2023-Test beam data analysis updates

M. Louka

June 2024

Configurations

configuration	runs	gas	angle	momentum	events	MB
1	tbdata_1, _2, _3 run1,2	90/10	3°	10	18800 6987	460,4 3382
2	tbdata_4 run4	90/10	45°	10	4800 2585	119,3 1240
3	tbdata_10 run10	90/10	5°	8	4709 3413	118,2 ?
4	tbdata_5,_6,_7,_8,_9 run5,7,8	90/10	45°	8	8100 + 4548 +	67,1 + 2190 +
5	tbdata_11 run11	90/10	0°	6	4618 4973	115,3 2390
6	tbdata_12 run12	90/10	45°	6	3041 ?	83,9 ?
7	tbdata_14 run14	90/10	0°	4	1001 4365	25,2 ?
8	tbdata_13 run13	90/10	45°	4	1700 5355	42,7 ?
9	tbdata_15 run15	90/10	0°	2	6947 3516	184,6 ?
10	tbdata_16 run16	90/10	45°	2	? 4023	43,9 ?
11	tbdata_17 run17	85/15	0°	10	10400 4000	268,4 ?
12	tbdata_18 run18	85/15	45°	10	2000 2500	117 ?
13	tbdata_26 run26	85/15	0°	8	19814 5039	
14	tbdata_25 run25	85/15	45°	8	10000 ?	
15	tbdata_20 run20	85/15	0°	6	9800 5019	247,5 ?
16	tbdata_19 run19	85/15	45°	6	4112 3767	104 ?
17	tbdata_21 run21	85/15	0°	4	2827 3760	70,3 ?
18	tbdata_24 run24	85/15	45°	4	2900 4215	104,9 ?
19	tbdata_22 run22	85/15	0°	2	923 2691	23,2 ?
20	tbdata_23 run23	85/15	45°	2	2000 4000	83,9 ?

The set up

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

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

Derivative algorithm optimization

for DRS & OSC data

example run no. 4 (Gas mix. 90/10, angle 45, momentum 10 GeV)

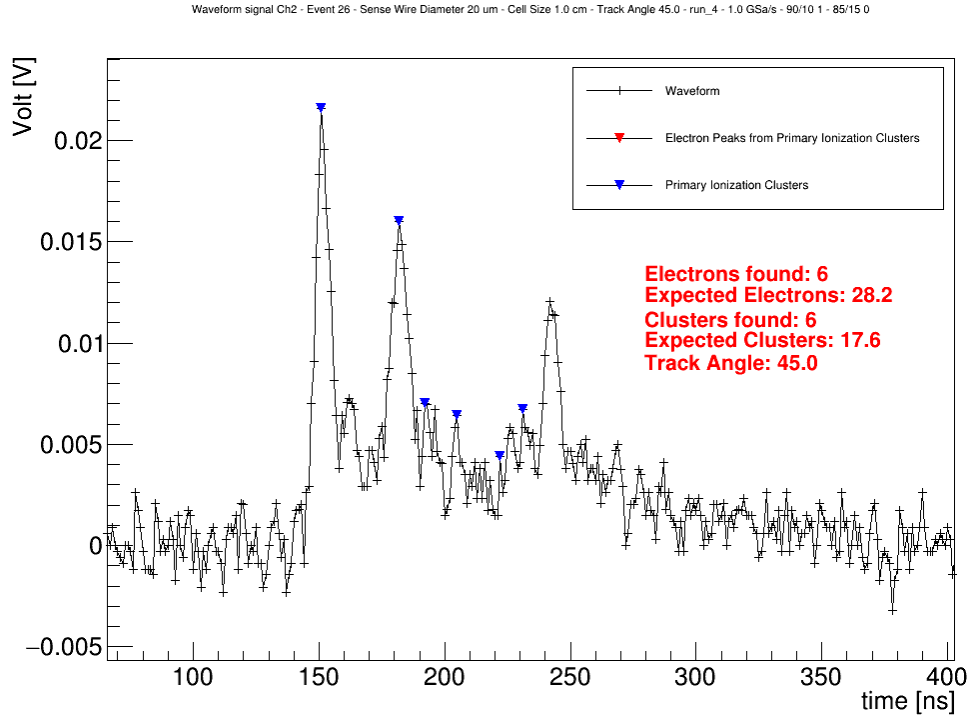
Different set of cuts are tested:

[run number] [first event] [last event] [sampling rate] [cut on RMS] [cut on amplitude] [1st der.] [2nd der.] [Bsln time] [n bins] [clusterization]

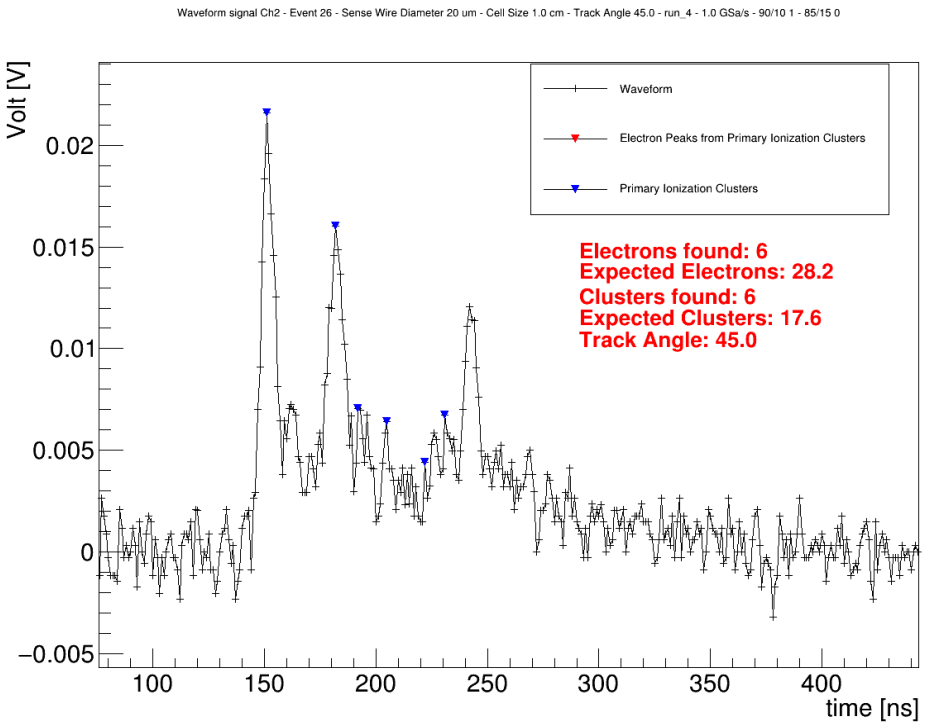
1st der. : 0.4, 0.6, 0.8, 1.0
2nd der. : 0.4, 0.6, 0.8, 1.0
scale cut : 0.2, 0.22, 0.24, 0.26

scan on the 1st derivative cut

Cut on 2nd der. : 0.4
Cut on clusterization : 0.24


Waveform signal Ch2 - Event 26 - Sense Wire Diameter 20 um - Cell Size 1.0 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 6
Expected Electrons: 28.2
Clusters found: 6
Expected Clusters: 17.6
Track Angle: 45.0
Volt [V]
time [ns]

0.4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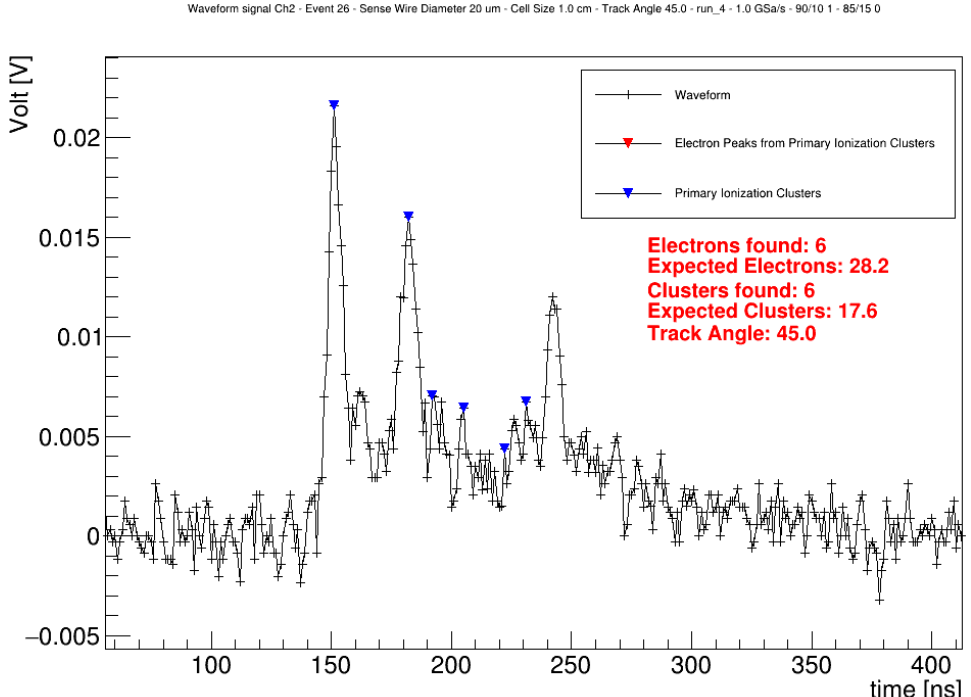
Volt [V]
time [ns]

0.8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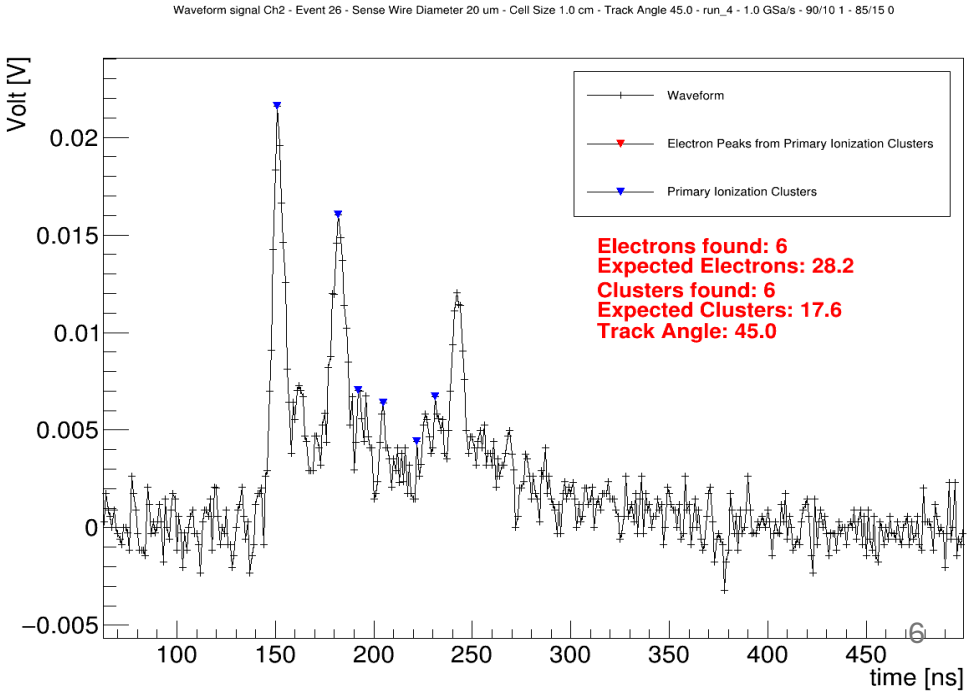
Volt [V]
time [ns]

0.6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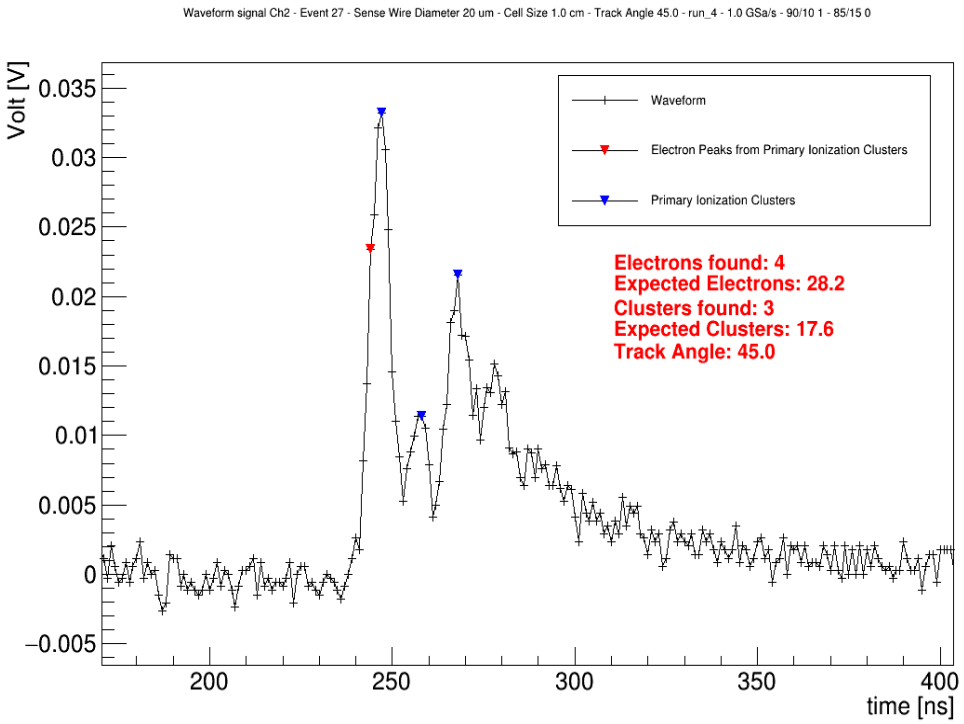
Volt [V]
time [ns]

1.0

0.4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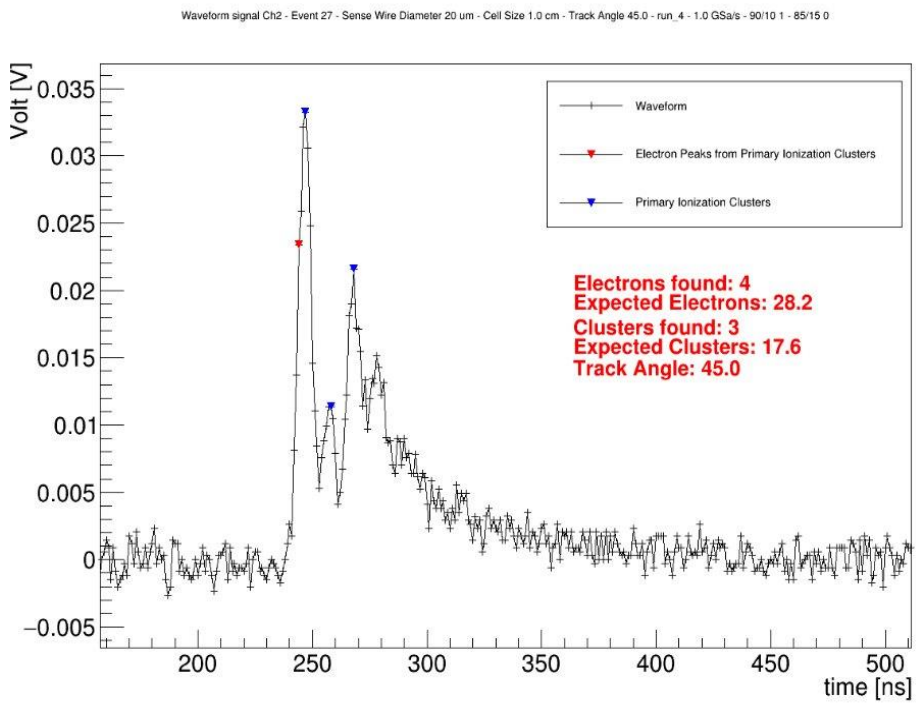
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 4
Expected Electrons: 28.2
Clusters found: 3
Expected Clusters: 17.6
Track Angle: 45.0

0.8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Volt [V]
time [ns]
Waveform
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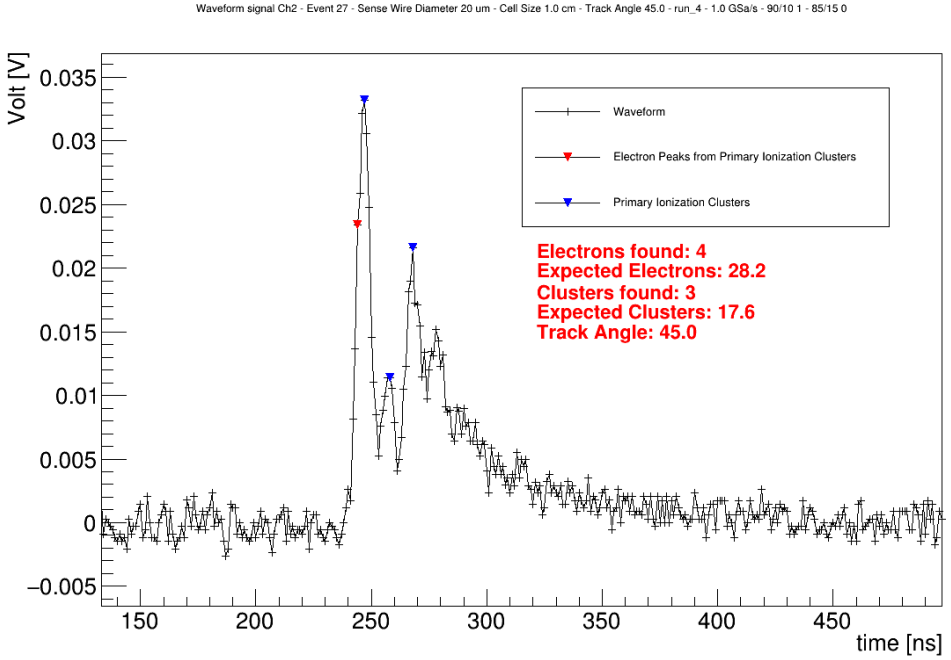
Track Angle: 45.0

