
CERN

Weekly Progress

Jesus A. Galarza

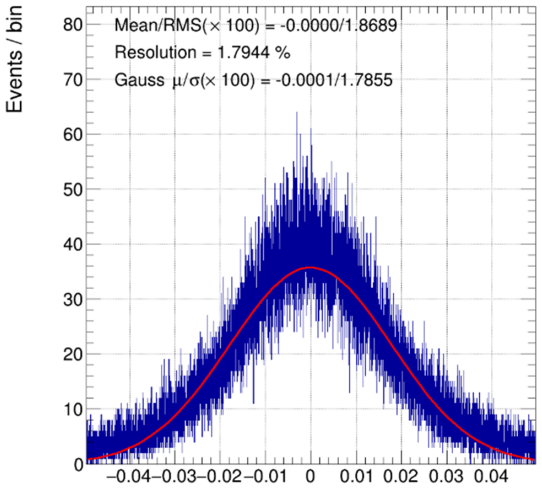
Introduction

Z$\rightarrow \mu\mu$ at 240GeV

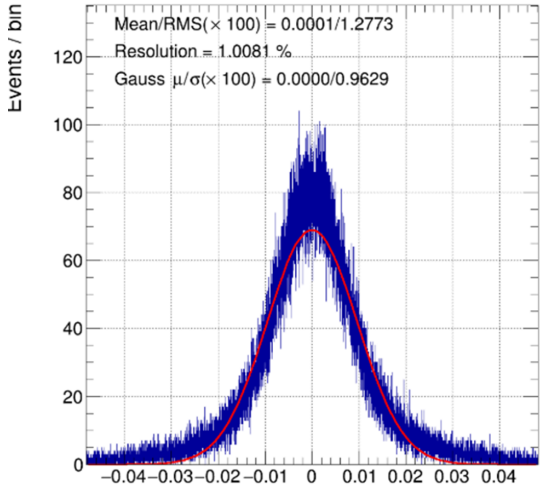
Z$\rightarrow$ uu at 91.2GeV

Z$\rightarrow \mu\mu$ at 240GeV

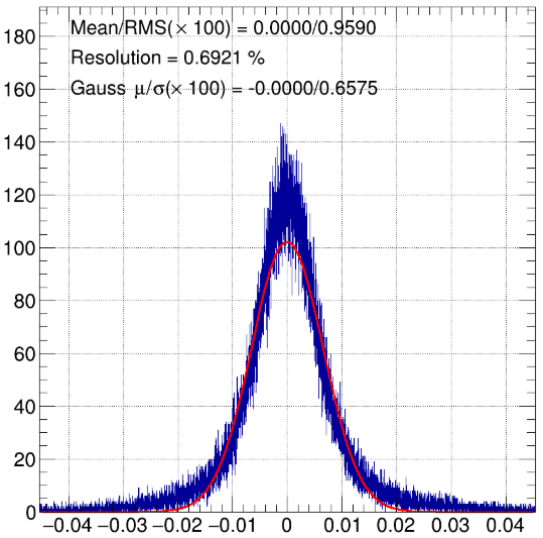
p resolution in CLD



0.5 Tesla

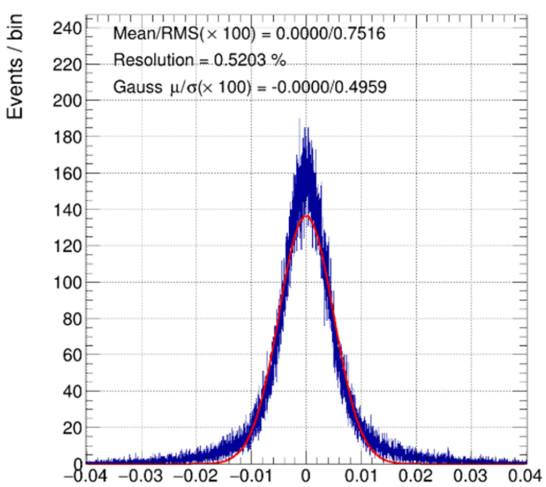


1 Tesla

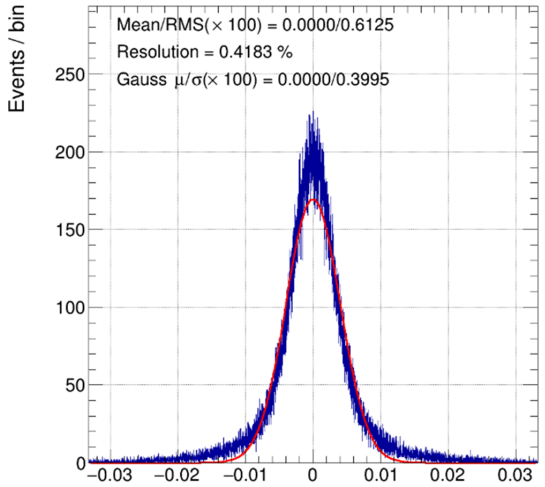


1.5 Tesla

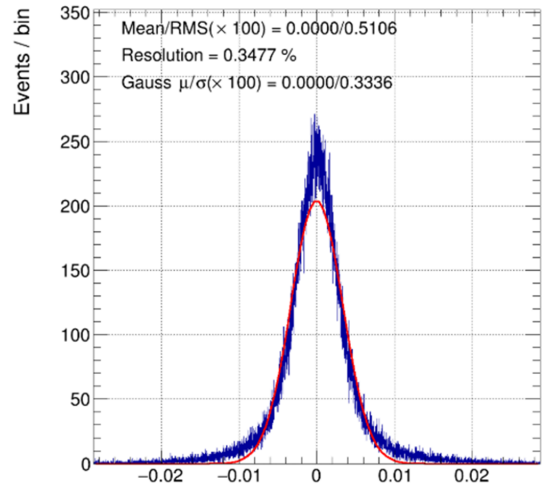
p resolution in CLD



2 Tesla

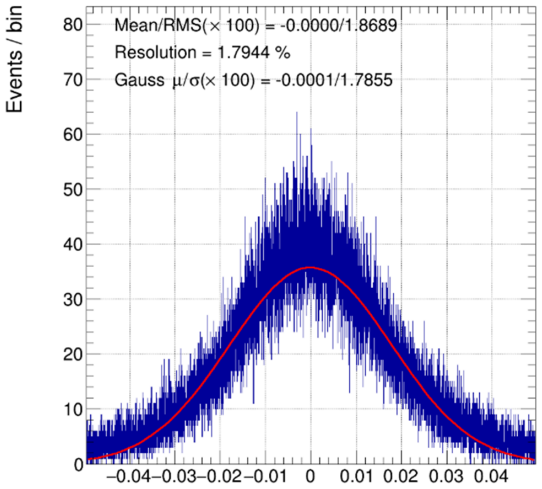


2.5 Tesla

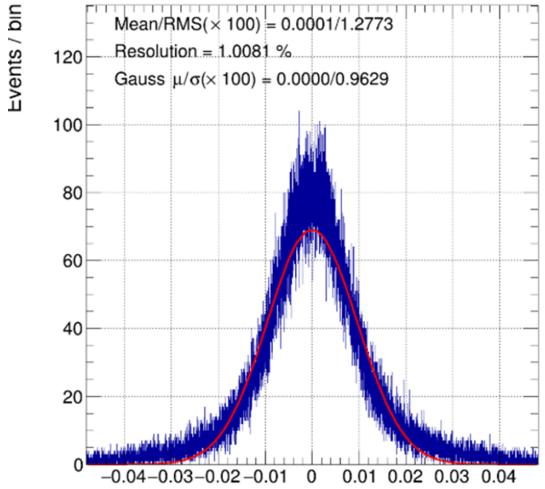


3 Tesla

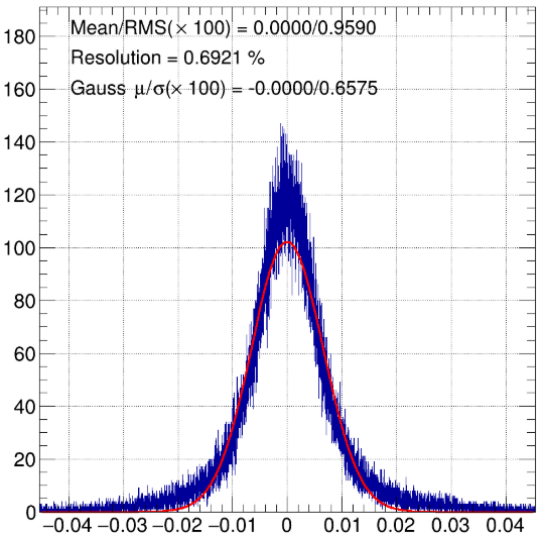
pT resolution in CLD



0.5 Tesla

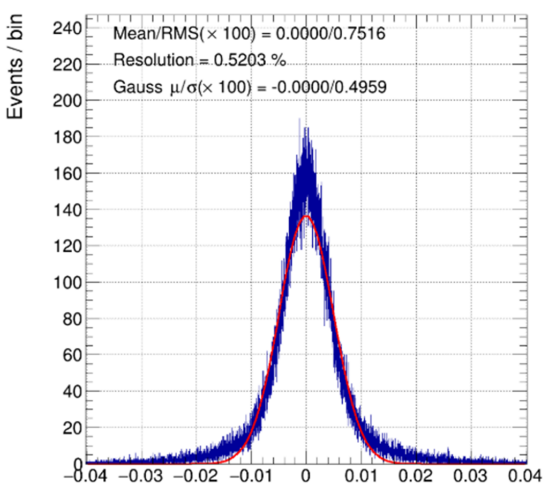


1 Tesla

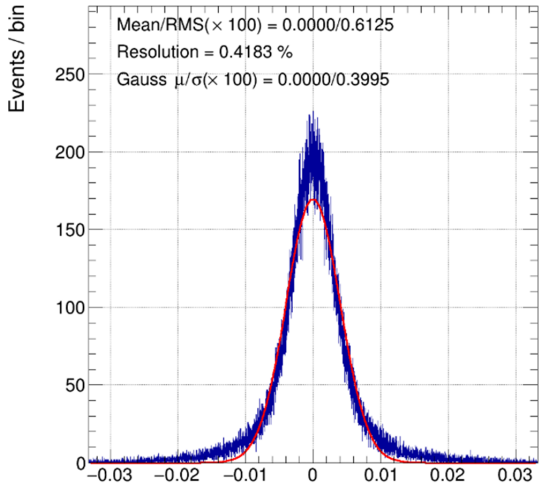


1.5 Tesla

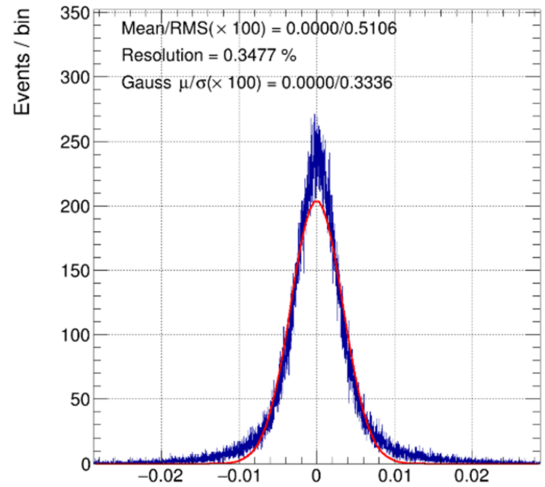
pT resolution in CLD



2 Tesla

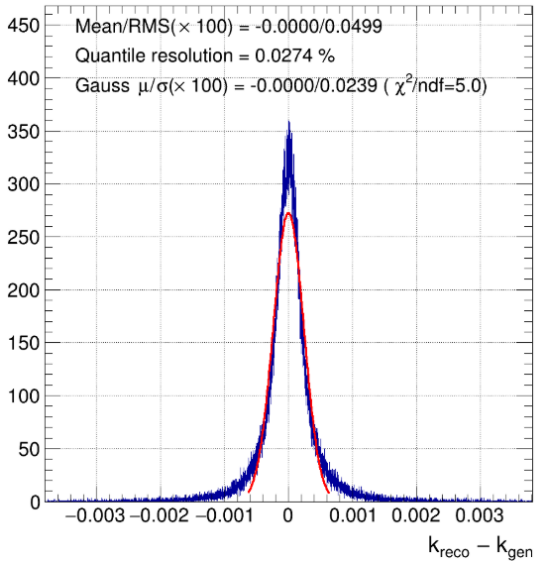


2.5 Tesla

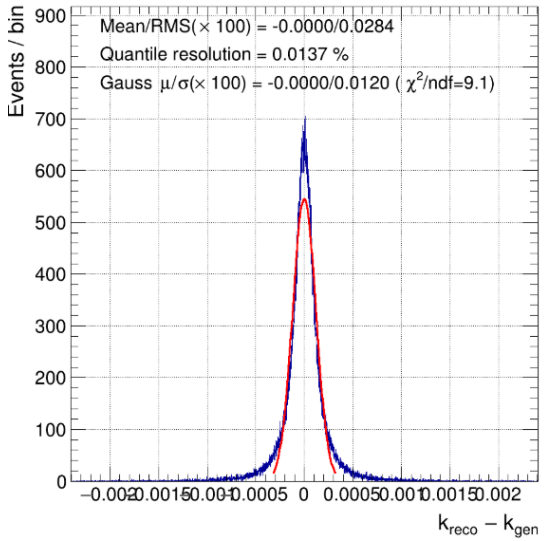


3 Tesla

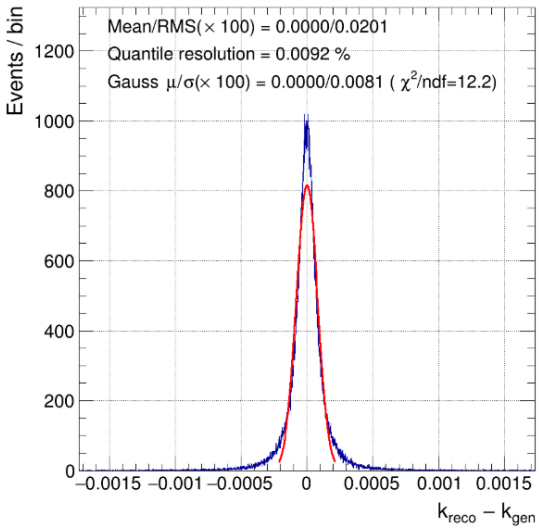
k resolution in CLD



0.5 Tesla

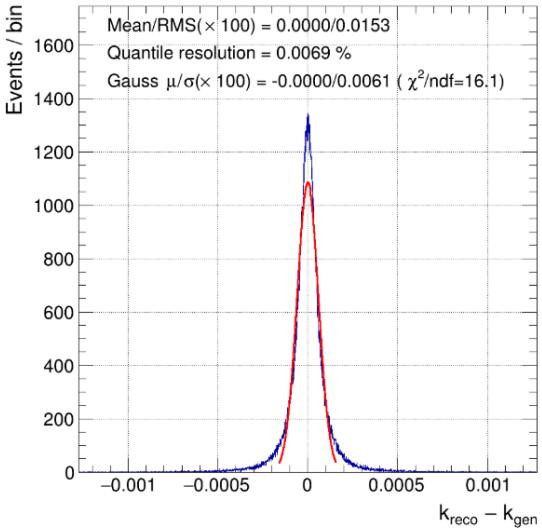


1 Tesla

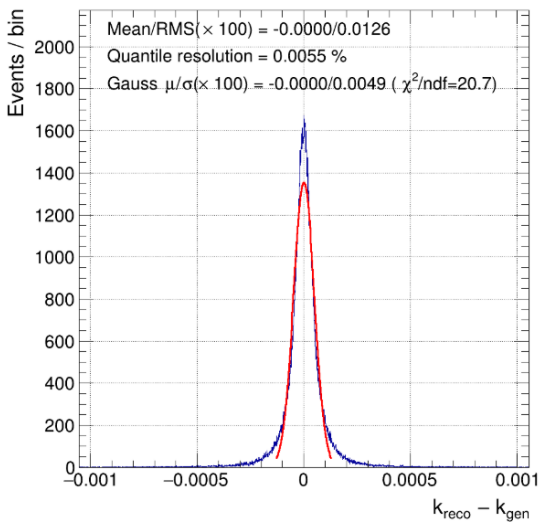


1.5 Tesla

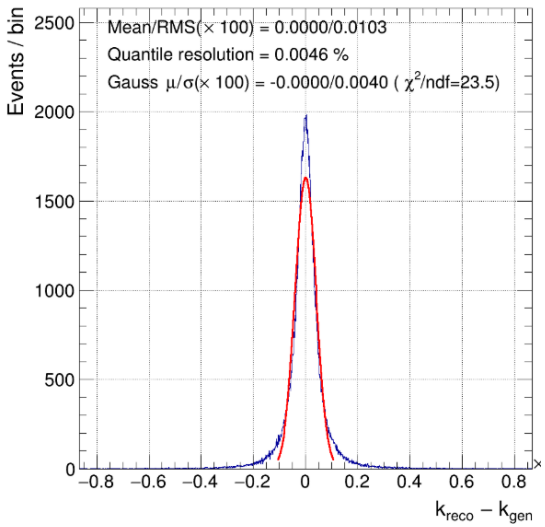
k resolution in CLD



2 Tesla

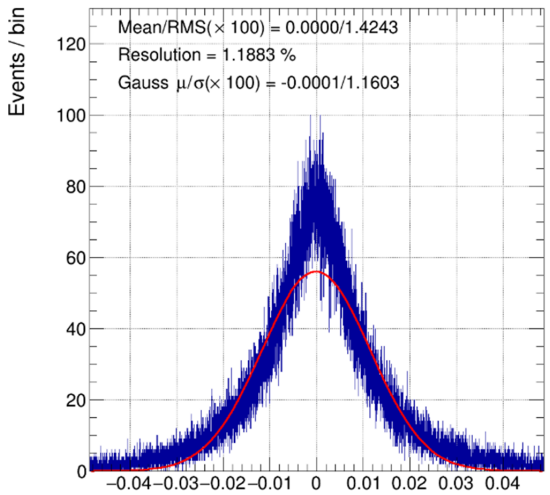


2.5 Tesla

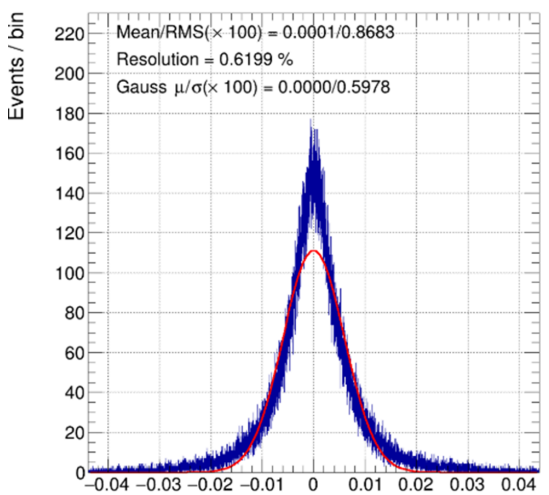


3 Tesla

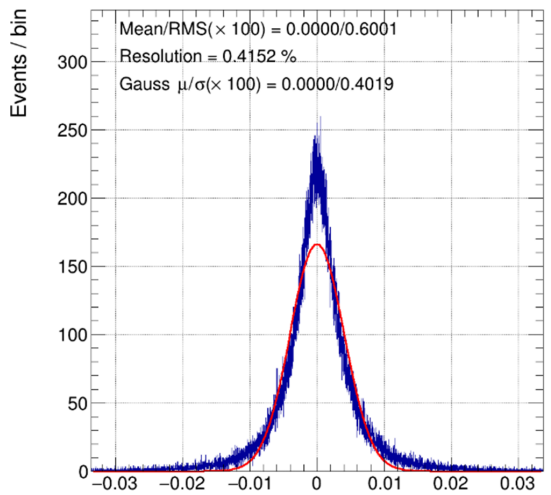
p resolution in IDEA



0.5 Tesla

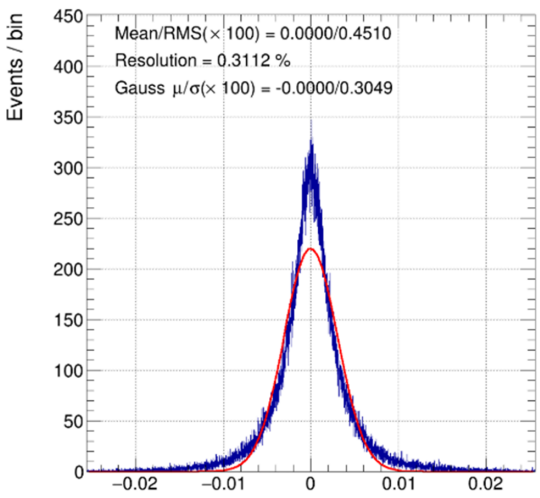


1 Tesla

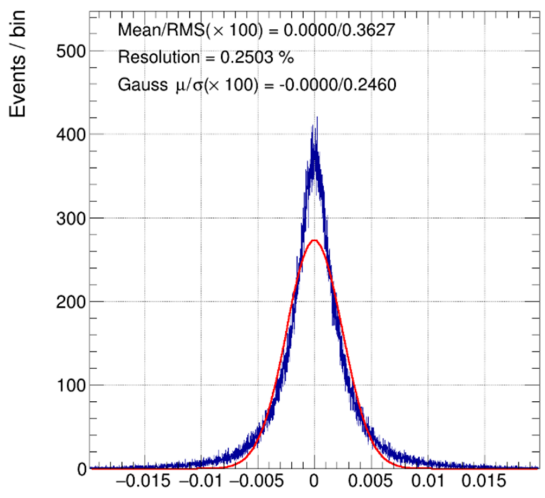


1.5 Tesla

p resolution in IDEA



2 Tesla



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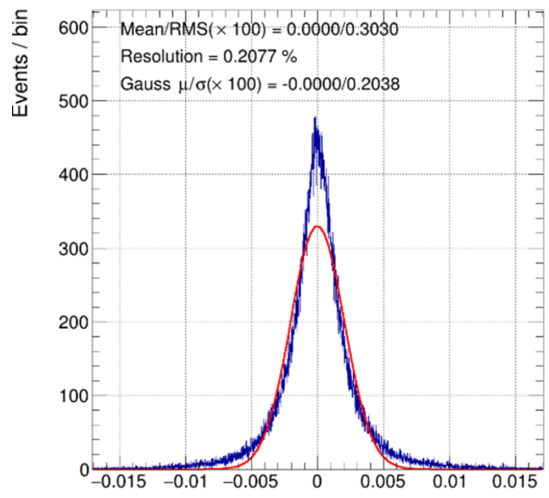
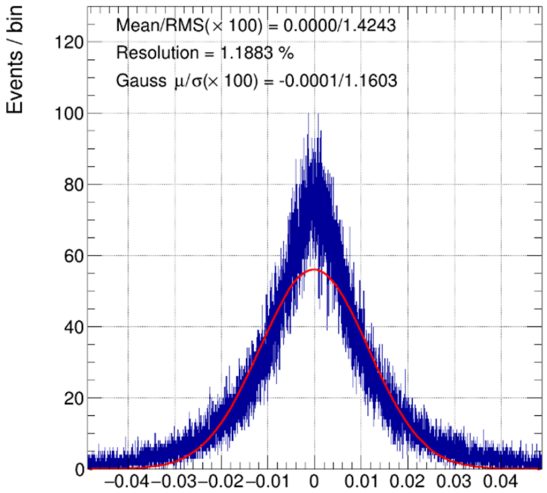
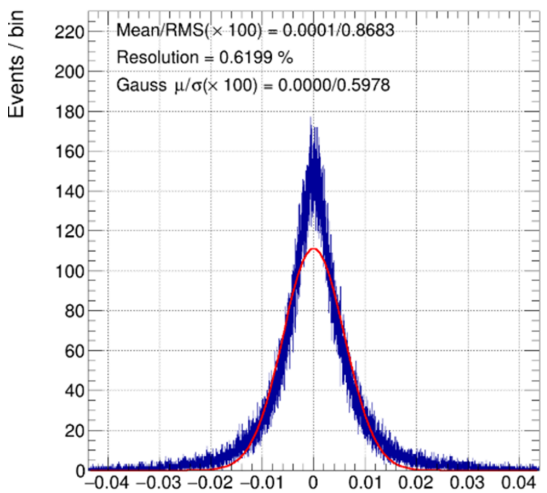


