ECal Reconstruction and Photon Results with GEANT4

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  (by Dr.Iwasaki)
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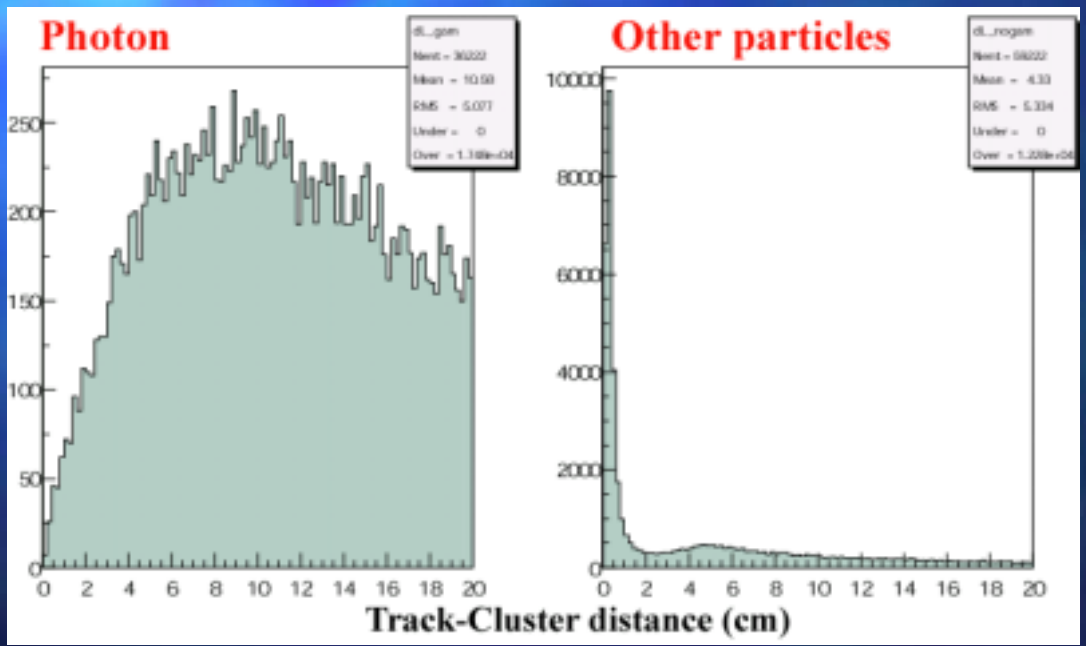
Introduction

- Requirements from future linear collider
  →very good jet energy resolution
  →needs energy flow method
  typical multi-jet event
  chrg. part. carry 64% E→ tracker
  photon carry 25% E→EM cal.
  neut. Had. carry 11% E→HAD cal.
- Calorimeter must be optimized for energy flow.→ need full simulation study (GEANT4)

Photon reconstruction (by Dr.Iwasaki)

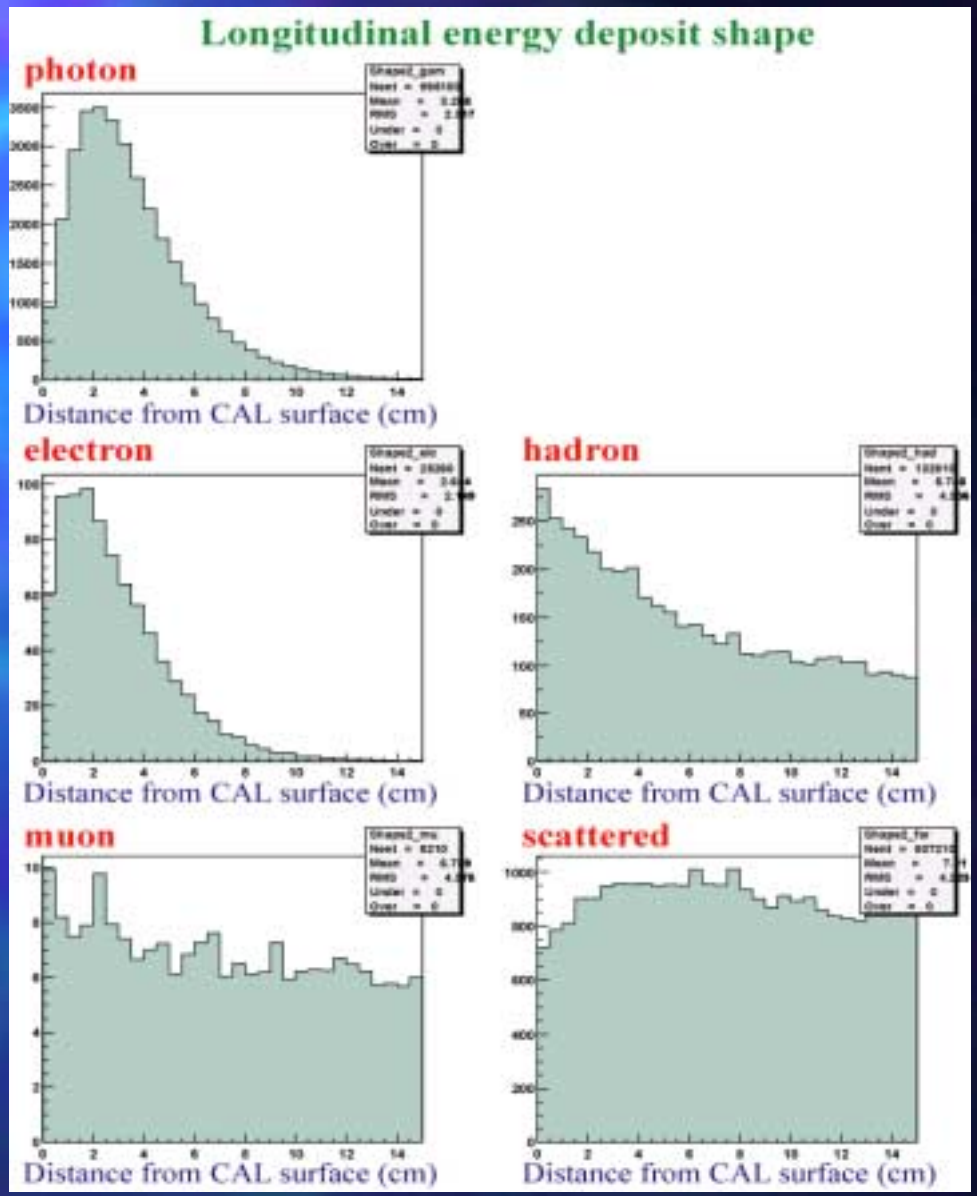
γ selection by transverse information

- Extrapolate charged tracks to the cluster radius.
- Associate the nearest track to the cluster.