0.6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time [ns]
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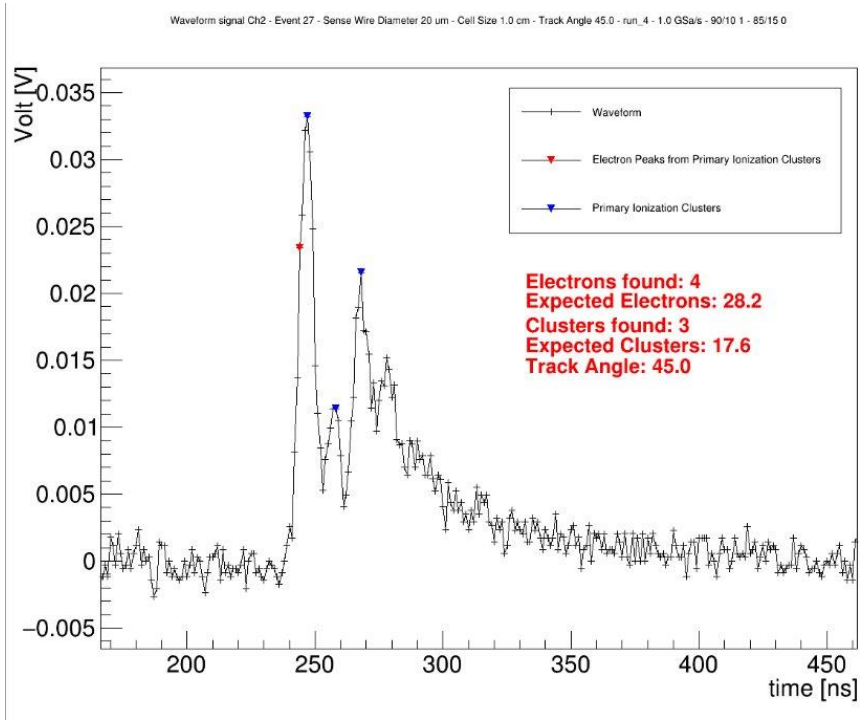
1.0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Volt [V]
time [ns]
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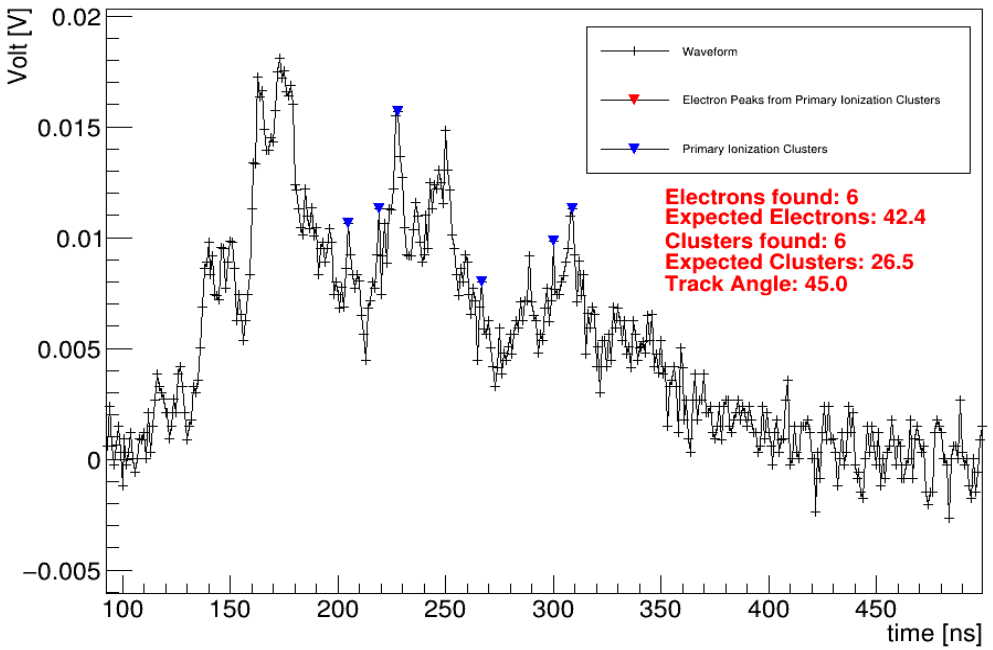
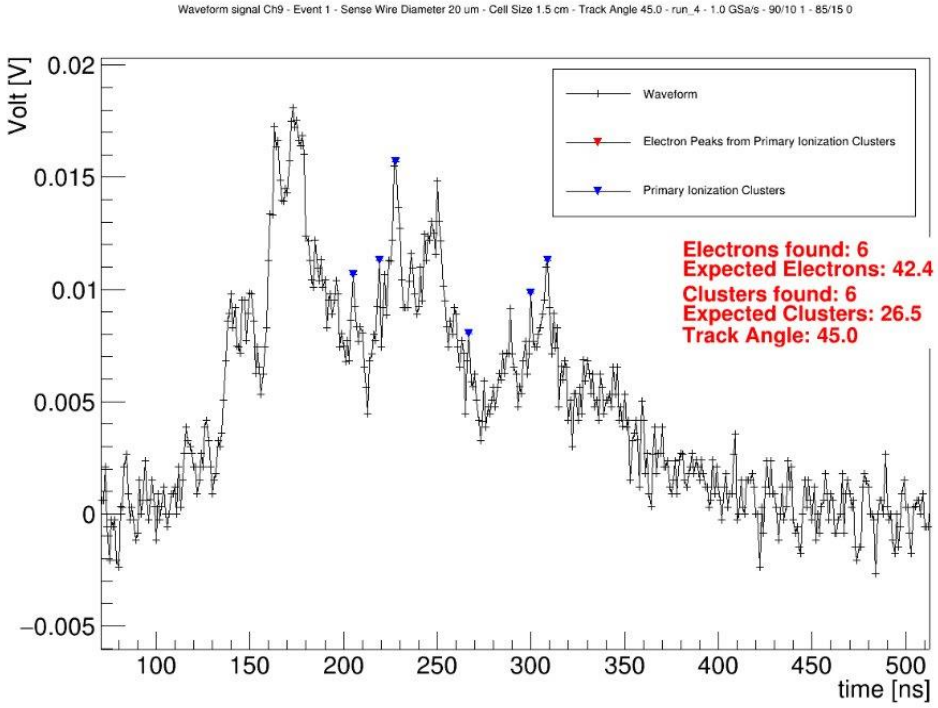
Track Angle: 45.0

0.4


Waveform signal Ch9 - Event 1 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 6
Expected Electrons: 42.4
Clusters found: 6
Expected Clusters: 26.5
Track Angle: 45.0

0.8


Waveform signal Ch9 - Event 1 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
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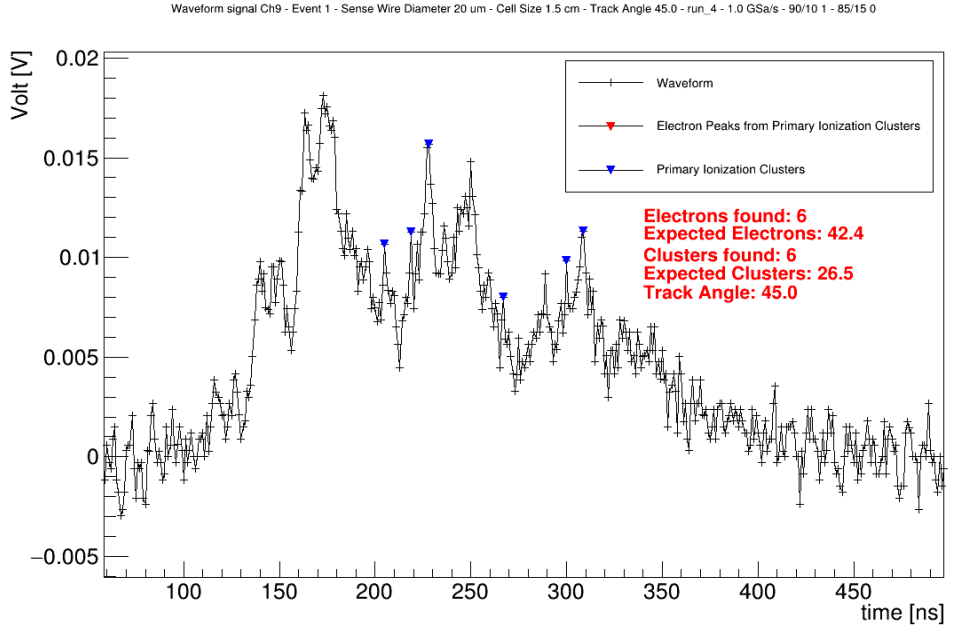
Clusters found: 6
Expected Clusters: 26.5
Track Angle: 45.0

0.6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Volt [V]
time [ns]
Waveform
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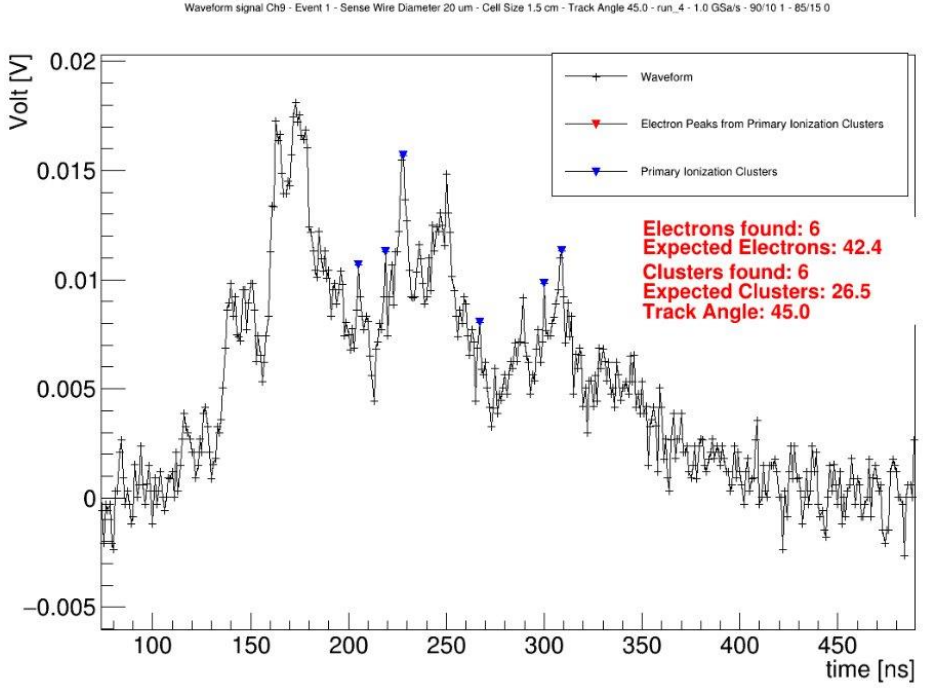
Expected Electrons: 42.4
Clusters found: 6
Expected Clusters: 26.5
Track Angle: 45.0

1.0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Volt [V]
time [ns]
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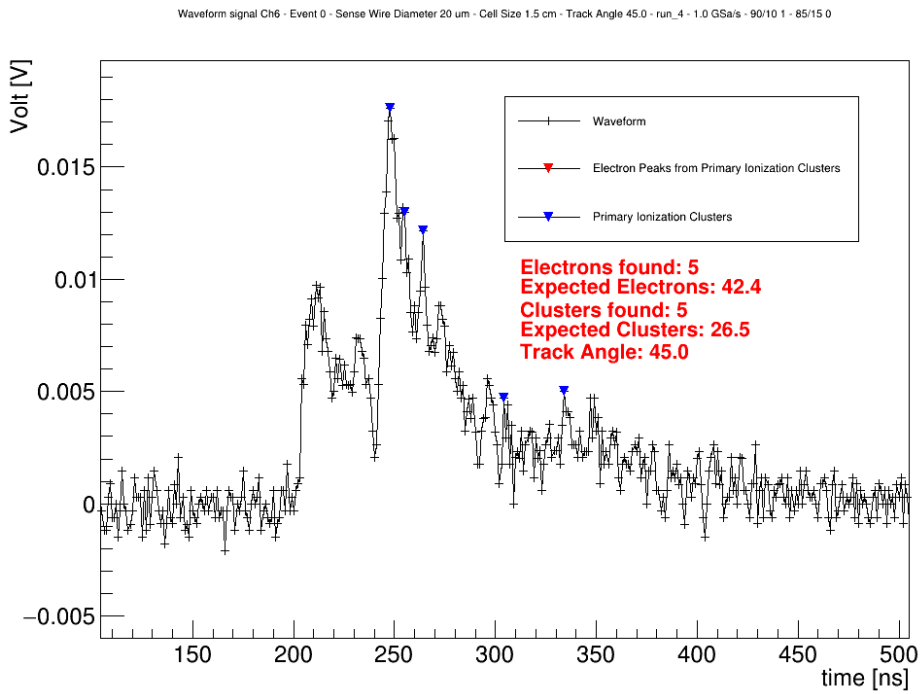
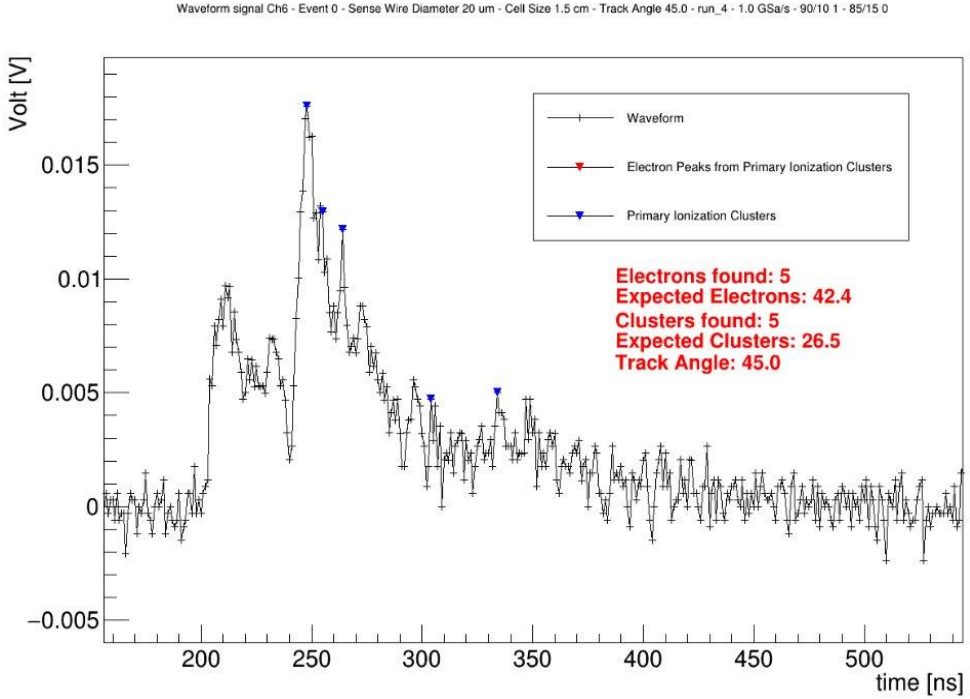
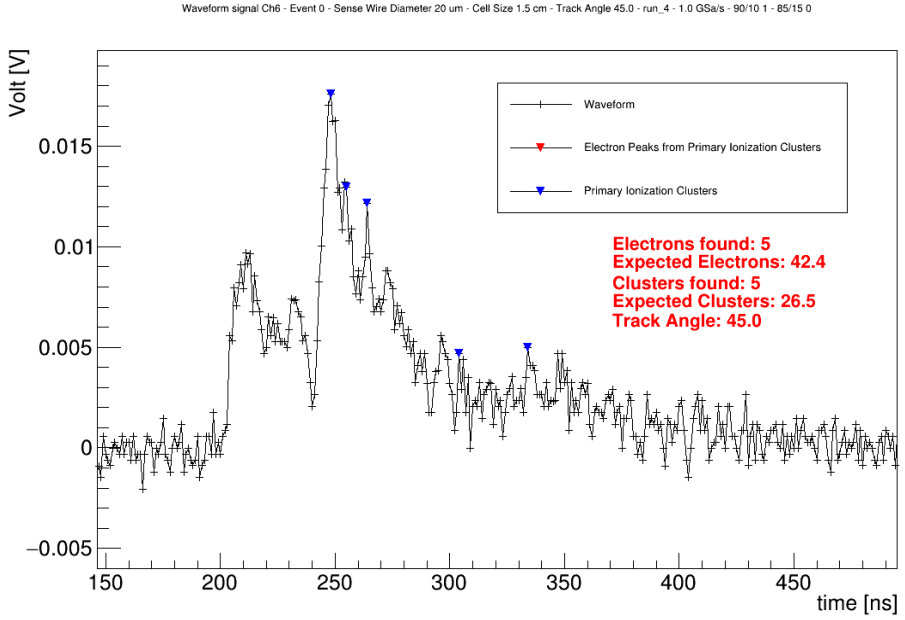
0.4


Waveform signal Ch6 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 5
Expected Electrons: 42.4
Clusters found: 5
Expected Clusters: 26.5
Track Angle: 45.0

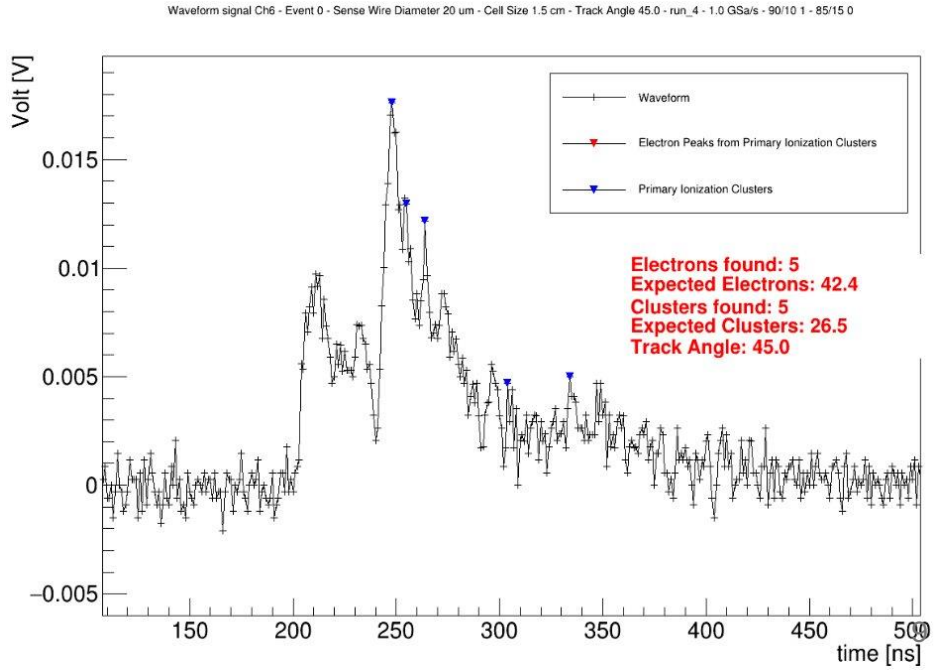
0.8


Waveform signal Ch6 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 5
Expected Electrons: 42.4
Clusters found: 5
Expected Clusters: 26.5
Track Angle: 45.0

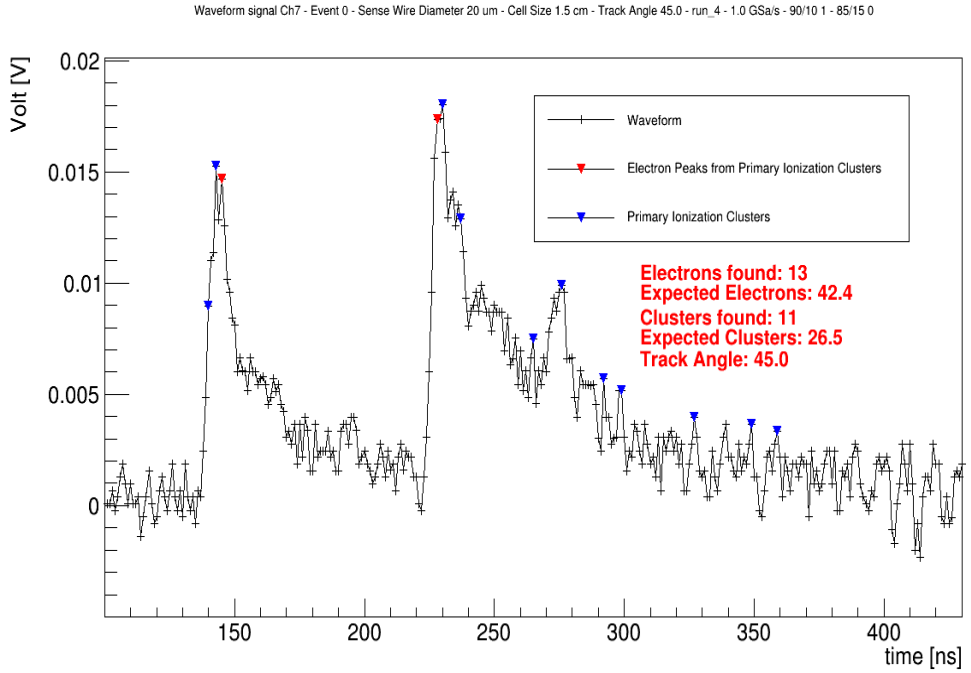
0.6


Waveform signal Ch6 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 5
Expected Electrons: 42.4
Clusters found: 5
Expected Clusters: 26.5
Track Angle: 45.0

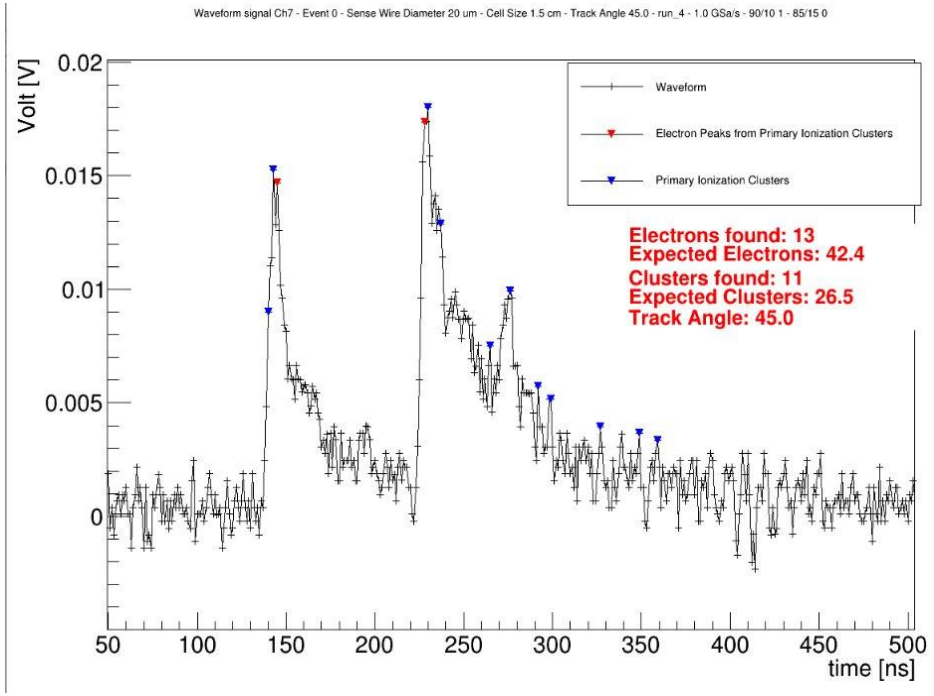
1.0


Waveform signal Ch6 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 5
Expected Electrons: 42.4
Clusters found: 5
Expected Clusters: 26.5
Track Angle: 45.0

0.4


Waveform signal Ch7 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 13
Expected Electrons: 42.4
Clusters found: 11
Expected Clusters: 26.5
Track Angle: 45.0

