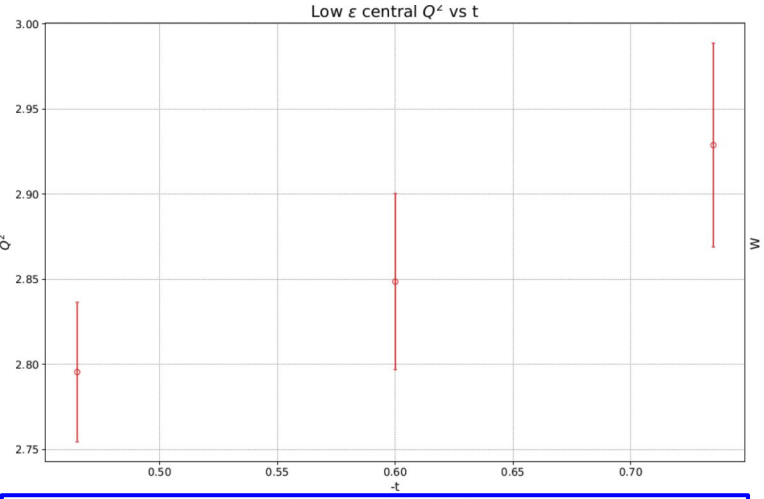
KaonLT Meeting

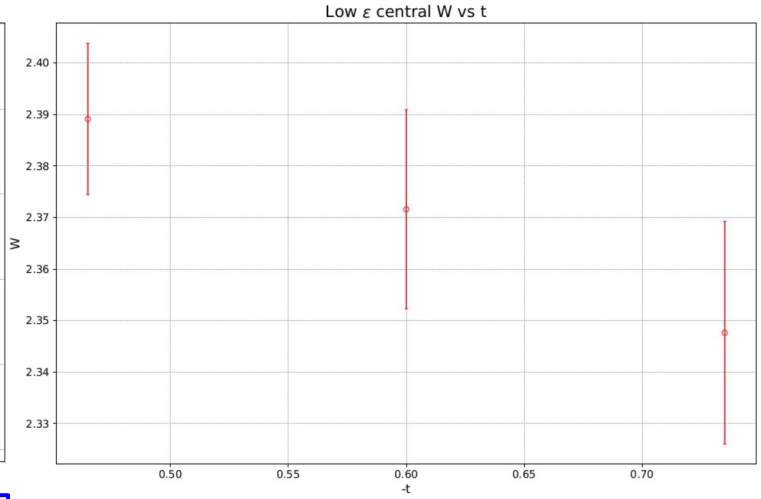
March 26-27th, 2026

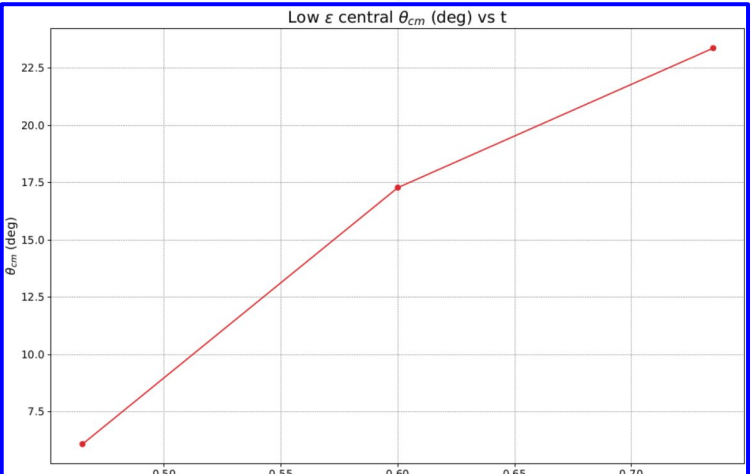
Richard L. Trotta

Small |t| θ_{cm} behavior

Low Epsilon







Q^2=3.0, W=2.32

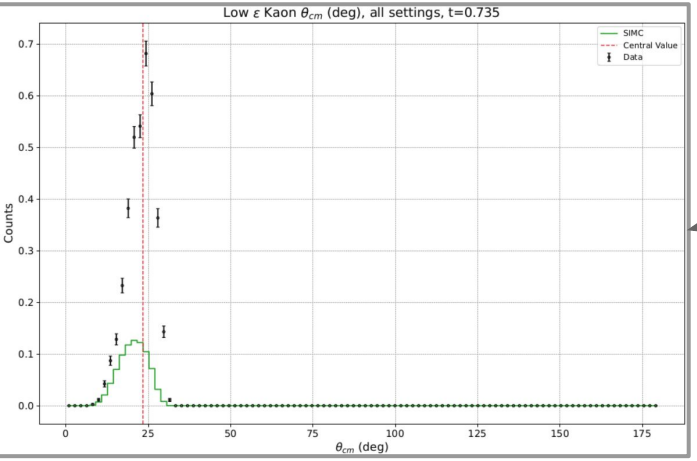
