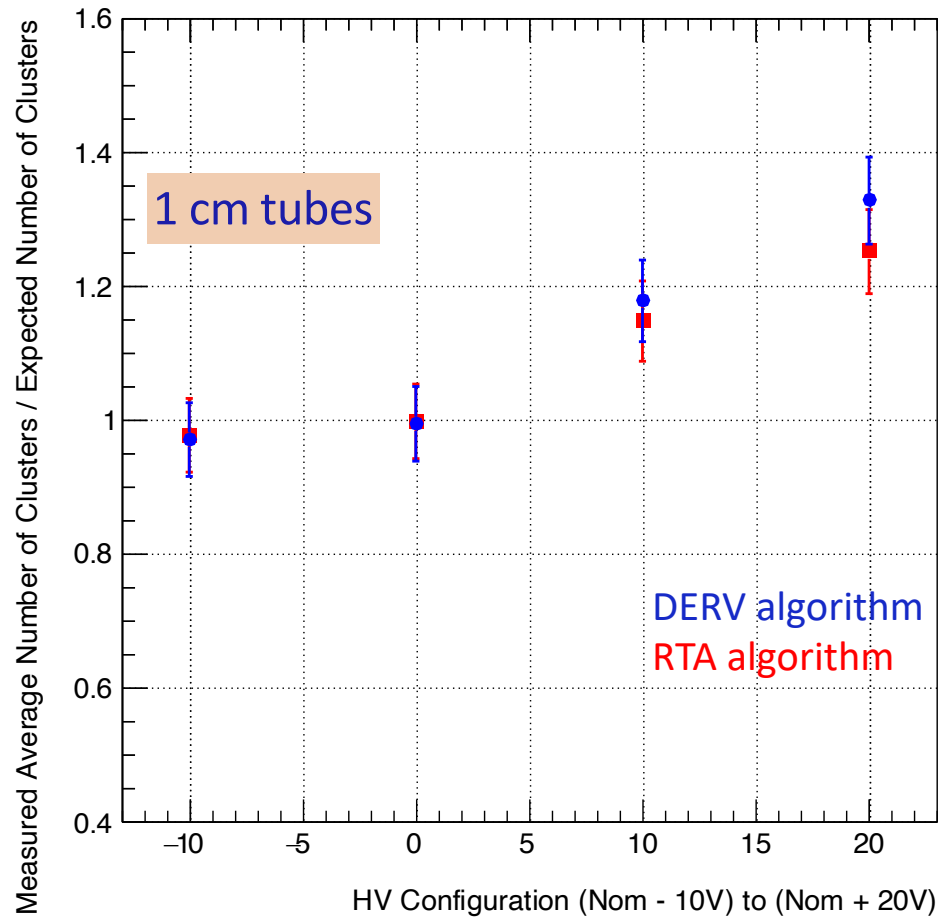


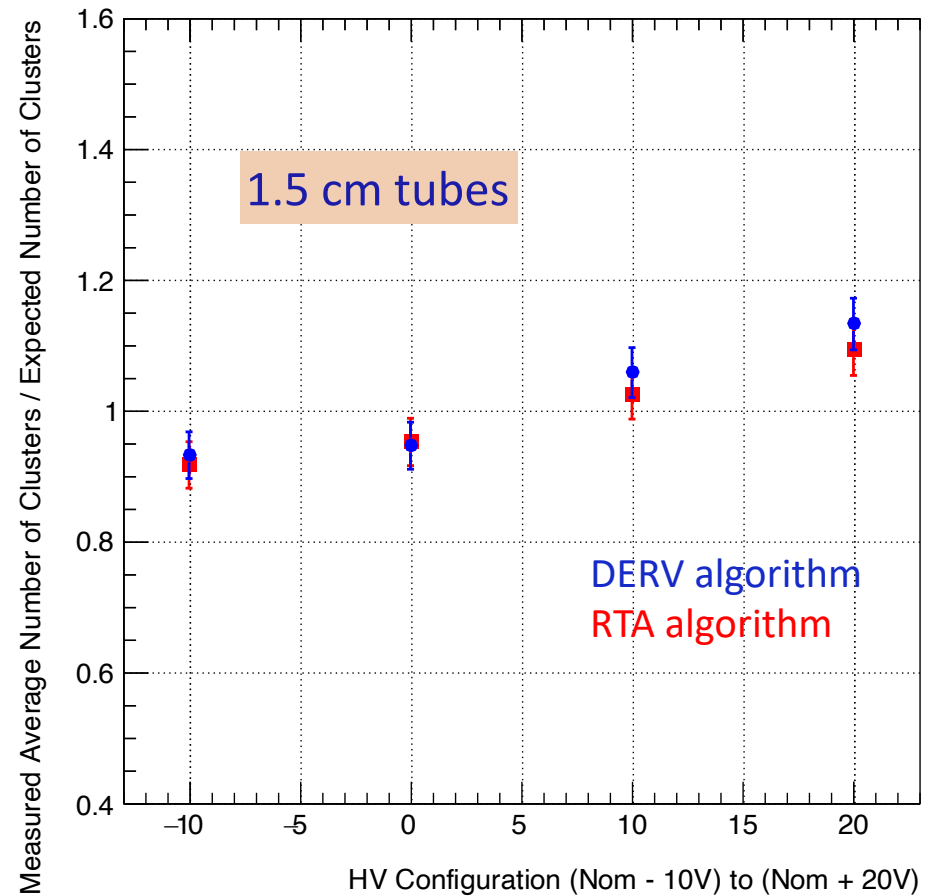
Test beam analysis update
using RTA algorithm

