H(e,e'p) Elastics Check!

Beam Time: 1 hr

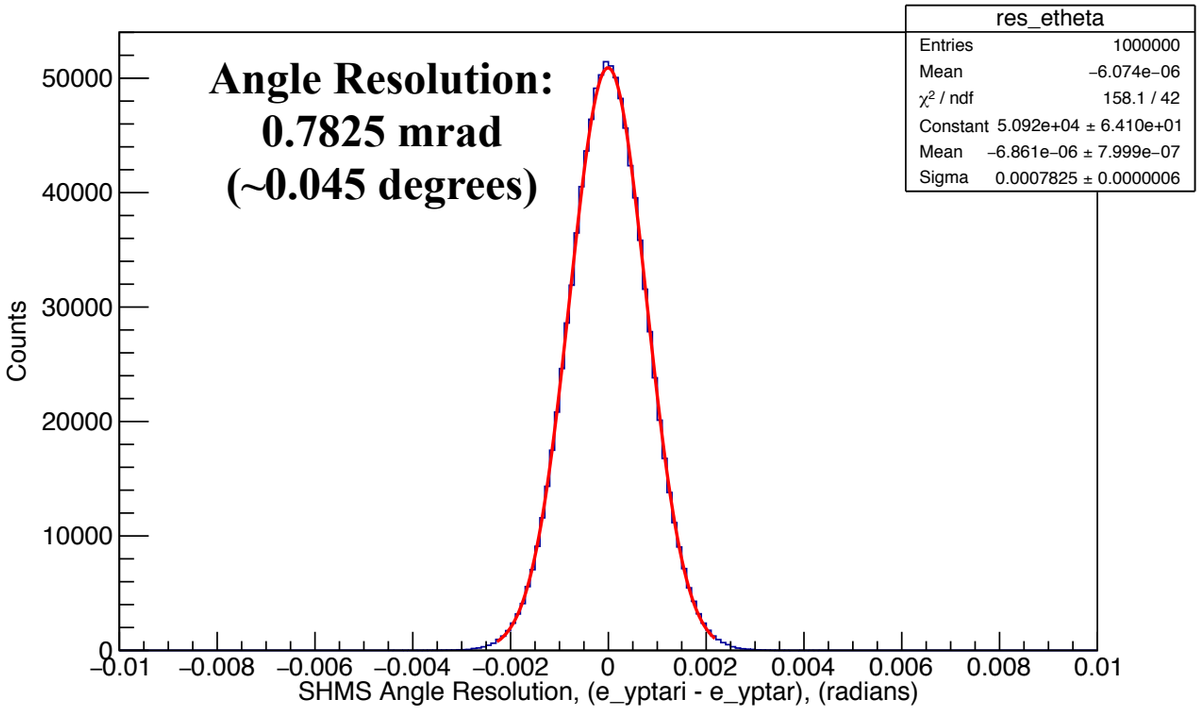
Q2 = 4.02714 GeV2
|q| = 2.938 GeV
omega (w) = 2.14604 GeV
x = 1.0
Scat. e- Momentum: 8.453 GeV/c

****SPECTROMETER SETTING****

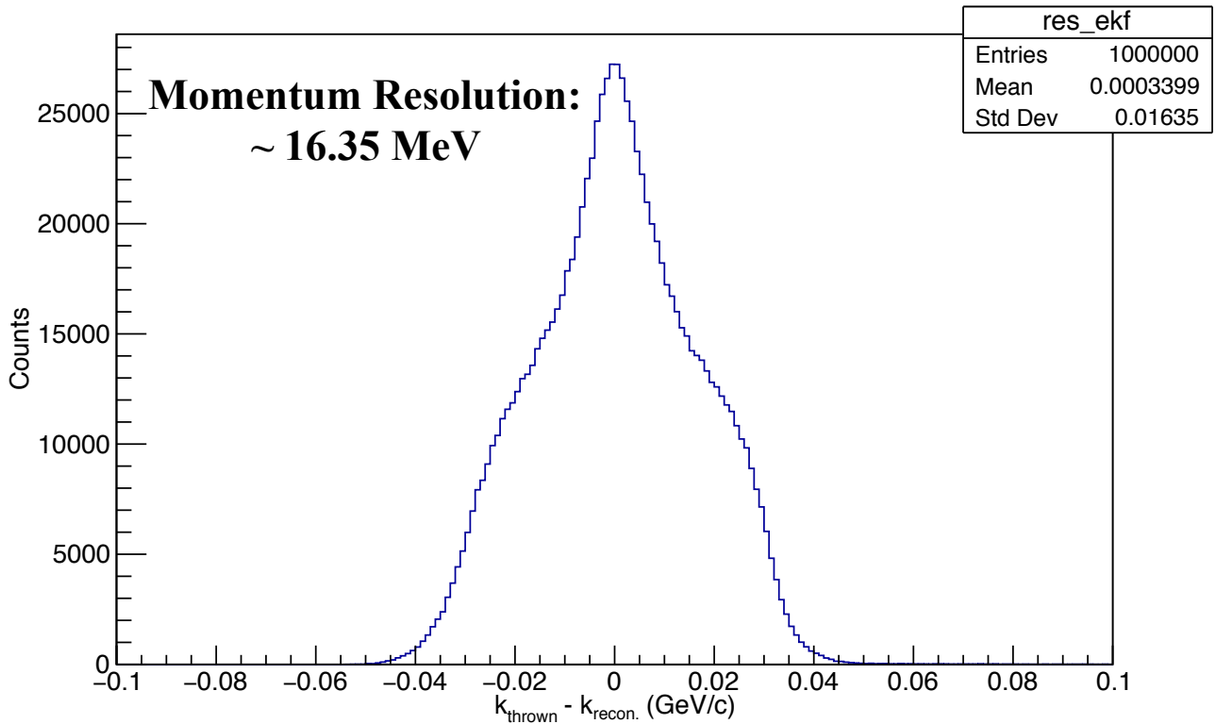
SHMS (electron Arm):
Angle: 12.169 deg
Momentum: 8.7 GeV/c

HMS (proton Arm):
Angle: 37.338 deg
Momentum: 2.93814 GeV/c

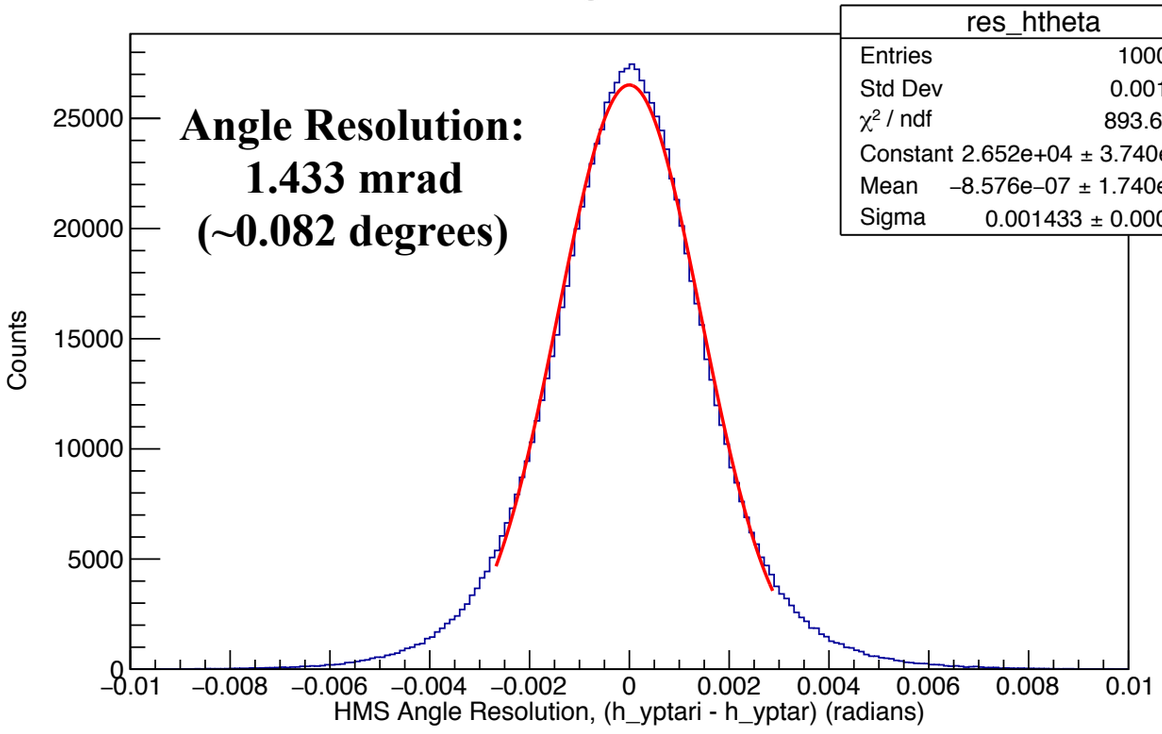
SHMS Angle Resolution



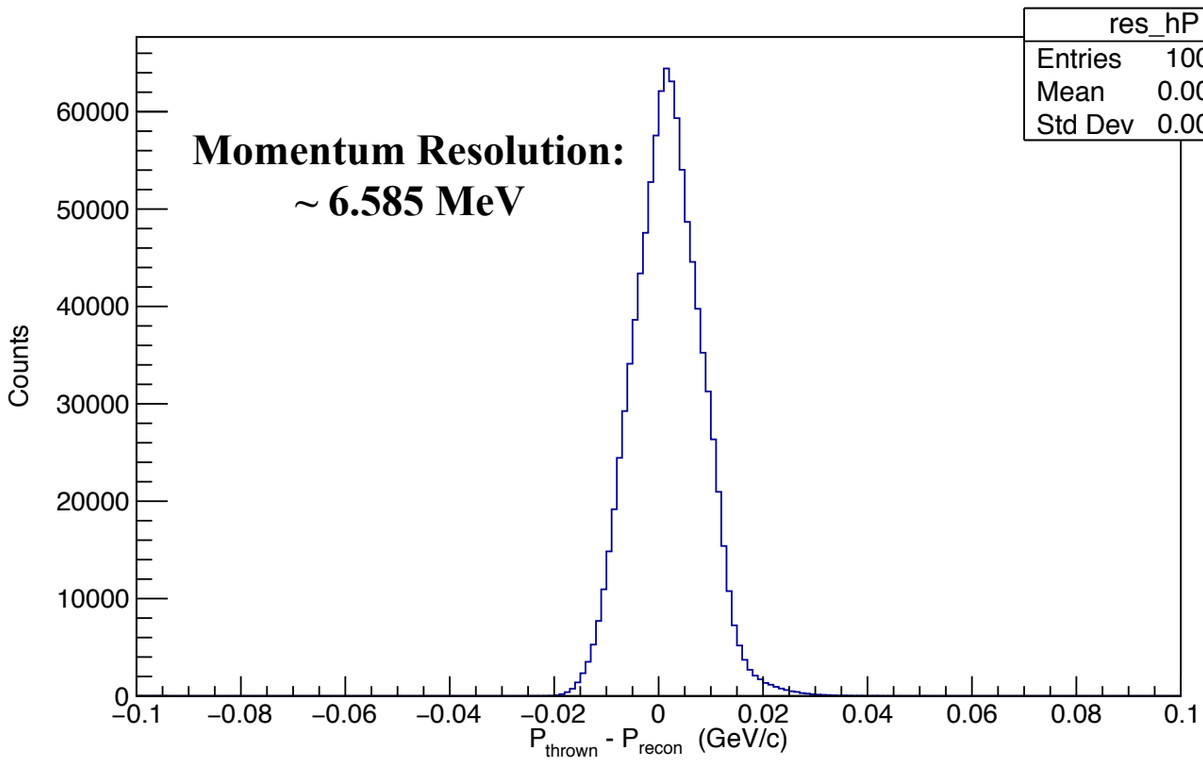
SHMS Momentum Resolution



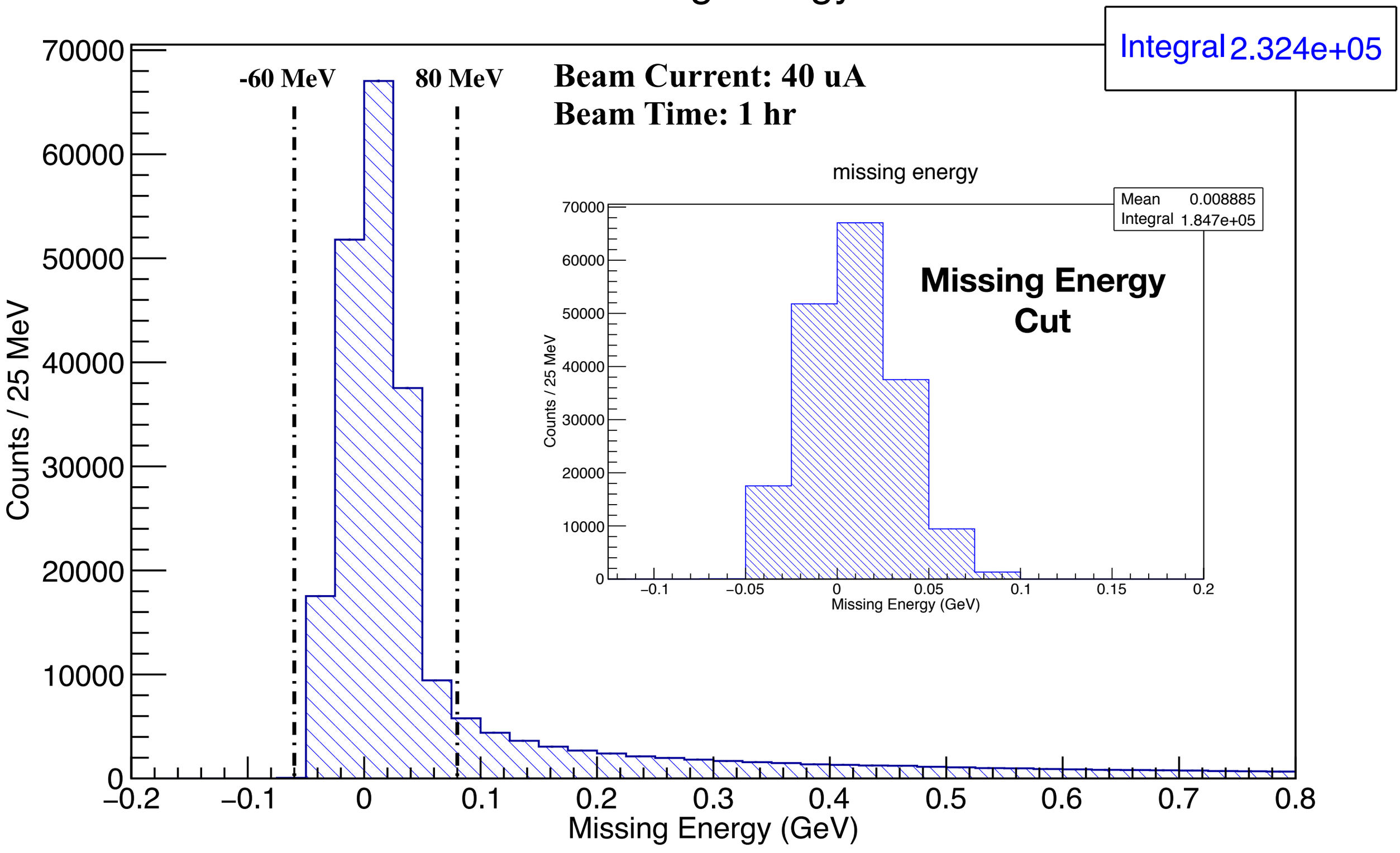
HMS Angle Resolution

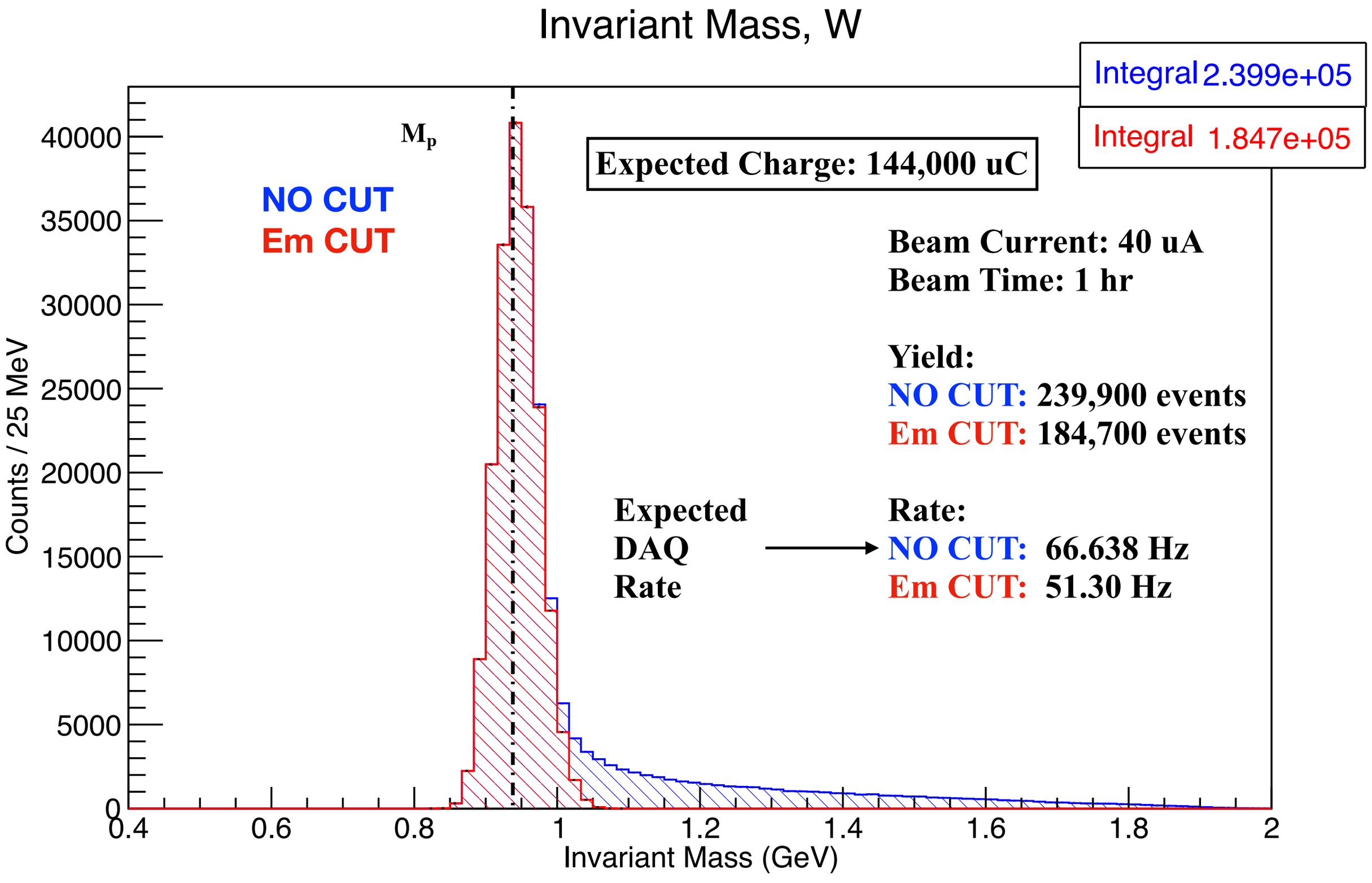


HMS Momentum Resolution

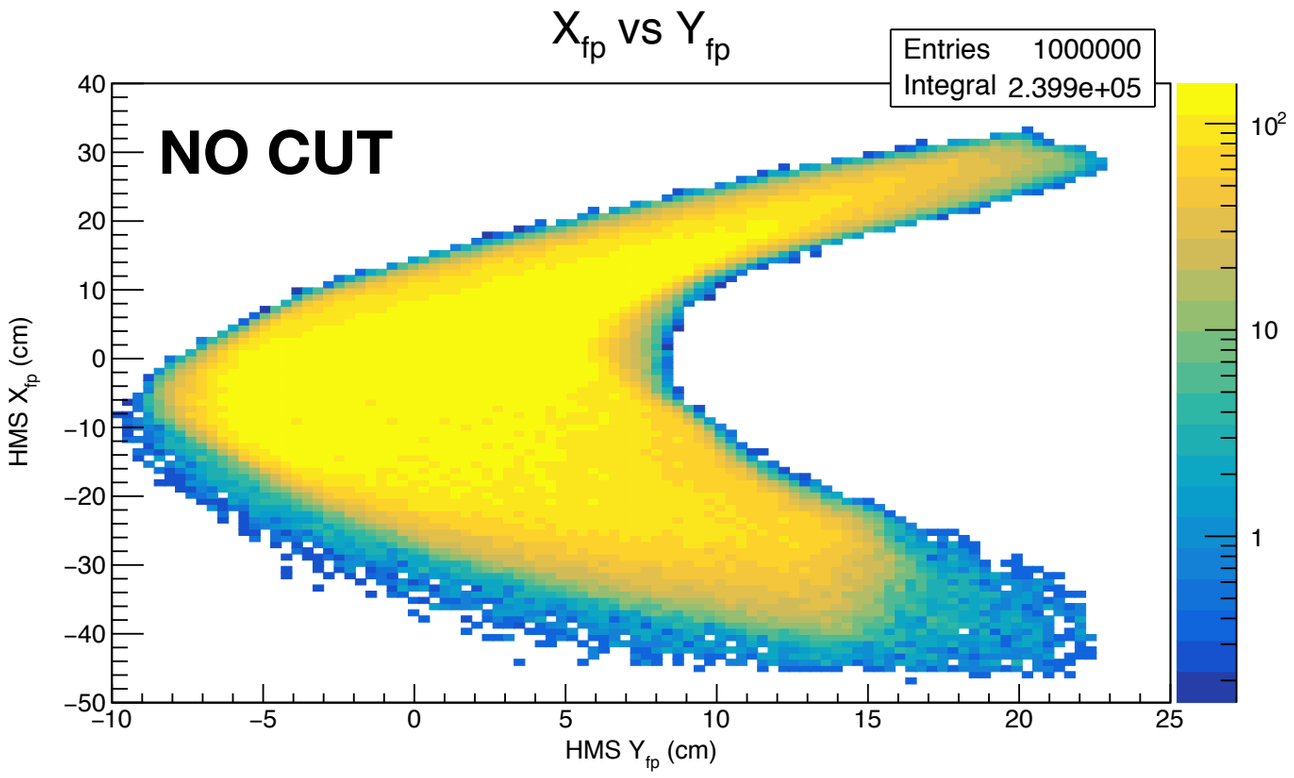


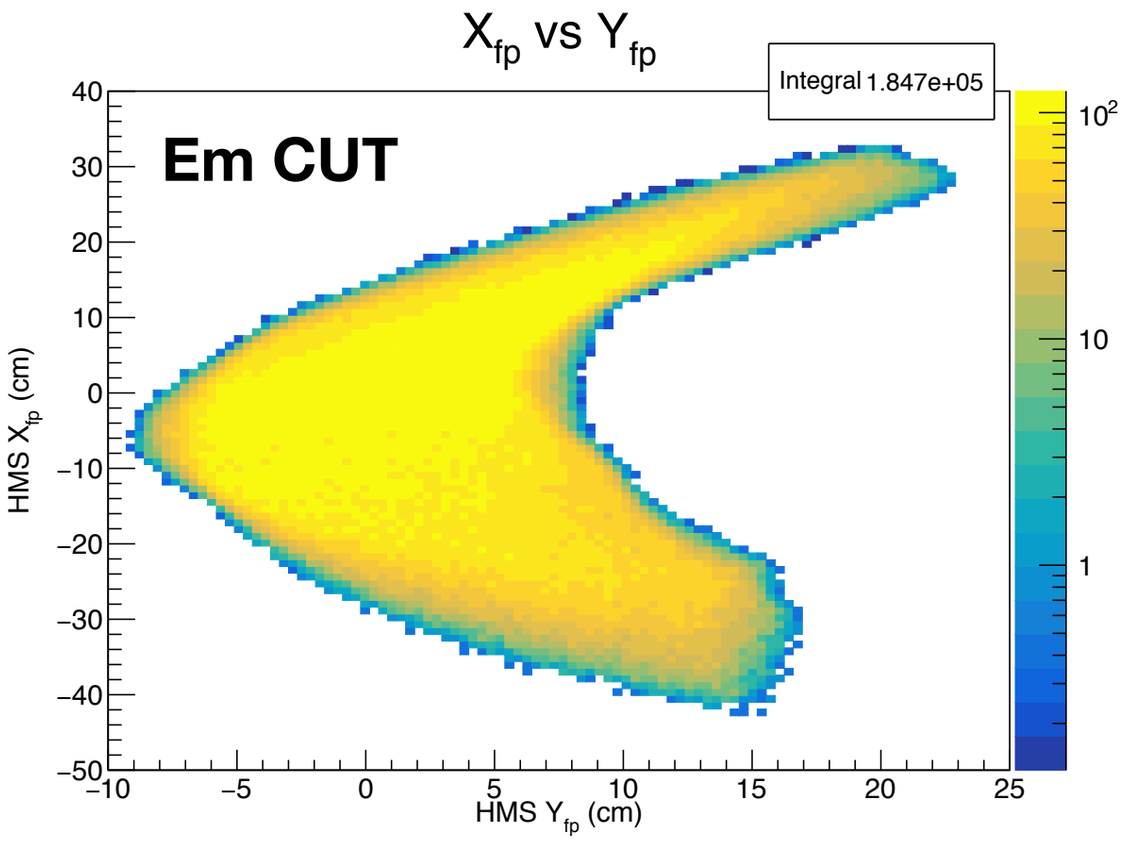
missing energy

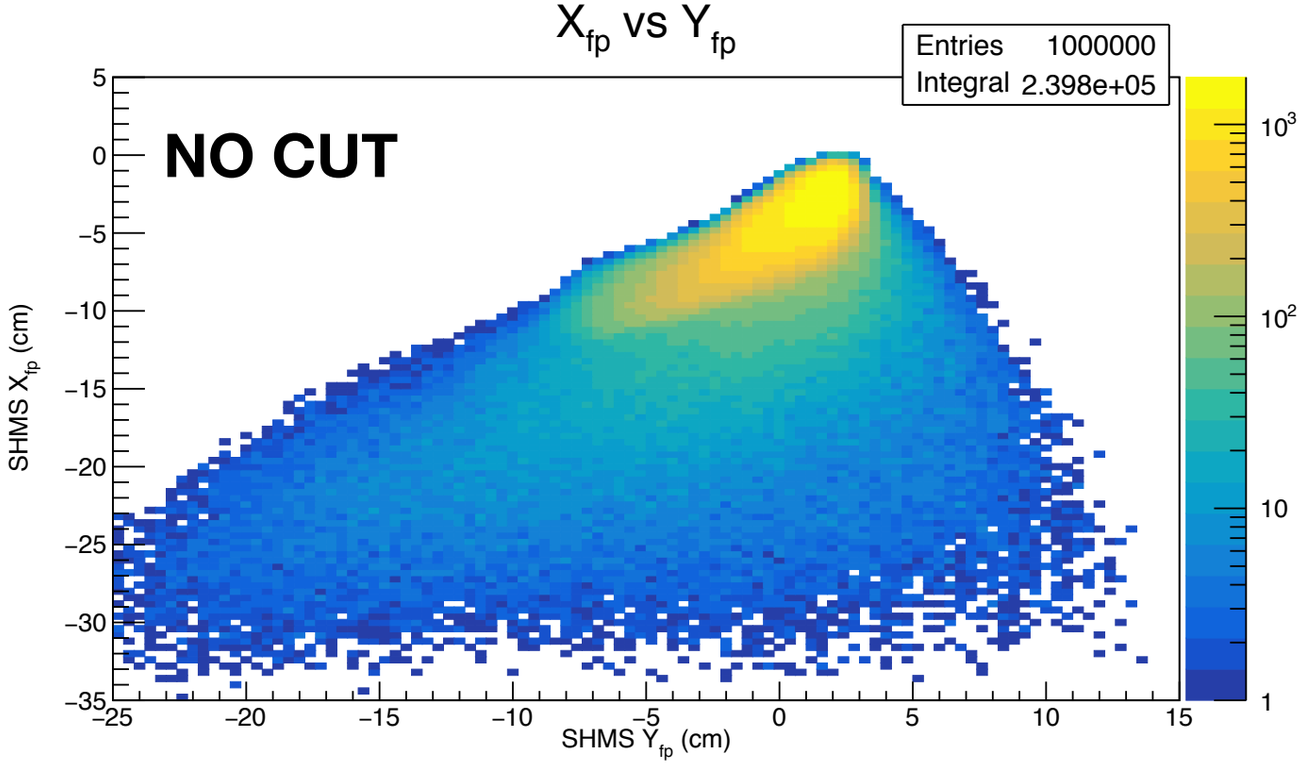


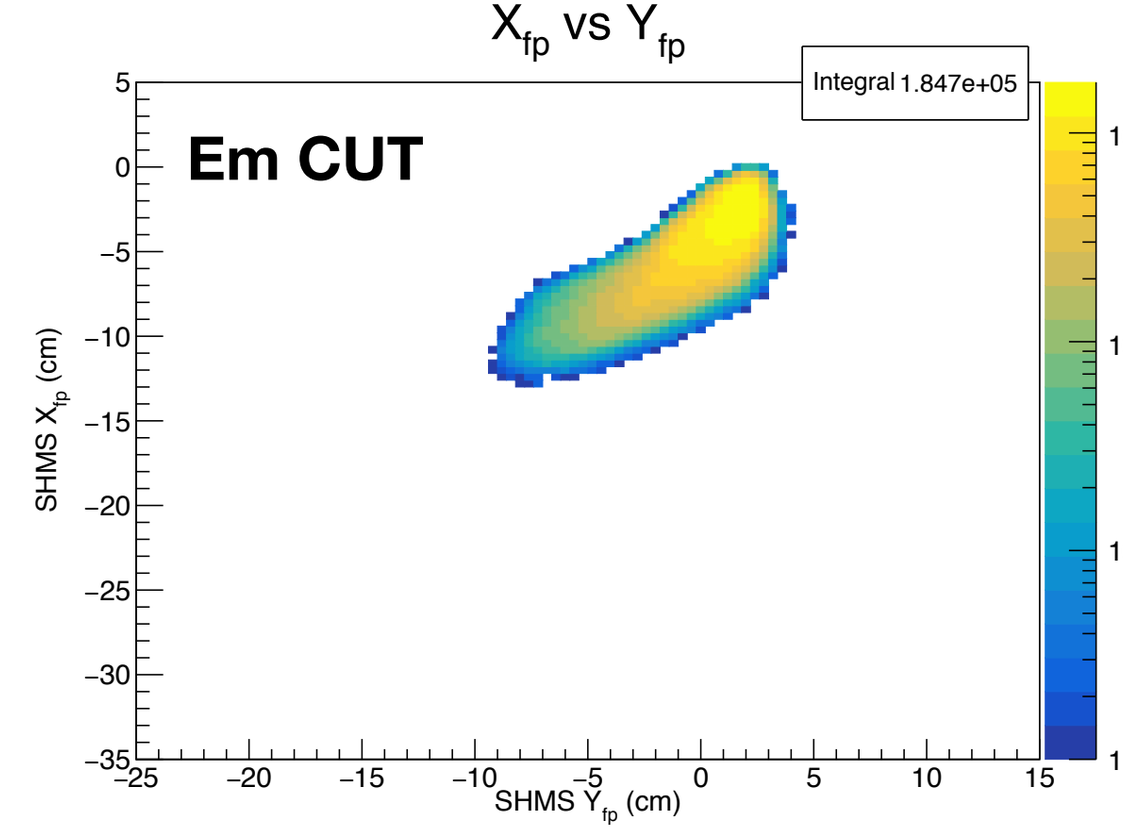

Invariant Mass, W
Integral 2.399e+05
Integral 1.847e+05
M_p
NO CUT
Em CUT
Expected Charge: 144,000 uC
Beam Current: 40 uA
Beam Time: 1 hr
Yield:
NO CUT: 239,900 events
Em CUT: 184,700 events
Expected DAQ Rate
Rate:
NO CUT: 66.638 Hz
Em CUT: 51.30 Hz
Counts / 25 MeV
Invariant Mass (GeV)
0
5000
10000
15000
20000
25000
30000
35000
40000
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2

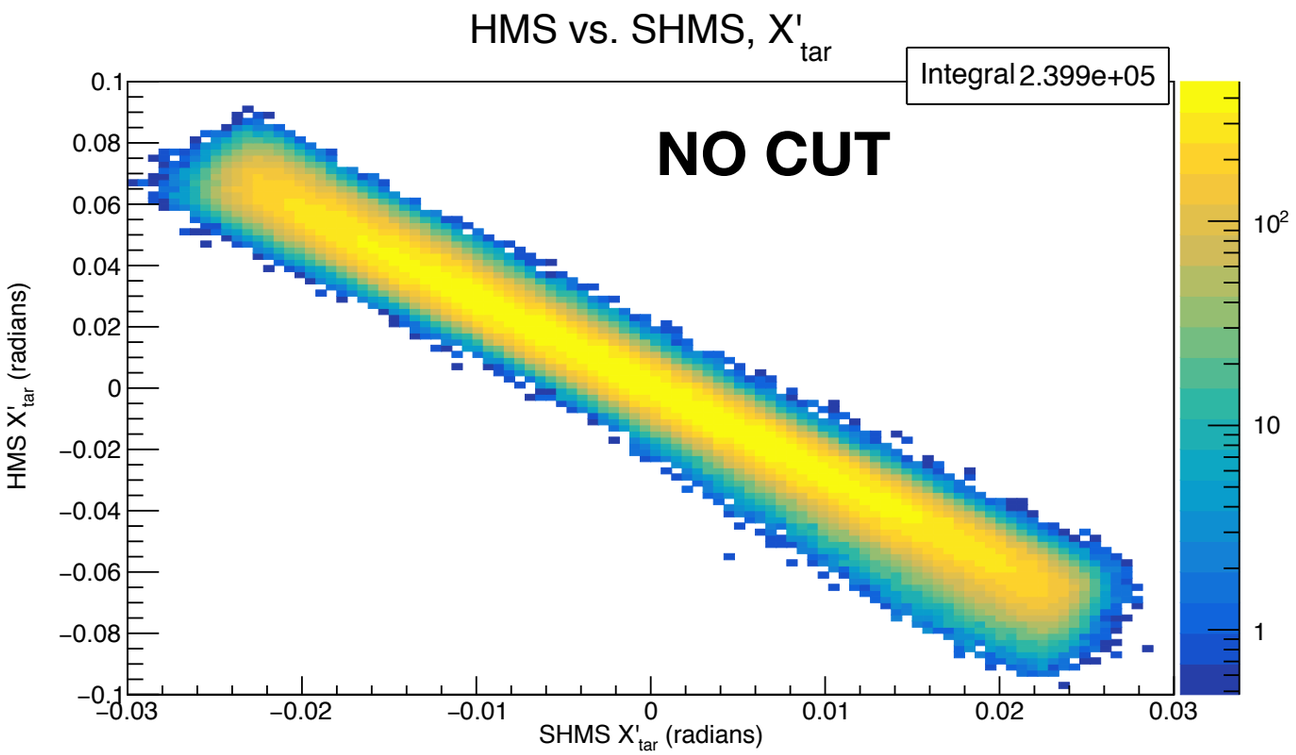
FOCAL PLANE / RECONSTRUCTED VARIABLES (SIMC)

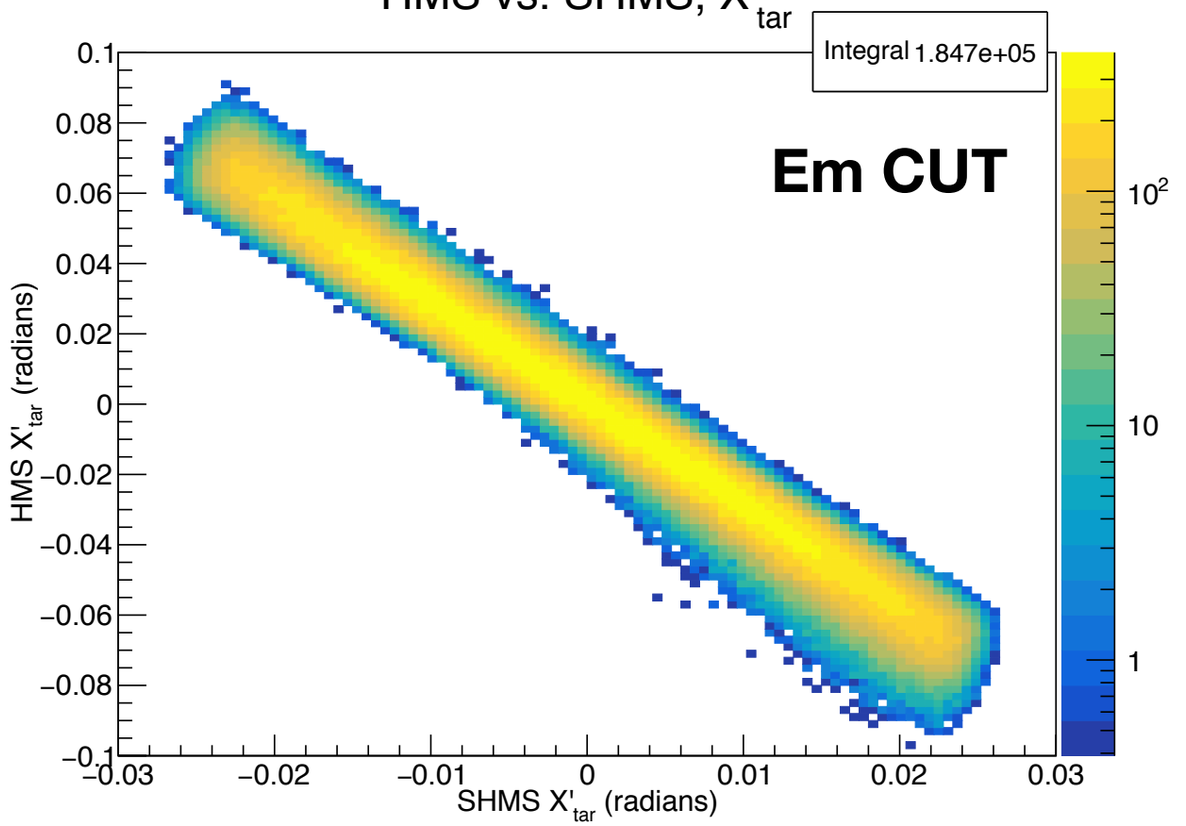

X_{fp} vs Y_{fp}
Entries 1000000
Integral 2.399e+05
NO CUT
HMS X_{fp} (cm)
HMS Y_{fp} (cm)

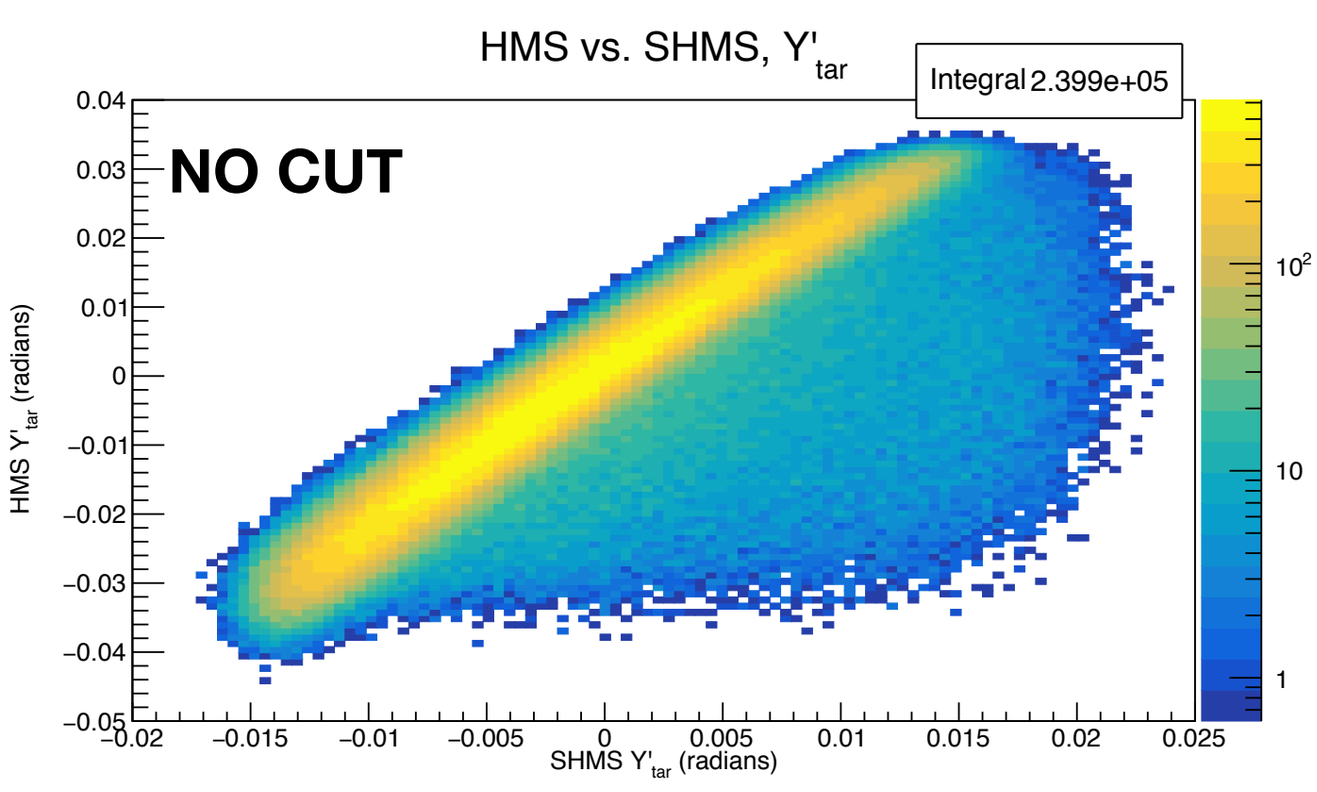

X_{fp} vs Y_{fp}
Integral 1.847e+05
Em CUT
HMS X_{fp} (cm)
HMS Y_{fp} (cm)

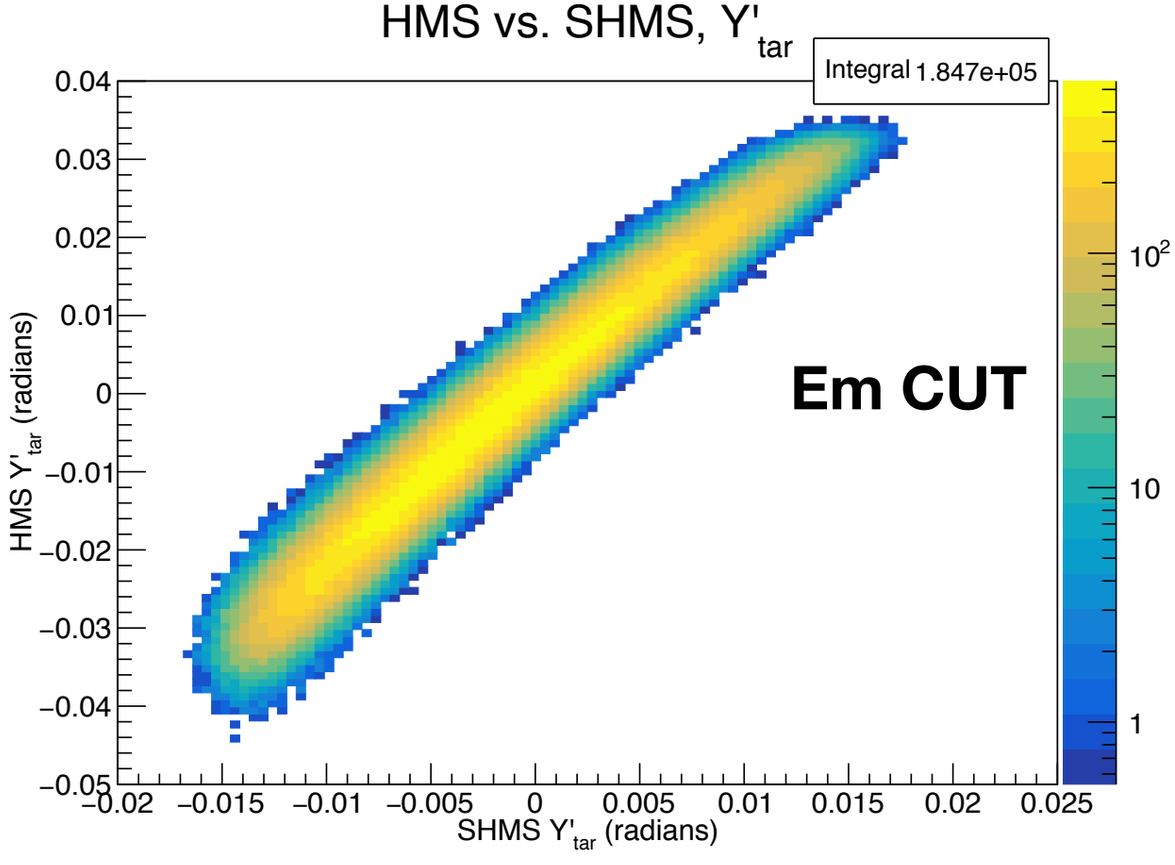

X_{fp} vs Y_{fp}
Entries 1000000
Integral 2.398e+05
NO CUT
SHMS X_{fp} (cm)
SHMS Y_{fp} (cm)

