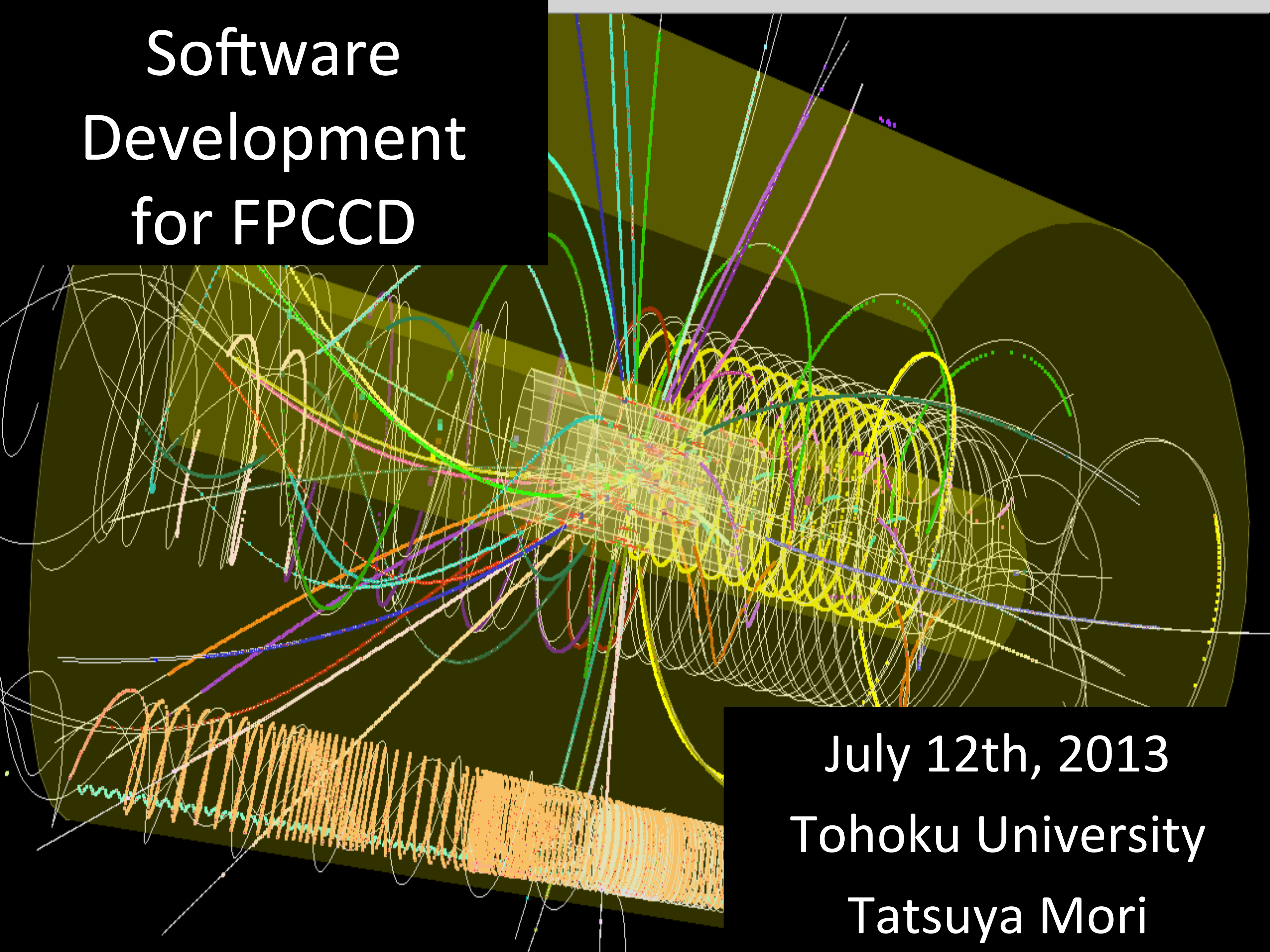
Software Development for FPCCD



July 12th, 2013

Tohoku University

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Contents

1. Rejection of pair BGs in clustering
2. Track finder for FPCCD

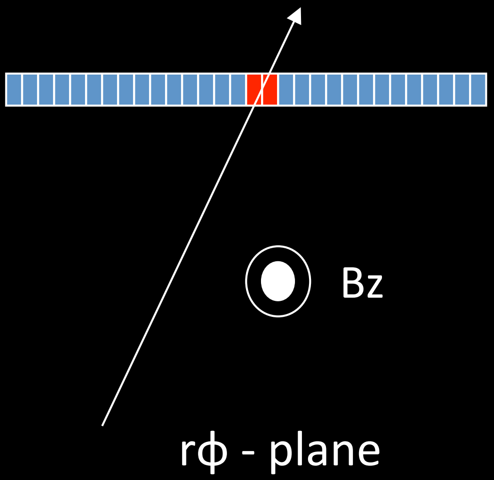
1. Rejection of pair BGs in clustering

Rejection of pair BGs in clustering

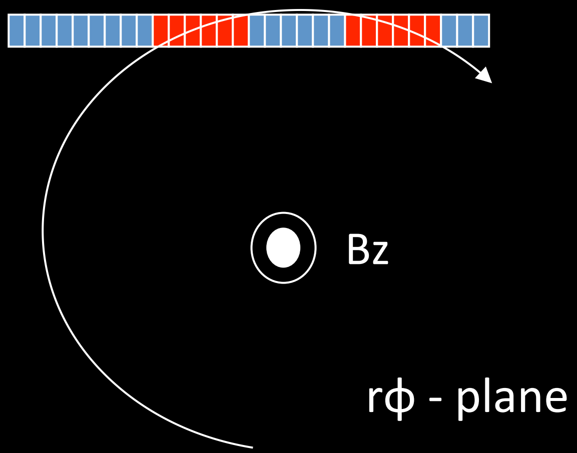
- Motivation
  - As possible, we want to reduce BGs
  - Shape and Position of clusters are different in type of event ;
    → signal event or pair BG event

Character of signal and BG

In BG event, more particles with low Pt come out than signal event



signal evt



BG evt

→ Most of long clusters are from BG evt

Figure by Kamai-san

1st Cut

Sample : ttbar 350GeV evt
To keep almost all signal hits and reduce BG hits, “1st Cut” was implemented

Requirement		
# of pixels in a cluster	Cluster width in rϕ [unit : 1 pixel]	Cluster width in Z [unit : 1 pixel]
< 20	< 10	< 15

