



MENP

University of
Massachusetts
Amherst

2018-01 Run, Bethe-Heitler Study $\gamma p \rightarrow e^+e^-(p)$

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Friday, August 23 2019



Objectives of the BH Analysis:

1. Use Bethe-Heitler pair production for normalization in the Charged Pion Polarizability experiment. Therefore, developing an analysis suite for BH pairs is necessary.
2. We would like to extract the polarization signal of the BH pairs.
3. Measure the form factor/charge radius of the proton.

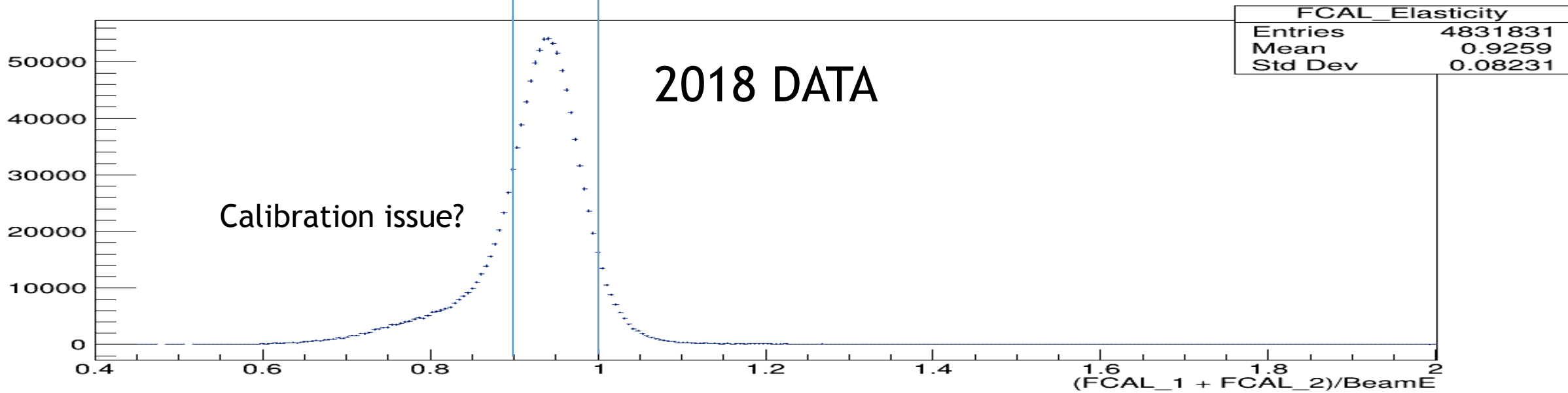
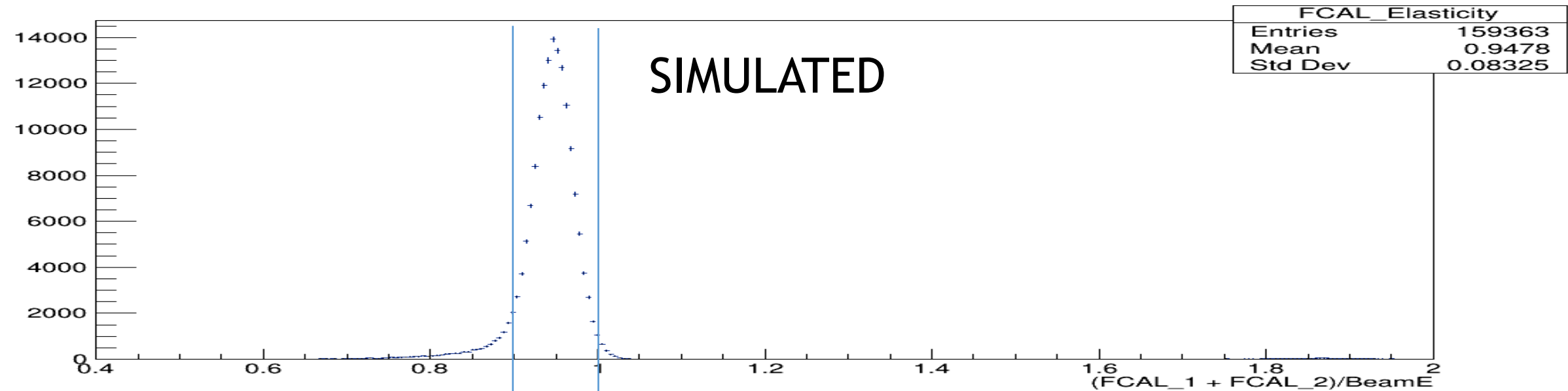
Cuts for $\gamma p \rightarrow e^+ e^- (p)$

Preselection Cuts

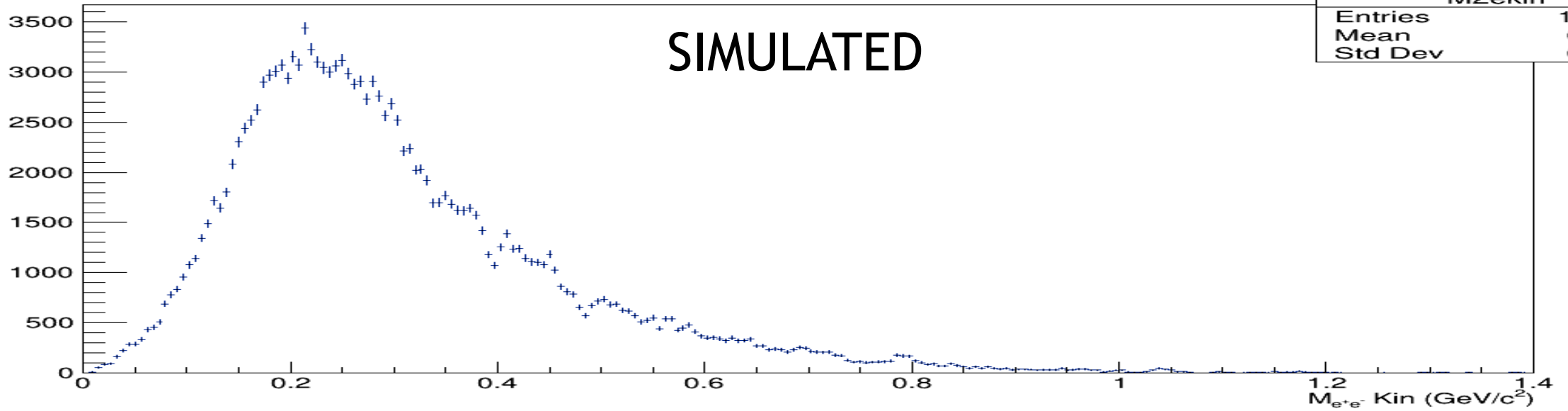
1. Default GlueX cuts: https://halldweb.jlab.org/wiki/index.php/Spring_2017_Analysis_Launch_Cuts
2. Require $E/p = 0.7$ for electron and positron tracks in FCAL and BCAL

DSelector Cuts

1. Cut on coherent peak: $8.12 < E_\gamma < 8.88$
2. Require both electron and positron tracks have hit in FCAL
3. Require both electron and positron tracks have hit in TOF
4. Require $d\text{MinKinFitCL} > 10\text{E-}6$
5. Eliminate events with $\text{NumUnusedTracks} \geq 2$
6. Eliminate events with $\text{Energy_UnusedShowers} > 0$
7. TOF dE/dx cut for electron and positron tracks at 3σ
8. FCAL DOCA cut for e^+ and e^- tracks at 3σ