Missing Mass Shifts

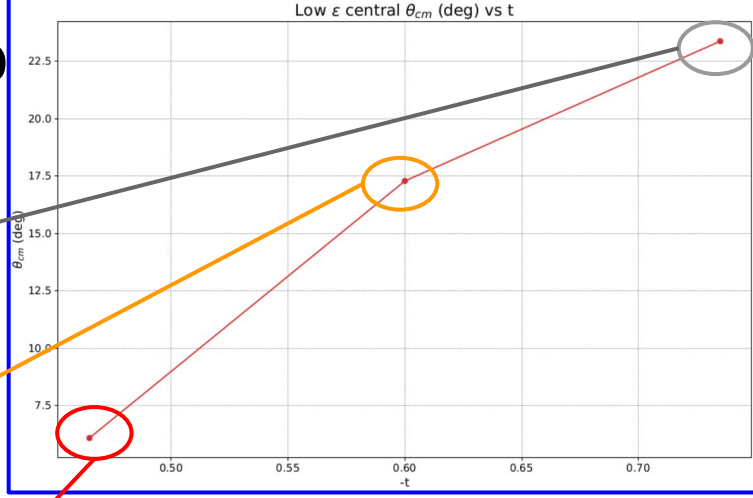
- Center MM_shift = -0.001918
- Left MM_shift = -0.000941

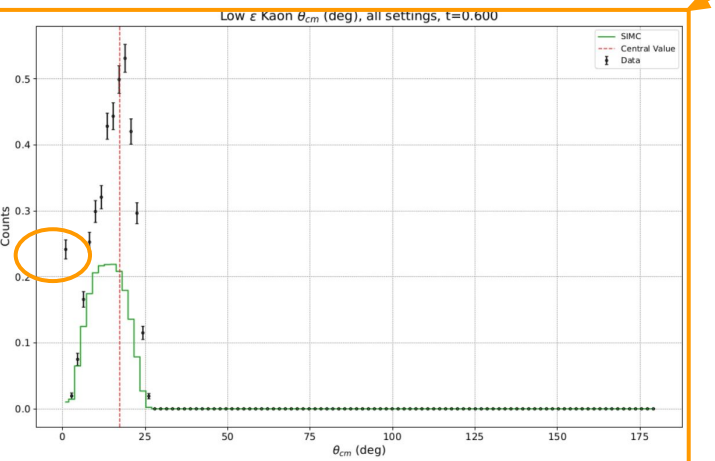
-t Shifts

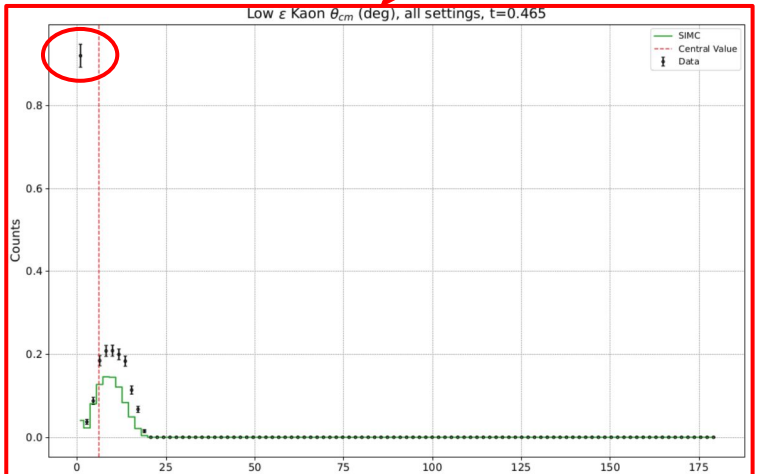
- Center t_shift = +0.003220
- Left t_shift = +0.001576

