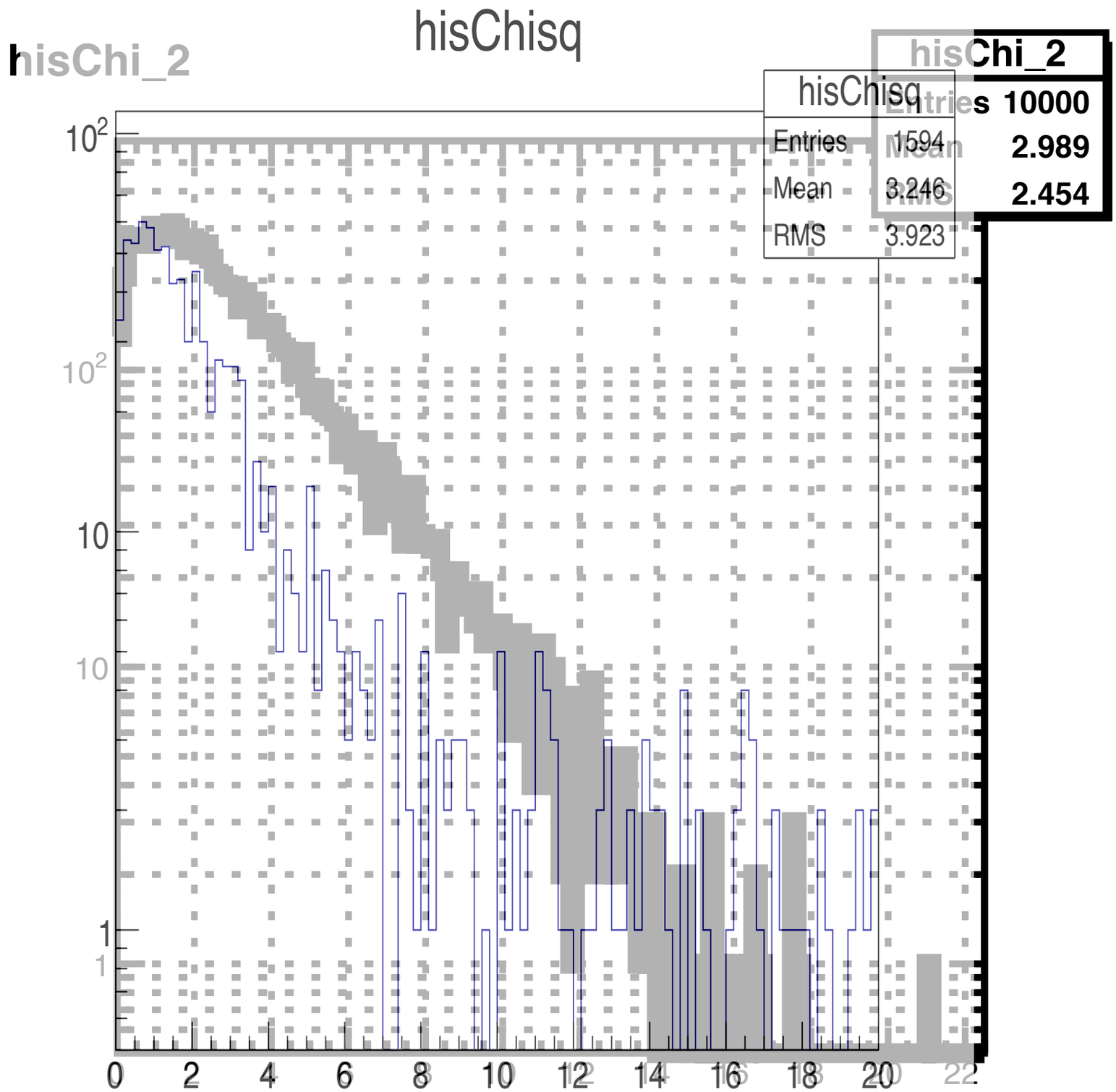
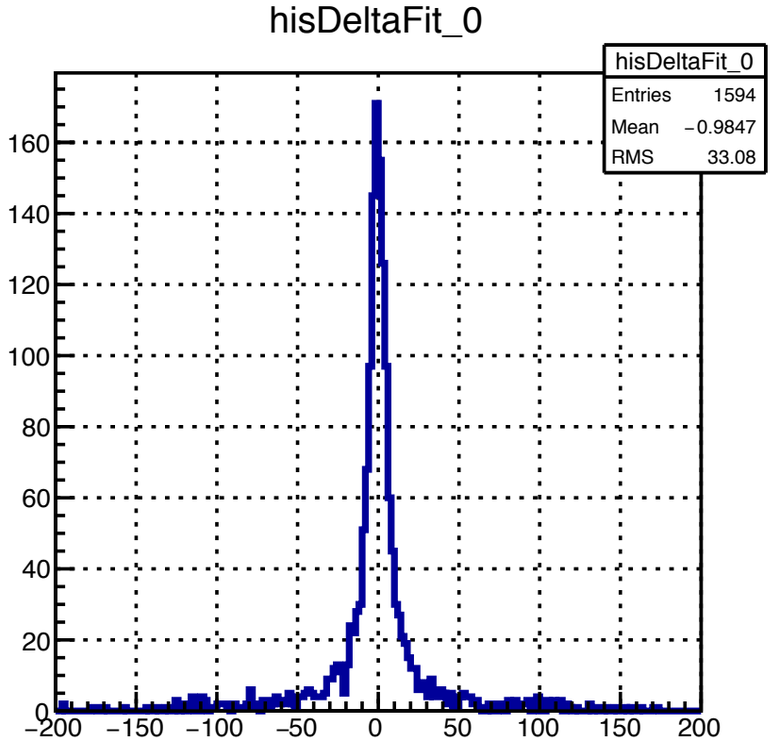
Halo KL with Constraints fitting

Halo event generation

- x, y : 2d-gaussian, sigma ~1m, select r < 0.5m
- z : 3000 at KOTO coordinate (CsI : 6.148 m, target -21m)
- momentum : various momentum, direction : target center(0,0,- 21 m) to (x,y,z)
- 1e6event generated.
- ChisqZ < 5 required


hisChi_2
hisChisq
hisChisq
Entries 1594
Mean 3.246
RMS 3.923
hisChi_2
Entries 10000
Mean 2.989
RMS 2.454
10^2
10^2
10
10
1
1
0 2 4 6 8 10 12 14 16 18 20 22

X


hisDeltaFit_0
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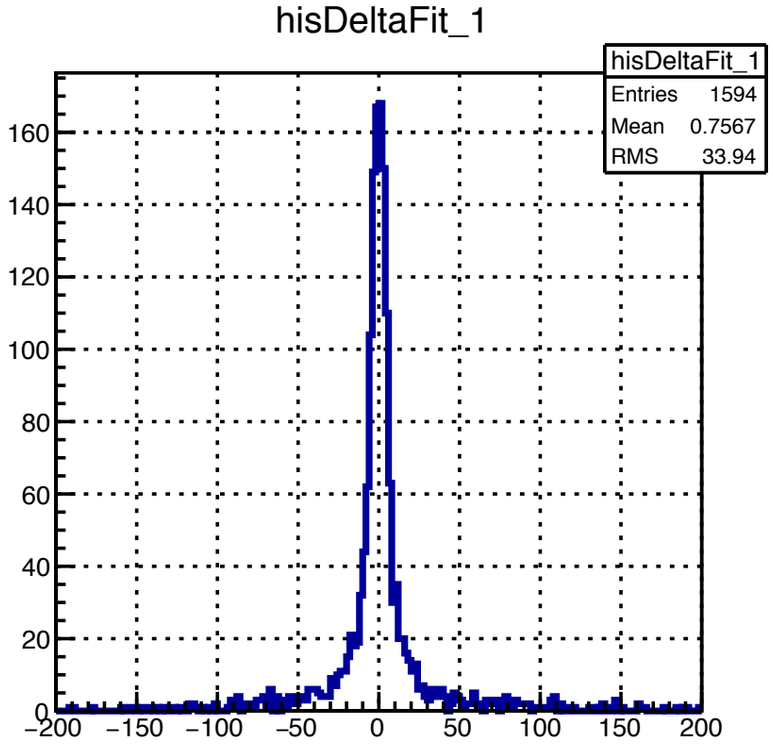
Entries 1594
Mean −0.9847
RMS 33.08
160
140
120
100
80
60
40
20
0
−200 −150 −100 −50 0 50 100 150 200

