

Studying the effect of the magnetic field on the momentum resolution and the hadronic resolution.

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1 $Z \rightarrow \mu\mu$ at 240 GeV

1.1 p resolution in CLD

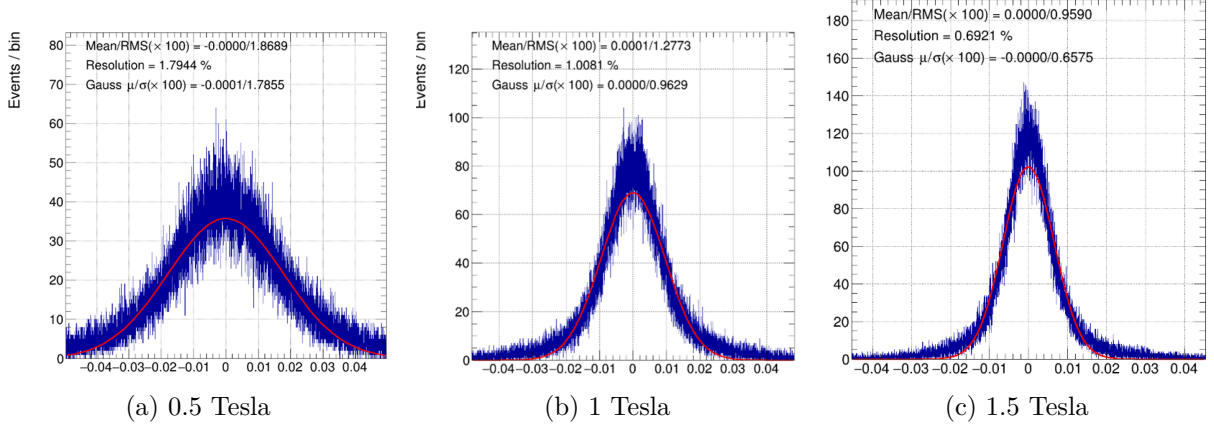


Figure 1: Momentum resolution in CLD

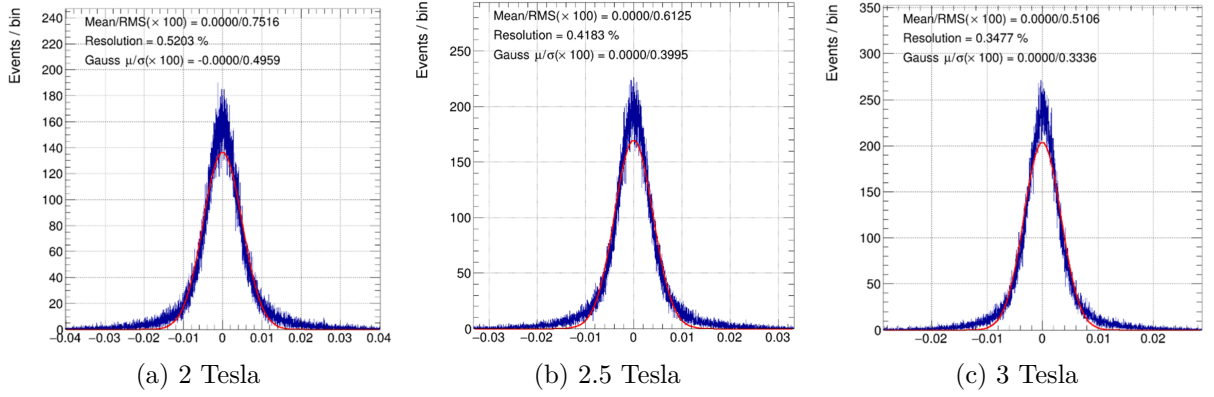


Figure 2: Momentum resolution in CLD

1.2 p_T resolution in CLD

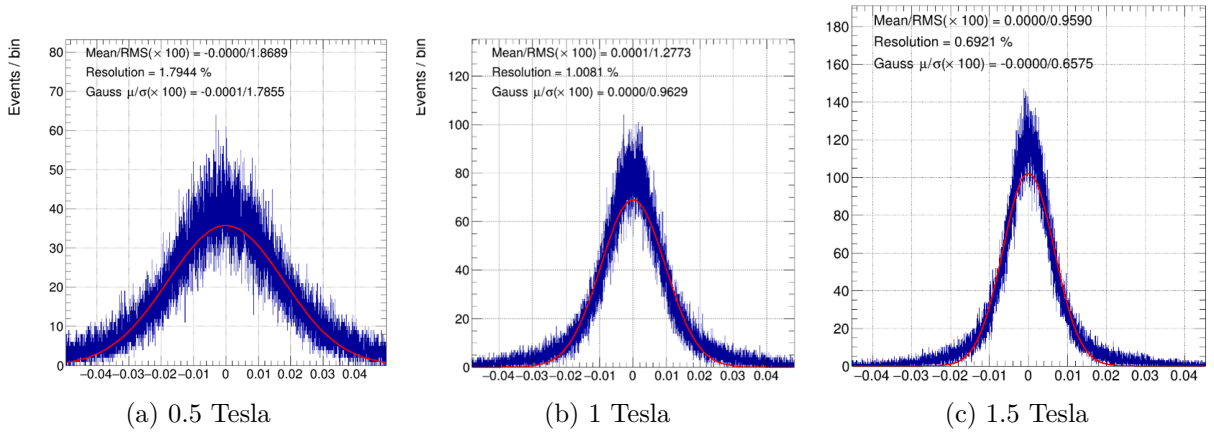


Figure 3: p_T resolution in CLD

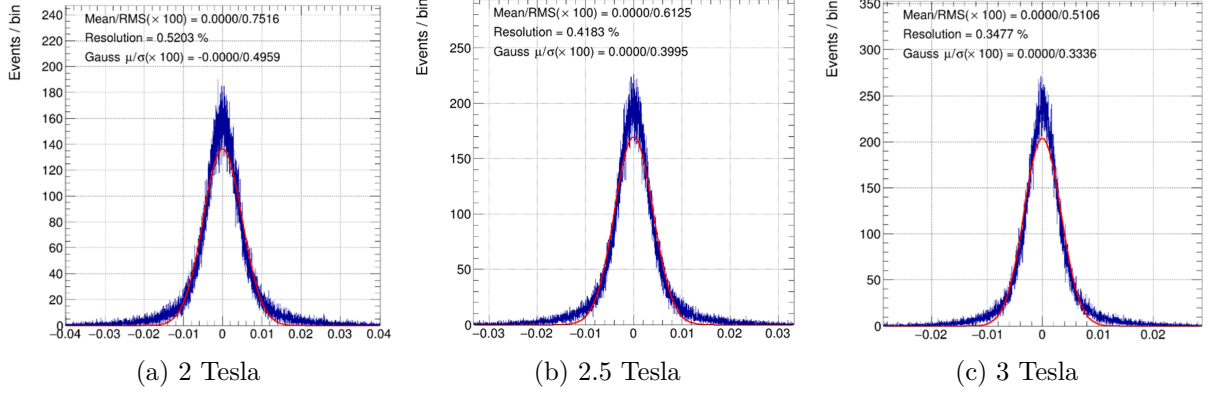


Figure 4: p_T resolution in CLD

1.3 k resolution in CLD

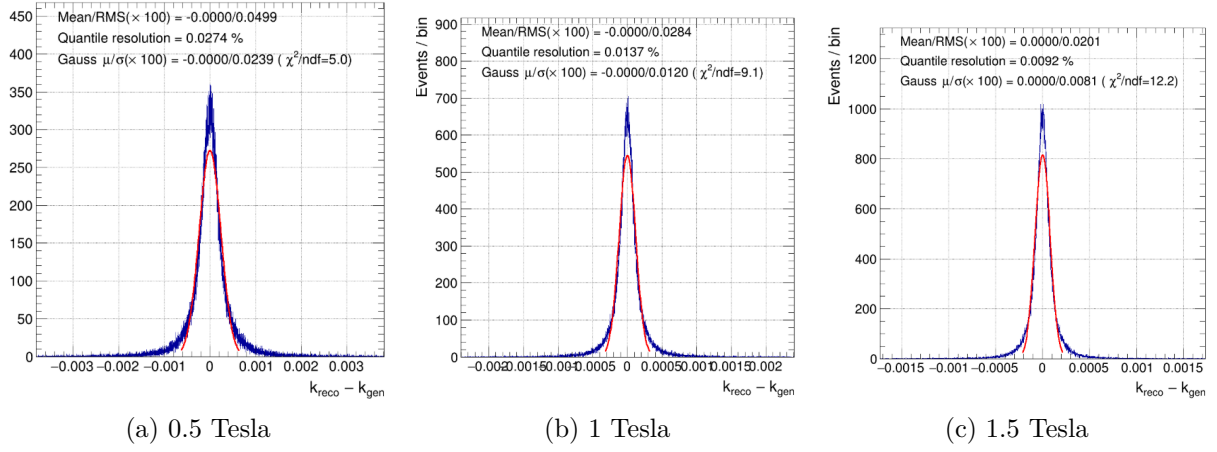


Figure 5: k resolution in CLD

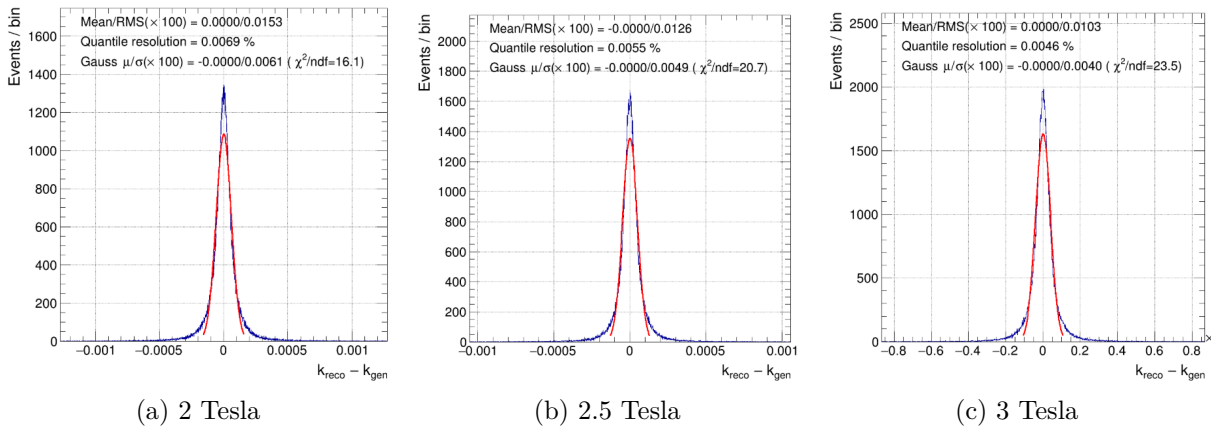


Figure 6: k resolution in CLD

1.4 p resolution in IDEA

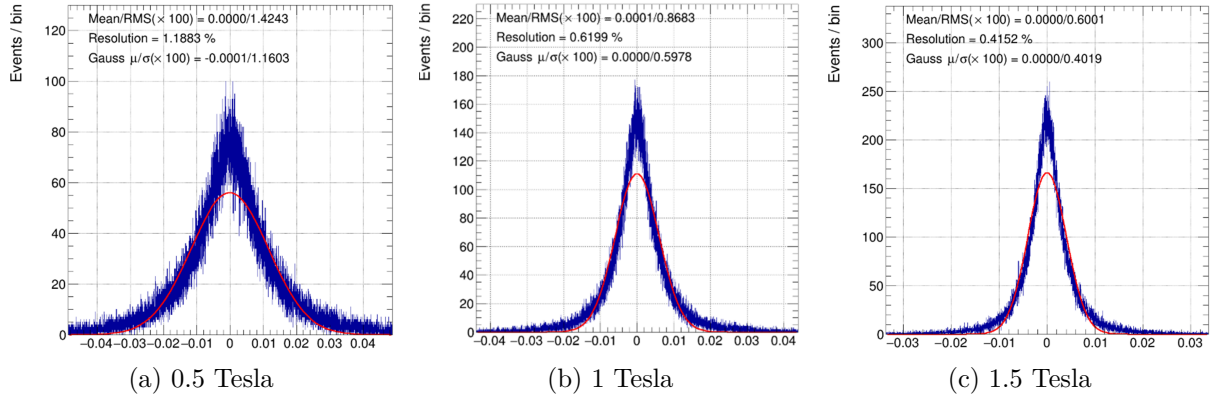


Figure 7: Momentum resolution in IDEA

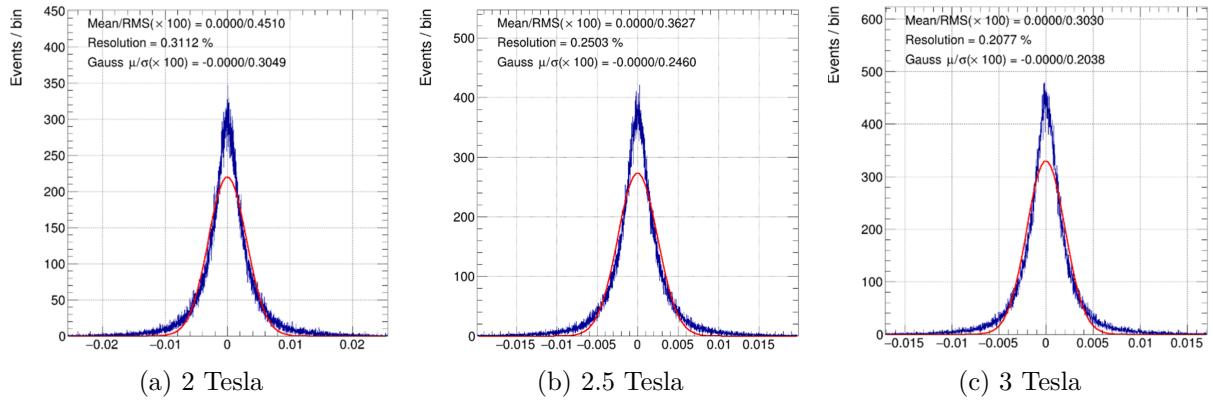


Figure 8: Momentum resolution in IDEA

1.5 p_T resolution in IDEA

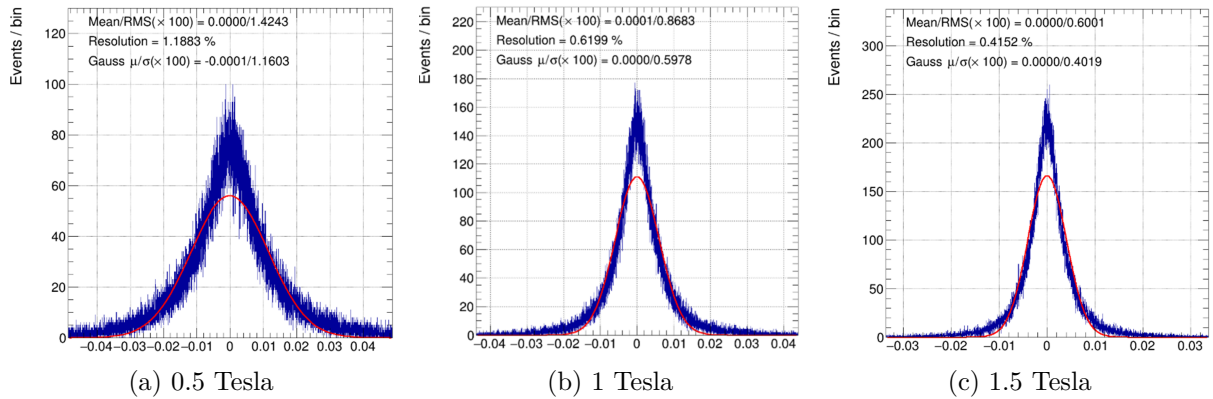


