Background in Vertex Detector

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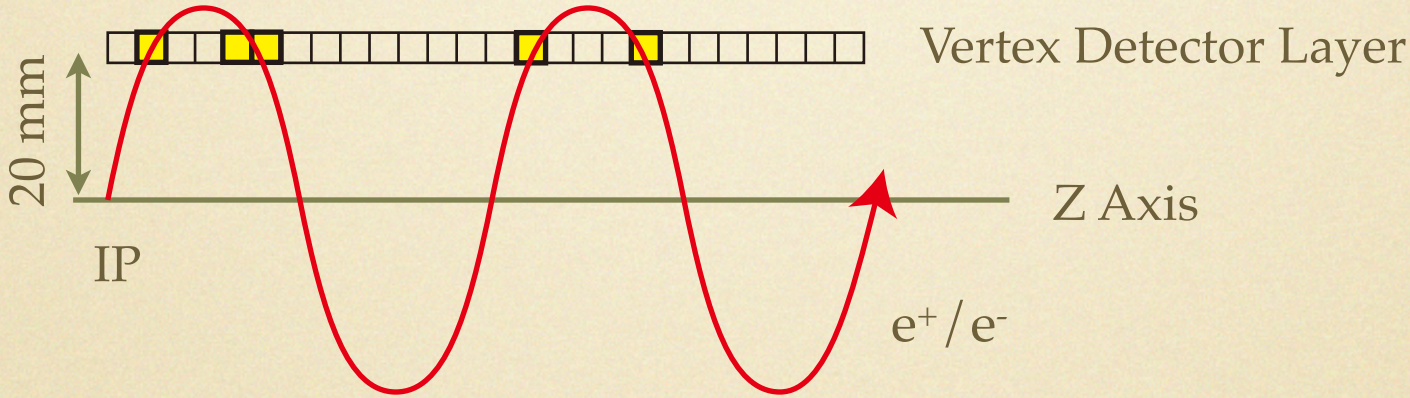
Outline

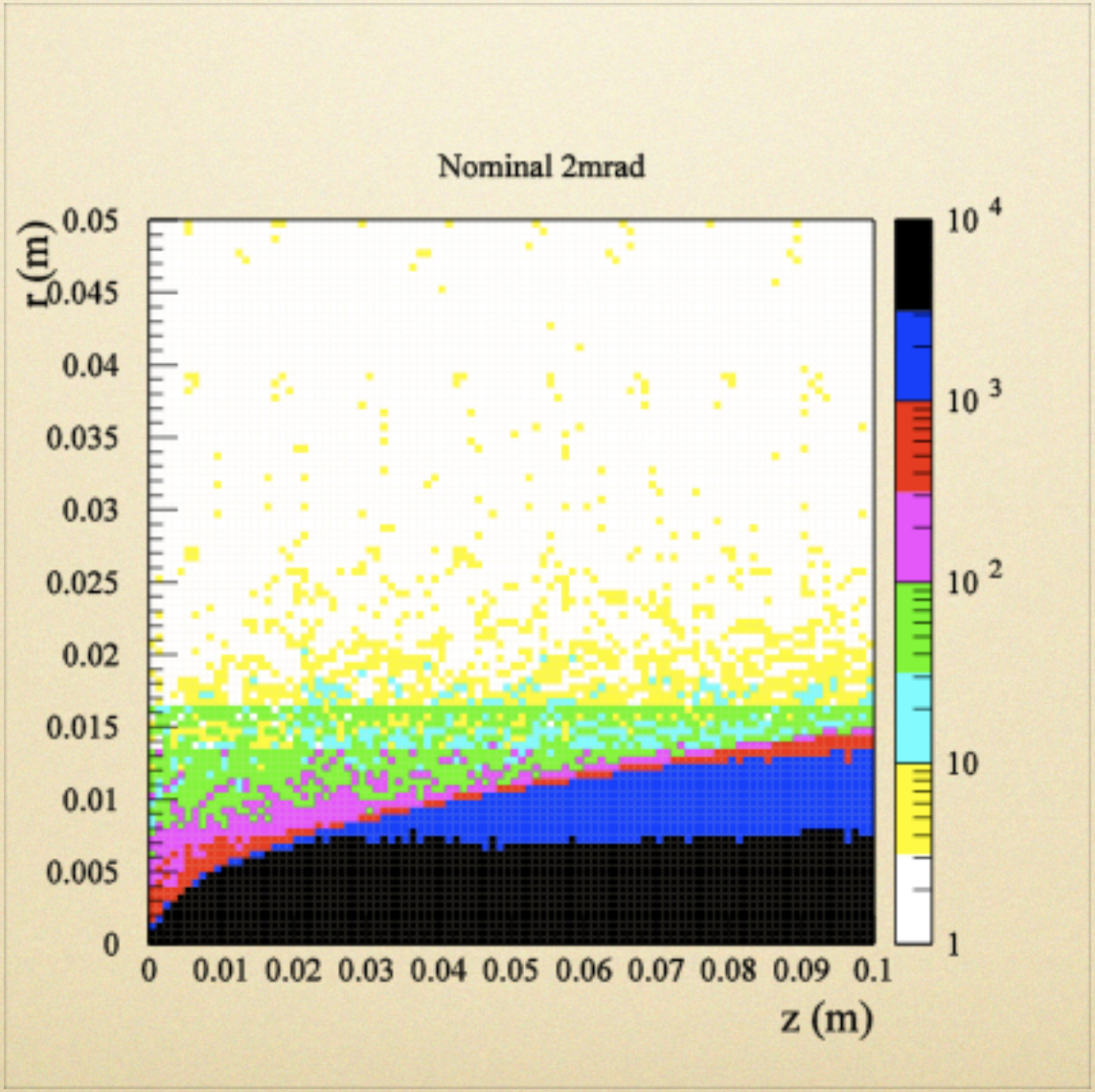
- Pair Background in Vertex Detector
- Impact Parameter Resolution vs R
- Track finding/fitting in Vertex Detector
- Cluster Shape Analysis

Pair BackGround Trajectory



- Pair Background(e+/e-) have low-Pt
- Their Radii are small
- They hit the vertex detector many times

