

Study of the ambiguities in the B-Bbar Events (Progress Report)

C. Milstene- September 25,03

A closer study of the Pions, Kaons and Protons which passed the muon algorithm has shown that, in 95% of the cases,. Those Particles where accompanied by a muon having a Φ , Θ within the $\Delta\Phi$ and $\Delta\Theta$ cuts.

Therefore to those tracks one finds, associated an actual Muon Hit, in the 1st layer of the Muon Detector.

We will show that using the Hadron calorimeter, one remove part of the ambiguities.

Typical cases Of Pi's Passing The Muon Algorithm

3 Cases with Hadrons passing the Muon Algorithm by SHARING the HITS with a Muon in the Muon Detector. This is ~95% of the cases of wrong Track ID passing the Algorithm.

Two such events are also shown in the Event Display.

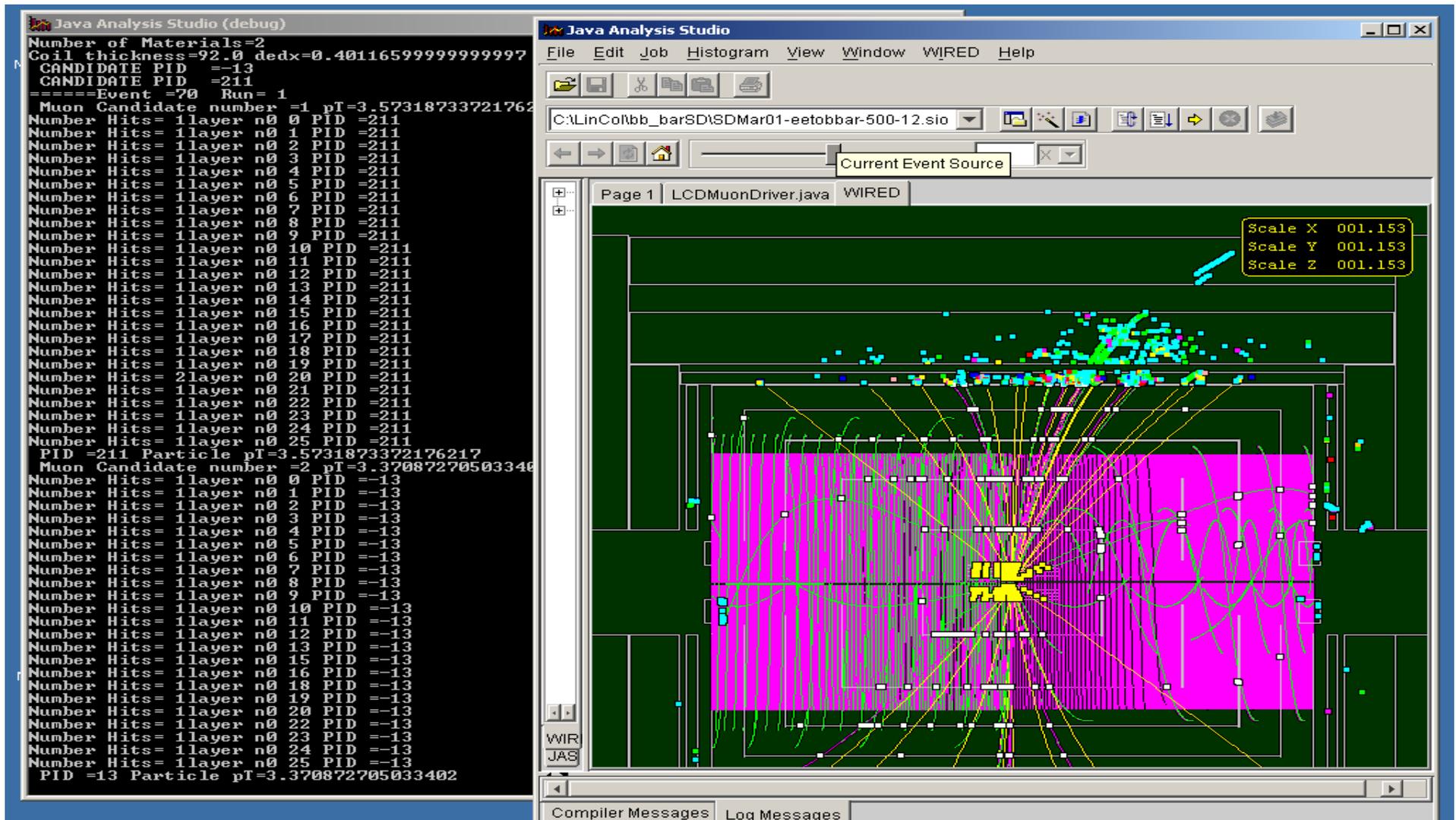
- Pi-Track associated to Mu Hit in Event Number = 112-Run 11
PI : $p=4.4744$ GeV, $\phi=112.42$
MU: $p=5.10158$ GeV, $\phi=112.68$
- Pi-Track associated to Mu Hit in Event Number = 158 –Run 11
PI : $p=29.43$ GeV , $\phi=201.93$
MU : $p=-51.52$ GeV , $\phi=201.53$
- Pi-&K Tracks associated to Mu Hit in Event Number =326-Run13
K : $p=16.62$, $\phi =338.24$
PI: $p=16.26$, $\phi =338.503$
MU: $p=16.44$, $\phi =335.908$