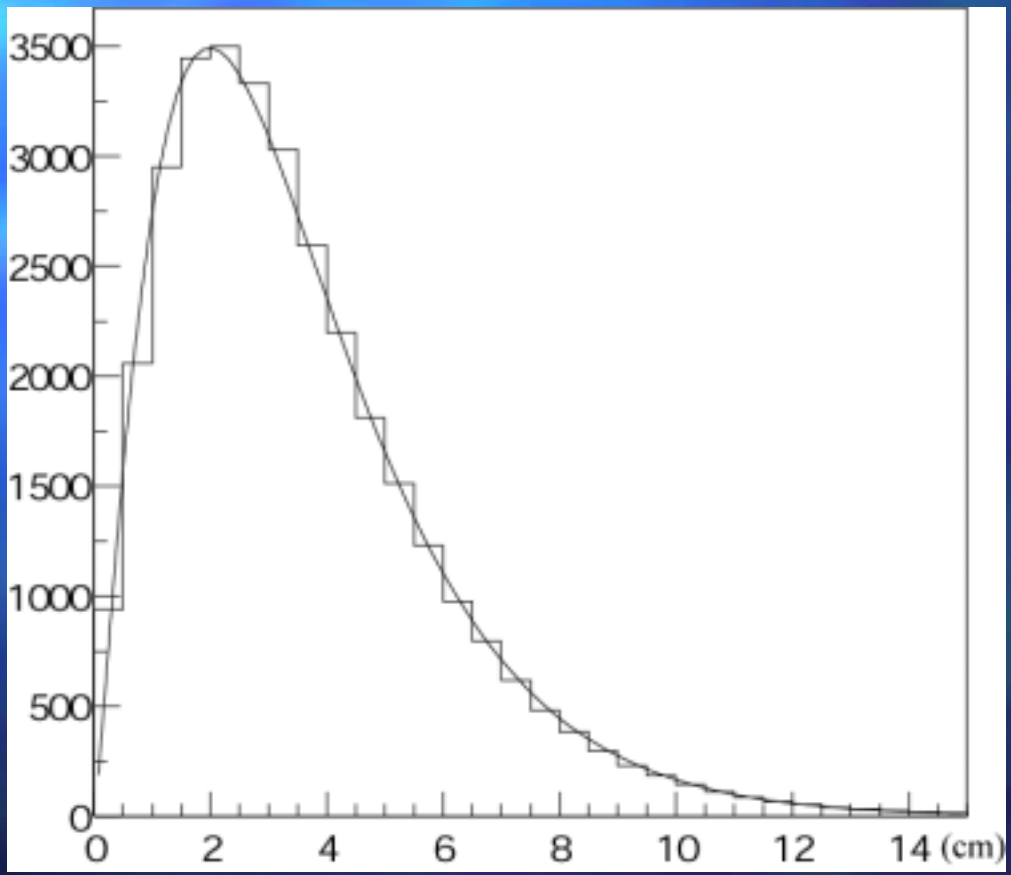
γ selection:
Π=48%
ε=98%

γ selection by longitudinal information



γ selection by longitudinal information (cont.)

We determine the longitudinal γ shape by fitting.