0.8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Volt [V]
time [ns]
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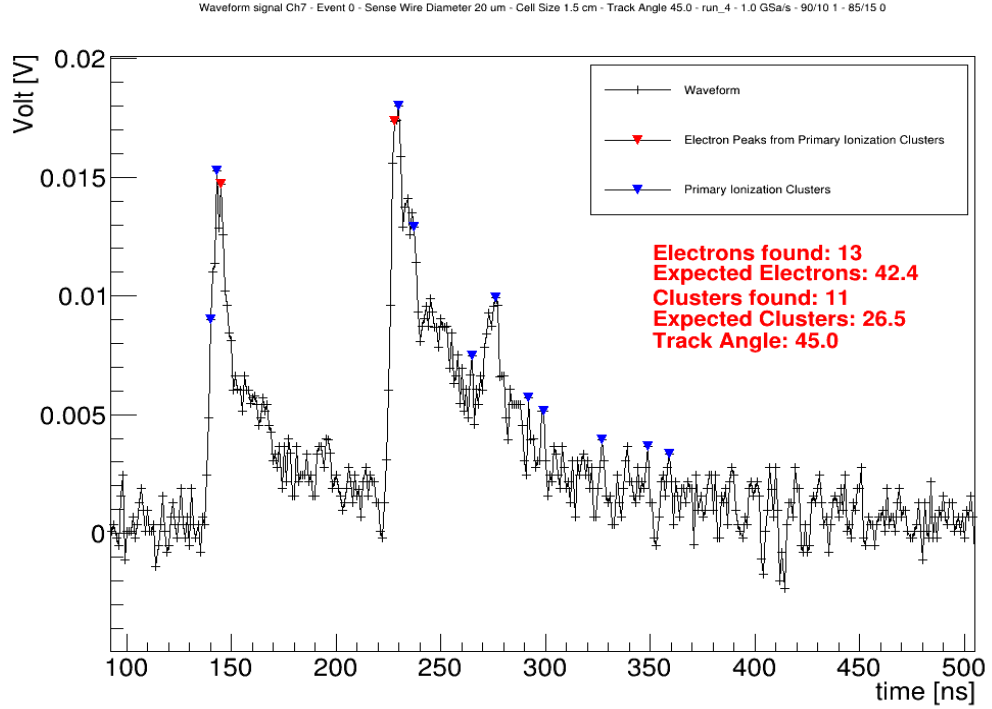
Clusters found: 11
Expected Clusters: 26.5
Track Angle: 45.0

0.6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Volt [V]
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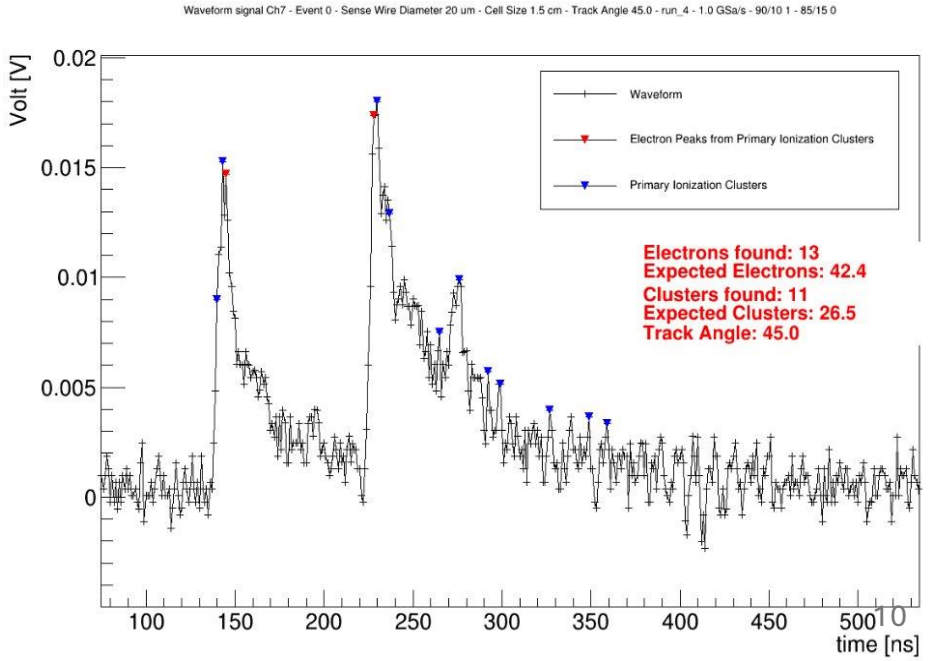
1.0


Waveform signal Ch7 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
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Electrons found: 13
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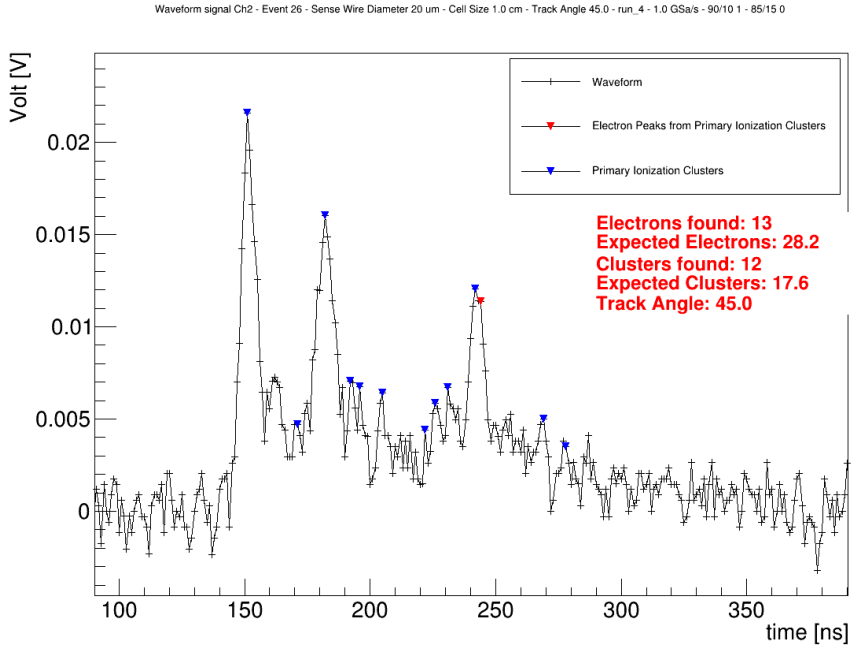
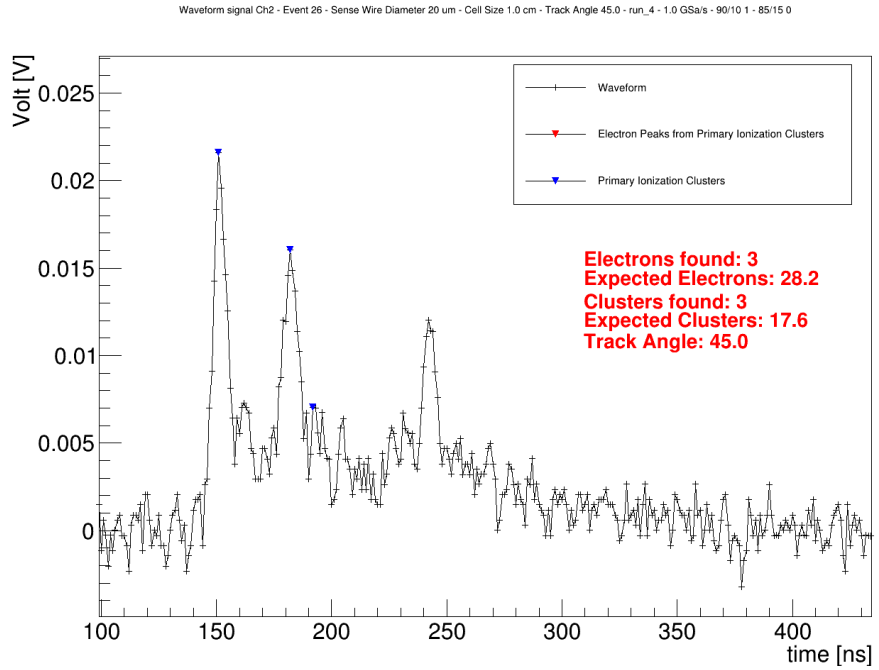
Clusters found: 11
Expected Clusters: 26.5
Track Angle: 45.0

scan on the 2nd derivative cut

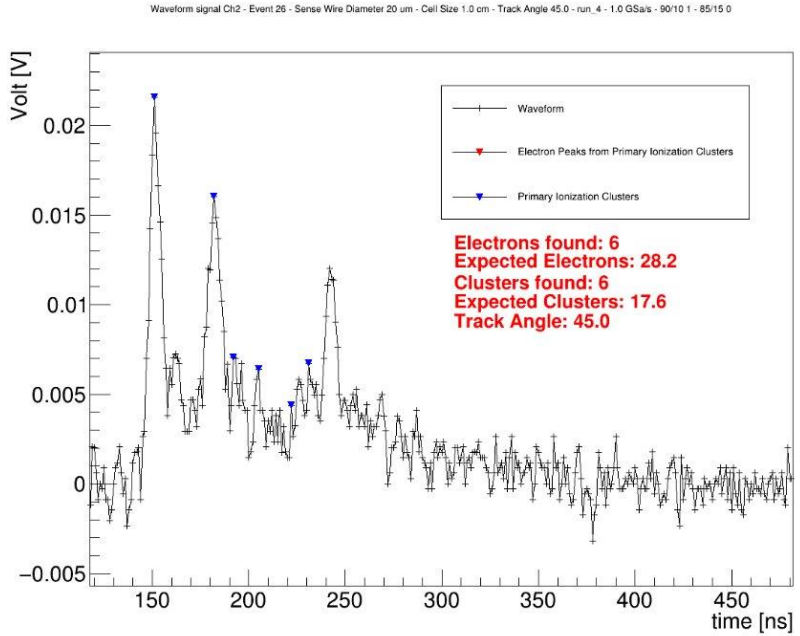
Cut on 1st der. : 0.6
Cut on clusterization : 0.24


Waveform signal Ch2 - Event 26 - Sense Wire Diameter 20 um - Cell Size 1.0 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 13
Expected Electrons: 28.2
Clusters found: 12
Expected Clusters: 17.6
Track Angle: 45.0

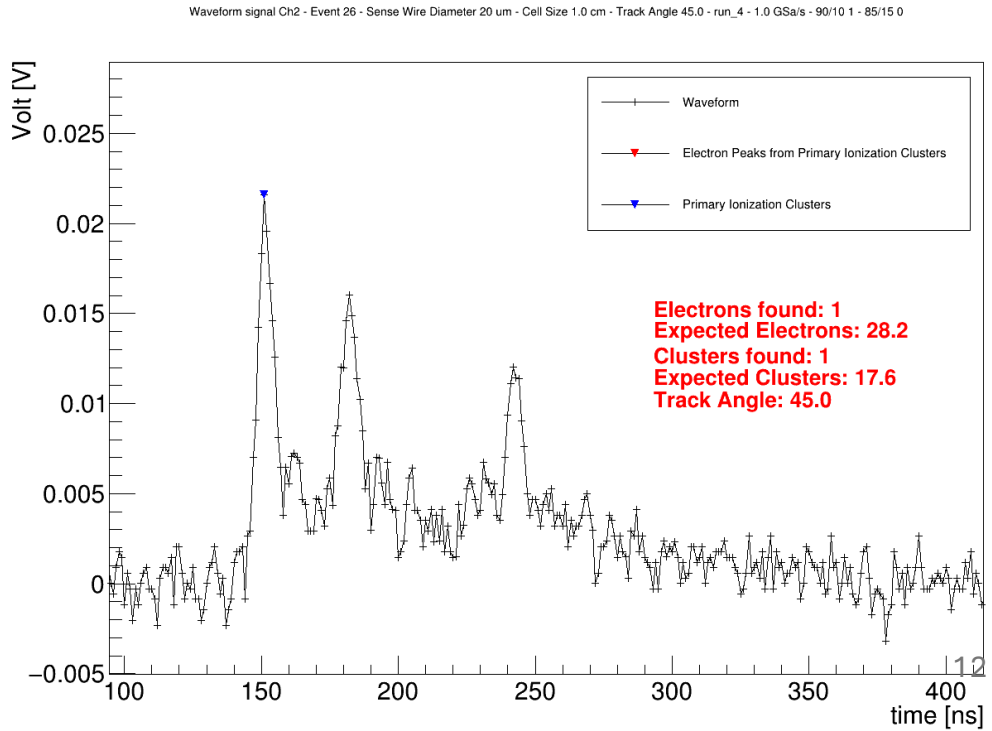
0.4


Waveform signal Ch2 - Event 26 - Sense Wire Diameter 20 um - Cell Size 1.0 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 3
Expected Electrons: 28.2
Clusters found: 3
Expected Clusters: 17.6
Track Angle: 45.0

0.8

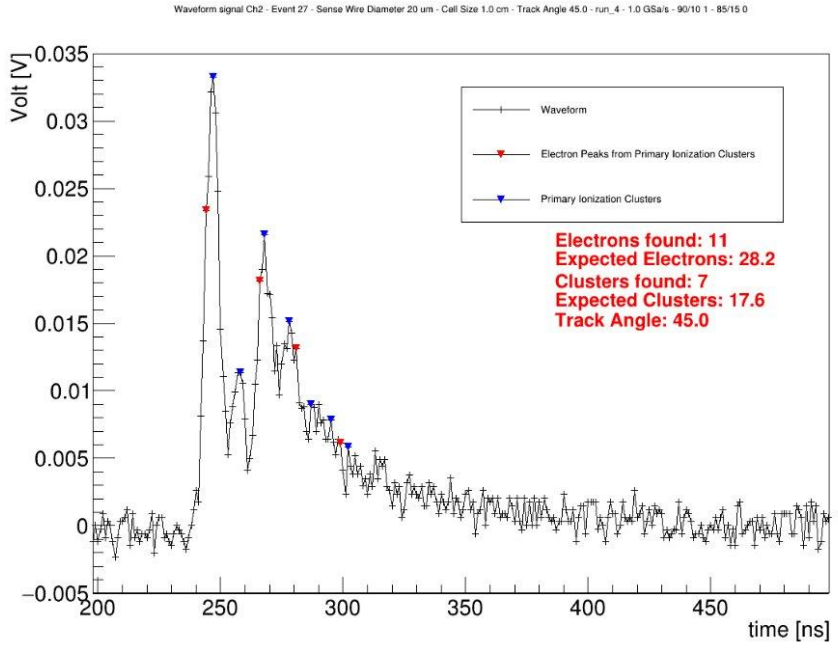

Waveform signal Ch2 - Event 26 - Sense Wire Diameter 20 um - Cell Size 1.0 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 6
Expected Electrons: 28.2
Clusters found: 6
Expected Clusters: 17.6
Track Angle: 45.0

0.6

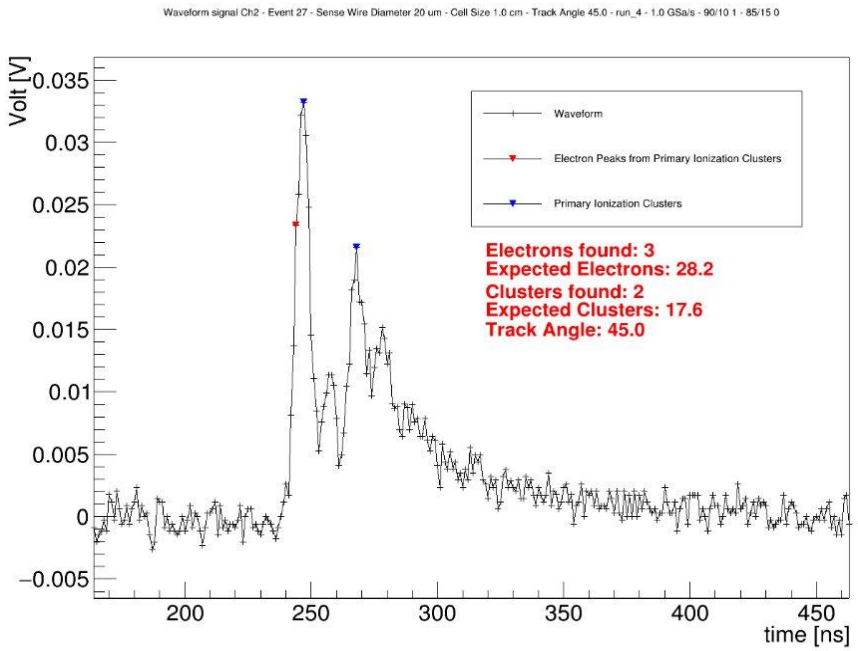

Waveform signal Ch2 - Event 26 - Sense Wire Diameter 20 um - Cell Size 1.0 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 1
Expected Electrons: 28.2
Clusters found: 1
Expected Clusters: 17.6
Track Angle: 45.0

1.0

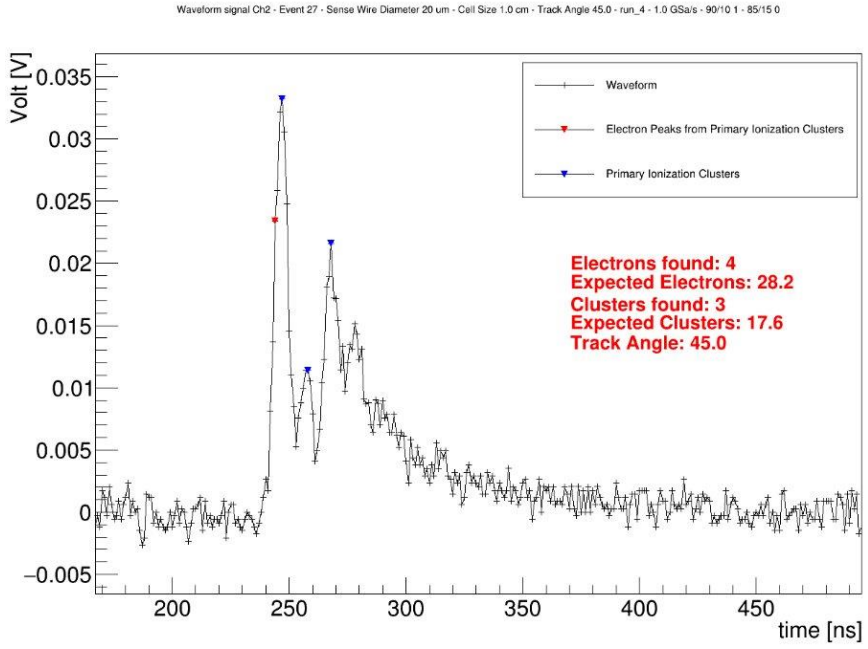
0.4


Waveform signal Ch2 - Event 27 - Sense Wire Diameter 20 um - Cell Size 1.0 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 11
Expected Electrons: 28.2
Clusters found: 7
Expected Clusters: 17.6
Track Angle: 45.0

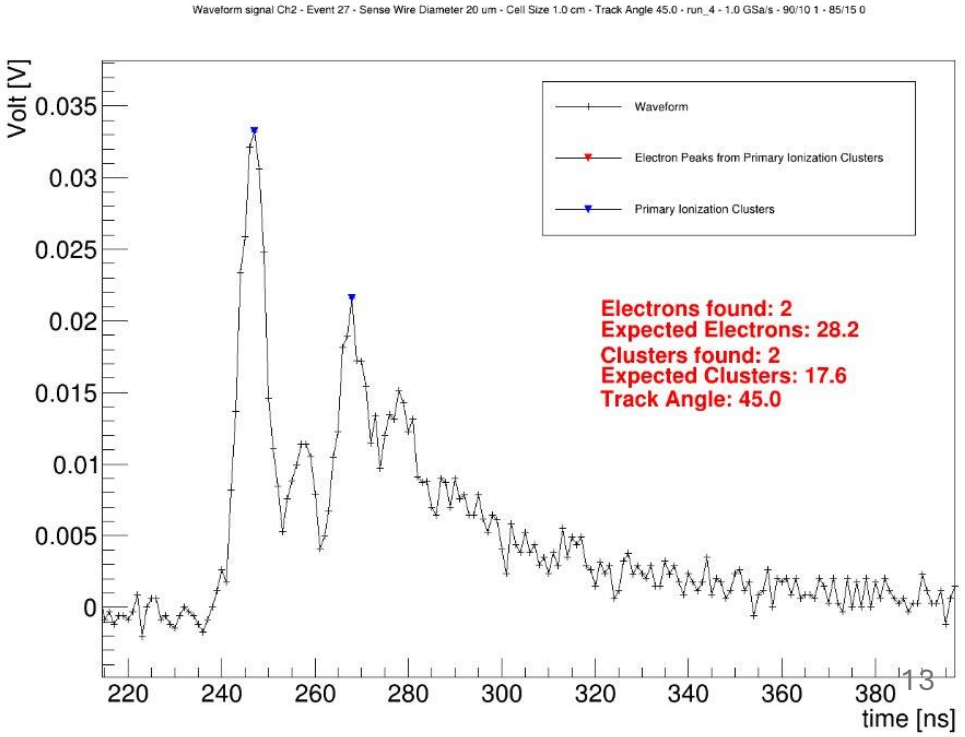
0.8

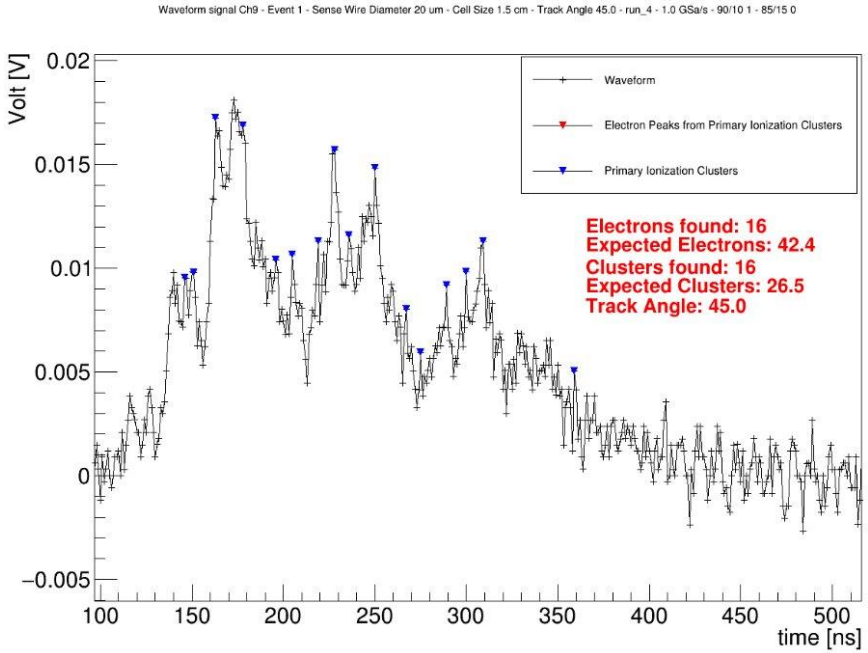

Waveform signal Ch2 - Event 27 - Sense Wire Diameter 20 um - Cell Size 1.0 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 3
Expected Electrons: 28.2
Clusters found: 2
Expected Clusters: 17.6
Track Angle: 45.0

