

# CALICE Si/W ECAL prototype, first testbeam results

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## Outline

- ▶ **General**
- ▶ **Si/W prototype**
- ▶ **First testbeam results**
- ▶ **Summary**

# General

- ▶ . **particle flow paradigm**

- : highly granular EM and HADR calorimeters to allow very efficient pattern recognition for excellent shower separation and pid within jets to provide excellent jet reconstruction efficiency

- ▶ . **CALICE ECAL(Si/W) and HCAL(Scint/Fe, RPC/Fe) prototype studies**

- : debug technology/detector concept(s)

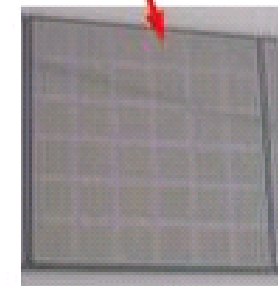
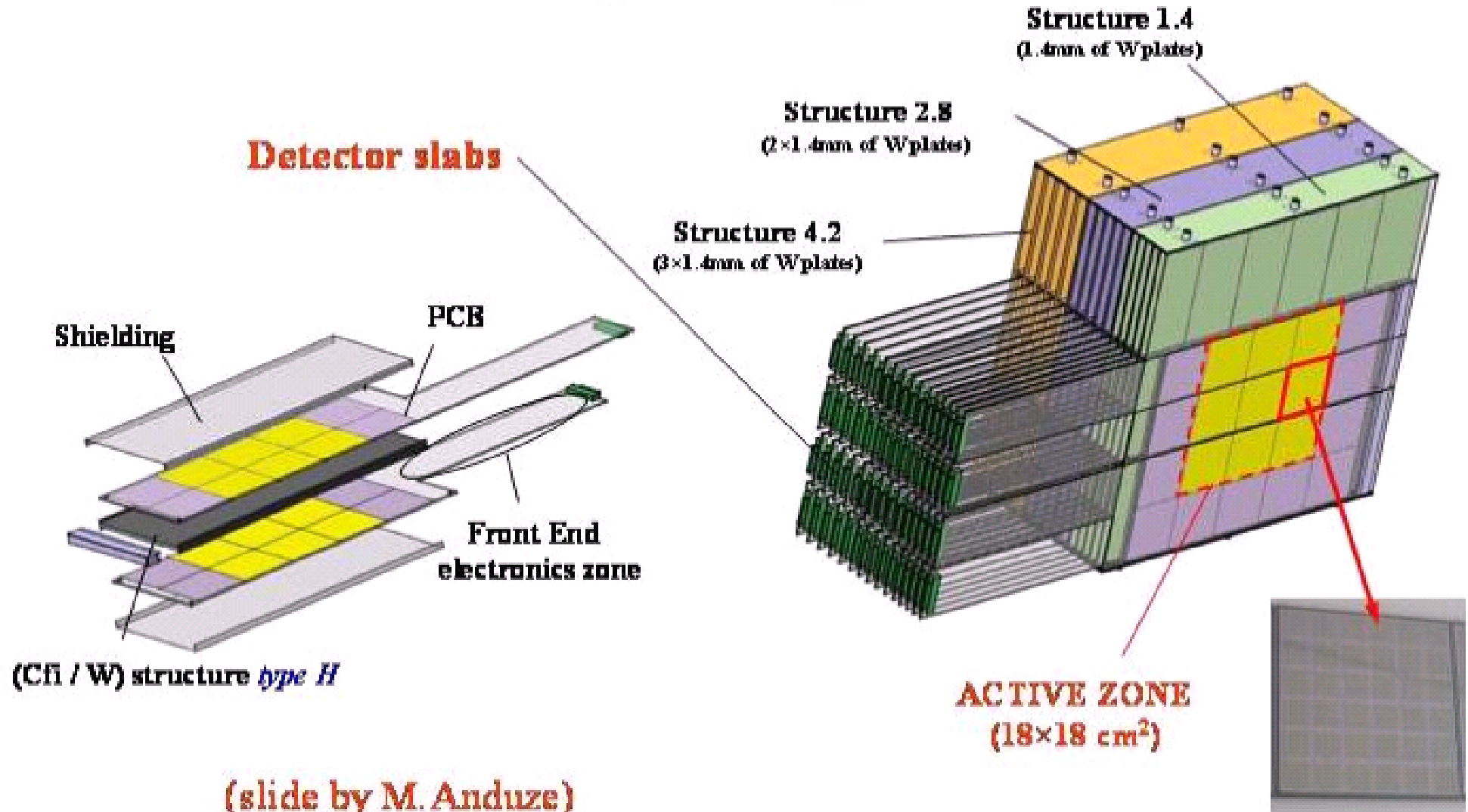
- : detector characterisation

- : test "particle flow paradigm", interplay between hard/soft-ware

- : test-validate-improve simulation codes and shower packages

- ▶ . details about CALICE Si/W ECAL protoype follow

# CALICE ECAL prototype

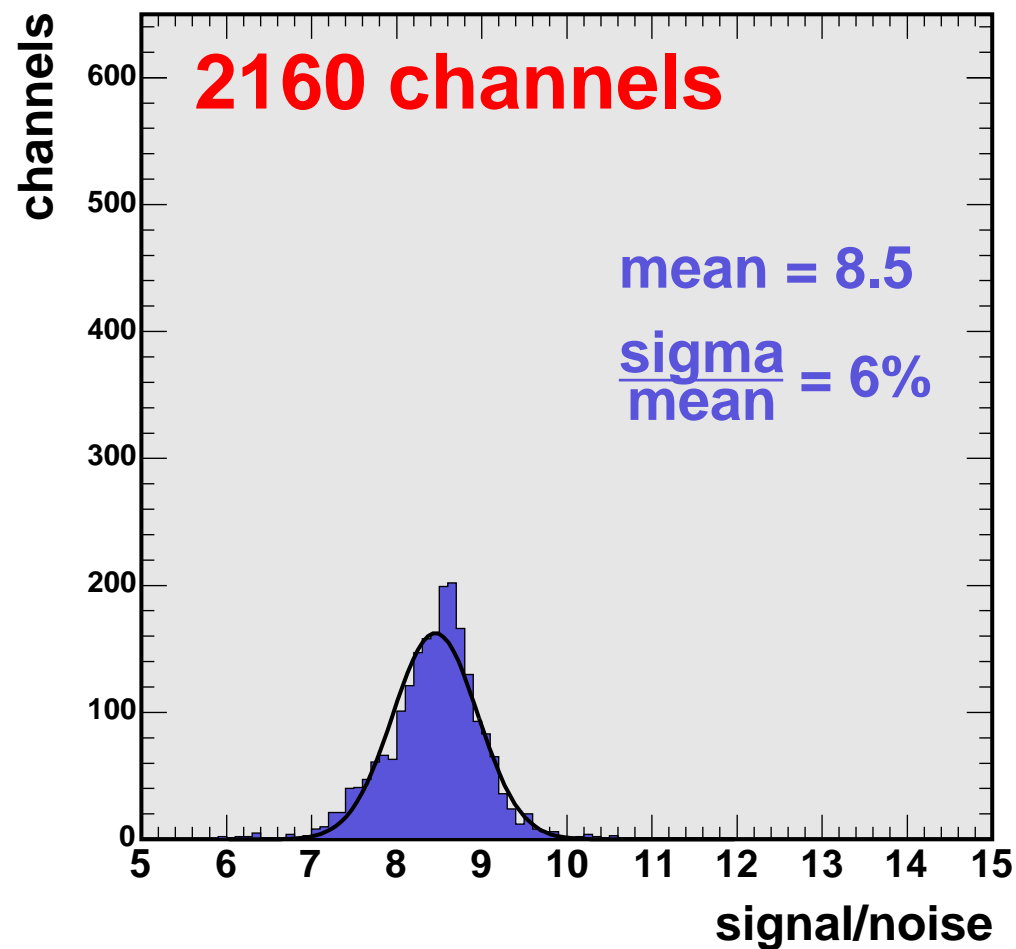
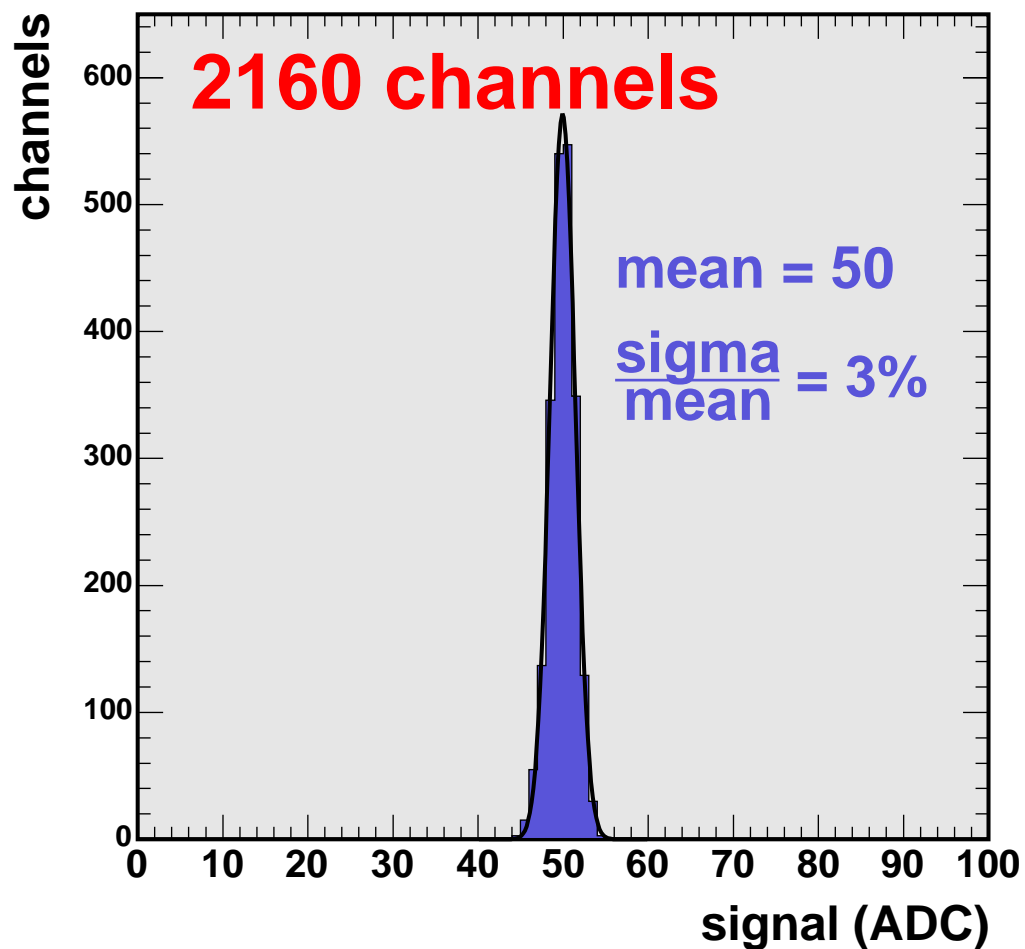


