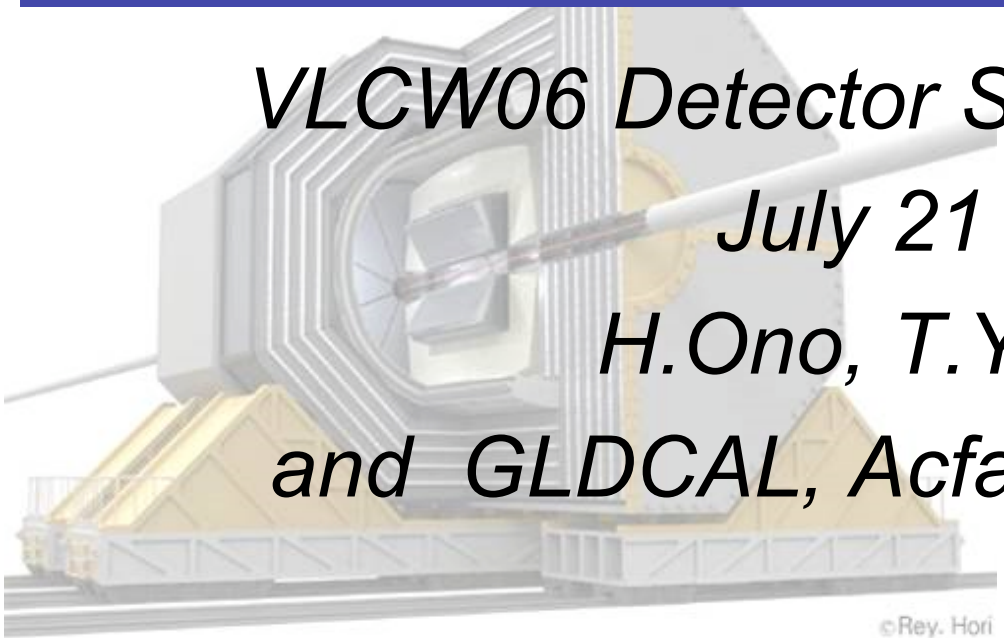
New Calorimeter Geometry in GLD Full Simulator and Performance Test



VLCW06 Detector Sim/Recon section

July 21 2006

H.Ono, T.Yoshioka

and GLDCAL, Acfa-Sim-J members

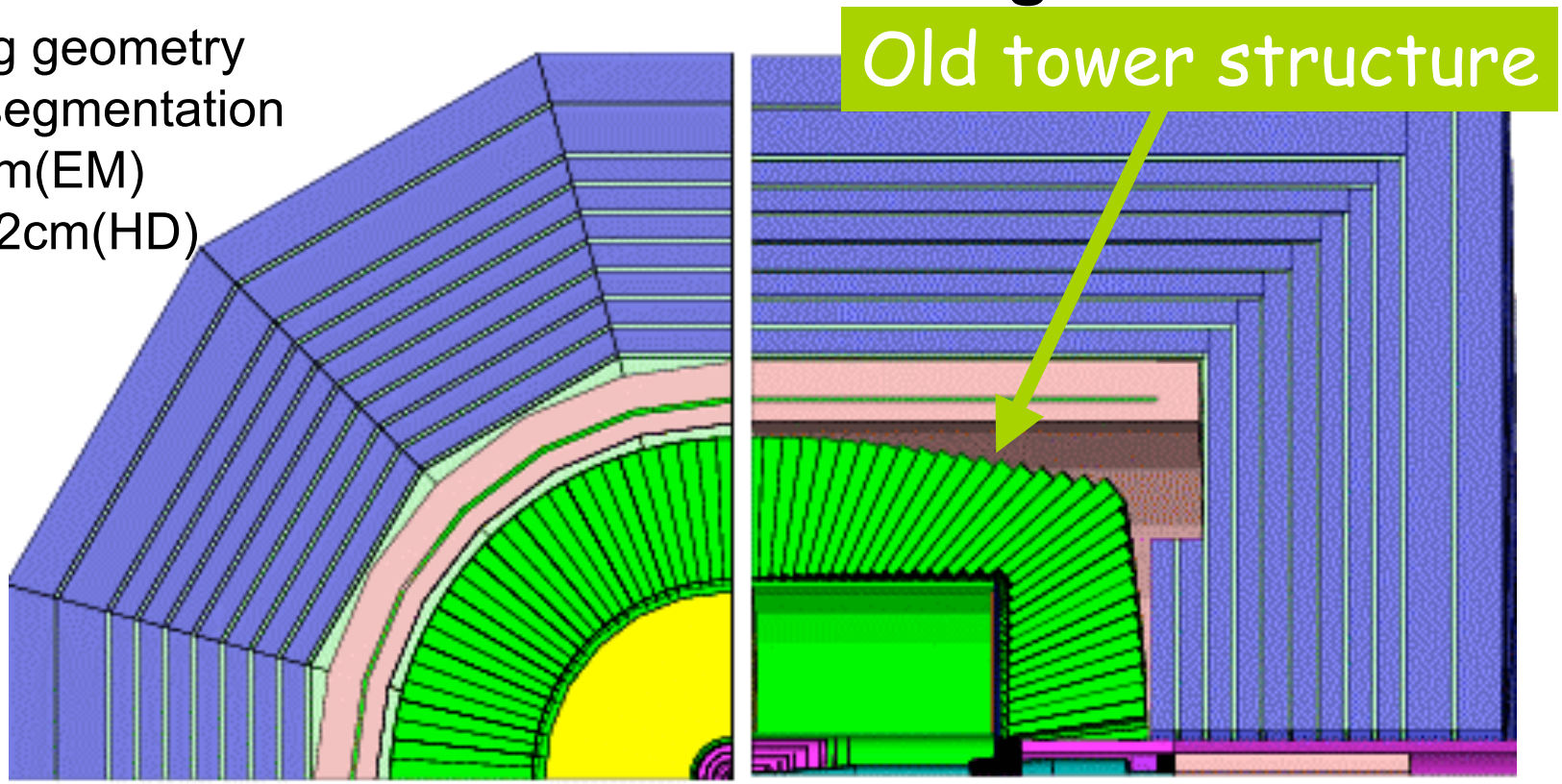
GLD Full Simulator Study

- GLD is one of the detector concepts for ILC experiment.
  - Scintillator based calorimeter with large radius.
  - 3T magnetic field with TPC tracker.
- Realistic PFA study was performed for previous tower structure calorimeter.
- This year, realistic calorimeter geometry has been implemented into GLD Full Simulator. Thus we start studying PFA by new geometry calorimeter.
- Realistic PFA method will be talked by next T.Yosioka-san. My talk is cheated PFA case.

