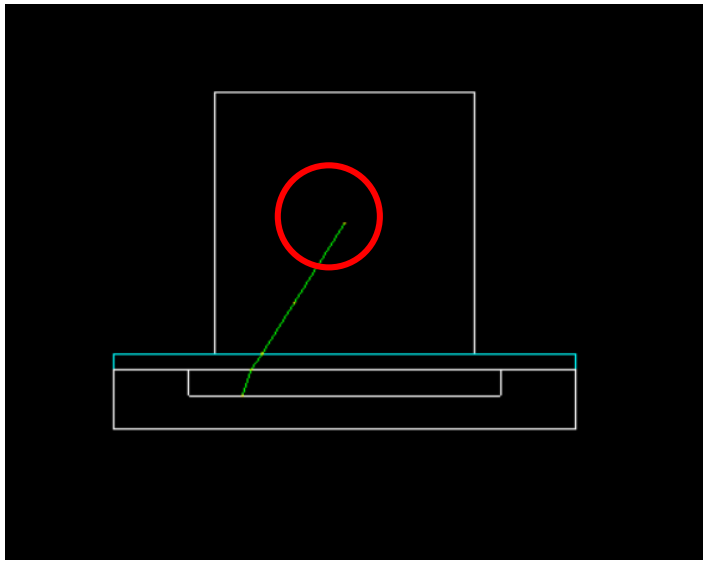
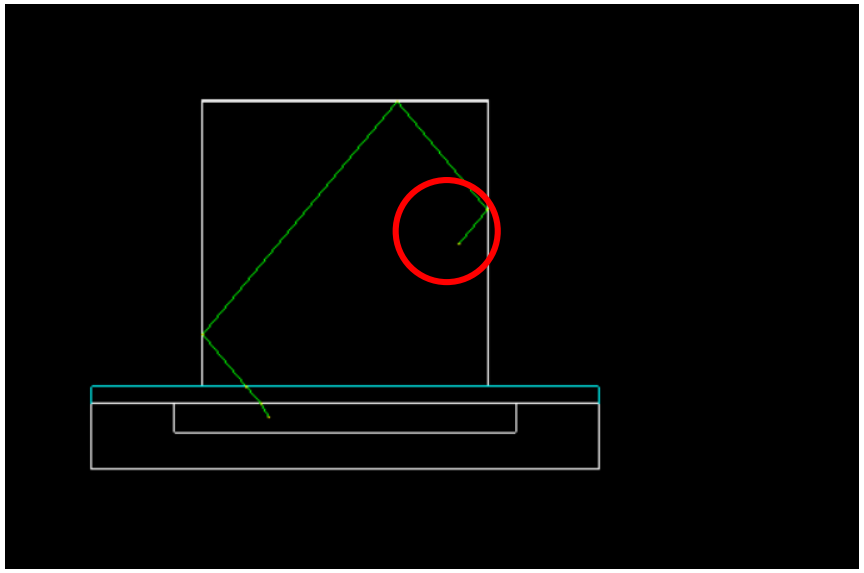
The number of photons that arrive at MPPC depending on emission point

