GAS GAIN PROBLEM

GARFIELD++ && GARFIELD

14,02,2023

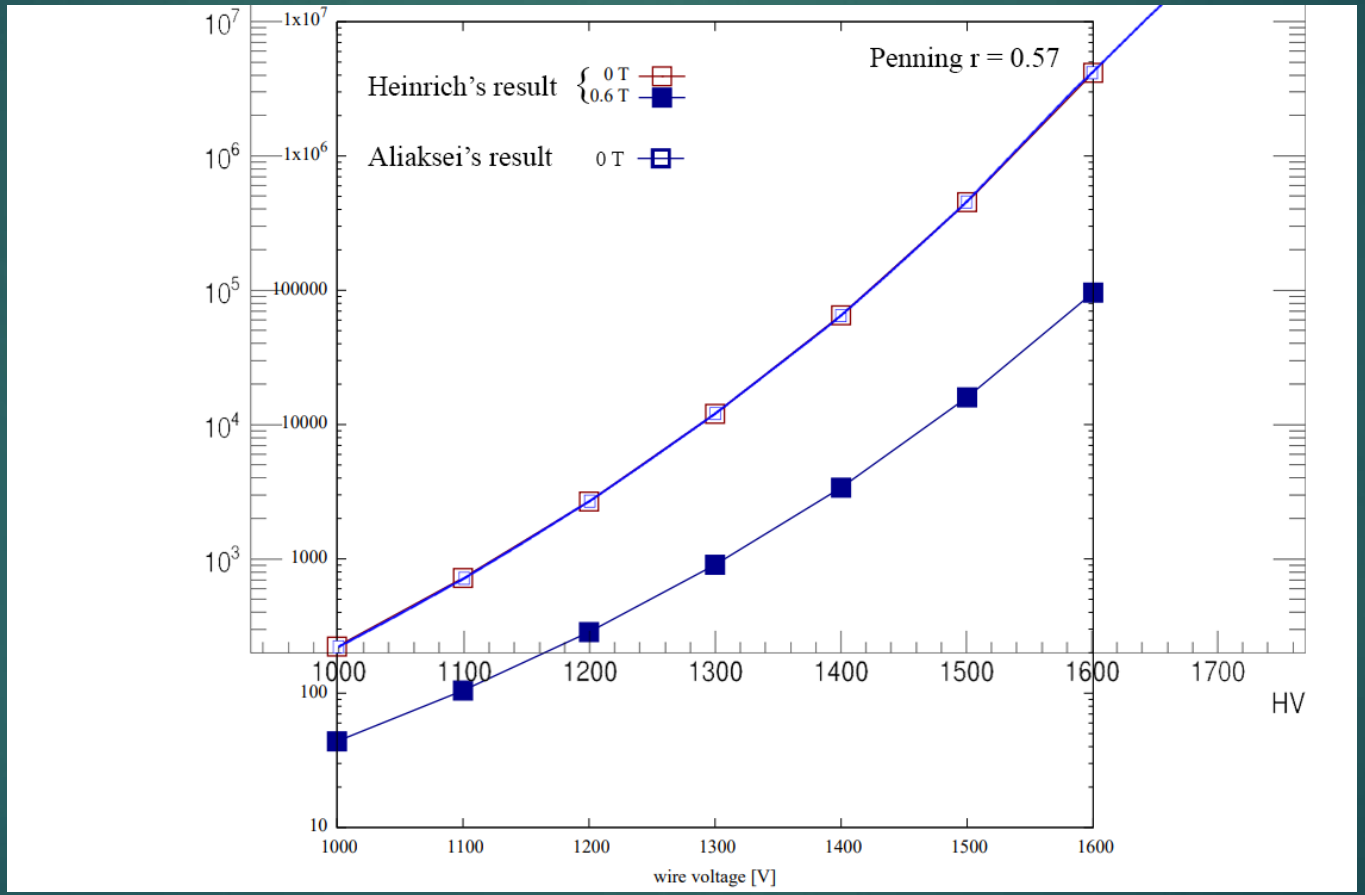
Aliaksei Paulau
on behalf of the Straw Group

Main questions

Issue			Status	Description
01	Gas Gain	Exact value	Not fixed	**17.12.2022** After discussion with Garfield & Garfield++ devs. Heinrich sent a source C++ file with RKF Gas gain modeling. ☑ My results matched Heinrich's, but still the ~~gas gain is different from ATLAS TRT.~~ ☑ **30.12.2022** Add plots from Garfield simulation. Choice between gas gain distribution.
		Shape of gas gain distribution	done	
02	Signal different between visualization and data output		Not fixed	**17.12.2022** Difference between signal amplitude in inner class and output data

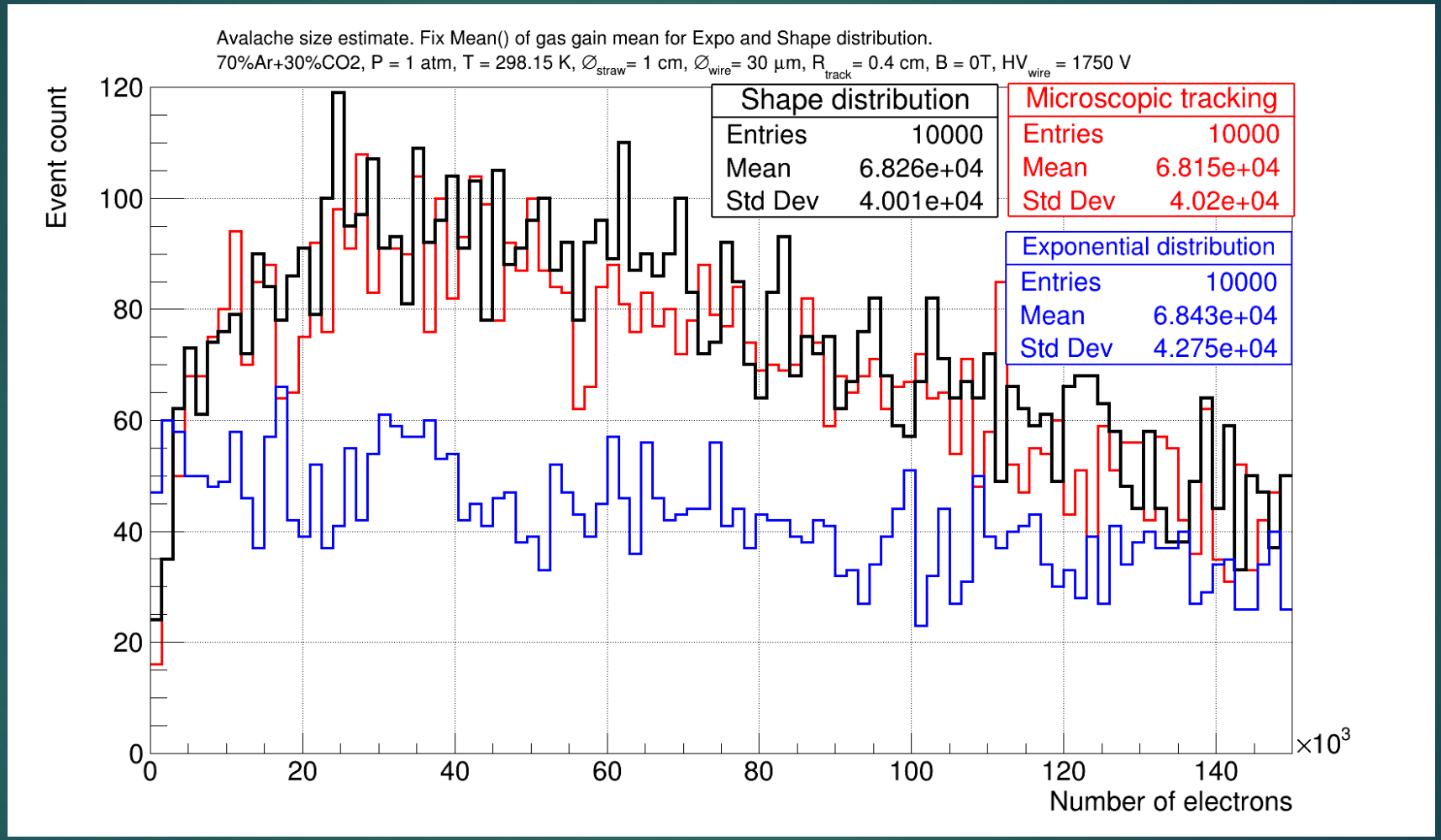
01 Gas gain problem
with exact value

Cross check with Heinrich's results



01 Gas gain
shape of distribution

Choice between gas gain distribution.



Because the shape distribution agrees well with the Microscopic distribution .
It is recommended to use a Shape distribution with a sigma = 0.5

01 Gas gain problem
with exact value

Cross check with ATLAS TRT from TDR

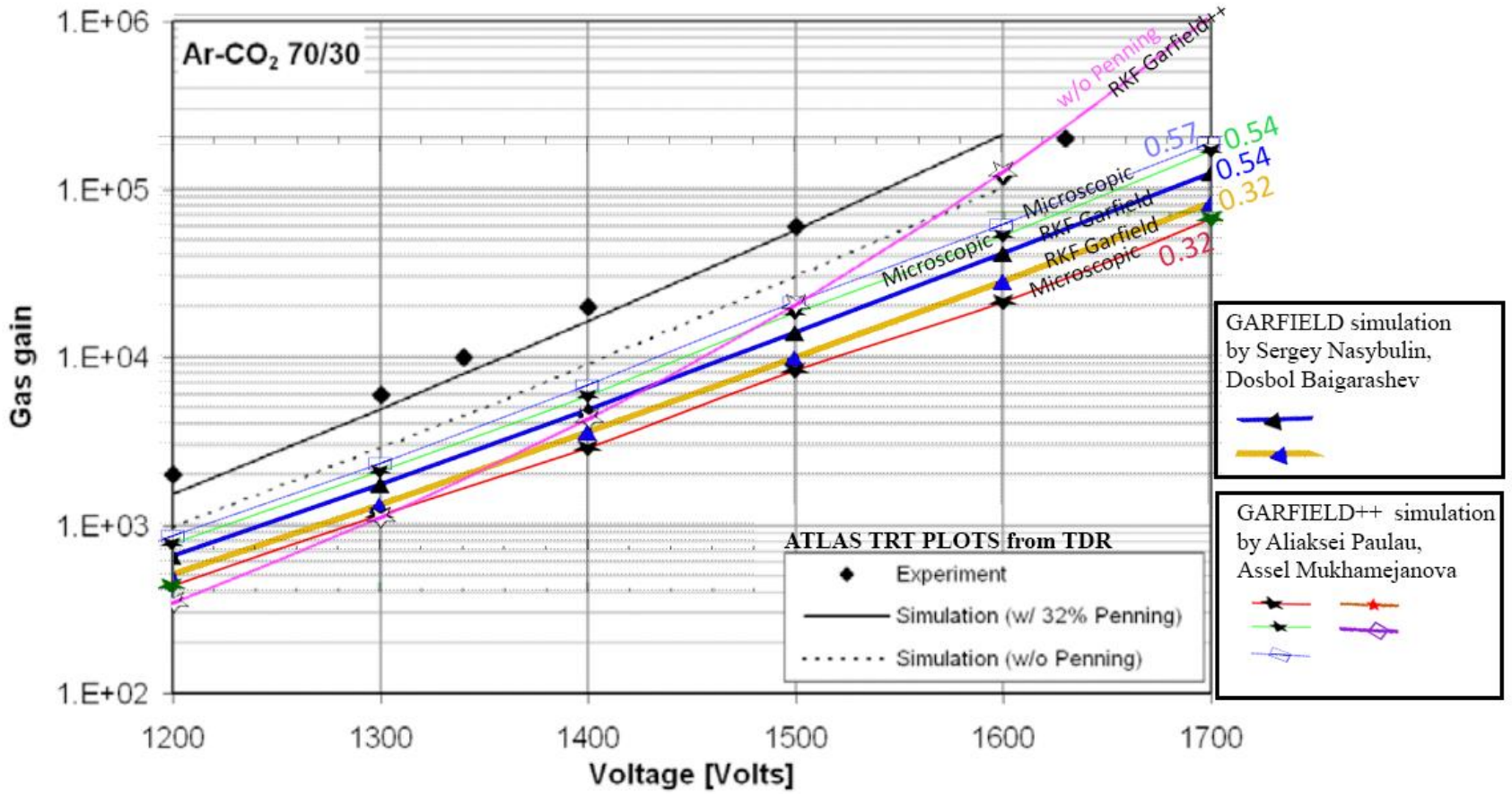


Figure 4-21 Gas gain in Ar/CO_2 70/30 (experimental data and simulation).

01 Gas gain problem
with exact value

Cross check with ATLAS TRT from TDR

UPDATE

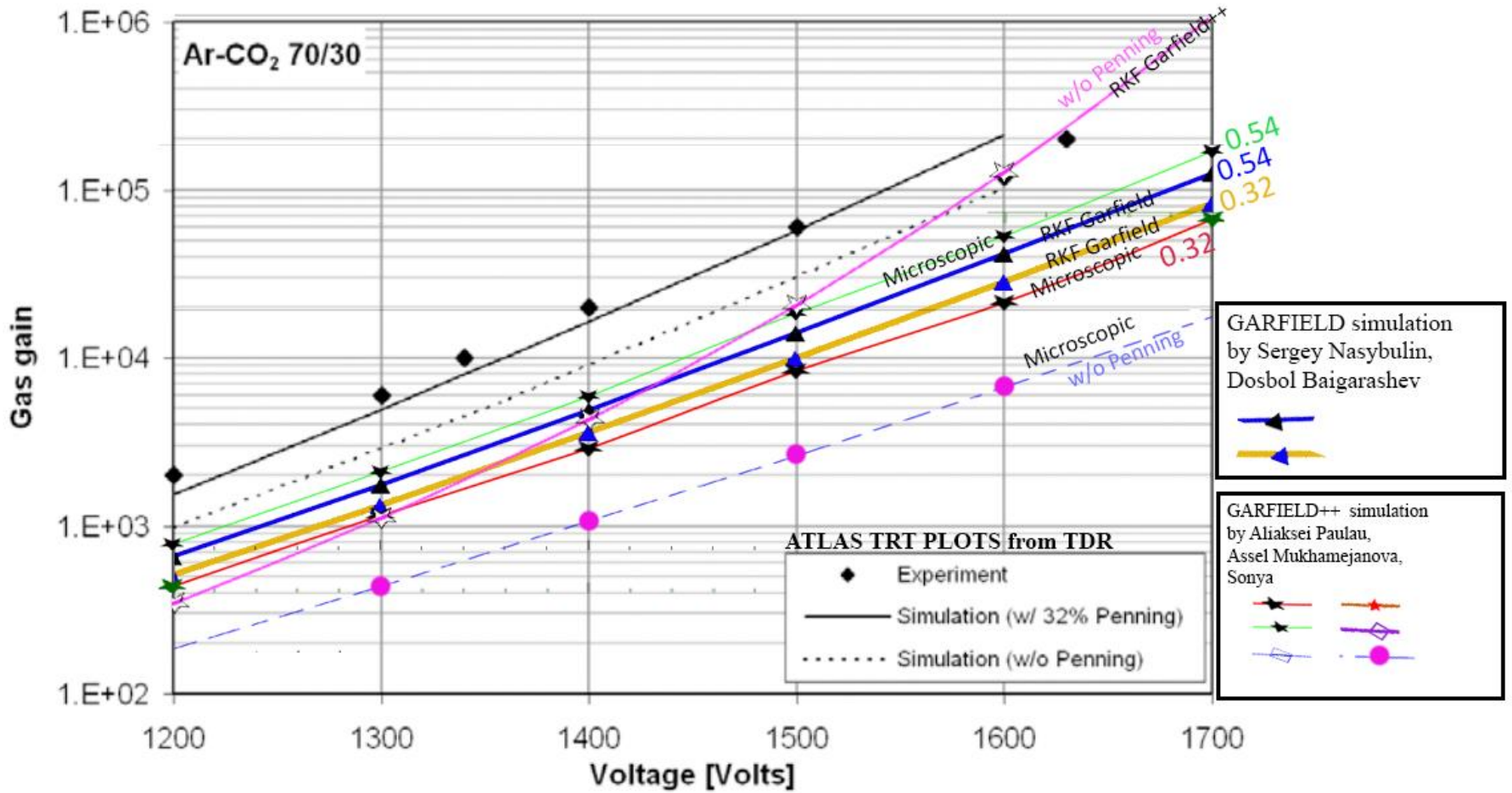
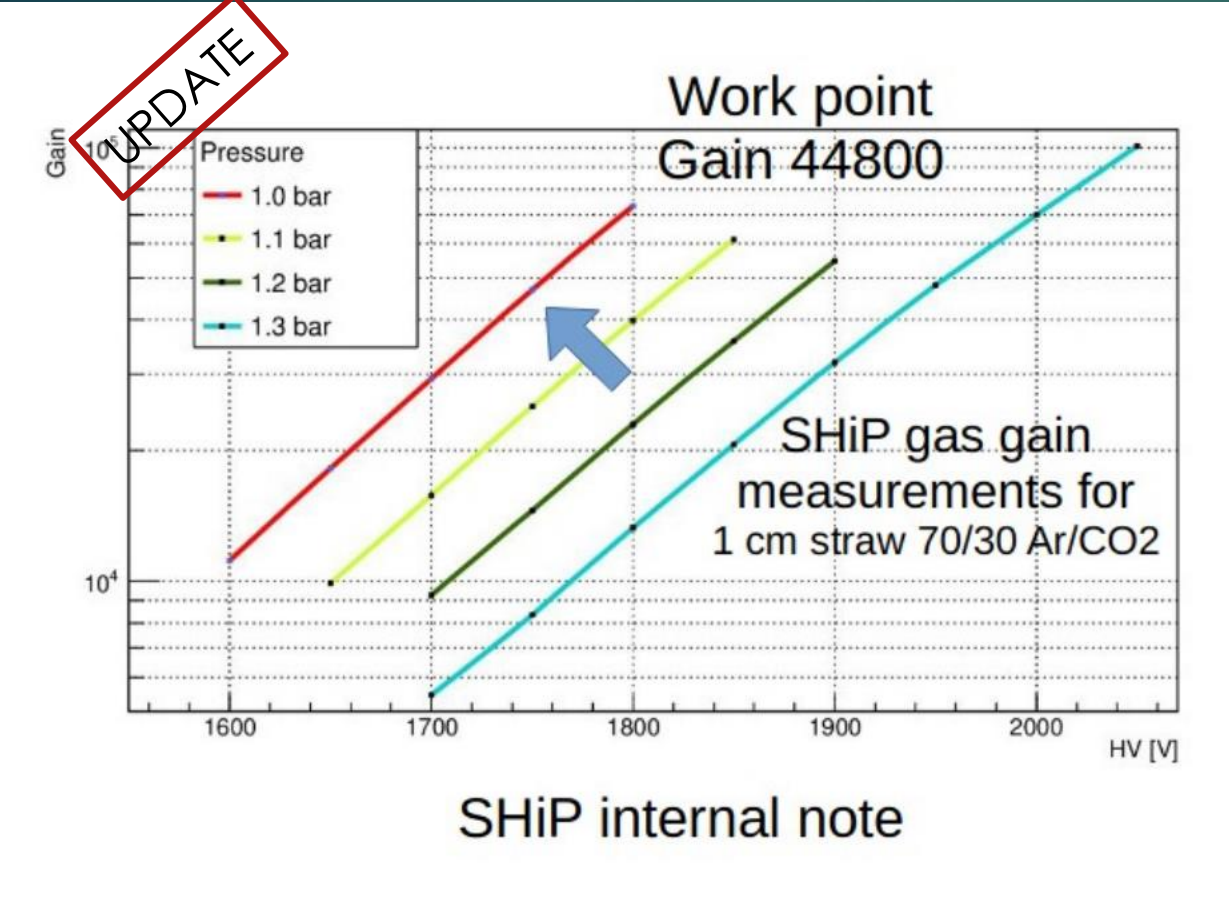
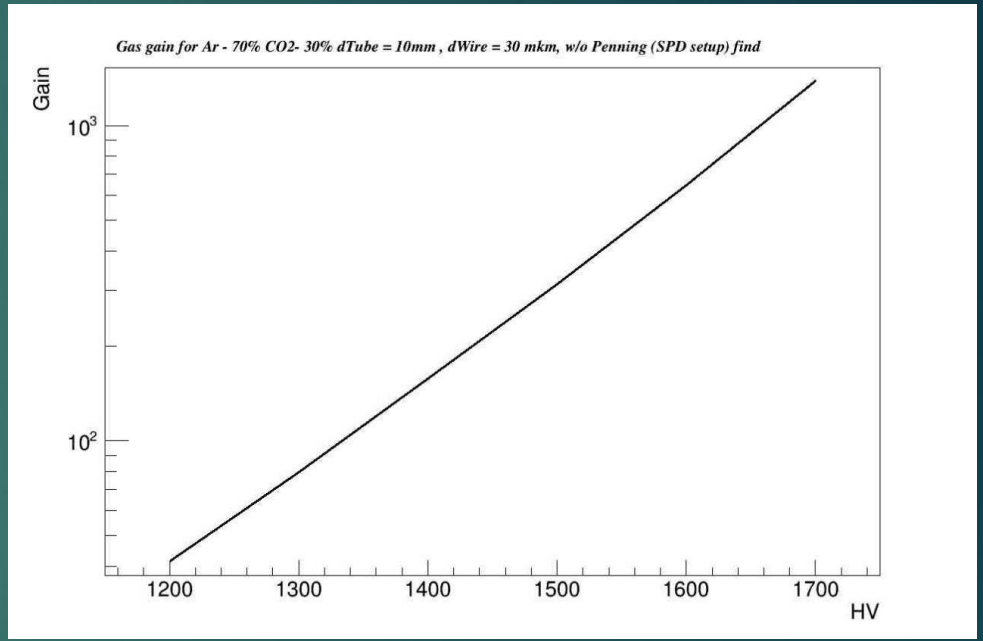


Figure 4-21 Gas gain in Ar/CO_2 70/30 (experimental data and simulation).

