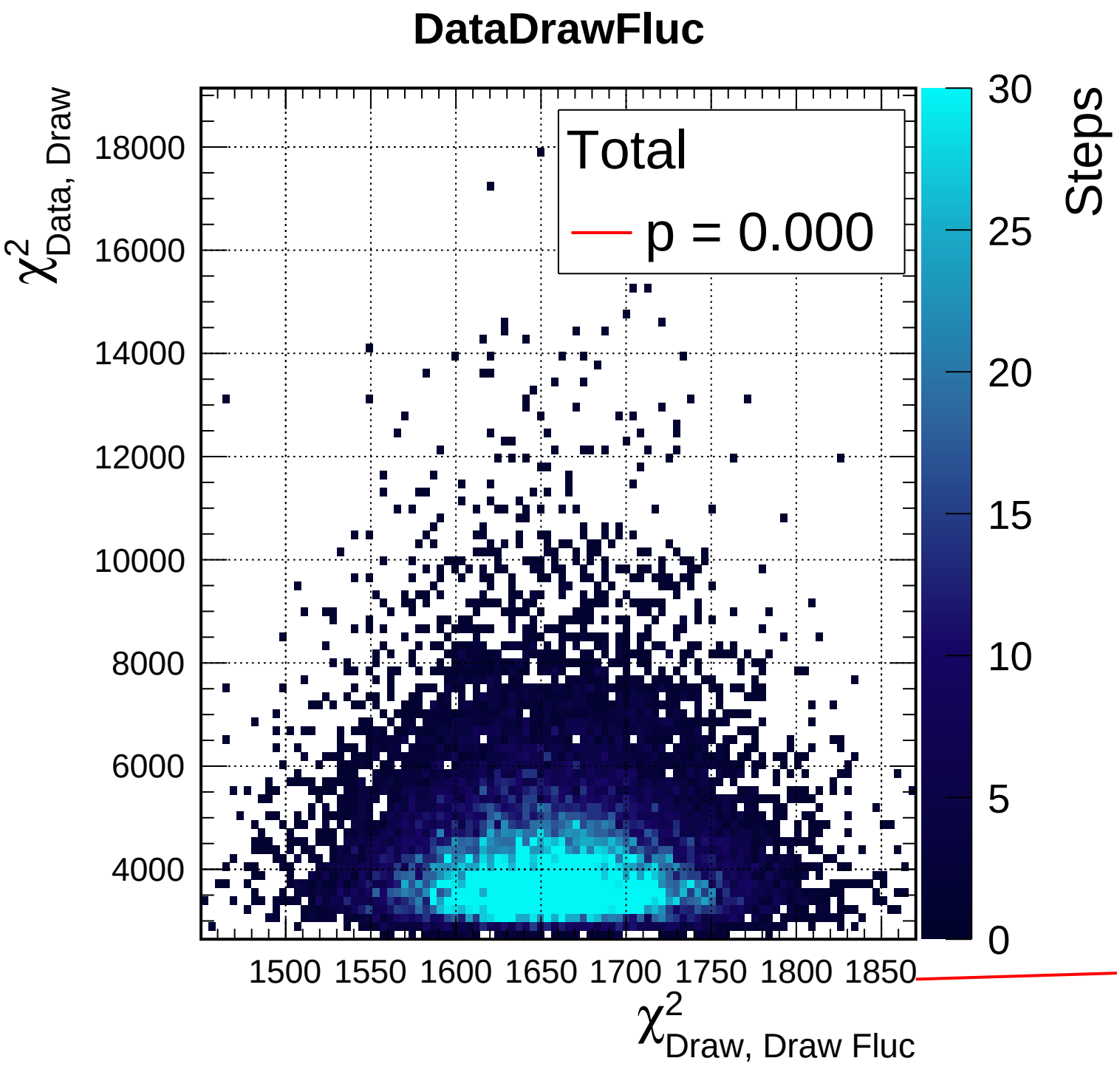
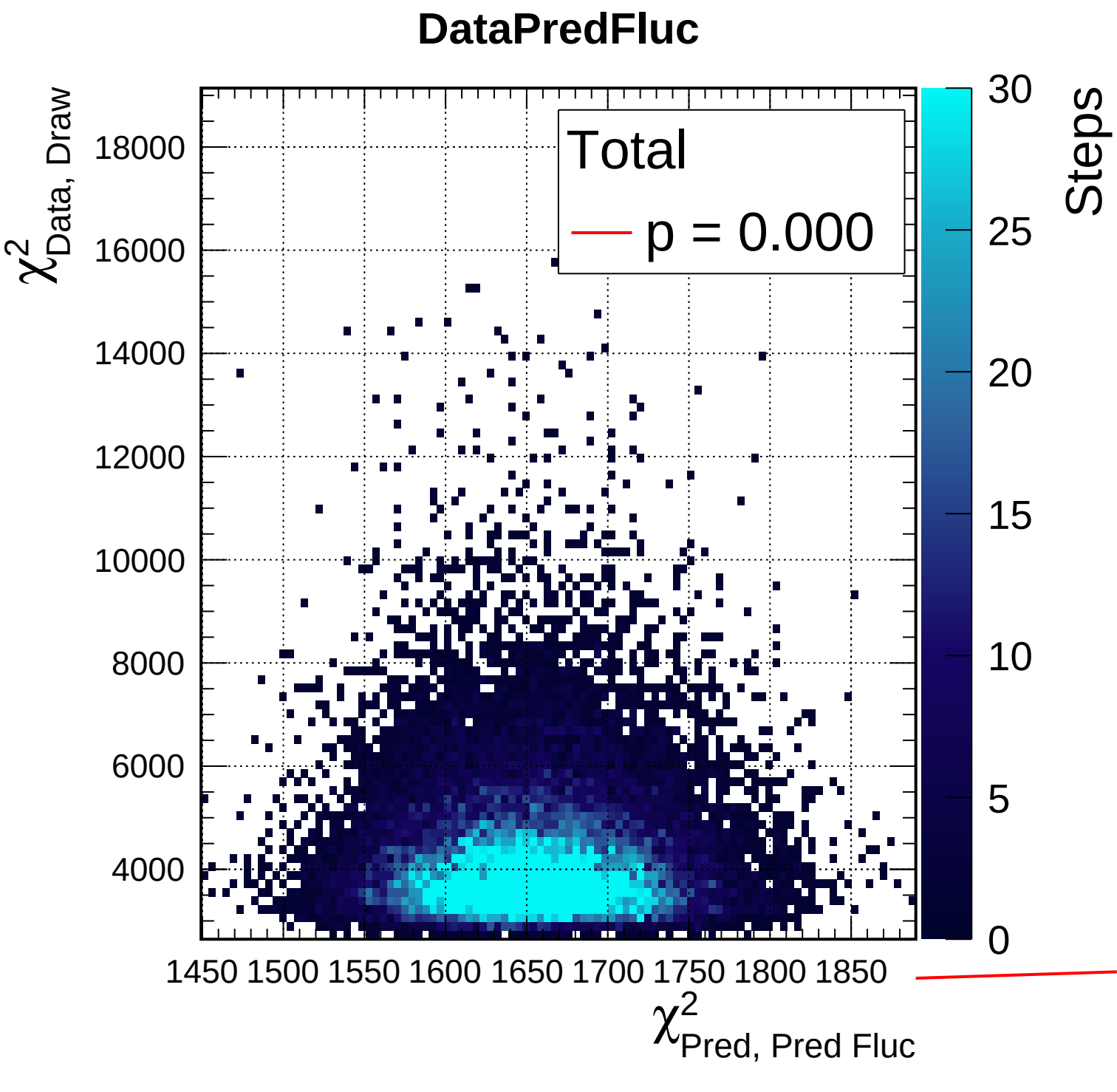
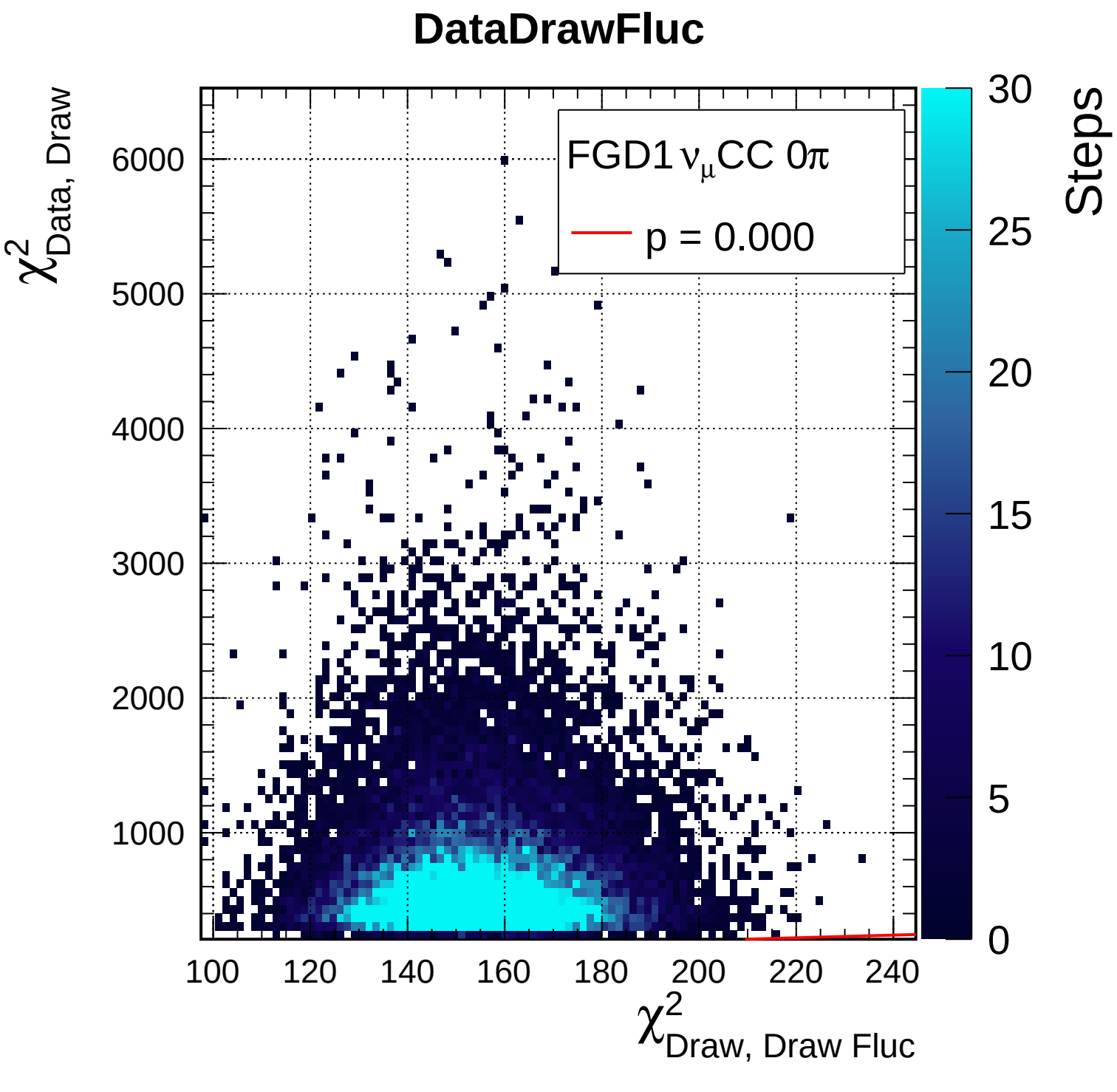
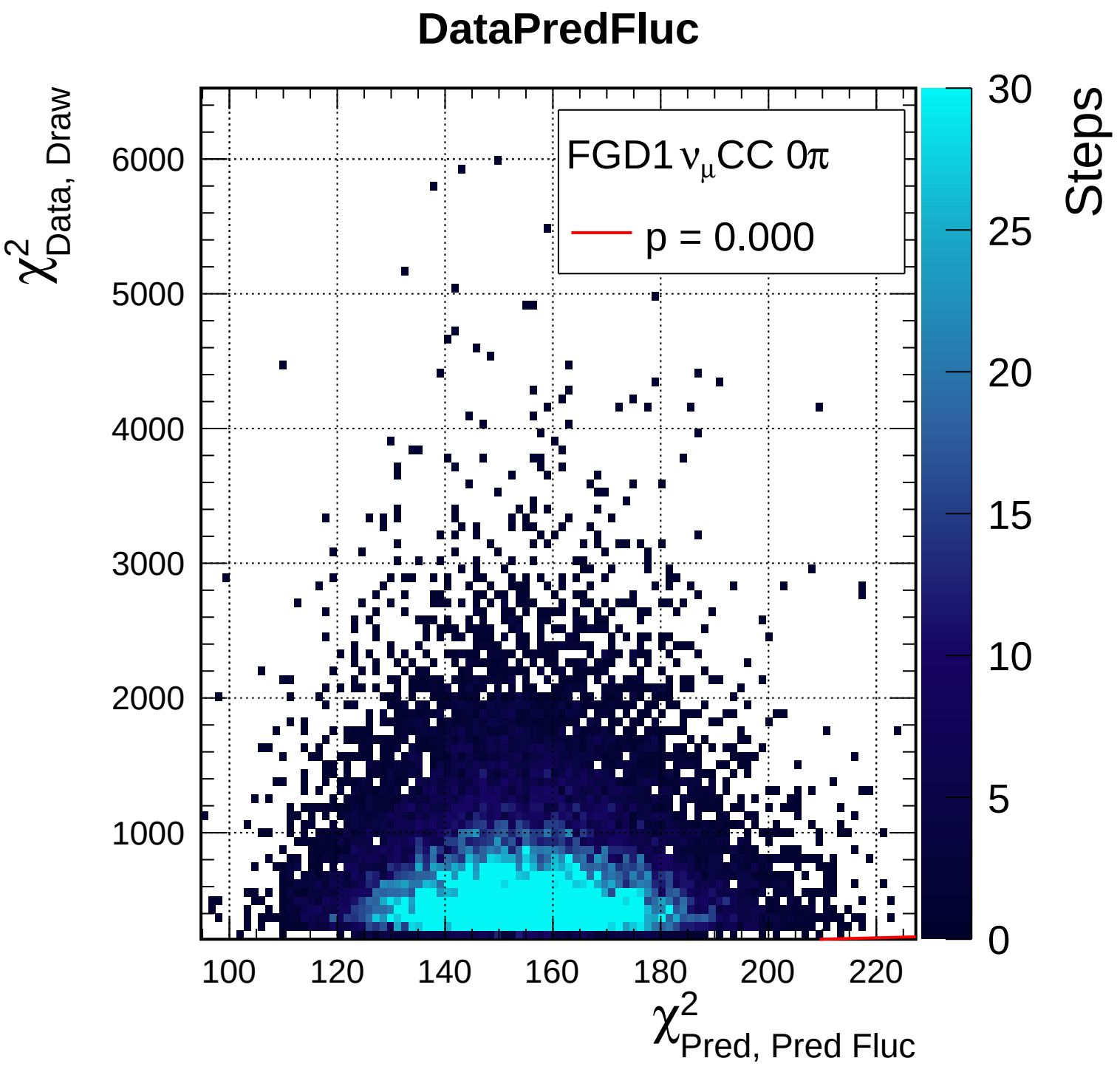
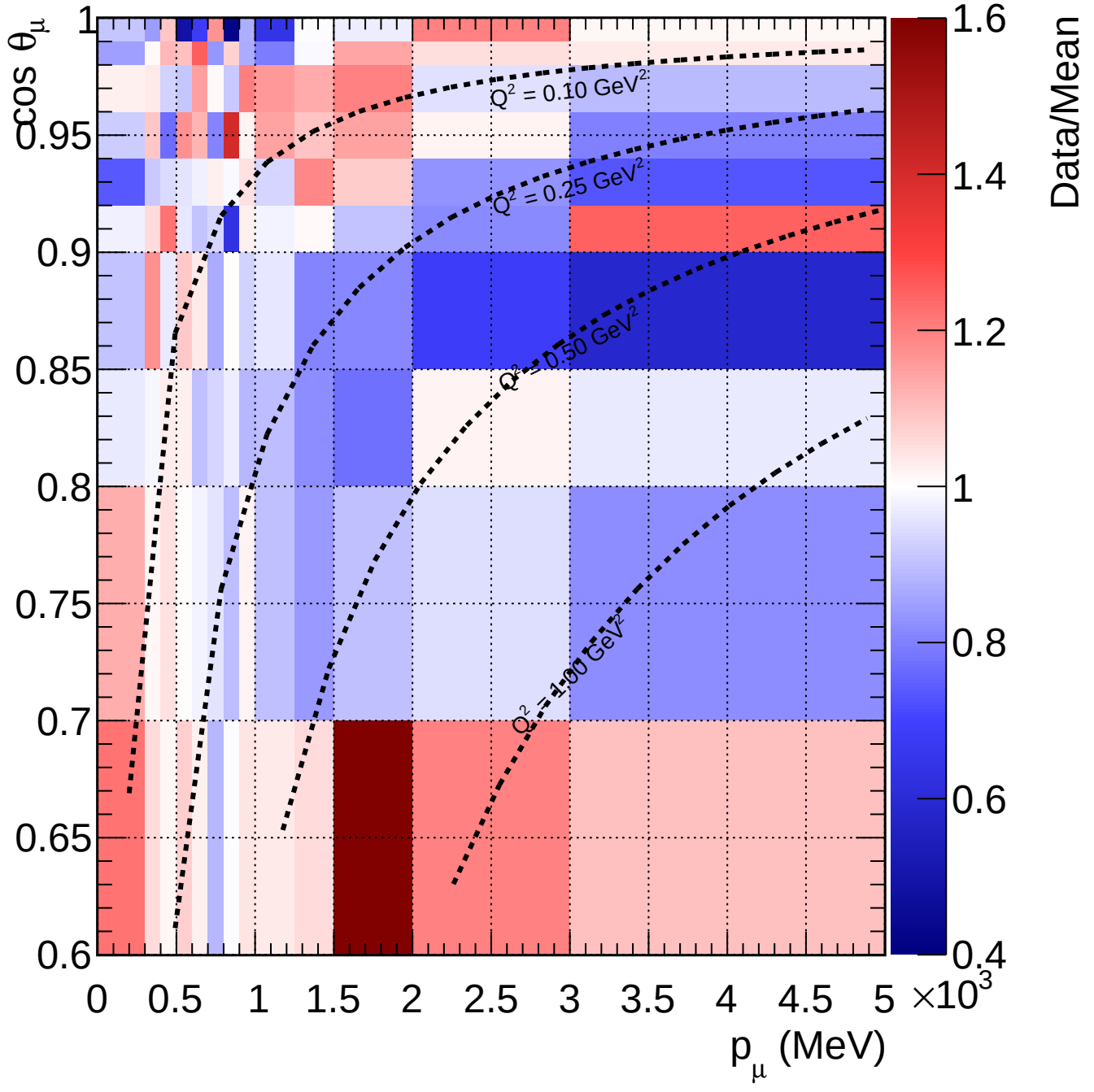
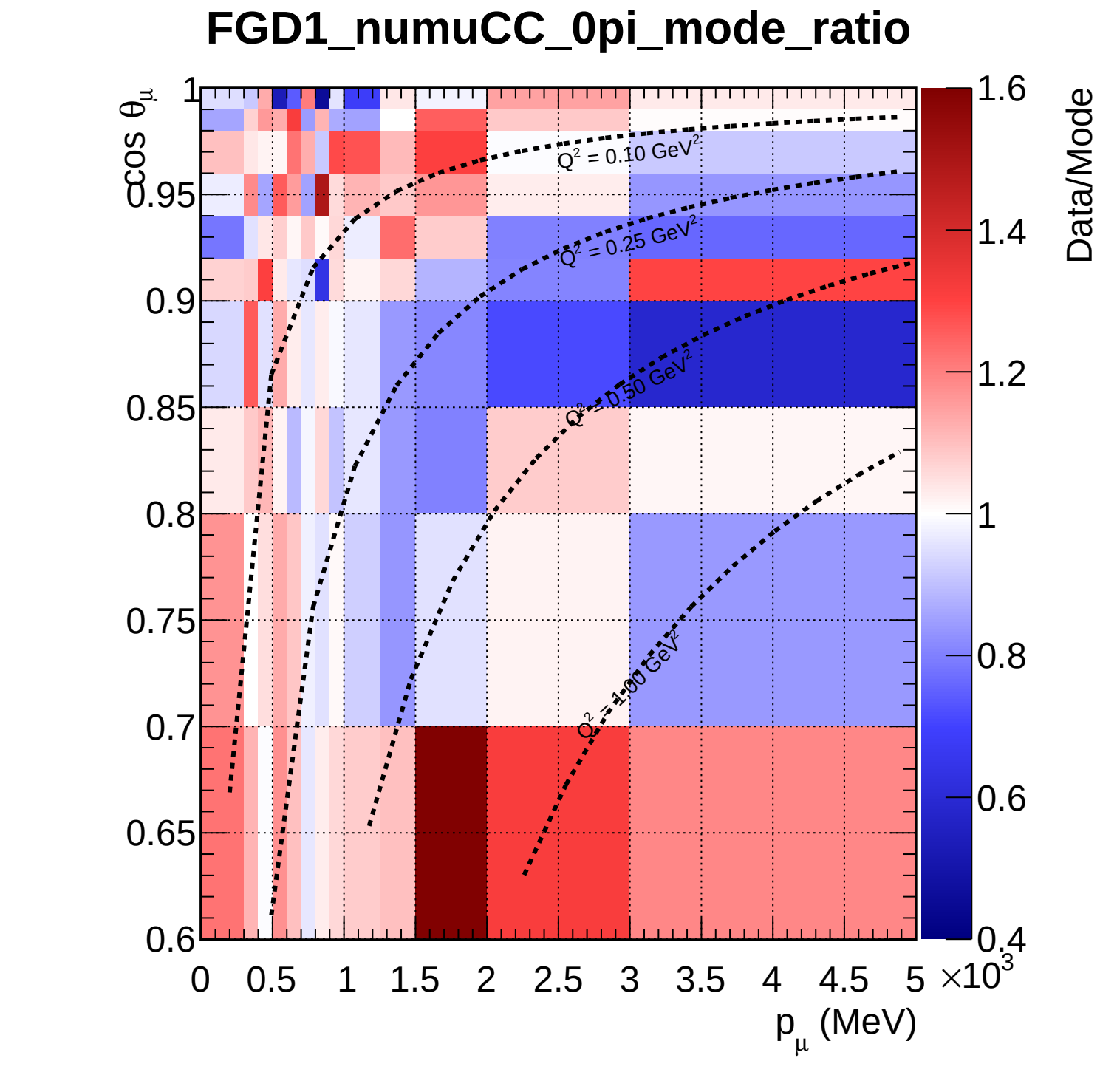

DataDrawFluc
Total
p = 0.000
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Draw, Draw Fluc}}$
Steps
18000
16000
14000
12000
10000
8000
6000
4000
1500 1550 1600 1650 1700 1750 1800 1850
30
25
20
15
10
5
0

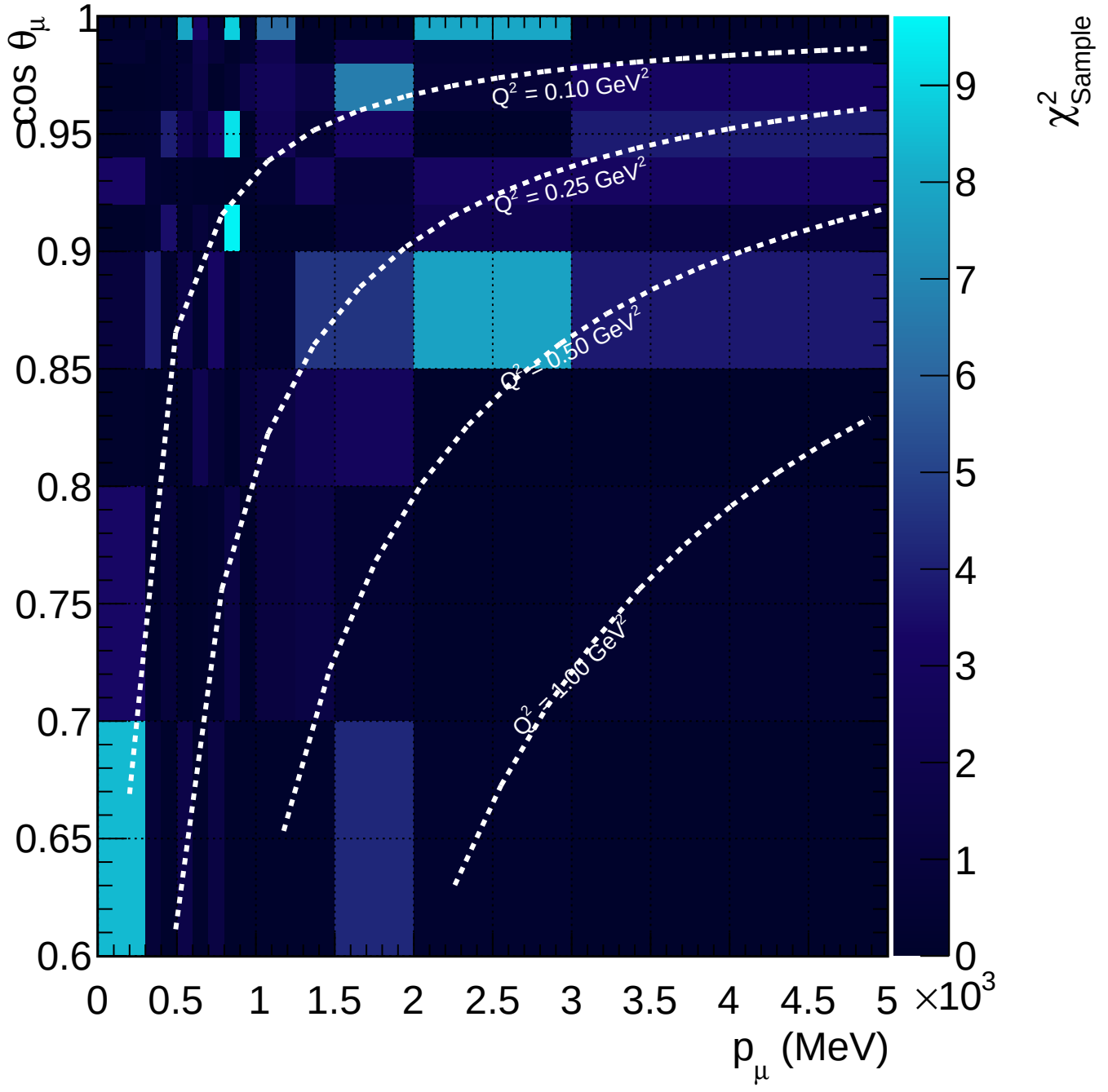

DataPredFluc
Total
p = 0.000
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Pred, Pred Fluc}}$
Steps
18000
16000
14000
12000
10000
8000
6000
4000
1450 1500 1550 1600 1650 1700 1750 1800 1850
30
25
20
15
10
5
0

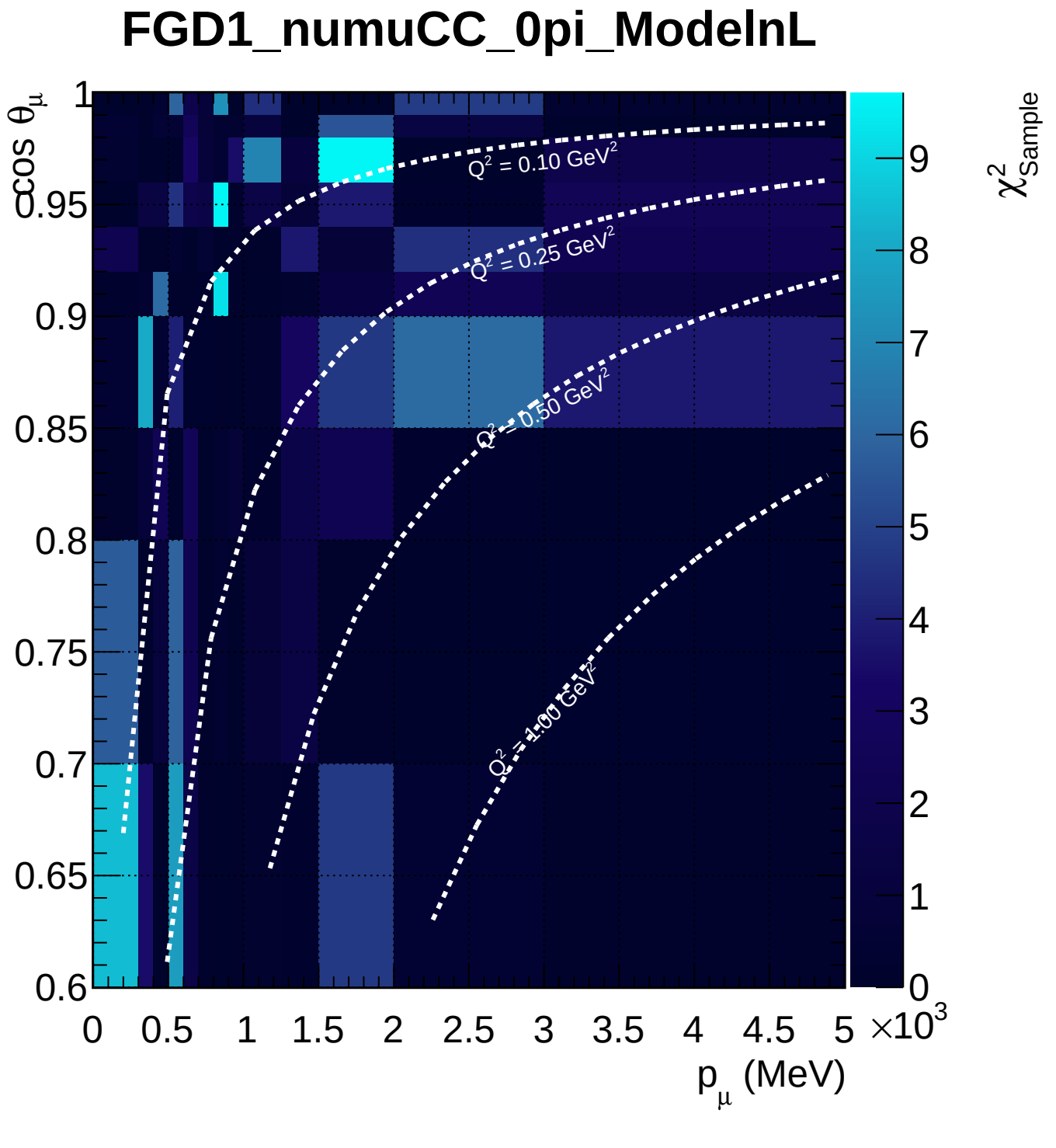

DataDrawFluc
FGD1 ν_μCC 0π
p = 0.000
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Draw, Draw Fluc}}$
Steps
6000
5000
4000
3000
2000
1000
100
120
140
160
180
200
220
240
30
25
20
15
10
5
0

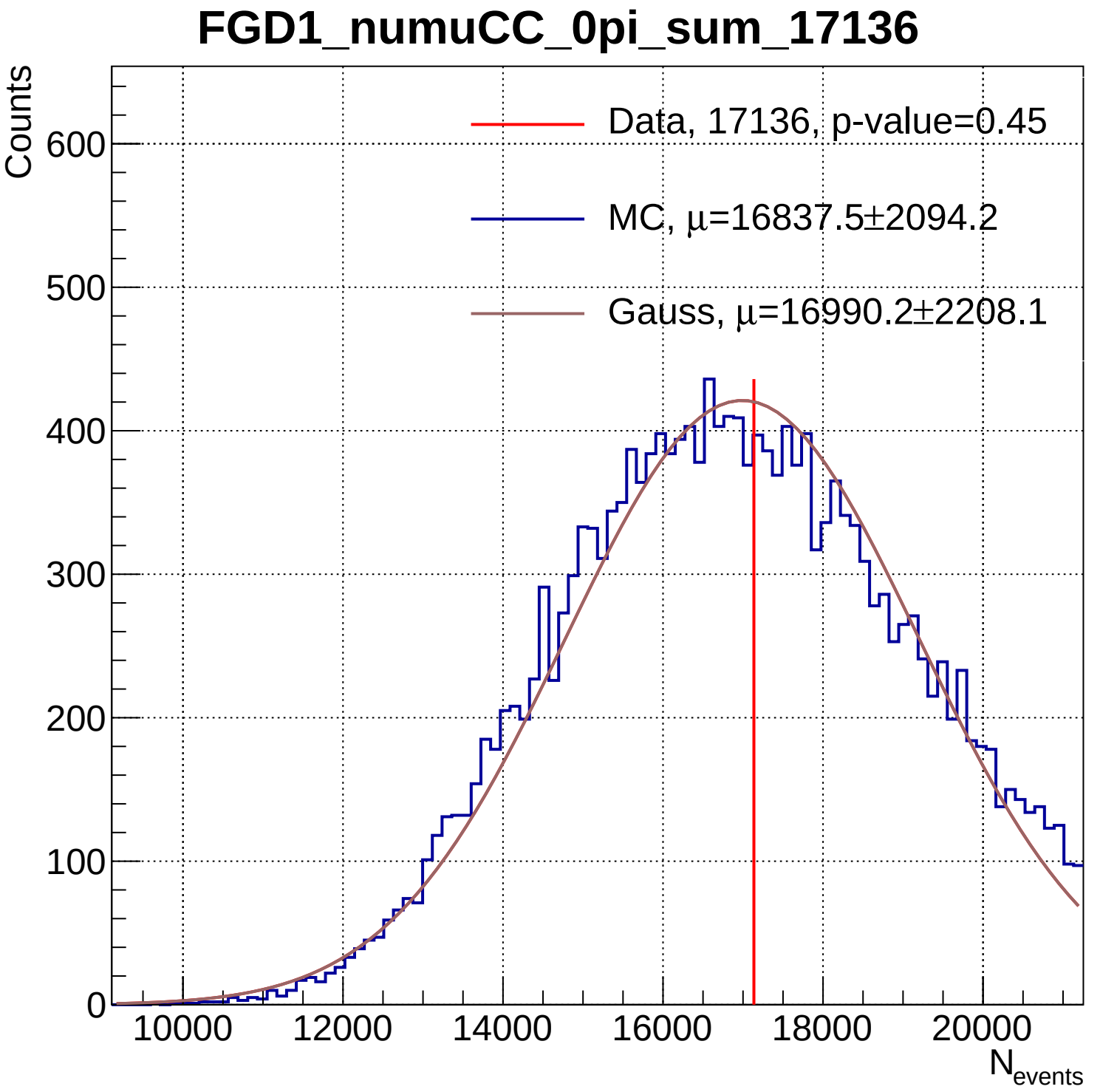

DataPredFluc
FGD1 ν_μCC 0π
p = 0.000
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Pred, Pred Fluc}}$
Steps
6000
5000
4000
3000
2000
1000
100
120
140
160
180
200
220
30
25
20
15
10
5
0

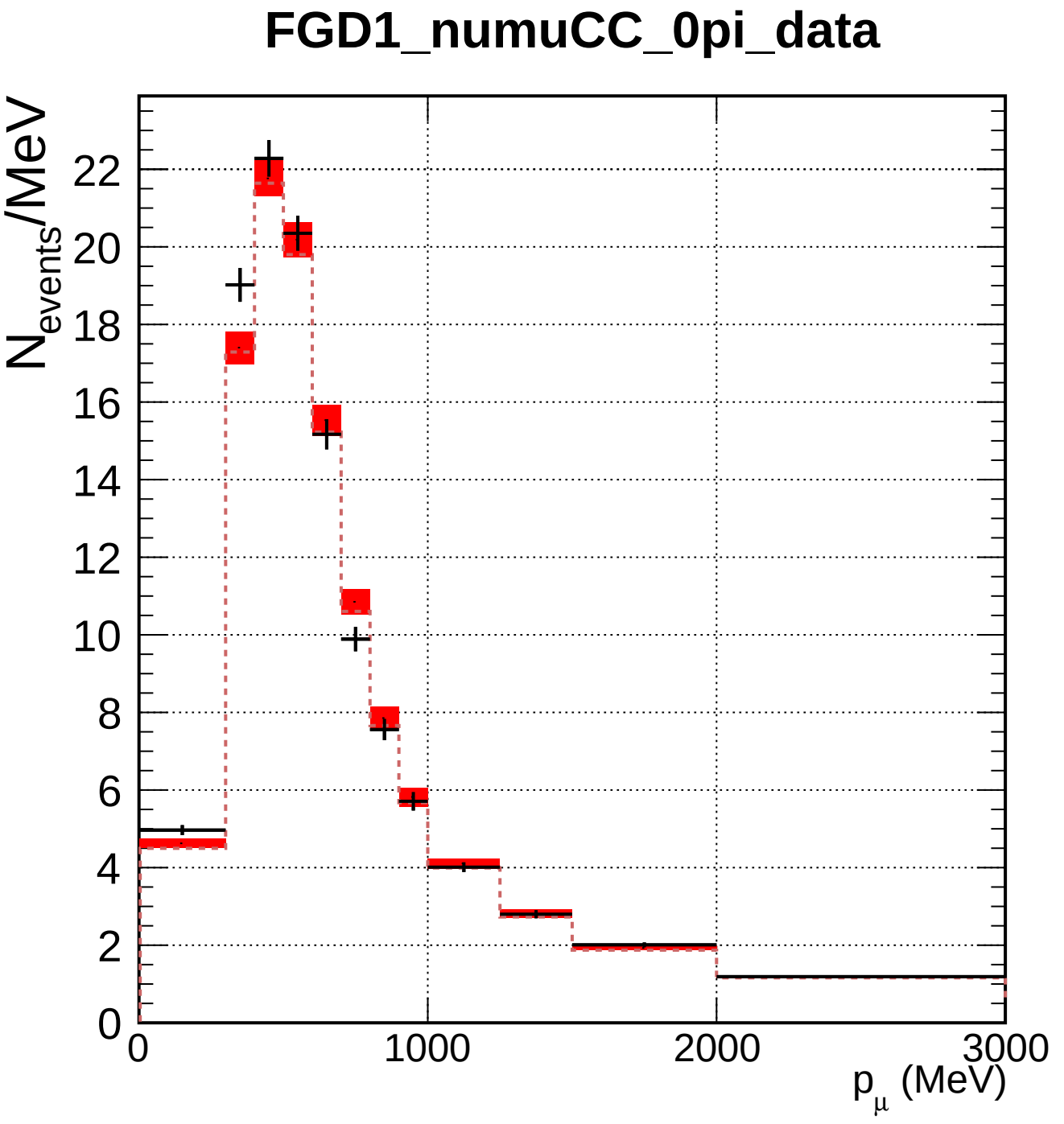

FGD1_numuCC_0pi_mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

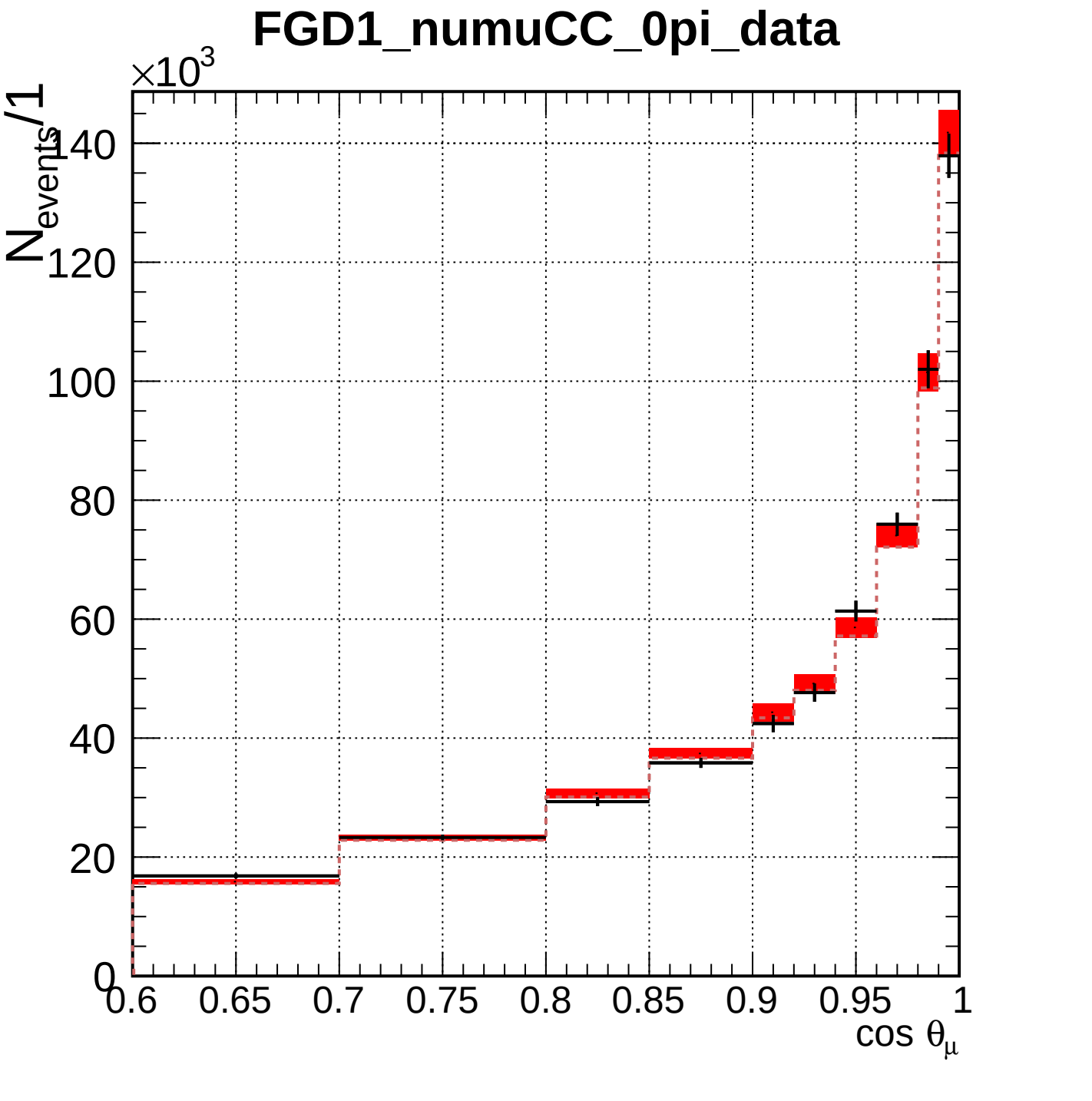

FGD1_numuCC_0pi_mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

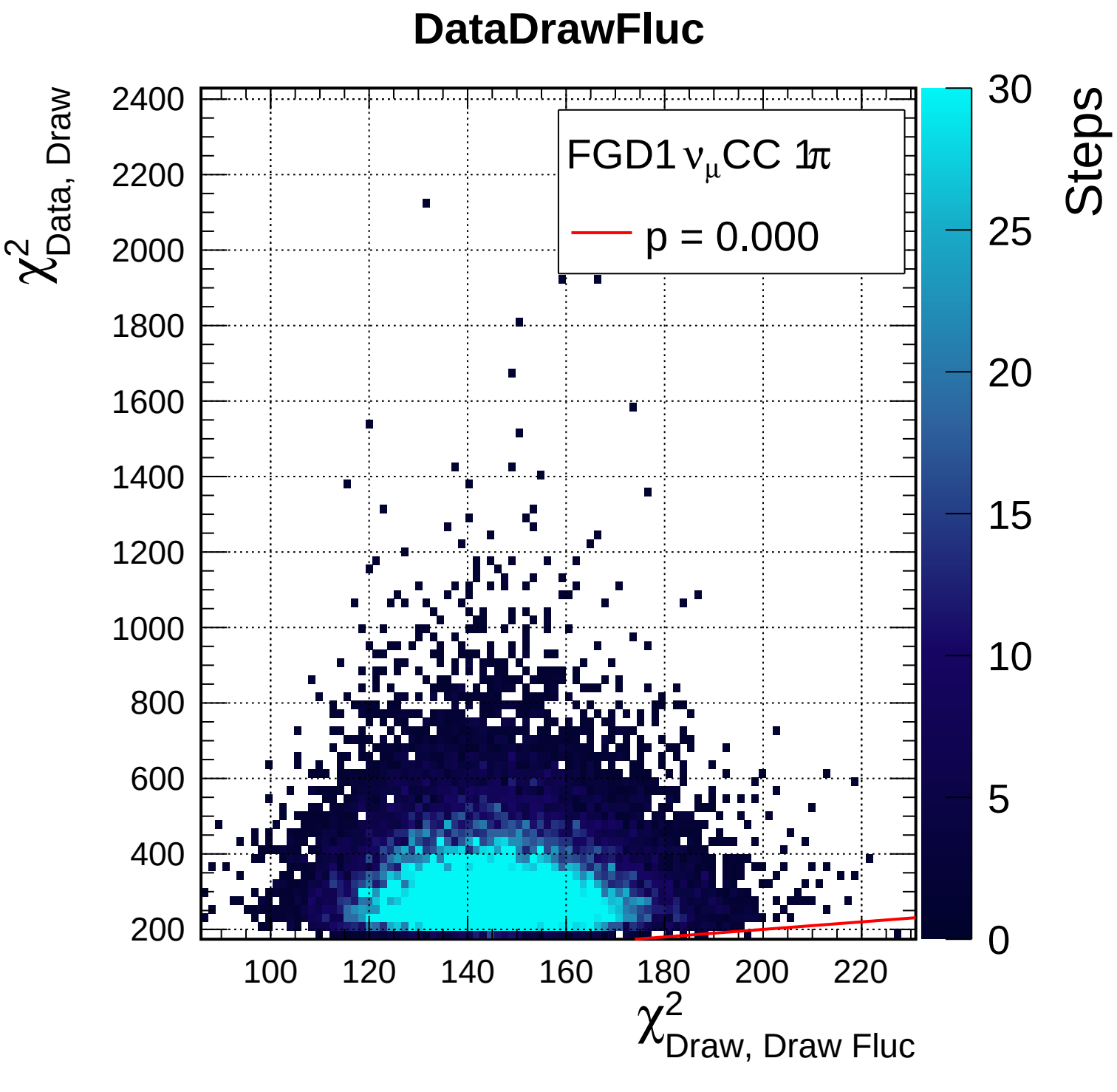

FGD1_numuCC_0pi_MeanlnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
χ²Sample
9
8
7
6
5
4
3
2
1
0

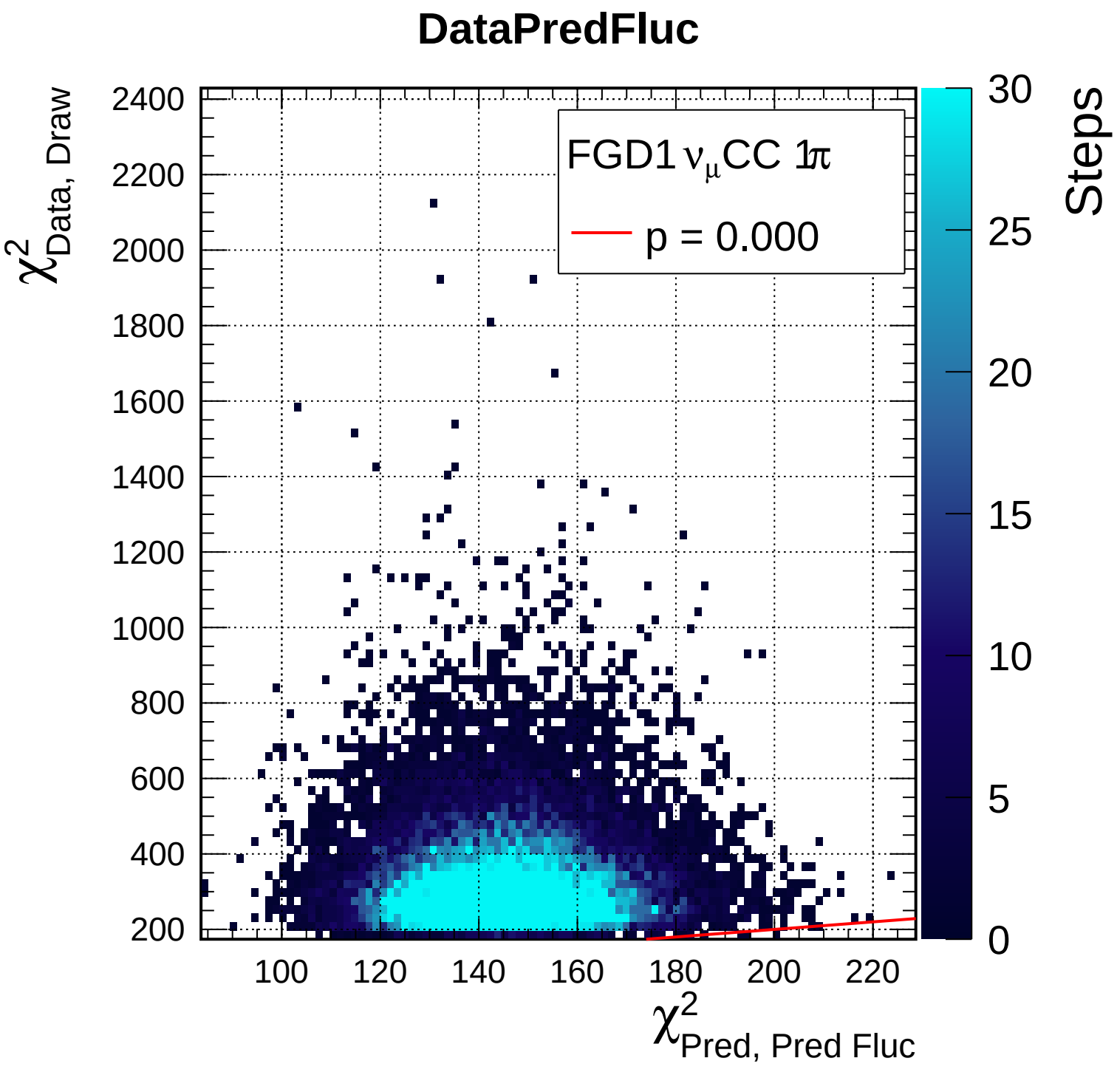

FGD1_numuCC_0pi_ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
χ²Sample
9
8
7
6
5
4
3
2
1
0

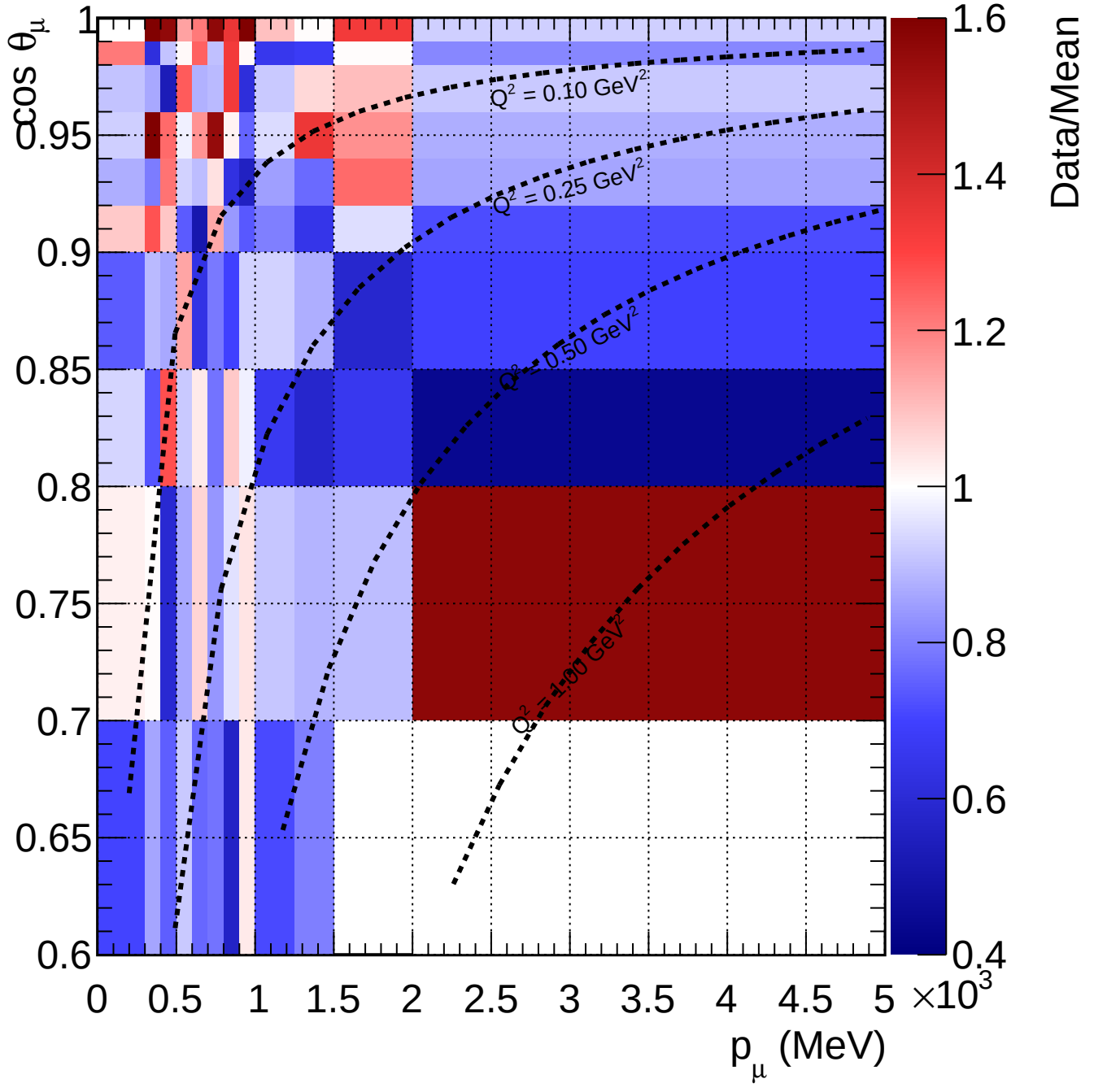

FGD1_numuCC_0pi_sum_17136
Counts
Data, 17136, p-value=0.45
MC, μ=16837.5±2094.2
Gauss, μ=16990.2±2208.1
0
100
200
300
400
500
600
10000
12000
14000
16000
18000
20000
N events

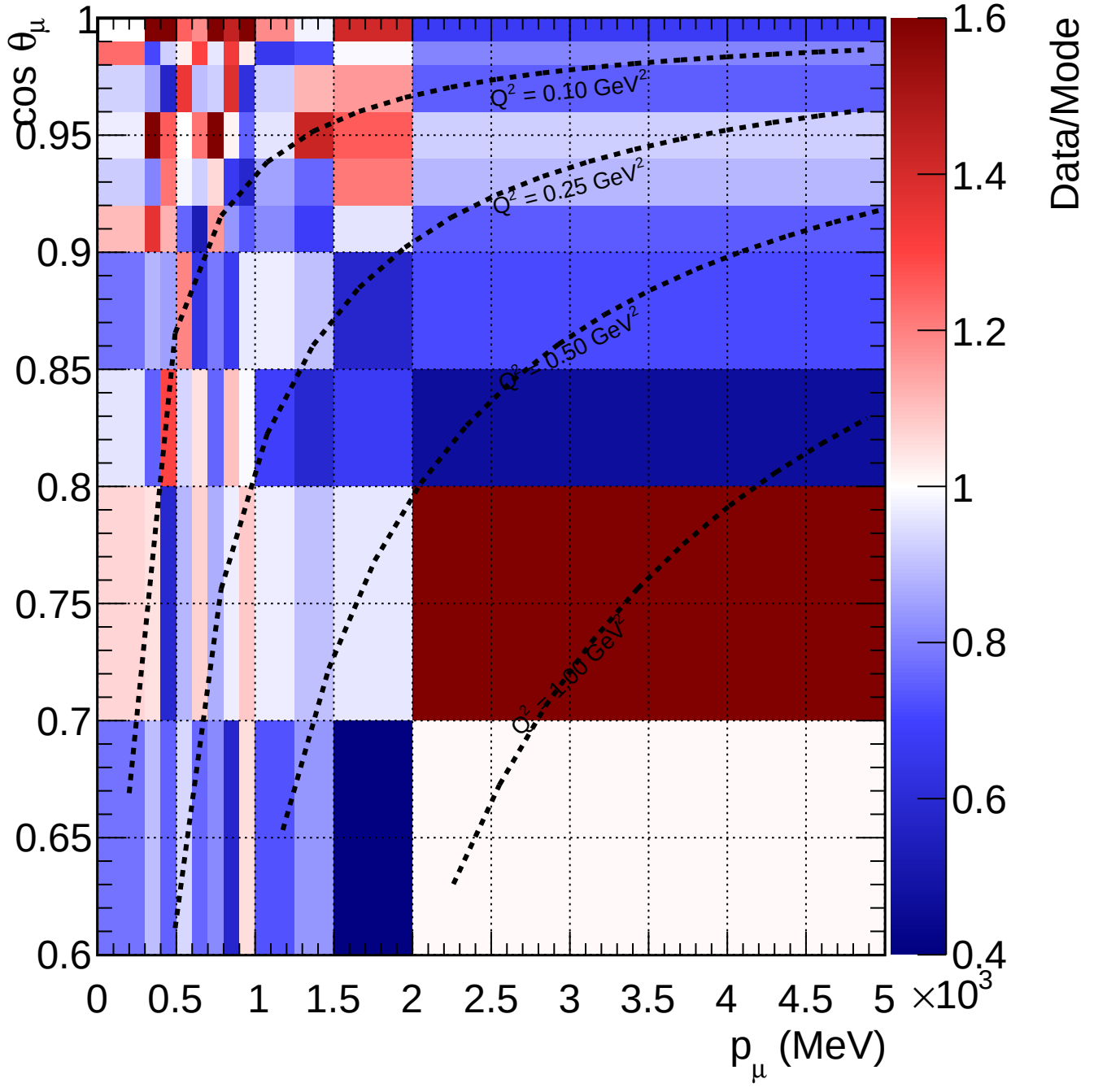

FGD1_numuCC_0pi_data
N_events/MeV
0
2
4
6
8
10
12
14
16
18
20
22
0
1000
2000
3000
p_μ (MeV)

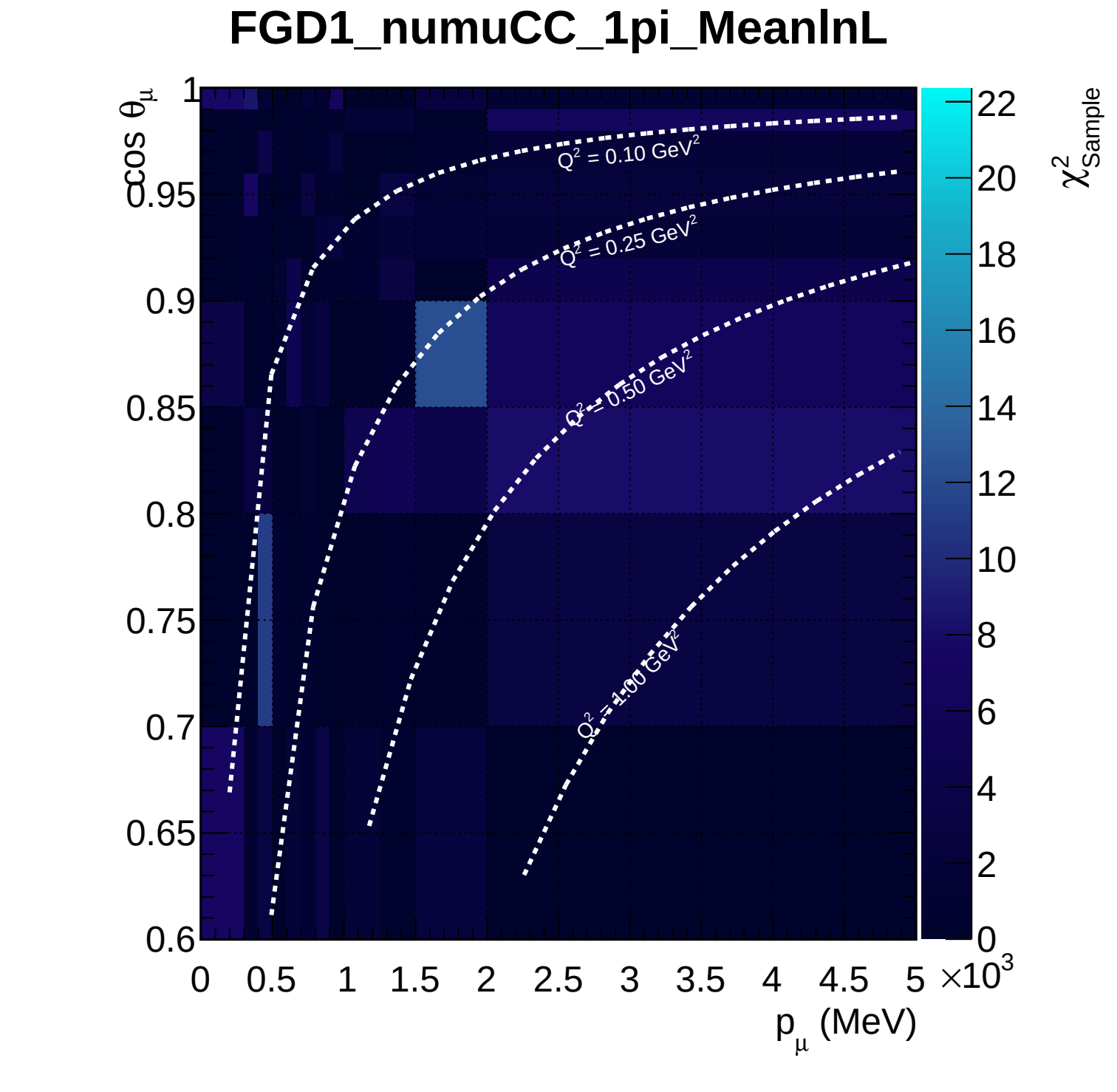

FGD1_numuCC_0pi_data
×10^3
N_events/1
140
120
100
80
60
40
20
0
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
cos θ_μ