Y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Entries 1594
Mean 0.7567
RMS 33.94
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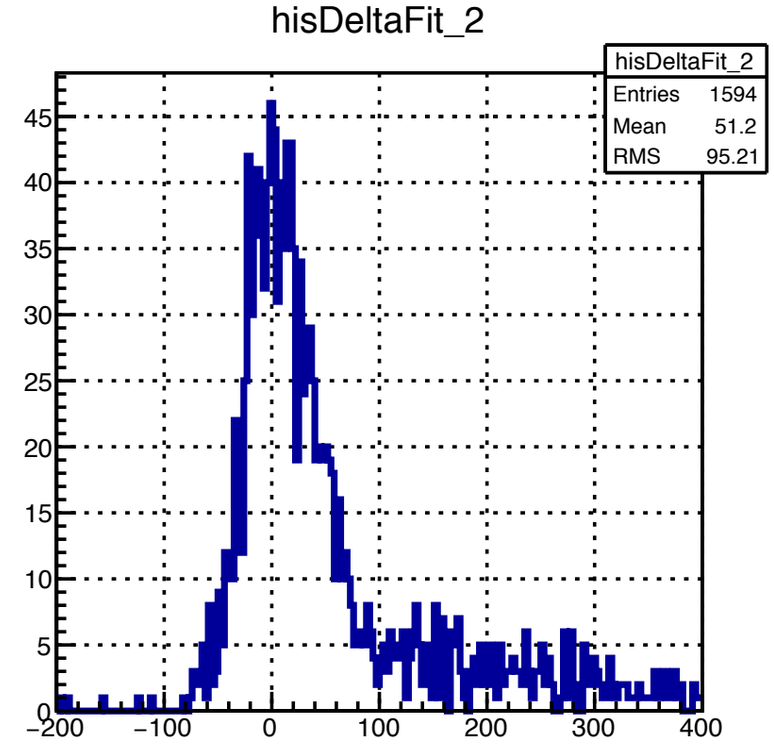
140
120
100
80
60
40
20
0
−200 −150 −100 −50 0 50 100 150 200

Z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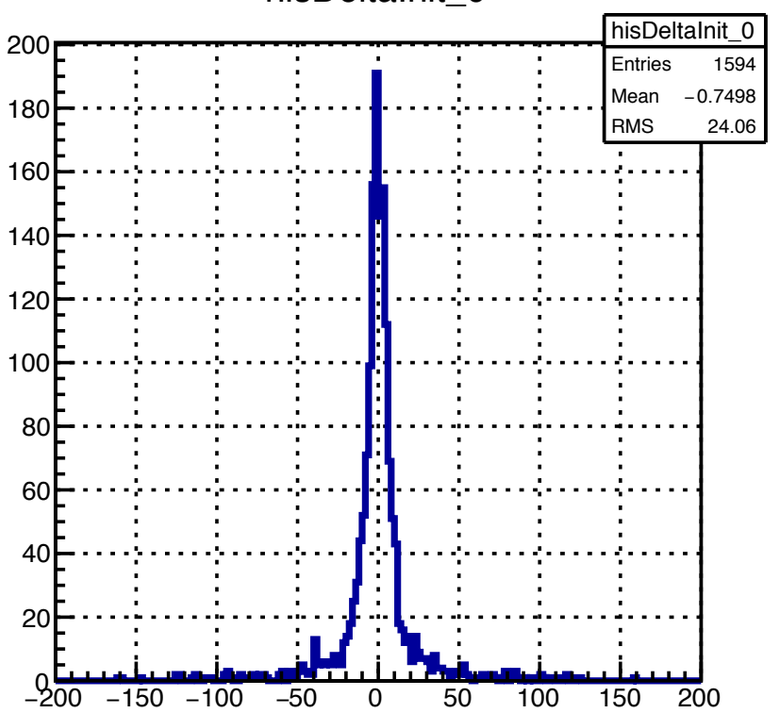
Mean 51.2
RMS 95.21
45
40
35
30
25
20
15
10
5
0
−200 −100 0 100 200 300 400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Mean −0.7498
RMS 24.06
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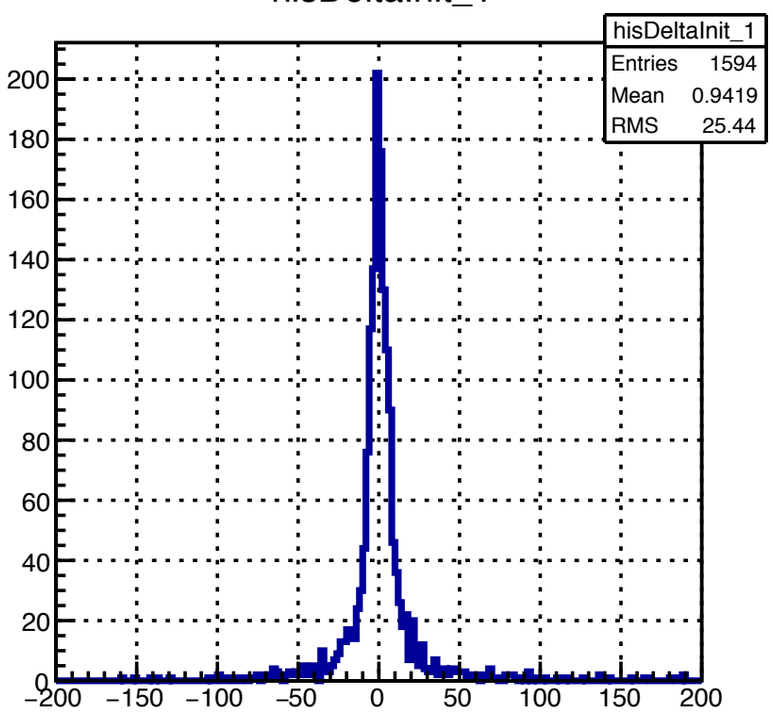
180
160
140
120
100
80
60
40
20
0
−200 −150 −100 −50 0 50 100 150 200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hisDeltaInit_1
Entries 1594
Mean 0.9419
RMS 25.44
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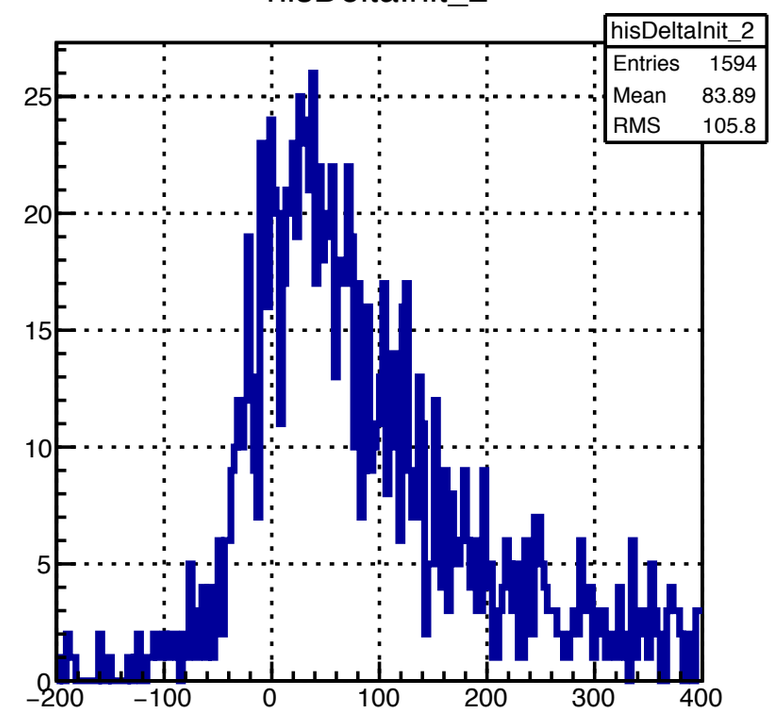
180
160
140
120
100
80
60
40
20
0
−200 −150 −100 −50 0 50 100 150 200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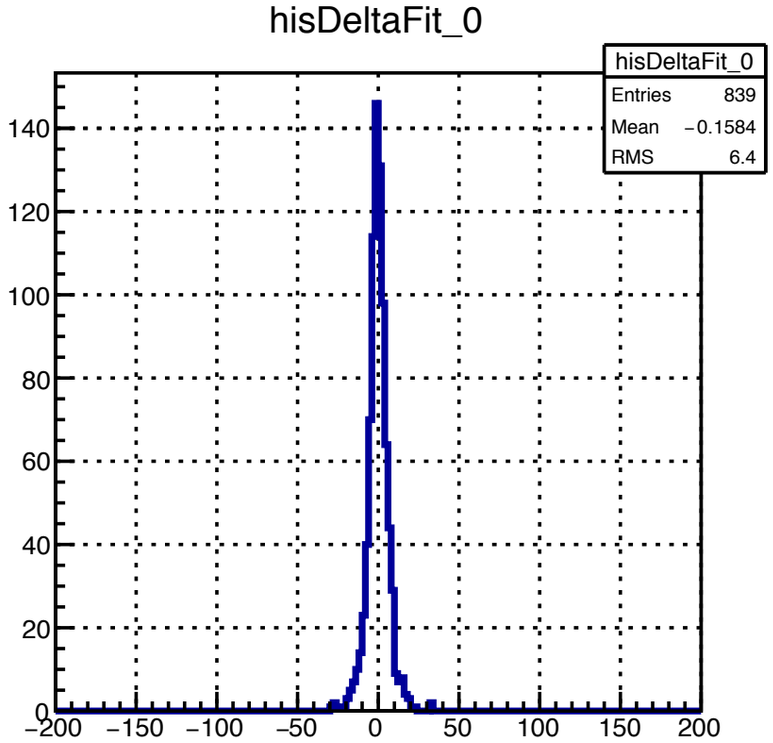
Entries 1594
Mean 83.89
RMS 105.8
25
20
15
10
5
0
−200 −100 0 100 200 300 400