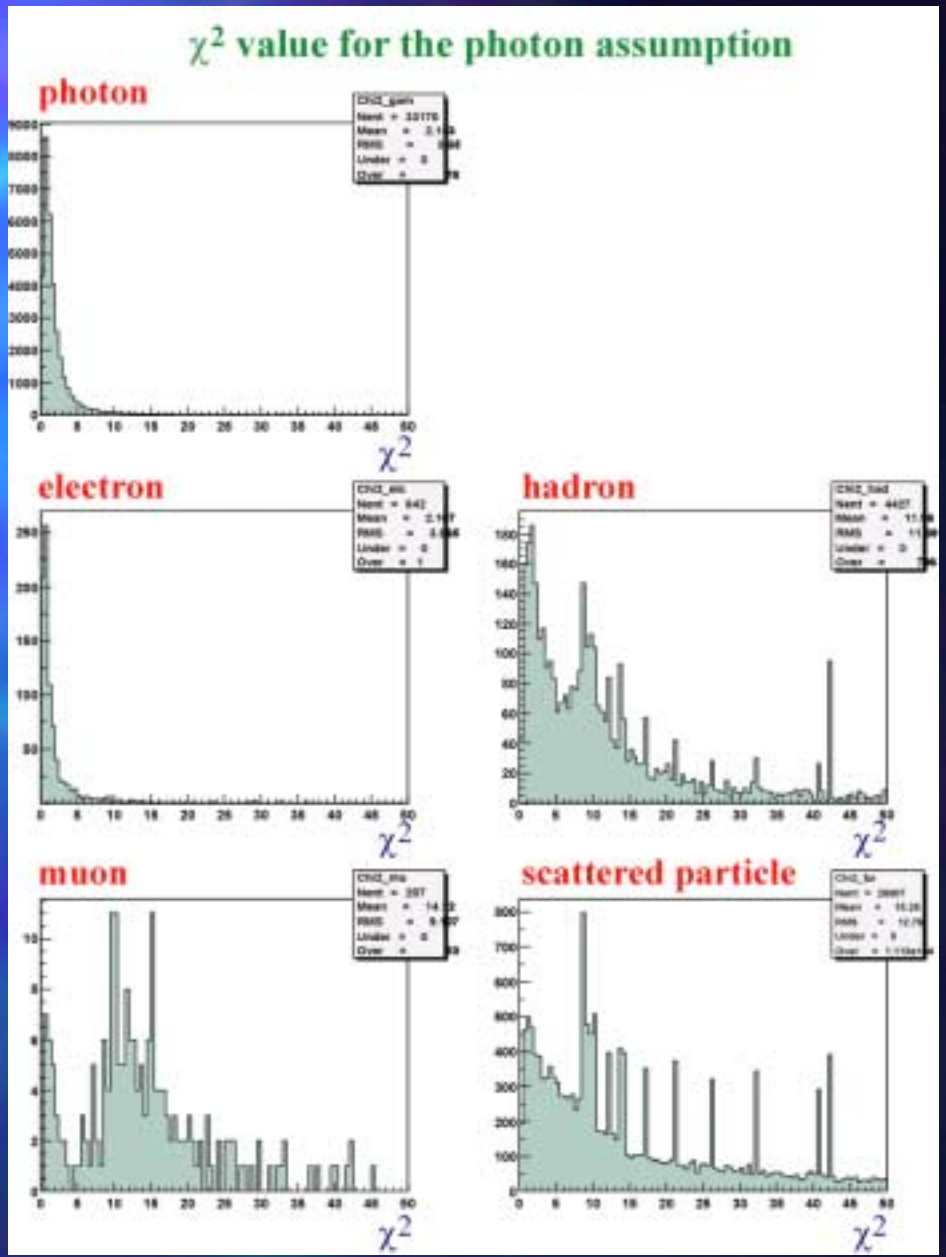


χ^2 for the γ assumption

- Overall γ selection performance with other selection:

  Π=85%

  ε=85%



Mass reconstruction (no kin. con.)

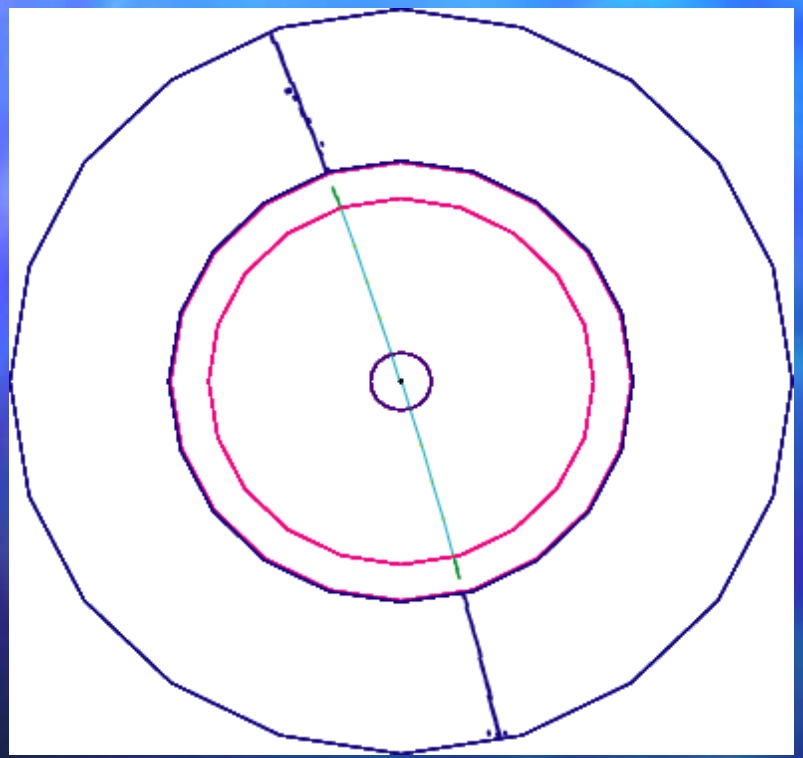
GEANT4	W mass	error	Top mass	error
Track + γ	67.1±15.9 GeV	(28%)	141.0±33.5	(24%)
Track + γ (true)	70.2±16.9	(24%)	147.0±31.7	(22%)
Track + γ (true) + h^0(true)	77.2±15.1	(20%)	159.7±30.7	(19%)

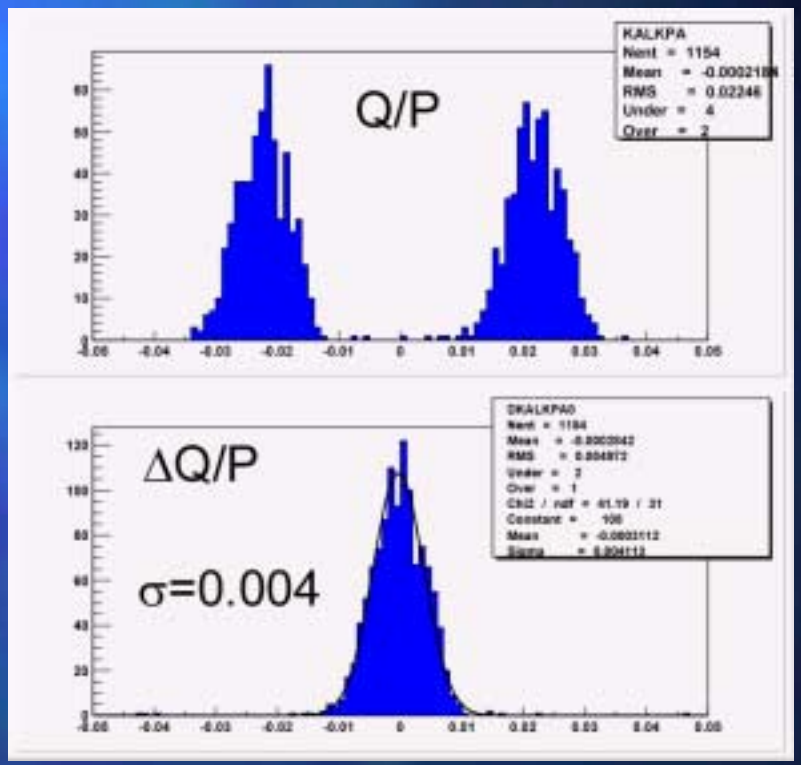
- True-γ/selected-γ difference ... 2~4%
  →very good γ selection performance
- Adding the neutral hadron clusters
  →can improve mass resolution 3~4%

Calorimeter tracking

- Fine granularity of SD calorimeter ($5X5mm^2$) makes enable tracking.
- Calorimeter may help track finding with tracking device and can significantly contribute to physics analysis (GMSB,…)
- We have checked the tracking performance using $Z \rightarrow \mu\mu$ and single photon events.

