^{241}Am Scintillator Source in AD1 & AD2

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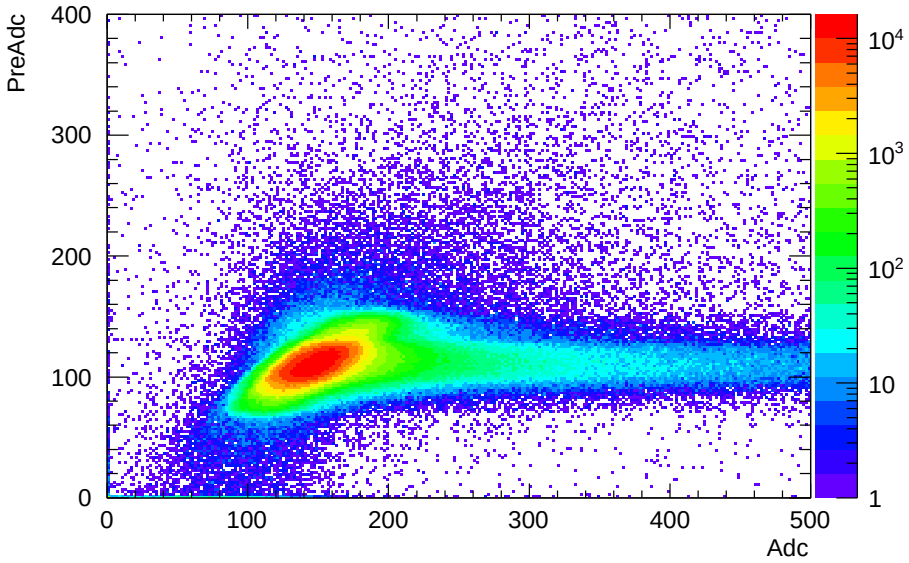
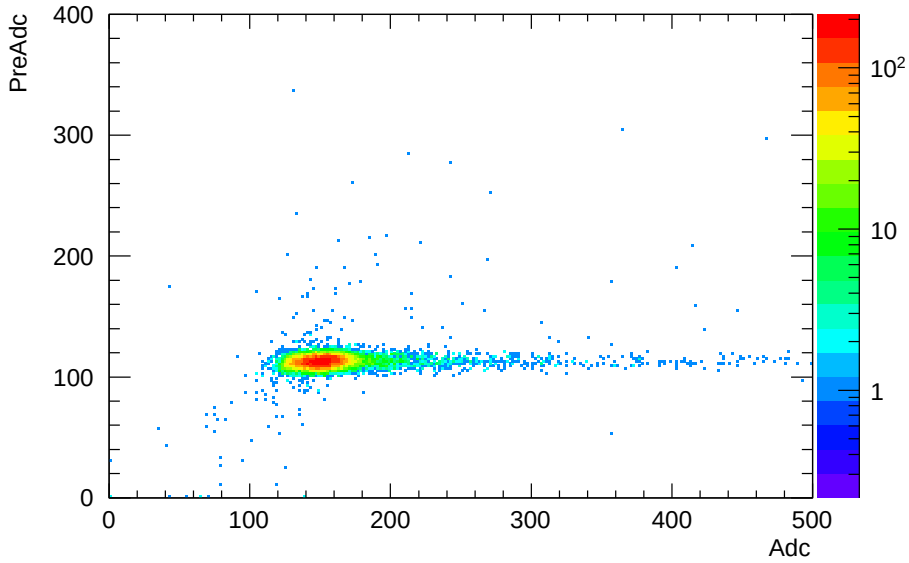
^{241}Am scintillator source

- Follow Dan's Doc 5631, try gain calibration and background subtraction.
- Forced Trigger runs (2k Hz): 6621 $\sim$ 6633
- $N_{PMT} > 7$ Trigger runs: 6634 $\sim$ 6646
- Run 6634 $\sim$ 6646 have much more statistics for the ^{241}Am scintillation signal, this study focus on Run 6634 $\sim$ 6646.

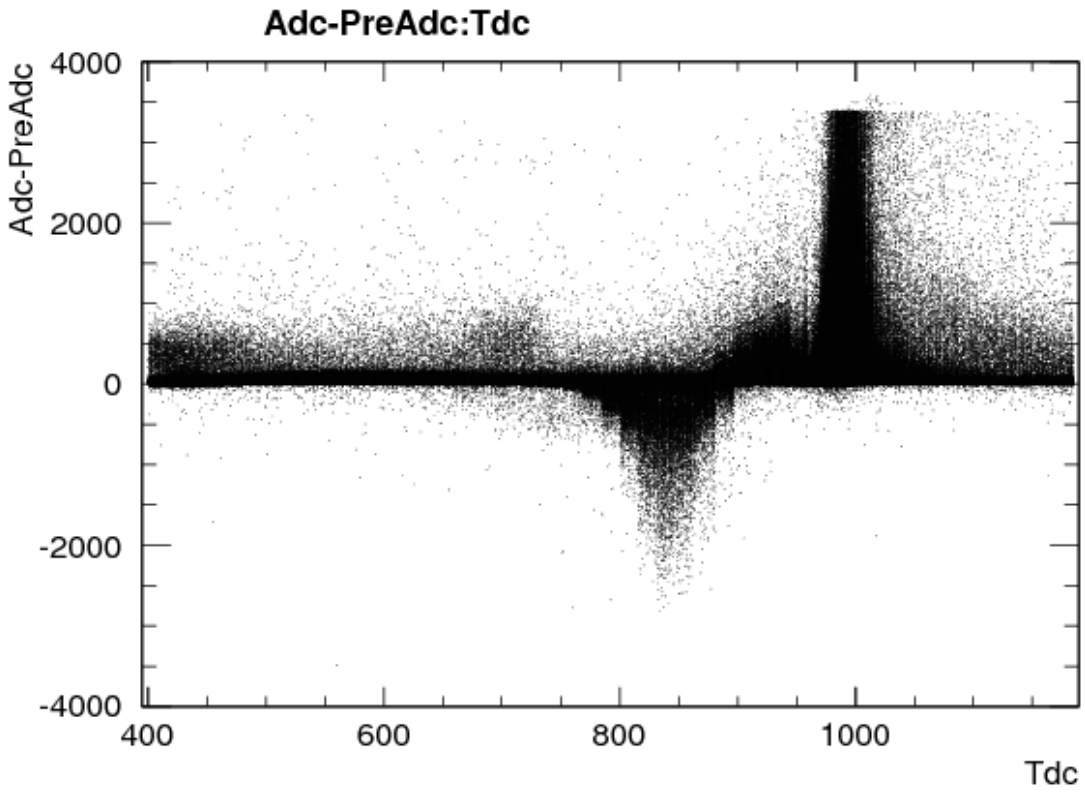
Adc vs PreAdc





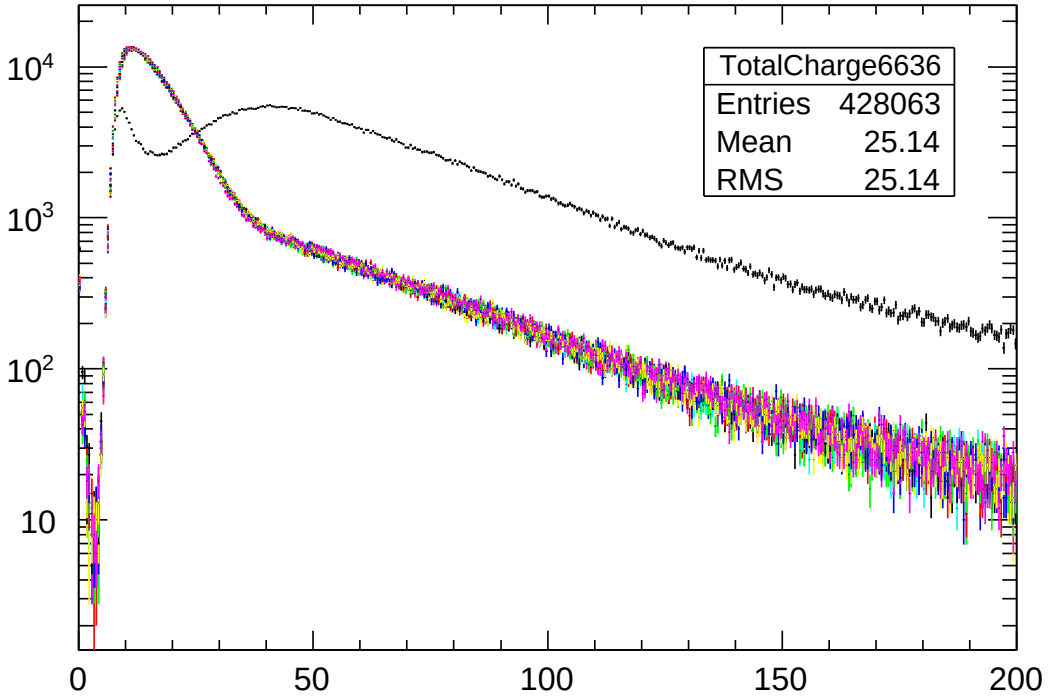
- Left: all channels; Right: channel #1
- The correlation seen in the left plot is because different channels have different pedestals.

