

Weekly Report

Yebo

2020.07.07

OUTLINE

- Comparisons between before and after TPC smearing
- Modify the resolutions of sub-detectors
- Turn off the TPC
- Summary

Comparisons between before and after TPC smearing

- Hits distributions
- Resolutions of local x and local y of TPC
- Residuals and pulls
- Fitting outcomes

Comparisons between before and after TPC smearing

- Branch: combine-bump
 - Before TPC smearing
(commit id: 047c8ebab2da85ac2e9b2d1daec7762e5e763eec)
 - After TPC smearing
(commit id: d55e55fca5b1c18c4b21664a1ccb34dd35f6d8a7)

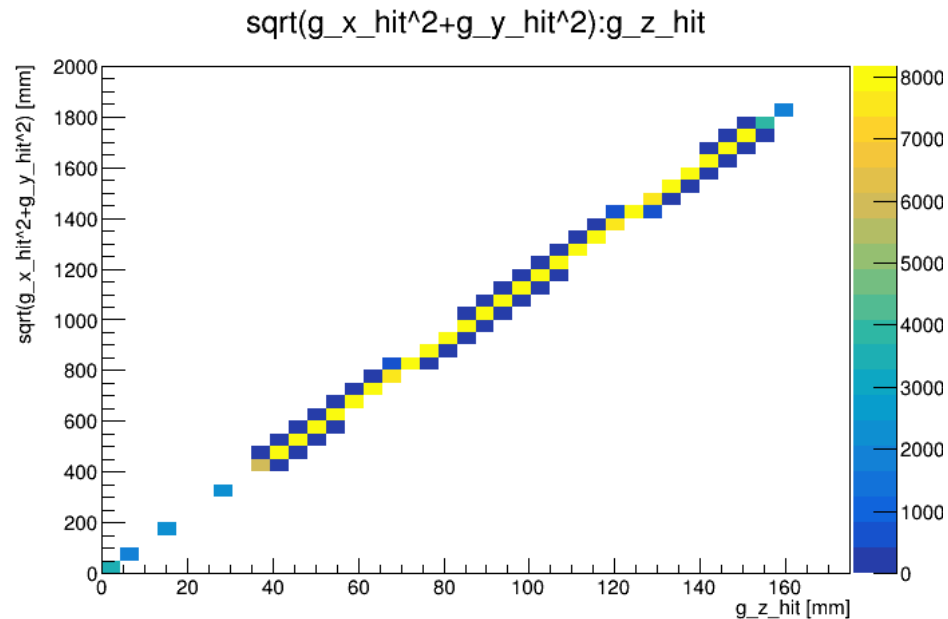
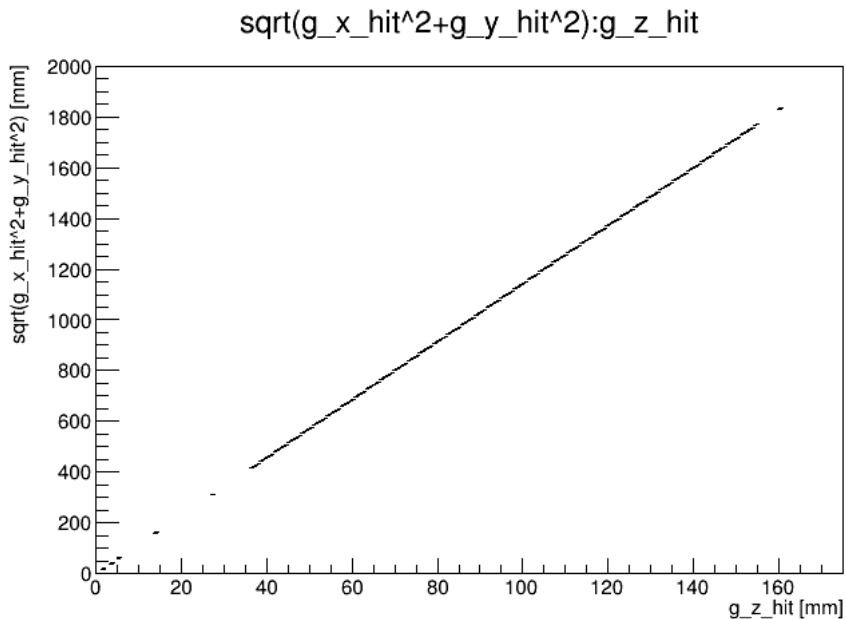
- Same options
 - Particle gun: 10000 μ from (0, 0, 0)
 - Magnetic field: (0, 0, 3T)
 - p_T : 100GeV
 - θ : 85°
 - φ : uniform distribution

- Codes

```
#theta=85
cos_theta=0.087155743
eta=$(echo "-0.5*|((1-{$cos_theta})/(1+{$cos_theta}))"|bc -l)

./ActsSimFatrasDD4hep \
--evg-input-type gun \
--dd4hep-input ../../Detectors/DD4hepDetector/compact/CEPC/cepc_v04_master.xml \
--dd4hep-envelopeR 0.1 \
--dd4hep-envelopeZ 0.1 \
--bf-values 0 0 3 \
--pg-pt-range 100 100 \
--pg-eta-range {$eta} {$eta} \
--pg-nparticles 1 \
--events 10000 \
--output-root 1
```

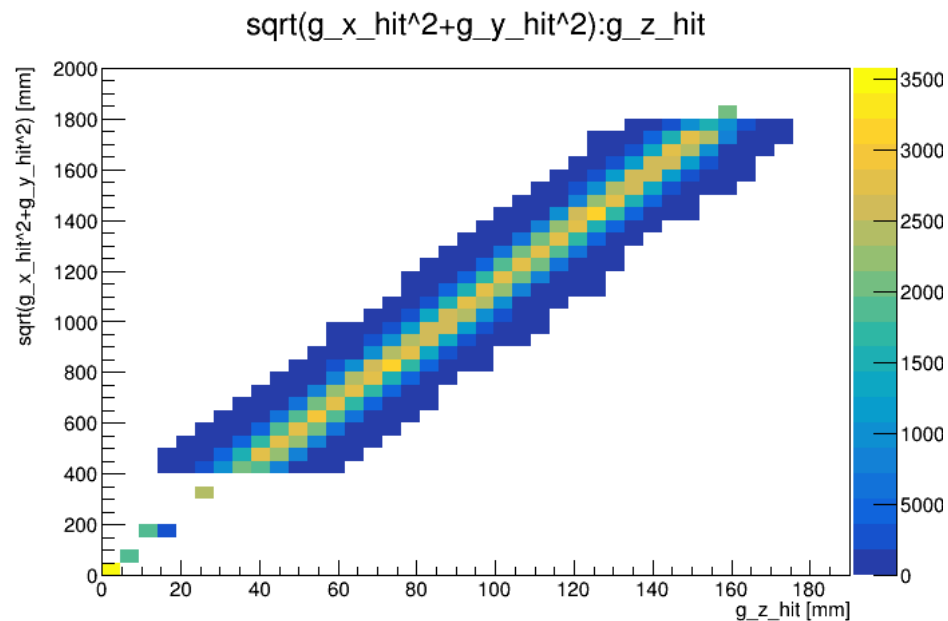
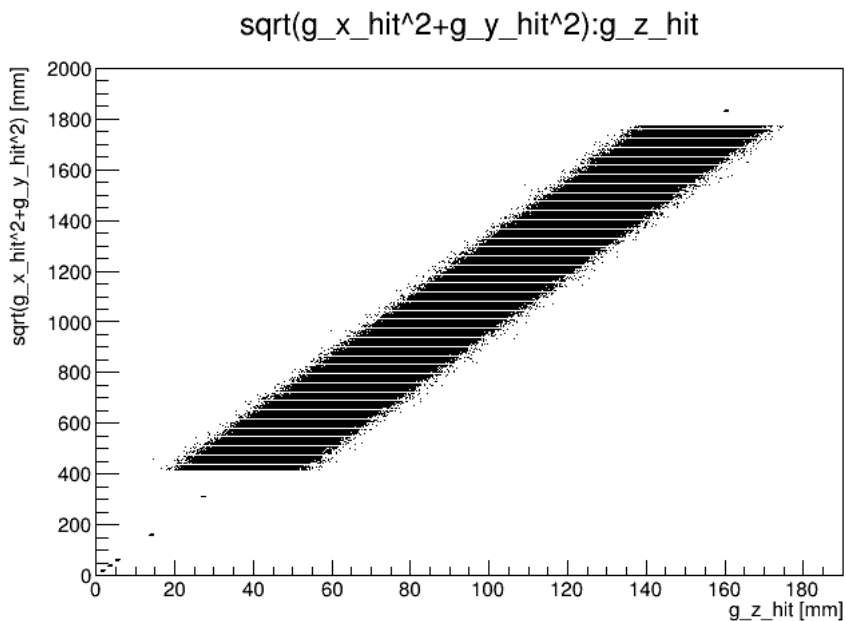
Hits distributions



Before
TPC smearing

Resolution
Local x: 25 μ m
Local y: 10 μ m

Entries/Nparticles
10000/10000

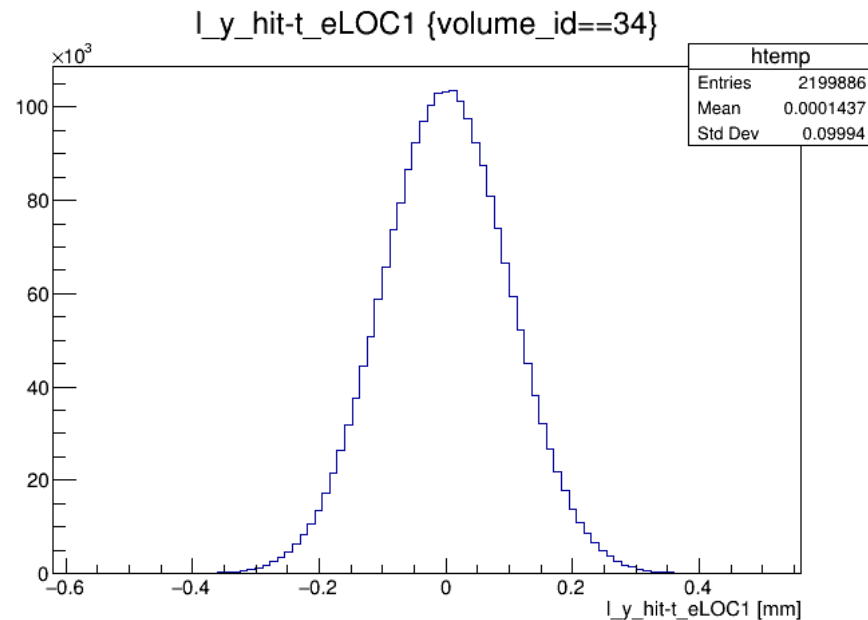
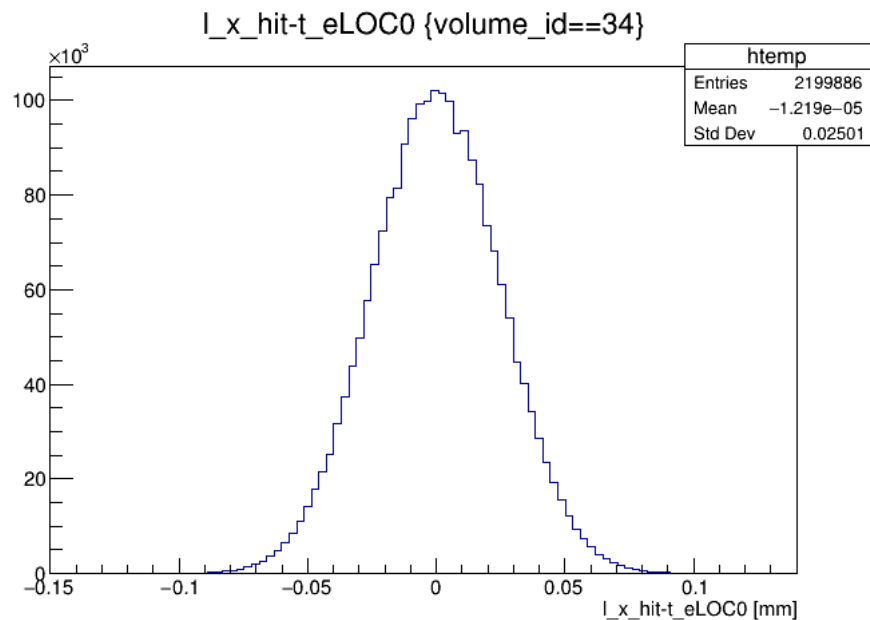


After
TPC smearing

Resolution
Local x: 100 μ m
Local y: 5mm

Entries/Nparticles
9995/10000

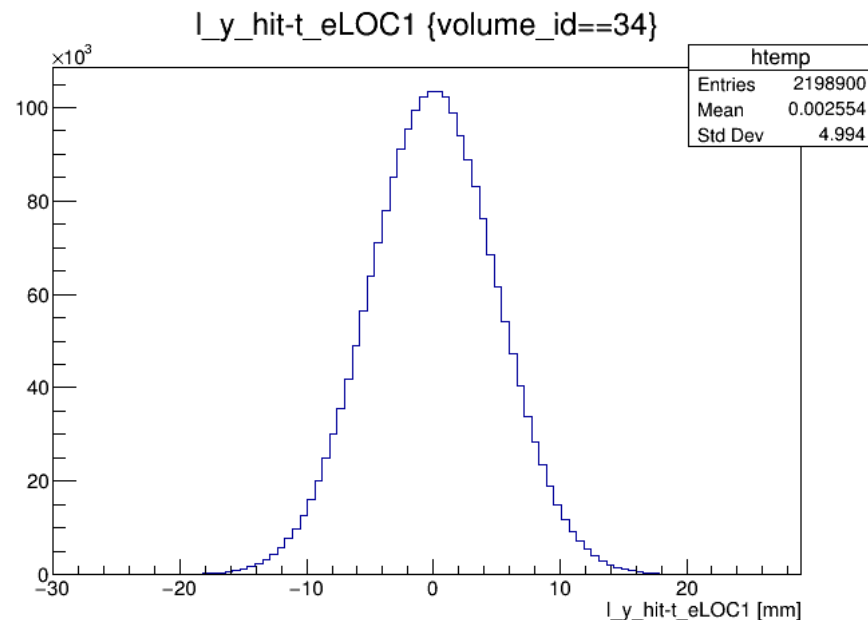
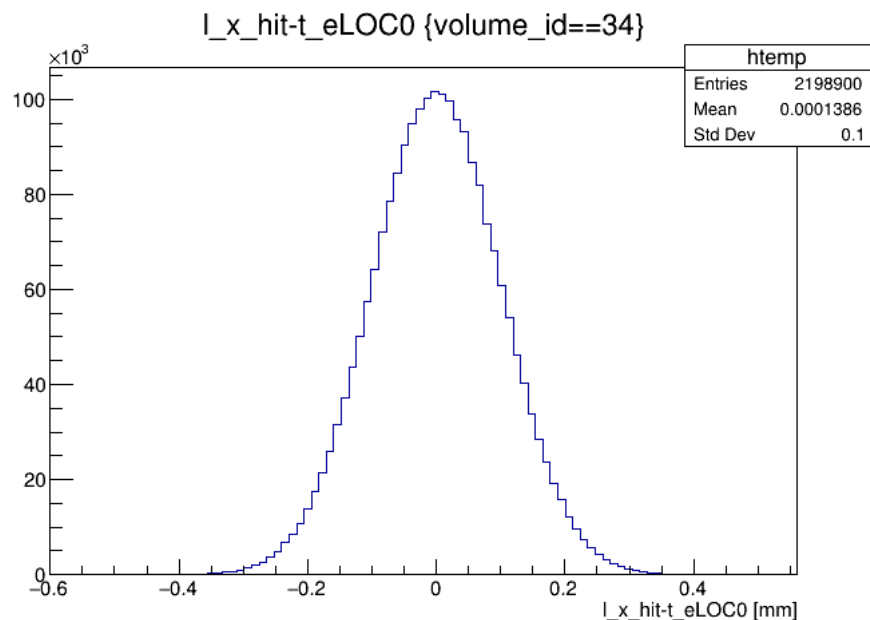
Resolutions of local x and local y of TPC



Before
TPC smearing

Resolution
Local x: 25 μ m
Local y: 10 μ m

Entries/Nparticles
10000/10000

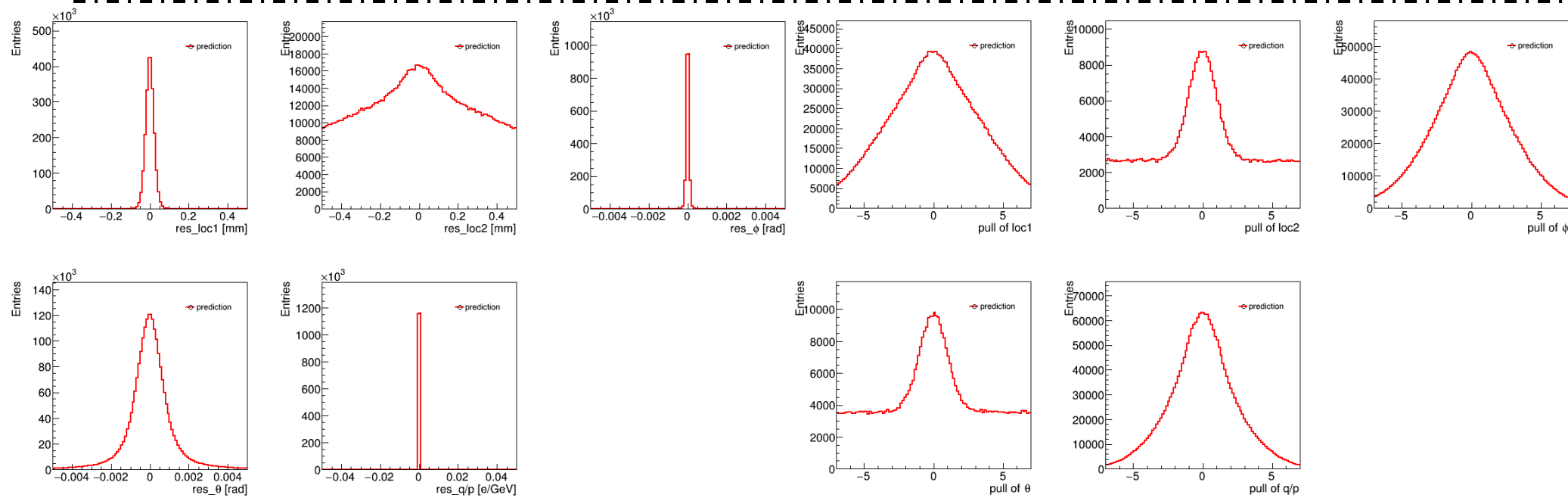
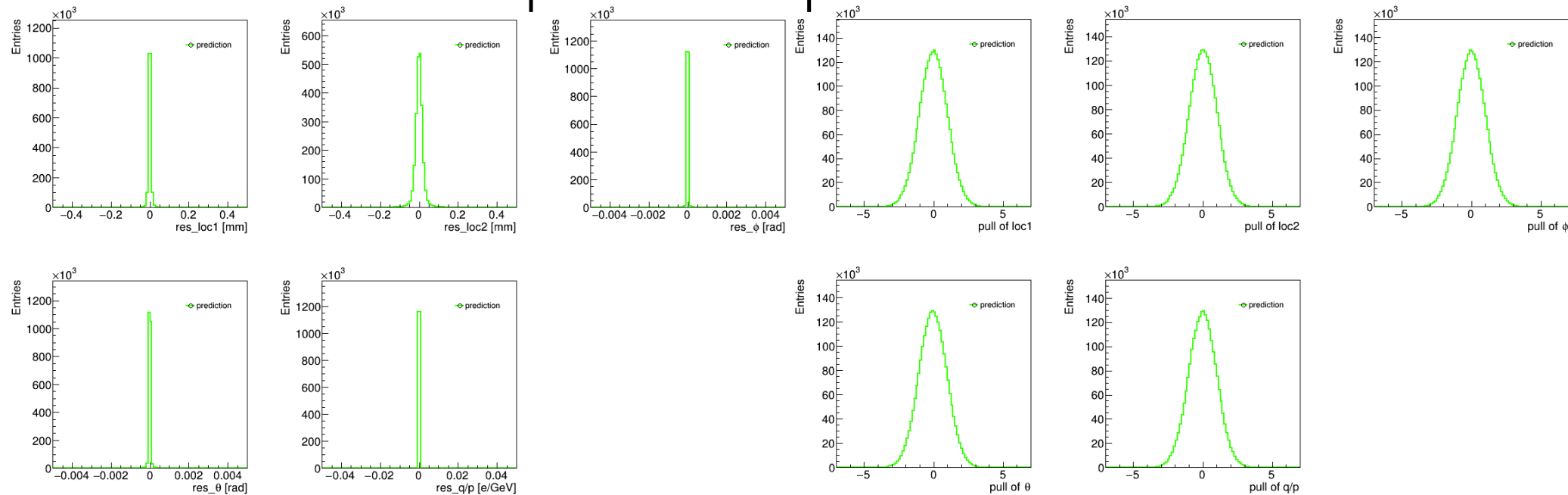


After
TPC smearing

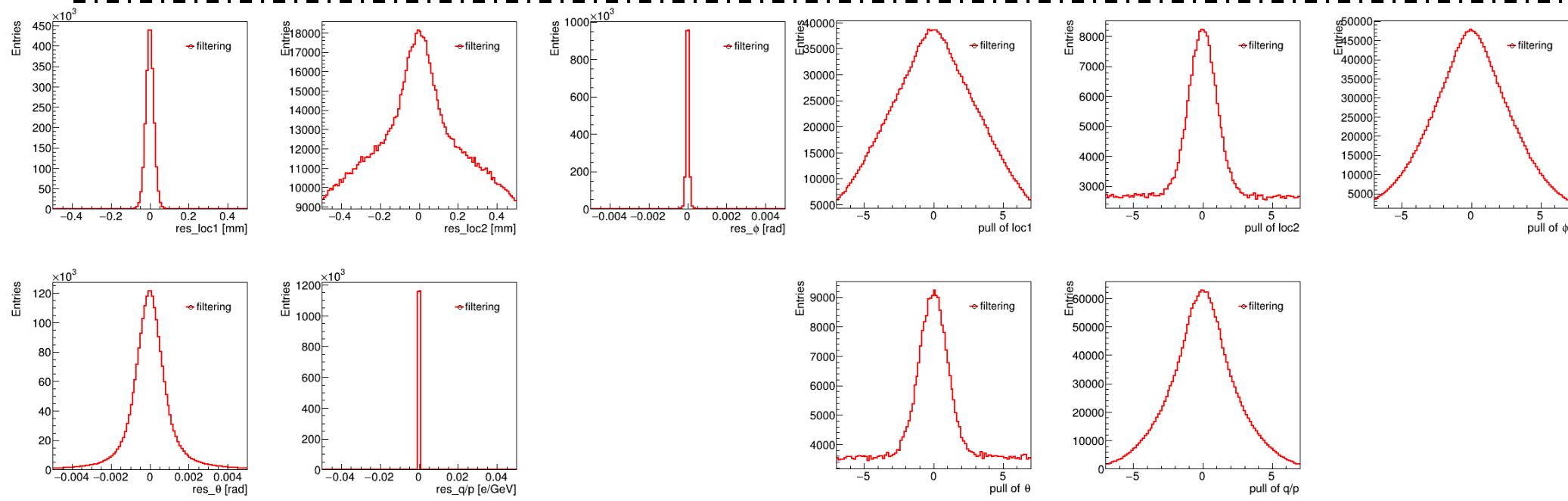
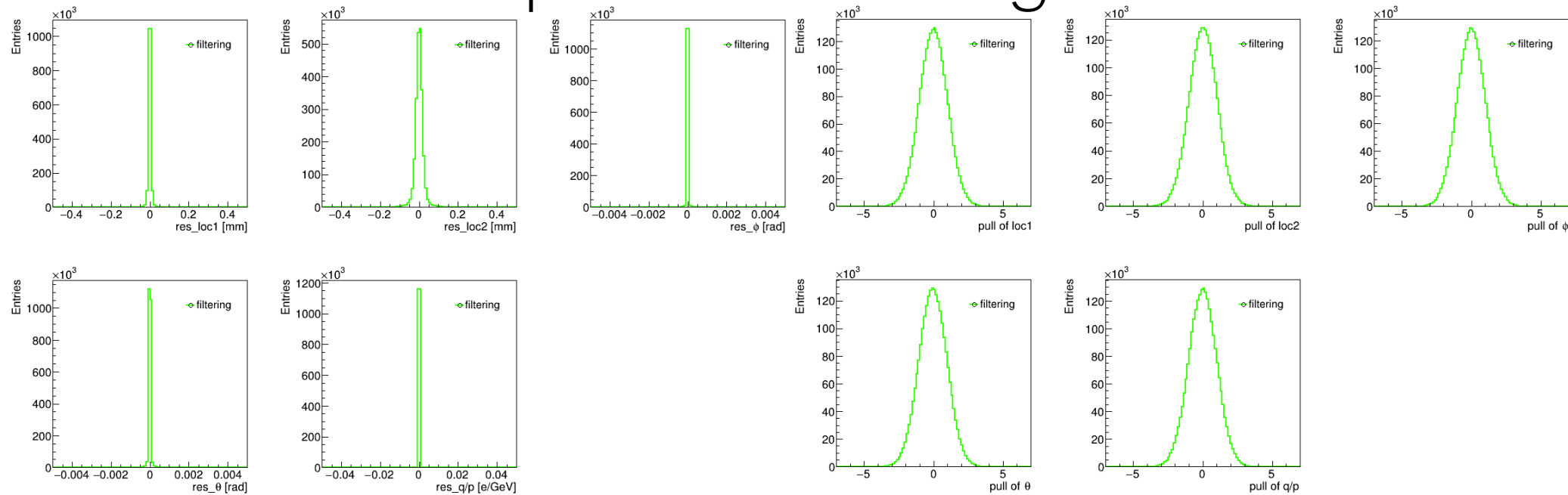
Resolution
Local x: 100 μ m
Local y: 5mm

Entries/Nparticles
9995/10000

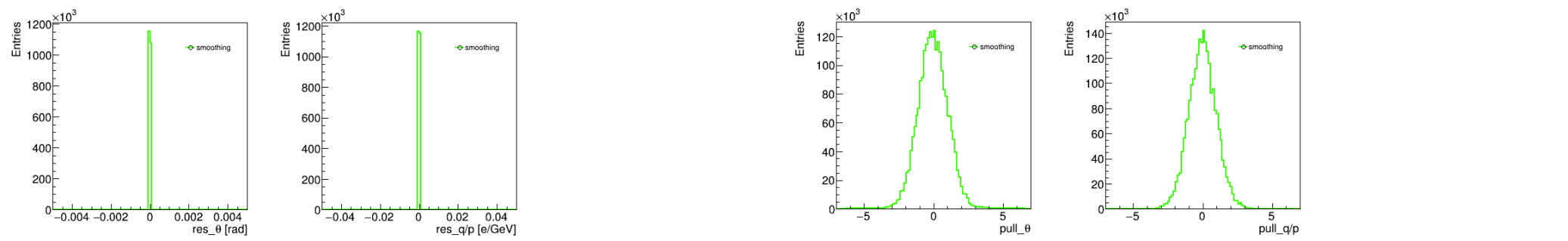
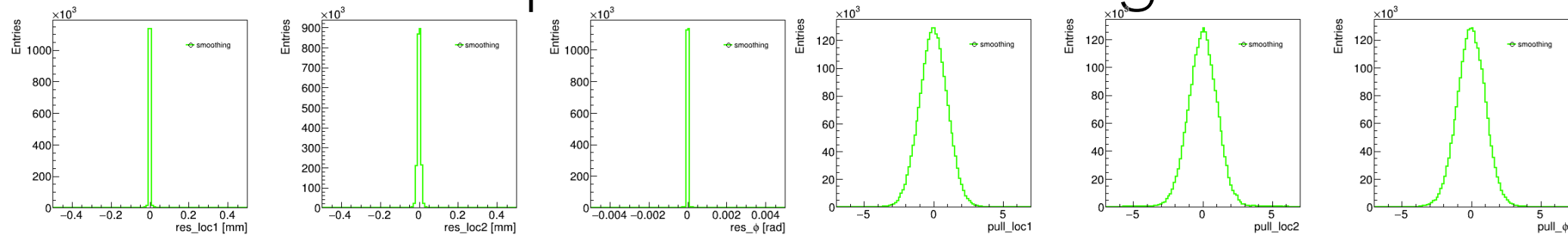
Residuals and pulls -- prediction



Residuals and pulls -- filtering



Residuals and pulls -- smoothing



Before
TPC smearing

Resolution
Local x: 25 μ m
Local y: 10 μ m

Entries/Nparticles
10000/10000

After
TPC smearing

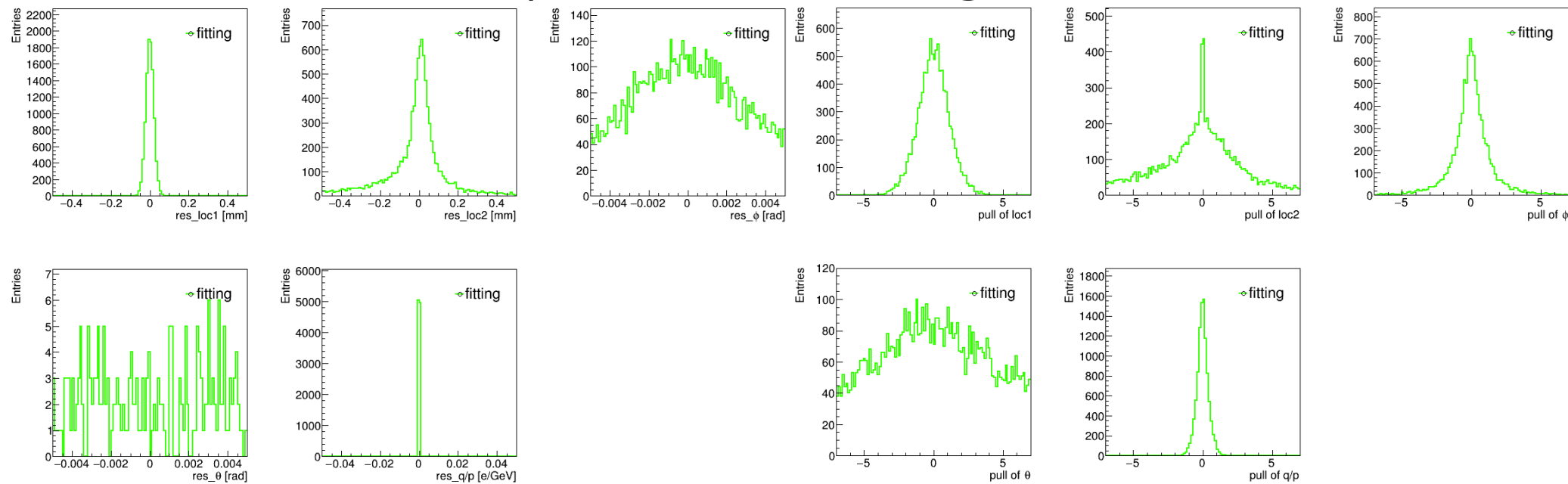
Resolution
Local x: 100 μ m
Local y: 5mm

Entries/Nparticles
9995/10000

Comparisons between before and after TPC smearing

- Before TPC smearing
 - Prediction, filtering and smoothing ✓
- After TPC smearing
 - Prediction, filtering and smoothing ✗

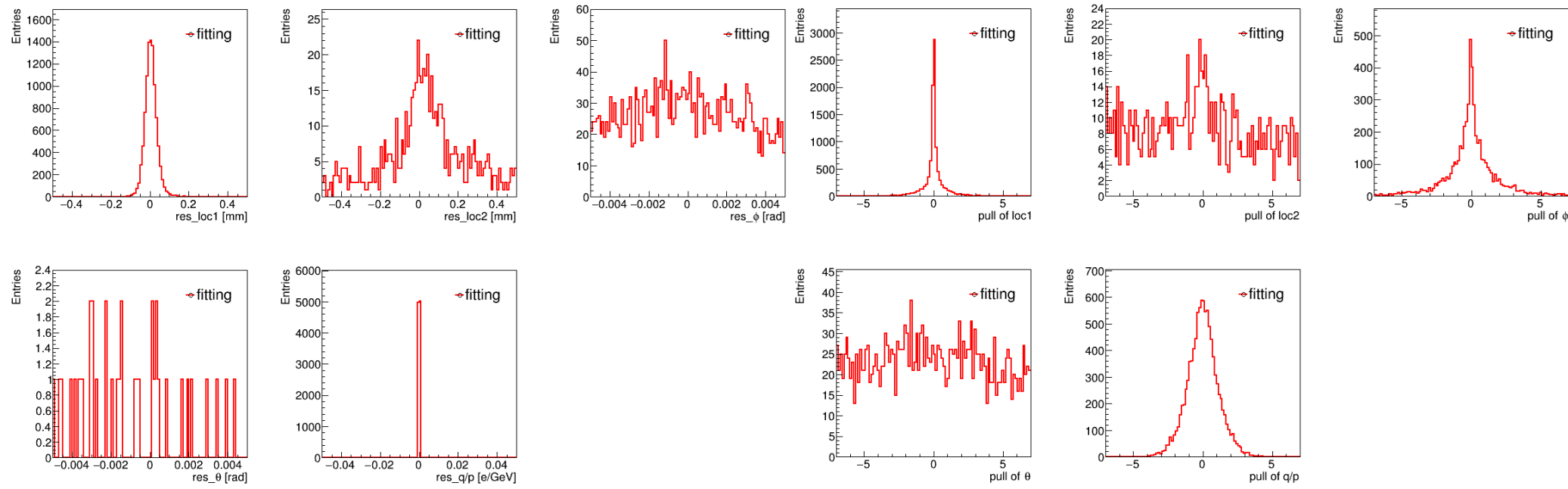
Residuals and pulls -- fitting



Before
TPC smearing

Resolution
Local x: 25 μ m
Local y: 10 μ m

Entries/Nparticles
10000/10000



After
TPC smearing

Resolution
Local x: 100 μ m
Local y: 5mm

Entries/Nparticles
9995/10000

Comparisons between before and after TPC smearing

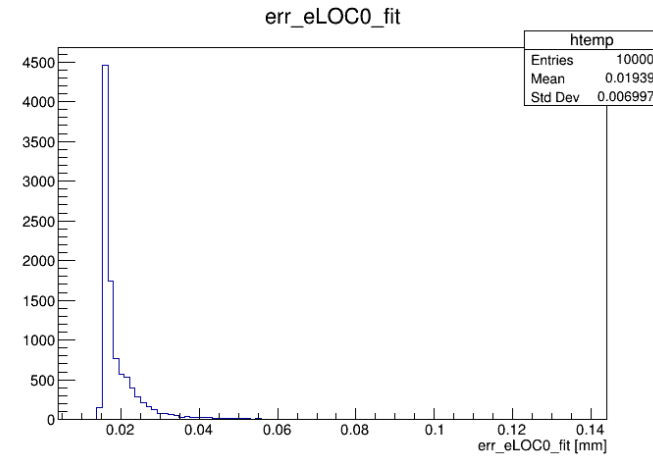
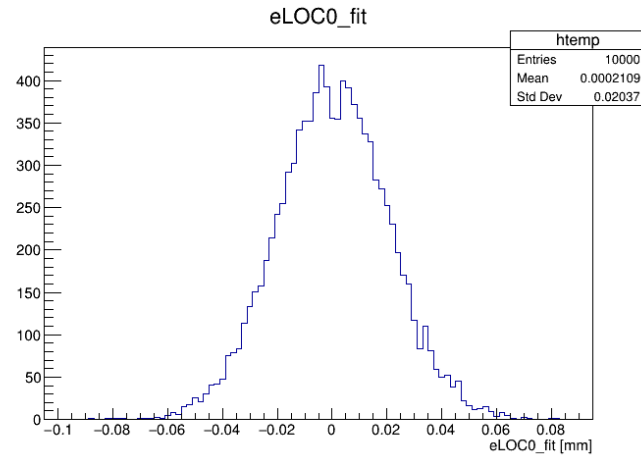
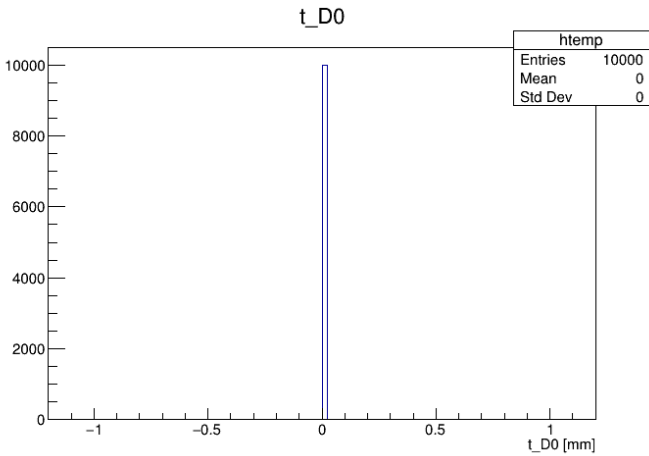
- Before TPC smearing
 - Prediction, filtering and smoothing ✓
 - Fitting ×
- After TPC smearing
 - Prediction, filtering and smoothing ×
 - Fitting ×

Fitting outcomes -- LOC0

Before
TPC smearing

Resolution
Local x: 25 μ m
Local y: 10 μ m

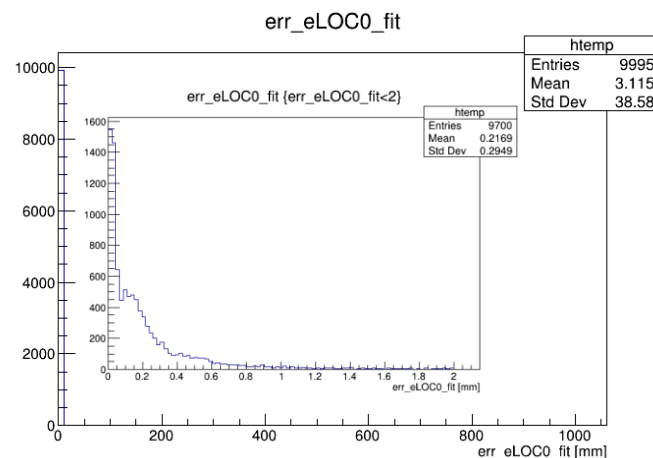
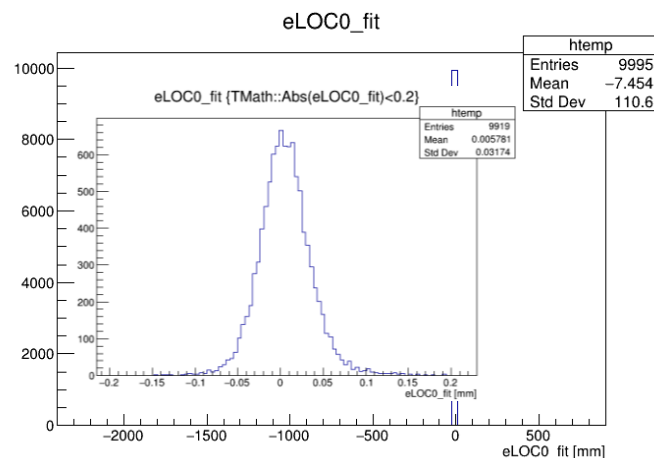
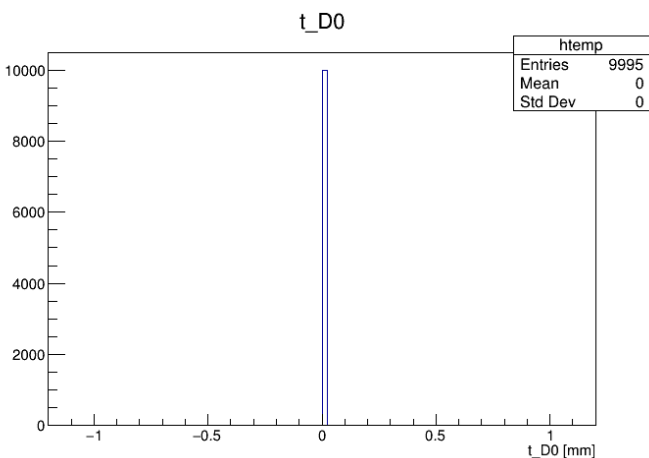
Entries/Nparticles
10000/10000



After
TPC smearing

Resolution
Local x: 100 μ m
Local y: 5mm

Entries/Nparticles
9995/10000

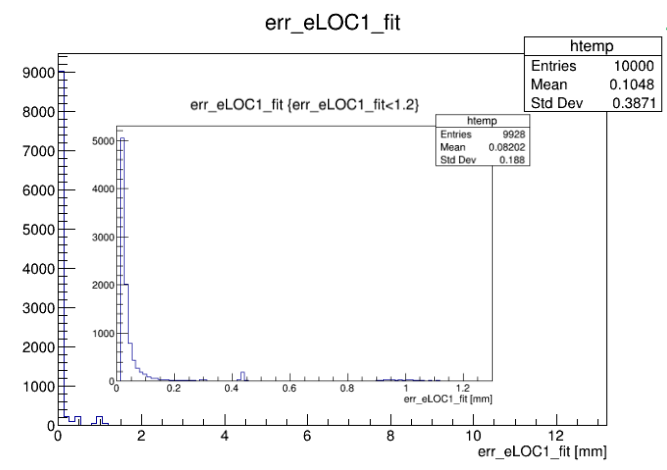
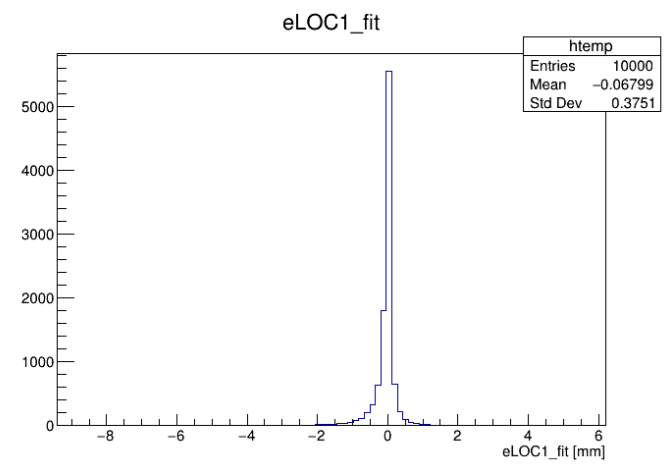
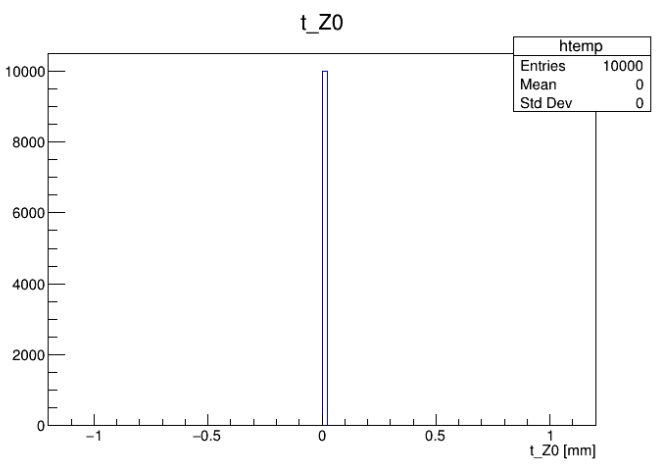