3 Tesla

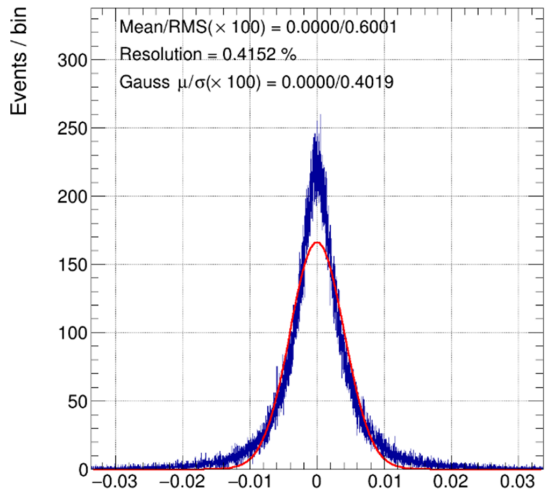
pT resolution in IDEA



0.5 Tesla

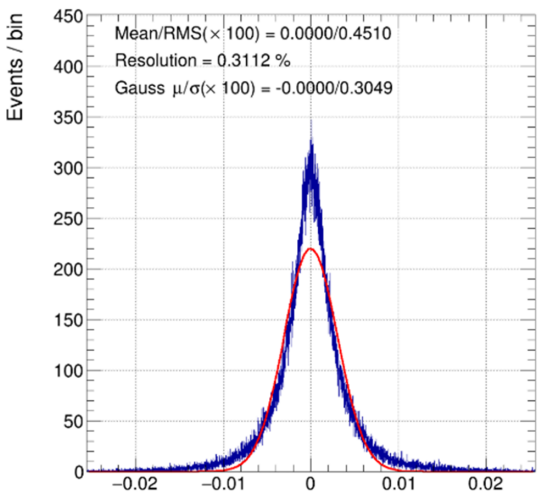


1 Tesla

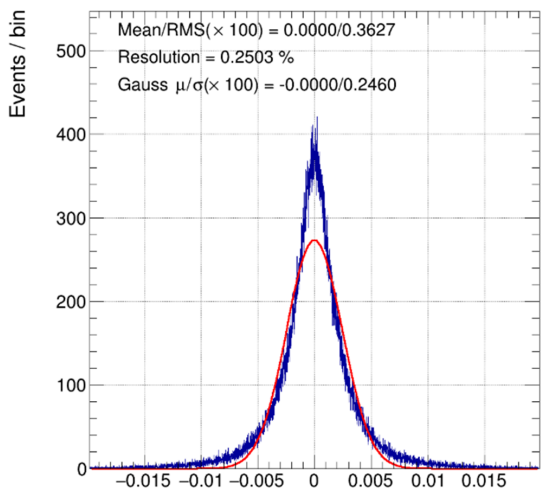


1.5 Tesla

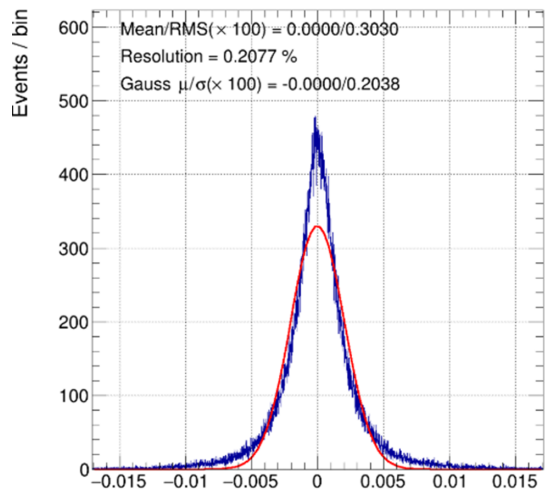
pT resolution in IDEA



2 Tesla

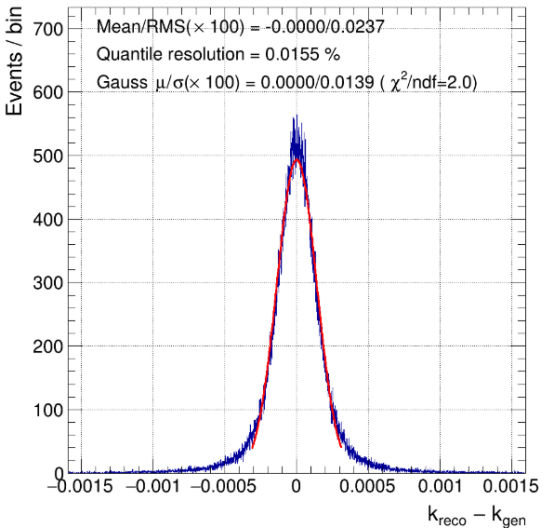


2.5 Tesla

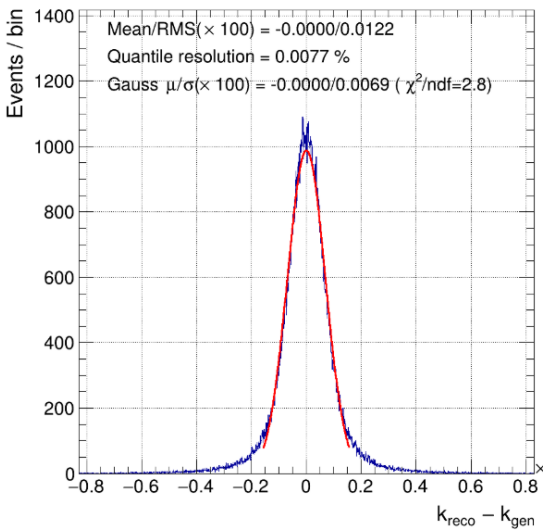


3 Tesla

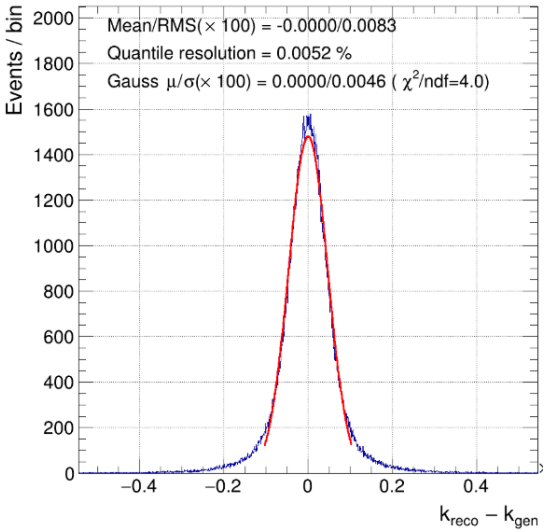
k resolution in IDEA



0.5 Tesla

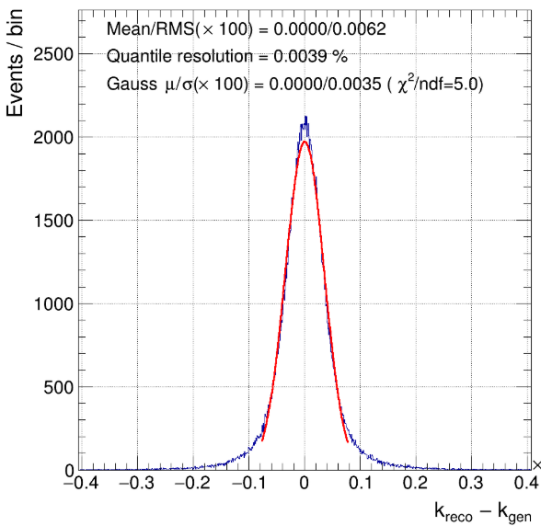


1 Tesla

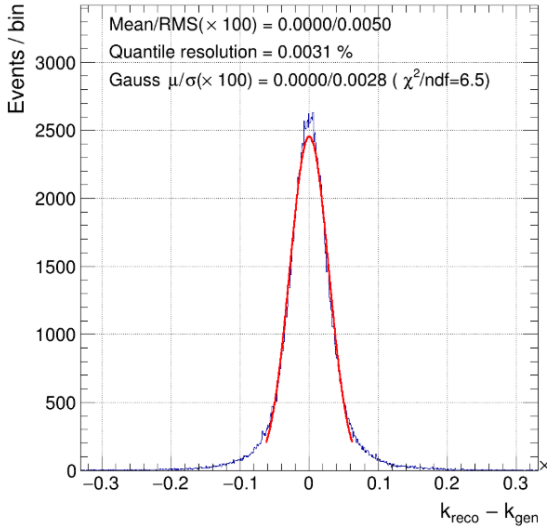


1.5 Tesla

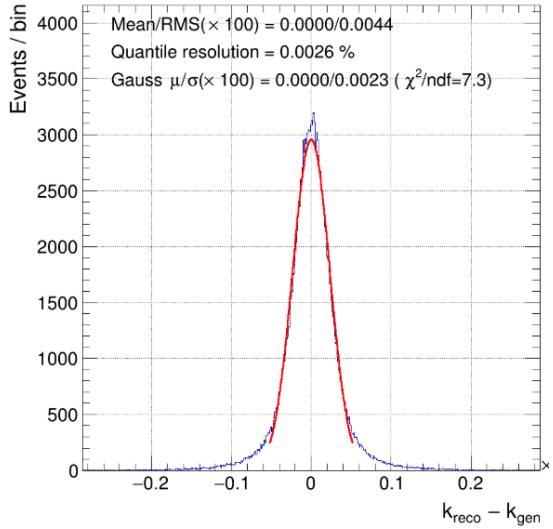
k resolution in IDEA



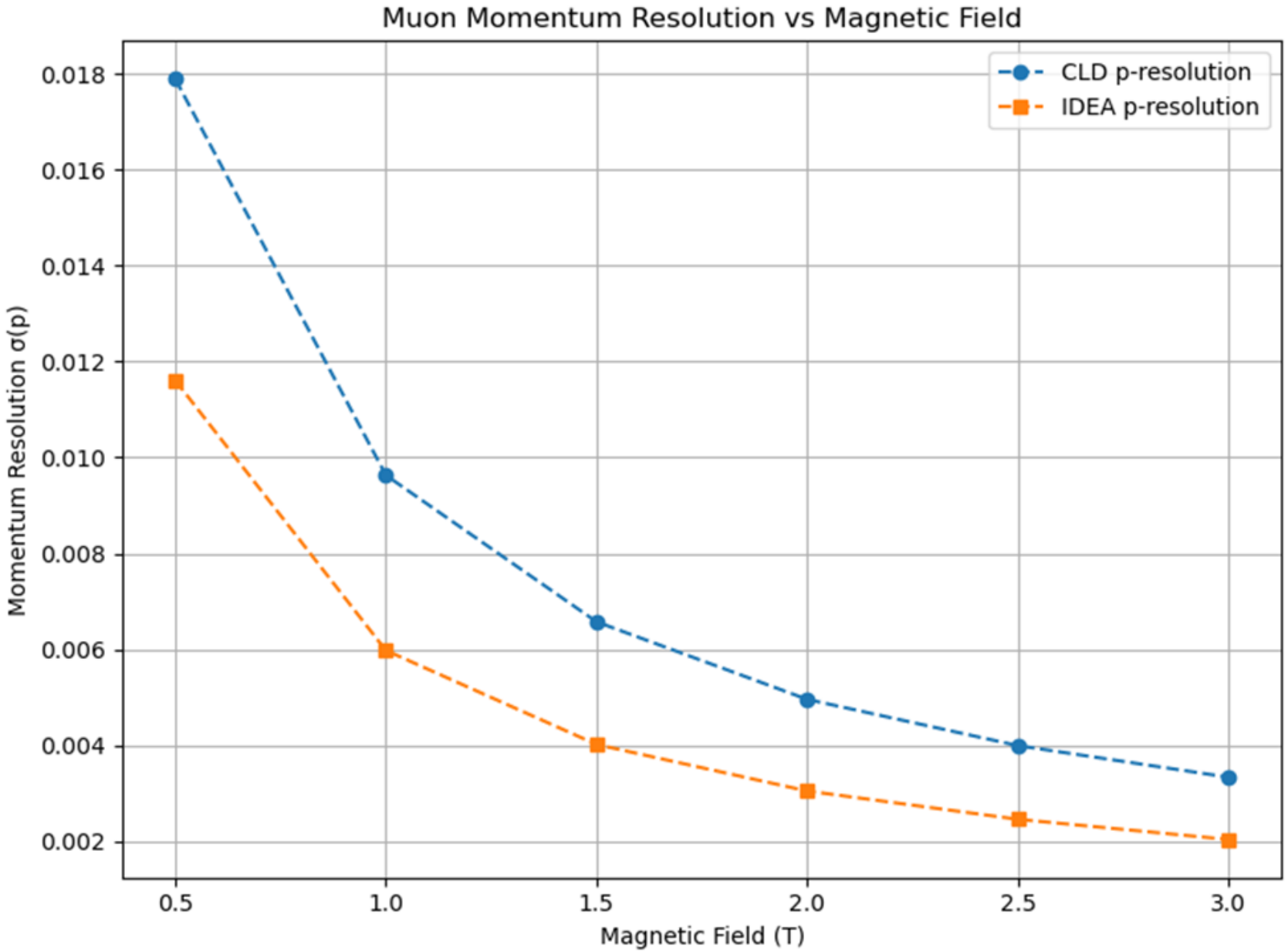
2 Tesla

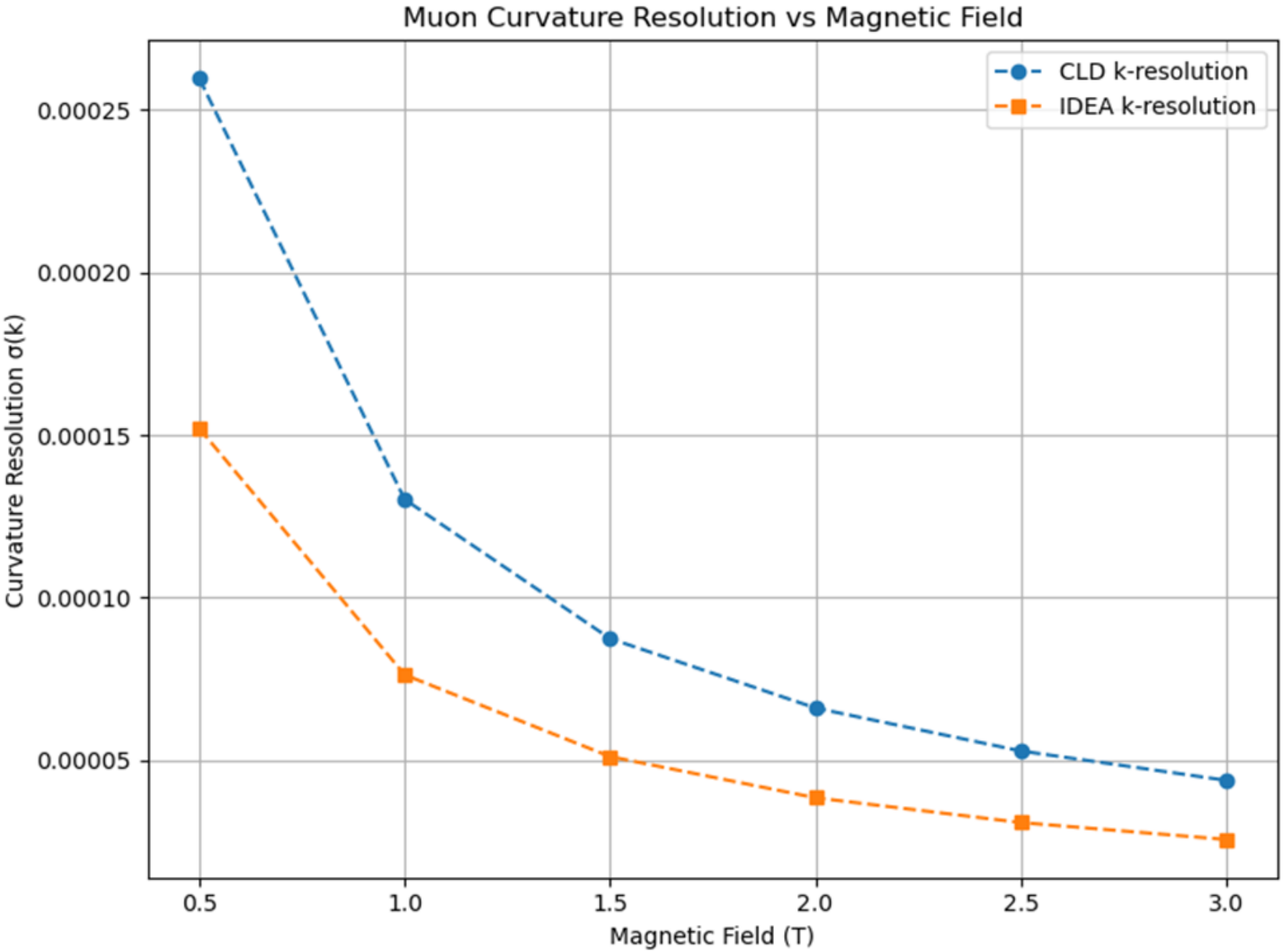


2.5 Tesla



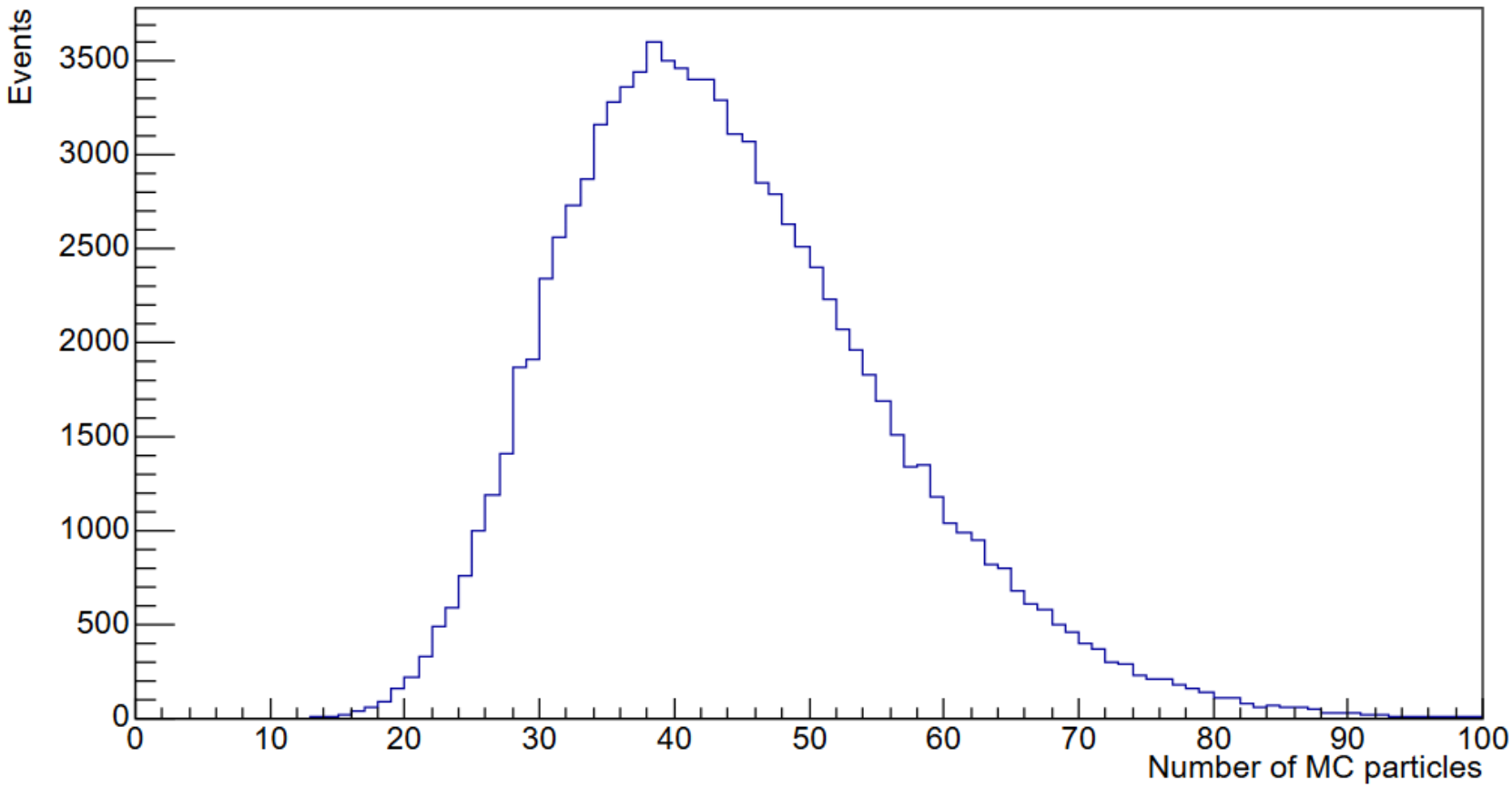
3 Tesla


Muon Momentum Resolution vs Magnetic Field
CLD p-resolution
IDEA p-resolution
Momentum Resolution σ(p)
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.5
1.0
1.5
2.0
2.5
3.0
Magnetic Field (T)

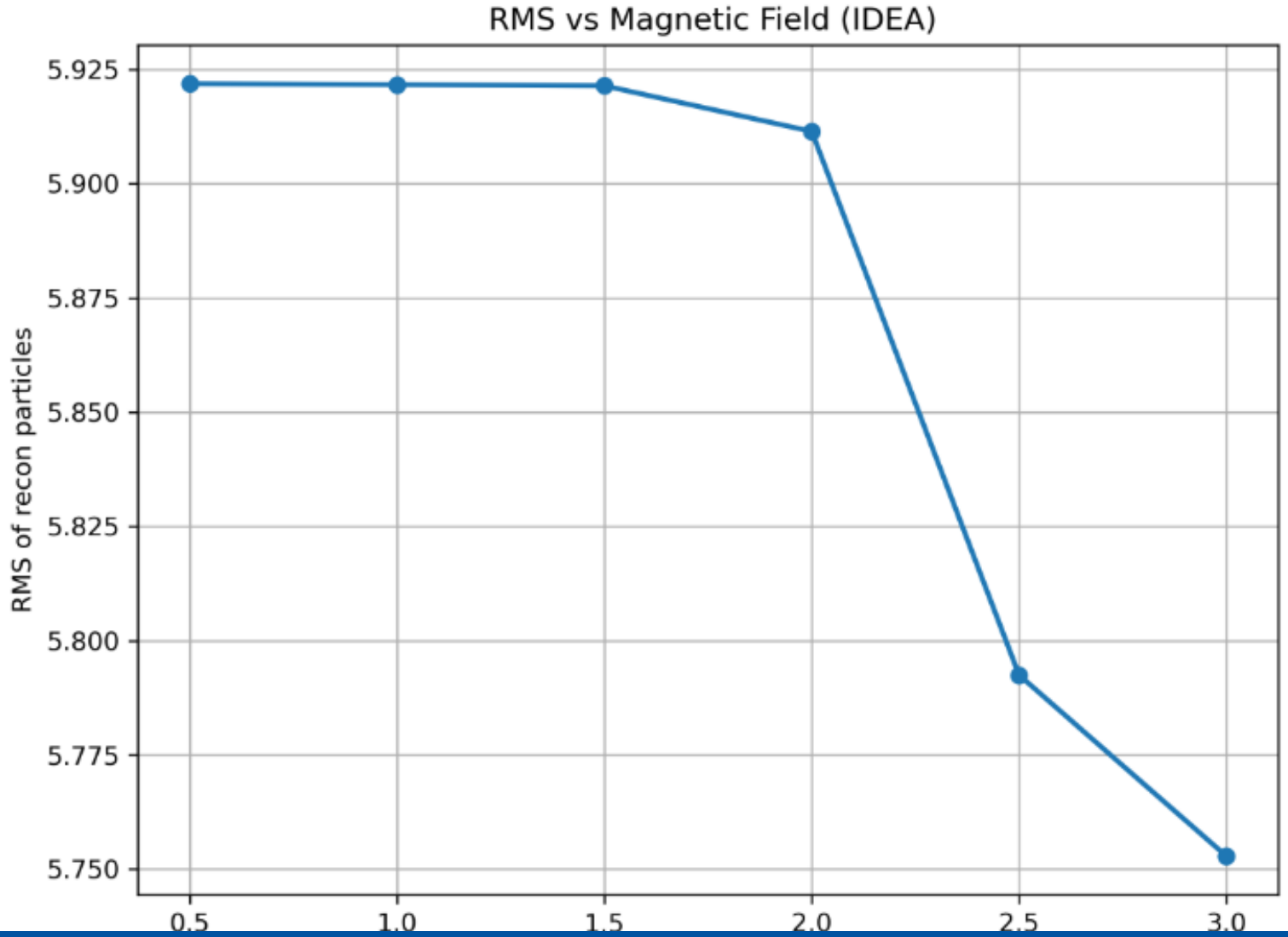

Muon Curvature Resolution vs Magnetic Field
CLD k-resolution
IDEA k-resolution
Curvature Resolution σ(k)
0.00025
0.00020
0.00015
0.00010
0.00005
0.5
1.0
1.5
2.0
2.5
3.0
Magnetic Field (T)

