

2023/2024-Test beam data analysis updates

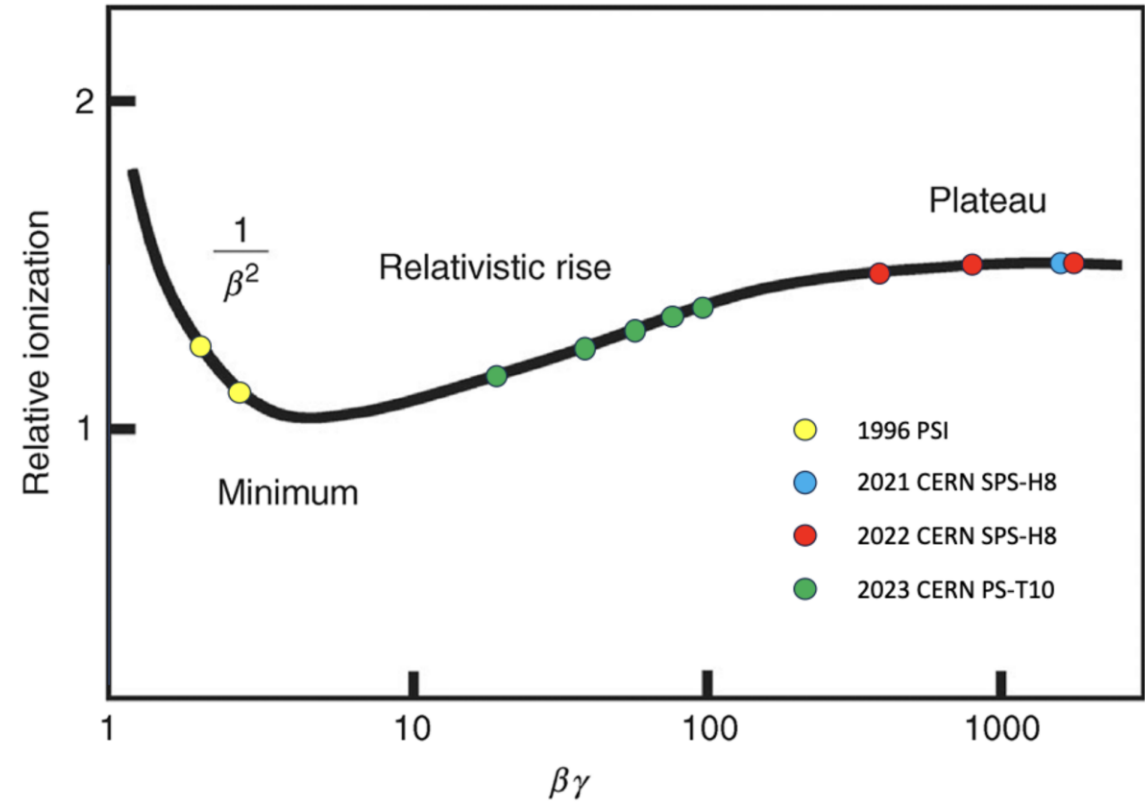
The Derivative algorithm for peak finding

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Configurations and data collected in 2023&2024

Year/P [GeV]	2	4	6	8	10
2023	✓	✓	✓	✓	✓
2024	✓	✓	✓	✓	✓

✗ 2 gas mix. (90/10 & 85/15) ✗ 2 angles (0 & 45)



Configurations and data collected in 2023&2024

2023

[Link to CERN box](#) / [run documentation](#)

DRS16 channels	HV channels	Tubes
0	0	1.0cm-20μm
1	1	1.0cm-20μm
2	2	1.0cm-20μm
3	3	1.0cm-20μm
4	4	1.0cm-20μm
5	5	1.0cm-20μm
6	12	1.5cm-20μm
7	13	1.5cm-20μm
8	14	1.5cm-20μm
9	15	1.5cm-20μm
10	-	-
11	-	-
12	-	-
13	-	-
14	-	Sipm Scintillator upstream
15	-	Sipm Scintillator downstream

Tubes setup with DRS

Tubes	Channels	HV channels	HV tag	HV tag
			1	2
Tubes	Channels	HV channels	Volt (V)	Volt (V)
OSC 1cm-20um	5,6,7,8	8,6,9,10	1450	
DRS16 1cm-20um	0,1,2,3,4,5	0,1,2,3,4,5	1450	
OSC 1.5cm-20um	1,2,3,4	16,17,18,19	1550	
DRS16 1.5cm-20um	6,7,8,9	12,13,14,15	1550	

HV tags with 90/10 gas mix runs

Oscilloscope	HV channels	Tubes
1	16	1.5cm-20μm
2	17	1.5cm-20μm
3	18	1.5cm-20μm
4	19	1.5cm-20μm
5	8	1.0cm-20μm
6	6	1.0cm-20μm
7	9	1.0cm-20μm
8	10	1.0cm-20μm

Tubes setup with OSC

Tubes	Channels	HV channels	HV tag	HV tag
			1	2
Tubes	Channels	HV channels	Volt (V)	Volt (V)
OSC 1cm-20um	5,6,7,8	8,6,9,10	1450	1630
DRS16 1cm-20um	0,1,2,3,4,5	0,1,2,3,4,5	1450	1630
OSC 1.5cm-20um	1,2,3,4	16,17,18,19	1550	1730
DRS16 1.5cm-20um	6,7,8,9	12,13,14,15	1550	1730

HV tags with 85/15 gas mix runs

2024

[Link to CERN box](#) / [run documentation](#)

HV CHANNEL – HV PIN – DAQ					
0 45 OSC-1	1 46 DRS-0	2 47 DRS-2	3 48 DRS-6	4 49 DRS-10	5 50 OSC-5
12 24 OSC-2	13 25 DRS-3	14 26 DRS-7	15 27 OSC-6		
16 28 OSC-3	17 29 DRS-4	18 14 DRS-8	19 15 OSC-7		
6 34 OSC-4	7 35 DRS-1	8 36 DRS-5	9 37 DRS-9	10 38 DRS-11	11 39 OSC-8

Tubes setup

Tubes	Channels	HV channels	HV tag	HV tag	HV tag	HV tag	HV tag	HV tag	HV tag
			1	2	3	4	5	6	7
Tubes	Channels	HV channels	Volt (V)	Volt (V)	Volt (V)	Volt (V)	Volt (V)	Volt (V)	Volt (V)
OSC 1cm	1,4,5,8	0,5,6,11	1440	1470	1480	1430	1480	1730	1780
DRS16 1cm	0,1,2,5,6,9,10,11	1,2,3,4,7,8,9,10	1440	1470	1480	1430	1480	1730	1780
OSC 1.5cm	2,3,6,7	12,15,16,19	1530	1580	1580	1510	1570	1820	1880
DRS16 1.5cm	3,4,7,8	13,14,17,18	1530	1580	1580	1510	1570	1820	1880

HV tags

The recipe of peak finding using the derivative algorithm

Events cleaning:-

- Peaks within these time windows:
30 - 500 ns (1 cm tubes)
30 - 750 ns (1.5 cm tubes)
- Time span of the peaks:
180 ns (1 cm tubes)
270 ns (1.5 cm tubes)

A voltage pulse is identified as an electrons peak if it passes the following conditions:-

- Voltage amplitude $> N1 * RMS_{noise}$
- $[Amplitude - (Amp_{before} + Amp_{after})]/2 > N2 * RMS$
- $1^{st} \text{ der. (peak)} < N3 * \sqrt{2} * RMS / TimeRes$ **OR**
 $1^{st} \text{ der. (peak before)} < -N3 * \sqrt{2} * RMS / TimeRes$ **OR**
 $1^{st} \text{ der. (peak after)} < -N3 * 2\sqrt{2} * RMS / TimeRes$
- $2^{nd} \text{ der. (peak)} < -N4 * 2 RMS / (TimeRes)^2$

$N1, N2, N3$ & $N4$ are the hyperparameters of the algo. to be optimized

Hyperparameters optimization

1- Define the expected N. clusters

- Define the expected range of N. clusters within (1.0 - 1.3 relativistic rise factor)

2- Scan over the hyperparameters space (5D)

- Cut on amplitude: 2.0, 3.0, 4.0, 5.0
- Diff. In amplitude: 0.5, 1.0, 1.5, 2.0, 2.5
- Cut of 1st der. : 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8
- Cut on 2nd der. : 0.02, 0.03, 0.04, 0.05, 0.06, 0.07
- Cluster scale : 0.20 0.22 0.24 0.26 0.28 0.3 0.32