θ_{cm} blows up as it approaches zero



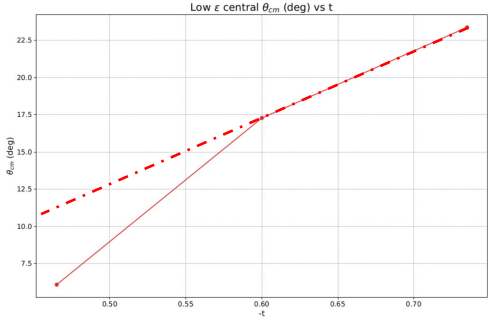






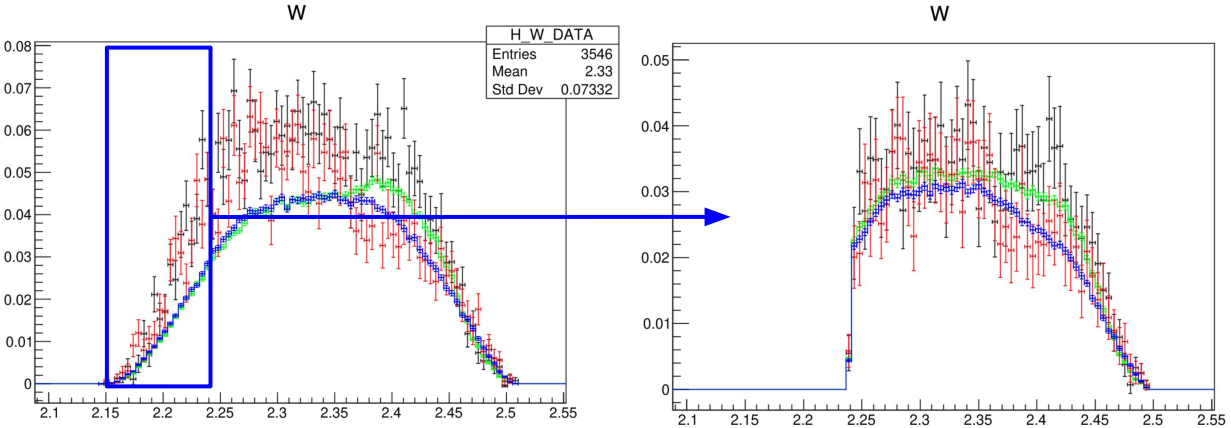
Ignore simc/data scale issue (bug)

Steps Towards a Fix



- Upon suggestion, θ_{cm} was exchanged with $\sin(\theta_{cm})$ throughout the code
  - There was still the spike around zero
- I spent some time investigating $\Delta t = t - t_{min}$
  - For testing, I started with a basic $\Delta t > 0$ cut
    - Note: This is not a proper cut that should be used. This was only for testing
    - This fixed the issue in θ_{cm}, but also gave me some weird looking W plots
- Upon further investigation, I noticed a discrepancy between my MM and other kinematics histograms
- I tracked this down to the **empirical fits**

1/15/2026

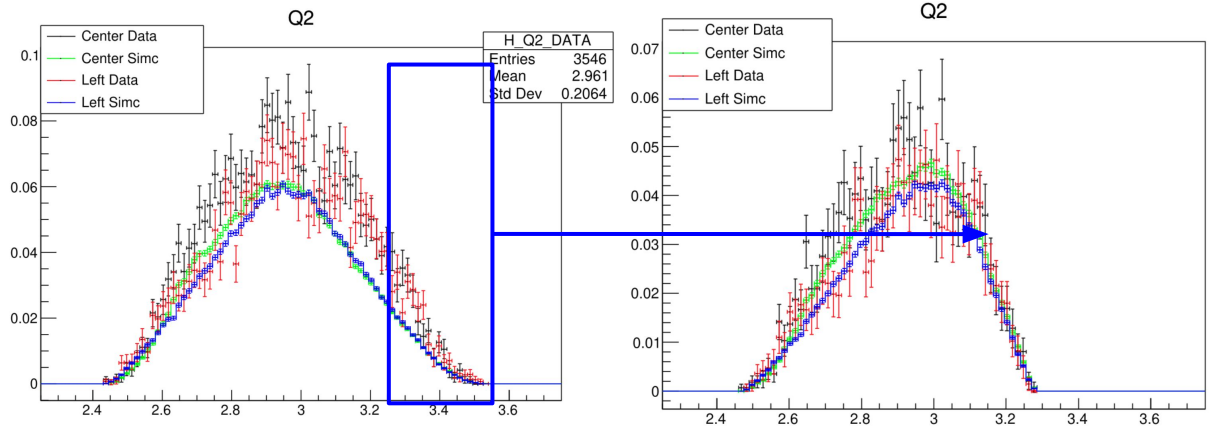


3/25/2026

Empirical Fit Subtraction

- Nothing in the actual MM empirical fits changed, so all yields/ratios remain consistent with previous results
- What did change was the subtraction for all non-MM variables
  - Therefore, the central acceptance of the kinematics
- Previously for non-MM variables, I was effectively doing a bin-index subtraction of an MM-shaped background histogram (i.e., applying a global scale factor) rather than a variable-specific background estimate
- Now I am doing an event-by-event MM-weighted background subtraction for each variable
  - **NOTE: Ongoing study**