$Z \rightarrow uu$ at 91.2GeV

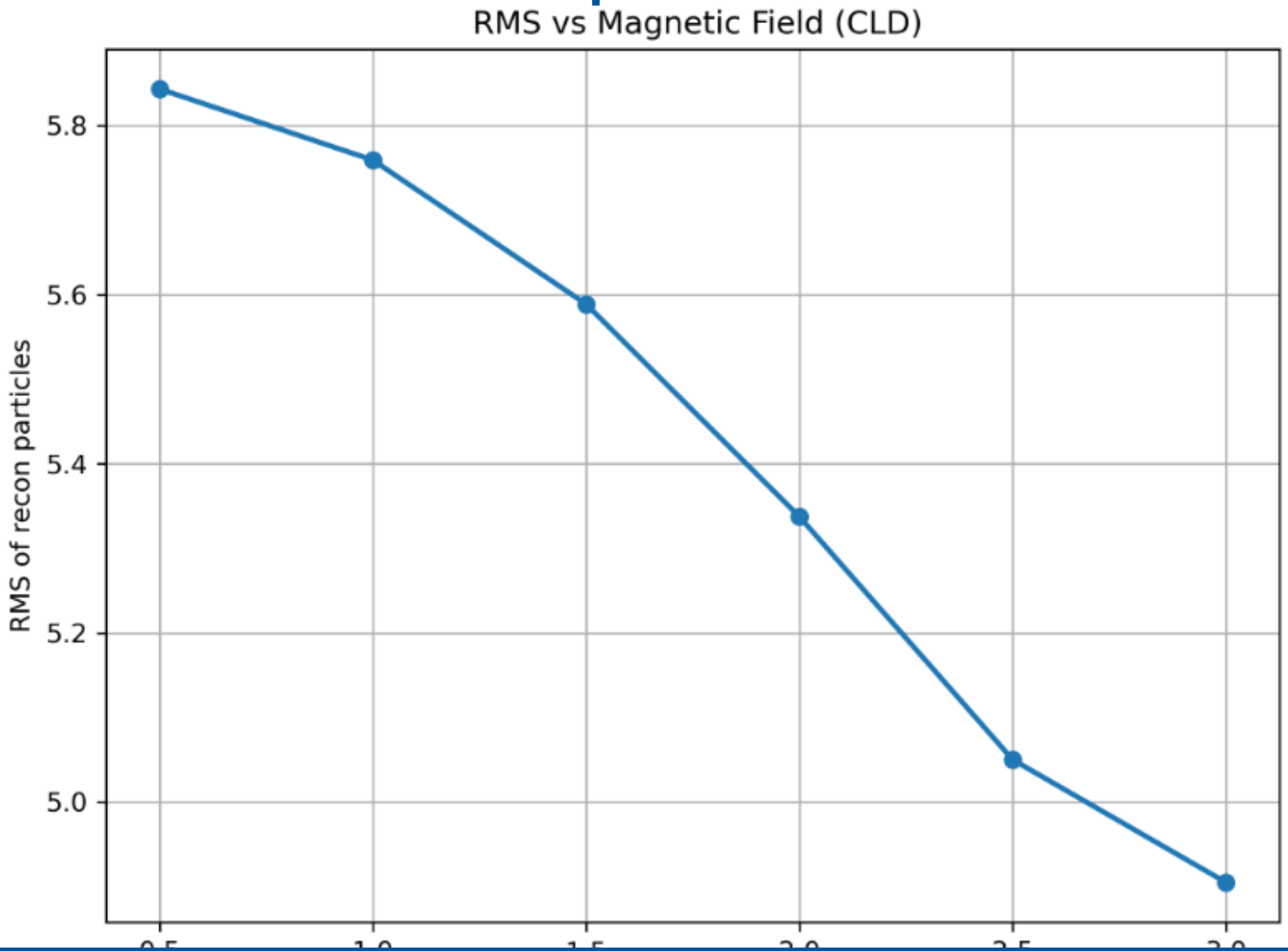
Number of MC particles in CLD and IDEA



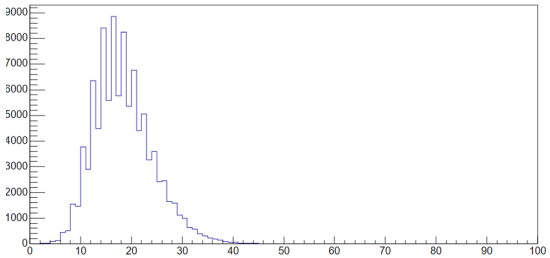
Number of Recon particles



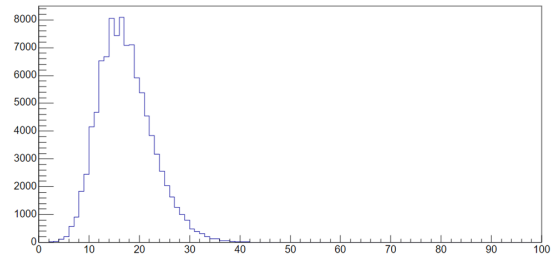
Number of Recon particles



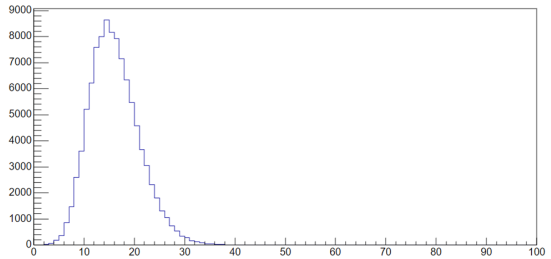
Number of Recon particles



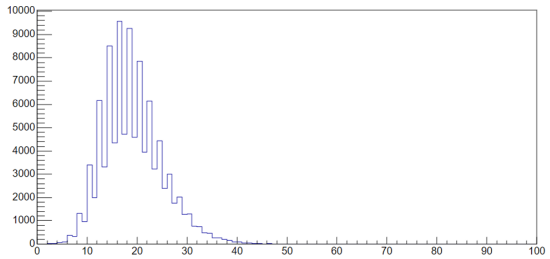
1T in CLD



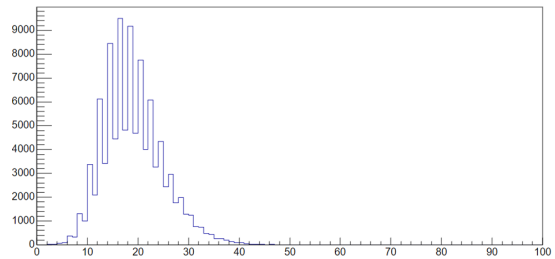
2T in CLD



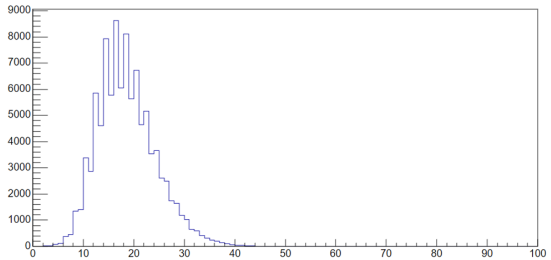
3T in CLD



1T in IDEA

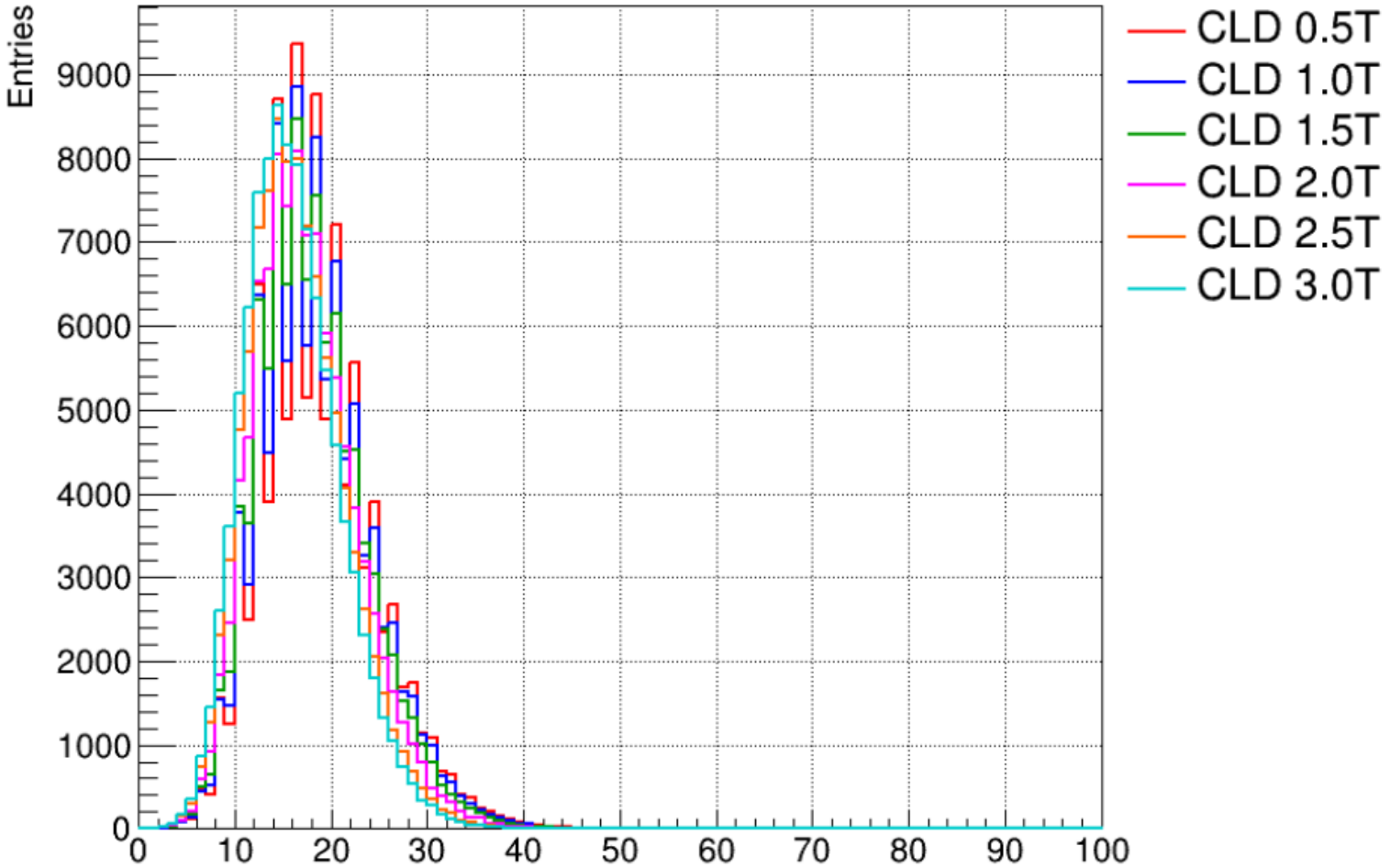


2T in IDEA

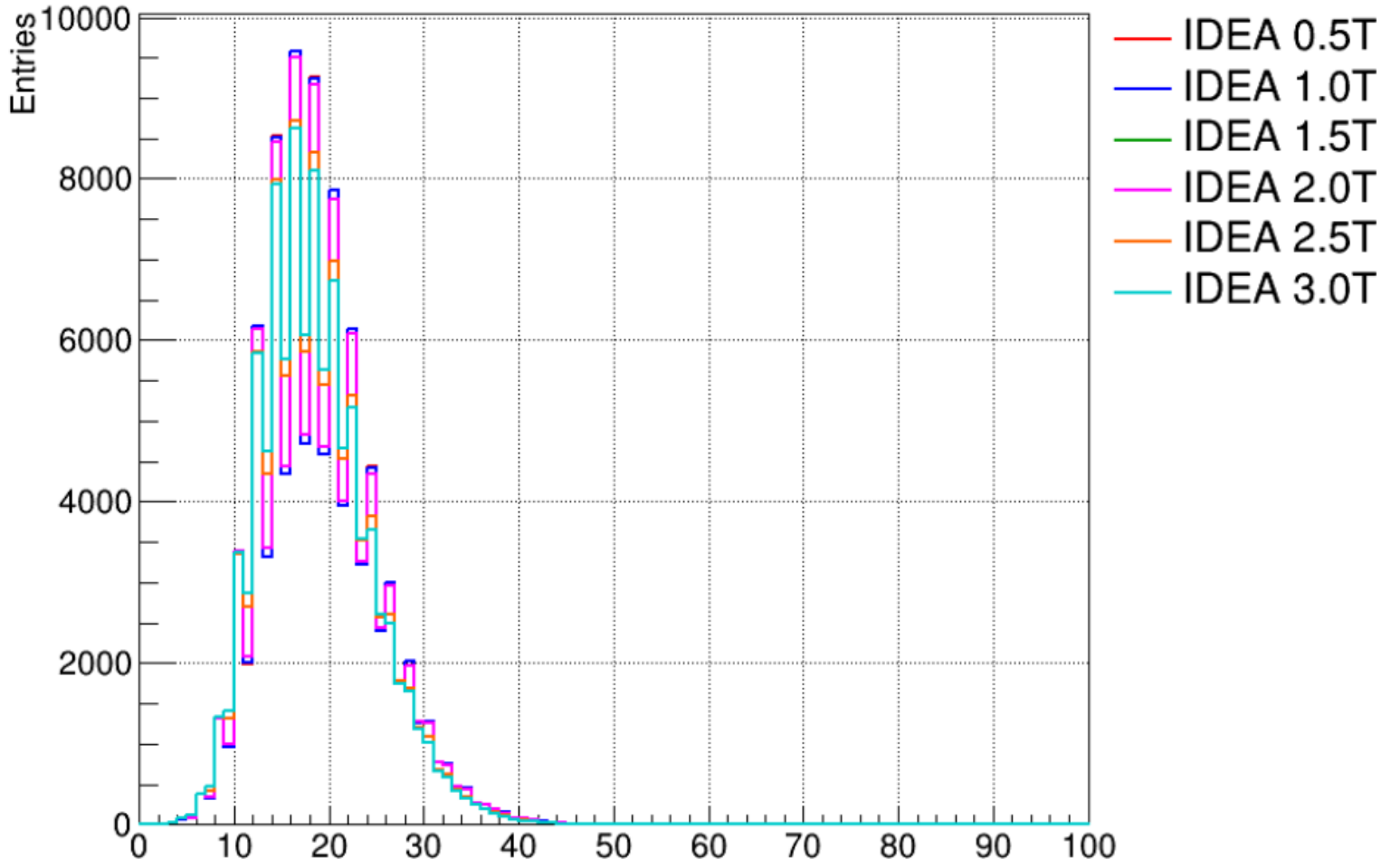


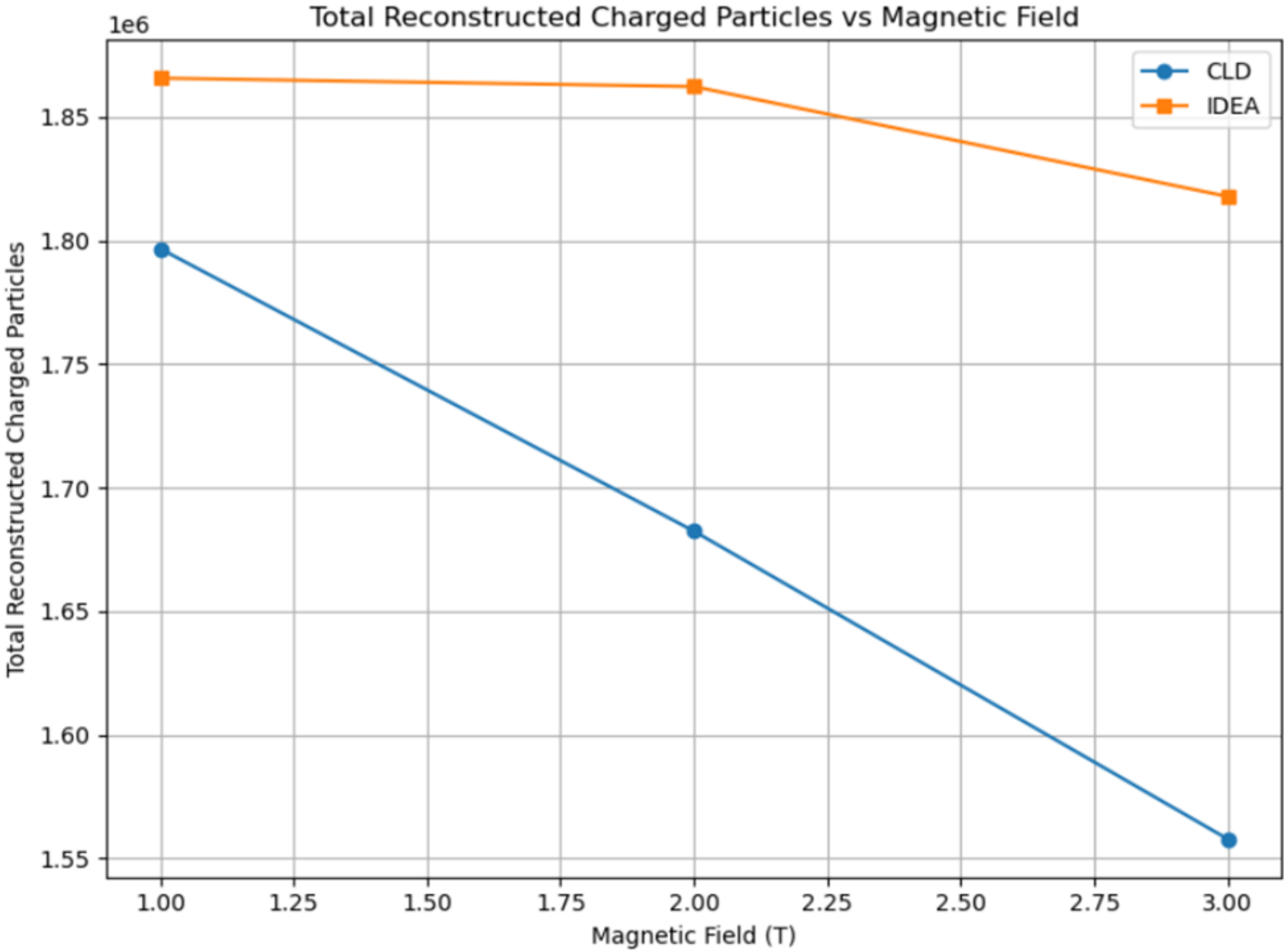
3T in IDEA

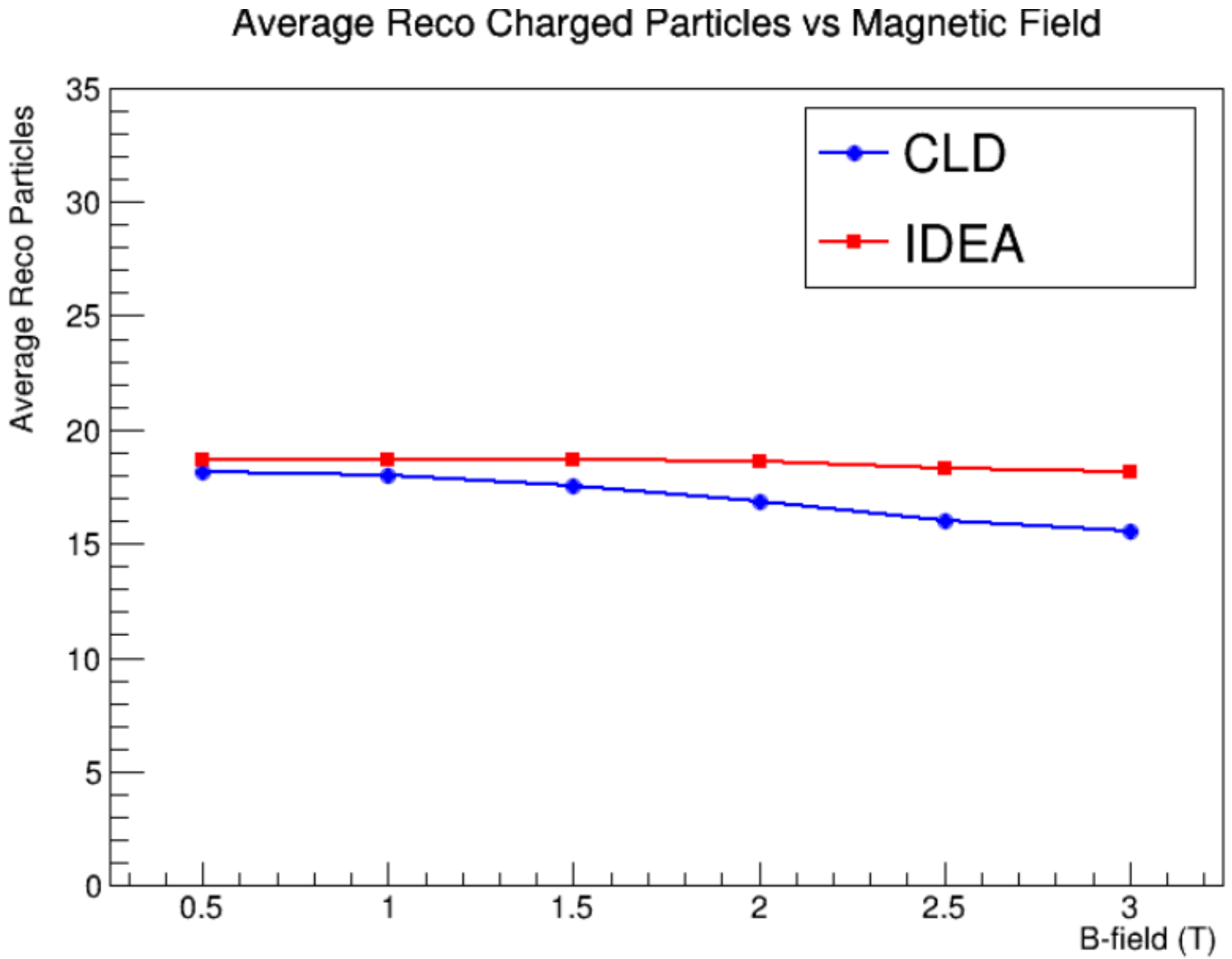
Number of Recon particles



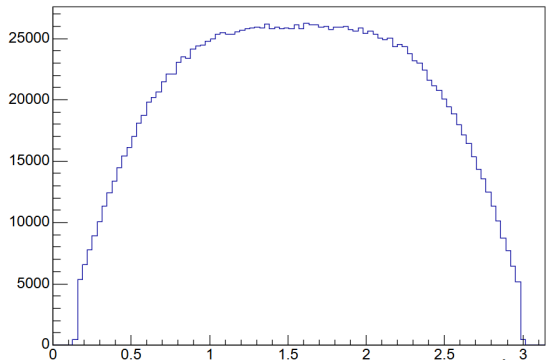
Number of Recon particles



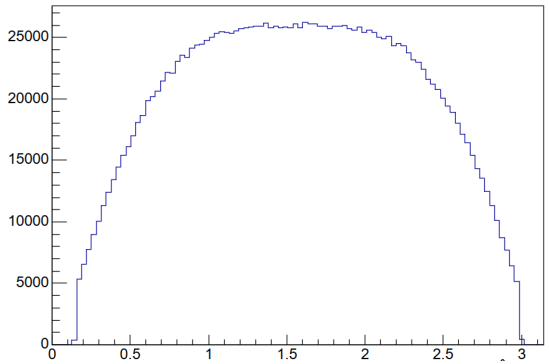

Total Reconstructed Charged Particles vs Magnetic Field
1e6
CLD
IDEA
Total Reconstructed Charged Particles
1.85
1.80
1.75
1.70
1.65
1.60
1.55
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00
Magnetic Field (T)