Fitting outcomes -- LOC1

Before
TPC smearing

Resolution
Local x: 25 μ m
Local y: 10 μ m

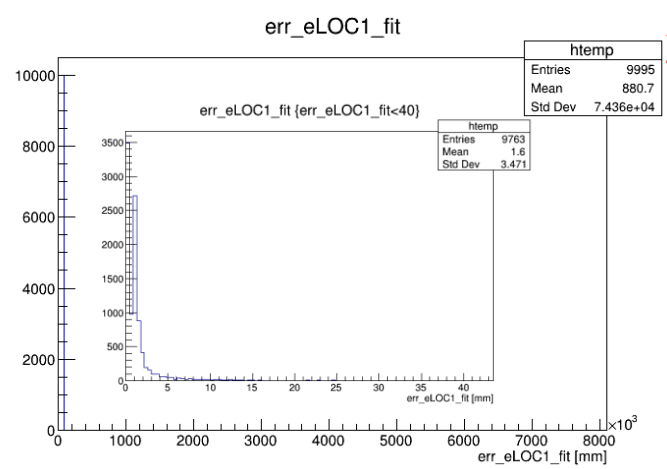
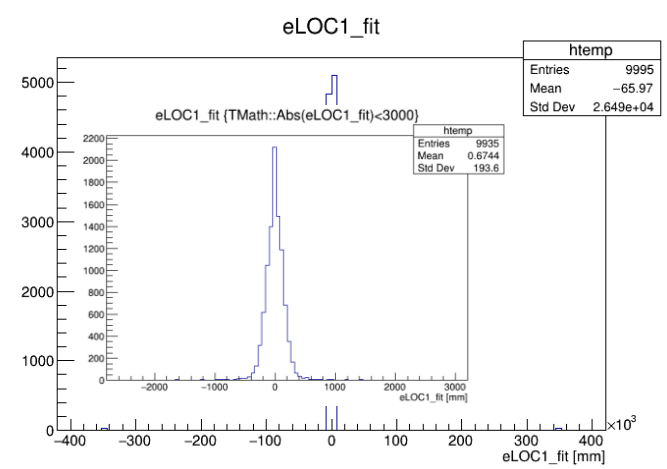
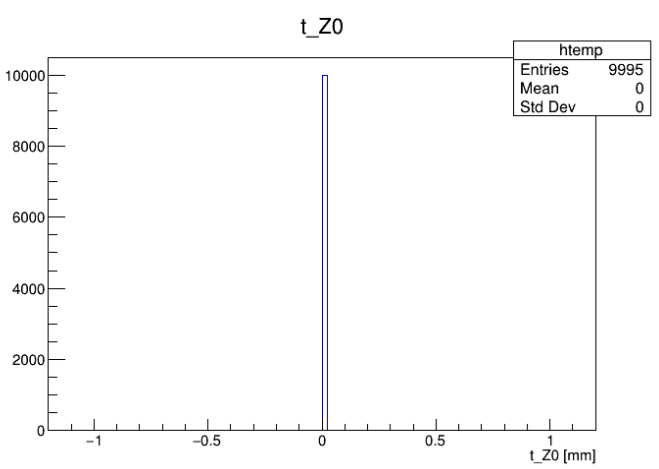
Entries/Nparticles
10000/10000



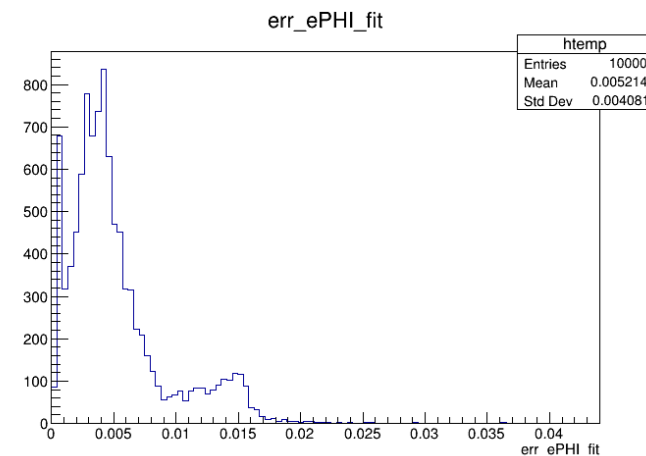
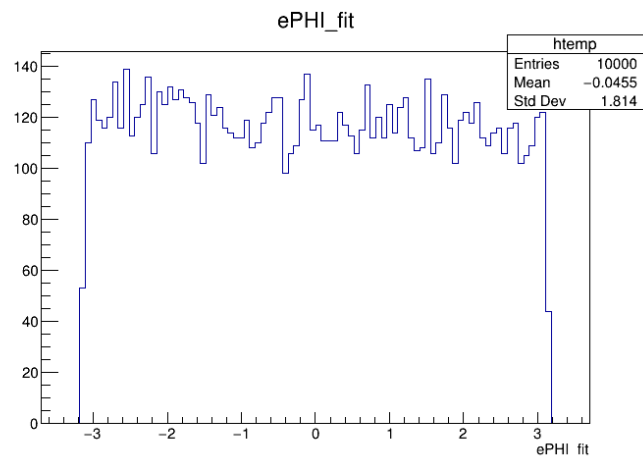
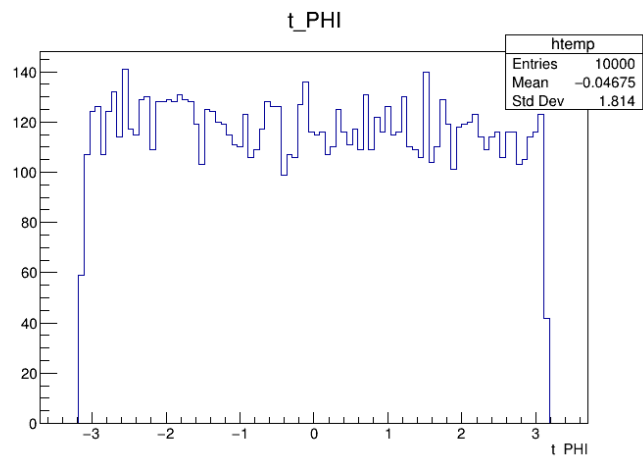
After
TPC smearing

Resolution
Local x: 100 μ m
Local y: 5mm

Entries/Nparticles
9995/10000



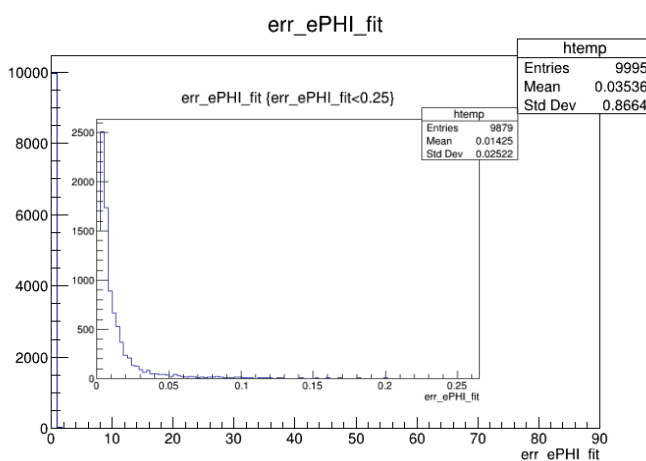
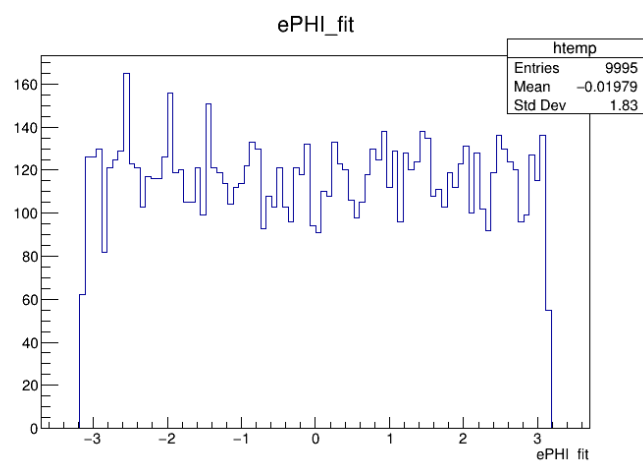
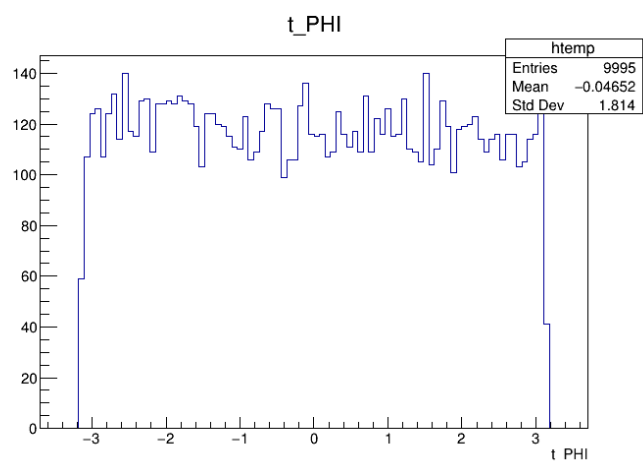
Fitting outcomes -- PHI



Before
TPC smearing

Resolution
Local x: 25 μ m
Local y: 10 μ m

Entries/Nparticles
10000/10000



After
TPC smearing

Resolution
Local x: 100 μ m
Local y: 5mm

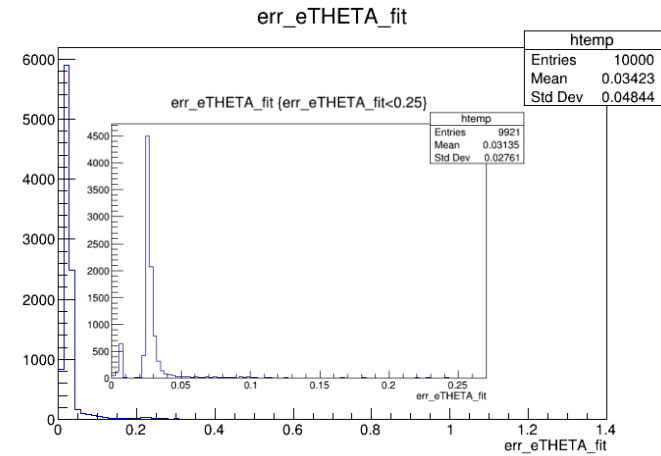
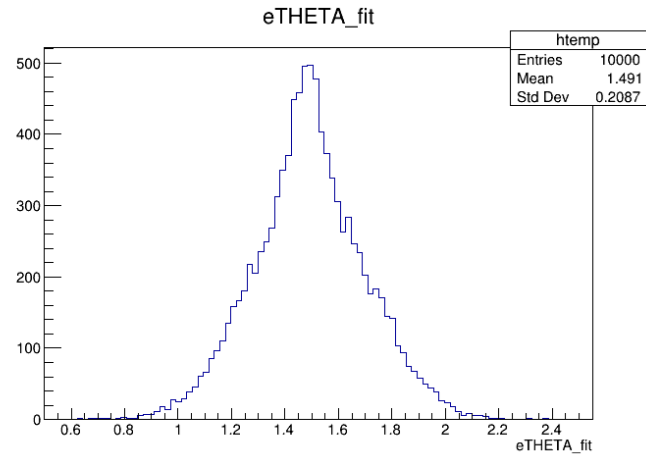
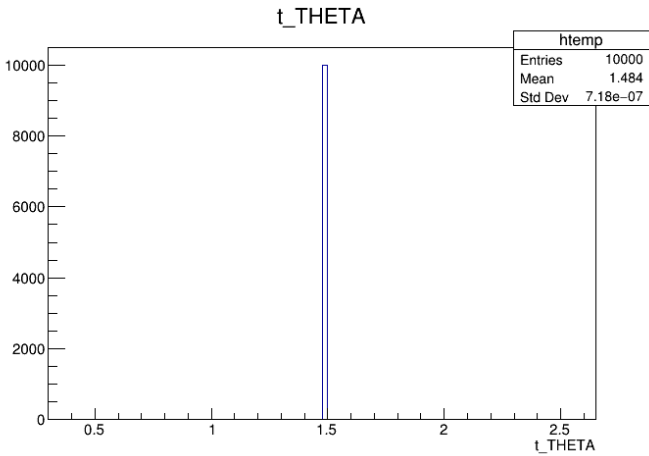
Entries/Nparticles
9995/10000

Fitting outcomes -- THETA

Before
TPC smearing

Resolution
Local x: 25 μ m
Local y: 10 μ m

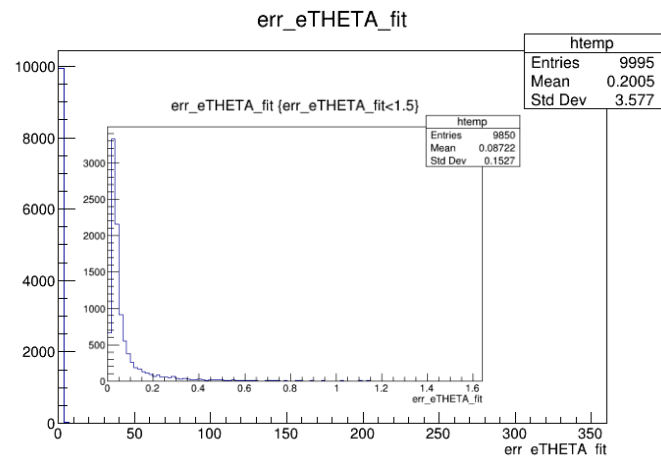
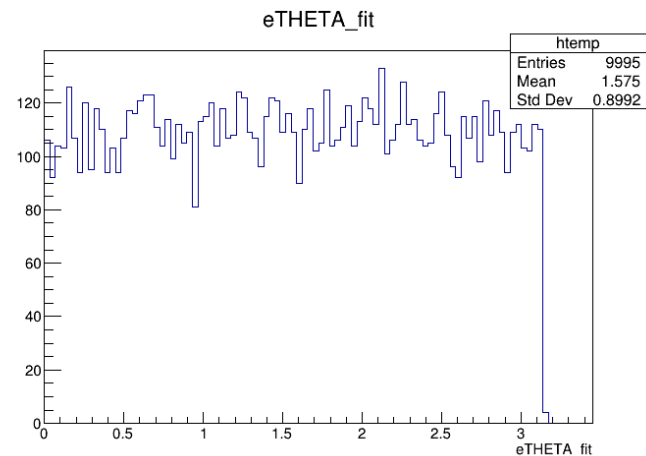
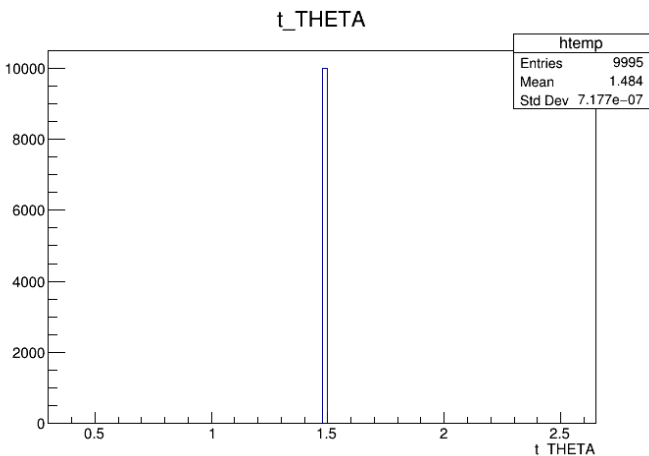
Entries/Nparticles
10000/10000



After
TPC smearing

Resolution
Local x: 100 μ m
Local y: 5mm

Entries/Nparticles
9995/10000

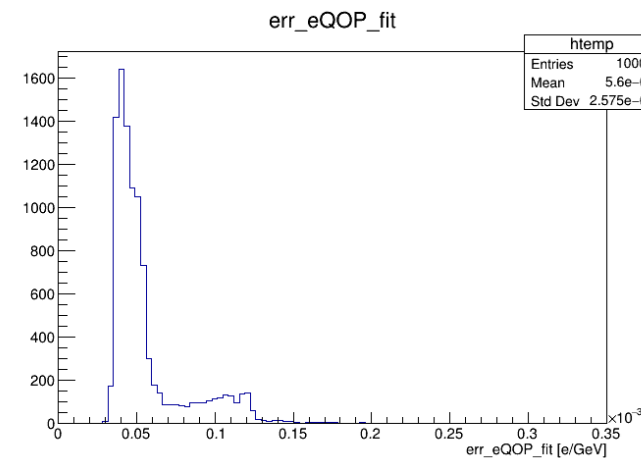
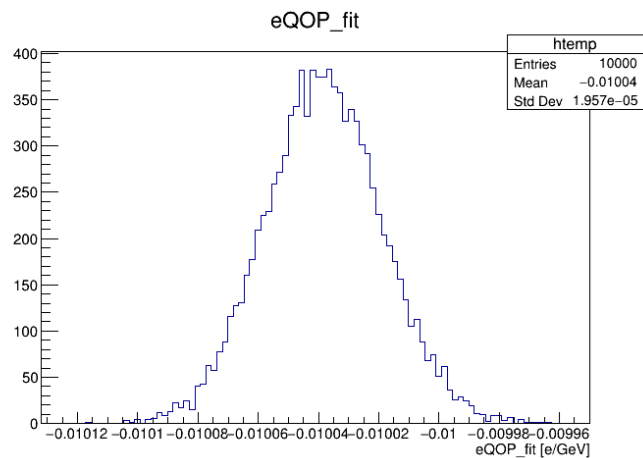
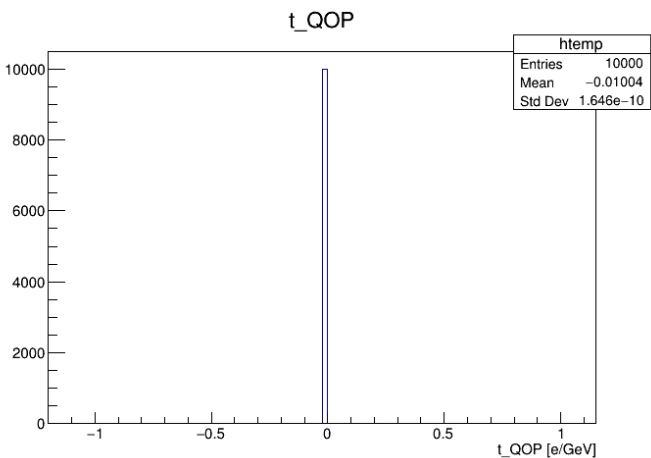


Fitting outcomes -- QOP

Before
TPC smearing

Resolution
Local x: 25 μ m
Local y: 10 μ m

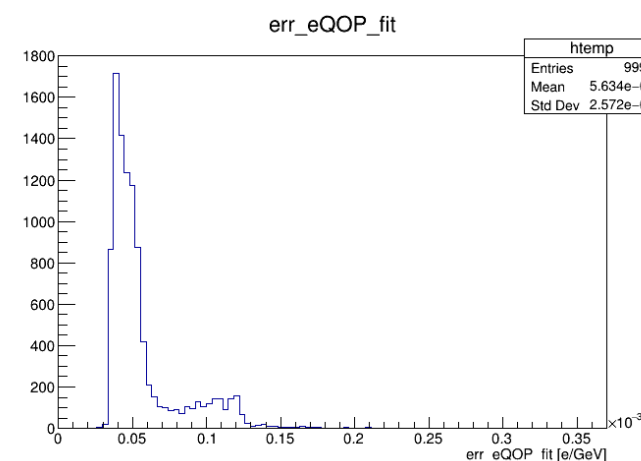
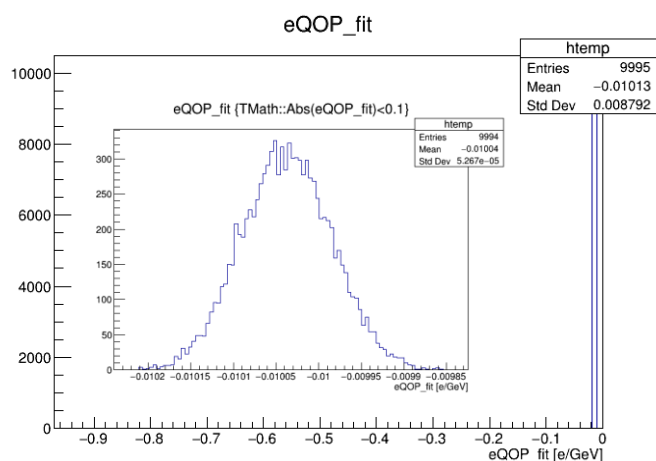
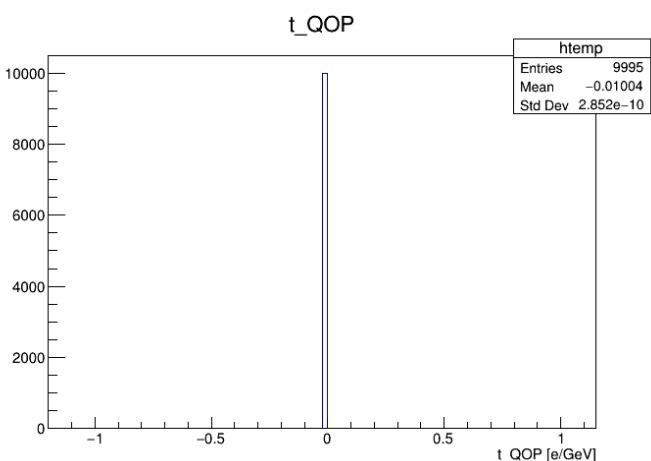
Entries/Nparticles
10000/10000



After
TPC smearing

Resolution
Local x: 100 μ m
Local y: 5mm

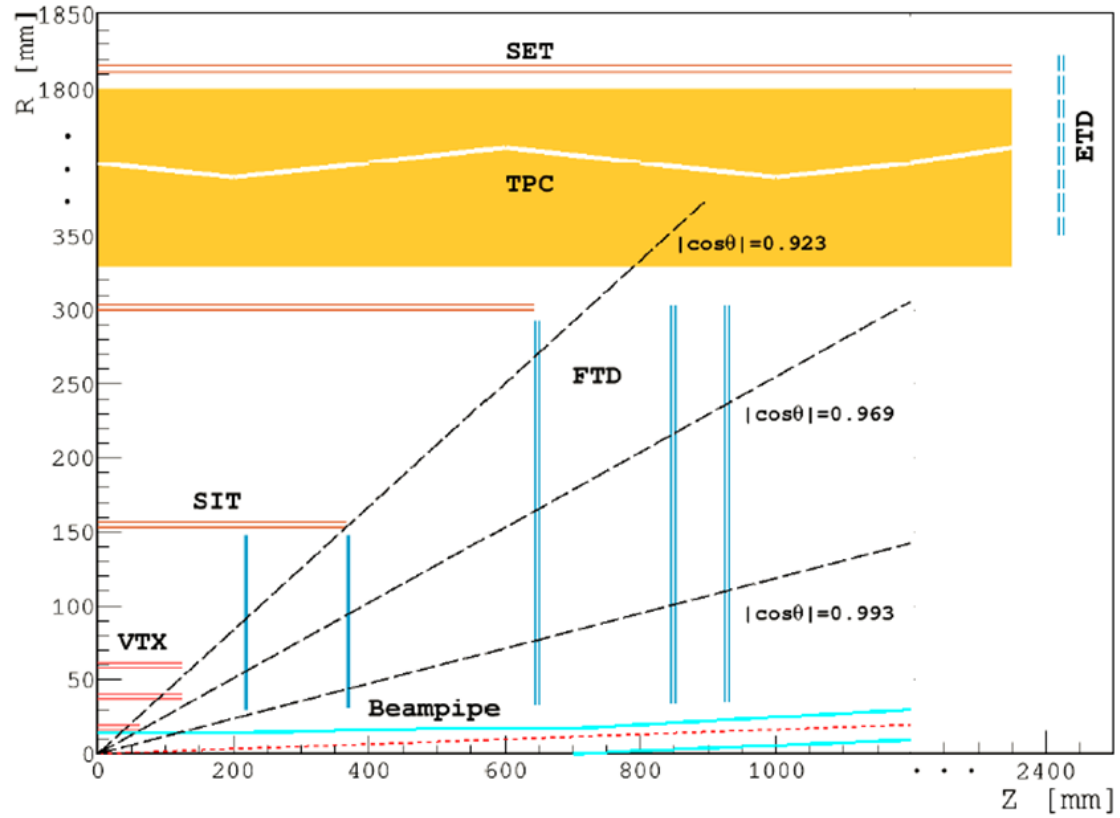
Entries/Nparticles
9995/10000



Modify the resolutions of sub-detectors

- Resolutions of loc0 and loc1
- Hits distributions
- Residuals and pulls
 - Total
 - Each sub-detector

Resolutions of loc0 and loc1



Sub-detector	Volume_id	Layer_id	loc0_res [μm]	loc1_res [μm]	If strip
Vertex	25	2	3	3	
		4	4	4	
		6	4	4	
SIT 1	28	2	5	250	✓
SIT 2	31	2	5	250	✓
FTD 1, 2 neg	24	2	3	3	
FTD 1, 2 pos	26	2	3	3	
FTD 3 neg	19	2	5	250	✓
FTD 3 pos	29	2	5	250	✓
FTD 4, 5 neg	14	2	5	250	✓
FTD 4, 5 pos	32	2	5	250	✓
TPC	34	2	100	5000	
SET	36	2	5	250	✓
ETD neg	6	2	5	250	✓
ETD pos	37	2	5	250	✓

- Branch: combine-bump
 - Commit id: cb6ab478e13654bca66c7e588b0686506ff9836c
- Same options
 - Particle gun: 10000 μ from (0, 0, 0)
 - Magnetic field: (0, 0, 3T)
 - p_T : 100GeV
 - $\cos\theta$: uniform distribution
 - φ : uniform distribution

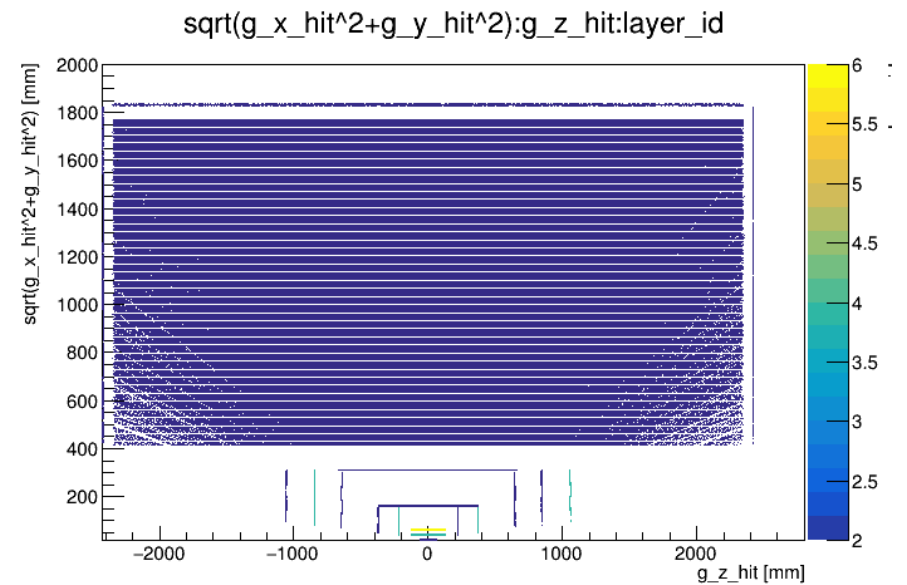
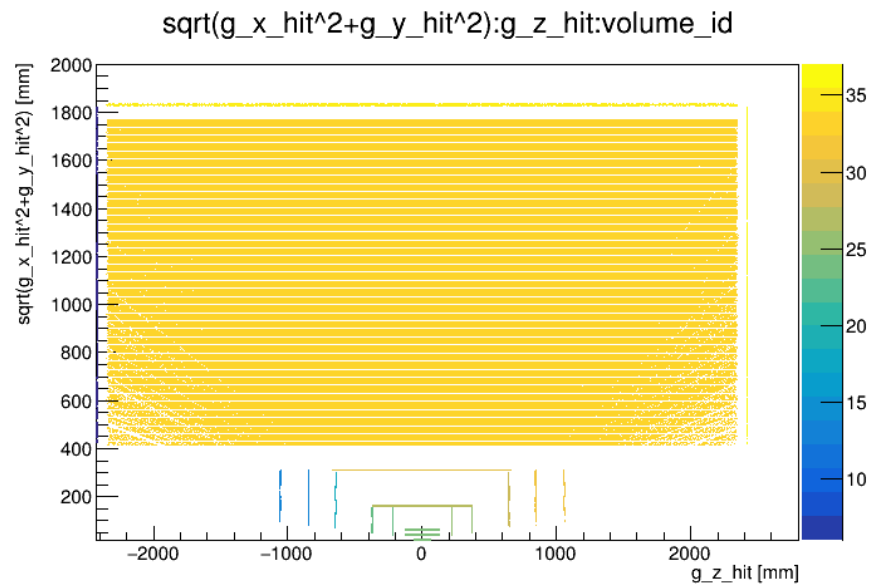
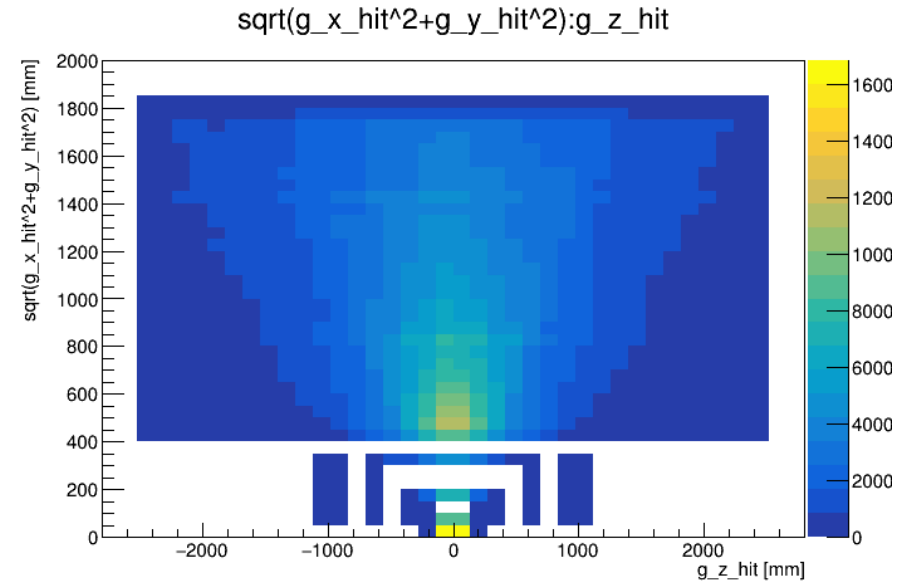
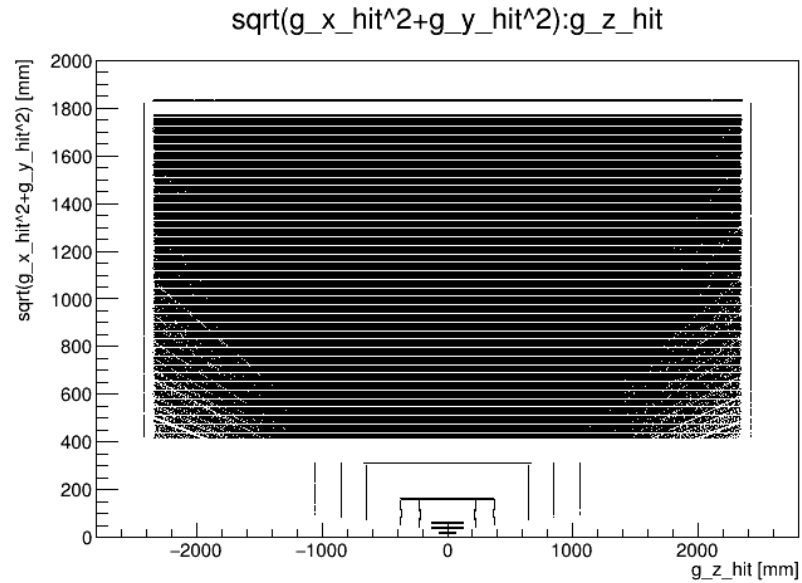
- Codes

```
pT=100
dirName=cepc_sim_${pT}
NParticles=1
NEvents=10000
```

```
./ActsSimFatrasDD4hep \
--evg-input-type gun \
--dd4hep-input ../../Detectors/DD4hepDetector/compact/CEPC/cepc_v04_master.xml \
--dd4hep-envelopeR 0.1 \
--dd4hep-envelopeZ 0.1 \
--bf-values 0 0 3 \
--pg-pt-range ${pT} ${pT} \
--pg-nparticles ${NParticles} \
--events ${NEvents} \
--output-root 1 \
--output-dir ${dirName}
```

Hits distributions

- Entries/Nparticles: 9952/10000



- Branch: combine-bump
 - Commit id: cb6ab478e13654bca66c7e588b0686506ff9836c
- Same options
 - Particle gun: 10000 μ from (0, 0, 0)
 - Magnetic field: (0, 0, 3T)
 - p_T : 100GeV
 - θ : 85°
 - φ : uniform distribution

- Codes

```

pT=100
theta=85
cos_theta=$(echo "$theta"|gawk '{printf("%12.10f\n",cos($1/180.*3.141592653))}')
dirName=cepc_sim_${pT}_${theta}
NParticles=1
NEvents=10000

./ActsSimFatrasDD4hep \
--evg-input-type gun \
--dd4hep-input ../../Detectors/DD4hepDetector/compact/CEPC/cepc_v04_master.xml \
--dd4hep-envelopeR 0.1 \
--dd4hep-envelopeZ 0.1 \
--bf-values 0 0 3 \
--pg-pt-range ${pT} ${pT} \
--pg-costheta-range ${cos_theta} ${cos_theta} \
--pg-nparticles ${NParticles} \
--events ${NEvents} \
--output-root 1 \
--output-dir ${dirName}

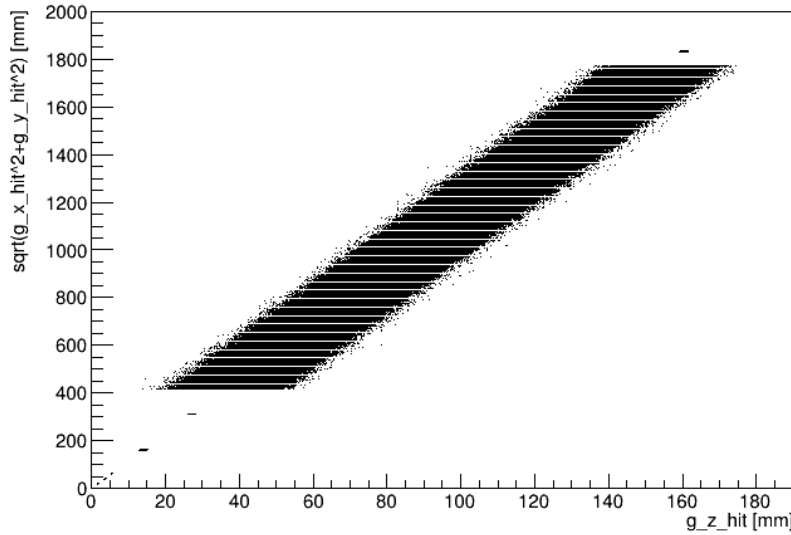
```

Hits distributions

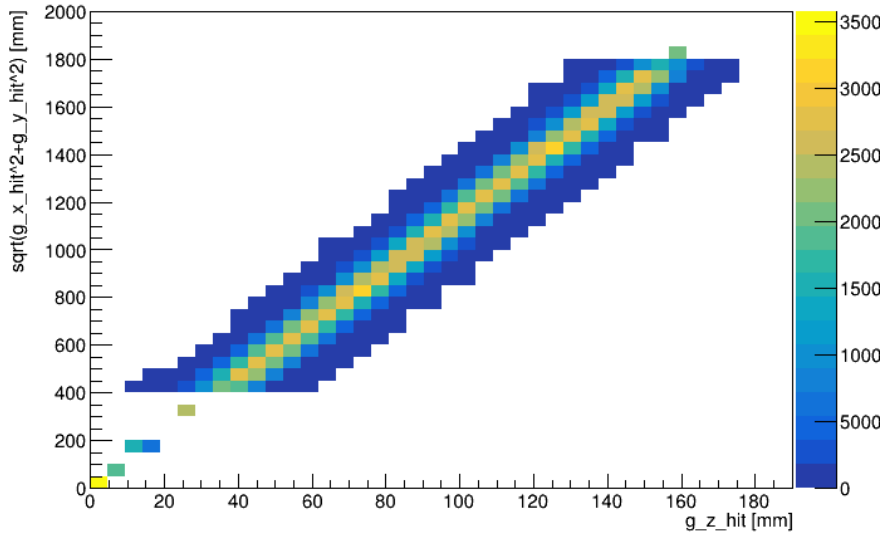
- Entries/Nparticles: 9996/10000

• $\theta: 85^\circ$

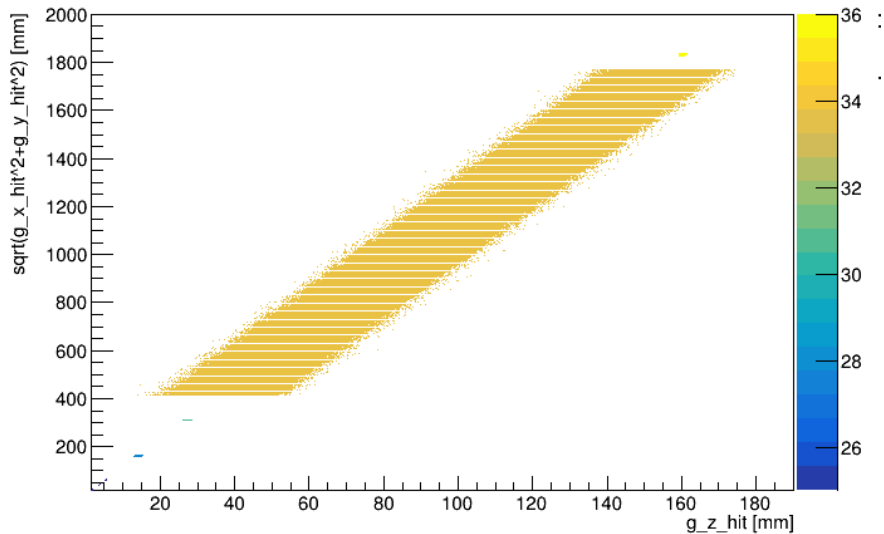
$\sqrt{g_x_hit^2+g_y_hit^2}:g_z_hit$



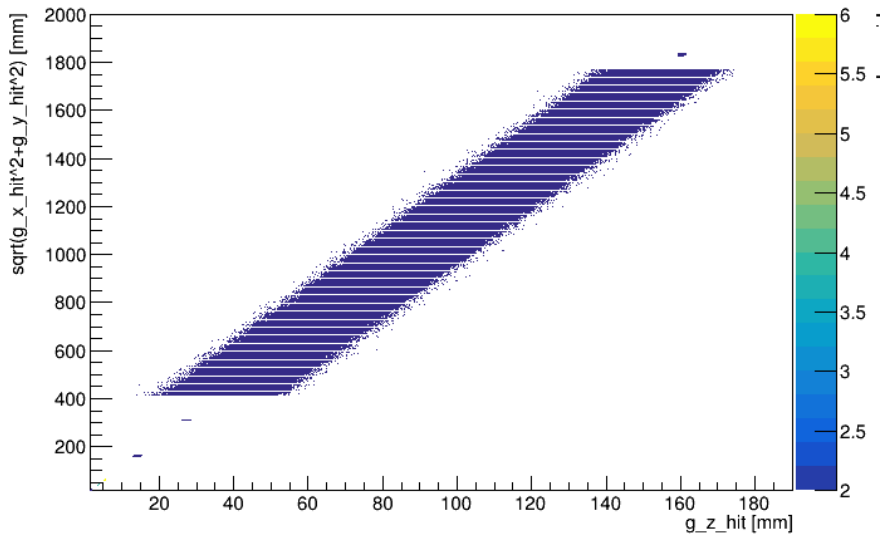
$\sqrt{g_x_hit^2+g_y_hit^2}:g_z_hit$



$\sqrt{g_x_hit^2+g_y_hit^2}:g_z_hit:volume_id$



$\sqrt{g_x_hit^2+g_y_hit^2}:g_z_hit:layer_id$

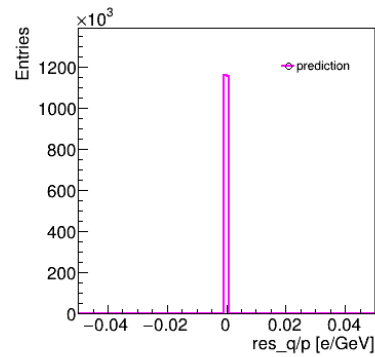
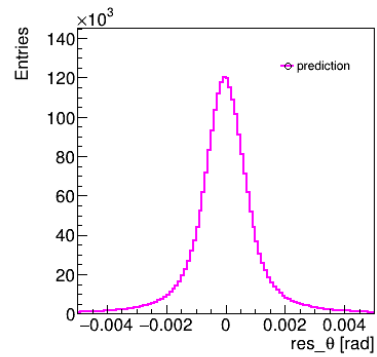
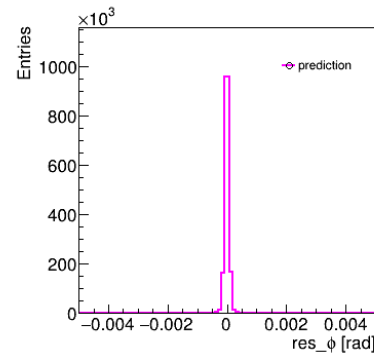
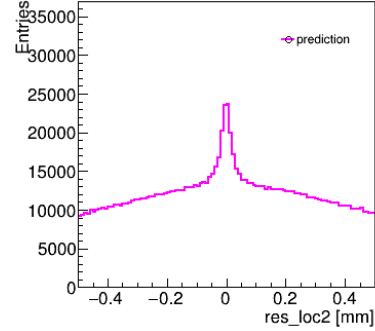
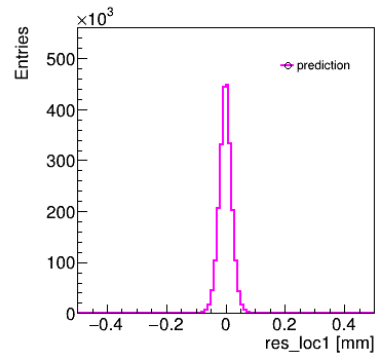


