Group meeting, (Calibration of Heavy Gas Cherenkov Detector) "SHMS"

Vijay Kumar

Introduction

The purpose of the calibration is to generate a reliable translation from the raw FADC channel to the physical meaningful number of photoelectrons (NPE)

I did calibrate of all carbon data of Kaon L-T experiment

Single run from carbon data does not have the sufficient statistics, so I made some set of run numbers and added to get sufficient statistics

The secondary check, fit of Poisson distribution to separate out the single, double and third photo-electrons still not good but I am working on to make it more suitable

The calibration code, sought the single & double photo-electron peaks and fit these peaks with Gaussian distribution function to get the mean of single photo-electrons peak

After getting the mean of single photoelectrons peak, then calibration code did the conversion of charge of ADC channel (pC) into number of photoelectrons
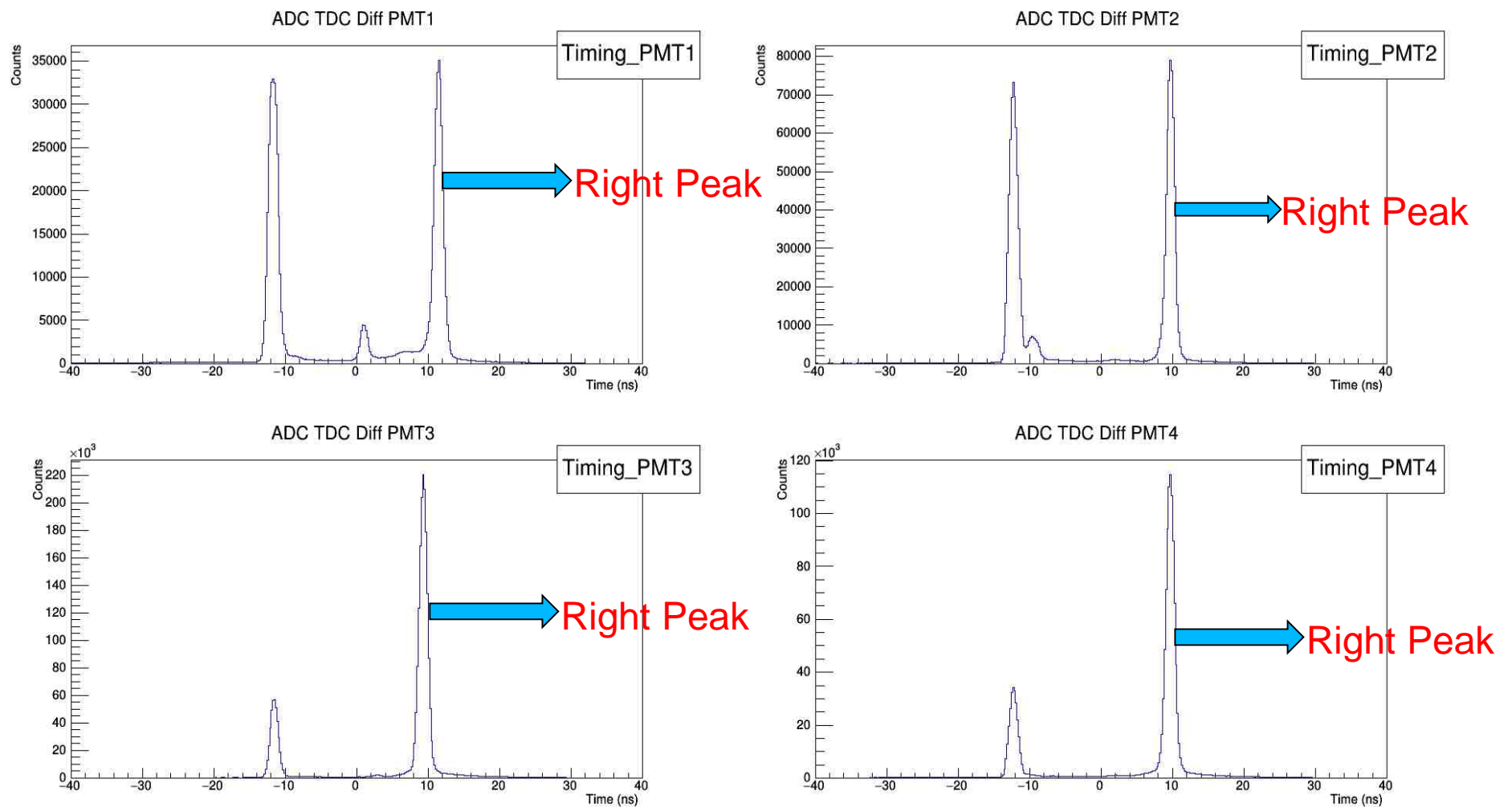
Now, new histogram is filled bin-by-bin with the previous histogram data scaled by the obtained calibration value

First set of run numbers, 4780, 4781, 4782, 4783, & 4787

Beam energy = 10.6 GeV
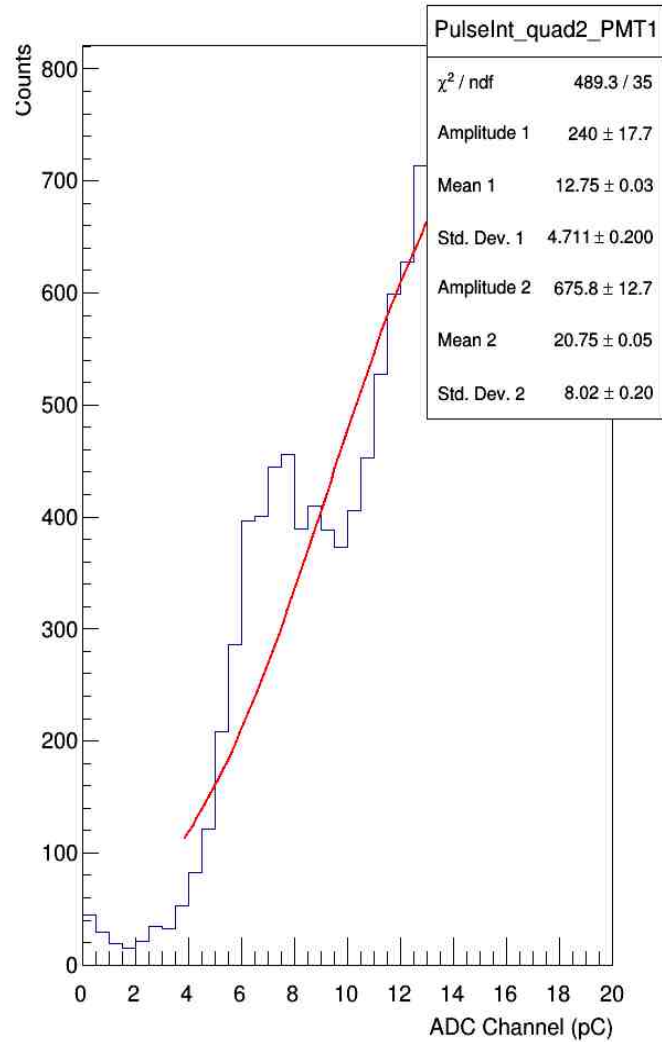
Momentum of SHMS = -6.30 (Negative polarity)
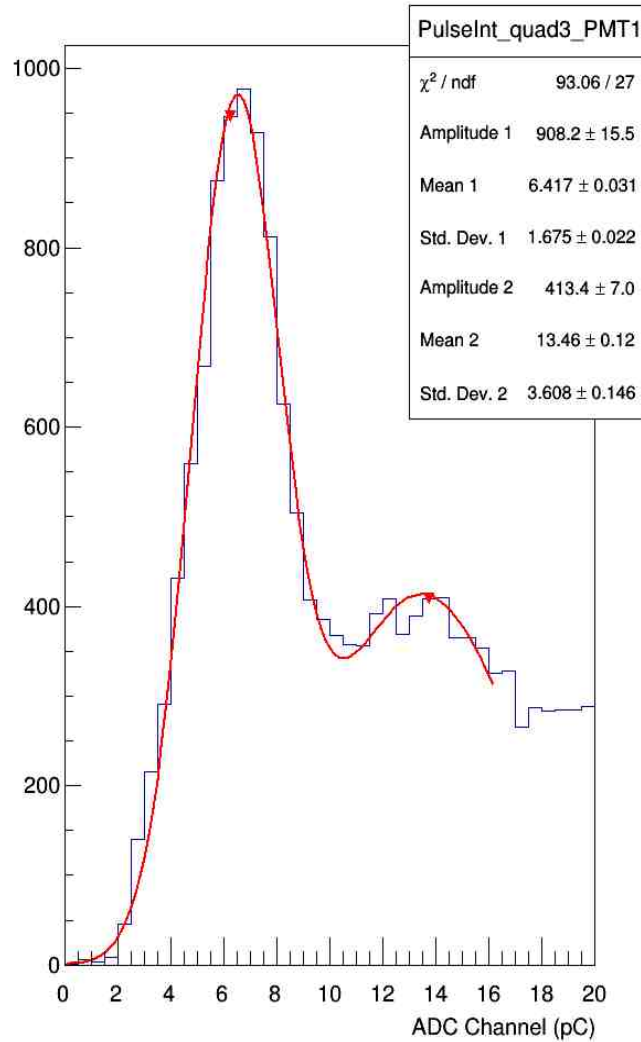
Timing information in each PMTS

Pulse Integral for PMT1
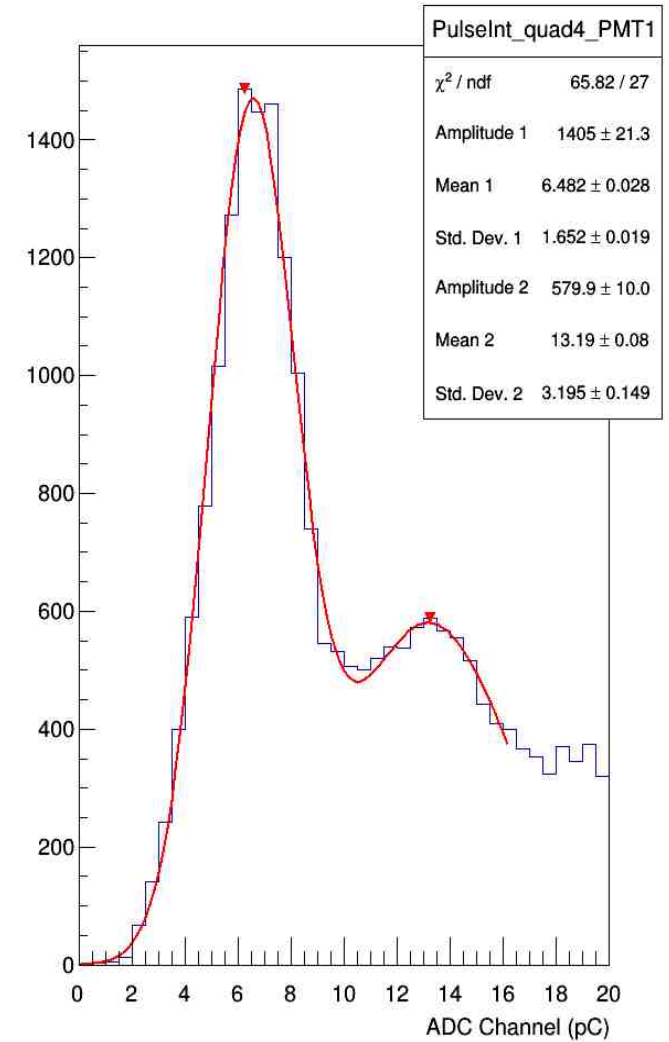
4780, 4781, 7482, 4783, & 4787
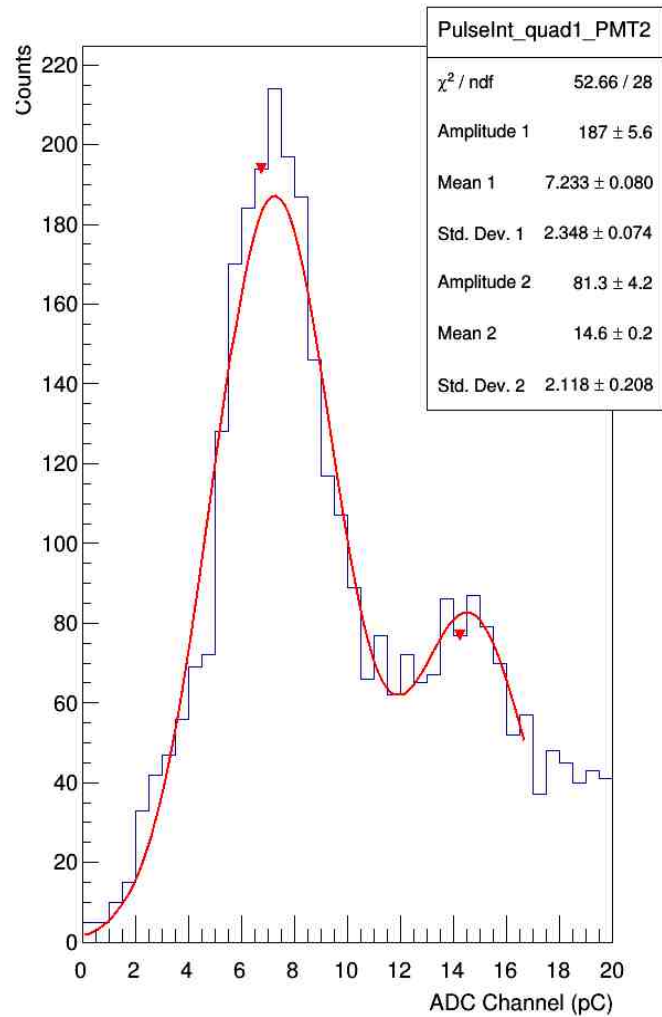
Pulse Integral PMT1 quad2

PulseInt_quad2_PMT1	
χ^2 / ndf	489.3 / 35
Amplitude 1	240 ± 17.7
Mean 1	12.75 ± 0.03
Std. Dev. 1	4.711 ± 0.200
Amplitude 2	675.8 ± 12.7
Mean 2	20.75 ± 0.05
Std. Dev. 2	8.02 ± 0.20

Pulse Integral PMT1 quad3

PulseInt_quad3_PMT1	
χ^2 / ndf	93.06 / 27
Amplitude 1	908.2 ± 15.5
Mean 1	6.417 ± 0.031
Std. Dev. 1	1.675 ± 0.022
Amplitude 2	413.4 ± 7.0
Mean 2	13.46 ± 0.12
Std. Dev. 2	3.608 ± 0.146

Pulse Integral PMT1 quad4

PulseInt_quad4_PMT1	
χ^2 / ndf	65.82 / 27
Amplitude 1	1405 ± 21.3
Mean 1	6.482 ± 0.028
Std. Dev. 1	1.652 ± 0.019
Amplitude 2	579.9 ± 10.0
Mean 2	13.19 ± 0.08
Std. Dev. 2	3.195 ± 0.149