Figure 9: p_T resolution in IDEA

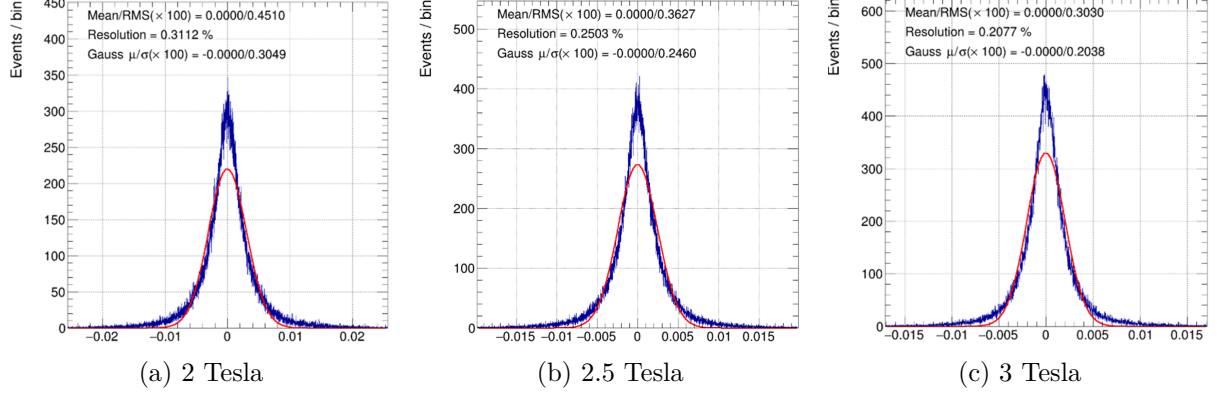


Figure 10: p_T resolution in IDEA

1.6 k resolution in IDEA

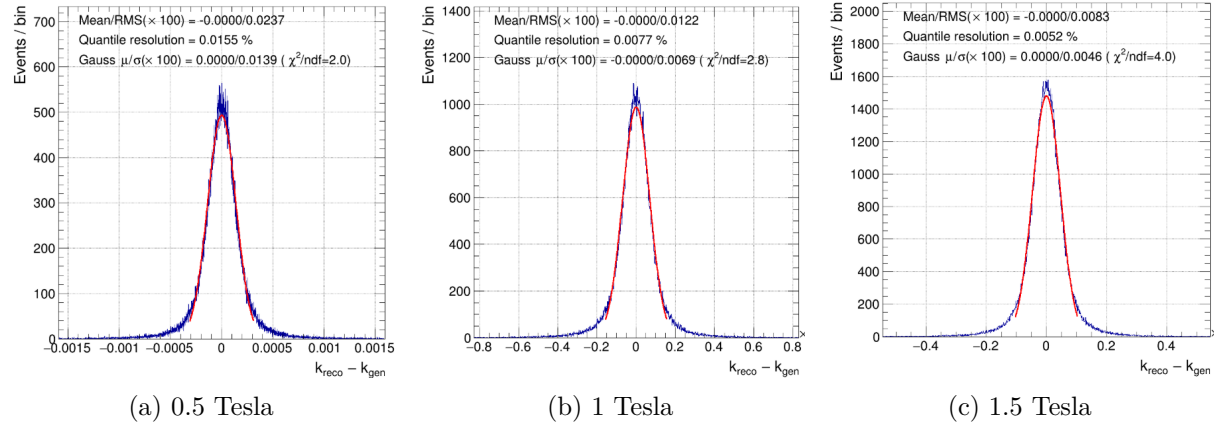


Figure 11: k resolution in IDEA

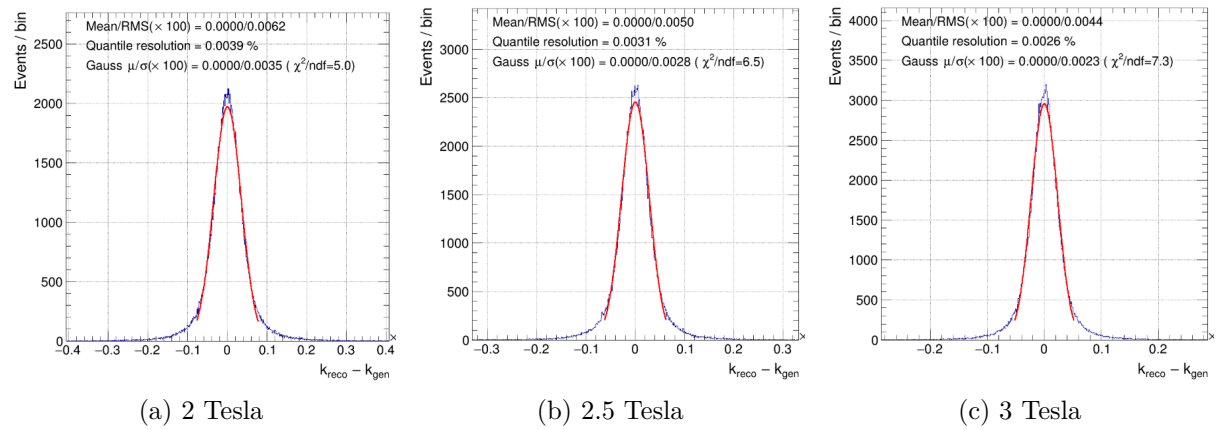


Figure 12: k resolution in IDEA

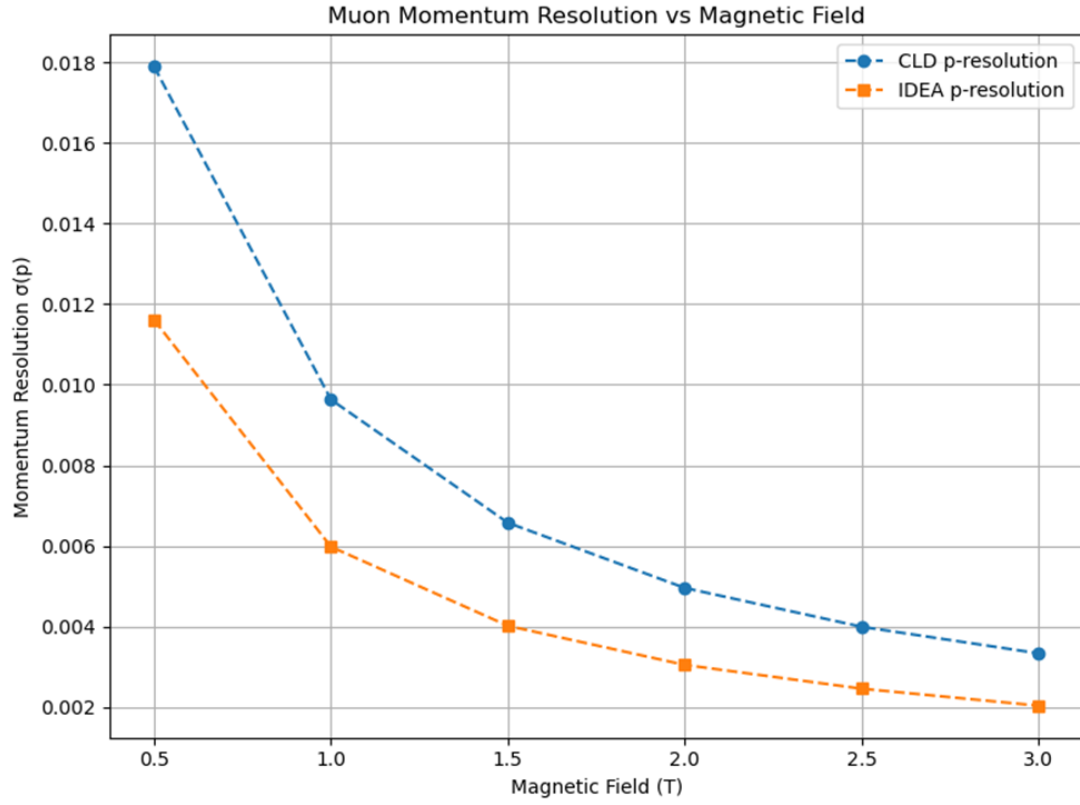


Figure 13: Summary: $Z \rightarrow \mu\mu$

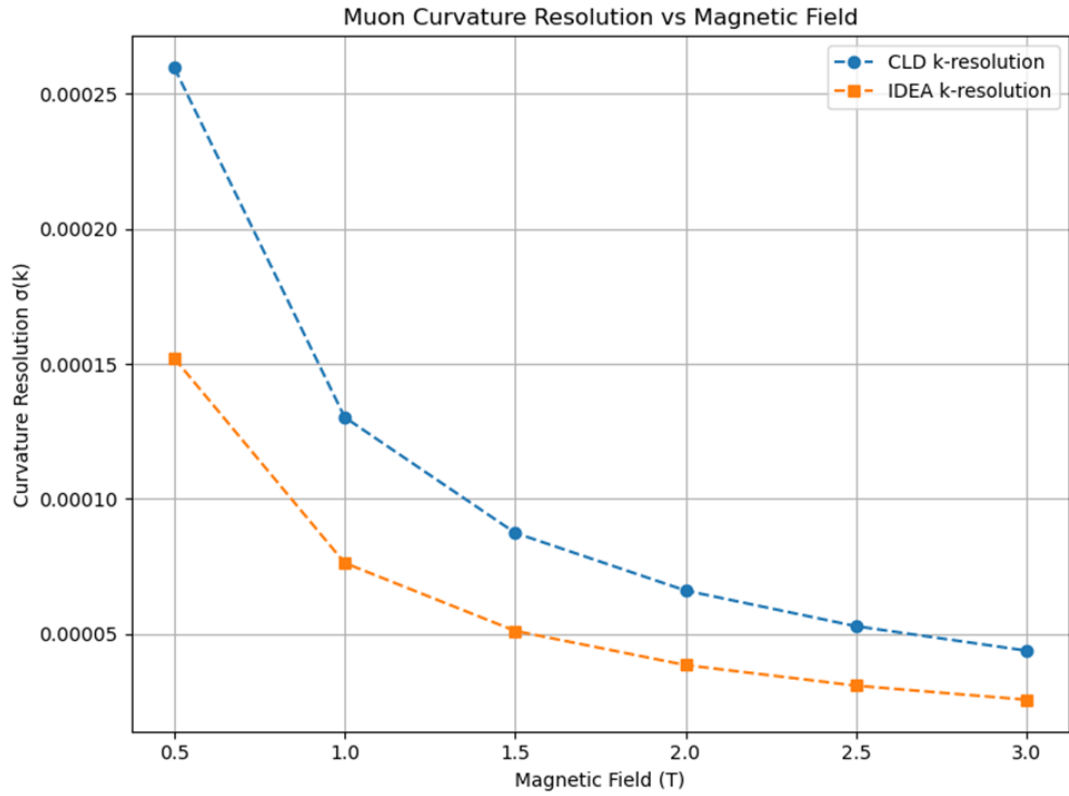


Figure 14: Curvature resolution summary

2 $Z \rightarrow uu$ at 91.2 GeV

2.1 Numbers of particles

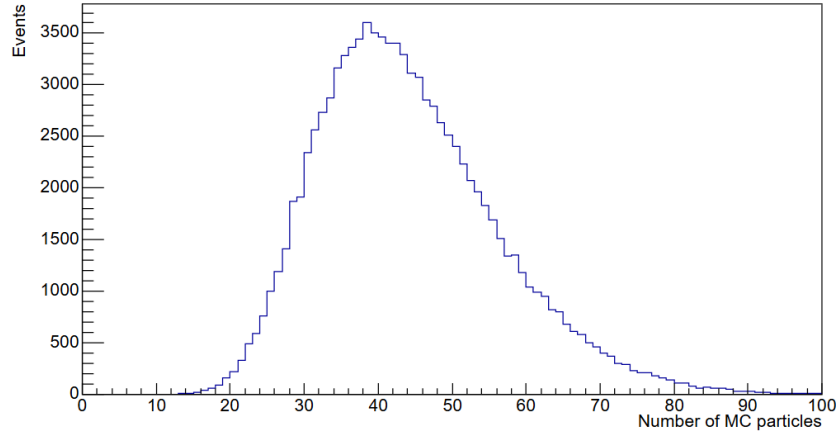


Figure 15: Number of MC particles in CLD and IDEA

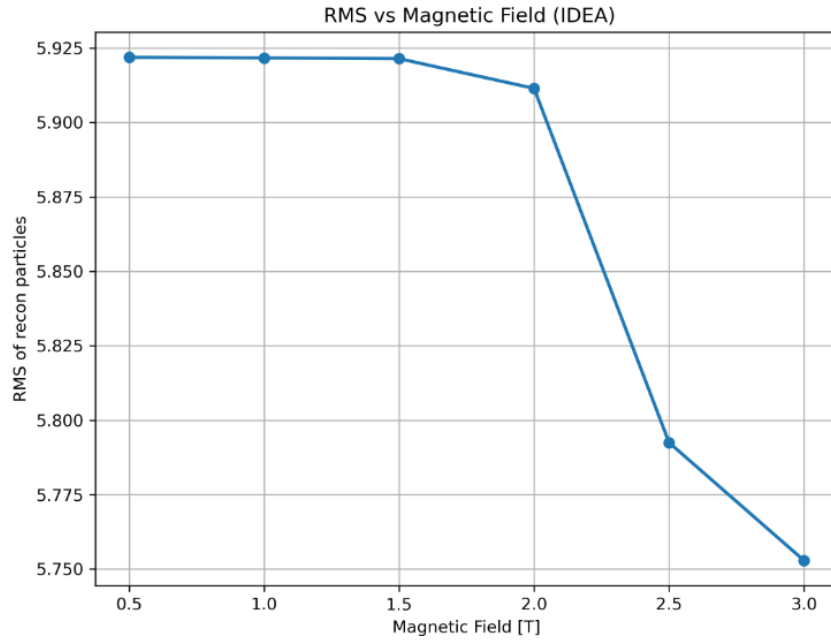


Figure 16: Number of reconstructed particles (IDEA)

2.2 Reco multiplicities per field

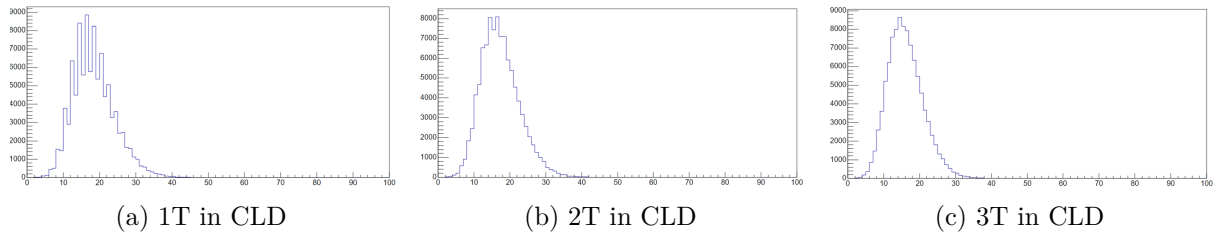


Figure 18: Reconstructed particles (CLD)

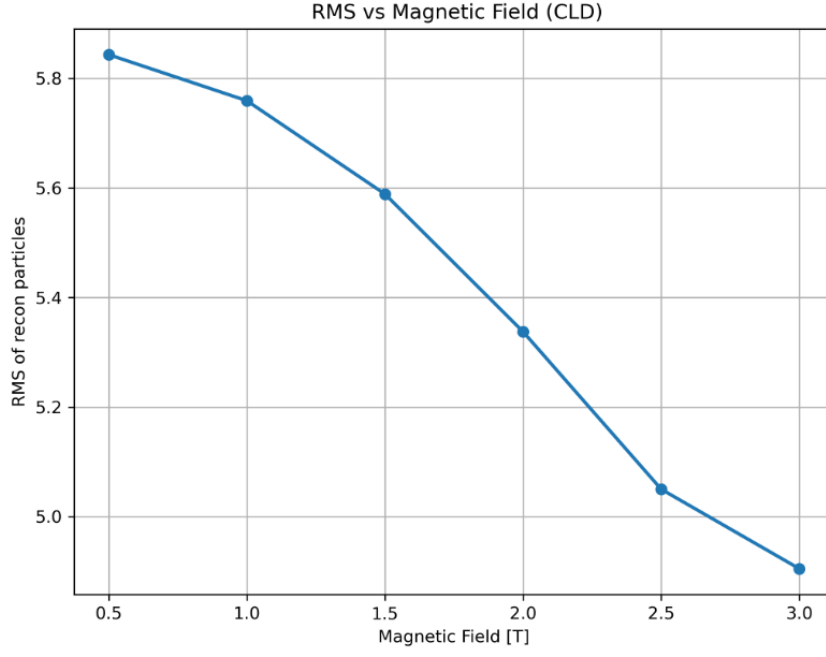


Figure 17: Number of reconstructed particles (CLD)

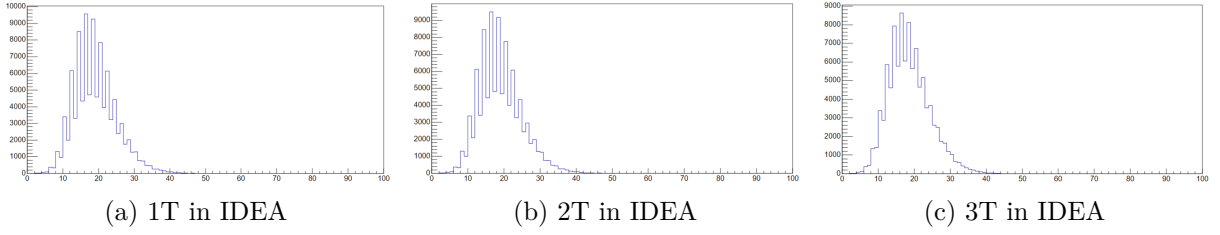


Figure 19: Reconstructed particles (IDEA)

