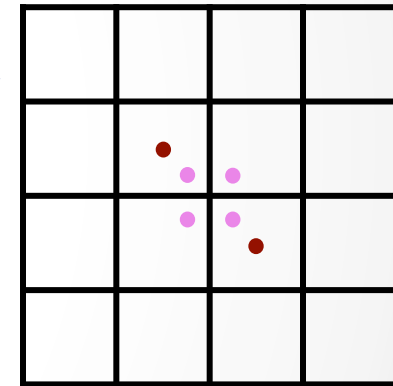


Pure CsI Test Beam Update

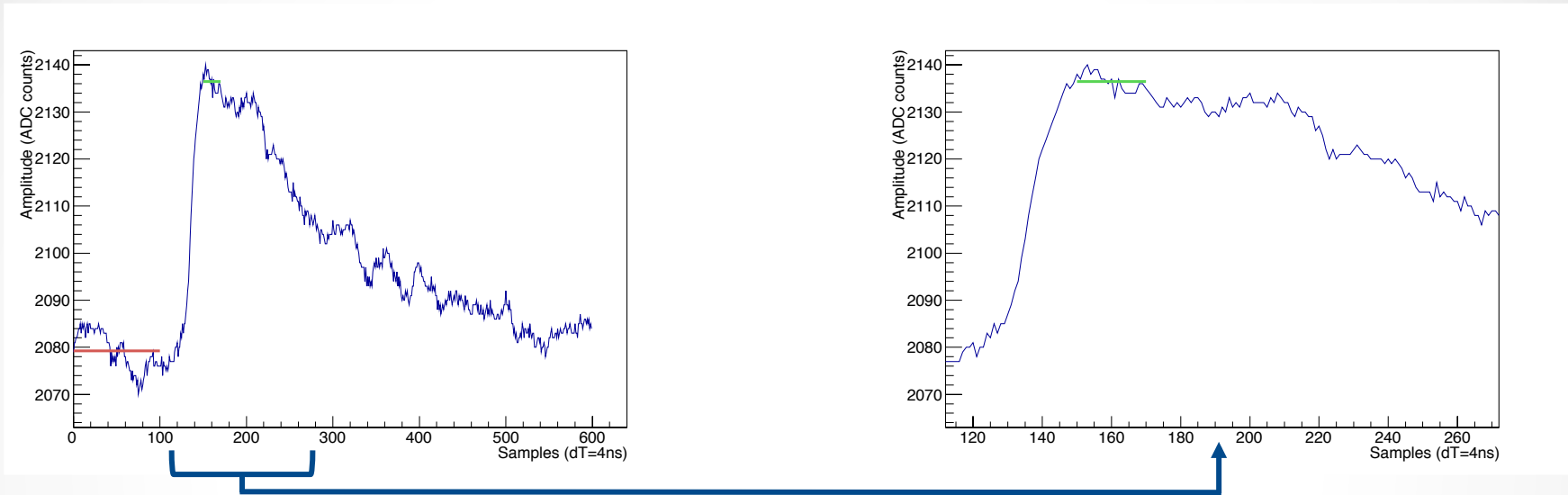
A. Rossi, C. Cecchi, E. Manoni

Data acquisition configurations

- We acquired 5 different energies for each run
 - Trigger : 5 different tagger in OR
 - The 5 tagger signals used in the trigger are acquired for offline separation of the energies
- Three different trigger configuration:
 - **Calibration: 289MeV – 350MeV – 422MeV – 480MeV – 550MeV**
 - One run at the center of each crystal
 - **Low Energy: 50MeV – 76MeV – 99MeV – 151MeV – 201MeV**
 - 1 run at the center of two internal crystals (red dots)
 - 4 runs at each points which maximize the containment according to MC (pink dots)
 - **High Energy: 301MeV – 400MeV – 501MeV – 651MeV – 780MeV**
 - 1 run at the center of two internal crystals (red dots)
 - 4 runs at each points which maximize the containment according to MC (pink dots)

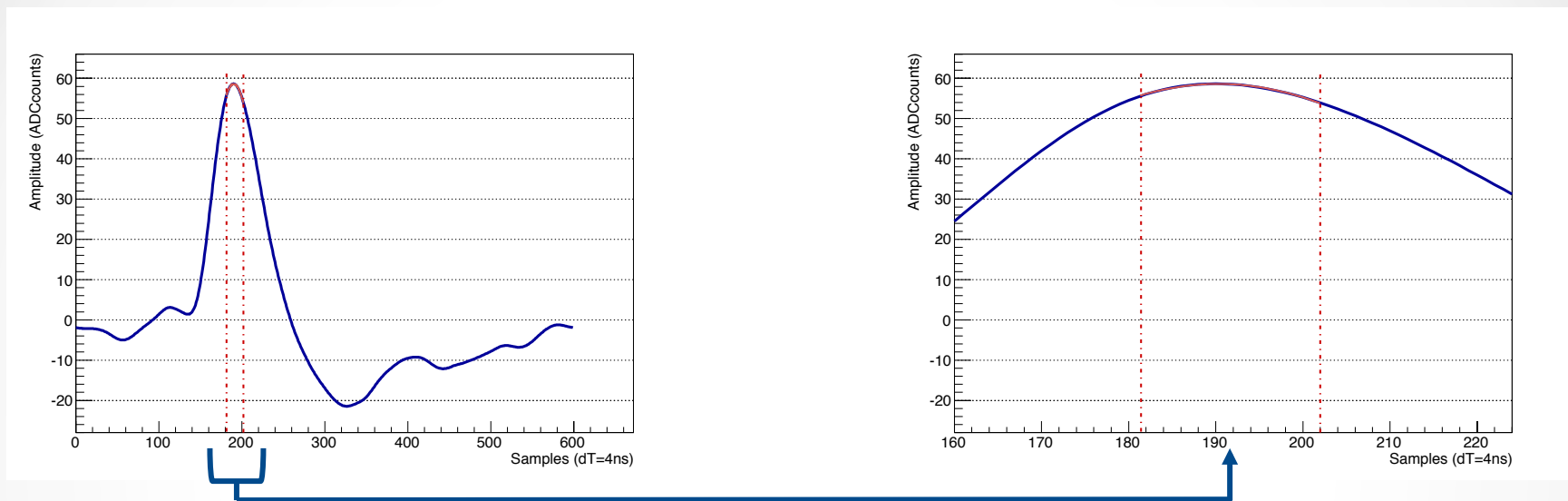


Amplitude Extraction



- Pedestal : first 100 samples mean
- Signal : Mean between fixed windows (20samples)
- Amplitude : Signal - Pedestal

Amplitude Extraction (shaping)

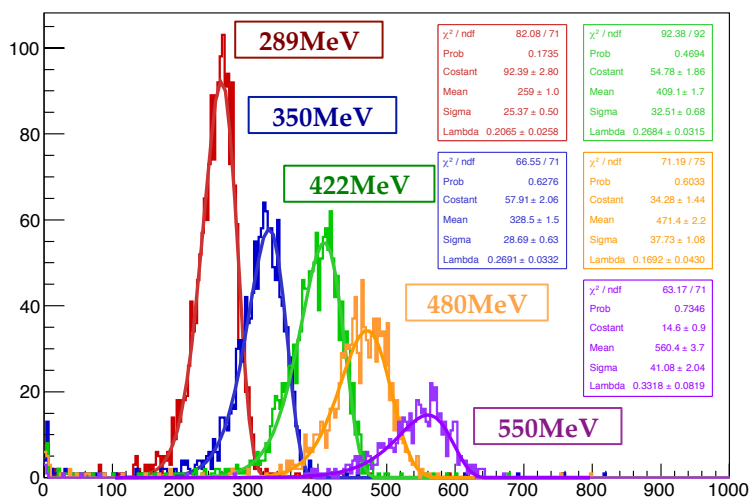


- Signal : Gaussian fit on fixed windows (20samples)
- No pedestal subtraction
 - With software shaping baseline always at zero

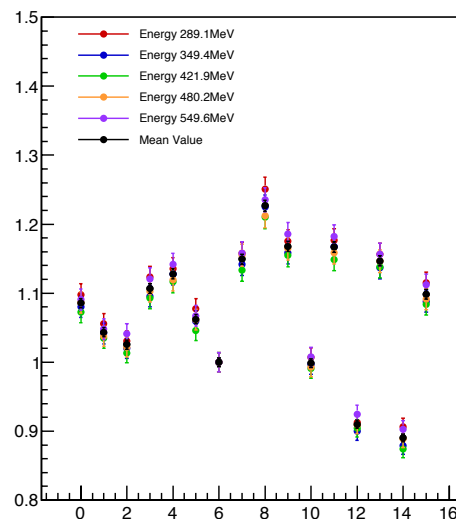
Calibration

- Fit the deposited energy distribution for each APD for each energy with Novosibirsk function
 - Only the deposited energy on the crystal in which the beam is directed
- Using the Mean value to intercalibrate the 32Chs
- We have 5 different constants (one for each energy) for each channel
 - Final constants as the mean value**

