Correction of the measured theta angle depending on the Z position of the interaction point

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- BOX Gen 300 000 events with multiplicity one photon per event;
- Energy = 500MeV;
- Interaction point in three Z positions:

  [-50; 0; 50] cm;
- Angles:

$\varphi = 89.2^\circ, 38^\circ < \theta < 138^\circ$

$\varphi = 89.2^\circ, 40^\circ < \theta < 140^\circ$

$\varphi = 89.2^\circ, 48^\circ < \theta < 148^\circ$

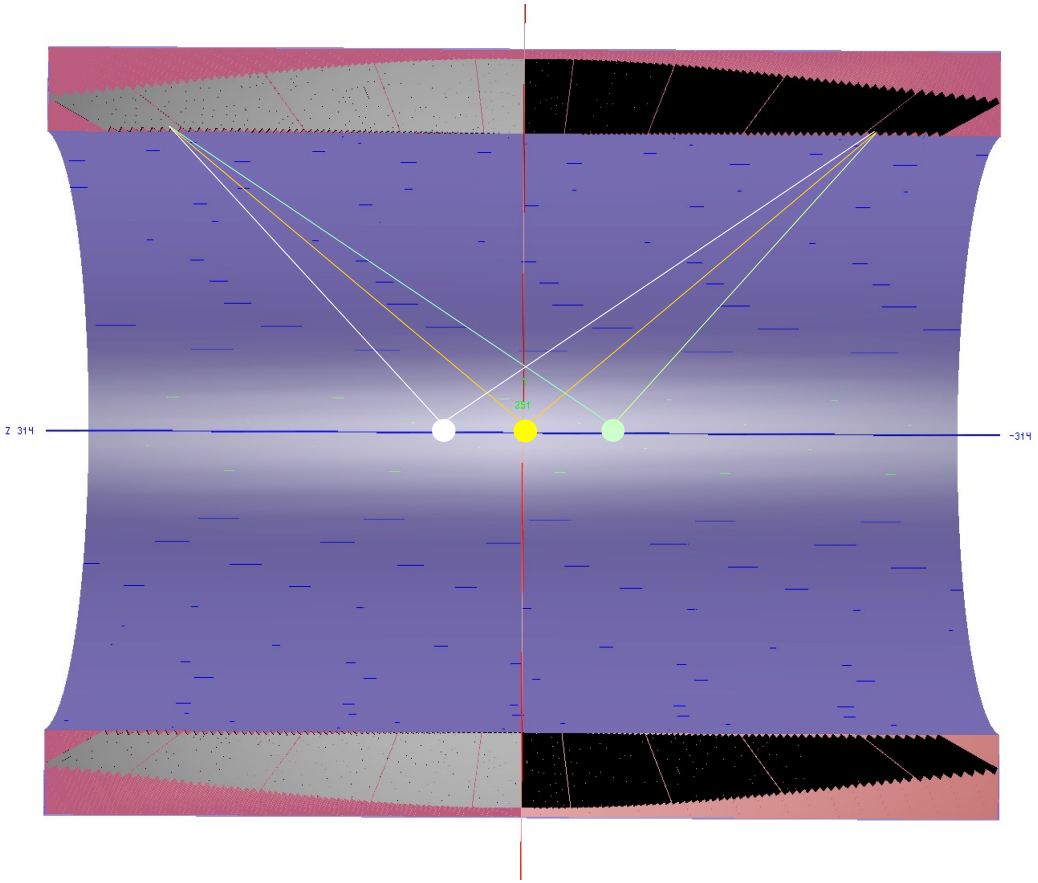
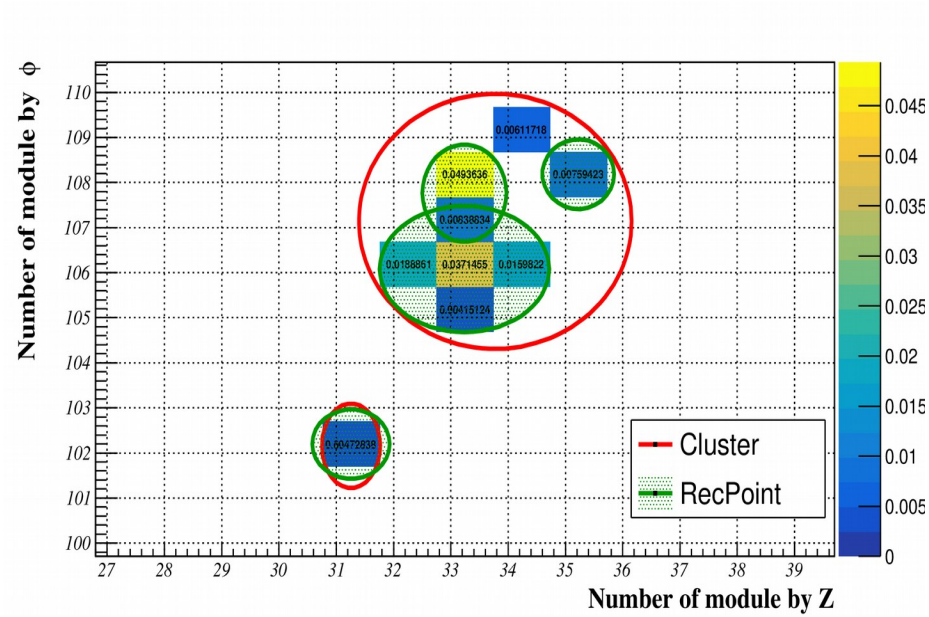