1- DERV vs RTA algorithm

Cluster Finding efficiency

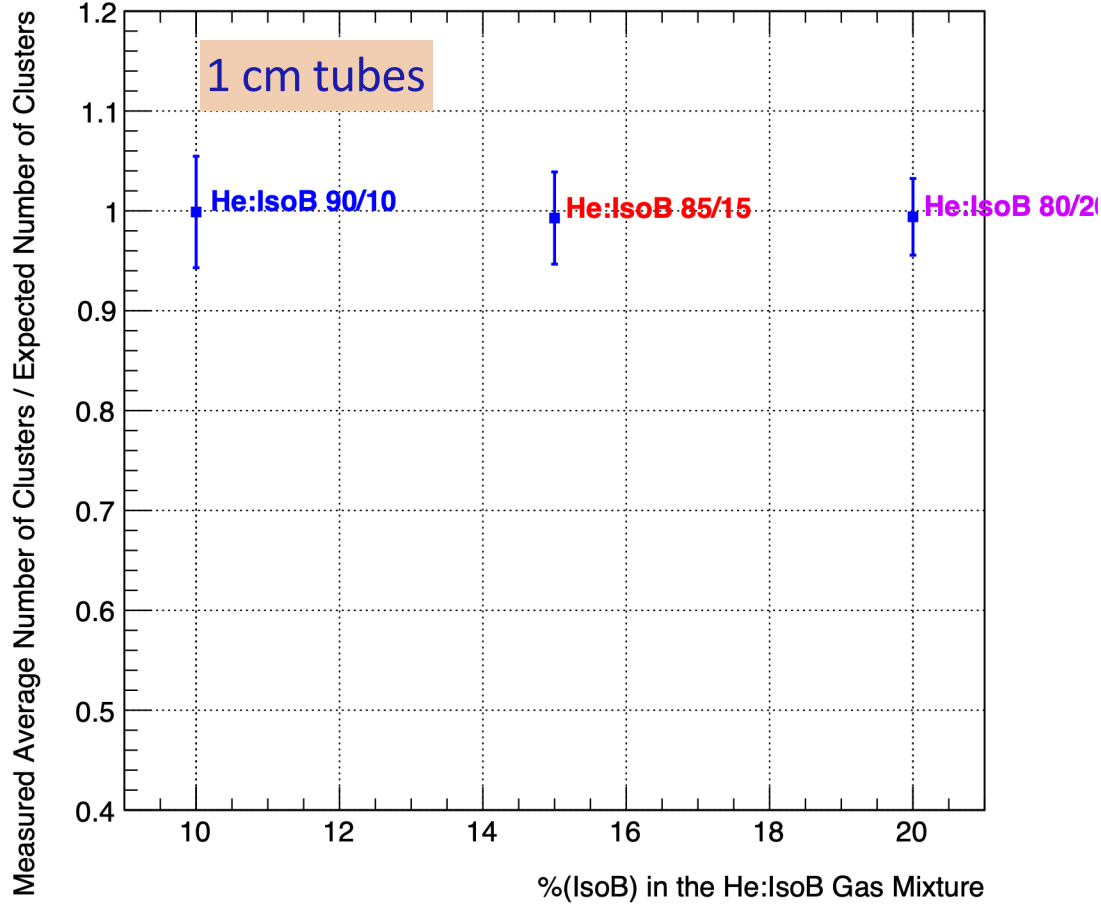


Cluster Finding efficiency

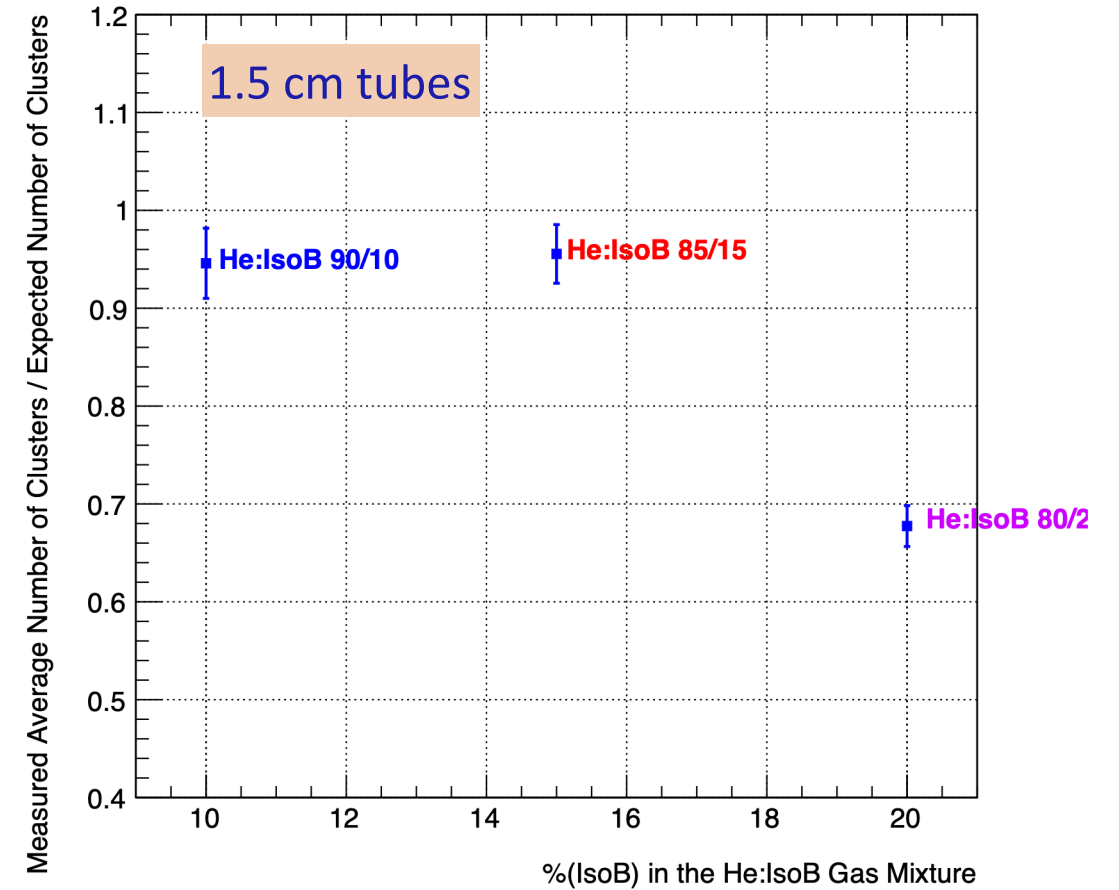


1- Gas Mix Scan

Cluster Finding efficiency



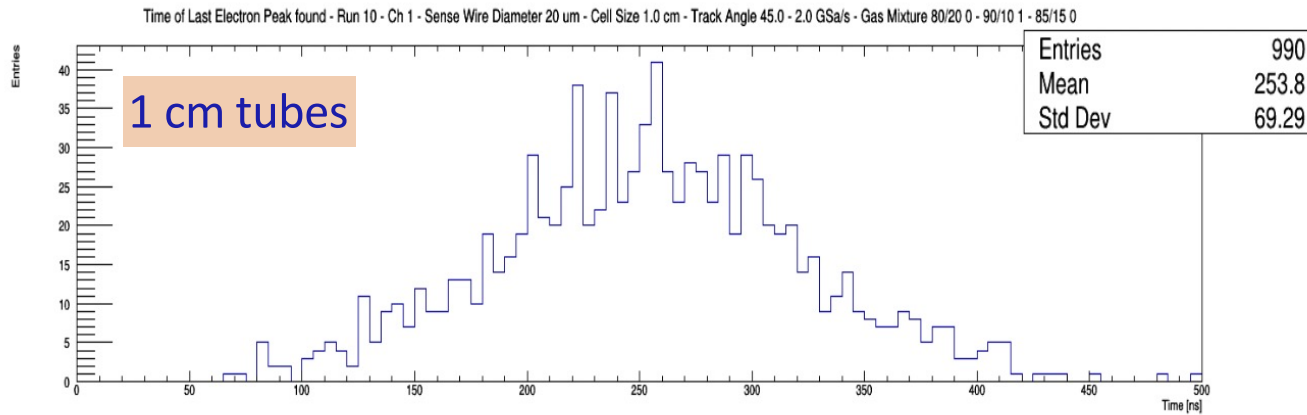
Cluster Finding efficiency



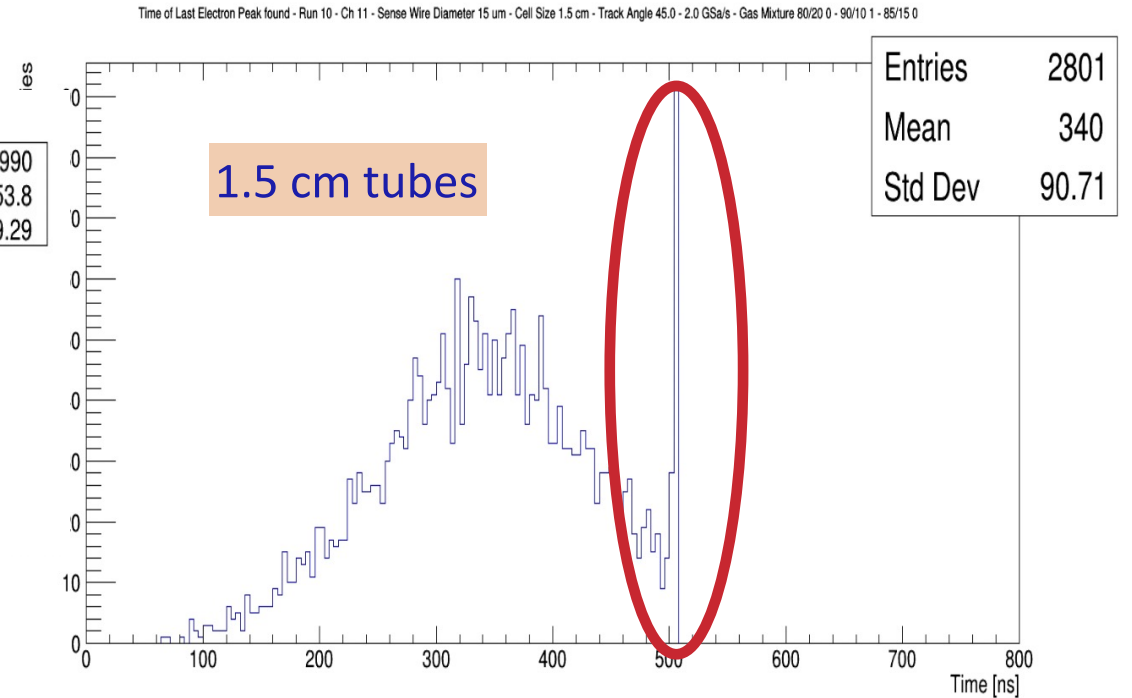
The clusterization cut has been optimised for each gas mixture to count for the change in the drift velocity.

Inefficiency 5% for 1.5 cm tubes using He:IsoB 90/10 & He:IsoB 85/15 and inefficiency ~ 30% using He:IsoB 80/20.

1.5 cm tubes inefficiency 5%



We have 1024 bins,
@ 2GSa \Rightarrow 1/2 ns/bin
 \Rightarrow 512 ns.

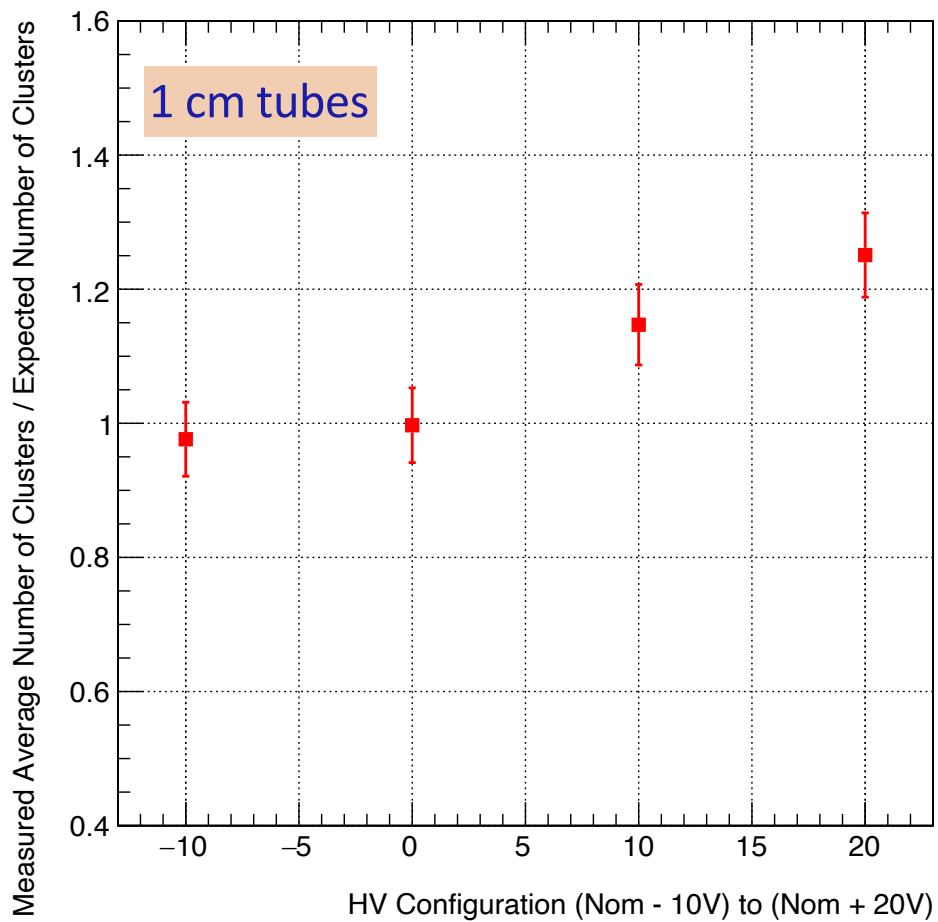


For He: IsoB 90/10: missing clusters caused 5 % inefficiency

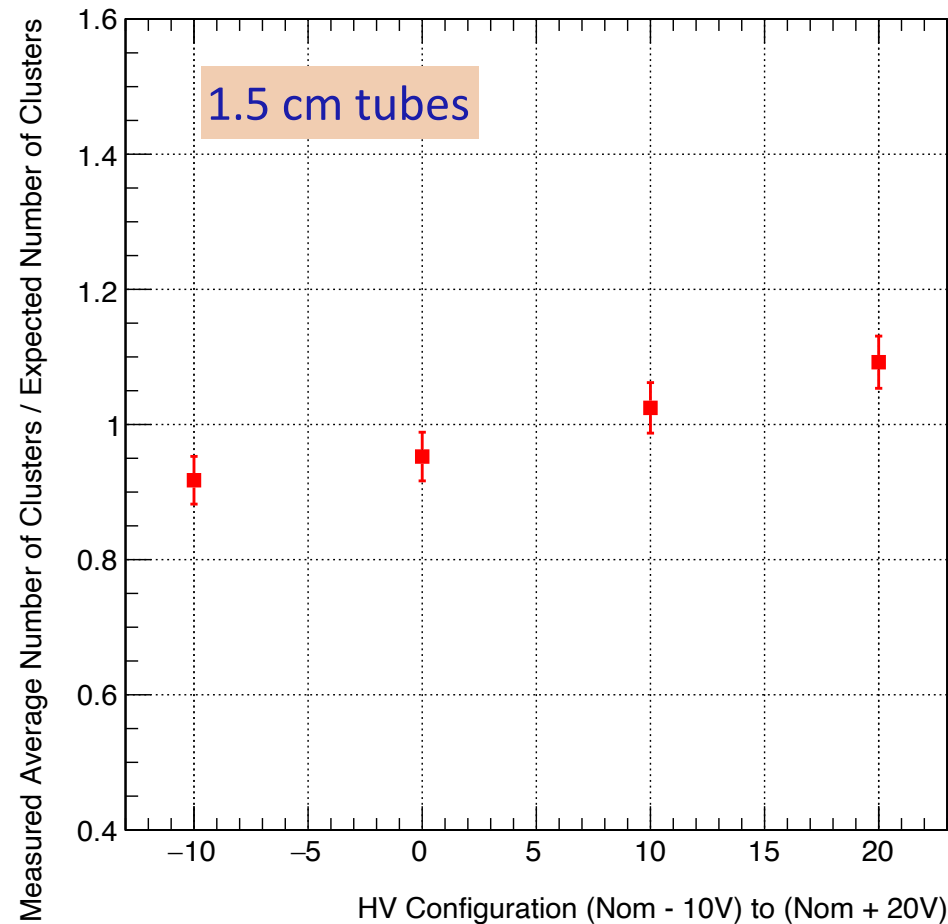
2- HV scan

He:IsoB 90:10

Cluster Finding efficiency

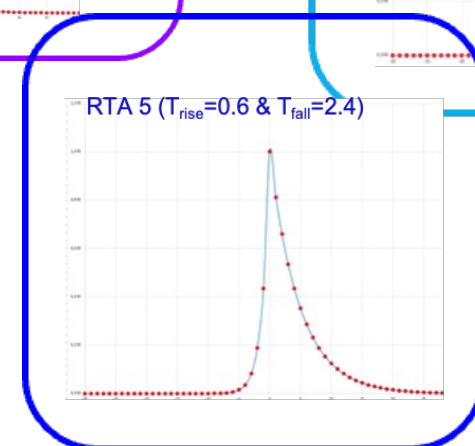
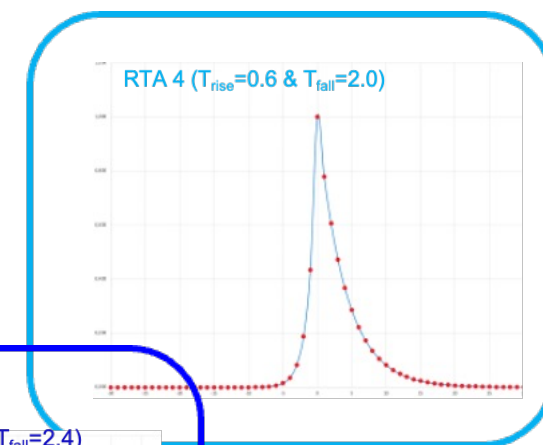
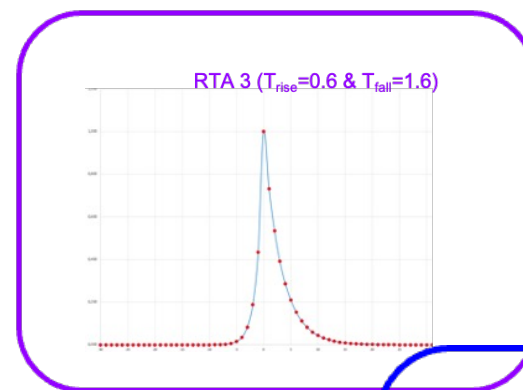
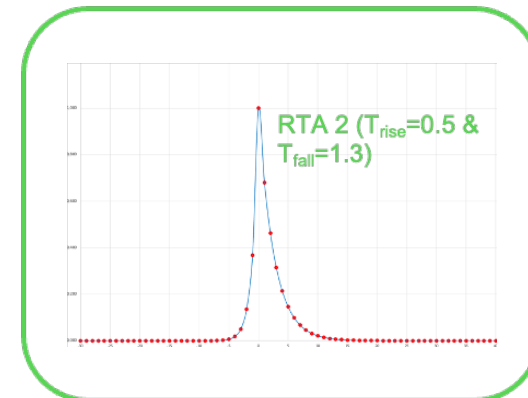
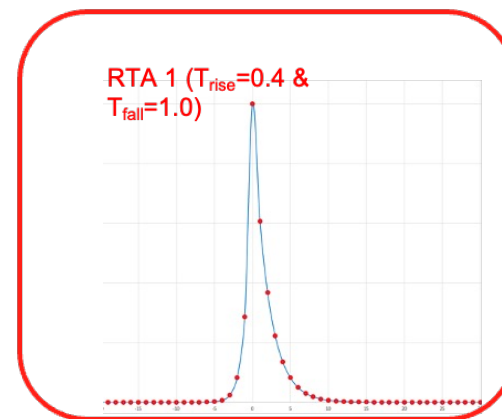
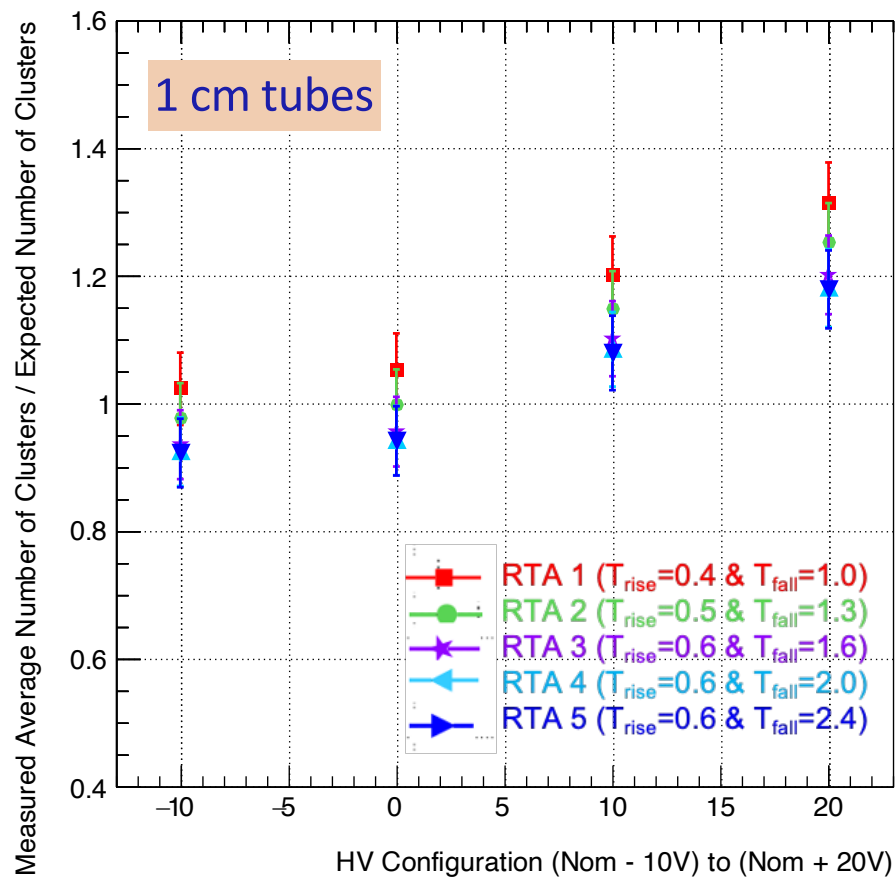