Pulse Integral for PMT2

4780, 4781, 7482, 4783, & 4787

Pulse Integral PMT2 quad1

PulseInt_quad1_PMT2	
χ^2 / ndf	52.66 / 28
Amplitude 1	187 ± 5.6
Mean 1	7.233 ± 0.080
Std. Dev. 1	2.348 ± 0.074
Amplitude 2	81.3 ± 4.2
Mean 2	14.6 ± 0.2
Std. Dev. 2	2.118 ± 0.208

Pulse Integral PMT2 quad3

PulseInt_quad3_PMT2	
χ^2 / ndf	36.16 / 18
Amplitude 1	223.7 ± 11.6
Mean 1	2.222 ± 0.028
Std. Dev. 1	0.6611 ± 0.0295
Amplitude 2	80.26 ± 3.86
Mean 2	7.315 ± 0.097
Std. Dev. 2	2.215 ± 0.114

Pulse Integral PMT2 quad4

PulseInt_quad4_PMT2	
χ^2 / ndf	209 / 29
Amplitude 1	1600 ± 21.6
Mean 1	7.127 ± 0.034
Std. Dev. 1	2.01 ± 0.02
Amplitude 2	764 ± 11.3
Mean 2	15.06 ± 0.10
Std. Dev. 2	3.497 ± 0.181
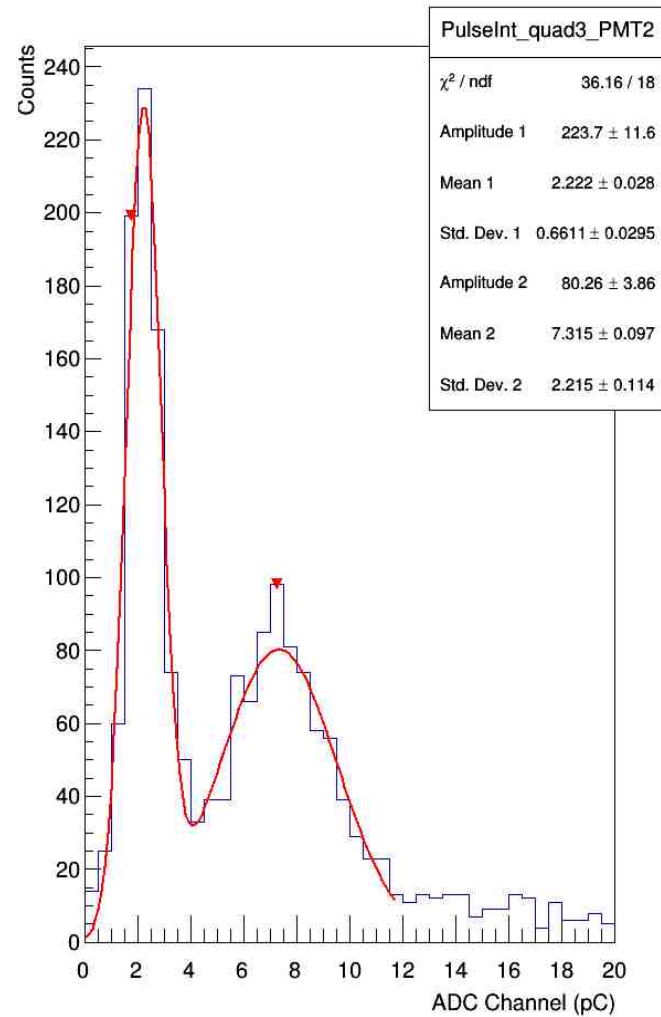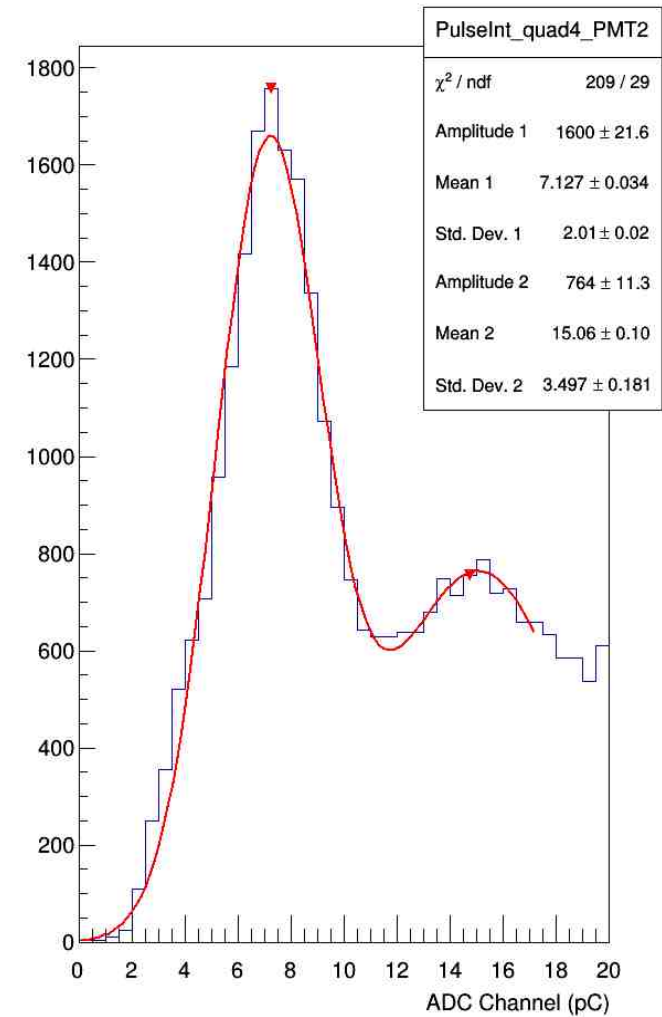
Pulse Integral for PMT3

4780, 4781, 7482, 4783, & 4787

Pulse Integral PMT3 quad1

PulseInt_quad1_PMT3	
χ^2 / ndf	40.44 / 26
Amplitude 1	37.59 ± 2.78
Mean 1	5.872 ± 0.121
Std. Dev. 1	1.862 ± 0.119
Amplitude 2	7.567 ± 1.363
Mean 2	13.54 ± 0.41
Std. Dev. 2	2.221 ± 0.728

Pulse Integral PMT3 quad2

PulseInt_quad2_PMT3	
χ^2 / ndf	225.9 / 20
Amplitude 1	157.8 ± 9.5
Mean 1	2.892 ± 0.045
Std. Dev. 1	0.6609 ± 0.0290
Amplitude 2	19.75 ± 1.54
Mean 2	20.75 ± 0.24
Std. Dev. 2	10 ± 0.1

Pulse Integral PMT3 quad4

PulseInt_quad4_PMT3	
χ^2 / ndf	396.7 / 27
Amplitude 1	2000 ± 0.9
Mean 1	5.965 ± 0.020
Std. Dev. 1	1.569 ± 0.018
Amplitude 2	1936 ± 13.3
Mean 2	12.39 ± 0.06
Std. Dev. 2	4.504 ± 0.039
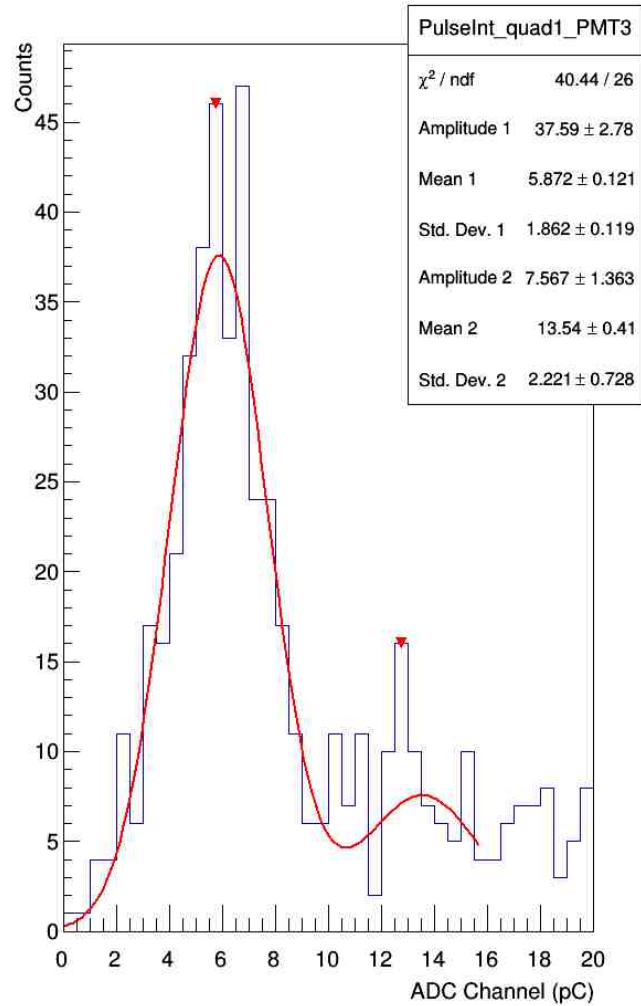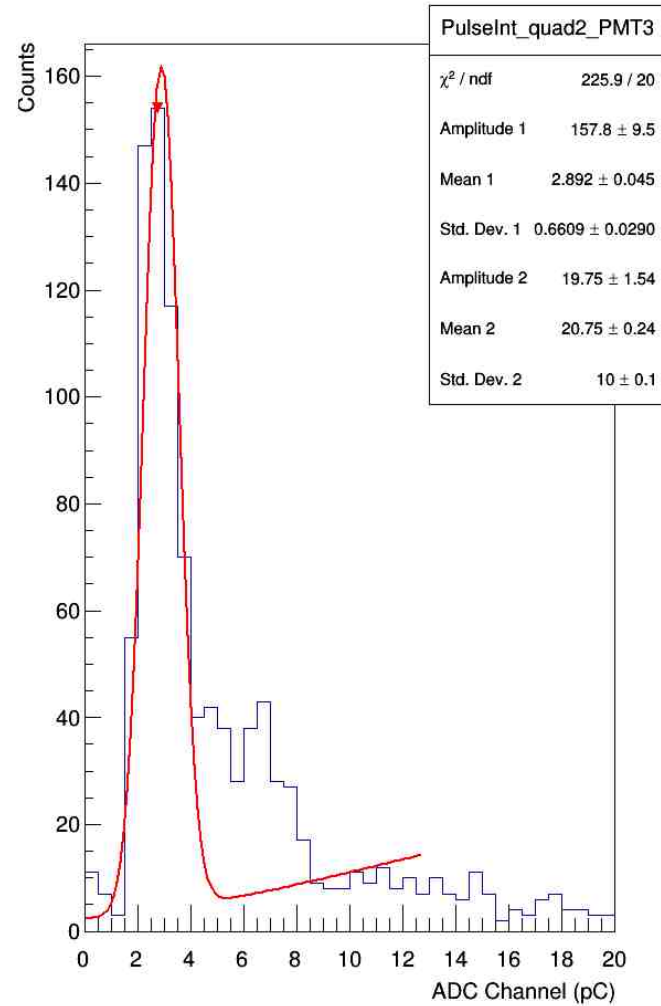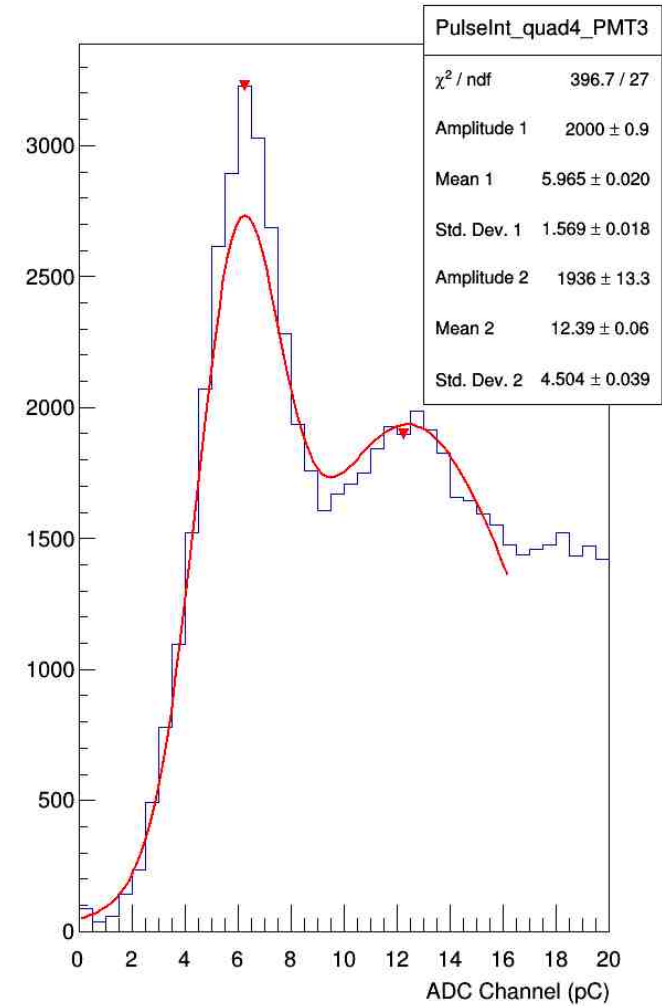
Pulse Integral for PMT4

4780, 4781, 7482, 4783, & 4787

Pulse Integral PMT4 quad1

PulseInt_quad1_PMT4	
χ^2 / ndf	27.32 / 23
Amplitude 1	6.429 ± 1.237
Mean 1	6.478 ± 0.305
Std. Dev. 1	1.754 ± 0.280
Amplitude 2	4.582 ± 0.884
Mean 2	24.75 ± 1.84
Std. Dev. 2	10 ± 1.2

Pulse Integral PMT4 quad2

PulseInt_quad2_PMT4	
χ^2 / ndf	23.39 / 24
Amplitude 1	19.28 ± 1.69
Mean 1	6.687 ± 0.174
Std. Dev. 1	2.15 ± 0.14
Amplitude 2	8.966 ± 1.361
Mean 2	15.85 ± 1.19
Std. Dev. 2	2.011 ± 0.609