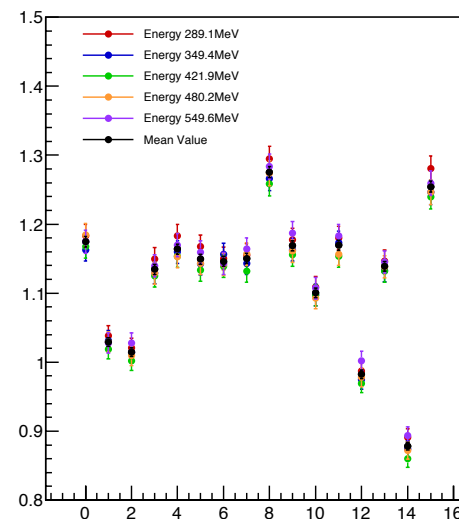
Ch0 APD0 - Calibration



Calibration Constants - APD0



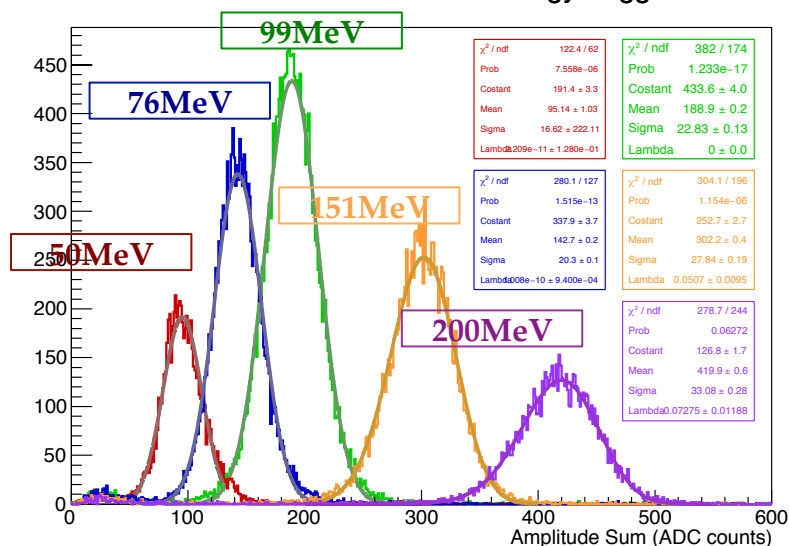
Calibration Constants - APD1



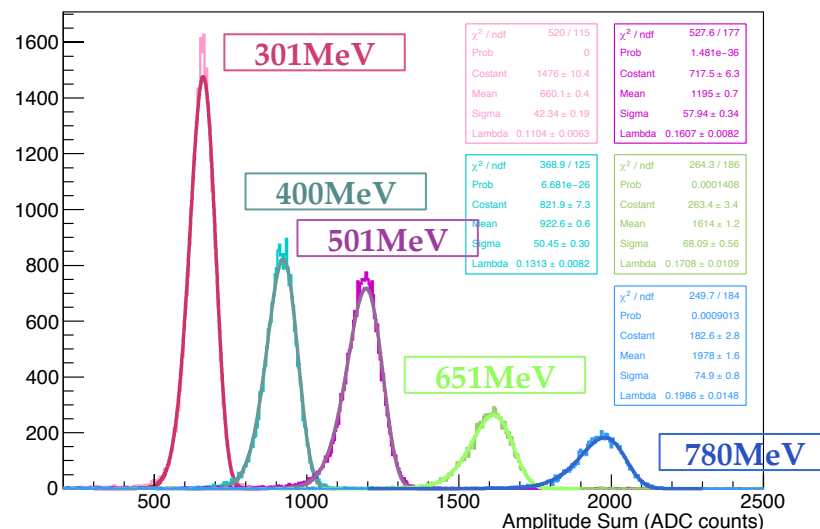
Energy Distributions

- Sum all the channels with Signal greater than 0 together
 - Intercalibration parameters applied
- Stable temperature during all the test period
 - No T correction needed

Ch6 - Position Cen - LowEnergy Trigger



Ch6 - Position Cen - HighEnergy Trigger

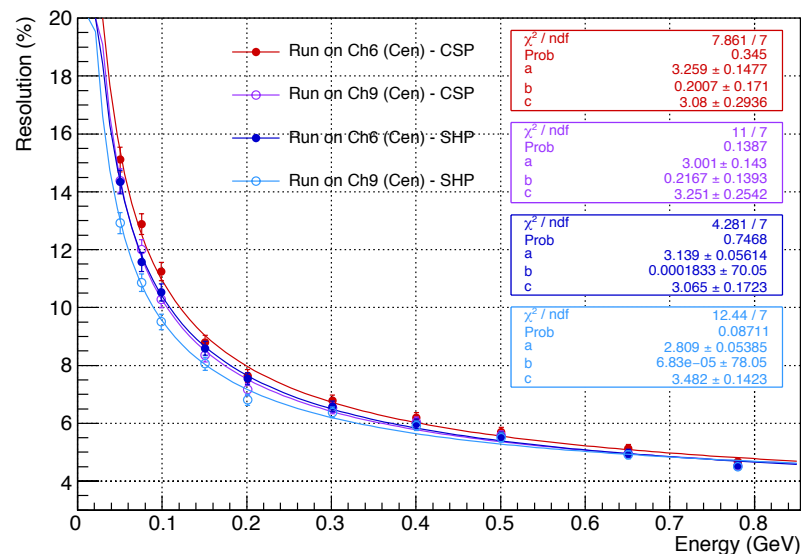


Resolution

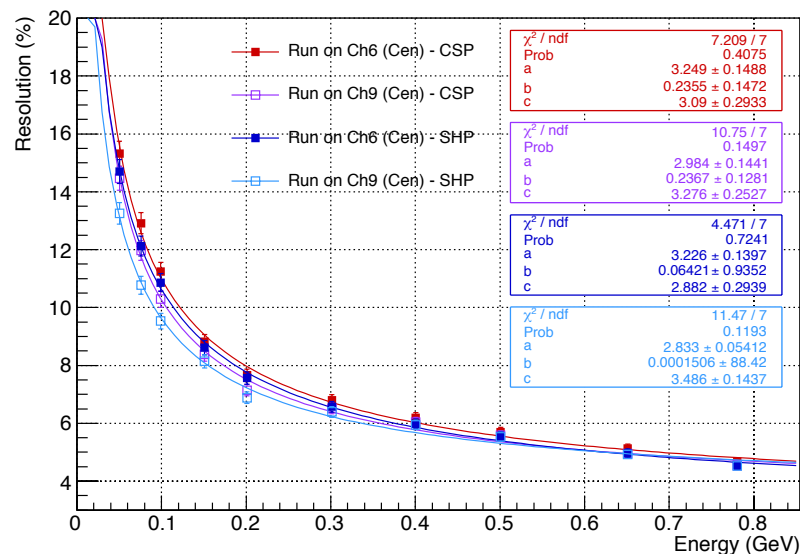
- Crystal Center

$$\text{Fit function : } \sigma(E)/E = \frac{a}{\sqrt{E}} \oplus \frac{b}{E} \oplus c$$

Resolution - Calib. Ch6 Apd0

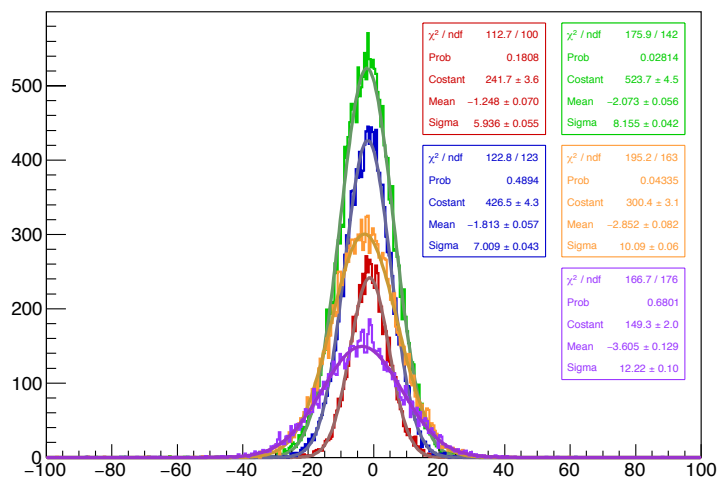


Resolution - Calib. Ch9 Apd0

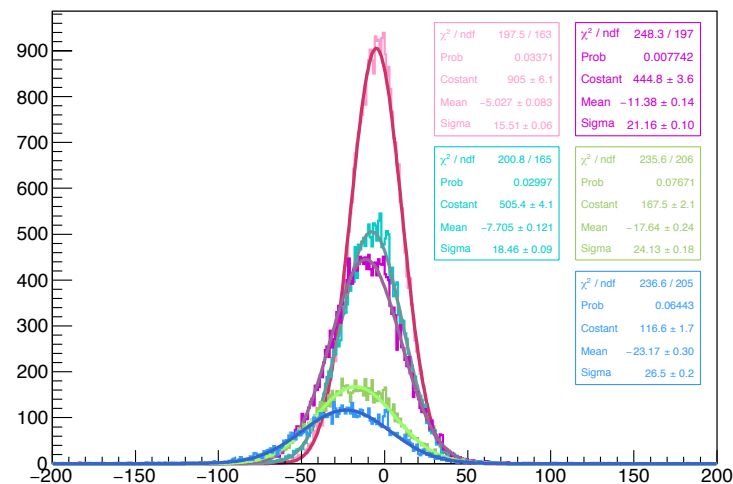


- Resolution after shaping not updated

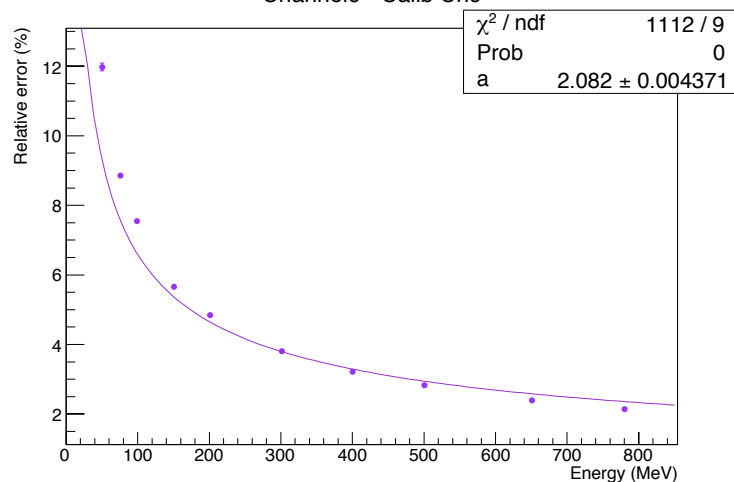
Ch6 - Position Cen - Calib Ch6 - LowEnergy Trigger



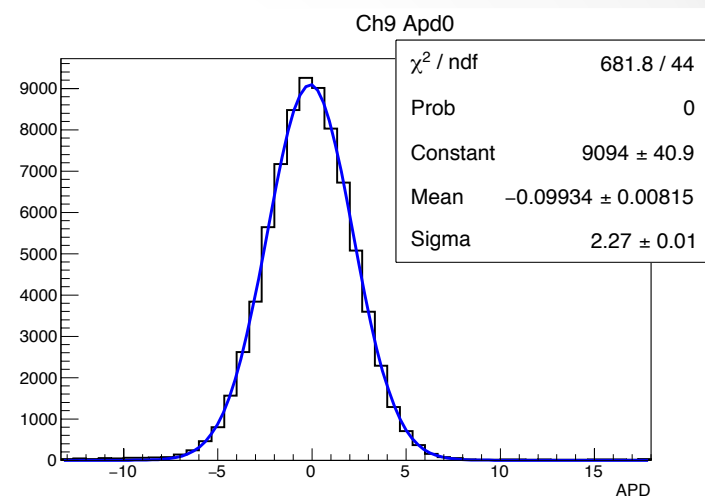
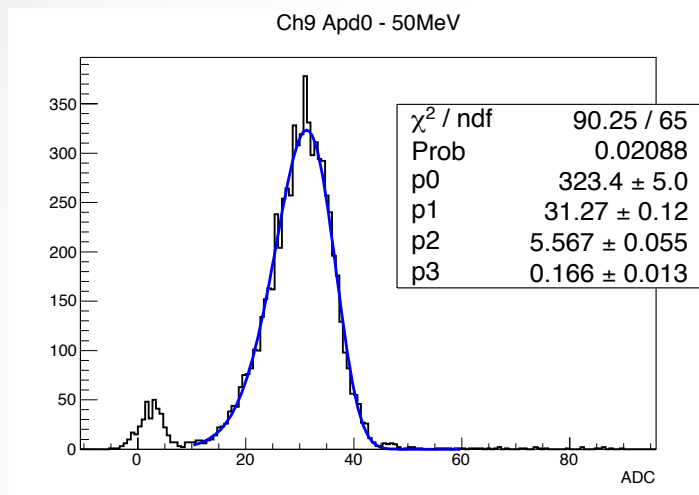
Ch6 - Position Cen - Calib Ch6 - HighEnergy Trigger