*Si Wafer :*  
6×6 pads of detection  
(10×10 mm<sup>2</sup>)

## full Si/W prototype (24 $X_0$ )

- ▷ 30 layers × 18 cm × 18 cm interleaved with 0.5 mm Si pads
- ▷ W absorber, 10+10+10 layers, 1.4 mm:2.8 mm:4.2 mm thick per respective layer
- ▷ readout by **1 × 1 cm<sup>2</sup> cells, total: 9720 channels**

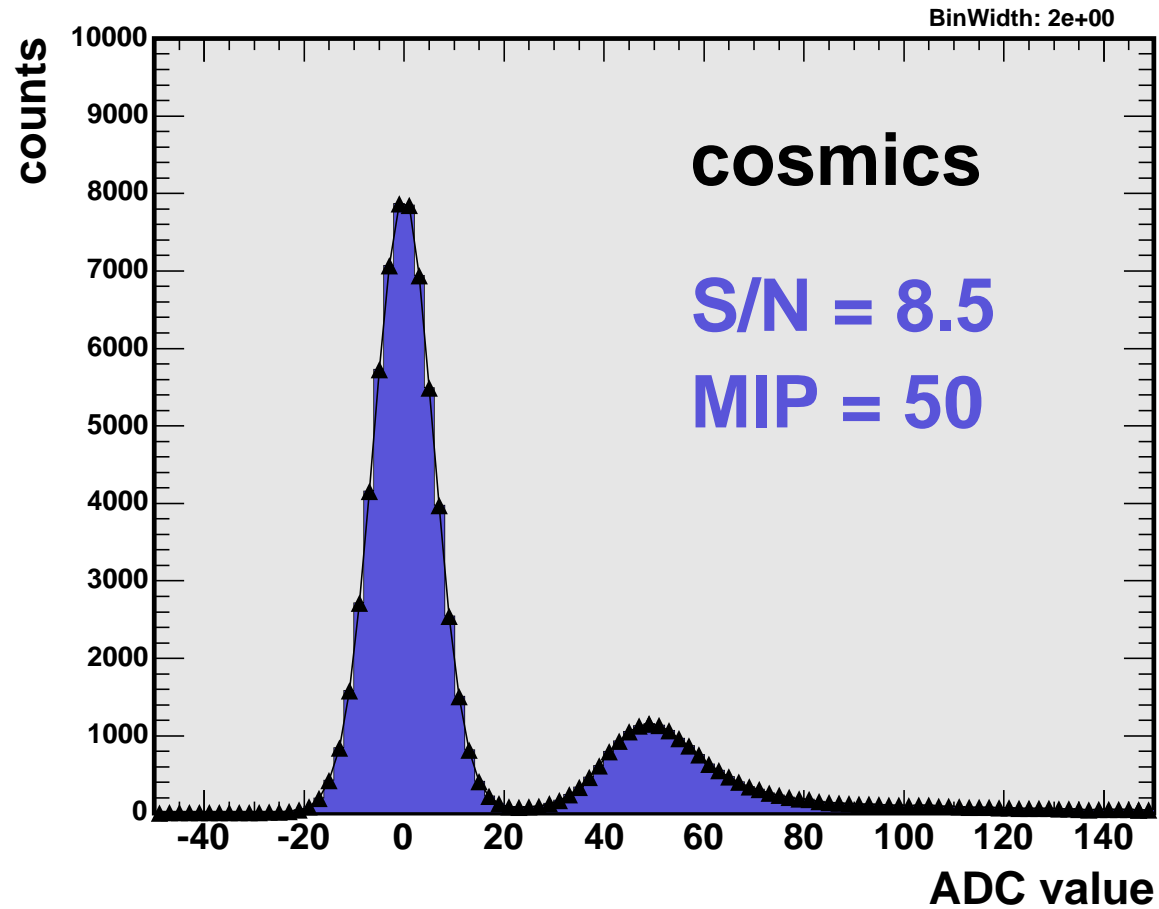
# Calibration with cosmics



▷ 10 layers (2160 channels) calibrated with cosmics (1 Mevents)

(LLR-Paris, Dec04)

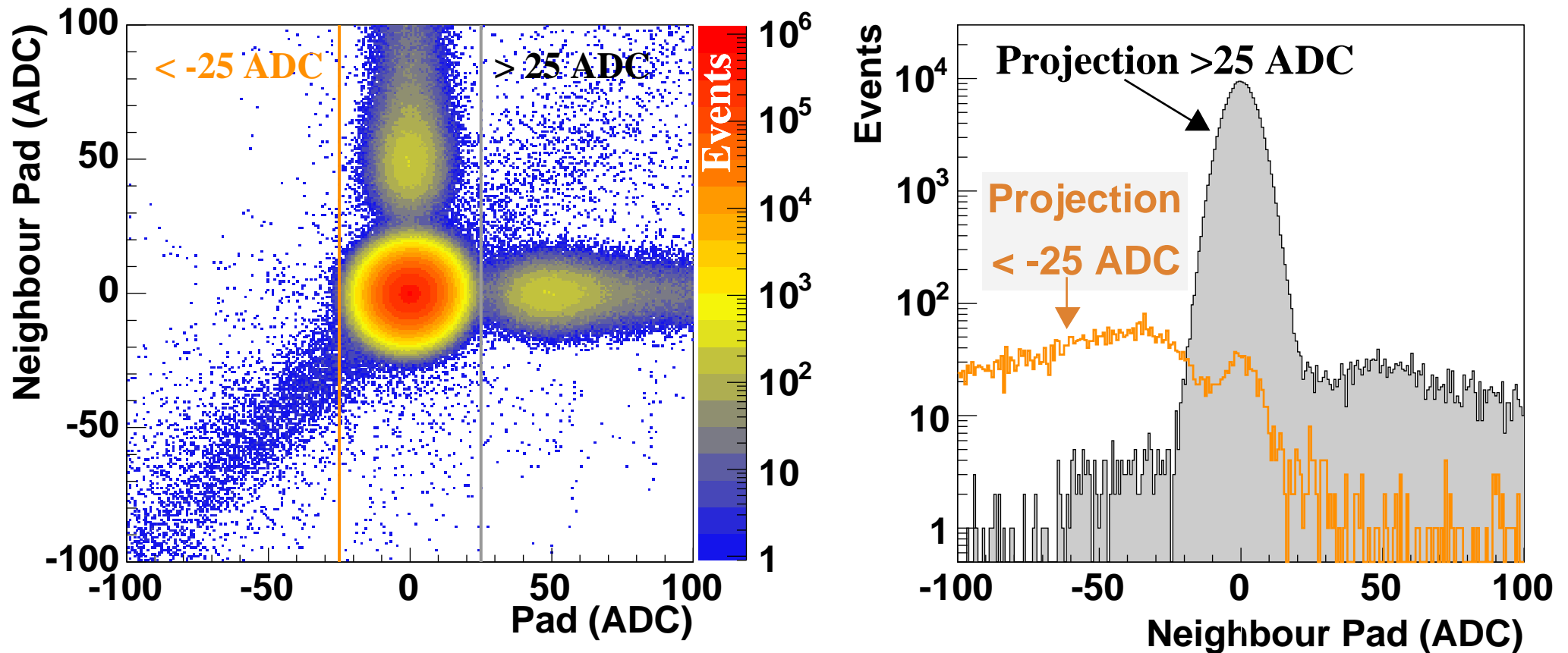
# Calibration with cosmics



▷ a typical channel: gaussian noise, landau signal

# Coherent/Common mode noise

(see talk by G.Gaycken)



- ▷ pad and neighbour read-out by same chip (half wafer)
- ▷ similar correlation between pads of different half wafers / wafers

# CALICE-ECAL testbeam at DESY

- ▶ - **"30%" equipped Si/W prototype**

- : i.e. 14 W layers (10 at 1.4mm + 4 at 2.8mm) interleaved with 18 × 12 matrix of active Si cells, 1 × 1 cm<sup>2</sup> each, total: 3024 channels

- : first testbeam at DESY with electrons during Jan/Feb05

- ▶ - **in summary (configurations: position × energy × angle)**

- : position scan (center - edge - corner of wafers)

- energy scan (mainly 1, 2, 3 GeV, some runs at 4, 5, 6 GeV)

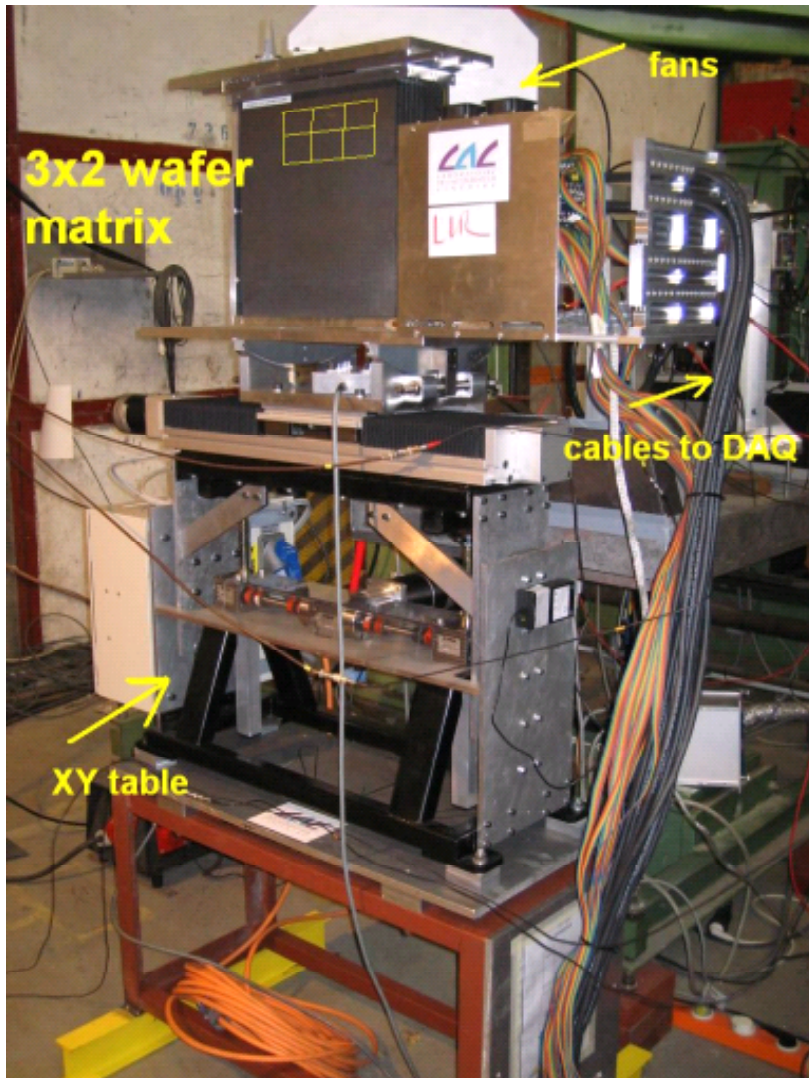
- angle scan (0°, 10°, 20°, 30°)