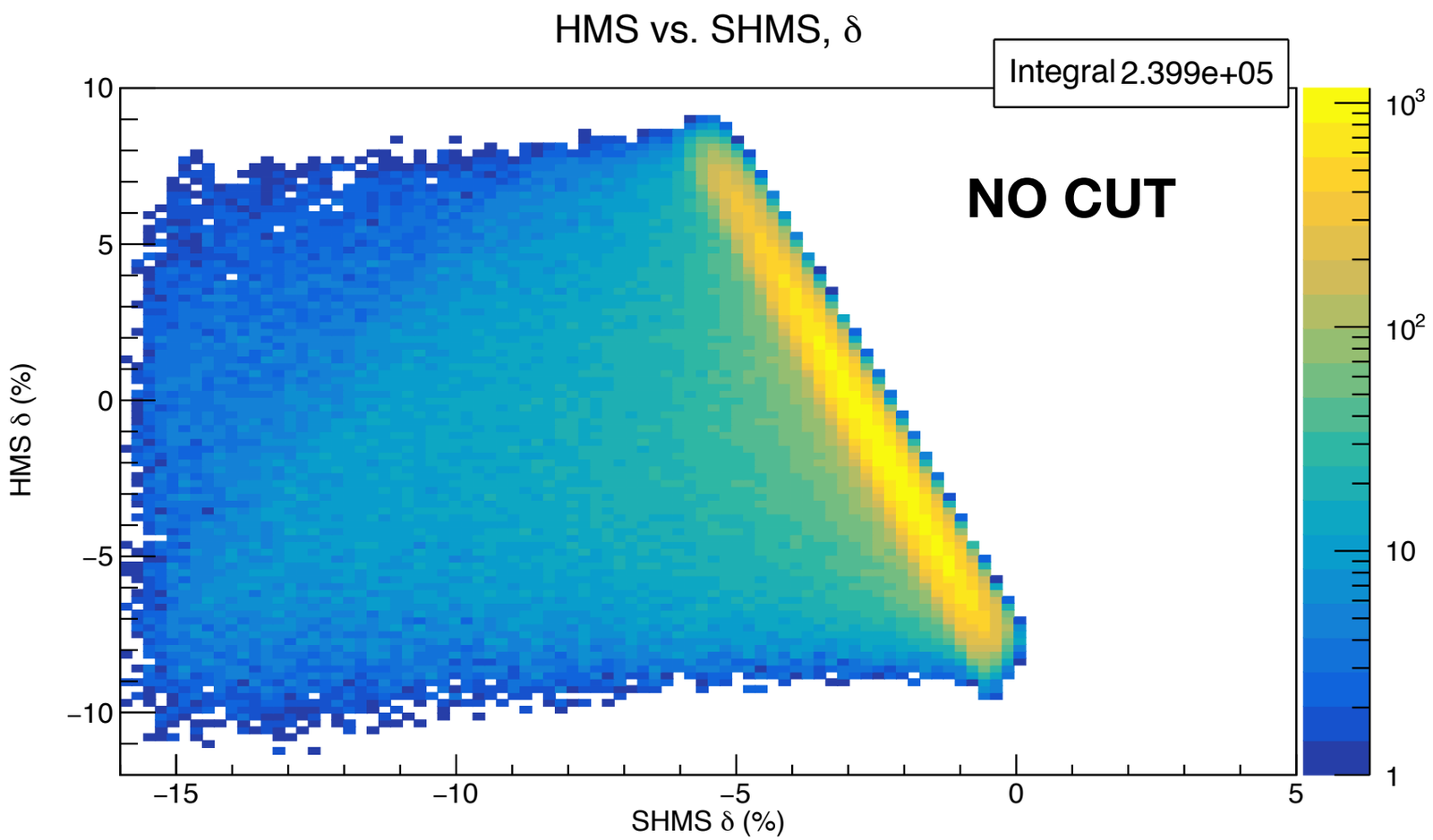

X_{fp} vs Y_{fp}
Integral 1.847e+05
Em CUT
SHMS X_{fp} (cm)
SHMS Y_{fp} (cm)

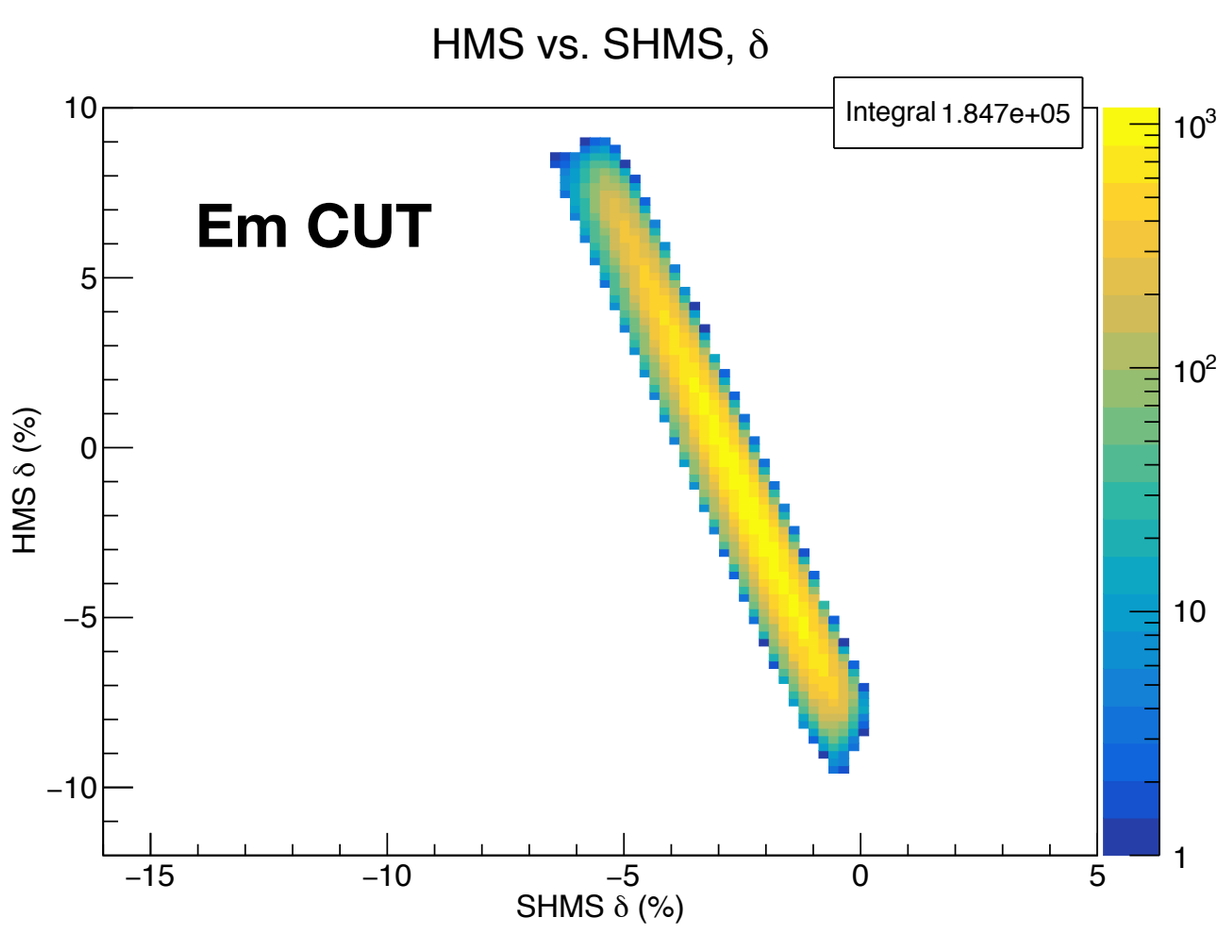

HMS vs. SHMS, X'tar
Integral 2.399e+05
NO CUT
HMS X'tar (radians)
SHMS X'tar (radians)


HMS vs. SHMS, X'tar
Integral 1.847e+05
Em CUT
HMS X'tar (radians)
SHMS X'tar (radians)


HMS vs. SHMS, Y'tar
Integral 2.399e+05
NO CUT
HMS Y'tar (radians)
SHMS Y'tar (radians)


HMS vs. SHMS, Y'tar
Integral 1.847e+05
Em CUT
HMS Y'tar (radians)
SHMS Y'tar (radians)


HMS vs. SHMS, δ
Integral 2.399e+05
NO CUT
HMS δ (%)
SHMS δ (%)
10
5
0
−5
−10
−15
−10
−5
0
5
10^3
10^2
10
1


HMS vs. SHMS, δ
Integral 1.847e+05
Em CUT
HMS δ (%)
SHMS δ (%)
10
5
0
−5
−10
−15
−10
−5
0
5
10^3
10^2
10
1

SHMS δ vs. Y'$_{tar}$

Entries	1000000
Integral	2.399e+05

NO CUT

H(e,e'p) Check! PLOT

SHMS δ (%)

5
0
−5
−10
−15

−0.02 −0.015 −0.01 −0.005 0 0.005 0.01 0.015 0.02 0.025

SHMS Y'$_{tar}$ (radians)

10^3
10^2
10
1

SHMS δ vs. Y'$_{tar}$

Integral 1.847e+05

Em CUT

H(e,e'p) Check! PLOT

SHMS δ (%)

5
0
−5
−10
−15

−0.02 −0.015 −0.01 −0.005 0 0.005 0.01 0.015 0.02 0.025

SHMS Y'$_{tar}$ (radians)

10^3
10^2
10
1

D(e,e'p)n: Pmiss = 80 MeV (small or NO FSI)

Beam Time: 1 hr

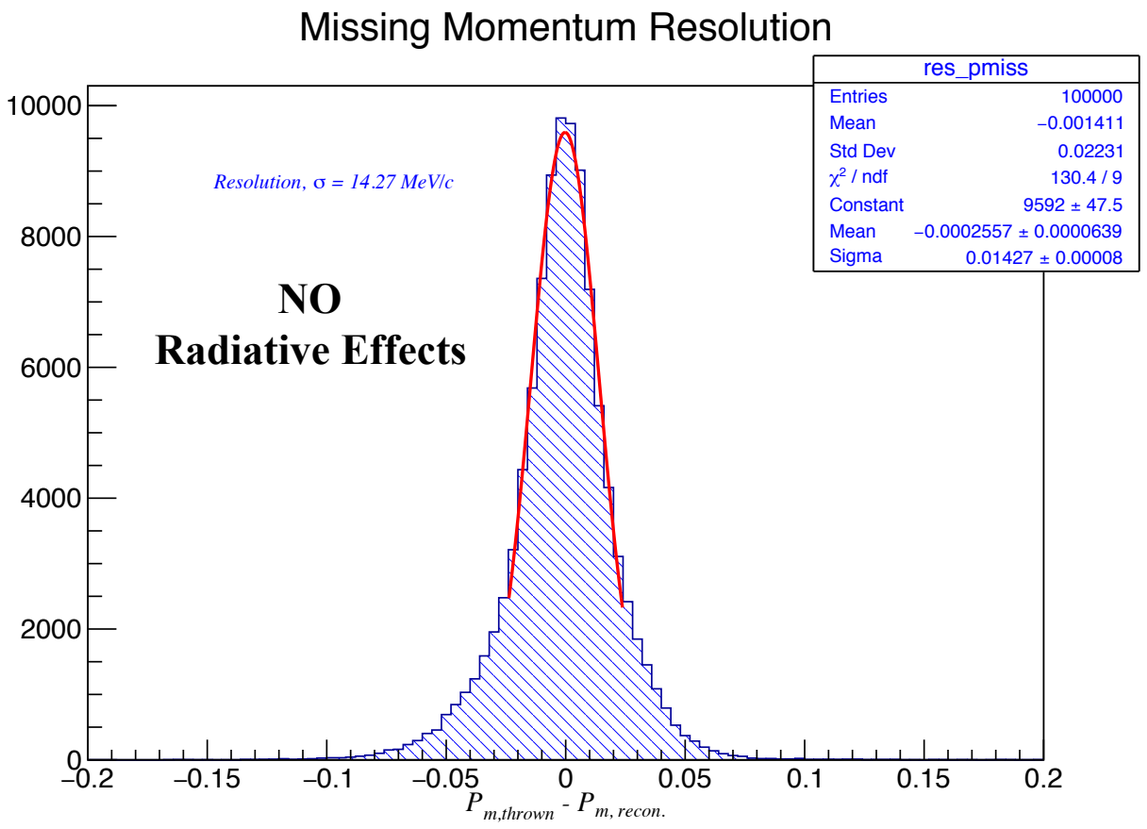
Q2 = 4.02714 GeV2
|q| = 2.938 GeV
omega (w) = 2.14604 GeV
x = 1.0
Scat. e- Momentum: 8.453 GeV/c
theta_nq = 84.98 deg

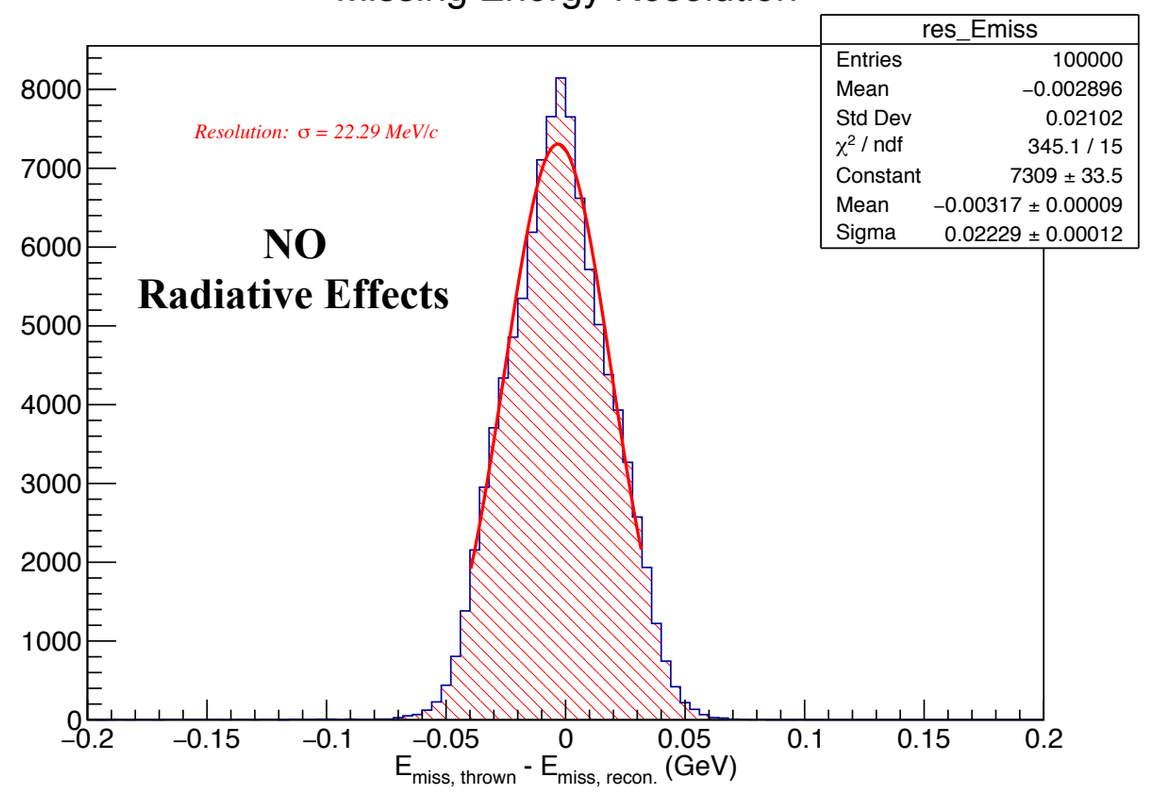
****SPECTROMETER SETTING****

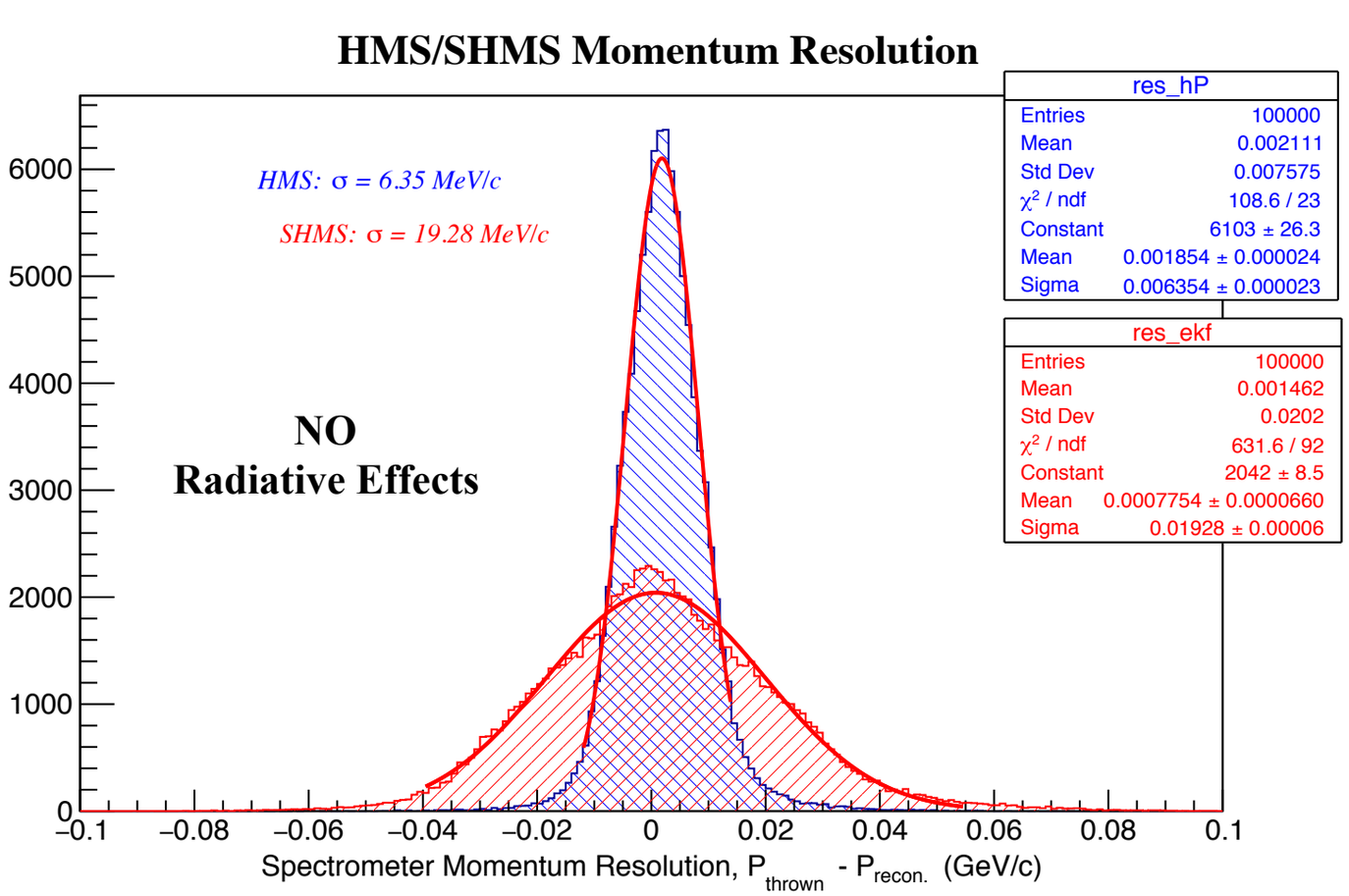
SHMS (electron Arm):
Angle: 12.169 deg
Momentum: 8.7 GeV/c

HMS (proton Arm):
Angle: 38.896 deg
Momentum: 2.93223 GeV/c

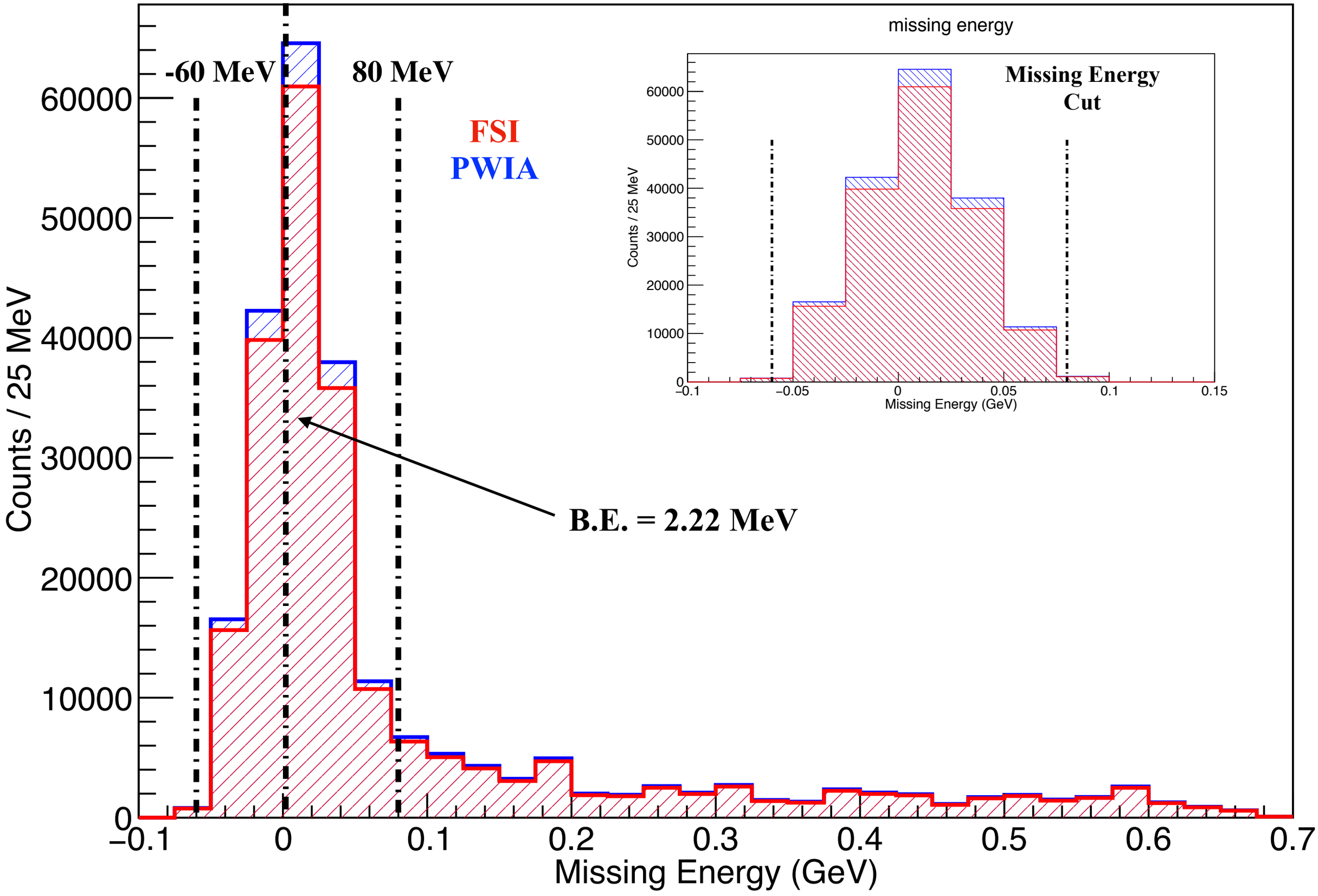
Spectrometer Resolutions





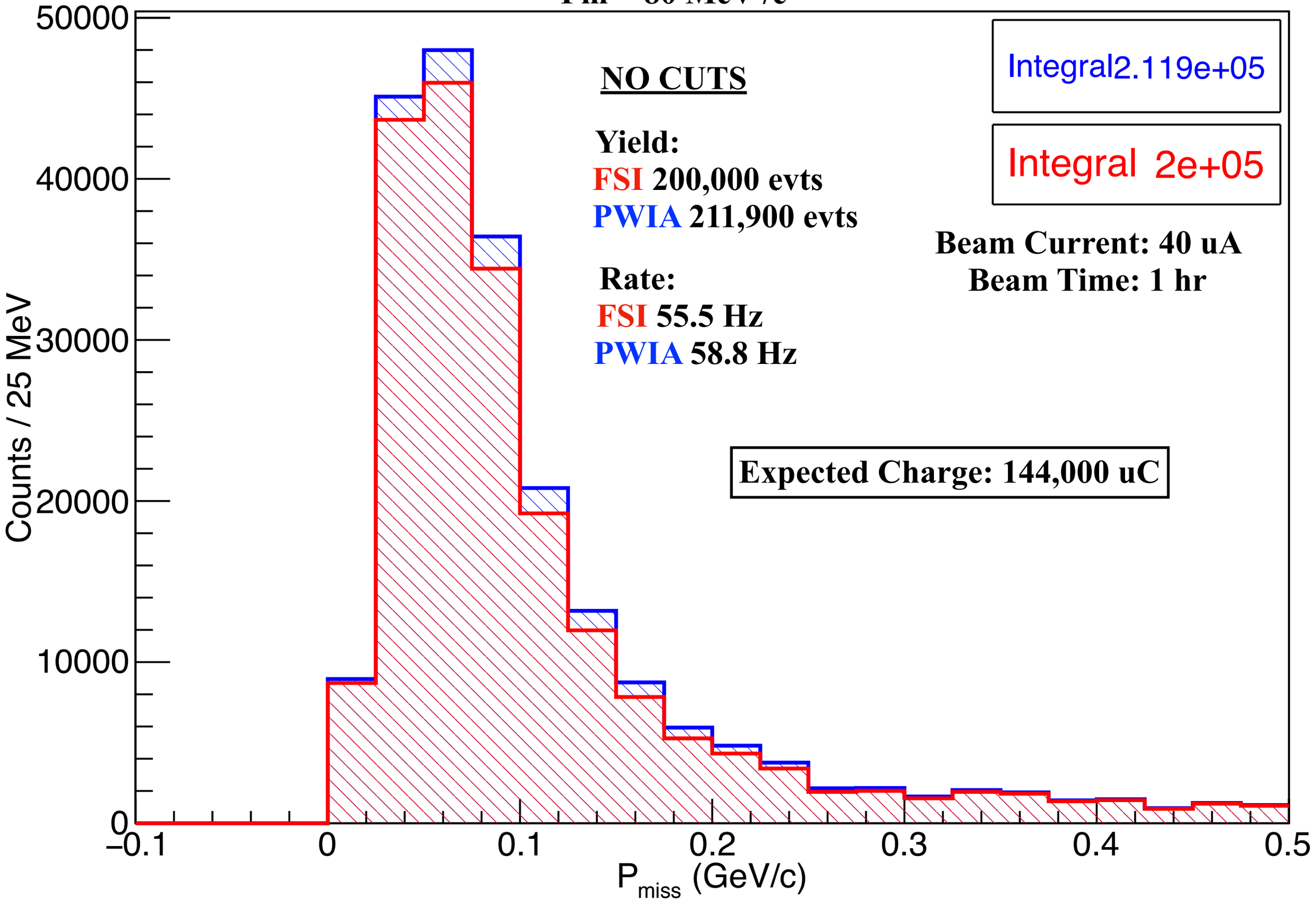


missing energy



missing momentum

Pm = 80 MeV /c



NO CUTS

Yield:
FSI 200,000 evts
PWIA 211,900 evts

Rate:
FSI 55.5 Hz
PWIA 58.8 Hz

Integral2.119e+05

Integral 2e+05

Beam Current: 40 uA
Beam Time: 1 hr

Expected Charge: 144,000 uC

missing momentum

Pm = 80 MeV /c

Model: FSI

CUT: -60 < Em < 80 MeV

Entries	100000
Integral	2e+05
Entries	79855
Integral	1.646e+05

Yield:

NO_CUT: 200,000 evts

CUT: 164,600 evts

Rate:

NO_CUT: 55.5 Hz

CUT: 45.7 Hz

Expected DAQ rate

Counts / 25 MeV

45000
40000
35000
30000
25000
20000
15000
10000
5000
0

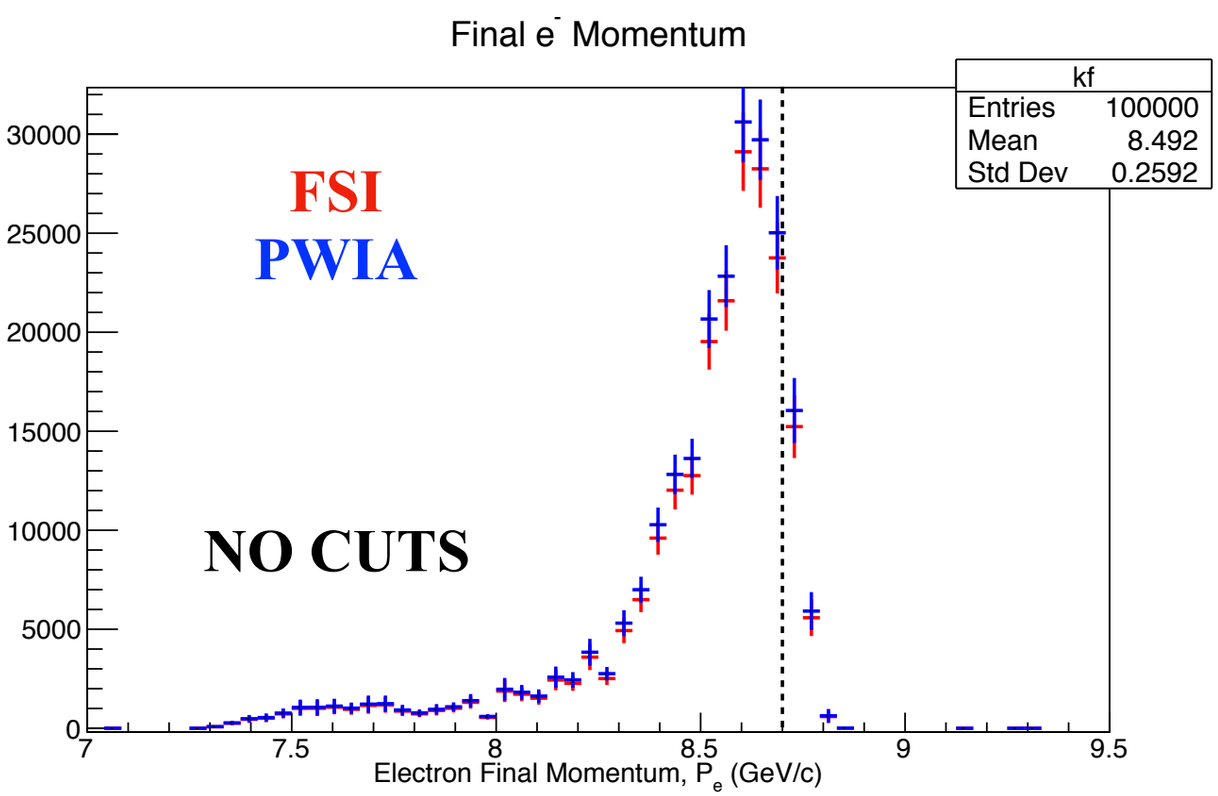
−0.1 0 0.1 0.2 0.3 0.4 0.5

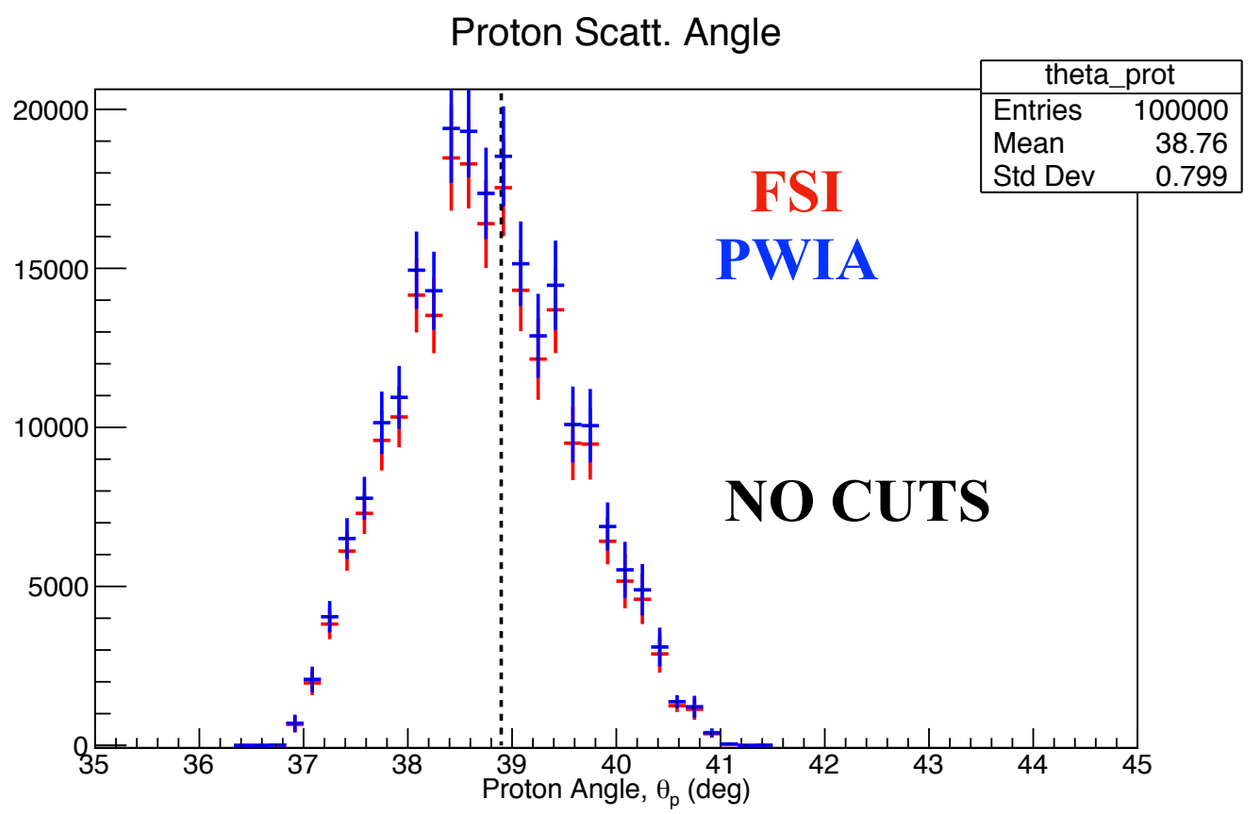
P_{miss} (GeV/c)

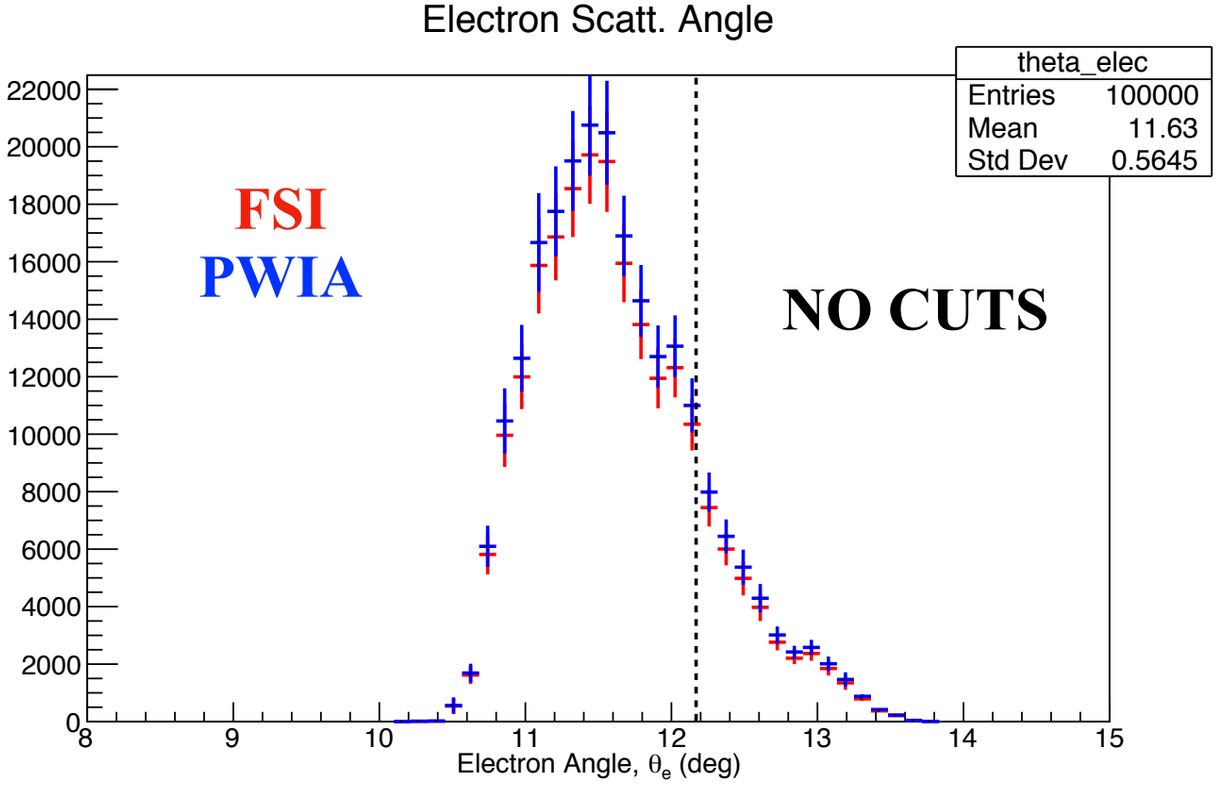
KINEMATICS COMPARISONS (SIMC)

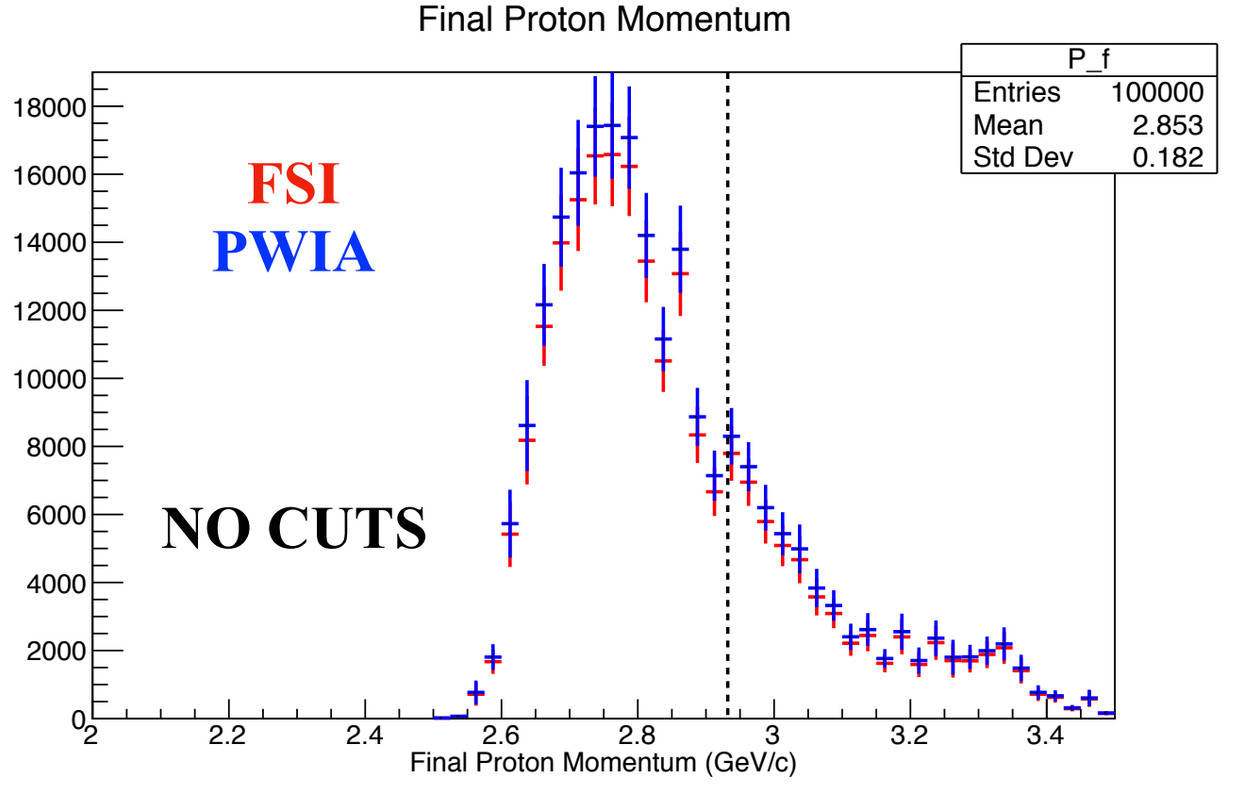
NOTE There was NO need to Apply kinematics cuts, as FSI are Negligible at high Q2 and low missing momentum.**

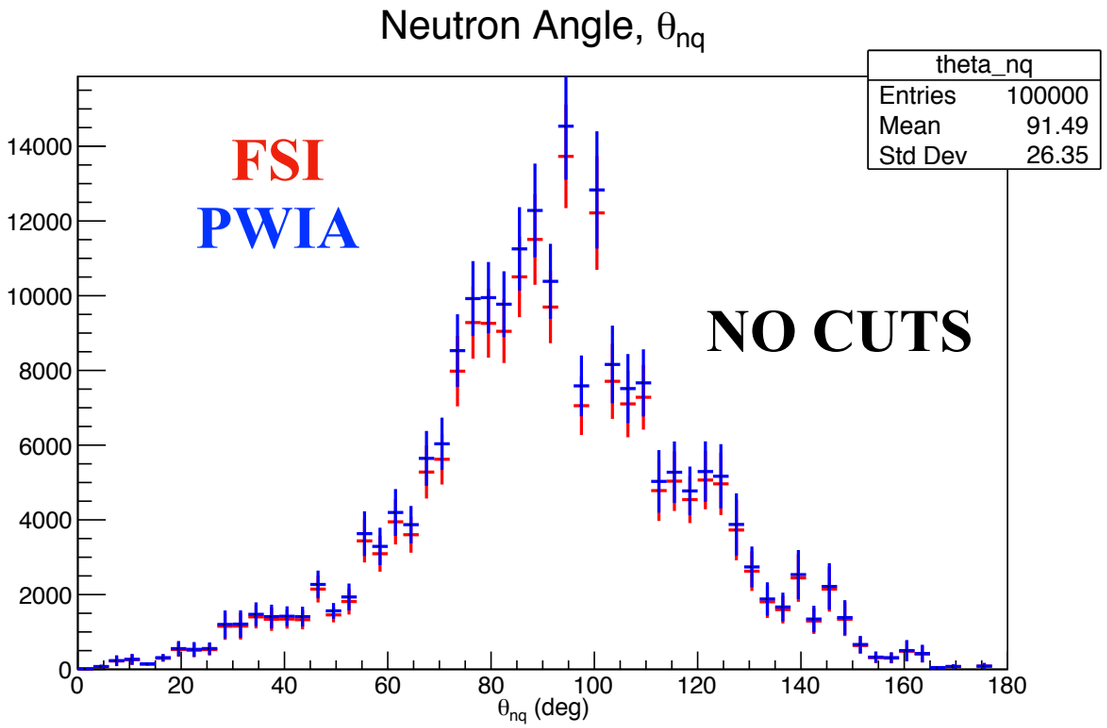
FSI ~ PWIA, at low missing momentum and high Q2

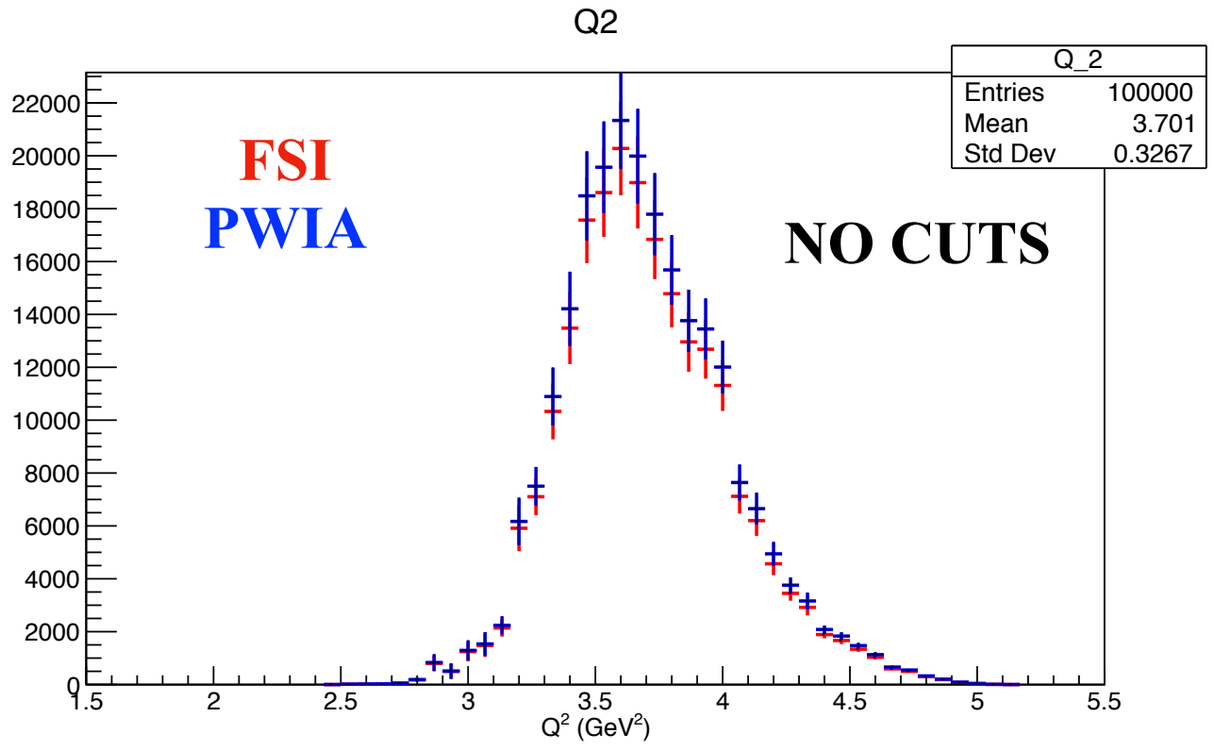

Final e⁻ Momentum
kf
Entries 100000
Mean 8.492
Std Dev 0.2592
FSI
PWIA
NO CUTS
Electron Final Momentum, P_e (GeV/c)

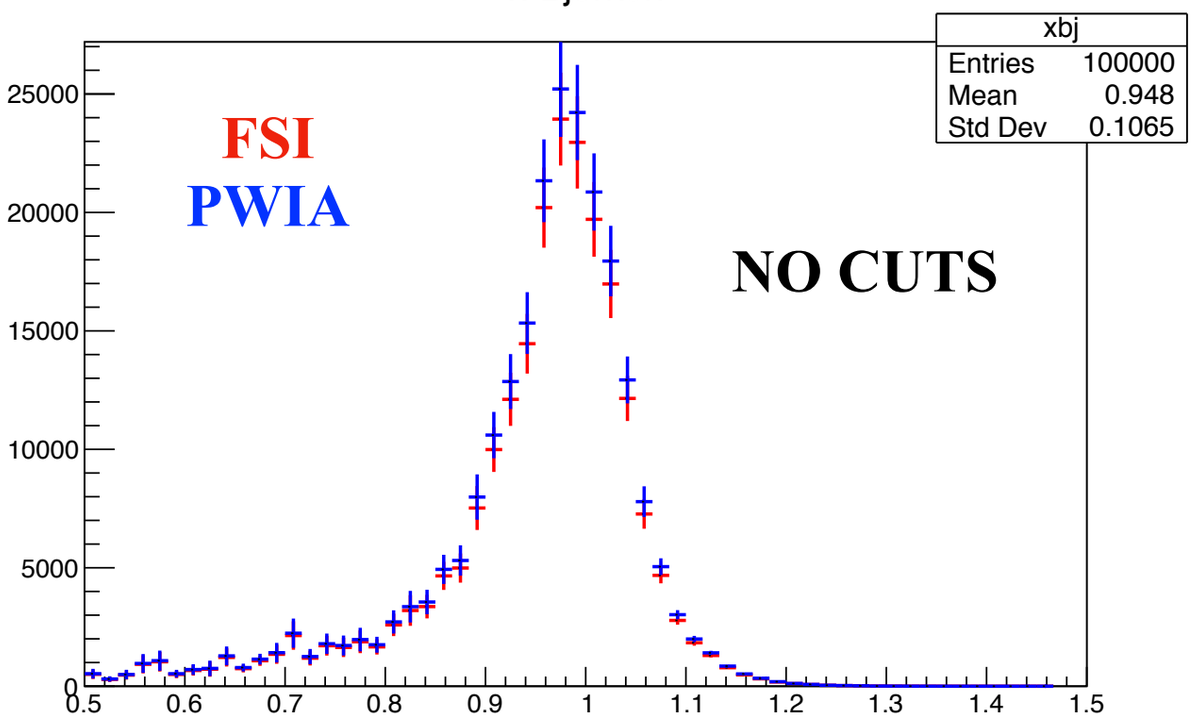

Proton Scatt. Angle
theta_prot
Entries 100000
Mean 38.76
Std Dev 0.799
FSI
PWIA
NO CUTS
Proton Angle, θ_p (deg)

