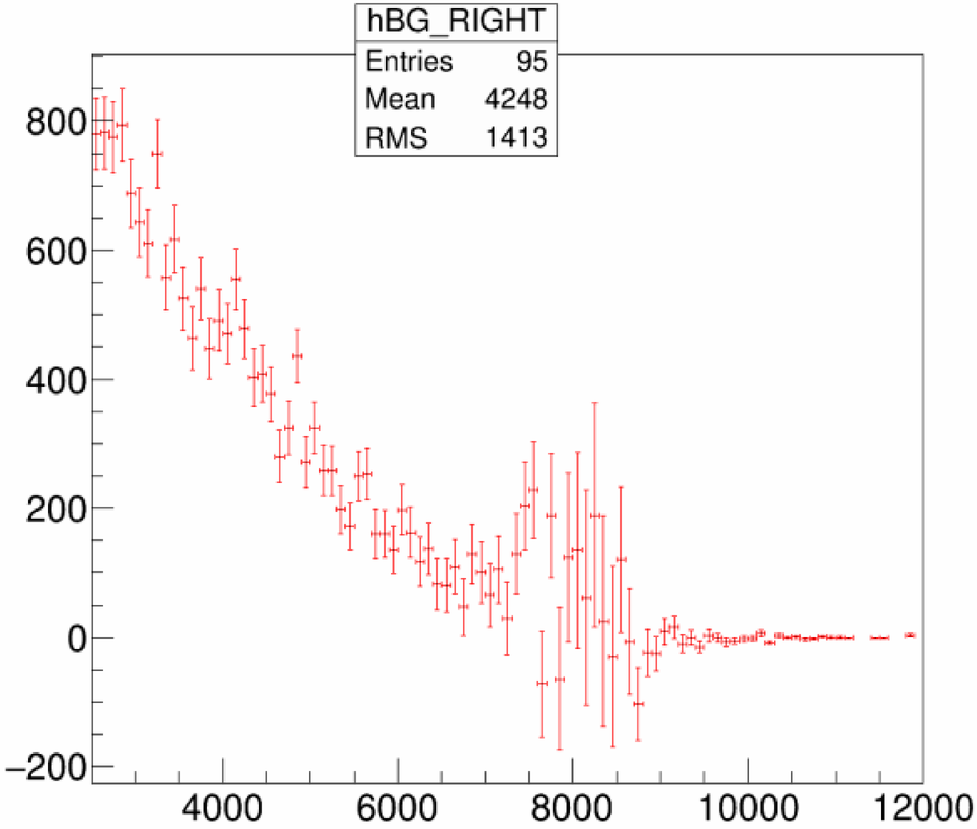
Run 8545, 350nm Foil
Right Detector

Determining Background in Mott Energy Spectra

2 (related) problems....

1) $$b_i = \frac{1}{2}\left[(N_i^+ + N_i^-) - (\frac{N_i^+ - N_i^-}{\varepsilon_c}) \right]$$ Only gives one sensible background signal





Run 8545, polarization set to be in y-axis => asymmetry in Left/Right detectors, not Up/Down

Determining Background in Mott Energy Spectra

2) We do not calculate detector-specific asymmetry, we look at detectors in pairs and then use cross-ratio method to calculate asymmetries in a given plane

$$r = \sqrt{\frac{N_L^+ N_R^-}{N_L^- N_R^+}} \qquad \varepsilon = \frac{1-r}{1+r}$$

Using the same assumptions as before,

$\forall i$,

$$\varepsilon_c = \left\{ \left(1 - \sqrt{\frac{n_L^+ n_R^-}{n_L^- n_R^+}} \right) \Big/ \left(1 + \sqrt{\frac{n_L^+ n_R^-}{n_L^- n_R^+}} \right) \right\}_i \qquad r_c = \left\{ \sqrt{\frac{n_L^+ n_R^-}{n_L^- n_R^+}} \right\}_i$$

$$\left\{ N_{L/R}^{\pm} = n_{L/R}^{\pm} + b \right\}_i$$

$$(b_{L/R}^{\pm})_i = b_i$$

Determining Background in Mott Energy Spectra

$$(N_L^{\pm})_i \to L_i^{\pm} \longrightarrow L_i^{\pm} = (n_L^{\pm})_i + b_i \longrightarrow (n_L^{\pm})_i = L_i^{\pm} - b_i$$

$$\varepsilon_c = \left\{ \left(1 - \sqrt{\frac{n_L^+ n_R^-}{n_L^- n_R^+}} \right) / \left(1 + \sqrt{\frac{n_L^+ n_R^-}{n_L^- n_R^+}} \right) \right\}_i \longrightarrow \left\{ \varepsilon_c = \frac{1 - r_c}{1 + r_c} \right\}_i$$

$$\varepsilon_c = \frac{1 - r_c}{1 + r_c} \to r_c = \frac{1 - \varepsilon_c}{1 + \varepsilon_c}$$

$$r_c = \left\{ \sqrt{\frac{n_L^+ n_R^-}{n_L^- n_R^+}} \right\}_i \longrightarrow r_c = \sqrt{\frac{(L_i^+ - b_i)(R_i^- - b_i)}{(L_i^- - b_i)(R_i^+ - b_i)}}$$

Determining Background in Mott Energy Spectra

Solving for b_i ...
$$r_c^2 = \frac{(L_i^+ - b_i)(R_i^- - b_i)}{(L_i^- - b_i)(R_i^+ - b_i)}$$

$$(r_c^2 - 1) * b_i^2 \ + (L_i^+ + R_i^- - r_c^2(L_i^- + R_i^+)) * b_i + r_c^2 L_i^- R_i^+ - L_i^+ R_i^- = 0$$

$$b_i = \frac{r_c^2(L_i^- + R_i^+) - (L_i^+ + R_i^-) \pm \sqrt{(L_i^+ + R_i^- - r_c^2(L_i^- + R_i^+))^2 - 4(r_c^2 - 1)(r_c^2 L_i^- R_i^+ - L_i^+ R_i^-)}}{2(r_c^2 - 1)}$$

Where
$$r_c = \frac{1 - \varepsilon_c}{1 + \varepsilon_c}$$

Determining Background in Mott Energy Spectra

Results Forthcoming....