Tdc cut



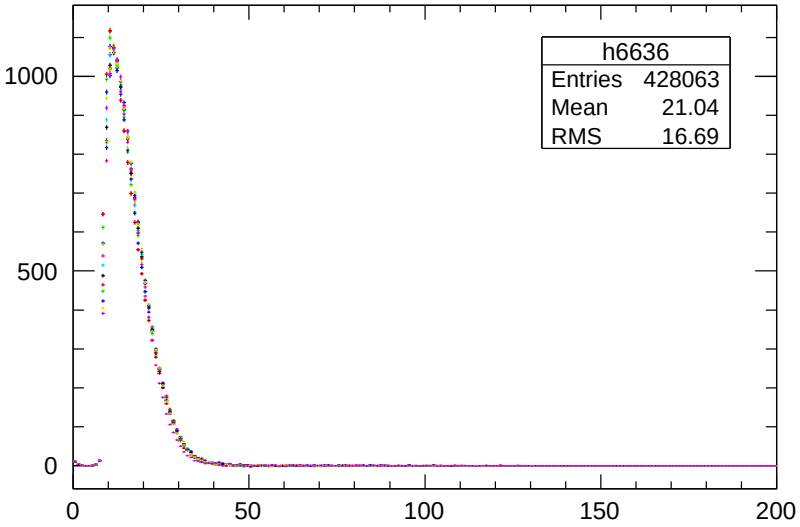
- Require 900<Tdc<1050 to remove dark noise.

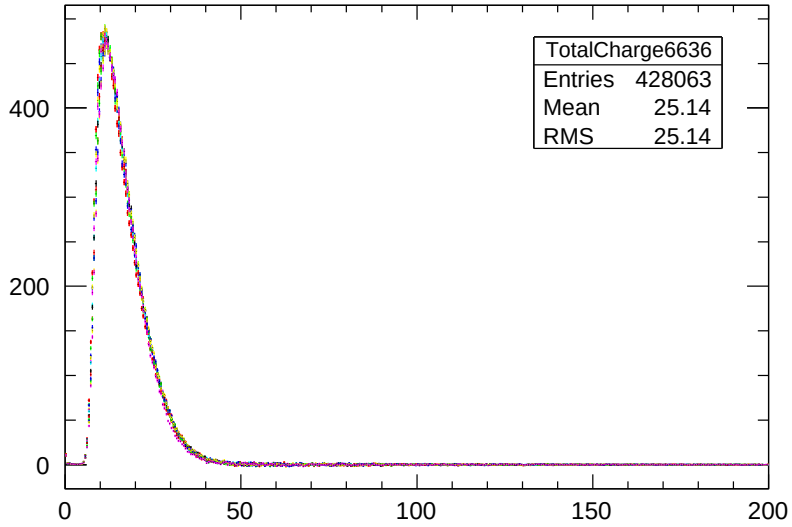
Normalization



- Background run time: 614.5 seconds, the rest runs are about 240 seconds.
- Forced maximum 2K Hz trigger, resulted dead time $N_{trigger} \times 500\mu S$.
- Normalized according livetime=runningtime-deadtime.

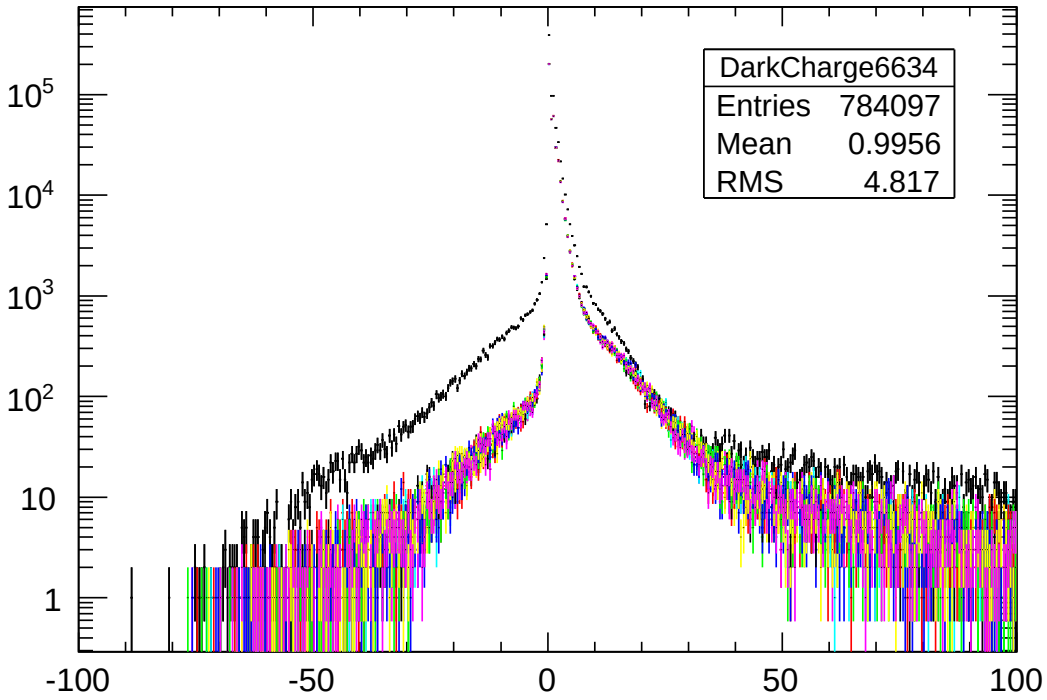
Background subtraction





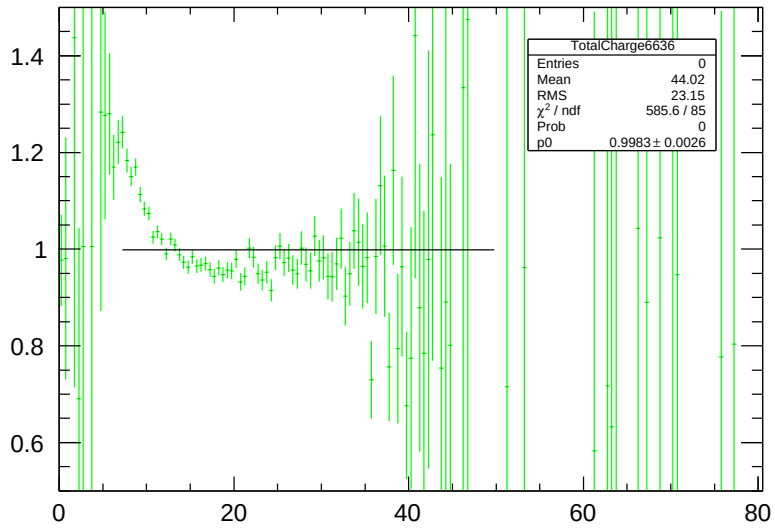
- Subtract the background after normalization.
- Left: NHit distribution; Right: Total Charge distribution.

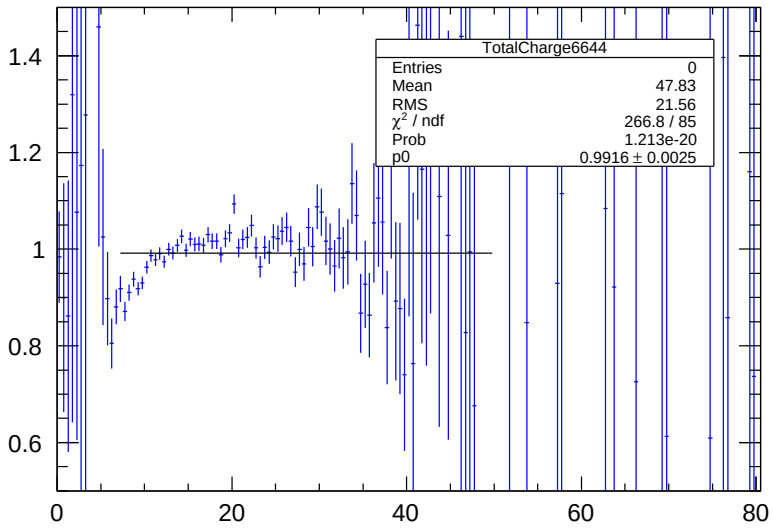
Dark Noise spectral



- Total charge distribution when Tdc<900 or Tdc>1050.