All 3 Particles share the Mu Hits in MUDet

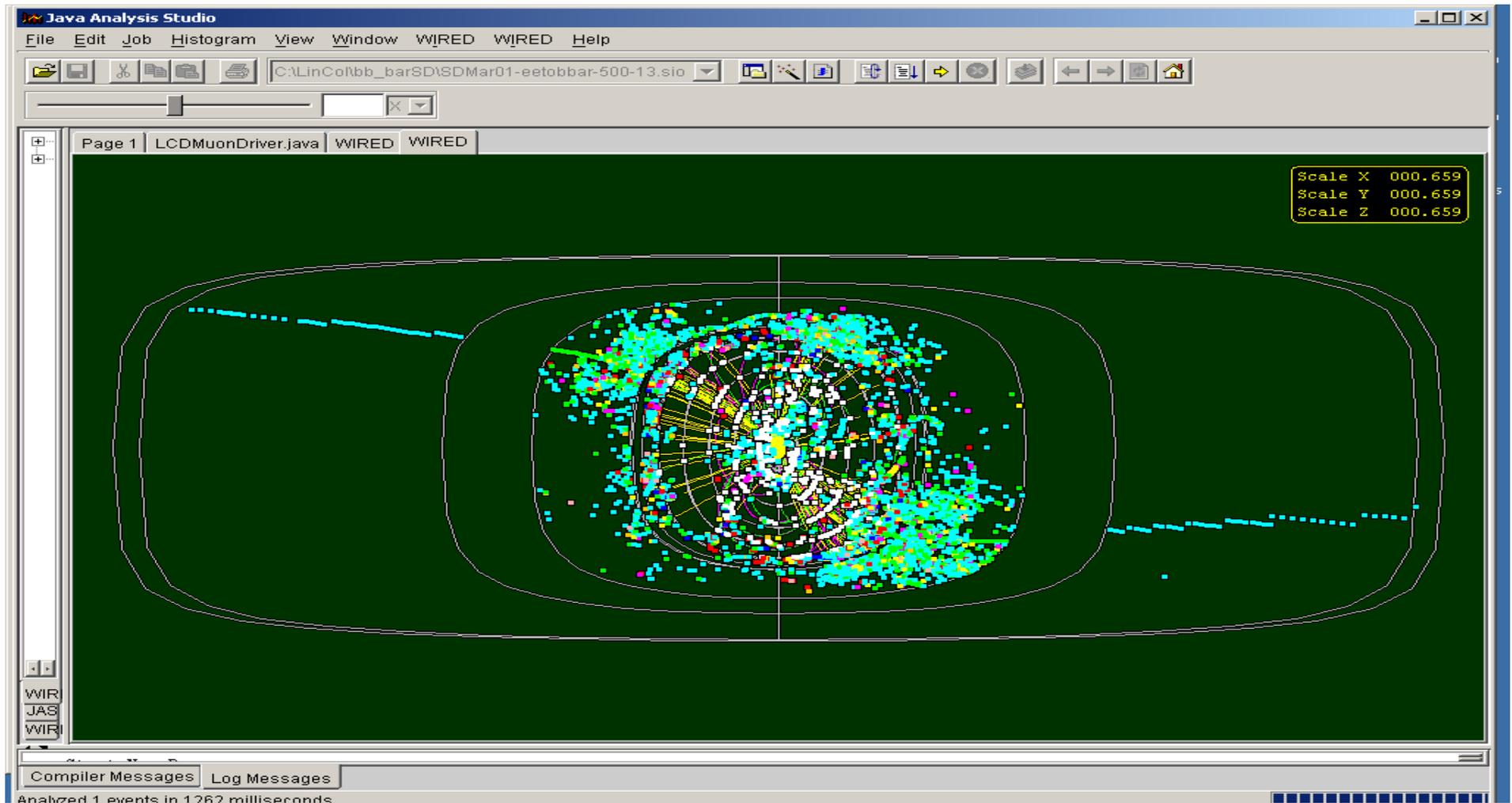
B-Bbar- 2 Mu “Candidates”

1Pi(3.6GeV)-1Mu(3.6GeV)

Each 31 Layers- Sharing MuDet Hits(?)