Cluster Finding efficiency



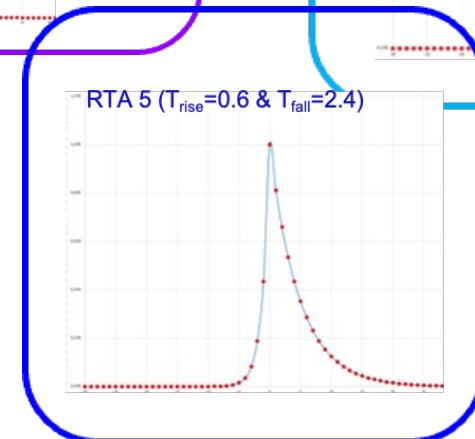
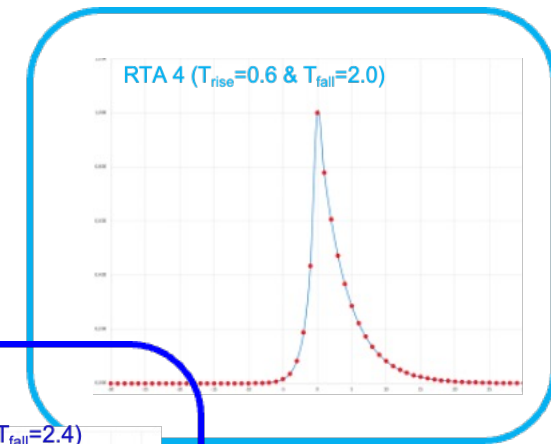
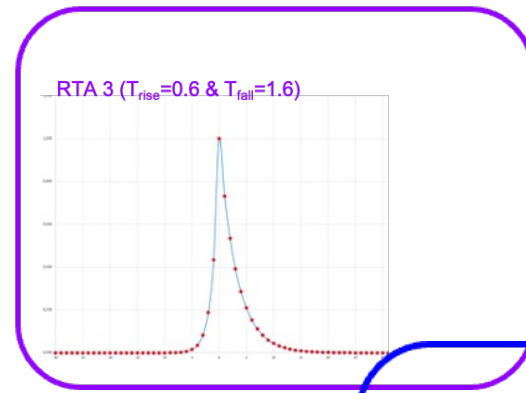
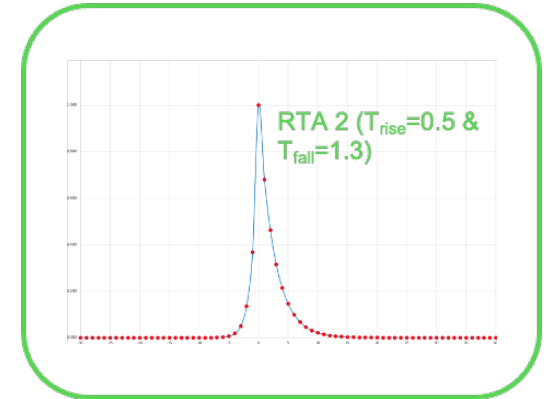
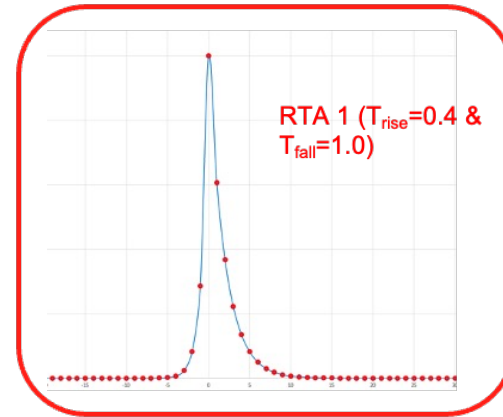
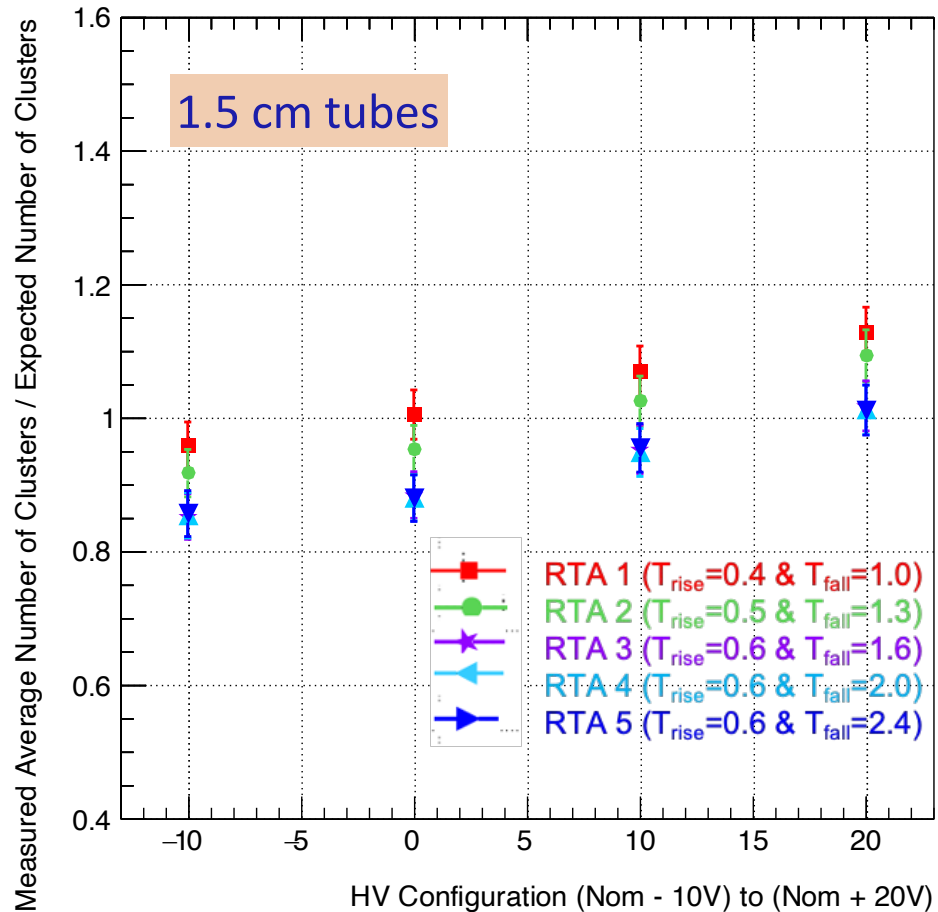
4- RTA scan

Cluster Finding efficiency

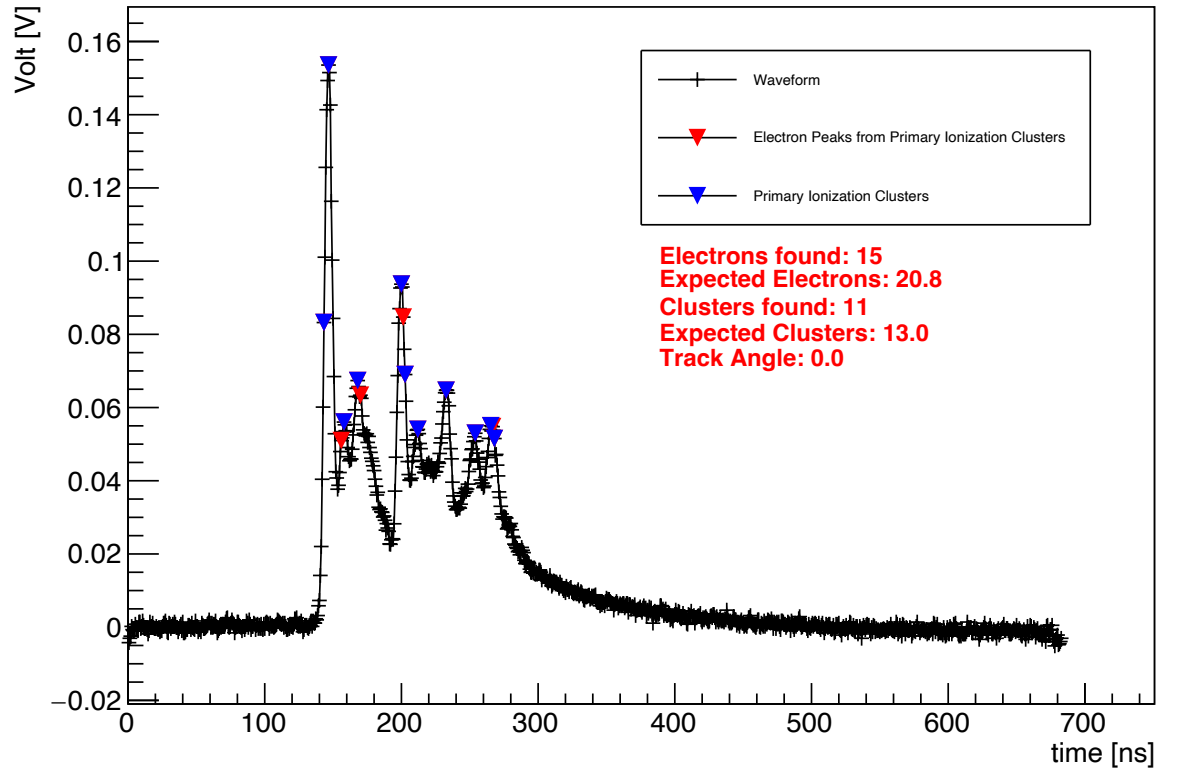
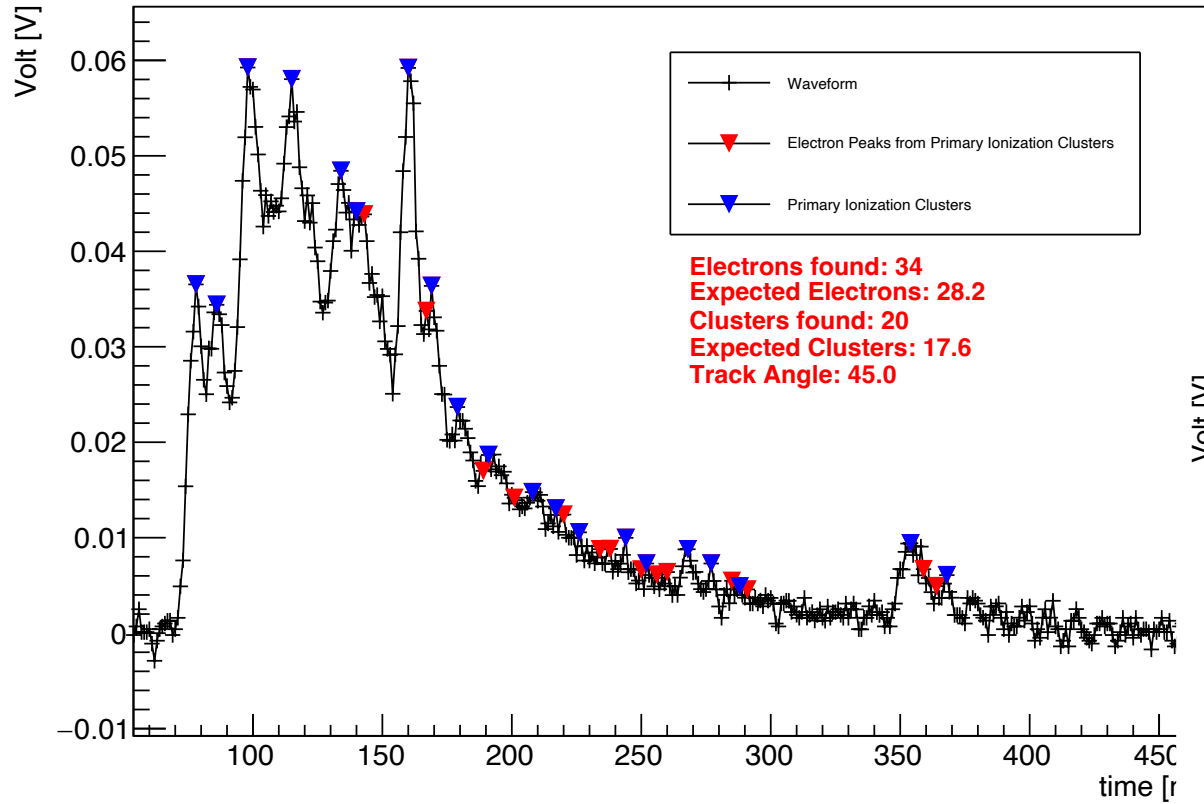