01 Gas gain problem
with exact value

Cross check with ATLAS TRT from TDR

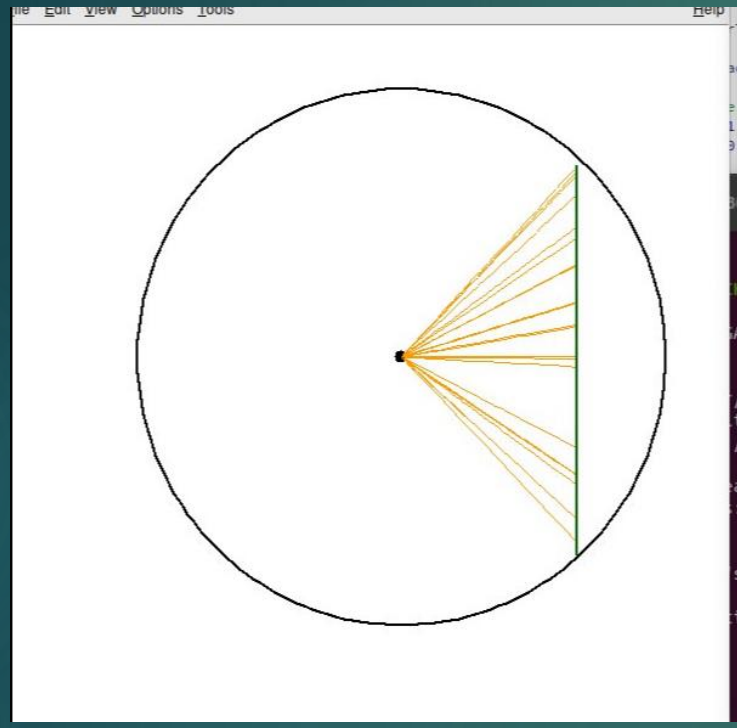


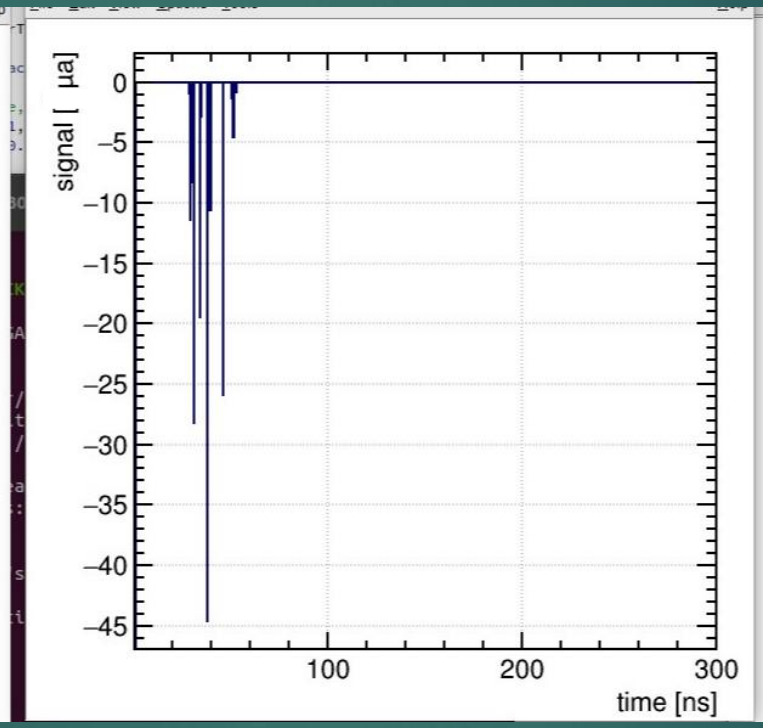


END

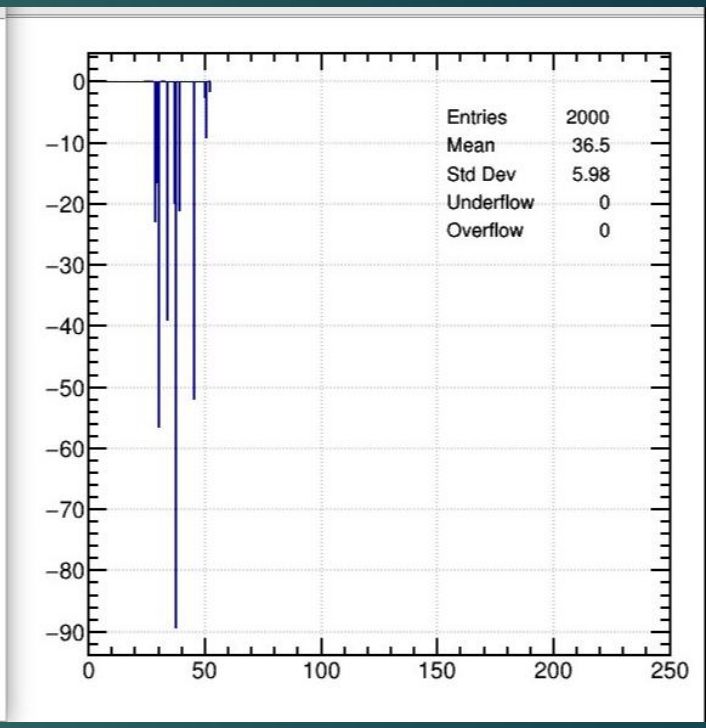
background

02 Signal difference between visualization and data output





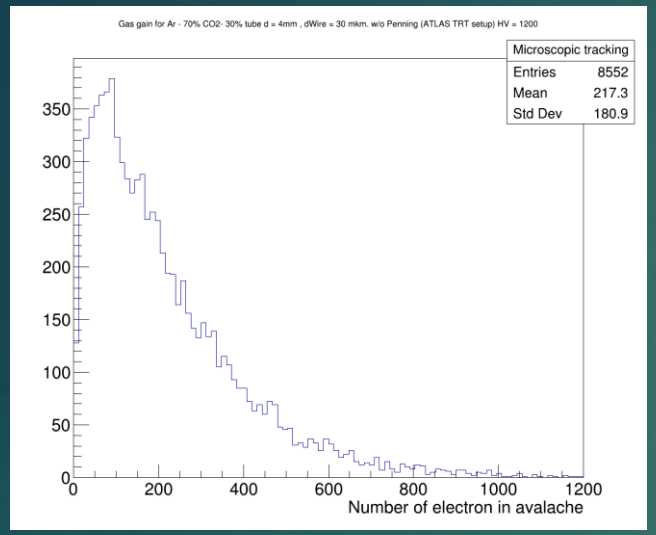
Visualization data from GARFIELD++

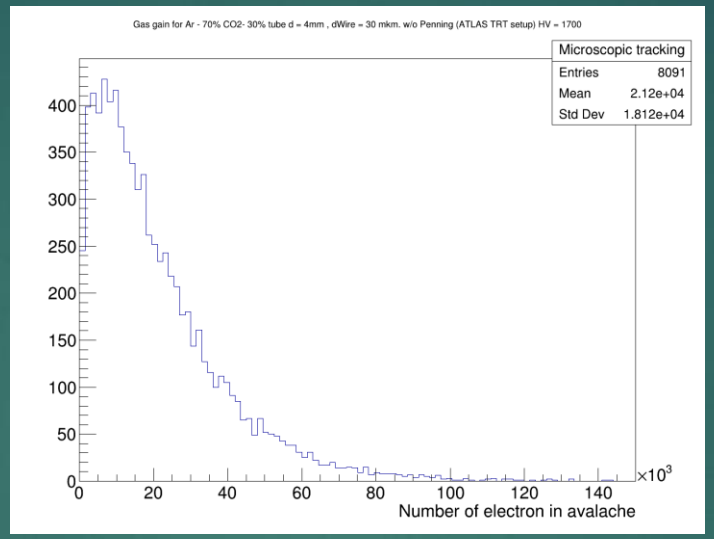


OUTPUT data from GARFIELD++

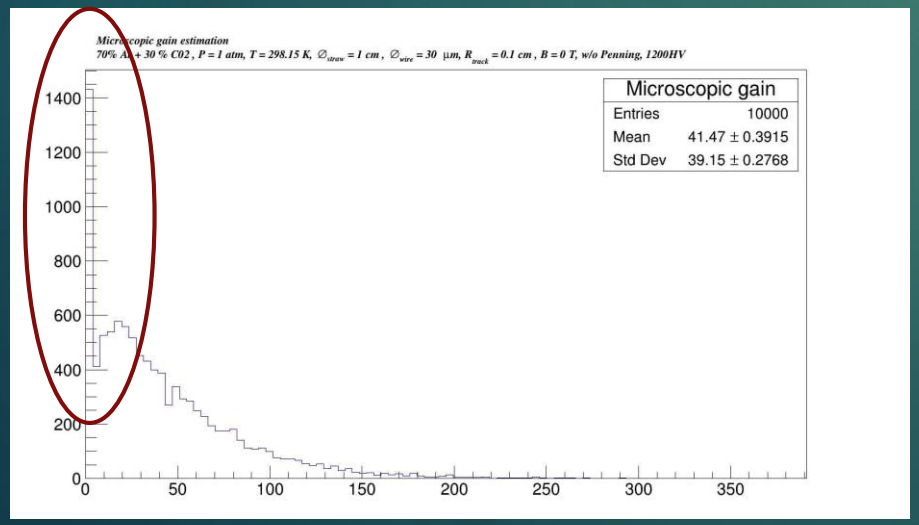
Not solved, need to think about it

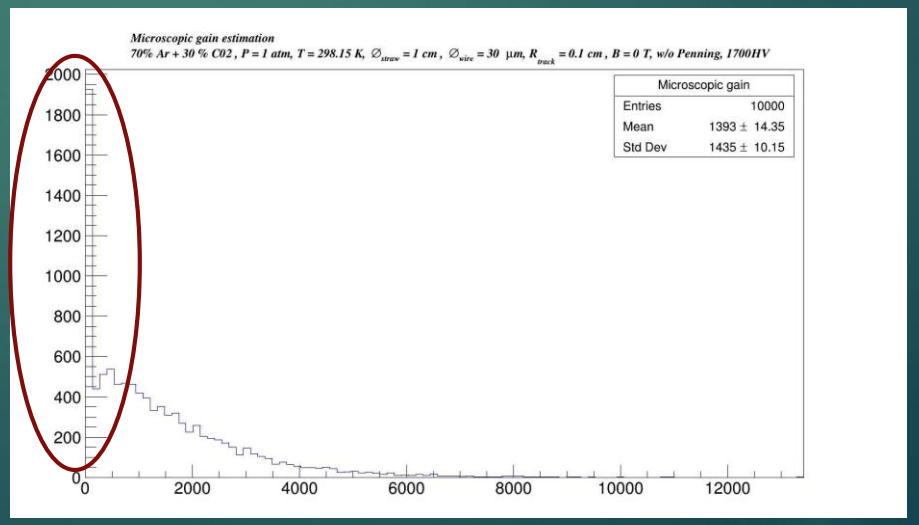
Example gas gain distribution





Sonya

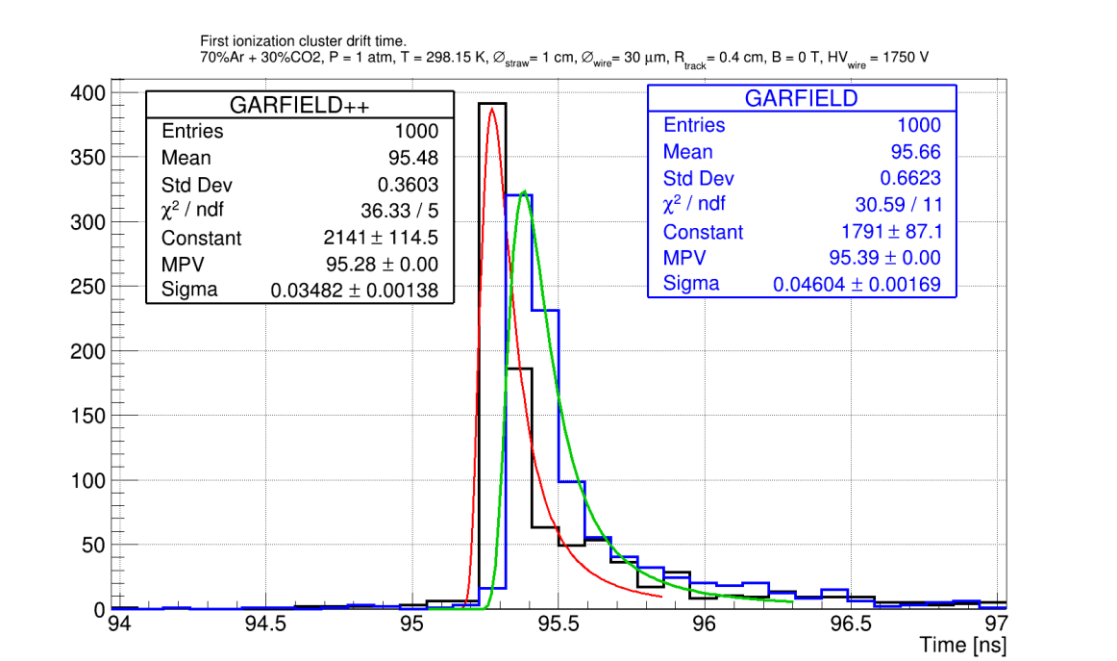


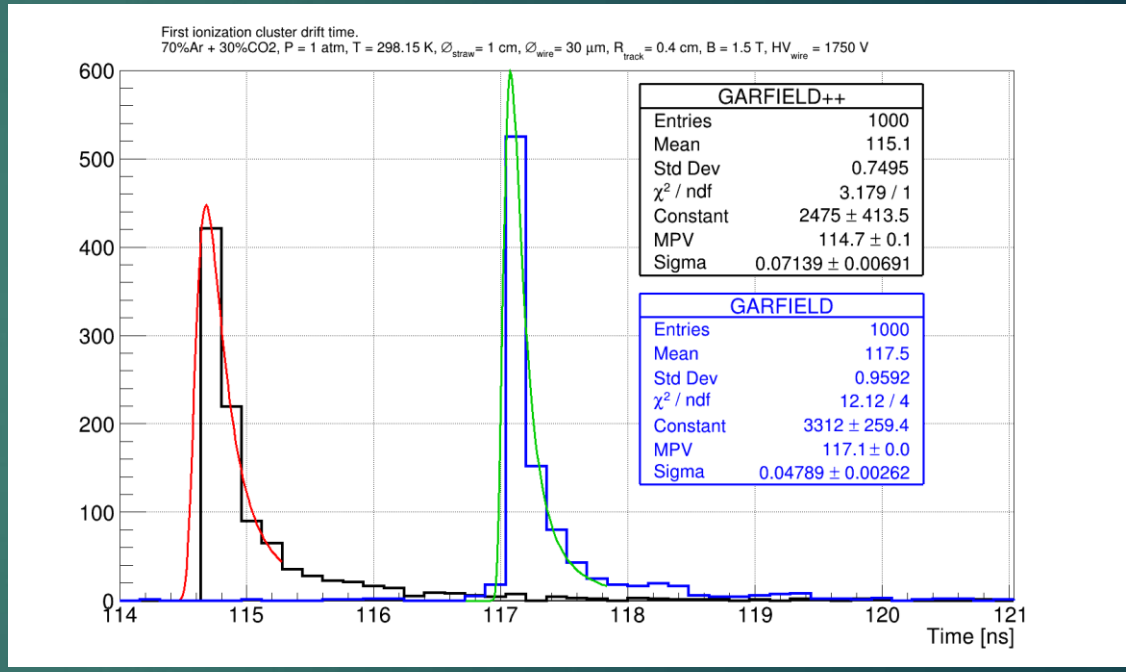


Assel

TDR plots update

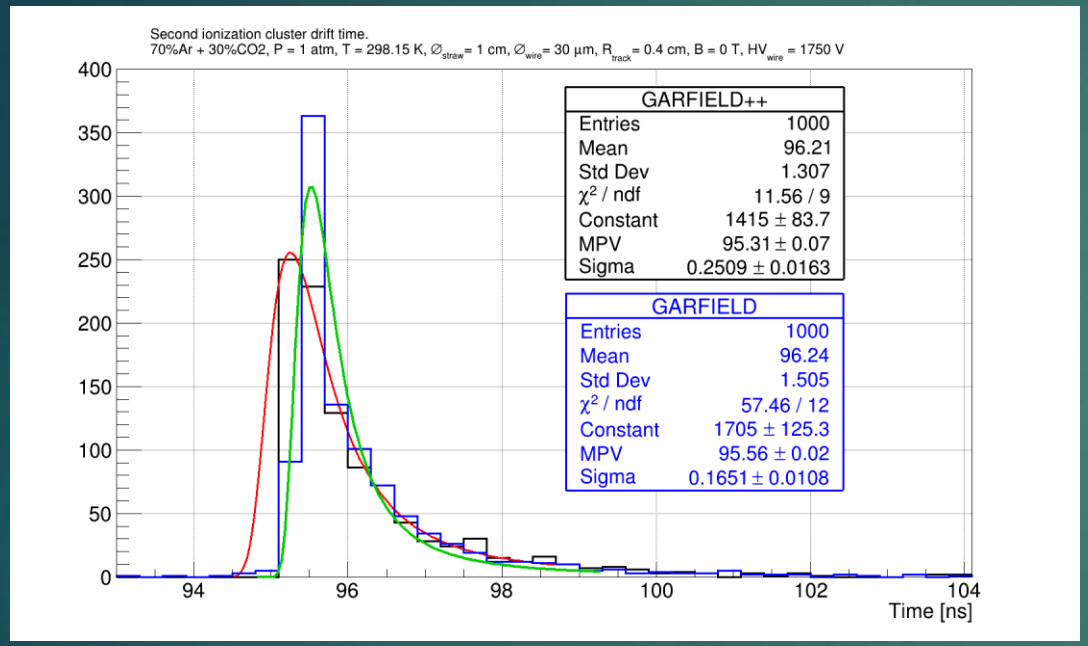
Final TDR plots

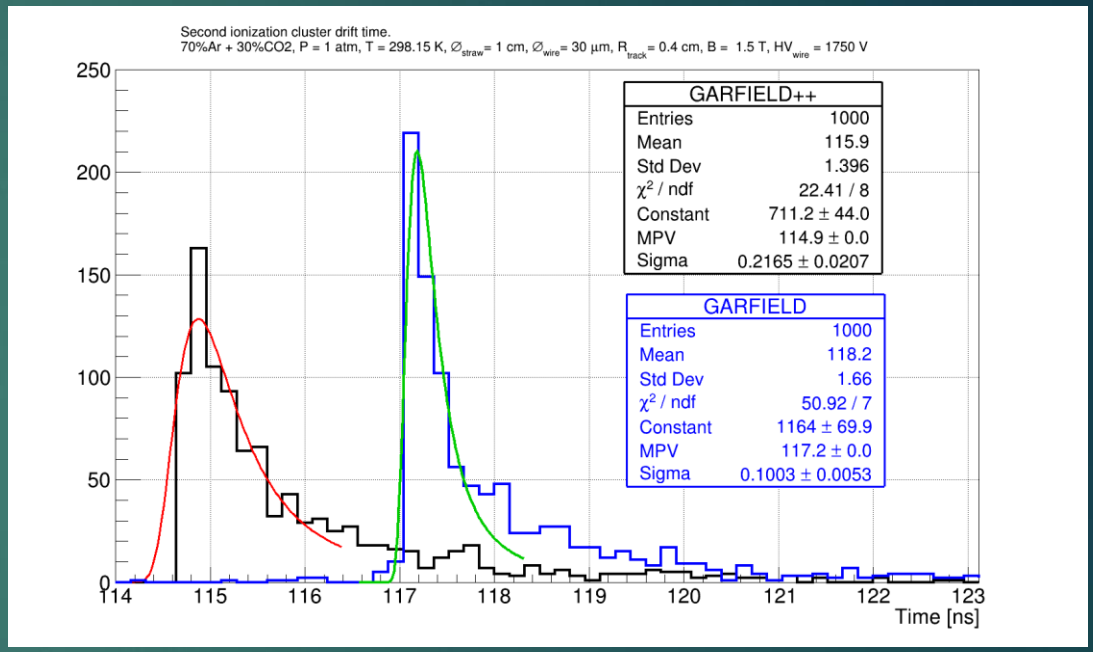




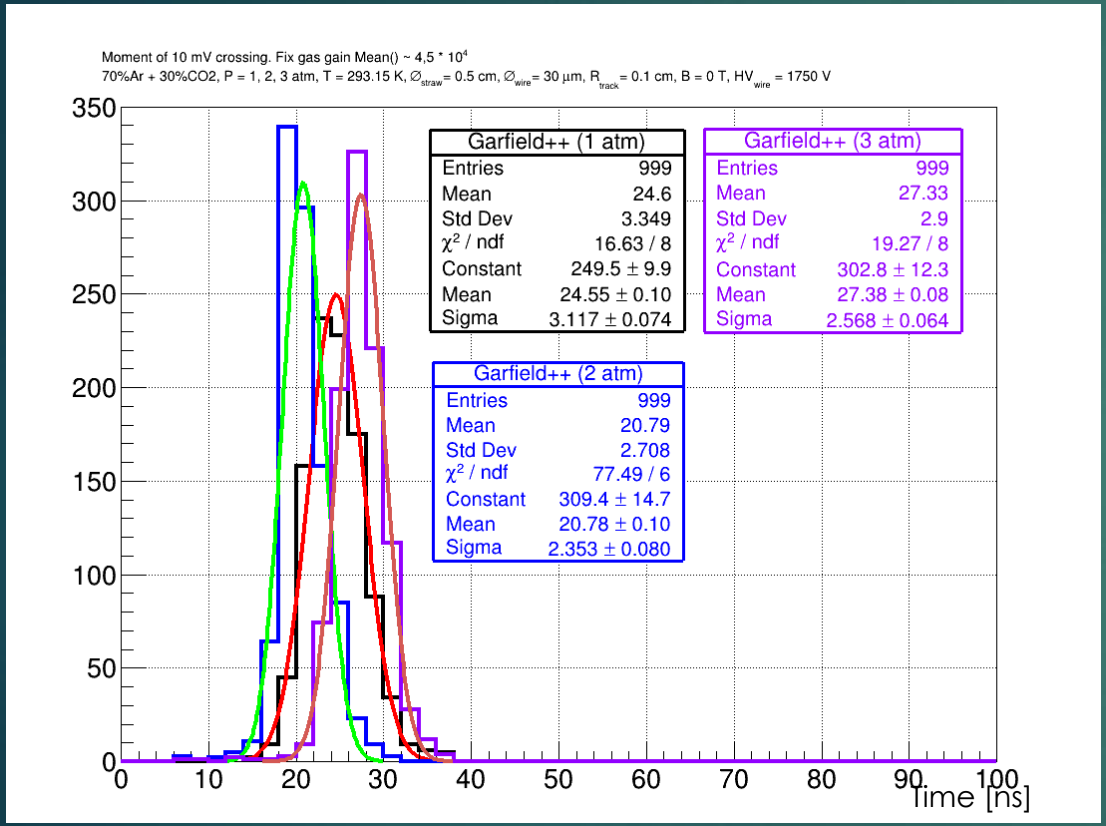
TDR plots update

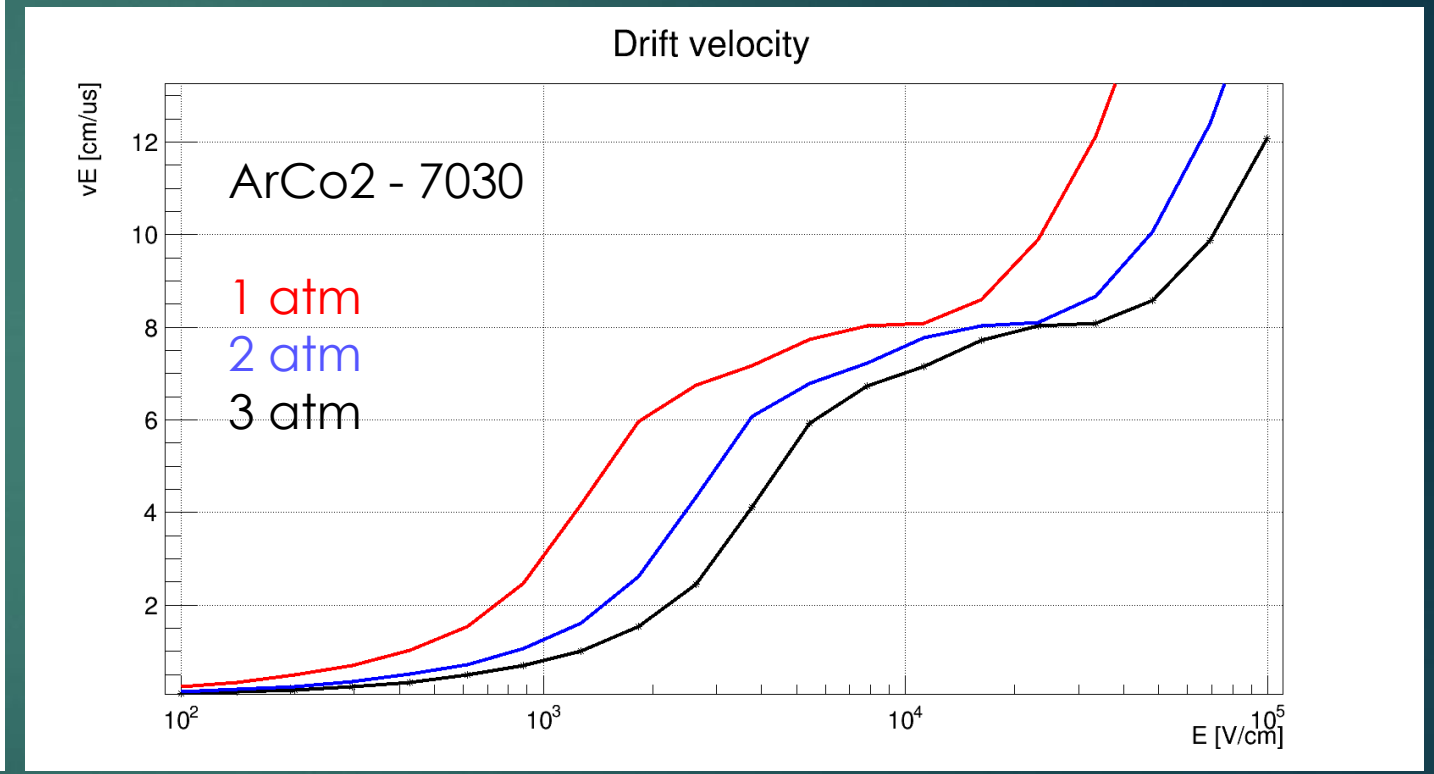
Final TDR plots





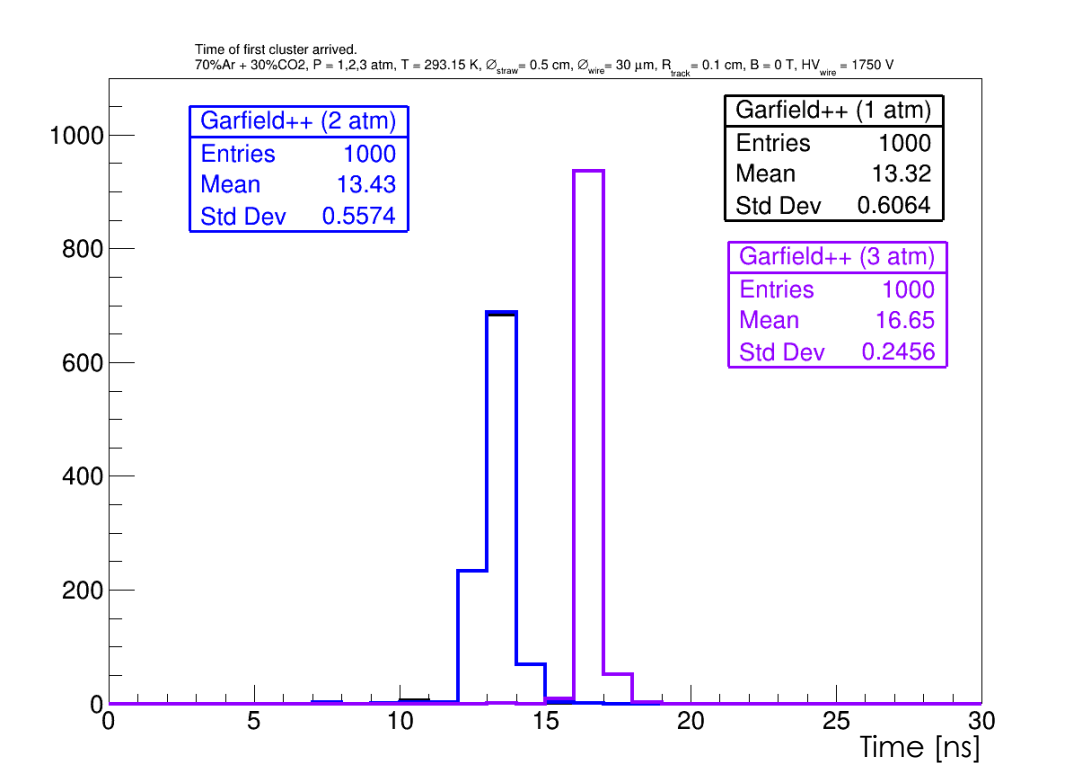
Strange behavior of time distribution

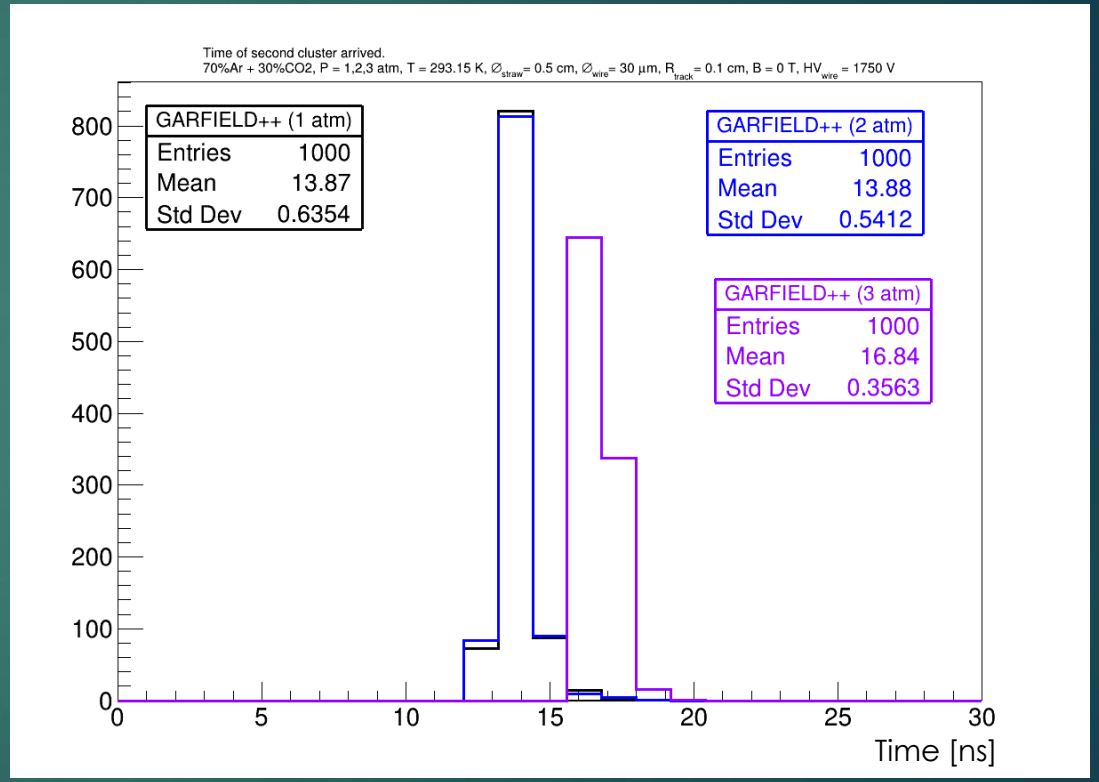




Strange behavior of time distribution