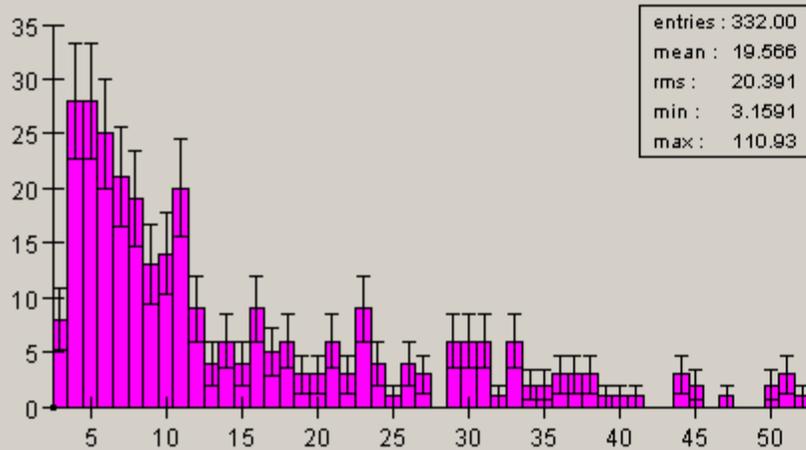


Mu-Pi, Mu-K-Share MuDet Hits-Run13-evt11

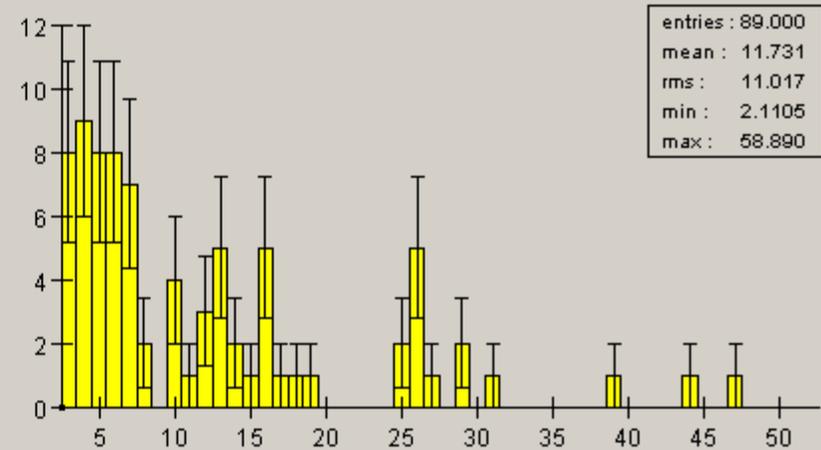


Hadron Contamination- From 5000 B-Bbar

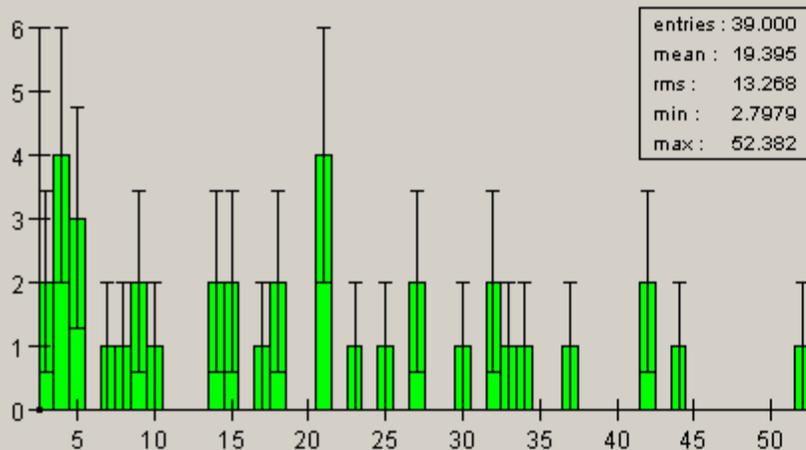
PMC(Mu-Detected)



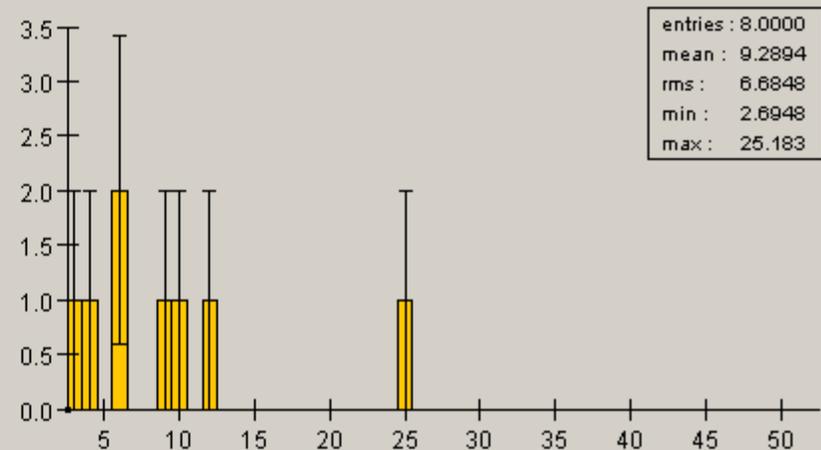
PMC (Pions-Detected)



PMC (Kaons-Detected)



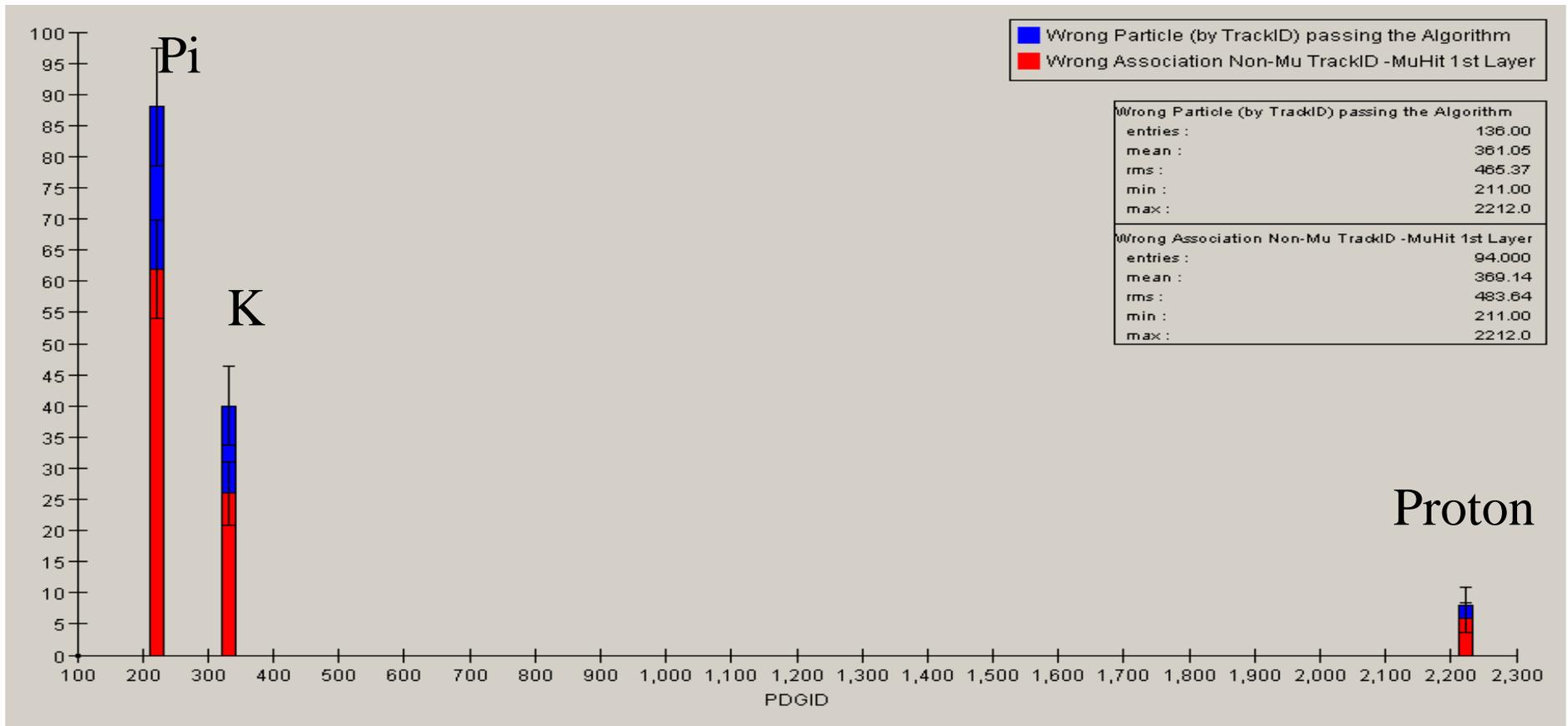
PMC (Protons-Detected)



