# Rapport de

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portant sur le sujet suivant :

# Embedding and work at BNL : August-September 2006

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UMR 6457

Université de Nantes-Ecole des Mines de Nantes-CNRS/IN2P3

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# Chapitre 1

# efficiency

## 1.1 Definition

The efficiency is defined as a binomial distribution between the number of possible hits and the number of fitted hits for all the tracks.

$$p(k) = \frac{n!}{n!(n-k)!}(Eff)^k(1-Eff)^{n-k} \tag{1.1}$$

where :

- n = number of possible hits.
- k = number of fitted hits.

Eff is the probability of success, here to have the number of possible hit equal the number of fitted hits.
We want to know Eff :
a sucess is defined for n = k and we have access directly to this number by dividing the bin content (called $p_{sucess}$) by the sum of this column ; the bin content for n $\neq$ k dividing bu the sum give us $p_{fail}$.
If success, (1.1) become $p_{sucess} = Eff^k$ (since n = k)
Then :

- For the ssd, we have n = k = 1 then (1) leads to Eff = $p_{sucess}$
- For the SVT , the case n = k = 3 give Eff = $(p_{sucess})^{\frac{1}{3}}$

## 1.2 Error on the efficiency

Now suppose that we want the variance for n such trials (i.e. for the general binomial distribution). Since the trials are independent, we may add the variances for each trial, giving :

$$\sigma^2 = np(1-p) \tag{1.2}$$

and finally the variance is given by

$$s = \frac{\sigma}{n} = \frac{\sqrt{np(1-p)}}{n} = \sqrt{\frac{(1-p)p}{n}} = \sqrt{\frac{p(0)p(1)}{sum}} \tag{1.3}$$

## 1.3 2-d plots

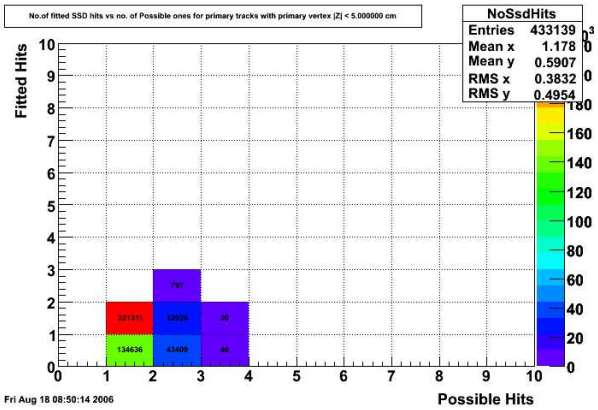


Fig. 1.1 – Real Data 62 GeV

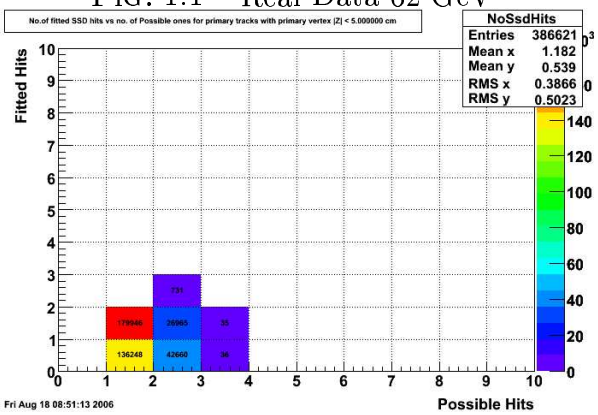


Fig. 1.2 – Real Data 200 GeV

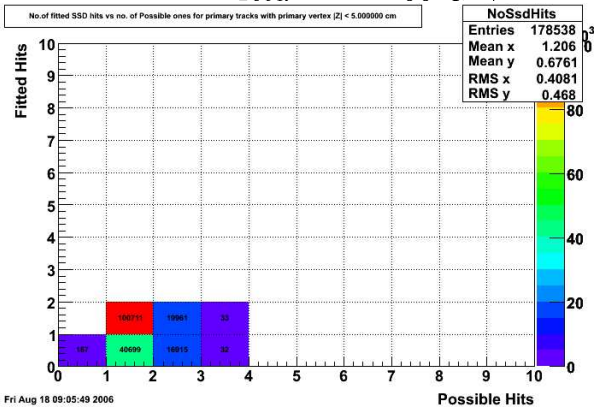


Fig. 1.3 – Simulation (Hijing) 200 GeV

Comments : as explained after, severals cuts are applied in order to select only the tracks that cross the SSD (I don't care if there are fitted points otr not in the SVT). This reduced the statistics mainly due to the cut on the position of the vertex of the collision along the beam axis (Z vertex).
I select only tracks with at least one possible hit in the tracking and look for the distribution of tracks with 0,1,2 hits fitted from the SSD.
Hypothesis for the 2 hits fitted tracks :

1. : tracks that cross 2 overlapped layers.
2. : the tracking was not able to make the difference between these 2 hits.
3. : 1 hit from the first tracking pass, another found during the re-fit from inside to the outside.

But we can see that this case rarely appears ($\sim 0.15\%$ for the both datasets)
Then the efficiency as defined(2) in for the SSD is roughly 60%.
As we can see from the figures 1.4, 1.5 and 1.6, efficiencies are $p_T$ dependant and charge dependant. The work in chapter 2 is to explain and find why we observe differency between the real data and the simulation.

