Proton Absorption

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Basic Concept

SHMS

e-

Electron

beam

p

HMS

Proton

H(e,e'p) Elastics Acceptance

H(e,e'p) Elastics Acceptance

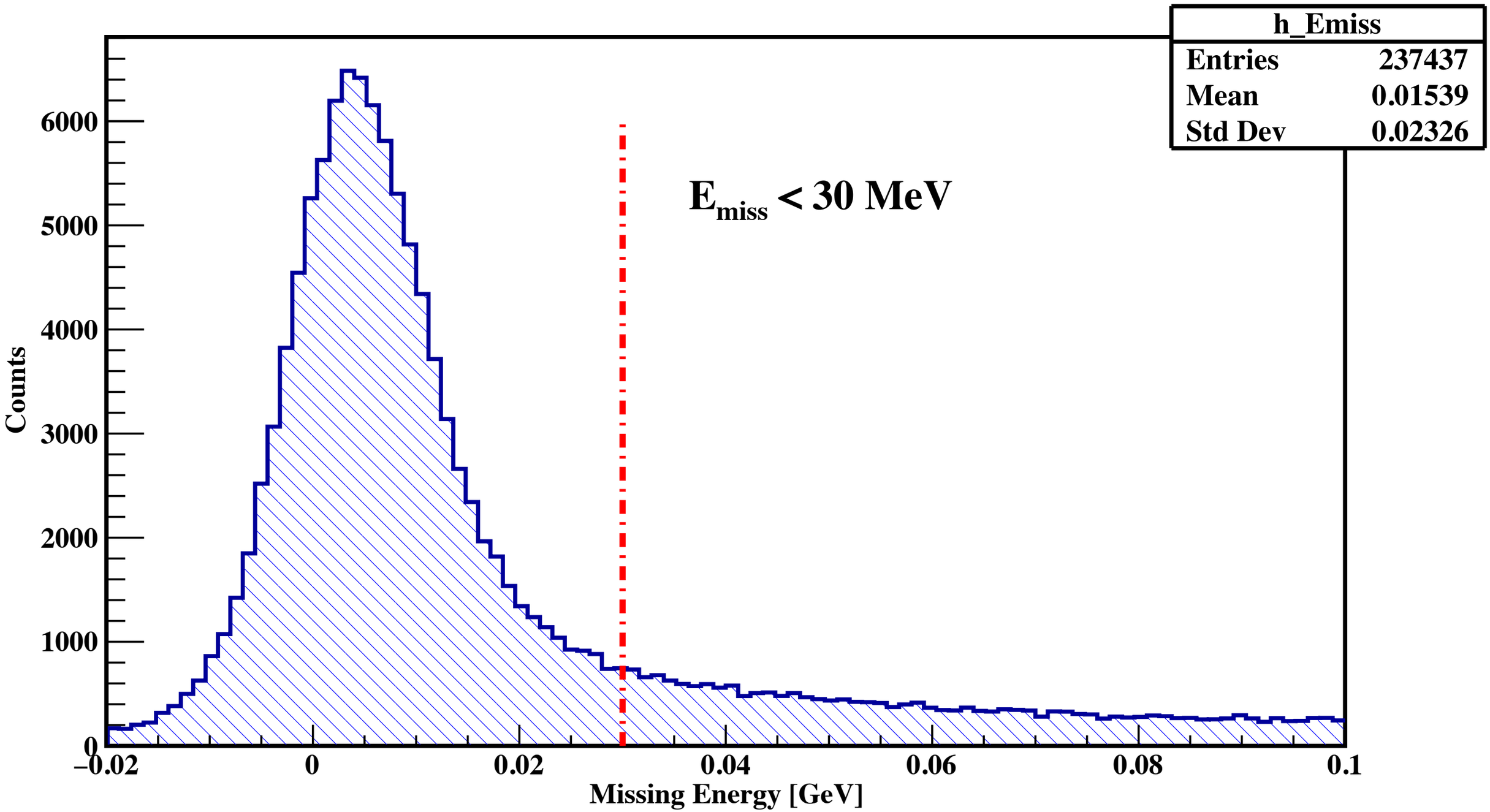
1. Use coincidence run to determine ep-elastics electron acceptance region

2. Look at SHMS e- singles, with a cut on the ep-elastic acceptance, and determine whether the proton made it through the HMS to form a trigger.

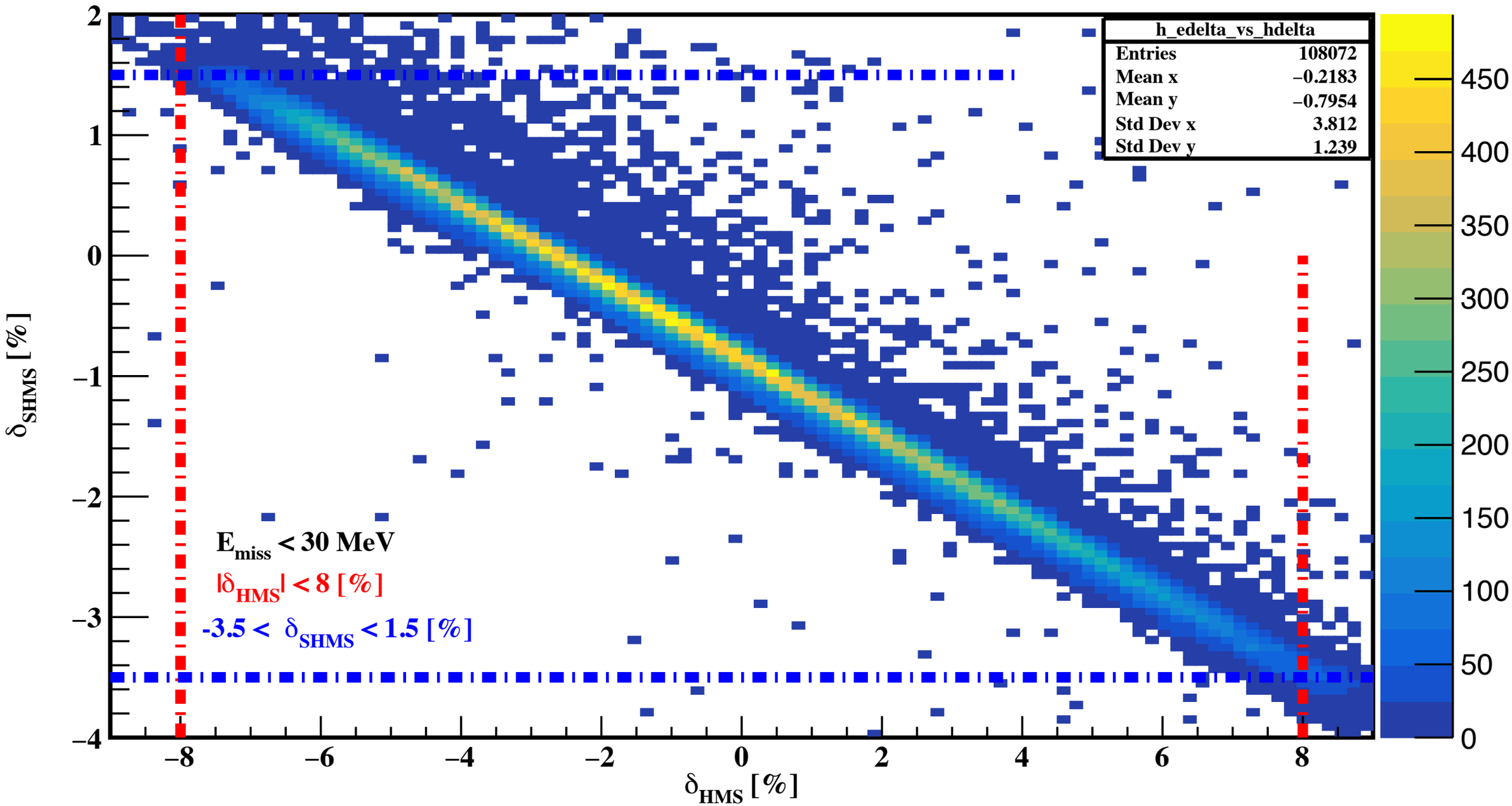
In SHMS e- singles, correlated proton traverses through various HMS spectrometer materials which causes it to lose energy. (dipole window, target wall, etc.)

Question: Will the proton make it to form a trigger?
The number of protons that did NOT made it is the Proton Absorption Coefficient.

Use Coincidence to Select SHMS ep-elastics Acceptance Region



Use Coincidence to Select SHMS ep-elastics Acceptance Region



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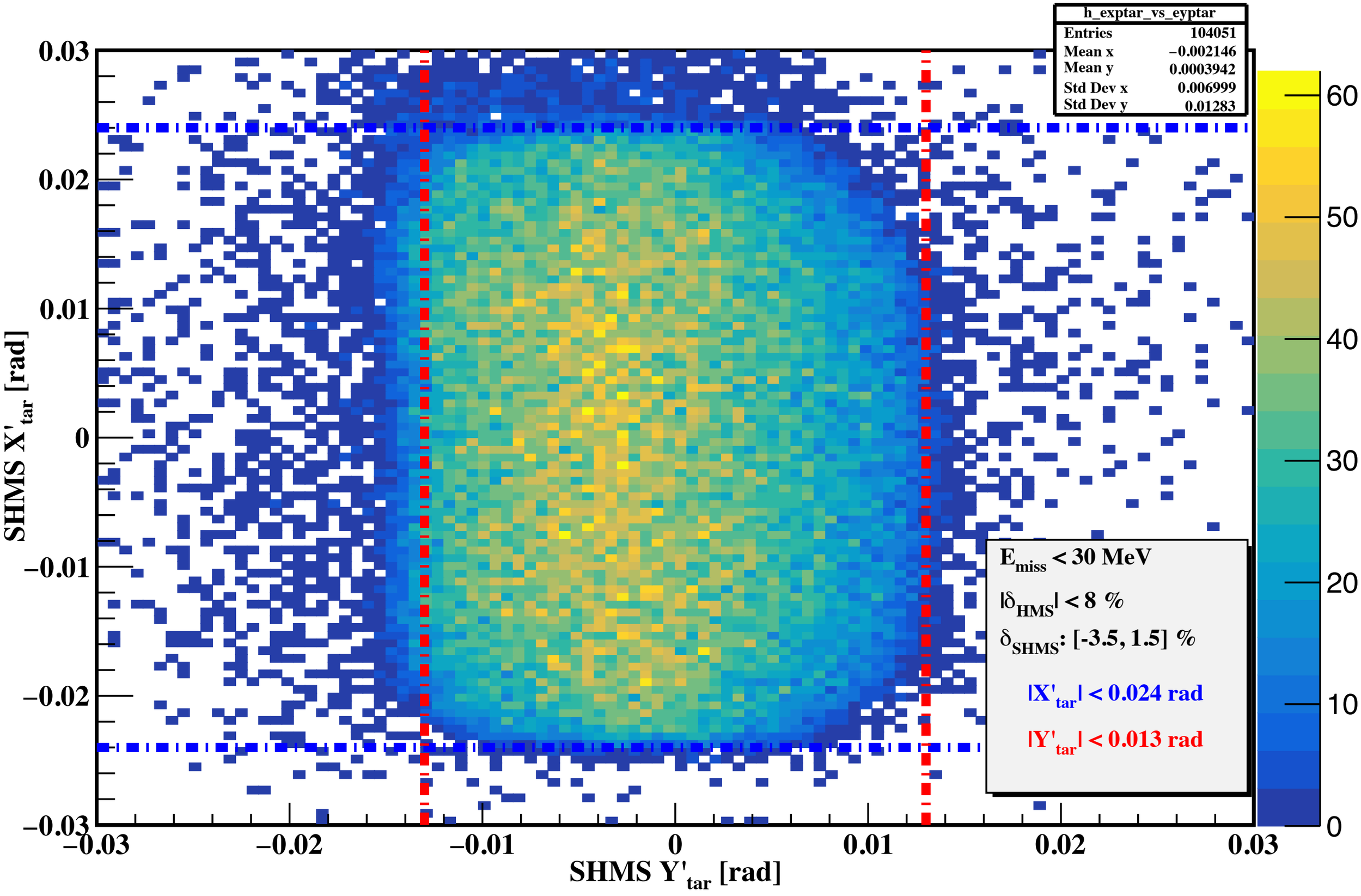