Previous geometry in Full Simulator

- **Muon detector has installed as dodecagon.**
- **Calorimeter was old tower configuration.**

•Pointing geometry
•Large segmentation
4cmx4cm(EM)
12cmx12cm(HD)



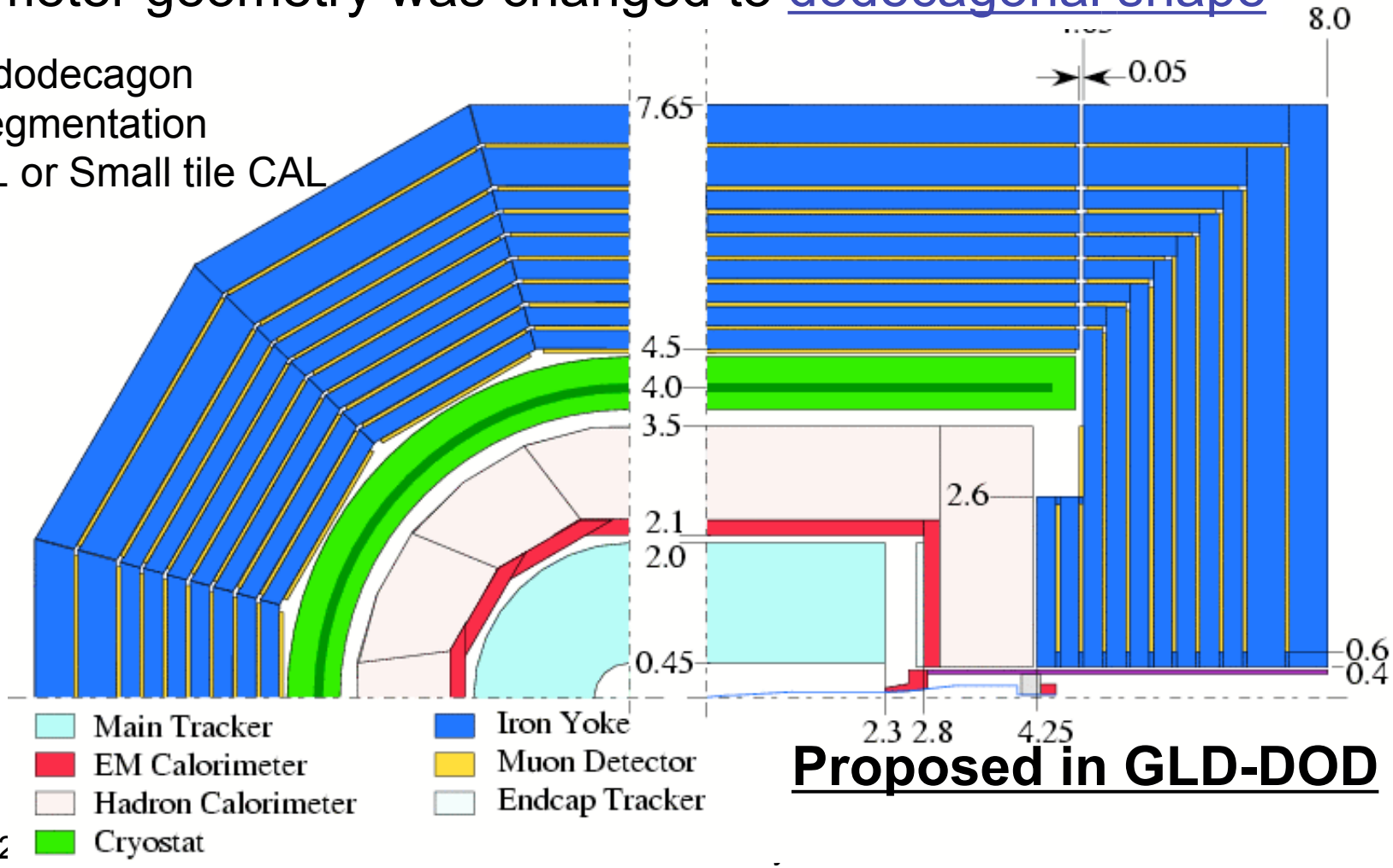
r-ϕ cut view **Z cut view**

Latest Design of GLD detector

Calorimeter geometry was changed to dodecagonal shape

- EM,HD dodecagon
- Small segmentation

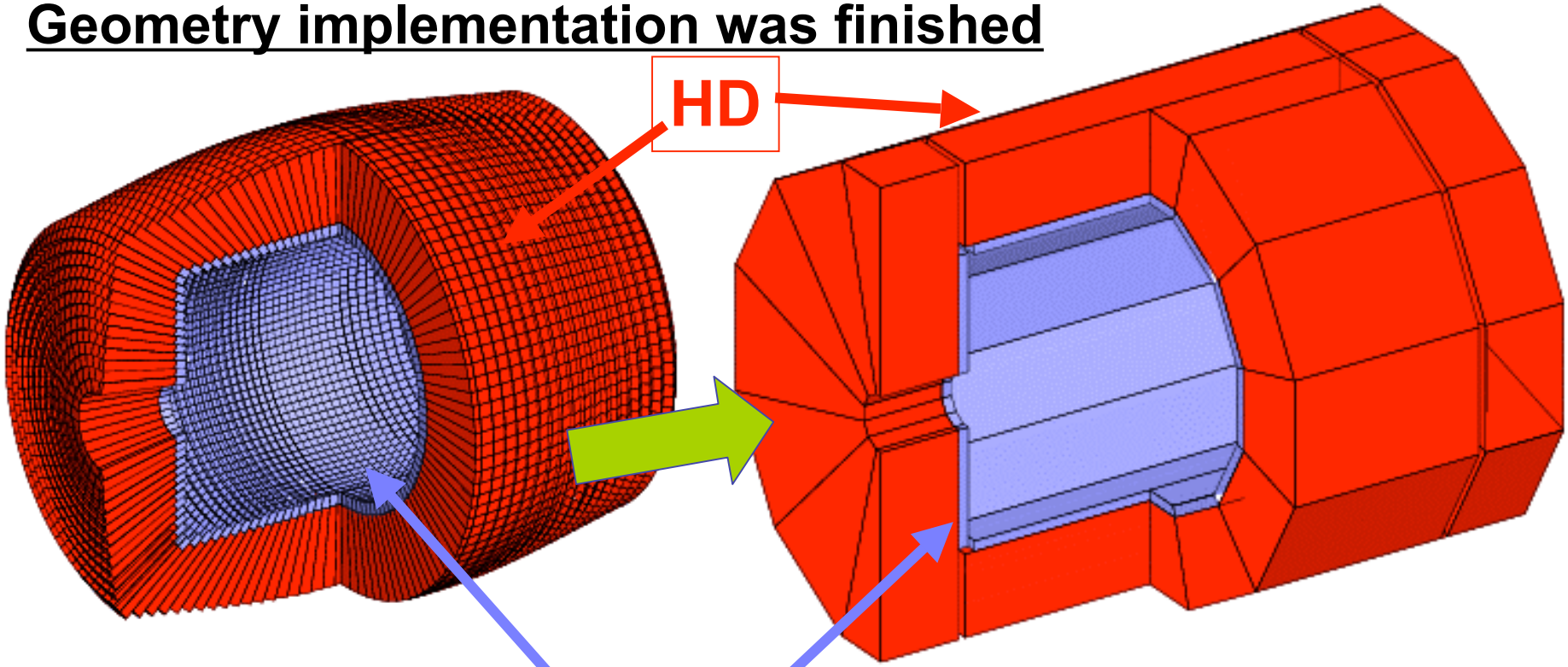
Strip CAL or Small tile CAL



Proposed in GLD-DOD

Calorimeter Geometry Update

Geometry implementation was finished



Tower structure

Dodecagonal structure
(12-gon)

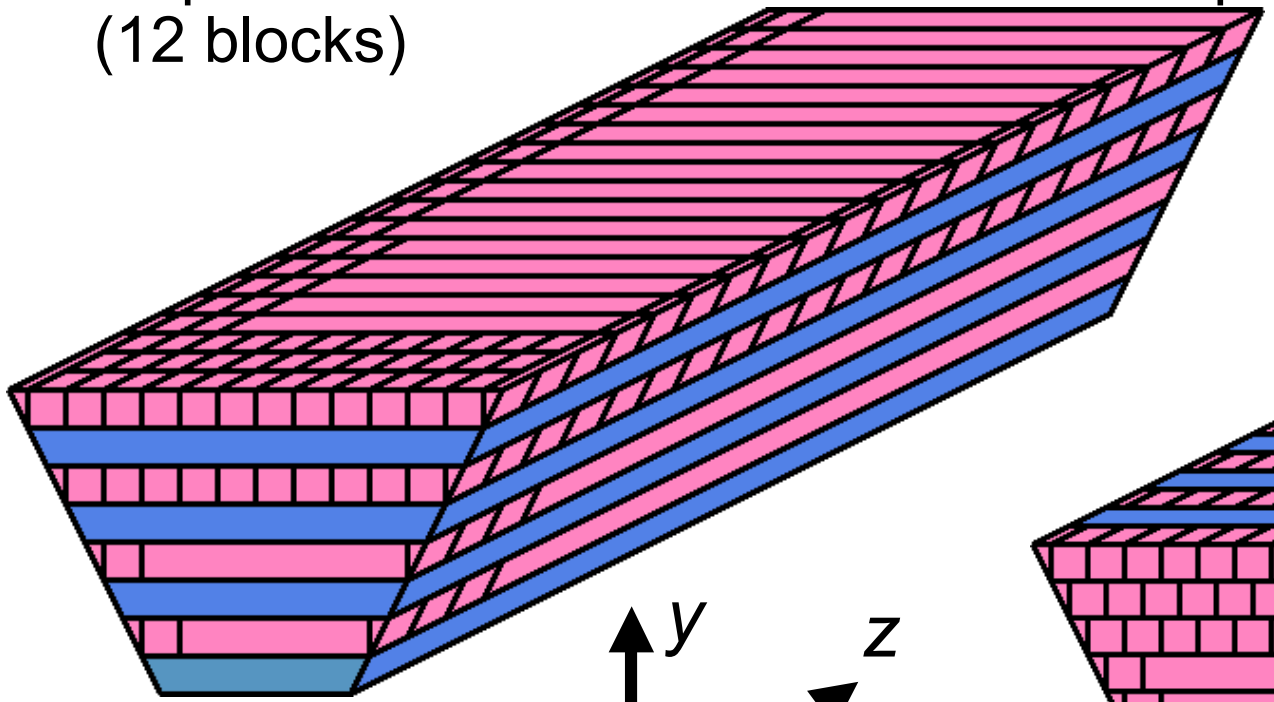
New calorimeter geometry

Trapezoid structure of barrel and Endcap
(12 blocks)

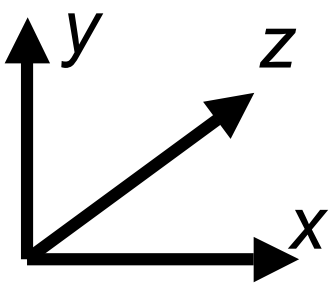
Active Layer

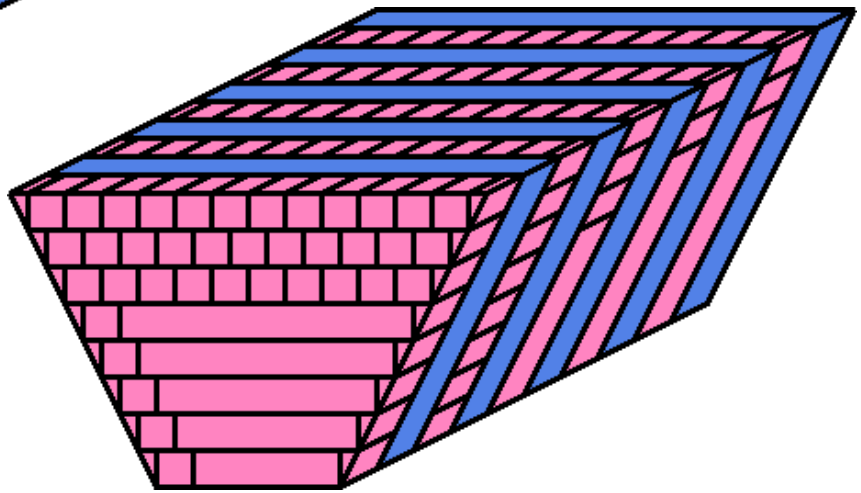
Absorber

(Readout layer)



Barrel



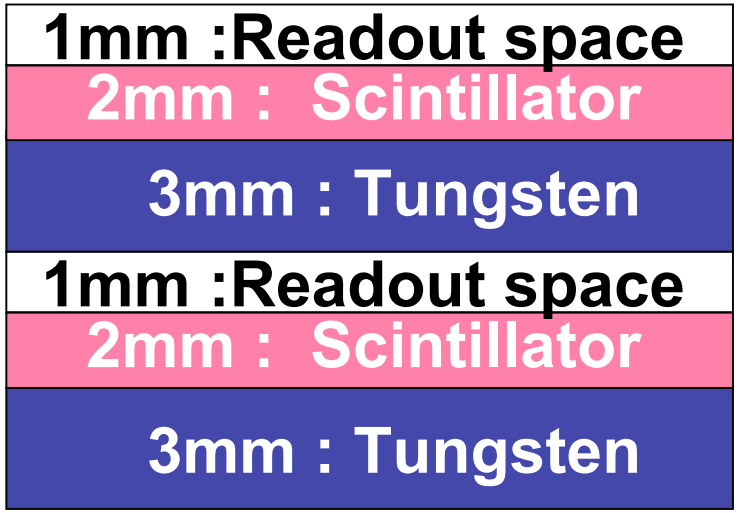


Endcap

Default cell size : 1x1, 2x2cm

Calorimeter Layer new configuration

Previous configuration : Lead + Scintillator
4cmx4cm(EM), 12cmx12cm(HD))



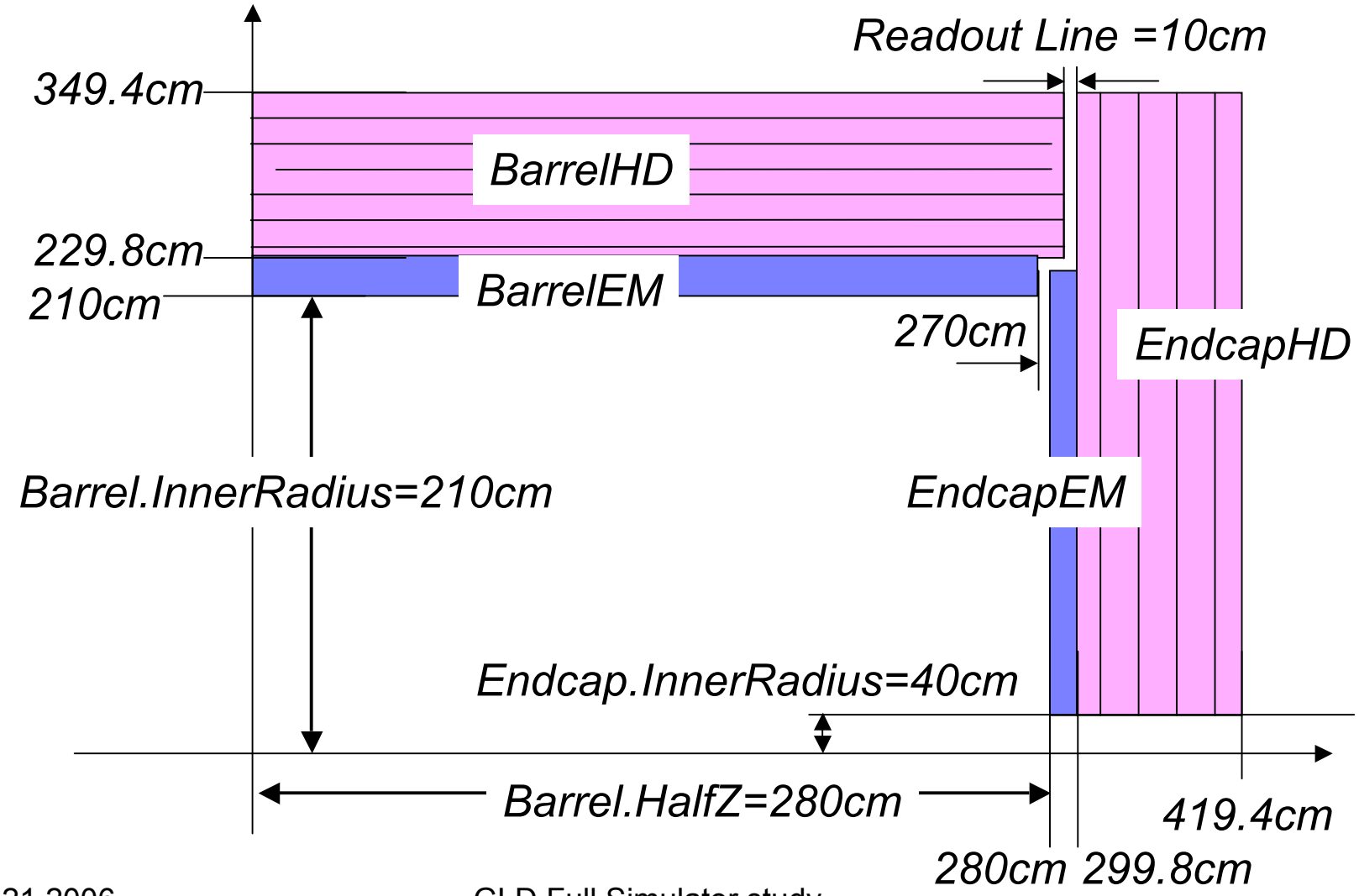
EM : 33 Layers ($26X_0$)

HD : 46 Layers ($6\lambda_0$)

EM/HD default segmentation
1cmx1cm, 2cmx2cm

1cmx1cm : Effective size of Strip CAL
2cmx2cm : Backup plan of Tile CAL

Detail of Calorimeter Dimensions

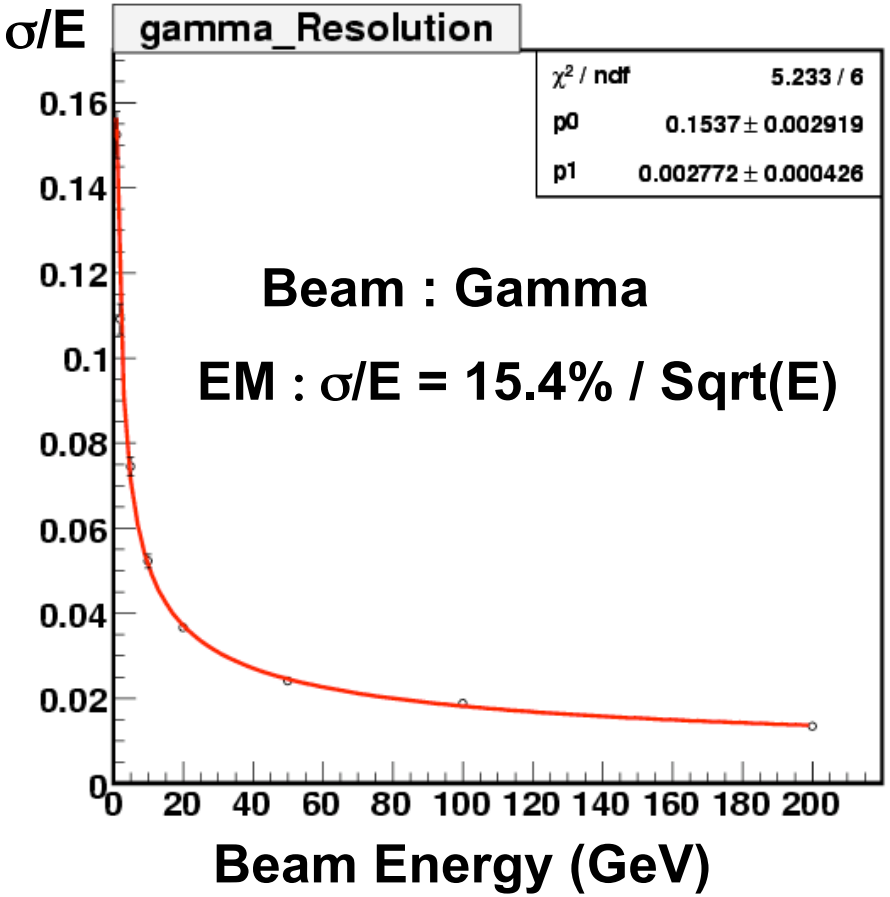


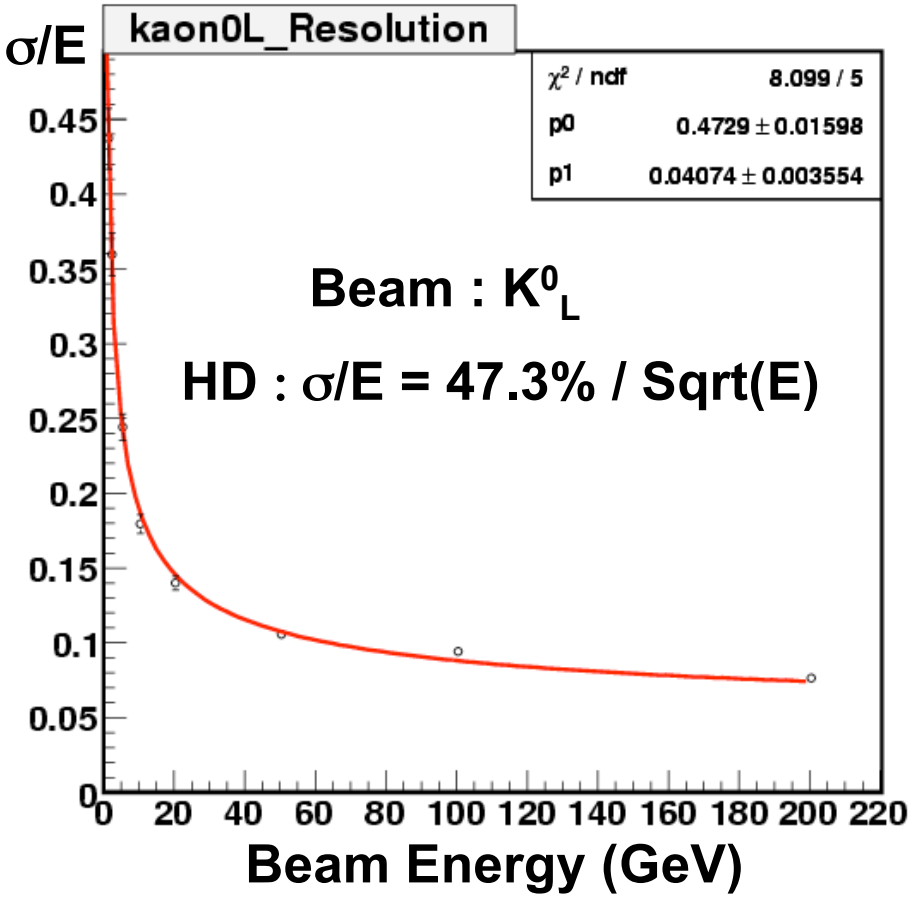
Basic Performance Test

Following version of software was used,

Geant 4.8.0.p01
Root v5.10.00

Energy Resolution

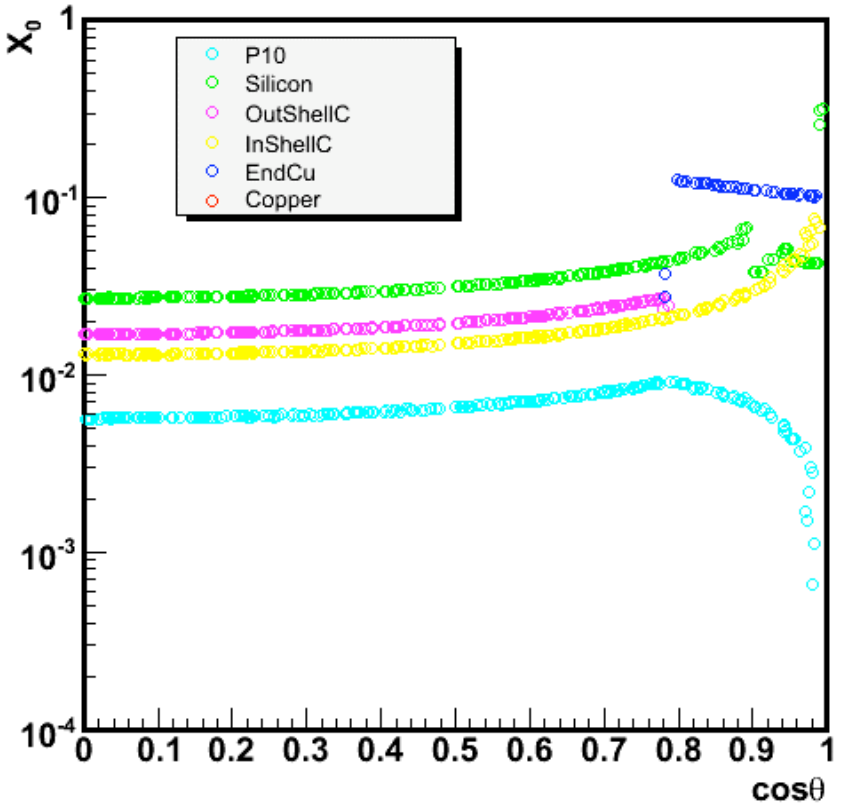




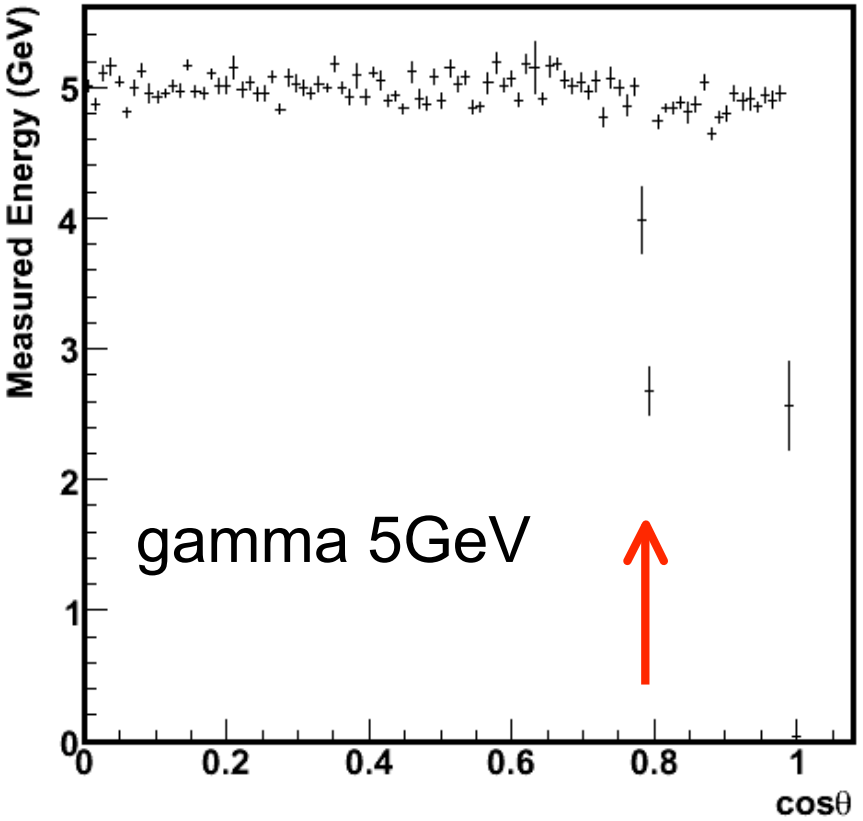
EM:14.0%/Sqrt(E) and HD:41.2%/Sqrt(E) by old tower configuration.

Theta dependence

CAL inner Material vs cosθ



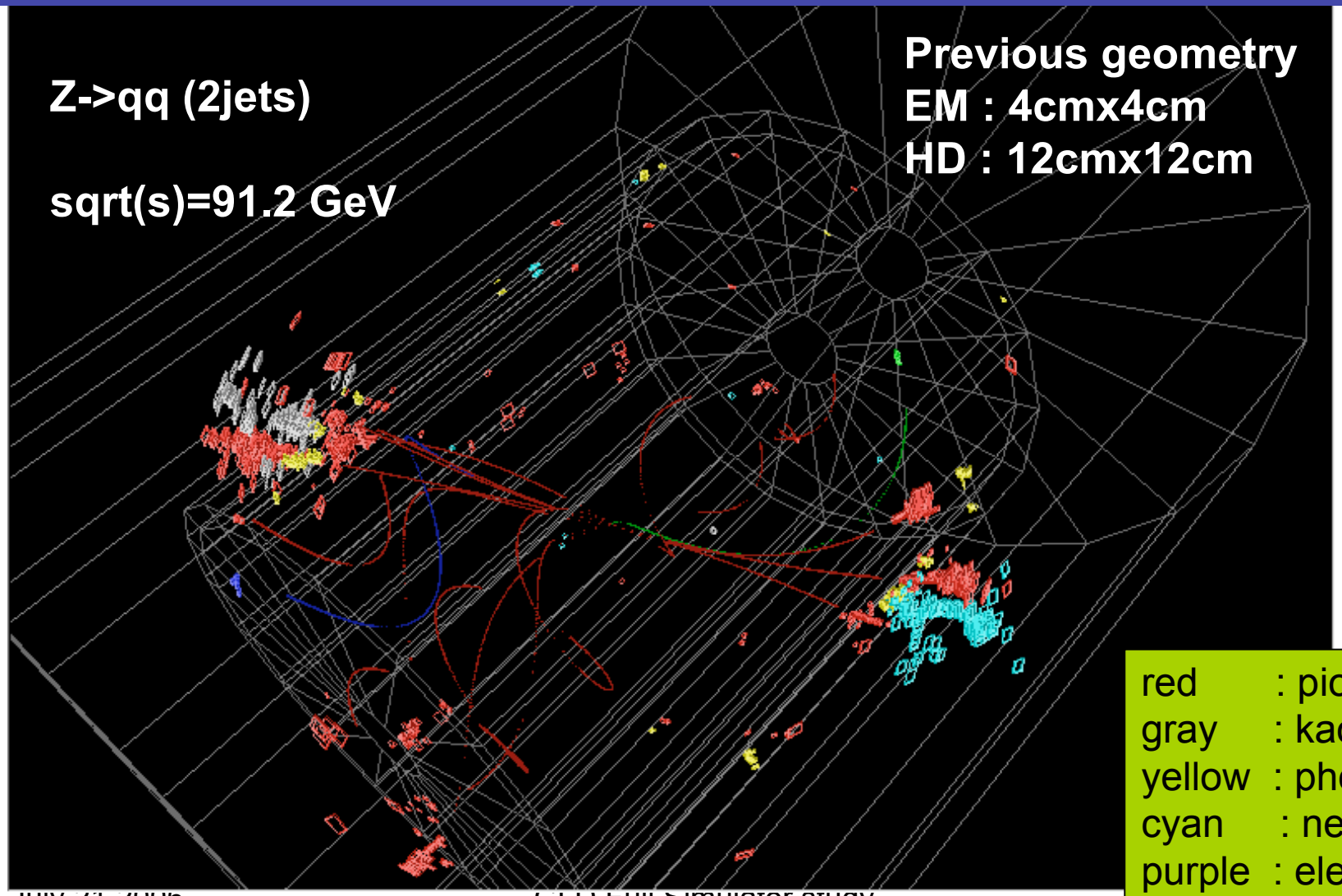
Energy vs cosθ



There is a gap between barrel and endcap for cabling space (10cm)

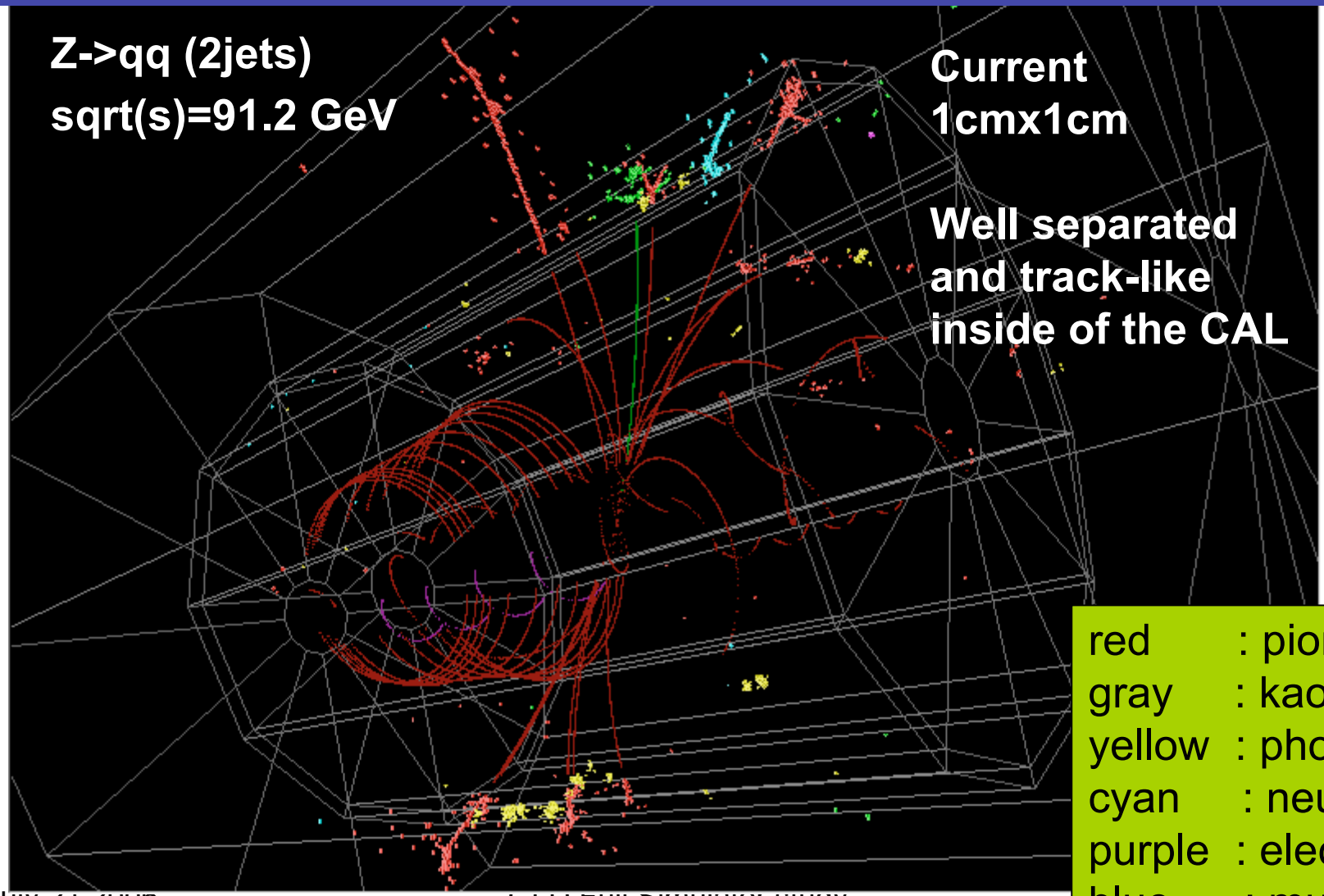
Cheated PFA basic study

Previous Geometry Event Display

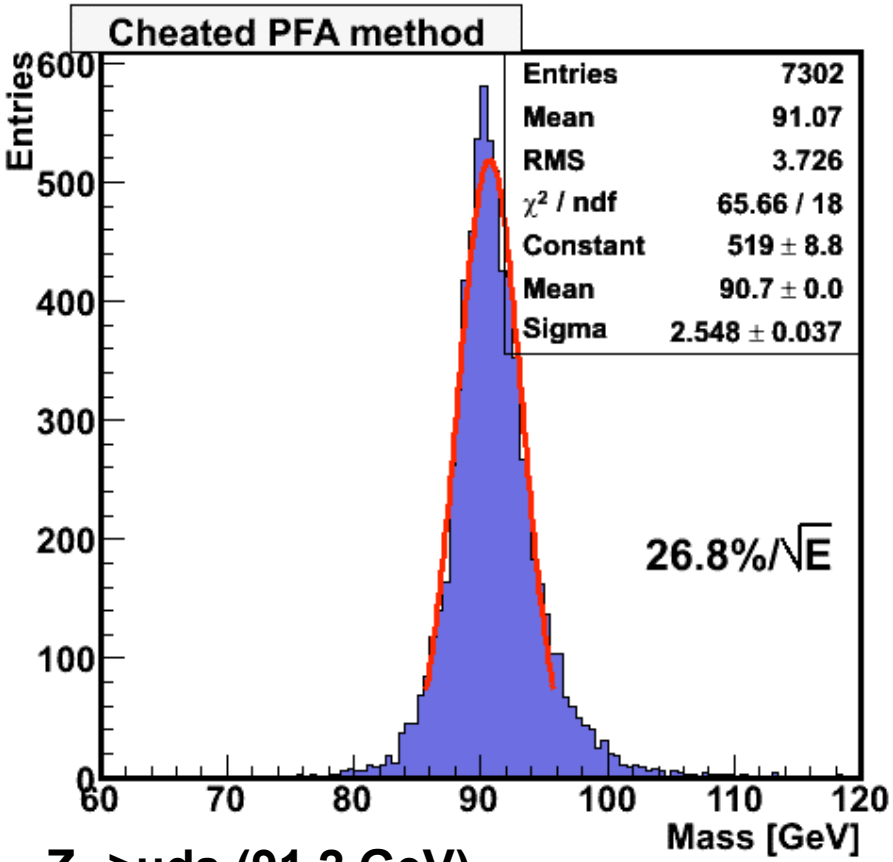


red : pion
gray : kaon0L
yellow : photon
cyan : neutron
purple : electron
blue : muon

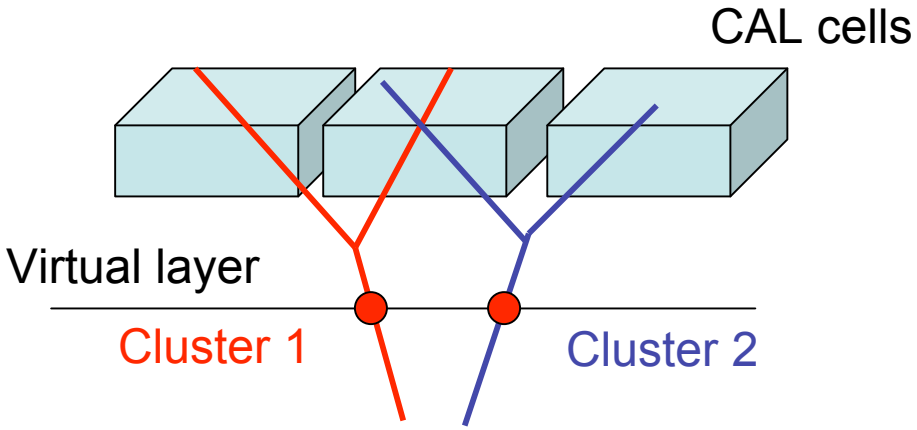
Current geometry Event Display



Z-pole event study by cheating method (Perfect clustering)



Z-->uds (91.2 GeV)
1cmx1cm segmentation (barrel only)



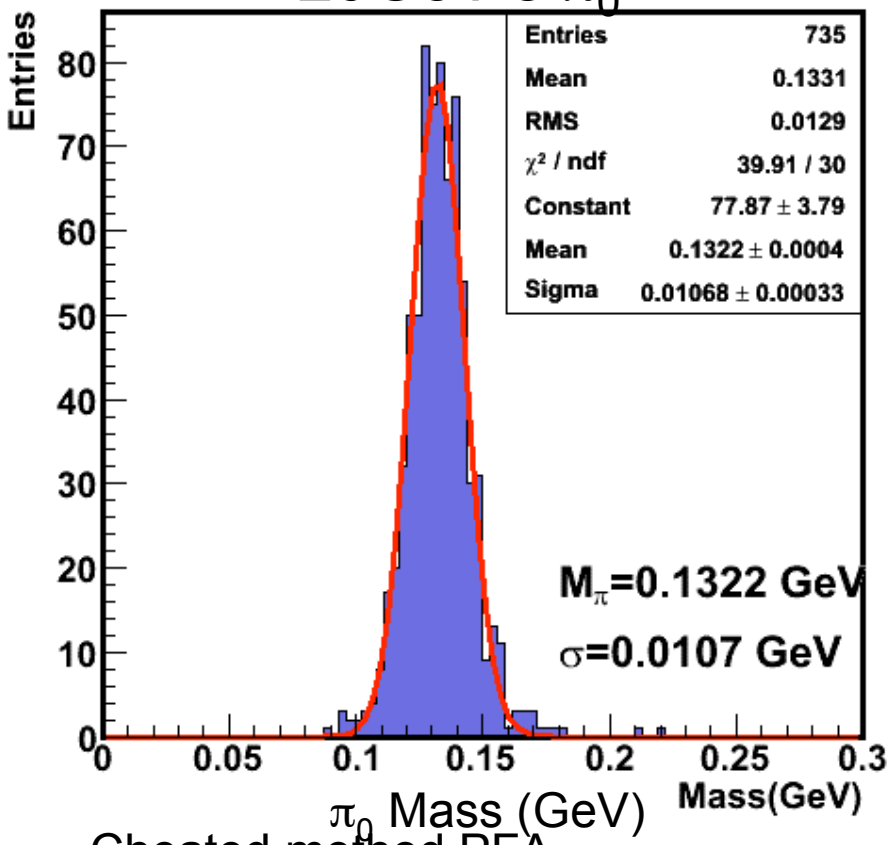
Different mother particle's CAL hits have been clustered as different cluster (perfect clustering)

We can select merging or not merging hits inside of one cell.
Merge case : same cell's hits from different mother particle will be merged as one hit.

(25.9%/Sqrt(E) for tower configuration with Infinite segmentation case)

π_0 reconstruction test by cheating method (Perfect clustering)

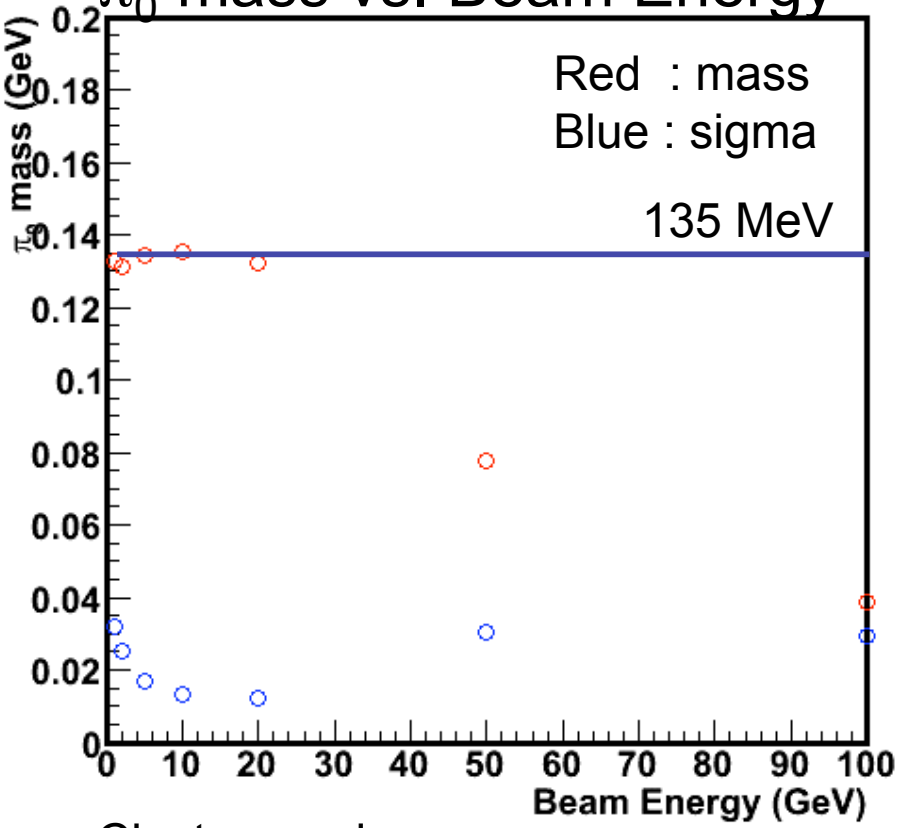
20GeV's π_0



π_0 Mass (GeV)