→ 1st Cut keeps signal hits 99.87%

BG hits @ 350GeV

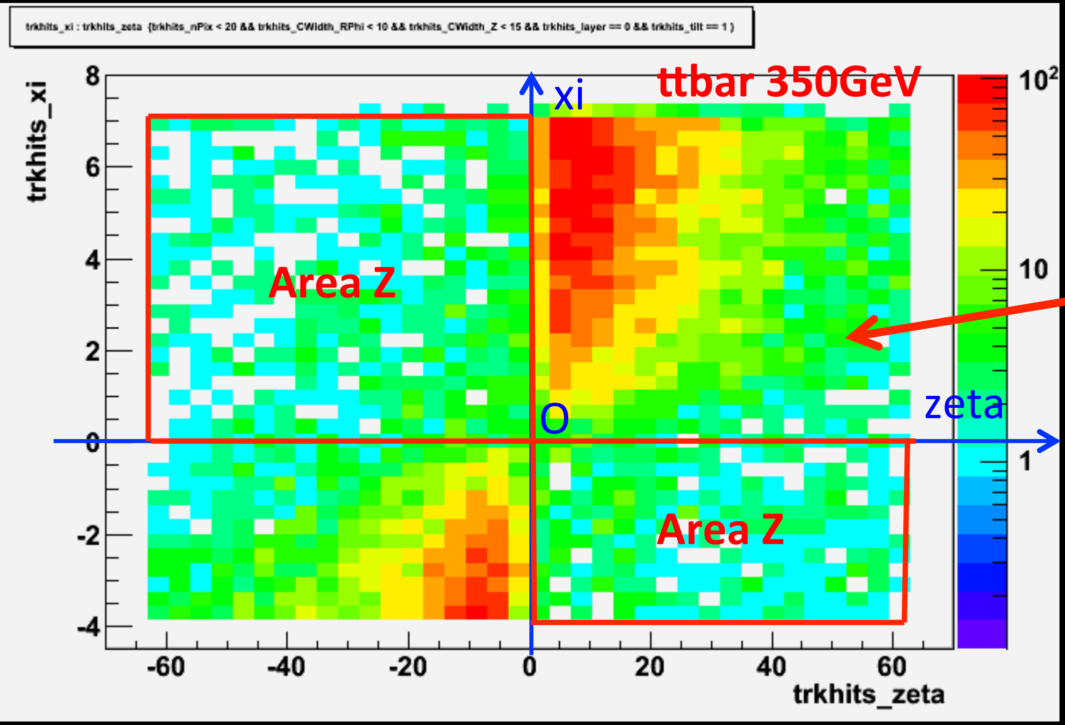
layer No.	# of clusters before 1st Cut	# of clusters after 1st Cut	yield
0	673500	626660	93%

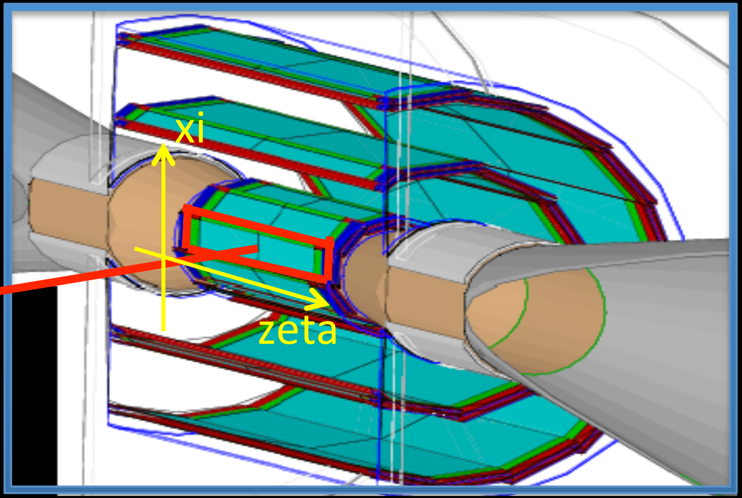
It’s better than nothing….

2nd Cut

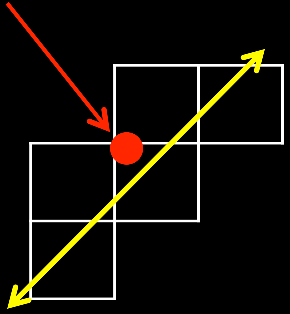
- In addition to 1st Cut, 3 types of cuts are considered
    - Mori Area Z Cut
    - Kamai Cut
    - Kamai Dot Cut

Idea of “Mori Area Z Cut”





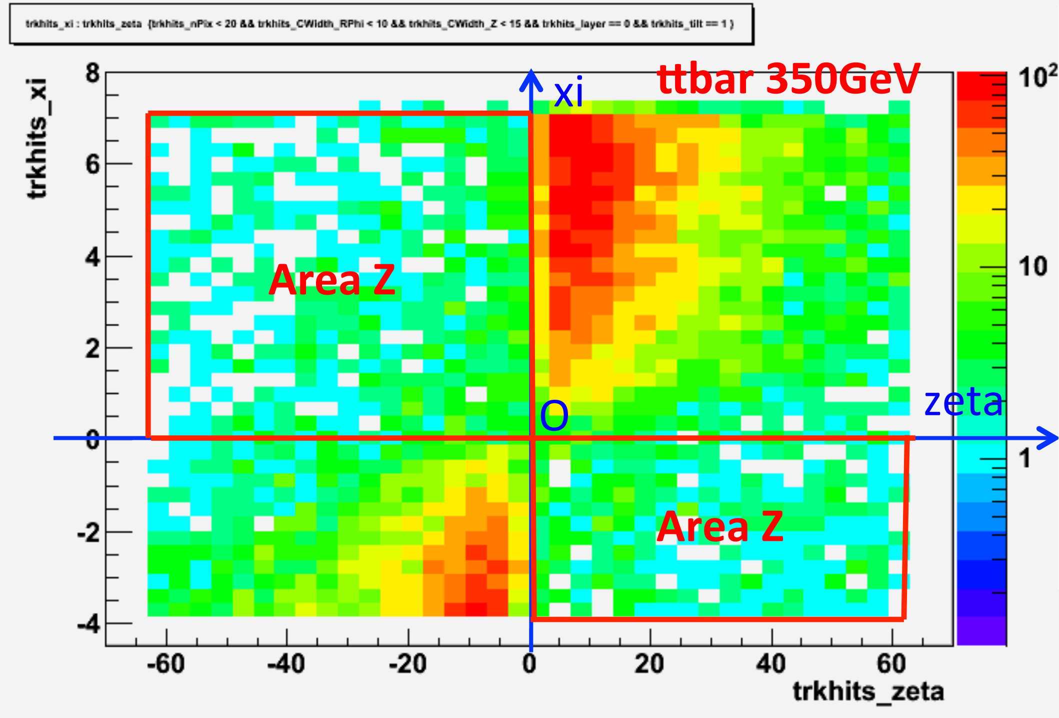
Position of tracker hits calculated by this cluster