1/15/2026



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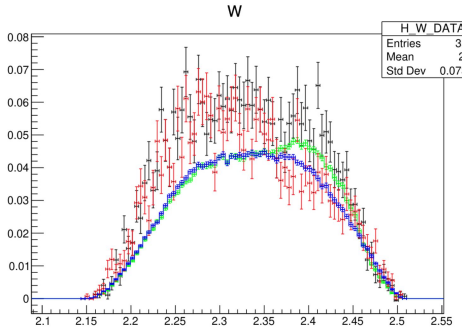
Event-by-event MM-weighted background subtraction

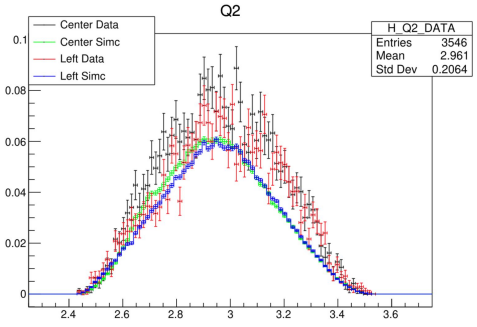
- The empirical background is fit only in MM
- For every other observable, it converts the MM fit into an MM-dependent event weight
  - Then reloops over the event trees, and fills background templates for all the other histograms with those weights.
  - Those templates are then subtracted from the already random/dummy/pion-subtracted histograms
- The background in Q2, W, focal-plane variables, etc. is estimated by asking:
  - “Given an event at this MM, what fraction of it is predicted by the MM background fit?”
  - then assigning that fraction of the event to the background template of every correlated observable
  - This preserves MM correlations automatically.
    - For example, if background sits mostly at specific Q2 or W values, the template will reflect that because it is filled event-by-event, not by a single global scale factor.
- For a variable like Q2:
  - Q2 histogram (H_Q2_DATA) after random/dummy/pion subtraction is the starting spectrum
  - The code reloops all relevant trees
  - Each event contributes a weighted amount based on its adj_MM
  - Those weighted contributions form a Q2-background template.
  - That template is subtracted from H_Q2_DATA

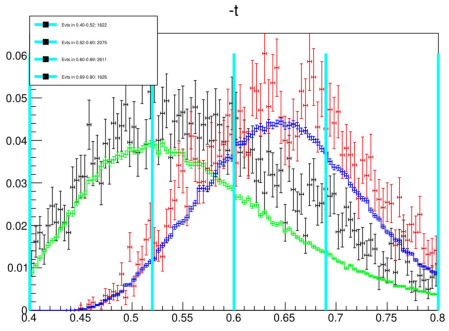
Q2=3.0, W=2.32 Comparison

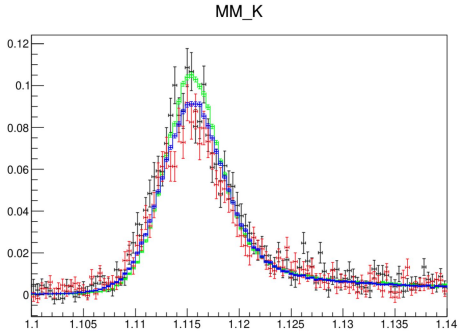
NOTE: No other cuts added, only evt-evt MM-weight subtraction