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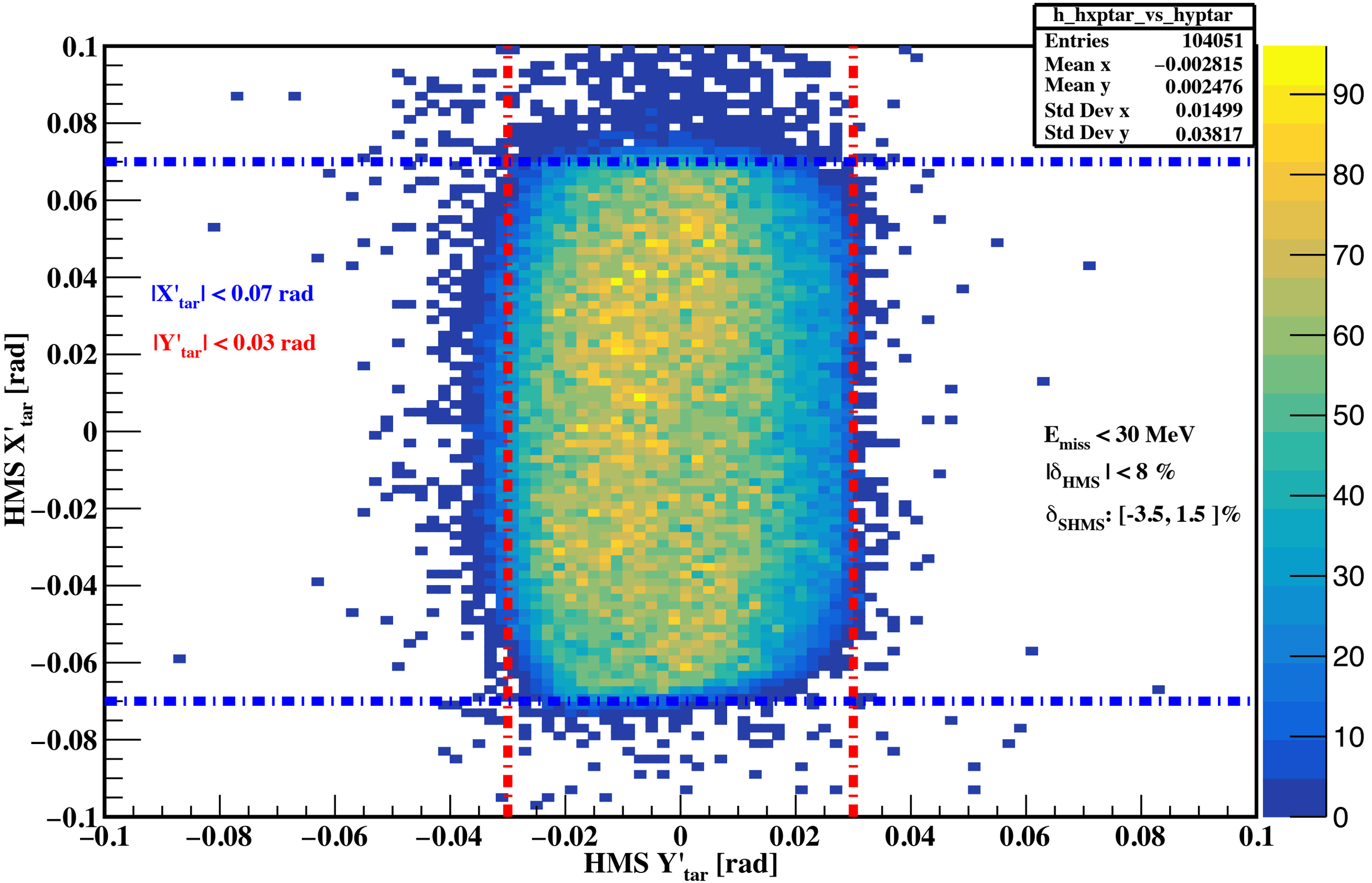
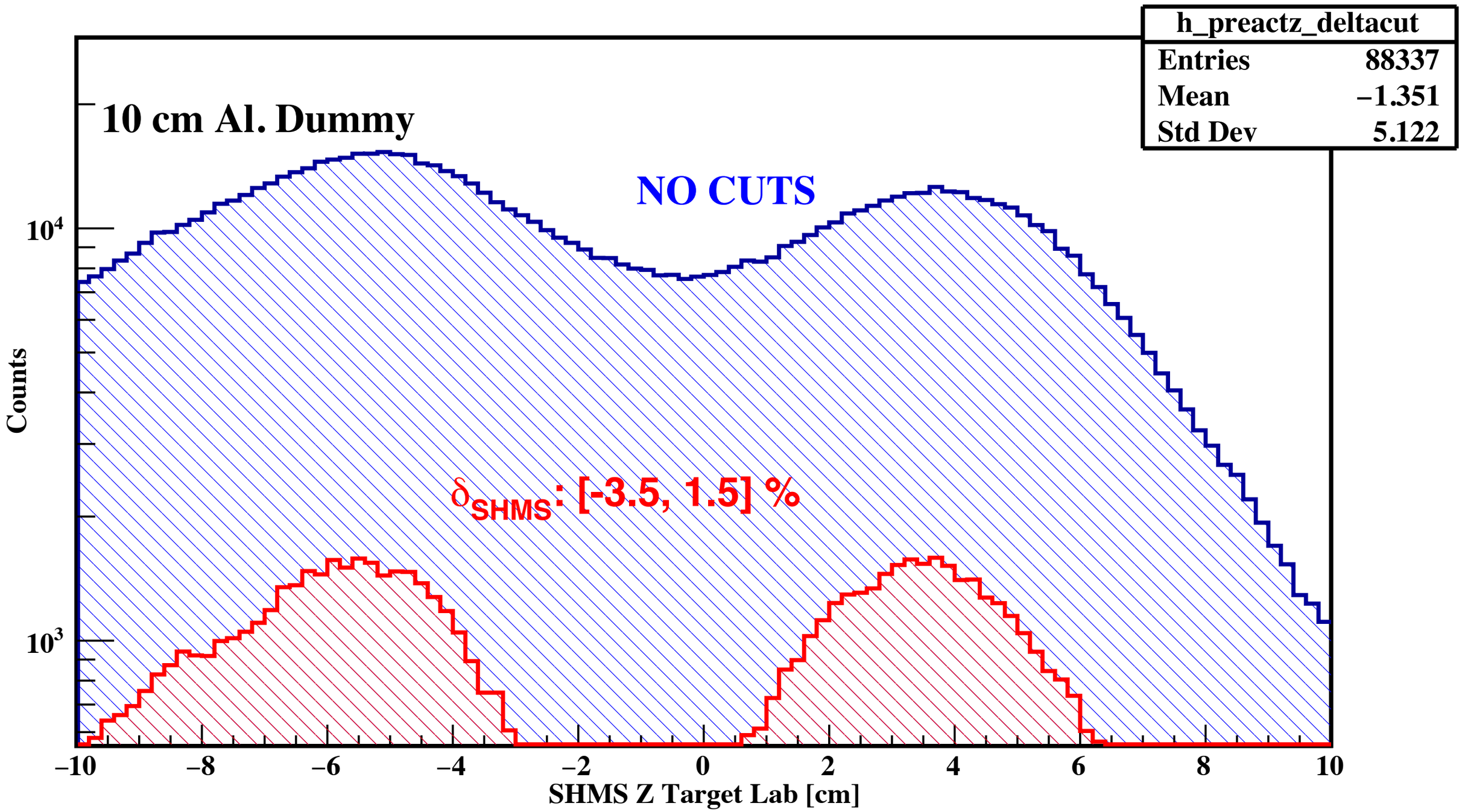
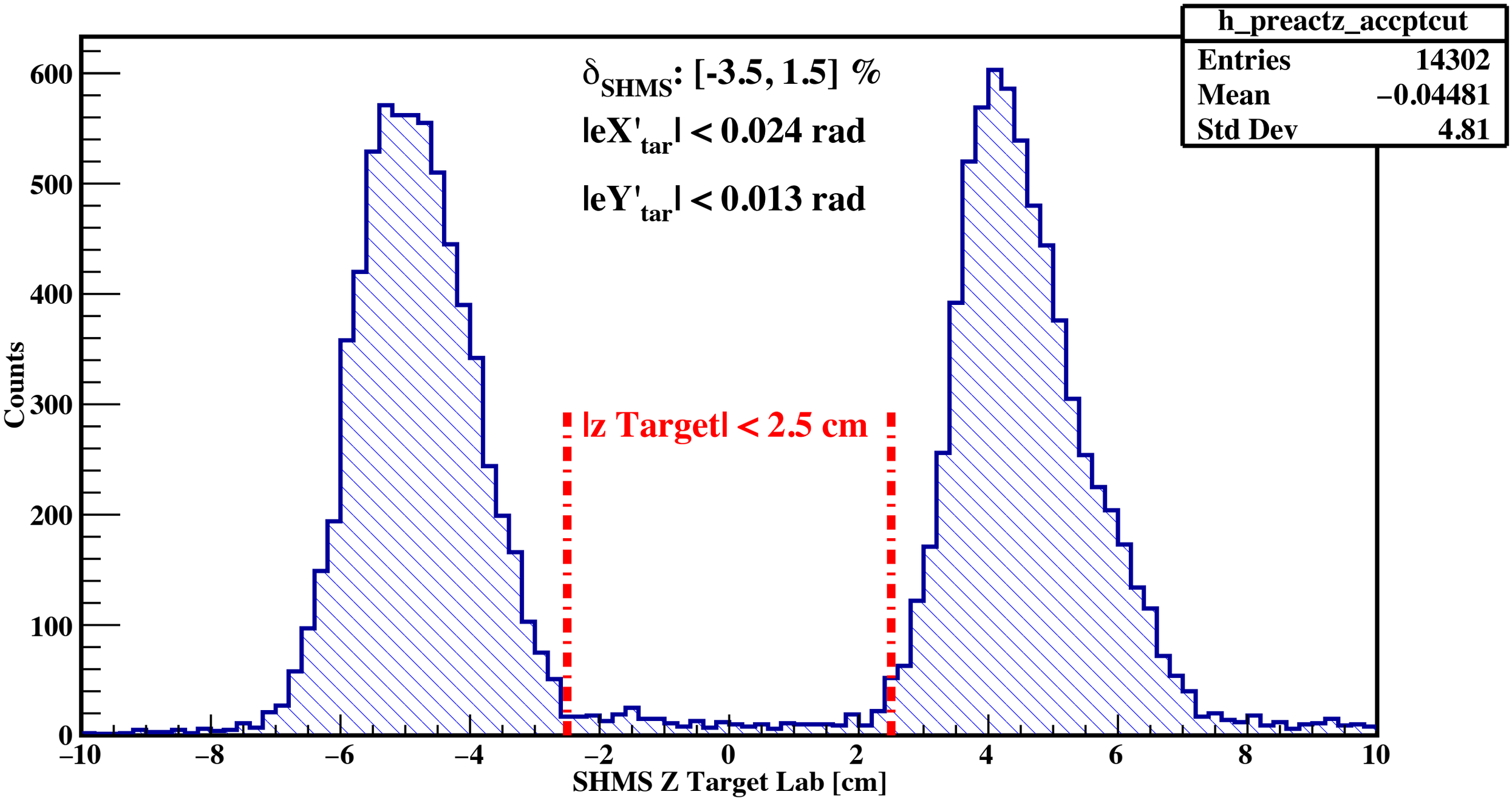


