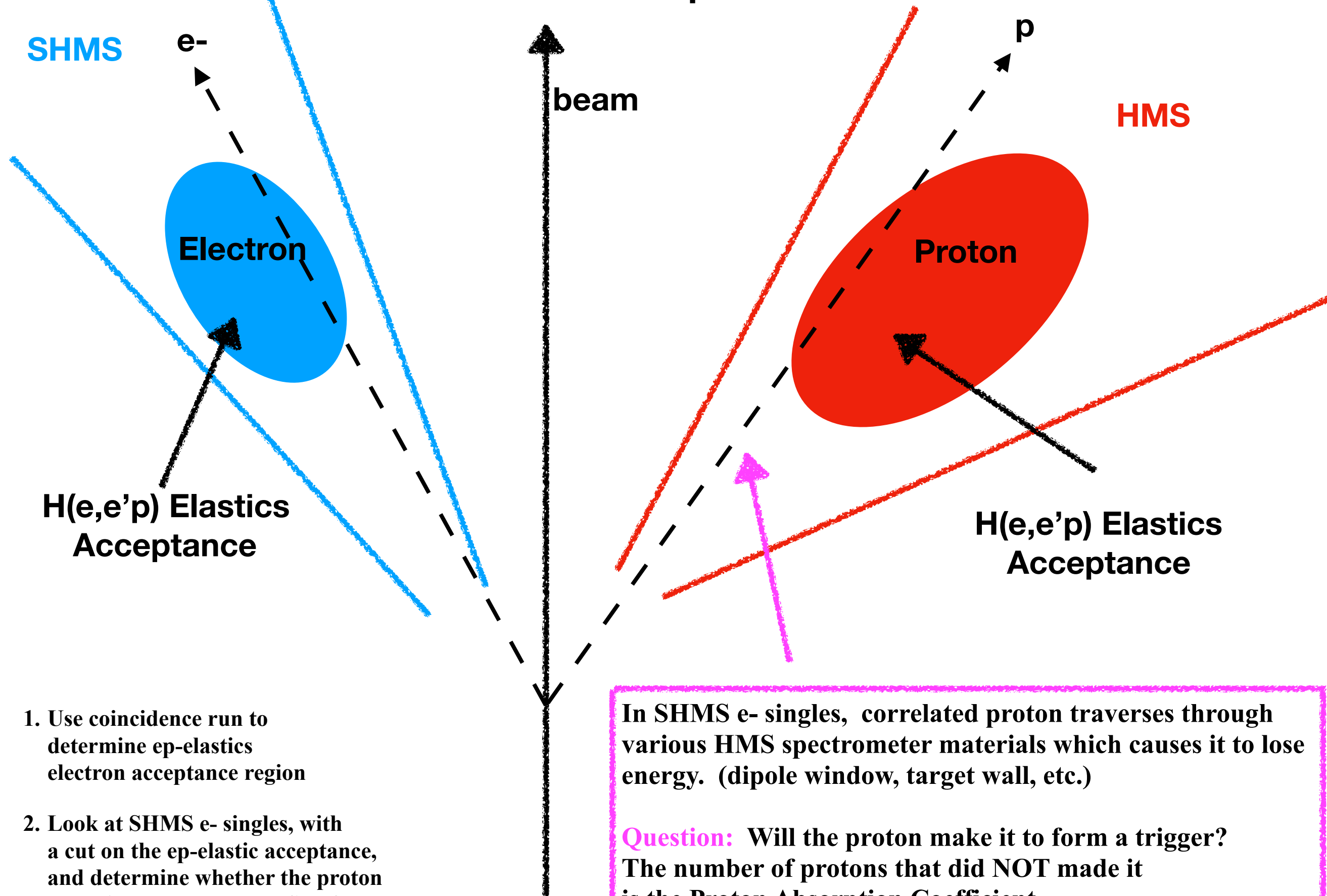


Proton Absorption

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April 4, 2019

Basic Concept

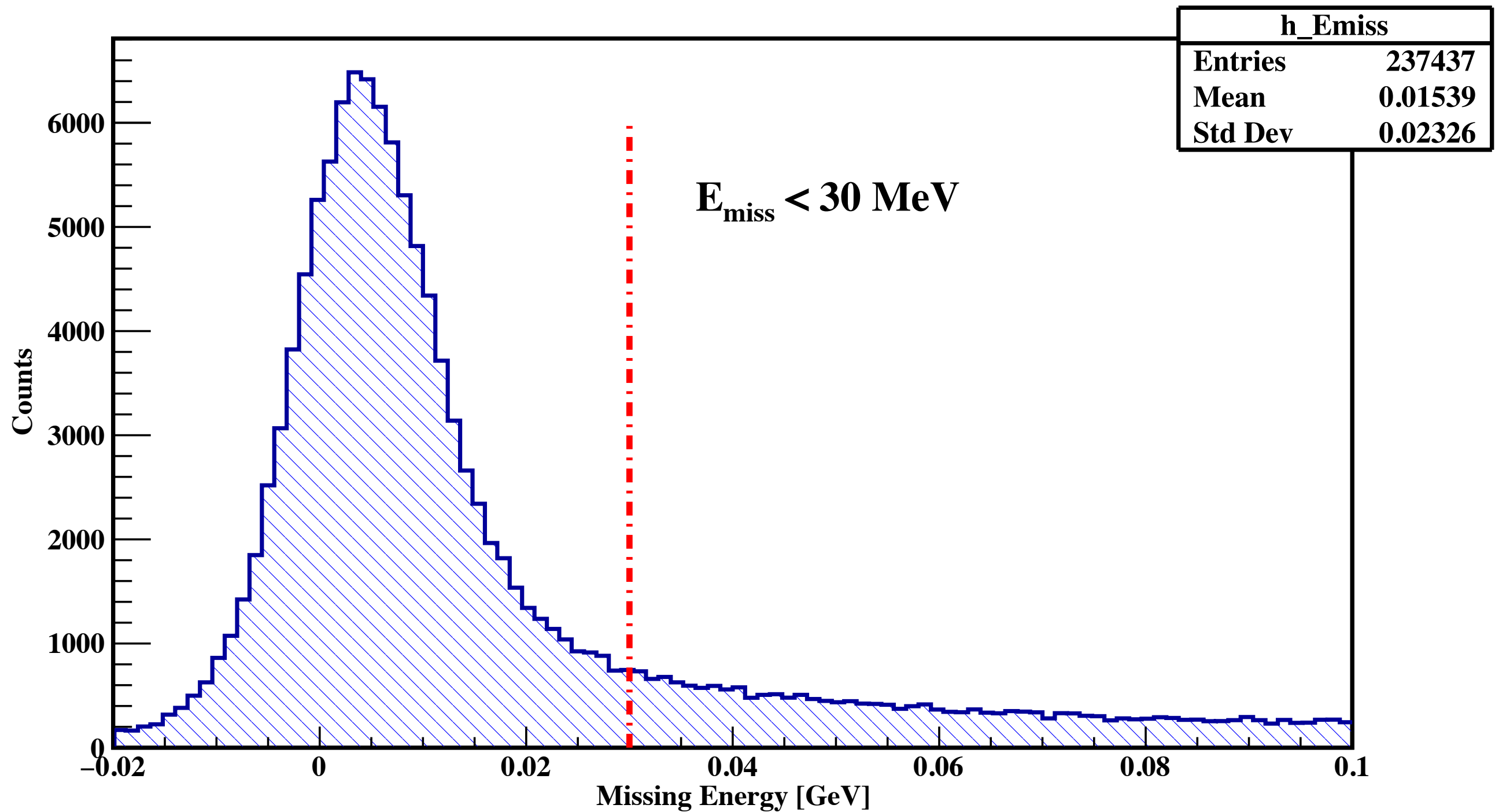


1. Use coincidence run to determine ep-elastics electron acceptance region
2. Look at SHMS e- singles, with a cut on the ep-elastic acceptance, and determine whether the proton made it through the HMS to form a trigger.