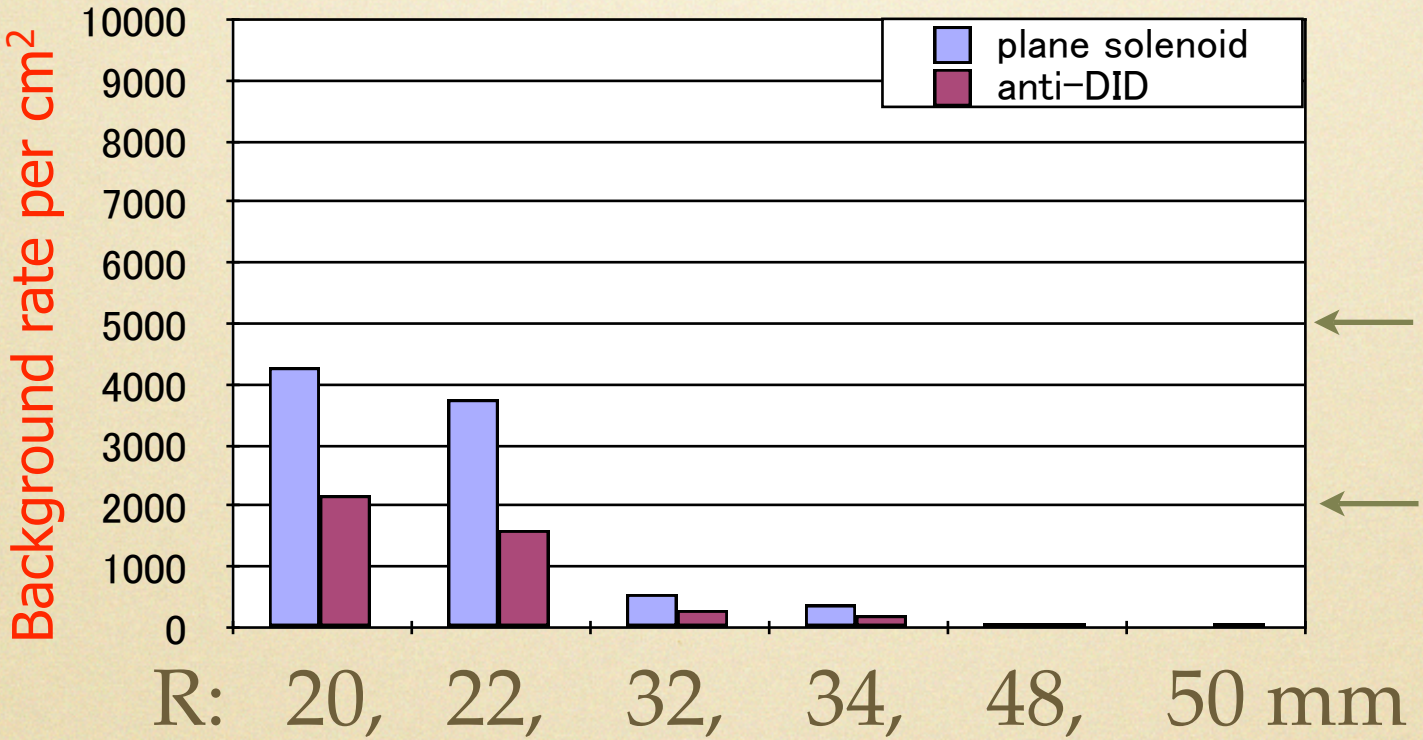
Distribution of Pair Background in Vertex Region



B=3T

By Sugimoto

Background rate
Plain vs. anti-DID in VTX



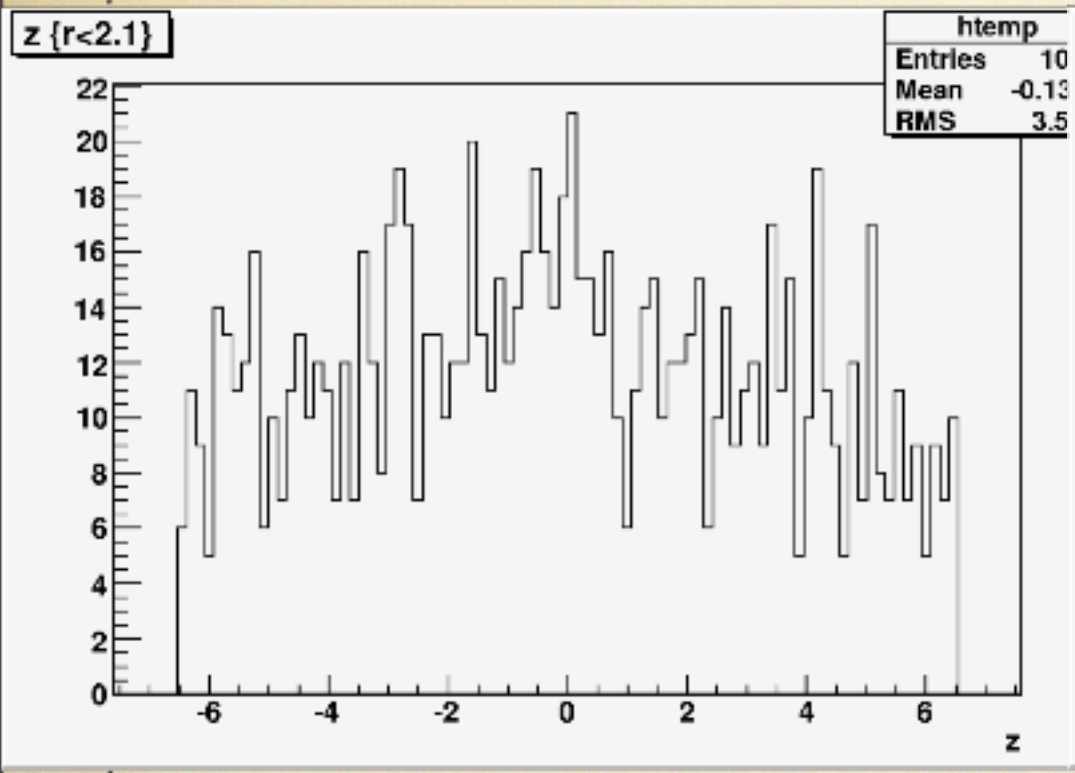
← 50 hits/mm²

← 20 hits/mm²

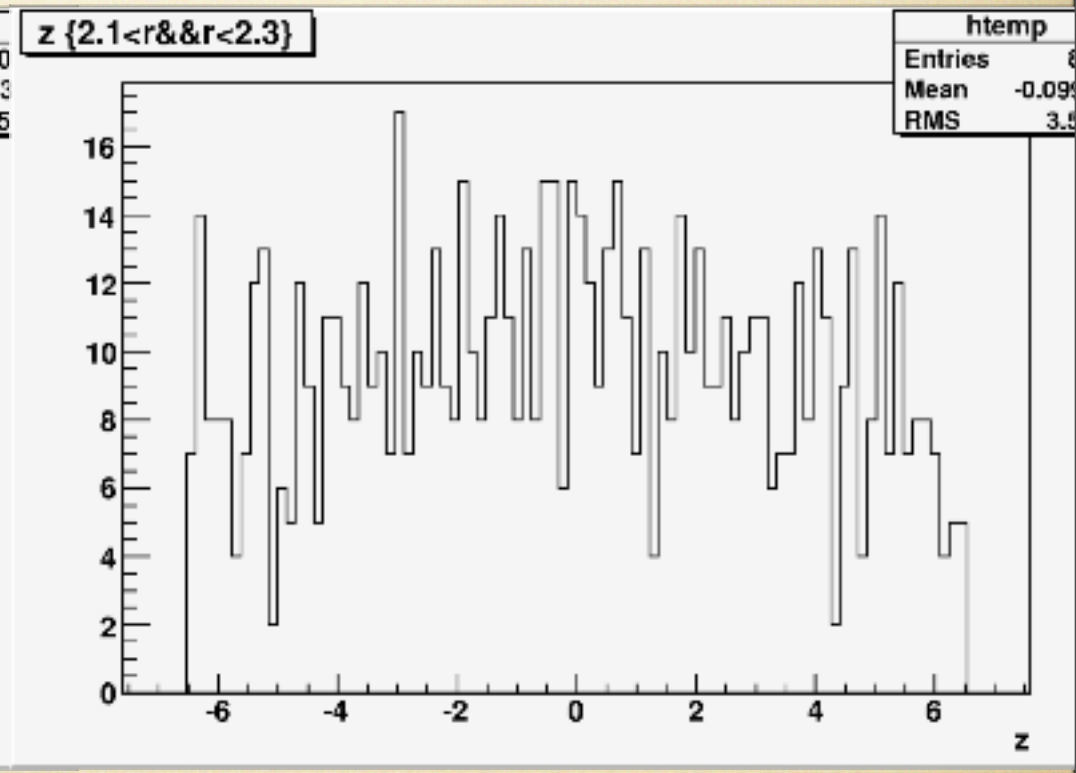
By Fujishima

- CAIN/Jupiter/Geant4 results
- Beam Parameter: nominal 500GeV, 14mrad
- Background rate is reduced to 1/2 with ANTI-DID Field