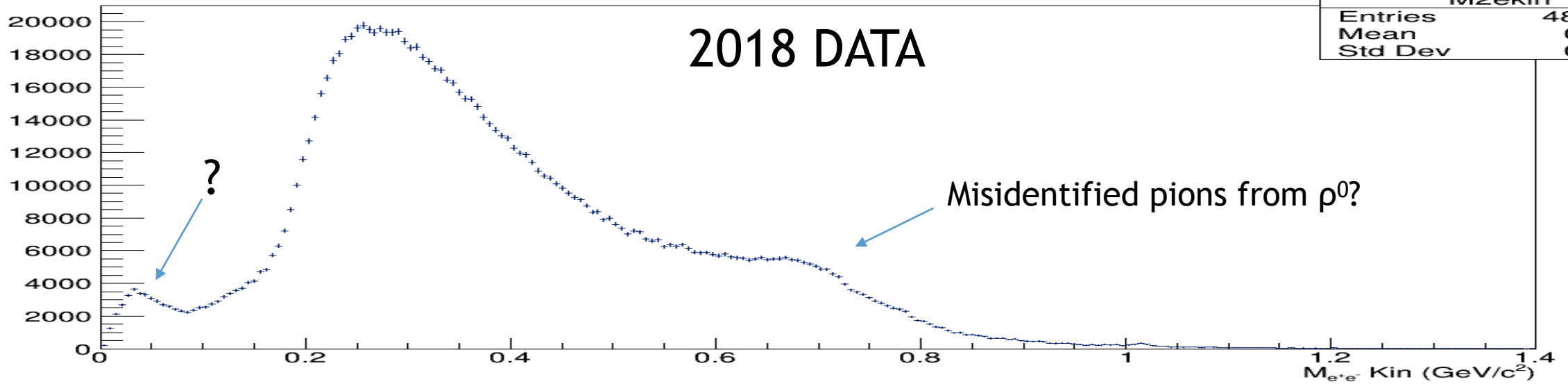


SIMULATED

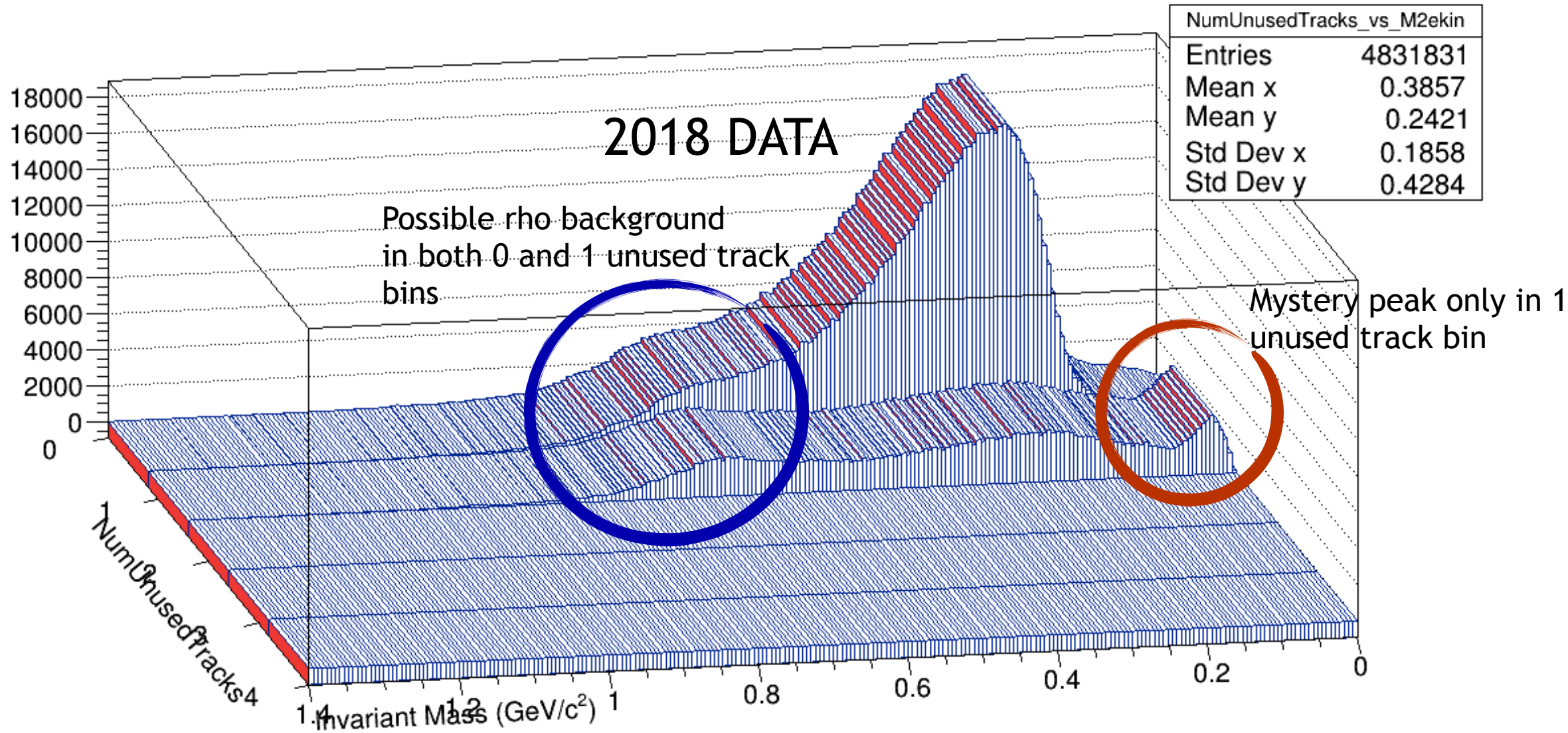


M2ekin	
Entries	159363
Mean	0.3055
Std Dev	0.1628

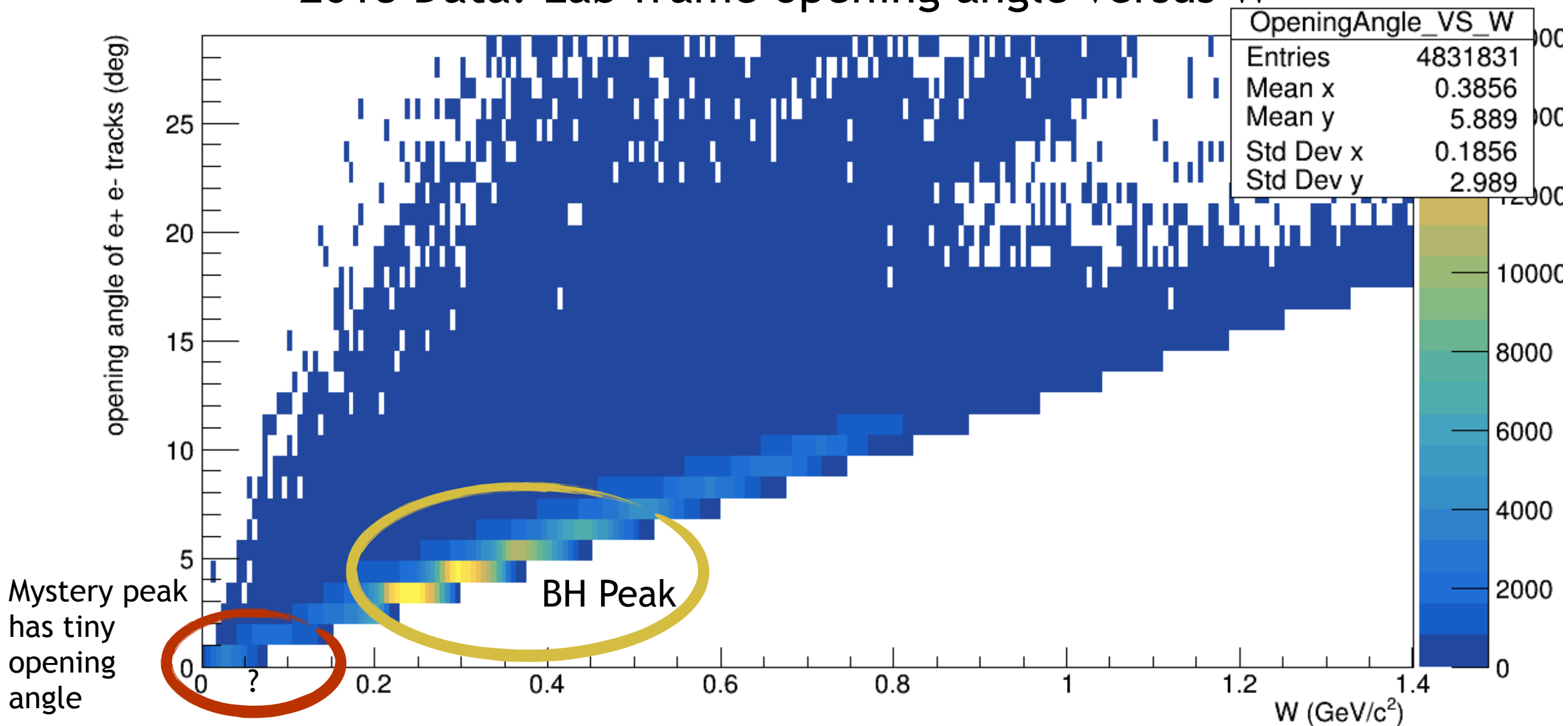
2018 DATA



M2ekin	
Entries	4831831
Mean	0.3857
Std Dev	0.1858

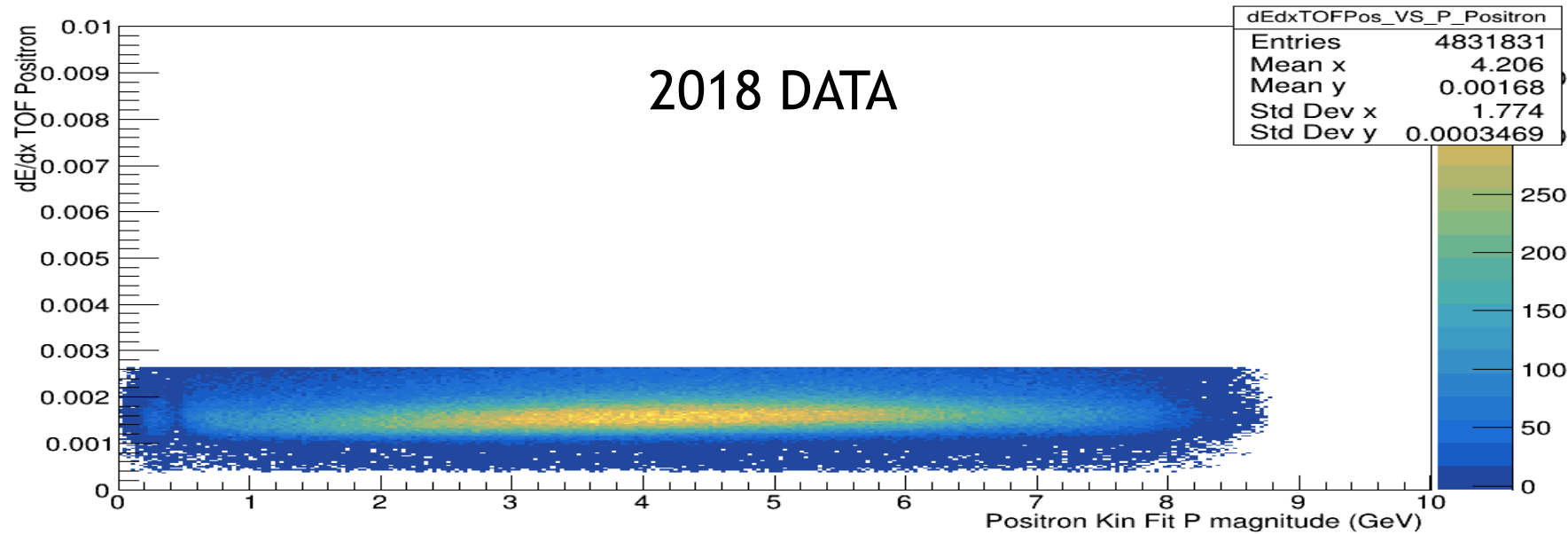
