

First LCD Geant4 results

Toshinori Abe & Masako Iwasaki

1/8/2002

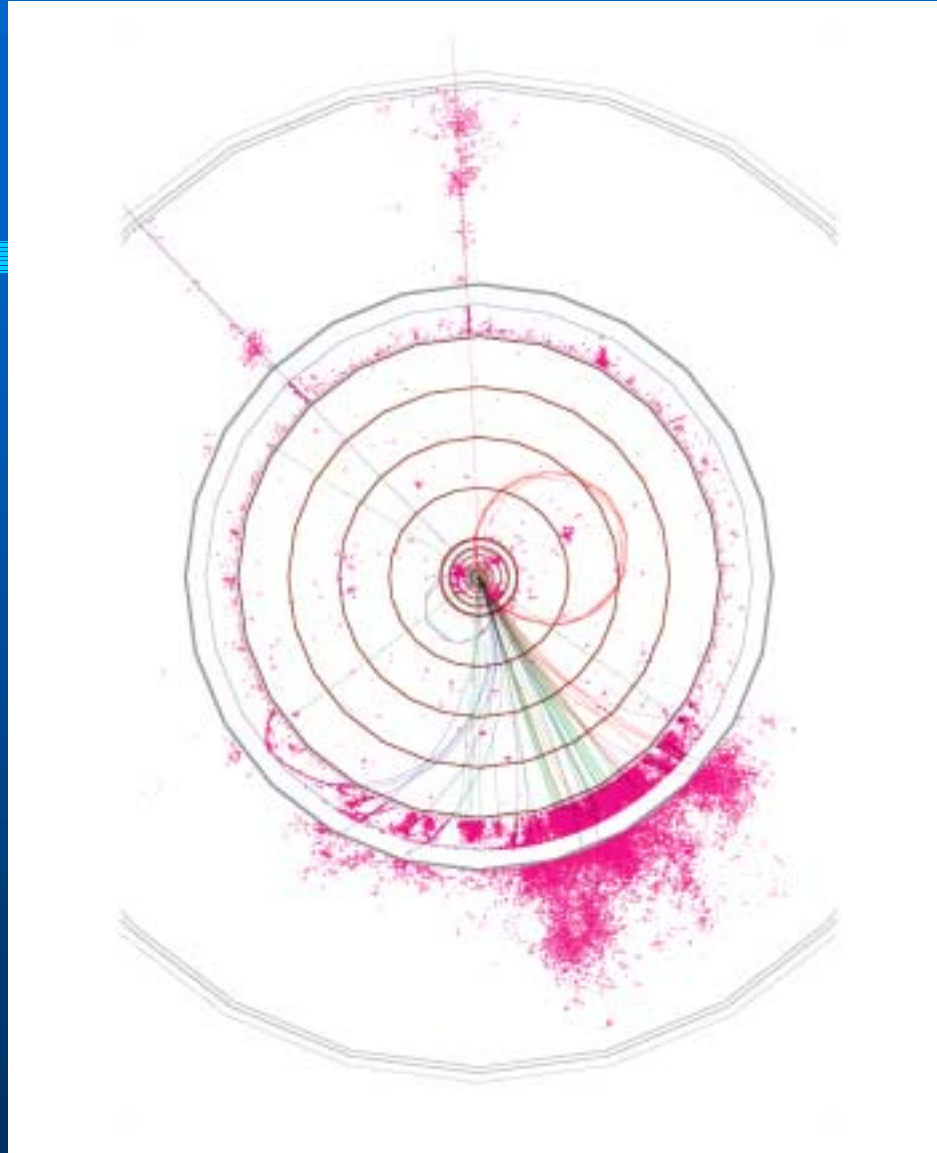
Contents of this talk

- **Specification of the full simulation**
- **Test results**
 - MIP energy distribution**
 - Energy linearity and resolution**
 - Momentum and Impact parameter resolution**
- **Summary and future**