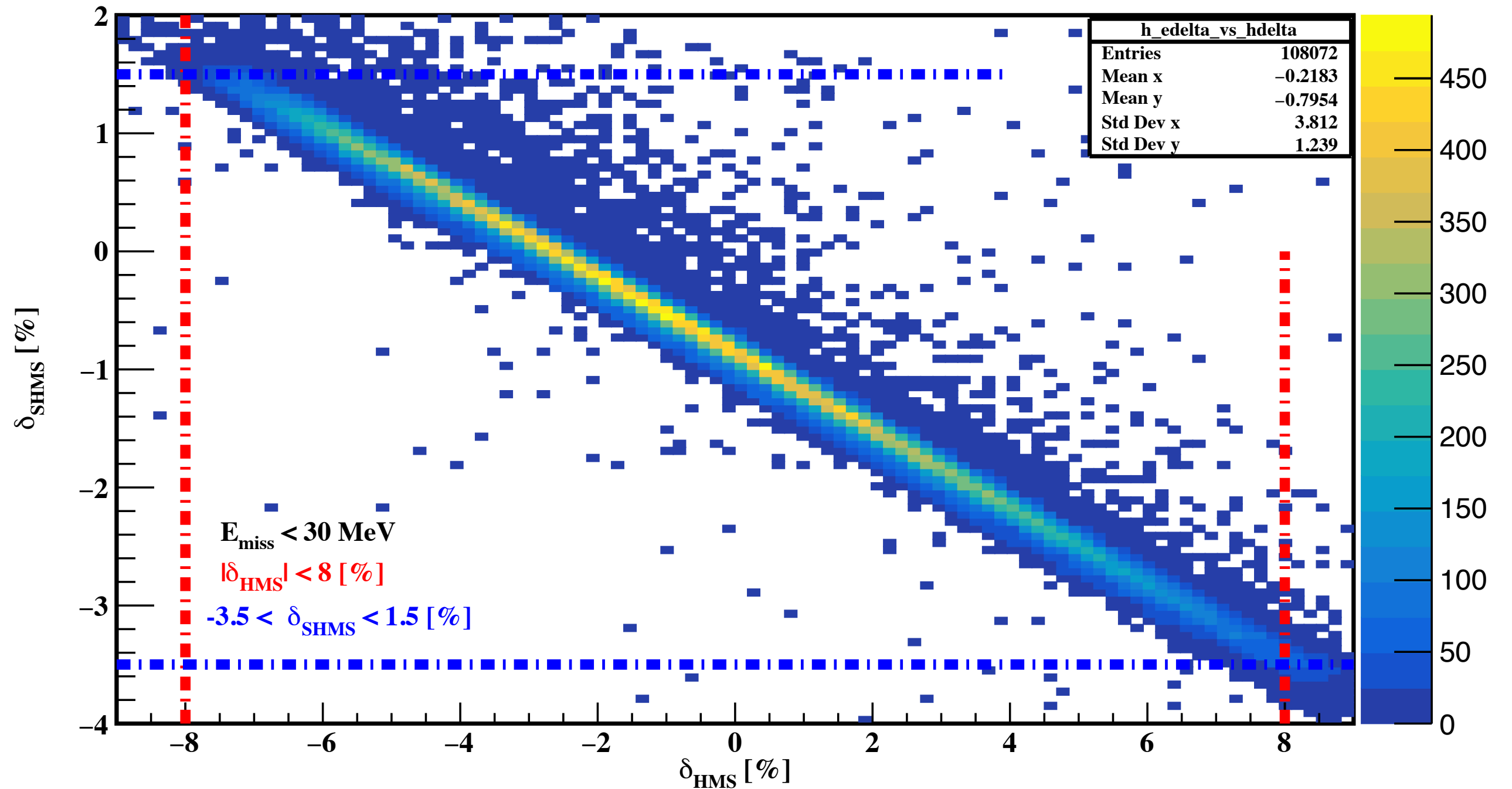
In SHMS e- singles, correlated proton traverses through various HMS spectrometer materials which causes it to lose energy. (dipole window, target wall, etc.)

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

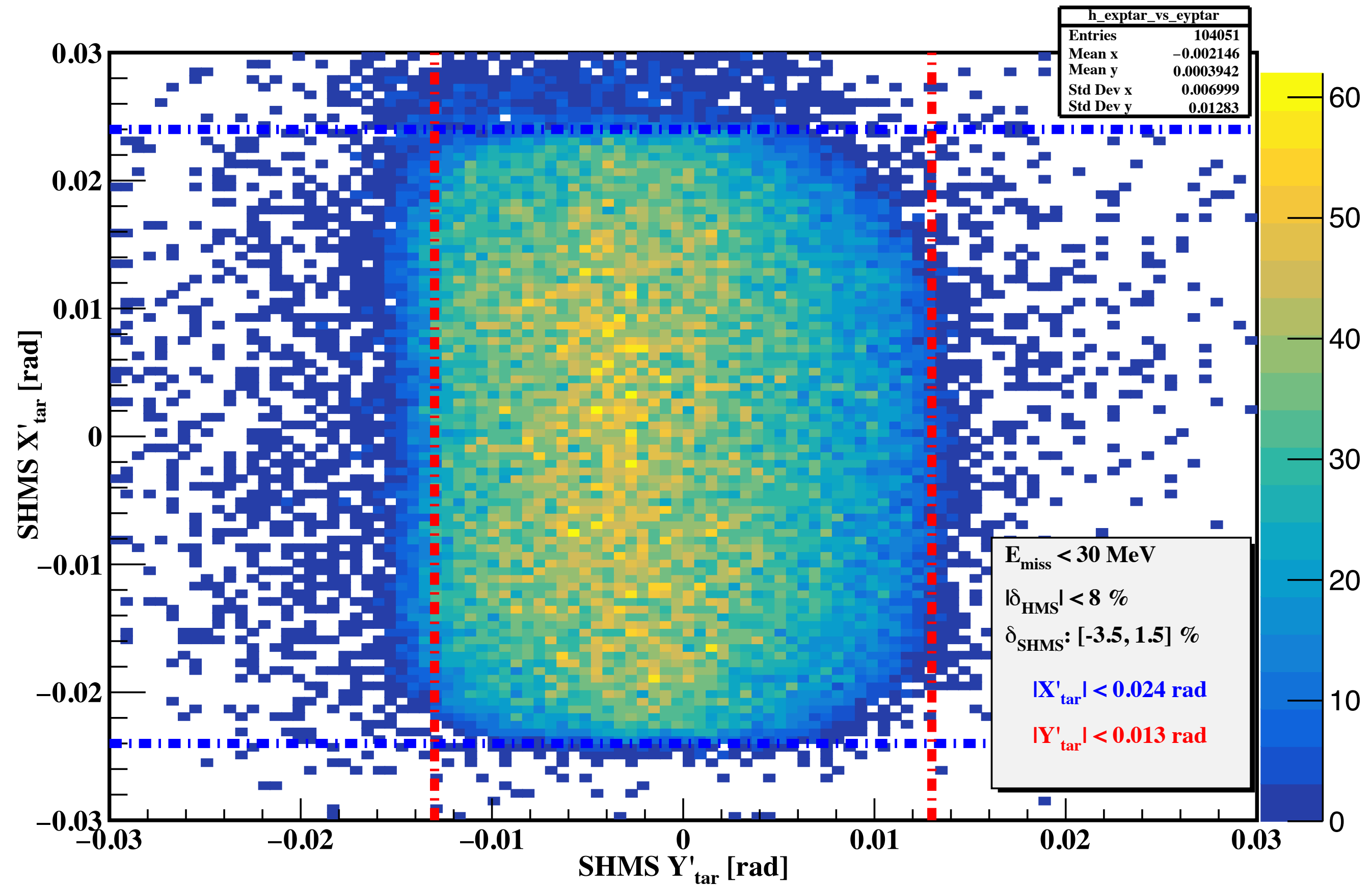
Use Coincidence to Select SHMS ep-elastics Acceptance Region



