dE/dx analysis of TPC detector using UV laser

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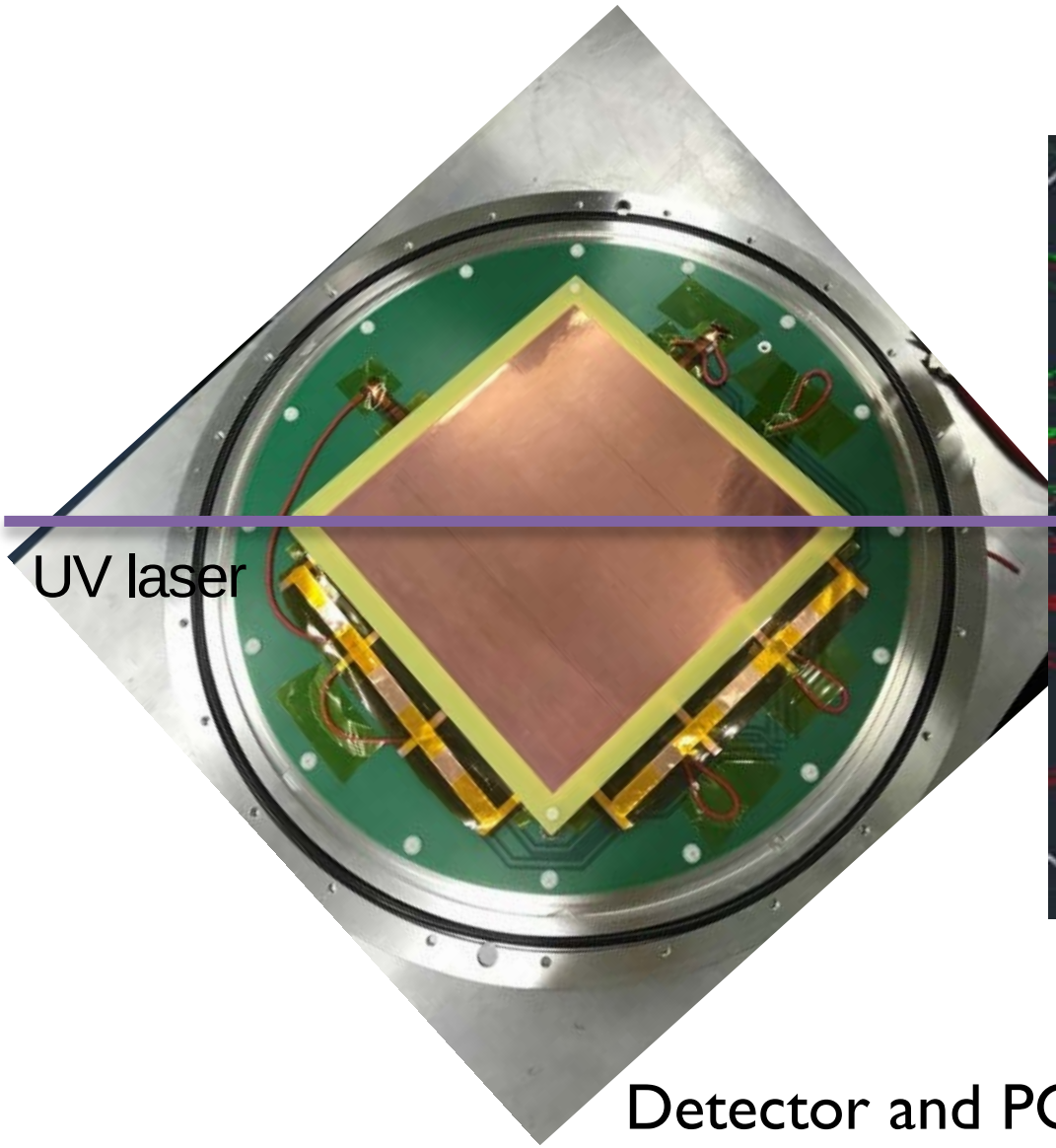
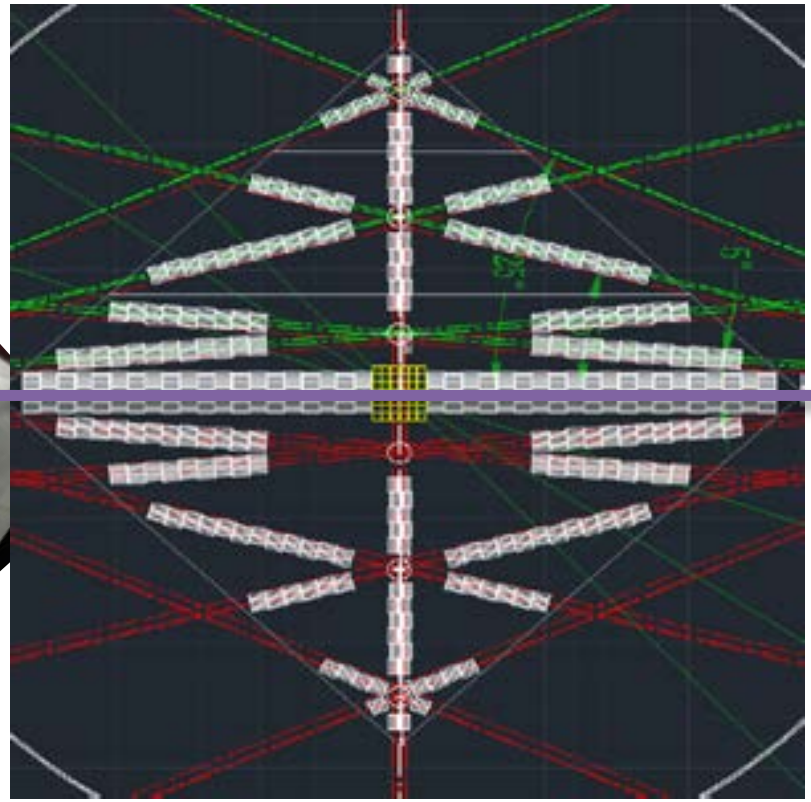
Overview