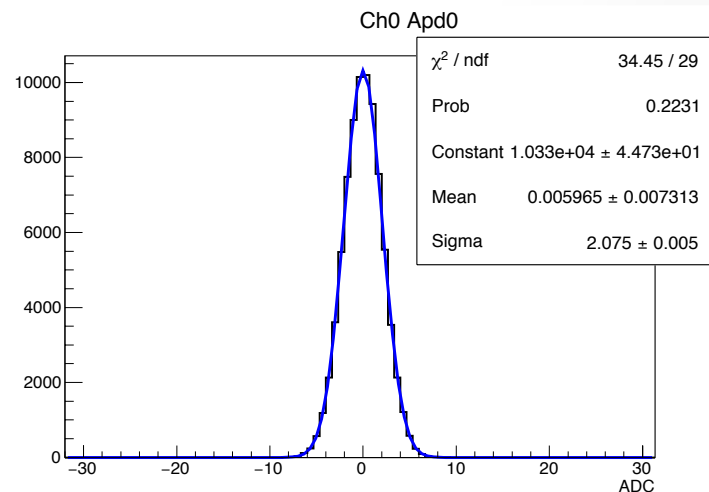
Channel6 - Calib Ch9



- $a/\sqrt{E}$ evaluated with total deposited energy in the matrix

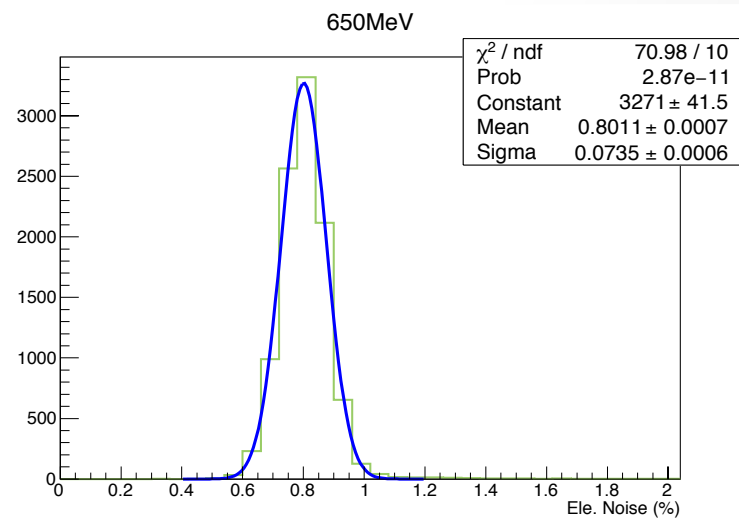
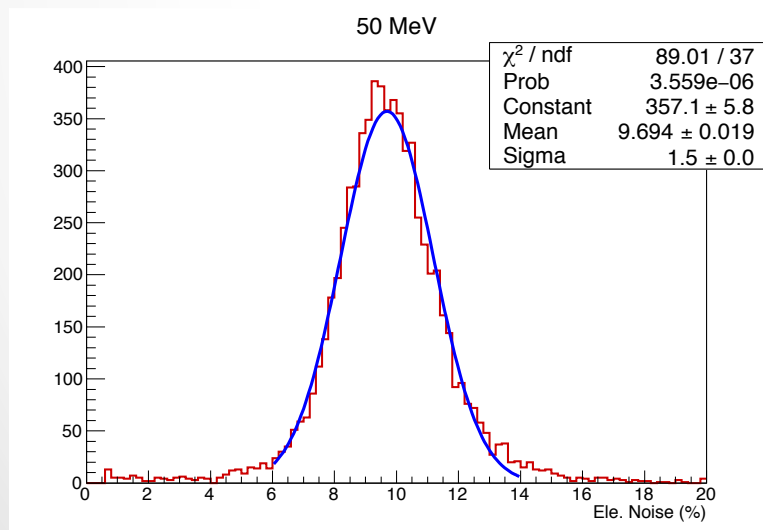


- If $e1/e_{\text{tot}} \sim 80\%$
- ENE
 - $40\text{MeV} \cdot 2.1/31.3 = \mathbf{2.7\text{MeV}}$
- **For 9xtal cluster**
 - **Noise $2.7/\sqrt{9} \sim 0.9\text{MeV}$**



Noise Contribution

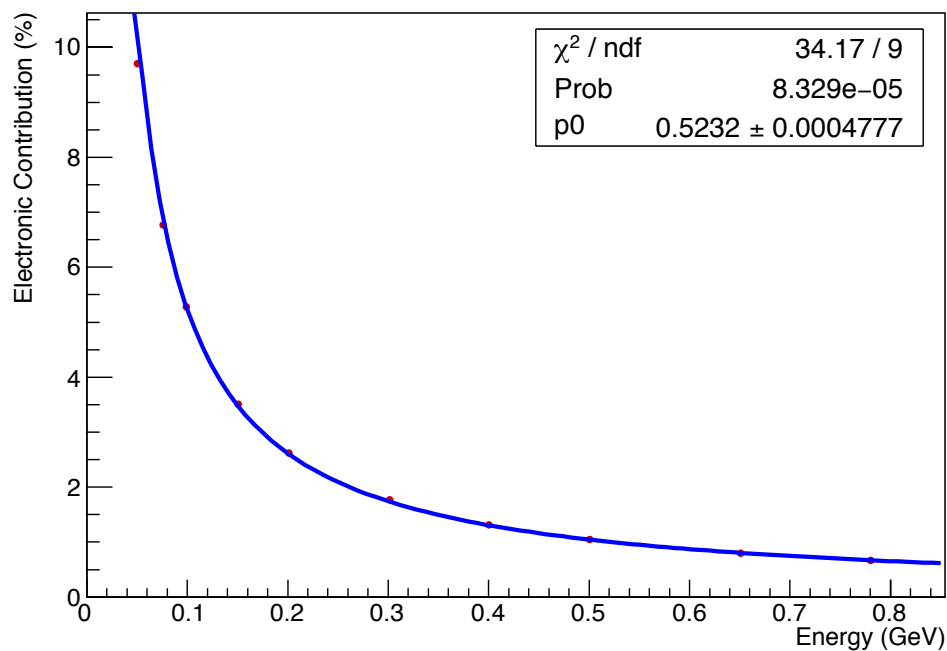
- Sum all the noise from crystals inside the cluster
- Divide event by event Noise/Etot
- Extract mean Electronic noise contribution with gaussian fit