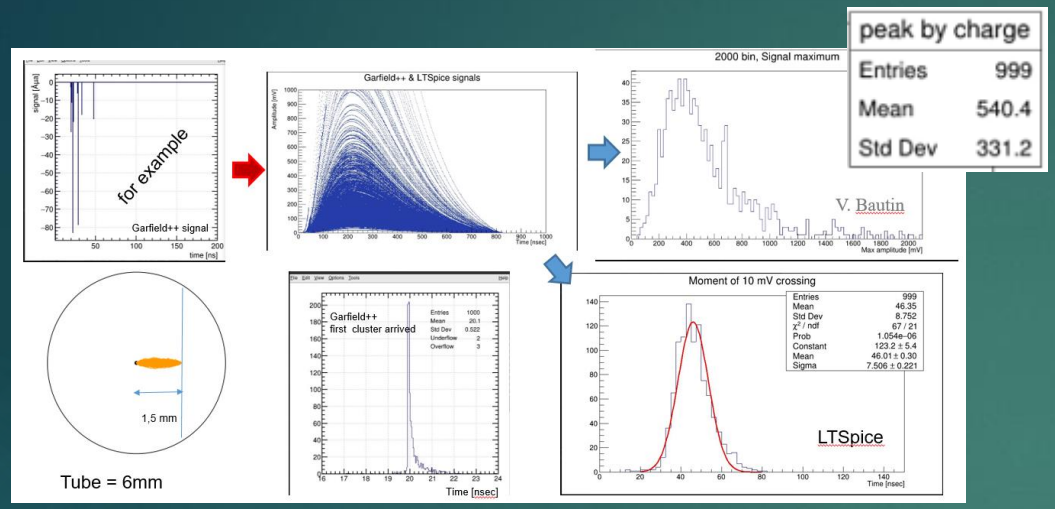
First & Second cluster arrived time

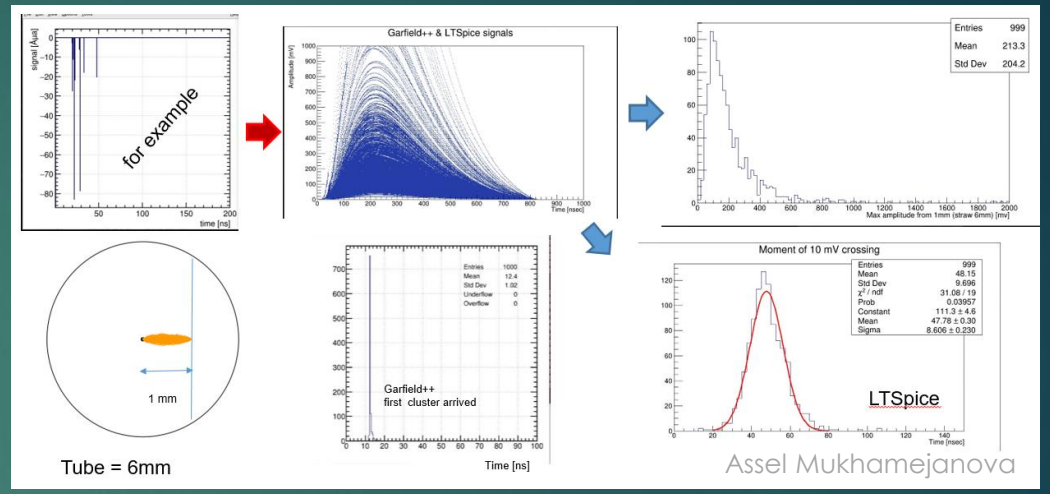


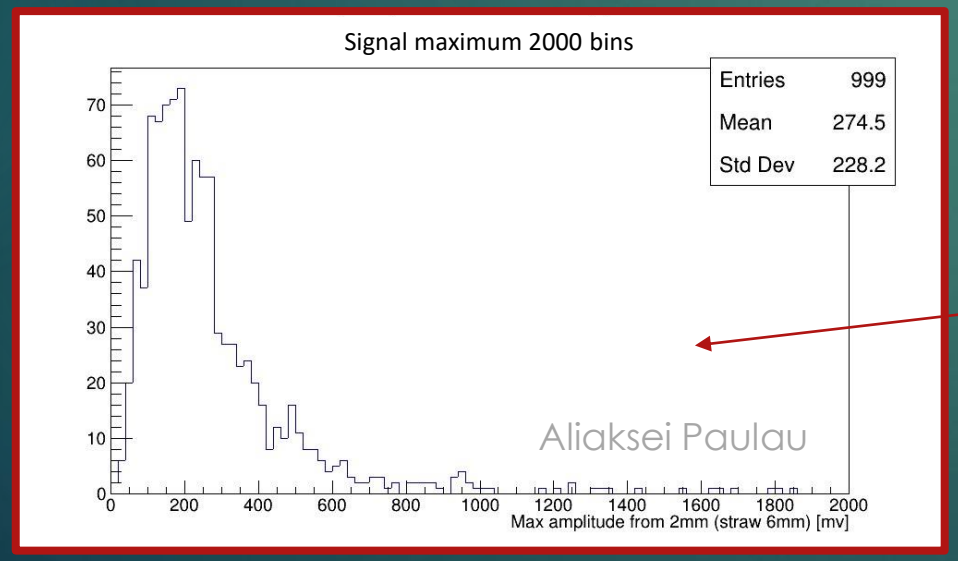


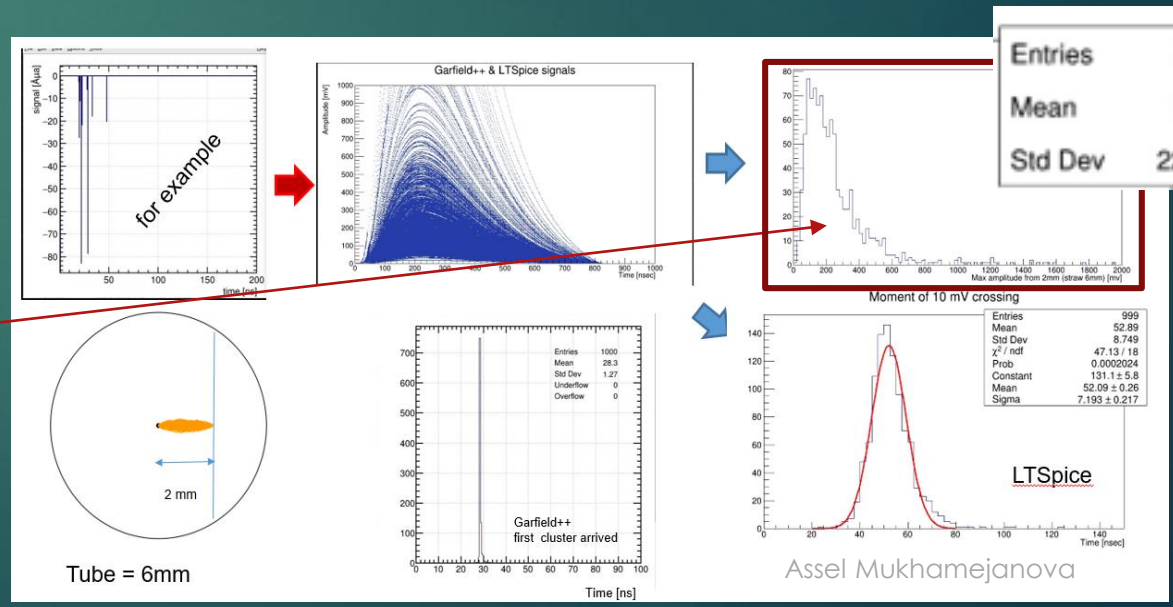
0 3 Difference between signal output Aliaksei and Assel, after LTSpice simulation

Garfield++ & LTSpice



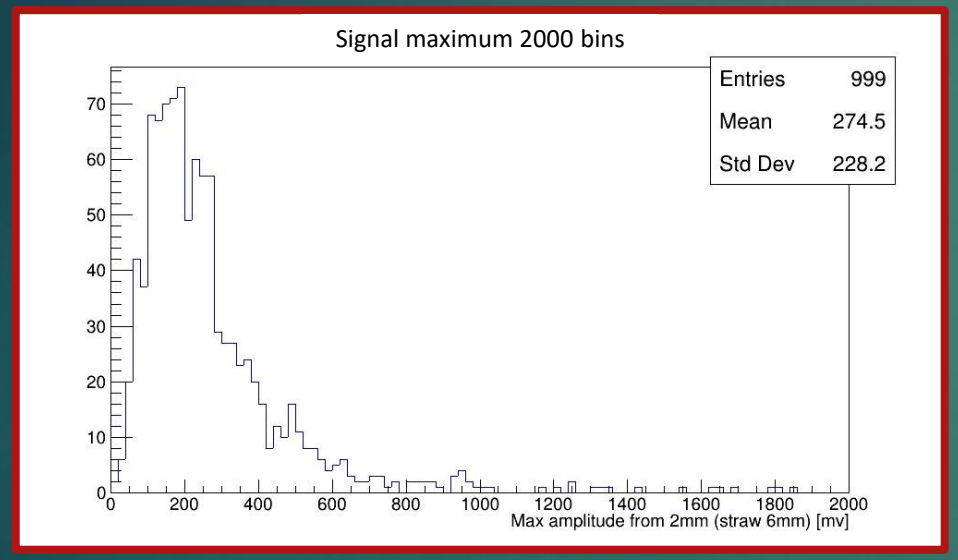


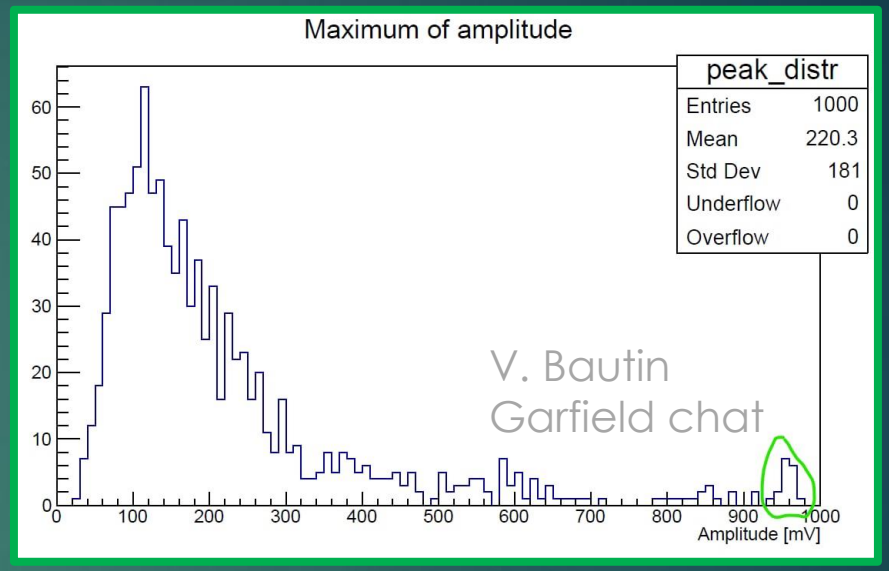


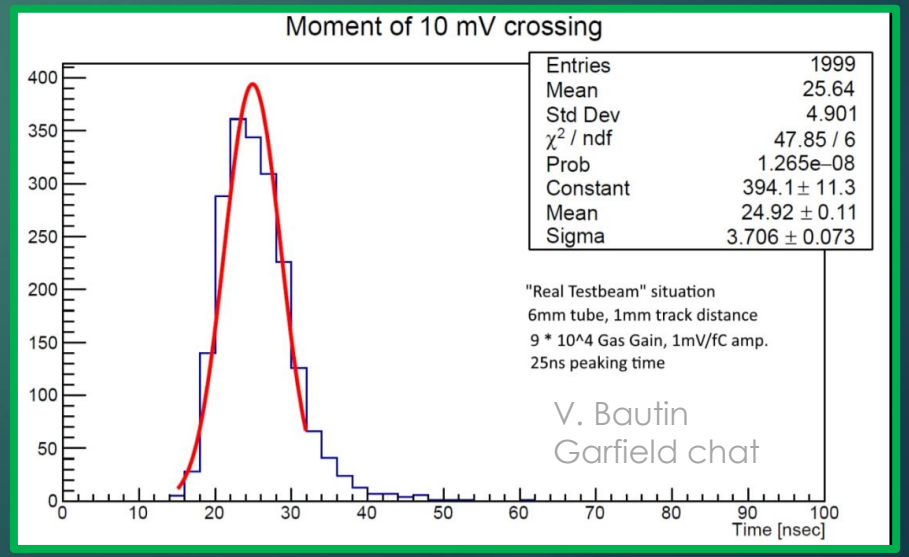


03 Difference between signal output Aliaksei and Assel, after LTSpice simulation

Garfield++ & LTSpice





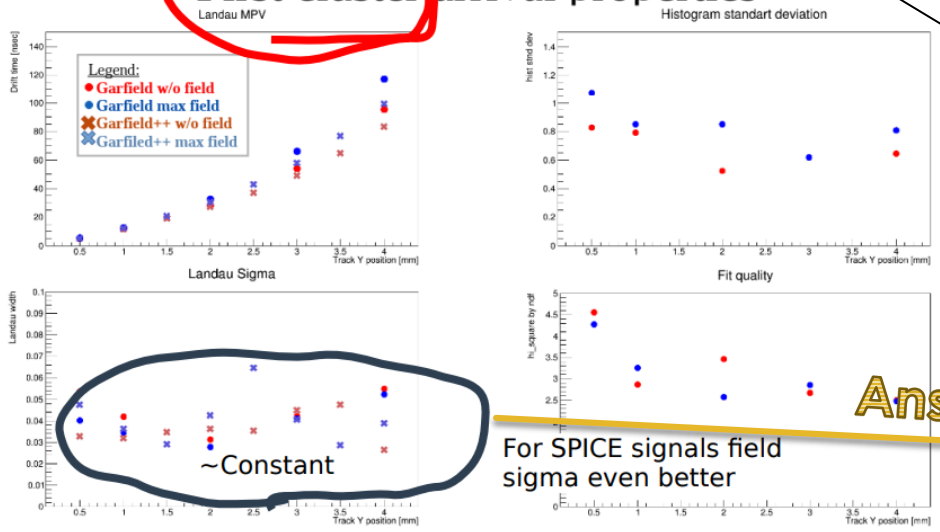


04 Comparing drift path/time distributions

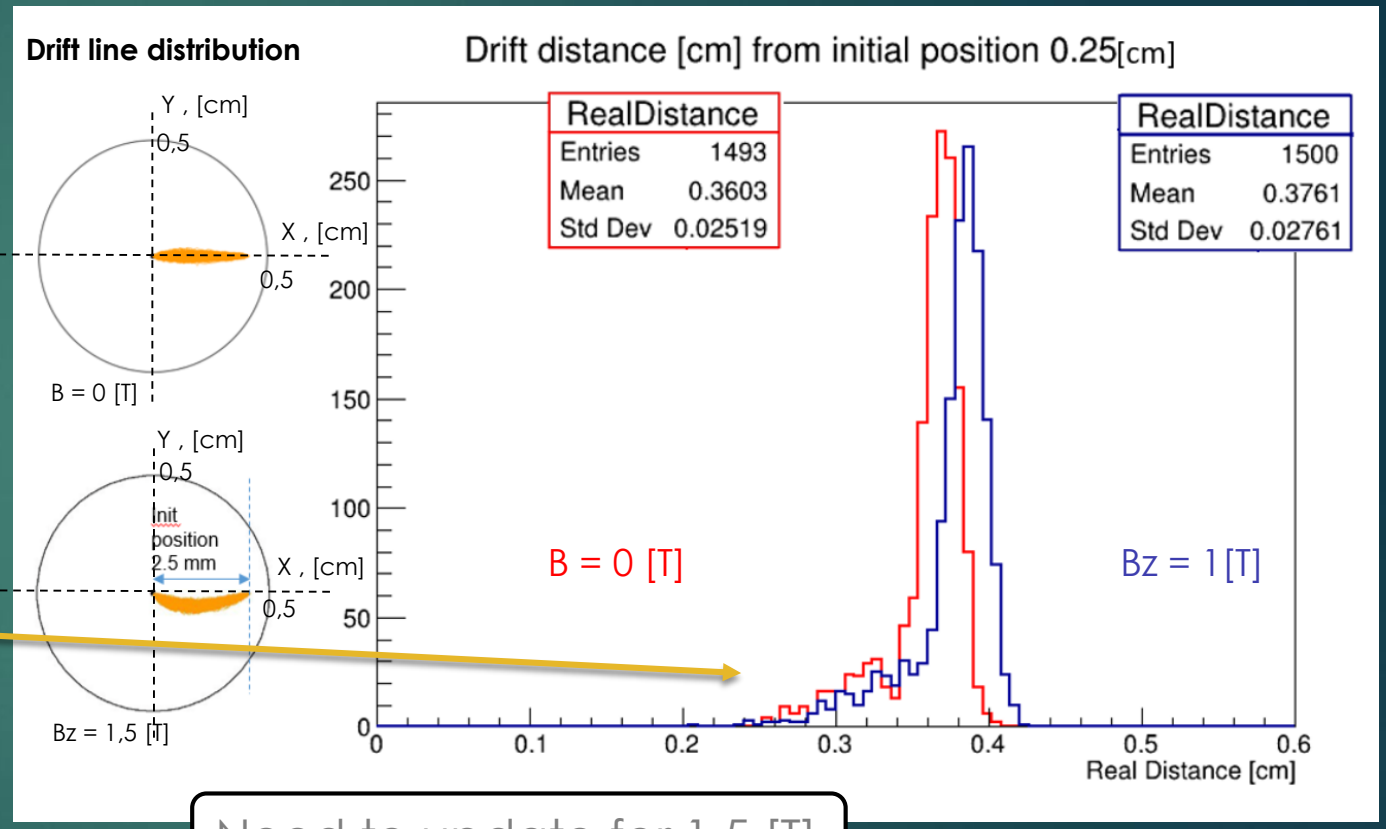
Magnetic field problem

Sergey's slide

First cluster arrival properties



Answer



Need to update for 1.5 [T]

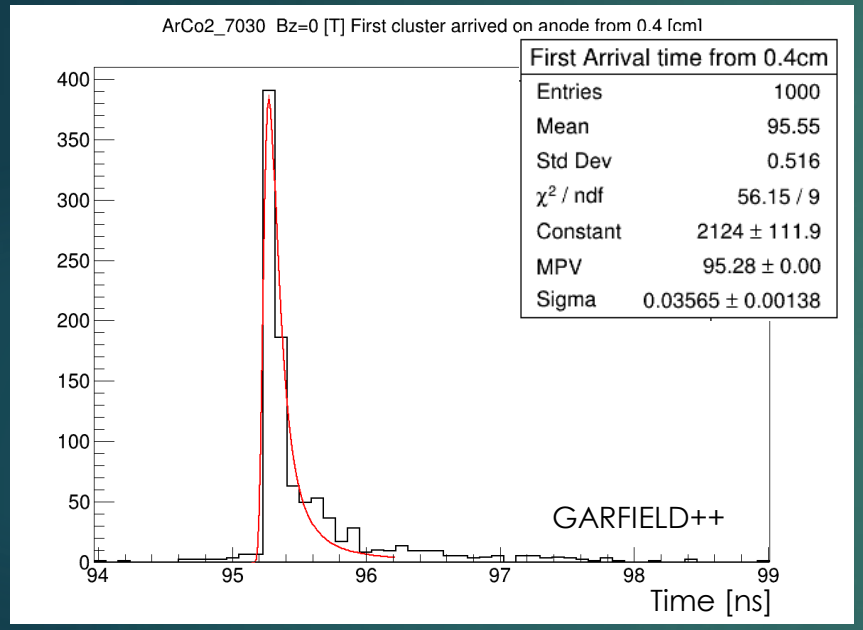
5 | TDR Garfield known problems | 10.11.22

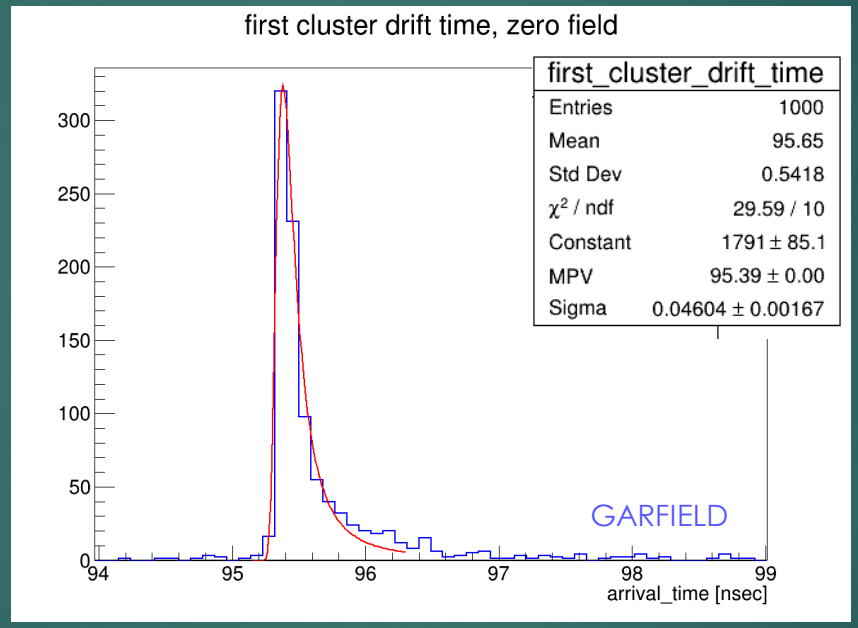
Что-то умное дописать…

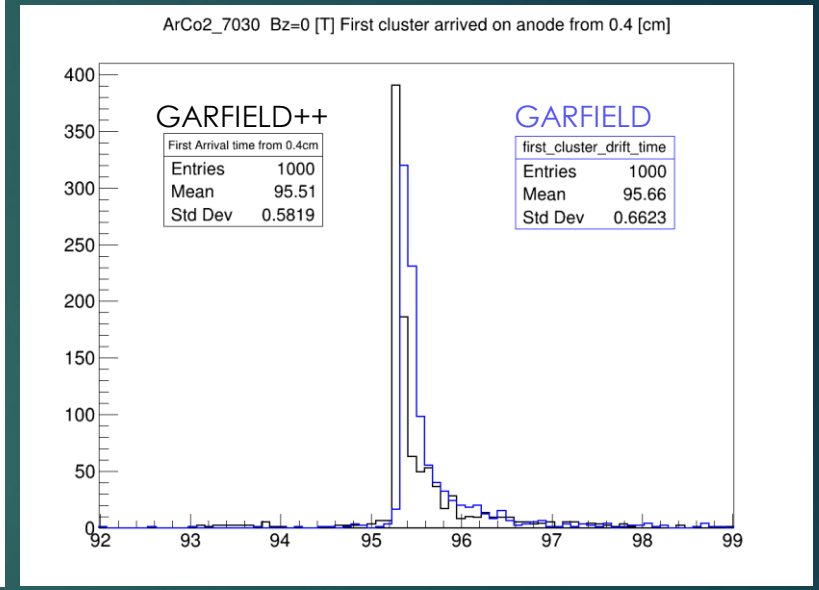
05 TDR plots update

First cluster arrived Bz= 0 [T]. Garfield & Garfield++ plots.