- : total: ~ 25 Mevents (~ 230 GB)

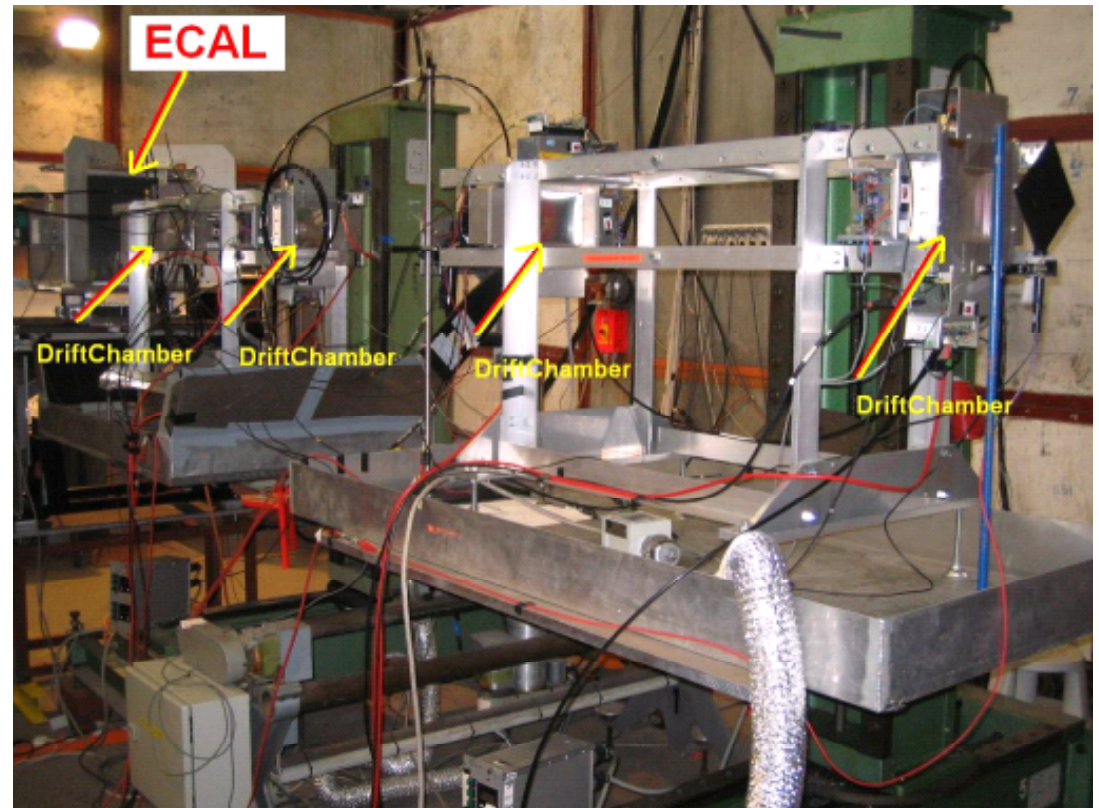
- ▶ - **next round in Jun05 with more layers-channels**

# CALICE-ECAL testbeam at DESY

## ECAL



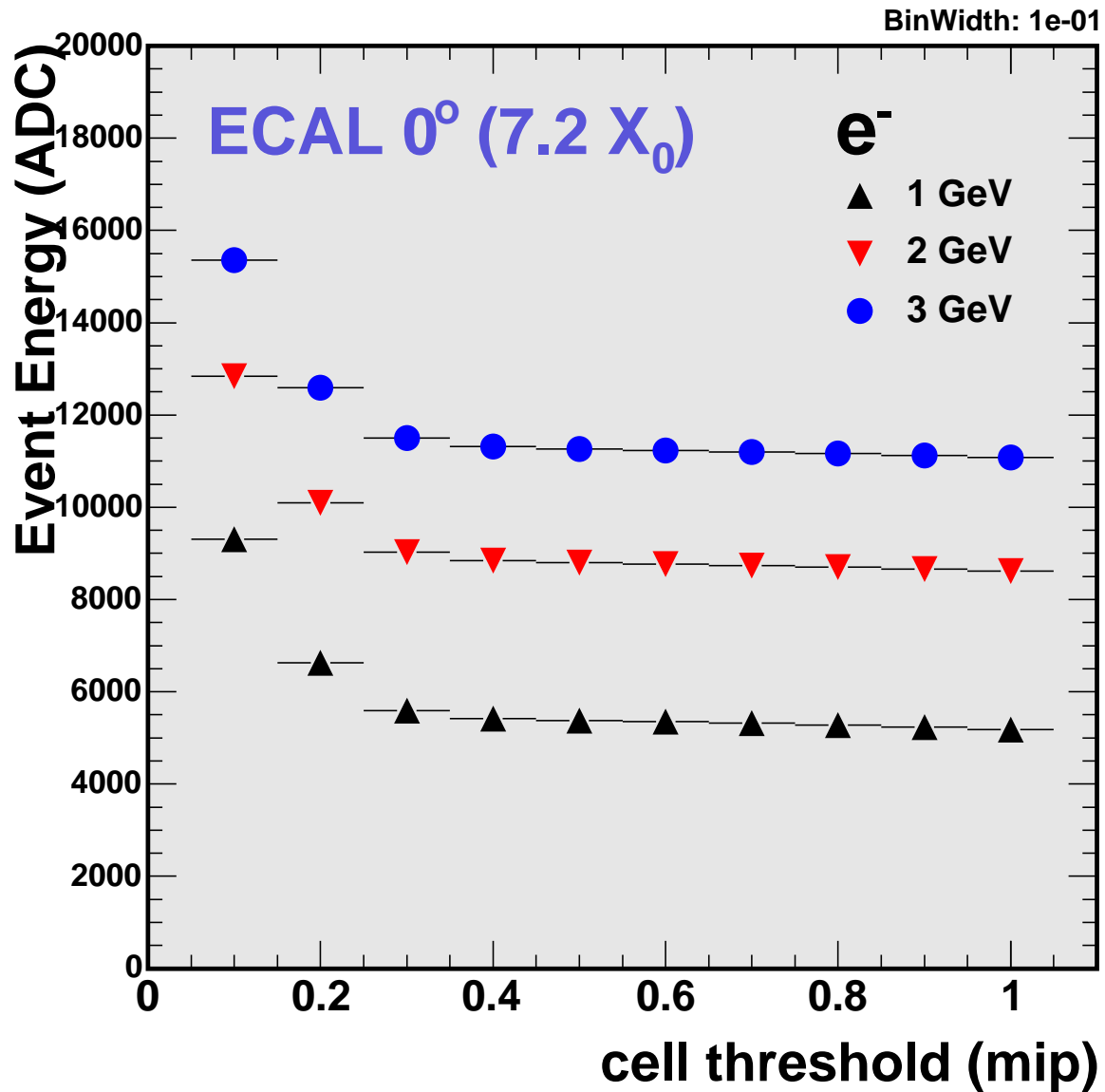
## layout at DESY T21



DriftChambers and installation courtesy of Tsukuba Univ. and Kobe Univ.

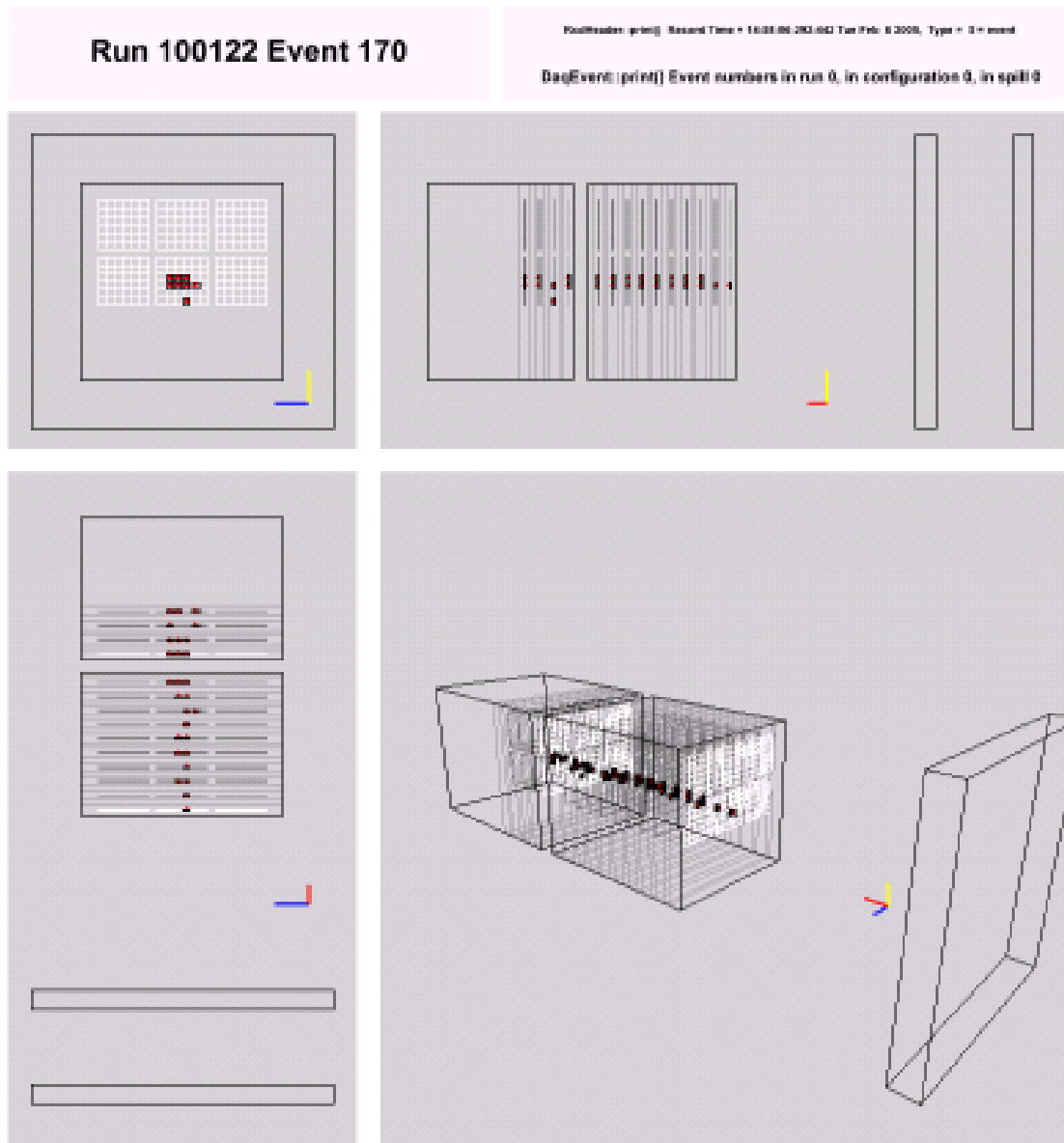


# "Response" vs cell threshold



- ▷ safe limit a threshold around 0.5 - 0.6 mip
- ▷ following analysis with threshold = 0.5 mip