Wrong Particle Wrong Association-From 5000 B- Bbar events

In Blue: Non Muons passing the Algorithm, 136 tracks

In Red : Those non-Muons with a Hit in the 1st layer of MuCal with a Muon Monte-Carlo ID, $94/136 = \sim 70\%$ of them



The response of the Hadron Calorimeter

- One requests that 1 Hit of the track in the Hadron Calorimeter
- We looked at single Pions and Muons at 3,5,10,20,50 GeV/c
- The mean number of layers with hits is reported in the next table with the mean number of hits/layer for both Pions and Muons

The Response of the Hadron Calorimeter (cont.)

P(GeV/c)	<u>Muons</u>	<u>Muons</u>	<u>Pions</u>	<u>Pions</u>
	<#Layers> with hits	<#Hits/Lay>	<#Layers> with hits	<#Hits/Lay>
3	20	1.40	7.5	1.95
5	27	1.23	10.0	2.22
10	33	1.11	12	2.96
20	34	1.053	16.3	4.17
50	34	1.023	20	5.97

Cut on the HD-Hits/track Event by Event

- As a first parameter, I have chosen to define ,event by event, the number of hits/per layer , represented in the next 2 transparencies for 5 GeV/c and 20 GeV/c Mu's and Pi's.

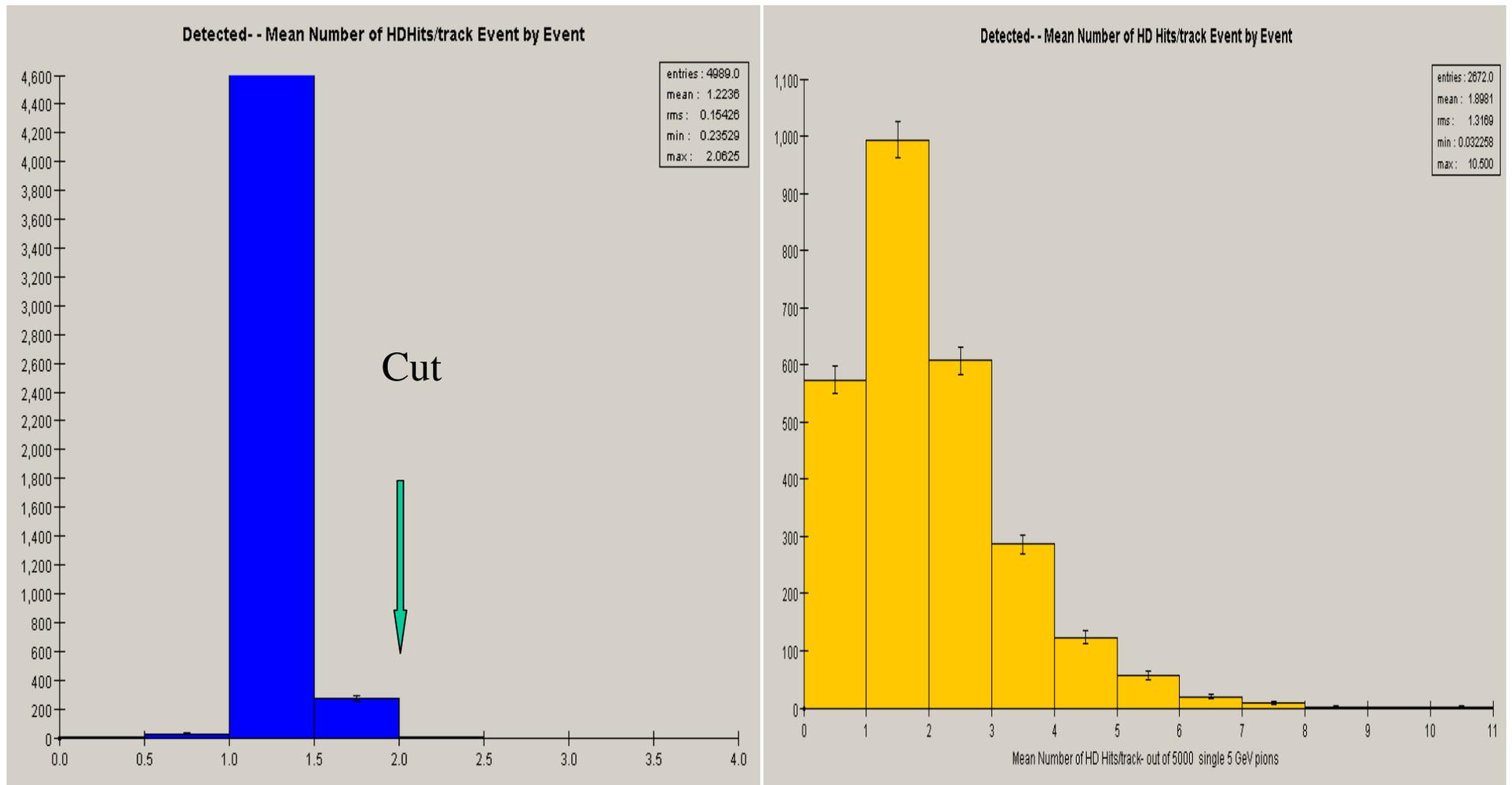
The Mu's and Pi's separation increases with Energy