straw d = 10 [mm], radius track = 4[mm]



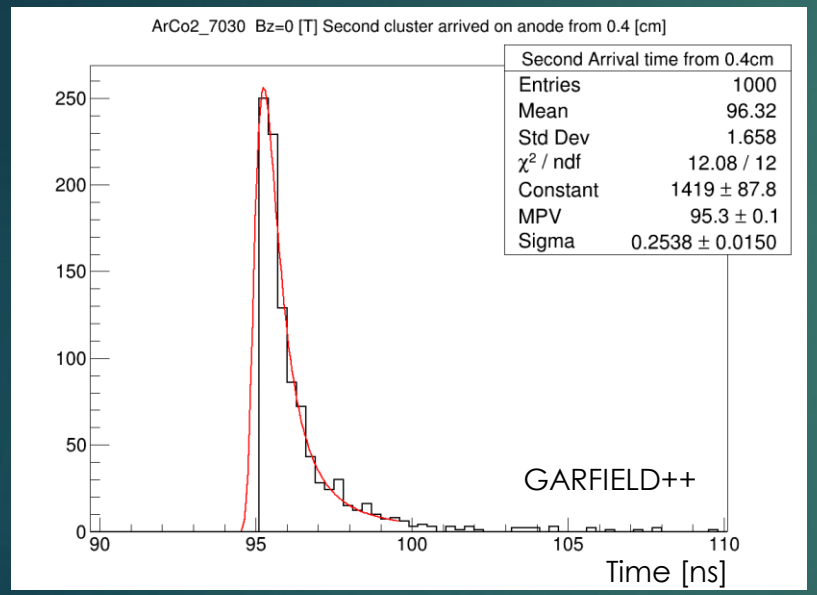


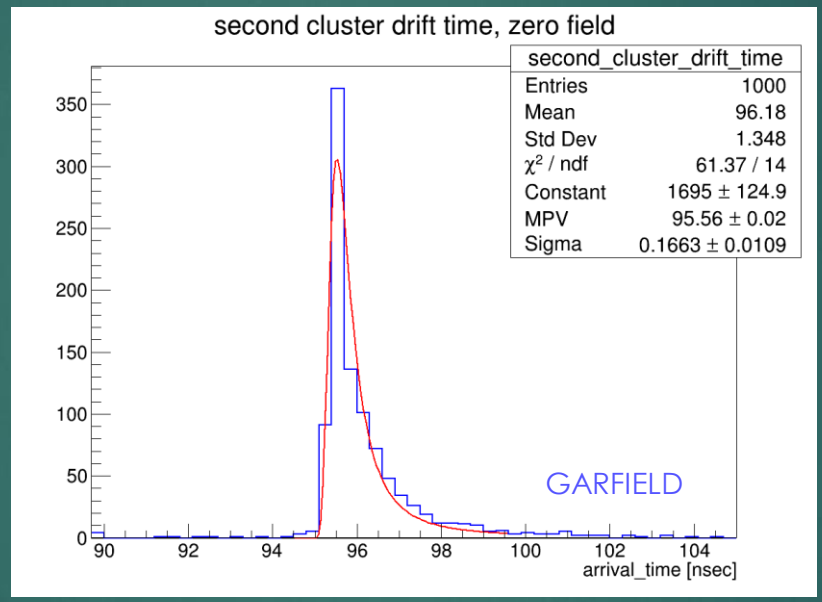


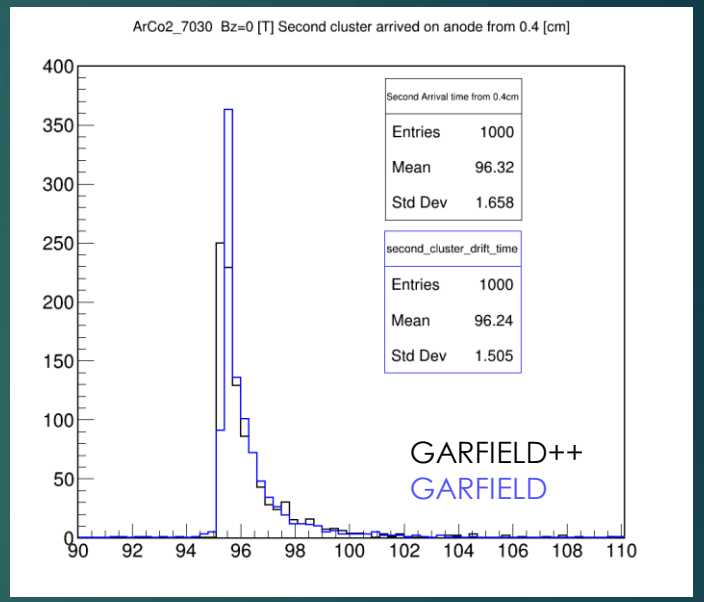
05 TDR plots update

Second cluster arrived Bz= 0 [T]. Garfield & Garfield++ plots.

straw d = 10 [mm], radius track = 4[mm]



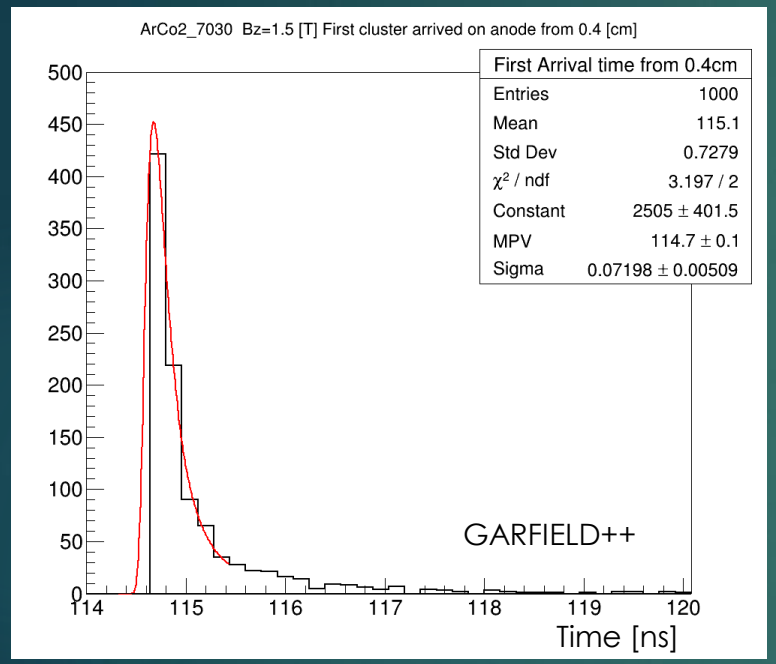


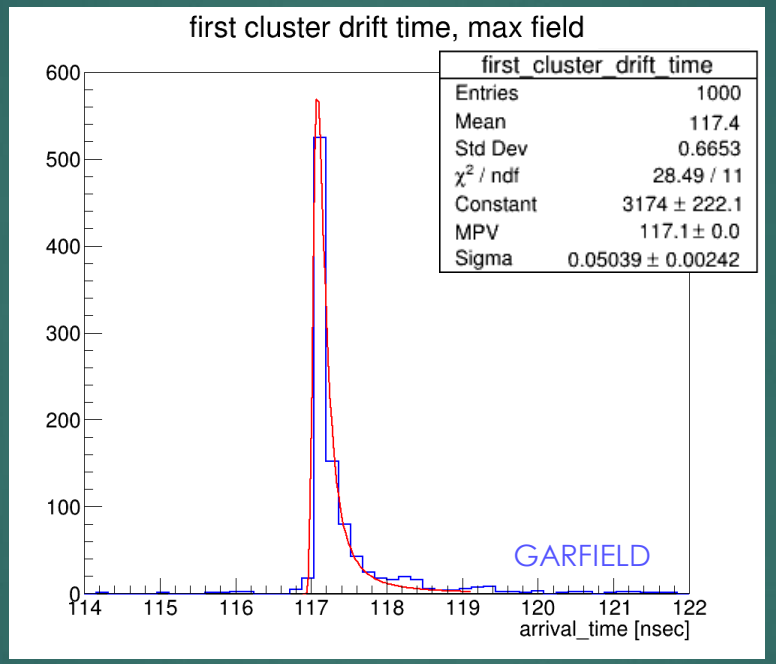


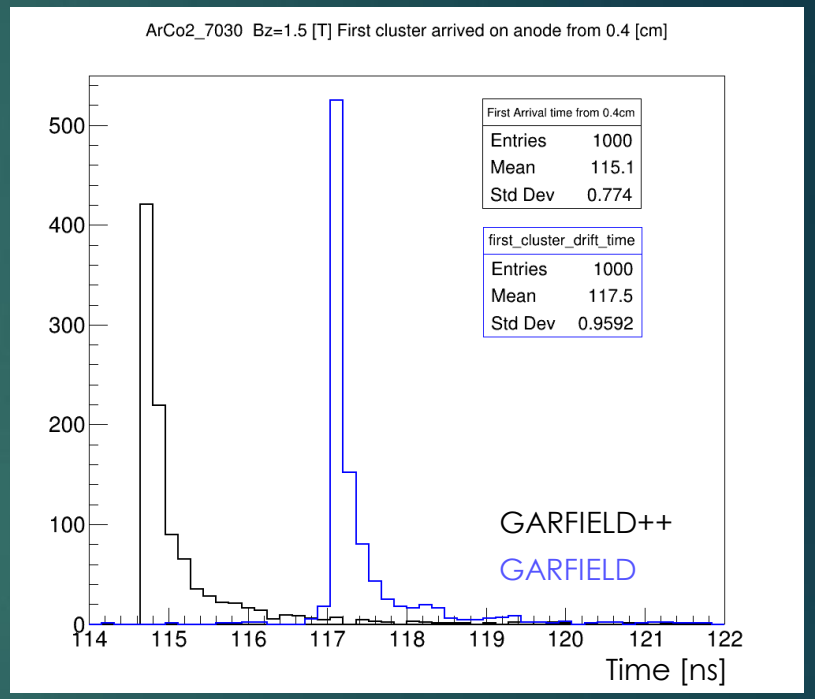
05 TDR plots update

Garfield & Garfield++ plots. First cluster arrived Bz= 1.5 [T].

Straw d = 10 [mm], radius Track = 4[mm]



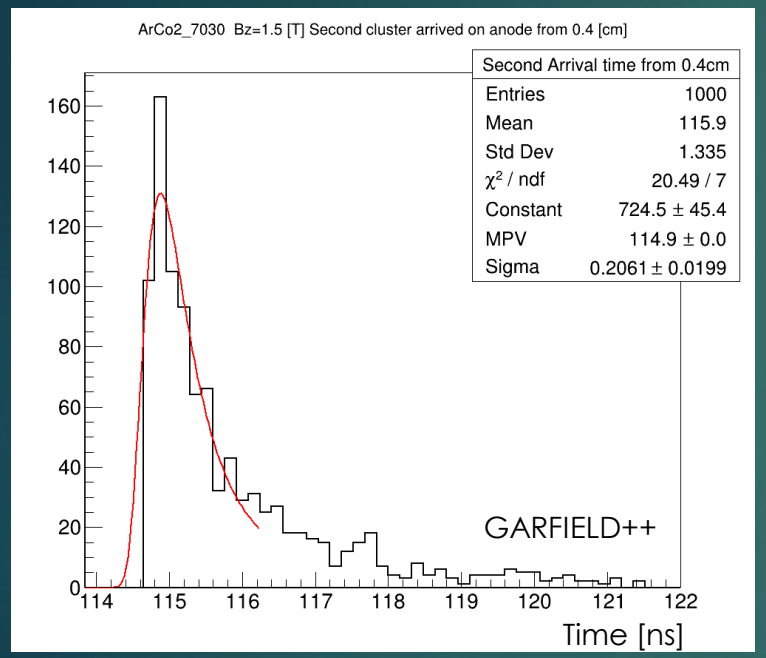


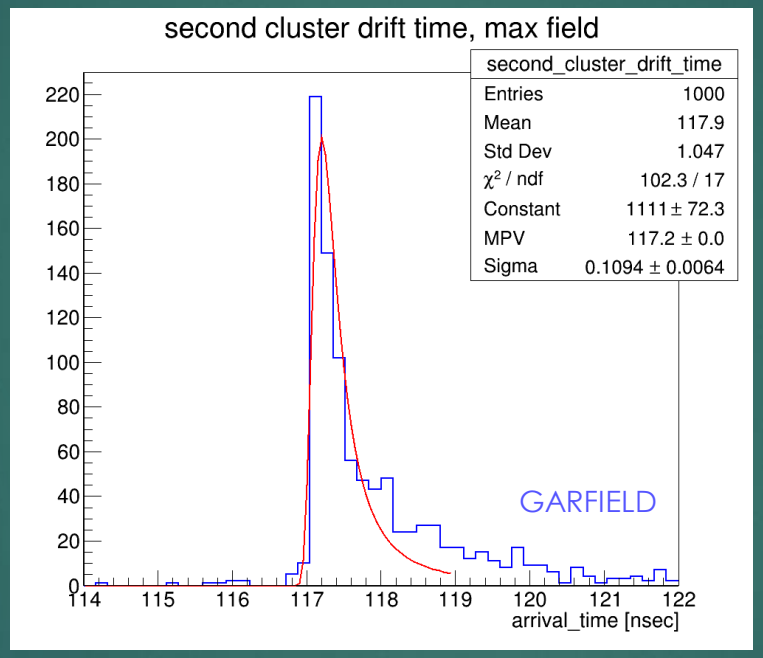


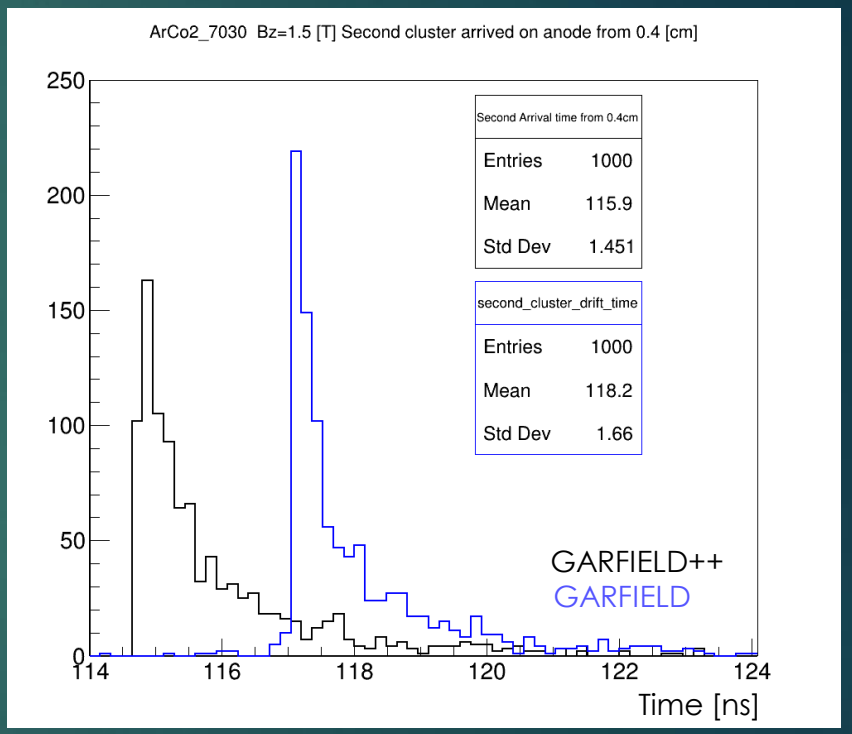
05 TDR plots update

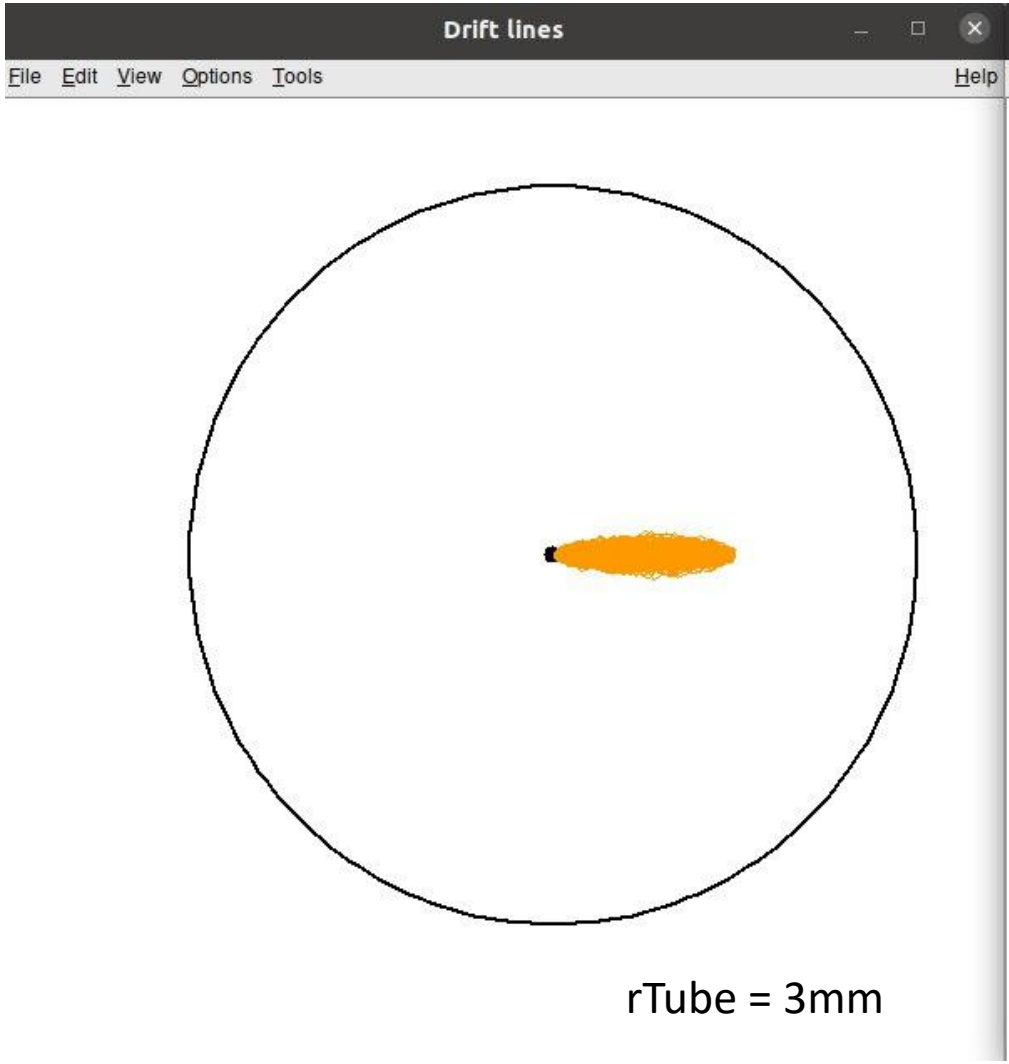
Second cluster arrived Bz= 1.5 [T]. Garfield & Garfield++ plots.

straw d = 10 [mm], radius track = 4[mm]