Simulation

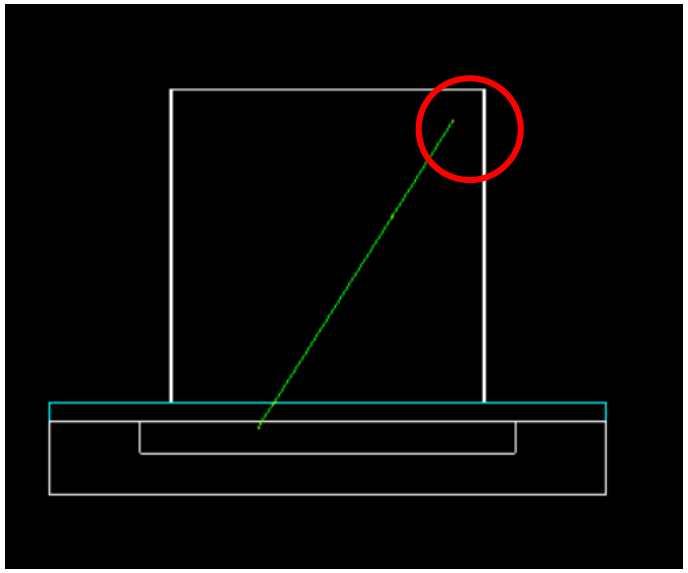
Emission point : center



Emission point : edge

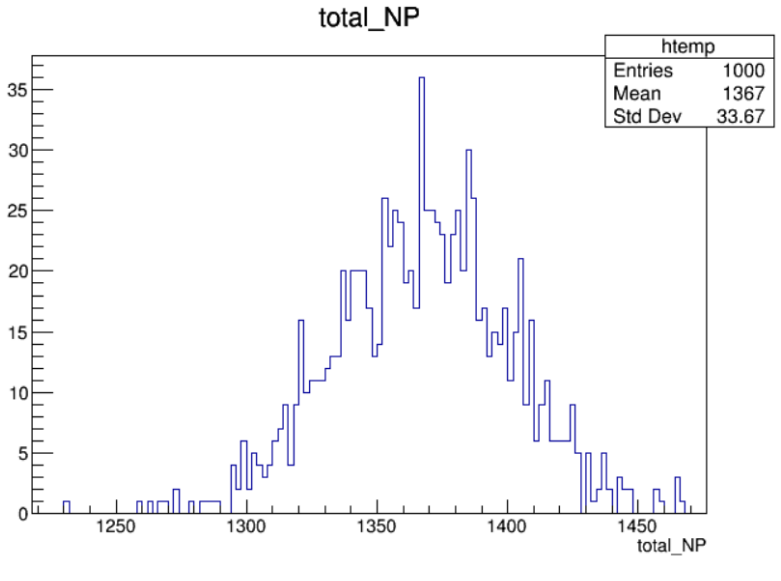


Emission point : edge

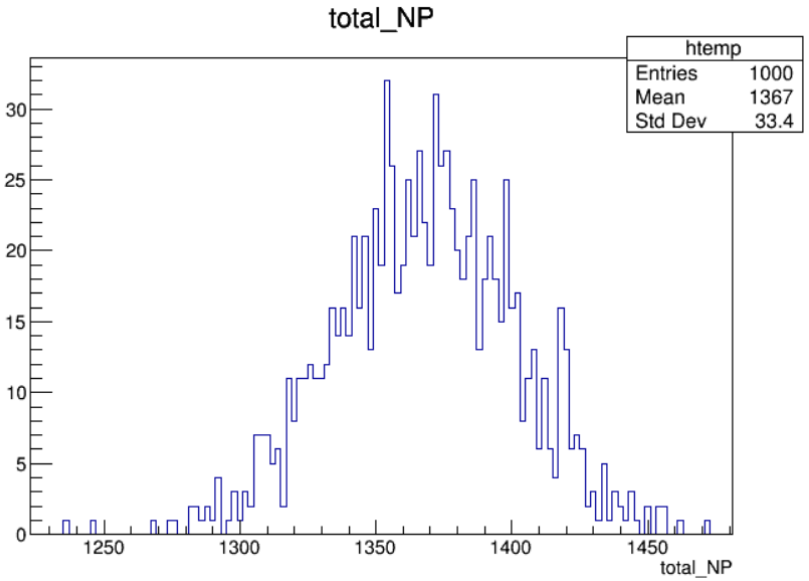


Simulation

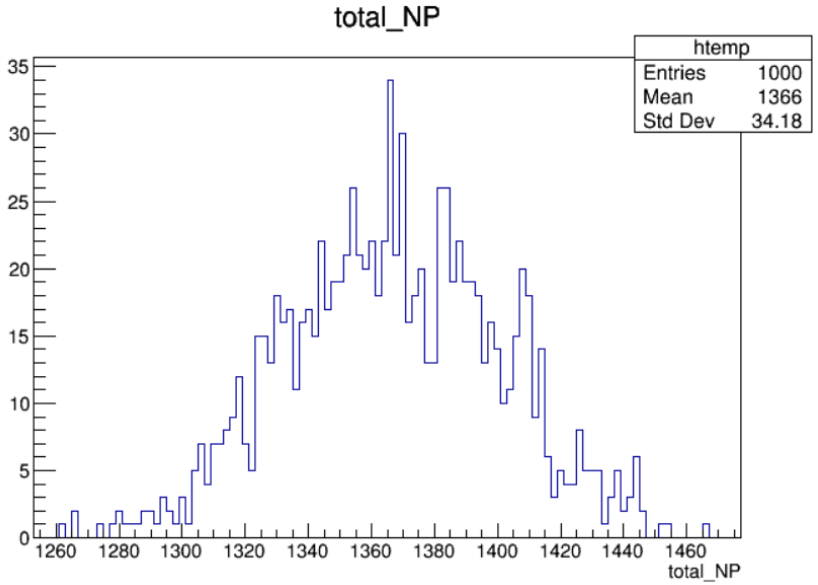
Emission point : center



Emission point : edge



Emission point : edge



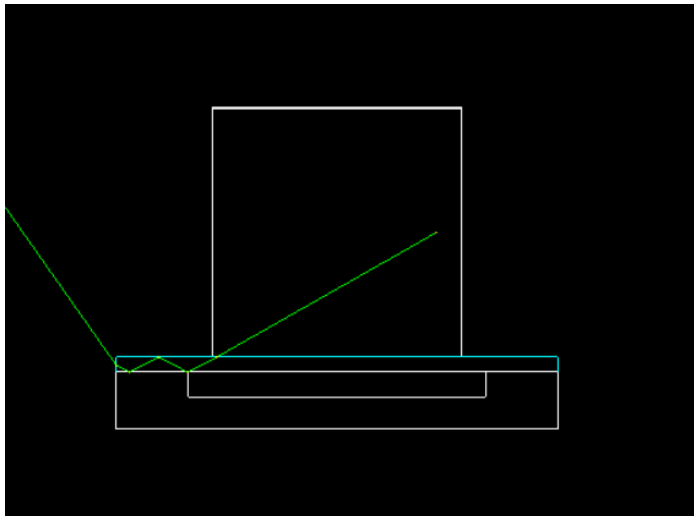
Make 9000 photons for one event, and count the number of photons in MPPC.
Therefore Landau distribution is not appeared.
And as a result, the number of photons arrived MPPC is independent of the position where photon is emitted.
However the number of photons arrived MPPC is smaller than our calculation.

