# GEN-II Asymmetry Formalism

Sean Jeffas
April 18, 2024

# Data Asymmetry Formalism

**From GEN-I**

$$A_{\text{phys}} = \frac{A_{\text{raw}} - \left(\frac{\Delta_{\text{bk}}}{\Sigma} + \frac{\Delta_{\text{p}}}{\Sigma} + \frac{\Delta_{\text{other}}}{\Sigma}\right)}{P_{\text{beam}}\, P_{^3\text{He}}\, P_{\text{n}}\, D_{\text{bk}}\, D_{\text{N}_2}\, D_{\text{p}}\, D_{\text{other}}}$$

$$\Delta_x = N_x^p - N_x^m$$

$$\Sigma_x = N_x^p + N_x^m$$

$$\Sigma = \sum_x \Sigma_x$$

$$A_x = \Delta_x / \Sigma_x$$

$$f_x = \Sigma_x / \Sigma$$

$$f_n = 1 - \sum_x f_x$$

**Idea for GEN-II**

$$A_{phys} = \frac{A_{raw} - f_{acc} A_{acc} - f_p A_p - f_\pi A_\pi - f_{inel} A_{inel} - f_{FSI} A_{FSI}}{P_{He3} P_n P_{beam} f_n}$$

- $f_x$ denotes the fractional contribution inside the final QE cuts.
- $A_x$ denote the asymmetry of the contribution.
- Each count $N_x$ should be the number of x sample inside the QE cuts.

# Formalism from GEN-I

$$D_{\mathrm{bk}} = 1 - \frac{\Sigma_{\mathrm{bk}}}{\Sigma},$$

$$D_{\mathrm{N}_2} = 1 - \frac{\Sigma_{\mathrm{N}_2}}{\Sigma - \Sigma_{\mathrm{bk}}},$$

$$D_{\mathrm{p}} = 1 - \frac{\Sigma_{\mathrm{p}}}{\Sigma - \Sigma_{\mathrm{bk}} - \Sigma_{\mathrm{N}_2}},$$

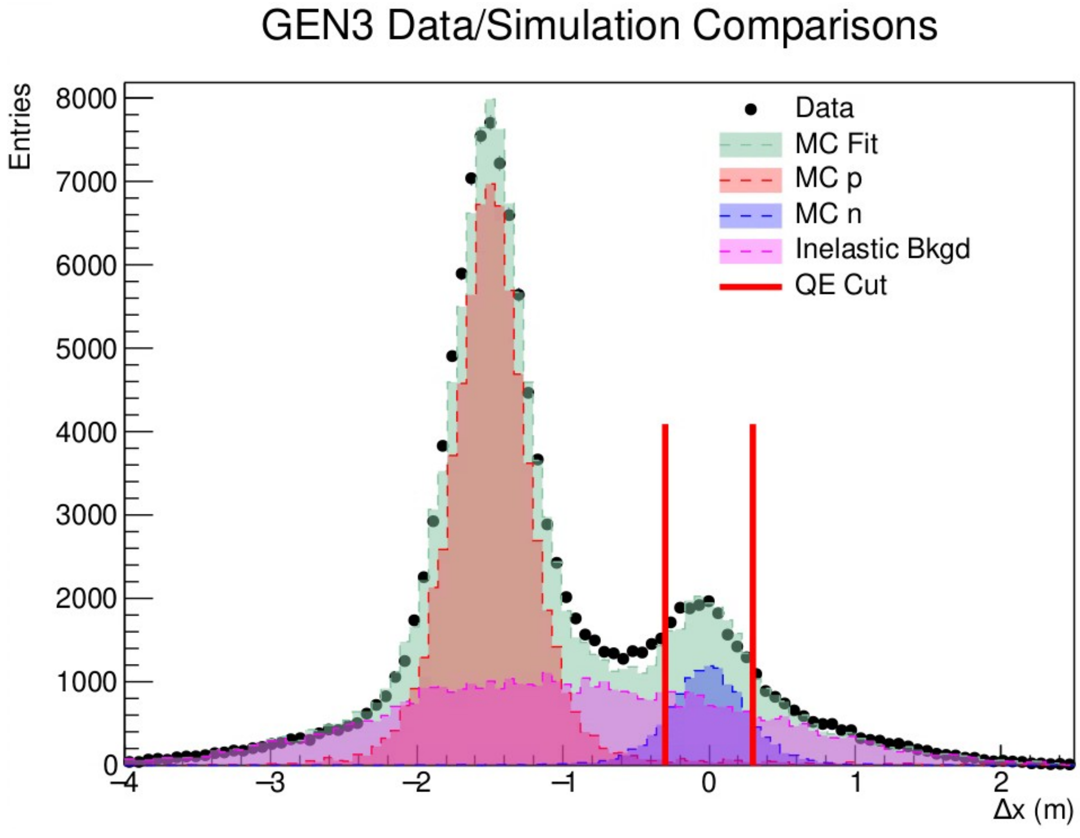
$$D_{\mathrm{other}} = 1 - \frac{\Sigma_{\mathrm{other}}}{\Sigma - \Sigma_{\mathrm{bk}} - \Sigma_{\mathrm{N}_2} - \Sigma_{\mathrm{p}}}.$$

- In GEN-I the dilutions are calculated iteratively.
  - The accidental background is calculated first from timing coincidence cuts.
  - The N2 is calculated next, but needs the background subtracted first.