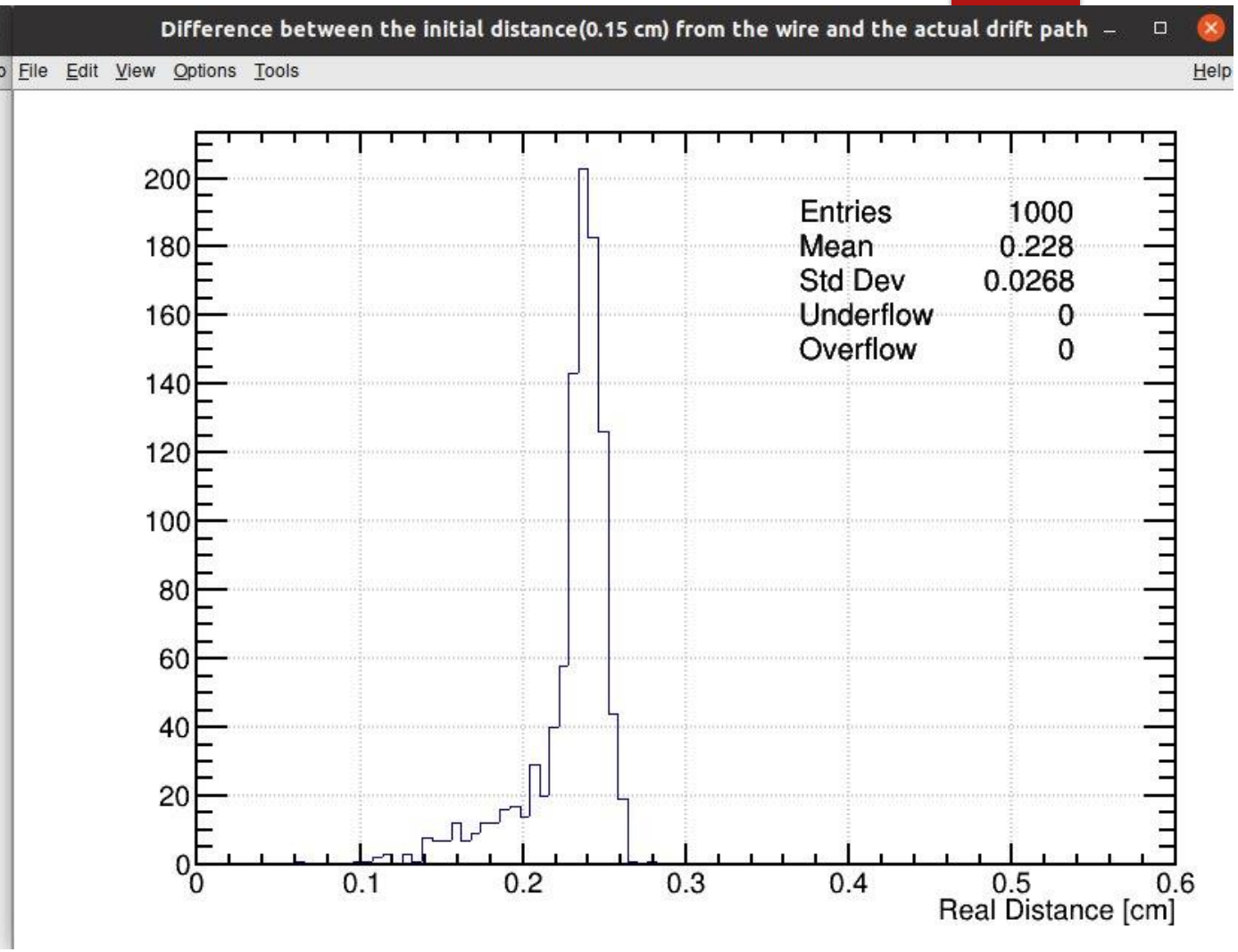




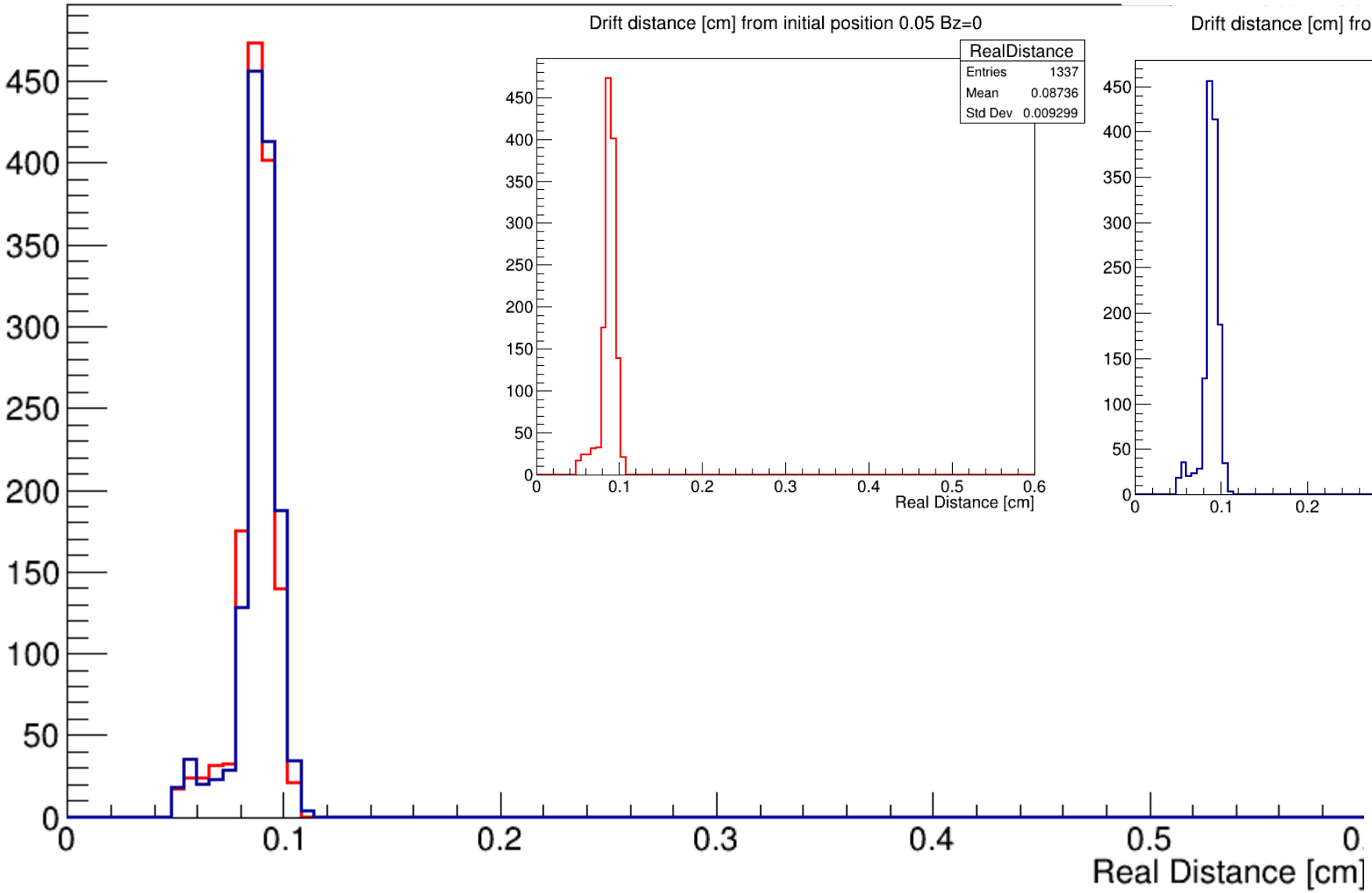


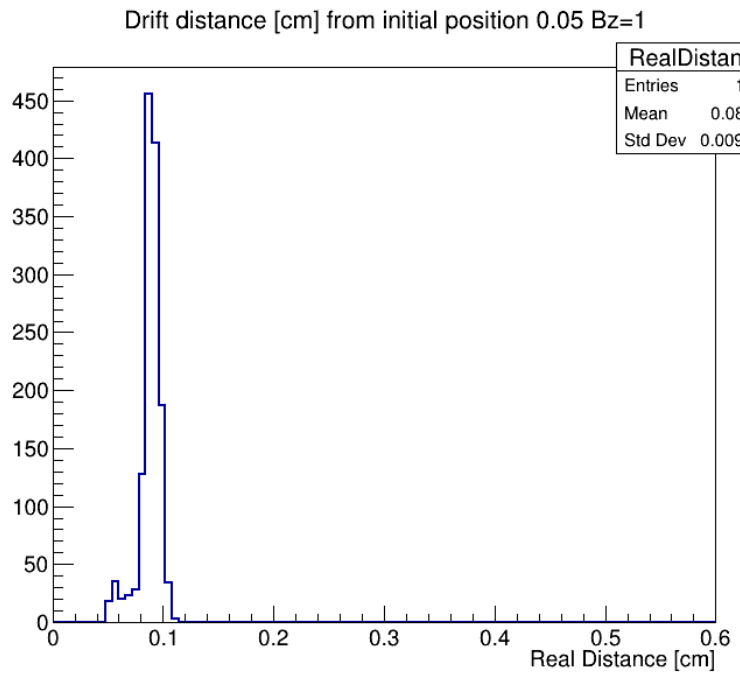

Drift lines
File Edit View Options Tools Help

rTube = 3mm

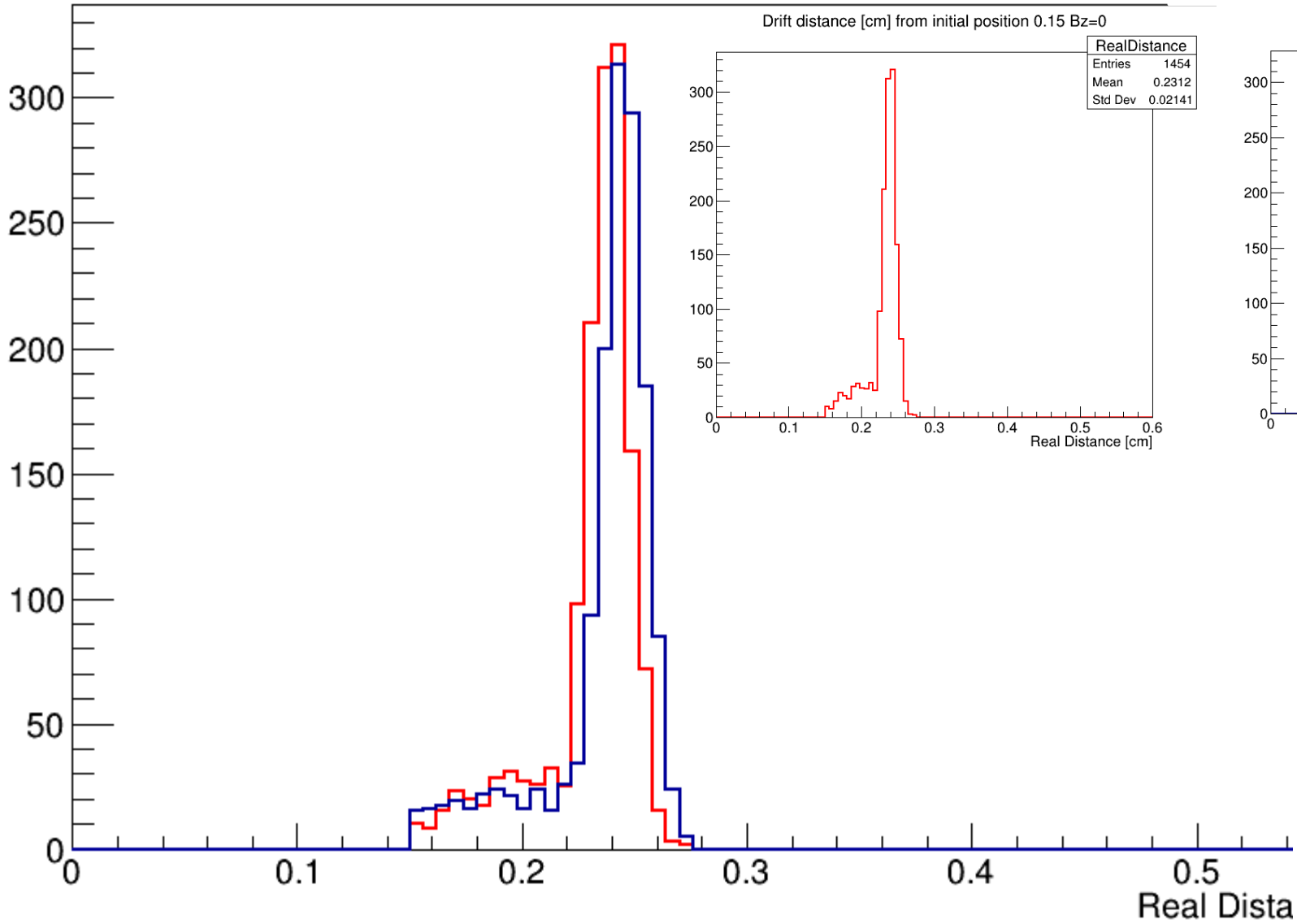

Difference between the initial distance(0.15 cm) from the wire and the actual drift path
File Edit View Options Tools Help
Entries 1000
Mean 0.228
Std Dev 0.0268
Underflow 0
Overflow 0
200
180
160
140
120
100
80
60
40
20
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Real Distance [cm]

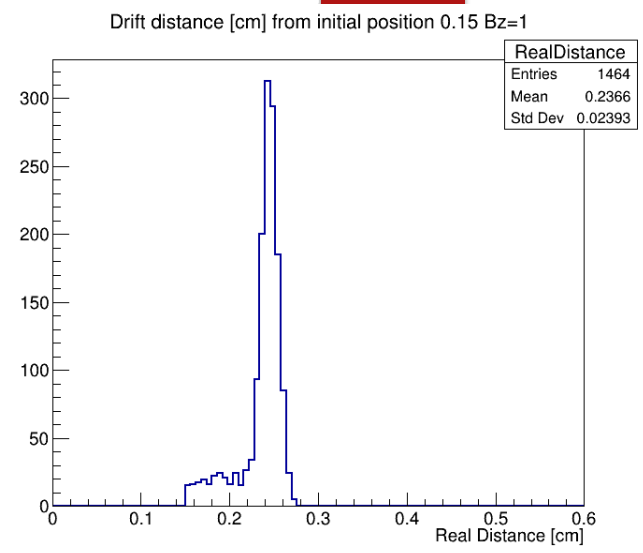
Drift distance [cm] from initial position 0.05[cm]

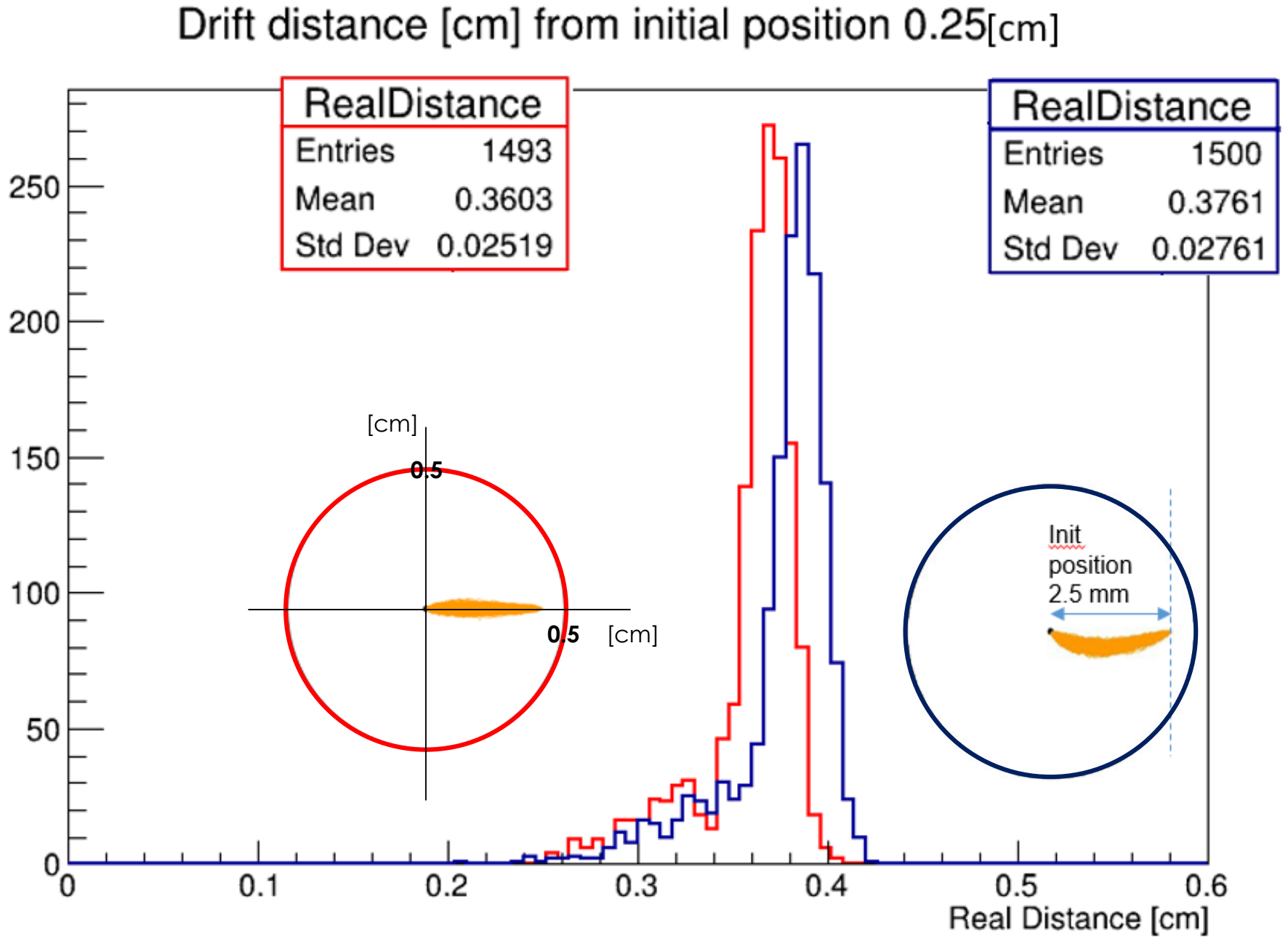


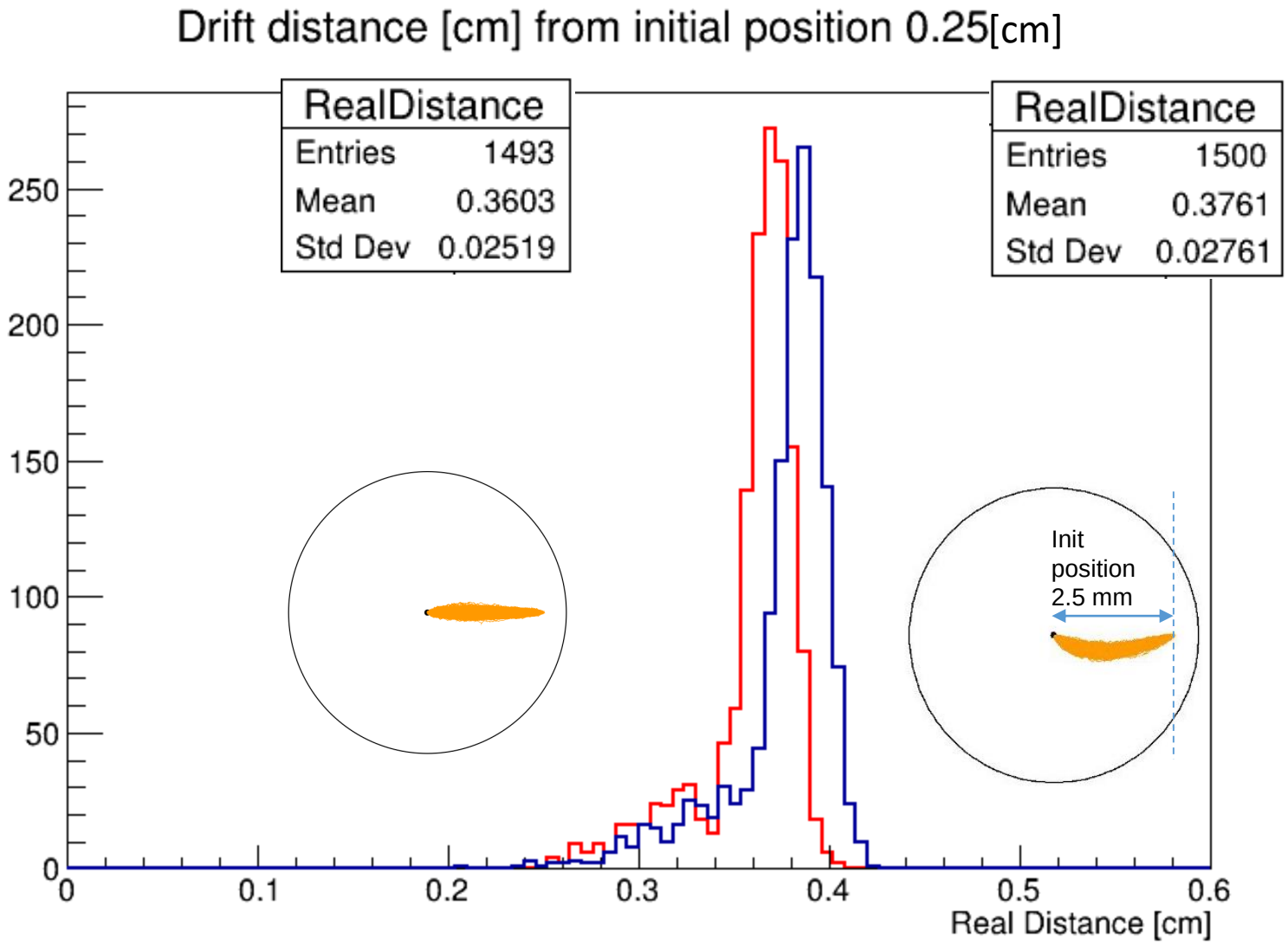


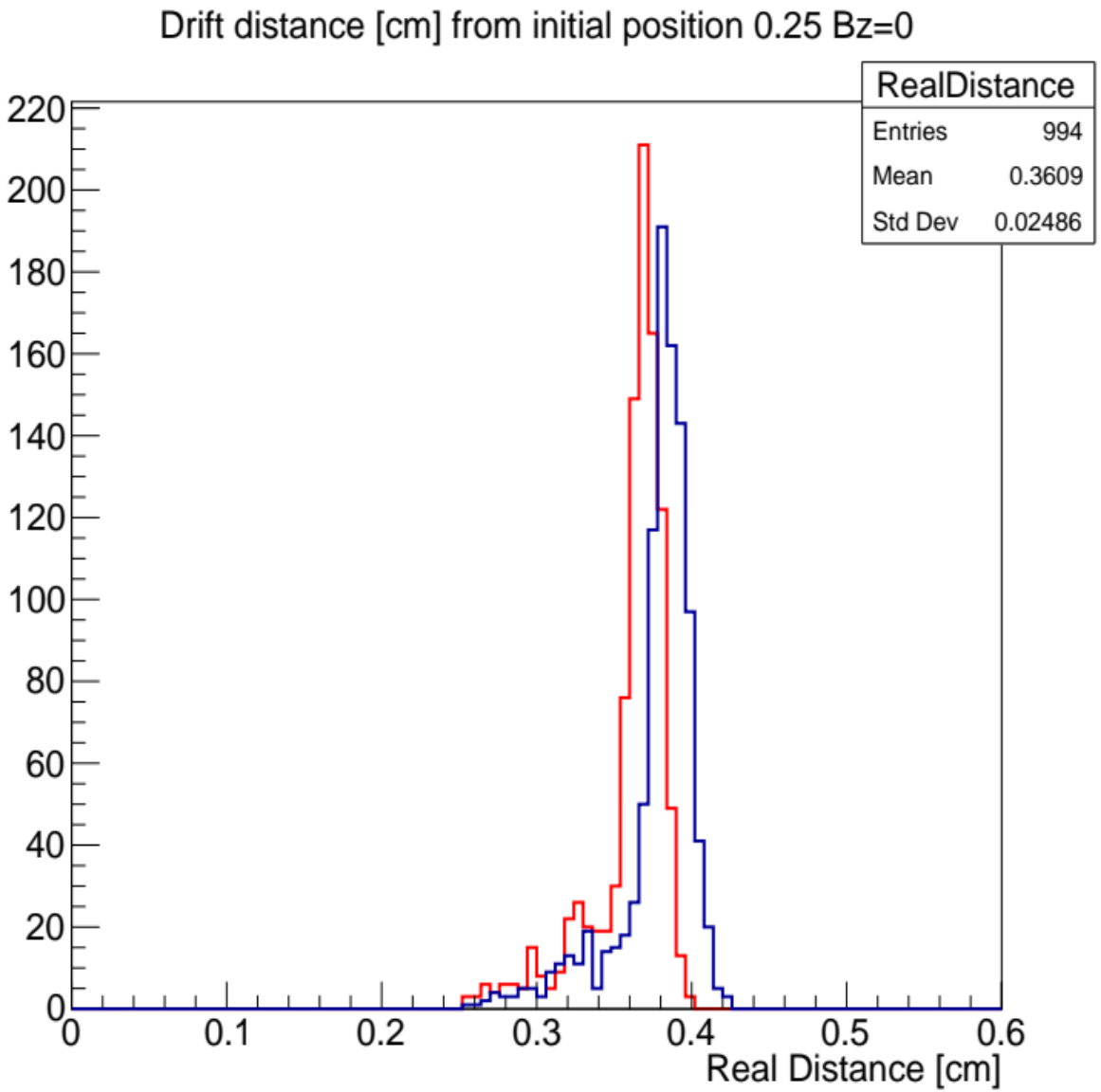
Drift distance [cm] from initial position 0.15[cm]

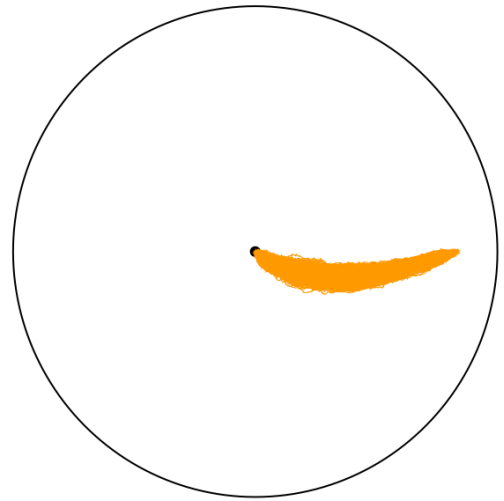


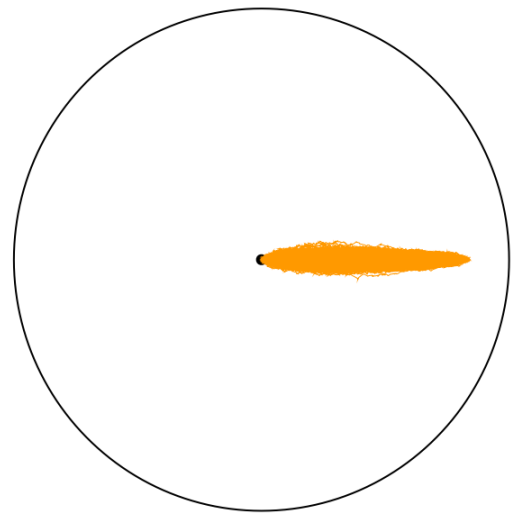


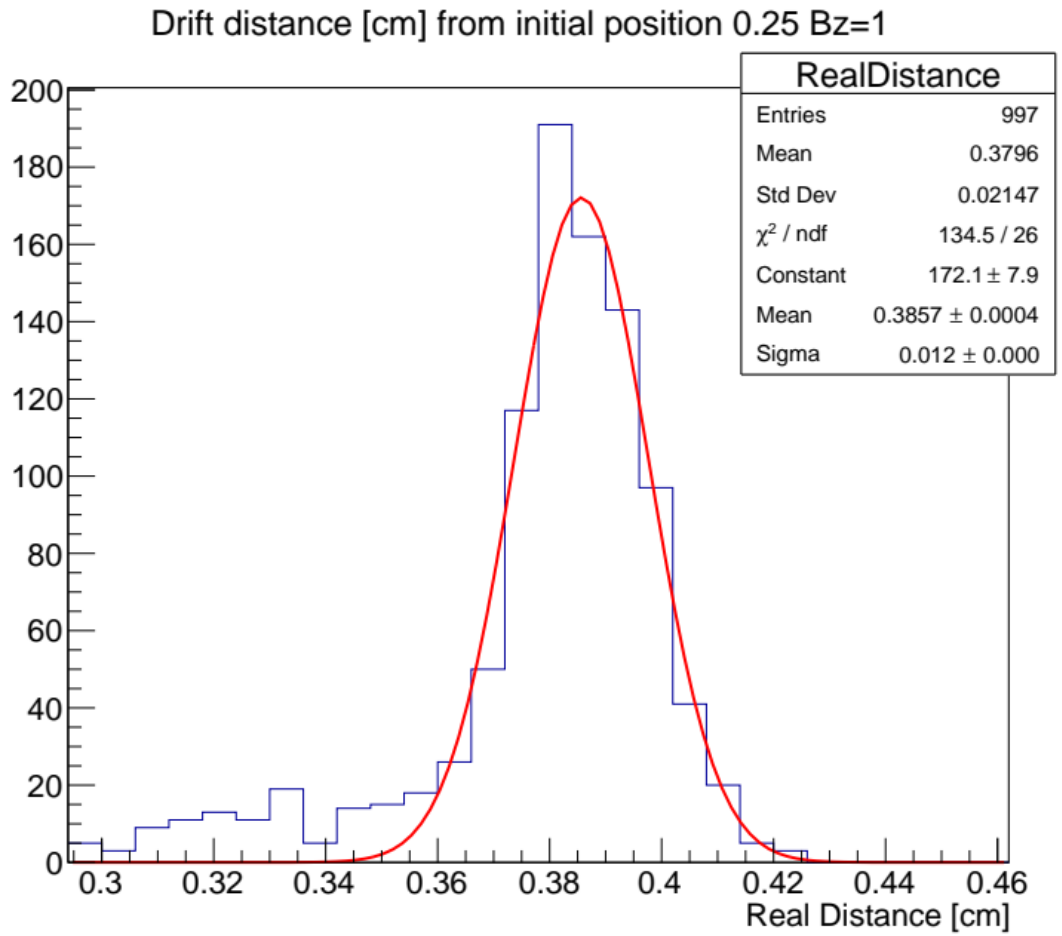

Drift distance [cm] from initial position 0.25[cm]
RealDistance
Entries 1493
Mean 0.3603
Std Dev 0.02519
RealDistance
Entries 1500
Mean 0.3761
Std Dev 0.02761
[cm]
0.5
0.5
[cm]
Init
position
2.5 mm
250
200
150
100
50
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Real Distance [cm]