z distribution of VTX hits



Layer 1

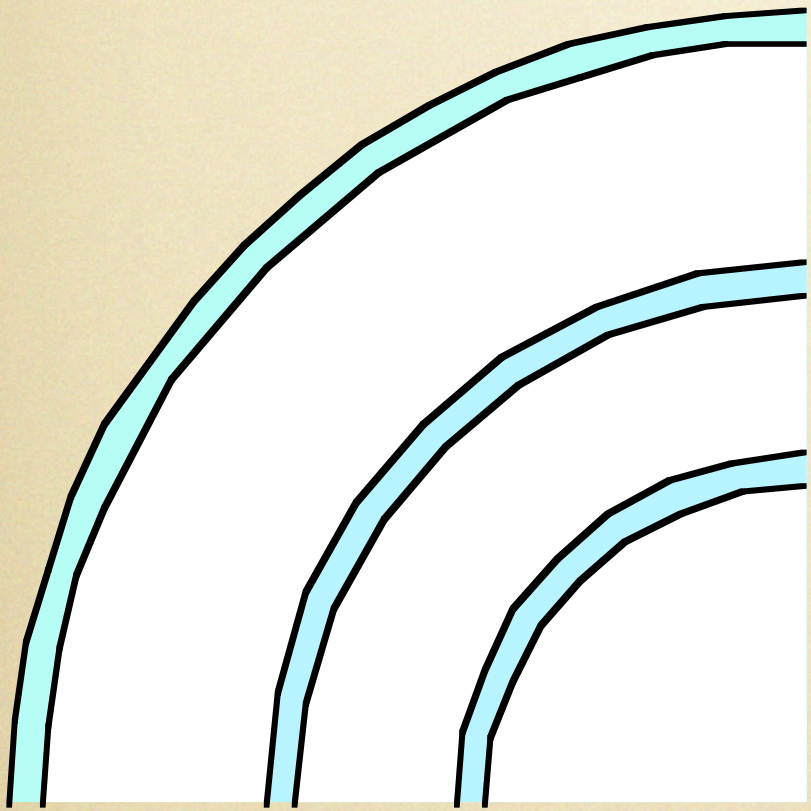


Layer 2

Hits distribute almost uniformly in Z

By Fujishima

Geometry for Simulation Study(OLD)

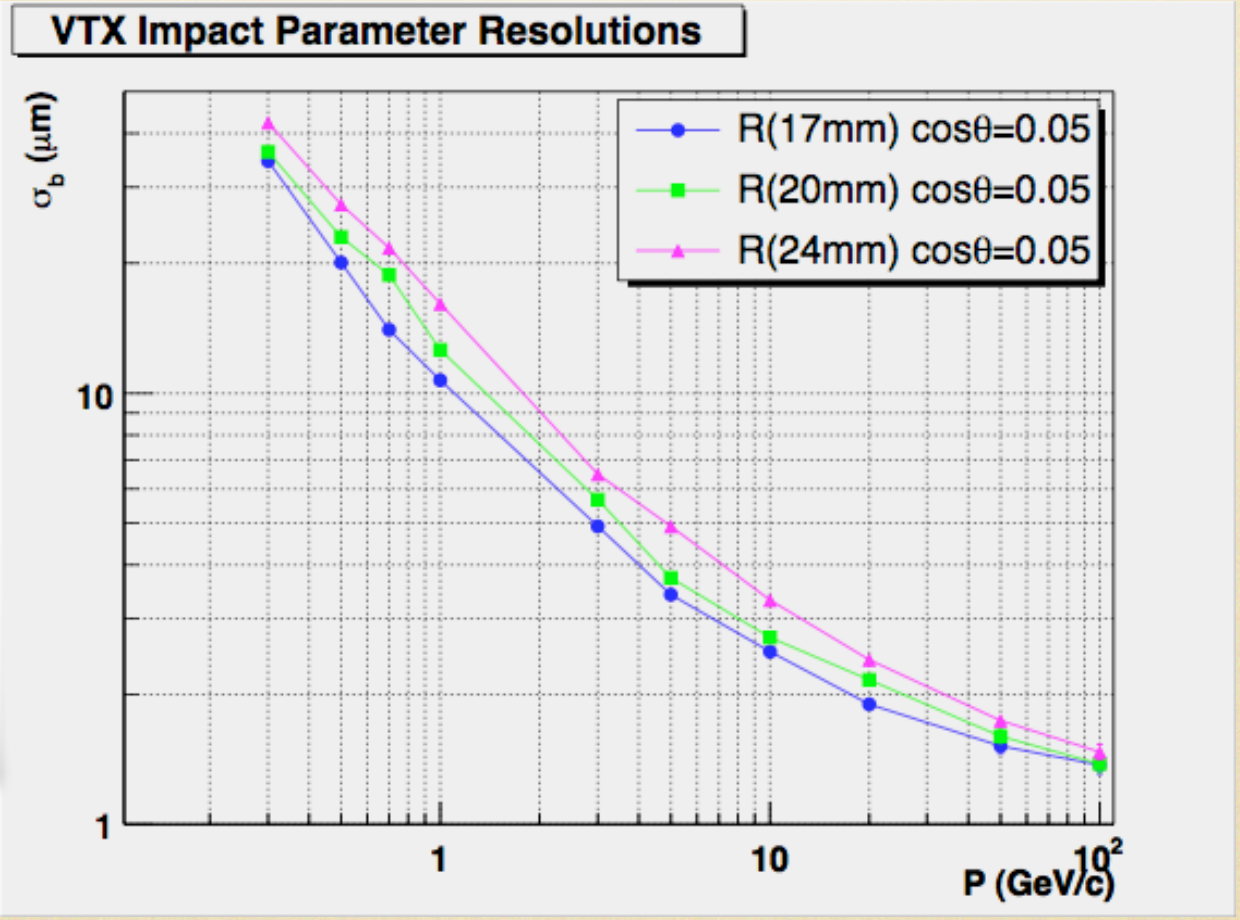


58 mm 32 mm 17,20,24 mm

- Tube shape used as each layer
- Layer thickness : 80μm
- 50μm for CCD
- 30μm for Support Material)
- No support material(Air used)
- 2 mm separation for each doublet
- 3 configurations are studied
- Doublet 1 : R=17, 20, 24 mm
- Doublet 2 : R=32 mm
- Doublet 3 : R=58 mm
- Hit position resolution: 2μm
- Beam Pipe : Be, t=500μm,
- R=15, (18, 22) mm