Pulse Integral PMT4 quad3

PulseInt_quad3_PMT4	
χ^2 / ndf	64.85 / 28
Amplitude 1	64.55 ± 4.65
Mean 1	6.999 ± 0.127
Std. Dev. 1	1.741 ± 0.139
Amplitude 2	36.83 ± 1.82
Mean 2	13.25 ± 1.88
Std. Dev. 2	8.289 ± 0.579
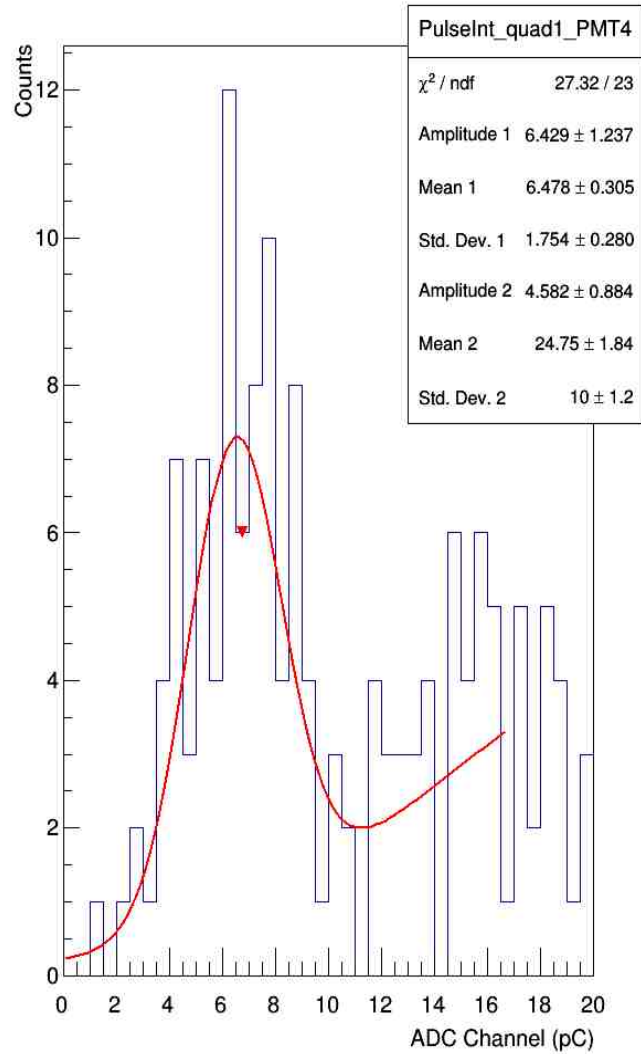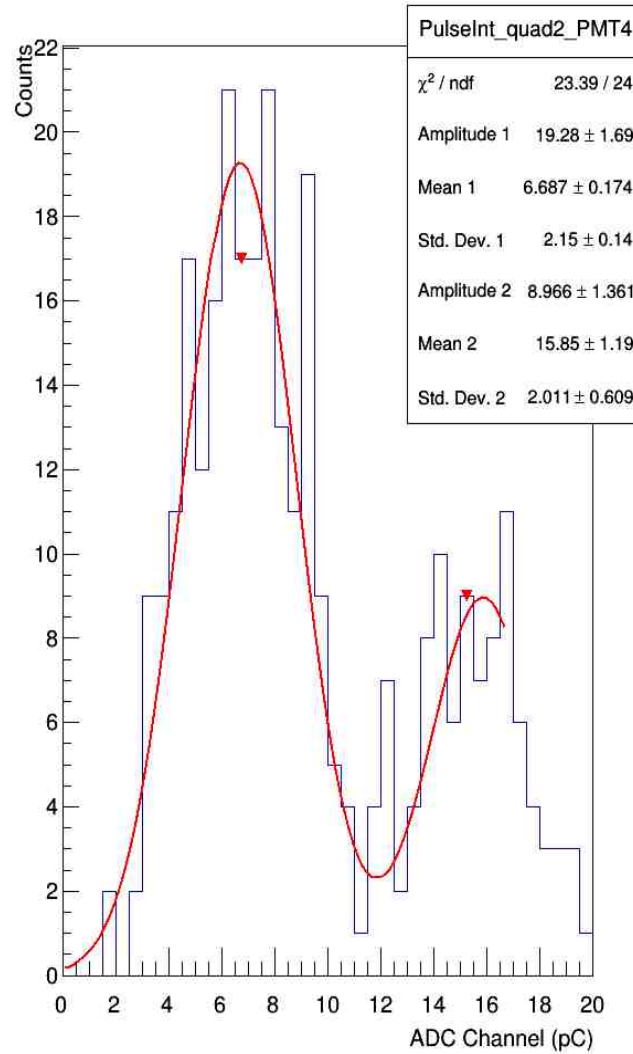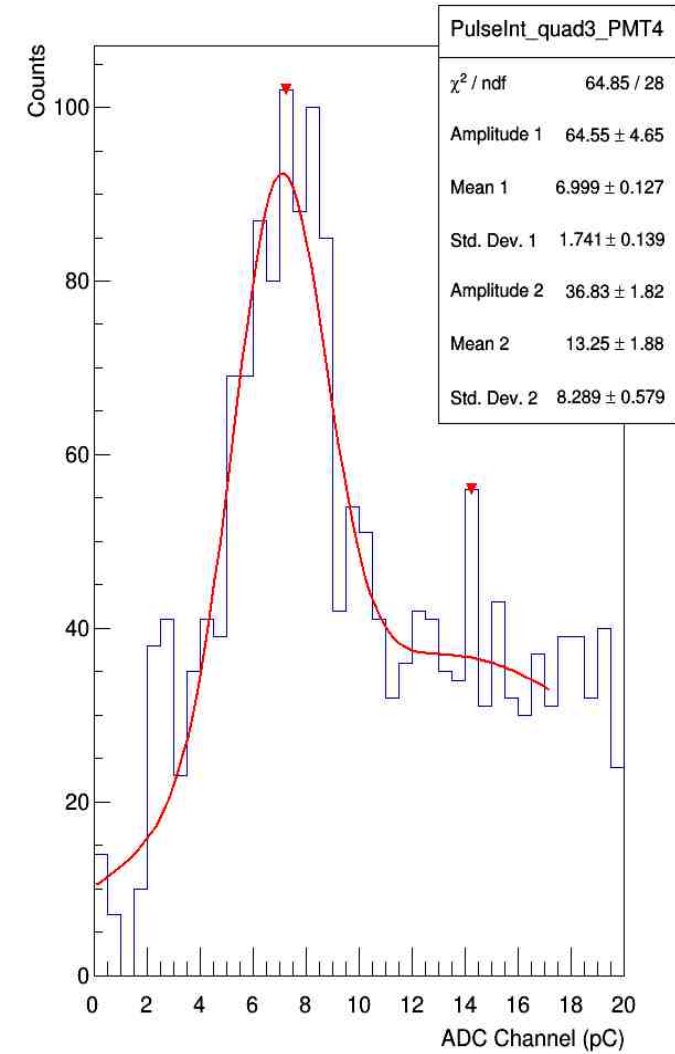
Electrons Selection

4780, 4781, 7482, 4783, & 4787
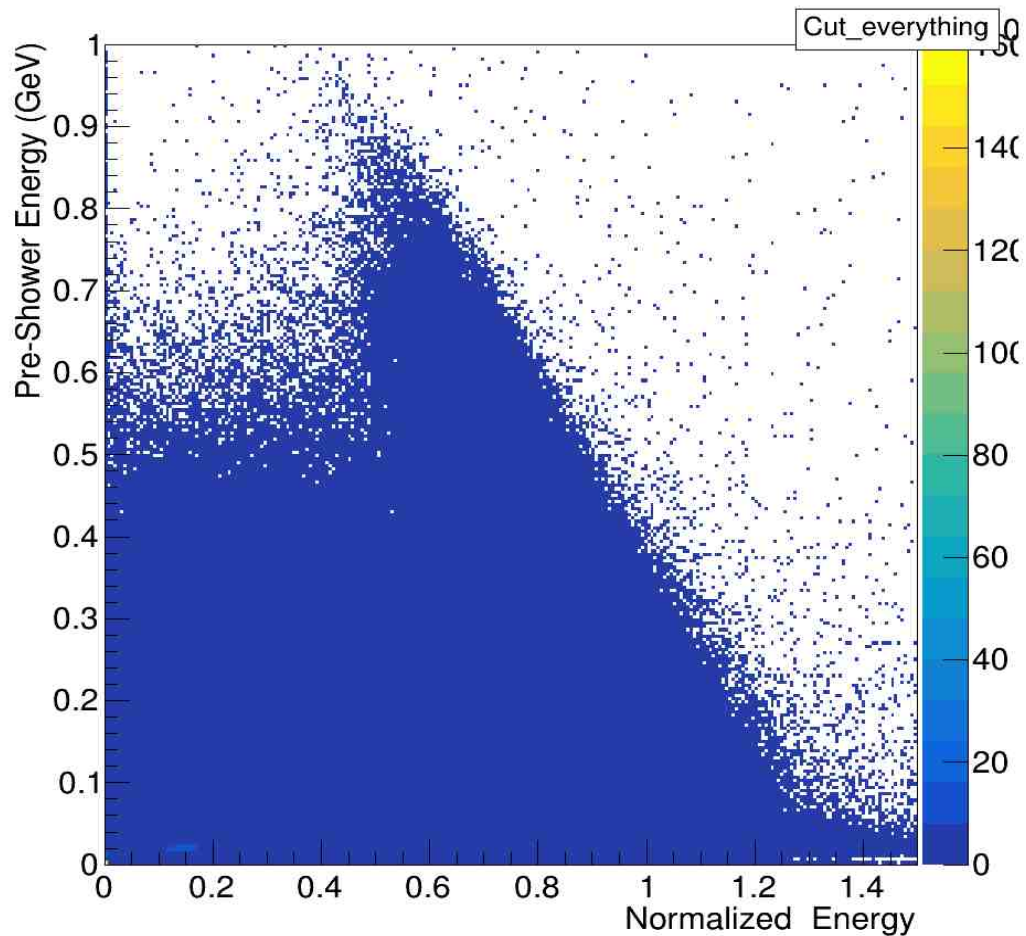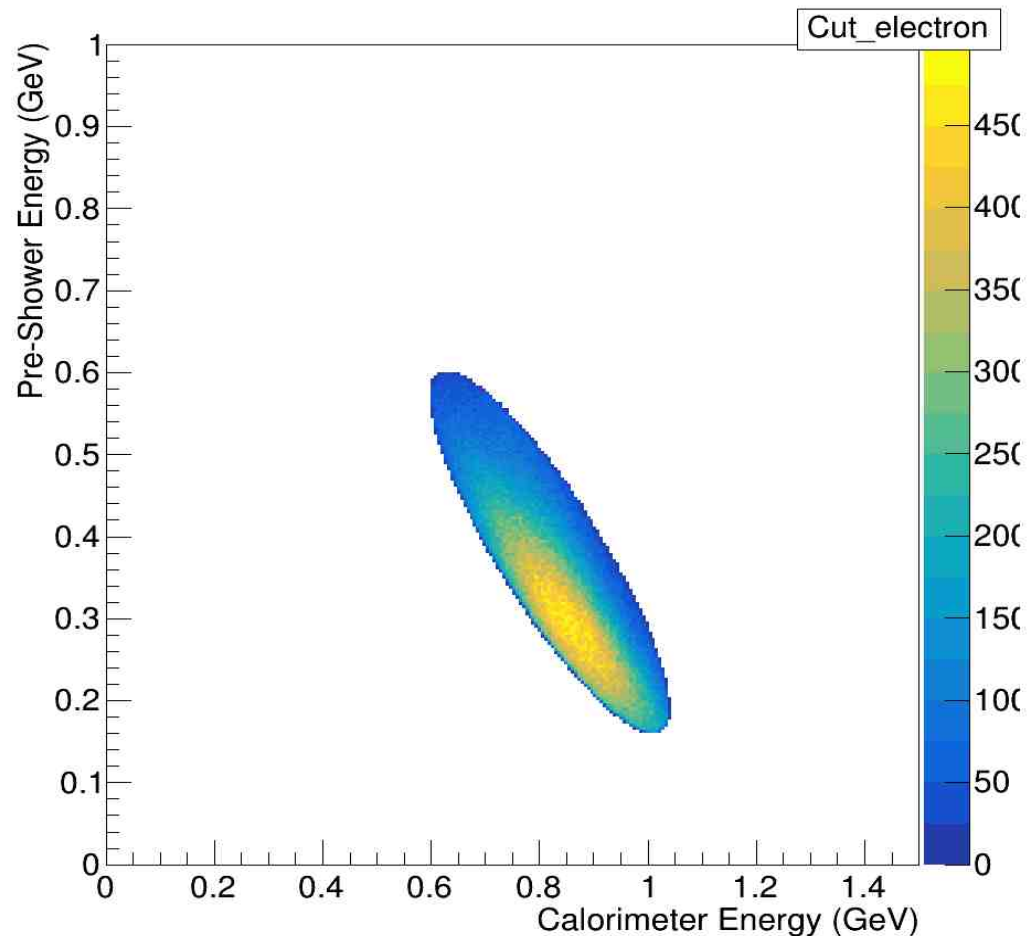
Calibration parameters for this set of runs

PMT1: 8.55   PMT3: 4.42
PMT2: 5.52   PMT4: 6.99

Some few sets of run numbers

Beam energy = 10.602 GeV

Momentum of SHMS = 6.842 (Positive polarity)
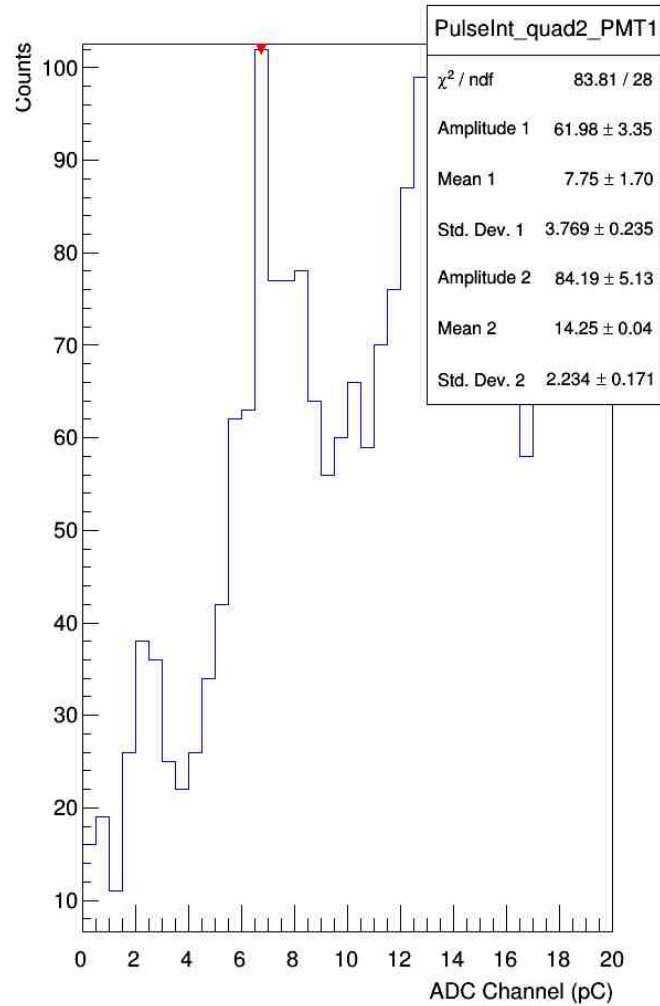
5154, 5155 & 5156   5175, 5176 & 5178