## 1.4 Efficiency

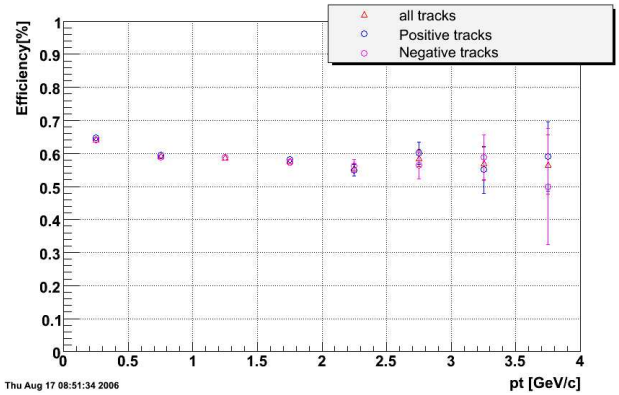


FIG. 1.4 – Real Data 62 GeV

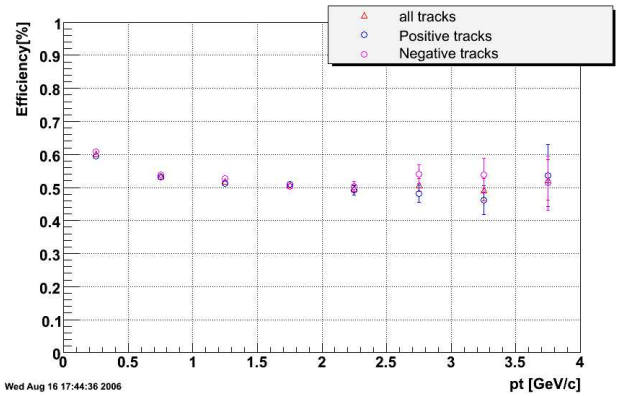


FIG. 1.5 – Real Data 200 GeV

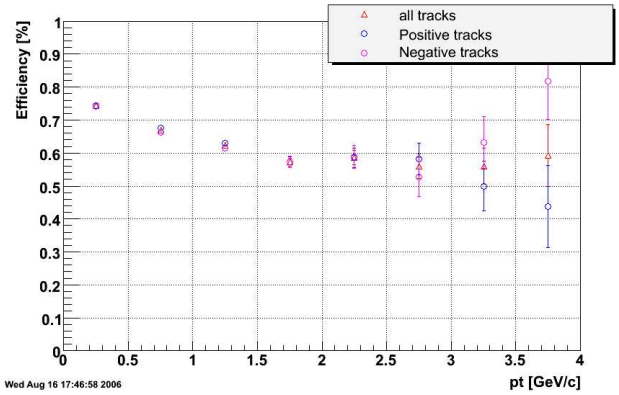


FIG. 1.6 – Simulation (Hijing) 200 GeV

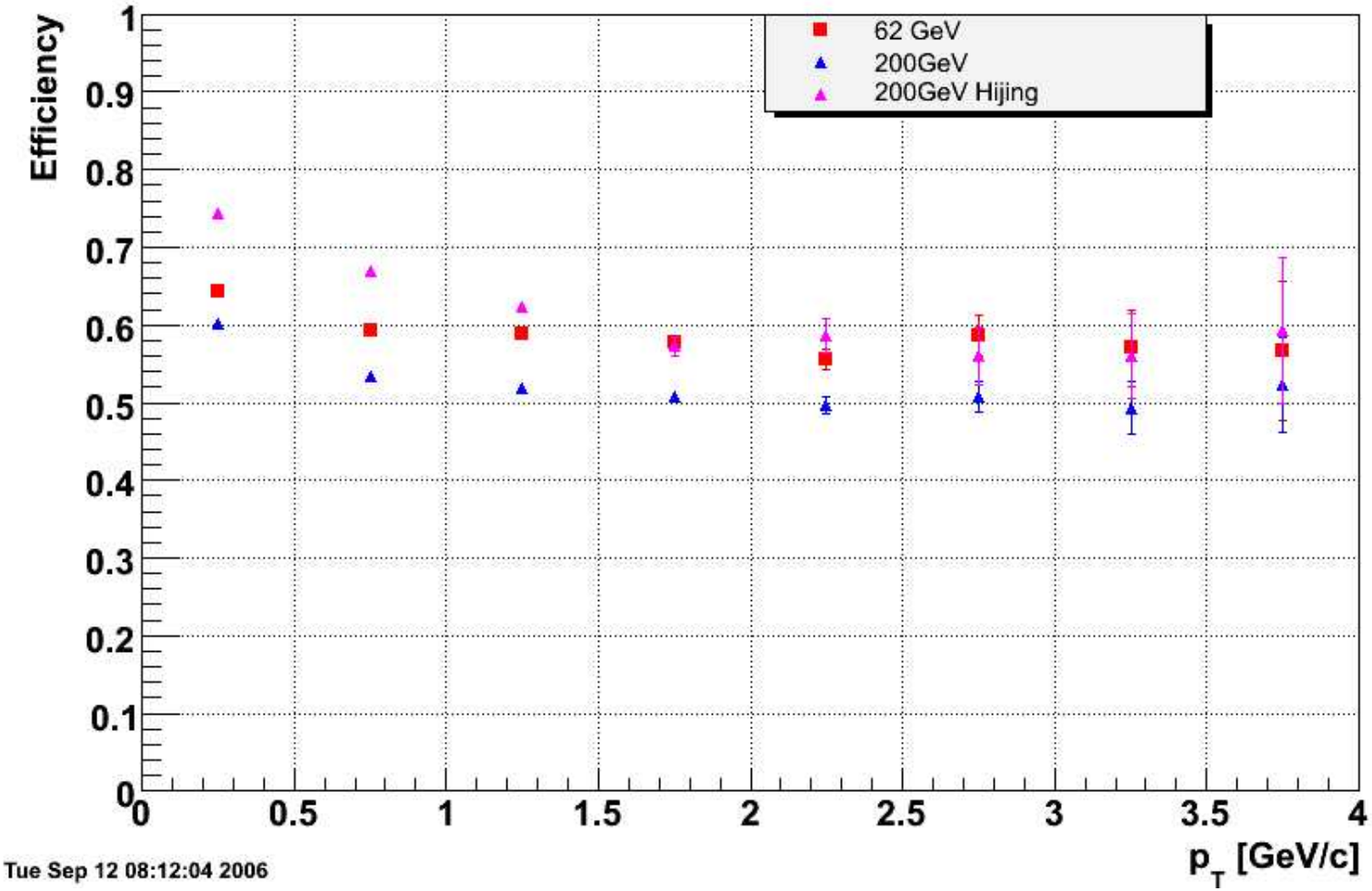


FIG. 1.7 – Summary of the efficiency

The final cuts are :
- $\|$z vertex$\| \leq 5$ cm
- NFit Hits $\geq 15$
- $\|\eta\| \leq 1$
- $p_T \geq 1$GeV/c
- DCA $\leq$ 1cm
- $\phi \in$ [-180 ;-40]$\cup$[0,180]

Comments :

### 1.4.1 efficiency vs centrality

The differents centralities are :

| | 0-10% | 10-20% | 20-30% | 30-40% |
|---|---|---|---|---|
| 62 GeV | 100 | [70 ;100] | [48 ;70] | [27,48] |