Impact Parameter Resolution (OLD Geometry)

del(sig)/sig = 1/2 del(r)/r

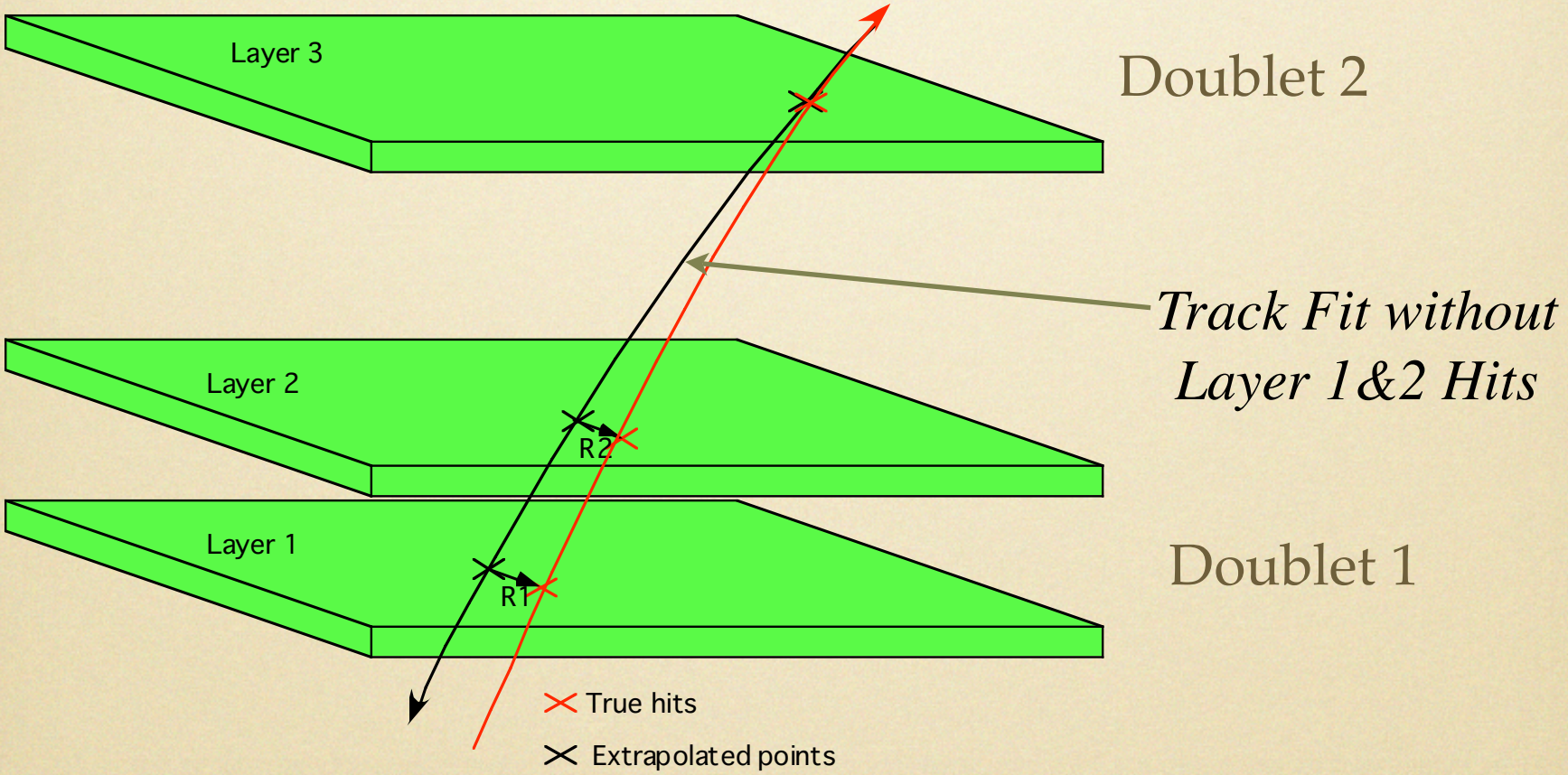


- Impact Parameter Resolution(R-phi plane) v.s. Momentum
- μ^- at cos(θ)=0.05
- Impact Parameter Resolution increases as radius increases

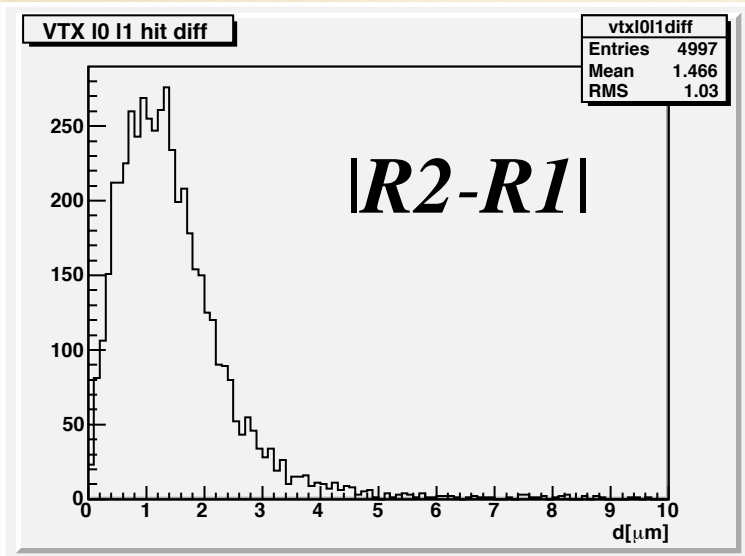
Effect of Background on Track Finding

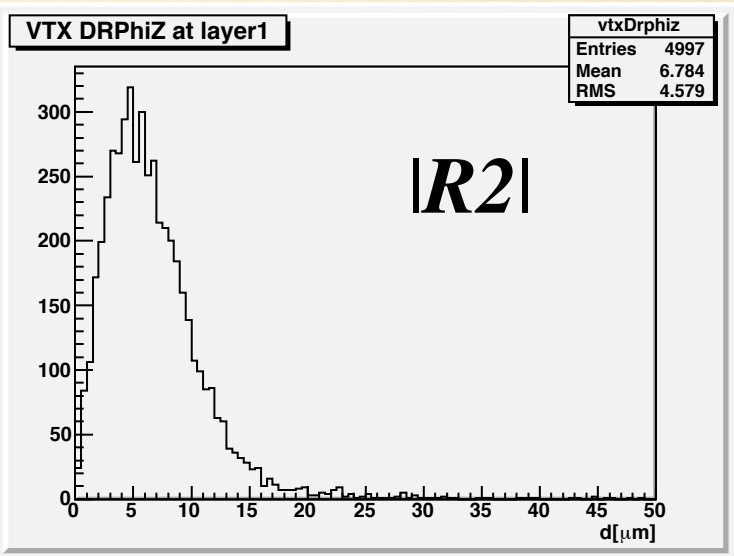
- Estimate track-hit matching efficiency using Toy MC
- Generate a true hit around a track with distribution functions obtained by Full MC
- Generate Background hits randomly around the track ; 50, 100 and 200 hits/mm^2
- Accept the true hit closer to the track than background hits