Average Reco Charged Particles vs Magnetic Field
Average Reco Particles
B-field (T)
CLD
IDEA
0
5
10
15
20
25
30
35
0.5
1
1.5
2
2.5
3

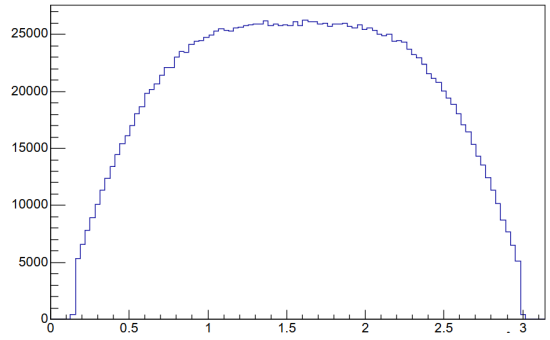
θ resolution in IDEA



0.5 Tesla

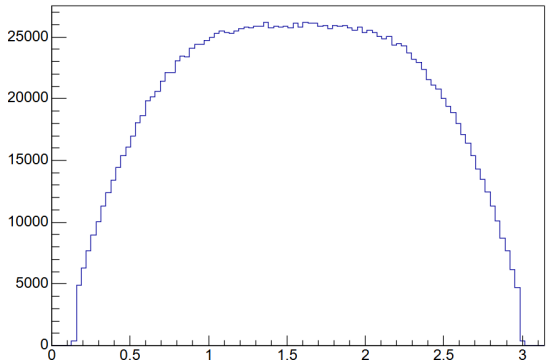


1.0 Tesla

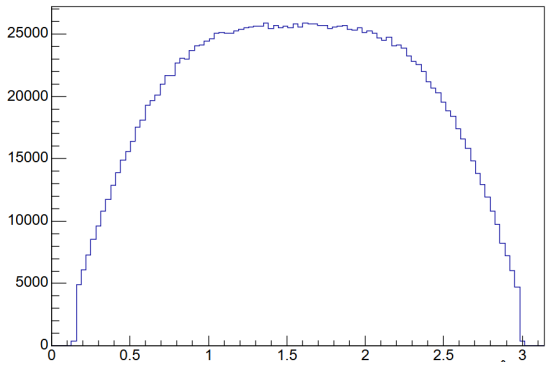


1.5 Tesla

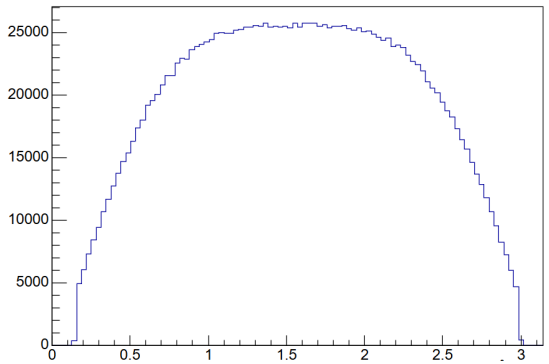
θ resolution in IDEA



2.0 Tesla

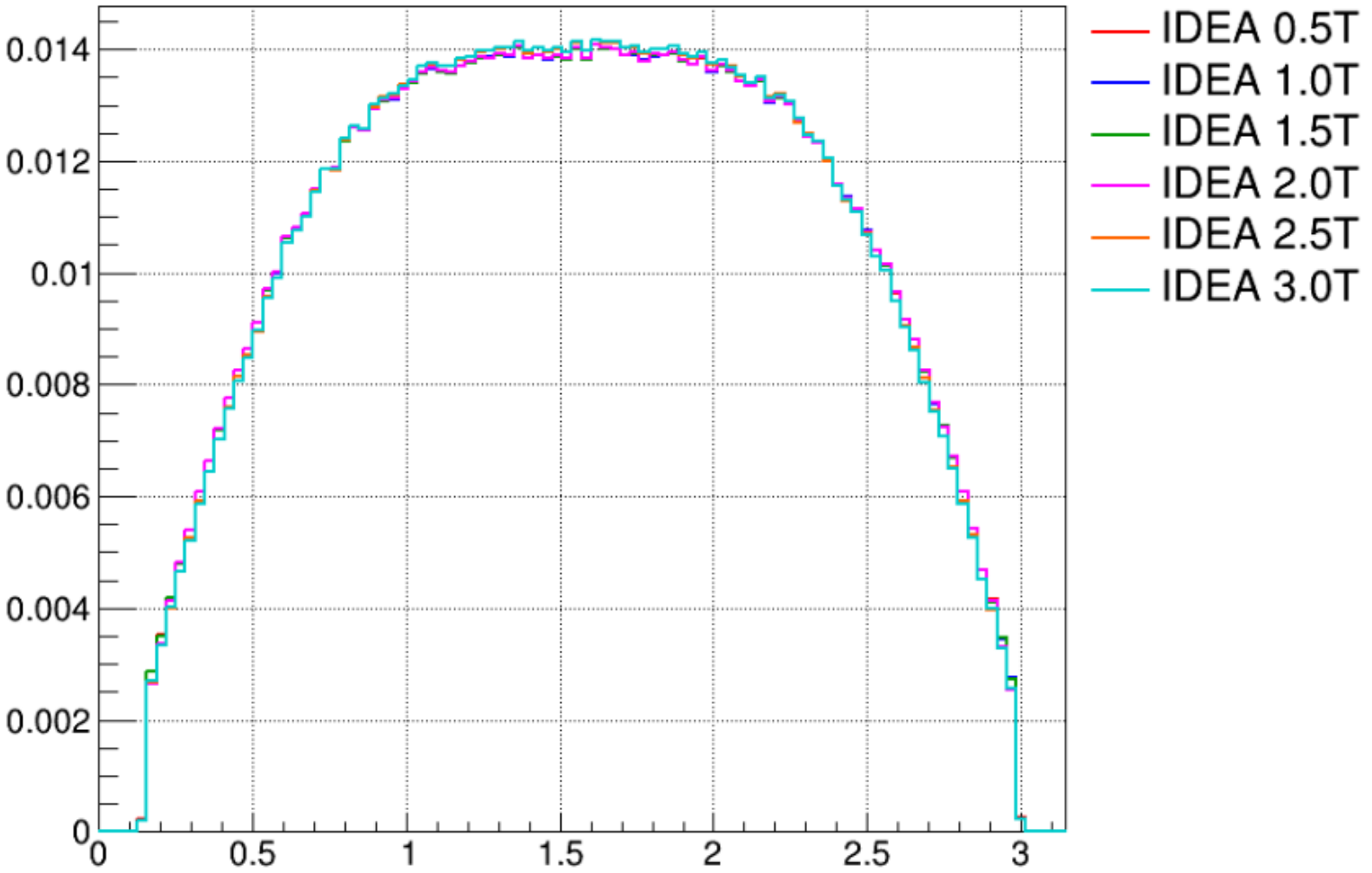


2.5 Tesla

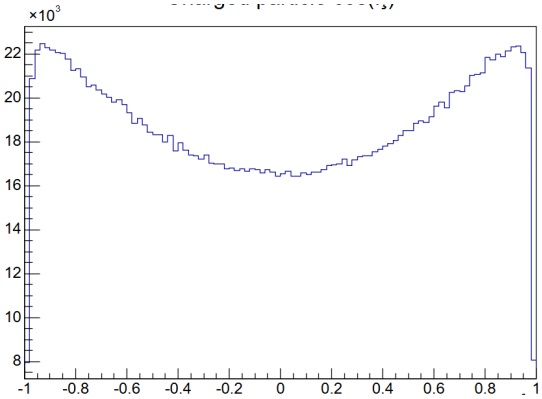


3.0 Tesla

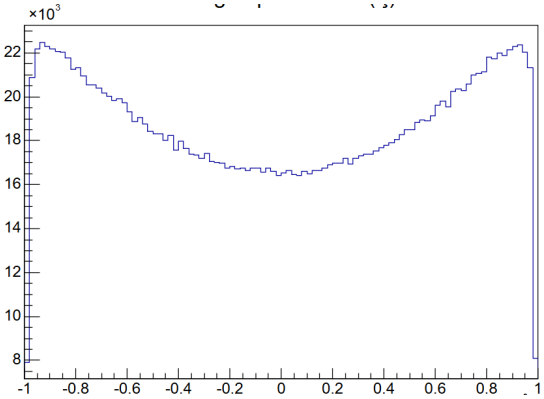
θ resolution in IDEA



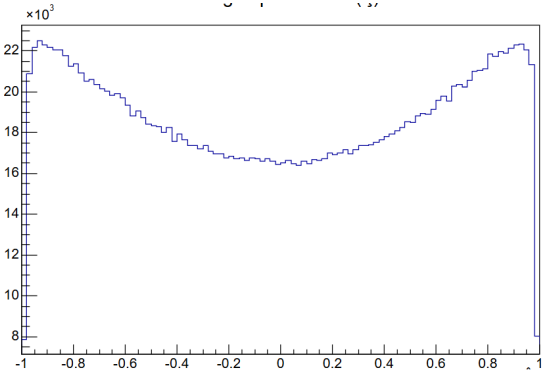
$\cos(\theta)$ resolution in IDEA



0.5 Tesla

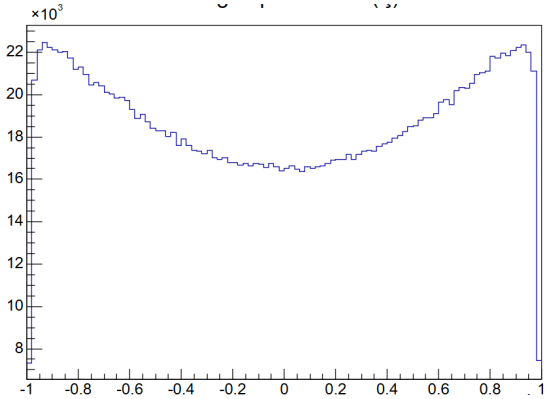


1.0 Tesla

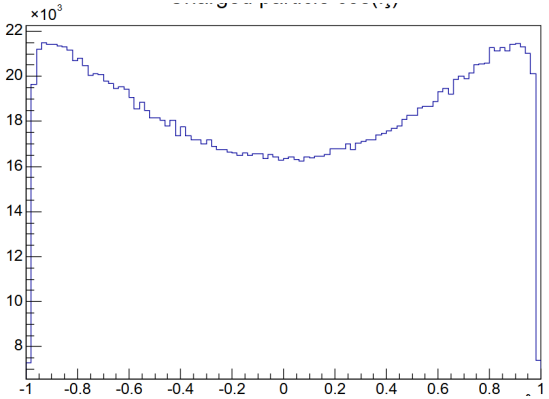


1.5 Tesla

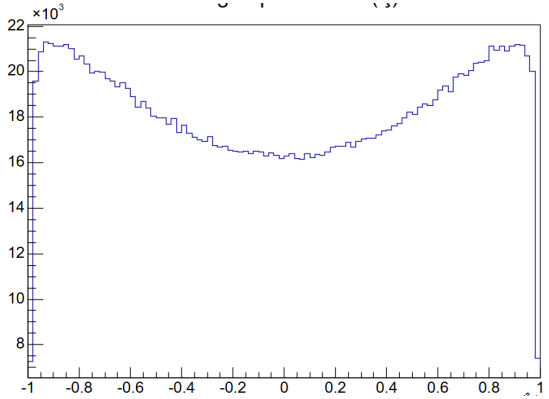
$\cos(\theta)$ resolution in IDEA



2.0 Tesla

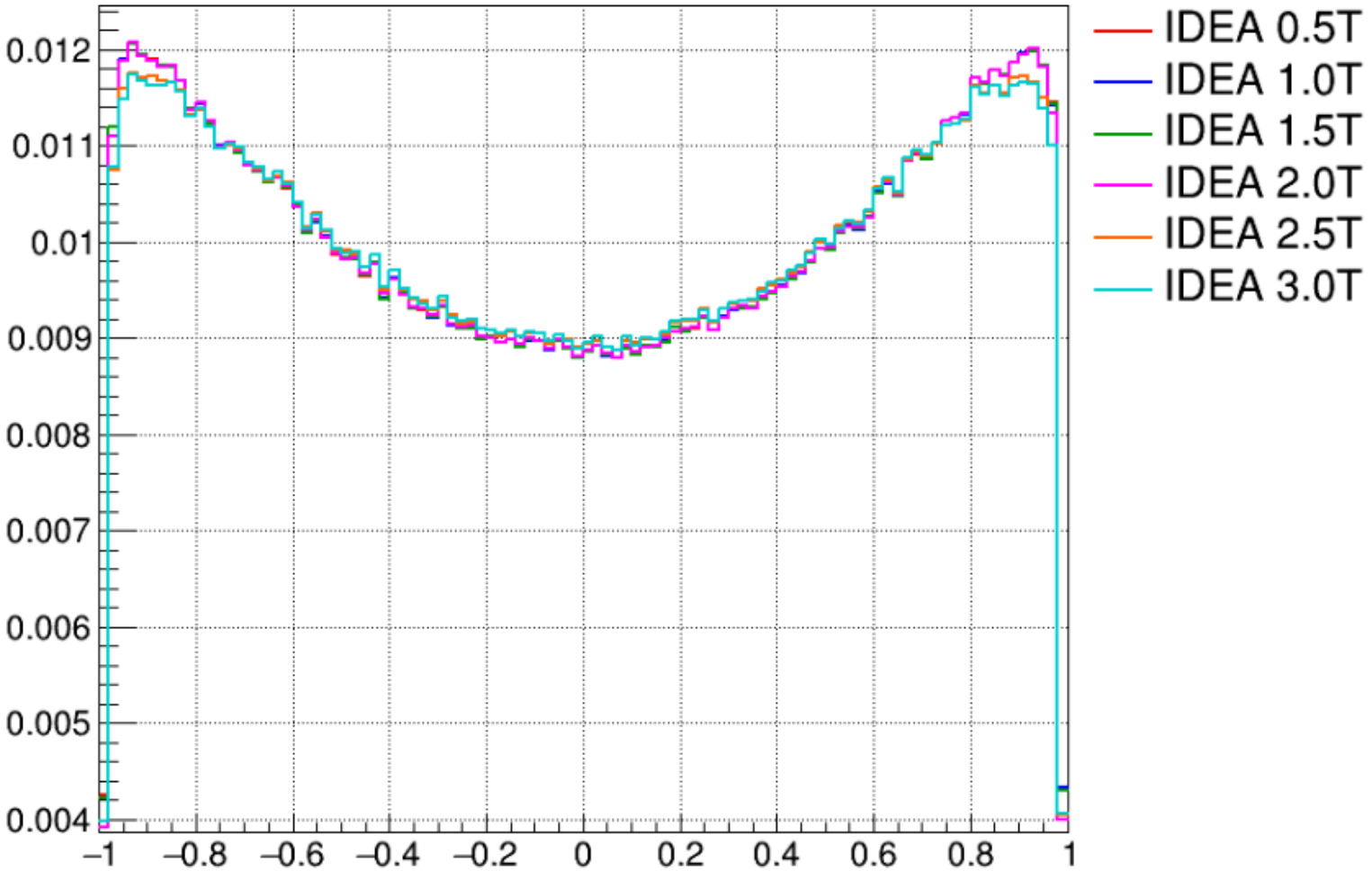


2.5 Tesla

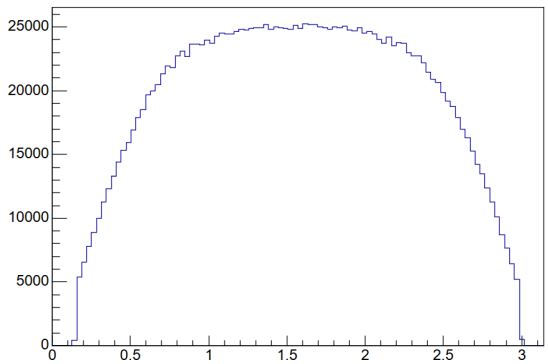


3.0 Tesla

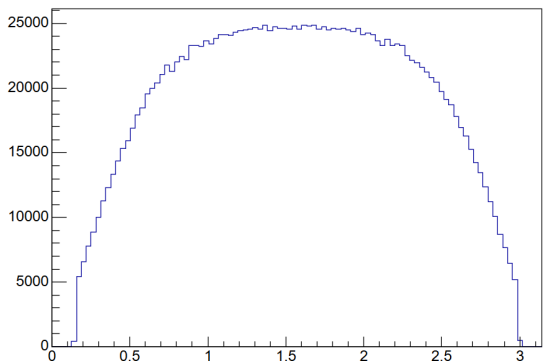
$\cos(\theta)$ resolution in IDEA



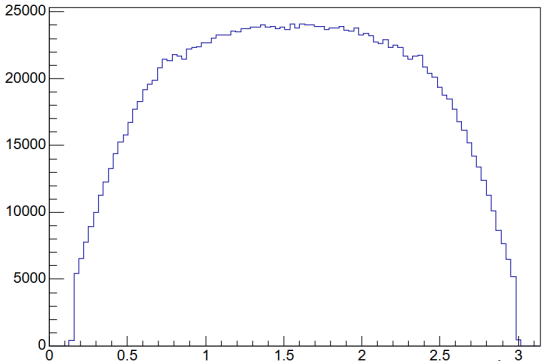
θ resolution in CLD



0.5 Tesla

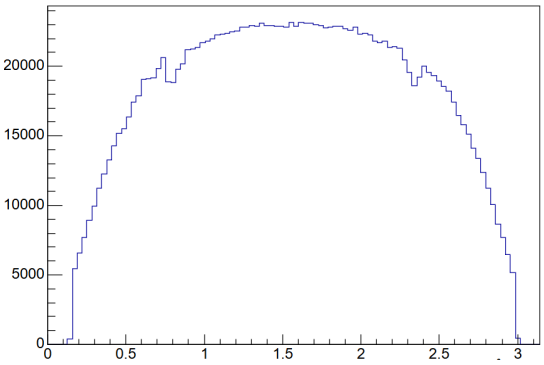


1.0 Tesla

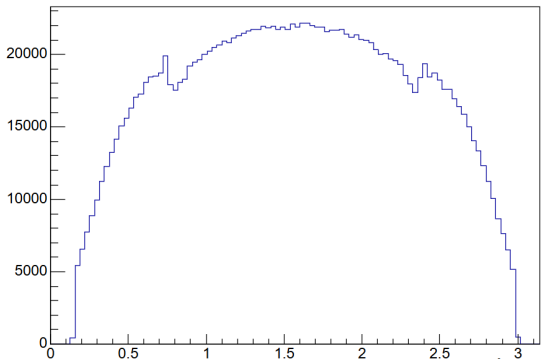


1.5 Tesla

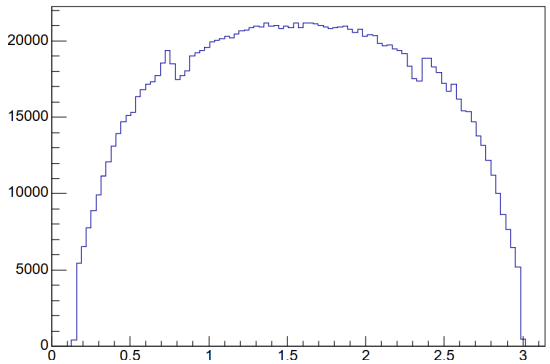
θ resolution in CLD



2.0 Tesla

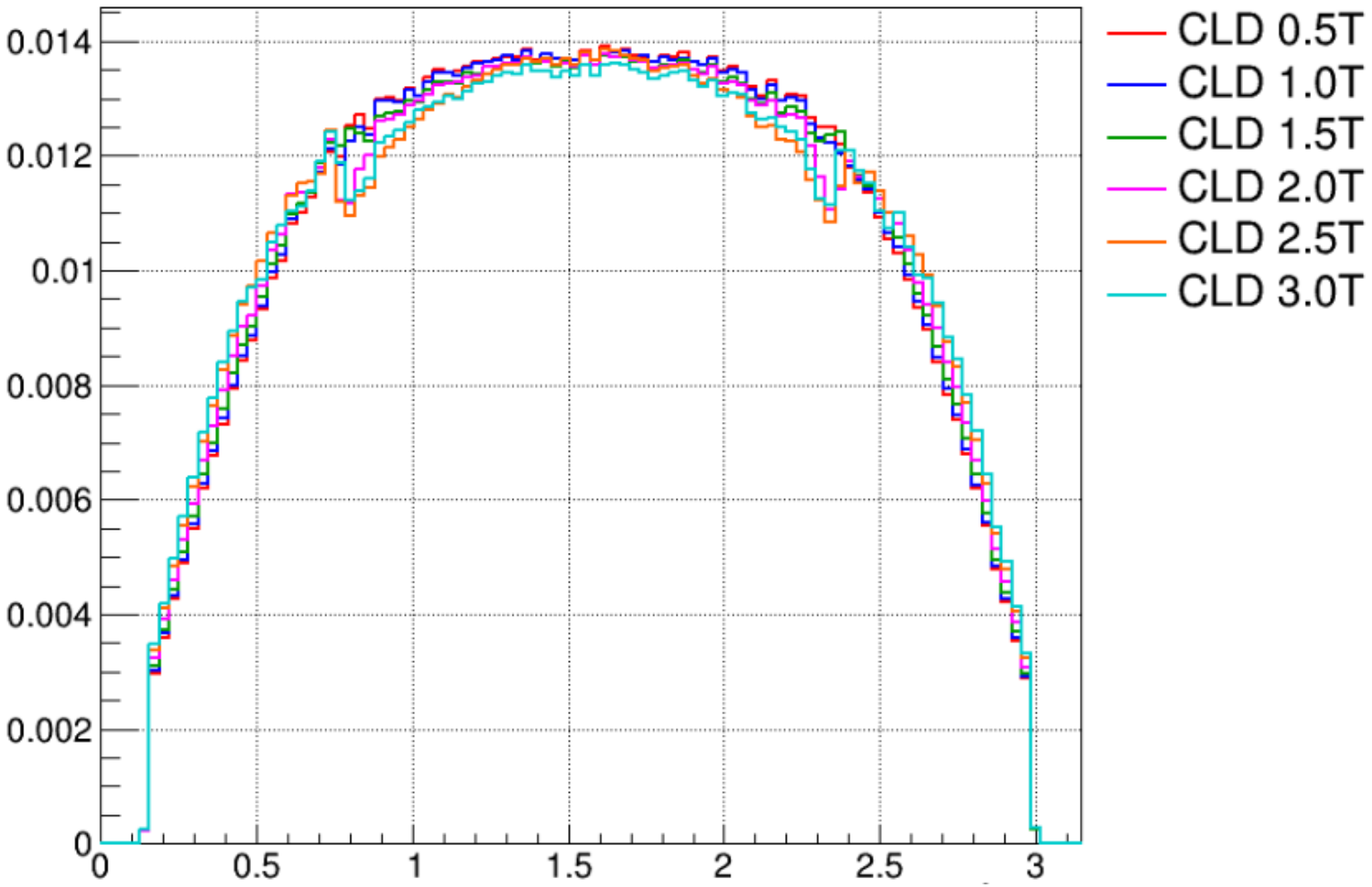


2.5 Tesla

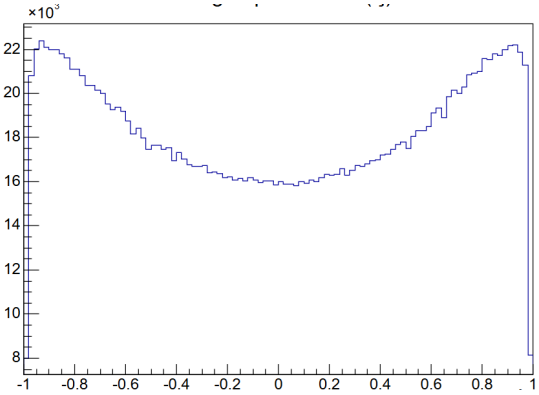


3.0 Tesla

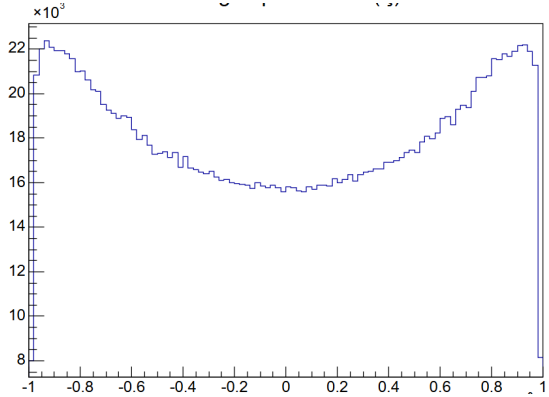
θ resolution in CLD



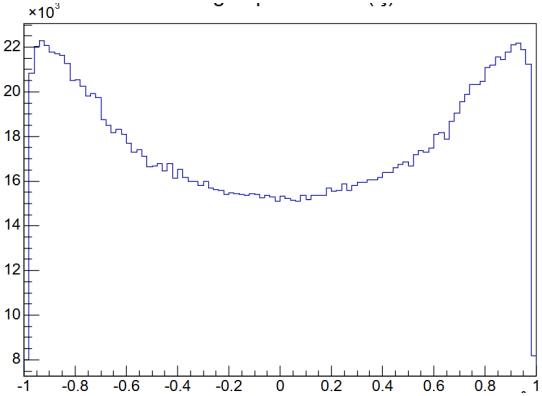
$\cos(\theta)$ resolution in CLD