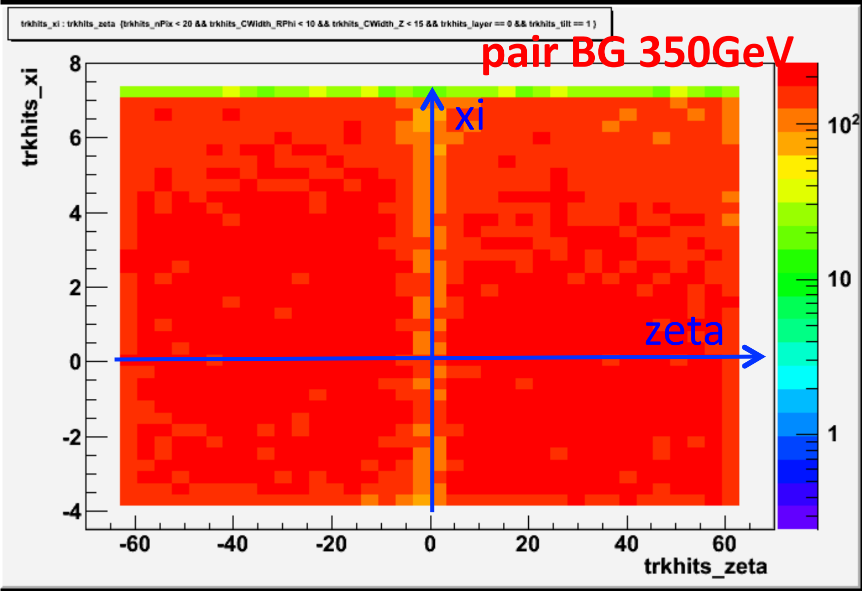


Position of tracker hits calculated by clusters from left bottom to right top is shown in the two histograms

Those hits in “Area Z ” (xi * zeta < 0) are minority

Idea of “Mori Area Z Cut”

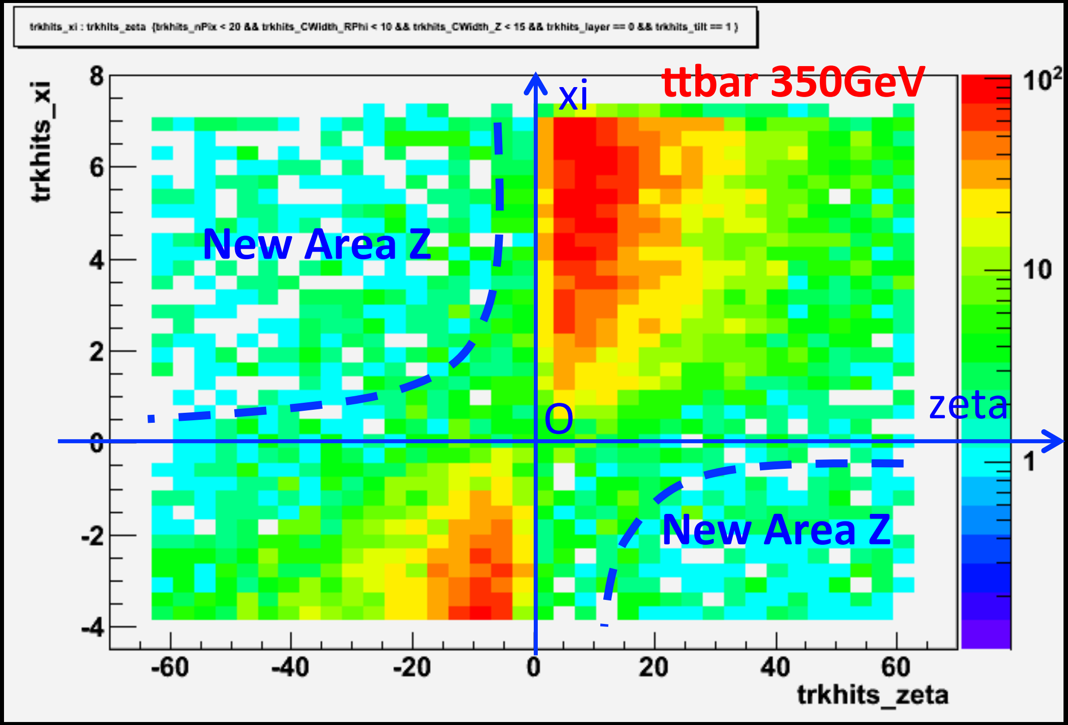




hit position of pair BGs is uniformly distributed!

We may be able to cut those hits in Area Z (xi * zeta < 0)

Appendix :
Loosening Mori Area Z Cut



New Area Z → xi * zeta < - Z

The larger Z, the weaker cut

→Today, I will only show the case in Z = 0

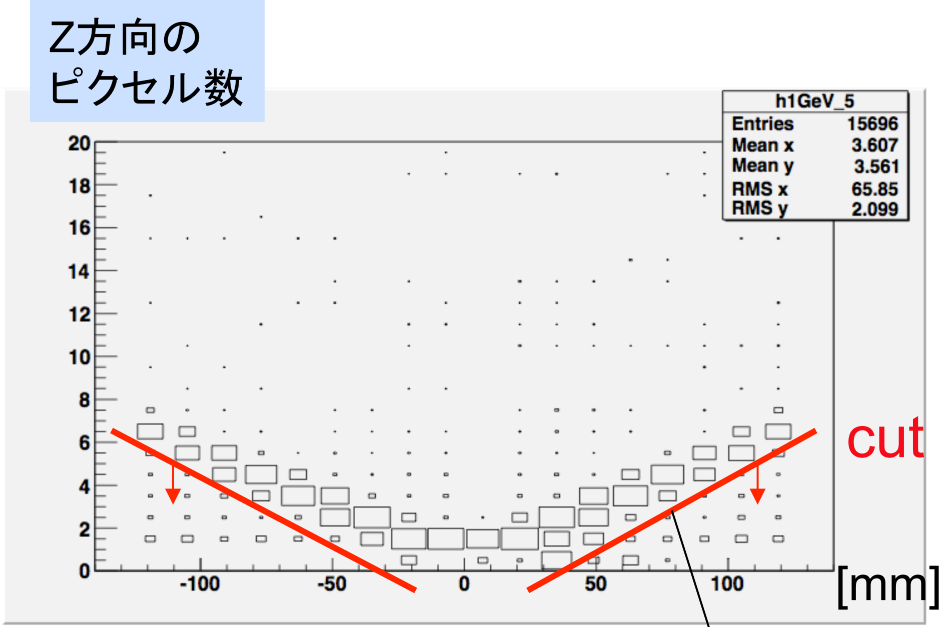
Kamai-san Cut

http://ilcphys.kek.jp/meeting/vertex/archives/2010-02-24/VTX%20100224.ppt

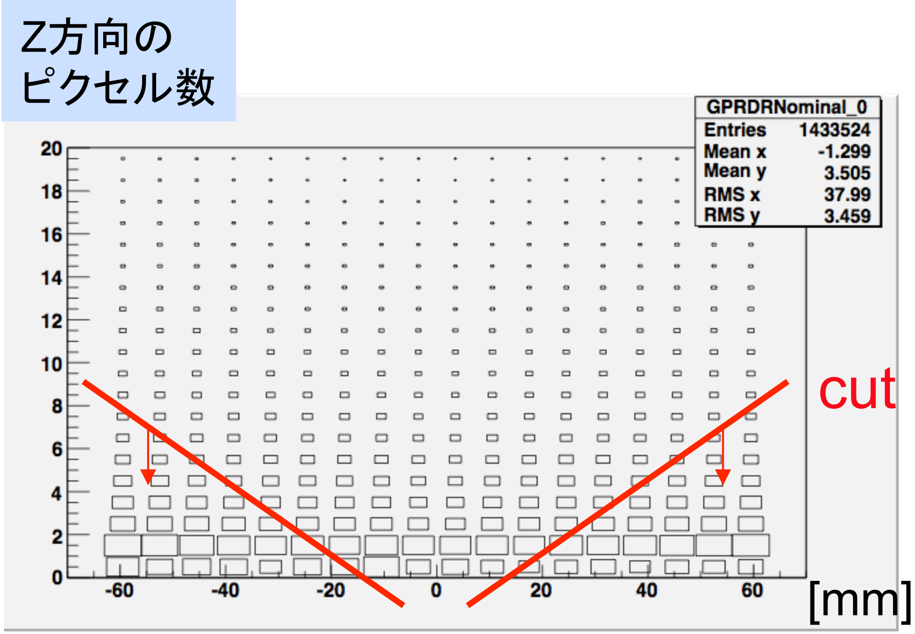
Distributions of Fired Pixels Width of Z vs Z

▷各ヒットでのピクセル数とZとの相関

・Layer6での分布の比較



1GeV e-



Pair-background

Z×(layer thickness)/(layer radius)-2

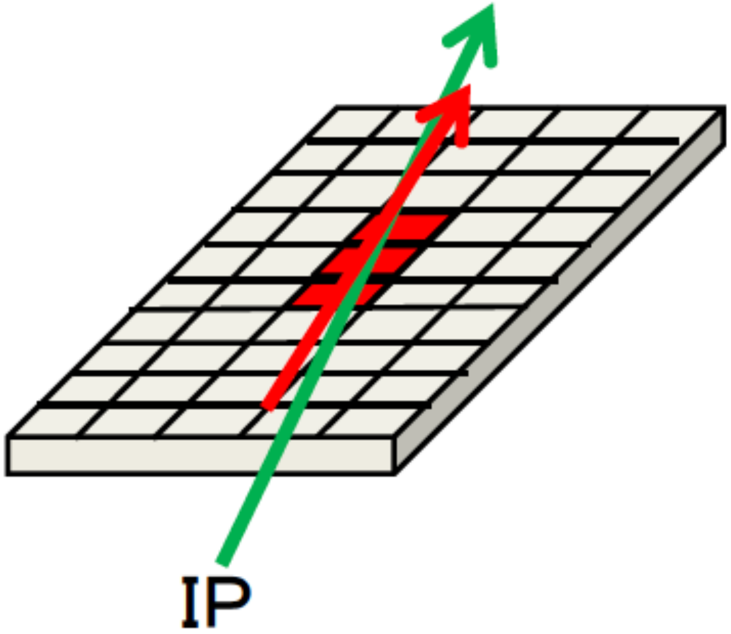
I defined this as “b parameter”

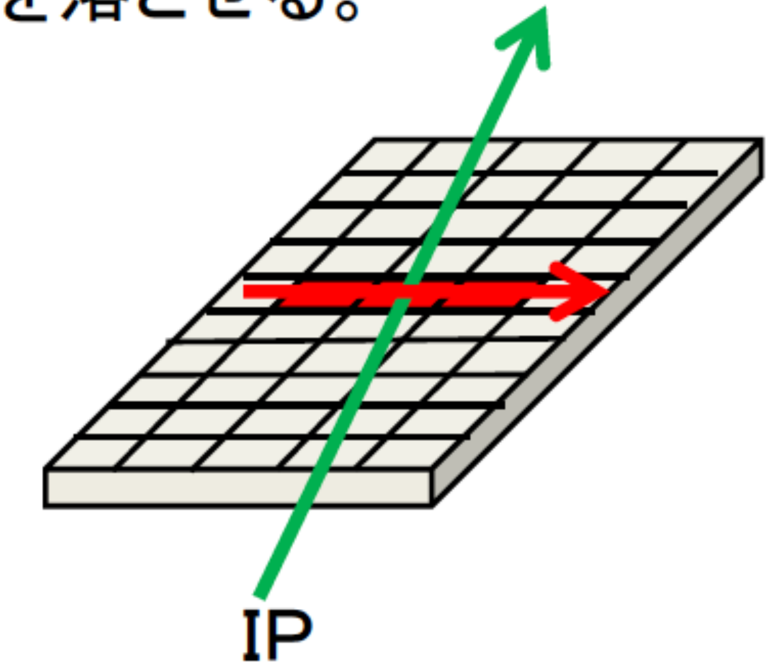
Kamai-san Dot Cut
~ Dot of Cluster Tilt and Position ~

- http://kds.kek.jp/conferenceDisplay.py?confId=8452

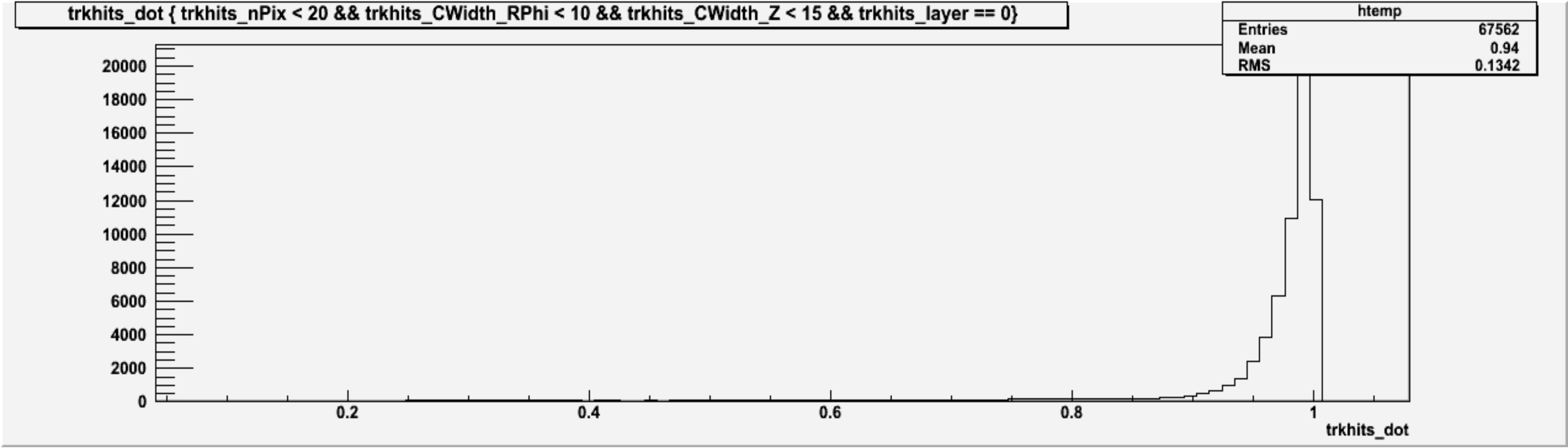
クラスターの方向と位置ベクトルの内積

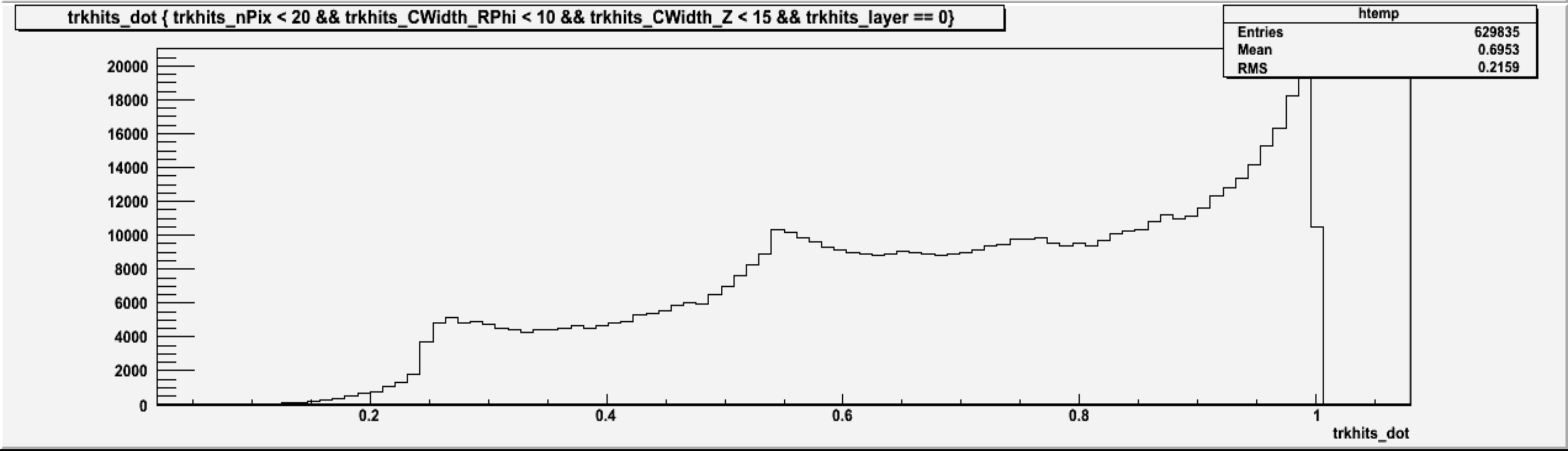
- IPからクラスターへ伸ばしたベクトルとクラスター自信の持つ方向との相関をみる
  - クラスターの方向は3次元のベクトルとして定義
    - ピクセル1個ではラダーに垂直なベクトルになる
  - IP以外から来ているものを落とせる。



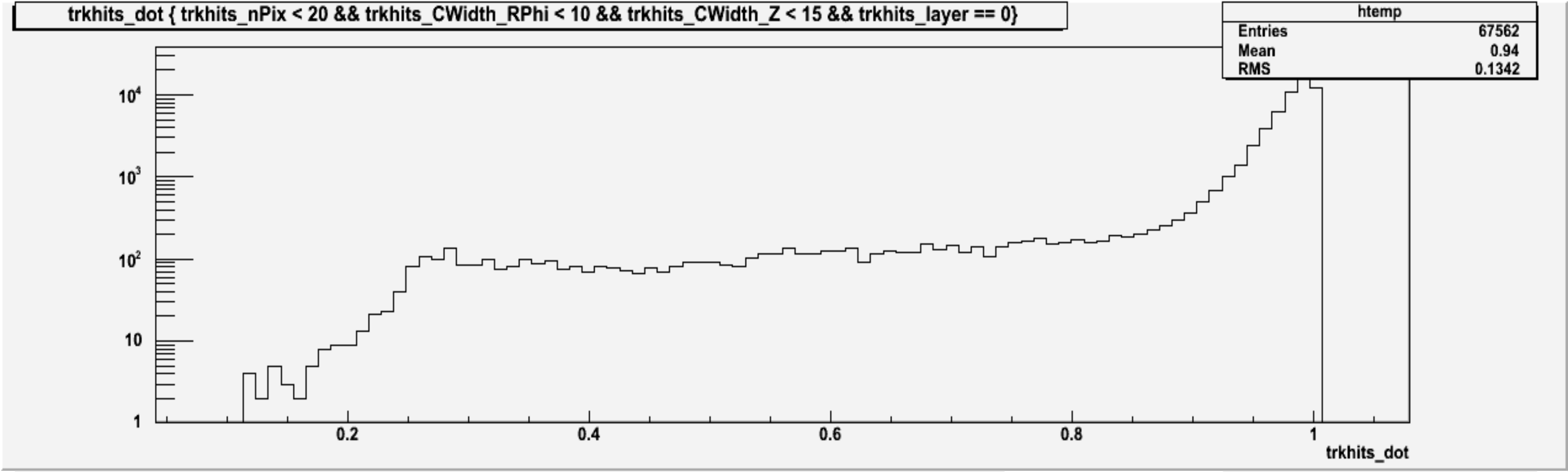


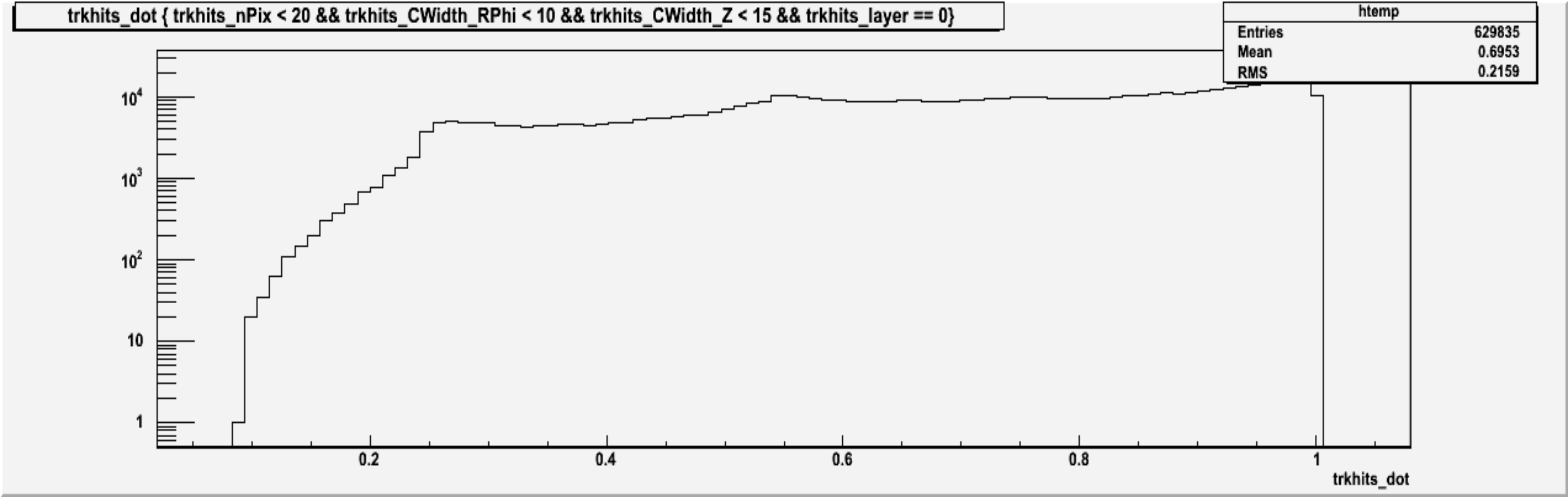
Dot of Cluster Tilt and Position





Dot of Cluster Tilt and Position (log scale)