- One can see that cut at 2 hits/layer, will clean a good deal of Unwanted hadrons and leave the Muons almost untouched.

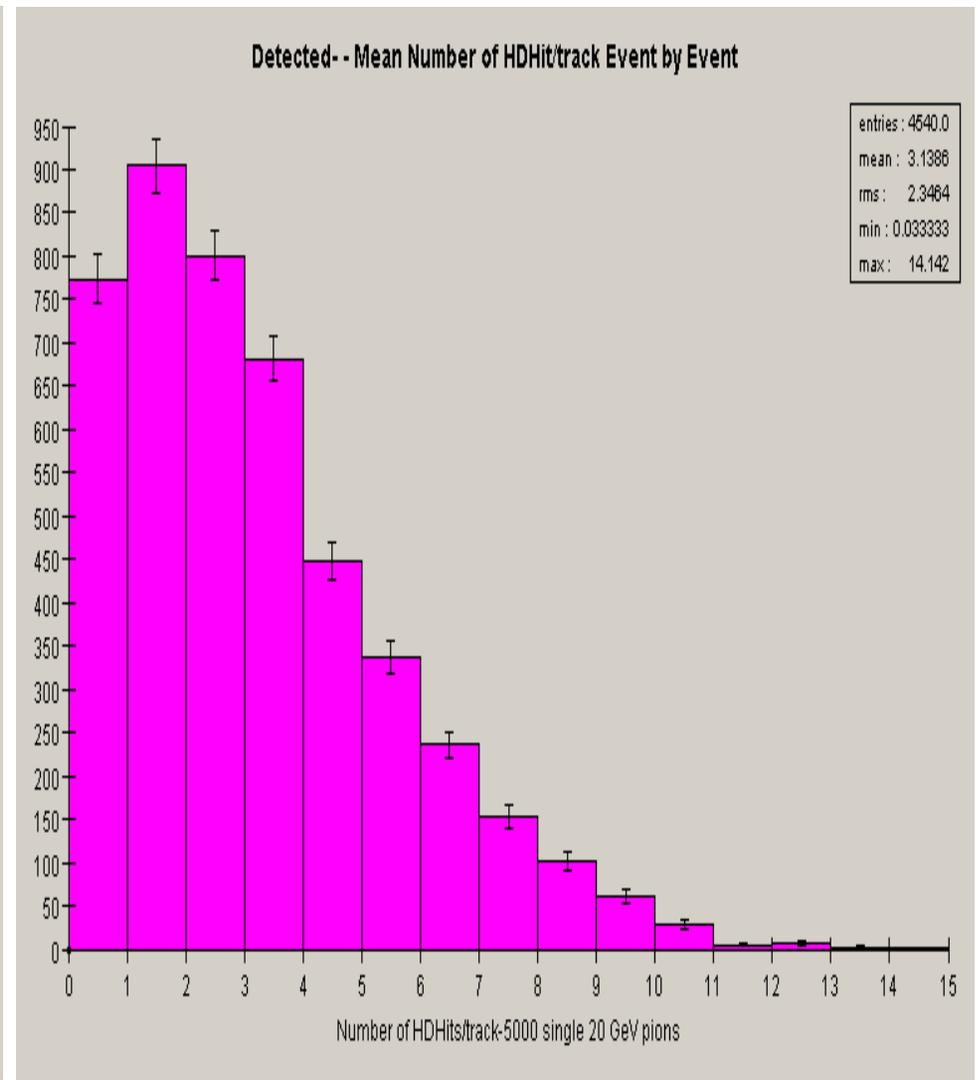
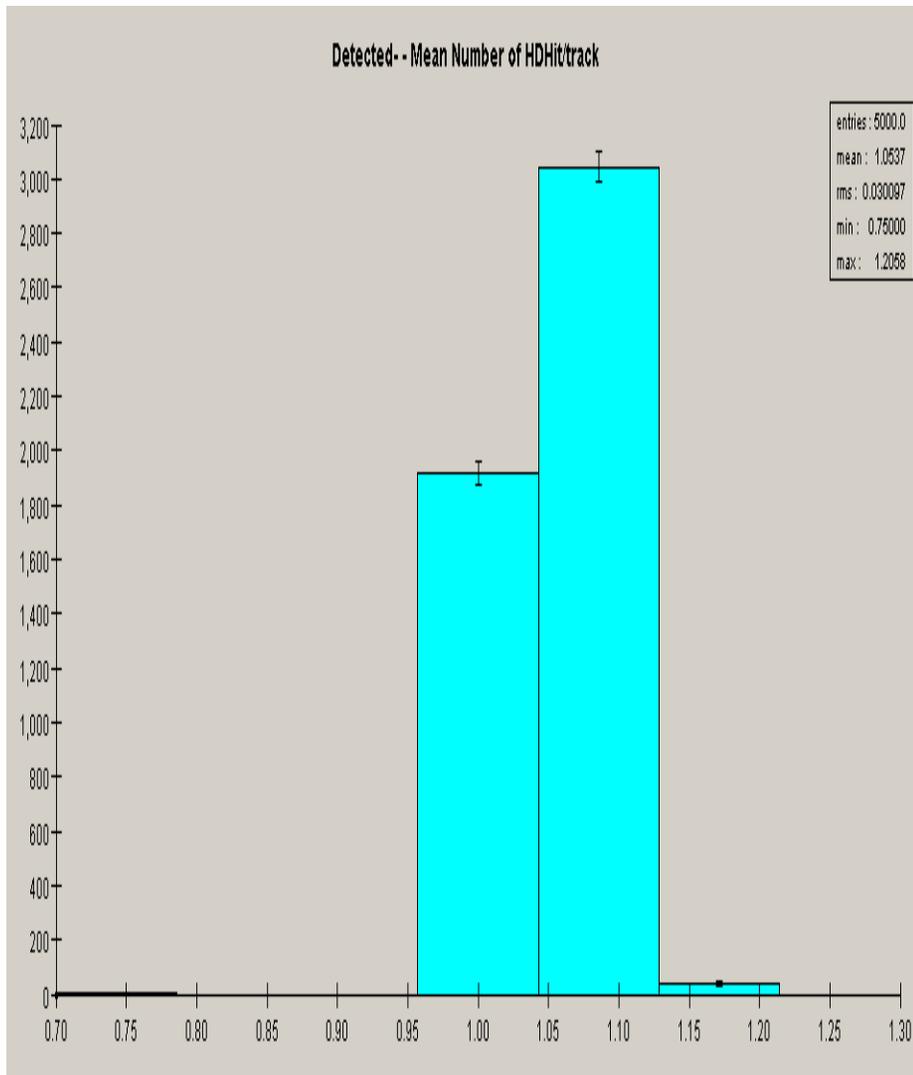
Remark: At low momenta, I will bound the momentum range from below by the lower Momentum limit of the Muon in the field.