X


hisDeltaFit_0
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Mean −0.1584
RMS 6.4
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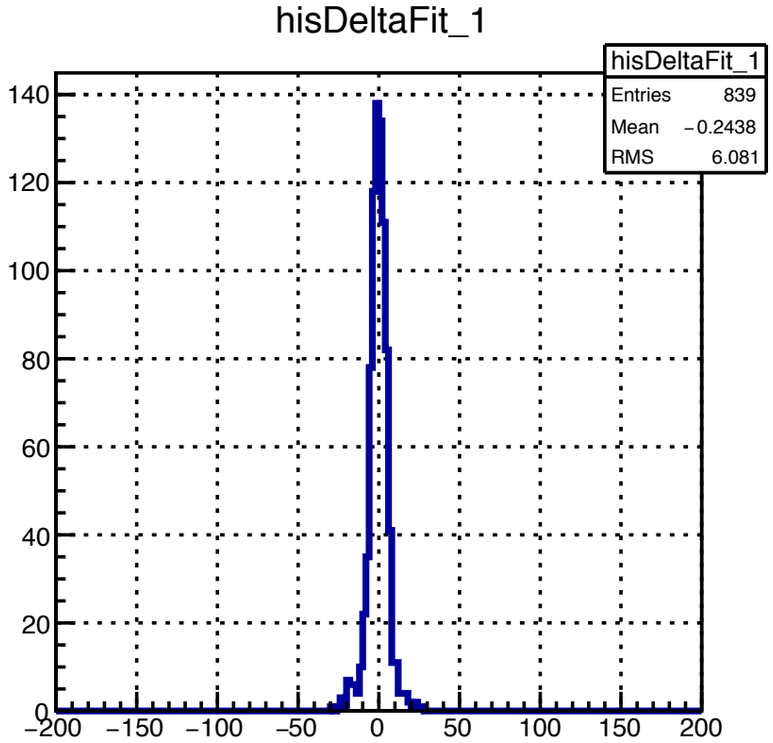
120
100
80
60
40
20
0
−200 −150 −100 −50 0 50 100 150 200

Y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Mean −0.2438
RMS 6.081
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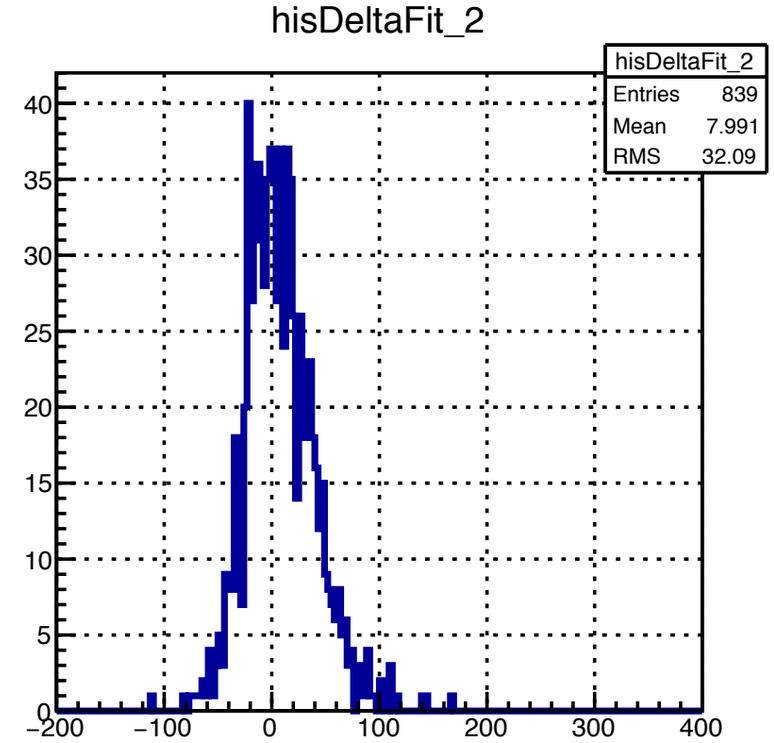
120
100
80
60
40
20
0
−200 −150 −100 −50 0 50 100 150 200

