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4. y_0 at TOF0 [1D]
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6. y'_0 at TOF0 [1D]
7. (x_0, x'_0) at TOF0 [2D]
8. (x_0, x'_0) at TOF0 with rms-ellipses [2D]
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22. P_{total} at TOF1 [1D]
23. E at TOF1 [1D]
24. Relativistic β at TOF1 [1D]
25. $\chi^2_{xx''}$ at TOF1 [1D]
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42. (y_1, $P_{\frac{1}{2}}$) at TOF1 [2D]
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45. (y_1, δ) at TOF1 [2D]
46. (χ^2_x, χ^2_y) at TOF1 [2D]

Plots from (3, 200)μ^+ Data

The cuts used to make these plots were:

(A) To make sure muons pass within calibrated TOF slabs:

$-500 \leq x_0$, x at TOF0 $\leq$ 500 mm

$-500 \leq y_0$, y at TOF0 $\leq$ 500 mm

$-0.3 \leq x_0'$, x' at TOF0 $\leq$ 0.3 rad

$-0.3 \leq y_0'$, y' at TOF0 $\leq$ 0.3 rad

$-500 \leq x_1$, x at TOF1 $\leq$ 500 mm

$-500 \leq y_1$, y at TOF1 $\leq$ 500 mm

$-0.3 \leq x_1'$, x' at TOF1 $\leq$ 0.3 rad

$-0.3 \leq y_1'$, y' at TOF1 $\leq$ 0.3 rad

(B) To remove low momentum muons and/or select a momentum region:

$180 \leq P_z$ at TOF1 $\leq$ 600 MeV/c

(C) Muons that pass the above cuts are added to a covariance matrix, Σ_1. Muons must then pass a χ^2 cut such that

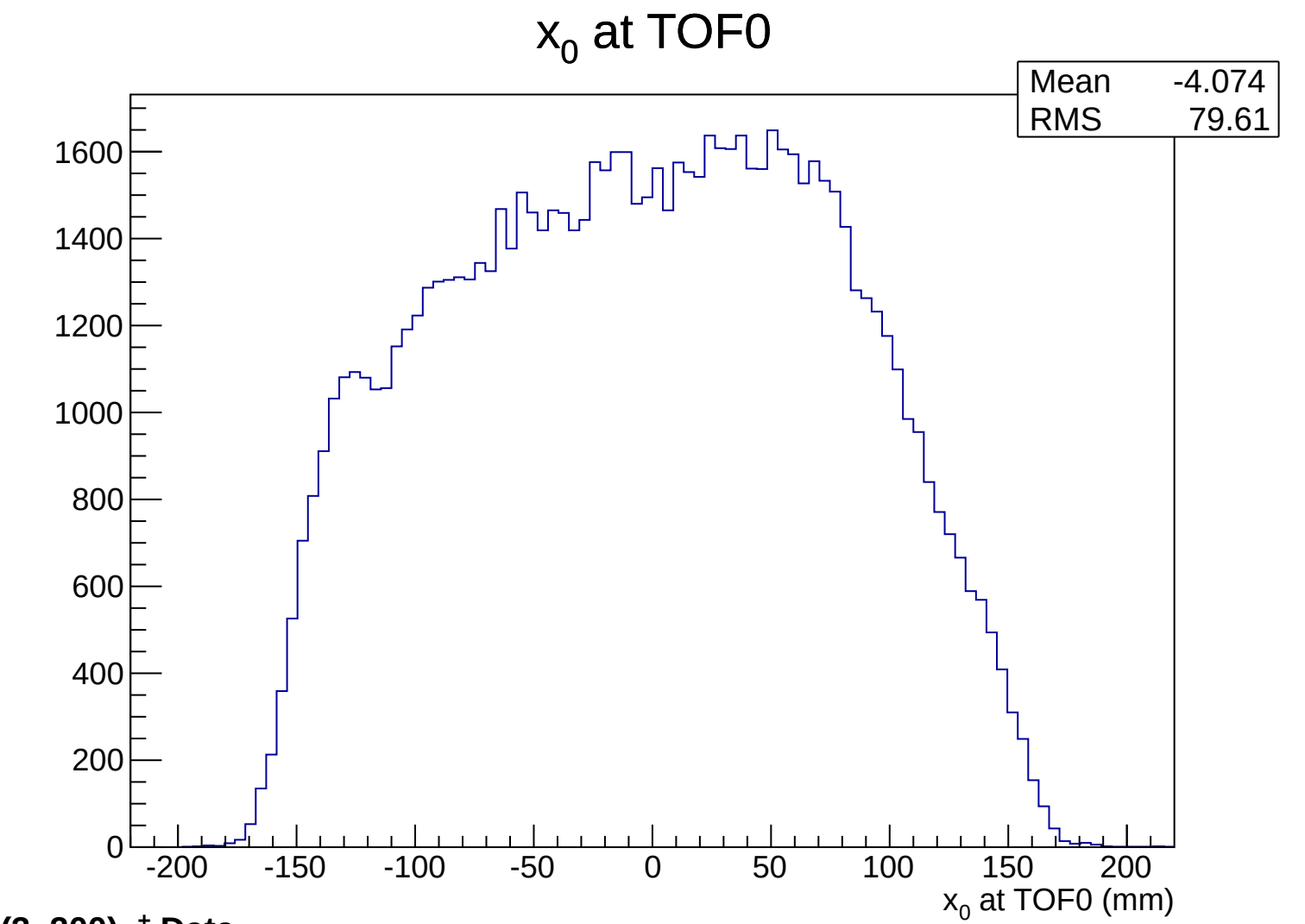
$\chi^2_x \leq 10$

$\chi^2_y \leq 10$

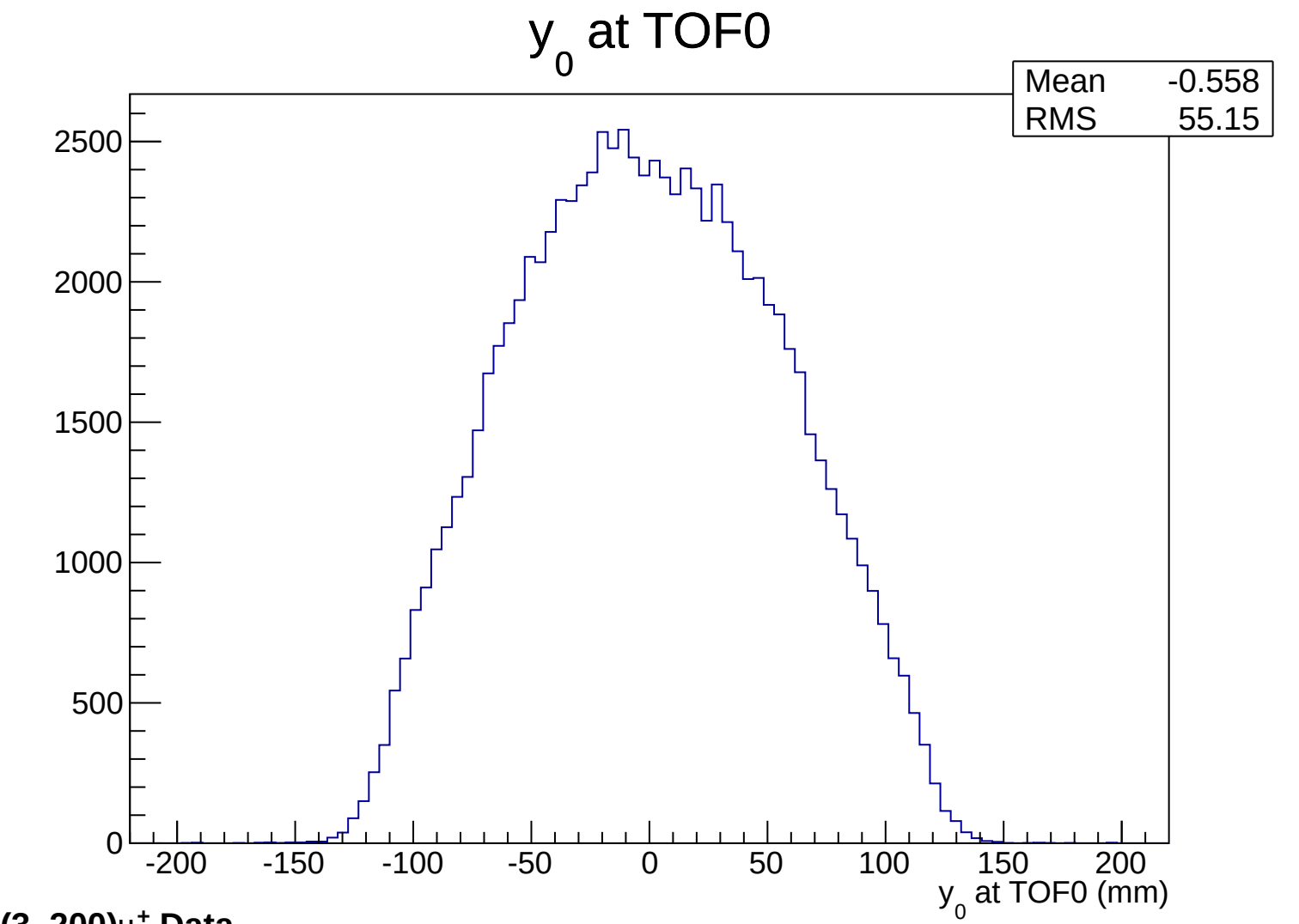
$\chi^2_{Pz} \leq$ None applied.

(D) Muons are now added to a second covariance matrix, Σ_2, and Twiss parameters are calculated.

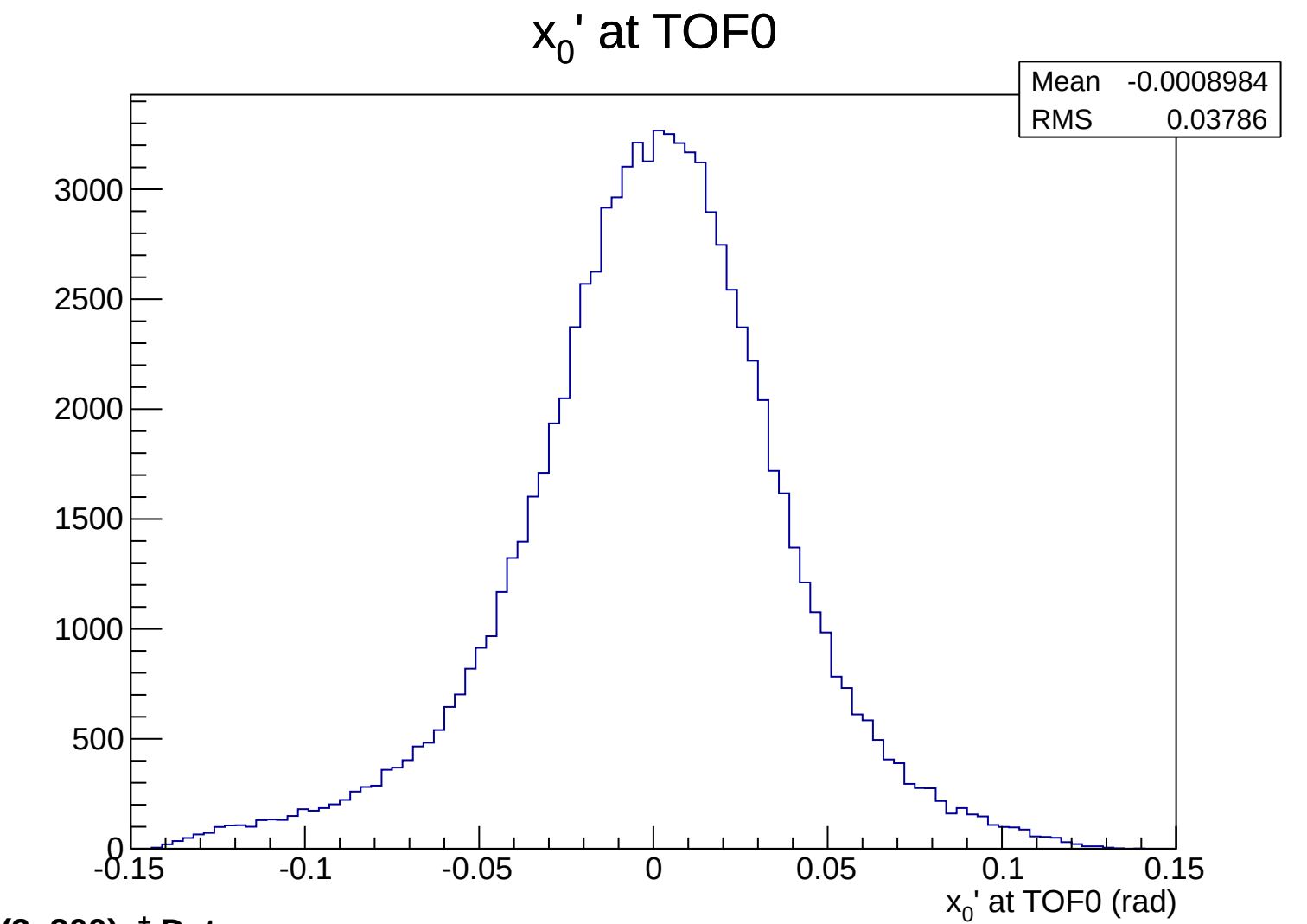
NB: χ^2 is recalculated for all muons in Σ_2 before plotting here.


x_0 at TOF0
Mean -4.074
RMS 79.61
1600
1400
1200
1000
800
600
400
200
0
-200
-150
-100
-50
0
50
100
150
200
x_0 at TOF0 (mm)

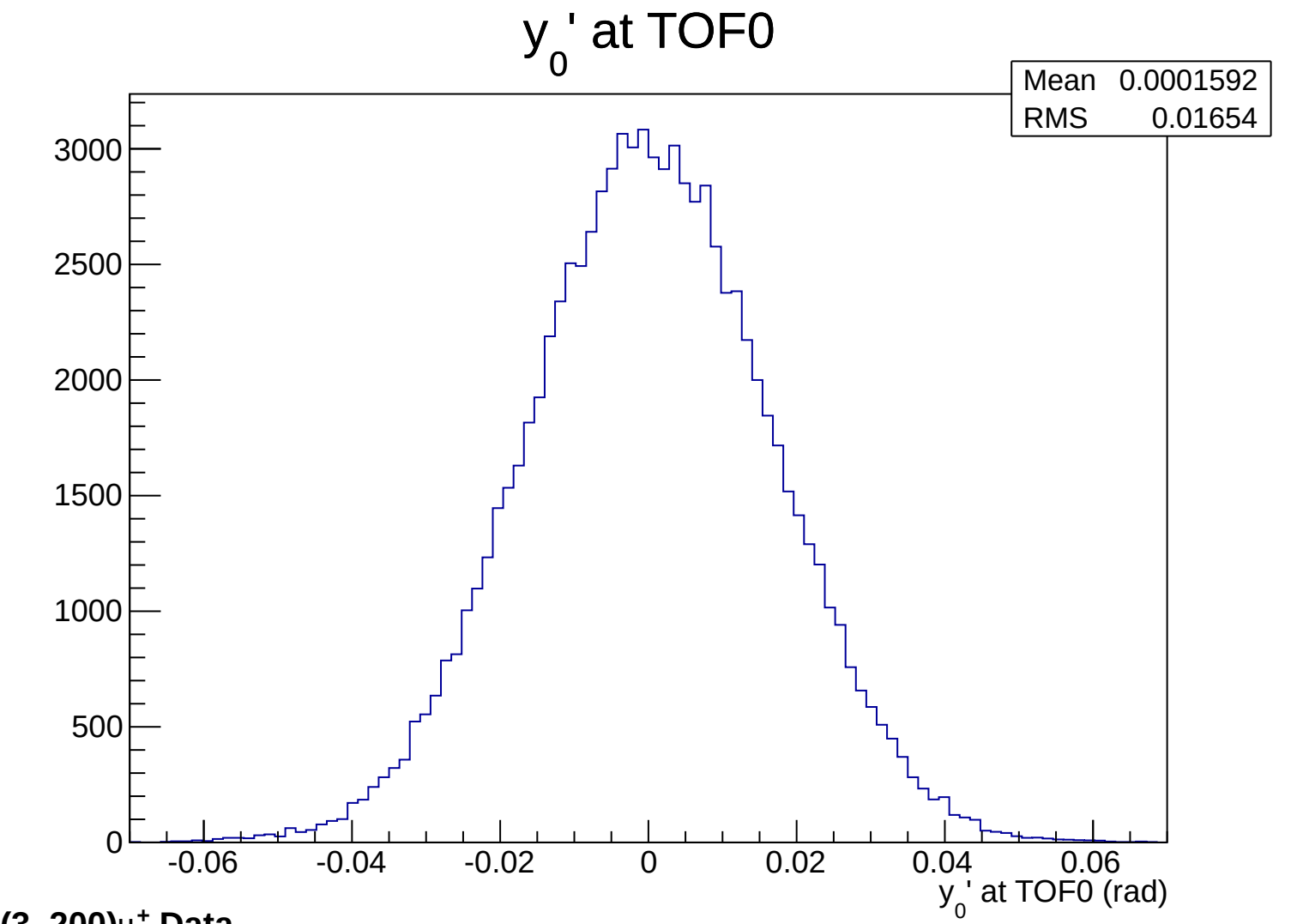
(3, 200)μ^+ Data


y_0 at TOF0
Mean -0.558
RMS 55.15
2500
2000
1500
1000
500
0
-200
-150
-100
-50
0
50
100
150
200
y_0 at TOF0 (mm)

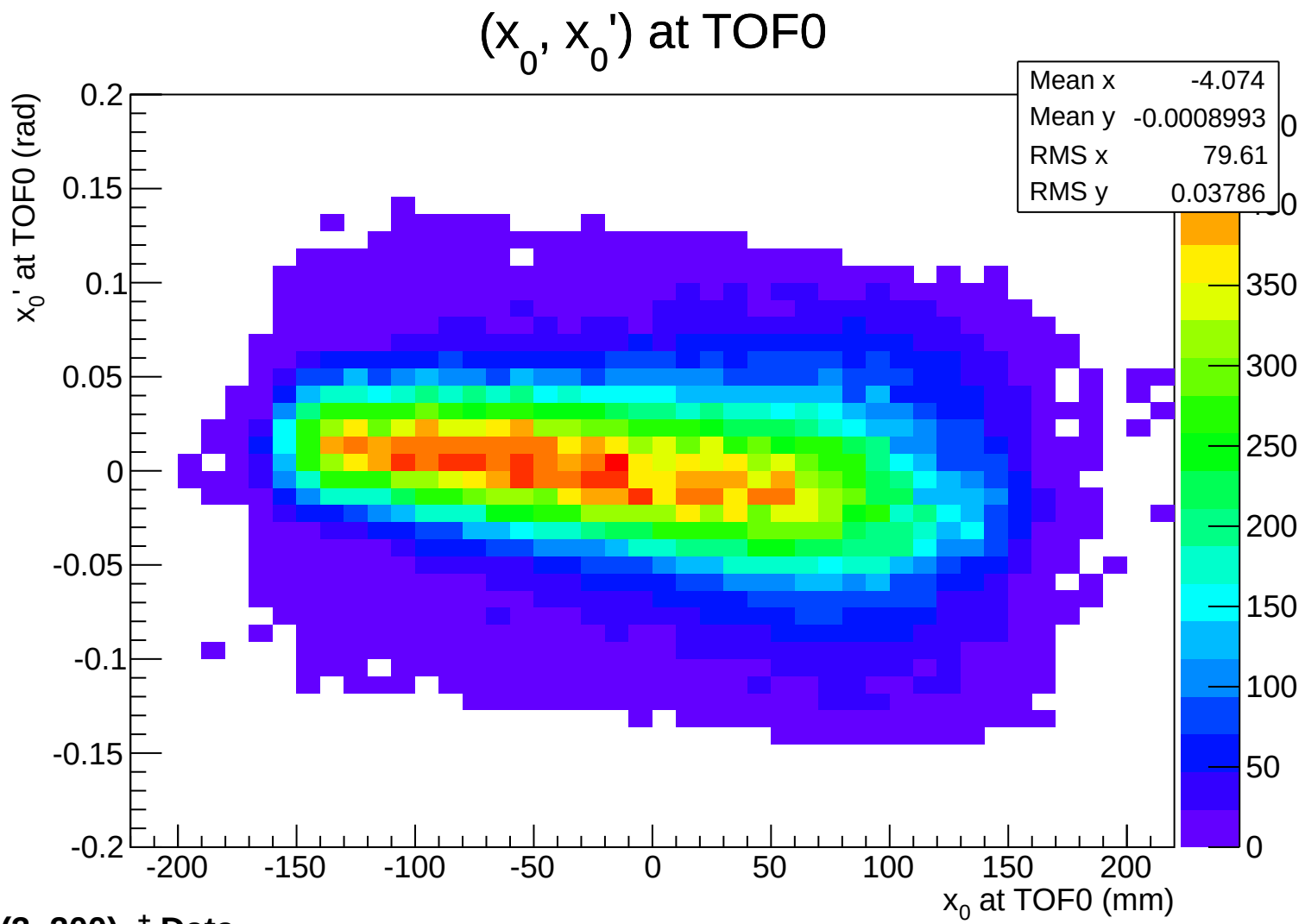
(3, 200)μ^+ Data


x_0' at TOF0
Mean -0.0008984
RMS 0.03786
3000
2500
2000
1500
1000
500
0
-0.15
-0.1
-0.05
0
0.05
0.1
0.15
x_0' at TOF0 (rad)