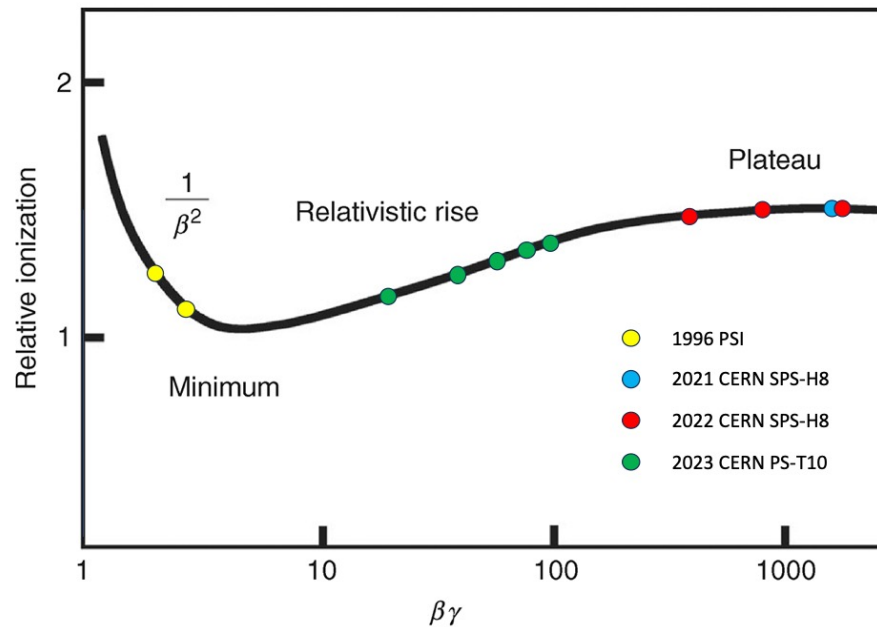
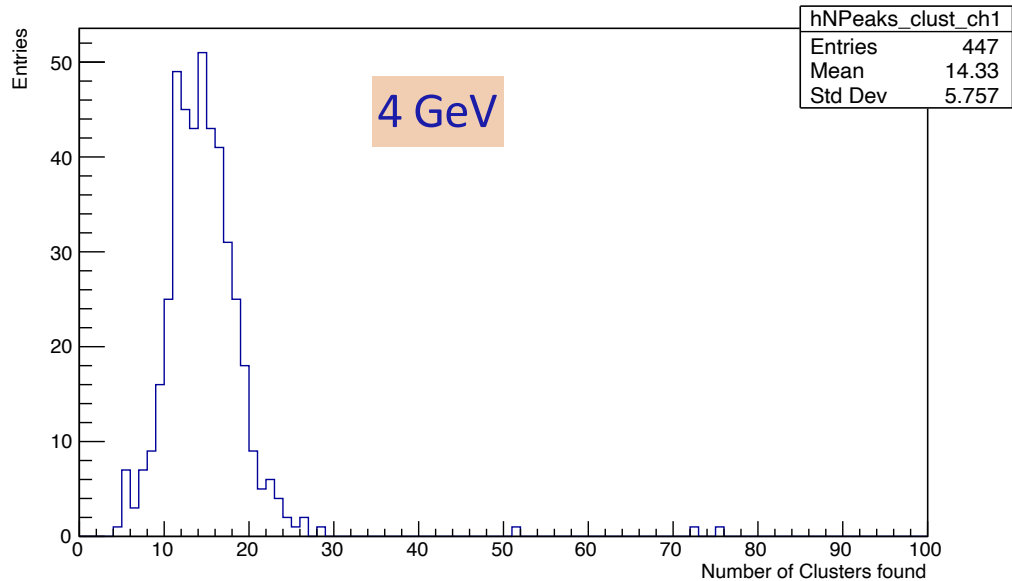
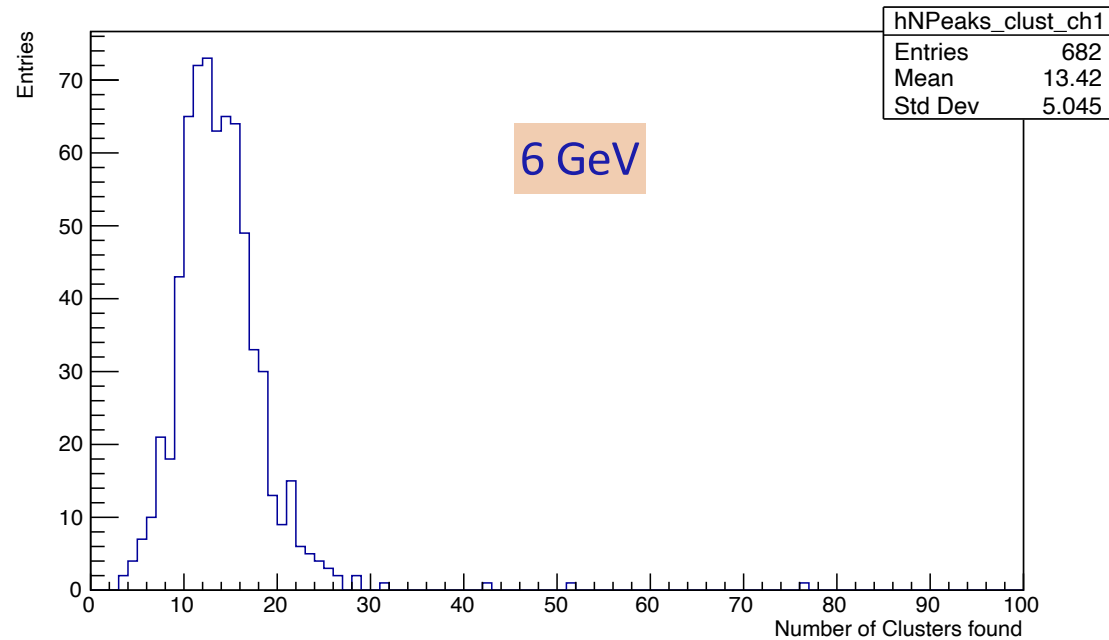
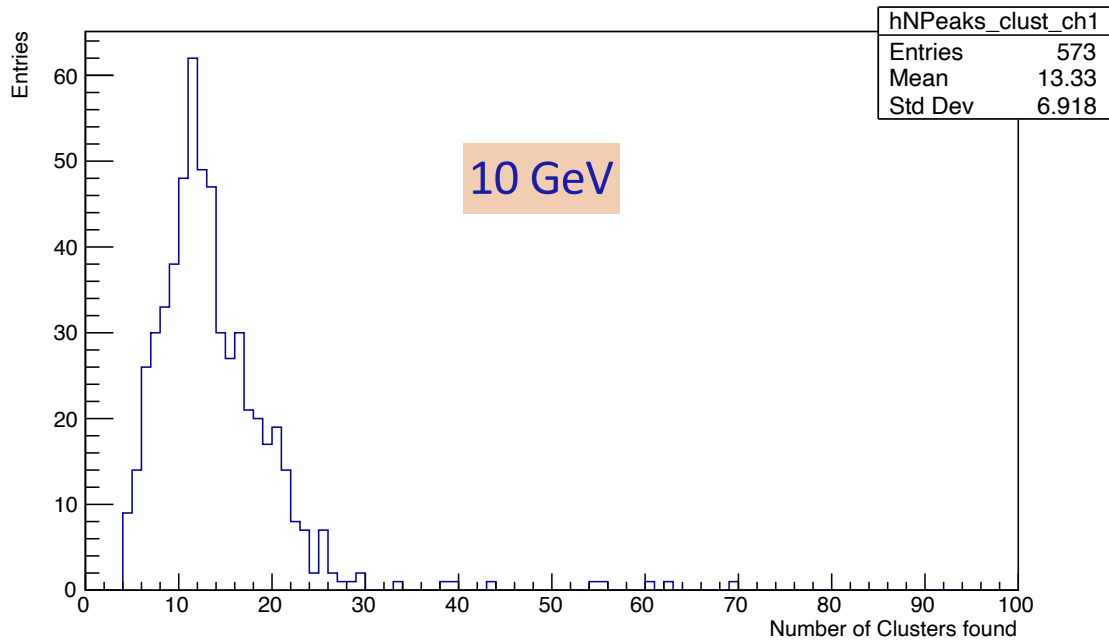
4- RTA scan

Cluster Finding efficiency



2023 DATA ANALYSIS

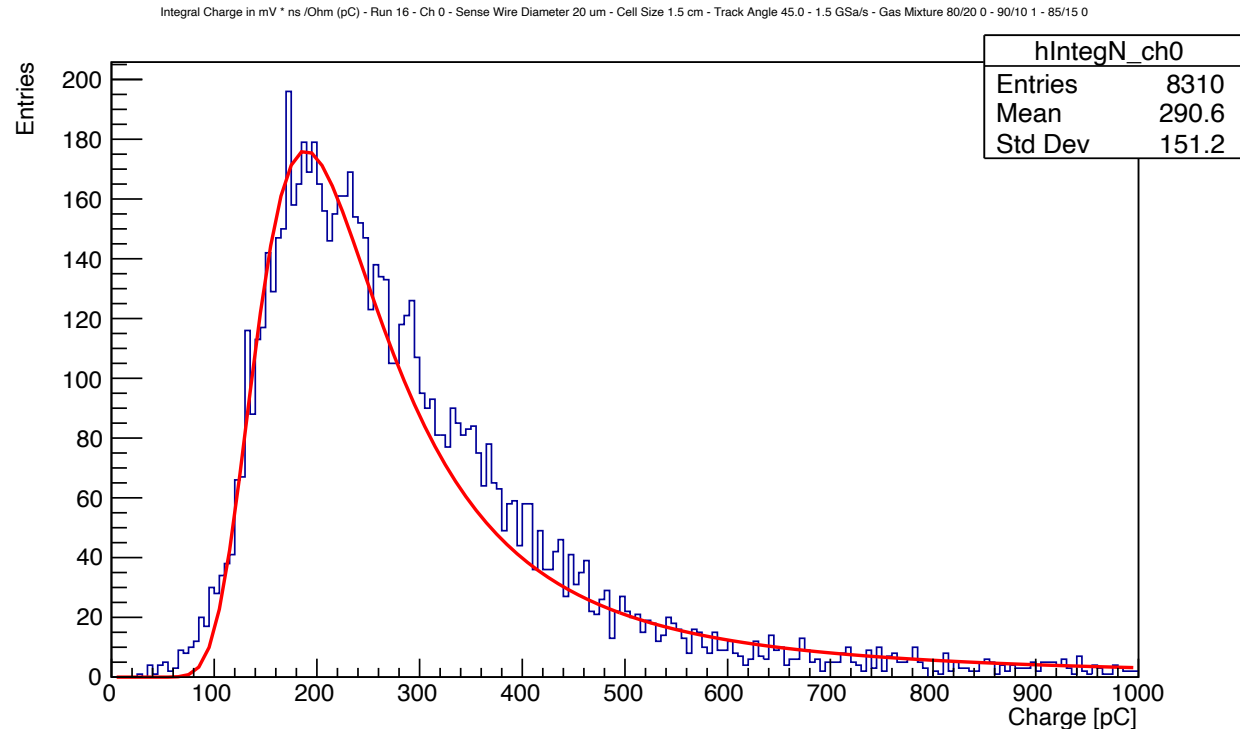




Backup

1-dE/dx Resolution study:

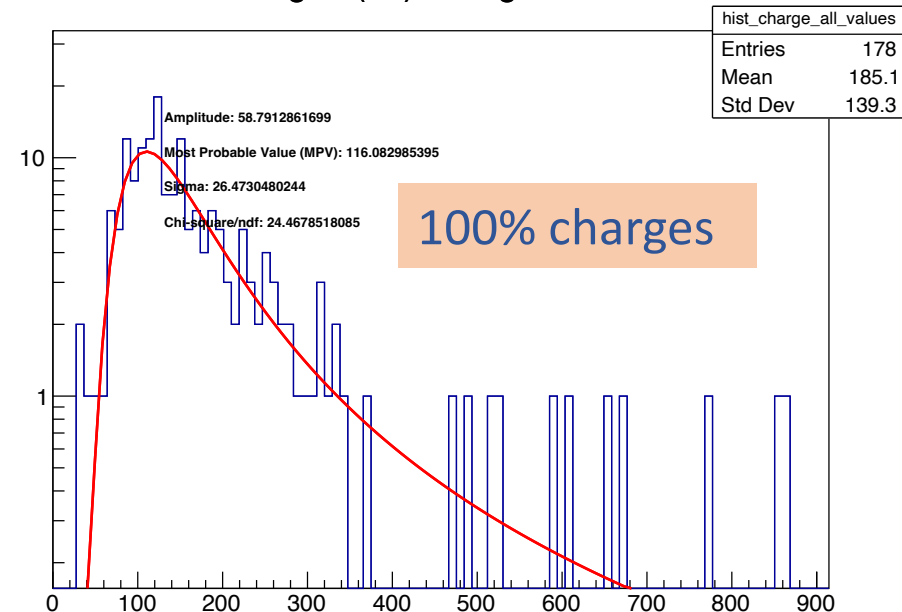
- Landau distribution for the charges.
- Measure charge of many samples (cells) along track.
- Get "mean" charge over samples = dE/dx.
- Simple "mean" charge subject to large fluctuations \Rightarrow "Truncated Mean" (robust).
- Reject samples with highest charge (typically) 20-30% and calculate mean ("truncated" mean) of remaining samples.
- Optimize truncation empirically (\Rightarrow best dE/dx resolution).



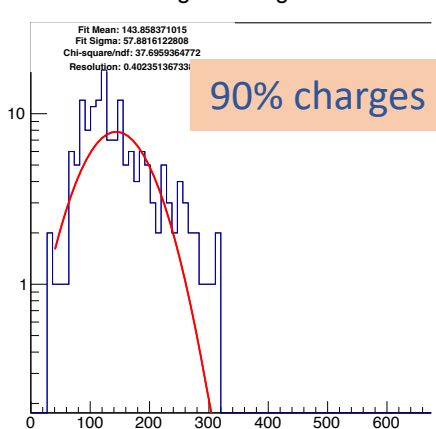
1- dE/dx Resolution study:

- 2m track length.
- Landau distribution for the charges.
- Optimize truncation empirically (⇔ best dE/dx resolution).
- Tested the resolution for each.
- Selected the distribution with 80% of the charges to be compared with dN/dx.