Z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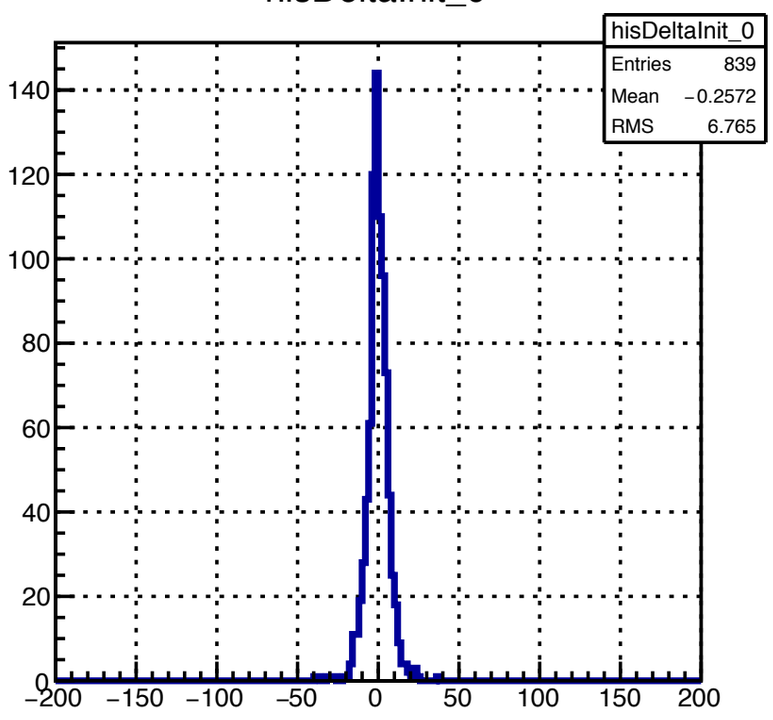
Entries 839
Mean 7.991
RMS 32.09
40
35
30
25
20
15
10
5
0
−200 −100 0 100 200 300 400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Mean −0.2572
RMS 6.765
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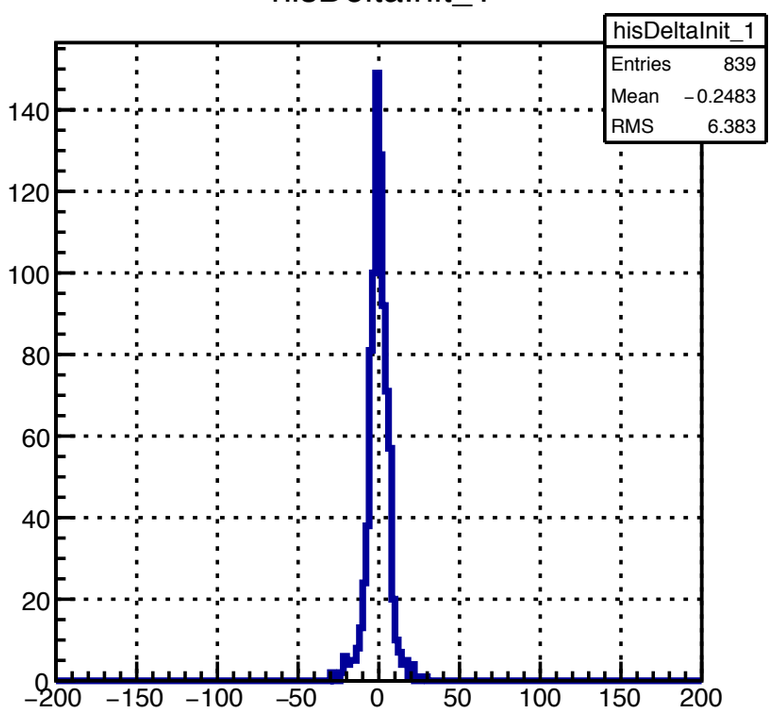
120
100
80
60
40
20
0
−200 −150 −100 −50 0 50 100 150 200


hisDeltaInit_1
hisDeltaInit_1
Entries 839
Mean −0.2483
RMS 6.383
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120
100
80
60
40
20
0
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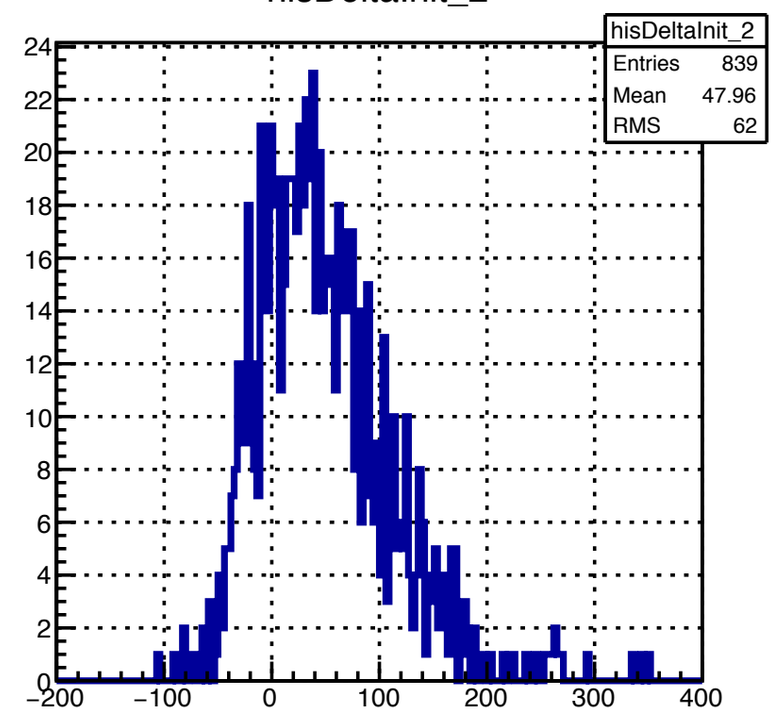
hisDeltaInit_2
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Entries 839
Mean 47.96
RMS 62
24
22
20
18
16
14
12
10
8
6
4
2
0
−200 −100 0 100 200 300 400