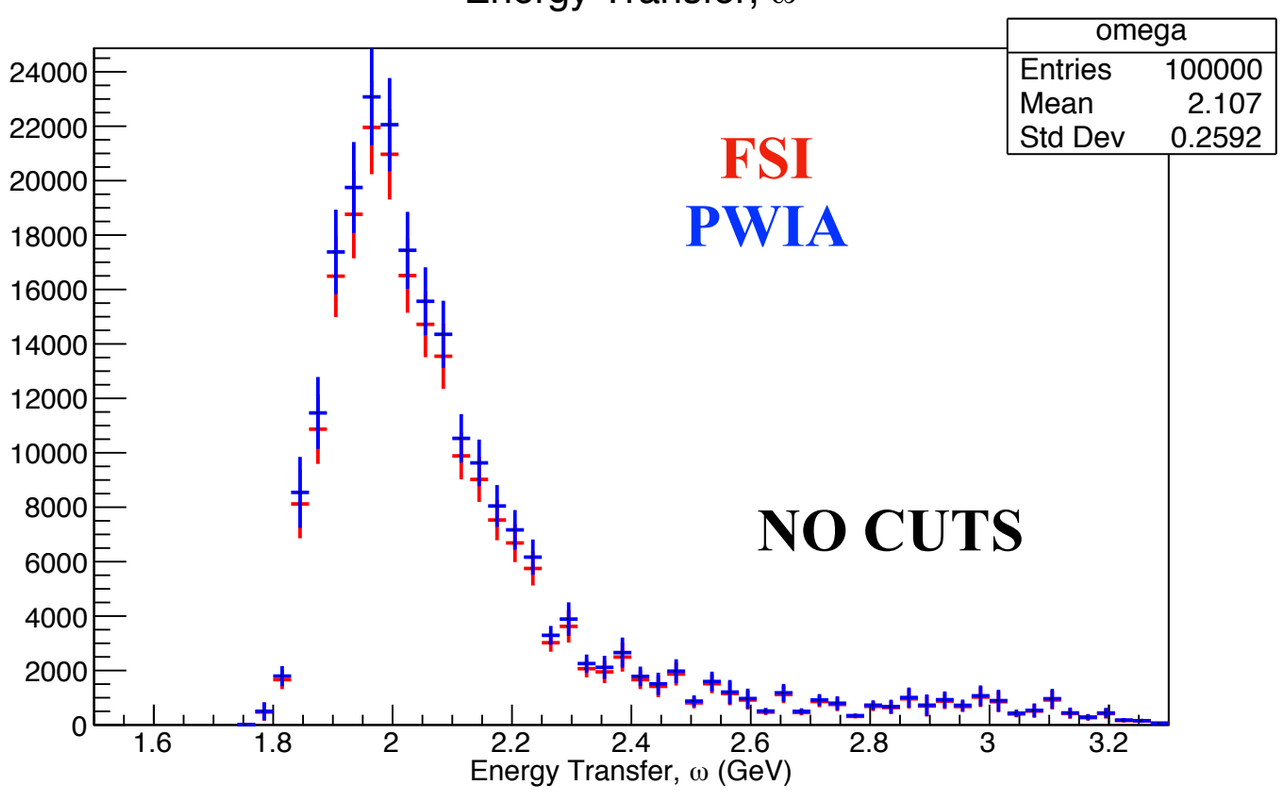

Electron Scatt. Angle
theta_elec
Entries 100000
Mean 11.63
Std Dev 0.5645
FSI
PWIA
NO CUTS
Electron Angle, θ_e (deg)


Final Proton Momentum
P_f
Entries 100000
Mean 2.853
Std Dev 0.182
FSI
PWIA
NO CUTS
Final Proton Momentum (GeV/c)

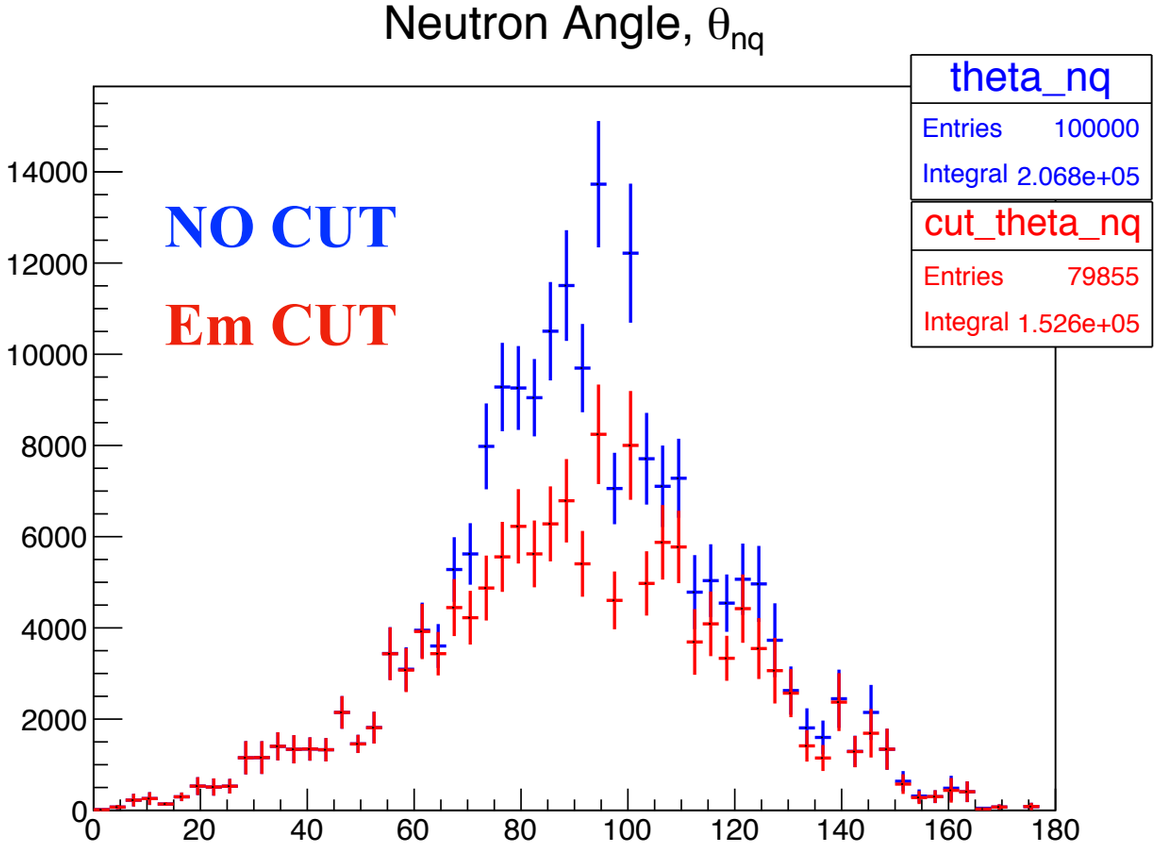

Neutron Angle, θnq
theta_nq
Entries 100000
Mean 91.49
Std Dev 26.35
FSI
PWIA
NO CUTS
θnq (deg)

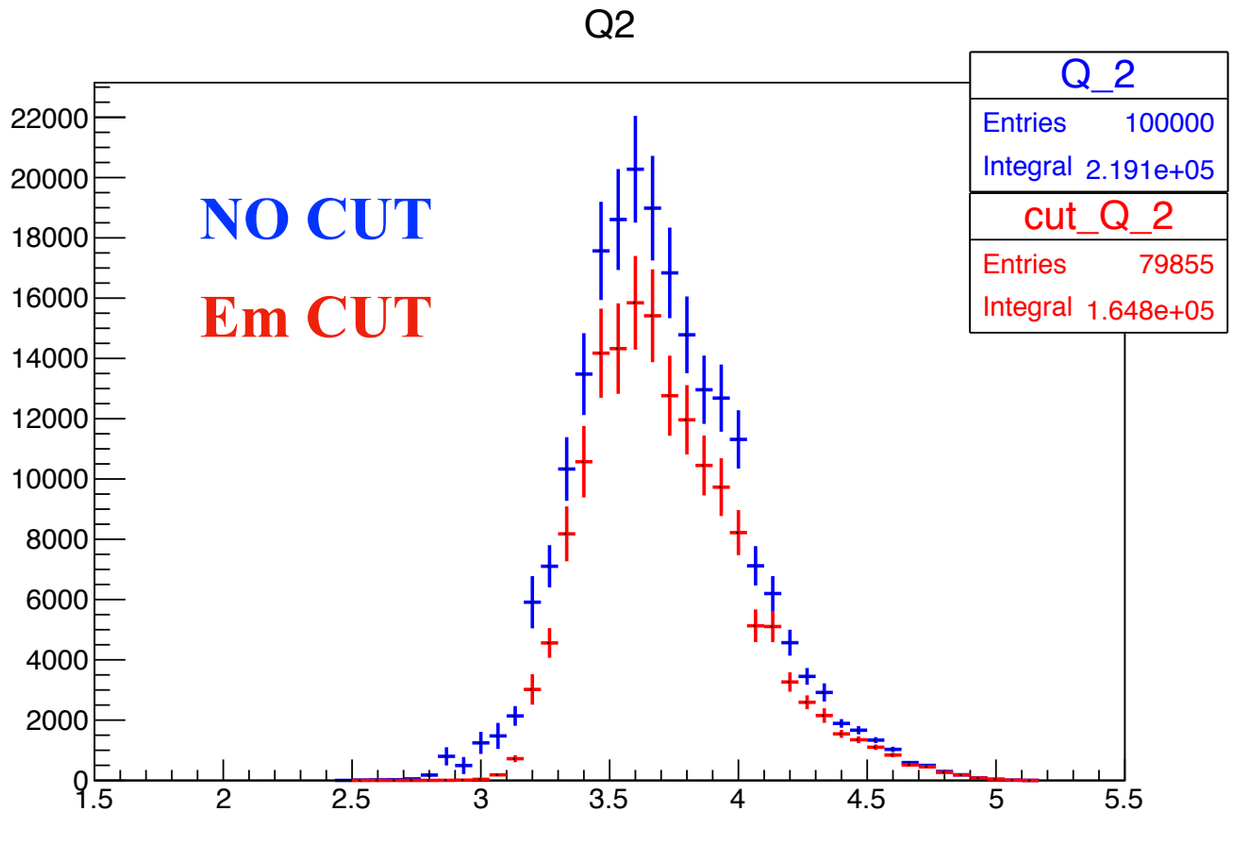

Q2
Q_2
Entries 100000
Mean 3.701
Std Dev 0.3267
FSI
PWIA
NO CUTS
Q2 (GeV2)

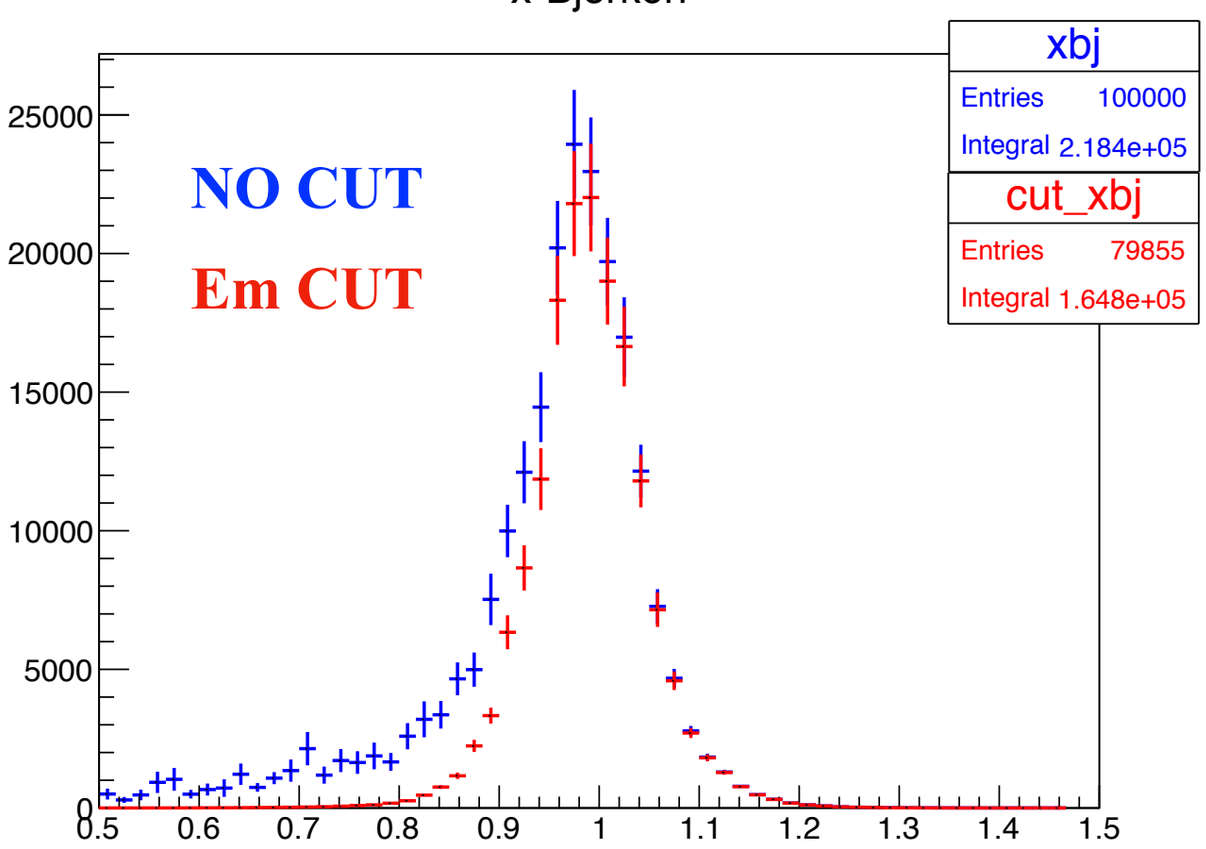

x-Bjorken
xbj
Entries 100000
Mean 0.948
Std Dev 0.1065
FSI
PWIA
NO CUTS

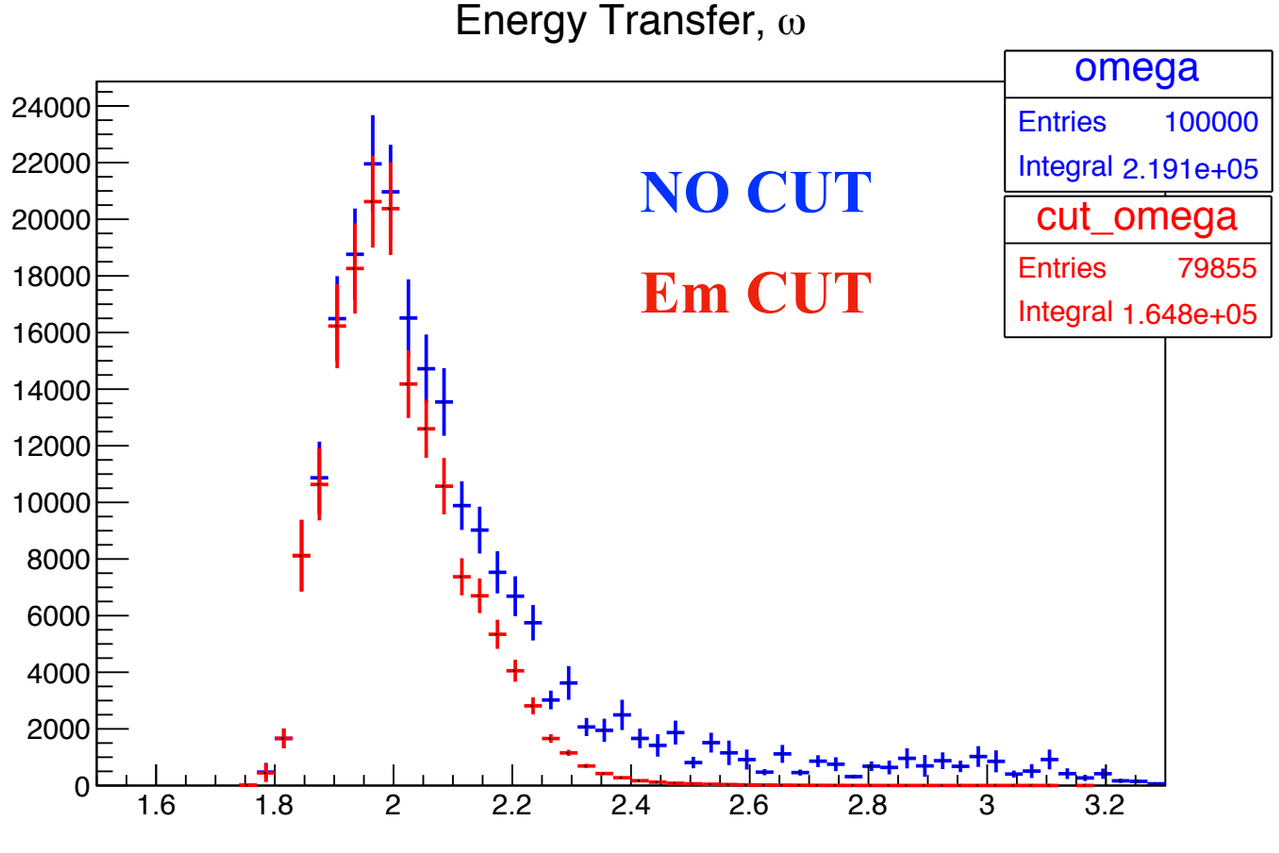

Energy Transfer, ω
omega
Entries 100000
Mean 2.107
Std Dev 0.2592
FSI
PWIA
NO CUTS
Energy Transfer, ω (GeV)

Model: FSI

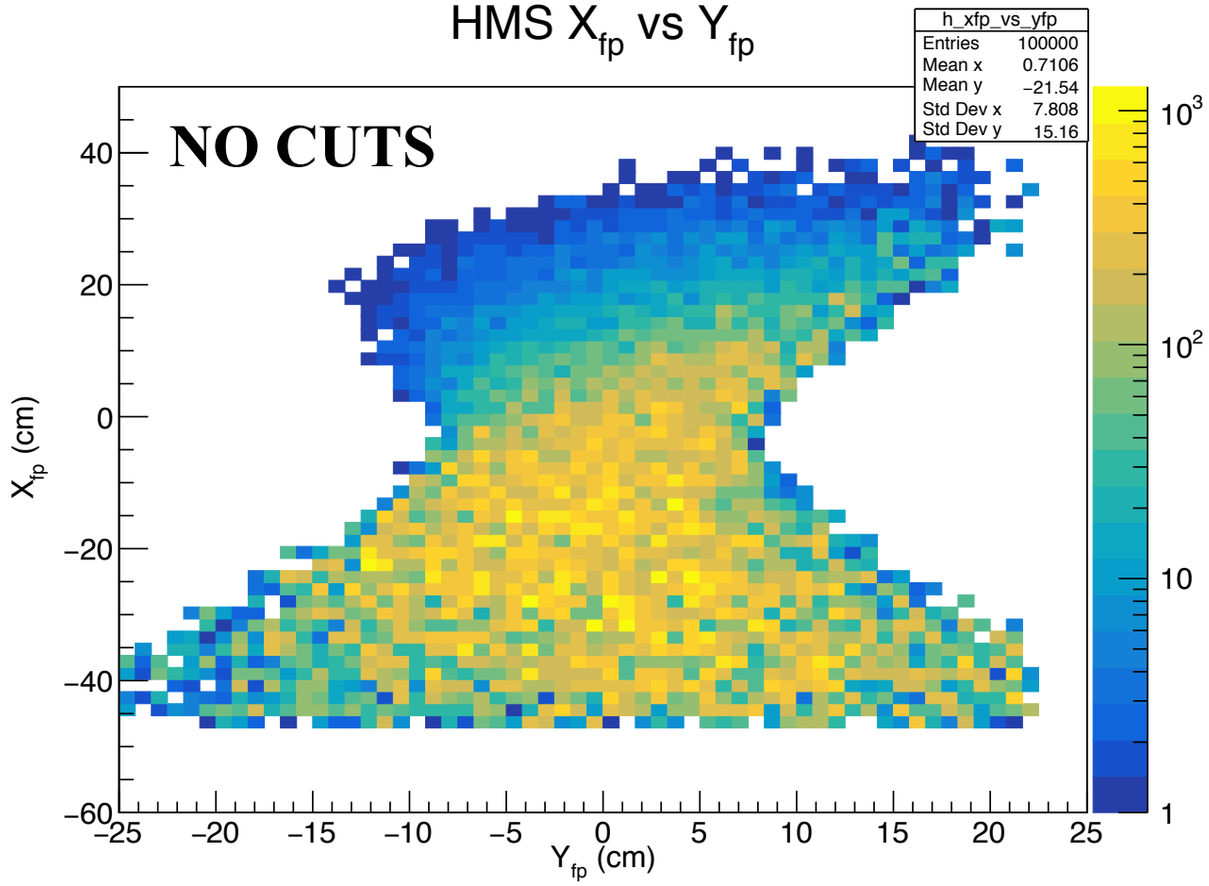

Neutron Angle, θnq
theta_nq
Entries 100000
Integral 2.068e+05
cut_theta_nq
Entries 79855
Integral 1.526e+05
NO CUT
Em CUT

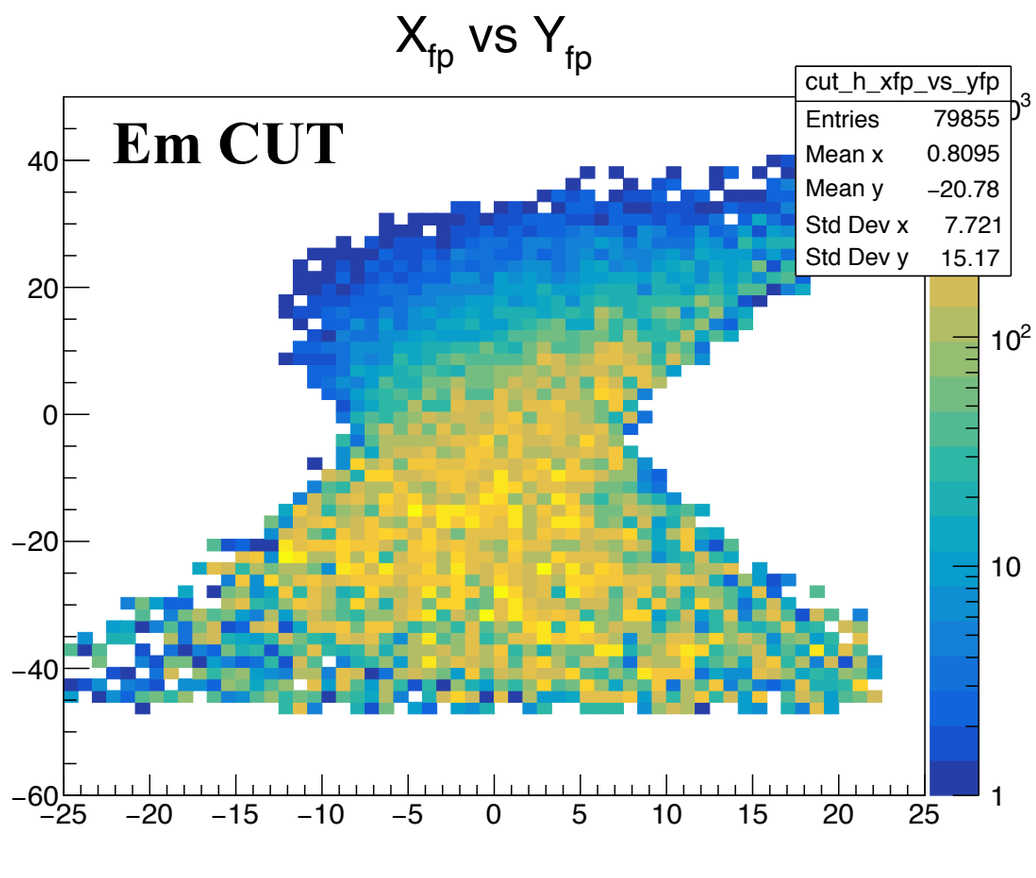

Q2
Q_2
Entries 100000
Integral 2.191e+05
cut_Q_2
Entries 79855
Integral 1.648e+05
NO CUT
Em CUT


x-Bjorken
xbj
Entries 100000
Integral 2.184e+05
cut_xbj
Entries 79855
Integral 1.648e+05
NO CUT
Em CUT

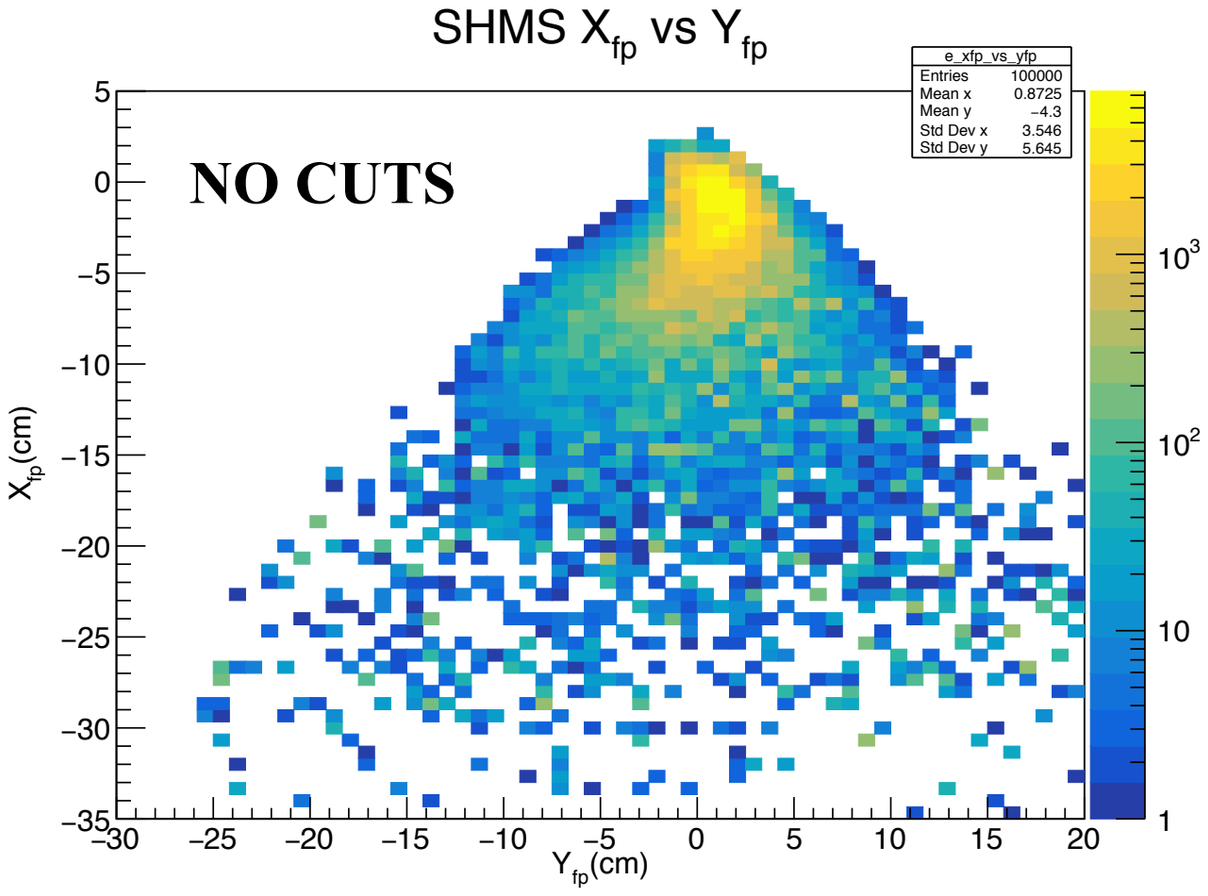

Energy Transfer, ω
omega
Entries 100000
Integral 2.191e+05
cut_omega
Entries 79855
Integral 1.648e+05
NO CUT
Em CUT

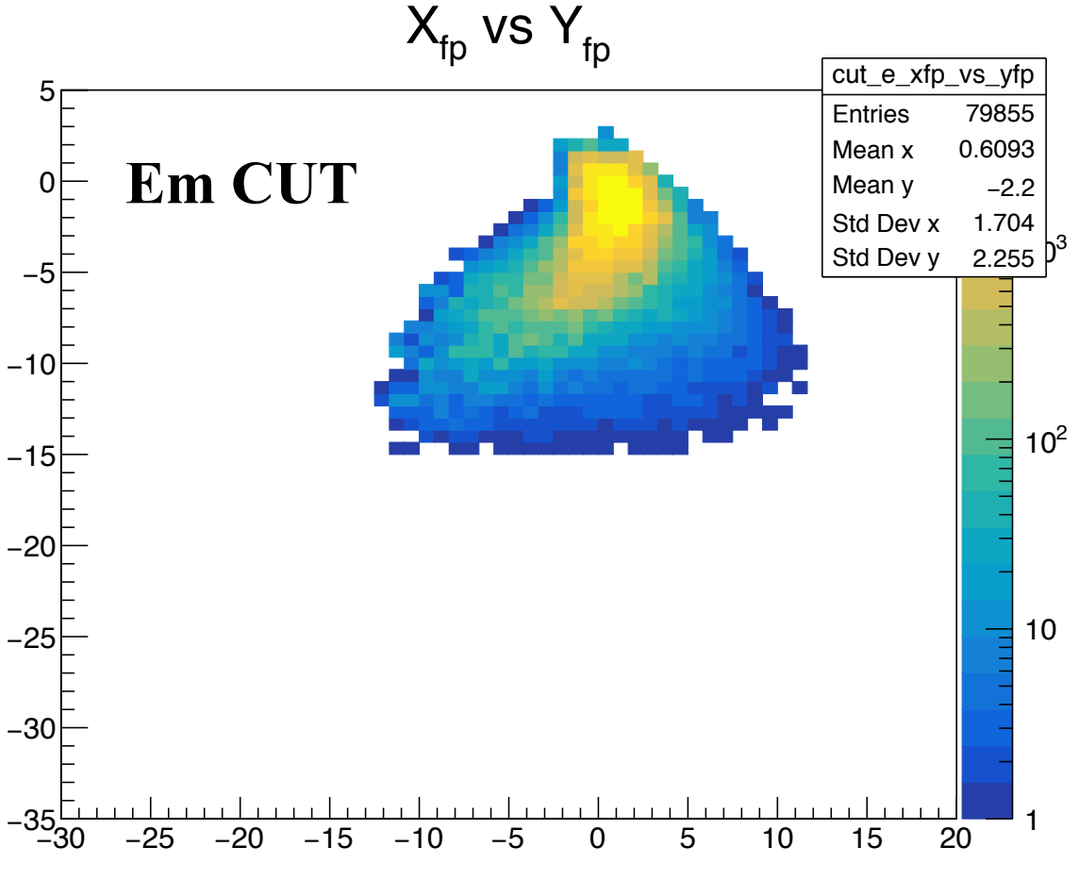
FOCAL PLANE / RECONSTRUCTED VARIABLES (SIMC)


HMS X_{fp} vs Y_{fp}
NO CUTS
h_xfp_vs_yfp
Entries 100000
Mean x 0.7106
Mean y −21.54
Std Dev x 7.808
Std Dev y 15.16
X_{fp} (cm)
Y_{fp} (cm)

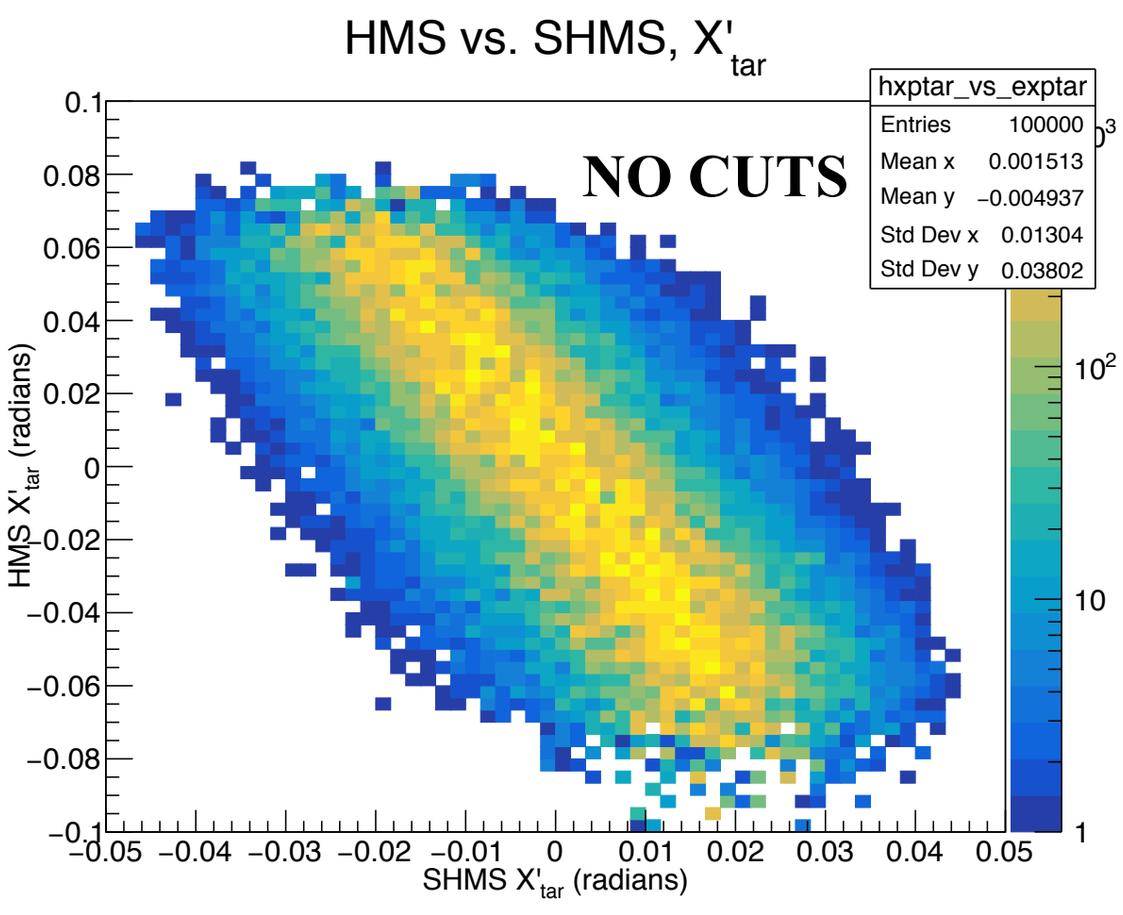

X_{fp} vs Y_{fp}
Em CUT
cut_h_xfp_vs_yfp
Entries 79855
Mean x 0.8095
Mean y −20.78
Std Dev x 7.721
Std Dev y 15.17

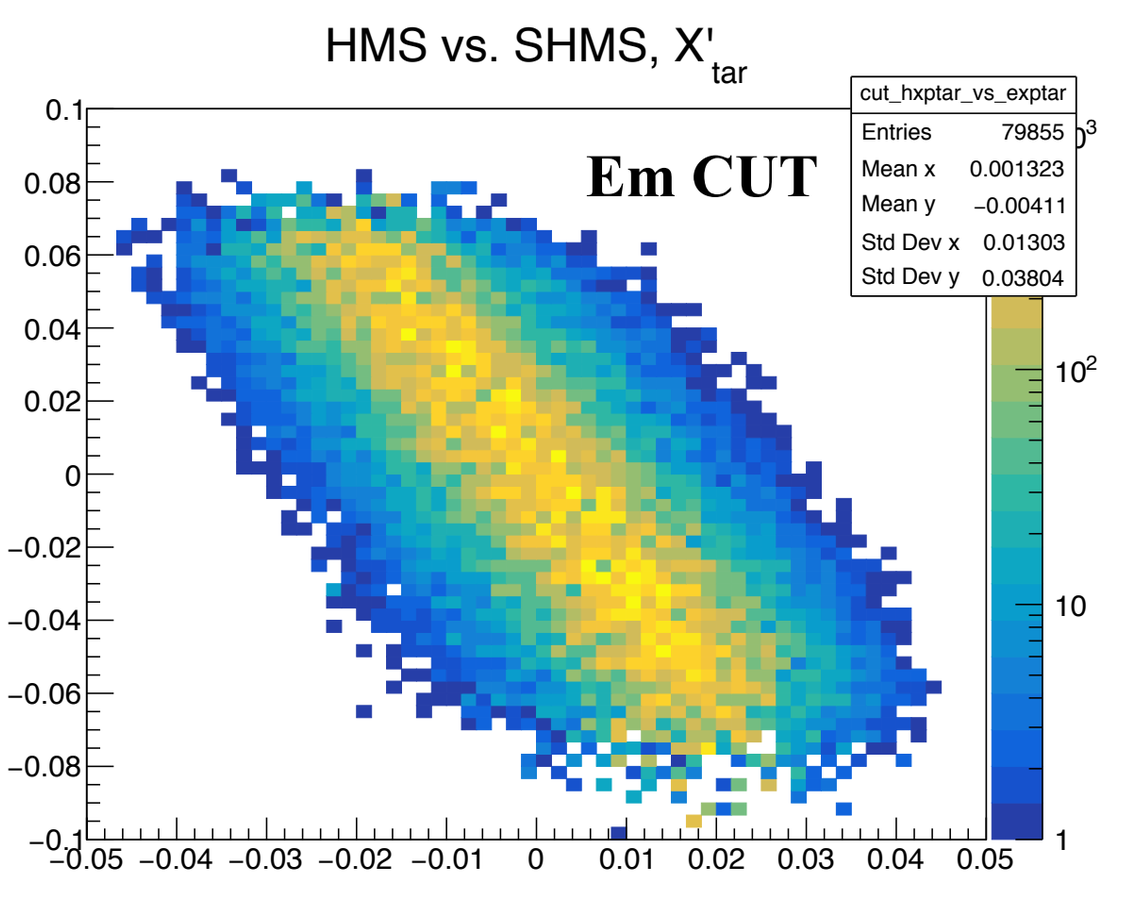
Model: FSI

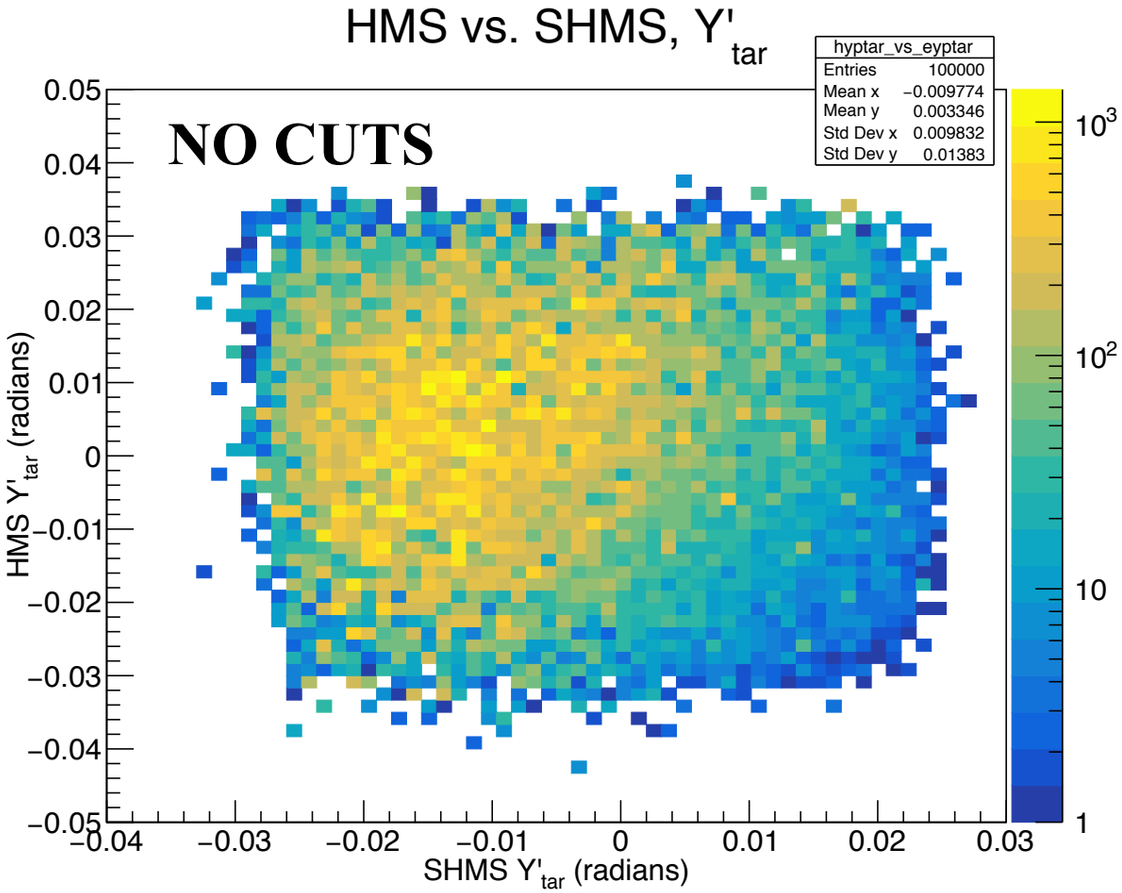

SHMS X_{fp} vs Y_{fp}
NO CUTS
e_xfp_vs_yfp
Entries 100000
Mean x 0.8725
Mean y −4.3
Std Dev x 3.546
Std Dev y 5.645
X_{fp}(cm)
Y_{fp}(cm)

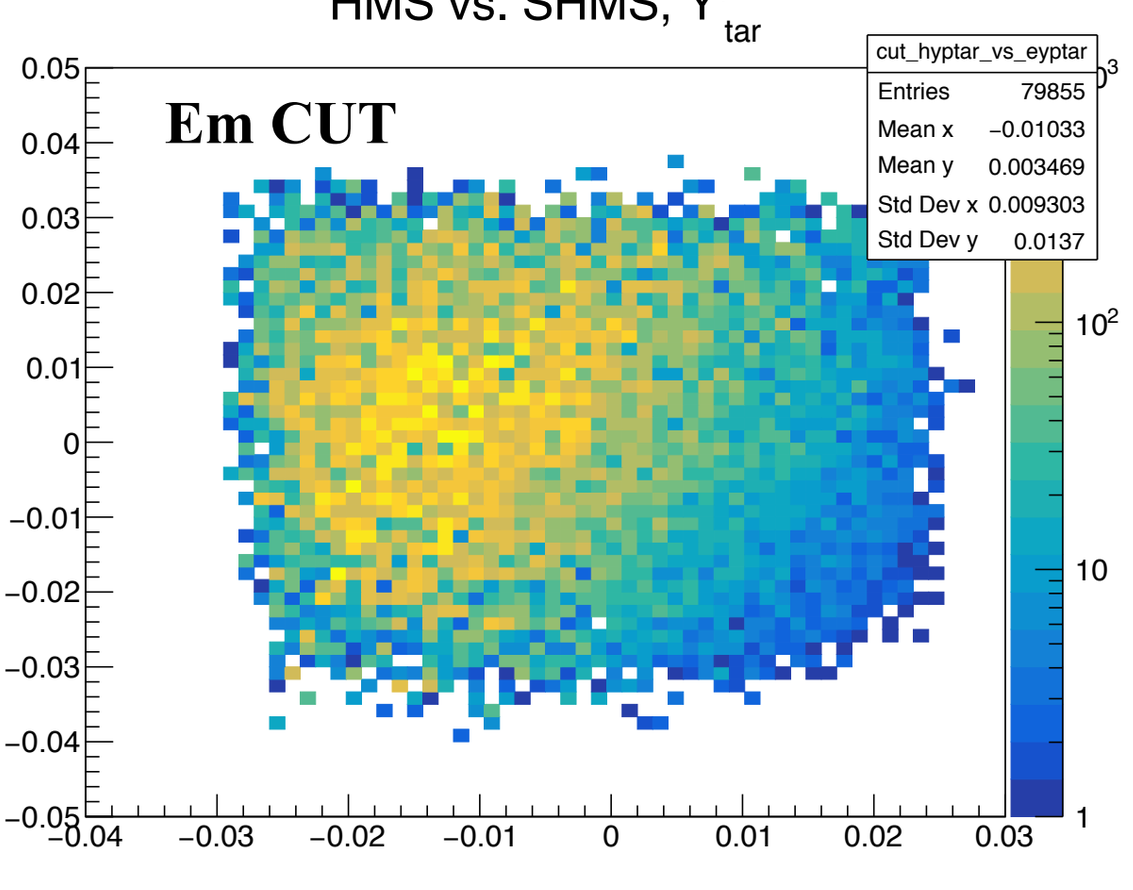

X_{fp} vs Y_{fp}
Em CUT
cut_e_xfp_vs_yfp
Entries 79855
Mean x 0.6093
Mean y −2.2
Std Dev x 1.704
Std Dev y 2.255

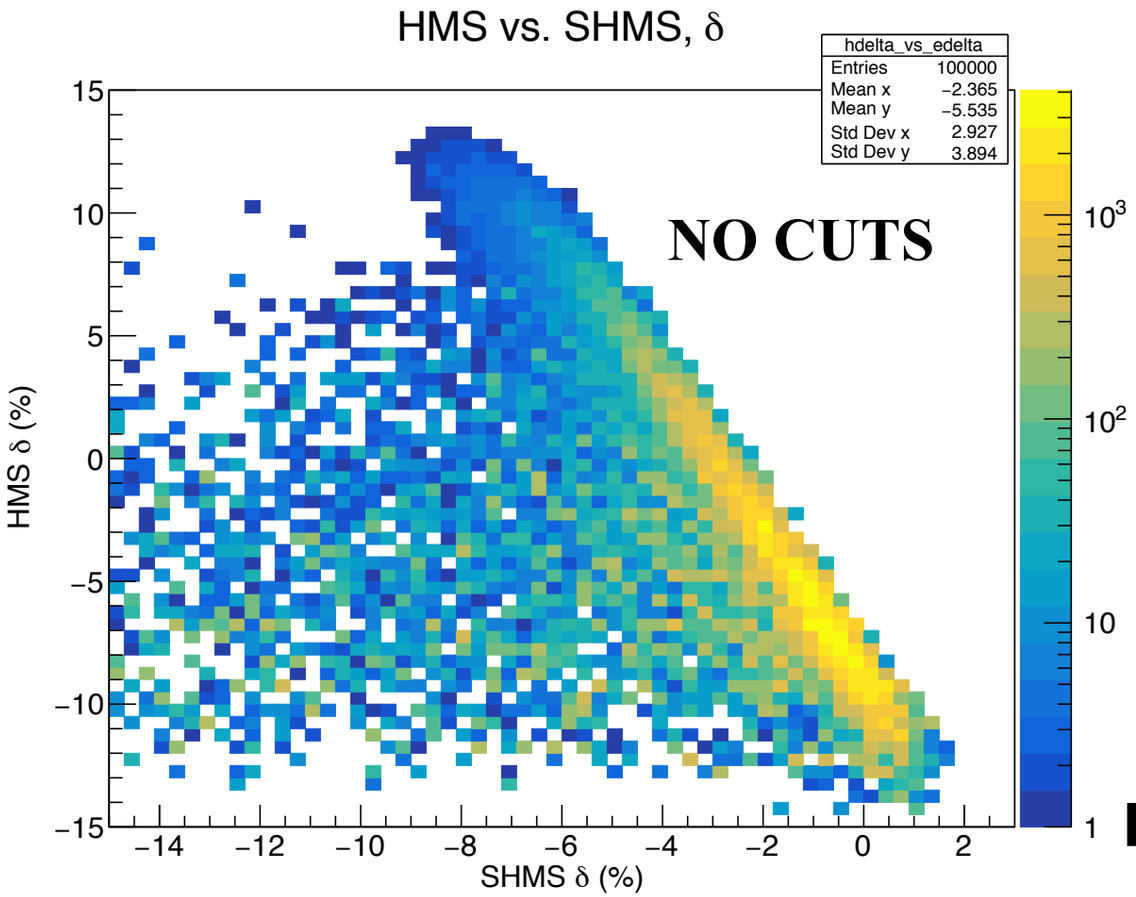
Model: FSI


HMS vs. SHMS, X'tar
NO CUTS
hxptar_vs_exptar
Entries 100000
Mean x 0.001513
Mean y −0.004937
Std Dev x 0.01304
Std Dev y 0.03802
HMS X'tar (radians)
SHMS X'tar (radians)

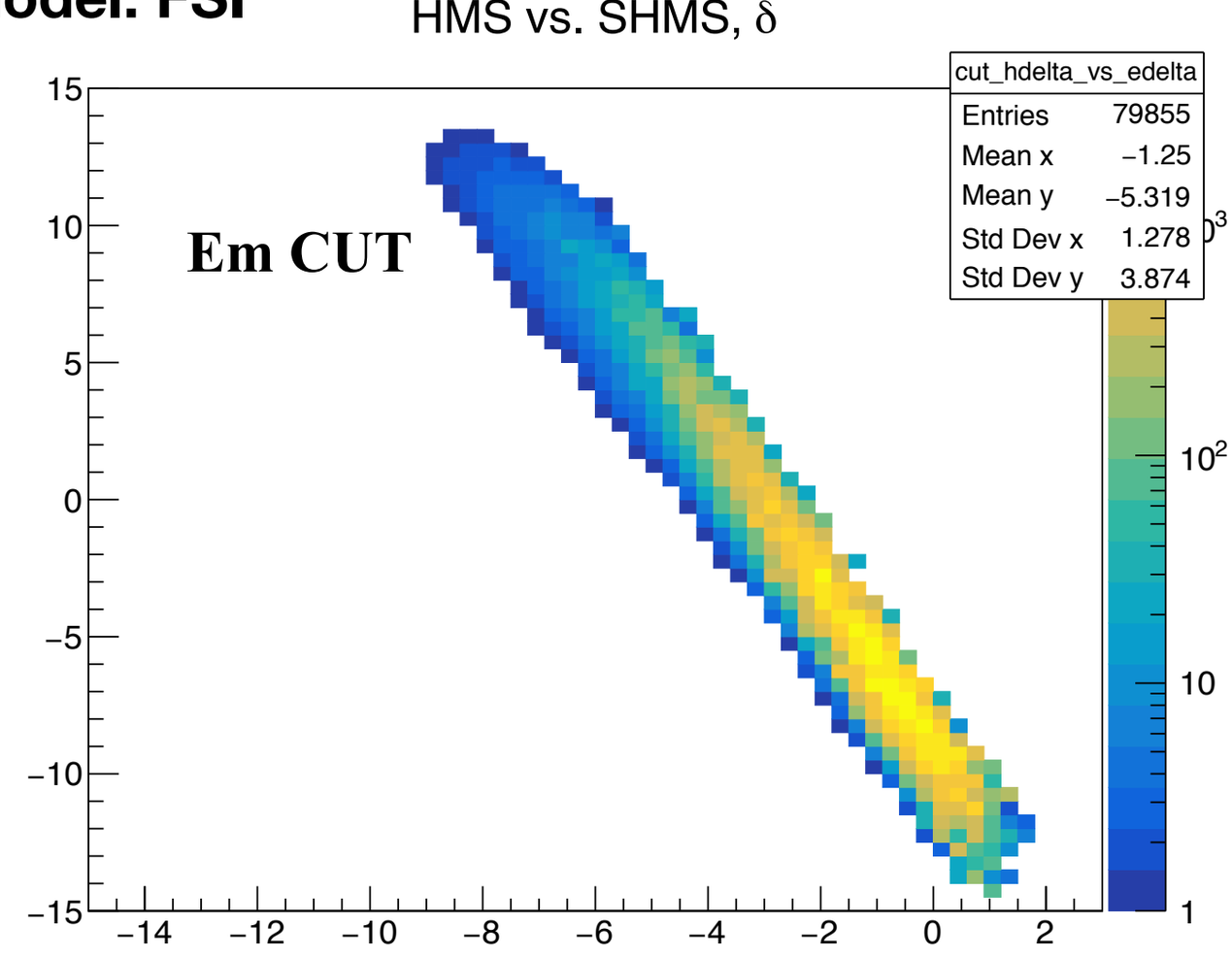

HMS vs. SHMS, X'tar
Em CUT
cut_hxptar_vs_exptar
Entries 79855
Mean x 0.001323
Mean y −0.00411
Std Dev x 0.01303
Std Dev y 0.03804


HMS vs. SHMS, Y'tar
NO CUTS
hyptar_vs_eyptar
Entries 100000
Mean x −0.009774
Mean y 0.003346
Std Dev x 0.009832
Std Dev y 0.01383
HMS Y'tar (radians)
SHMS Y'tar (radians)


HMS vs. SHMS, Y'tar
Em CUT
cut_hyptar_vs_eyptar
Entries 79855
Mean x −0.01033
Mean y 0.003469
Std Dev x 0.009303
Std Dev y 0.0137


HMS vs. SHMS, δ
hdelta_vs_edelta
Entries 100000
Mean x −2.365
Mean y −5.535
Std Dev x 2.927
Std Dev y 3.894
NO CUTS
HMS δ (%)
SHMS δ (%)
15
10
5
0
−5
−10
−15
−14
−12
−10
−8
−6
−4
−2
0
2
10^3
10^2
10
1

Model: FSI


HMS vs. SHMS, δ
cut_hdelta_vs_edelta
Entries 79855
Mean x −1.25
Mean y −5.319
Std Dev x 1.278
Std Dev y 3.874
Em CUT
15
10
5
0
−5
−10
−15
−14
−12
−10
−8
−6
−4
−2
0
2
10^2
10
1

D(e,e'p)n: Pmiss = 580 MeV

Beam Time: 20 hrs

SHMS (electron Arm):
Angle: 12.169 deg
Momentum: -8.7 GeV/c

HMS (proton Arm):
Angle: 54.9613 deg
Momentum: 2.2622 GeV/c

Q2 = 4.25 GeV2
|q| = 2.6579 GeV
omega (w) = 1.677 GeV
x = 1.35
theta_nq = 42.22 deg

D(e,e'p)n: Pmiss = 750 MeV

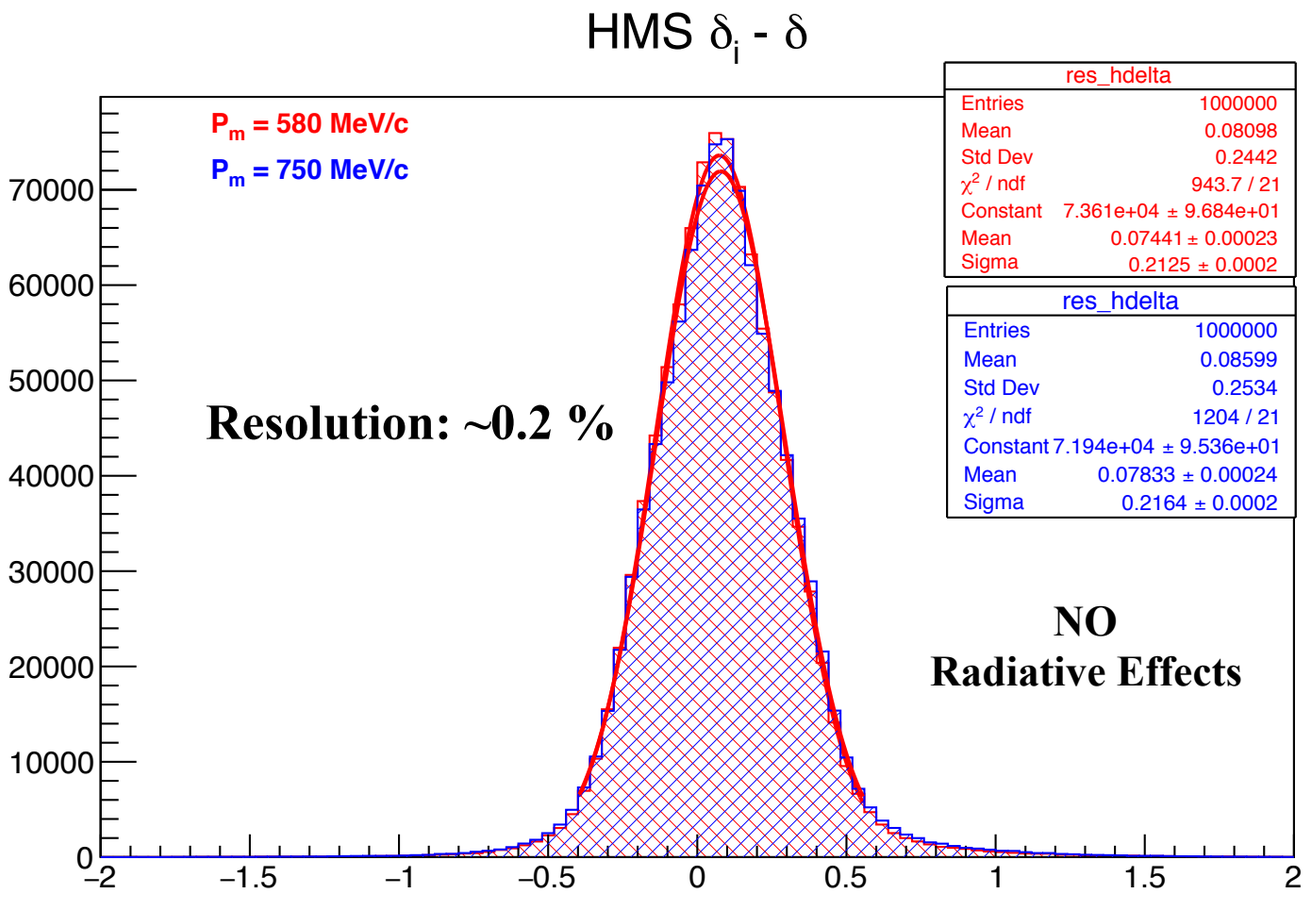
Beam Time: 42 hrs

SHMS (electron Arm):
Angle: 12.169 deg
Momentum: -8.7 GeV/c

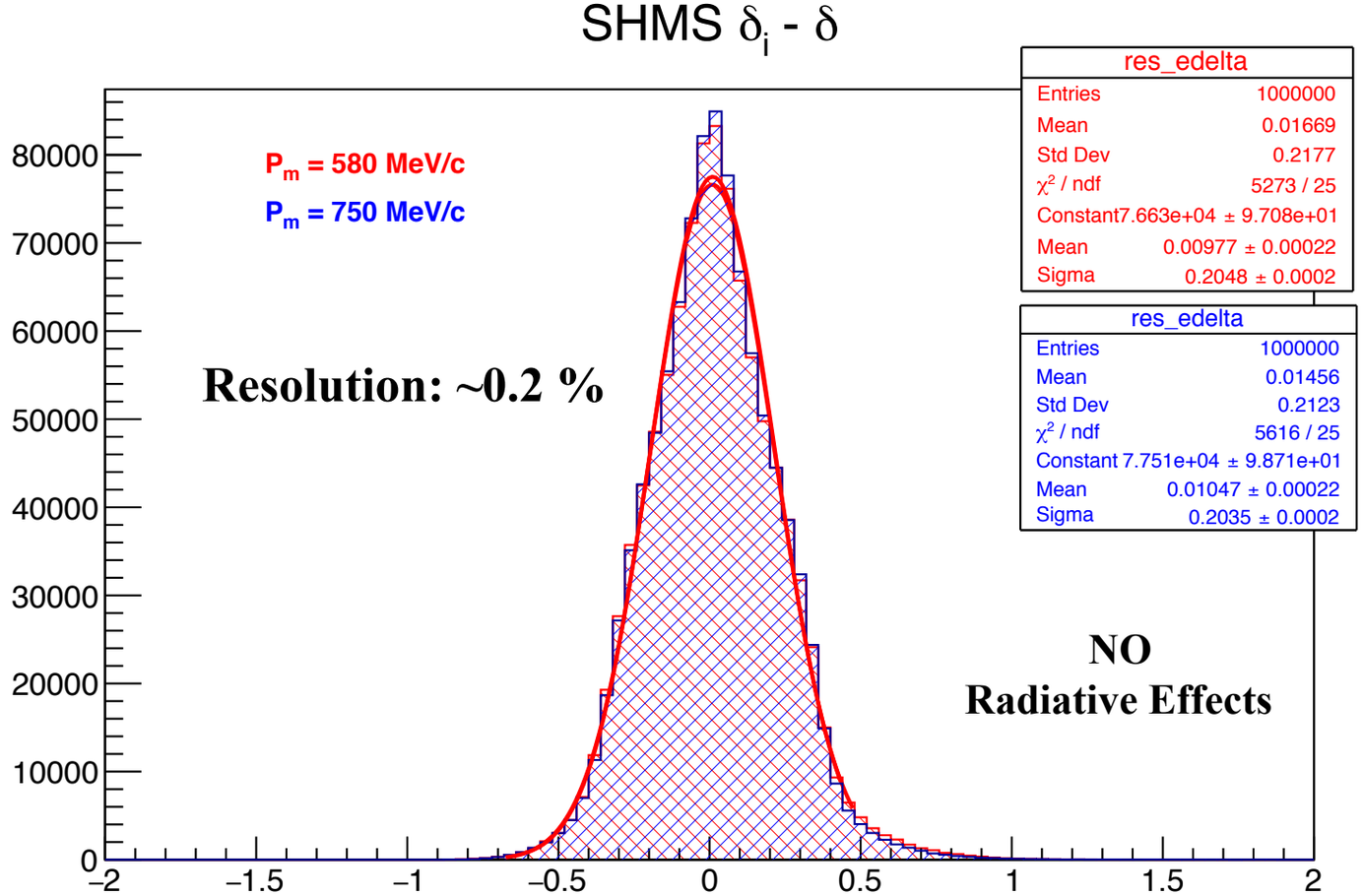
HMS (proton Arm):
Angle: 58.404 deg
Momentum: 2.1557 GeV/c

Q2 = 4.25 GeV2
|q| = 2.6579 GeV
omega (w) = 1.677 GeV
x = 1.35
theta_nq = 41.6318 deg

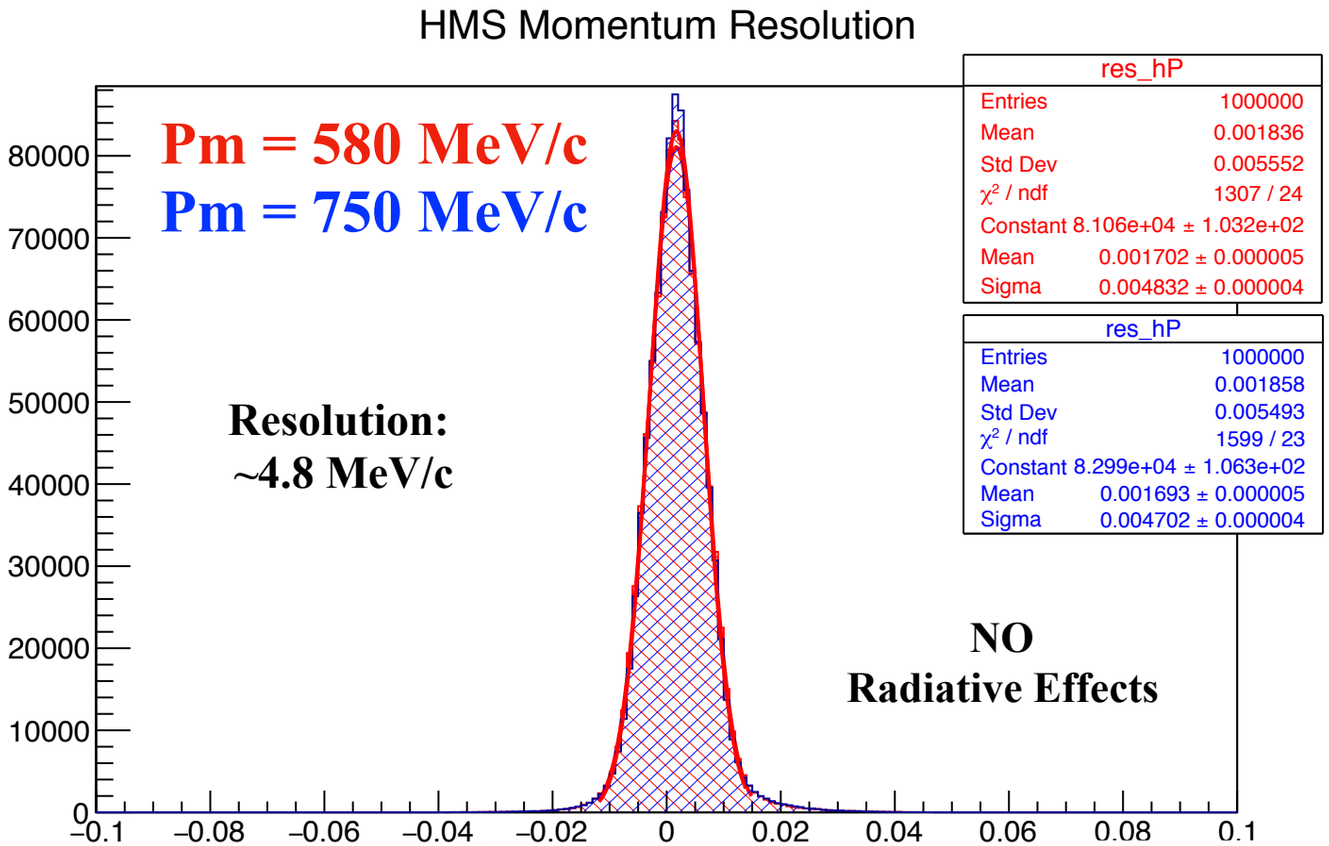
HMS Delta Resolution

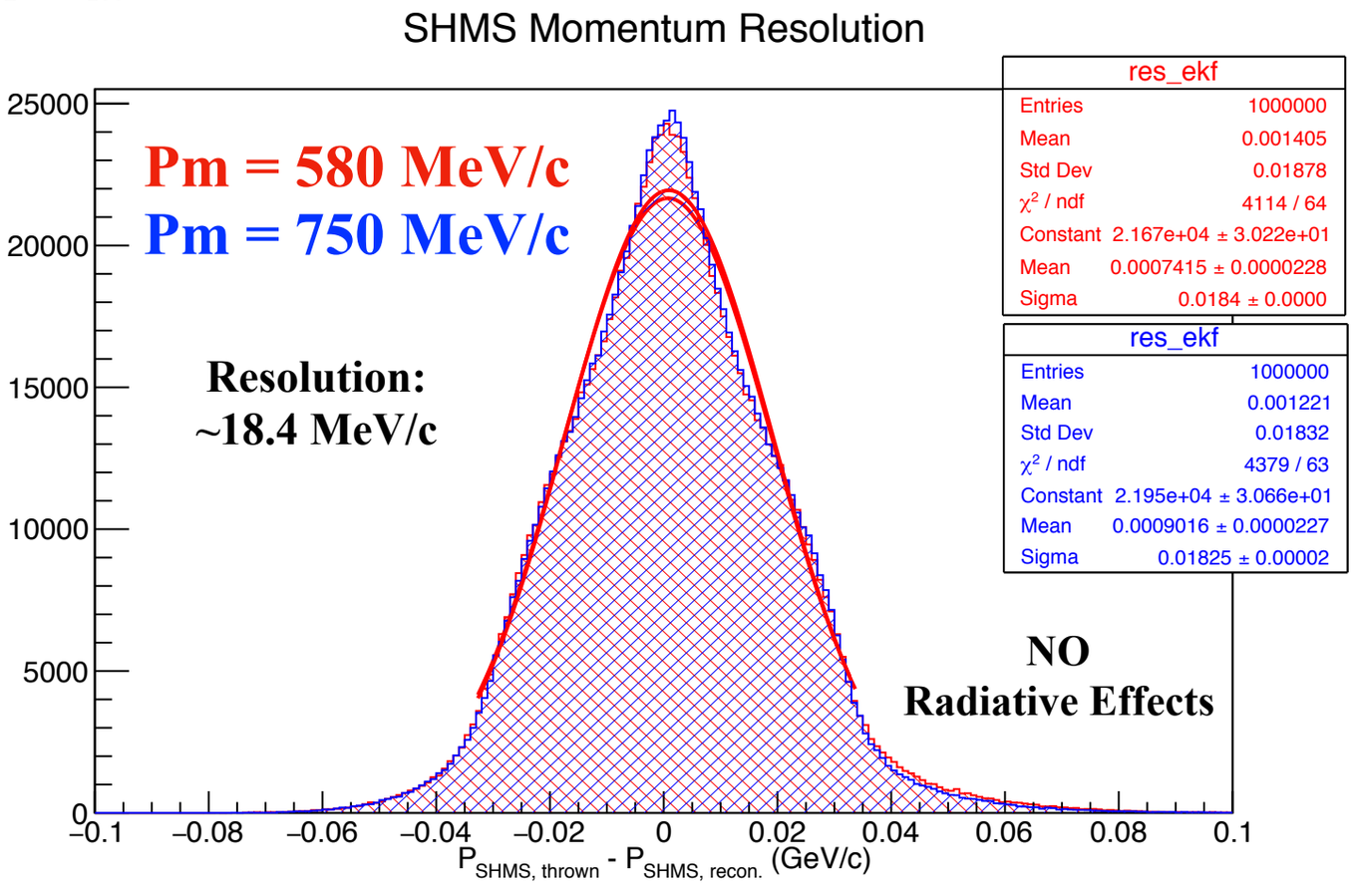


SHMS Delta Resolution

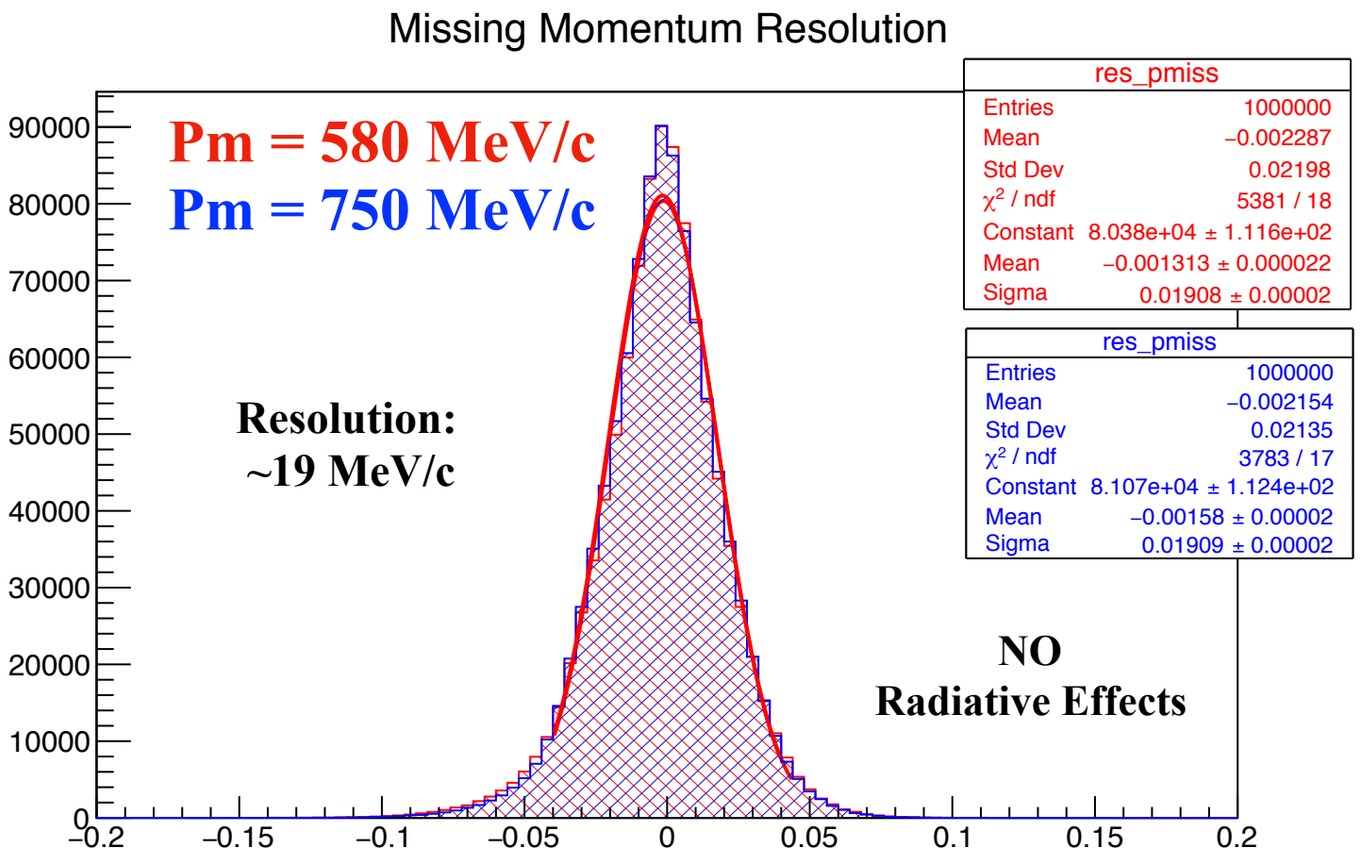


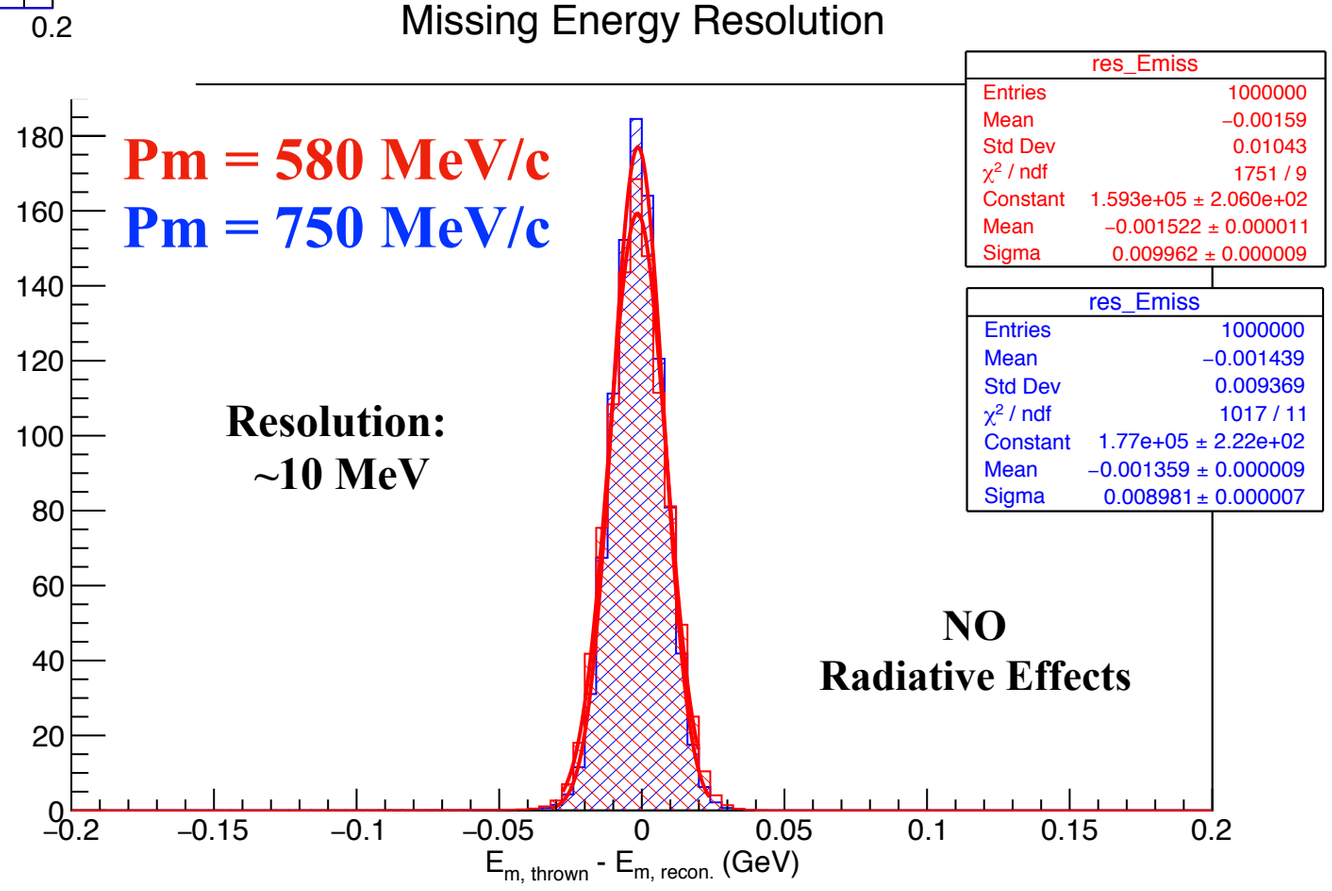
Spectrometer Momentum Resolution





Missing Momentum/Energy Resolution



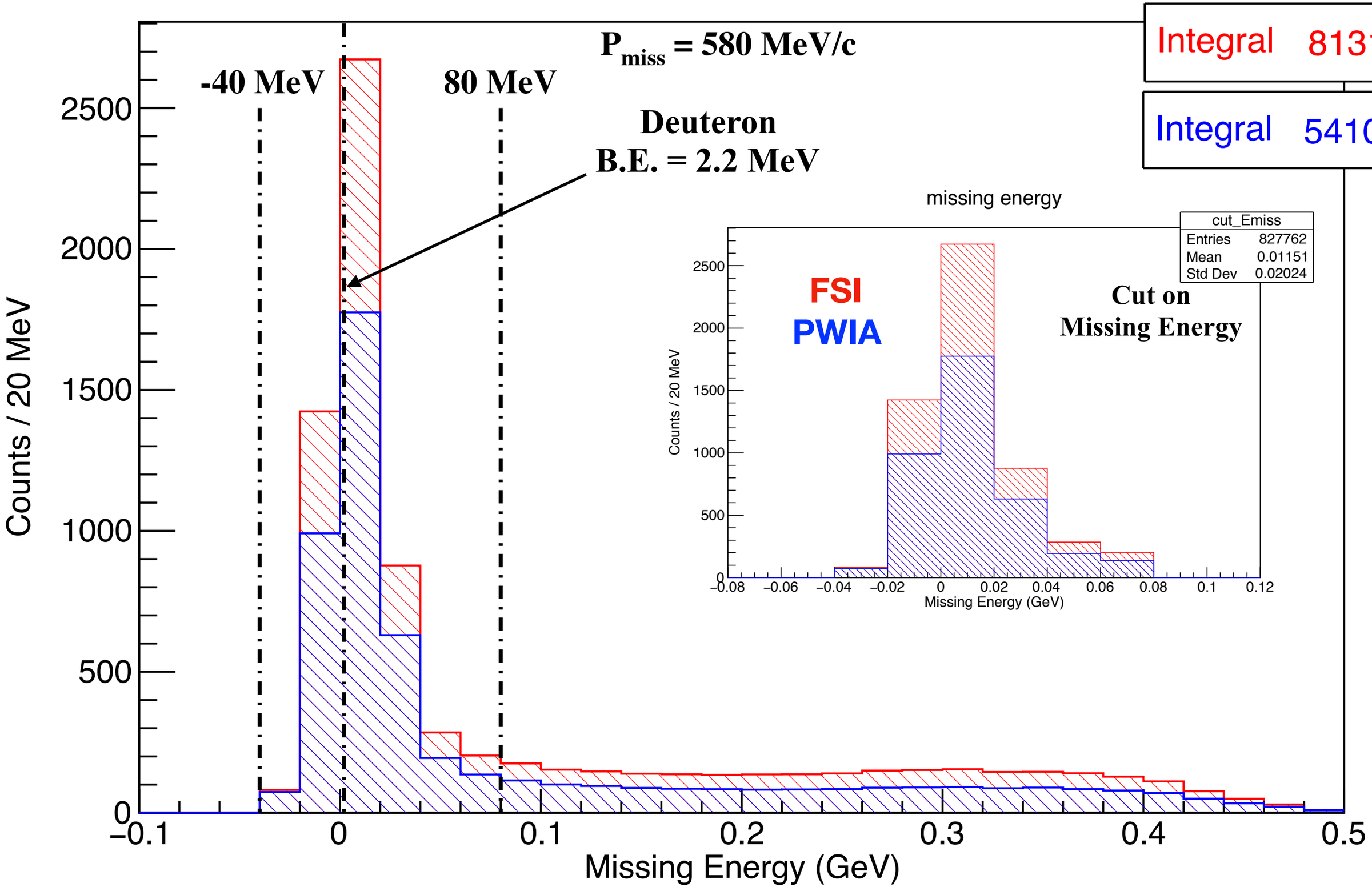


Missing Momentum Setting

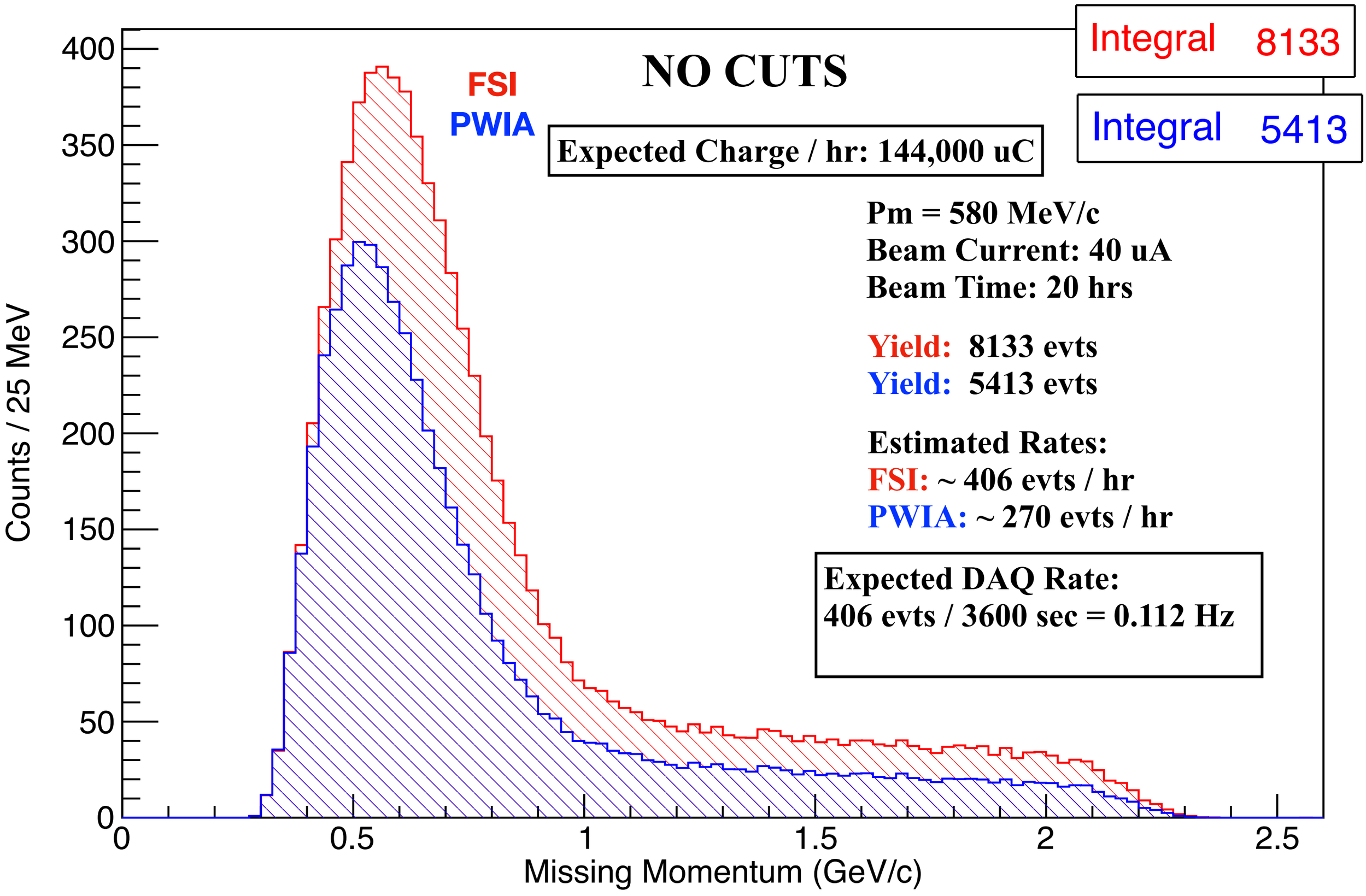
Pm = 580 MeV

SIMC ANALYSIS

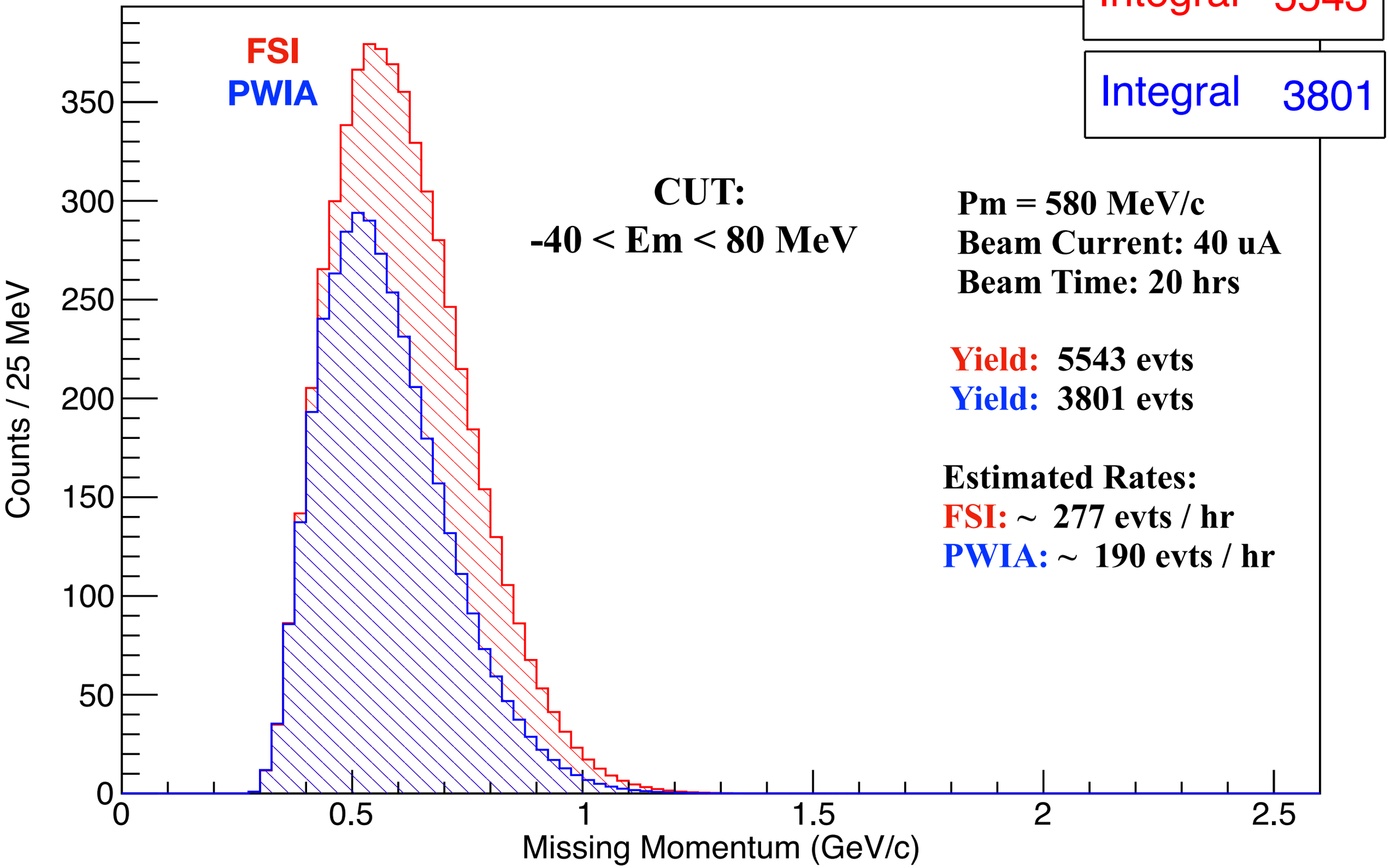
missing energy



missing momentum



missing momentum



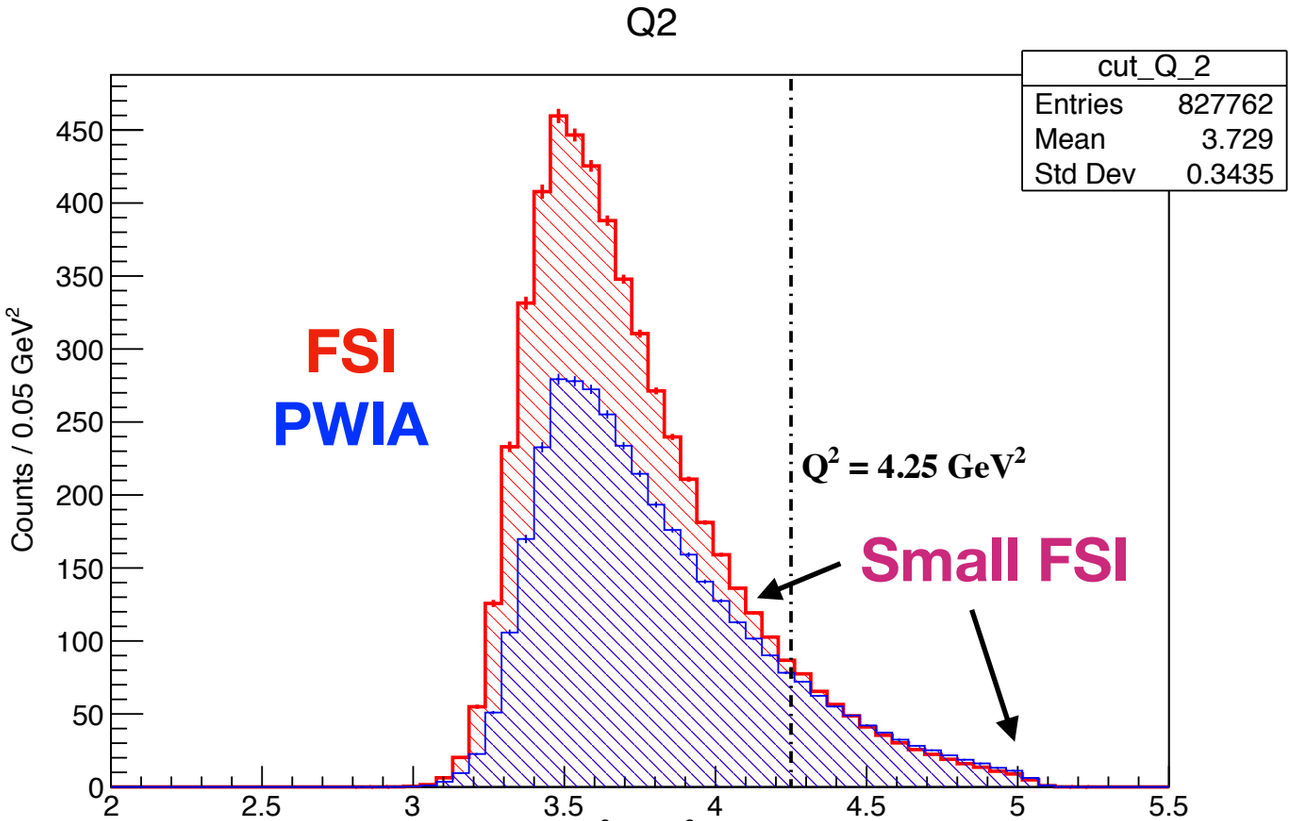
Pm = 580 MeV/c

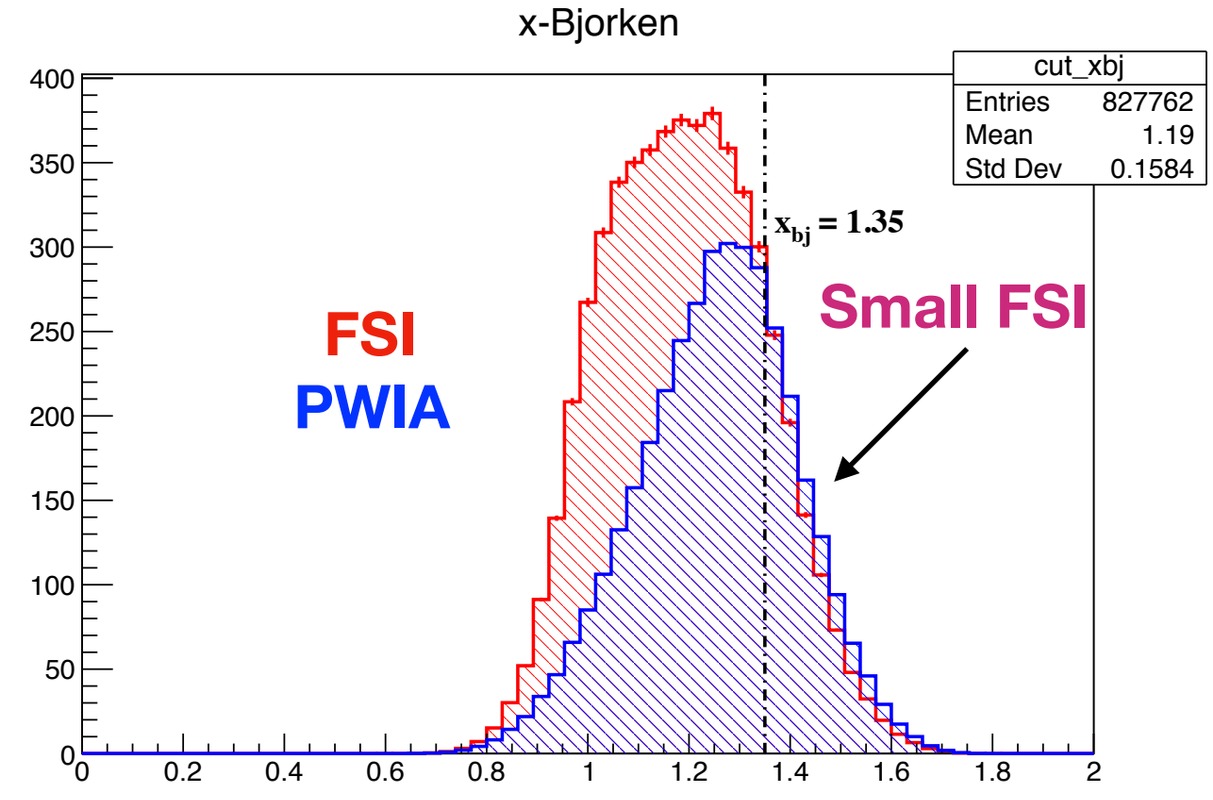
KINEMATICS

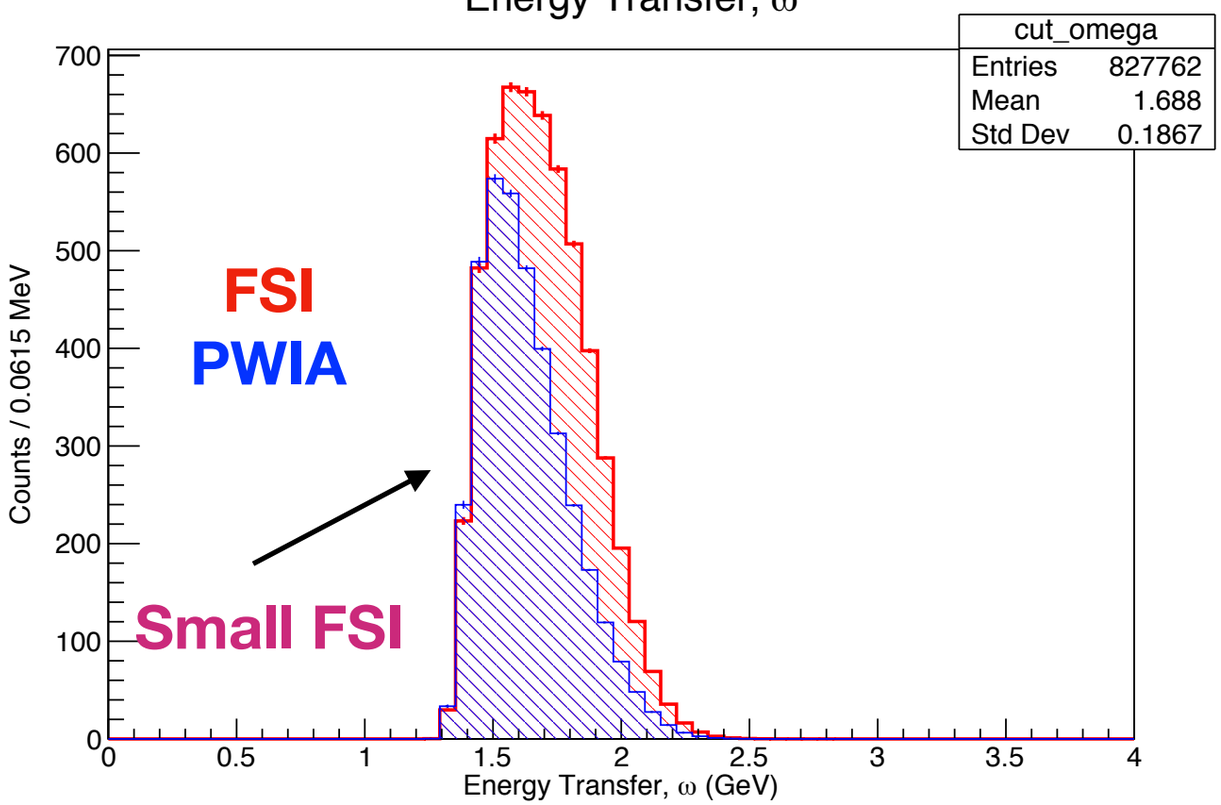
COMPARISONS

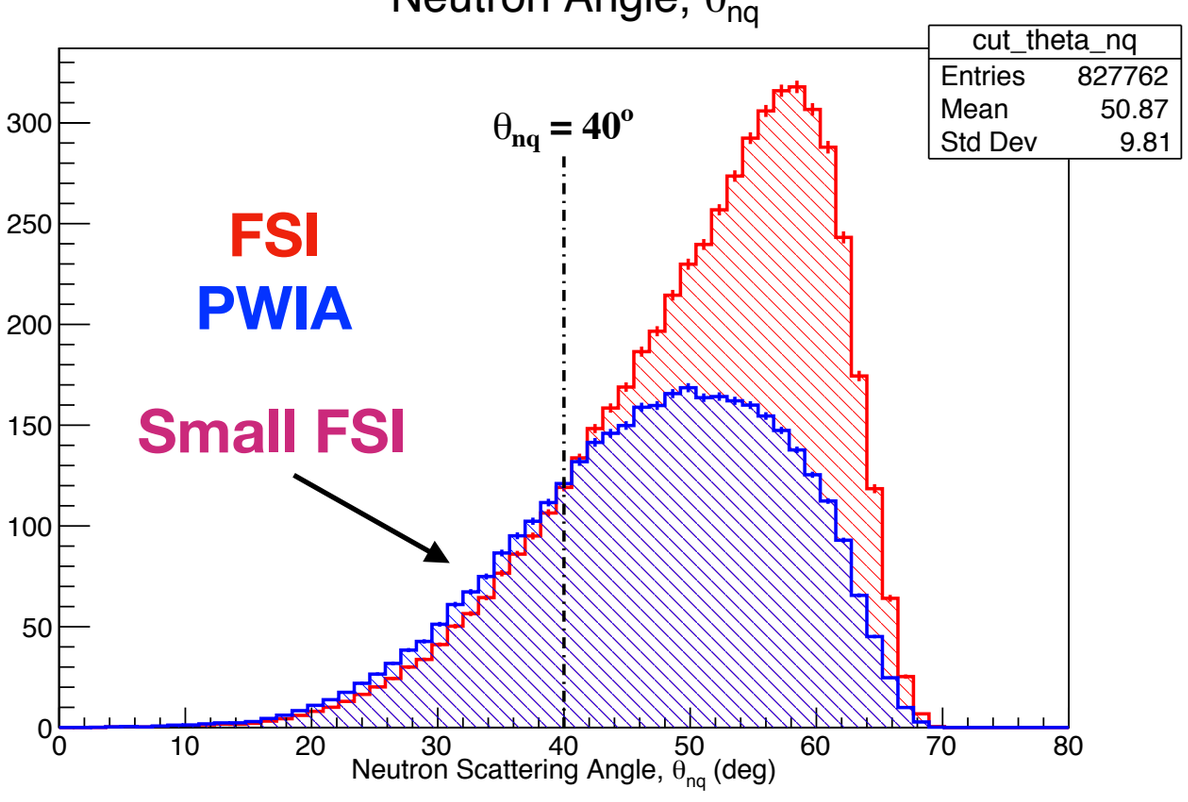
(SIMC)

Missing Momentum = 580 MeV/c
CUT: -40 < Em < 80 MeV







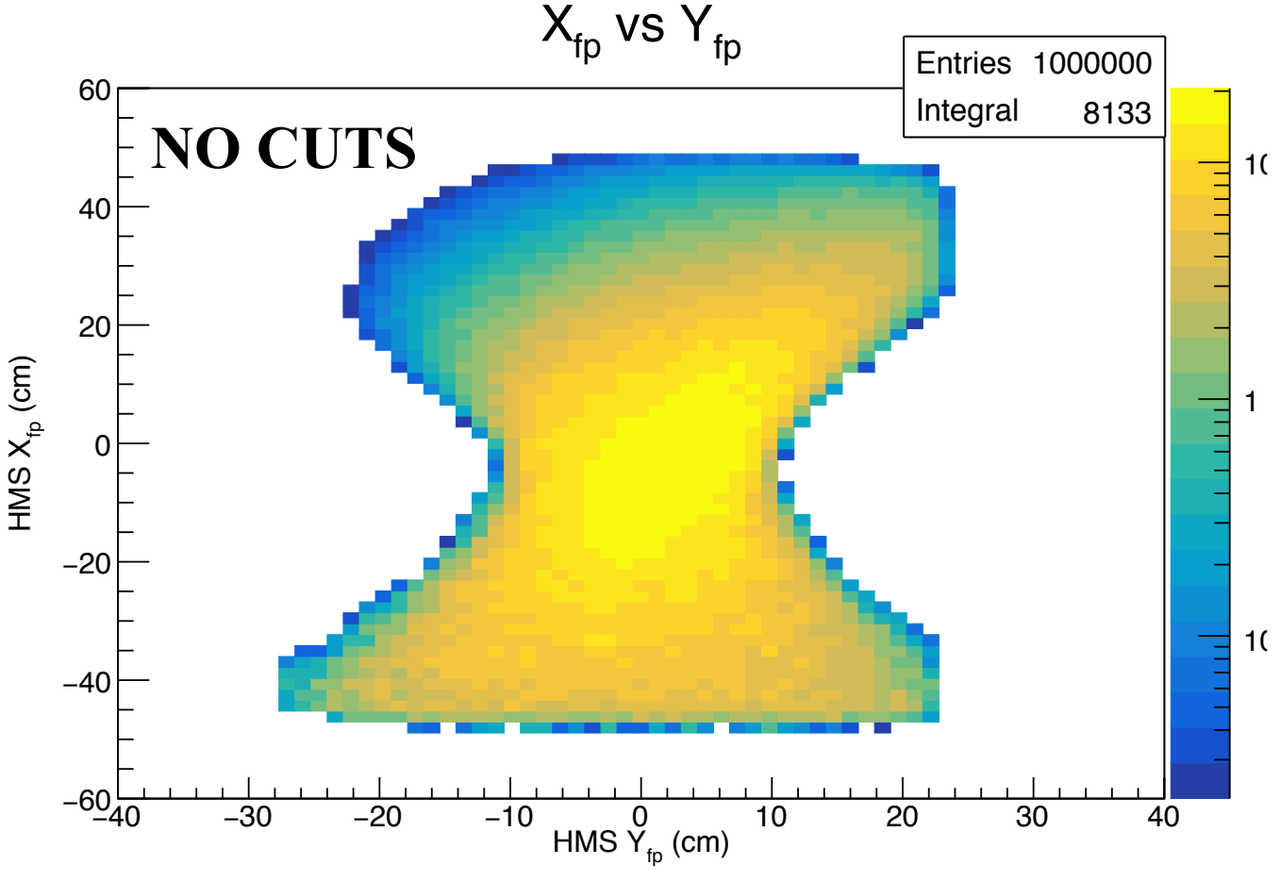


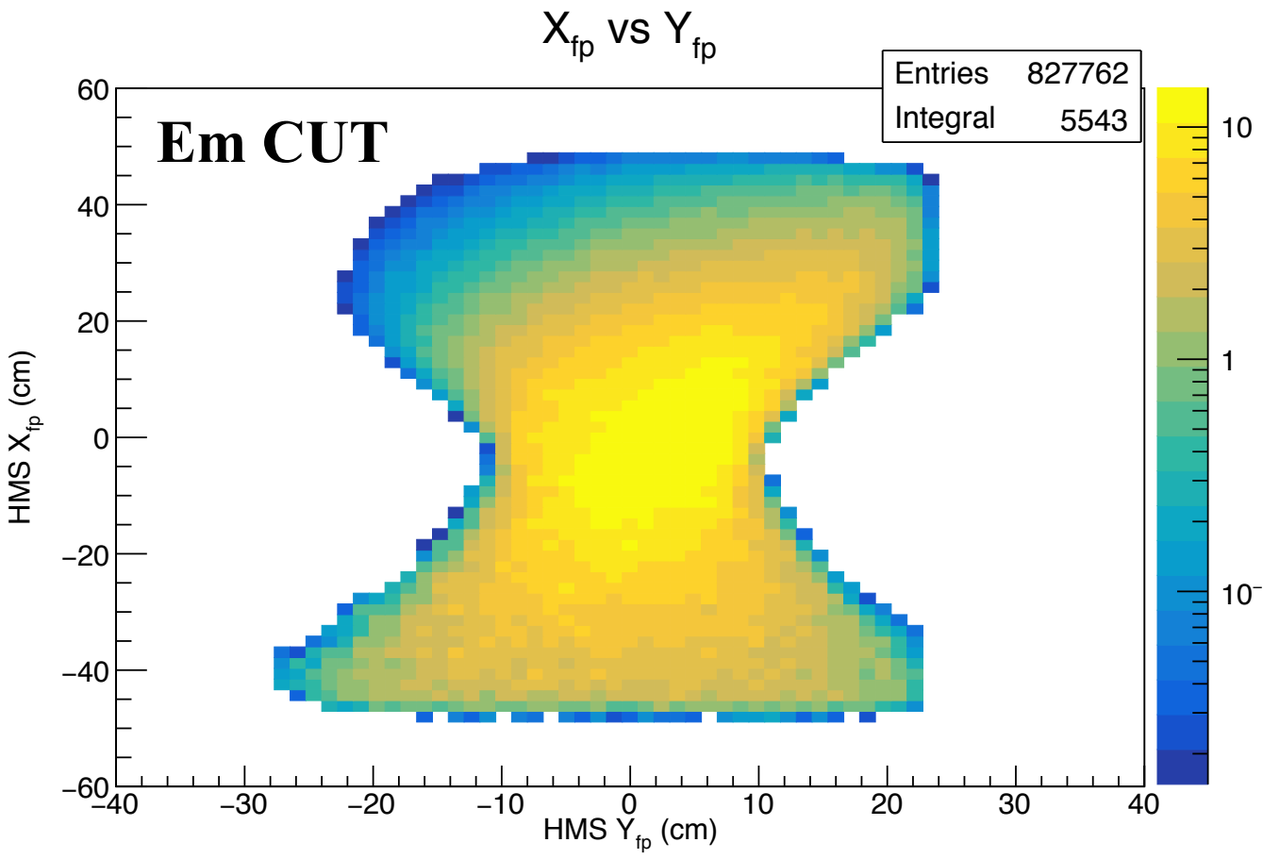
Pm = 580 MeV/c

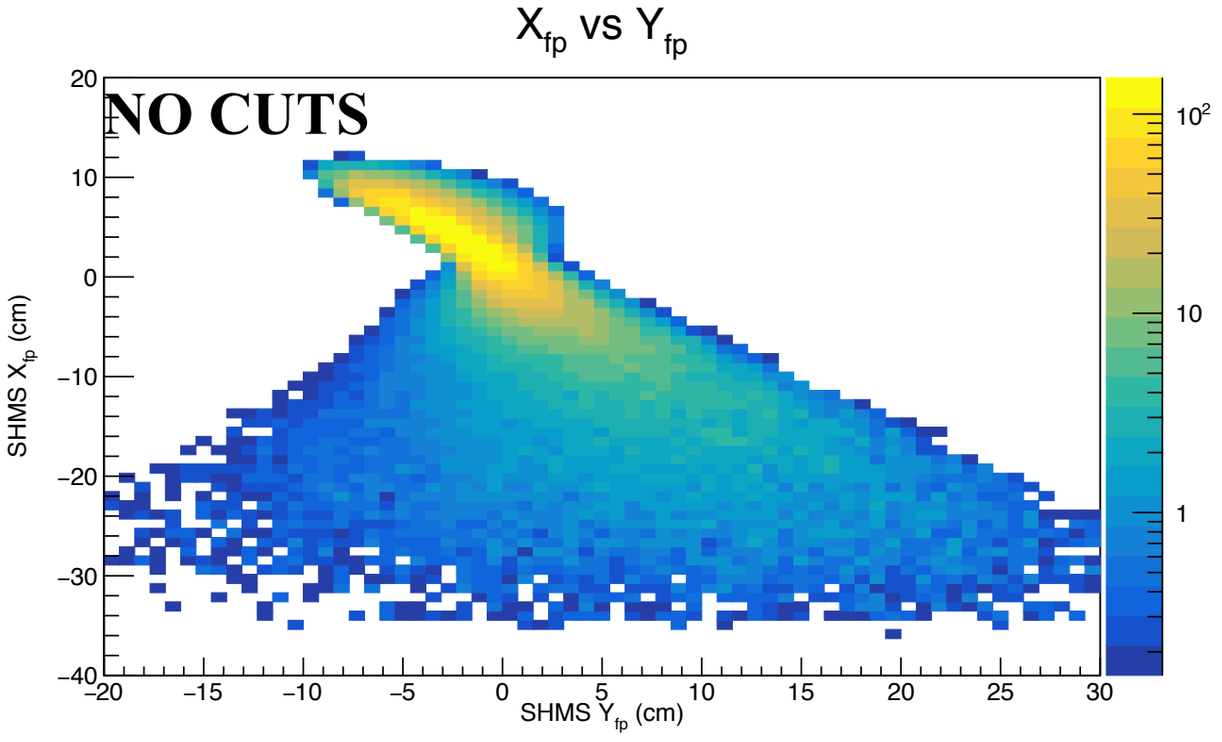
FOCAL PLANE / RECONSTRUCTED

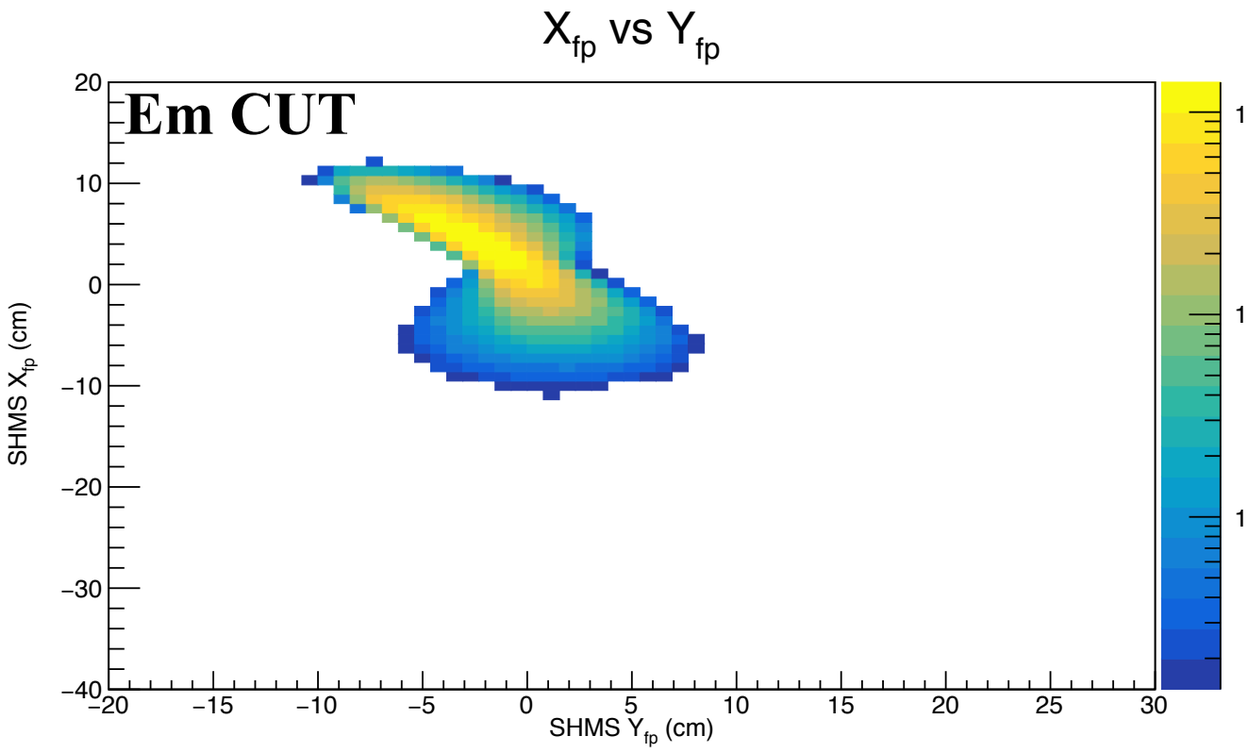
Variables (SIMC)

Model: FSI

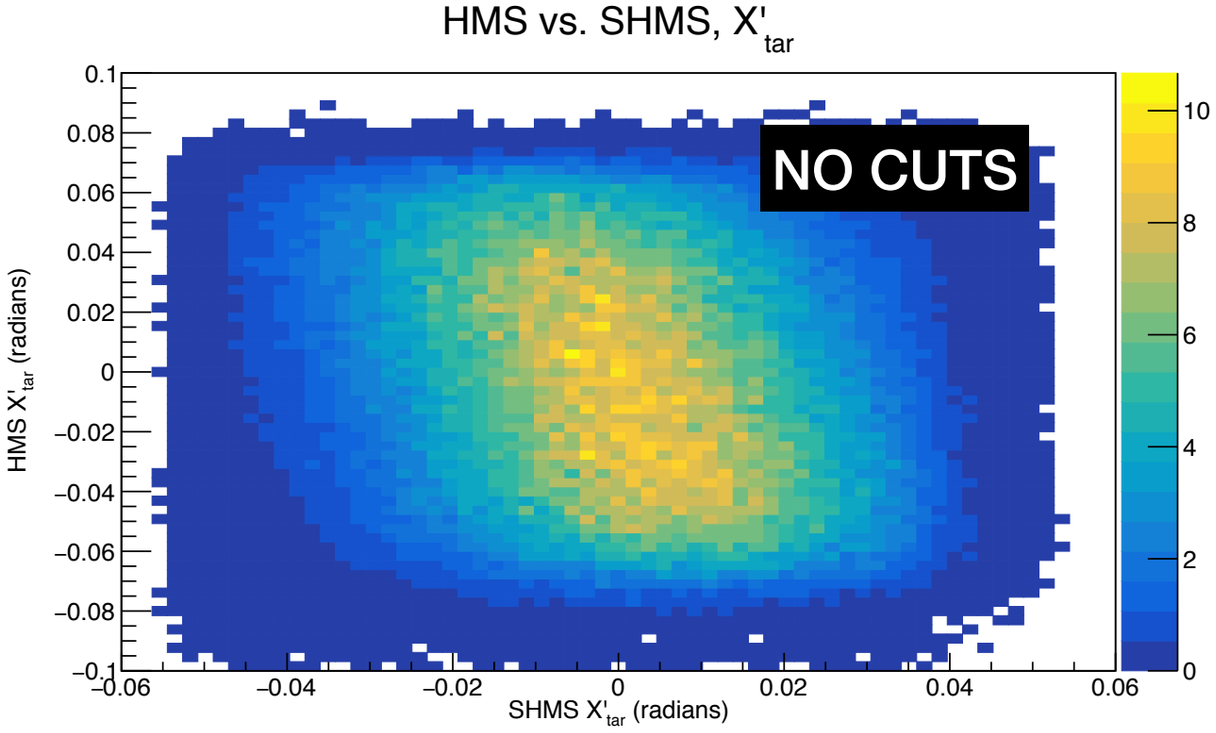

X_fp vs Y_fp
NO CUTS
Entries 1000000
Integral 8133
HMS X_fp (cm)
HMS Y_fp (cm)

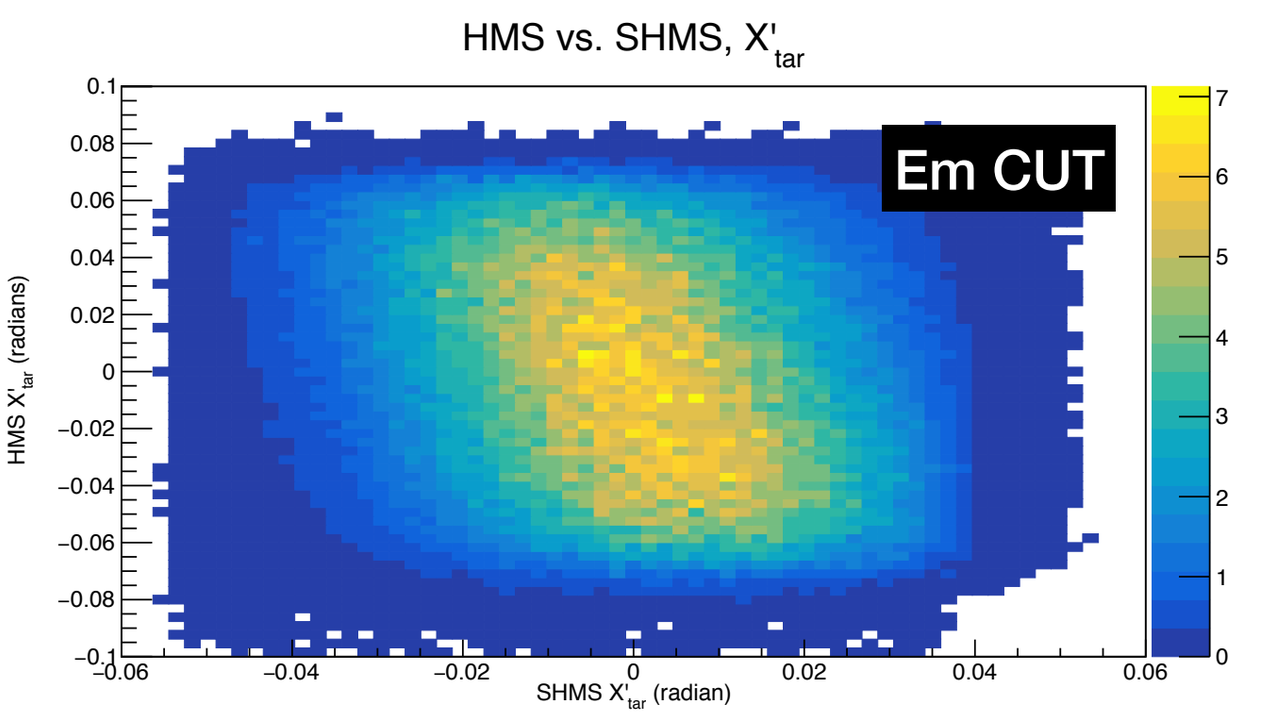

X_fp vs Y_fp
Em CUT
Entries 827762
Integral 5543
HMS X_fp (cm)
HMS Y_fp (cm)

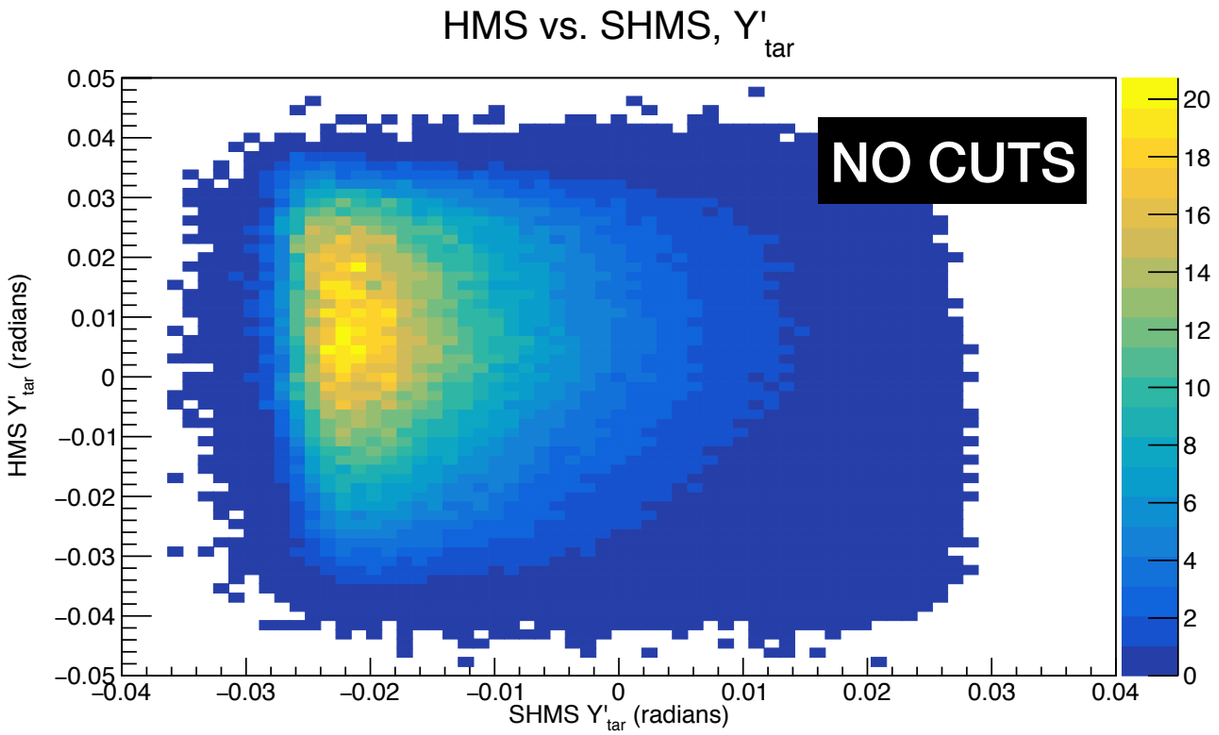

X_fp vs Y_fp
NO CUTS
SHMS X_fp (cm)
SHMS Y_fp (cm)

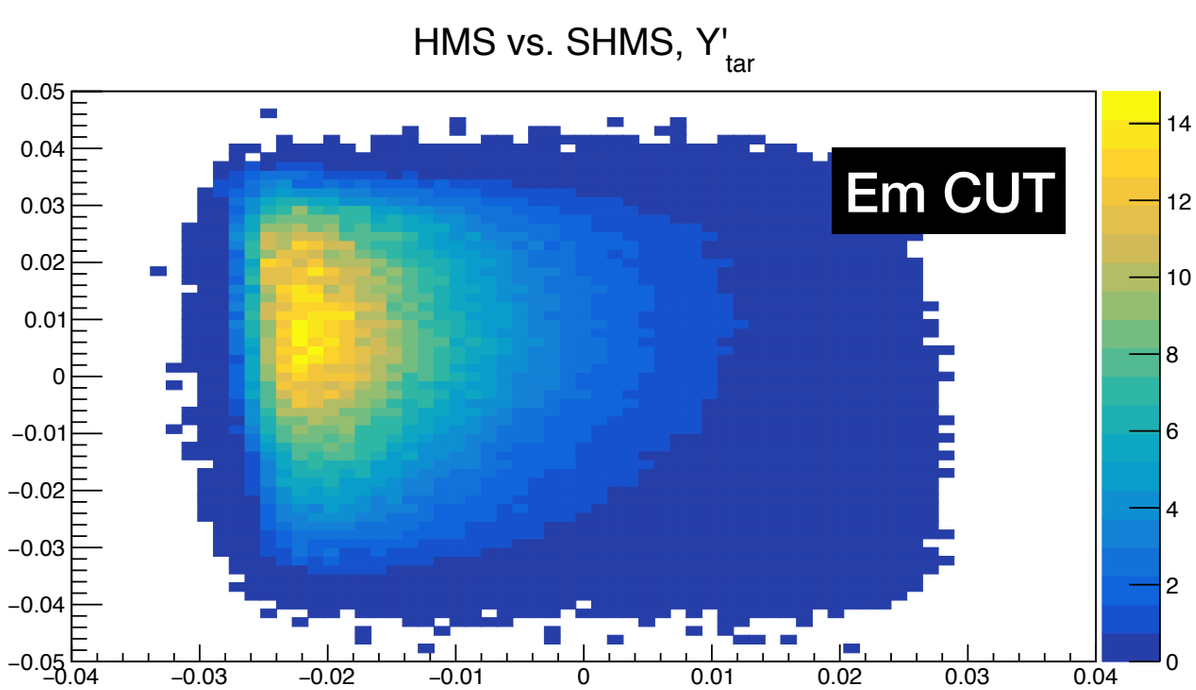

X_fp vs Y_fp
Em CUT
SHMS X_fp (cm)
SHMS Y_fp (cm)

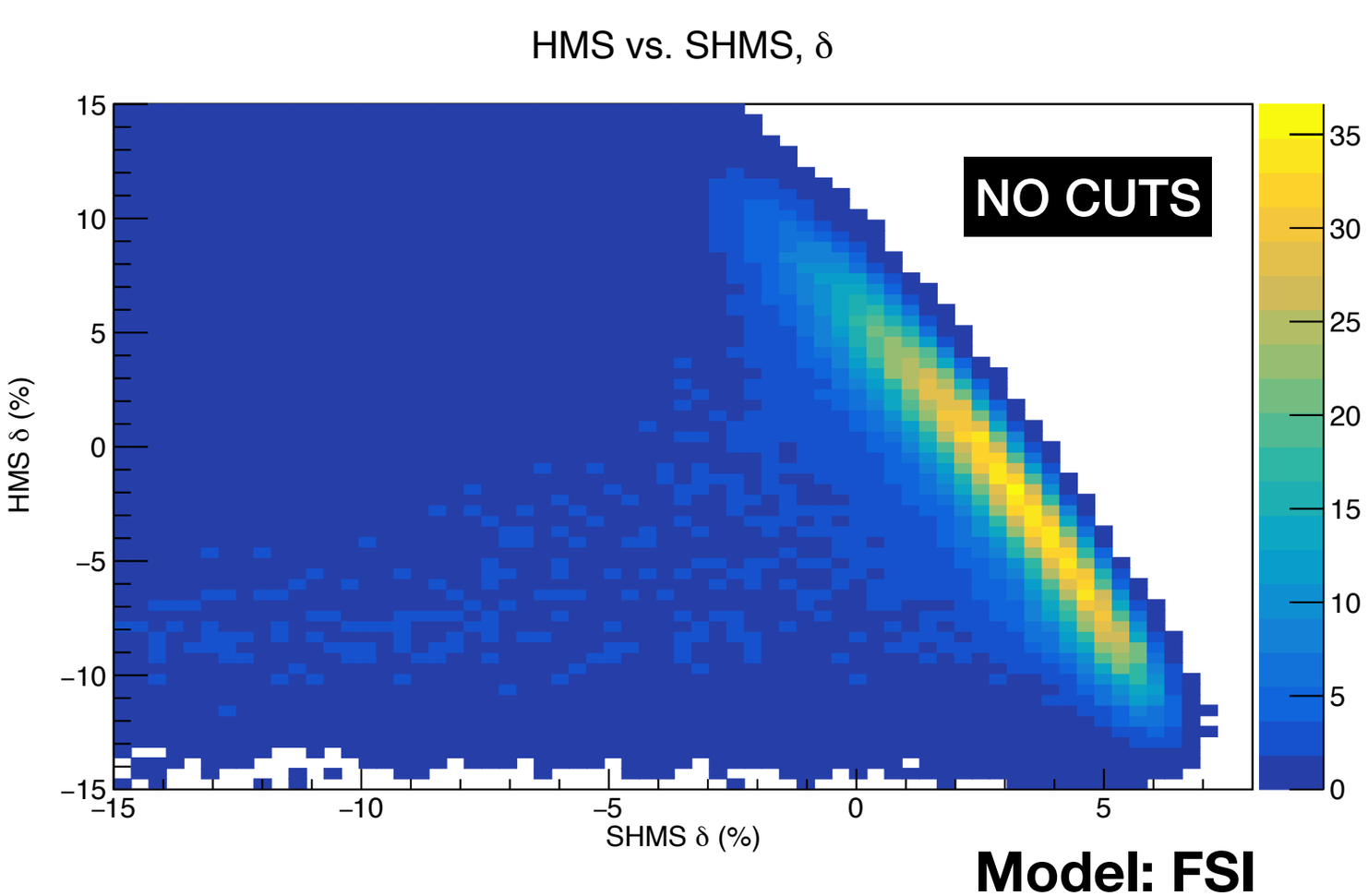
Model: FSI


HMS vs. SHMS, X'tar
NO CUTS
HMS X'tar (radians)
SHMS X'tar (radians)

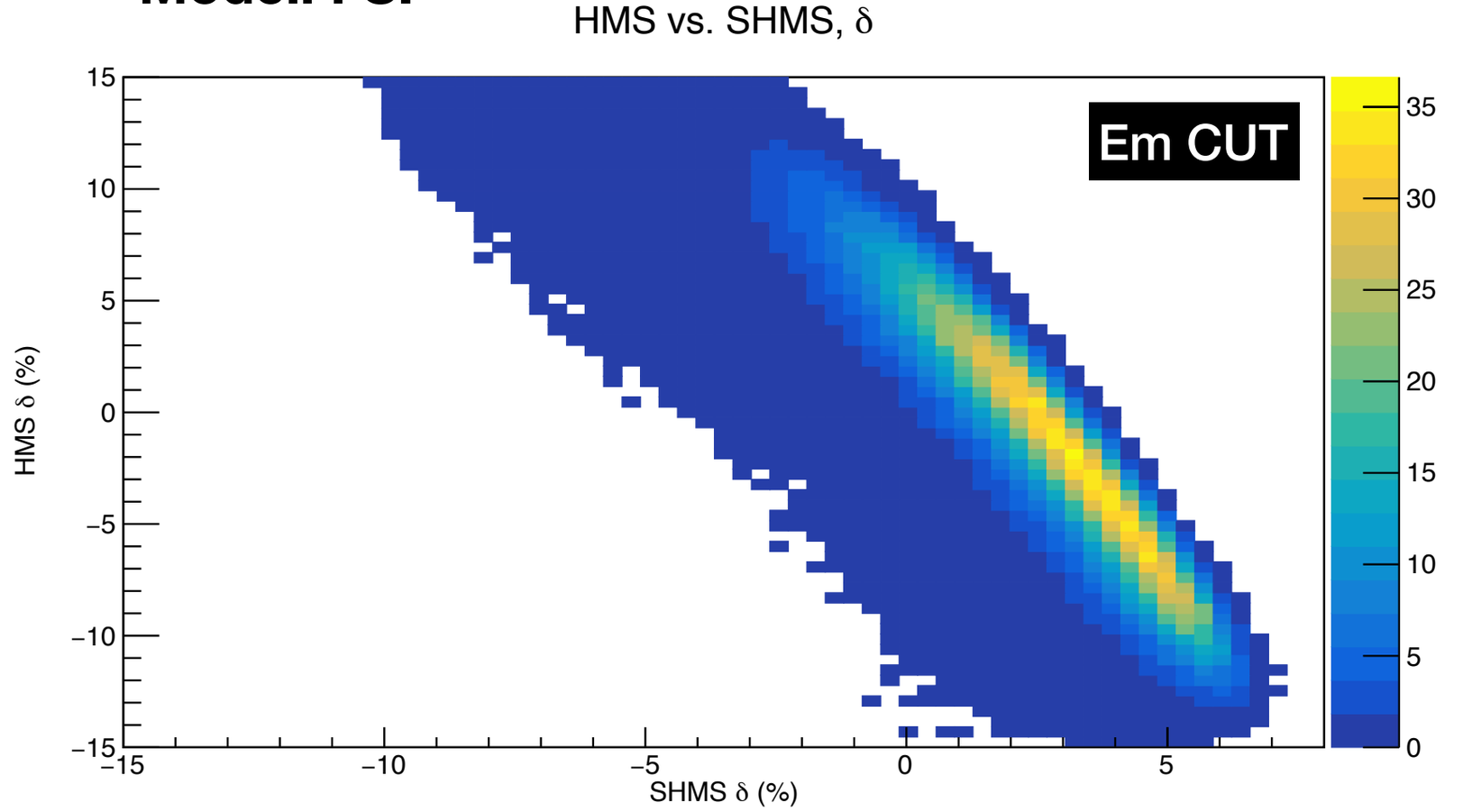

HMS vs. SHMS, X'tar
Em CUT
HMS X'tar (radians)
SHMS X'tar (radian)


HMS vs. SHMS, Y'tar
NO CUTS
HMS Y'tar (radians)
SHMS Y'tar (radians)


HMS vs. SHMS, Y'tar
Em CUT


HMS vs. SHMS, δ
NO CUTS
HMS δ (%)
SHMS δ (%)
15
10
5
0
−5
−10
−15
35
30
25
20
15
10
5
0

Model: FSI


HMS vs. SHMS, δ
Em CUT
HMS δ (%)
SHMS δ (%)
15
10
5
0
−5
−10
−15
35
30
25
20
15
10
5
0

Apply Kinematic CUTS based on kinematic regions where FSI~PWIA (see Slide 23)

Applied CUTS in Next Slides:

-40 < Em < 80 MeV

4.0 < Q2 < 5.0 GeV2

1.3 < xBj < 1.7

missing momentum

Entries	169533
Integral	696.8
Entries	169533
Integral	608.1

P_m = 580 MeV/c

PWIA
FSI

CUTS:
-40 < Em < 80 MeV
4.0 < Q2 < 5.0 GeV2
1.3 < xBj < 1.7

Expected # of Good Neutrons (FSI ~ small)

Beam Current: 40 uA
Beam Time: 20 hrs

Yield: 608 evts
Yield: 696 evts

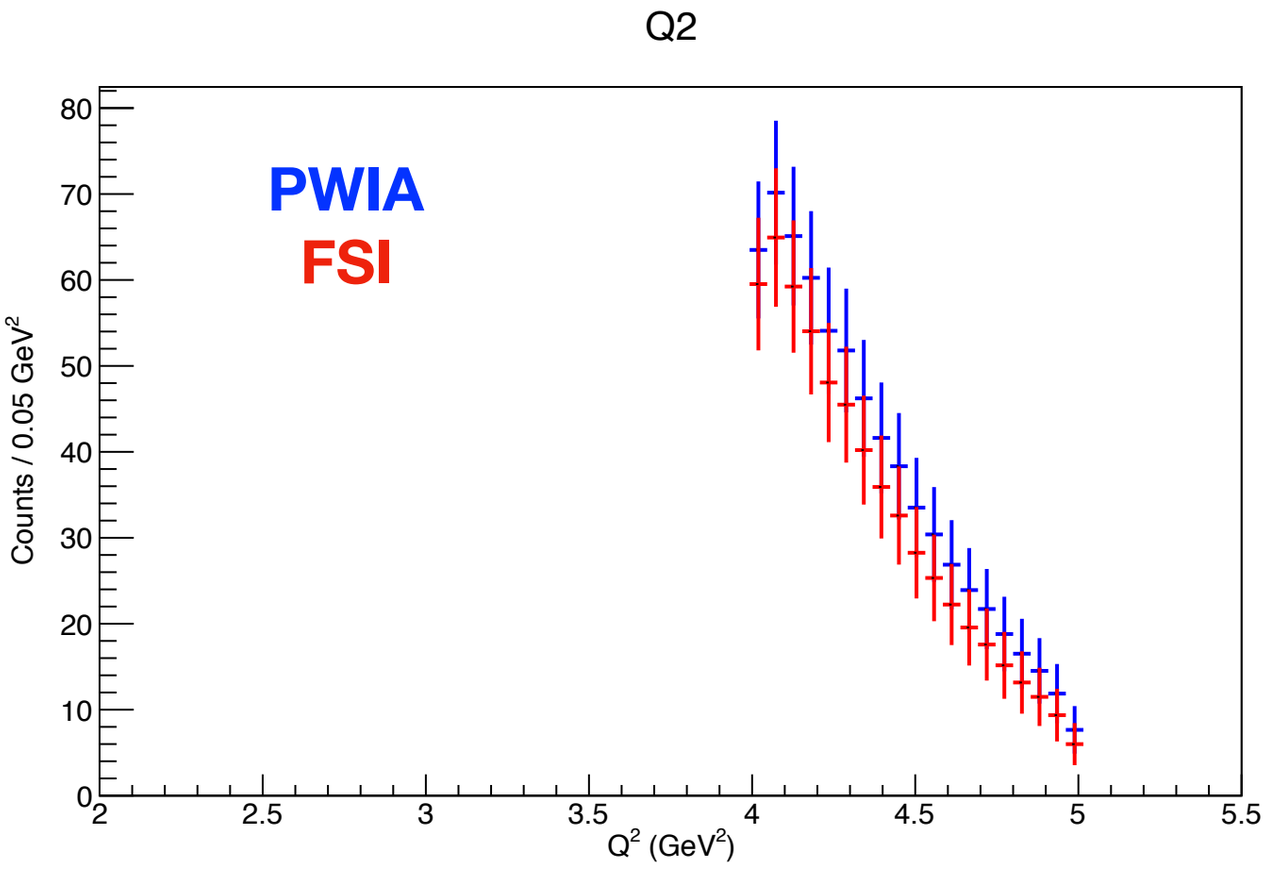
Estimated Rates:
FSI: ~ 30 evts / hr
PWIA: ~ 34.8 evts / hr