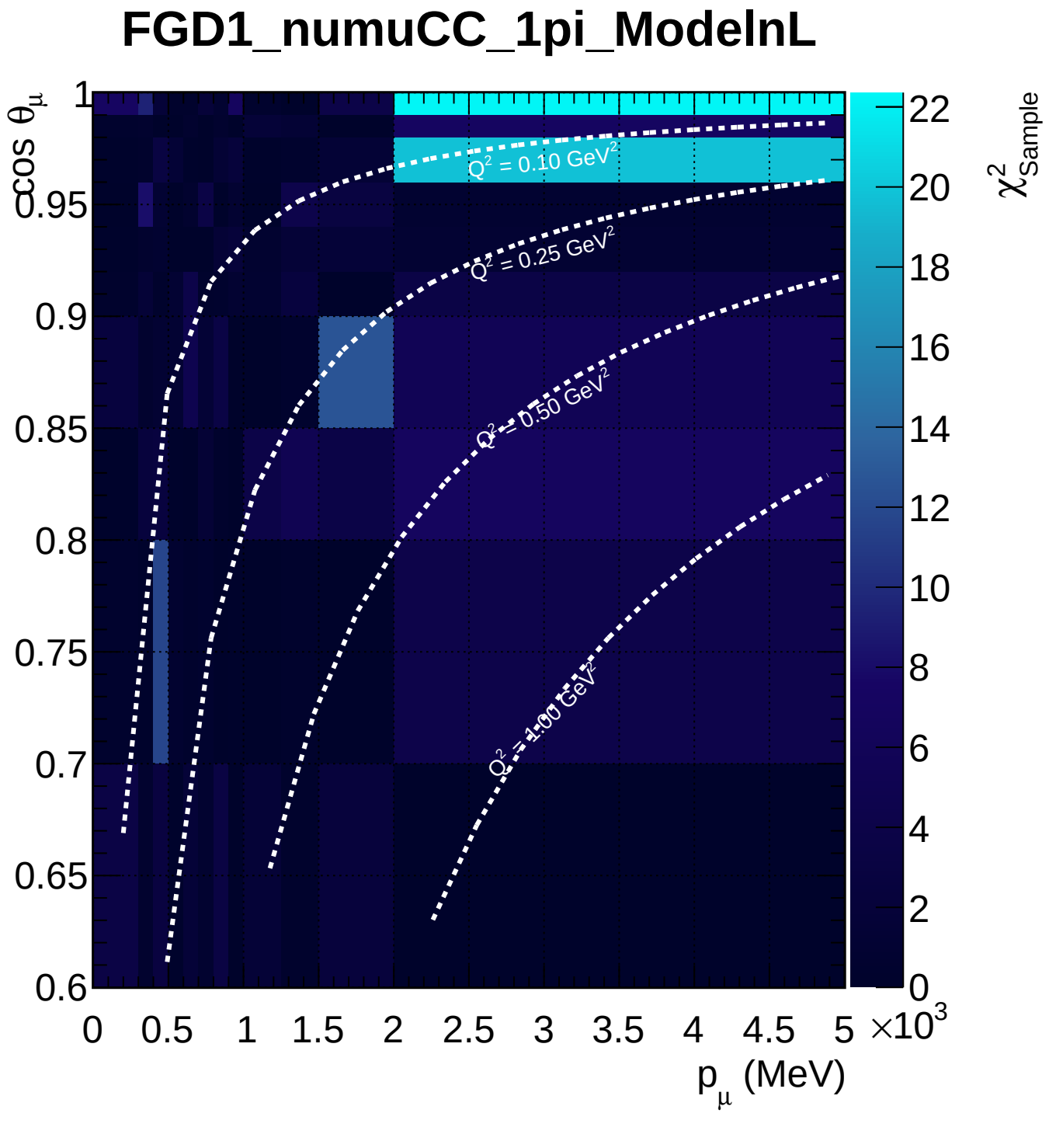

DataDrawFluc
FGD1 ν_μCC 1π
p = 0.000
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Draw, Draw Fluc}}$
Steps
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
100
120
140
160
180
200
220
30
25
20
15
10
5
0

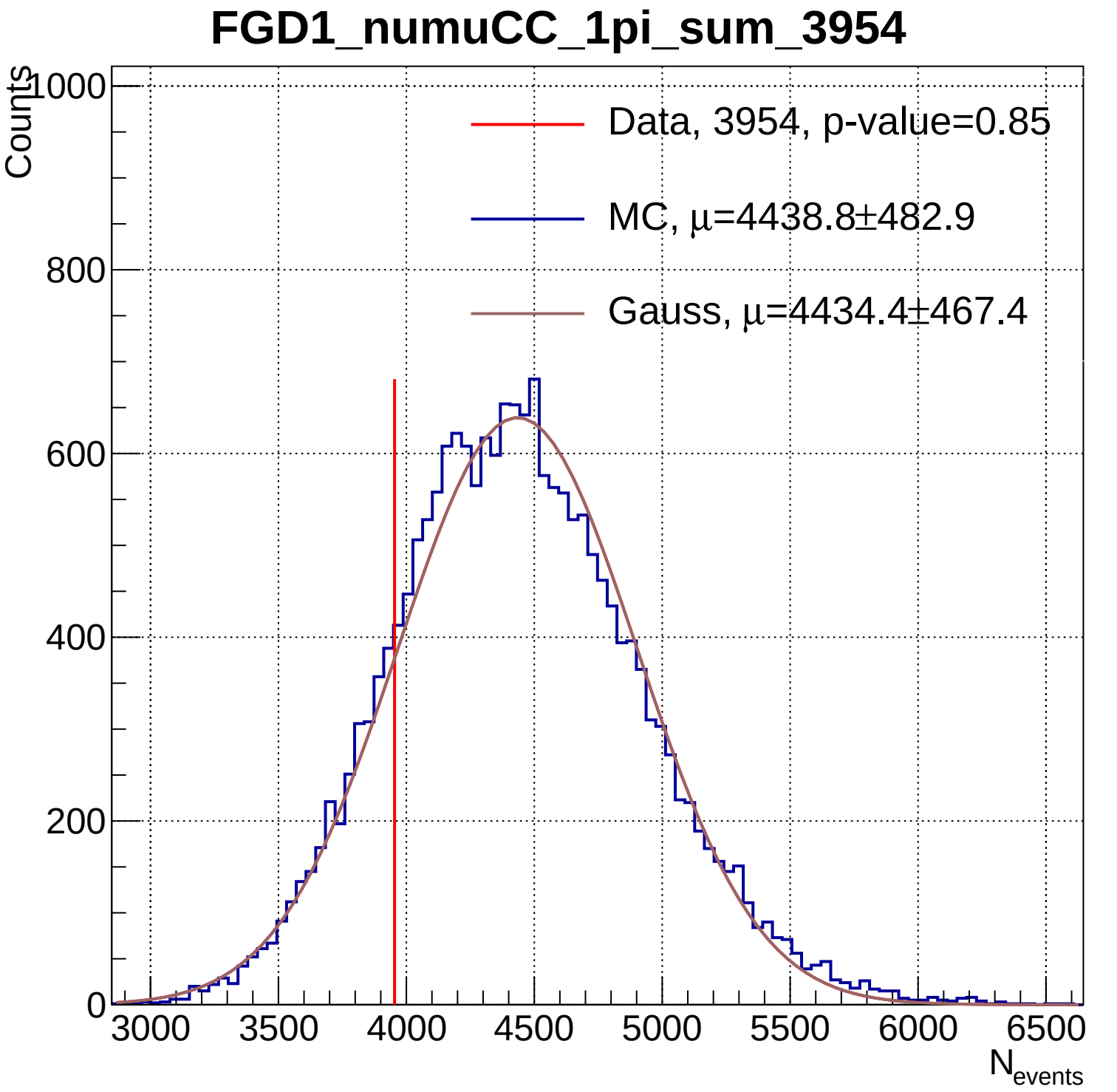

DataPredFluc
FGD1 ν_μCC 1π
p = 0.000
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Pred, Pred Fluc}}$
Steps
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
100
120
140
160
180
200
220
30
25
20
15
10
5
0

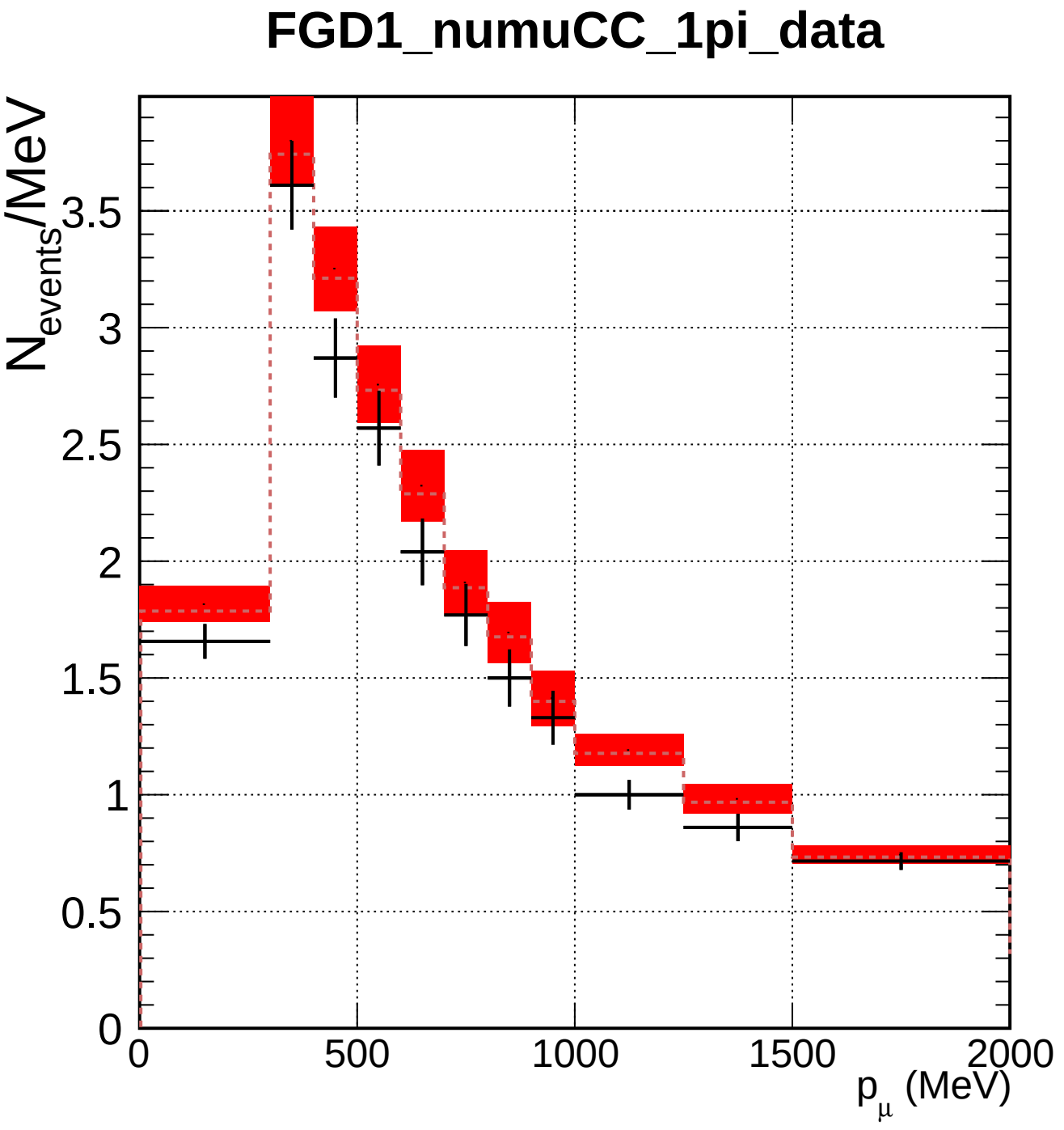

FGD1_numuCC_1pi_mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

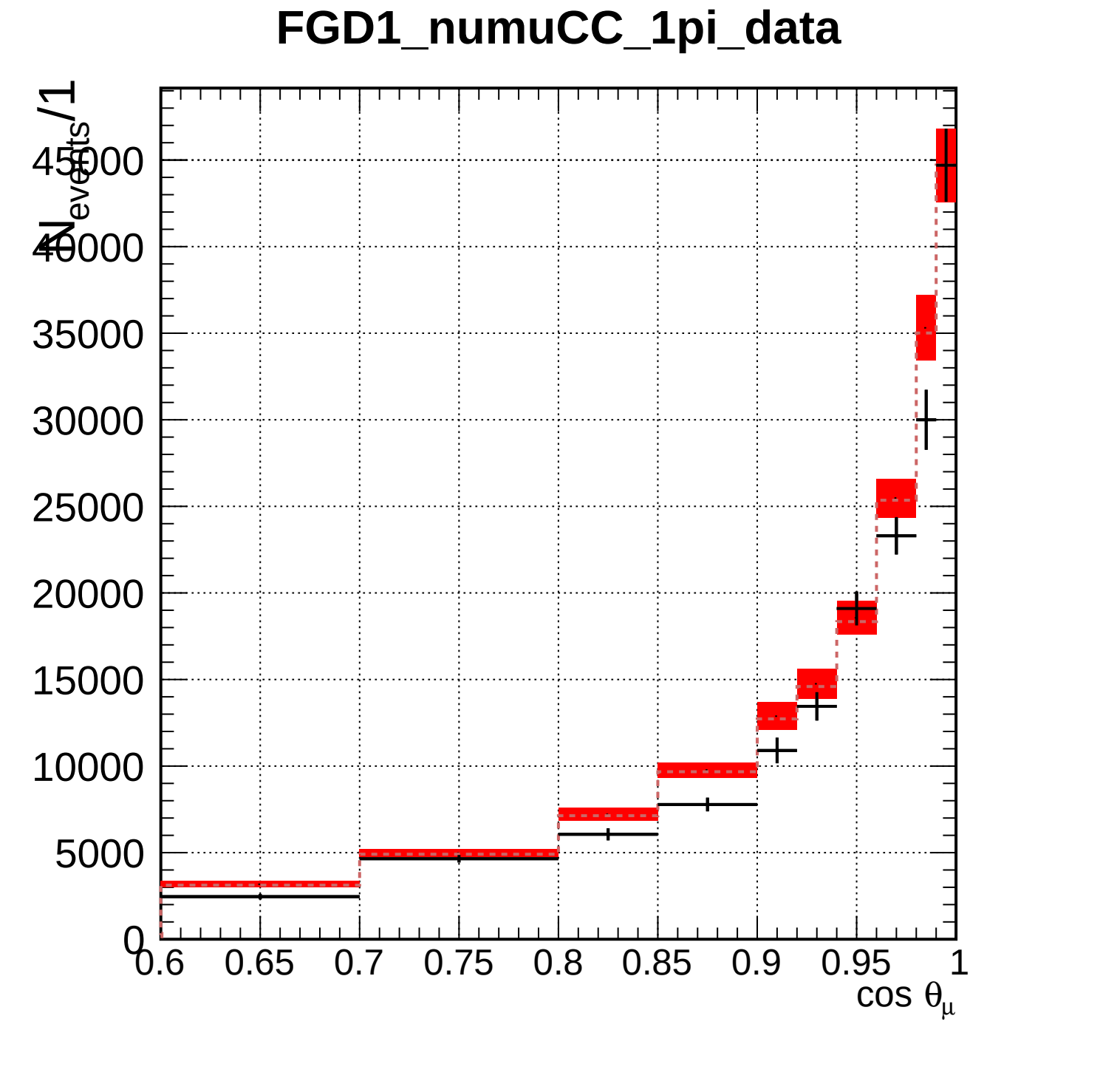

FGD1_numuCC_1pi_mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

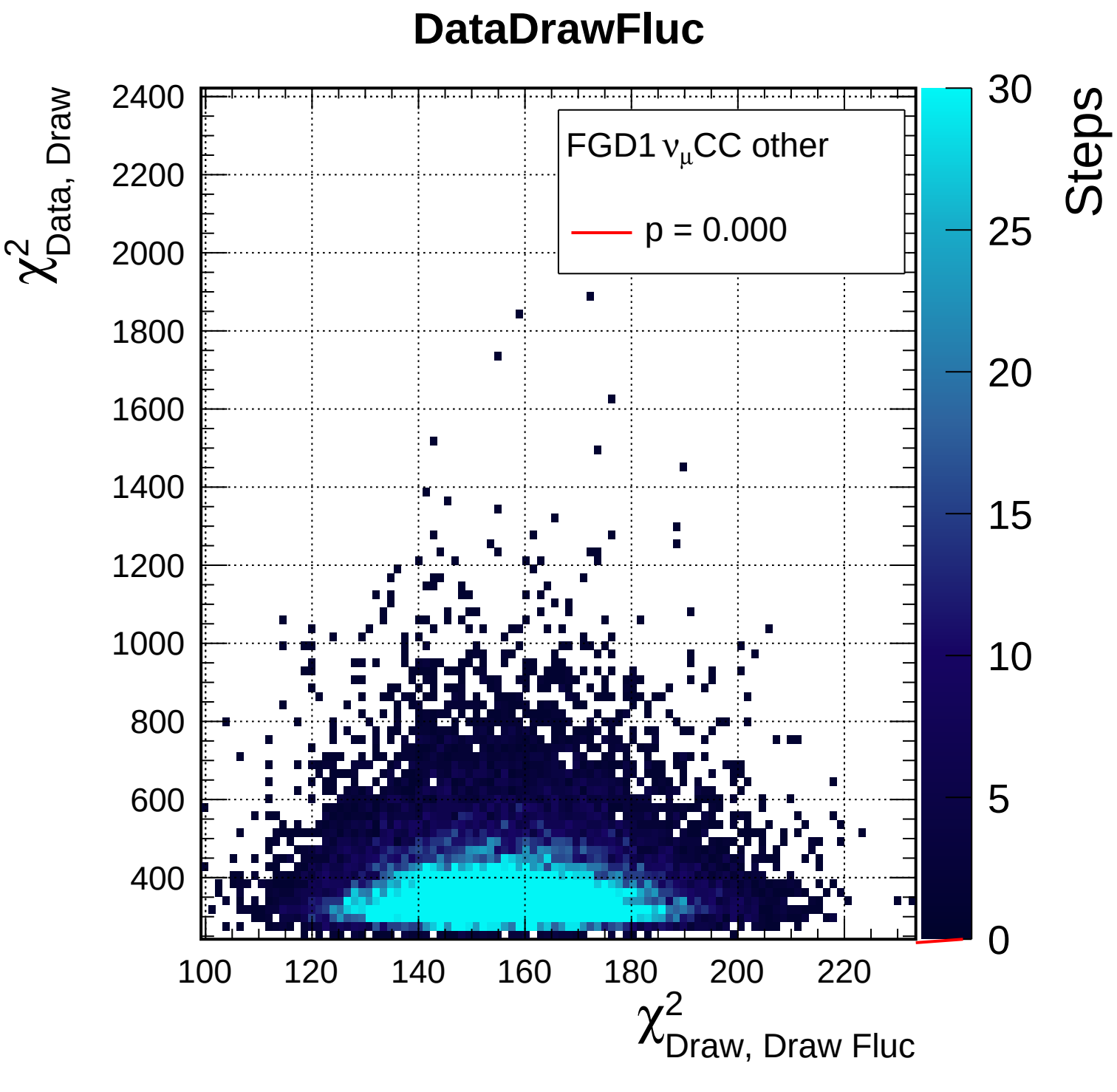

FGD1_numuCC_1pi_MeanlnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
22
20
18
16
14
12
10
8
6
4
2
0
χ²Sample

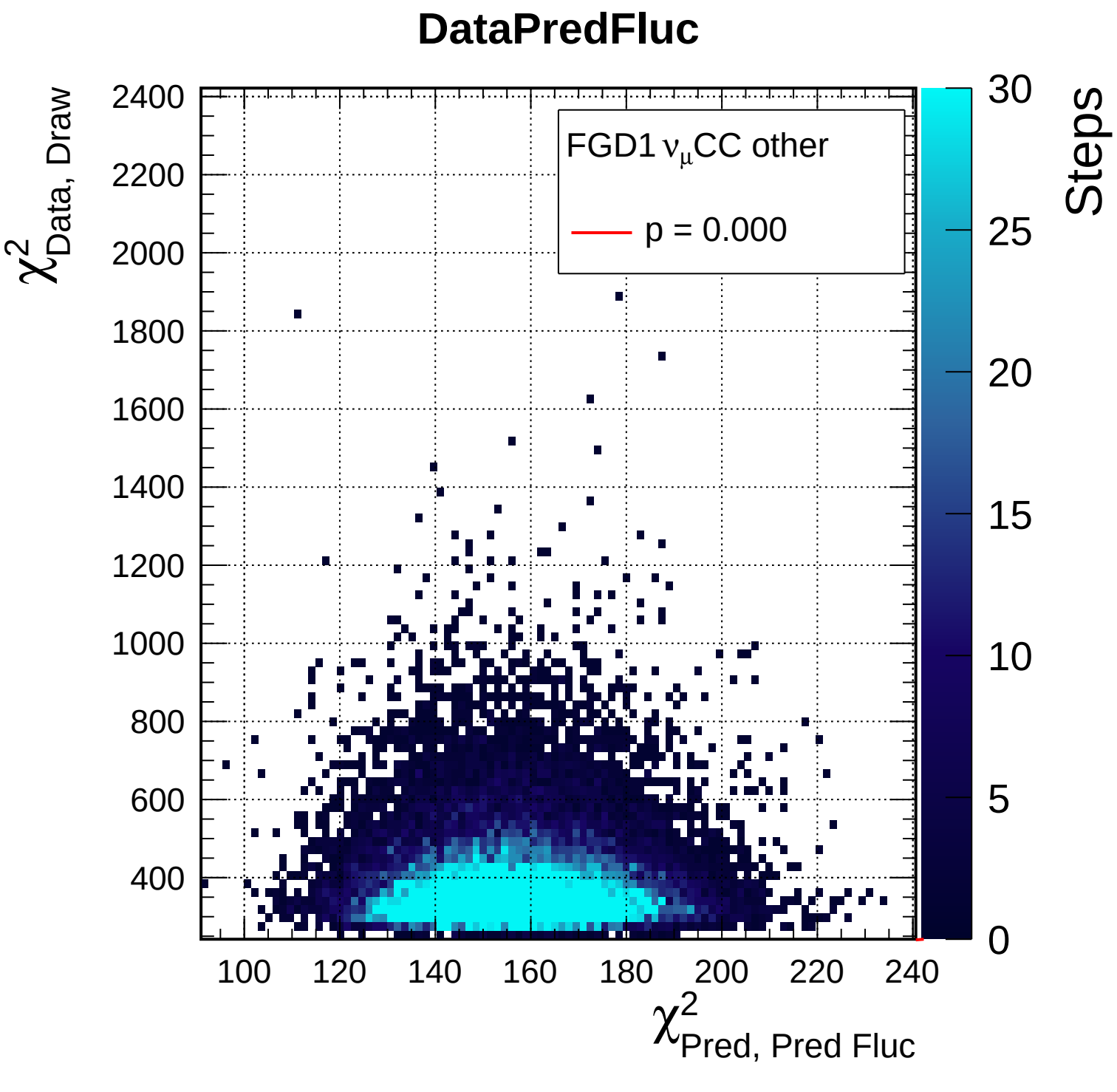

FGD1_numuCC_1pi_ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
22
20
18
16
14
12
10
8
6
4
2
0
χ²Sample

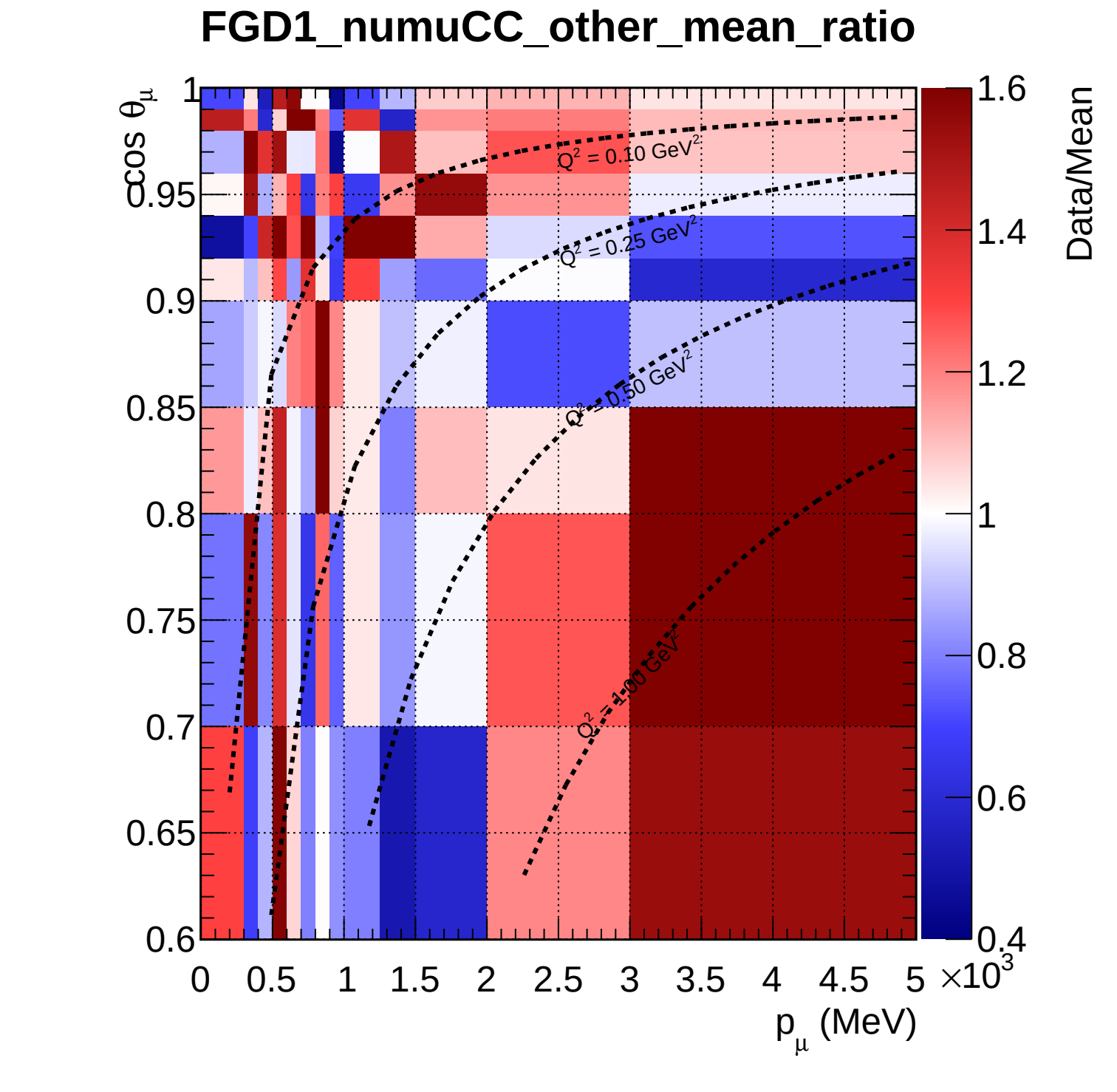

FGD1_numuCC_1pi_sum_3954
Counts
1000
800
600
400
200
0
3000
3500
4000
4500
5000
5500
6000
6500
N events
Data, 3954, p-value=0.85
MC, μ=4438.8±482.9
Gauss, μ=4434.4±467.4

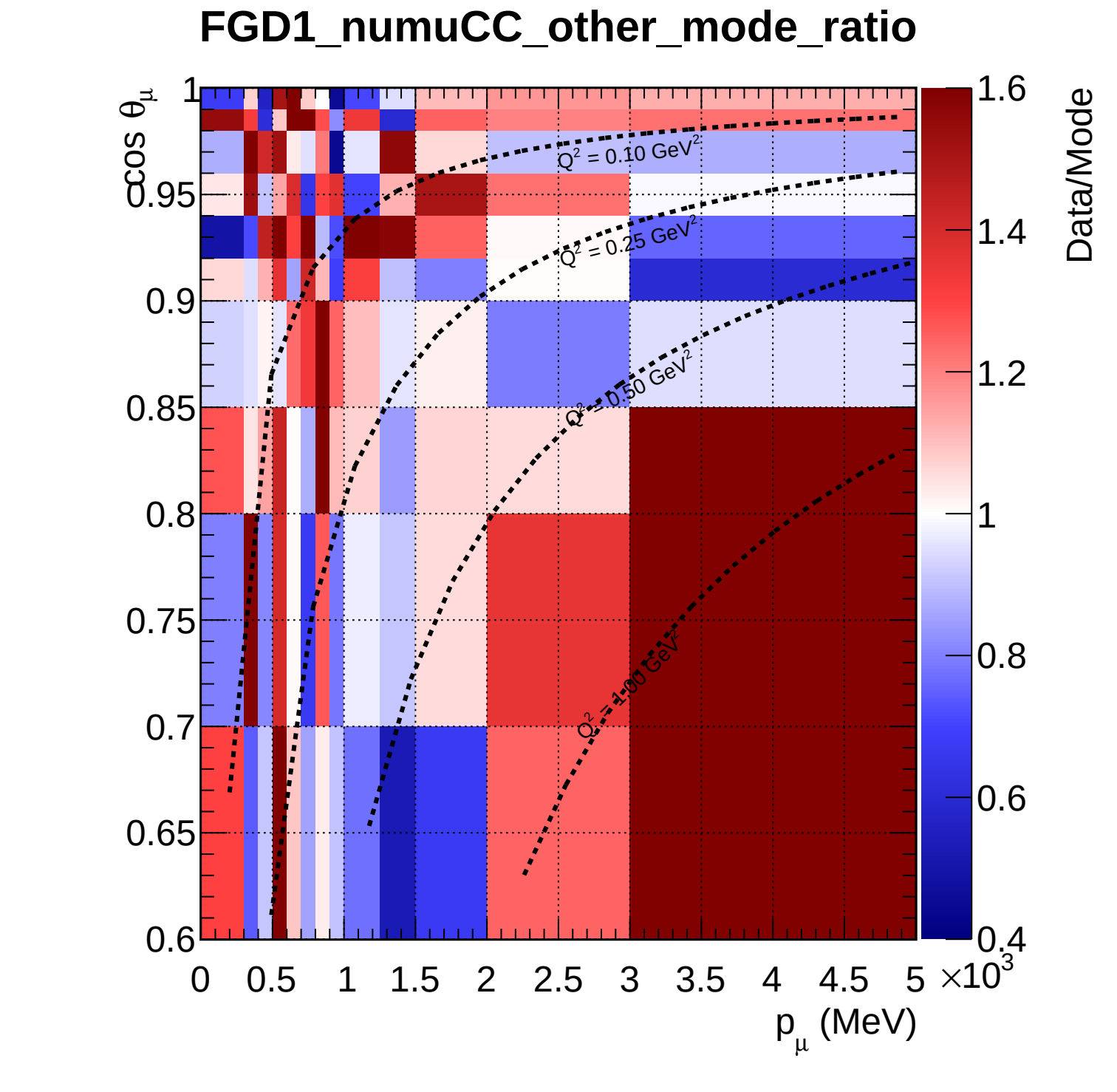

FGD1_numuCC_1pi_data
N_events/MeV
3.5
3
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
p_μ (MeV)

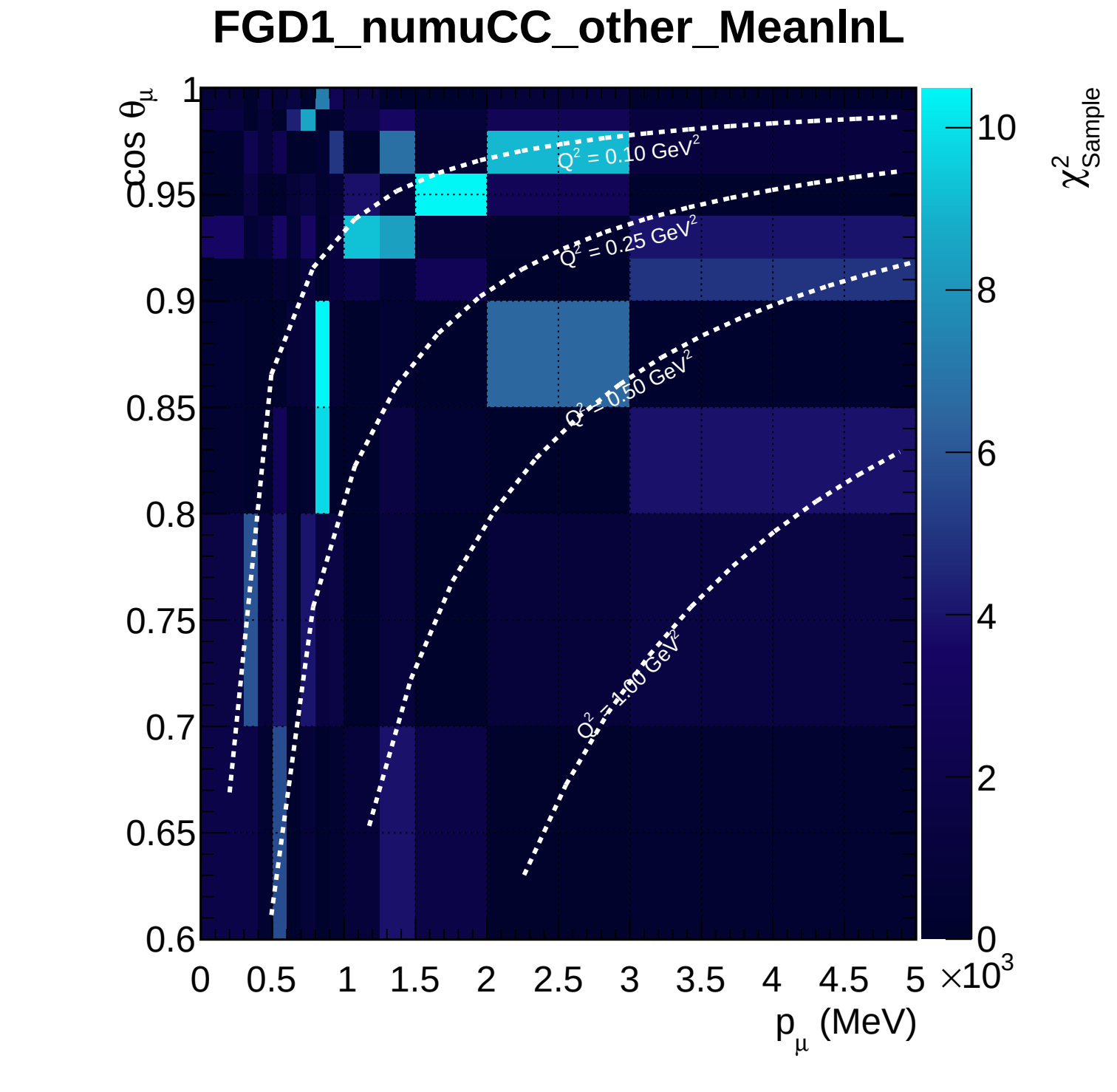

FGD1_numuCC_1pi_data
N_events /1
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
cos θ_μ

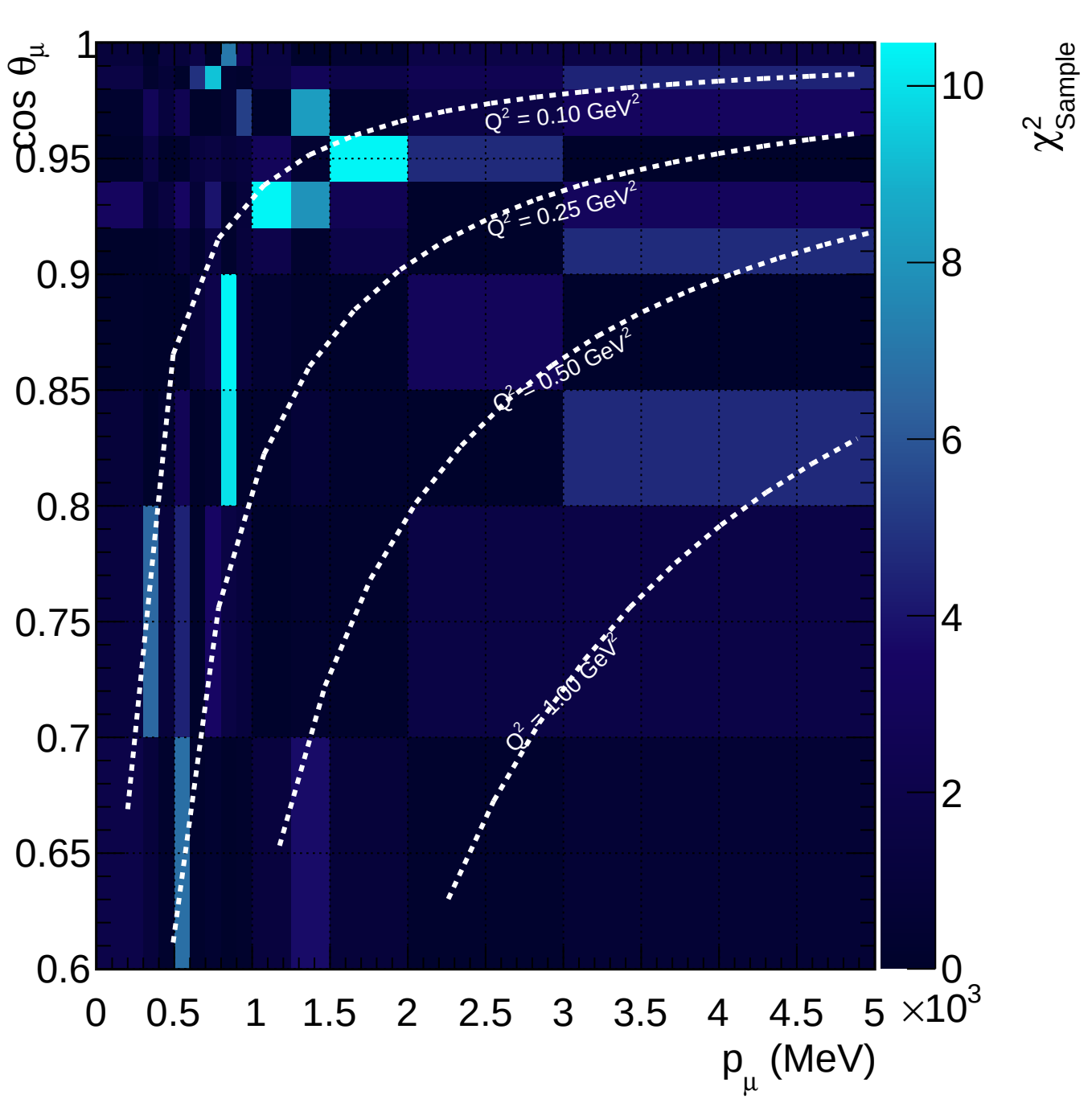

DataDrawFluc
FGD1 ν_μCC other
p = 0.000
$\chi^2_{Data, Draw}$
$\chi^2_{Draw, Draw Fluc}$
Steps
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
100
120
140
160
180
200
220
30
25
20
15
10
5
0

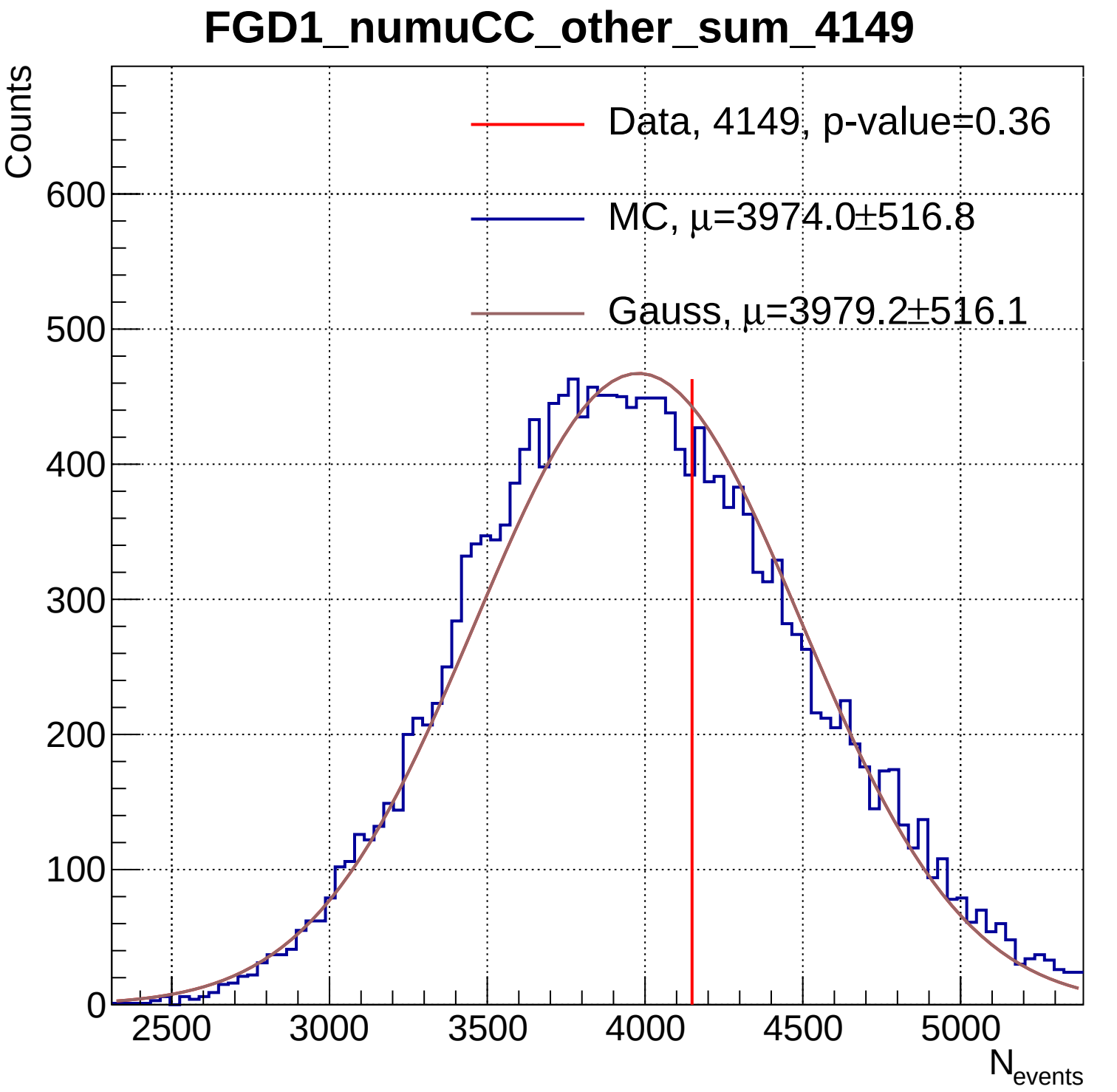

DataPredFluc
FGD1 ν_μCC other
p = 0.000
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Pred, Pred Fluc}}$
Steps
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
100
120
140
160
180
200
220
240
30
25
20
15
10
5
0

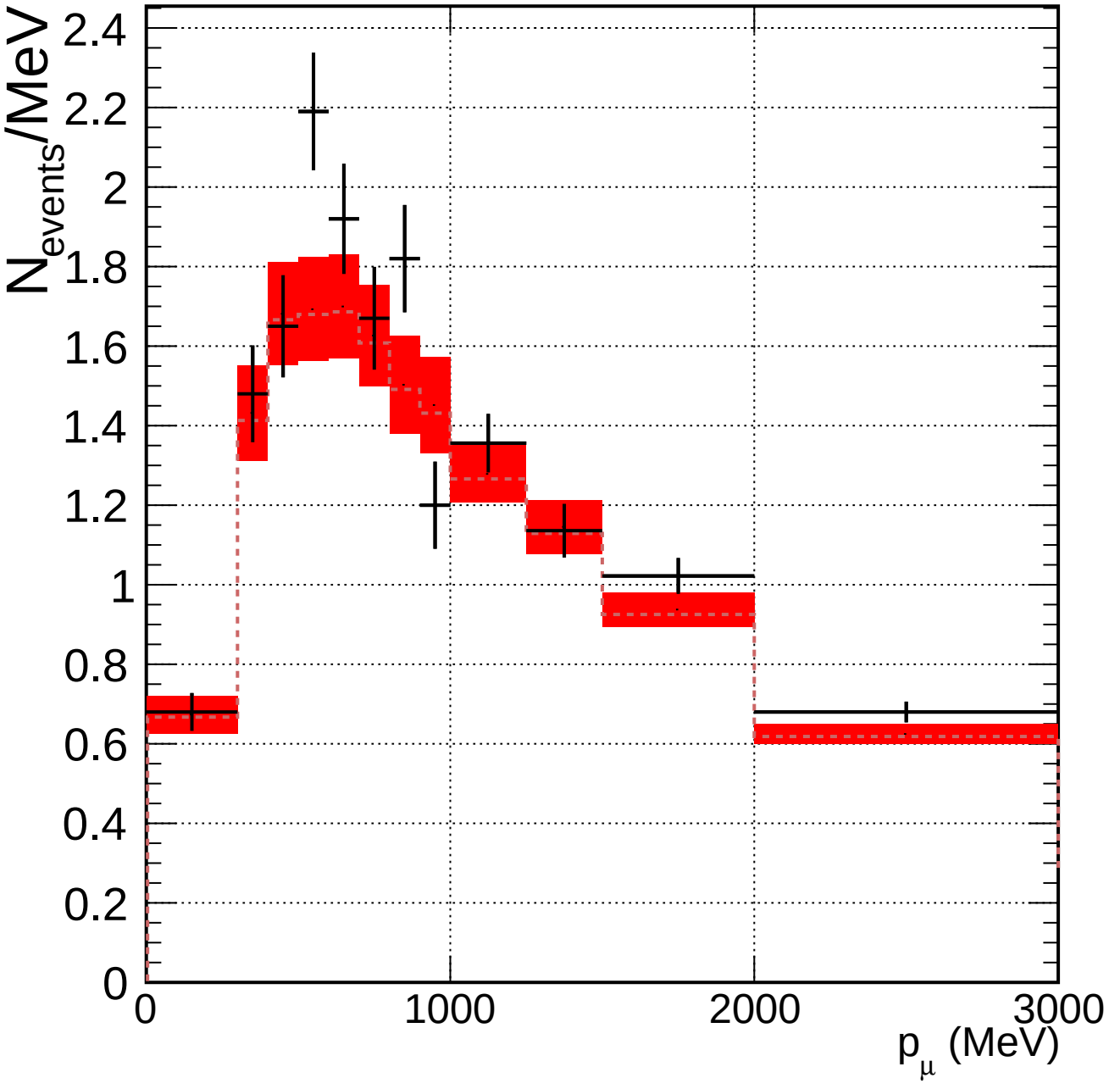

FGD1_numuCC_other_mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

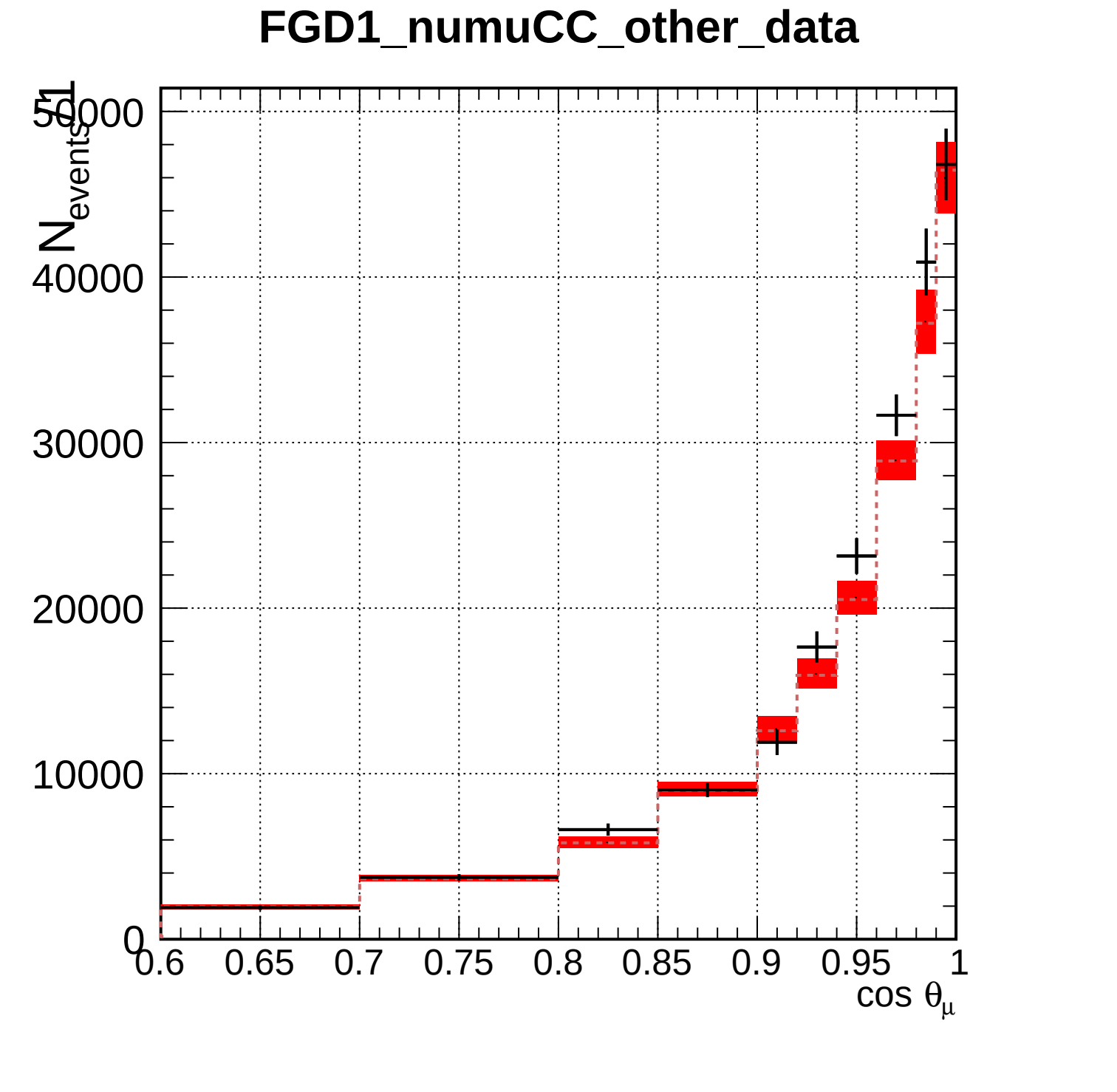

FGD1_numuCC_other_mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

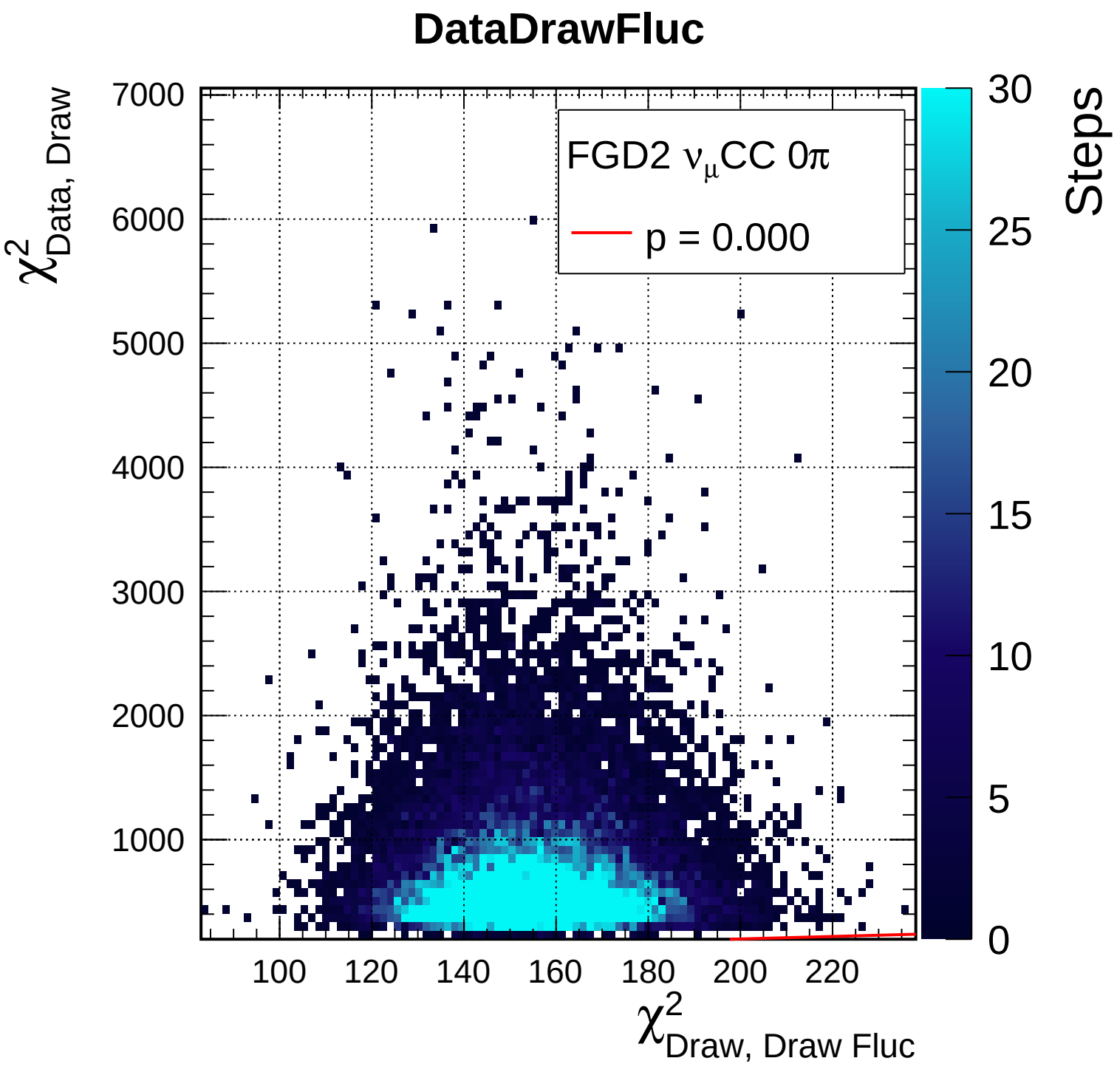

FGD1_numuCC_other_MeanInL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
10
8
6
4
2
0
χ²Sample

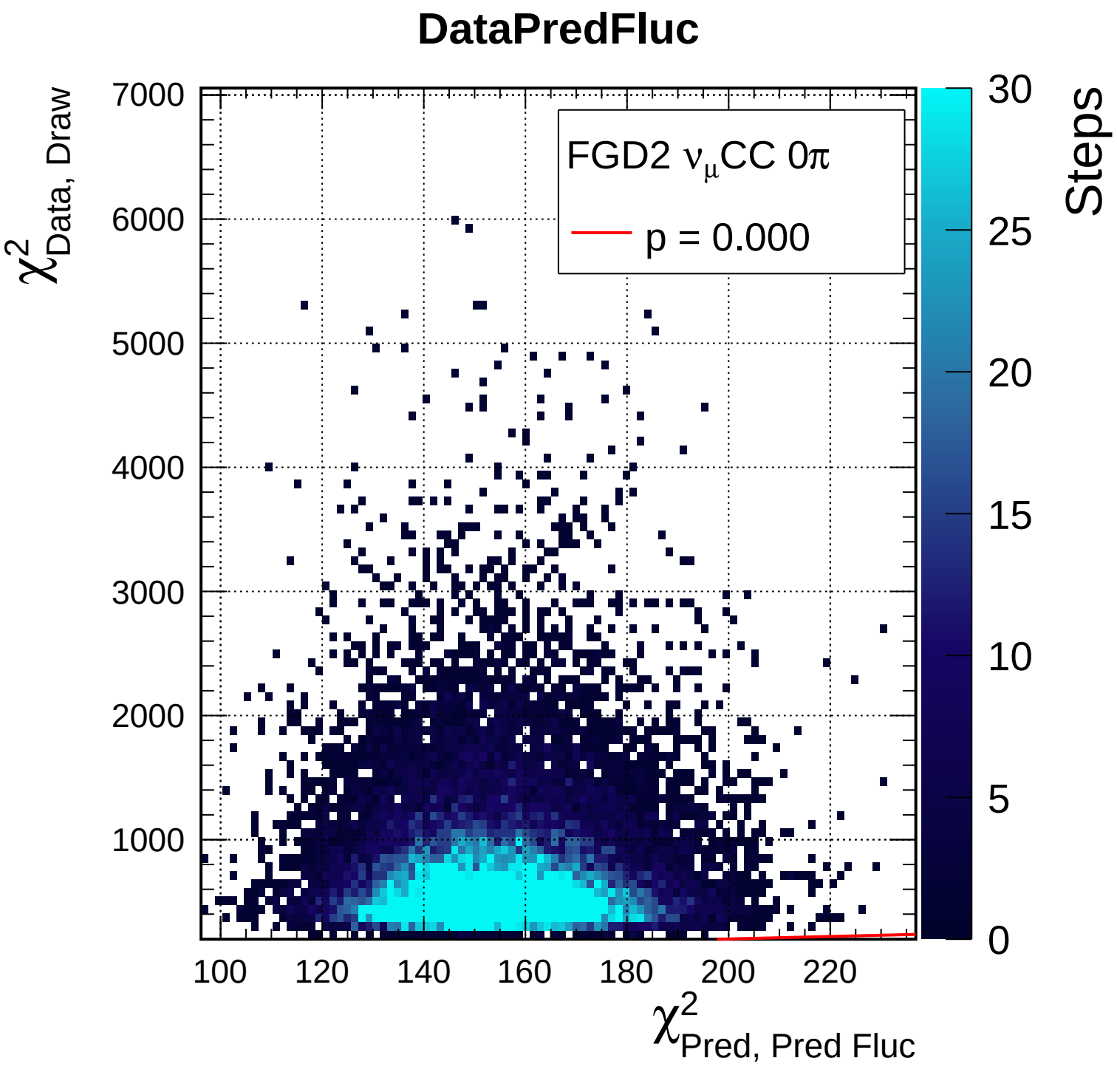

FGD1_numuCC_other_ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
10
8
6
4
2
0
χ²Sample

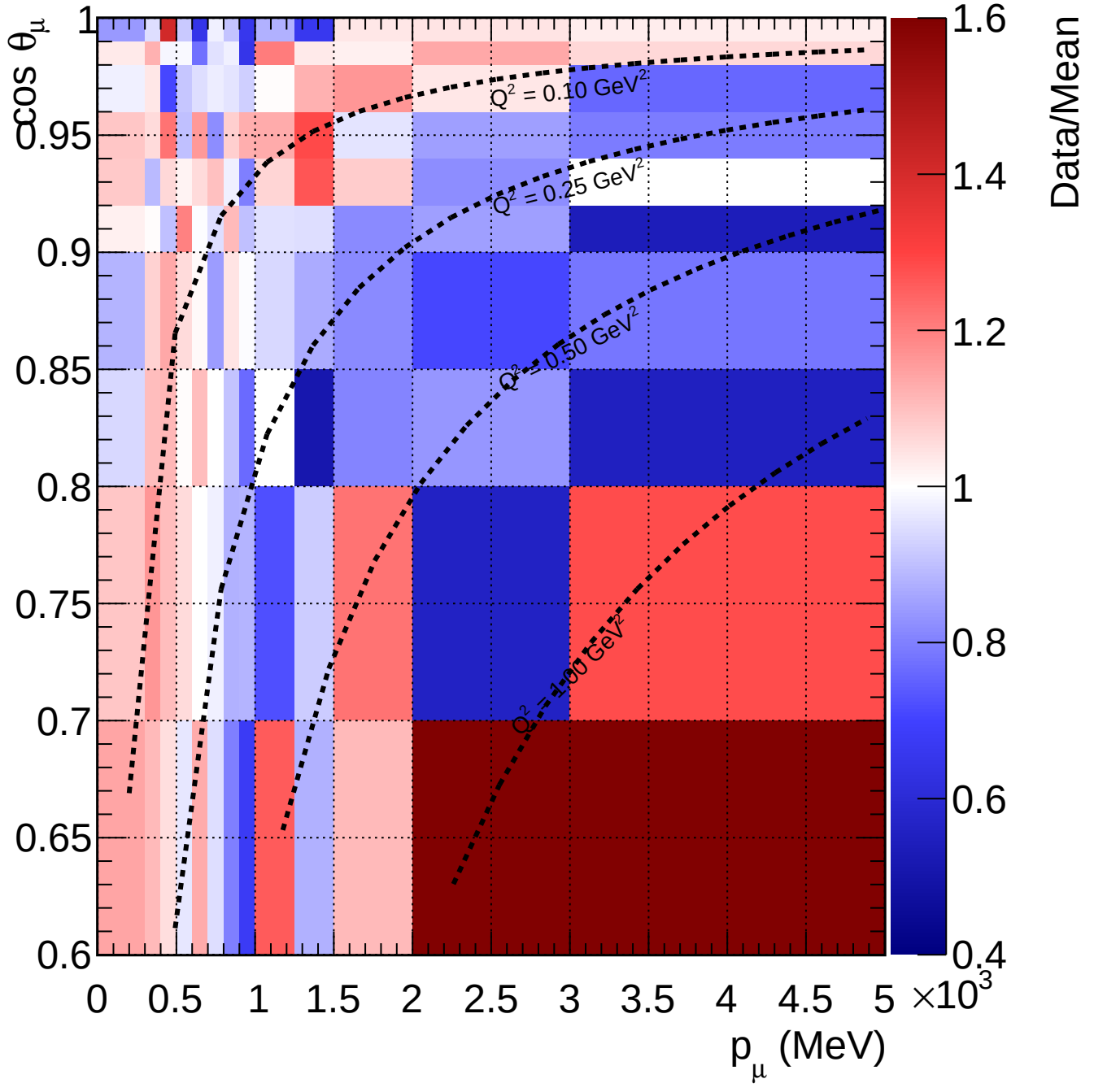

FGD1_numuCC_other_sum_4149
Counts
Data, 4149, p-value=0.36
MC, μ=3974.0±516.8
Gauss, μ=3979.2±516.1
600
500
400
300
200
100
0
2500
3000
3500
4000
4500
5000
N events