0.5 Tesla

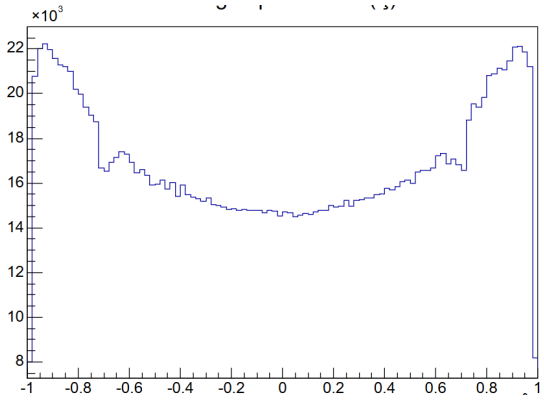


1.0 Tesla

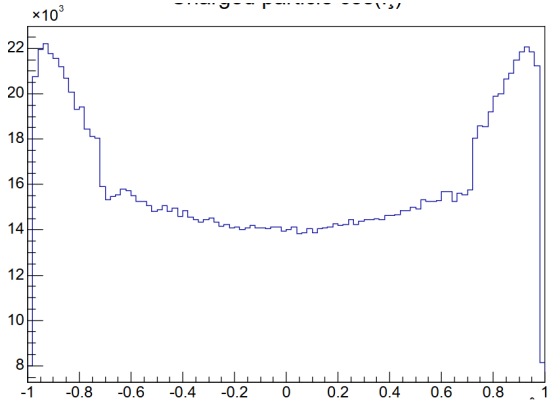


1.5 Tesla

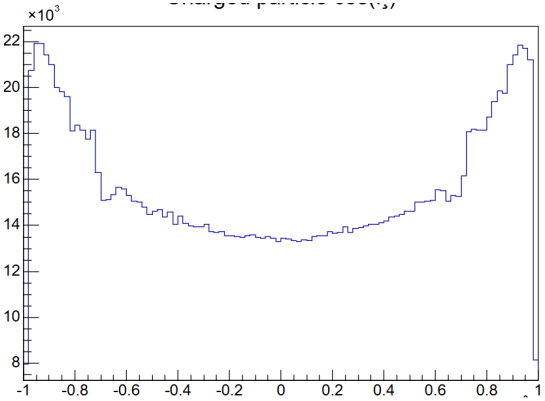
$\cos(\theta)$ resolution in CLD



2.0 Tesla

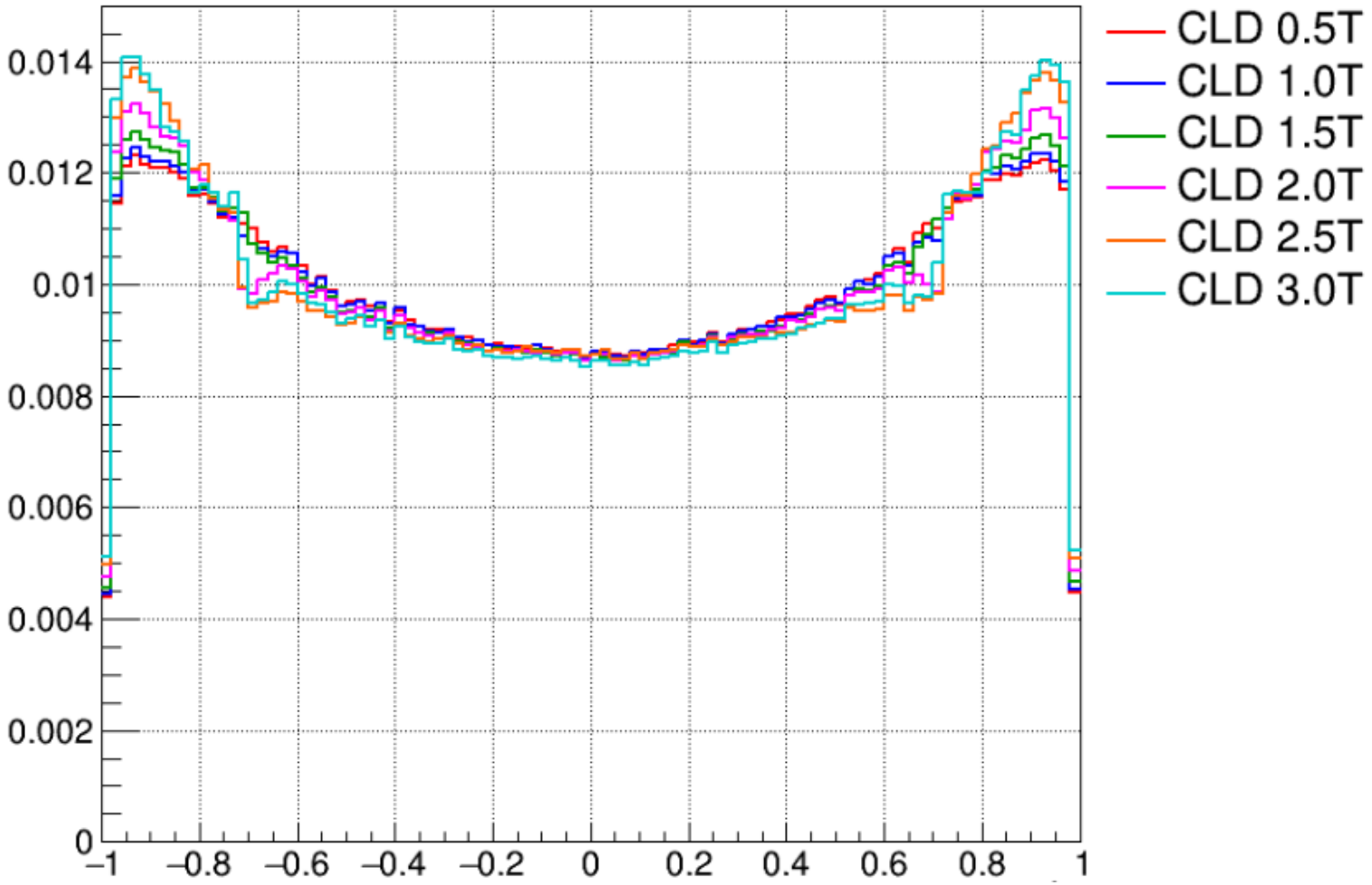


2.5 Tesla

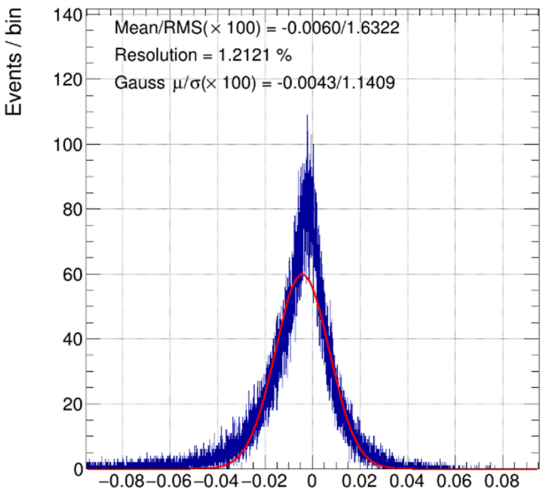


3.0 Tesla

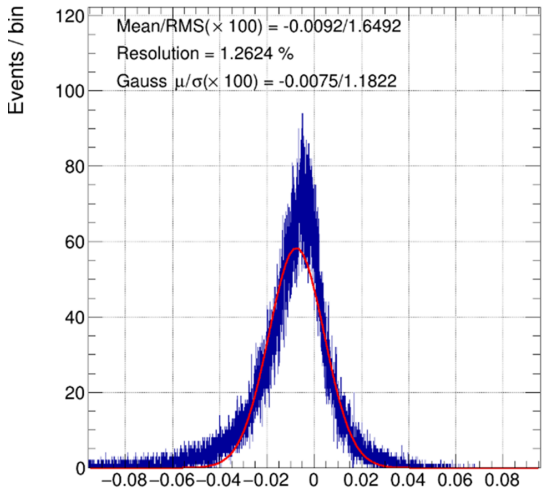
$\cos(\theta)$ resolution in CLD



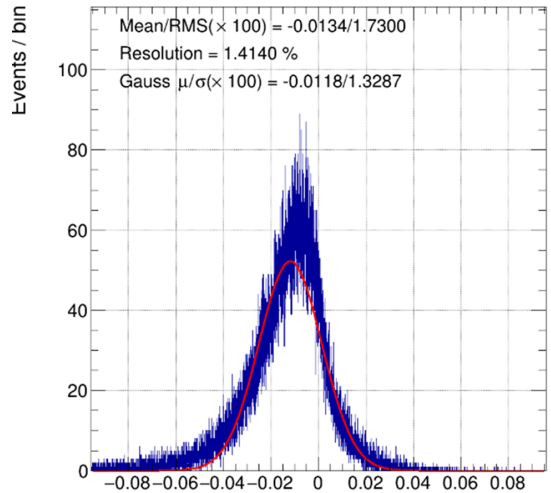
Momentum Resolution in CLD



1 Tesla

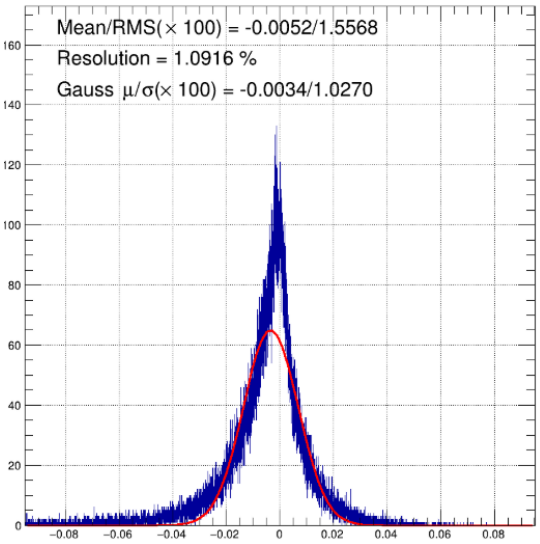


2 Tesla

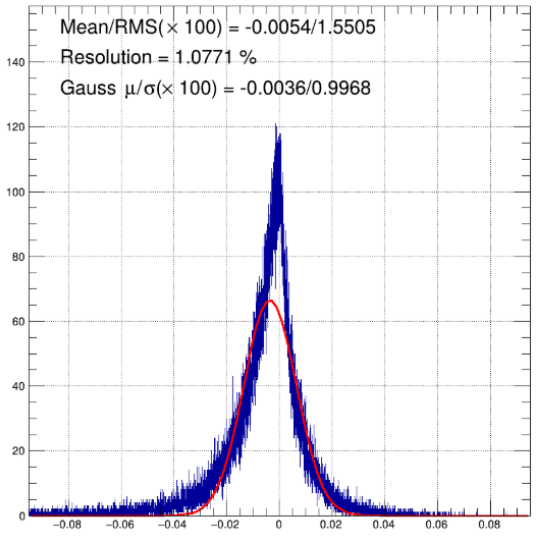


3 Tesla

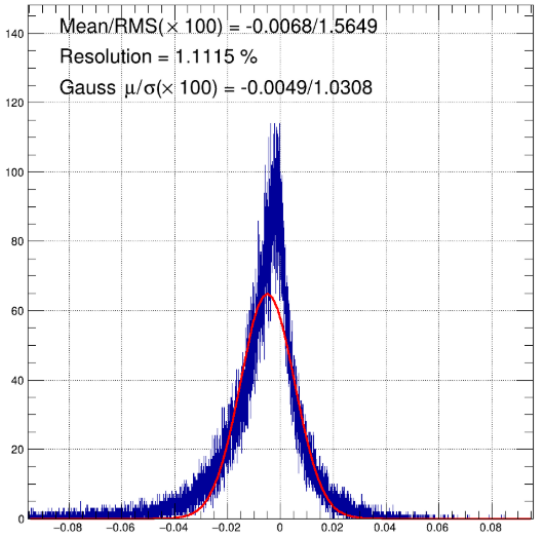
Momentum Resolution in IDEA



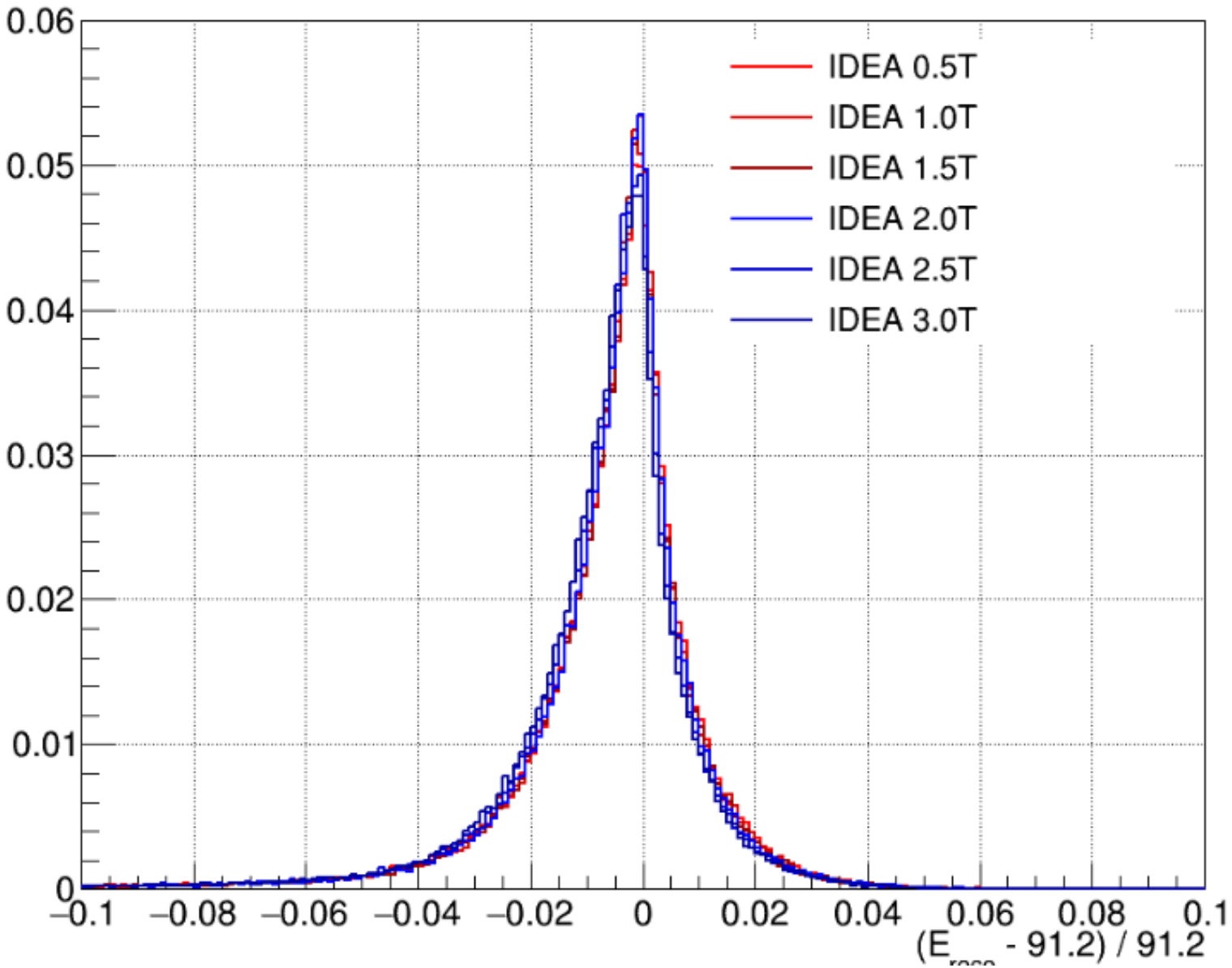
1 Tesla

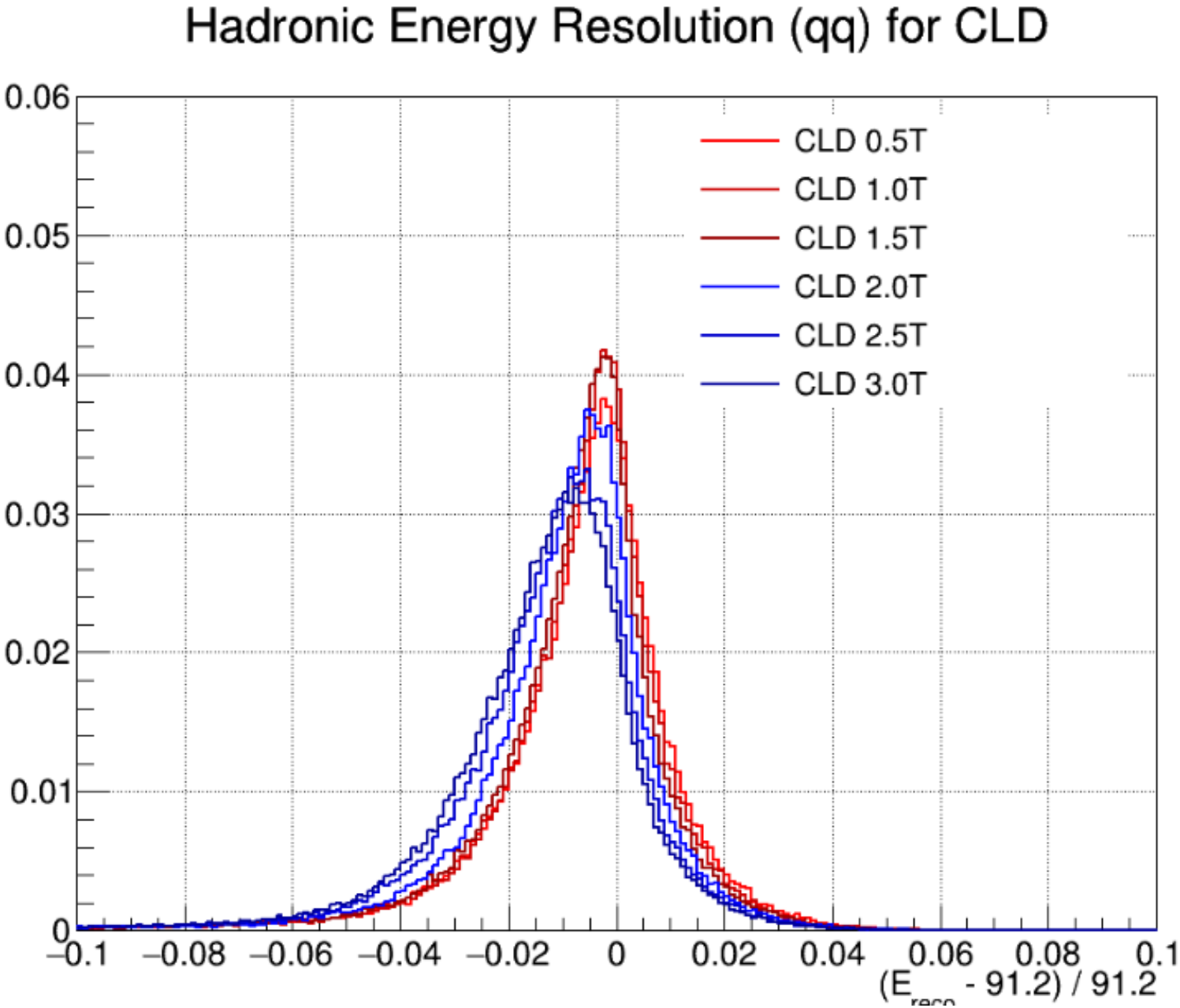


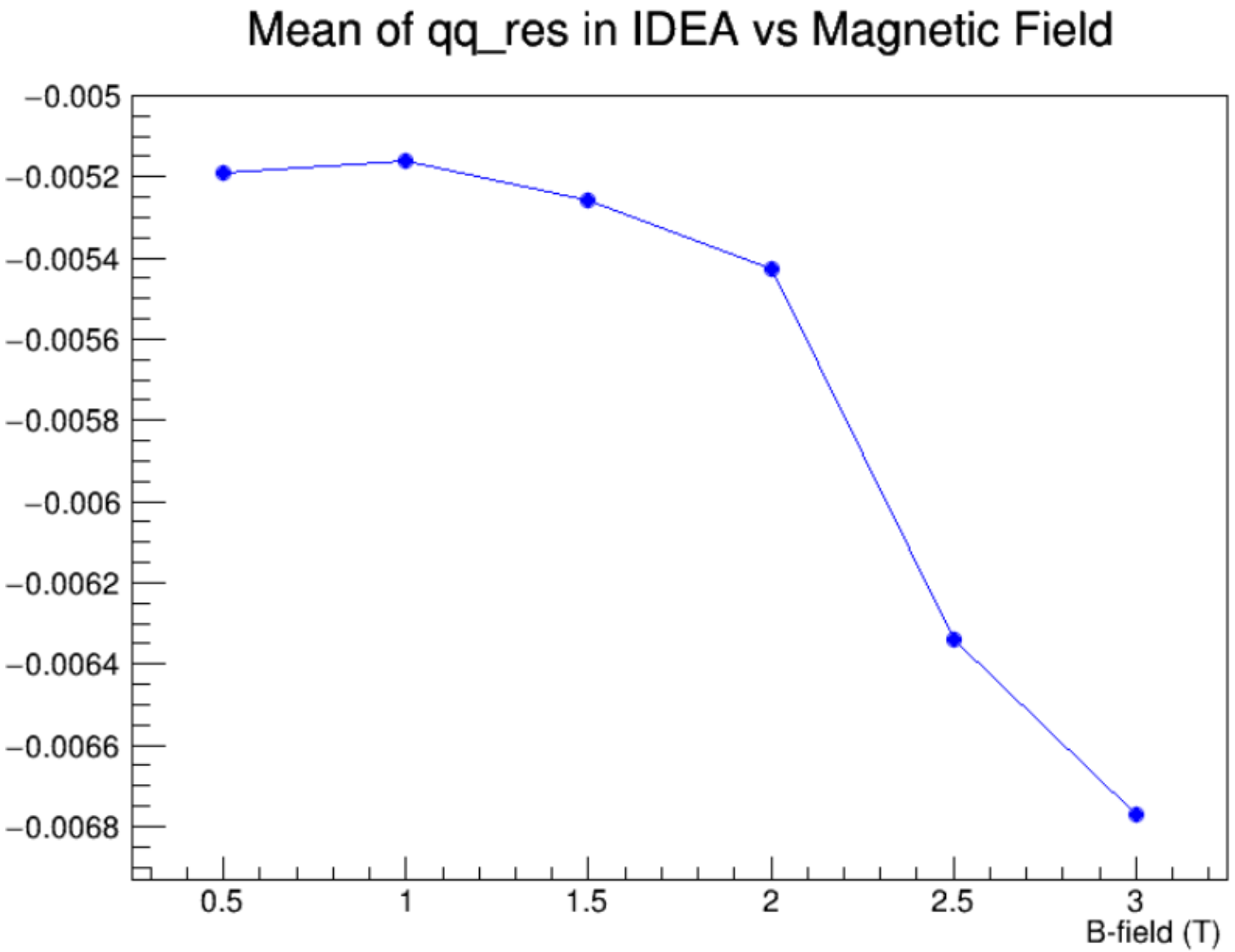
2 Tesla

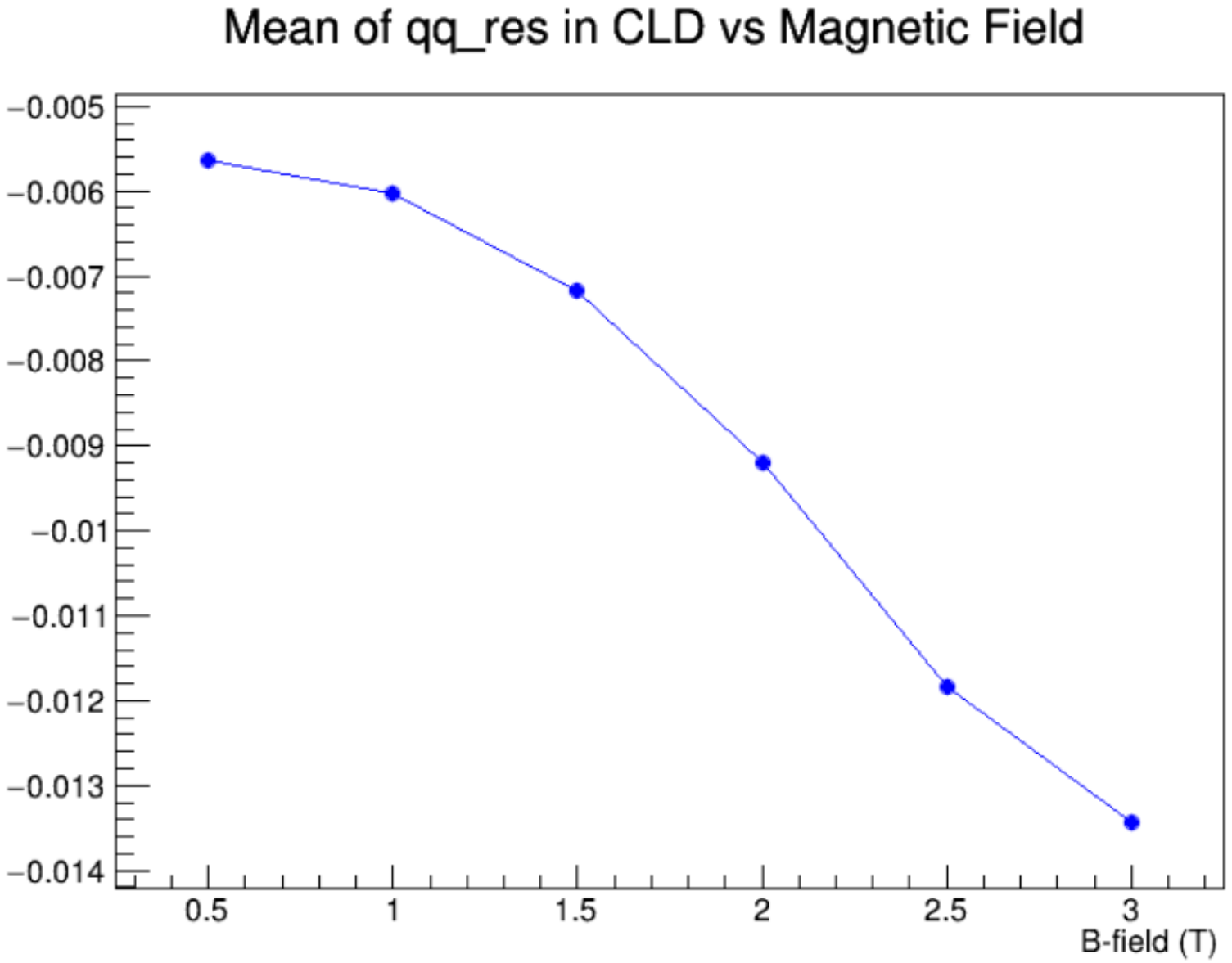


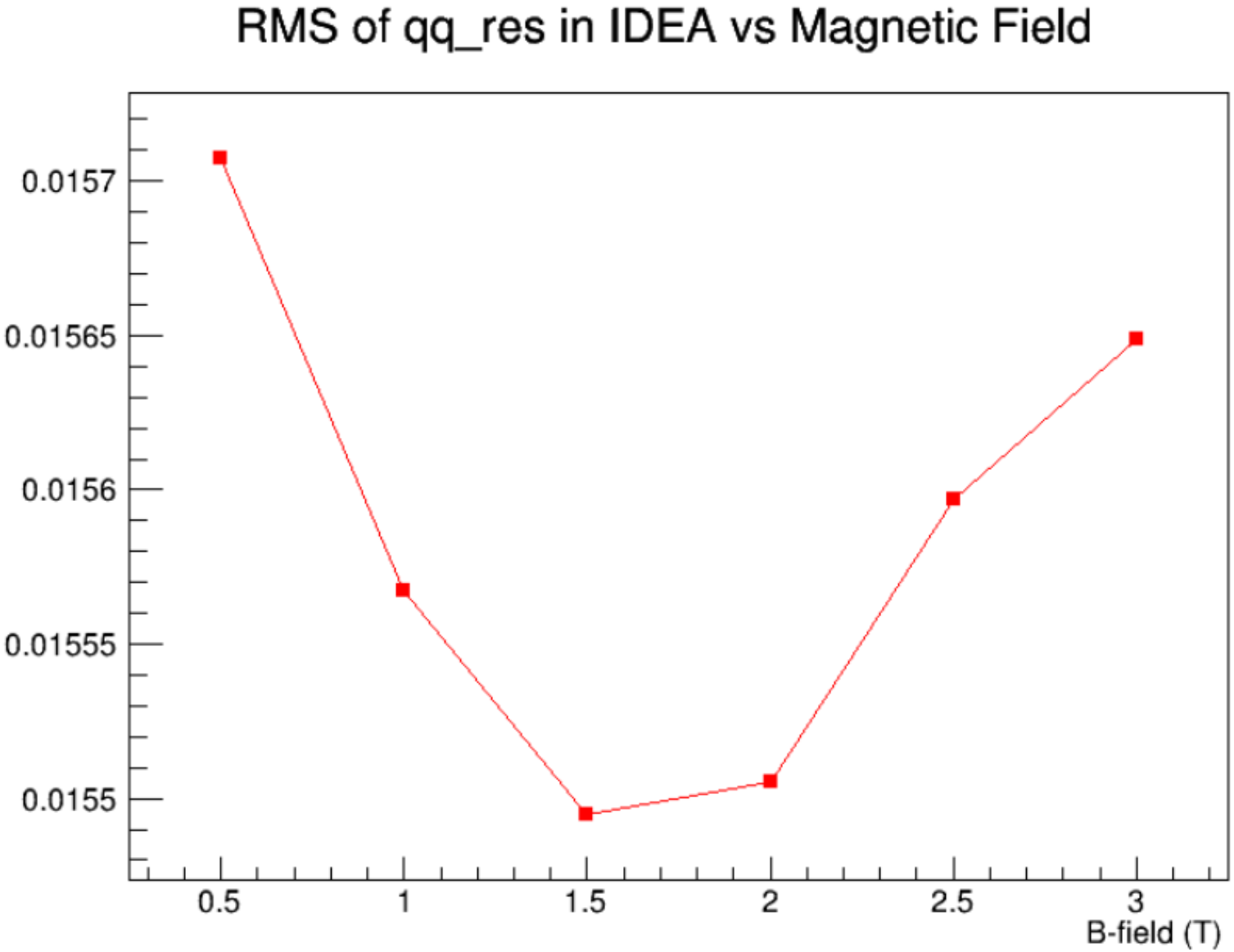
3 Tesla

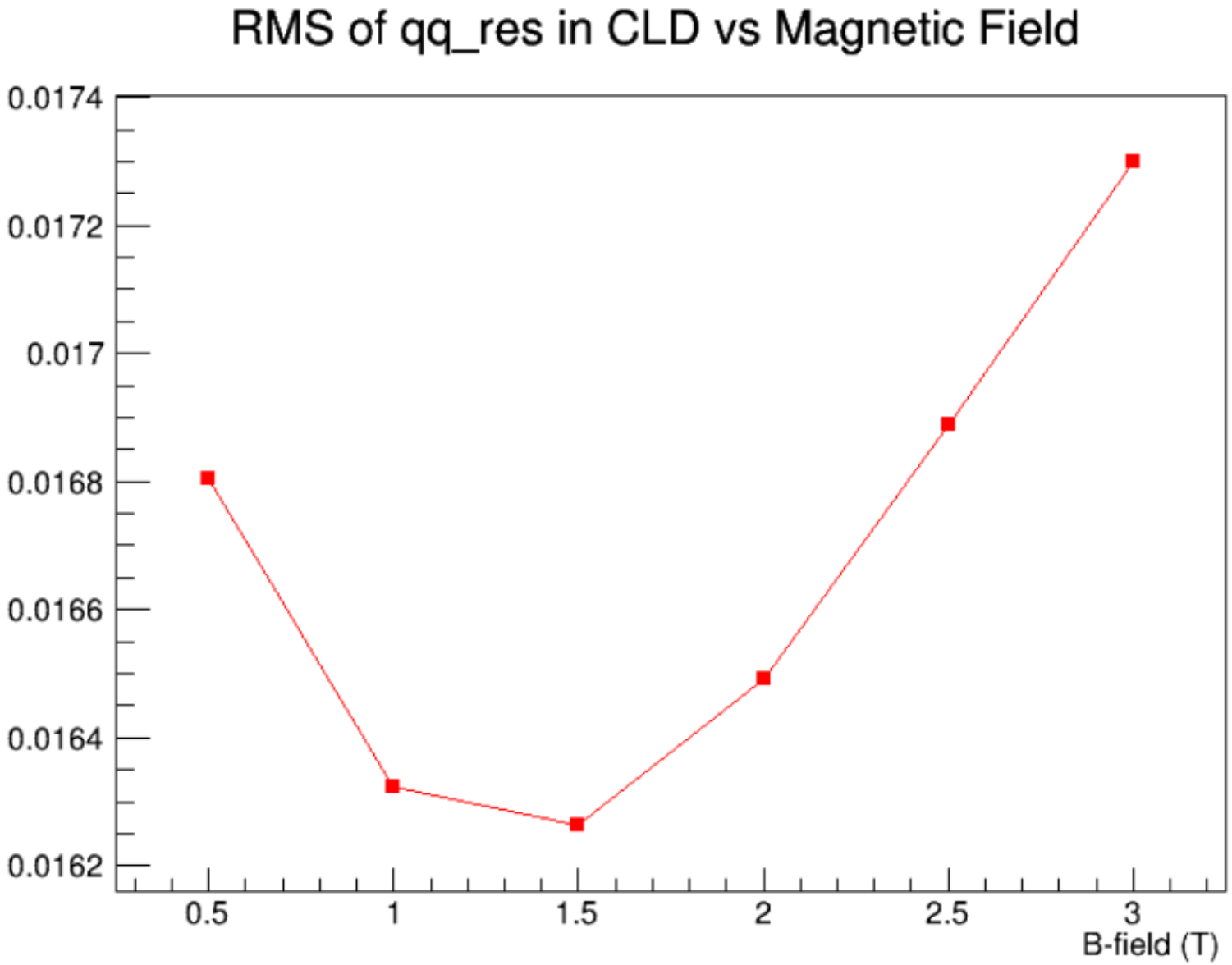

Hadronic Energy Resolution (qq) for IDEA
IDEA 0.5T
IDEA 1.0T
IDEA 1.5T
IDEA 2.0T
IDEA 2.5T
IDEA 3.0T
0.06
0.05
0.04
0.03
0.02
0.01
0
−0.1
−0.08
−0.06
−0.04
−0.02
0
0.02
0.04
0.06
0.08
0.1
(E_reco - 91.2) / 91.2


Hadronic Energy Resolution (qq) for CLD
CLD 0.5T
CLD 1.0T
CLD 1.5T
CLD 2.0T
CLD 2.5T
CLD 3.0T
0.06
0.05
0.04
0.03
0.02
0.01
0
−0.1
−0.08
−0.06
−0.04
−0.02
0
0.02
0.04
0.06
0.08
0.1
(E_reco - 91.2) / 91.2

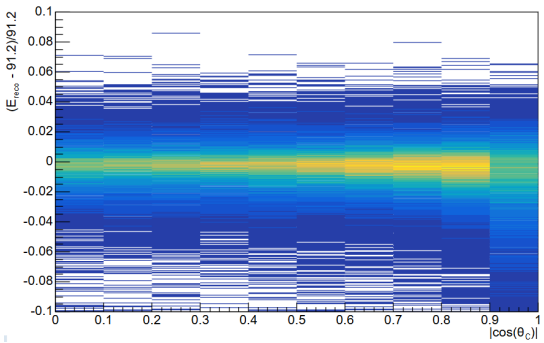

Mean of qq_res in IDEA vs Magnetic Field
−0.005
−0.0052
−0.0054
−0.0056
−0.0058
−0.006
−0.0062
−0.0064
−0.0066
−0.0068
0.5
1
1.5
2
2.5
3
B-field (T)