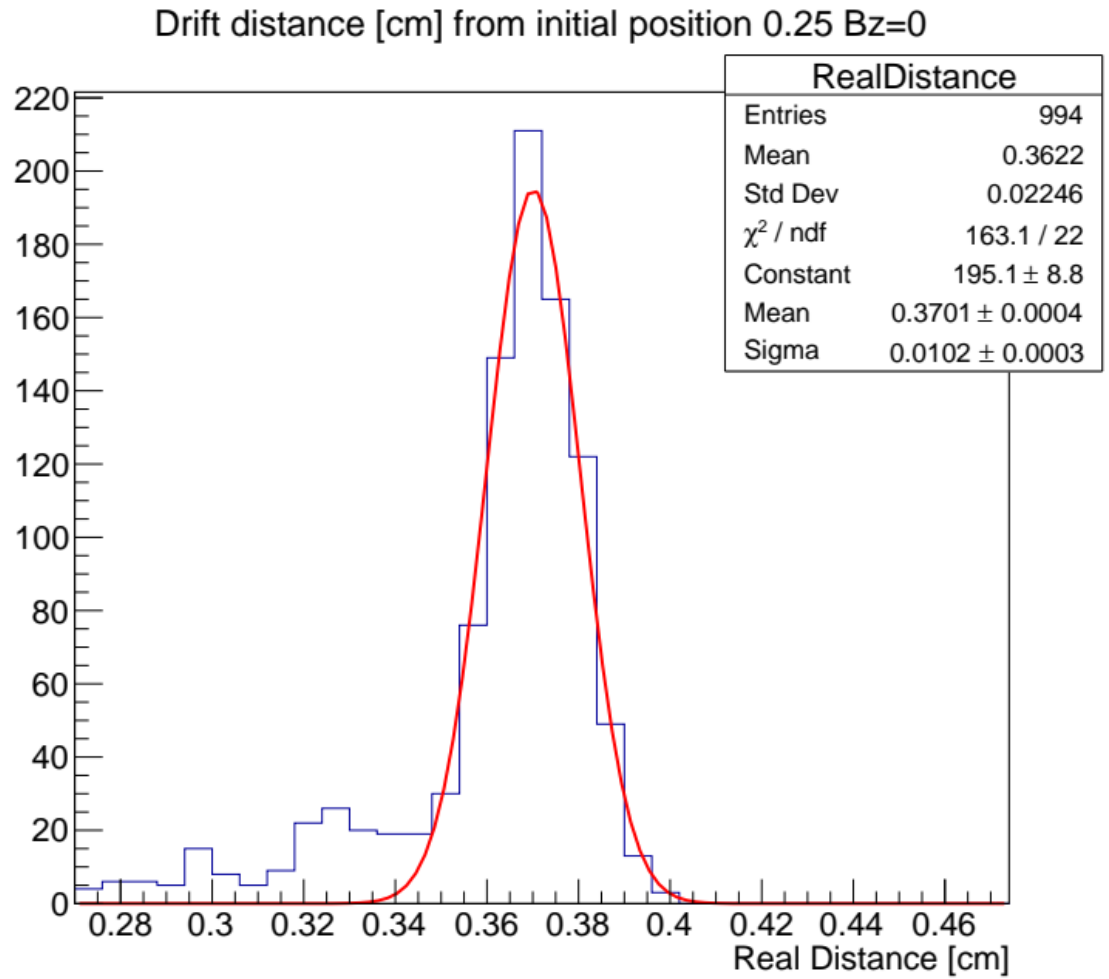

Drift distance [cm] from initial position 0.25[cm]
RealDistance
Entries 1493
Mean 0.3603
Std Dev 0.02519
RealDistance
Entries 1500
Mean 0.3761
Std Dev 0.02761
Init
position
2.5 mm
250
200
150
100
50
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Real Distance [cm]

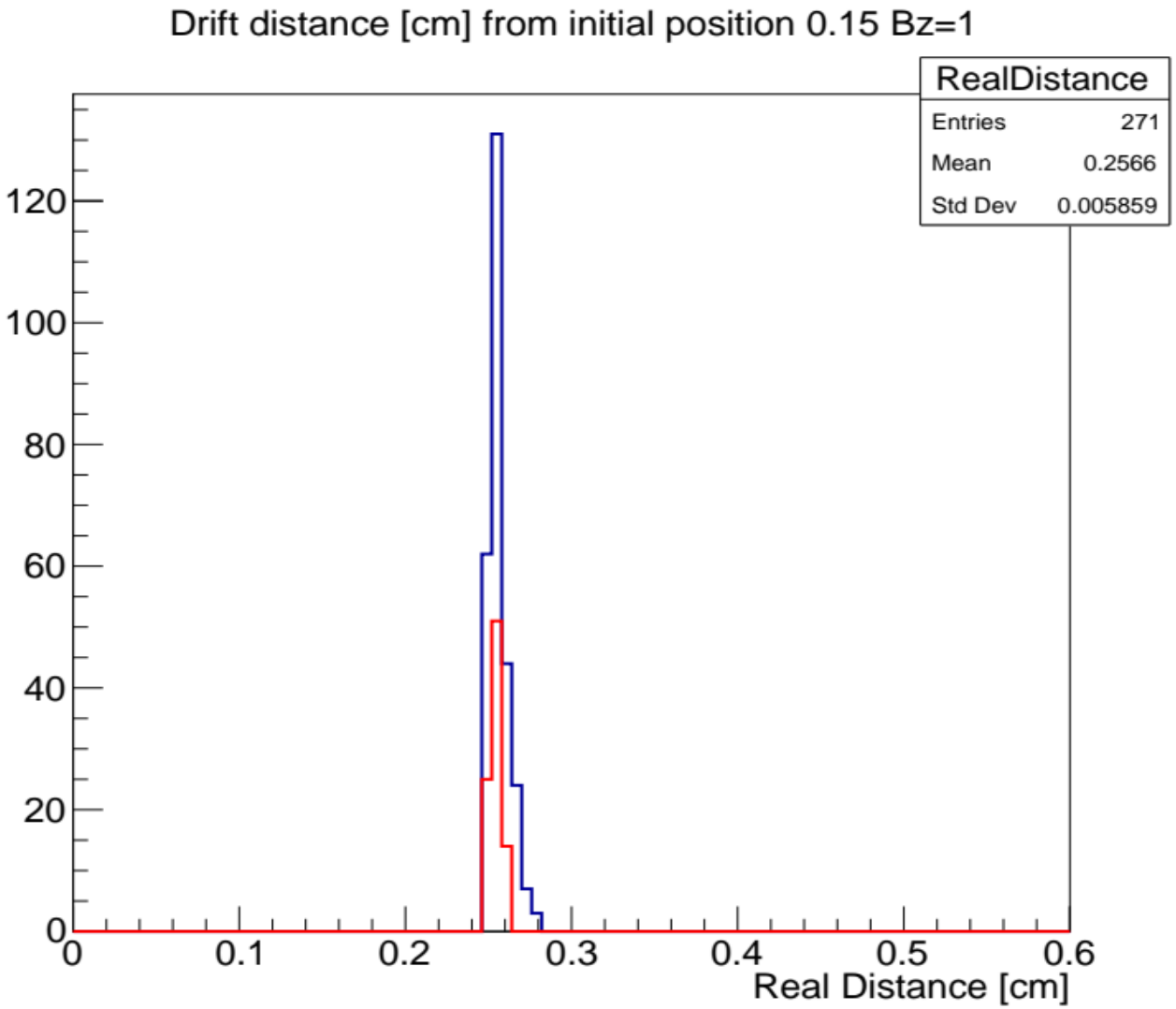

Drift distance [cm] from initial position 0.25 Bz=0
RealDistance
Entries 994
Mean 0.3609
Std Dev 0.02486
220
200
180
160
140
120
100
80
60
40
20
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Real Distance [cm]

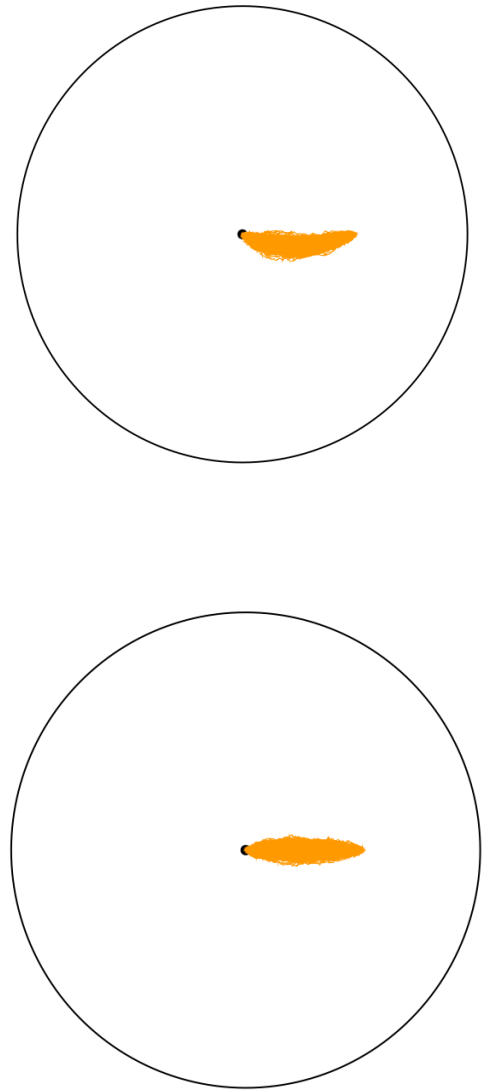


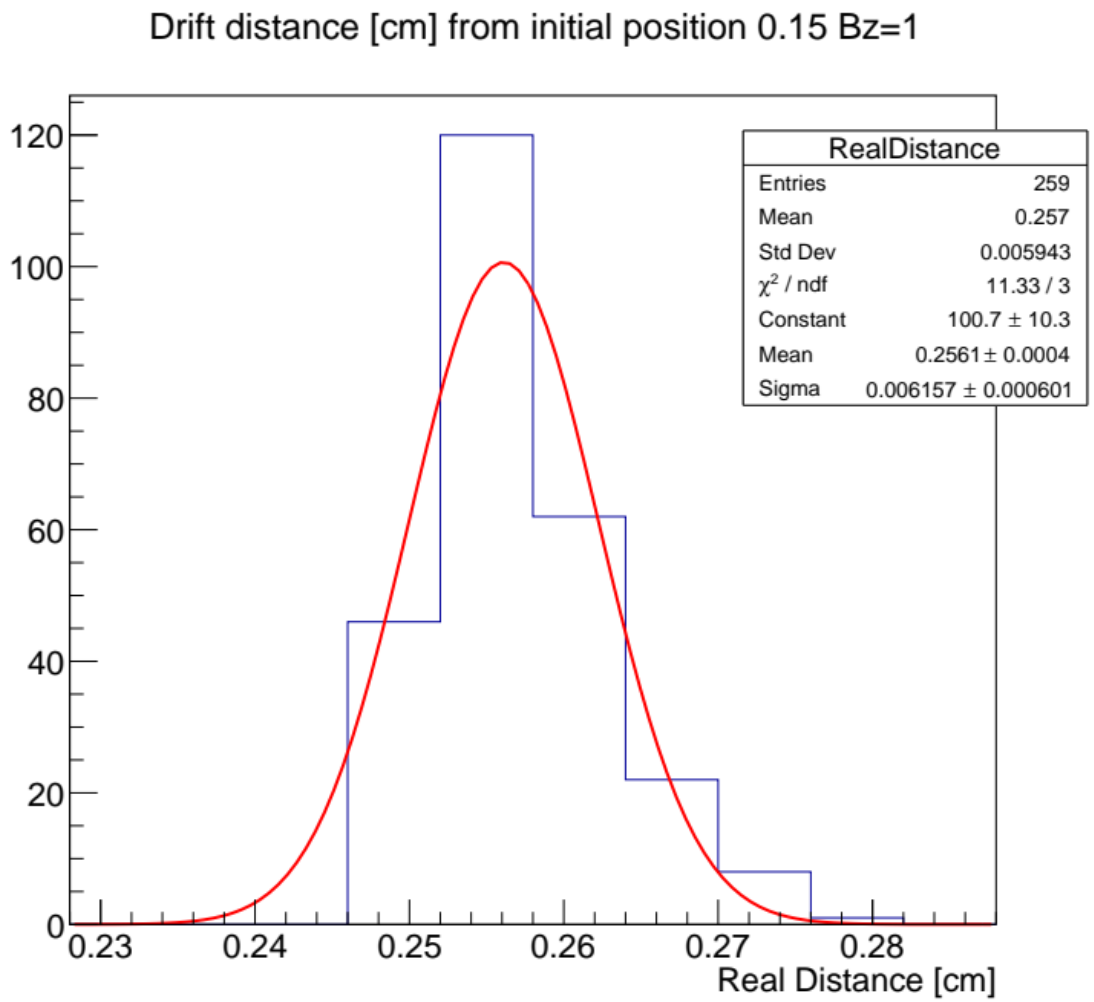


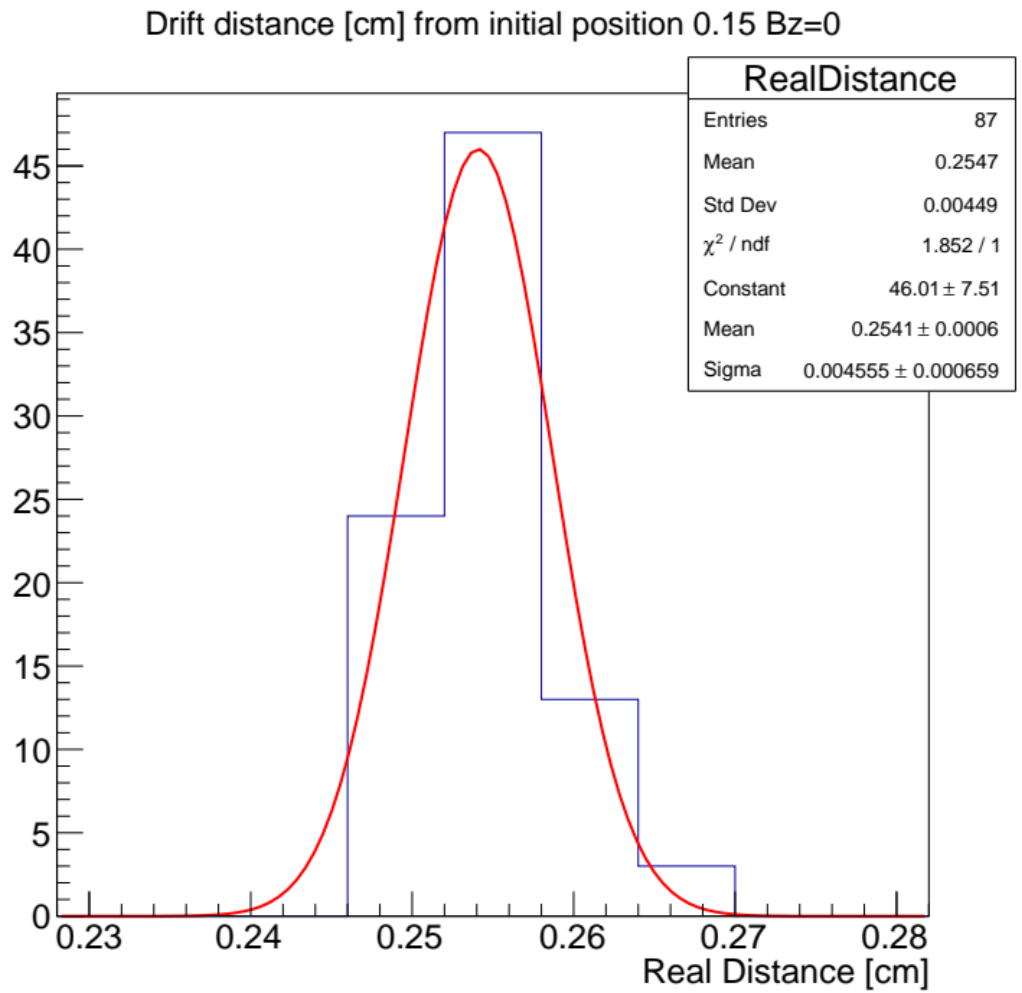

Drift distance [cm] from initial position 0.25 Bz=1
RealDistance
Entries 997
Mean 0.3796
Std Dev 0.02147
χ² / ndf 134.5 / 26
Constant 172.1 ± 7.9
Mean 0.3857 ± 0.0004
Sigma 0.012 ± 0.000
Real Distance [cm]


Drift distance [cm] from initial position 0.25 Bz=0
RealDistance
Entries 994
Mean 0.3622
Std Dev 0.02246
χ² / ndf 163.1 / 22
Constant 195.1 ± 8.8
Mean 0.3701 ± 0.0004
Sigma 0.0102 ± 0.0003
Real Distance [cm]

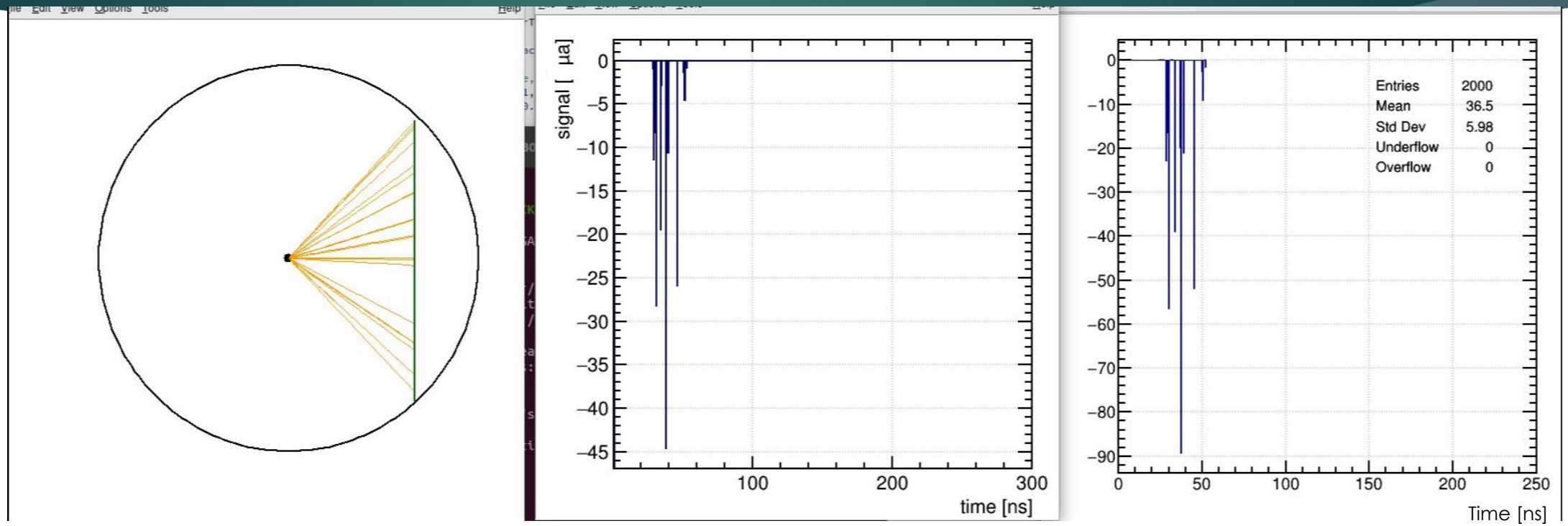

Drift distance [cm] from initial position 0.15 Bz=1
RealDistance
Entries 271
Mean 0.2566
Std Dev 0.005859
120
100
80
60
40
20
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Real Distance [cm]

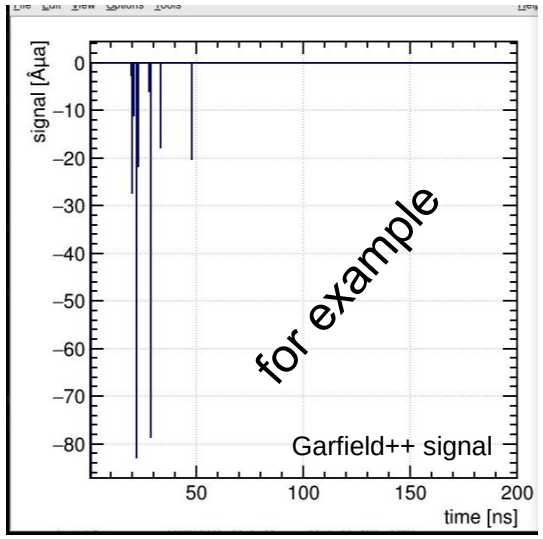


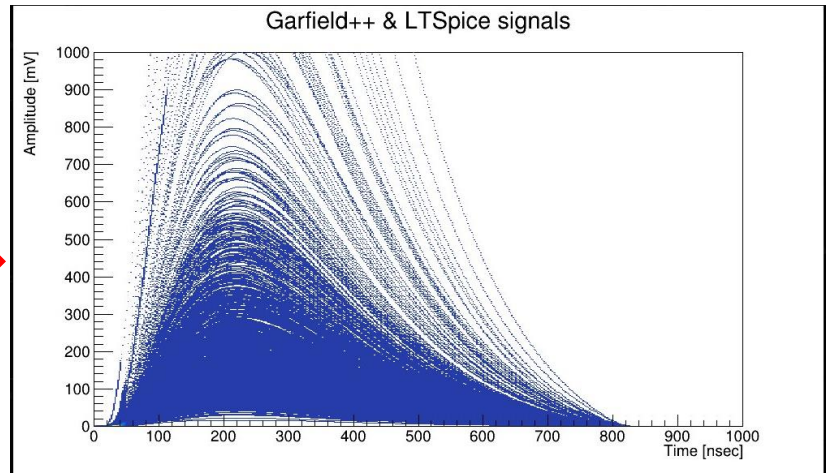

Drift distance [cm] from initial position 0.15 Bz=1
RealDistance
Entries 259
Mean 0.257
Std Dev 0.005943
χ² / ndf 11.33 / 3
Constant 100.7 ± 10.3
Mean 0.2561 ± 0.0004
Sigma 0.006157 ± 0.000601
120
100
80
60
40
20
0
0.23
0.24
0.25
0.26
0.27
0.28
Real Distance [cm]

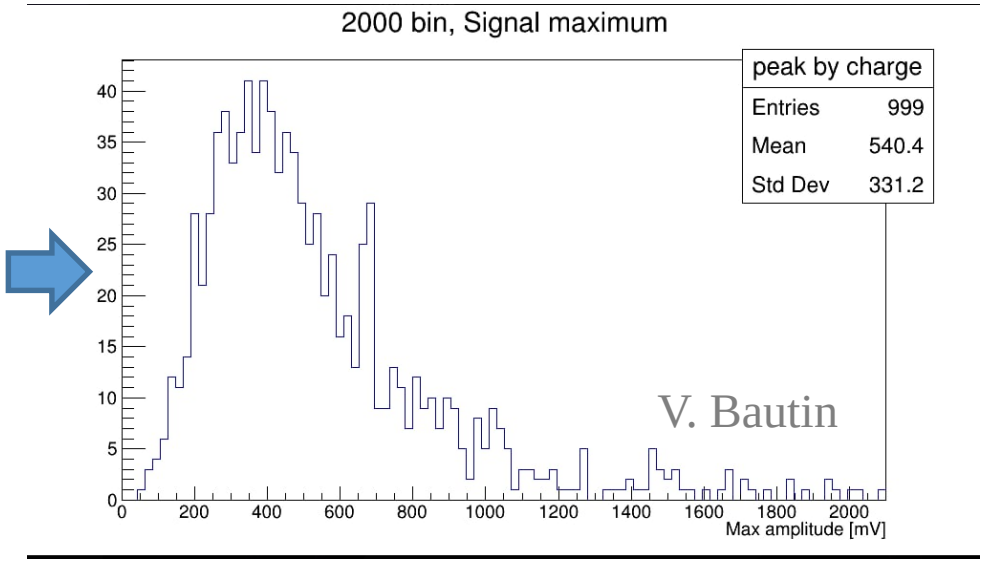

Drift distance [cm] from initial position 0.15 Bz=0
RealDistance
Entries 87
Mean 0.2547
Std Dev 0.00449
χ² / ndf 1.852 / 1
Constant 46.01 ± 7.51
Mean 0.2541 ± 0.0006
Sigma 0.004555 ± 0.000659
45
40
35
30
25
20
15
10
5
0
0.23
0.24
0.25
0.26
0.27
0.28
Real Distance [cm]