Yeild of 3 types

innermost layer

cut（after 1st Cut）	sig yeid	BG yeild	BG loss ／sig loss
mori Area Z Cut	95.8%	62.52%	9.0
kamai Cut b = 10	99.1%	92.11%	9.2
kamai Cut b = 9	98.7%	89.60%	7.9
kamai Cut b = 8	98.1%	85.43%	7.7
kamai Cut b = 7	97.4%	80.30%	7.4
kamai Cut b = 6	96.5%	74.52%	7.3
kamai Cut b = 5	95.7%	68.32%	7.3
kamai Cut b = 4	94.6%	61.81%	7.1
kamai Cut b = 3	93.5%	55.03%	7.0
kamai Cut b = 2	92.2%	48.08%	6.7
kamai Cut b = 1	90.6%	40.77%	6.3
kamai Cut b = 0	80.7%	31.93%	3.5
kamai dot cut ＞ 0.2	99.2%	92.50%	9.7
kamai dot cut ＞ 0.3	98.3%	88.01%	7.2
kamai dot cut ＞ 0.4	97.1%	81.76%	6.4
kamai dot cut ＞ 0.5	96.0%	73.96%	6.6
kamai dot cut ＞ 0.6	94.5%	61.32%	7.0
kamai dot cut ＞ 0.7	92.7%	48.93%	7.0
kamai dot cut ＞ 0.8	90.6%	35.74%	6.9

We plan to use

Area Z Cut (which drops the hits calculated by their skewing cluster)

+

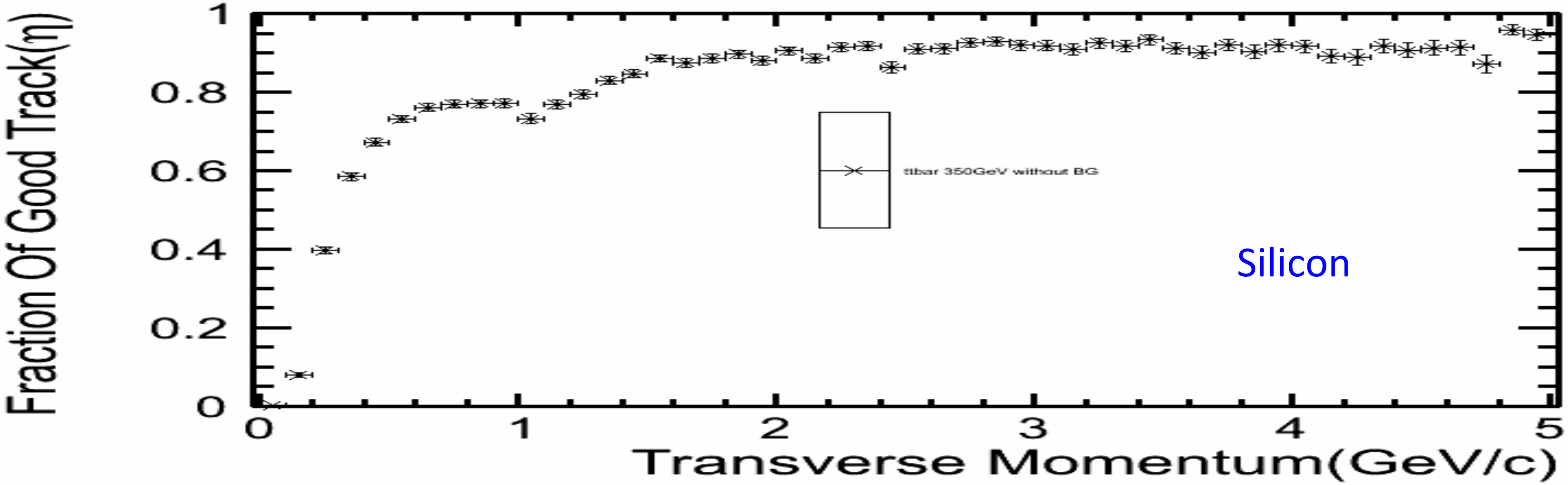
Kamai Cut (which drops the hits calculated by their straight cluster)

2. Track finder for FPCCD

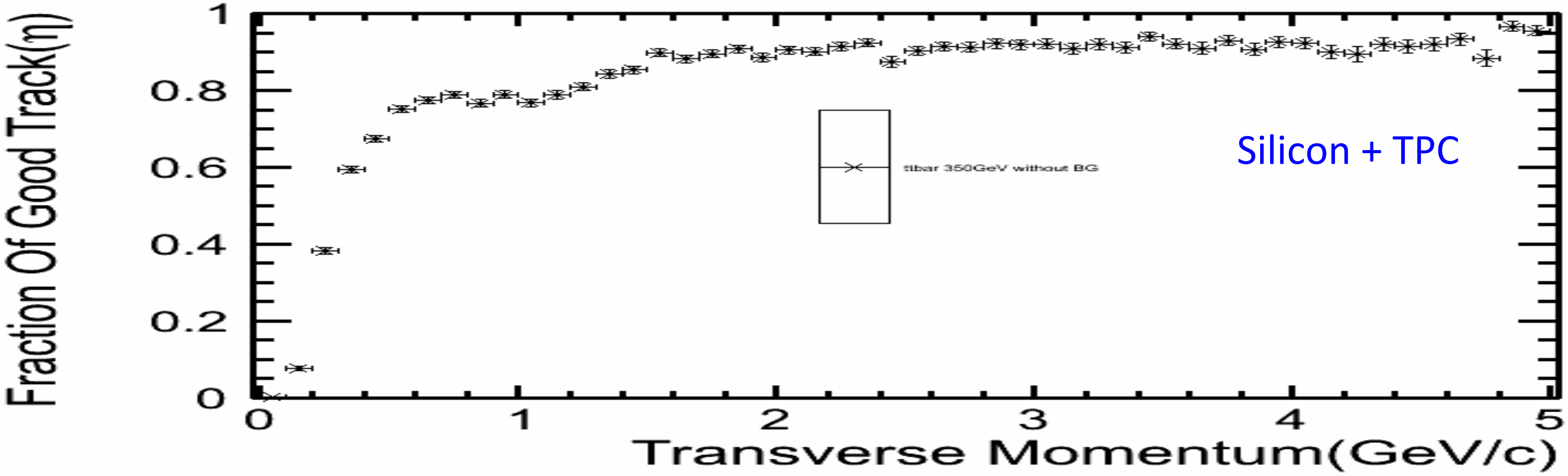
Why do we loss tracking efficiency in low Pt?