Figure 1: *ECal view.*

- ➢ Using AZ method;
- ➢ Selected only those events where the generated photon hit the calorimeter;
- ➢ $E_{digit} > 5MeV$;
- ➢ One reconstructed point per event, with maximum Eloss;

- $\theta_{RecPoint}$ - the weighted angle of the reconstructed point, but recalculated by the position of the emission of photons on Z, using the inner radius of the calorimeter (172 cm);



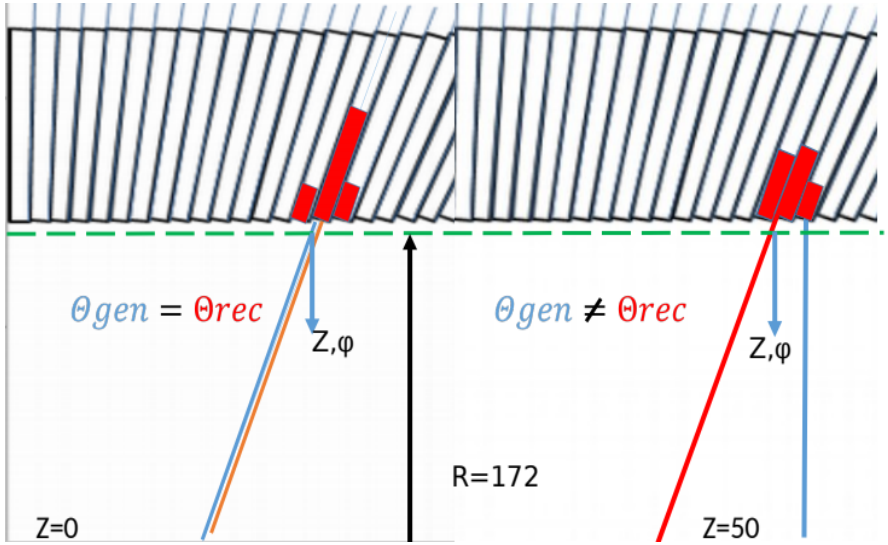


Figure 2*: Distribution of digits of one event.*

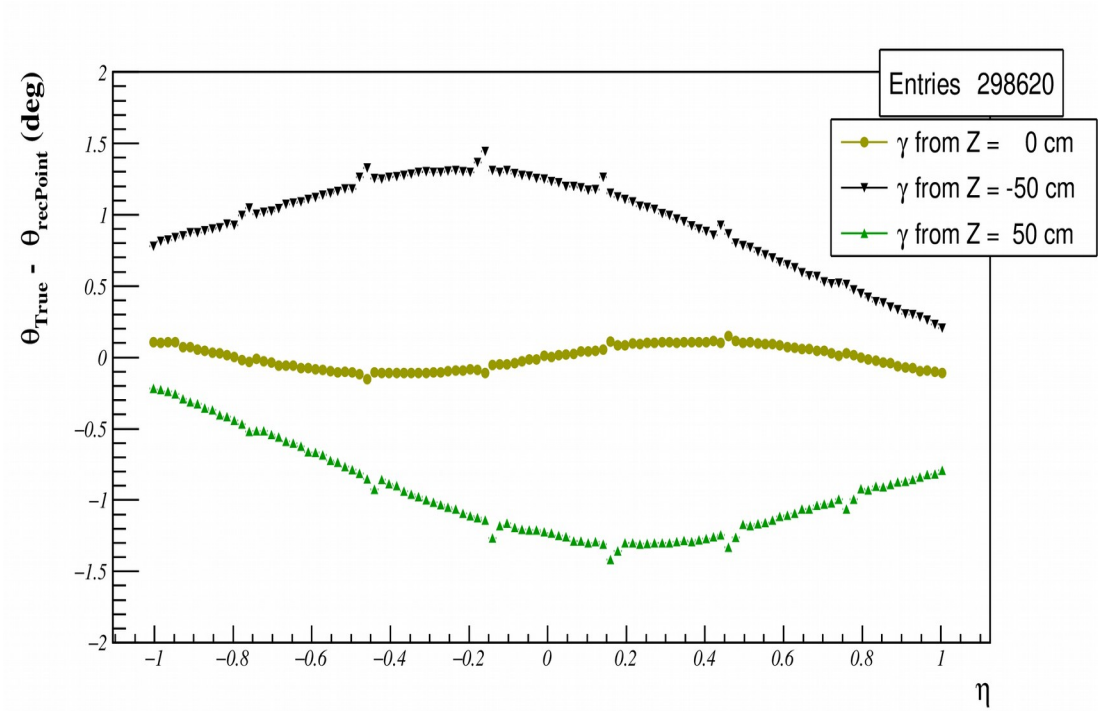


Figure 3: *Difference of the simulated and reconstructed angle vs pseudorapidity (η – with corrected reconstructed angle by the zero position in Z).*

$$\eta = -\ln\left[\tan\left(\frac{\theta_{True}}{2}\right)\right]$$

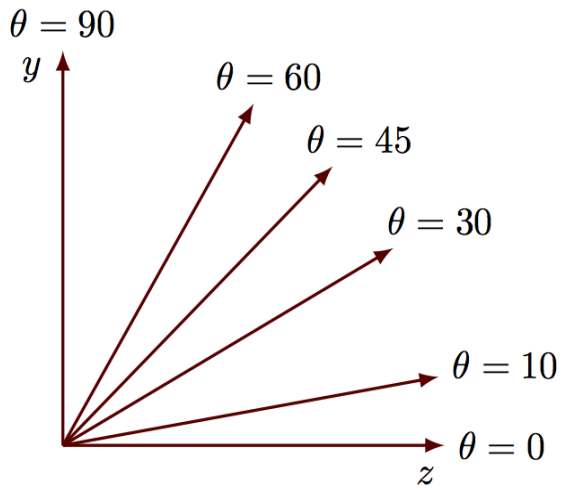


Figure 4: *Pseudorapidity values shown on a polar plot.*

η – the global parameter. The maximum difference of the theta angles is the particles hit perpendicularly in the calorimeter, where the interaction point is +-50cm => +- 1.5 deg (0.03 read).