2.3 θ resolution in IDEA

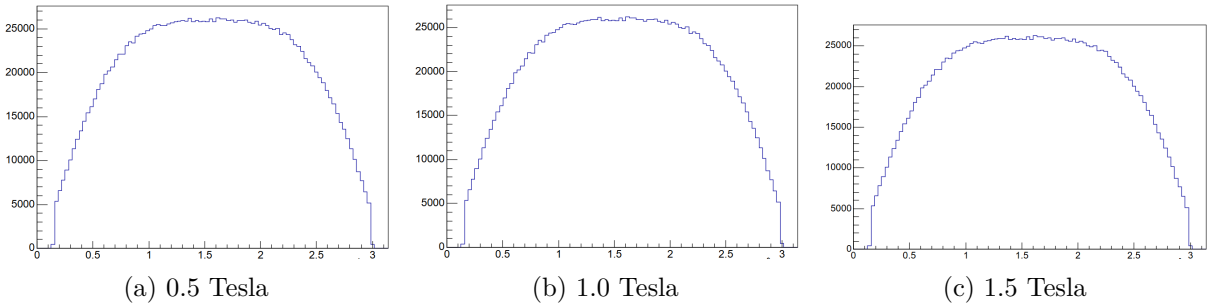


Figure 24: θ resolution in IDEA (0.5–1.5 T)

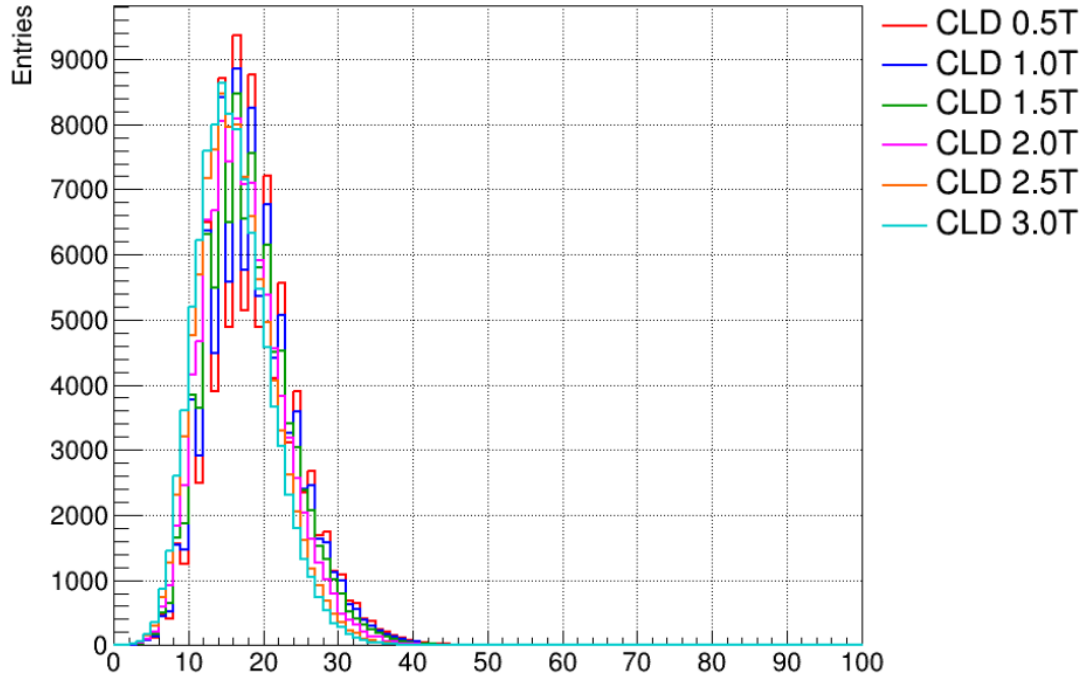


Figure 20: All reconstructed particles (CLD)

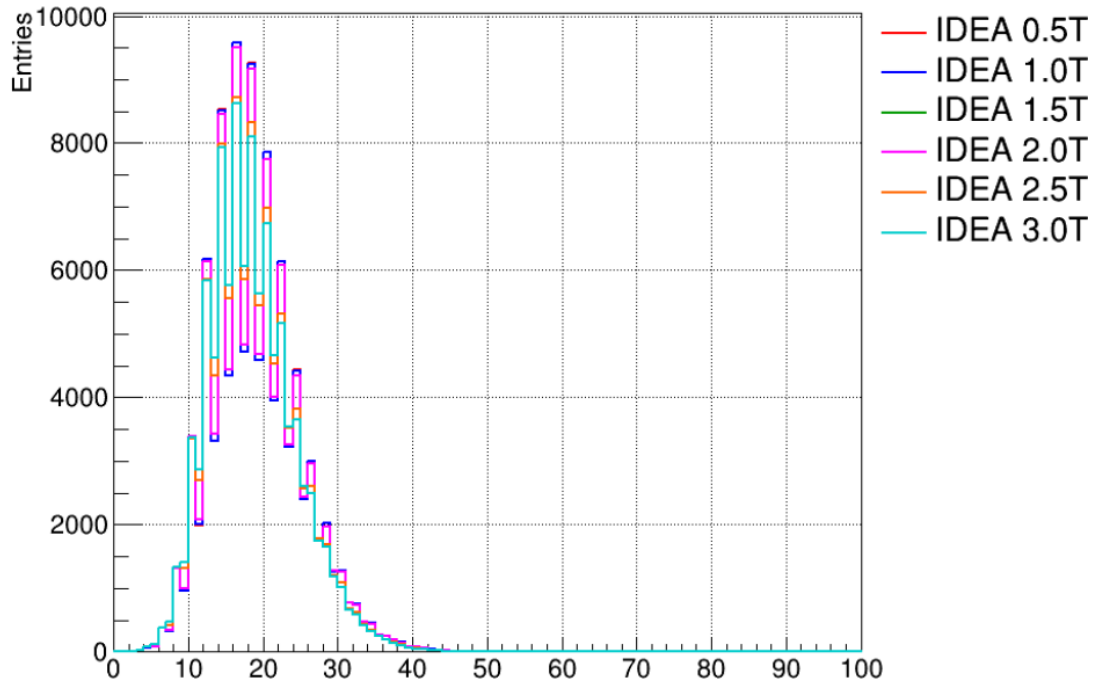


Figure 21: All reconstructed particles (IDEA)

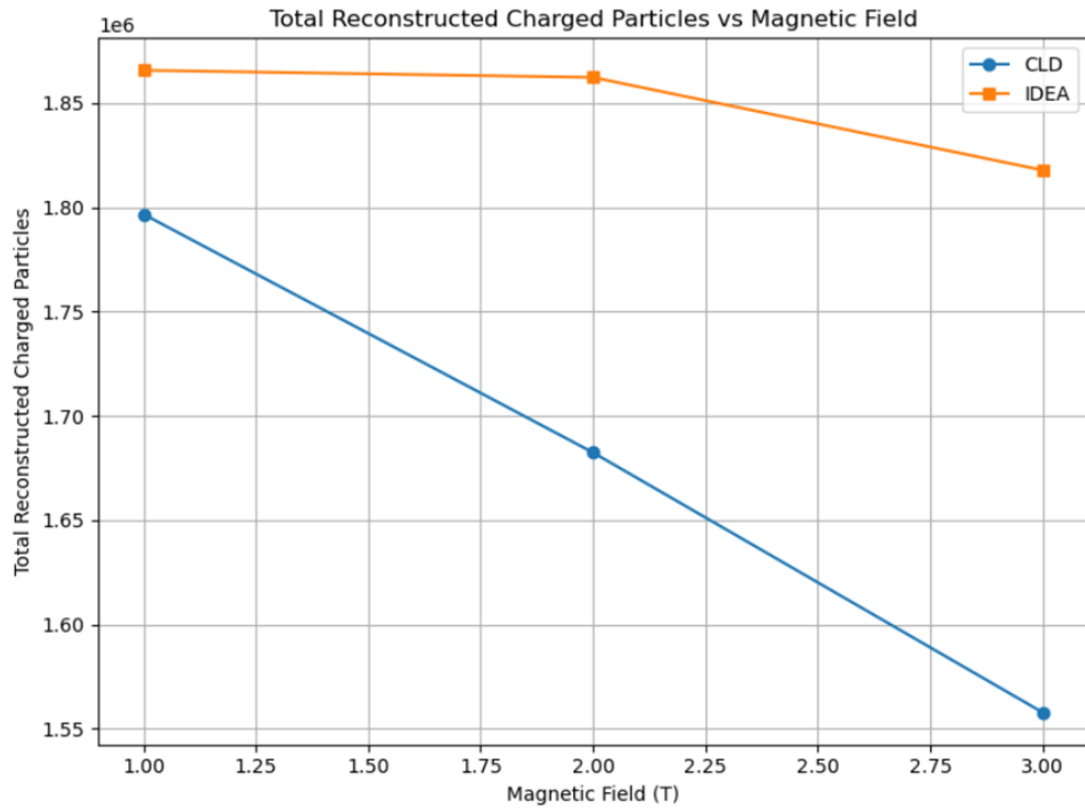


Figure 22: Total reconstructed particles

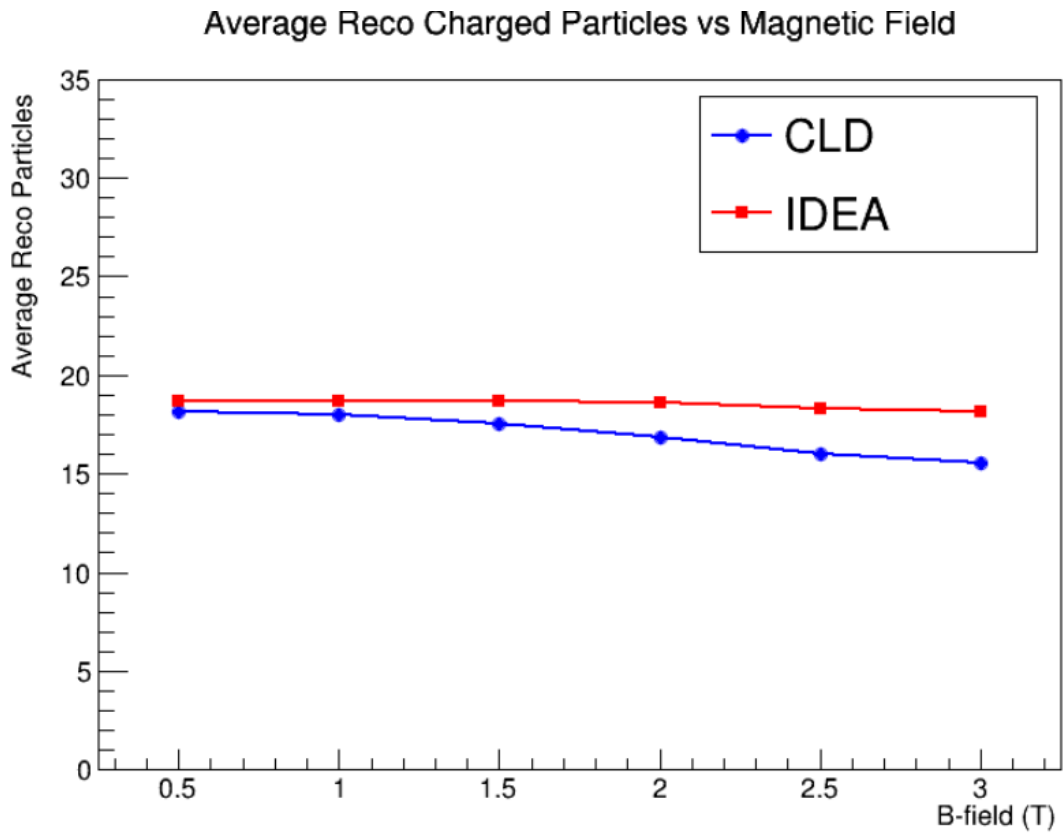


Figure 23: Average reconstructed particles vs. B

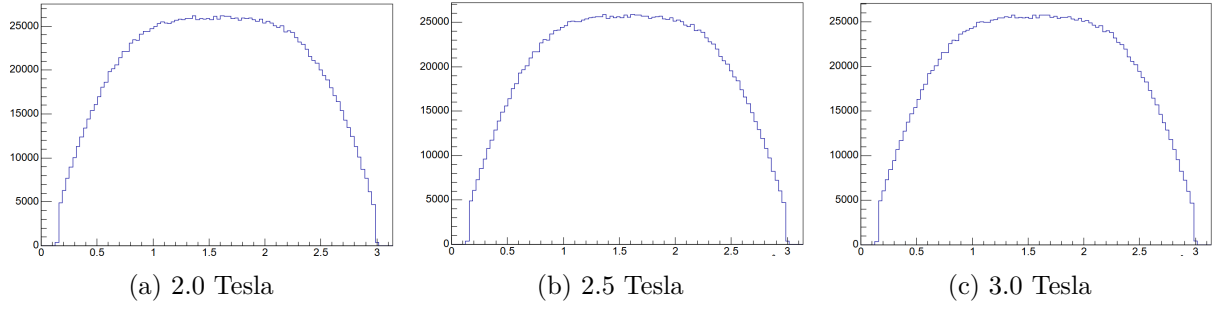


Figure 25: θ resolution in IDEA (2.0–3.0 T)

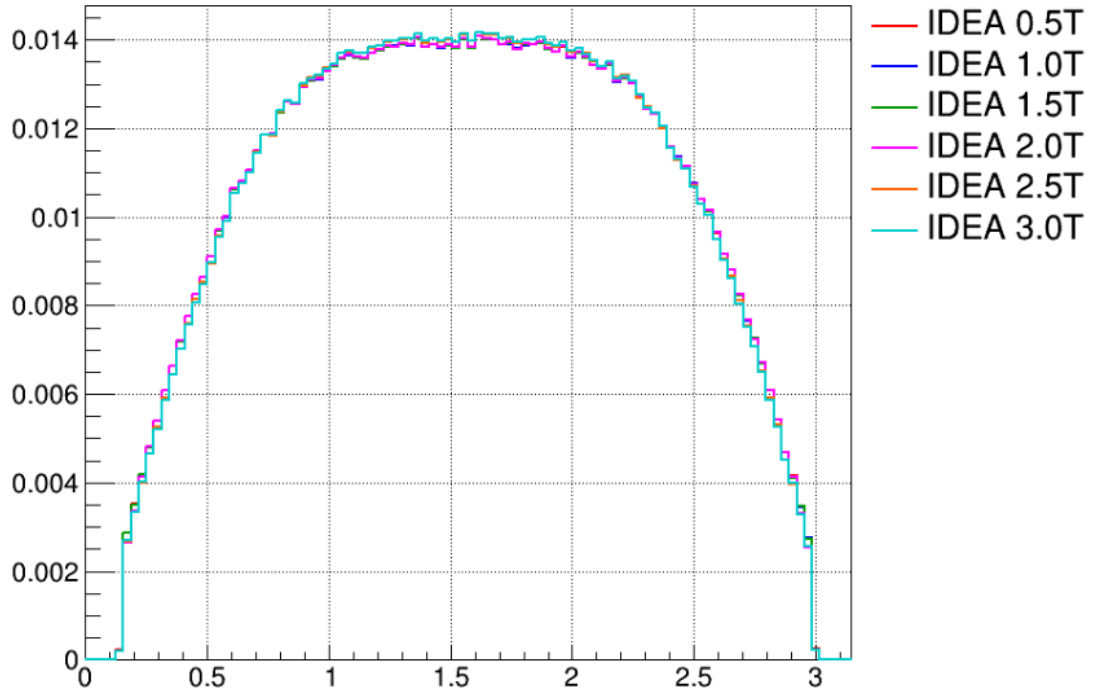


Figure 26: θ resolution (IDEA, normalized)

2.4 $\cos\theta$ resolution in IDEA

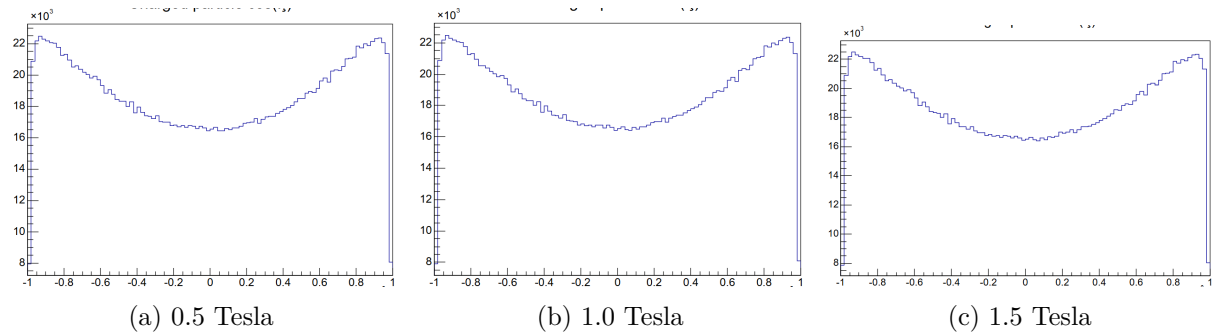


Figure 27: $\cos\theta$ resolution in IDEA (0.5–1.5 T)