Visualization

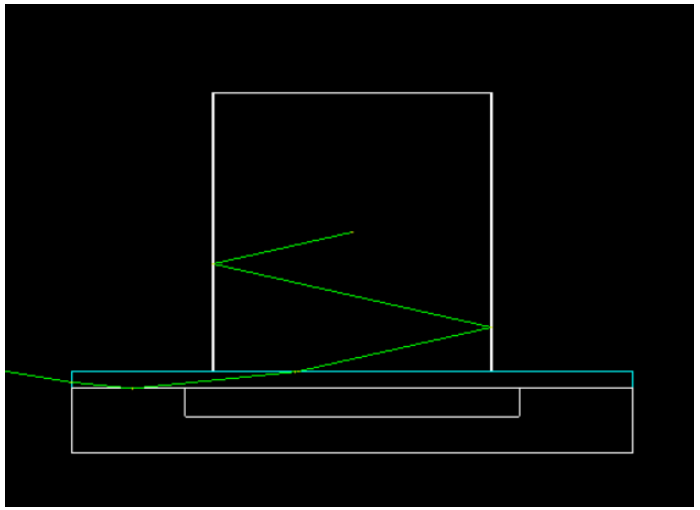
Factor unconsidered

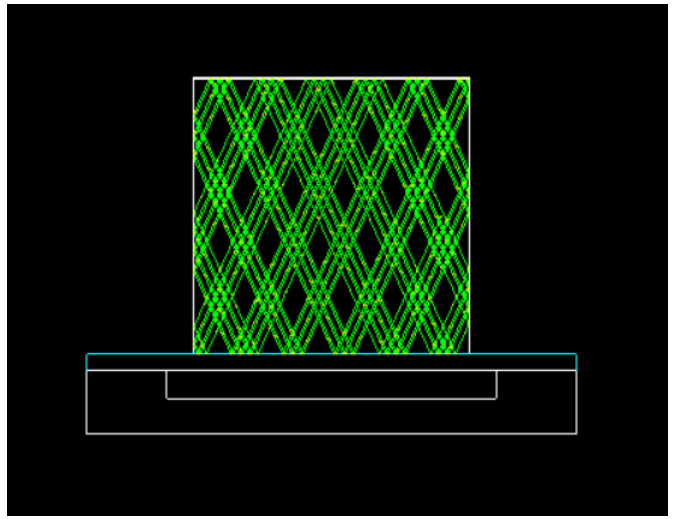
Factor Considered

Photosensitive part has not been reached

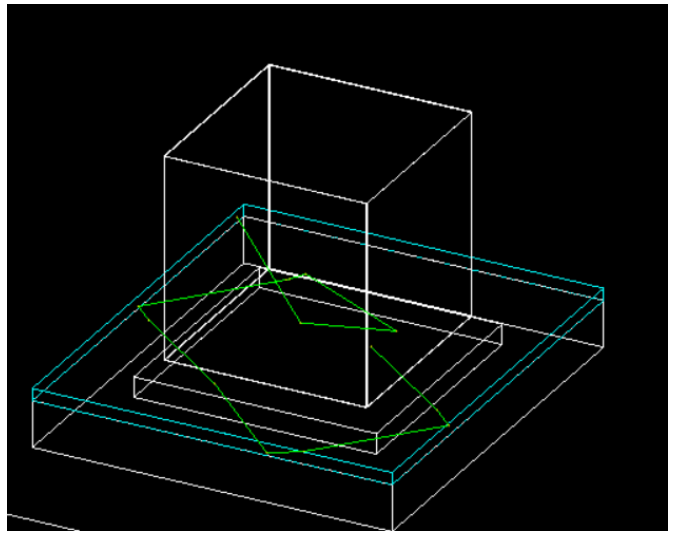


Exit after reflected by case of MPPC





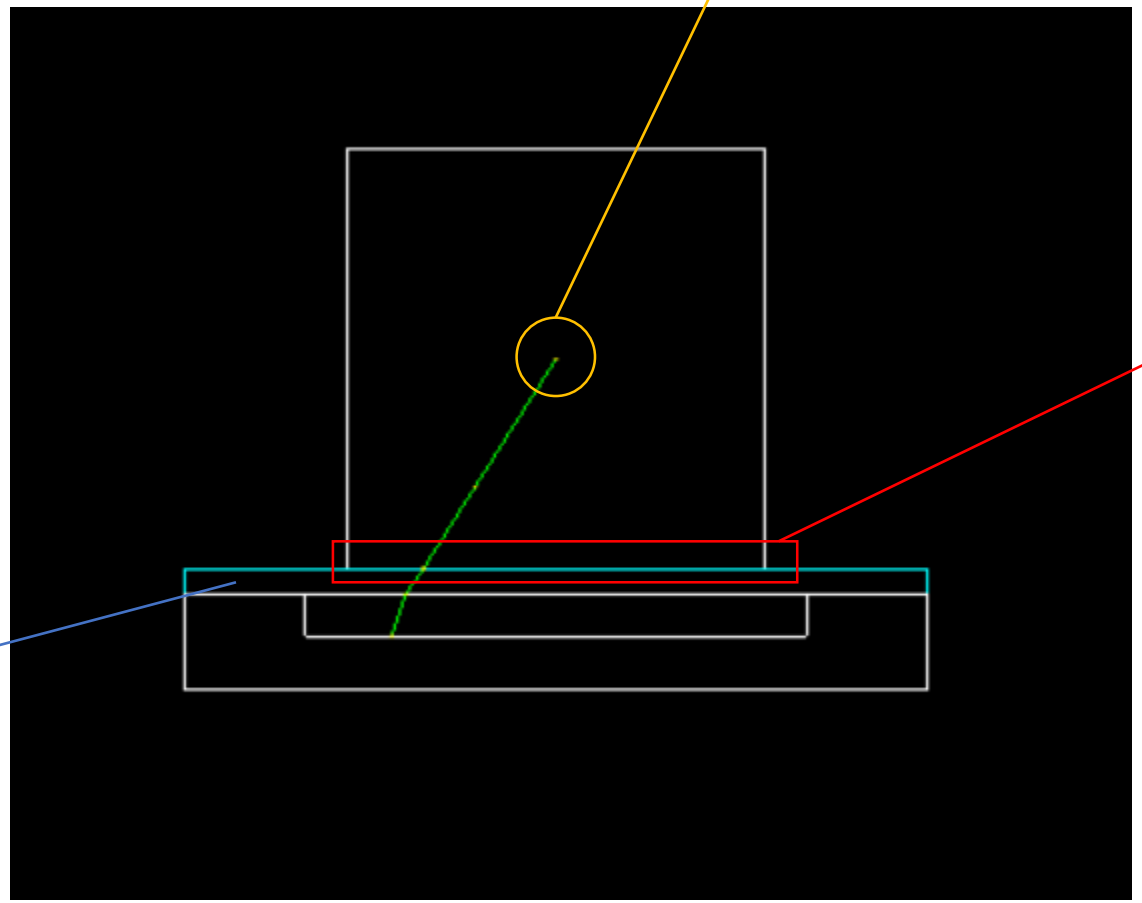
Dead in Scintillator



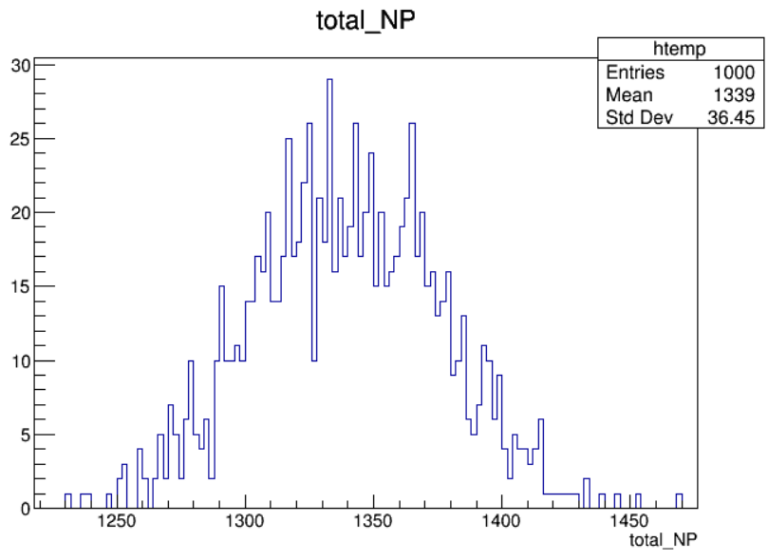
Photon in

Interspace dependency

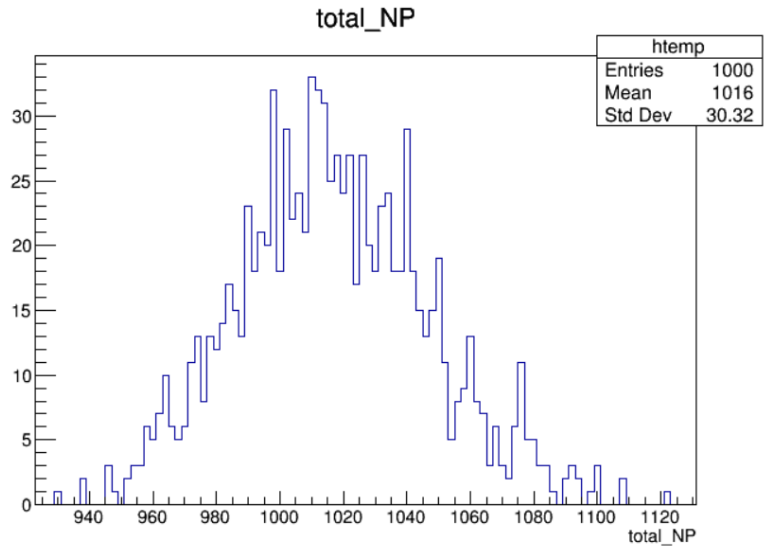
Simulation



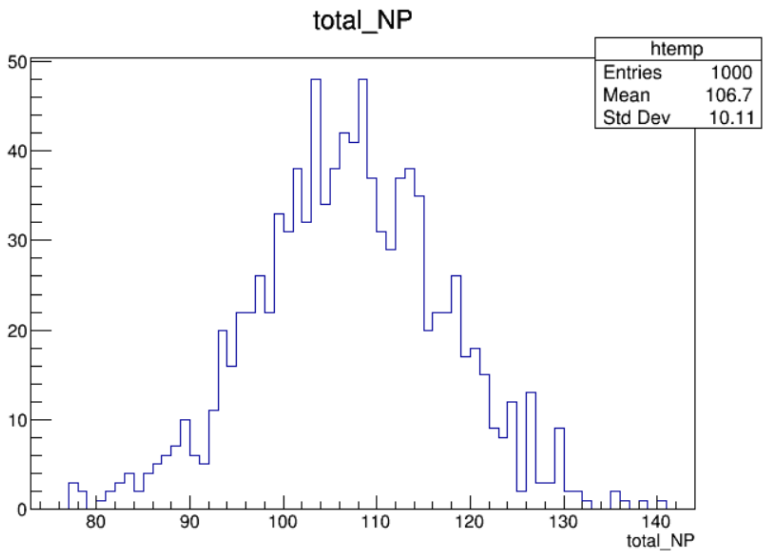
Interspace dependency