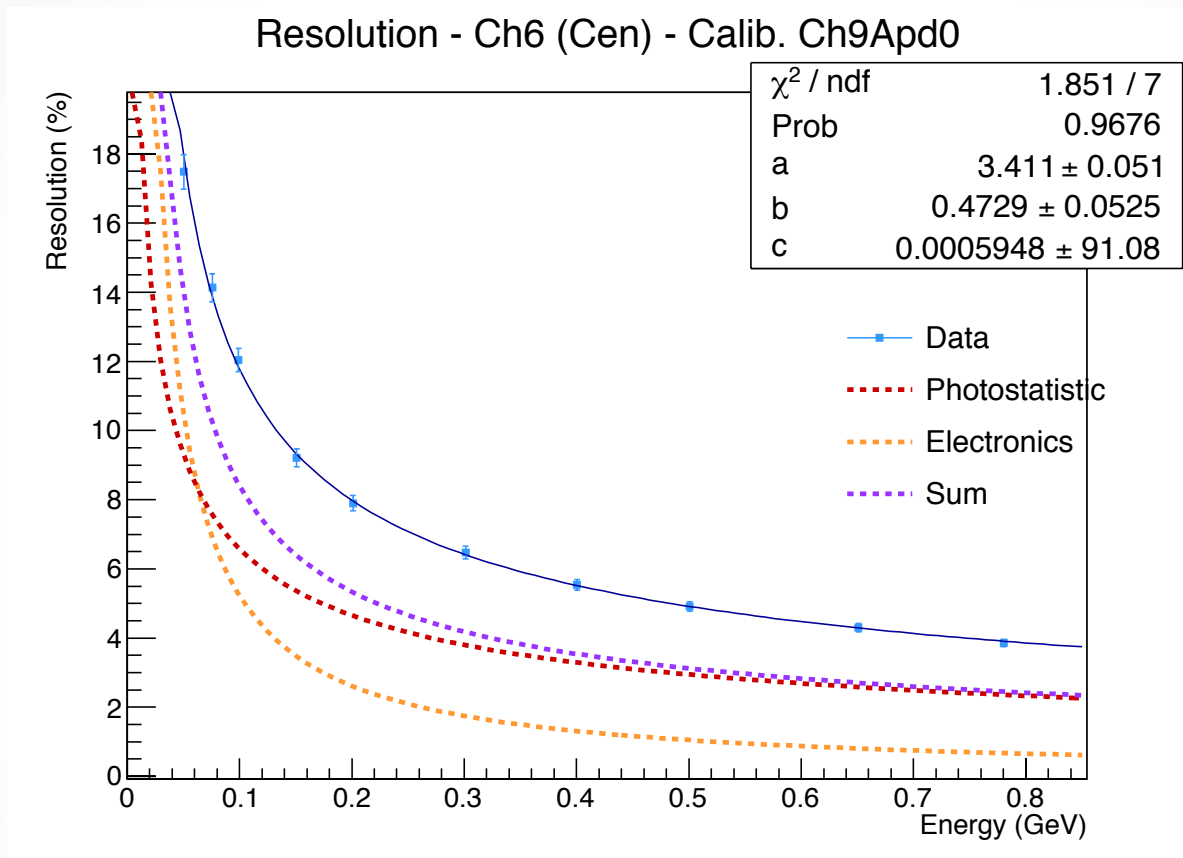
Noise Contribution

- Extract noise term by fitting with $f(E)=b/E$

Electronic Noise Contribution



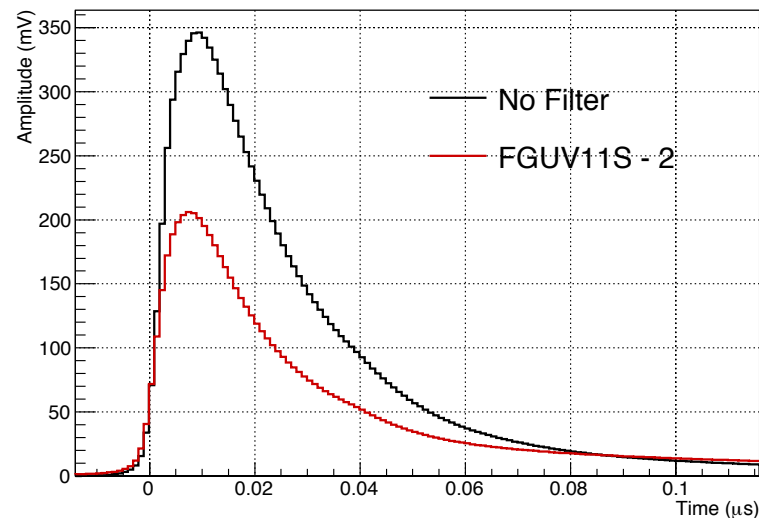
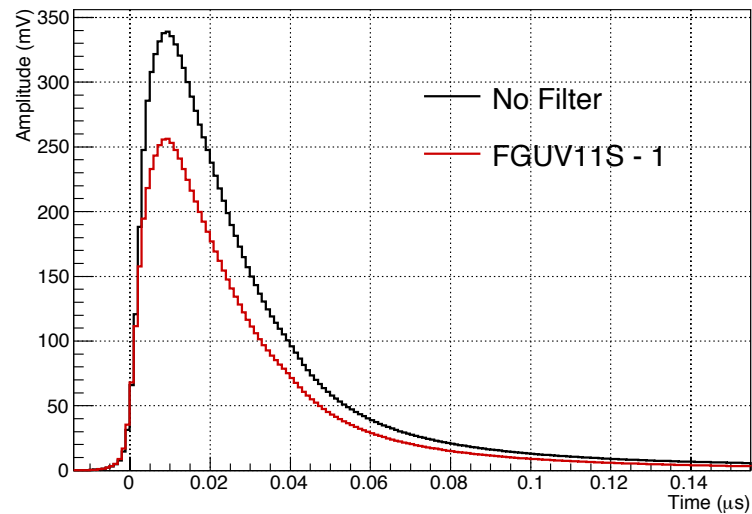
Campare contribution



- No linearity correction applied!

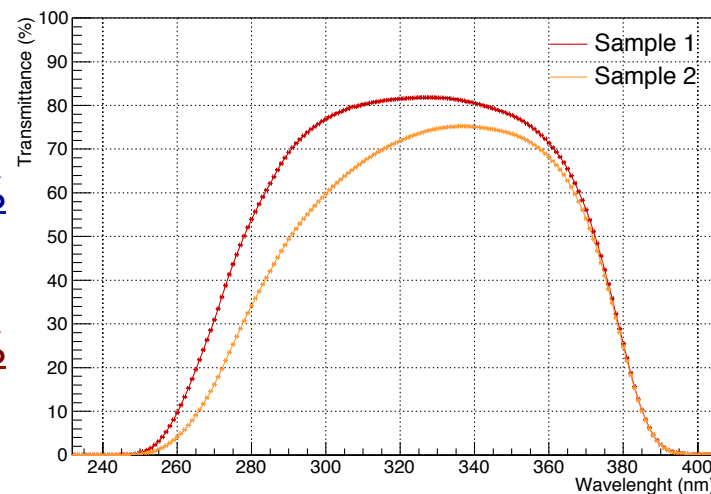
Filtri

Waveform comparison



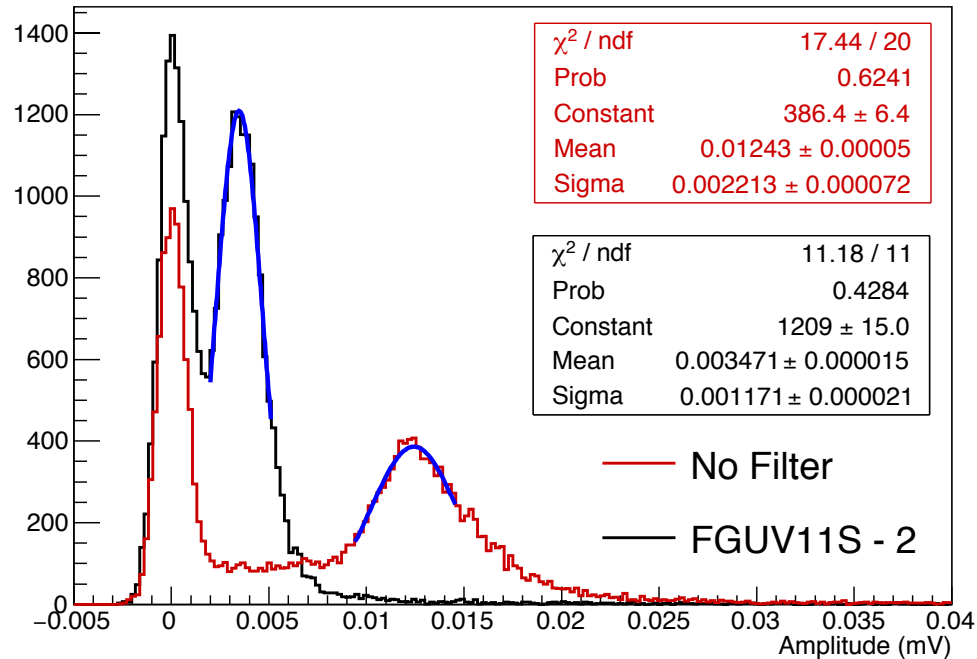
FGUV11S

- FGUV11S – Sample 1
 - $(340-250)/340=0.27 \rightarrow$ **Fast light loss ~ 26%**
- FGUV11S – Sample 2
 - $(350-200)/350=0.43 \rightarrow$ **Fast light loss ~ 43%**



APD response

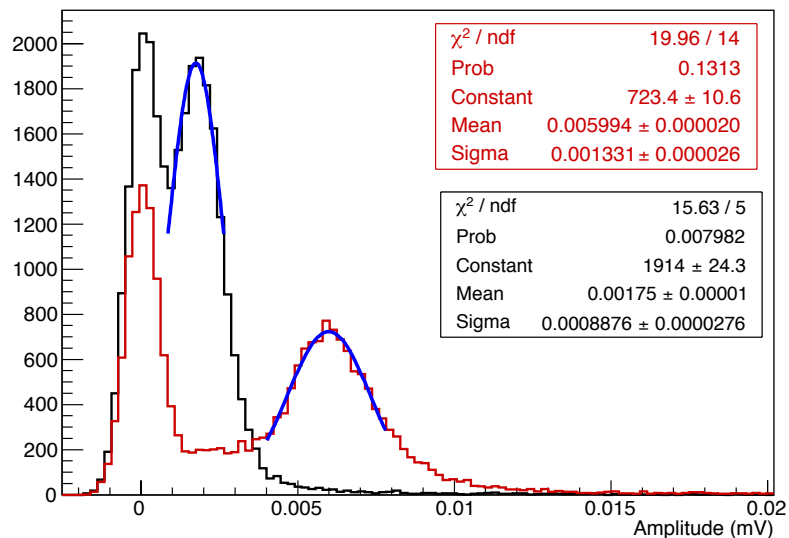
APD Response



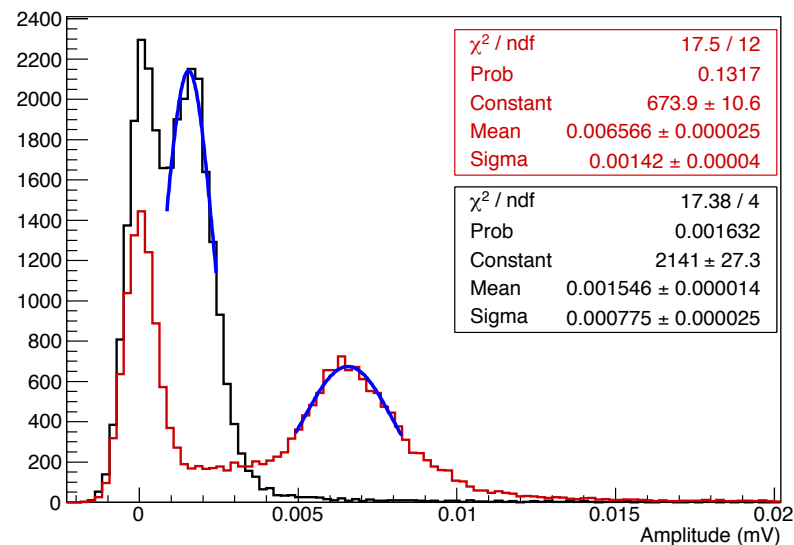
- FGUV11S – Sample 2

- $(12.43-3.47)/12.43=0.72 \rightarrow$ **Fast Light Loss 72% ???**

APD 0



APD 1



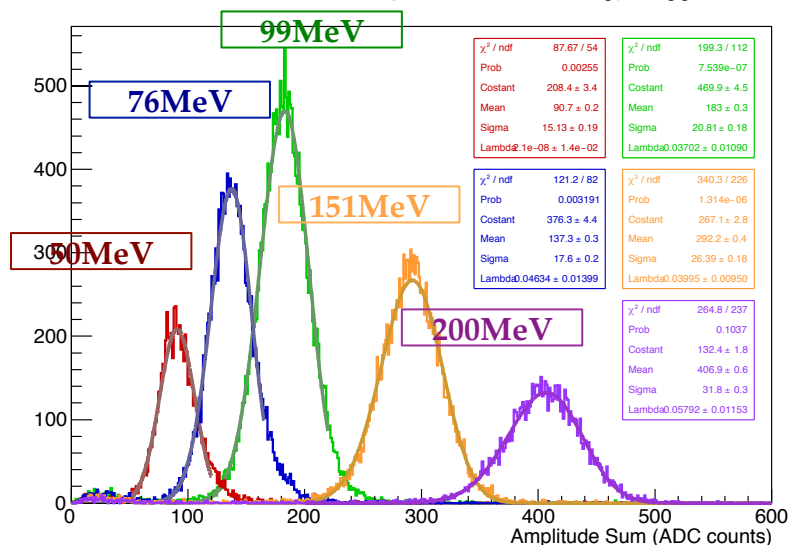
- APD 0
 - $(5.99-1.75)/5.99 \sim 0.71 \rightarrow$ Light Loss 71%
- APD 1
 - $(6.56-1.55)/6.56 \sim 0.76 \rightarrow$ Light Loss 76%
- APD ratio
 - No filter $5.99/6.56 = 0.91$
 - Filter $1.75/1.55 = 1.12$