# "Tracking Calorimetry"



(not to scale)

$e^-$  1 GeV

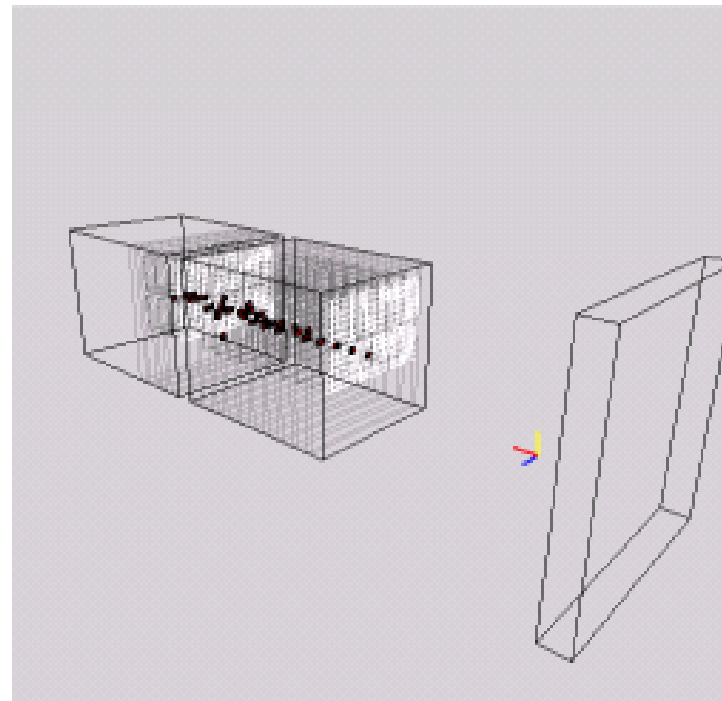
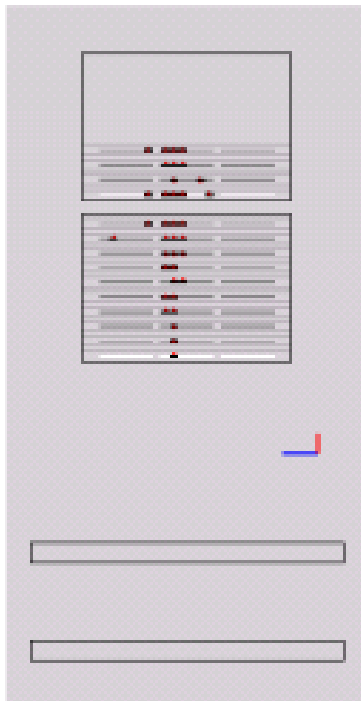
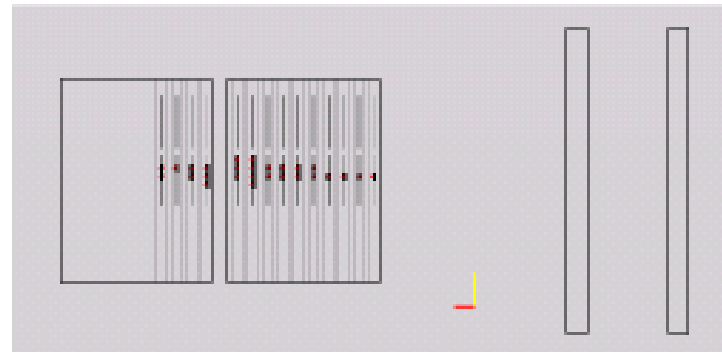
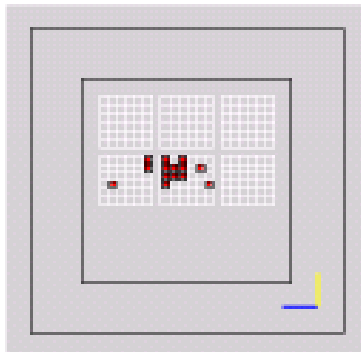
cell threshold = 0.5 mip

# "Tracking Calorimetry"

Run 100123 Event 270

RootHeader(print) Record Time = 10.11.01.000.124 Data File # 2000, Type = 0 = event

Daq(Event)(print) Event numbers in run 0, in configuration 0, in spill 0

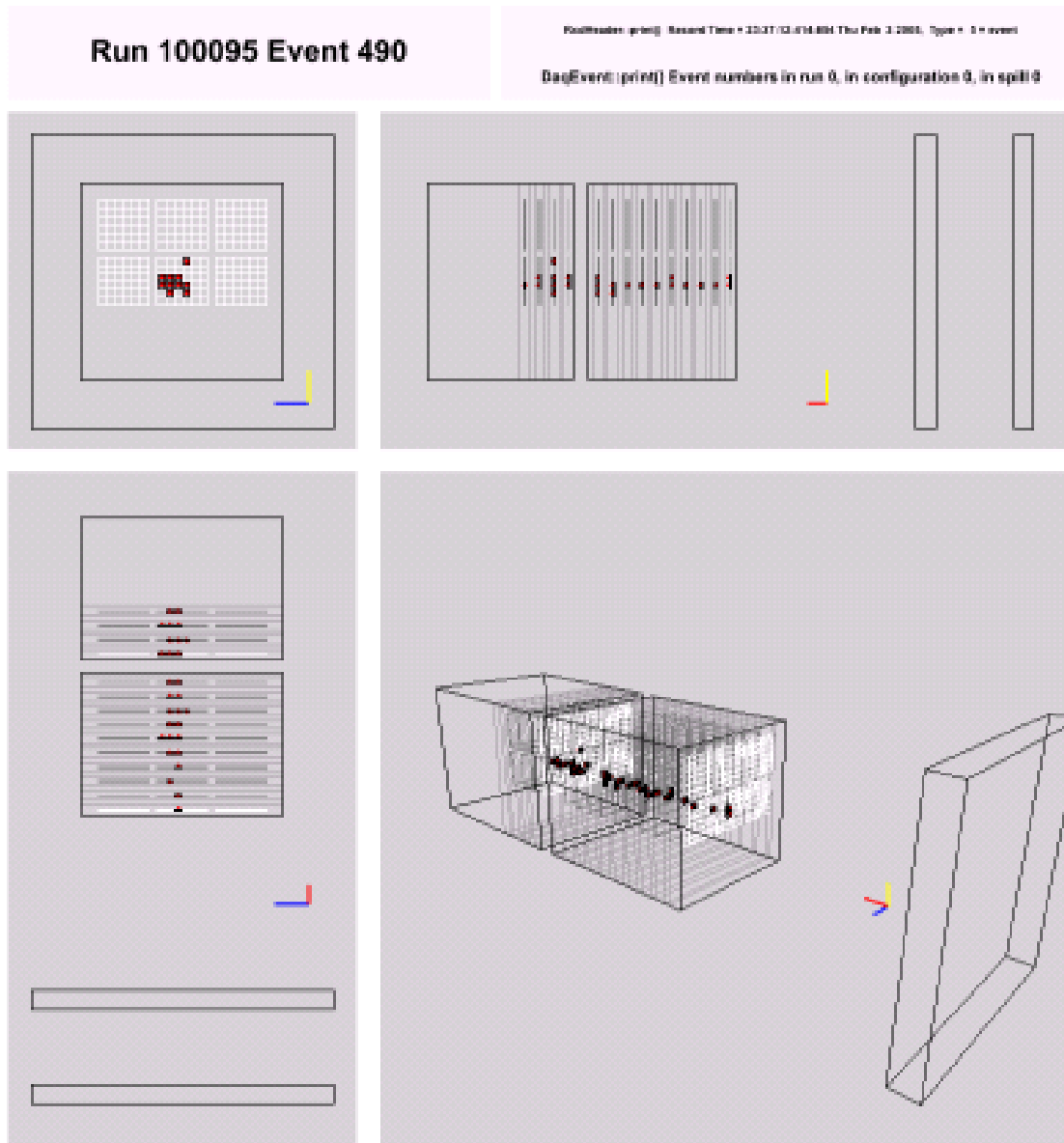


(not to scale)

$e^-$  2 GeV

cell threshold = 0.5 mip

# "Tracking Calorimetry"



(not to scale)

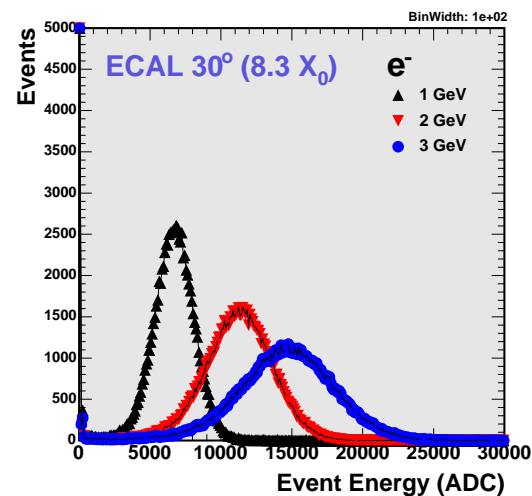
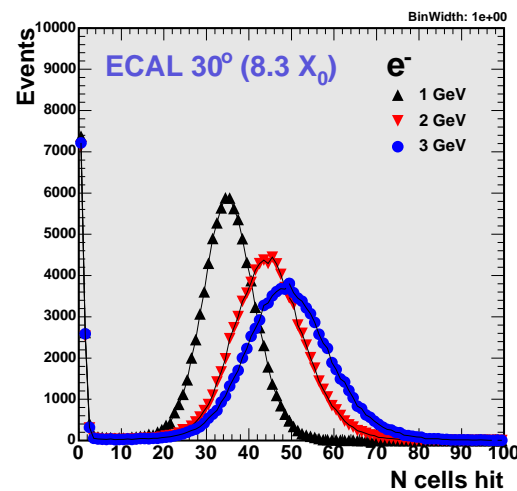
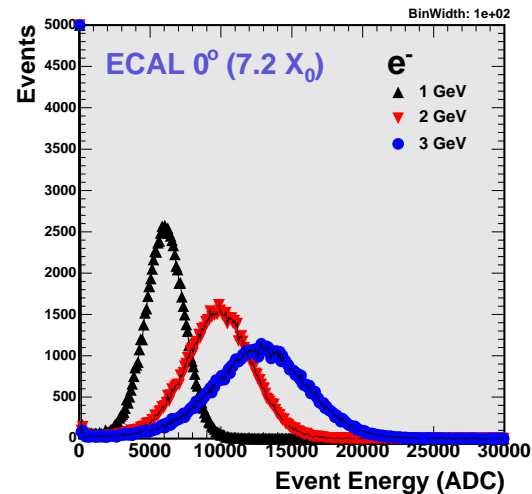
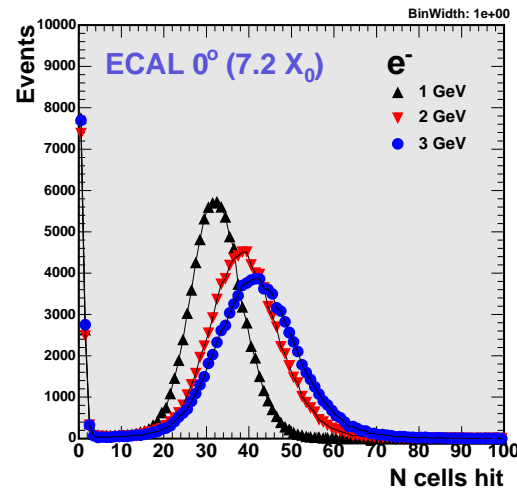
$e^-$  3 GeV