0.6

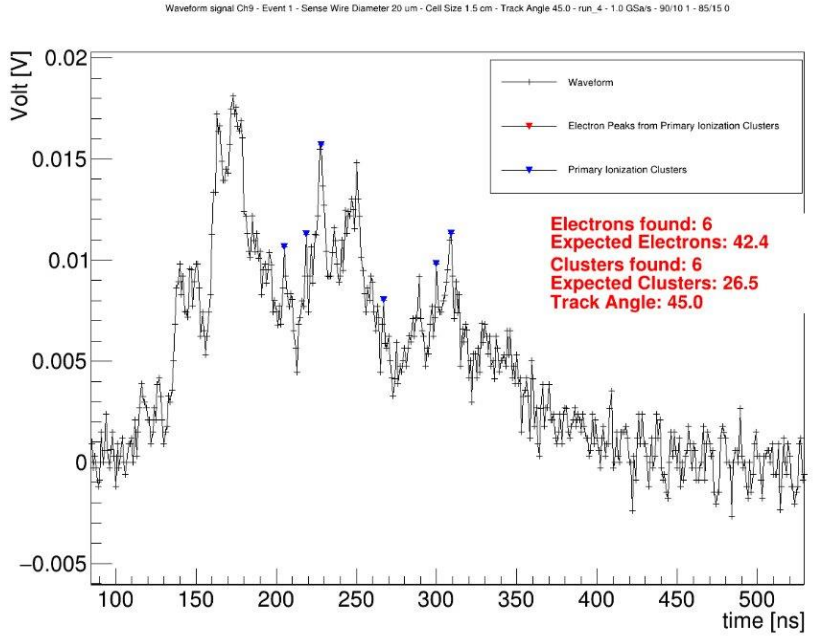

Waveform signal Ch2 - Event 27 - Sense Wire Diameter 20 um - Cell Size 1.0 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 4
Expected Electrons: 28.2
Clusters found: 3
Expected Clusters: 17.6
Track Angle: 45.0

1.0


Waveform signal Ch2 - Event 27 - Sense Wire Diameter 20 um - Cell Size 1.0 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 2
Expected Electrons: 28.2
Clusters found: 2
Expected Clusters: 17.6
Track Angle: 45.0


Waveform signal Ch9 - Event 1 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 16
Expected Electrons: 42.4
Clusters found: 16
Expected Clusters: 26.5
Track Angle: 45.0

0.4

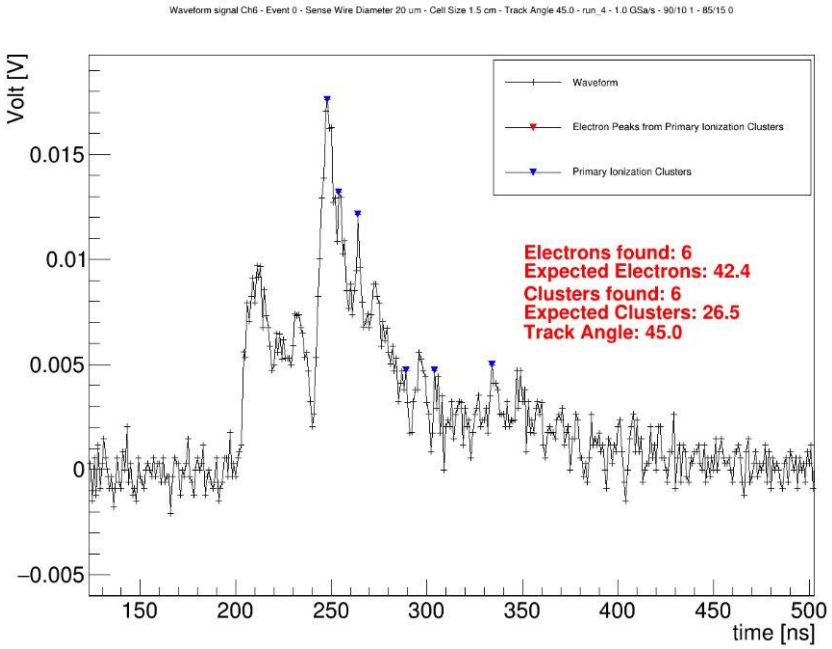

Waveform signal Ch9 - Event 1 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 6
Expected Electrons: 42.4
Clusters found: 6
Expected Clusters: 26.5
Track Angle: 45.0

0.6

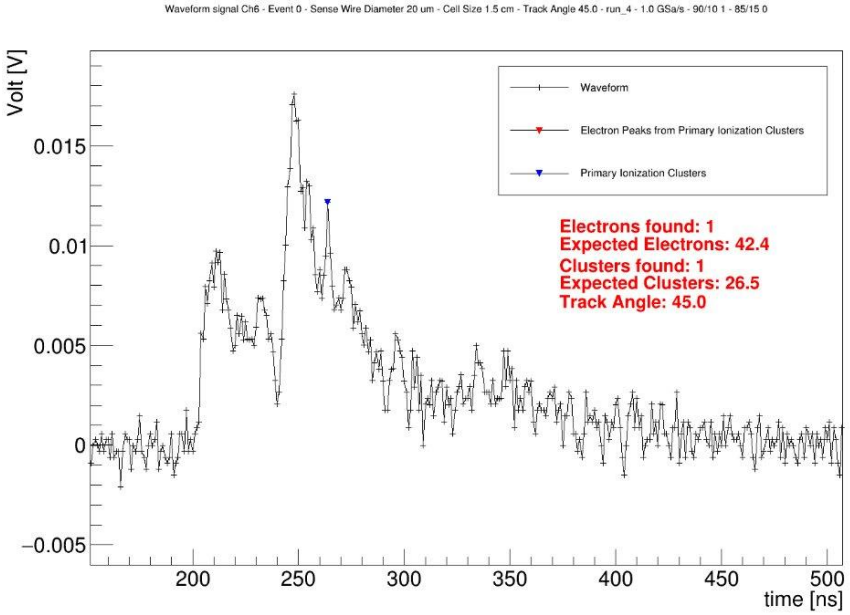
0.8

1.0

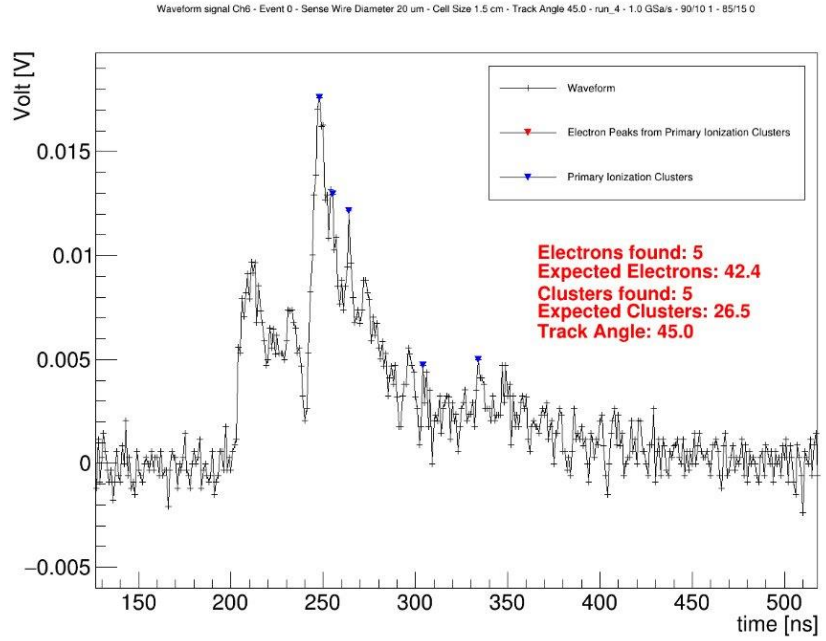
0.4


Waveform signal Ch6 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 6
Expected Electrons: 42.4
Clusters found: 6
Expected Clusters: 26.5
Track Angle: 45.0
Volt [V]
time [ns]

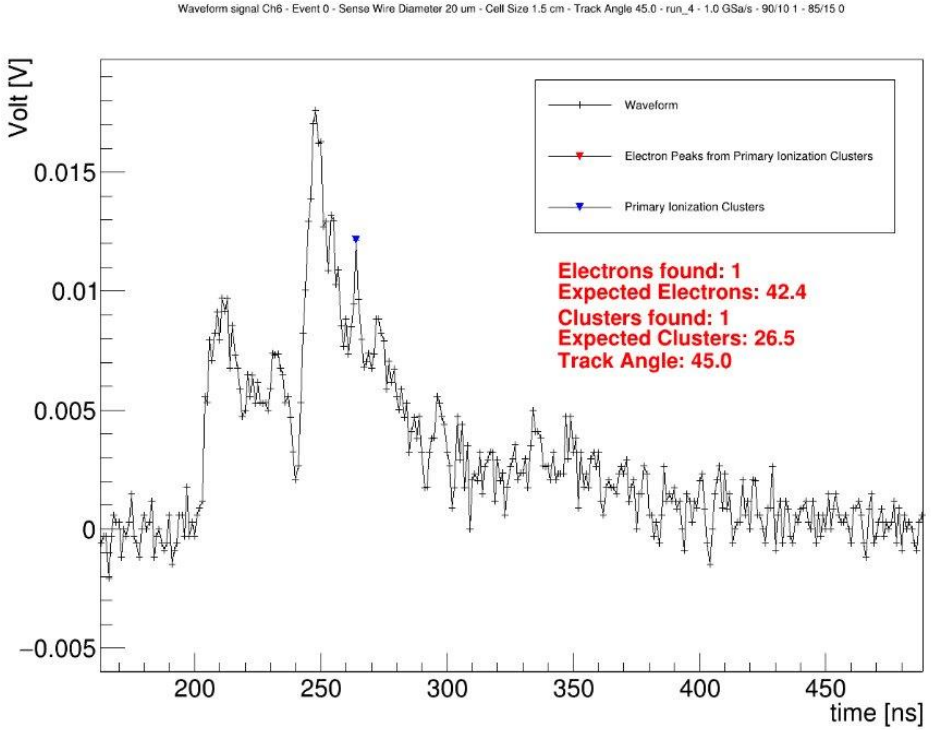
0.8


Waveform signal Ch6 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 1
Expected Electrons: 42.4
Clusters found: 1
Expected Clusters: 26.5
Track Angle: 45.0
Volt [V]
time [ns]

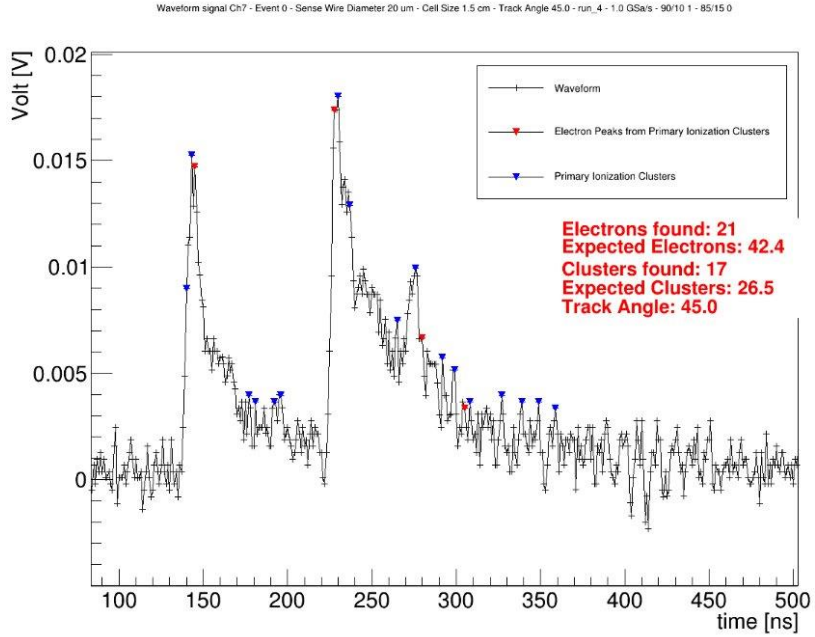
0.6


Waveform signal Ch6 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 5
Expected Electrons: 42.4
Clusters found: 5
Expected Clusters: 26.5
Track Angle: 45.0
Volt [V]
time [ns]

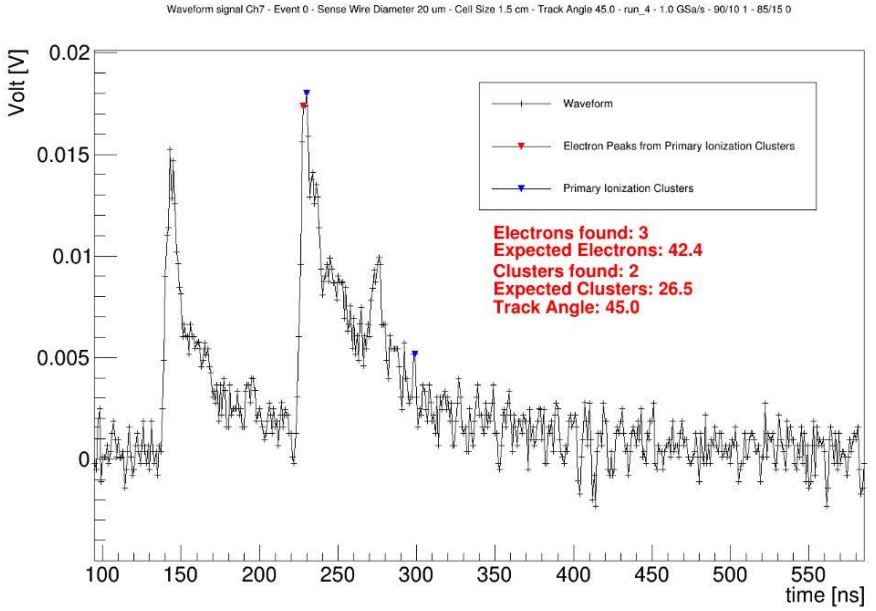
1.0


Waveform signal Ch6 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 1
Expected Electrons: 42.4
Clusters found: 1
Expected Clusters: 26.5
Track Angle: 45.0
Volt [V]
time [ns]

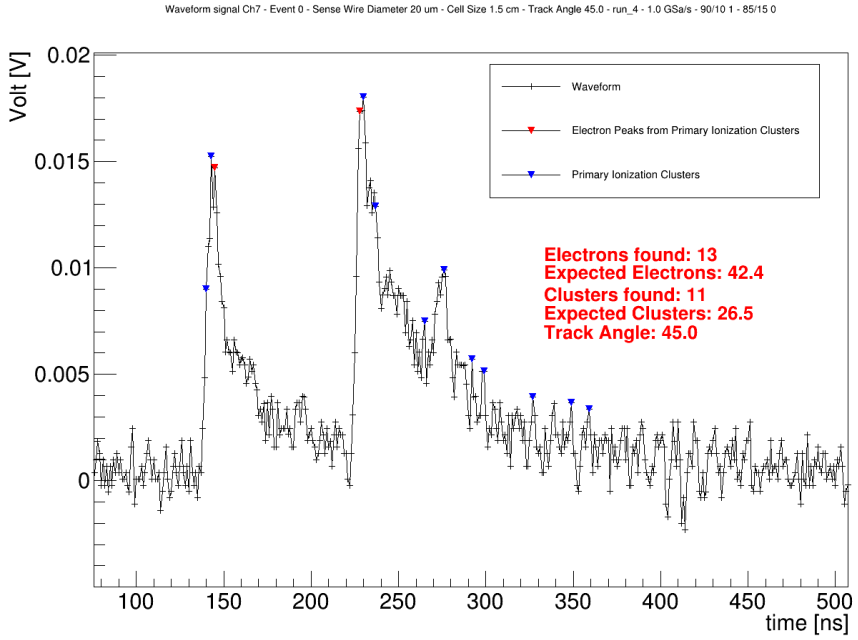
0.4


Waveform signal Ch7 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 21
Expected Electrons: 42.4
Clusters found: 17
Expected Clusters: 26.5
Track Angle: 45.0

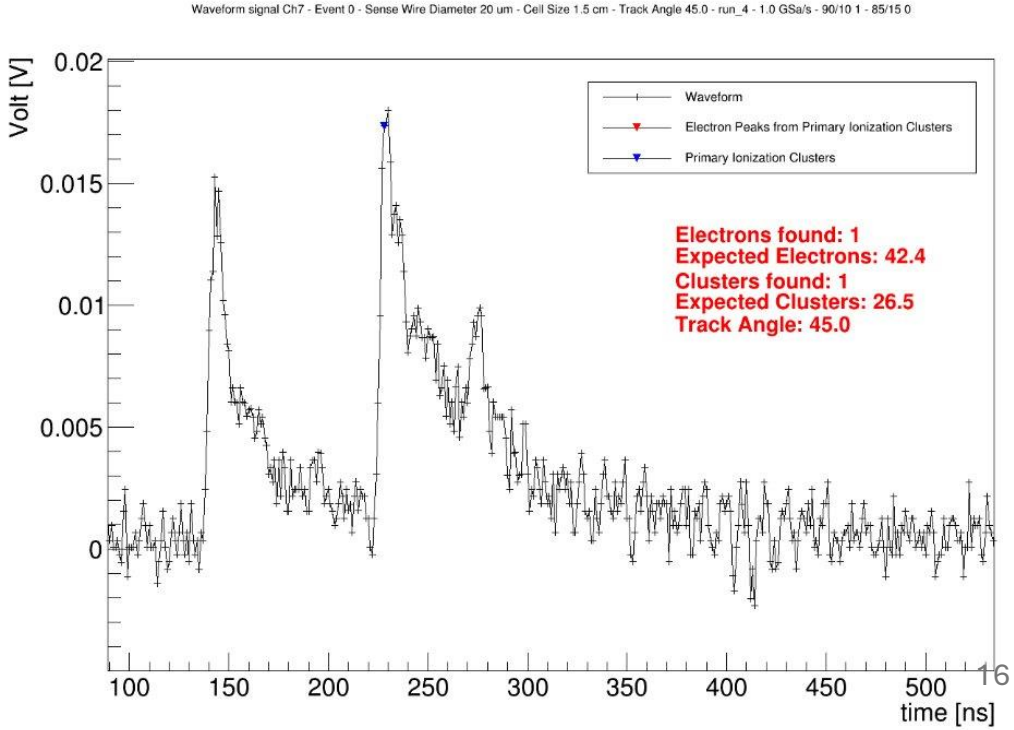
0.8


Waveform signal Ch7 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 3
Expected Electrons: 42.4
Clusters found: 2
Expected Clusters: 26.5
Track Angle: 45.0

0.6

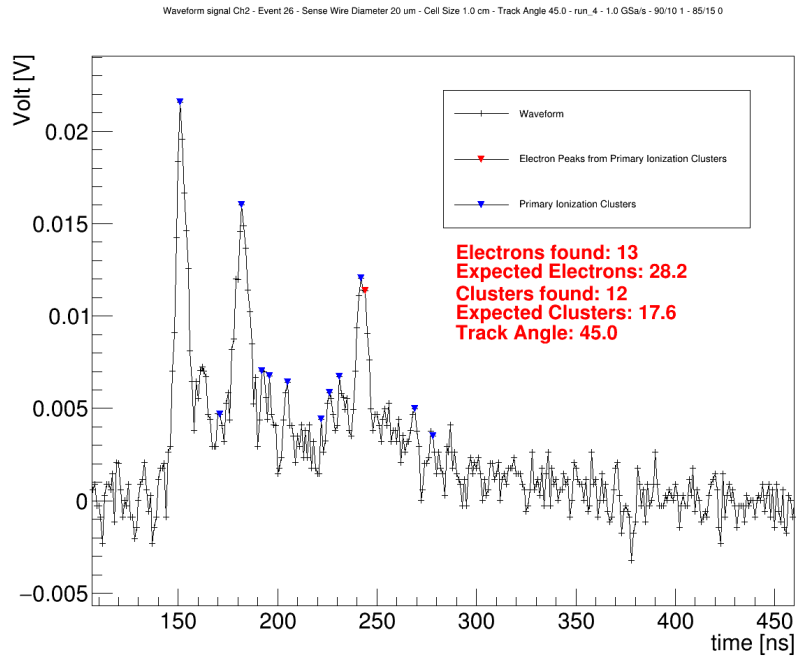

Waveform signal Ch7 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 13
Expected Electrons: 42.4
Clusters found: 11
Expected Clusters: 26.5
Track Angle: 45.0