Interspace length = 0.1 mm



Interspace length = 1 mm



Interspace length = 10 mm

The wider width of air gap, the smaller the number of photons arrive

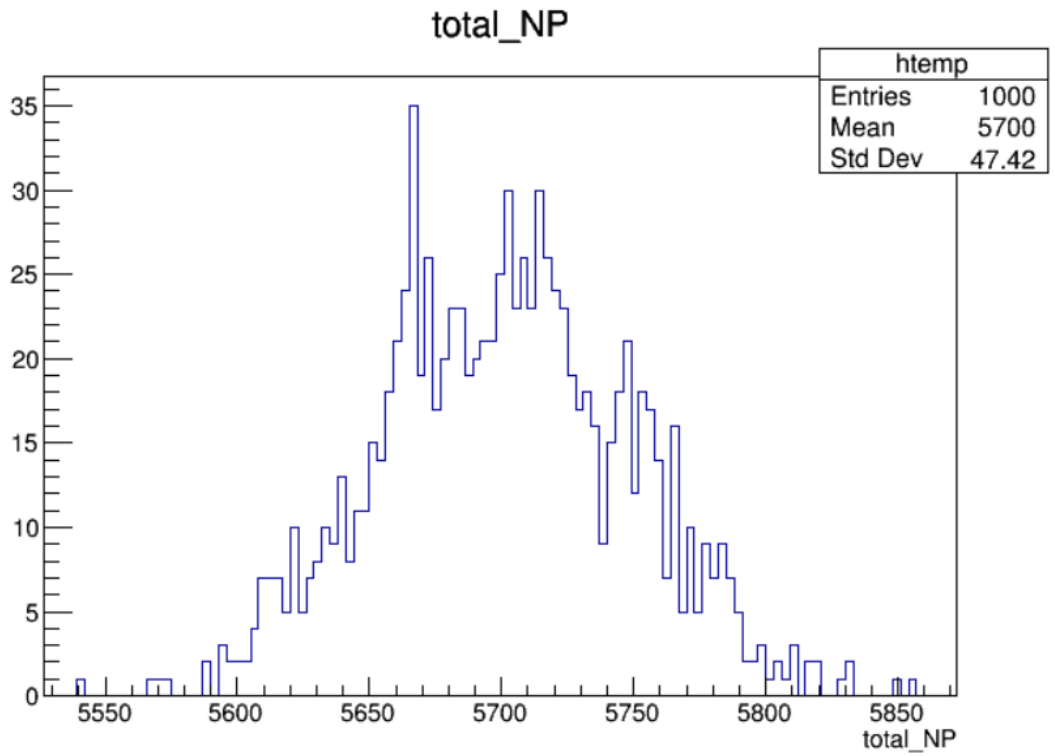
Existance of Optical cement

Motivation

- Can we expect the number of photons arrive MPPC when optical cement exist?

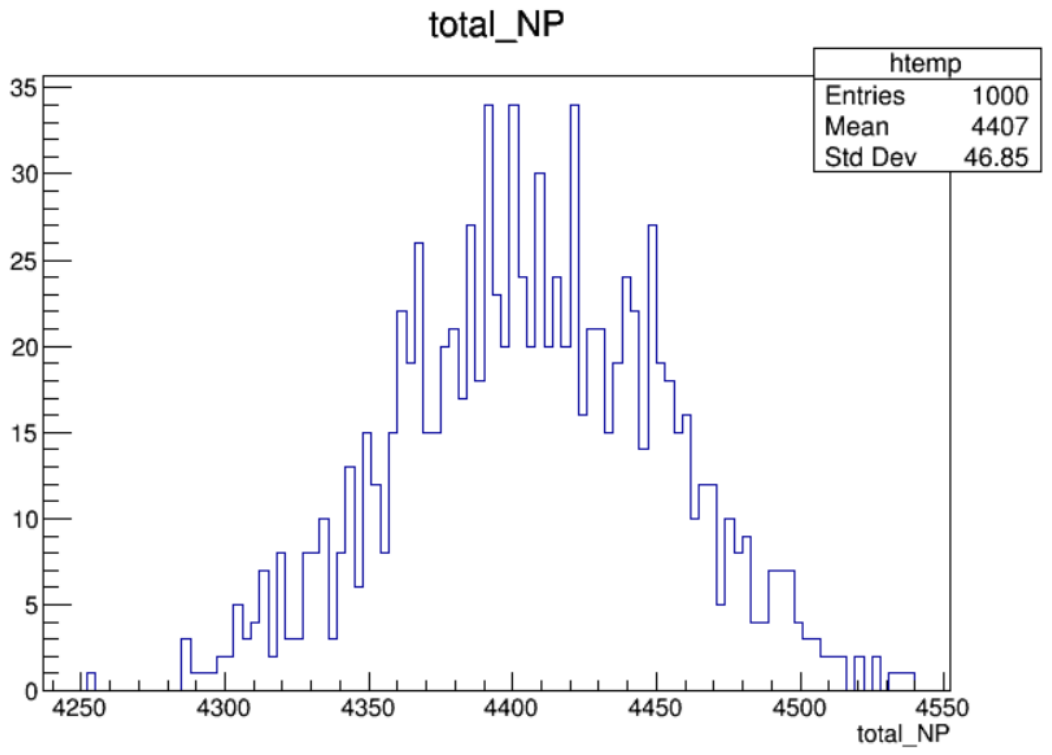
- By calculating it only cosindering refractive index, the probability is about 0.7465.
- Therefore, probability is smaller than 0.7465, because escaping through MPPC box is not considered.