cell threshold = 0.5 mip

# "Response" to electrons

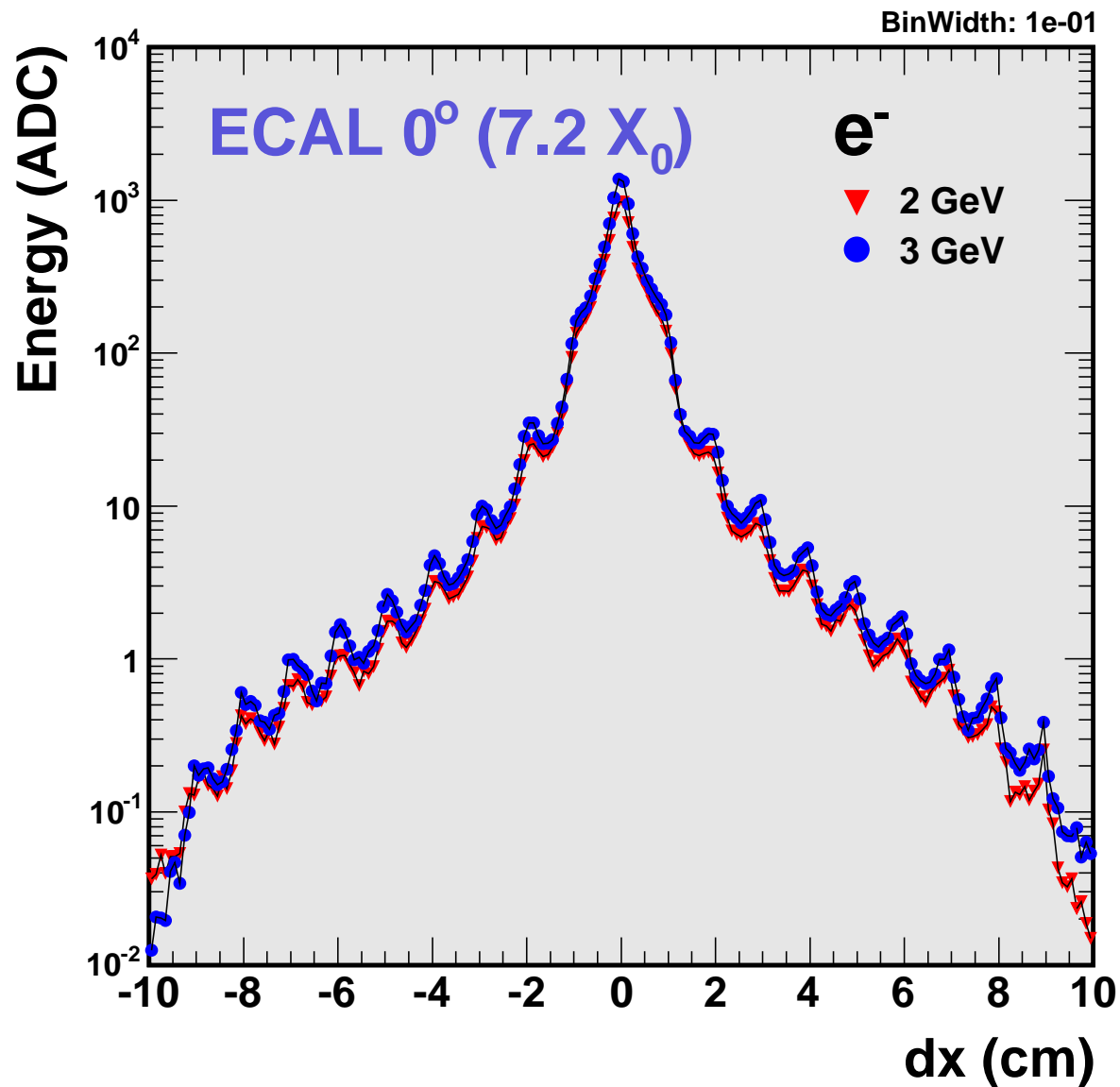
**N cells hit**

**E deposited**



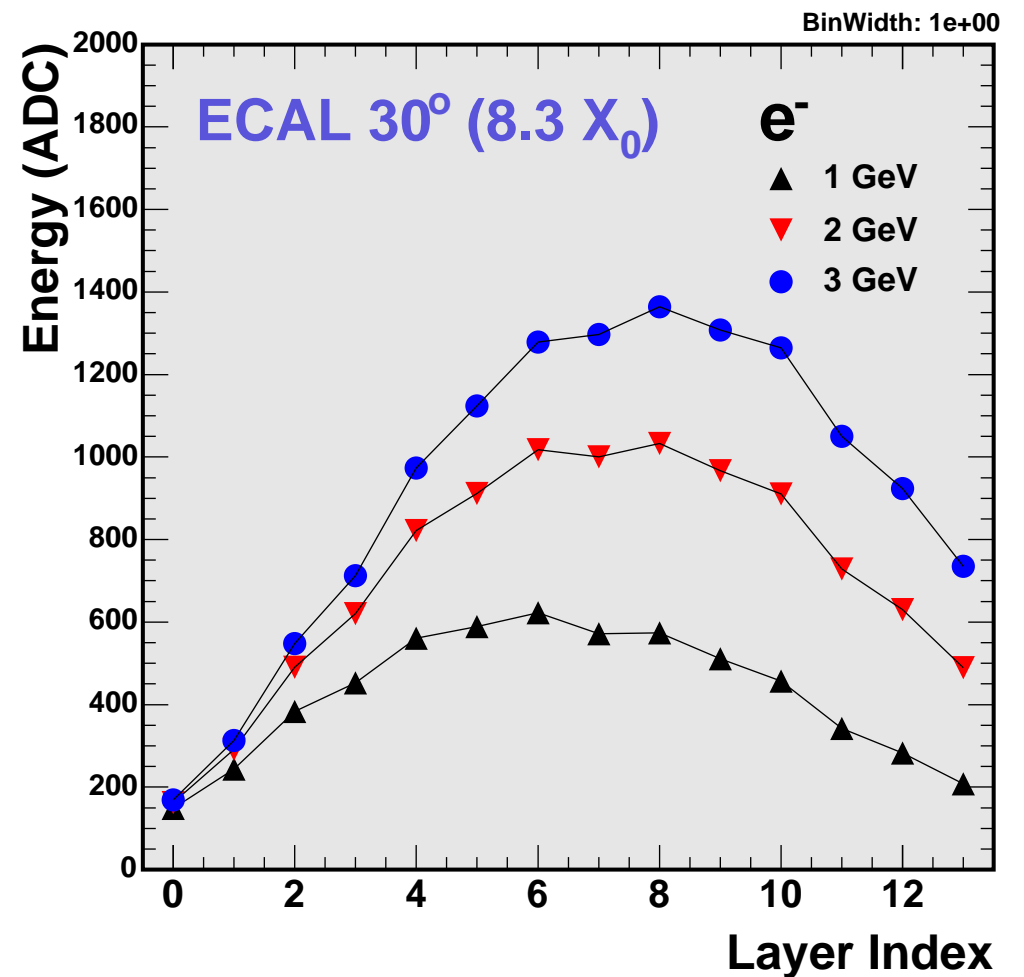
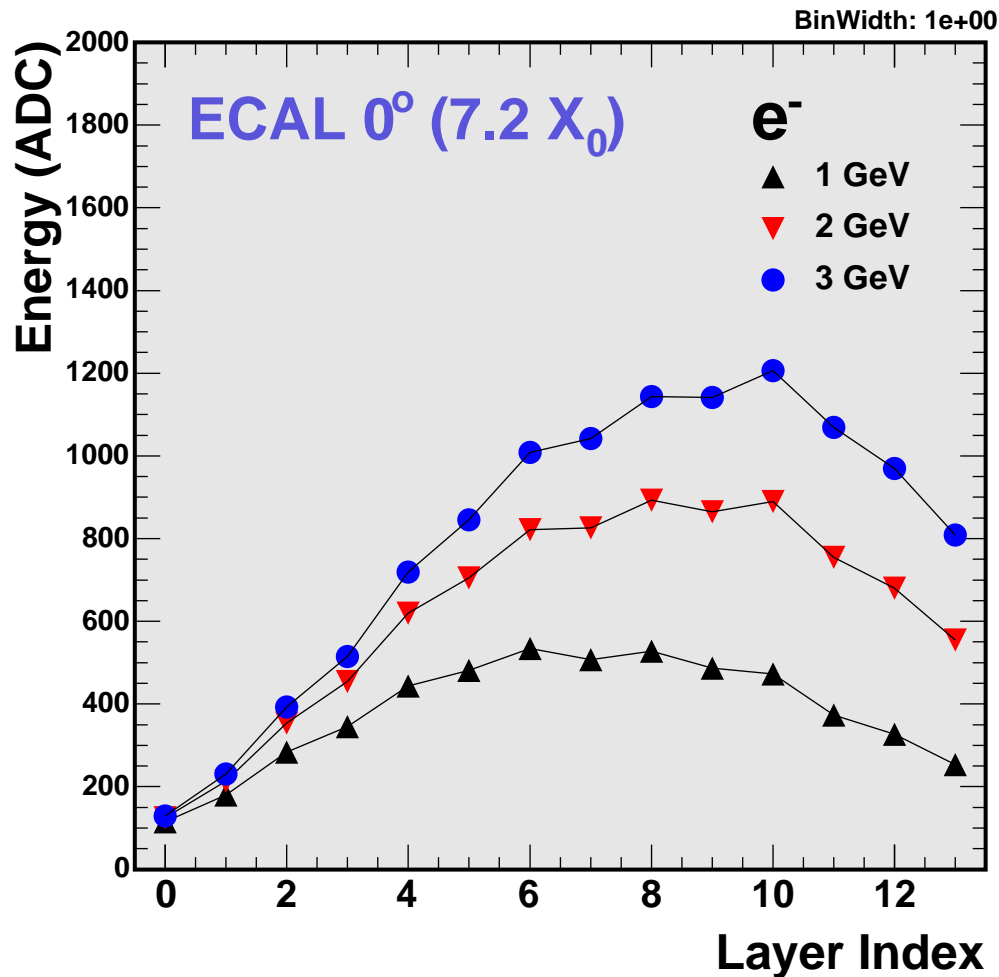
- ▷ no weighting, no event selection, no tracking
- ▷ showers better contained at 30°