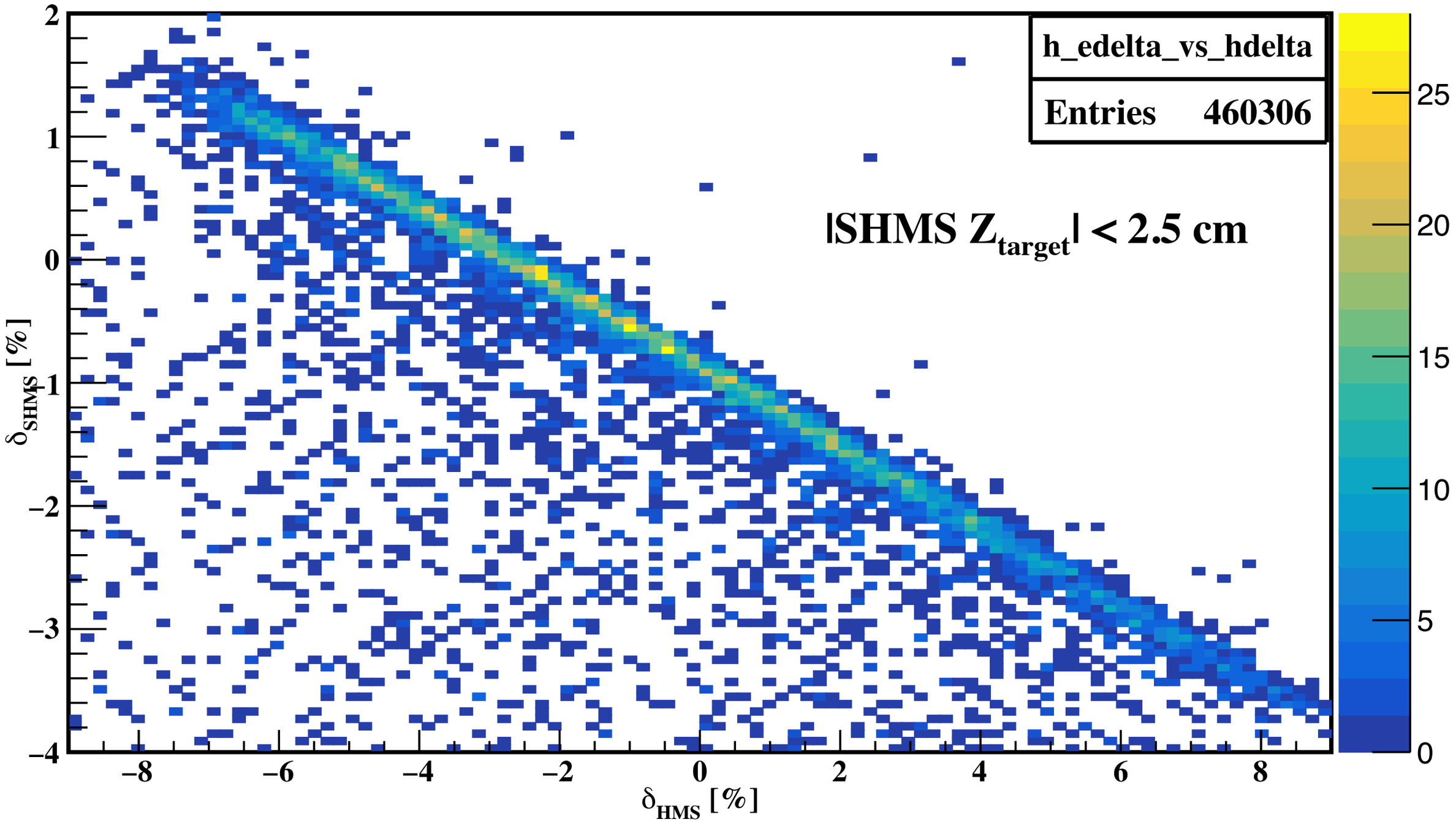
Use Al. Dummy Run to Select Z-Target Cut (SHMS singles)



Use Al. Dummy Run to Select Z-Target Cut (SHMS singles elastics)