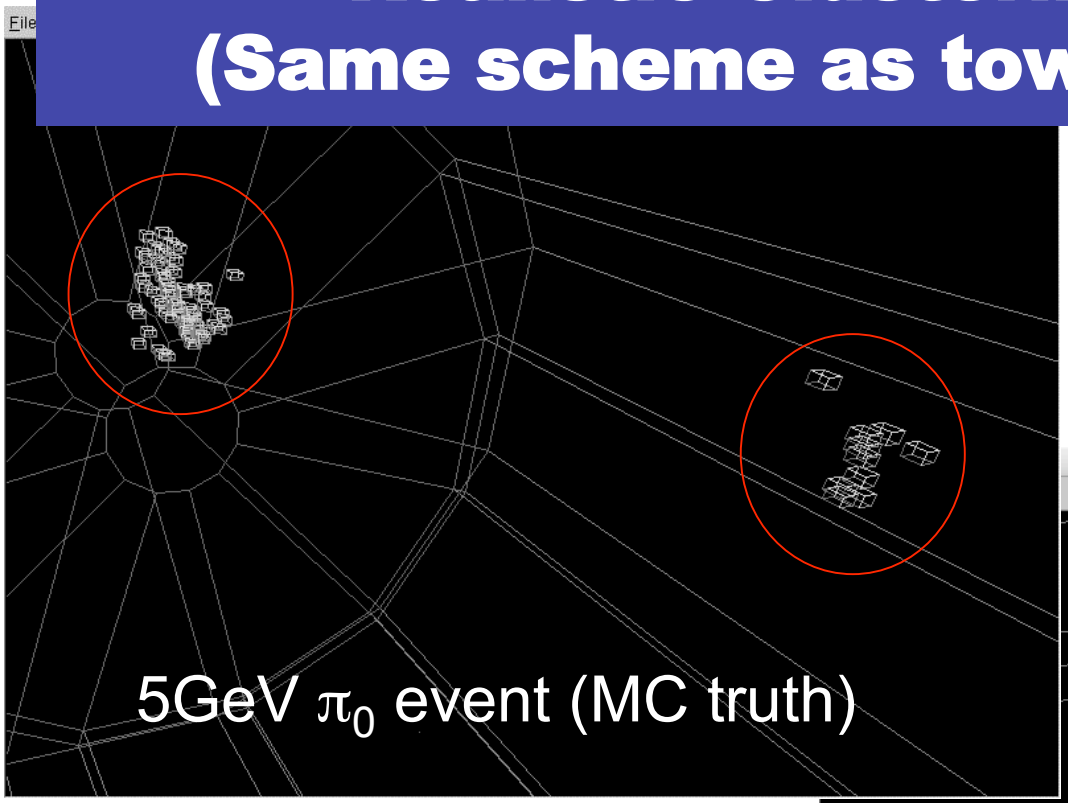
Cheated method PFA
with actual(1cmx1cm) segmentation

π_0 mass vs. Beam Energy

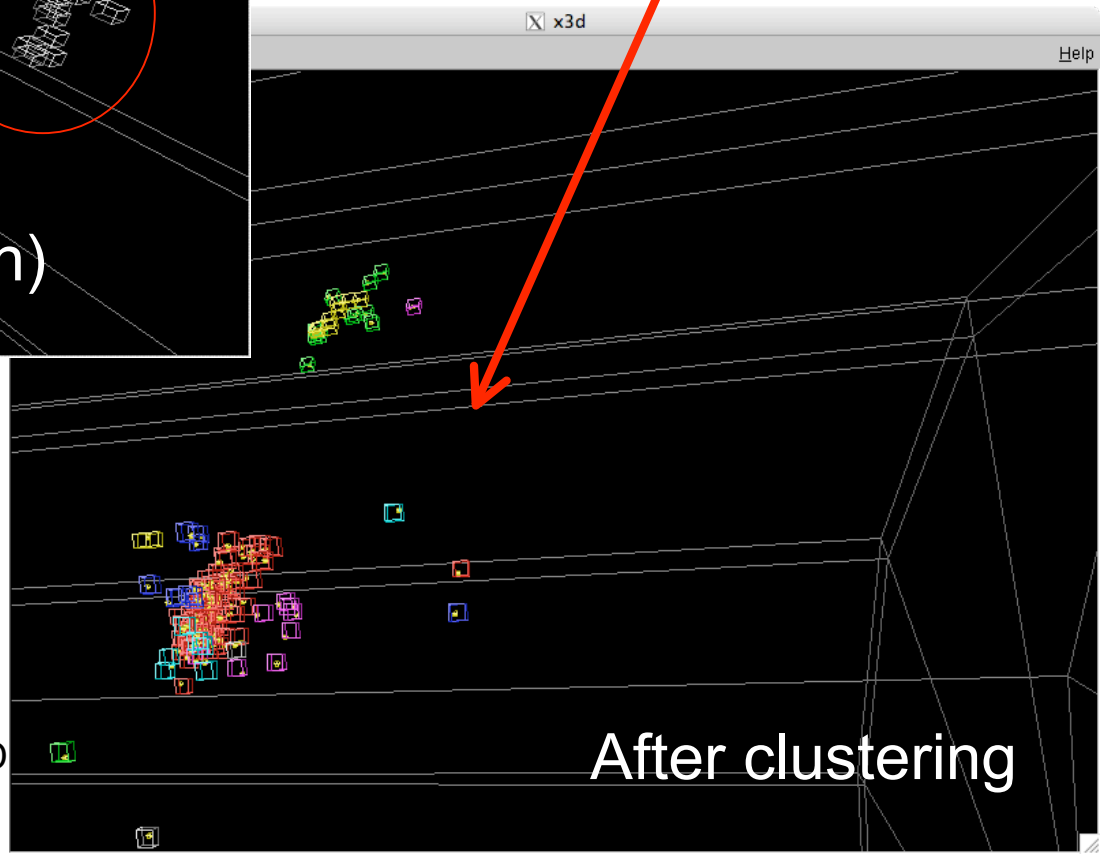


Cluster overlap
and multi hits at one cell over 20GeV

Realistic Clustering, PFA test (Same scheme as tower calorimeter)



Different clusters are displayed in different colors



Parameters should be optimized for new calorimeter. Detail of realistic clustering method will be talked by next speaker.

Summary and plans

- New calorimeter geometry has been implemented into GLD full simulator
- Basic performance was checked by single particle and Z-pole, π_0 reconstruction with cheated PFA.
- Realistic PFA parameter for new geometry calorimeter should be optimized.
  - For smaller segmentation CAL.

Parameter optimization for realistic PFA,
next T. Yoshioka-san's talk.

Remaining Tasks

- Responses merging method in cells need to be implemented for strip structure study (in analysis part).
- Develop strip clustering method and implemented it into current realistic clustering scheme.