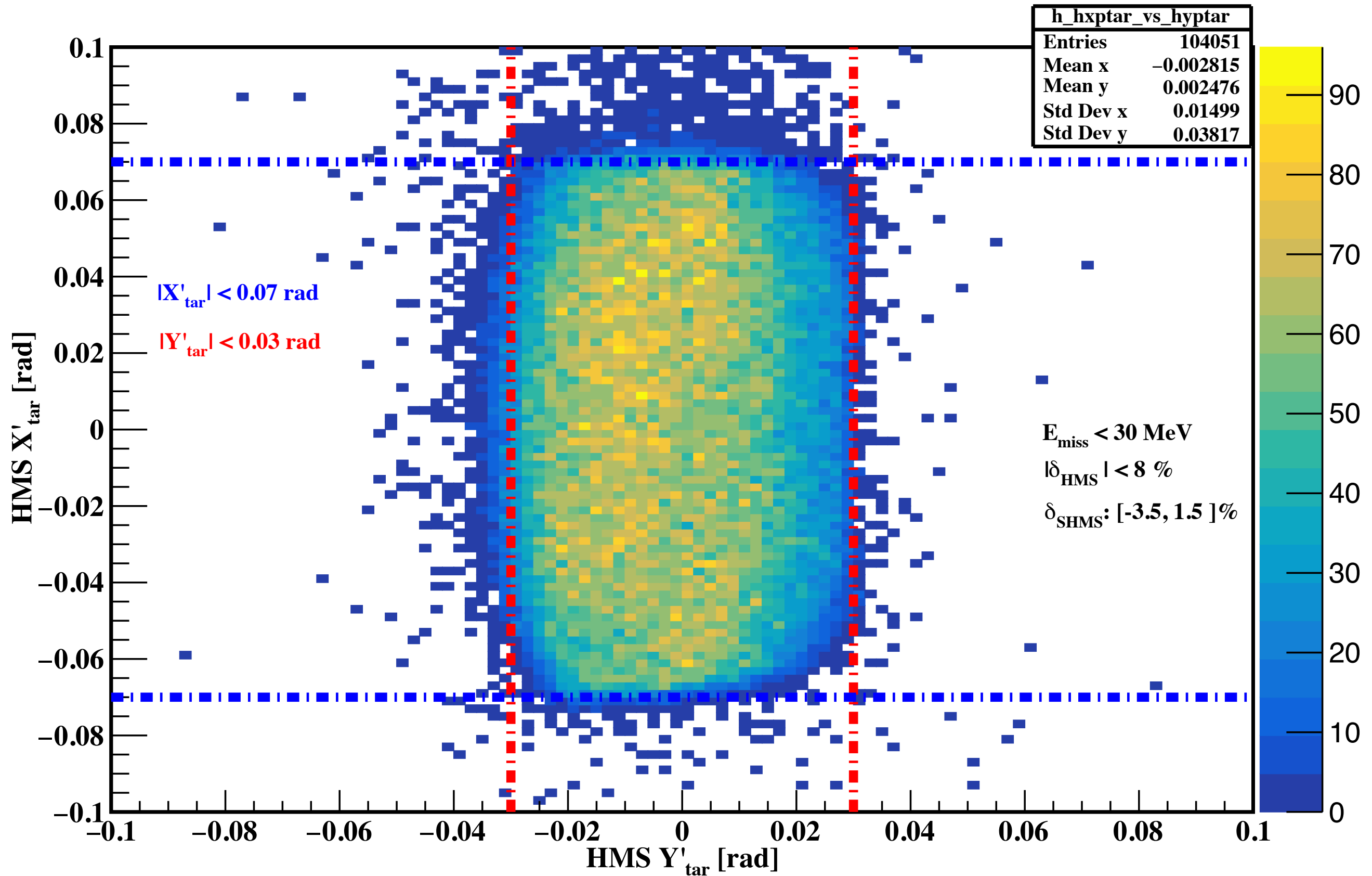
Use Coincidence to Select SHMS ep-elastics Acceptance Region



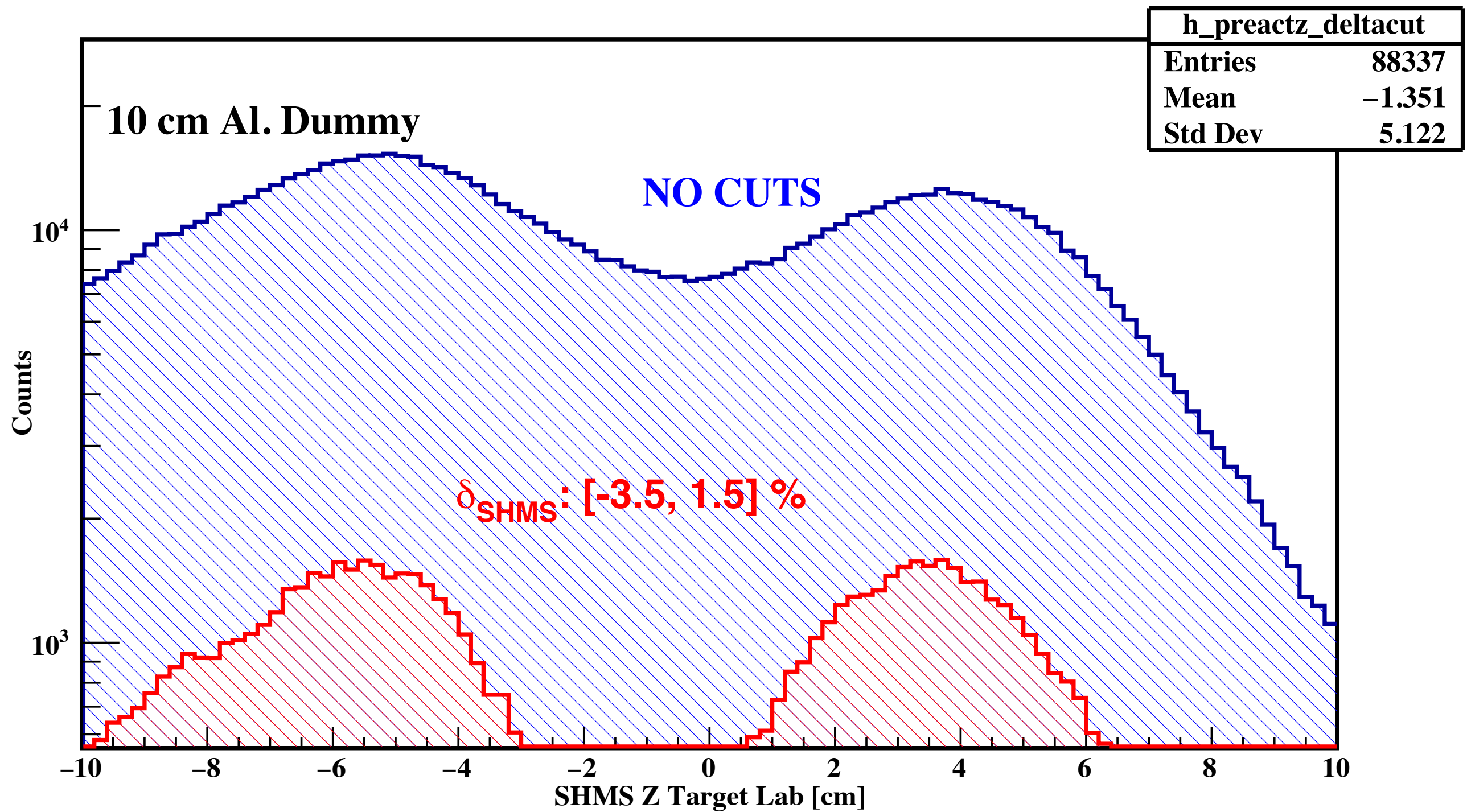
Use Coincidence to Select SHMS ep-elastics Acceptance Region