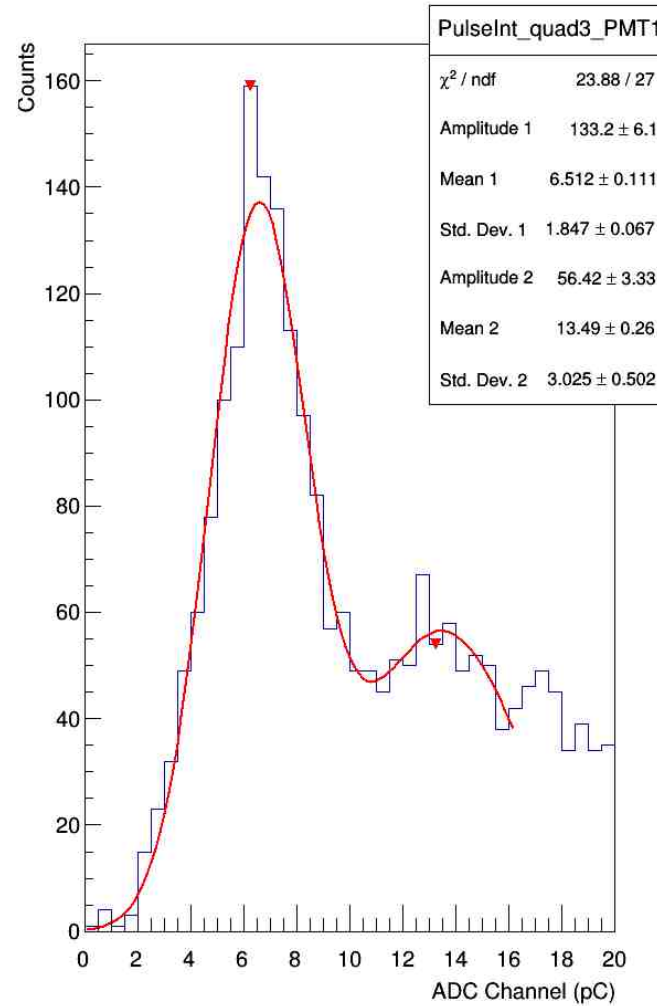5157, 5158 & 5174   5179, 5180 & 5181

5298 & 5299

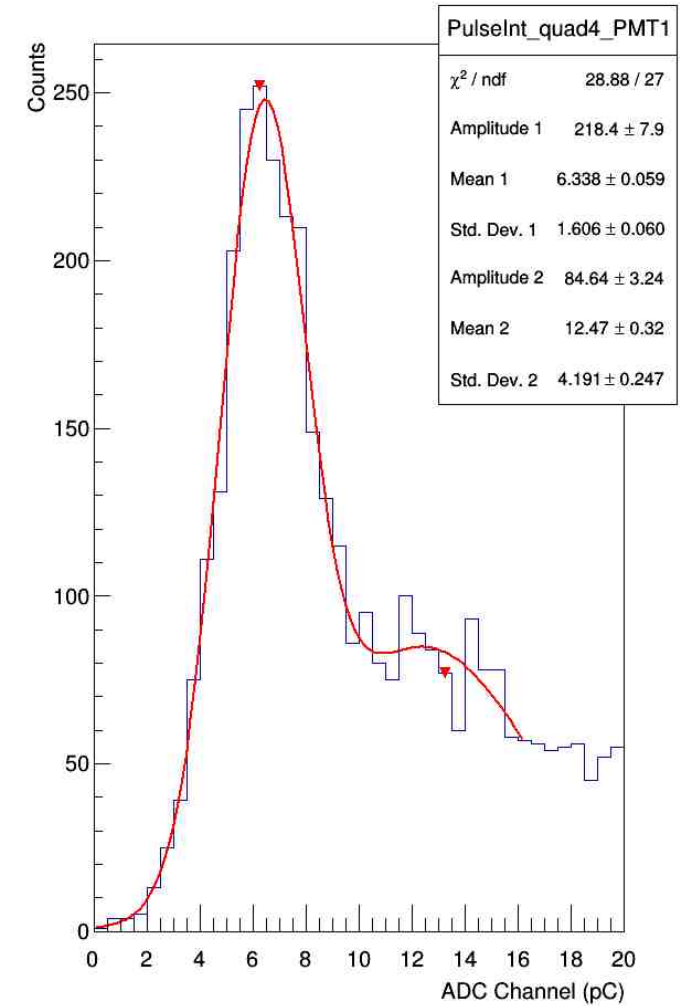# Pulse Integral for PMT1

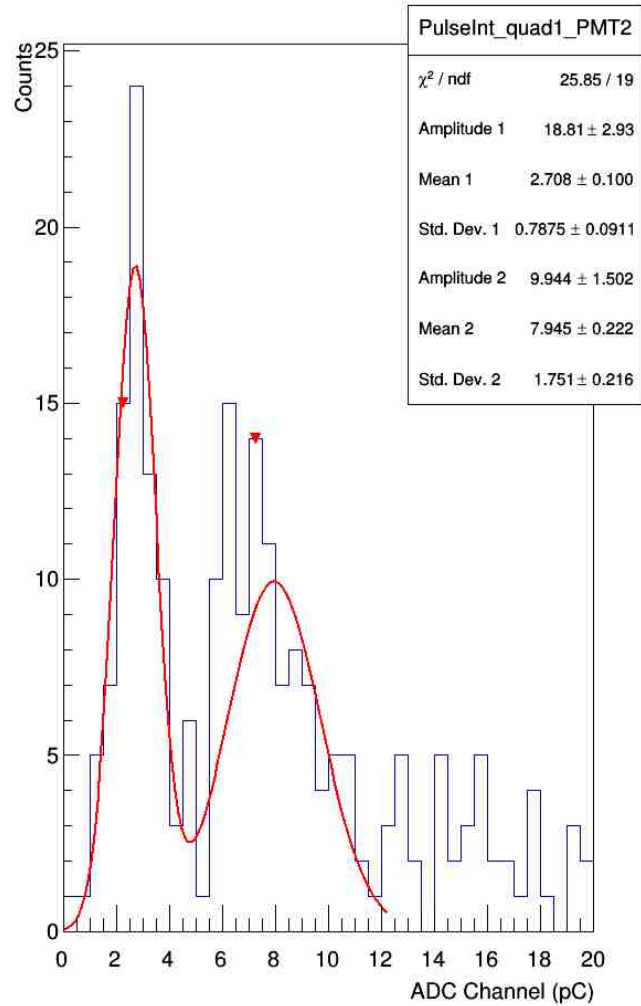5154, 5155 & 5156

Pulse Integral PMT1 quad2

PulseInt_quad2_PMT1	
χ^2 / ndf	83.81 / 28
Amplitude 1	61.98 ± 3.35
Mean 1	7.75 ± 1.70
Std. Dev. 1	3.769 ± 0.235
Amplitude 2	84.19 ± 5.13
Mean 2	14.25 ± 0.04
Std. Dev. 2	2.234 ± 0.171

Pulse Integral PMT1 quad3

PulseInt_quad3_PMT1	
χ^2 / ndf	23.88 / 27
Amplitude 1	133.2 ± 6.1
Mean 1	6.512 ± 0.111
Std. Dev. 1	1.847 ± 0.067
Amplitude 2	56.42 ± 3.33
Mean 2	13.49 ± 0.26
Std. Dev. 2	3.025 ± 0.502

Pulse Integral PMT1 quad4

PulseInt_quad4_PMT1	
χ^2 / ndf	28.88 / 27
Amplitude 1	218.4 ± 7.9
Mean 1	6.338 ± 0.059
Std. Dev. 1	1.606 ± 0.060
Amplitude 2	84.64 ± 3.24
Mean 2	12.47 ± 0.32
Std. Dev. 2	4.191 ± 0.247

Pulse Integral for PMT2

5154, 5155 & 5156

Pulse Integral PMT2 quad1

PulseInt_quad1_PMT2	
χ² / ndf	25.85 / 19
Amplitude 1	18.81 ± 2.93
Mean 1	2.708 ± 0.100
Std. Dev. 1	0.7875 ± 0.0911
Amplitude 2	9.944 ± 1.502
Mean 2	7.945 ± 0.222
Std. Dev. 2	1.751 ± 0.216

Pulse Integral PMT2 quad3

PulseInt_quad3_PMT2	
χ² / ndf	37.33 / 18
Amplitude 1	182.2 ± 9.9
Mean 1	2.169 ± 0.030
Std. Dev. 1	0.6621 ± 0.0278
Amplitude 2	23.14 ± 2.24
Mean 2	6.866 ± 0.228
Std. Dev. 2	2.234 ± 0.265

Pulse Integral PMT2 quad4

PulseInt_quad4_PMT2	
χ² / ndf	34.7 / 29
Amplitude 1	226.2 ± 6.6
Mean 1	7.111 ± 0.099
Std. Dev. 1	2.197 ± 0.058
Amplitude 2	120.9 ± 4.7
Mean 2	15.51 ± 0.27
Std. Dev. 2	3.188 ± 0.443
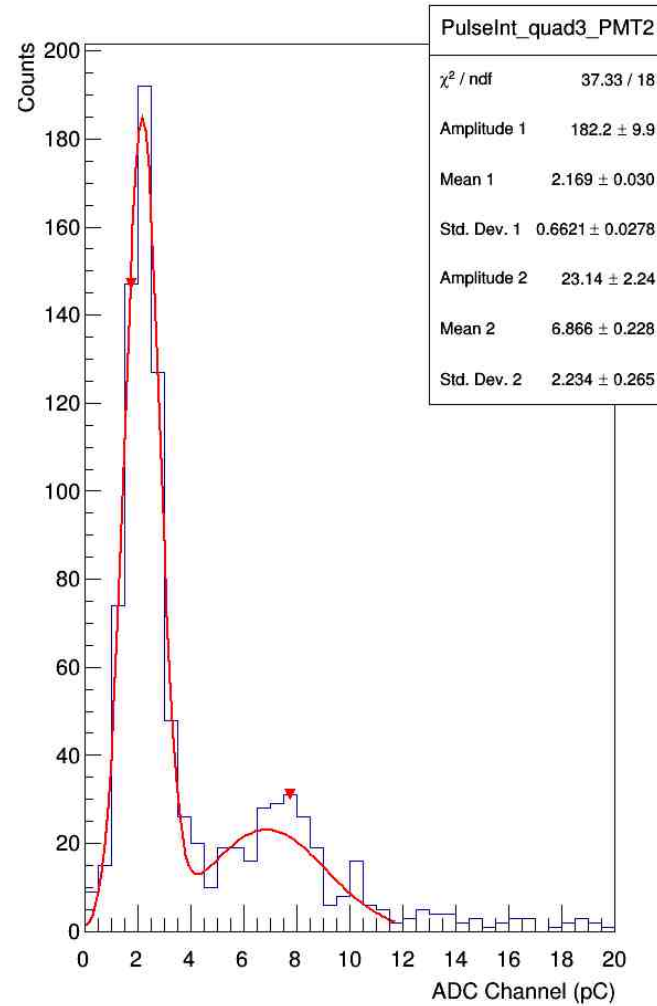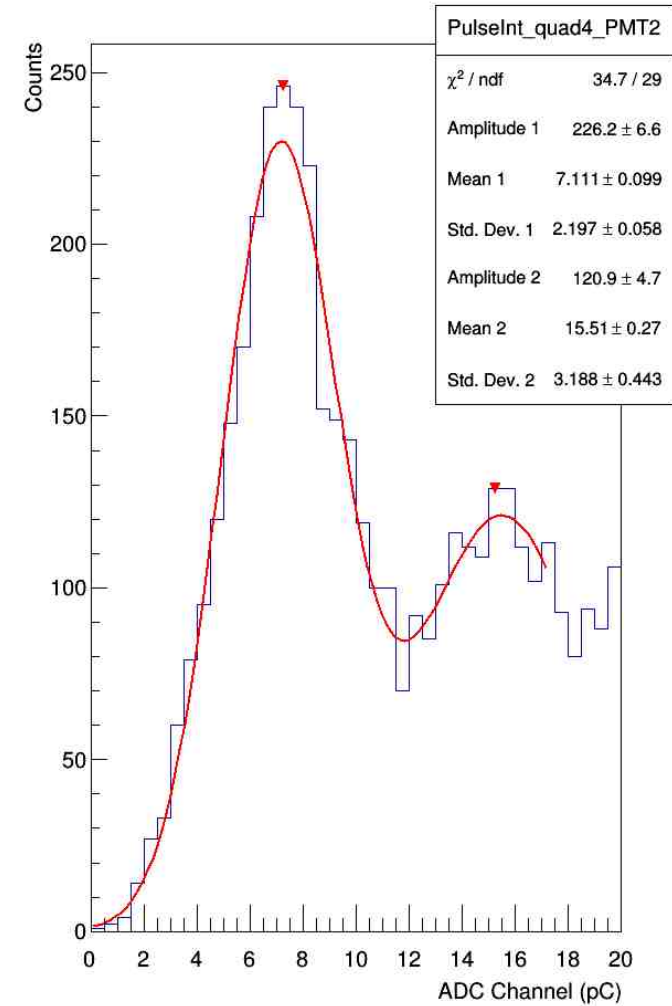
Pulse Integral for PMT3

5154, 5155 & 5156

Pulse Integral PMT3 quad1

PulseInt_quad1_PMT3	
χ^2 / ndf	11.35 / 15
Amplitude 1	3.114 ± 1.022
Mean 1	5.017 ± 0.503
Std. Dev. 1	1.846 ± 0.657
Amplitude 2	1.511 ± 0.559
Mean 2	11.75 ± 1.01
Std. Dev. 2	10 ± 9.0

Pulse Integral PMT3 quad2

PulseInt_quad2_PMT3	
χ^2 / ndf	26.5 / 18
Amplitude 1	106.2 ± 7.1
Mean 1	2.698 ± 0.040
Std. Dev. 1	0.7147 ± 0.0331
Amplitude 2	8.301 ± 1.342
Mean 2	7.25 ± 0.08
Std. Dev. 2	2.444 ± 0.500

