# *Incomplete* Memo on the Energy Calibration for the MVD Detector

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## 1 Introduction

The MVD detector is designed to measure total multiplicity, vertex position, and pseudorapidity distribution of the event. This device can be divided into the barrel part having two layers of silicon strip detectors and the endcap part having twelve of $30^0$ wedge-shaped silicon pad detectors. During the run, automatically pedestal subtracted ADC values are supposed to be collected from both types of the detectors. After the proper calibration, those ADC values can be converted to the multiplicity of particles passing the MVD detector and their respective pseudorapidities. Thus we should be able to estimate expected ADC value of any given detector assuming passage of a single minimum ionizing particle so that we can predict particle multiplicity from raw ADC values. Such ADC values can be most easily obtained by utilizing lower multiplicity events which have very small multi-hit probability in the cluster. Calibration procedures for the barrel and endcap parts will be discussed separately in the following.

## 2 Calibration of the barrel(strip) detectors

The barrel detector can be divided into 6 sectors, each of which has inner(r=5cm) and outer(r=7.5cm) panels covering $60^0$ in the azimuthal angle. The 63.6cm long panel is parallel to the beam(or z) axis and readout strips in the panel are aligned perpendicularly to the beam direction for z-position measurement. The thickness of the detector is 300$\mu$m and the pitch size of the readout strip is 200$\mu$m. As shown in the figure 1, typical minimum ionizing particle registers more than one ADC channels. The number of fired ADC channels is determined by incident angle of particle into the detector plane and cross talks between neighboring channels. Thus it is necessary to clusterize contiguous ADC hits to be associated with single particle. Sometimes more than one particles which are coming very closely can pass a single cluster. For the calibration run containing only low multiplicity events, such probability would be so small that ADC sum in the cluster would be almost equal to the energy deposition by single particle. If we assume the same gain for all ADC channels in the strip detector, we can define the normalized ADC sum which is independent of the incident angle. The incident angle can be calculated using the vertex position which is obtained by connecting average z-positions of clusters in the inner and outer layer. With this incident angle shown in the figure 1, we can calculate the normalized ADC sum as follow

$$ADC\_SUM' = ADC\_SUM \times COS(\theta)$$

After this procedure, the normalized ADC sum($ADC\_SUM'$) in the clusters of any polar angle $\theta$ should be equal. Figure 2-(a),(b) are showing cluster size depending on the incident angle. As expected, we can see more fired ADC's for clusters(or clumps) with large $\theta$. Figure 2-(c),(d) are scatter plots of ADC sum in the cluster versus incident angle before and after normalization, respectively. Clearly angular dependence of the ADC sum in the figure 2-(c) is disappeared in the figure 2-(d). It should be pointed out that we can not remove ADC variation due to different azimuthal angle as we can not tell this within $\pm$ $30^0$. Thus the final ADC distribution should contain additional width of $\pm 15\%$ due to this uncertainty. Figure 3-(a) shows this ADC distribution from Au+Au collisions with 13fm of impact parameter. The remaining plots in the figure 3 are ADC distributions of single, double, and triple occupancy of particles in the cluster. The average multiplicity of particles in the cluster is 1.036 in this case. The remaining task for the MVD calibration would be then finding an average of the normalized ADC sum. This value in the figure 3-(a) is 34.09, which is not much different from corresponding value of 32.94 for true single particle in the figure 3-(b). After plugging this average $ADC\_SUM'$ to calculate multiplicity in the cluster, pseudorapidity distribution from the inner barrel is obtained. Figure 4-(a) shows this distribution using this procedure(histogram). This is compared with the same distribution using geometrically obtained dE/dx value for the minimum ionizing particle(cross symbols). In the figure 4-(b), calculated vertex positions using z-positions of the cluster(solid line) is shown along with the original one(dotted line). Figure 4-(c),(d) are showing multiplicities measured in the inner and outer barrel, respectively.