# Transverse tomography



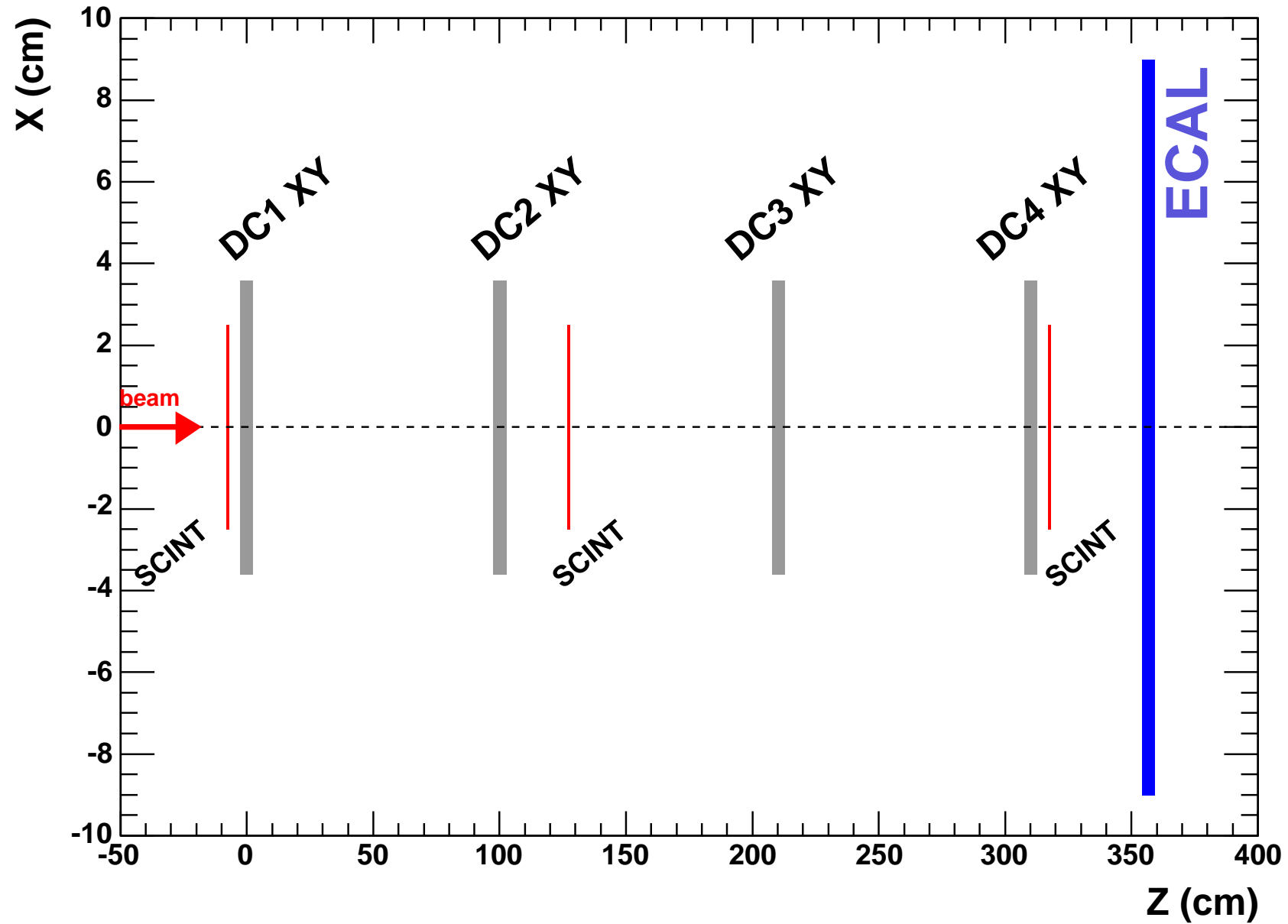
- ▷ no weighting, no event selection, no tracking
- ▷  $dx = \text{CellX} - \text{BarycenterX}$
- ▷ distance between peaks = 1 cm = transverse granularity

# Shower longitudinal profile



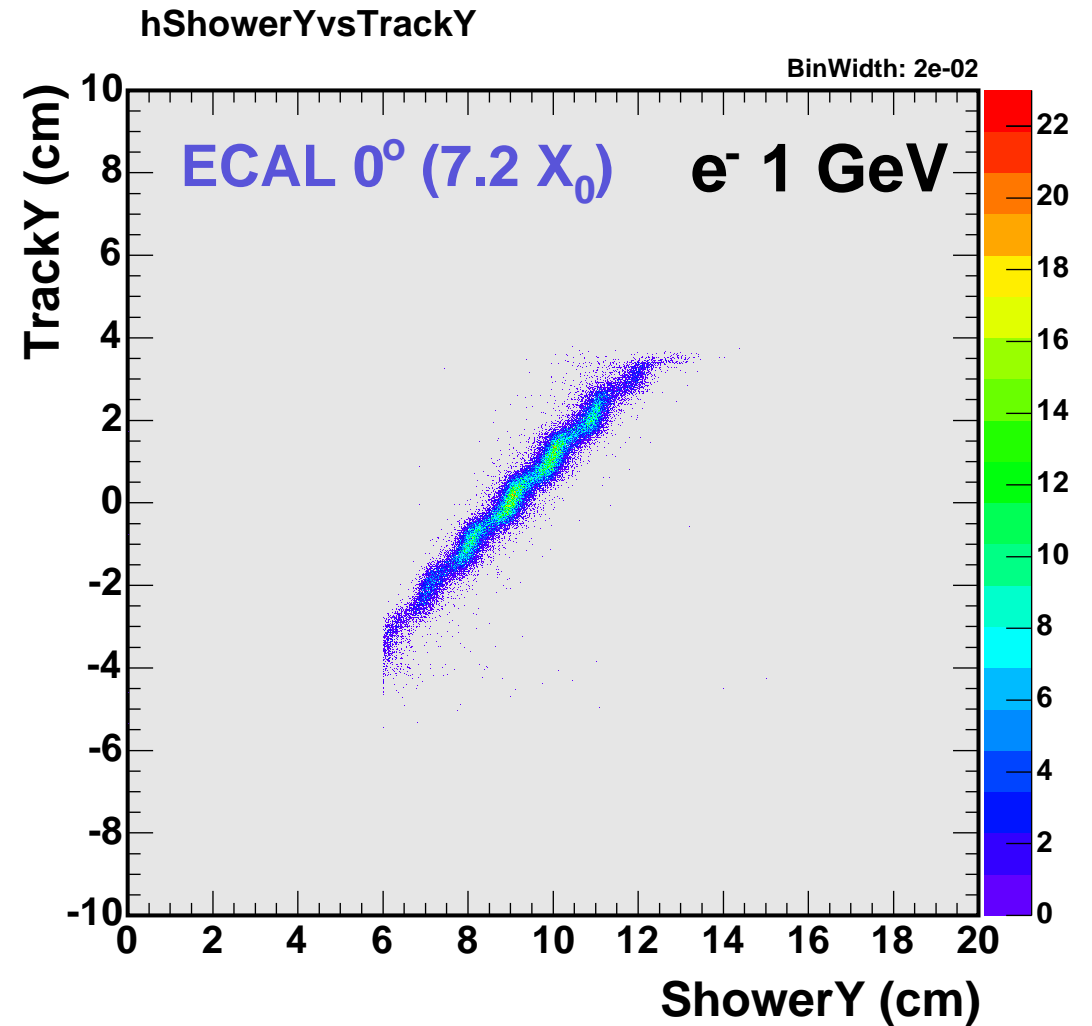
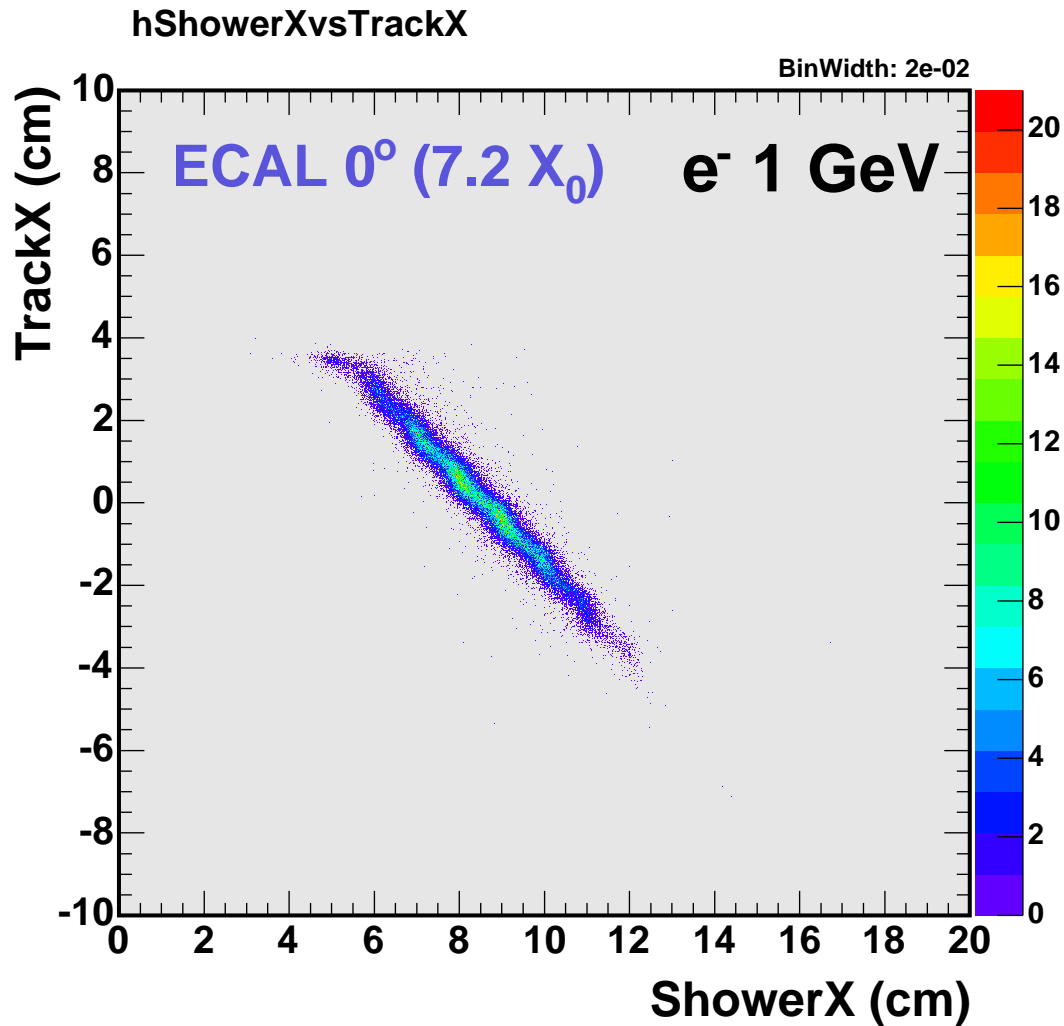
- ▷ no weighting, no event selection, no tracking
- ▷ odd/even asymmetry of construction observed
- ▷ showers better contained at  $30^\circ$