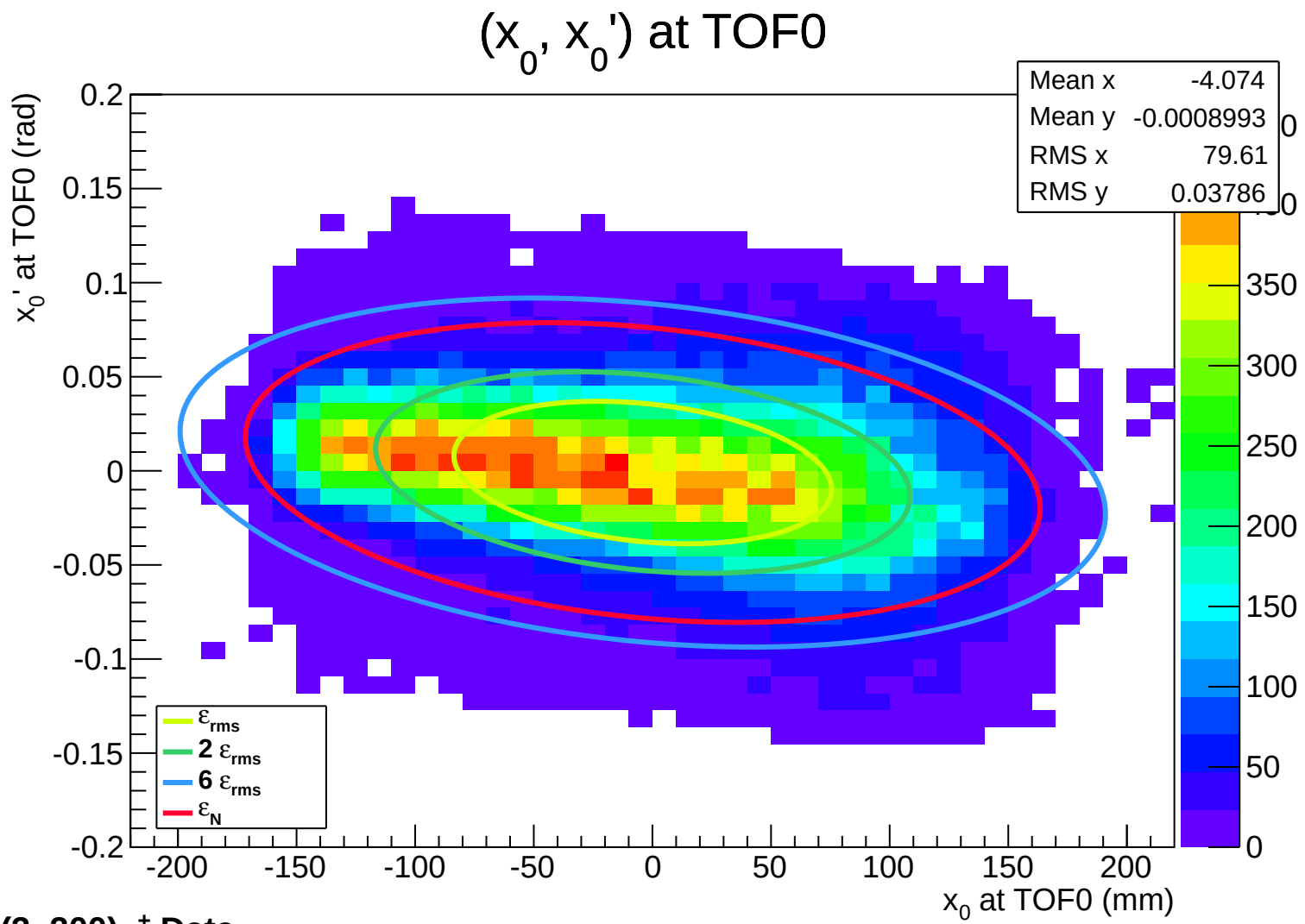
(3, 200)μ^+ Data


y0' at TOF0
Mean 0.0001592
RMS 0.01654
3000
2500
2000
1500
1000
500
0
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
y0' at TOF0 (rad)

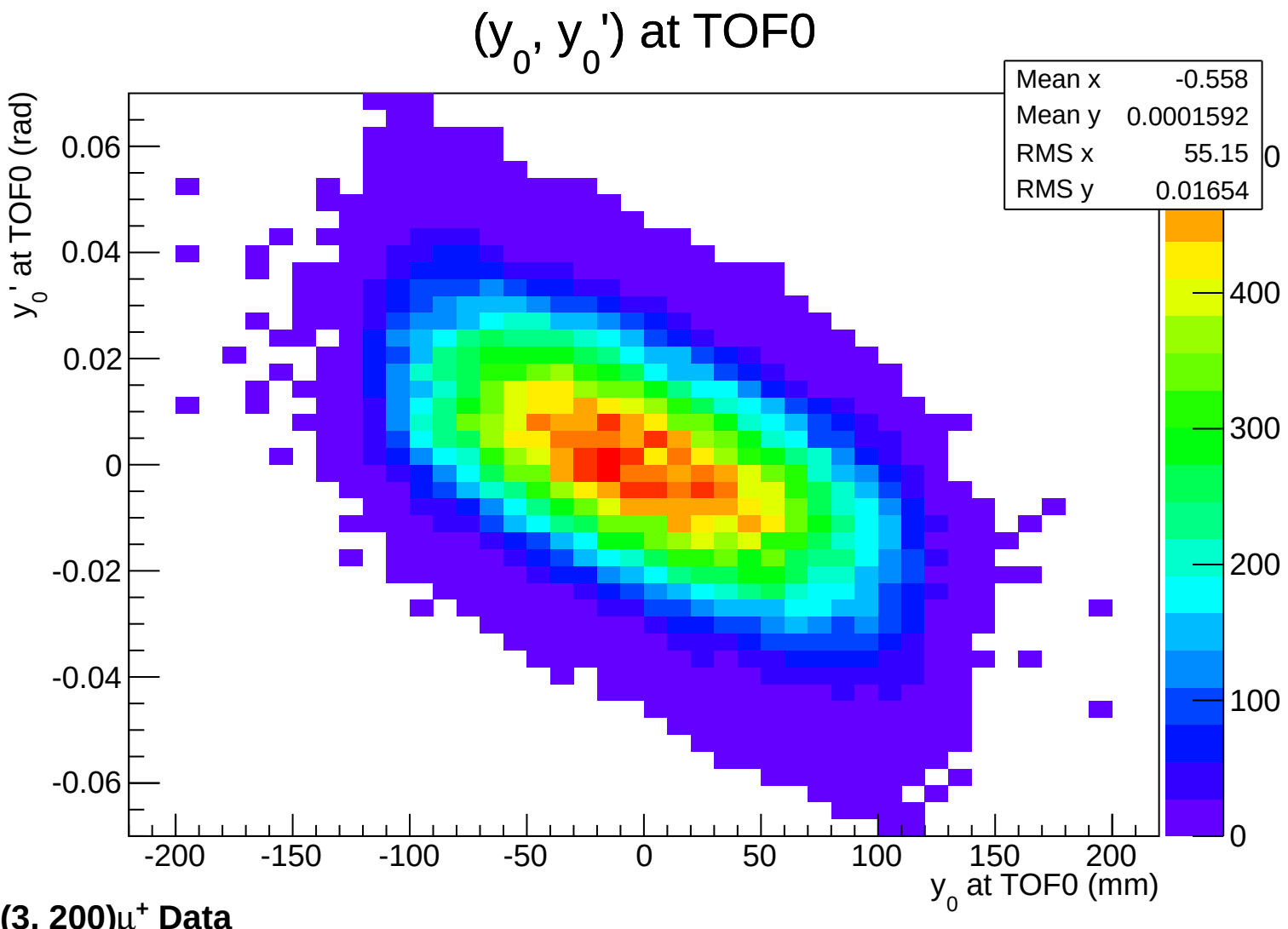
(3, 200)μ^+ Data


(x0, x0') at TOF0
Mean x -4.074
Mean y -0.0008993
RMS x 79.61
RMS y 0.03786
x0' at TOF0 (rad)
x0 at TOF0 (mm)
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-200
-150
-100
-50
0
50
100
150
200
350
300
250
200
150
100
50
0

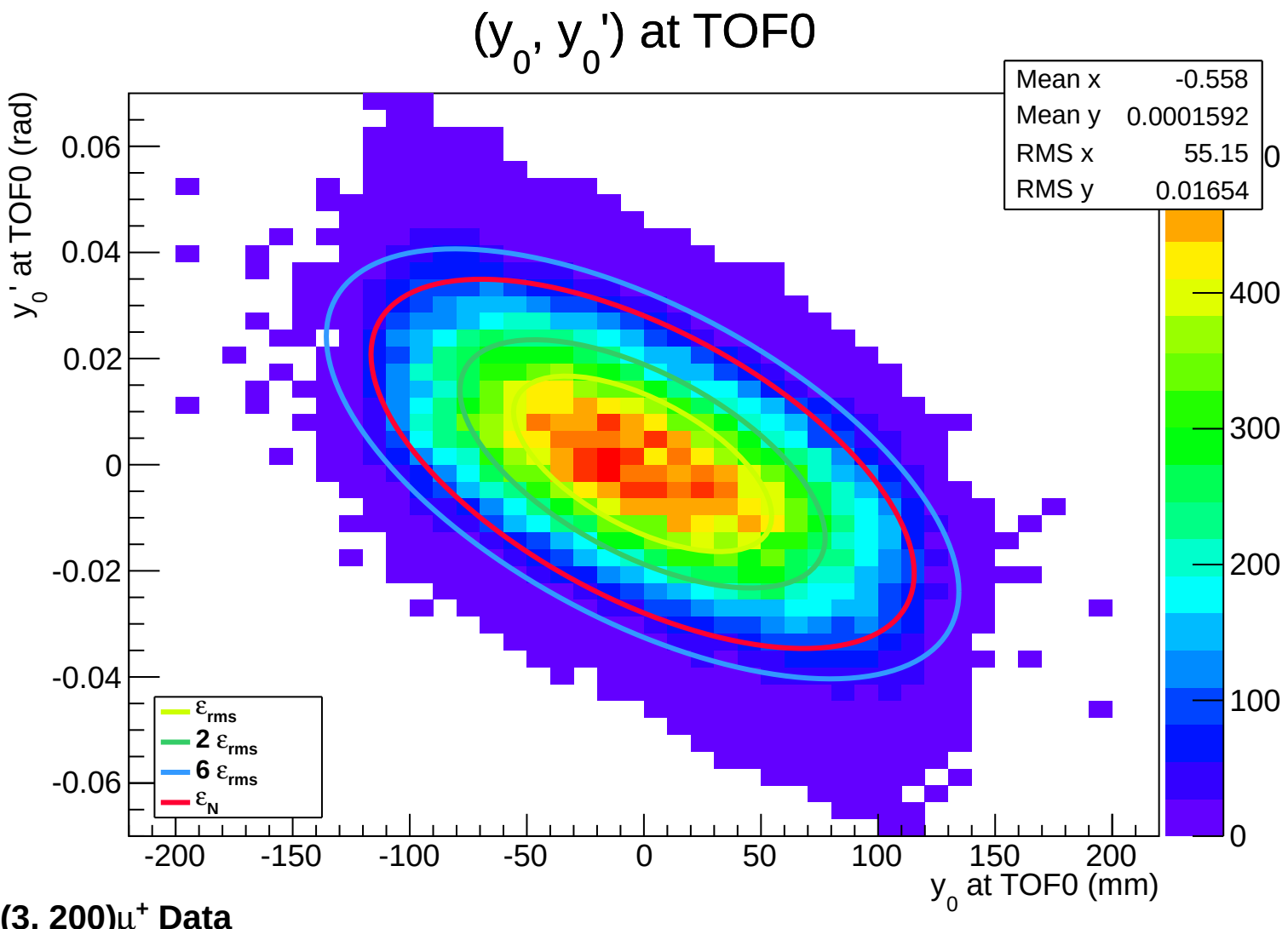
(3, 200)μ⁺ Data


(x0, x0') at TOF0
Mean x -4.074
Mean y -0.0008993
RMS x 79.61
RMS y 0.03786
x0' at TOF0 (rad)
x0 at TOF0 (mm)
εrms
2 εrms
6 εrms
εN
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-200
-150
-100
-50
0
50
100
150
200
350
300
250
200
150
100
50
0

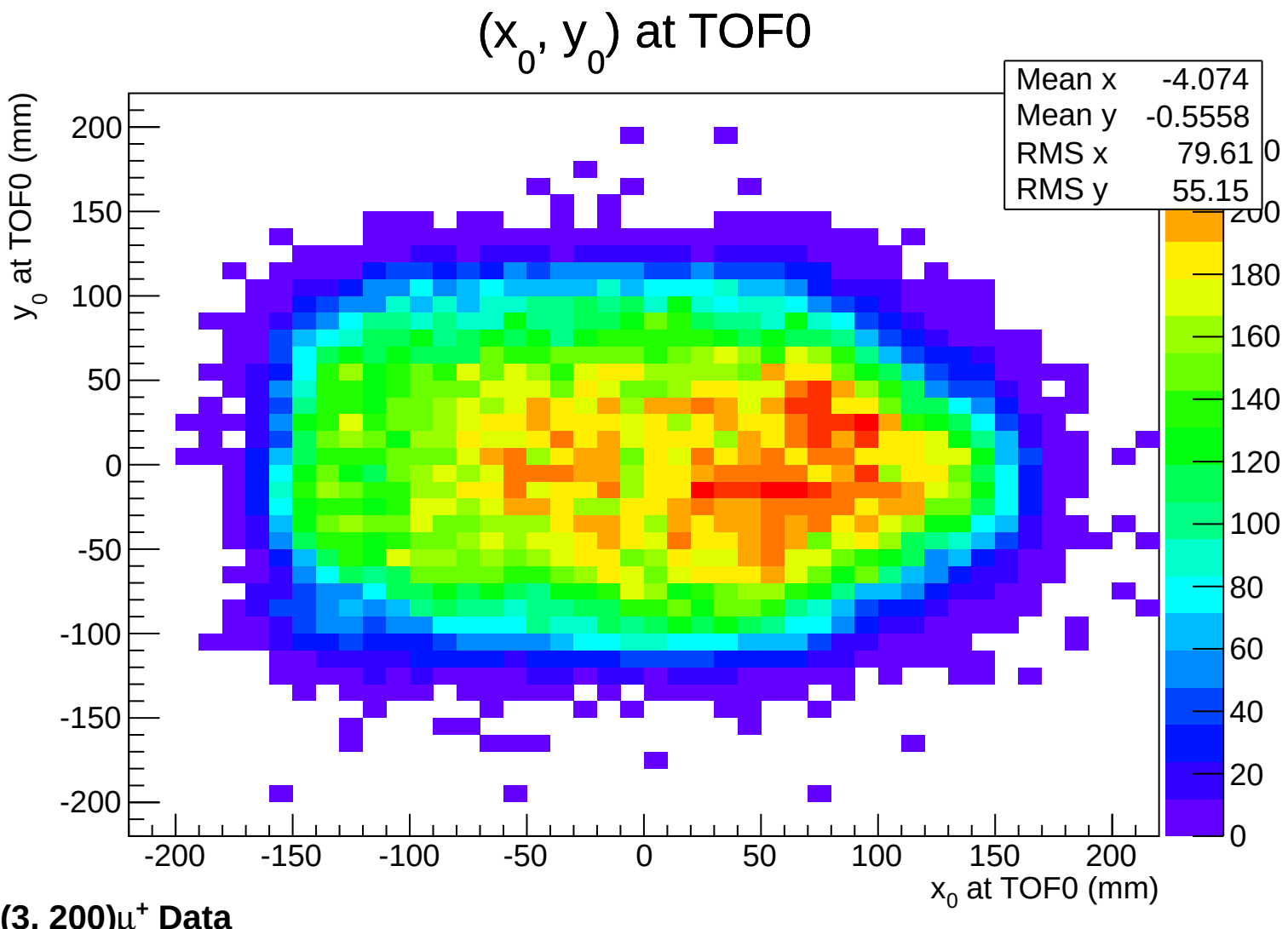
(3, 200)μ⁺ Data


(y0, y0') at TOF0
Mean x -0.558
Mean y 0.0001592
RMS x 55.15
RMS y 0.01654
y0' at TOF0 (rad)
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-200
-150
-100
-50
0
50
100
150
200
y0 at TOF0 (mm)
400
300
200
100
0

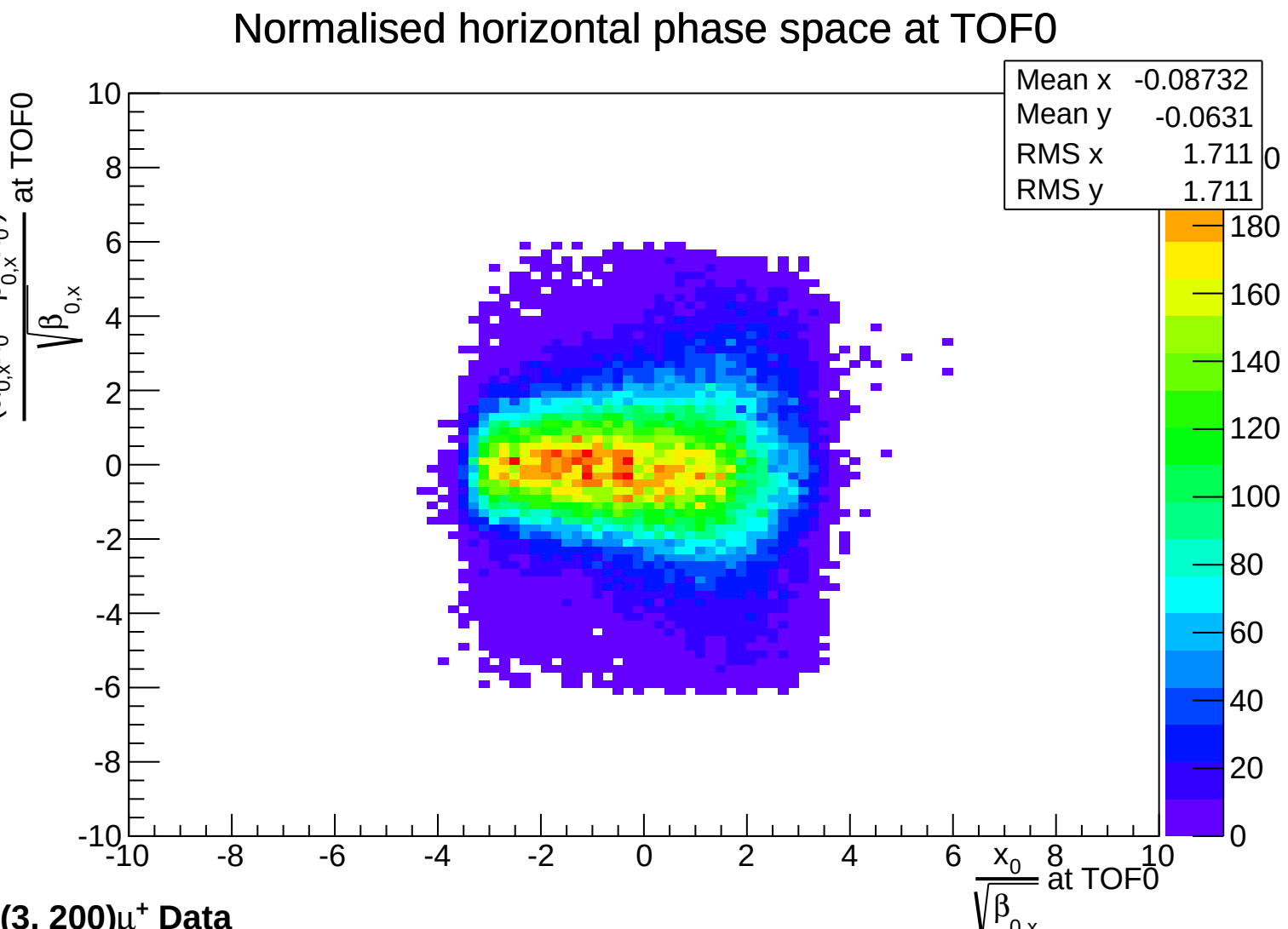
(3, 200)μ^+ Data


(y0, y0') at TOF0
Mean x -0.558
Mean y 0.0001592
RMS x 55.15
RMS y 0.01654
y0' at TOF0 (rad)
y0 at TOF0 (mm)
εrms
2 εrms
6 εrms
εN
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-200
-150
-100
-50
0
50
100
150
200
400
300
200
100
0

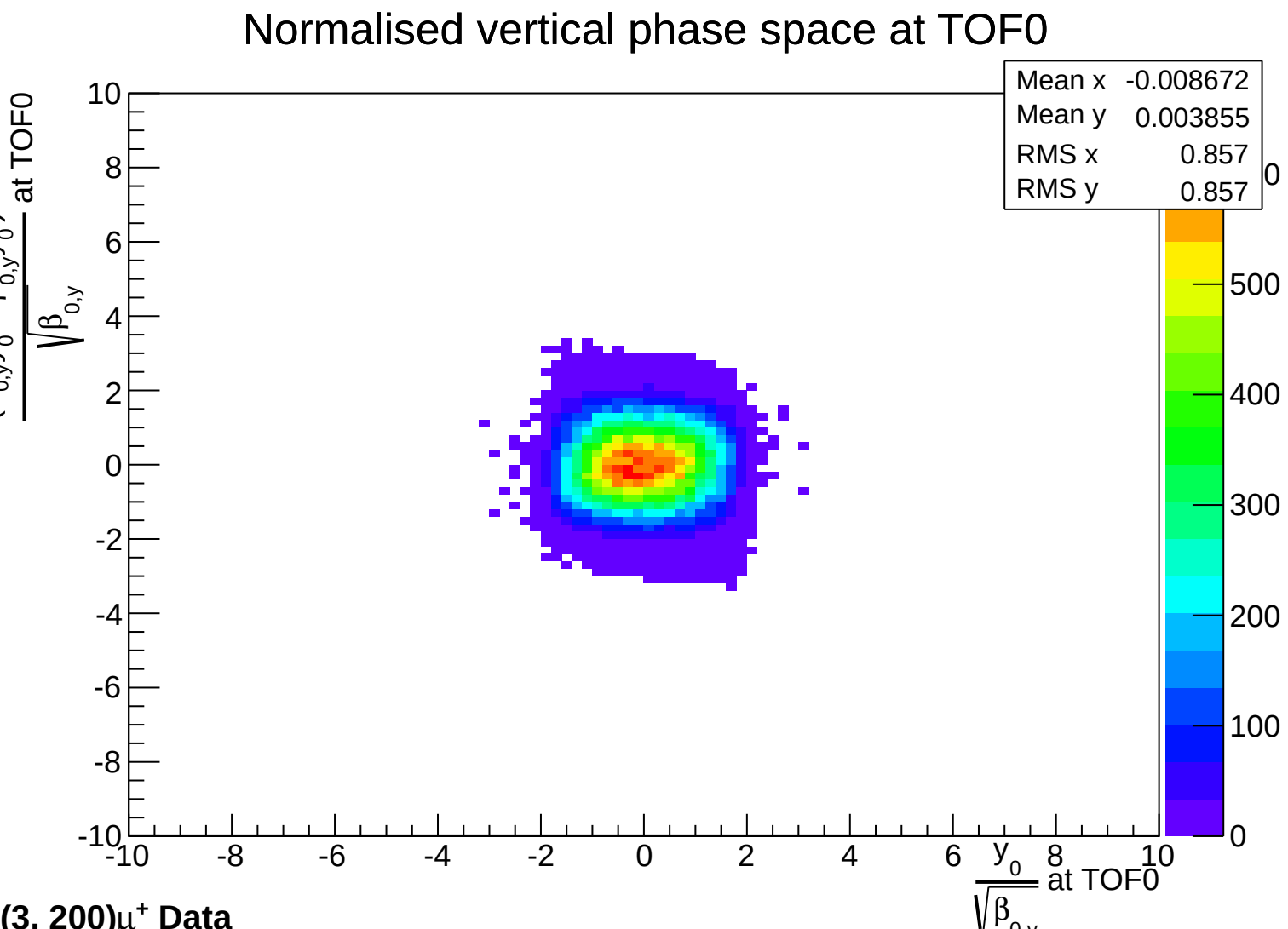
(3, 200)μ^+ Data


(x_0, y_0) at TOF0
Mean x -4.074
Mean y -0.5558
RMS x 79.61
RMS y 55.15
y_0 at TOF0 (mm)
x_0 at TOF0 (mm)
200
150
100
50
0
-50
-100
-150
-200
180
160
140
120
100
80
60
40
20
0