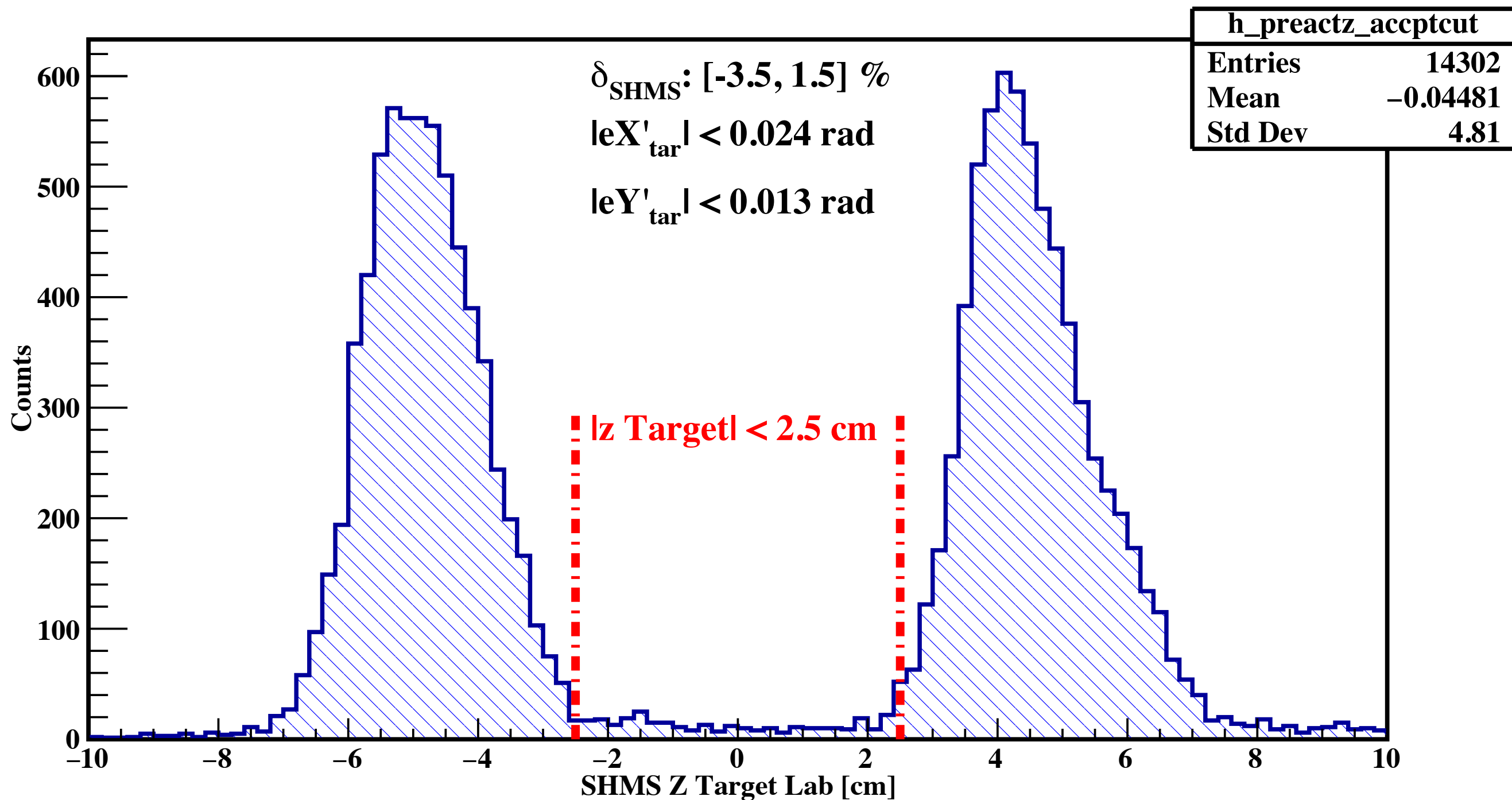
Use Coincidence to Select SHMS ep-elastics Acceptance Region



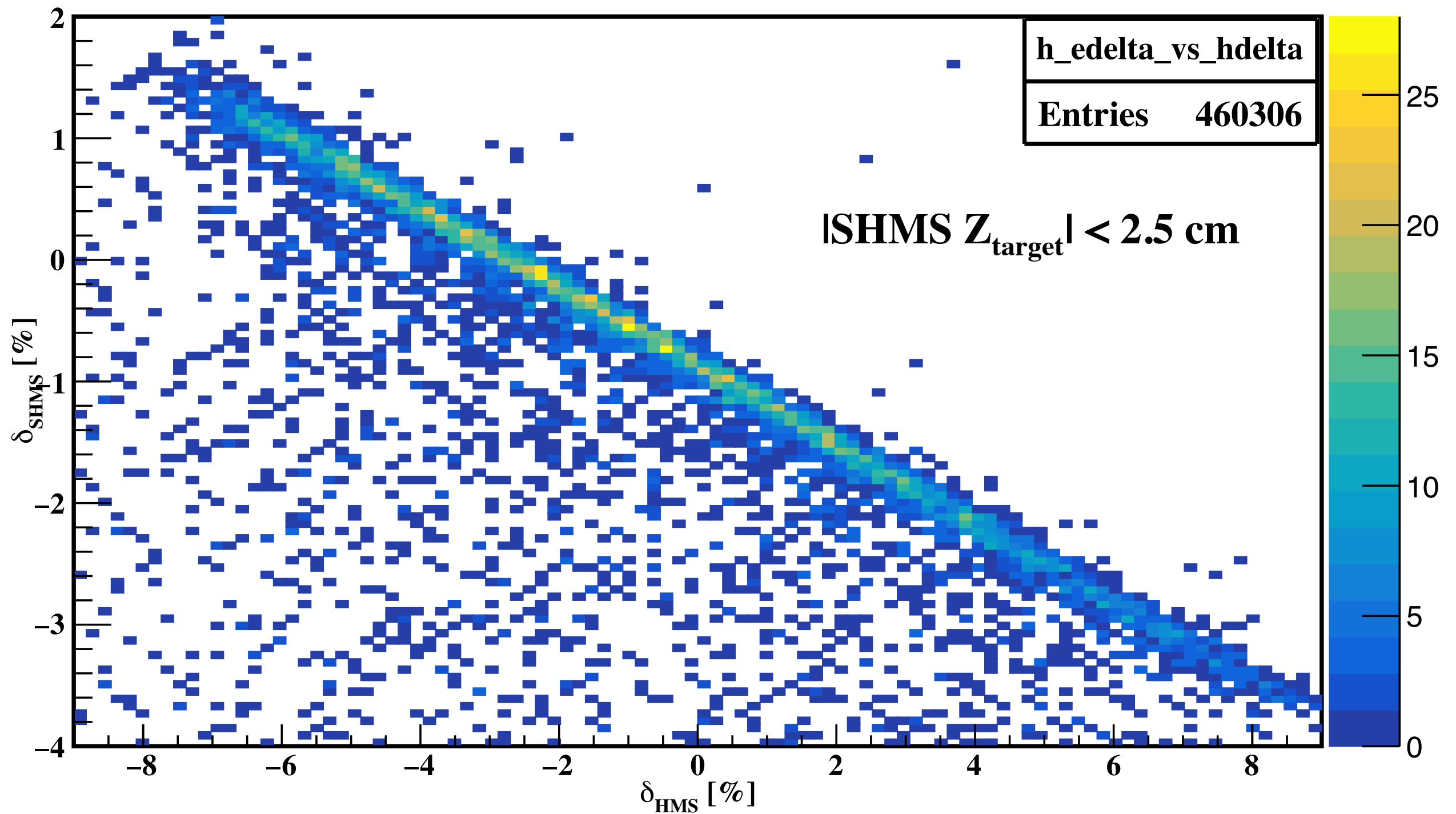
Use Al. Dummy Run to Select Z-Target Cut (SHMS singles)