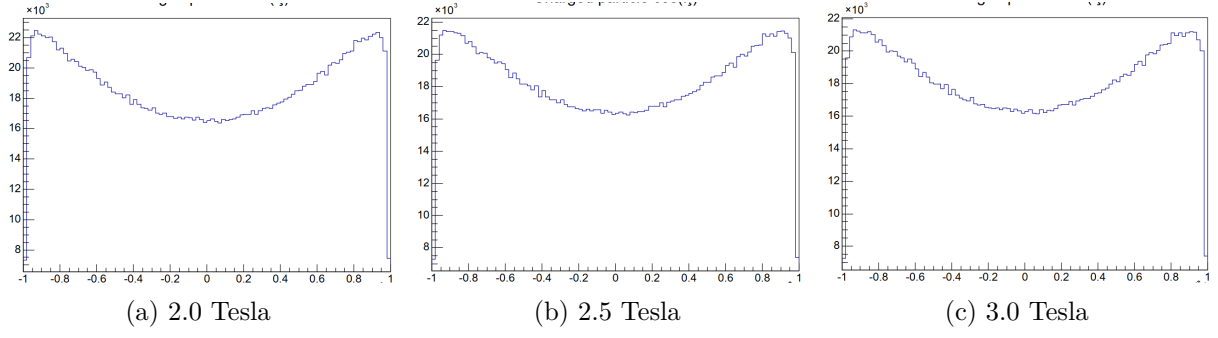


Figure 28: $\cos \theta$ resolution in IDEA (2.0–3.0 T)

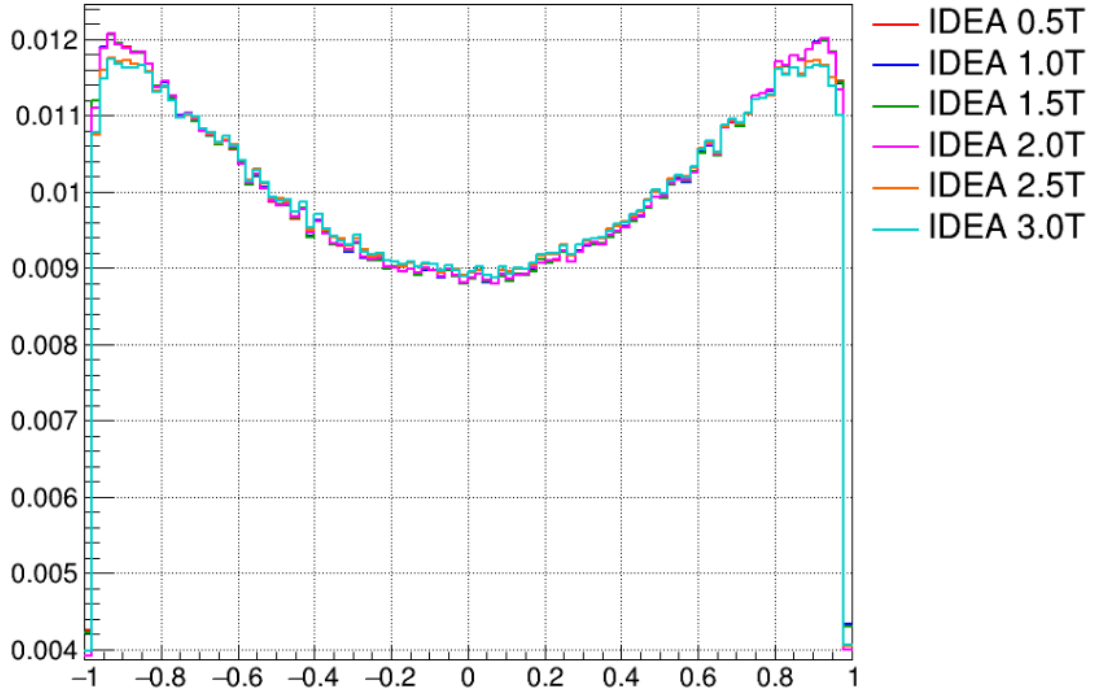


Figure 29: $\cos \theta$ resolution (IDEA, normalized)

2.5 θ resolution in CLD

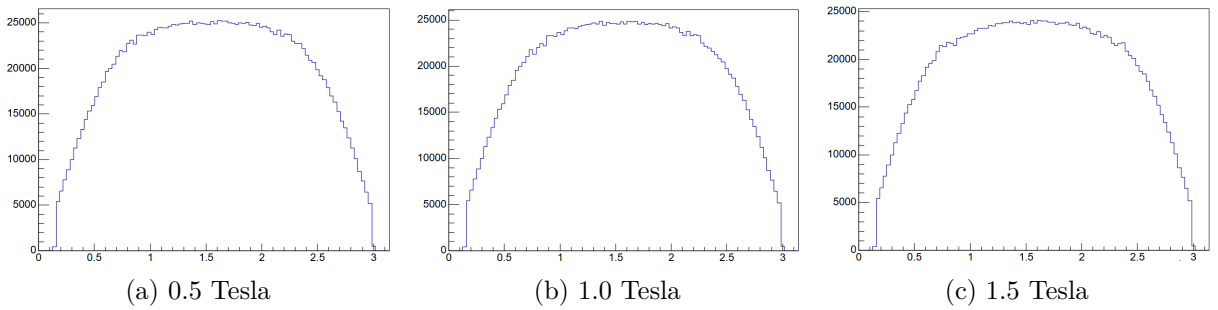


Figure 30: θ resolution in CLD (0.5–1.5 T)

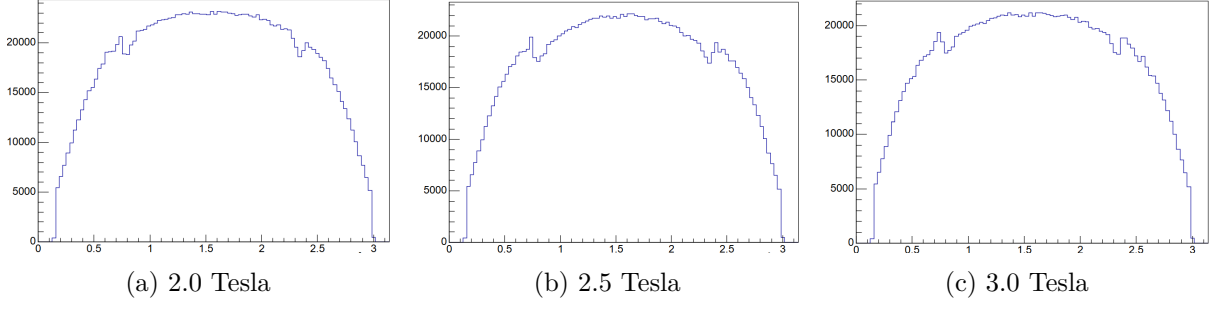


Figure 31: θ resolution in CLD (2.0–3.0 T)

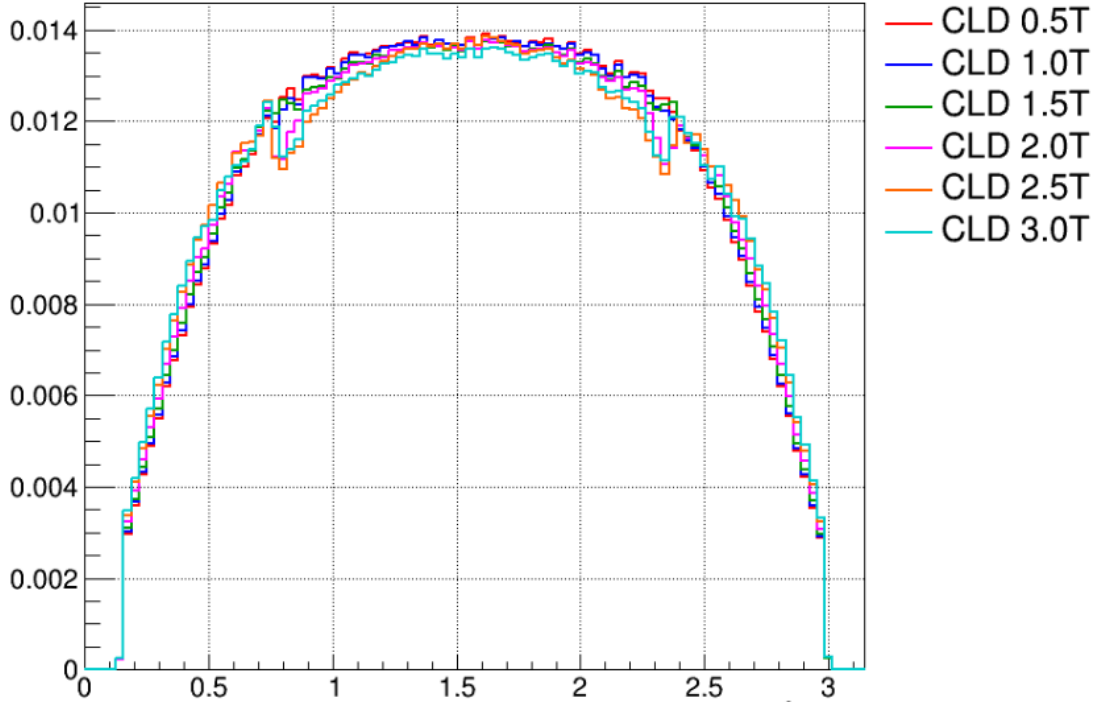


Figure 32: θ resolution (CLD, normalized)

2.6 $\cos \theta$ resolution in CLD

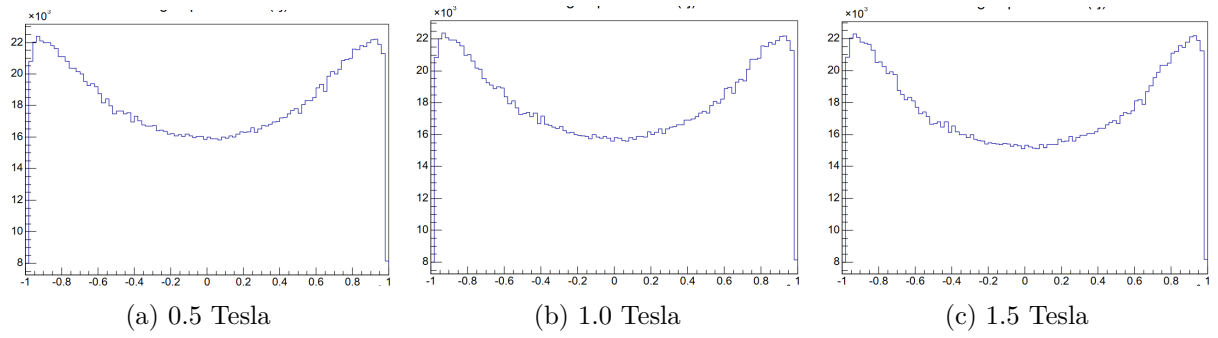


Figure 33: $\cos \theta$ resolution in CLD (0.5–1.5 T)

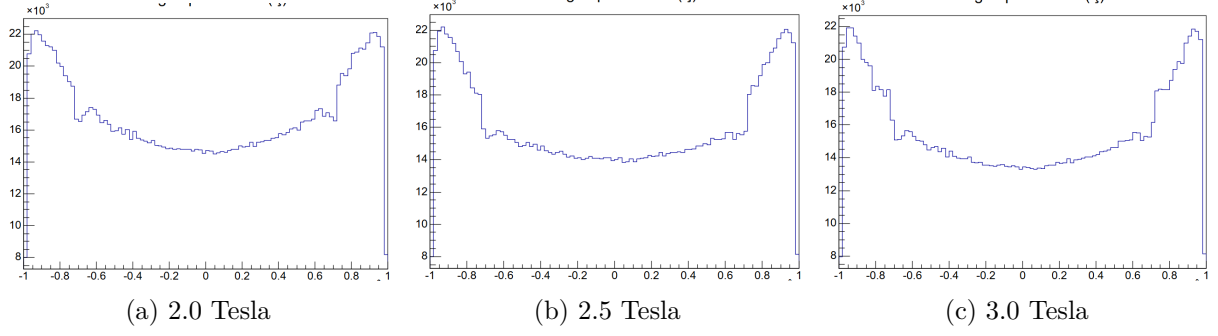


Figure 34: $\cos \theta$ resolution in CLD (2.0–3.0 T)

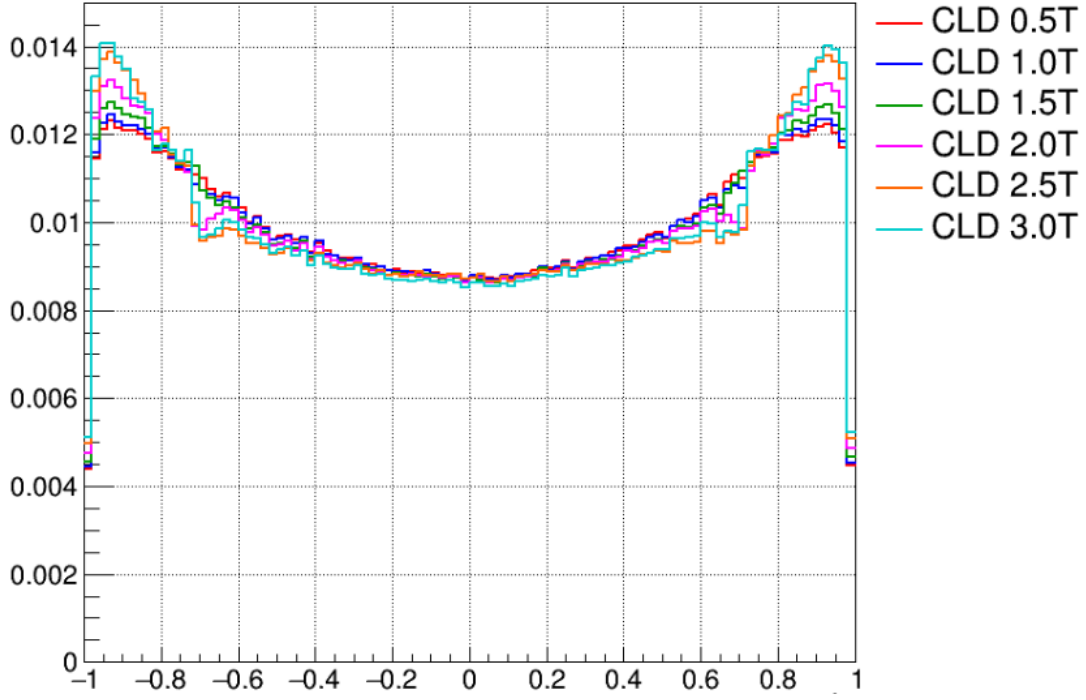


Figure 35: $\cos \theta$ resolution (CLD, normalized)