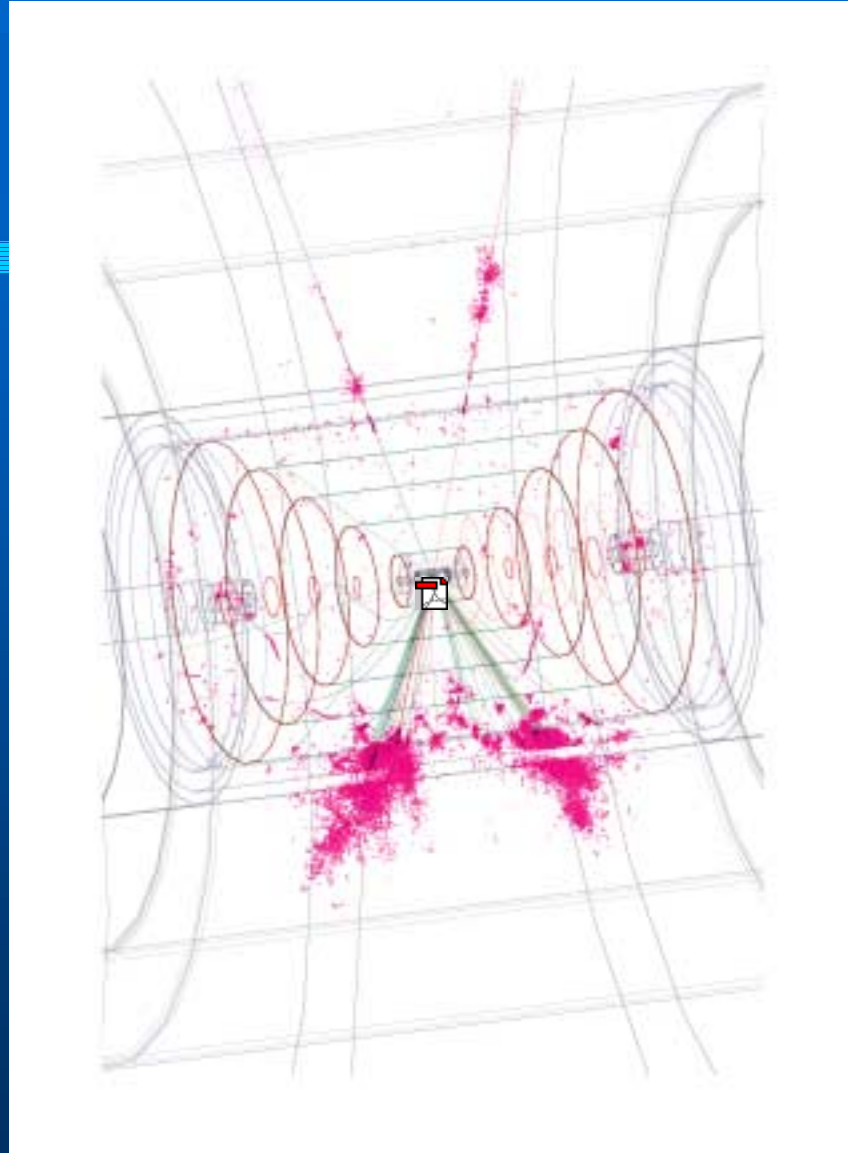
Specification of a full simulation with Geant4

- Detector geometry is given by XML file for a flexible detector setting.
- Output data (hits,...) is written in ROOT file format to take advantage of object oriented I/O.
- The package works on various computer platforms (Linux, SunOS, Windows,...).
- The simulation will be released as a part of LCDROOT.

$$ee \rightarrow ZH ; Z \rightarrow \mu\mu$$



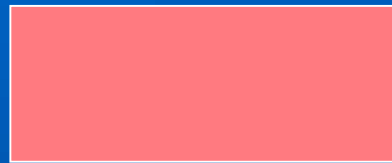
$$ee \rightarrow ZH ; Z \rightarrow \mu\mu$$



Fist test analysis results

- Detailed studies with LCDROOT and Geant4 → **see Dr. Iwasaki's talk**
- We check energy linearity and energy resolution with single particle simulation data.
- Tracking performance with SD calorimeter has been studied using Geant4.
- Since these are the first tests, you should not think them seriously.