Pulse Integral PMT3 quad4

PulseInt_quad4_PMT3	
χ^2 / ndf	909 / 26
Amplitude 1	2.197e−07 ± 1.925e+00
Mean 1	6.714 ± 0.082
Std. Dev. 1	9.516 ± 0.408
Amplitude 2	323.4 ± 4.4
Mean 2	10.75 ± 0.01
Std. Dev. 2	5.922 ± 0.078
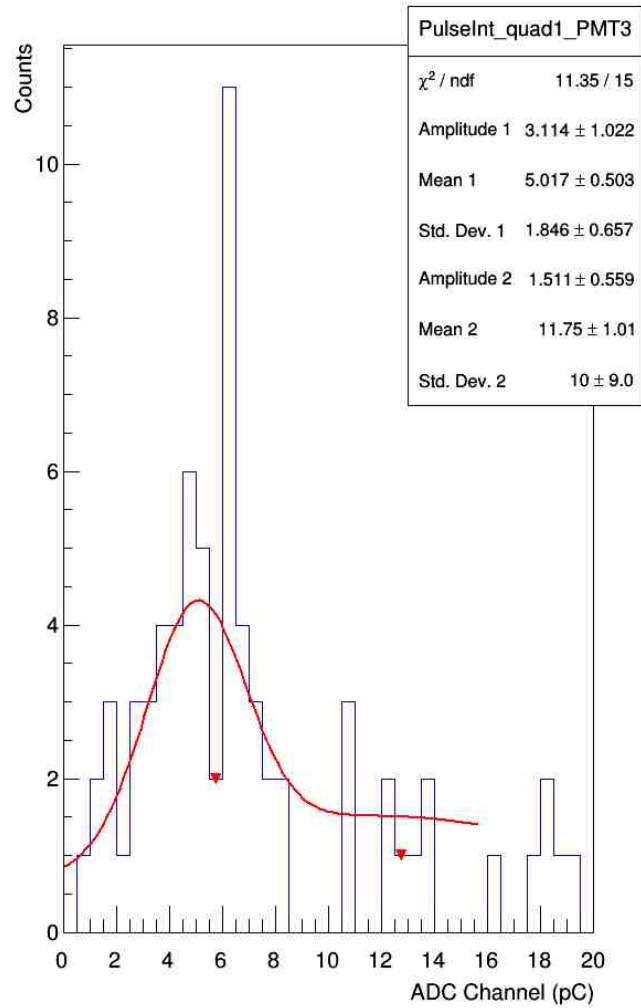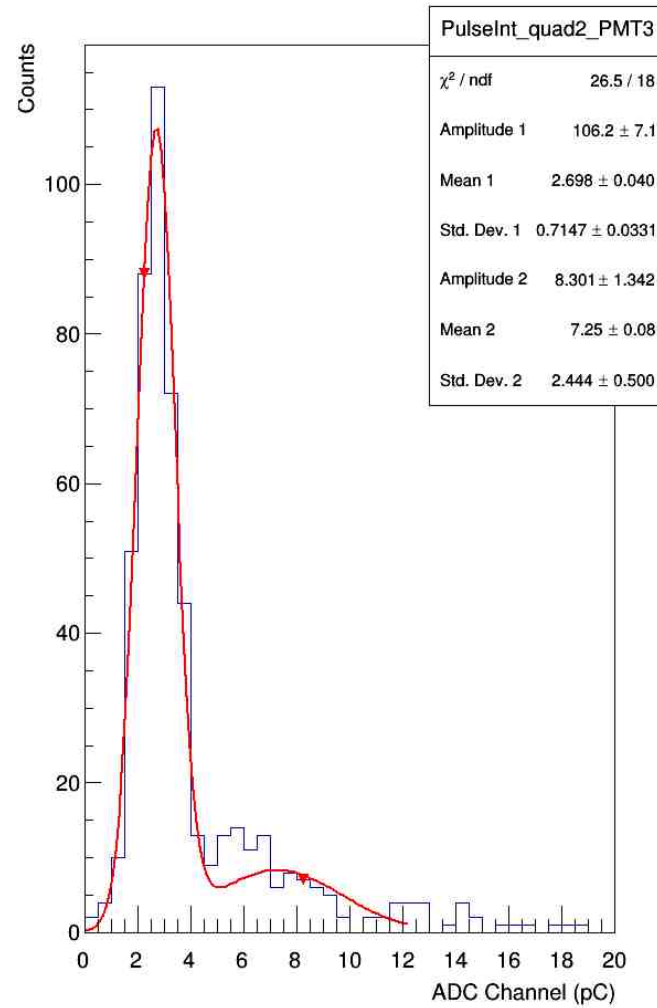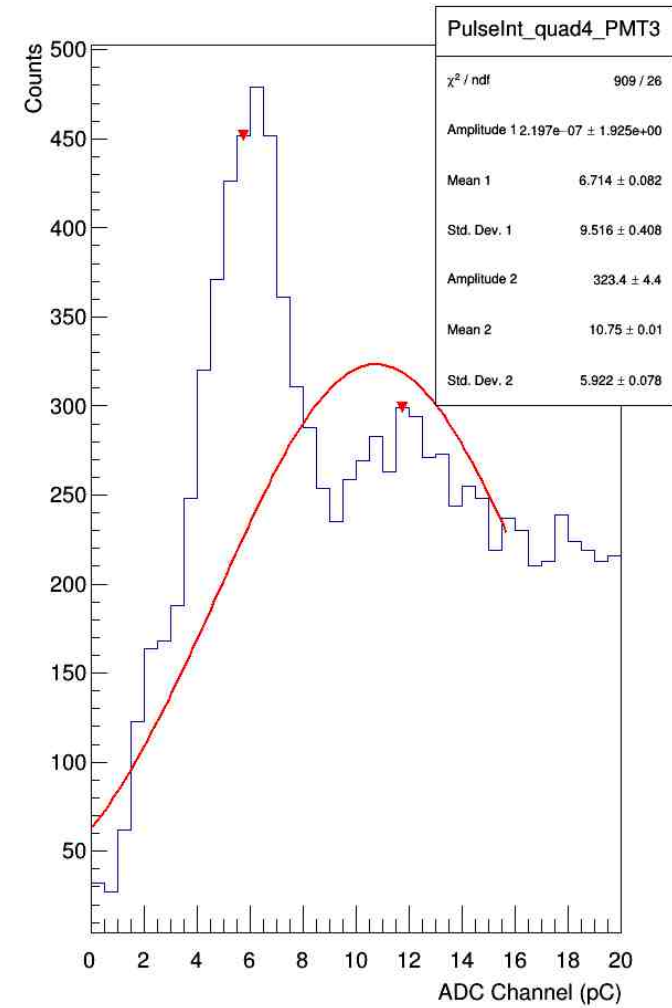
Pulse Integral for PMT4

5154, 5155 & 5156

Pulse Integral PMT4 quad1

PulseInt_quad1_PMT4	
χ^2 / ndf	5.362 / 10
Amplitude 1	1.538 ± 0.338
Mean 1	4.751 ± 1.436
Std. Dev. 1	10 ± 6.4
Amplitude 2	2.019e−06 ± 5.780e+00
Mean 2	12.25 ± 1.43
Std. Dev. 2	3.492 ± 7.671

Pulse Integral PMT4 quad2

PulseInt_quad2_PMT4	
χ^2 / ndf	9.83 / 14
Amplitude 1	4.358 ± 0.763
Mean 1	5.704 ± 1.414
Std. Dev. 1	3.65 ± 1.45
Amplitude 2	5.074 ± 92.475
Mean 2	21.75 ± 2.00
Std. Dev. 2	4.138 ± 5.328

Pulse Integral PMT4 quad3

PulseInt_quad3_PMT4	
χ^2 / ndf	92.02 / 28
Amplitude 1	10.65 ± 1.76
Mean 1	6.536 ± 0.542
Std. Dev. 1	6.006 ± 1.025
Amplitude 2	14.65 ± 3.14
Mean 2	7.478 ± 0.246
Std. Dev. 2	1.167 ± 0.186
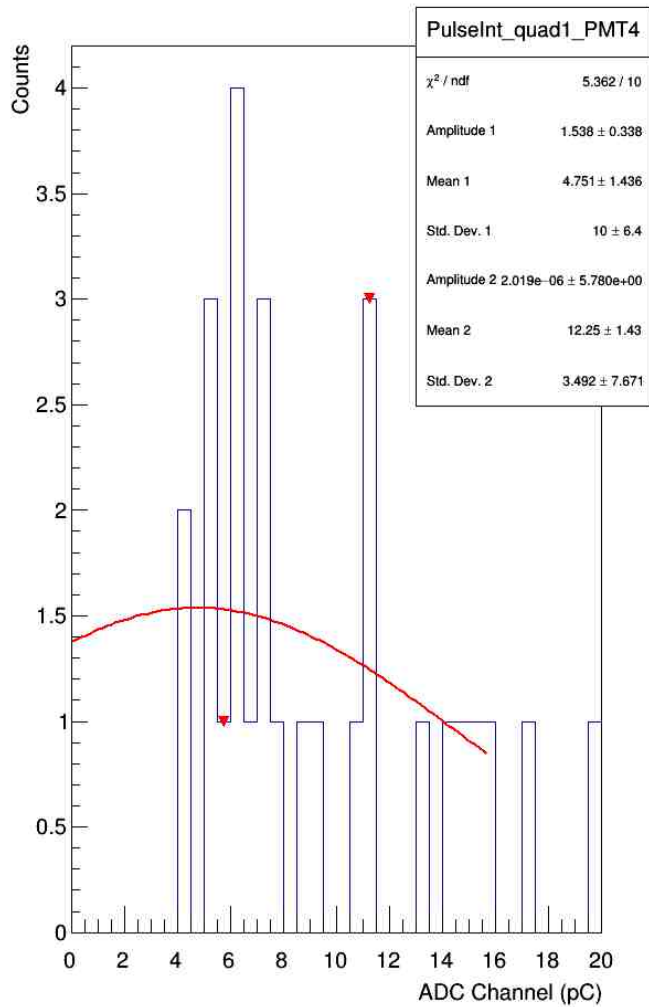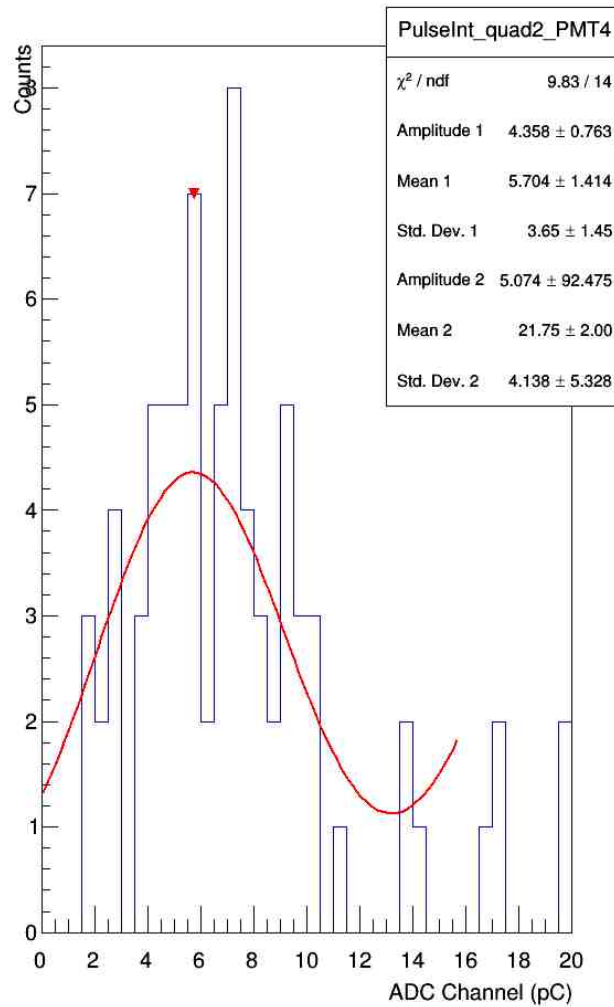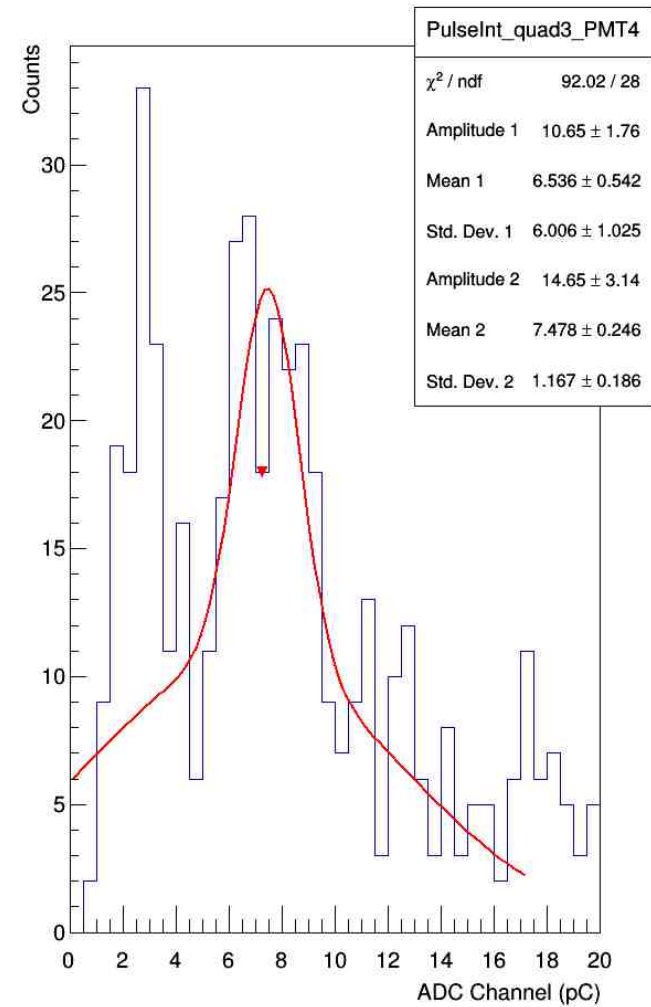
Pions Selection