1/15/2026 **Q2=4.4 Parameters**

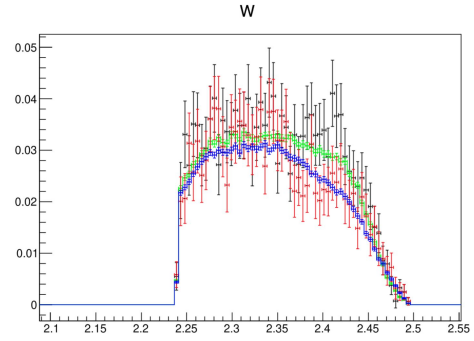


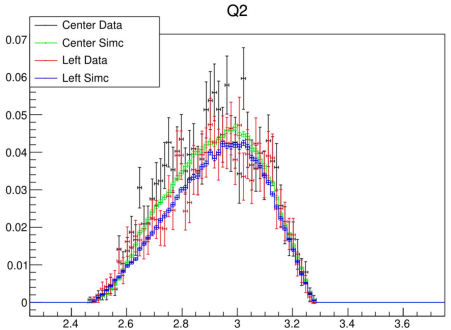




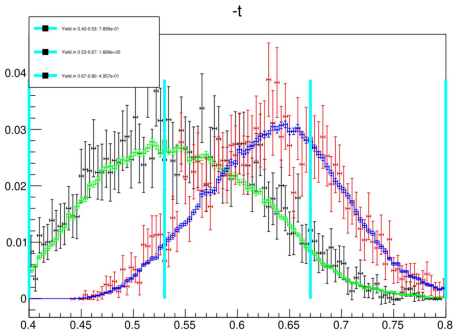


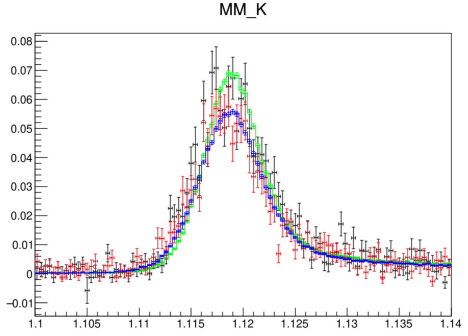
3/25/2026 **Iteration 1**





MM+t shift difference





Q2=3.0, W=2.32 Comparison

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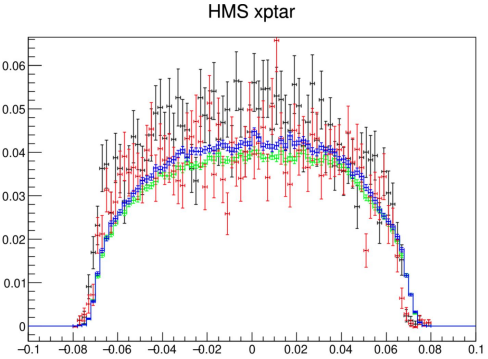

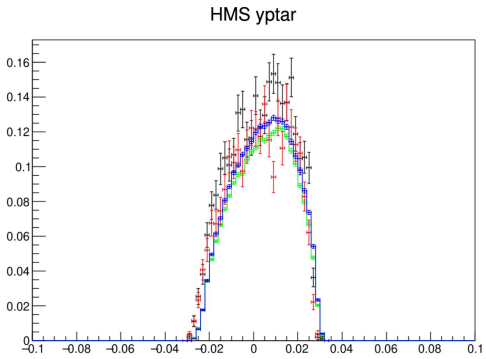

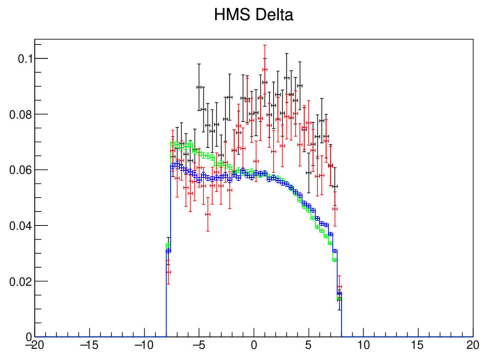

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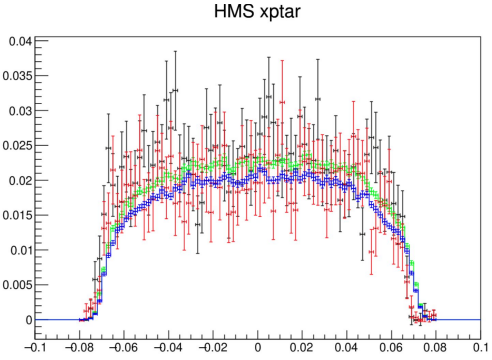