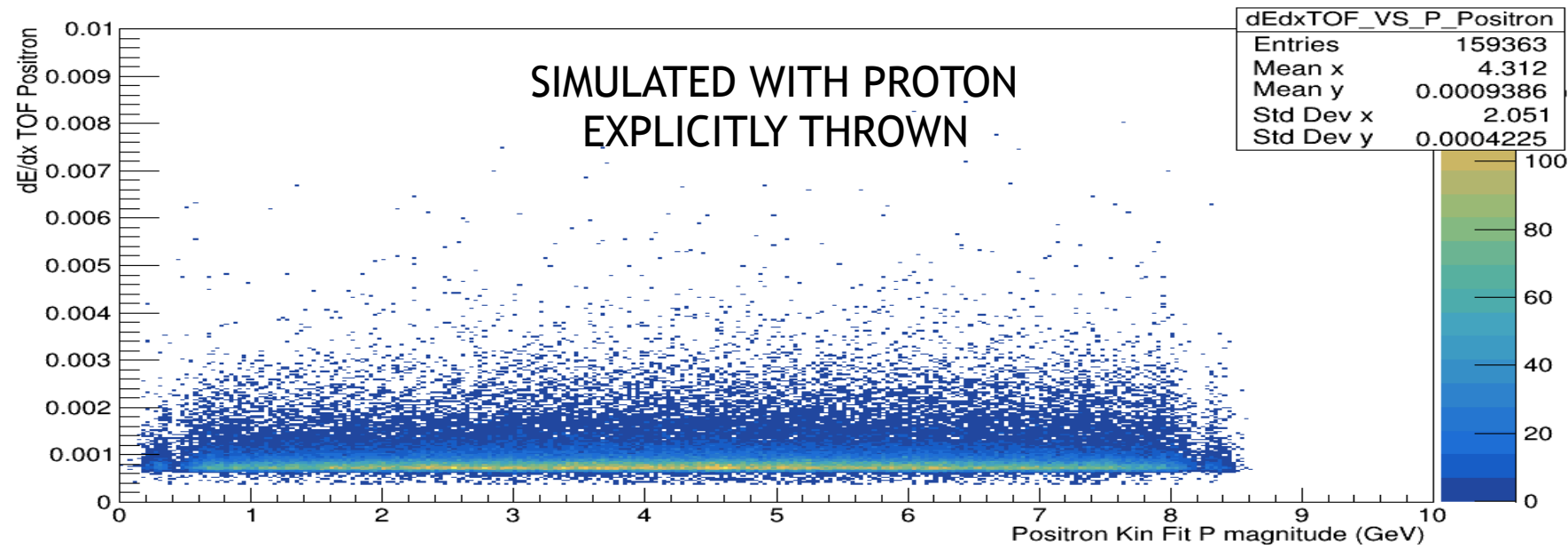


2018 Data: Lab frame opening angle versus W

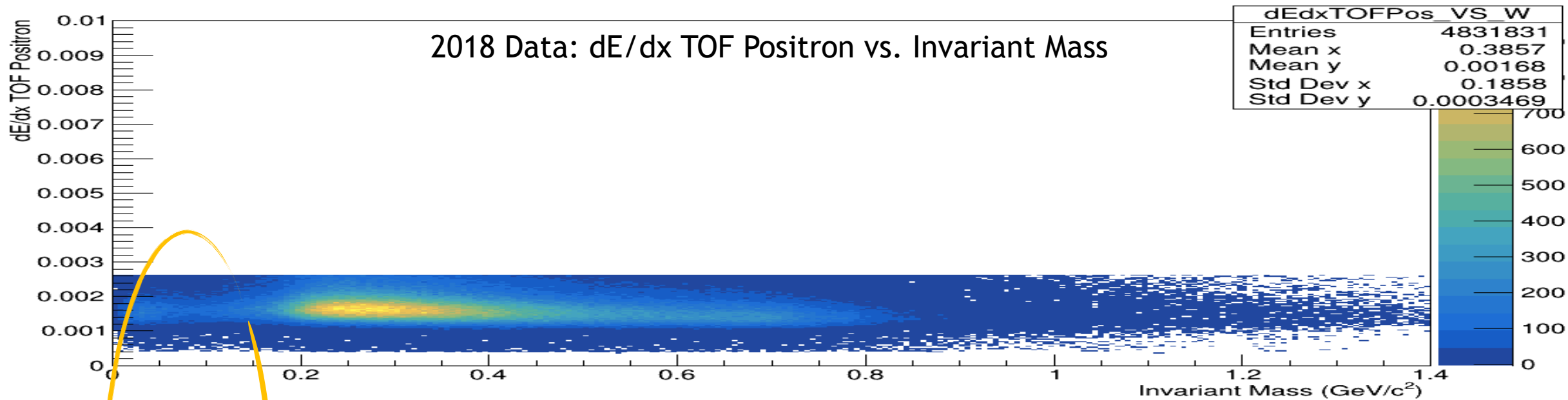


Proton Mis-ID?

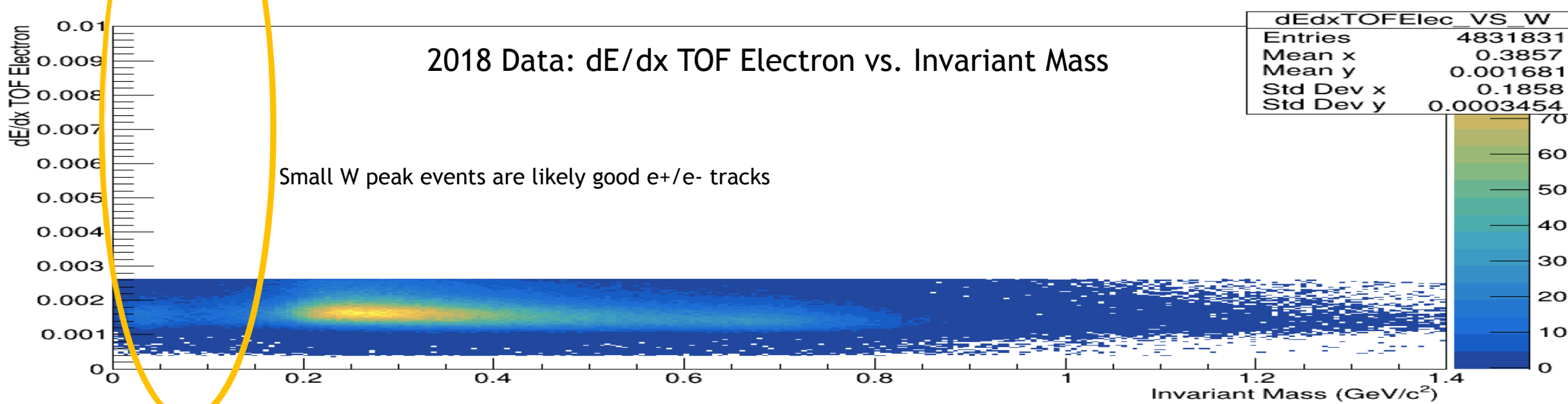
- Calibration is off between MC and DATA
- Otherwise, dE/dx for positron looks mostly independent of momentum