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

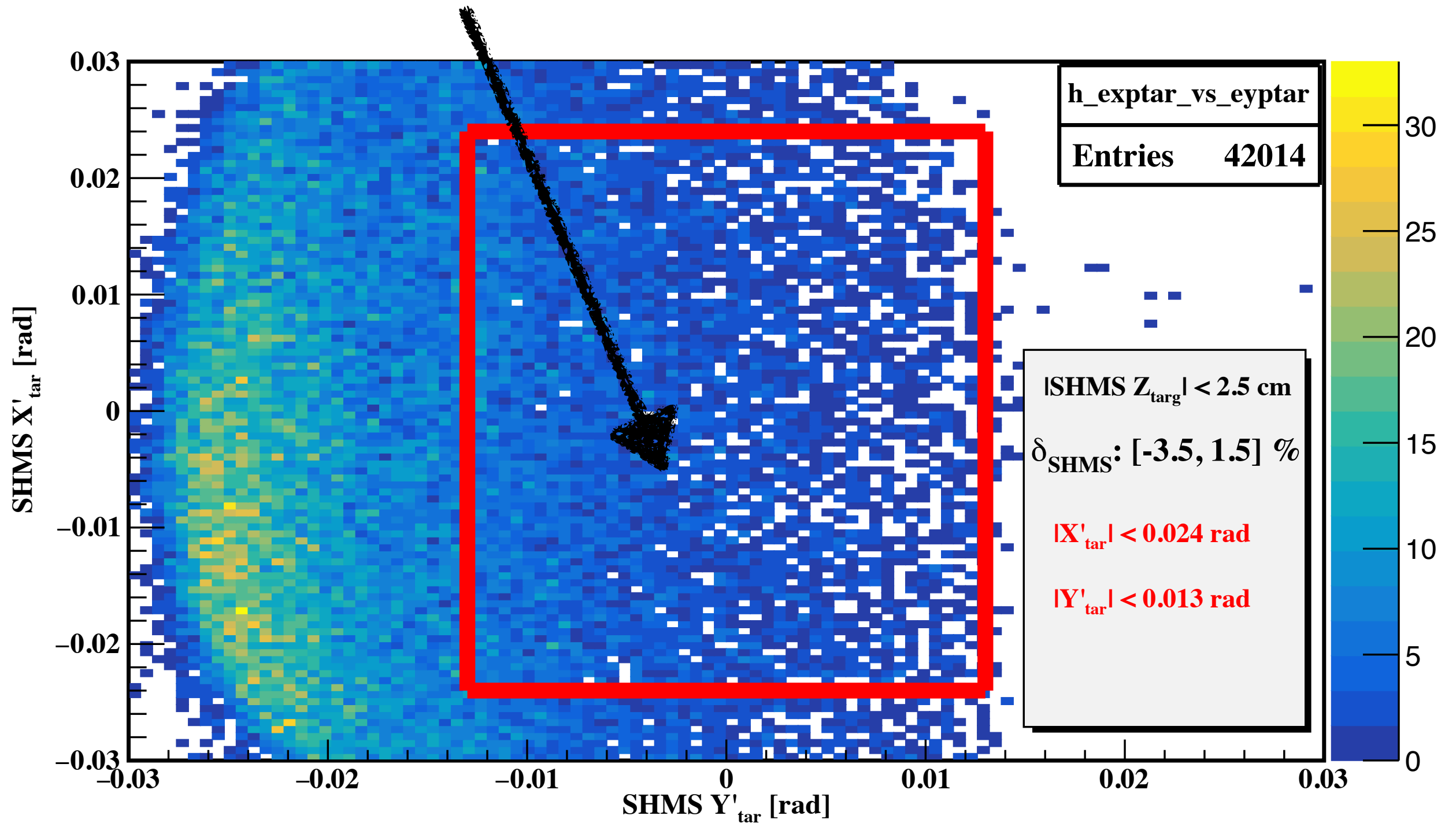


Extract Proton Absorption from SHMS e- Singles

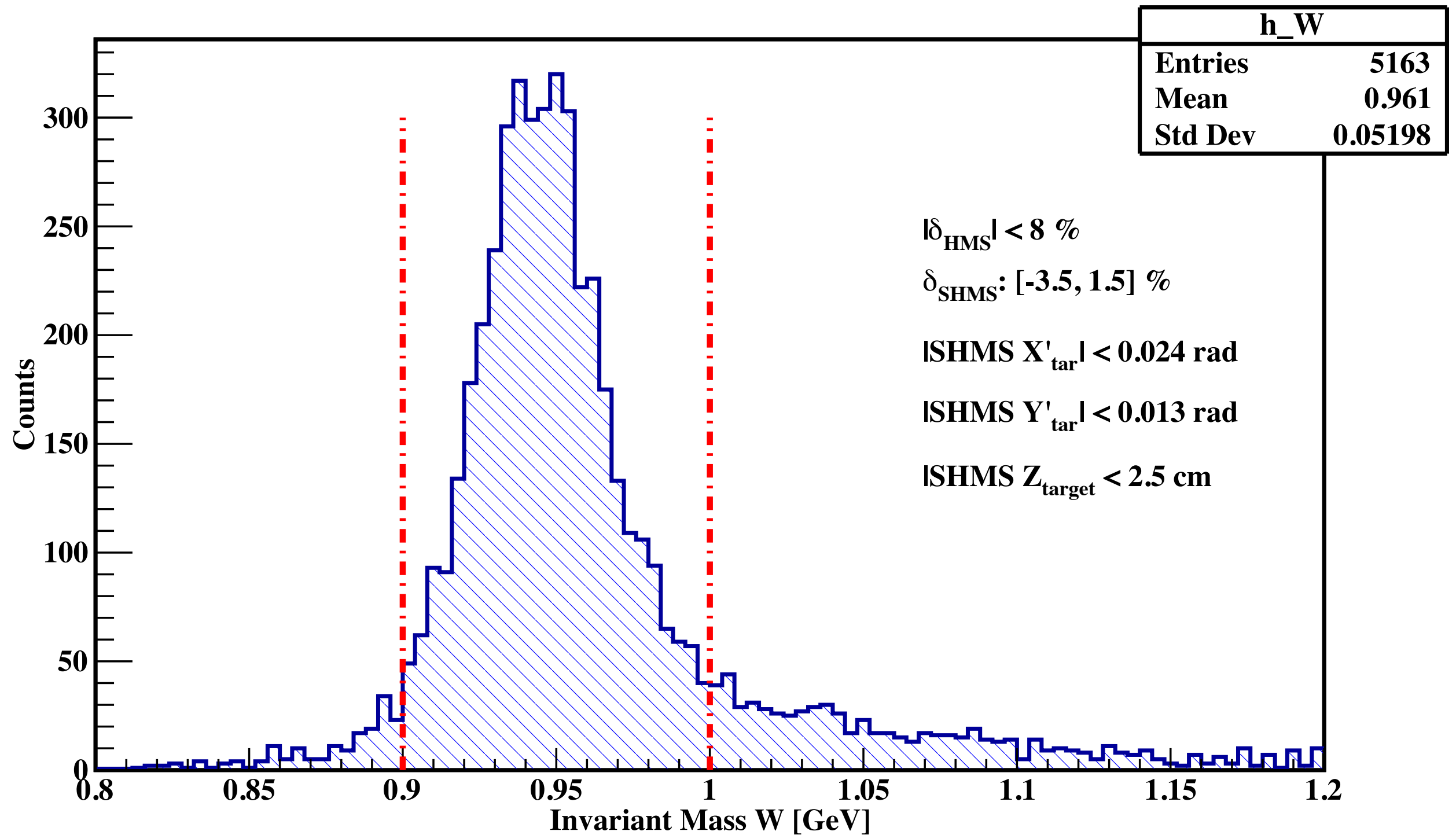


Extract Proton Absorption from SHMS e- Singles

ep-elastics region as determined from coincidence run