TPC detector with UV laser

Pad size: 1mm × 6mm





Detector and PCB readout board

TPC detector with UV laser

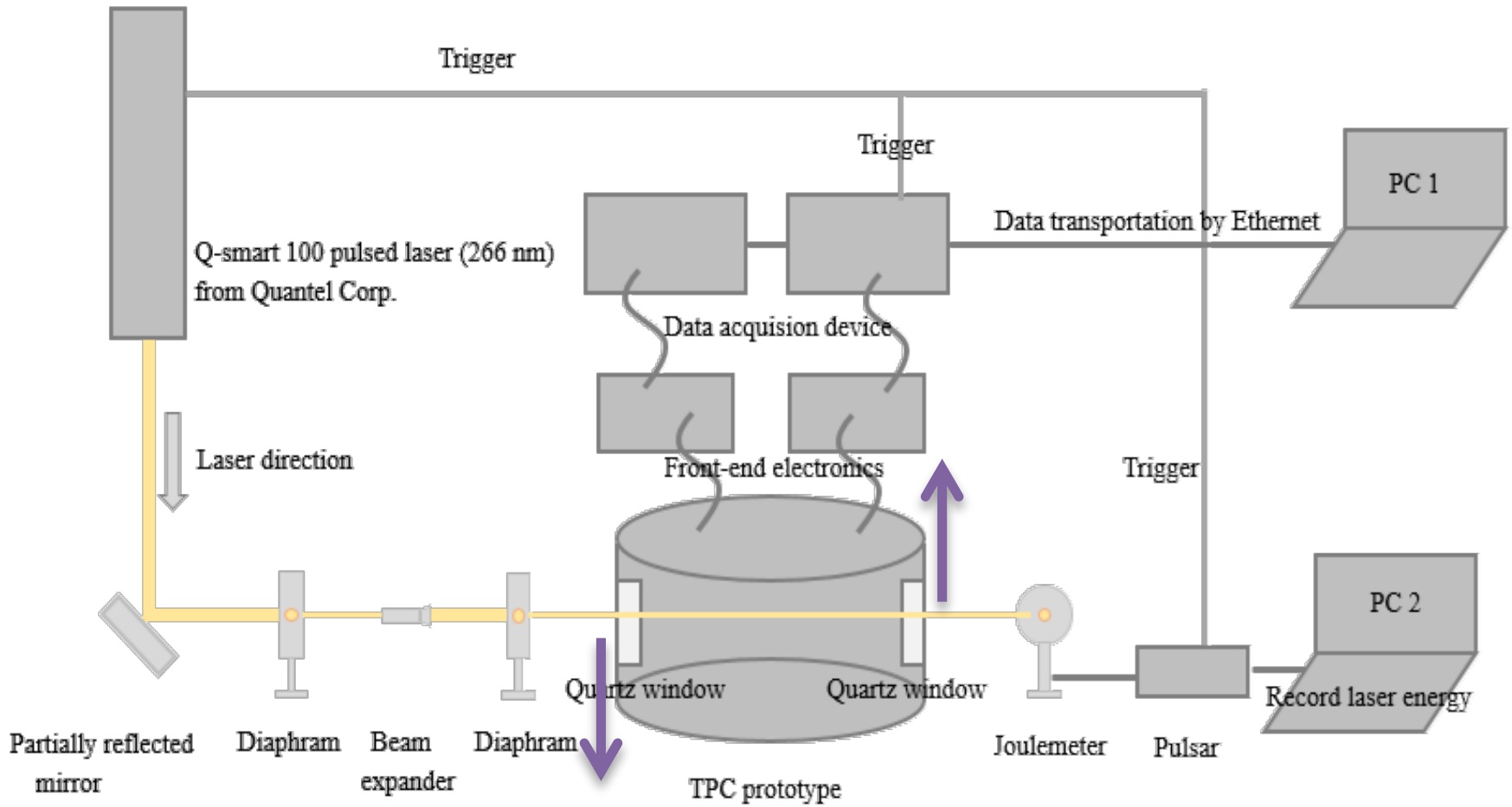
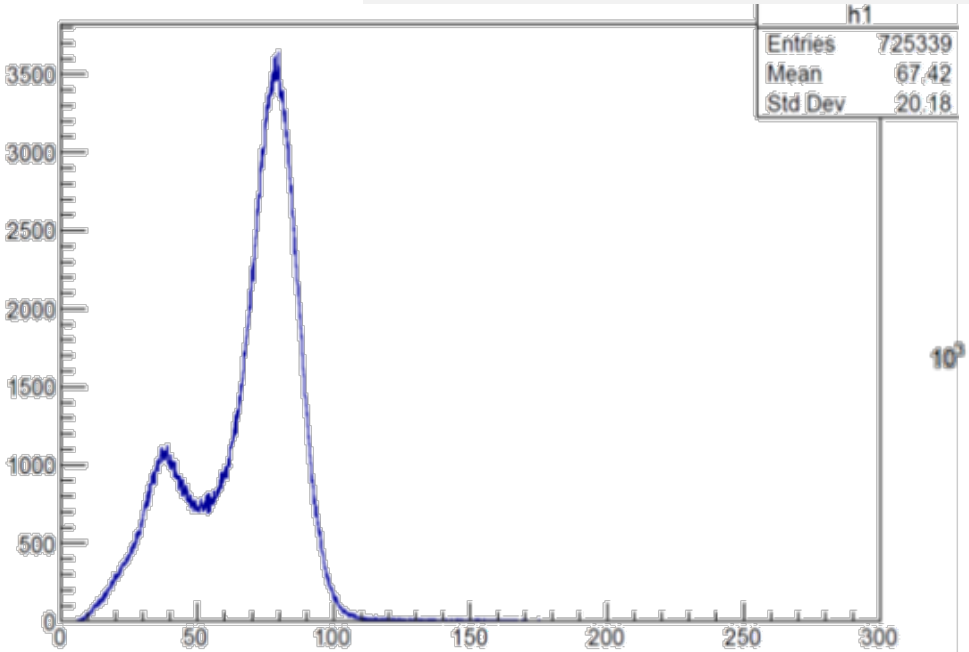
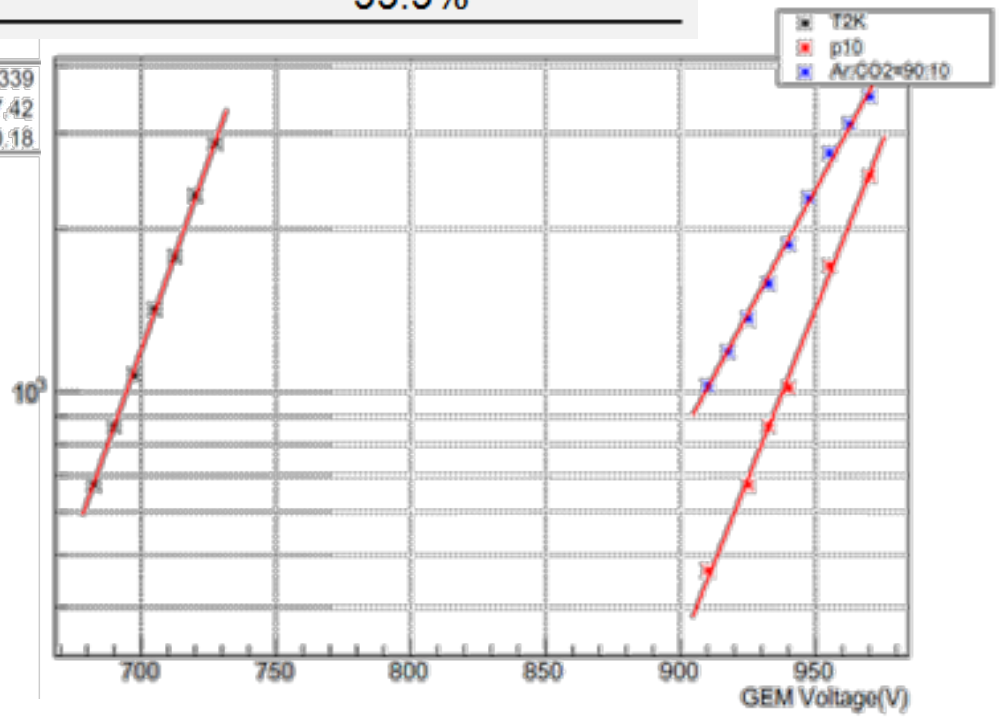