# 3 Calibration of the endcap(pad) detectors

"*to be done in the future*"

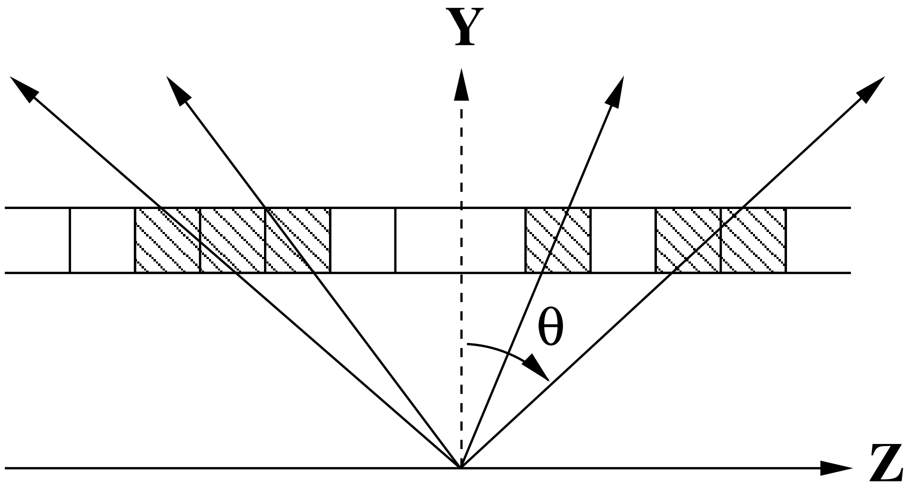



Figure 1: side view of the inner barrel(strip) detector

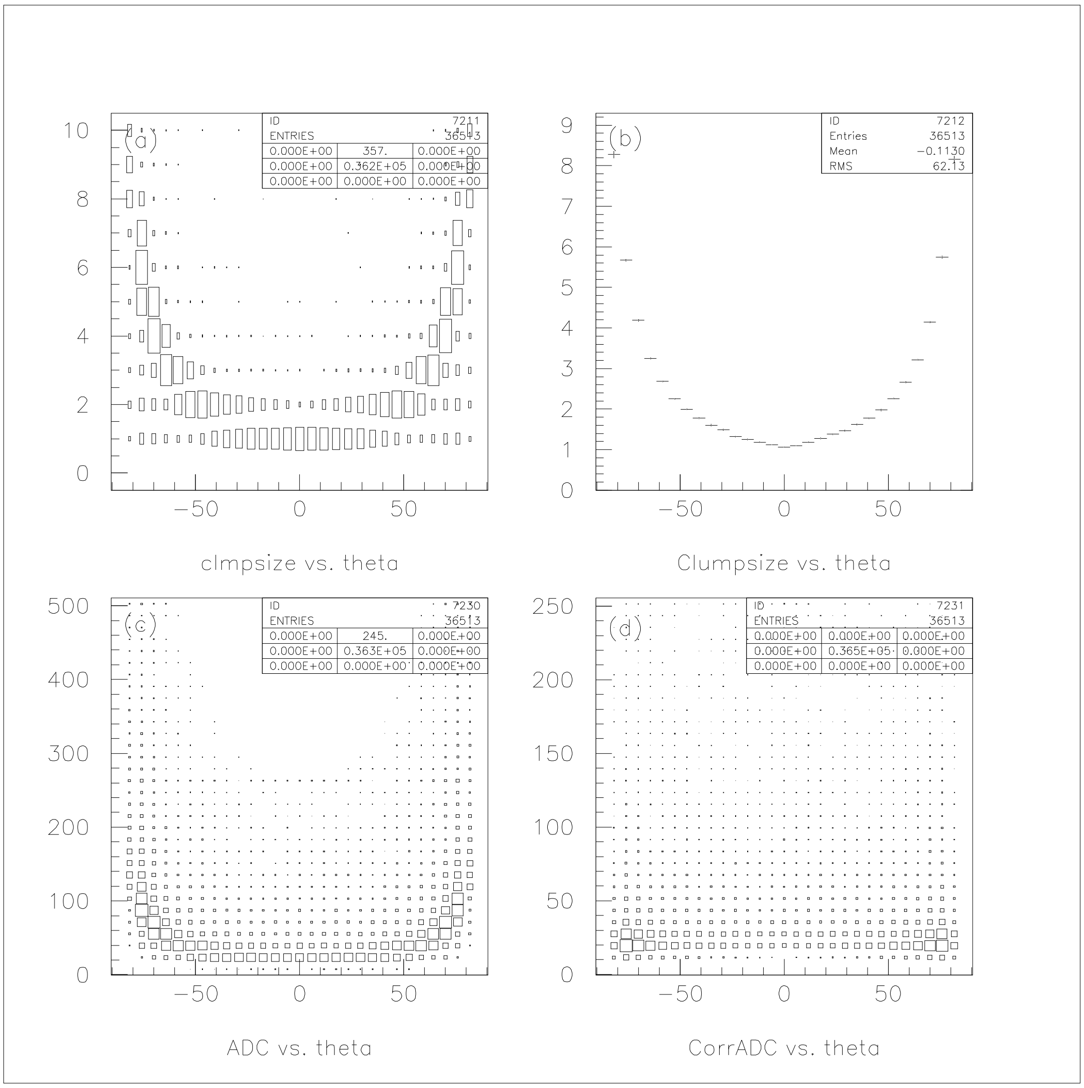
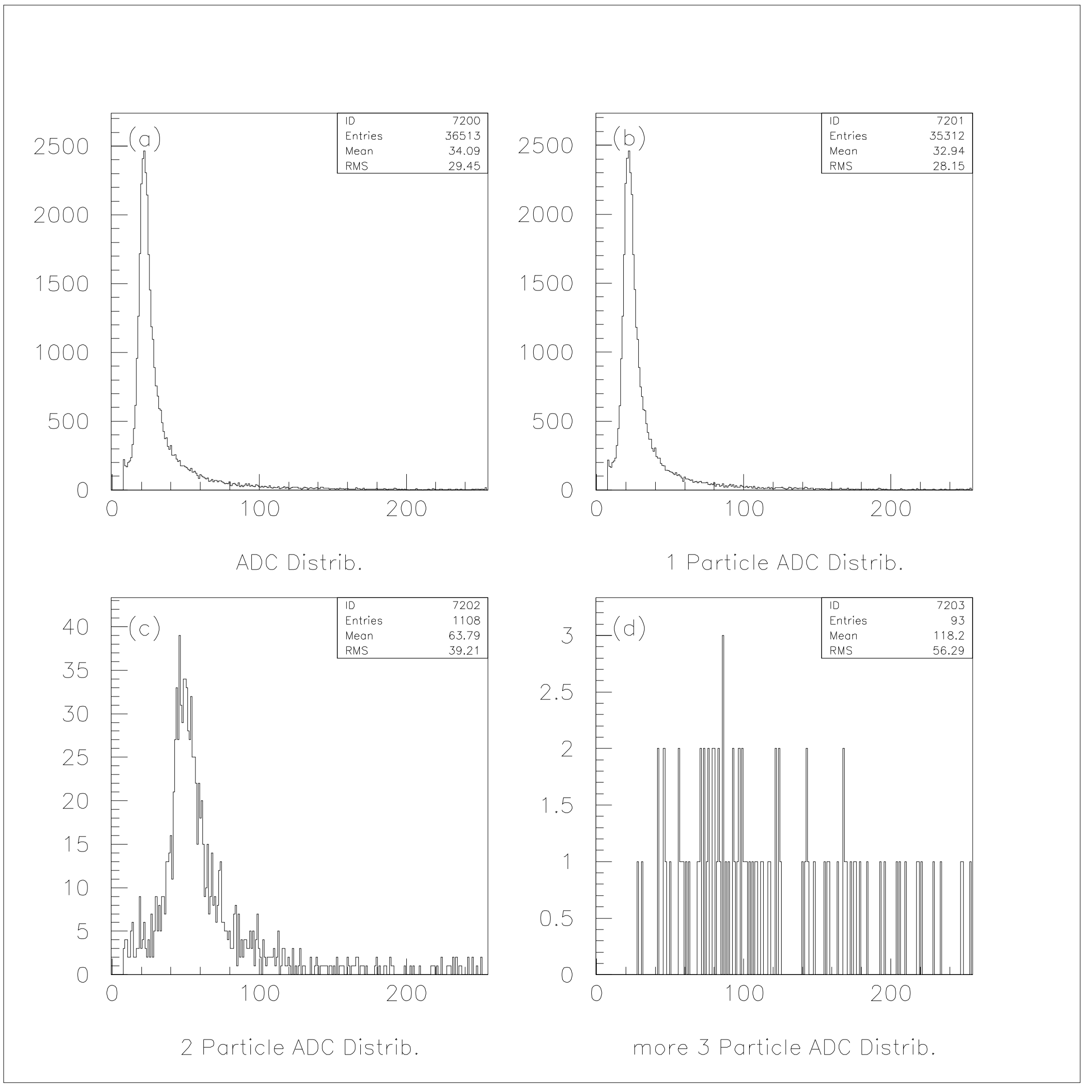

(a)
clmpsize vs. theta
(b)
Clumpsize vs. theta
ID 7212
Entries 36513
Mean −0.1130
RMS 62.13
(c)
ADC vs. theta
(d)
CorrADC vs. theta

Figure 2:



(a)
ID 7200
Entries 36513
Mean 34.09
RMS 29.45
ADC Distrib.
(b)
ID 7201
Entries 35312
Mean 32.94
RMS 28.15
1 Particle ADC Distrib.
(c)
ID 7202
Entries 1108
Mean 63.79
RMS 39.21
2 Particle ADC Distrib.
(d)
ID 7203
Entries 93
Mean 118.2
RMS 56.29
more 3 Particle ADC Distrib.