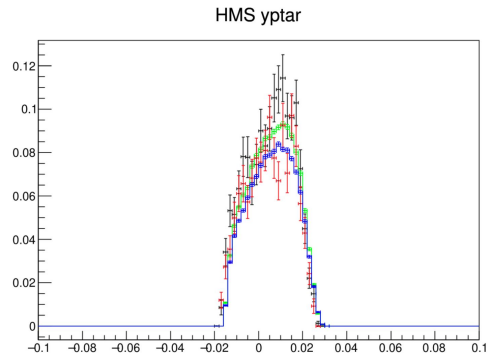

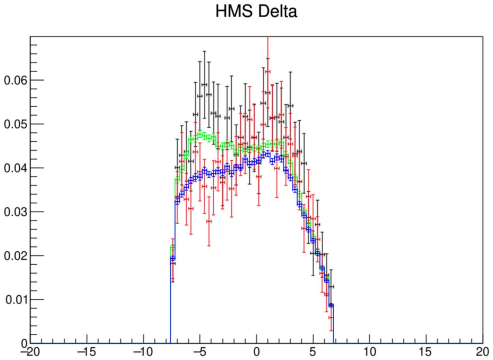

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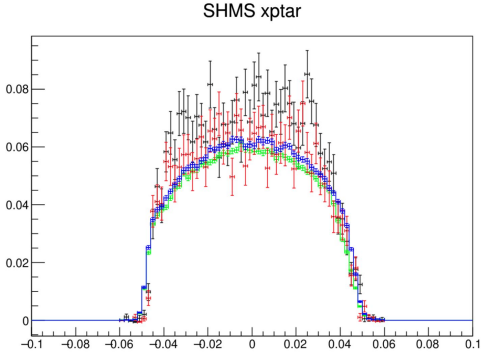

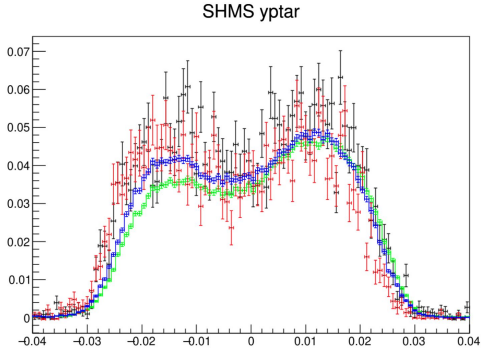

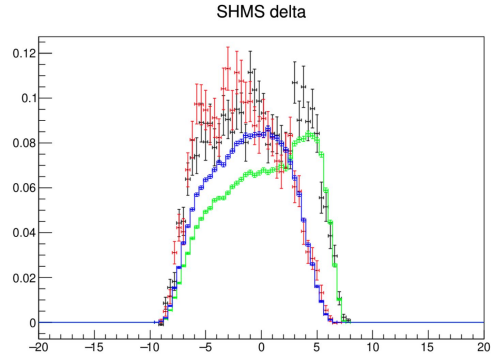

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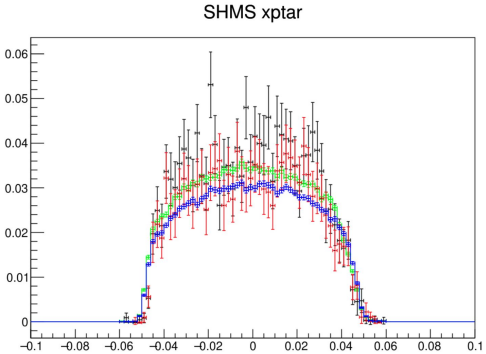

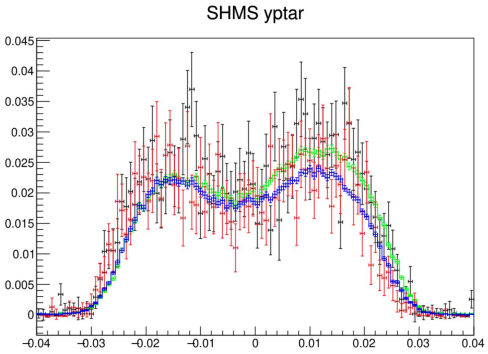

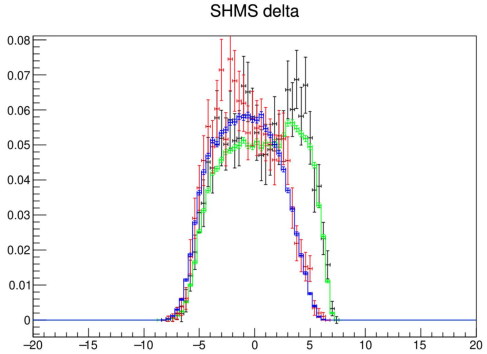

EXTRA