Diagram of TPC detector study

^{55}Fe study

Gas	Purity
Ar	99.999%
CO2	99.999%
CH4	99.999%
CF4	99.999%
Isobutane (iC4H10)	99.9%

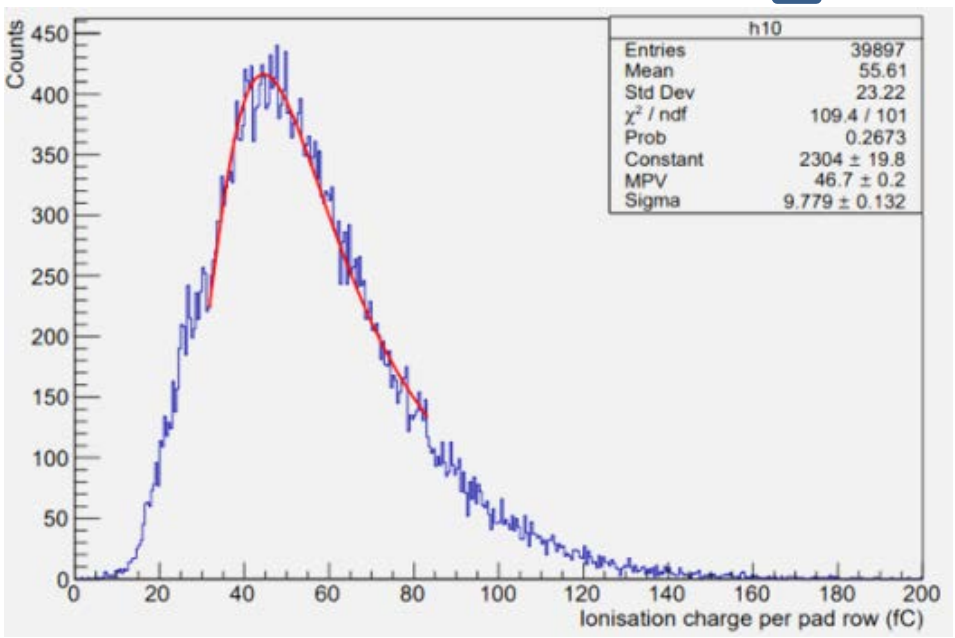


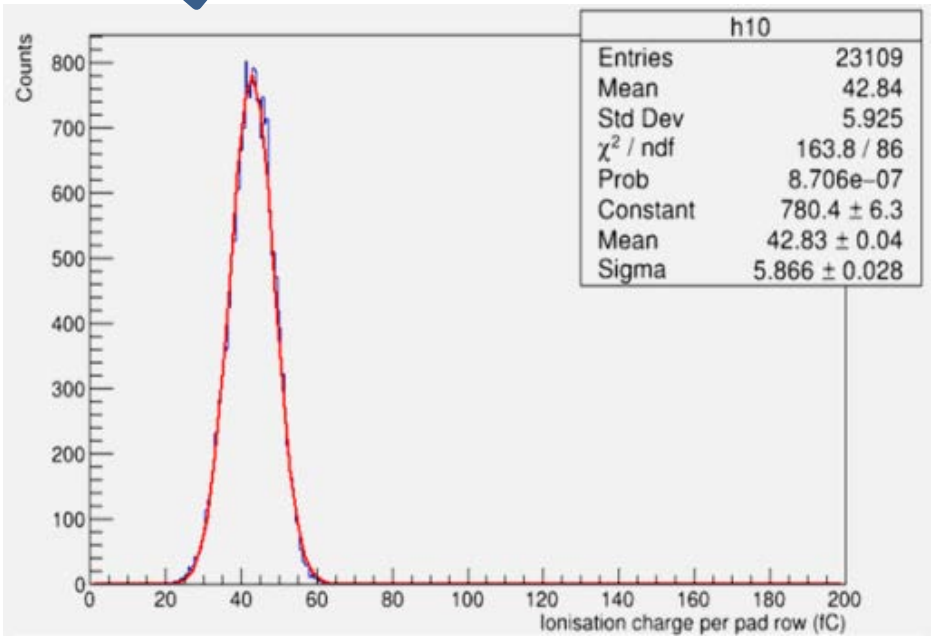


Energy spectrum and gain at T2K/P10/Ar:CO2

UV laser spectrum - Truncated method

Energy cutting and correction by the events



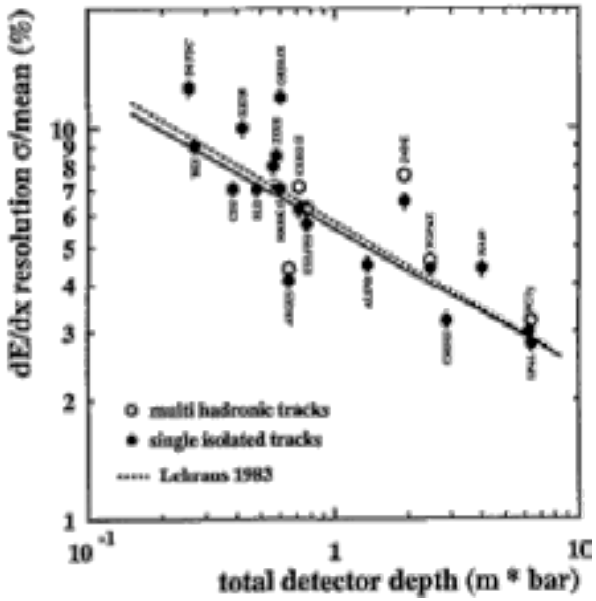