Sub-detector	Volume_id	Layer_id	nMeasurements
Vertex	25	2	17433
		4	18331
		6	19395
SIT 1	28	2	21203
SIT 2	31	2	23442
FTD 1, 2 neg	24	2	
FTD 1, 2 pos	26	2	
FTD 3 neg	19	2	
FTD 3 pos	29	2	
FTD 4, 5 neg	14	2	
FTD 4, 5 pos	32	2	
TPC	34	2	2199120
SET	36	2	19913
ETD neg	6	2	
ETD pos	37	2	
Total			2318837

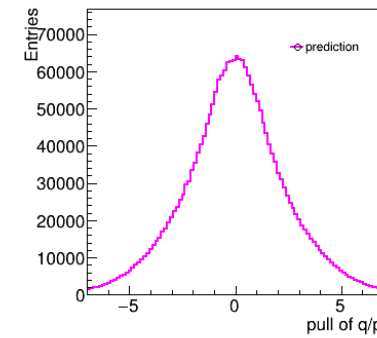
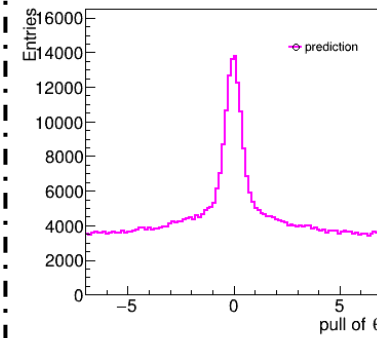
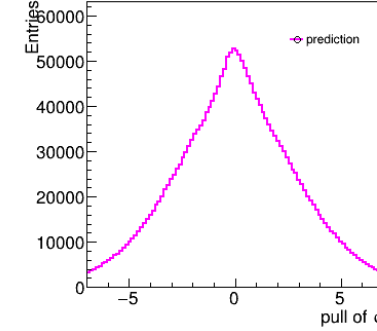
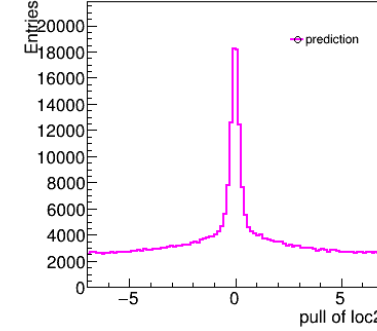
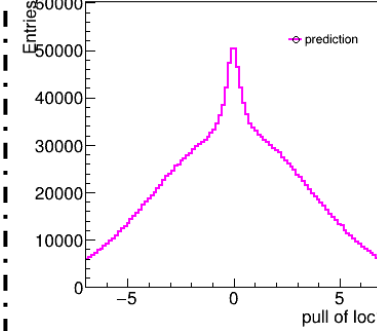
Residuals and pulls -- prediction

- Parameters of measurements
- Total

• $\theta: 85^\circ$



Residual

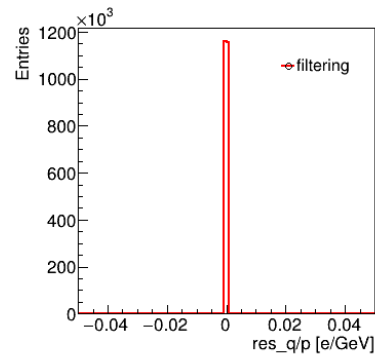
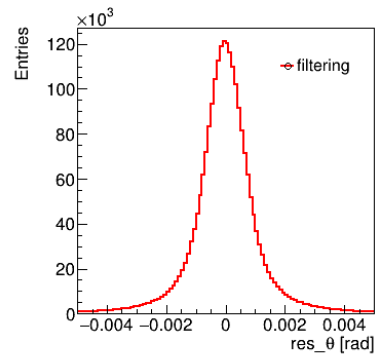
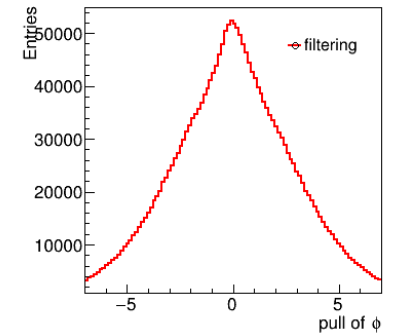
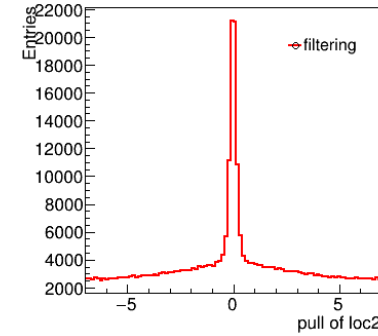
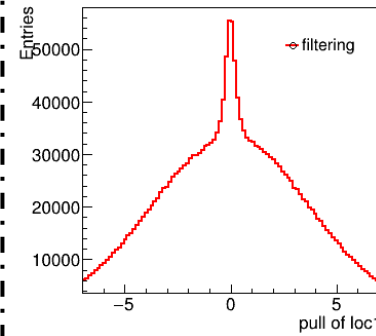
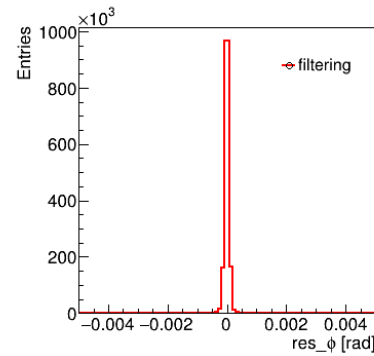
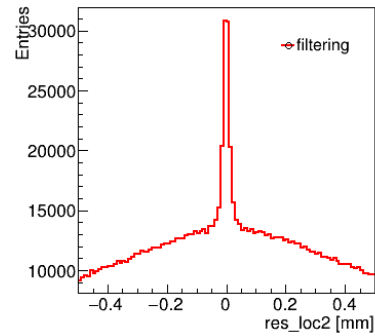
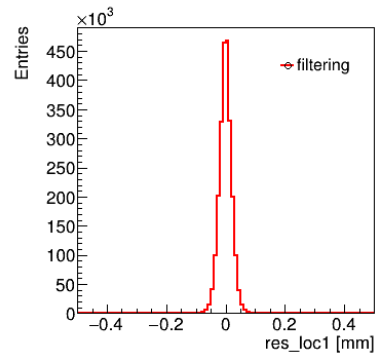


Pull

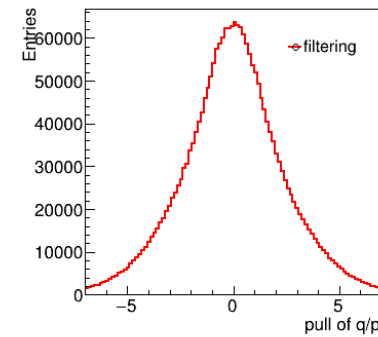
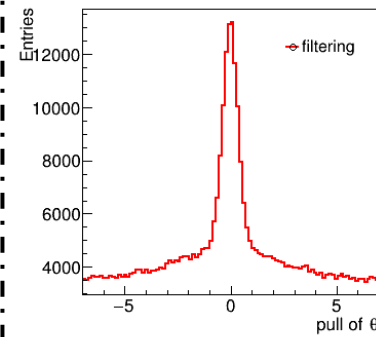
Residuals and pulls -- filtering

- Parameters of measurements
- Total

• $\theta: 85^\circ$



Residual

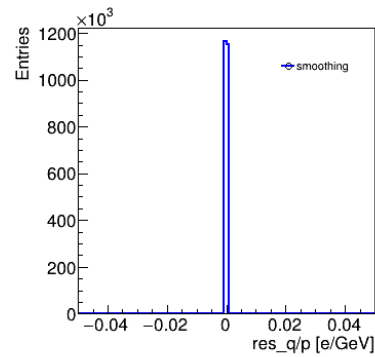
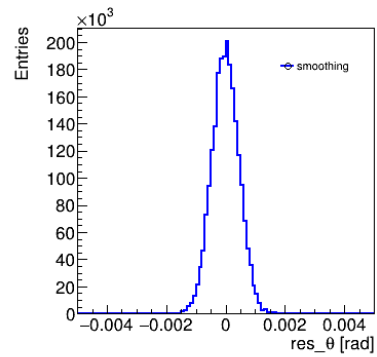
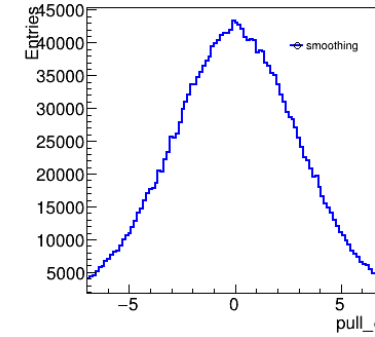
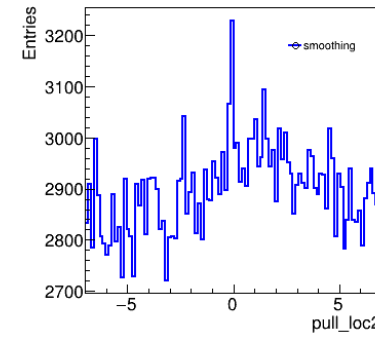
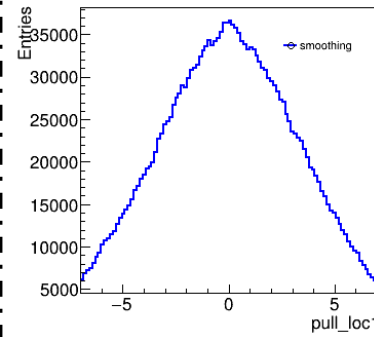
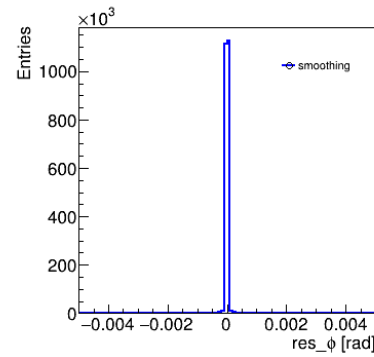
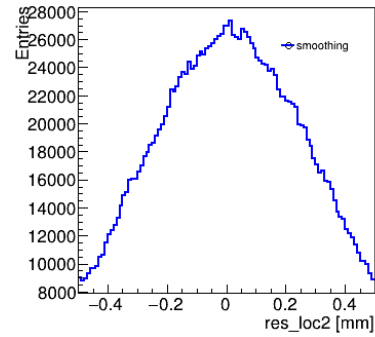
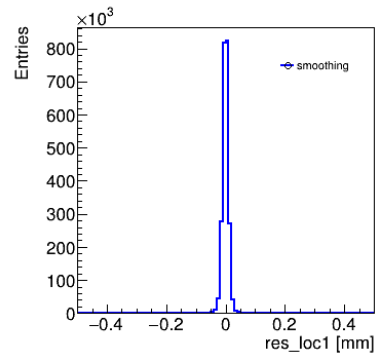


Pull

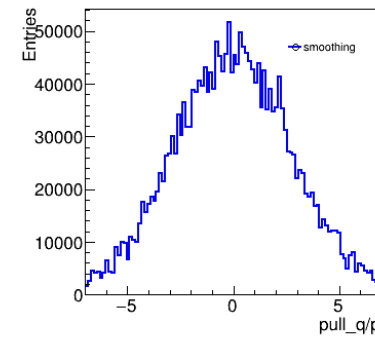
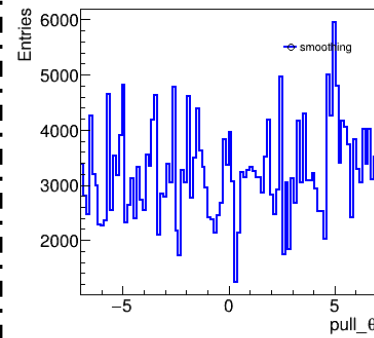
Residuals and pulls -- smoothing

- Parameters of measurements
- Total

• $\theta: 85^\circ$



Residual

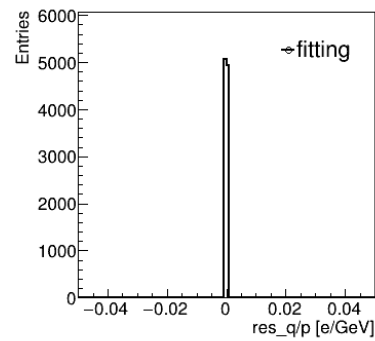
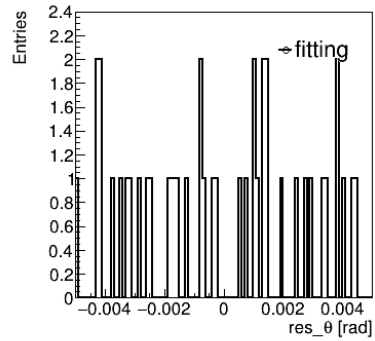
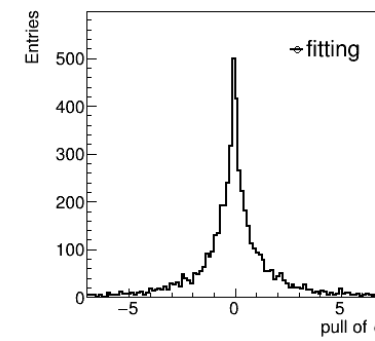
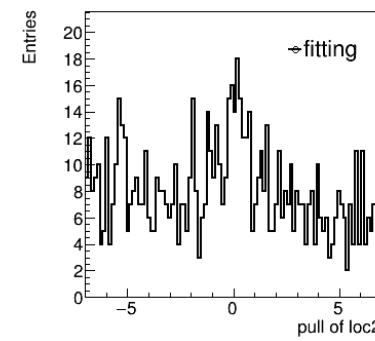
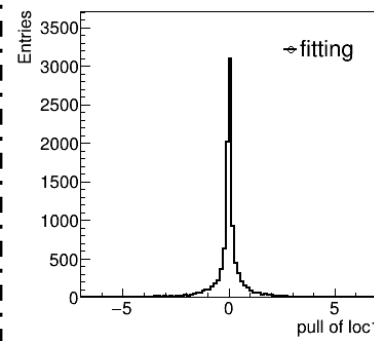
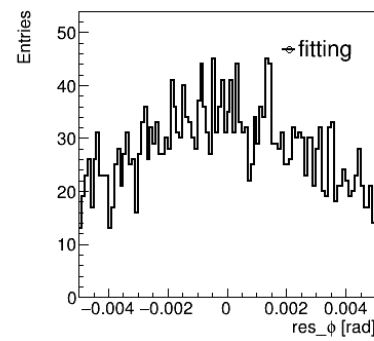
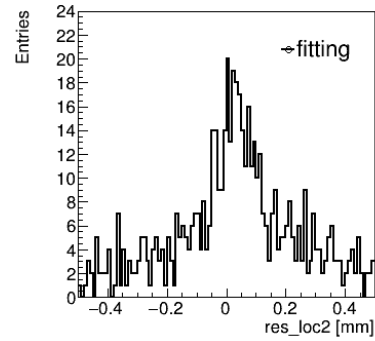
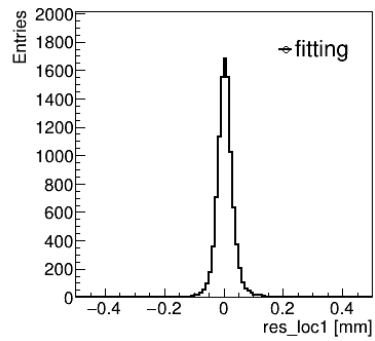


Pull

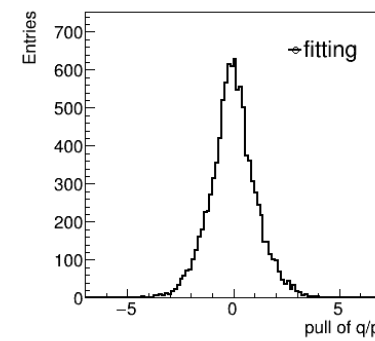
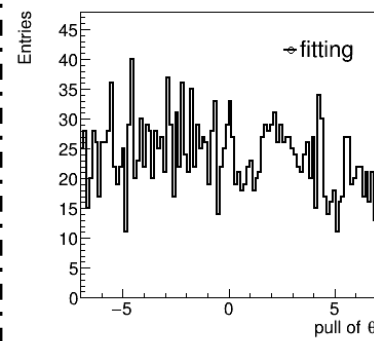
Residuals and pulls -- fitting

- Parameters of tracks
- Total

• $\theta: 85^\circ$



Residual

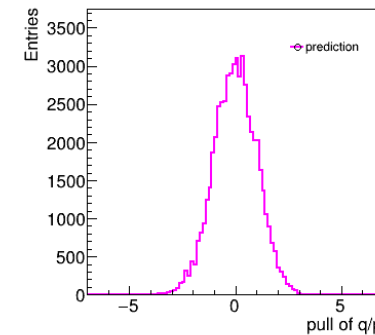
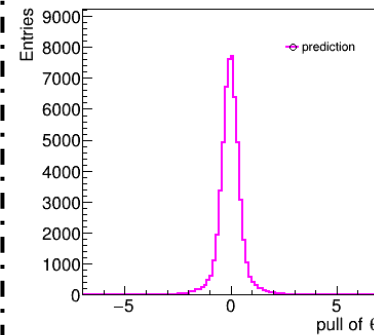
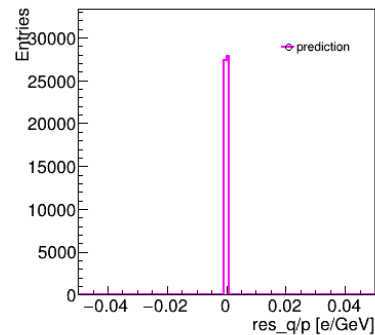
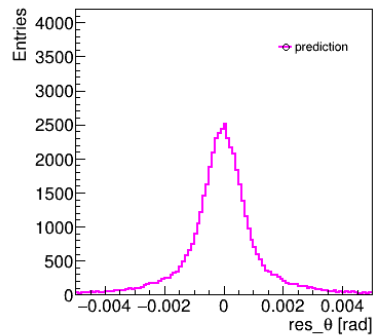
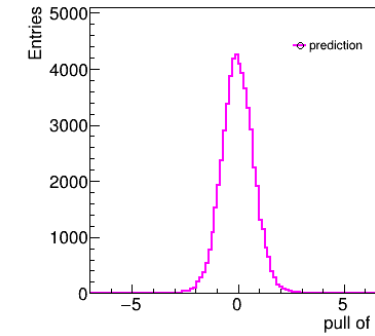
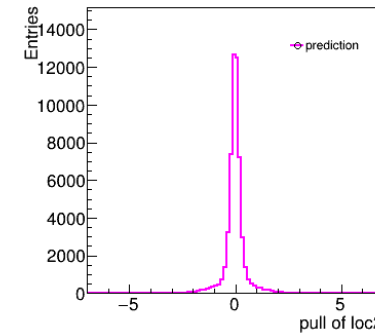
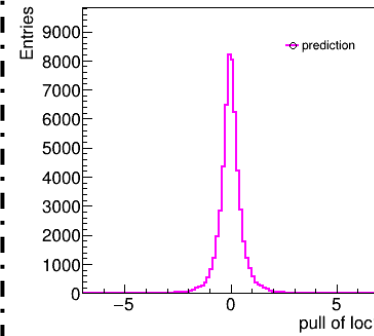
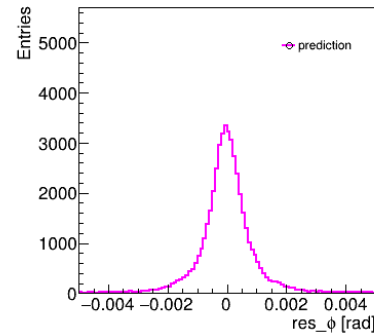
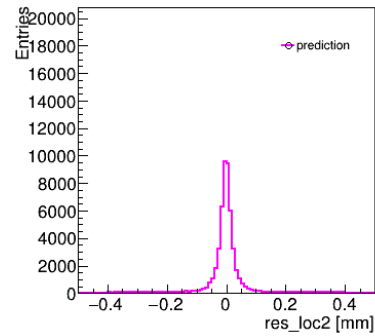
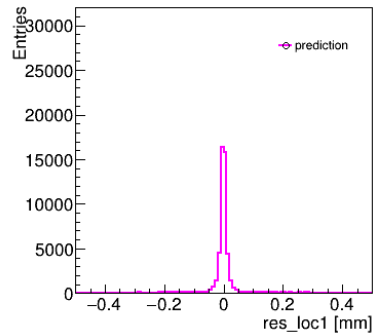


Pull

Residuals and pulls -- prediction

- Parameters of measurements
- Vertex

• $\theta: 85^\circ$



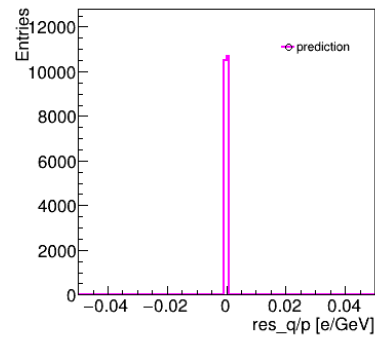
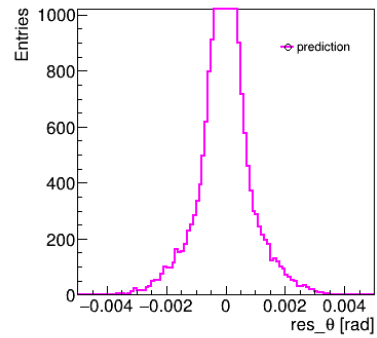
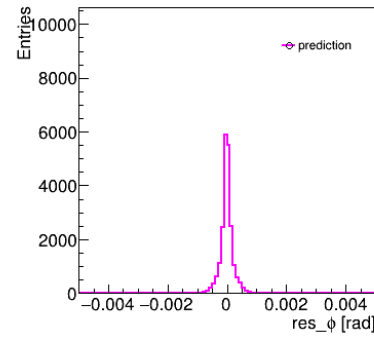
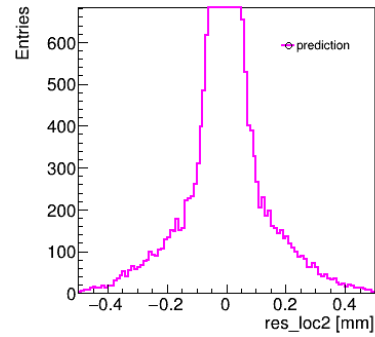
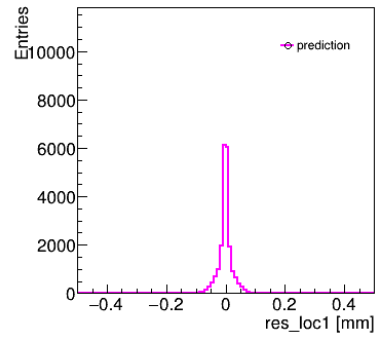
Residual

Pull

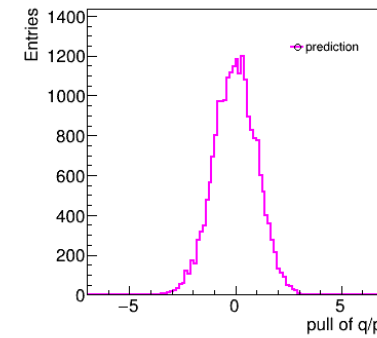
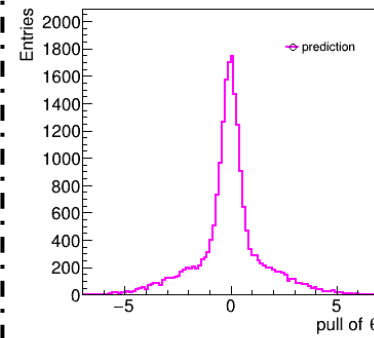
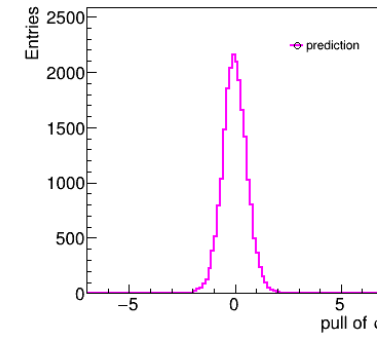
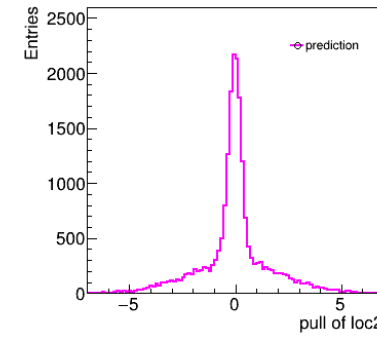
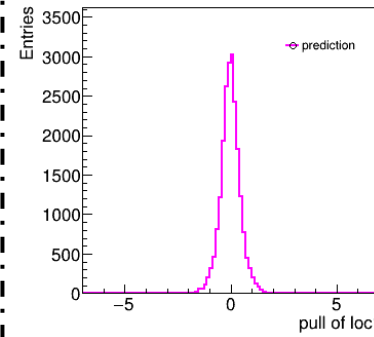
Residuals and pulls -- prediction

- Parameters of measurements
- SIT 1

• $\theta: 85^\circ$



Residual

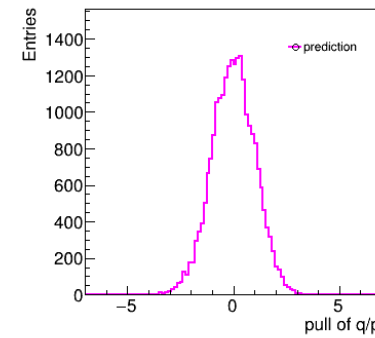
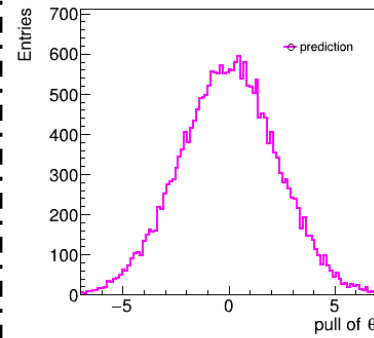
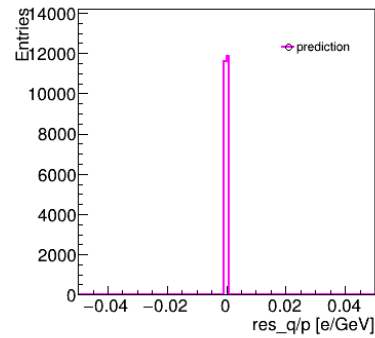
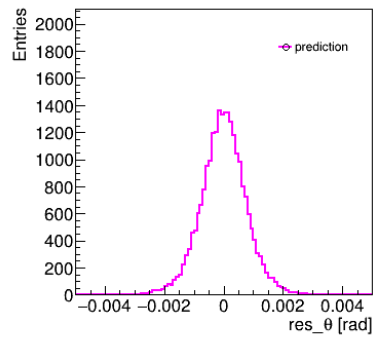
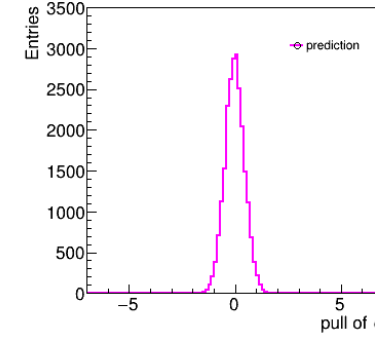
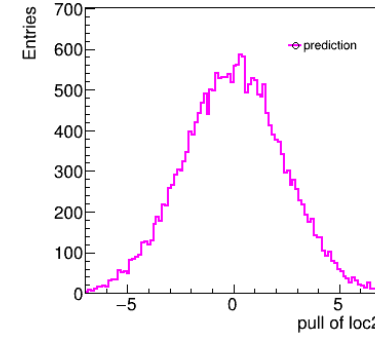
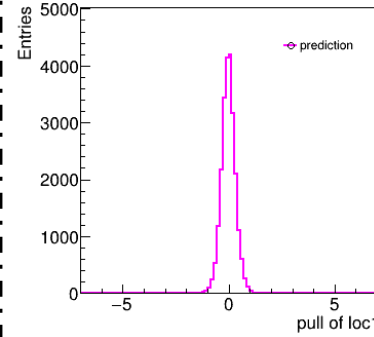
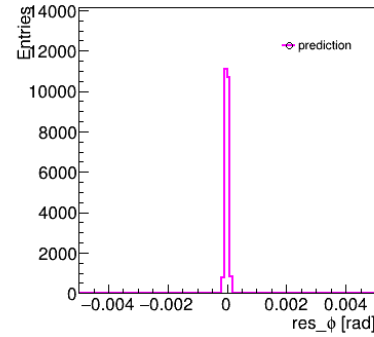
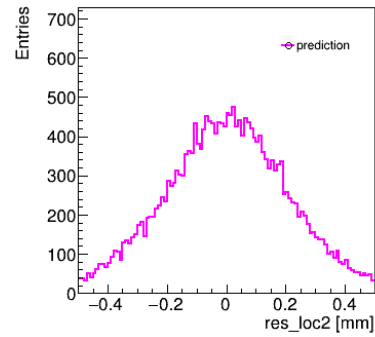
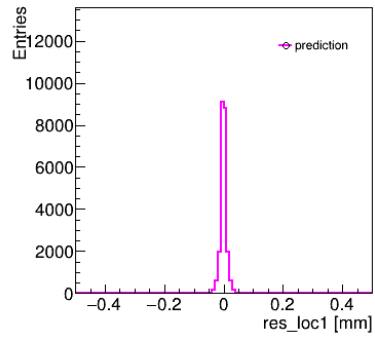


Pull

Residuals and pulls -- prediction

- Parameters of measurements
- SIT 2

• $\theta: 85^\circ$



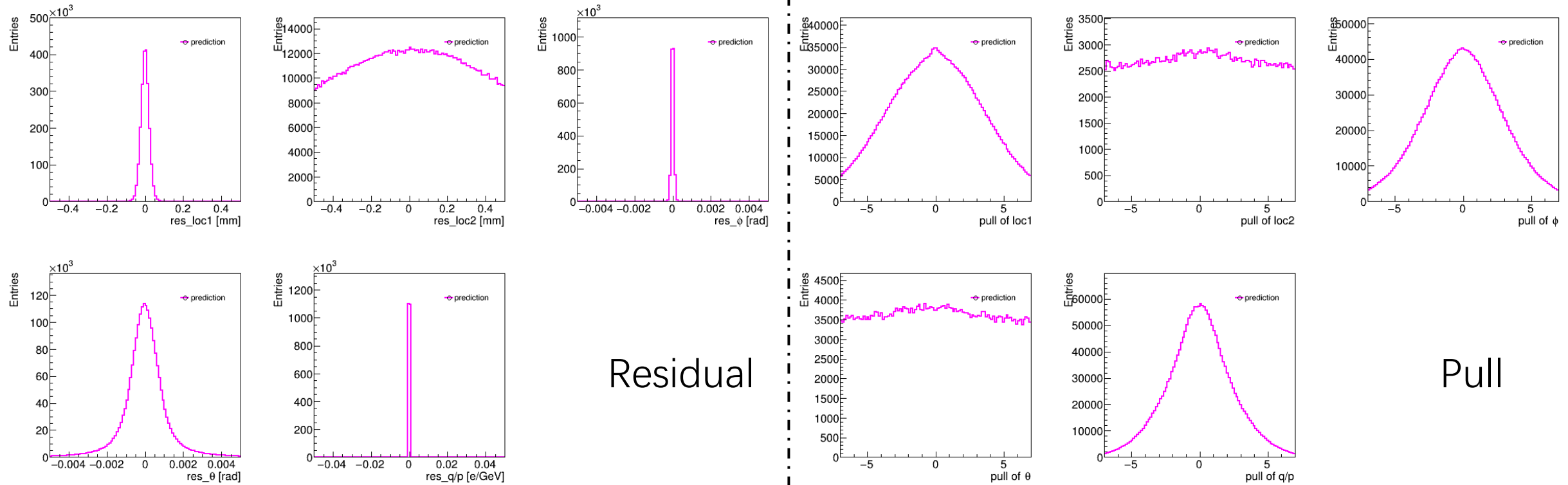
Residual

Pull

Residuals and pulls -- prediction

- Parameters of measurements
- TPC

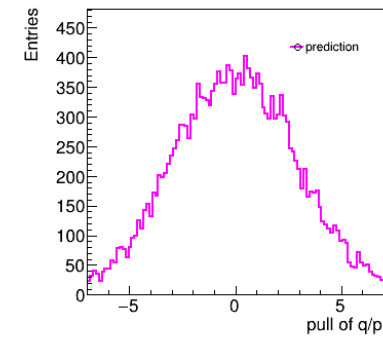
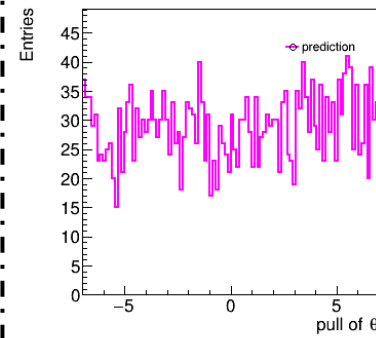
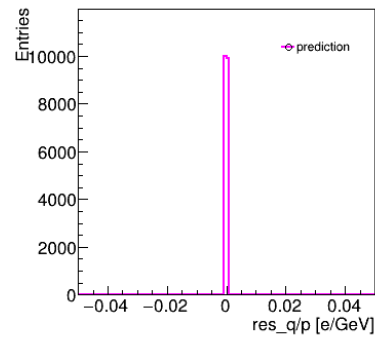
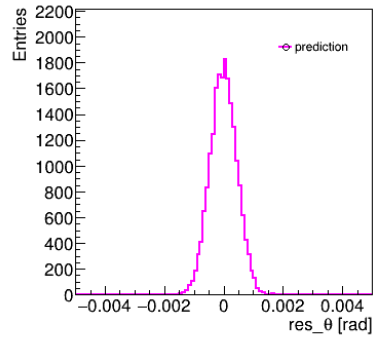
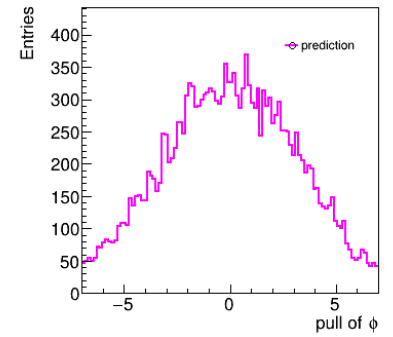
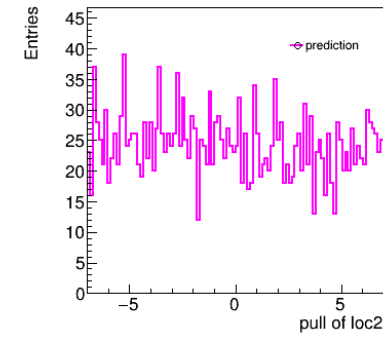
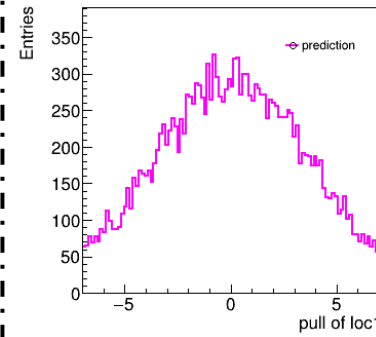
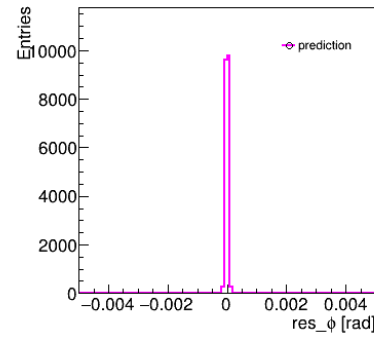
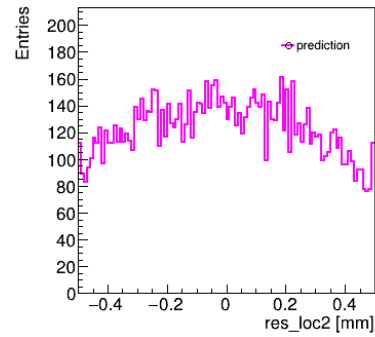
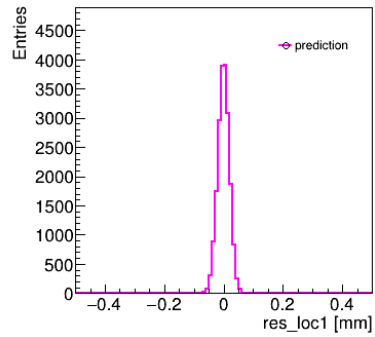
• $\theta: 85^\circ$



Residuals and pulls -- prediction

- Parameters of measurements
- SET

• $\theta: 85^\circ$



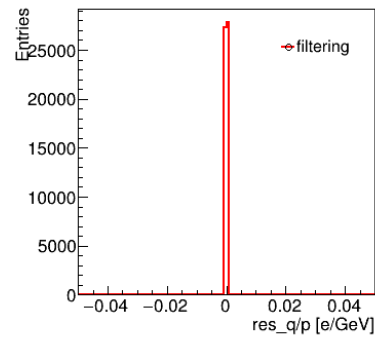
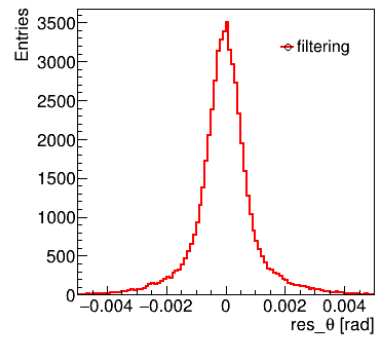
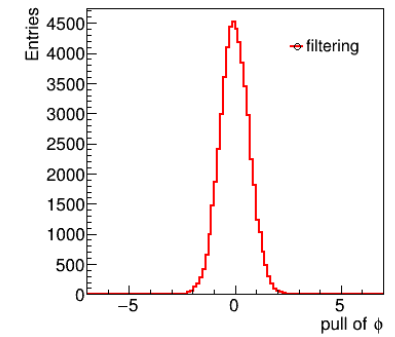
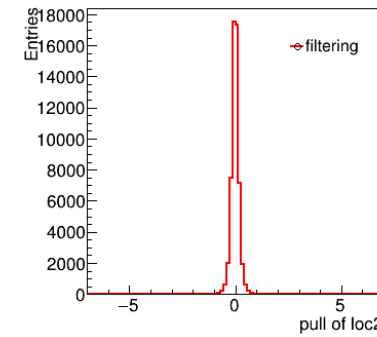
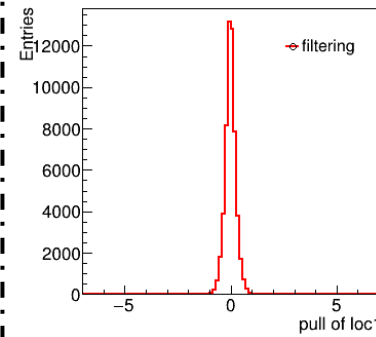
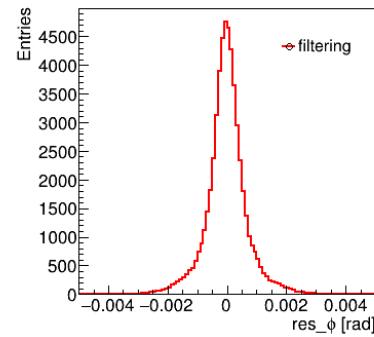
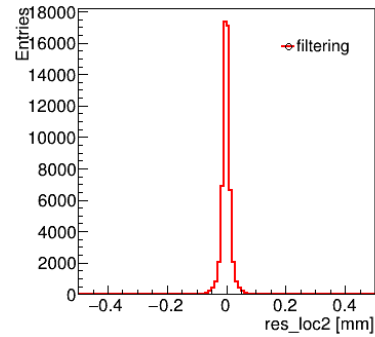
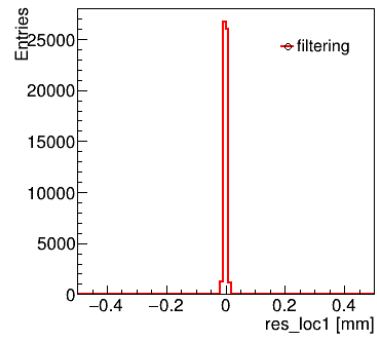
Residual

