



Calibration of NPS/CCAL prototype

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Calibration procedure C++ class calibration.h

Required minimization :

$$\sum_{events} \left(\sum_{i=1}^{Nseg} k_i A_i - E_{ps} \right)^2 \rightarrow min$$

Where,

k_i - Calibration coefficient

A_i - Amplitude integral in 80 ns time window

E_{ps} - Calibration constant, (energy of e- from e-/e+ pair)

Transforms to linear system involve
 N_{seg} equations and N_{seg} variables

$$\frac{\partial \left(\sum_{events} \left(\sum_{i=1}^{Nseg} k_i A_i - E_{ps} \right)^2 \right)}{\partial k_i} = 0$$

Linear system than can be
 expressed in matrix form and
 solved using ROOT

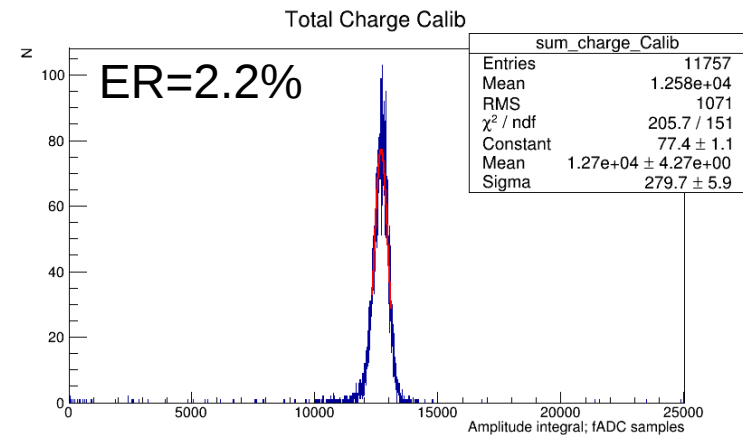
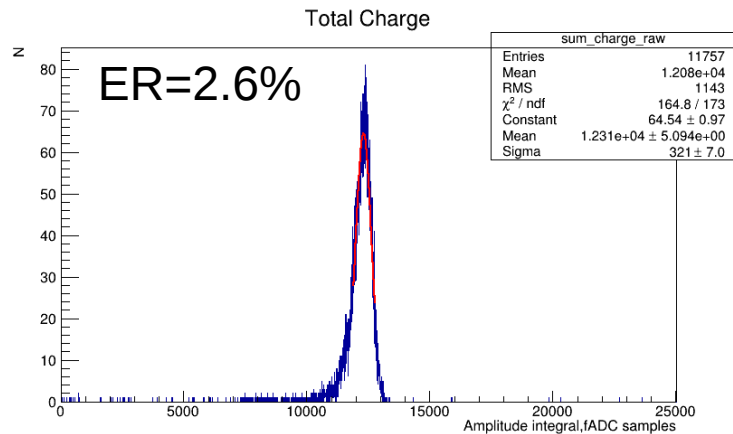
$$\begin{bmatrix} \sum_{events} A_1 A_1 & \sum_{events} A_i A_1 & \sum_{events} A_{Nseg} A_1 \\ \vdots & \vdots & \vdots \\ \sum_{events} A_1 A_j & \sum_{events} A_i A_j & \sum_{events} A_{Nseg} A_j \\ \vdots & \vdots & \vdots \\ \sum_{events} A_1 A_{Nseg} & \sum_{events} A_i A_{Nseg} & \sum_{events} A_{Nseg} A_{Nseg} \end{bmatrix} * \begin{bmatrix} k_1 \\ \vdots \\ k_j \\ \vdots \\ k_{Nseg} \end{bmatrix} = \begin{bmatrix} \sum_{events} E_{ps} A_1 \\ \vdots \\ \sum_{events} E_{ps} A_j \\ \vdots \\ \sum_{events} E_{ps} A_{Nseg} \end{bmatrix}$$

Calibration.h is C++ class which include several functions :

- Filling the matrix elements event by event
- Normalization (amount of events)
- Matrix solution of the system (coefficients calculation)

Prototype calibration results

GlueX Run 41844 [same voltage 700V for all PMT`s]



Next step is analysis of GlueX Run 42129:

- PMT gains adjusted and new HV applied normalized to central segment gain with 700V set using single electron spectrum from LED measurements in cleanroom
- 2M of Pair Spectrometer trigger events
- Time window adjustments
- Central PS tile search improvement