2.7 Momentum resolution summaries

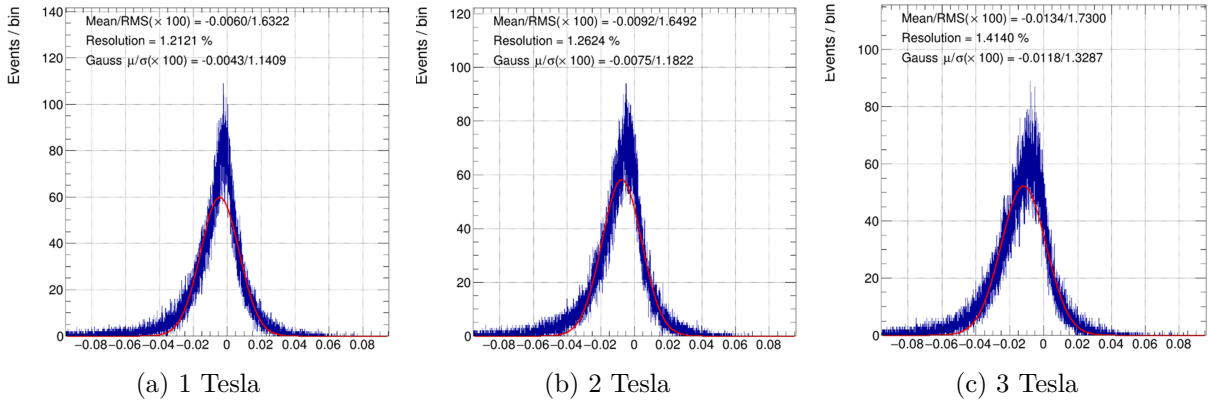


Figure 36: Momentum resolution in CLD

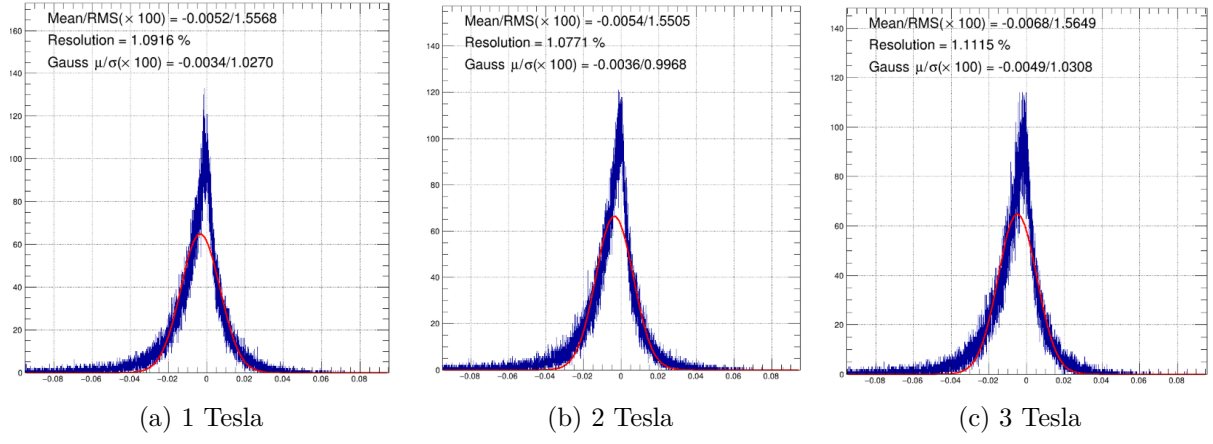


Figure 37: Momentum resolution in IDEA

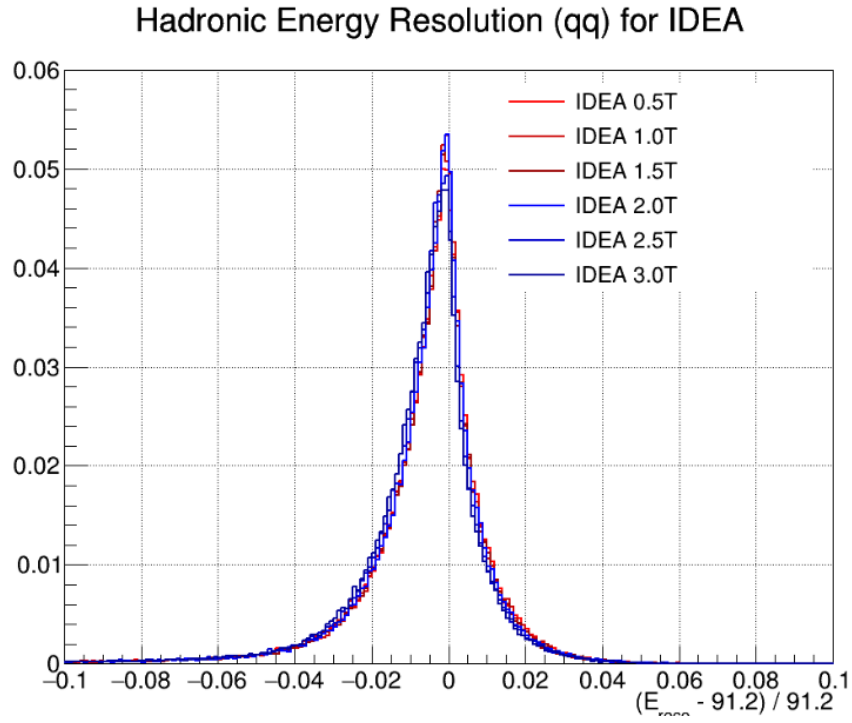


Figure 38: Hadronic energy resolution (normalized)

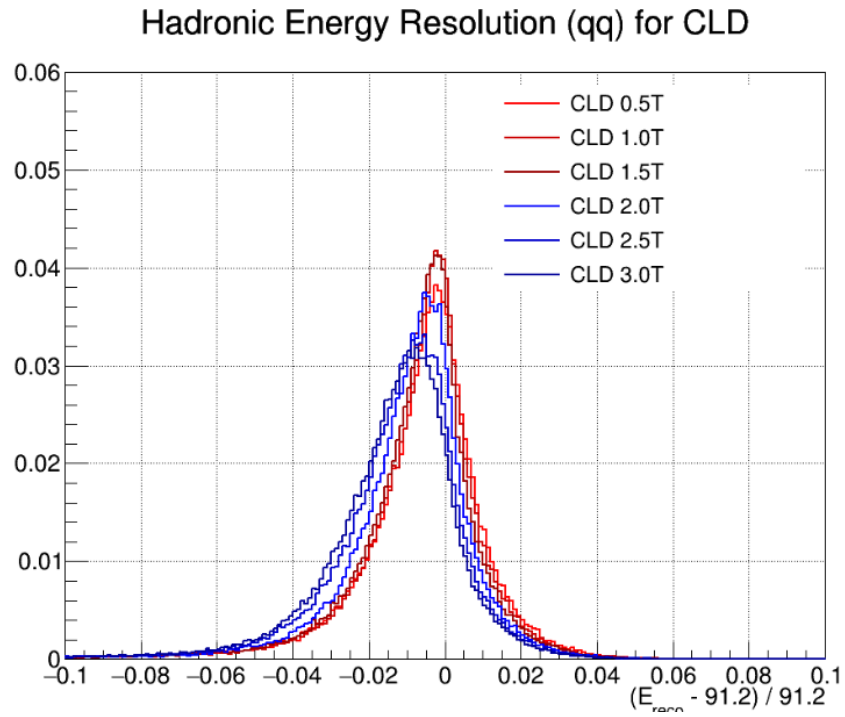


Figure 39: Hadronic energy resolution (CLD, normalized)

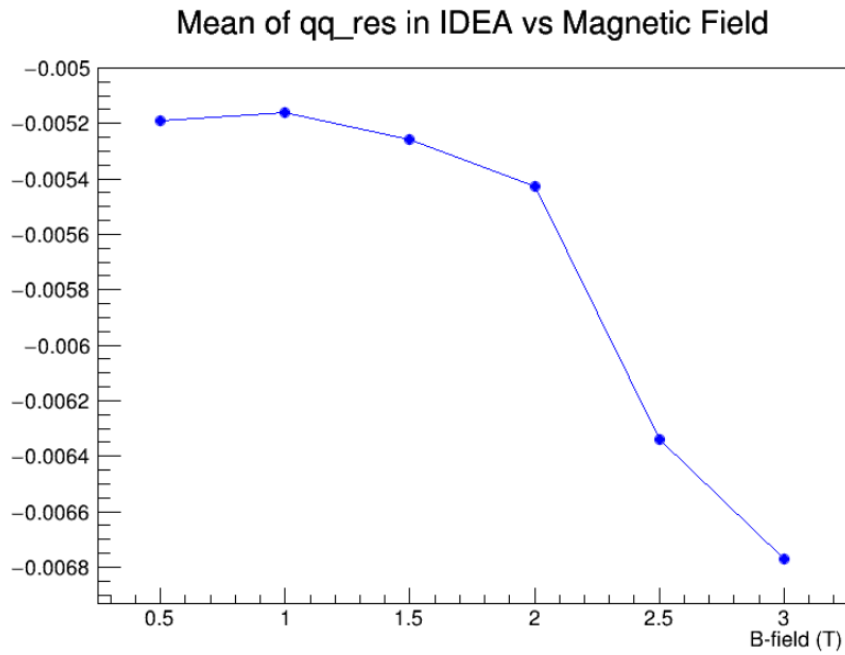


Figure 40: Mean resolution (IDEA)

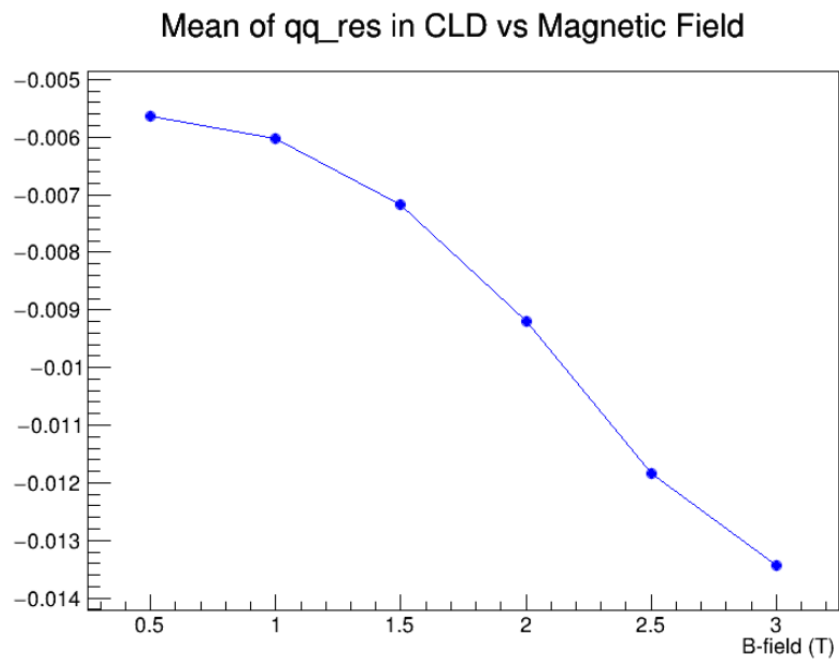


Figure 41: Mean resolution (CLD)

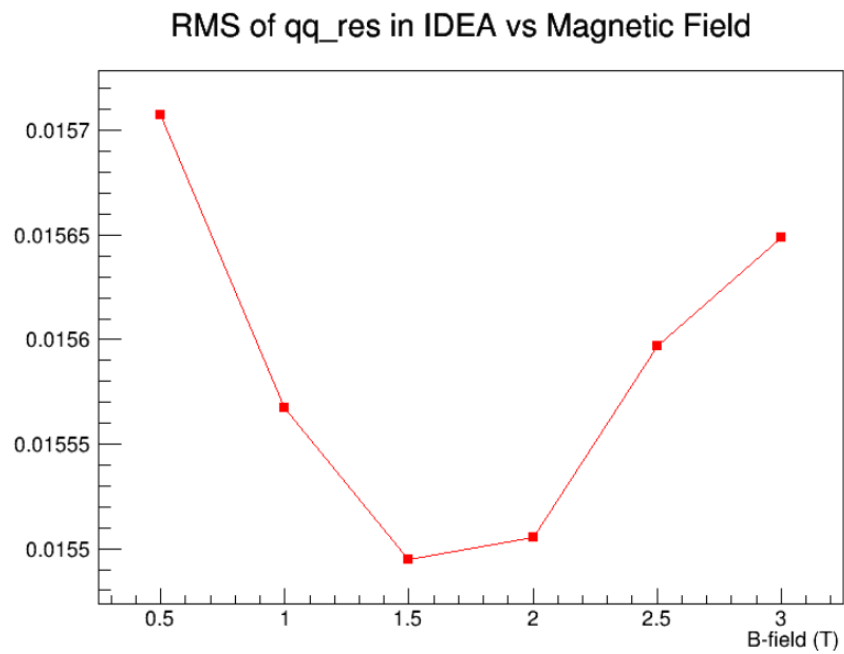


Figure 42: RMS resolution (IDEA)

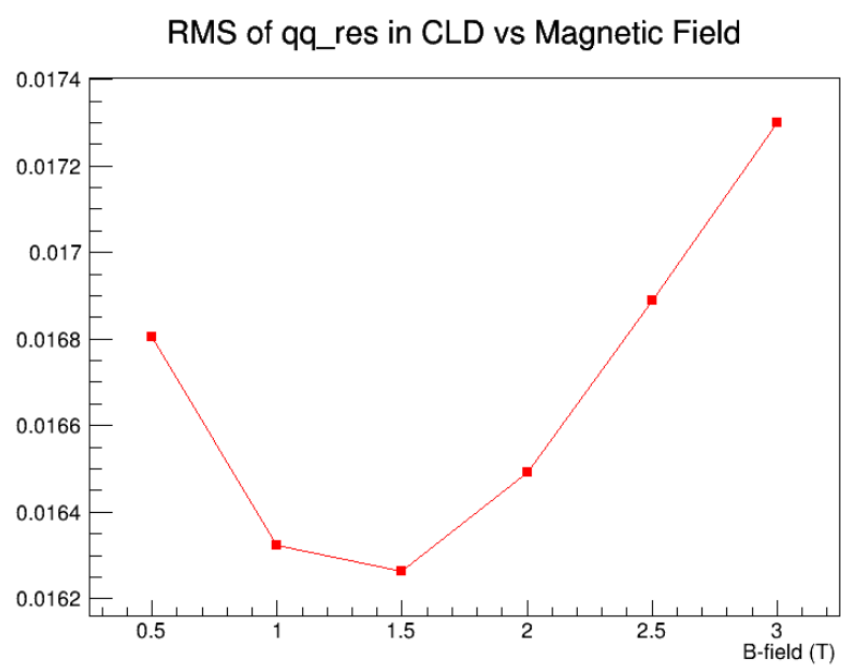


Figure 43: RMS resolution (CLD)

2.8 # particles per $|\cos(\theta_C)|$ (CLD)

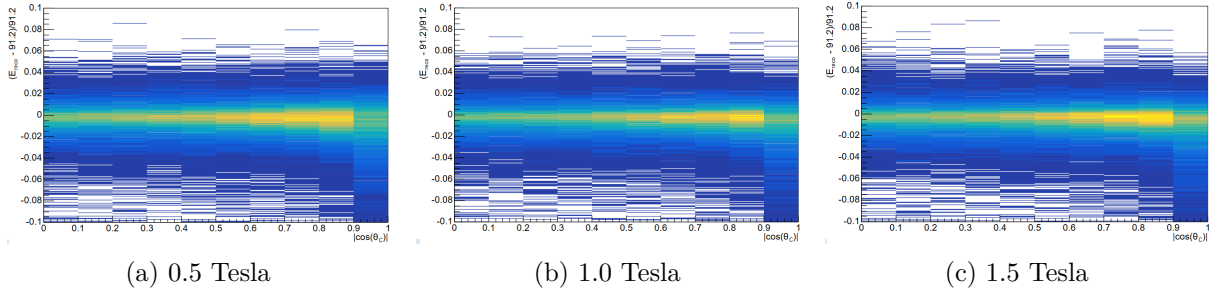


Figure 44: # particles per $|\cos(\theta_C)|$ in CLD (0.5–1.5 T)

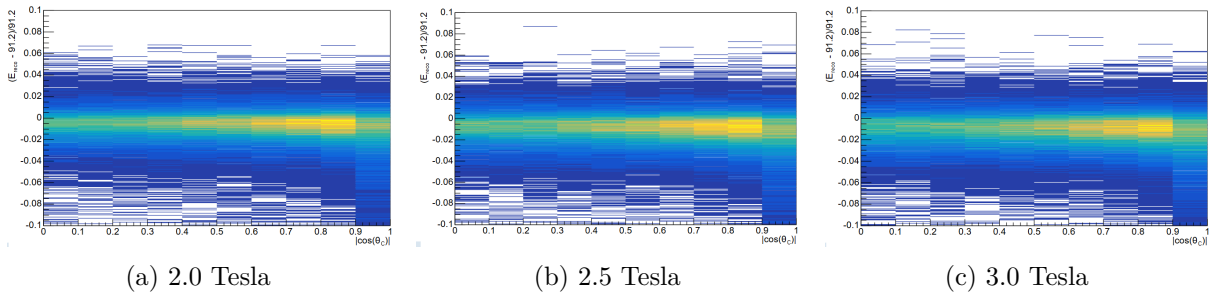


Figure 45: # particles per $|\cos(\theta_C)|$ in CLD (2.0–3.0 T)

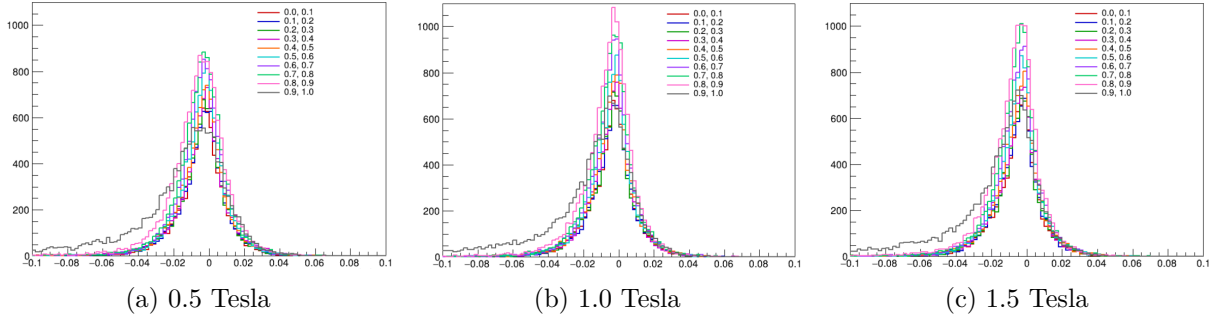


Figure 46: Resolution per $|\cos(\theta_C)|$ in CLD (0.5–1.5 T)

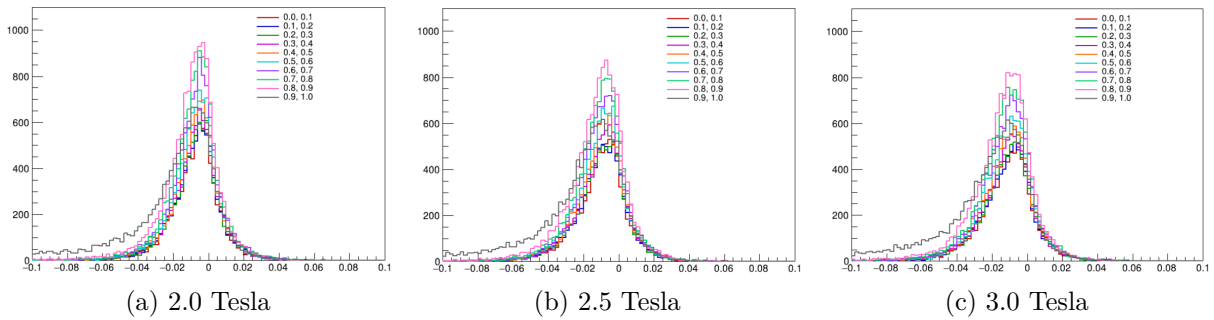


Figure 47: Resolution per $|\cos(\theta_C)|$ in CLD (2.0–3.0 T)

Conclusions (CLD)

- Worse resolution at high $|\cos(\theta_C)|$ (worst zone).
- Narrower at low $|\cos(\theta_C)|$ (best detector zones).
- Packed/underestimated resolution at $0.7 < |\cos(\theta_C)| < 0.9$.
- Best resolution at 1.0 T (consistent with hadronic resolution for CLD).