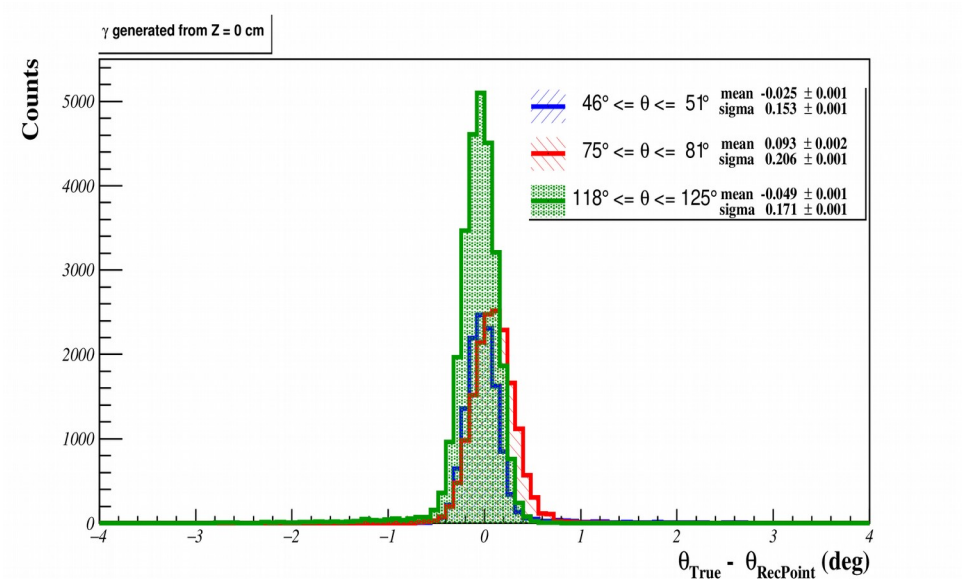


Figure 5*: Difference of the simulated and reconstructed angle in three range of theta and position of interaction point in 0cm by Z.*