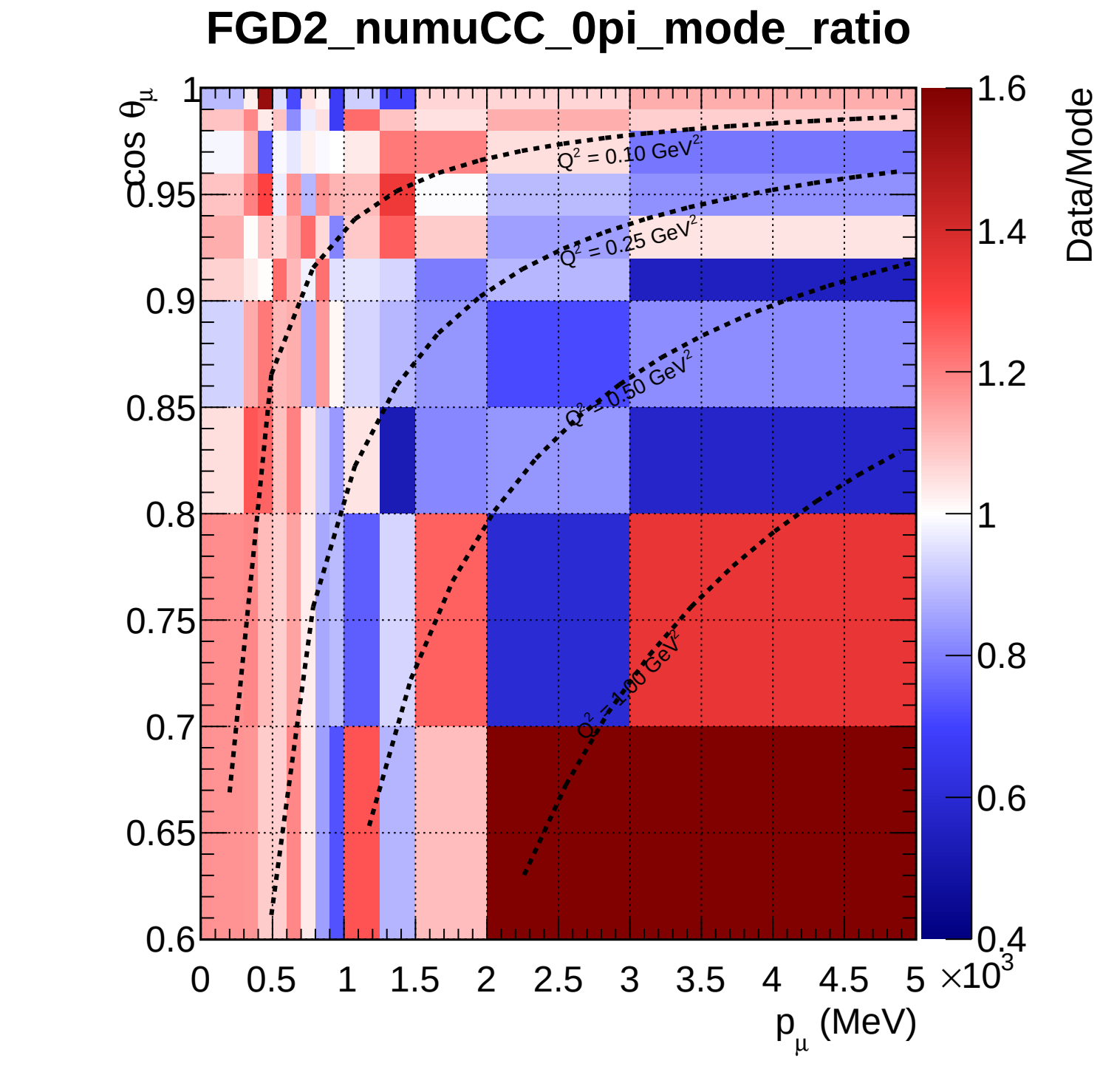

FGD1_numuCC_other_data
N_events/MeV
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
1000
2000
3000
p_μ (MeV)

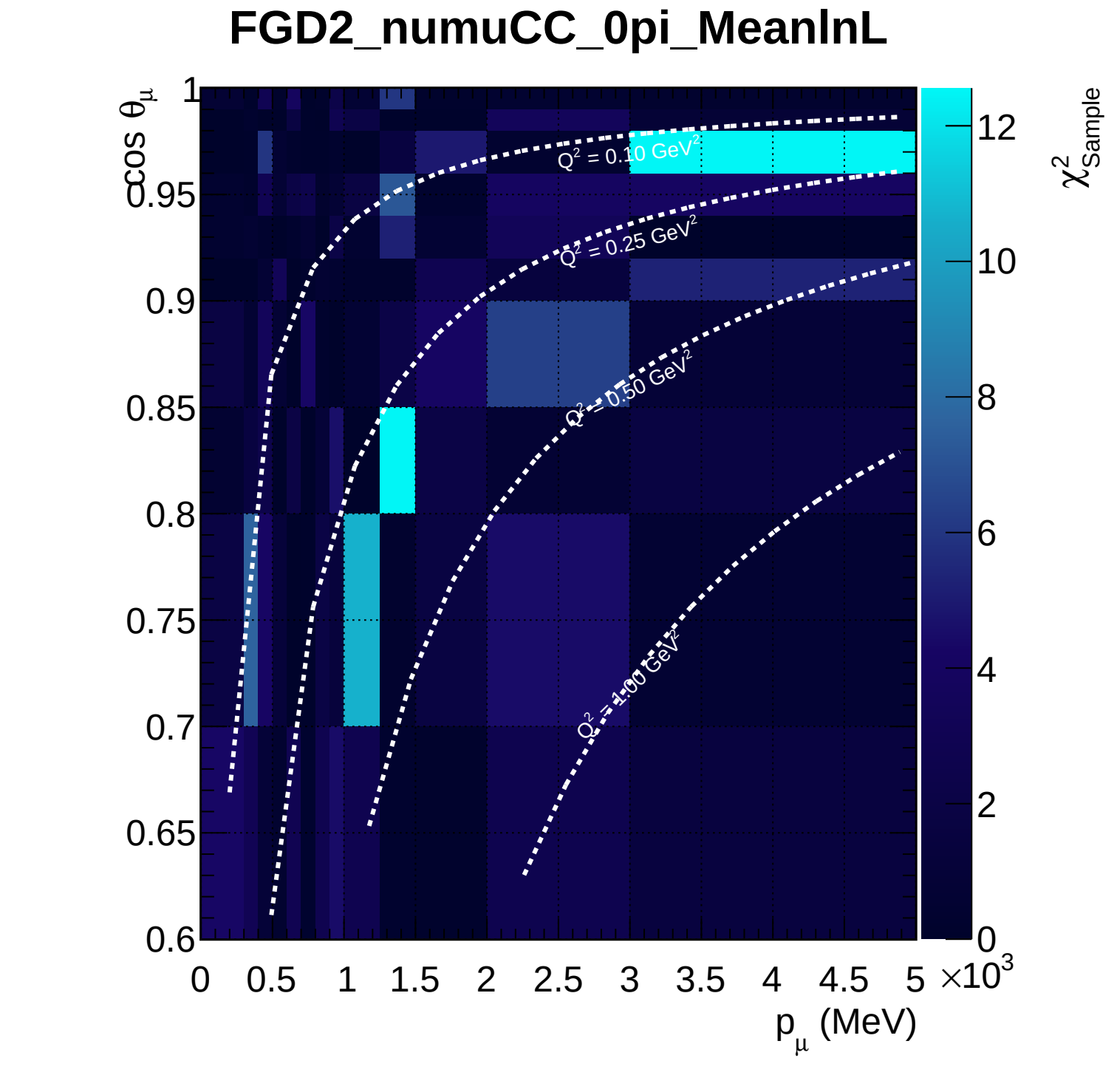

FGD1_numuCC_other_data
N_{events}
50000
40000
30000
20000
10000
0
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
cos θ_μ

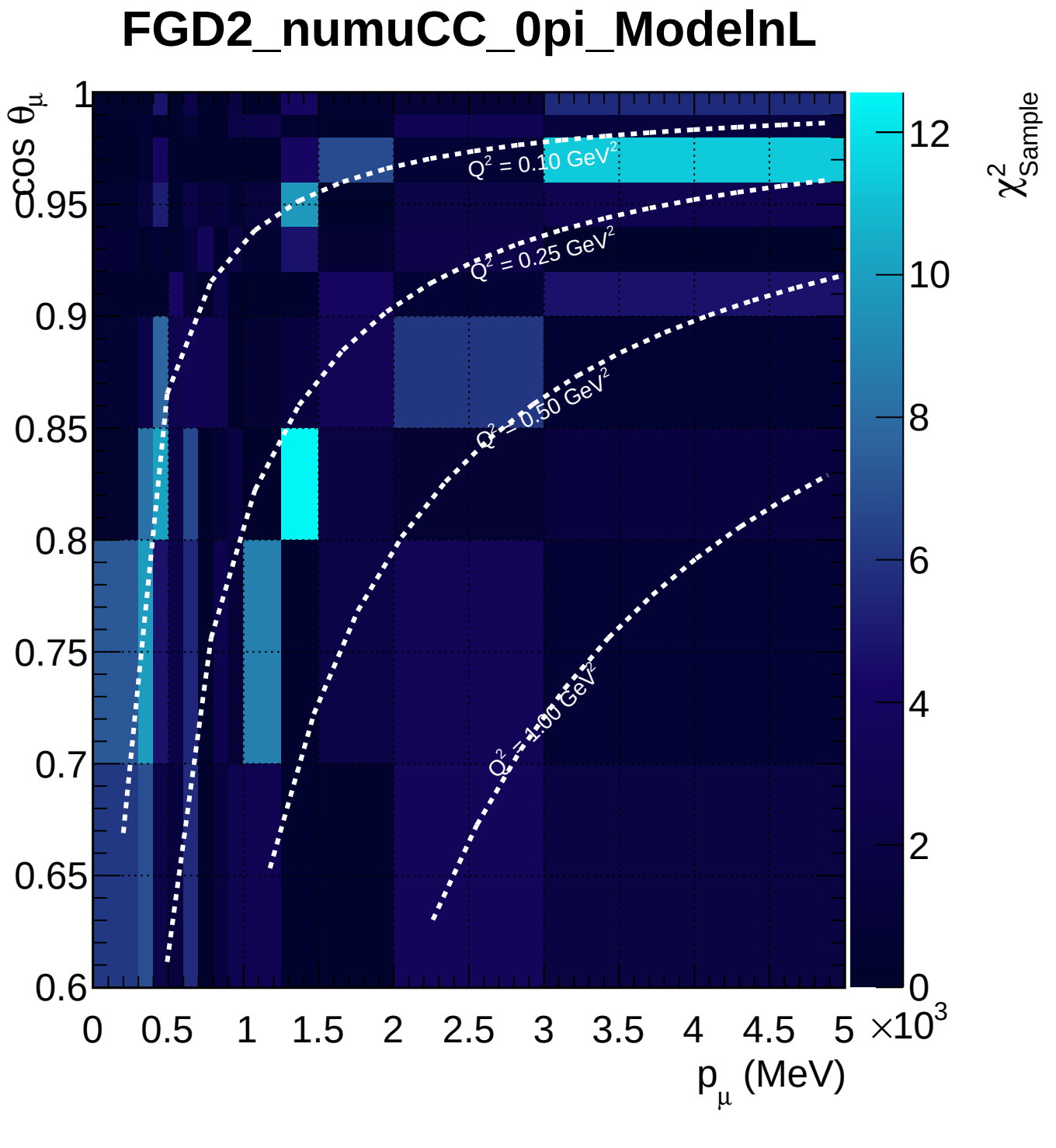

DataDrawFluc
FGD2 ν_μCC 0π
p = 0.000
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Draw, Draw Fluc}}$
Steps
7000
6000
5000
4000
3000
2000
1000
100
120
140
160
180
200
220
30
25
20
15
10
5
0

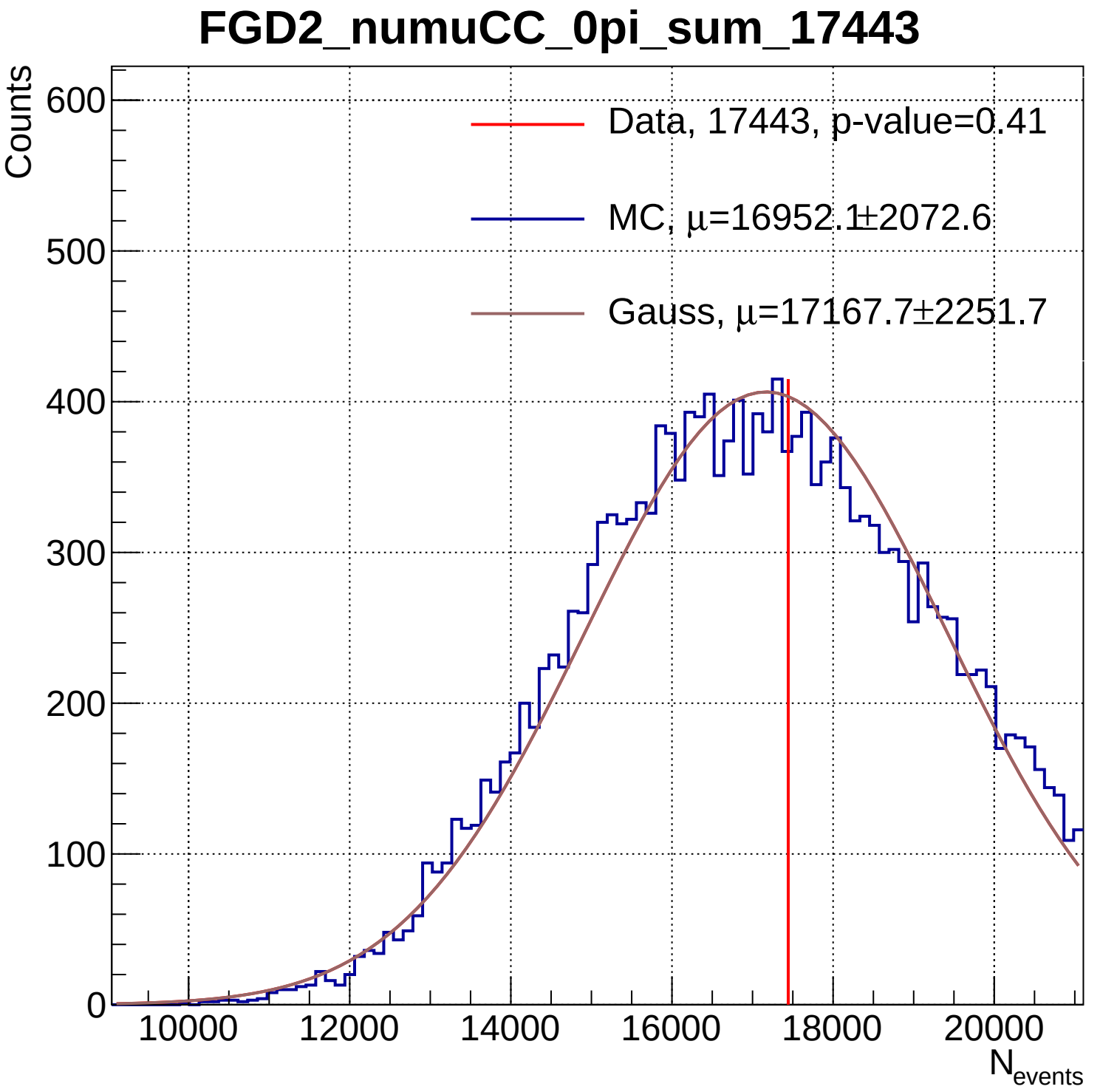

DataPredFluc
FGD2 ν_μCC 0π
p = 0.000
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Pred, Pred Fluc}}$
Steps
7000
6000
5000
4000
3000
2000
1000
100
120
140
160
180
200
220
30
25
20
15
10
5
0

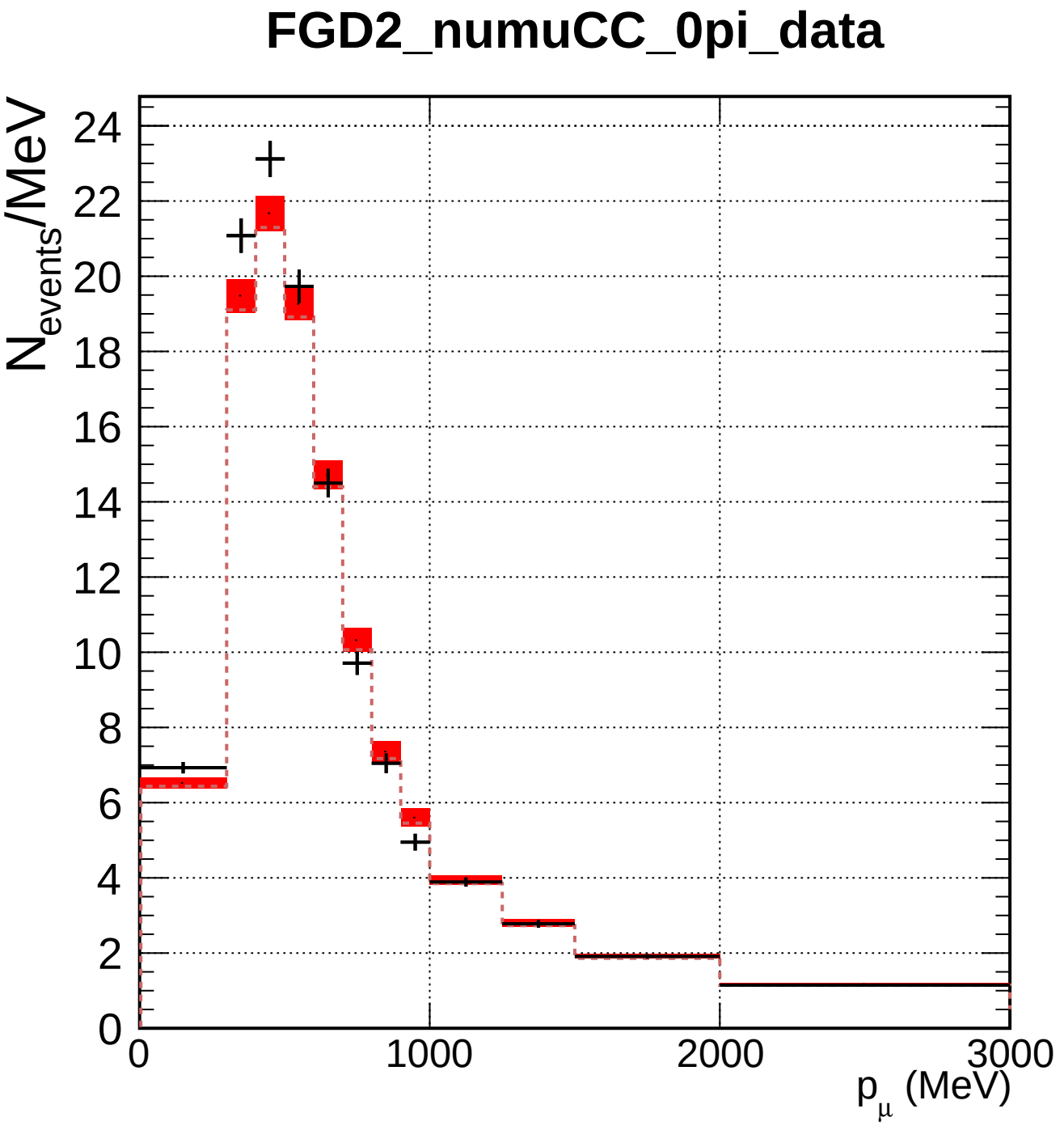

FGD2_numuCC_0pi_mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

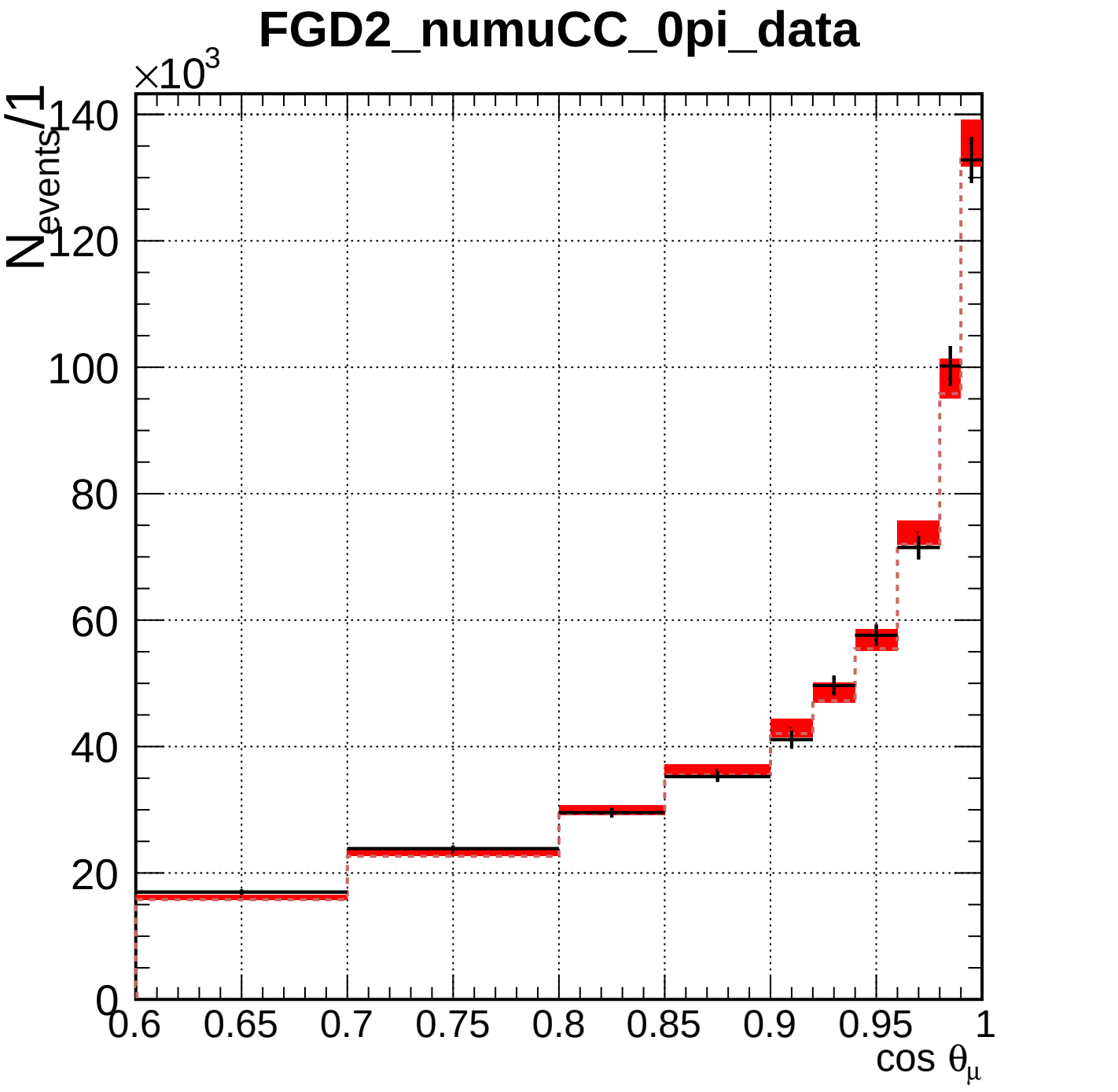

FGD2_numuCC_0pi_mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

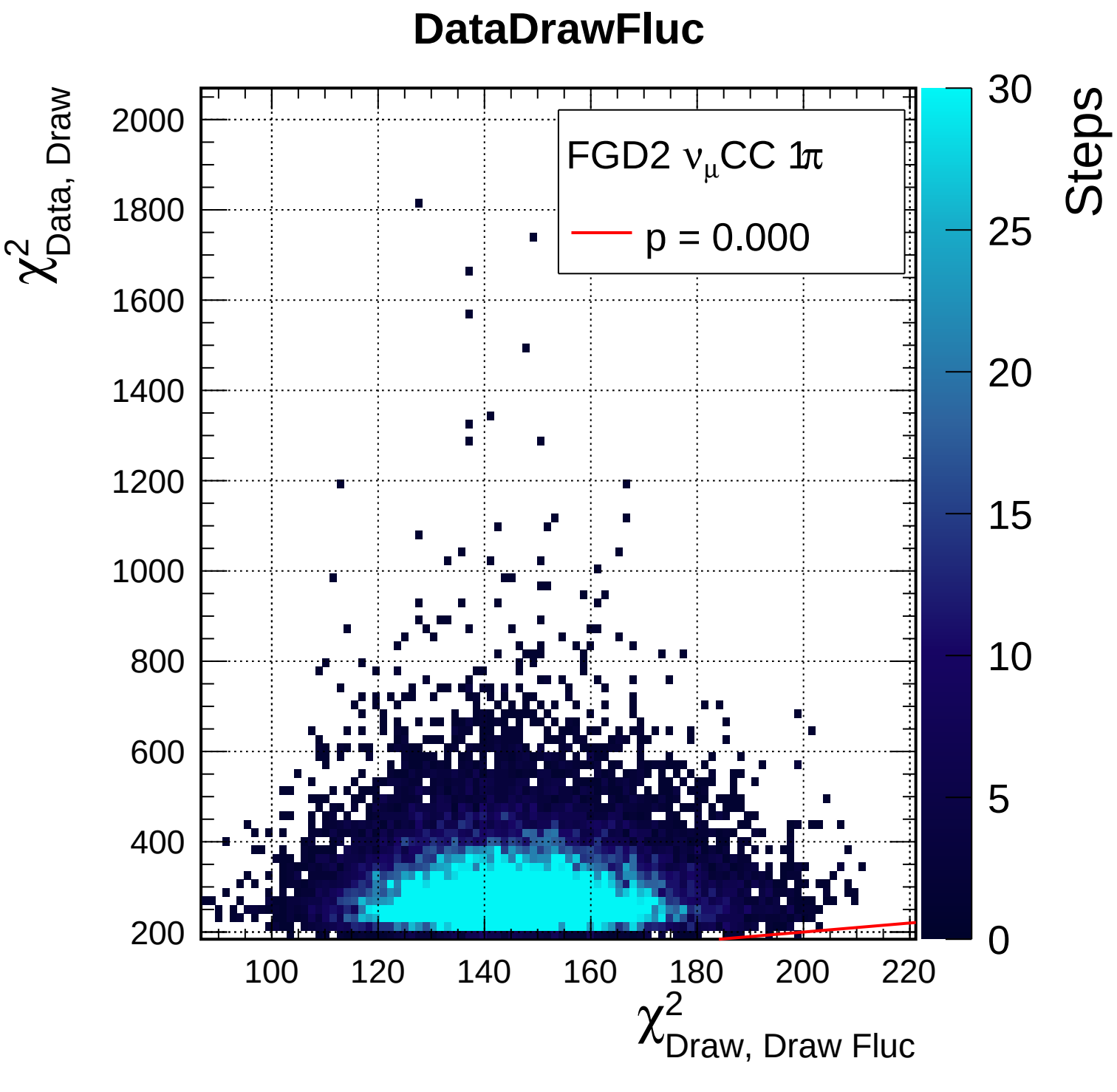

FGD2_numuCC_0pi_MeanlnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
χ²Sample
12
10
8
6
4
2
0

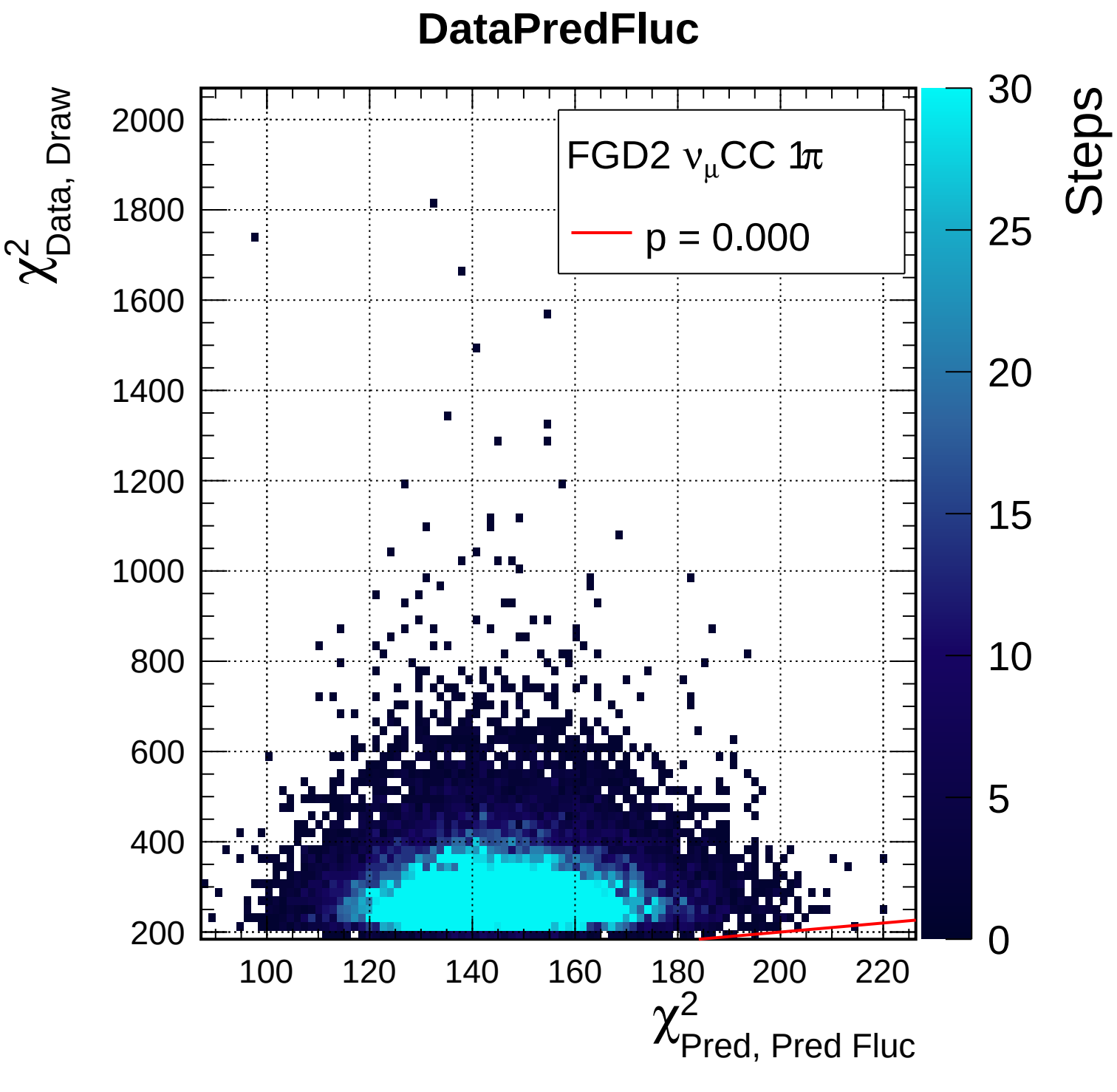

FGD2_numuCC_0pi_ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
χ²Sample
12
10
8
6
4
2
0

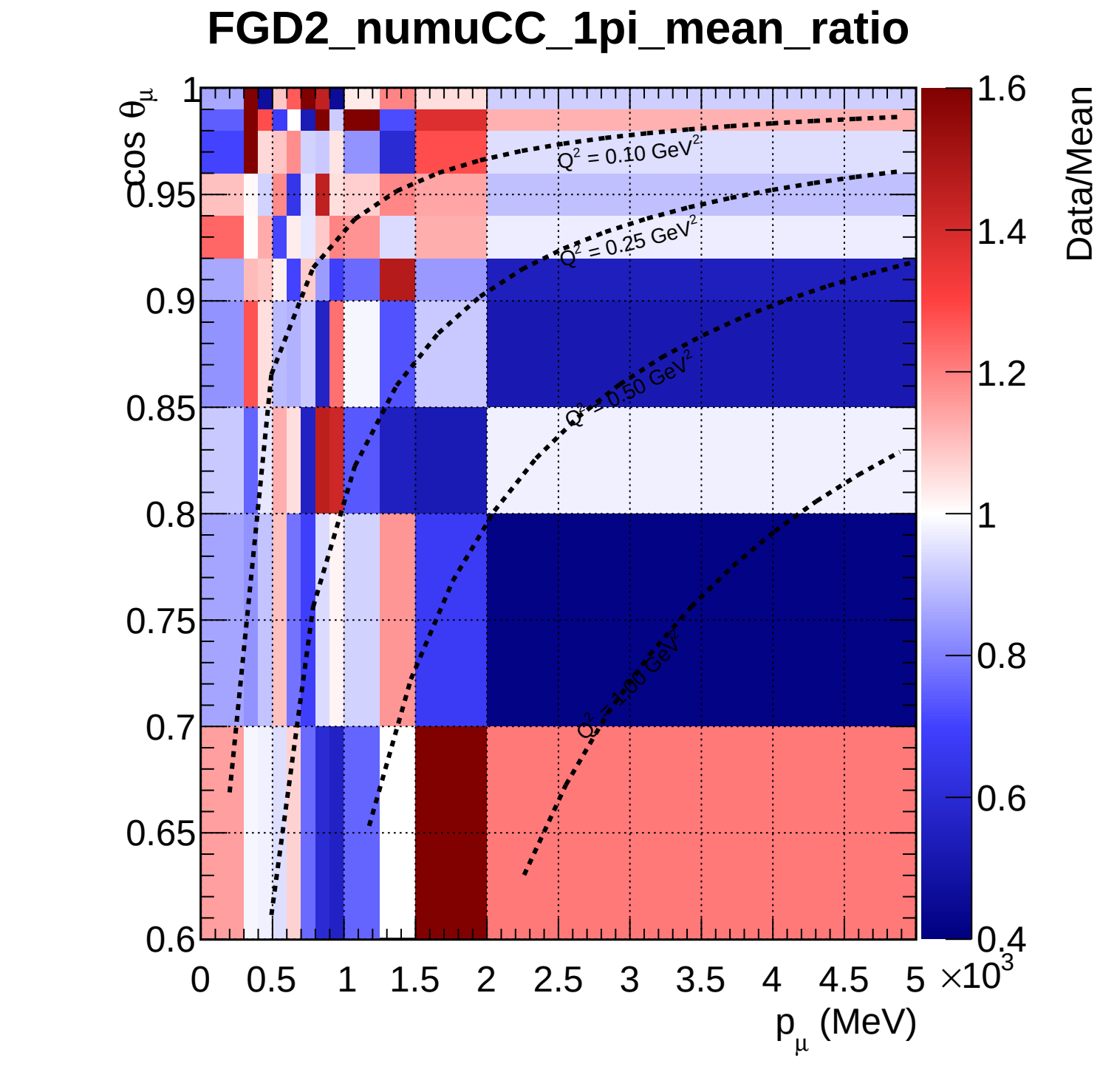

FGD2_numuCC_0pi_sum_17443
Counts
600
500
400
300
200
100
0
Data, 17443, p-value=0.41
MC, μ=16952.1±2072.6
Gauss, μ=17167.7±2251.7
10000
12000
14000
16000
18000
20000
N events

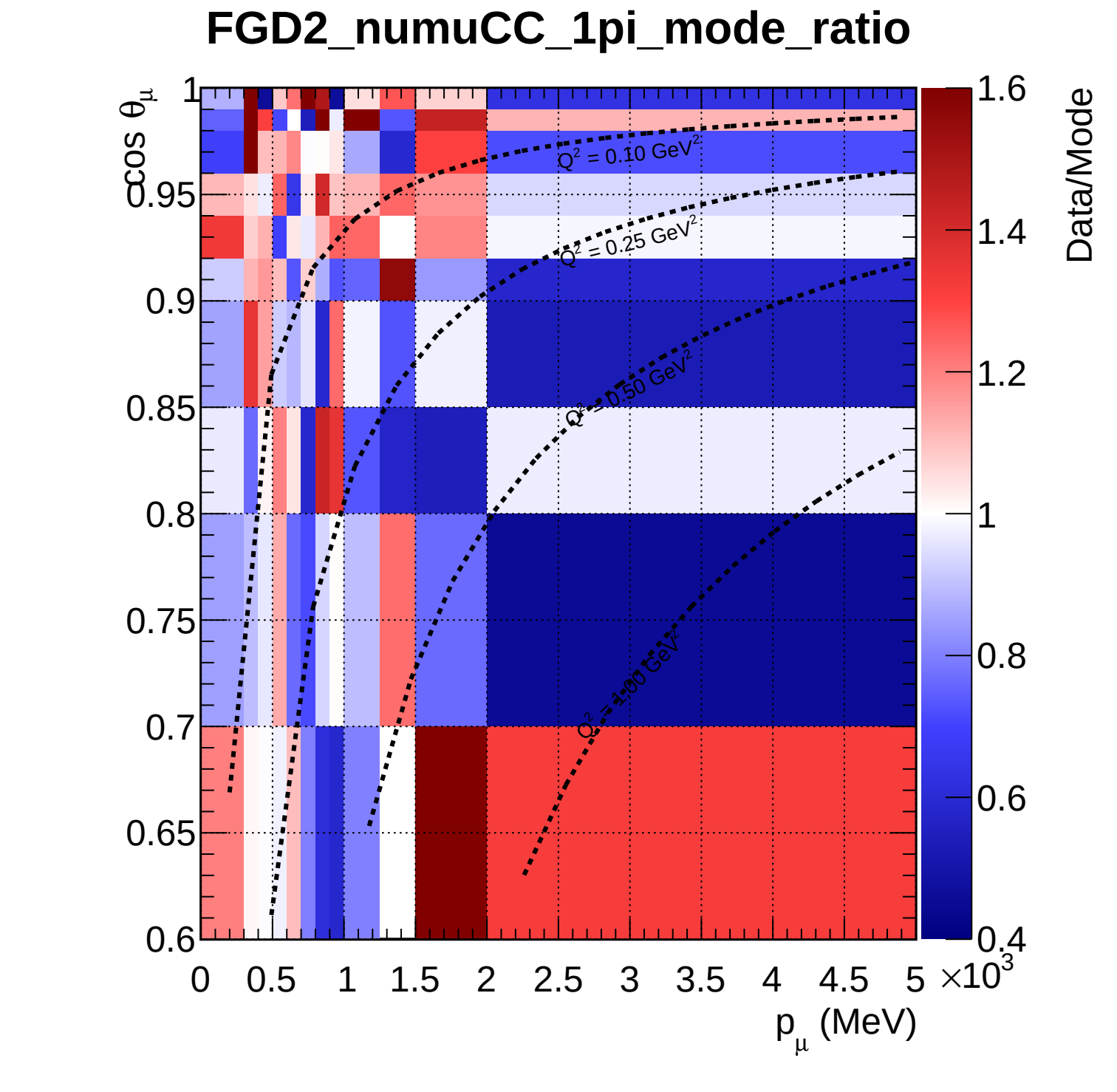

FGD2_numuCC_0pi_data
N_events/MeV
0
2
4
6
8
10
12
14
16
18
20
22
24
0
1000
2000
3000
p_μ (MeV)

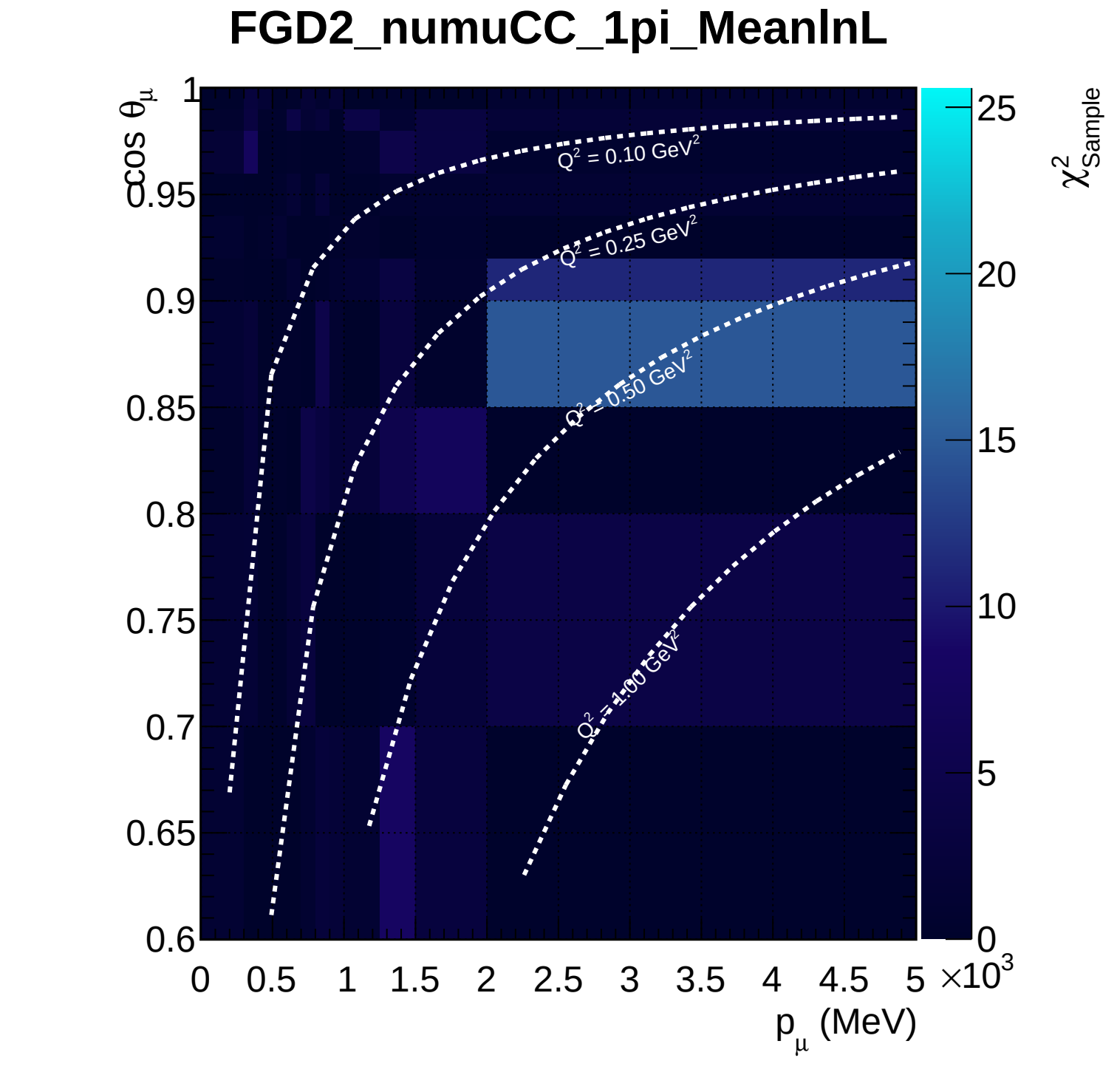

FGD2_numuCC_0pi_data
×10^3
N_events/1
140
120
100
80
60
40
20
0
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
cos θ_μ

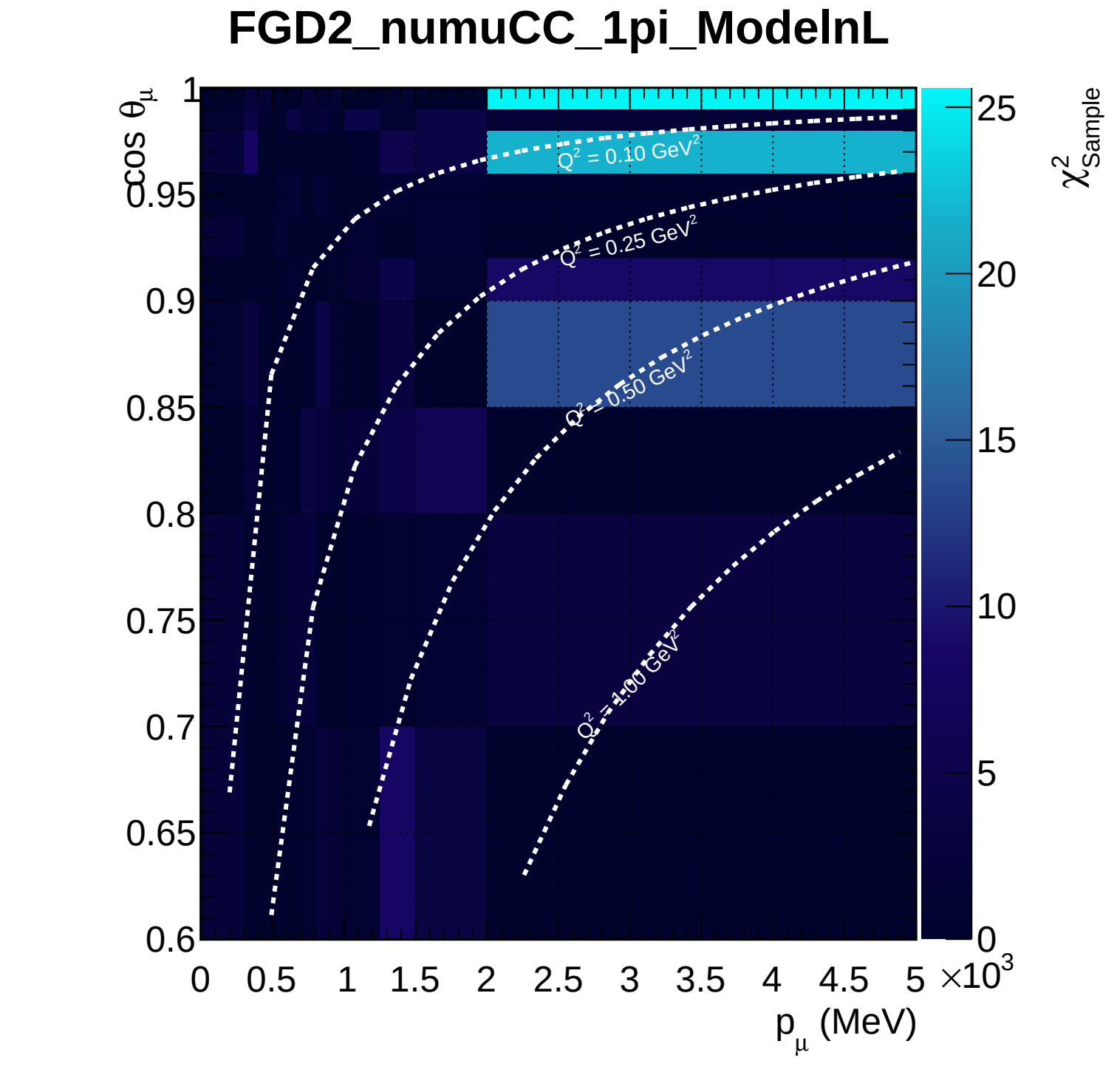

DataDrawFluc
FGD2 ν_μCC 1π
p = 0.000
$\chi^2_{Data, Draw}$
$\chi^2_{Draw, Draw Fluc}$
Steps
2000
1800
1600
1400
1200
1000
800
600
400
200
100
120
140
160
180
200
220
30
25
20
15
10
5
0

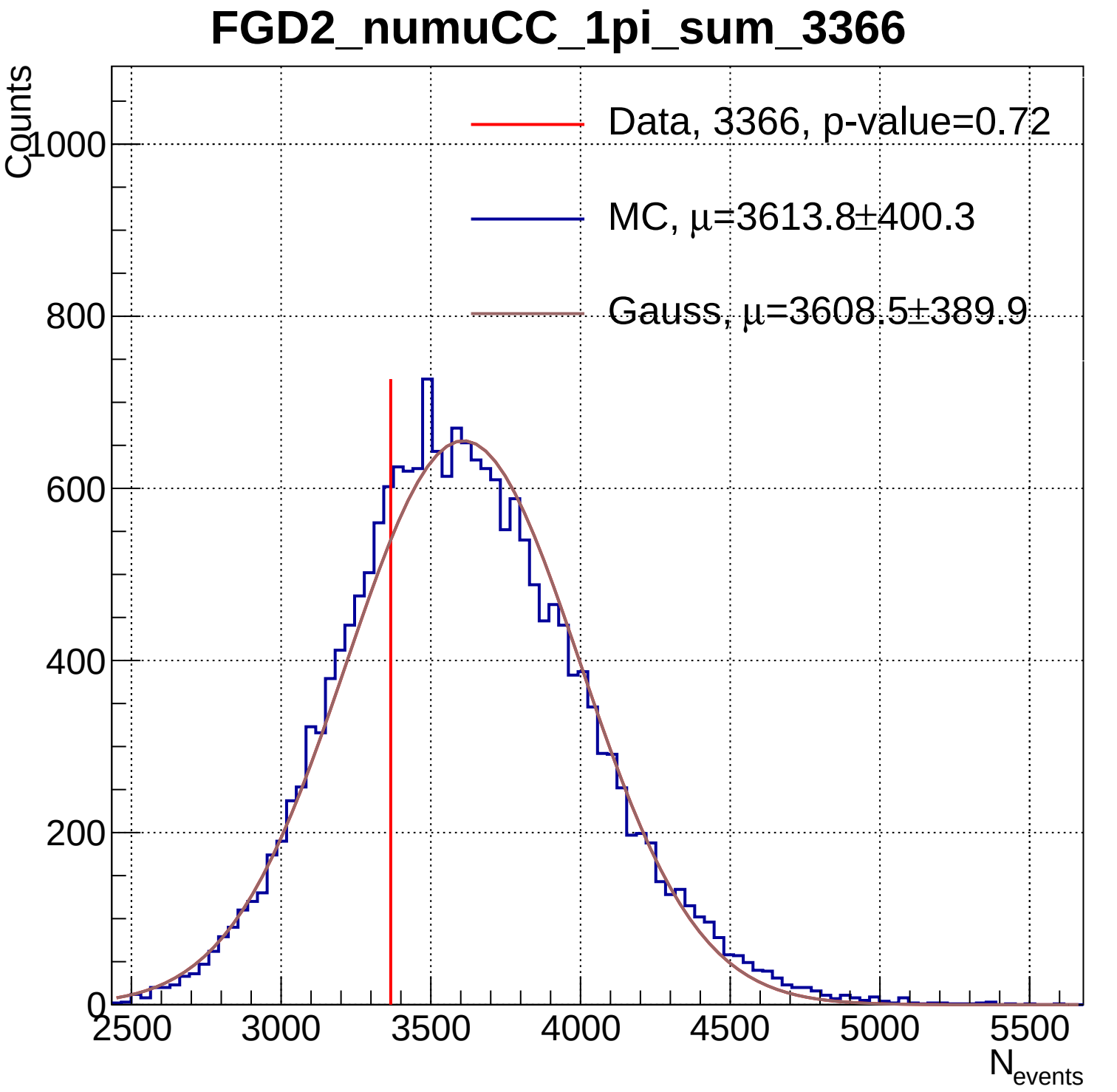

DataPredFluc
FGD2 ν_μCC 1π
p = 0.000
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Pred, Pred Fluc}}$
Steps
2000
1800
1600
1400
1200
1000
800
600
400
200
100
120
140
160
180
200
220
30
25
20
15
10
5
0

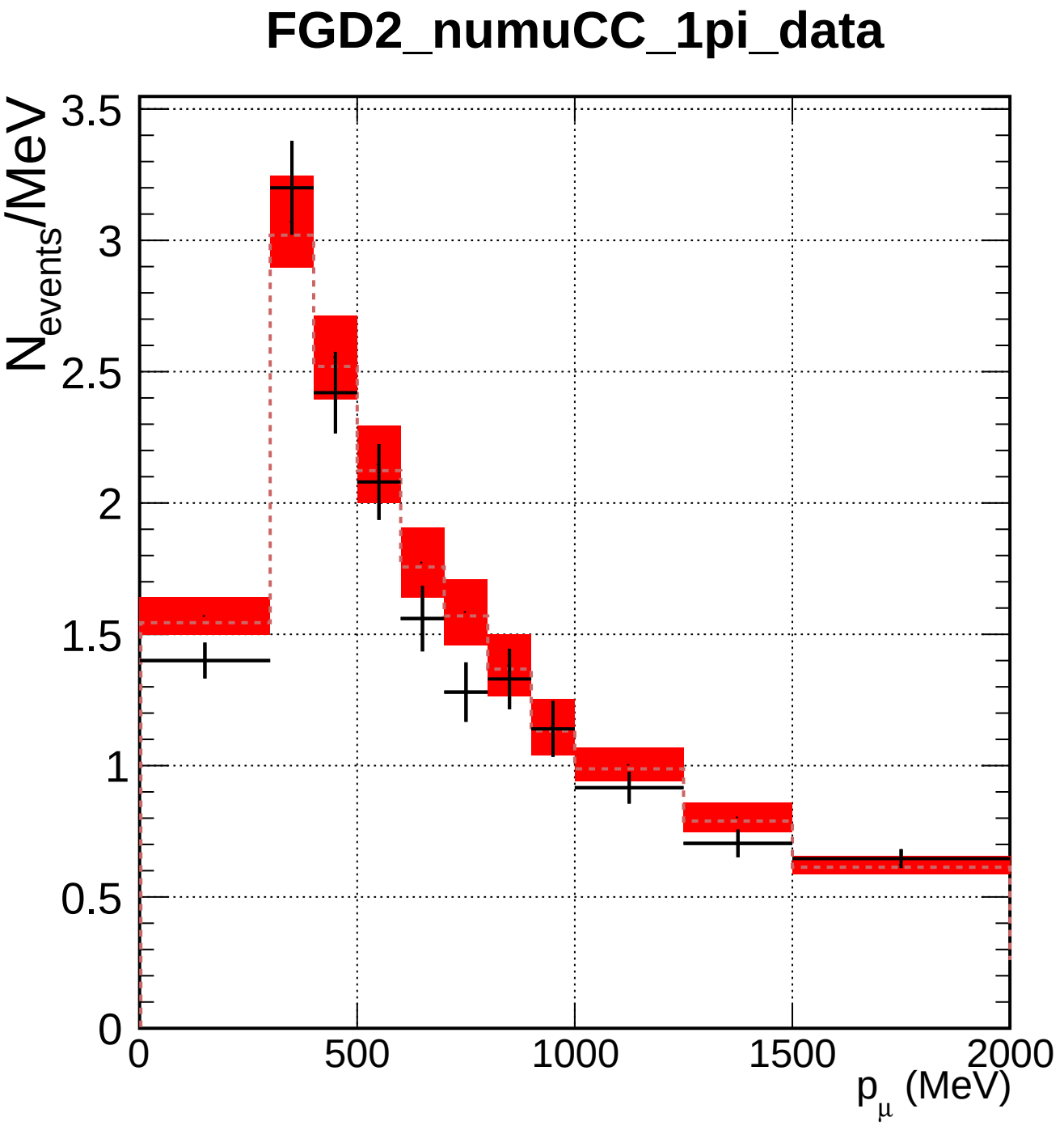

FGD2_numuCC_1pi_mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
1.6
1.4
1.2
1
0.8
0.6
0.4
Data/Mean

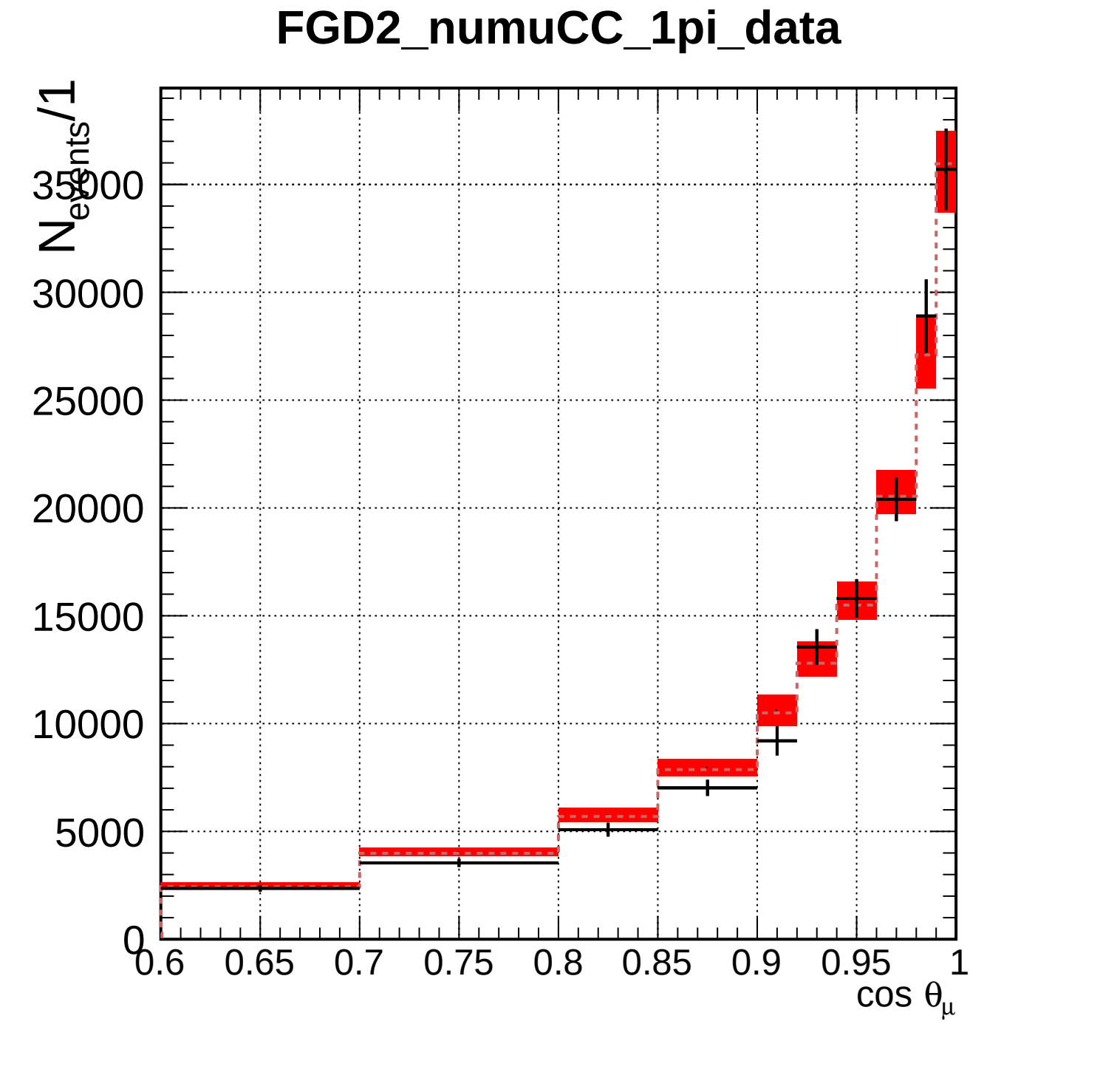

FGD2_numuCC_1pi_mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

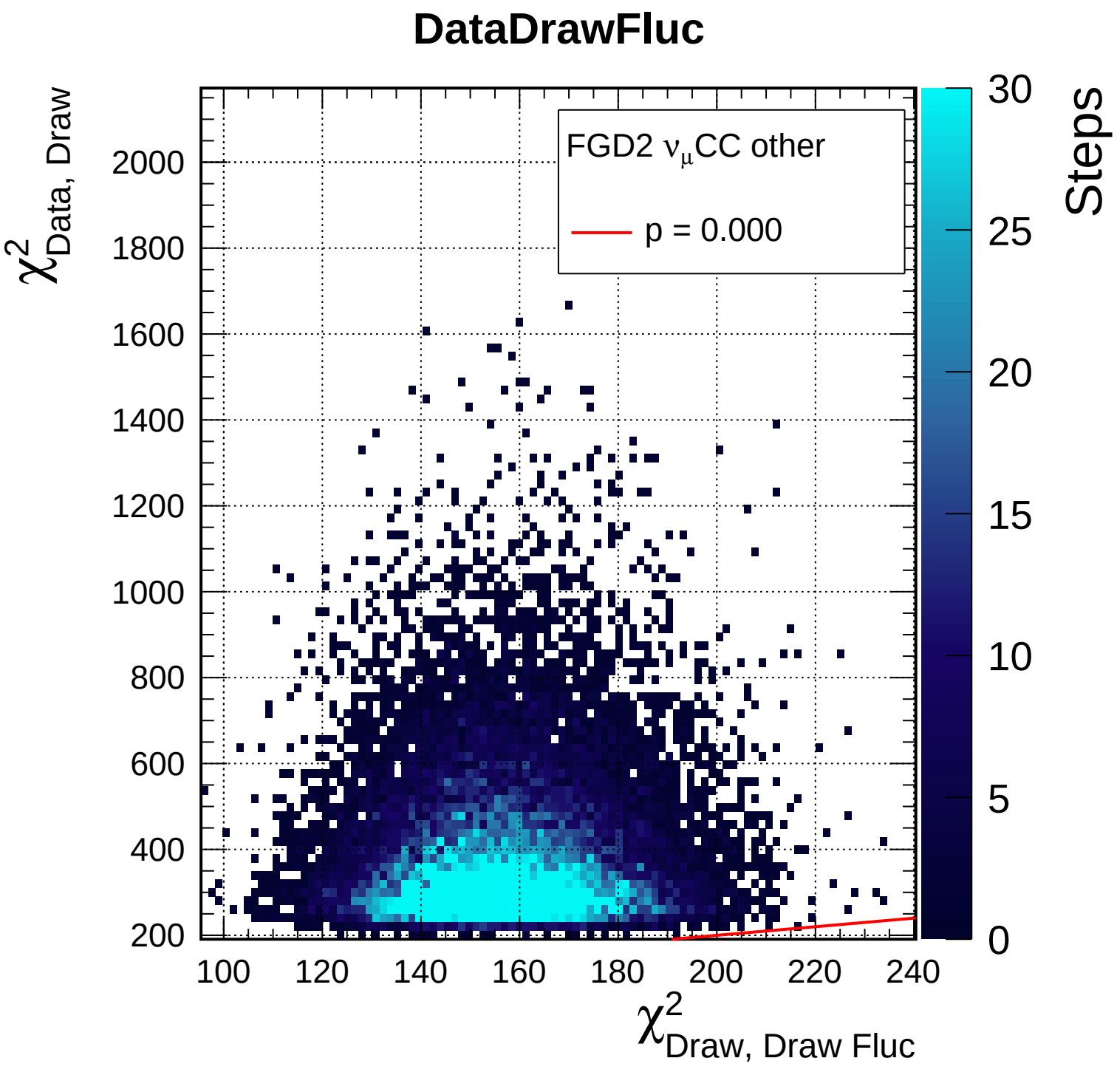

FGD2_numuCC_1pi_MeanlnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
25
20
15
10
5
0
χ²Sample

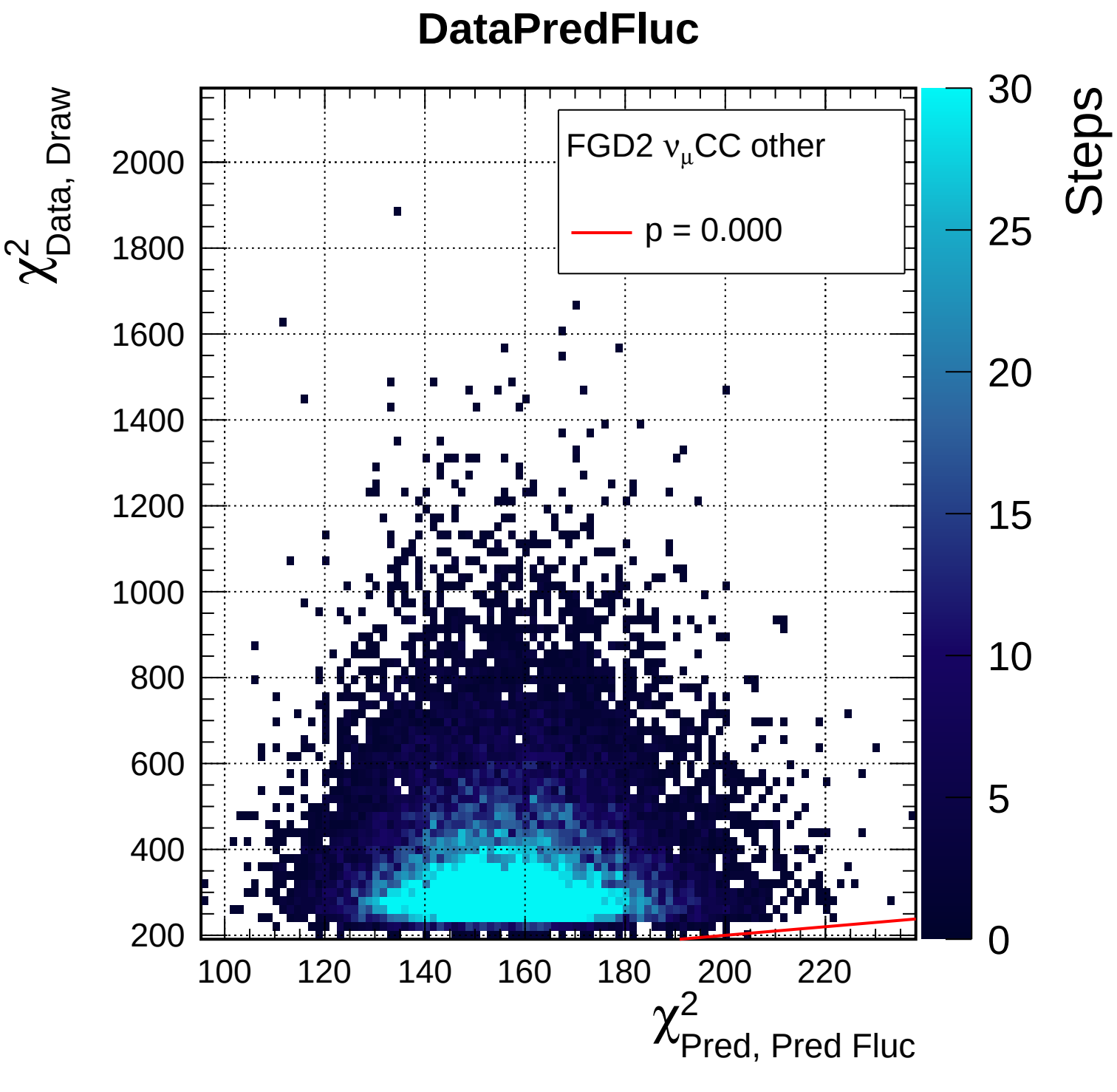

FGD2_numuCC_1pi_ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
25
20
15
10
5
0
χ²Sample