Detector designs



29 cm Al

120x



$\Lambda \sim 6$



2 mm scint
8 mm Pb

40x



$X_0 \sim 28$
 $\Lambda \sim 1$



1 mm scint
4 mm Pb



r

coil



40 cm Al

34x



$\Lambda \sim 4$

HAD
Cal



1 cm scint
2 cm Stainless_steel

30x



$X_0 \sim 21$
 $\Lambda \sim 0.8$

EM
Cal



0.1 mm Air
2 mm G10
0.4 mm Si
2.5 mm W

1/5/02

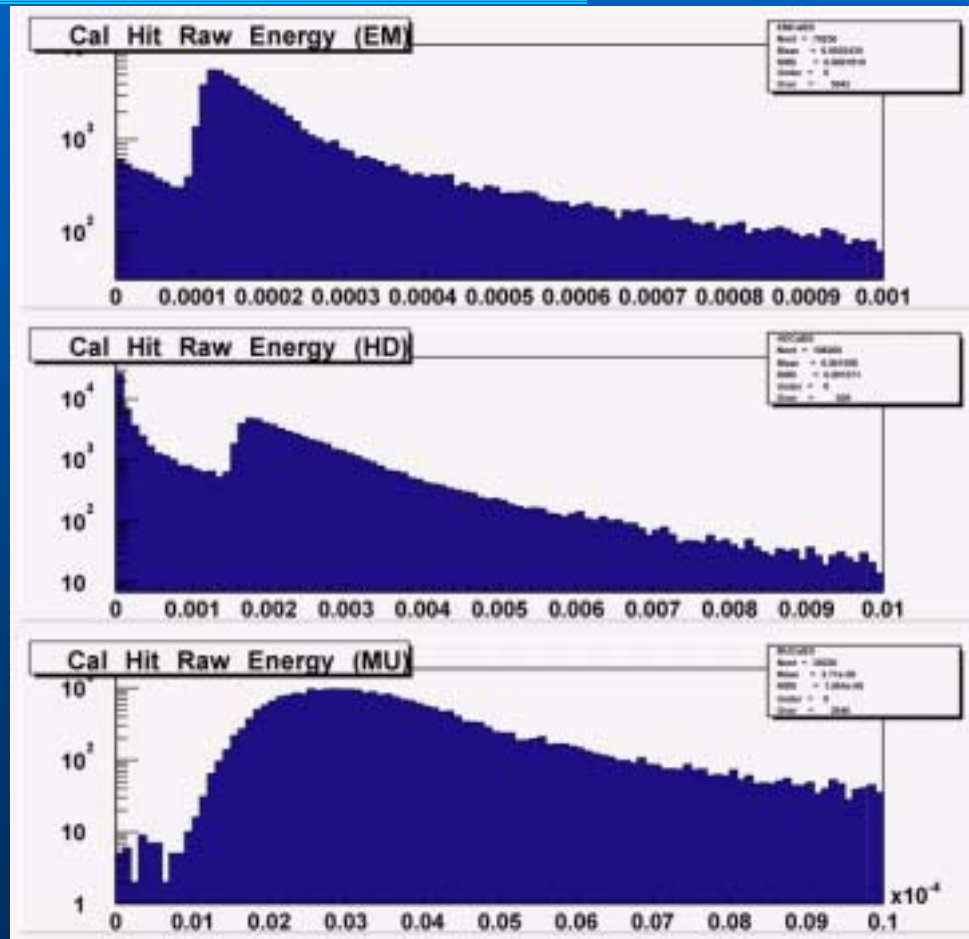
LD

SD

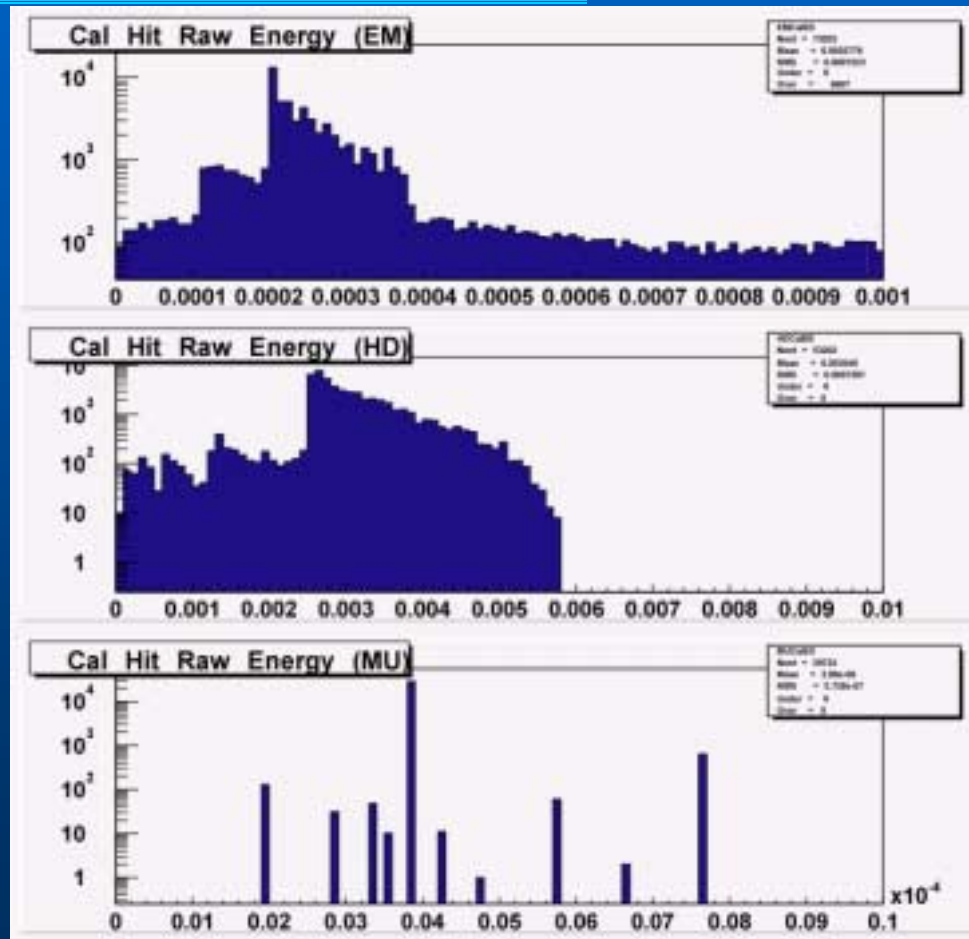
Event generation time

- **Generate $ee \rightarrow tt$ @ $E_{cm}=500$ GeV**
- **Computer: Sun Solaris8 300MHz CPU**
 - SD: ~ 5mim/event**
 - LD: ~ 10mim/event**