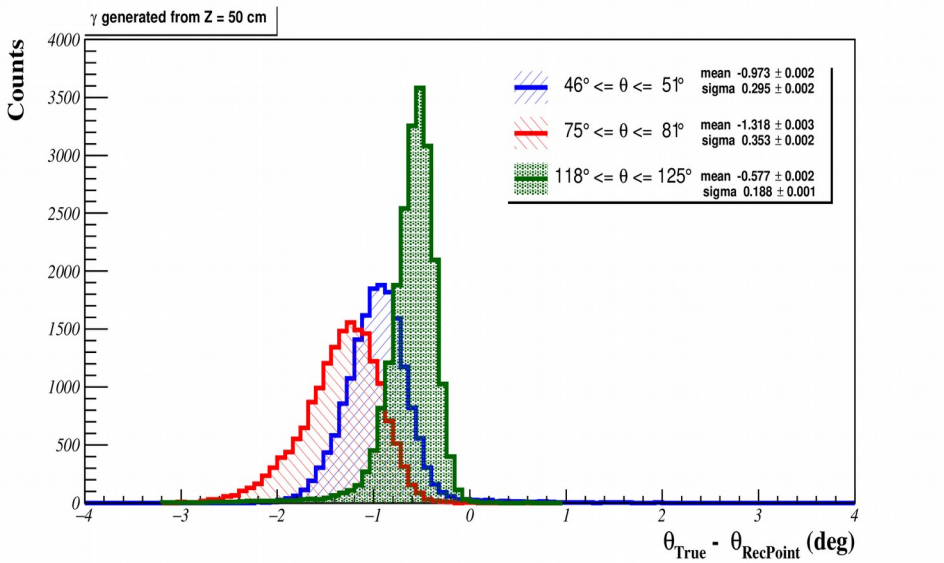
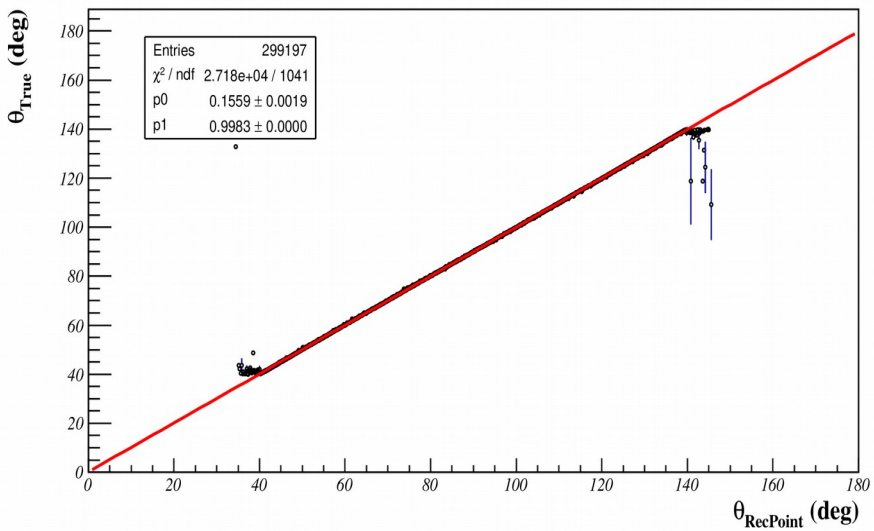