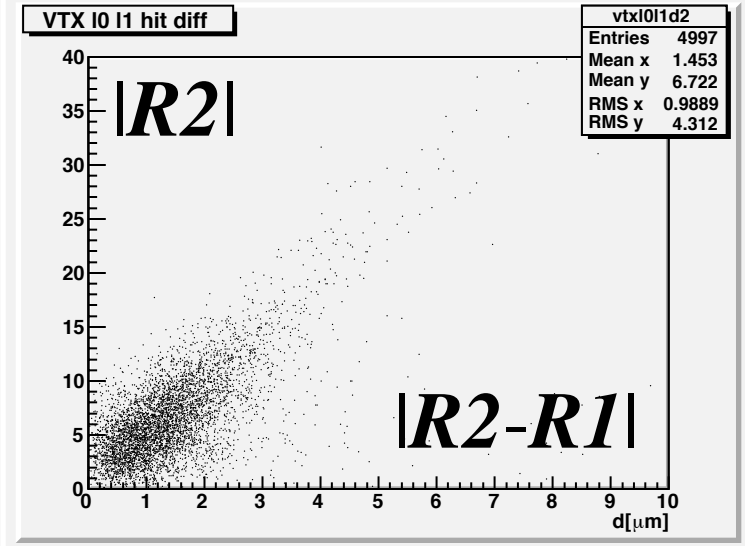
Track-Hit Matching Efficiency



Track-Hit differences distributions



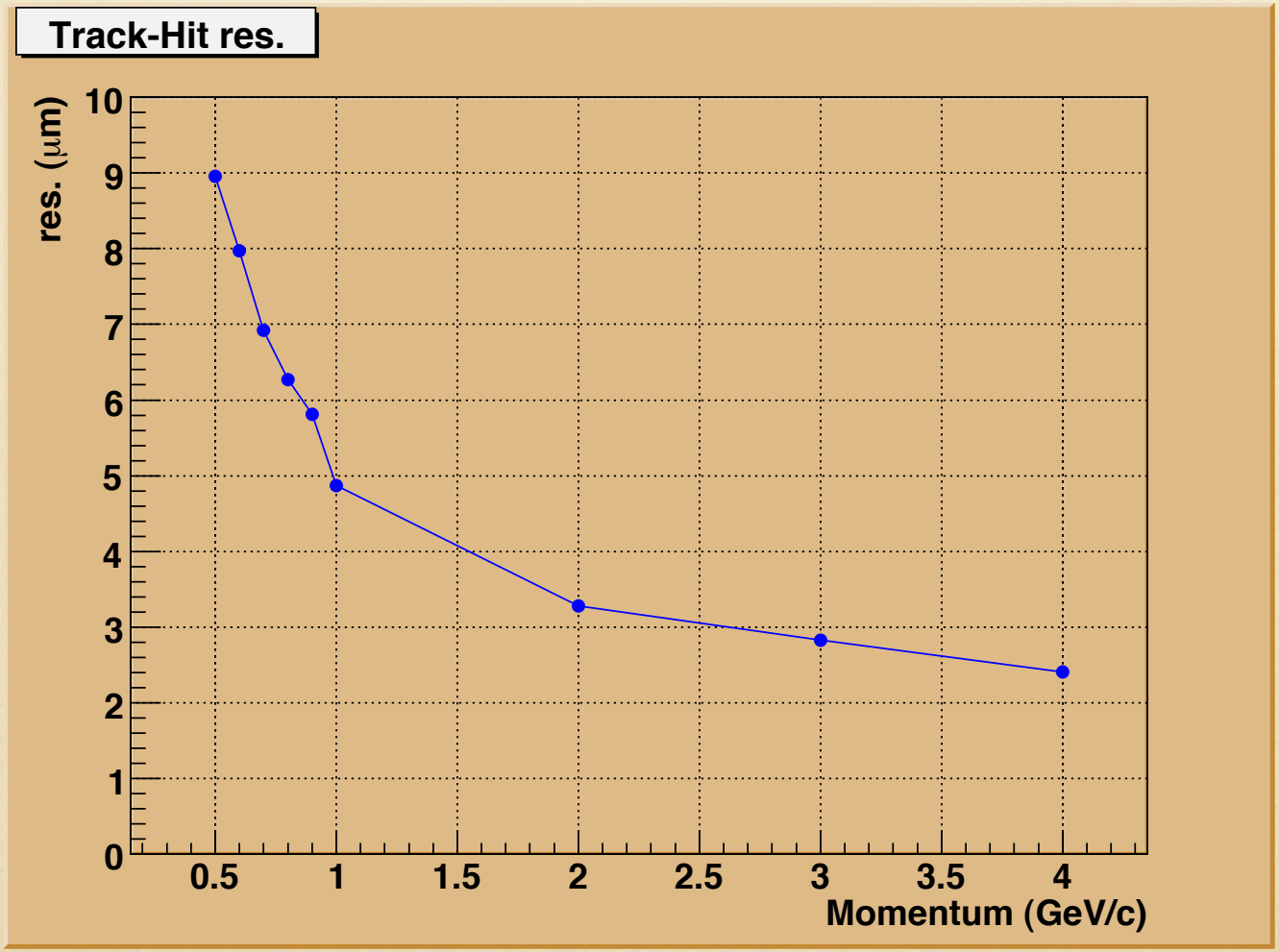




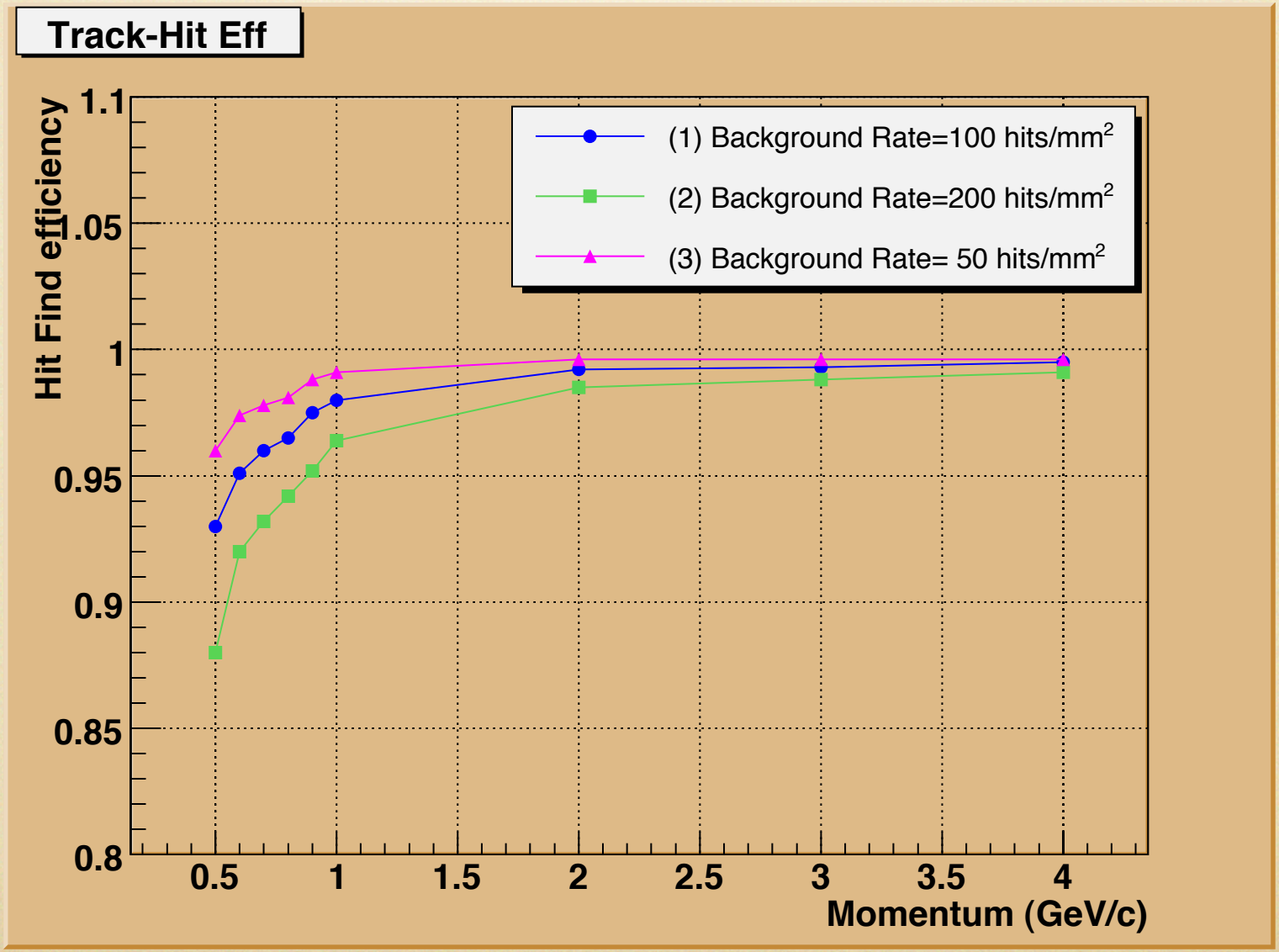
P=1.0 GeV/c

COSθ=0.05