Extract Proton Absorption from SHMS e- Singles



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.

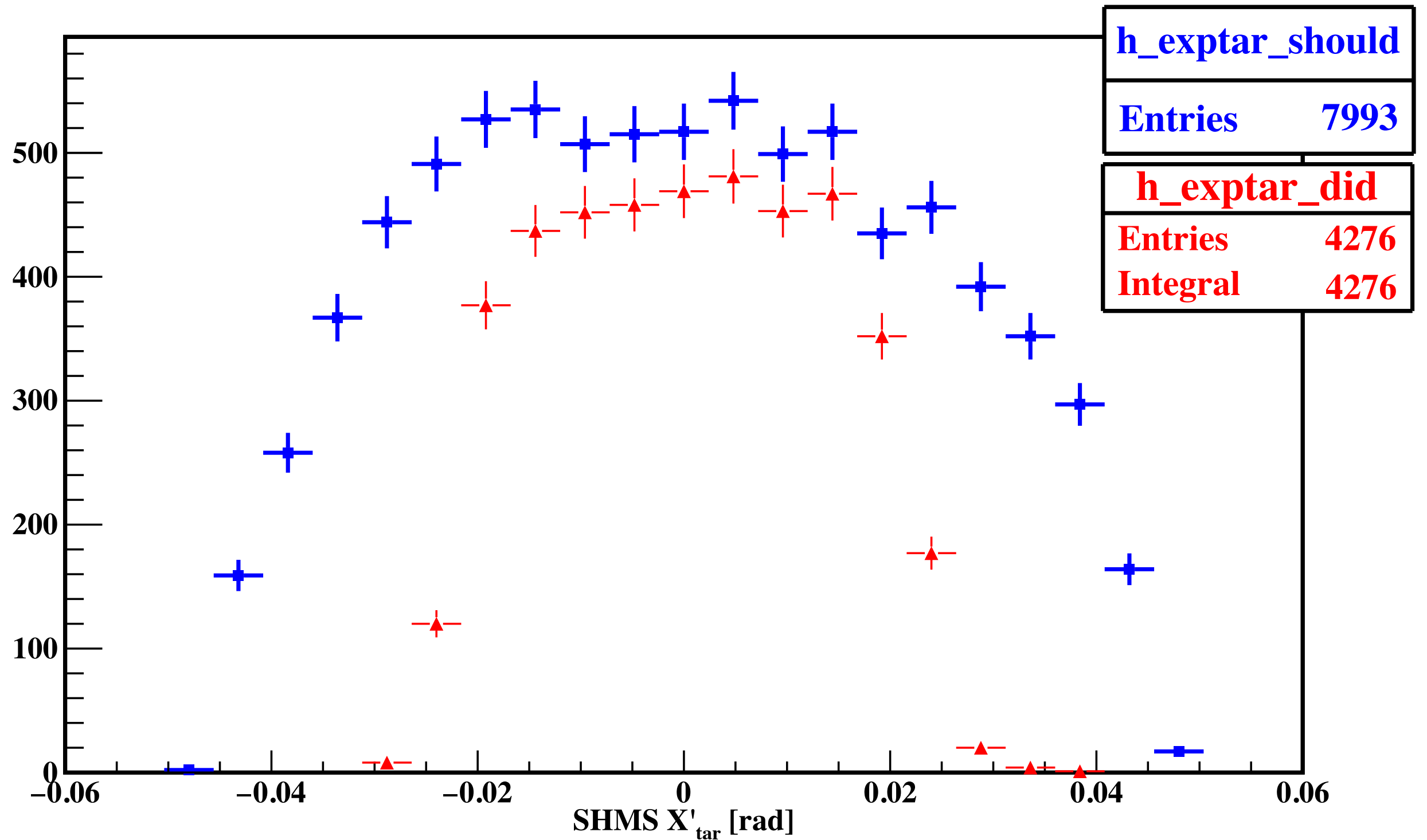
$$e^- \text{ did} = e^- \text{ should} \cdot \delta_{HMS} \cdot h\text{TRIG1}$$

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.