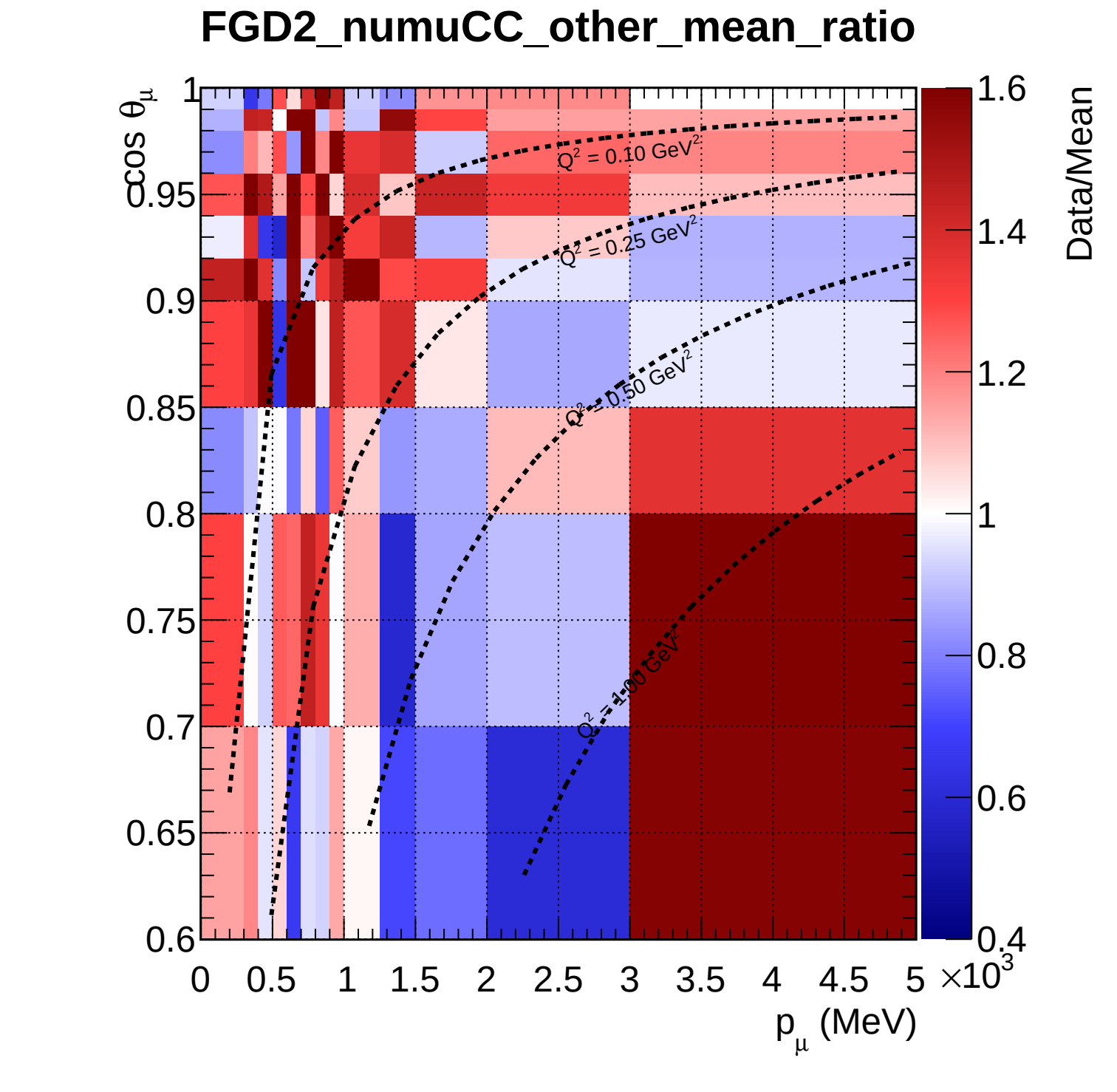

FGD2_numuCC_1pi_sum_3366
Counts
Data, 3366, p-value=0.72
MC, μ=3613.8±400.3
Gauss, μ=3608.5±389.9
0
200
400
600
800
1000
2500
3000
3500
4000
4500
5000
5500
N_events

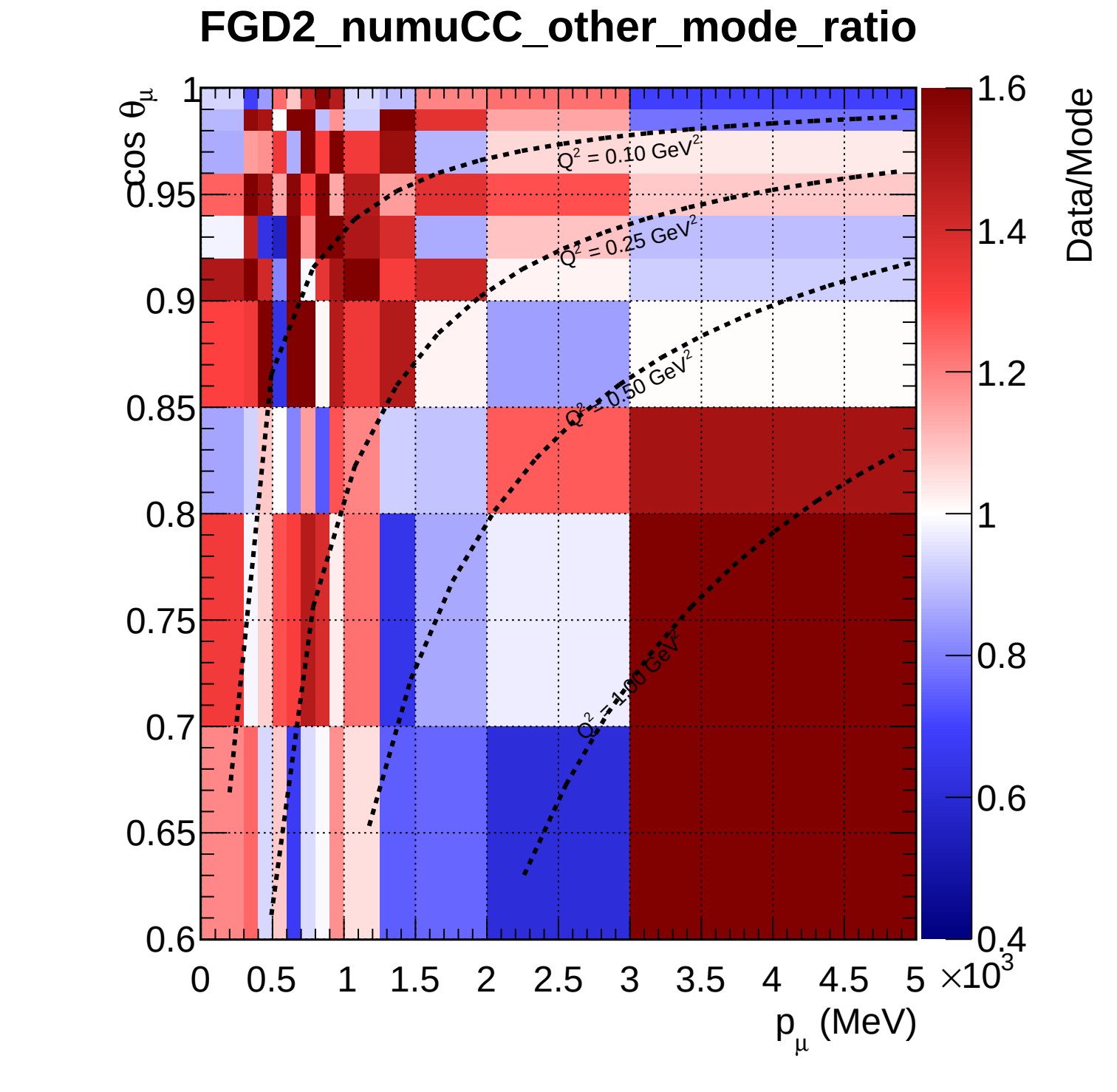

FGD2_numuCC_1pi_data
N_events/MeV
3.5
3
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
p_μ (MeV)

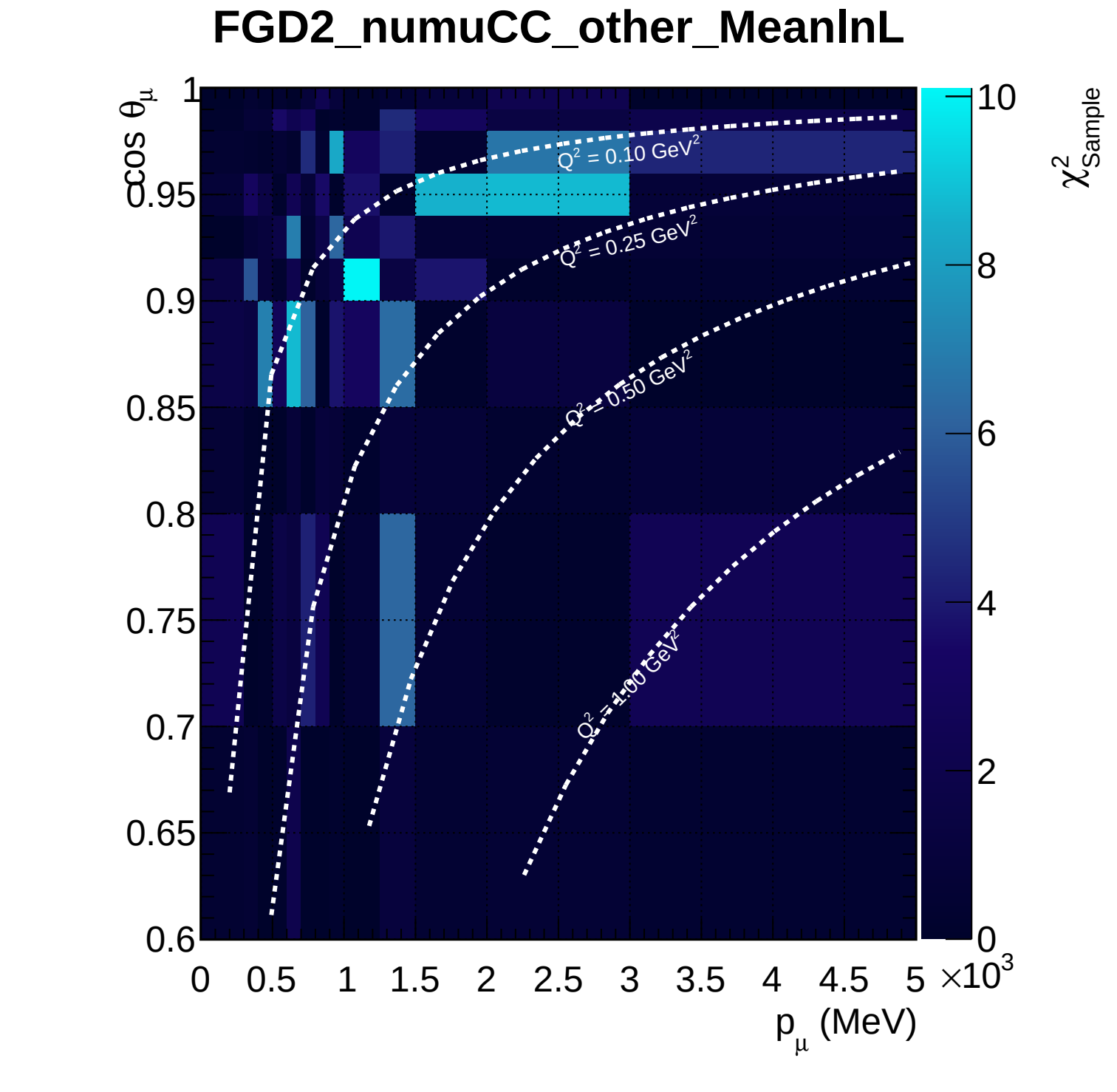

FGD2_numuCC_1pi_data
N_events/1
35000
30000
25000
20000
15000
10000
5000
0
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
cos θ_μ

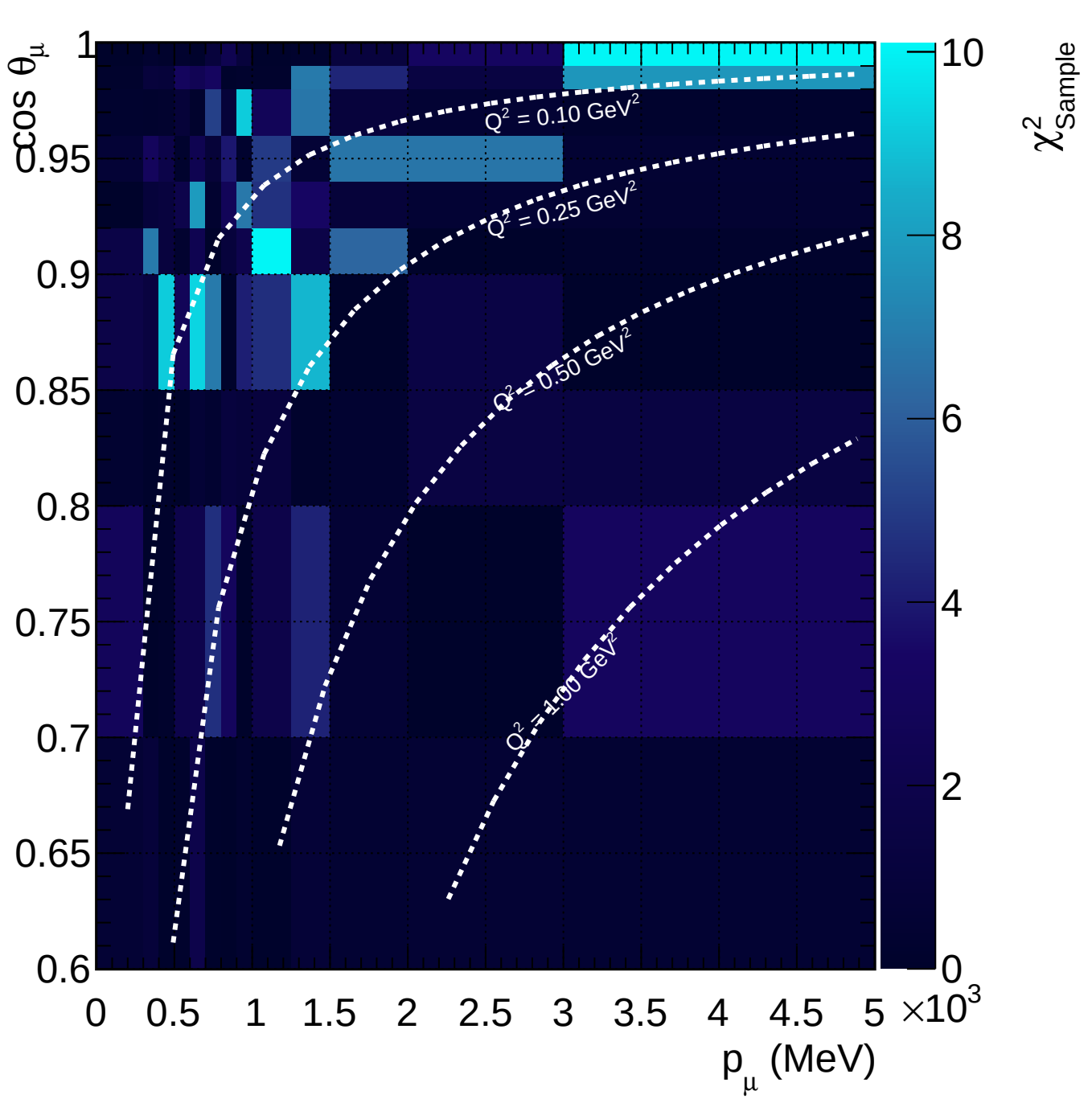

DataDrawFluc
FGD2 ν_μCC other
p = 0.000
$\chi^2_{Data, Draw}$
$\chi^2_{Draw, Draw Fluc}$
Steps
2000
1800
1600
1400
1200
1000
800
600
400
200
100
120
140
160
180
200
220
240
30
25
20
15
10
5
0

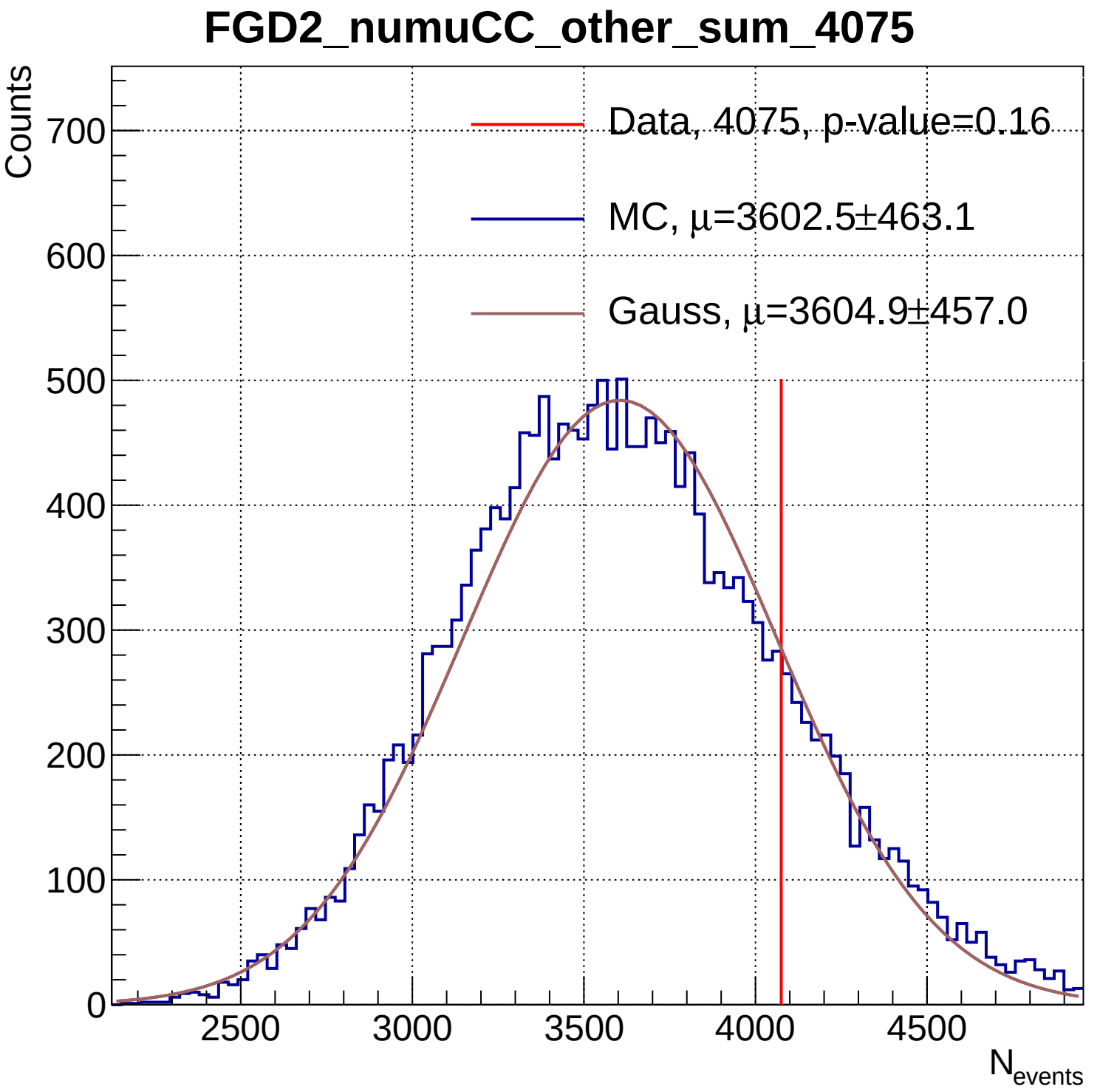

DataPredFluc
FGD2 ν_μCC other
p = 0.000
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Pred, Pred Fluc}}$
Steps
2000
1800
1600
1400
1200
1000
800
600
400
200
100
120
140
160
180
200
220
30
25
20
15
10
5
0

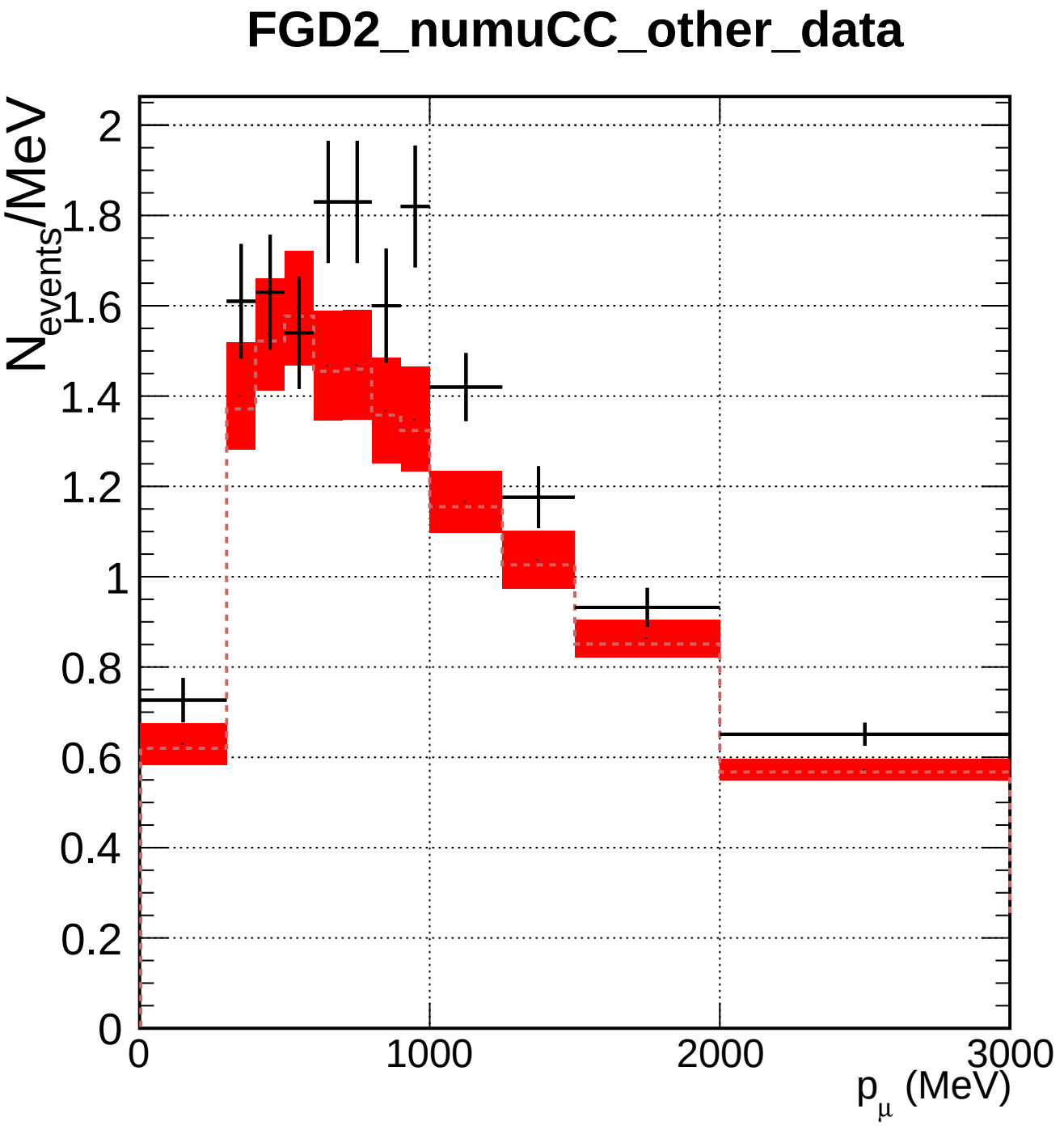

FGD2_numuCC_other_mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

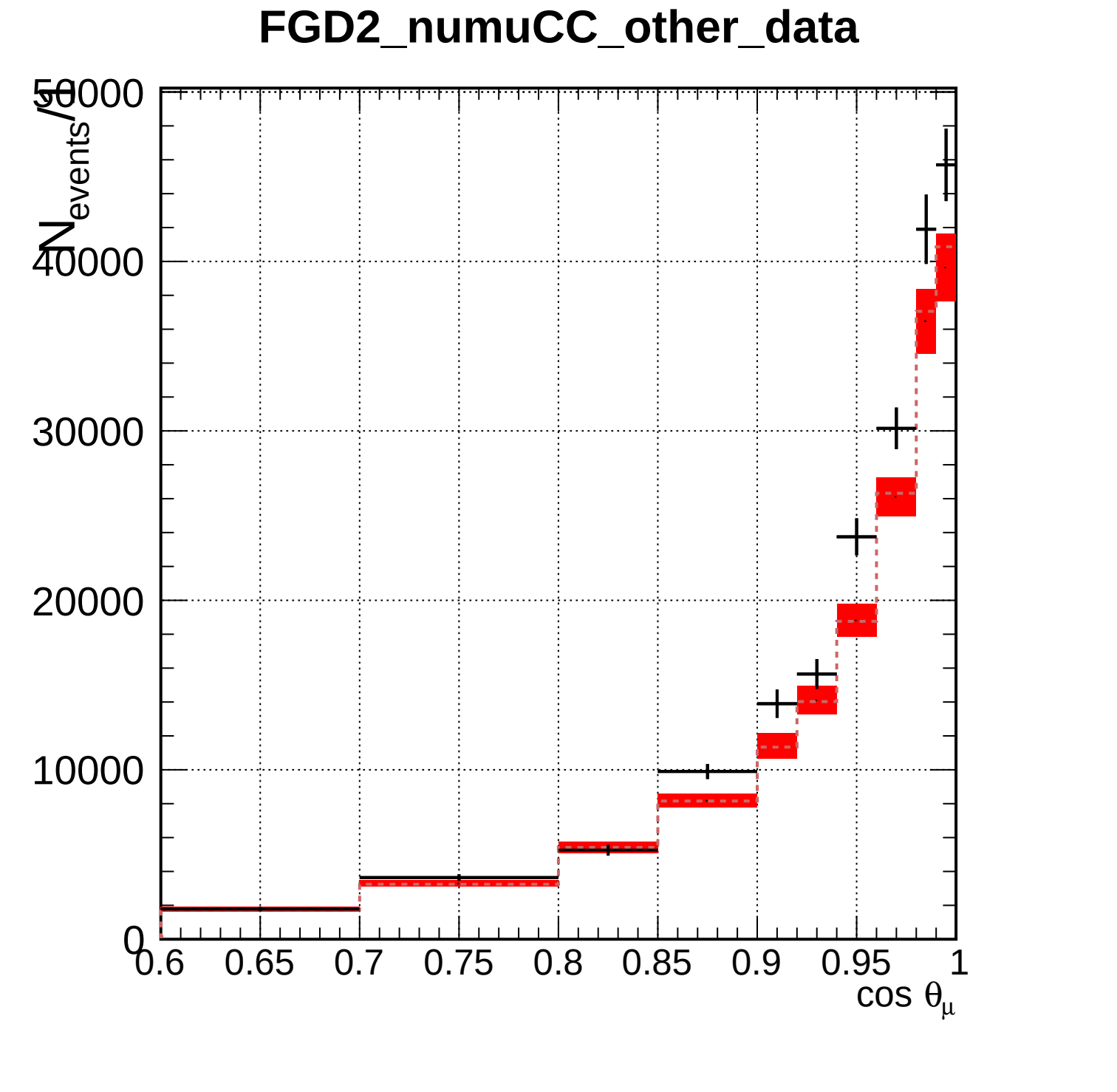

FGD2_numuCC_other_mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

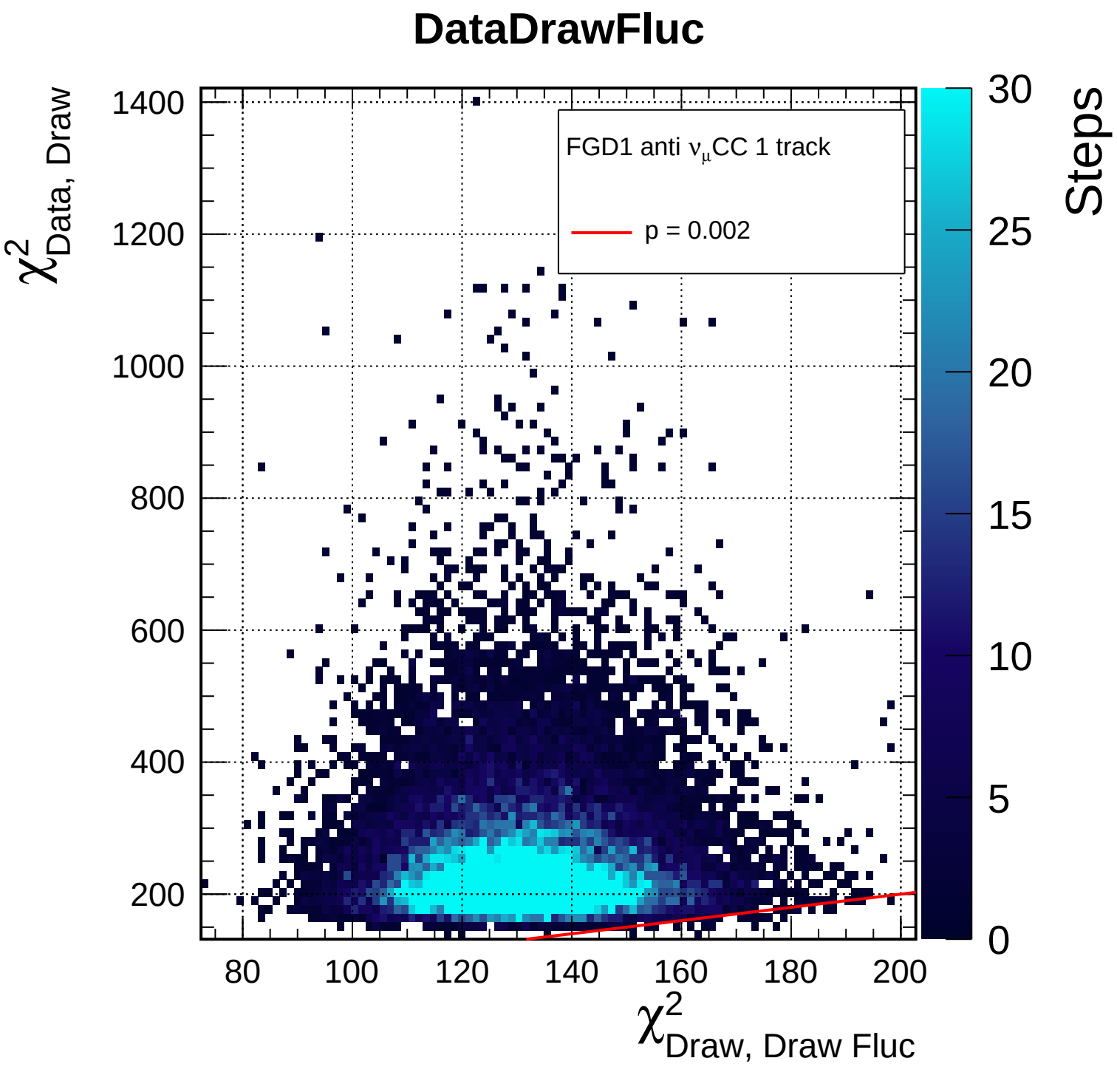

FGD2_numuCC_other_MeanInL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
10
8
6
4
2
0
χ²Sample

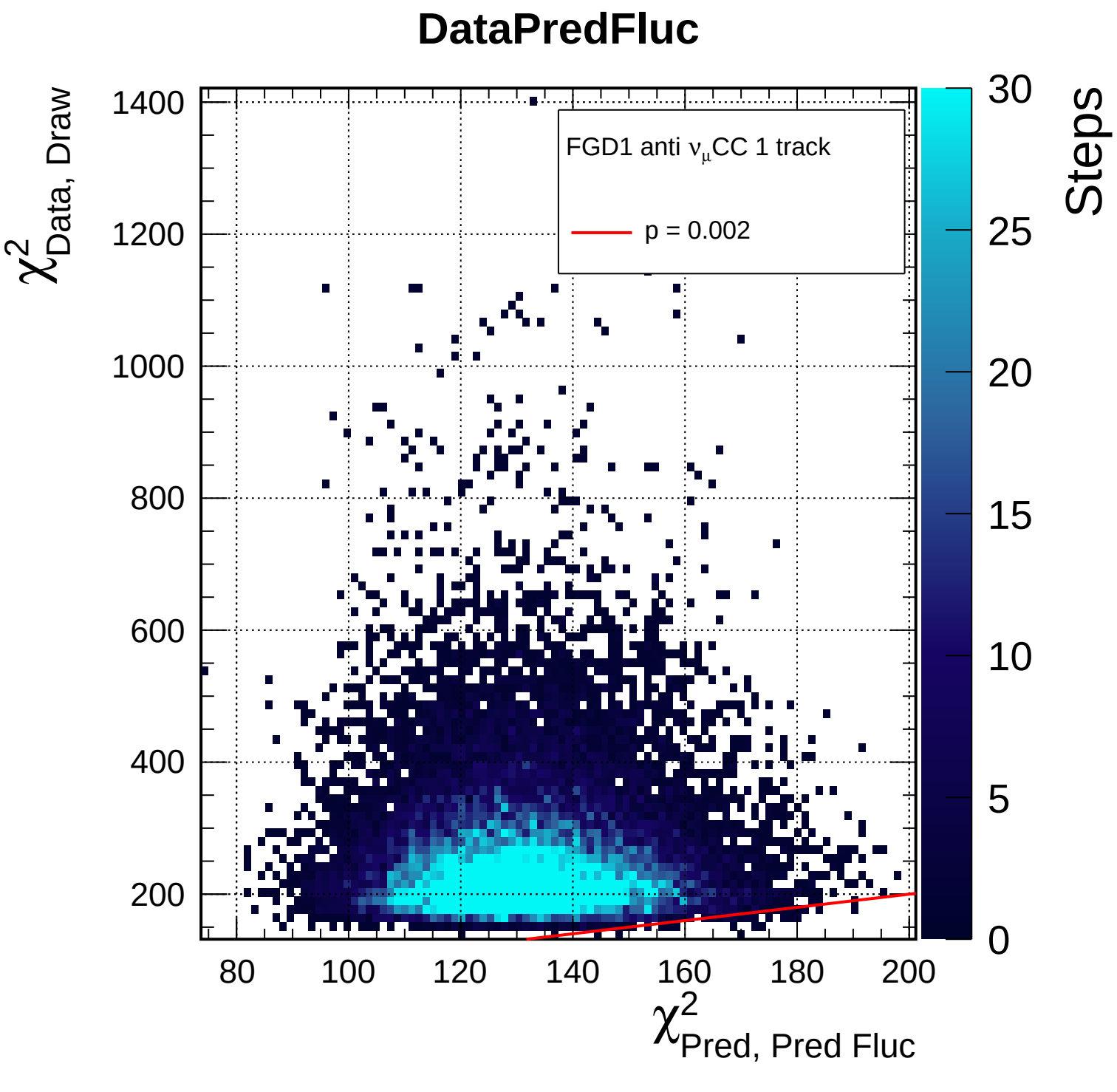

FGD2_numuCC_other_ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
×10³
pμ (MeV)
10
8
6
4
2
0
χ²Sample

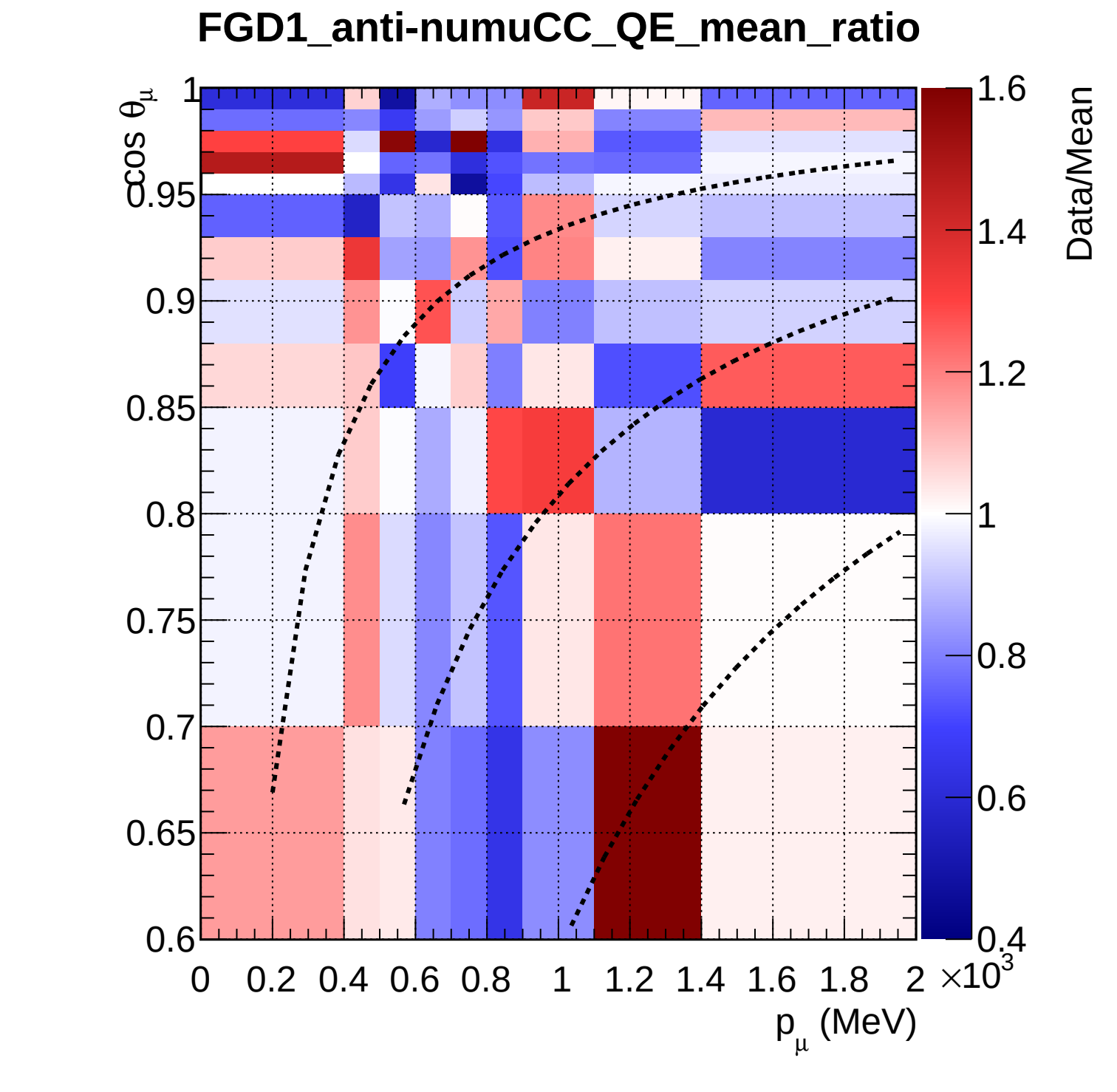

FGD2_numuCC_other_sum_4075
Counts
Data, 4075, p-value=0.16
MC, μ=3602.5±463.1
Gauss, μ=3604.9±457.0
700
600
500
400
300
200
100
0
2500
3000
3500
4000
4500
N_events

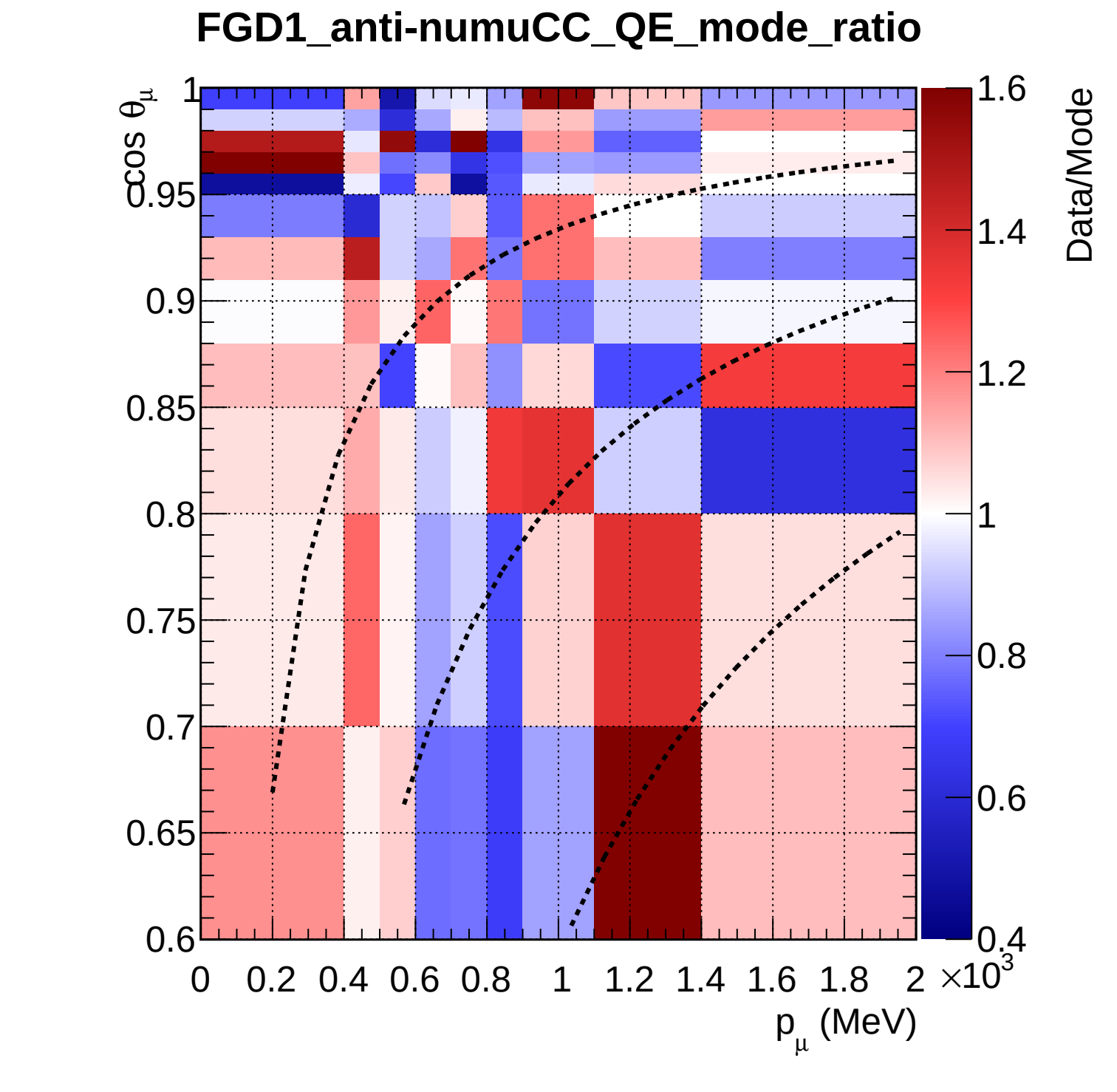

FGD2_numuCC_other_data
N_events/MeV
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
1000
2000
3000
p_μ (MeV)

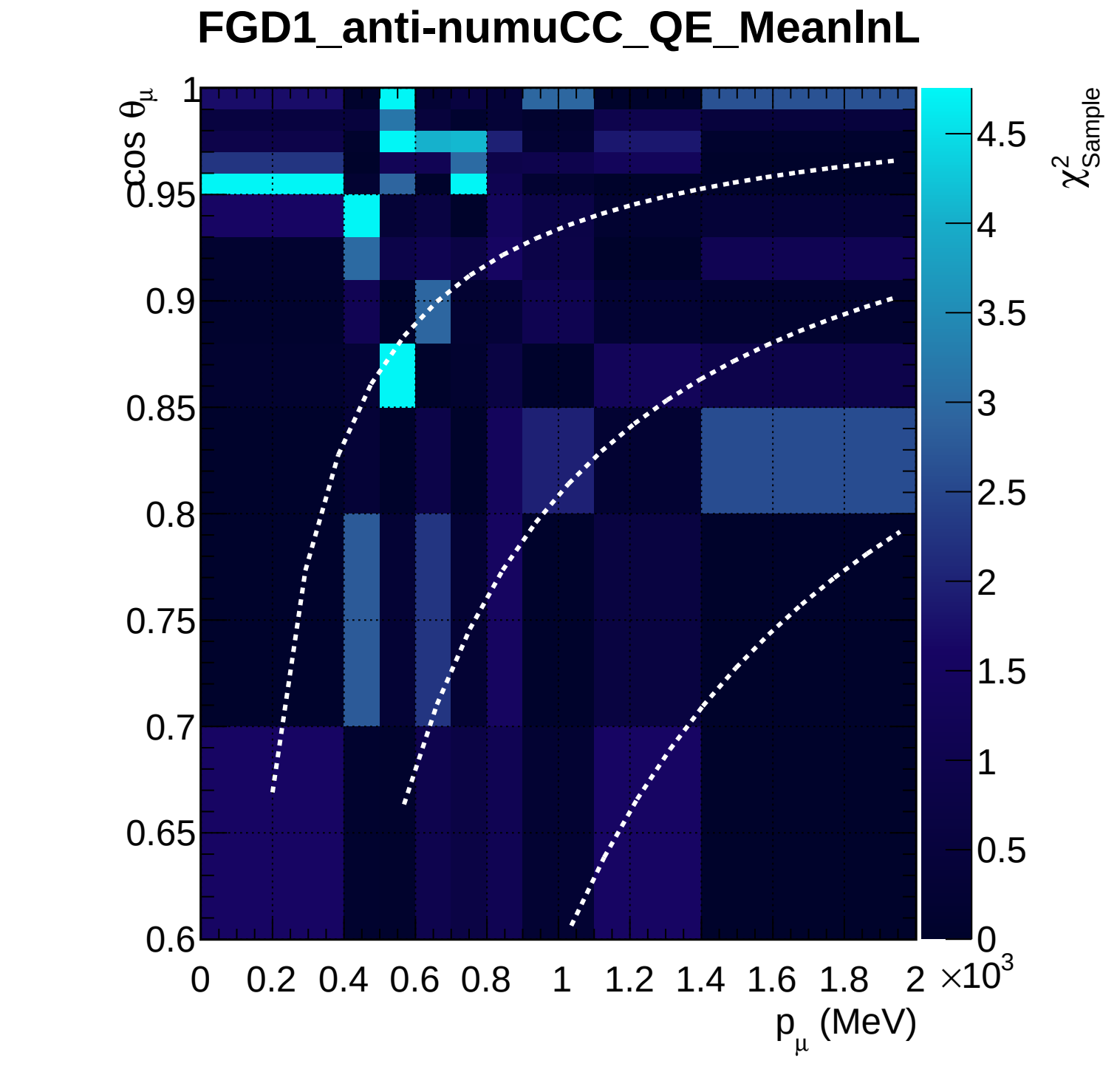

FGD2_numuCC_other_data
N_{events}
50000
40000
30000
20000
10000
0
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
cos θ_μ

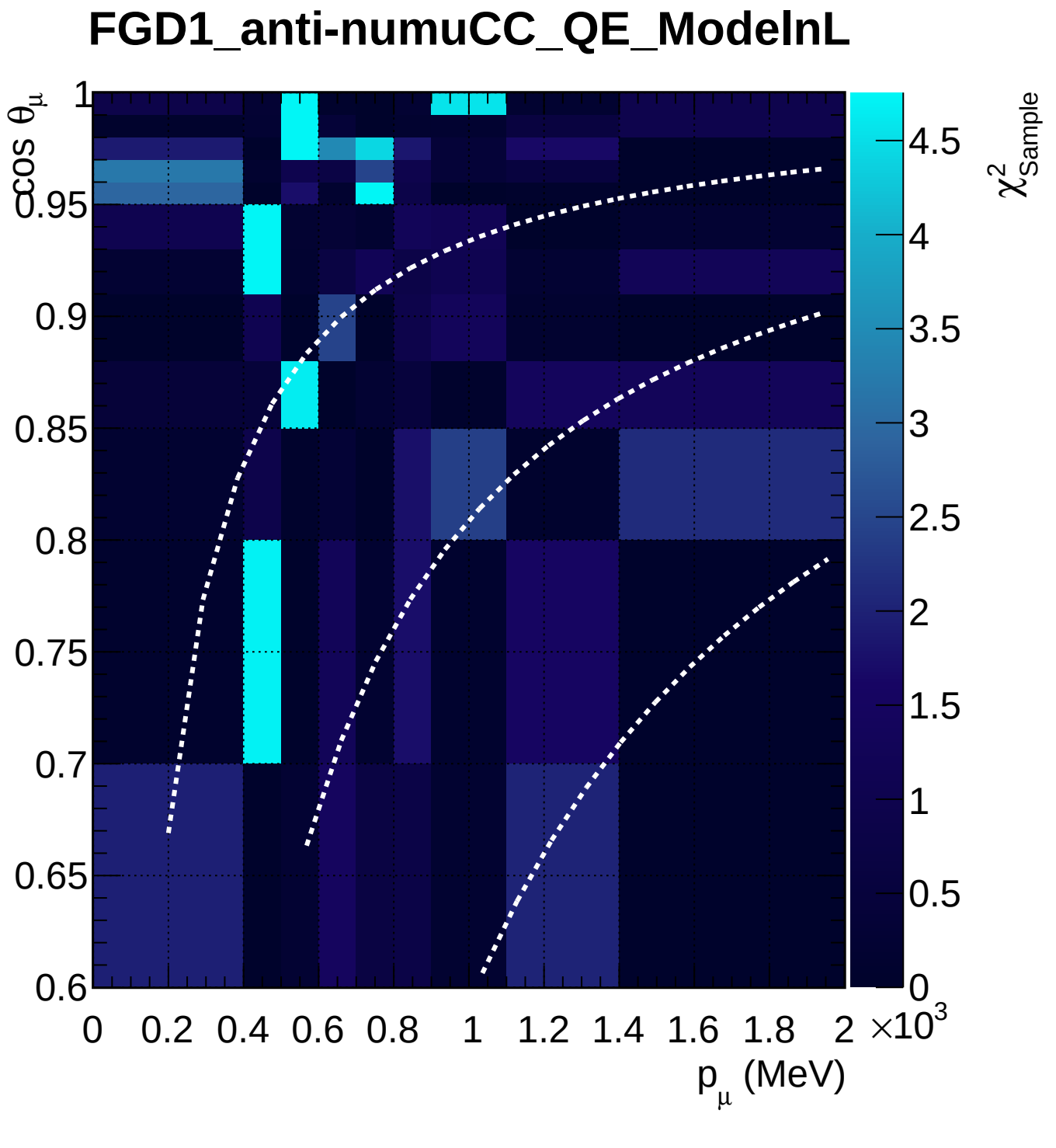

DataDrawFluc
FGD1 anti ν_μCC 1 track
p = 0.002
χ²Data, Draw
χ²Draw, Draw Fluc
Steps
1400
1200
1000
800
600
400
200
80
100
120
140
160
180
200
30
25
20
15
10
5
0

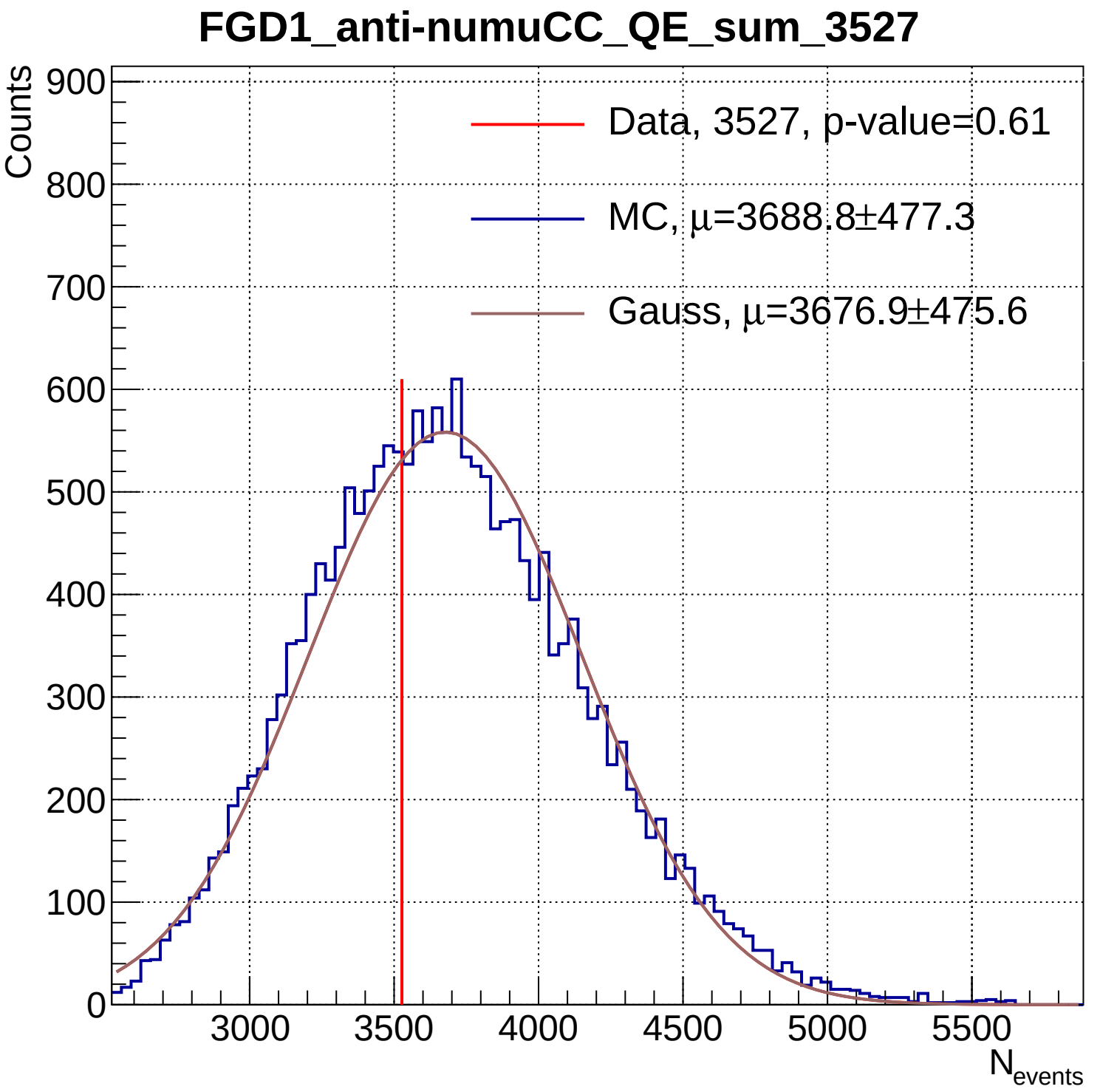

DataPredFluc
FGD1 anti ν_μCC 1 track
p = 0.002
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Pred, Pred Fluc}}$
Steps
1400
1200
1000
800
600
400
200
80
100
120
140
160
180
200
30
25
20
15
10
5
0

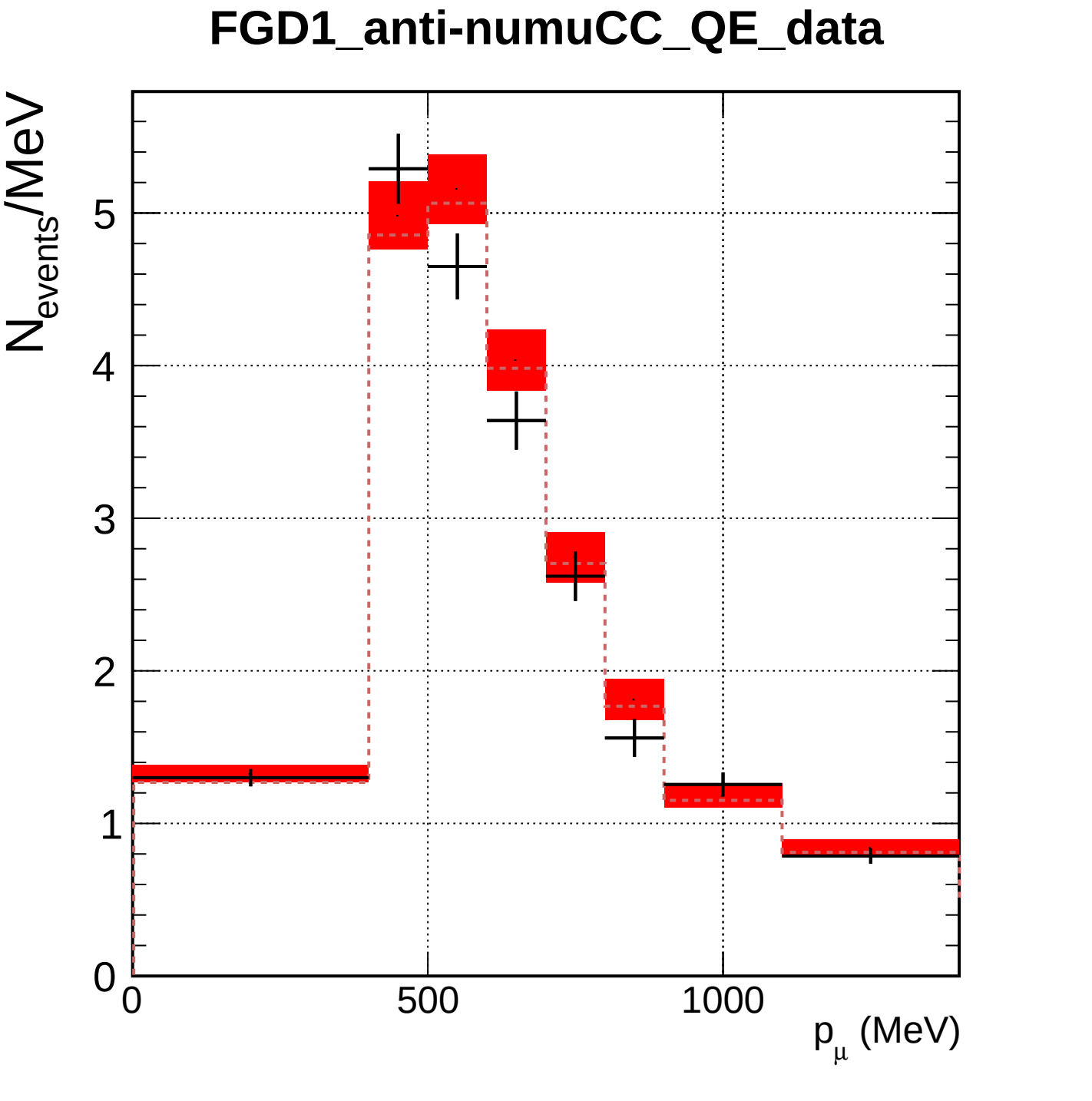

FGD1_anti-numuCC_QE_mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

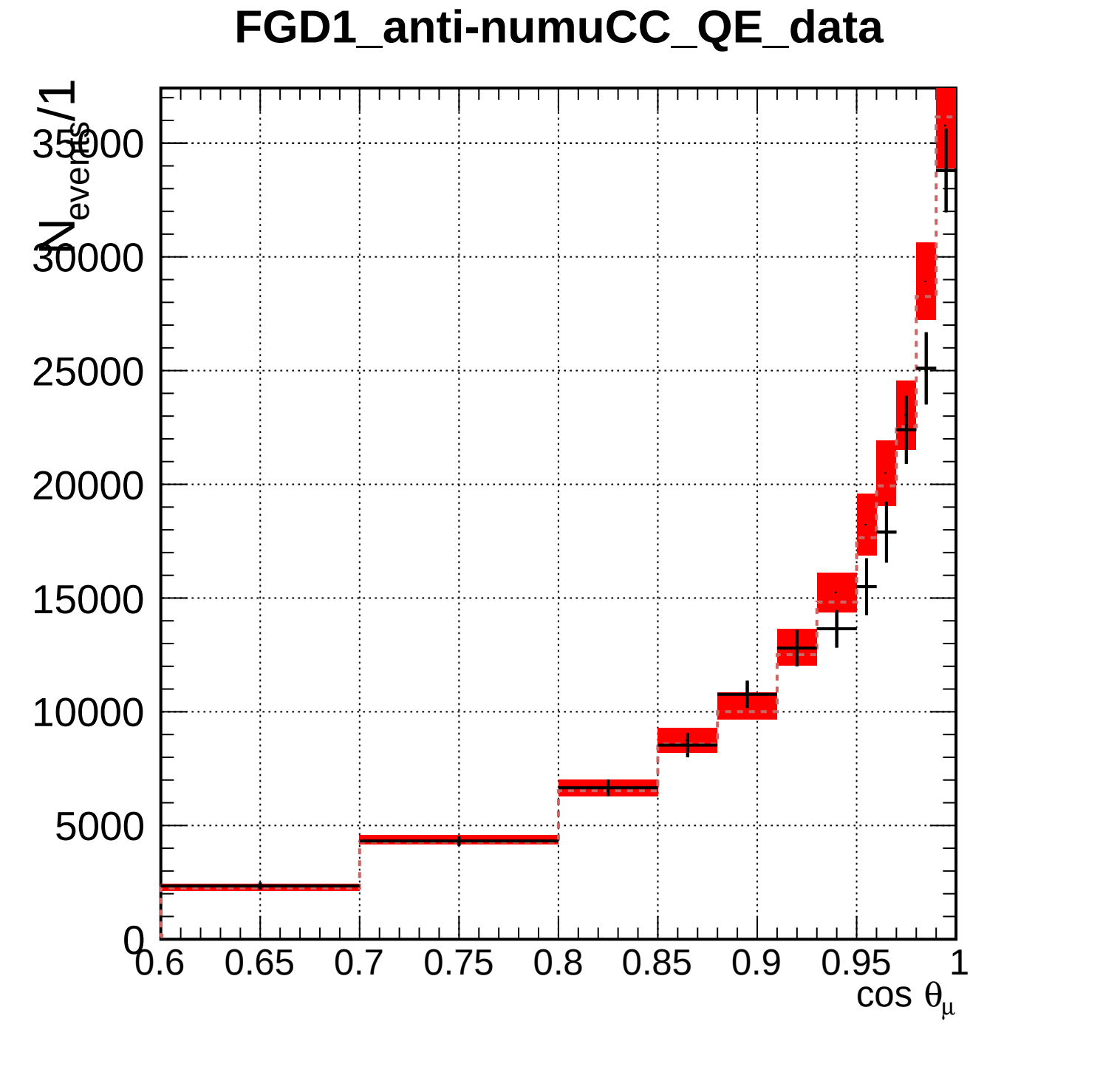

FGD1_anti-numuCC_QE_mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

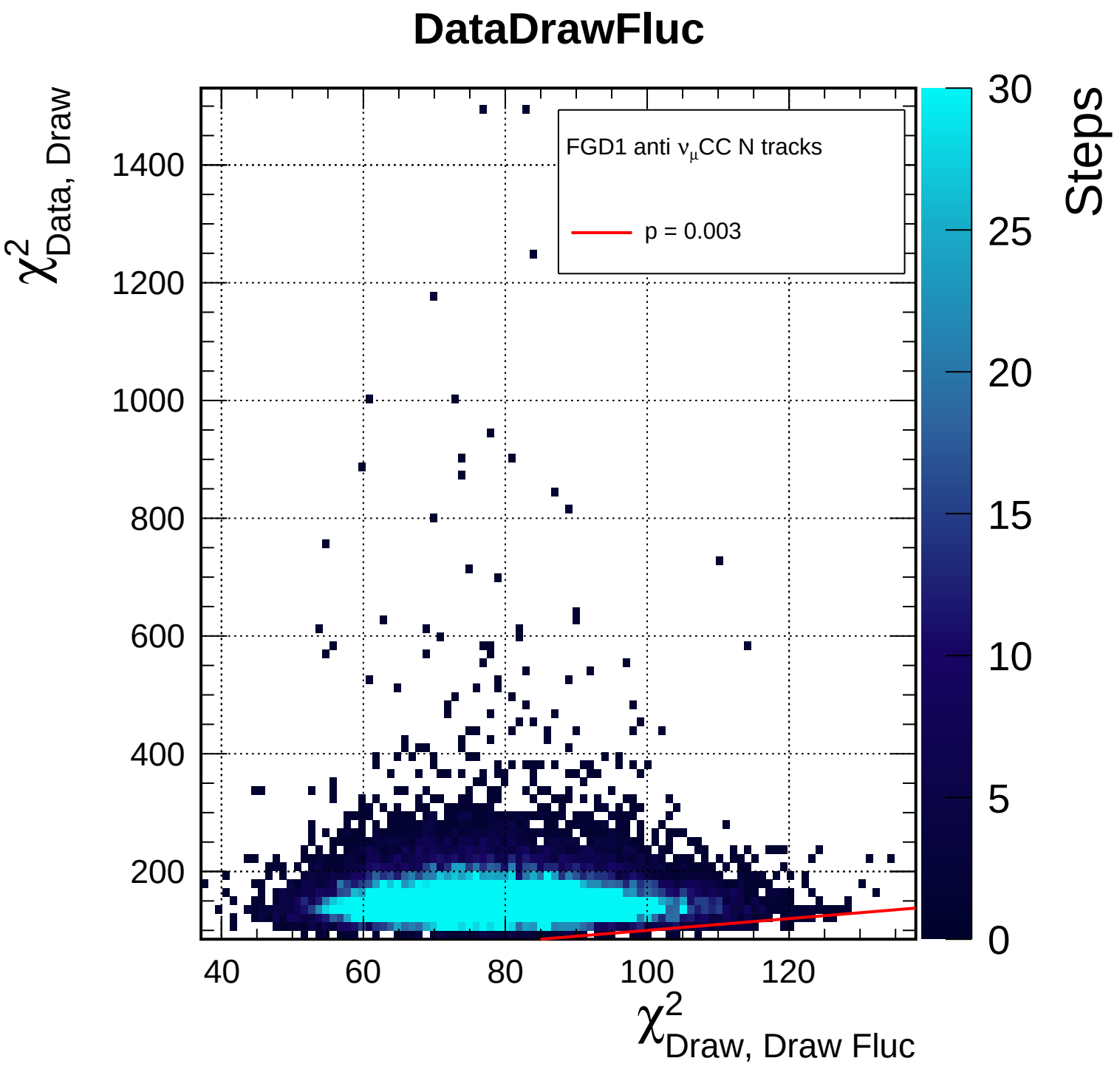

FGD1_anti-numuCC_QE_MeanlnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
χ²Sample
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0