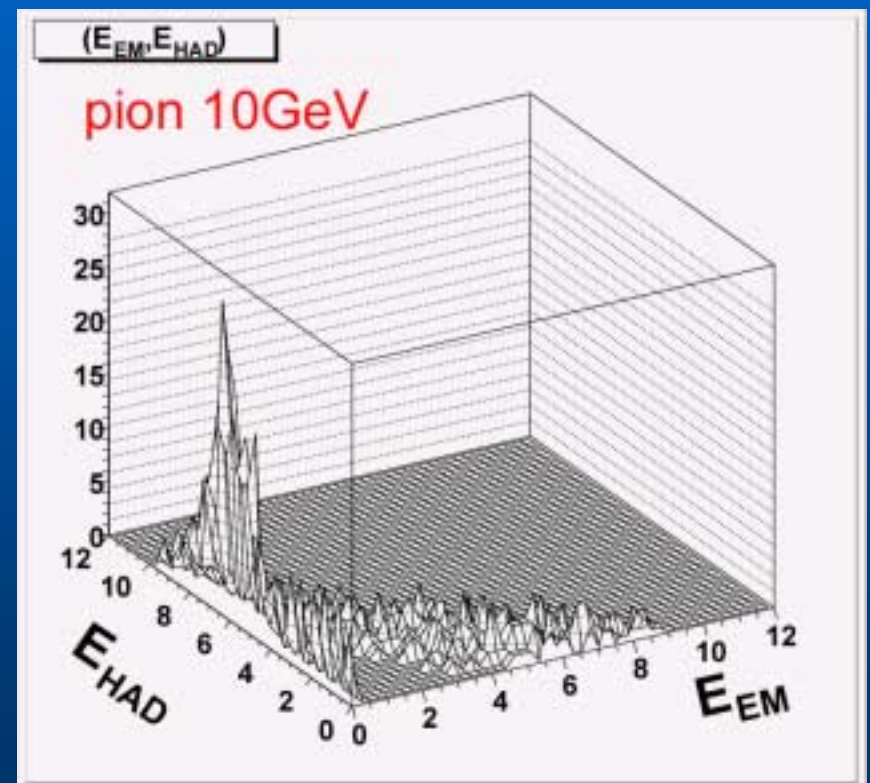
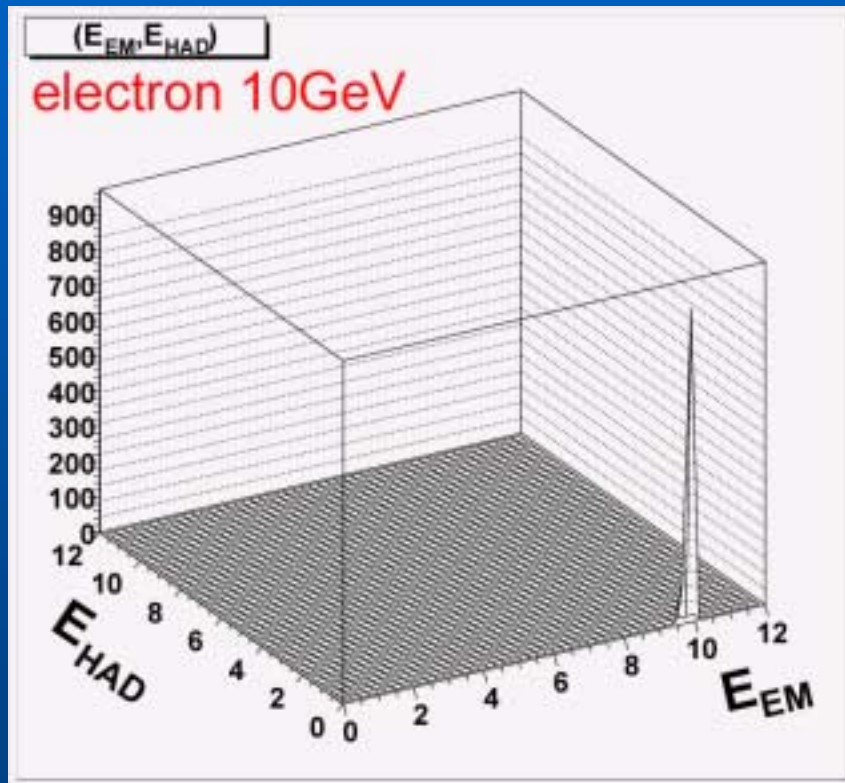
Hit Energy ($Z \rightarrow \mu\mu$, SD, Geant4)



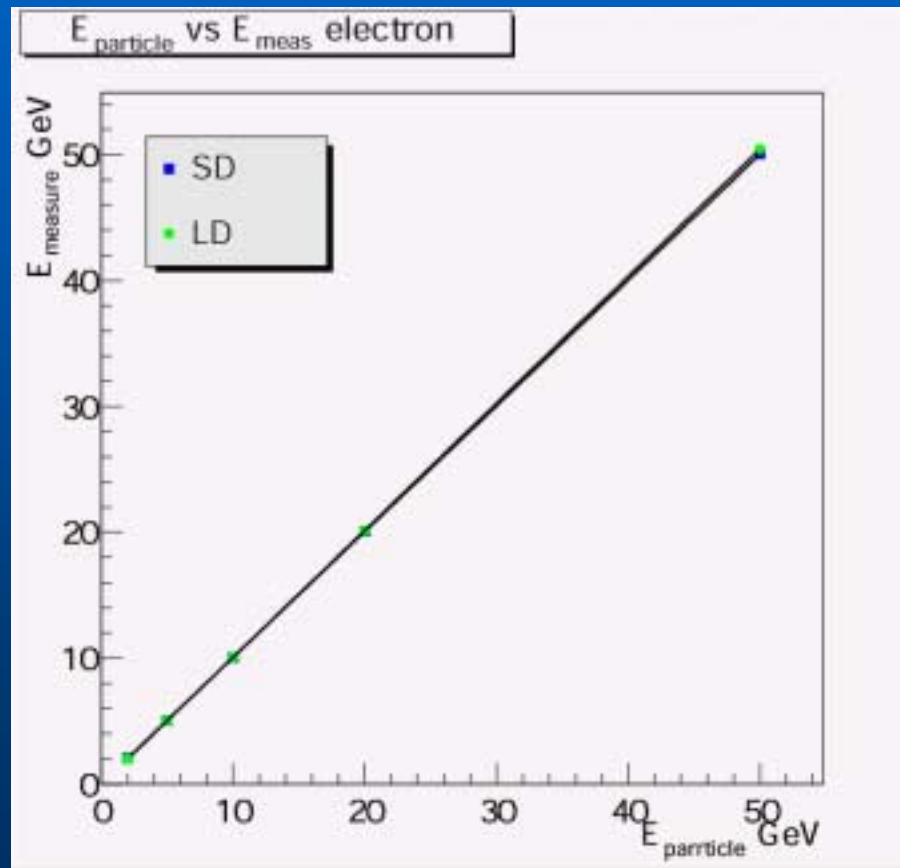
Hit Energy ($Z \rightarrow \mu\mu$, SD, Gismo)