Simulation



Scintillator -> Optical cement -> Epoxy Window

Calculation value = 74.65%
Ratio that arrive = 63%



Scintillator -> Optical cement -> Silicon Window

Calculation value = 49.73%
Ratio that arrive = 48.96%

Using Alpha particle

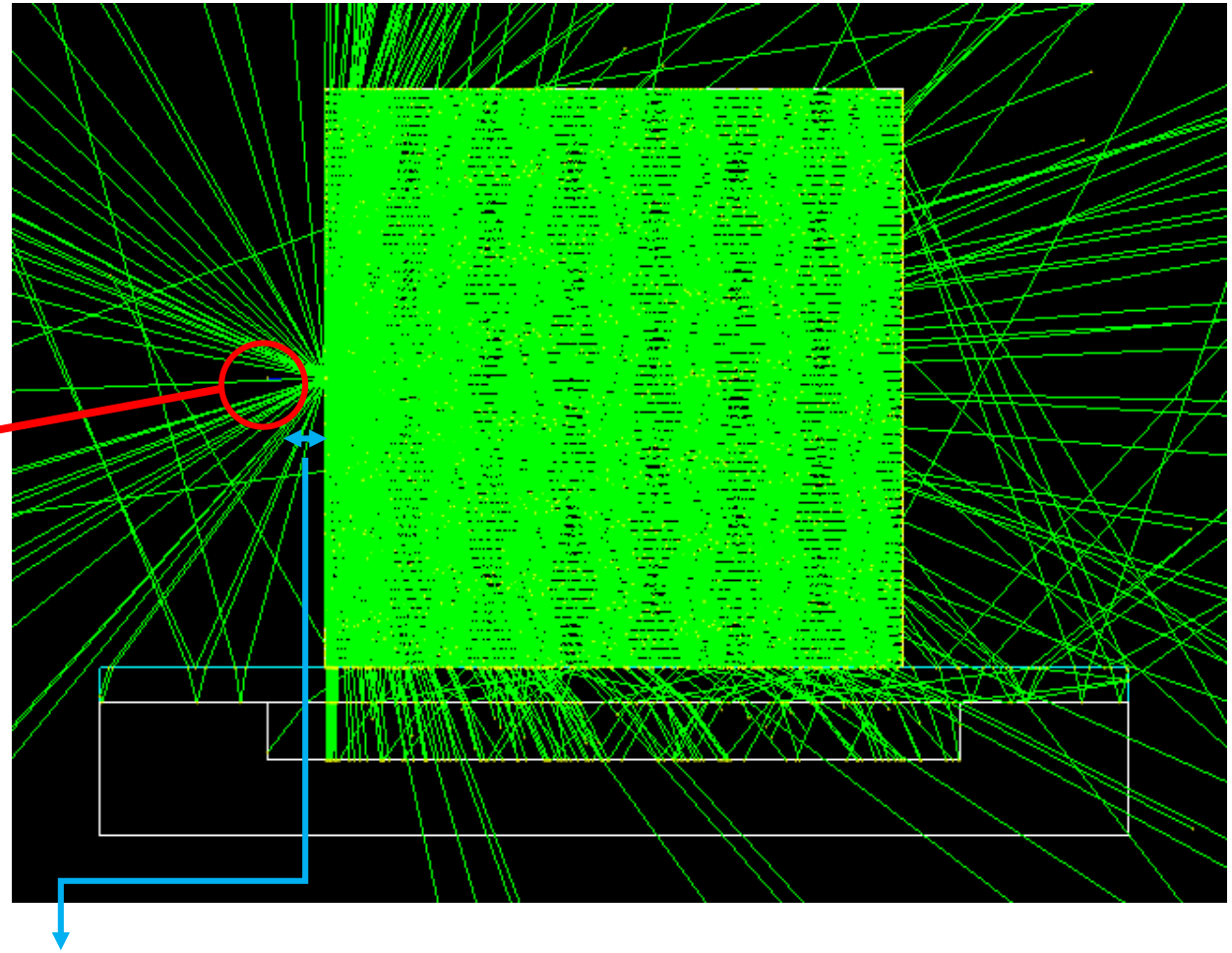
Motivation

- To specify energy spectrum of source, we can use alpha particle.
- However, permeability of alpha particle is too small to wrap scintillator with aluminum mylar.

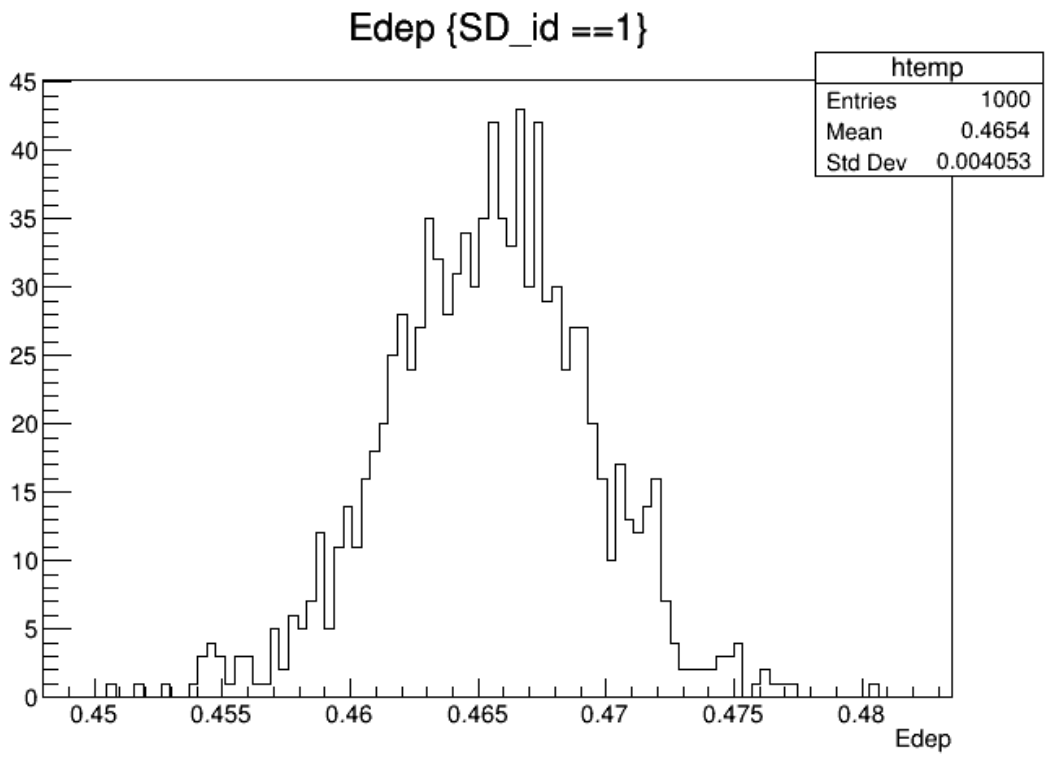
Simulation

Alpha particle
- Kinetic energy = 5.486 MeV
  (241 Americium)

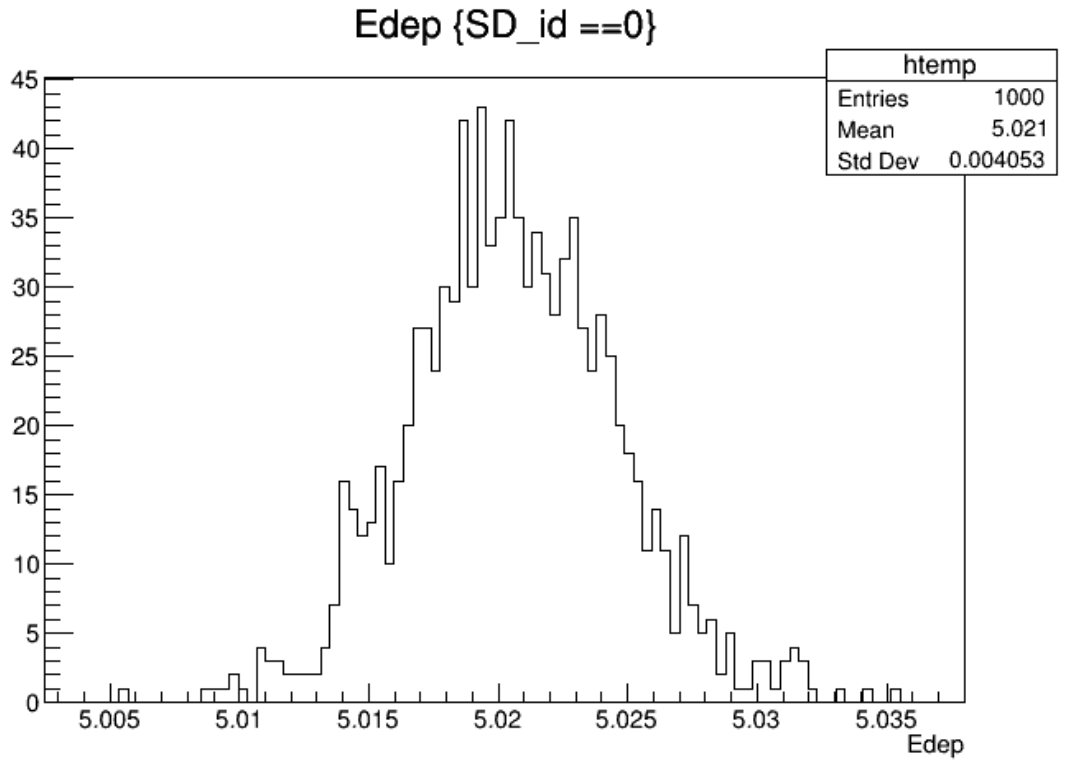
Incident direction = normal



Result

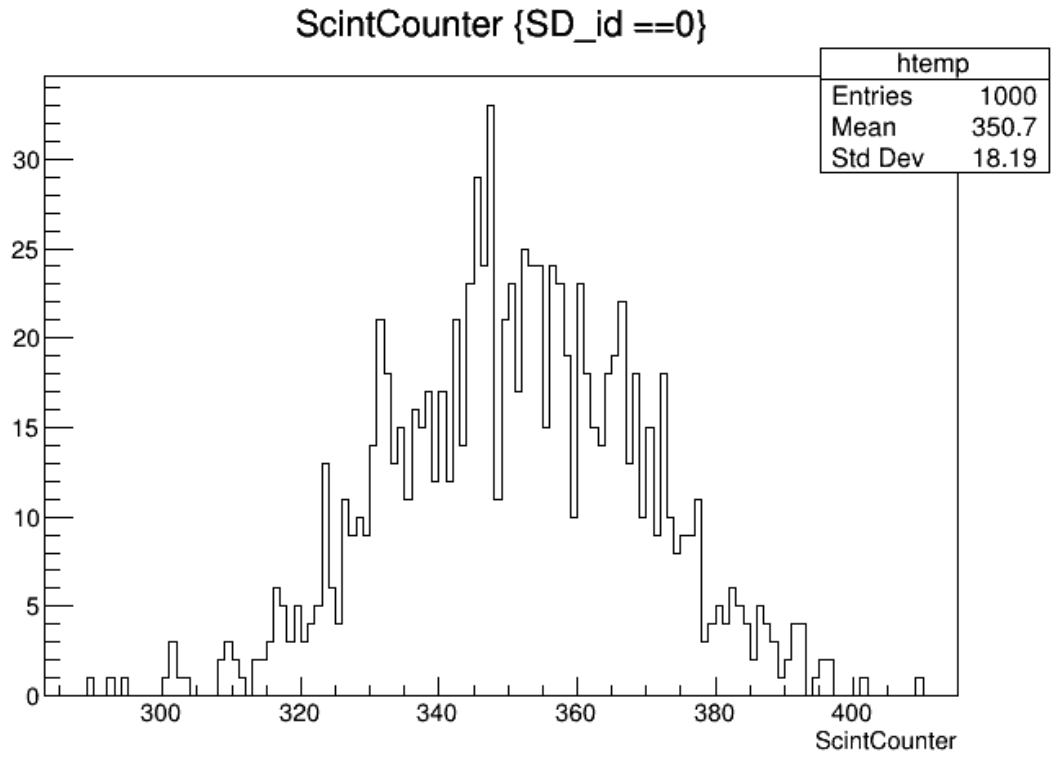


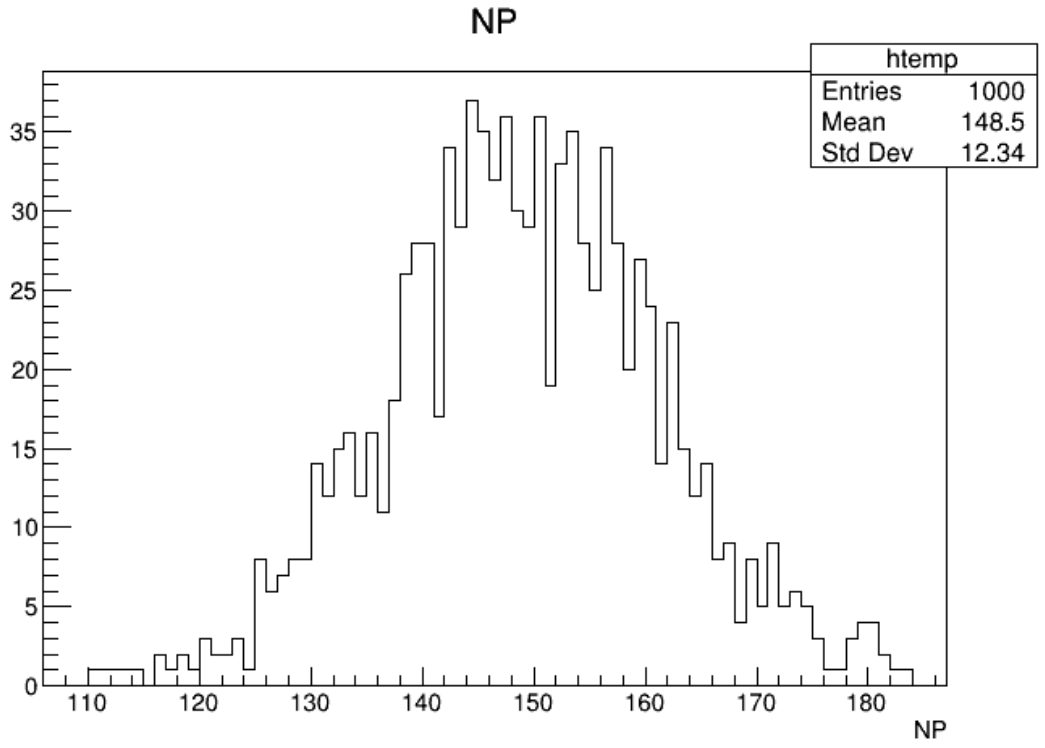
Energy deposit on Air



Energy deposit on scintillator

Result

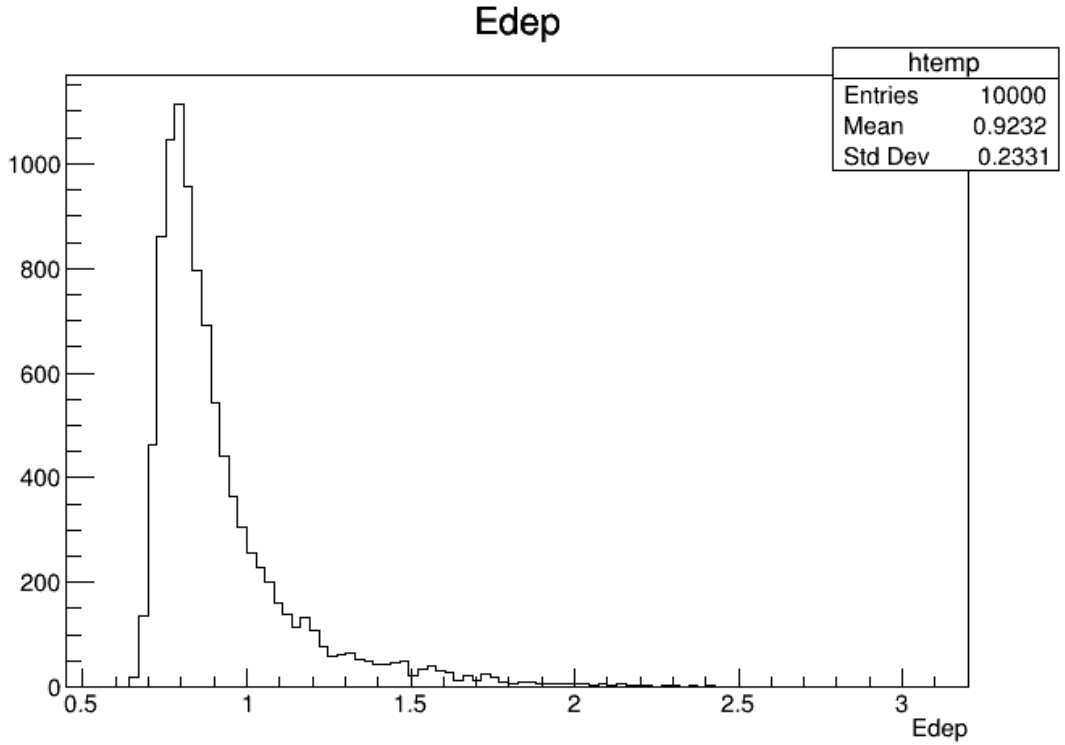

ScintCounter {SD_id ==0}
htemp
Entries 1000
Mean 350.7
Std Dev 18.19
0
5
10
15
20
25
30
300
320
340
360
380
400
ScintCounter


NP
htemp
Entries 1000
Mean 148.5
Std Dev 12.34
0
5
10
15
20
25
30
35
110
120
130
140
150
160
170
180
NP

Scintillation Process

Purpose of Simulation

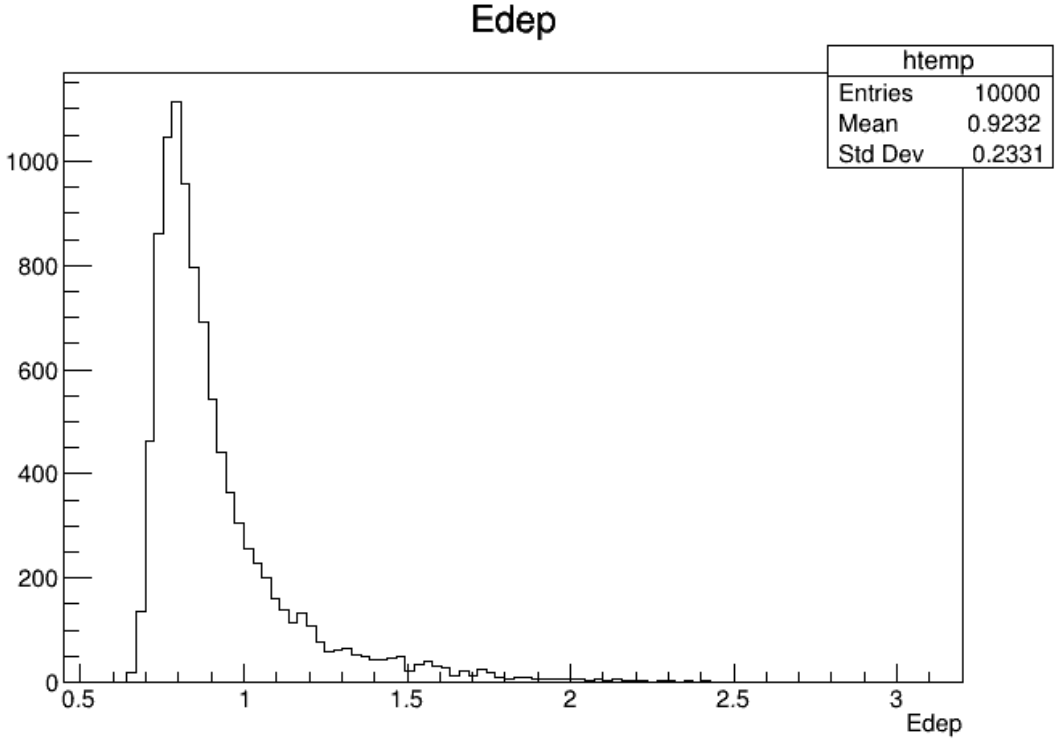
- According to Bethe-Bloch formula, the average deposit energy on scintillator should be 1 MeV.
- However, in simulation, energy deposit on scintillator is about 0.92 MeV.
- Therefore, we want to compensate for this.



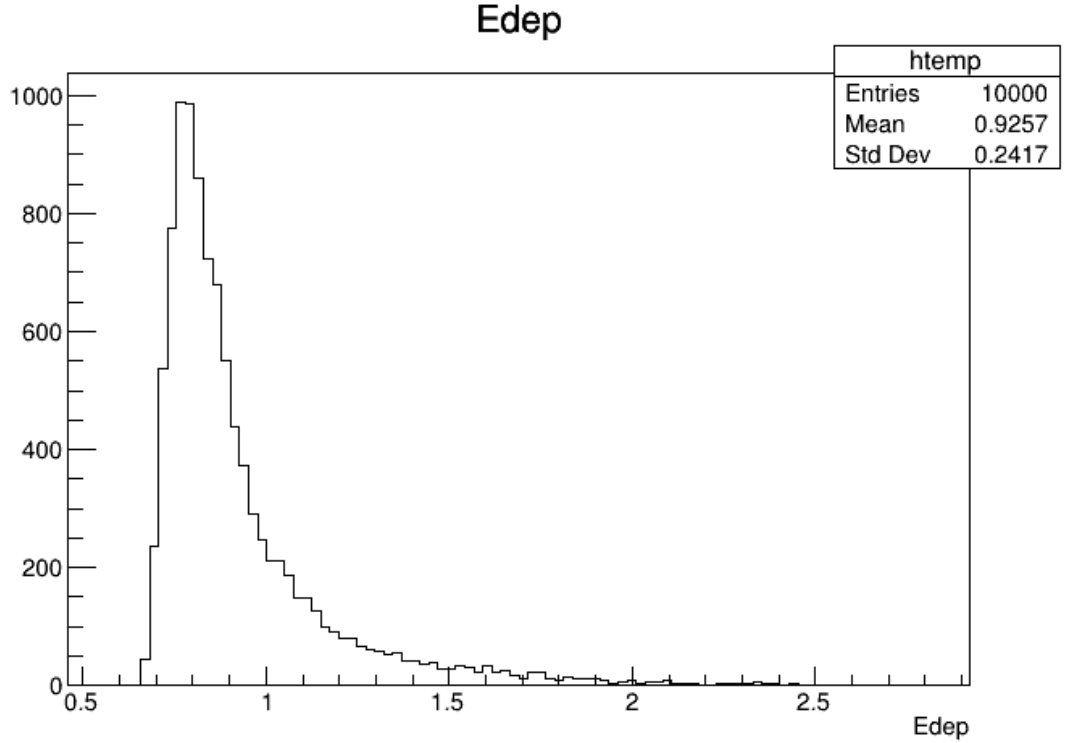

```
/*  G4Material* scintillator = new G4Material("scintillator", 1.023*g / cm3, 2);
scintillator -> AddElement(C, 91.6*perCent);
scintillator -> AddElement(H, 8.4*perCent);*/

G4Material* scintillator = nist->FindOrBuildMaterial("G4_PLASTIC_SC_VINYLTOLUENE", false);
// false = Isotopes are not explicitly built
// true = elemnt is built of isofotpes with natural abundance
```