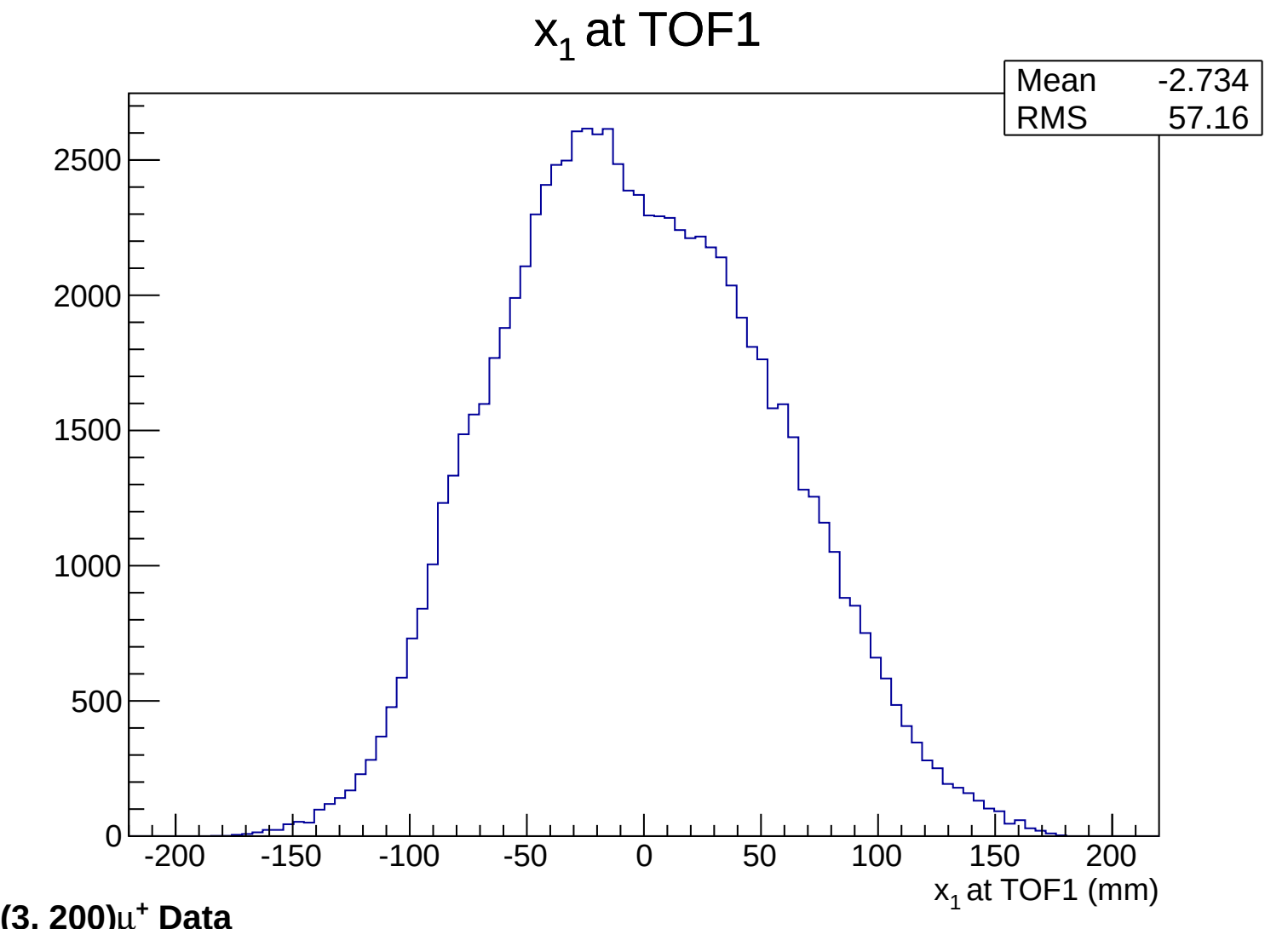
(3, 200)μ^+ Data


Normalised horizontal phase space at TOF0
Mean x -0.08732
Mean y -0.0631
RMS x 1.711
RMS y 1.711
$\frac{x_0}{\sqrt{\beta_{0,x}}}$ at TOF0
$\frac{x'_{0,x}\cdot\beta_{0,x} - \alpha_{0,x}\cdot x_0}{\sqrt{\beta_{0,x}}}$ at TOF0
10
8
6
4
2
0
-2
-4
-6
-8
-10
-10
-8
-6
-4
-2
0
2
4
6
8
10
180
160
140
120
100
80
60
40
20
0

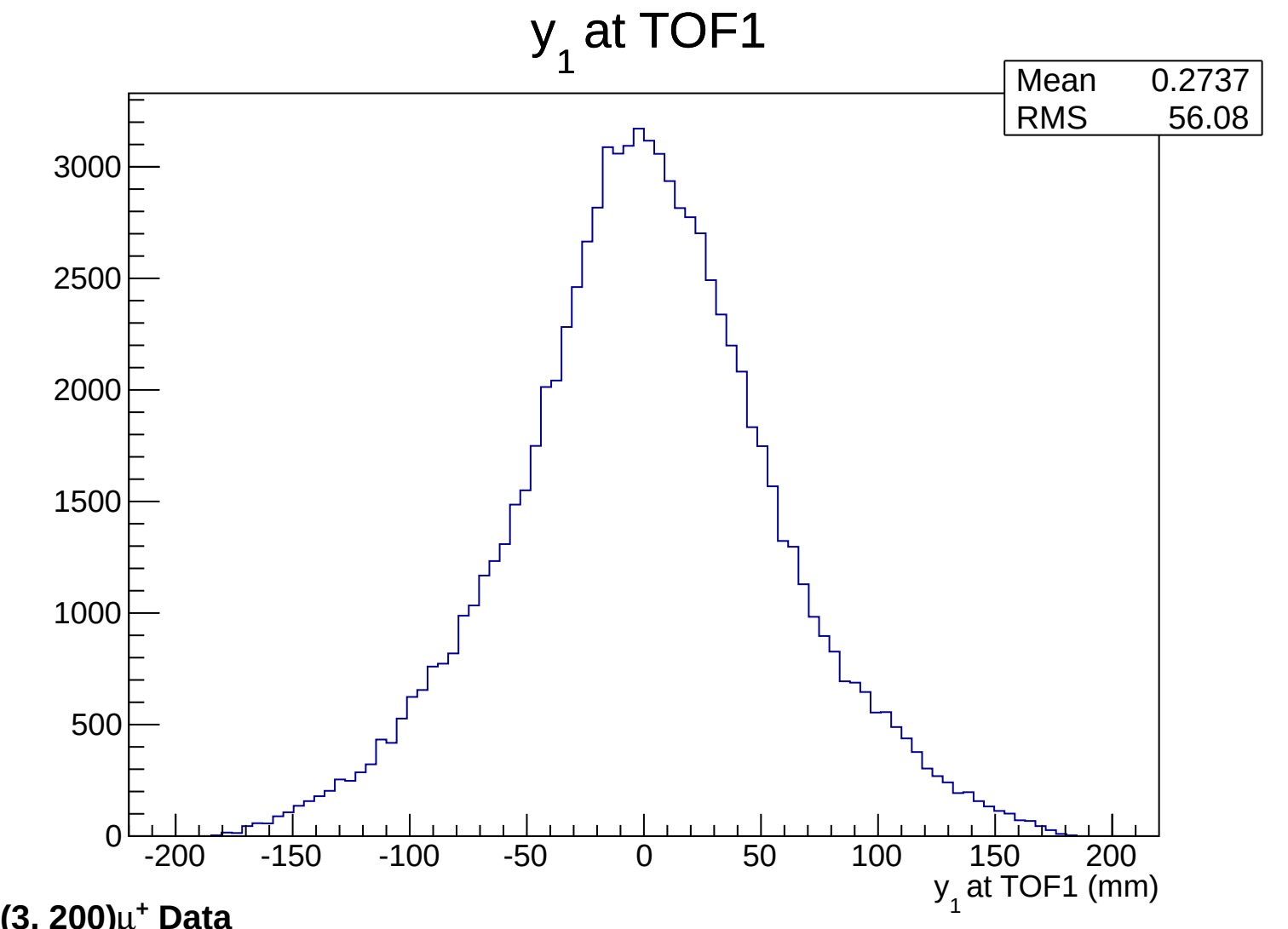
(3, 200)μ^+ Data


Normalised vertical phase space at TOF0
Mean x -0.008672
Mean y 0.003855
RMS x 0.857
RMS y 0.857
$\frac{y_0 - \eta_{0,y} x'_0}{\sqrt{\beta_{0,y}}}$ at TOF0
$\frac{y_0}{\sqrt{\beta_{0,y}}}$ at TOF0
10
8
6
4
2
0
-2
-4
-6
-8
-10
-10
-8
-6
-4
-2
0
2
4
6
8
10
500
400
300
200
100
0

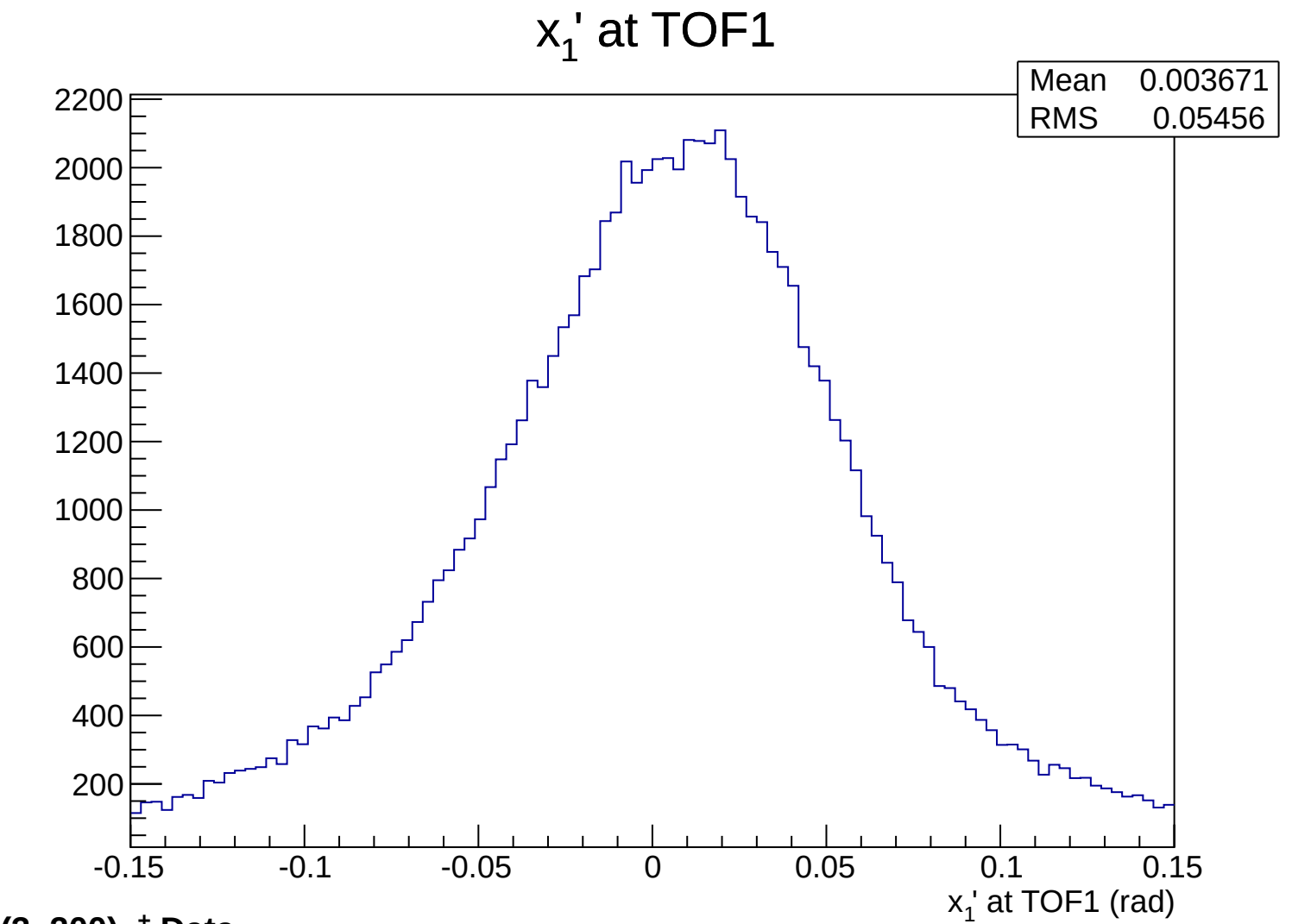
(3, 200)μ^+ Data


x_1 at TOF1
Mean -2.734
RMS 57.16
2500
2000
1500
1000
500
0
-200
-150
-100
-50
0
50
100
150
200
x_1 at TOF1 (mm)

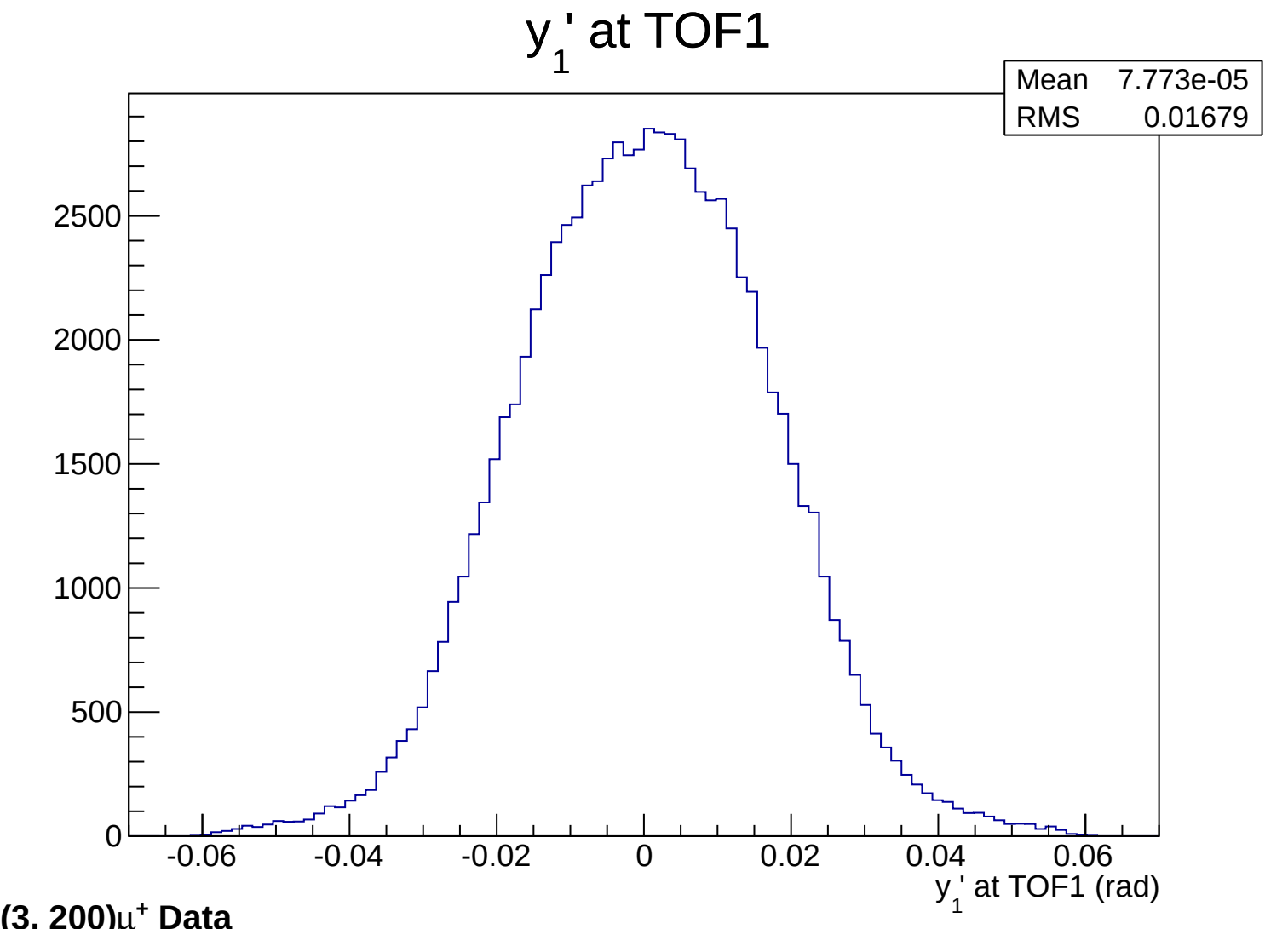
(3, 200)μ^+ Data


y1 at TOF1
Mean 0.2737
RMS 56.08
3000
2500
2000
1500
1000
500
0
-200
-150
-100
-50
0
50
100
150
200
y1 at TOF1 (mm)

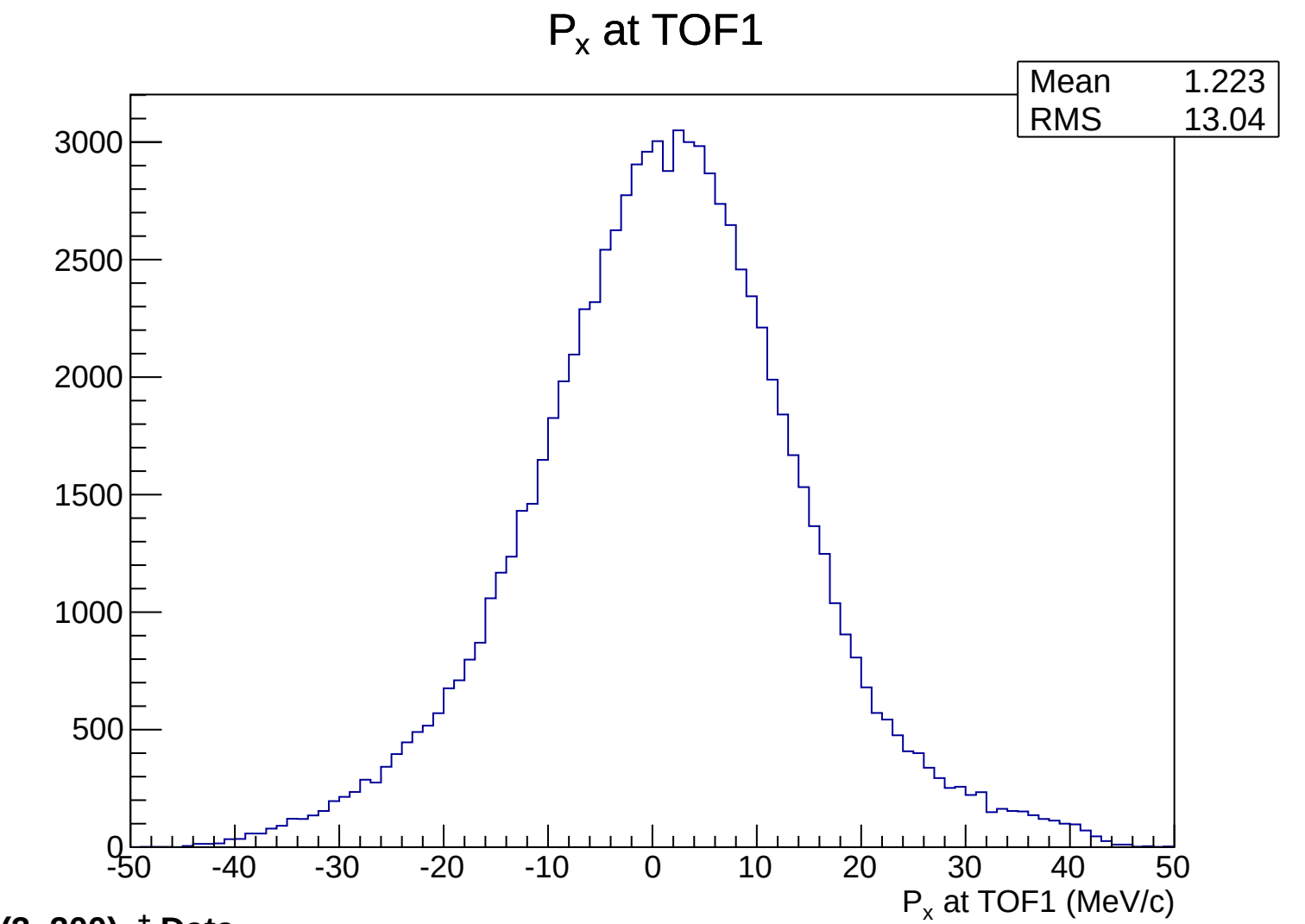
(3, 200)μ^+ Data


x1' at TOF1
Mean 0.003671
RMS 0.05456
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
-0.15
-0.1
-0.05
0
0.05
0.1
0.15
x1' at TOF1 (rad)