2018 Data: dE/dx TOF Positron vs. Invariant Mass

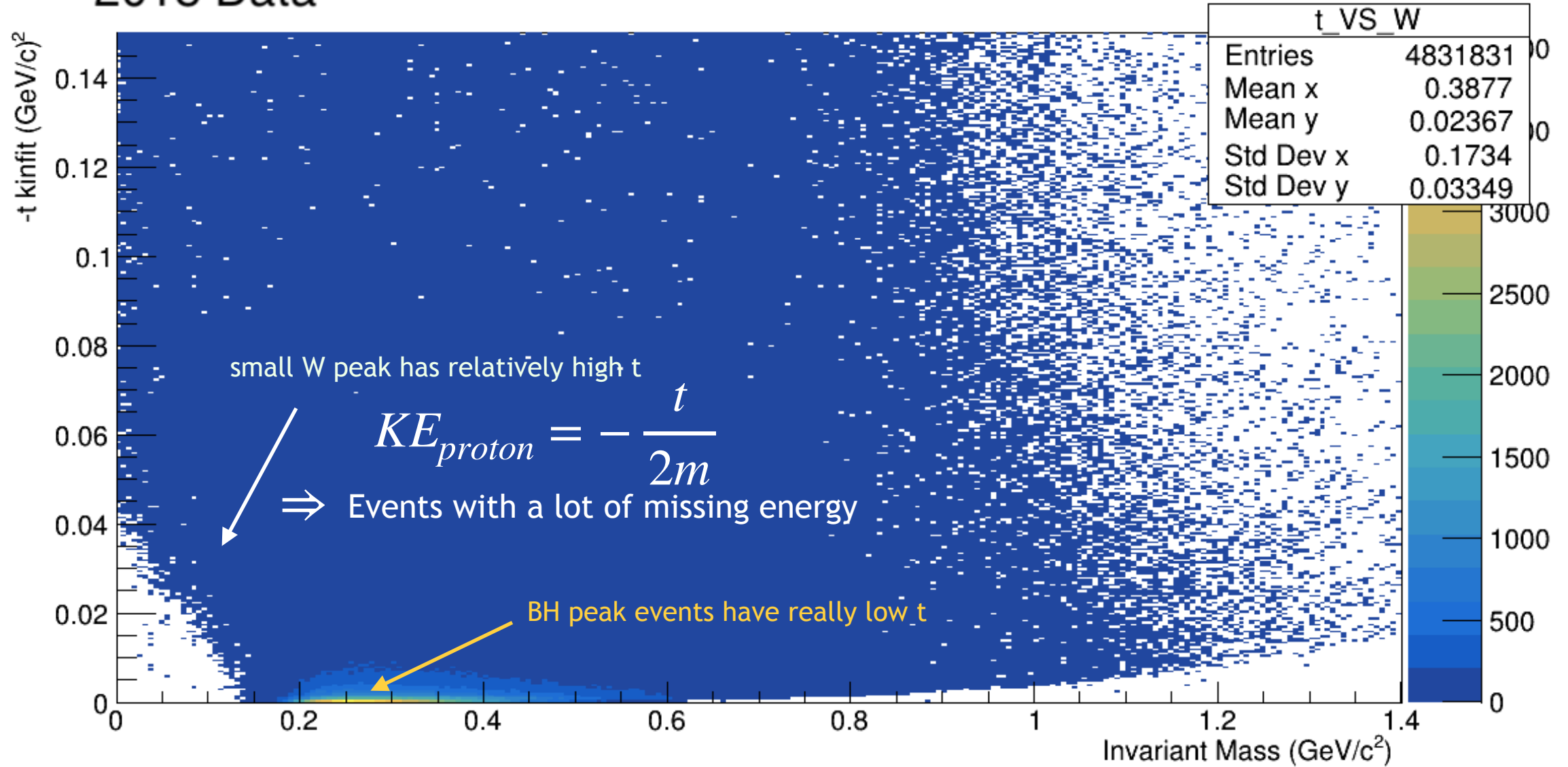


2018 Data: dE/dx TOF Electron vs. Invariant Mass



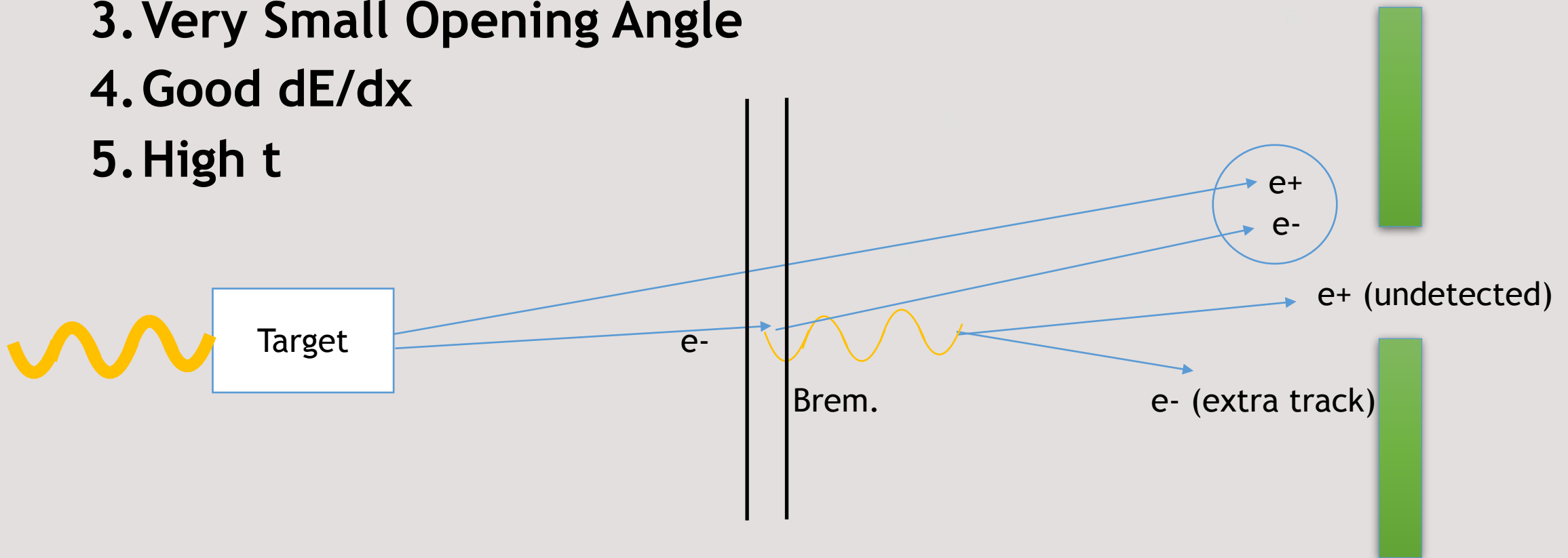
Small W peak events are likely good e⁺/e⁻ tracks

2018 Data



Need explanation that satisfies:

1. Small Invariant Mass
2. One Extra (Unused) Track
3. Very Small Opening Angle
4. Good dE/dx
5. High t



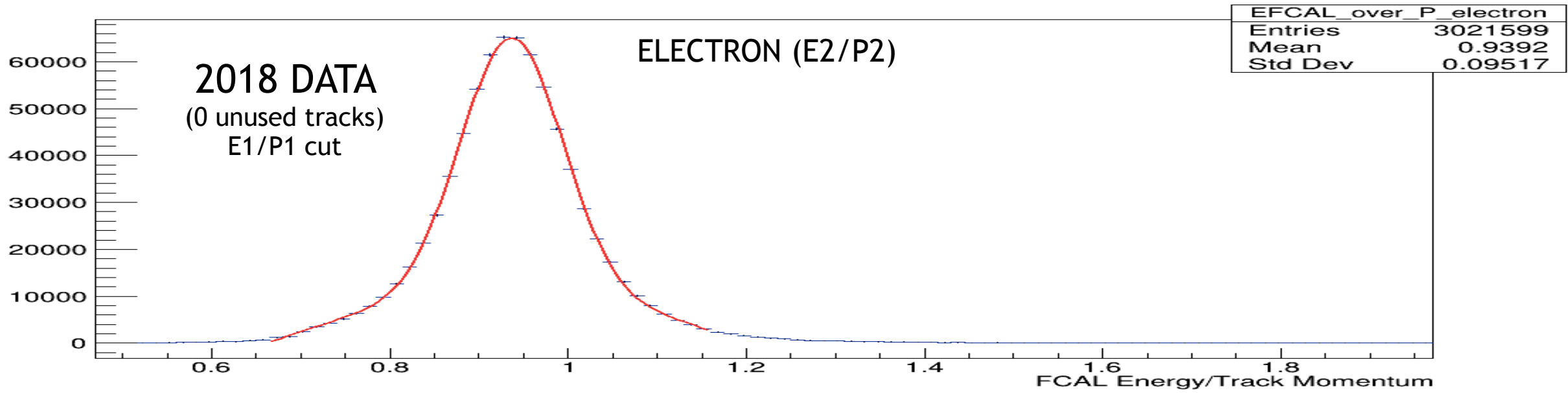
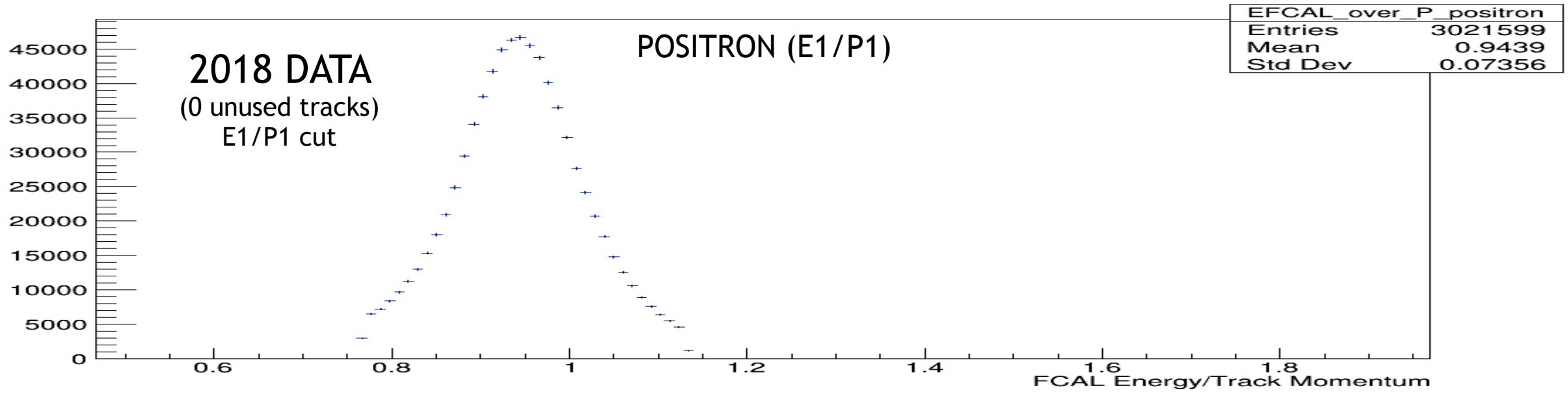
Split Up Analysis Into “No Unused Track” and “One Unused Track” channels.

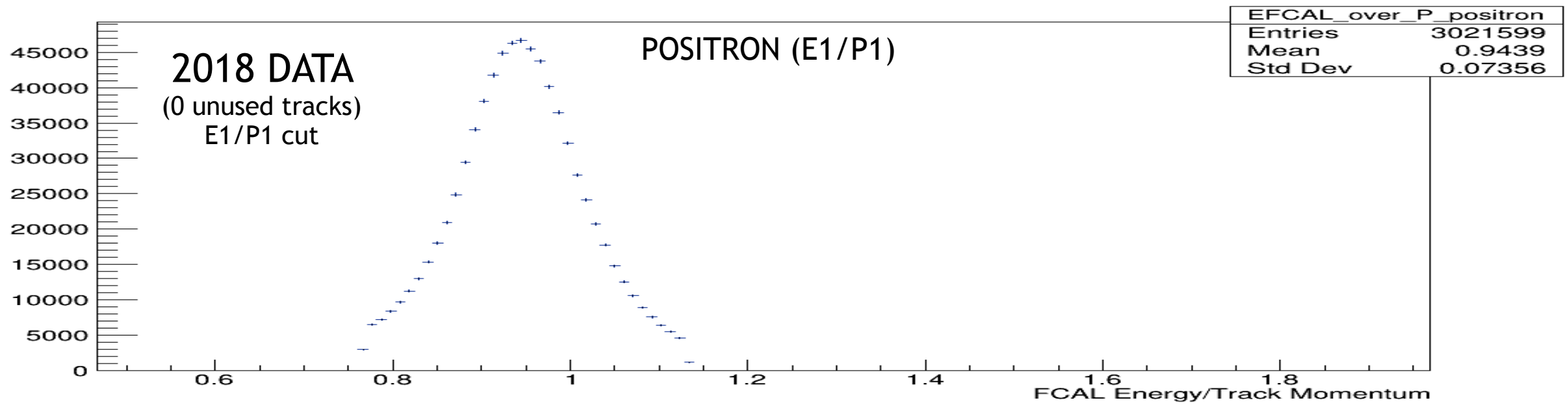
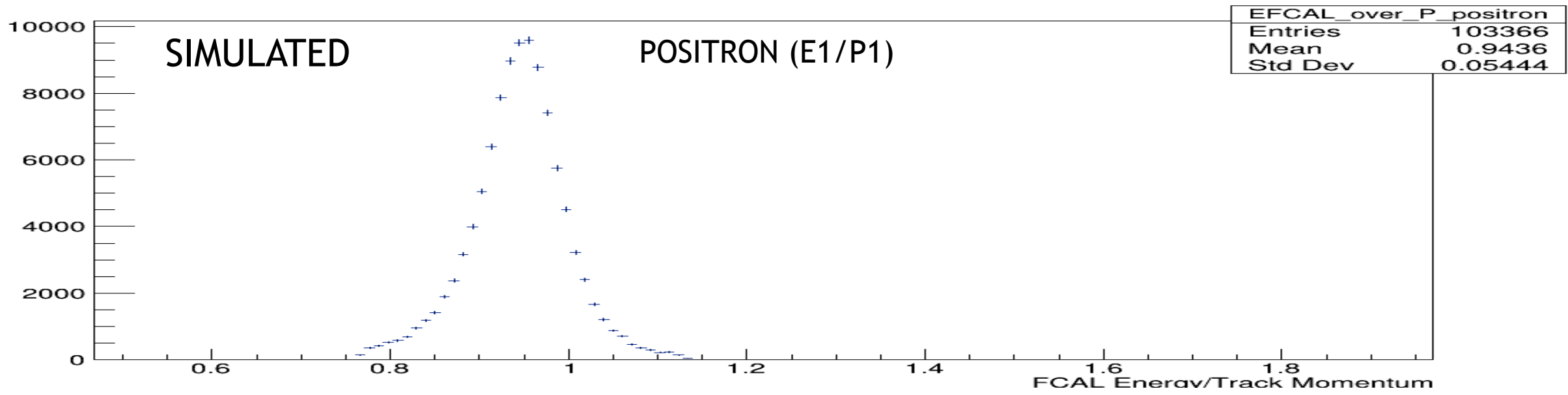
1. Cut on $\frac{E_1}{p_1}$ at $\pm 3\sigma$ (p1 is kinematic, not measured)