- The Result is :A reduction of the number of “Wrong” particle type passing the algorithm by almost a factor two.

Number of HD-Hits/track Event by Event – For 5 GeV/c Muons and Pions

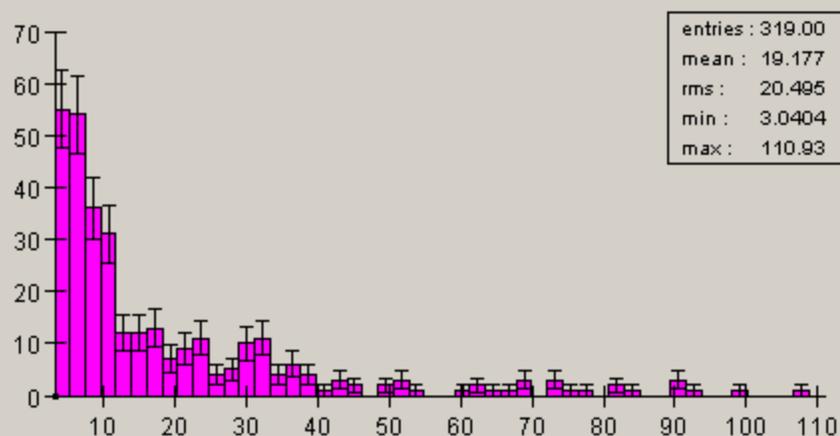


Number of HD-Hits/track Event by Event For 20 GeV/c Muons and Pions

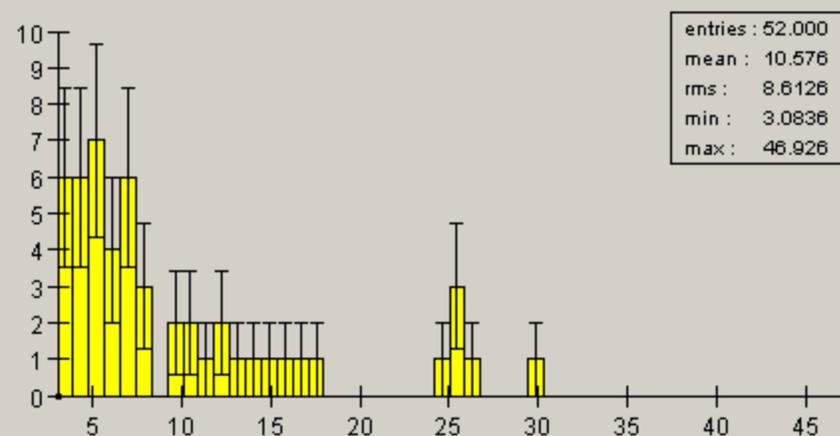


Using the Cut on 5000 B-Bbar Events

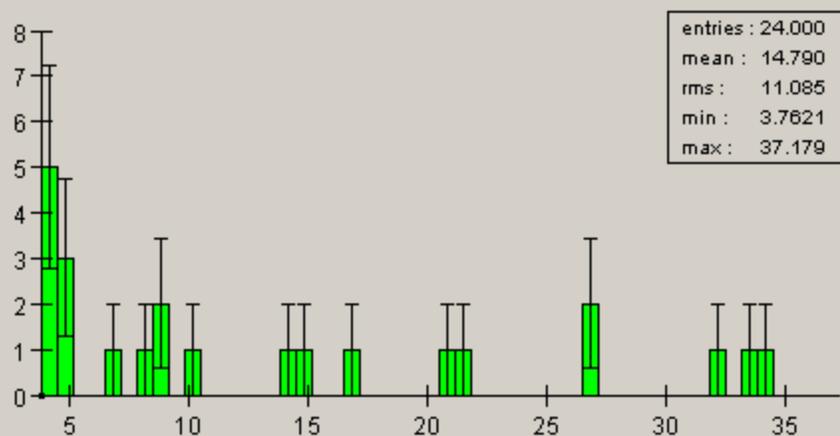
Detected- - P(Mu-Detected)-out of 5000 B-Bbar Events