Pull

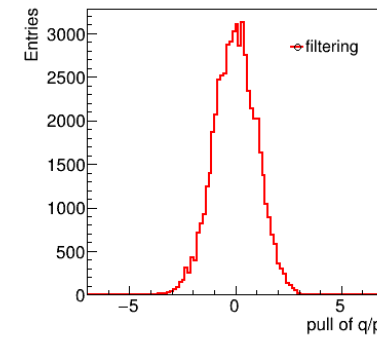
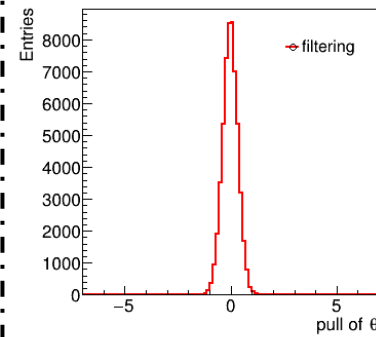
Residuals and pulls -- filtering

- Parameters of measurements
- Vertex

• $\theta: 85^\circ$



Residual

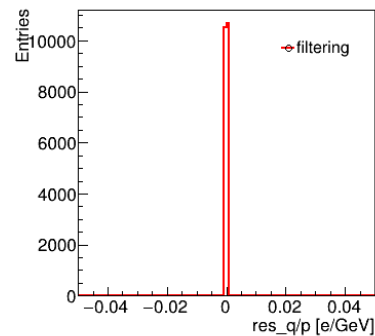
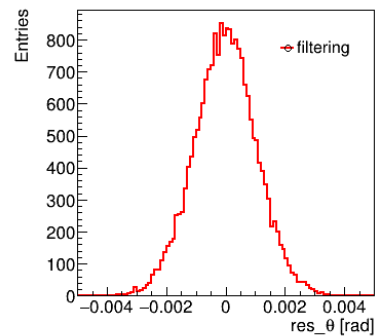
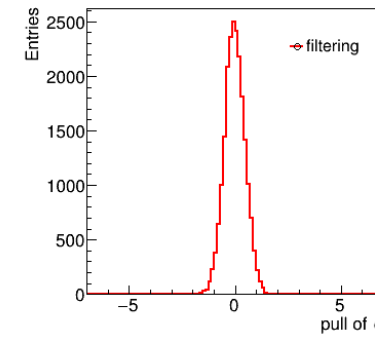
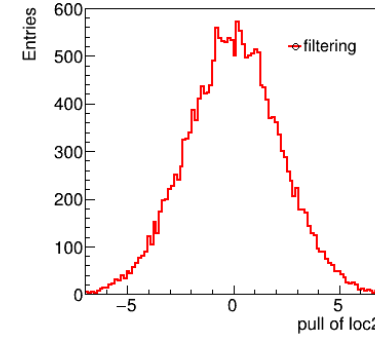
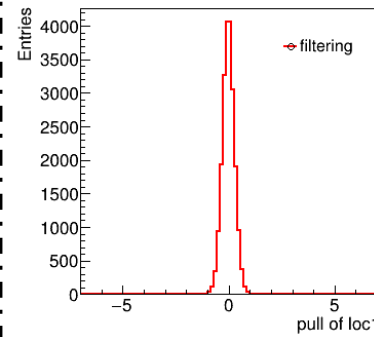
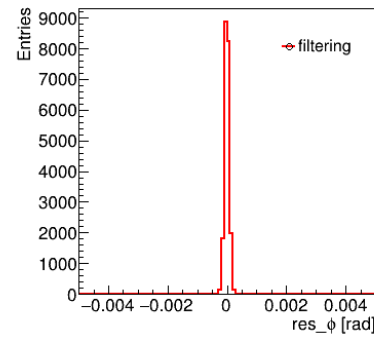
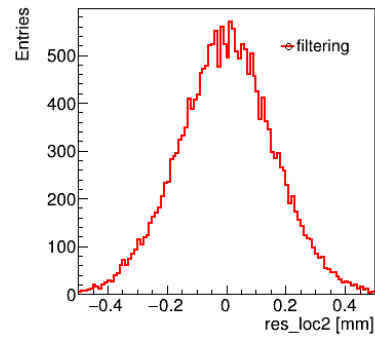
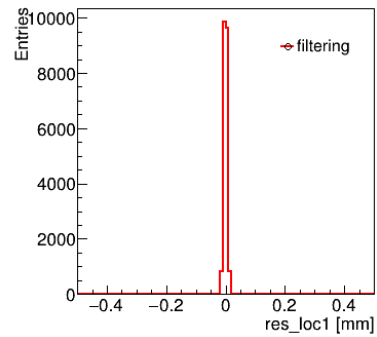


Pull

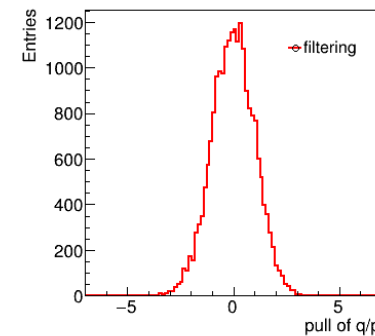
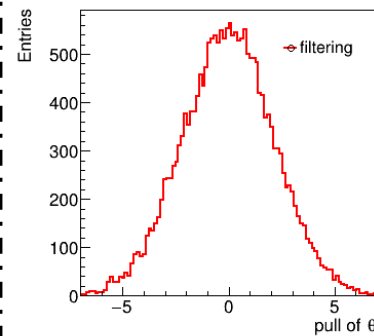
Residuals and pulls -- filtering

- Parameters of measurements
- SIT 1

• $\theta: 85^\circ$



Residual

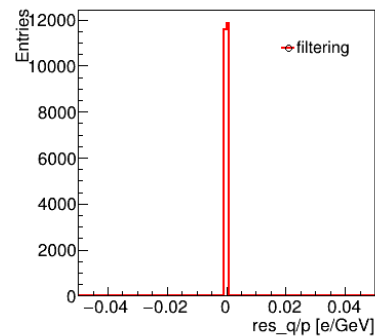
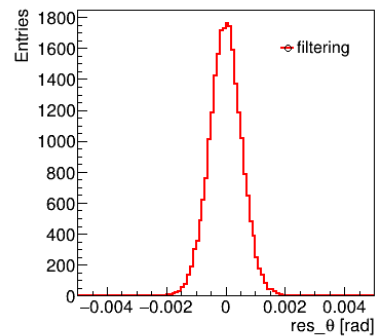
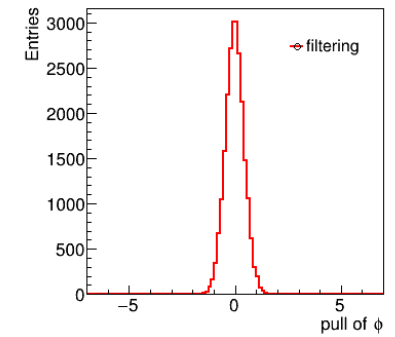
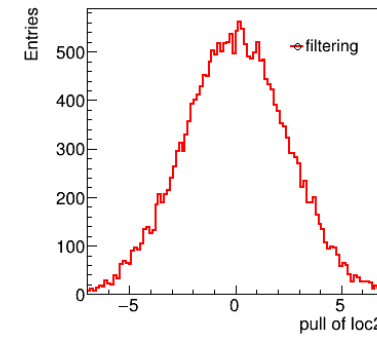
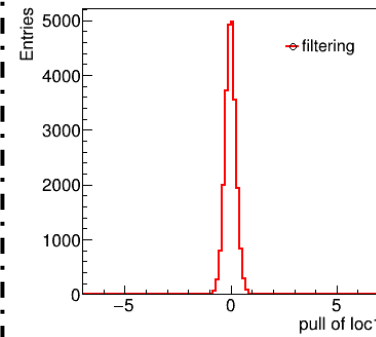
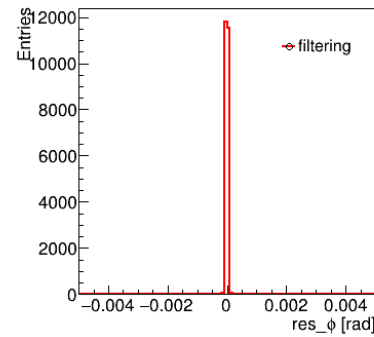
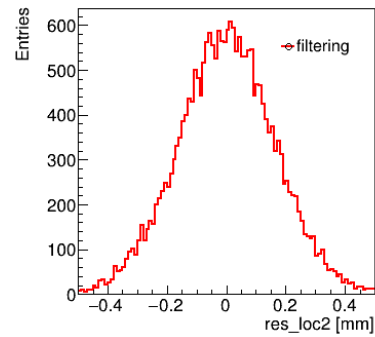
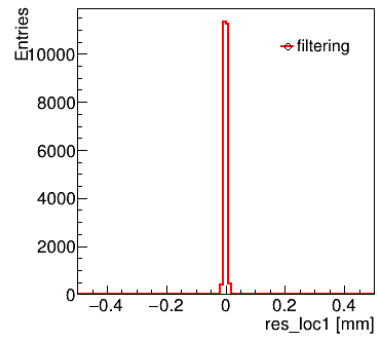


Pull

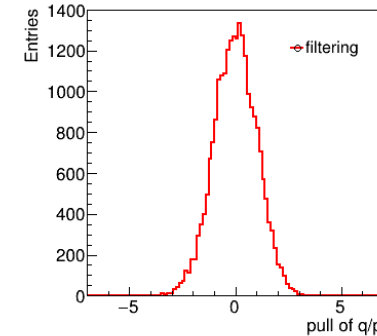
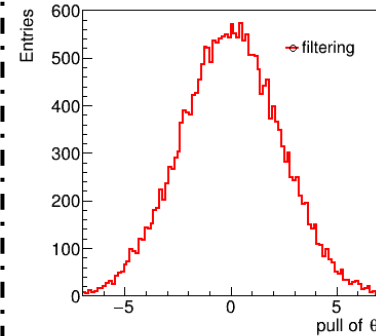
Residuals and pulls -- filtering

- Parameters of measurements
- SIT 2

• $\theta: 85^\circ$



Residual

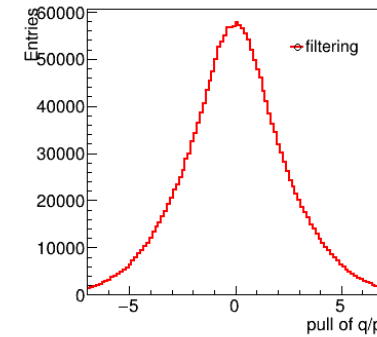
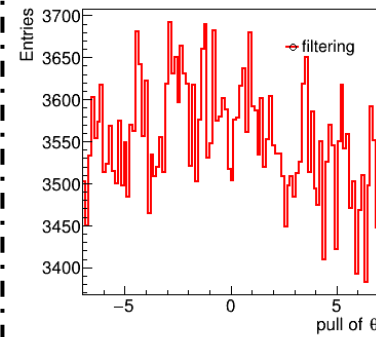
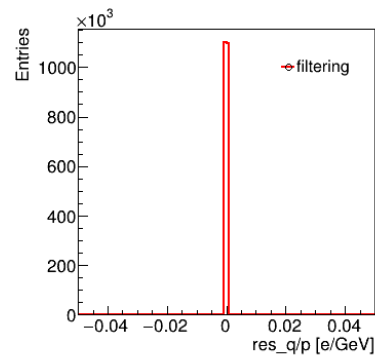
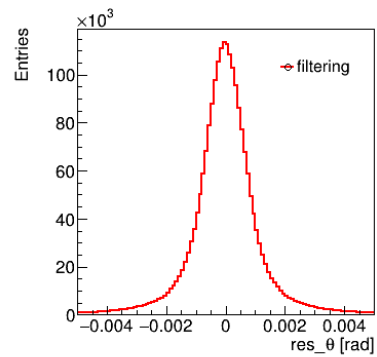
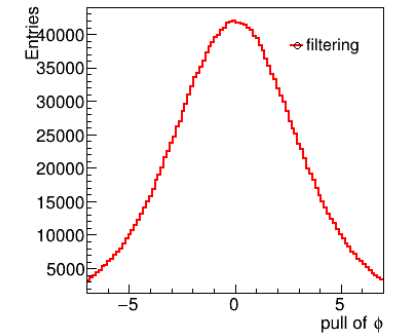
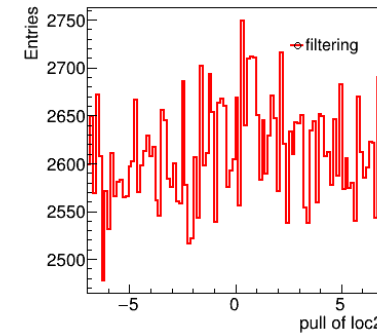
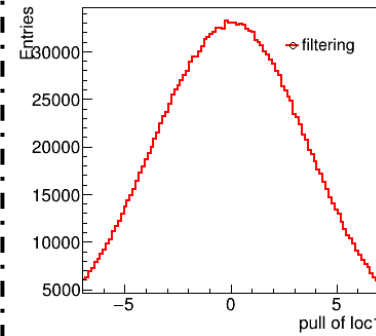
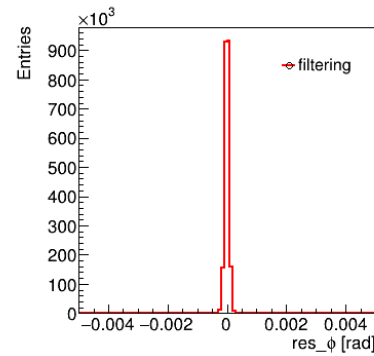
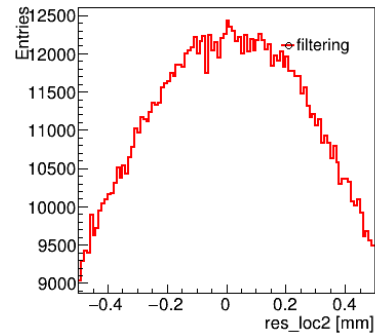
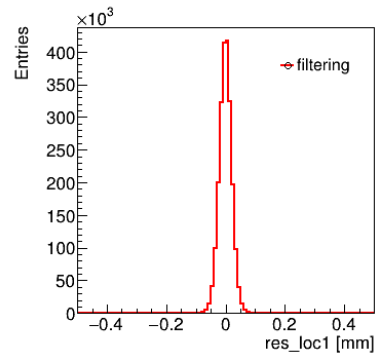


Pull

Residuals and pulls -- filtering

- Parameters of measurements
- TPC

• $\theta: 85^\circ$



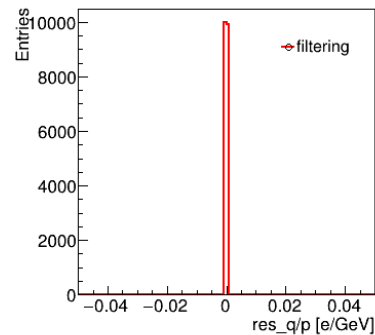
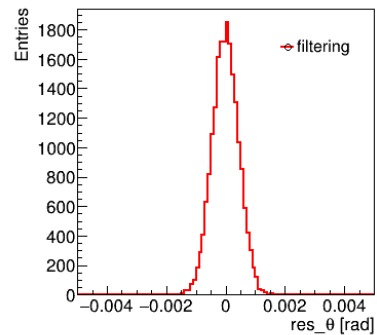
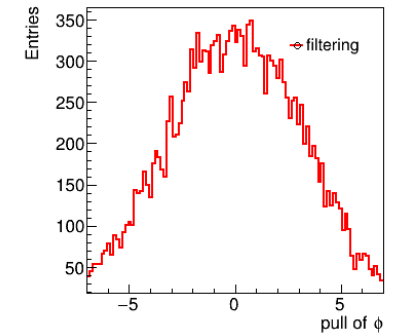
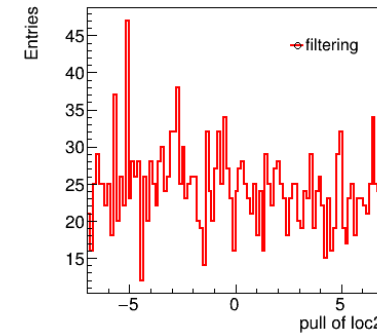
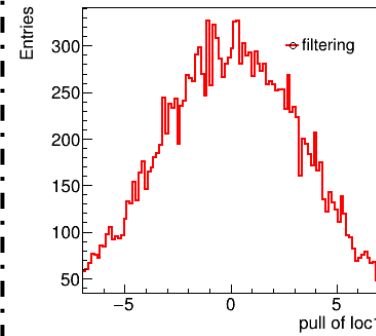
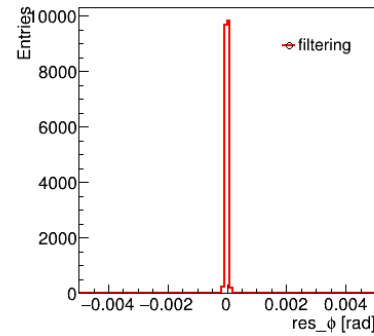
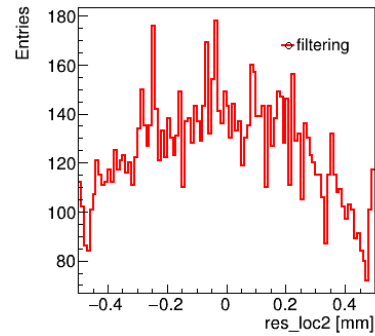
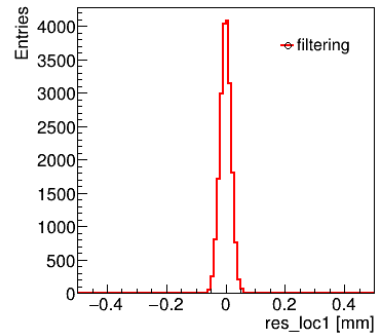
Residual

Pull

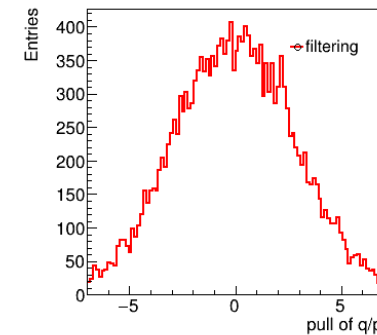
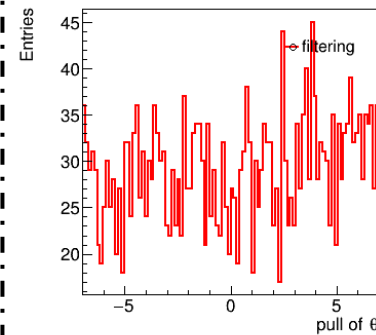
Residuals and pulls -- filtering

- Parameters of measurements
- SET

• $\theta: 85^\circ$



Residual

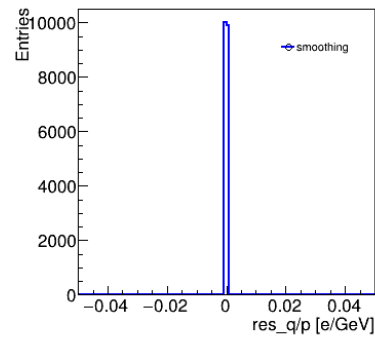
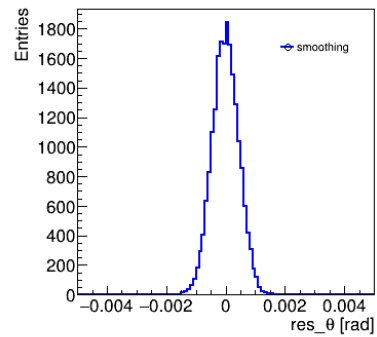
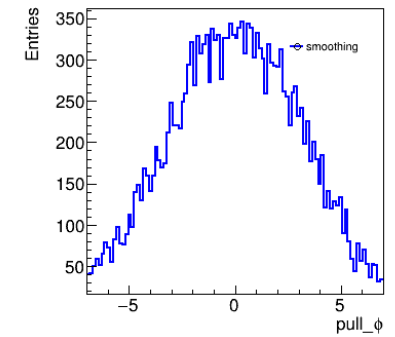
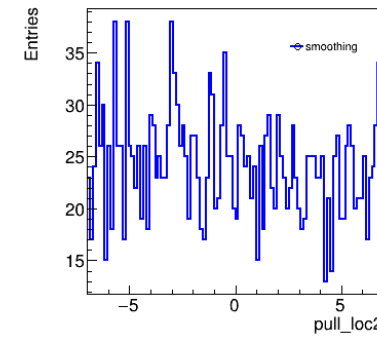
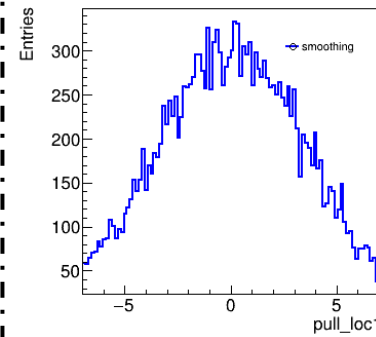
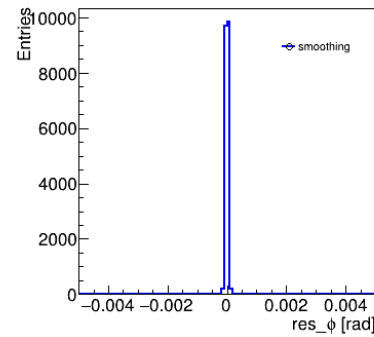
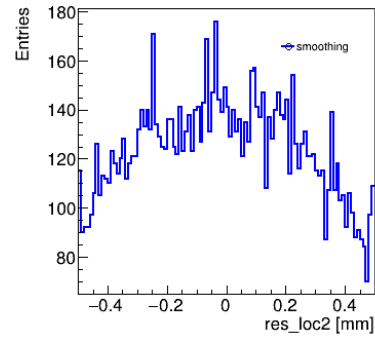
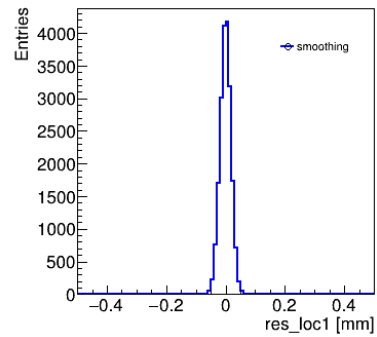


Pull

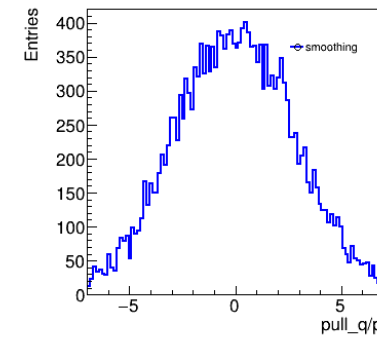
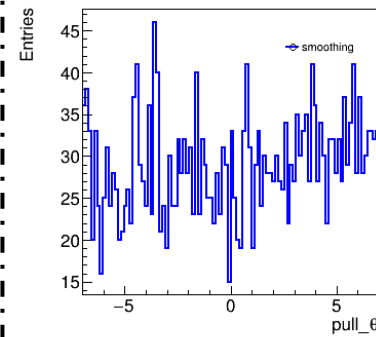
Residuals and pulls -- smoothing

- Parameters of measurements
- SET

• $\theta: 85^\circ$



Residual

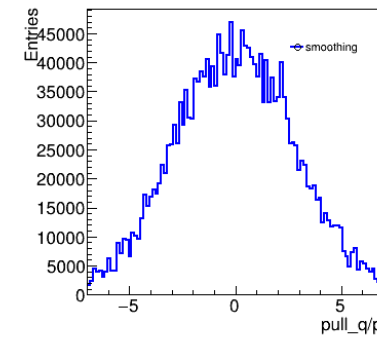
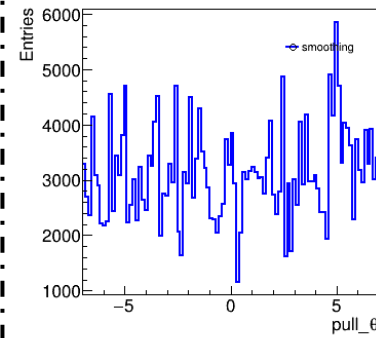
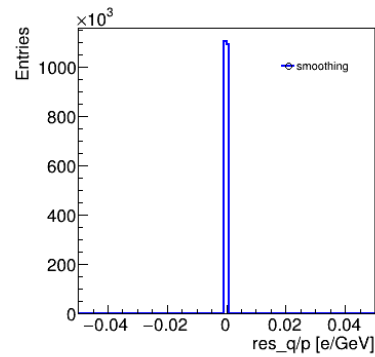
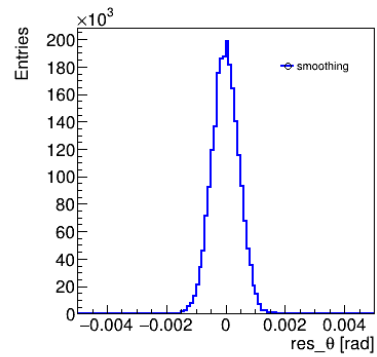
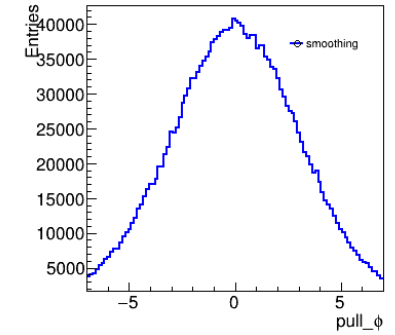
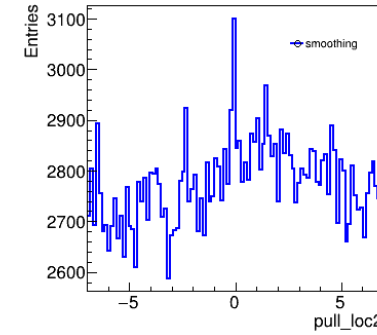
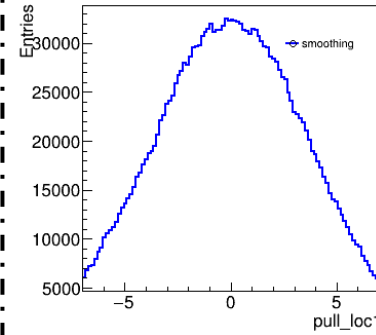
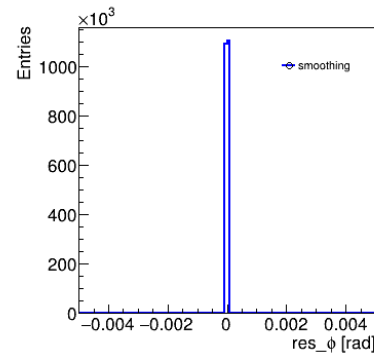
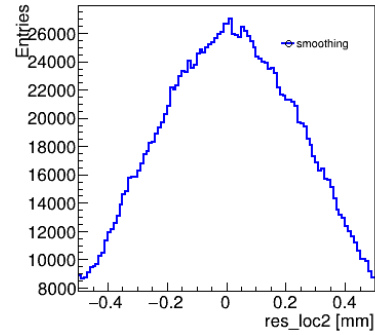
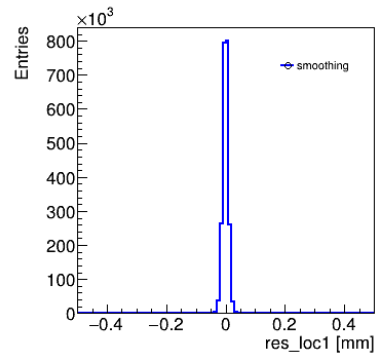


Pull

Residuals and pulls -- smoothing

- Parameters of measurements
- TPC

• $\theta: 85^\circ$



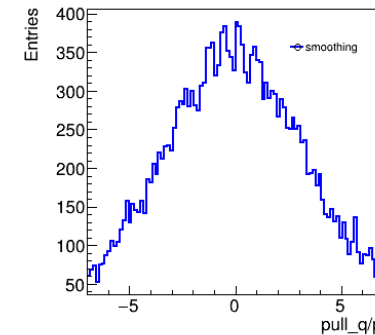
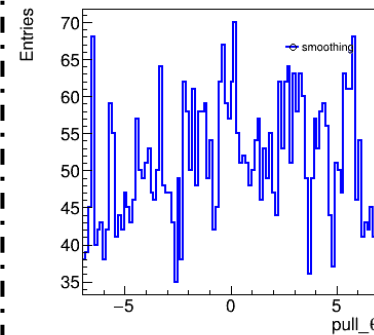
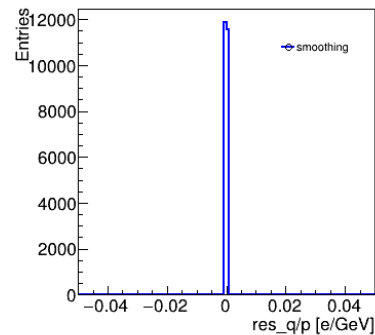
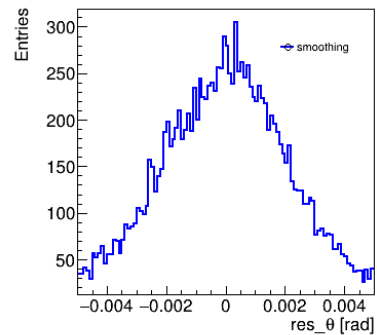
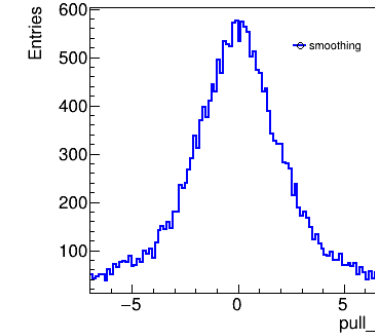
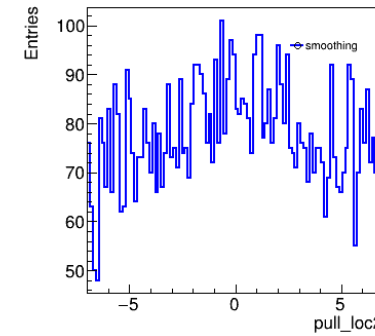
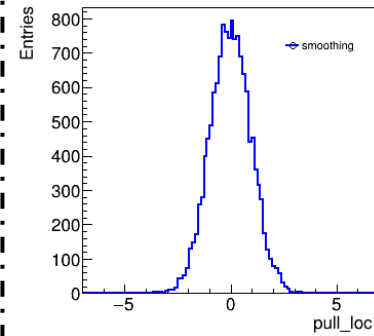
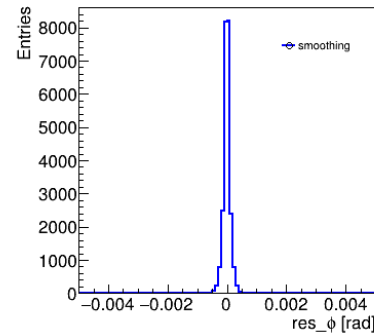
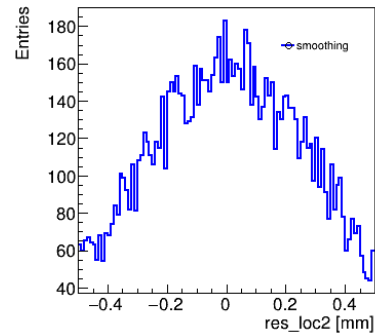
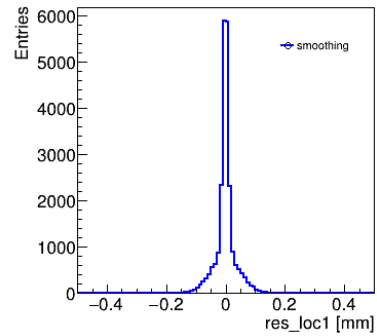
Residual

Pull

Residuals and pulls -- smoothing

- Parameters of measurements
- SIT 2

• $\theta: 85^\circ$



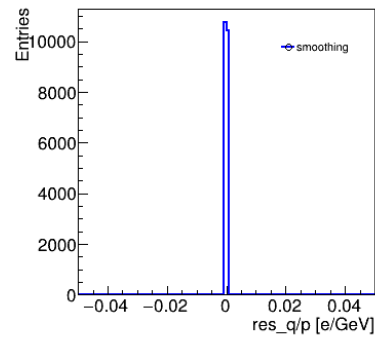
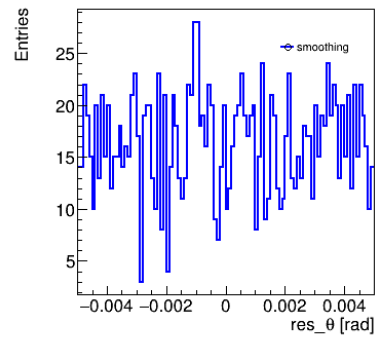
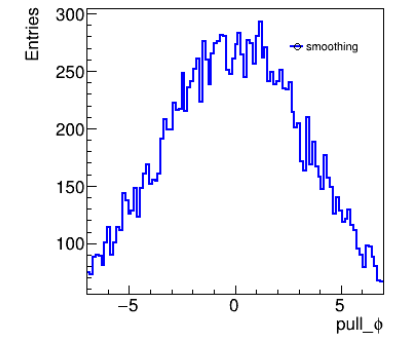
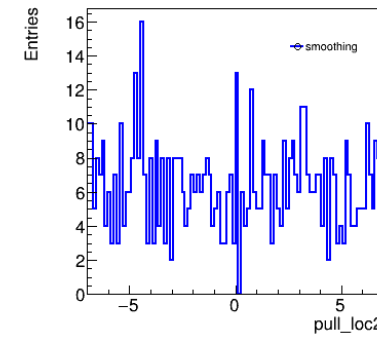
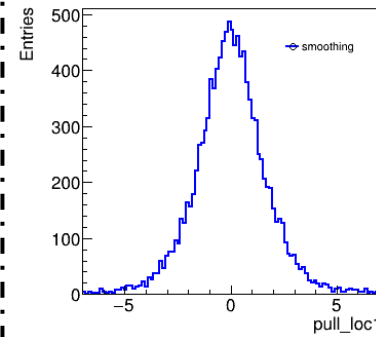
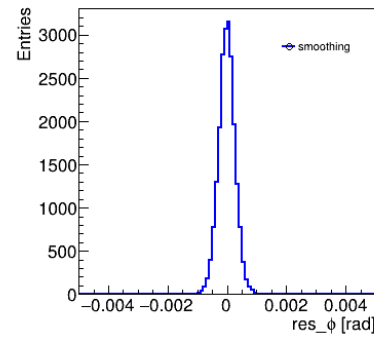
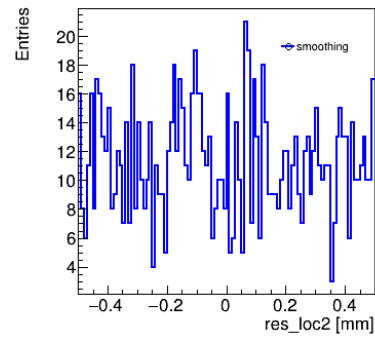
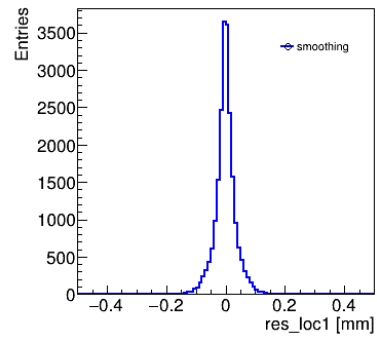
Residual

Pull

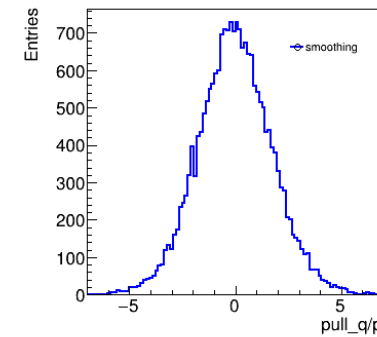
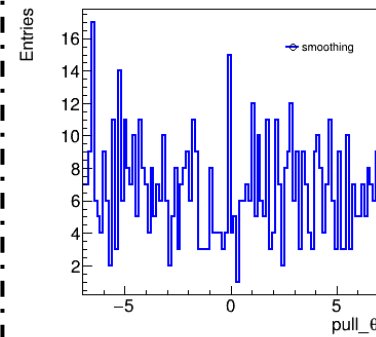
Residuals and pulls -- smoothing

- Parameters of measurements
- SIT 1

• $\theta: 85^\circ$



Residual

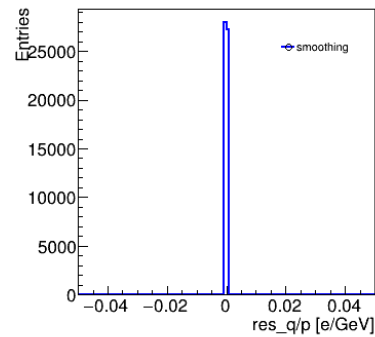
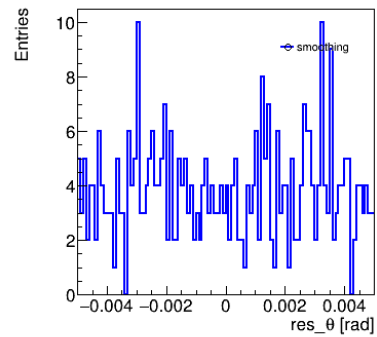
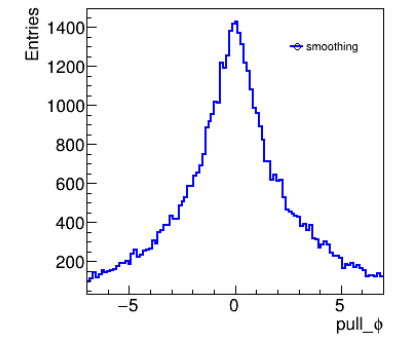
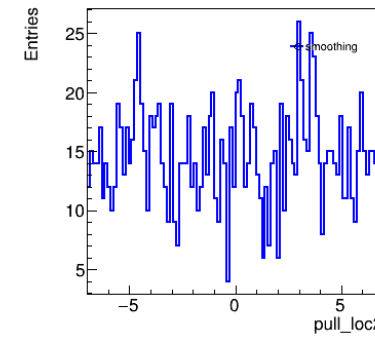
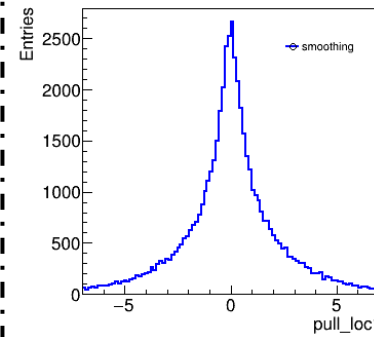
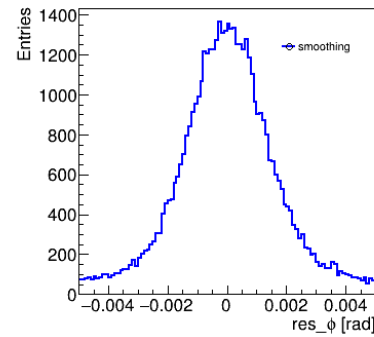
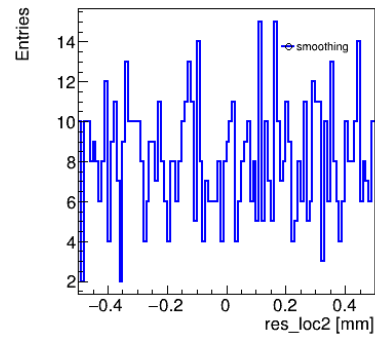
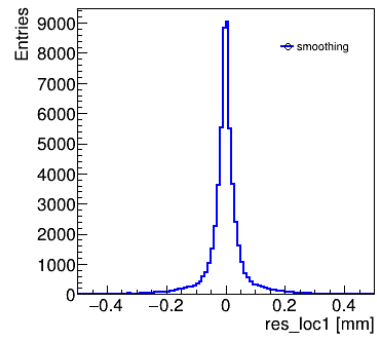


Pull

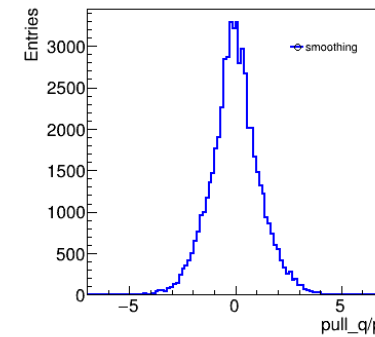
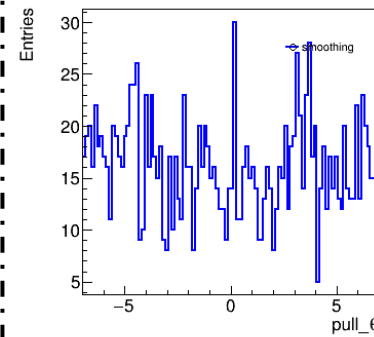
Residuals and pulls -- smoothing

- Parameters of measurements
- Vertex

• $\theta: 85^\circ$



Residual



Pull

- Branch: combine-bump
 - Commit id: cb6ab478e13654bca66c7e588b0686506ff9836c
- Same options
 - Particle gun: 10000 μ from (0, 0, 0)
 - Magnetic field: (0, 0, 3T)
 - p_T : 100GeV
 - θ : 20°
 - φ : uniform distribution