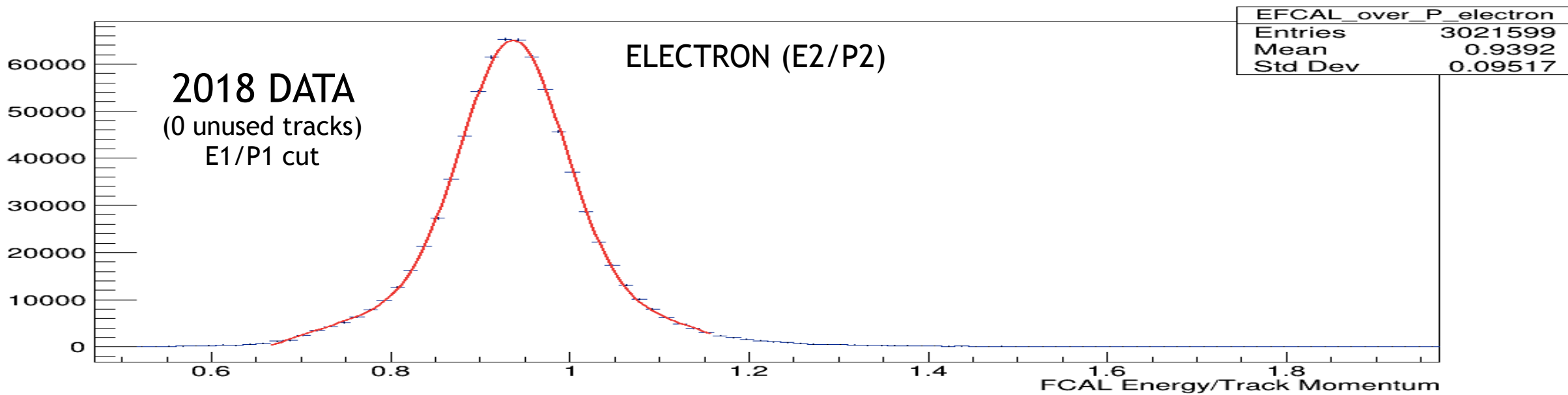
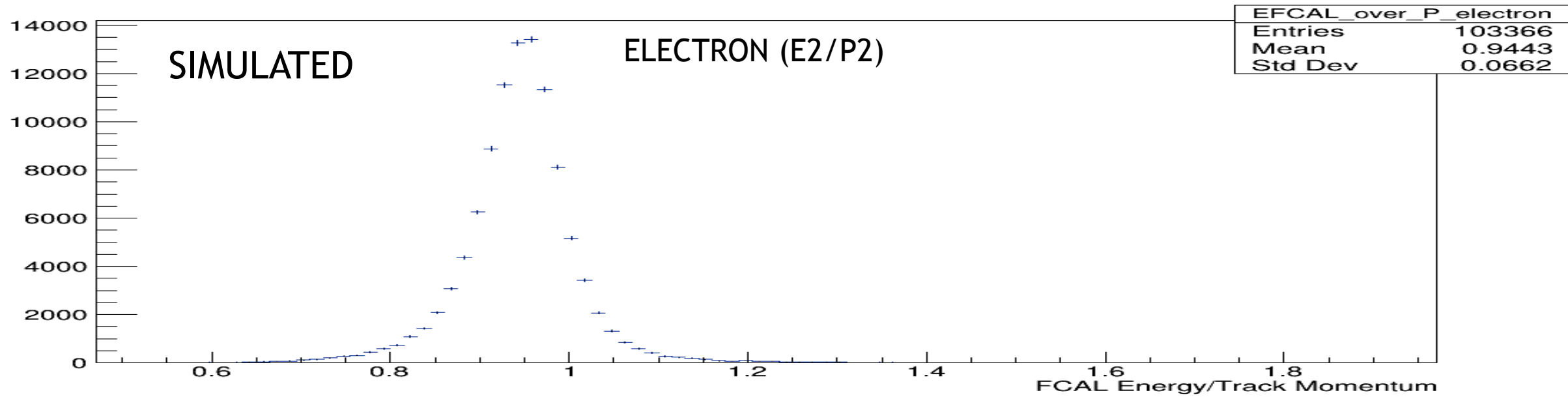
We'll look at some plots with this cut applied.

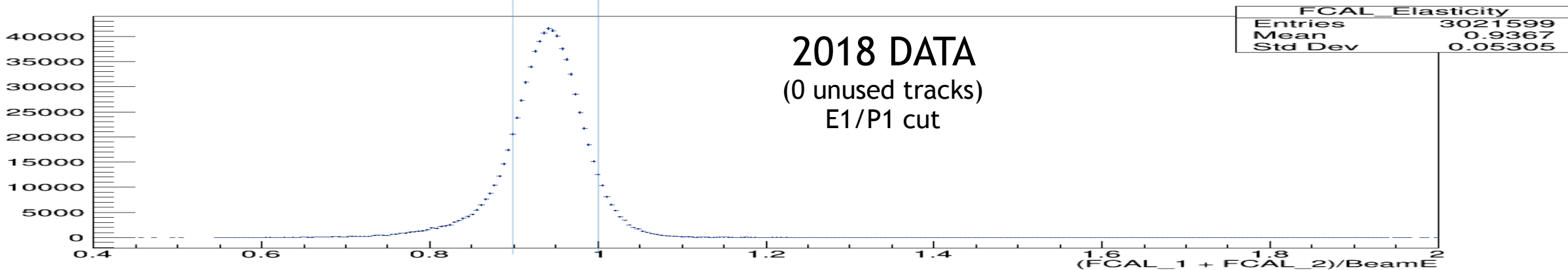
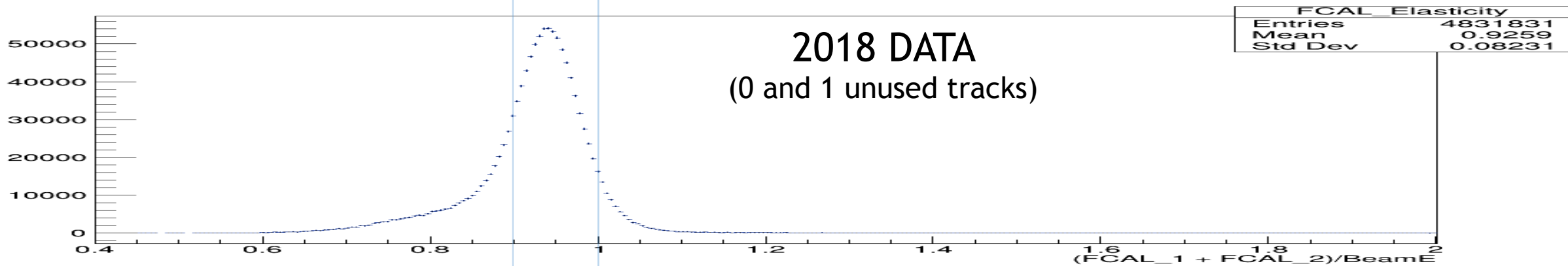
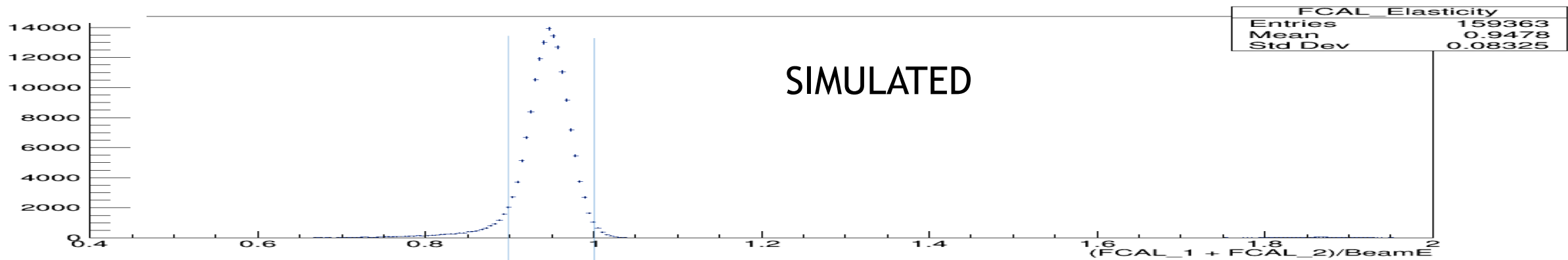
2. Fit $\frac{E_2}{P_2}$ (p2 is kin. not meas.) and subtract background

Not yet implemented. Still need to carve time away to learn how to properly fit.