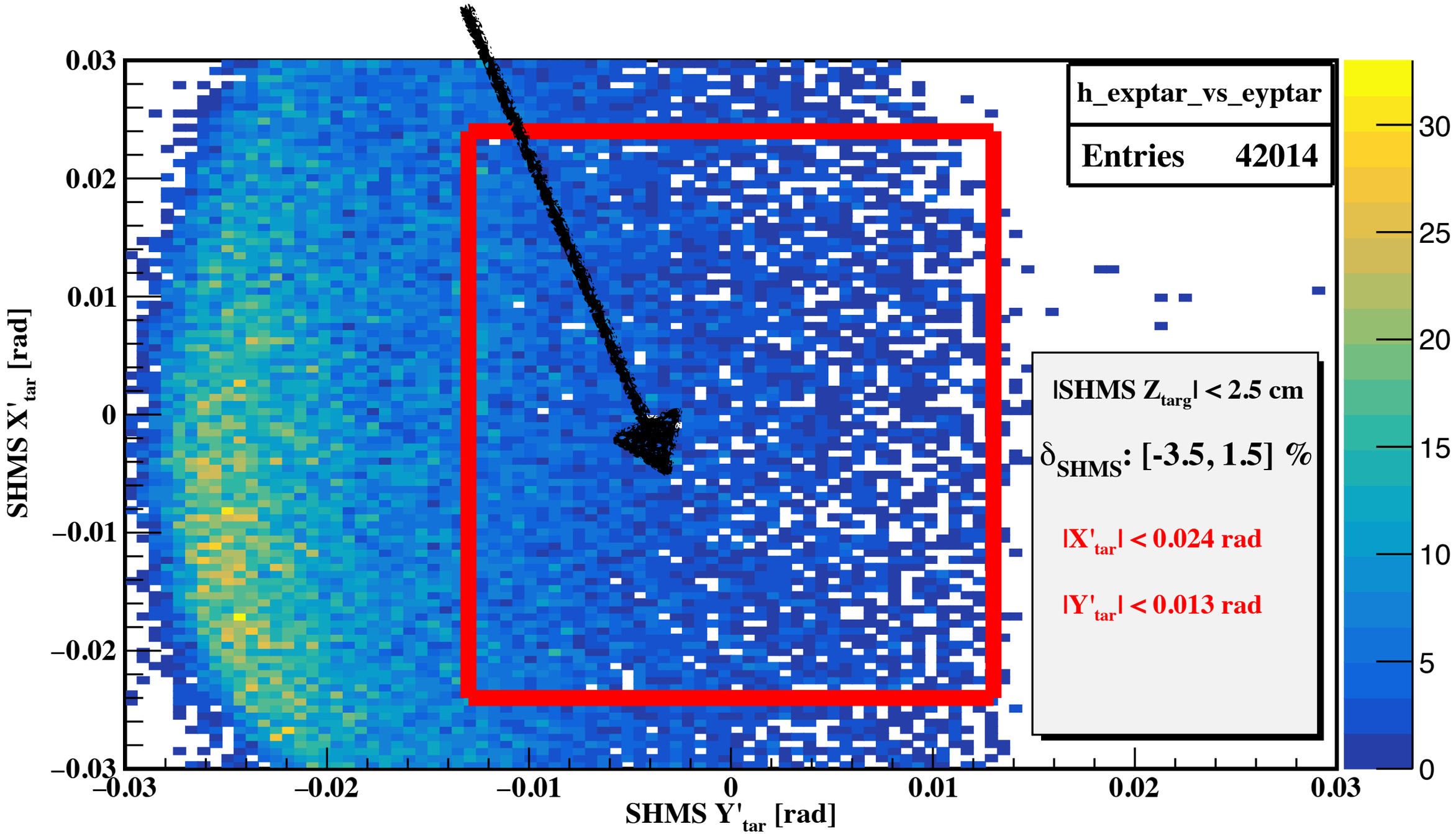


Extract Proton Absorption from SHMS e- Singles



Extract Proton Absorption from SHMS e- Singles

ep-elastics region as determined from coincidence run



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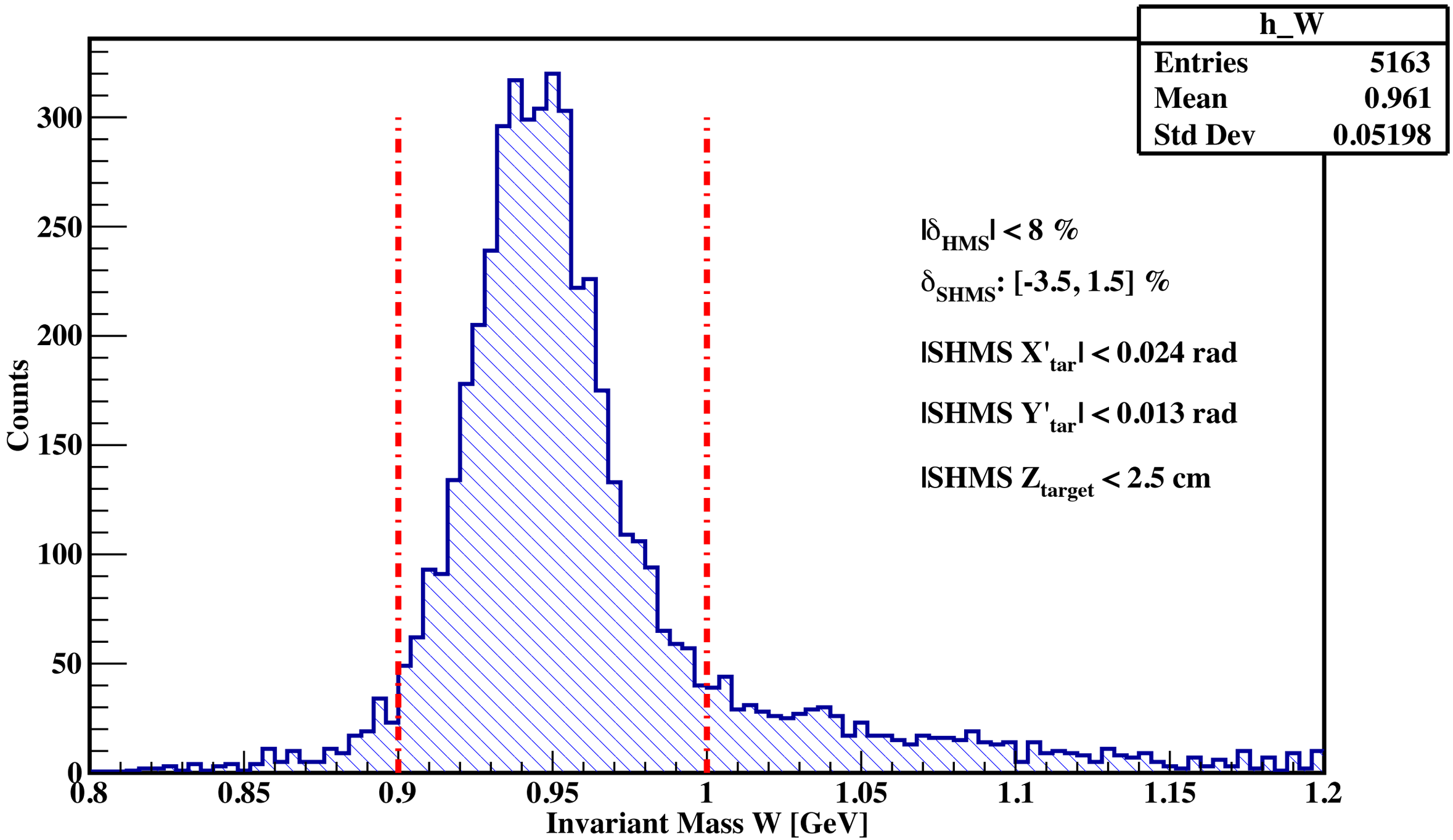


Extract Proton Absorption from SHMS e- Singles

$$e^- \text{should} = \delta_{SHMS} \cdot d\Omega_e \cdot Z_{tar} \cdot W$$

Definition: Number of electrons within the SHMS acceptance cuts for which the correlated ep-elastic proton should have been detected in the HMS

Other tight cuts are also placed, such as the target cuts, and invariant mass cut to ensure the counted electron indeed came from a knocked out proton in the target, and **NOT** from a scattered proton in the Aluminum target walls.

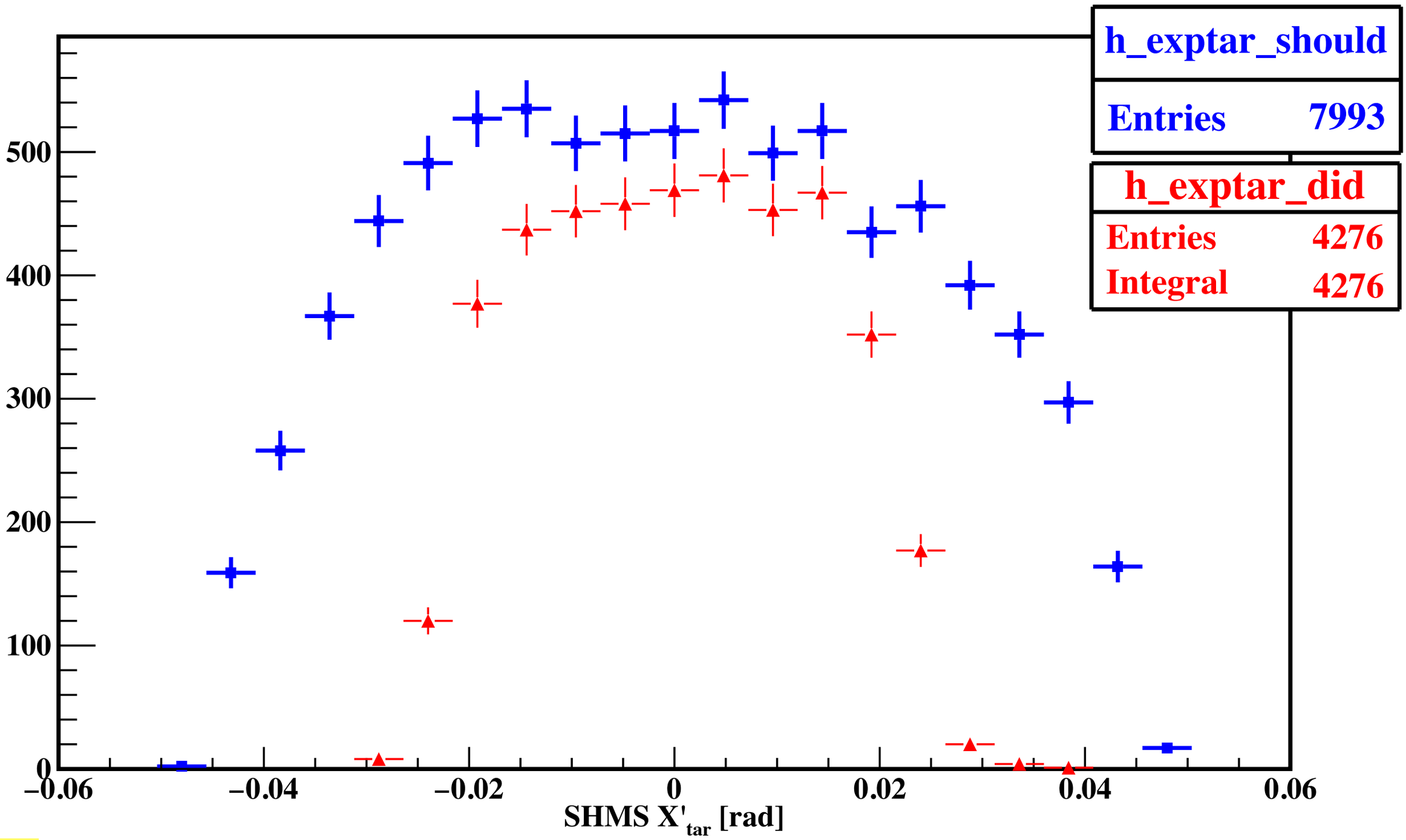
$$e^- \text{did} = e^- \text{should} \cdot \delta_{HMS} \cdot \text{hTRIG1}$$

Definition: Number of electrons within the SHMS acceptance cuts for which a correlated ep-elastic proton was detected in the HMS.

To require the detection of a proton in the HMS, an HMS delta acceptance cut and an HMS 3/4 trigger were required in addition to the electron-cuts.

$$\text{Proton Absorption} = 1 - \frac{e^- \text{did}}{e^- \text{should}} \qquad \text{Error} = \frac{\sqrt{e^- \text{should} - e^- \text{did}}}{e^- \text{should}}$$

Extract Proton Absorption from SHMS e- Singles

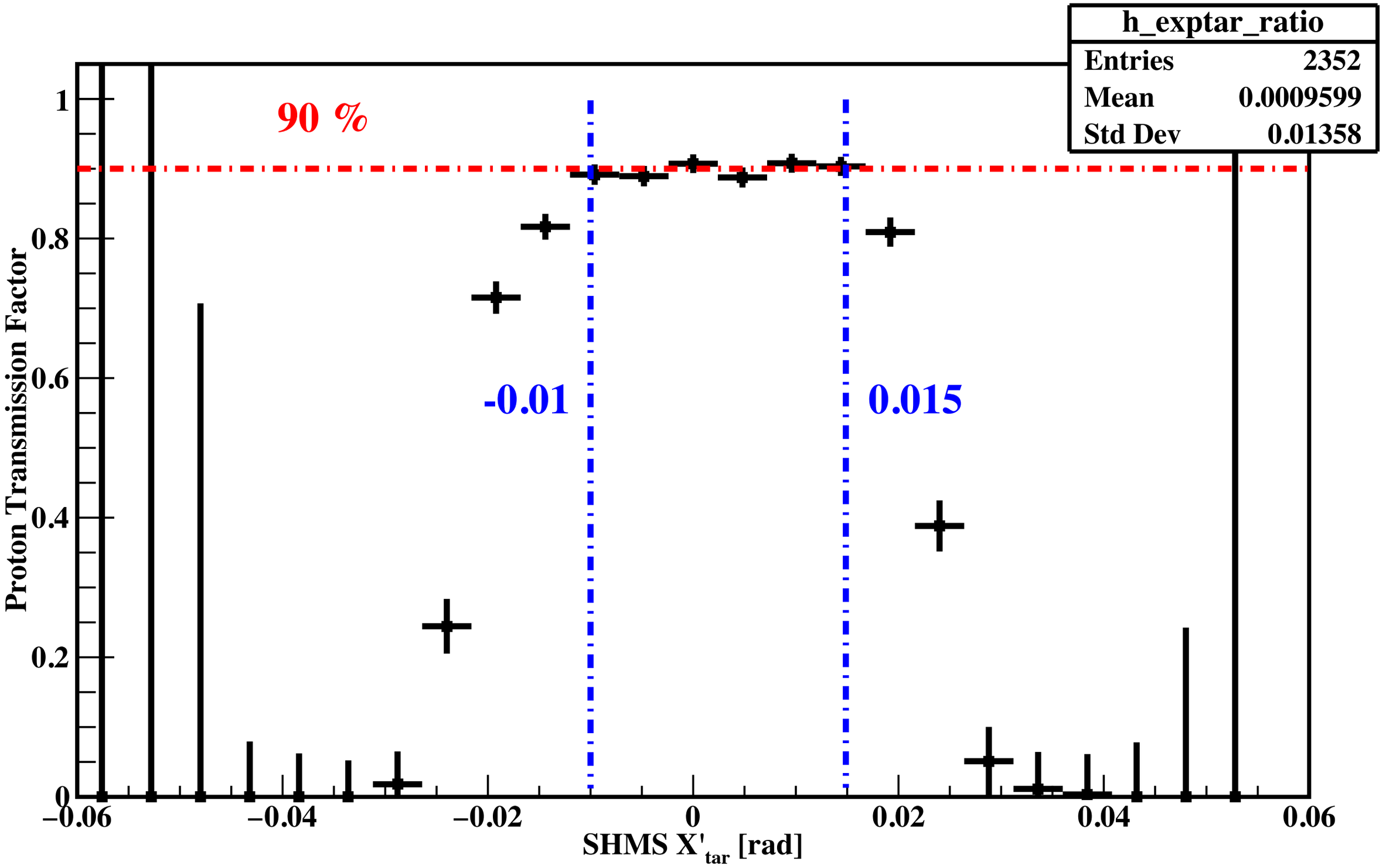


CUTS:

$$e^-\text{did} = e^-\text{should} \cdot |\delta_{HMS}| < 8 \cdot \text{hms:hTRIG1(3/4 trigger)} > 0$$