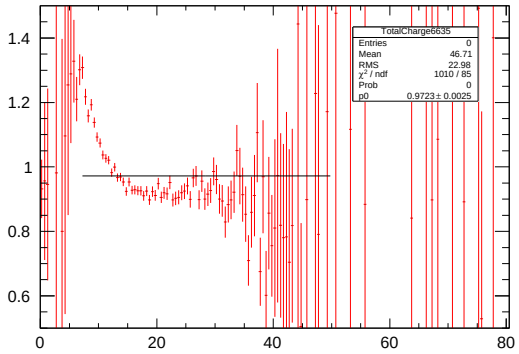
Spectral ratio



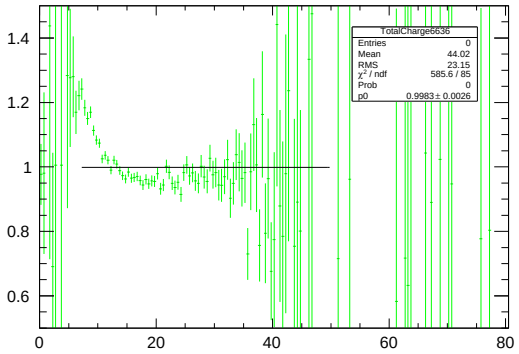


$$R(E,z) = \frac{S(E,z)}{S(E,z=0)} \tag{1}$$

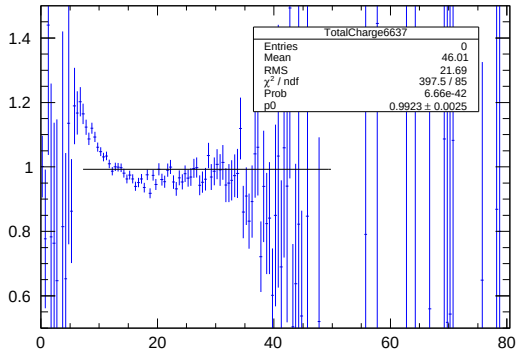
- Doc 5631: if the spectrum is undistorted with source z-position, then ratio should be 1 for all bins.



