Bethe-Heitler Data

$\gamma\, p \rightarrow e^+ e^- (p)$

Andrew Schick

May 24th, 2019

Ground Level Cuts

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

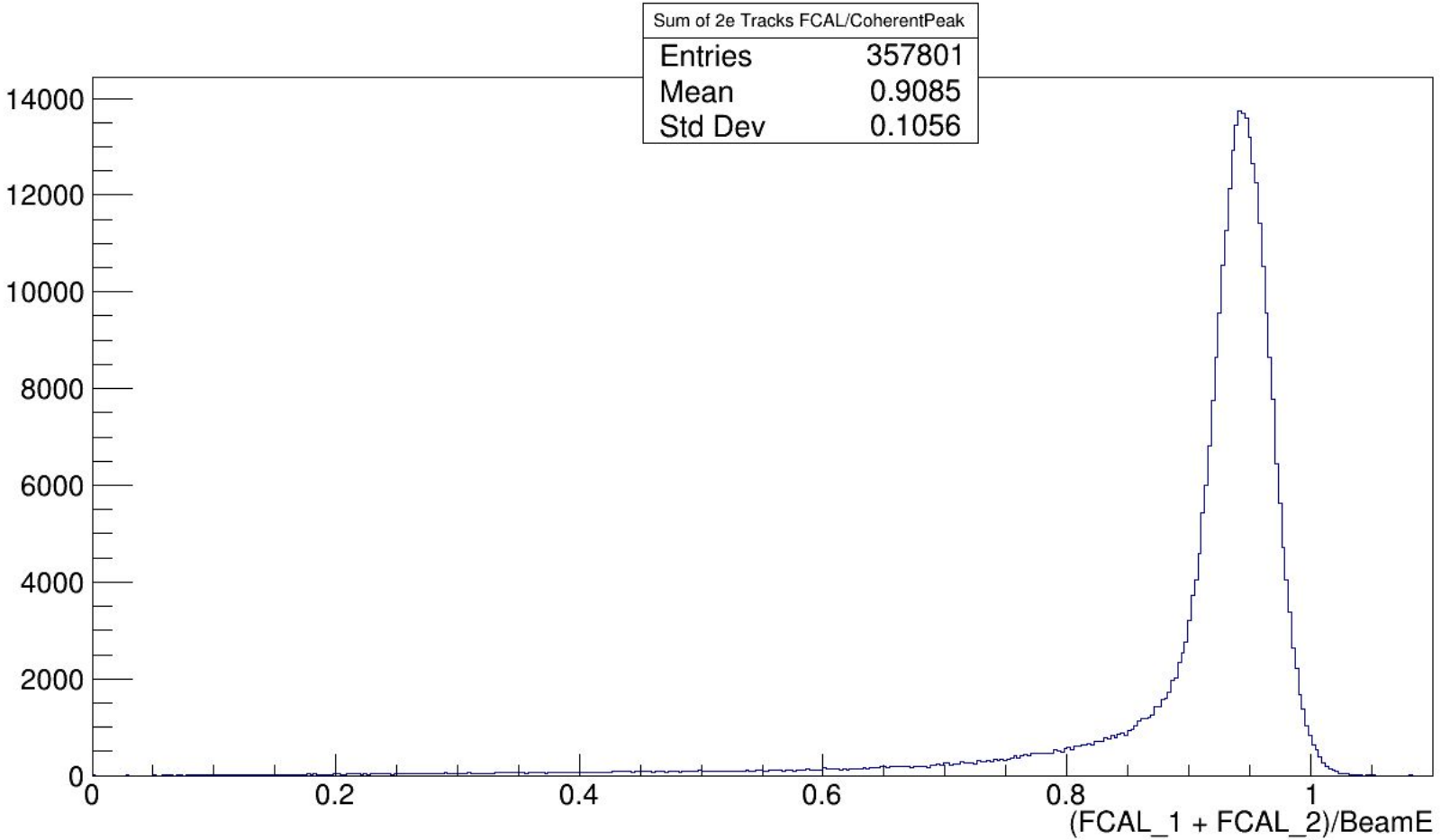
1. Cut on Coherent Peak: $8.12 < E_{\gamma} < 8.88$
2. Require both electron and positron tracks have hits in the FCAL
3. Require both electron and positron tracks have hits in the TOF
4. Require dMinKinFitCL > 10E-6
5. Eliminate NumUnusedTracks ≥ 2

Additional Cuts Investigated

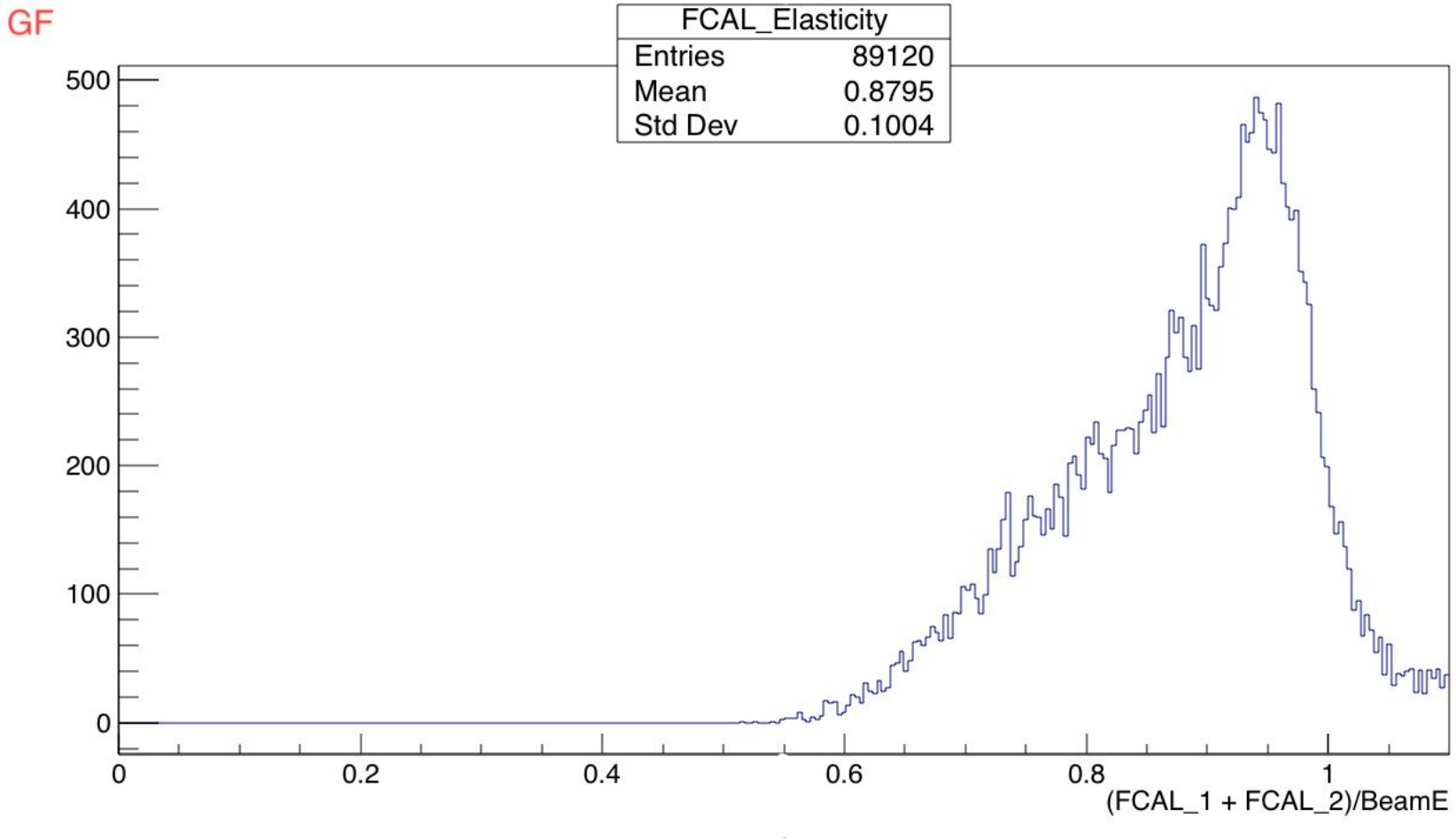
1. $-3\sigma < p/E - \langle p/E \rangle < +2\sigma$ Lubomir's Cut
2. Eliminate Energy_UnusedShowers > 0
3. Eliminate CL < 0.01, 0.05