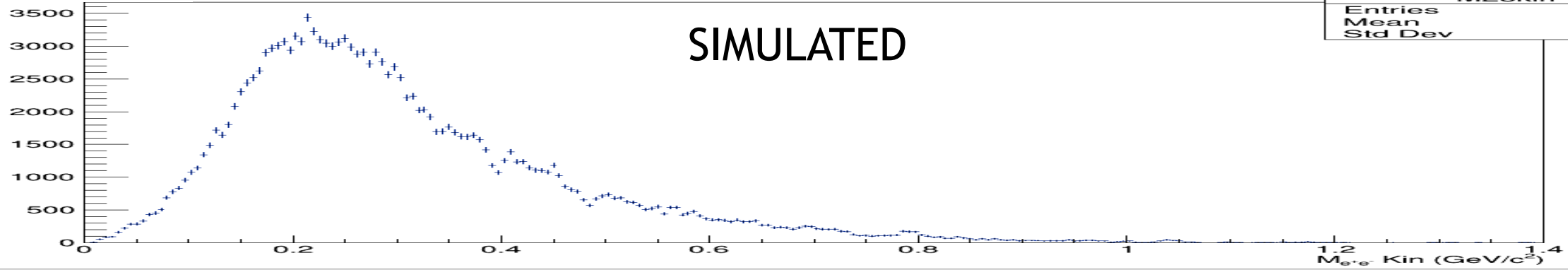






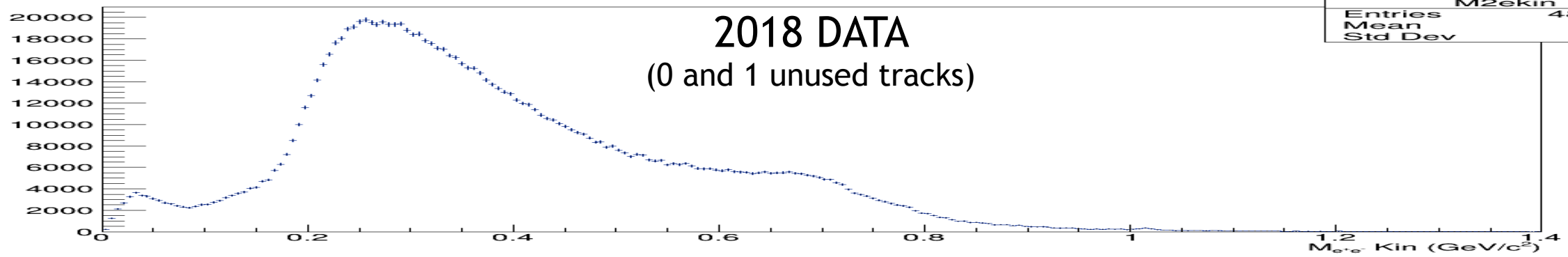


SIMULATED



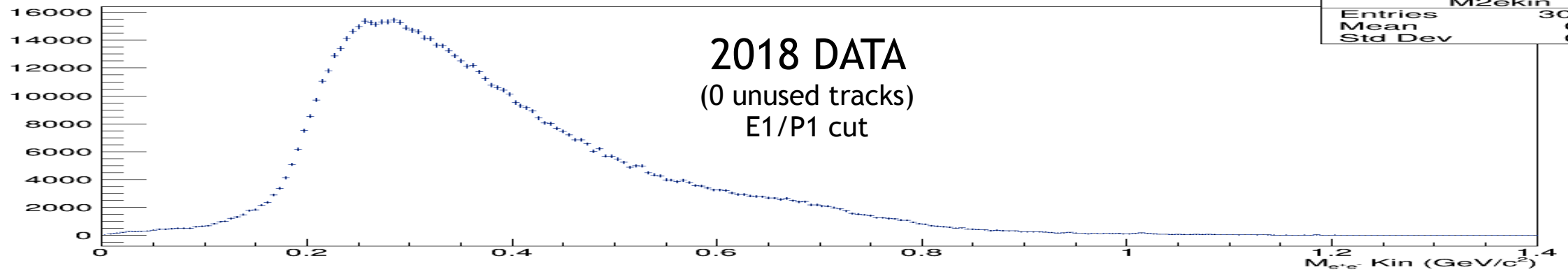
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2018 DATA (0 and 1 unused tracks)



M2ekin	
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Mean	0.3857
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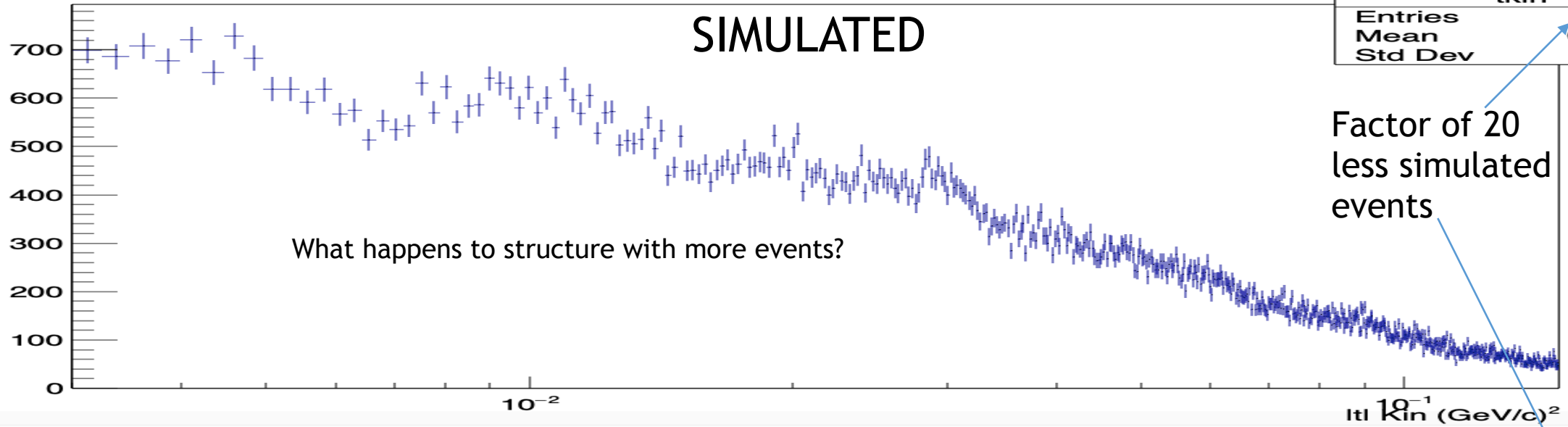
2018 DATA (0 unused tracks) E1/P1 cut



M2ekin	
Entries	3021599
Mean	0.3805
Std Dev	0.1598

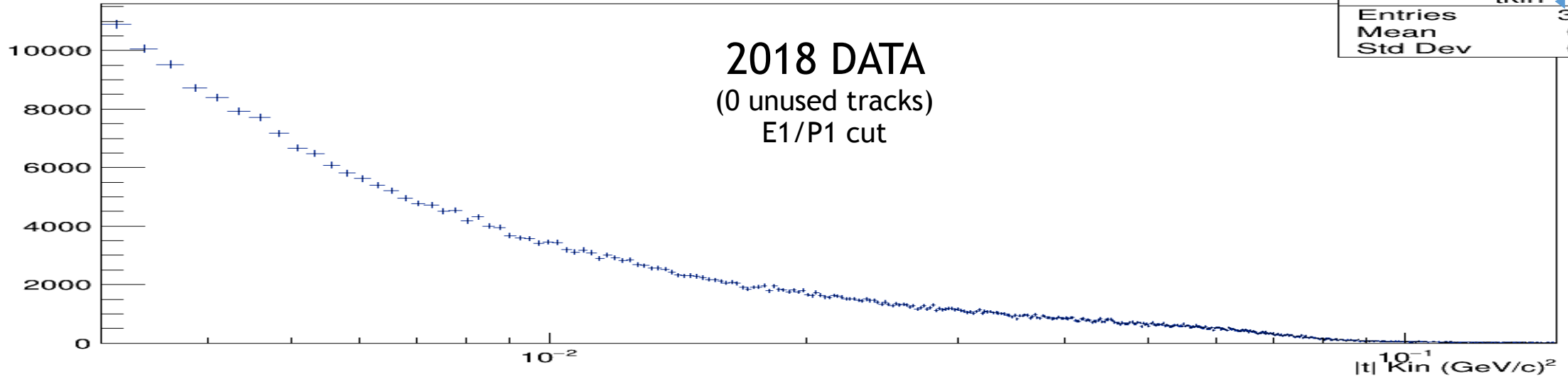
-t, semi-log x

SIMULATED

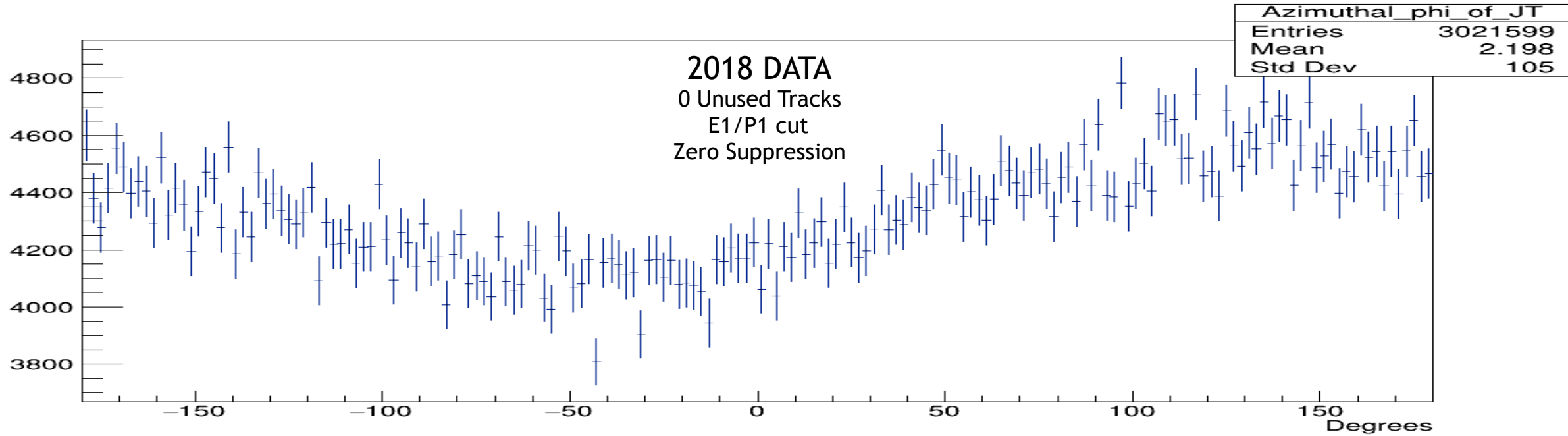
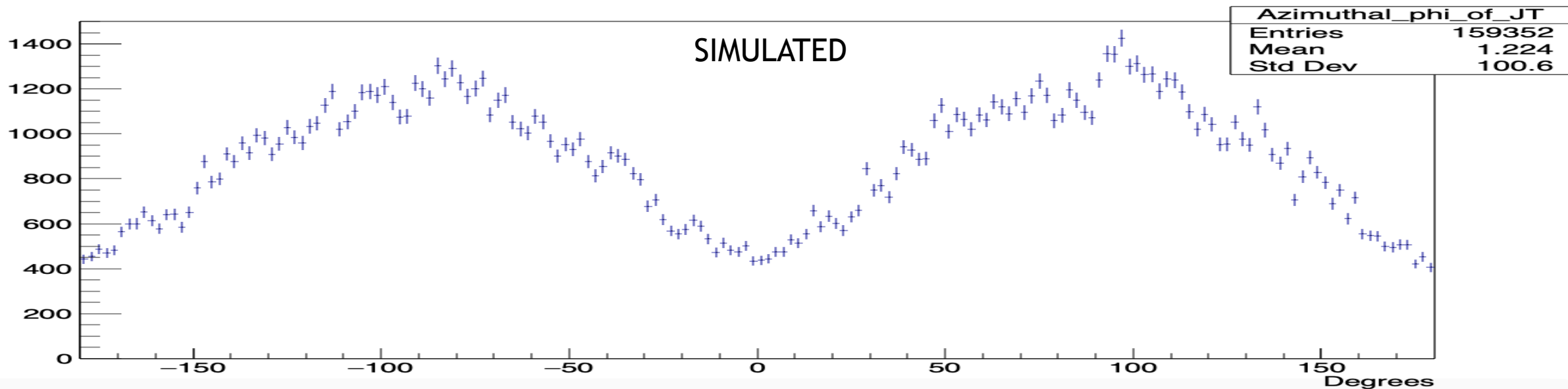