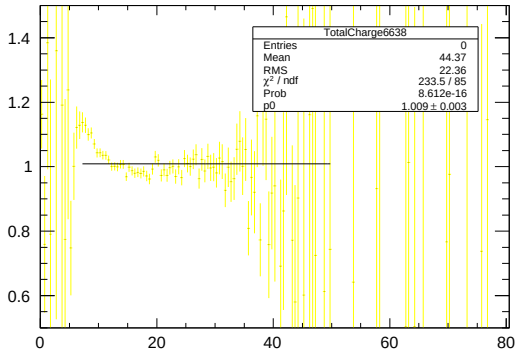
Run 6635



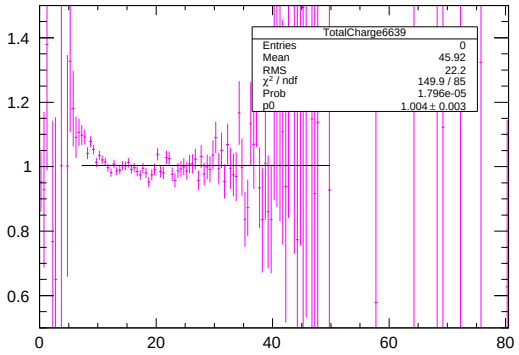
Run 6636



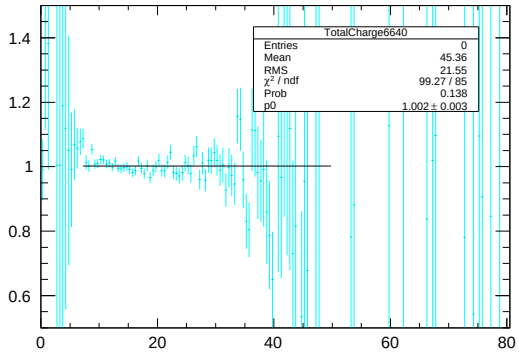
Run 6637



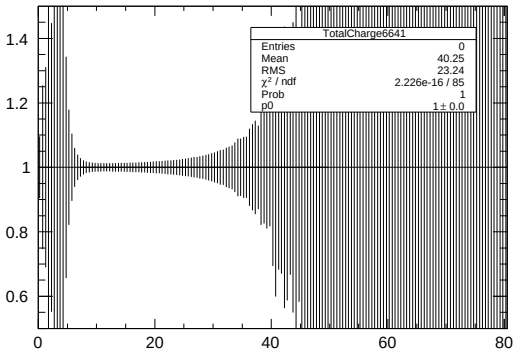
Run 6638



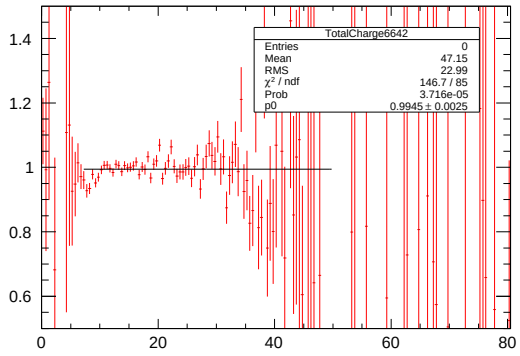
Run 6639



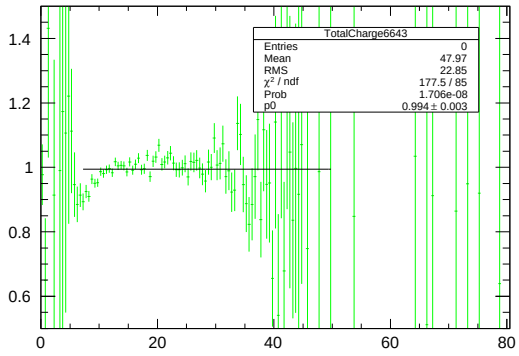
Run 6640



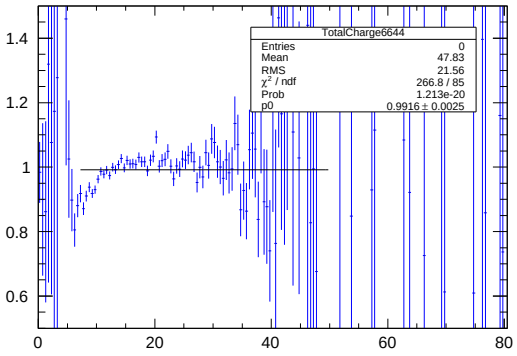
Run 6641



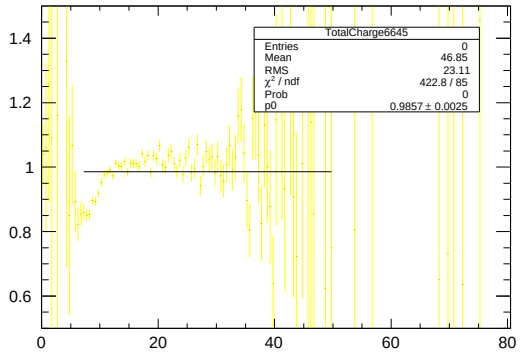
Run 6642



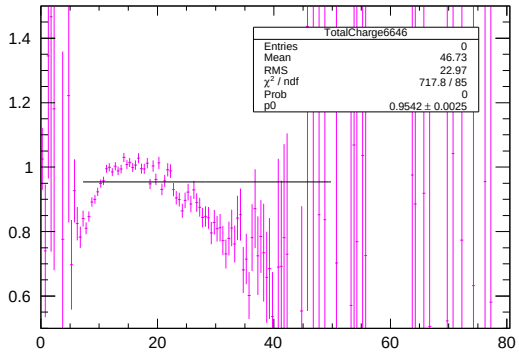
Run 6643



Run 6644



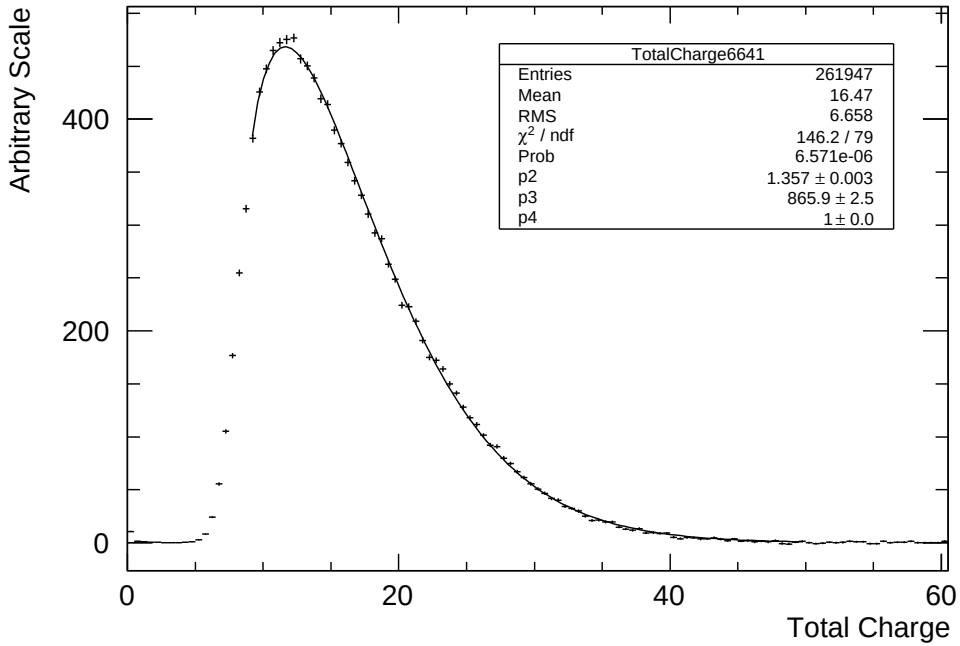
Run 6645



Run 6646

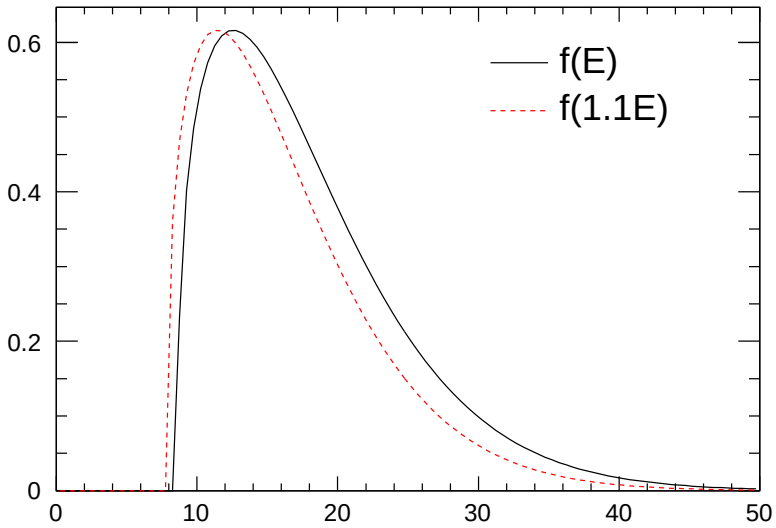
- There is some small variation at the edge of signal region, indicate the spectral has some small shift at different z-position.

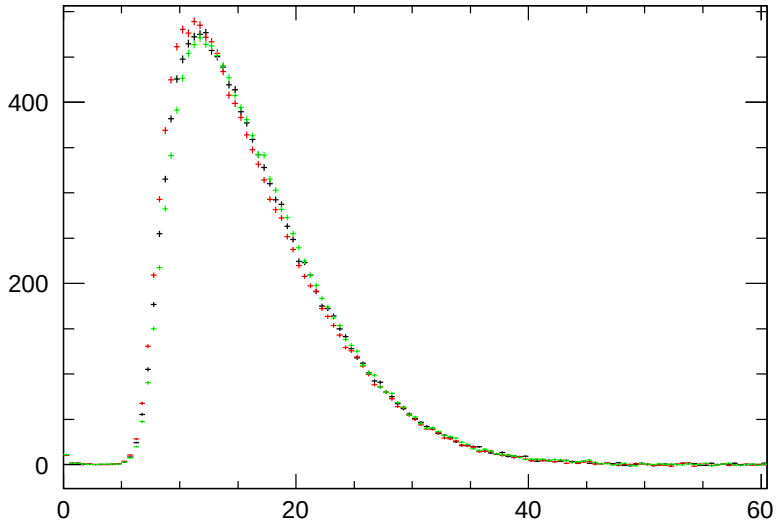
Spectral fit



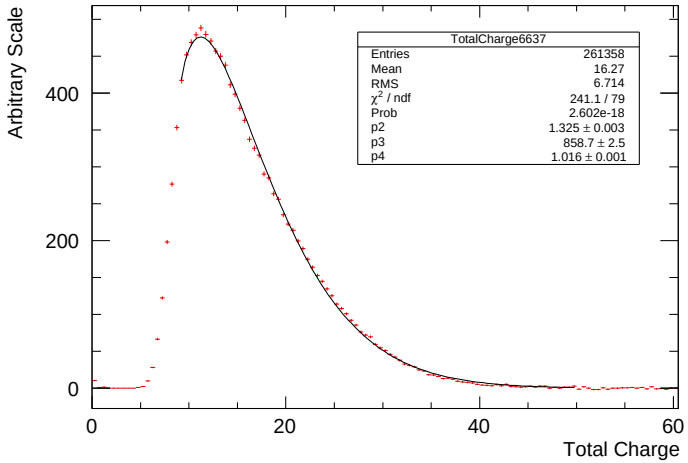
- Suppose the energy response at different z position is $E = \alpha(z)E$, where $\alpha(0) = 1$.
- Suppose the spectrum is $f(\alpha(z)E)$, then we can extract $\alpha(z)$ if we know the shape $f(E)$.
- Tried many distributions, found the distribution from 9$\sim$60 can be reasonably represented by a WeilBull function.