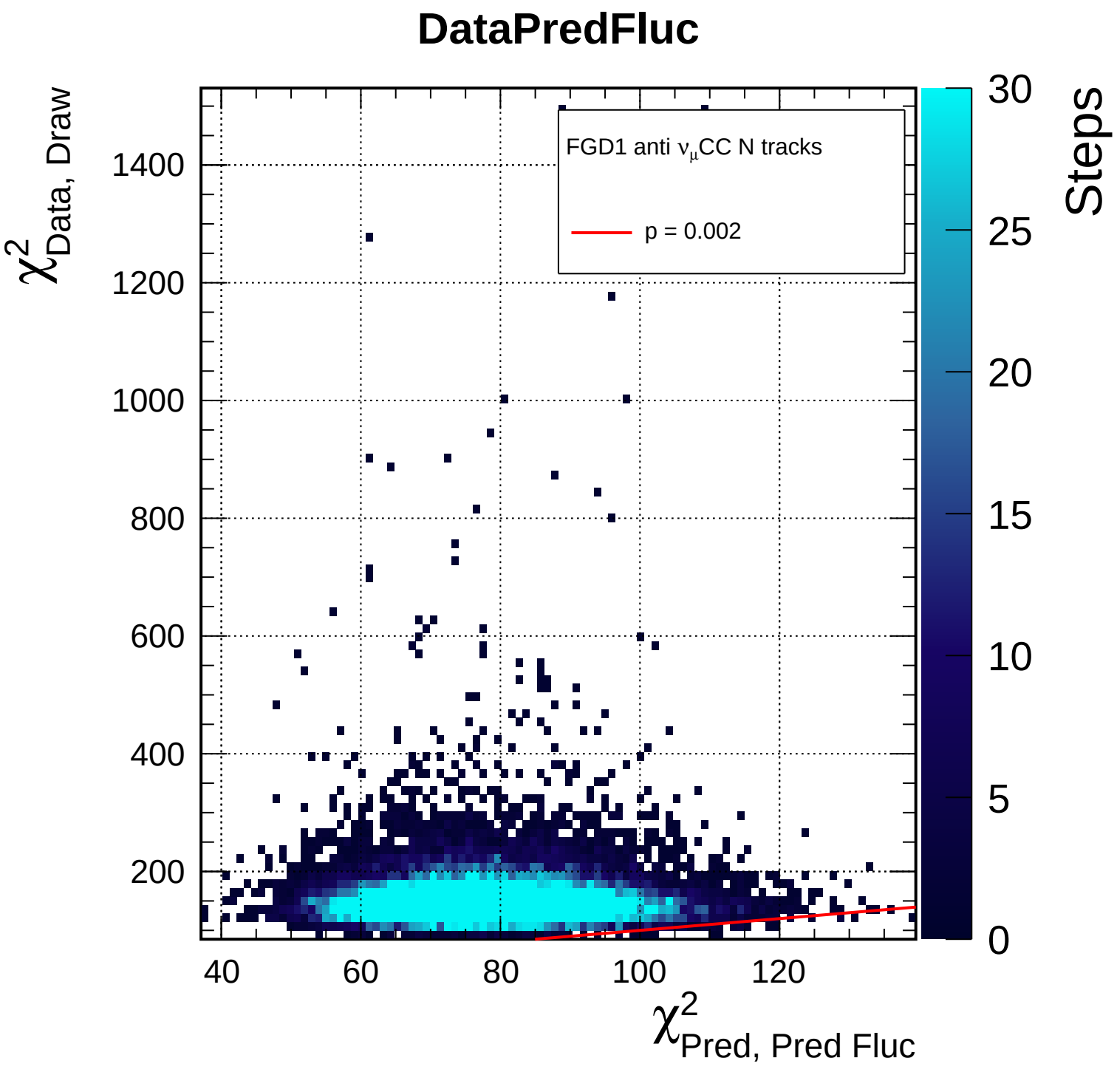

FGD1_anti-numuCC_QE_ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
χ²Sample

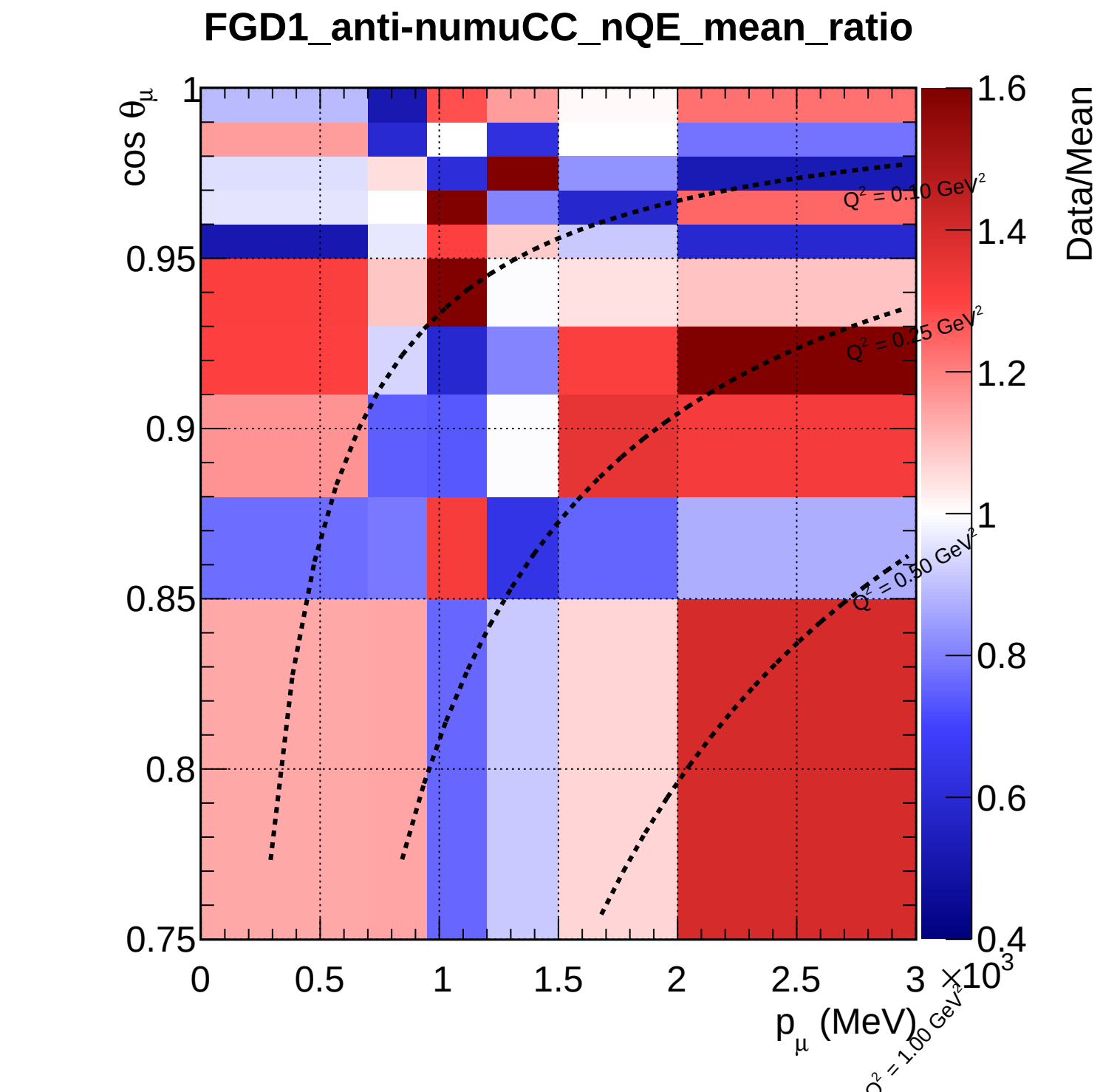

FGD1_anti-numuCC_QE_sum_3527
Counts
900
800
700
600
500
400
300
200
100
0
3000
3500
4000
4500
5000
5500
N events
Data, 3527, p-value=0.61
MC, μ=3688.8±477.3
Gauss, μ=3676.9±475.6

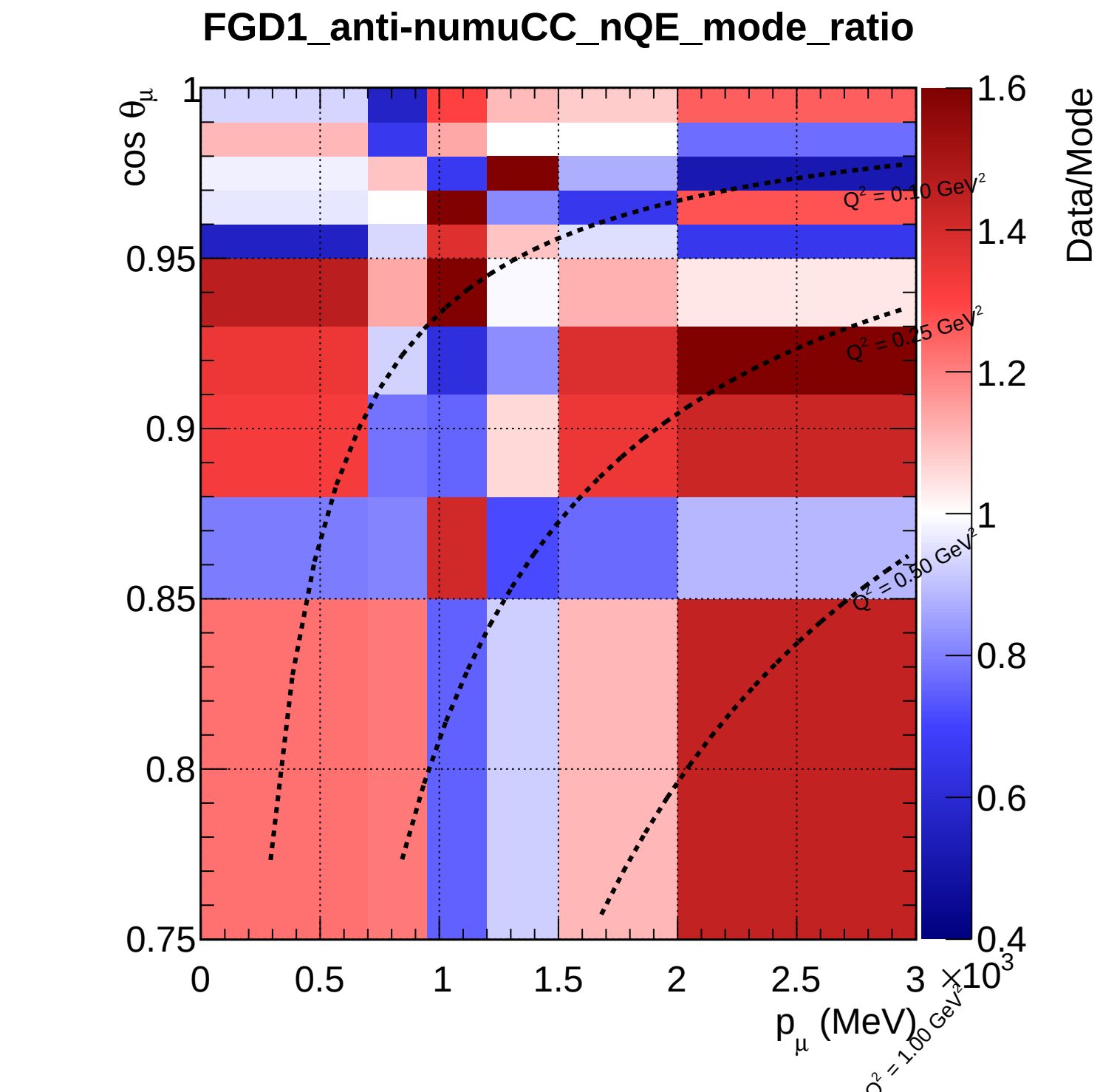

FGD1_anti-numuCC_QE_data
N_events/MeV
0
1
2
3
4
5
0
500
1000
p_μ (MeV)

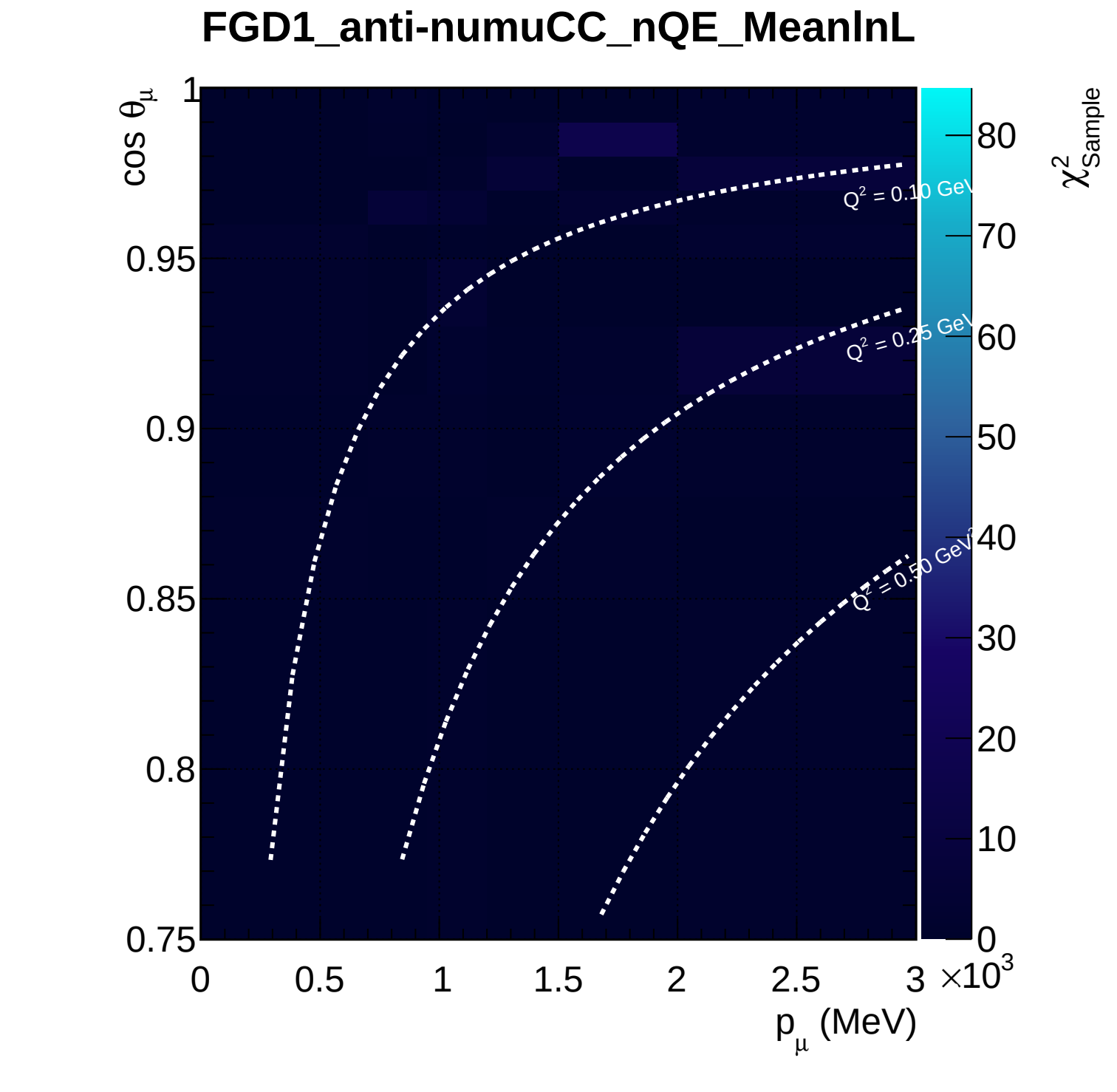

FGD1_anti-numuCC_QE_data
N_events/1
35000
30000
25000
20000
15000
10000
5000
0
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
cos θ_μ

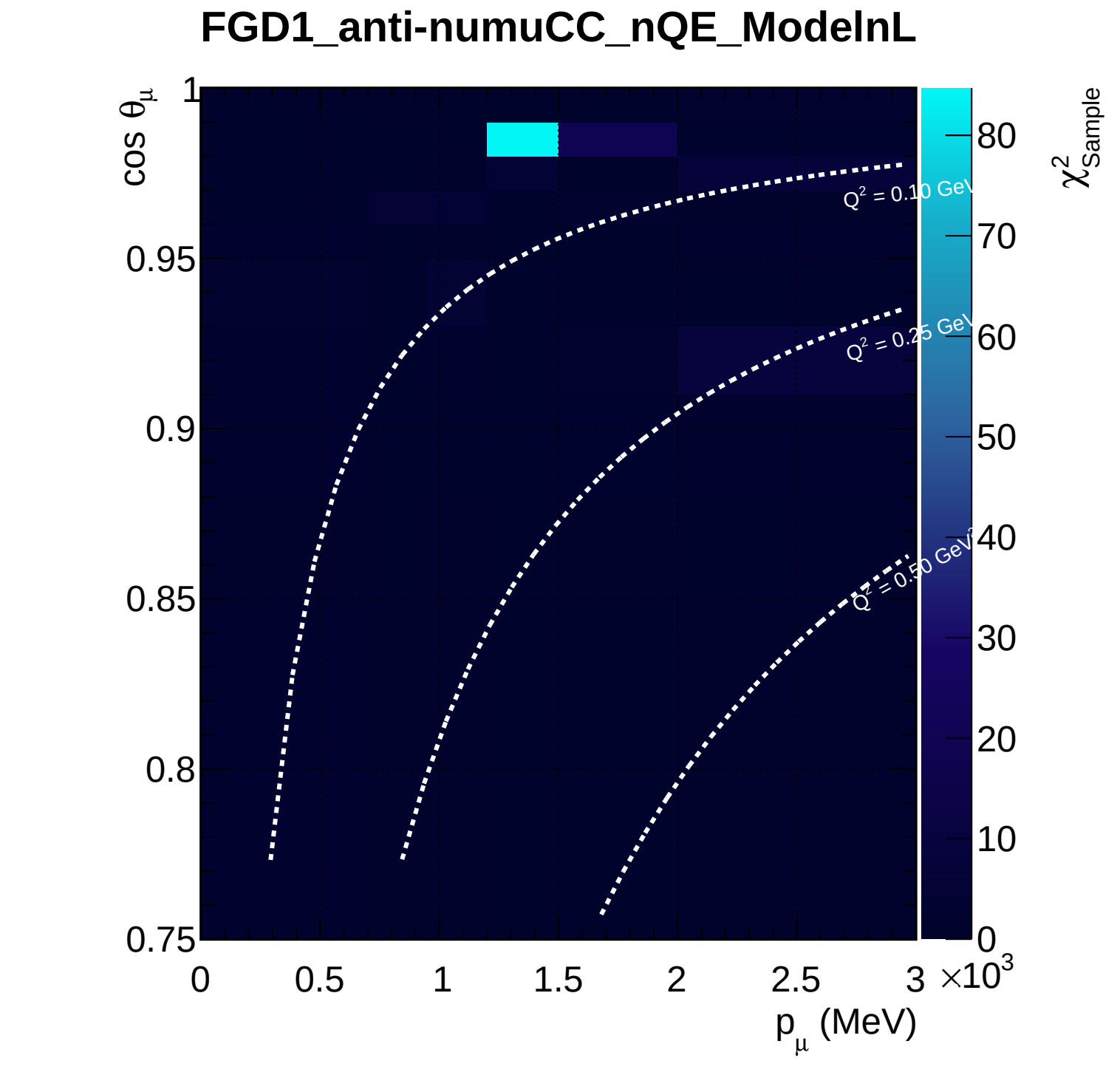

DataDrawFluc
FGD1 anti ν_μCC N tracks
p = 0.003
$\chi^2_{Data, Draw}$
$\chi^2_{Draw, Draw Fluc}$
Steps
1400
1200
1000
800
600
400
200
40
60
80
100
120
30
25
20
15
10
5
0

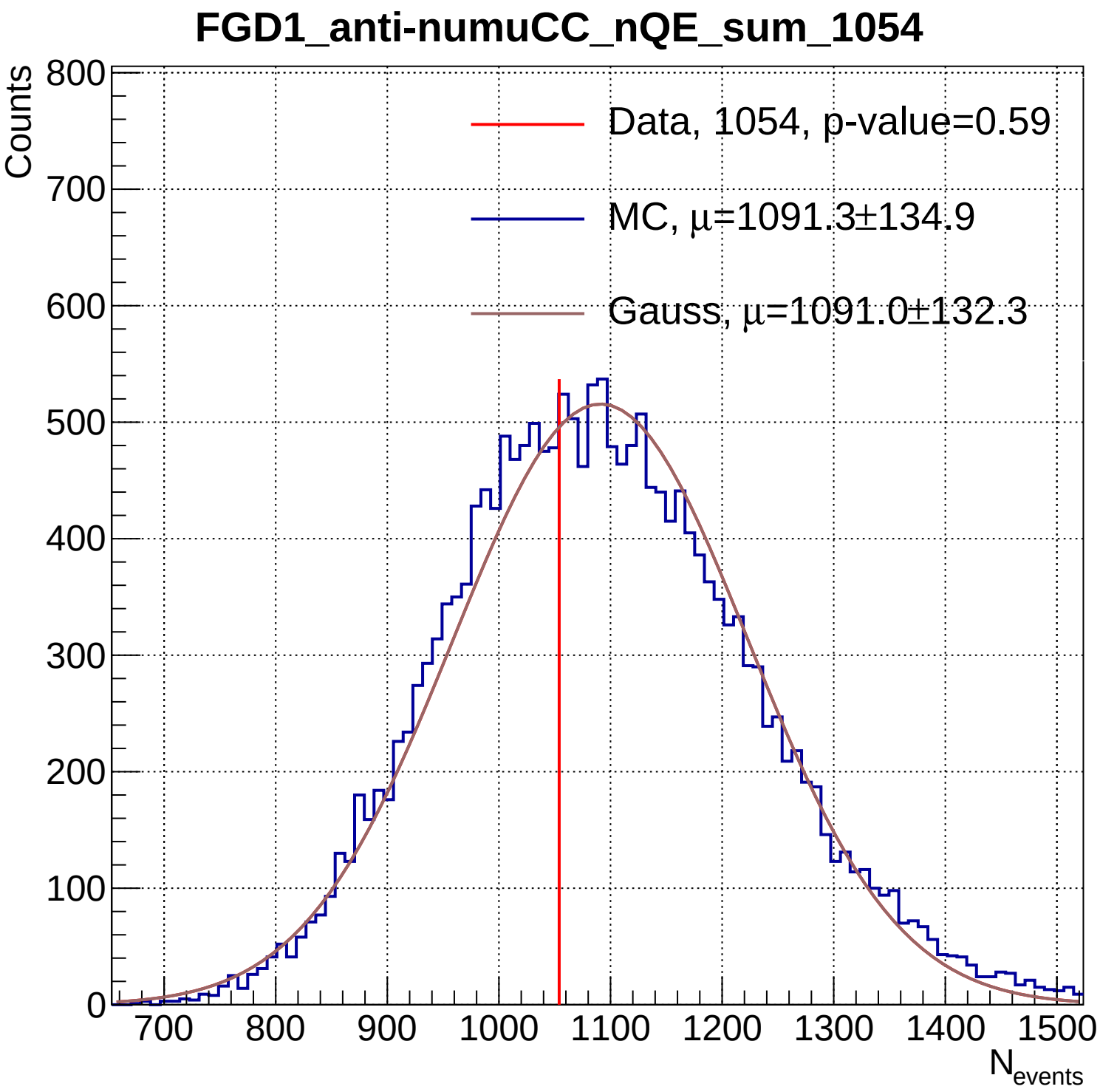

DataPredFluc
FGD1 anti ν_μCC N tracks
p = 0.002
$\chi^2_{Data,\ Draw}$
$\chi^2_{Pred,\ Pred\ Fluc}$
Steps
1400
1200
1000
800
600
400
200
40
60
80
100
120
30
25
20
15
10
5
0

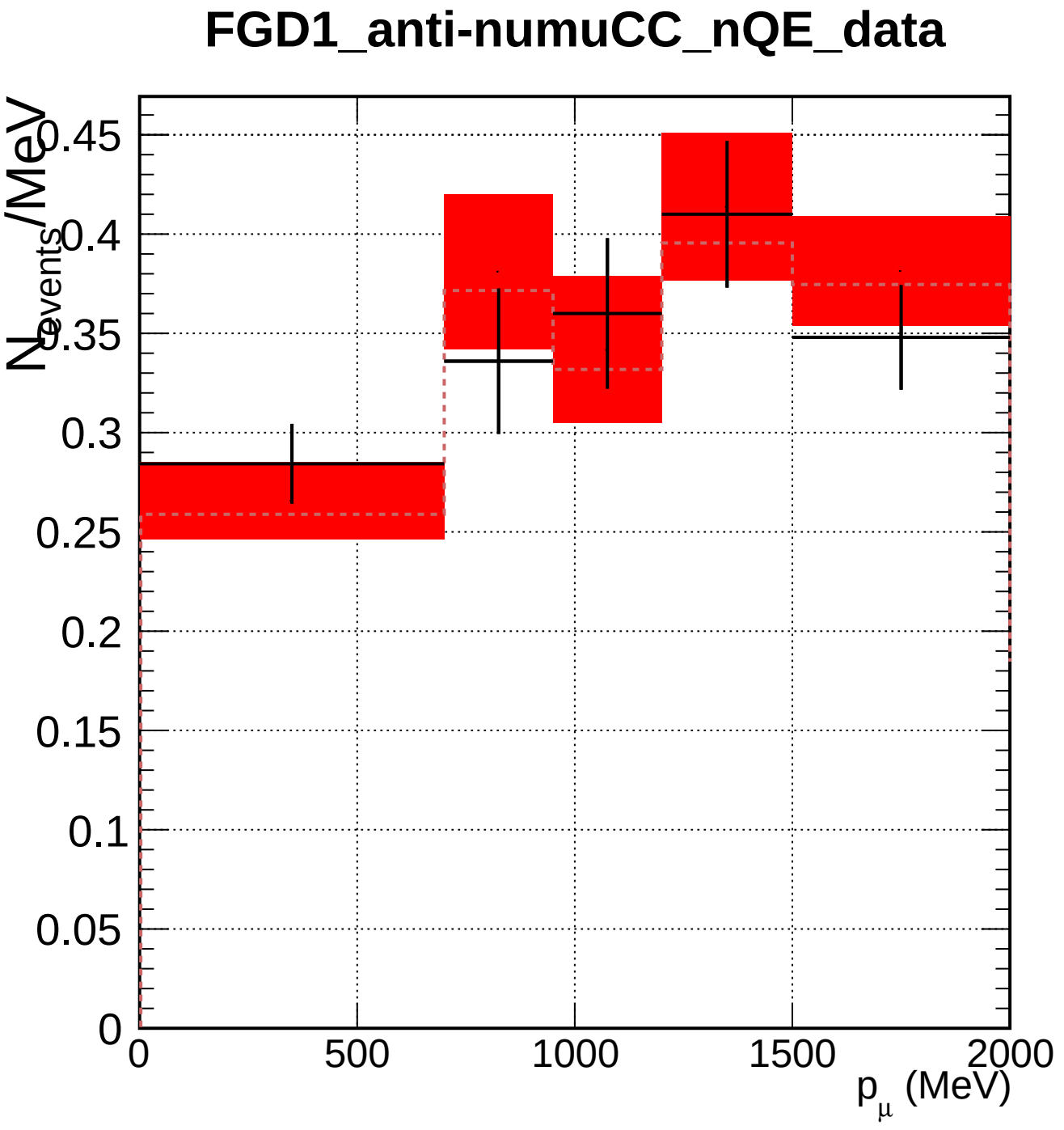

FGD1_anti-numuCC_nQE_mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0
0.5
1
1.5
2
2.5
3
×10³
pμ (MeV)
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

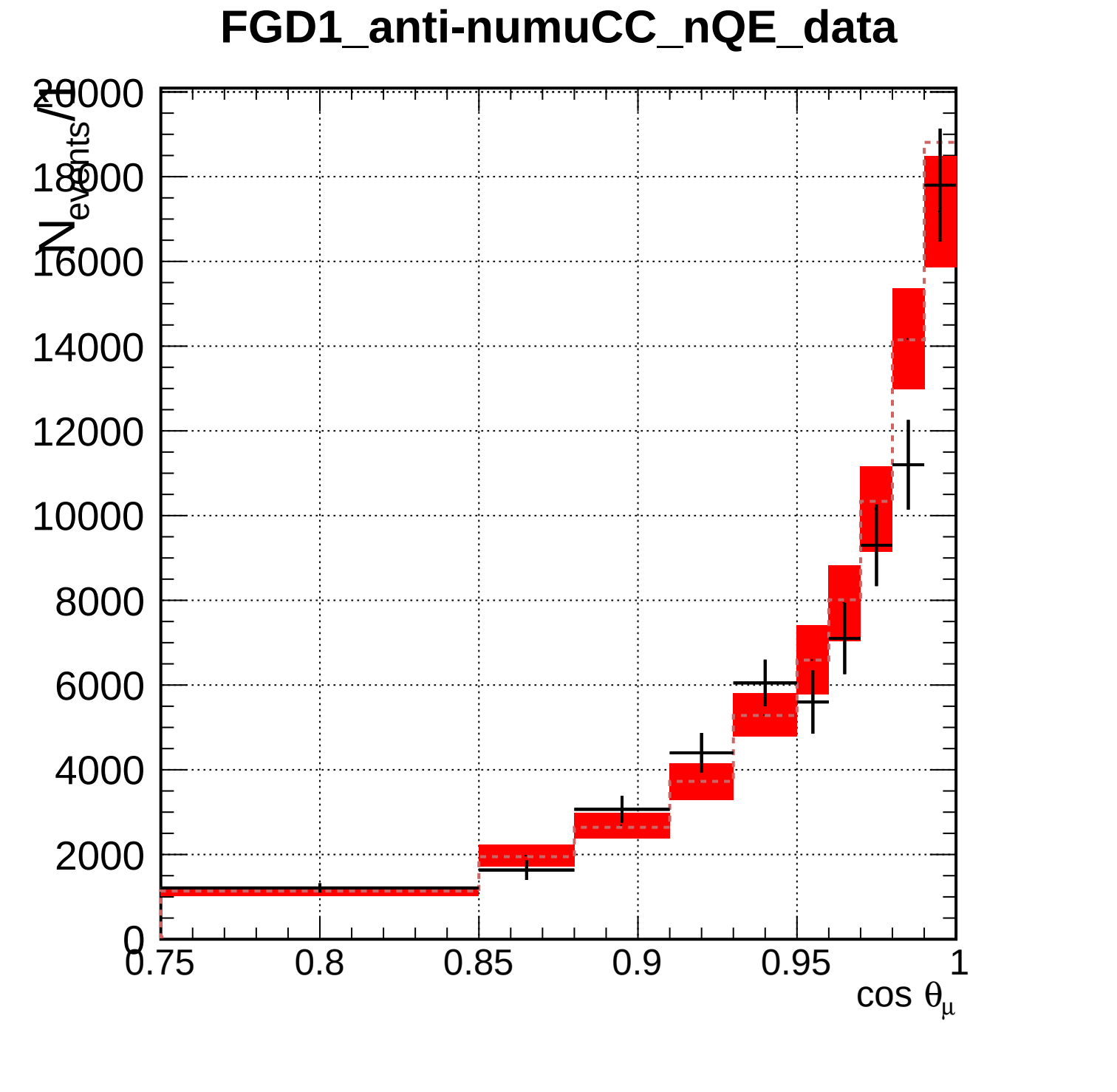

FGD1_anti-numuCC_nQE_mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0
0.5
1
1.5
2
2.5
3
×10³
pμ (MeV)
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

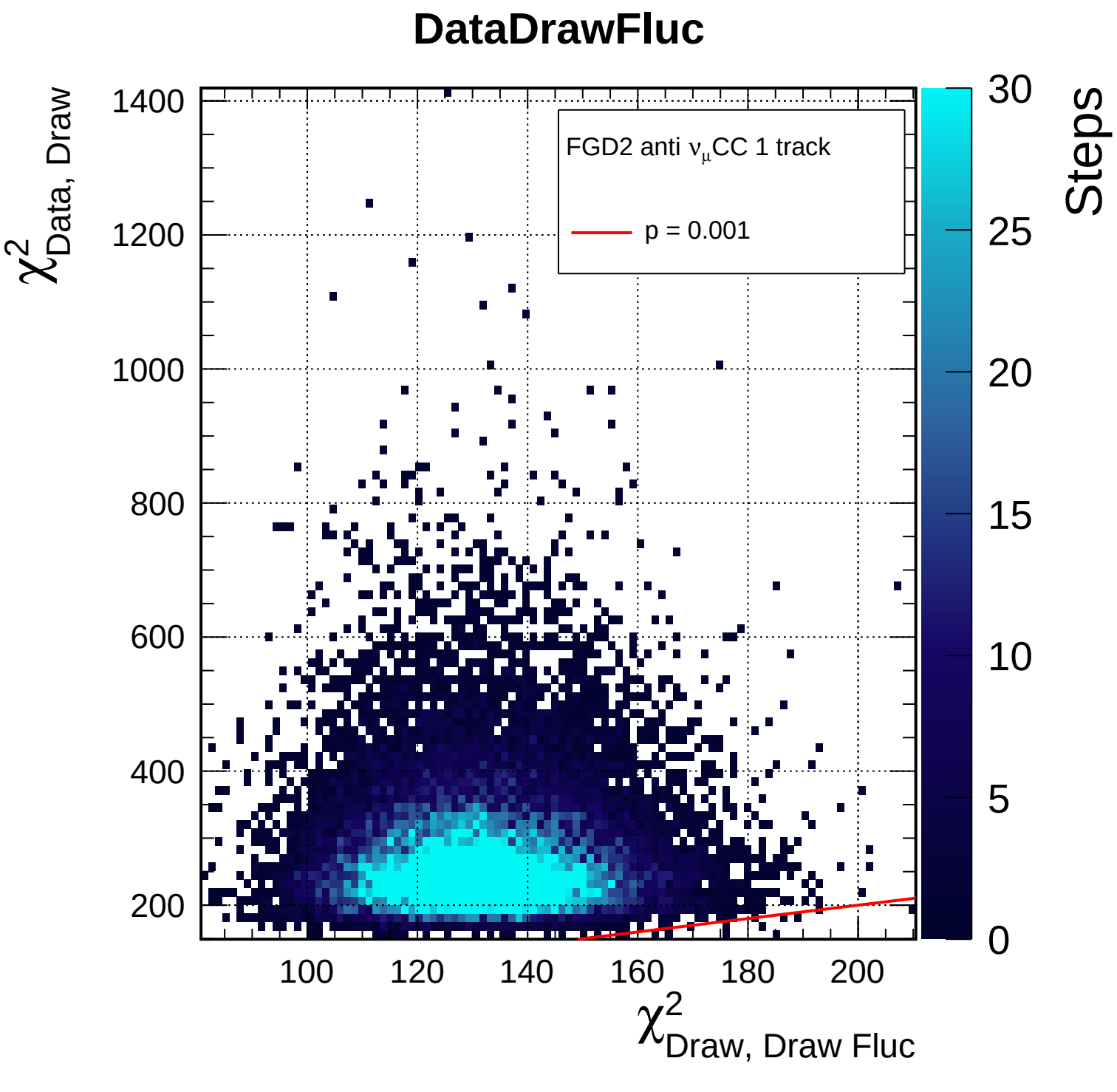

FGD1_anti-numuCC_nQE_MeanlnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0
0.5
1
1.5
2
2.5
3
×10^3
pμ (MeV)
Q² = 0.10 GeV
Q² = 0.25 GeV
Q² = 0.50 GeV
χ²Sample
80
70
60
50
40
30
20
10
0

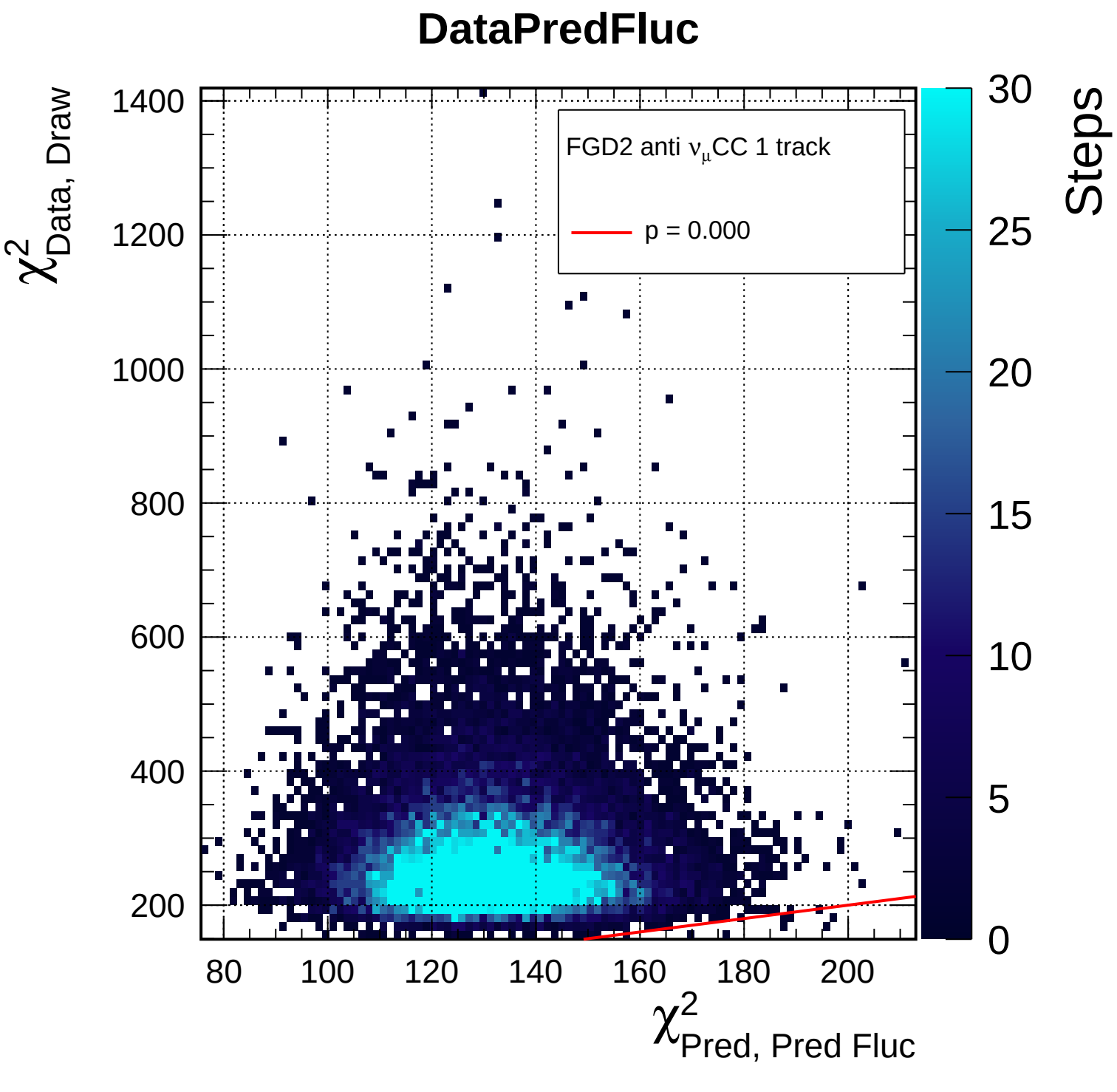

FGD1_anti-numuCC_nQE_ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0
0.5
1
1.5
2
2.5
3
×10^3
pμ (MeV)
Q² = 0.10 GeV
Q² = 0.25 GeV
Q² = 0.50 GeV
χ²Sample
80
70
60
50
40
30
20
10
0

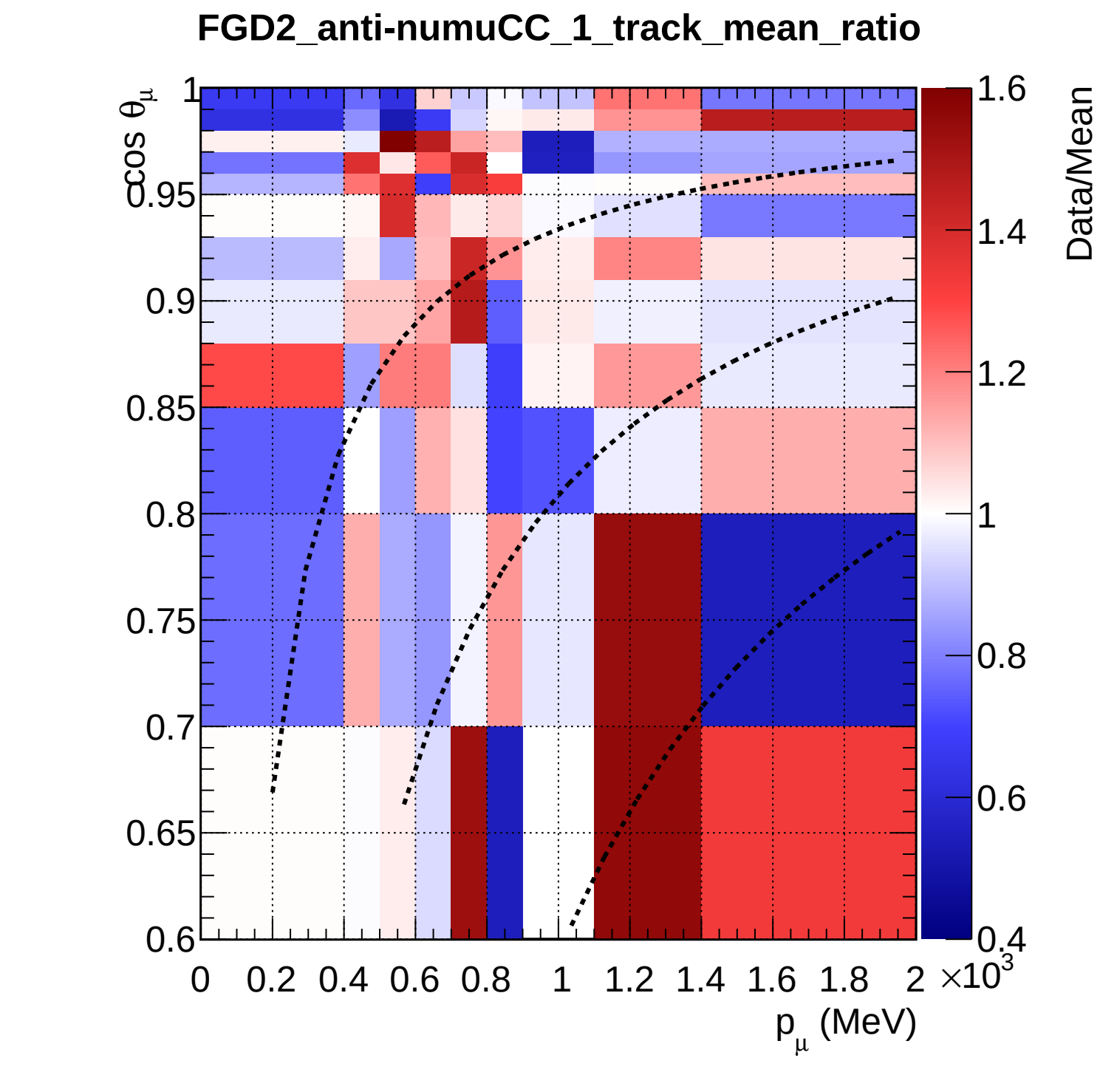

FGD1_anti-numuCC_nQE_sum_1054
Counts
Data, 1054, p-value=0.59
MC, μ=1091.3±134.9
Gauss, μ=1091.0±132.3
0
100
200
300
400
500
600
700
800
700
800
900
1000
1100
1200
1300
1400
1500
N events

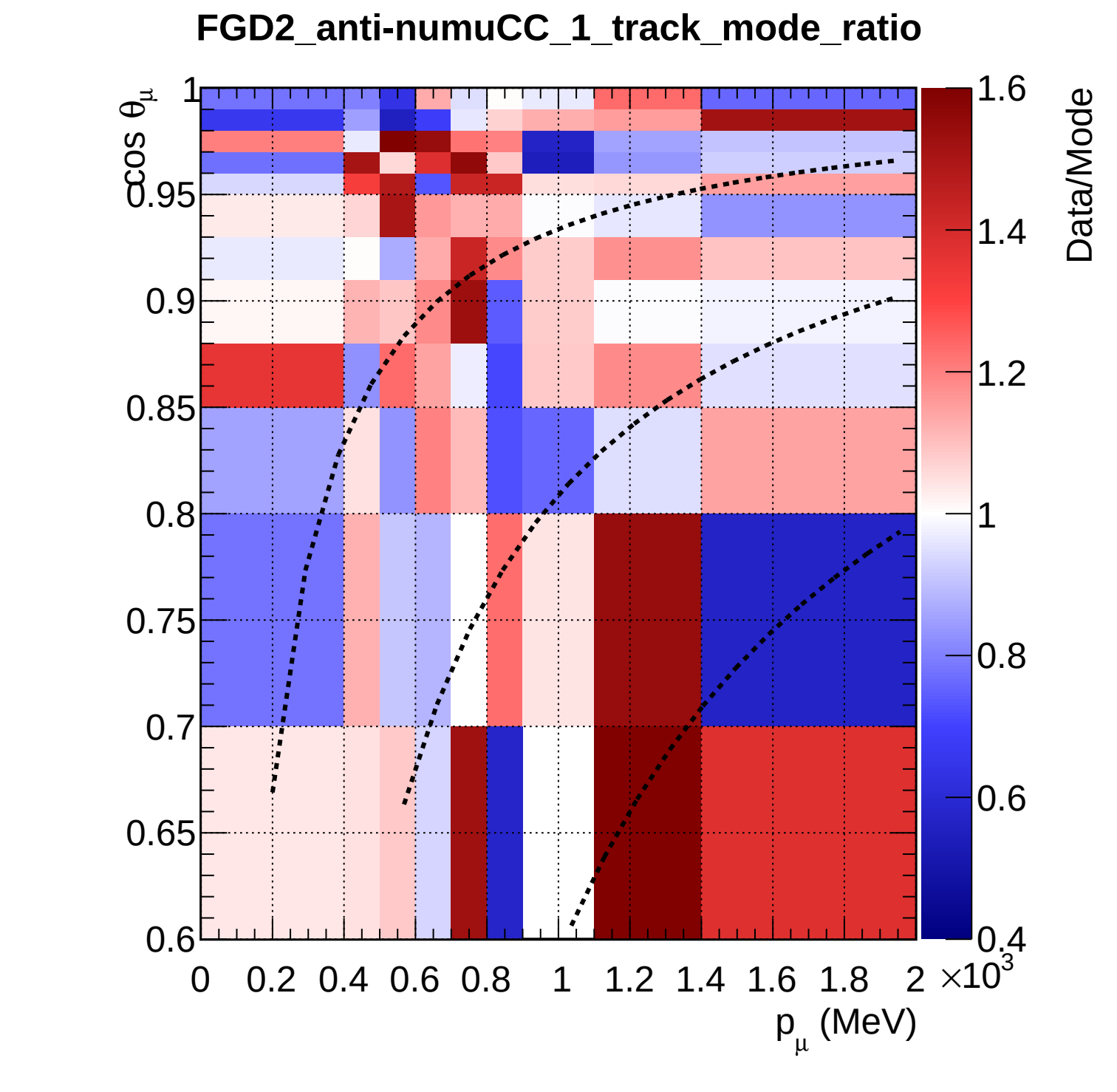

FGD1_anti-numuCC_nQE_data
N events/MeV
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
500
1000
1500
2000
p_μ (MeV)

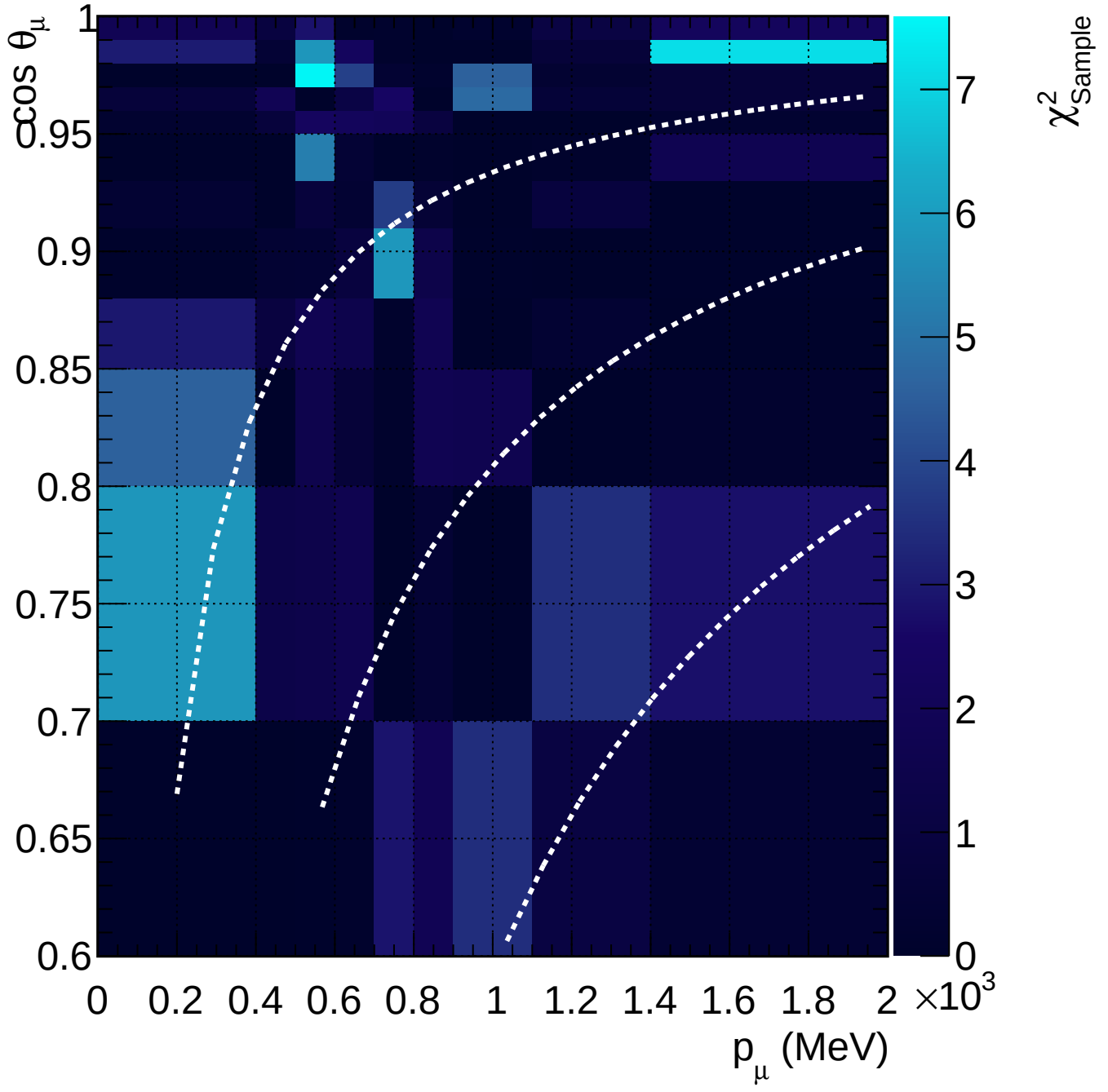

FGD1_anti-numuCC_nQE_data
N_events/
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0.75
0.8
0.85
0.9
0.95
1
cos θ_μ

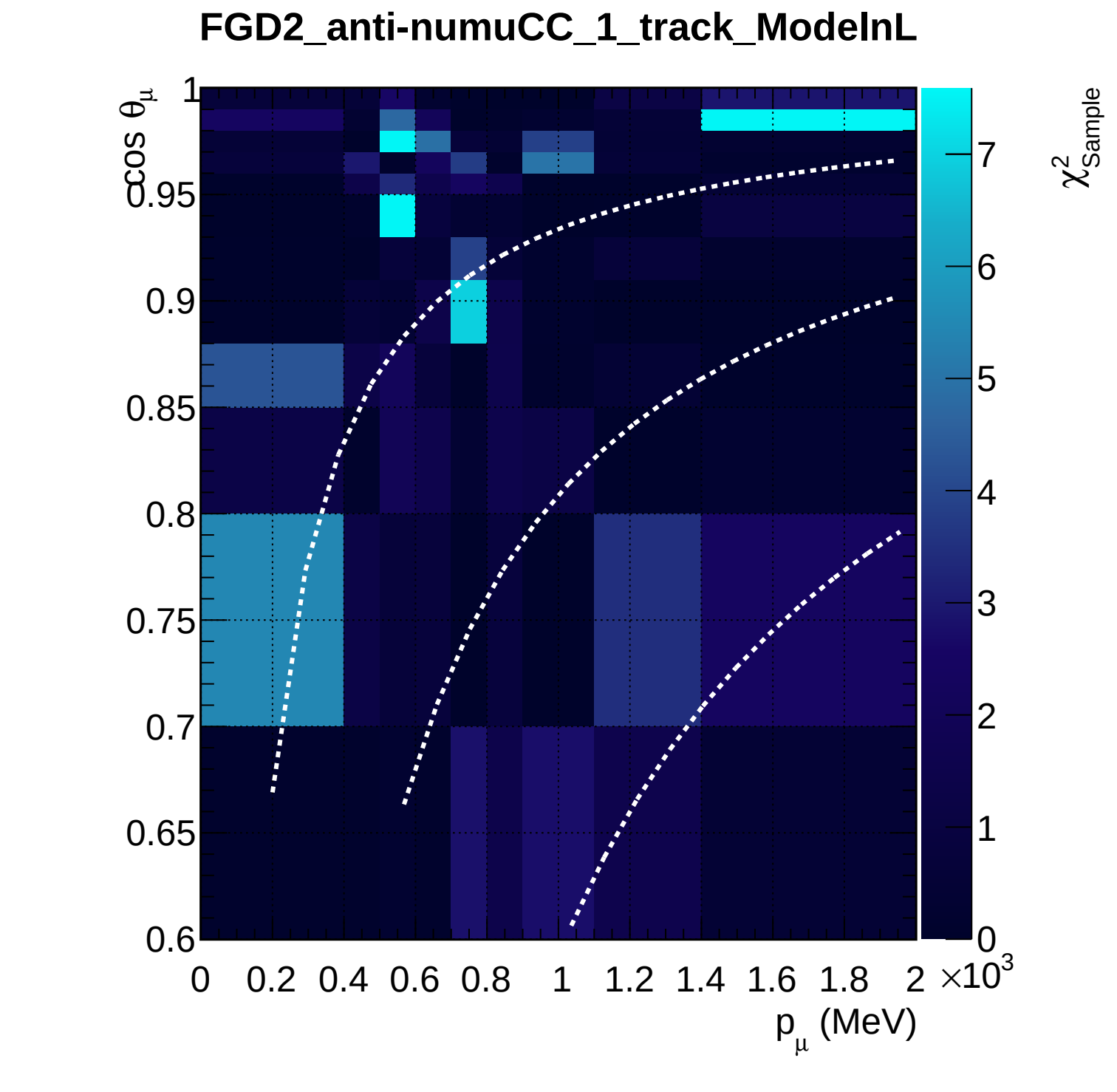

DataDrawFluc
FGD2 anti ν_μCC 1 track
p = 0.001
$\chi^2_{Data,\ Draw}$
$\chi^2_{Draw,\ Draw\ Fluc}$
Steps
1400
1200
1000
800
600
400
200
100
120
140
160
180
200
30
25
20
15
10
5
0

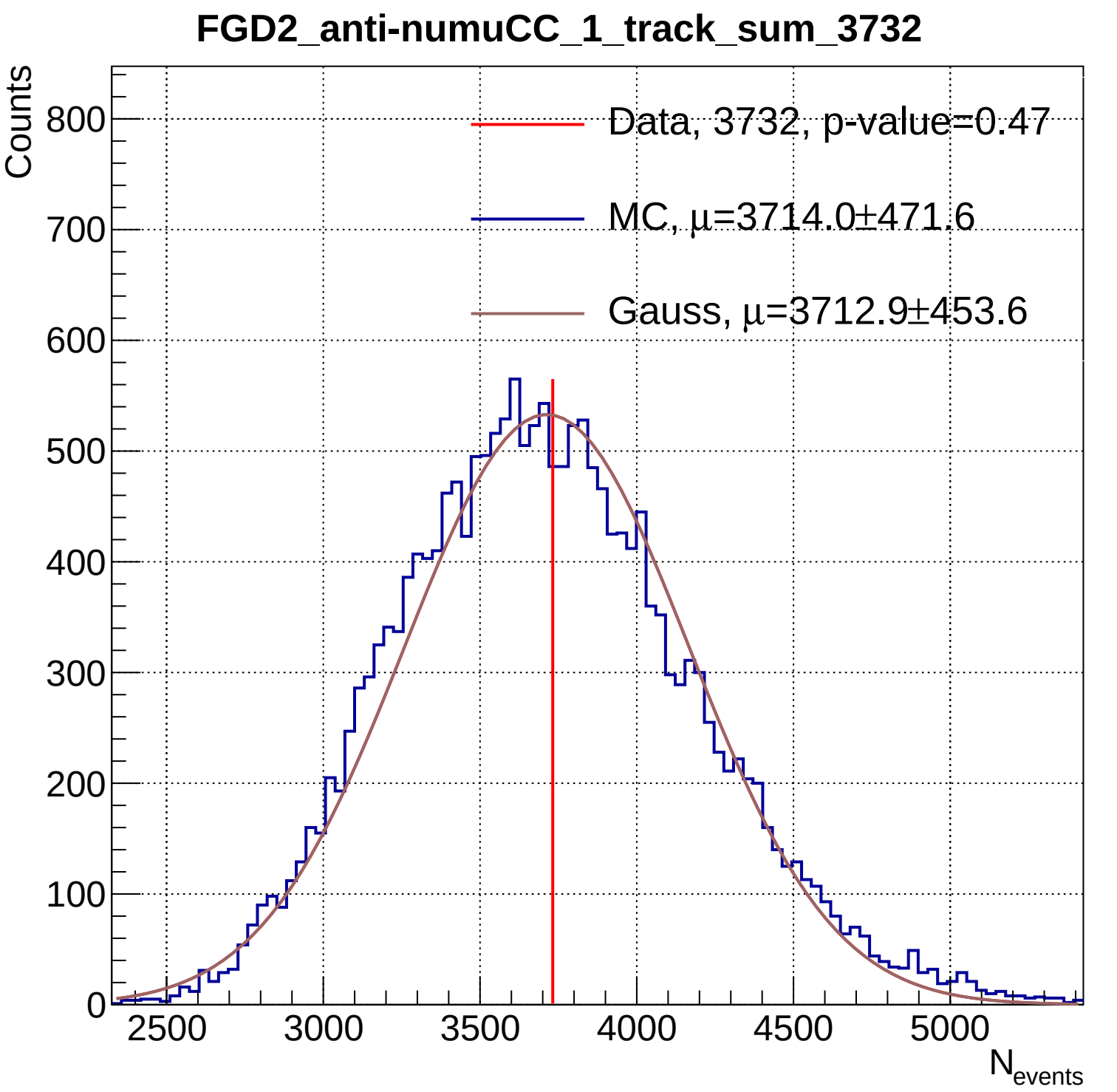

DataPredFluc
FGD2 anti ν_μCC 1 track
p = 0.000
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Pred, Pred Fluc}}$
Steps
1400
1200
1000
800
600
400
200
80
100
120
140
160
180
200
30
25
20
15
10
5
0