# Testbeam layout



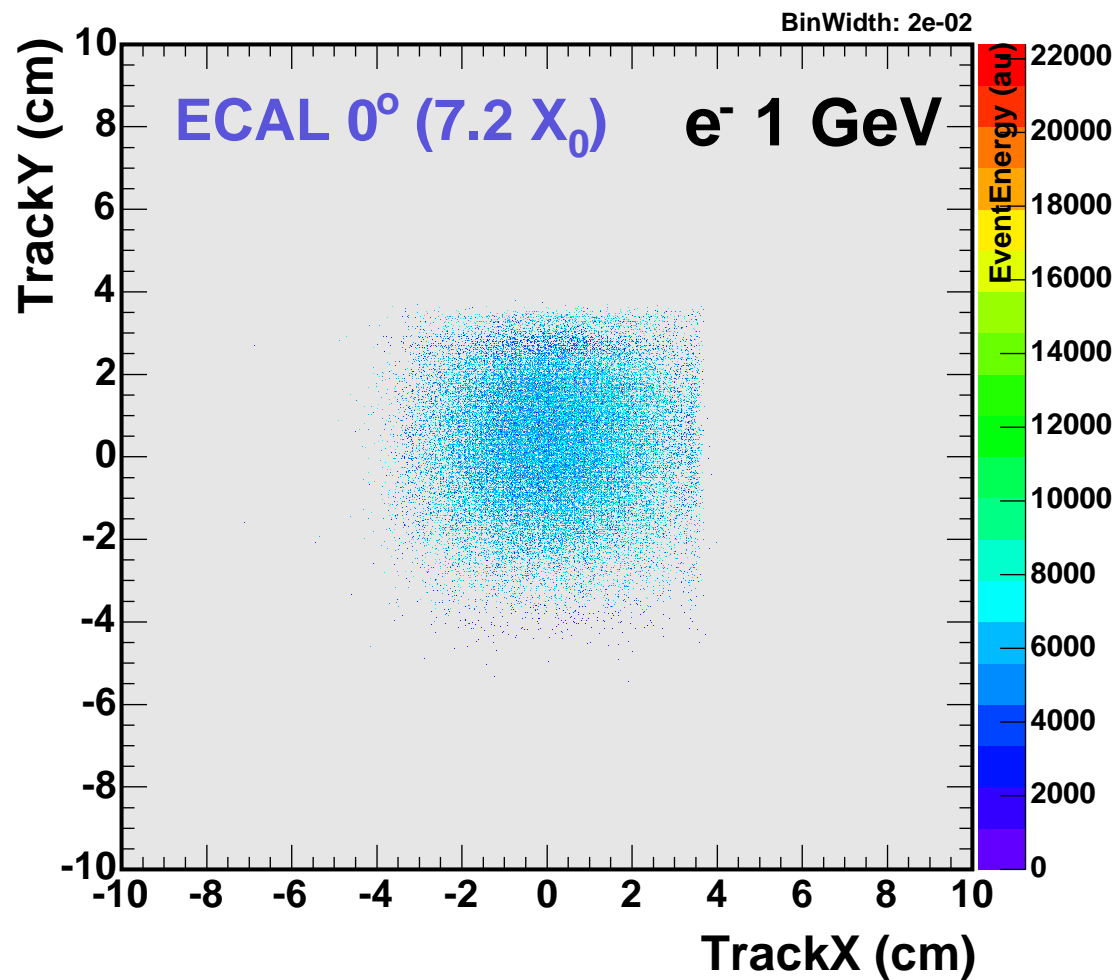
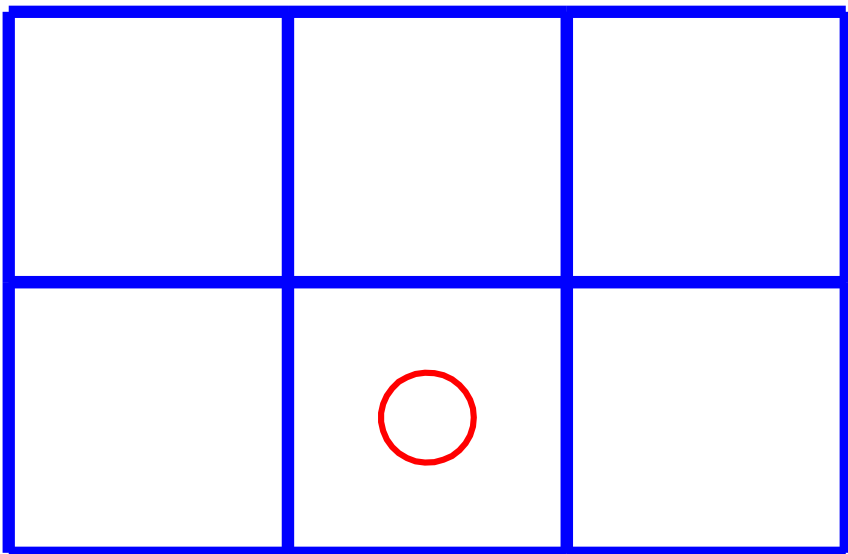


# Position scan

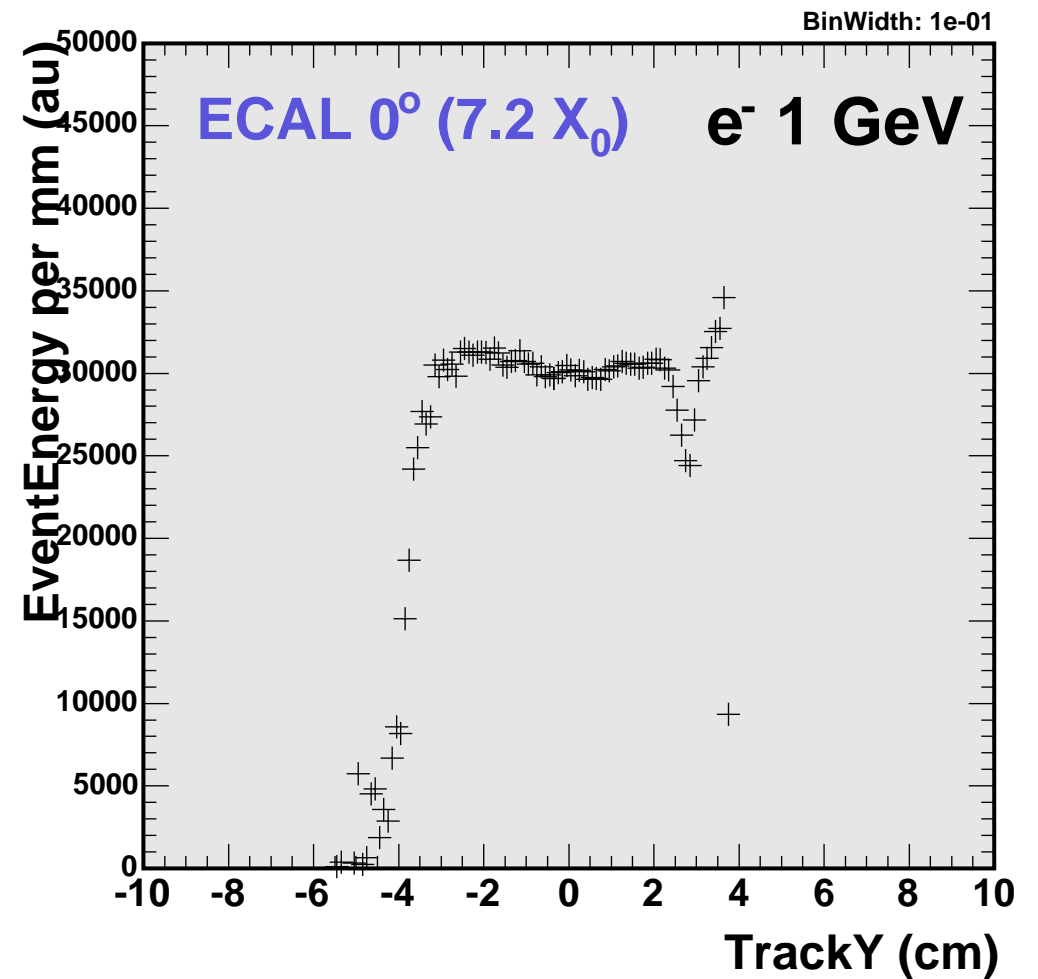
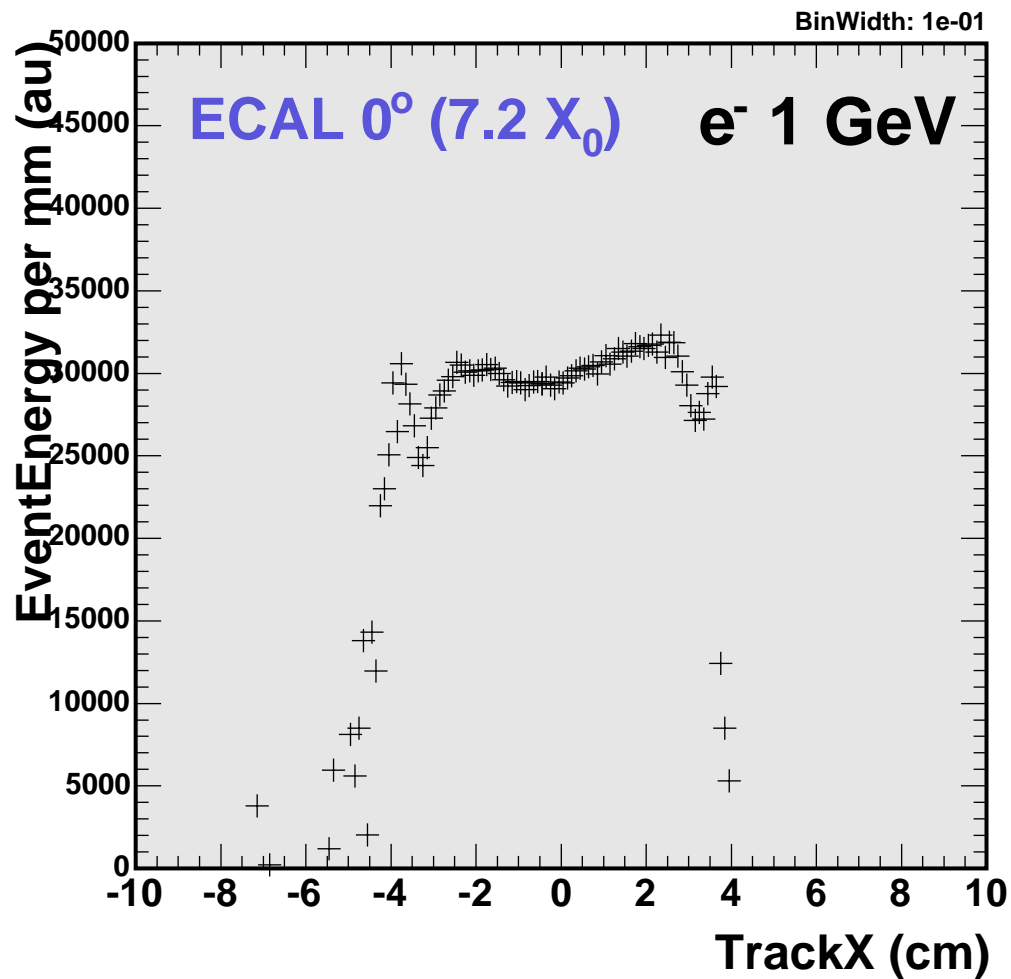