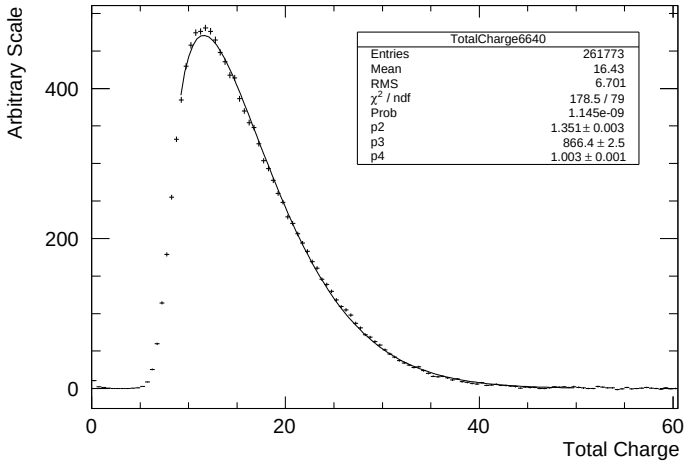
How distortion looks like

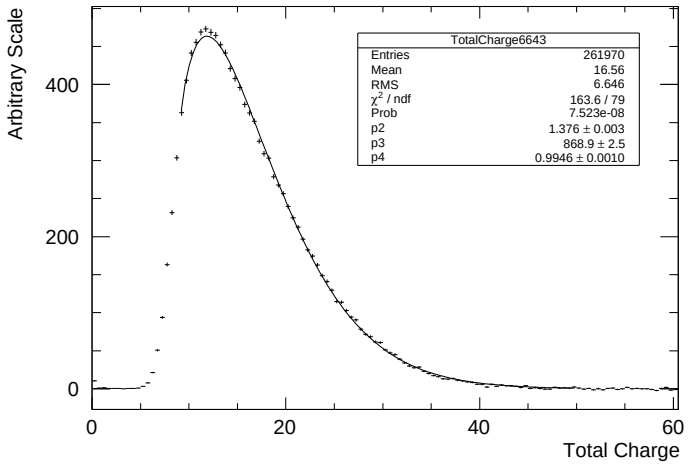


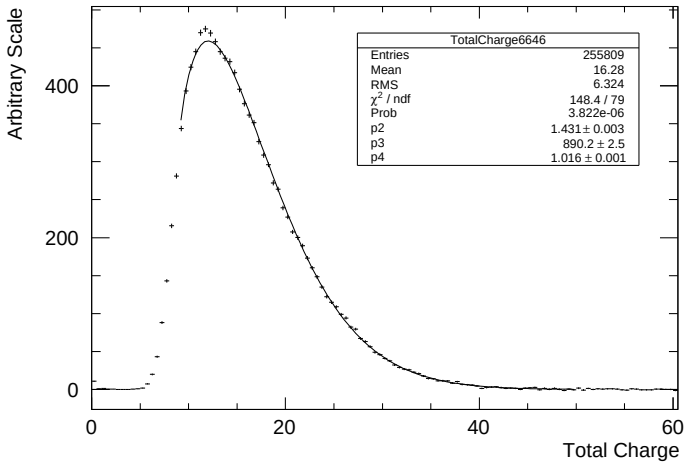


- If there is 10% variation
- Real case: z=-1.25 m,0 m,1 m



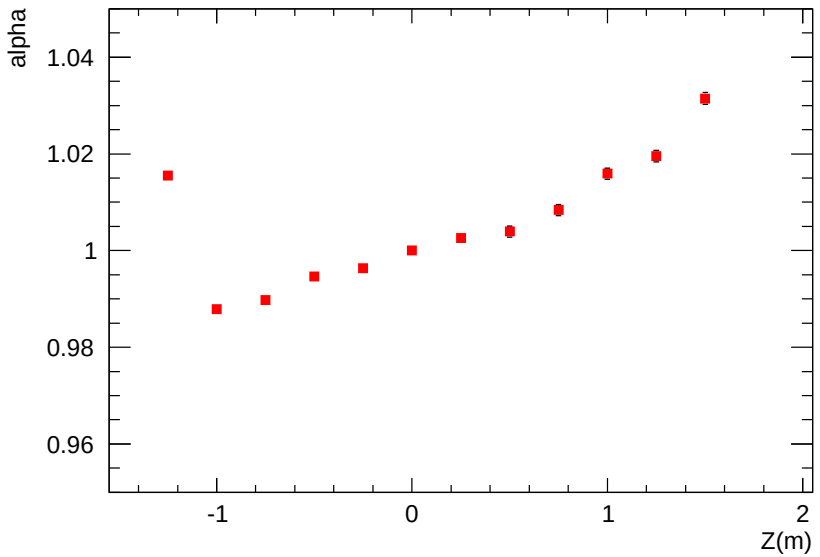


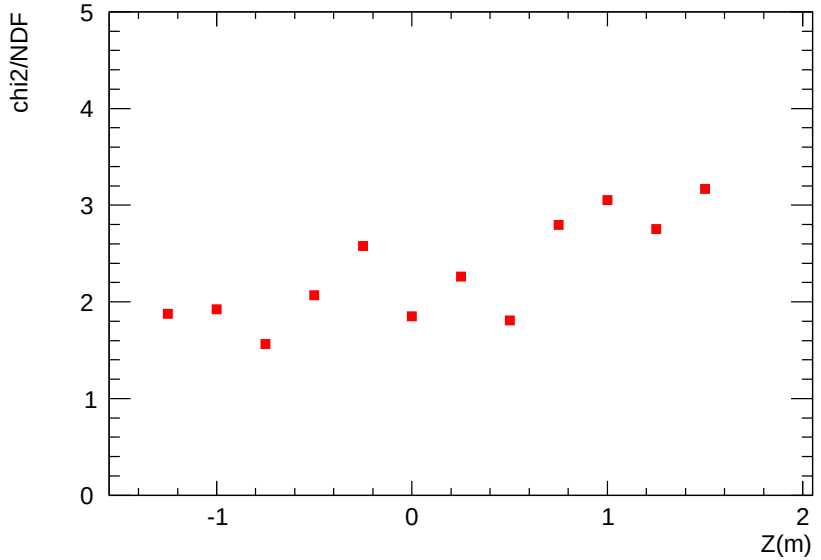




- Use z=0 distribution to determine all the parameters
- Only let α float (fix other parameters) for $z \neq 0$ fits.

α & χ^2



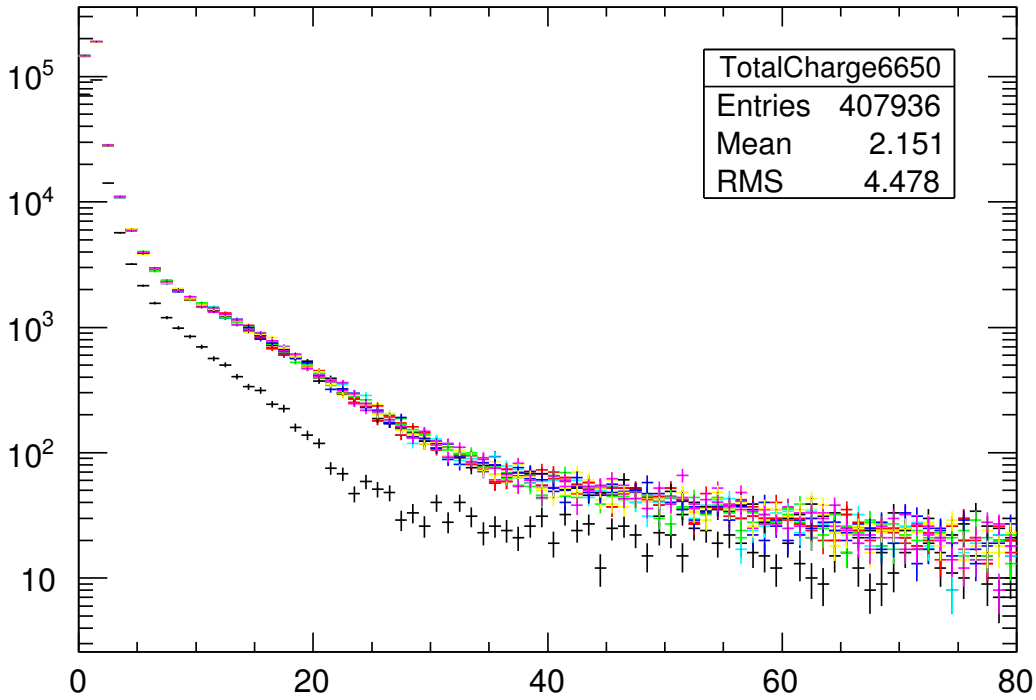


- Only a small variation along z-position, lower z has smaller α, means more light is collected.

AD1 AcuB

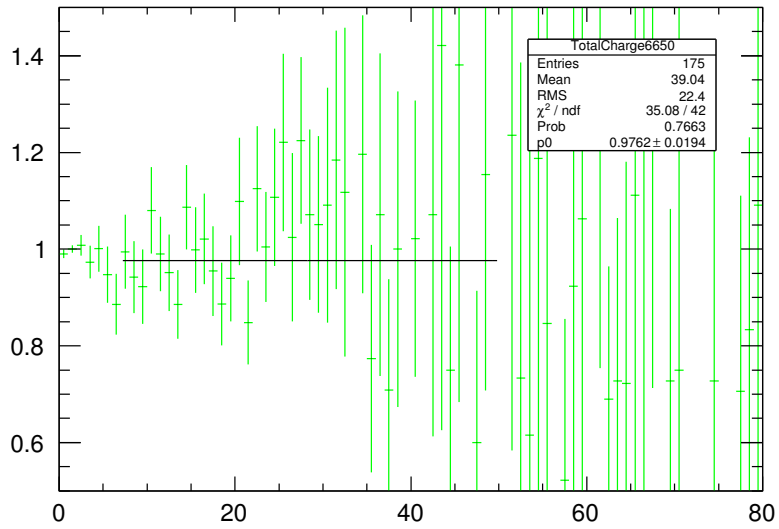
Run 6648 – Run 6660

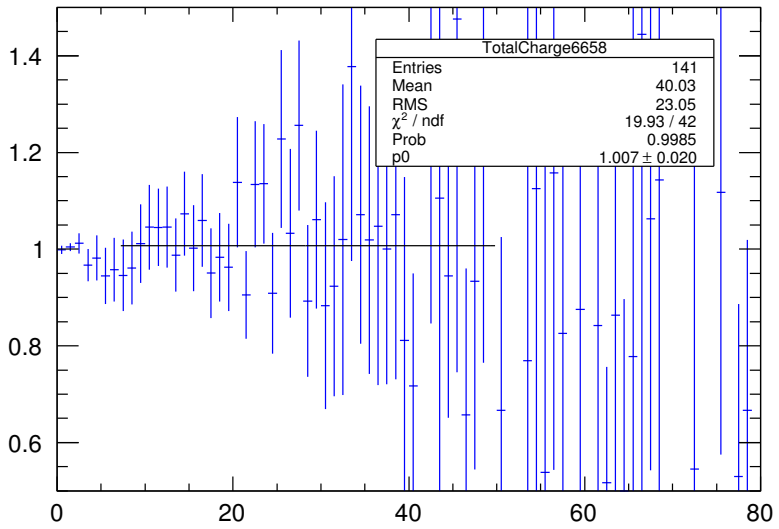
Normalization



- Run 6648–6660
- Black histogram is the background run
- Forced triggers, all runs have same running time, no additional renormalization applied in this study.