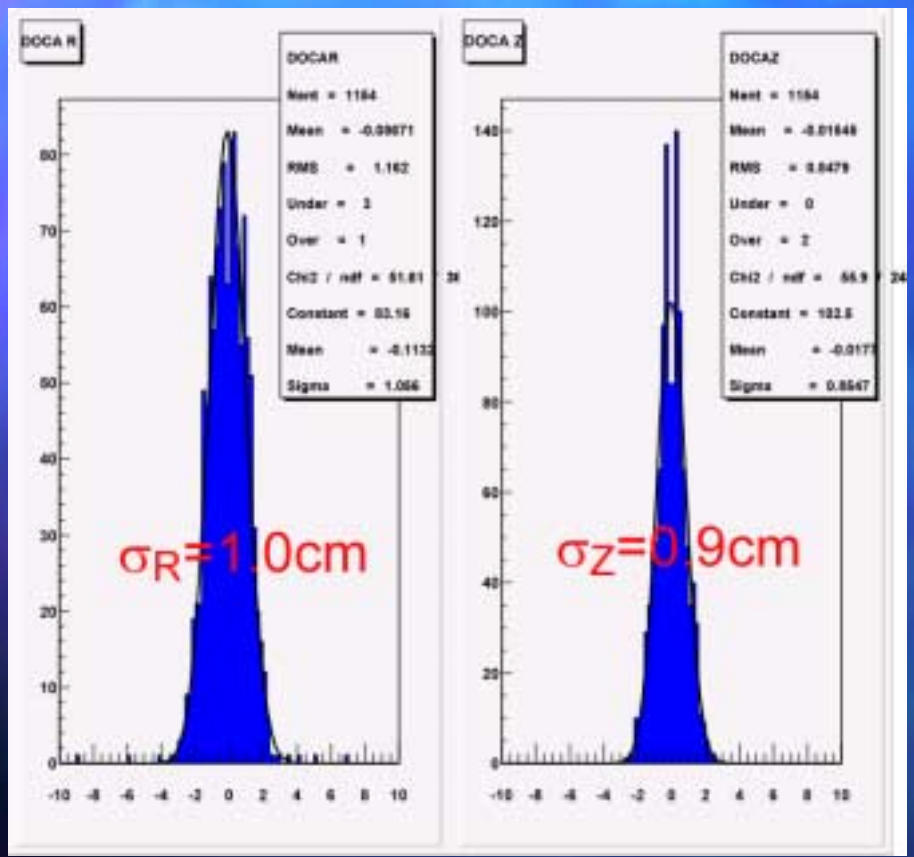
Charge separation





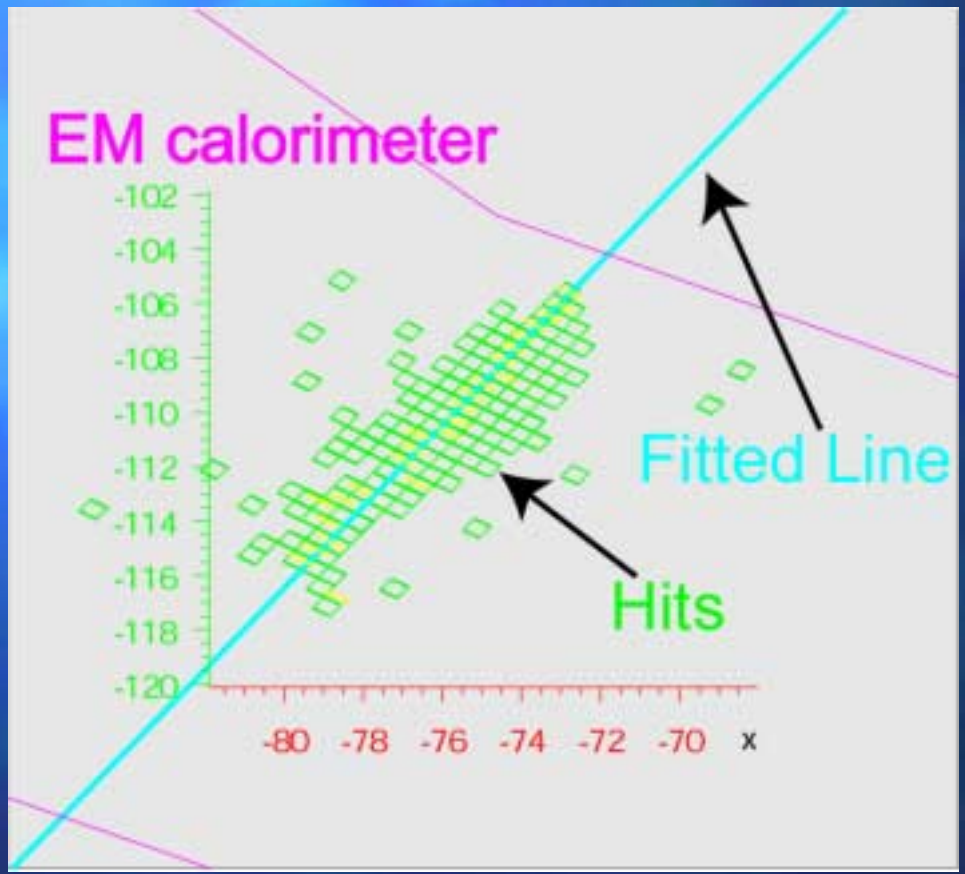
- Sample is Z→μμ @ Ecm=91.26GeV

Impact parameter resolution

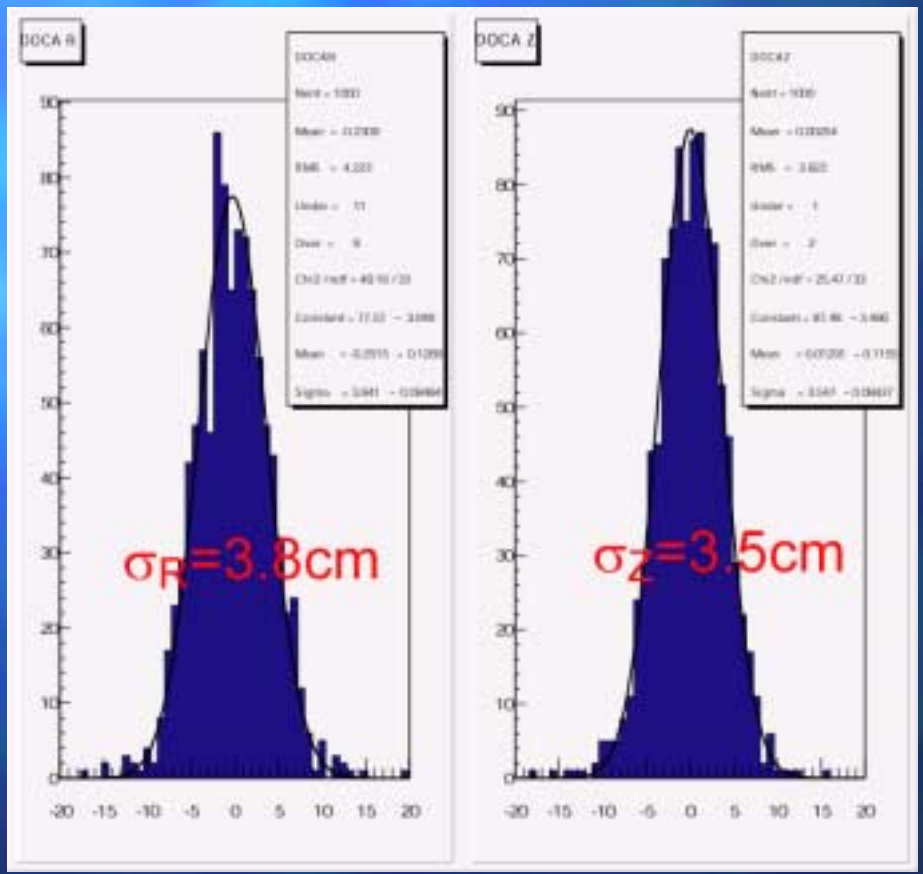


- Impact parameter and momentum resolution must improve when the tracks link to hits in outer layer of tracking device.