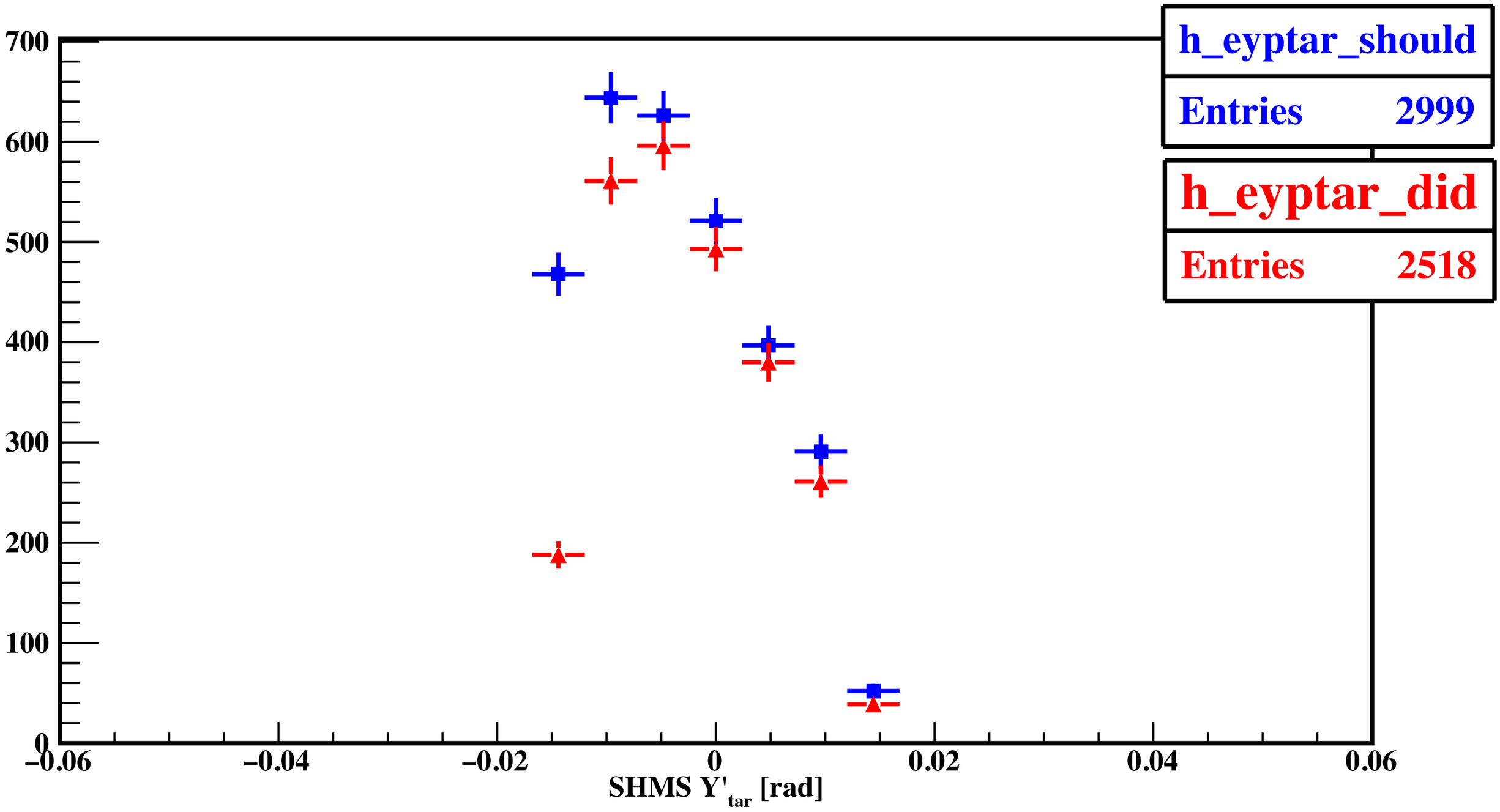
$$e^-\text{should} = \delta_{SHMS}(-3.5, 1.5) \cdot |\text{shms}Y'_{tar}| < 0.013 \cdot |Z_{tar}| < 2.5 \cdot W(0.9, 1)$$

Extract Proton Absorption from SHMS e- Singles
Ratio: e-_did / e-_should



From the ratio, X'tar acceptance can be made tighter—> (-0.01, 0.015)

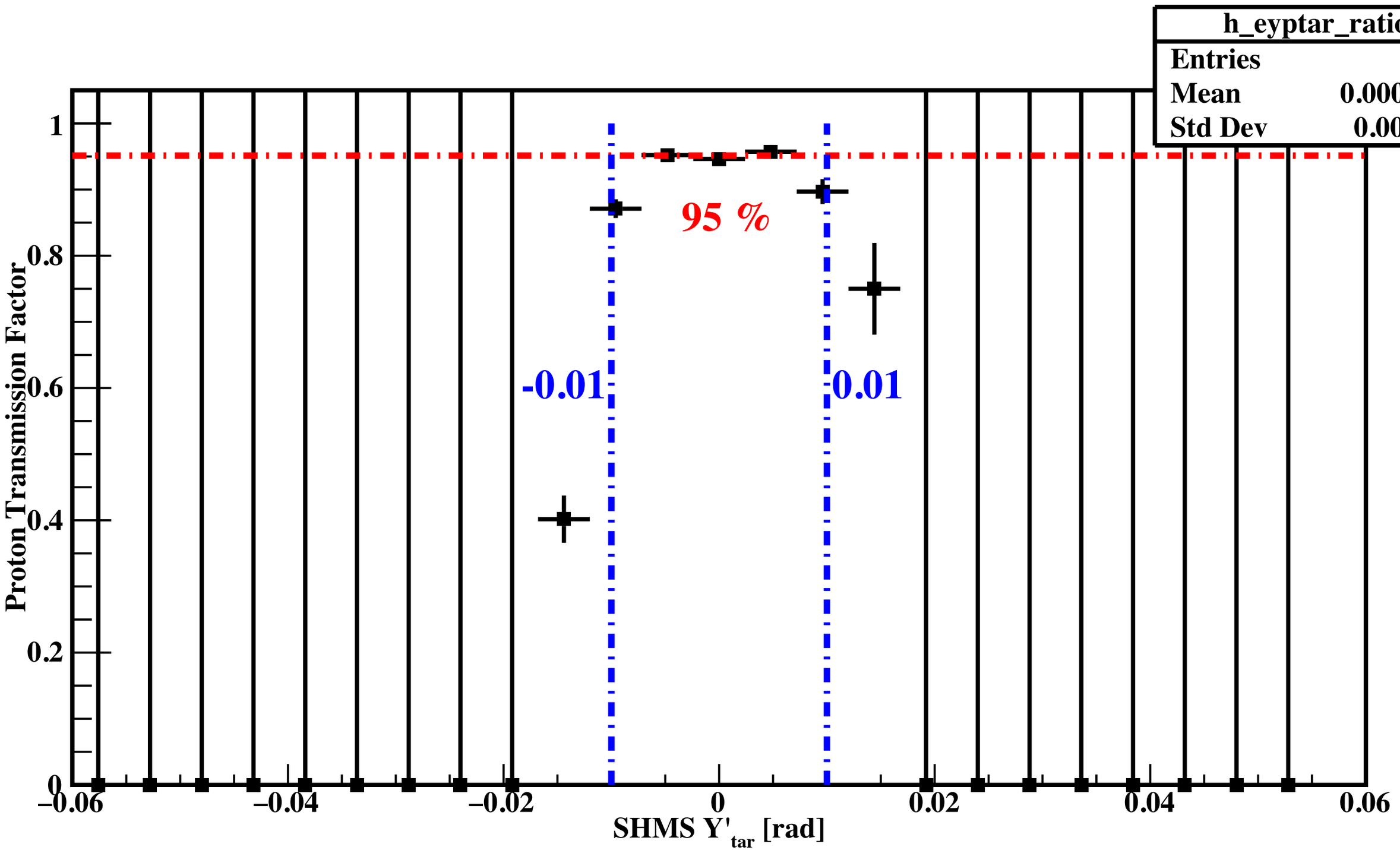
Extract Proton Absorption from SHMS e- Singles



$e^-\text{did} = e^-\text{should} \cdot |\delta_{HMS}| < 8 \cdot \text{hms:hTRIG1(3/4 trigger)} > 0$

$e^-\text{should} = \delta_{SHMS}(-3.5, 1.5) \cdot \text{shms}X'_{tar}(-0.01, 0.015) \cdot |Z_{tar}| < 2.5 \cdot W(0.9, 1)$

Extract Proton Absorption from SHMS e- Singles



From the ratio, Y'tar acceptance can be made tighter—> (-0.01, 0.01)

Extract Proton Absorption from SHMS e- Singles

After determining tighter acceptance cuts from the ratios previously shown, the SHMS X'tar and Y'tar ratios are plotted again, with the tighter acceptance cuts.