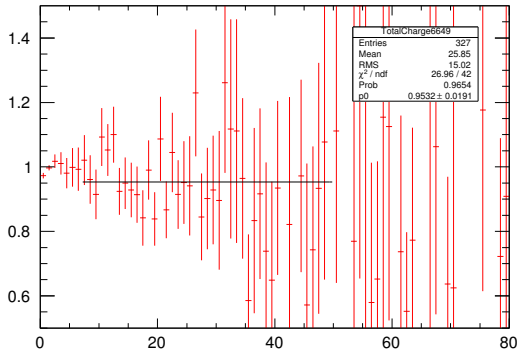
Spectral ratio



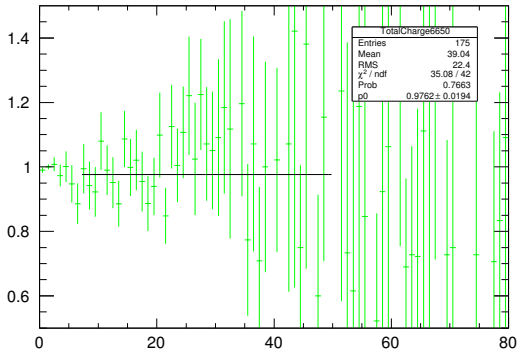


$$R(E,z) = \frac{S(E,z)}{S(E,z=0)} \tag{2}$$

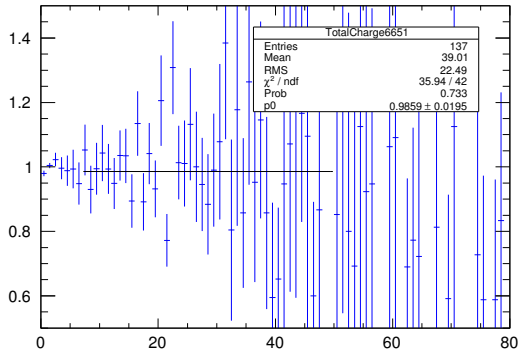
- Doc 5631: if the spectrum is undistorted with source z-position, then ratio should be 1 for all bins.