Line fitting of photon clusters



DOCA resolution



10GeV gamma from I.P.

A new calorimeter geometry

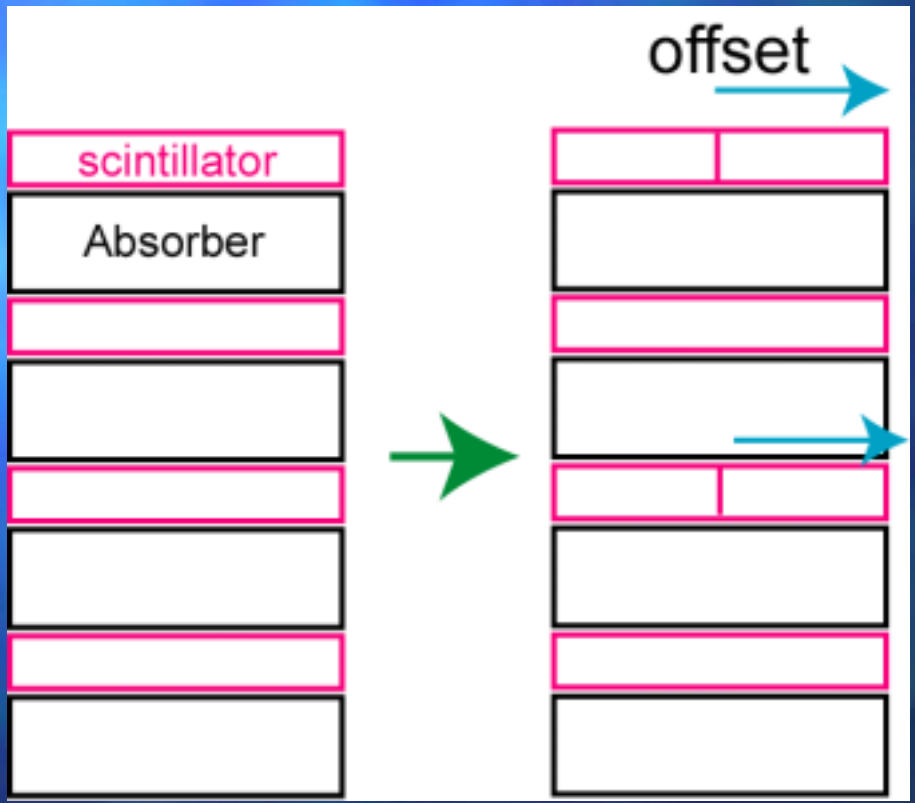
Toshinori Abe, Uriel Nauenberg, and Joseph Proulx

- A very fine granular calorimeter shows excellent performance.