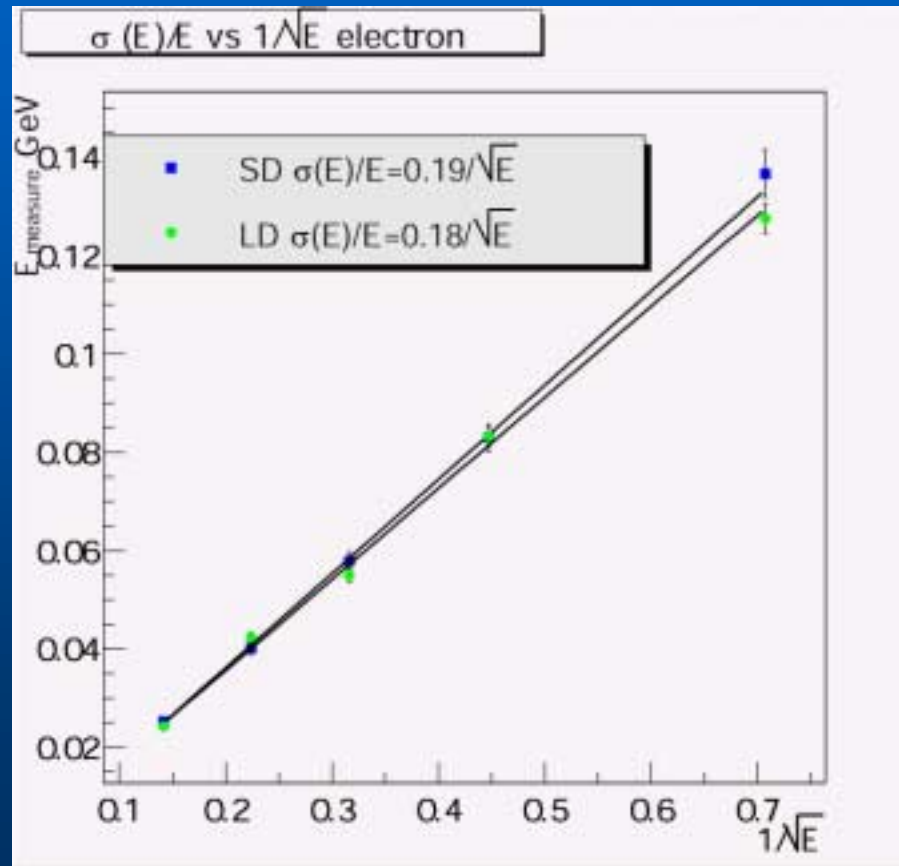
EM energy vs. HAD energy (SD)



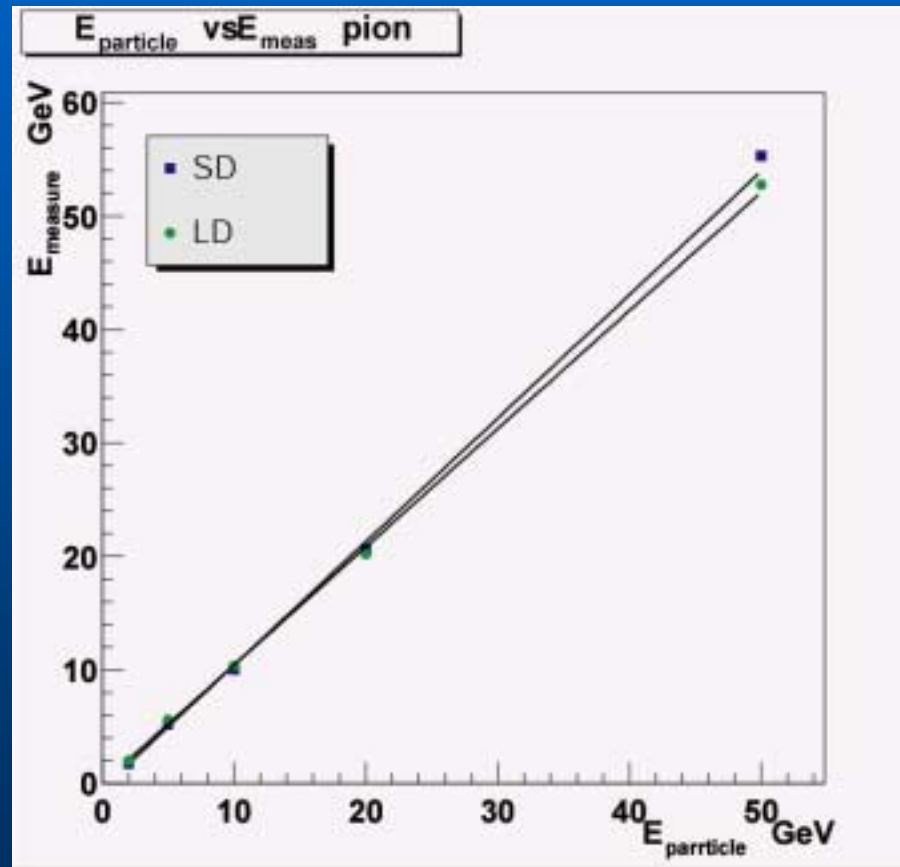
Energy linearity (electron)



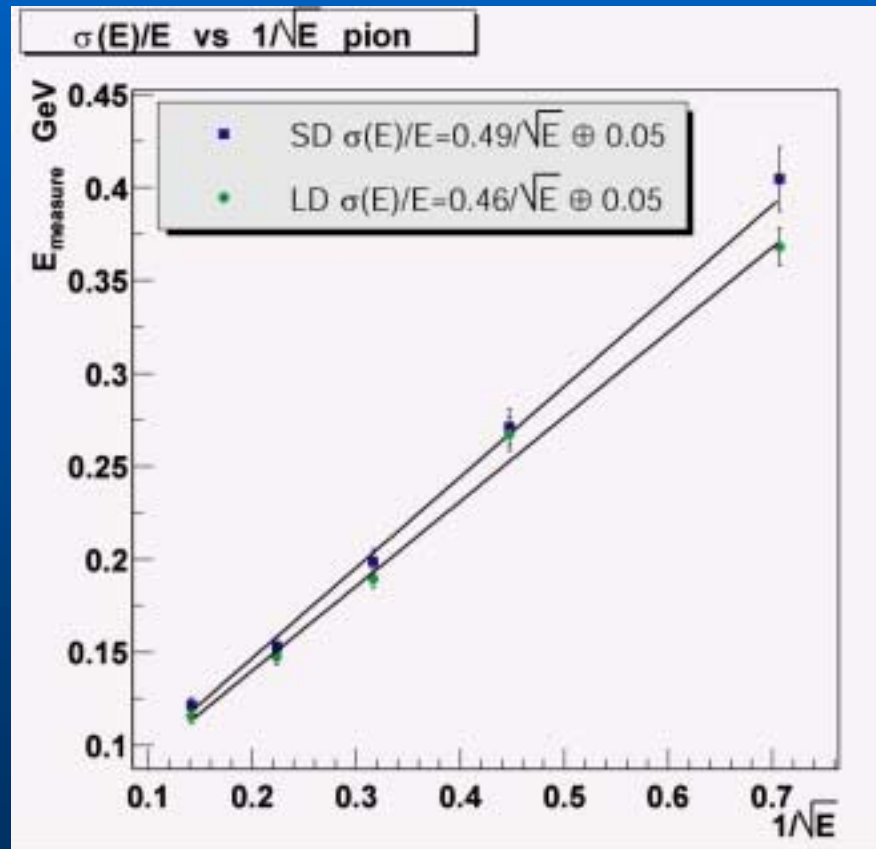
Resolution vs. Energy (electron)



Energy linearity (pion)



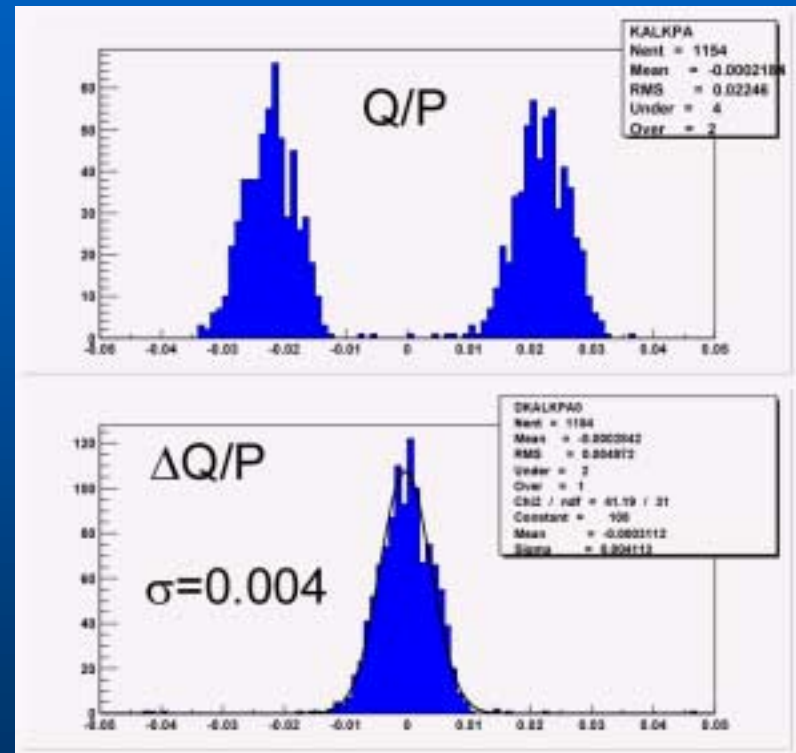
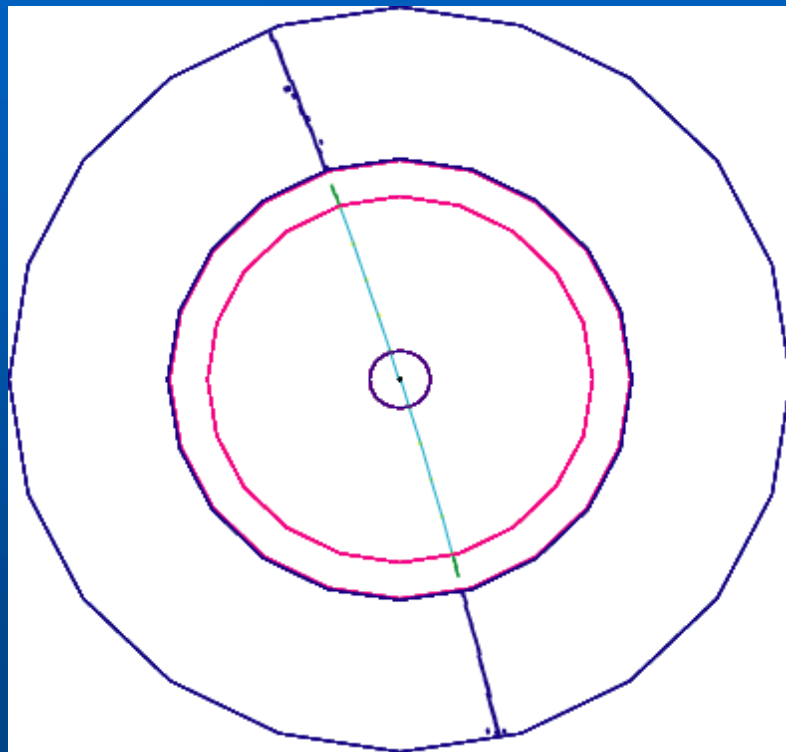
Resolution vs. Energy (pion)