5154, 5155 & 5156
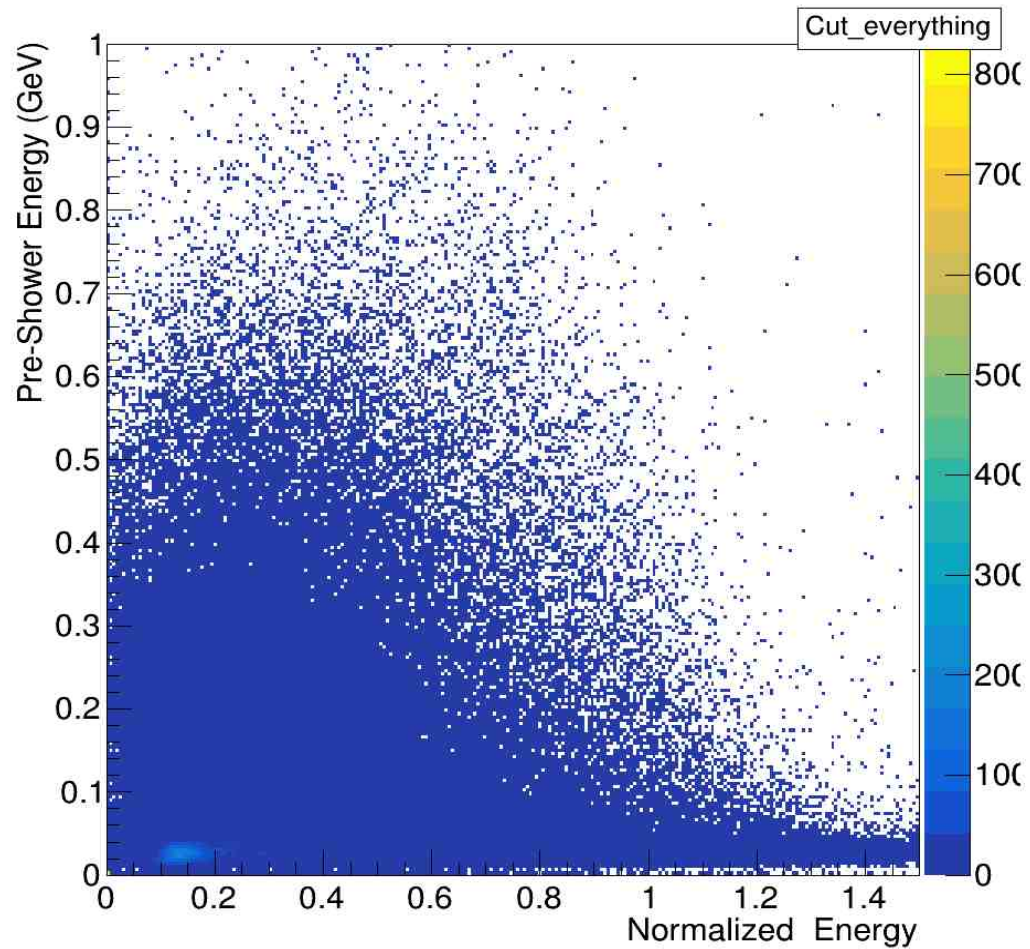
Visualization of no cuts

Visualization of pion cut
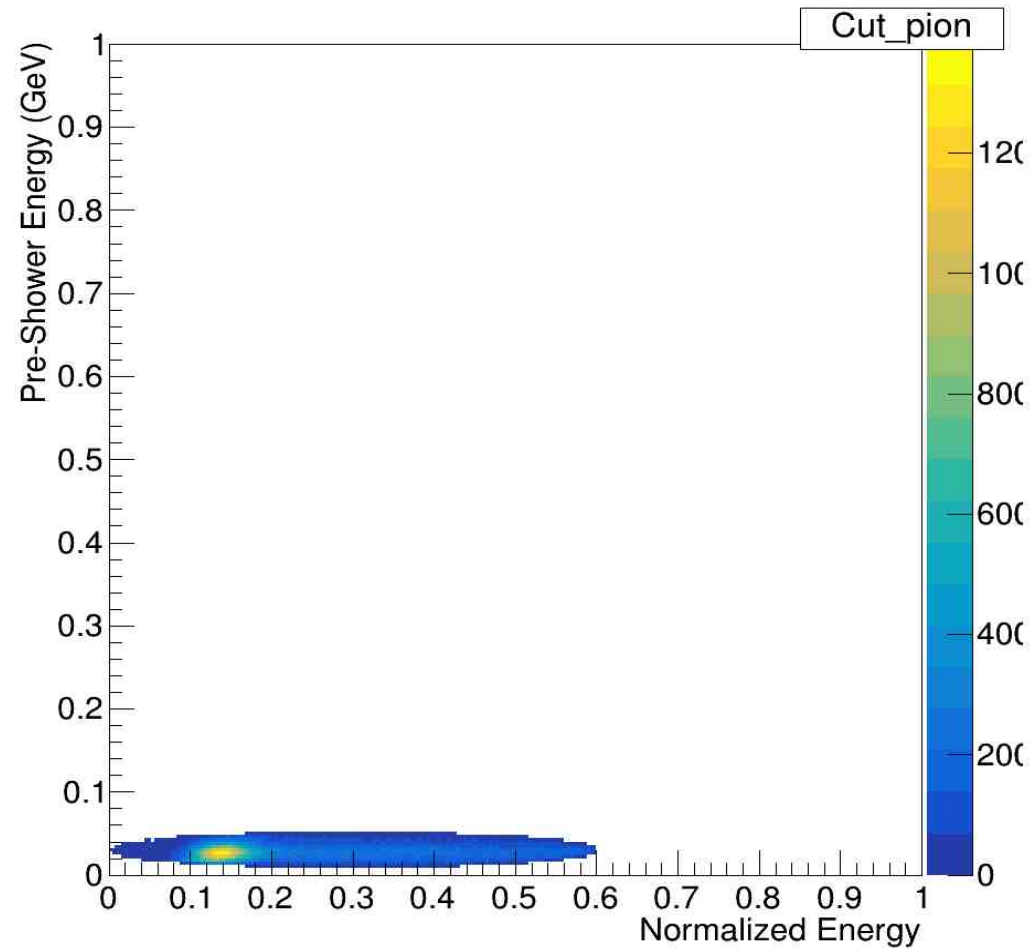
PMT1: 6.867   PMT3: 6.714
PMT2: 4.640   PMT4: 7.750

5154, 5155 & 5156

PMT1: 6.867
PMT2: 4.640

PMT3: 6.714
PMT4: low statistics

5157, 5158 & 5174

PMT1: 8.331
PMT2: 4.650

PMT3: 5.505
PMT4: low statistics

5175, 5176 & 5178

PMT1: 8.999
PMT2: 4.770

PMT3: 4.216
PMT4: low statistics

5179, 5180 & 5181

PMT1: 8.229
PMT2: 7.214

PMT3: 5.633
PMT4: low statistics

5298 & 5299

PMT1: 6.436
PMT2: 4.714

PMT3: 5.475
PMT4: low statistics

Beam energy = 10.599 GeV

Momentum of SHMS = 6.053 (Positive polarity)

5300 & 5301

PMT1: 8.990
PMT2: 4.688

PMT3: 4.219
PMT4: low statistics

Lower momentum carbon run

Timing plot of 6731

Beam energy = 3.82 GeV

Momentum of SHMS = 2.5830
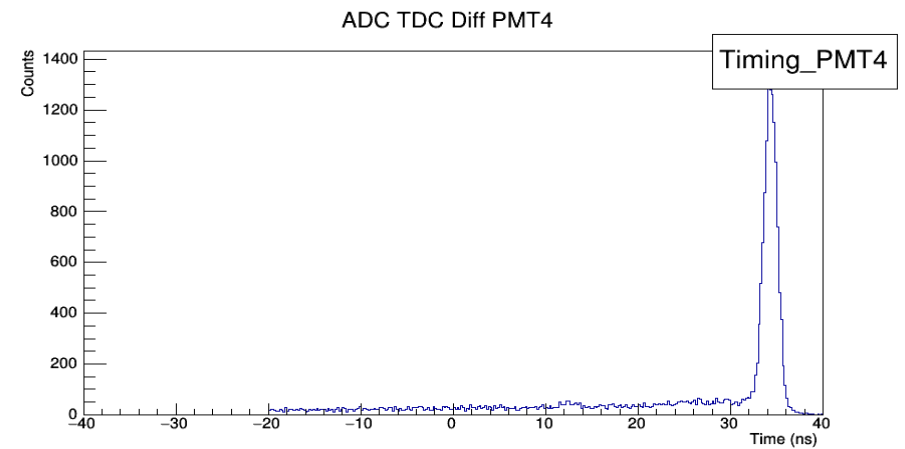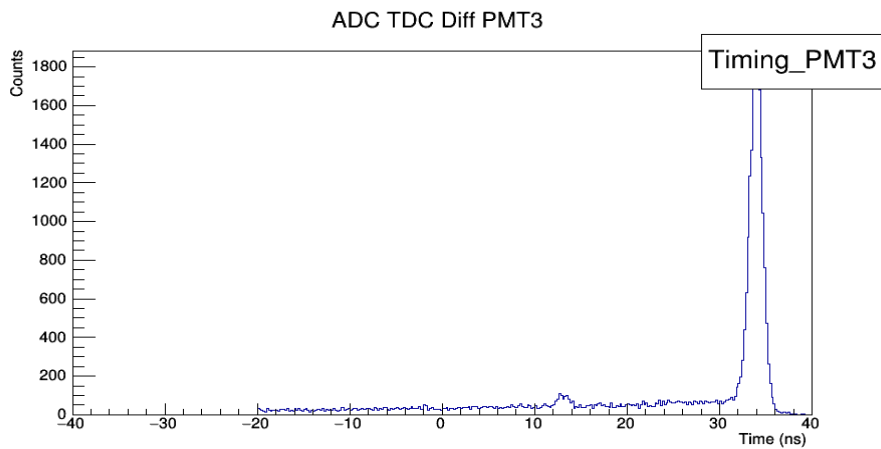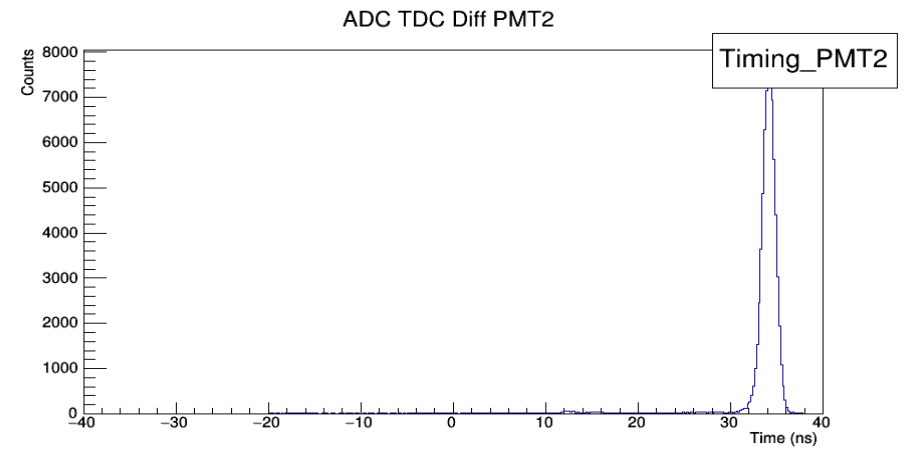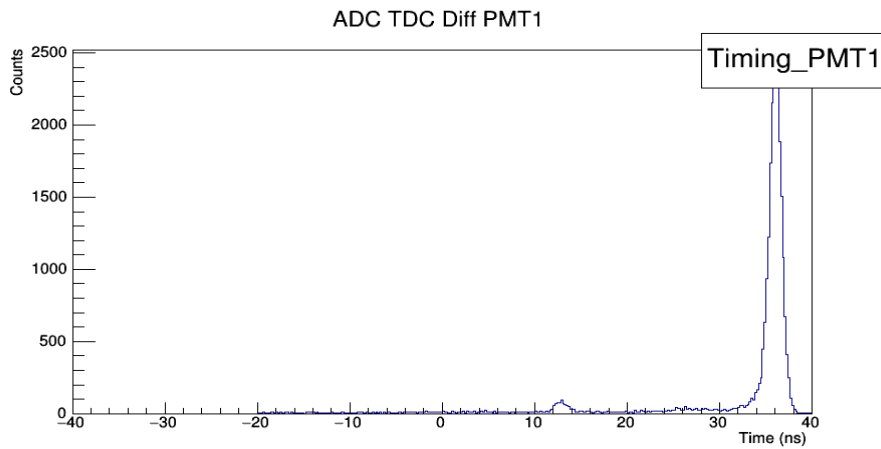
PMT1: 6.150   PMT3: 5.484
PMT2: 6.783   PMT4: low statistics

6618 & 6620

Beam energy = 3.835 GeV

Momentum of SHMS = -2.478

Visualization of no cuts
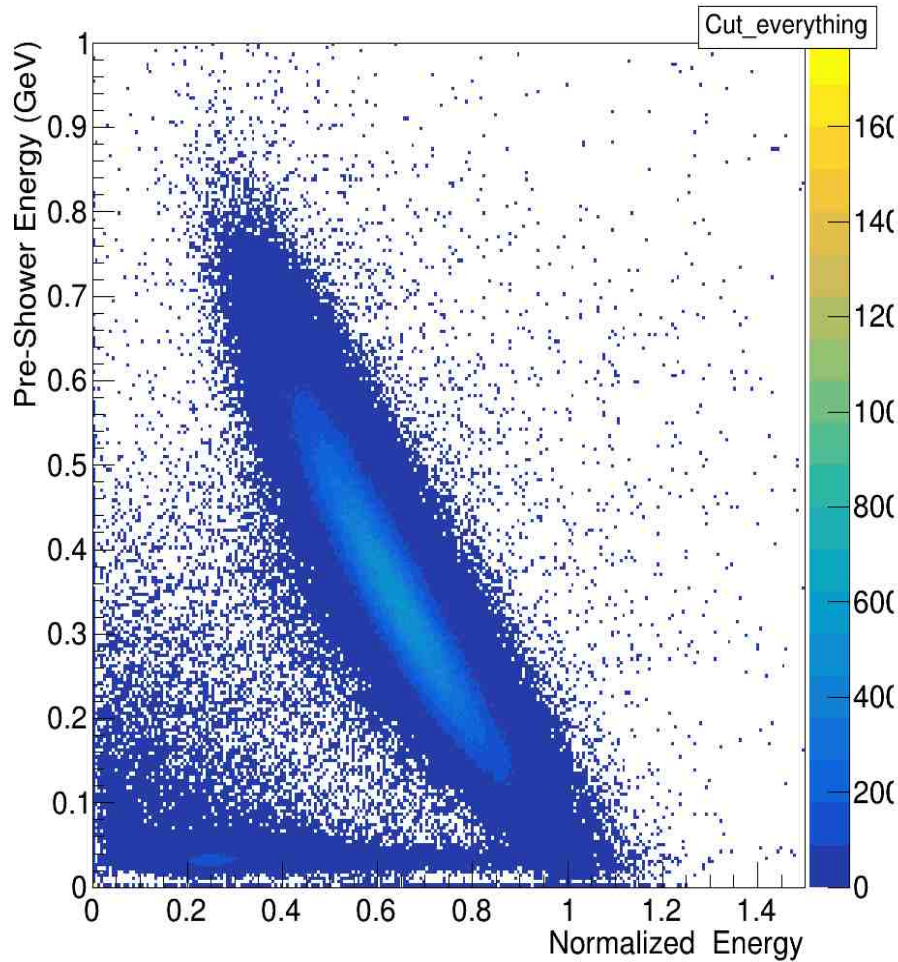
Visualization of electron cut
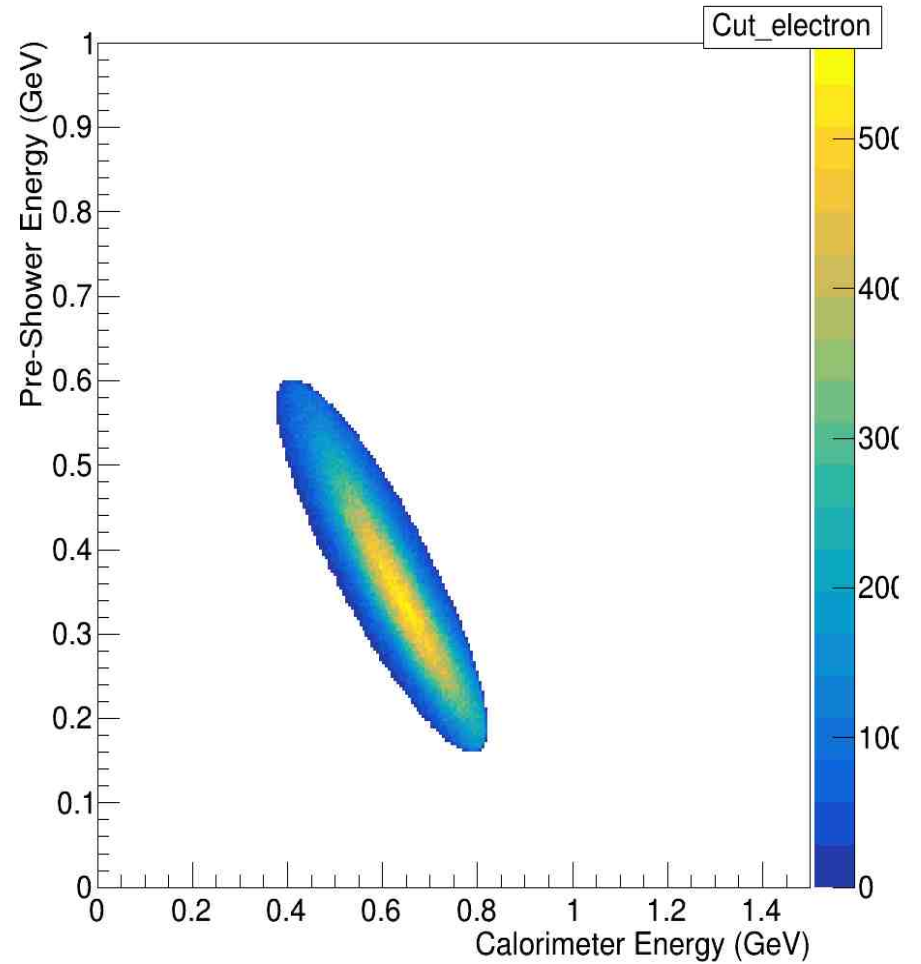
6618 & 6620