Backup

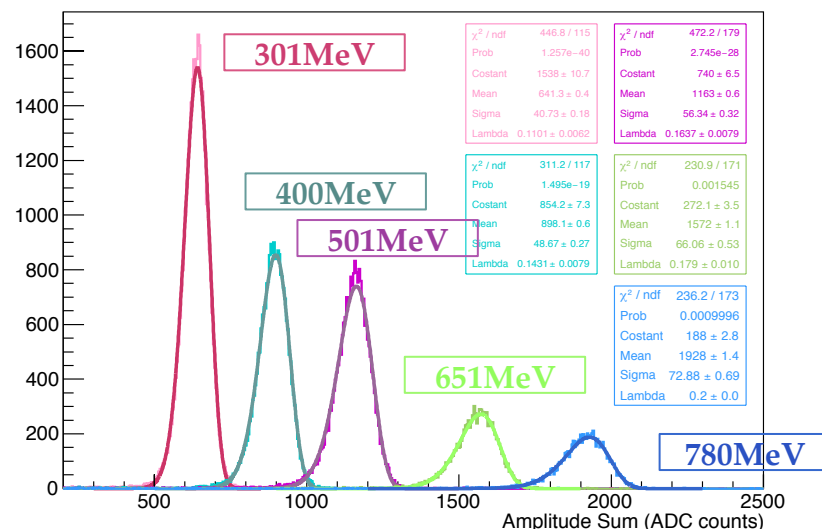
Shaped Signal Analysis

- Same analysis applied also to shaped (100ns) signals

Ch6 - Position Cen - Shp 100ns - LowEnergy Trigger

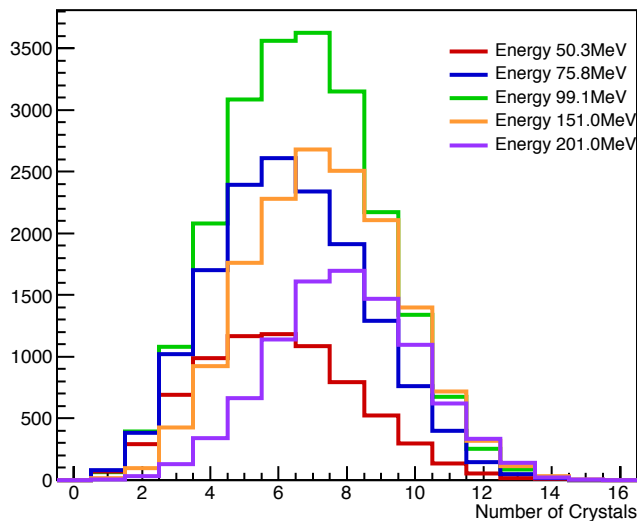


Ch6 - Position Cen - Shp 100ns - HighEnergy Trigger

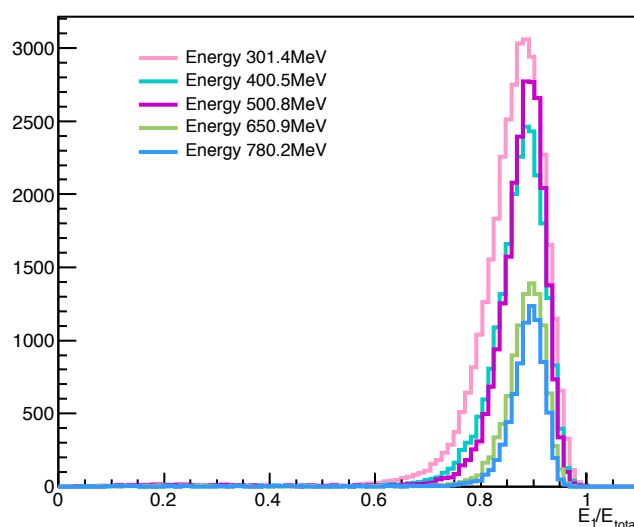
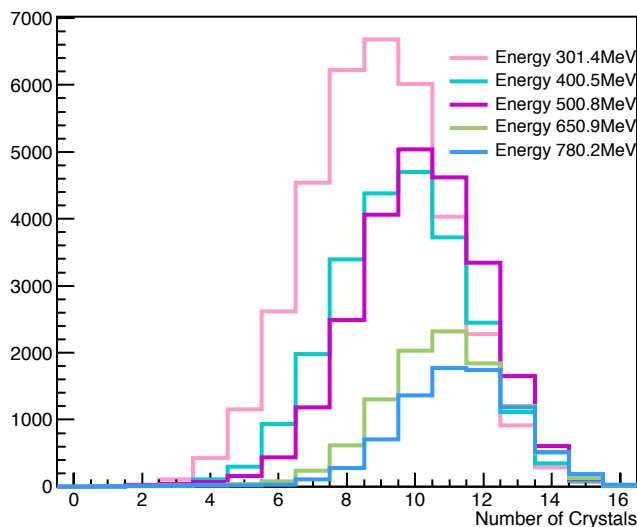
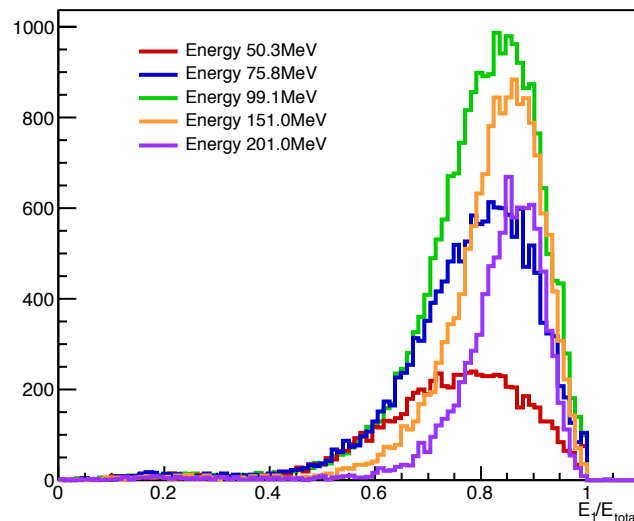


Cluster Size (SHP)

Ch6 - Position Cen - Cluster Size



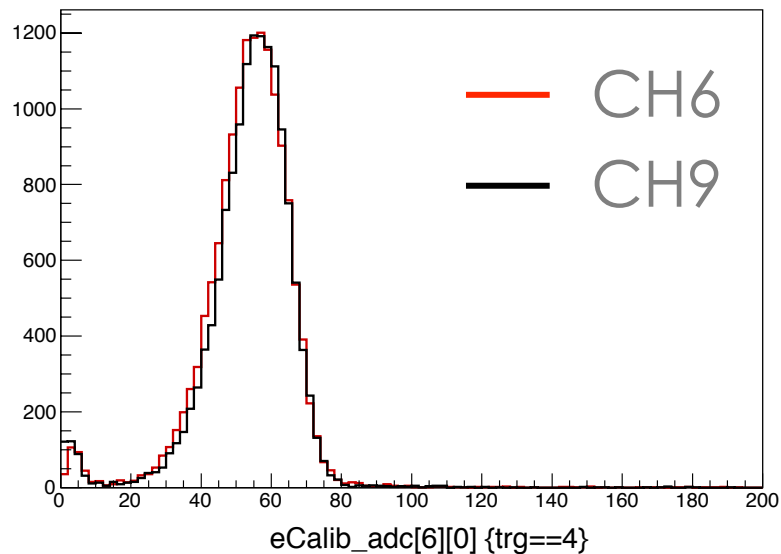
Ch6 - Position Cen - E_1/E_{total}



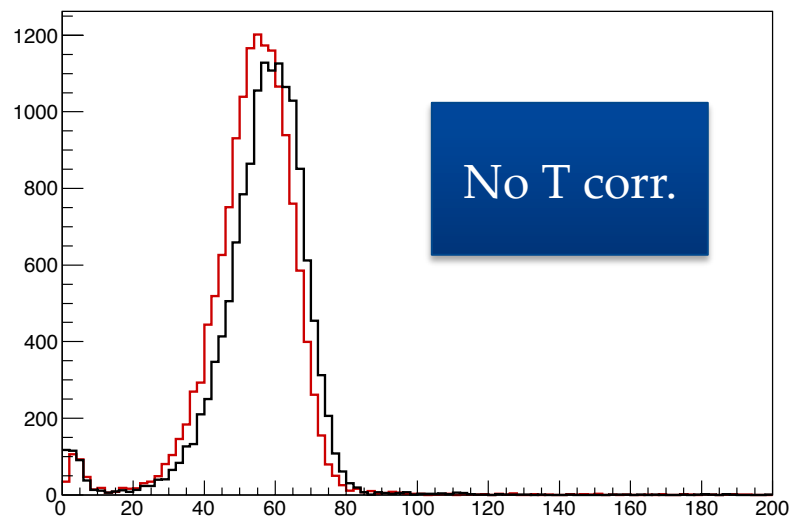
- Cluster Size slightly bigger wrt CSP
 - ~0.3 crystals
- E_1/E_{tot} has same behavior as before shaping