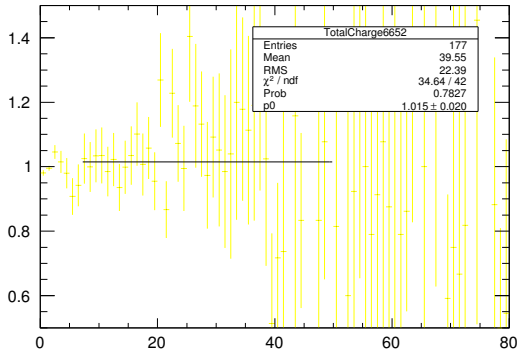
Run 6649



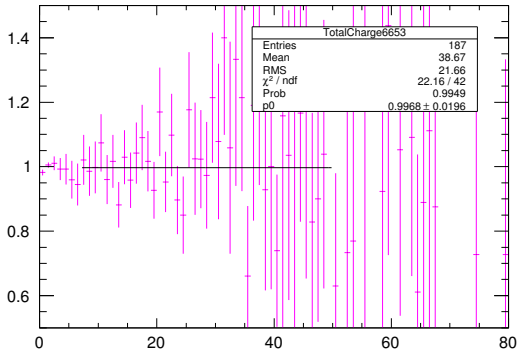
Run 6650



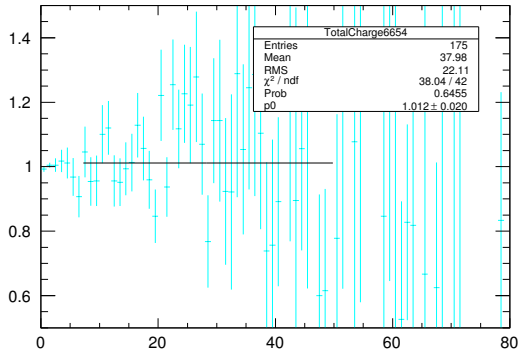
Run 6651



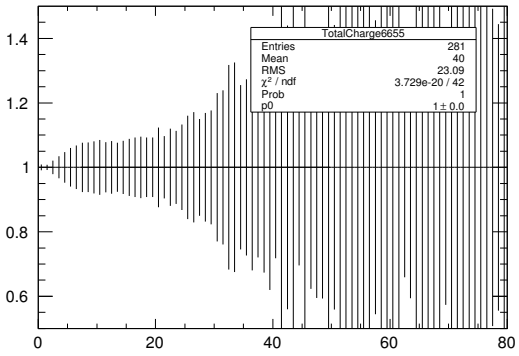
Run 6652



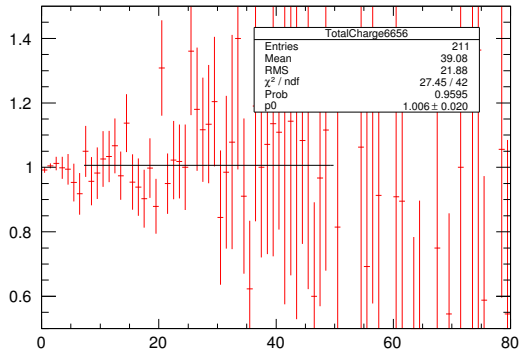
Run 6653



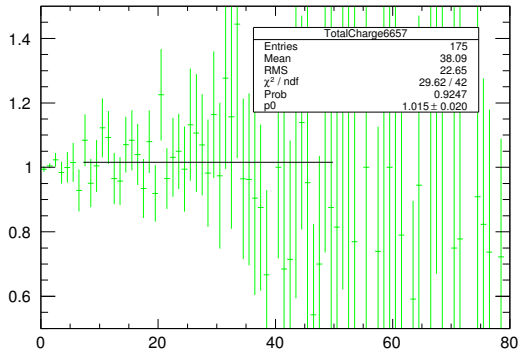
Run 6654



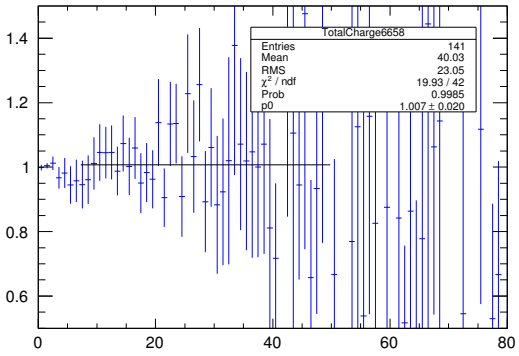
Run 6655



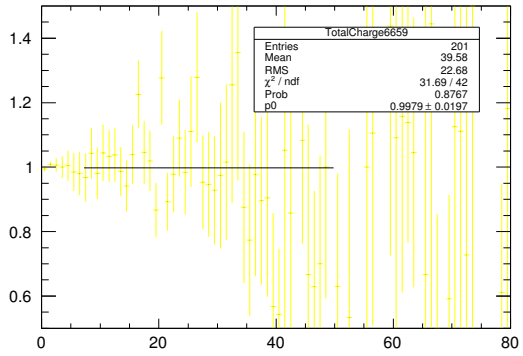
Run 6656



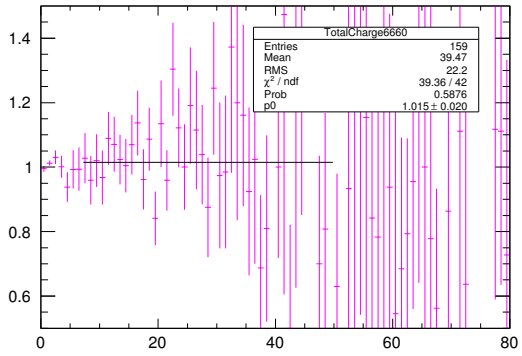
Run 6657



Run 6658



Run 6659



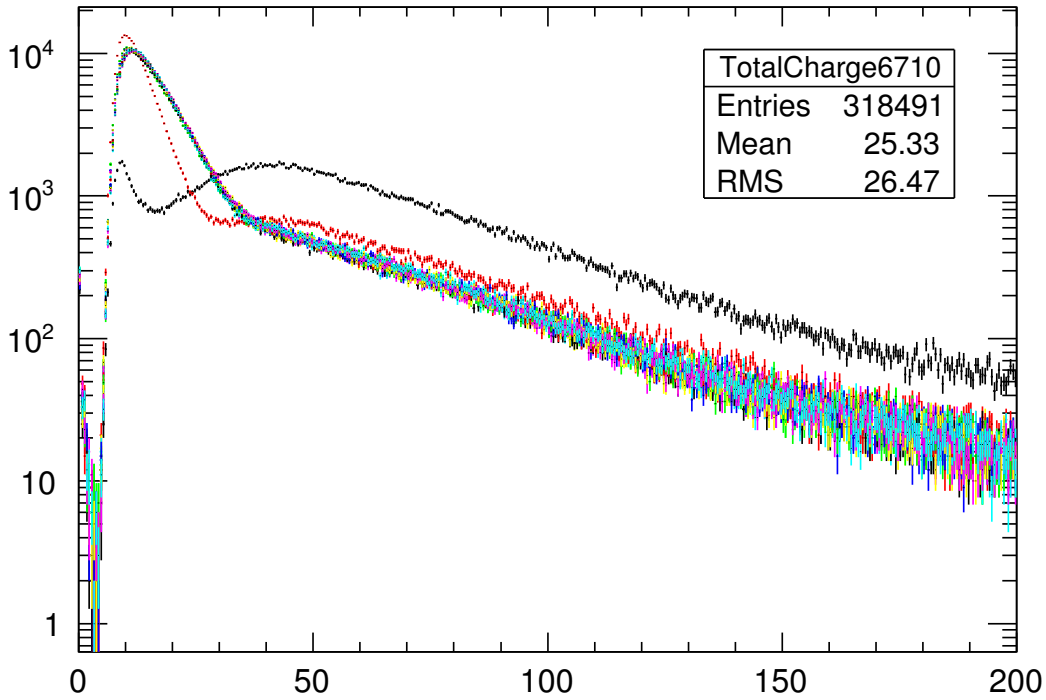
Run 6660

- There is some small variation at the edge of signal region, indicate the spectral has some small shift at different z-position.

AD2 AcuA

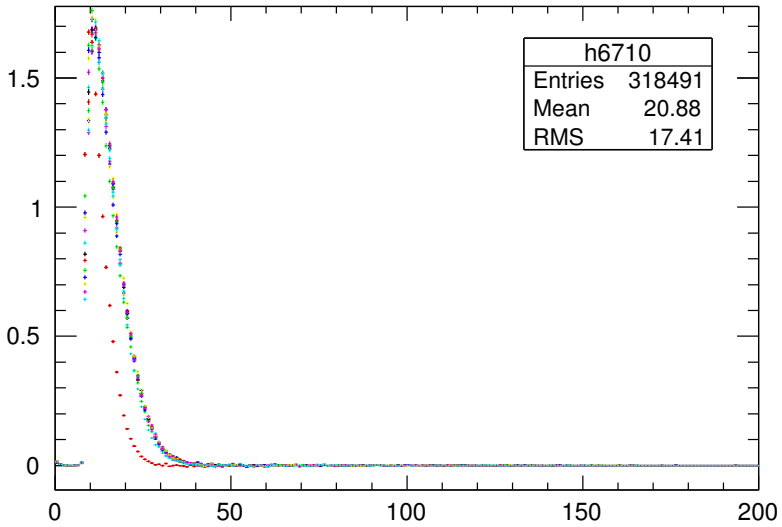
Run 6708 – Run 6721

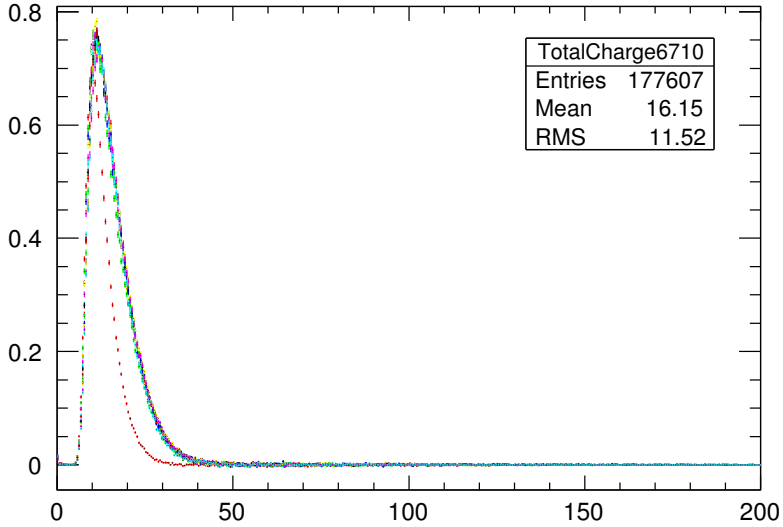
Normalization



- Black histogram is the background run
- Forced maximum 2K Hz trigger, resulted dead time $N_{trigger} \times 500\mu S$.
- Normalized according livetime=runningtime-deadtime.

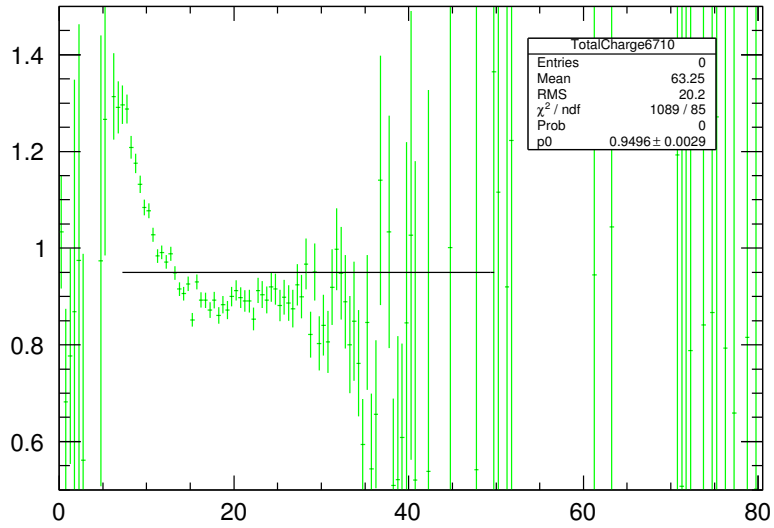
Background subtraction

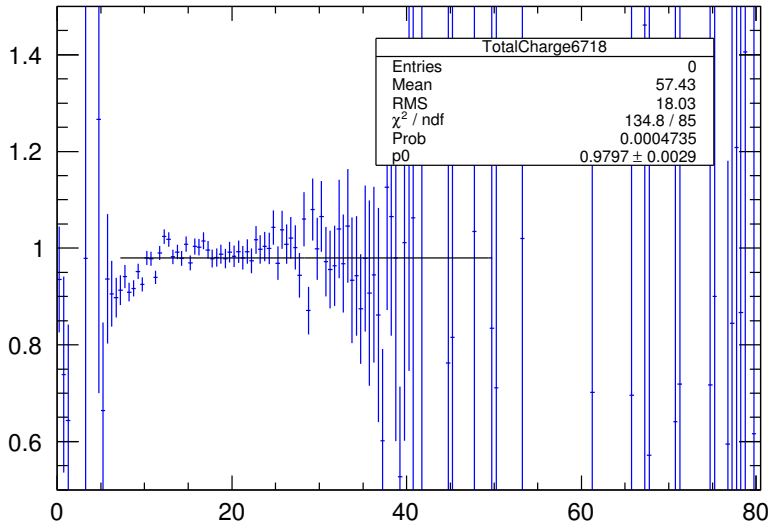




- Subtract the background after normalization.
- Left: NHit distribution; Right: Total Charge distribution.
- Run 6709 (z=1.9 m) is significantly different from other runs.