- Codes

```

pT=100
theta=20
cos_theta=$(echo "$theta"|gawk '{printf("%12.10f\n",cos($1/180.*3.141592653))}')
dirName=cepc_sim_${pT}_${theta}
NParticles=1
NEvents=10000

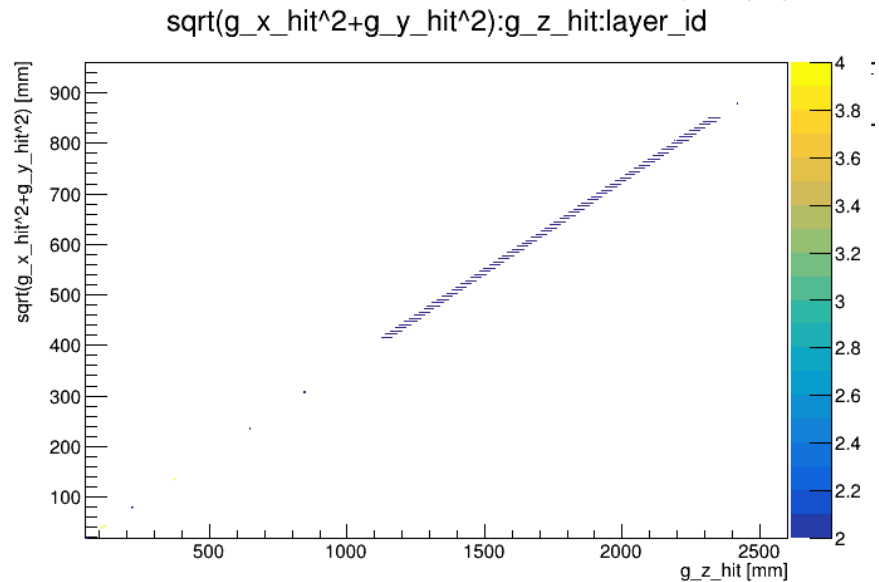
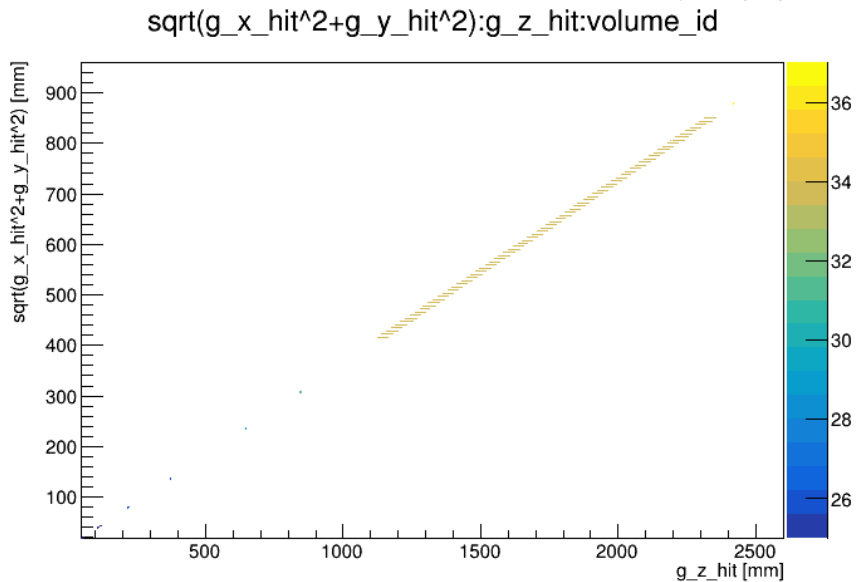
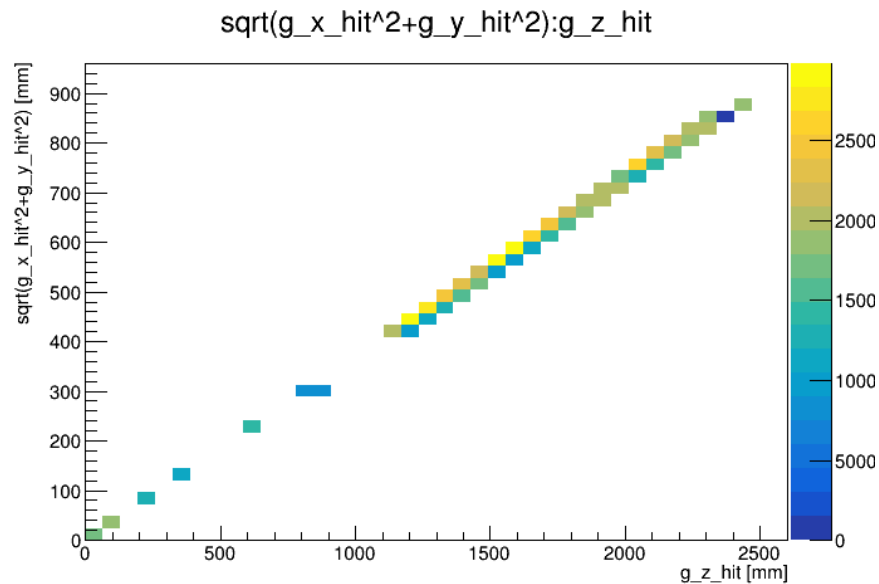
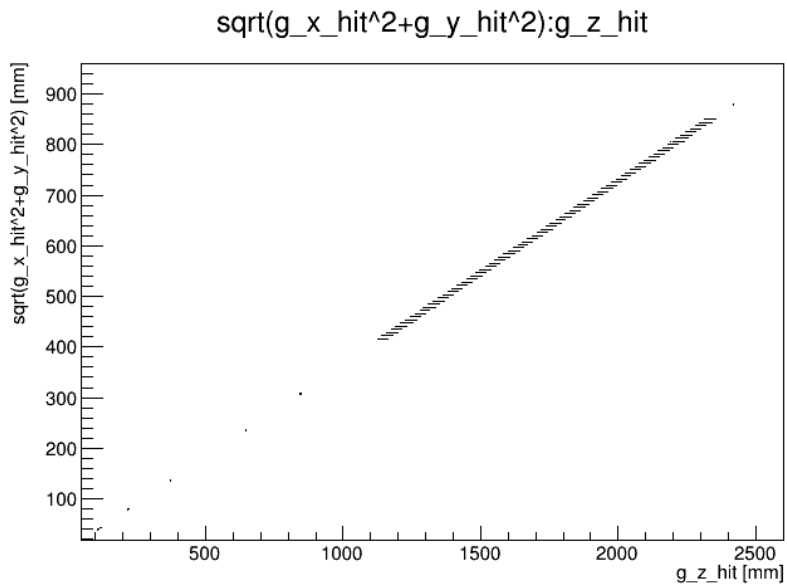
./ActsSimFatrasDD4hep \
--evg-input-type gun \
--dd4hep-input ../../Detectors/DD4hepDetector/compact/CEPC/cepc_v04_master.xml \
--dd4hep-envelopeR 0.1 \
--dd4hep-envelopeZ 0.1 \
--bf-values 0 0 3 \
--pg-pt-range ${pT} ${pT} \
--pg-costheta-range ${cos_theta} ${cos_theta} \
--pg-nparticles ${NParticles} \
--events ${NEvents} \
--output-root 1 \
--output-dir ${dirName}

```

Hits distributions

- Entries/Nparticles: 9999/10000

• $\theta: 20^\circ$

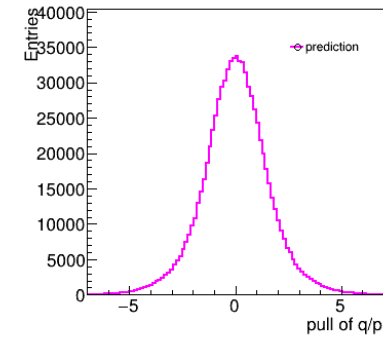
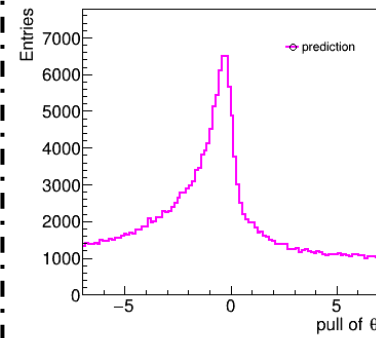
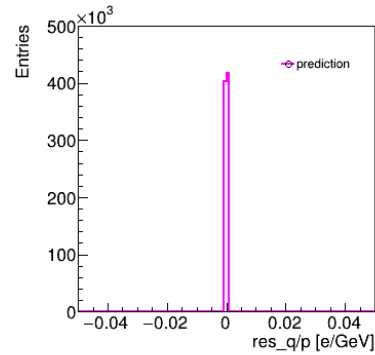
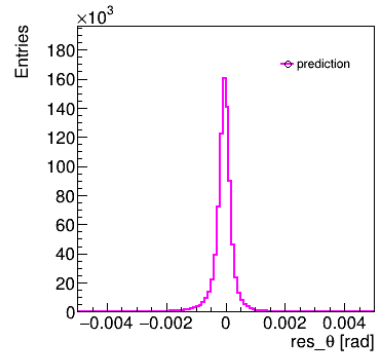
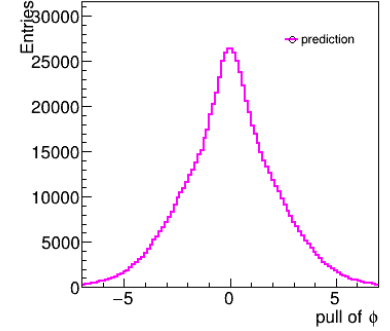
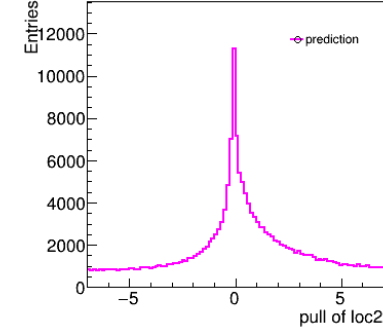
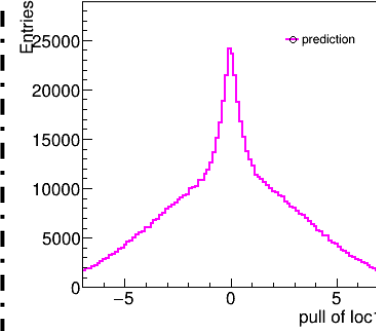
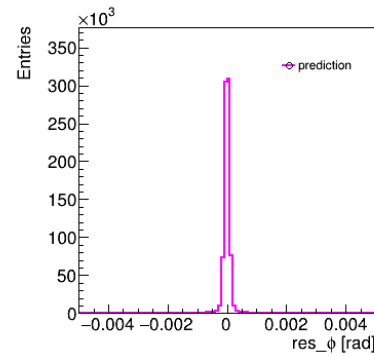
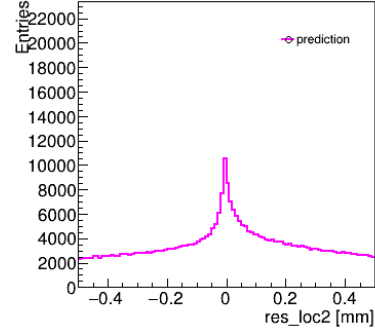
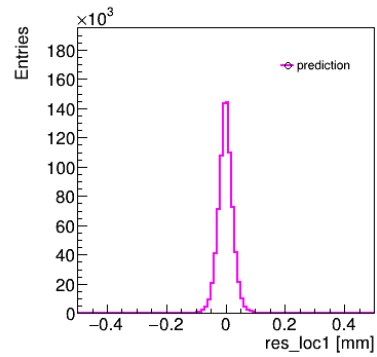


Sub-detector	Volume_id	Layer_id	nMeasurements
Vertex	25	2	17196
		4	18205
		6	
SIT 1	28	2	
SIT 2	31	2	
FTD 1, 2 neg	24	2	
FTD 1, 2 pos	26	2	23355
FTD 3 neg	19	2	
FTD 3 pos	29	2	14212
FTD 4, 5 neg	14	2	
FTD 4, 5 pos	32	2	16970
TPC	34	2	709828
SET	36	2	
ETD neg	6	2	
ETD pos	37	2	19304
Total			819070

Residuals and pulls -- prediction

- Parameters of measurements
- Total

• $\theta: 20^\circ$



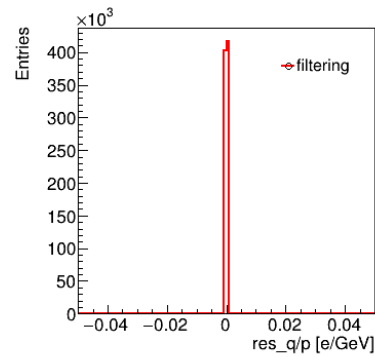
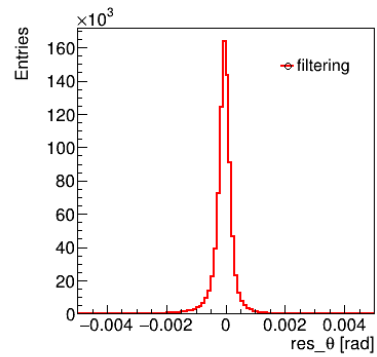
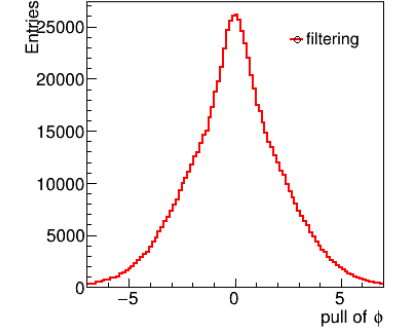
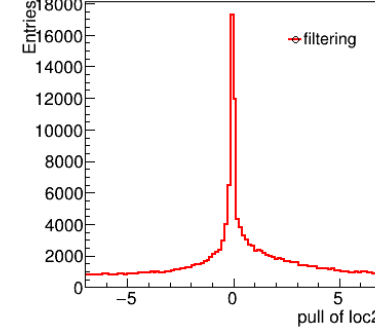
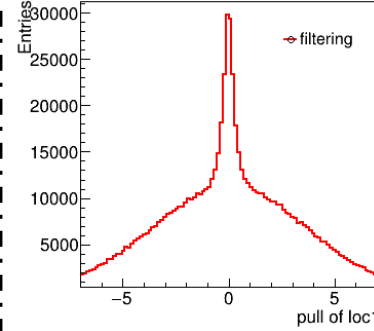
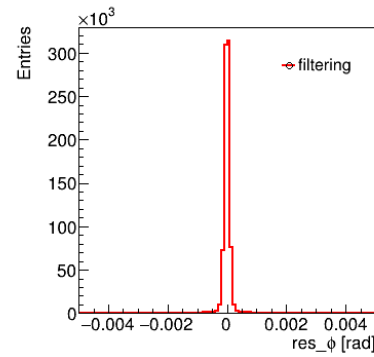
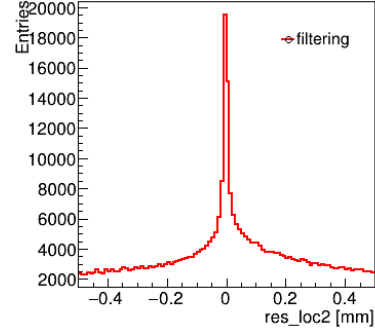
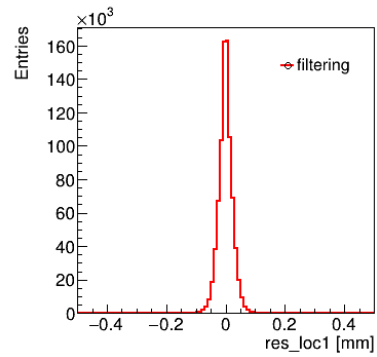
Residual

Pull

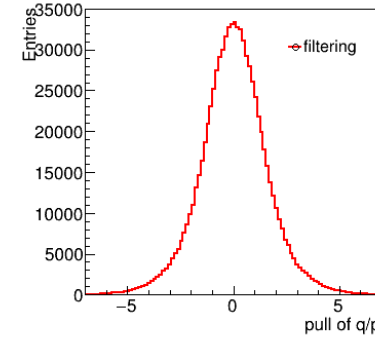
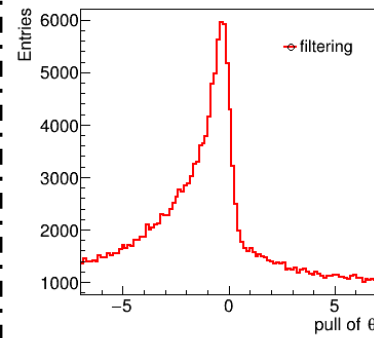
Residuals and pulls -- filtering

- Parameters of measurements
- Total

• $\theta: 20^\circ$



Residual

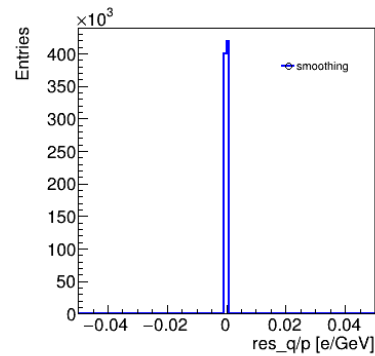
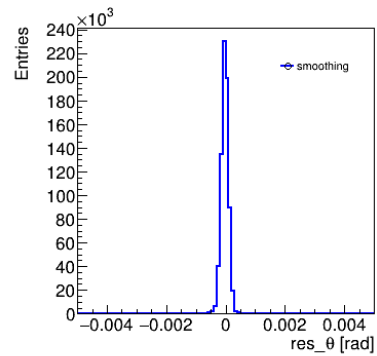
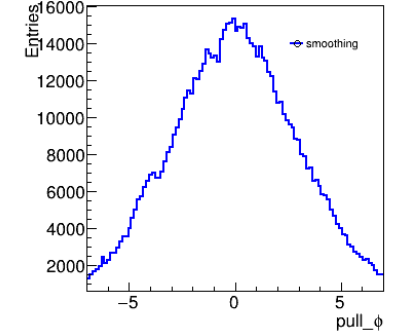
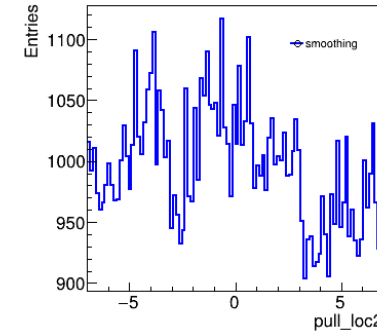
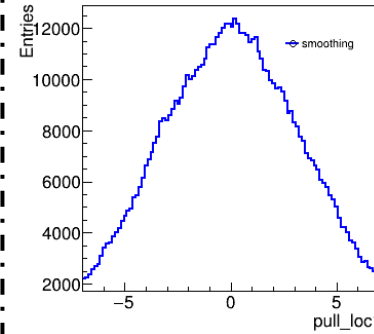
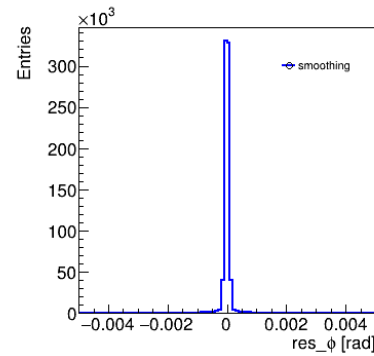
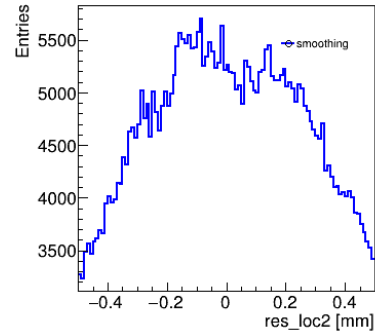
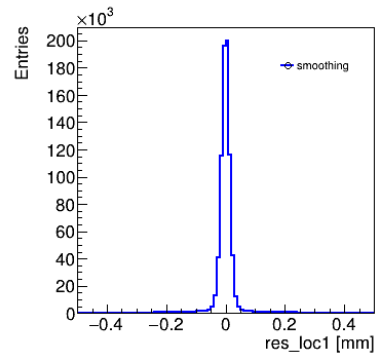


Pull

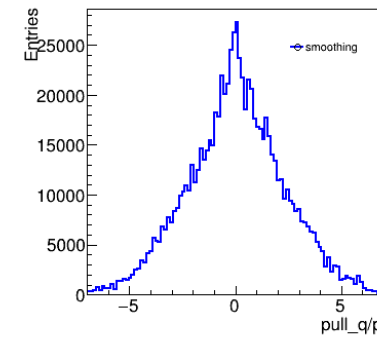
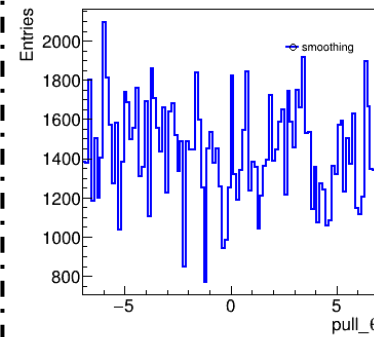
Residuals and pulls -- smoothing

- Parameters of measurements
- Total

• $\theta: 20^\circ$



Residual

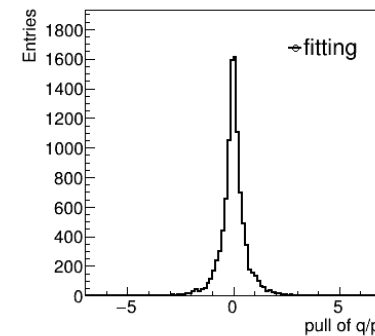
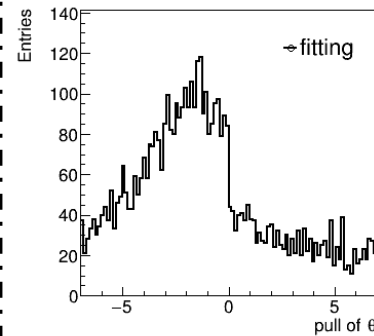
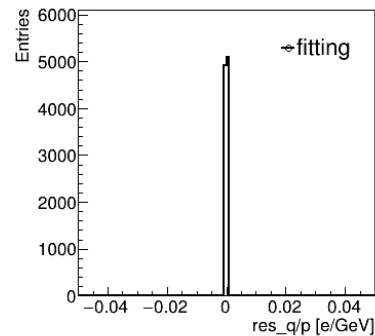
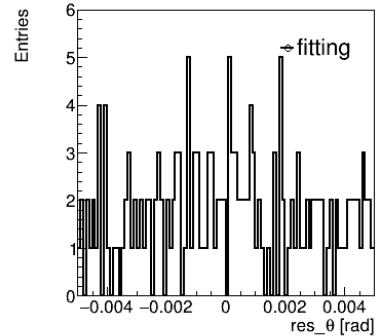
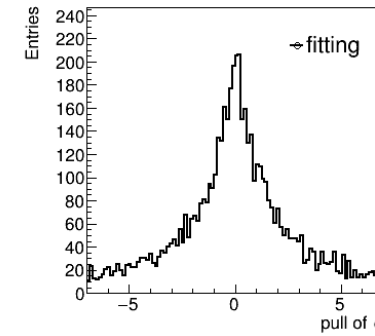
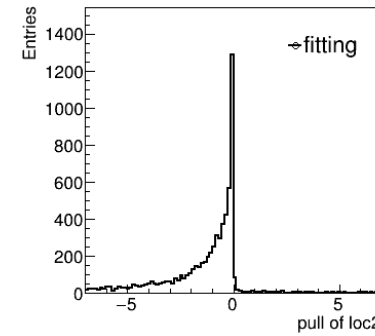
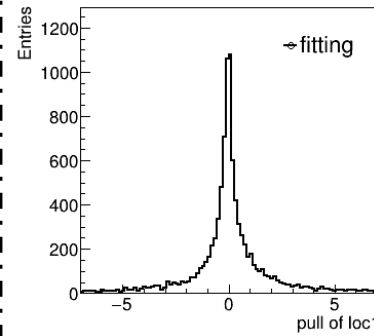
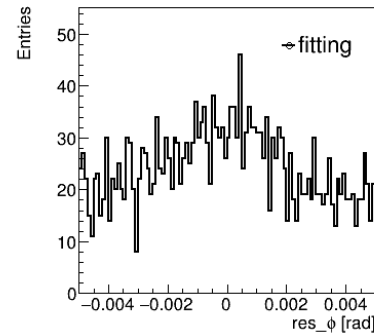
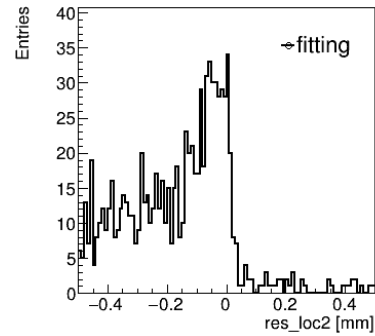
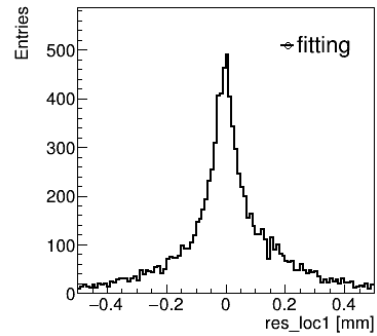


Pull

Residuals and pulls -- fitting

- Parameters of tracks
- Total

• $\theta: 20^\circ$



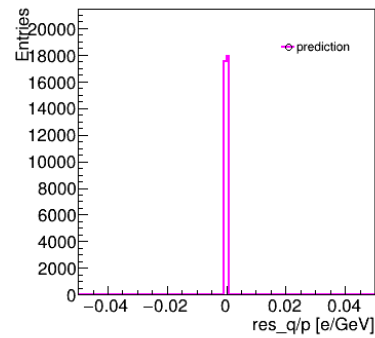
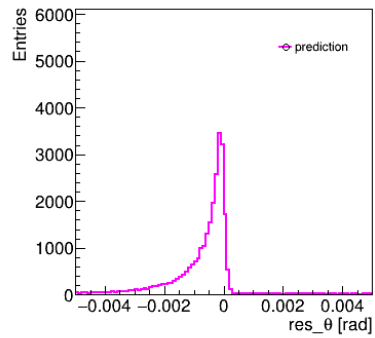
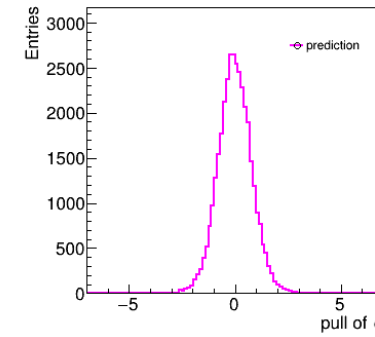
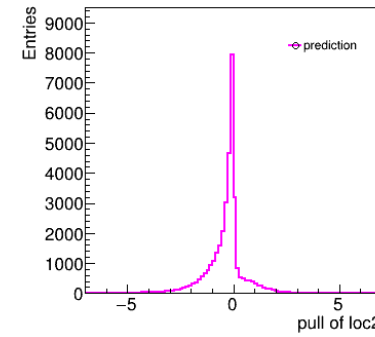
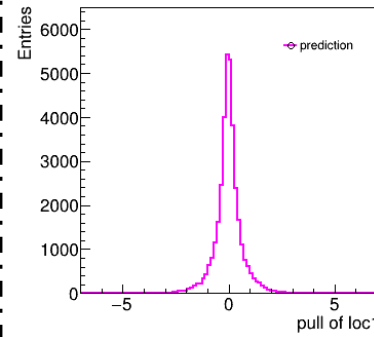
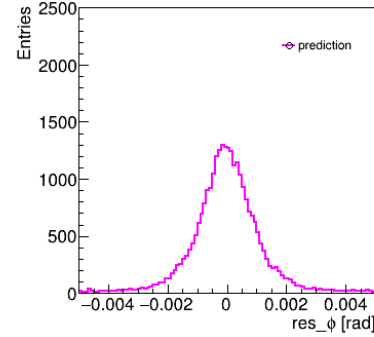
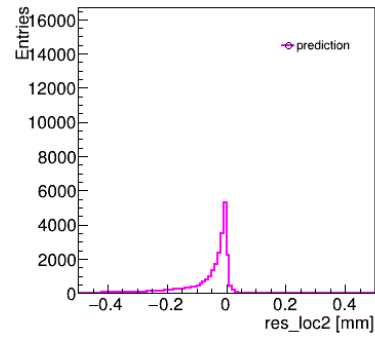
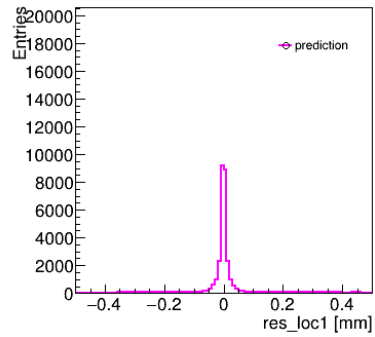
Residual

Pull

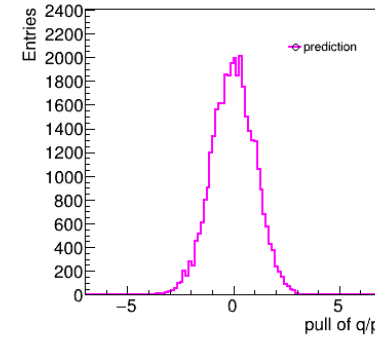
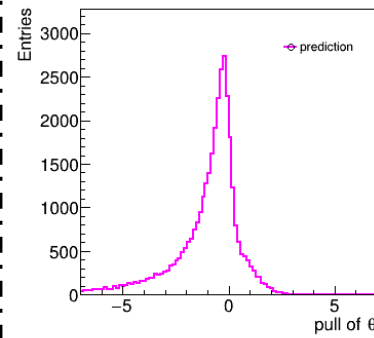
Residuals and pulls -- prediction

- Parameters of measurements
- Vertex

• $\theta: 20^\circ$



Residual

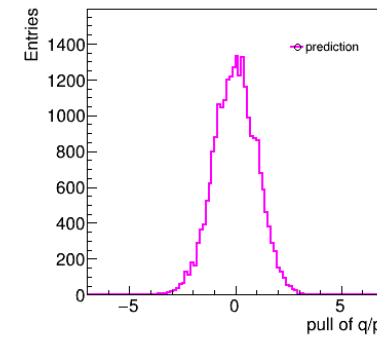
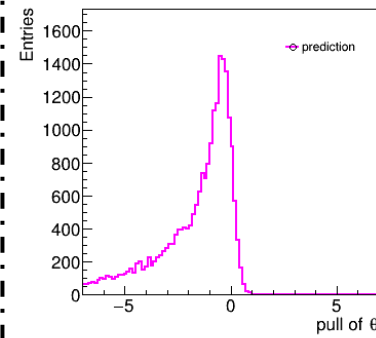
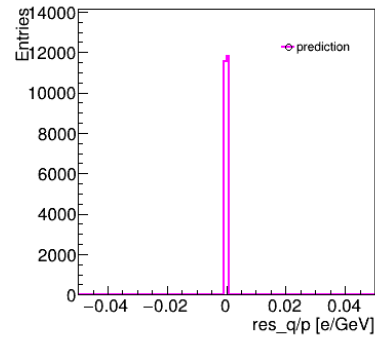
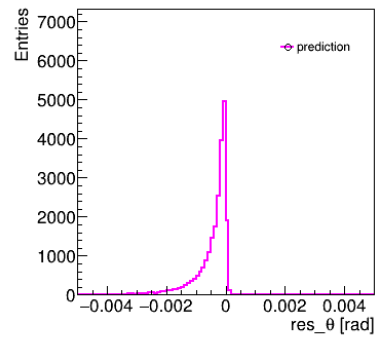
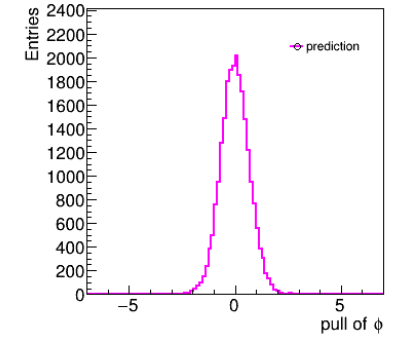
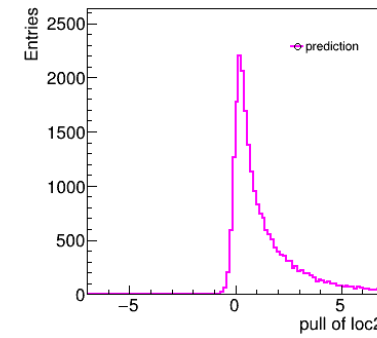
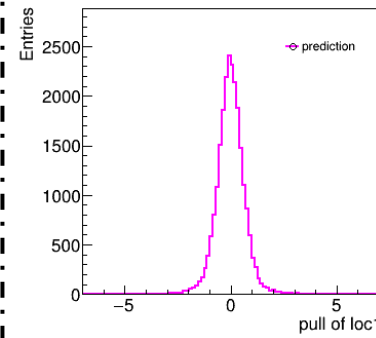
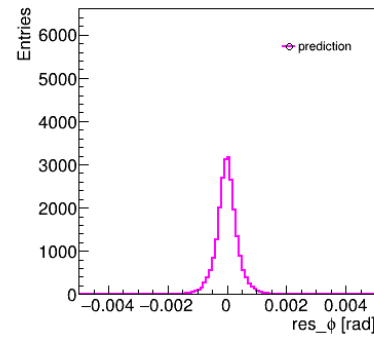
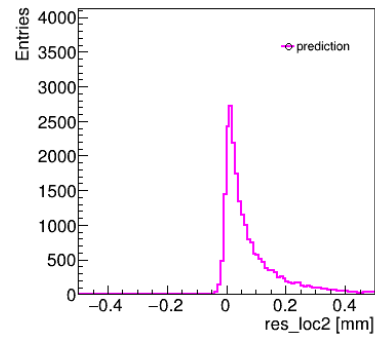
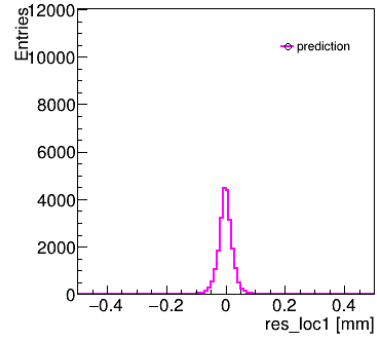


Pull

Residuals and pulls -- prediction

- Parameters of measurements
- FTD 1, 2 pos

• $\theta: 20^\circ$



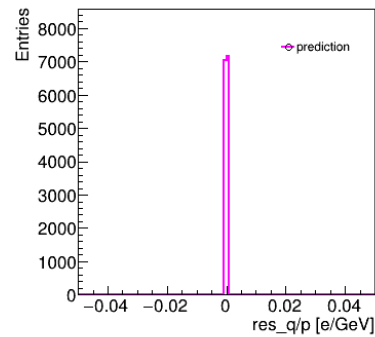
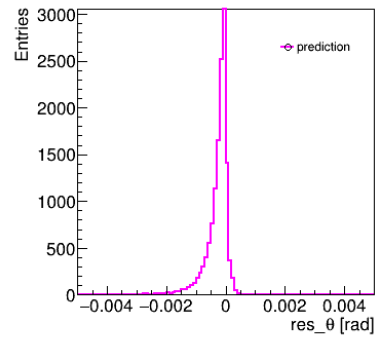
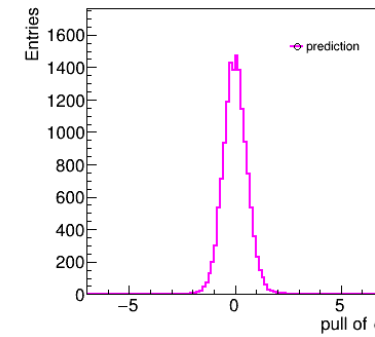
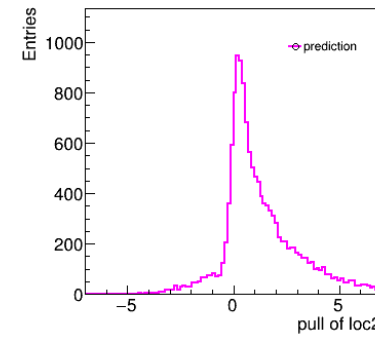
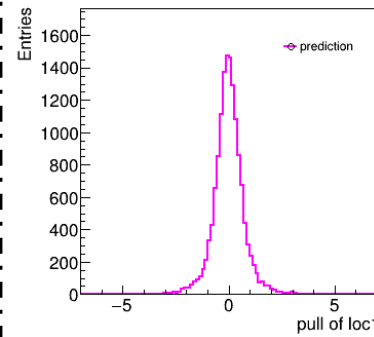
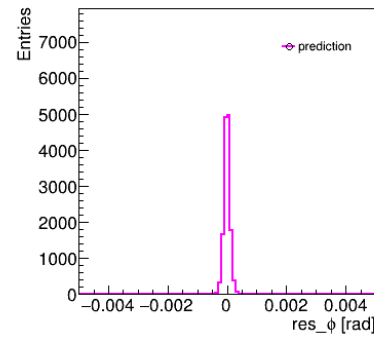
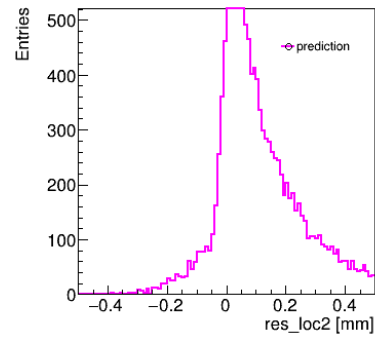
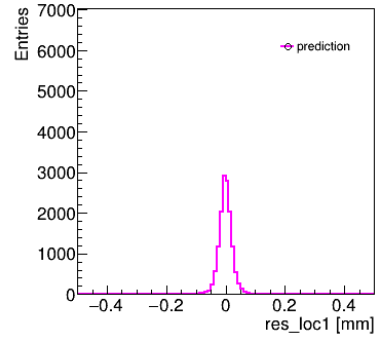
Residual

Pull

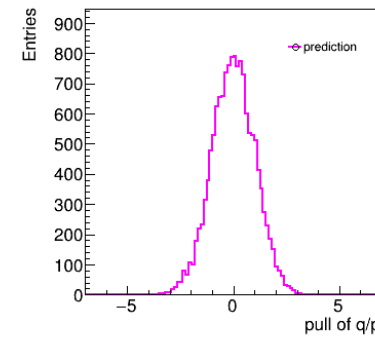
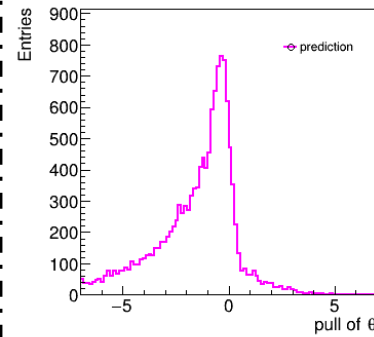
Residuals and pulls -- prediction

- Parameters of measurements
- FTD 3 pos

• $\theta: 20^\circ$



Residual

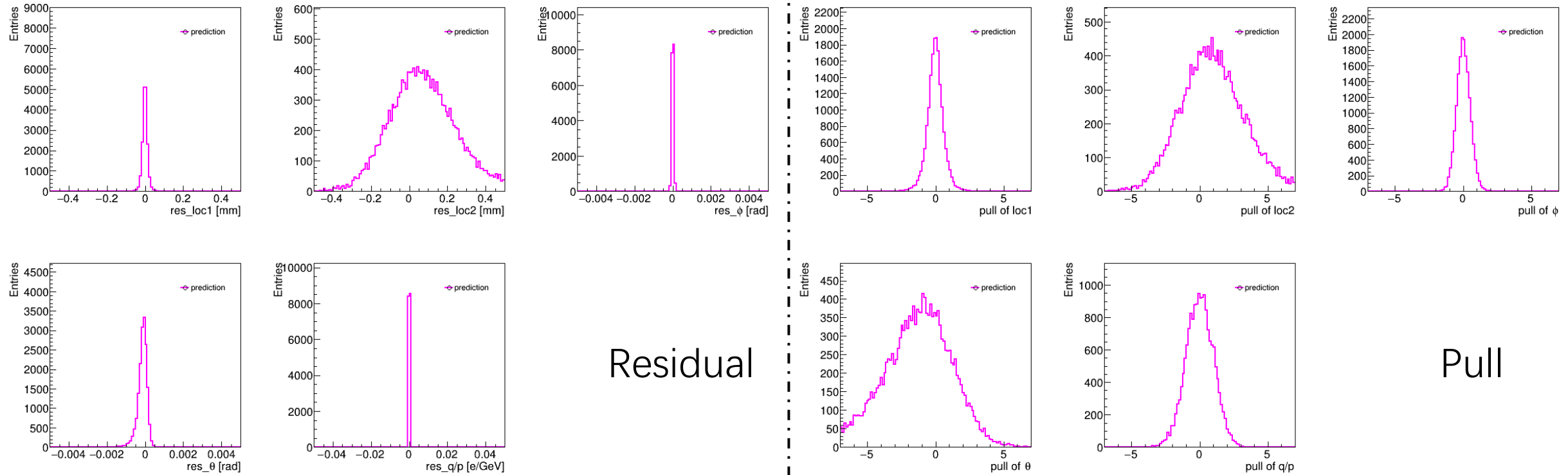


Pull

Residuals and pulls -- prediction

- Parameters of measurements
- FTD 4, 5 pos

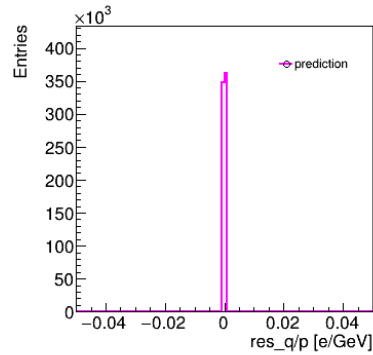
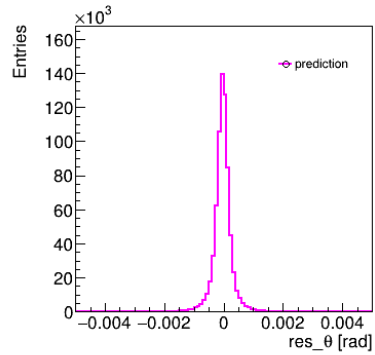
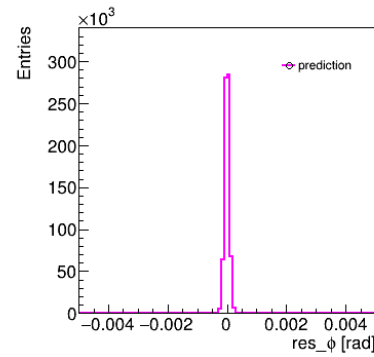
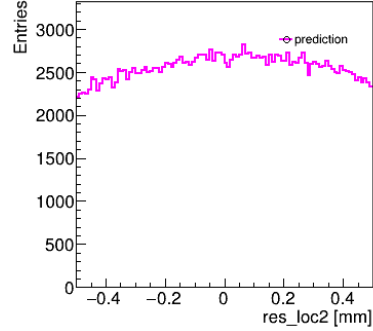
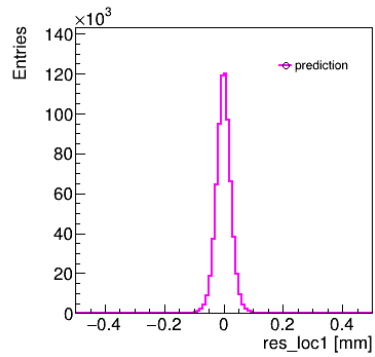
• $\theta: 20^\circ$