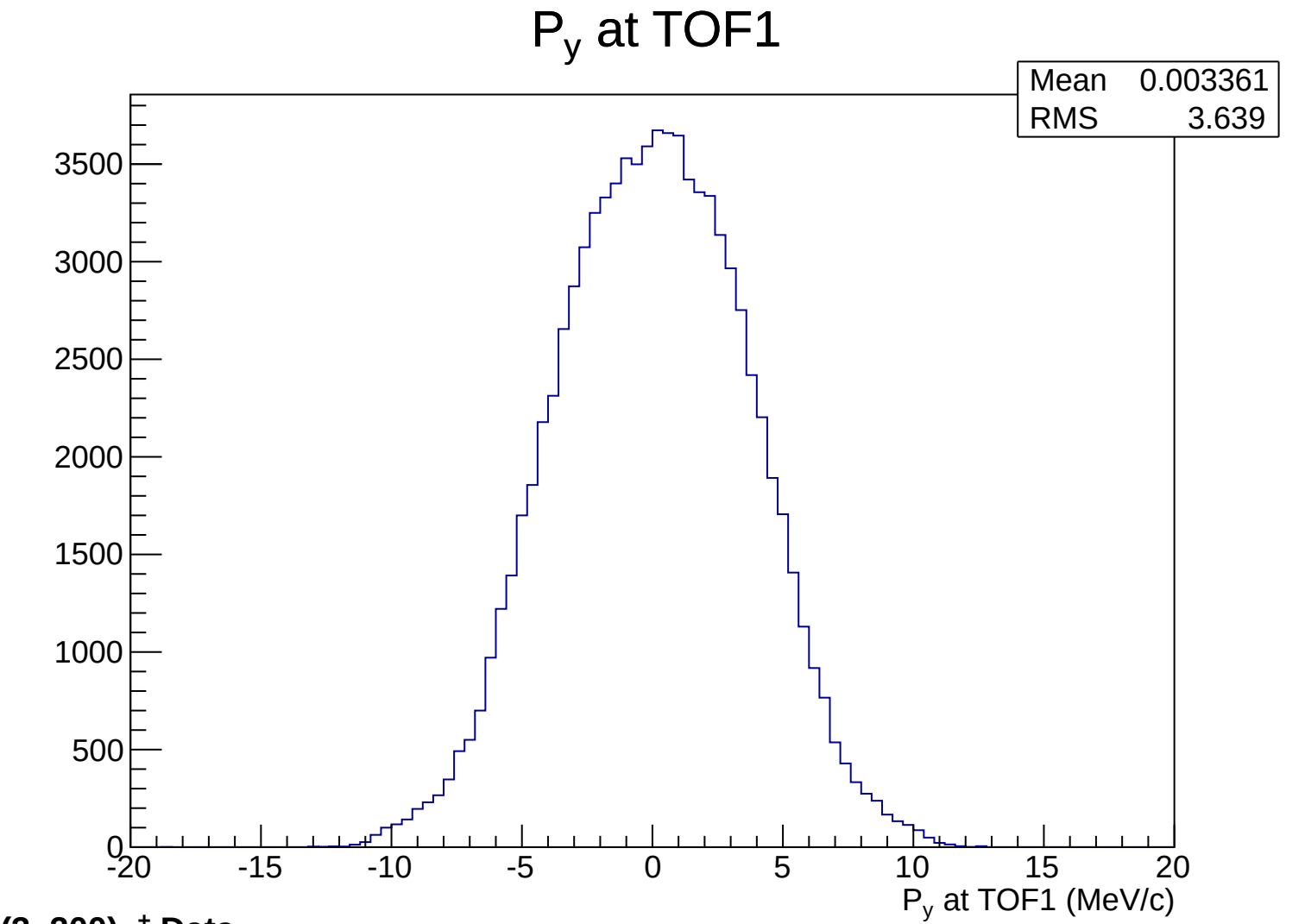
(3, 200)μ^+ Data


y1' at TOF1
Mean 7.773e-05
RMS 0.01679
2500
2000
1500
1000
500
0
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
y1' at TOF1 (rad)

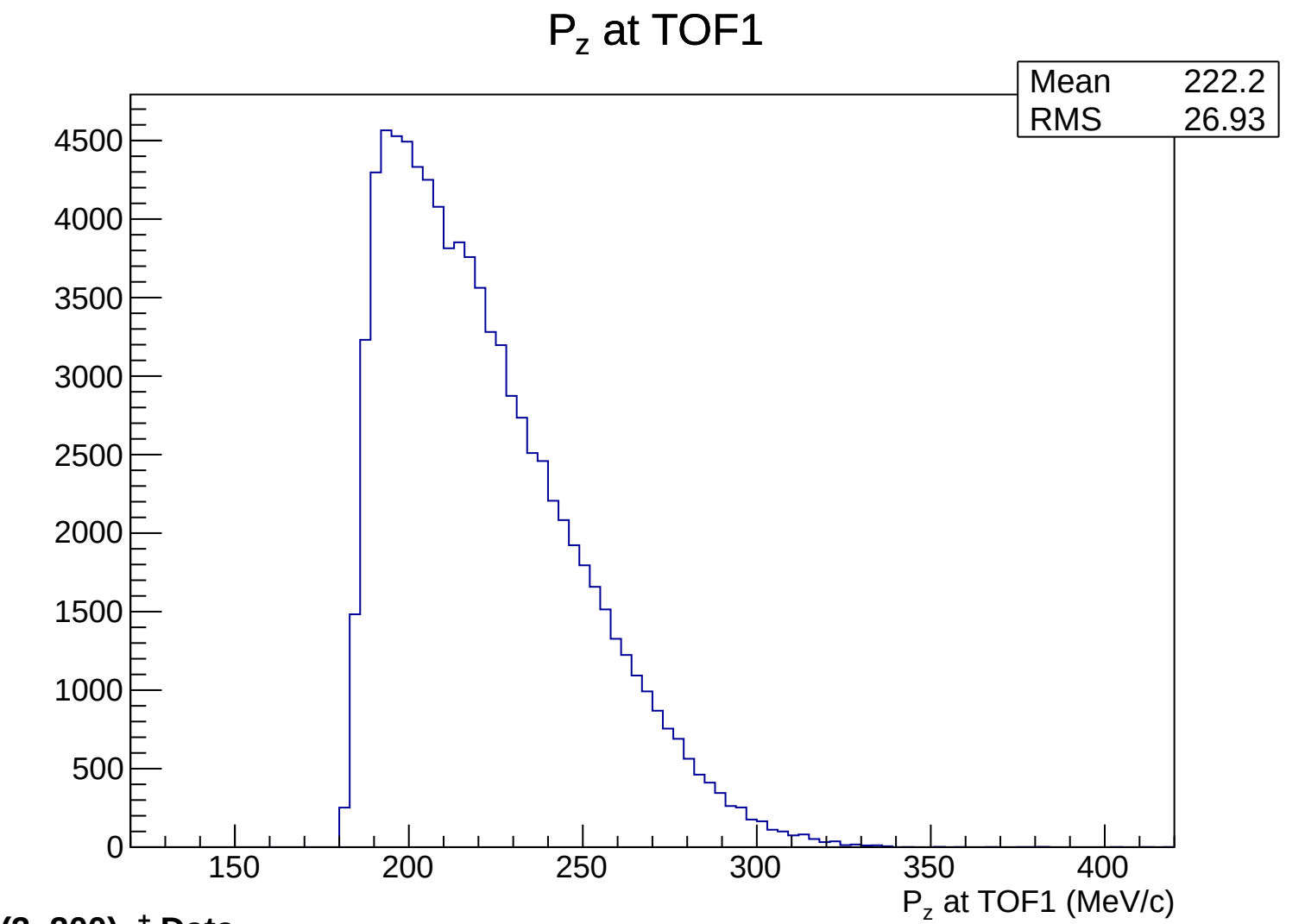
(3, 200)μ^+ Data


P_x at TOF1
Mean 1.223
RMS 13.04
3000
2500
2000
1500
1000
500
0
-50
-40
-30
-20
-10
0
10
20
30
40
50
P_x at TOF1 (MeV/c)

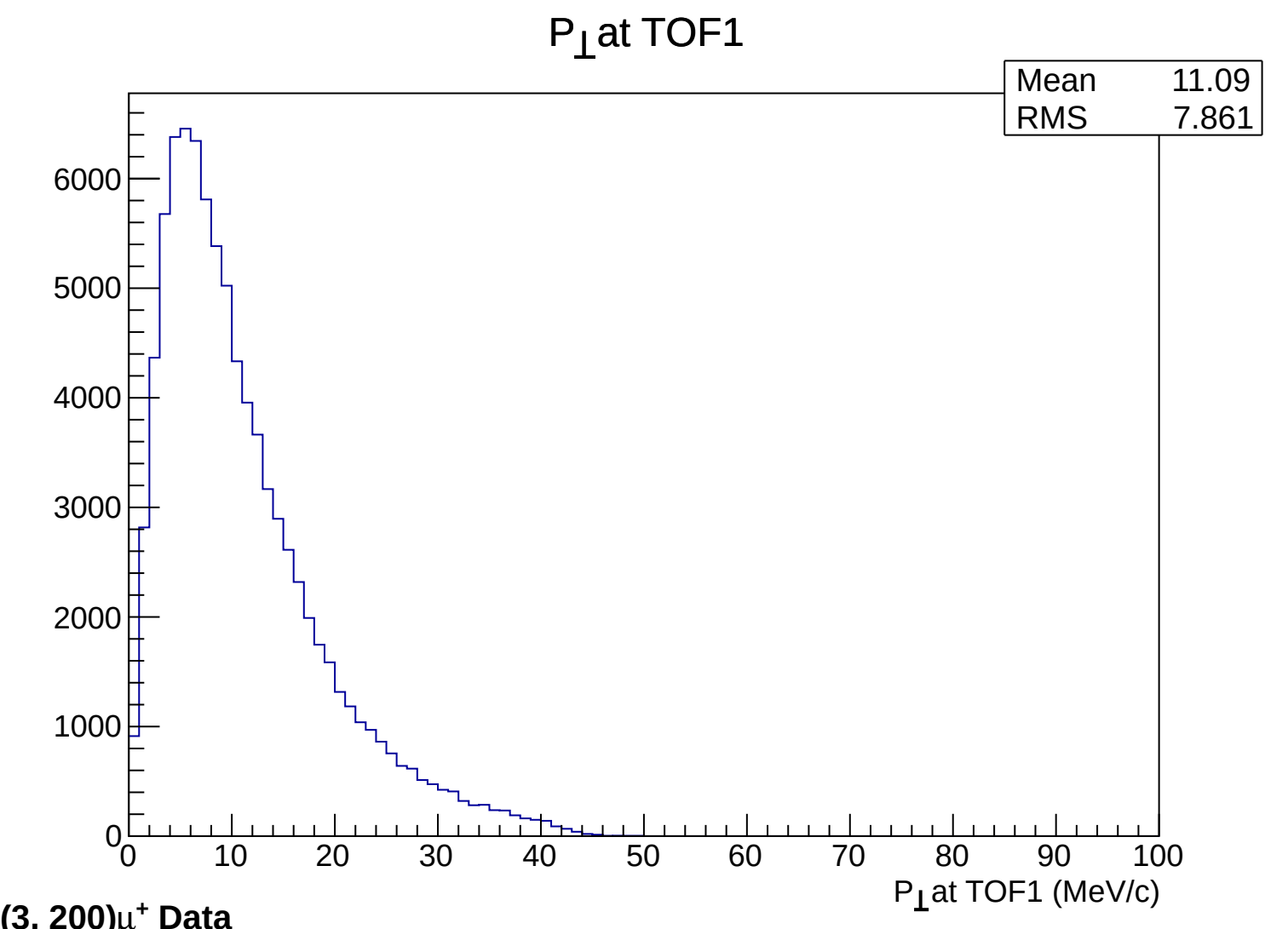
(3, 200)μ^+ Data


P_y at TOF1
Mean 0.003361
RMS 3.639
3500
3000
2500
2000
1500
1000
500
0
-20
-15
-10
-5
0
5
10
15
20
P_y at TOF1 (MeV/c)

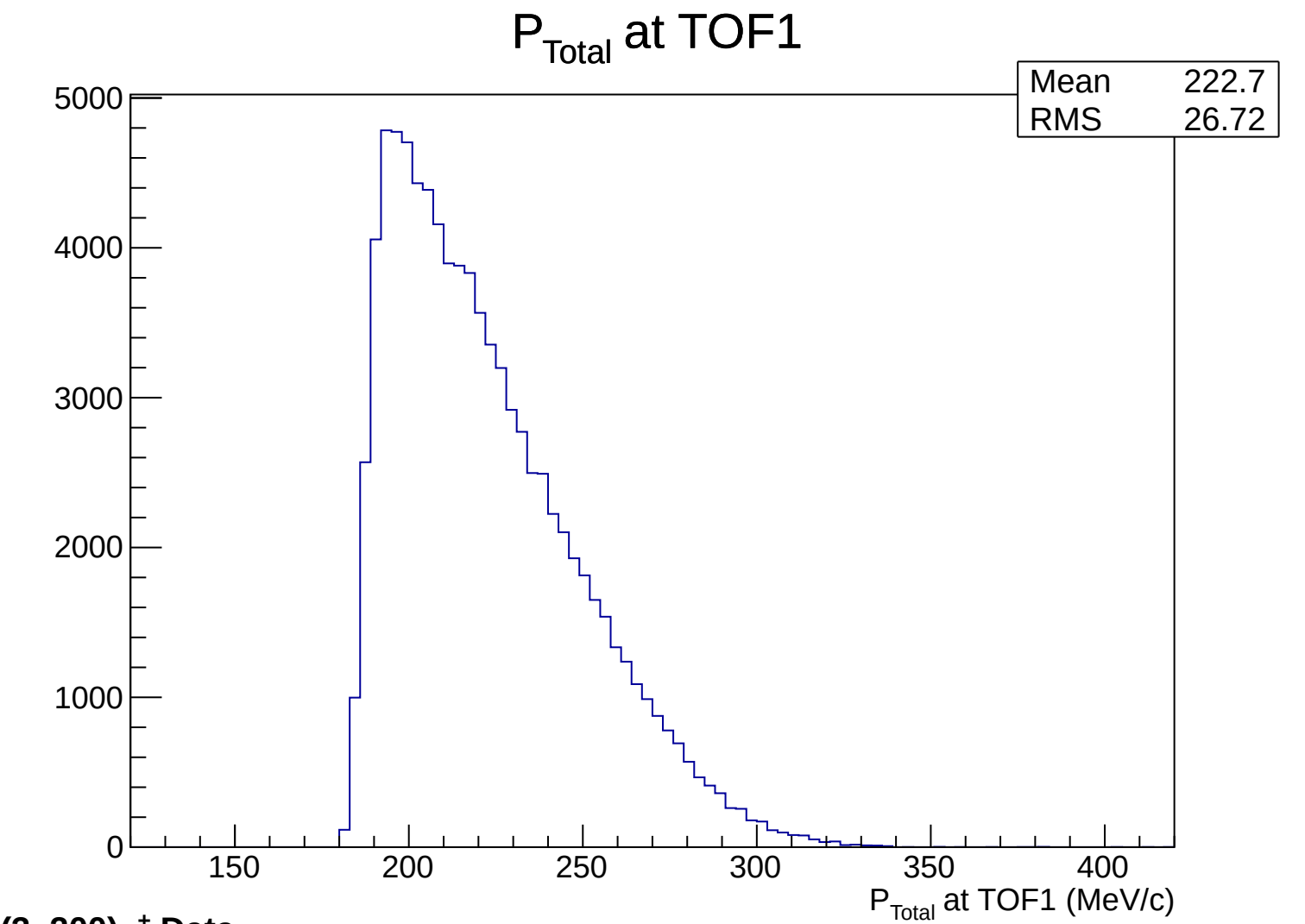
(3, 200)μ^+ Data


P_z at TOF1
Mean 222.2
RMS 26.93
4500
4000
3500
3000
2500
2000
1500
1000
500
0
150
200
250
300
350
400
P_z at TOF1 (MeV/c)

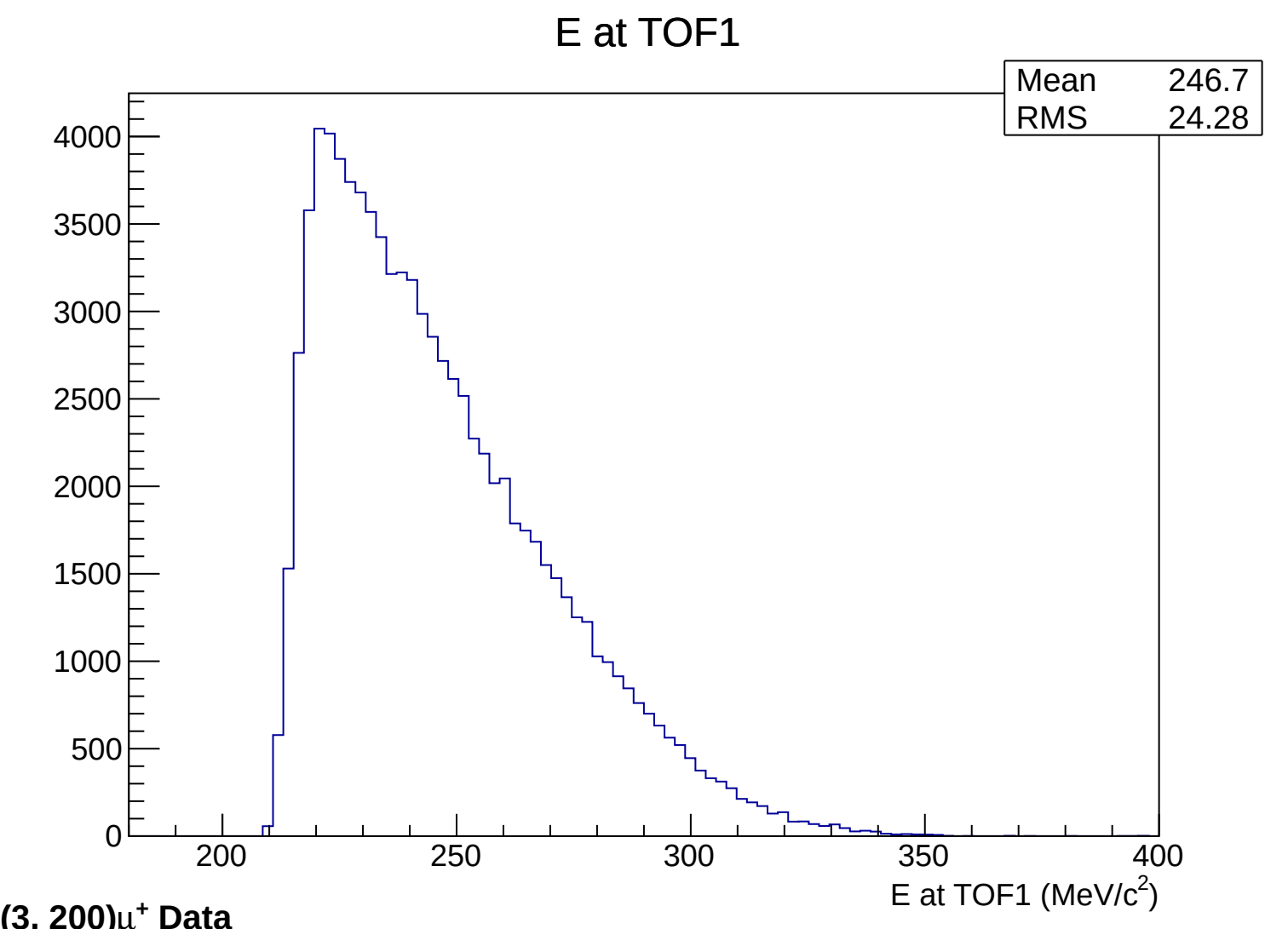
(3, 200)μ^+ Data


P⊥at TOF1
Mean 11.09
RMS 7.861
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
50
60
70
80
90
100
P⊥at TOF1 (MeV/c)

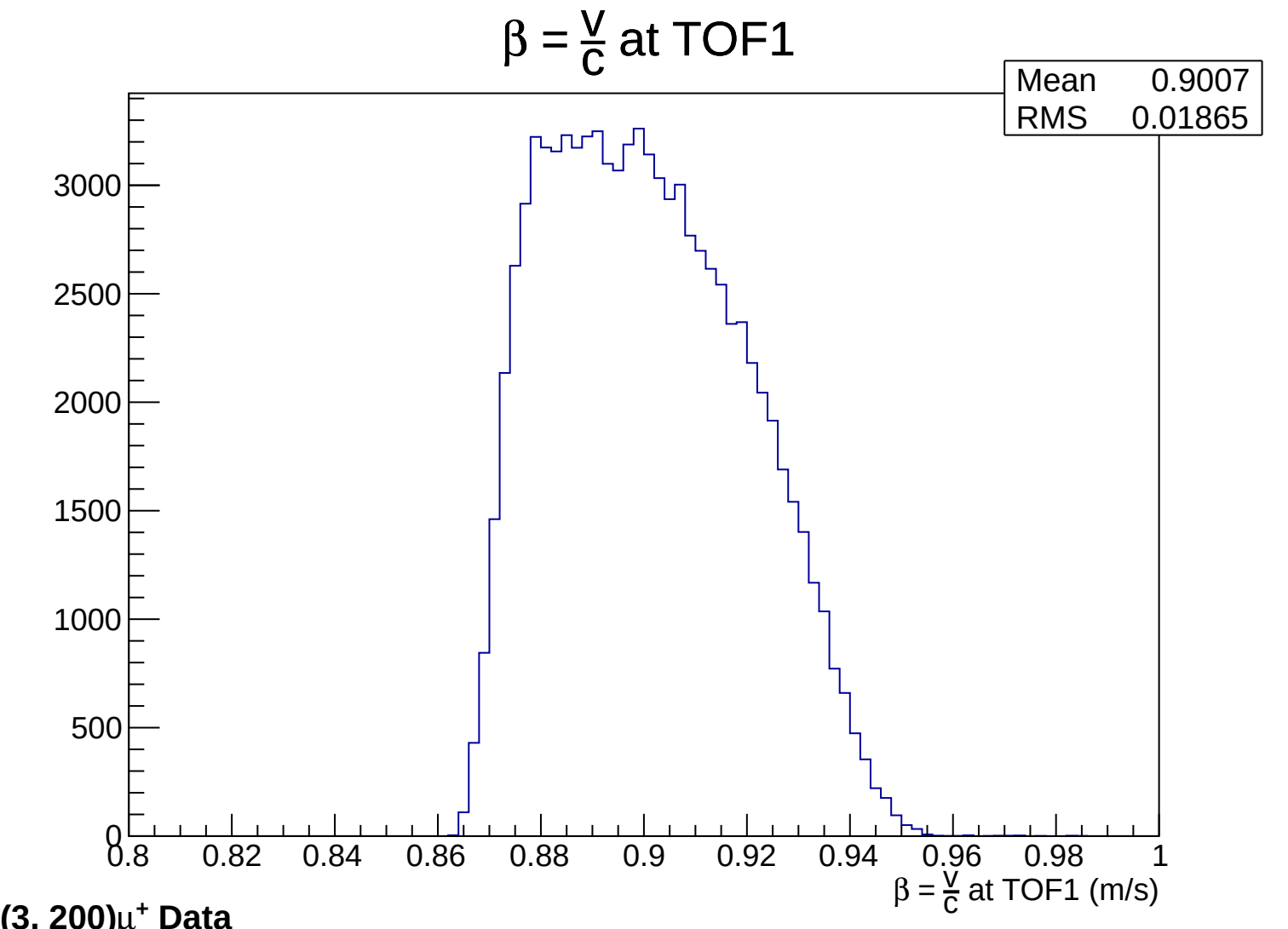
(3, 200)μ^+ Data


P Total at TOF1
Mean 222.7
RMS 26.72
5000
4000
3000
2000
1000
0
150
200
250
300
350
400
P Total at TOF1 (MeV/c)