Energy spectrum of UV

dE /dx resolution - pseudo-tracks

$$\frac{\langle dE/dx \rangle}{\sigma(dE/dx)}$$

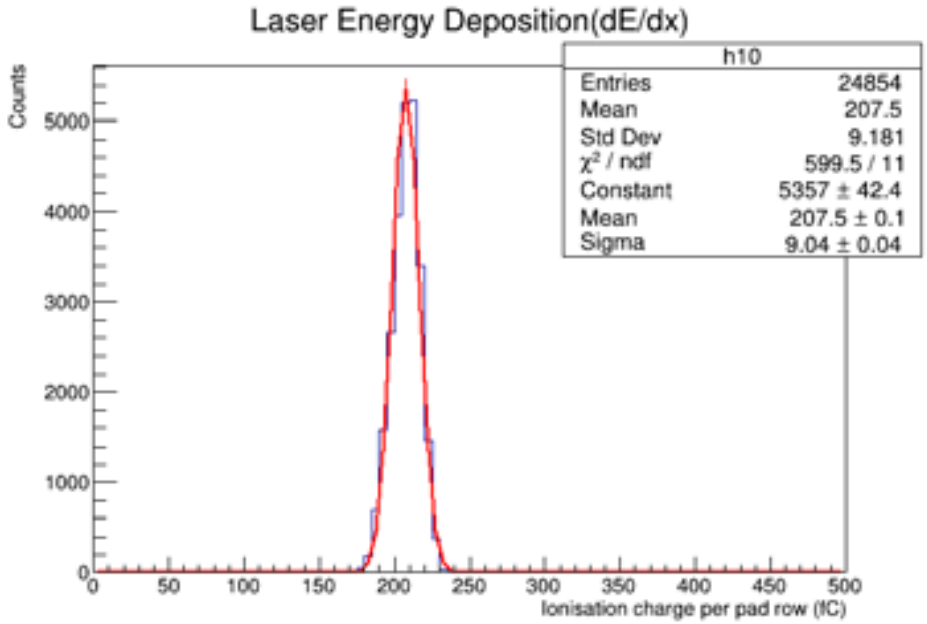
220 points per track



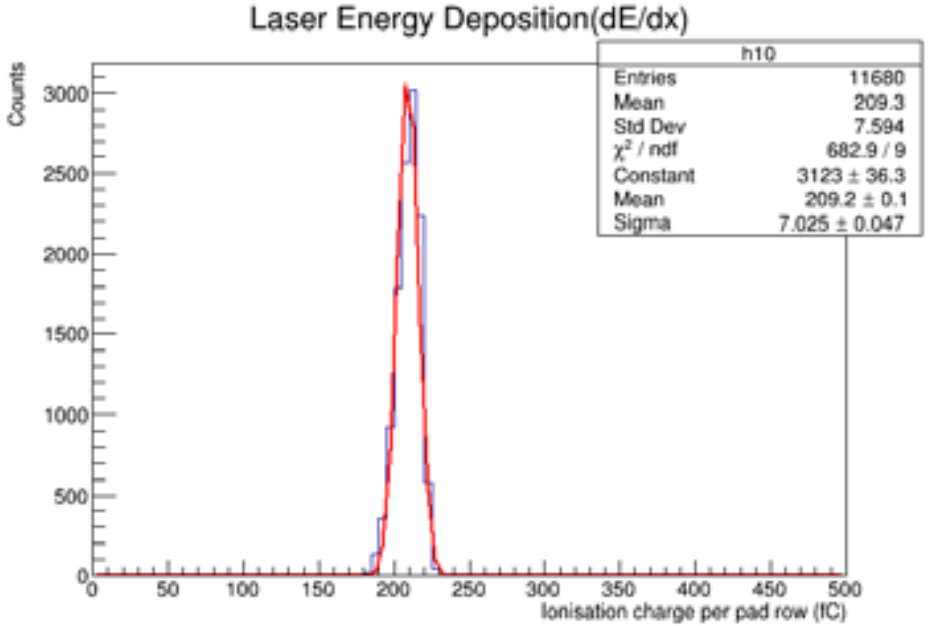
Hauschild's formula	$\frac{\sigma(dE/dx)}{dE/dx} = 5.5 \times L^{-0.36}\ (\%)$
Walenta's formula	$\frac{\sigma(dE/dx)}{dE/dx} = 5.57 \cdot L^{-0.30}\ (\%)$