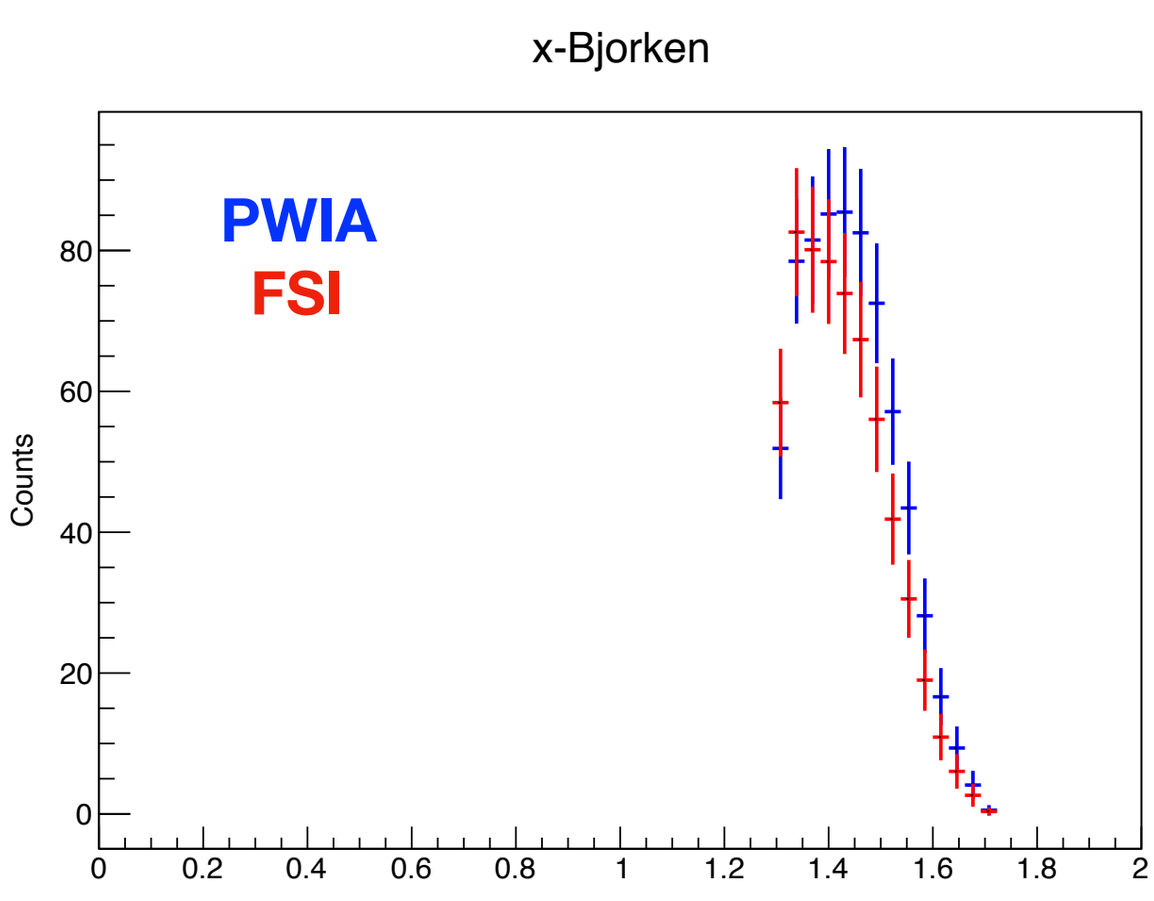
Counts / 25 MeV

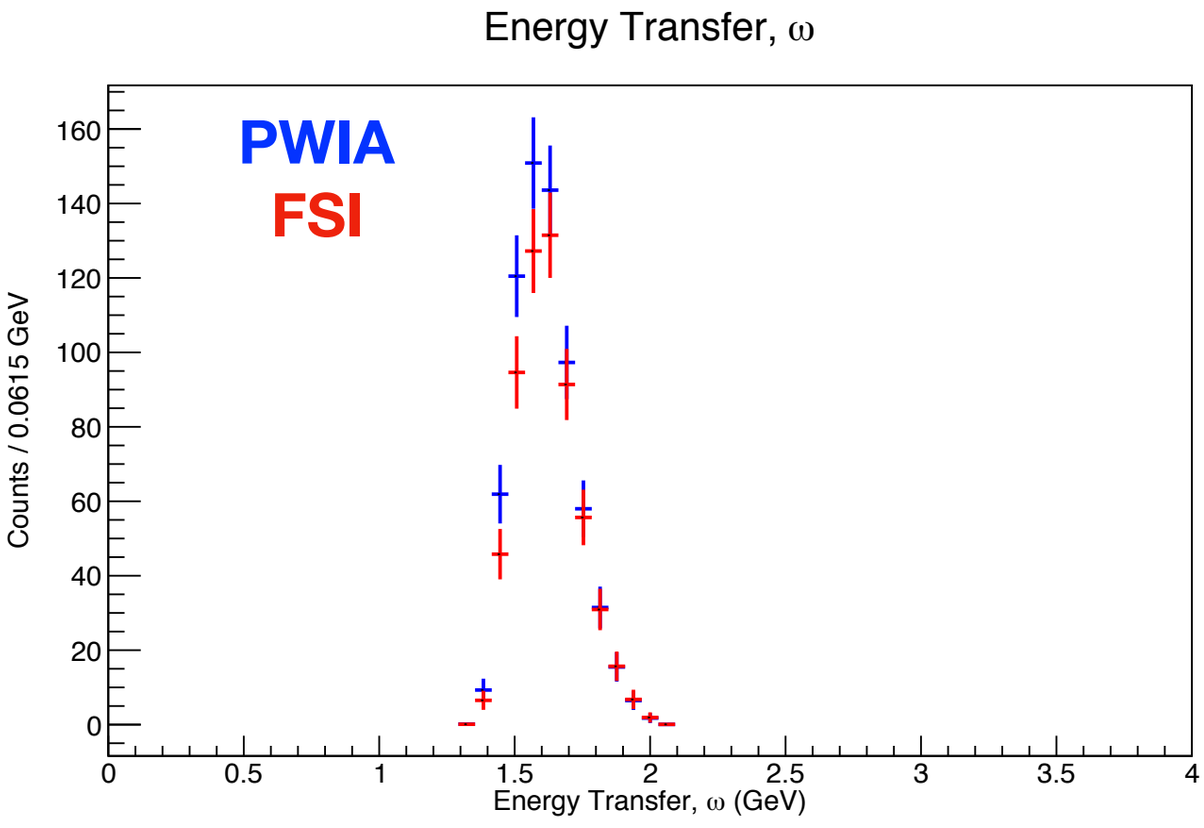
0 10 20 30 40 50 60 70

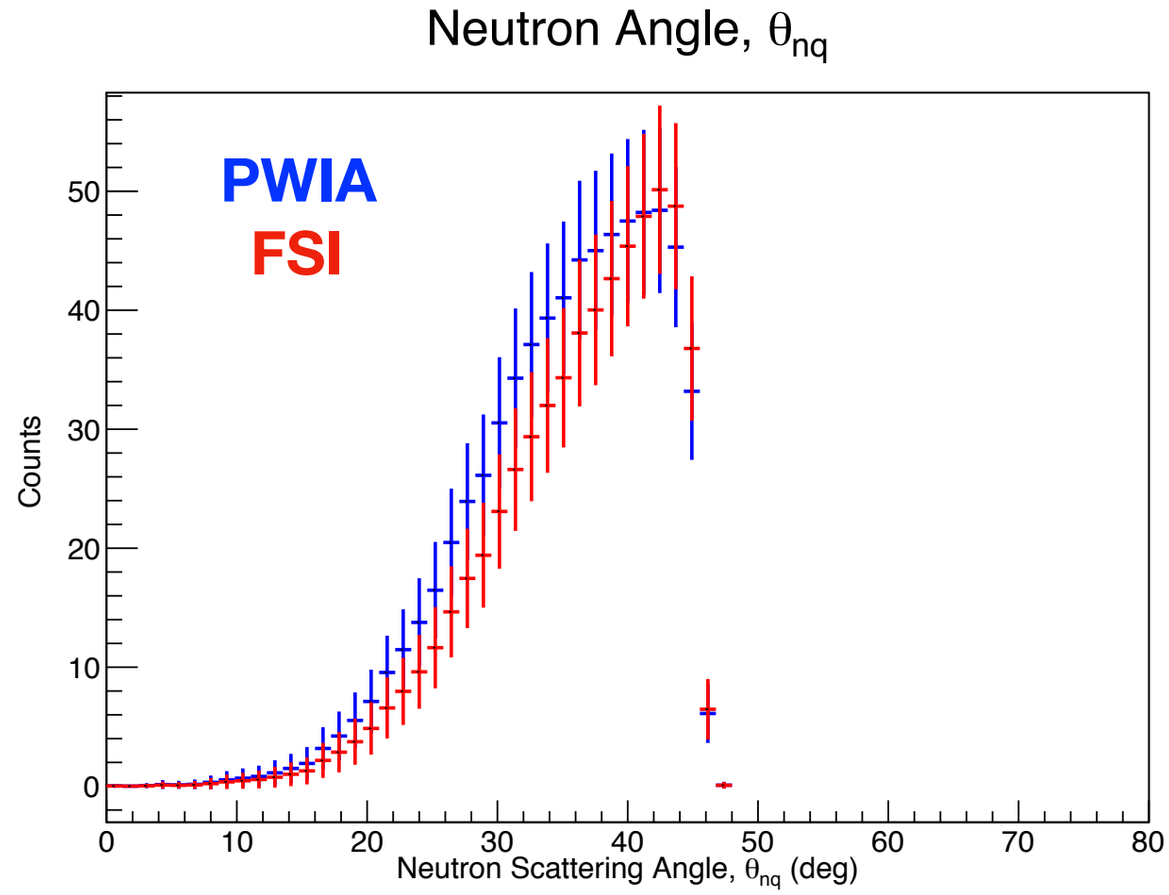
0 0.5 1 1.5 2 2.5

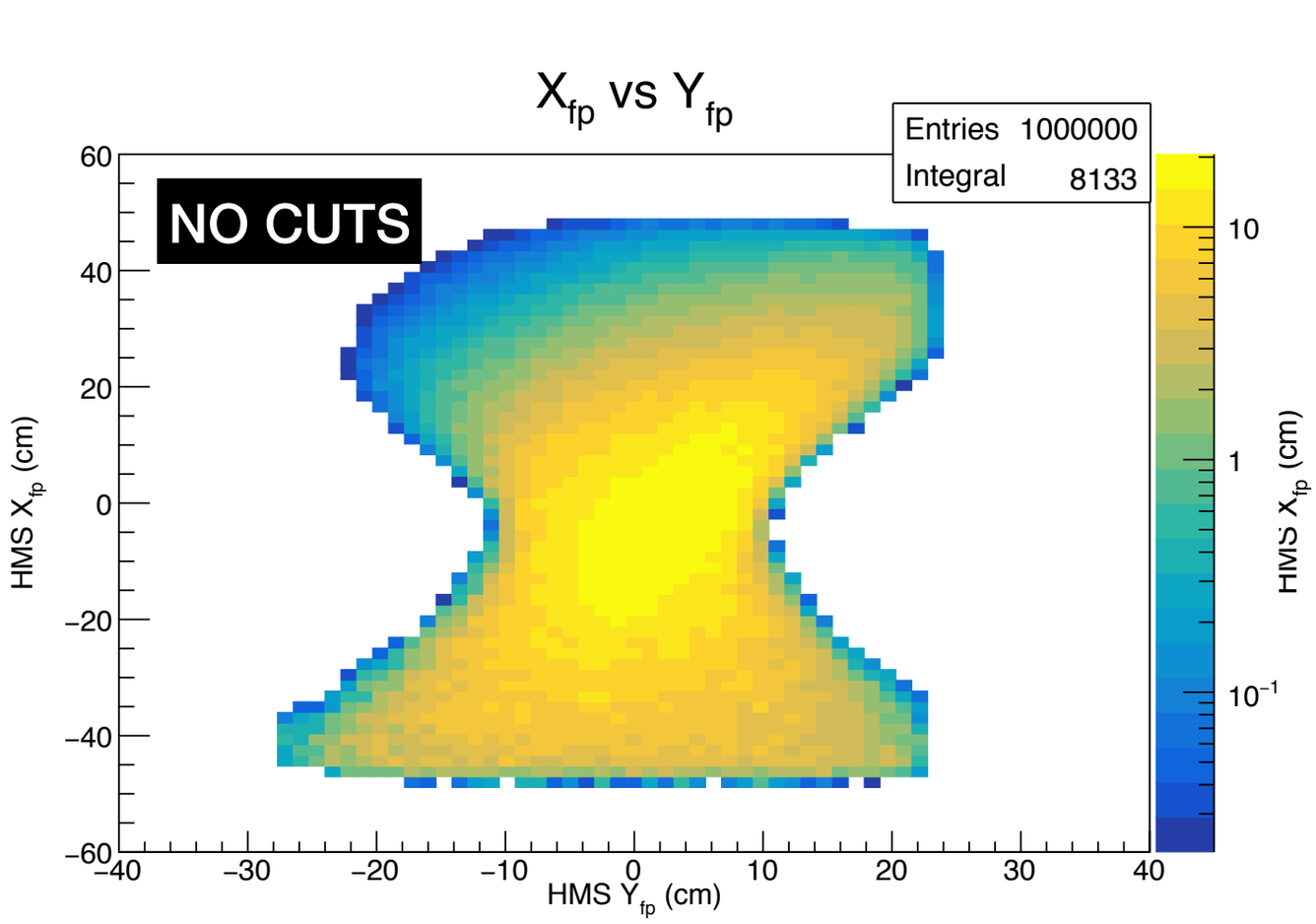
Missing Momentum (GeV/c)

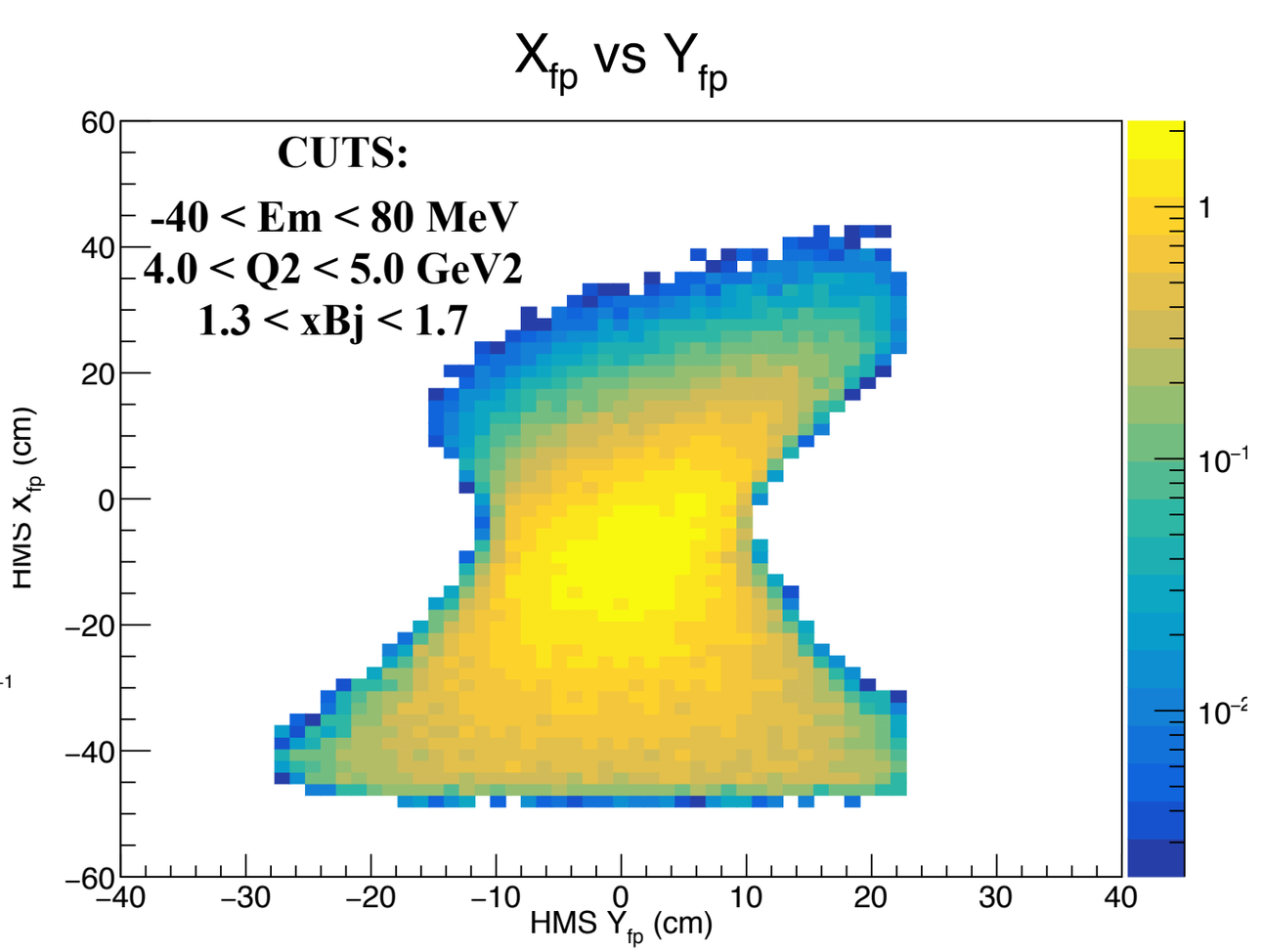

Q2
PWIA
FSI
Counts / 0.05 GeV^2
Q^2 (GeV^2)

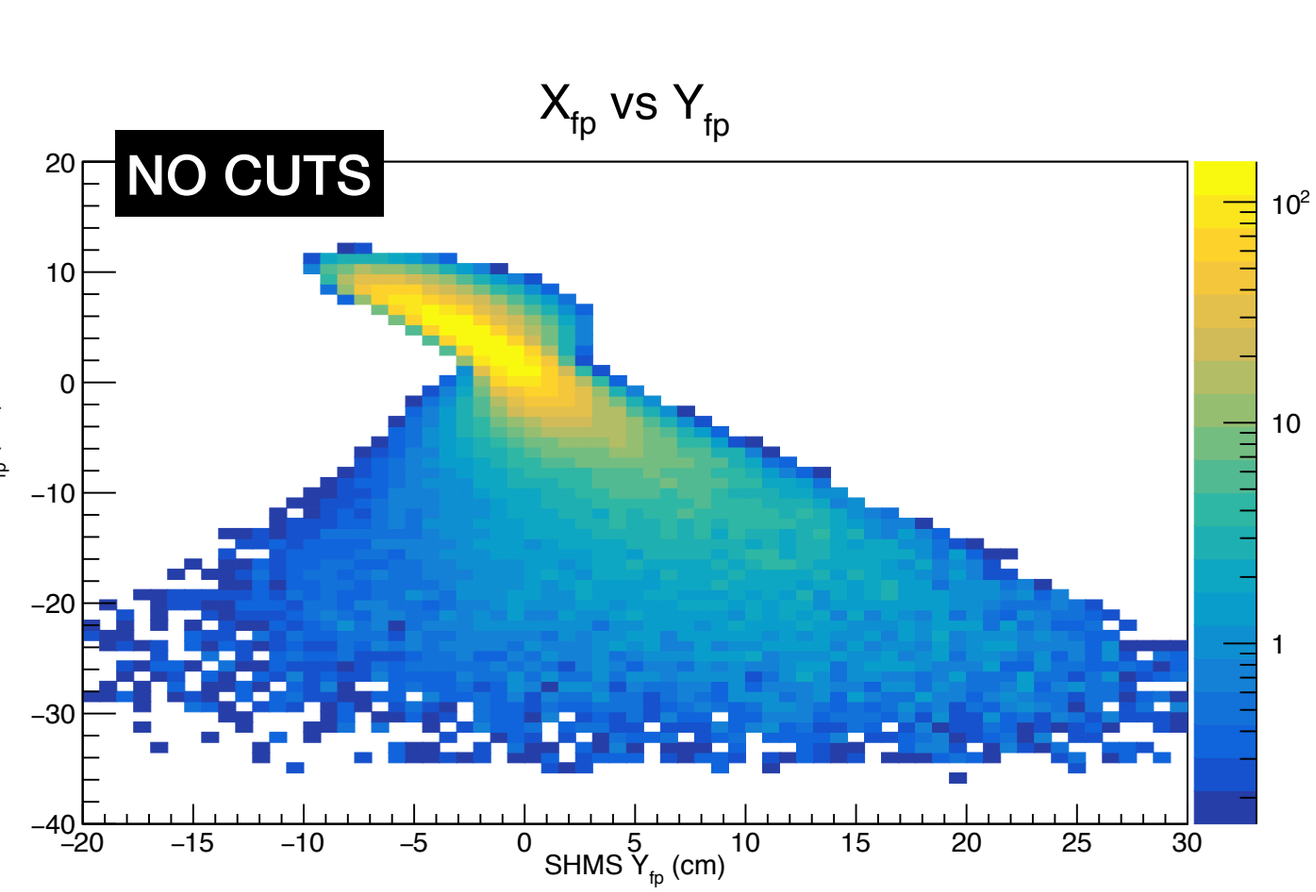

x-Bjorken
PWIA
FSI
Counts

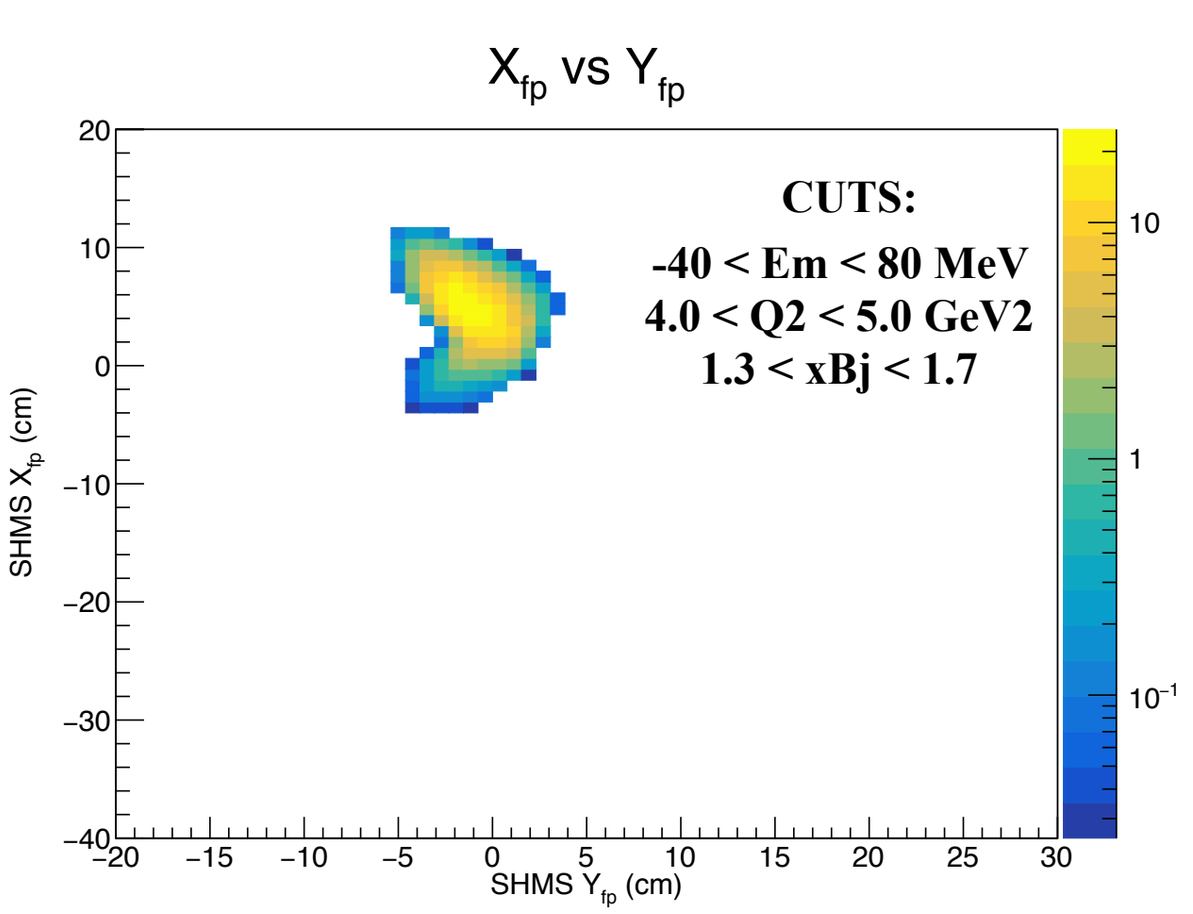

Energy Transfer, ω
PWIA
FSI
Counts / 0.0615 GeV
Energy Transfer, ω (GeV)

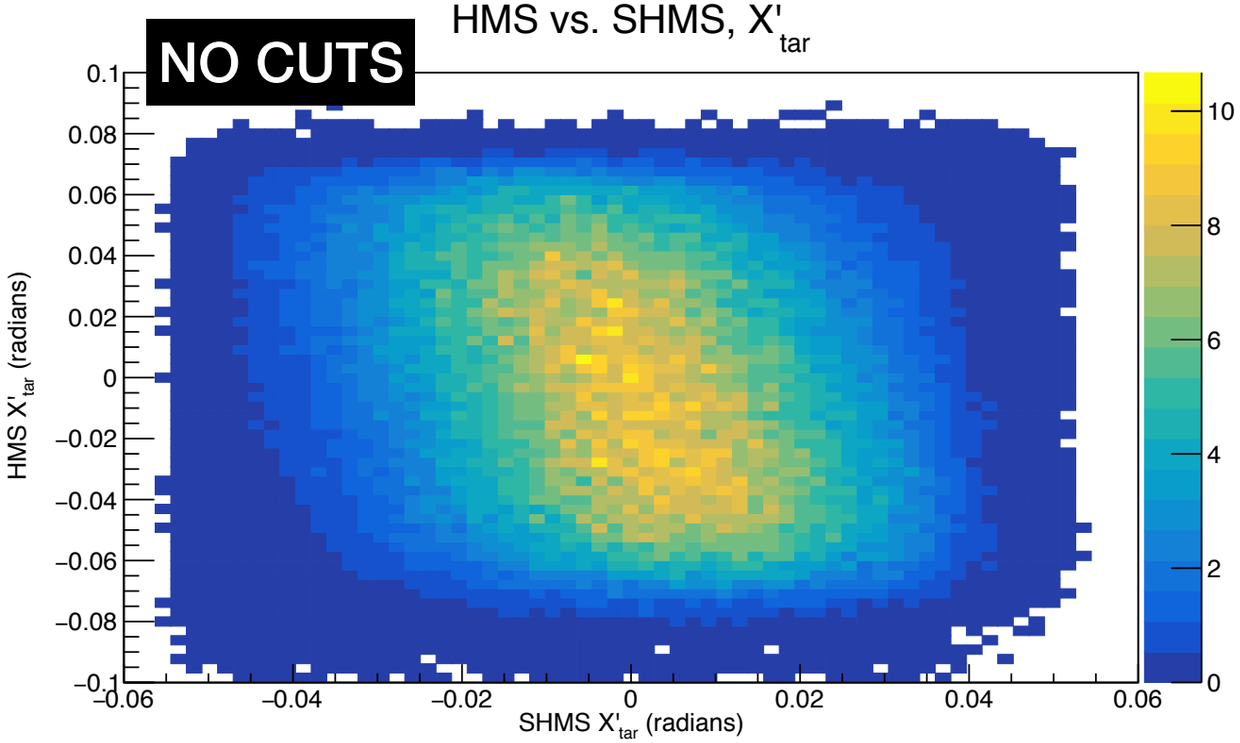

Neutron Angle, θnq
PWIA
FSI
Counts
Neutron Scattering Angle, θnq (deg)

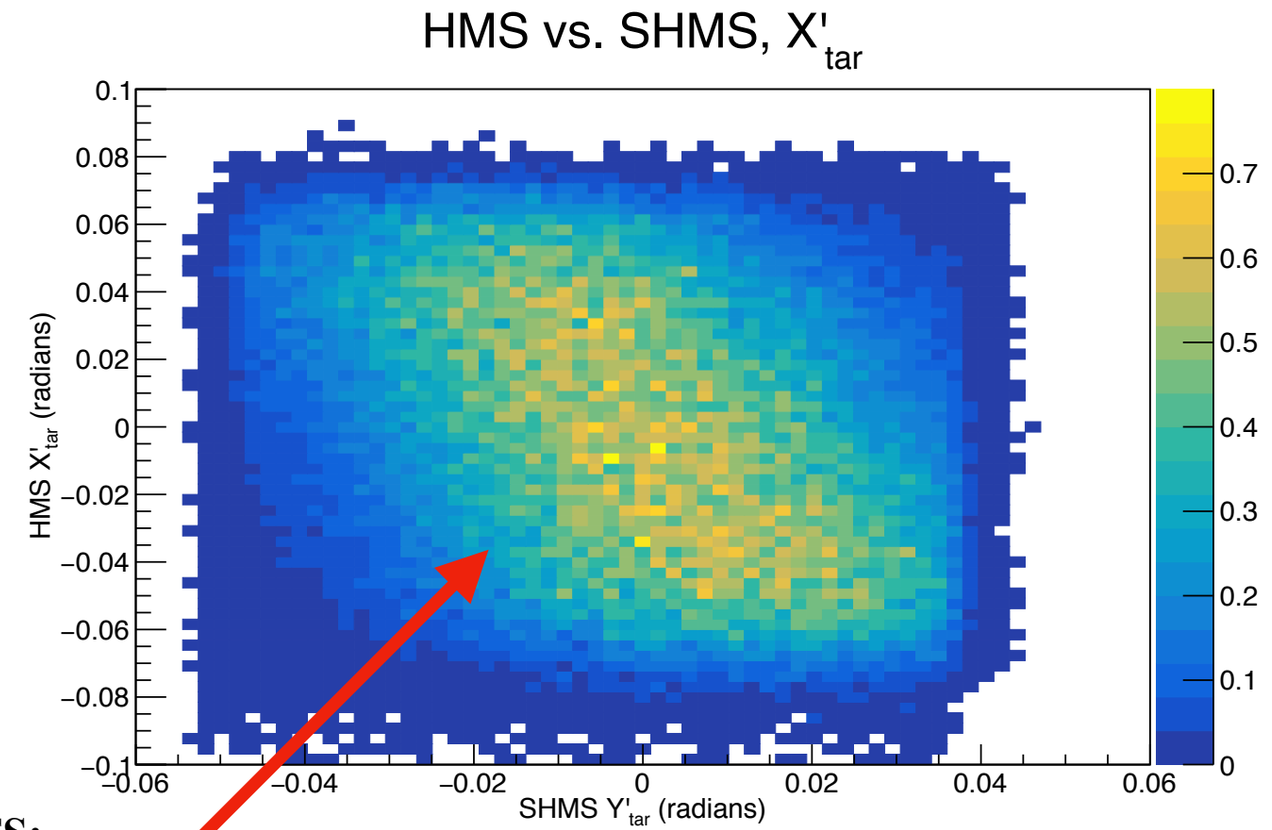

X_{fp} vs Y_{fp}
Entries 1000000
Integral 8133
NO CUTS
HMS X_{fp} (cm)
HMS Y_{fp} (cm)


X_{fp} vs Y_{fp}
CUTS:
-40 < Em < 80 MeV
4.0 < Q2 < 5.0 GeV2
1.3 < xBj < 1.7
HMS X_{fp} (cm)
HMS Y_{fp} (cm)


X_{fp} vs Y_{fp}
NO CUTS
SHMS Y_{fp} (cm)

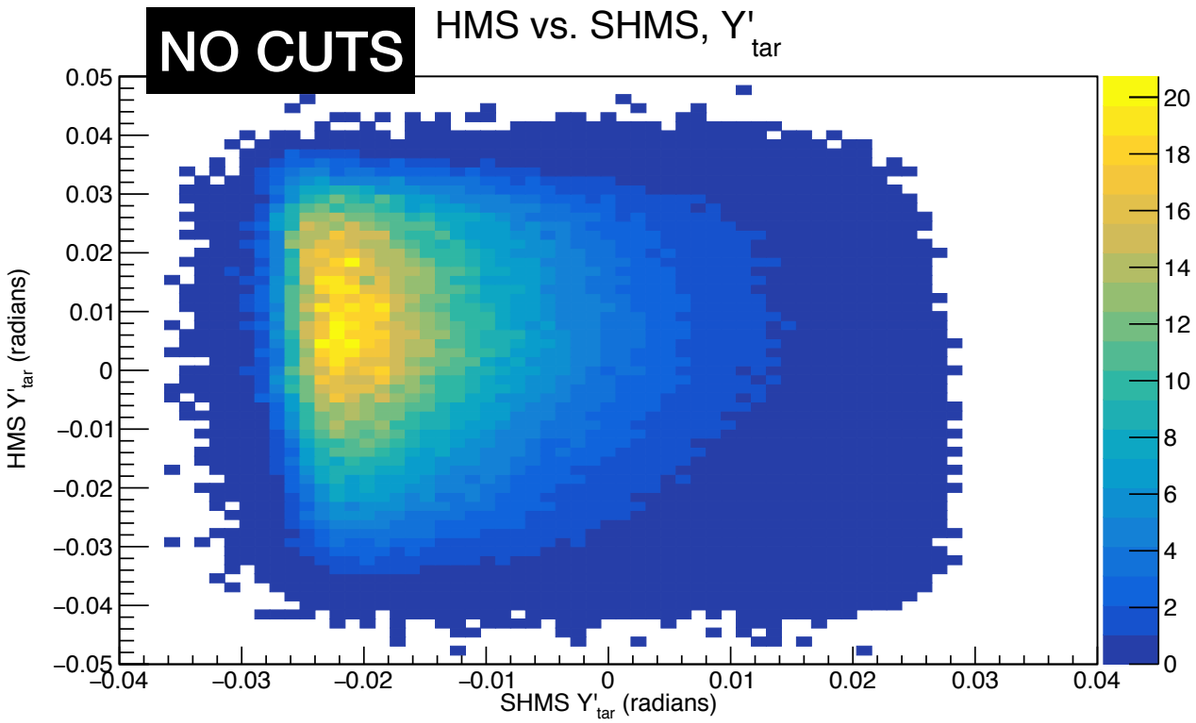

X_{fp} vs Y_{fp}
CUTS:
-40 < Em < 80 MeV
4.0 < Q2 < 5.0 GeV2
1.3 < xBj < 1.7
SHMS X_{fp} (cm)
SHMS Y_{fp} (cm)

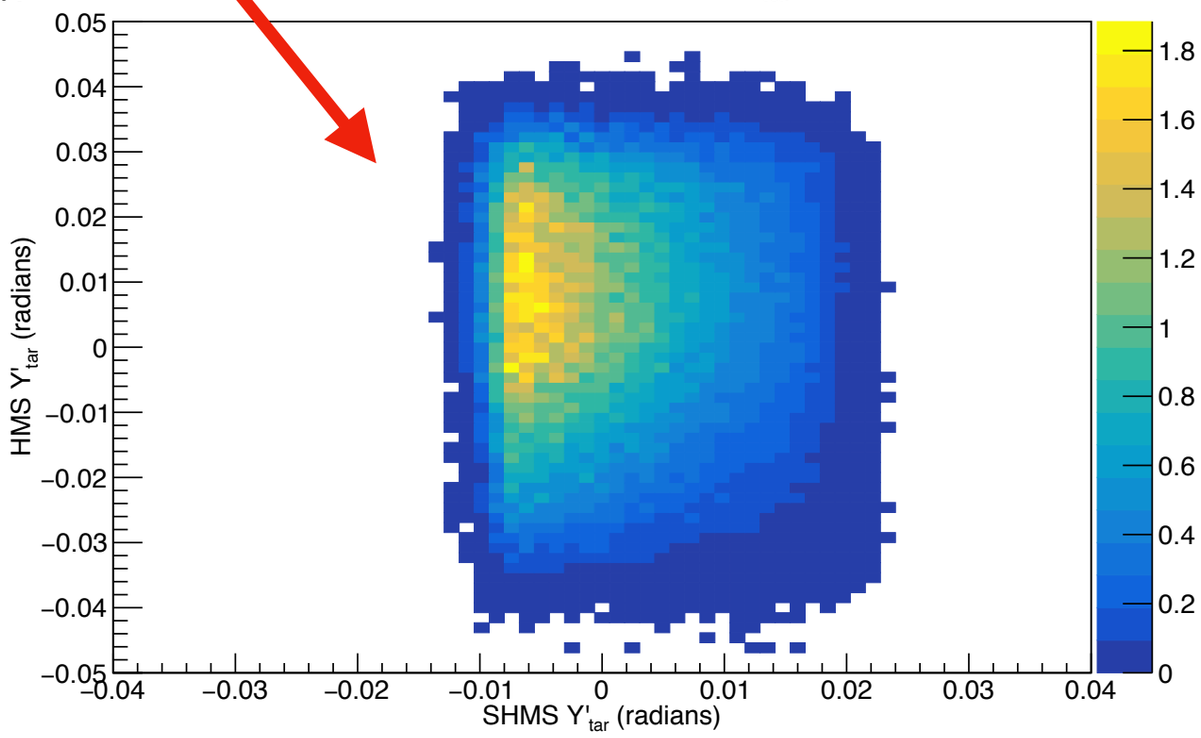




CUTS:

-40 < Em < 80 MeV
4.0 < Q2 < 5.0 GeV2
1.3 < xBj < 1.7





HMS vs. SHMS, δ

NO CUTS

HMS δ (%)

SHMS δ (%)

HMS vs. SHMS, δ

CUTS:
-40 < Em < 80 MeV
4.0 < Q2 < 5.0 GeV2
1.3 < xBj < 1.7

HMS δ (%)

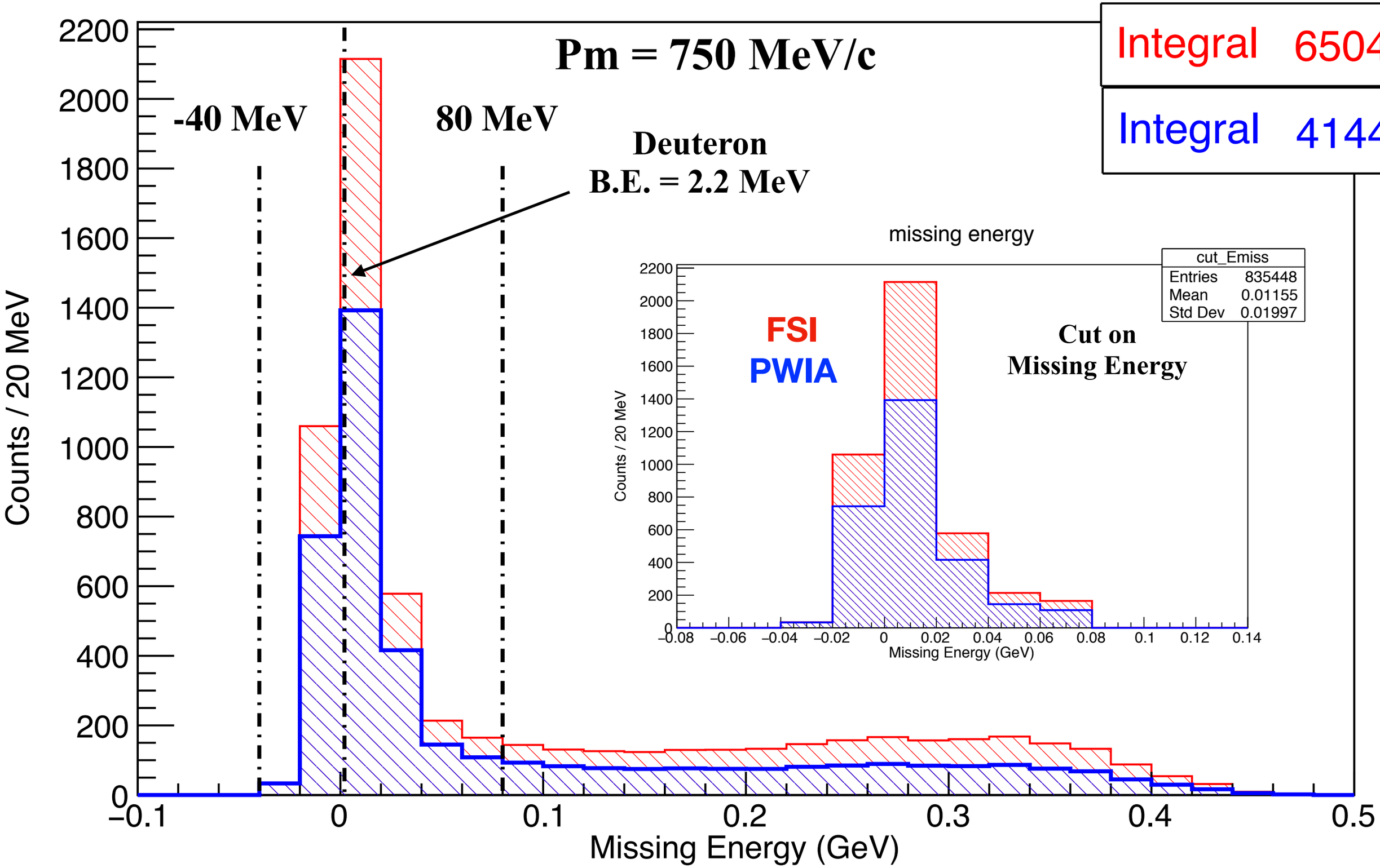
SHMS δ (%)