1.0

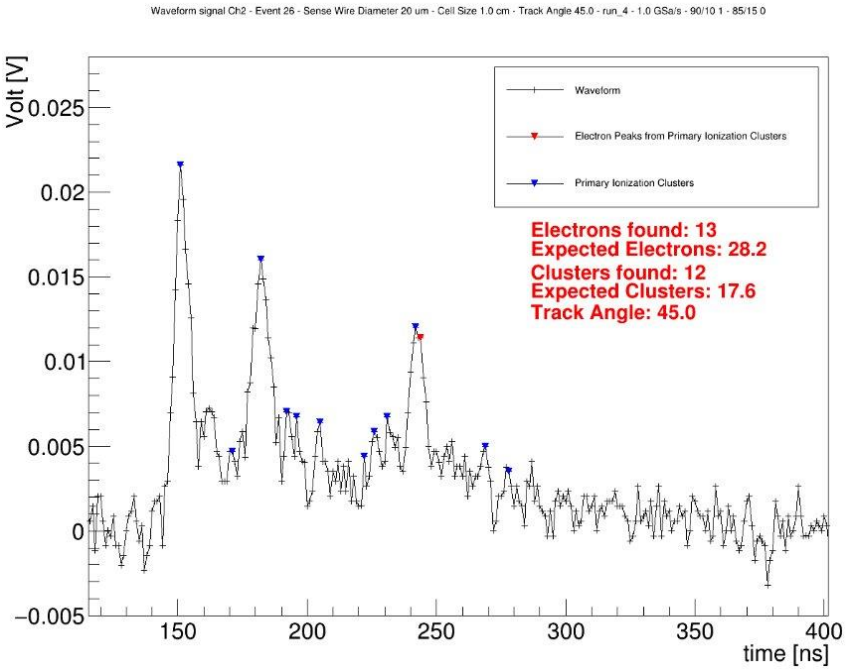

Waveform signal Ch7 - Event 0 - Sense Wire Diameter 20 um - Cell Size 1.5 cm - Track Angle 45.0 - run_4 - 1.0 GSa/s - 90/10 1 - 85/15 0
Volt [V]
time [ns]
Waveform
Electron Peaks from Primary Ionization Clusters
Primary Ionization Clusters
Electrons found: 1
Expected Electrons: 42.4
Clusters found: 1
Expected Clusters: 26.5
Track Angle: 45.0

scan on the clusterization cut scale

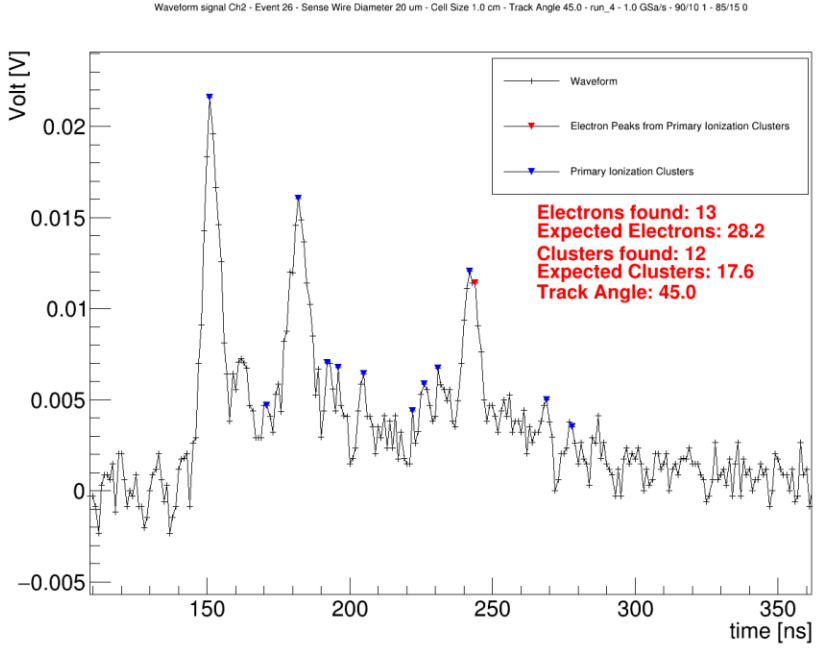
Cut on 1st der. : 0.6
Cut on 2nd der. : 0.4



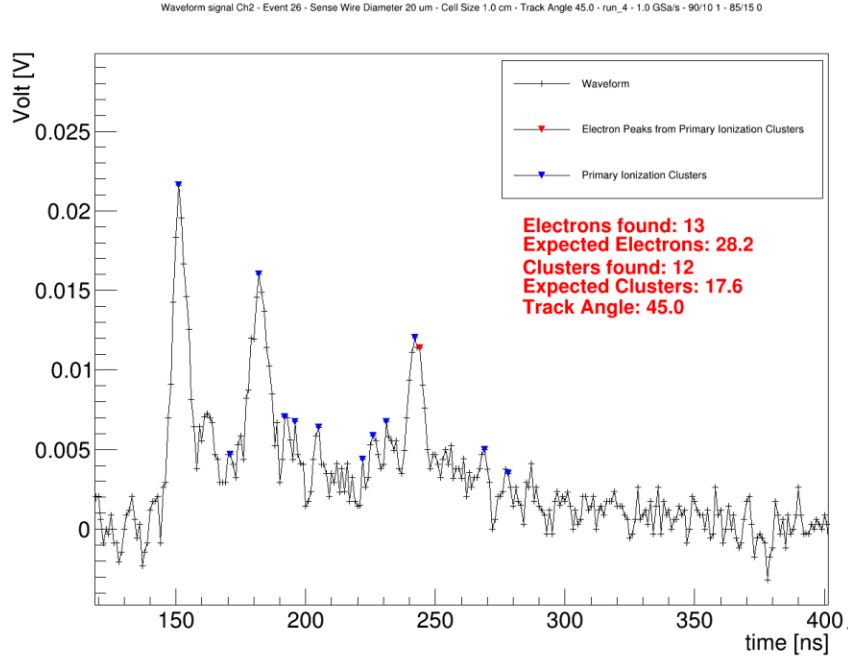
0.2



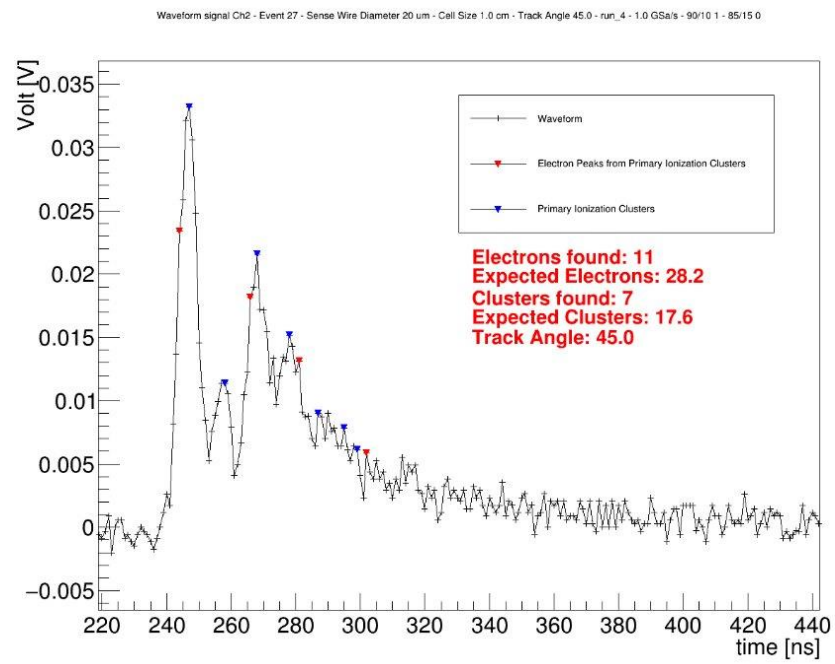
0.24



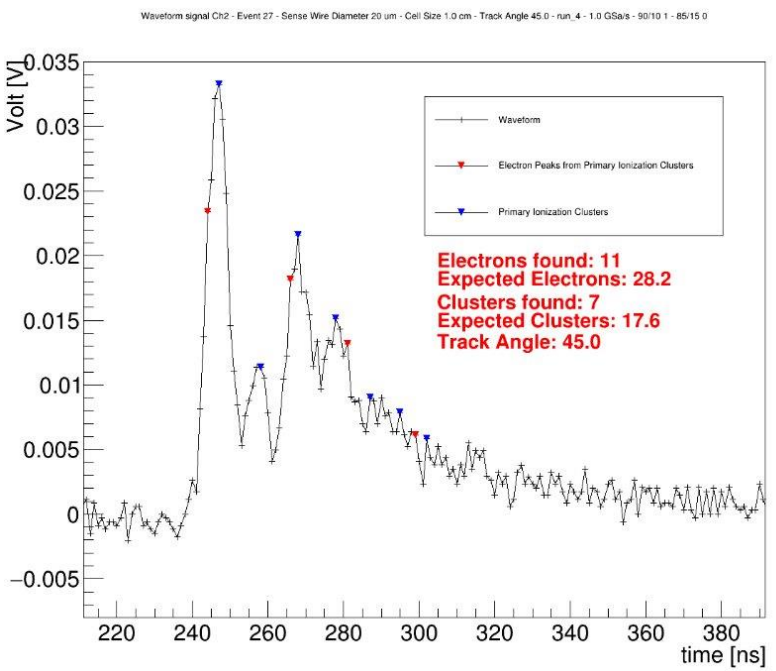
0.22



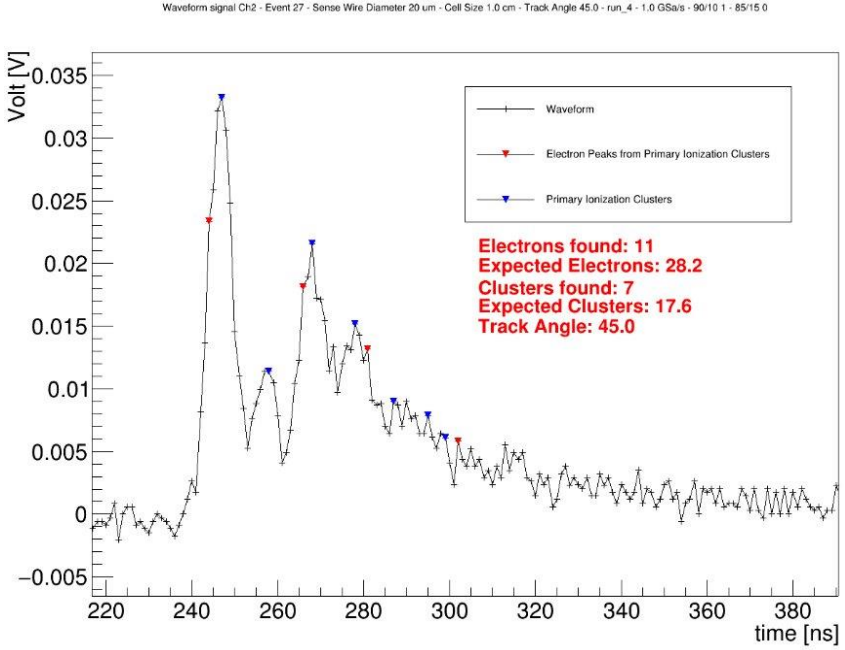
0.26



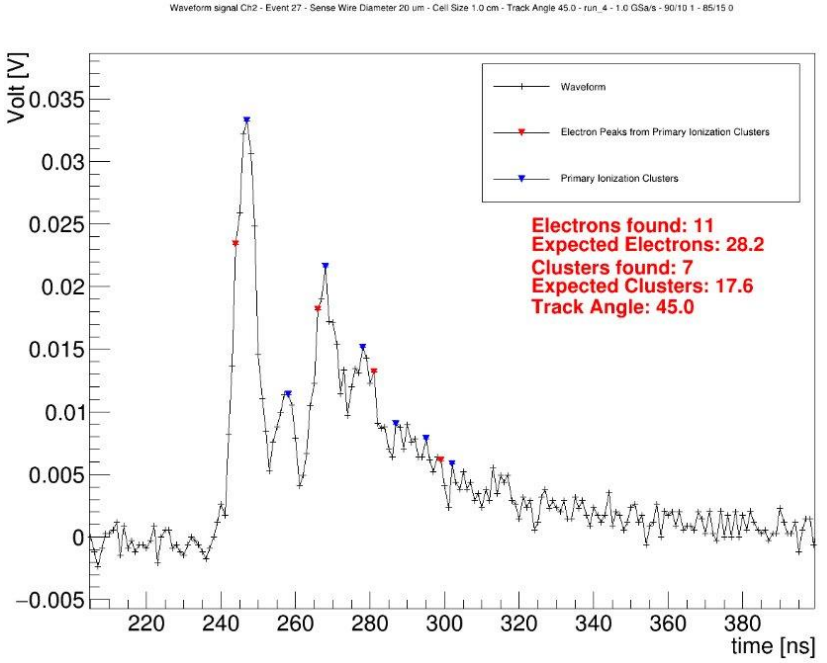
0.2



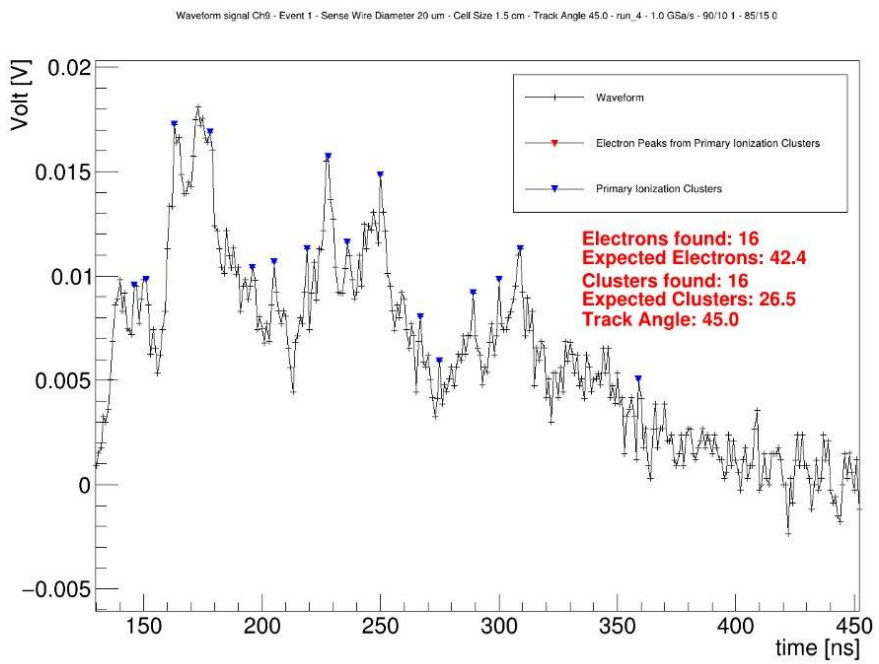
0.24



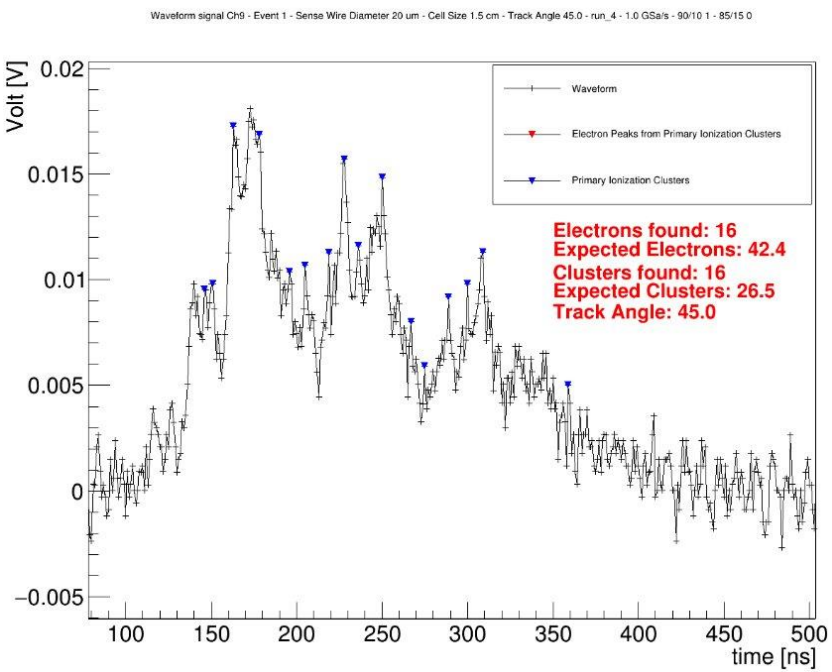
0.22



0.26



0.2



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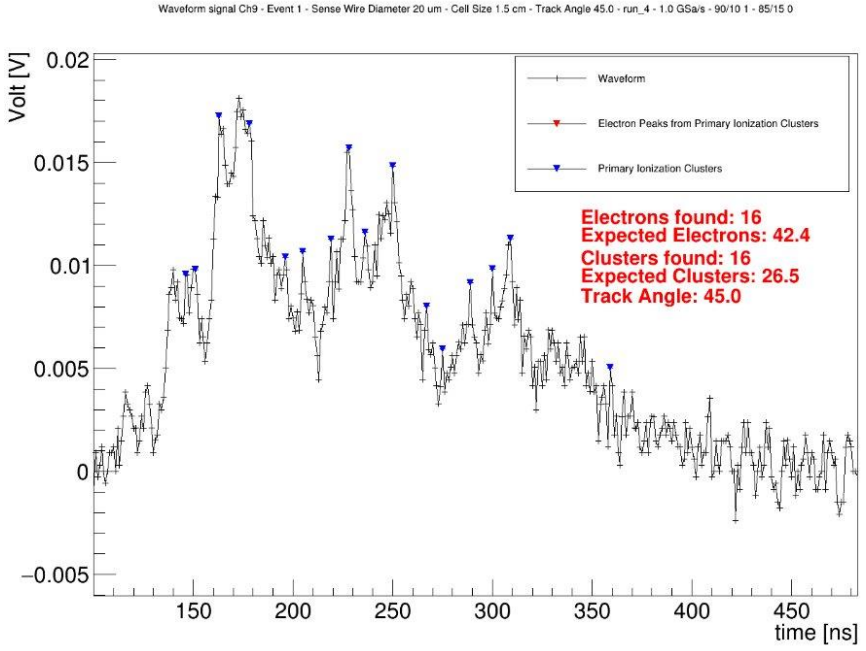

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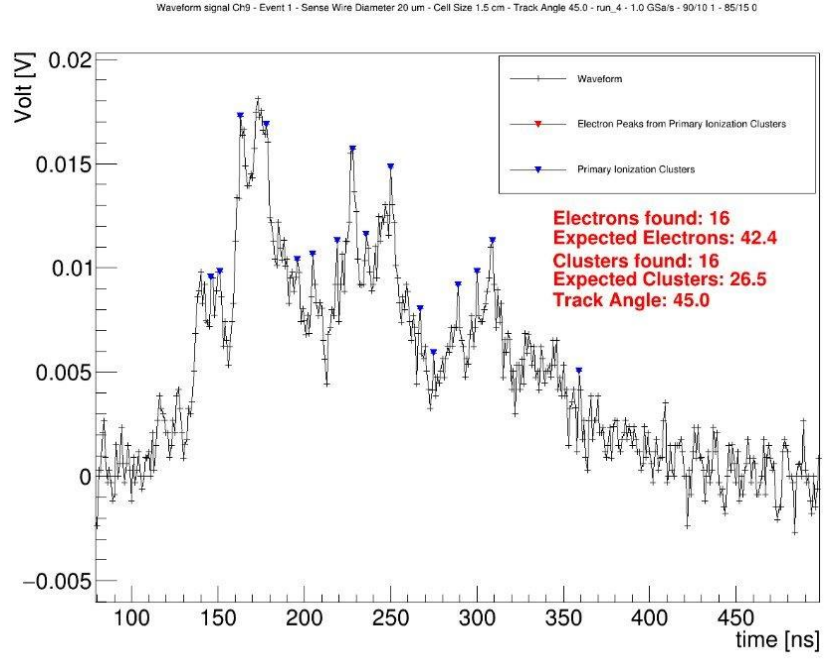

