

Charge Division measurements with CDC prototype for z -position tracking in GlueX

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1 Introduction

In a previous GlueX note [1], we described our setup for charge division measurements using a 2 m long CDC prototype and an ^{55}Fe X-ray radiation source. Within noise and experimental errors, we calibrated two adjacent straw tubes (Ch. 2 and Ch. 15) to give a z -position resolution (along the length of the straw tubes) of about $\Delta z \approx \pm 10$ cm .

In this note, we present measurements for three other pairs of straw-tubes using the same basic setup (Fig. 1a). We also re-calibrate Ch 2 and Ch 15, placing the source above Ch 15 this time. Table 1 lists the four straw-tube pairs and Fig. 1b shows their relative geometrical alignment as viewed from the “resistor end” of the prototype. The particular choice of the straw tubes and our limitation to only four pairs were due to the fact that some of the other straw tubes were found to be defective (broken wires, dead spots, sagging in the middle, etc.).

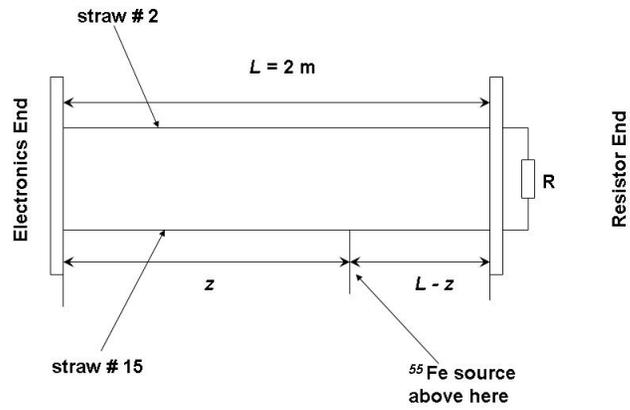
2 Results

Our signal readout procedure using a pre-amplifier, a signal shaper board and two flash-ADC (fADC) modules, remain the same as in Ref. [1]. We always trigger the fADC’s internally on the channel above which the source is placed – for example, we trigger on Ch.15 for the pair Ch.15/Ch.2.

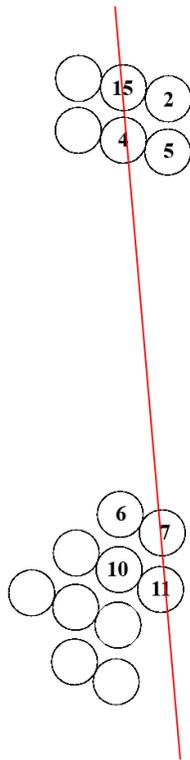
Following the procedure adopted in Ref. [1], at every z -position, we fit the amplitude ratio distribution to a Gaussian and quote the mean μ and the error σ from the fit as the extracted amplitude ratio and its associated error. Fig. 2a show this for a particular position for the pair Ch.7/Ch.6. Similar procedures were followed for Ch.15/Ch.2 and Ch.11/Ch.10. For the pair Ch.4/Ch.5, we found that a Landau function was a better fit than a Gaussian. This is shown in Fig. 2b.

Coupled channels	^{55}Fe source above channel
Ch. 15, Ch. 2	Ch. 15
Ch. 4, Ch. 5	Ch. 4
Ch. 7, Ch. 6	Ch. 7
Ch. 11, Ch. 10	Ch. 11

Table 1: Table of straw tubes coupled for the charge division measurement in this note. The basic setup is the same as in Ref. [1].



(a)



(b)

Figure 1: (a) Setup for Charge Division measurement with a 2 m long CDC prototype. (b) Looking *into* the straw tubes from the “resistor end”. The relative geometrical positions of the four pairs of straw tubes are drawn to scale and the channel number is marked for each straw. The passage of a hypothetical charged track is also shown here (in red).

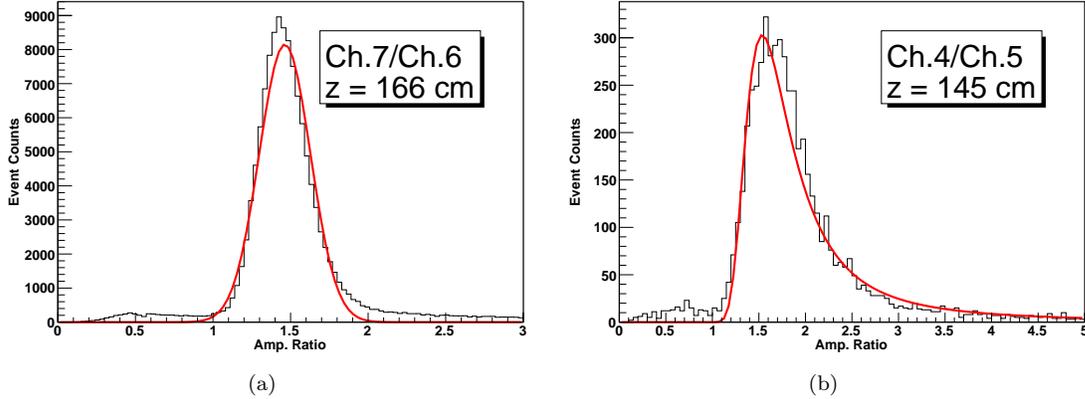


Figure 2: Fits to the amplitude ratio distribution for two straw pairs (a) Gaussian fit for Ch.7/Ch.6 (b) Landau fit for Ch.4/Ch.5.

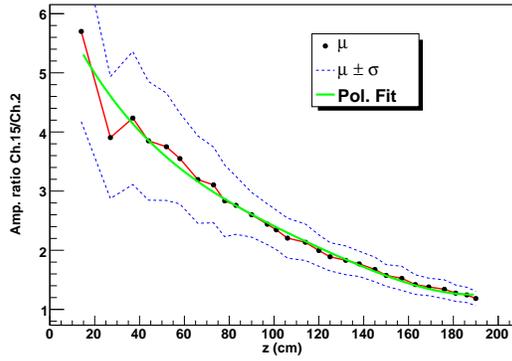
Fig. 3 shows the final calibration curves for all the four pairs of coupled straws and Fig.4 shows a comparison. The calibration curve for the pair Ch.4/Ch.5 is evidently the least smooth amongst all four. This might be because, due to the geometry of our CDC prototype, collimated radiation from the ^{55}Fe source had to first pass through straw #15 before it could reach straw #4, unlike the other three cases, which causes additional fluctuation in our calibration of the Ch.4/Ch.5 pair. Also, note that z -position coverage range for the different straw pairs in Fig. 3 vary, because of the stereo layers in the prototype, which made the low z positions unreachable in certain cases. However, for the CDC, our interest is mainly in the forward z positions, so this is not really a problem as such.

3 Conclusion

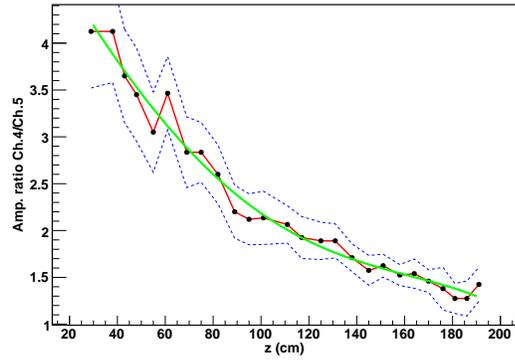
As a follow-up on our study in Ref.[1], we present the z -position calibration curves for charge division measurements for four different coupled pairs of straw tubes. With experimental limitations, the calibration looks consistent between the different straw pairs we have studied. Currently, we have begun recording data using cosmic rays to do z -position tracking using these results.

References

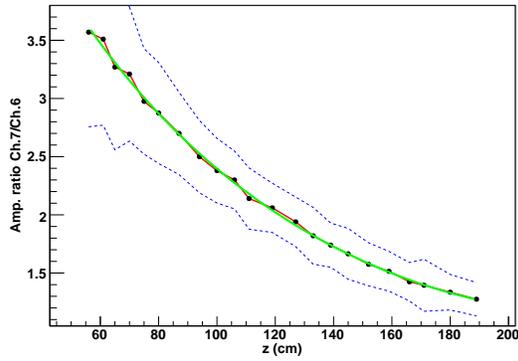
- [1] B. Dey, Y. Van Haarlem and C. A. Meyer, **Charge Division measurements with CDC prototype for GlueX**, GlueX-doc-1220, (2009)



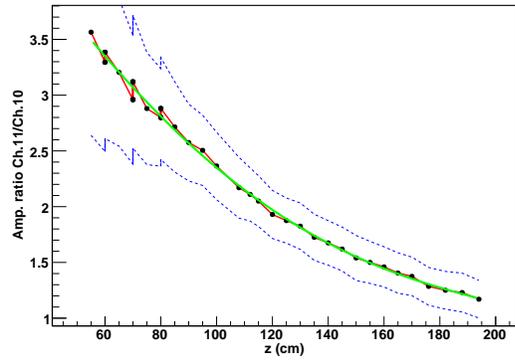
(a)



(b)



(c)



(d)

Figure 3: Charge Division calibration for (a) Ch.15/Ch.2, (b) Ch.4/Ch.5, (c) Ch.7/Ch.6 and (d) Ch.11/Ch.10. The blue dashed lines give the estimated resolution while the green curves are 4th order polynomial fits to the data.

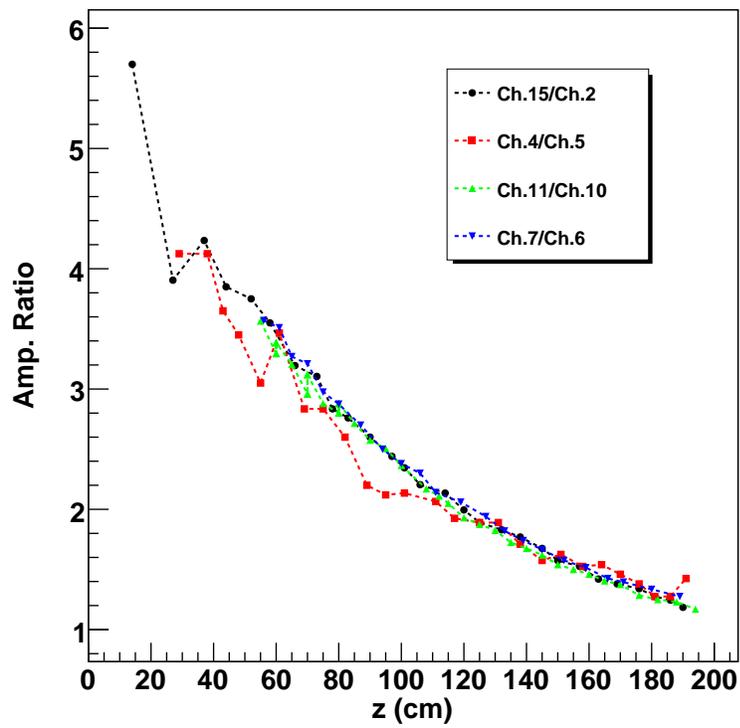


Figure 4: Comparison of the charge division calibration curves for all four coupled straw tube pairs in this study.