pixel size : 2.5um 5um

ttbar 350 GeV



Silicon

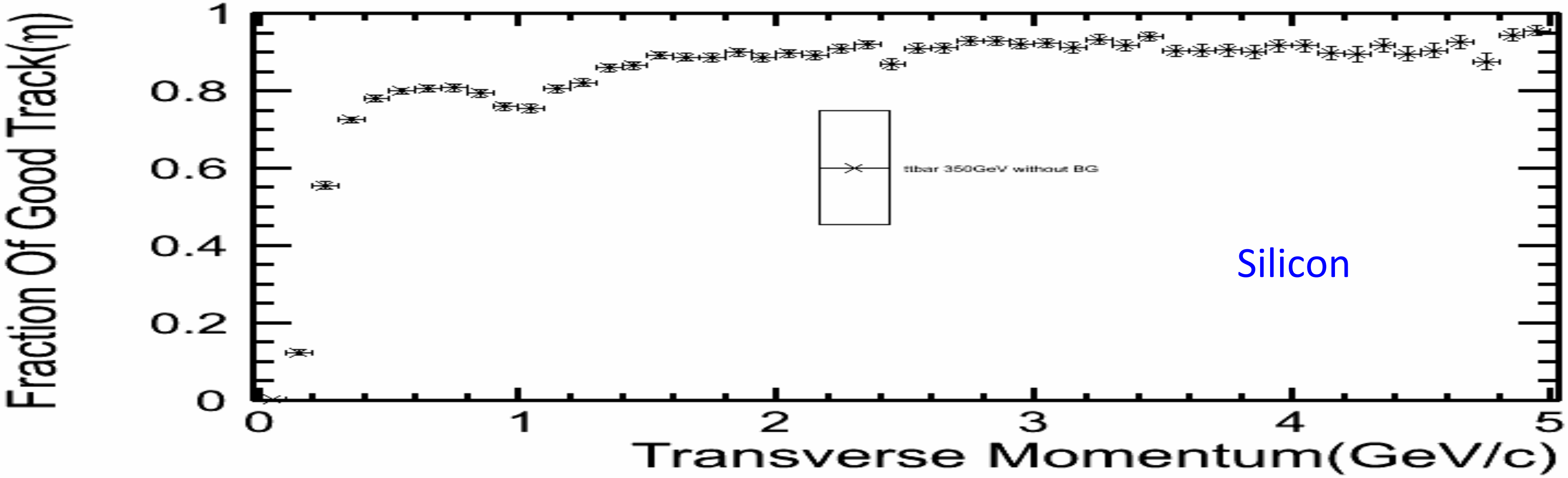


Silicon + TPC

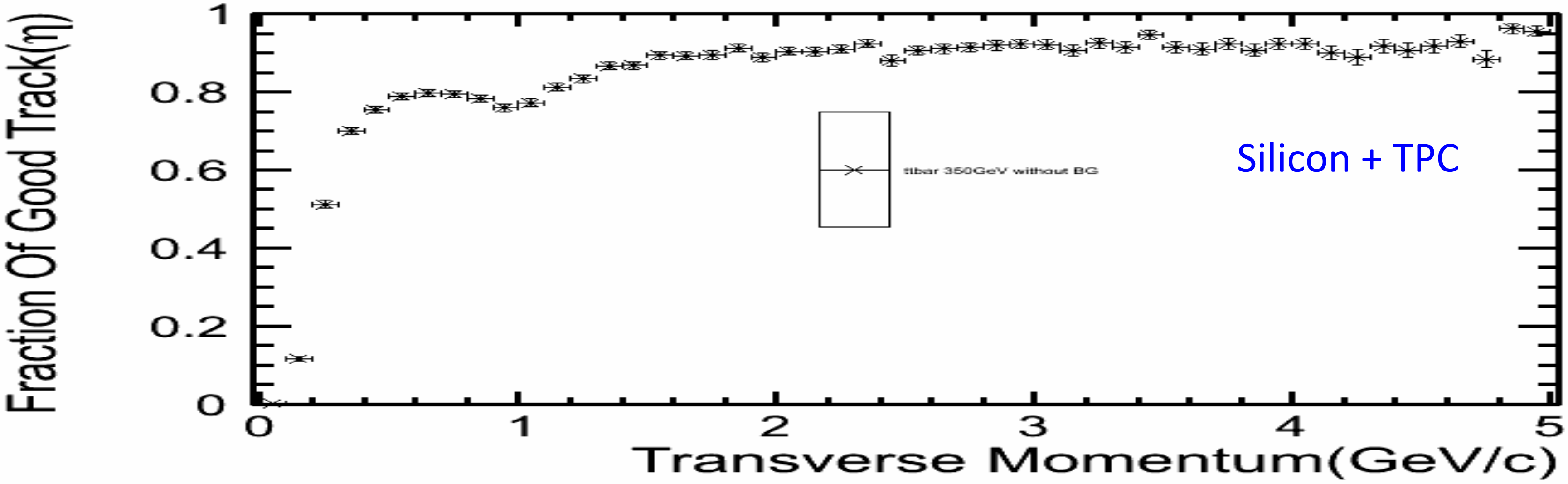
Why do we loss tracking efficiency in low Pt?