| 200 GeV | 141 | [100 ;141] | [70 ;100] | [50 ;70] |

TAB. 1.1 – Multiplicity of tracks for the definition of centrality

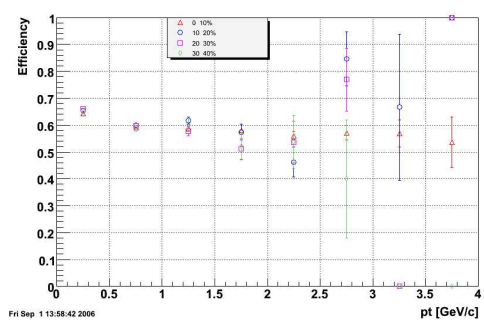


FIG. 1.8 – Efficiency (62 GeV)

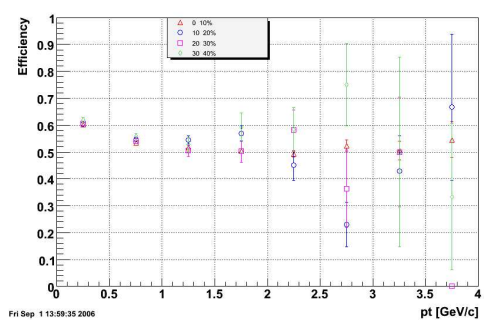


FIG. 1.9 – Efficiency (62 GeV)

### 1.4.2 Pointing accurancy aka DCA

At infinite momentum, limit of the resolution (DCA) is 30um in XY and 700um in Z (This is the digital resolution of the wafer) Resolution here includes vertex and hit resolutions. Calibration details :

- The alignment was done for CuCu 62 Gev data
- The same values were used for the CuCu 200 GeV data
- Things in 200 GeV are not as well tuned as in 62 Gev