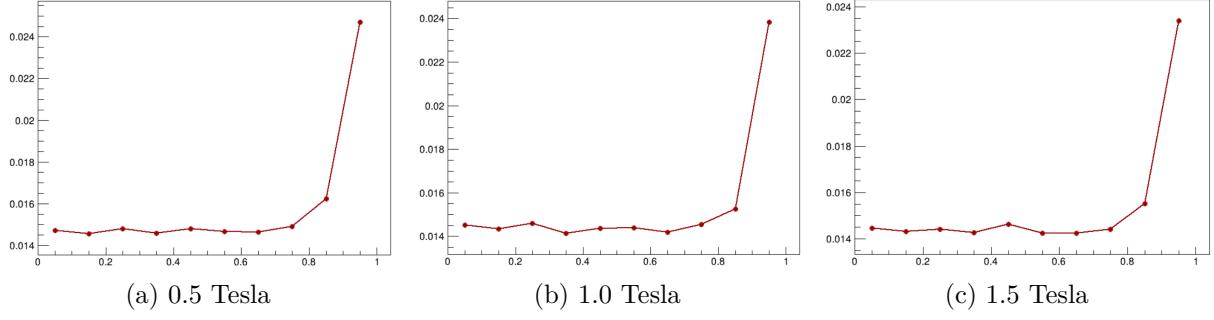


Figure 48: RMS per $|\cos(\theta_C)|$ in CLD (0.5–1.5 T)

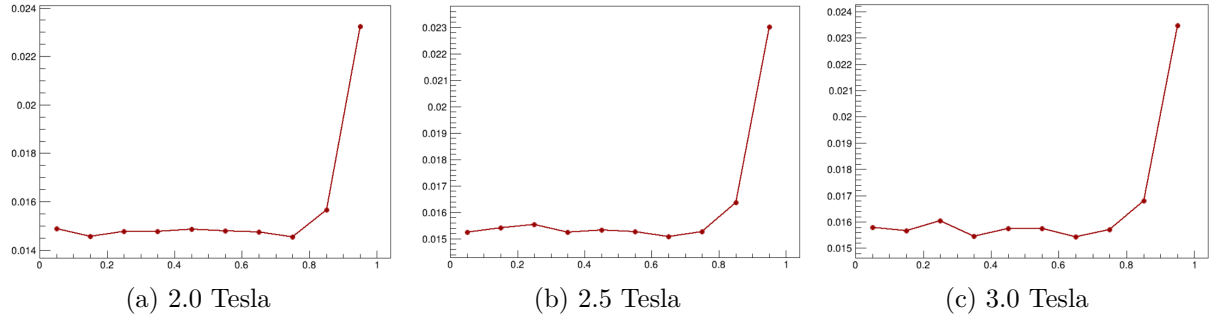


Figure 49: RMS per $|\cos(\theta_C)|$ in CLD (2.0–3.0 T)

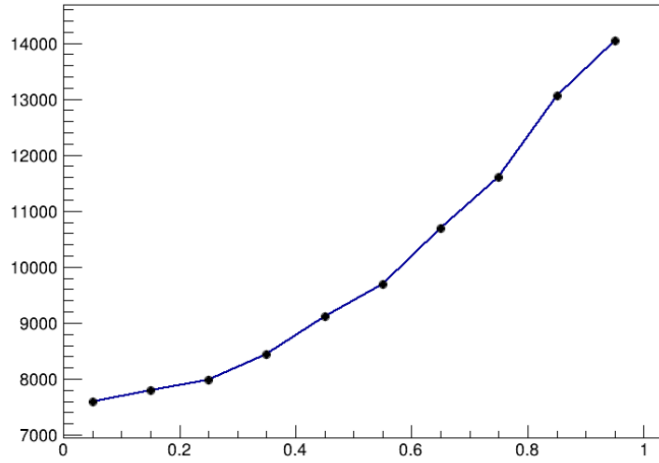


Figure 50: # of events per $|\cos(\theta_C)|$ (CLD)

2.9 # particles per $|\cos(\theta_C)|$ (IDEA)

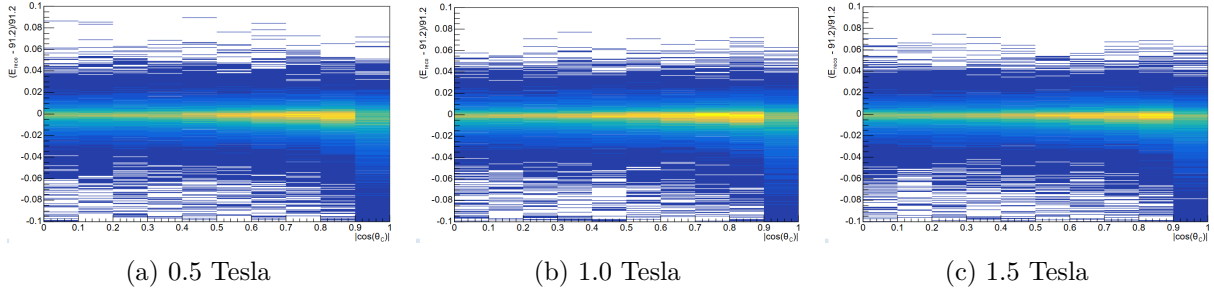


Figure 51: # particles per $|\cos(\theta_C)|$ in IDEA (0.5–1.5 T)

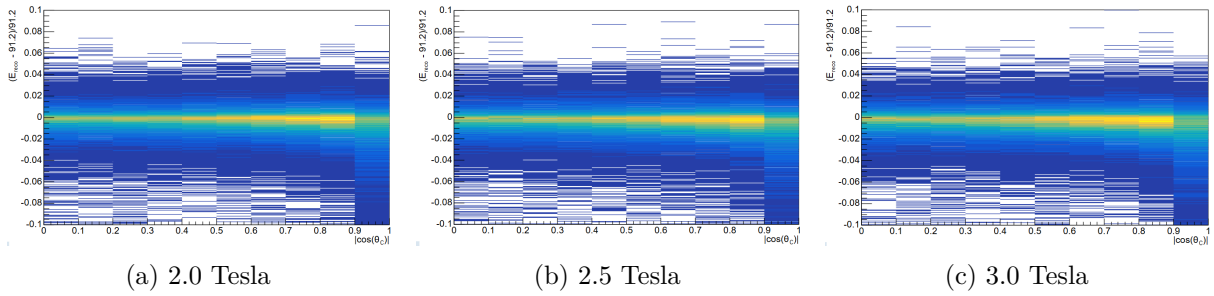


Figure 52: # particles per $|\cos(\theta_C)|$ in IDEA (2.0–3.0 T)

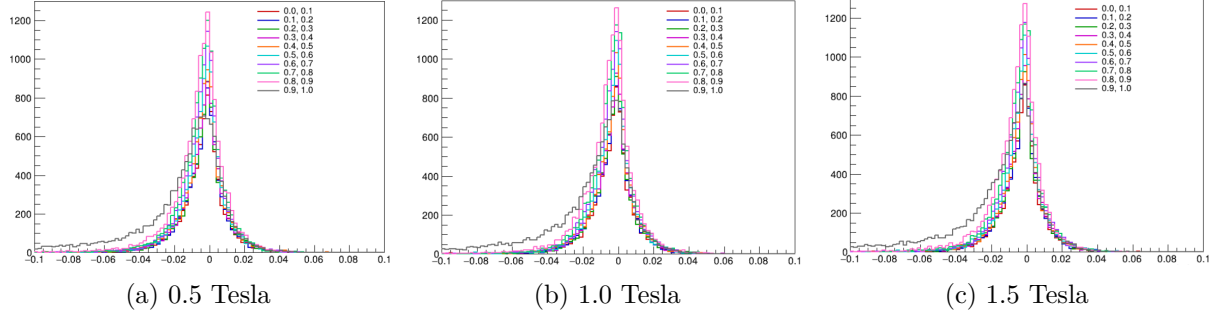


Figure 53: Resolution per $|\cos(\theta_C)|$ in IDEA (0.5–1.5 T)

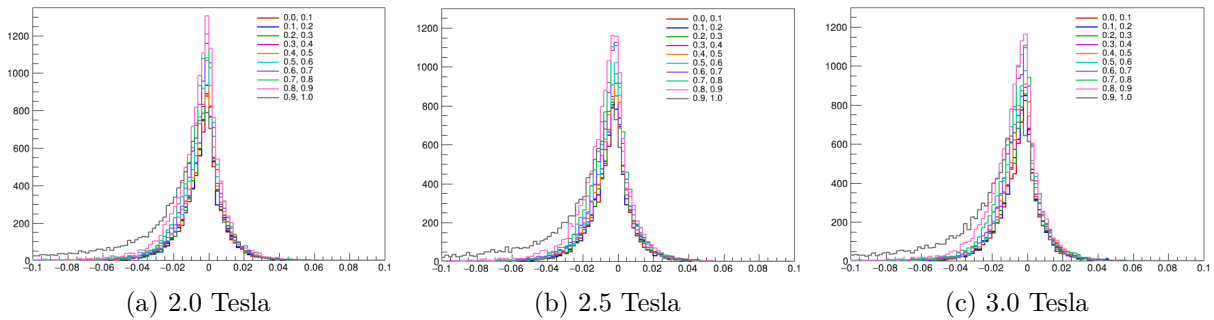


Figure 54: Resolution per $|\cos(\theta_C)|$ in IDEA (2.0–3.0 T)

Conclusions (IDEA)

- No strong improvement from 0.5 to 2.0 T; noticeable concentration of better resolutions at 2.5 T (similar to hadronic resolution in IDEA).

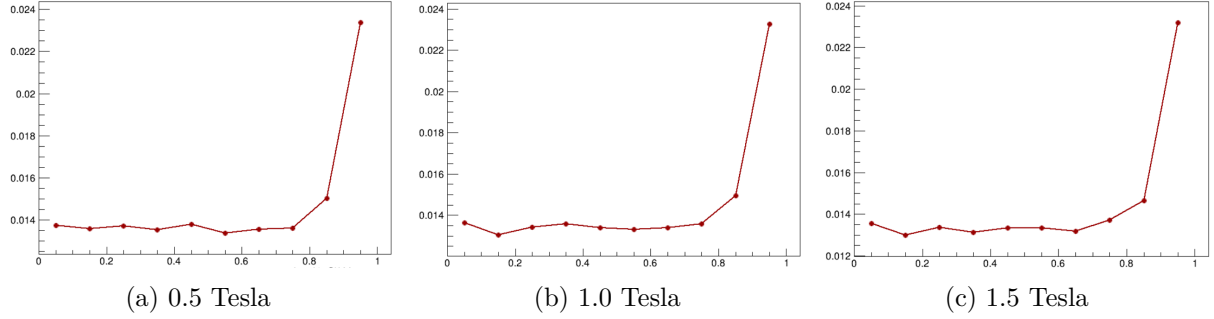


Figure 55: RMS per $|\cos(\theta_C)|$ in IDEA (0.5–1.5 T)

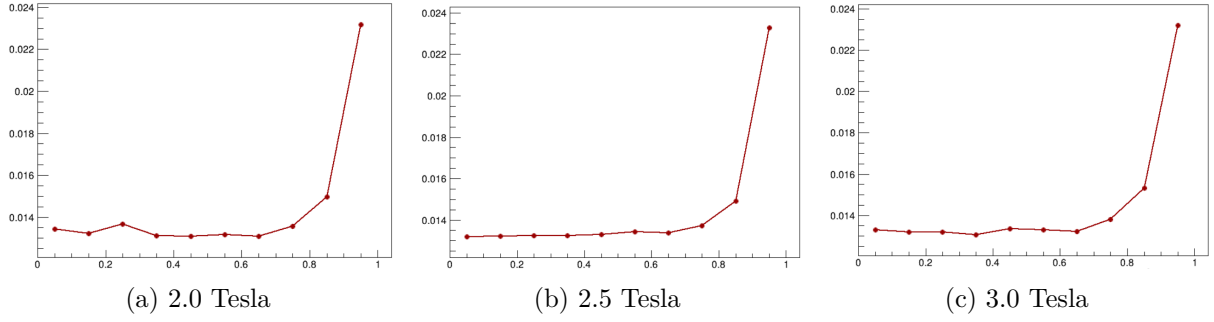


Figure 56: RMS per $|\cos(\theta_C)|$ in IDEA (2.0–3.0 T)

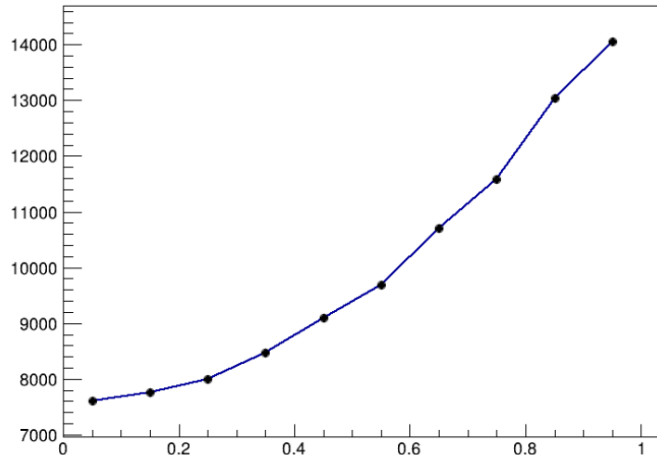


Figure 57: # of events per $|\cos(\theta_C)|$ (IDEA)

2.10 Particle losses

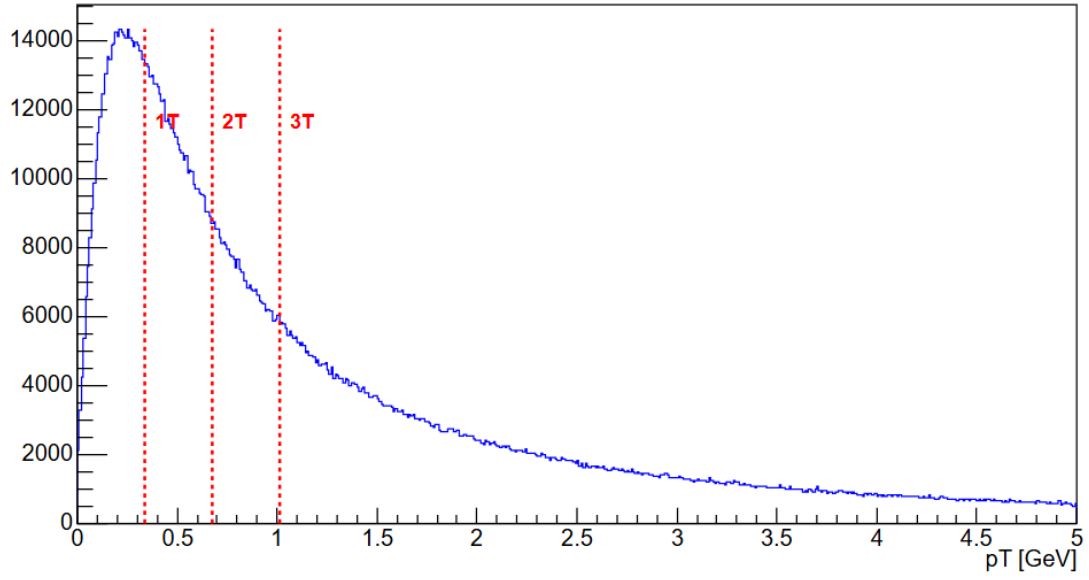


Figure 58: Particles lost (0–5 GeV)

Table 1: Particles lost below p_T threshold.