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

Extract Proton Absorption from SHMS e- Singles



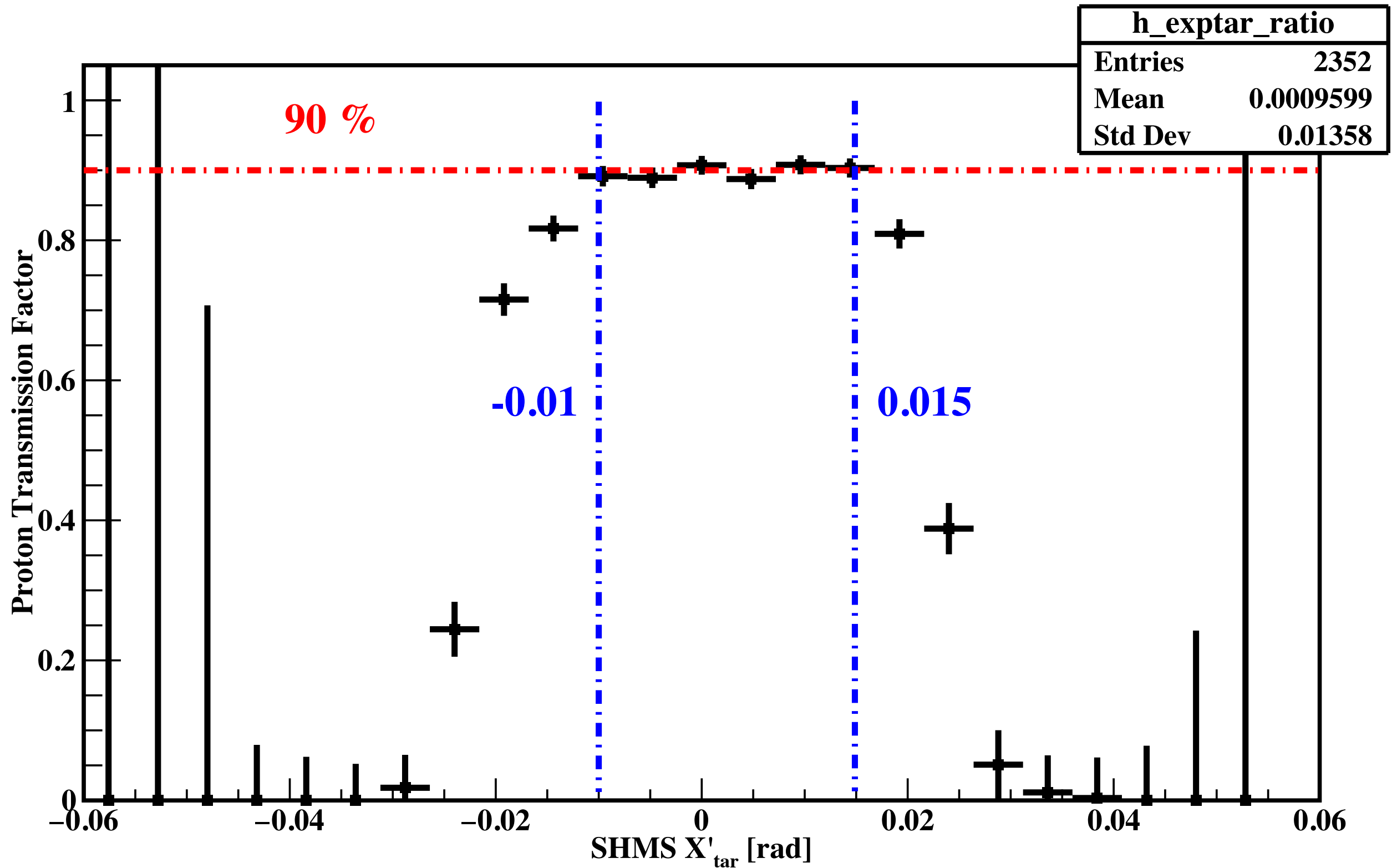
CUTS:

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

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

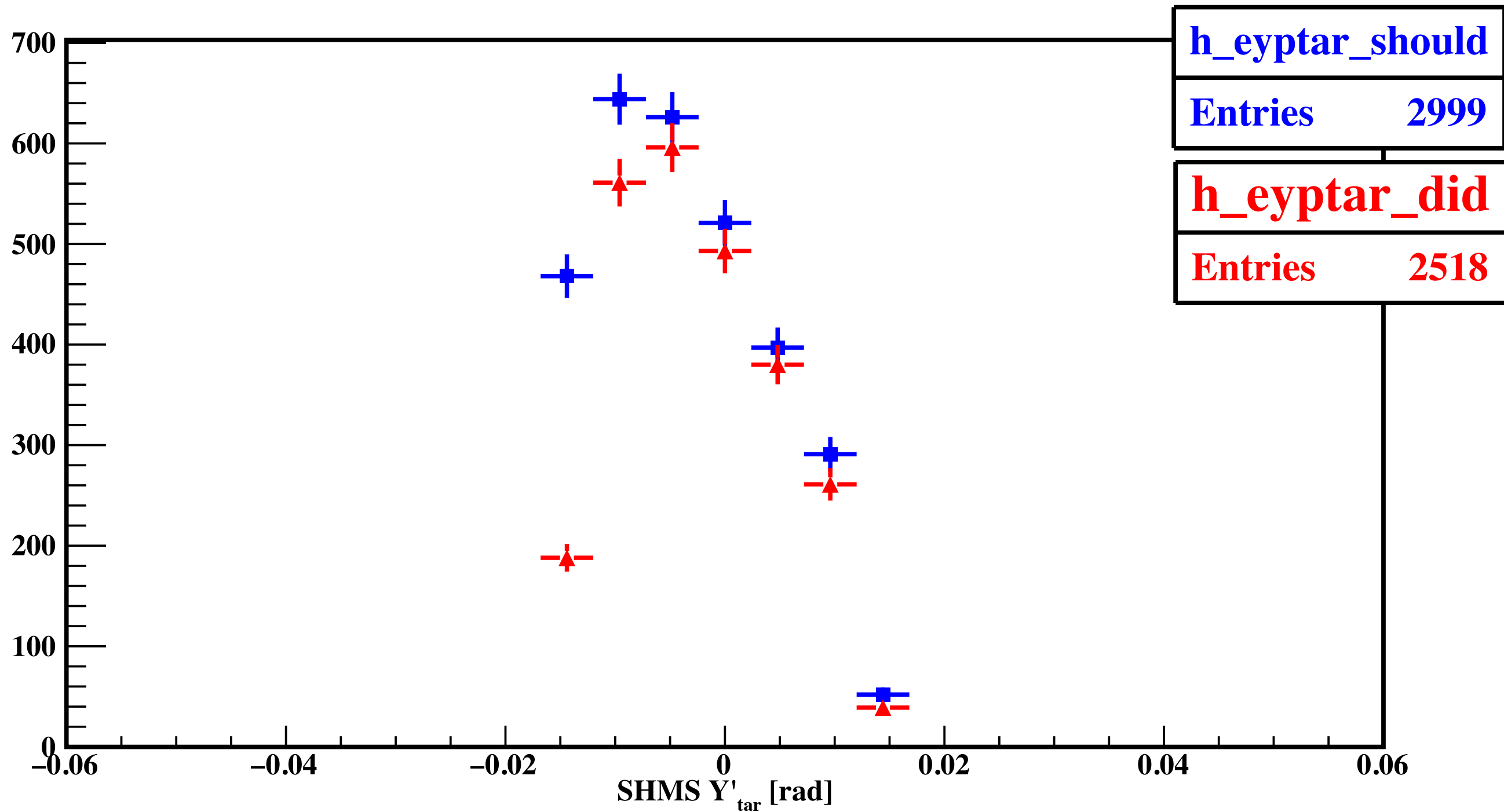
Extract Proton Absorption from SHMS e- Singles