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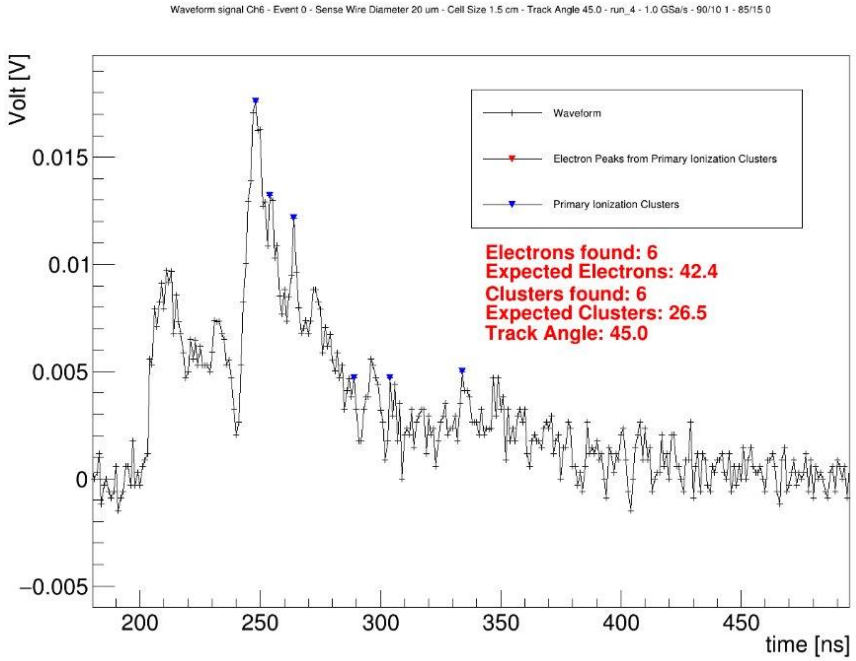
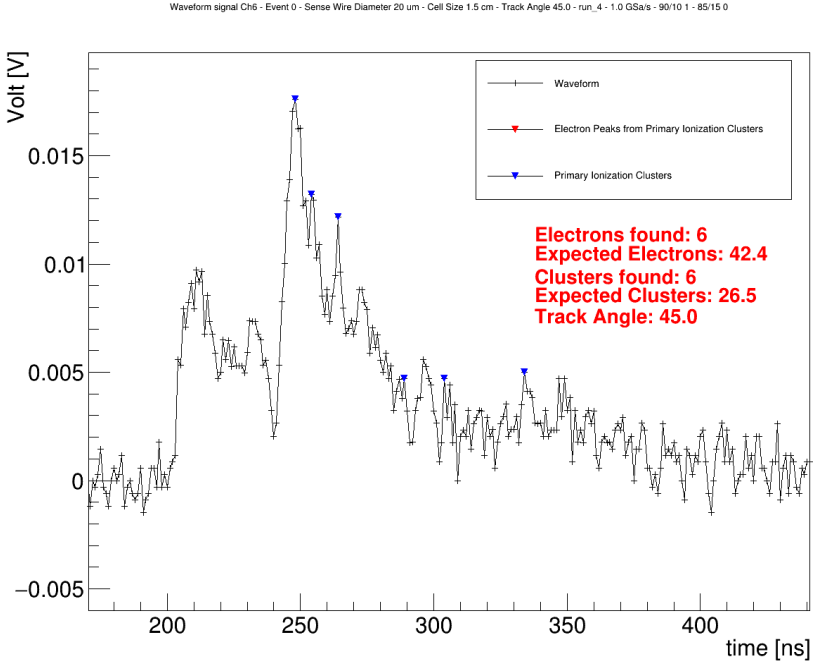


0.2



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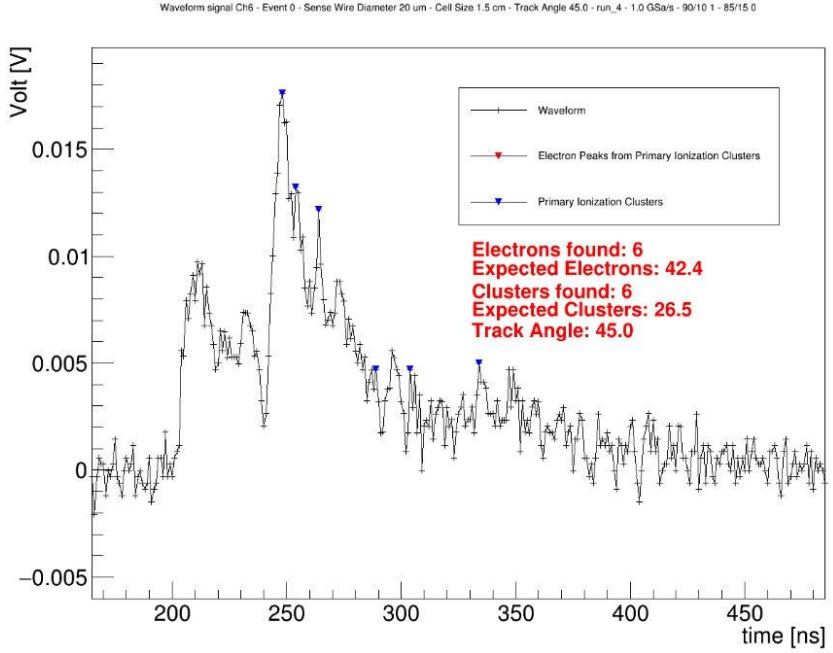
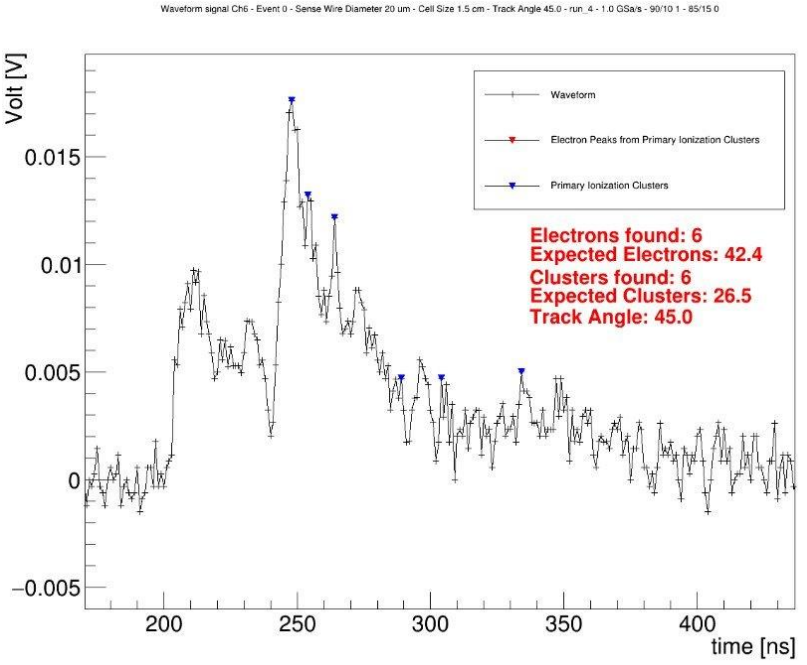
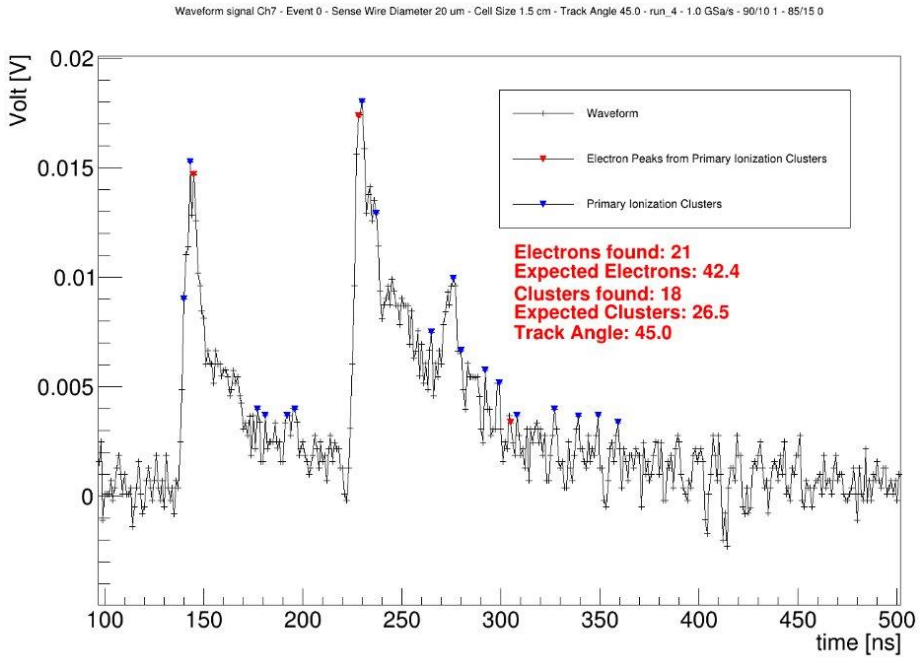


0.22



0.26



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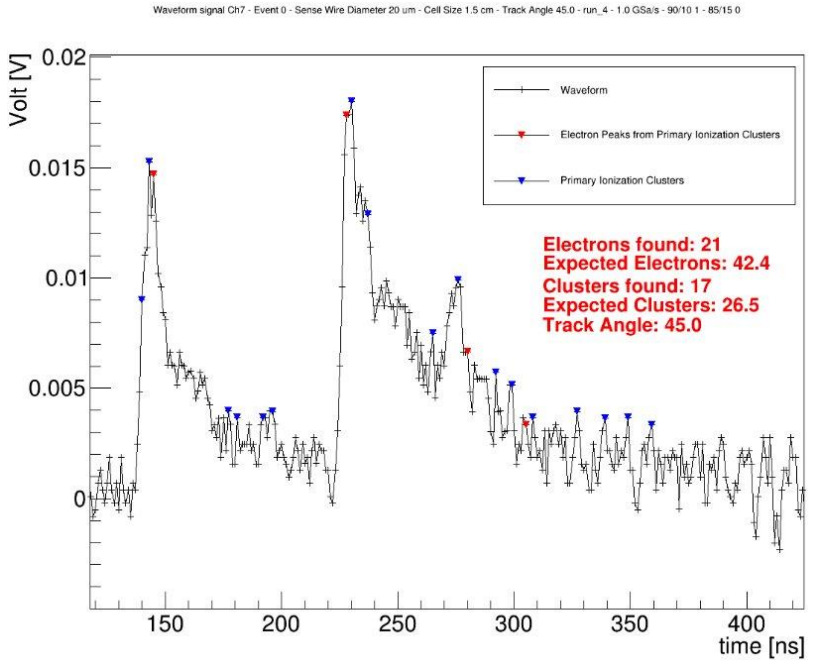

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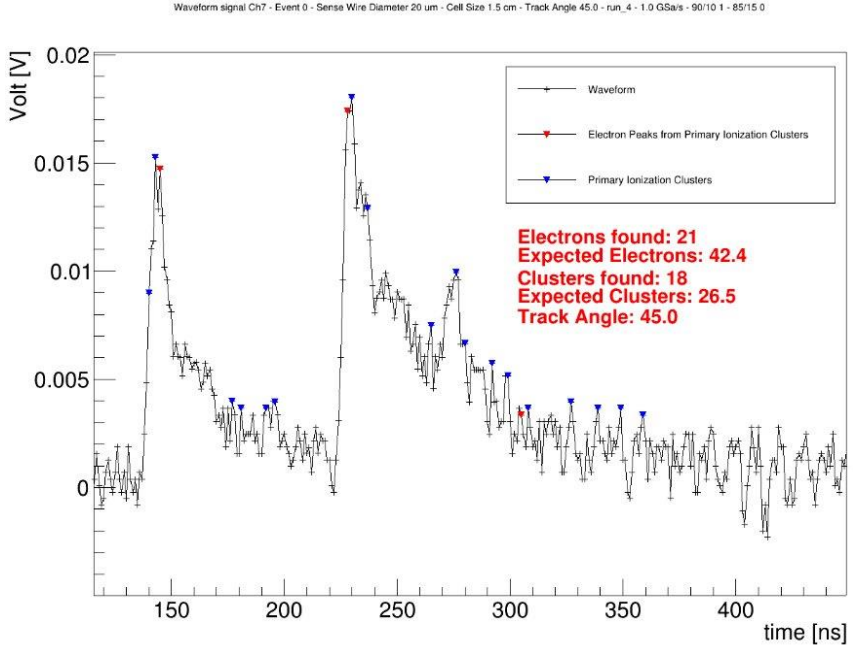
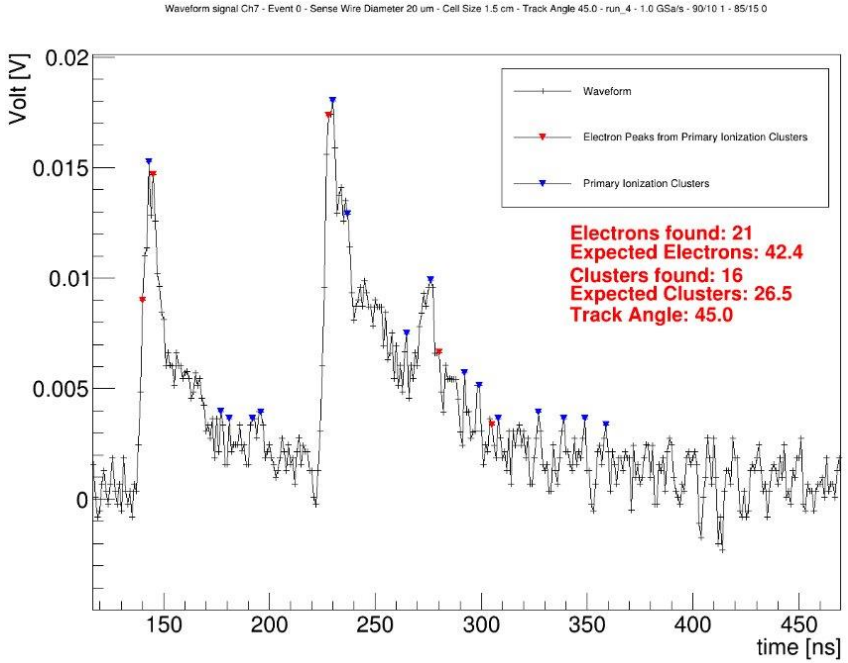


0.22



0.26

DRS / OSC : example run no. 4

(Gas mix. 90/10, angle 45, momentum 10 GeV

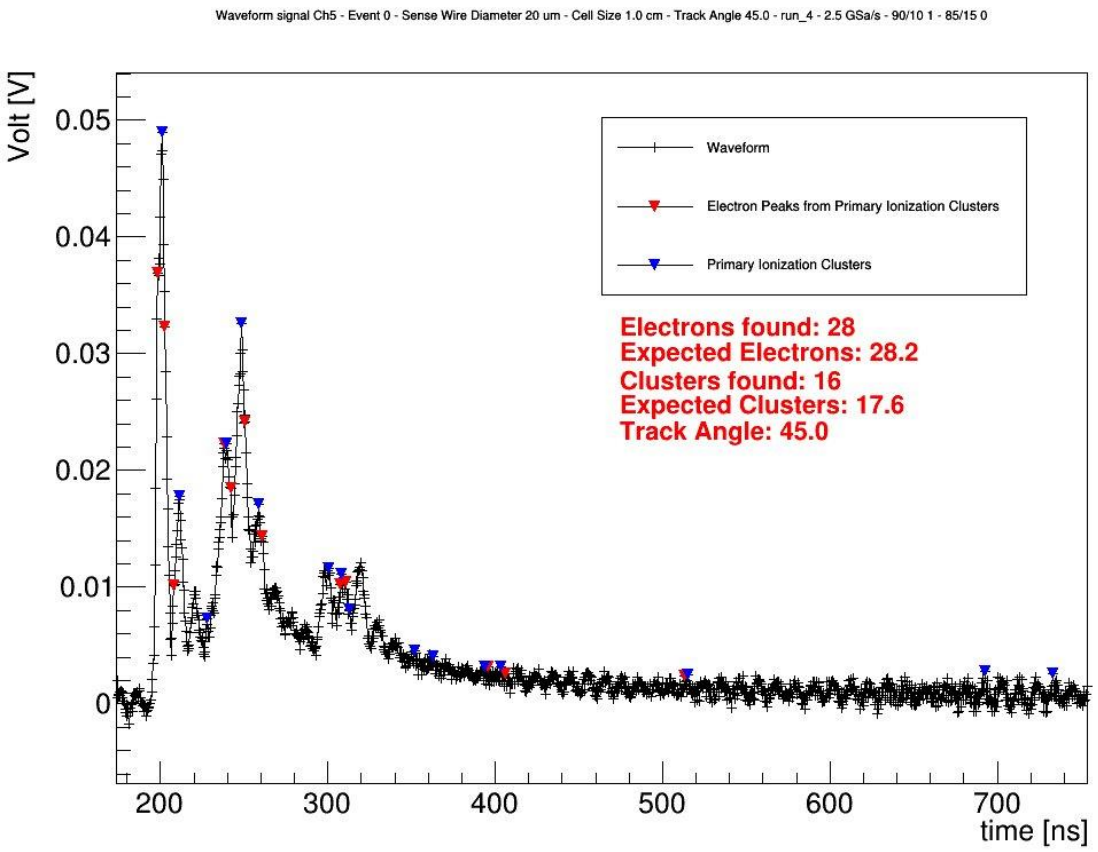
Cut on 1st der. : 0.6
Cut on 2nd der. : 0.4
Cut on clusterization : 0.24

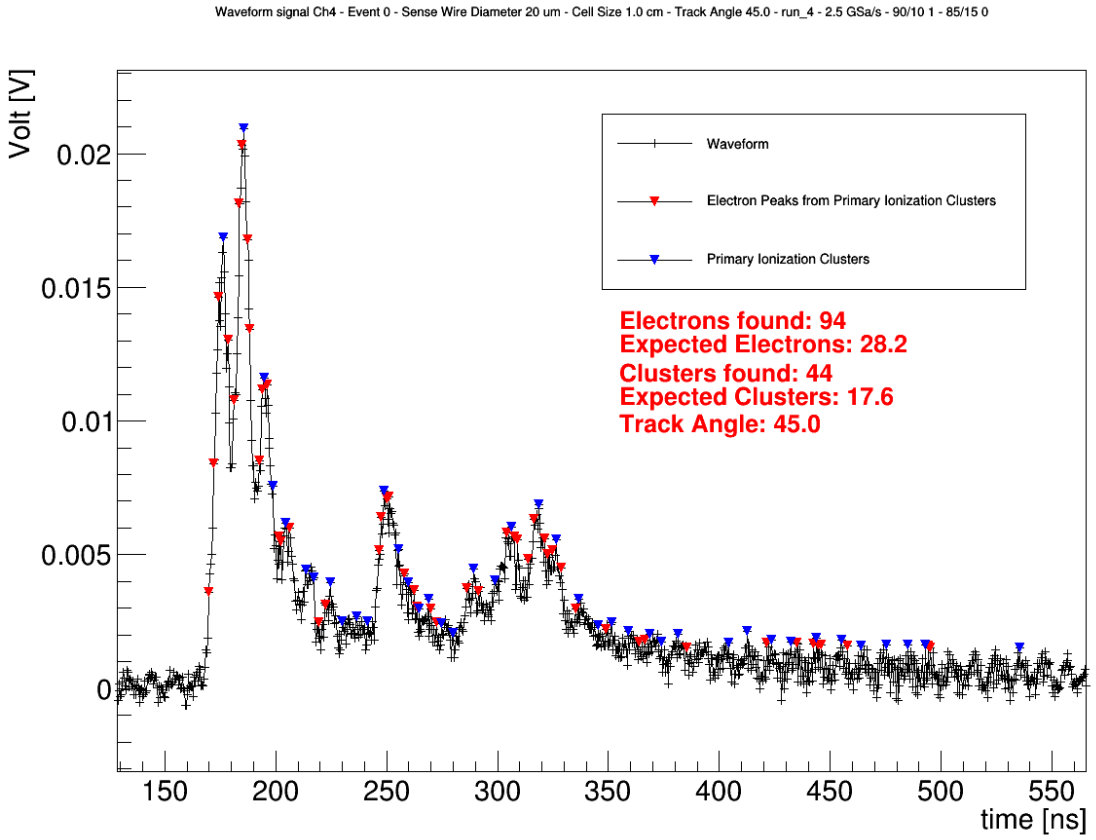
This tunning is working quit good for DRS data sets but not for OSC