# Proton/Neutron/Background Fits

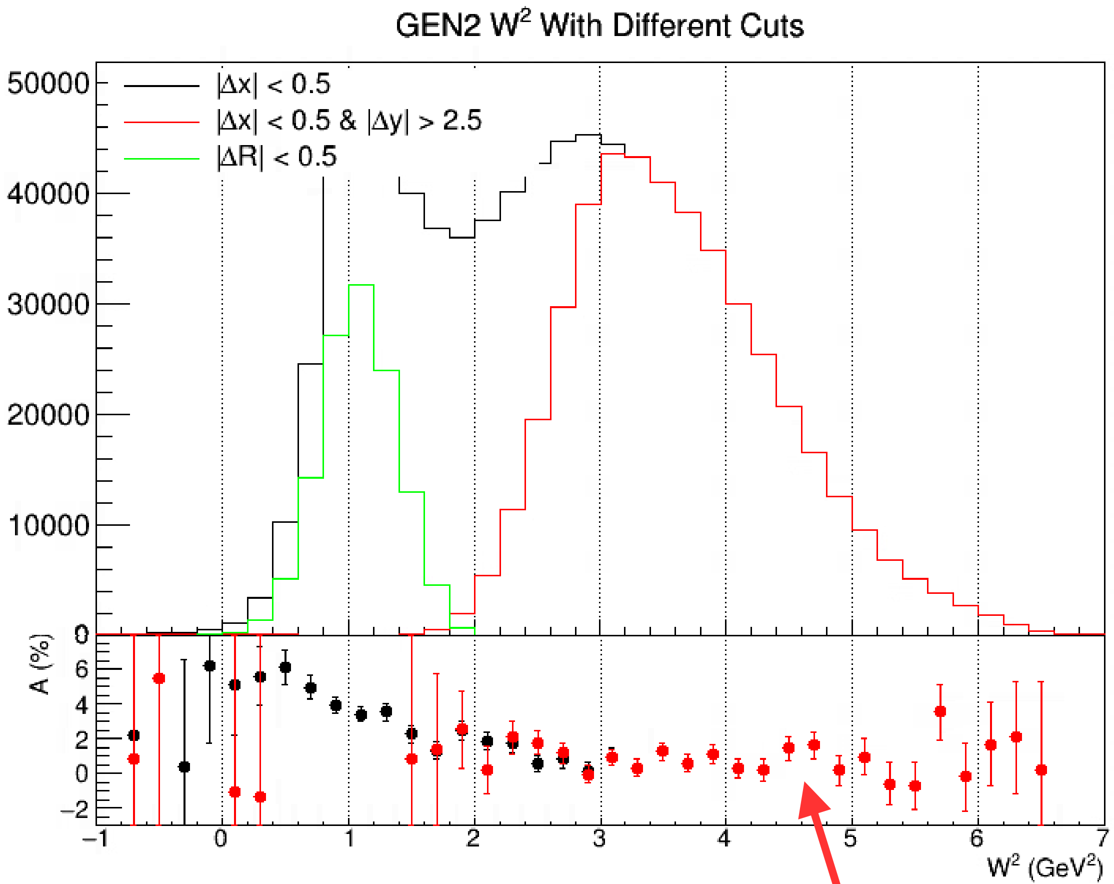
- Below we fit the $N_{data} = N_n + N_p + N_{ot}$.
  - Previously I had denoted $N_{ot}$ as "inelastics" but it is more accurate to represent it as "other".
- Since the proton/neutron distributions are from a clean elastic simulation then the background should be from "everything else"
  - $N_{ot} = N_{acc} + N_{N2} + N_{\pi} + N_{inel}$
- From this the full asymmetry can be formed from just the data, proton, and background fits.
- The fractions can be obtained from the fits below.

$$A_{phys} = \frac{A_{raw} - f_p A_p - f_{ot} A_{ot}}{P_{He3} P_n P_{beam} f_n}$$



# Proton/Neutron/Background Asym

- $A_{raw}$ comes from all data points (black dots in the Δx plot).
- $A_p$ comes from GEp/GMp parameterizations, so it does not come from our data.
- $A_{ot}$ comes from the extrapolation of data with non-elastic Δy cuts.
  - Is this asymmetry truly applicable to the equation (last slide). I am not sure...




Get asymmetry from this data

# Conclusion

- We can use $\Delta x$ fitting to get three asymmetry contributions to find the neutron asymmetry.
  - The background shape then encompasses all asymmetries that aren’t proton/neutron.
  - **In this case the individual contributions do not need to be calculated separately.**
- Is it necessary to disentangle the background contributions?