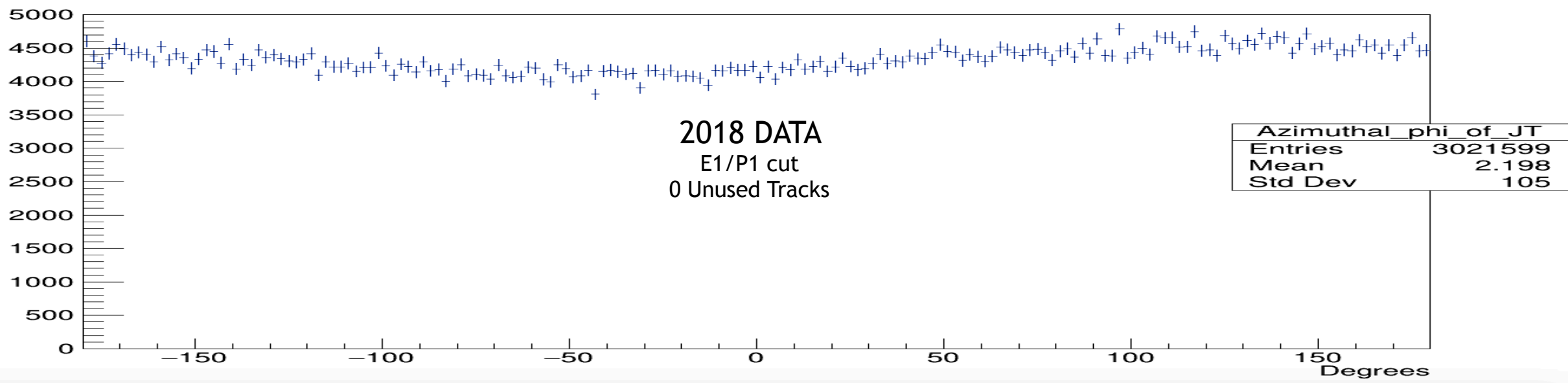
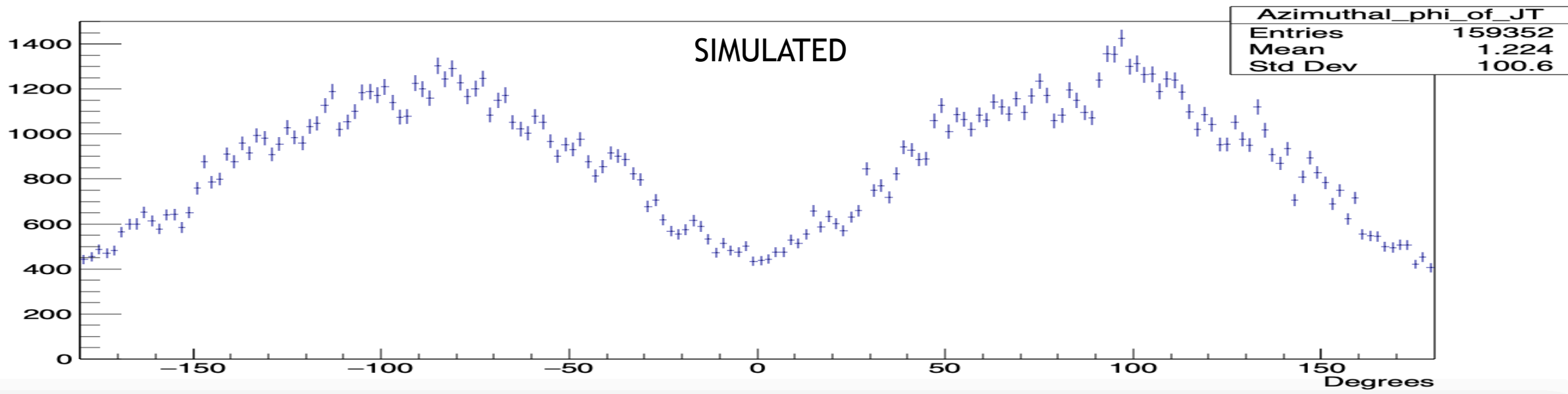
tkin	
Entries	159352
Mean	0.04704
Std Dev	0.0365

Factor of 20
less simulated
events



tkin	
Entries	3021599
Mean	0.02388
Std Dev	0.02297





Conclusions

Need to track down discrepancies between MC and data:

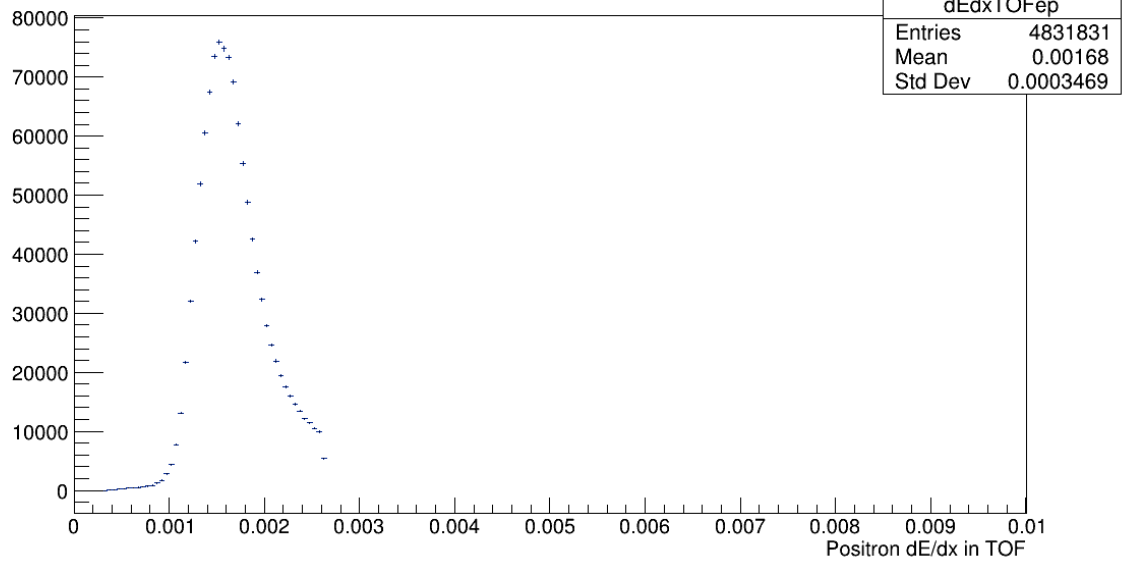
- Widths of peaks -> Calibration issues?
- Why does MC not model the low invariant mass peak?

Have to return to MC to make it as robust as possible:

- Real bremsstrahlung photon distribution
- Tagger Accidentals
- Open up phase space in theta to have very low angle tracks along the beam line
- More events!

Backup Slides

GF 2018 Data



GF 2018 Data