**62 GeV**

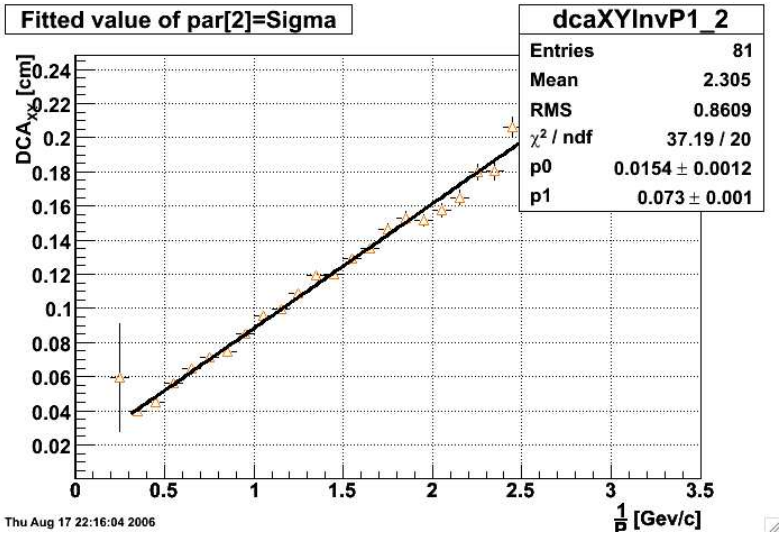


FIG. 1.10 – in the transverse plan XY

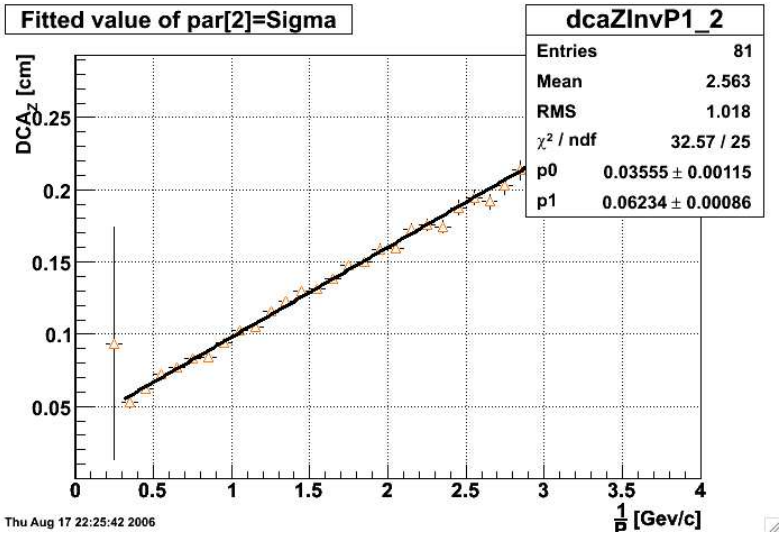


FIG. 1.11 – in Z

**200 GeV**

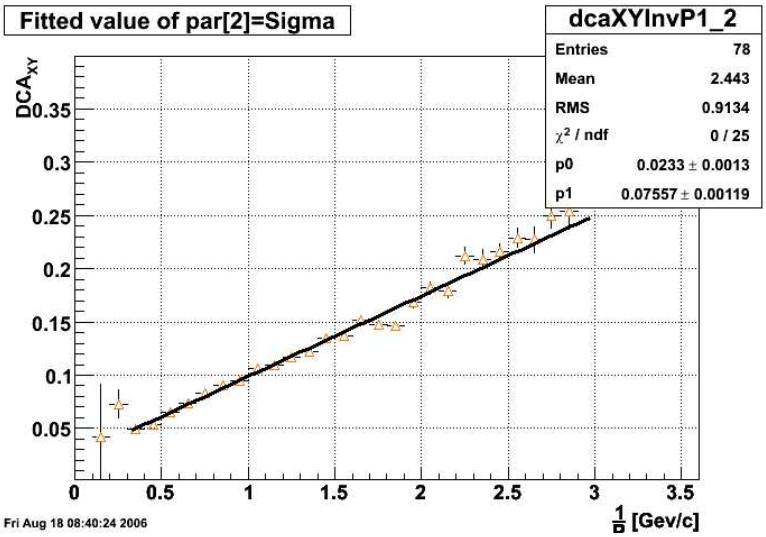


FIG. 1.12 – in the transverse plan XY

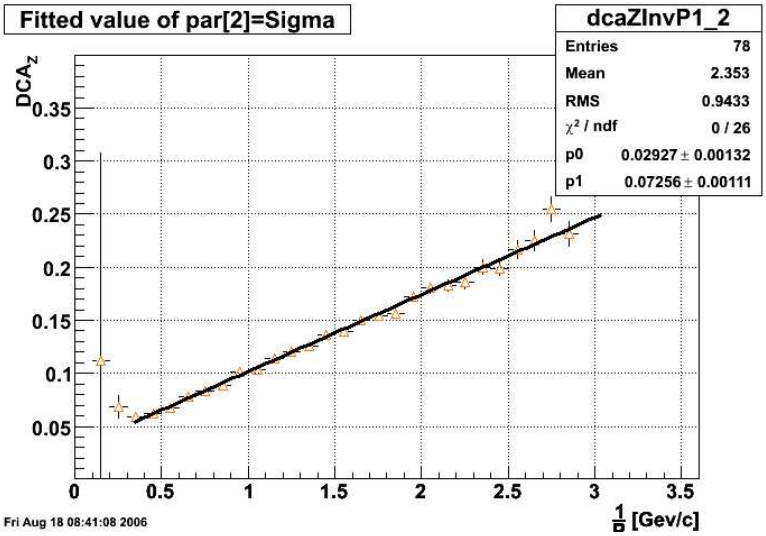


FIG. 1.13 – in Z

# Chapitre 2

# Comparison for the data

The first attempt in order to understand the difference between real data and simulation.
The causes could be differents :

- The ssd simulation soft (as well the hit reco.) is not optimized for CuCu collisions.
- The simulation soft took a default pedestal run where the noise and the pedestal values are set to respectively 3 and 100 ADC.
  But we saw from the pedestal runs in 2005 that the real values are slightly different. As the cluster finding is mainly based on a cut of the (signal/noise), it could explain the diffences.
- So the tasks are :
  1. Take the real pedestal and noise from the pedestal run as input for the simulation.
     I did not succeed it until now so in this case, modify the Maker that generate pedestal and noise in the simu with the closer state of the SSD
  2. Then rerun and produce MuDst and then do the eficiency.