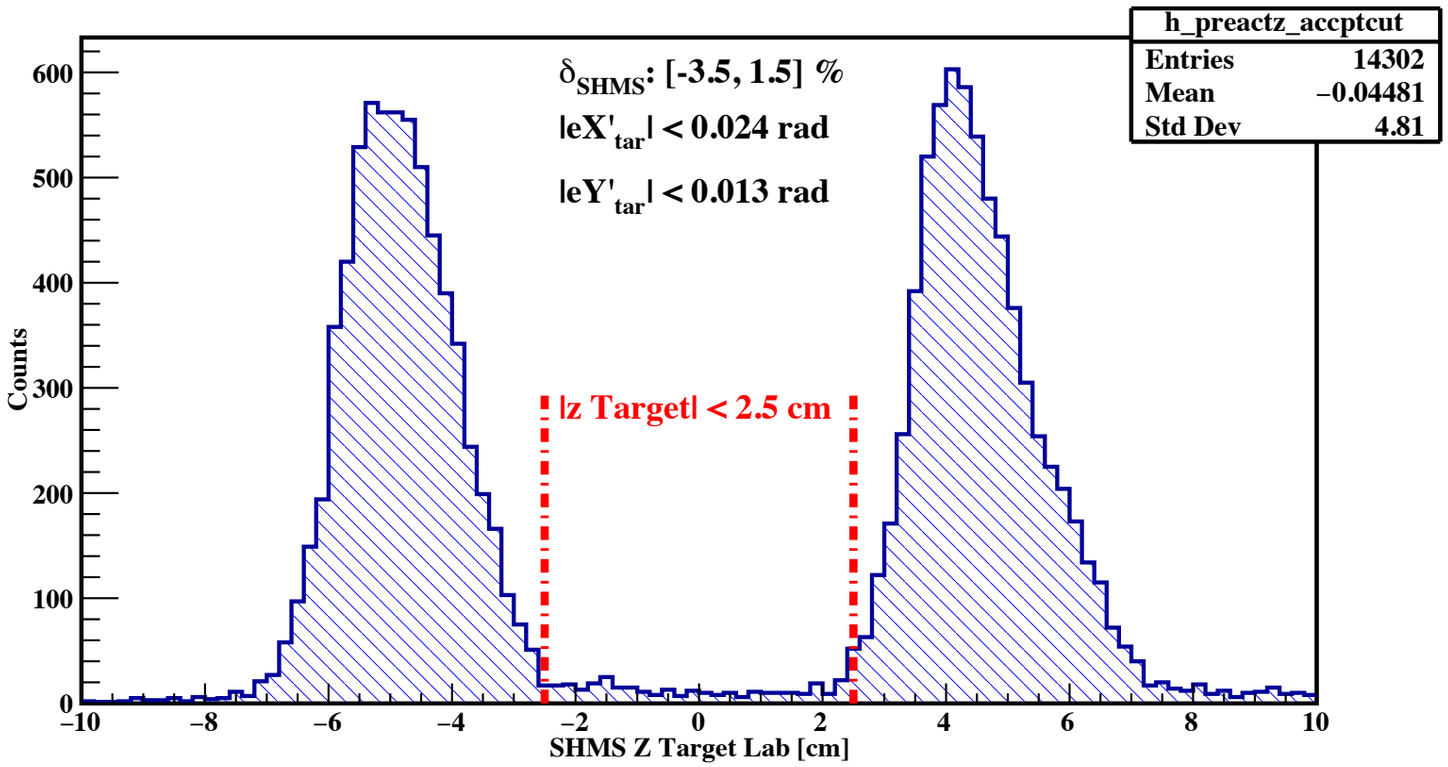
In addition, since the 'e-did' has an HMS variable, the HMS tracking efficiency needs to be accounted for. For the singles run being analyzed, it was found to be: ***99.07 %***

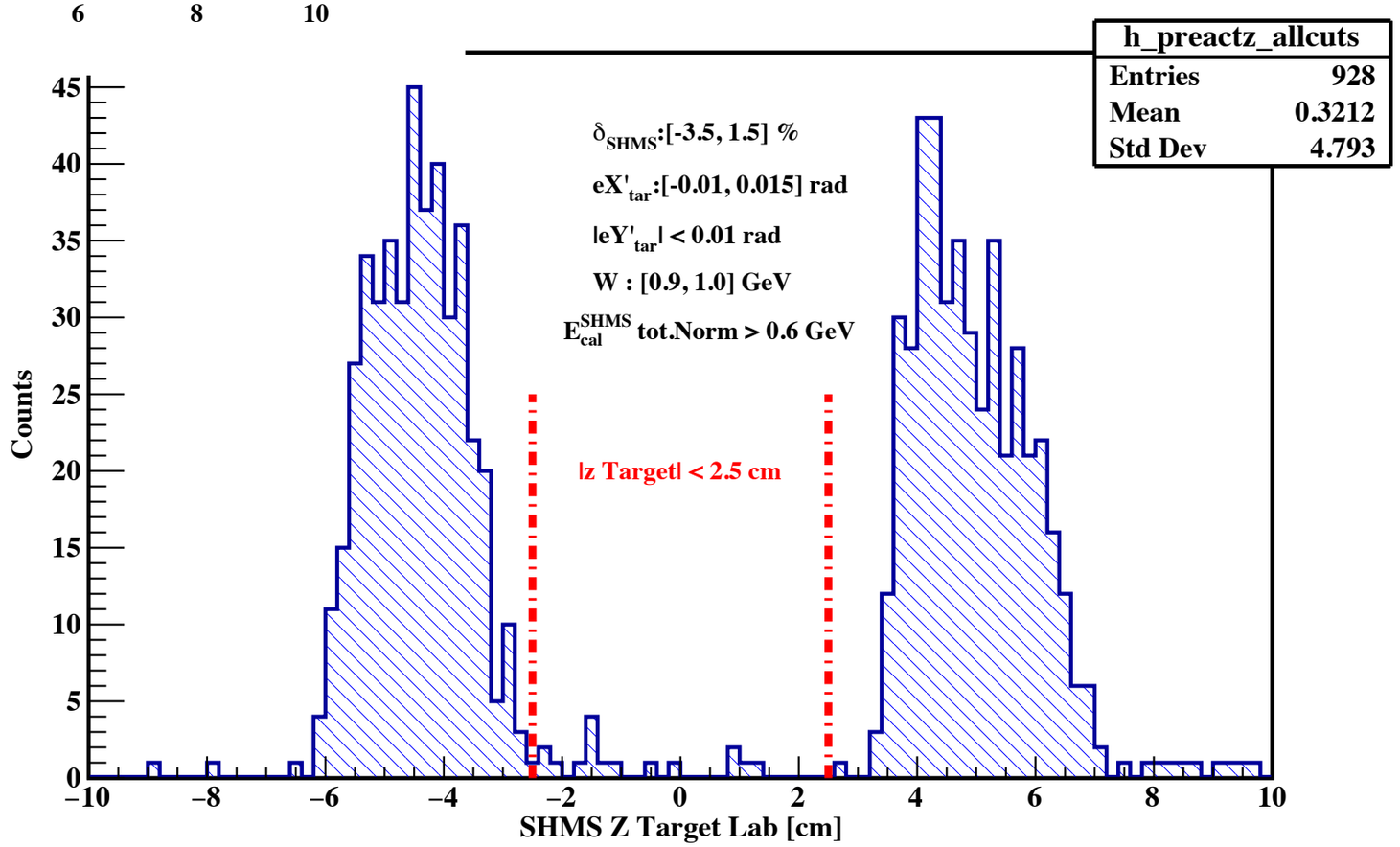
$$e^-\text{did} \rightarrow \frac{e^-\text{did}}{0.9907}$$

$$e^-\text{did} = e^-\text{should} \cdot |\delta_{HMS}| < 8 \cdot \text{hms:hTRIG1(3/4 trigger)} > 0$$

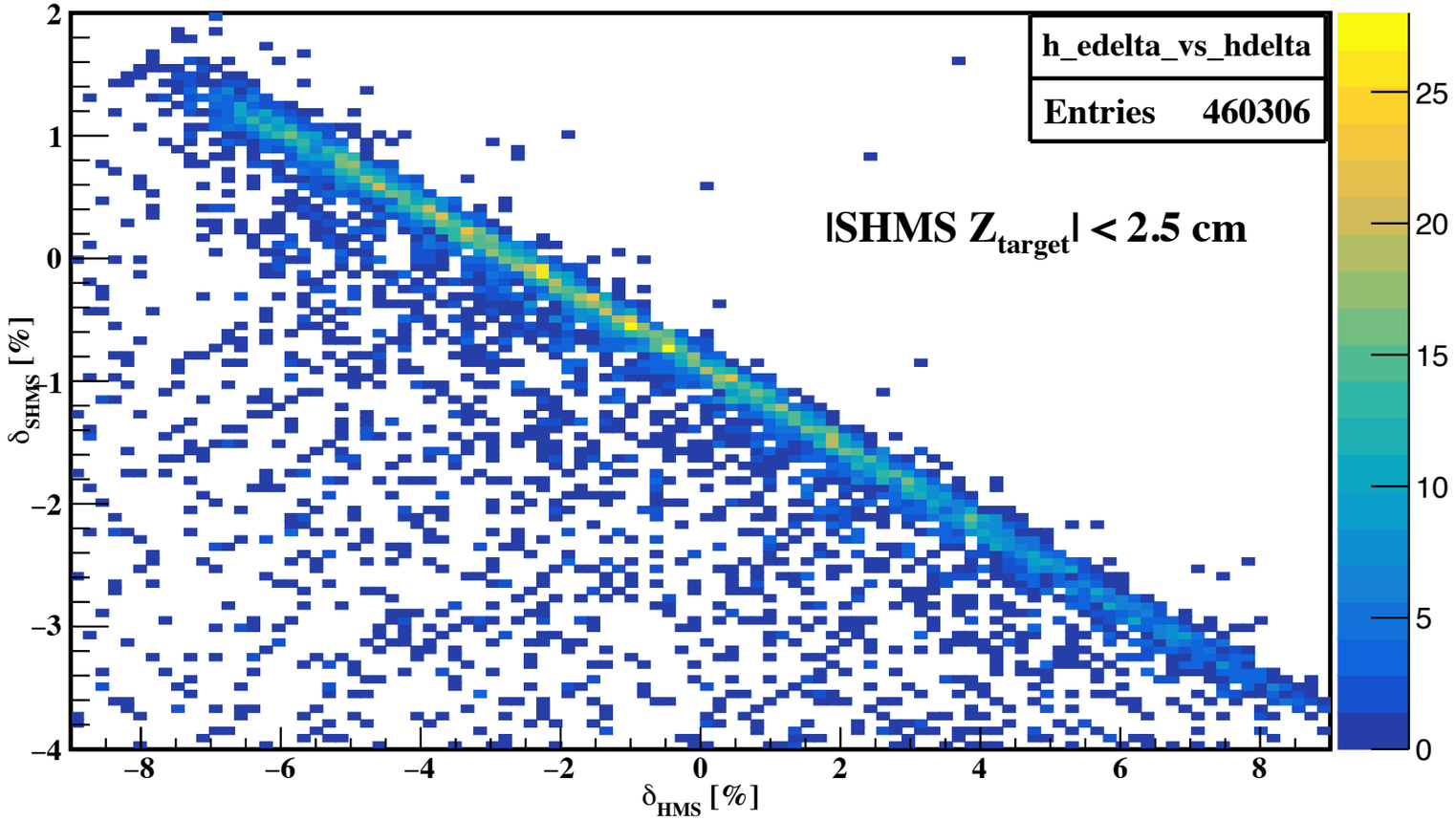
$$e^-\text{should} = \delta_{SHMS}(-3.5, 1.5) \cdot \text{shms}X'_{tar}(-0.01, 0.015) \cdot \text{shms}Y'_{tar}(-0.01, 0.01) \cdot |Z_{tar}| < 2.5 \cdot W(0.9, 1) \cdot E_{cal} > 0.6$$