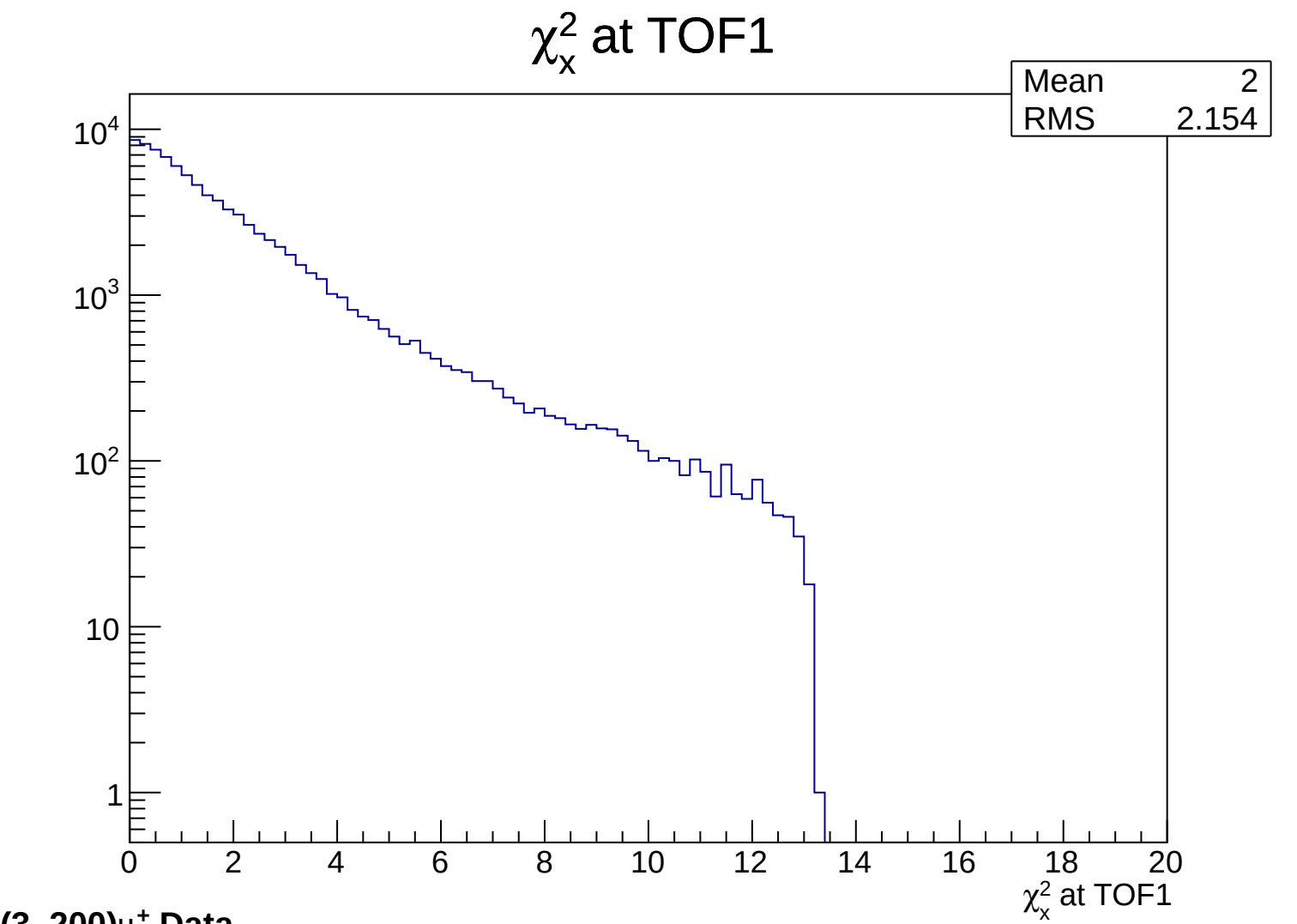
(3, 200)μ^+ Data


E at TOF1
Mean 246.7
RMS 24.28
4000
3500
3000
2500
2000
1500
1000
500
0
200
250
300
350
400
E at TOF1 (MeV/c^2)

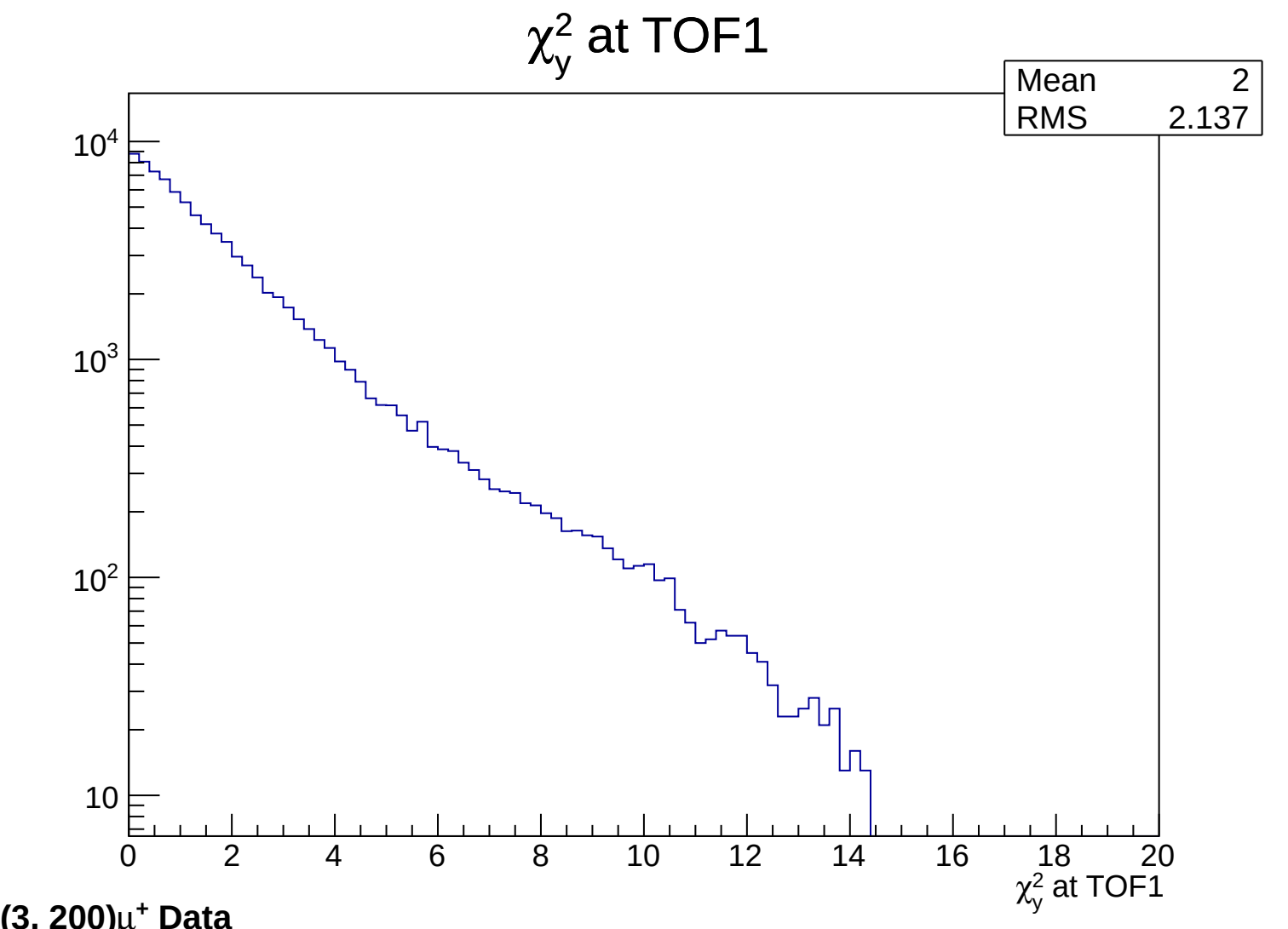
(3, 200)μ^+ Data


β = v/c at TOF1
Mean 0.9007
RMS 0.01865
3000
2500
2000
1500
1000
500
0
0.8
0.82
0.84
0.86
0.88
0.9
0.92
0.94
0.96
0.98
1
β = v/c at TOF1 (m/s)

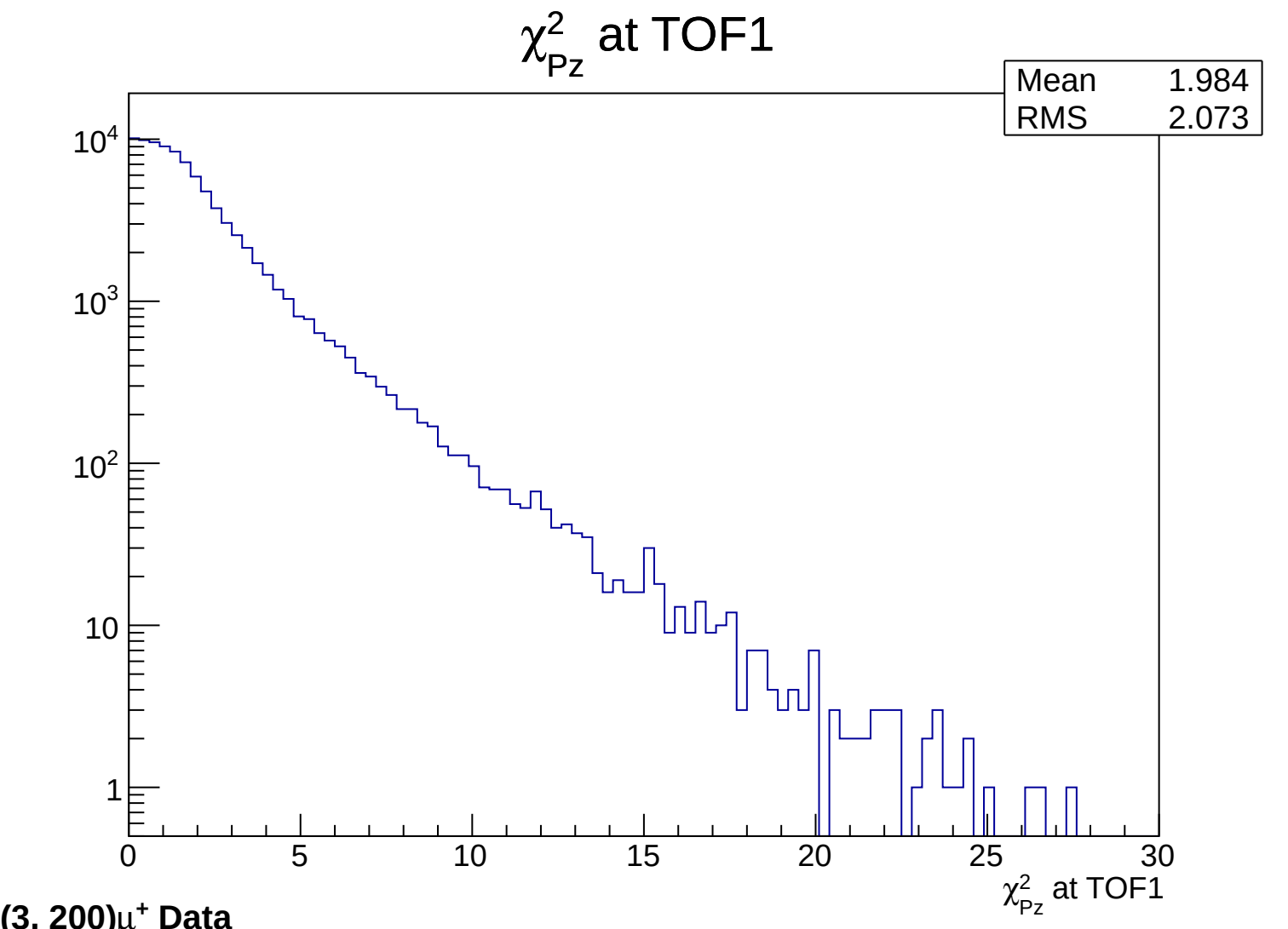
(3, 200)μ^+ Data


χ^2_x at TOF1
Mean 2
RMS 2.154
10^4
10^3
10^2
10
1
0
2
4
6
8
10
12
14
16
18
20
χ^2_x at TOF1

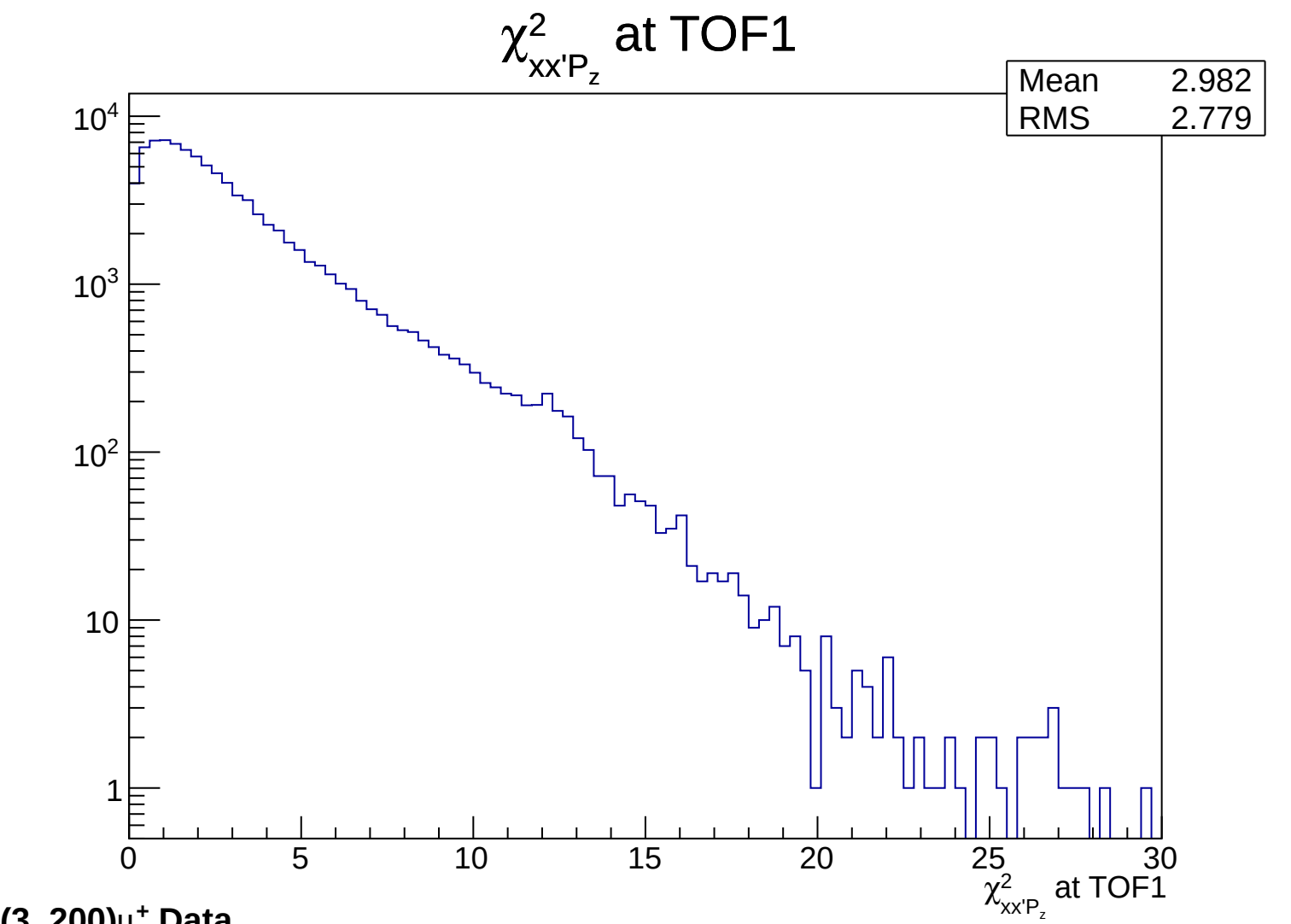
(3, 200)μ^+ Data


χ^2_y at TOF1
Mean 2
RMS 2.137
10^4
10^3
10^2
10
0
2
4
6
8
10
12
14
16
18
20
χ^2_y at TOF1

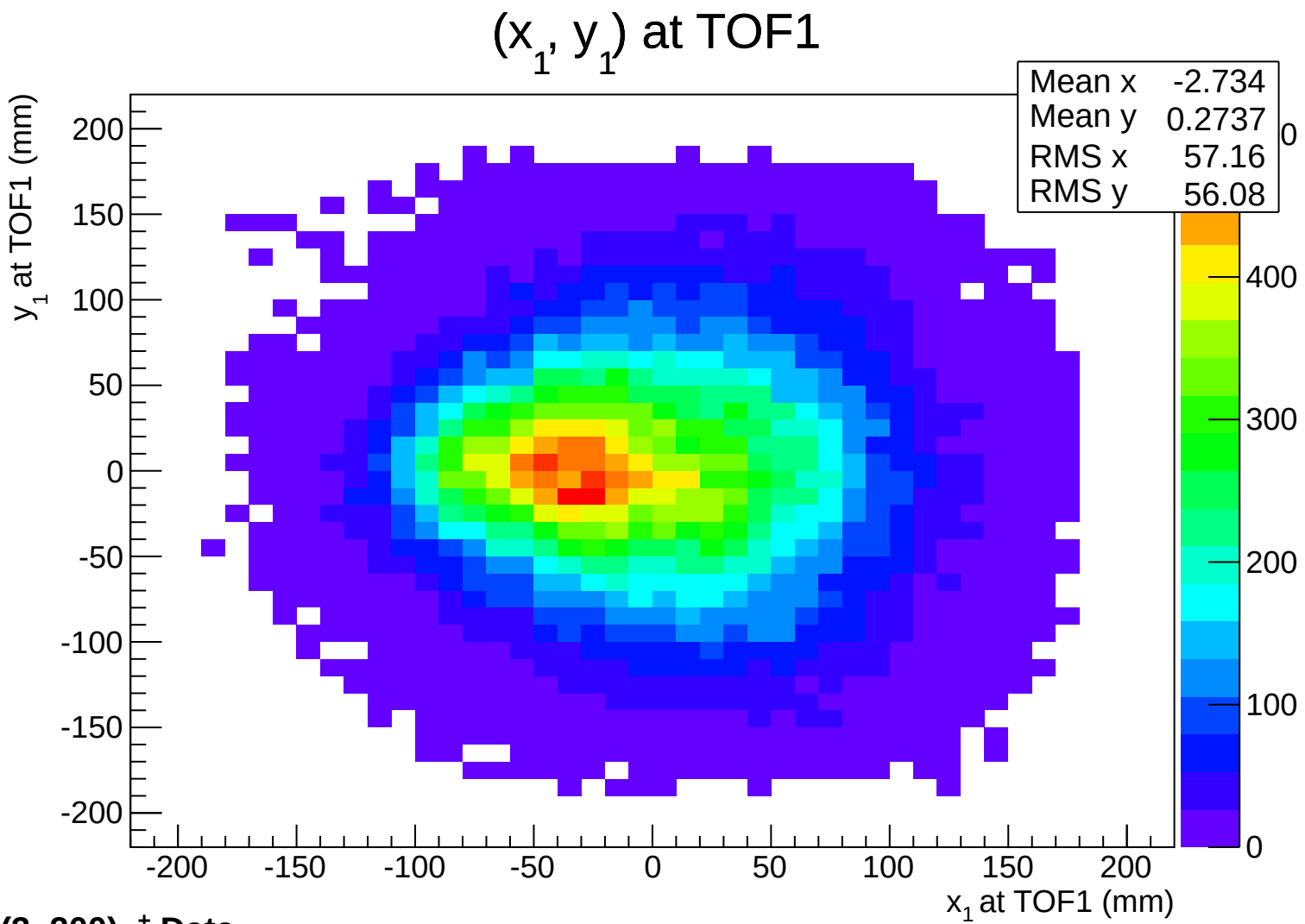
(3, 200)μ^+ Data


χ^2_{Pz} at TOF1
Mean 1.984
RMS 2.073
10^4
10^3
10^2
10
1
0
5
10
15
20
25
30
χ^2_{Pz} at TOF1

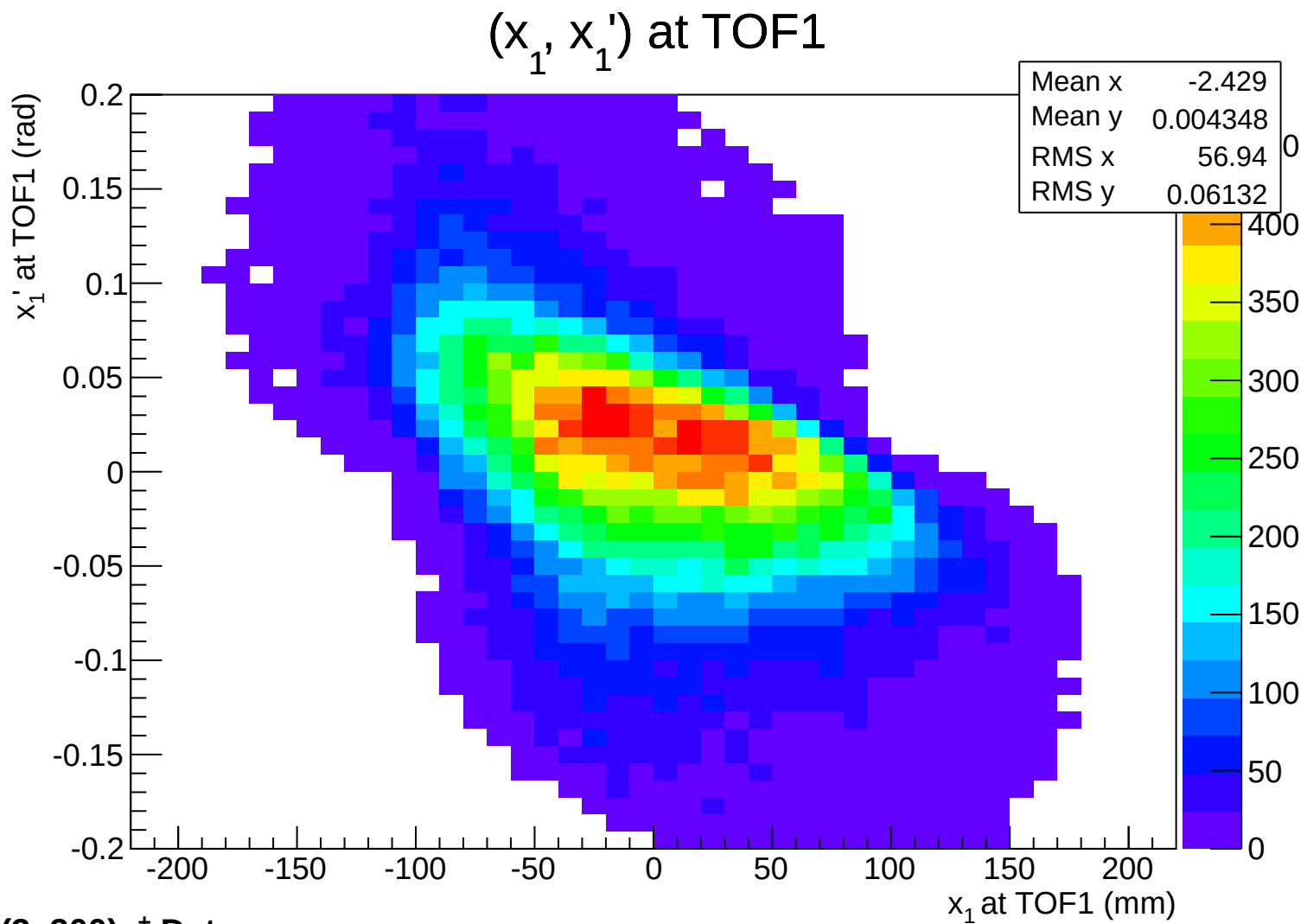
(3, 200)μ^+ Data


$\chi^2_{xx'P_z}$ at TOF1
Mean 2.982
RMS 2.779
10^4
10^3
10^2
10
1
0
5
10
15
20
25
30
$\chi^2_{xx'P_z}$ at TOF1