B [T]	p_T [GeV]	$p_T > \text{thr.}$	$p_T < \text{thr.}$	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

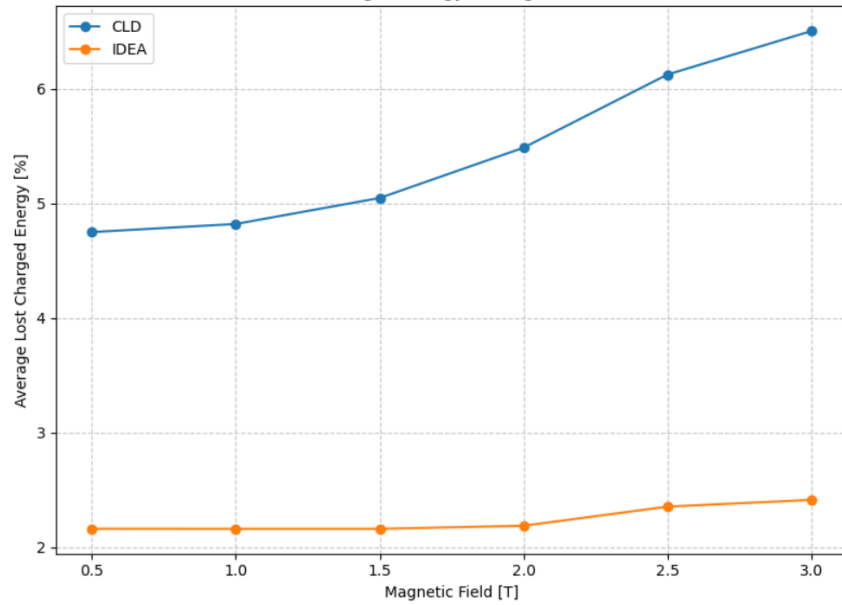


Figure 59: Average final-state energy loss (%) per event

2.11 Particle spectra vs. p_T

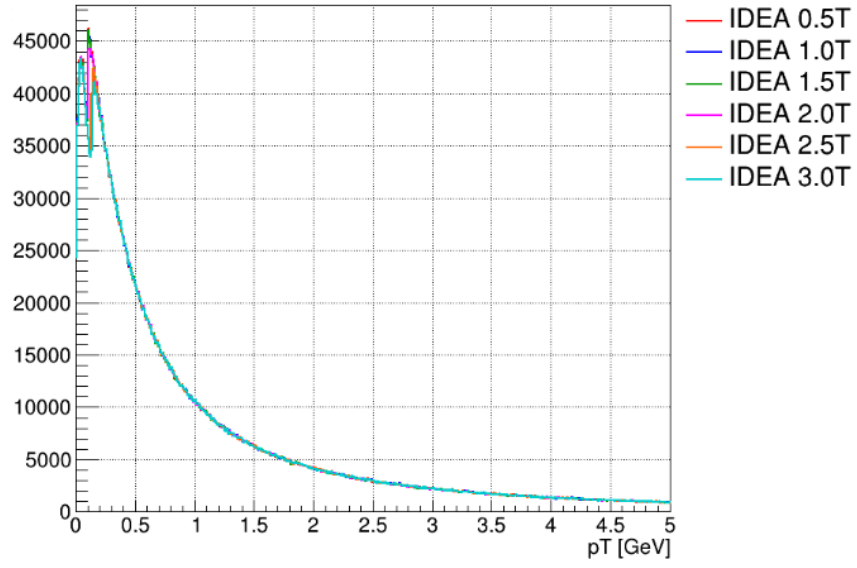


Figure 60: Number of particles per p_T (IDEA)

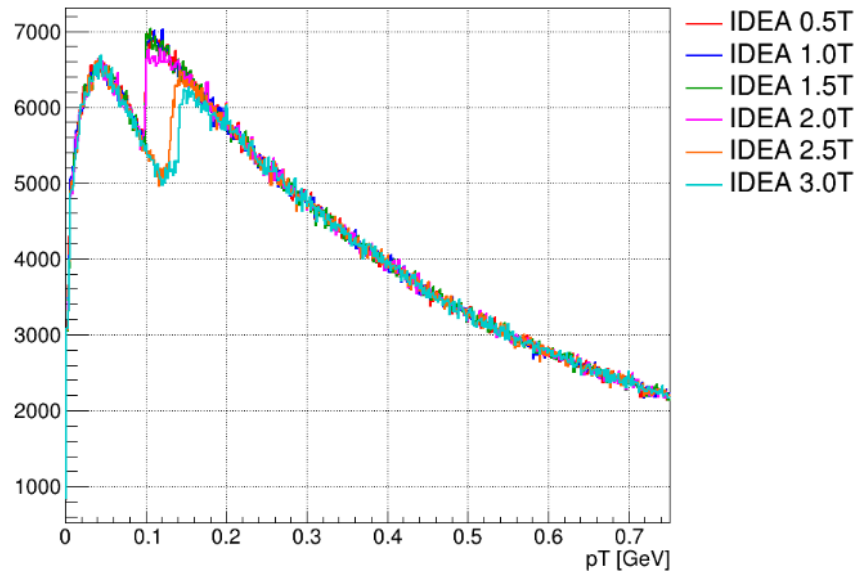


Figure 61: Number of particles per p_T (IDEA, zoom)

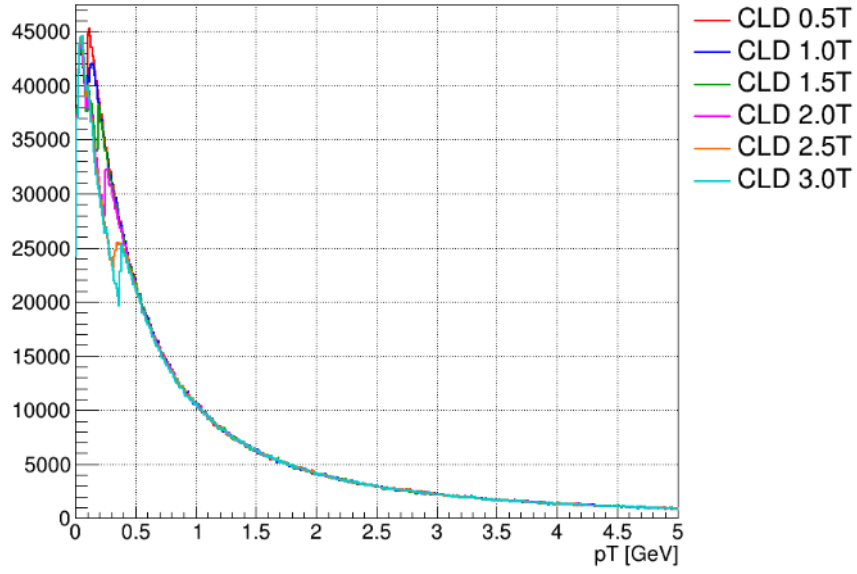


Figure 62: Number of particles per p_T (CLD)

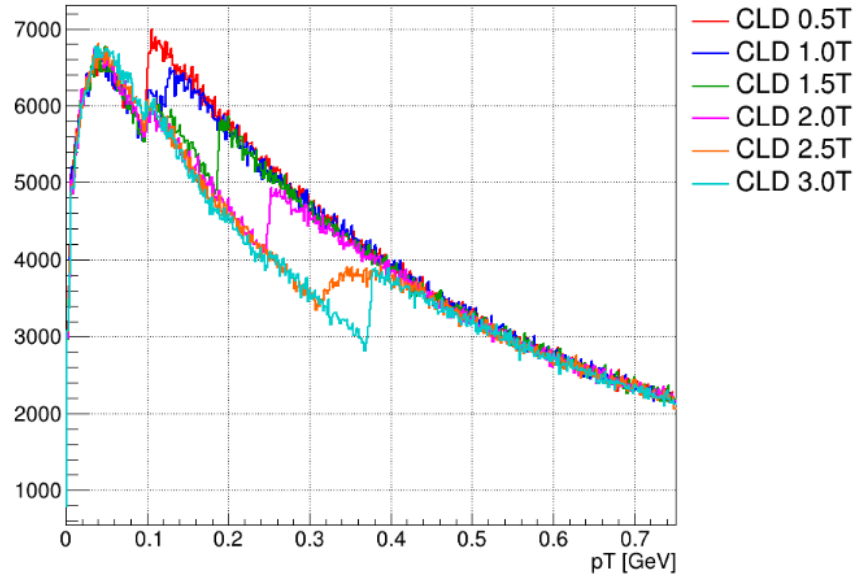


Figure 63: Number of particles per p_T (CLD, zoom)

2.12 Why is CLD so sensitive to B -fields?

Lever 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 decrease radius:

$$r = \frac{p_T}{0.3B} \Rightarrow \text{low } p_T \Rightarrow \text{tighter curve}.$$

Tracking requires 6 hits before the calorimeter; the calorimeter radius starts at 2.25 m.

Material budget. A higher material budget produces more scattering (increasing path length), especially for low p_T . We count active (flag = 1) and passive (flag = 0) layers under 2.25 m. Results:

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

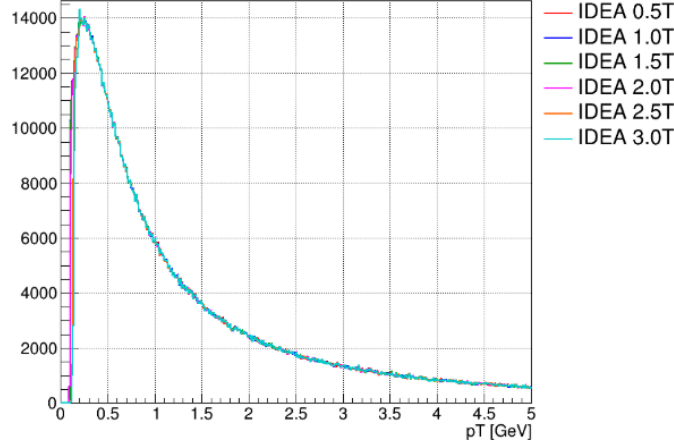


Figure 64: Number of Charged Particles per p_T (IDEA)

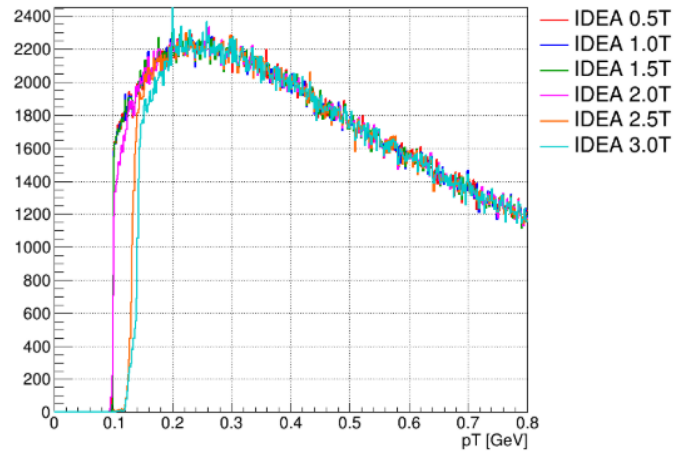


Figure 65: Number of Charged Particles per p_T (IDEA, zoom)

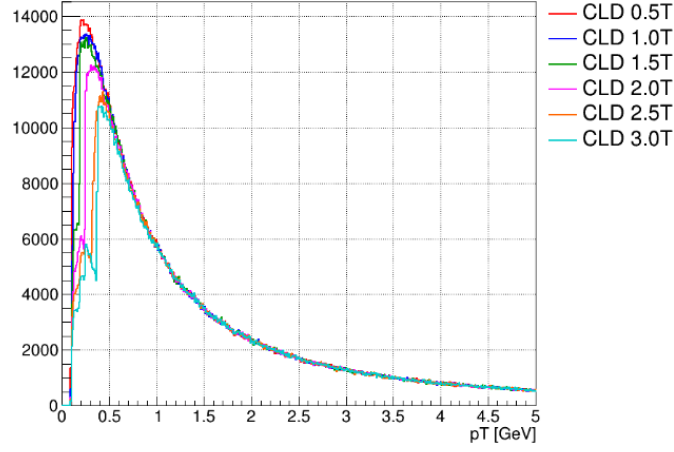


Figure 66: Number of Charged Particles per p_T (CLD)

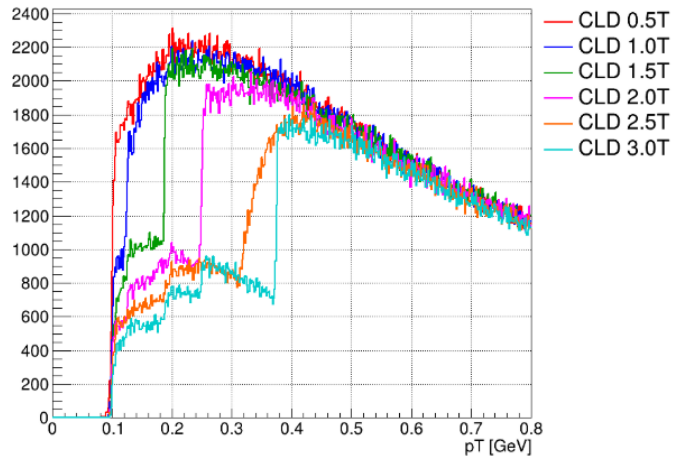


Figure 67: Number of Charged Particles per p_T (CLD, zoom)

2.13 Modified hit requirements

Modification Description. *Modification of minimum required hits with CLD to 8 and IDEA to 20.*

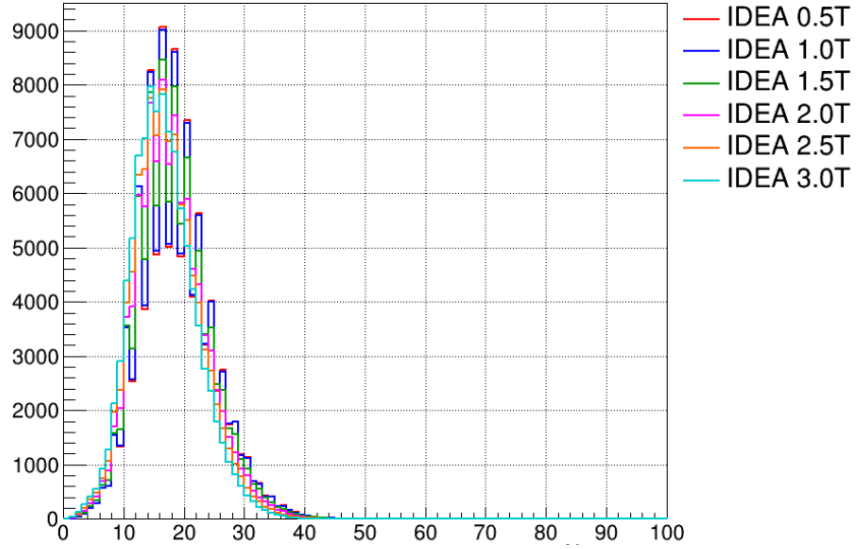


Figure 68: Number of charged reconstructed particles (both)

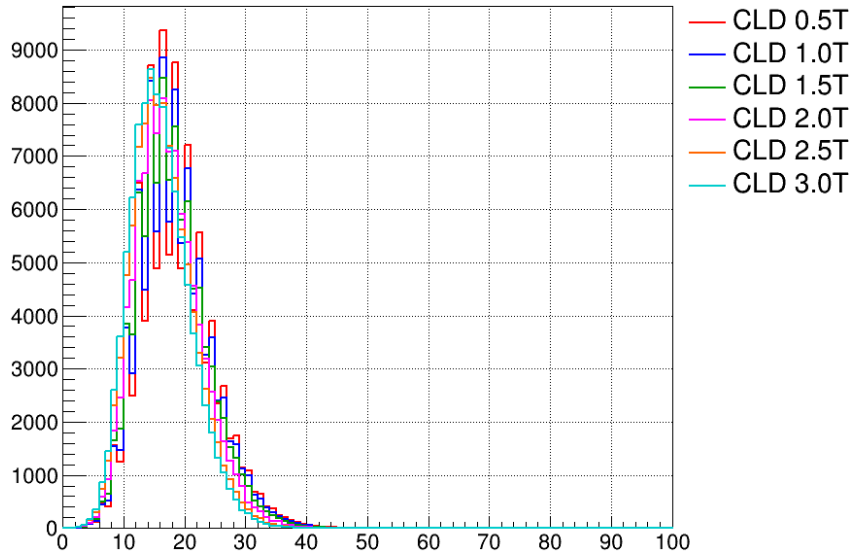


Figure 69: Number of charged reconstructed particles (CLD)