Cluster tracking

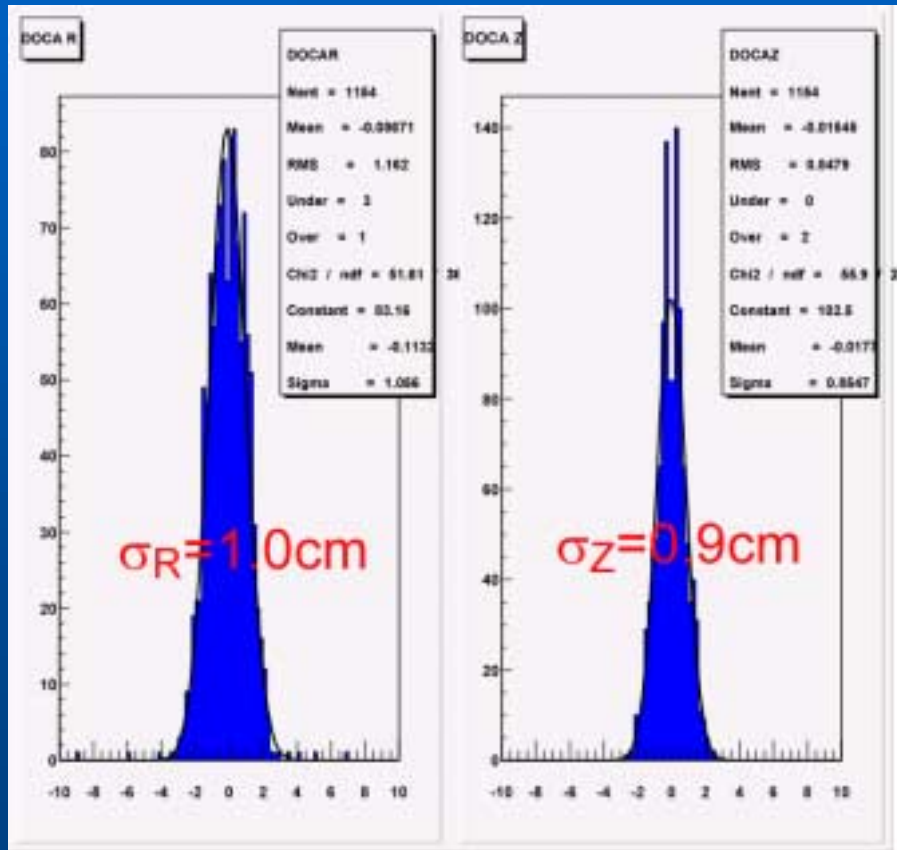
- In SD, it may be hard to reconstruct long lived charged particles because of small number of layers (5) in the tracking device.
- SD has a fine granular calorimeter (5mmX5mm) which make enable tracking.
- Calorimeter may help track finding with tracking device.
- We have checked the tracking performance using $Z \rightarrow \mu\mu$ and single photon events.

Charge separation



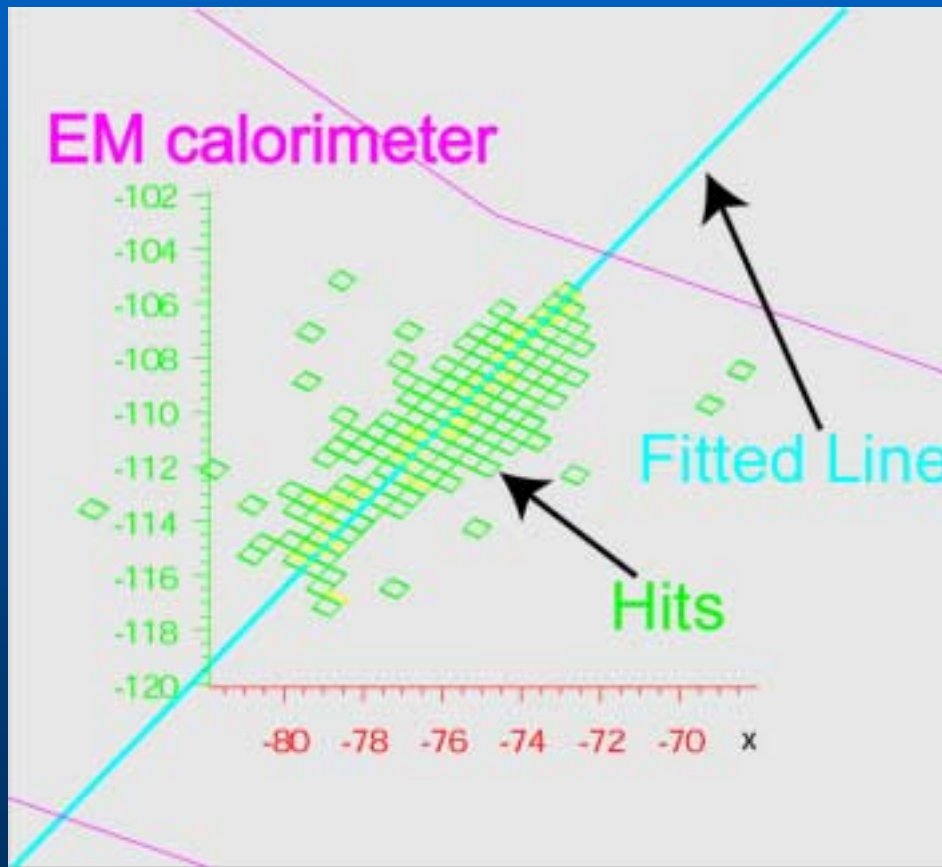
- Sample is $Z \rightarrow \mu\mu$ @ $E_{cm}=91.26\text{GeV}$

Impact parameter resolution

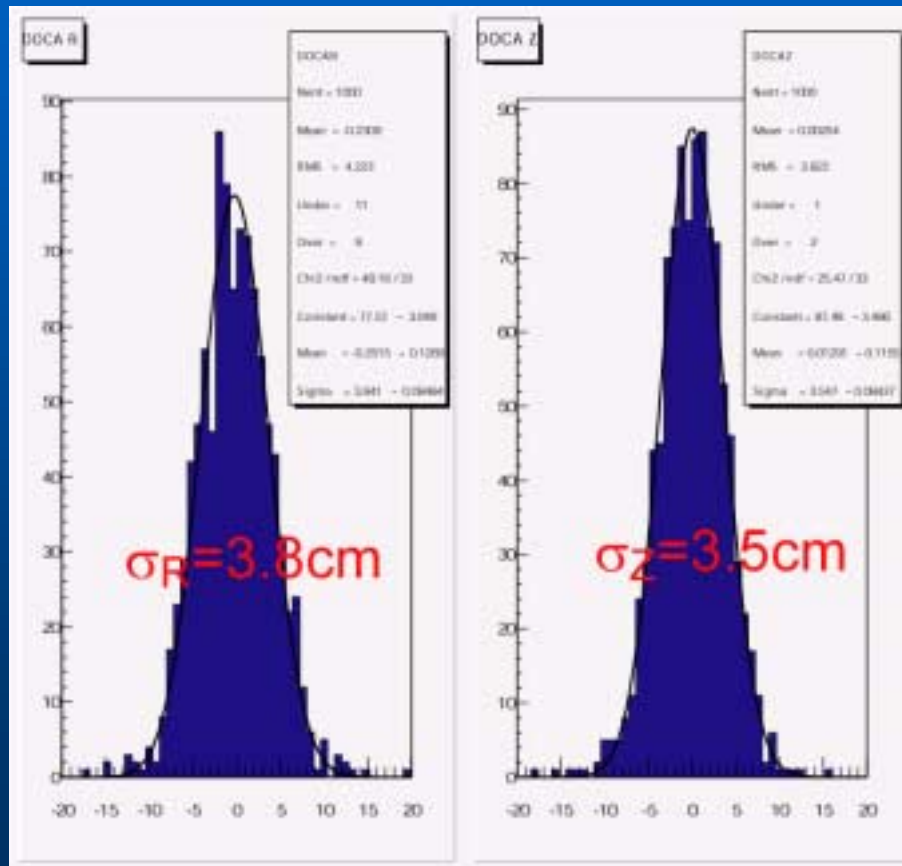


- Impact parameter and momentum resolution must improve when the tracks link to hits in outer layer of tracking device.

Line fitting of photon clusters



DOCA resolution



10 GeV gamma
from I.P.

Summary

- **Geant4 works with XML detector file on various computer platforms.**
- **The simulated data can be analyzed with LCDROOT**
 - **First test results are shown.**
- **Calorimeter tracking looks very promising for SD and will be used for some physics studies.**
- **Need more detailed check and debugs...**