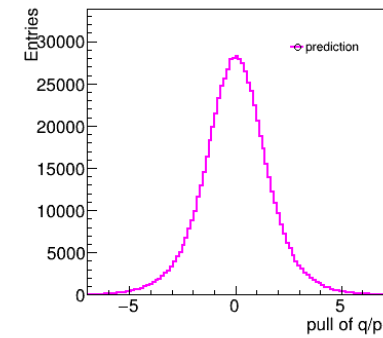
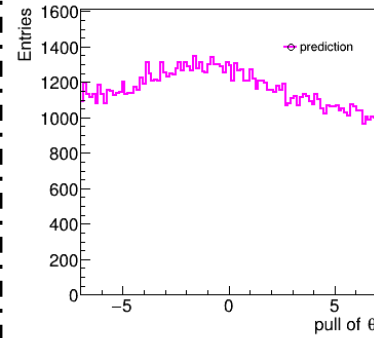
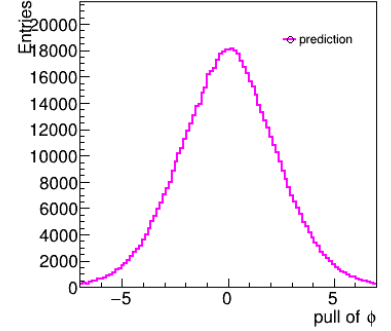
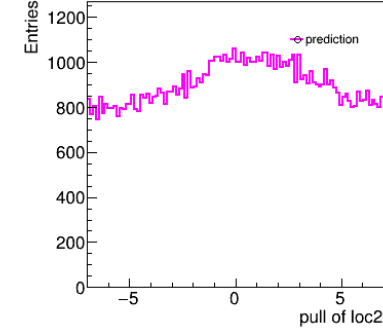
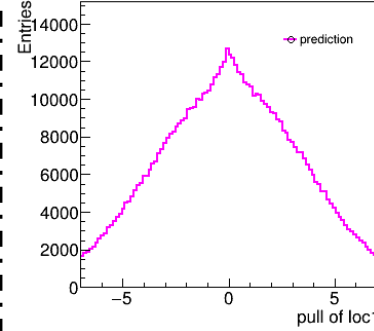
Residuals and pulls -- prediction

- Parameters of measurements
- TPC

• $\theta: 20^\circ$



Residual

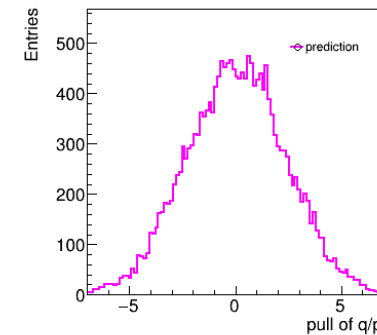
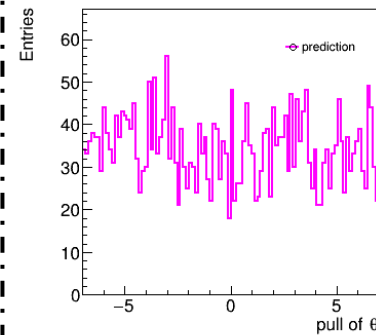
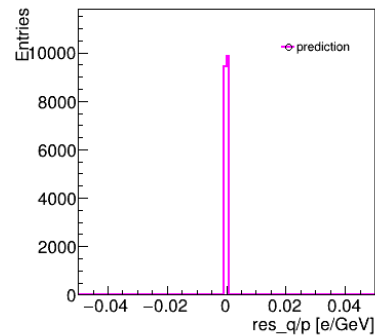
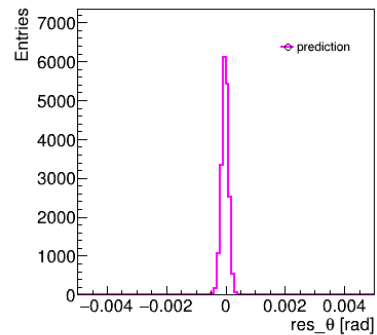
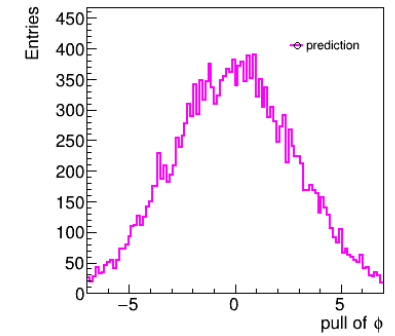
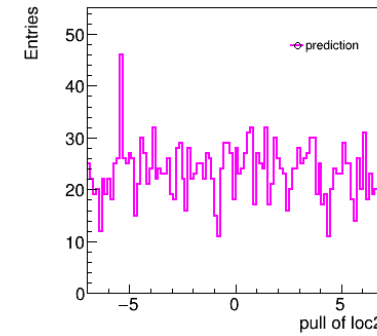
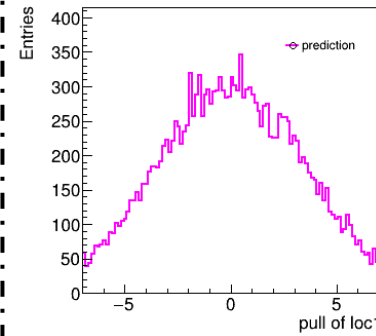
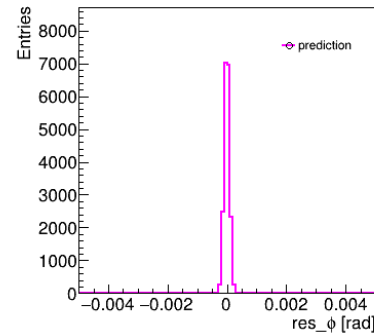
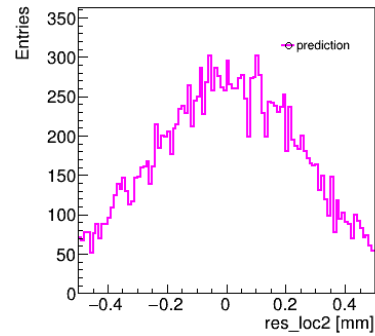
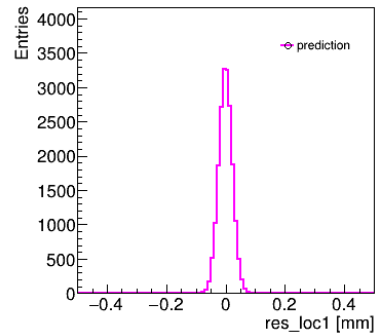


Pull

Residuals and pulls -- prediction

- Parameters of measurements
- ETD pos

• $\theta: 20^\circ$



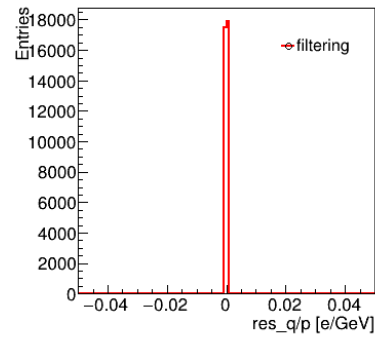
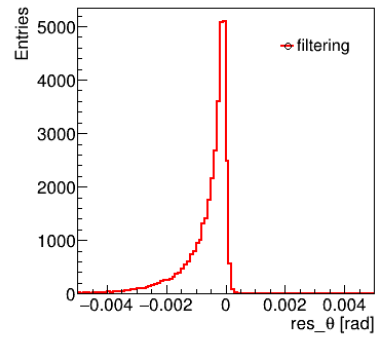
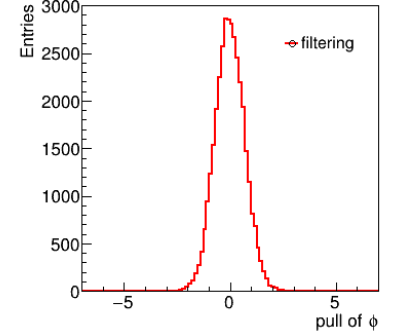
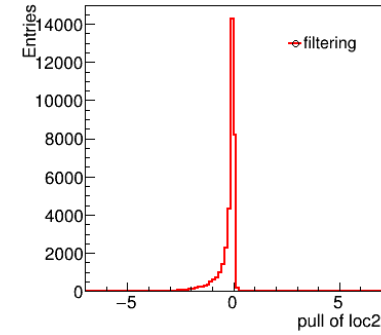
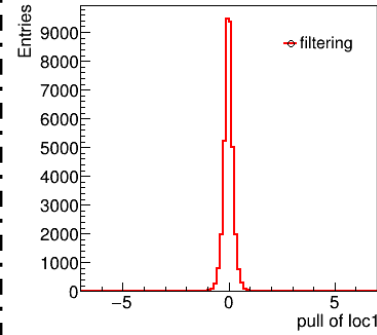
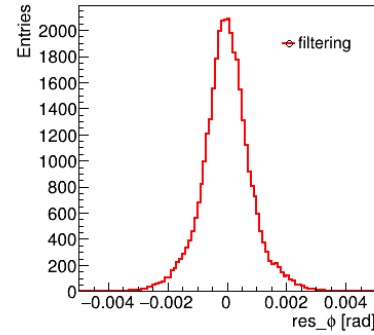
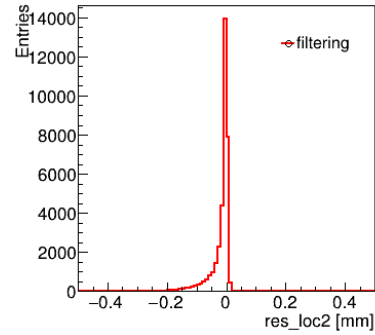
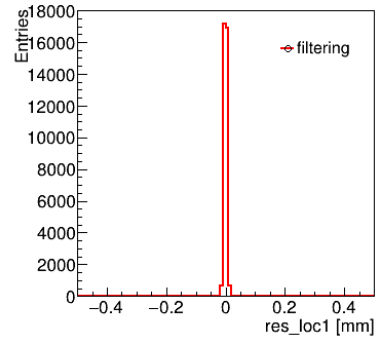
Residual

Pull

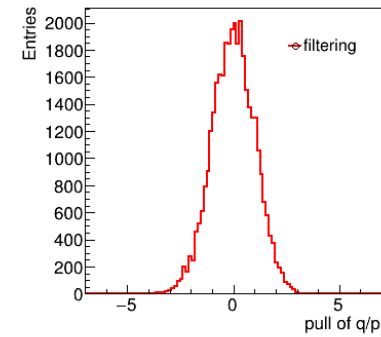
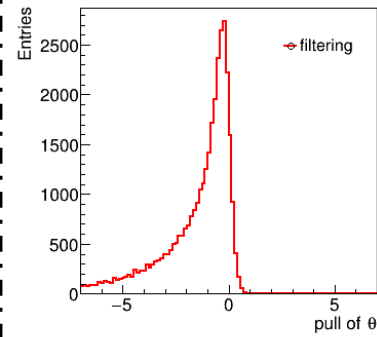
Residuals and pulls -- filtering

- Parameters of measurements
- Vertex

• $\theta: 20^\circ$



Residual

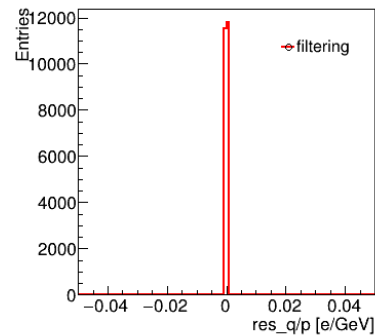
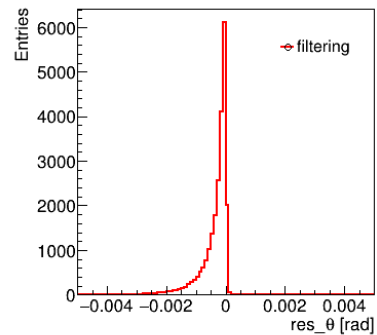
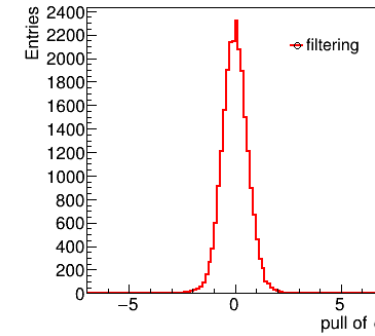
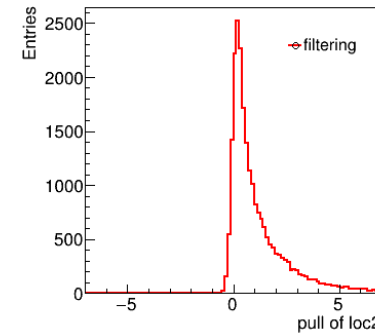
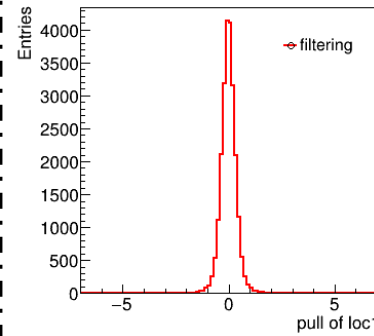
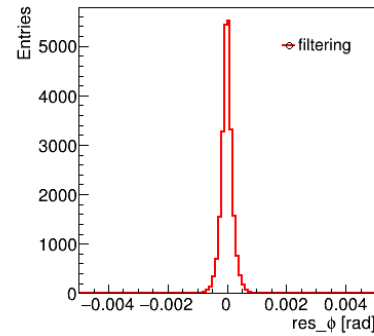
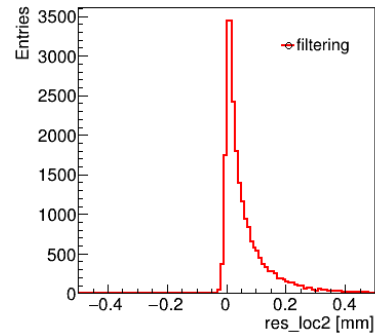
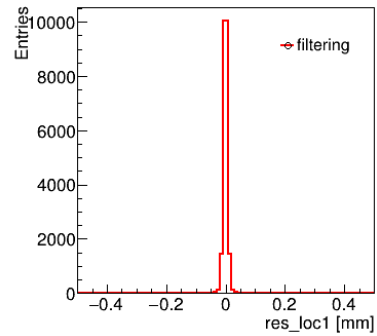


Pull

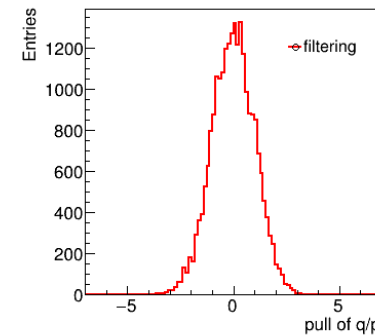
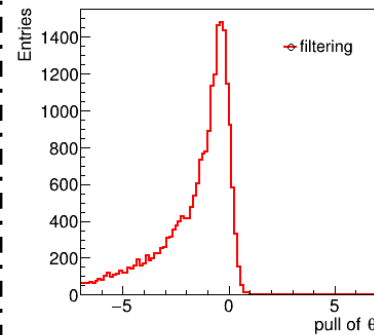
Residuals and pulls -- filtering

- Parameters of measurements
- FTD 1, 2 pos

• $\theta: 20^\circ$



Residual

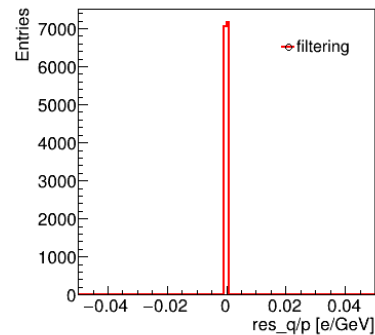
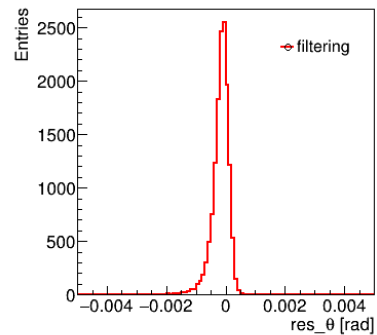
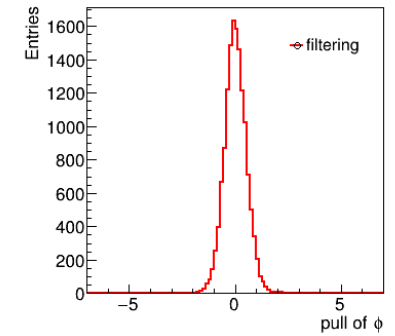
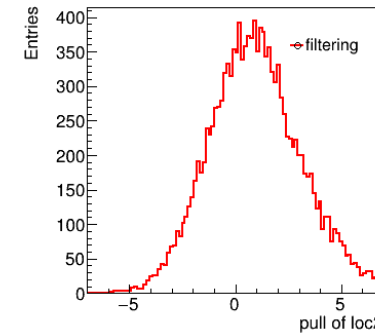
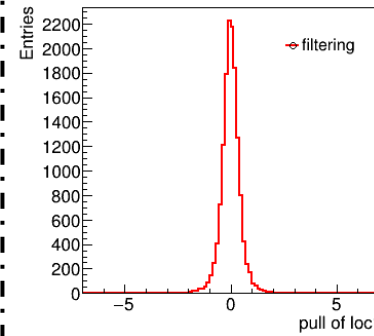
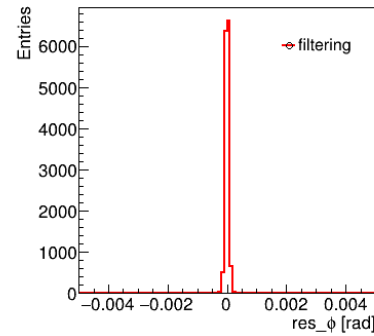
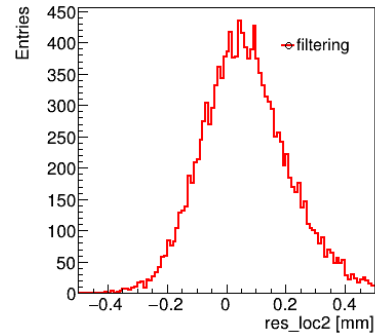
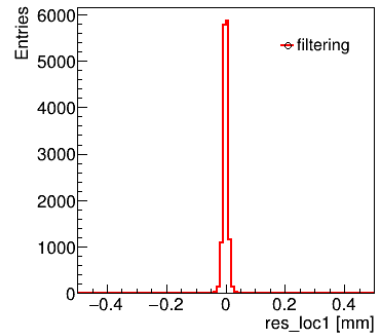


Pull

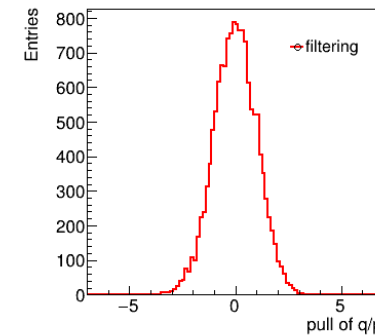
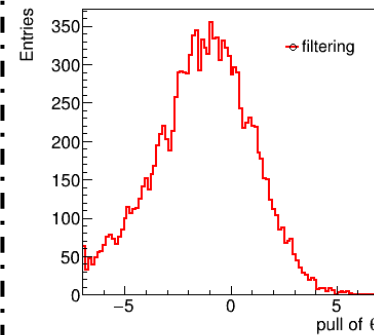
Residuals and pulls -- filtering

- Parameters of measurements
- FTD 3 pos

• $\theta: 20^\circ$



Residual

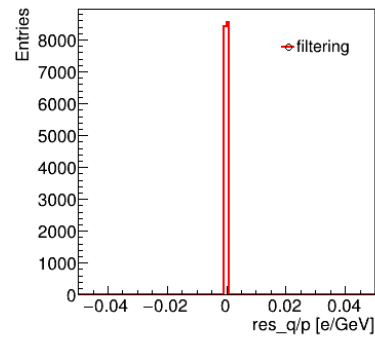
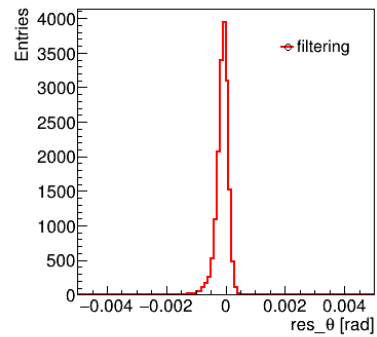
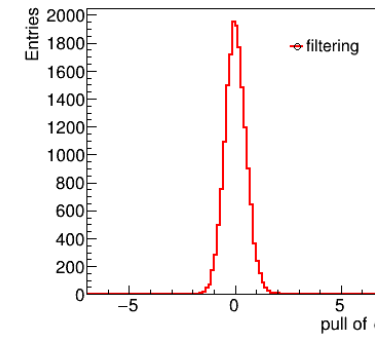
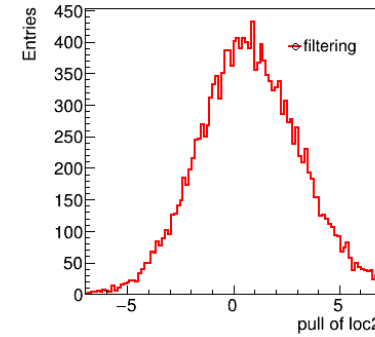
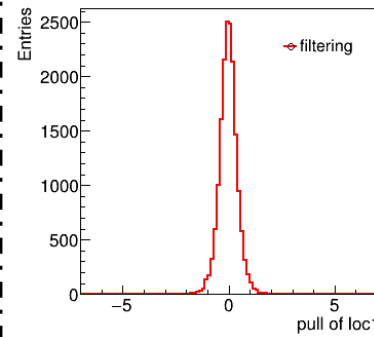
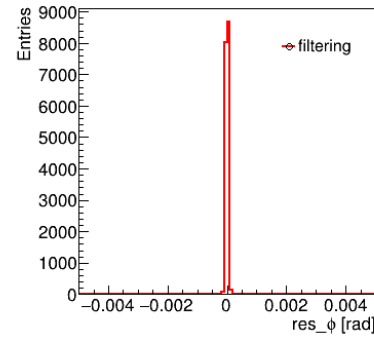
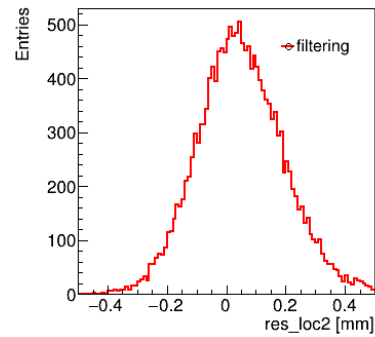
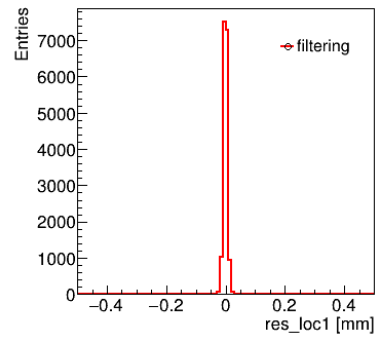


Pull

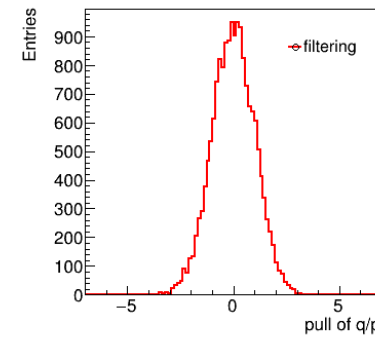
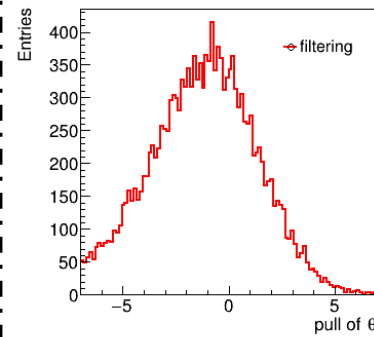
Residuals and pulls -- filtering

- Parameters of measurements
- FTD 4, 5 pos

• $\theta: 20^\circ$



Residual

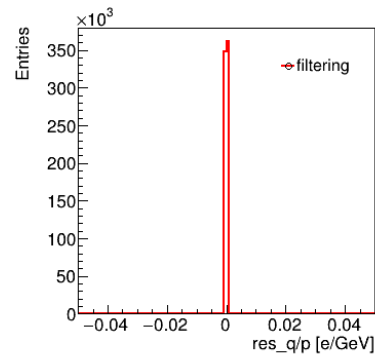
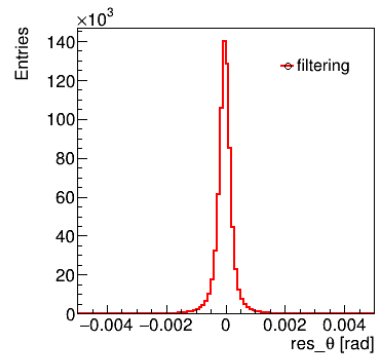
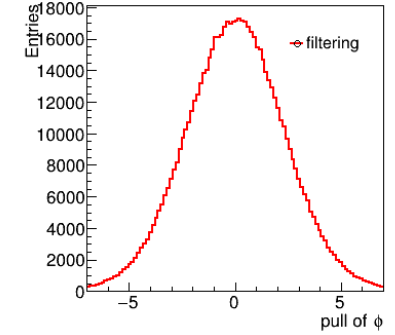
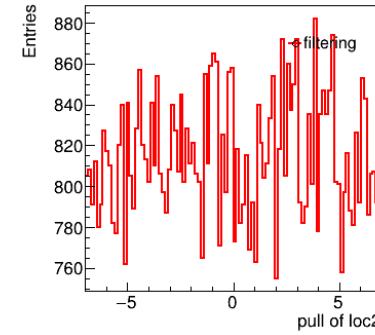
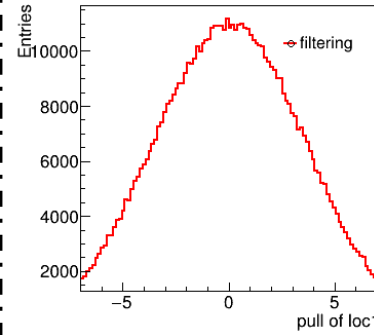
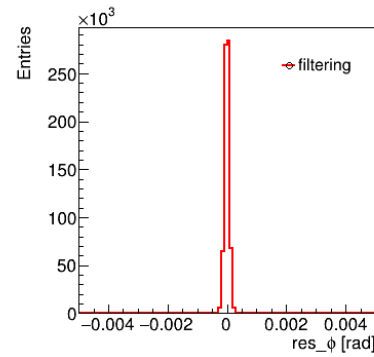
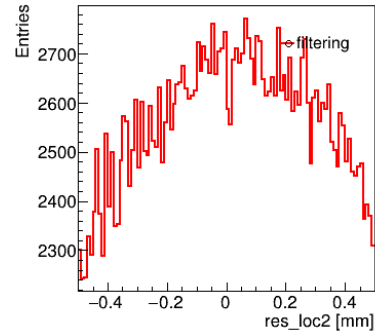
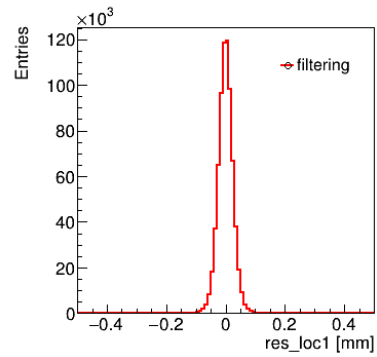


Pull

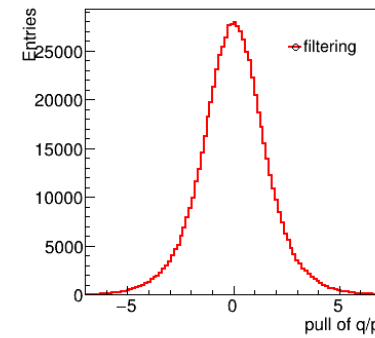
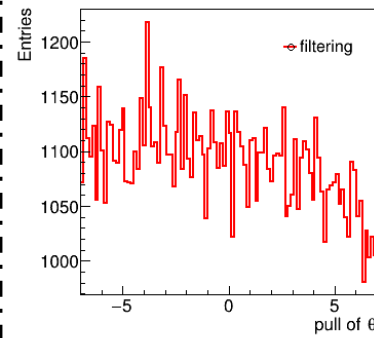
Residuals and pulls -- filtering

- Parameters of measurements
- TPC

• $\theta: 20^\circ$



Residual

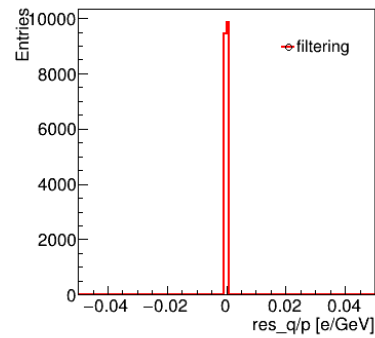
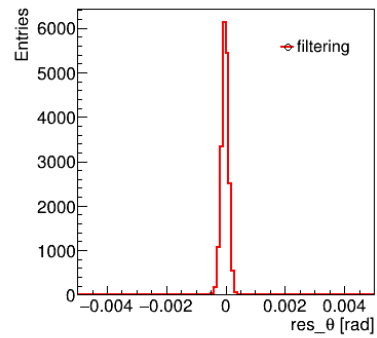
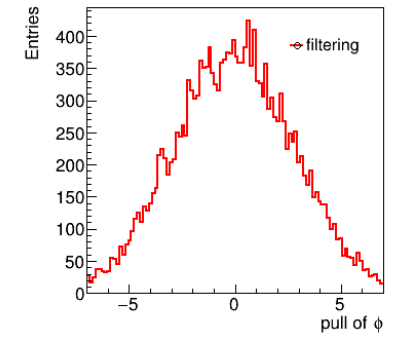
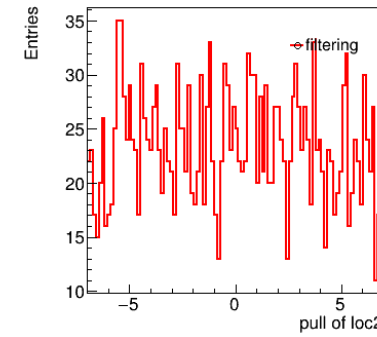
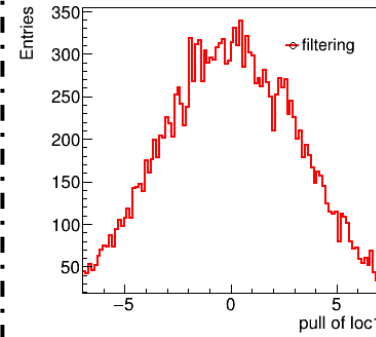
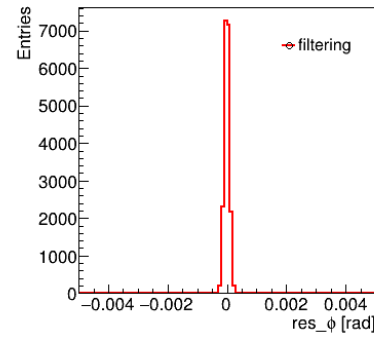
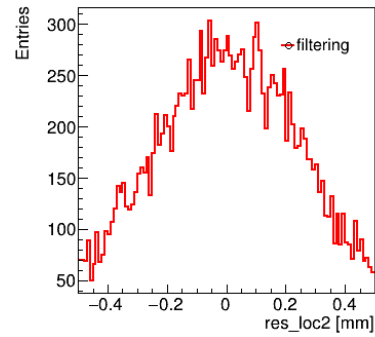
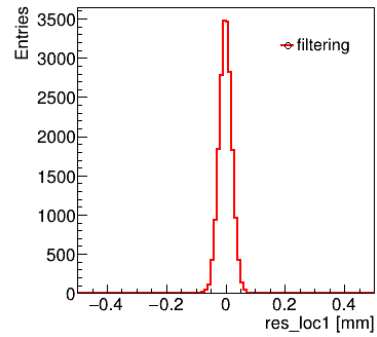


Pull

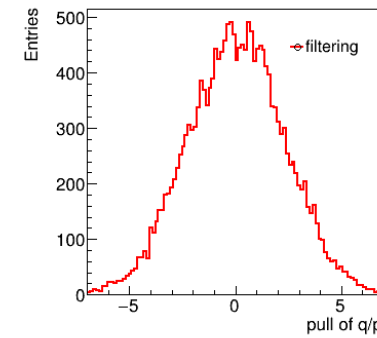
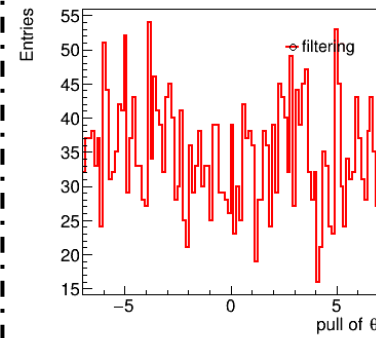
Residuals and pulls -- filtering

- Parameters of measurements
- ETD pos

• $\theta: 20^\circ$



Residual

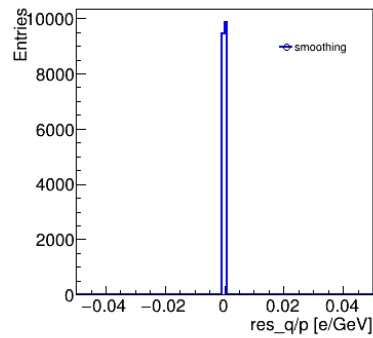
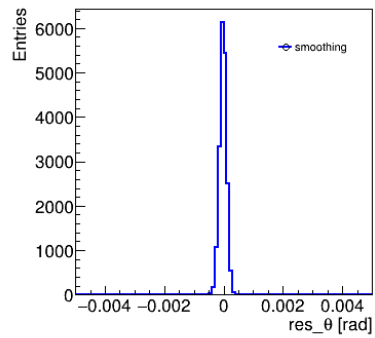
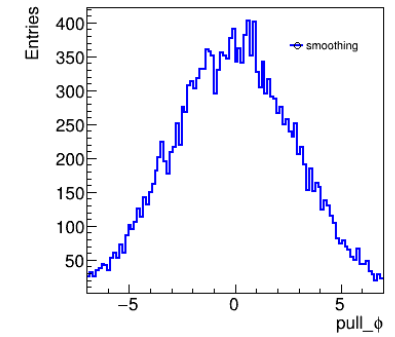
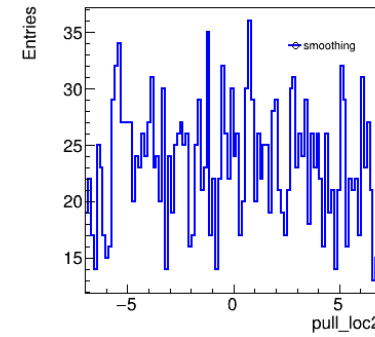
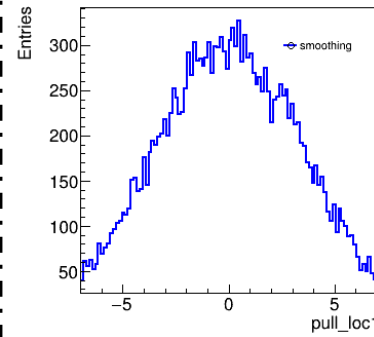
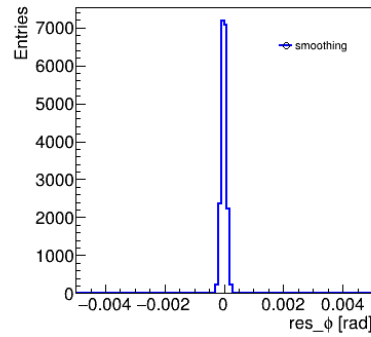
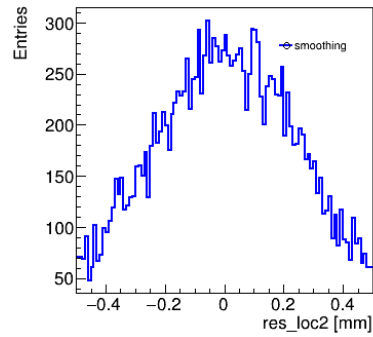
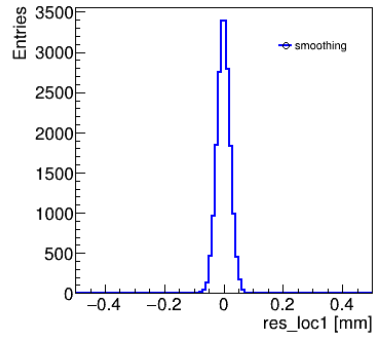


Pull

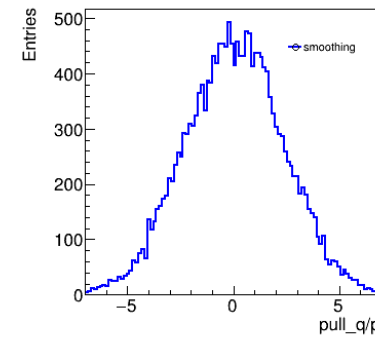
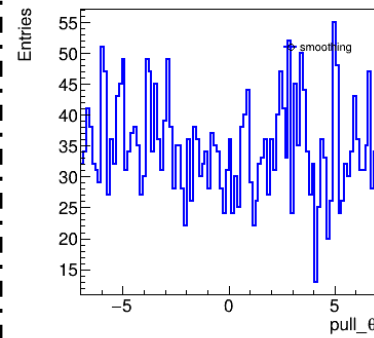
Residuals and pulls -- smoothing

- Parameters of measurements
- ETD pos

• $\theta: 20^\circ$



Residual

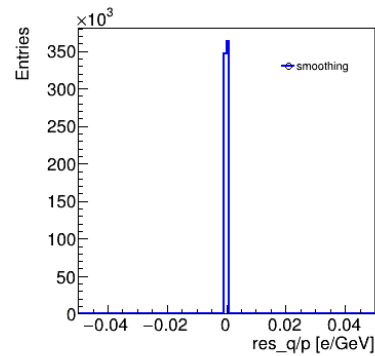
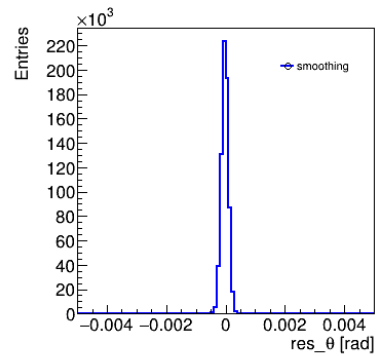
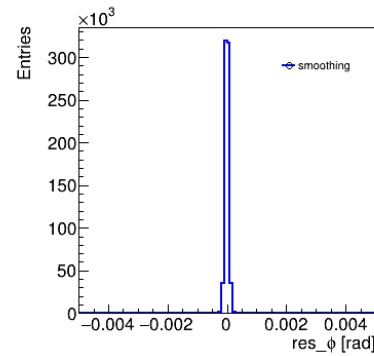
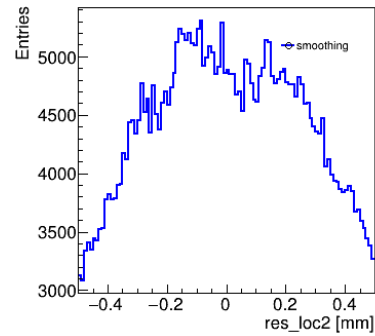
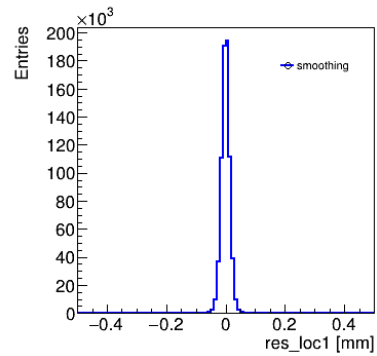