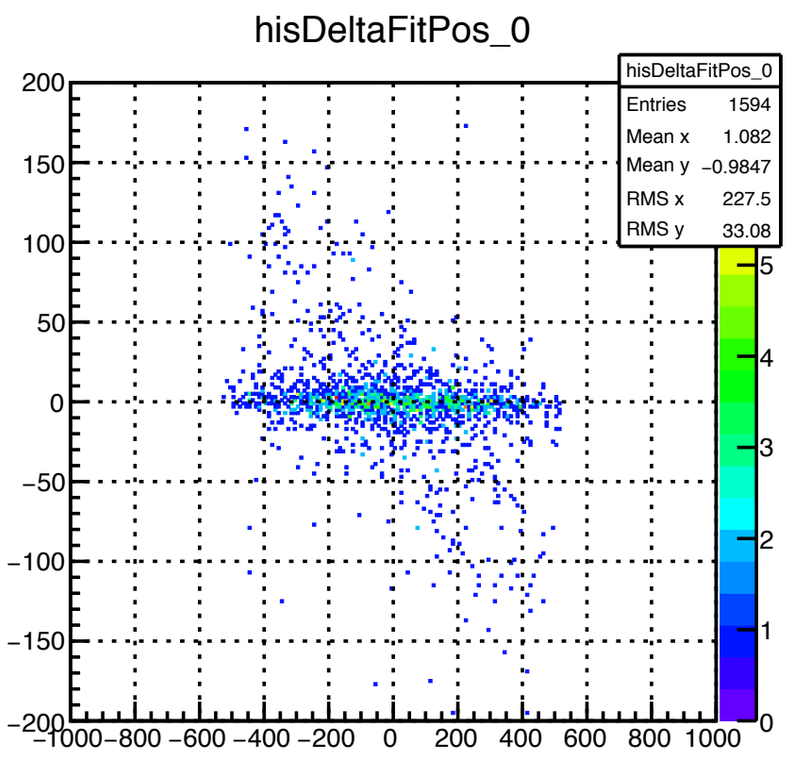
RMS(mm) of residuals from MC value

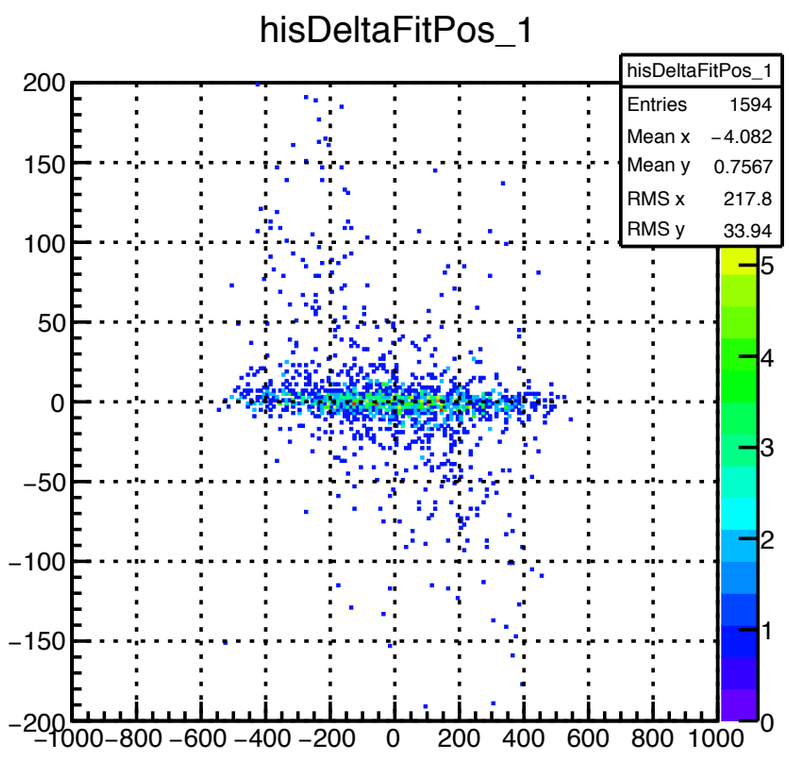
KL position	KOTO	KOTO (cut)	Kinematic	Kinematic (cut)
X	24	6.8	33	6.4
Y	25	6.4	34	6.1
Z	106	62	95	32

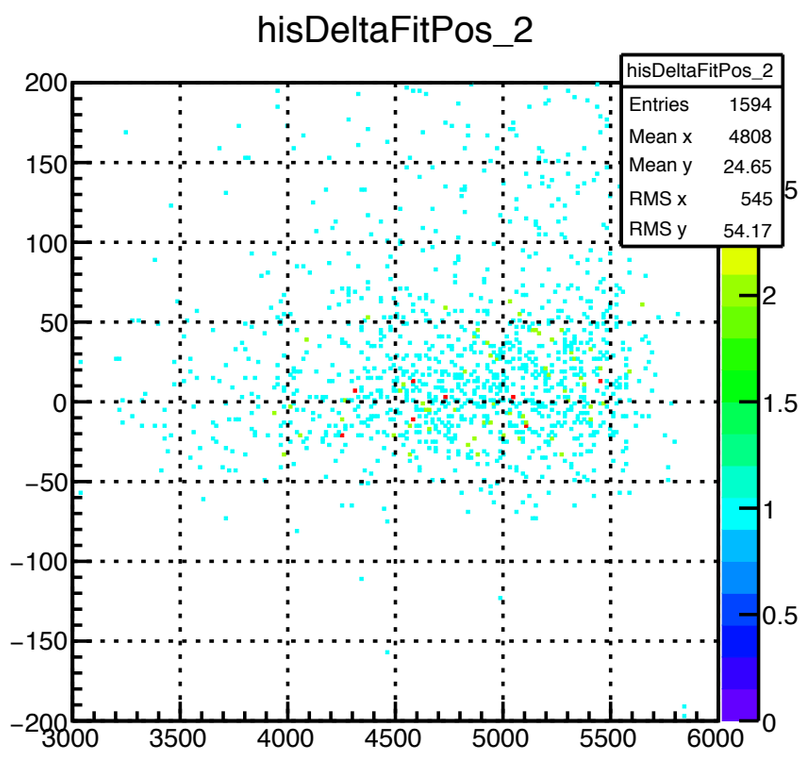
Conclusion

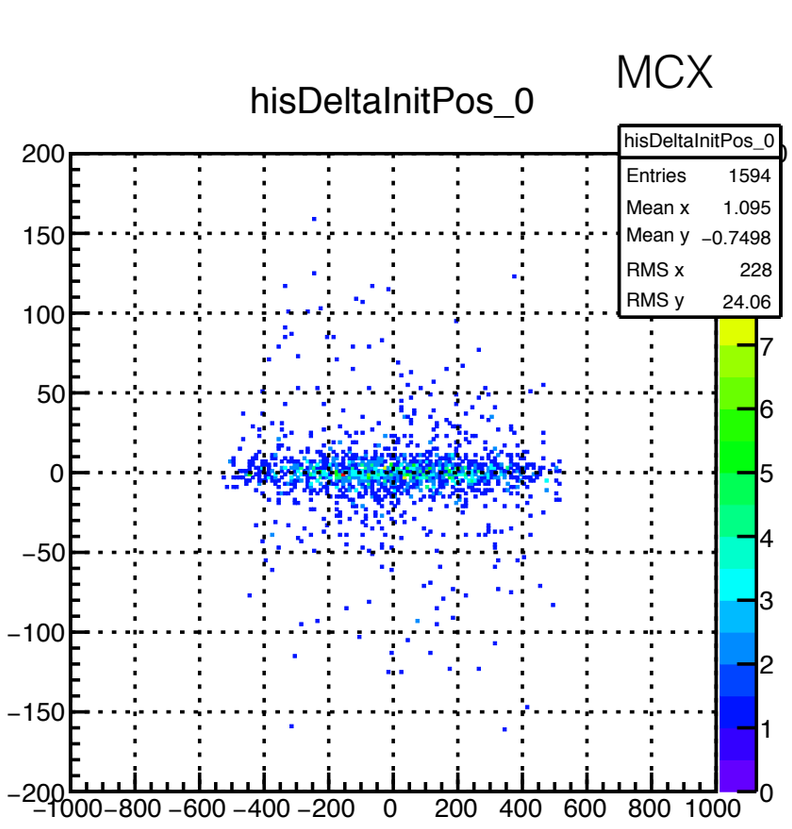
Using Chi-square from the kinematic fitting method, we can determine KL decay vertex with uncertainty of 6 mm for x, y and 3 cm for z.