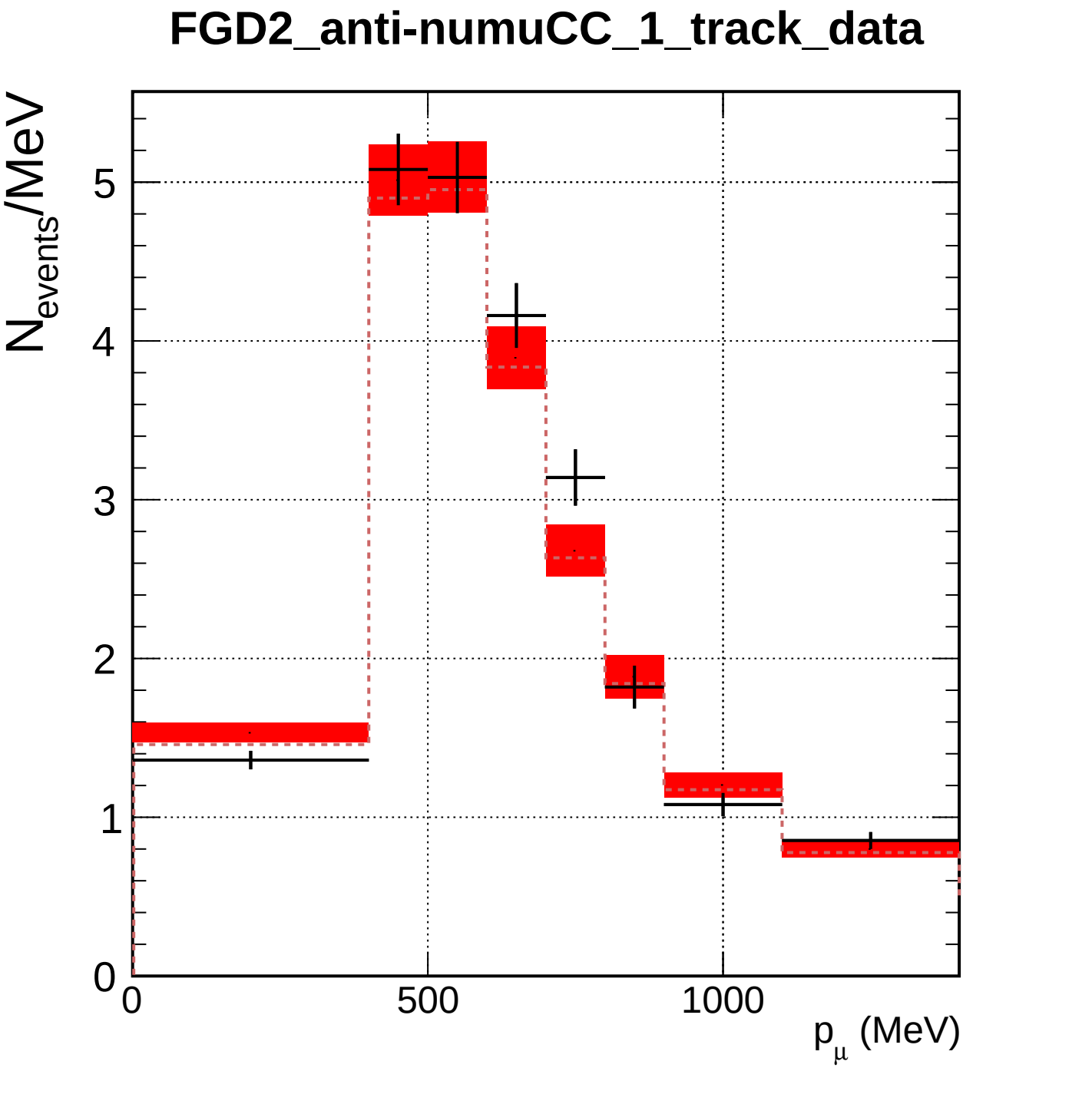

FGD2_anti-numuCC_1_track_mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

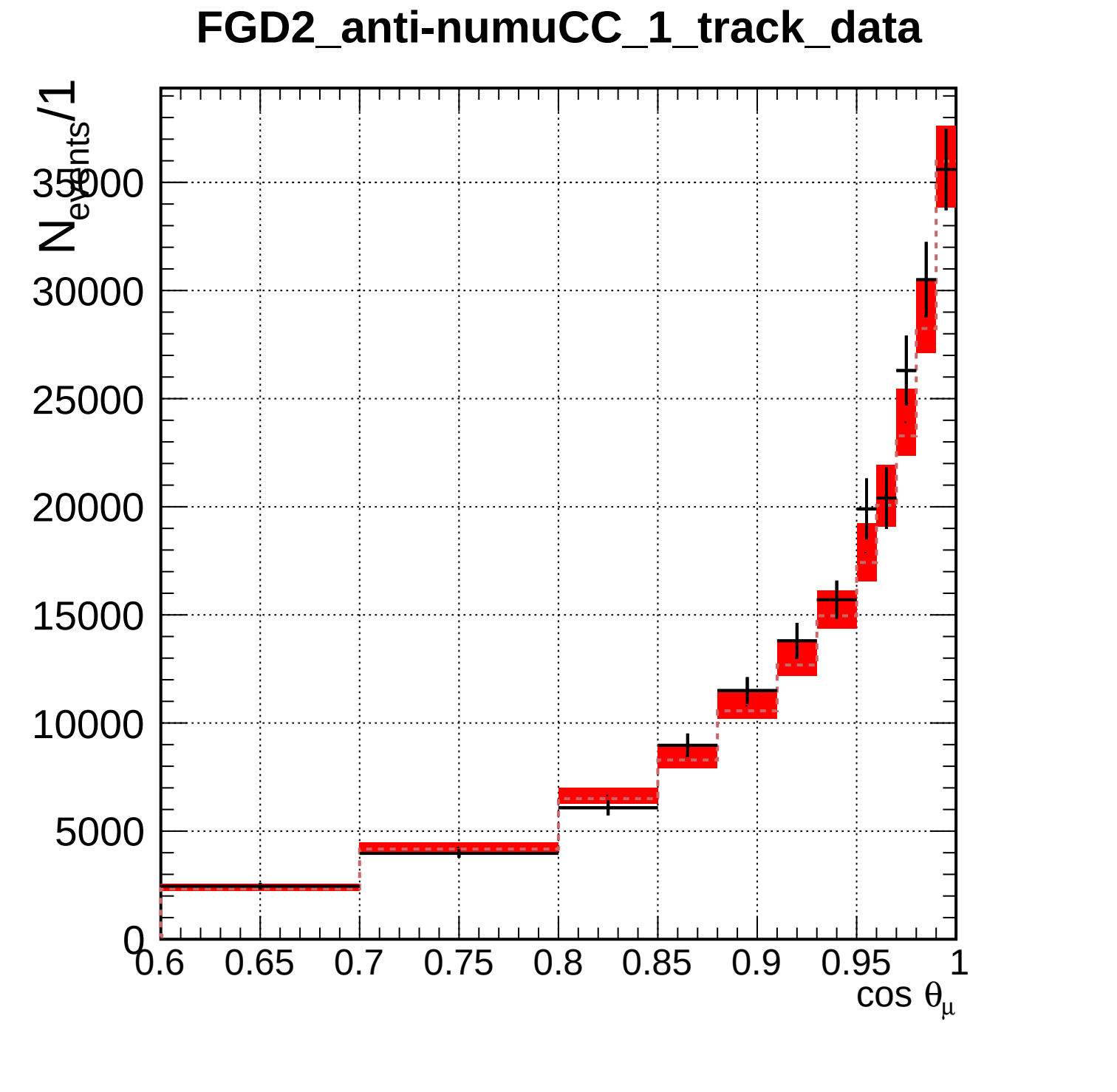

FGD2_anti-numuCC_1_track_mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

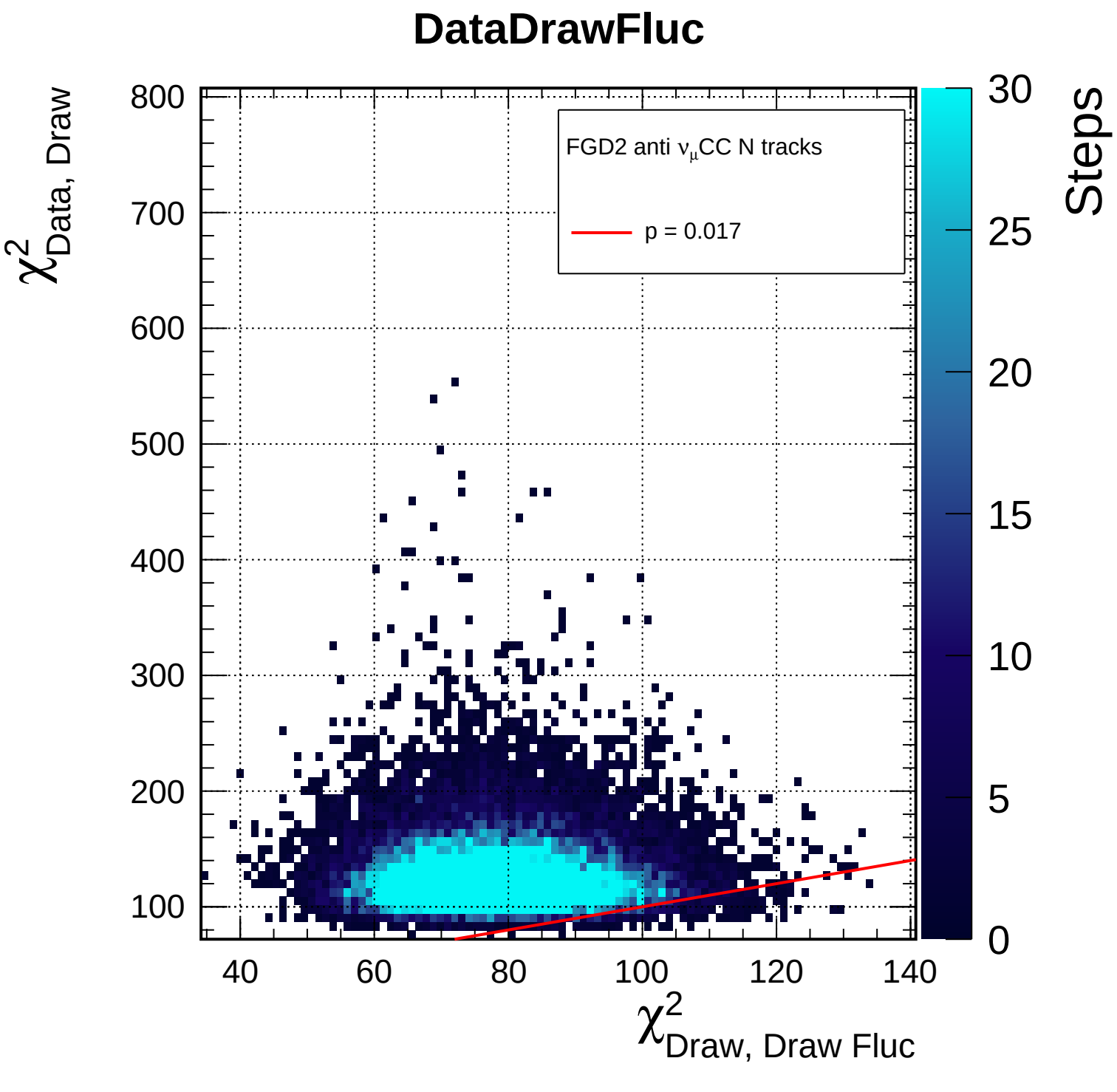

FGD2_anti-numuCC_1_track_MeanlnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
χ²Sample
7
6
5
4
3
2
1
0

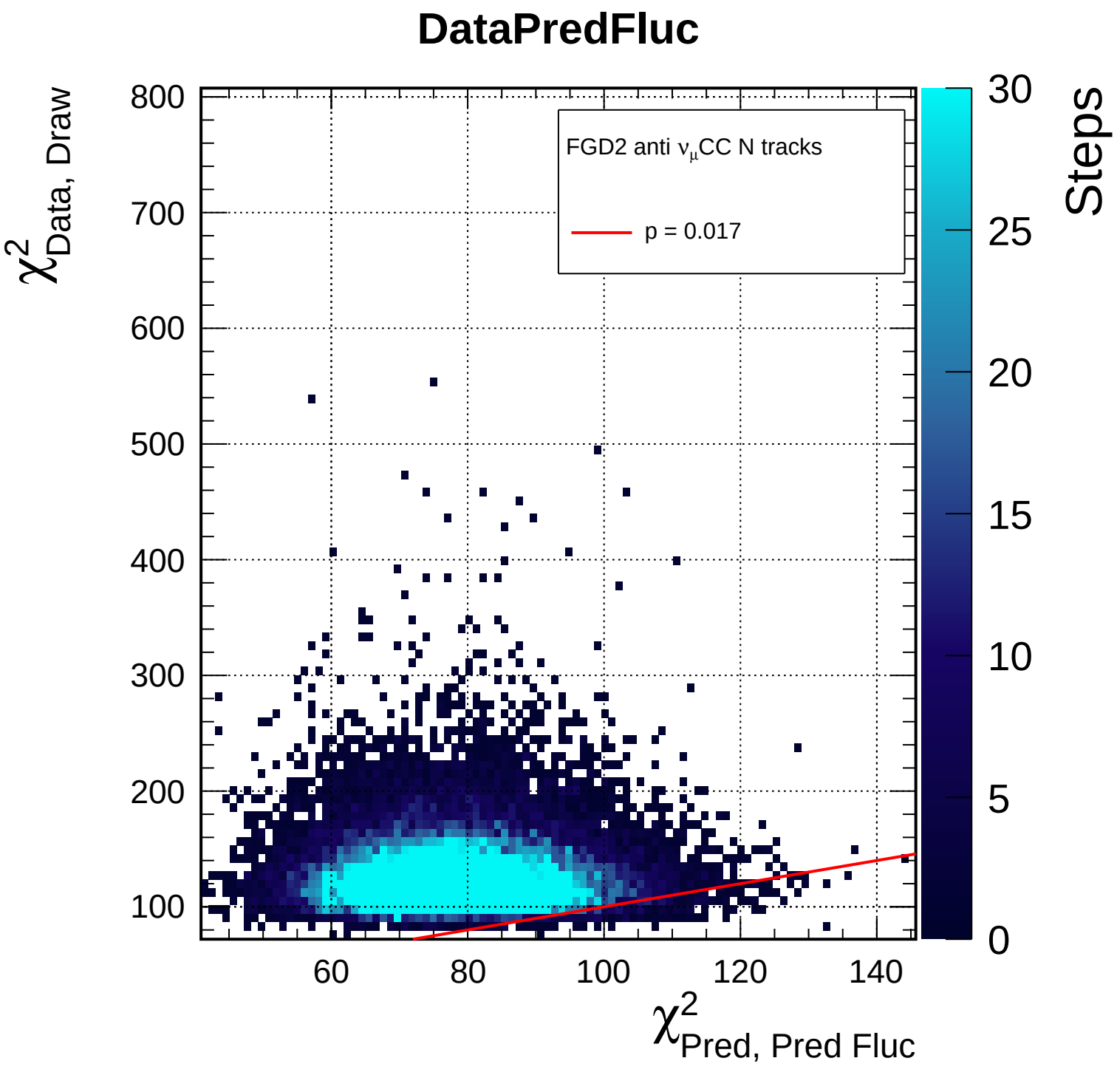

FGD2_anti-numuCC_1_track_ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
χ²Sample
7
6
5
4
3
2
1
0

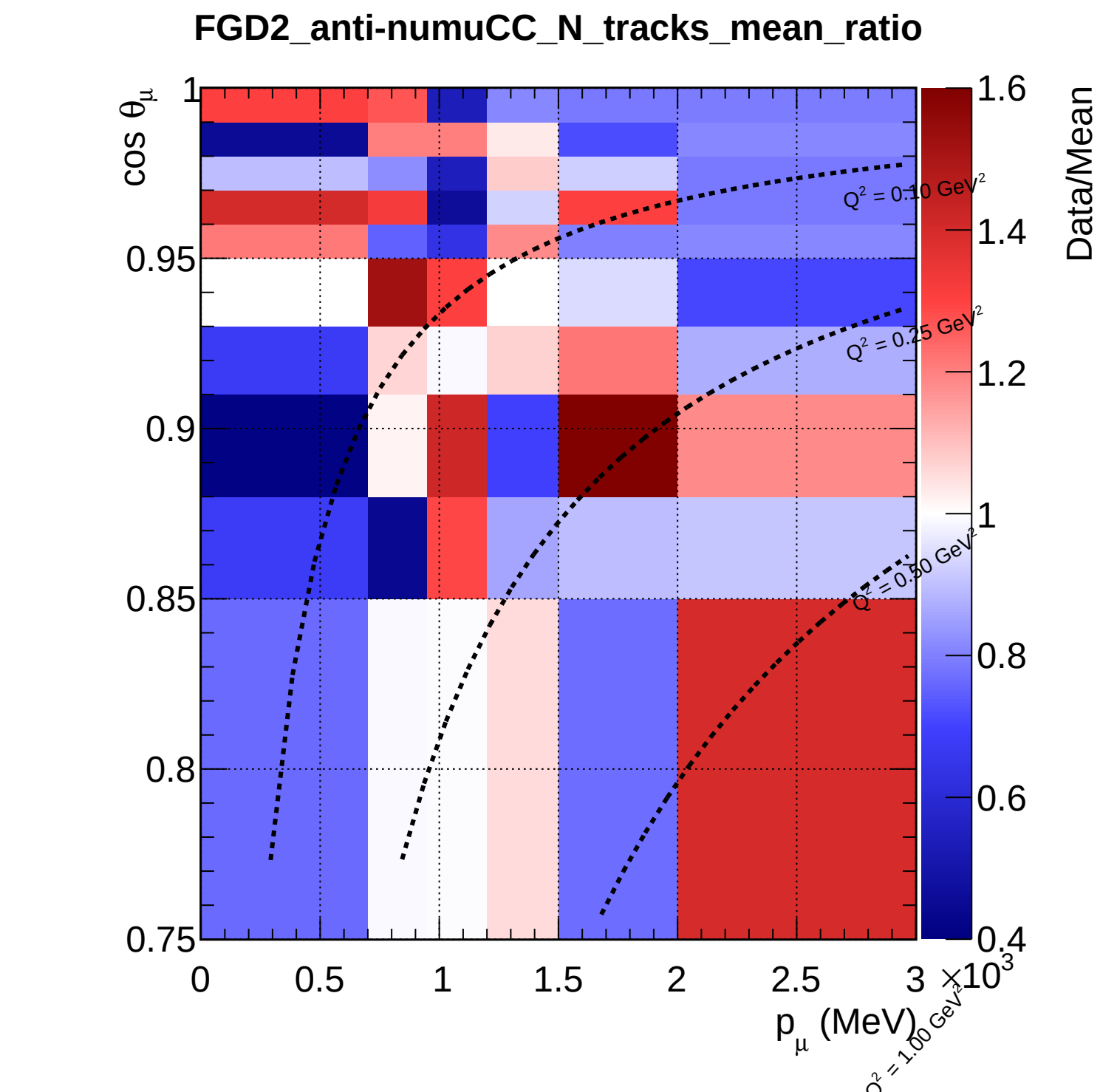

FGD2_anti-numuCC_1_track_sum_3732
Counts
800
700
600
500
400
300
200
100
0
2500
3000
3500
4000
4500
5000
N events
Data, 3732, p-value=0.47
MC, μ=3714.0±471.6
Gauss, μ=3712.9±453.6

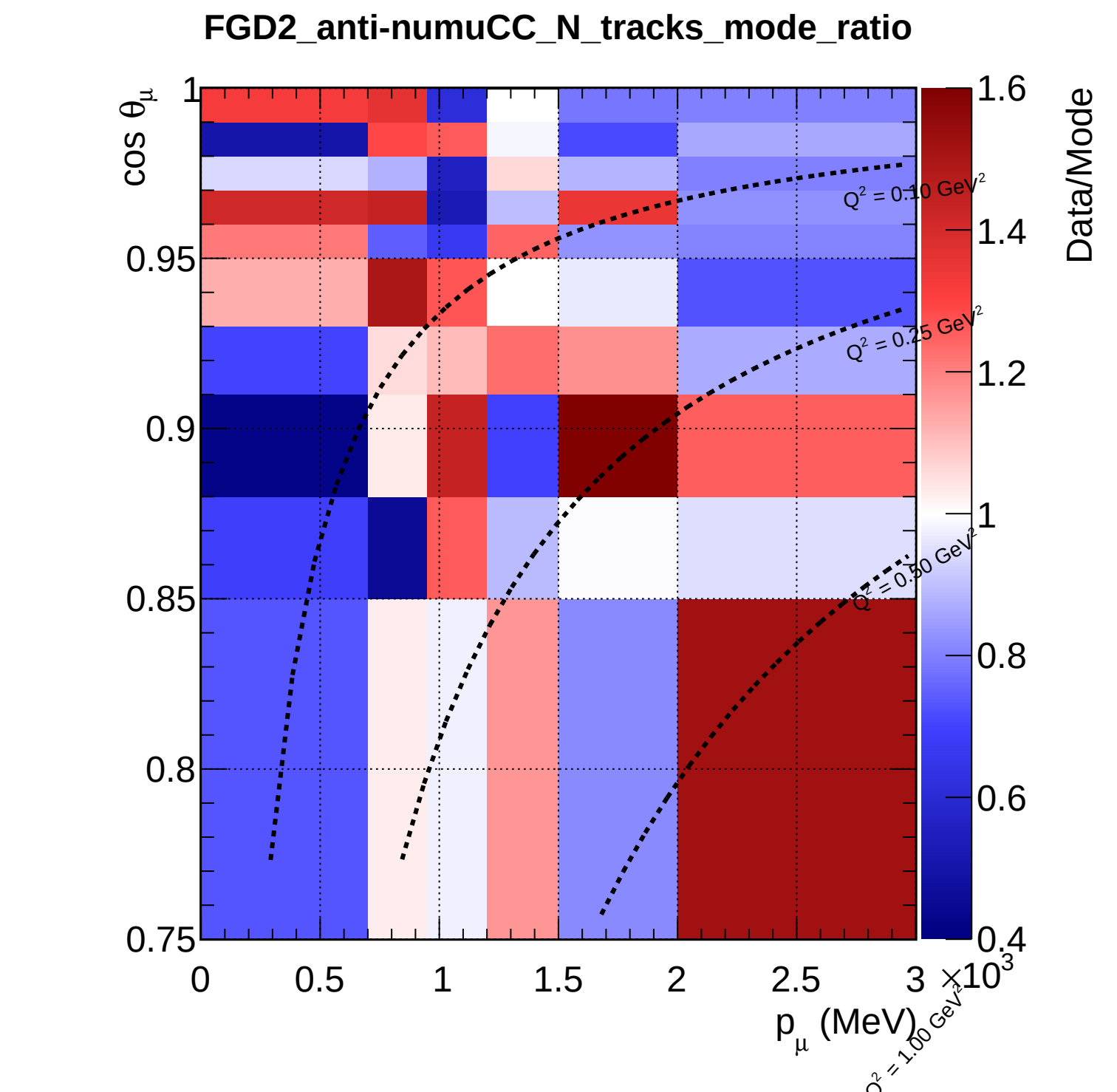

FGD2_anti-numuCC_1_track_data
N_events/MeV
0
1
2
3
4
5
0
500
1000
p_μ (MeV)

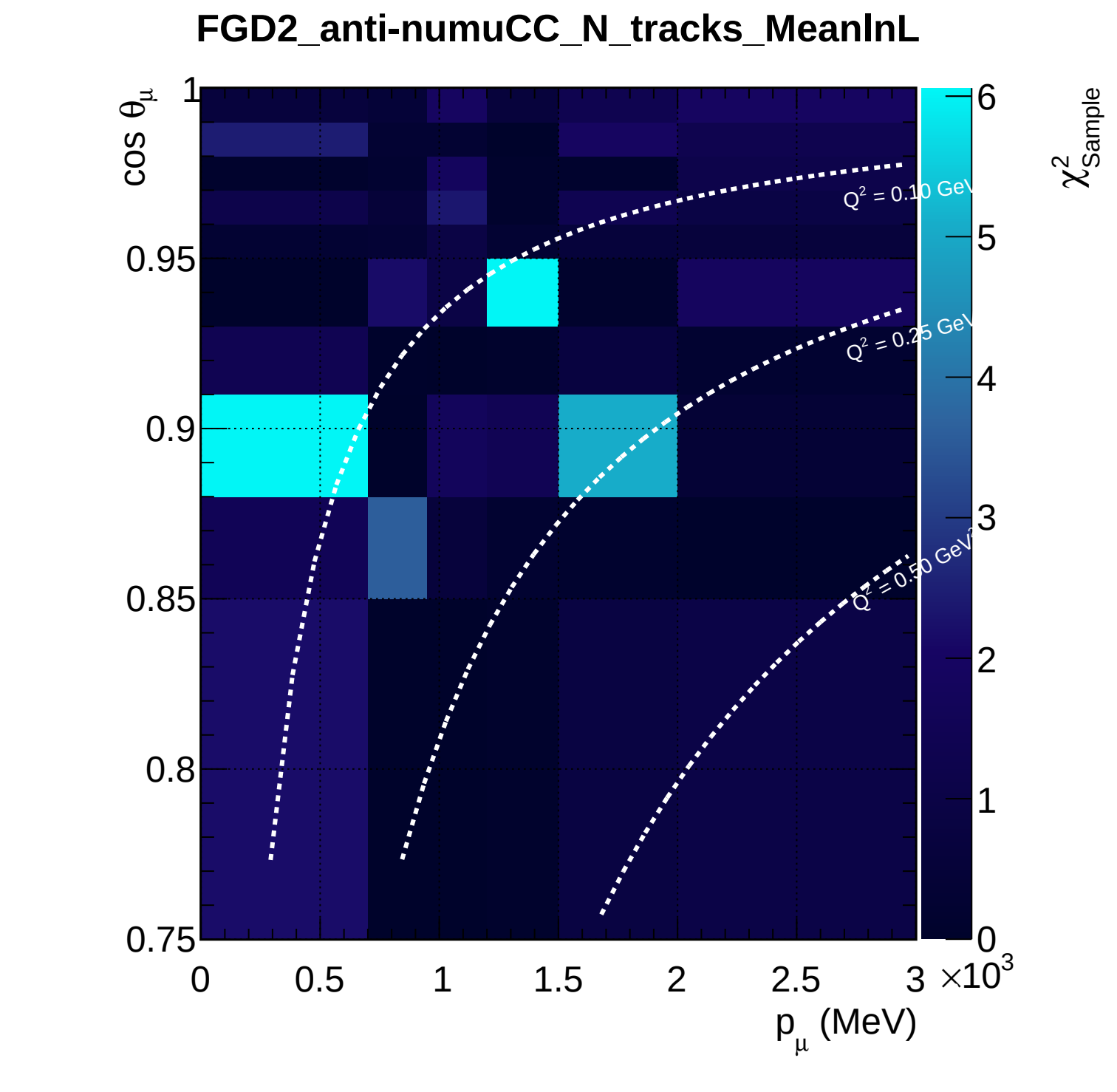

FGD2_anti-numuCC_1_track_data
N_events/1
35000
30000
25000
20000
15000
10000
5000
0
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
cos θ_μ

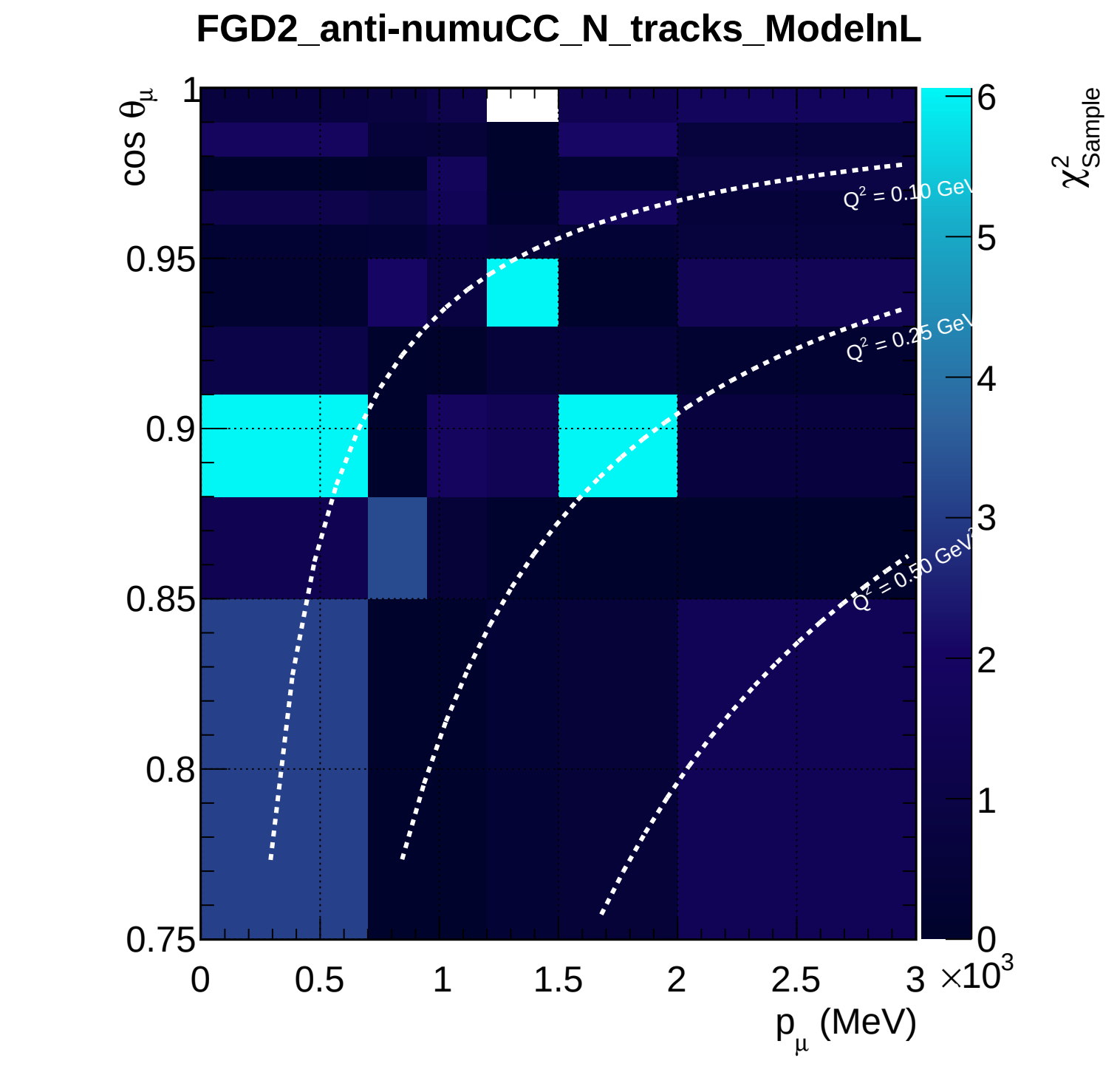

DataDrawFluc
FGD2 anti ν_μCC N tracks
p = 0.017
$\chi^2_{Data, Draw}$
$\chi^2_{Draw, Draw Fluc}$
Steps
800
700
600
500
400
300
200
100
40
60
80
100
120
140
30
25
20
15
10
5
0

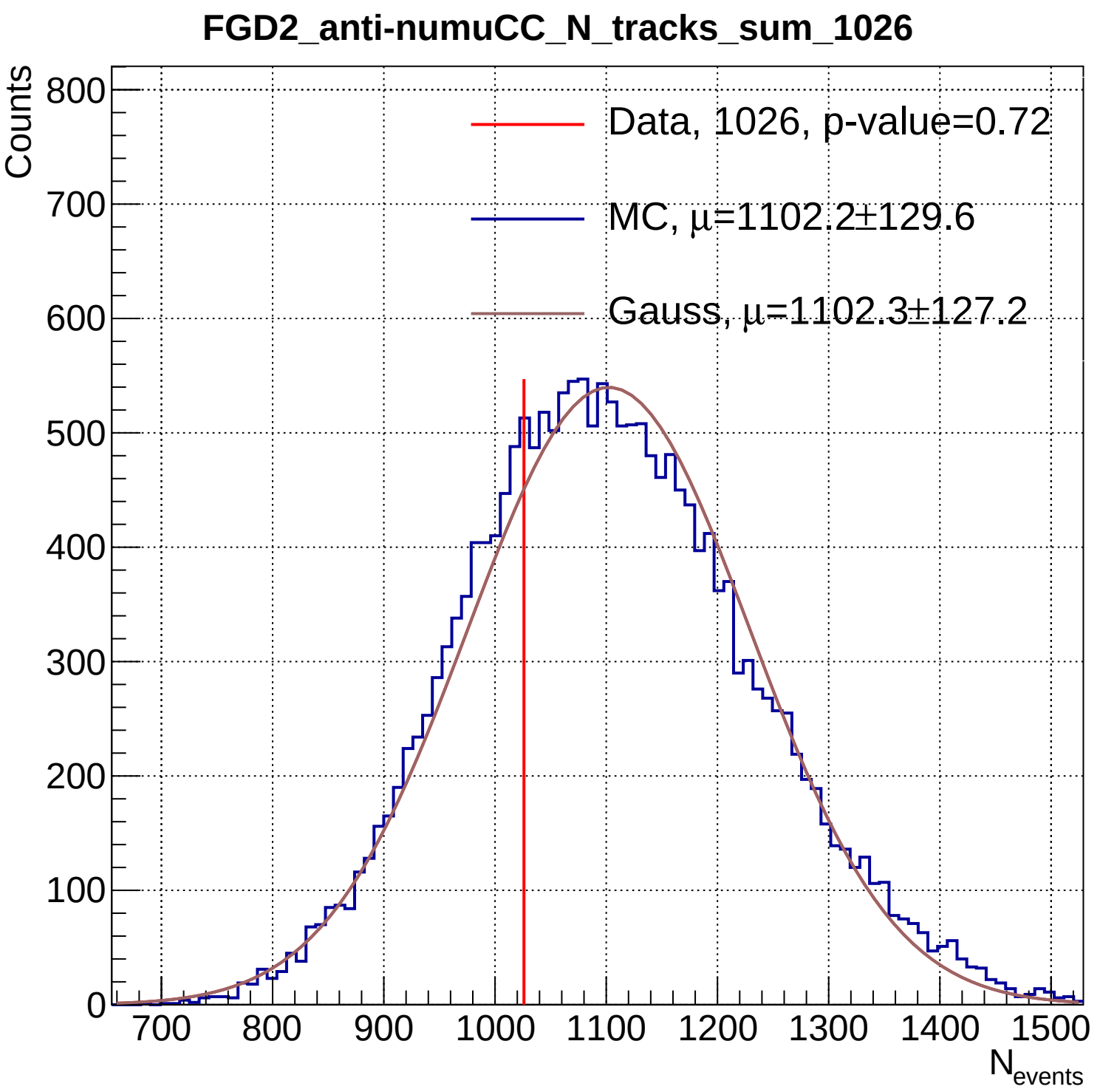

DataPredFluc
FGD2 anti ν_μCC N tracks
p = 0.017
$\chi^2_{Data,\ Draw}$
$\chi^2_{Pred,\ Pred\ Fluc}$
Steps
800
700
600
500
400
300
200
100
60
80
100
120
140
30
25
20
15
10
5
0

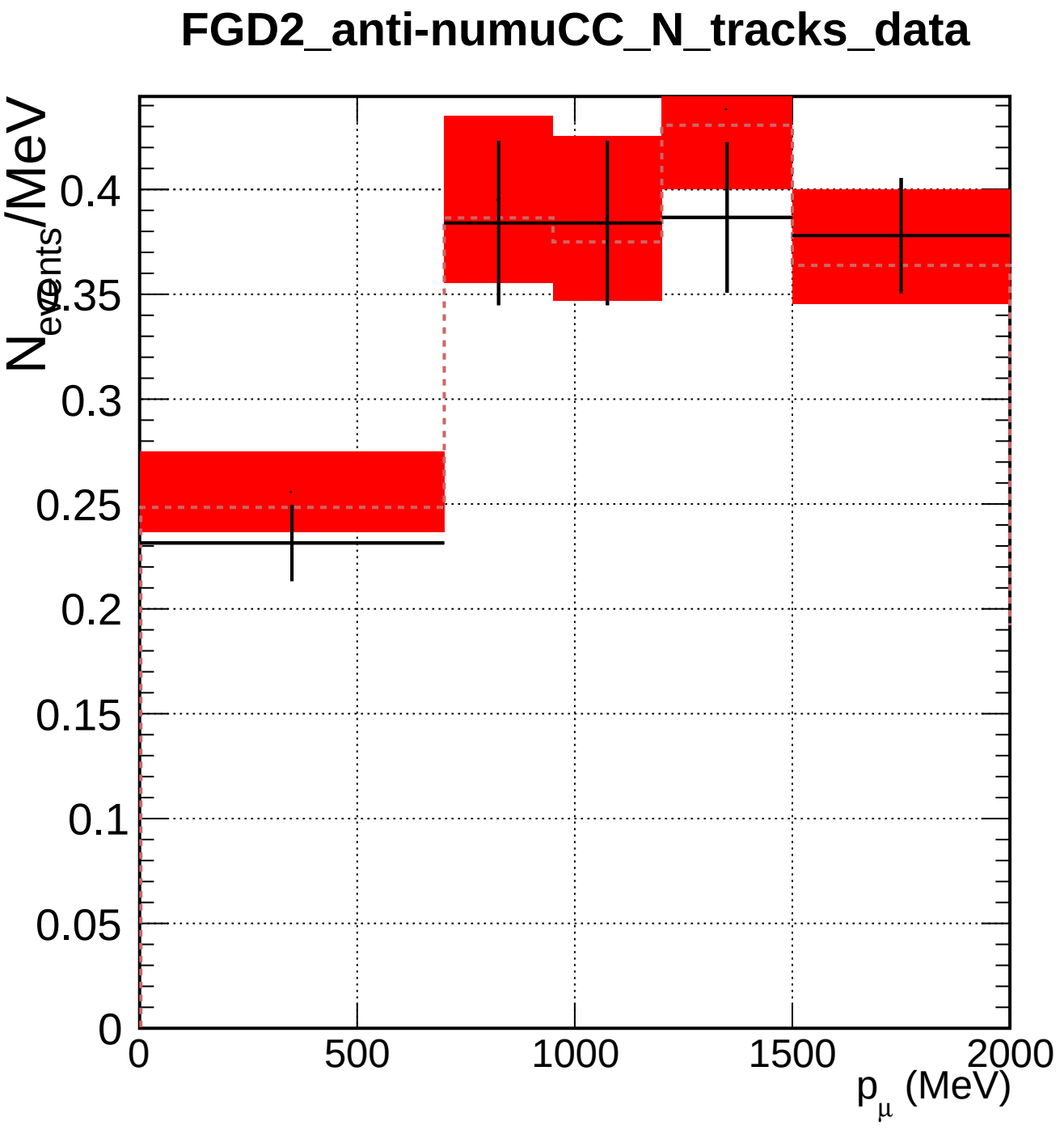

FGD2_anti-numuCC_N_tracks_mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0
0.5
1
1.5
2
2.5
3
×10³
pμ (MeV)
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

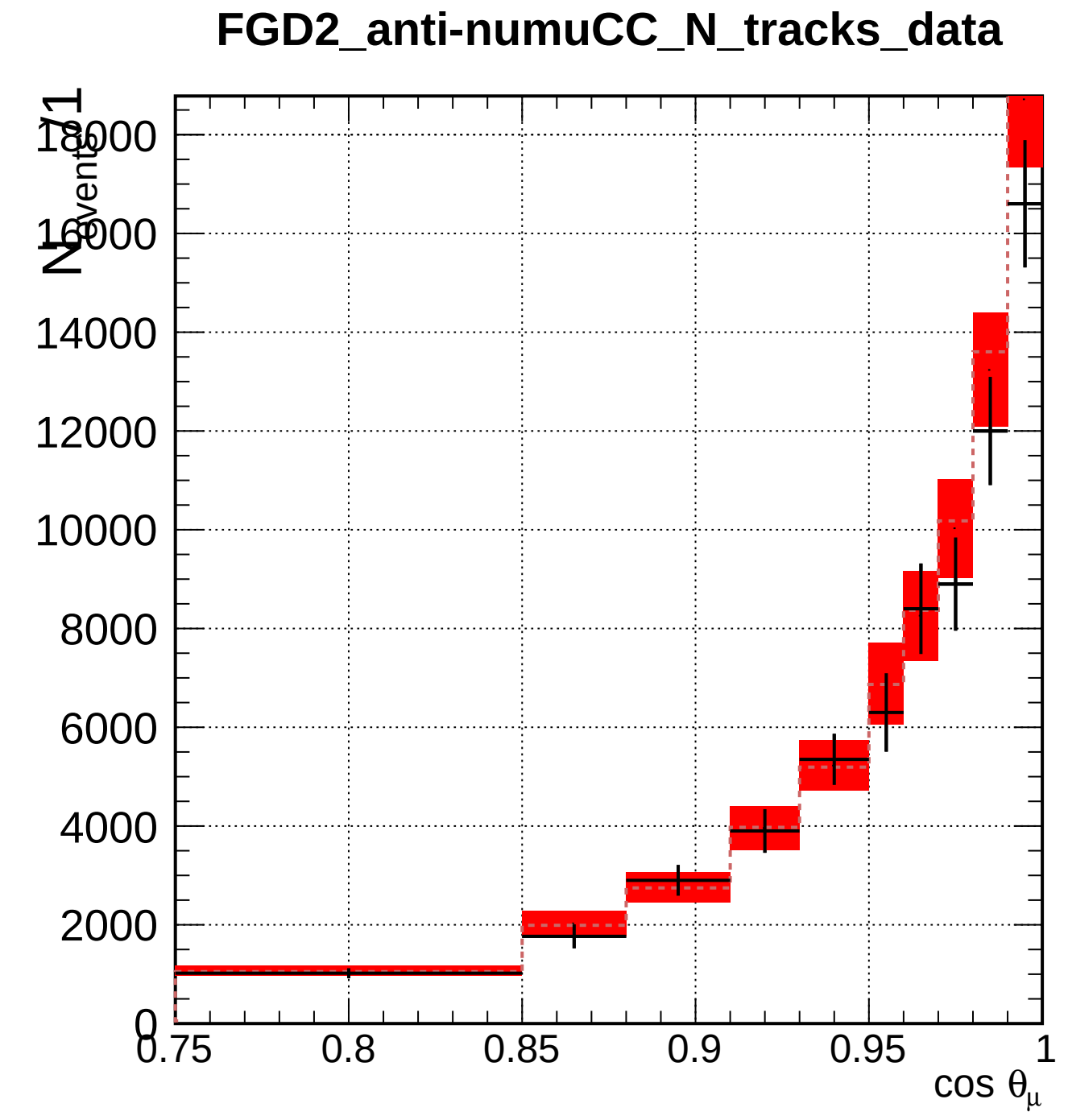

FGD2_anti-numuCC_N_tracks_mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0
0.5
1
1.5
2
2.5
3
×10³
pμ (MeV)
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

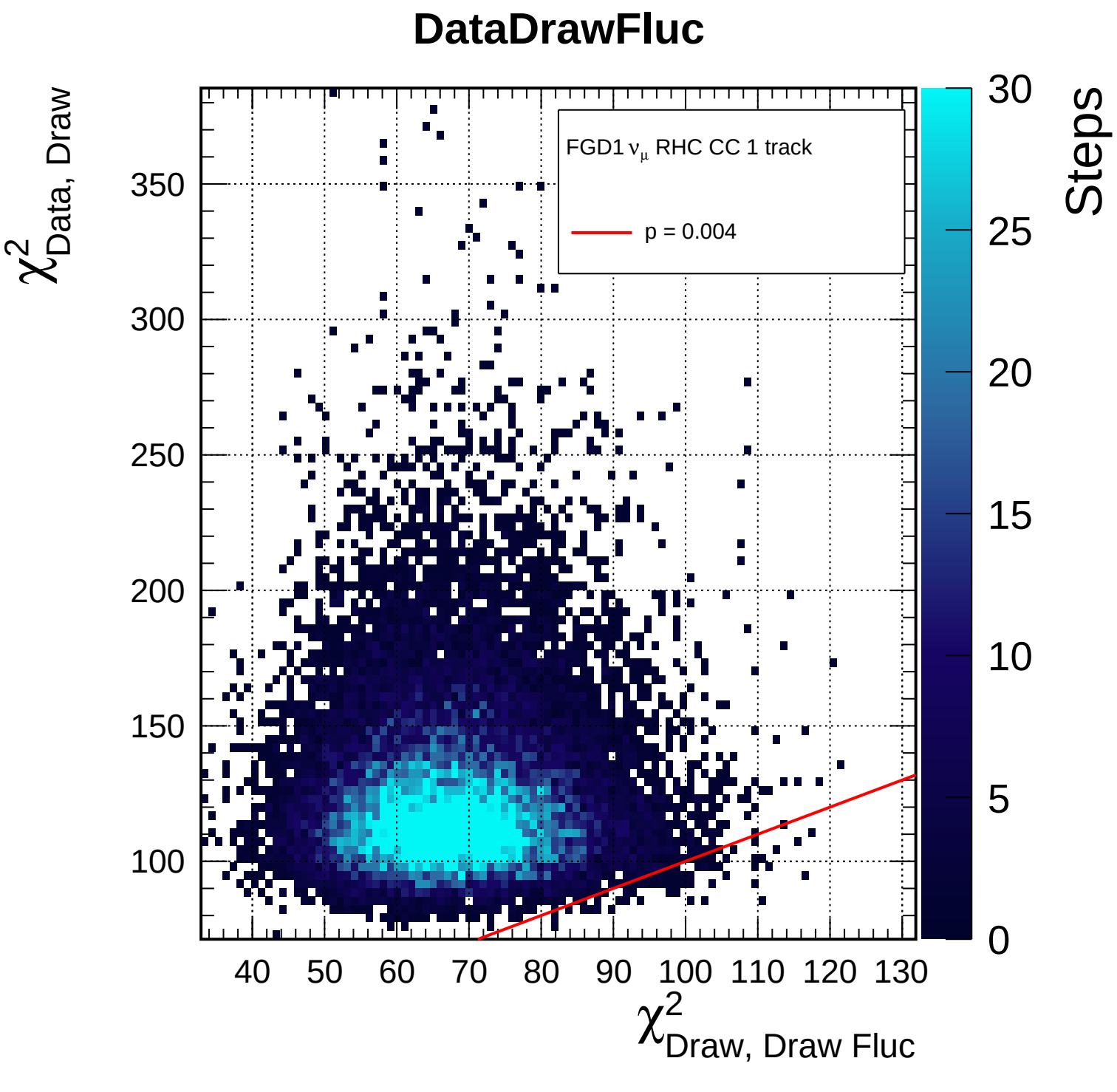

FGD2_anti-numuCC_N_tracks_MeanlnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0
0.5
1
1.5
2
2.5
3
×10^3
pμ (MeV)
Q² = 0.10 GeV
Q² = 0.25 GeV
Q² = 0.50 GeV
χ²Sample
6
5
4
3
2
1
0

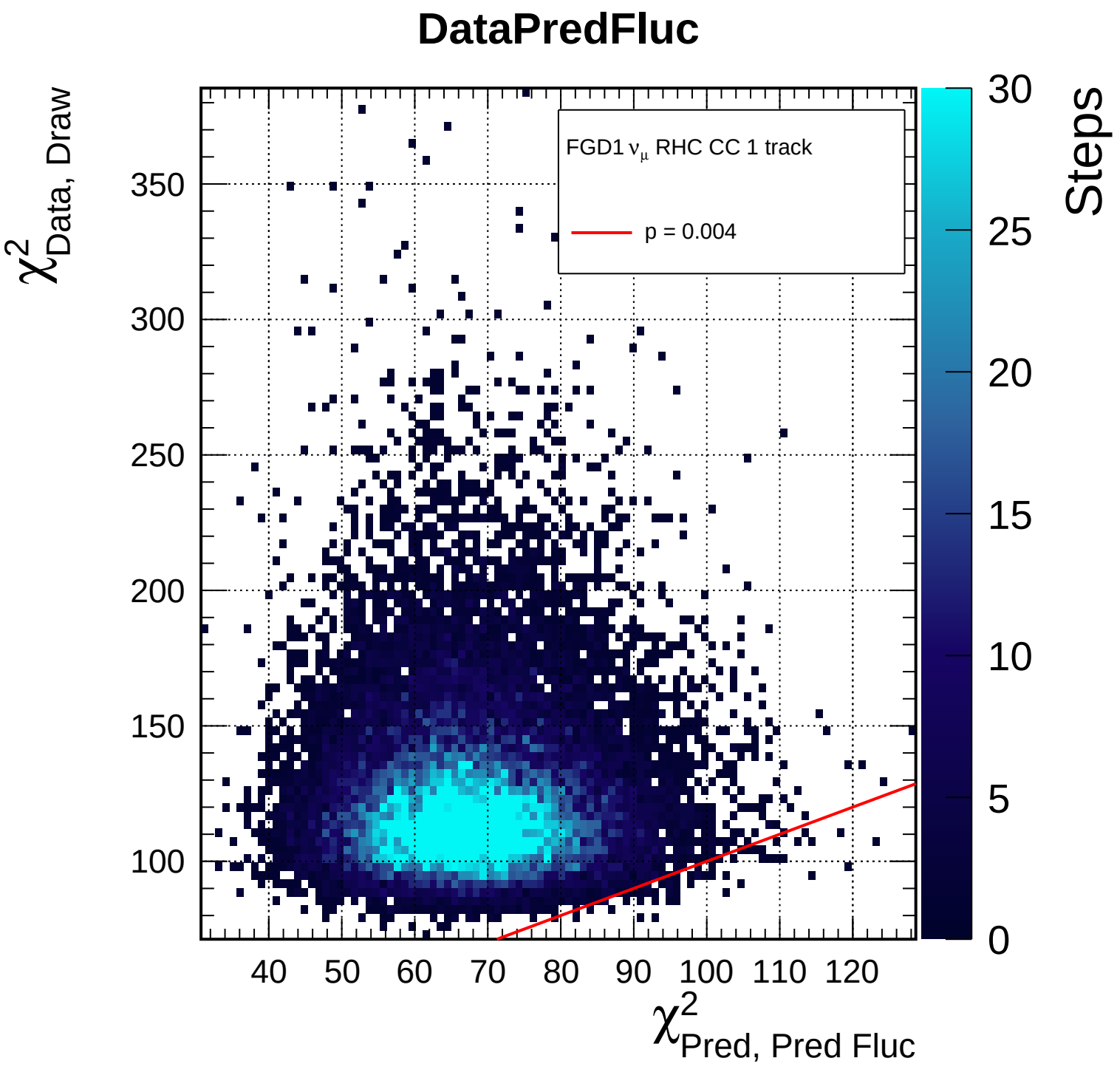

FGD2_anti-numuCC_N_tracks_ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0
0.5
1
1.5
2
2.5
3
×10^3
pμ (MeV)
Q² = 0.10 GeV
Q² = 0.25 GeV
Q² = 0.50 GeV
6
5
4
3
2
1
0
χ²Sample

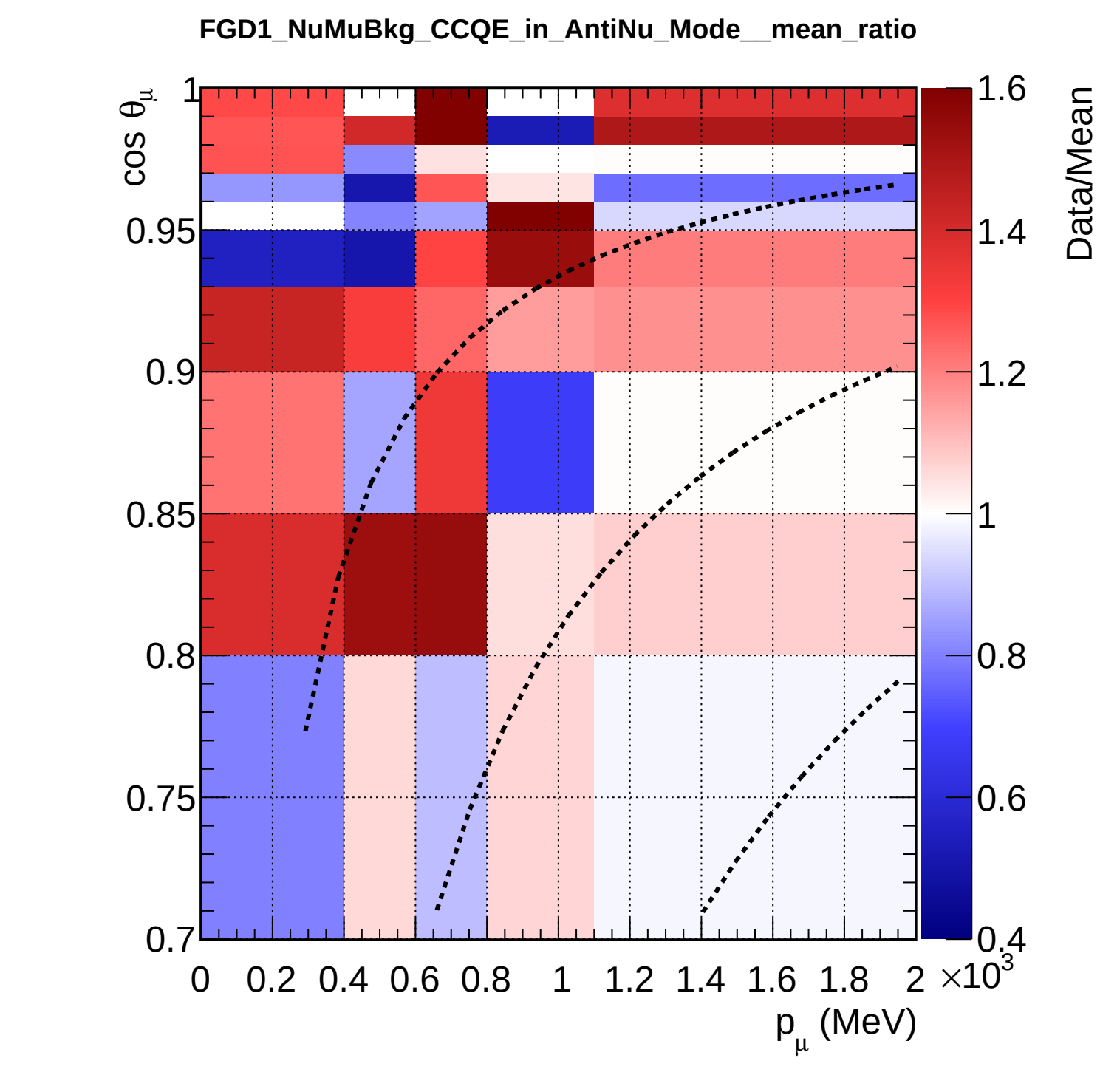

FGD2_anti-numuCC_N_tracks_sum_1026
Counts
Data, 1026, p-value=0.72
MC, μ=1102.2±129.6
Gauss, μ=1102.3±127.2
0
100
200
300
400
500
600
700
800
700
800
900
1000
1100
1200
1300
1400
1500
N events

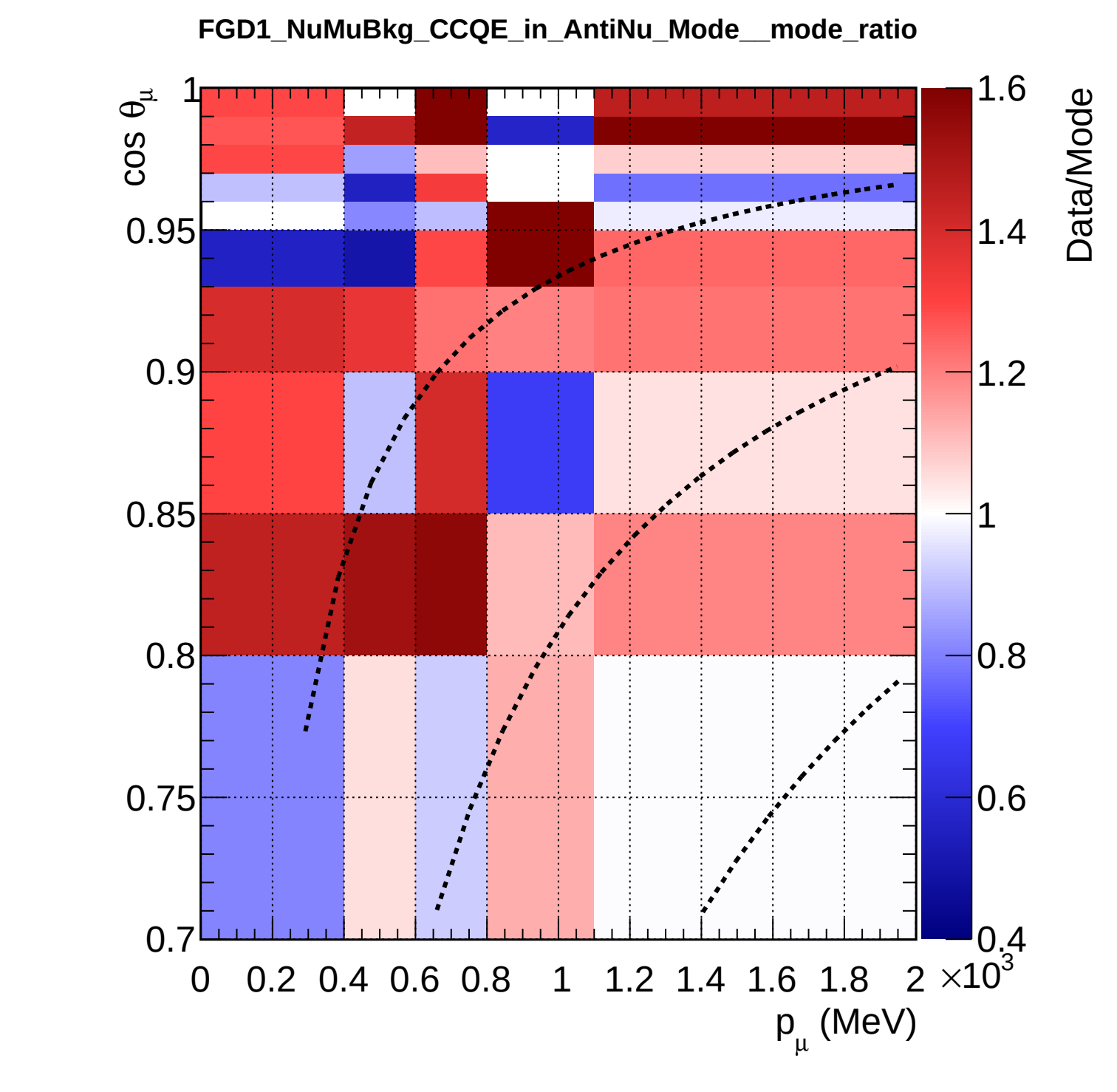

FGD2_anti-numuCC_N_tracks_data
N_events/MeV
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
500
1000
1500
2000
p_μ (MeV)

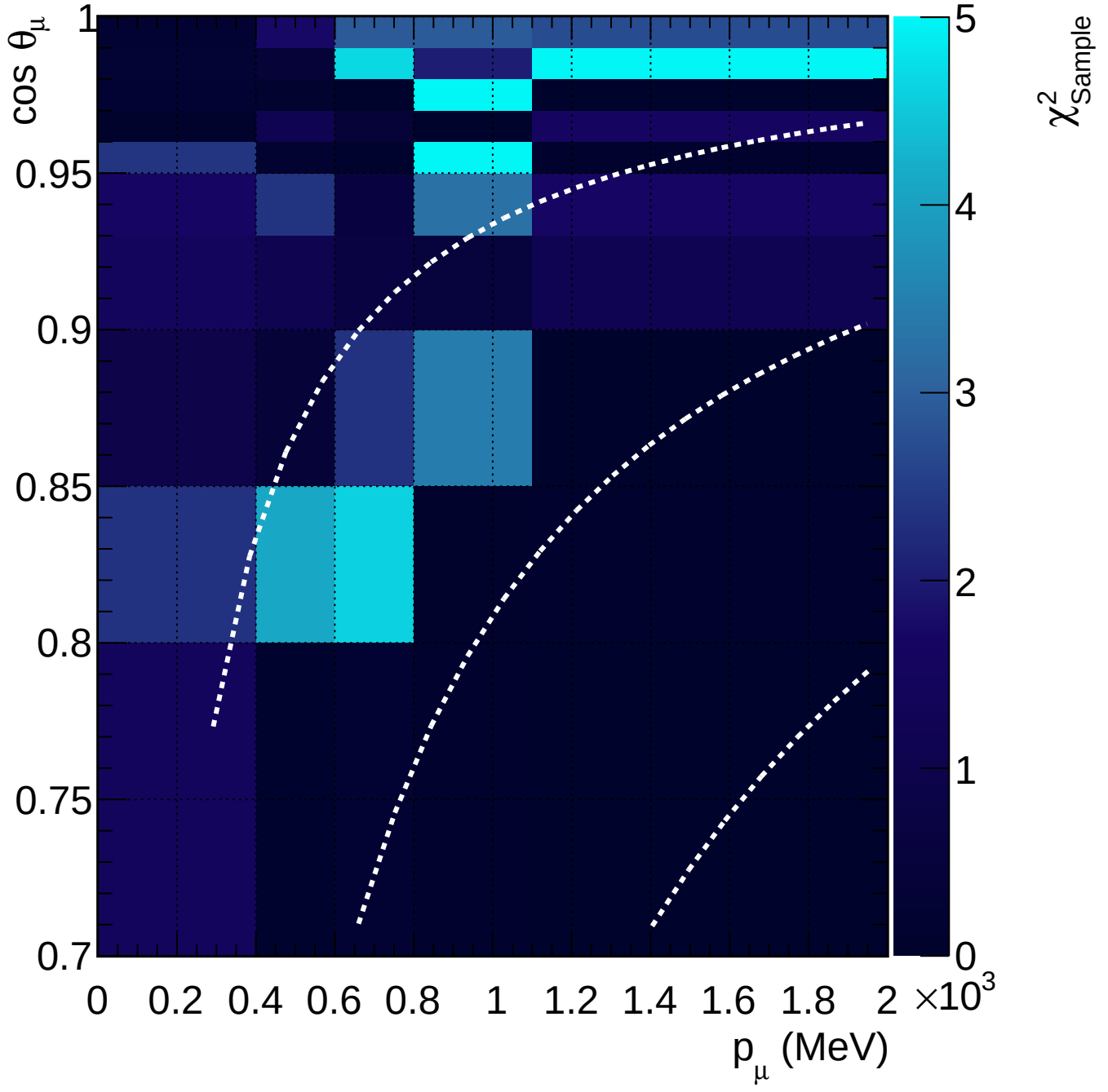

FGD2_anti-numuCC_N_tracks_data
N events / 1
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0.75
0.8
0.85
0.9
0.95
1
cos θμ