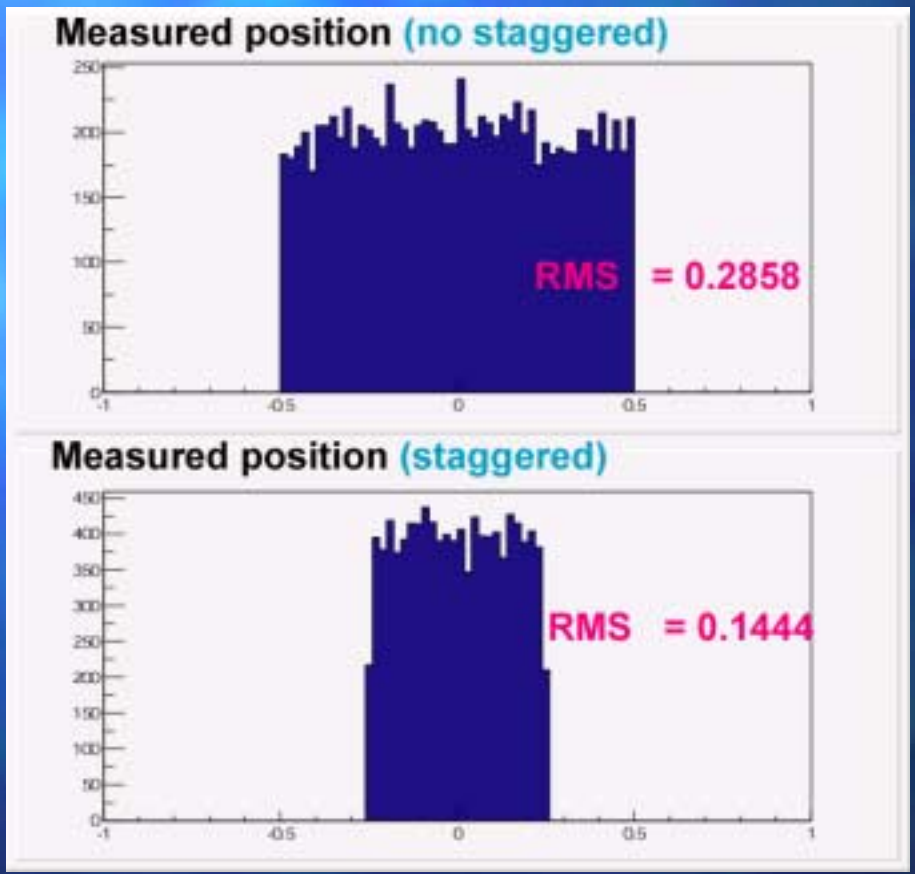
  → But it is very expensive!

- U. of Colorado proposes a new calorimeter geometry to give energy flow calorimeter with reasonable cost.

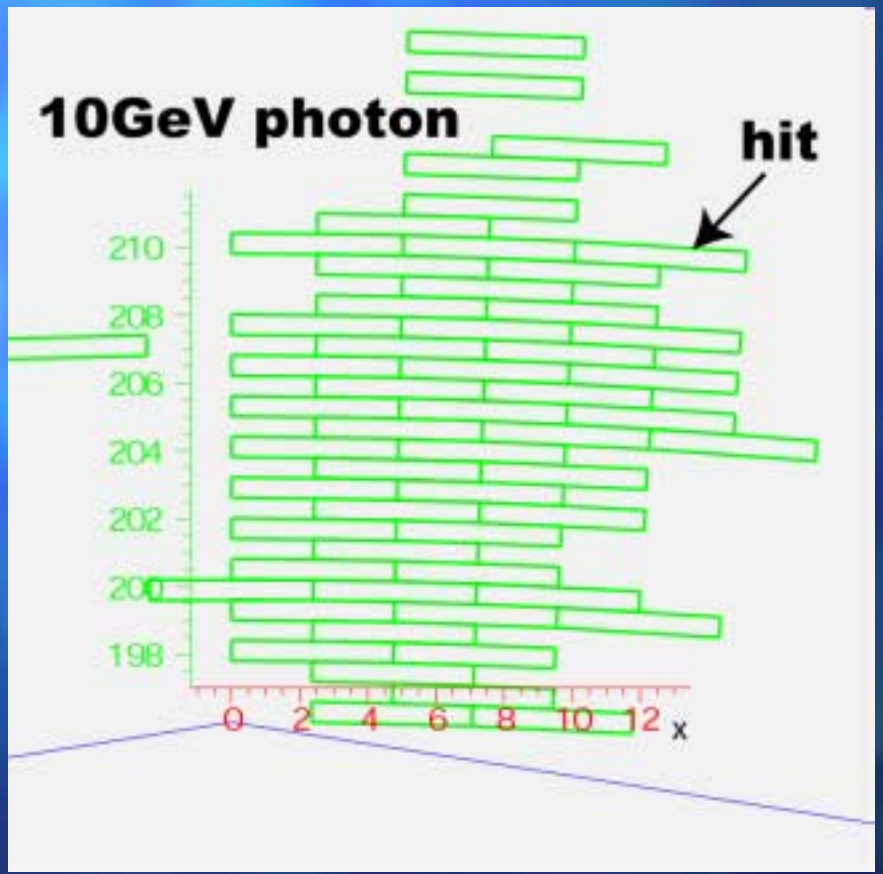
Staggered geometry



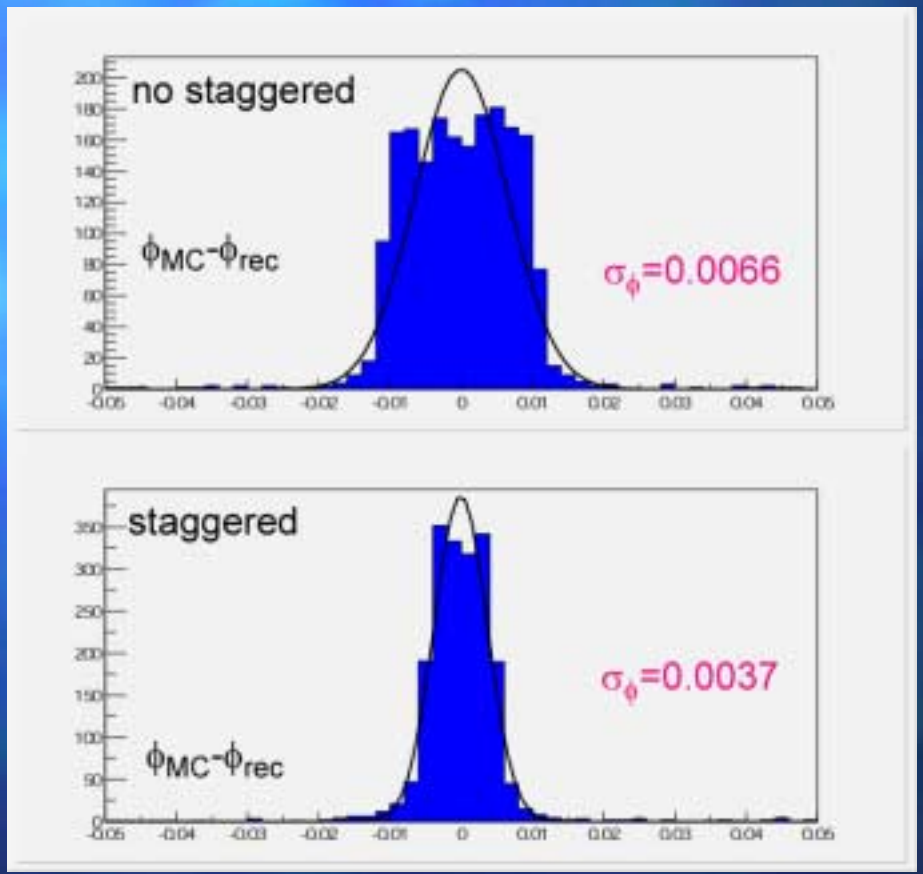
Benefit of this geometry



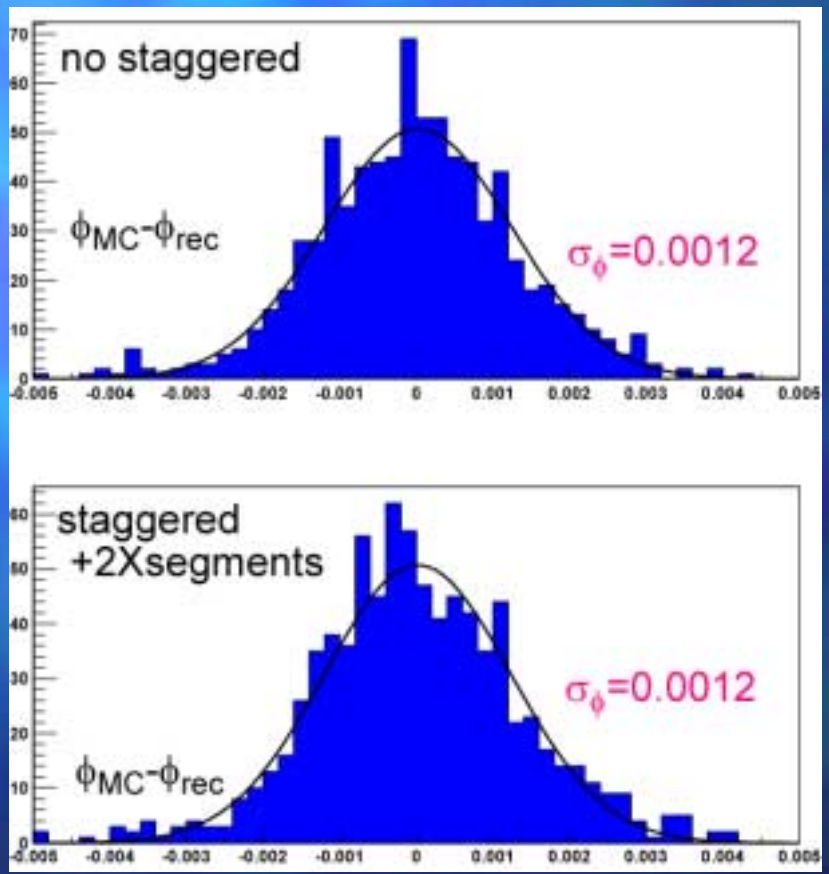
GEANT4 setup



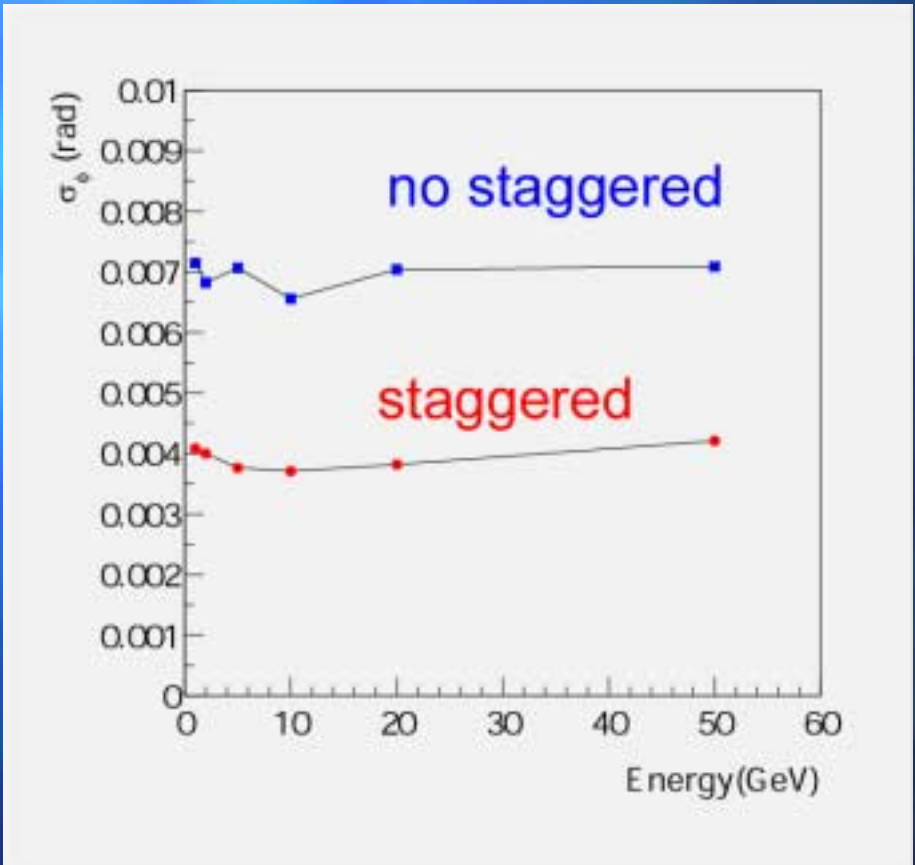
Position resolution (LD base)