Check calibration

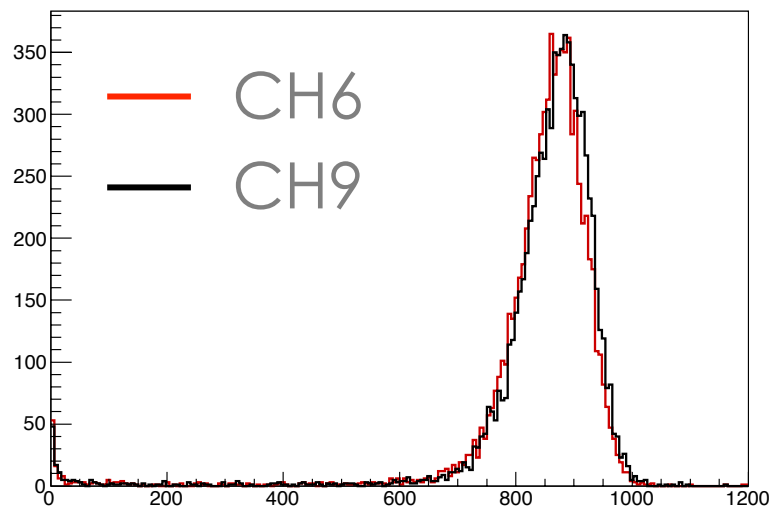
eCalib_adc[6][0] {trg==1}



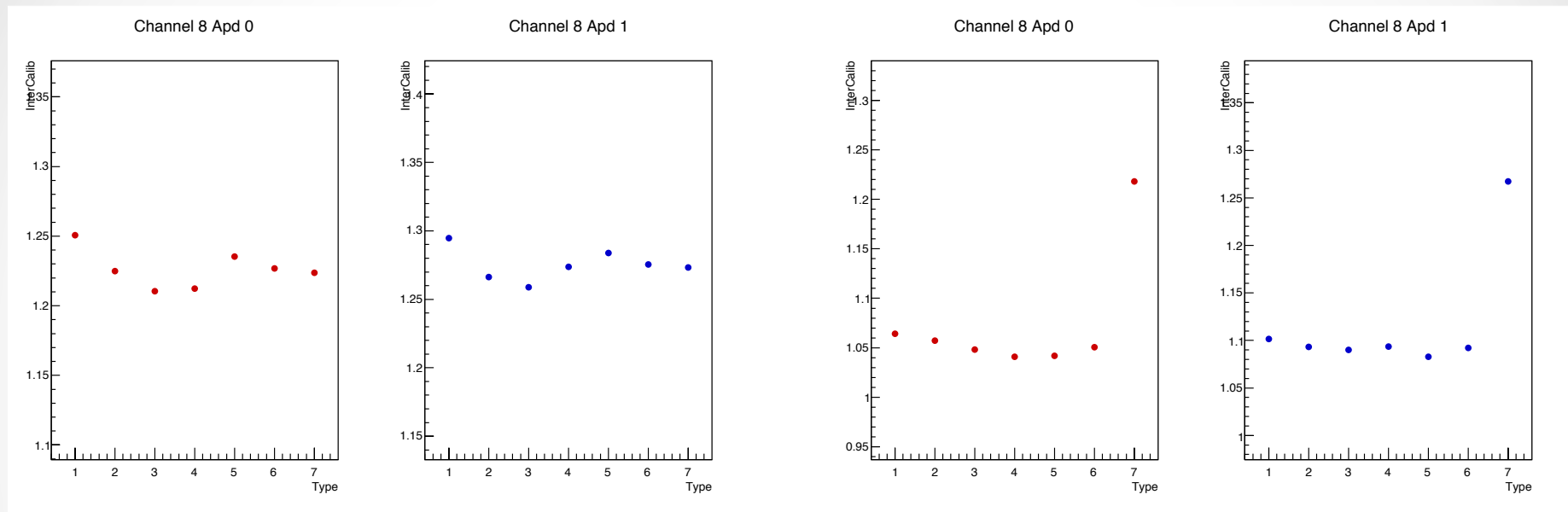
eCalib_adc[6][0] {trg==1}



eCalib_adc[6][0] {trg==4}



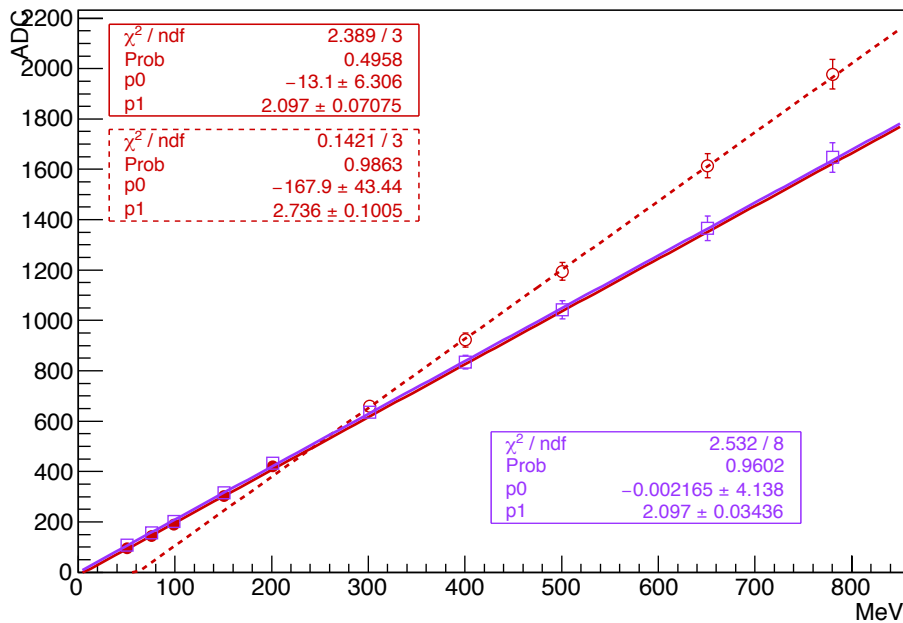
- Comparison at 75MeV and 780MeV between Ch6 and Ch9 (APD0)



- Intercalibration extracted by minimizing RMS of the sum of all channel
- Reasonable for Ch6 reference (with high errors) but completely wrong with Ch9 reference.

Linearity

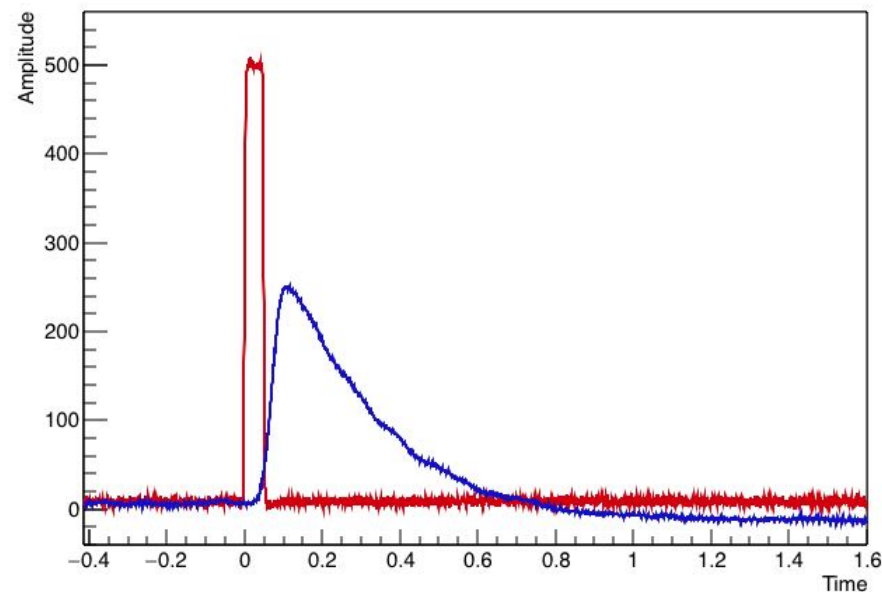
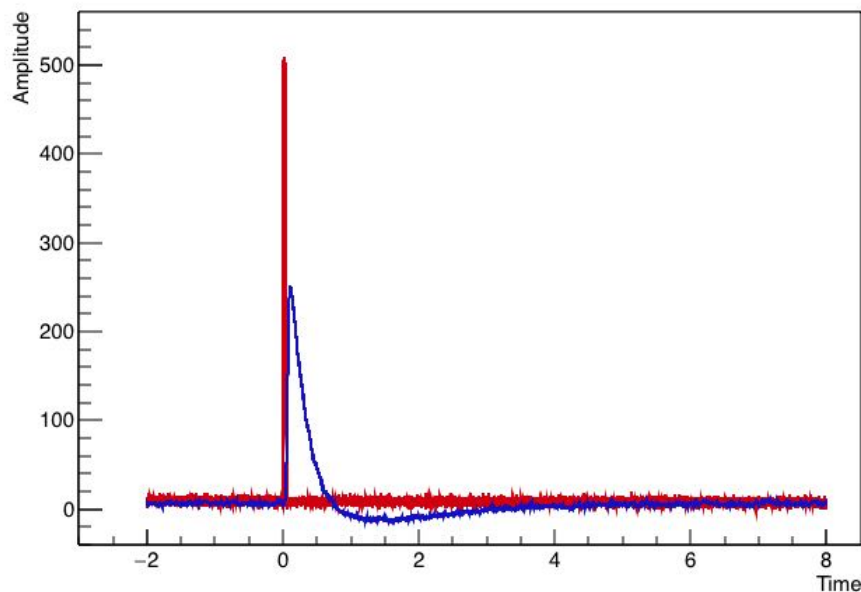
Channel 6 - Calib. Ch6 Apd0



- Non linearity observed
- Difference between the two different run (high/low energy)
- Source still unknown

- Correction applied to linearize the response
 - Shift on high energy points $\rightarrow$ worsening the resolution (conservative approach)

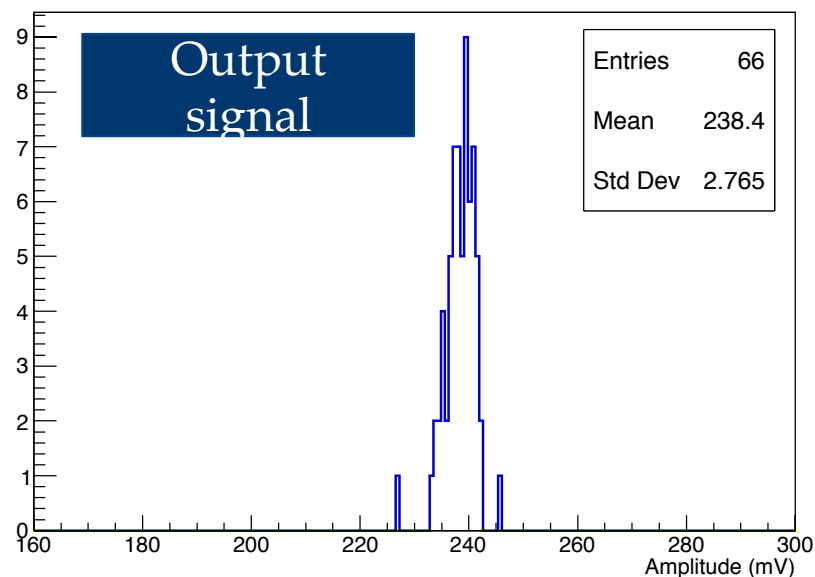
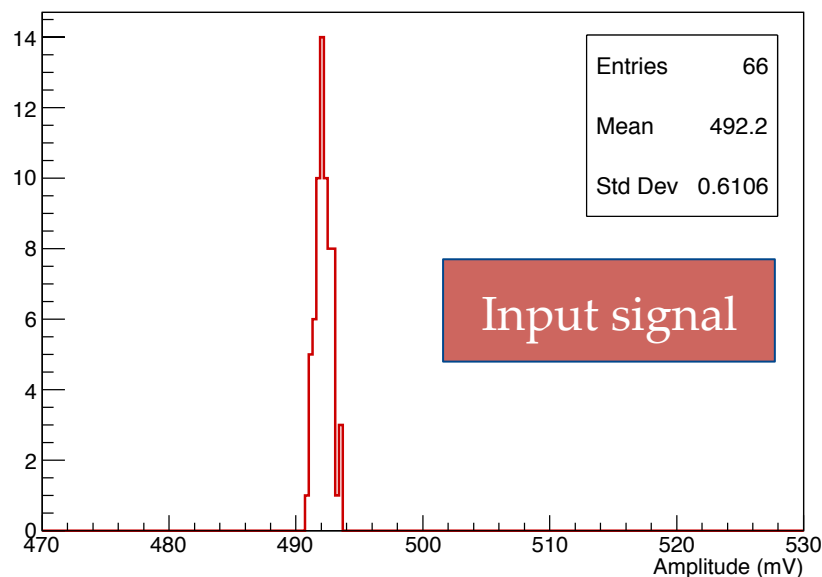
PreAmp Test setup



- Send charge as input to the preamp
 - Same range of beam test
- Analyze output amplitude