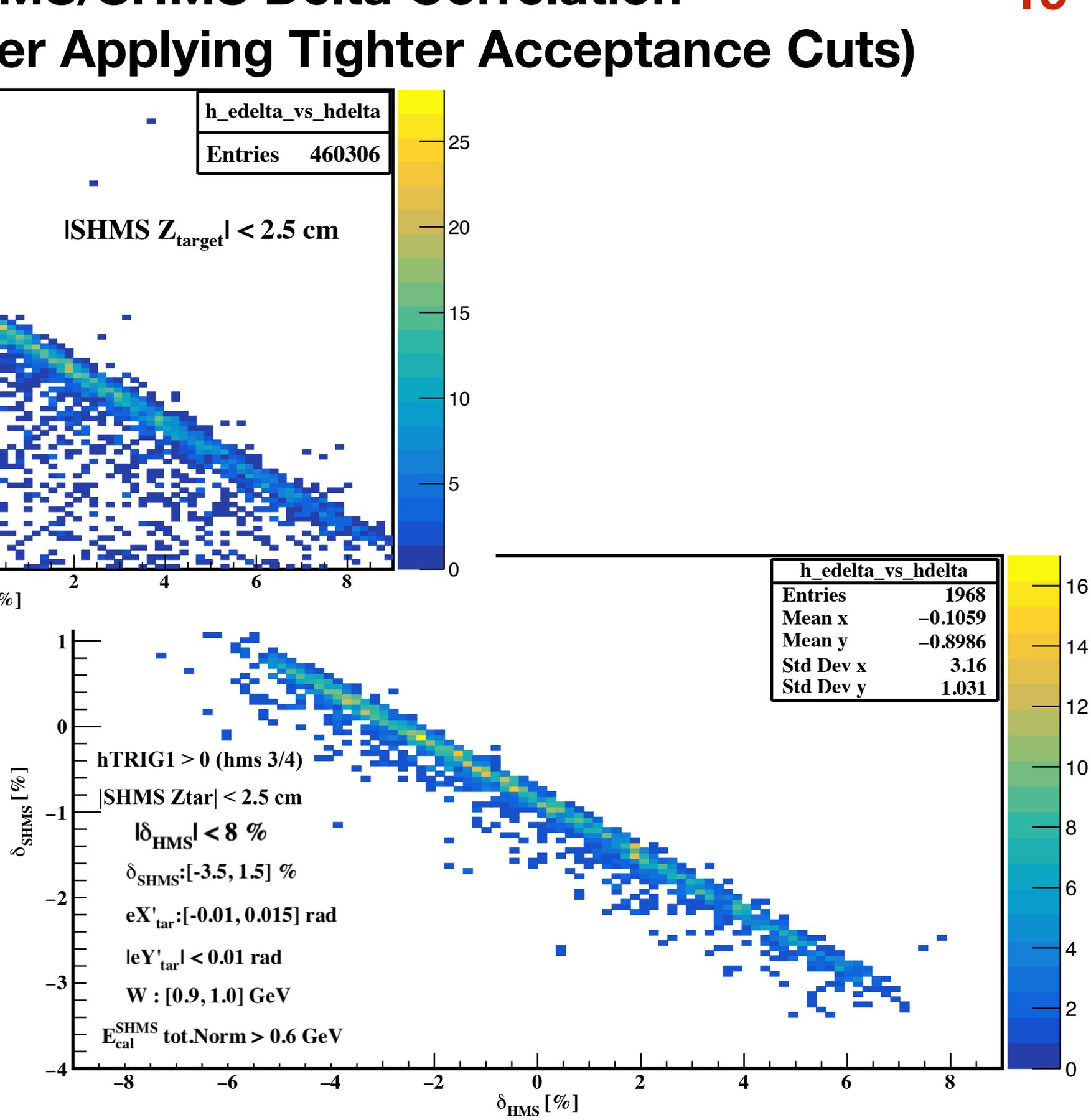
Z Target
(Before/After Applying Tighter Acceptance Cuts)



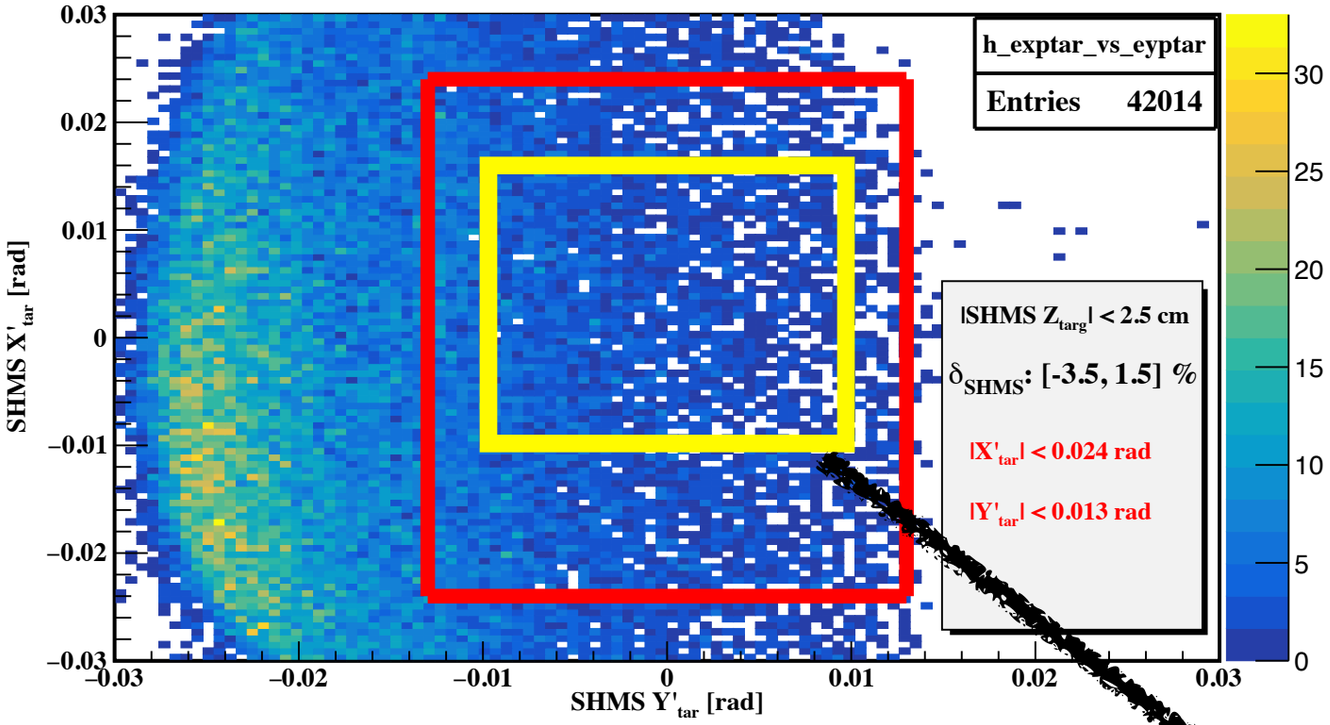


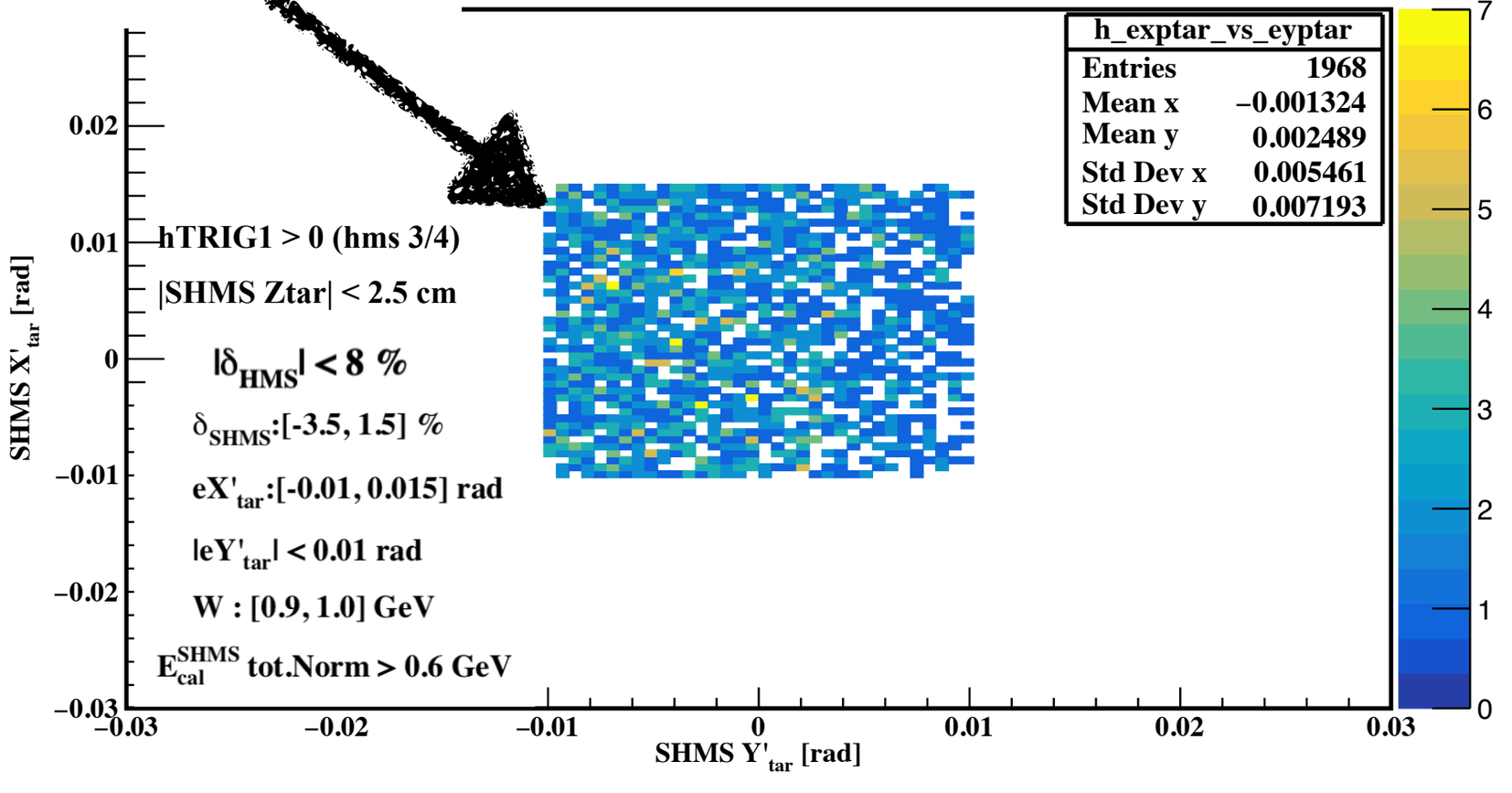
HMS/SHMS Delta Correlation (Before/After Applying Tighter Acceptance Cuts)