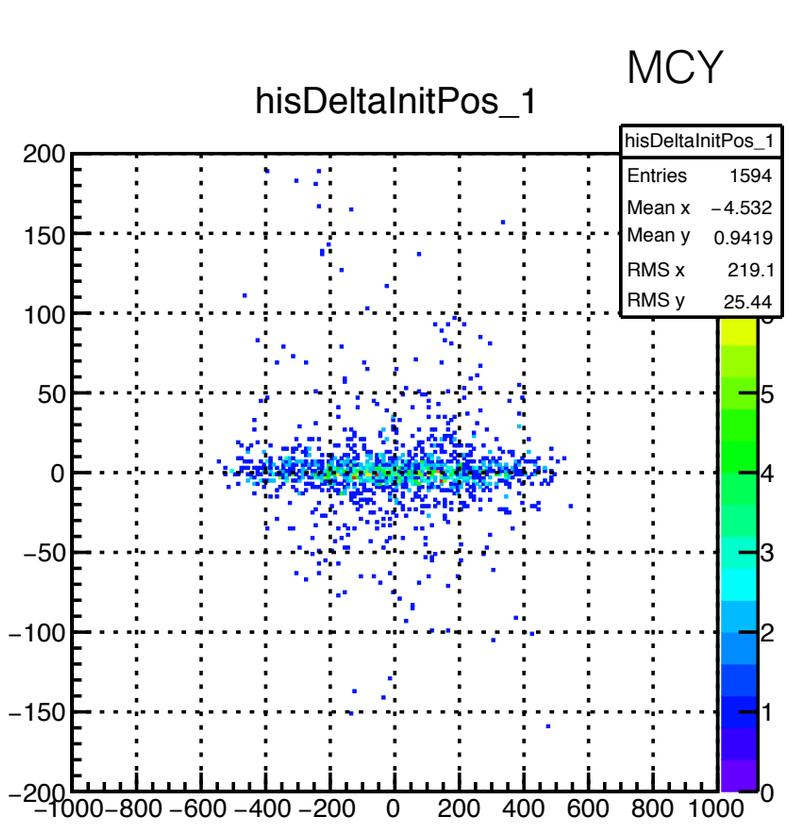
Residual (Fit or KOTO - MC) vs MC

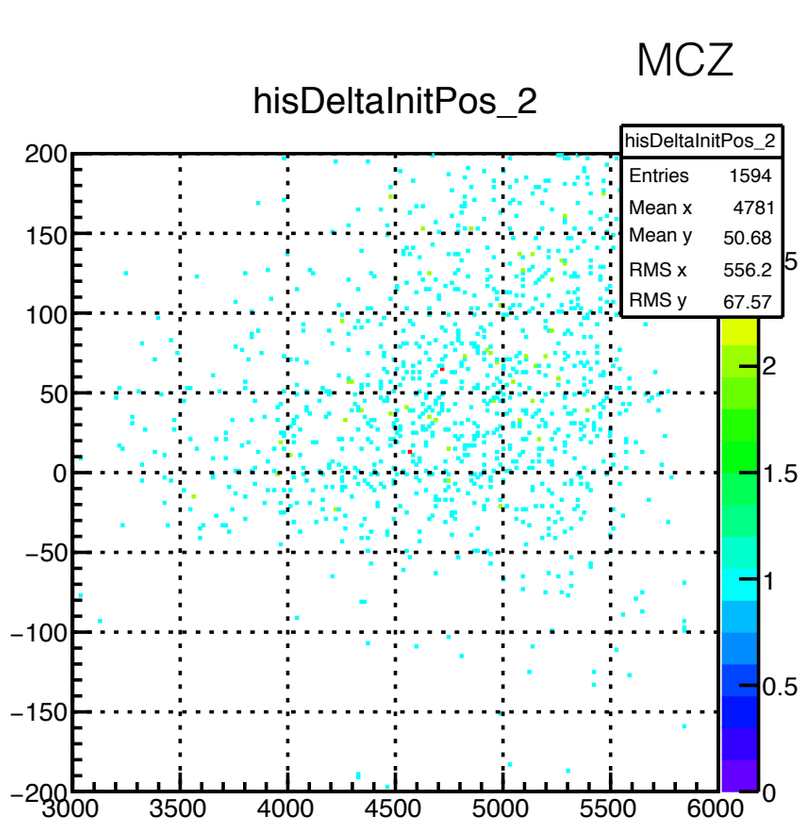




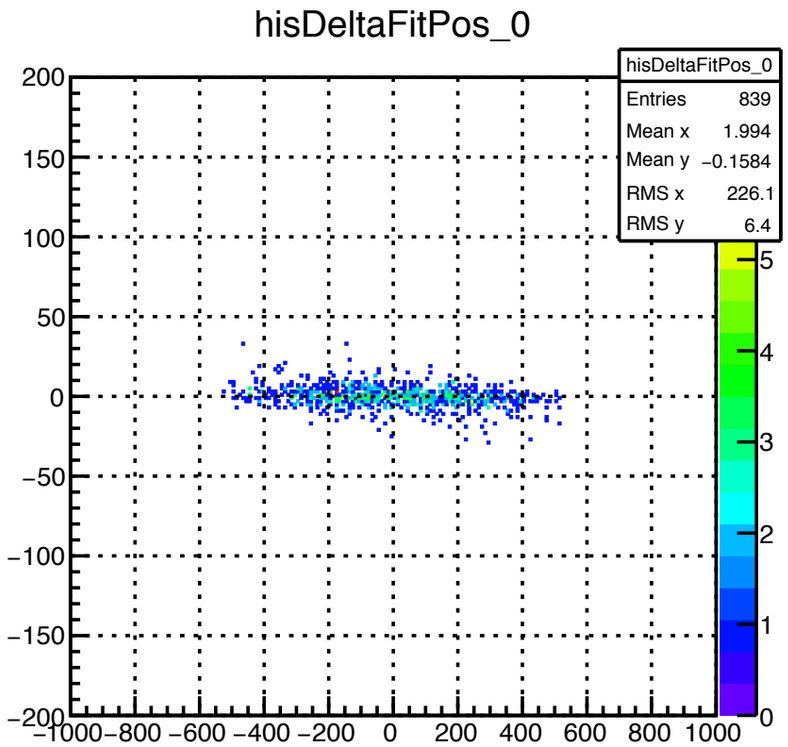