Mean of qq_res in CLD vs Magnetic Field
−0.005
−0.006
−0.007
−0.008
−0.009
−0.01
−0.011
−0.012
−0.013
−0.014
0.5
1
1.5
2
2.5
3
B-field (T)

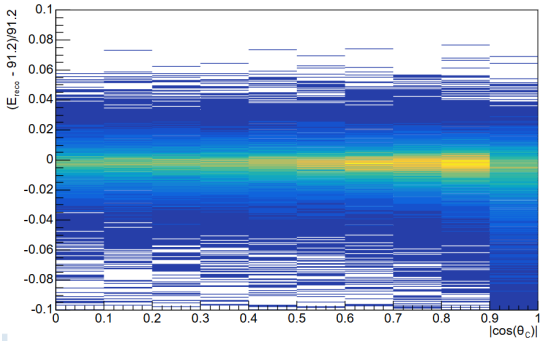

RMS of qq_res in IDEA vs Magnetic Field
0.0157
0.01565
0.0156
0.01555
0.0155
0.5
1
1.5
2
2.5
3
B-field (T)


RMS of qq_res in CLD vs Magnetic Field
0.0174
0.0172
0.017
0.0168
0.0166
0.0164
0.0162
0.5
1
1.5
2
2.5
3
B-field (T)

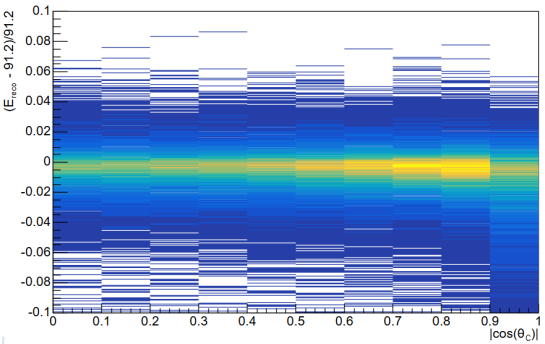
particles per $abs(cos(\theta_C))$ and resolution in CLD



0.5 Tesla

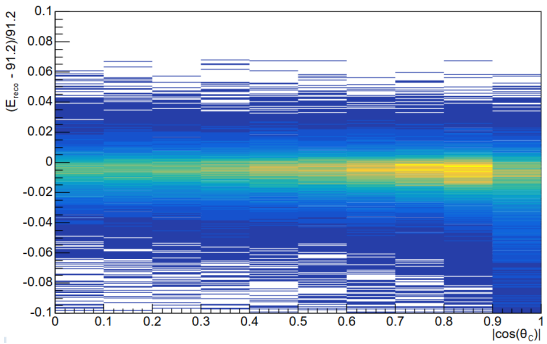


1.0 Tesla

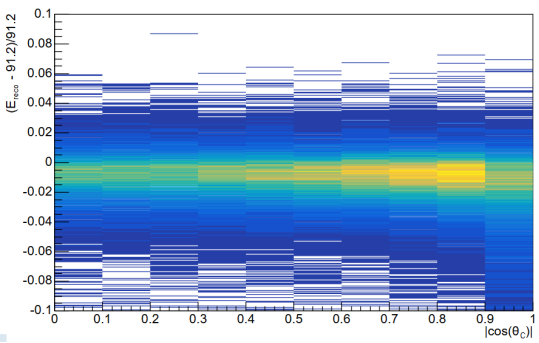


1.5 Tesla

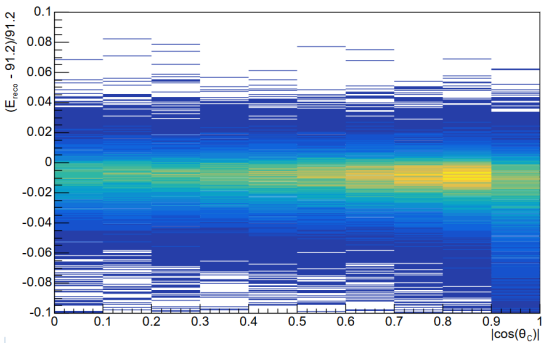
particles per $abs(cos(\theta_C))$ and resolution in CLD



2.0 Tesla

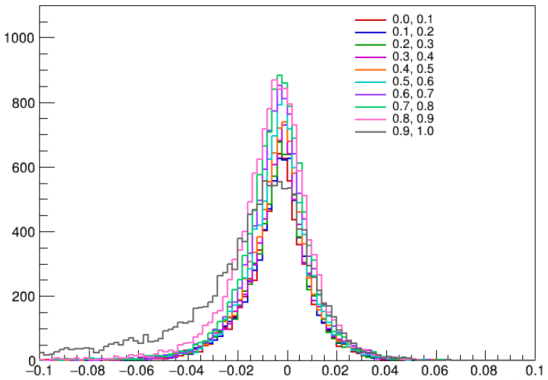


2.5 Tesla

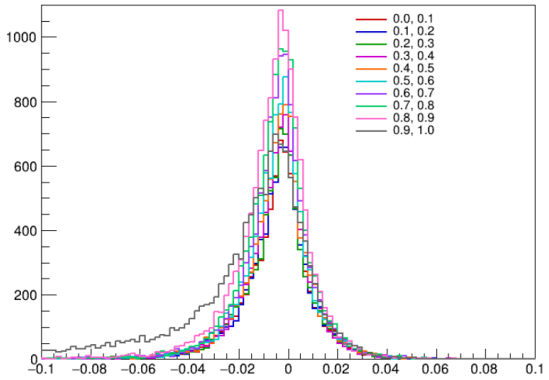


3.0 Tesla

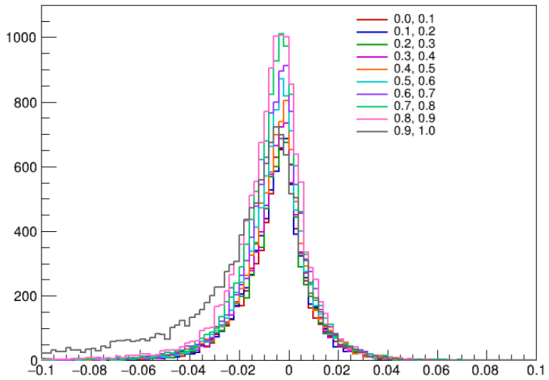
Resolution per $abs(cos(\theta_C))$ in CLD



0.5 Tesla

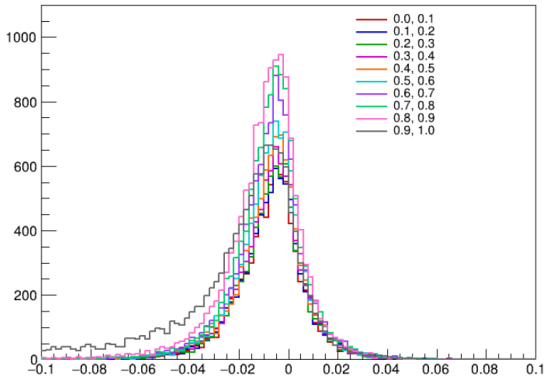


1.0 Tesla

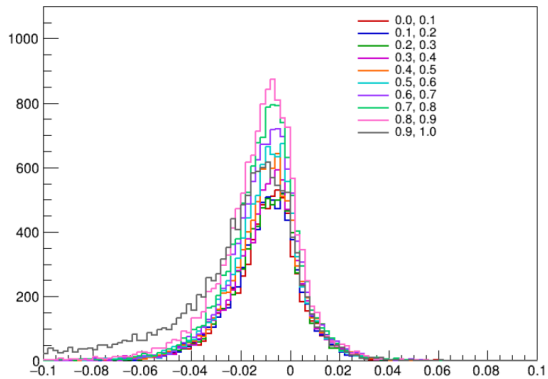


1.5 Tesla

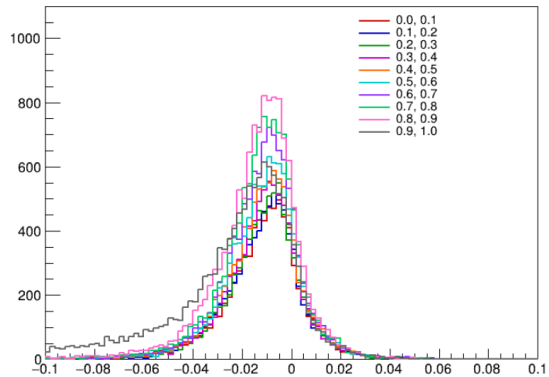
Resolution per $abs(cos(\theta_C))$ in CLD



2.0 Tesla



2.5 Tesla

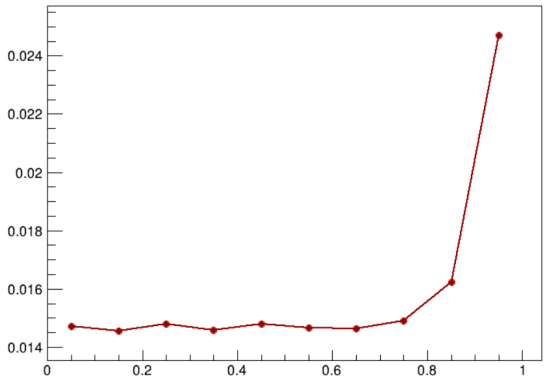


3.0 Tesla

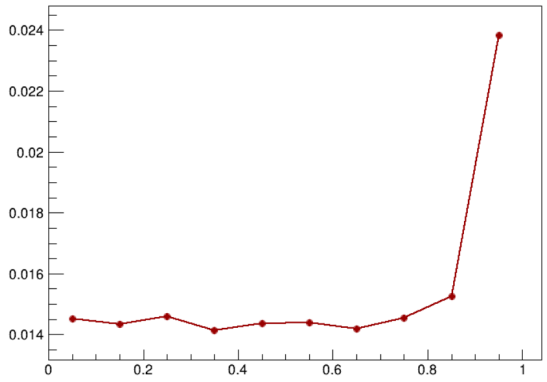
Conclusions

- Worse resolution at high $abs(cos(\theta_C))$
  - Worst zone
- Narrower at low $abs(cos(\theta_C))$.
  - Best zones for detectors
- Packed in underestimated resolution at $0.7 < abs(cos(\theta_C)) < 0.9$
- Best resolution at 1.0 T.
  - Consistent with hadronic resolution for CLD.