So first I look at the data and change the signal to noise ratio.
As the cuts in the StSsdpointMaker were setted for the Au+Au collisions, I look at differents cases and see what look like the charge distribution of the clusters.
The cases are :

1. $\frac{s}{n}\geq 3$ and no cut on the noise
2. $\frac{s}{n}\geq 3$ and cut on the noise (n$\geq$0)
3. $\frac{s}{n}\geq 5$ and no cut on the noise
4. $\frac{s}{n}\geq 5$ and cut on the noise (n$\geq$0)

Basically, I ran over the same number of events for the 4 differents cases for the comparison.

## 2.1 $\frac{s}{n}\geq 3$

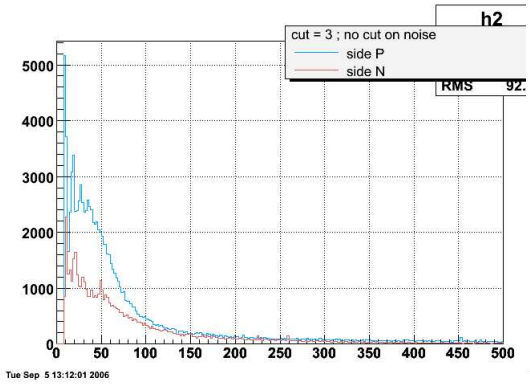


FIG. 2.1 – No cut on the noise

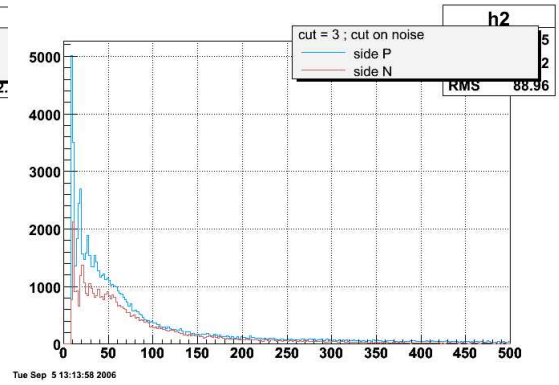


FIG. 2.2 – n≥0

## 2.2 $\frac{s}{n} \geq 5$

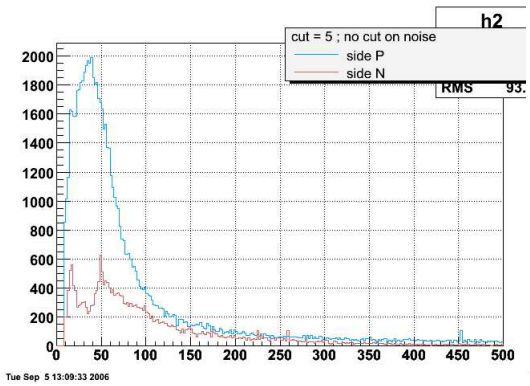


FIG. 2.3 – No cut on the noise

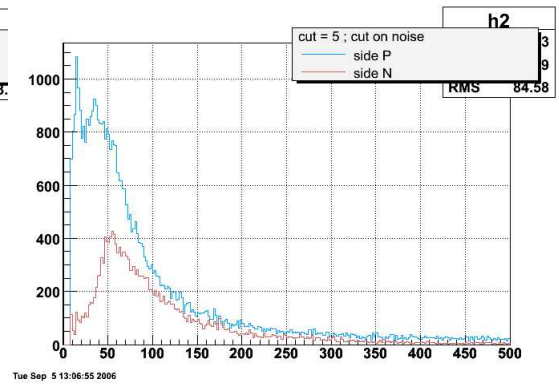


FIG. 2.4 – n≥0

It looks that the cut setted for the Au+Au collisions ($\frac{s}{n} \geq 3$ and noise≥0) remain the more effective for the Cu+Cu since the distribution of the charge of the clusters look like a landau distribution.