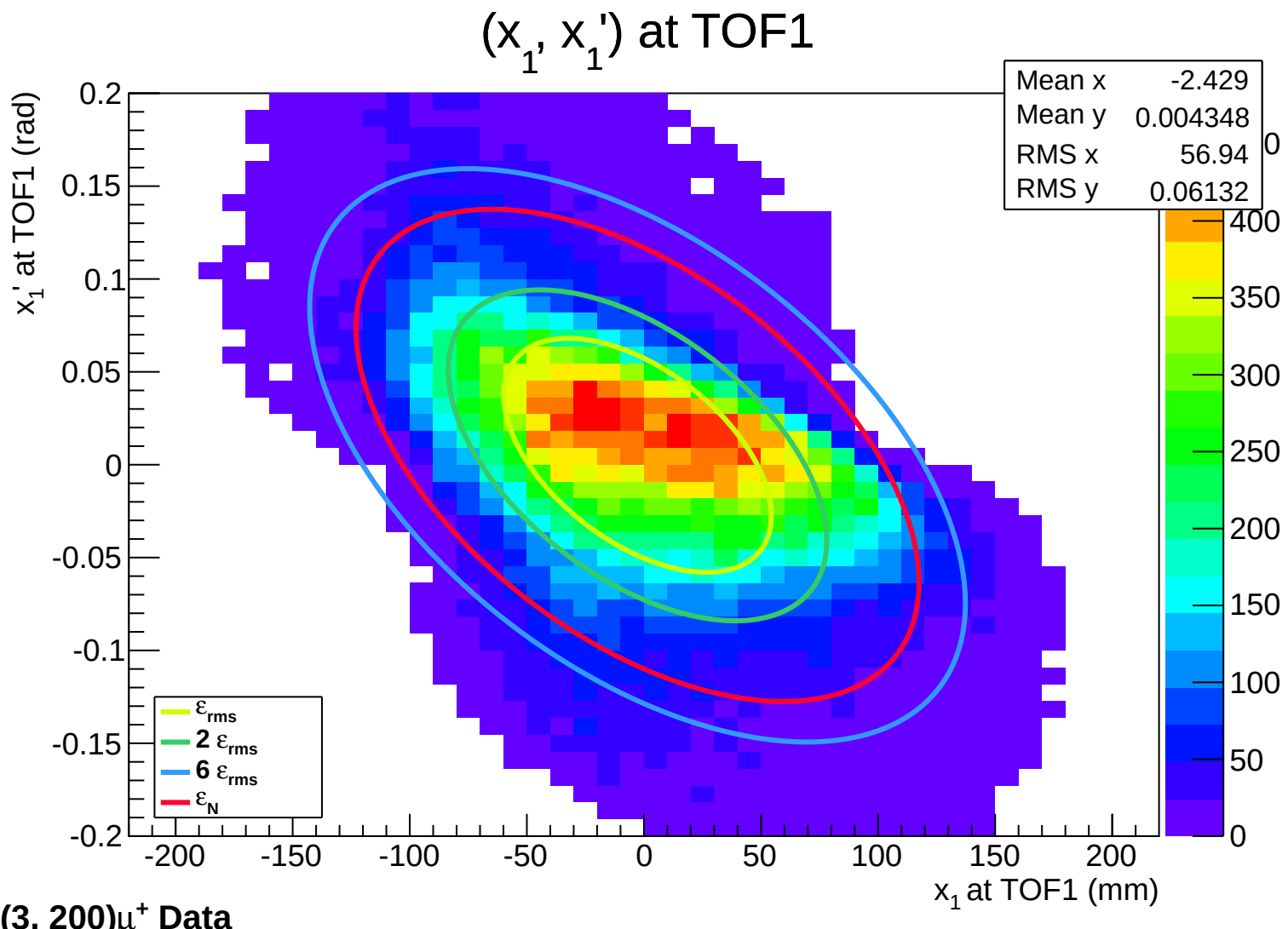
(3, 200)μ^+ Data


(x_1, y_1) at TOF1
Mean x -2.734
Mean y 0.2737
RMS x 57.16
RMS y 56.08
y_1 at TOF1 (mm)
x_1 at TOF1 (mm)
200
150
100
50
0
-50
-100
-150
-200
400
300
200
100
0

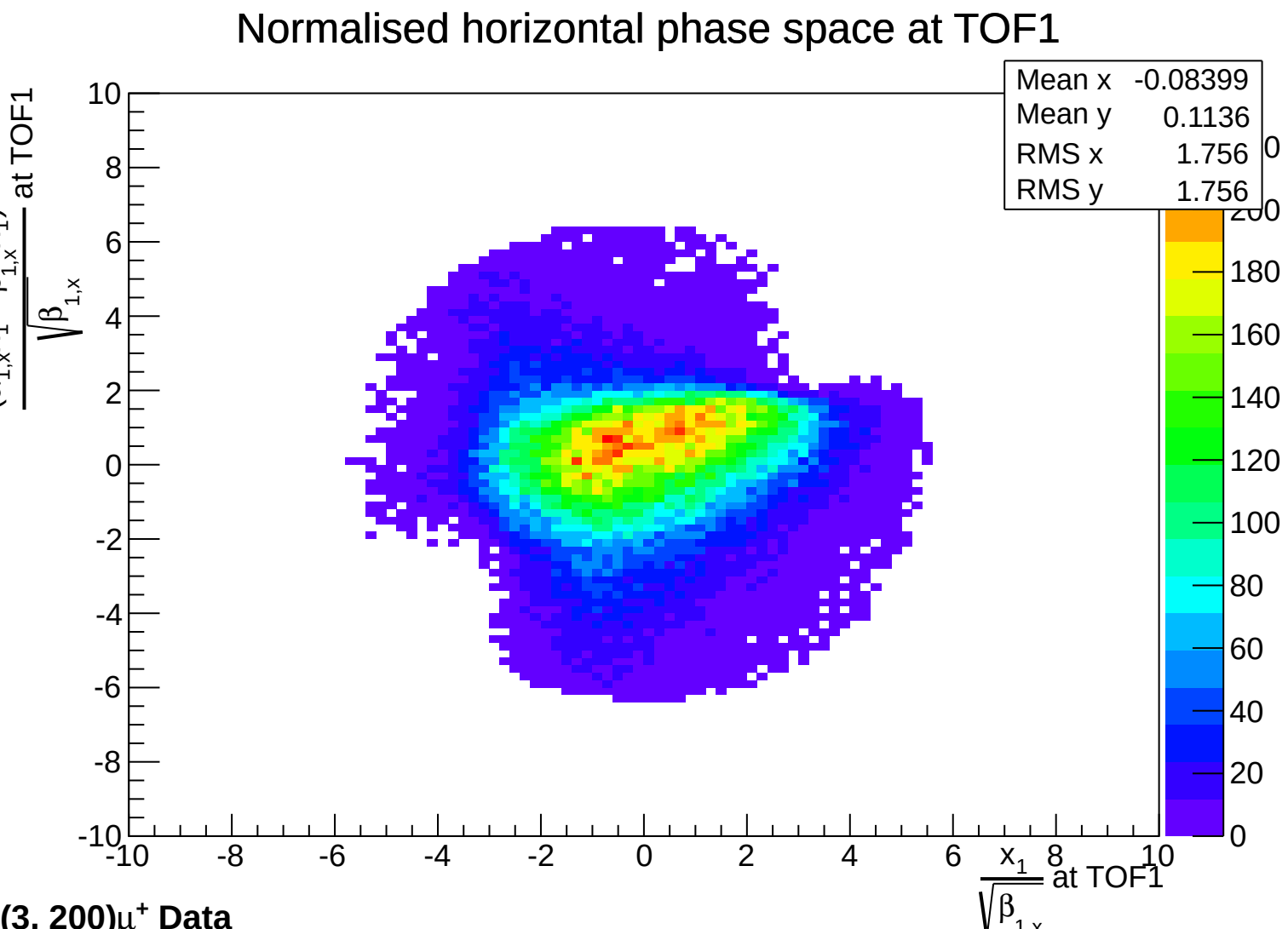
(3, 200)μ^+ Data


(x1, x1') at TOF1
Mean x -2.429
Mean y 0.004348
RMS x 56.94
RMS y 0.06132
x1' at TOF1 (rad)
x1 at TOF1 (mm)
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-200
-150
-100
-50
0
50
100
150
200
400
350
300
250
200
150
100
50
0

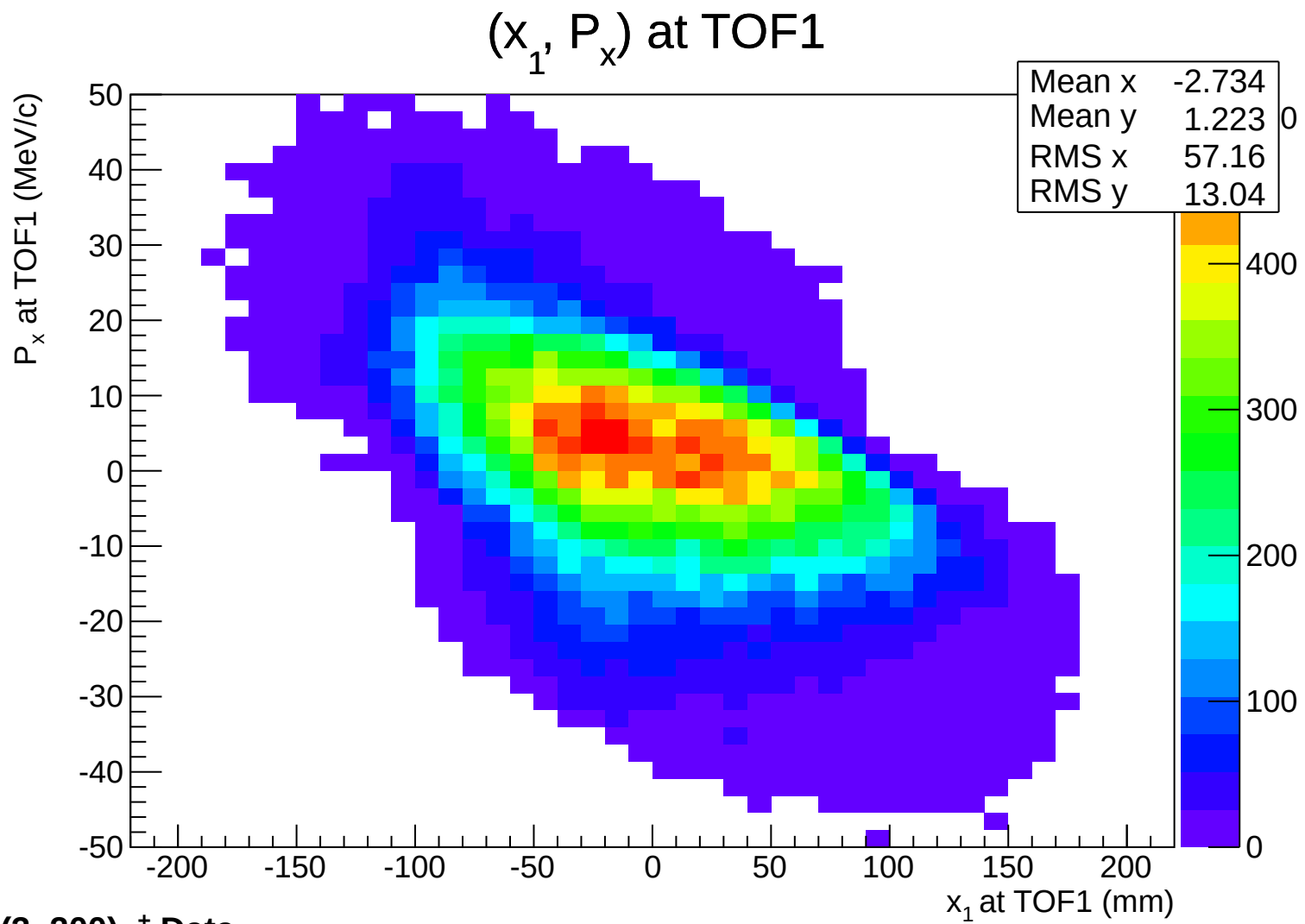
(3, 200)μ^+ Data


(x1, x1') at TOF1
Mean x -2.429
Mean y 0.004348
RMS x 56.94
RMS y 0.06132
x1' at TOF1 (rad)
x1 at TOF1 (mm)
εrms
2 εrms
6 εrms
εN
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-200
-150
-100
-50
0
50
100
150
200
400
350
300
250
200
150
100
50
0

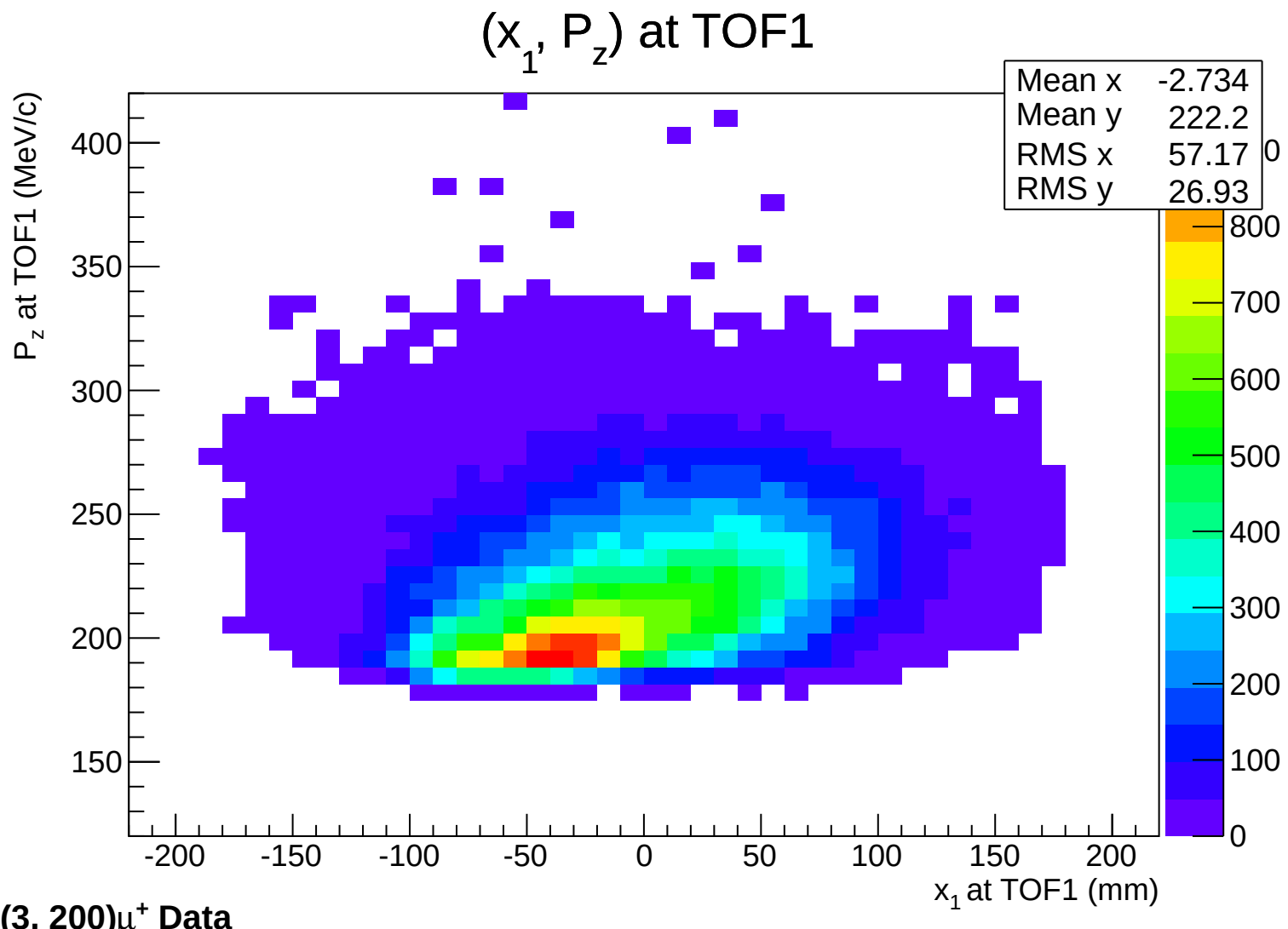
(3, 200)μ^+ Data


Normalised horizontal phase space at TOF1
Mean x -0.08399
Mean y 0.1136
RMS x 1.756
RMS y 1.756
$\frac{x_1 - D_{1,x}\frac{p-p_0}{p_0}}{\sqrt{\beta_{1,x}}}$ at TOF1
$\frac{x_1}{\sqrt{\beta_{1,x}}}$ at TOF1
10
8
6
4
2
0
-2
-4
-6
-8
-10
-10
-8
-6
-4
-2
0
2
4
6
8
10
200
180
160
140
120
100
80
60
40
20
0

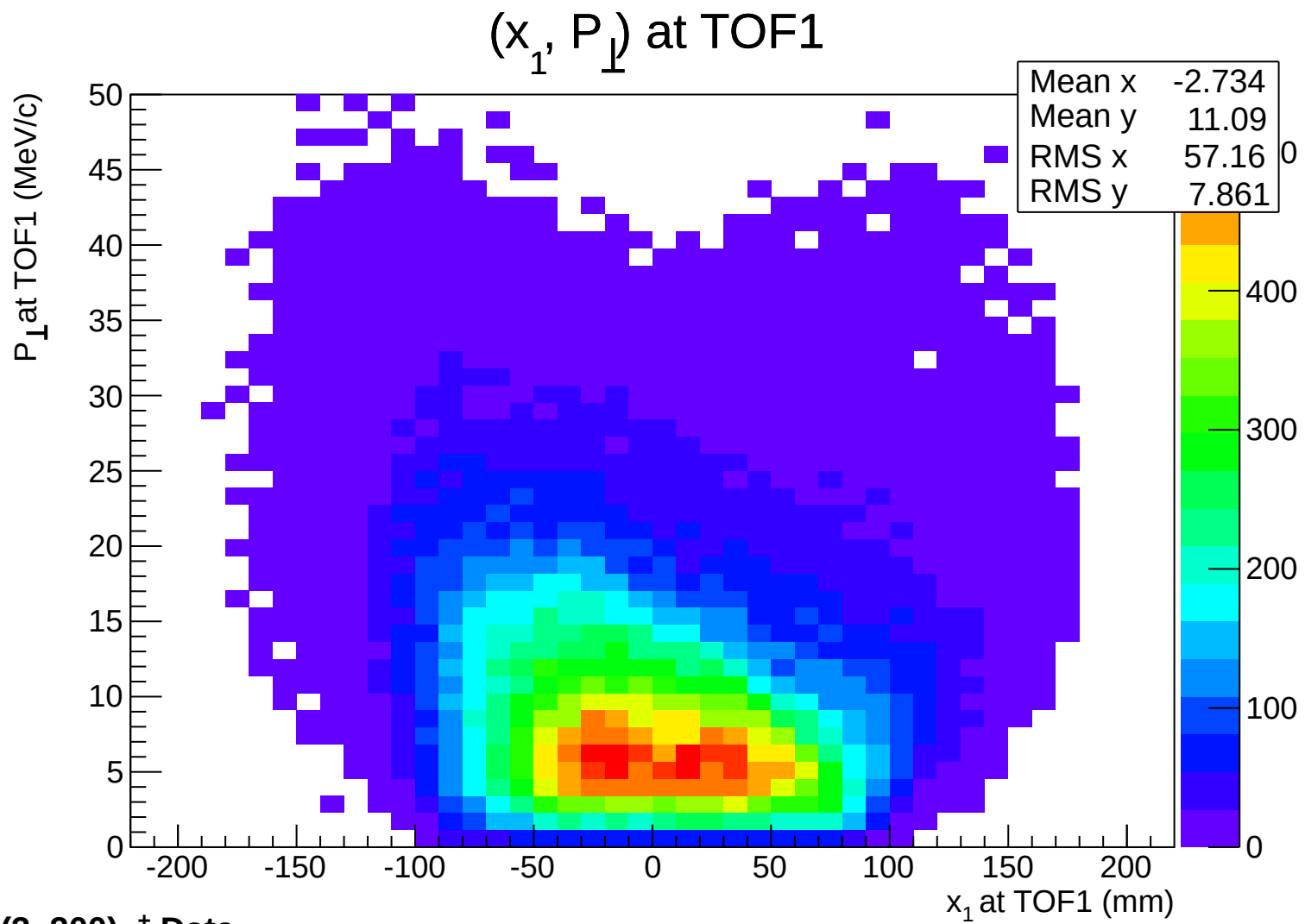
(3, 200)μ^+ Data


(x1, Px) at TOF1
Mean x -2.734
Mean y 1.223
RMS x 57.16
RMS y 13.04
Px at TOF1 (MeV/c)
x1 at TOF1 (mm)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-200
-150
-100
-50
0
50
100
150
200
400
300
200
100
0

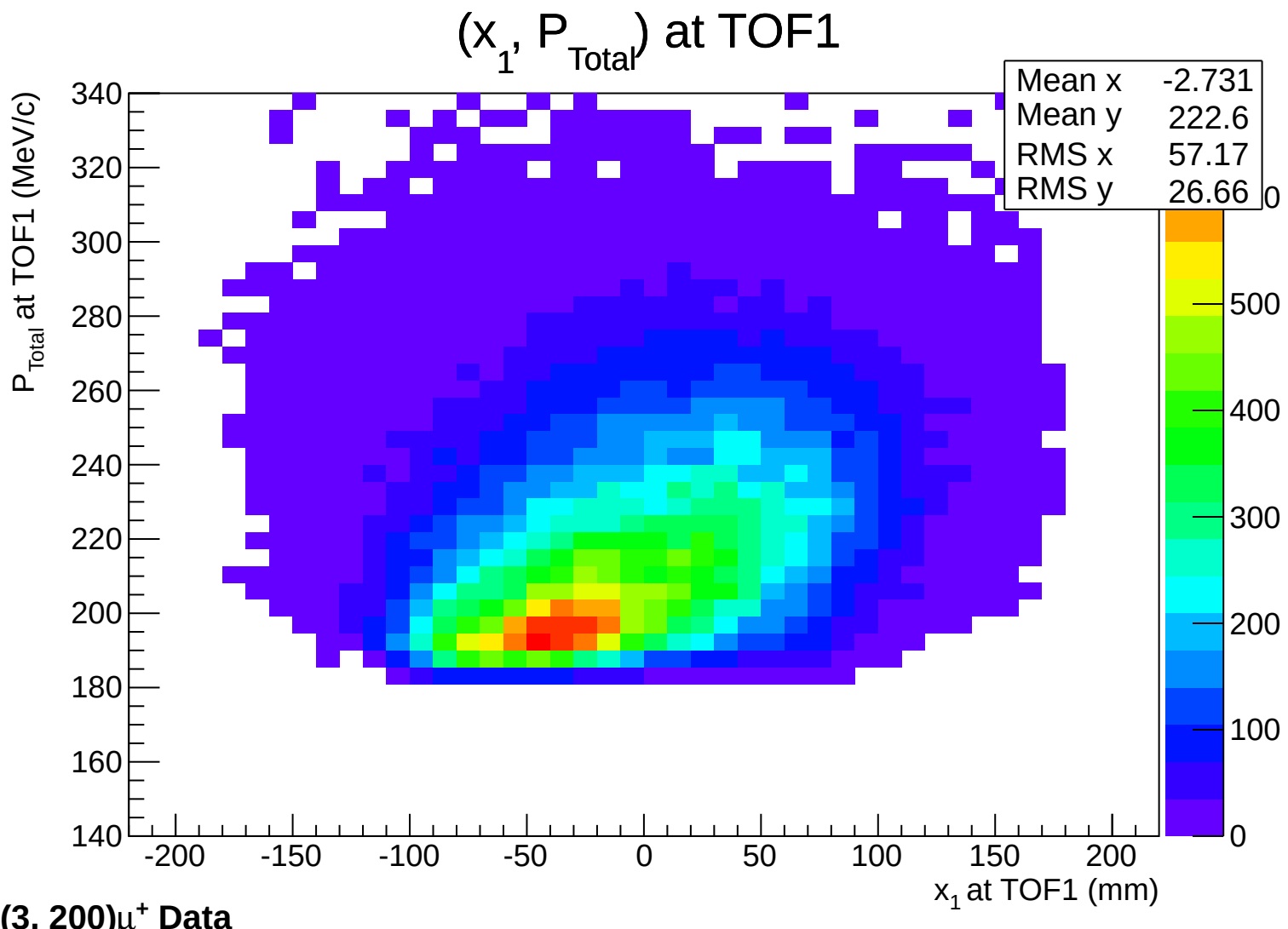
(3, 200)μ^+ Data


(x1, Pz) at TOF1
Mean x -2.734
Mean y 222.2
RMS x 57.17
RMS y 26.93
Pz at TOF1 (MeV/c)
400
350
300
250
200
150
-200
-150
-100
-50
0
50
100
150
200
x1 at TOF1 (mm)
800
700
600
500
400
300
200
100
0

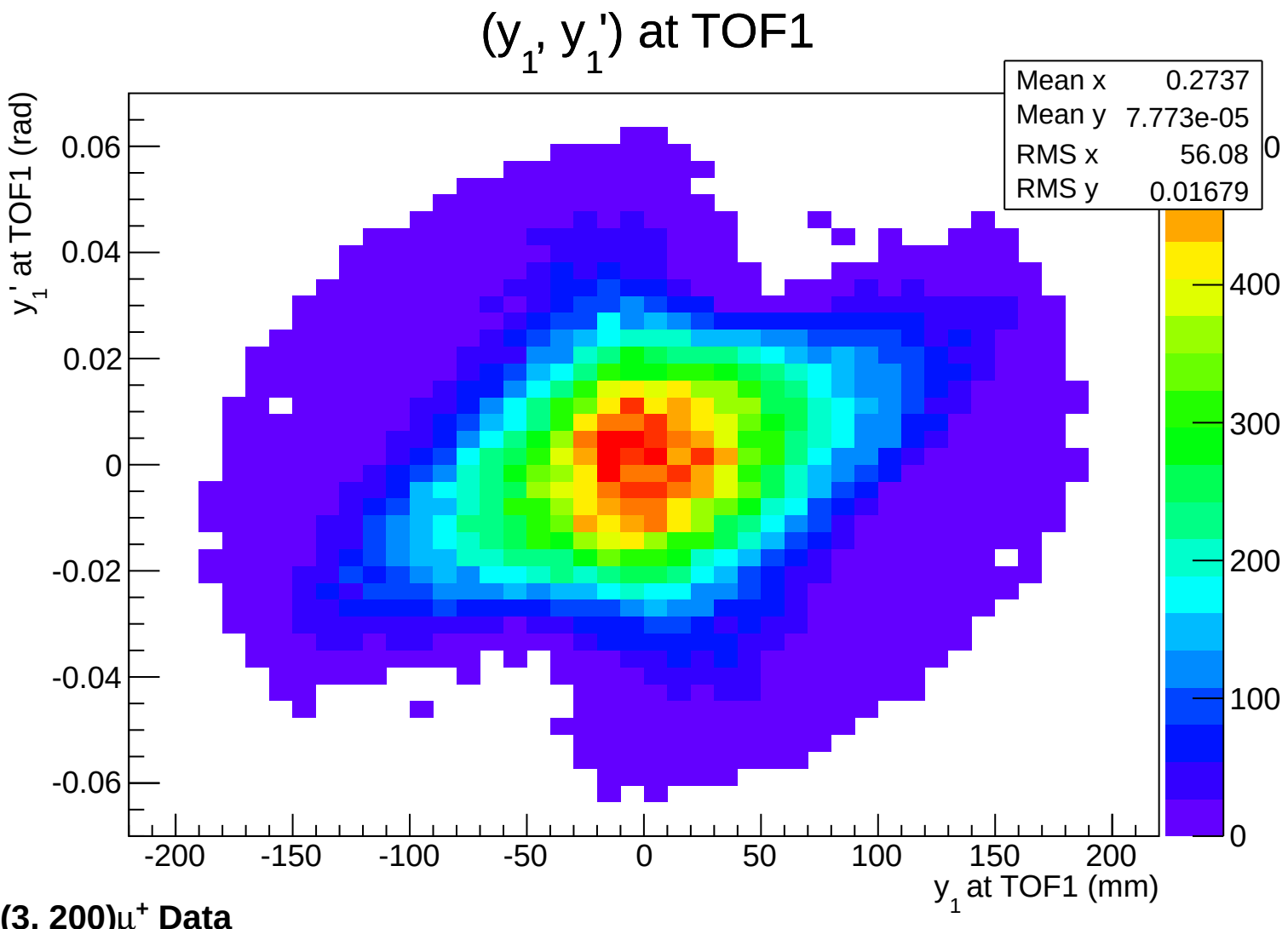
(3, 200)μ^+ Data


$(x_1, P_\perp)$ at TOF1
Mean x -2.734
Mean y 11.09
RMS x 57.16
RMS y 7.861
$P_\perp$ at TOF1 (MeV/c)
x_1 at TOF1 (mm)
0
5
10
15
20
25
30
35
40
45
50
-200
-150
-100
-50
0
50
100
150
200
0
100
200
300
400

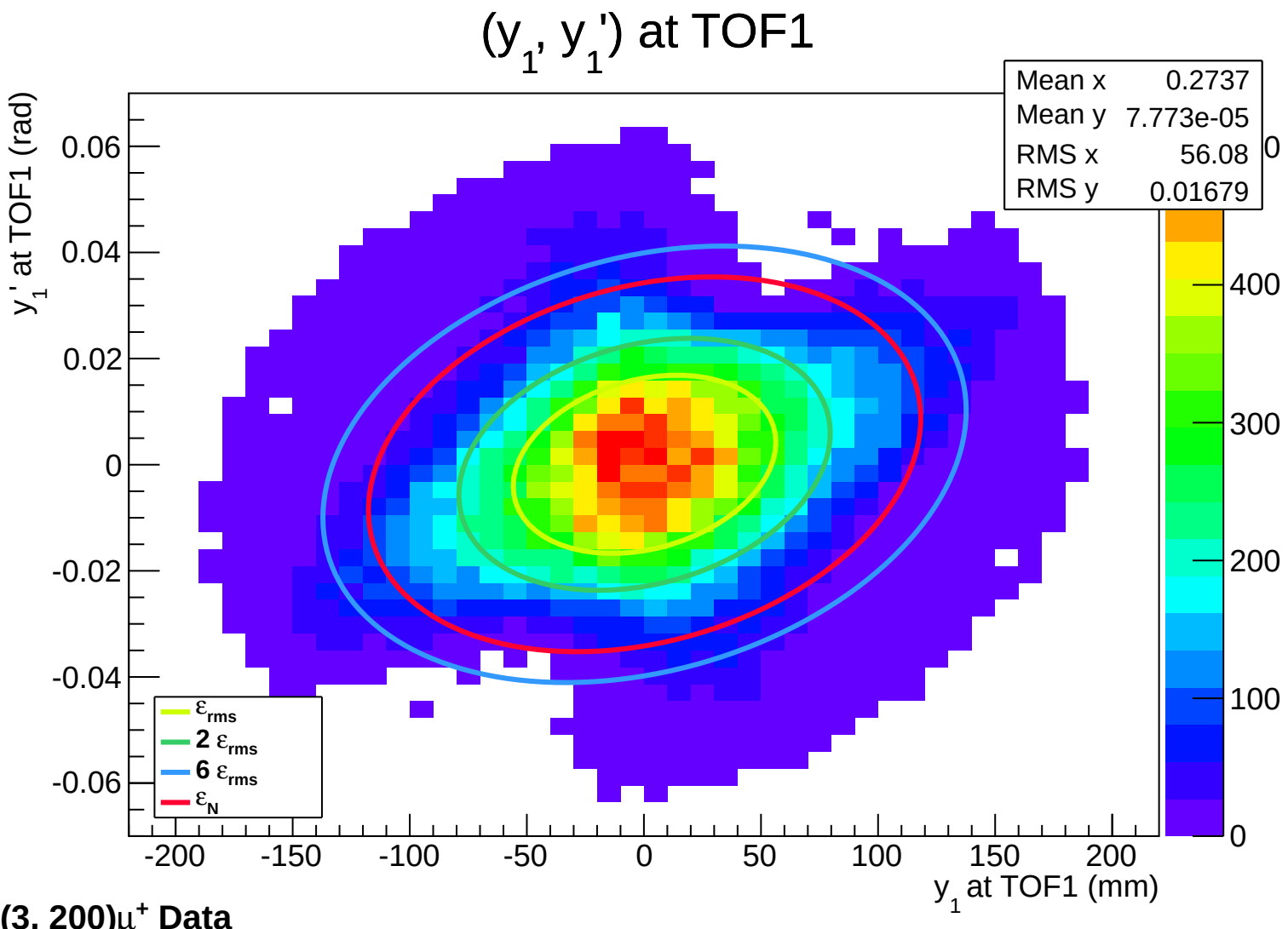
(3, 200)μ^+ Data


(x_1, P_{Total}) at TOF1
Mean x -2.731
Mean y 222.6
RMS x 57.17
RMS y 26.66
P_{Total} at TOF1 (MeV/c)
x_1 at TOF1 (mm)
340
320
300
280
260
240
220
200
180
160
140
-200
-150
-100
-50
0
50
100
150
200
500
400
300
200
100
0

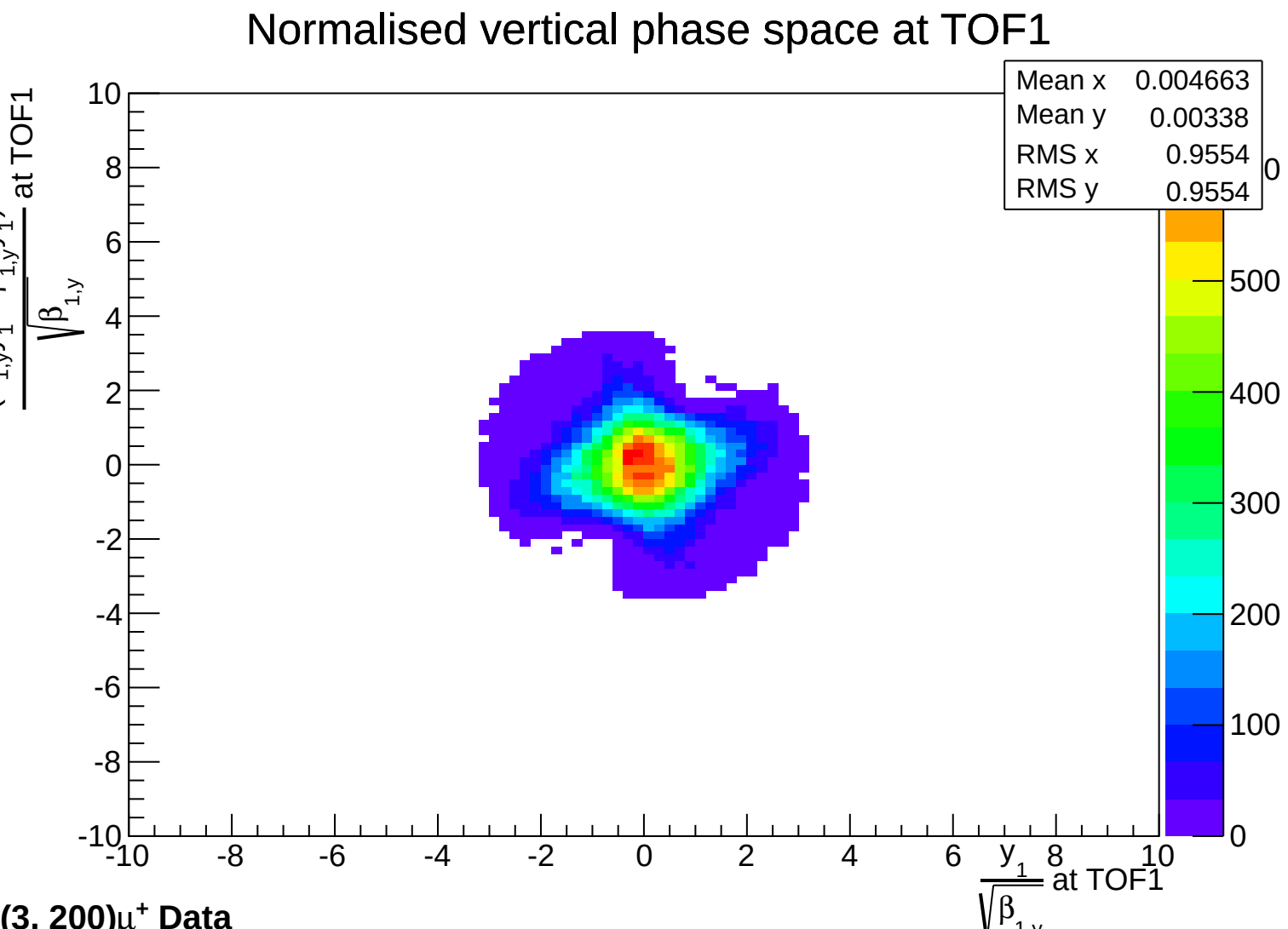
(3, 200)μ^+ Data

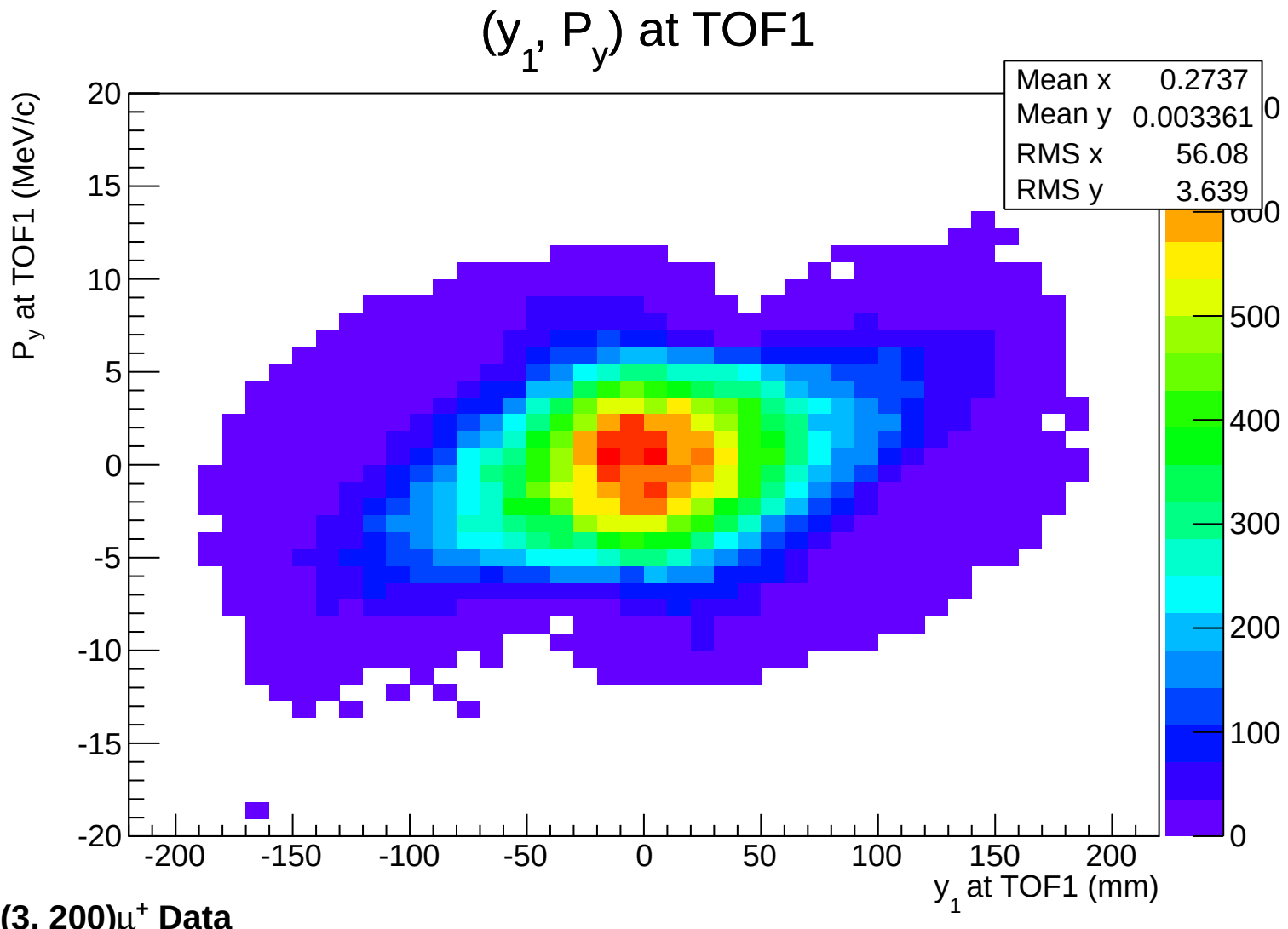

(y1, y1') at TOF1
Mean x 0.2737
Mean y 7.773e-05
RMS x 56.08
RMS y 0.01679
y1' at TOF1 (rad)
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-200
-150
-100
-50
0
50
100
150
200
y1 at TOF1 (mm)
400
300
200
100
0

(3, 200)μ^+ Data

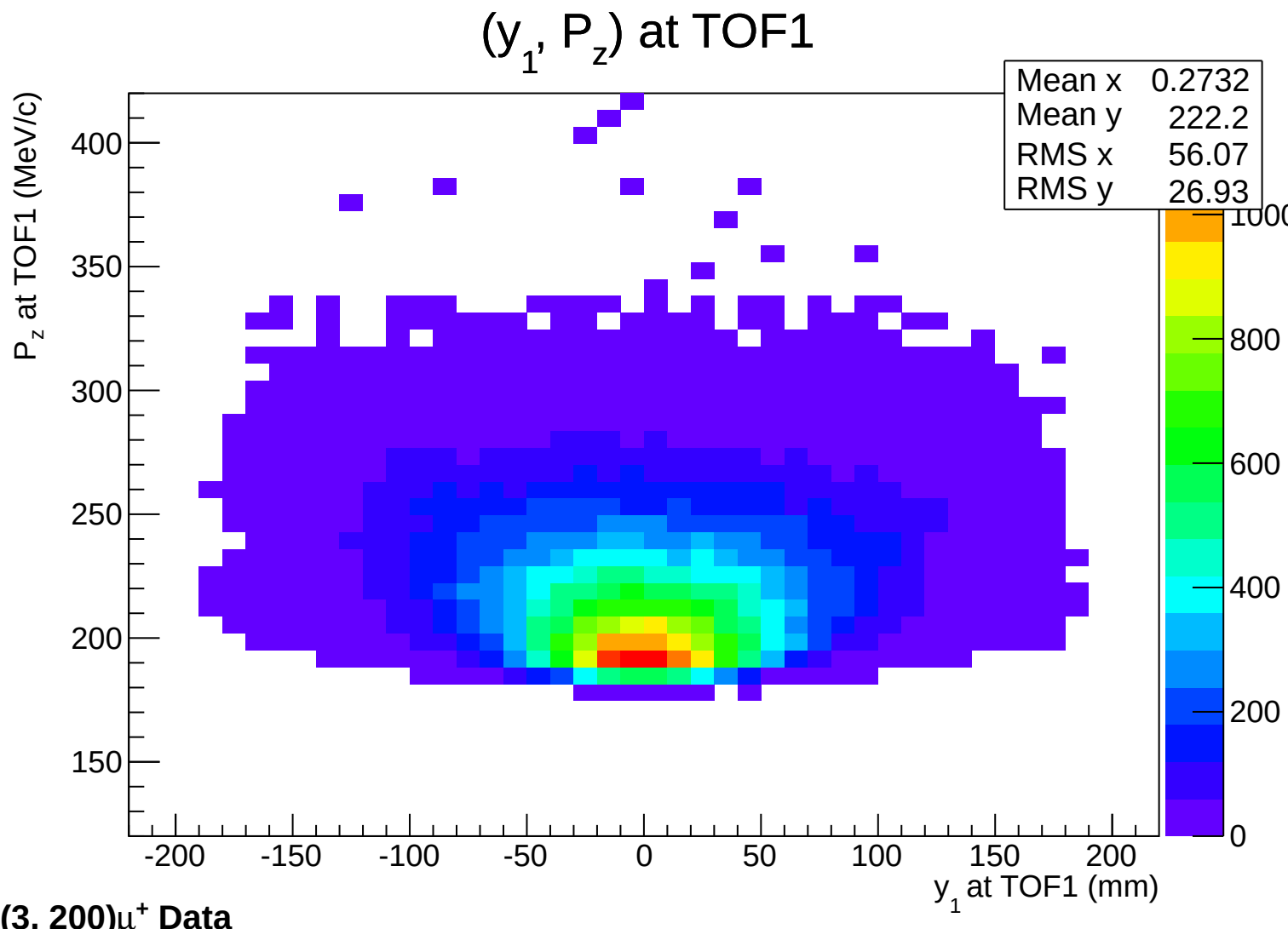

(y1, y1') at TOF1
Mean x 0.2737
Mean y 7.773e-05
RMS x 56.08
RMS y 0.01679
y1' at TOF1 (rad)
y1 at TOF1 (mm)
εrms
2 εrms
6 εrms
εN
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-200
-150
-100
-50
0
50
100
150
200
400
300
200
100
0

(3, 200)μ^+ Data

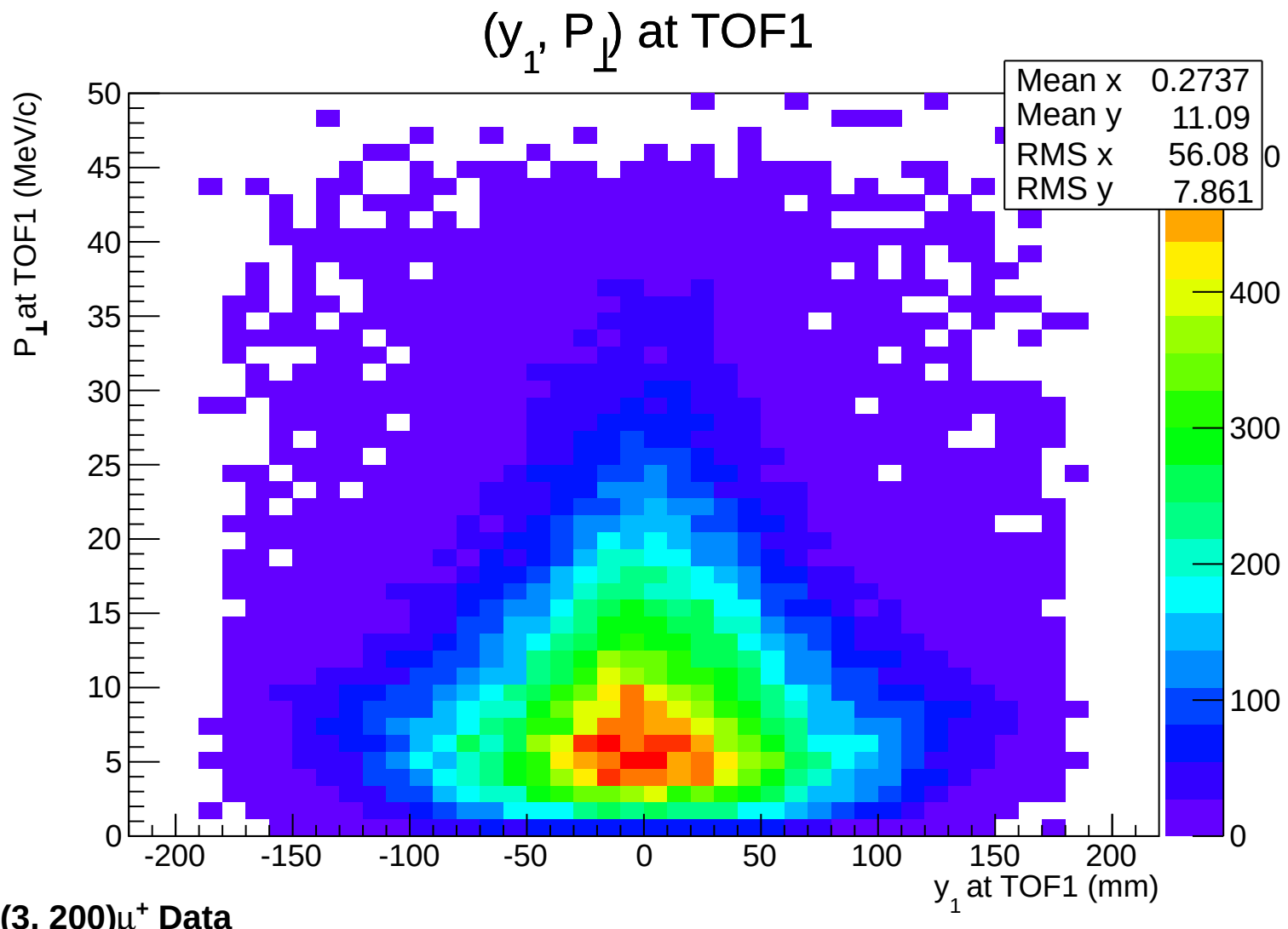

Normalised vertical phase space at TOF1
Mean x 0.004663
Mean y 0.00338
RMS x 0.9554
RMS y 0.9554
$\frac{y_1}{\sqrt{\beta_{1,y}}}$ at TOF1
$\frac{y_1}{\sqrt{\beta_{1,y}}}$ at TOF1
(3, 200)μ⁺ Data


(y1, Py) at TOF1
Mean x 0.2737
Mean y 0.003361
RMS x 56.08
RMS y 3.639
Py at TOF1 (MeV/c)
y1 at TOF1 (mm)
20
15
10
5
0
-5
-10
-15
-20
-200
-150
-100
-50
0
50
100
150
200
600
500
400
300
200
100
0

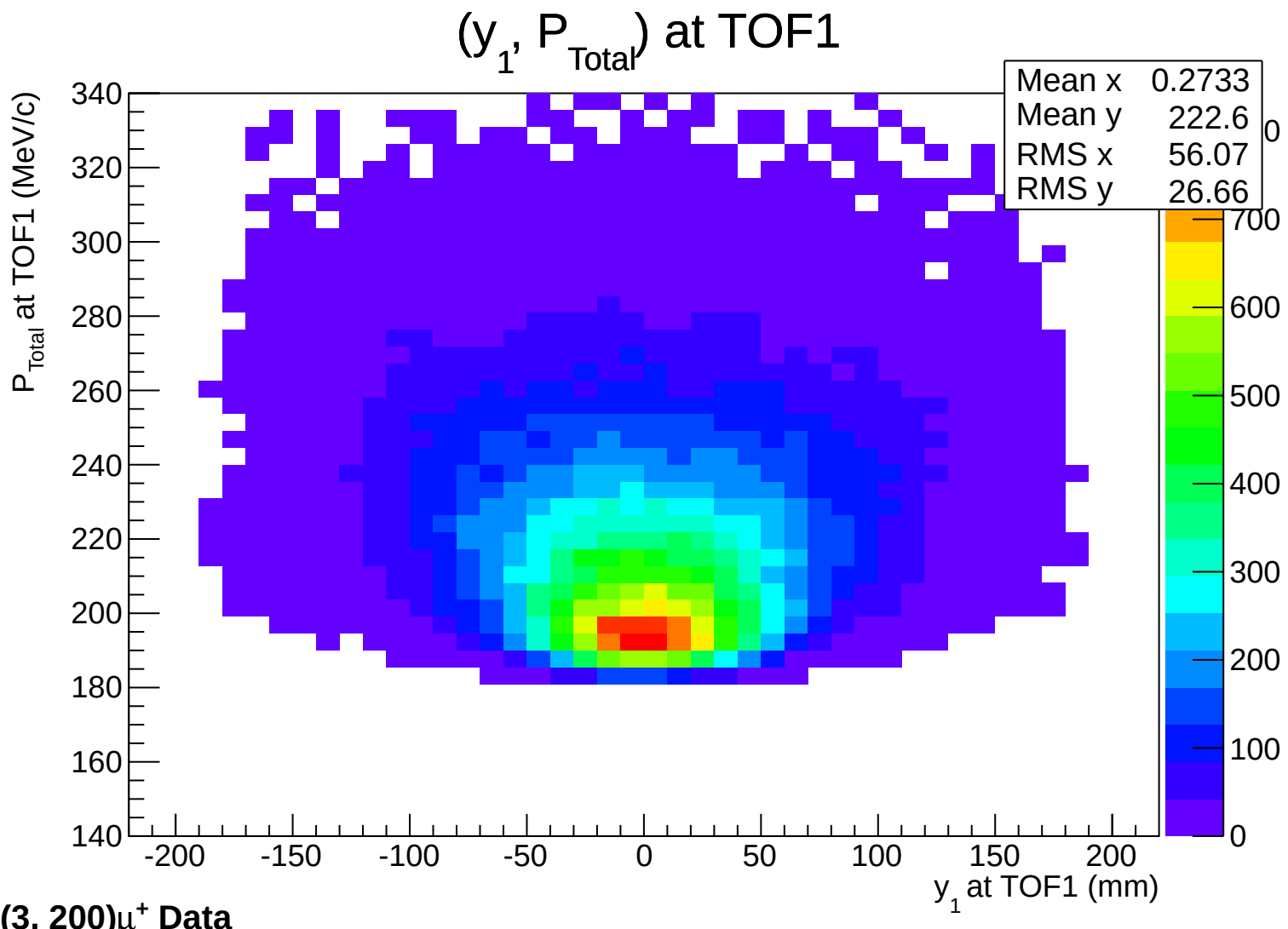
(3, 200)μ⁺ Data


(y1, Pz) at TOF1
Mean x 0.2732
Mean y 222.2
RMS x 56.07
RMS y 26.93
Pz at TOF1 (MeV/c)
400
350
300
250
200
150
-200
-150
-100
-50
0
50
100
150
200
y1 at TOF1 (mm)
1000
800
600
400
200
0

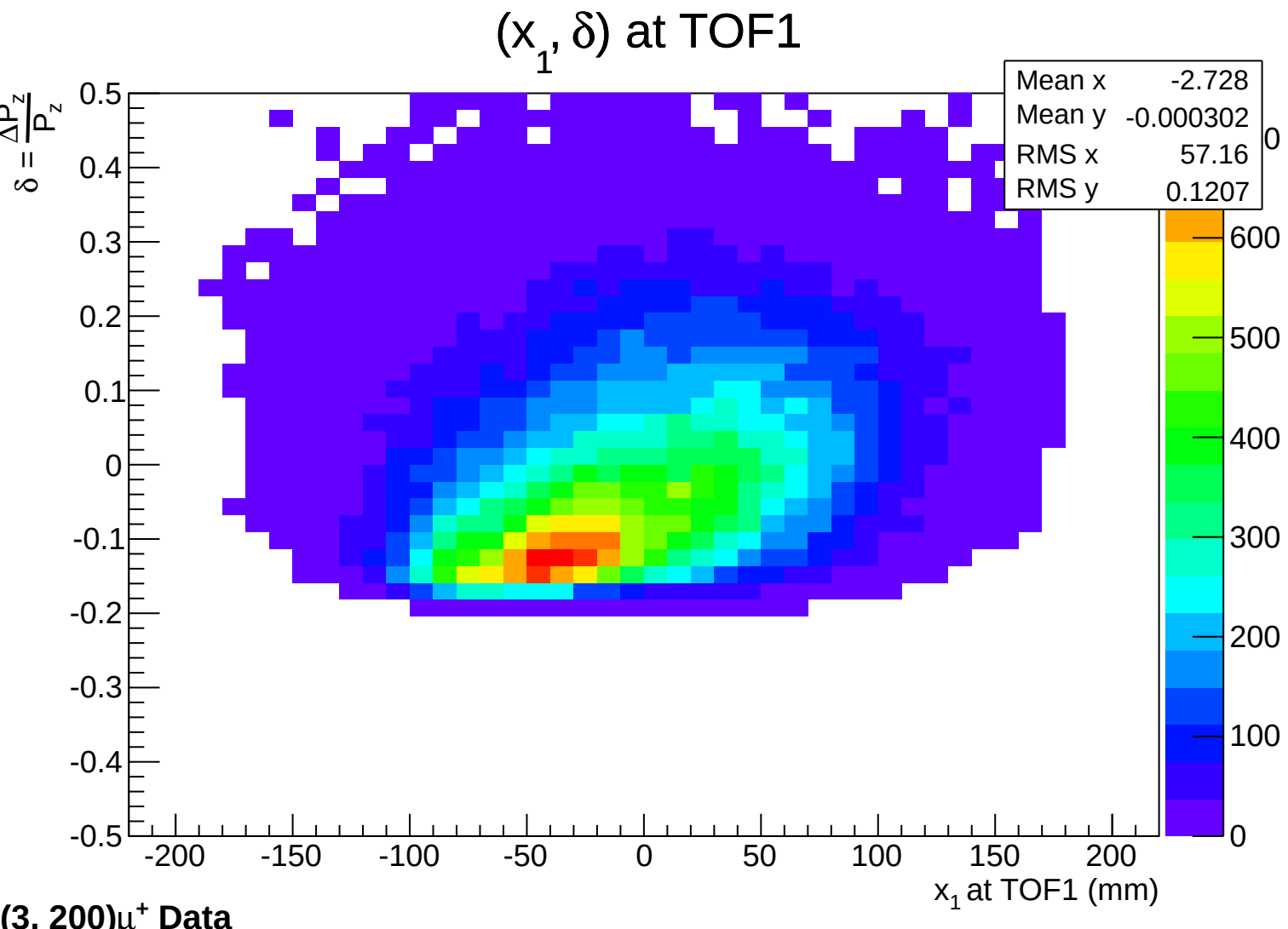
(3, 200)μ^+ Data


$(y_1, P_\perp)$ at TOF1
Mean x 0.2737
Mean y 11.09
RMS x 56.08
RMS y 7.861
$P_\perp$ at TOF1 (MeV/c)
y_1 at TOF1 (mm)
50
45
40
35
30
25
20
15
10
5
0
-200
-150
-100
-50
0
50
100
150
200
400
300
200
100
0

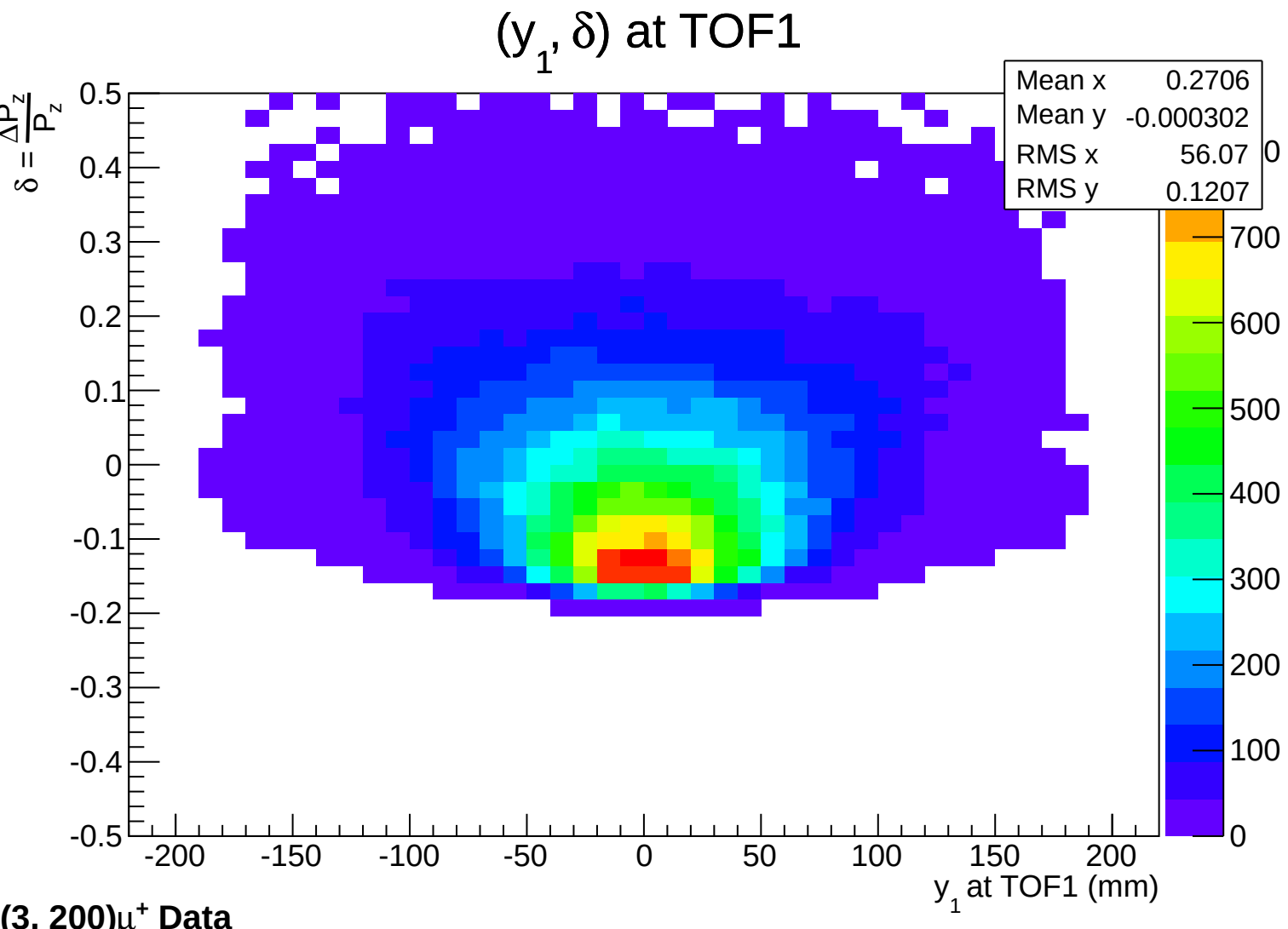
(3, 200)μ^+ Data

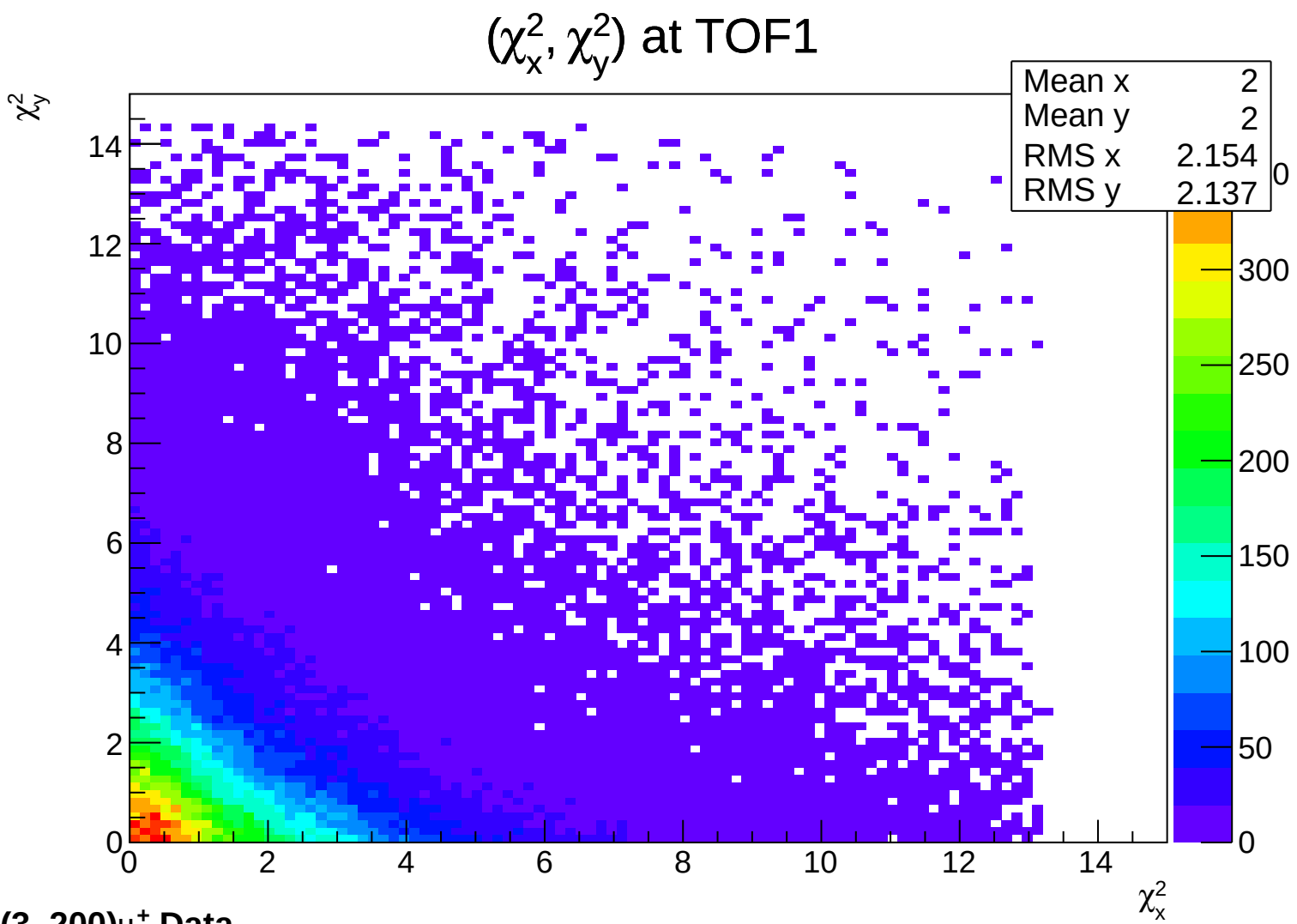

(y_1, P_{Total}) at TOF1
Mean x 0.2733
Mean y 222.6
RMS x 56.07
RMS y 26.66
P_{Total} at TOF1 (MeV/c)
340
320
300
280
260
240
220
200
180
160
140
-200
-150
-100
-50
0
50
100
150
200
y_1 at TOF1 (mm)
700
600
500
400
300
200
100
0

(3, 200)μ^+ Data


(x1, δ) at TOF1
Mean x -2.728
Mean y -0.000302
RMS x 57.16
RMS y 0.1207
δ = ΔPz/Pz
x1 at TOF1 (mm)
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-200
-150
-100
-50
0
50
100
150
200
600
500
400
300
200
100
0

(3, 200)μ^+ Data


(y1, δ) at TOF1
Mean x 0.2706
Mean y -0.000302
RMS x 56.07
RMS y 0.1207
δ = ΔPz/Pz
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-200
-150
-100
-50
0
50
100
150
200
y1 at TOF1 (mm)
700
600
500
400
300
200
100
0
(3, 200)μ+ Data


(χ_x^2, χ_y^2) at TOF1
Mean x 2
Mean y 2
RMS x 2.154
RMS y 2.137
χ_y^2
χ_x^2
0
2
4
6
8
10
12
14
0
50
100
150
200
250
300

(3, 200)μ^+ Data

Plots from (3, 200)μ^+ Data

The cuts used to make these plots were:

(A) To make sure muons pass within calibrated TOF slabs:

$-500 \leq x_0$, x at TOF0 $\leq$ 500 mm

$-500 \leq y_0$, y at TOF0 $\leq$ 500 mm

$-0.3 \leq x_0'$, x' at TOF0 $\leq$ 0.3 rad

$-0.3 \leq y_0'$, y' at TOF0 $\leq$ 0.3 rad

$-500 \leq x_1$, x at TOF1 $\leq$ 500 mm

$-500 \leq y_1$, y at TOF1 $\leq$ 500 mm

$-0.3 \leq x_1'$, x' at TOF1 $\leq$ 0.3 rad

$-0.3 \leq y_1'$, y' at TOF1 $\leq$ 0.3 rad

(B) To remove low momentum muons and/or select a momentum region:

$180 \leq P_z$ at TOF1 $\leq$ 600 MeV/c

(C) Muons that pass the above cuts are added to a covariance matrix, Σ_1. Muons must then pass a χ^2 cut such that

$\chi^2_x \leq 10$

$\chi^2_y \leq 10$

$\chi^2_{Pz} \leq$ None applied.

(D) Muons are now added to a second covariance matrix, Σ_2, and Twiss parameters are calculated.

NB: χ^2 is recalculated for all muons in Σ_2 before plotting here.