pixel size : 5um 10um

ttbar 350 GeV



Silicon

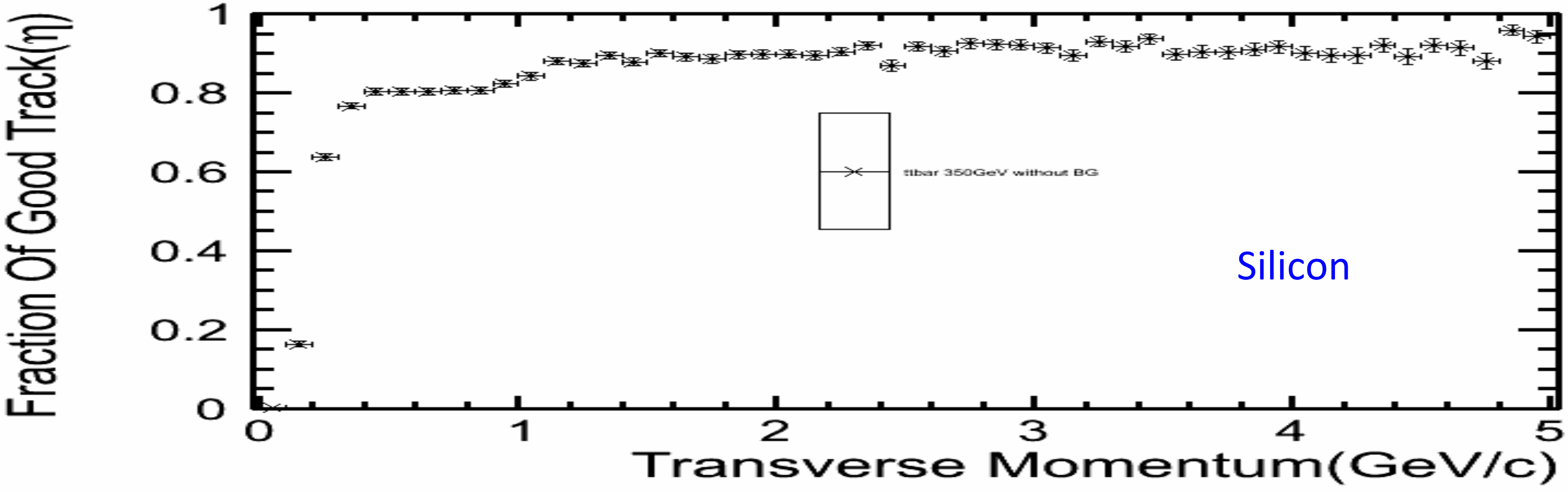


Silicon + TPC

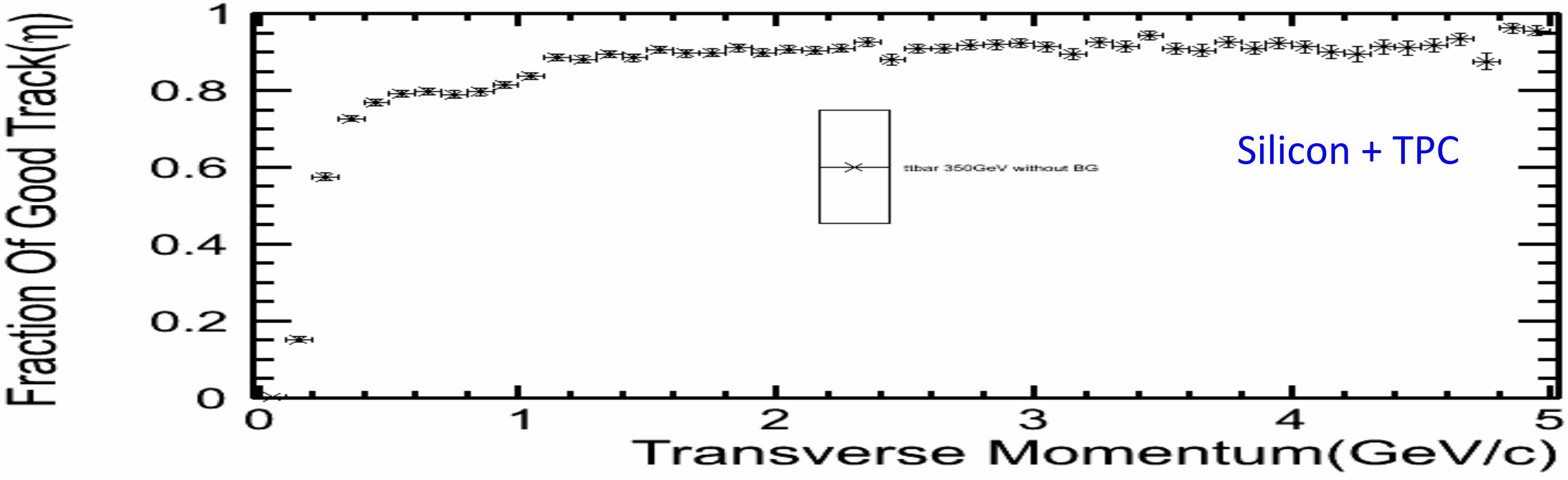
Why do we loss tracking efficiency in low Pt?

pixel size : 10um 20um

ttbar 350 GeV



Silicon



Silicon + TPC

Using Kalman Filter instead of Simple Helix Fit in extrapolation of track

- By default, Kalman Filter isn't used in extrapolation of track
  - Simple Helix Fit doesn't take energy loss & multiple scattering into account

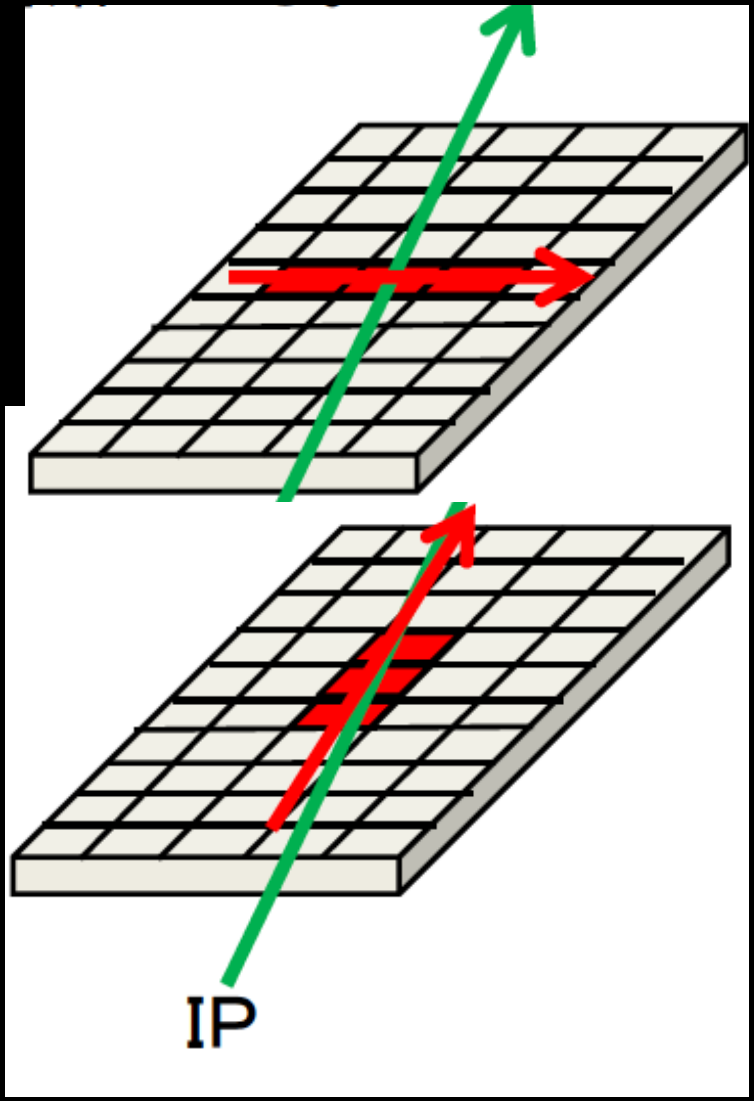
    →The more precise resolution becomes, The more resolution is overestimated

    →Then chi2/ndf value is calculated badly

- I implemented Kalman Filter in extrapolation of track for FPCCD
  - Evaluation Result is next week

Using cluster shape in extrapolation of track

double layer



In extrapolation of track,
we search for next cluster in inner layer

→By using dot of 2 clusters,
we can avoid to select
wrong combination of clusters

I implemented this algorithm
→Performance evaluation is next week

Plan

- Rejection of pair BGs in clustering
  - Reconstruction performance using 1st Cut & Mori Area Z Cut & Kamai-san Cut will be evaluated

- Track Finder for FPCCD
  - Kalman Filter in extrapolation of track was implemented → Performance evaluation is undergoing
  - Using dot of 2 clusters in extrapolation was implemented → Performance evaluation is undergoing