Missing Momentum Setting

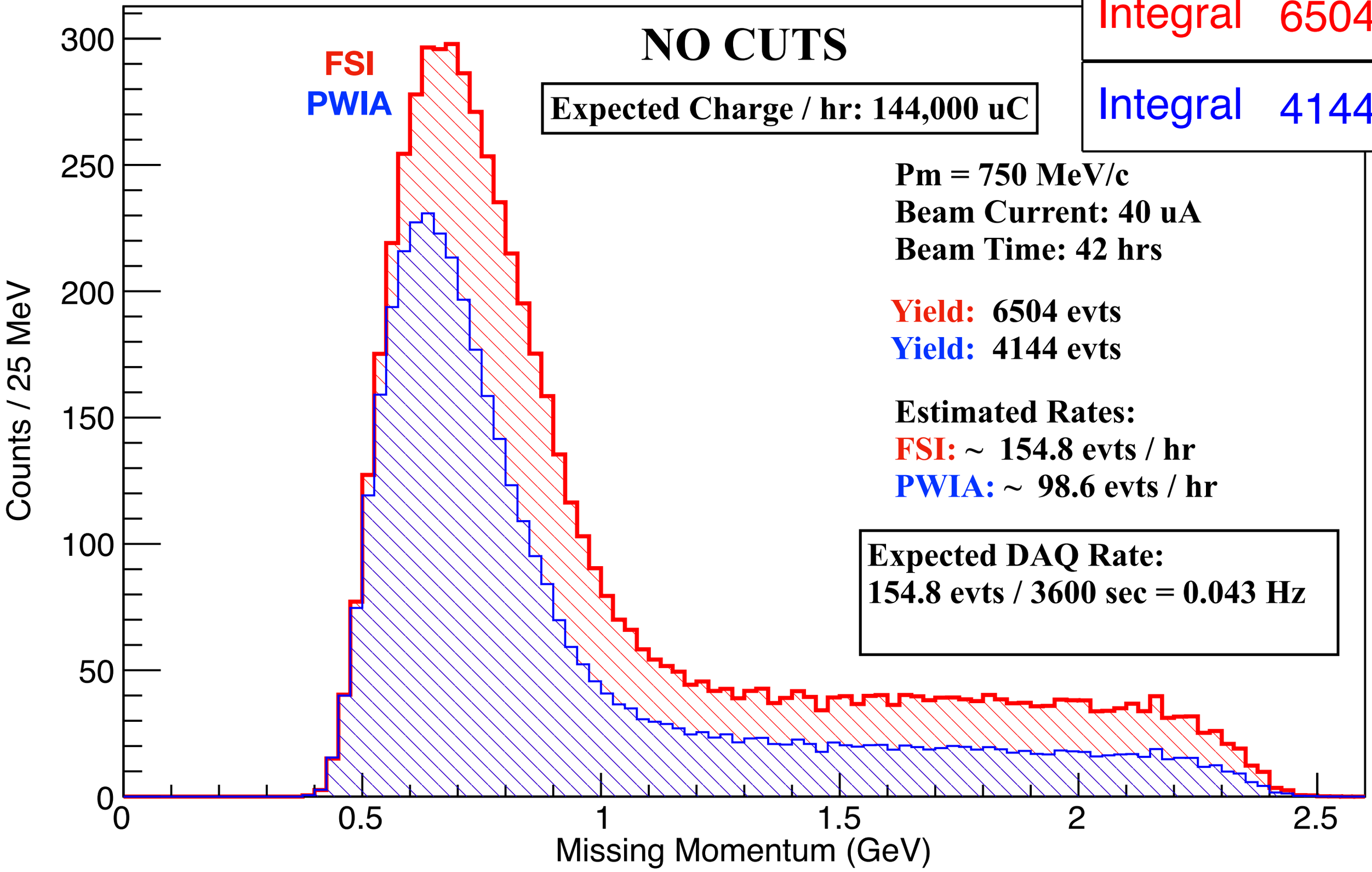
Pm = 750 MeV

SIMC ANALYSIS

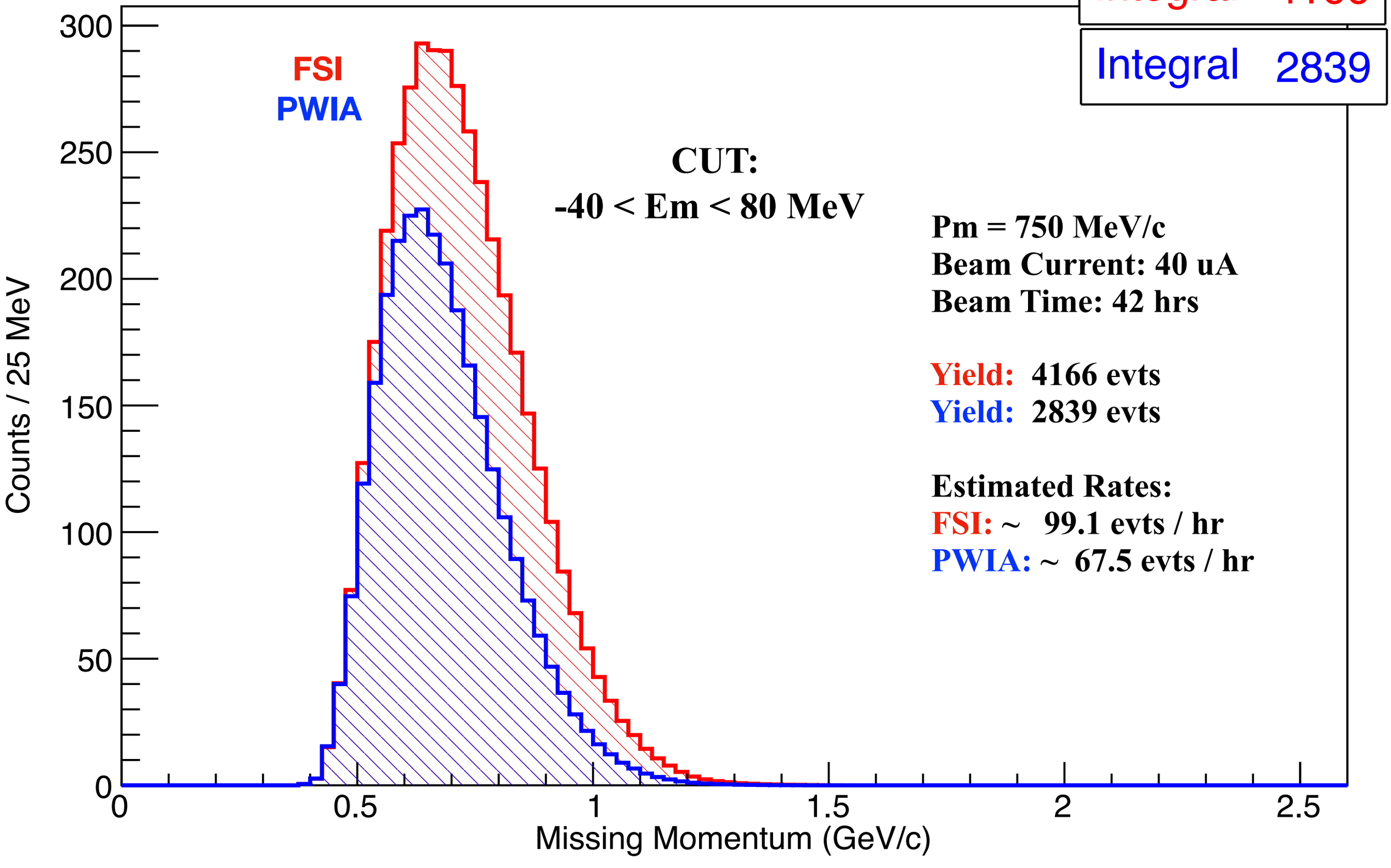
missing energy



missing momentum



missing momentum



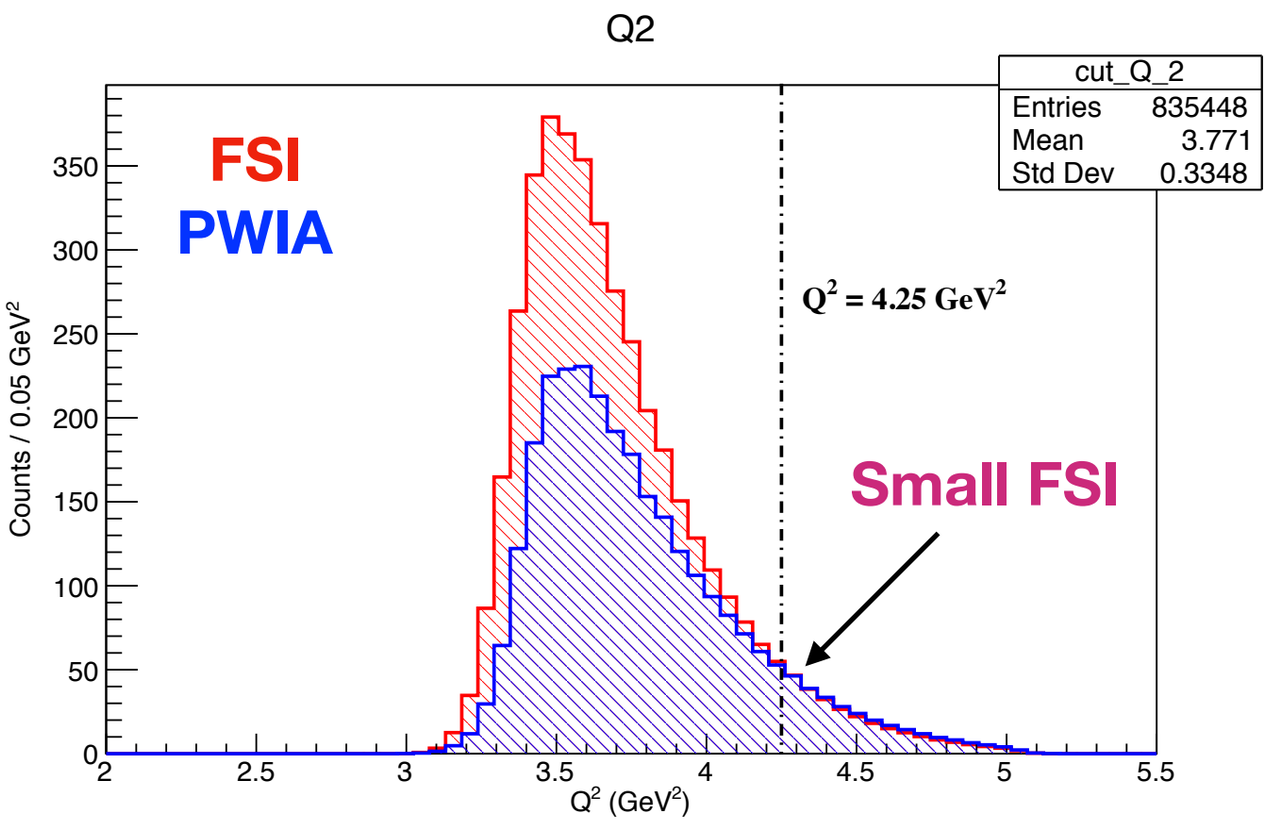
Pm = 750 MeV/c

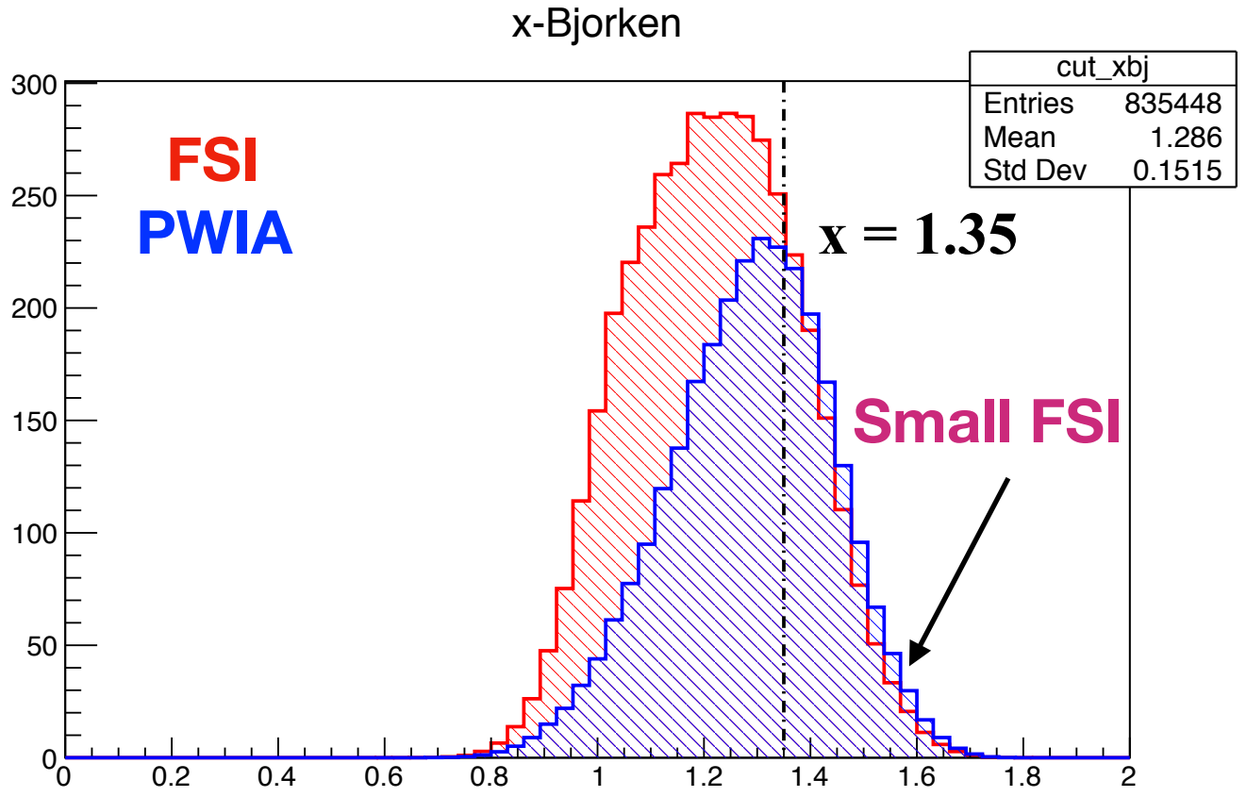
KINEMATICS

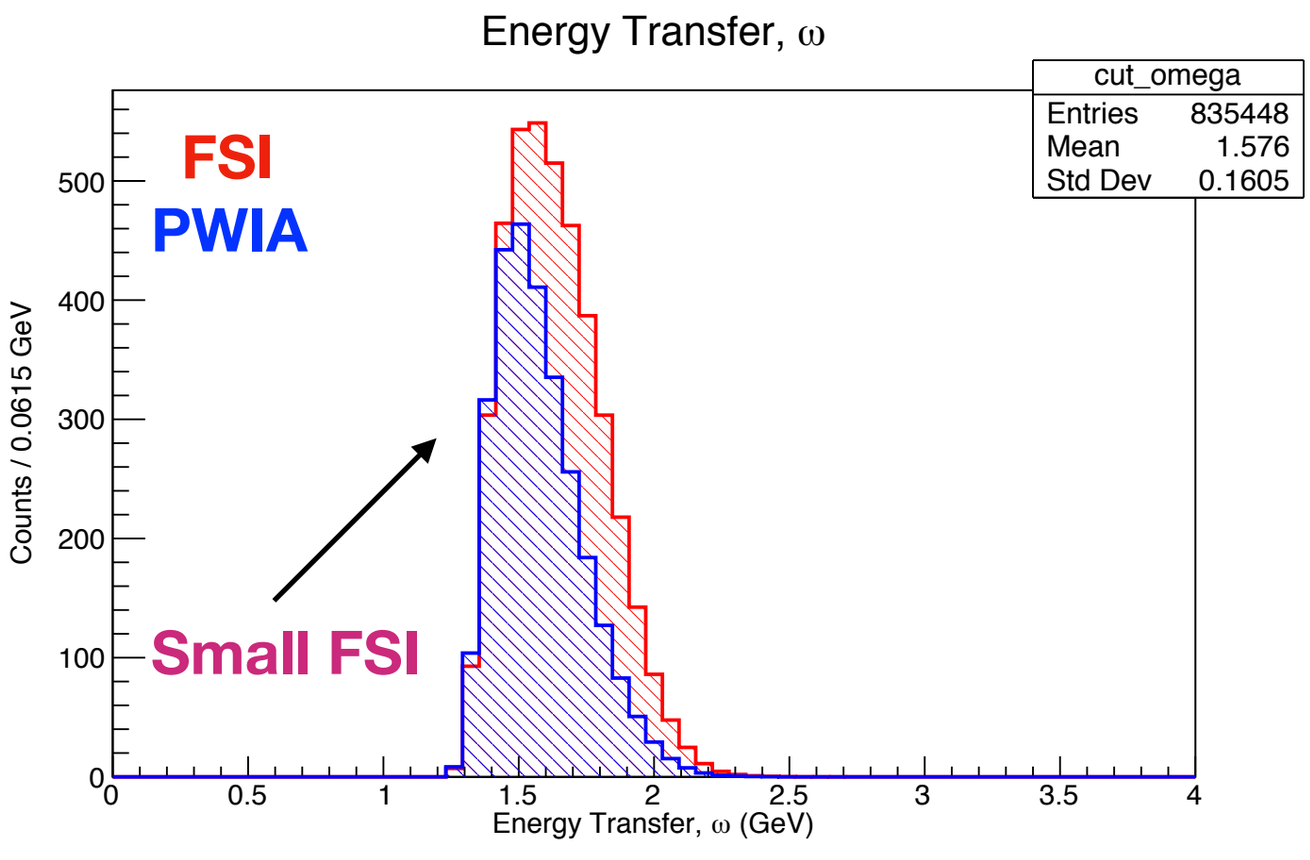
COMPARISONS

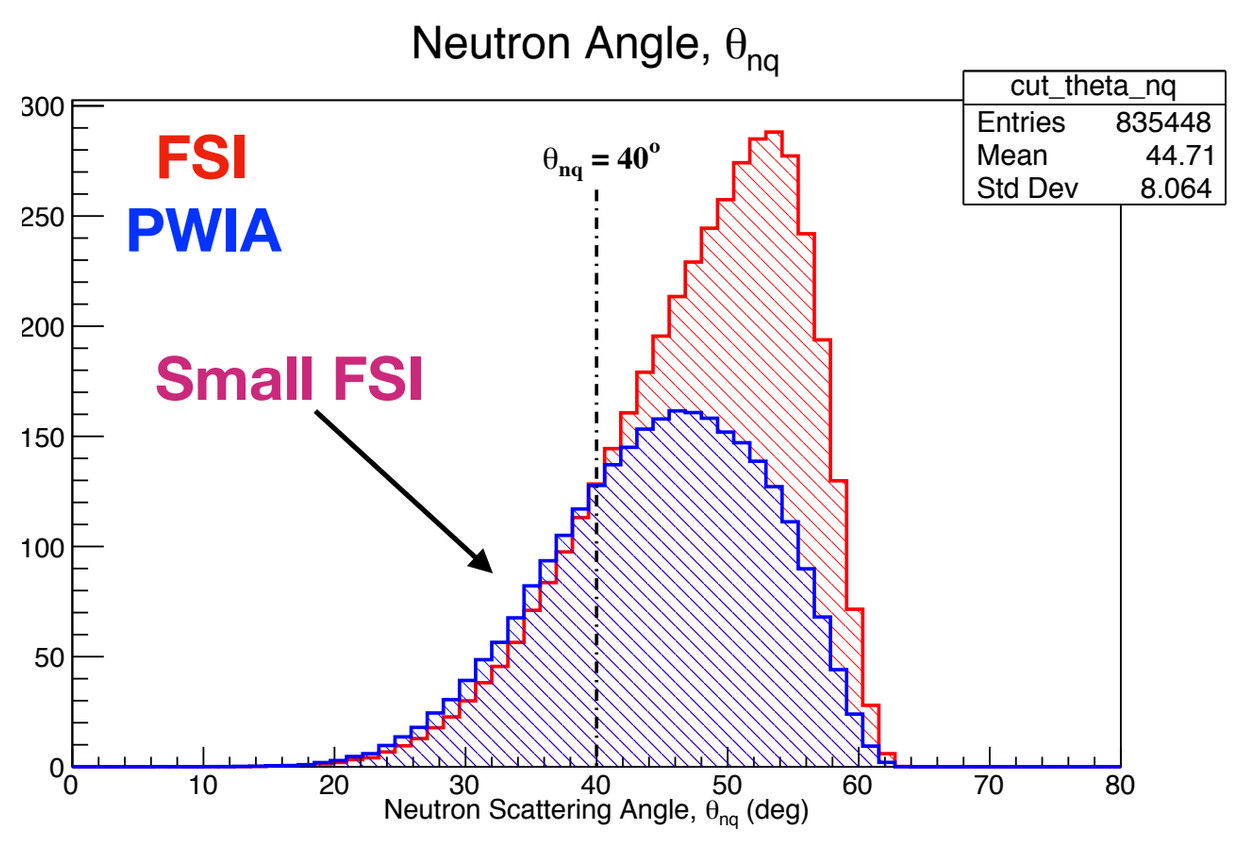
(SIMC)

Missing Momentum = 580 MeV/c
CUT: -40 < Em < 80 MeV







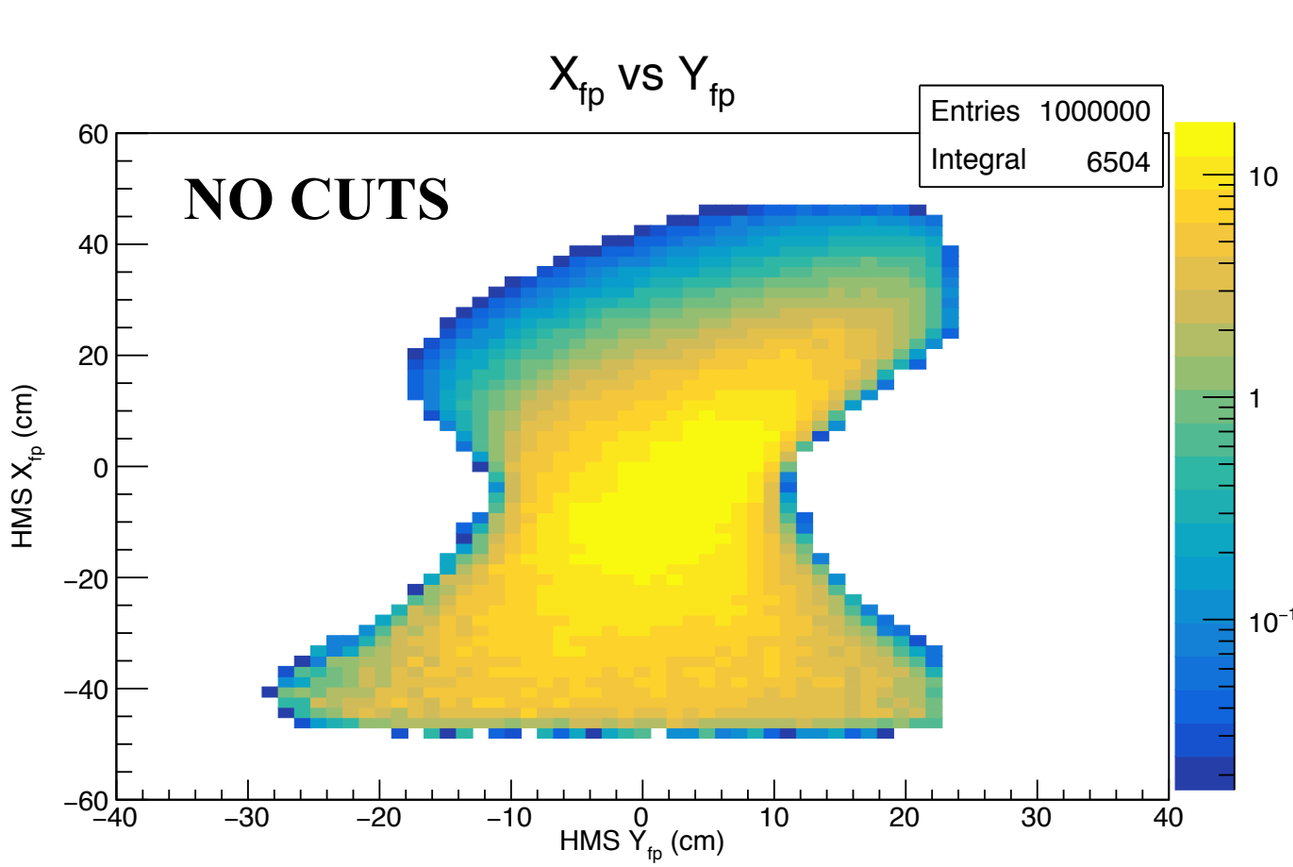


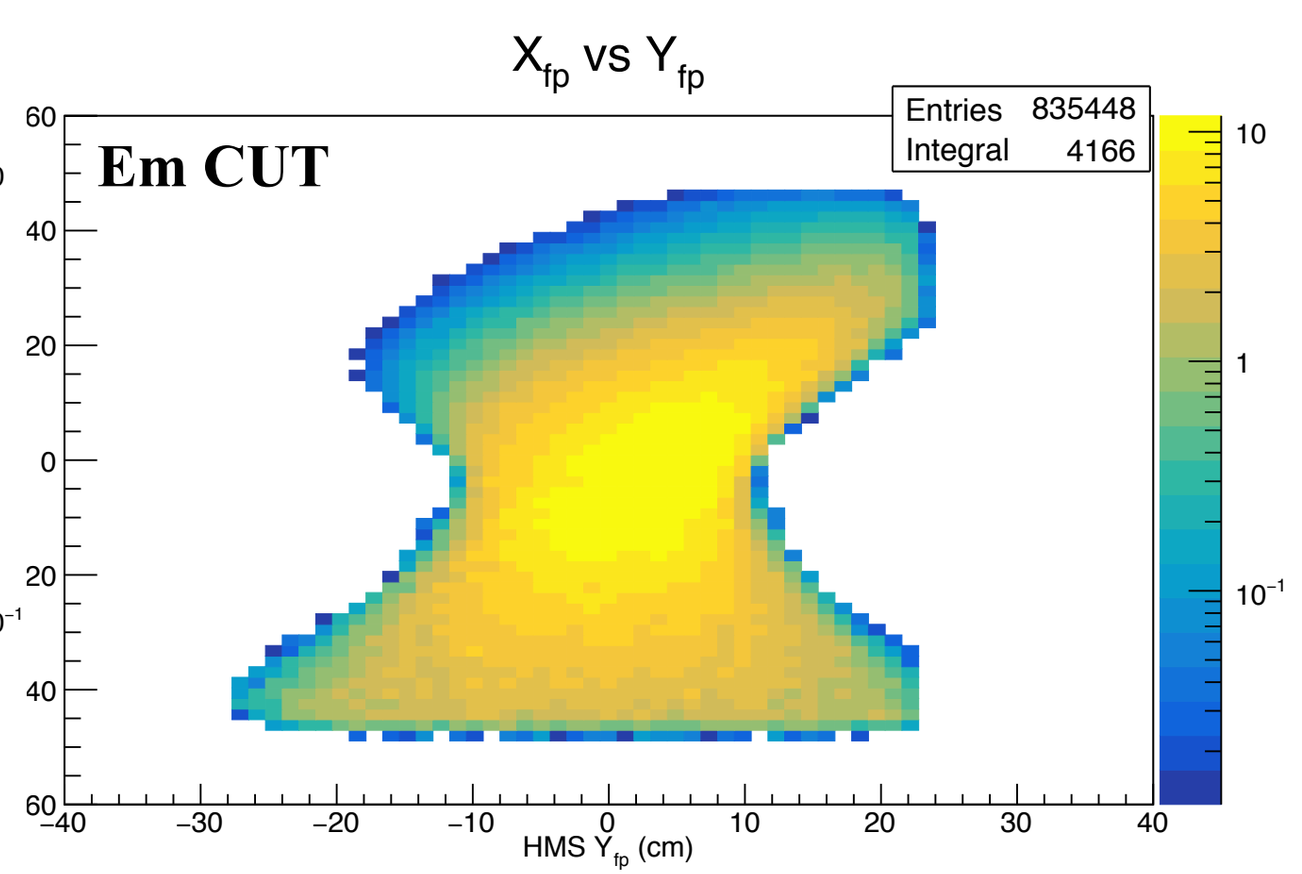
Pm = 750 MeV/c

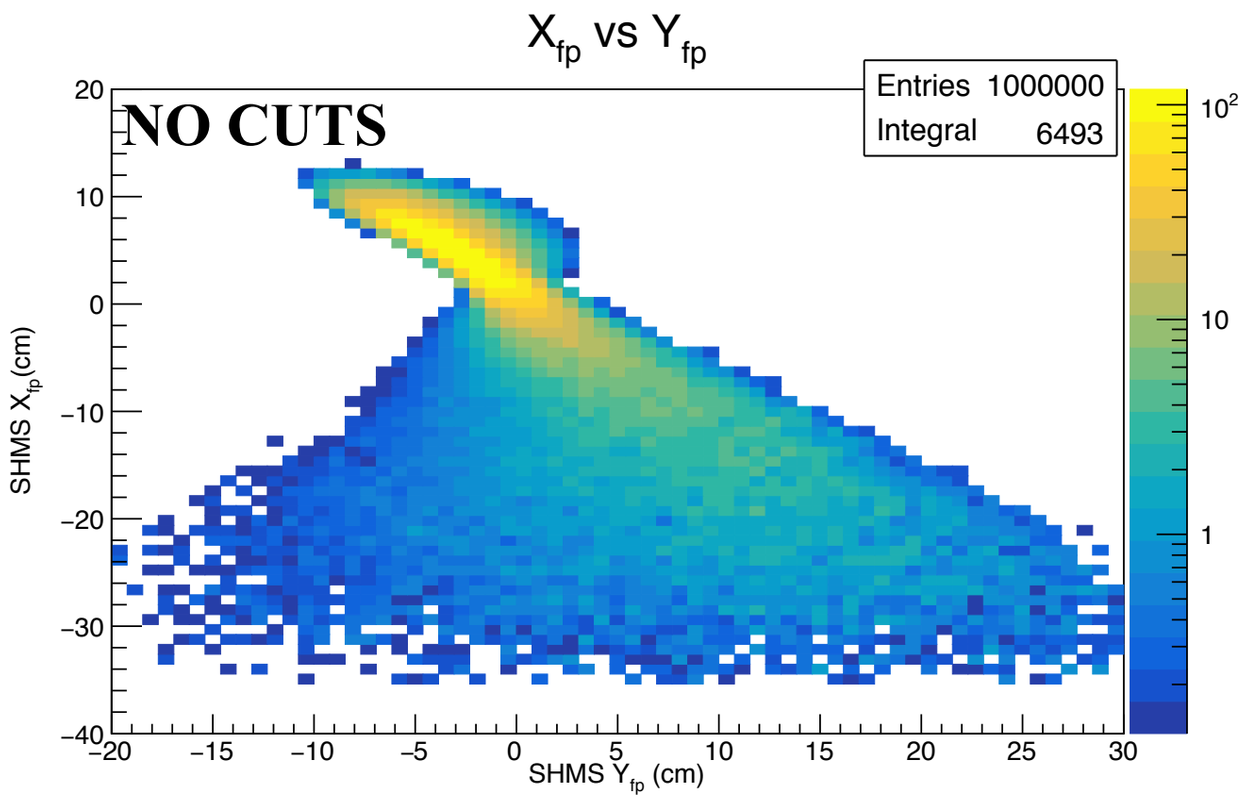
FOCAL PLANE / RECONSTRUCTED

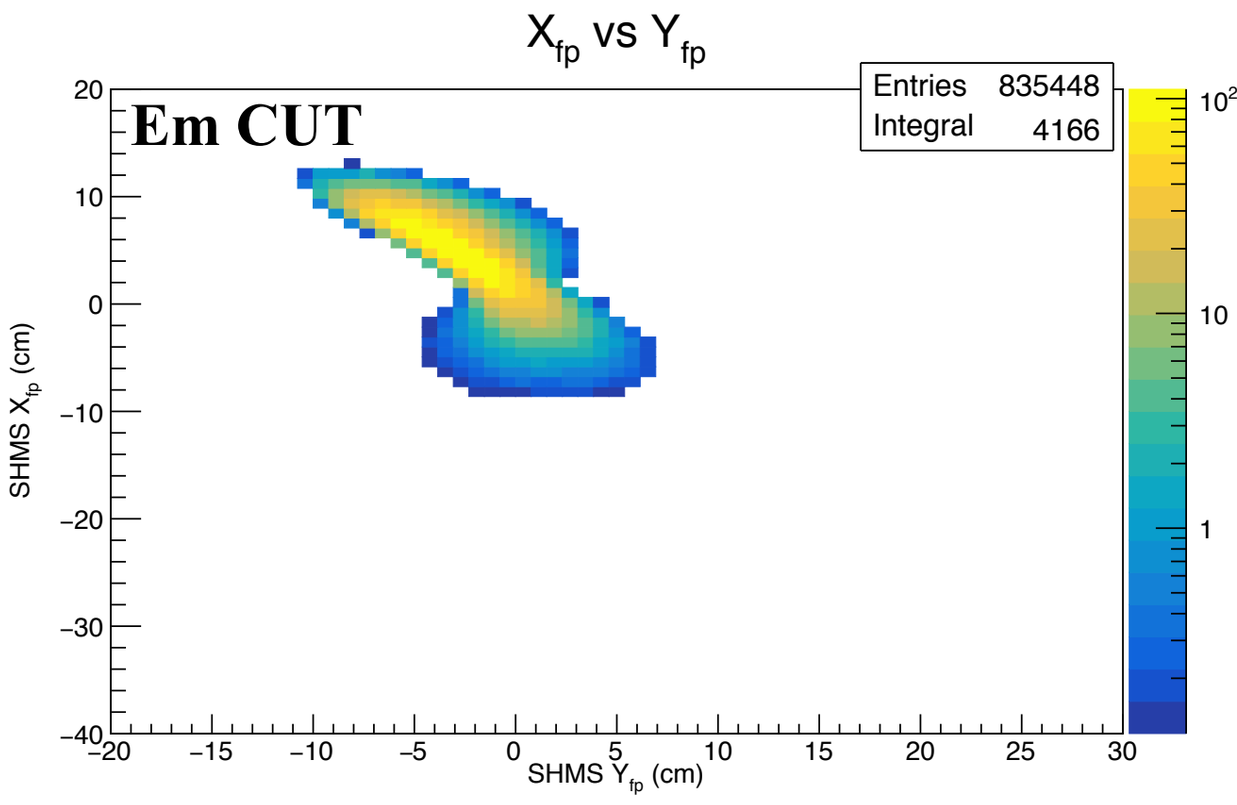
Variables (SIMC)

Model: FSI

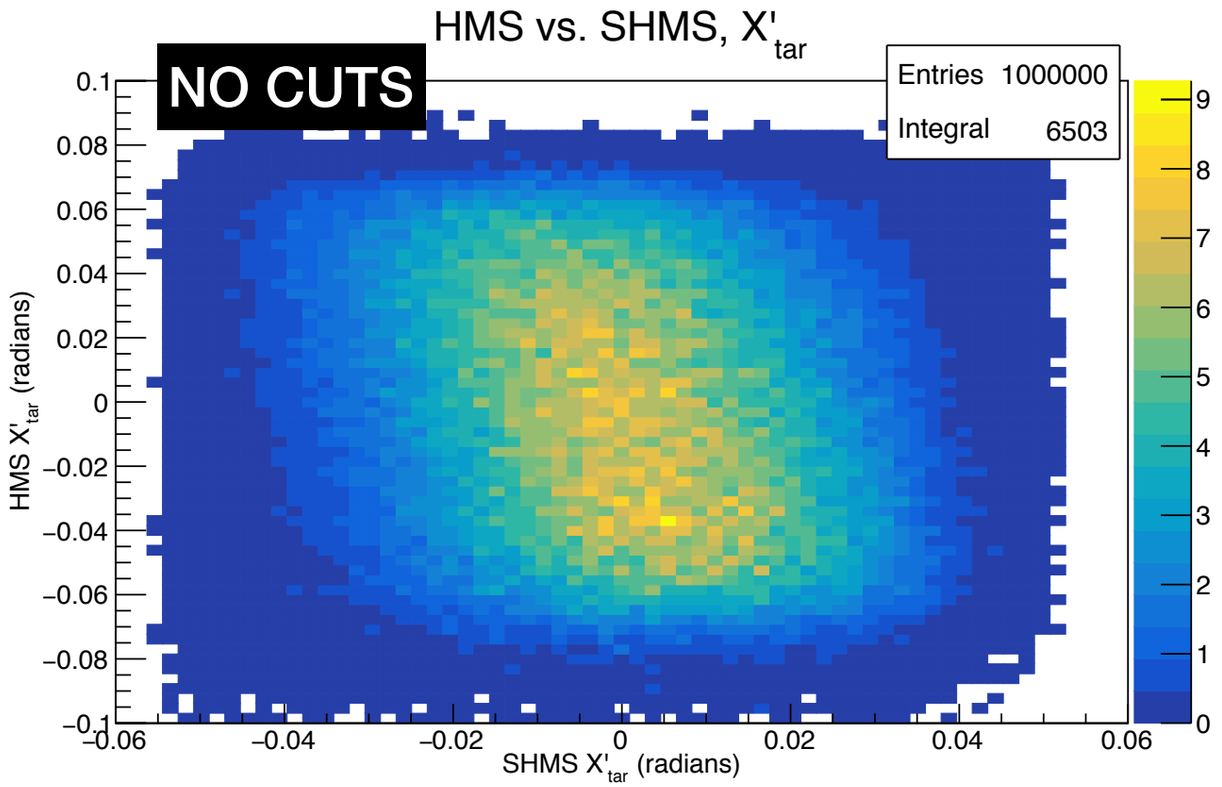

X_{fp} vs Y_{fp}
NO CUTS
Entries 1000000
Integral 6504
HMS X_{fp} (cm)
HMS Y_{fp} (cm)

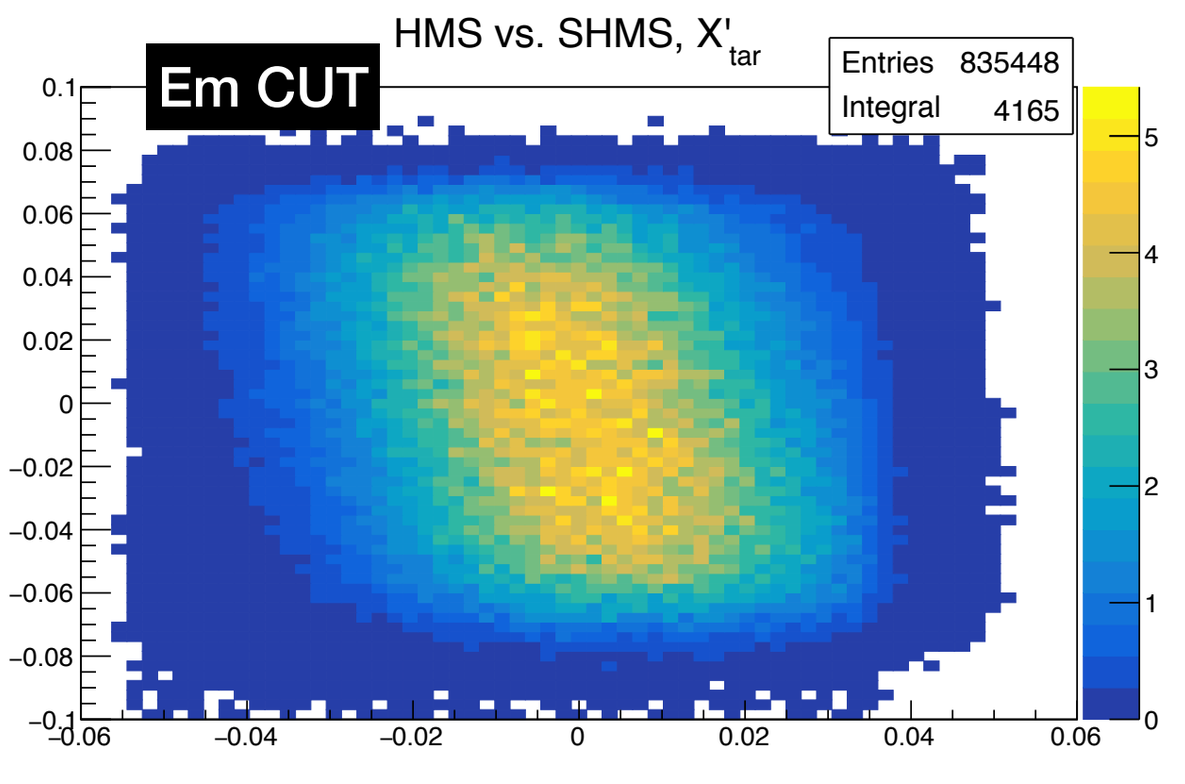

X_{fp} vs Y_{fp}
Em CUT
Entries 835448
Integral 4166
HMS X_{fp} (cm)
HMS Y_{fp} (cm)

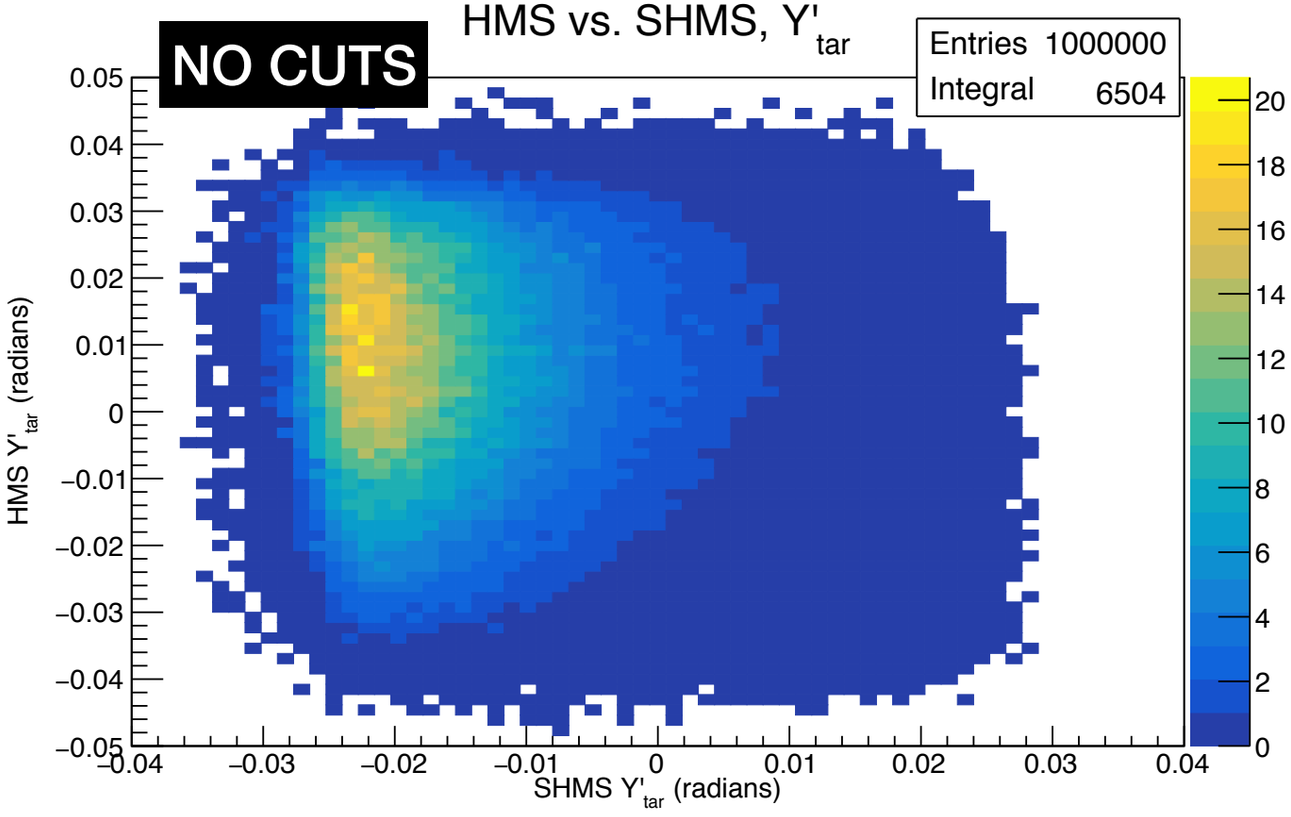

X_{fp} vs Y_{fp}
NO CUTS
Entries 1000000
Integral 6493
SHMS X_{fp} (cm)
SHMS Y_{fp} (cm)

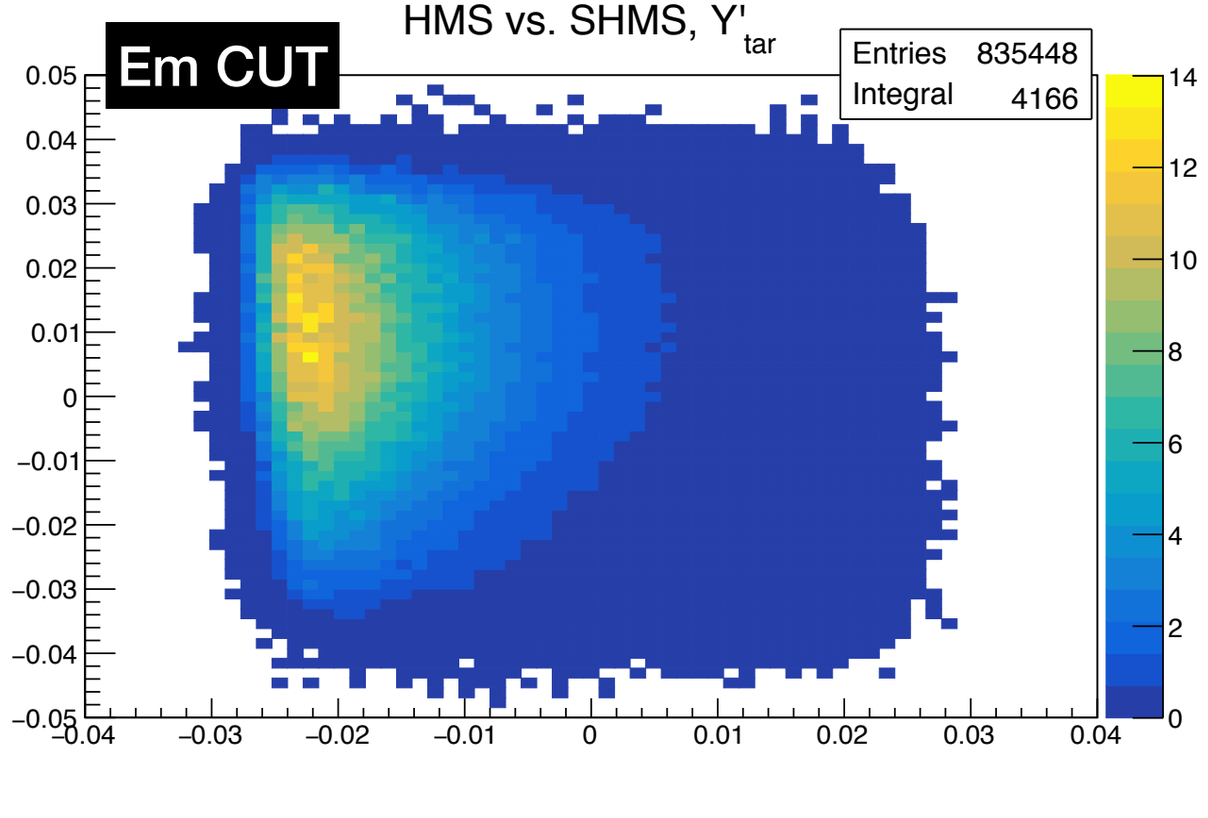

X_{fp} vs Y_{fp}
Em CUT
Entries 835448
Integral 4166
SHMS X_{fp} (cm)
SHMS Y_{fp} (cm)

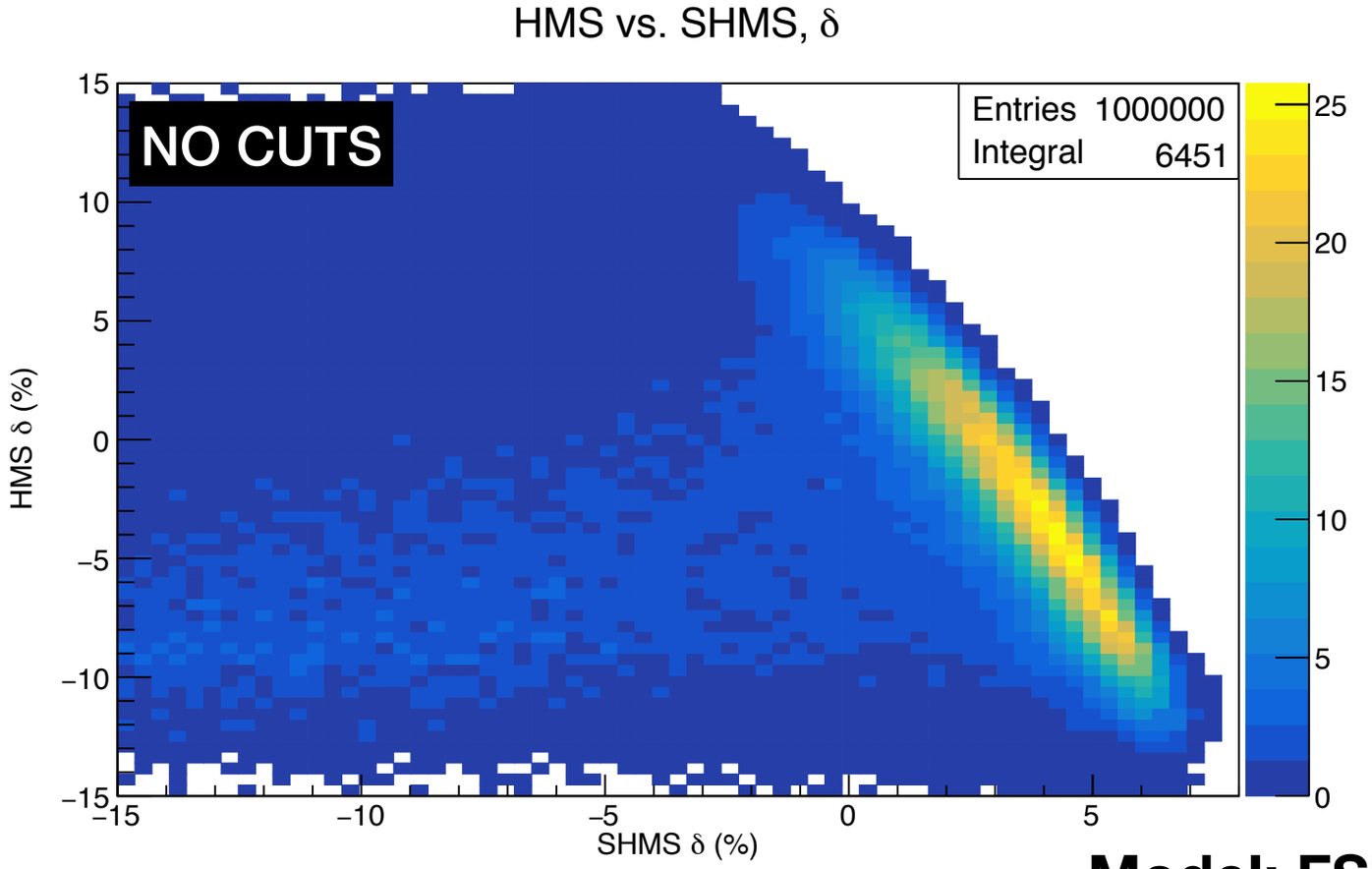
Model: FSI


NO CUTS
HMS vs. SHMS, X'tar
Entries 1000000
Integral 6503
HMS X'tar (radians)
SHMS X'tar (radians)

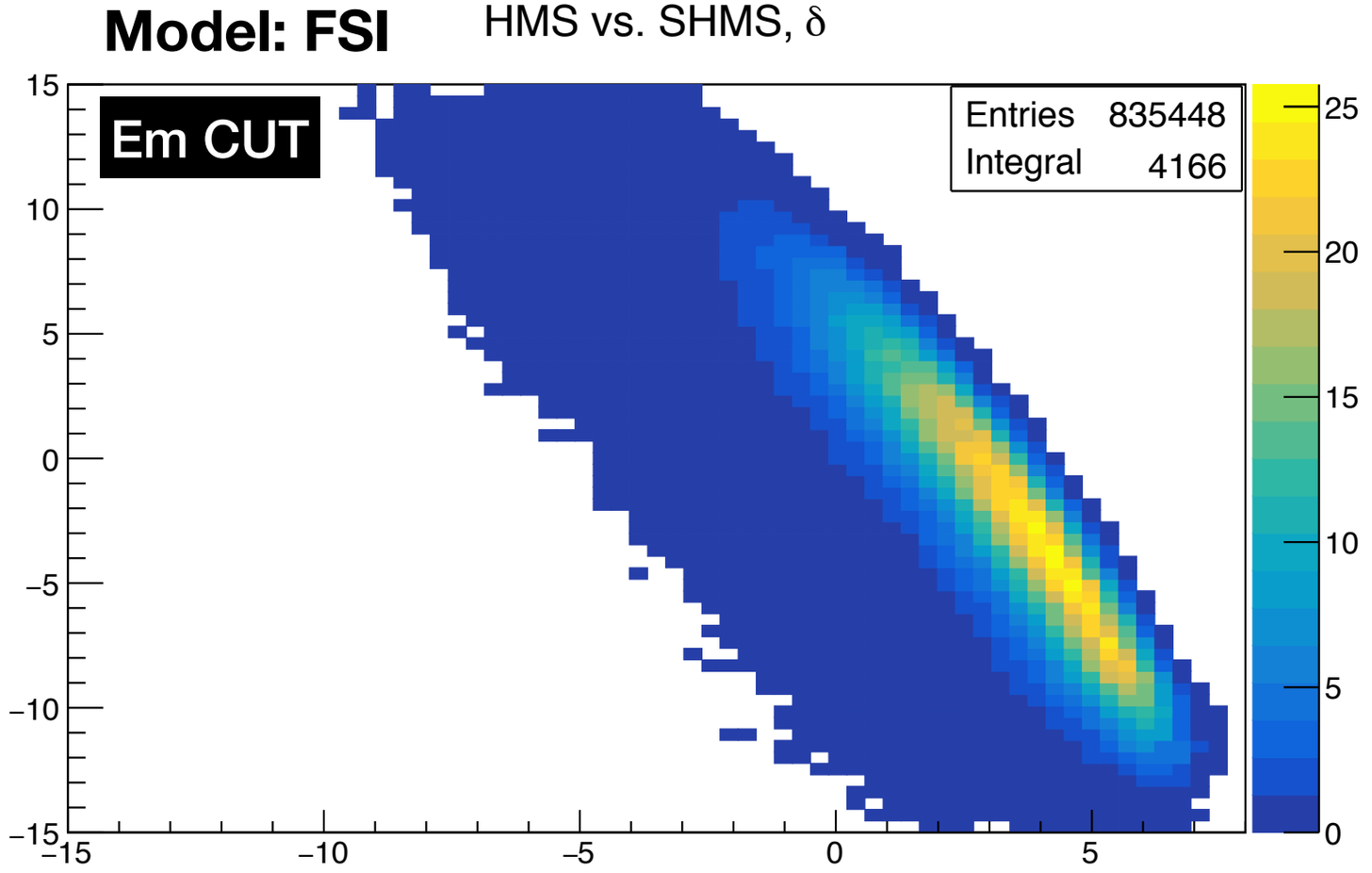

Em CUT
HMS vs. SHMS, X'tar
Entries 835448
Integral 4165


NO CUTS
HMS vs. SHMS, Y'tar
Entries 1000000
Integral 6504
HMS Y'tar (radians)
SHMS Y'tar (radians)


Em CUT
HMS vs. SHMS, Y'tar
Entries 835448
Integral 4166


HMS vs. SHMS, δ
NO CUTS
Entries 1000000
Integral 6451
HMS δ (%)
SHMS δ (%)
15
10
5
0
−5
−10
−15
−15
−10
−5
0
5
25
20
15
10
5
0

Model: FSI


HMS vs. SHMS, δ
Em CUT
Entries 835448
Integral 4166
15
10
5
0
−5
−10
−15
−15
−10
−5
0
5
25
20
15
10
5
0