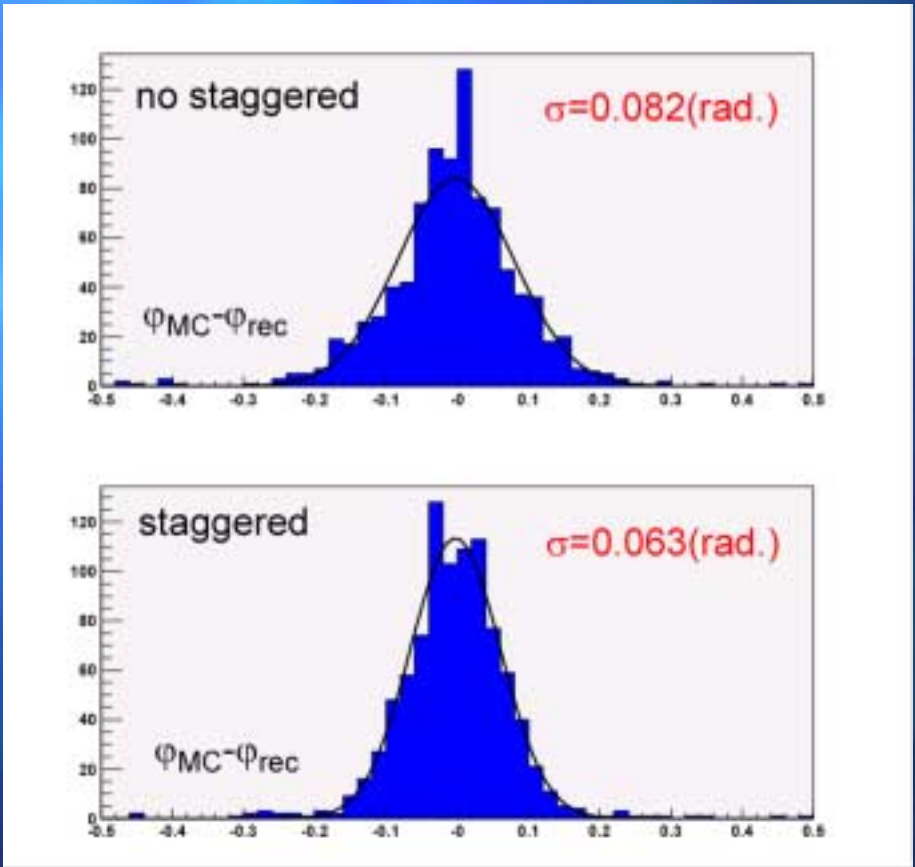
Position resolution (SD base)



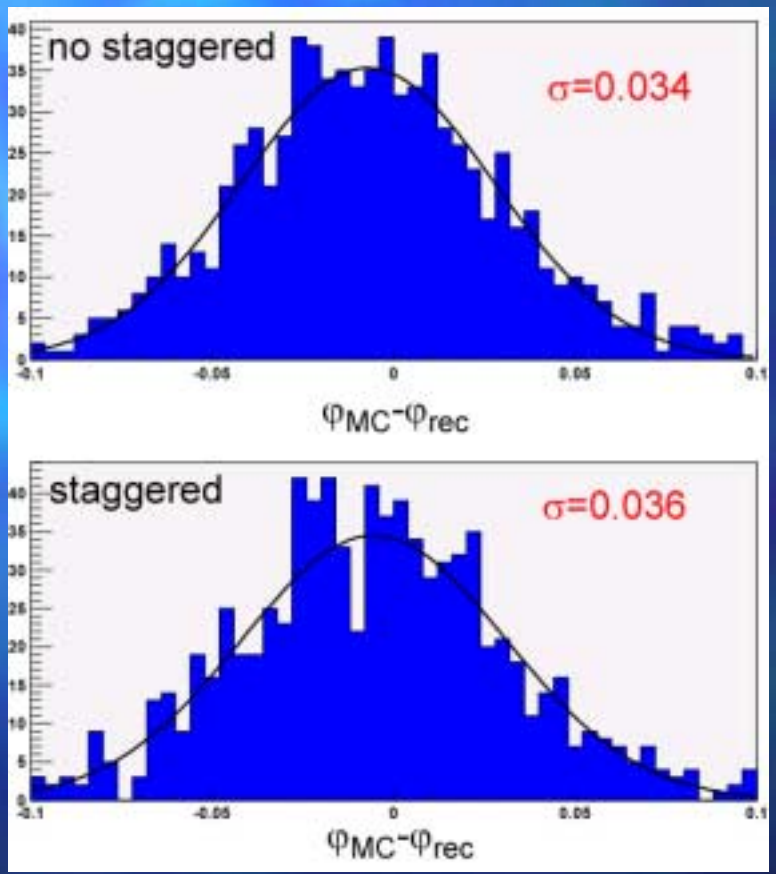
Energy vs. position resolution



Direction resolution (LD base)



Direction resolution (SD base)



Summary

- Current SD detector design gives very good photon reconstruction.
- Calorimeter tracking is promising for SD.
- U. of Colorado starts study of a new calorimeter design.

  → full simulation and hardware study