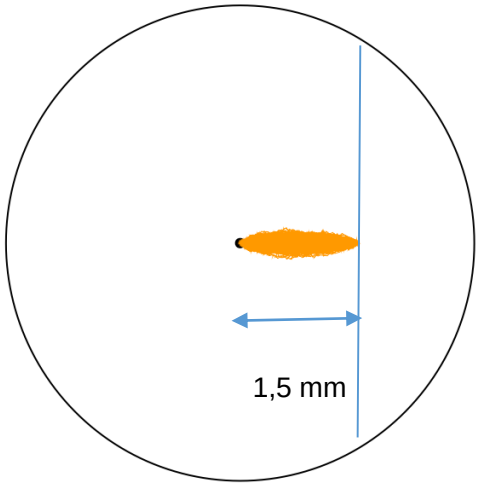
Garfield++ Amplitude BUG



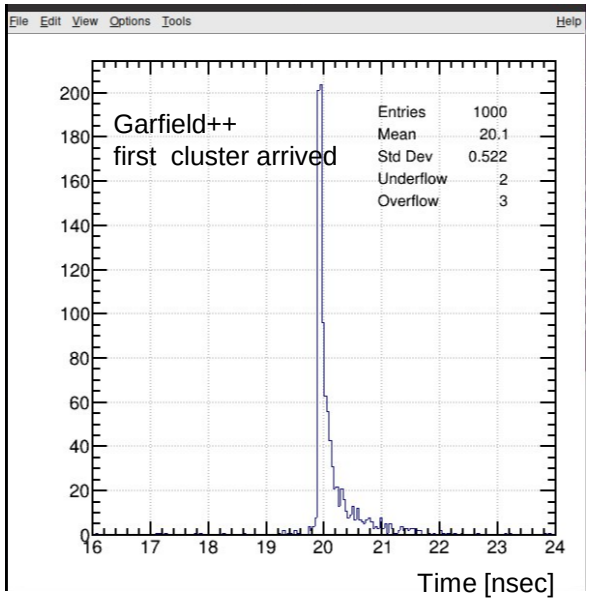

signal [Âµa]
time [ns]
for example
Garfield++ signal

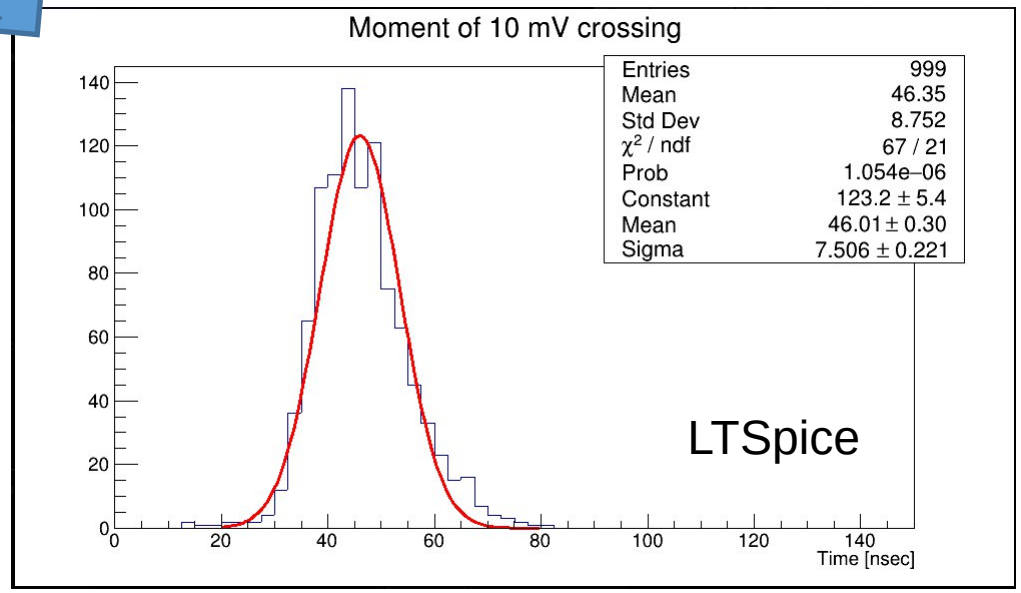

Garfield++ & LTSpice signals
Amplitude [mV]
Time [nsec]


2000 bin, Signal maximum
peak by charge
Entries 999
Mean 540.4
Std Dev 331.2
V. Bautin
Max amplitude [mV]

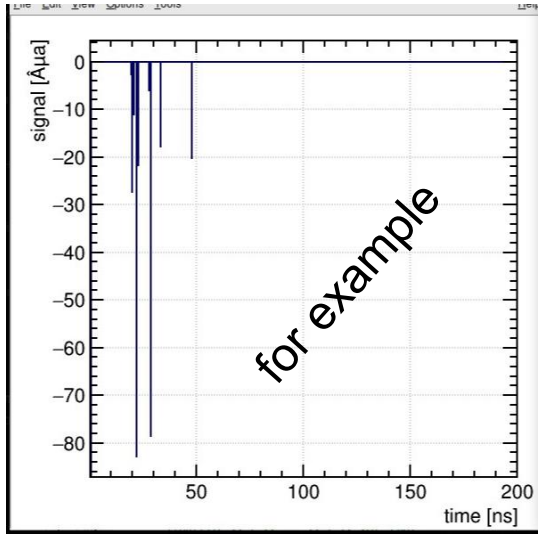

1,5 mm

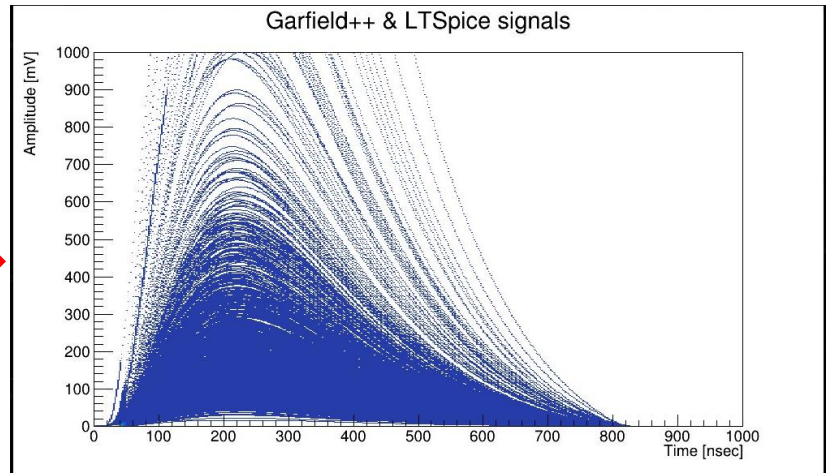
Tube = 6mm

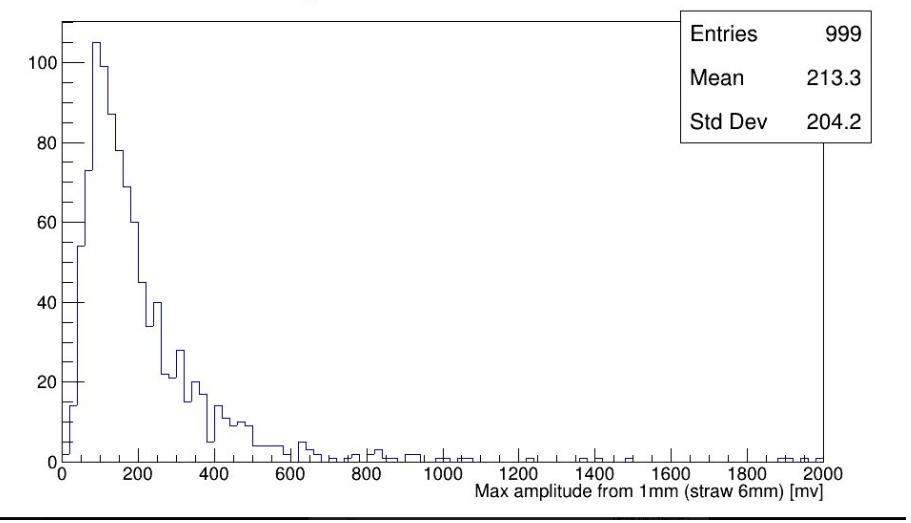

File Edit View Options Tools Help
Garfield++
first cluster arrived
Entries 1000
Mean 20.1
Std Dev 0.522
Underflow 2
Overflow 3
Time [nsec]

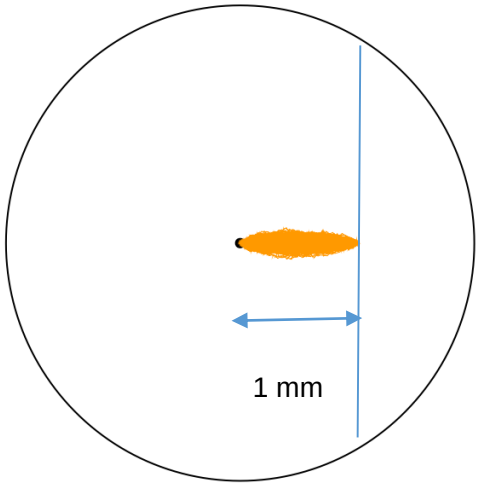

Moment of 10 mV crossing
Entries 999
Mean 46.35
Std Dev 8.752
χ² / ndf 67 / 21
Prob 1.054e−06
Constant 123.2 ± 5.4
Mean 46.01 ± 0.30
Sigma 7.506 ± 0.221
LTSpice
Time [nsec]