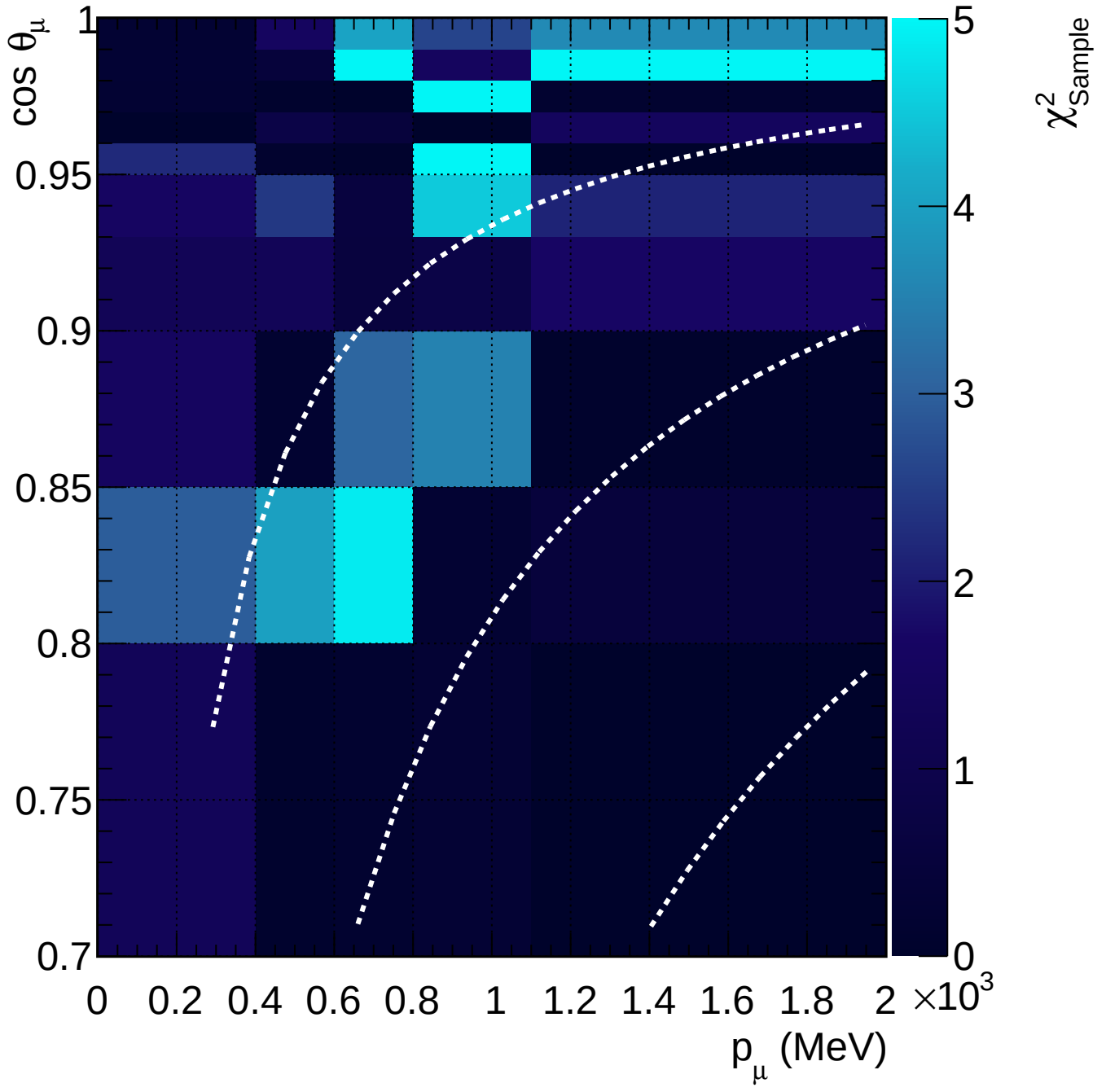

DataDrawFluc
FGD1 ν_μ RHC CC 1 track
p = 0.004
$\chi^2_{Data,\ Draw}$
$\chi^2_{Draw,\ Draw\ Fluc}$
Steps
350
300
250
200
150
100
40
50
60
70
80
90
100
110
120
130
30
25
20
15
10
5
0

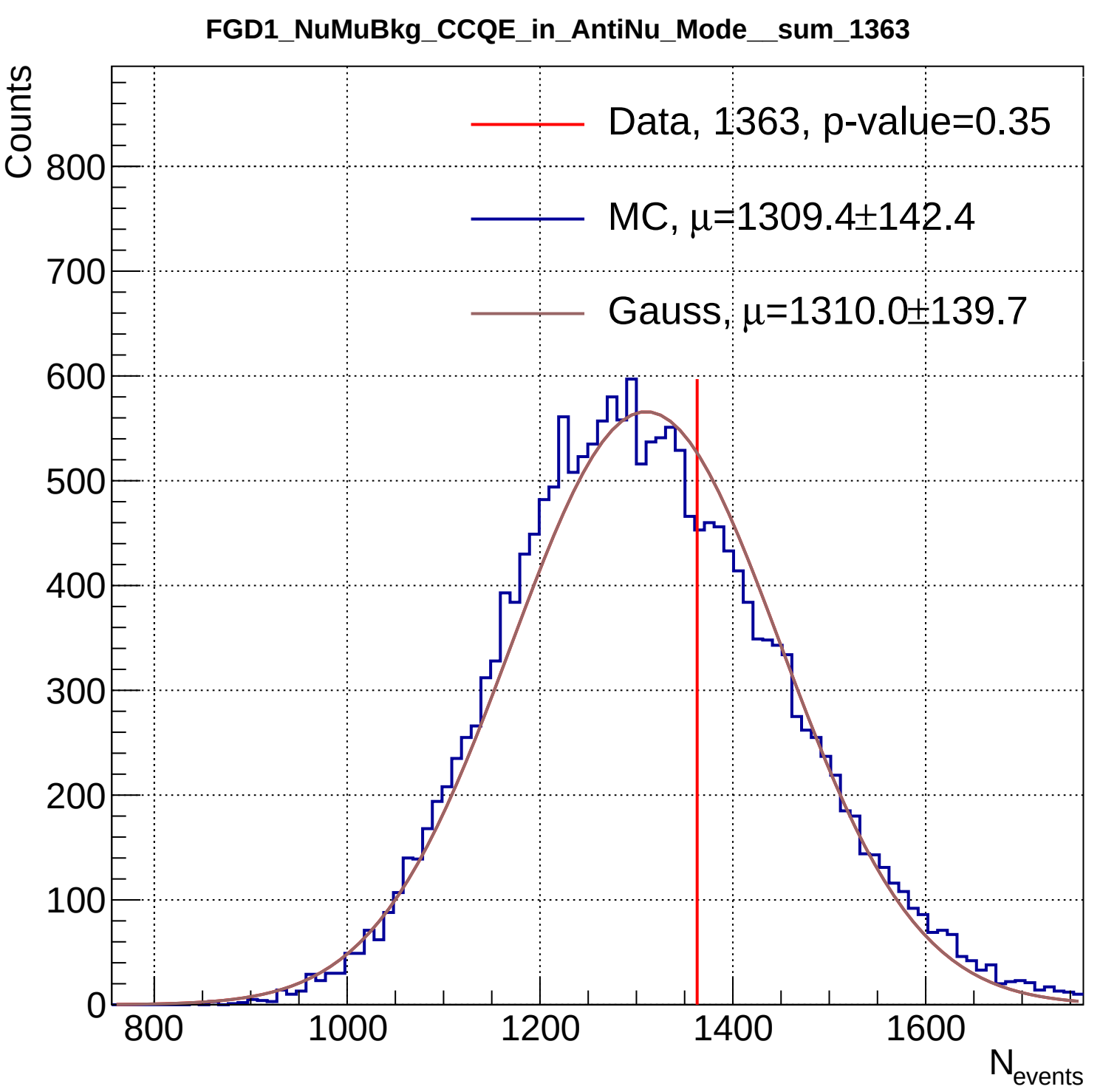

DataPredFluc
FGD1 ν_μ RHC CC 1 track
p = 0.004
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Pred, Pred Fluc}}$
Steps
350
300
250
200
150
100
40
50
60
70
80
90
100
110
120
30
25
20
15
10
5
0

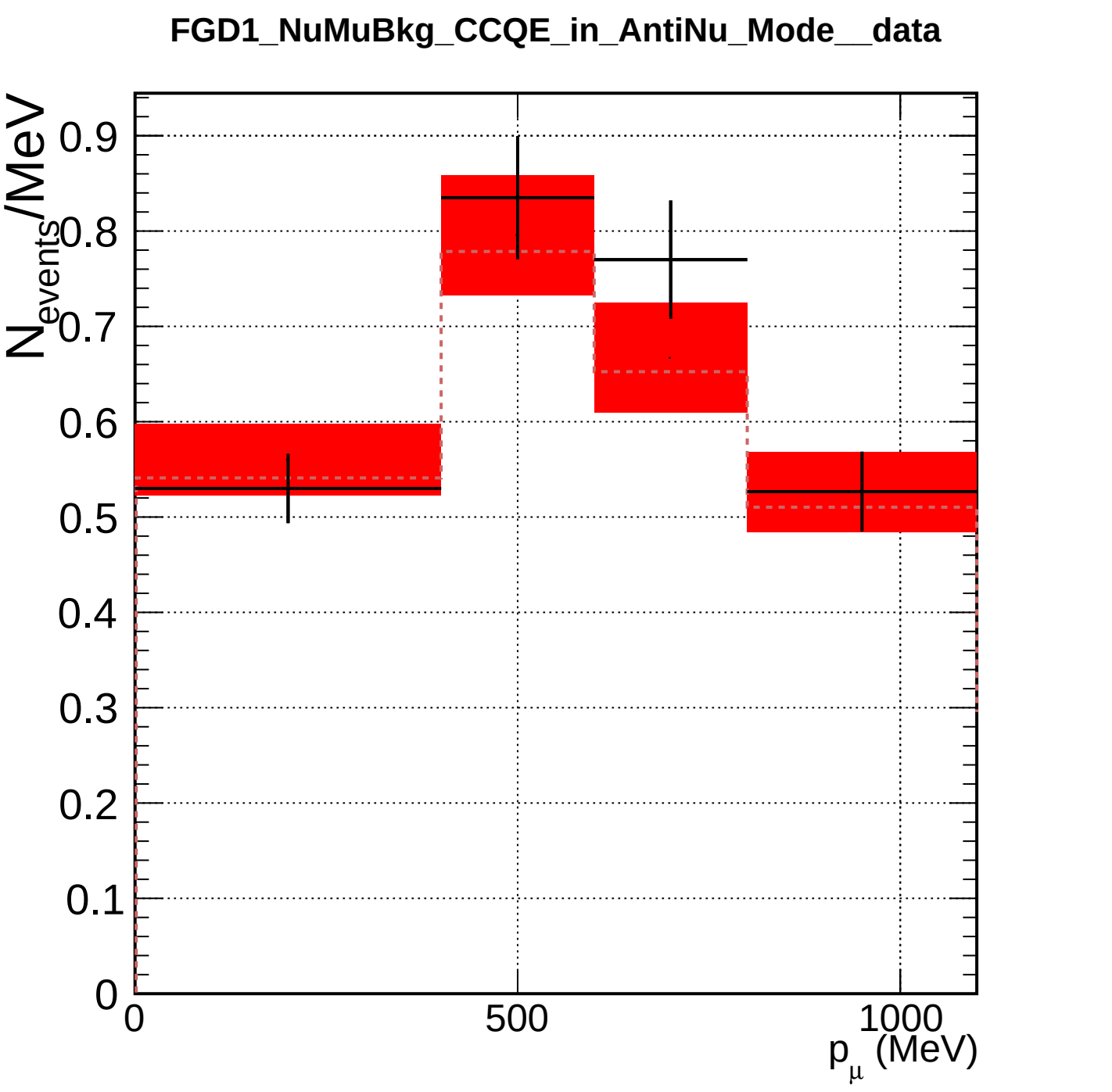

FGD1_NuMuBkg_CCQE_in_AntiNu_Mode__mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

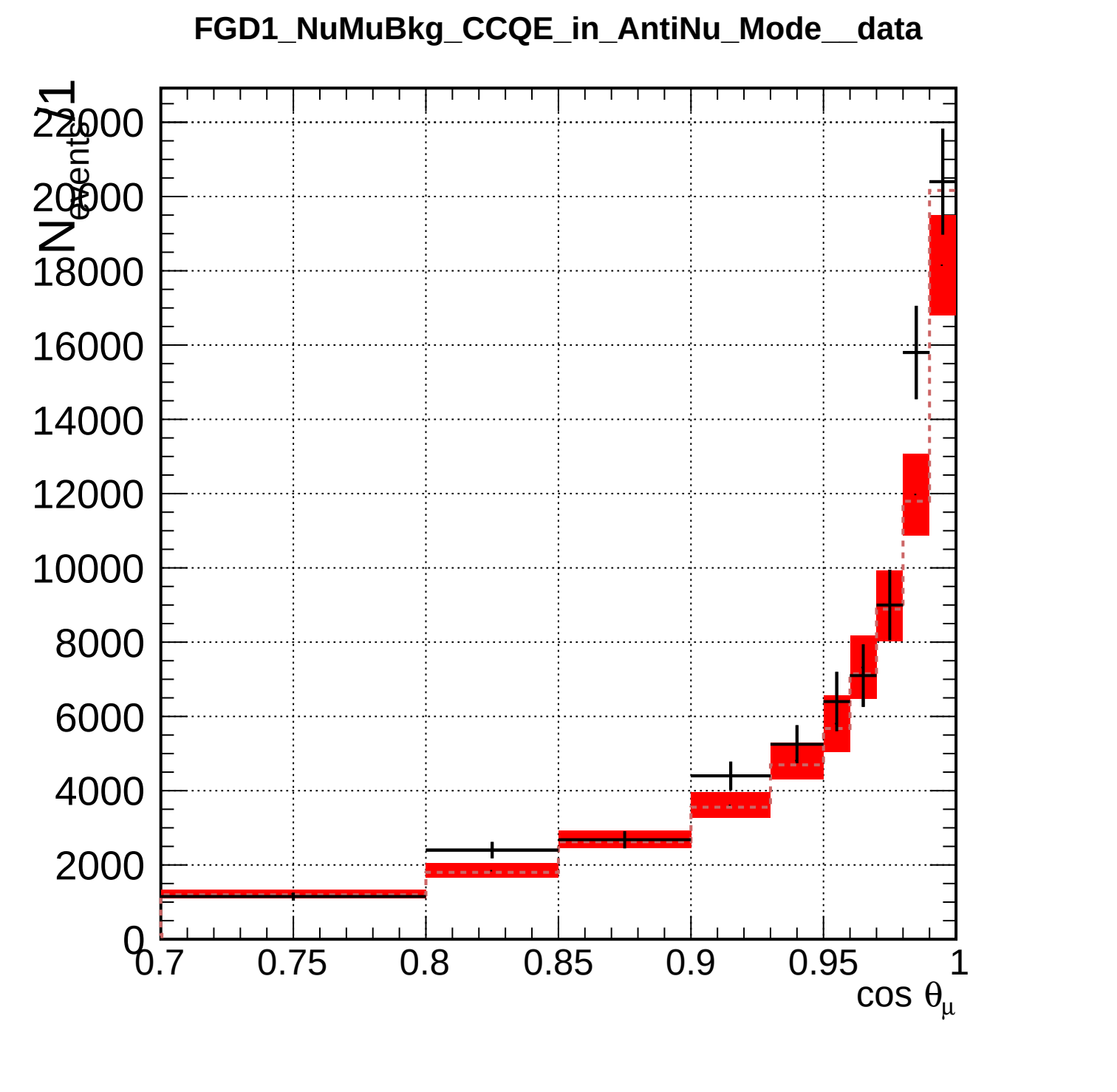

FGD1_NuMuBkg_CCQE_in_AntiNu_Mode__mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

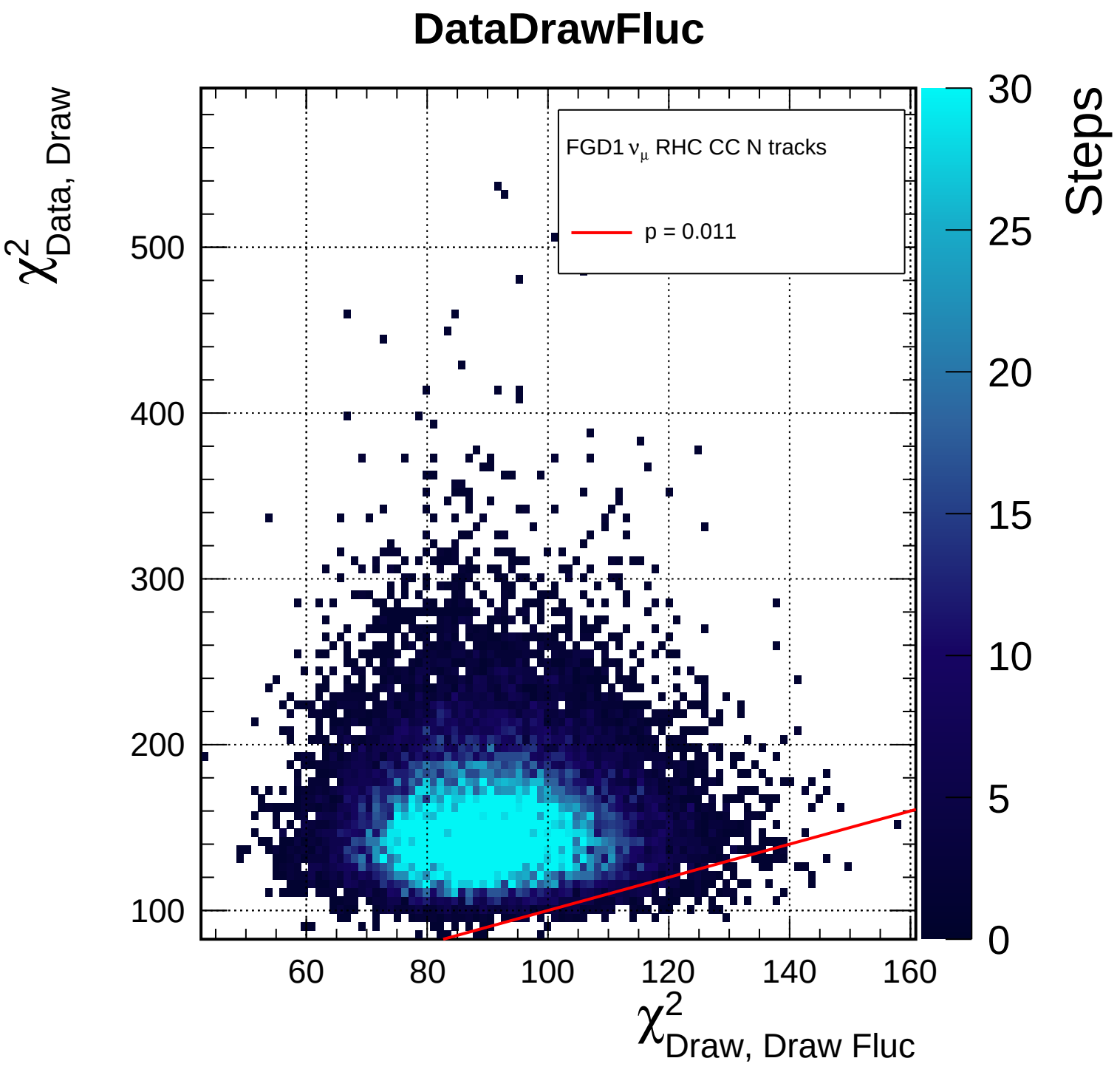

FGD1_NuMuBkg_CCQE_in_AntiNu_Mode__MeanlnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
5
4
3
2
1
0
χ²Sample

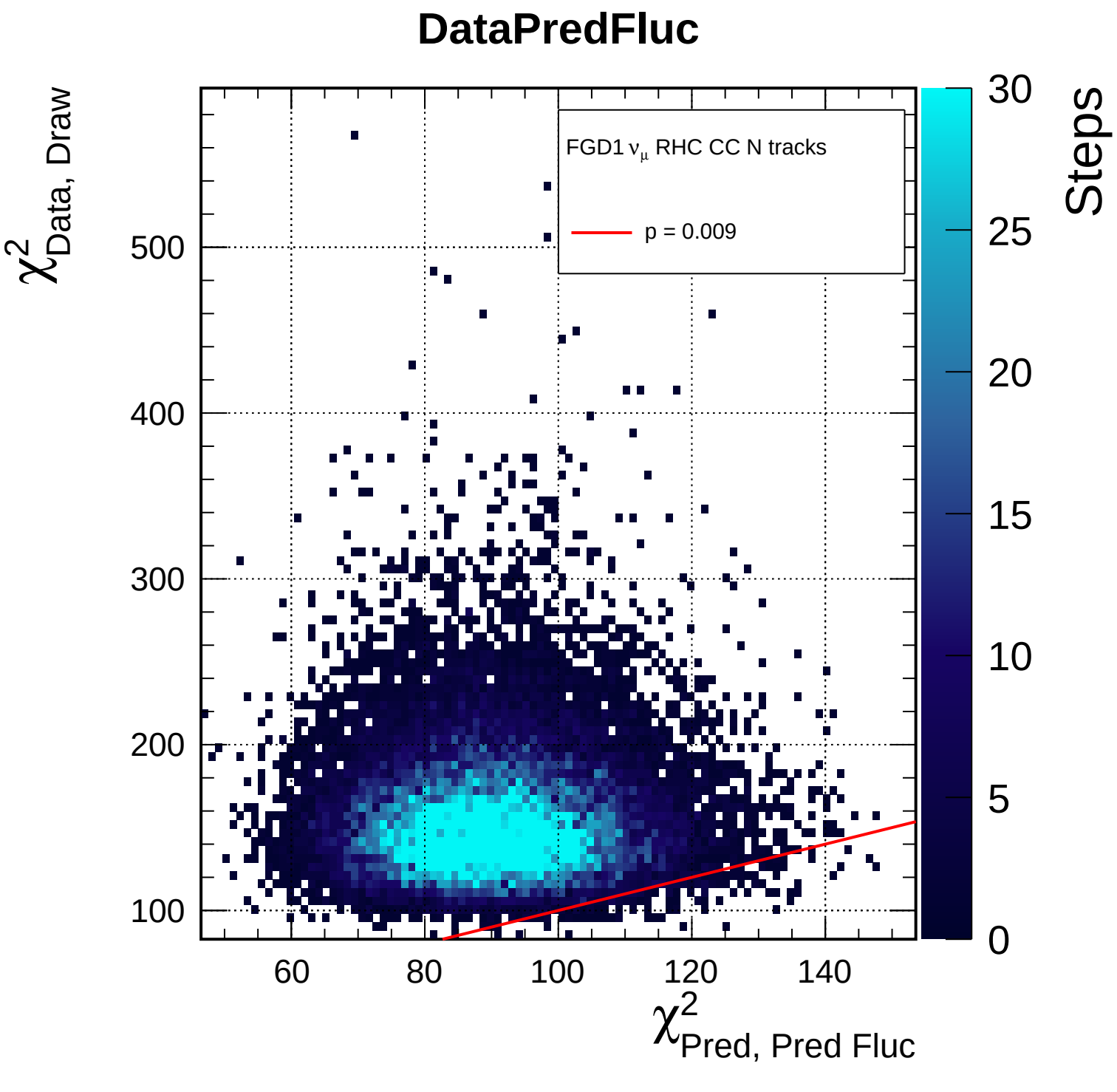

FGD1_NuMuBkg_CCQE_in_AntiNu_Mode__ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
5
4
3
2
1
0
χ²Sample

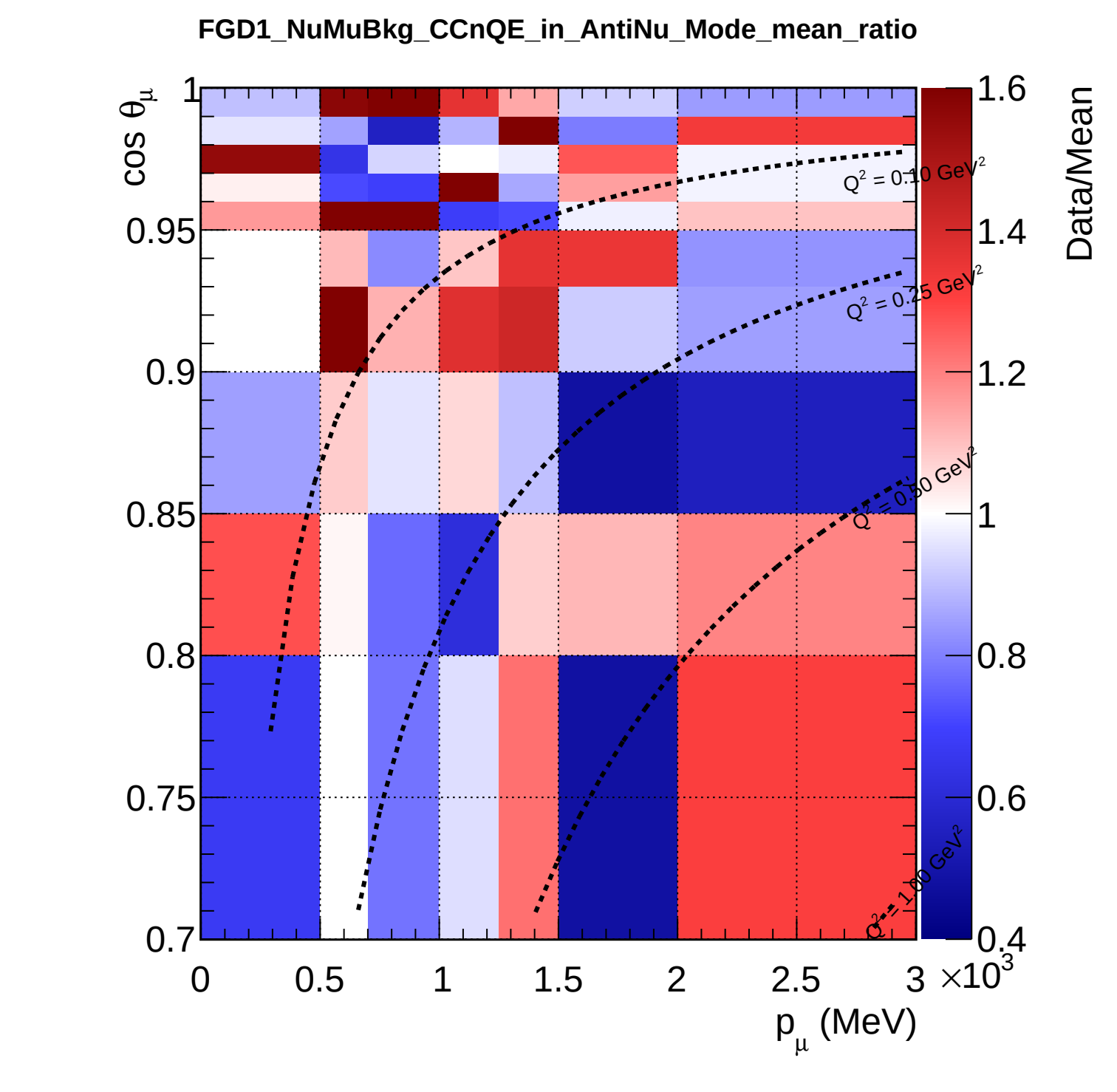

FGD1_NuMuBkg_CCQE_in_AntiNu_Mode__sum_1363
Counts
Data, 1363, p-value=0.35
MC, μ=1309.4±142.4
Gauss, μ=1310.0±139.7
0
100
200
300
400
500
600
700
800
800
1000
1200
1400
1600
N events

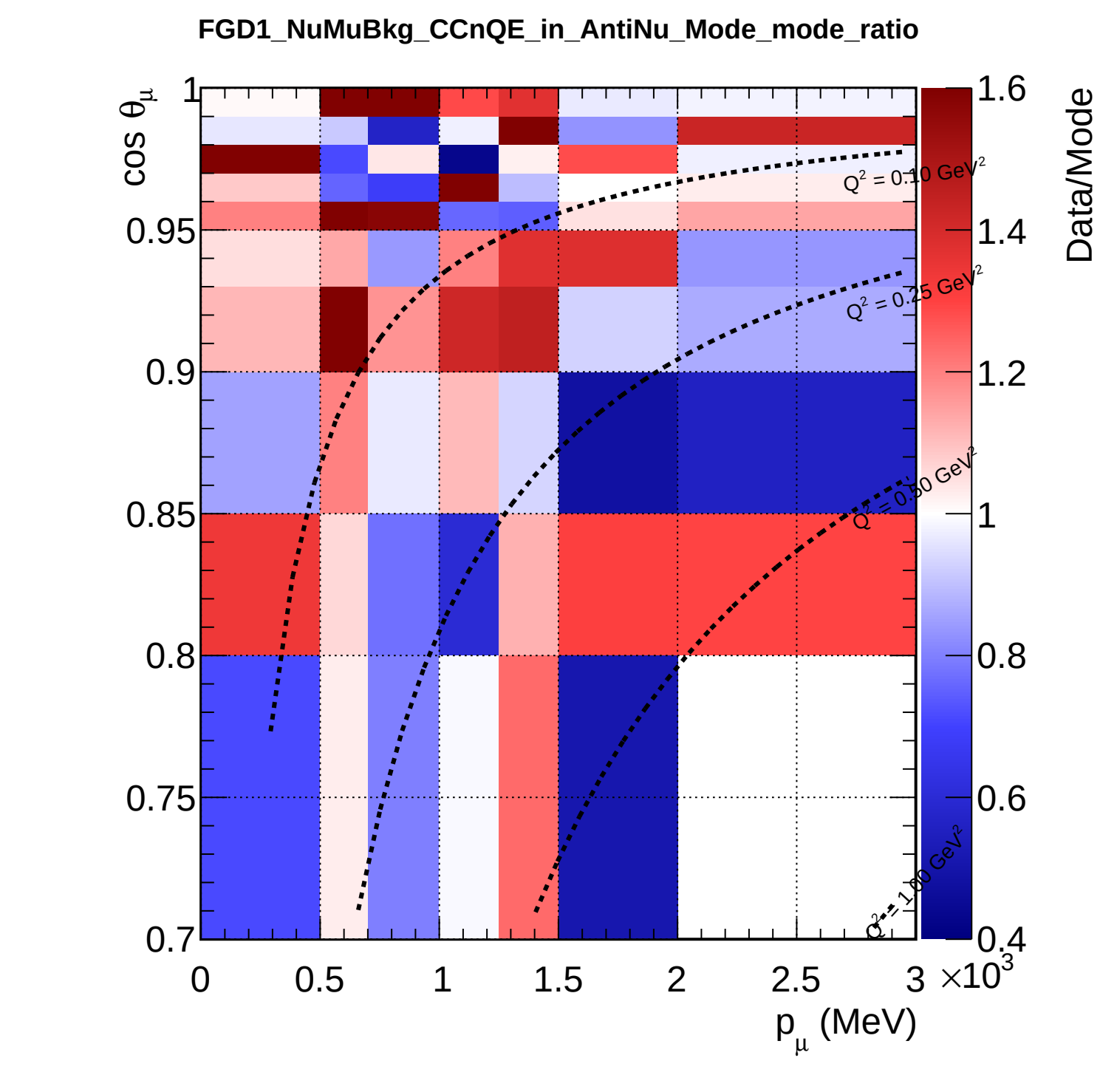

FGD1_NuMuBkg_CCQE_in_AntiNu_Mode__data
N_events/MeV
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
500
1000
p_μ (MeV)

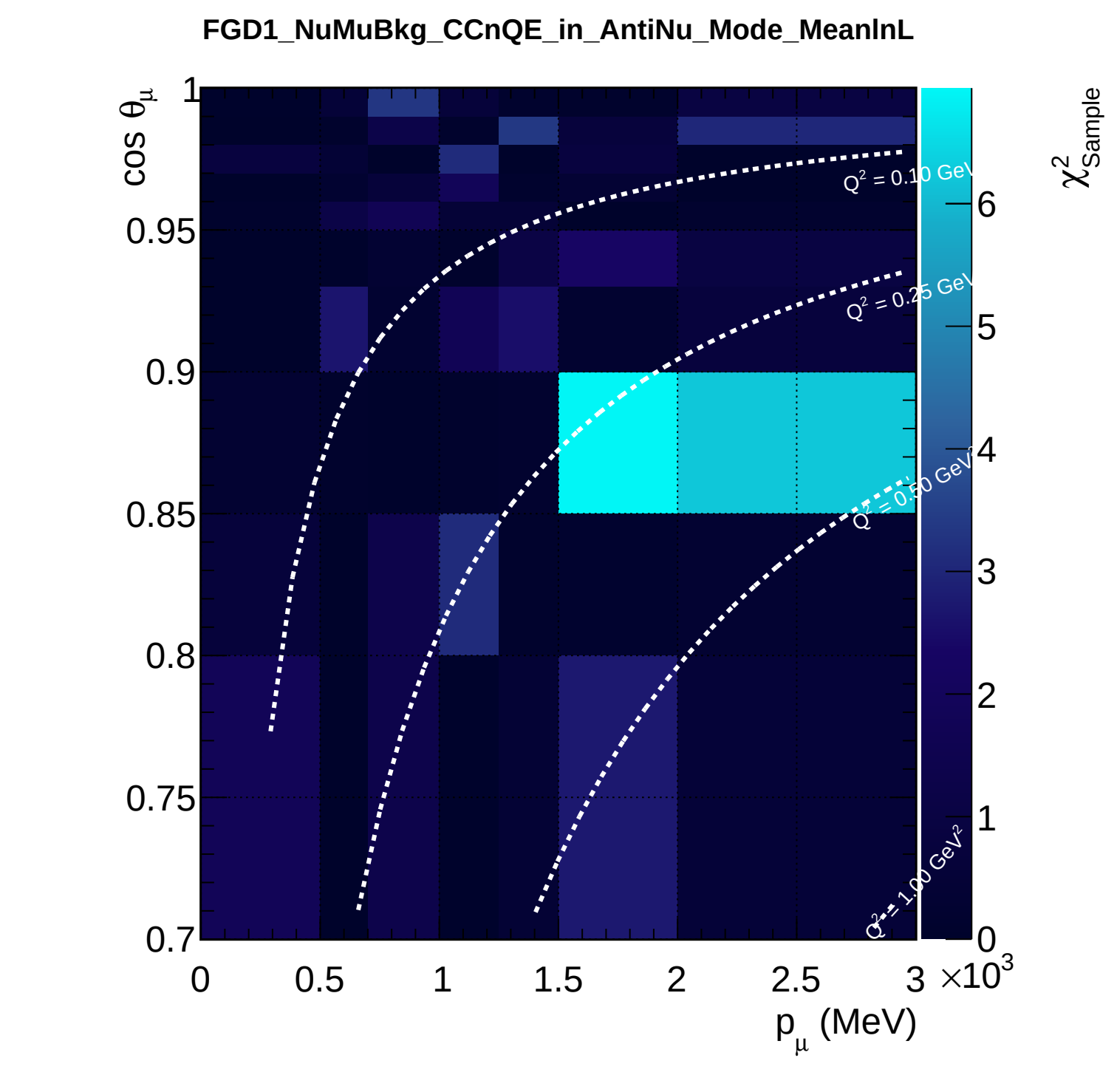

FGD1_NuMuBkg_CCQE_in_AntiNu_Mode__data
N_events^21
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0.7
0.75
0.8
0.85
0.9
0.95
1
cos θ_μ

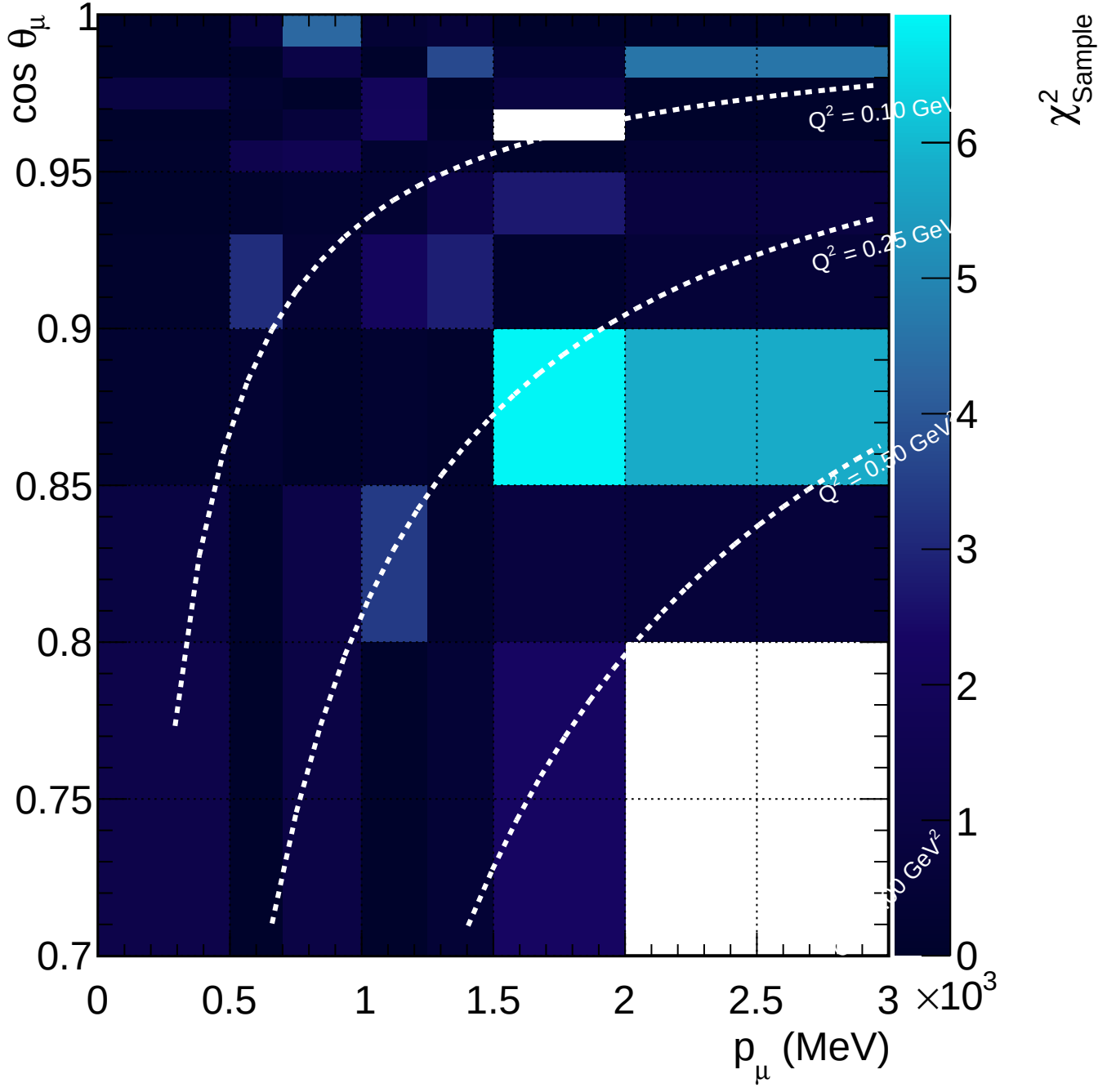

DataDrawFluc
FGD1 ν_μ RHC CC N tracks
p = 0.011
$\chi^2_{Data, Draw}$
$\chi^2_{Draw, Draw Fluc}$
Steps
100
200
300
400
500
60
80
100
120
140
160
0
5
10
15
20
25
30

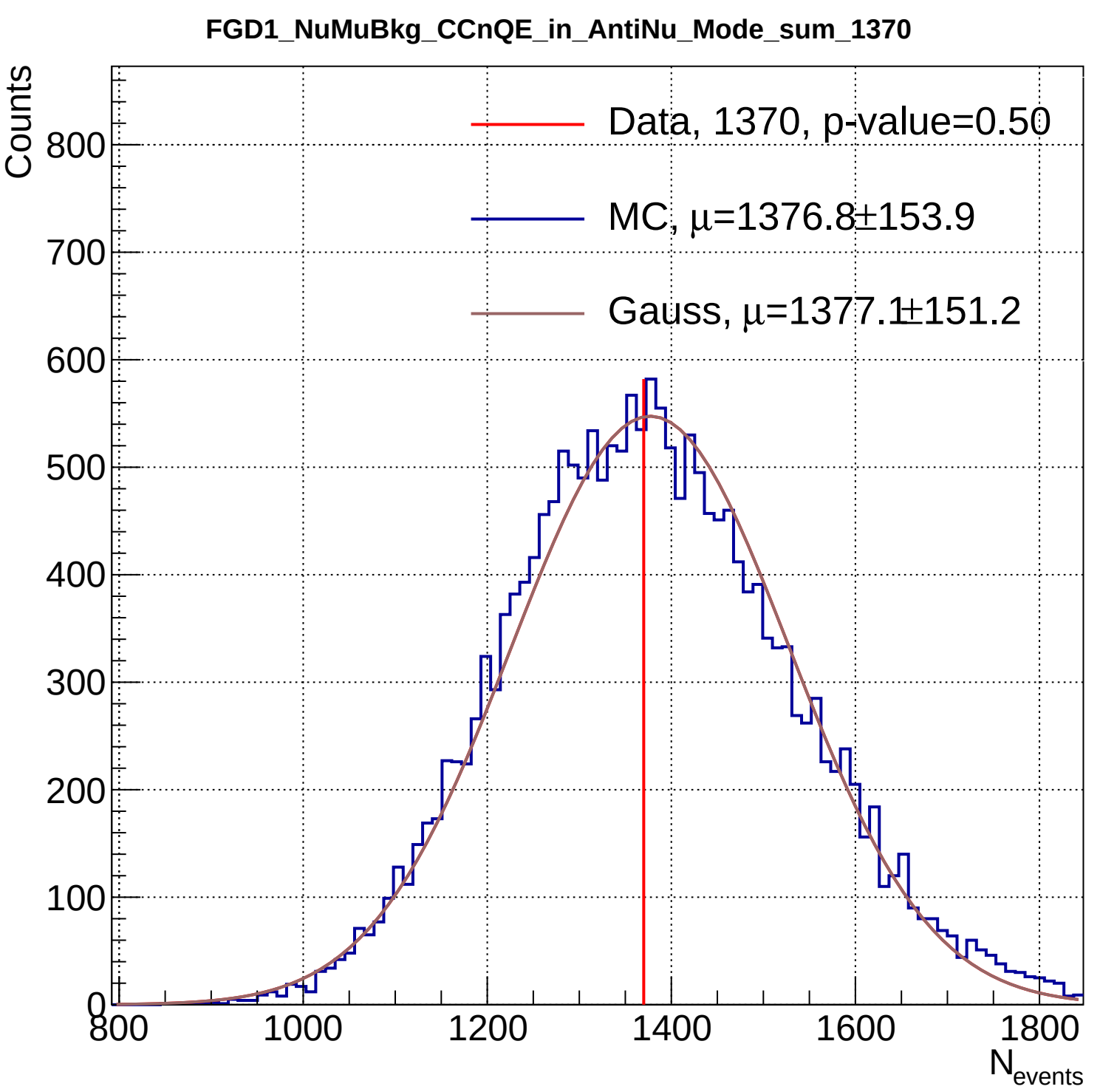

DataPredFluc
FGD1 ν_μ RHC CC N tracks
p = 0.009
$\chi^2_{\text{Data, Draw}}$
$\chi^2_{\text{Pred, Pred Fluc}}$
Steps
100
200
300
400
500
60
80
100
120
140
0
5
10
15
20
25
30

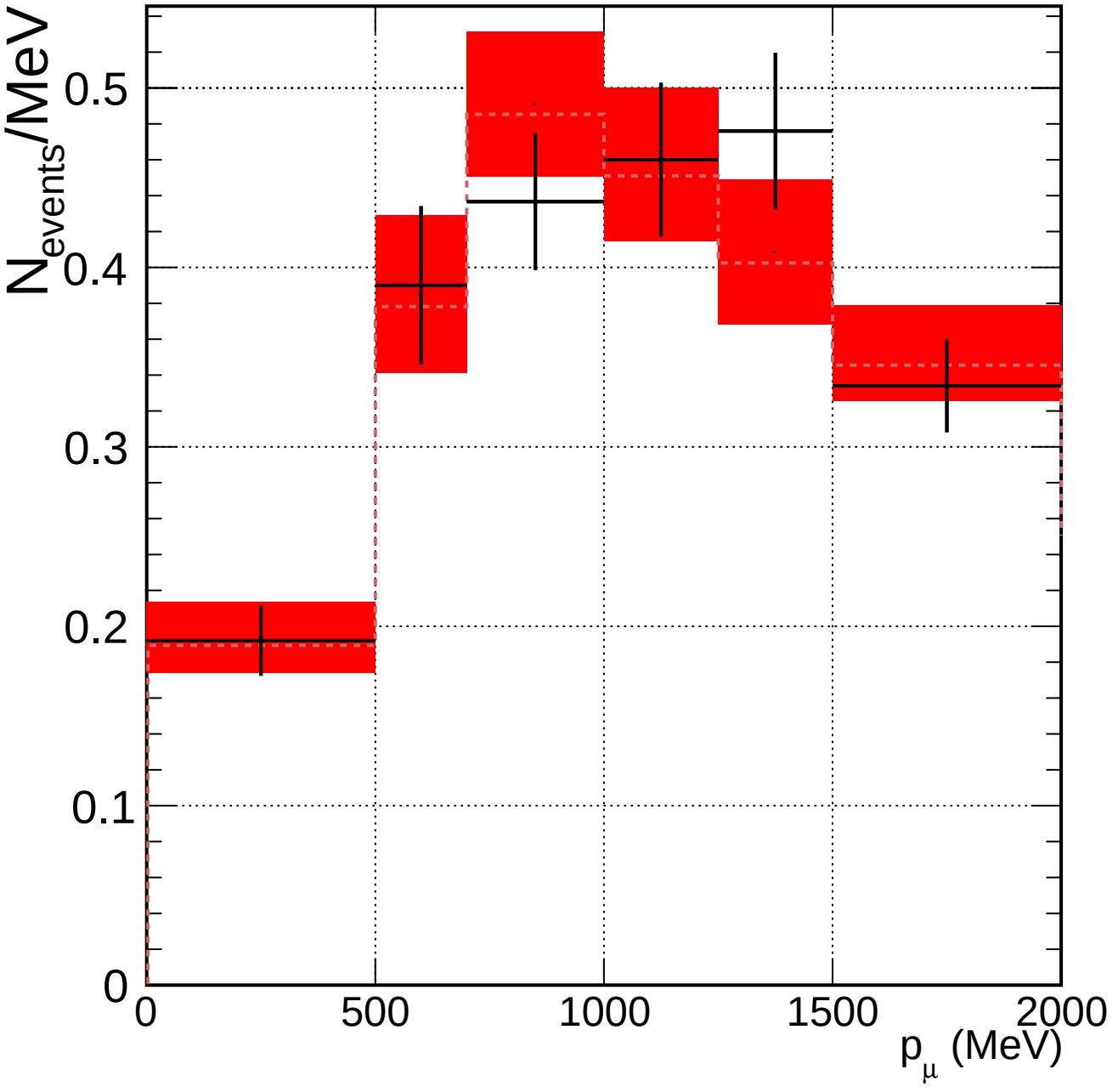

FGD1_NuMuBkg_CCnQE_in_AntiNu_Mode_mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.5
1
1.5
2
2.5
3
×10³
pμ (MeV)
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

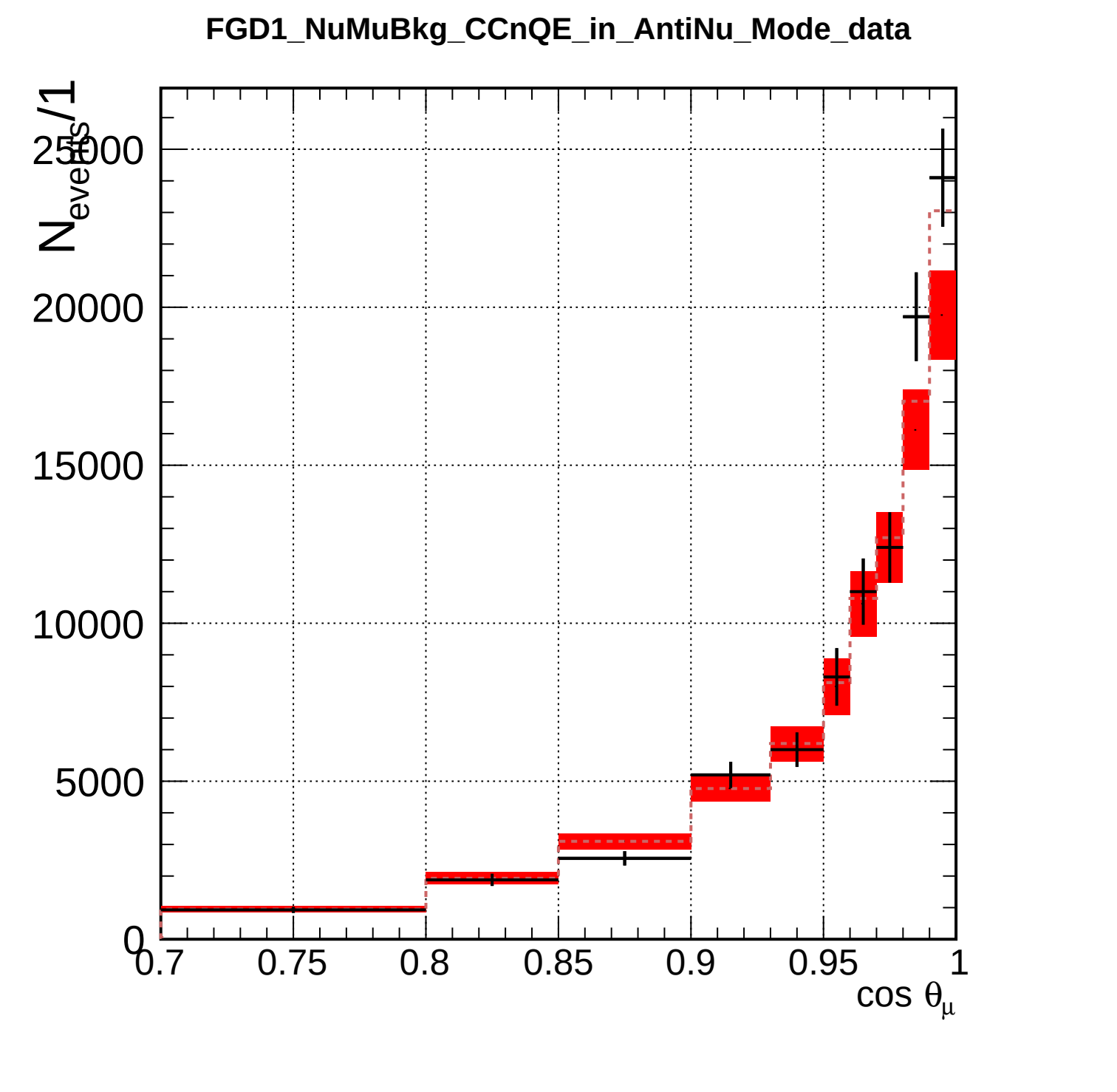

FGD1_NuMuBkg_CCnQE_in_AntiNu_Mode_mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.5
1
1.5
2
2.5
3
×10^3
pμ (MeV)
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

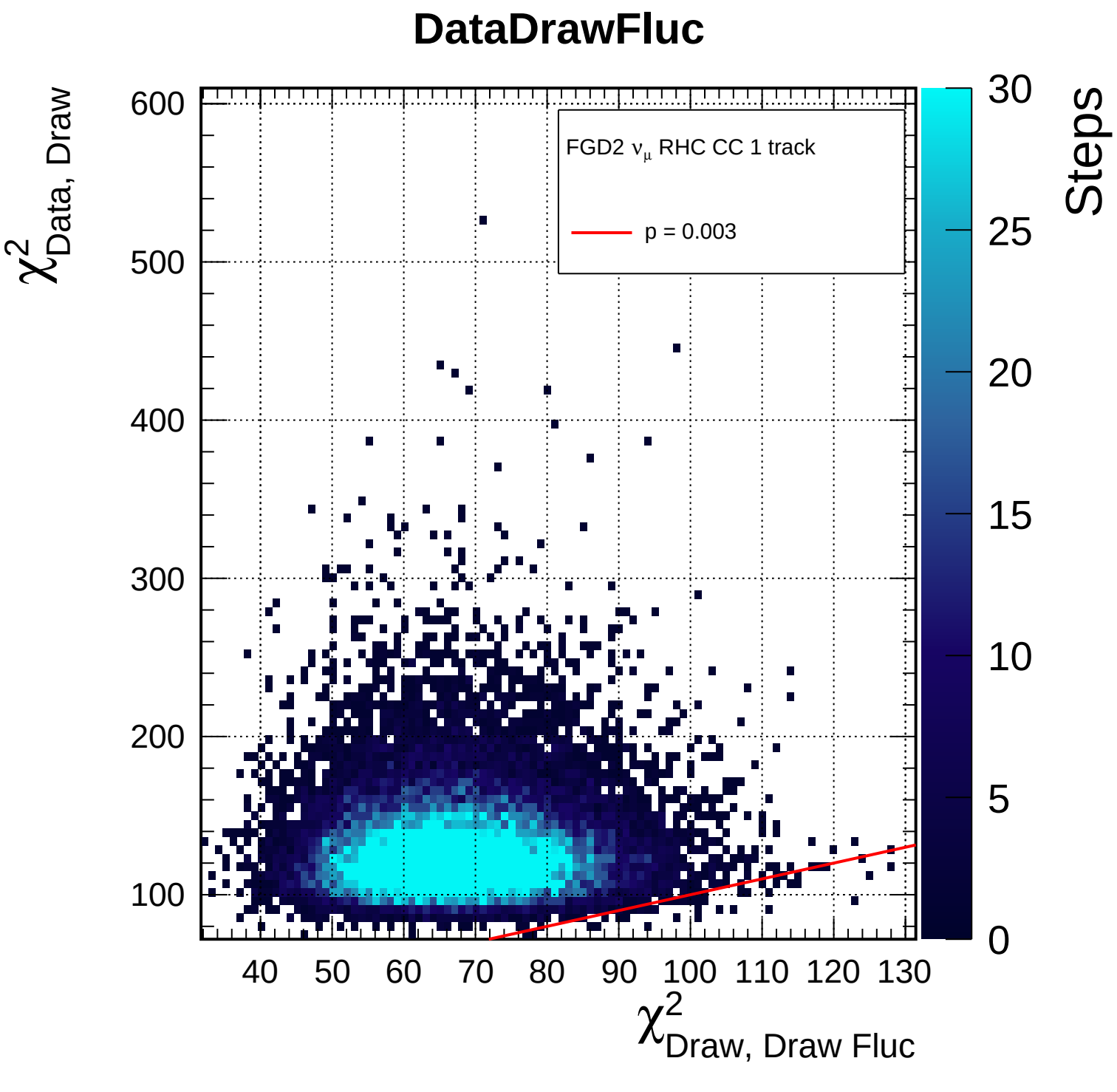

FGD1_NuMuBkg_CCnQE_in_AntiNu_Mode_MeanlnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.5
1
1.5
2
2.5
3
×10³
pμ (MeV)
Q² = 0.10 GeV
Q² = 0.25 GeV
Q² = 0.50 GeV
Q² = 1.00 GeV²
6
5
4
3
2
1
0
χ²Sample

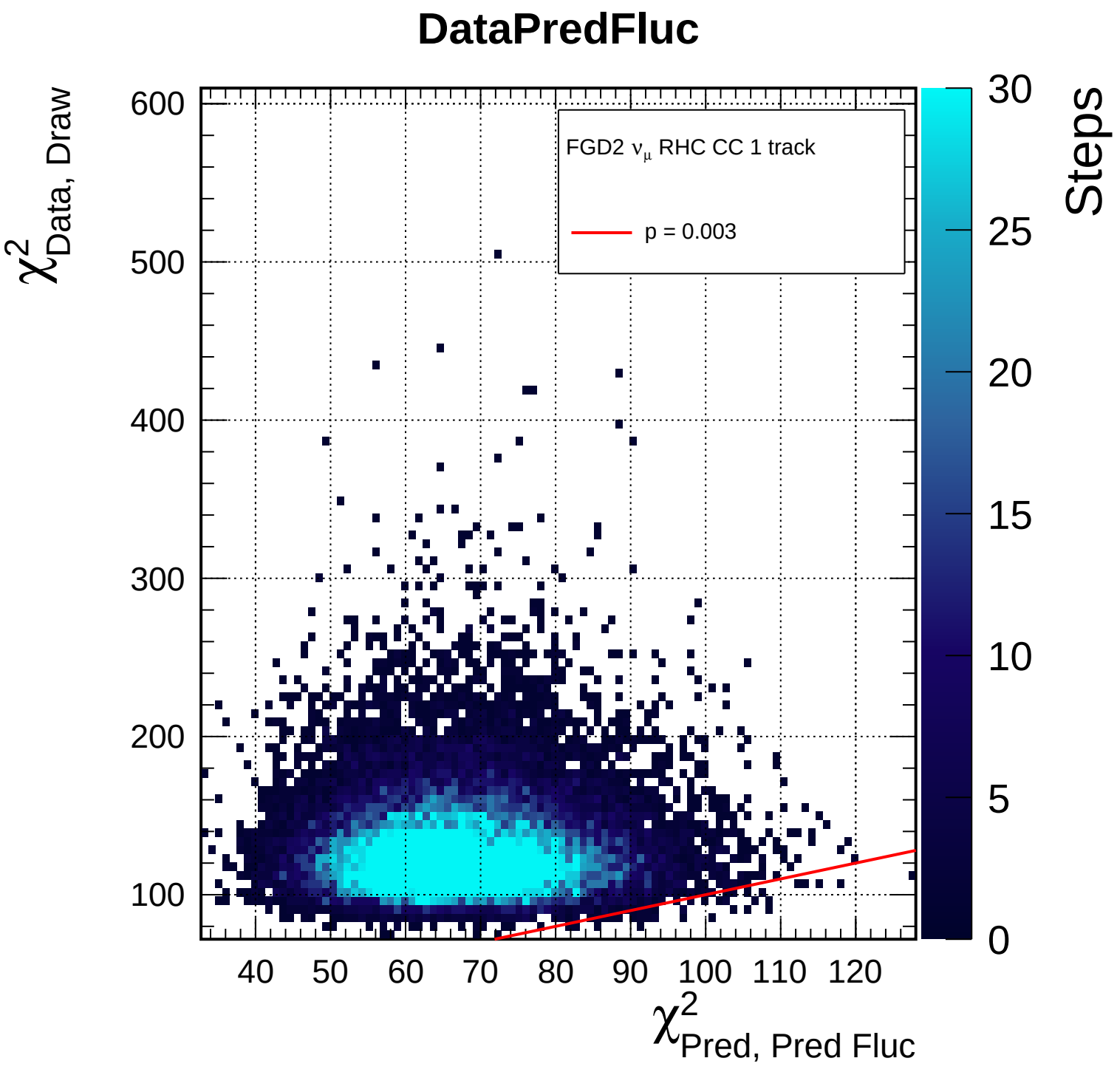

FGD1_NuMuBkg_CCnQE_in_AntiNu_Mode_ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.5
1
1.5
2
2.5
3
×10³
pμ (MeV)
Q² = 0.10 GeV
Q² = 0.25 GeV
Q² = 0.50 GeV
χ²Sample
6
5
4
3
2
1
0

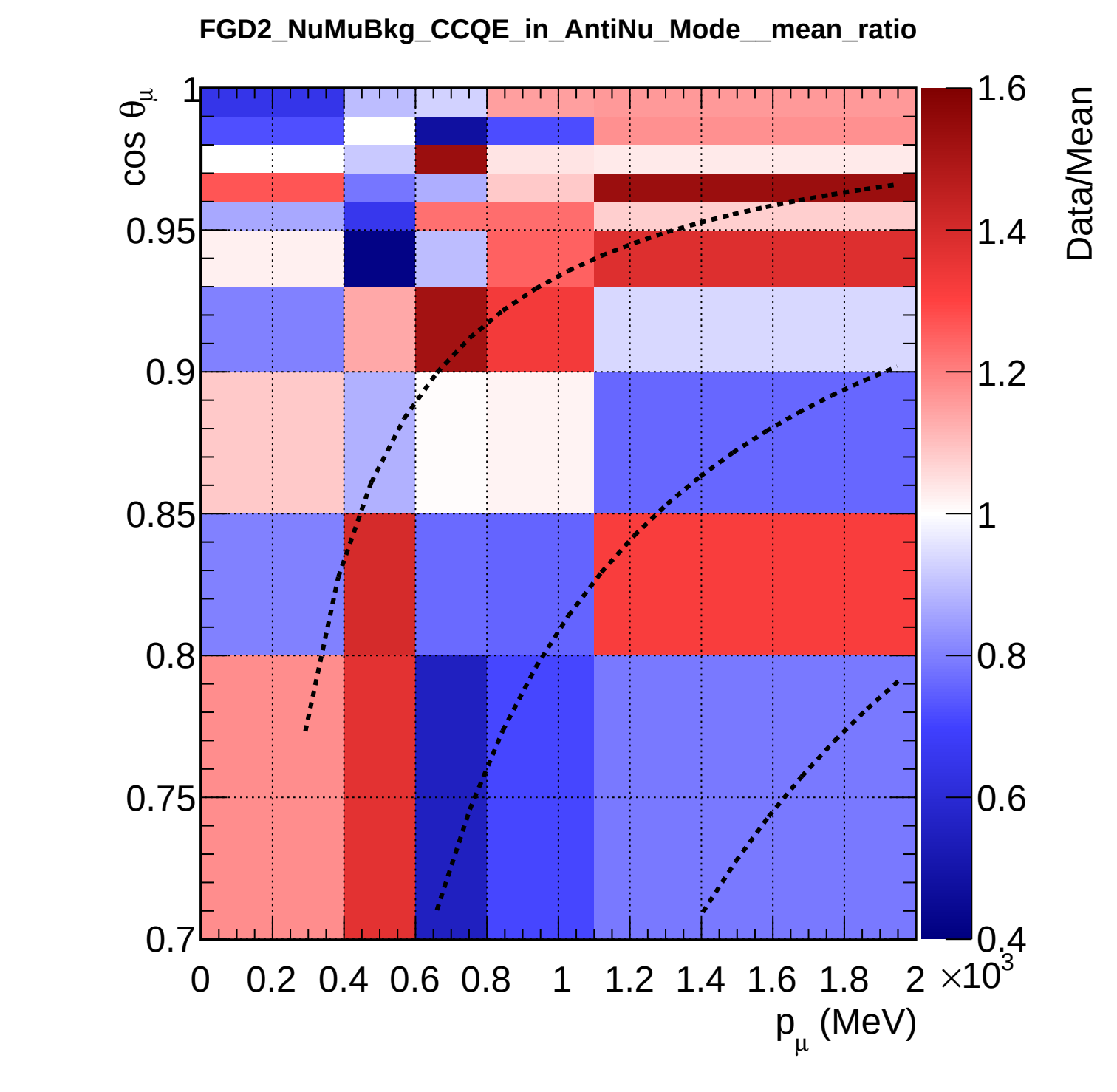

FGD1_NuMuBkg_CCnQE_in_AntiNu_Mode_sum_1370
Counts
Data, 1370, p-value=0.50
MC, μ=1376.8±153.9
Gauss, μ=1377.1±151.2
0
100
200
300
400
500
600
700
800
800
1000
1200
1400
1600
1800
N events