## 2.3 Clusters

### 2.3.1 Size of the clusters

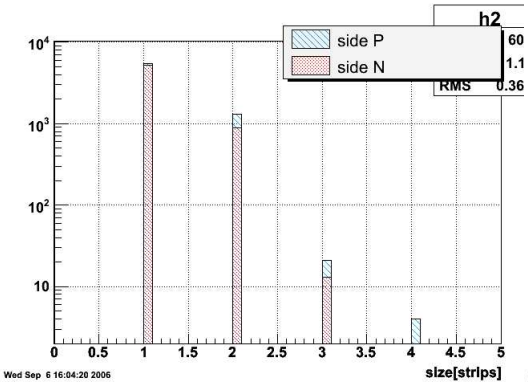


FIG. 2.5 – Real data

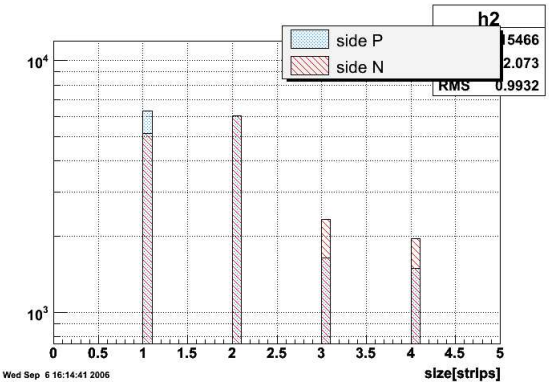


FIG. 2.6 – Simulation

### 2.3.2 $\frac{s}{n}$ ratio

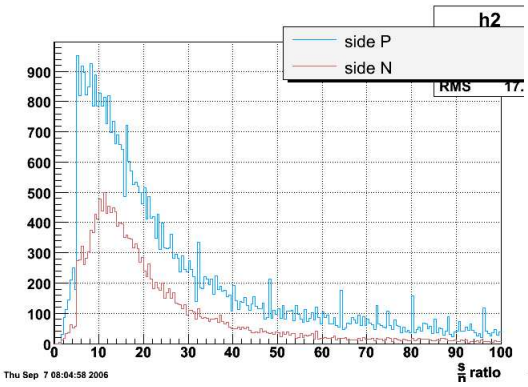


FIG. 2.7 – Real data

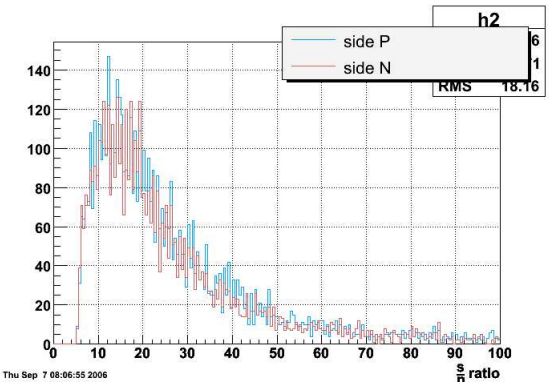


FIG. 2.8 – Simulation

## 2.4 Hits

### 2.4.1 All Packages

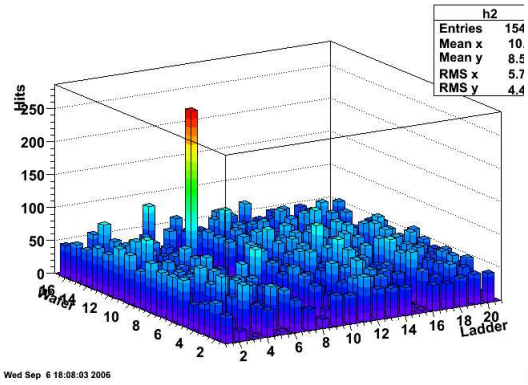


FIG. 2.9 – Real data

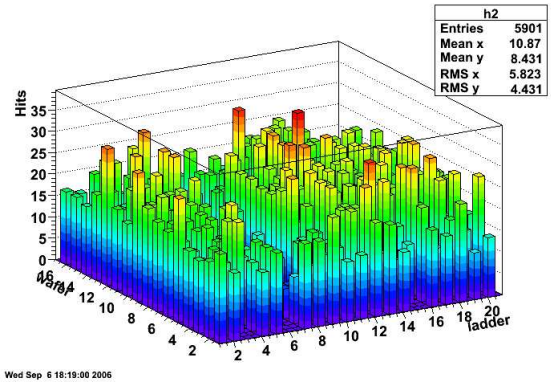


FIG. 2.10 – Simulation

### 2.4.2 Case 1-1 only

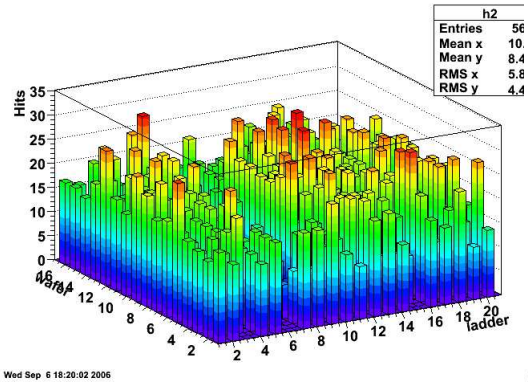


FIG. 2.11 – Real data

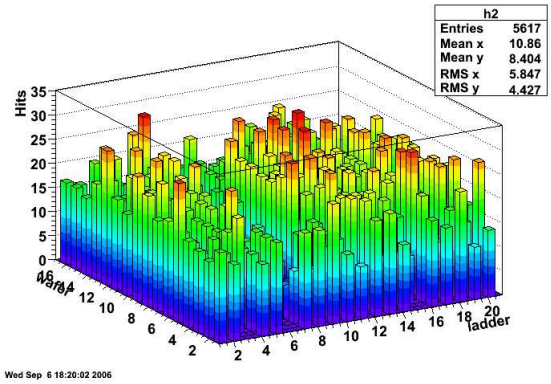


FIG. 2.12 – Simulation

### 2.4.3 difference of the pulses between N and P sides

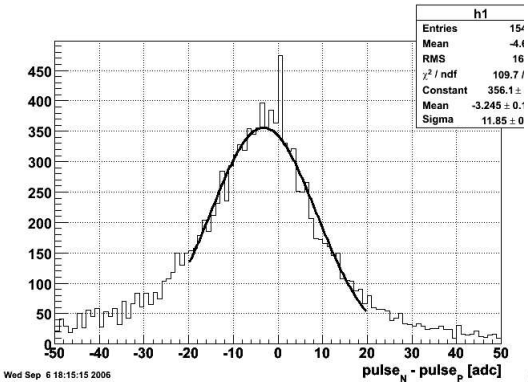


FIG. 2.13 – Real data

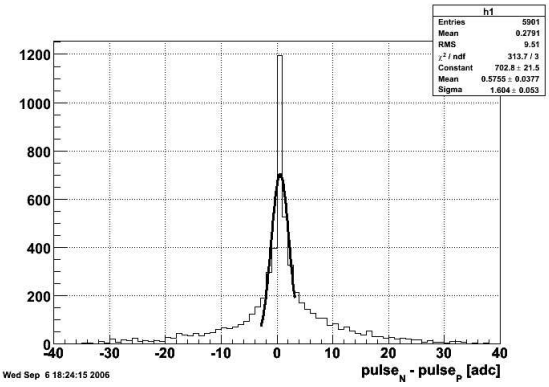


FIG. 2.14 – Simulation

## 2.5 Comparison for the simulation

I look here at 3 cases :