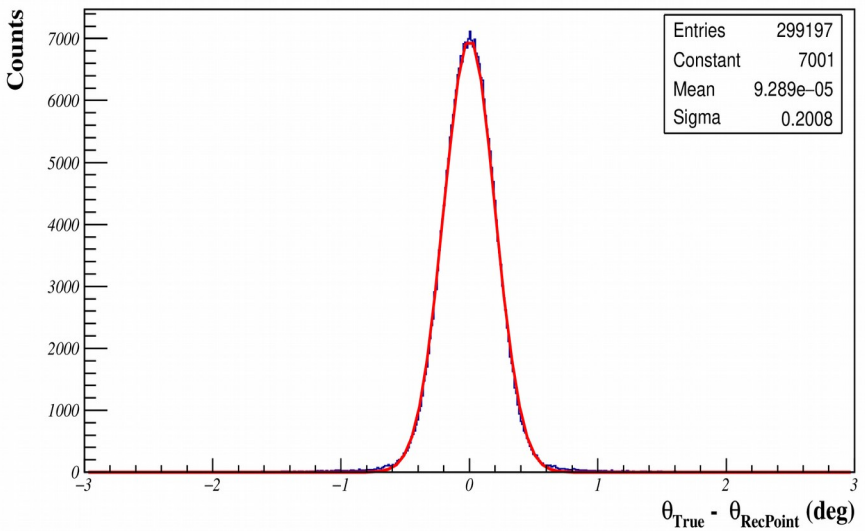
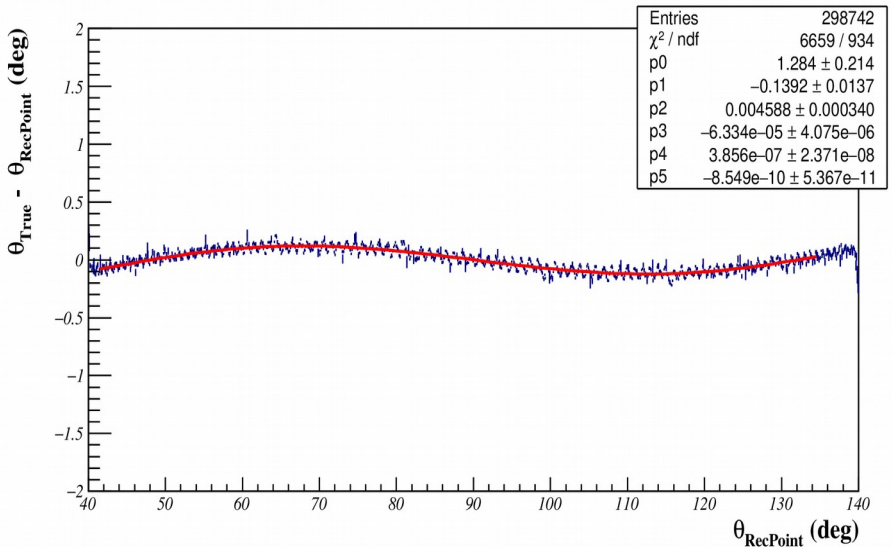