|*R2*| resolution v.s. Momentum



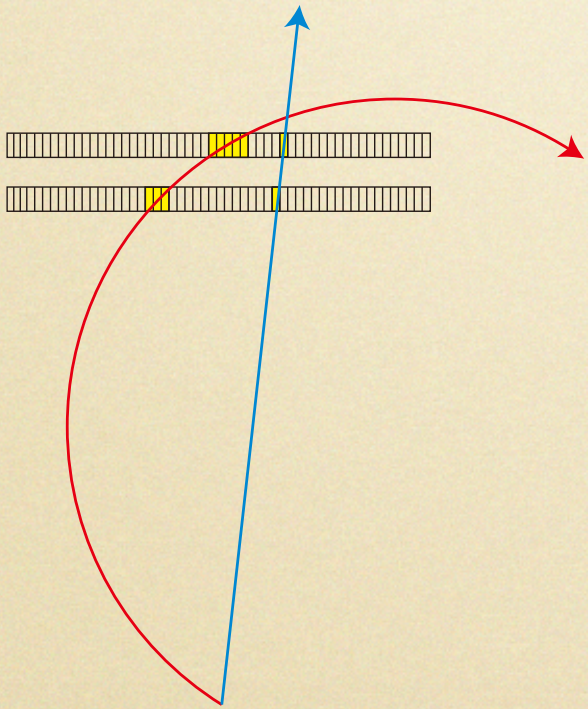
Efficiencies for different hit rates



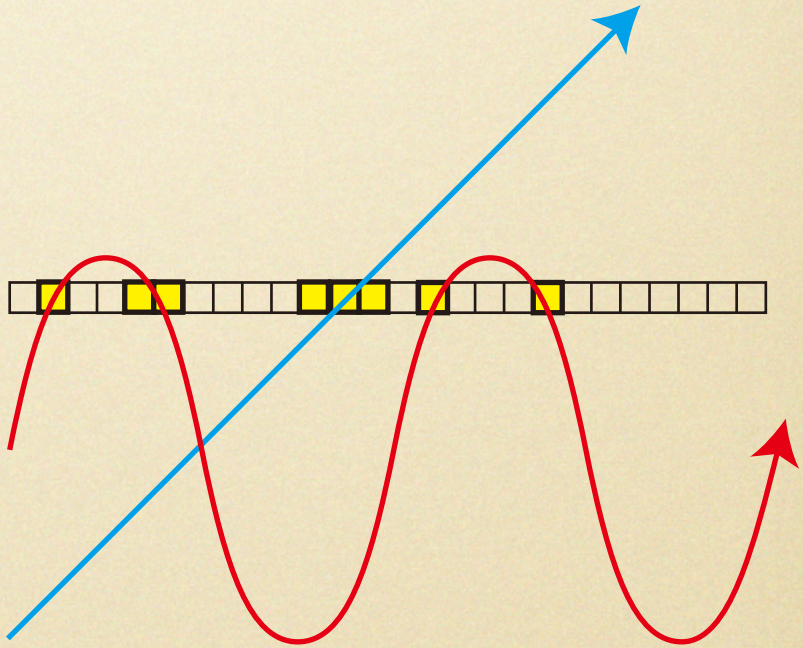
Cluster Shapes for Low-Pt and High-Pt tracks

RED: Low-Pt Track (Pair Background)