1. the simulation as the code is in cvs (scratch)
2. the simulation when the real pedestal and noise values are given as inputs (tuned)
3. the simulation but with a factor of 10 applied to the cuts

### 2.5.1 Charge distribution

One can see that with the real pedestal and noise values (not the default ssdStripCalib where the pedestal is 100 ADC and the noise is 3 ADC for all strips) that the charge distribution look like the real data.
With the factor of 10, the clusters with a high charge remain.

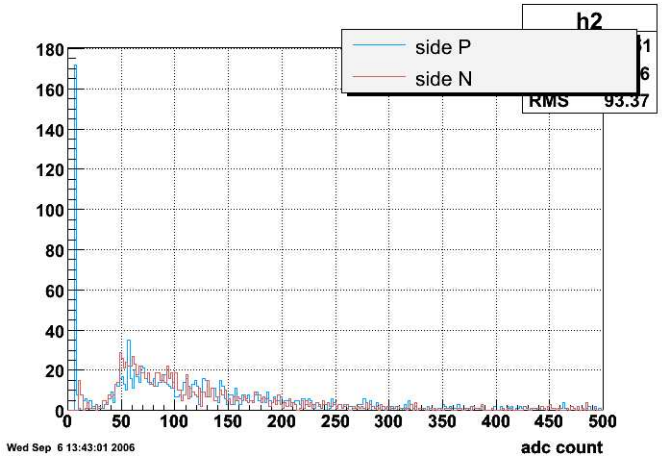


FIG. 2.15 – from scratch

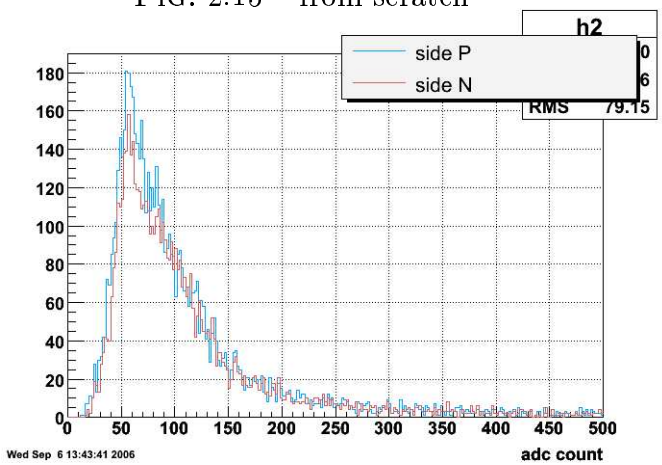


FIG. 2.16 – with the real pedestal and noise

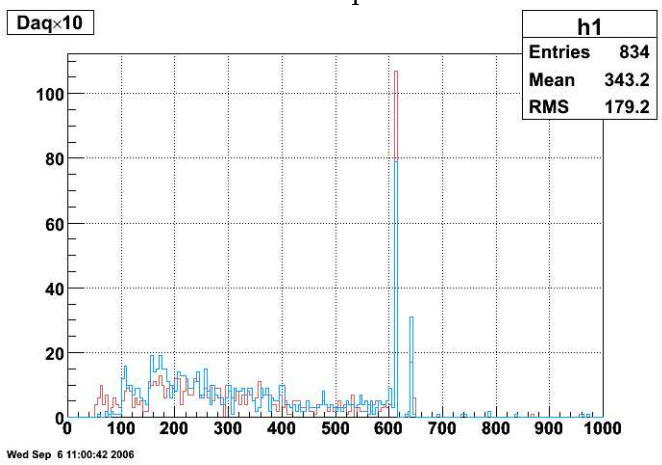


FIG. 2.17 – with the real pedestal and noise anf the factor of 10

### 2.5.2 Efficiency

Now the efficiency for the same 3 cases.
So the factor of 10 does affect the efficiency but we still have a better efficiency in the simulation compared to the real data.

