Systematics for The n-^{3}He Experiment

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Outline

1. **M1 Asymmetry**
2. **Detector Asymmetry**
3. **Instrumental Asymmetry**

M1 Asymmetry & Detector Asymmetry

$$\text{M1 Asymmetry: } A_b = \frac{M_1^{\uparrow} - M_1^{\downarrow}}{M_1^{\uparrow} + M_1^{\downarrow}} \tag{1}$$

$$\text{Detector Asymmetry: } A_d^i = \frac{Y_i - Y_{i^*}}{Y_i + Y_{i^*}} \tag{2}$$

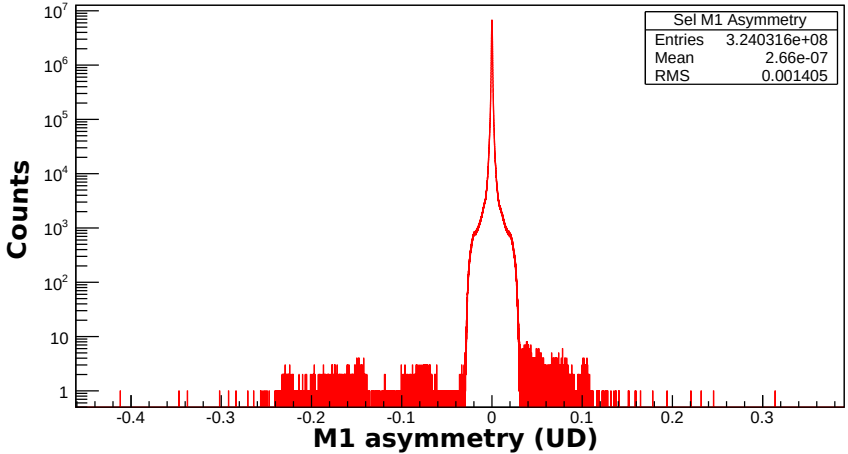
Where, i and i* are conjugate wire index.

$$A_d = \frac{\sum_i w_i A_d^i}{\sum_i w_i} \tag{3}$$

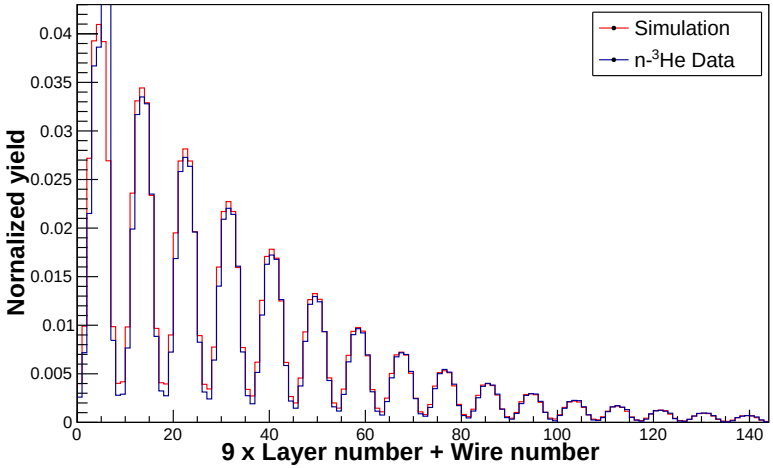
$$w_i = \delta^{-2} A_{phy}^i \tag{4}$$

$\delta^{-2} A_{phy}^i$ is the error from the wire physics asymmetry considering all the runs in a single batch.
— $A_b A_d$?