PMT1: 6.364   PMT3: 5.529
PMT2: 7.134   PMT4: low statistics

Beam energy = 6.18 GeV

Momentum of SHMS = -3.939

7841 & 7846

PMT1: 6129   PMT3: 5.411
PMT2: 6.808   PMT4: 7.245

7847, 7864 & 7865

PMT1: 6.096   PMT3: 5.452
PMT2: 7.035   PMT4: 7.404

Beam energy = 8.186 GeV

7947 & 7948

Momentum of SHMS = -5.745

Visualization of no cuts
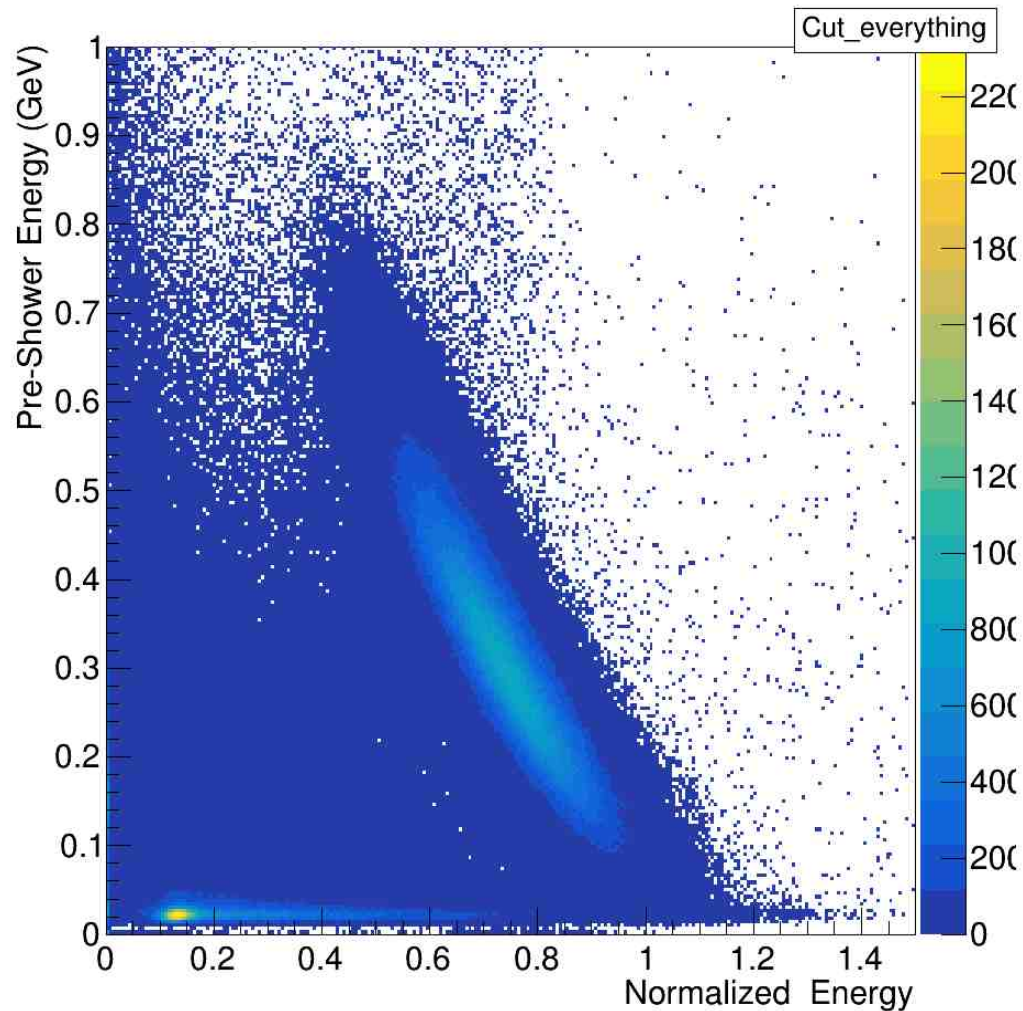
Visualization of electron cut
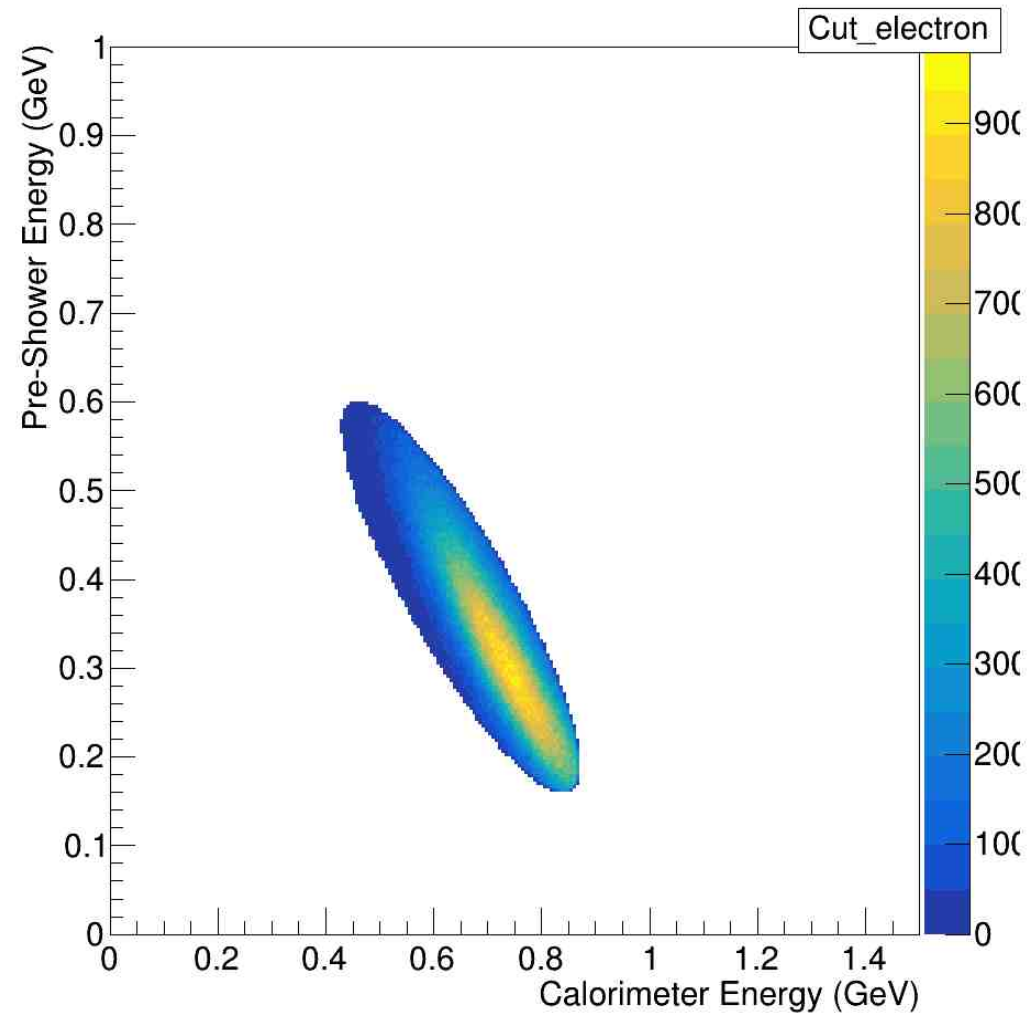
7947 & 7948

PMT1: 6.141   PMT3: 5.293
PMT2: 6.668   PMT4: 7.181

7949 & 7950

PMT1: 6.363   PMT3: 5.446
PMT2: 7.00   PMT4: 7.265

7951 & 7952

PMT1: 6.135   PMT3: 5.368
PMT2: 6.770   PMT4: 7.218

PID through efficiency code of 8977 run

Particle ID from calorimeter & preshower
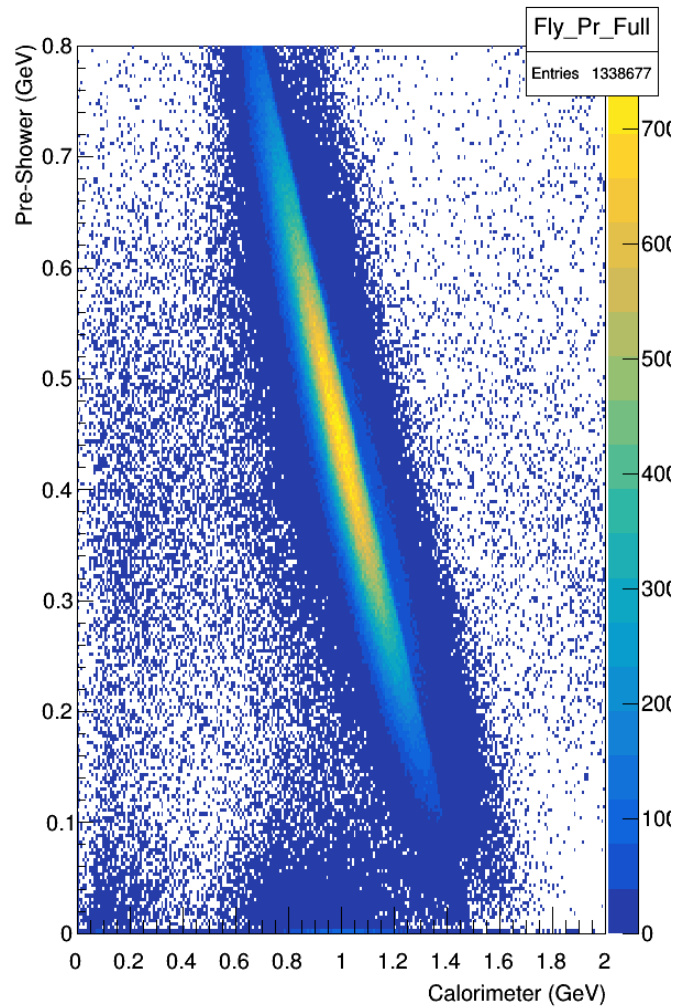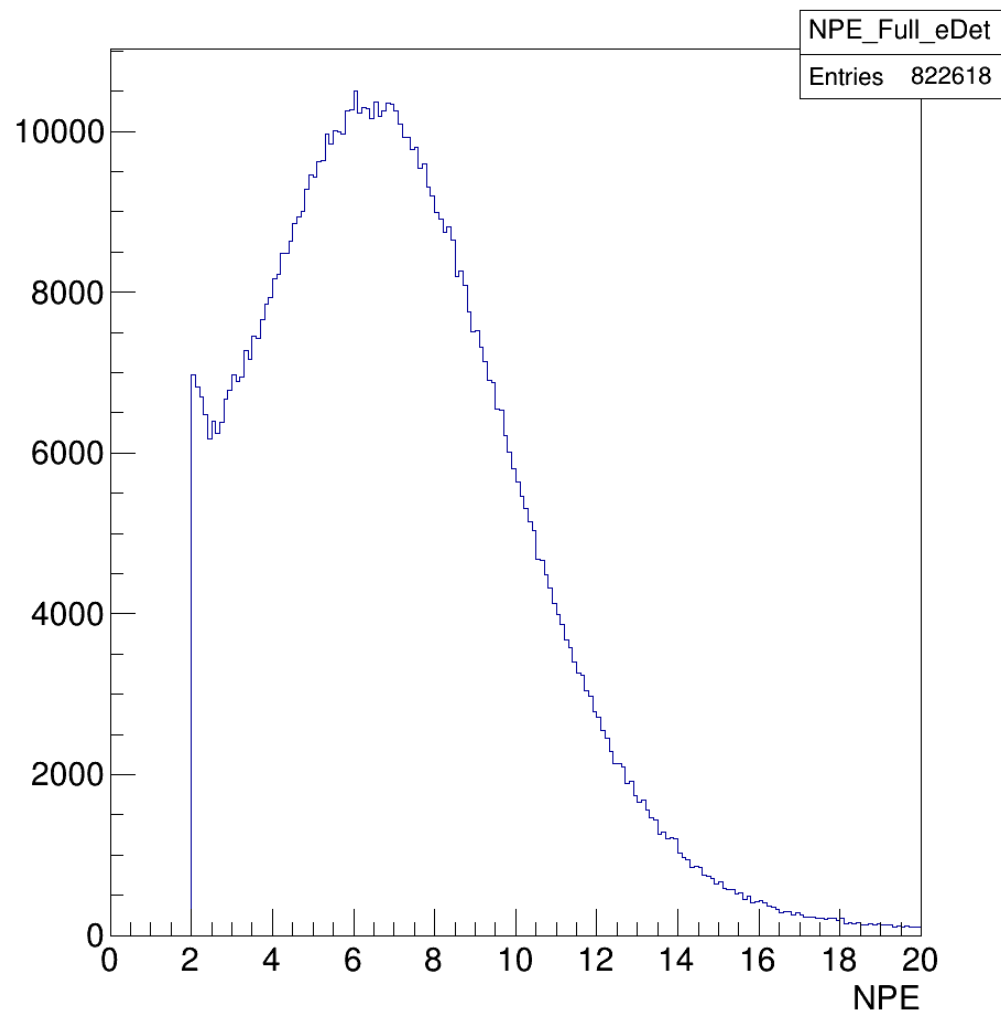
calorimeter & preshower electrons