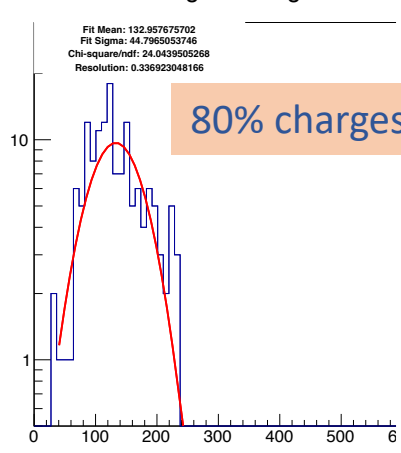
Integral (All) Charge Values



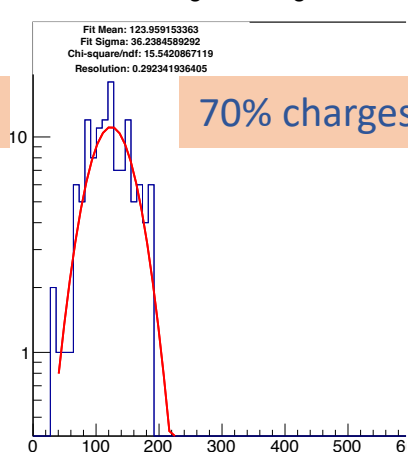
Integral Charge Values 0.9 C



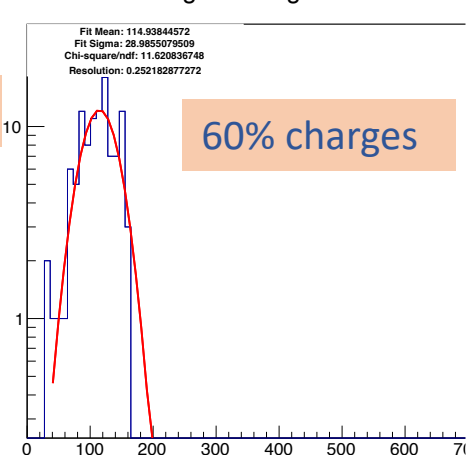
Integral Charge Values



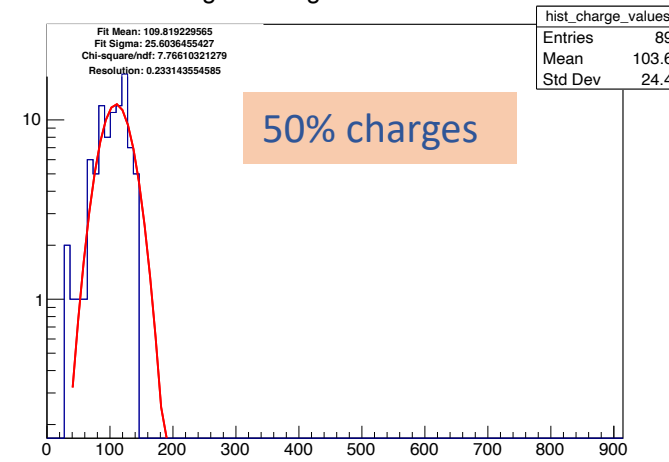
Integral Charge Values



Integral Charge Values 0.6 C

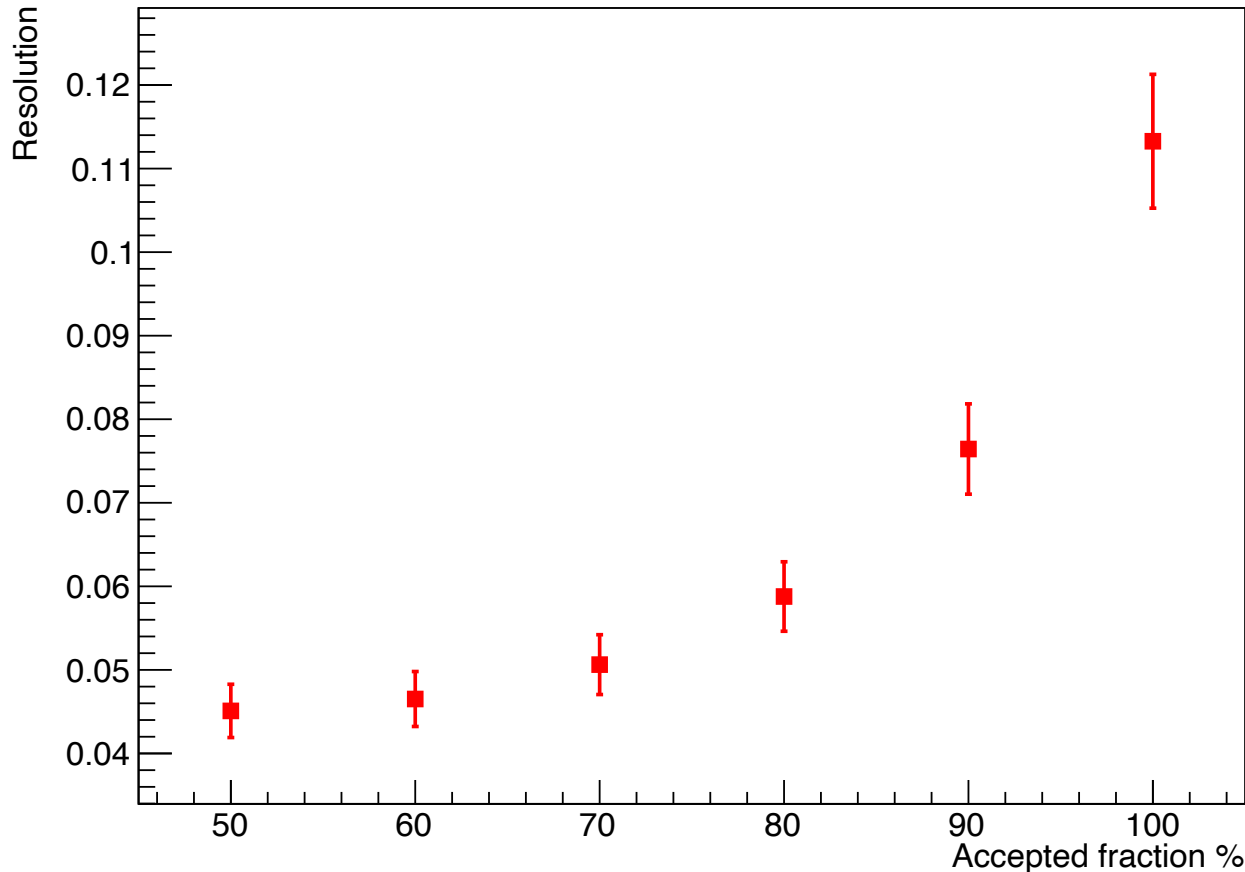


Integral Charge Values 0.5 Cut



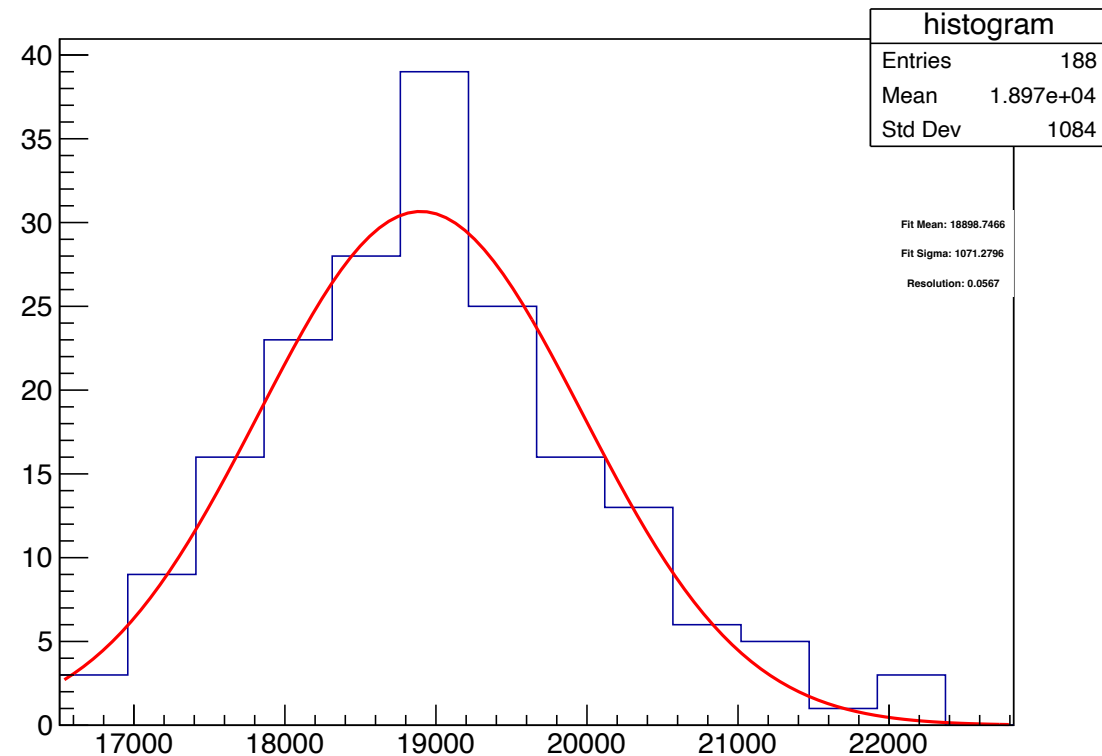
1- dE/dx Resolution study:

dE/dx Resolution Scan Vs accepted fraction of charge



dE/dx resolution varies from 4.5% - 11% relying on the accepted fraction of the charges.

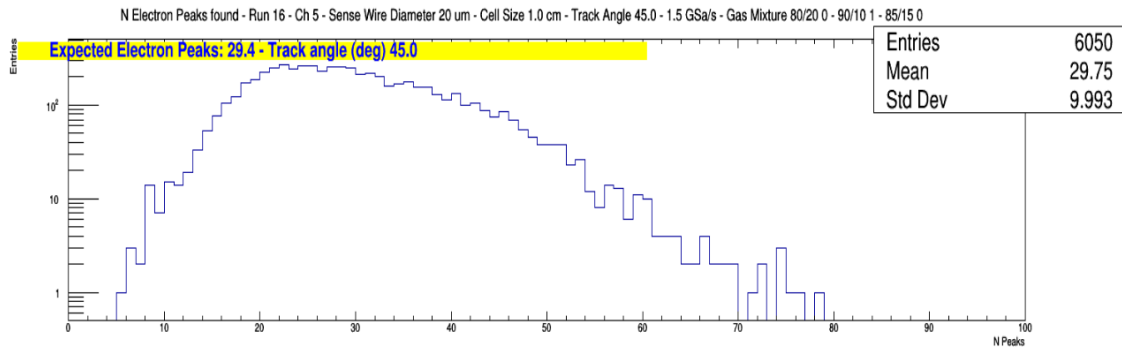
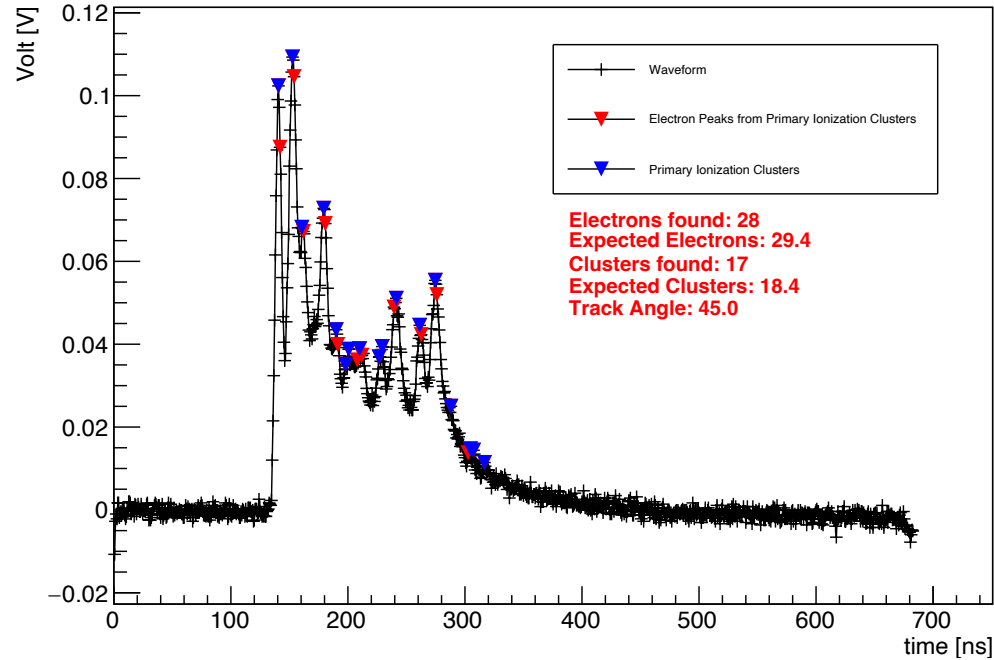
dE/dx Resolution (remove 20% higher charges for each track)



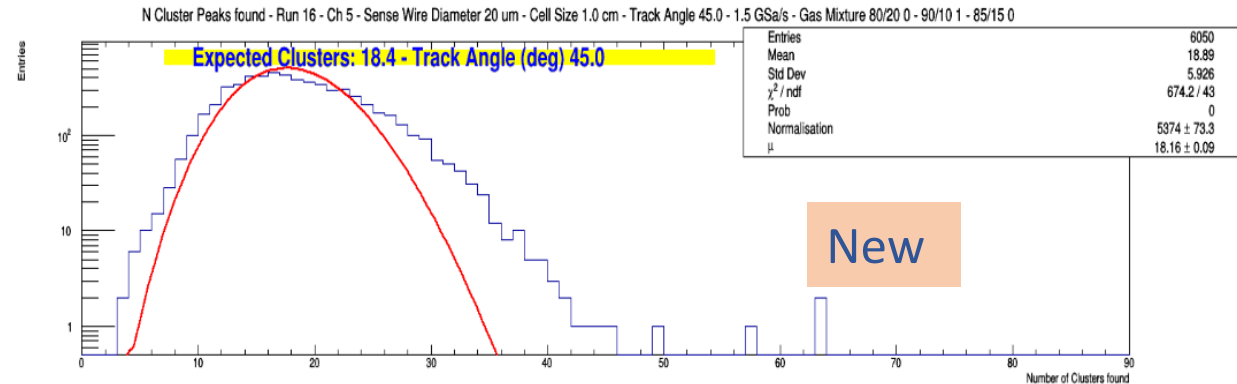
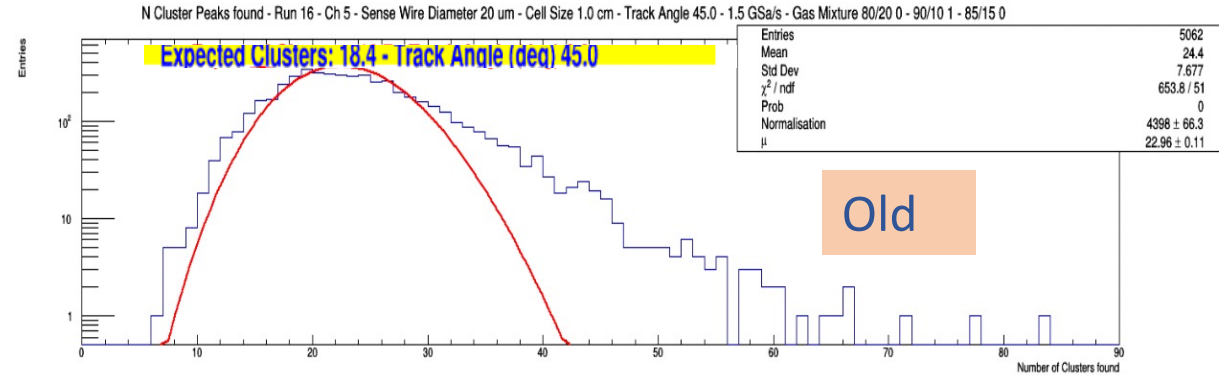
@2m long track we have dE/dx resolution 5.7%