Pull

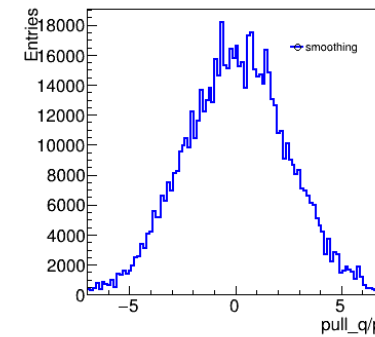
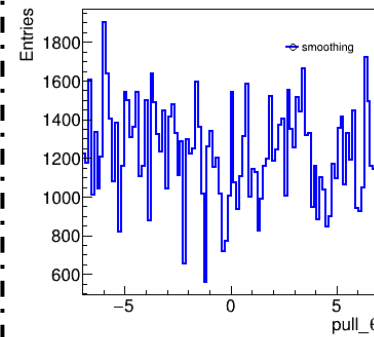
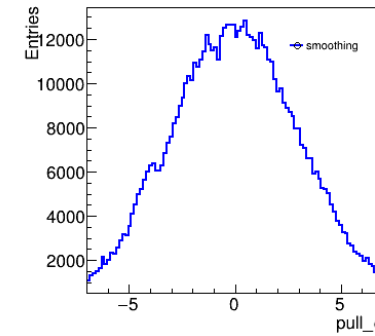
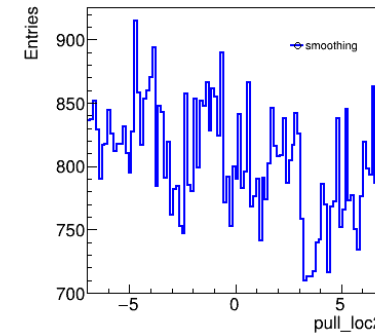
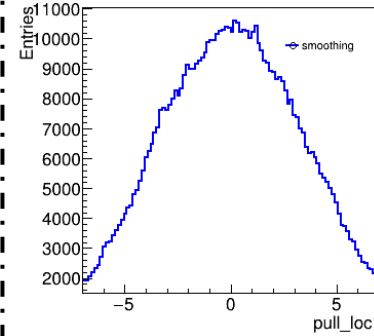
Residuals and pulls -- smoothing

- Parameters of measurements
- TPC

• $\theta: 20^\circ$



Residual

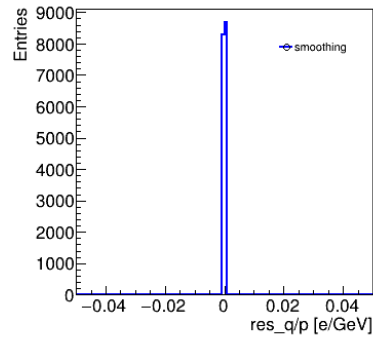
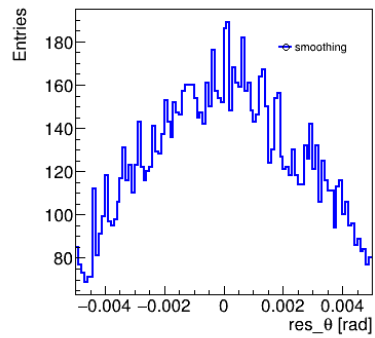
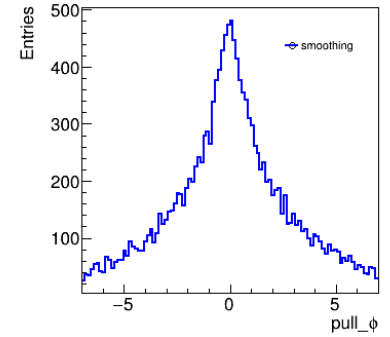
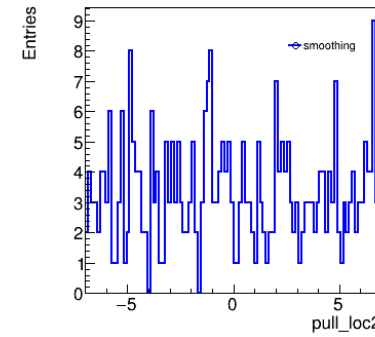
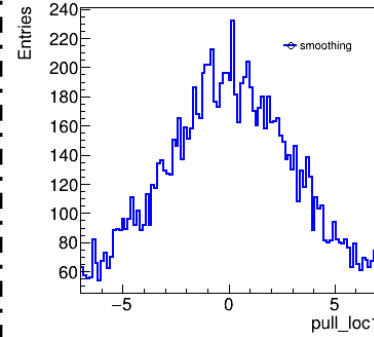
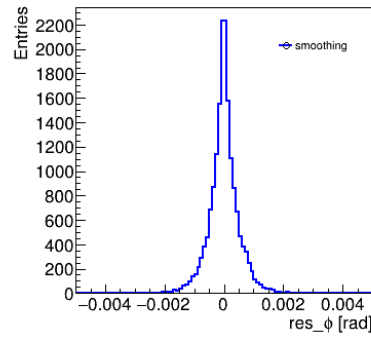
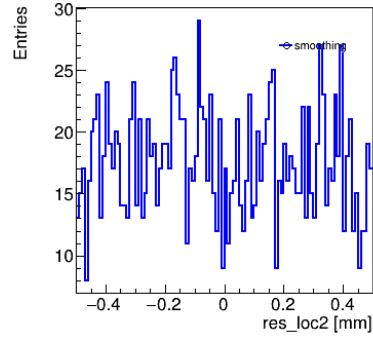
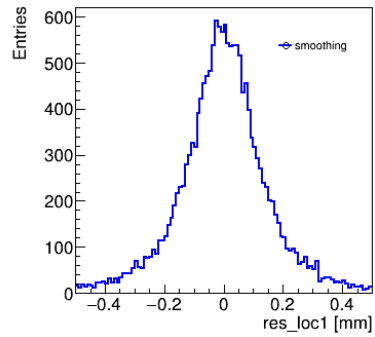


Pull

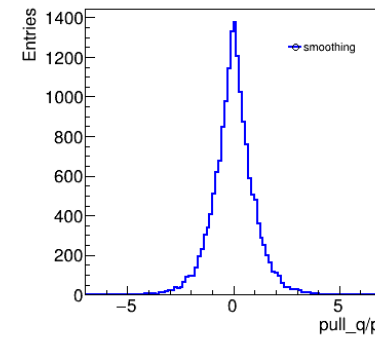
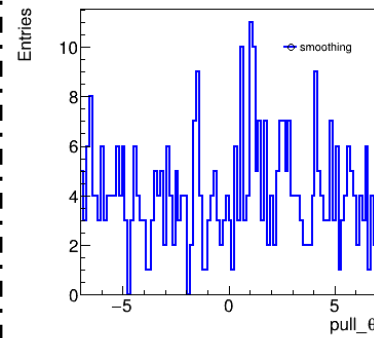
Residuals and pulls -- smoothing

- Parameters of measurements
- FTD 4, 5 pos

• $\theta: 20^\circ$



Residual

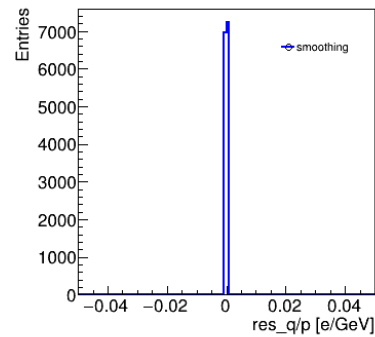
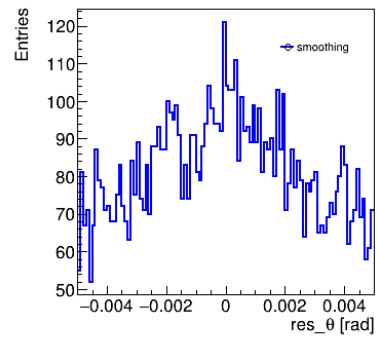
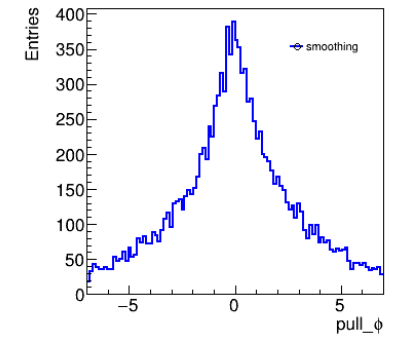
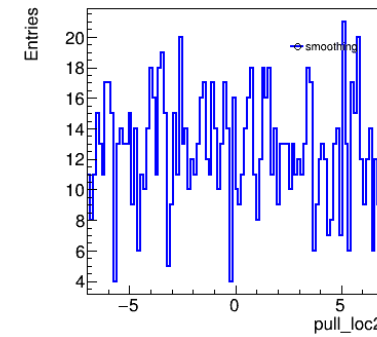
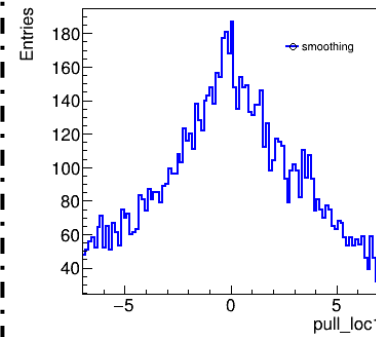
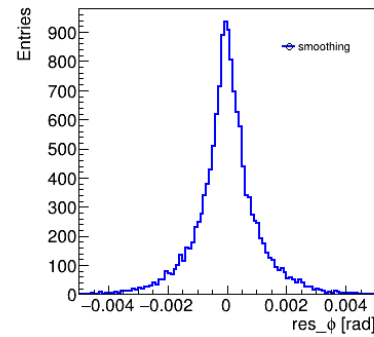
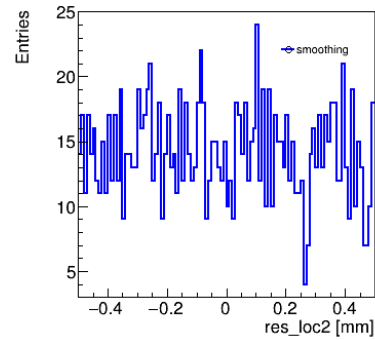
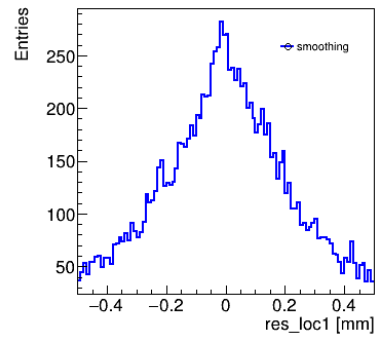


Pull

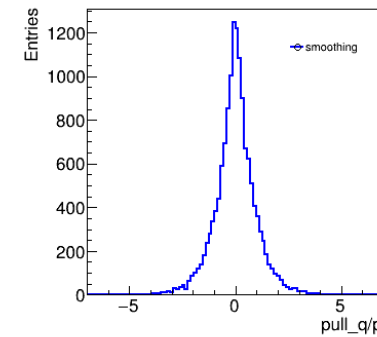
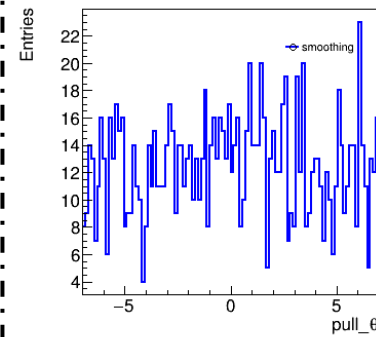
Residuals and pulls -- smoothing

- Parameters of measurements
- FTD 3 pos

• $\theta: 20^\circ$



Residual

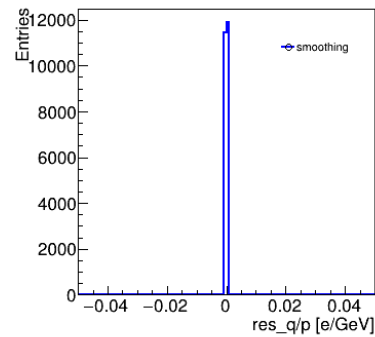
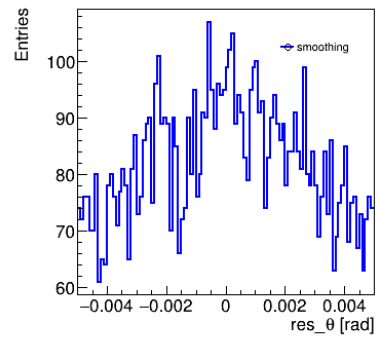
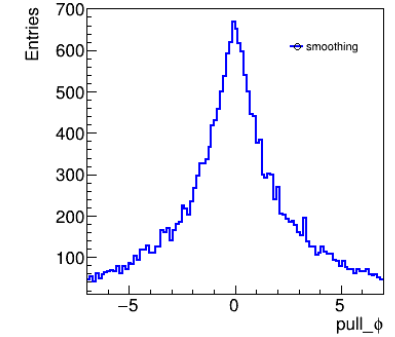
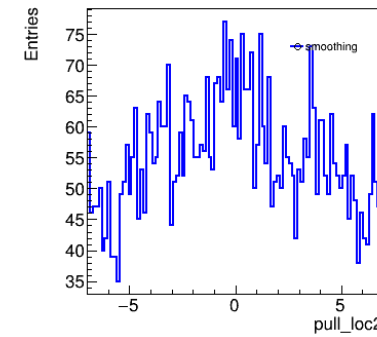
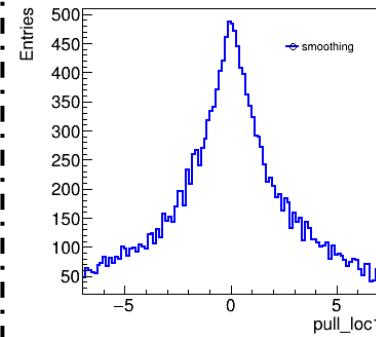
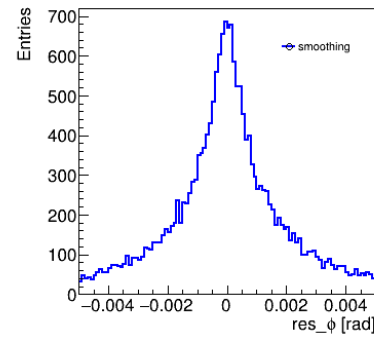
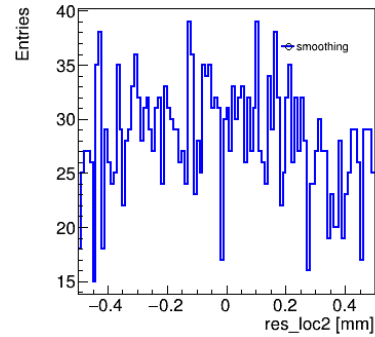
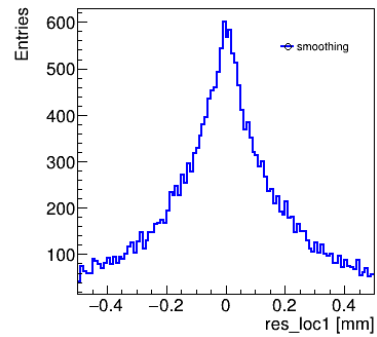


Pull

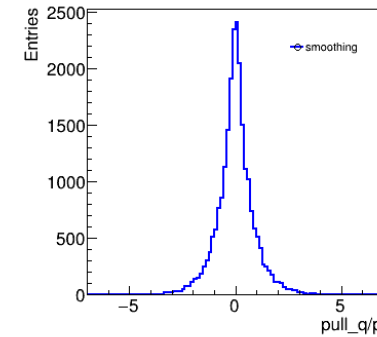
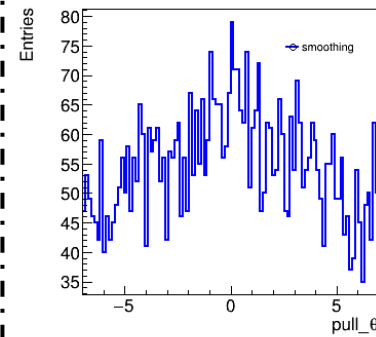
Residuals and pulls -- smoothing

- Parameters of measurements
- FTD 1, 2 pos

• $\theta: 20^\circ$



Residual

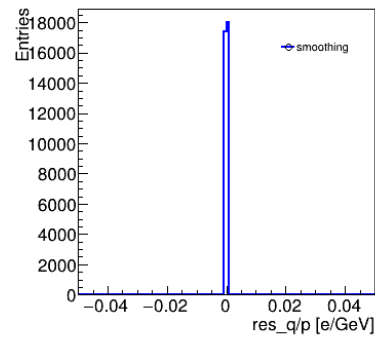
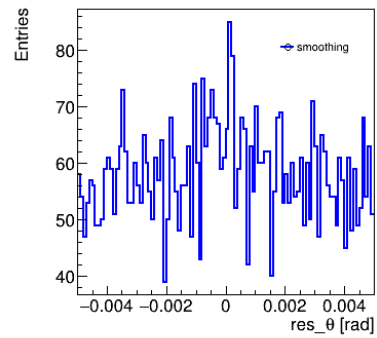
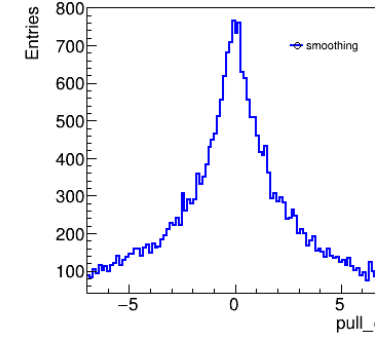
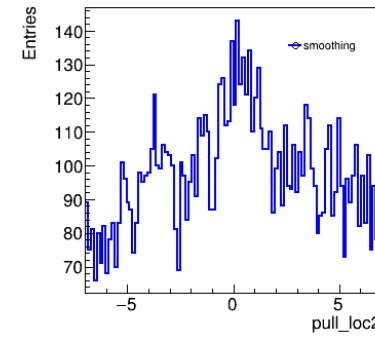
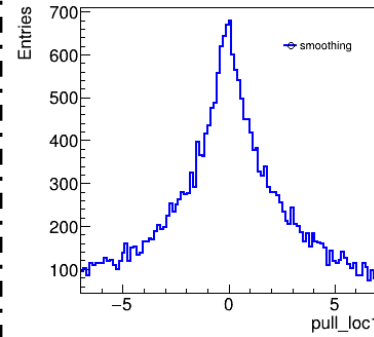
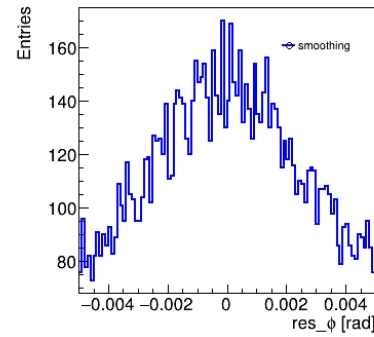
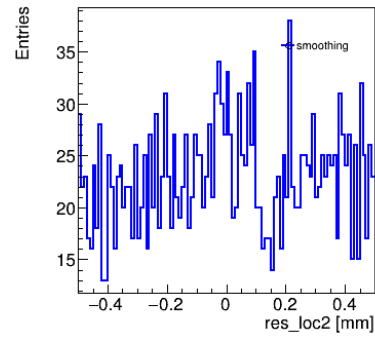
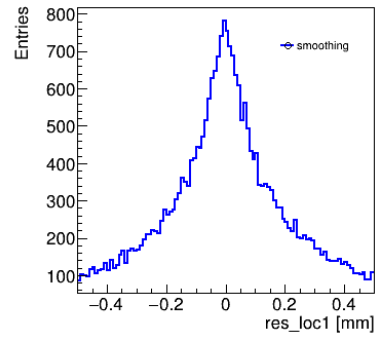


Pull

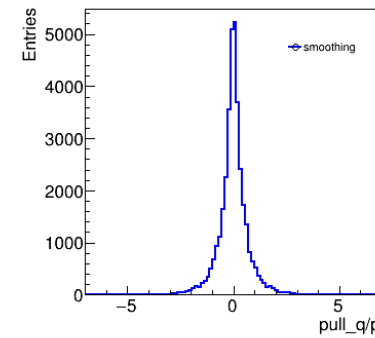
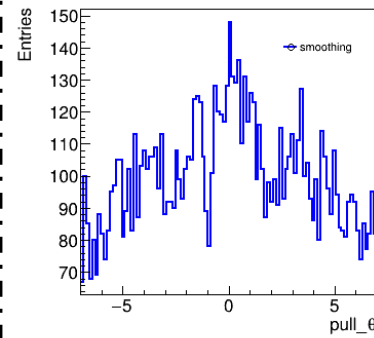
Residuals and pulls -- smoothing

- Parameters of measurements
- Vertex

• $\theta: 20^\circ$



Residual



Pull

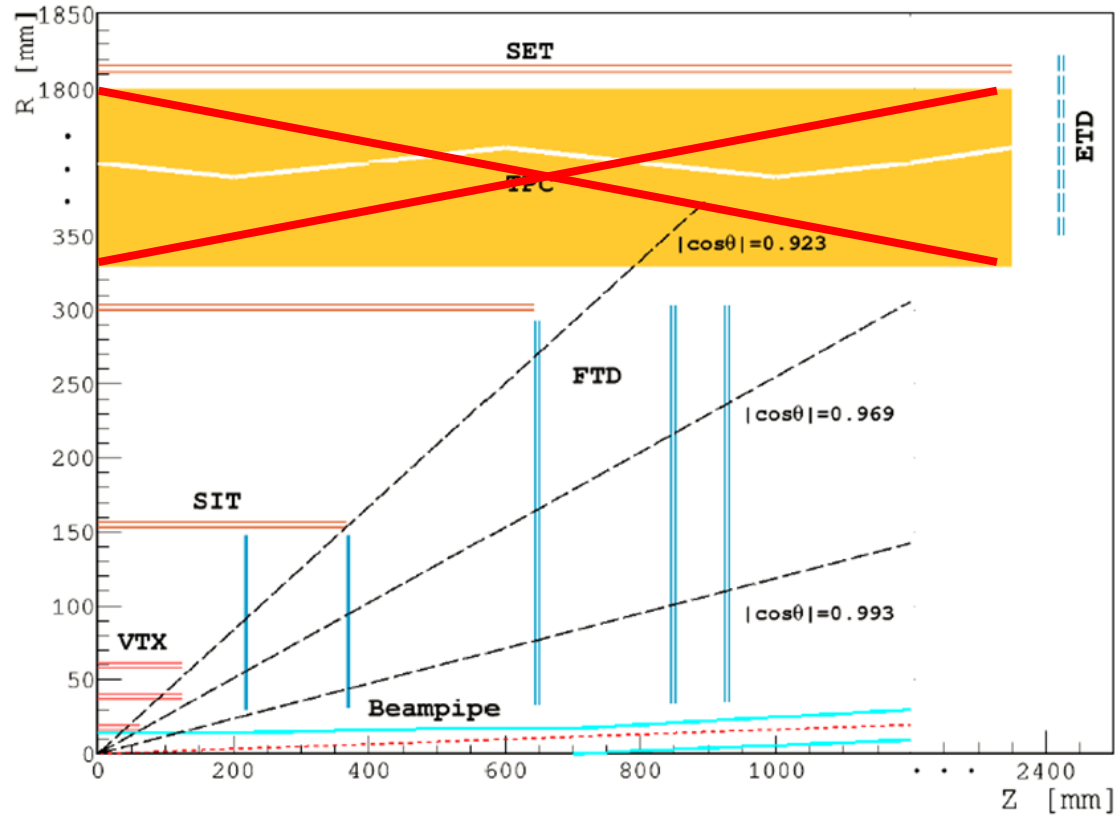
- Pixel
 - Prediction, filtering and smoothing \checkmark better than strip
- Strip
 - Prediction, filtering and smoothing \checkmark
- TPC
 - Prediction, filtering and smoothing \times

Turn off the TPC

- Hits distributions
- Residuals and pulls
 - Total

Turn off the TPC

- The new volume_ids



Sub-detector	Volume_id	New Volume_id	Layer_id	loc0_res [μm]	loc1_res [μm]	If strip
Vertex	25	20	2	3	3	
			4	4	4	
			6	4	4	
SIT 1	28	23	2	5	250	✓
SIT 2	31	26	2	5	250	✓
FTD 1, 2 neg	24	19	2	3	3	
FTD 1, 2 pos	26	21	2	3	3	
FTD 3 neg	19	14	2	5	250	✓
FTD 3 pos	29	24	2	5	250	✓
FTD 4, 5 neg	14	9	2	5	250	✓
FTD 4, 5 pos	32	27	2	5	250	✓
TPC	34		2	100	5000	
SET	36	31	2	5	250	✓
ETD neg	6	30	2	5	250	✓
ETD pos	37	32	2	5	250	✓

Turn off the TPC

- Branch: turn-off-TPC
 - Commit id: f8e6f93ed77e46cadd1646dc6583e5980fda9b9b
- Same options
 - Particle gun: 10000 μ from (0, 0, 0)
 - Magnetic field: (0, 0, 3T)
 - p_T : 100GeV
 - $\cos\theta$: uniform distribution
 - φ : uniform distribution

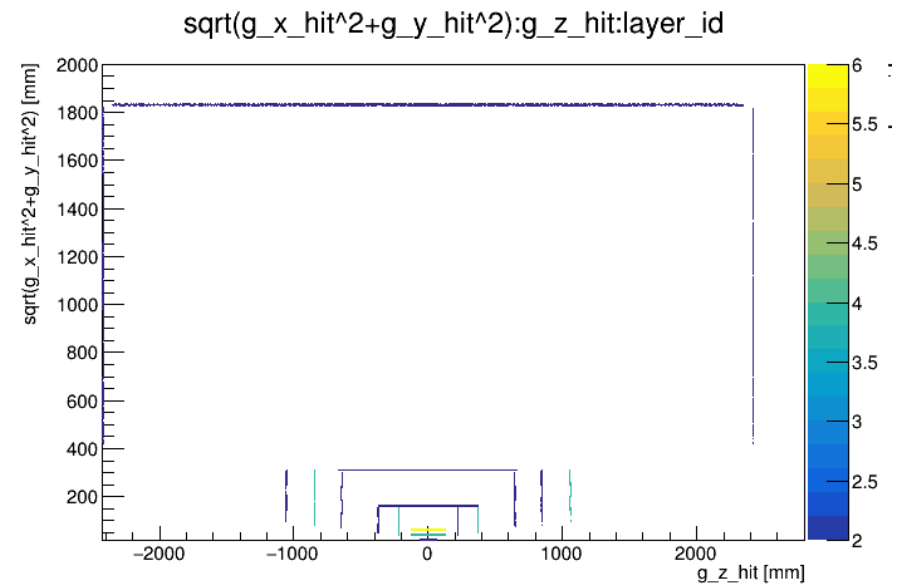
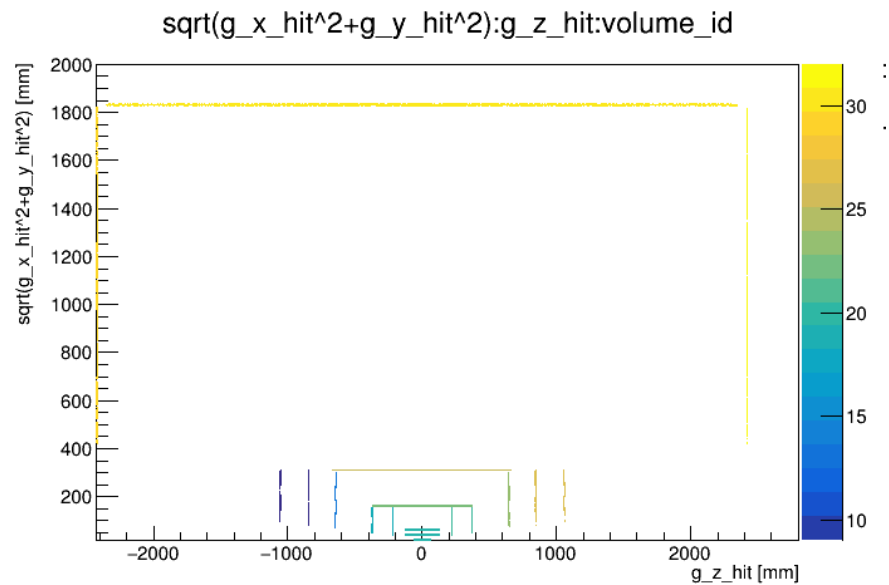
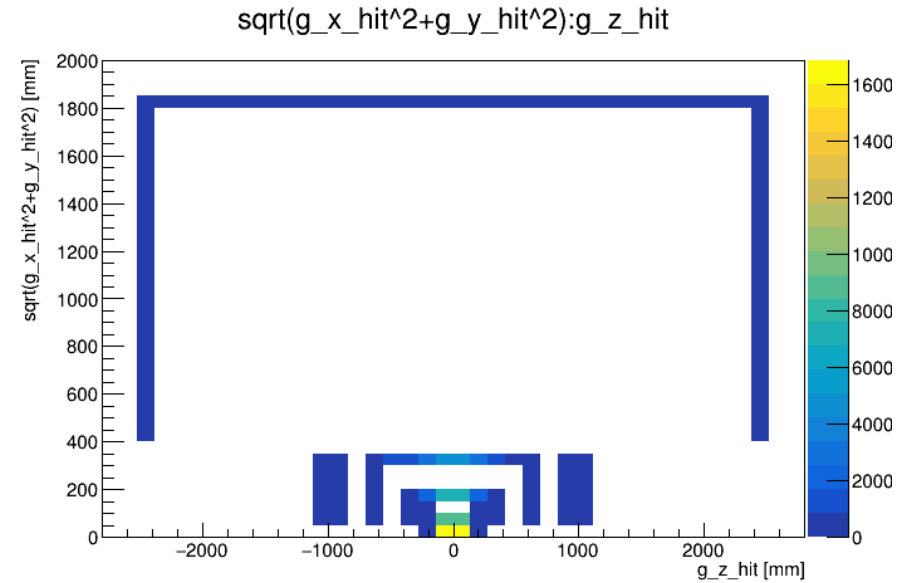
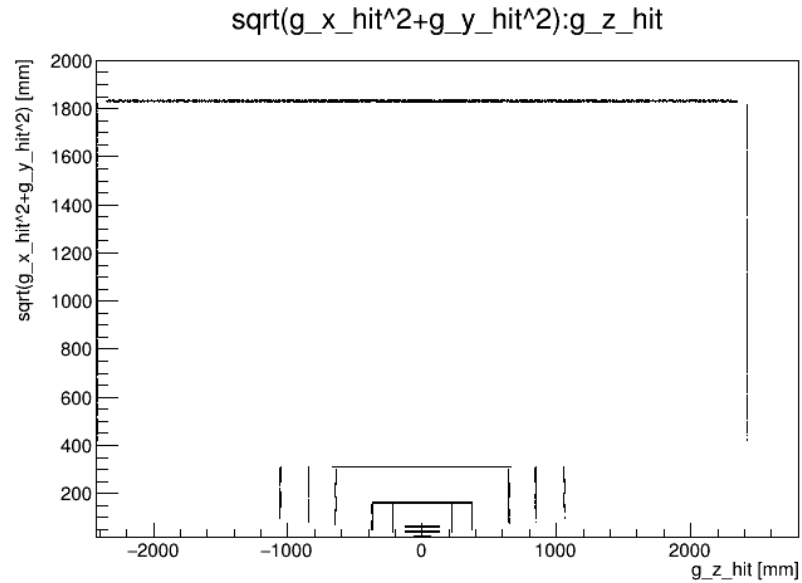
- Codes

```
pT=100
dirName=cepc_sim_{pT}
NParticles=1
NEvents=10000

./ActsSimFatrasDD4hep \
--evg-input-type gun \
--dd4hep-input ../../Detectors/DD4hepDetector/compact/CEPC/cepc_v04_master.xml \
--dd4hep-envelopeR 0.1 \
--dd4hep-envelopeZ 0.1 \
--bf-values 0 0 3 \
--pg-pt-range ${pT} ${pT} \
--pg-nparticles ${NParticles} \
--events ${NEvents} \
--output-root 1 \
--output-dir ${dirName}
```

Hits distributions

- Entries/Nparticles: 9949/10000



Turn off the TPC

- Branch: turn-off-TPC
 - Commit id: f8e6f93ed77e46cadd1646dc6583e5980fda9b9b
- Same options
 - Particle gun: 10000 μ from (0, 0, 0)
 - Magnetic field: (0, 0, 3T)
 - p_T : 100GeV
 - θ : 85°
 - φ : uniform distribution

- Codes

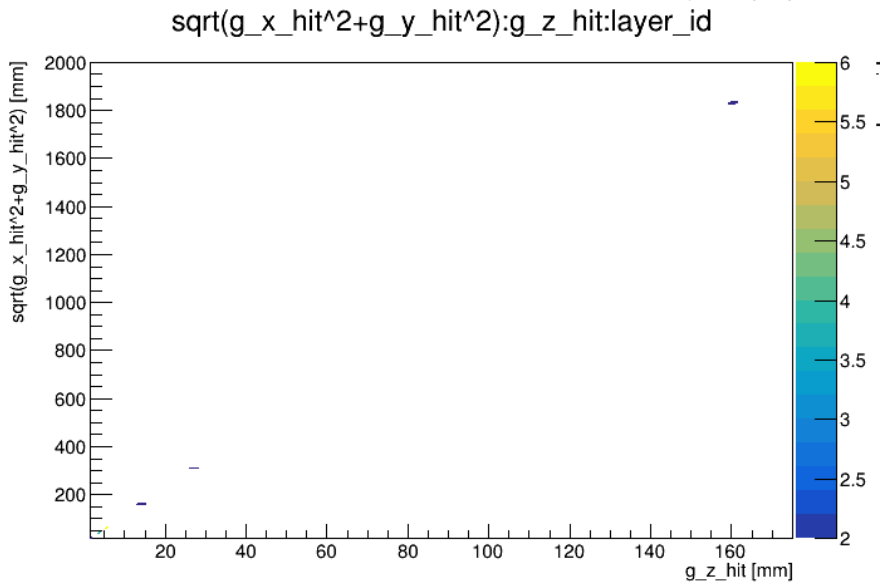
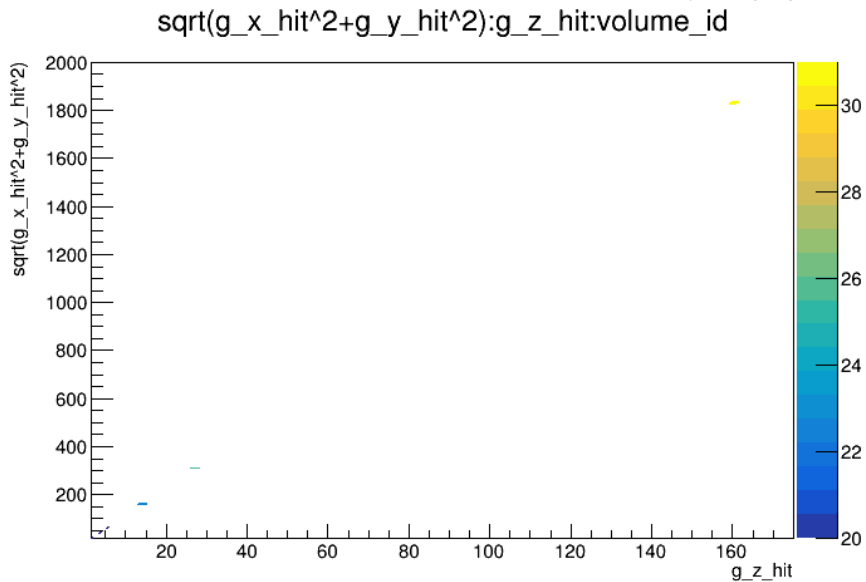
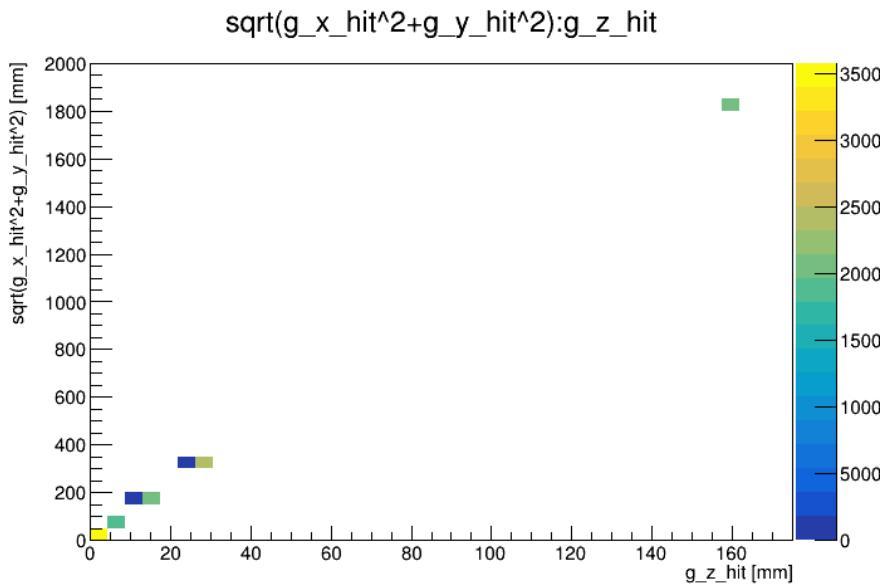
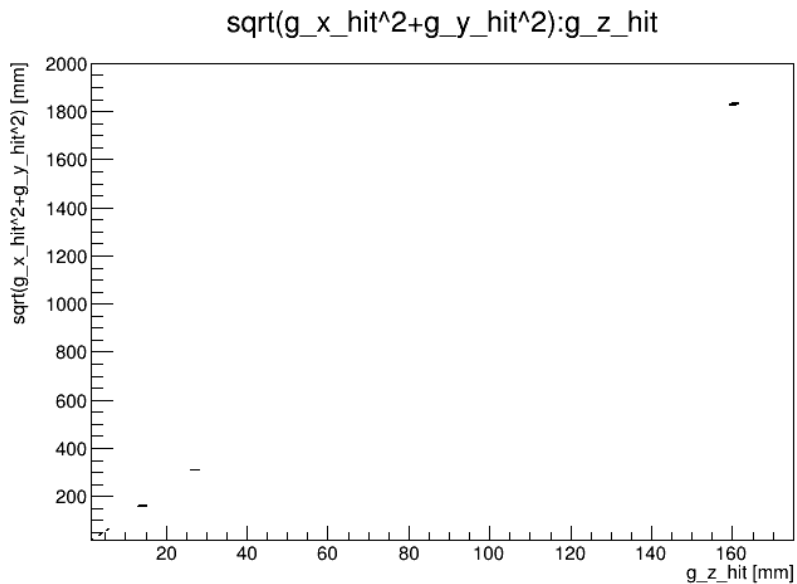
```
pT=100
theta=85
cos_theta=$(echo "$theta"|gawk '{printf("%12.10f\n",cos($1/180.*3.141592653))}')
dirName=cepc_sim_${pT}_${theta}
NParticles=1
NEvents=10000

./ActsSimFstrasDD4hep \
--evg-input-type gun \
--dd4hep-input ../../Detectors/DD4hepDetector/compact/CEPC/cepc_v04_master.xml \
--dd4hep-envelopeR 0.1 \
--dd4hep-envelopeZ 0.1 \
--bf-values 0 0 3 \
--pg-pt-range ${pT} ${pT} \
--pg-costheta-range ${cos_theta} ${cos_theta} \
--pg-nparticles ${NParticles} \
--events ${NEvents} \
--output-root 1 \
--output-dir ${dirName}
```


Hits distributions

- Entries/Nparticles: 10000/10000

• $\theta: 85^\circ$

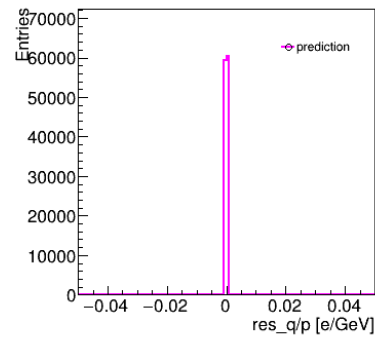
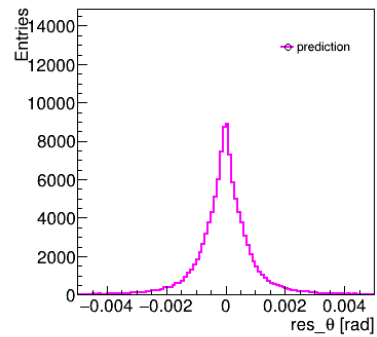
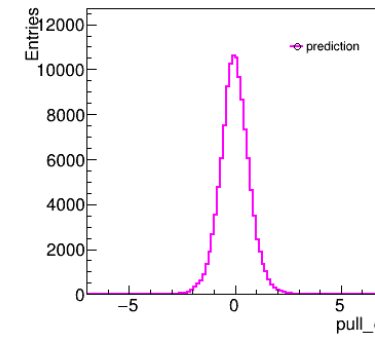
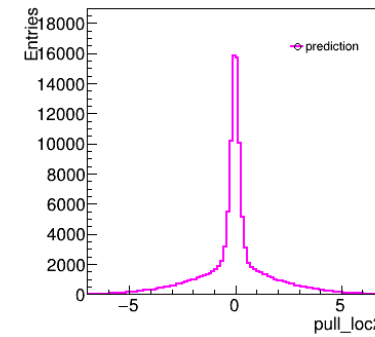
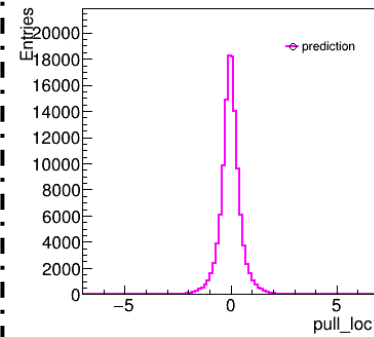
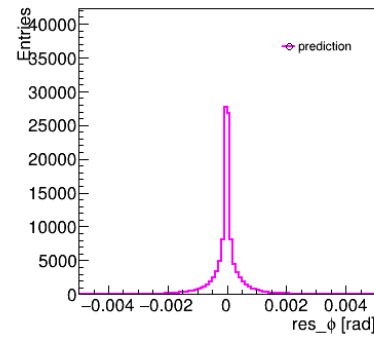
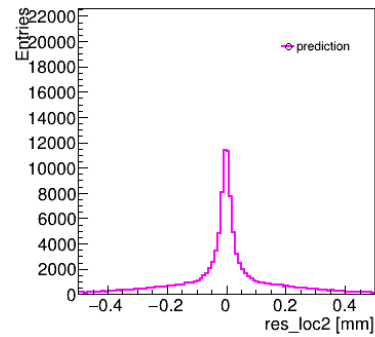
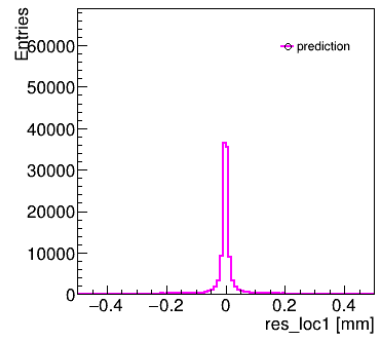