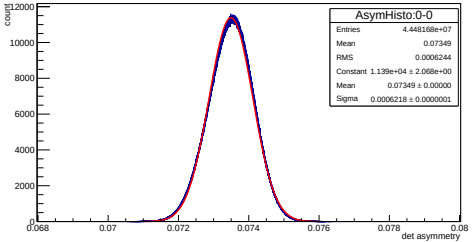
M1 Asymmetry

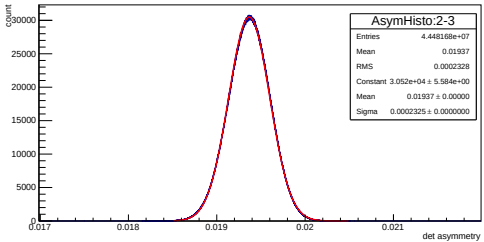


Detector Asymmetry

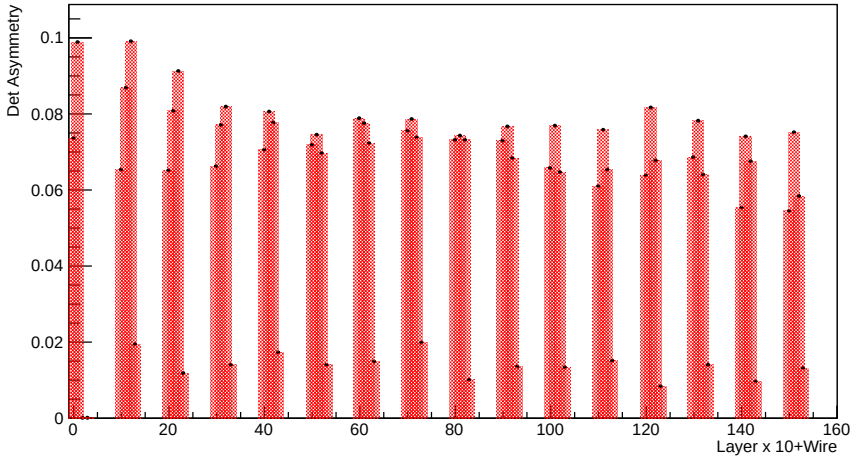


Detector Asymmetry

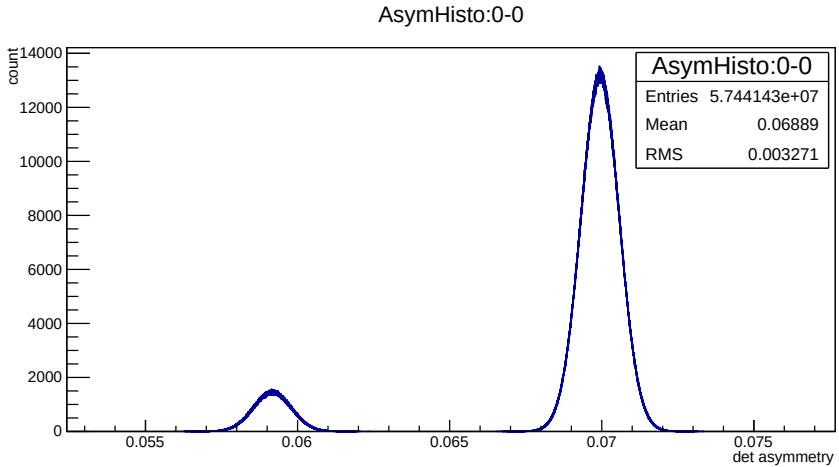




Detector Asymmetry



Detector Asymmetry



Instrumental Asymmetry

$$A_i = \frac{Y_i^{\uparrow} - Y_i^{\downarrow}}{Y_i^{\uparrow} + Y_i^{\downarrow}} = \frac{(S_i^{\uparrow} + b_i^{\uparrow}) - (S_i^{\downarrow} + b_i^{\downarrow})}{(S_i^{\uparrow} + b_i^{\uparrow}) + (S_i^{\downarrow} + b_i^{\downarrow})} \approx \frac{S_i^{\uparrow} - S_i^{\downarrow}}{S_i^{\uparrow} + S_i^{\downarrow}} + \frac{b_i^{\uparrow} - b_i^{\downarrow}}{S_i^{\uparrow} + S_i^{\downarrow}} \tag{5}$$

where $b_i^{\uparrow\downarrow}$ is the contribution from pedestal.

$$A_{inst}^{i} = \frac{b_i^{\uparrow} - b_i^{\downarrow}}{2S^i} \tag{6}$$

$$A_{inst} = \frac{\sum_i w_i A_{inst}^i}{\sum_i w_i} \tag{7}$$

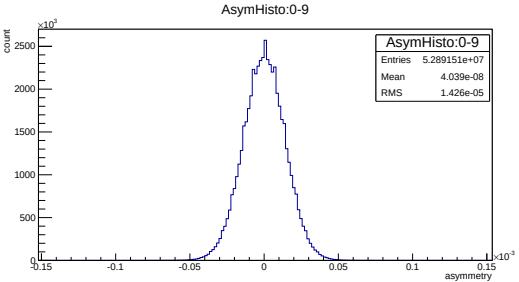
$$(\delta A_{inst})^2 = \frac{\sum_i w_i^2 (\delta A_{inst}^i)^2}{(\sum_i w_i)^2} \tag{8}$$

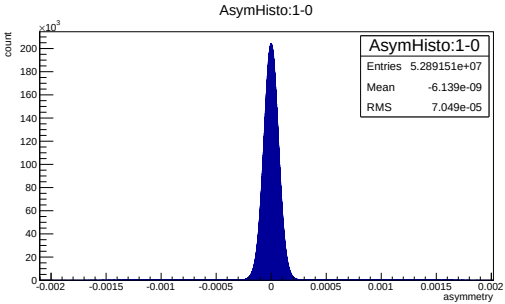
where,

$$w_i = \delta^{-2} A_{phy}^i \tag{9}$$

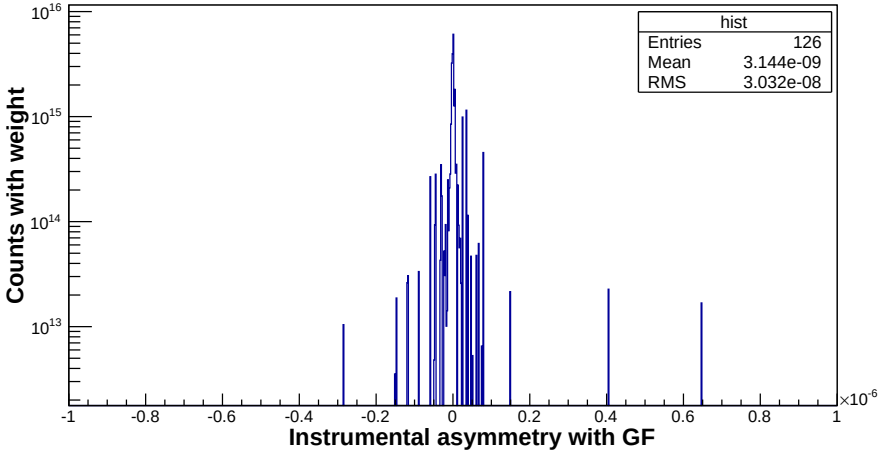
$$A_{inst}^{i} = \frac{1}{G_i} \frac{S_i^{\uparrow} - S_i^{\downarrow}}{S_i^{\uparrow} + S_i^{\downarrow}} \tag{10}$$

Instrumental Asymmetry





Instrumental Asymmetry



Instrumental Asymmetry

Analysis of all the no-beam data using Eq. 7 and Eq. 8 gives,

$$A_{inst} = (3.14 \pm 0.60) \times 10^{-9}. \tag{11}$$

This includes three types of no-beam runs —
— Maintenance day runs
— Long time accelerator down runs
— Accidental no beam runs during normal operations