BLUE: High-Pt Track

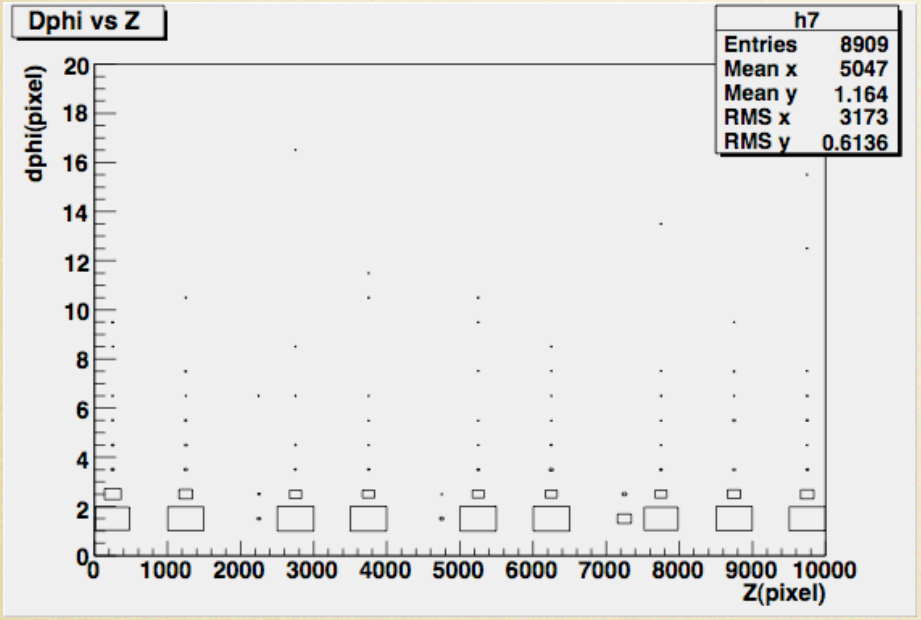


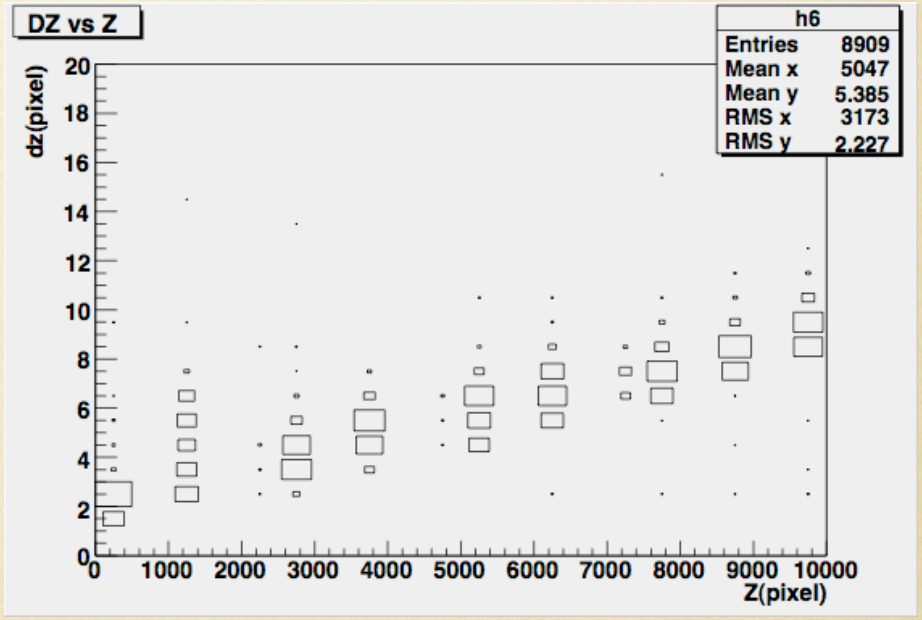
R-Phi Plain



R-Z Plain

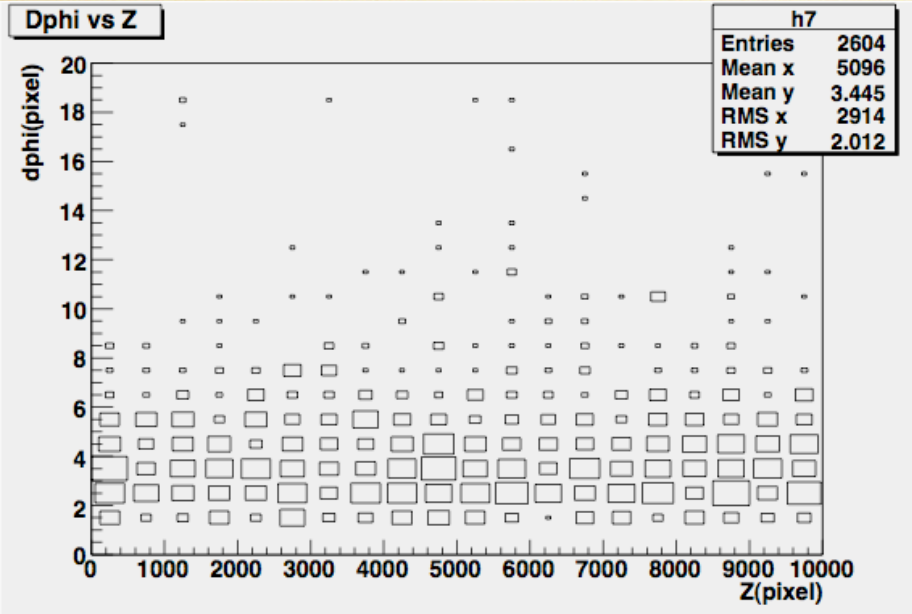
Distributions of Cluster Width v.s. Z for Muon Tracks

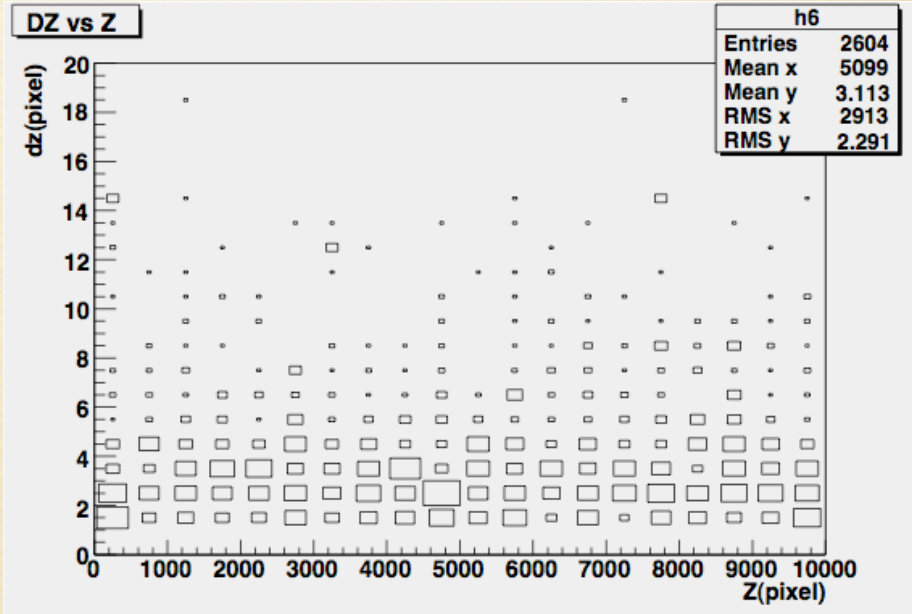




- 1 GeV/c μ^-
- Left: R-Phi, Right: R-Z
- Clear Z dependence of Cluster Width in R-Z