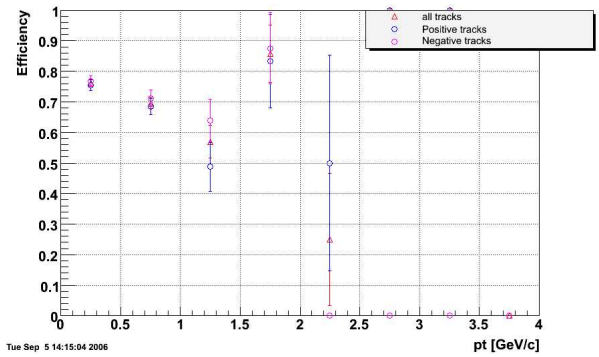


FIG. 2.18 – from scratch

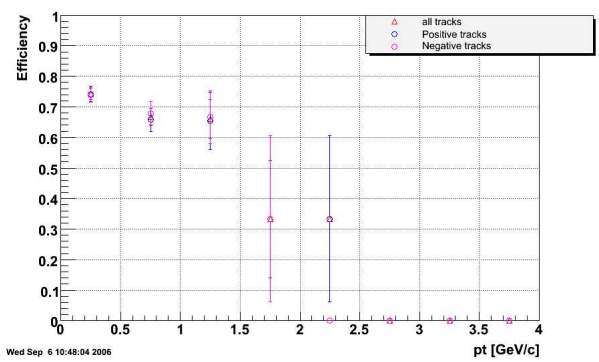


FIG. 2.19 – with the real pedestal and noise

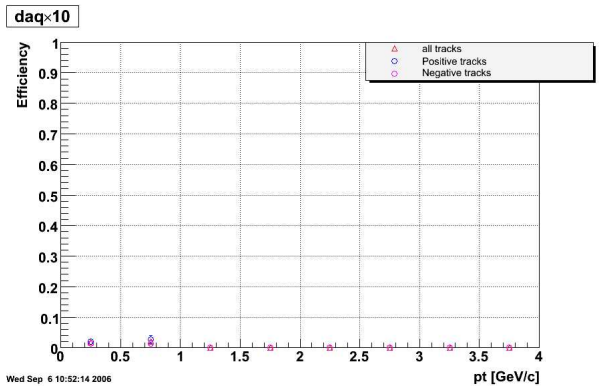


FIG. 2.20 – with the real pedestal and noise and the factor of 10

# Chapitre 3

# Pedestal from the simulation

## 3.1 Parameters

This section is to find the parameters of the pedestal file used in the production (ssd-StripCalib.20050218.81219.root) :

1. Mean Barrel pedestal
2. Mean Ladder pedestal
3. Mean wafer pedestal
4. Pedestal strip deviation
5. Mean strip noise
6. Noise strip deviation

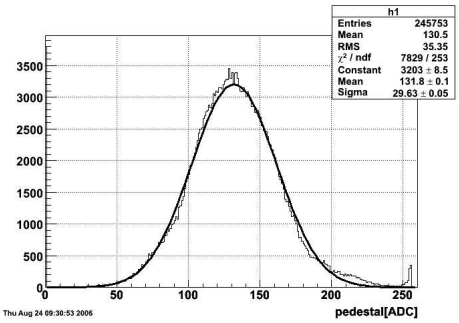


FIG. 3.1 – Pedestal for ladders of P side

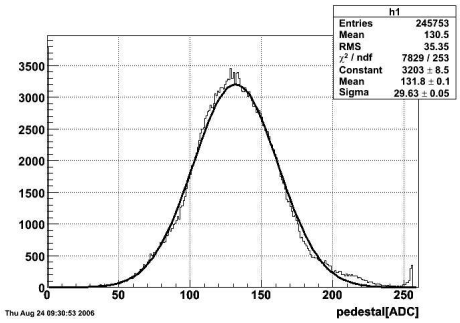


FIG. 3.2 – Pedestal for ladders of N side

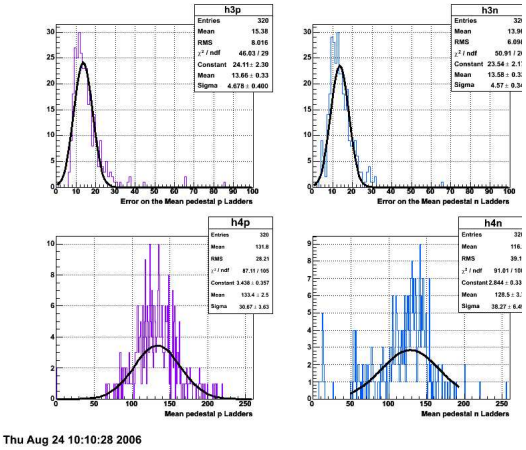


FIG. 3.3 – Mean wafer pedestal

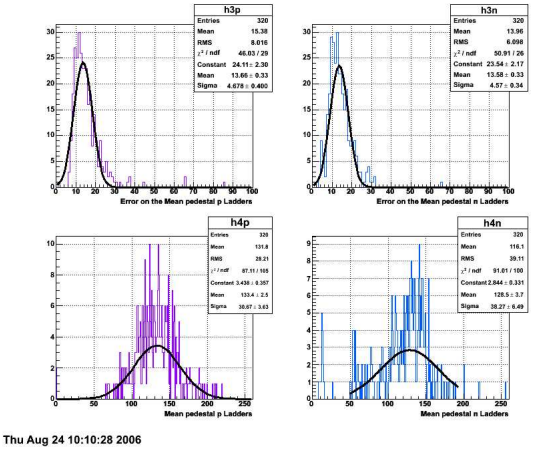


FIG. 3.4 – Pedestal strip deviation