Looking for signal in invariant mass and FCAL elasticity plots

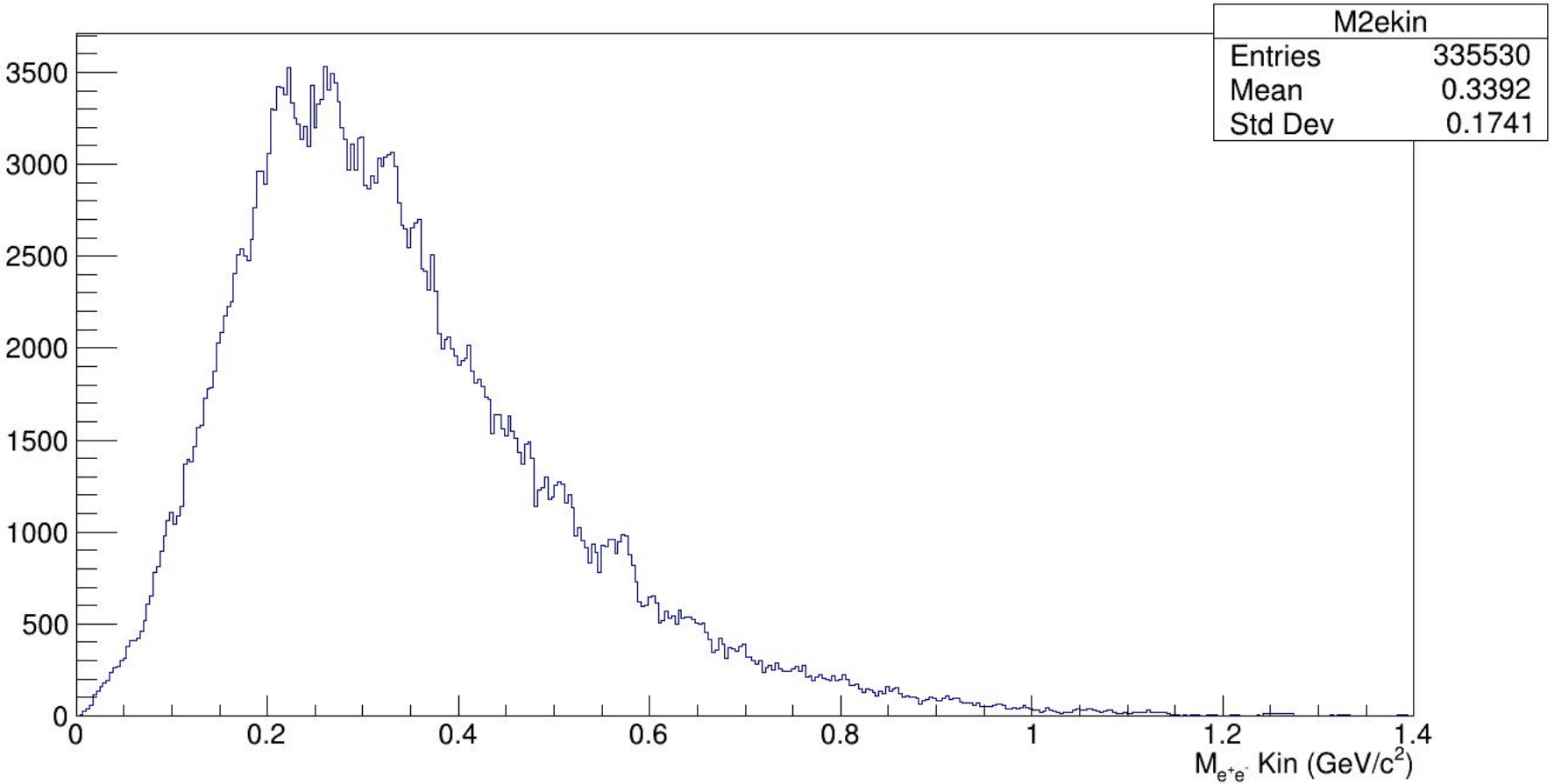
MC


Sum of 2e Tracks FCAL/CoherentPeak
Entries 357801
Mean 0.9085
Std Dev 0.1056
14000
12000
10000
8000
6000
4000
2000
0
0
0.2
0.4
0.6
0.8
1
(FCAL_1 + FCAL_2)/BeamE

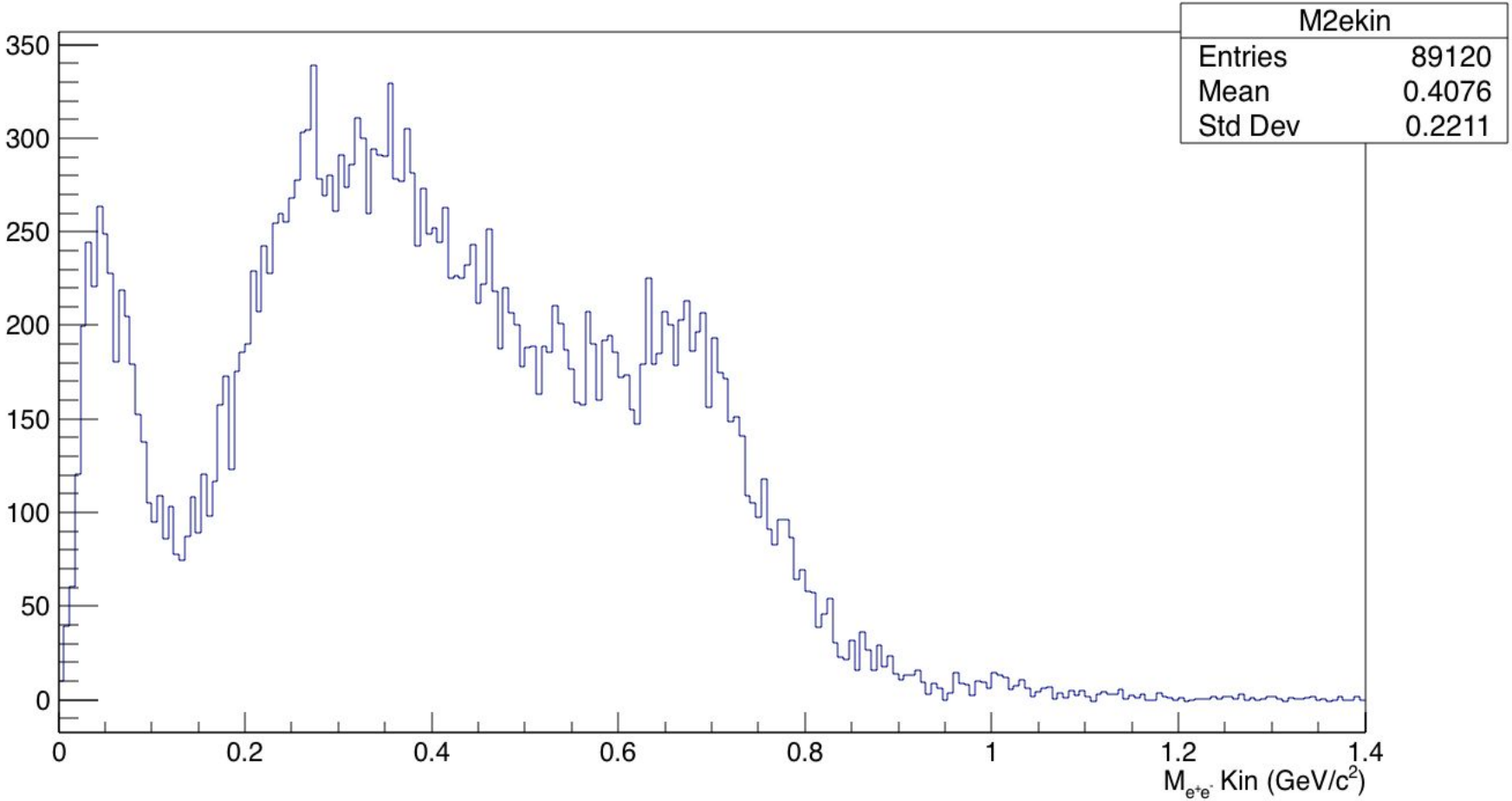
GF


FCAL_Elasticity
Entries 89120
Mean 0.8795
Std Dev 0.1004
500
400
300
200
100
0
0
0.2
0.4
0.6
0.8
1
(FCAL_1 + FCAL_2)/BeamE

MC


M2ekin
Entries 335530
Mean 0.3392
Std Dev 0.1741
3500
3000
2500
2000
1500
1000
500
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
$M_{e^+e^-}$ Kin (GeV/c^2)

GF


M2ekin
Entries 89120
Mean 0.4076
Std Dev 0.2211
350
300
250
200
150
100
50
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
$M_{e^+e^-}$ Kin (GeV/c^2)

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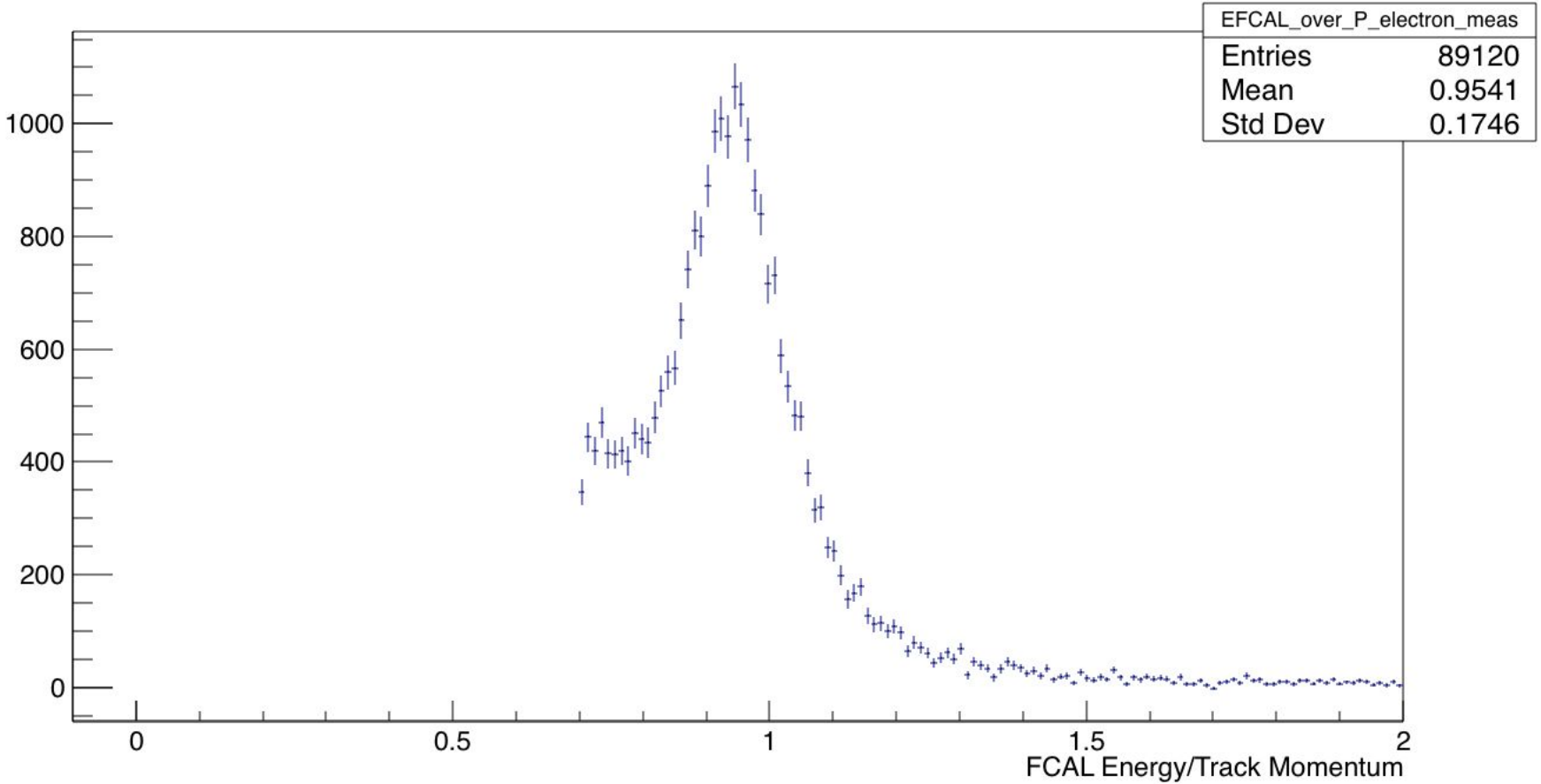
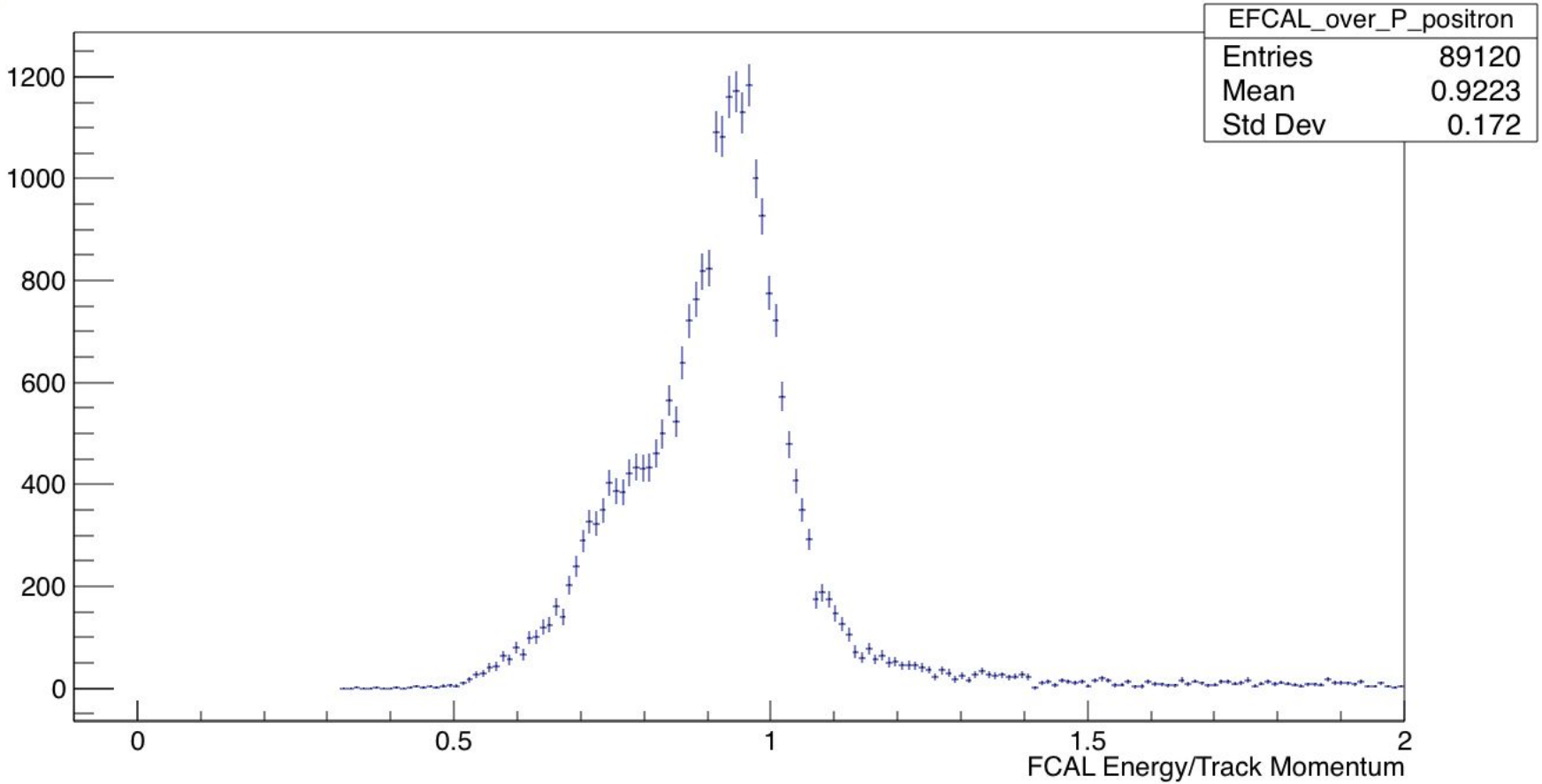
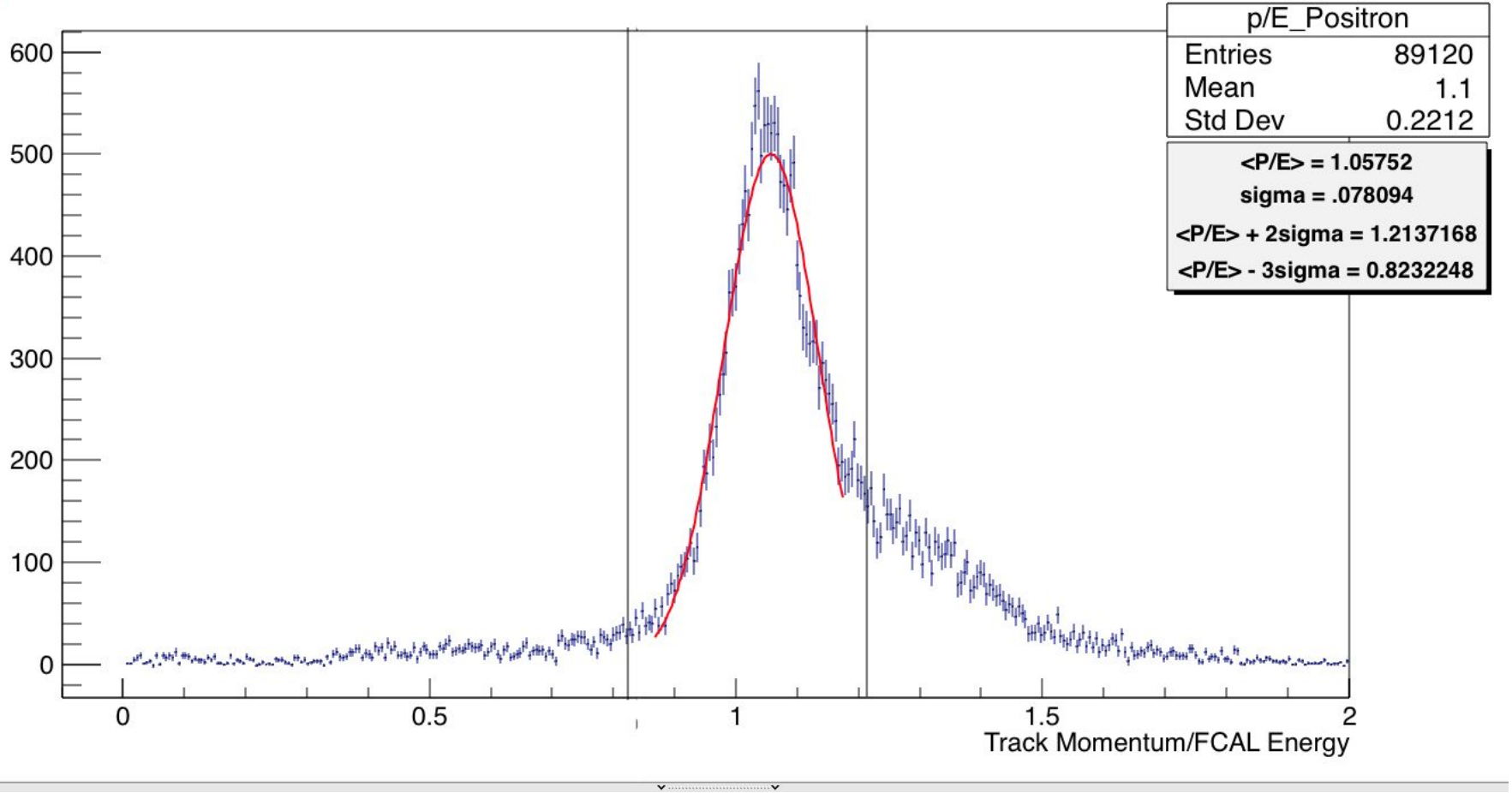

EFCAL_over_P_electron_meas
Entries 89120
Mean 0.9541
Std Dev 0.1746
1000
800
600
400
200
0
0
0.5
1
1.5
2
FCAL Energy/Track Momentum

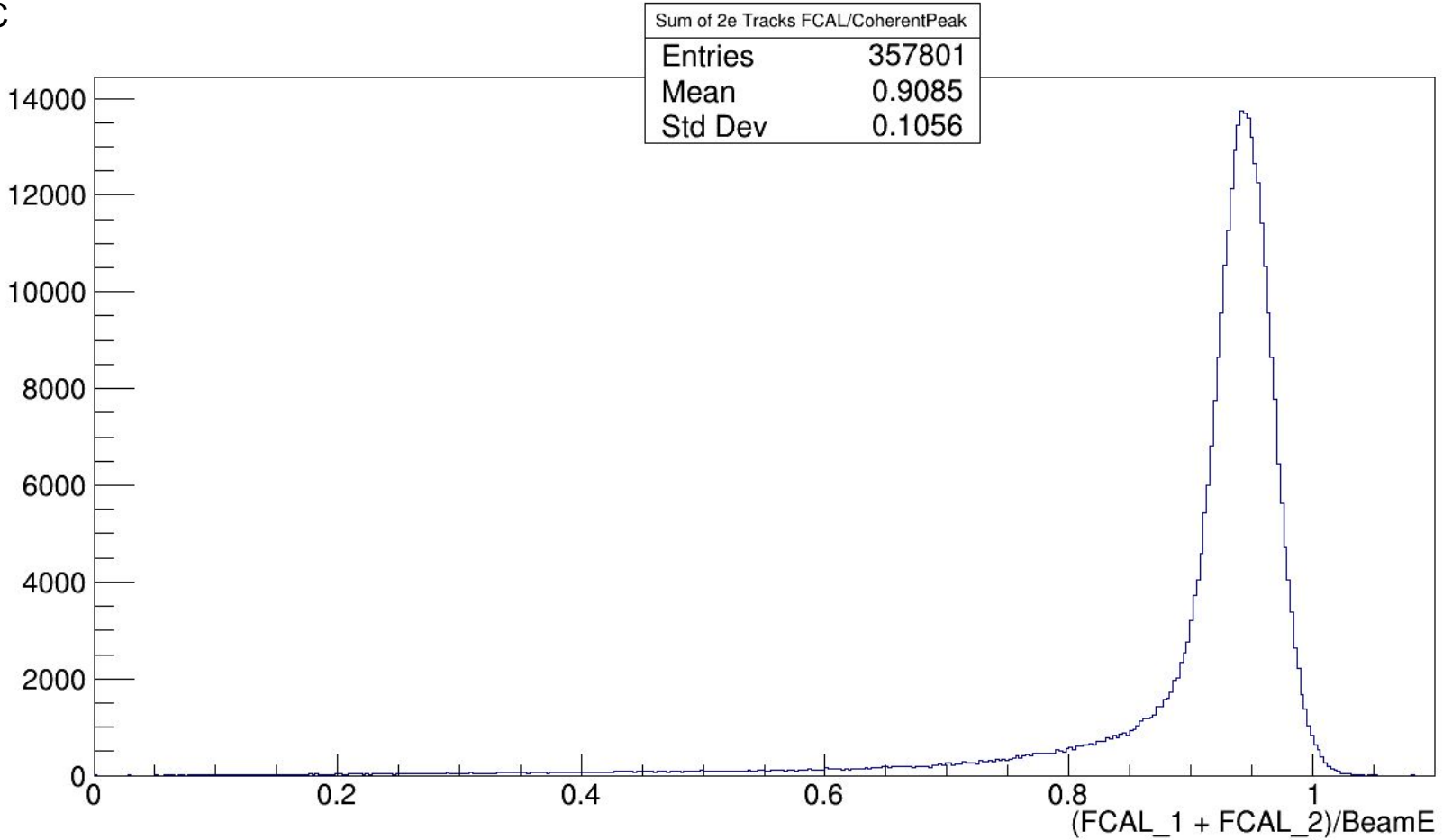
GF


EFCAL_over_P_positron
Entries 89120
Mean 0.9223
Std Dev 0.172
1200
1000
800
600
400
200
0
0
0.5
1
1.5
2
FCAL Energy/Track Momentum

GF


p/E_Positron
Entries 89120
Mean 1.1
Std Dev 0.2212
<P/E> = 1.05752
sigma = .078094
<P/E> + 2sigma = 1.2137168
<P/E> - 3sigma = 0.8232248
600
500
400
300
200
100
0
0
0.5
1
1.5
2
Track Momentum/FCAL Energy

MC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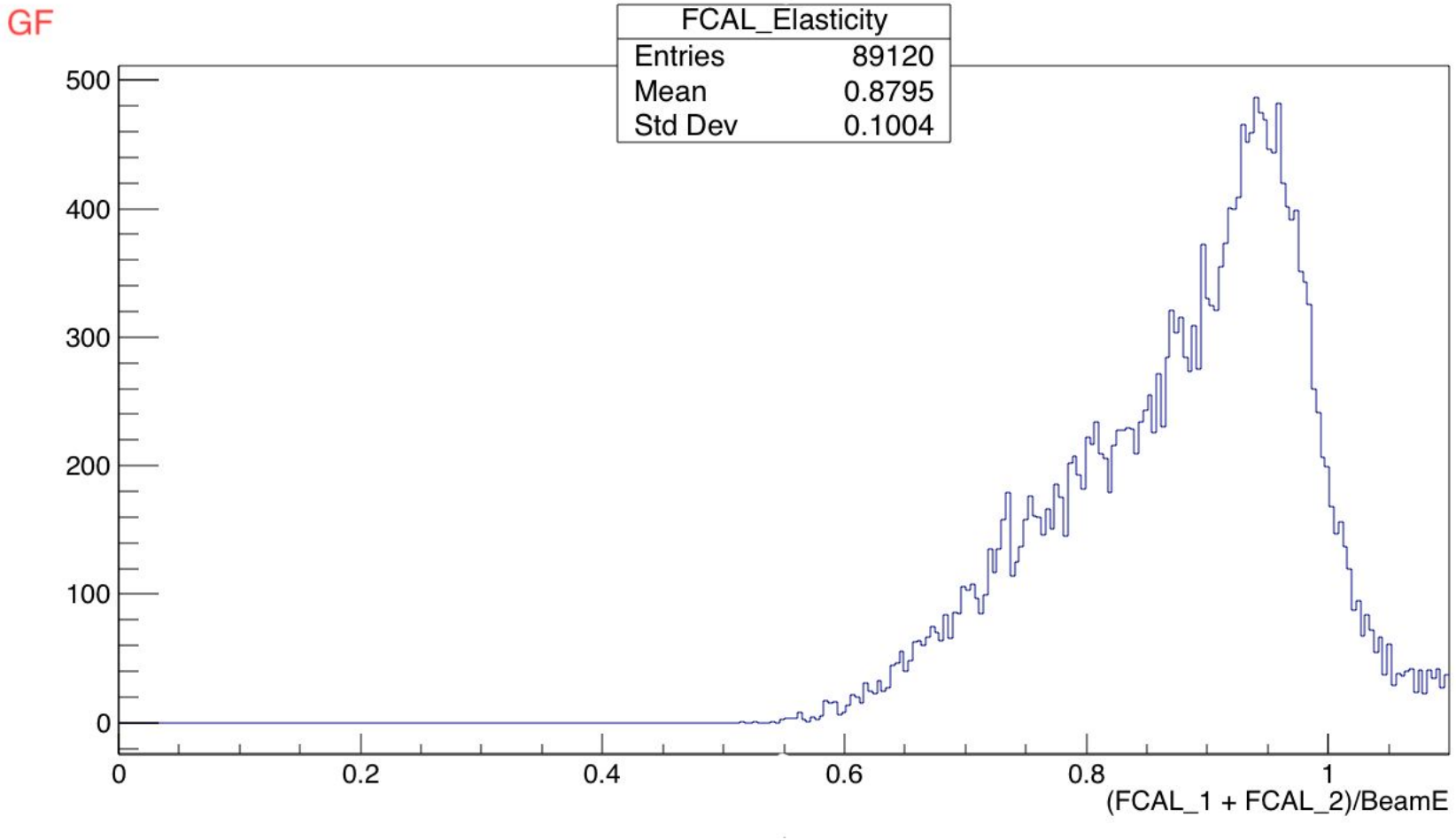
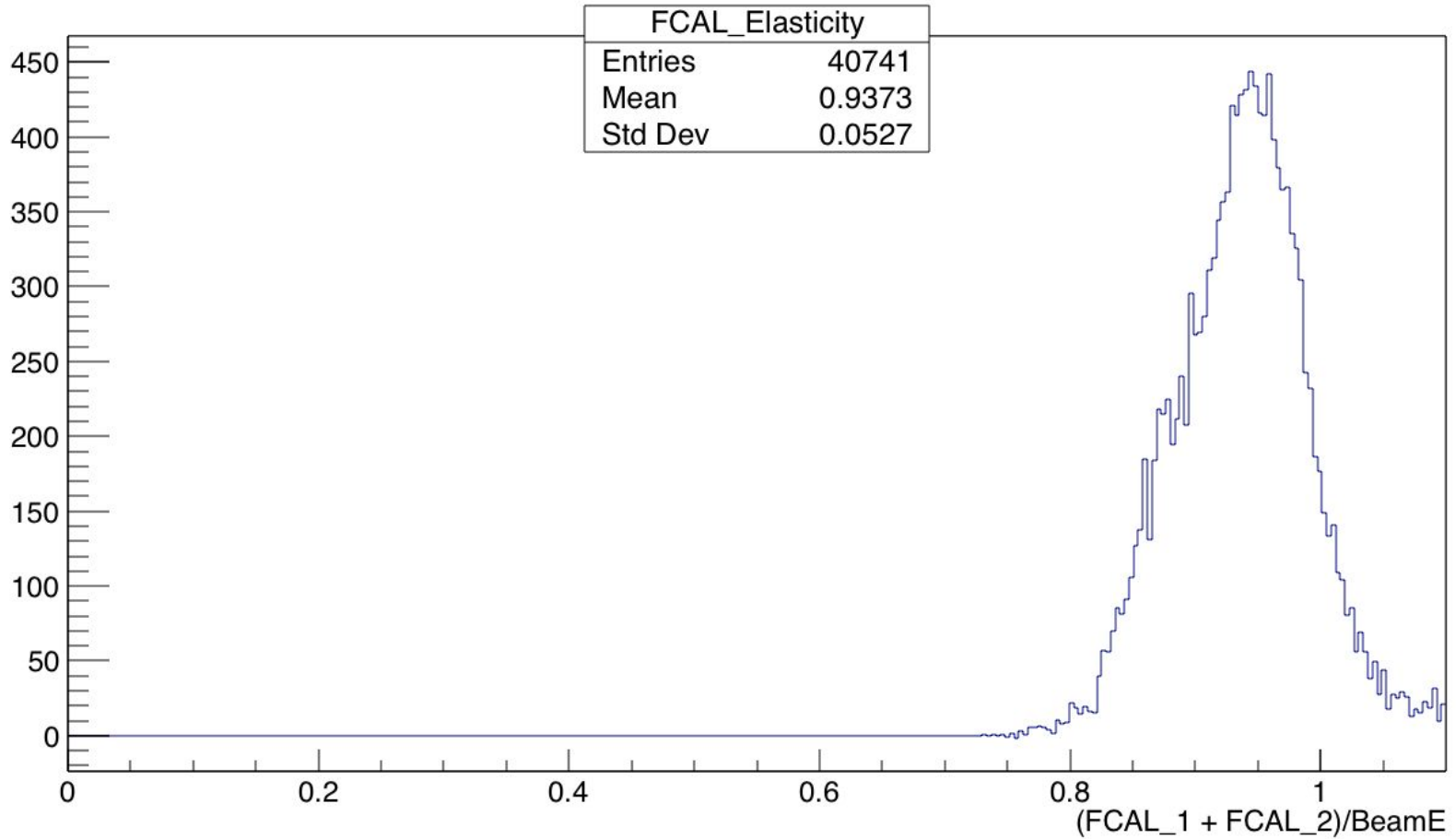
14000
12000
10000
8000
6000
4000
2000
0
0
0.2
0.4
0.6
0.8
1
(FCAL_1 + FCAL_2)/BeamE

GF

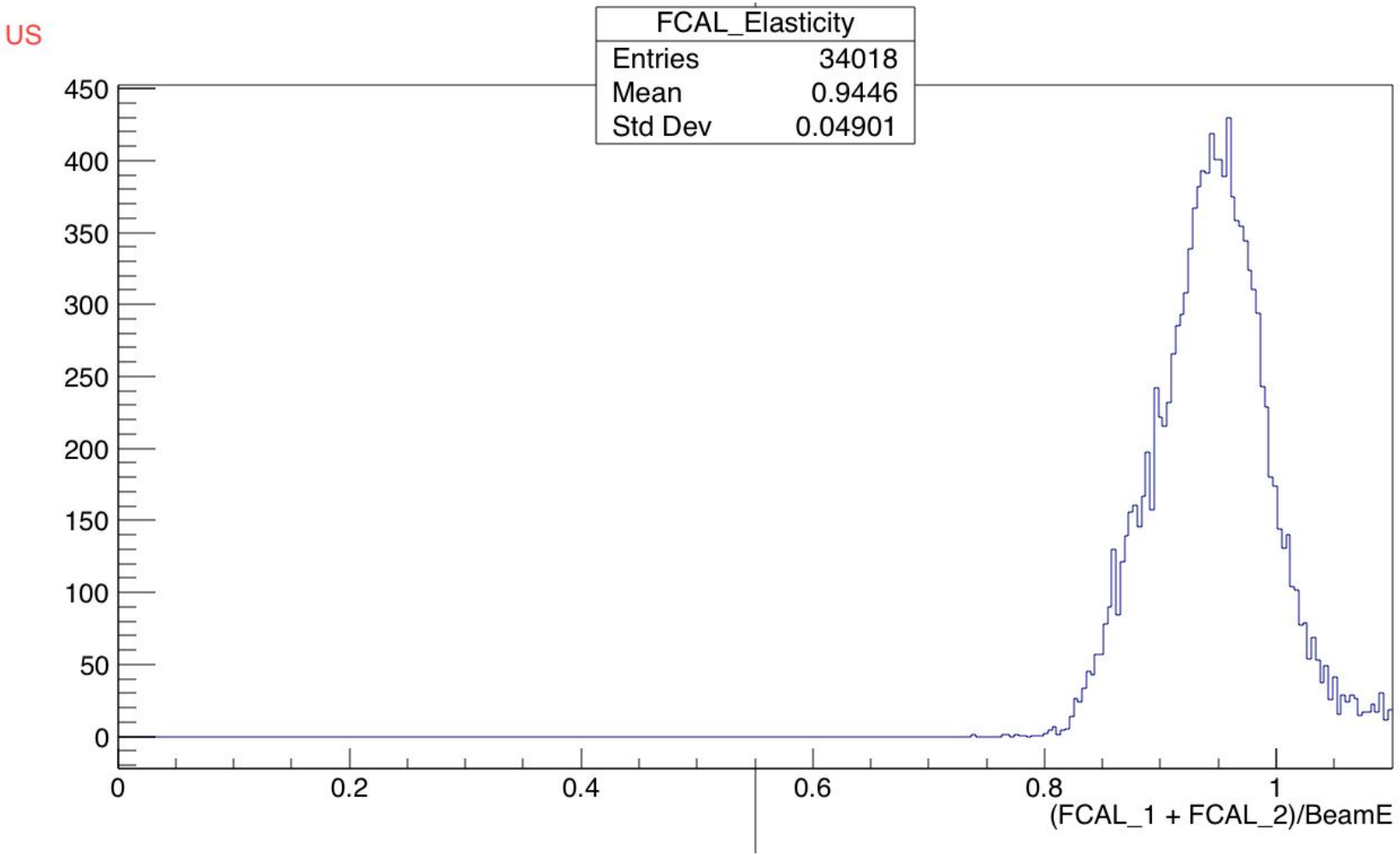

FCAL_Elasticity
Entries 89120
Mean 0.8795
Std Dev 0.1004
500
400
300
200
100
0
0
0.2
0.4
0.6
0.8
1
(FCAL_1 + FCAL_2)/BeamE

LC

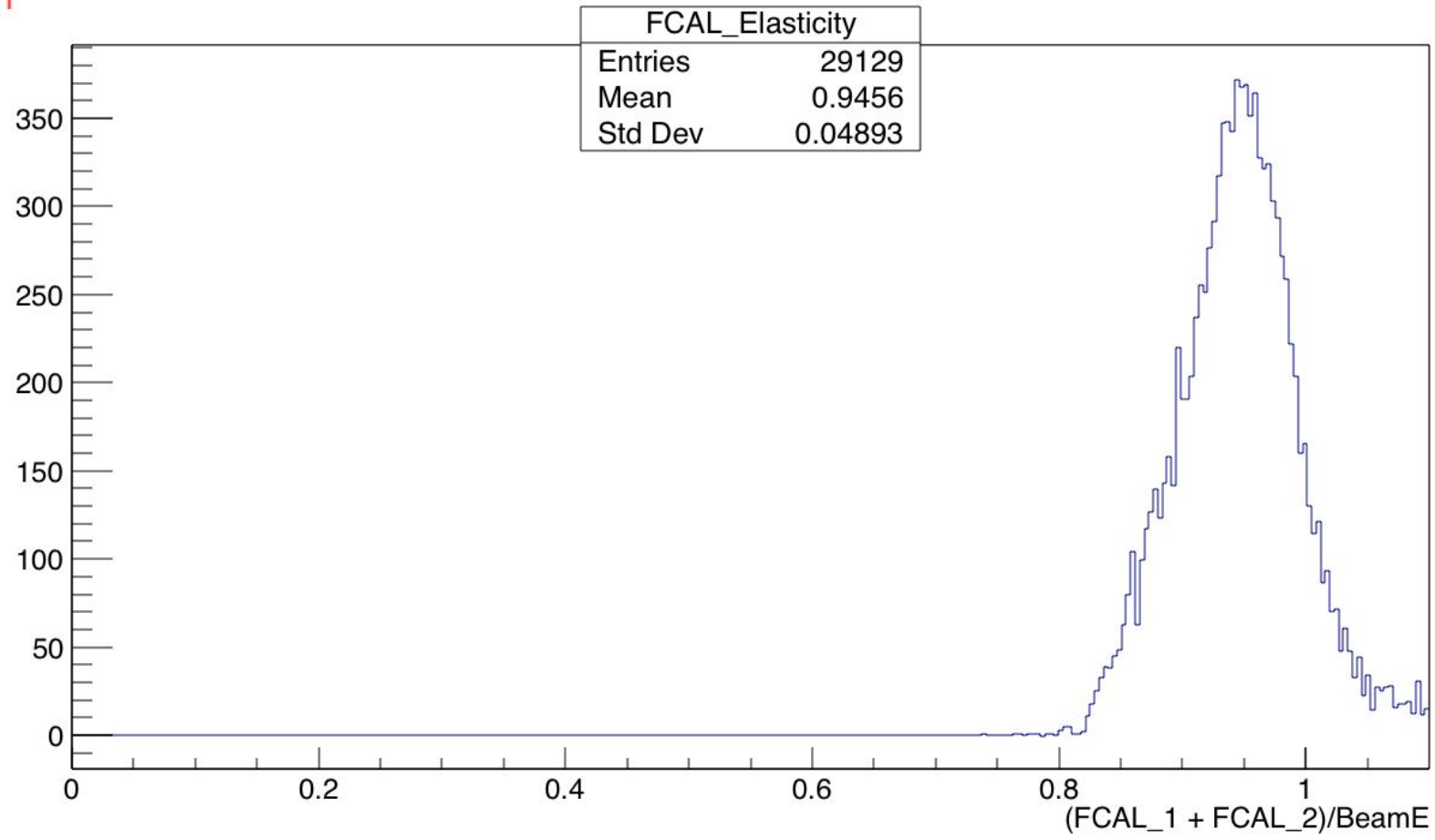
$-3\sigma < p/E - \langle p/E \rangle < +2\sigma$ Lubomir's Cut



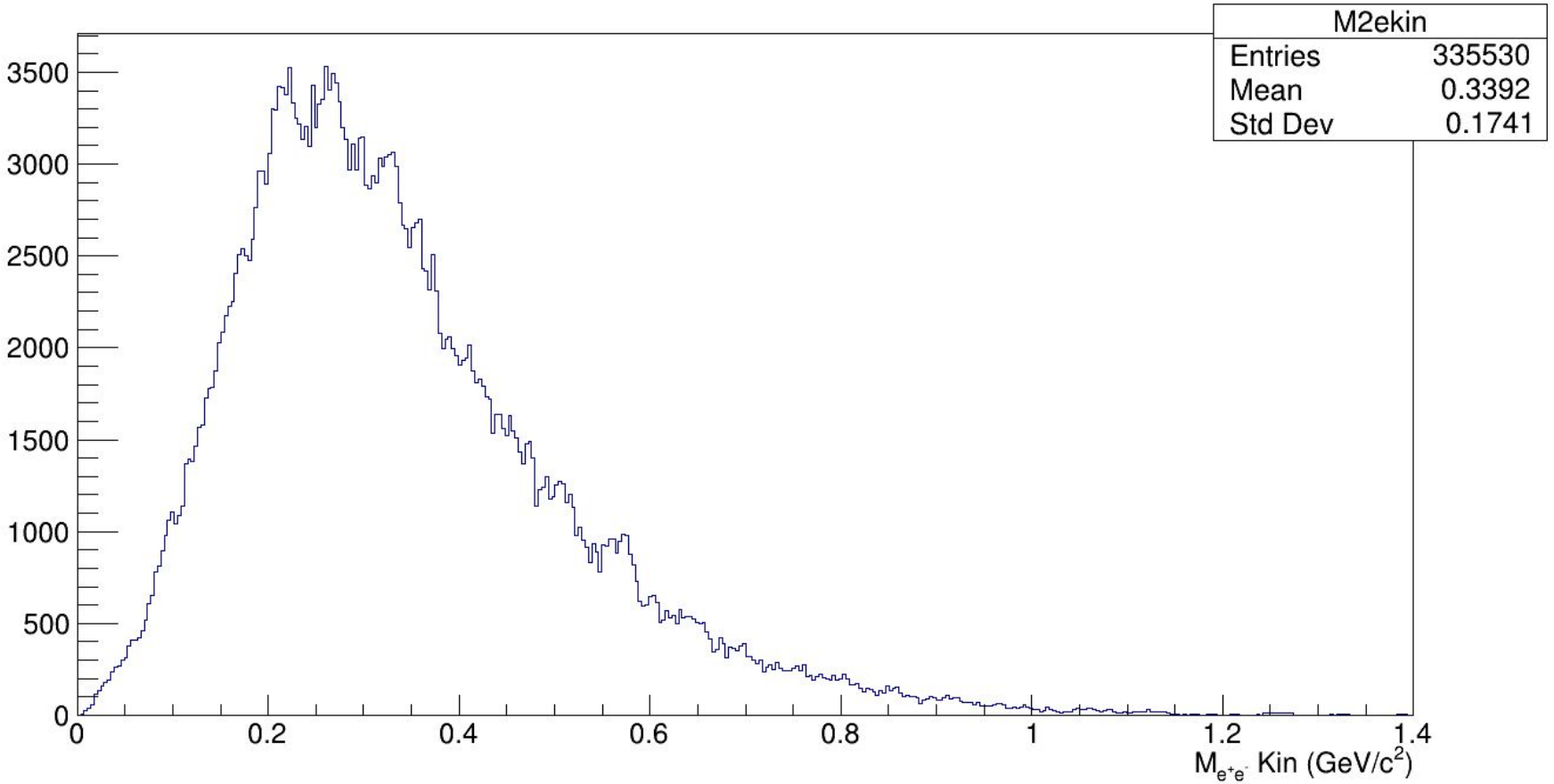
US


FCAL_Elasticity
Entries 34018
Mean 0.9446
Std Dev 0.04901
450
400
350
300
250
200
150
100
50
0
0
0.2
0.4
0.6
0.8
1
(FCAL_1 + FCAL_2)/BeamE

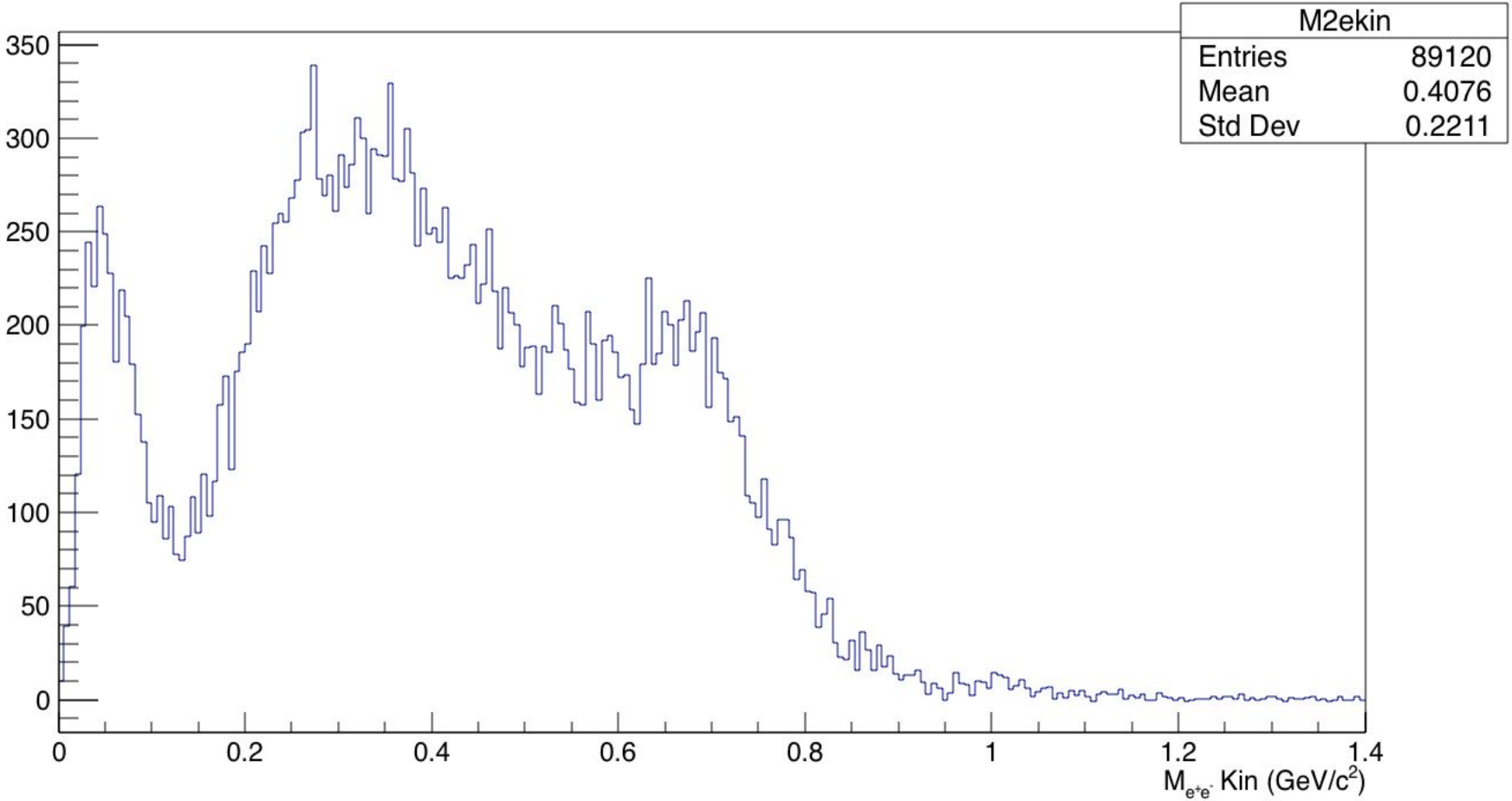
CL01


FCAL_Elasticity
Entries 29129
Mean 0.9456
Std Dev 0.04893
350
300
250
200
150
100
50
0
0
0.2
0.4
0.6
0.8
1
(FCAL_1 + FCAL_2)/BeamE

MC


M2ekin
Entries 335530
Mean 0.3392
Std Dev 0.1741
3500
3000
2500
2000
1500
1000
500
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
$M_{e^+e^-}$ Kin (GeV/c^2)

GF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Entries 89120
Mean 0.4076
Std Dev 0.2211
350
300
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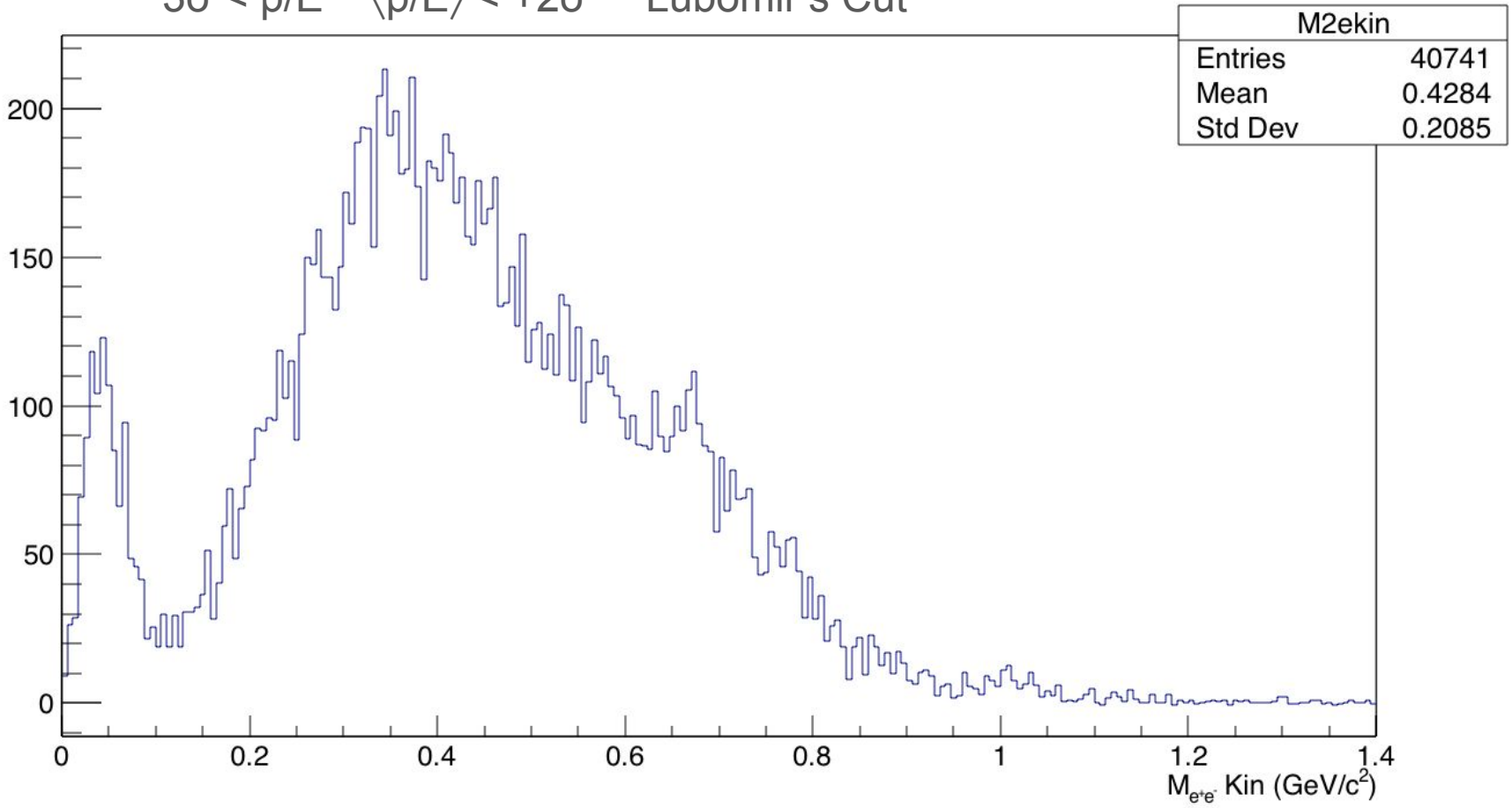
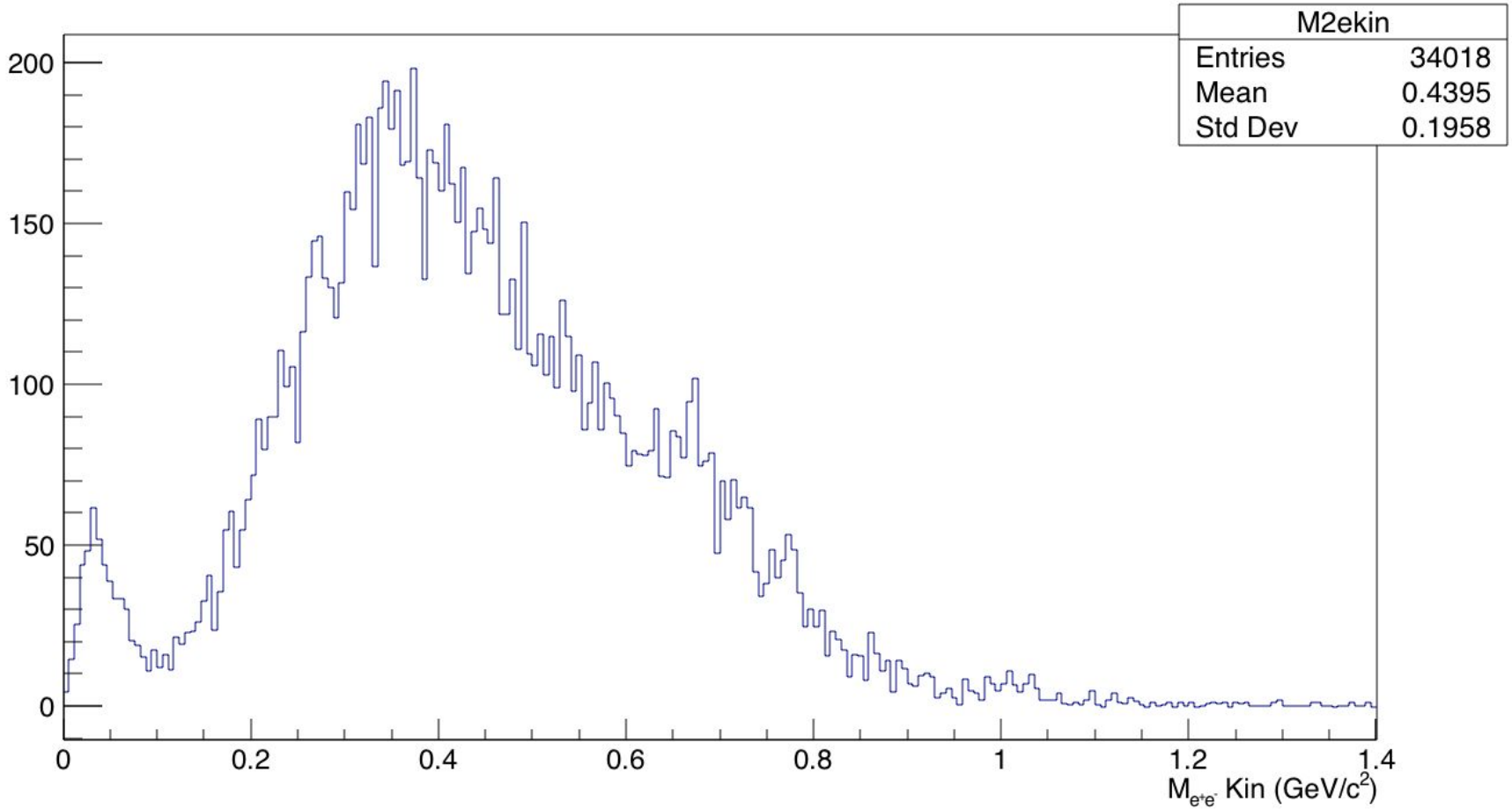
200
150
100
50
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
$M_{e^+e^-}$ Kin (GeV/c^2)

LC

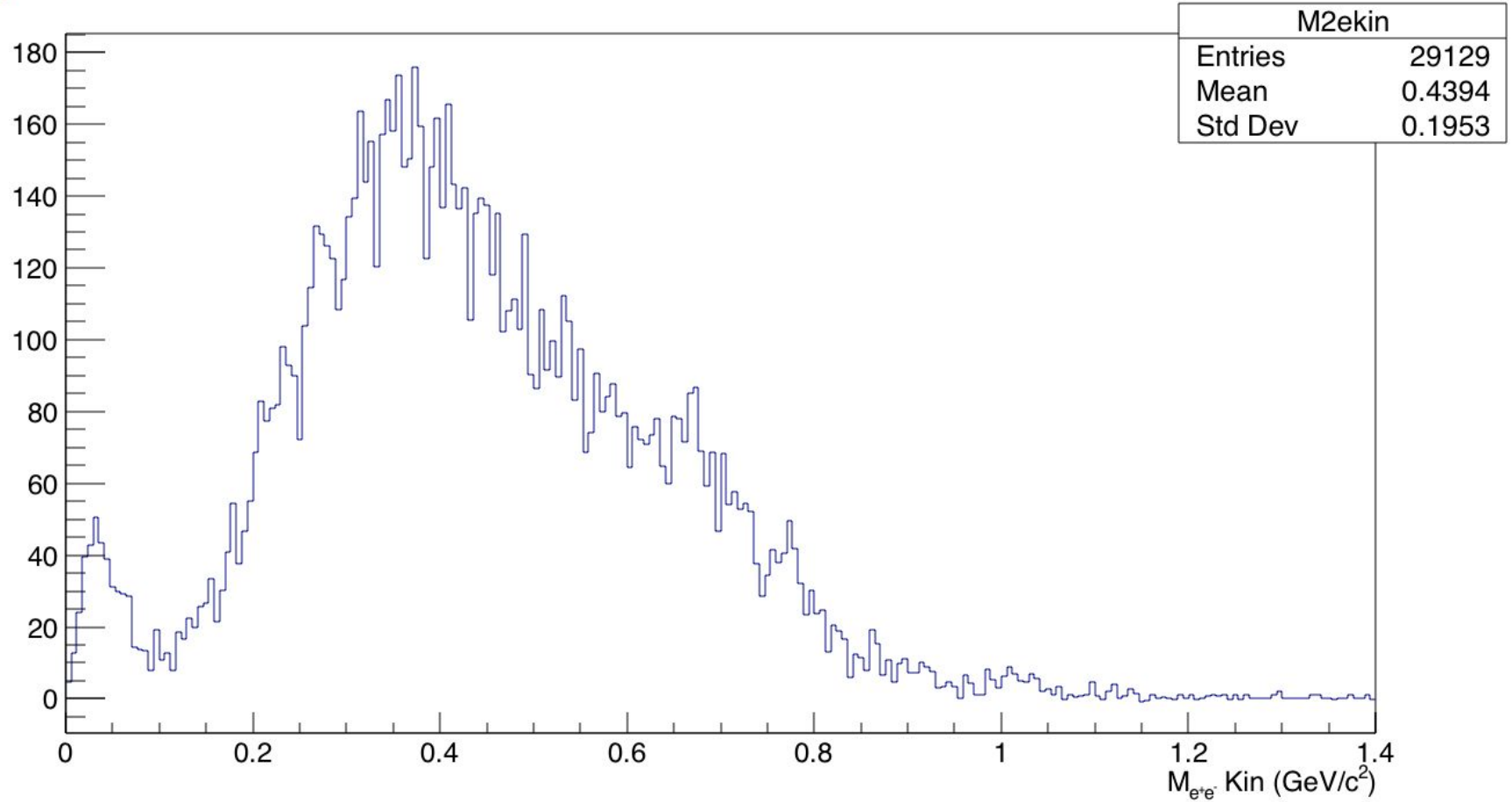
$-3\sigma < p/E - \langle p/E \rangle < +2\sigma$ Lubomir's Cut



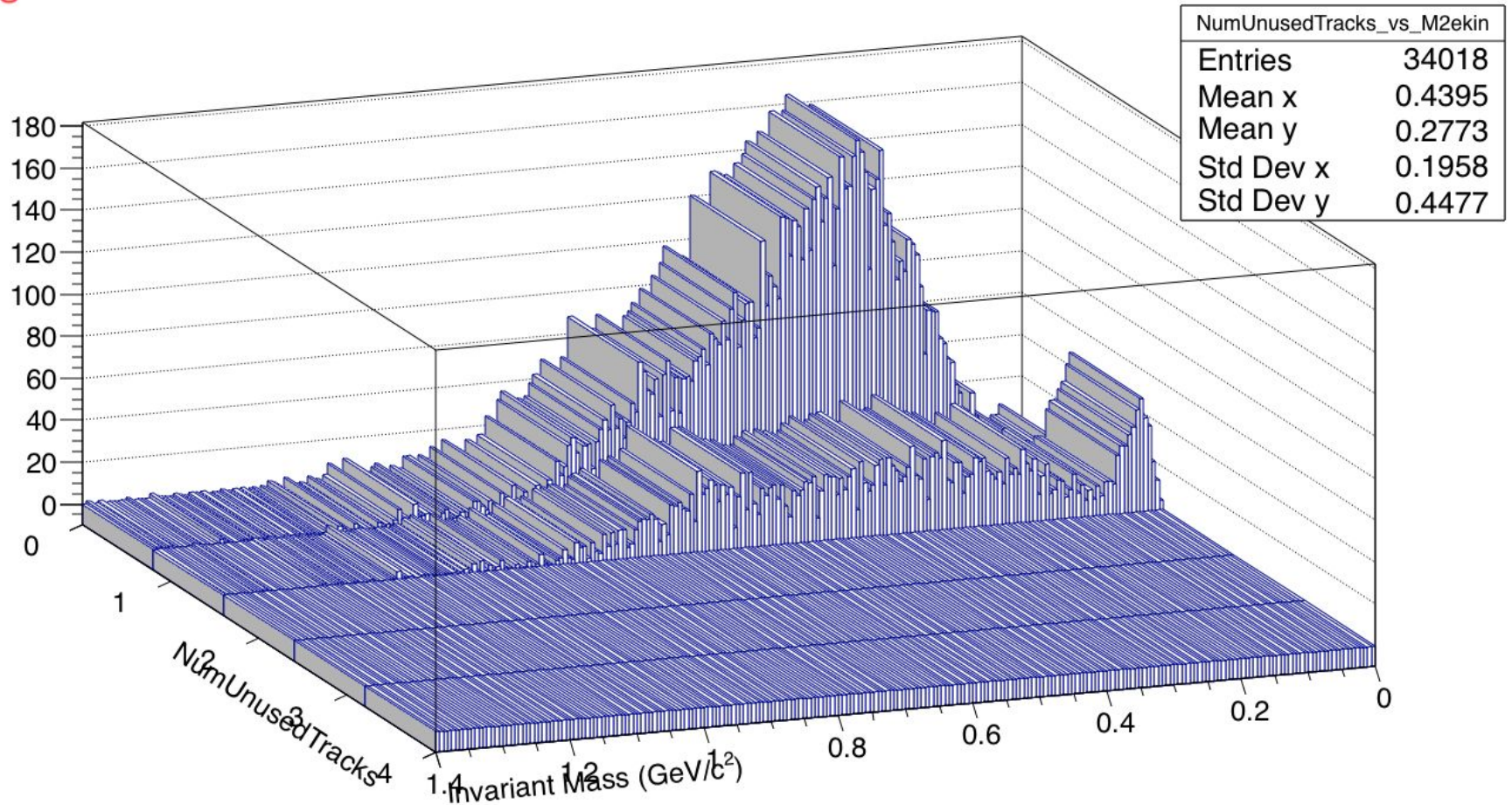
US


M2ekin
Entries 34018
Mean 0.4395
Std Dev 0.1958
200
150
100
50
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
$M_{e^+e^-}$ Kin (GeV/c^2)

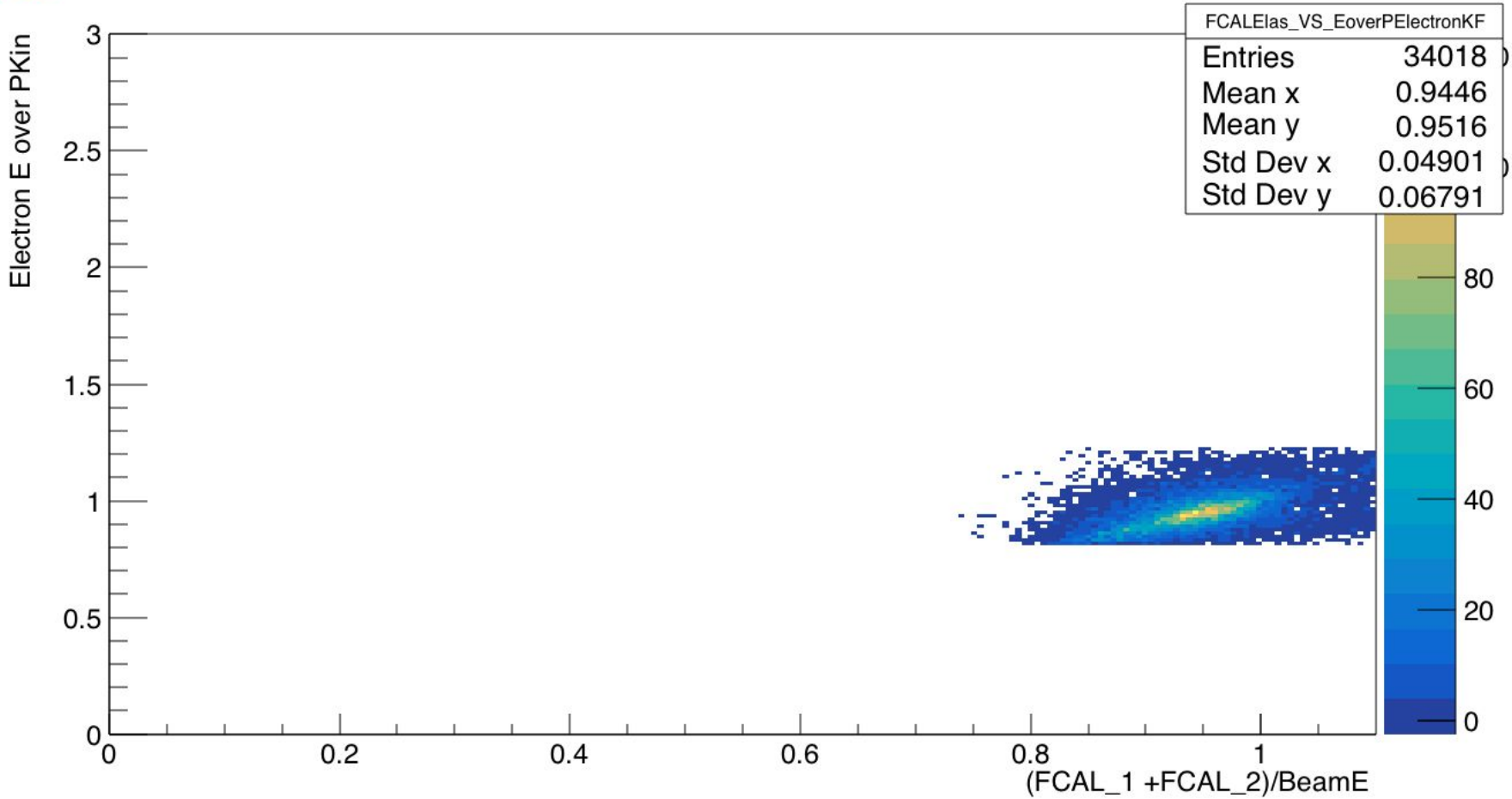
CL01


M2ekin
Entries 29129
Mean 0.4394
Std Dev 0.1953
180
160
140
120
100
80
60
40
20
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
$M_{e^+e^-}$ Kin (GeV/c^2)

US


NumUnusedTracks_vs_M2ekin
Entries 34018
Mean x 0.4395
Mean y 0.2773
Std Dev x 0.1958
Std Dev y 0.4477
180
160
140
120
100
80
60
40
20
0
0
1
2
3
4
NumUnusedTracks
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Invariant Mass (GeV/c²)

US


FCALElas_VS_EoverPElectronKF
Entries 34018
Mean x 0.9446
Mean y 0.9516
Std Dev x 0.04901
Std Dev y 0.06791
Electron E over PKin
(FCAL_1 +FCAL_2)/BeamE
0
0.2
0.4
0.6
0.8
1
0.5
1.5
2
2.5
3
20
40
60
80

Future Analysis

1. How many times is the proton the Unused Track? (MC Analysis)
2. Fitting E/P vs FCAL Elasticity plot (should switch to P/E to make consistent)
3. Fitting Elasticity in Bins of Invariant Mass

New Cut Approach

1. Only cut on P/E for positron, cut on elasiticty, and fit P/E for electron