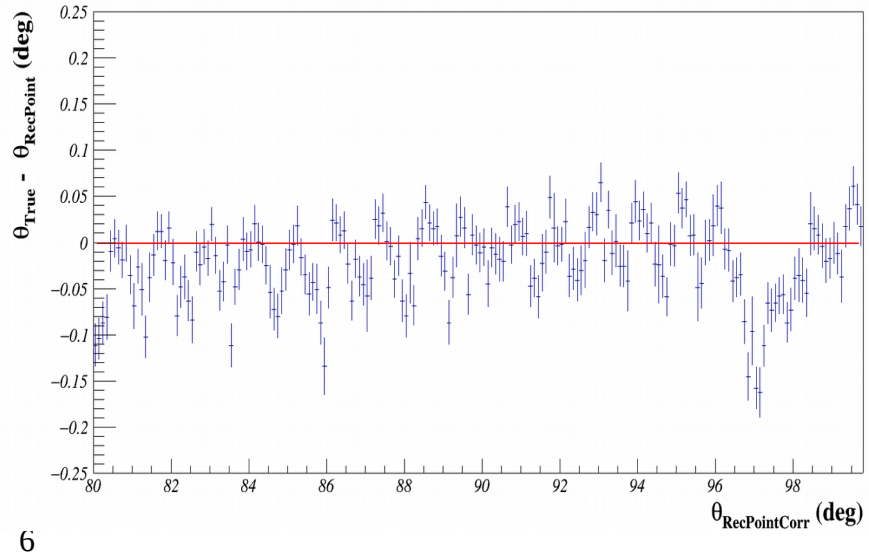
Figure 6: *Difference of the simulated and reconstructed angle in three range of theta and position of interaction point in 50cm by Z.*

Z = 0 cm

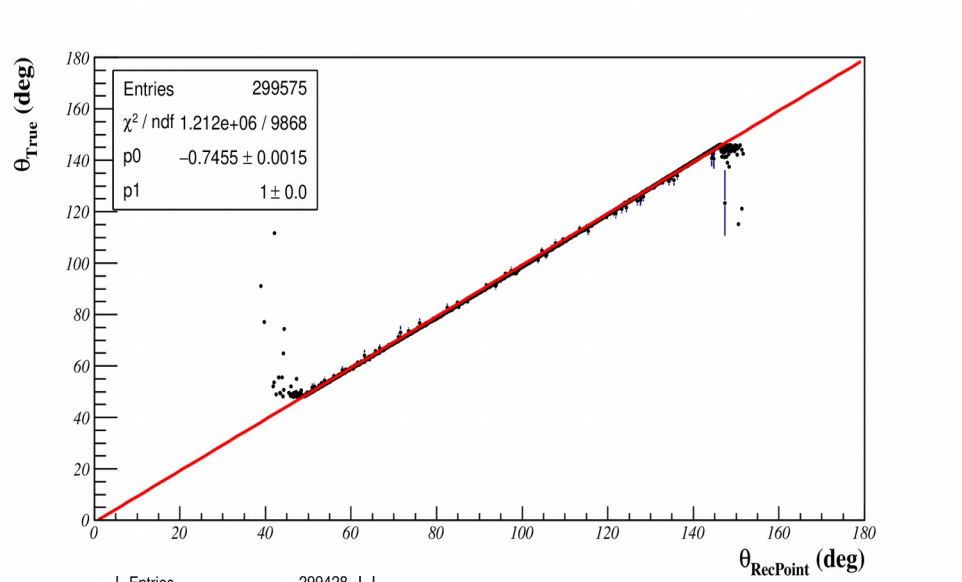

Entries 299197
χ² / ndf 2.718e+04 / 1041
p0 0.1559 ± 0.0019
p1 0.9983 ± 0.0000
θTrue (deg)
θRecPoint (deg)