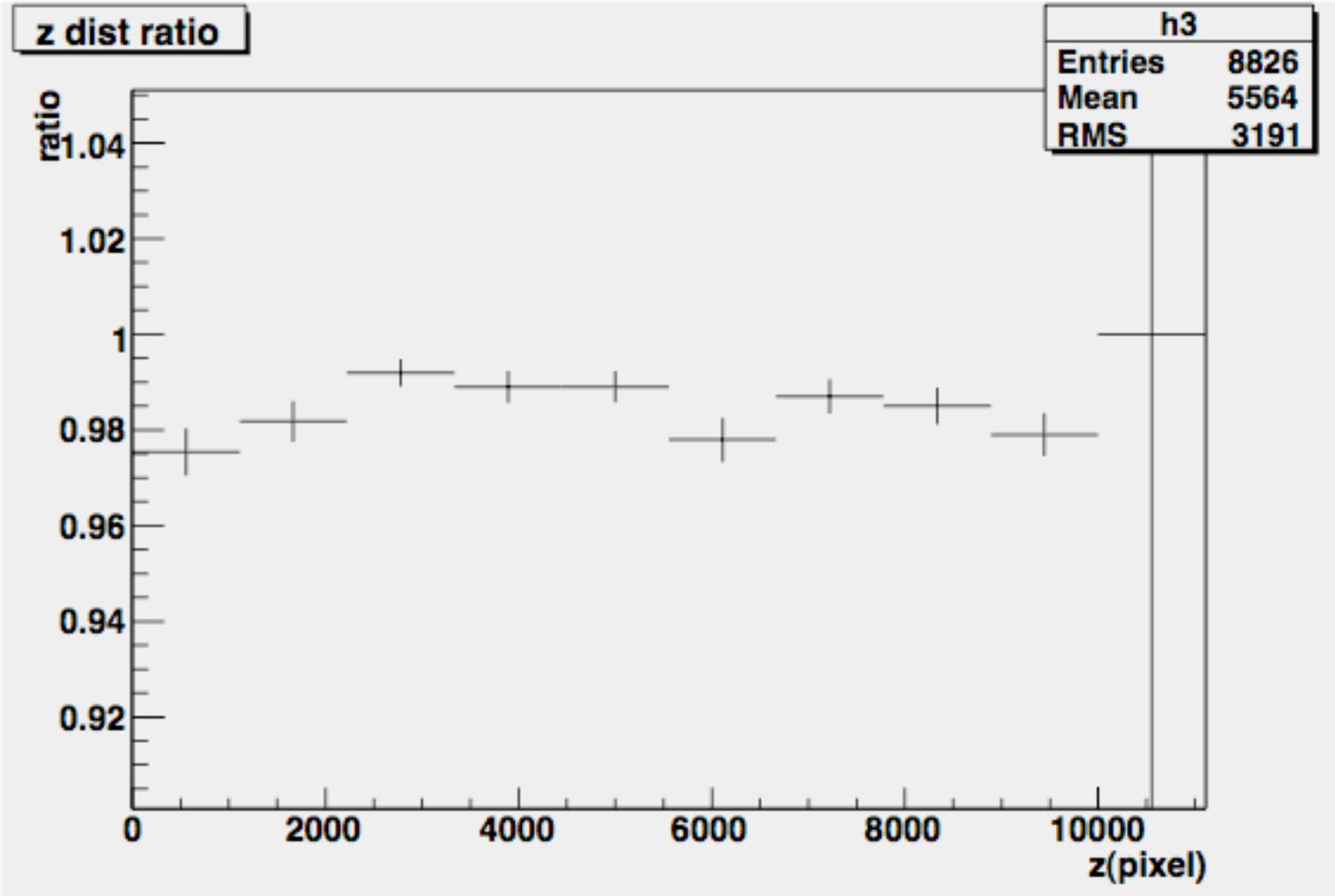
Distributions of Cluster width v.s. Z for Pair Background





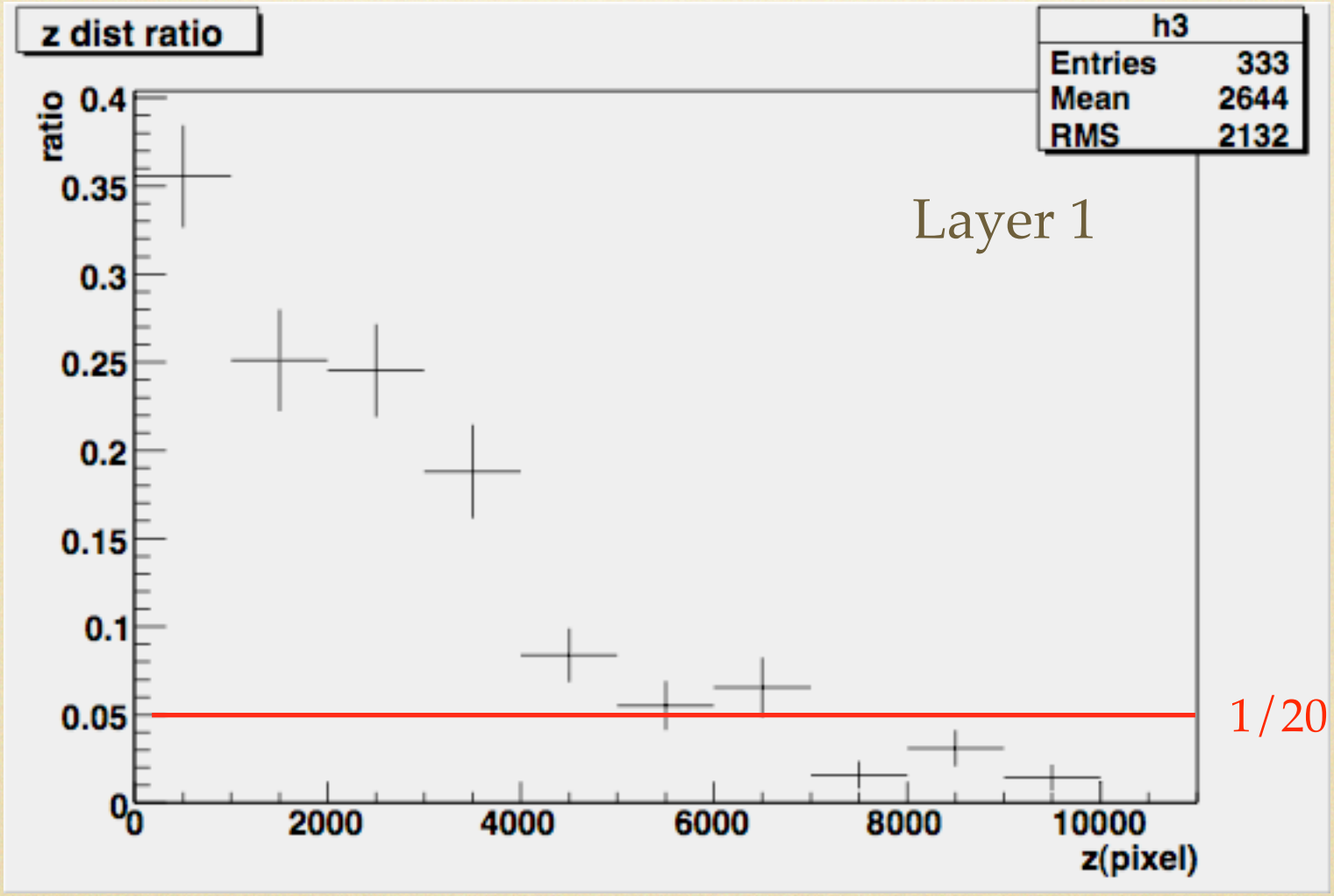
- Pair background
- Left: R-Phi, Right: R-Z
- No Z dependence in both R-Phi and R-Z

Efficiency for Muon track



- 1GeV/c μ^-

Efficiency for Pair Background



- Rejection factor is 1/2 ~ 1/20 depend on Z

Summary

- FPCCD based Vertex Detector can work under hit rate below 50 /mm^2
- Cluster Shape difference can be used to reject Pair Background
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