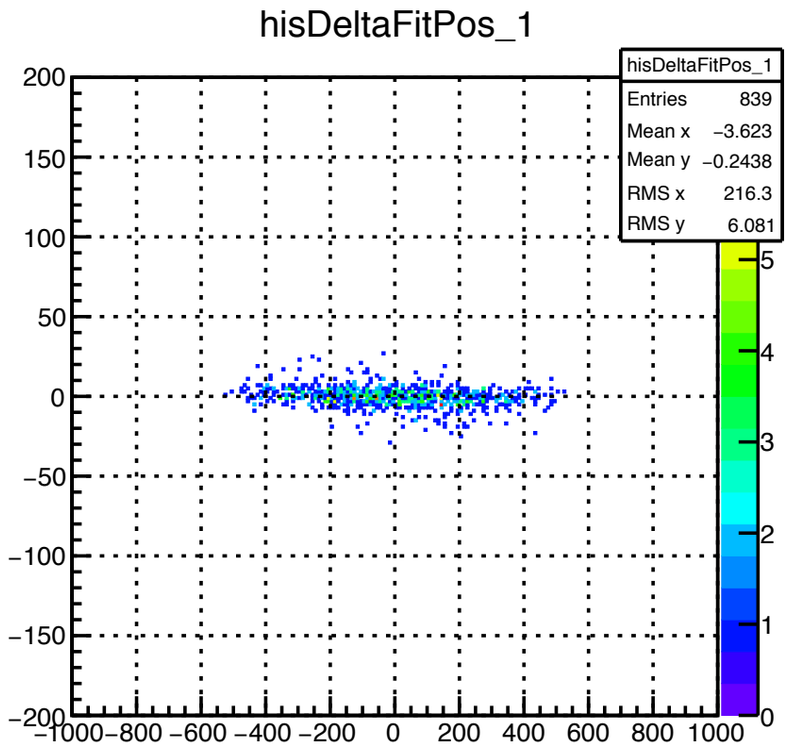


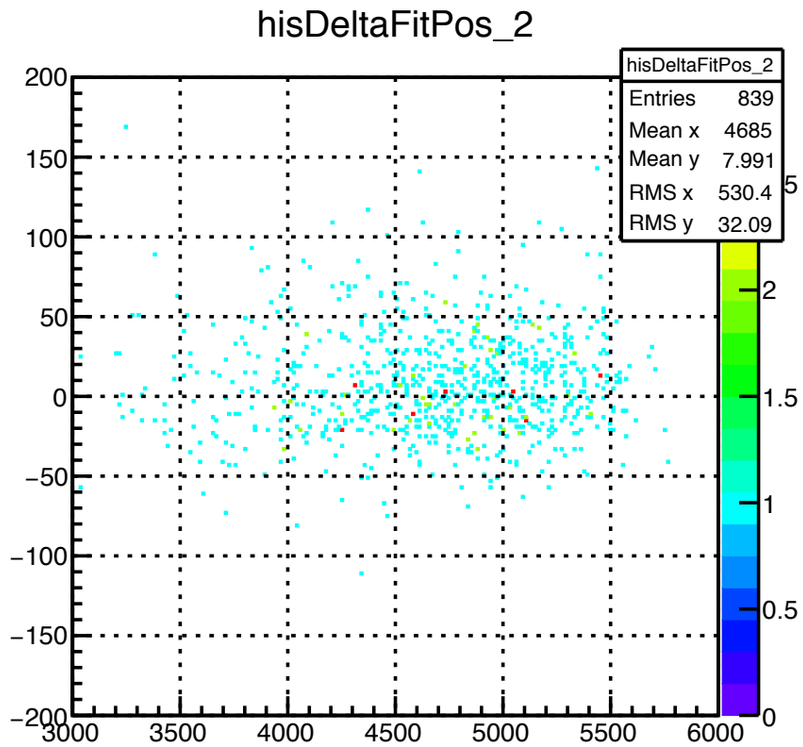




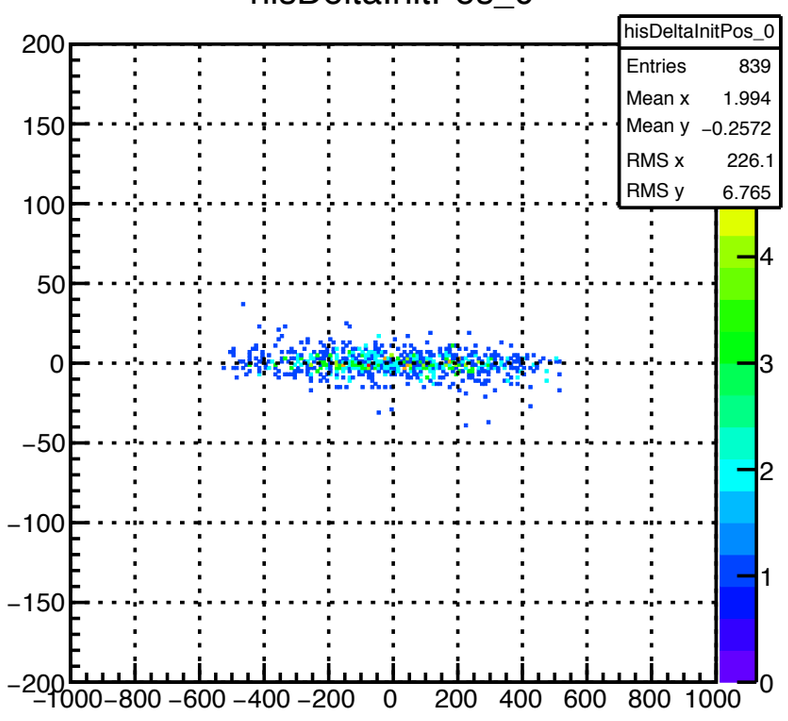
Residual (Fit or KOTO - MC) vs MC -Chisq2 < 10



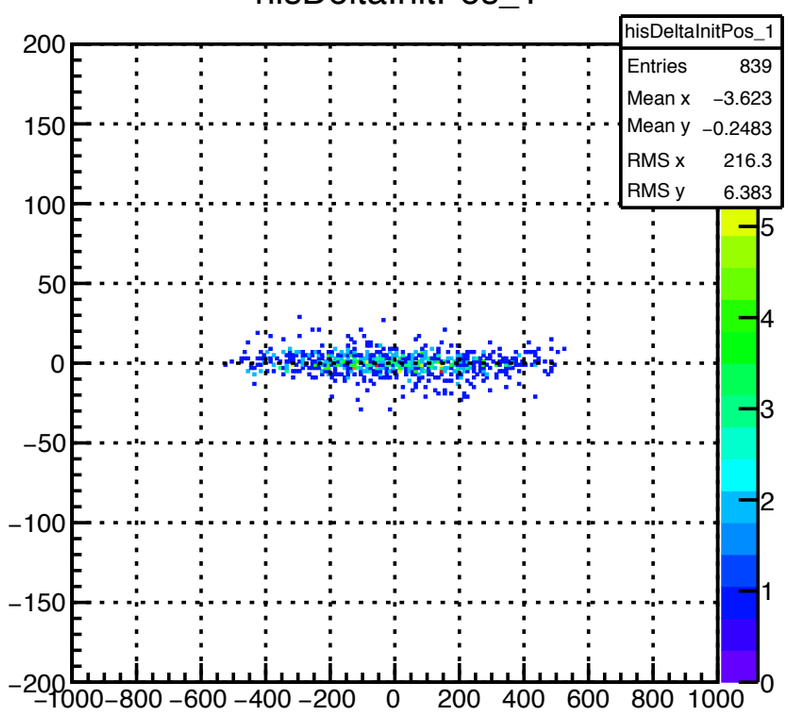




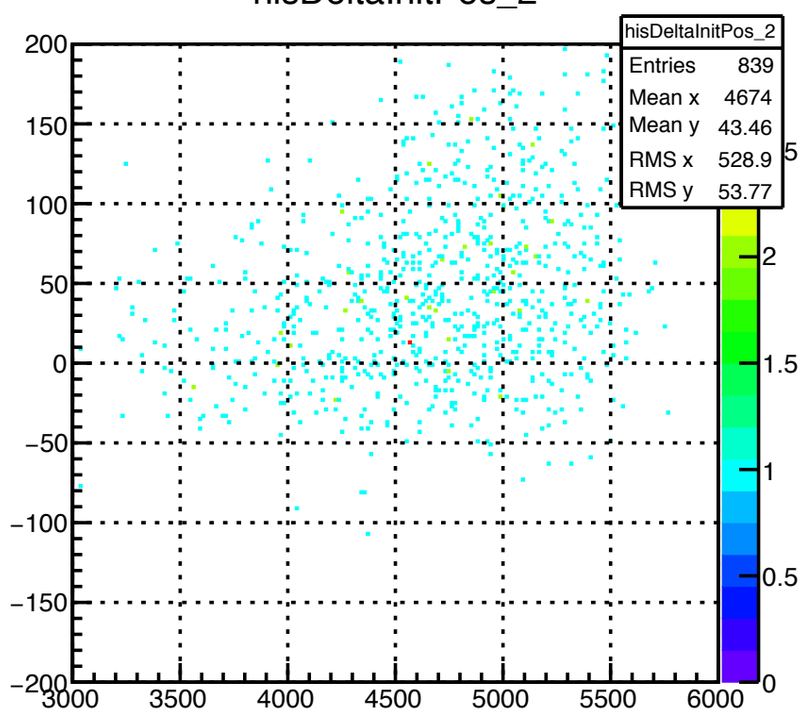
MCX



MCY



MCZ



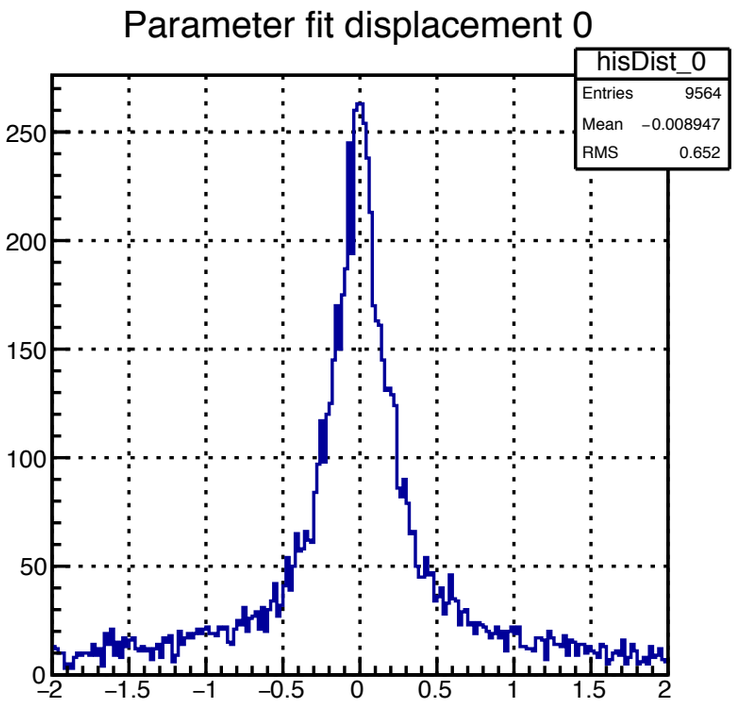
MCX

MCY

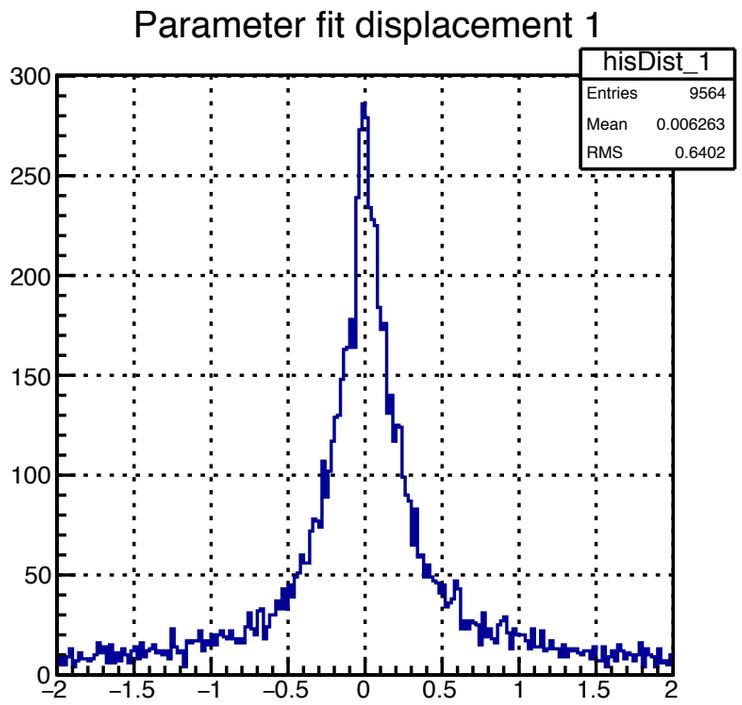
MCZ

Parameter distribution(p_f - p_i/dp)

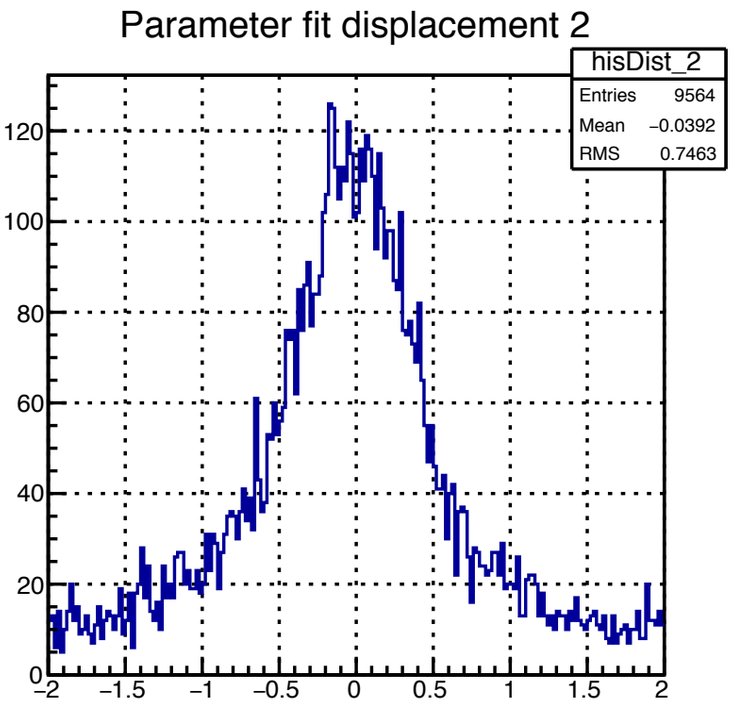
Gamma X



Gamma Y

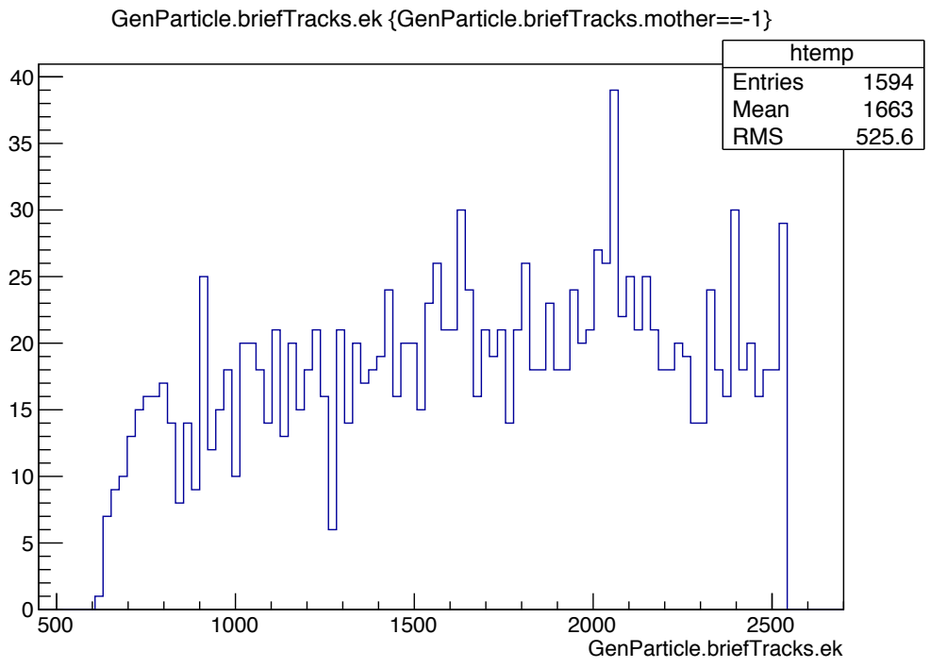


Gamma E



MC KL distributions

KL energy(EK)



KL Position(x,y)