3- Evaluate the performance of each set

Best set is defined by:-

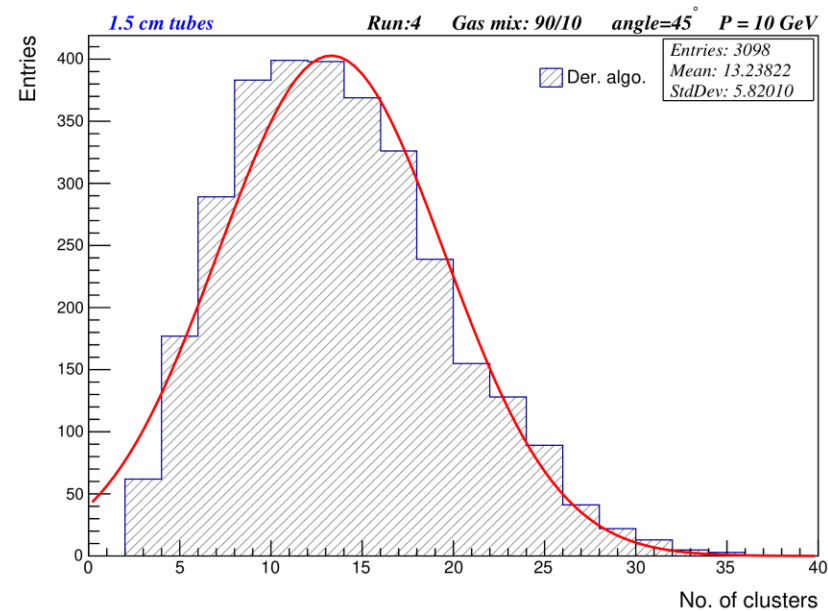
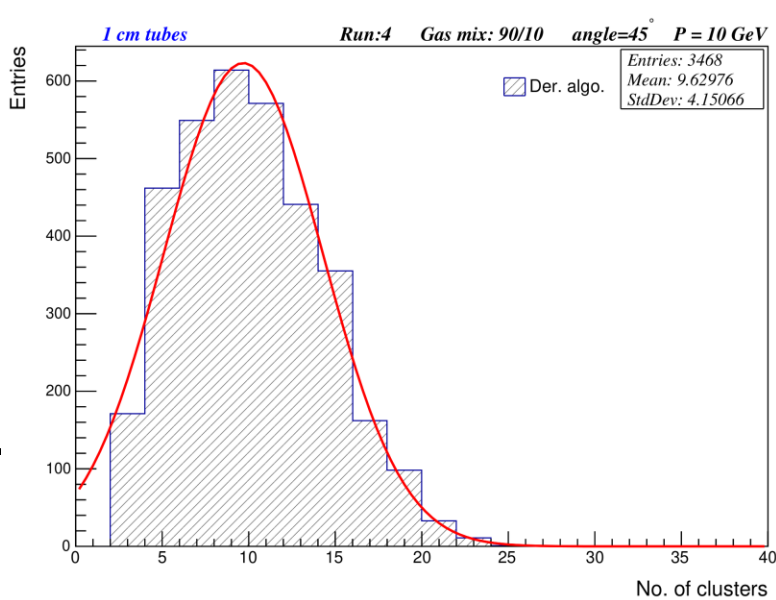
- leads to N. clusters within the expected range
- closest the mean of the range
- has the lowest standard deviation

Best configuration obtained:

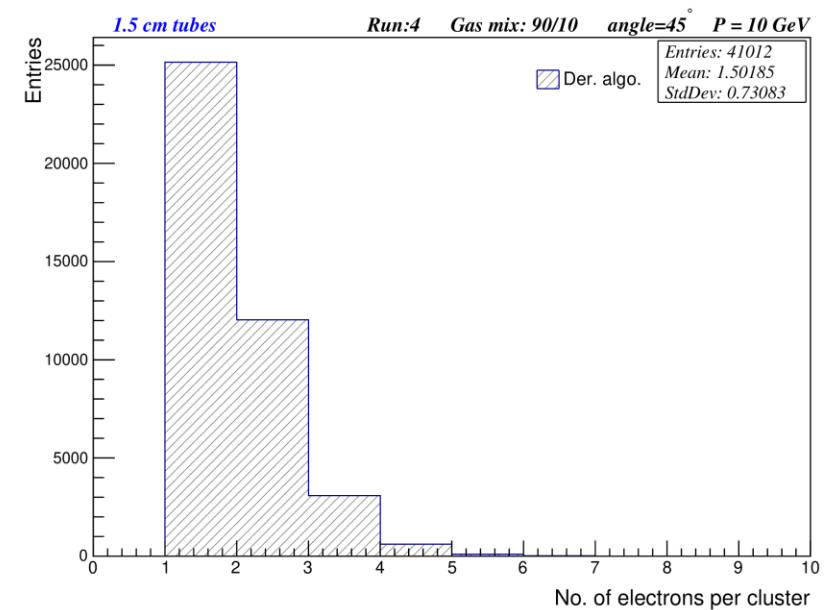
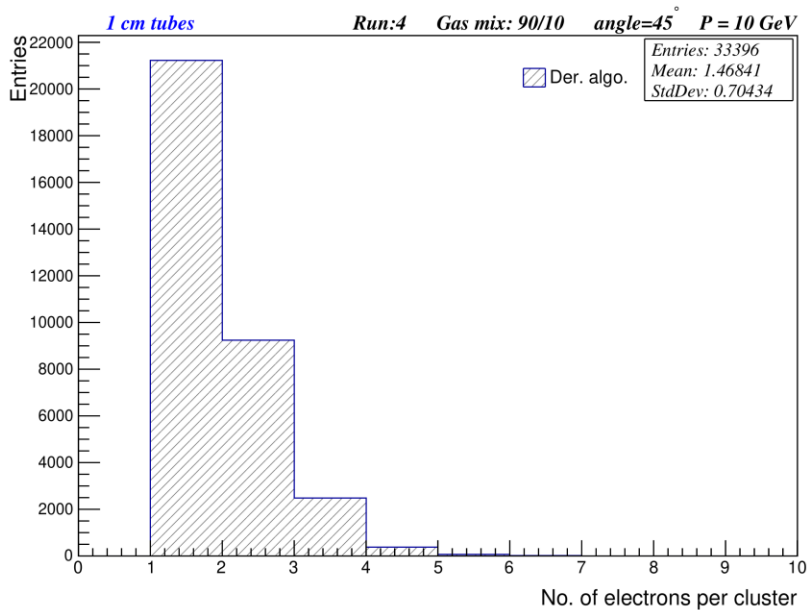
N1	N2	N3	N4	cluster scale
4.0	1.0	0.4	0.04	0.24