2- dN/dx Resolution study:

Waveform signal Ch1 - Event 287 - Sense Wire Diameter 20 μm - Cell Size 1.0 cm - Track Angle 45.0 - run_16 - 1.5 GSa/s - Gas Mixture 80/20 0 - 90/10 1 - 85/15 0



The distribution of the electron takes Landau distribution with number of detected electrons in acceptance with the expected number

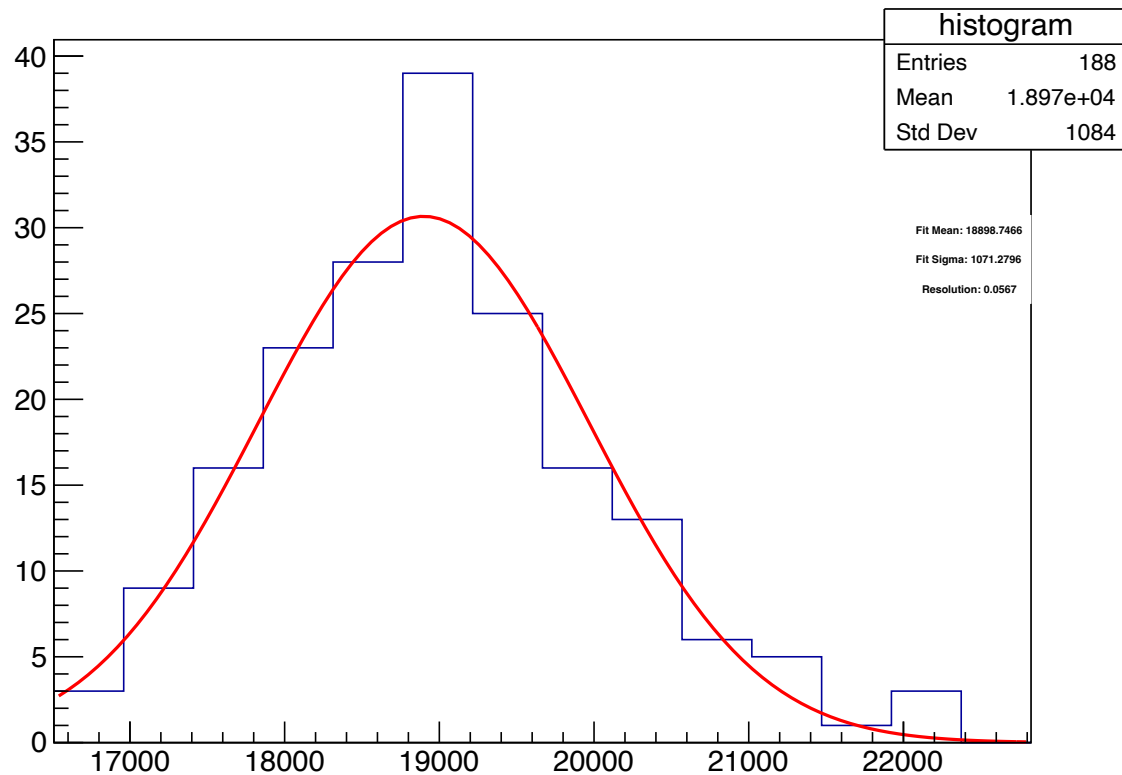


Poissonian distribution of the number of clusters with number of detected electrons in acceptance with the expected.

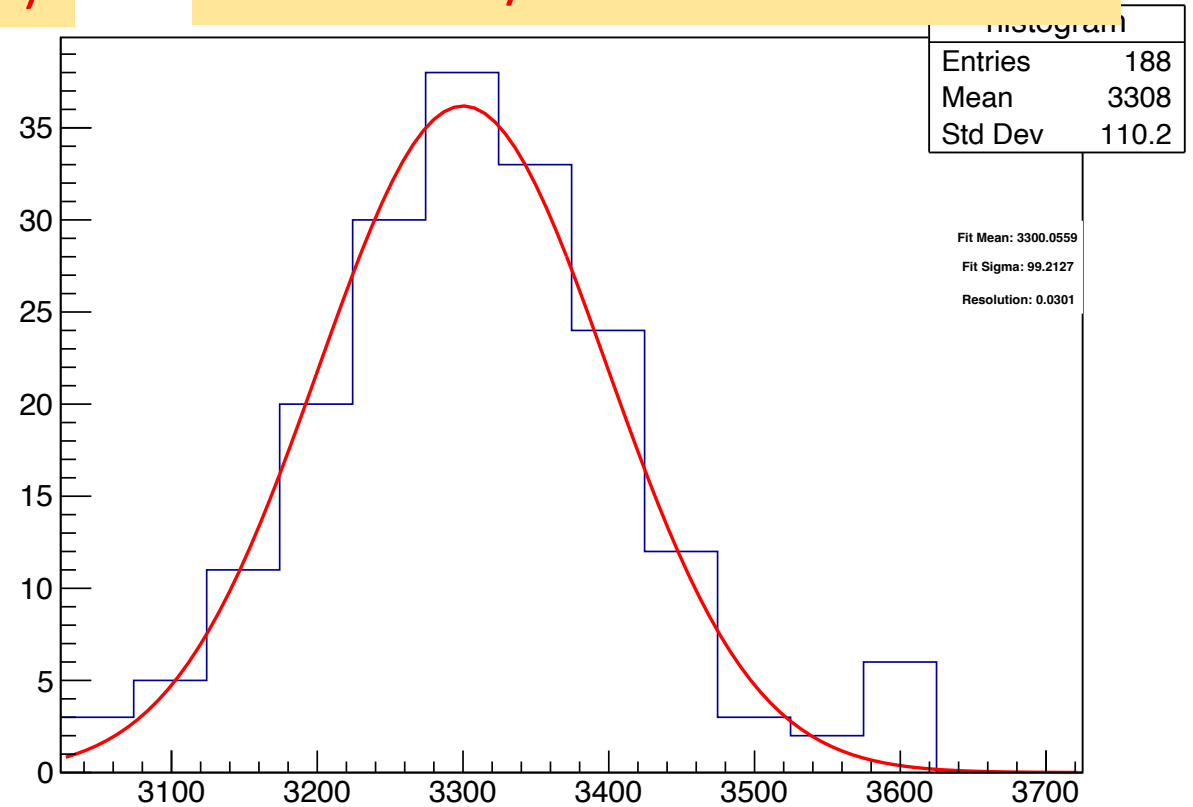
2- dN/dx vs dE/dx Resolution:

2m tracks length

dE/dx Resolution (remove 20% higher charges)



dN/dx Resolution



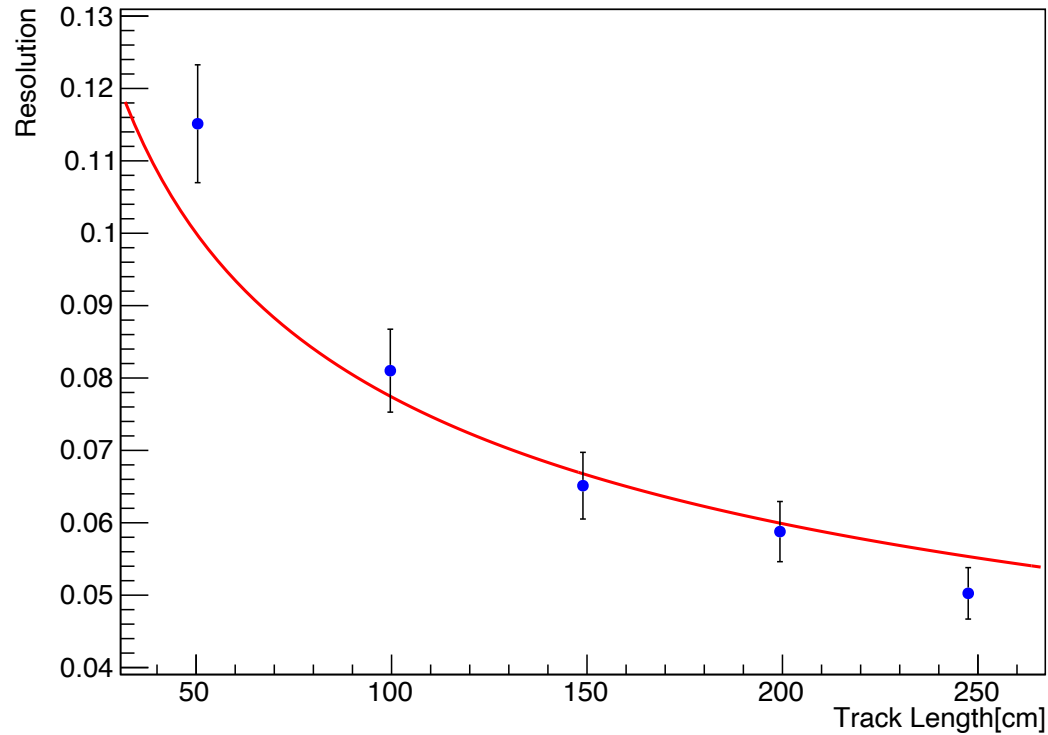
@2m long track we have dE/dx resolution 5.7%

@2m long track we have dN/dx resolution 3%

~ 2 times improvement in the resolution using dN/dx method

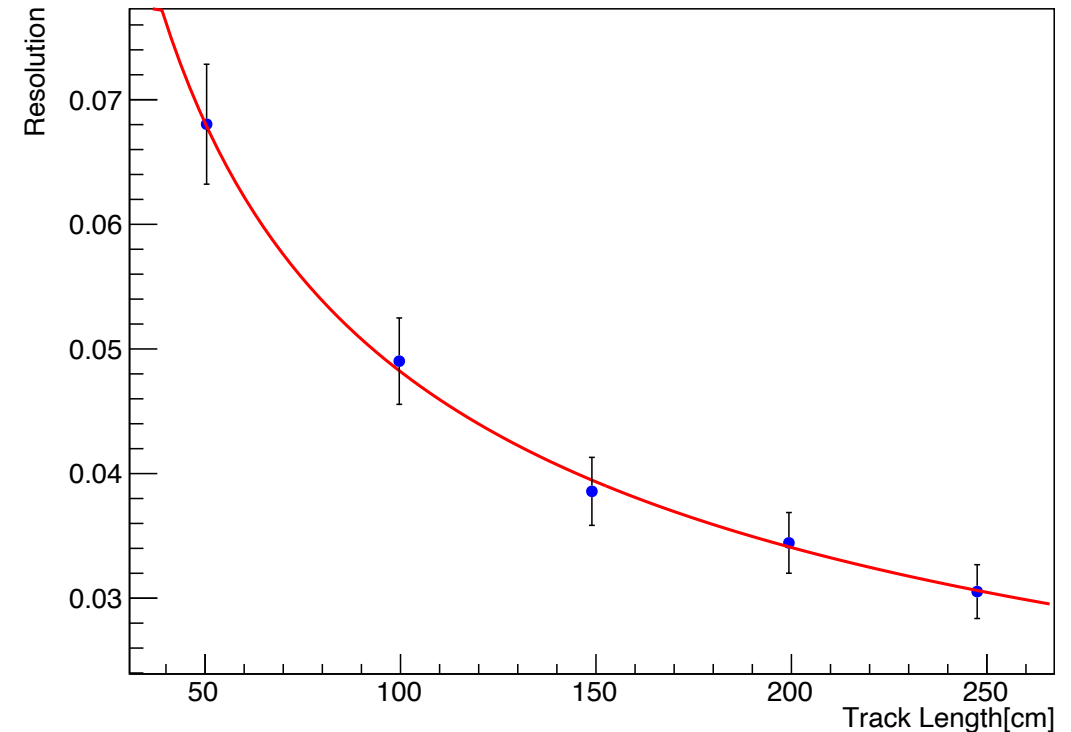
3- Resolution Scan:

dE/dx Resolution



dE/dx resolution dependence on the track length $L^{-0.37}$

dN/dx Resolution

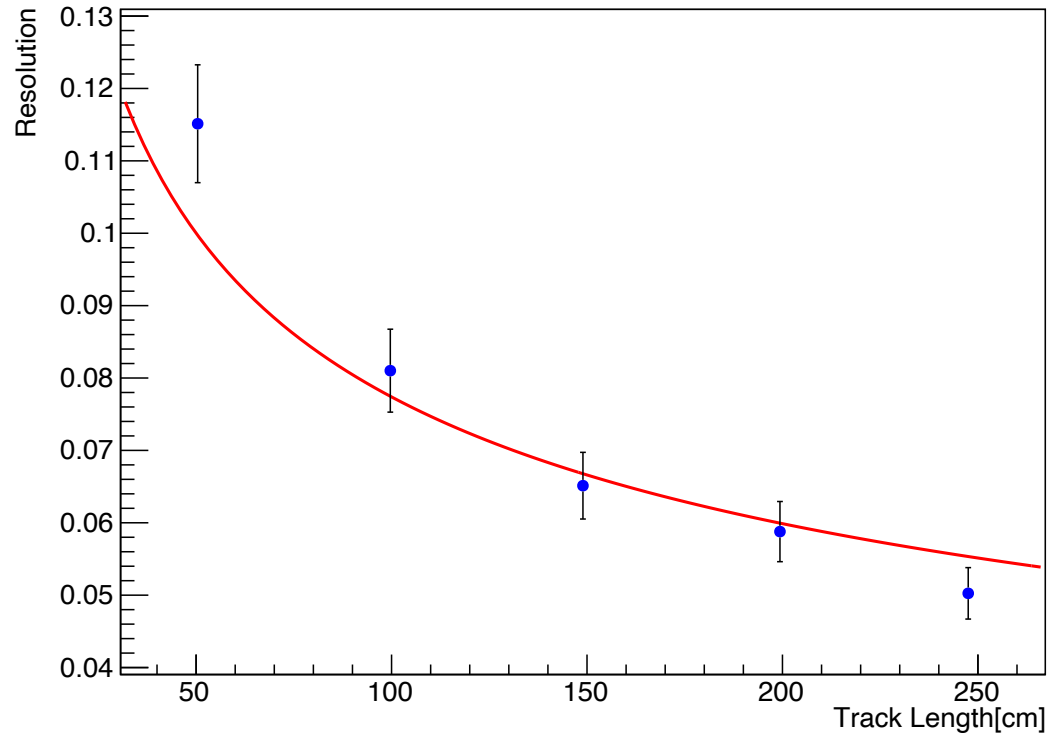


dN/dx resolution dependence on the track length $L^{-0.5}$

~ 2 times improvement in the resolution using dN/dx method

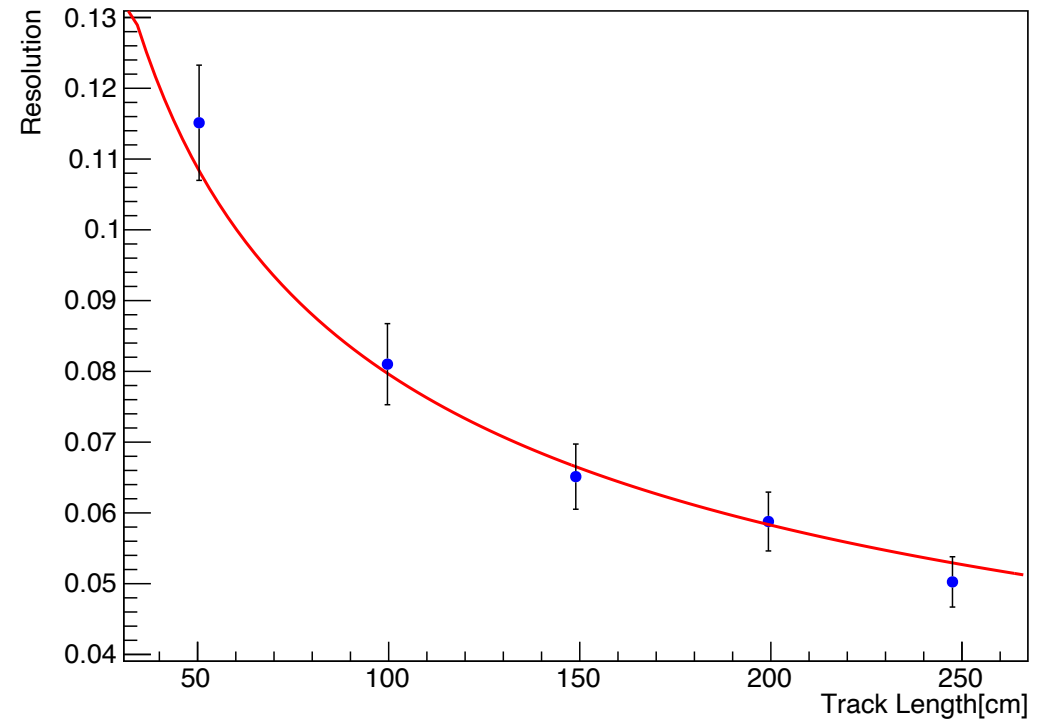
3- Resolution Scan:

Resolution vs Track Length for MeandEdx.txt



dE/dx resolution dependence on the track length $L^{-0.37}$

Resolution vs Track Length for MeandEdx.txt

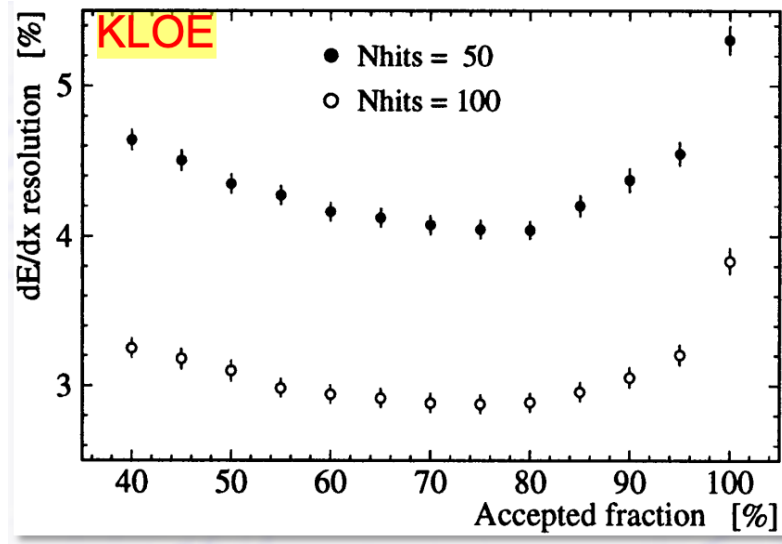


dE/dx resolution dependence on the track length $L^{-0.45}$

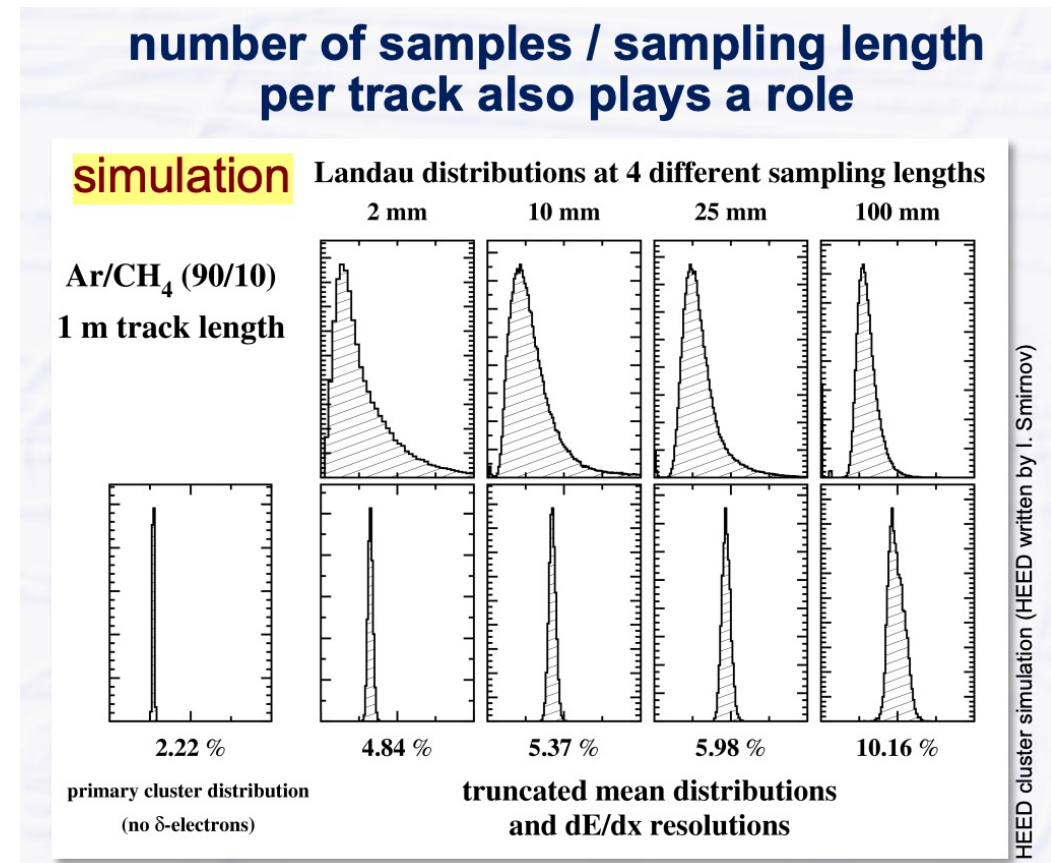
Backup

Classical dE/dx Measurement by charge:

- Measure charge of many samples (cells) along track.
- Get "mean" charge over samples = dE/dx.
- Simple "mean" charge subject to large fluctuations \Rightarrow "Truncated Mean" (robust).
- Reject samples with highest charge (typically) 20-30% and calculate mean ("truncated mean") of remaining samples.
- dE/dx resolution depends on:
 - effective detector length L (track length \times pressure). $L^{-0.37}$
 - Number of samples. $1/\sqrt{N}$



KLOE Collaboration, A. Andryakov et al., NIM A 409 (1998) 390-394

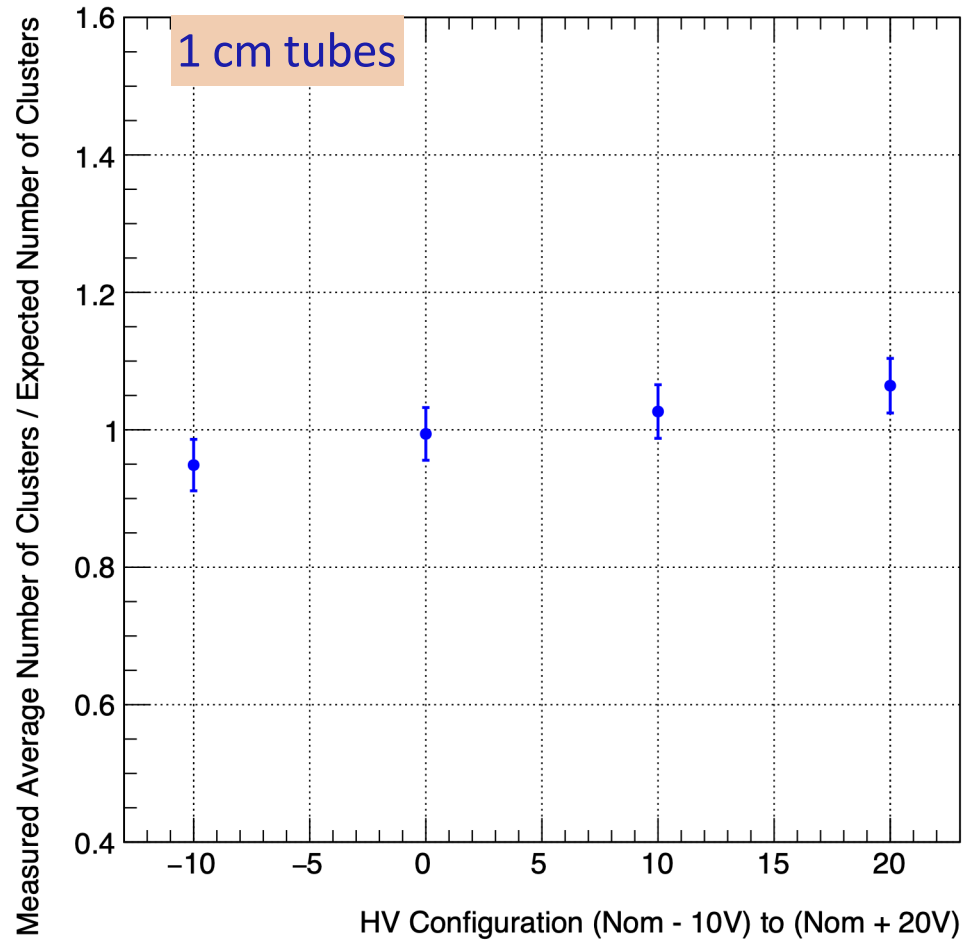


2- HV scan:

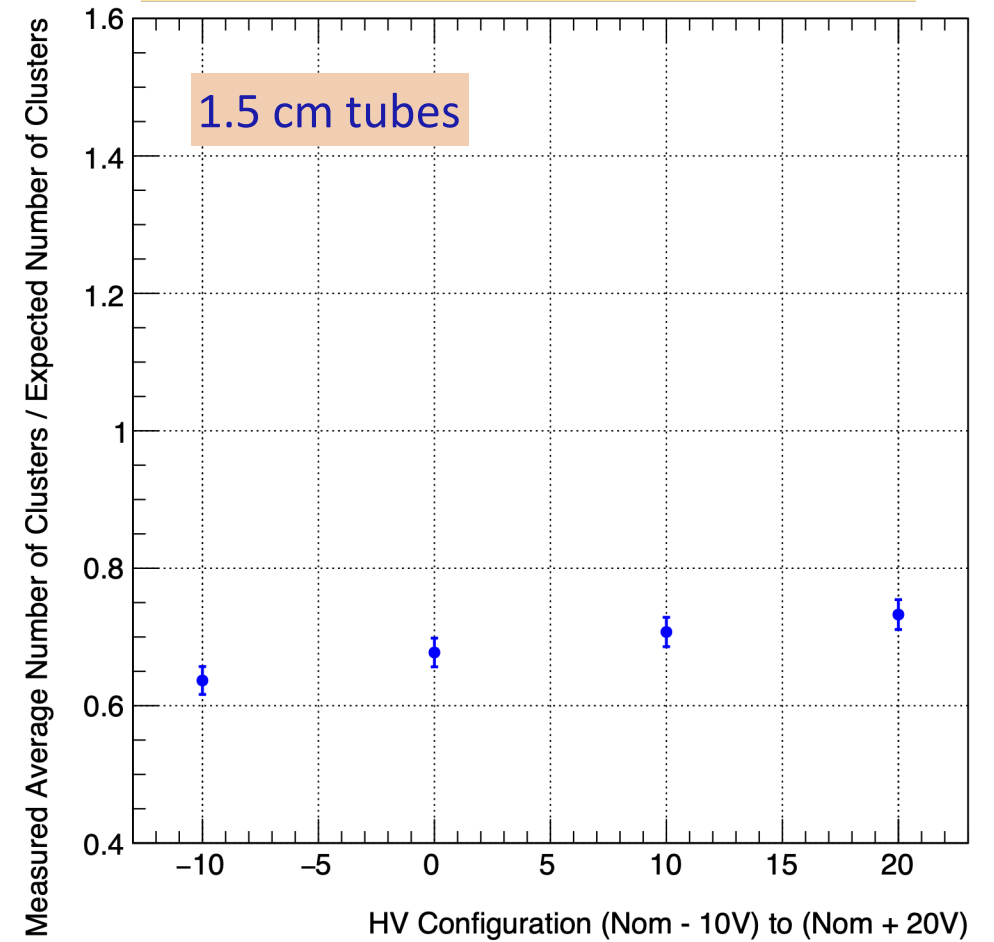
He:IsoB 80:20

Good stability with changing the HV

Cluster Finding efficiency



Cluster Finding efficiency

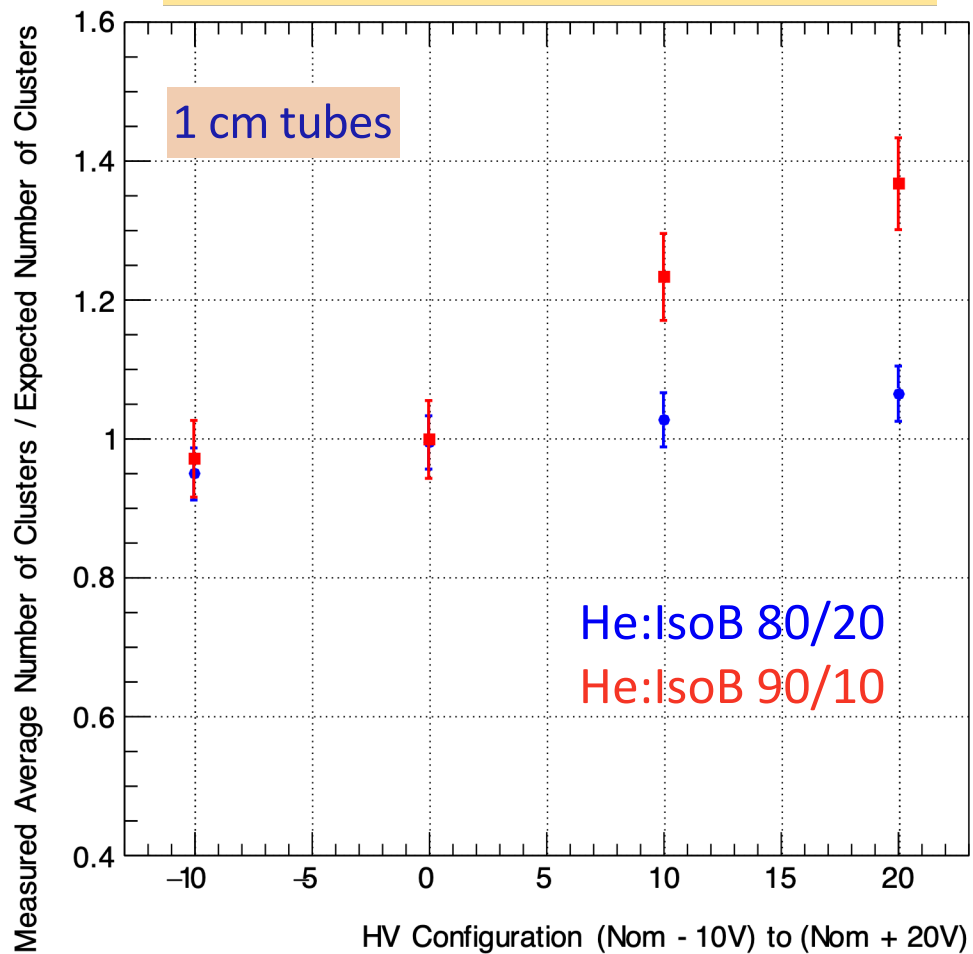


2
1

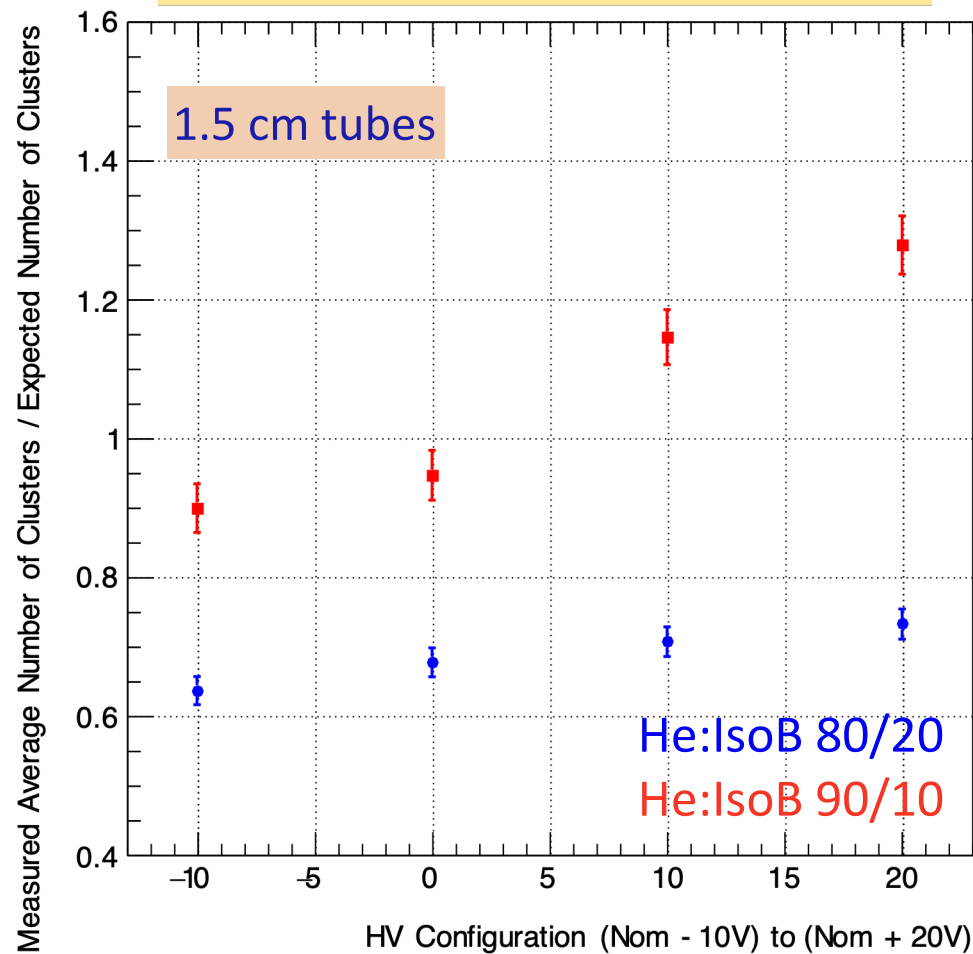
Inefficiency ~ 30% using He:IsoB 80/20 for 1.5 cm tubes

2- HV scan

Cluster Finding efficiency



Cluster Finding efficiency



dE/dx Resolutions of major Particle Physics Detectors

● Input data for the 2021 “Lehraus” plot

Detector	Accelerator	Type	Size (Ø x L)	B (T)	Gas Mixture	Pressure (bar)	Number of samples	Sampling length (mm)	Effective detector length (bar * m)	dE/dx resolution (%)		Truncation (%)	Reference
										isolated tracks	dense tracks		
ALEPH	LEP	TPC	3.6 m x 4.4 m	1.5	Ar/CH ₄ (91/9)	1	338	4	1.35	4.5		8-60	D. Buskulic et al., NIM A 360 (1995) 481
ALICE	LHC	TPC	5.0 m x 5.0 m	0.5	Ne/CO ₂ (90/10)	1	159	7.5, 10, 15	1.60	4.5	(5.0)	0-70	W. Yu, NIM A 706 (2013) 55, J. Alme et al., NIM A 622 (2010) 316
ARGUS	DORIS	drift cells	1.7 m x 2 m	0.8	C ₃ H ₈ /Methylal	1	36	18	0.65	4.1	(4.4)	10-70	Y. Oku, PhD Thesis, Univ. of Lund (1985), LUNFD6/(NFFL-7024)
BaBar	PEP-II	drift cells	1.6 m x 2.8 m	1.5	He/i-C ₄ H ₁₀ (80/20)	1	40	12	0.48	7.5		0-80	B. Aubert et al., NIM A 479 (2002) 1-116
BELLE	KEK-B	drift cells	1.9 m x 2.2 m	1.5	He/C ₂ H ₆ (50/50)	1	47	16	0.75	5.5	(7.0)	0-80	E. Nakano, NIM A 494 (2002) 402-408
BES	BEPC	jet cells	2.3 m x 2.1 m	0.4	Ar/CO ₂ /CH ₄ (89/10/1)	1	54	5	0.27	9.0		0-70	J.Z. Bai et al., NIM A 344 (1994) 319
CDF	TEVATRON	jet cells	2.6 m x 3.2 m	1.5	Ar/C ₂ H ₆ /C ₂ H ₆ O (49.6/49.6/0.8)	1	32	12	0.38	7.0		?	D. Stuart, private communications
CLEO II	CESR	drift cells	1.9 m x 1.9 m	1.5	Ar/C ₂ H ₆ (50/50)	1	51	14	0.71	6.2	(7.1)	0-50	Y. Kubota et al., NIM A 320 (1992) 66
CLEO III	CESR	drift cells	1.6 m x 1.9 m	1.5	He/C ₃ H ₈ (60/40)	1	47	14	0.66	5.0		0-70	D. Peterson et al., NIM A 478 (2002) 142-146
CRISIS	TEVATRON	jet cells	1 m x 1 m x 3 m	-	Ar/CO ₂ (80/20)	1	192	15	2.88	3.2		0-75	W.S. Toothacker et al., NIM A 273 (1988) 97
DELPHI	LEP	TPC	2.4 m x 2.7 m	1.2	Ar/CH ₄ (80/20)	1	192	4	0.77	5.7	(6.2)	0-80	P. Abreu et al., CERN-PPE/95-194, submitted to NIM
D0 FDC	TEVATRON	jet cells	1.2 m x 0.3 m	-	Ar/CH ₄ /CO ₂ (93/4/3)	1	32	8	0.26	12.7		0-70	S. Rajagopalan, PhD Thesis, Northwestern University (1992)
H1	HERA	jet cells	1.7 m x 2.2 m	1.13	Ar/C ₂ H ₆ (50/50)	1	56	10	0.56	10.0		---	I. Abt et al., NIM A 386 (1997) 348-396
JADE	PETRA	jet cells	1.6 m x 2.4 m	0.48	Ar/CH ₄ /i-C ₄ H ₁₀ (88.7/8.5/2.8)	4	48	10	1.92	6.5	(7.2)	5-70	K. Ambrus, PhD Thesis, Univ. of Heidelberg (1986)
KEDR	VEPP-4M	jet cells	1.1 m x 1.1 m	2.0	DME (100)	1	42	10	0.42	10.0		5-70	S.E. Baru et al., NIM A 323 (1992) 151
KLOE	DAΦNE	drift cells	4 m x 3.3 m	0.6	He/i-C ₄ H ₁₀ (90/10)	1	58	28	1.62	3.5		0-80	A. Andryakov et al., NIM A 409 (1998) 390-394 (prototype)
MARK II	SLC	drift cells	3 m x 2.3 m	0.475	Ar/CO ₂ /CH ₄ (89/10/1)	1	72	8.33	0.60	7.0		5-75	A. Bojarski et al., NIM A 283 (1989) 617
NA49	SPS	TPC	8 m x 3.8 m x 1.3 m	-	Ar/CH ₄ /CO ₂ (90/5/5)	1	90	40	3.60	4.7		10-65	B. Lasiuk, NIM A 409 (1998) 402-406
OBELIX	LEAR	jet cells	1.6 m x 1.4 m	0.5	Ar/C ₂ H ₆ (50/50)	1	40	15	0.60	12.0		0-70	F. Balestra et al., NIM A 323 (1992) 523
OPAL	LEP	jet cells	3.6 m x 4 m	0.435	Ar/CH ₄ /i-C ₄ H ₁₀ (88.2/9.8/2)	4	159	10	6.36	2.8	(3.2)	0-70	M. Hauschild, NIM A 379 (1996) 436
SLD	SLC	jet cells	2 m x 2 m	0.6	CO ₂ /Ar/i-C ₄ H ₁₀ (75/21/4)	1	80	6	0.48	7.0		?	M. Hildreth, private communications
STAR	RHIC	TPC	4 m x 4.2 m	0.5	Ar/CH ₄ (90/10)	1	45	17.2	0.77	8.0		0-70	M. Anderson et al., NIM A 499 (2003), 659
TOPAZ	TRISTAN	TPC	2.4 m x 2.2 m	1.0	Ar/CH ₄ (90/10)	3.5	175	4	2.45	4.4	(4.6)	0-65	M. Iwasaki et al., NIM A 365 (1995) 143
TPC/2γ	PEP	TPC	2 m x 2 m	1.375	Ar/CH ₄ (80/20)	8.5	183	4	6.22	3.0		0-65	G. Cowan, PhD Thesis, Lawrence Berkeley Lab. (1988), LBL-24715
ZEUS	HERA	jet cells	1.7 m x 2.4 m	1.43	Ar/CO ₂ /C ₂ H ₆ (90/8/2)	1	72	8	0.58	8.5		?	W. Zeuner, private communications

* = inverse gaussian mean 1/sqrt[(dE/dx)] used