calorimeter & preshower pions

NPE of 8977 run
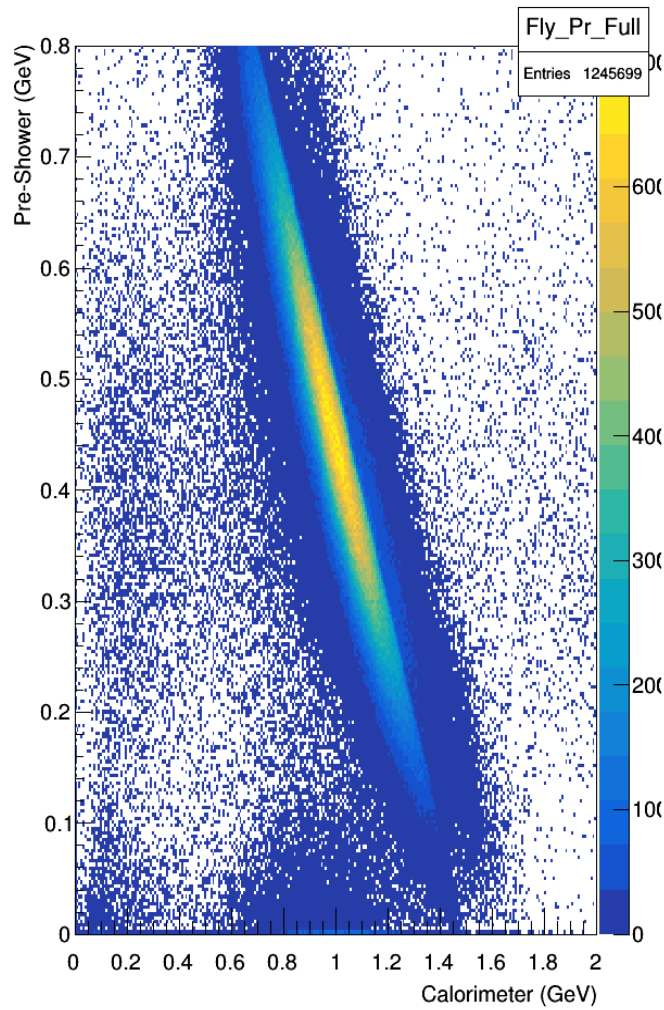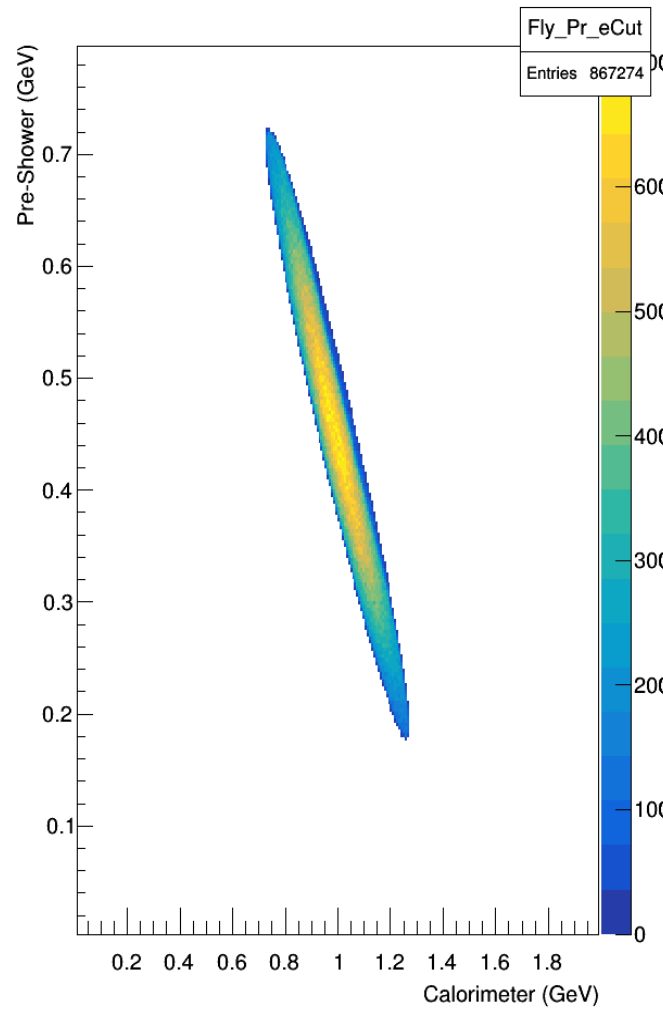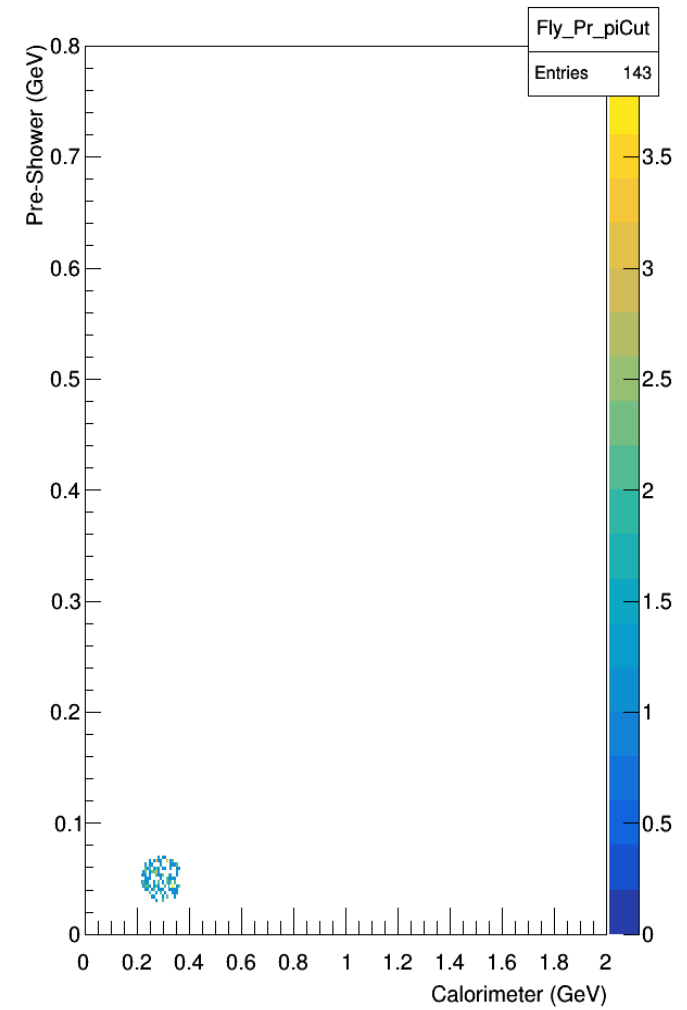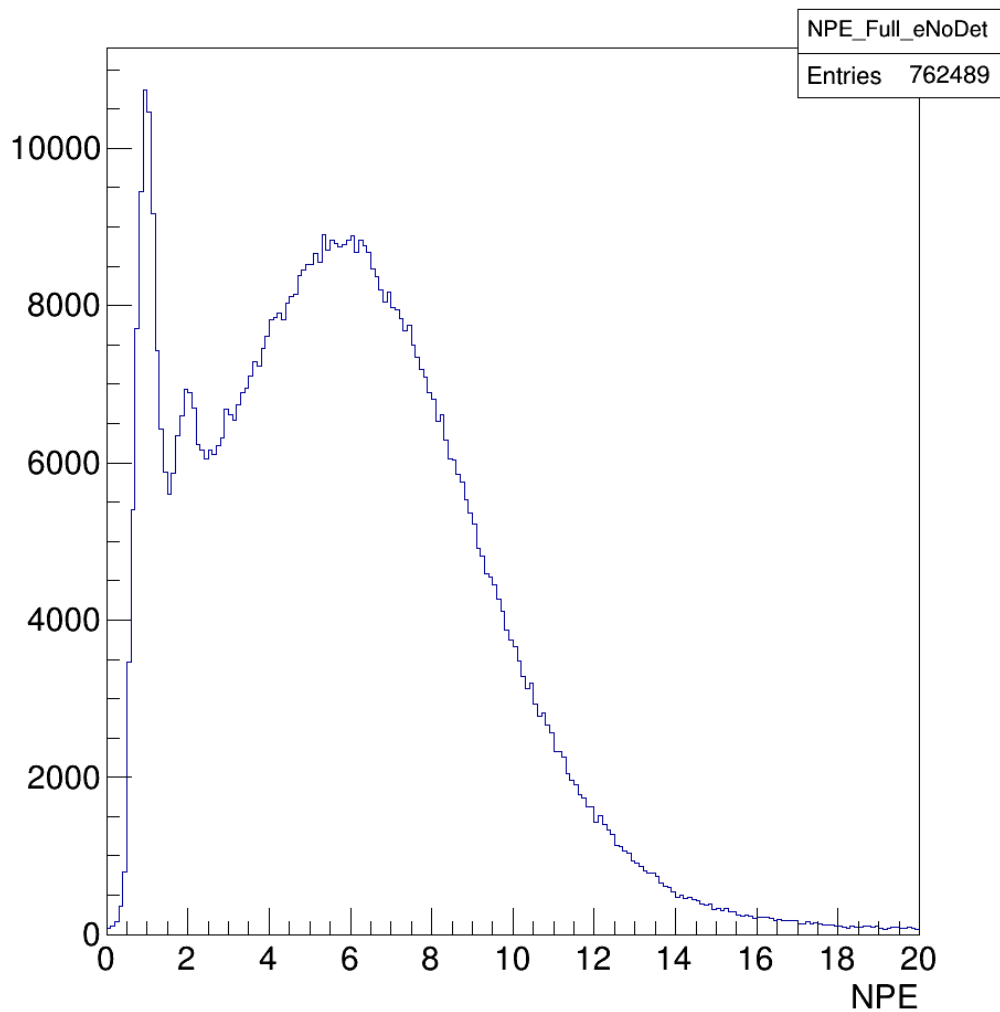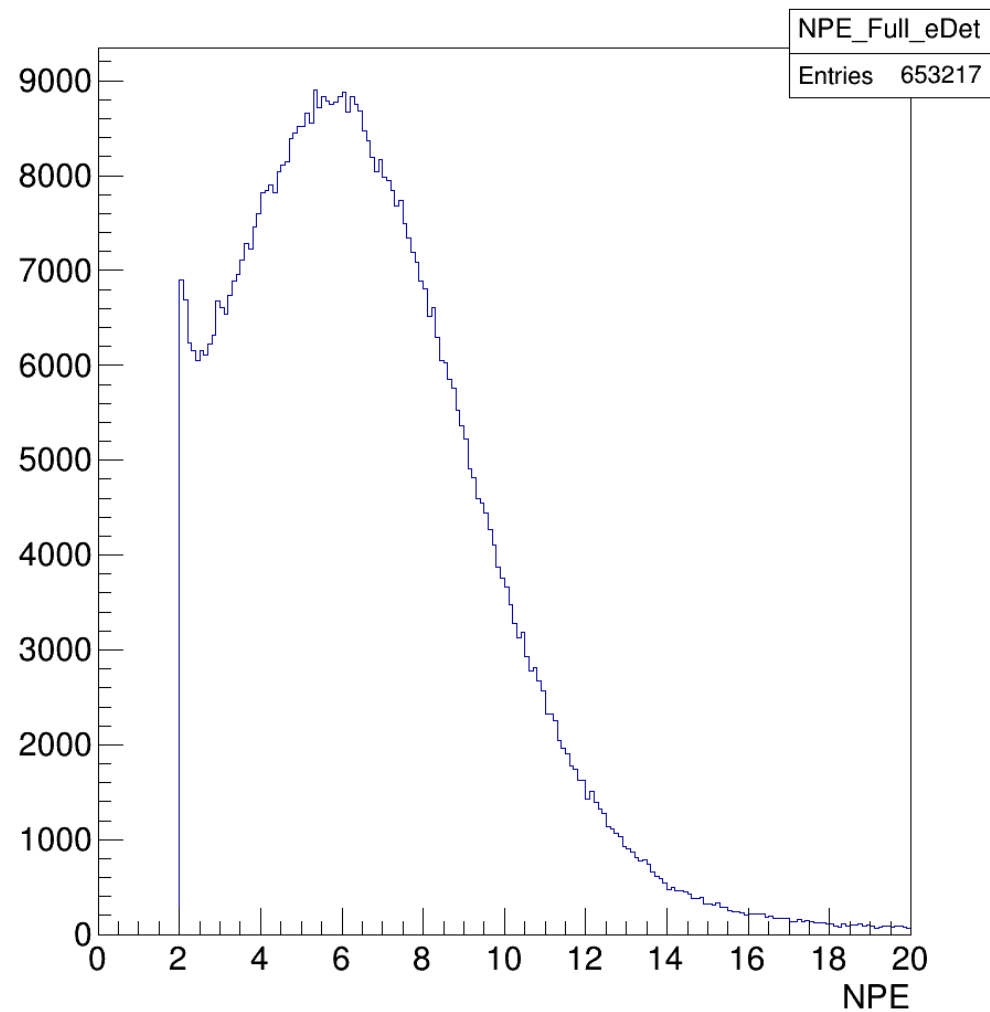
NPE in All PMTs with no Detector Cut

NPE_Full_eNoDet	
Entries	933535

NPE in All PMTs with Detector Cut

NPE_Full_eDet	
Entries	822618

PID through efficiency code of 8979 run

Particle ID from calorimeter & preshower

Fly_Pr_Full
Entries 1245699

calorimeter & preshower electrons

Fly_Pr_eCut
Entries 867274

calorimeter & preshower pions

Fly_Pr_piCut
Entries 143

NPE of 8979 run

Plan for next work

Still more work is needed for Kaon LT experiment. I have not checked the Pion data yet.

Then I'll move to efficiency, Delta & Position Scanning.