Assel Mukhamejanova

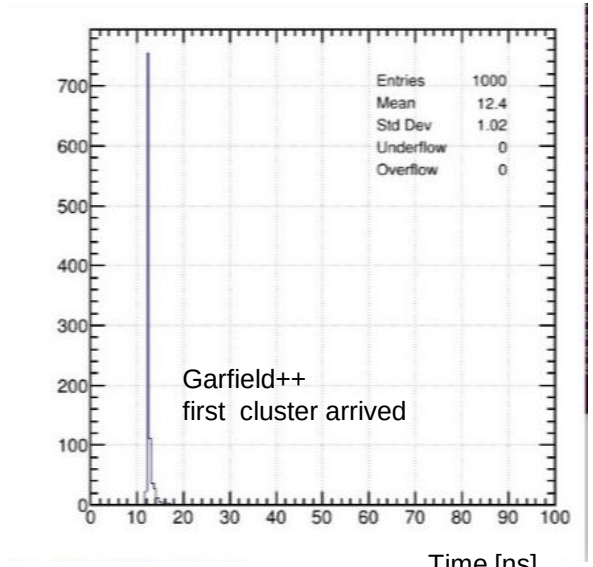


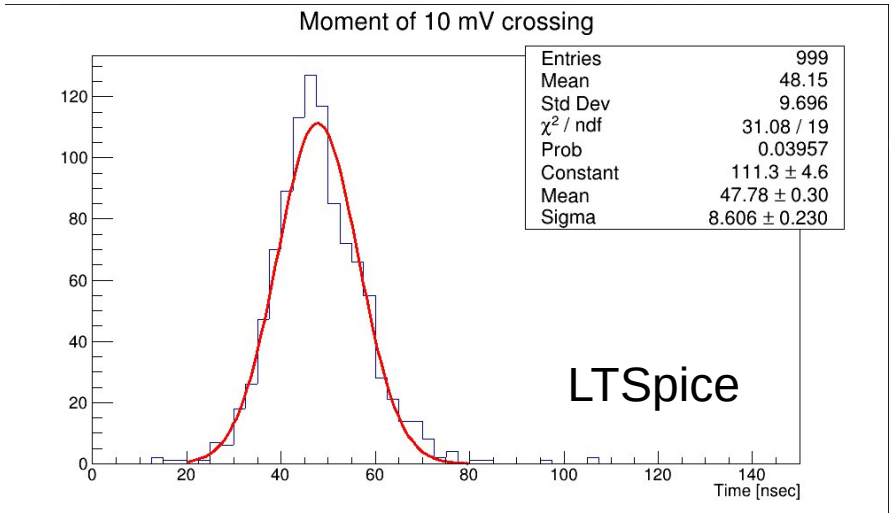


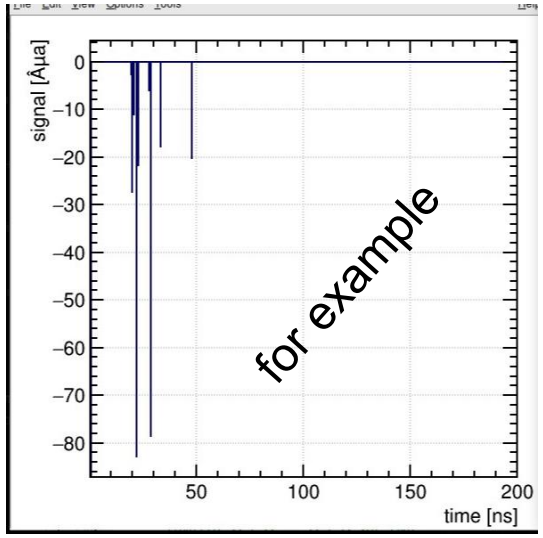


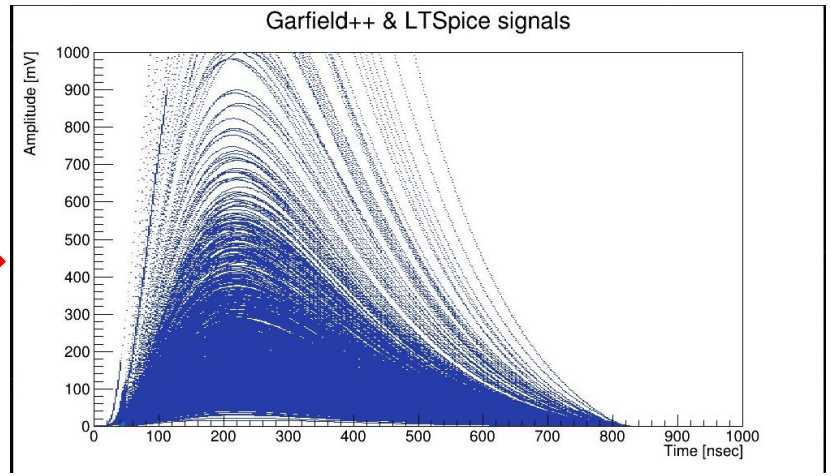


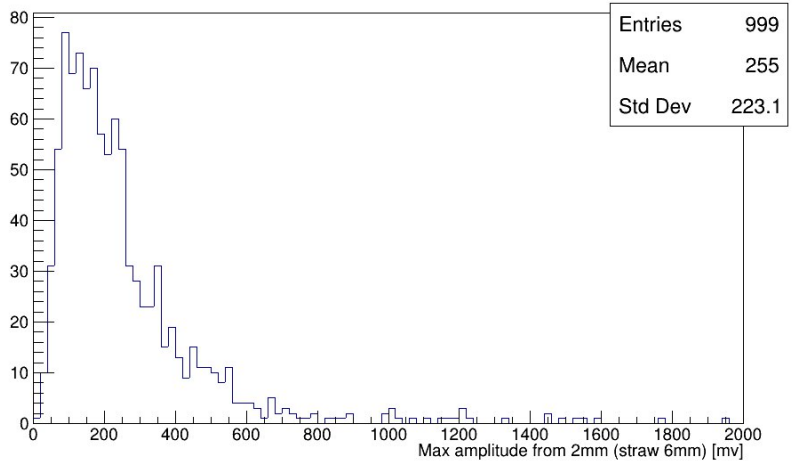
Tube = 6mm



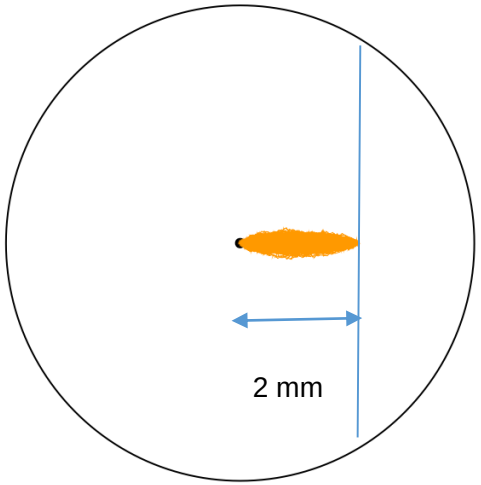




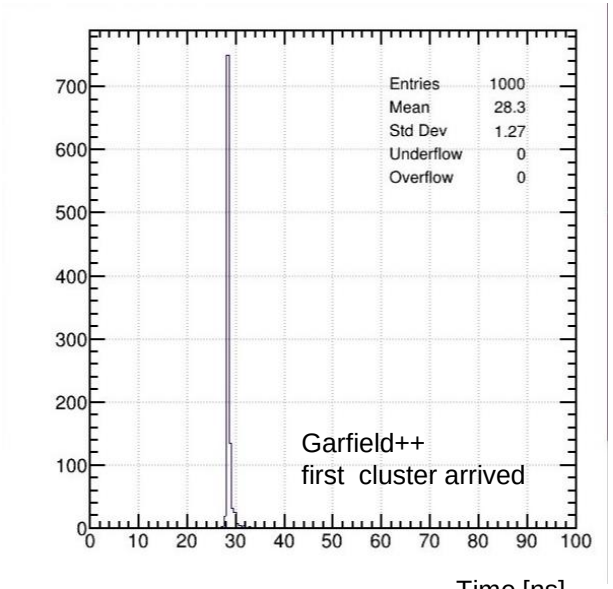


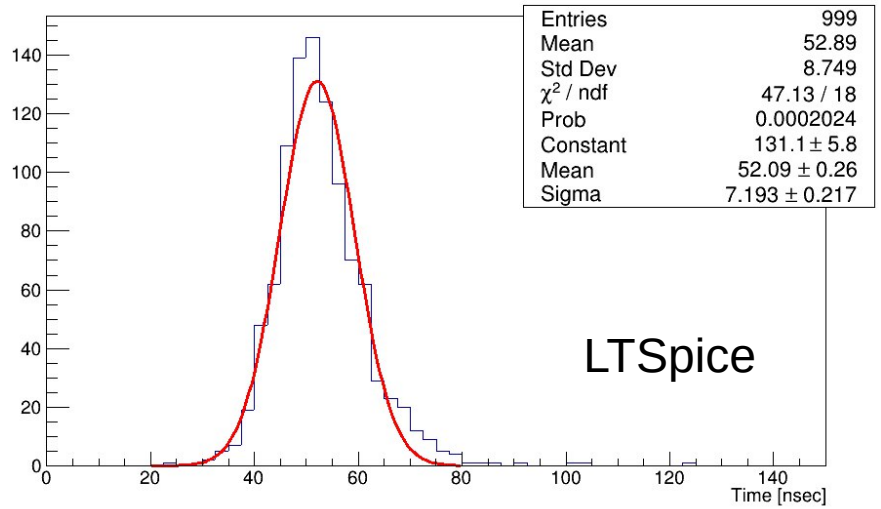


Moment of 10 mV crossing



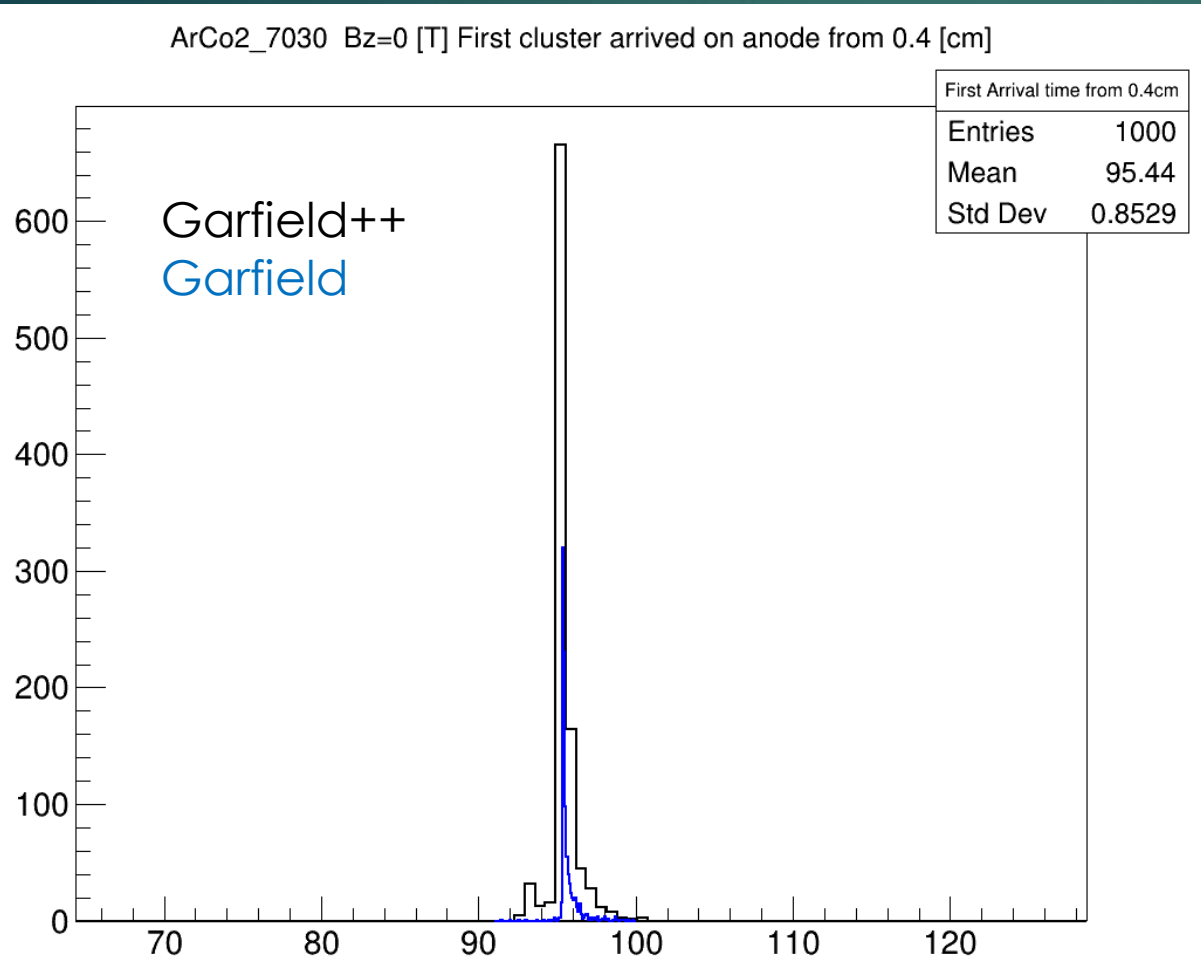
Tube = 6mm

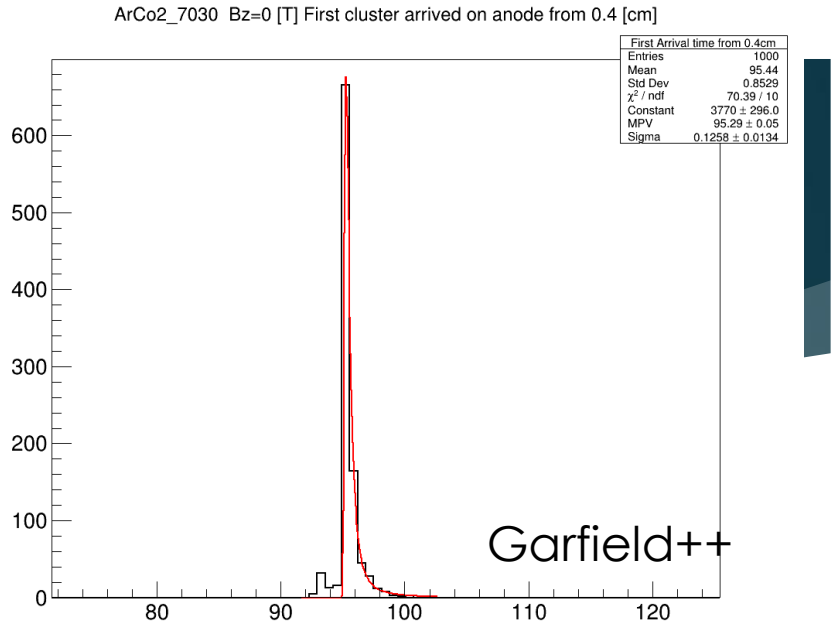


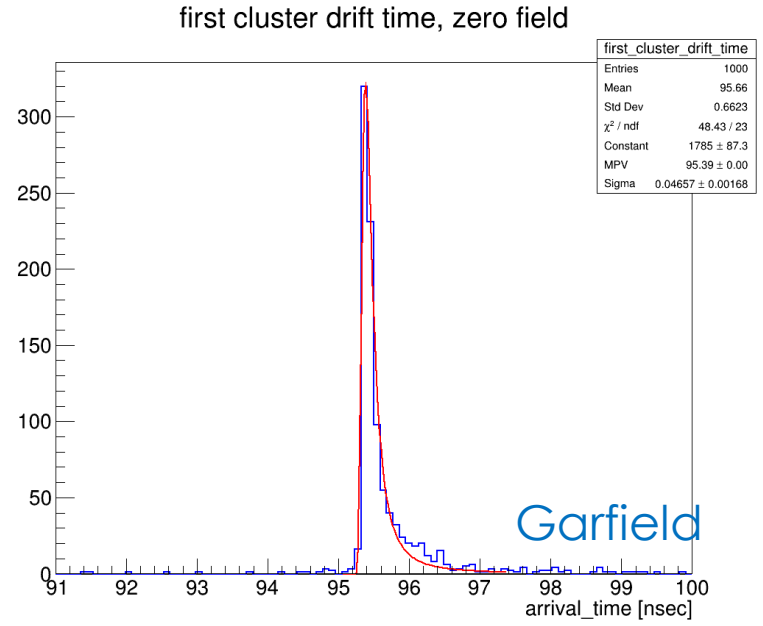


TDR Garfield & Garfield++

comparison of XT relation

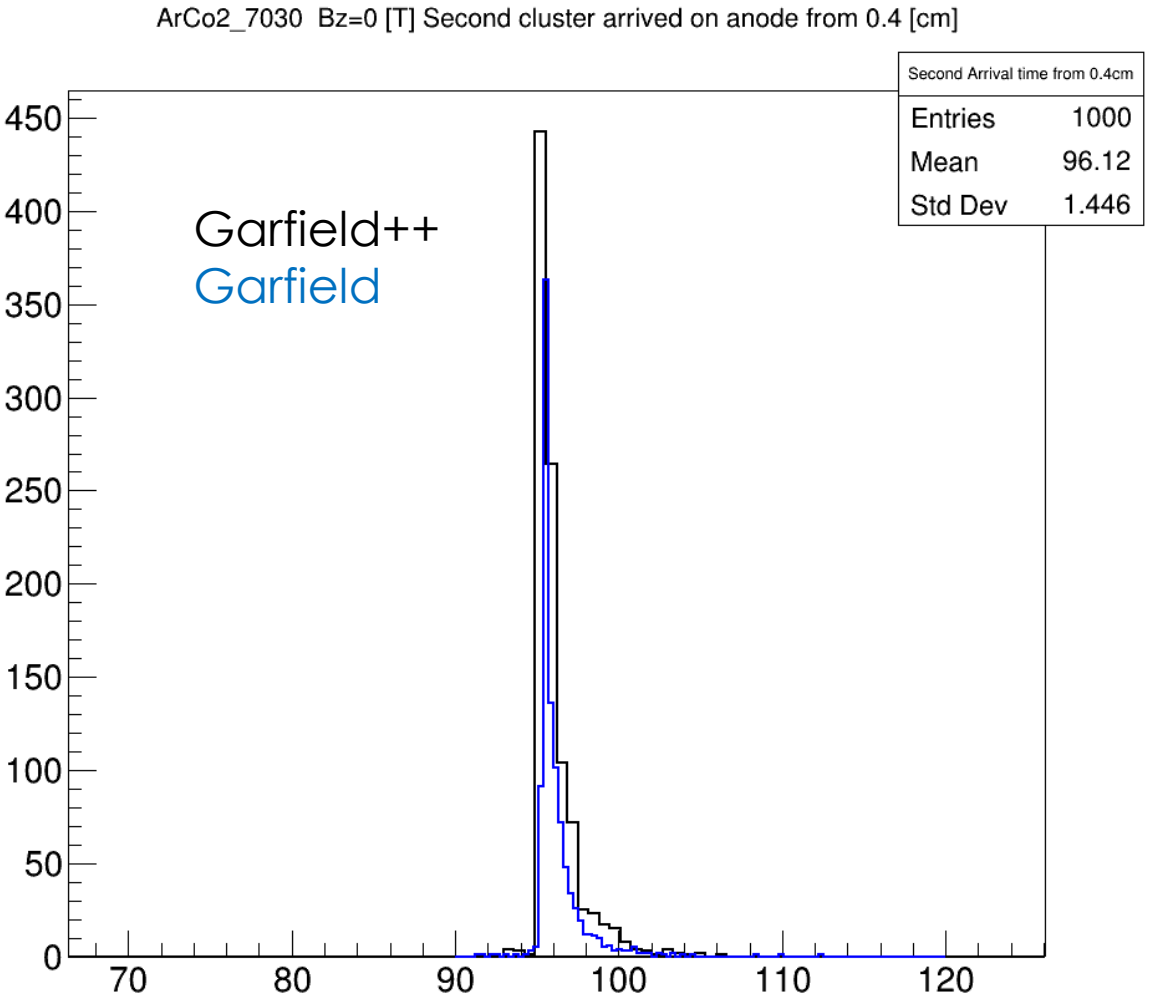


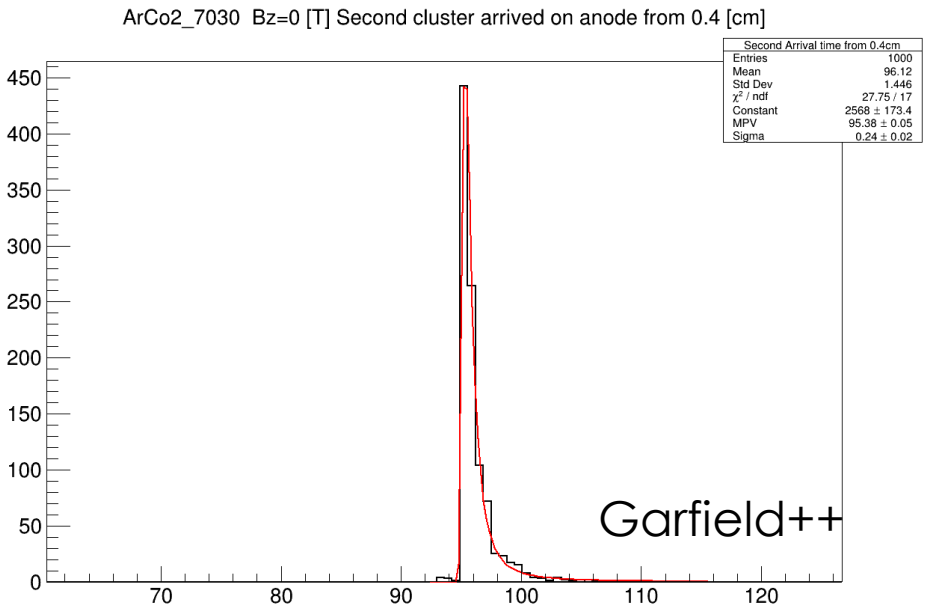


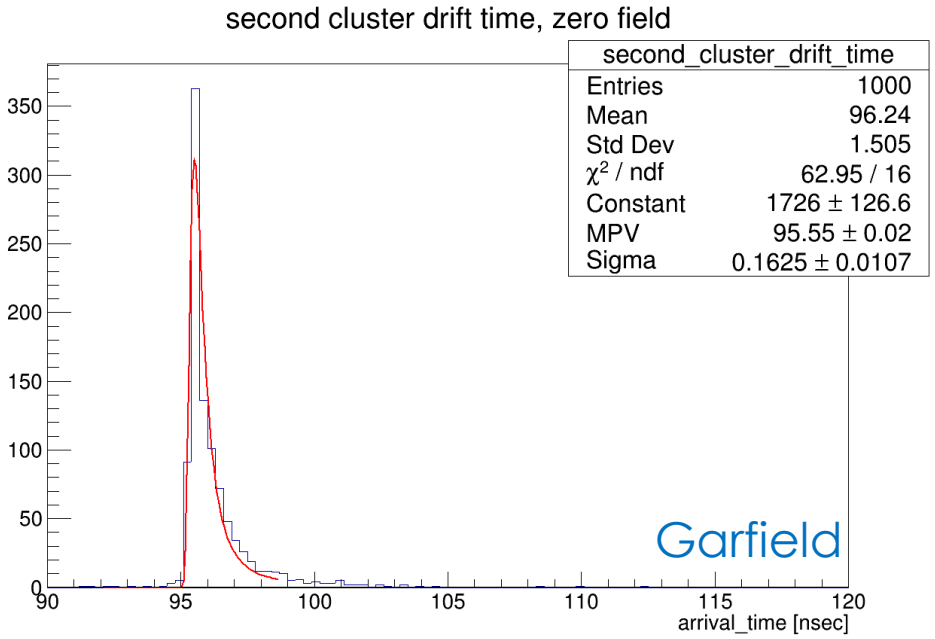


TDR Garfield & Garfield++

comparison of XT relation

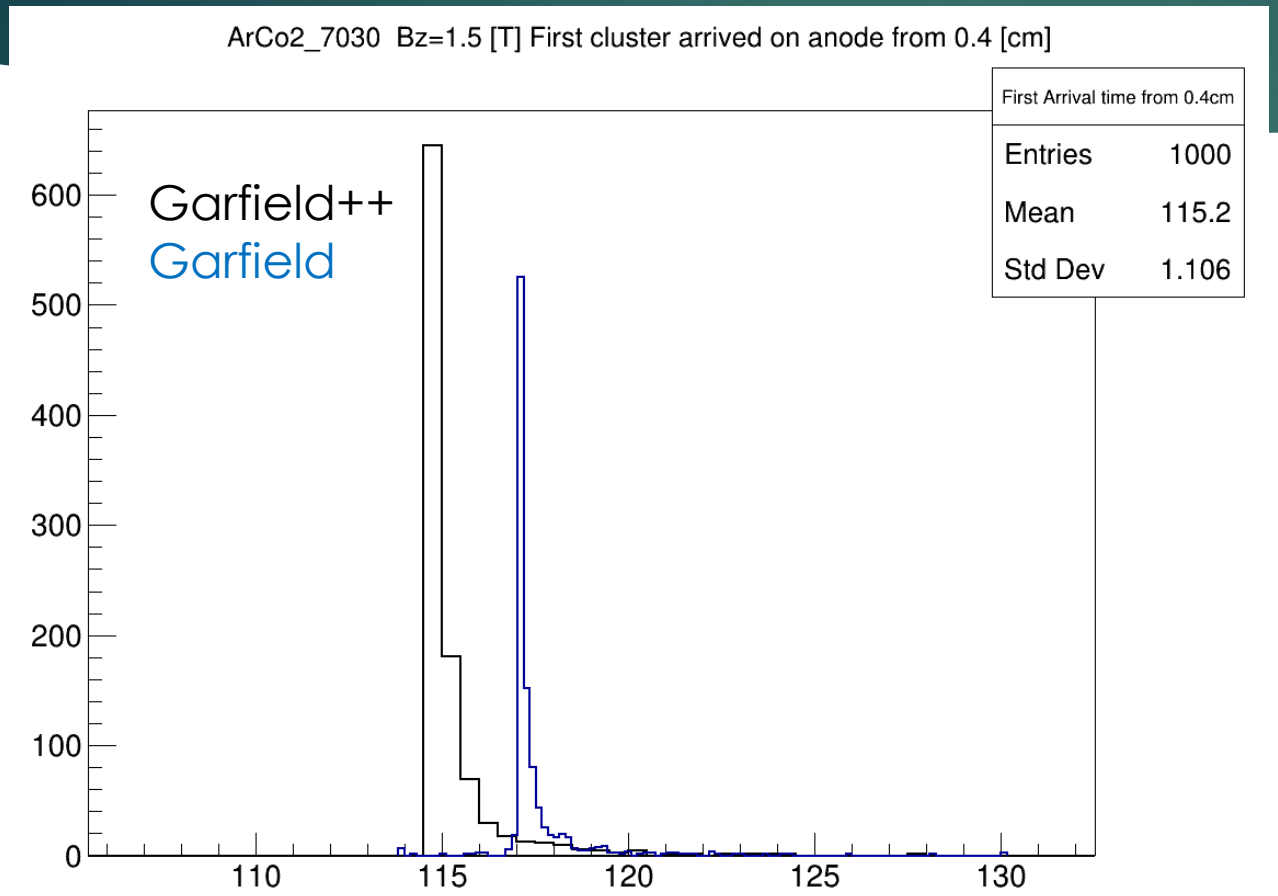


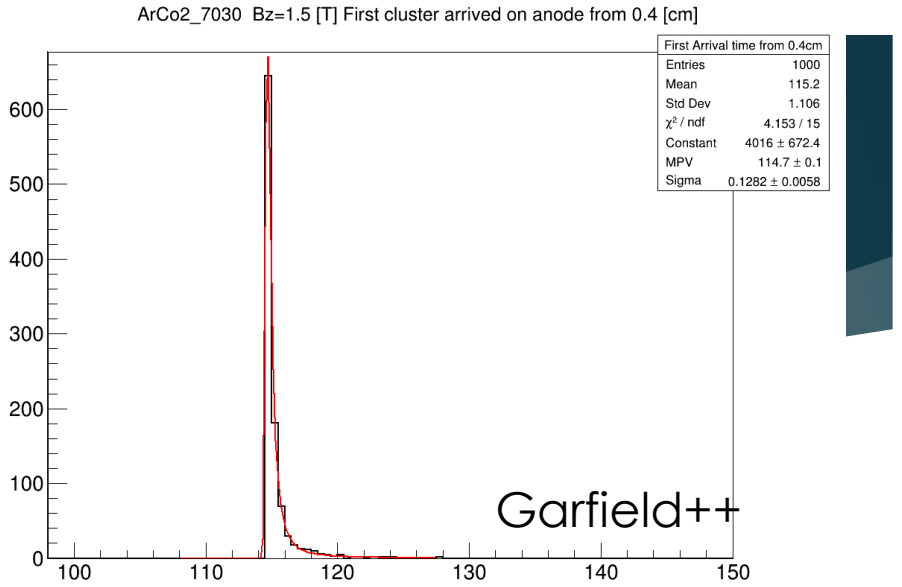


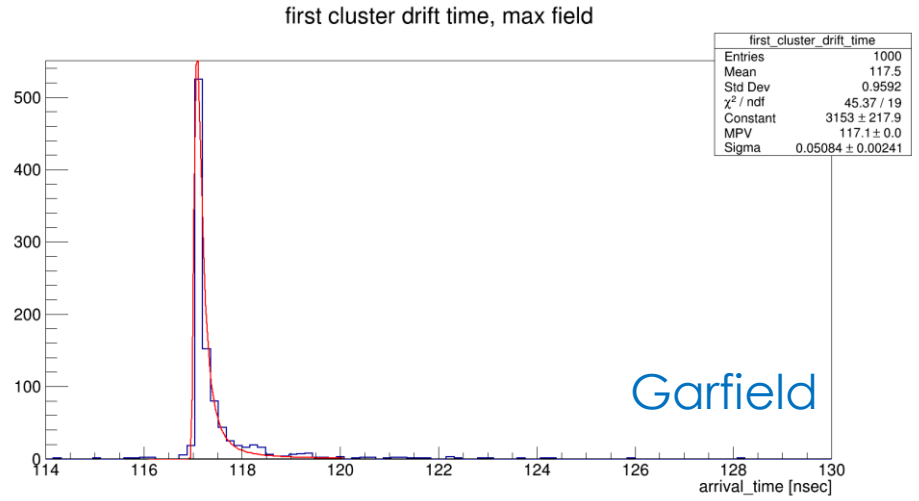


TDR Garfield & Garfield++

comparison of XT relation

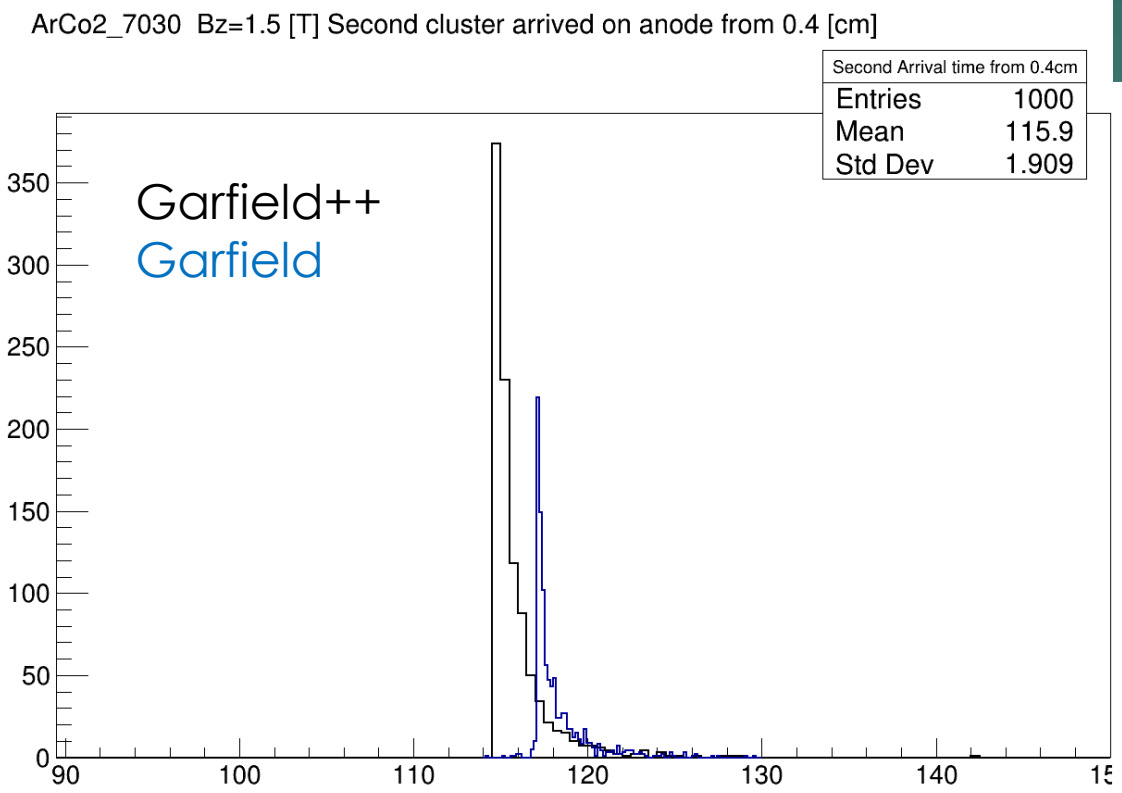


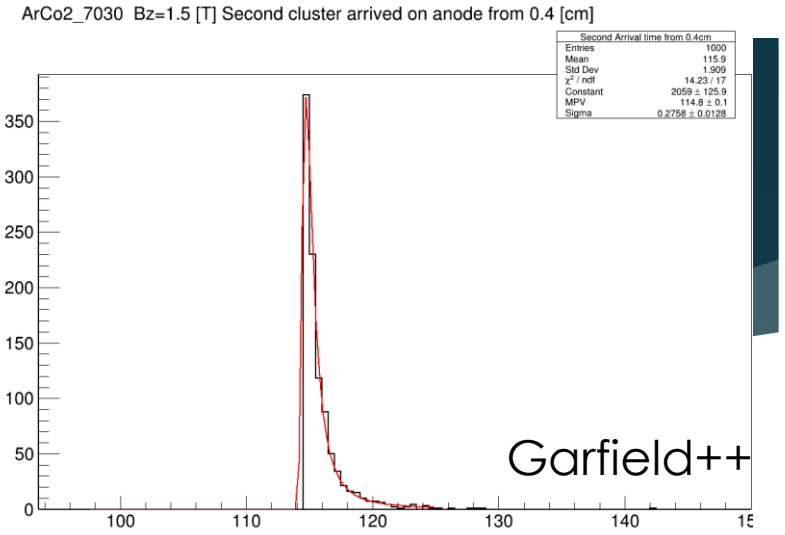


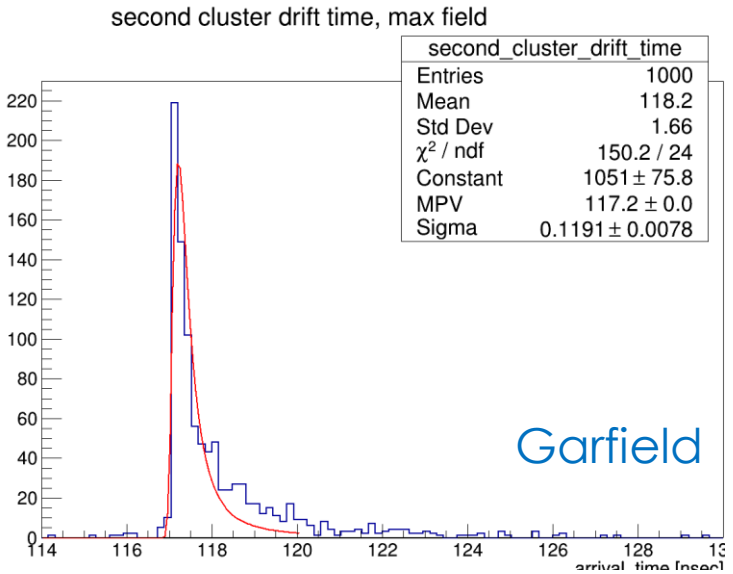


TDR Garfield & Garfield++

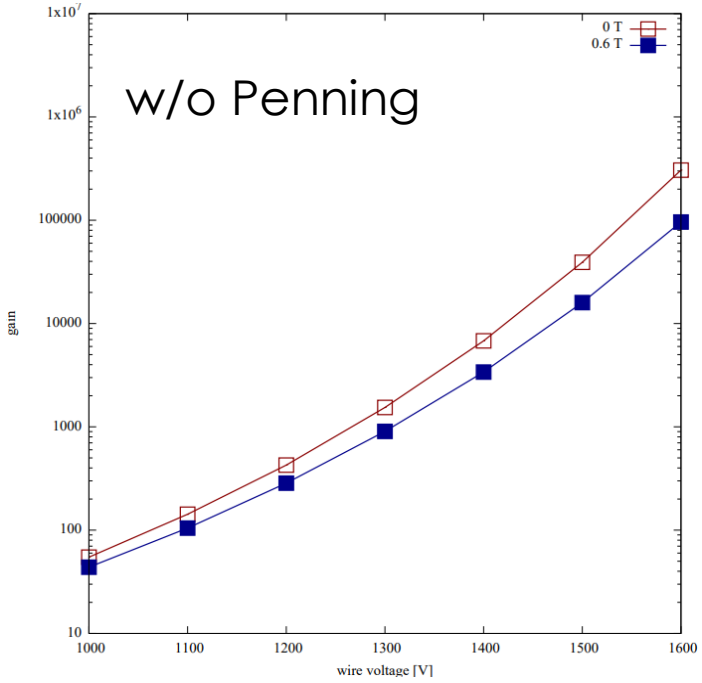
comparison of XT relation

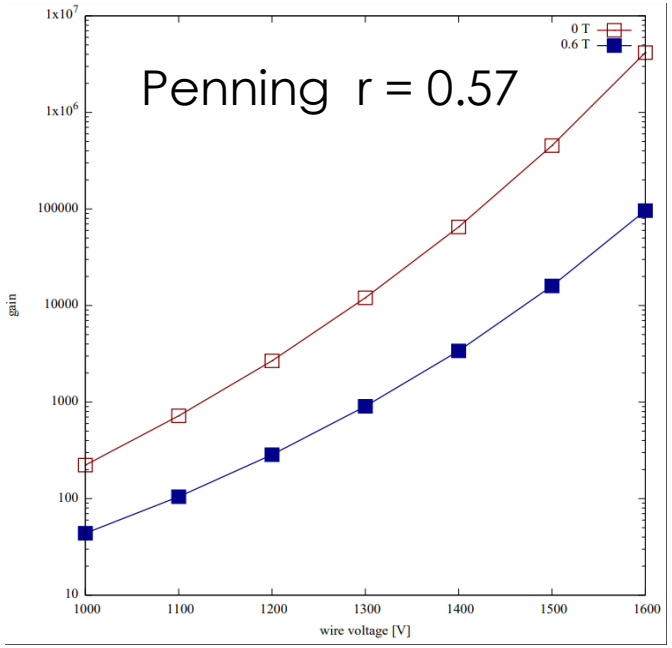






Gas gain problem. Garfield & Garfield++





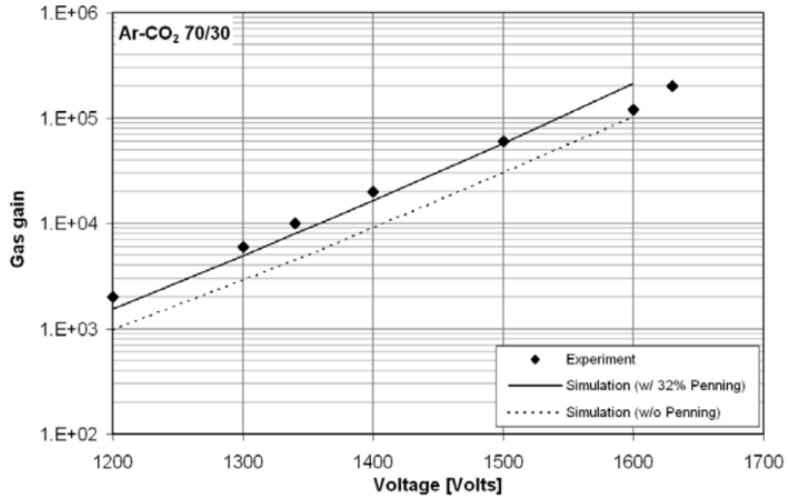


Figure 4-21 Gas gain in Ar/CO_2 70/30 (experimental data and simulation).

Issues:

01 Gas gain

02 Signal different between visualization and data output

03 Difference between signal output after LTSpice simulation

04 Comparing drift path/time distributions

05 TDR plots