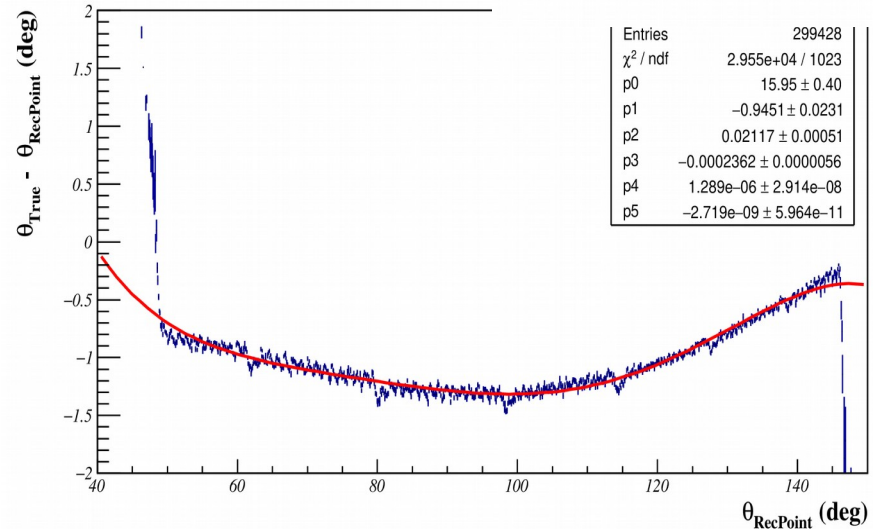

Entries 299197
Constant 7001
Mean 9.289e−05
Sigma 0.2008
Counts
θTrue - θRecPoint (deg)

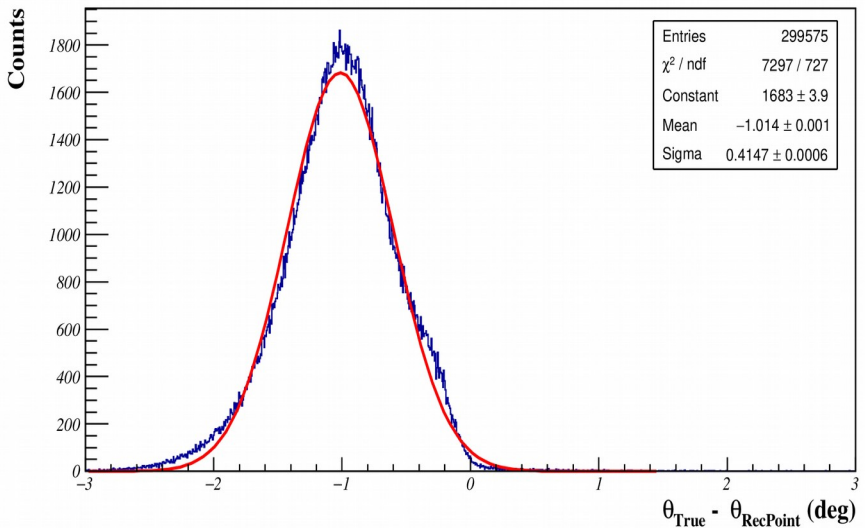

Entries 298742
χ² / ndf 6659 / 934
p0 1.284 ± 0.214
p1 −0.1392 ± 0.0137
p2 0.004588 ± 0.000340
p3 −6.334e−05 ± 4.075e−06
p4 3.856e−07 ± 2.371e−08
p5 −8.549e−10 ± 5.367e−11
θTrue - θRecPoint (deg)
θRecPoint (deg)