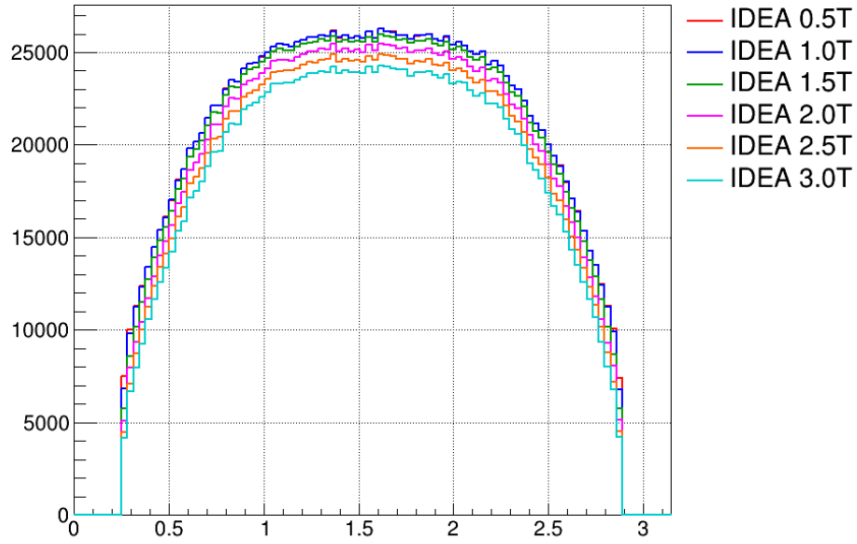


Figure 70: θ resolution (IDEA, modified hits)

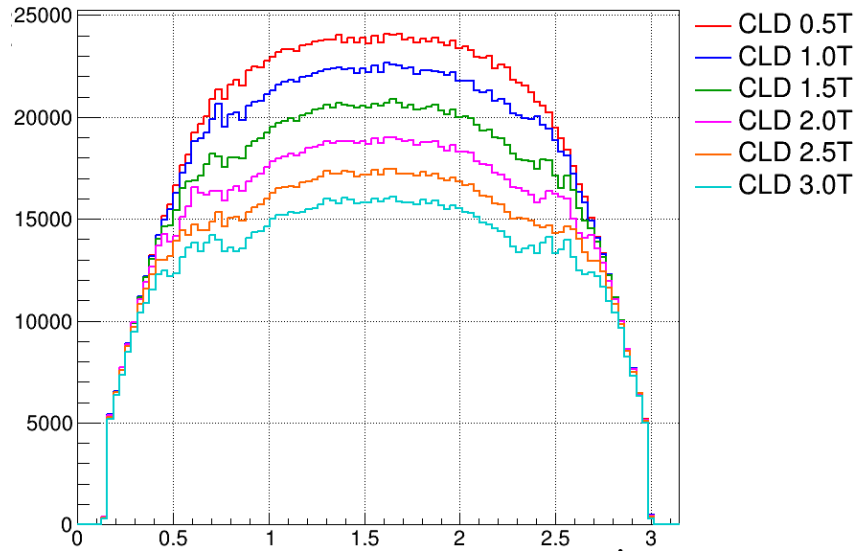


Figure 71: θ resolution (CLD, modified hits)

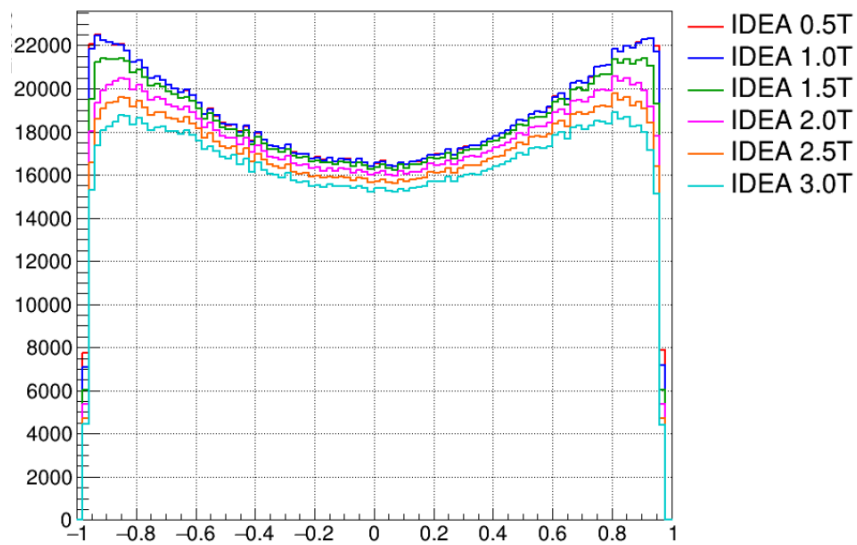


Figure 72: $\cos \theta$ resolution (IDEA, modified hits)

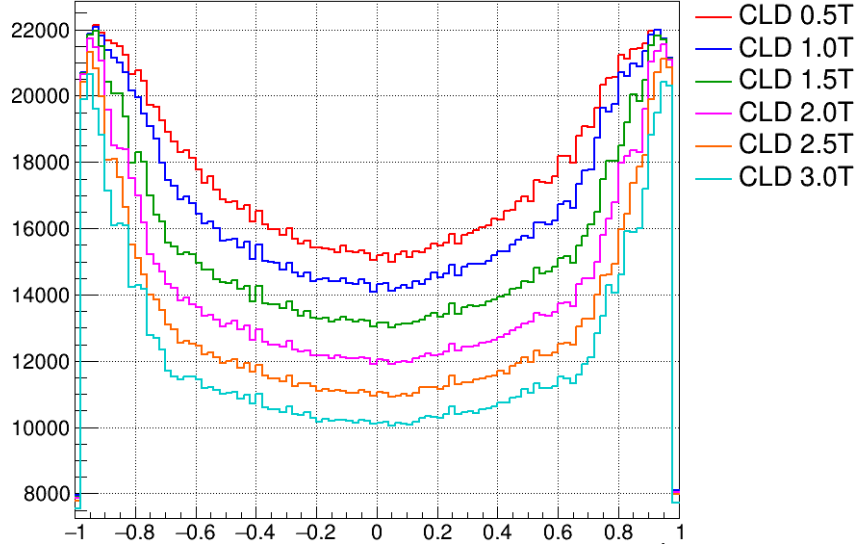


Figure 73: $\cos \theta$ resolution (CLD, modified hits)

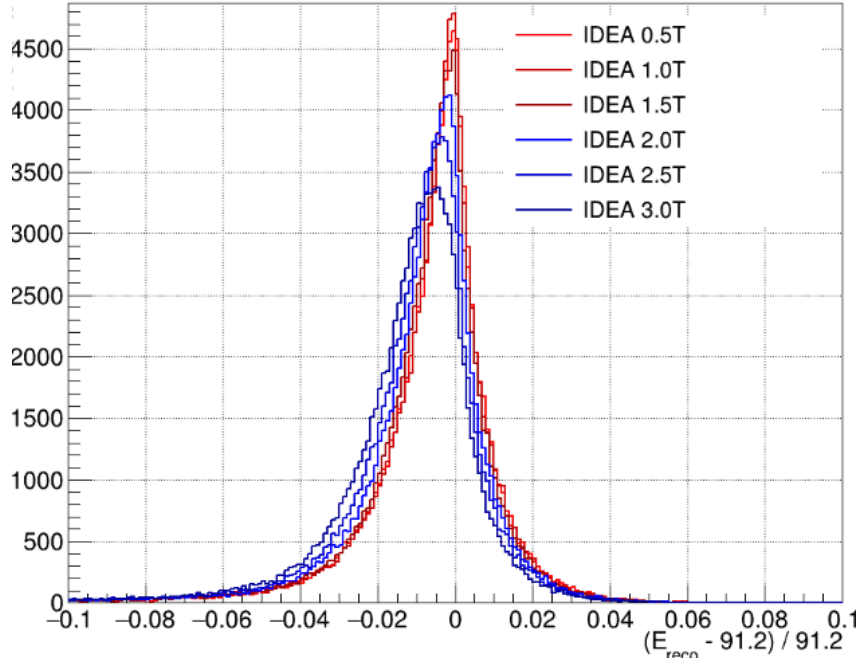


Figure 74: Hadronic energy resolution (IDEA, modified hits)

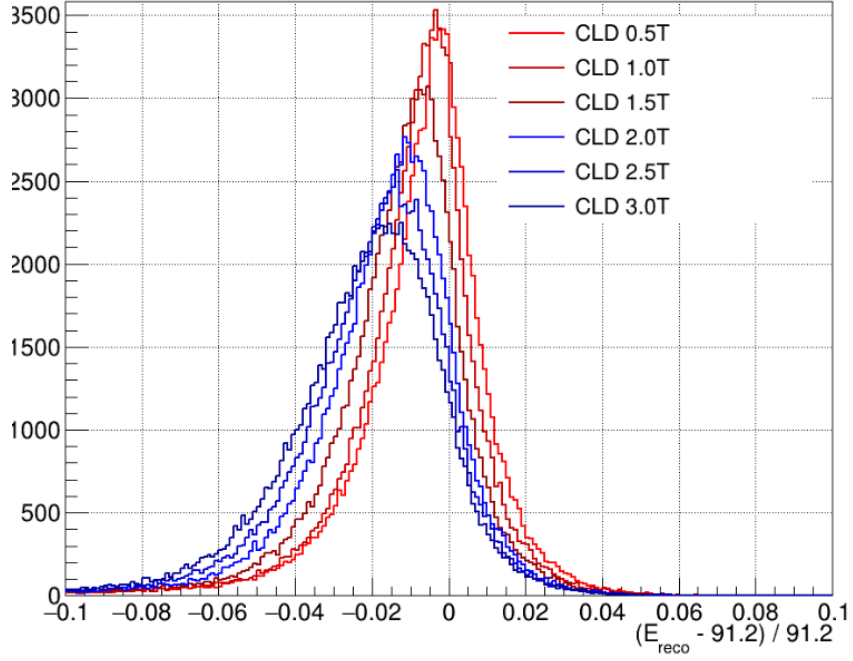


Figure 75: Hadronic energy resolution (CLD, modified hits)

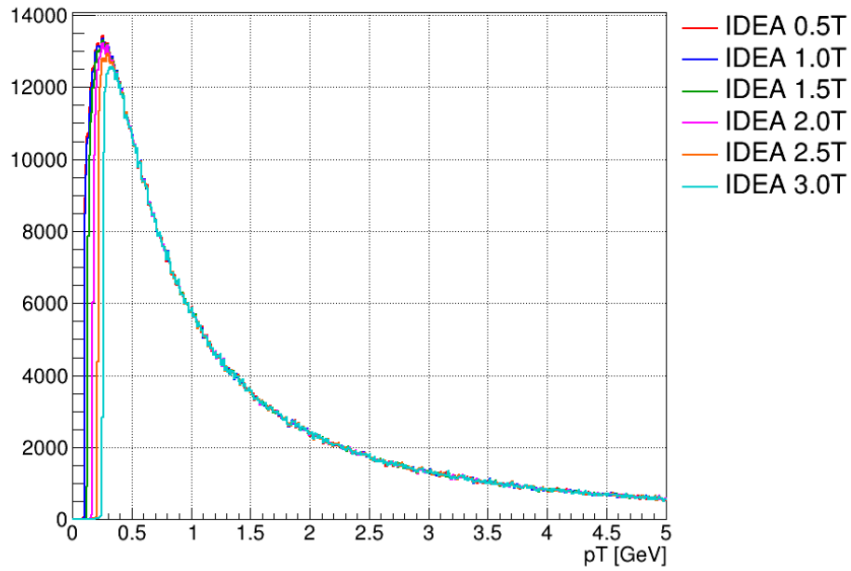


Figure 76: Charged particles per p_T (IDEA, modified hits)

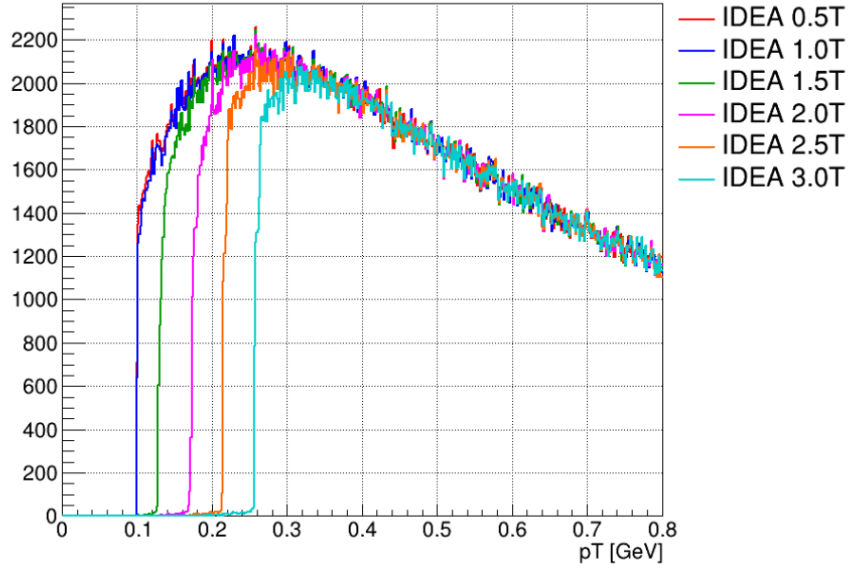


Figure 77: Charged particles per p_T (IDEA, zoom, modified hits)

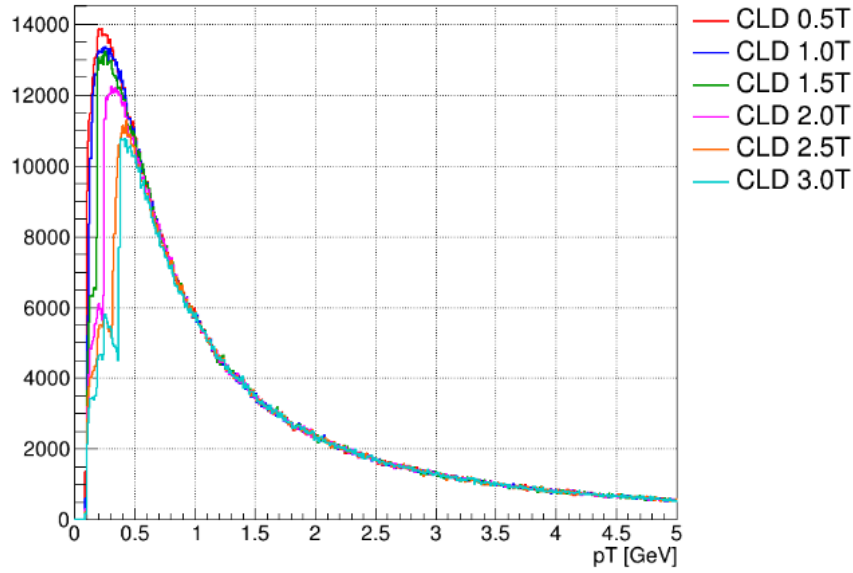


Figure 78: Charged particles per p_T (CLD)

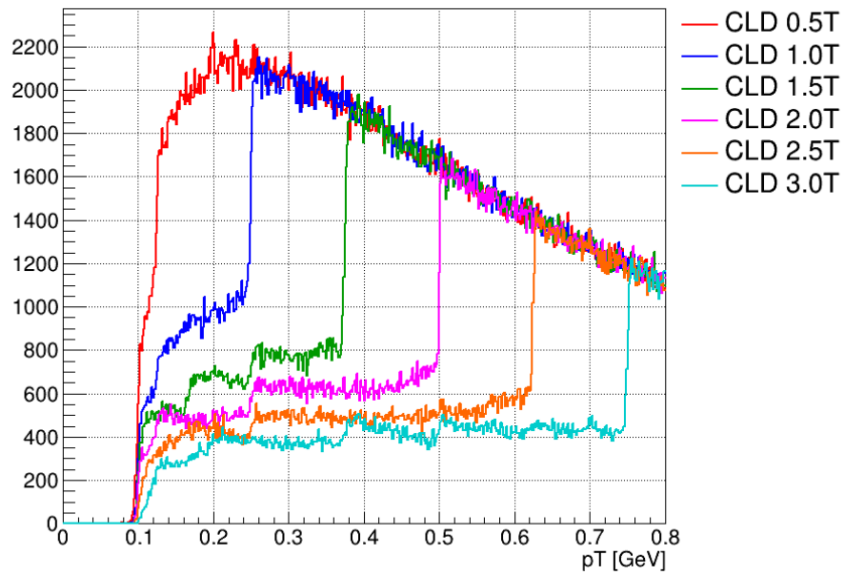


Figure 79: Charged particles per p_T (CLD, zoom, modified hits)