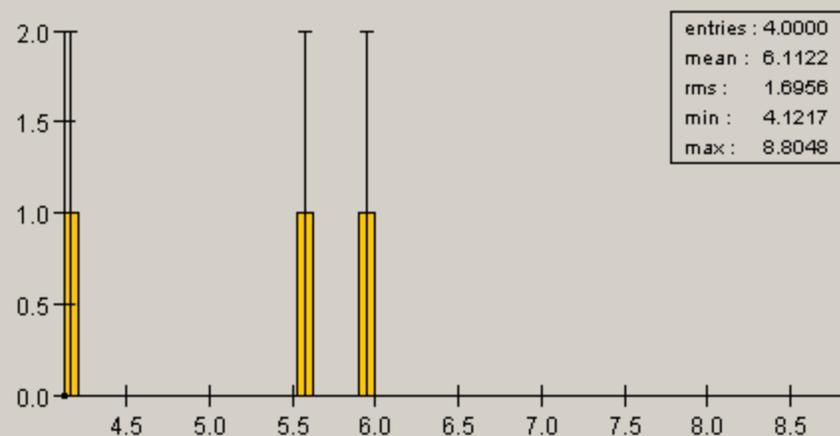
Detected- - P (Pions-Detected)



Detected- - P (Kaons-Detected)



Detected- - P (Protons-Detected)



Conclusion

Using the Hadron Calorimeter Hits/track/Event to separate Pions From Muons in B-Bbar jets has allowed to resolve 50% of the Hadronic ambiguous tracks.

The Muon Detector tends to be used also for Hadron Calorimetry Purposes. We can see that the Hadron Calorimeter information might improve the separation of Muons from hadrons as well.

Backup

Muon ID Algorithm Development-Progress Report

LC Muon-Meeting-7February 03

- Part of the μ 's below 5 GeV are lost with the actual algorithm.

We will try to broaden our acceptance toward low energy μ 's .

- The starting point:

– $\Delta\phi(\text{Tk-Hits})=3\text{bins}$, $\Delta\theta(\text{Tk-Hits})=1\text{bin}$ in the Mu Detector

$$\Delta\phi_{\text{bin}} = \Delta\theta_{\text{bin}} = 21\text{mrd}$$

– $\Delta\phi(\text{Tk-Hits})=4\text{bins}$, $\Delta\theta(\text{Tk-Hits})=2\text{bins}$ in the HAD Calorimeter

$$\Delta\phi_{\text{bin}} = \Delta\theta_{\text{bin}} = 5.2\text{mrd}$$

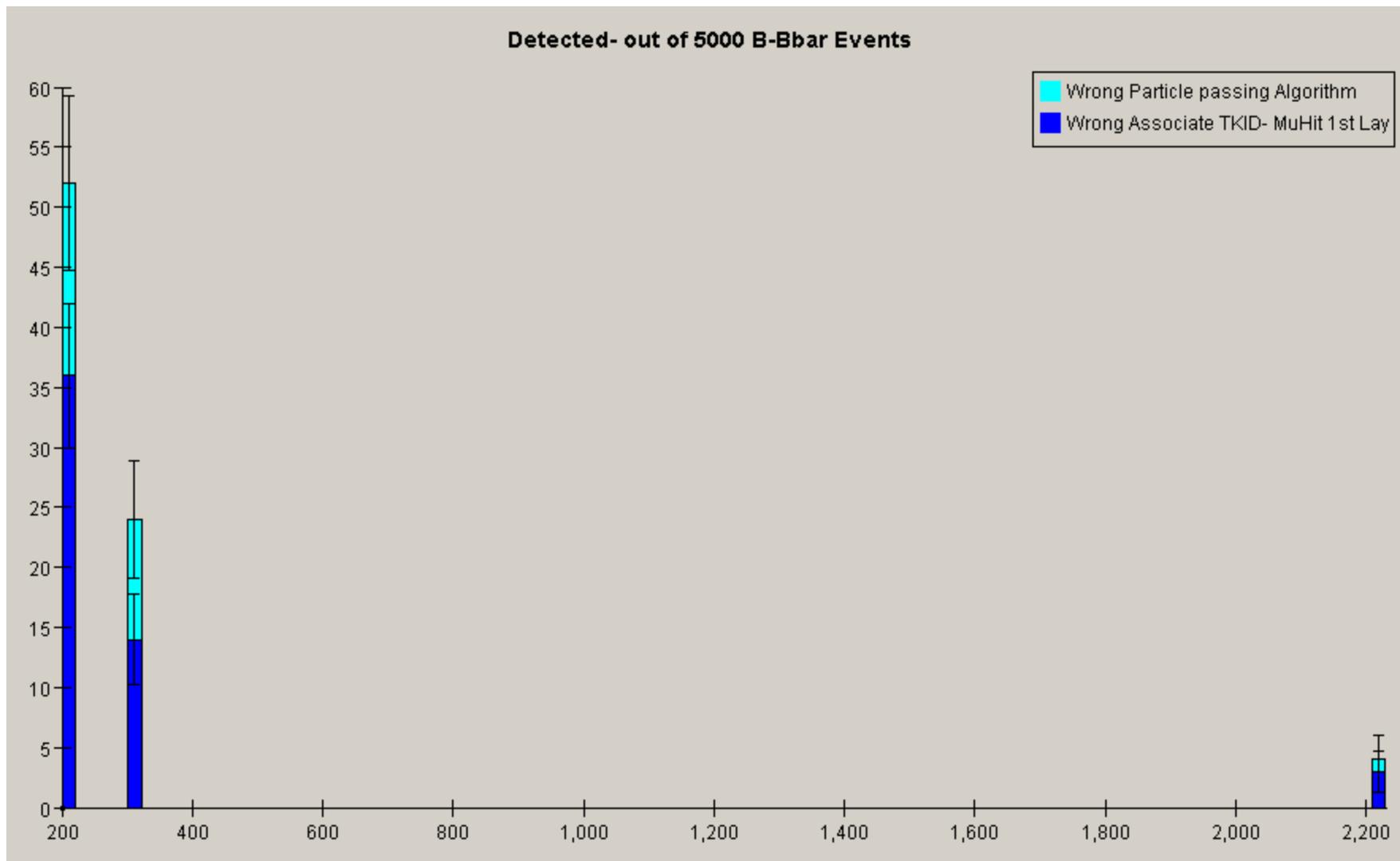
– $N_{\text{hits}} = 12$ hits, in the Mu Detector

- The Goal: Increase the Acceptance to Low Energy μ

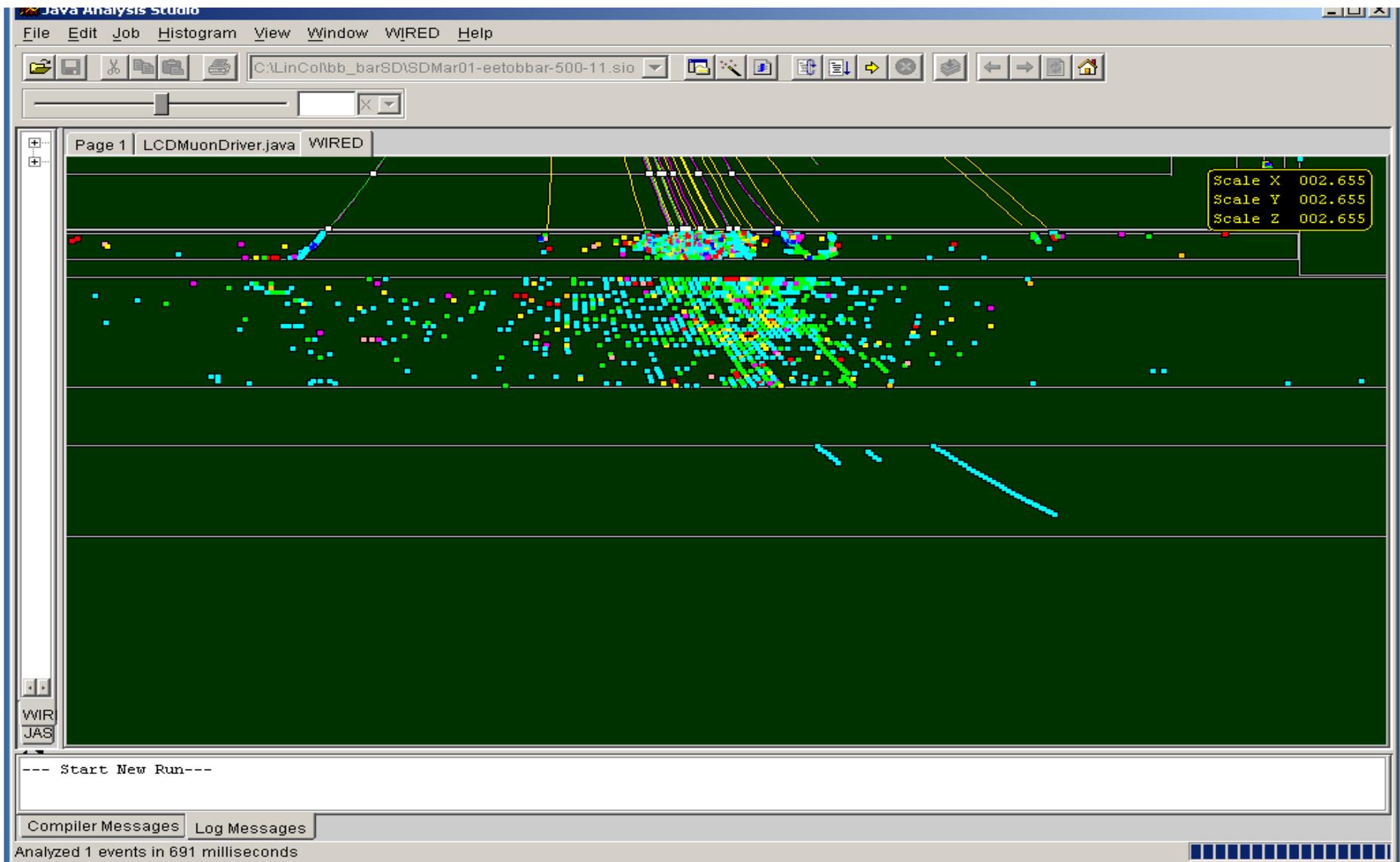
– 1) By Improving the existing cuts

– 2) By Including the EM Calorimeter into the ID package.

Using the Cut on 5000 B-Bbar Events



3 Particles-(Pi-Mu)-Pi- 2 sharing Mu Hits Layer 1



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