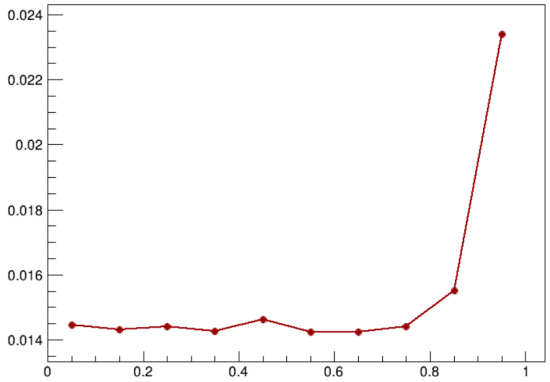
RMS per $abs(cos(\theta_C))$



0.5 Tesla

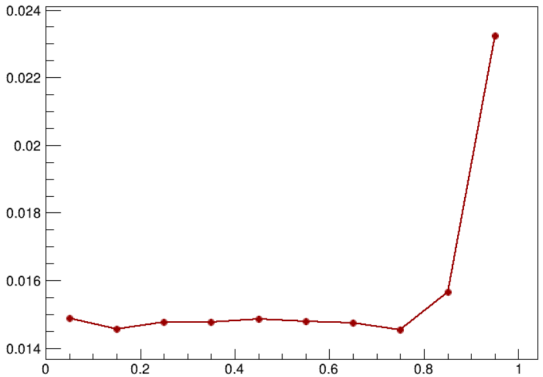


1.0 Tesla

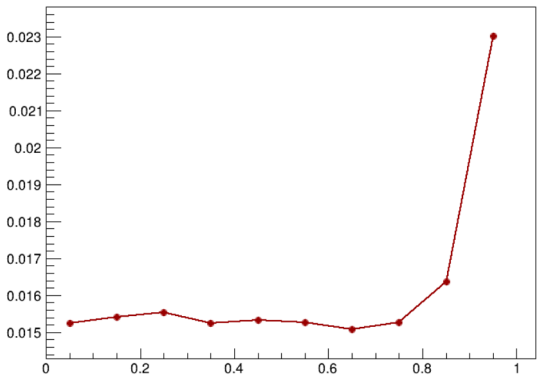


1.5 Tesla

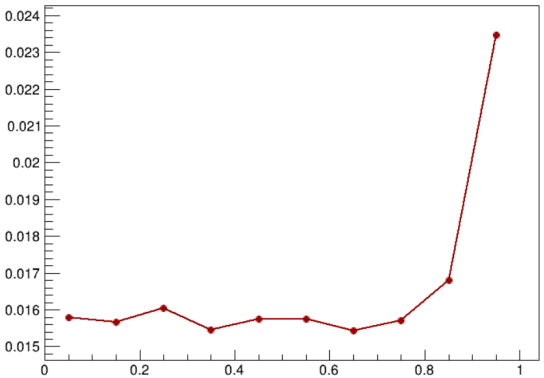
RMS per $abs(cos(\theta_C))$



2.0 Tesla

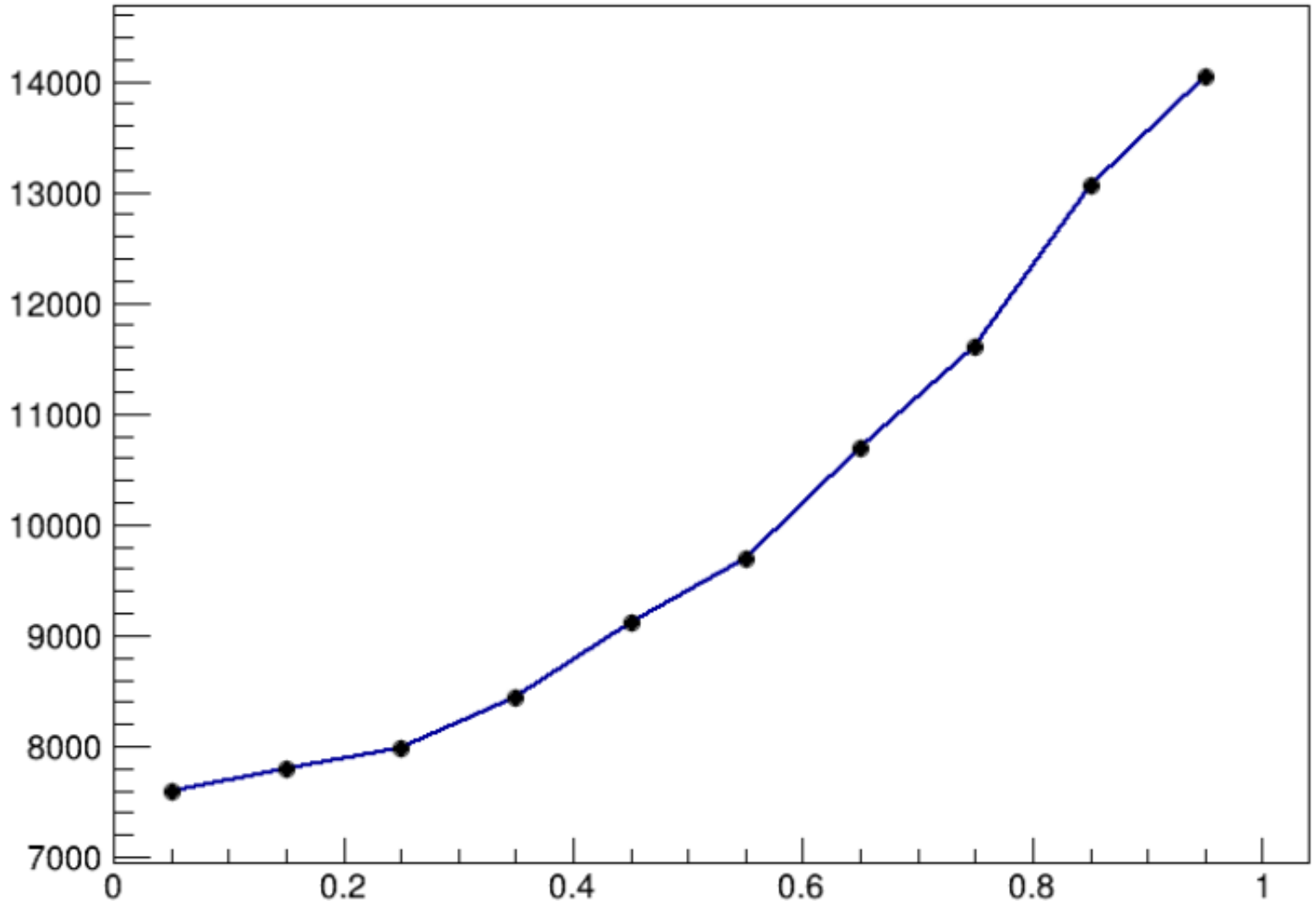


2.5 Tesla

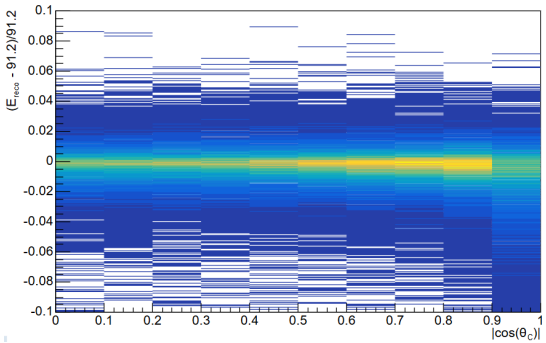


3.0 Tesla

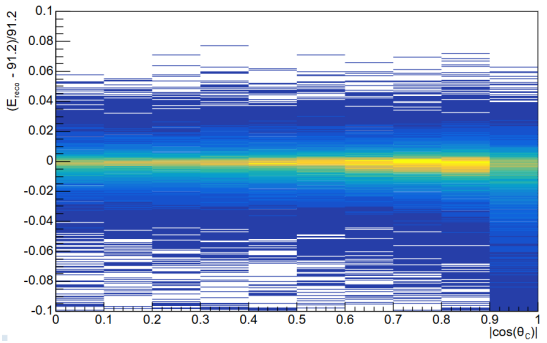
of events per $abs(cos(\theta_C))$



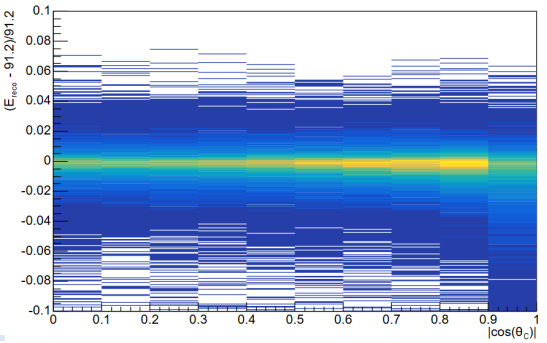
particles per $abs(cos(\theta_C))$ and resolution in IDEA



0.5 Tesla

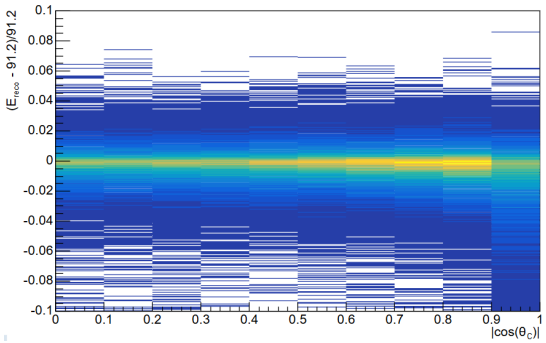


1.0 Tesla

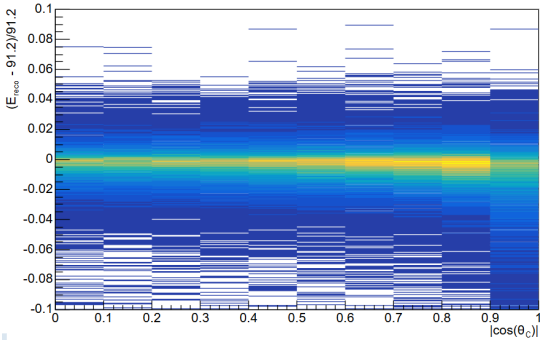


1.5 Tesla

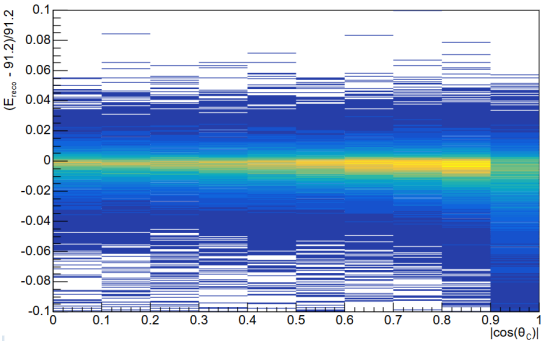
particles per $abs(cos(\theta_C))$ and resolution in IDEA



2.0 Tesla

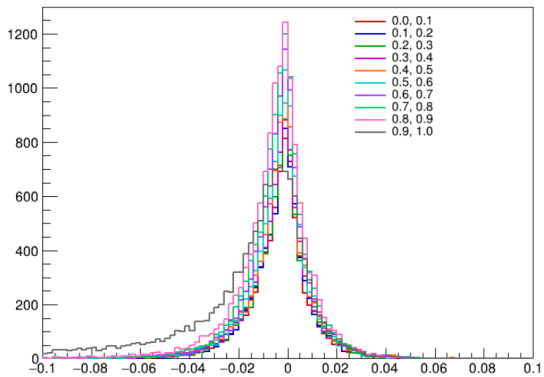


2.5 Tesla

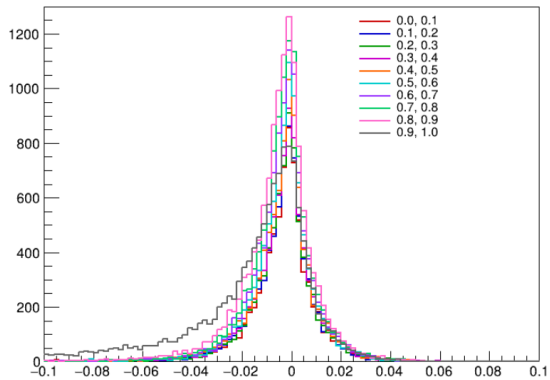


3.0 Tesla

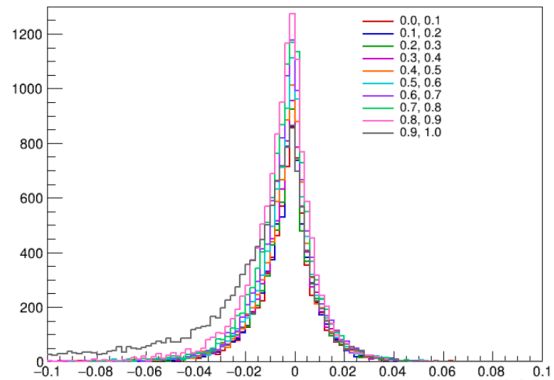
Resolution per $abs(cos(\theta_C))$ in IDEA



0.5 Tesla

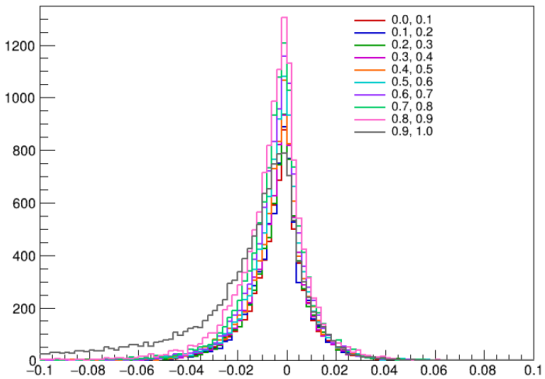


1.0 Tesla

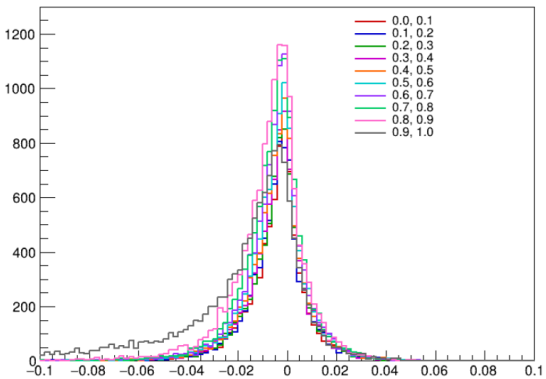


1.5 Tesla

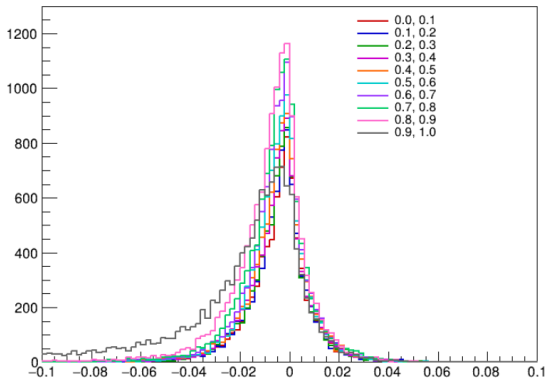
Resolution per $abs(cos(\theta_C))$ in IDEA



2.0 Tesla



2.5 Tesla

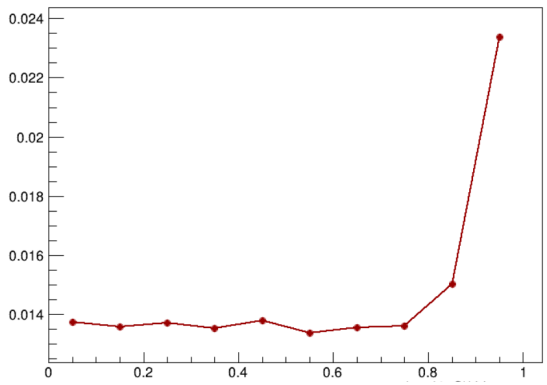


3.0 Tesla

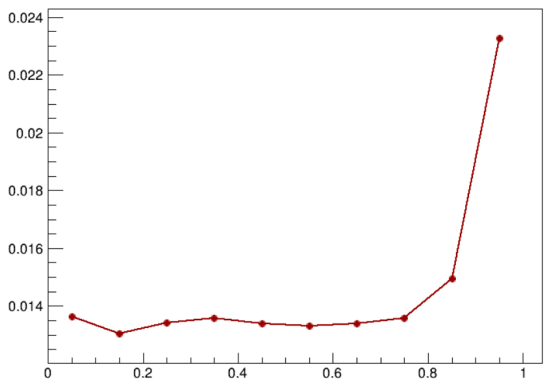
Conclusions

- No strongly visible enhancement in resolution from 0.5 to 2.0 Teslas but noticeable concentration of better resolutions at 2.5.
  - Similar to hadronic resolution obtained by IDEA.