Sub-detector	New Volume_id	Layer_id	nMeasurements
Vertex	20	2	17433
		4	18339
		6	19399
SIT 1	23	2	21211
SIT 2	26	2	23455
FTD 1, 2 neg	19	2	
FTD 1, 2 pos	21	2	
FTD 3 neg	14	2	
FTD 3 pos	24	2	
FTD 4, 5 neg	9	2	
FTD 4, 5 pos	27	2	
TPC			
SET	31	2	19878
ETD neg	30	2	
ETD pos	32	2	
Total			119715

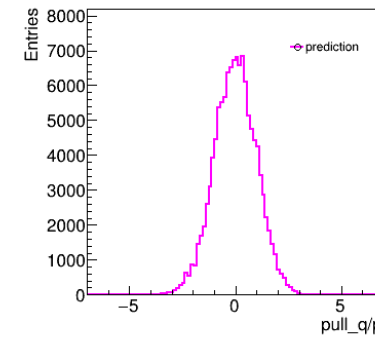
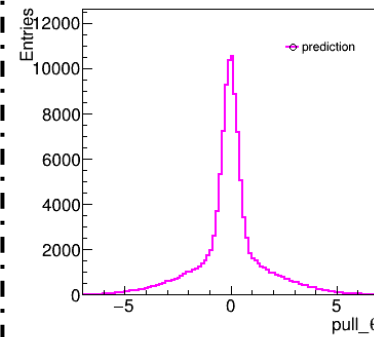
Residuals and pulls -- prediction

- Parameters of measurements
- Total

• $\theta: 85^\circ$



Residual

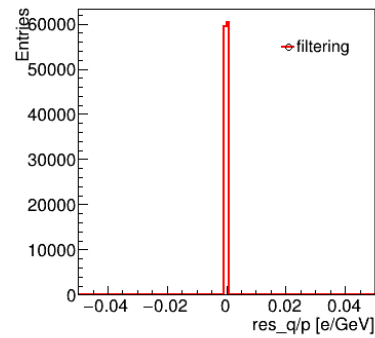
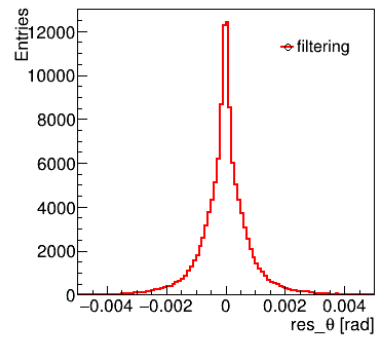
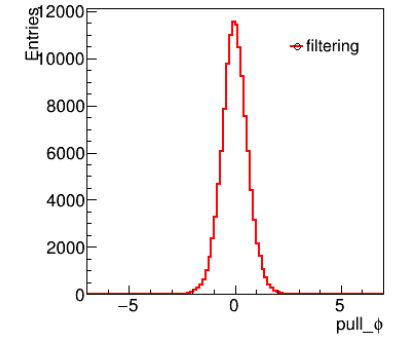
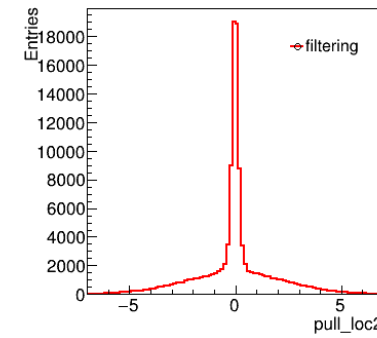
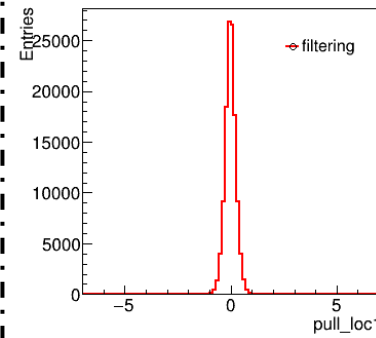
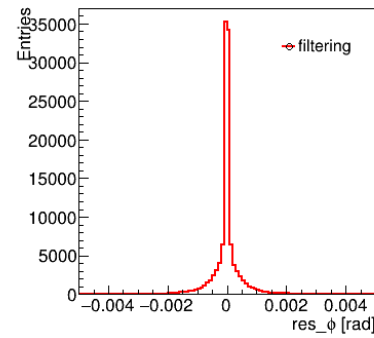
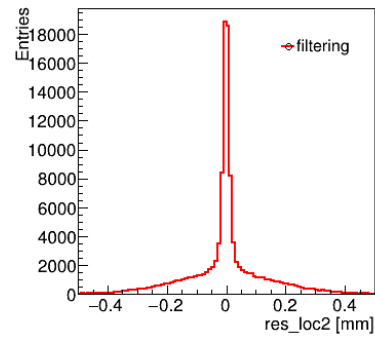
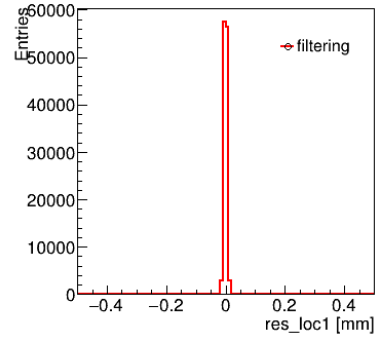


Pull

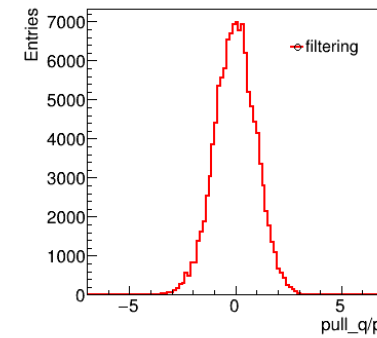
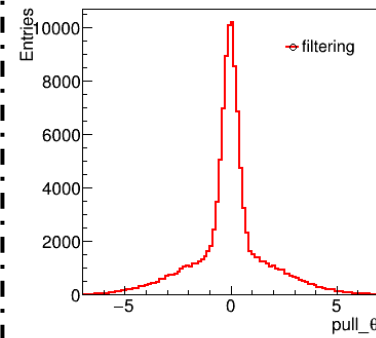
Residuals and pulls -- filtering

- Parameters of measurements
- Total

• $\theta: 85^\circ$



Residual

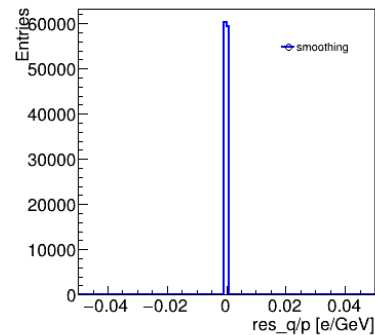
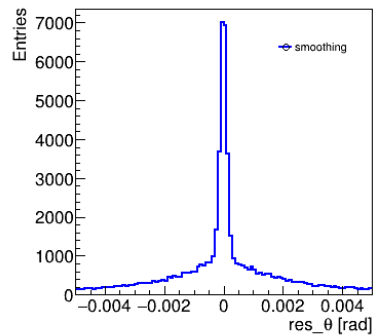
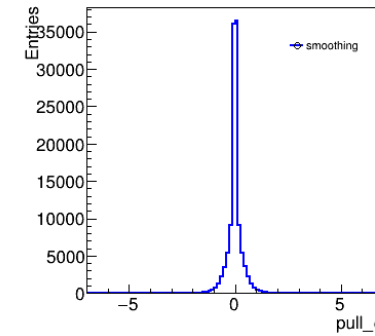
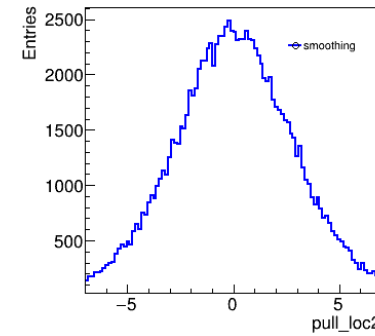
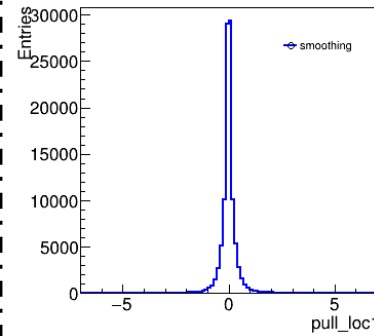
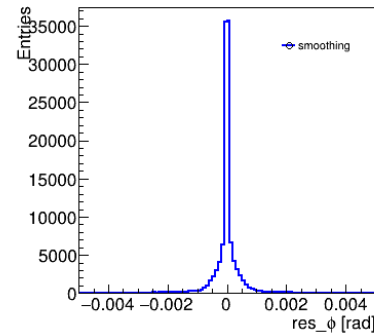
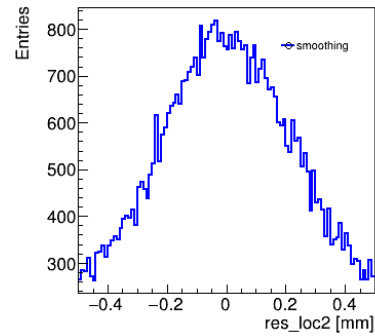
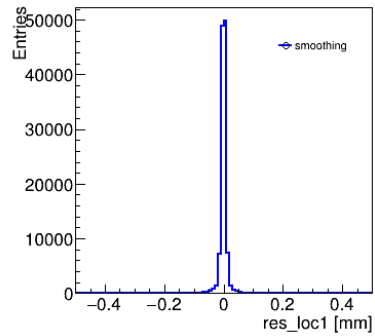


Pull

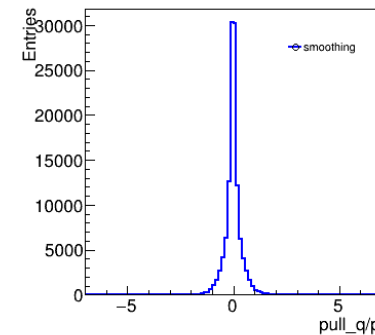
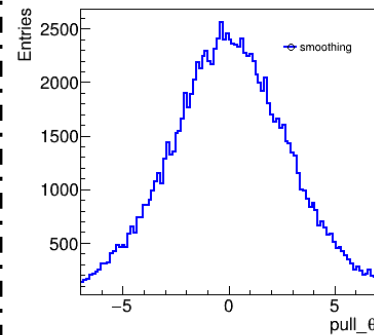
Residuals and pulls -- smoothing

- Parameters of measurements
- Total

• $\theta: 85^\circ$



Residual

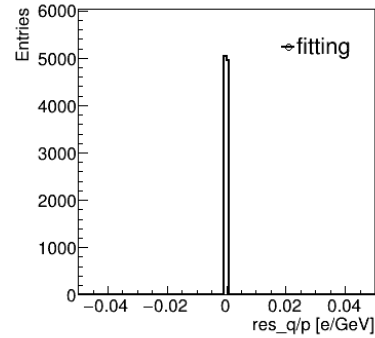
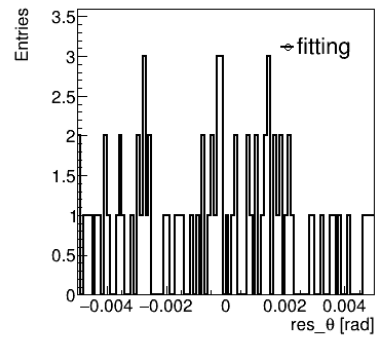
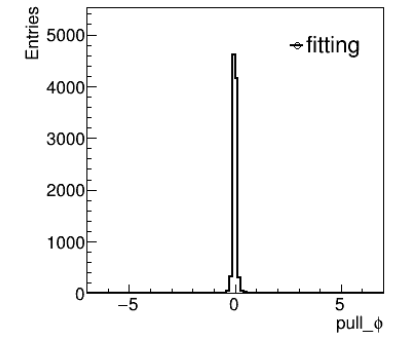
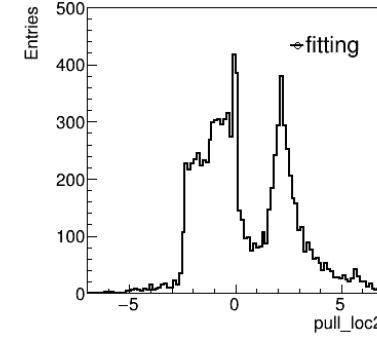
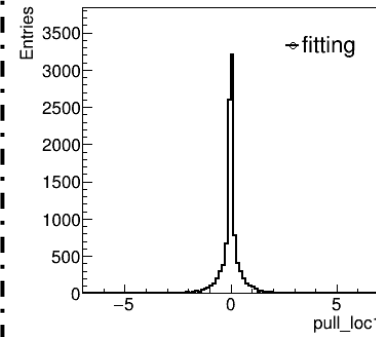
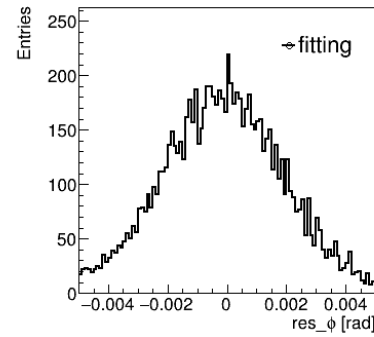
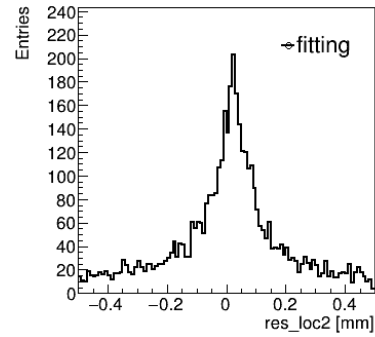
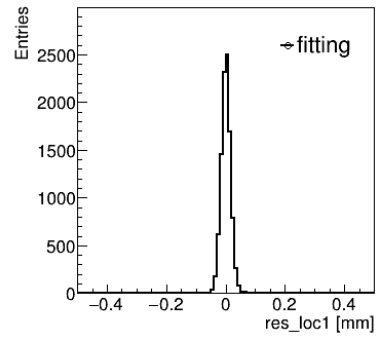


Pull

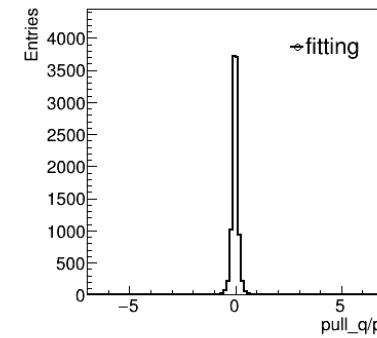
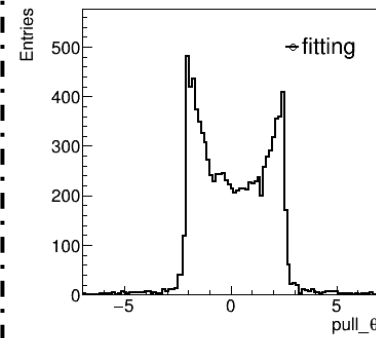
Residuals and pulls -- fitting

- Parameters of tracks
- Total

• $\theta: 85^\circ$



Residual



Pull

- Branch: turn-off-TPC
 - Commit id: f8e6f93ed77e46cadd1646dc6583e5980fda9b9b

- Same options
 - Particle gun: 10000 μ from (0, 0, 0)
 - Magnetic field: (0, 0, 3T)
 - p_T : 100GeV
 - θ : 20°
 - φ : uniform distribution

- Codes

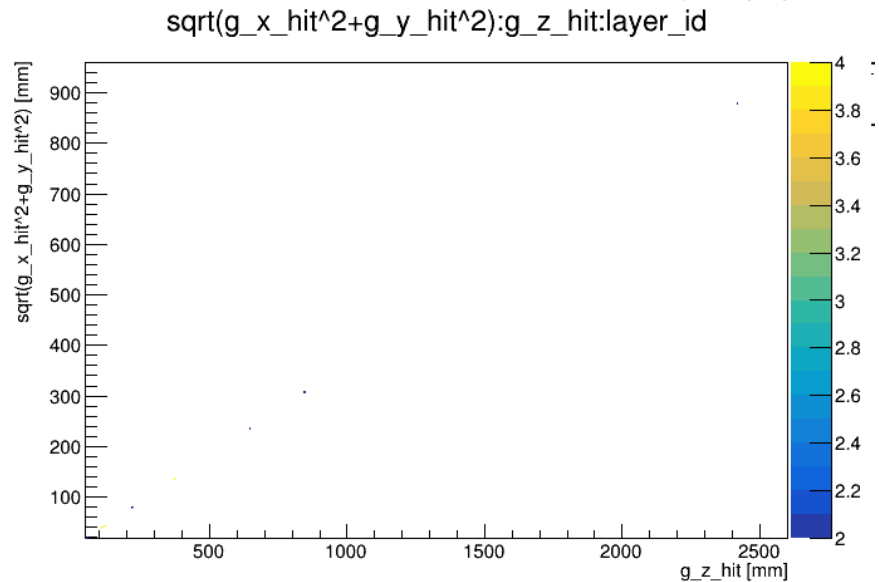
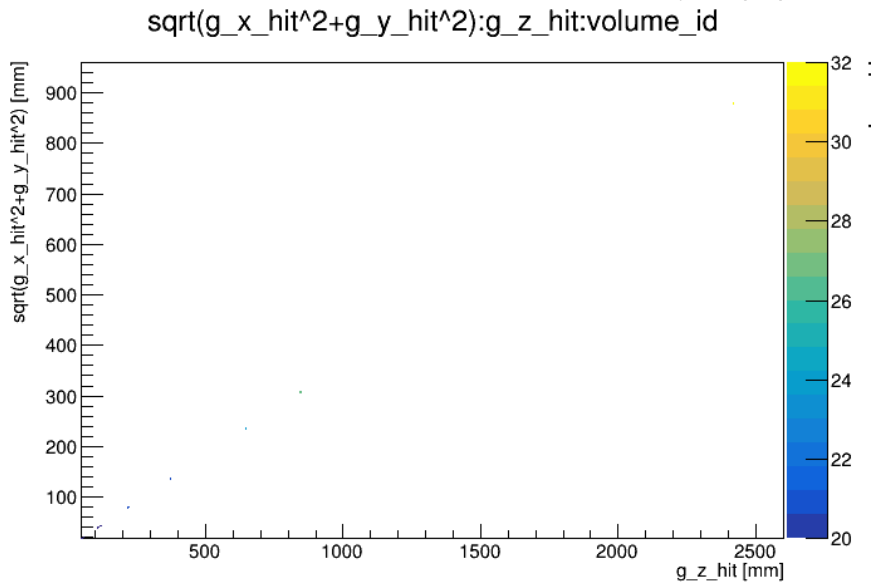
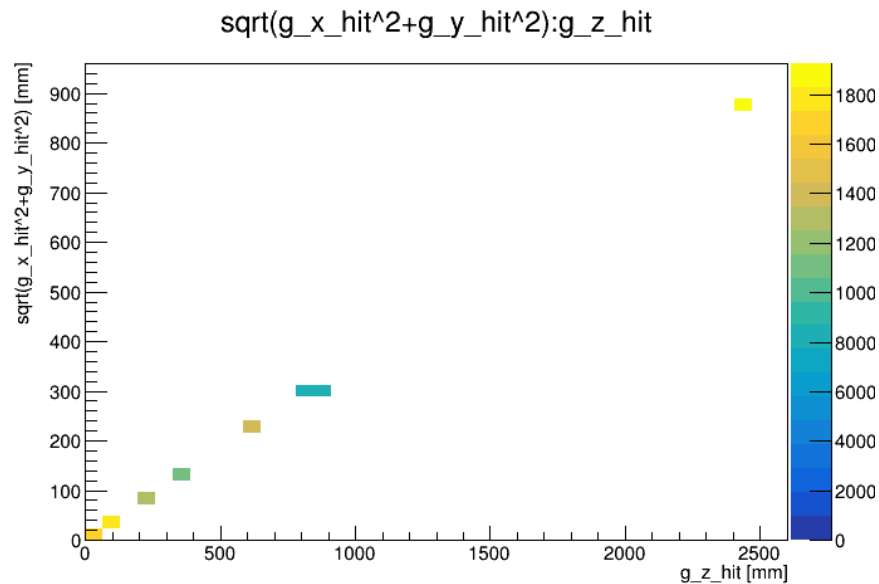
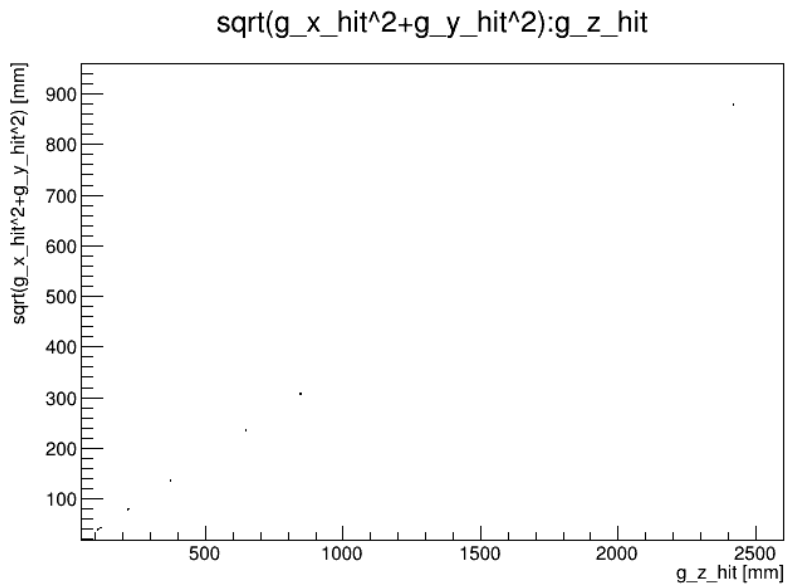
```
pT=100
theta=20
cos_theta=$(echo "$theta"|gawk '{printf("%12.10f\n",cos($1/180.*3.141592653))}')
dirName=cepc_sim_${pT}_${theta}
NParticles=1
NEvents=10000

./ActsSimFstrasDD4hep \
--evg-input-type gun \
--dd4hep-input ../../Detectors/DD4hepDetector/compact/CEPC/cepc_v04_master.xml \
--dd4hep-envelopeR 0.1 \
--dd4hep-envelopeZ 0.1 \
--bf-values 0 0 3 \
--pg-pt-range ${pT} ${pT} \
--pg-costheta-range ${cos_theta} ${cos_theta} \
--pg-nparticles ${NParticles} \
--events ${NEvents} \
--output-root 1 \
--output-dir ${dirName}
```

Hits distributions

- Entries/Nparticles: 10000/10000

• $\theta: 20^\circ$

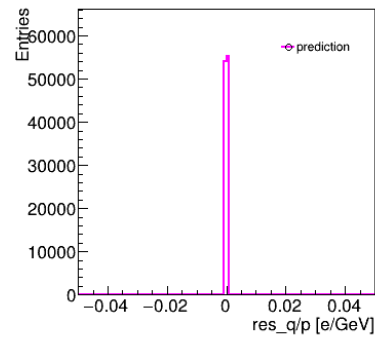
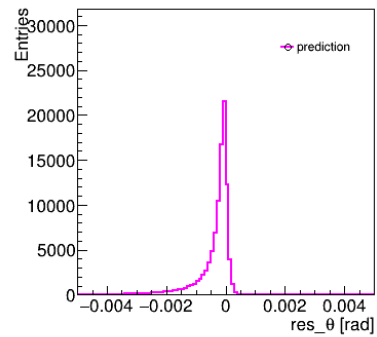
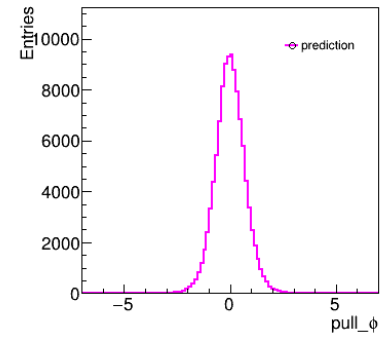
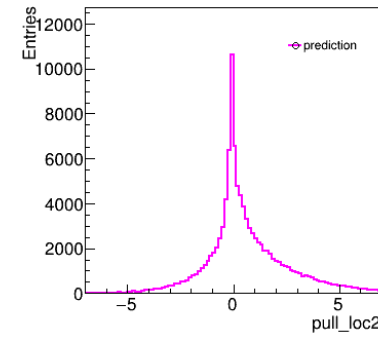
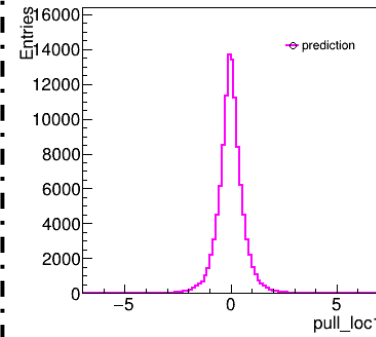
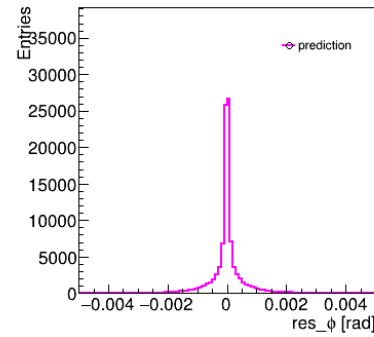
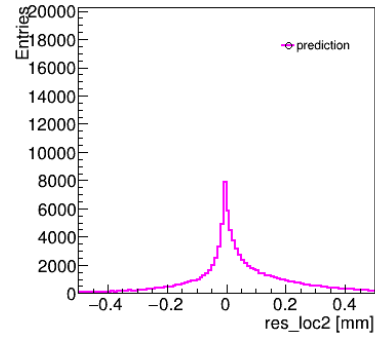
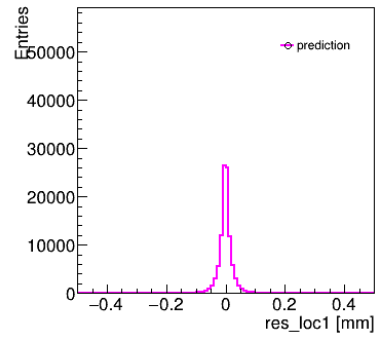


Sub-detector	New Volume_id	Layer_id	nMeasurements
Vertex	20	2	17196
		4	18207
		6	
SIT 1	23	2	
SIT 2	26	2	
FTD 1, 2 neg	19	2	
FTD 1, 2 pos	21	2	23357
FTD 3 neg	14	2	
FTD 3 pos	24	2	14214
FTD 4, 5 neg	9	2	
FTD 4, 5 pos	27	2	16972
TPC			
SET	31	2	
ETD neg	30	2	
ETD pos	32	2	19255
Total			109201

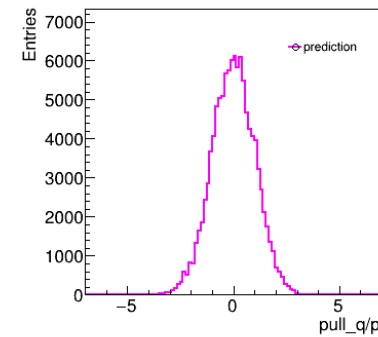
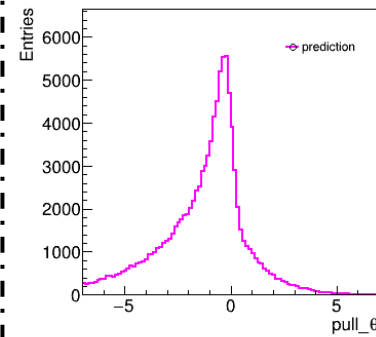
Residuals and pulls -- prediction

- Parameters of measurements
- Total

• $\theta: 20^\circ$



Residual

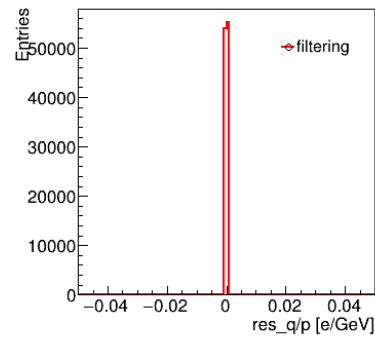
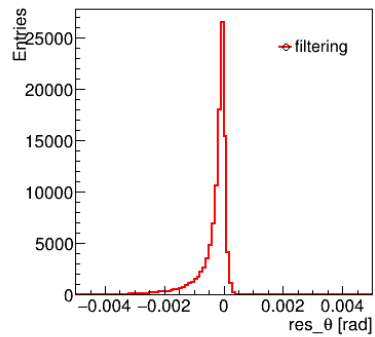
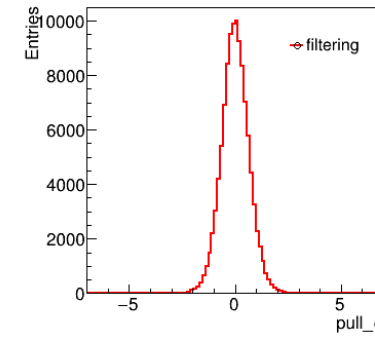
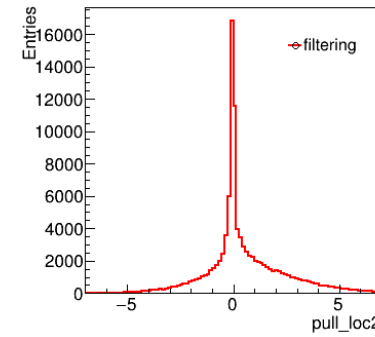
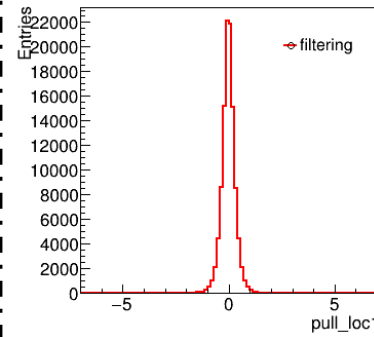
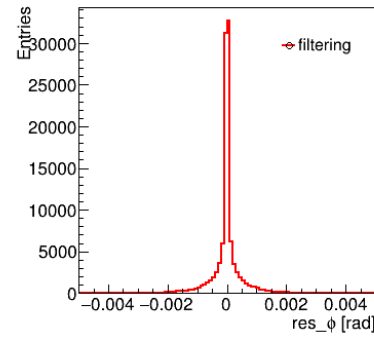
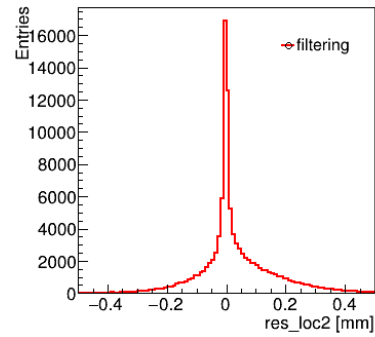
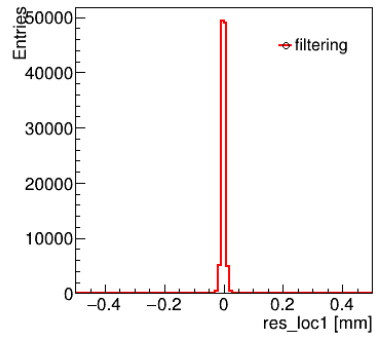


Pull

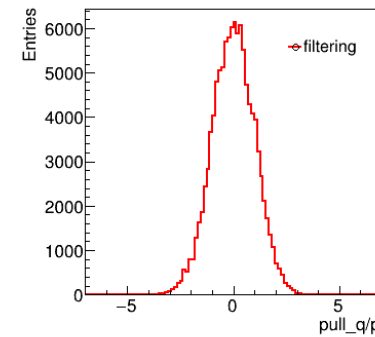
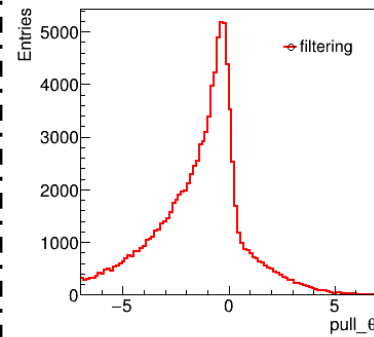
Residuals and pulls -- filtering

- Parameters of measurements
- Total

• $\theta: 20^\circ$



Residual

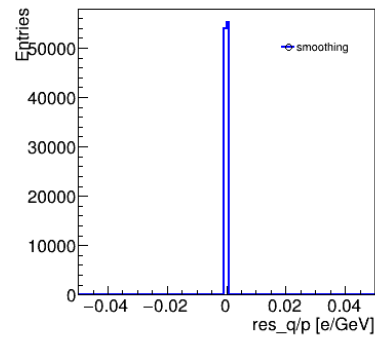
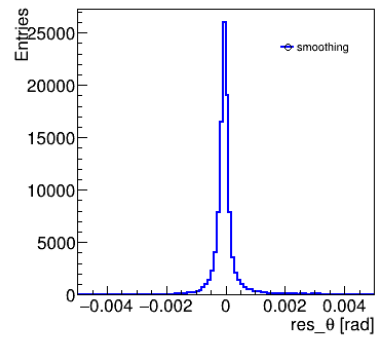
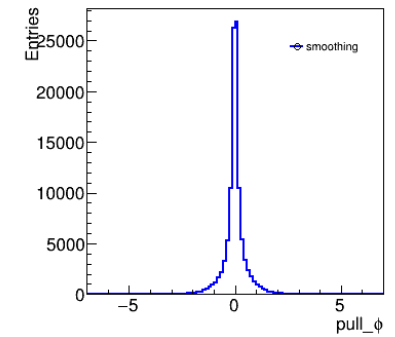
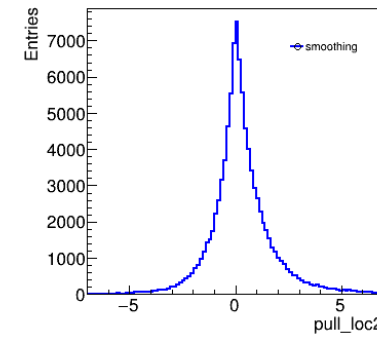
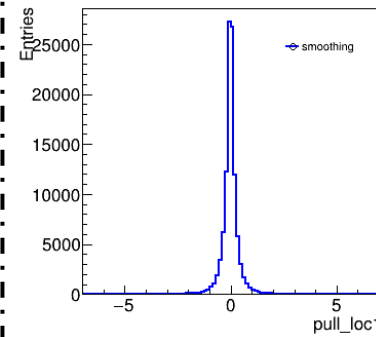
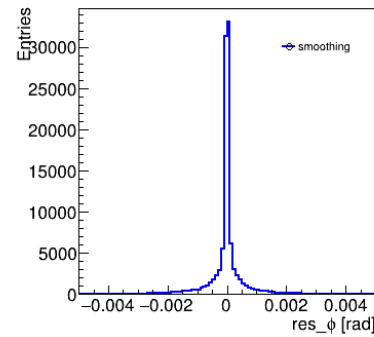
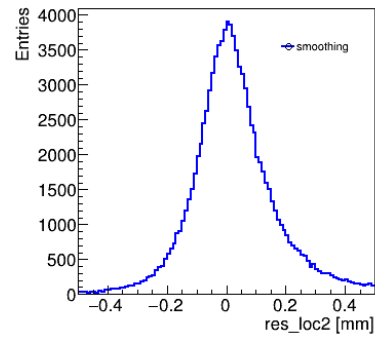
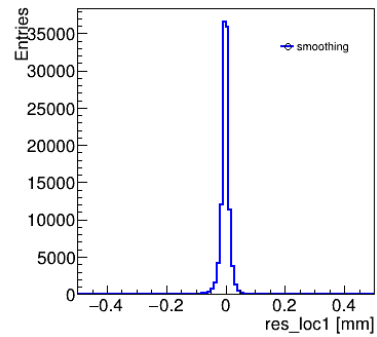


Pull

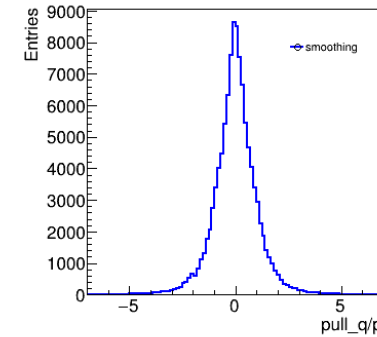
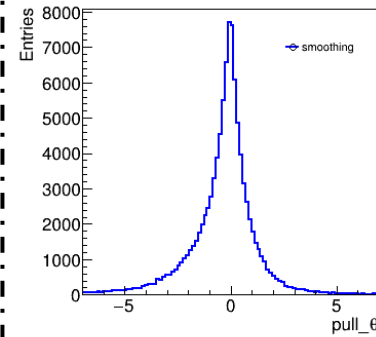
Residuals and pulls -- smoothing

- Parameters of measurements
- Total

• $\theta: 20^\circ$



Residual

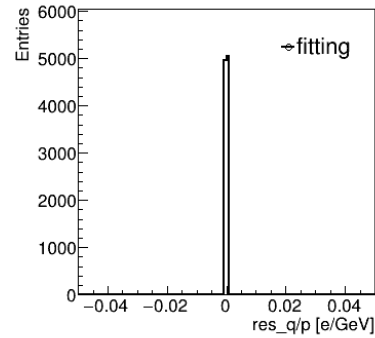
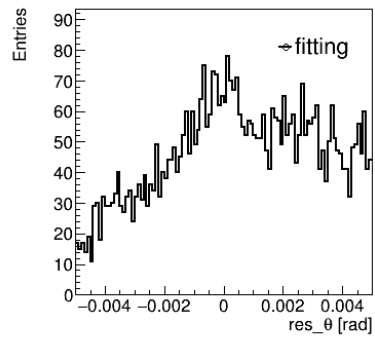
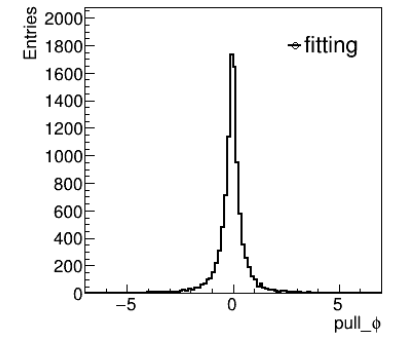
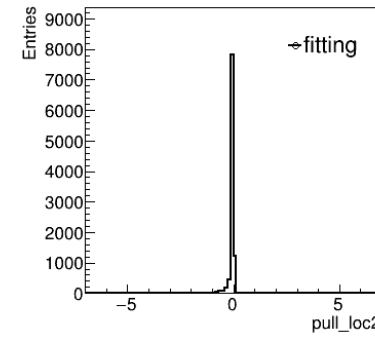
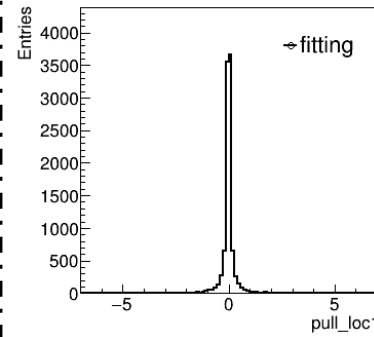
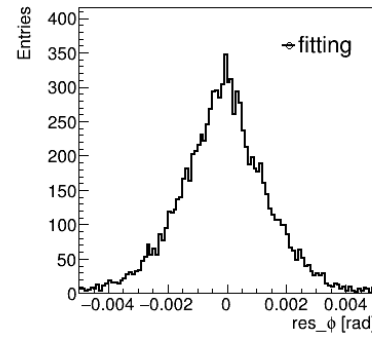
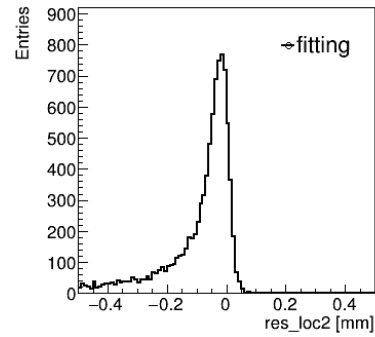
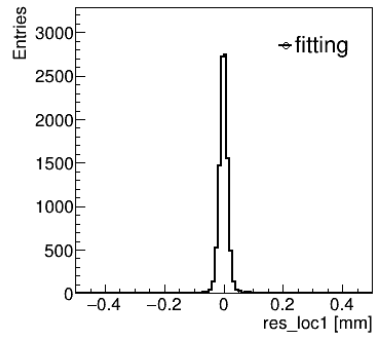


Pull

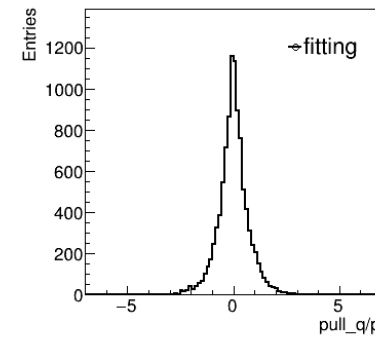
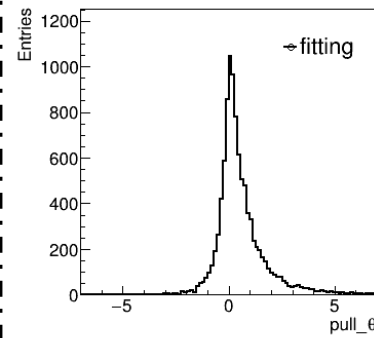
Residuals and pulls -- fitting

- Parameters of tracks
- Total

• $\theta: 20^\circ$



Residual



Pull

- TPC
 - Prediction, filtering and smoothing ×
- Fitting ×

Summary

- TPC
 - The bad resolutions of TPC highly affect the performance
- Fitting
 - Fitting has some problems of its own