OSC: example run no. 4

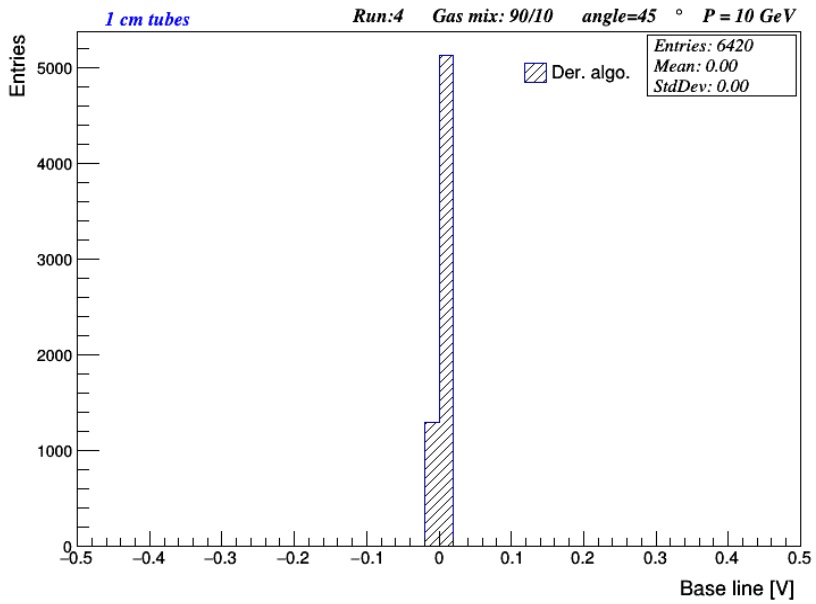
(Gas mix. 90/10, angle 45, momentum 10 GeV

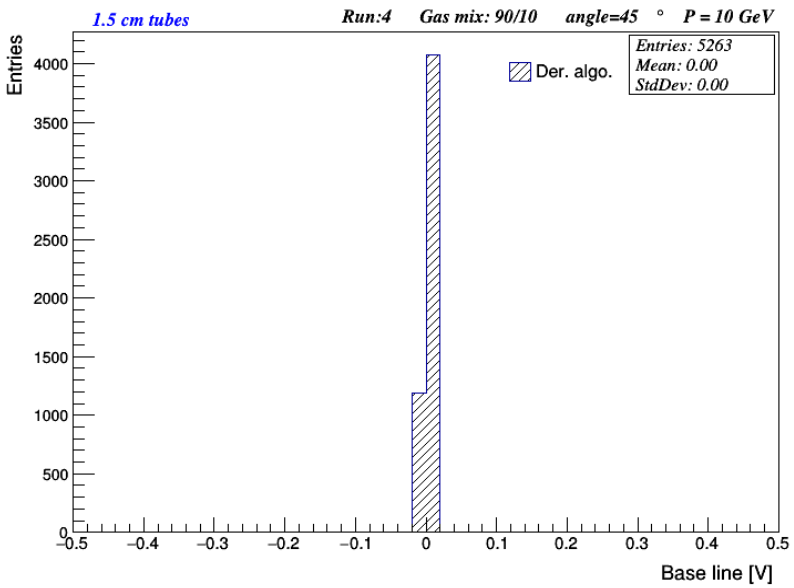
Cut on 1st der. : 0.6
Cut on 2nd der. : 0.4
Cut on clusterization : 0.24



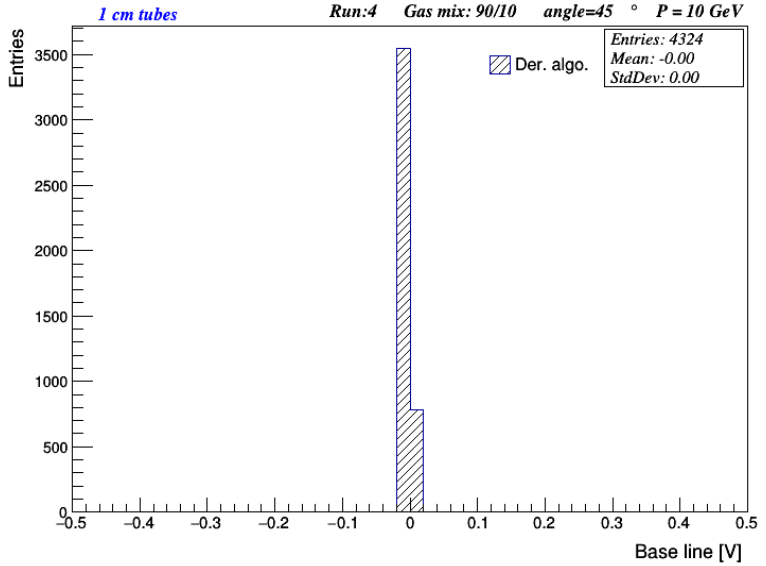


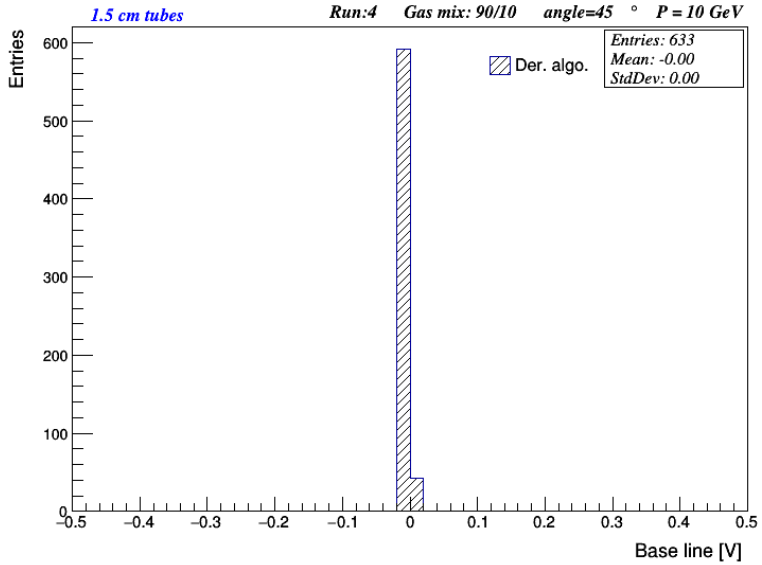
DRS


1 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Der. algo.
Entries: 6420
Mean: 0.00
StdDev: 0.00
Entries
Base line [V]

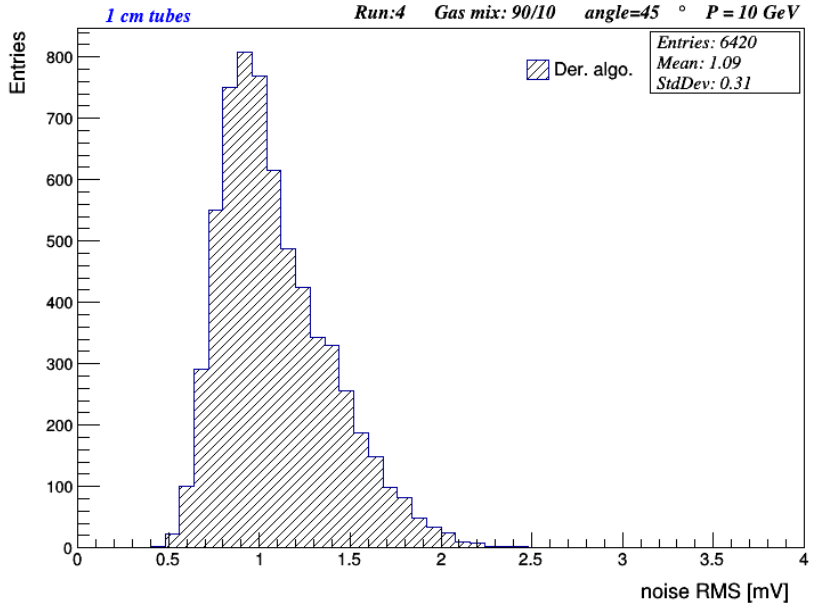

1.5 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Der. algo.
Entries: 5263
Mean: 0.00
StdDev: 0.00
Entries
Base line [V]

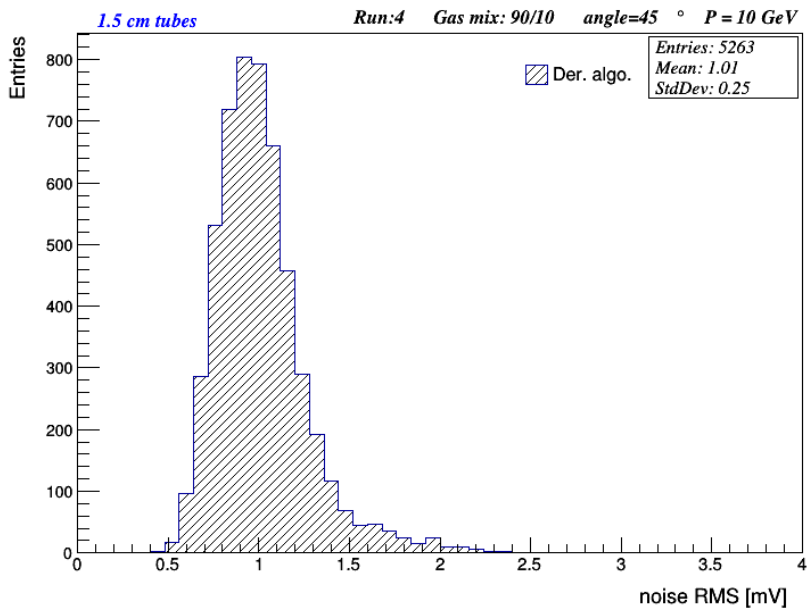
OSC


1 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Der. algo.
Entries: 4324
Mean: -0.00
StdDev: 0.00
Entries
Base line [V]

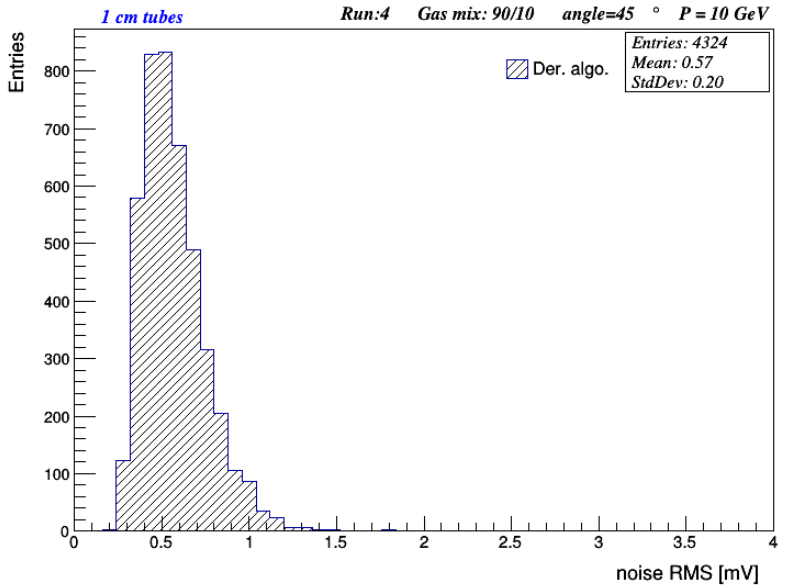

1.5 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Der. algo.
Entries: 633
Mean: -0.00
StdDev: 0.00
Entries
Base line [V]

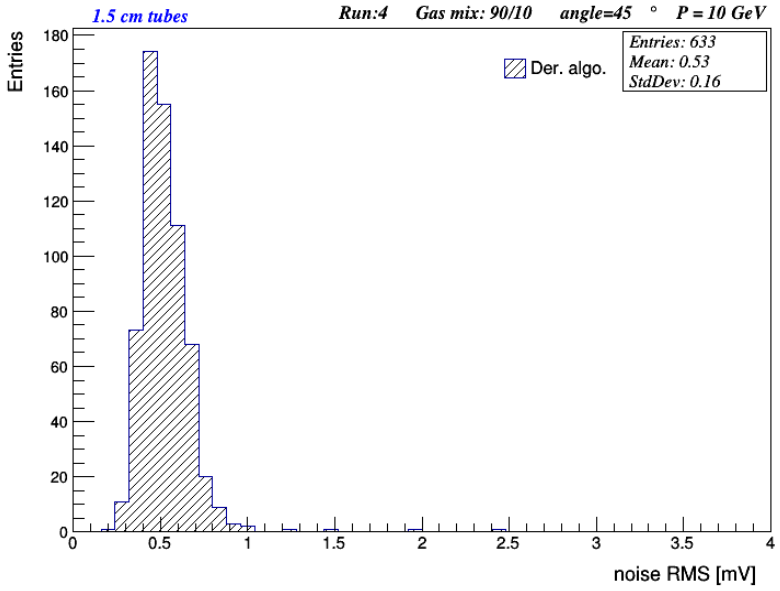
DRS


1 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 6420
Mean: 1.09
StdDev: 0.31
Der. algo.
Entries
noise RMS [mV]

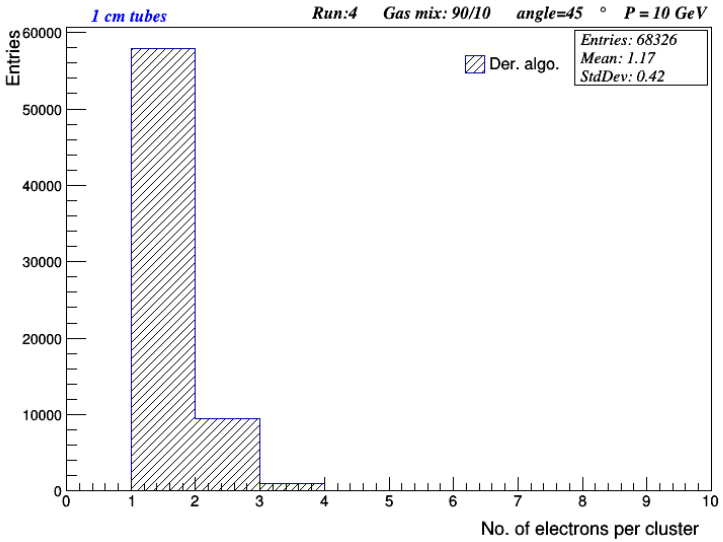

1.5 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 5263
Mean: 1.01
StdDev: 0.25
Der. algo.
Entries
noise RMS [mV]

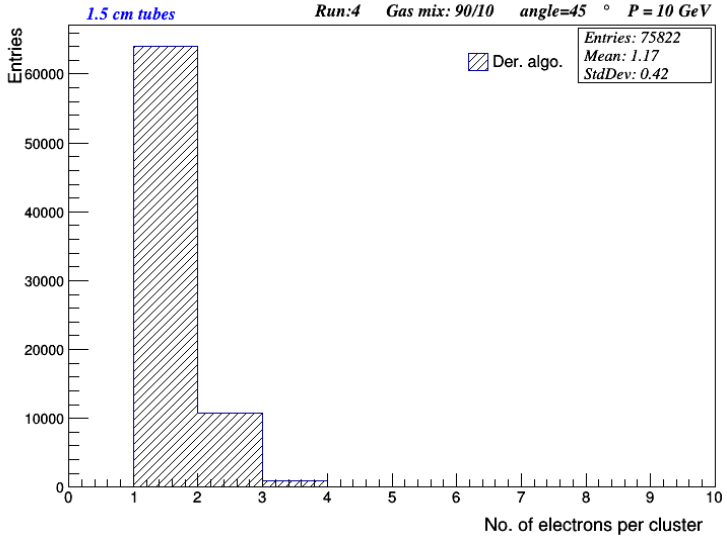
OSC


1 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 4324
Mean: 0.57
StdDev: 0.20
Der. algo.
Entries
noise RMS [mV]


1.5 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 633
Mean: 0.53
StdDev: 0.16
Der. algo.
Entries
noise RMS [mV]

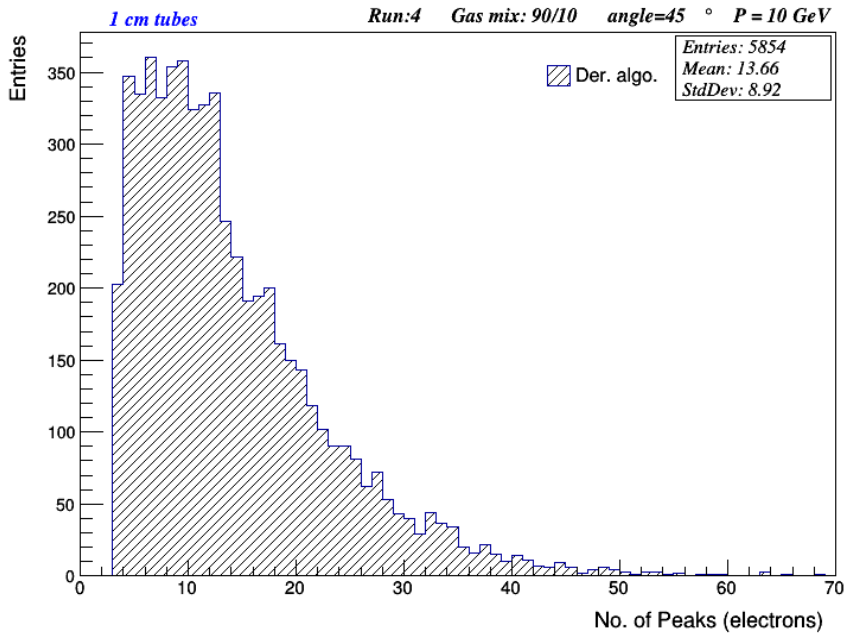
DRS

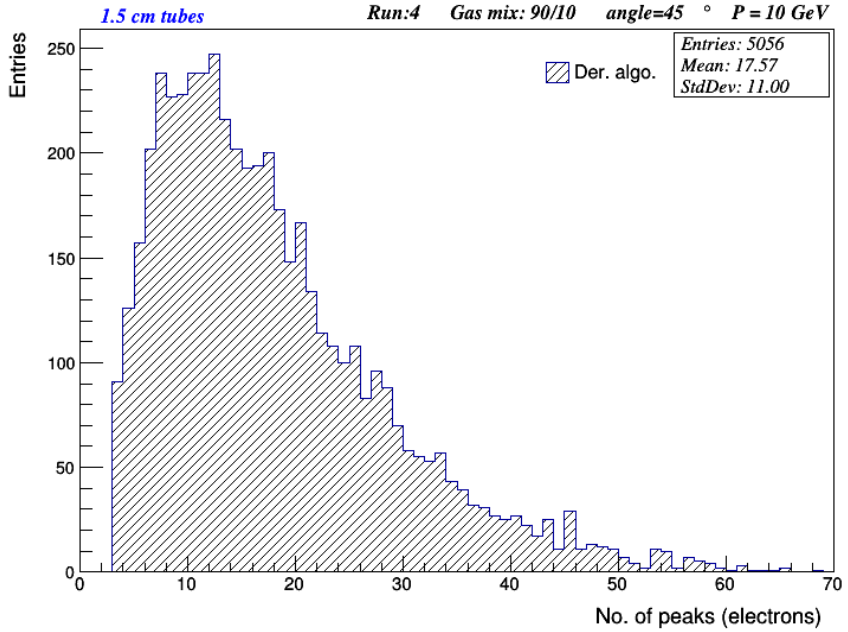

1 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 68326
Mean: 1.17
StdDev: 0.42
Der. algo.
Entries
No. of electrons per cluster


1.5 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 75822
Mean: 1.17
StdDev: 0.42
Der. algo.
Entries
No. of electrons per cluster

OSC

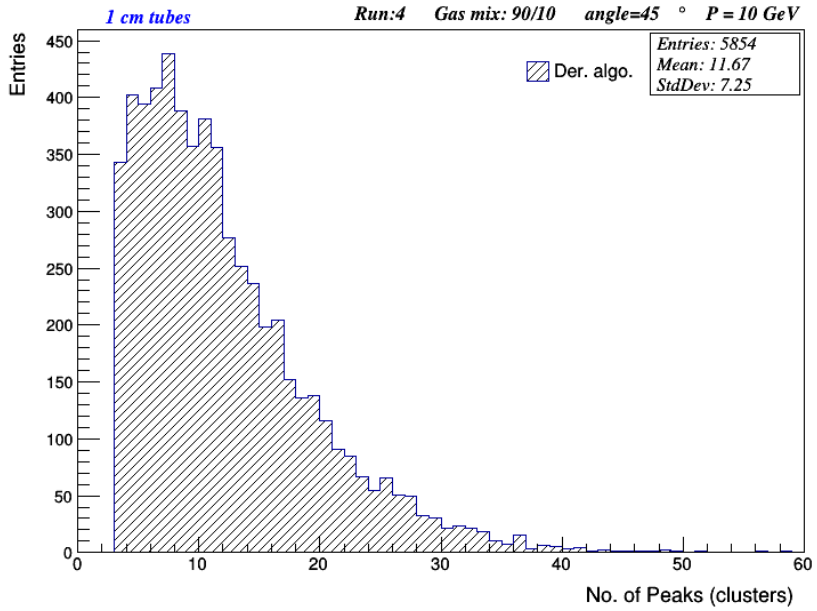
DRS

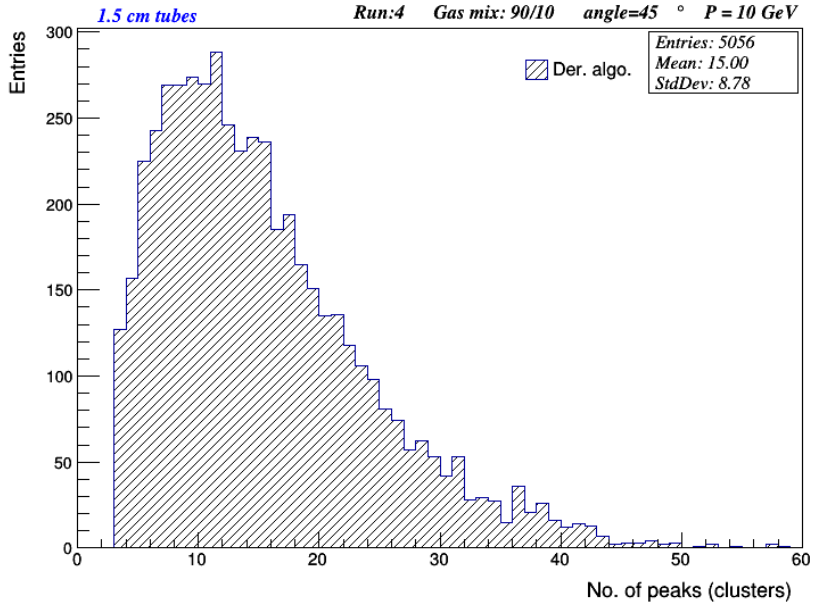

1 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Der. algo.
Entries: 5854
Mean: 13.66
StdDev: 8.92
Entries
No. of Peaks (electrons)