Ratio: e-_did / e-_should



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

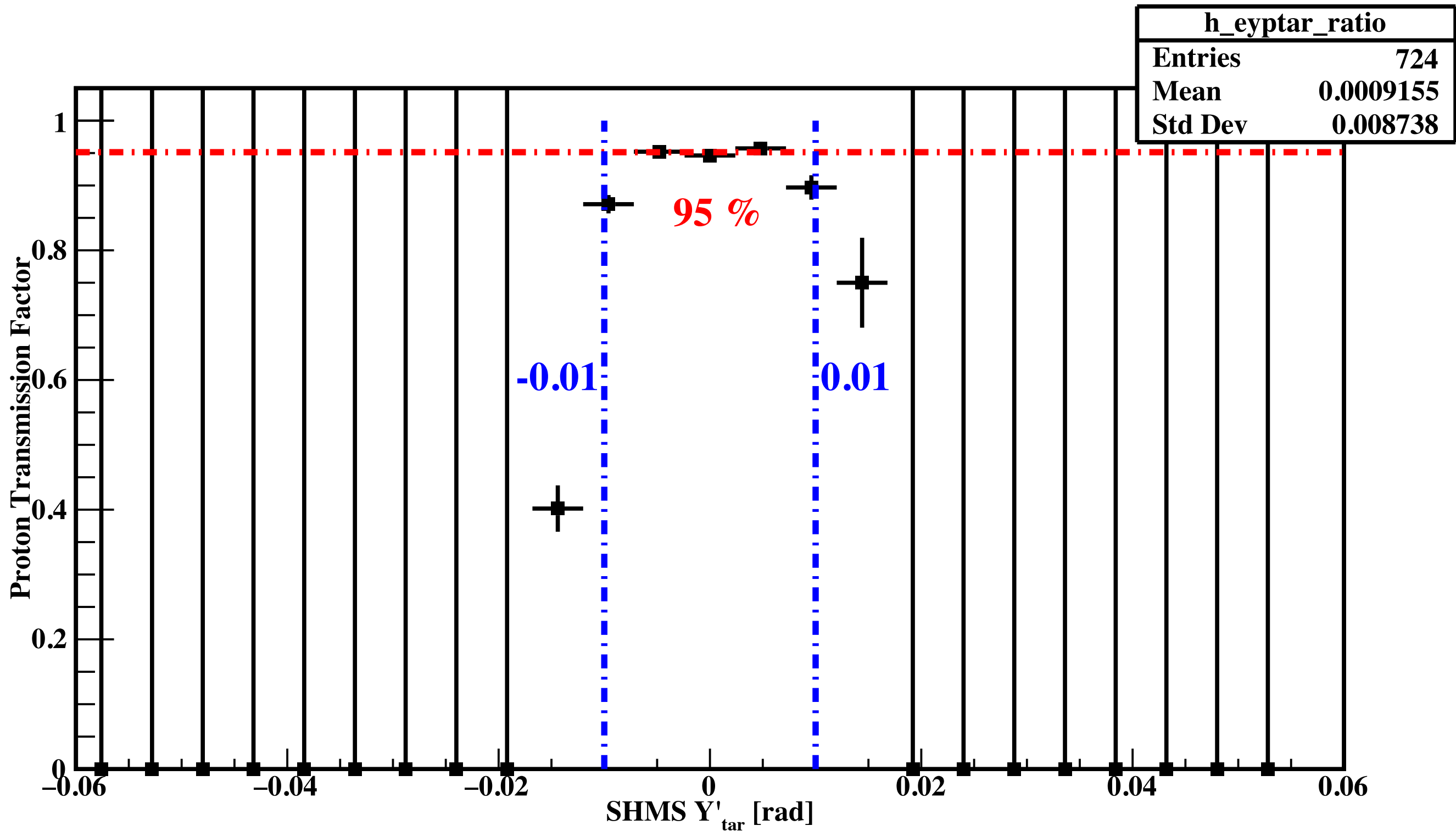
Extract Proton Absorption from SHMS e- Singles



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

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

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:

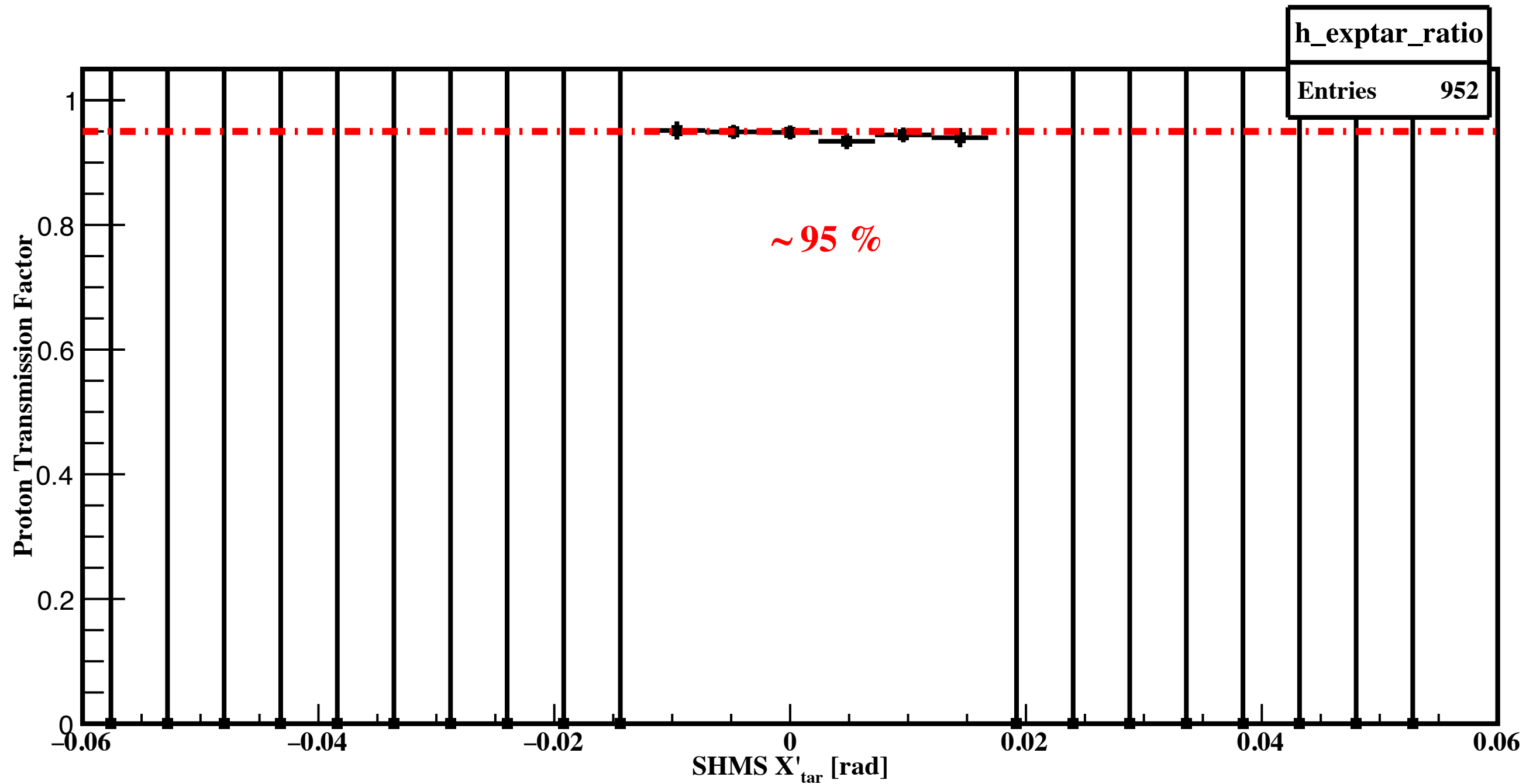
$$e^- \text{ did} = e^- \text{ should} \cdot |\delta_{HMS}| < 8 \cdot \text{hms:hTRIG1}(3/4 \text{ trigger}) > 0$$

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



Tighter acceptance cuts

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



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