Results: example run 4

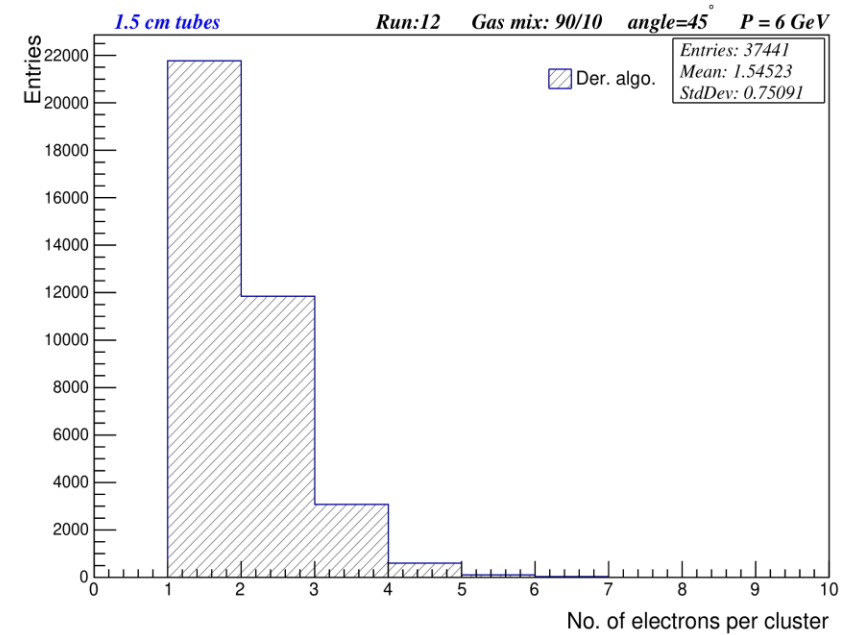
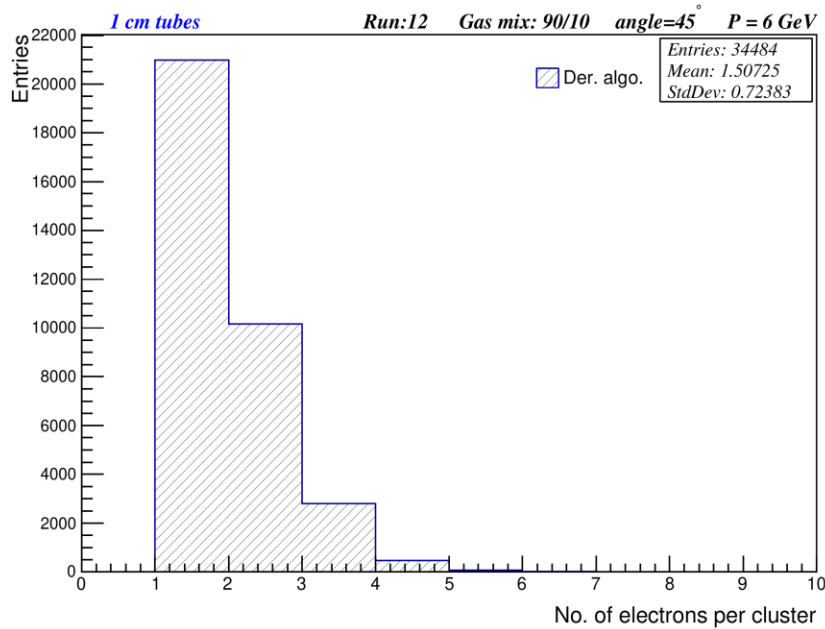
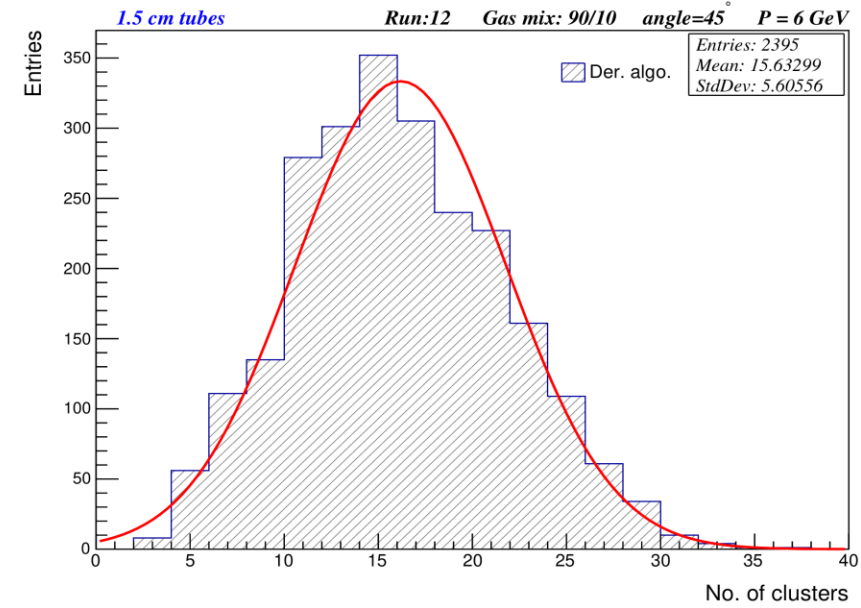
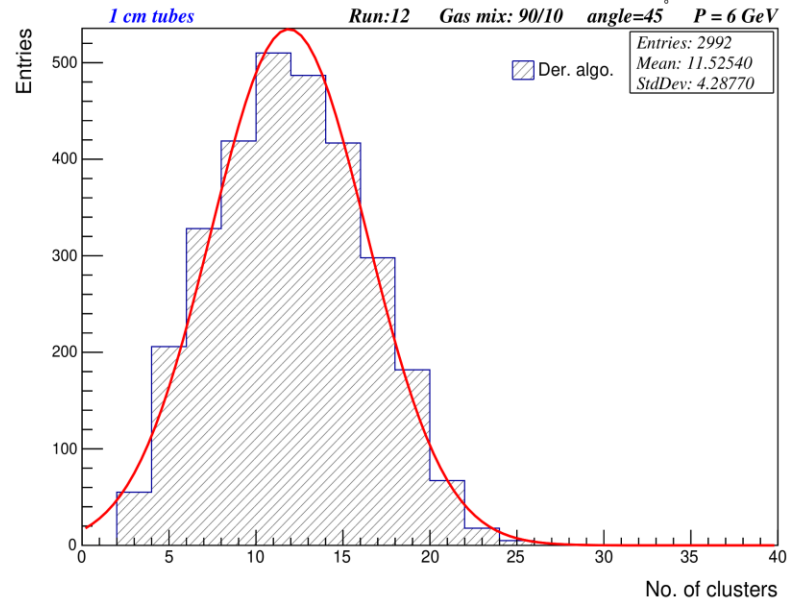
=== GOODNESS OF FIT ===
Chi-squared: 46.5117
NDF: 9
Chi-squared/NDF: 5.16796
Probability: 4.83819e-07
Mean: 9.68638 ± 0.0911549
Sigma: 4.59135 ± 0.0702397



=== GOODNESS OF FIT ===
Chi-squared: 70.7792
NDF: 14
Chi-squared/NDF: 5.05566
Probability: 1.39414e-09
Mean: 13.3028 ± 0.12239
Sigma: 6.20562 ± 0.111438



Results: example run 12



Results: overall 2023 data