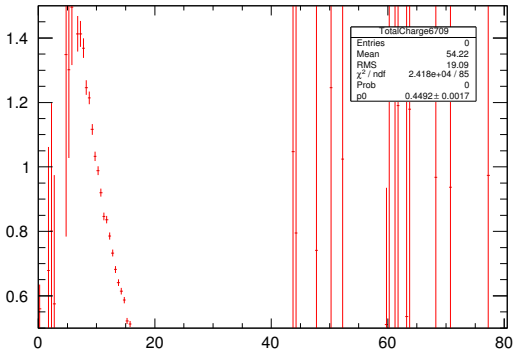
Spectral ratio



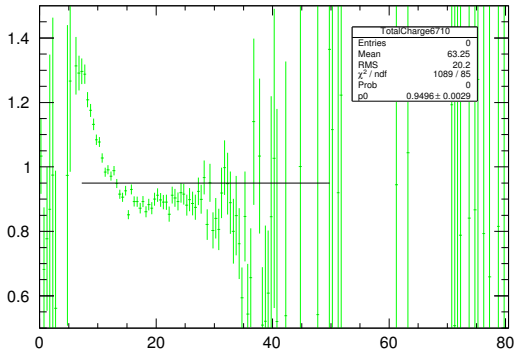


$$R(E,z) = \frac{S(E,z)}{S(E,z=0)} \tag{3}$$

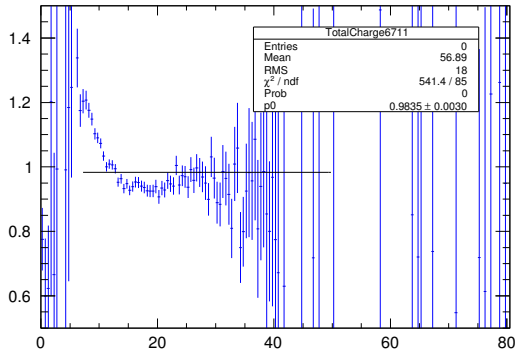
- Doc 5631: if the spectrum is undistorted with source z-position, then ratio should be 1 for all bins.



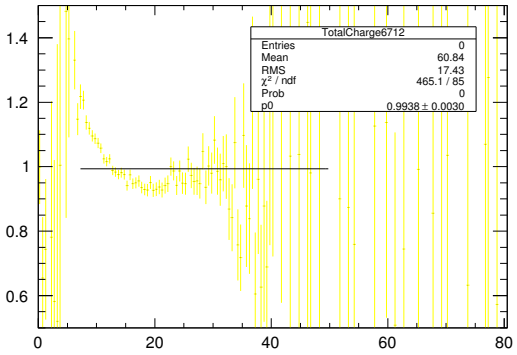
Run 6709



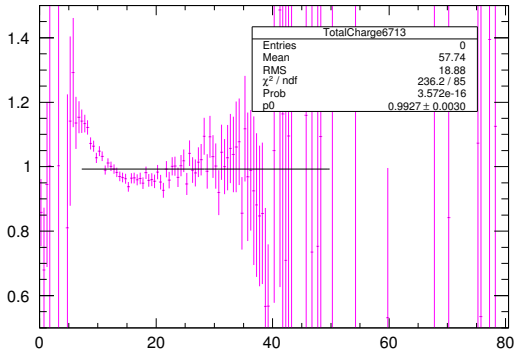
Run 6710



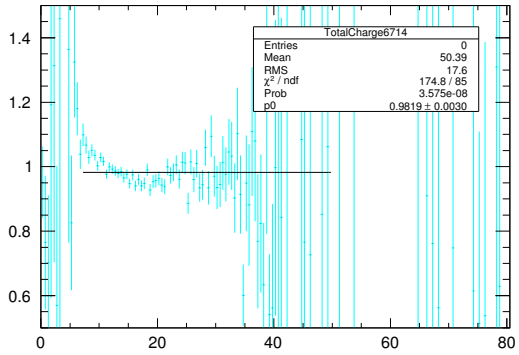
Run 6711



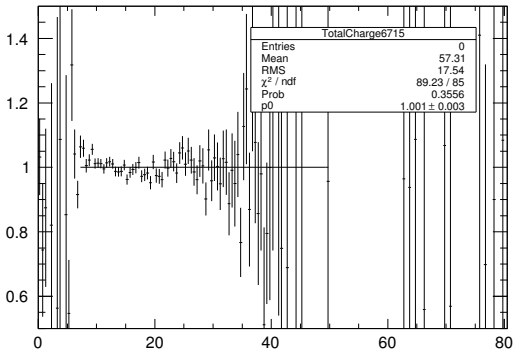
Run 6712



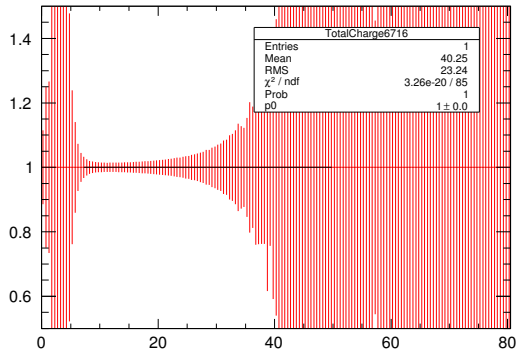
Run 6713



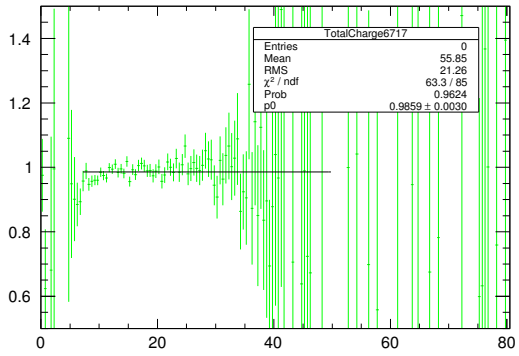
Run 6714



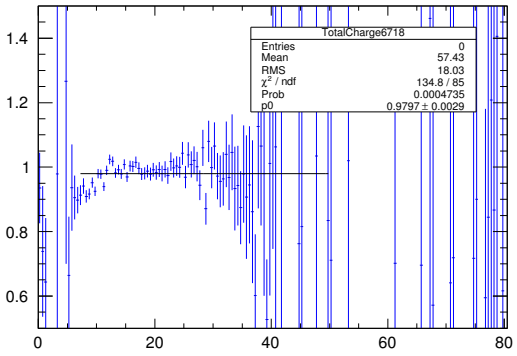
Run 6715



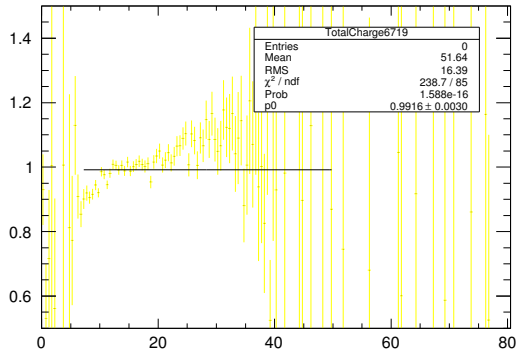
Run 6716



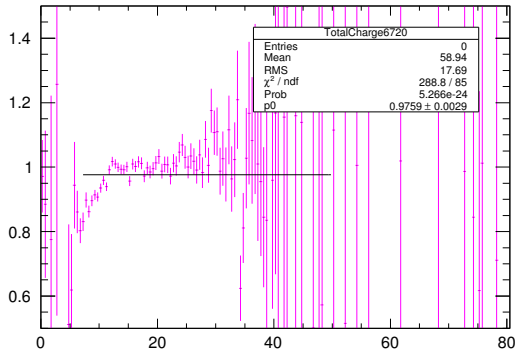
Run 6717



Run 6718



Run 6719



Run 6720

- There is some small variation at the edge of signal region, indicate the spectral has some small shift at different z-position.

Summary

- The result is very dependent on how normalization is done.
- The non-flat distribution of R(E,z) show that there is some variation.
- Using a shape function, we can extract the distortion factor. Only a small variation is seen.