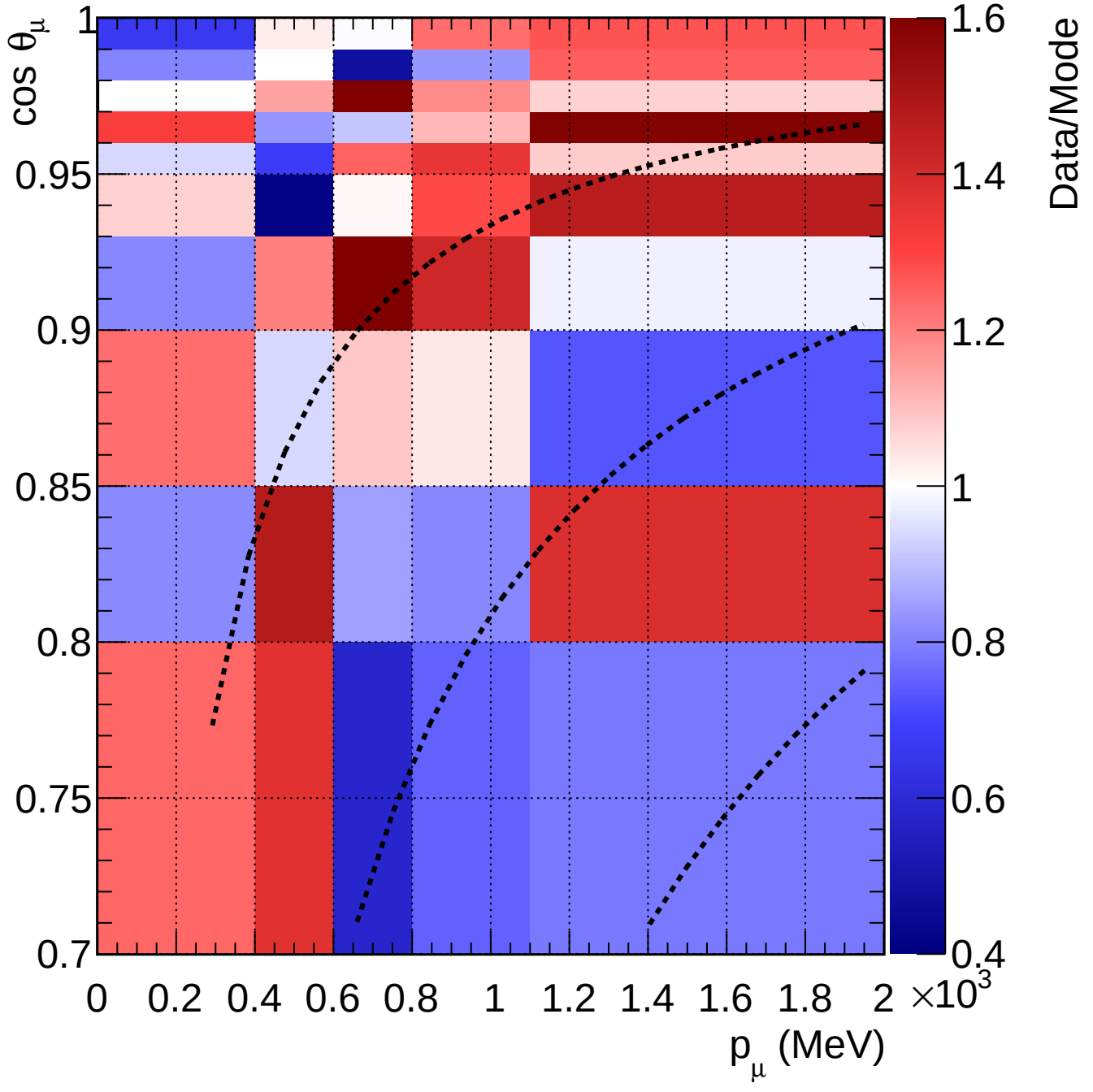

FGD1_NuMuBkg_CCnQE_in_AntiNu_Mode_data
N_events/MeV
0
0.1
0.2
0.3
0.4
0.5
0
500
1000
1500
2000
p_μ (MeV)

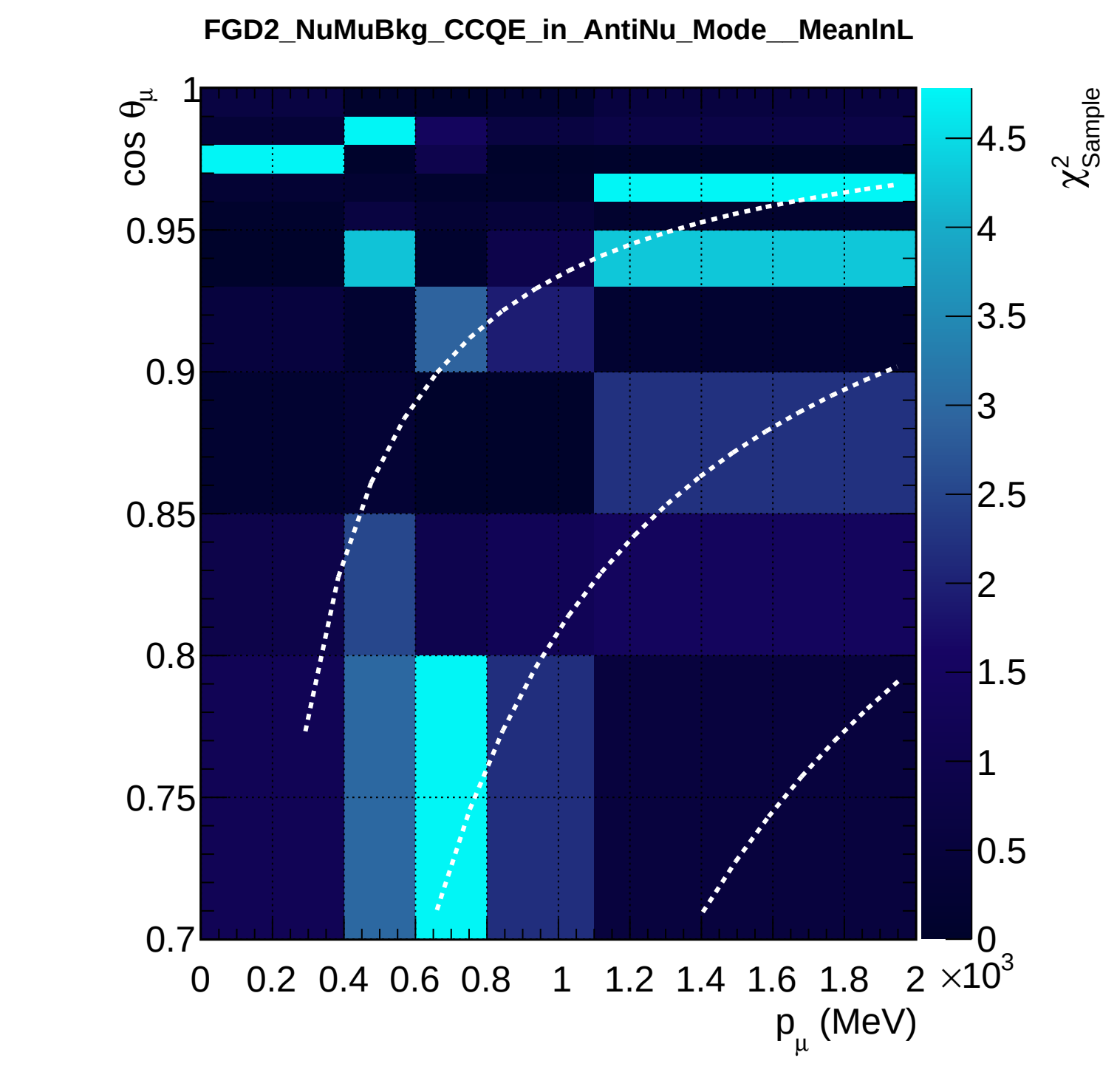

FGD1_NuMuBkg_CCnQE_in_AntiNu_Mode_data
N_events/1
25000
20000
15000
10000
5000
0
0.7
0.75
0.8
0.85
0.9
0.95
1
cos θ_μ

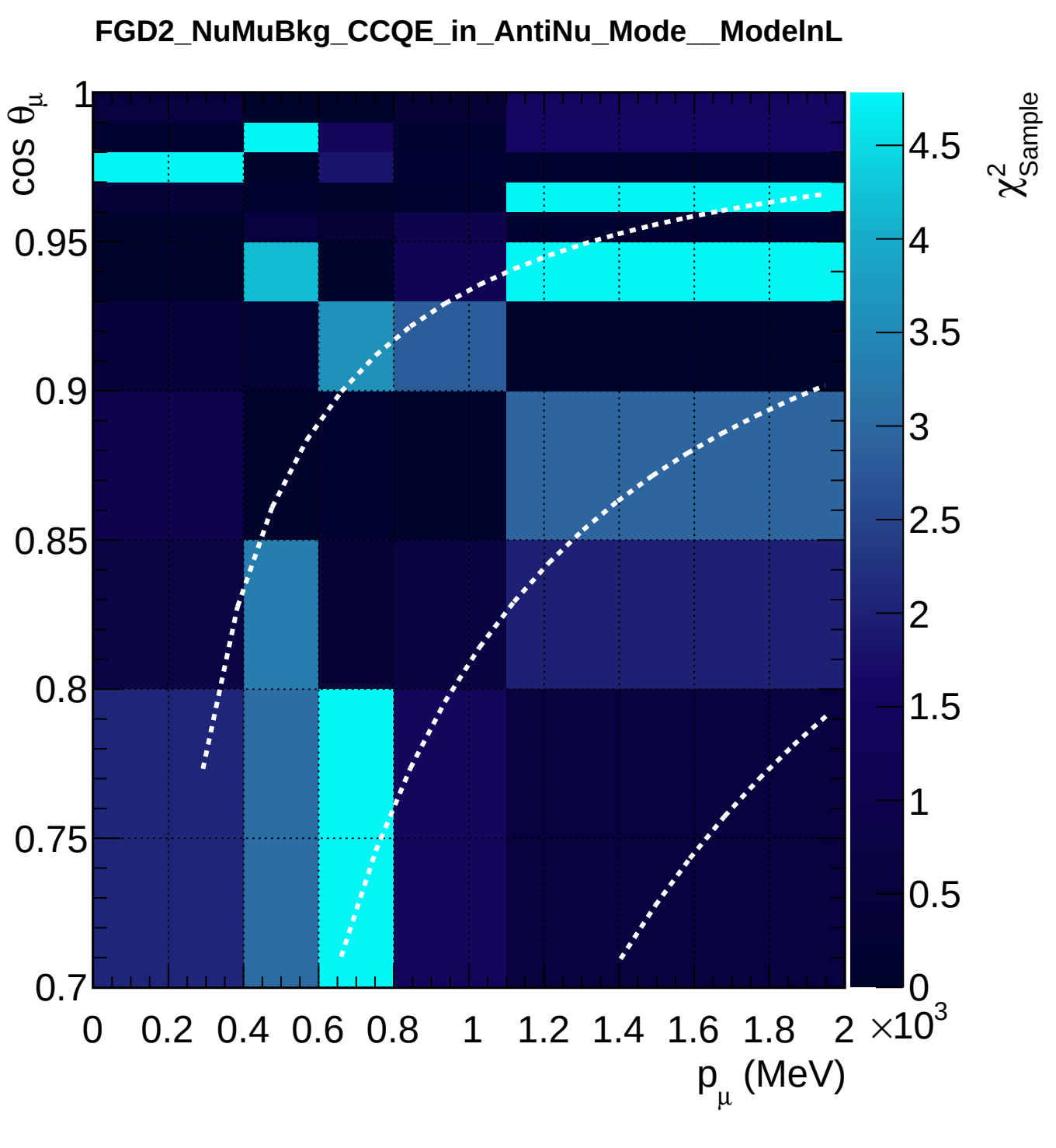

DataDrawFluc
FGD2 ν_μ RHC CC 1 track
p = 0.003
$\chi^2_{Data, Draw}$
$\chi^2_{Draw, Draw Fluc}$
Steps
600
500
400
300
200
100
40
50
60
70
80
90
100
110
120
130
30
25
20
15
10
5
0

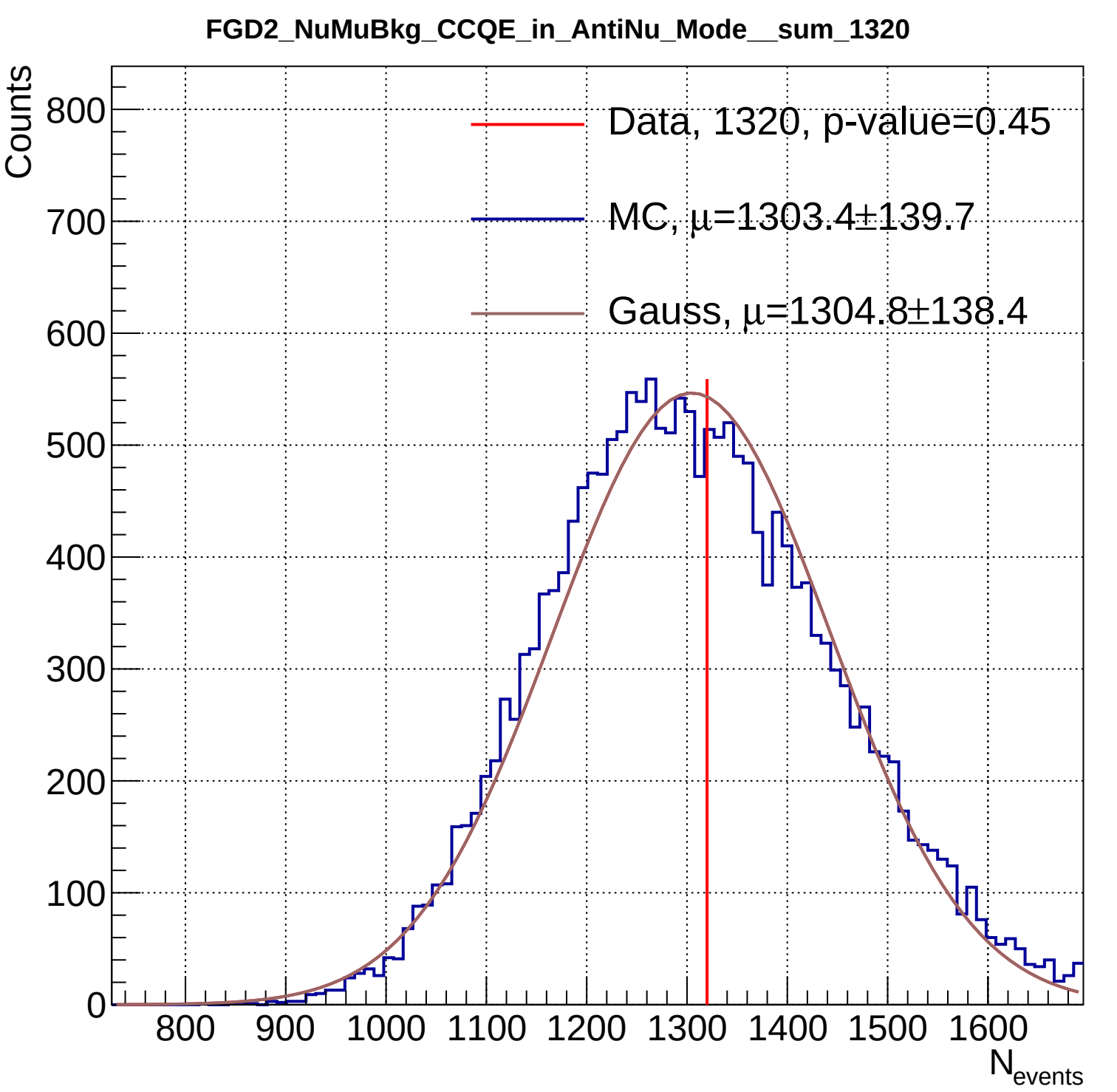

DataPredFluc
FGD2 ν_μ RHC CC 1 track
p = 0.003
$\chi^2_{Data,\ Draw}$
$\chi^2_{Pred,\ Pred\ Fluc}$
Steps
600
500
400
300
200
100
40
50
60
70
80
90
100
110
120
30
25
20
15
10
5
0

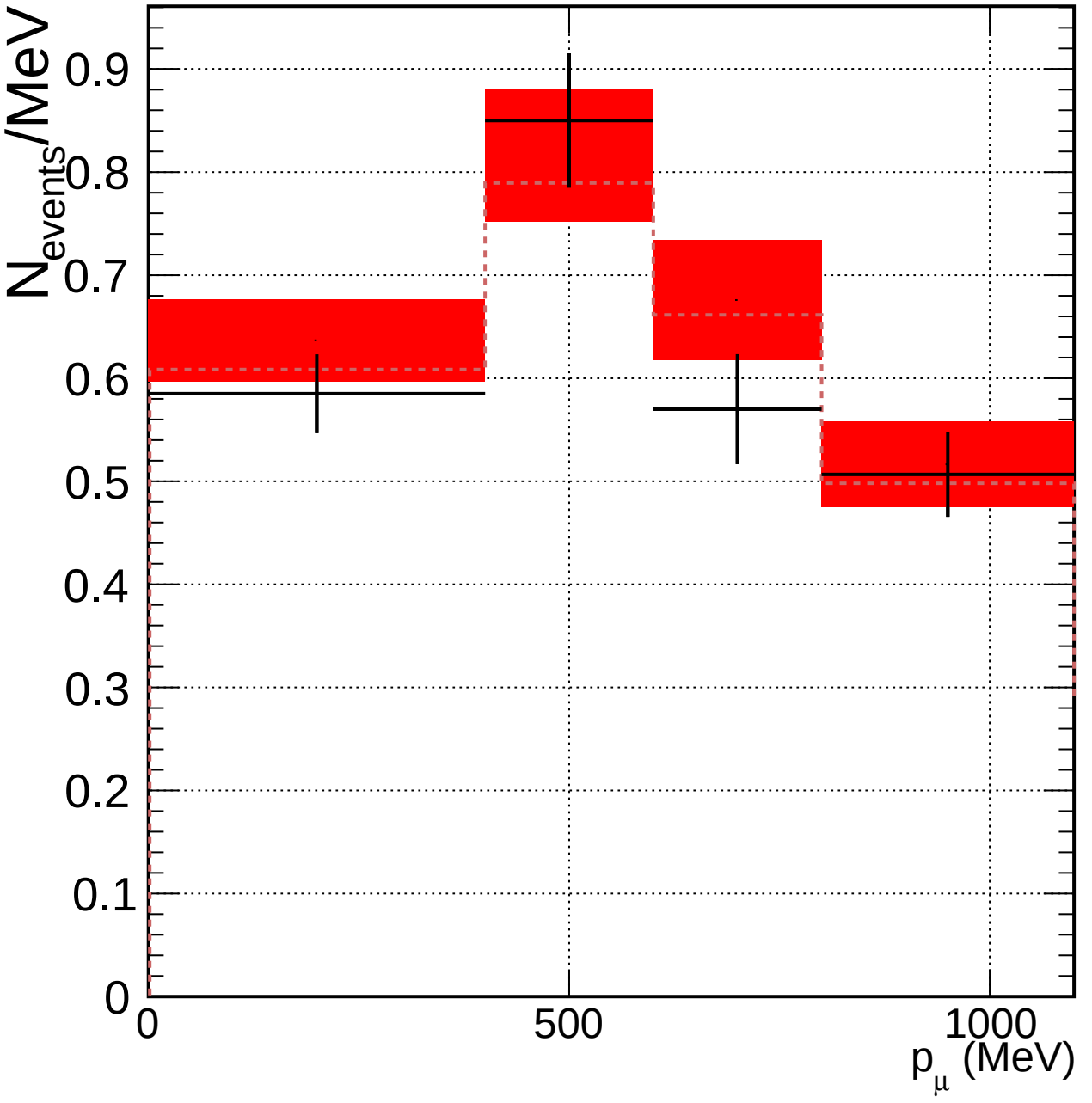

FGD2_NuMuBkg_CCQE_in_AntiNu_Mode__mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

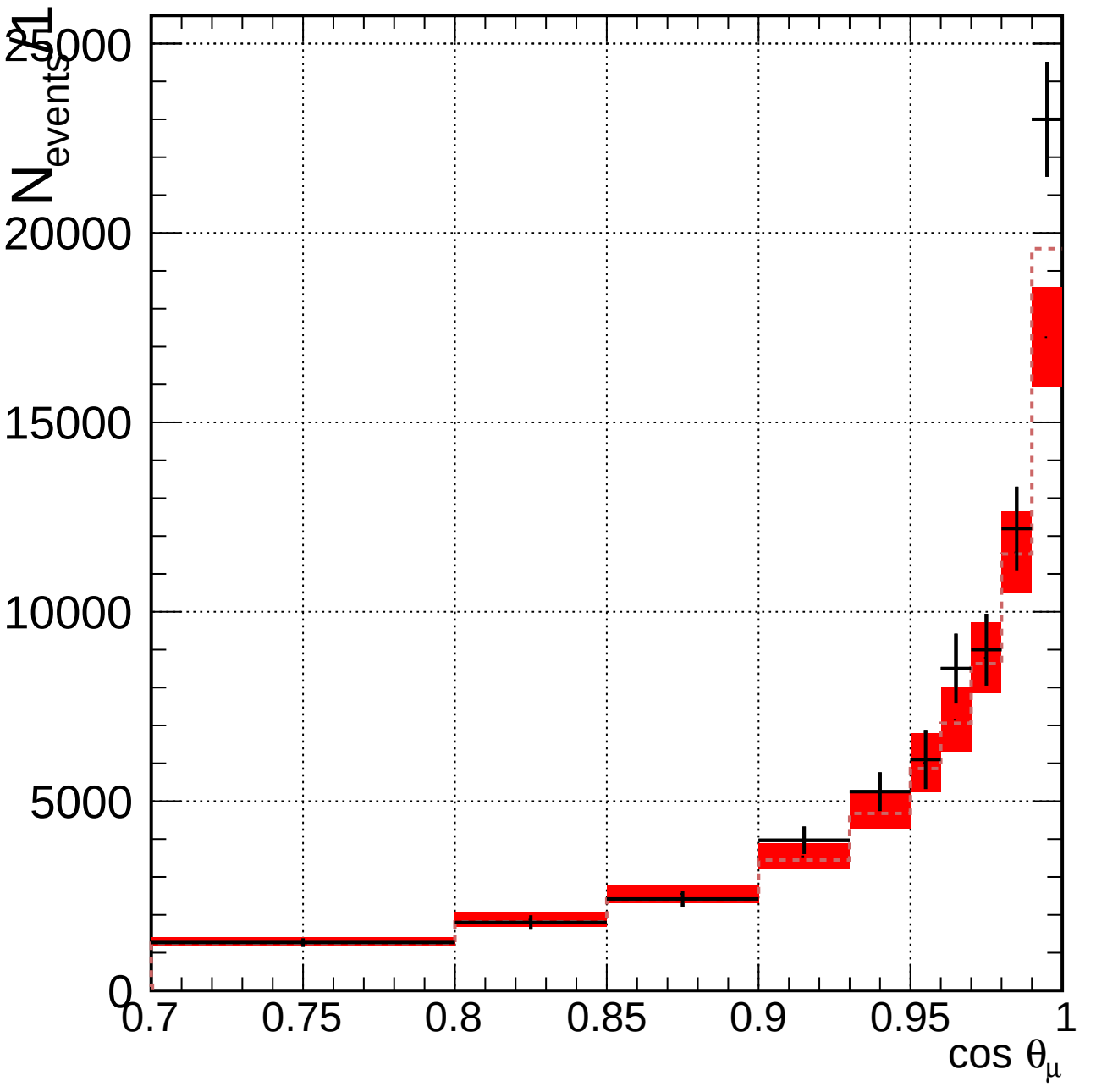

FGD2_NuMuBkg_CCQE_in_AntiNu_Mode__mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4

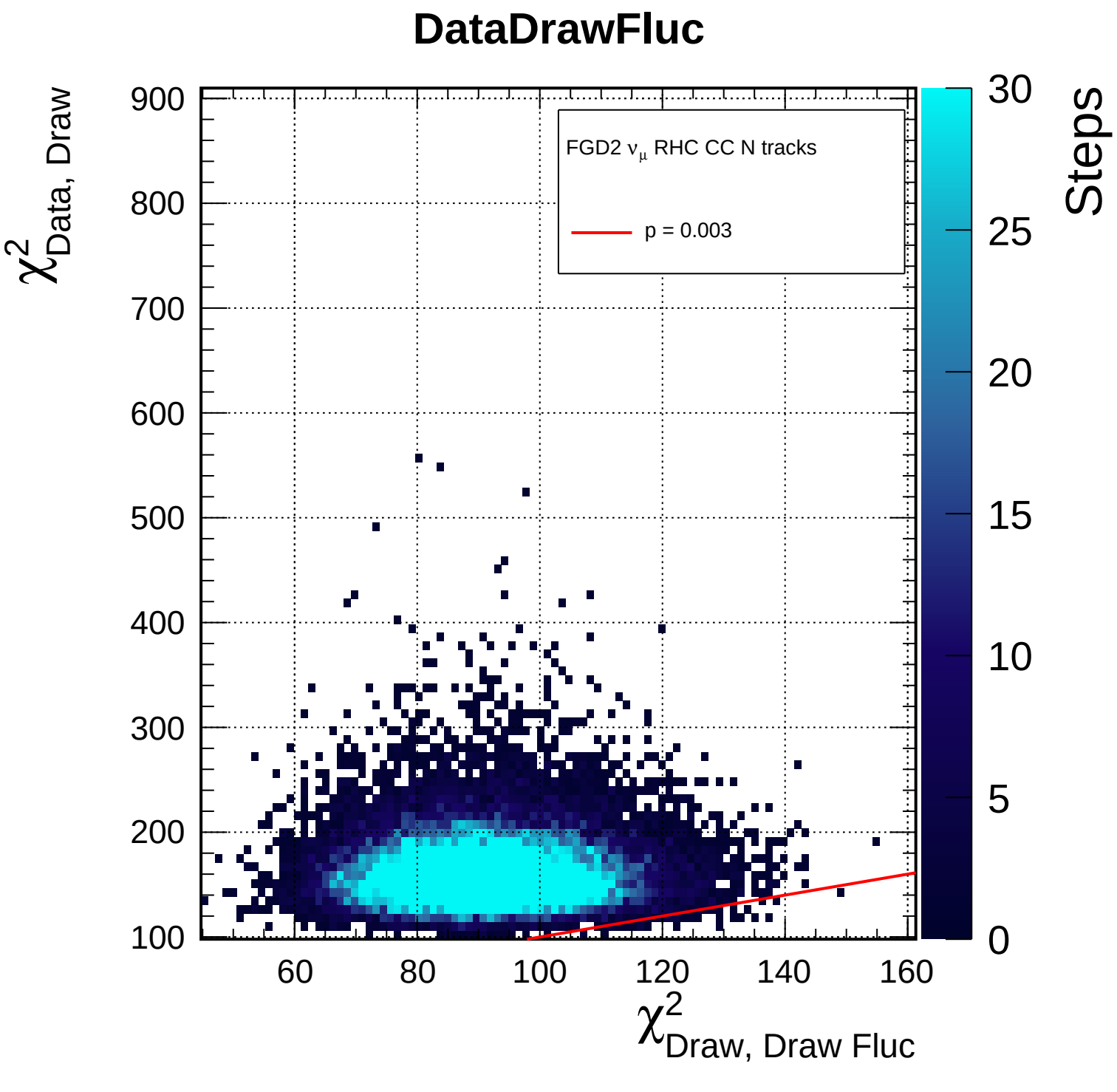

FGD2_NuMuBkg_CCQE_in_AntiNu_Mode__MeanlnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
χ²Sample
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0

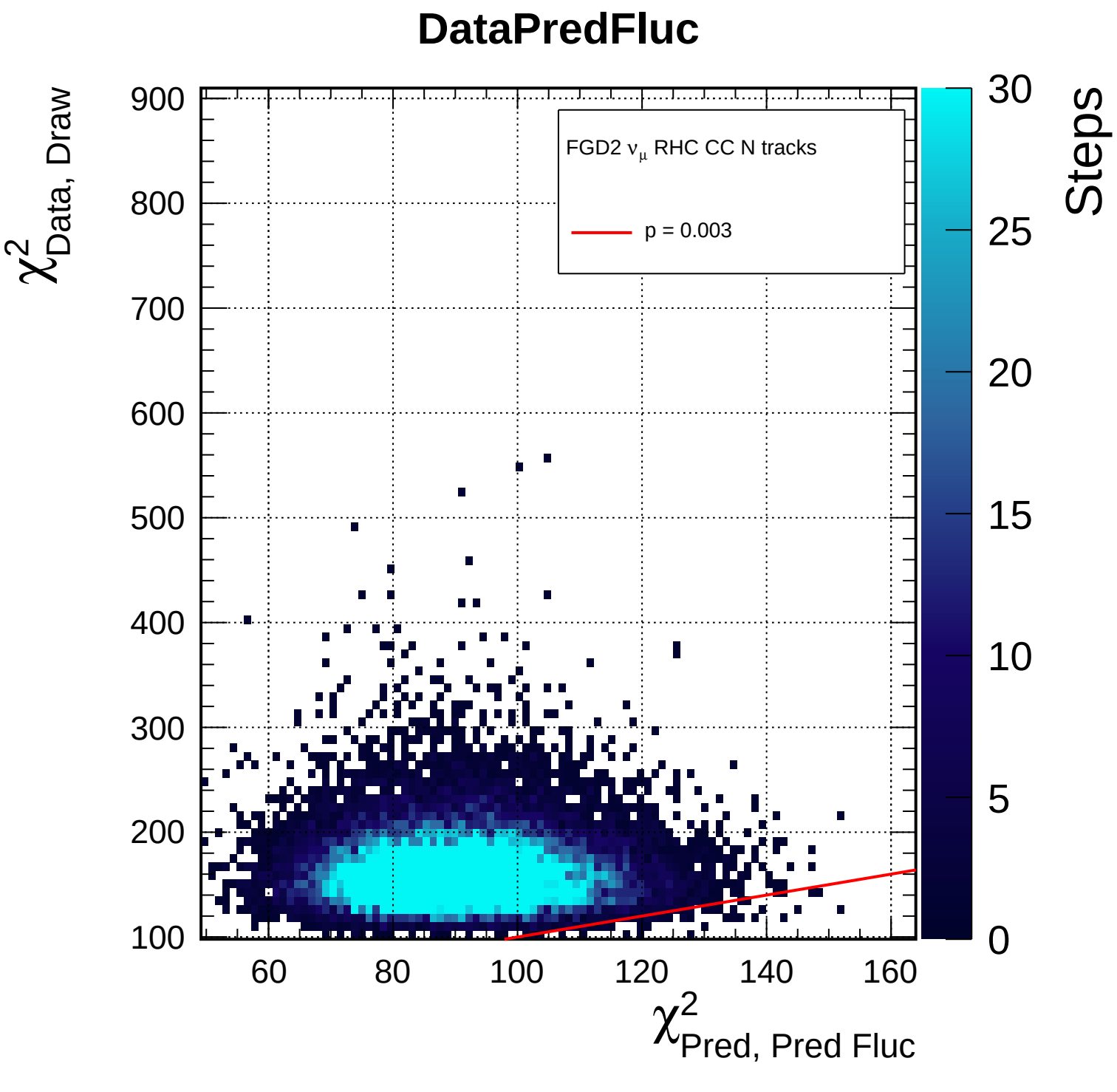

FGD2_NuMuBkg_CCQE_in_AntiNu_Mode__ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
×10^3
pμ (MeV)
χ²Sample
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0

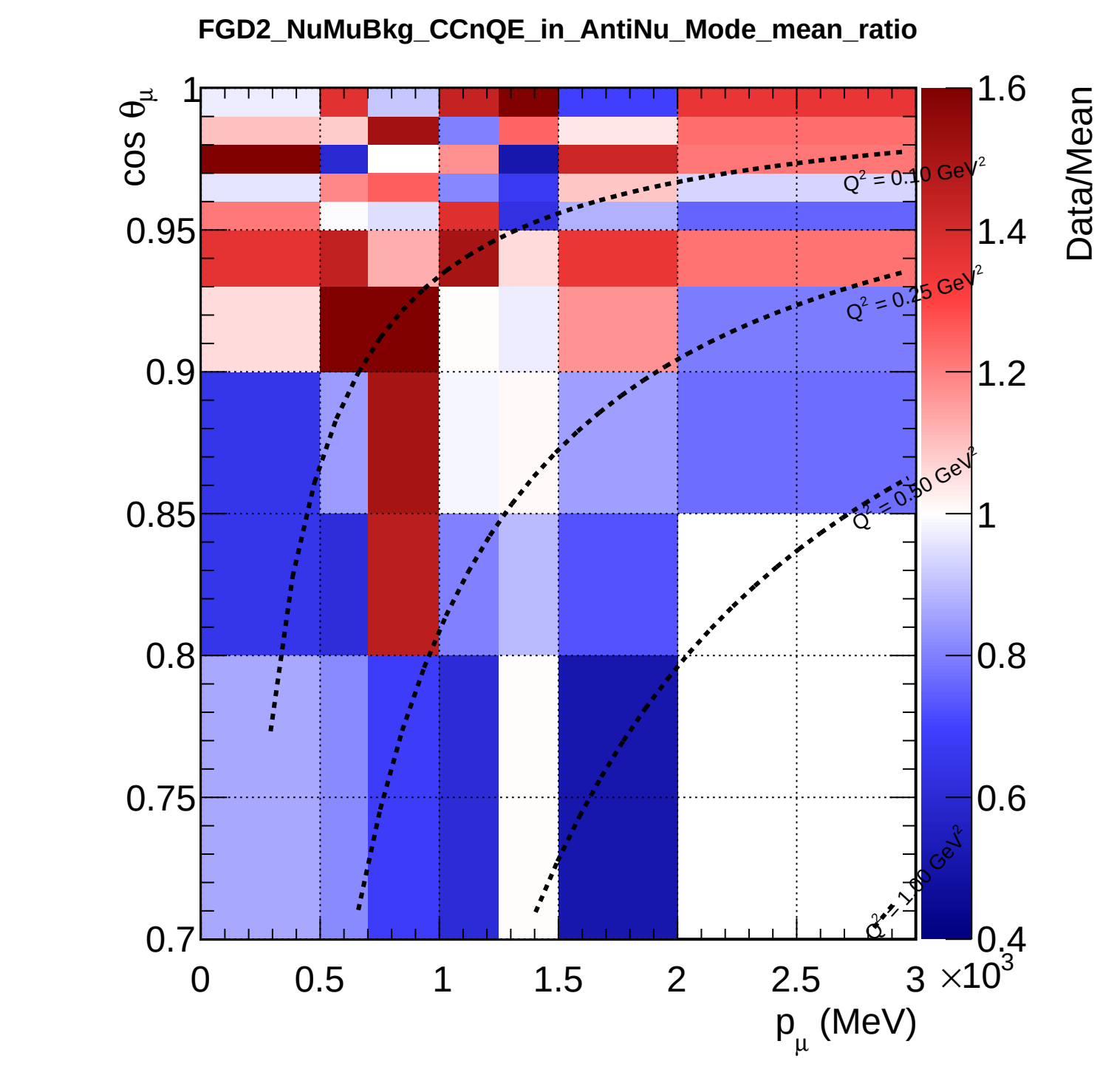

FGD2_NuMuBkg_CCQE_in_AntiNu_Mode__sum_1320
Counts
Data, 1320, p-value=0.45
MC, μ=1303.4±139.7
Gauss, μ=1304.8±138.4
0
100
200
300
400
500
600
700
800
800
900
1000
1100
1200
1300
1400
1500
1600
N events

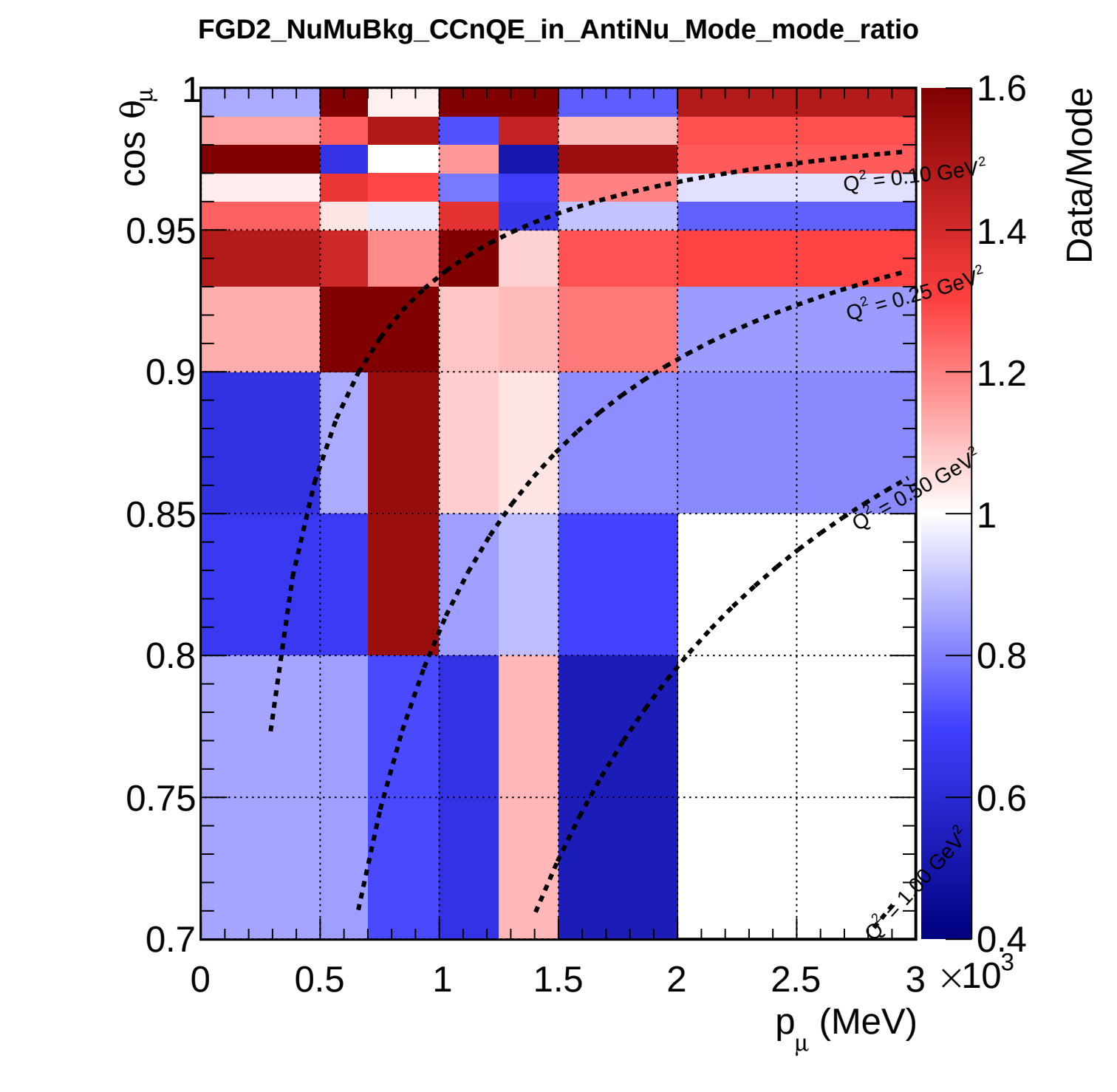

FGD2_NuMuBkg_CCQE_in_AntiNu_Mode__data
N_events/MeV
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
500
1000
p_μ (MeV)

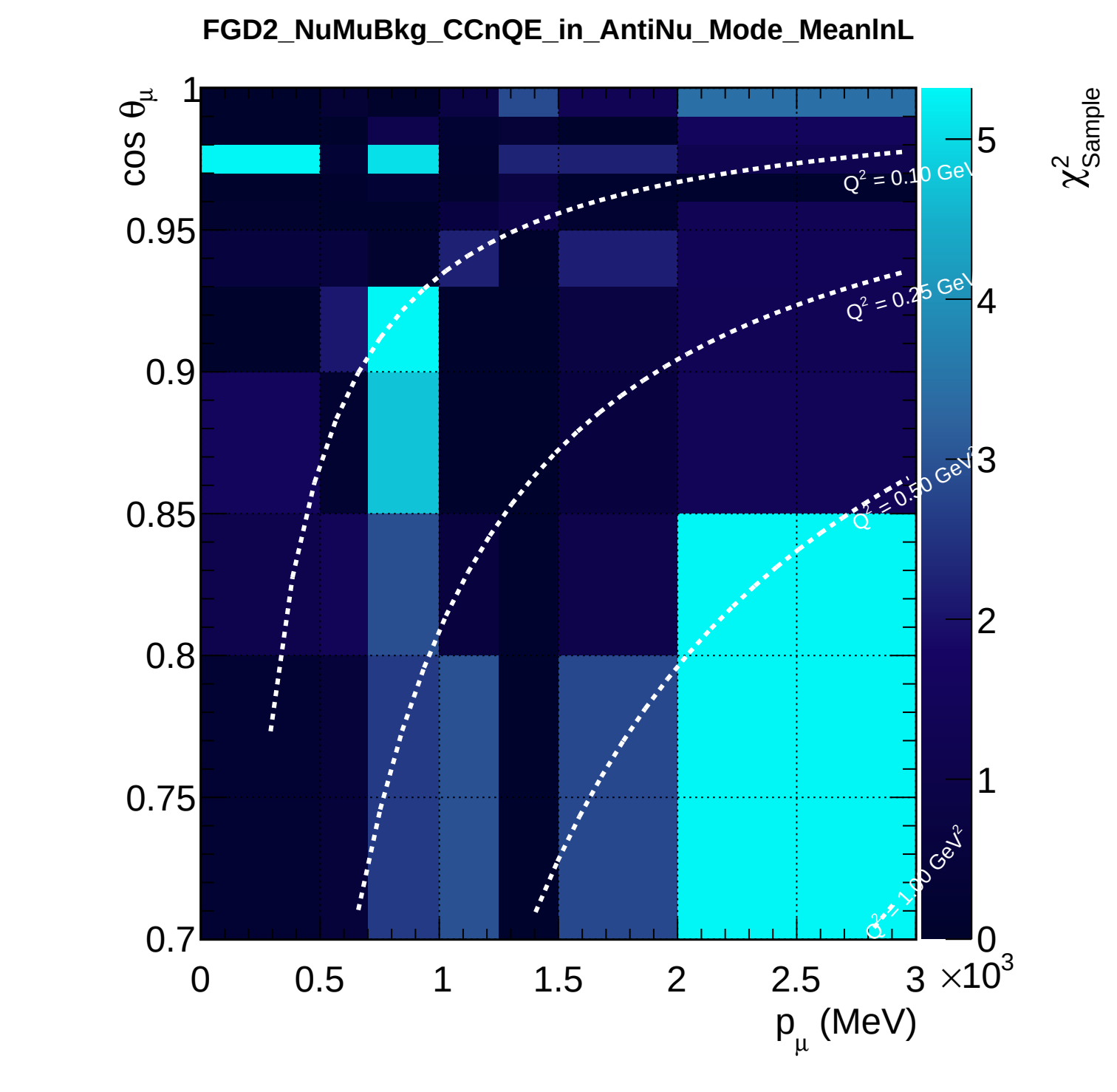

FGD2_NuMuBkg_CCQE_in_AntiNu_Mode__data
N_events
25000
20000
15000
10000
5000
0
0.7
0.75
0.8
0.85
0.9
0.95
1
cos θ_μ

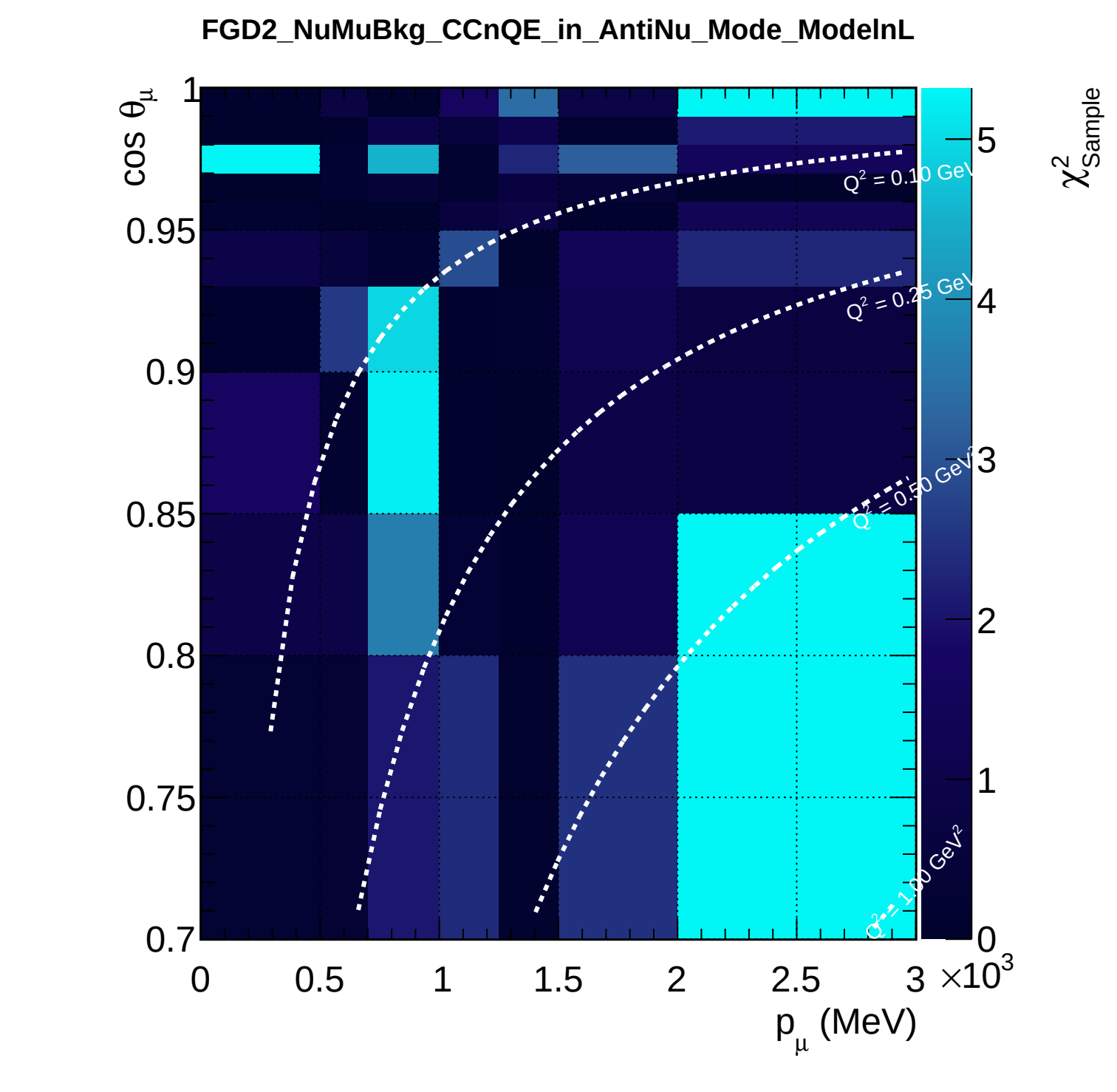

DataDrawFluc
FGD2 ν_μ RHC CC N tracks
p = 0.003
χ²Data, Draw
χ²Draw, Draw Fluc
Steps
900
800
700
600
500
400
300
200
100
60
80
100
120
140
160
30
25
20
15
10
5
0

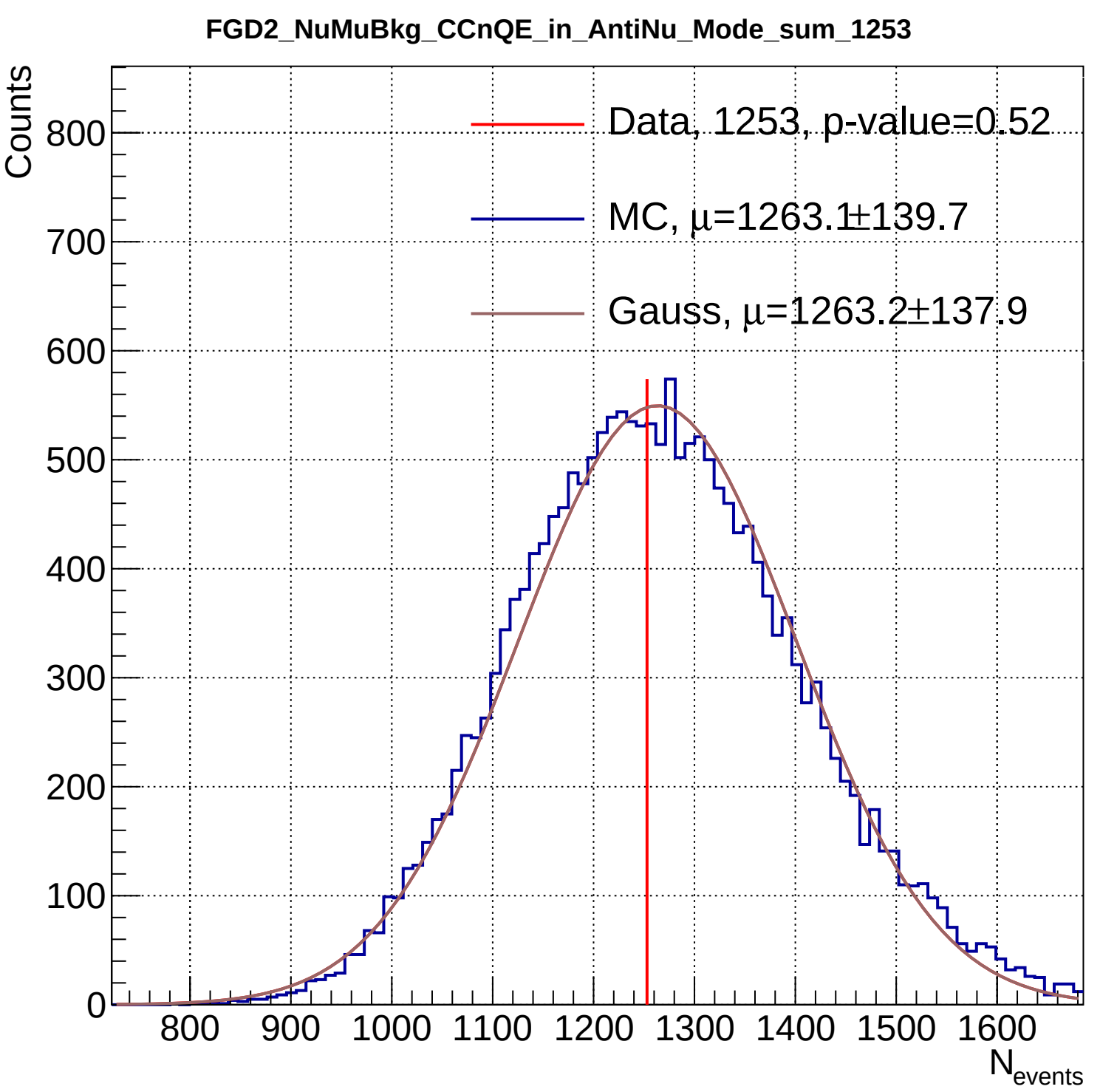

DataPredFluc
FGD2 ν_μ RHC CC N tracks
p = 0.003
$\chi^2_{Data,\ Draw}$
$\chi^2_{Pred,\ Pred\ Fluc}$
Steps
900
800
700
600
500
400
300
200
100
60
80
100
120
140
160
30
25
20
15
10
5
0

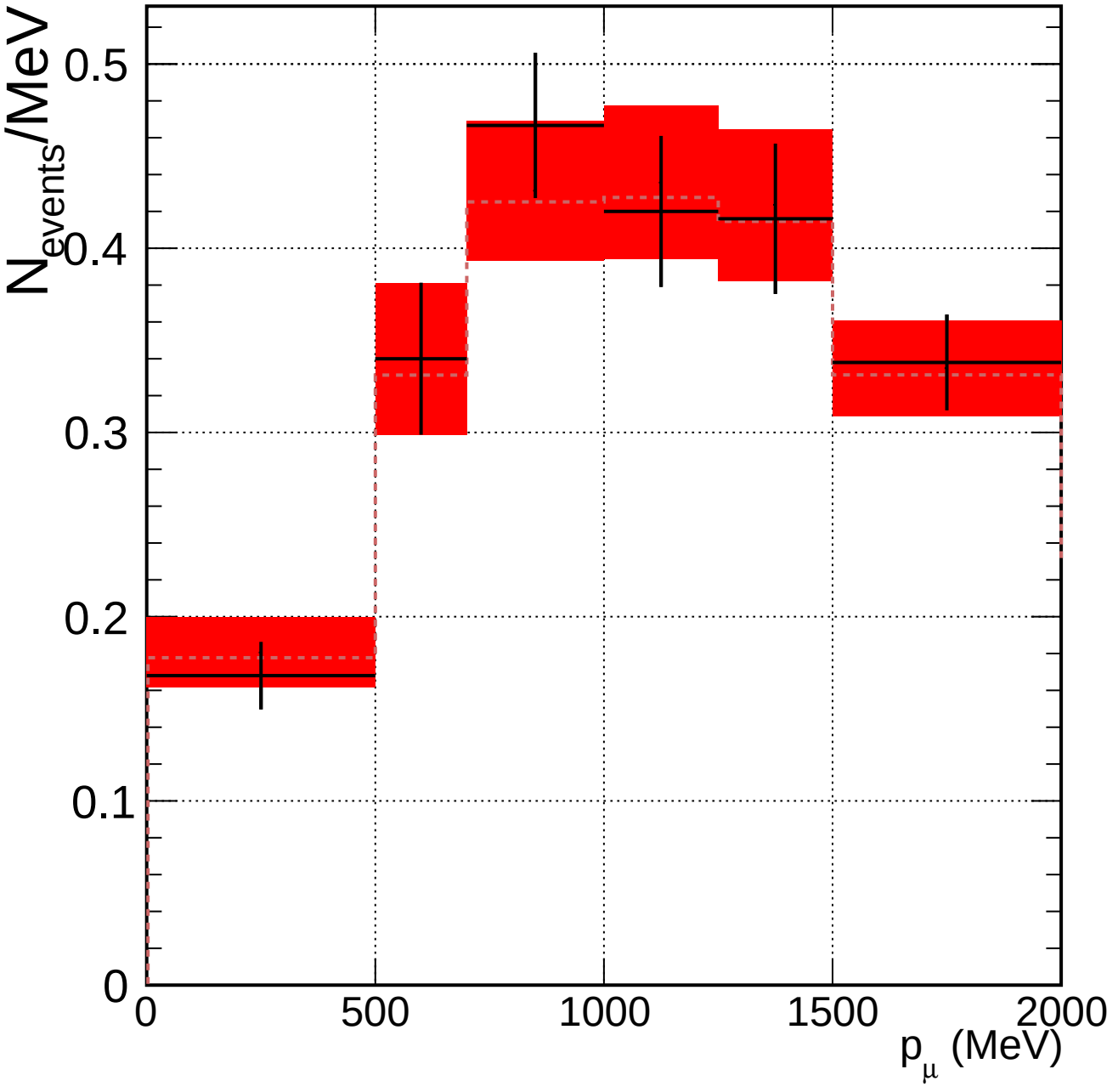

FGD2_NuMuBkg_CCnQE_in_AntiNu_Mode_mean_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.5
1
1.5
2
2.5
3
×10³
pμ (MeV)
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
Data/Mean
1.6
1.4
1.2
1
0.8
0.6
0.4

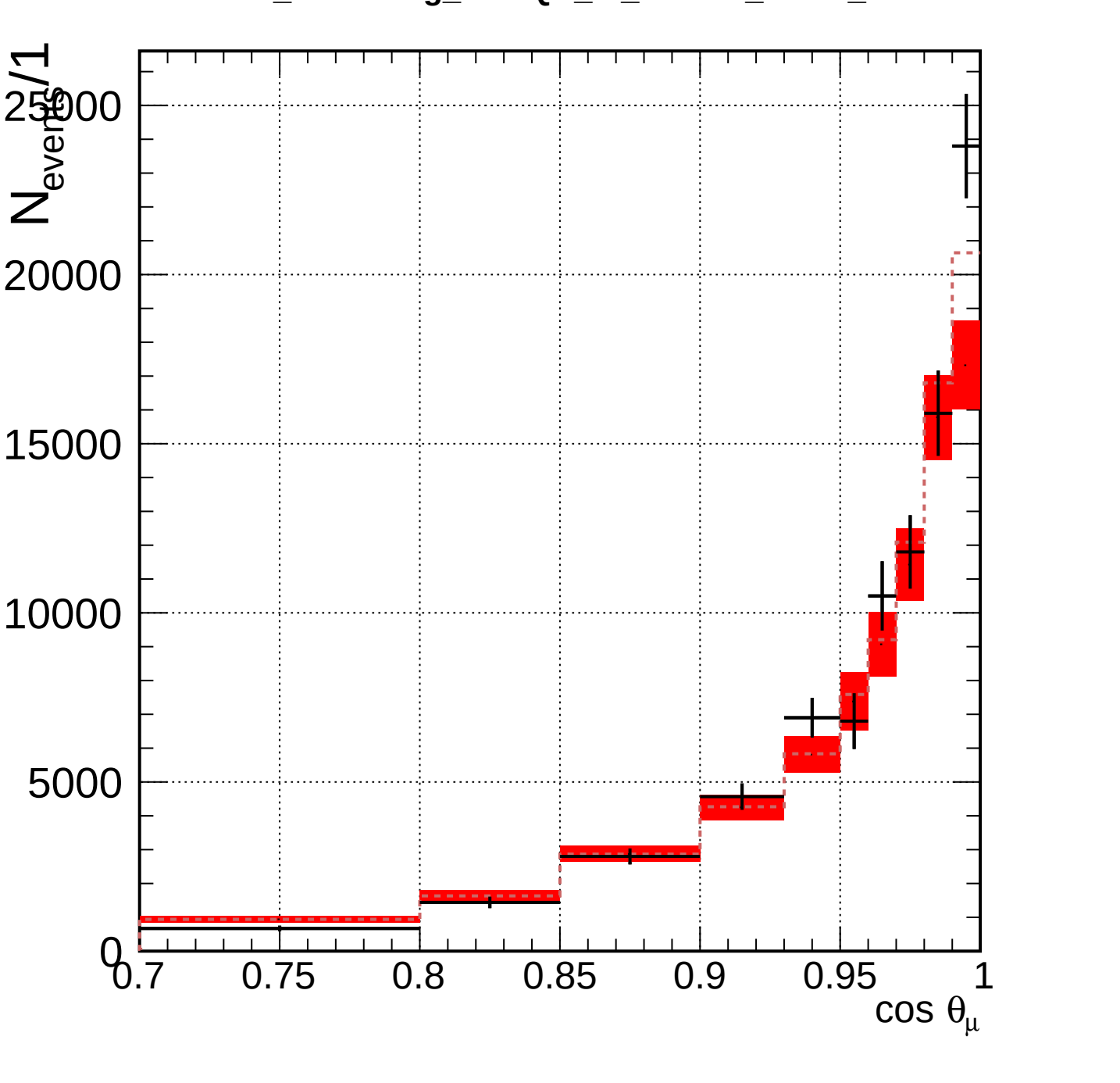

FGD2_NuMuBkg_CCnQE_in_AntiNu_Mode_mode_ratio
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.5
1
1.5
2
2.5
3
×10^3
pμ (MeV)
Q² = 0.10 GeV²
Q² = 0.25 GeV²
Q² = 0.50 GeV²
Q² = 1.00 GeV²
Data/Mode
1.6
1.4
1.2
1
0.8
0.6
0.4


FGD2_NuMuBkg_CCnQE_in_AntiNu_Mode_MeanlnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.5
1
1.5
2
2.5
3
×10³
pμ (MeV)
Q² = 0.10 GeV
Q² = 0.25 GeV
Q² = 0.50 GeV
Q² = 1.00 GeV²
χ²Sample
5
4
3
2
1
0


FGD2_NuMuBkg_CCnQE_in_AntiNu_Mode_ModelnL
cos θμ
1
0.95
0.9
0.85
0.8
0.75
0.7
0
0.5
1
1.5
2
2.5
3
×10³
pμ (MeV)
Q² = 0.10 GeV
Q² = 0.25 GeV
Q² = 0.50 GeV²
Q² = 1.00 GeV²
χ²Sample
5
4
3
2
1
0


FGD2_NuMuBkg_CCnQE_in_AntiNu_Mode_sum_1253
Counts
Data, 1253, p-value=0.52
MC, μ=1263.1±139.7
Gauss, μ=1263.2±137.9
0
100
200
300
400
500
600
700
800
800
900
1000
1100
1200
1300
1400
1500
1600
N events


FGD2_NuMuBkg_CCnQE_in_AntiNu_Mode_data
N_events/MeV
0.5
0.4
0.3
0.2
0.1
0
0
500
1000
1500
2000
p_μ (MeV)


FGD2_NuMuBkg_CCnQE_in_AntiNu_Mode_data
N events/1
25000
20000
15000
10000
5000
0
0.7
0.75
0.8
0.85
0.9
0.95
1
cos θμ