dE /dx resolution – cutting

laser events (UV laser 80% cutting)
4.36 ± 0.10%



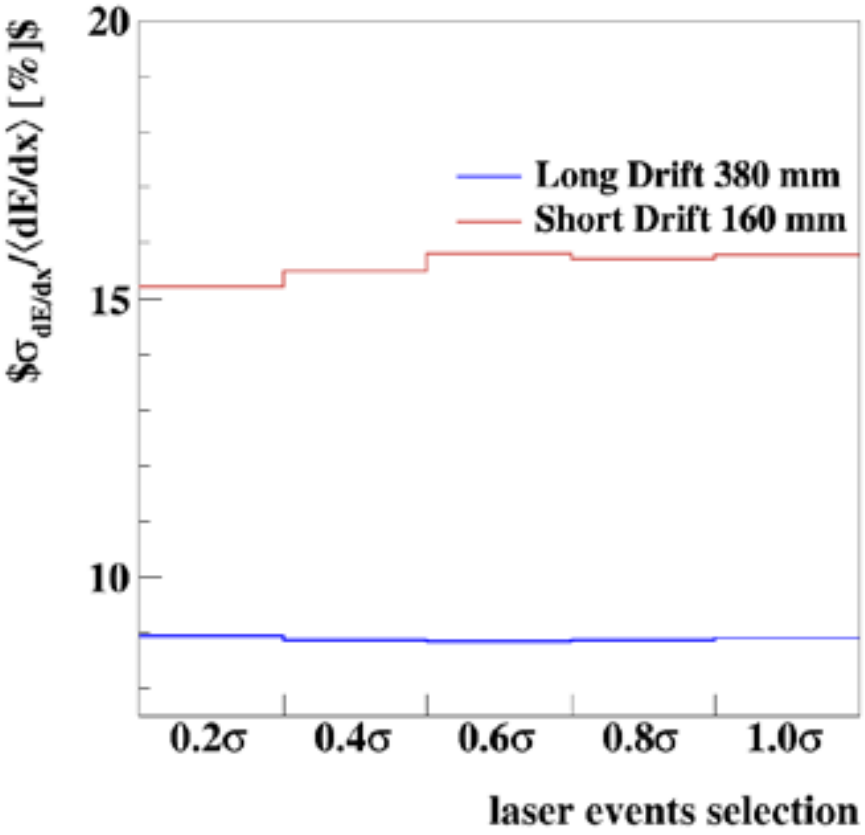
laser events (UV laser 70% cutting)
3.36 ± 0.26%



Scanning the cutting value

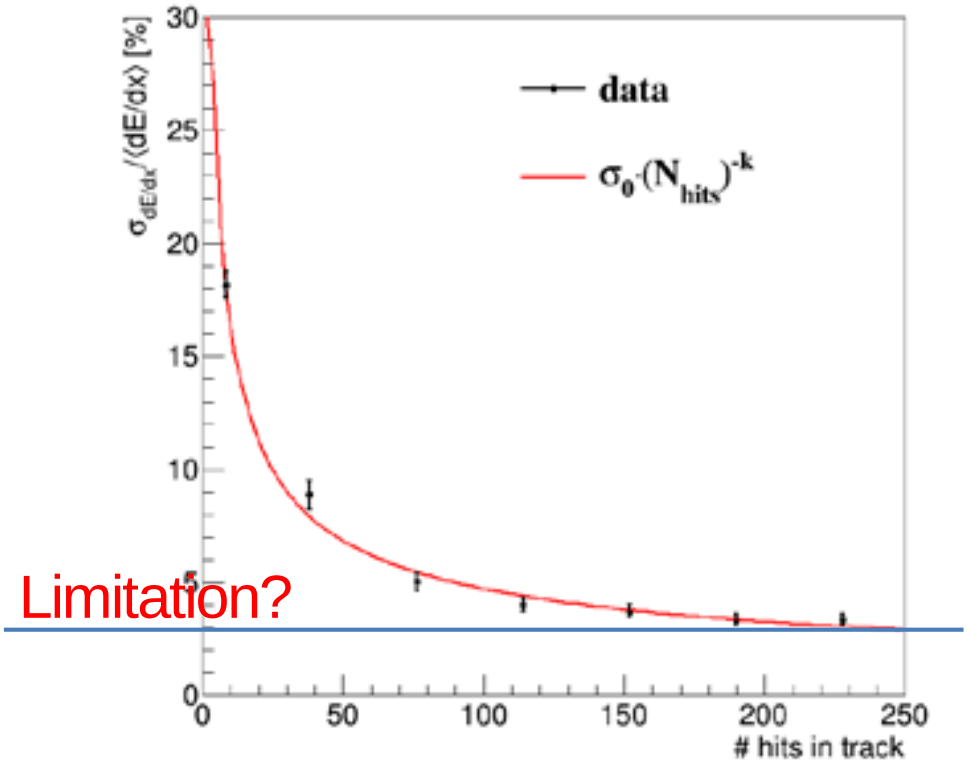
dE/dx resolution

Comparison of dE/dx estimators



The dE/dx resolution achieved with pseudo-tracks of various lengths.

$$\sigma_0 = 55.11 \pm 3.36\%$$
$$k = 0.534 \pm 0.016$$



Limitation?

Summary

- dE/dx study used TPC detector using 266nm UV laser
- ^{55}Fe and UV laser's energy spectrum and gain measured
- Pseudo-tracks with 220 layers and dE/dx can reach to 3.36 $\pm$ 0.26% , and it seems that the limitation of dE/dx by Pad size (1mm $\times$ 6mm)

Thanks