PreAmp Test: Amplitude extraction

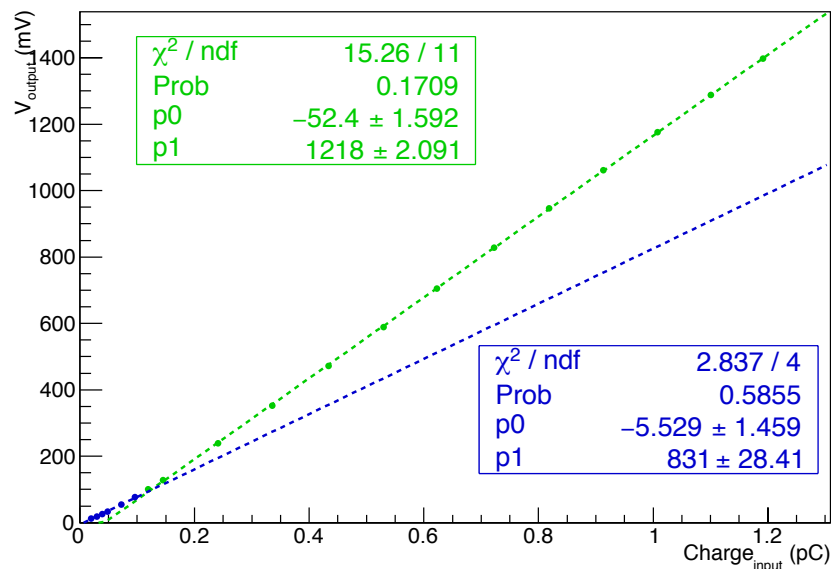
- Input Signal level extracted as mean value at the plateau of the square waveform
- Output Signal amplitude extracted as Mean around peak (40ns)
 - Same approach as at beam test



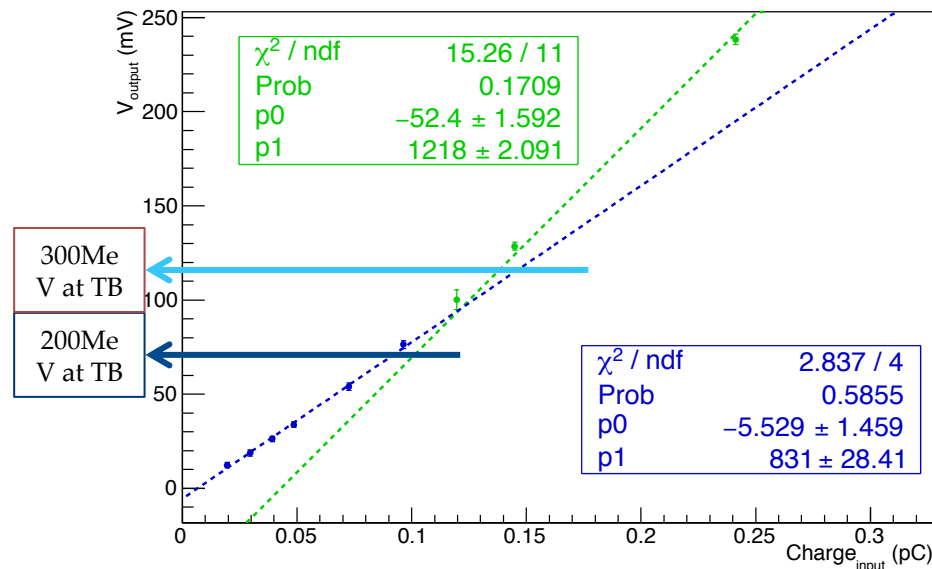
- Few data to perform fit
- Use mean and RMS as central value and error

PreAmp Test: Linearity

Linearity - Qin vs Vout (Mean)



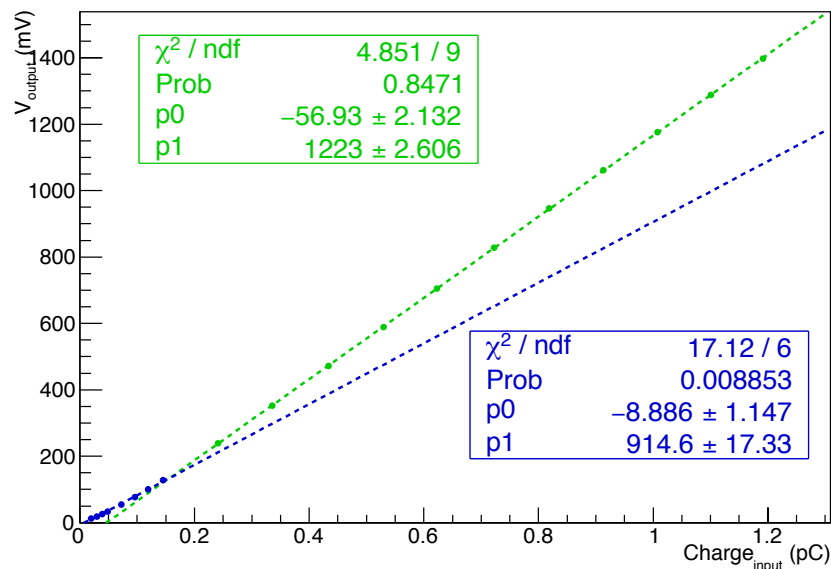
Linearity - Qin vs Vout (Mean)



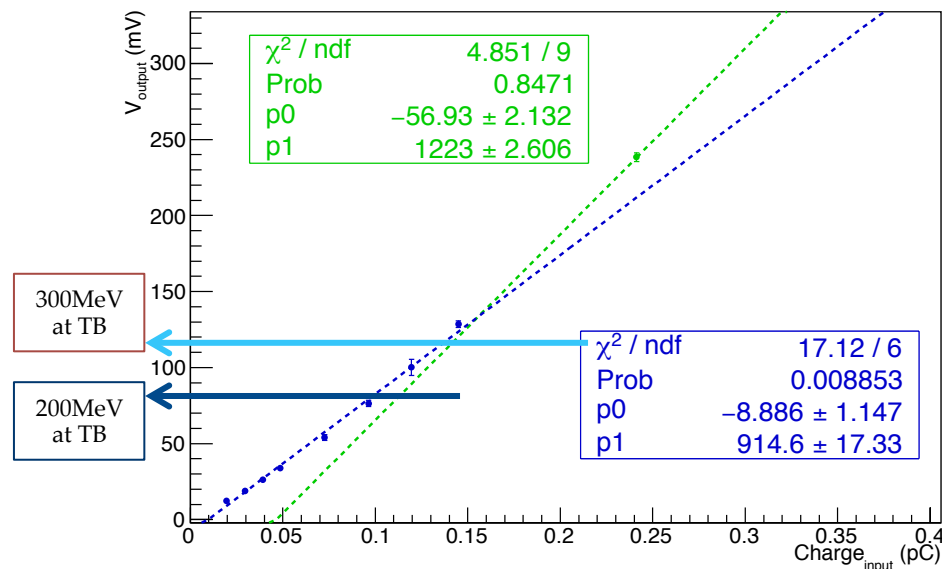
- Preamp seems to show the same non-linearity as observed on data

PreAmp Test: Linearity (2)

Linearity - Qin vs Vout (Mean)



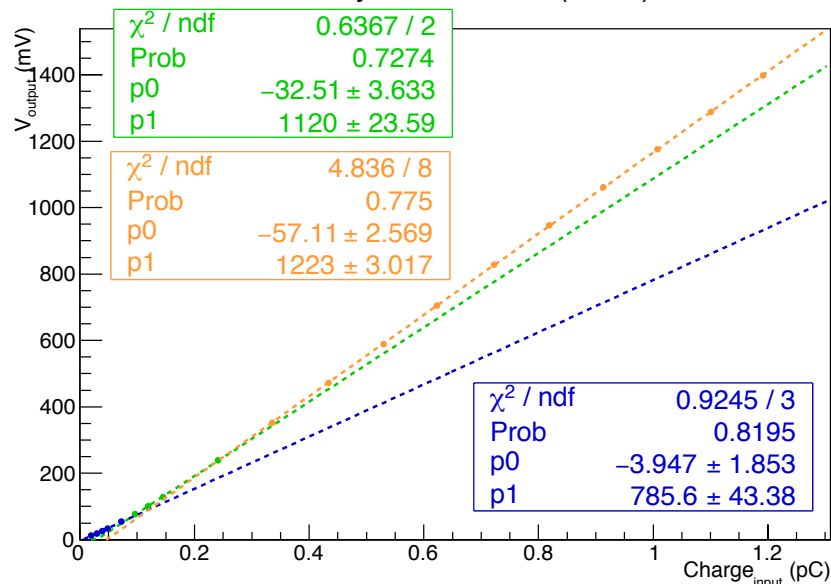
Linearity - Qin vs Vout (Mean)



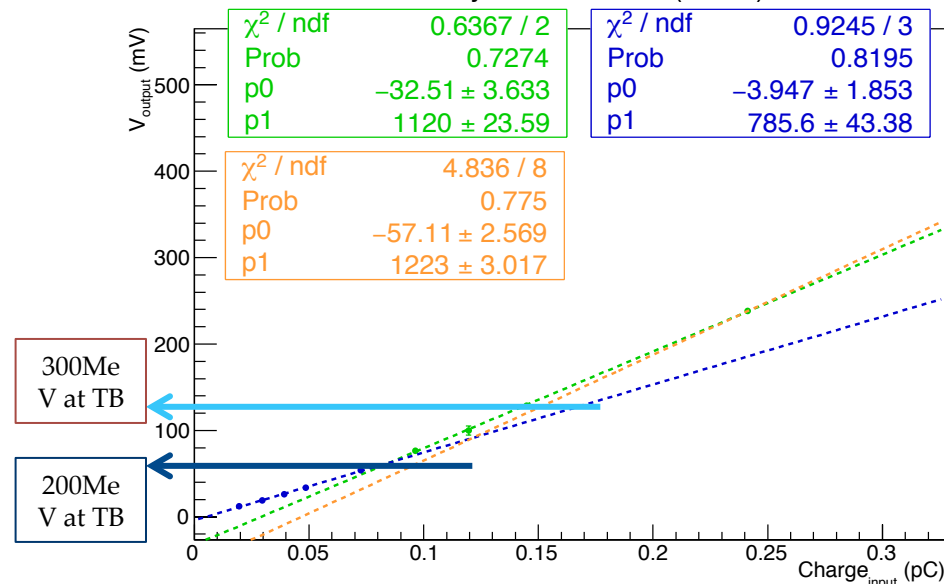
- Try to change the number of points used to fit the two Pol1

PreAmp Test: Linearity (3)

Linearity - Qin vs Vout (Mean)



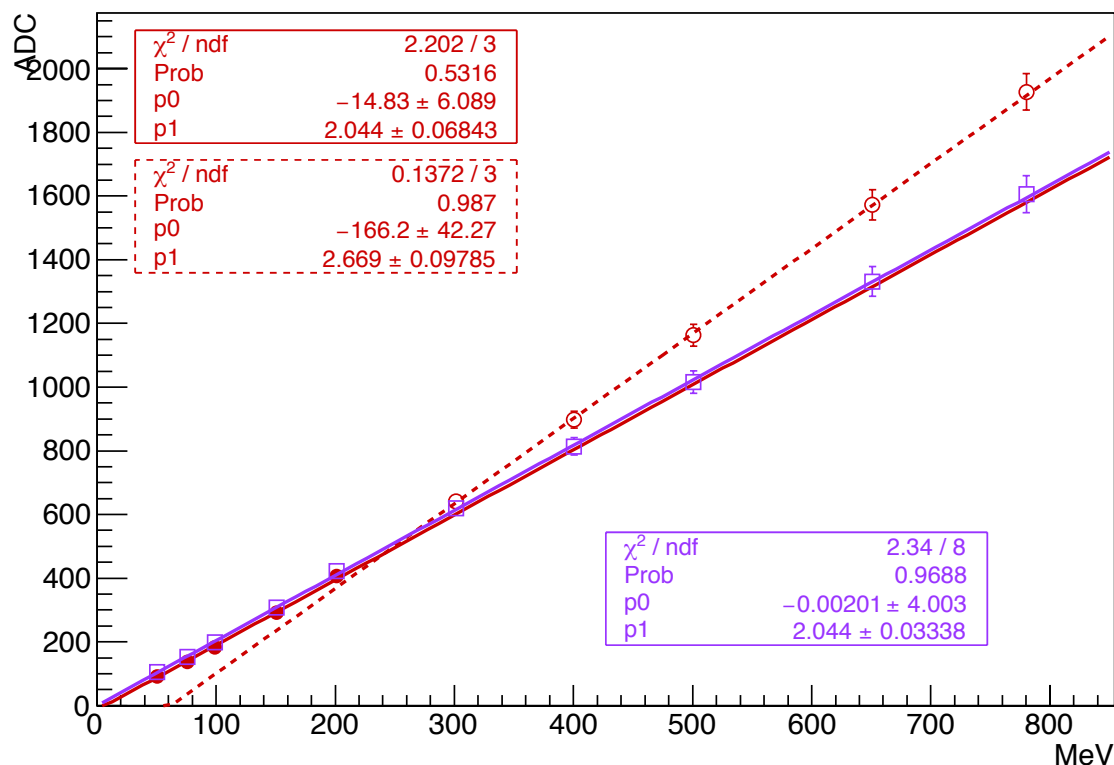
Linearity - Qin vs Vout (Mean)



- Use 3 different regions to describe the preamp response

Linearity (SHP)

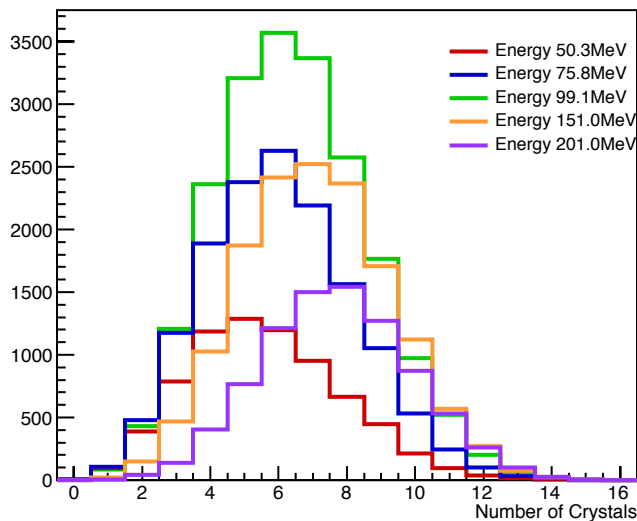
Channel 6 - Calib. Ch6 Apd0



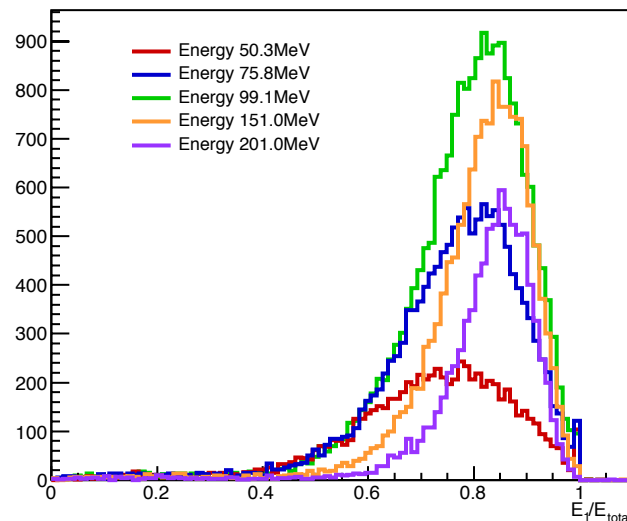
- Same strategy also for shaped data

Cluster Size

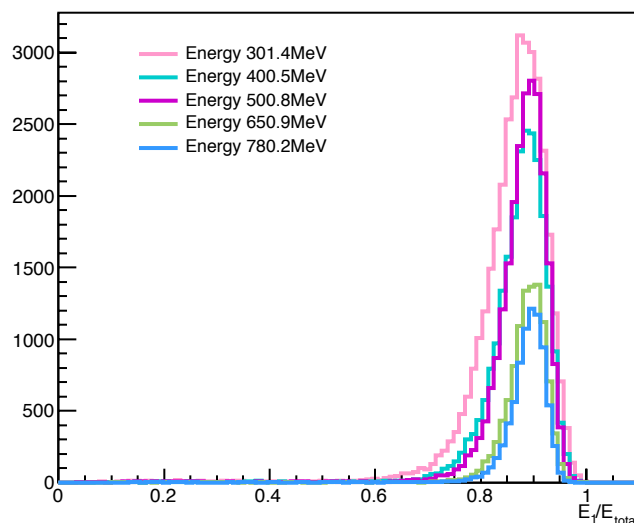
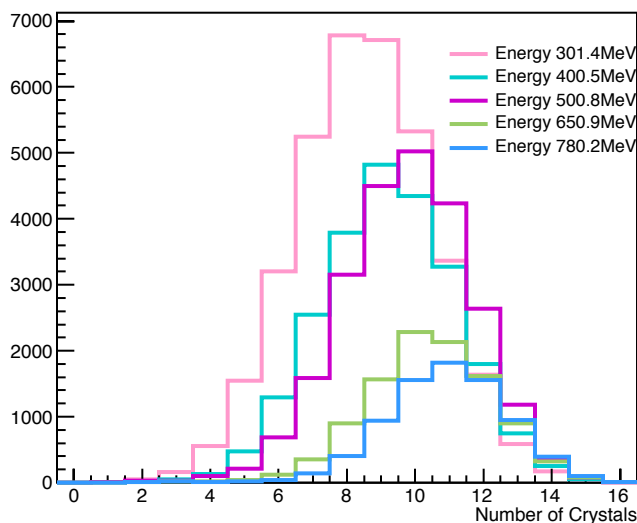
Ch9 - Position Cen - Cluster Size



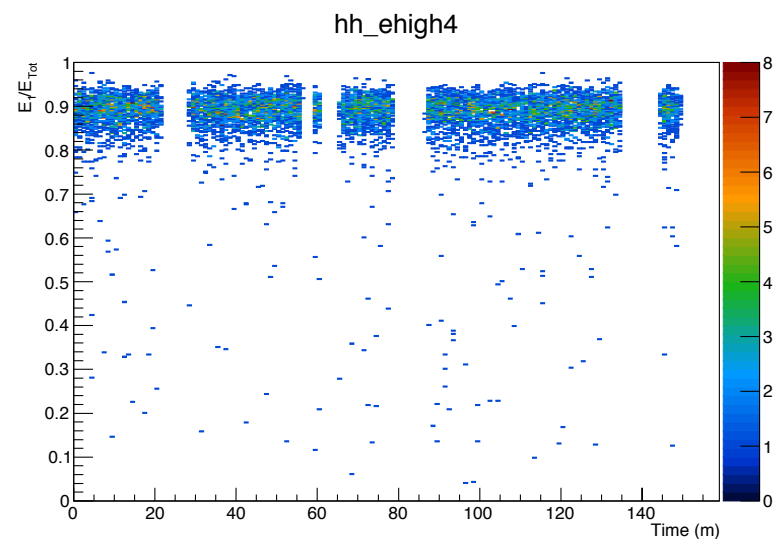
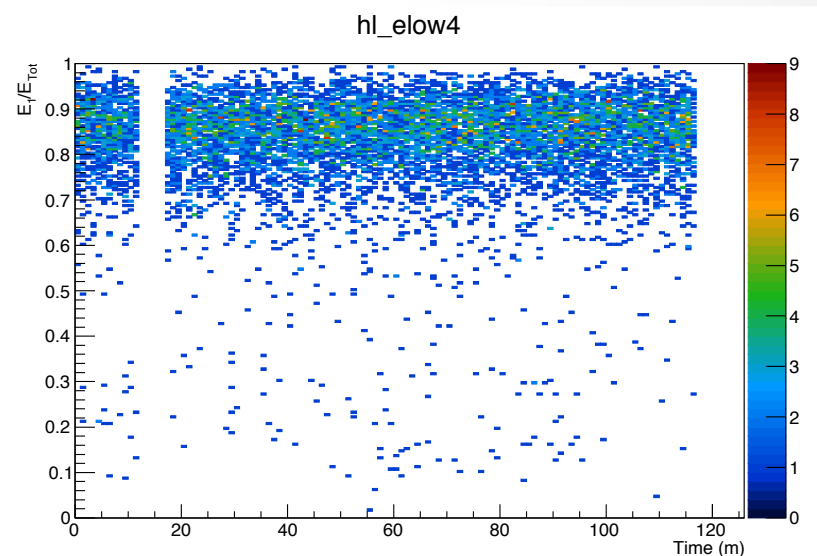
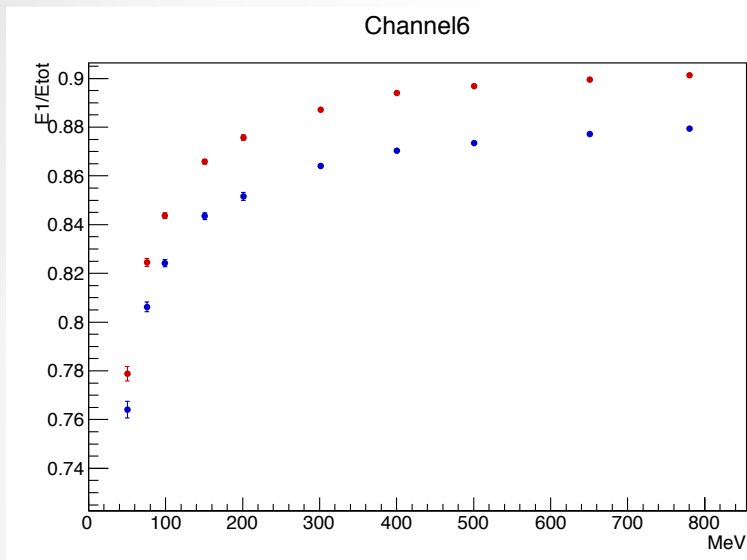
Ch9 - Position Cen - E_1/E_{total}



- E_1/E_{tot} ratio lower at lower energies
 - Is it as expected?
 - Higher contribution from low energy photons?



E1/ETot



- E_1/E_{Tot} stable with time
- The energy dependence is mainly due to the noise