1.5 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Der. algo.
Entries: 5056
Mean: 17.57
StdDev: 11.00
Entries
No. of peaks (electrons)

OSC

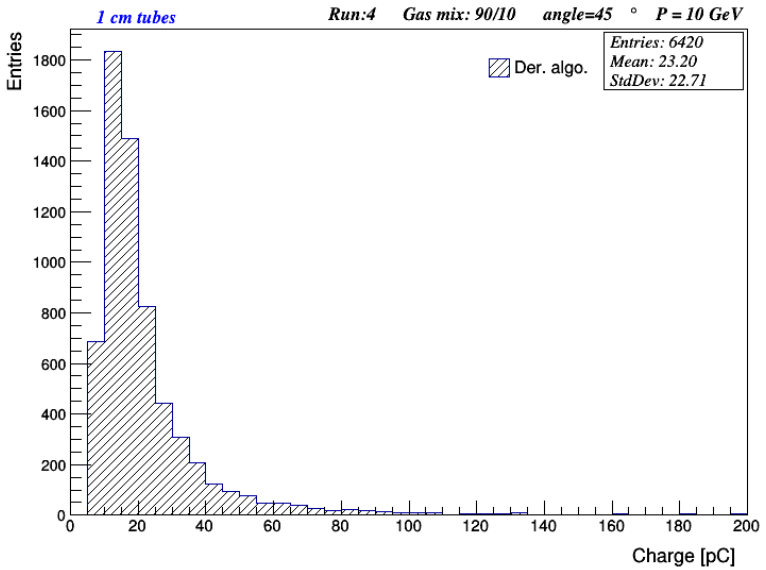
DRS

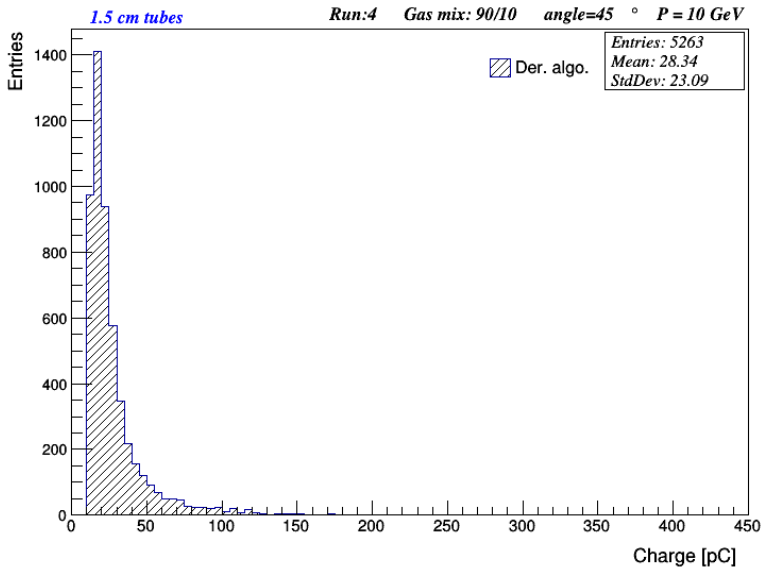

1 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 5854
Mean: 11.67
StdDev: 7.25
Der. algo.
Entries
No. of Peaks (clusters)


1.5 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 5056
Mean: 15.00
StdDev: 8.78
Der. algo.
Entries
No. of peaks (clusters)

OSC

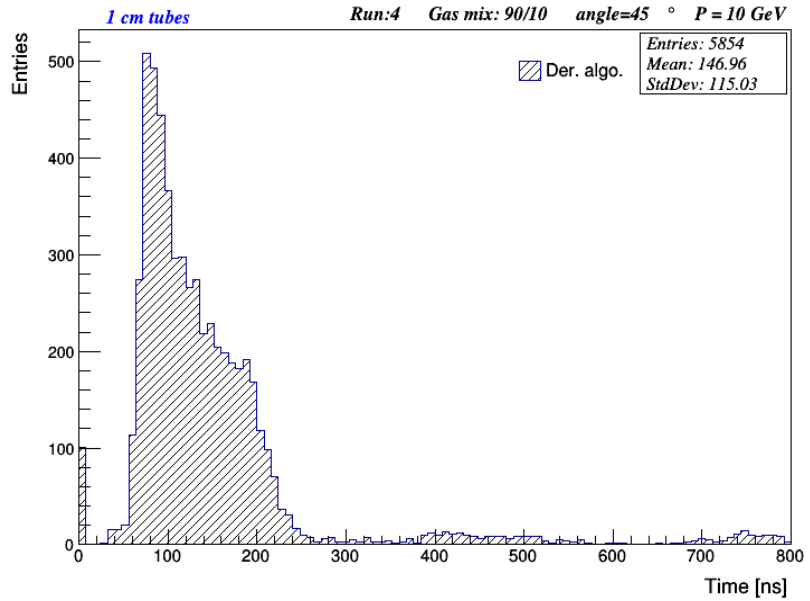
DRS

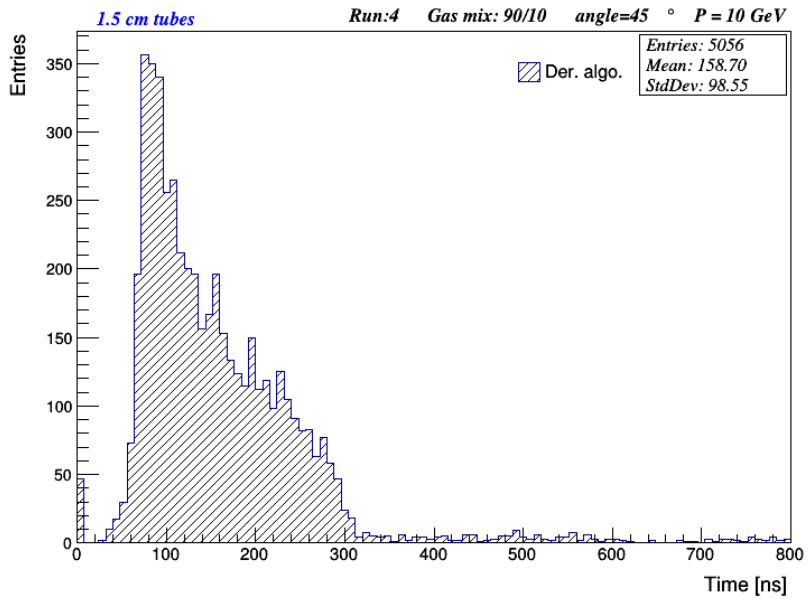

1 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Der. algo.
Entries: 6420
Mean: 23.20
StdDev: 22.71
Entries
Charge [pC]


1.5 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Der. algo.
Entries: 5263
Mean: 28.34
StdDev: 23.09
Entries
Charge [pC]

OSC

DRS **OSC**

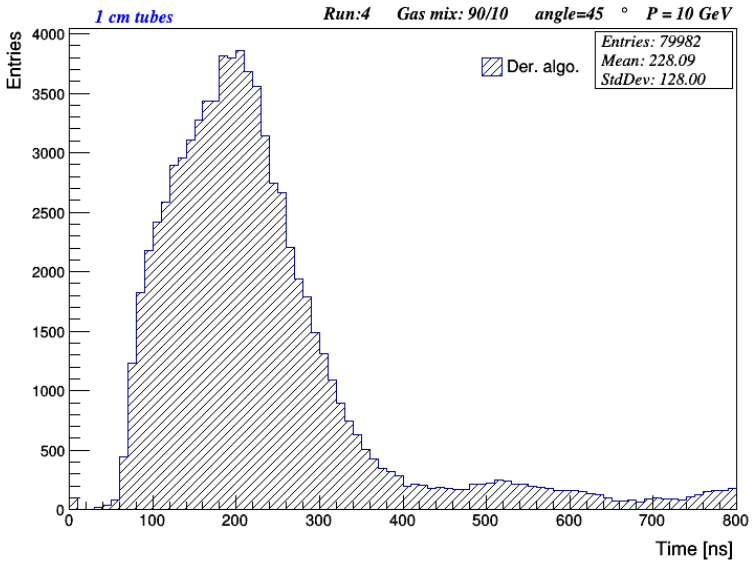


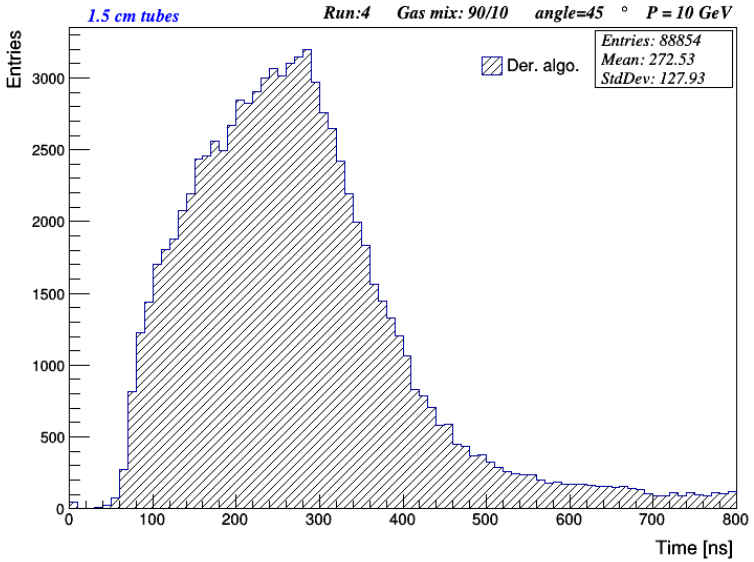


Time of first electrons peak

DRS

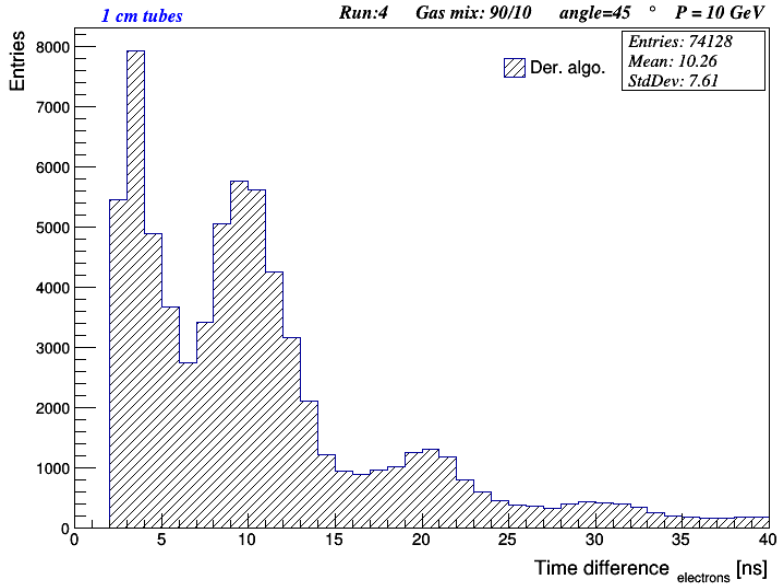
OSC

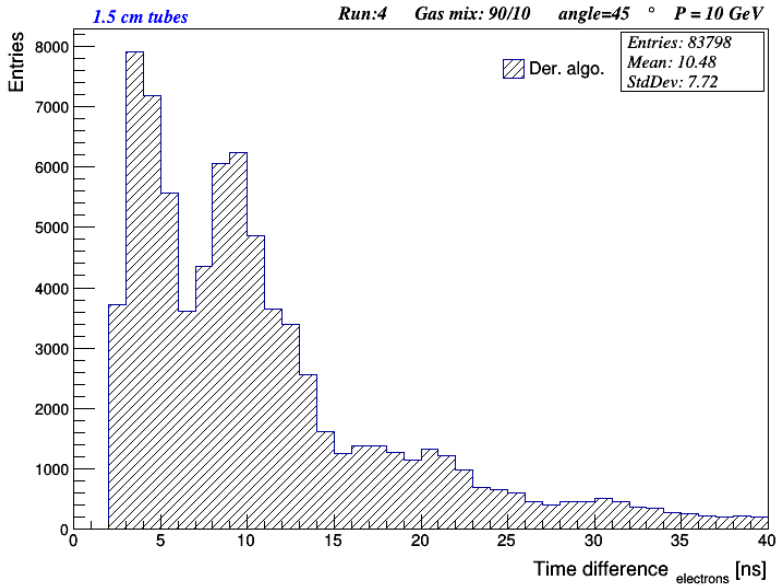




Time of electrons peaks

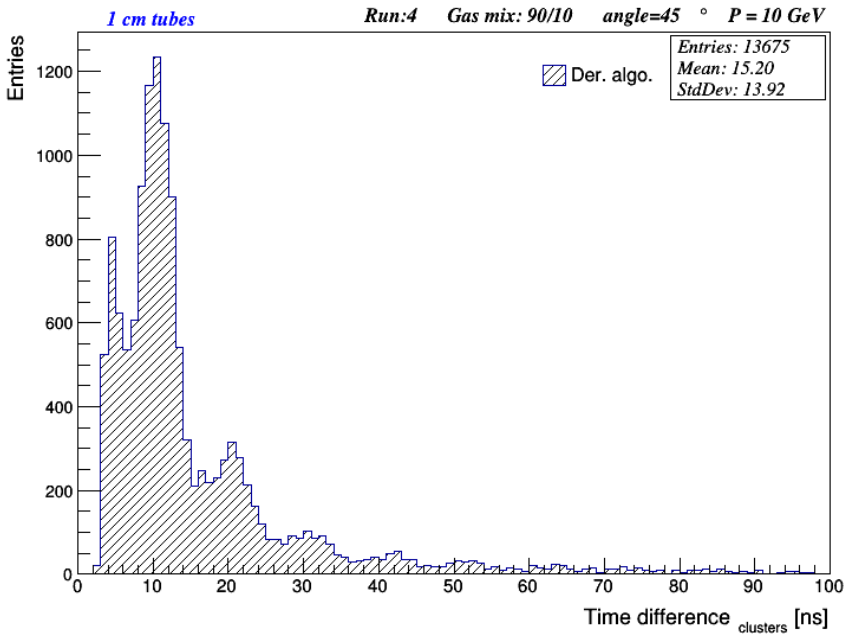
DRS

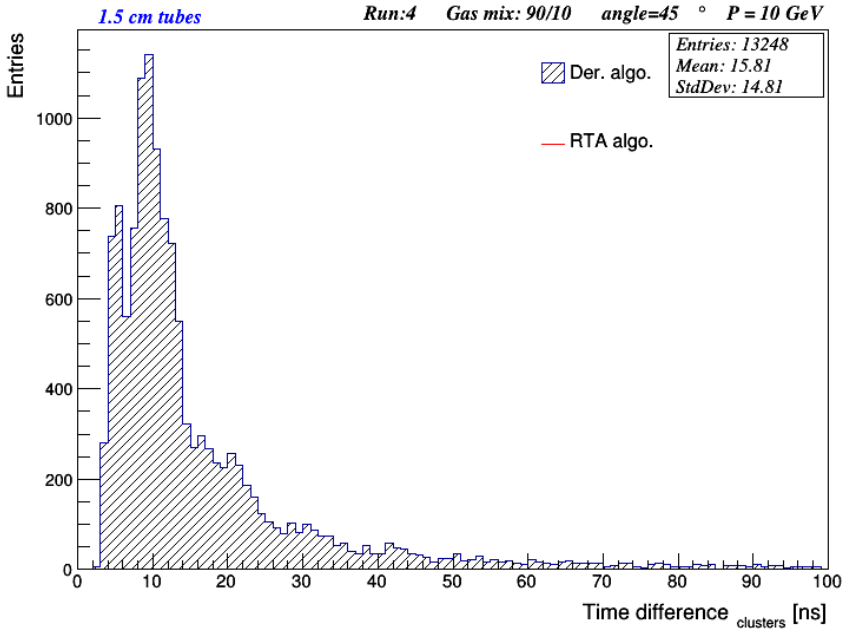

1 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 74128
Mean: 10.26
StdDev: 7.61
Der. algo.
Entries
Time difference electrons [ns]


1.5 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 83798
Mean: 10.48
StdDev: 7.72
Der. algo.
Entries
Time difference electrons [ns]

OSC

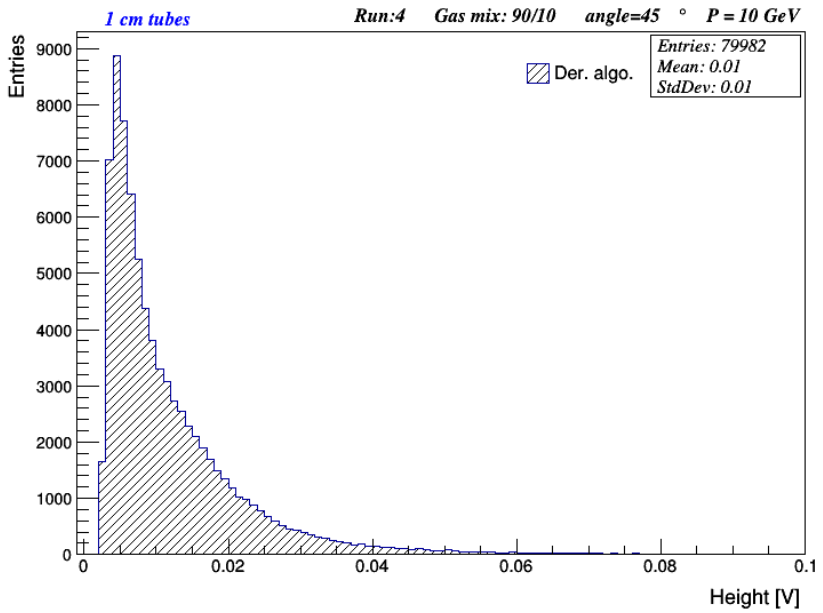
DRS

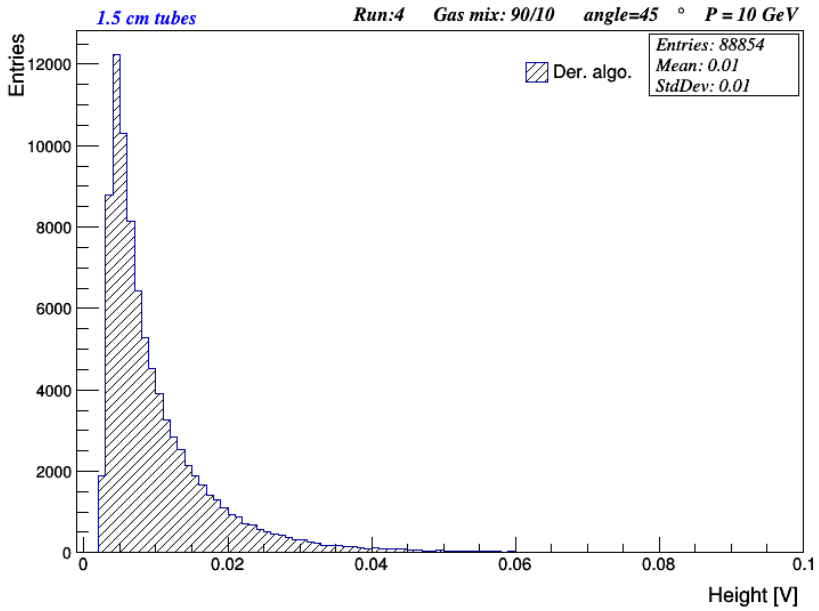

1 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 13675
Mean: 15.20
StdDev: 13.92
Der. algo.
Entries
Time difference clusters [ns]


1.5 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 13248
Mean: 15.81
StdDev: 14.81
Der. algo.
RTA algo.
Entries
Time difference clusters [ns]

OSC

DRS


1 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 79982
Mean: 0.01
StdDev: 0.01
Der. algo.
Entries
Height [V]


1.5 cm tubes
Run:4 Gas mix: 90/10 angle=45 ° P = 10 GeV
Entries: 88854
Mean: 0.01
StdDev: 0.01
Der. algo.
Entries
Height [V]

OSC