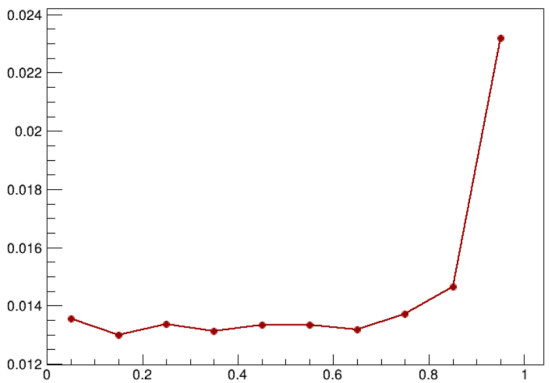
RMS per $abs(cos(\theta_C))$



0.5 Tesla

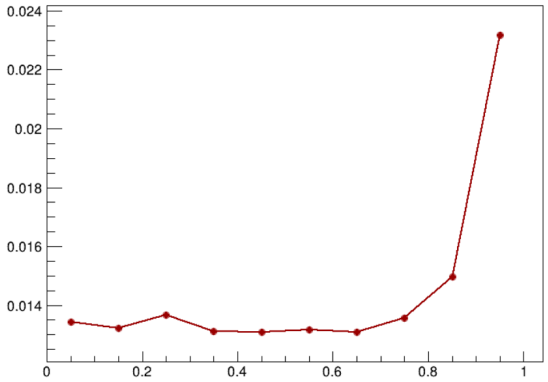


1.0 Tesla

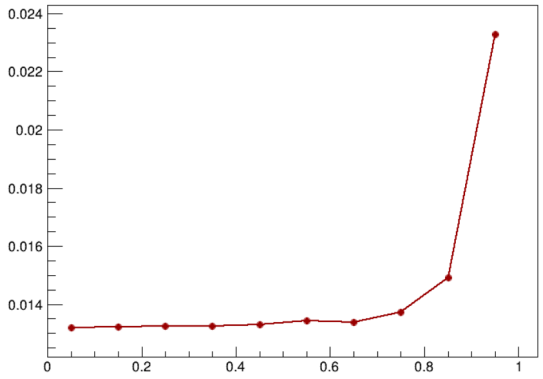


1.5 Tesla

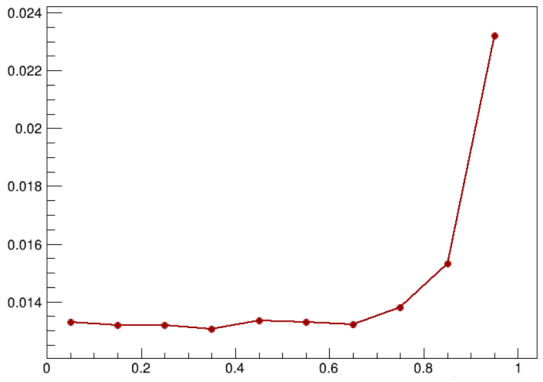
RMS per $abs(cos(\theta_C))$



2.0 Tesla

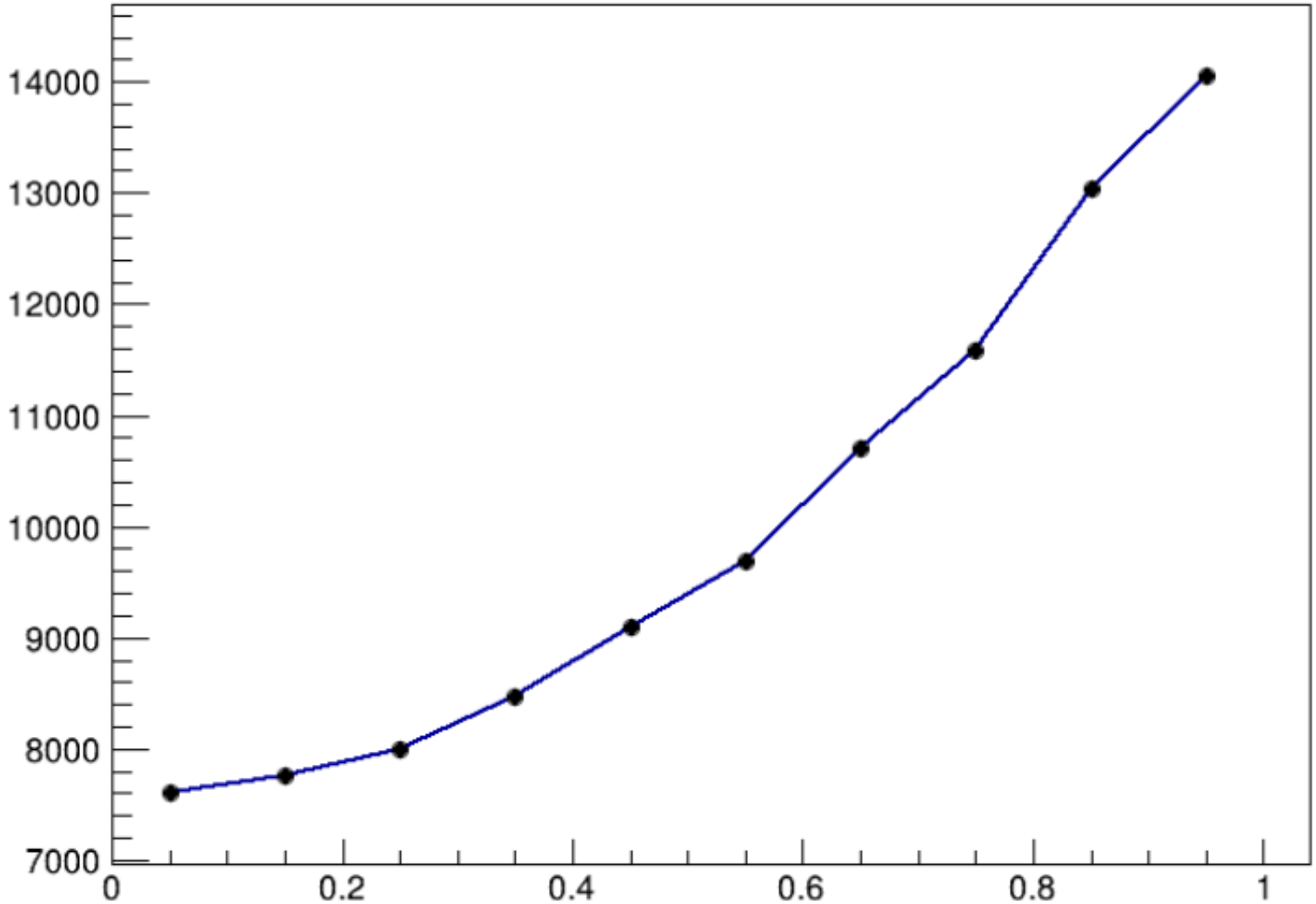


2.5 Tesla

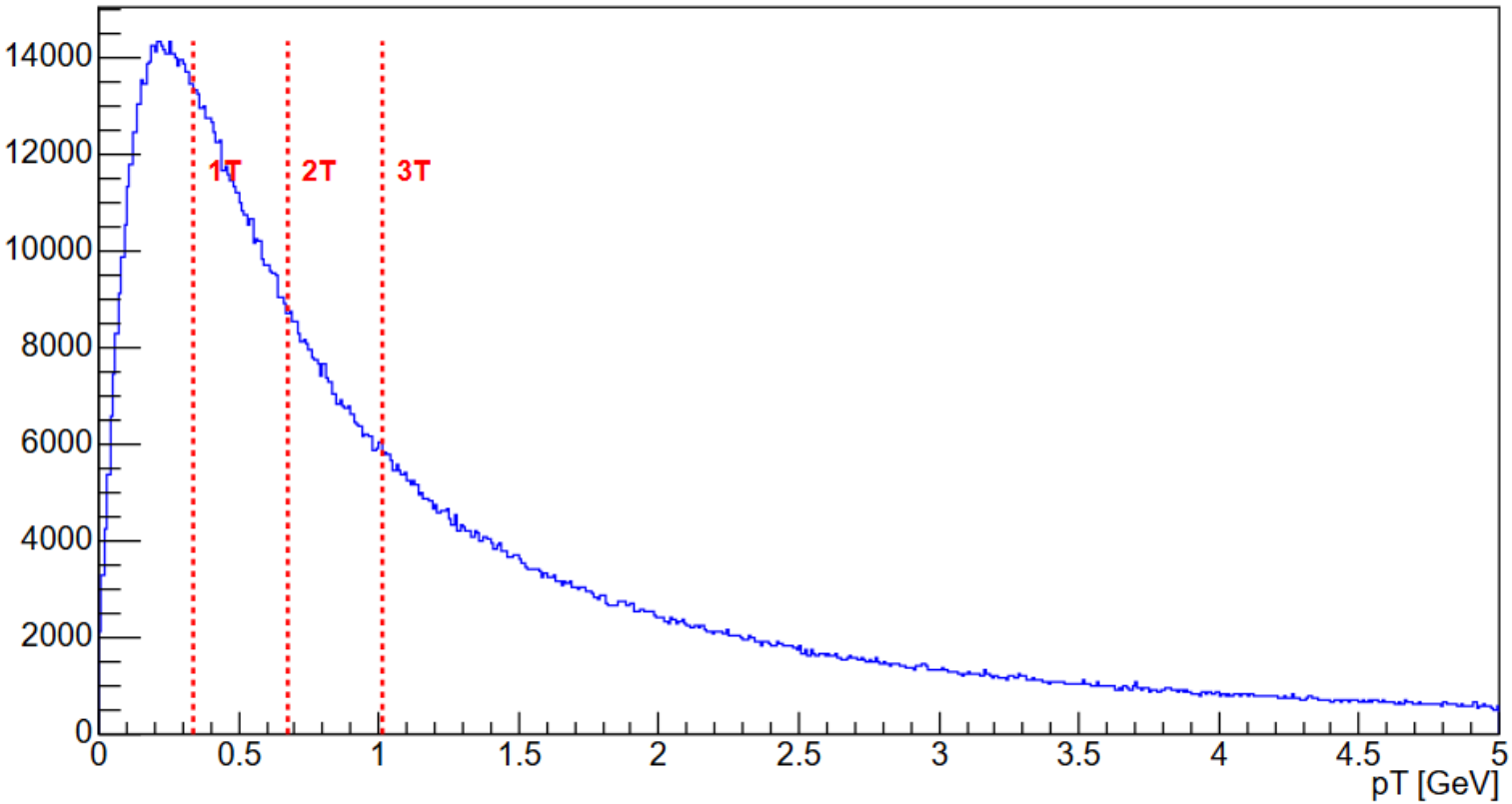


3.0 Tesla

of events per $abs(cos(\theta_C))$



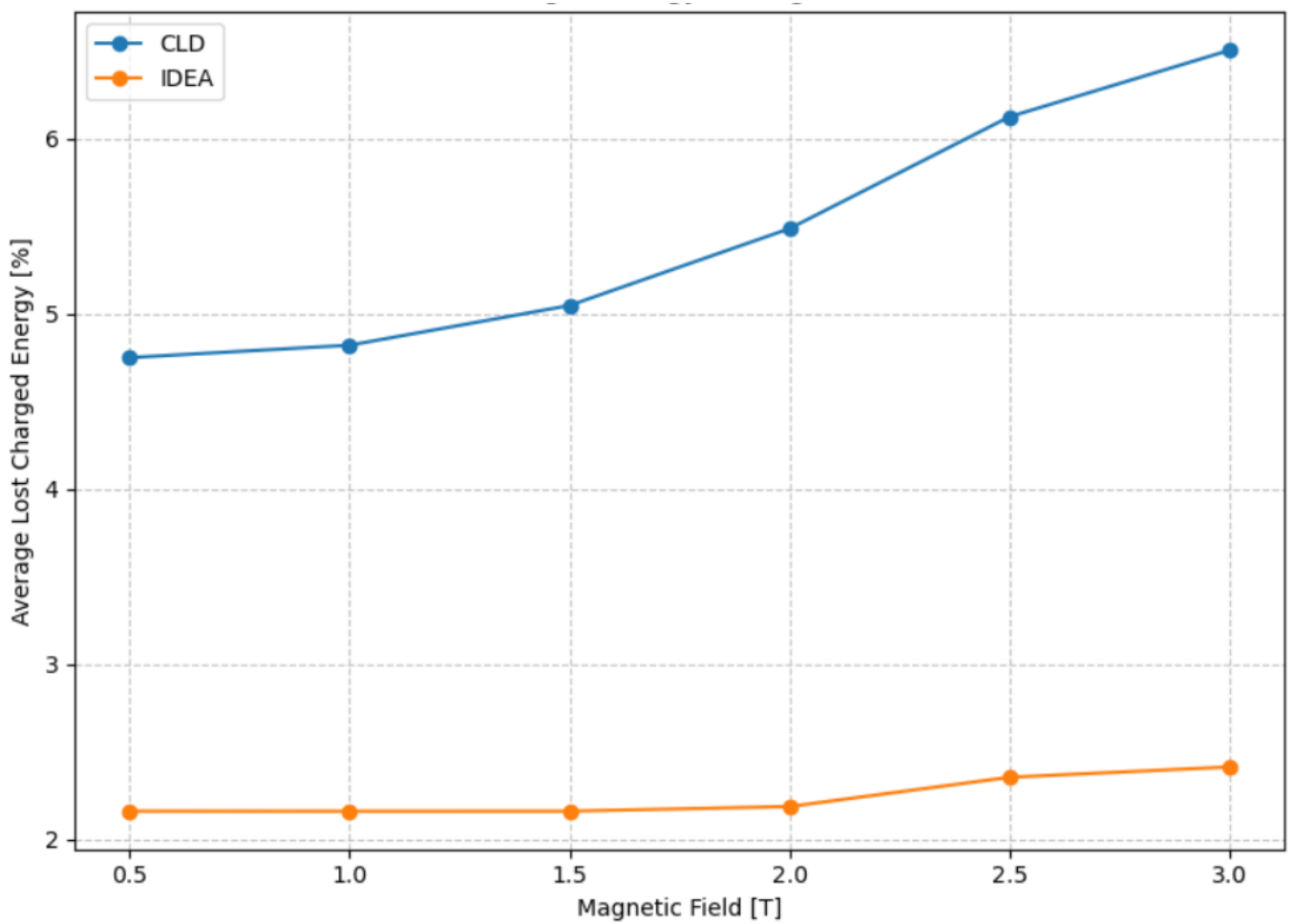
Particles loss (0-5 GeV)



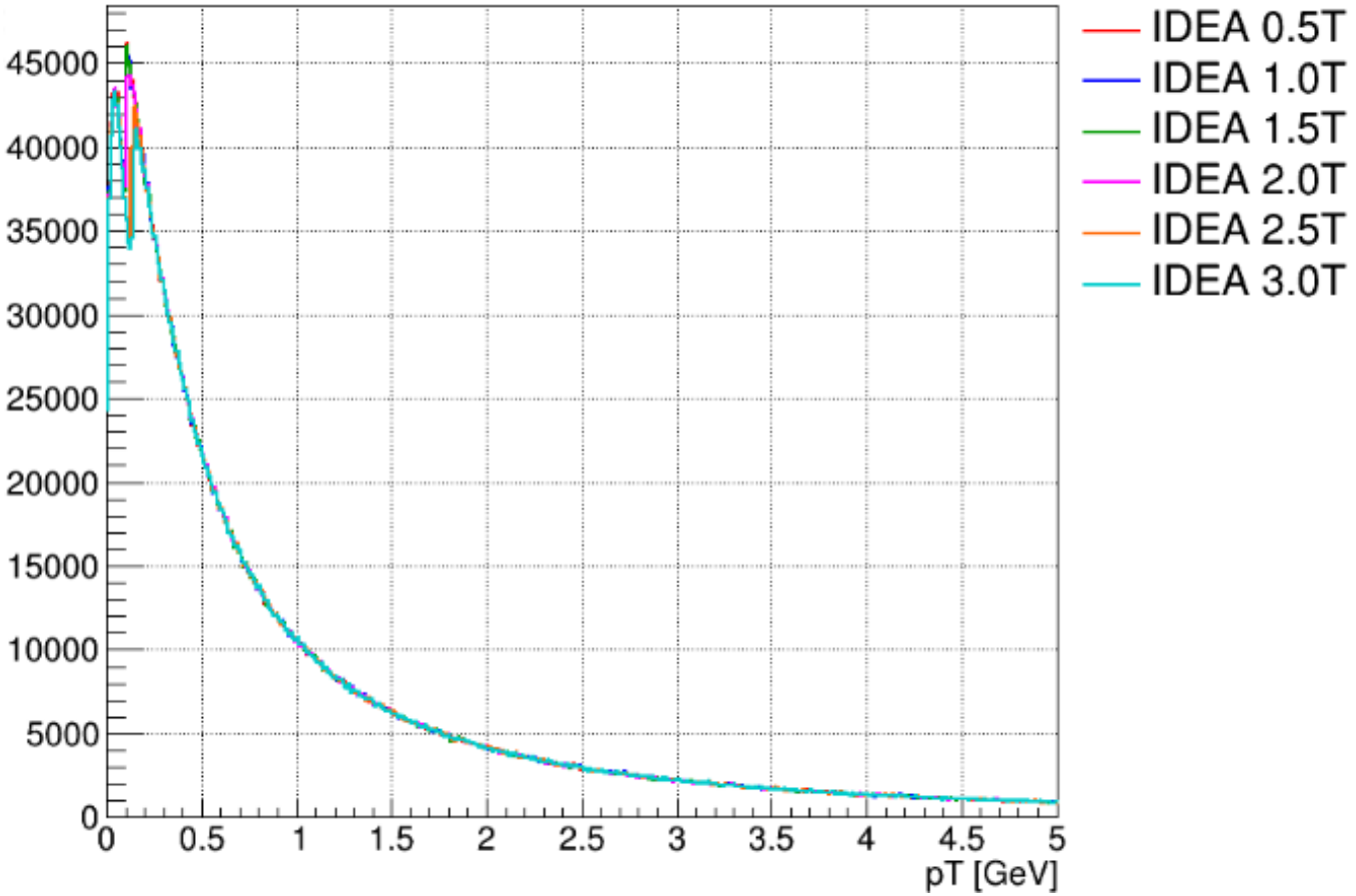
Particles loss

B [T]	p_T [GeV]	$p_T >$ thr.	$p_T <$ thr.	Lost [%]
1	0.34	1,563,731	389,827	19.95
2	0.68	1,189,472	764,086	39.11
3	1.01	947,575	1,005,983	51.49

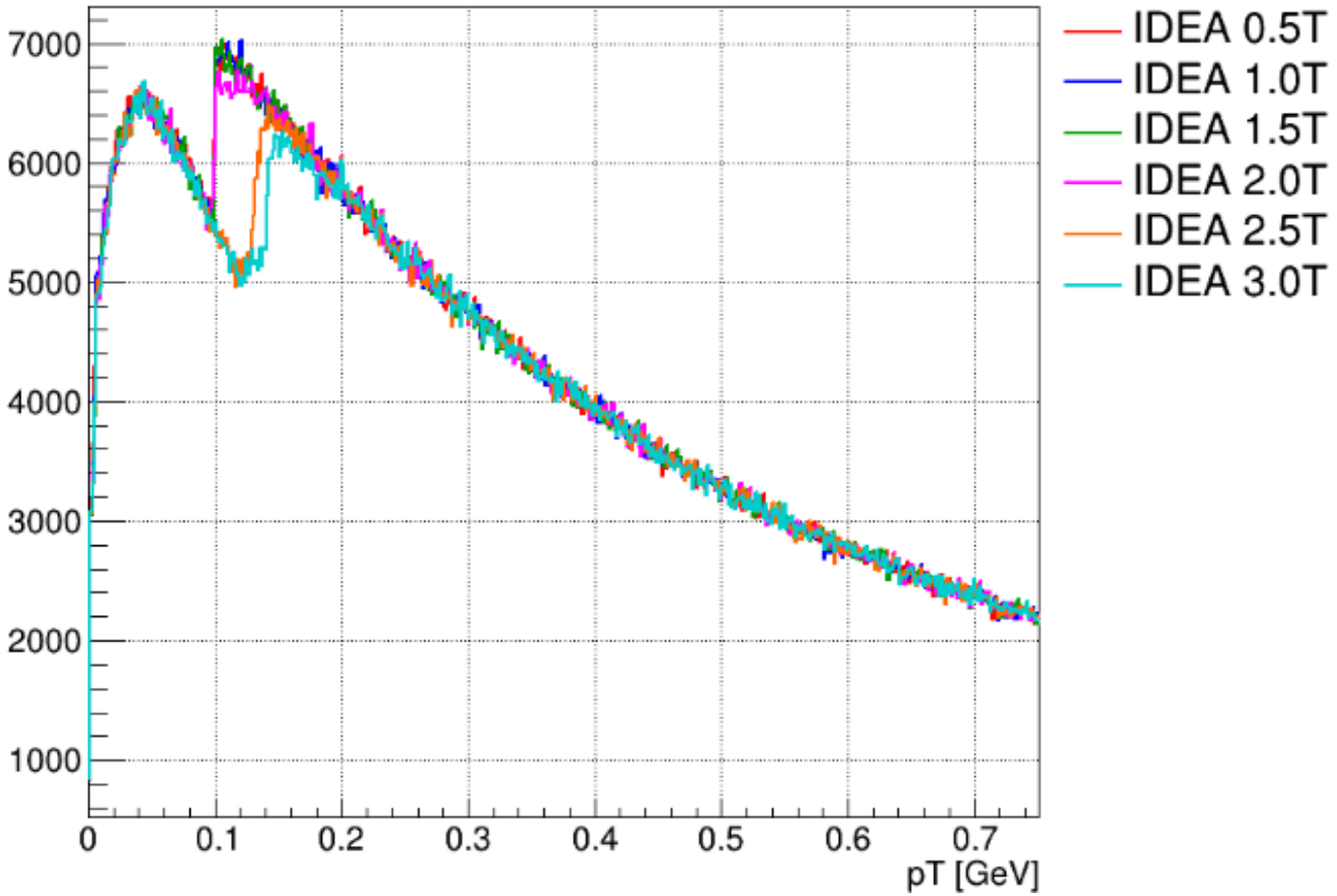
Average Final State Energy Loss (%) Per Event



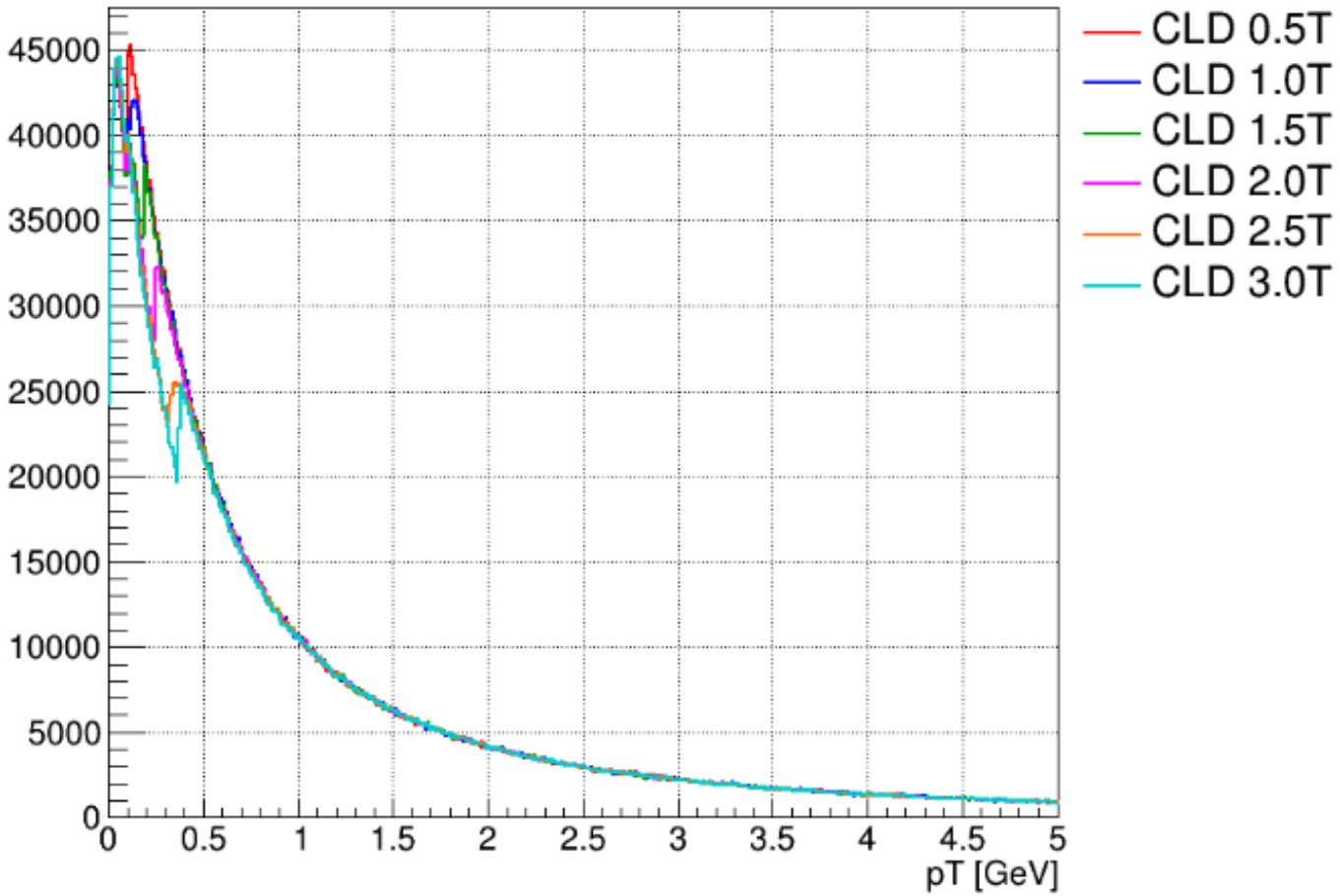
Number of Particles per pT (IDEA)



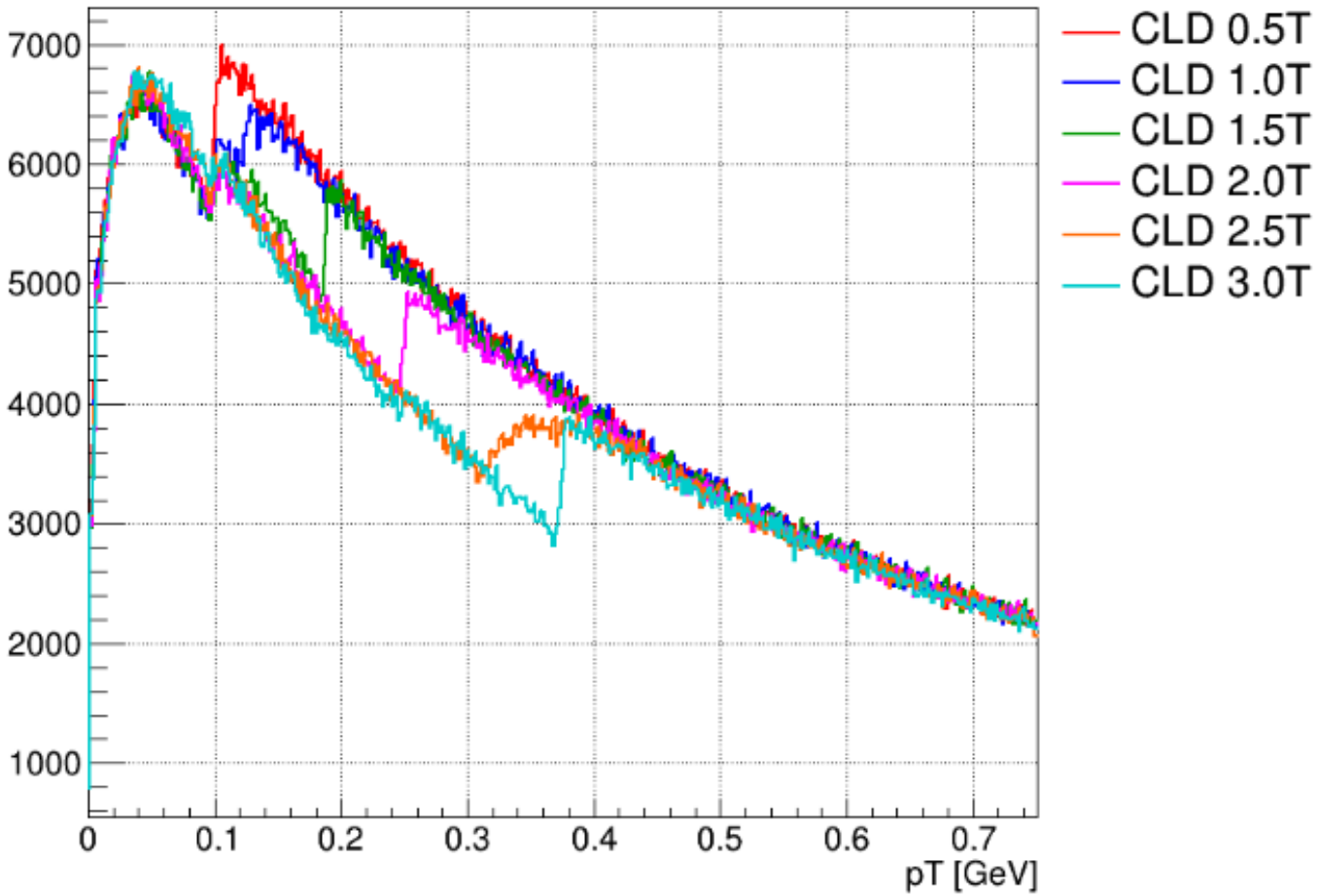
Number of Particles per pT (IDEA)



Number of Particles per pT (CLD)



Number of Particles per pT (CLD)



Why is CLD So Sensitive to B-fields?

Level Arm

- Tracker size:

$$\text{Lever arm} = 2.136\,\text{m} - 0.012\,\text{m} = 2.124\,\text{m}$$

- Strong B-field and low p_T decreases radius:

$$r = \frac{p_T}{0.3B} \quad \Rightarrow \quad \text{Low } p_T \Rightarrow \text{tighter curve}$$

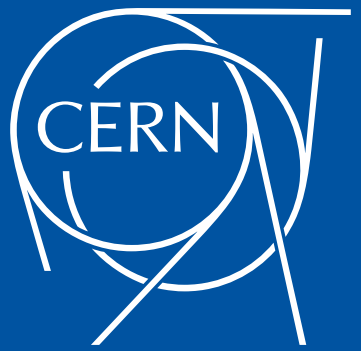
- Tracking requires 6 hits before calorimeter.
- Calorimeter radius starts at 2.25 m.

Why is CLD So Sensitive to B-fields?

Material budget

- A higher material budget produces more scattering which increases the path length.
- Effect enhanced for low p_T.
- We count active (flag $= 1$) and passive (flag $= 0$) layers under 2.25 m.
- Results:

$$\left(\frac{X}{X_0}\right)_{IDEA} = 0.1557; \quad \left(\frac{X}{X_0}\right)_{CLD} = 0.4575$$


CERN