Result

Material defined by Eljen company



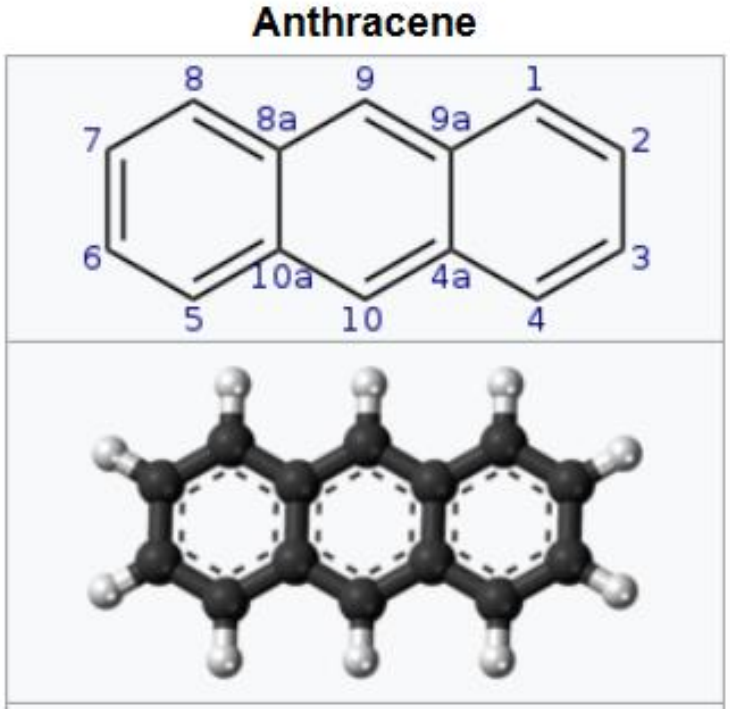
Material defined in NIST



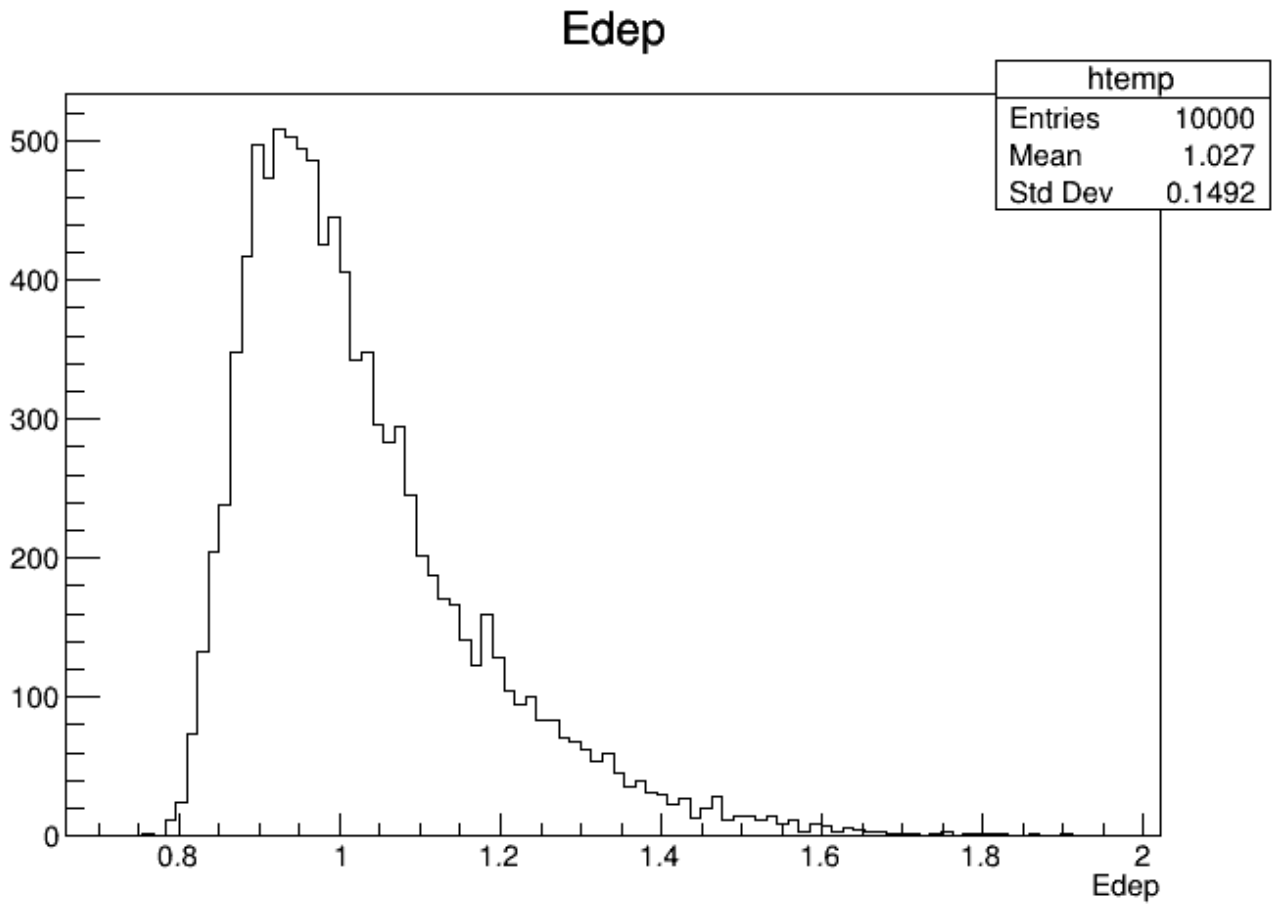
Difference between energy deposit is 0.0025.
And this is smaller than standard error(= 0.9257 / 100).

Anthracene

- Anthracene is a solid polycyclic aromatic hydrocarbon of formula $C_{14}H_{10}$ consisting of three fused benzene rings.
- Anthracene exhibits a bule fluorescence under ultraviolet radiation.



Result




```
// Anthracene
G4Material* scintillator = new G4Material("scintillator", 1.25 * g / cm3, 2);
scintillator -> AddElement(C, 14);
scintillator -> AddElement(H, 10);
```