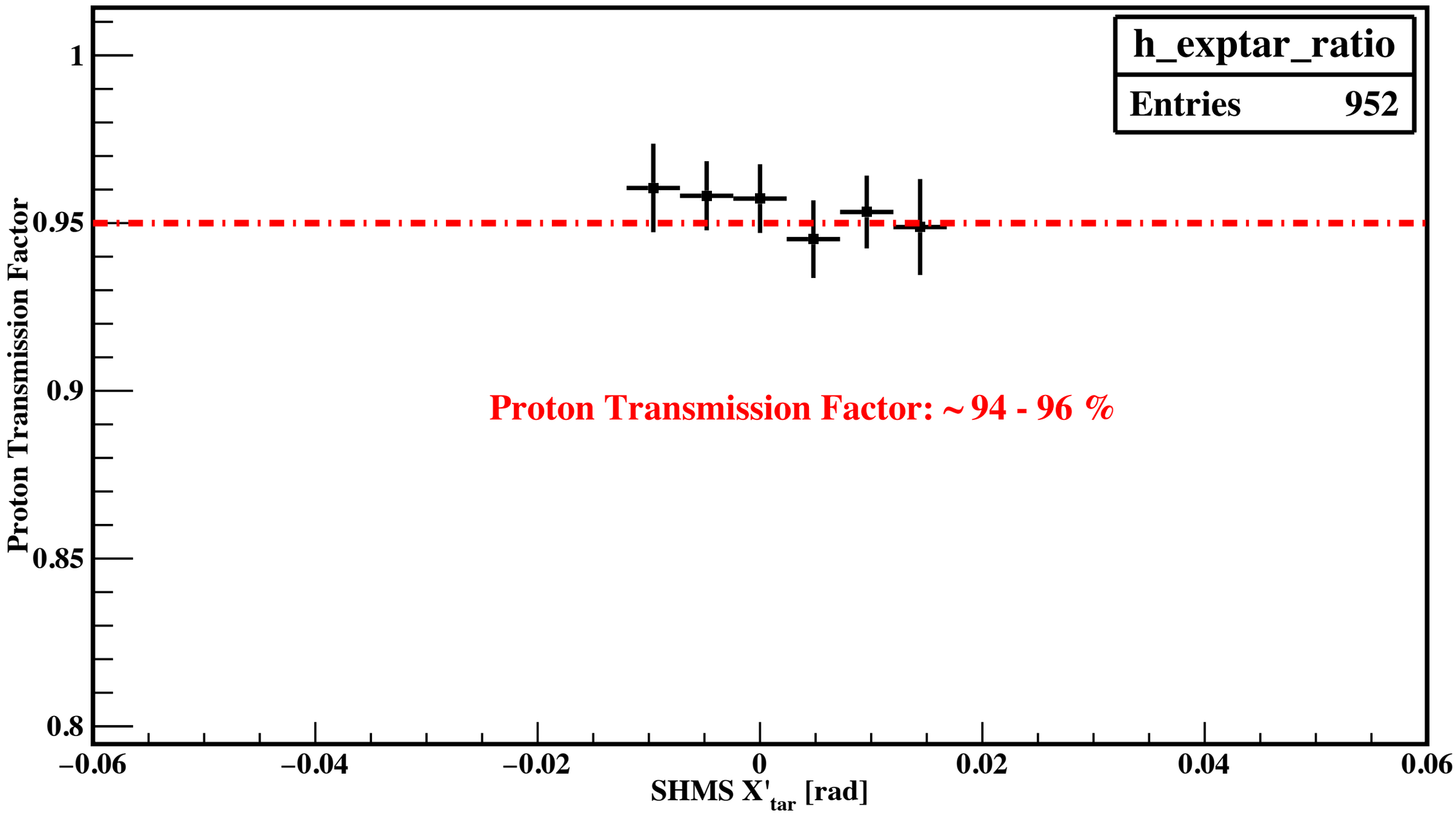


Extract Proton Absorption from SHMS e- Singles (Before/After Applying Tighter Acceptance Cuts)





SHMS X'tar Ratio
(After Applying Tighter Acceptance Cuts)



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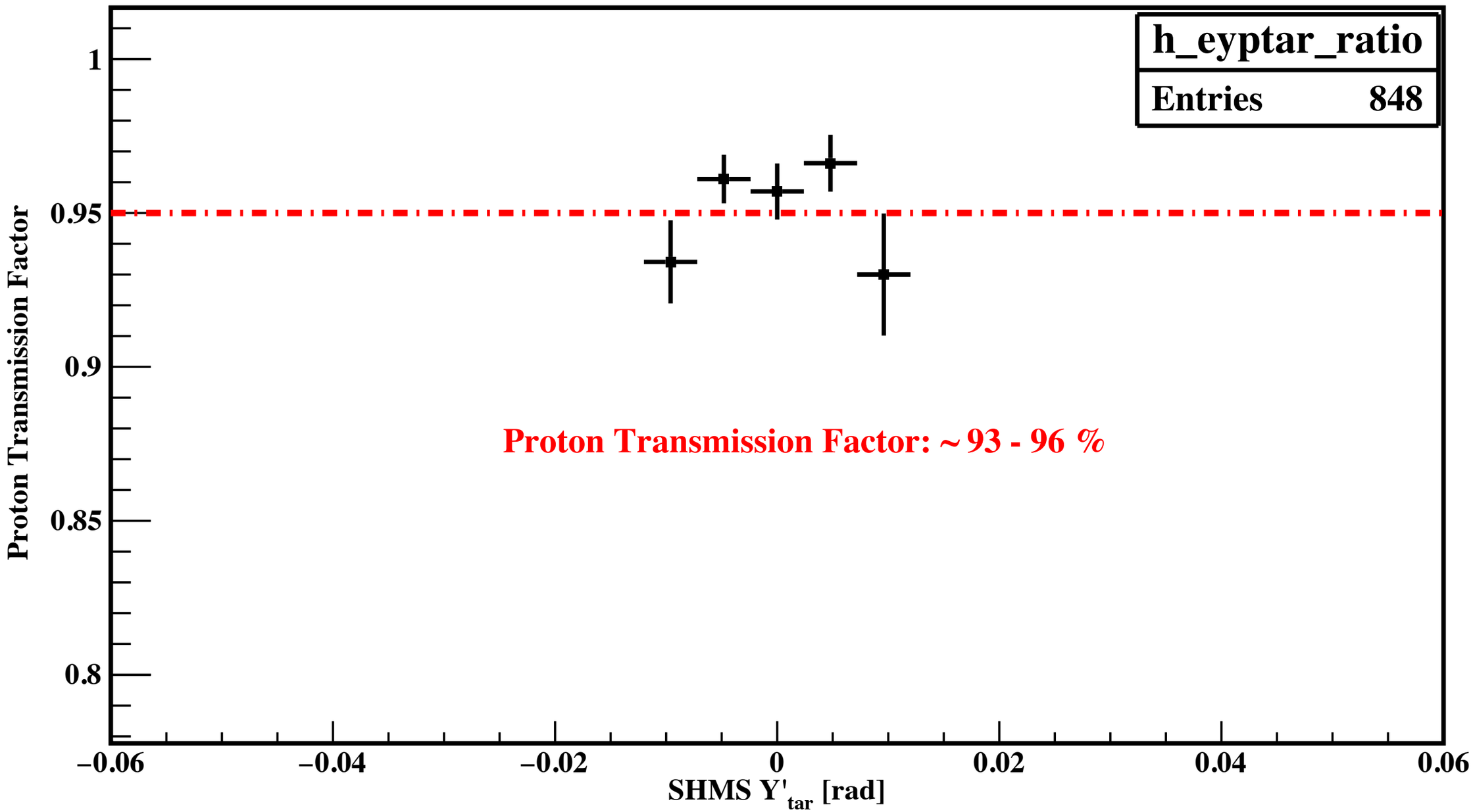
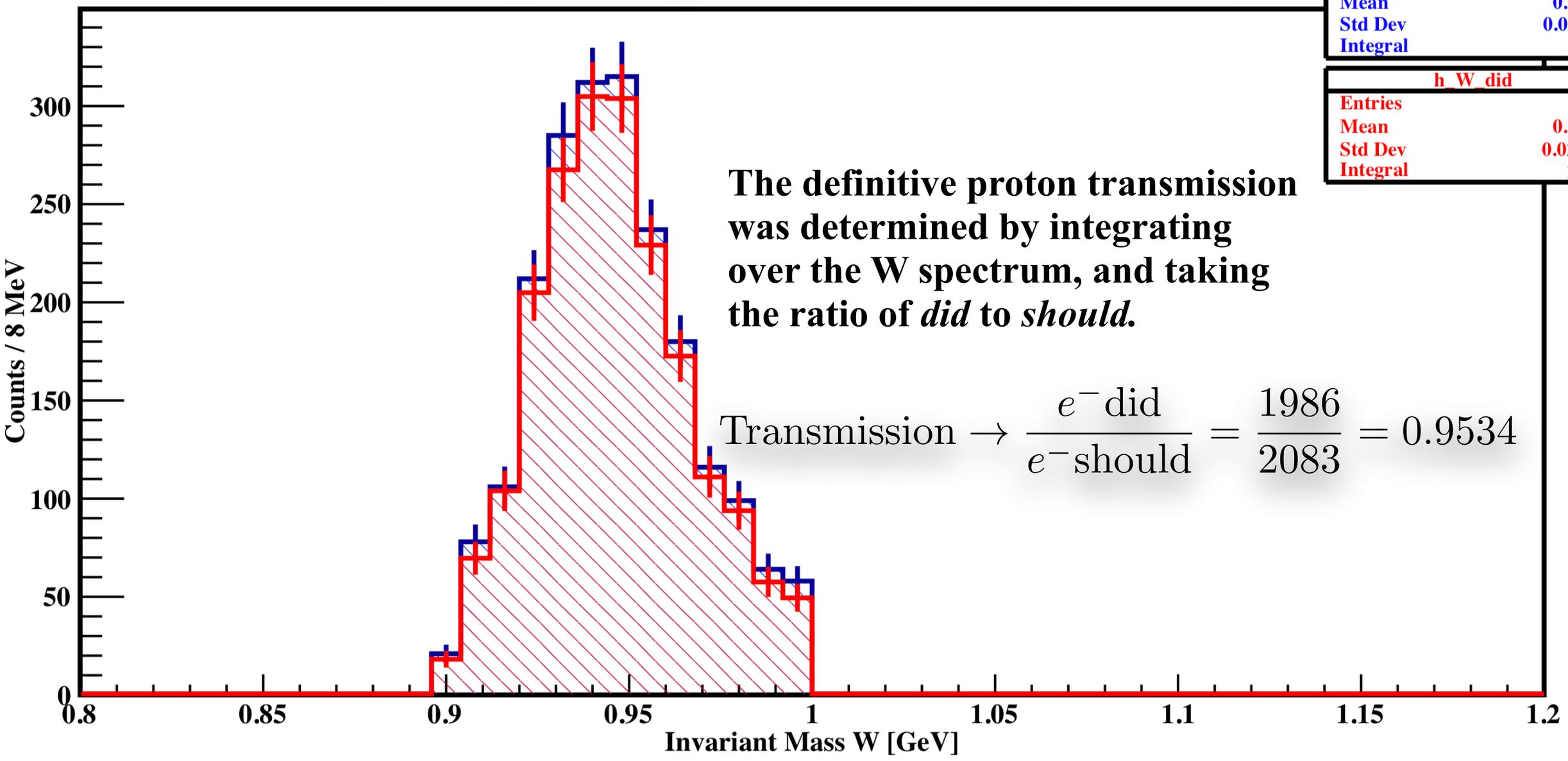


Invariant Mass W
(After Applying Tighter Acceptance Cuts)

$$\text{Proton Absorption} = 4.66 \pm 0.472\%$$



The definitive proton transmission was determined by integrating over the W spectrum, and taking the ratio of *did* to *should*.

$$\text{Transmission} \rightarrow \frac{e^- \text{did}}{e^- \text{should}} = \frac{1986}{2083} = 0.9534$$