Figure 3:

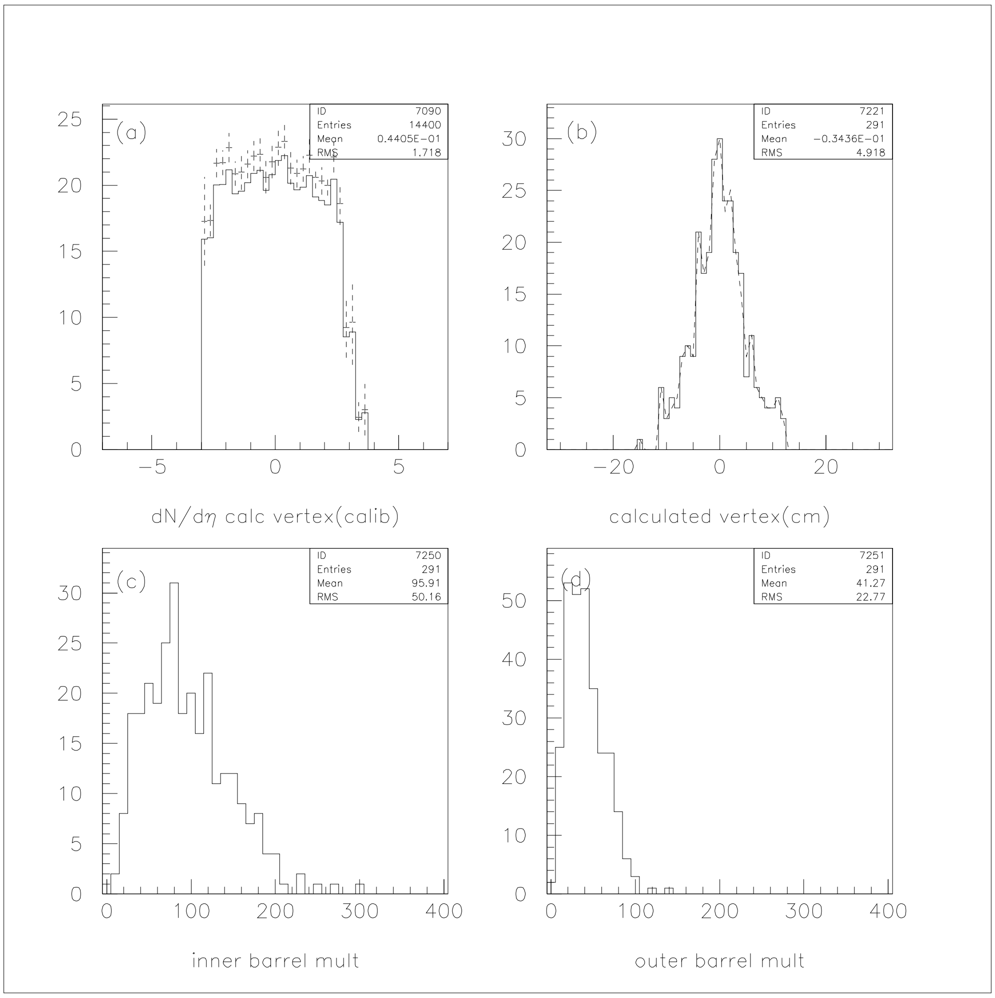

(a)
ID 7090
Entries 14400
Mean 0.4405E-01
RMS 1.718
dN/dη calc vertex(calib)
(b)
ID 7221
Entries 291
Mean −0.3436E-01
RMS 4.918
calculated vertex(cm)
(c)
ID 7250
Entries 291
Mean 95.91
RMS 50.16
inner barrel mult
(d)
ID 7251
Entries 291
Mean 41.27
RMS 22.77
outer barrel mult

Figure 4: