

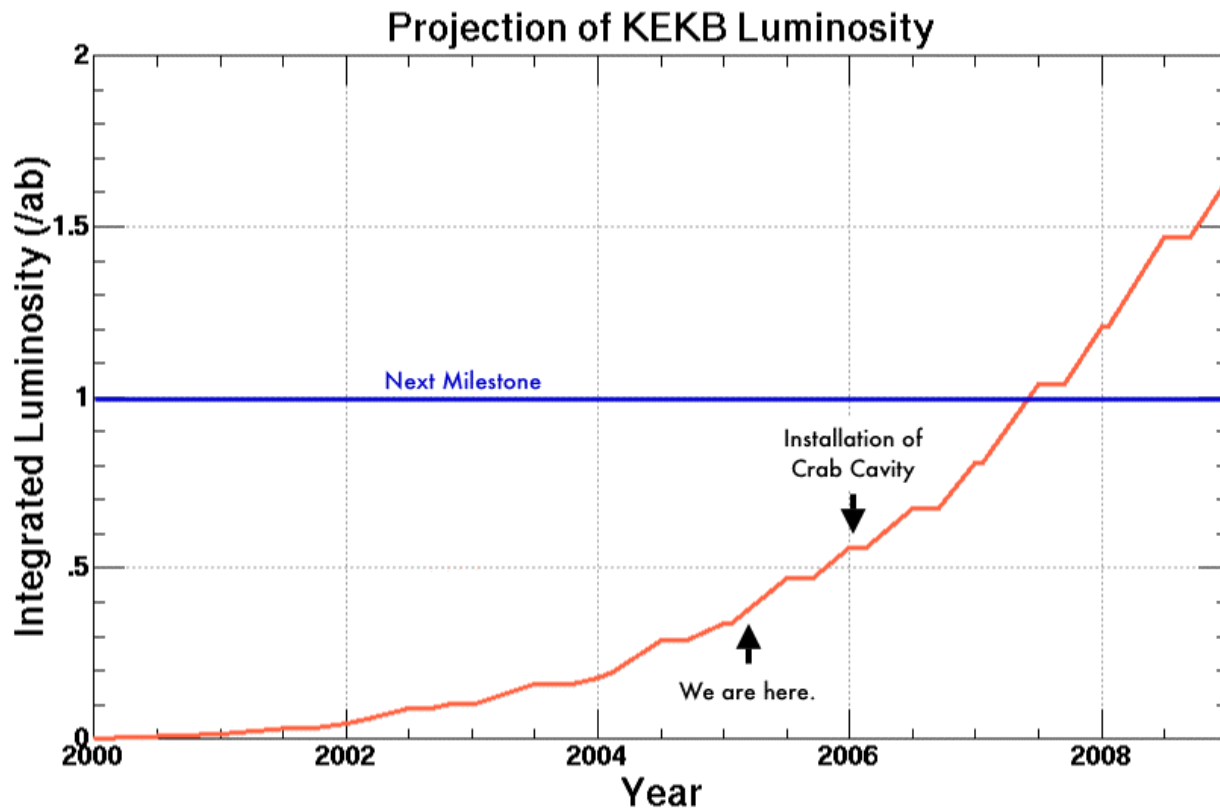
A decorative border of light blue hibiscus flowers and leaves runs vertically along both the left and right sides of the slide.

Vertexing Degradation

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2005/Apr/21 @Hawaii

Near Future



	2004	2008
Lumi.	13/nb/s → 60/nb/s	
HER	1.2 A → 2 A	
LER	1.8 A → 3 A	
SVD	nominal → x1.7~2.6	
CDC	nominal → x1.7~2.5	

~x3 BG study is needed

What will happen?

SVD x3 BG

Occupancy will increase
upto $\sim 25\%$ in 1st layer!



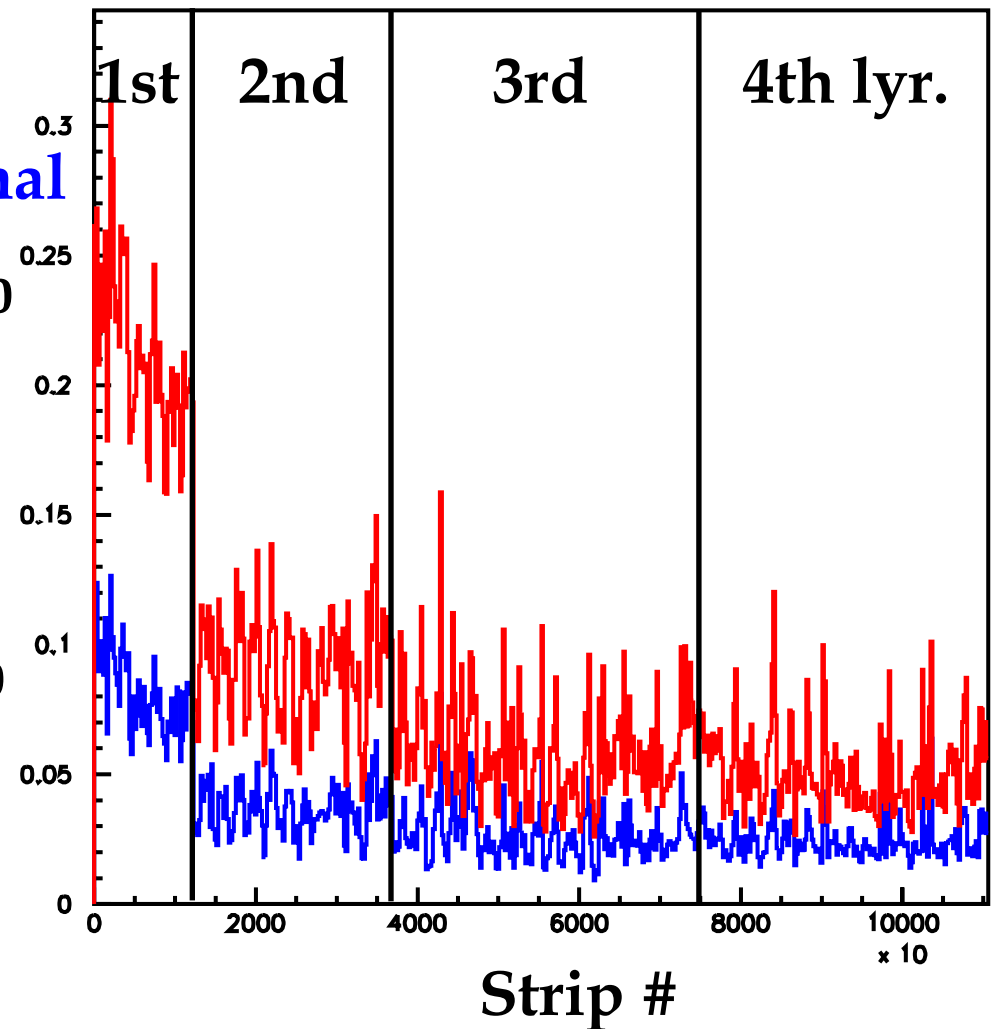
Vertexing is OK?!

Red : x3 BG

Blue : nominal

$\sim 25\%$

$\sim 8\%$



Performance Prediction

Procedure

$B \rightarrow J/\Psi K_s$, $B \rightarrow$ generic MC event (Detector Simulation)
+
Random-trigger real Background event (as of 2004)

Nominal BG

x3 BG



Performance Check

Some Assumptions

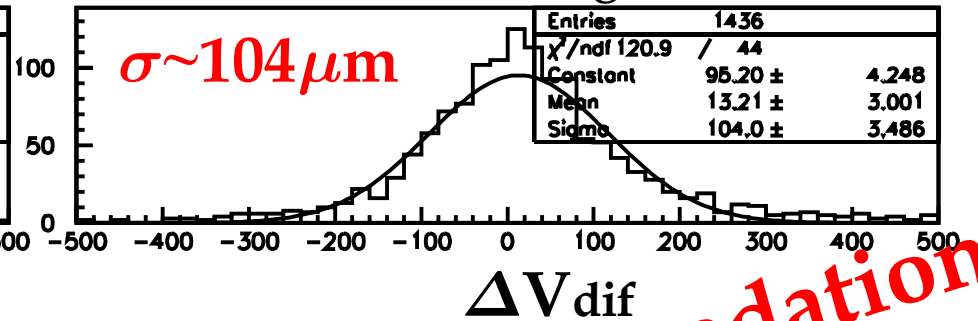
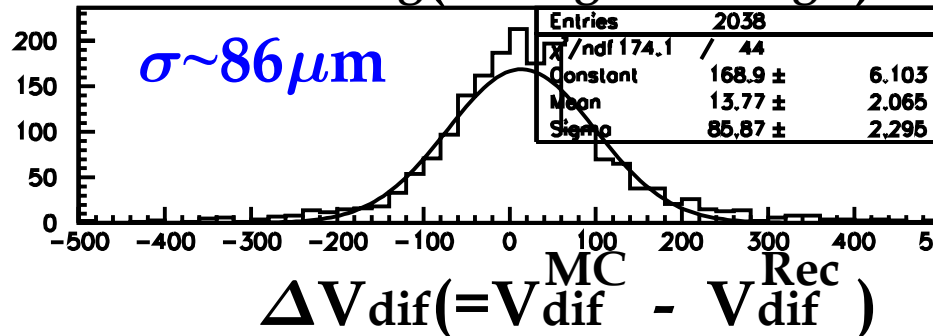
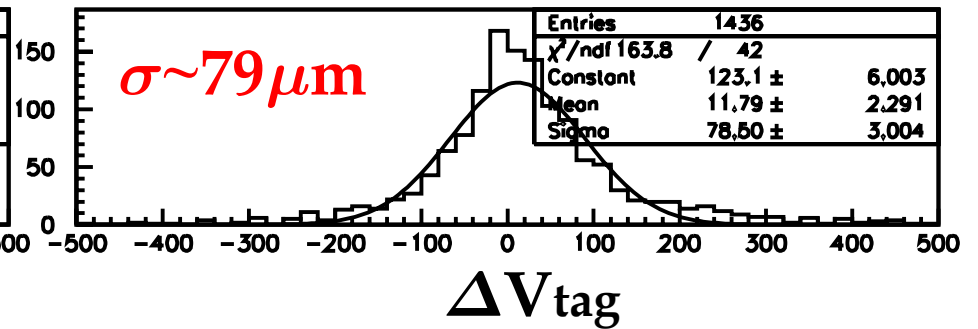
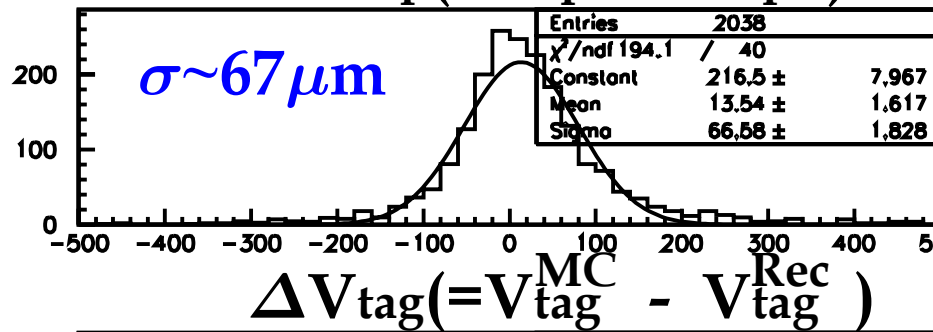
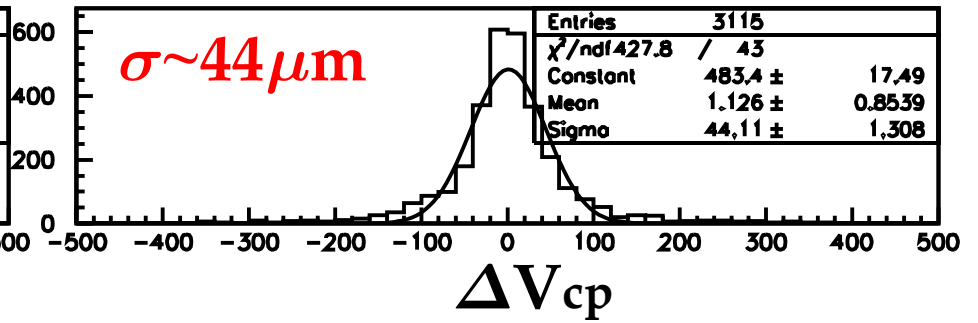
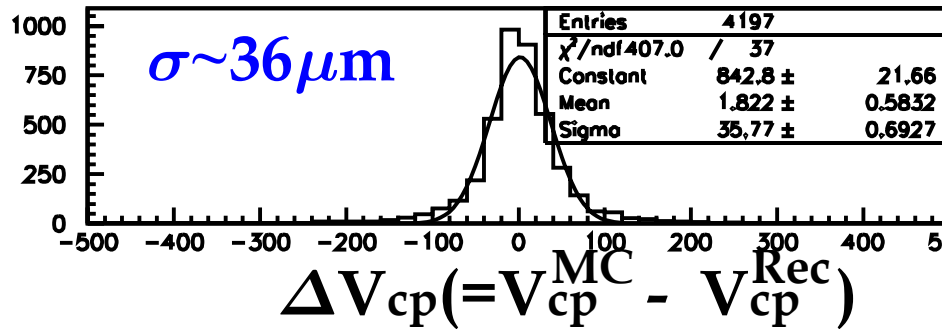
PID is perfect, Lepton/Kaon tagging only,
Current Hardware/Software

Vertex Resolution

(σ = single gaussian)

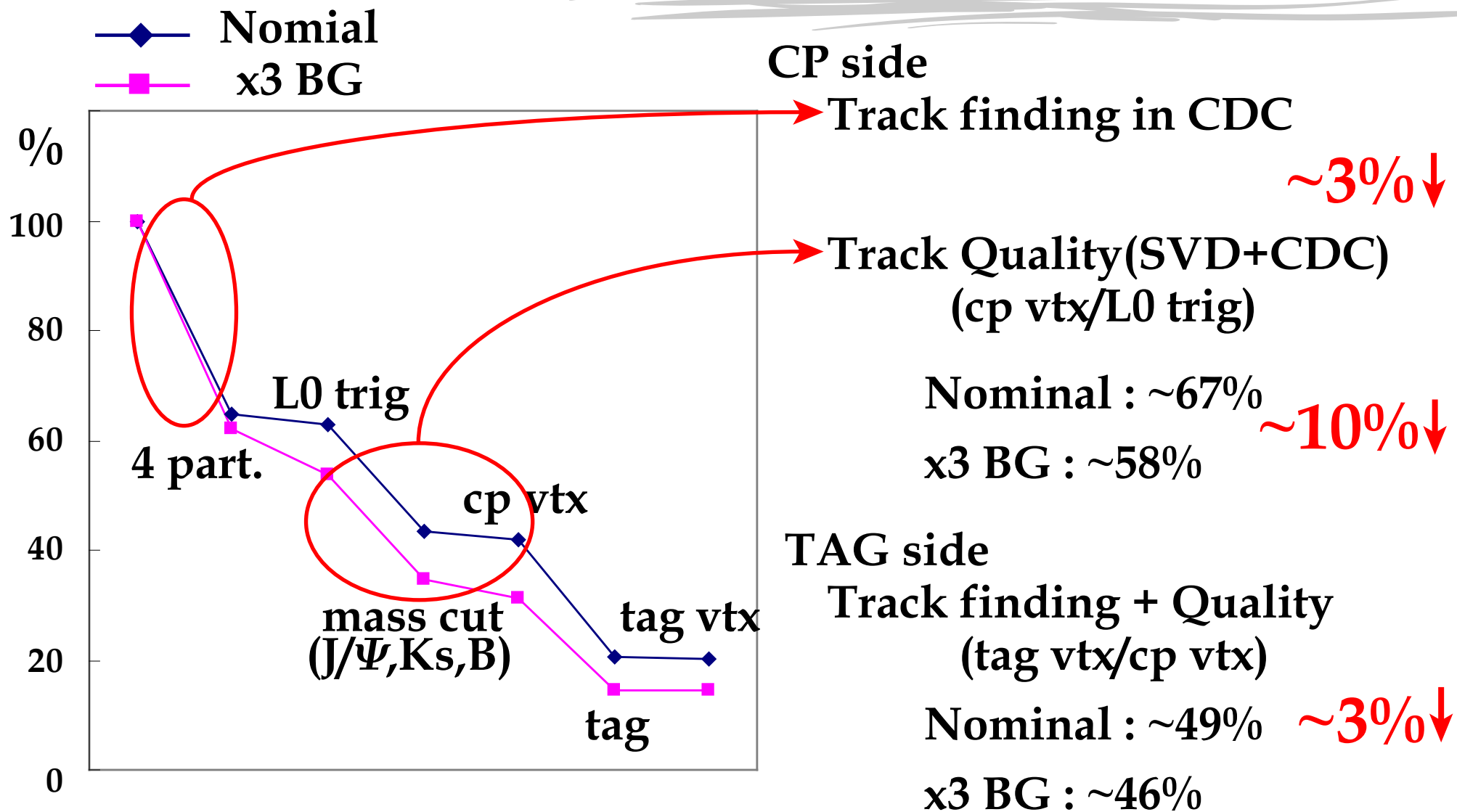
Nomial

x3 BG



~20% degradation

Reconstruction Efficiency



Most Responsible Part?

$B \rightarrow J/\psi K_s, B \rightarrow$ generic : 10,000 events ($\sigma =$ single gaussian)

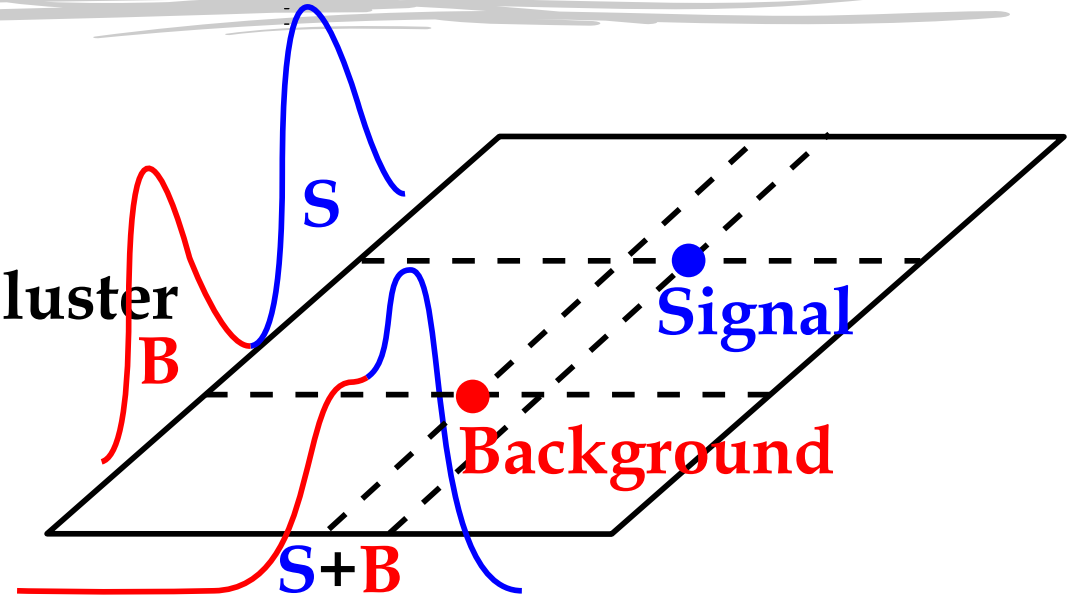
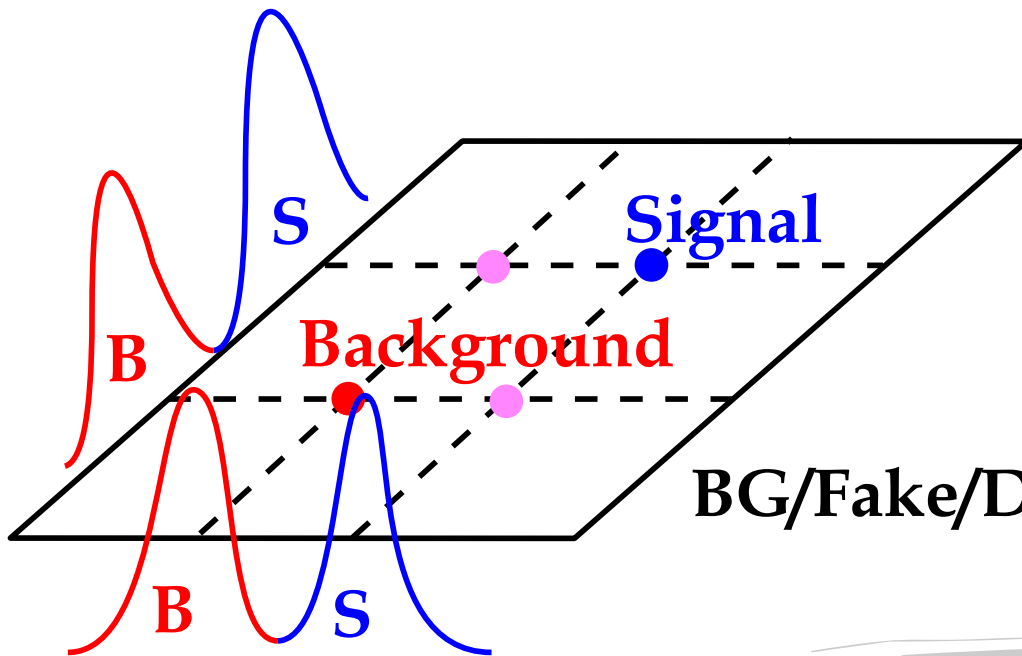
	1st : Nominal 2,3,4 : x3BG	1,2 : Nominal 3,4 : x3BG	1st : x3BG 2,3,4 : Nominal
ΔV_{cp}	~36 μm 3321 events	~36 μm 3382 events	~44 μm 3381 events
ΔV_{tag}	~66 μm 1531 events	~66 μm 1558 events	~72 μm 1568 events
ΔV_{dif}	~89 μm	~85 μm	~99 μm

resolution is not so different
from nominal BG case

1st layer!

SVD Cluster Classification

- (S, S) True cluster
- (B, B) Background(BG) cluster
- (B,S), (S,B) Fake cluster



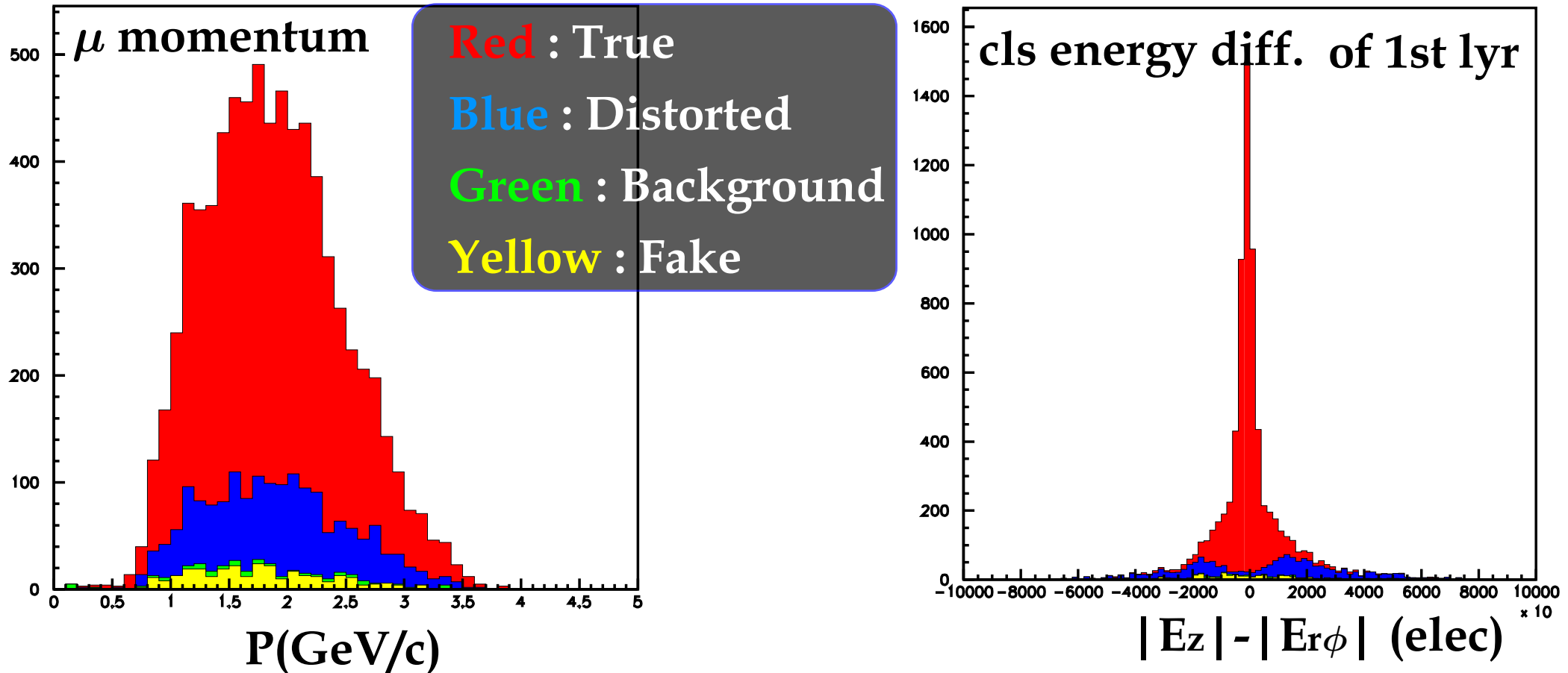
(S+B, S) Distorted cluster

BG/Fake/Distorted clusters smear hit position
affect tracking/vertexing

CP side(J/ Ψ K_s)

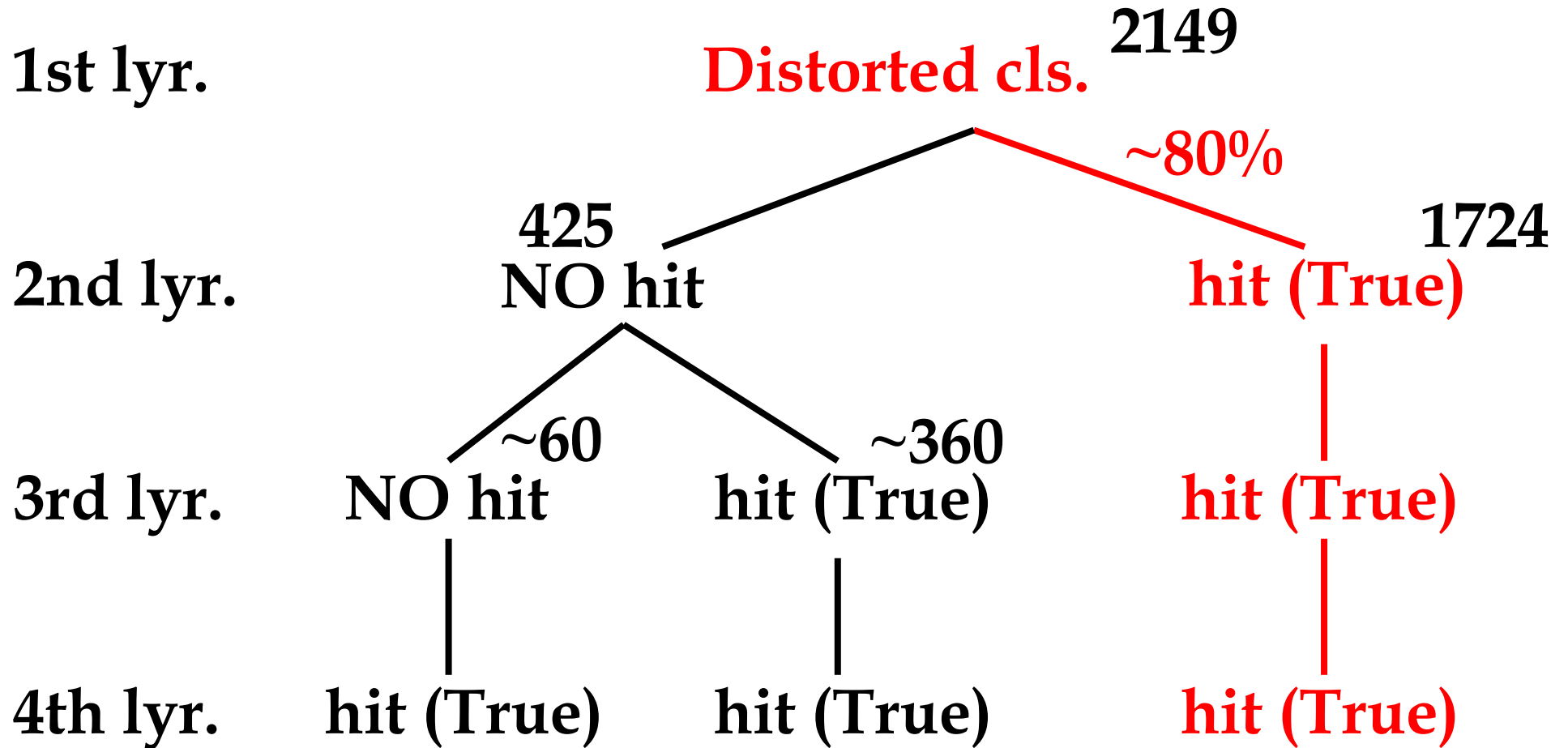
CP vertex = Vertex (J/ Ψ \rightarrow $\mu^+ \mu^-$)

x3 BG, 1st layer



Distorted cluster is the main cause

Distorted Cluster

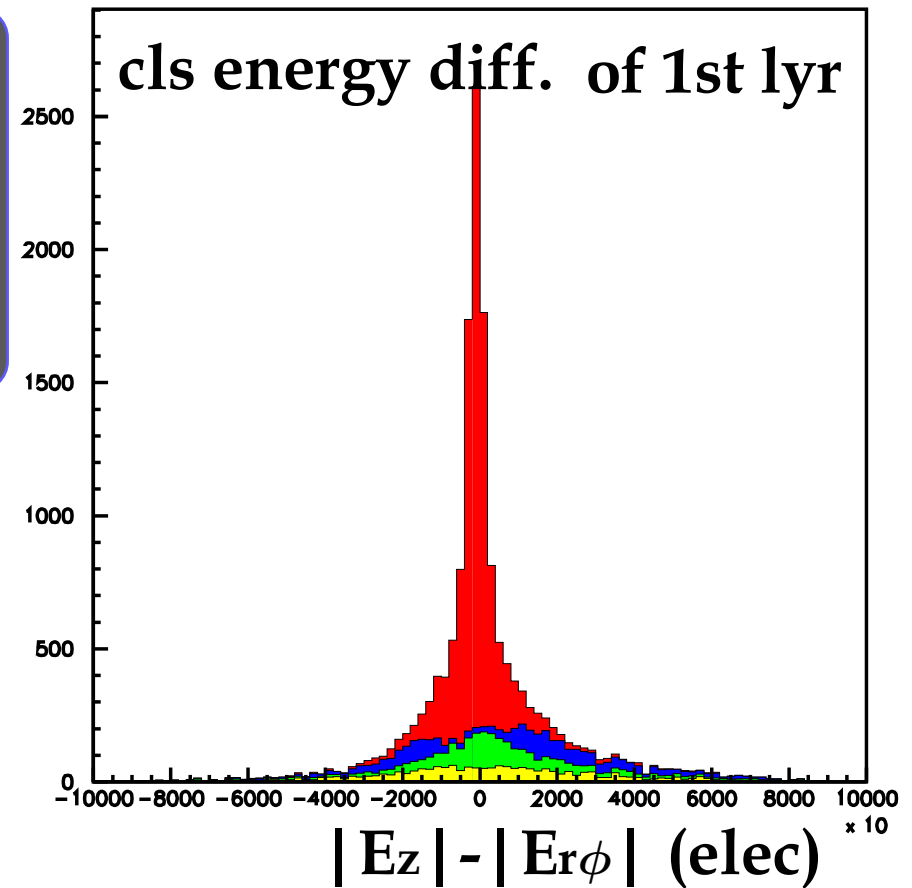
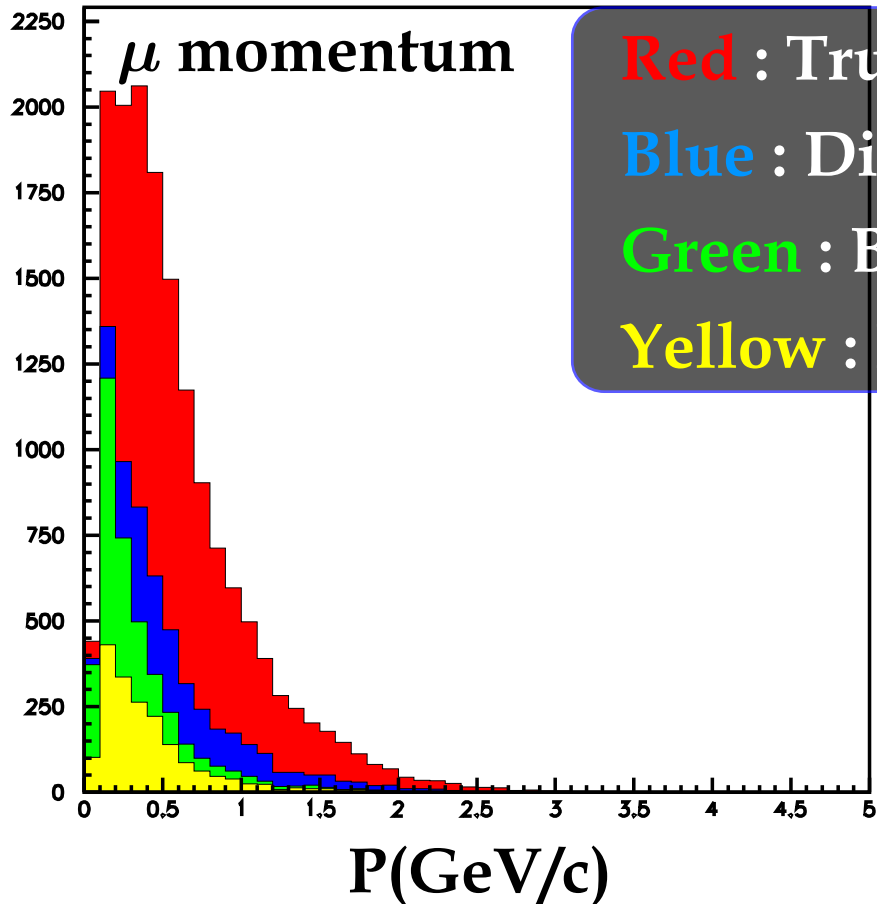


Tracking seems to be fine upto 2nd layer

Clustering sould be improved !

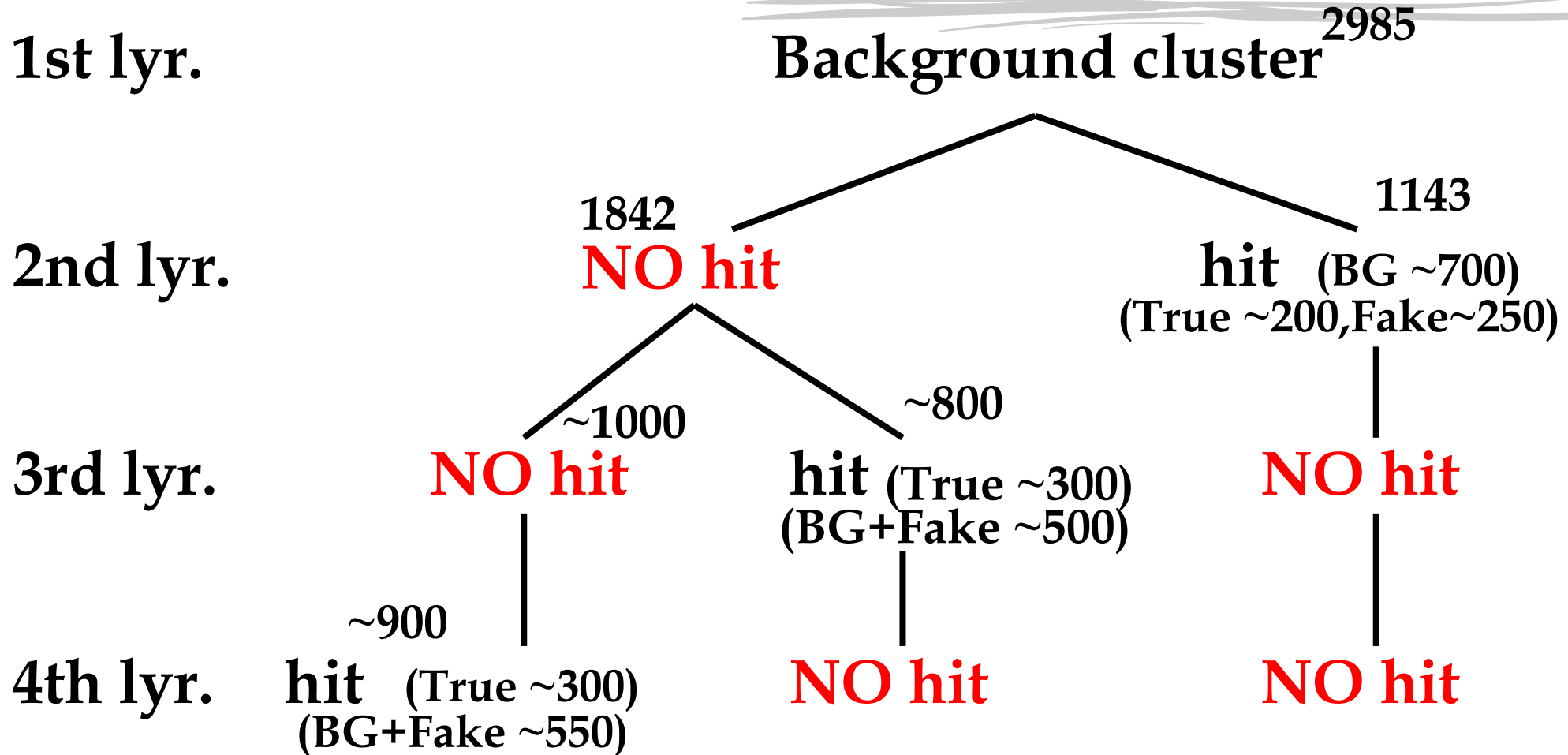
TAG side

x3 BG, 1st layer



Fraction of BG/Fake cluster increases

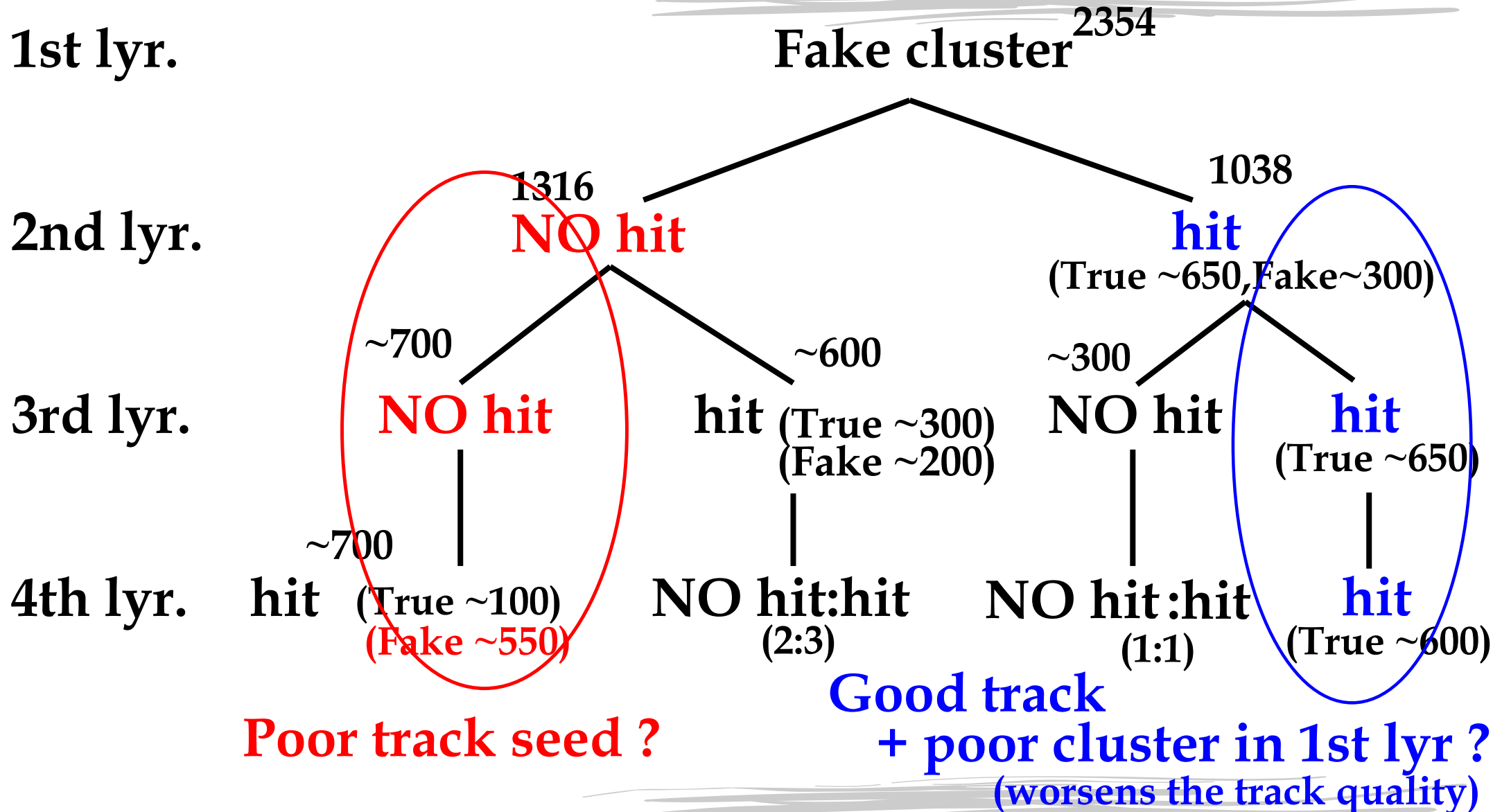
Background Cluster



2 of 3 remaining layers have no hit.

Track seed itself in CDC is not good !

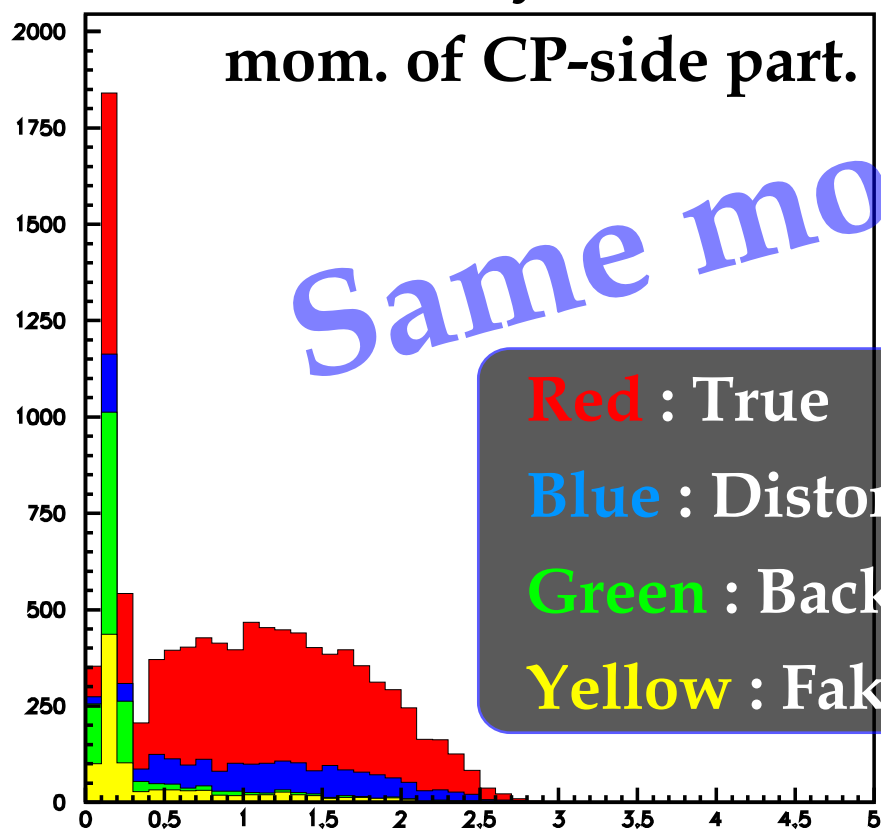
Fake Cluster



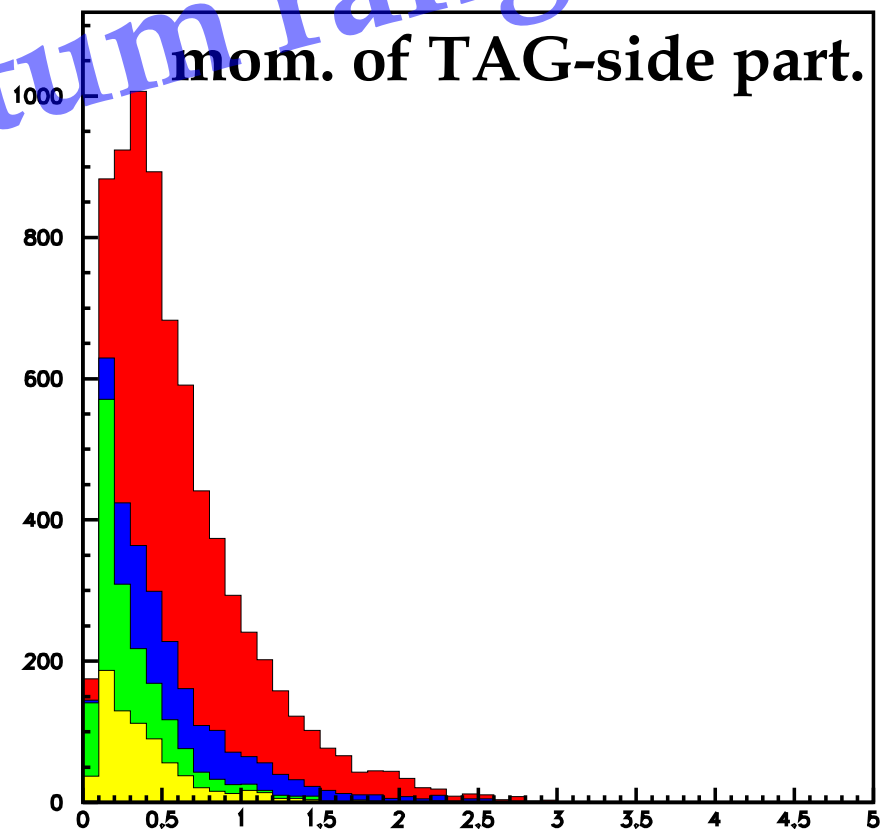
$B \rightarrow D^{*+} D^{*-}$ Case

$B \rightarrow D^{*+} D^{*-} (D^{*\pm} \rightarrow D(K\pi)\pi), B \rightarrow \text{generic}$

x3 BG, 1st layer



P(GeV/c)



P(GeV/c)

CP side \rightarrow High mom.

TAG side \rightarrow Low mom.

Not appropriate



Points so far

Causes of the vtx-resolution degradation

High Momentum (Distorted cluster)

Tracking (upto 2nd lyr) is fine

Distorted cluster in 1st lyr worsens trk-quality

Low Momentum (Background cluster)

Poor seed track in CDC

Low Momentum (Fake cluster)

Poor seed track in CDC (~a half)

Fine tracking (upto 2nd lyr) +Bad cluster in 1st lyr.



How to Recover ... Current Attempt

Energy balance cut

$$||E_z| - |E_{r\phi}|| > 15,000 \text{ e1} \quad \text{Cut}$$

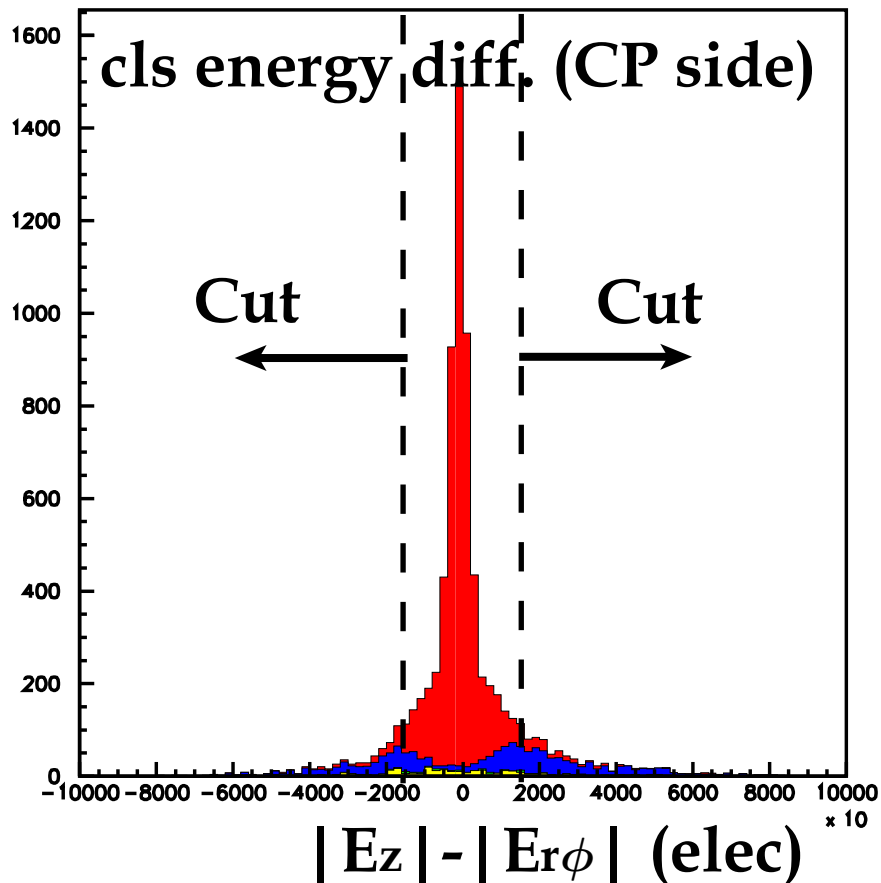
Not used for tracking in SVD
(for 1st, 2nd layer)

Quality of track

w/o Bad clst > w/ Bad clst
(esp. 1st lyr) (esp. 1st lyr)

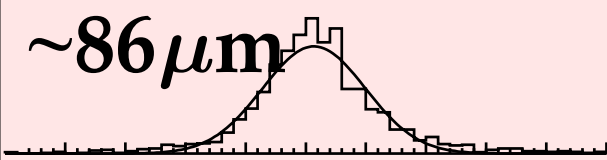
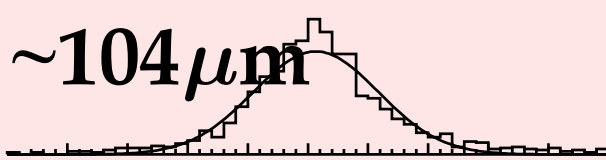
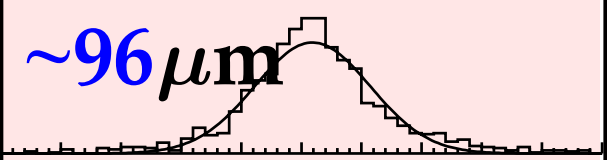


Better vtx resol.



Recovered V_{tx} Resolution

$B \rightarrow J/\psi K_s, B \rightarrow$ generic : 10,000 events (σ = single gaussian)

	Nominal BG	x3 BG	x3 BG w/ ene. balance
ΔV_{cp}	~36 μm 4197 events	~44 μm 3115 events	~42 μm 3120 events
ΔV_{tag}	~67 μm 2038 events	~79 μm 1436 events	~75 μm 1423 events
ΔV_{dif}	~86 μm 	~104 μm 	~96 μm 

Better v_{tx} resol.

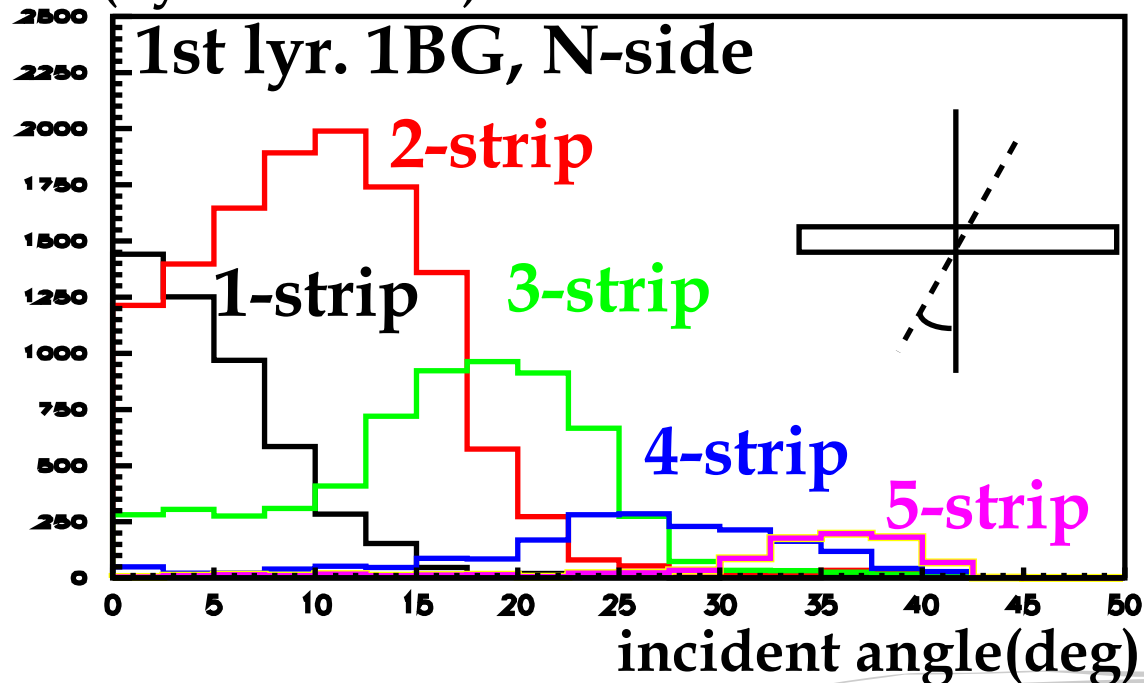
Other Attempts...

For High-momentum tracks

To avoid using Distorted cluster in the 1st layer

Is it possible to optimize clustering?
or cluster selection?

(by Heffernan)



cluster width,
clustering threshold,
incident angle of particle,
layer correlation of charge
.....

WIP

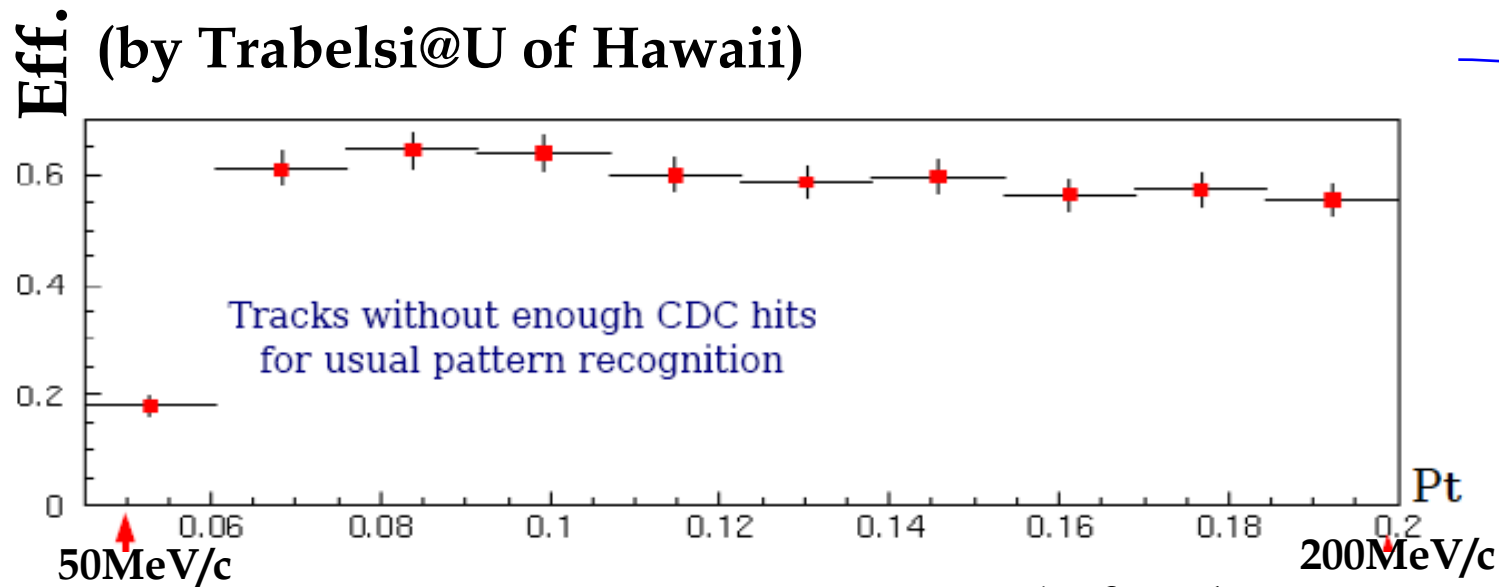
Other Attempts...

For Low-momentum tracks

To get more reliable low-momentum tracks

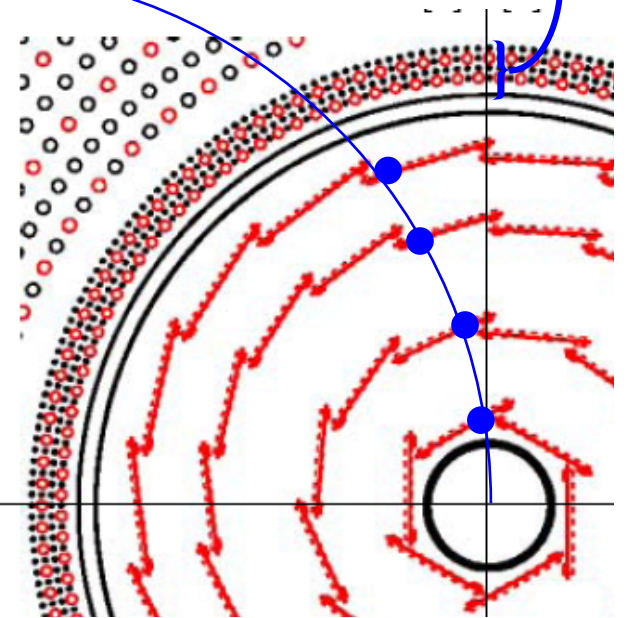
SVD self-track finding is difficult ...

(SVD 4 yrs + sCDC)



SVD+sCDC track finding ?

Still working on



Possible Hardware Updates

Optimizing shaping time of readout chip in SVD

(Background \downarrow $\sim 30\%$ @max)

Or replace the readout chip on the 1st layer

VA1TA \rightarrow APV25 (shaping time 800nsec \rightarrow ~ 50 nsec)

Pixel-type detector can reduce Distorted/Fake cluster

Replace the readout electronics in CDC

Deadtime can be reduced (2.2μ \rightarrow 0.8μ sec)

⋮

Key point is to reduce room for BG to sneak in

Summary

Vertex Resolution **deteriorates by ~20%** under x3 BG

Causes of deterioration

for High mom. track

Track finding/quality (upto 2nd lyr) seems to be OK

Distorted cluster in 1st lyr makes track quality worse

for Low mom. track

Track seed itself in CDC is poor

SVD true cluster can not be used correctly

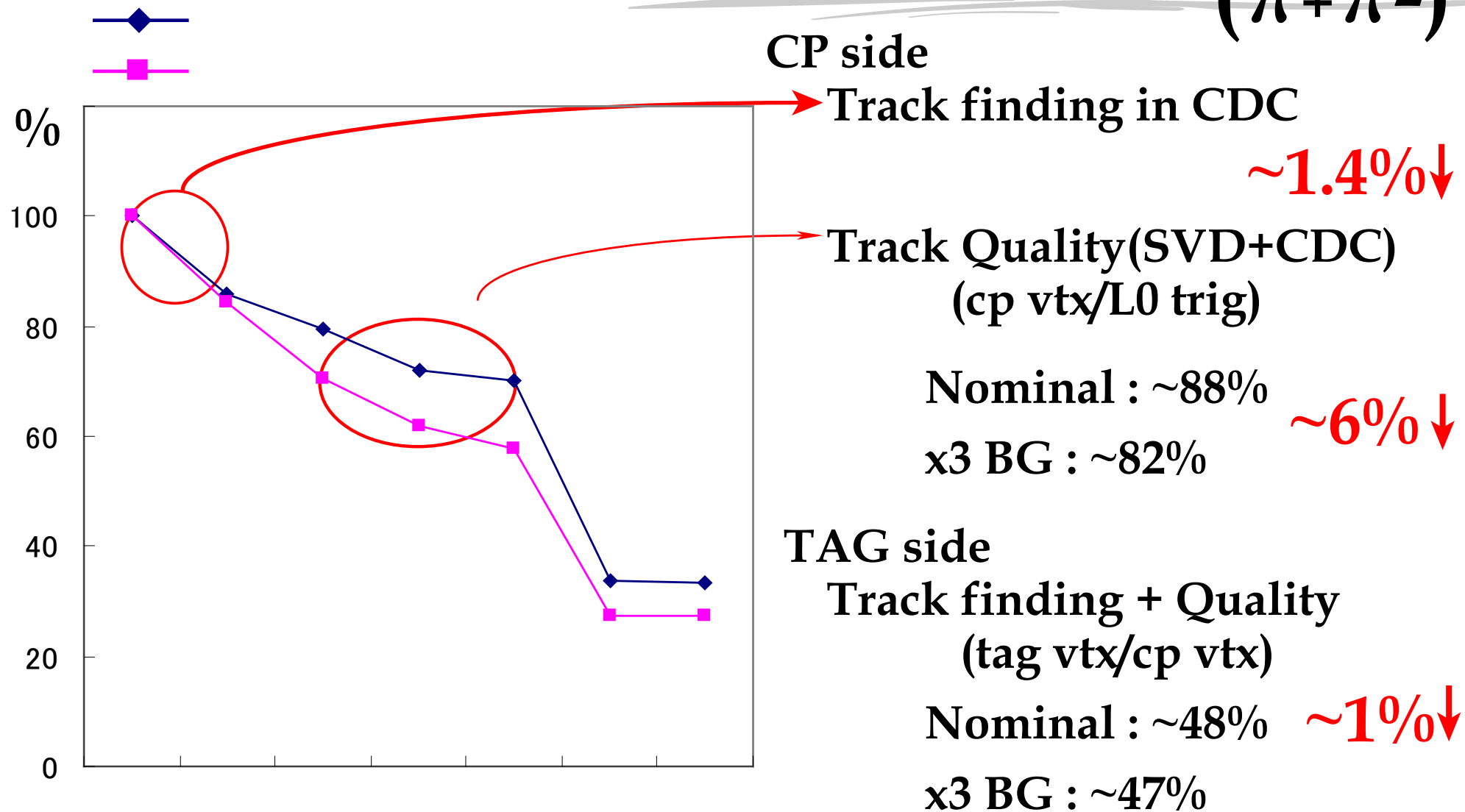
Way of Recovery

Energy balance cut → **Better vertex resolution**

But many things to do (low-pt tracking, better clustering,
hardware...)

Reconstruction Efficiency

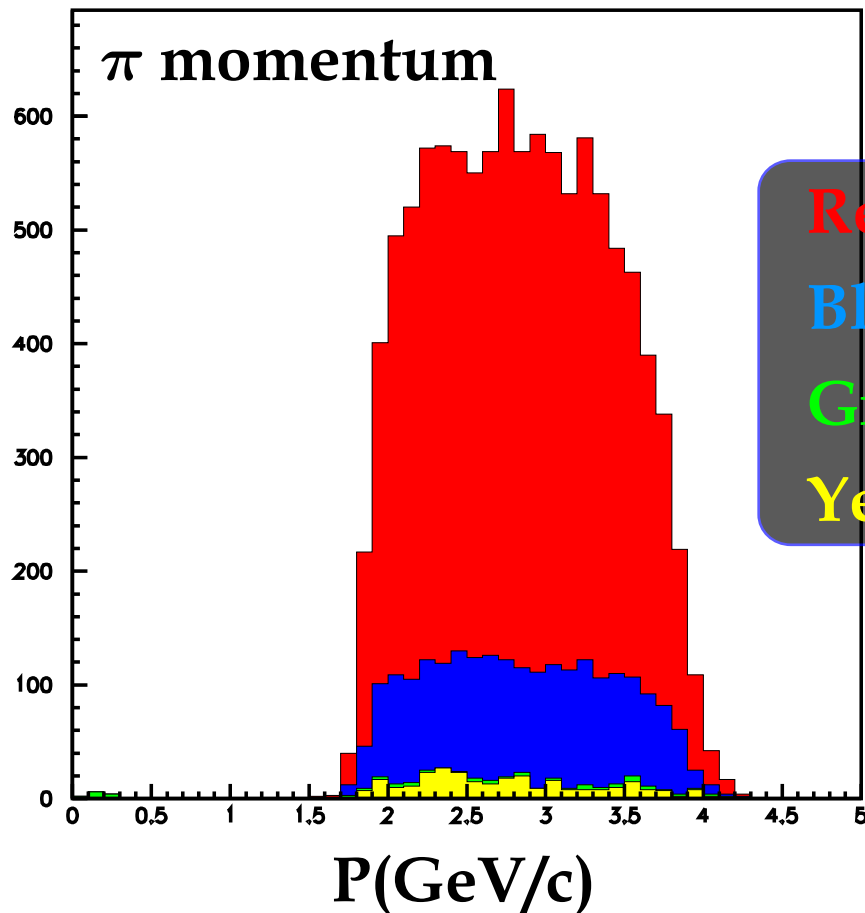
$(\pi^+\pi^-)$



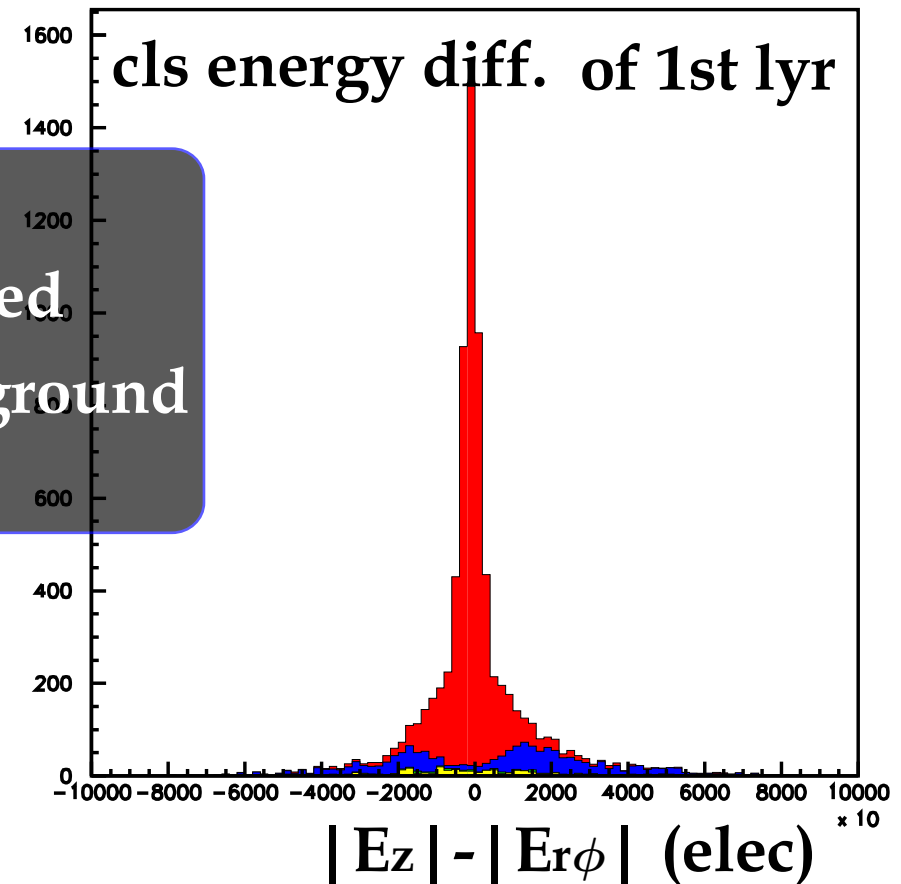
CP side($\pi^+\pi^-$)

CP vertex = Vertex ($B \rightarrow \pi^+ \pi^-$)

x3 BG, 1st layer



Red : True
Blue : Distorted
Green : Background
Yellow : Fake



Situation is the same. Distorted cluster !

Recovered V_{tx} Resolution

$B \rightarrow \pi^+ \pi^-$, $B \rightarrow$ generic : 10,000 events (σ = single gaussian)

	Nominal BG	x3 BG	x3 BG w/ ene. balance
ΔV_{cp}	$\sim 26 \mu\text{m}$ 7023 events	$\sim 32 \mu\text{m}$ 5775 events	$\sim 30 \mu\text{m}$ 5867 events
ΔV_{tag}	$\sim 59 \mu\text{m}$ 3356 events	$\sim 72 \mu\text{m}$ 2725 events	$\sim 71 \mu\text{m}$ 2754 events
ΔV_{dif}	$\sim 71 \mu\text{m}$	$\sim 97 \mu\text{m}$	$\sim 88 \mu\text{m}$

Better Efficiency ?!

Better V_{tx} Resol.