Apply Kinematic CUTS based on kinematic regions where FSI~PWIA (see Slide 38)

Applied CUTS in Next Slides:

-40 < Em < 80 MeV

4.0 < Q2 < 5.0 GeV2

1.3 < xBj < 1.7

missing momentum

Entries	199029
Integral	489.5
Entries	199029
Integral	429

Pm = 750 MeV/c

PWIA
FSI

CUTS:
-40 < Em < 80 MeV
4.0 < Q2 < 5.0 GeV2
1.3 < xBj < 1.7

Beam Current: 40 uA
Beam Time: 42 hrs

Expected # of Good Neutrons (FSI ~ small)

Yield: 429 evts
Yield: 489.5 evts

Estimated Rates:
FSI: ~ 10.2 evts / hr
PWIA: ~ 11.6 evts / hr

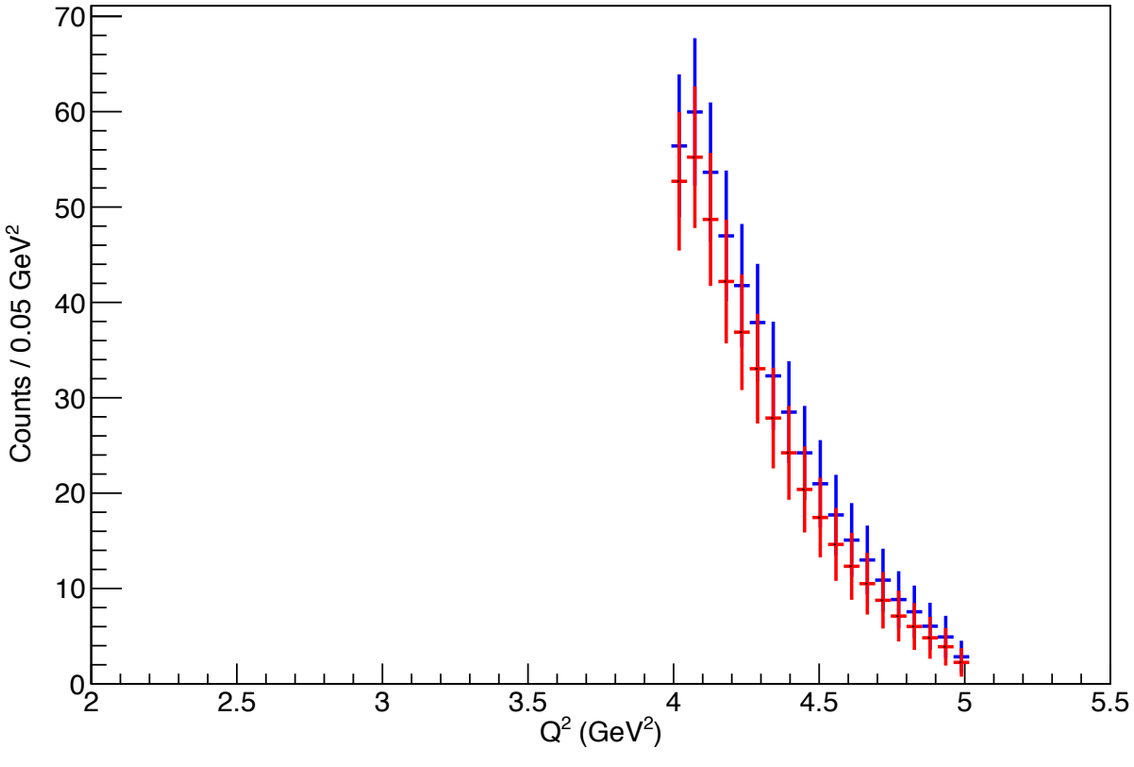
Counts / 25 MeV

0 10 20 30 40 50

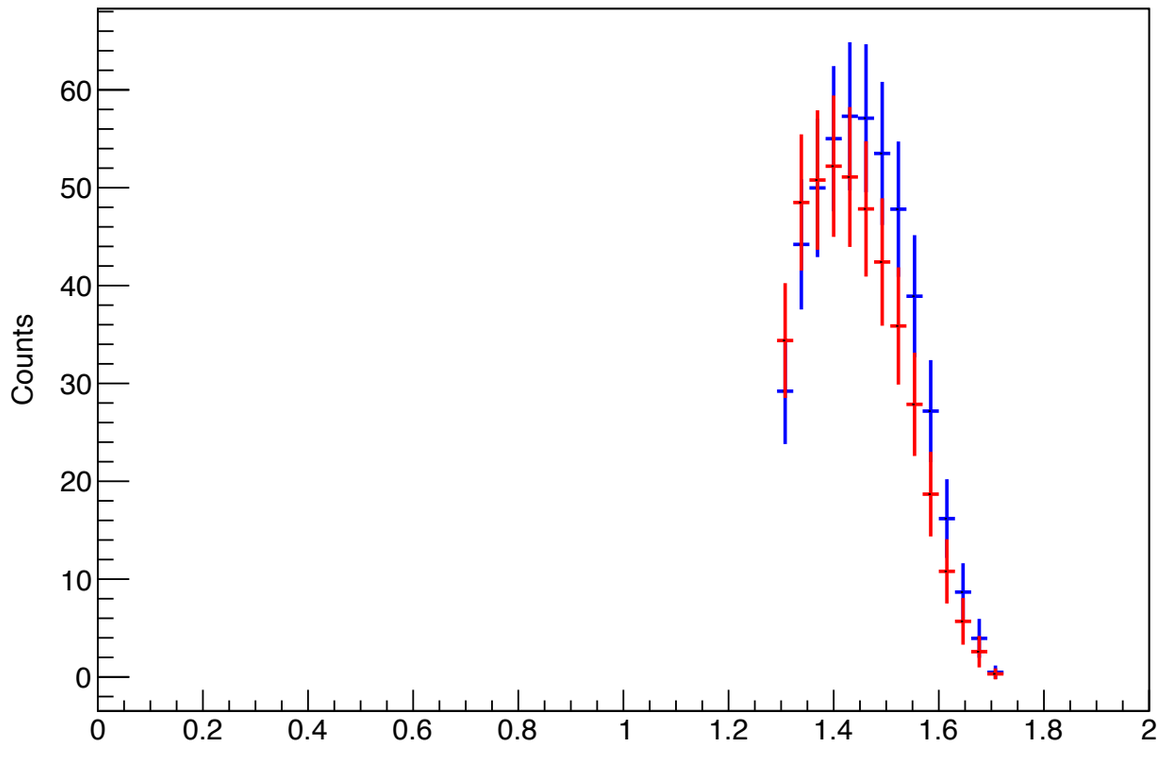
0 0.5 1 1.5 2 2.5

Missing Momentum (GeV/c)

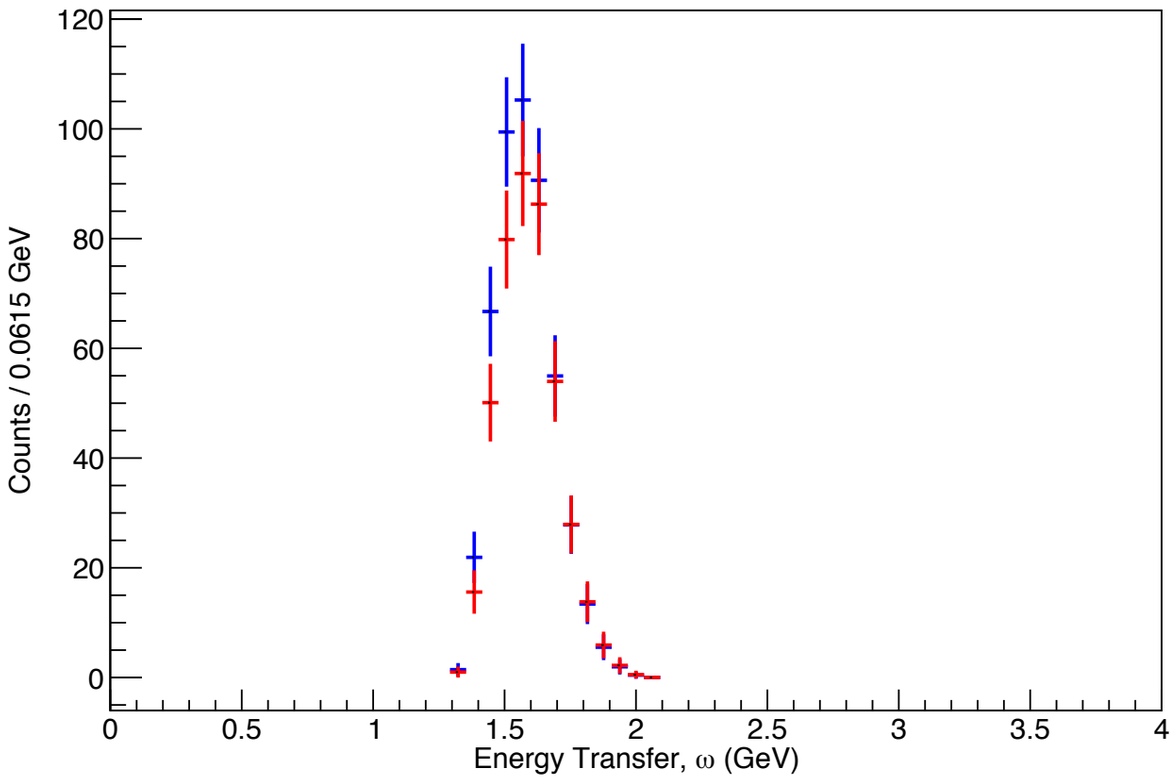
Q2



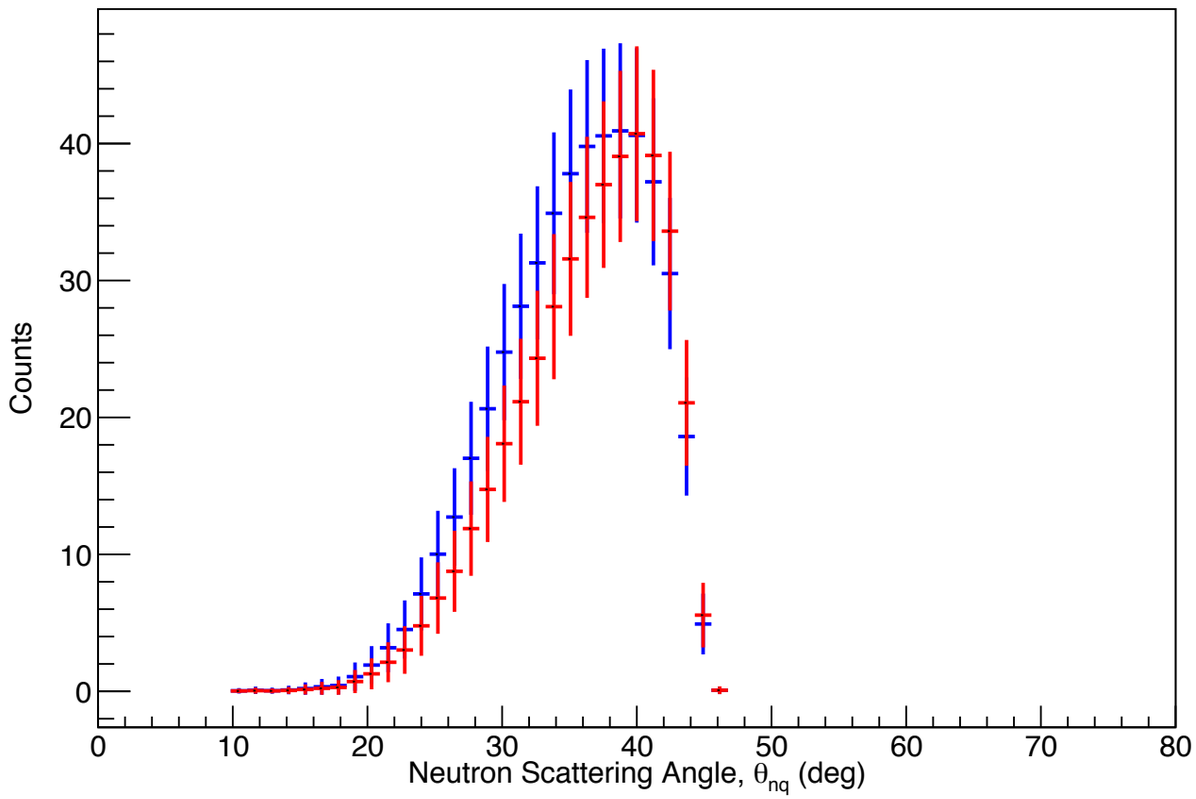
x-Bjorken

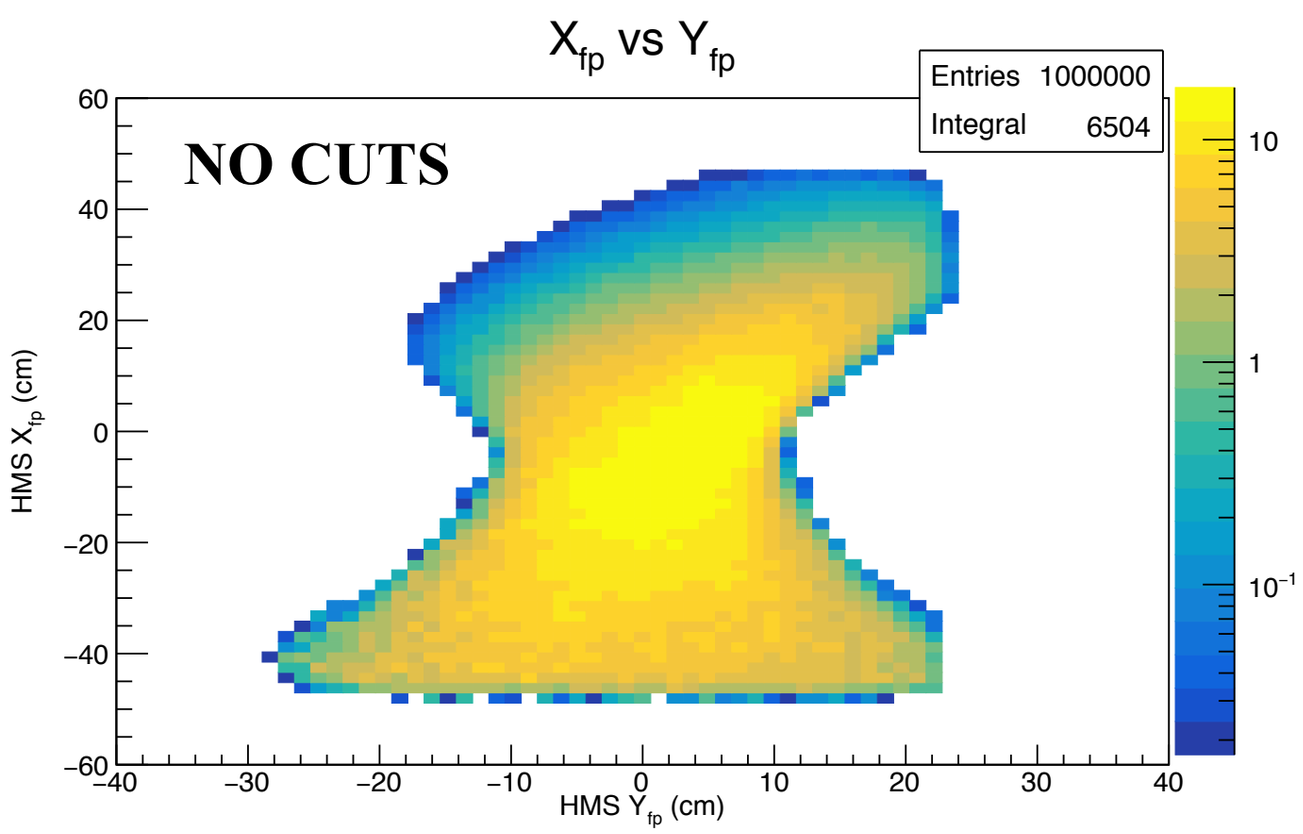


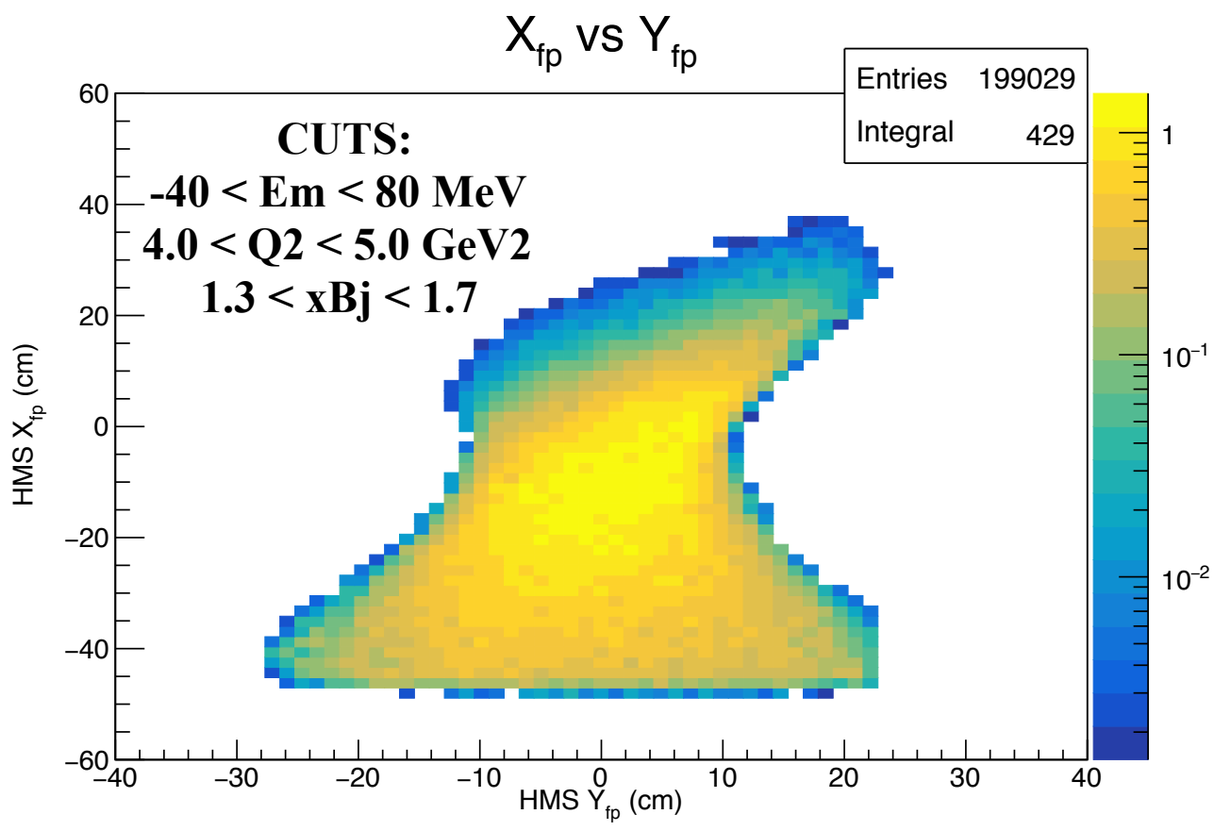
Energy Transfer, ω

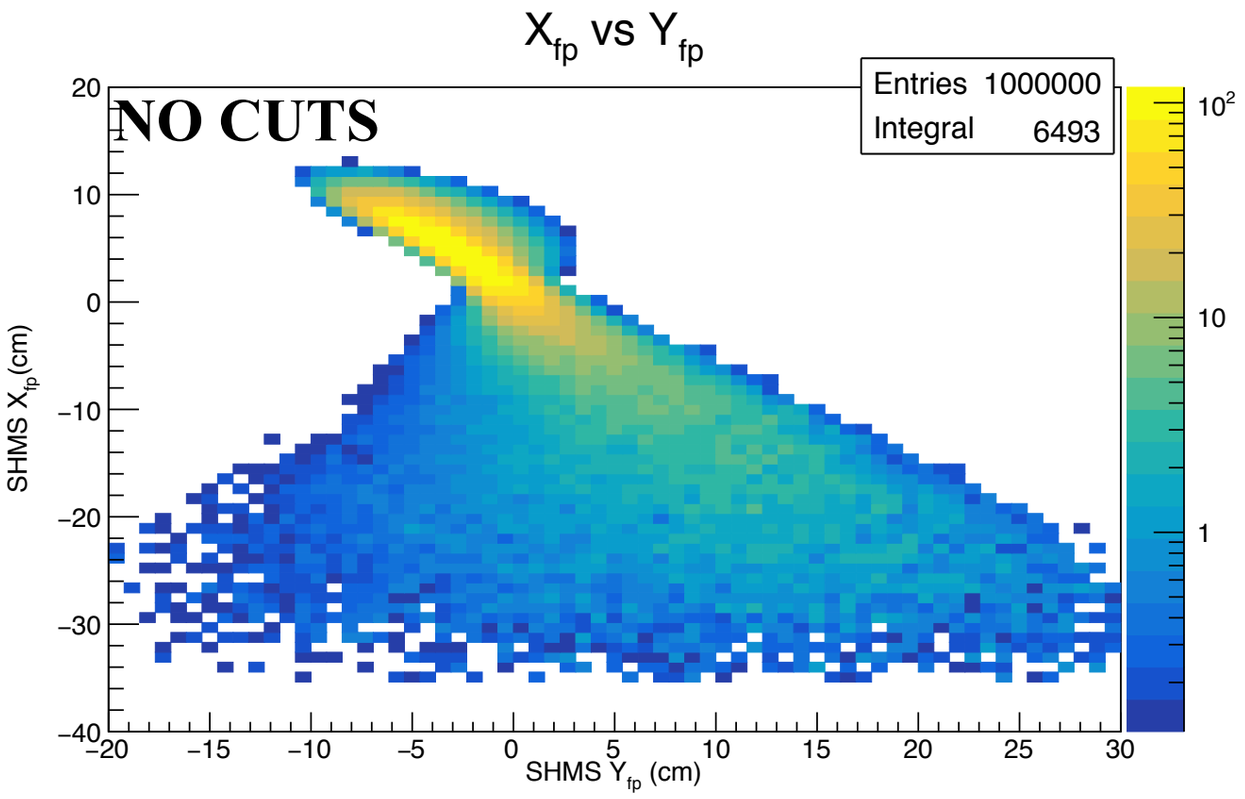


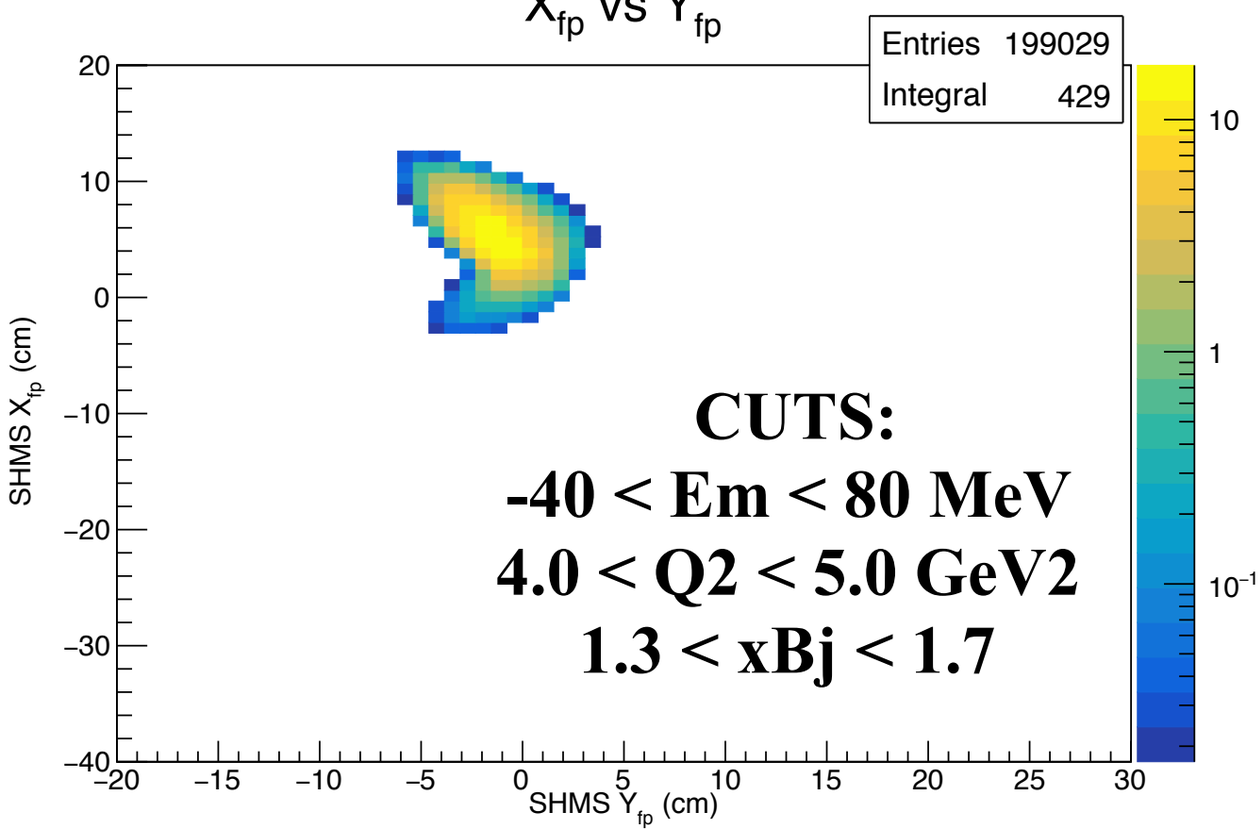
Neutron Angle, θ_{nq}

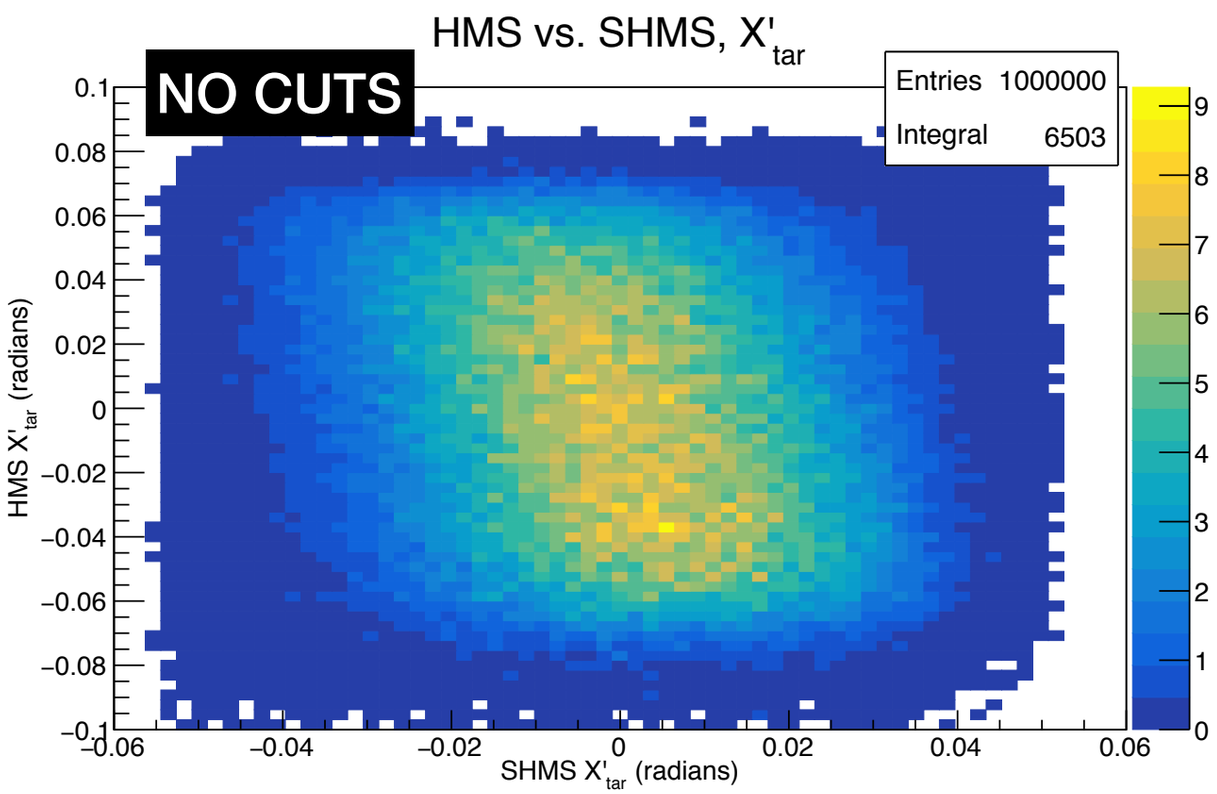


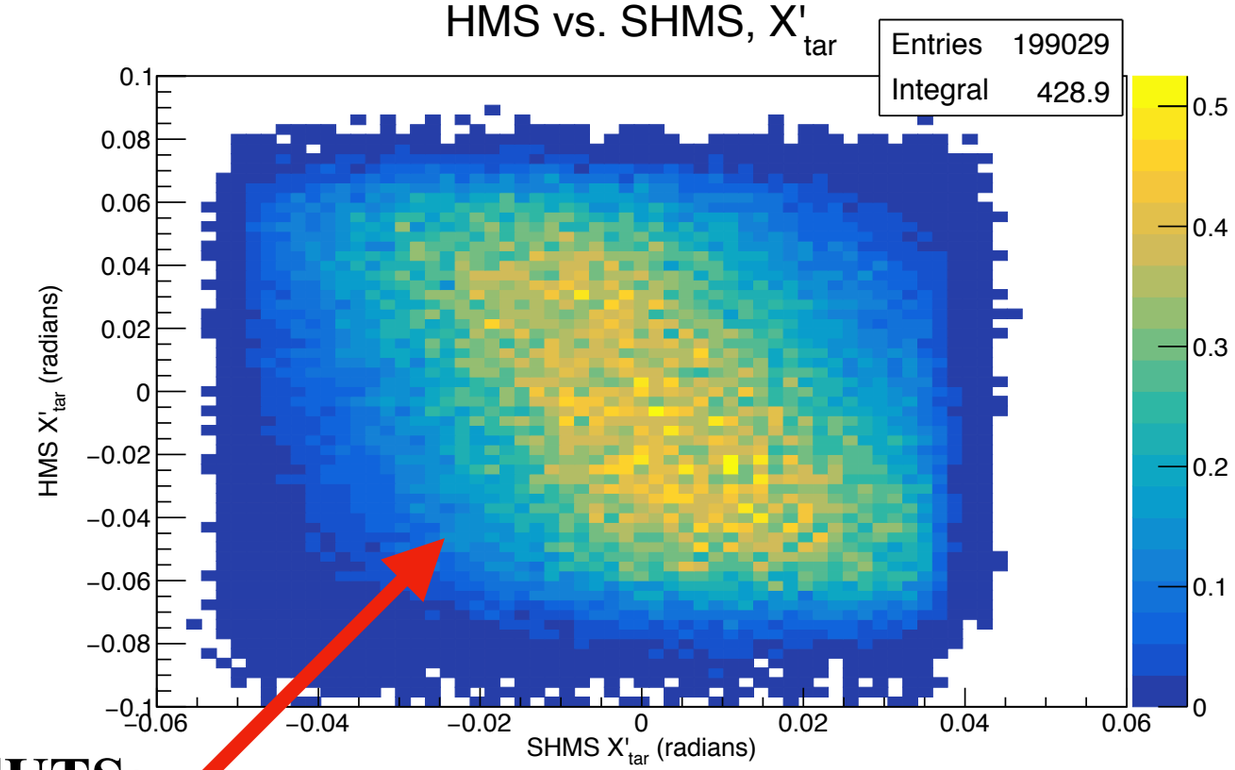

X_fp vs Y_fp
NO CUTS
Entries 1000000
Integral 6504
HMS X_fp (cm)
HMS Y_fp (cm)


X_fp vs Y_fp
CUTS:
-40 < Em < 80 MeV
4.0 < Q2 < 5.0 GeV2
1.3 < xBj < 1.7
Entries 199029
Integral 429
HMS X_fp (cm)
HMS Y_fp (cm)


X_fp vs Y_fp
NO CUTS
Entries 1000000
Integral 6493
SHMS X_fp (cm)
SHMS Y_fp (cm)


X_fp vs Y_fp
CUTS:
-40 < Em < 80 MeV
4.0 < Q2 < 5.0 GeV2
1.3 < xBj < 1.7
Entries 199029
Integral 429
SHMS X_fp (cm)
SHMS Y_fp (cm)



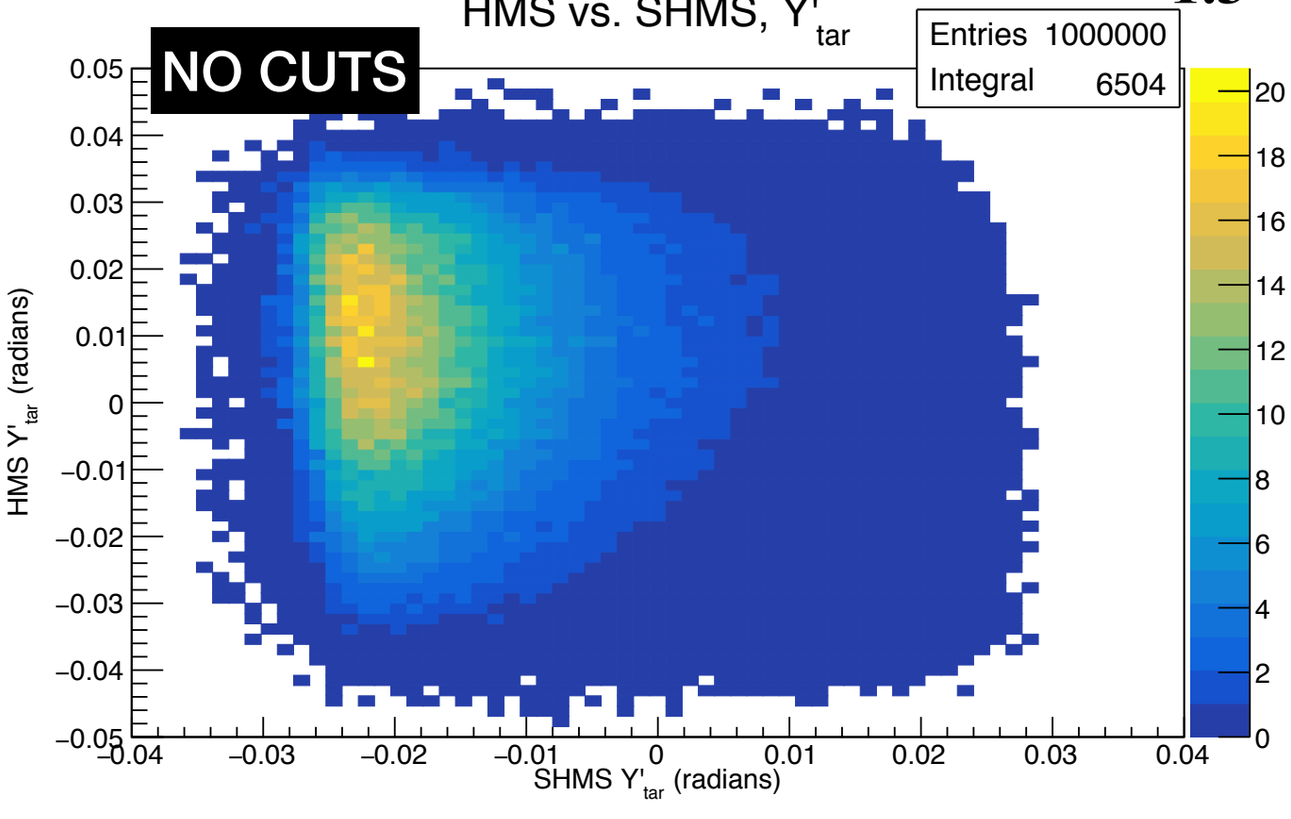


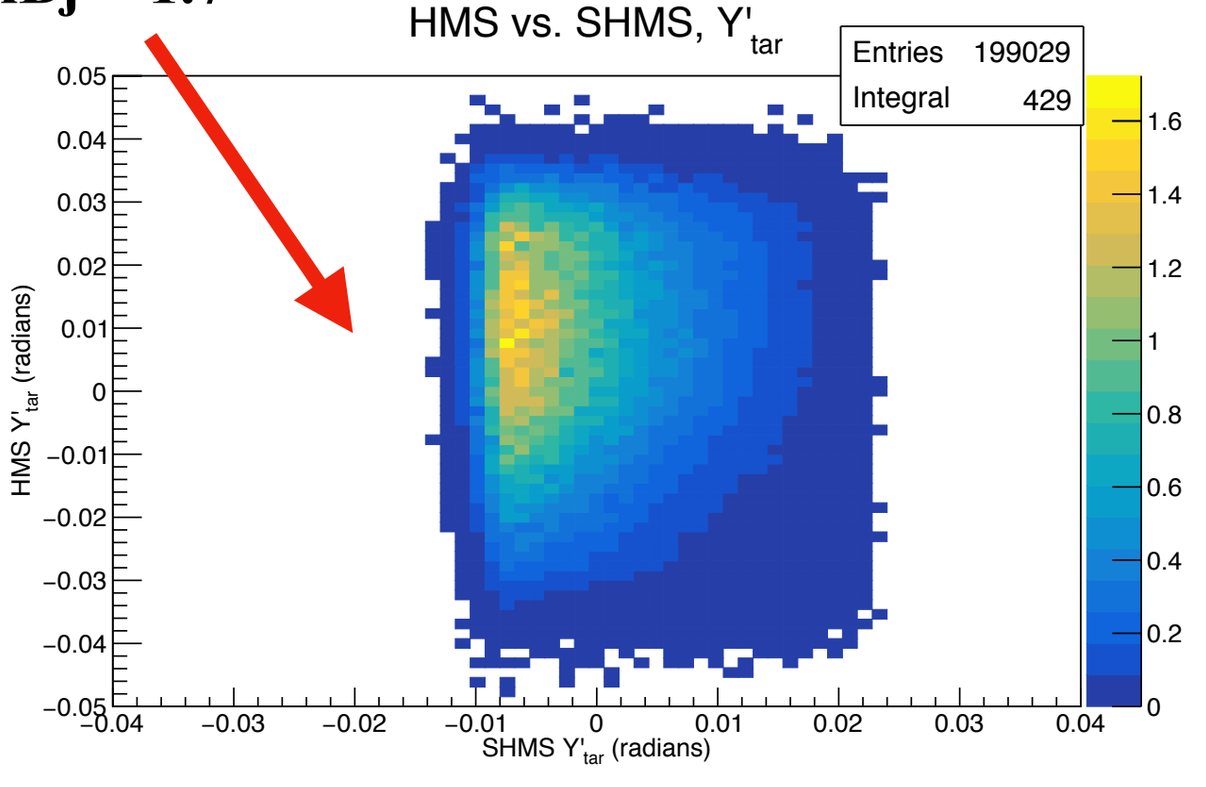
CUTS:

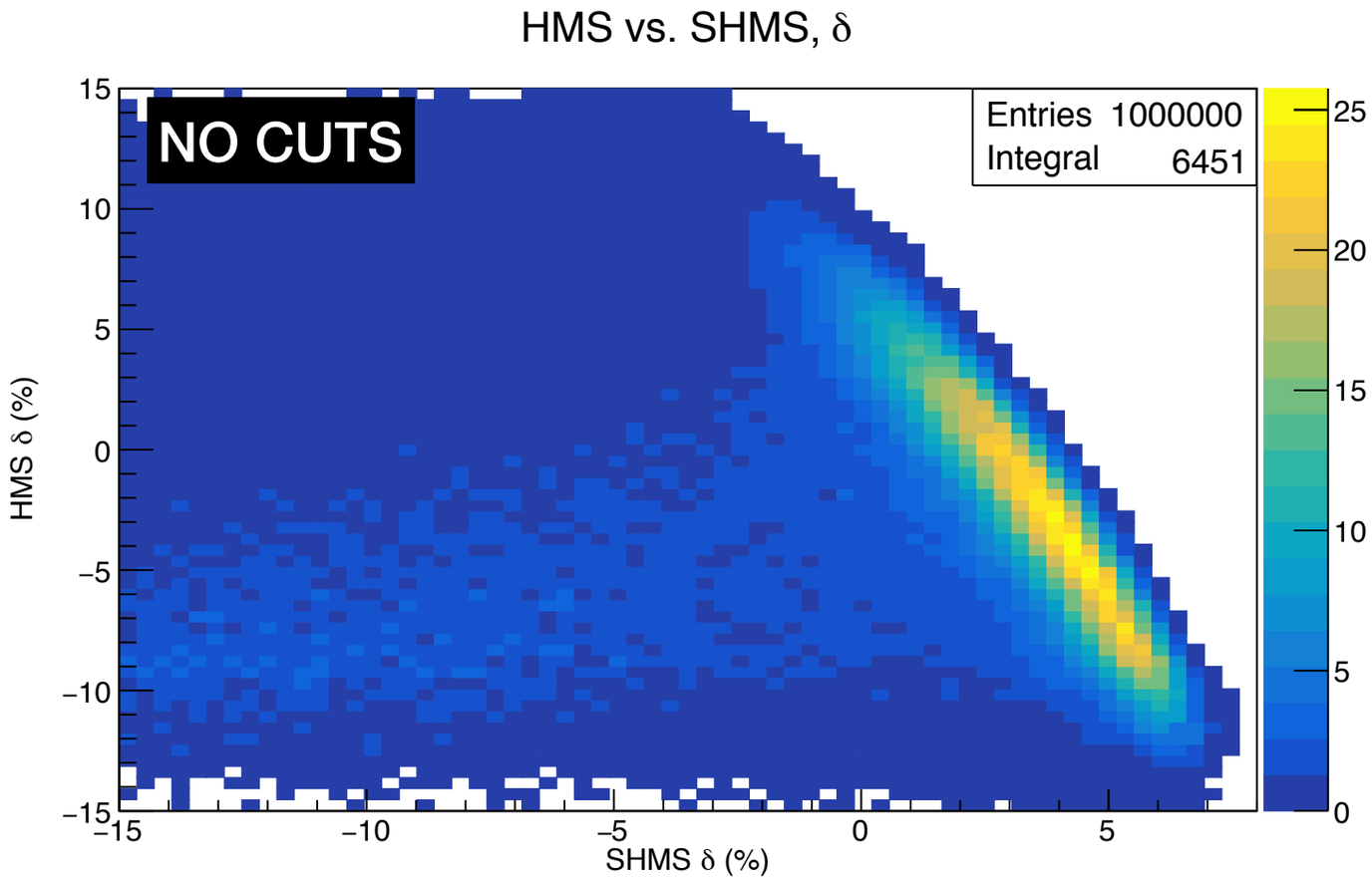
-40 < Em < 80 MeV

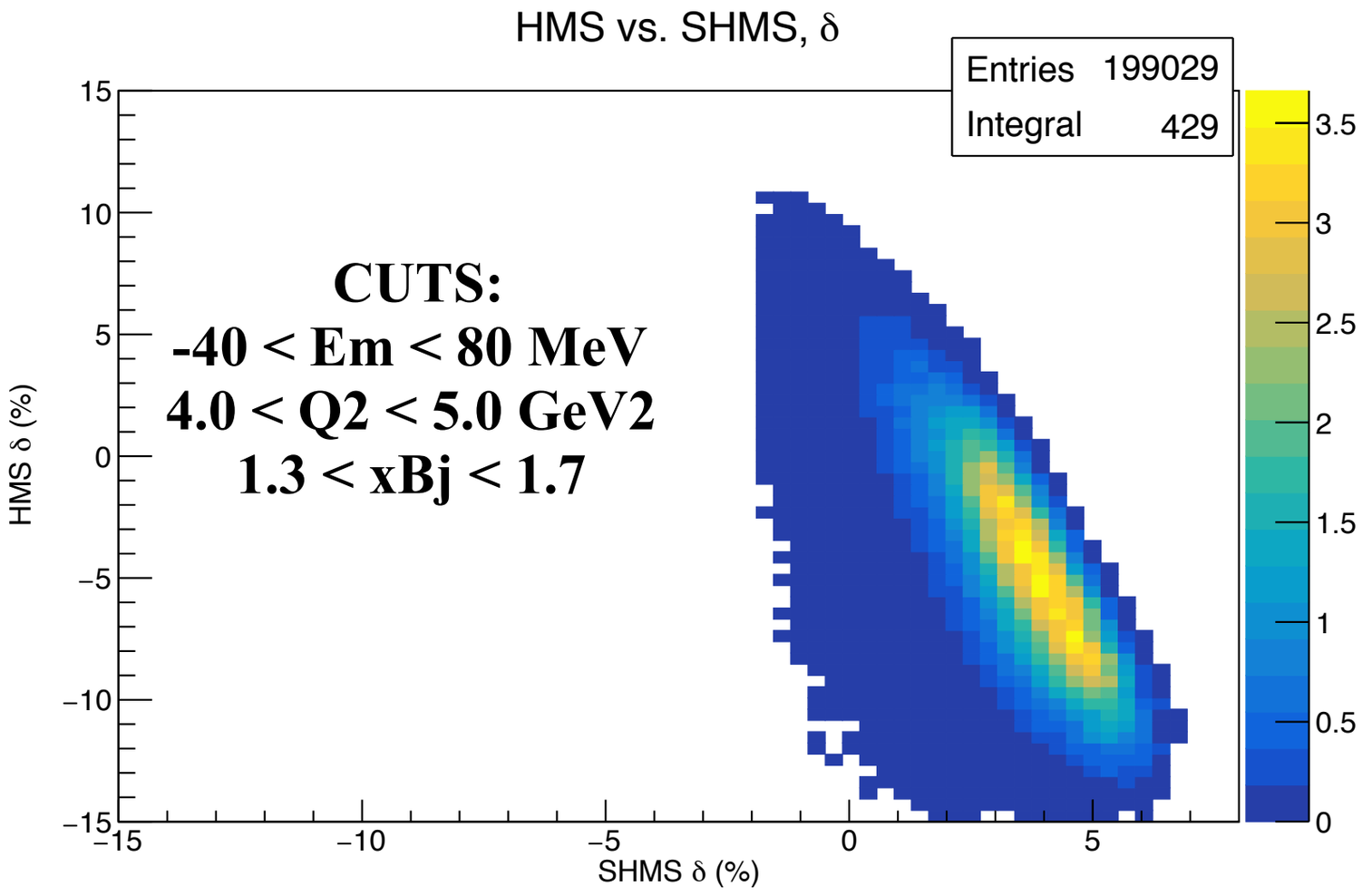
4.0 < Q2 < 5.0 GeV2

1.3 < xBj < 1.7






HMS vs. SHMS, δ
NO CUTS
Entries 1000000
Integral 6451
HMS δ (%)
SHMS δ (%)
15
10
5
0
−5
−10
−15
−15
−10
−5
0
5
25
20
15
10
5
0


HMS vs. SHMS, δ
Entries 199029
Integral 429
CUTS:
-40 < Em < 80 MeV
4.0 < Q2 < 5.0 GeV2
1.3 < xBj < 1.7
HMS δ (%)
SHMS δ (%)
15
10
5
0
−5
−10
−15
−15
−10
−5
0
5
3.5
3
2.5
2
1.5
1
0.5
0