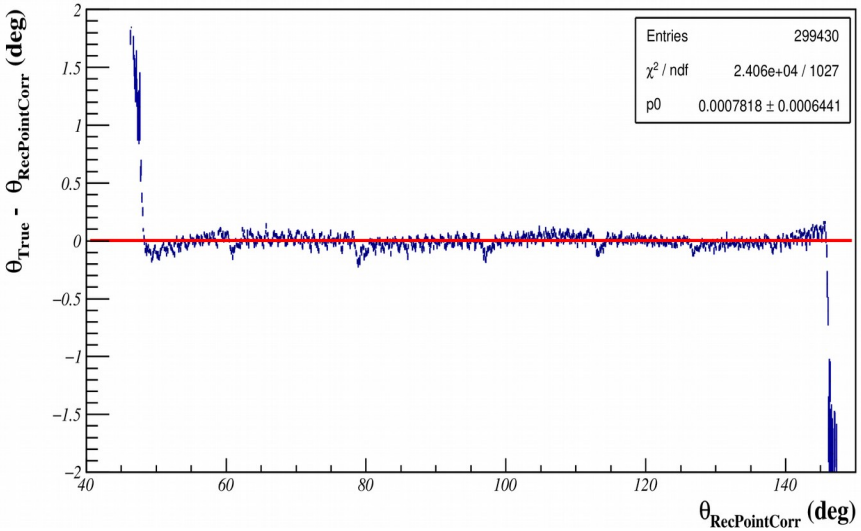

θTrue - θRecPoint (deg)
θRecPointCorr (deg)

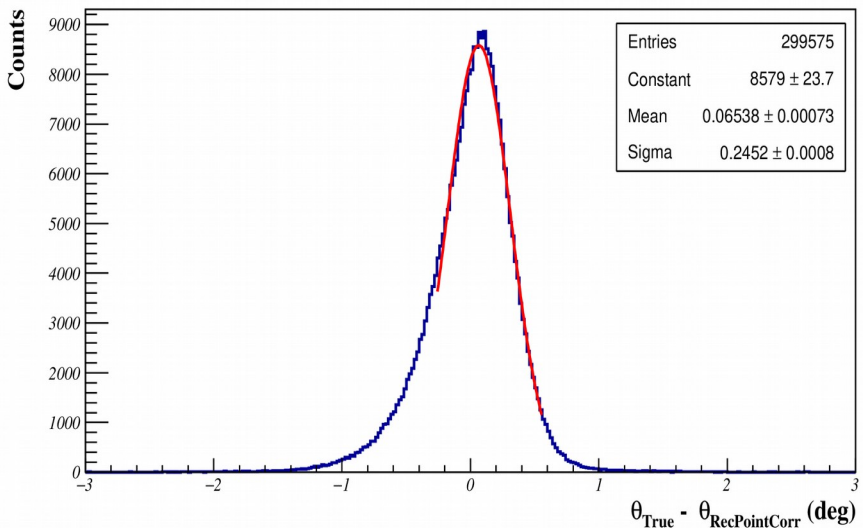
Z = 50 cm


Entries 299575
χ² / ndf 1.212e+06 / 9868
p0 −0.7455 ± 0.0015
p1 1 ± 0.0
θTrue (deg)
θRecPoint (deg)


Entries 299428
χ² / ndf 2.955e+04 / 1023
p0 15.95 ± 0.40
p1 −0.9451 ± 0.0231
p2 0.02117 ± 0.00051
p3 −0.0002362 ± 0.0000056
p4 1.289e−06 ± 2.914e−08
p5 −2.719e−09 ± 5.964e−11
θTrue - θRecPoint (deg)
θRecPoint (deg)


Entries 299575
χ² / ndf 7297 / 727
Constant 1683 ± 3.9
Mean −1.014 ± 0.001
Sigma 0.4147 ± 0.0006
Counts
θTrue - θRecPoint (deg)





$\Theta_{recPointCorr} = \Theta_{RecPoint} + f_{pol5}(\Theta_{RecPoint})$

The correction of theta angle on the position of the interaction point is possible. The correction factor must have for each interaction point position and energies.