- ▷ ShowerX,Y from barycenter in ecal
- ▷ TrackX,Y from 4 drift chambers

# Position scan - center of wafer

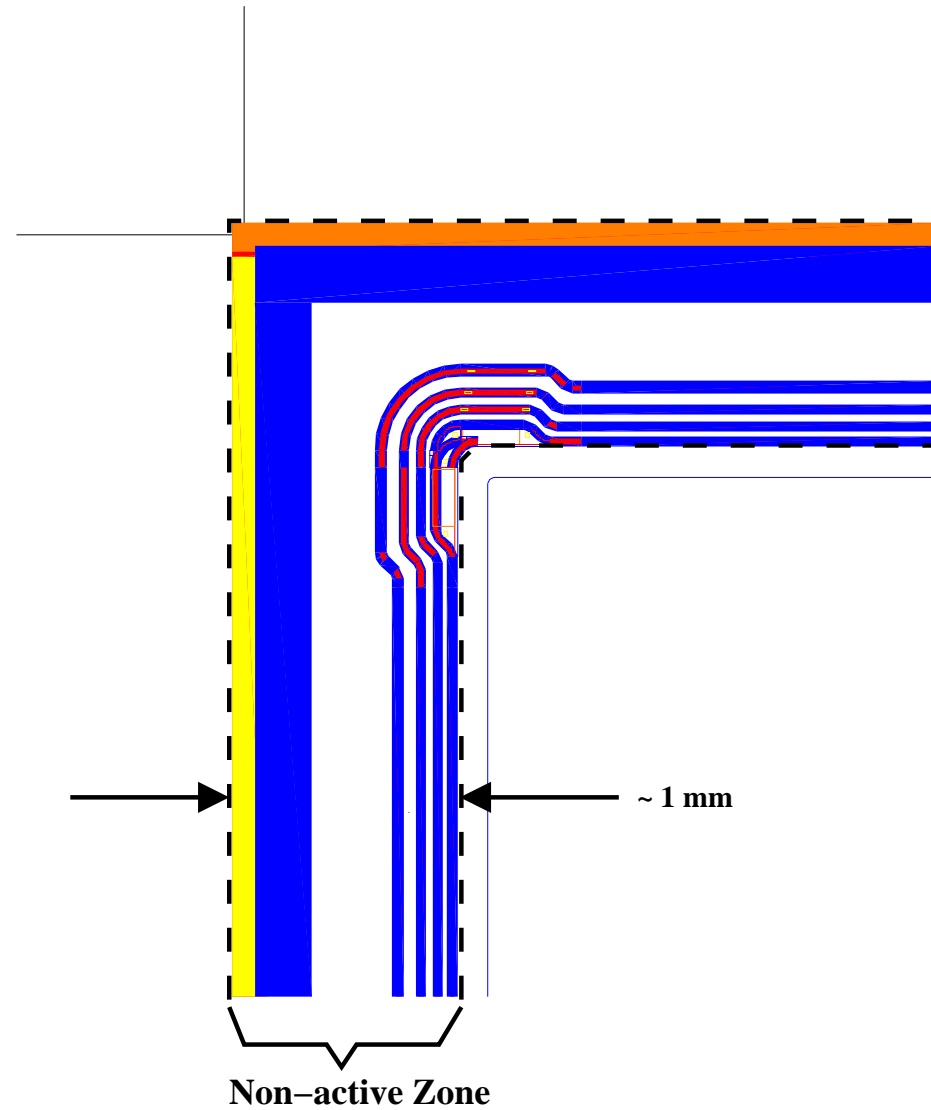


# Position scan - center of wafer

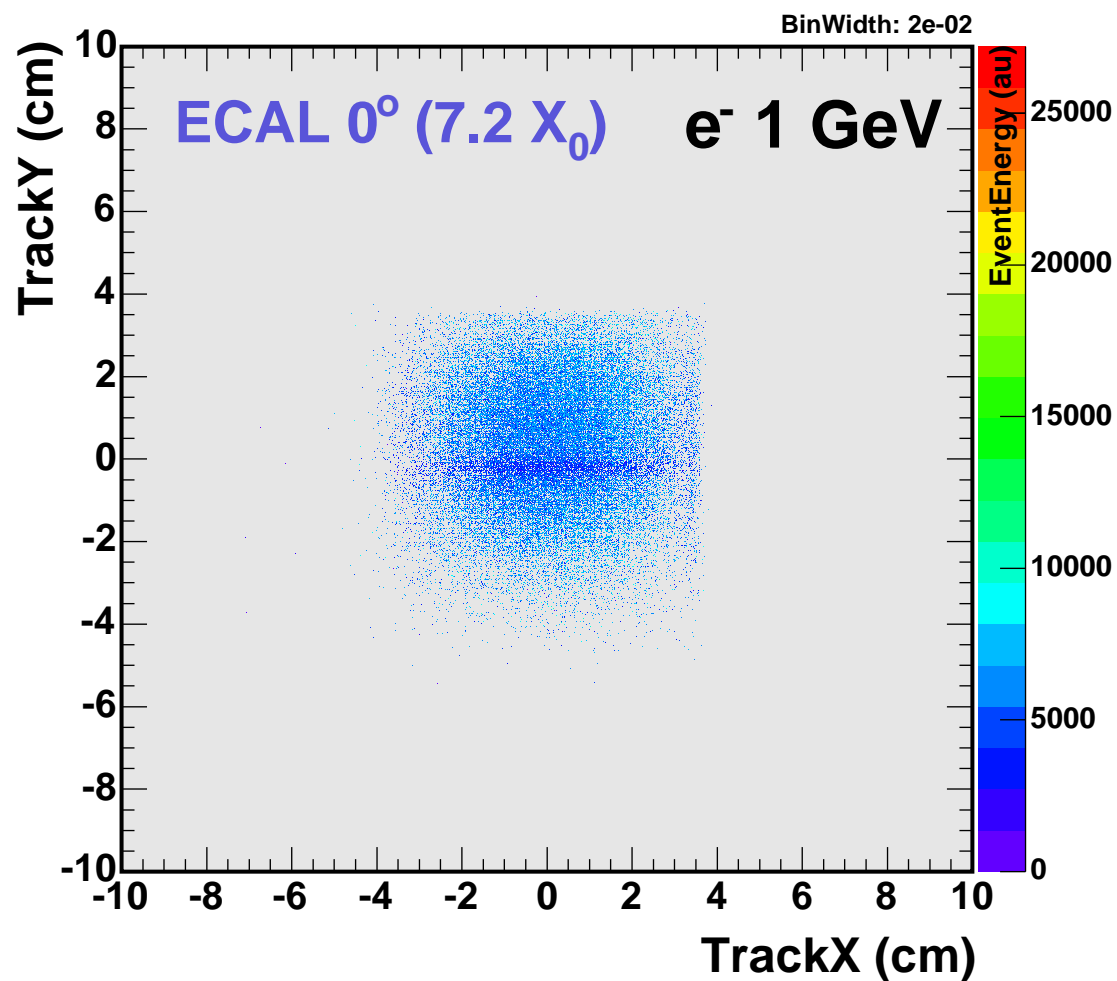
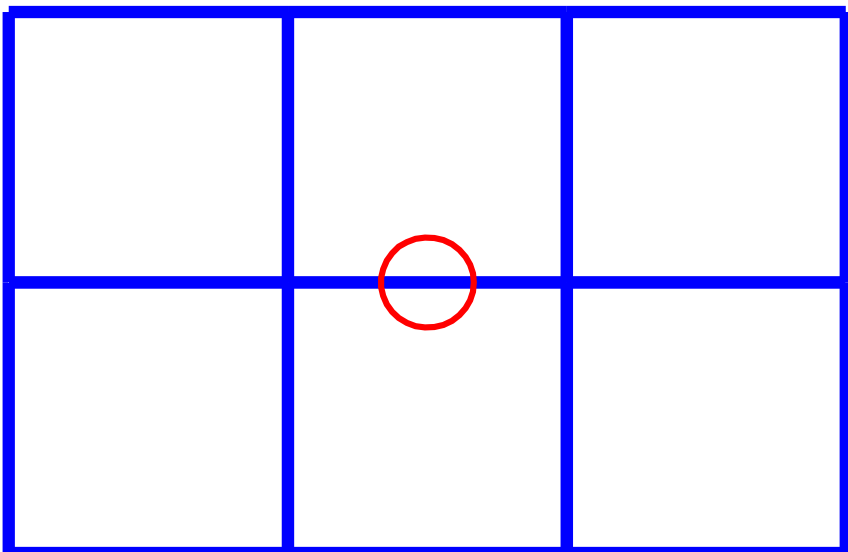


▷ PRELIMINARY

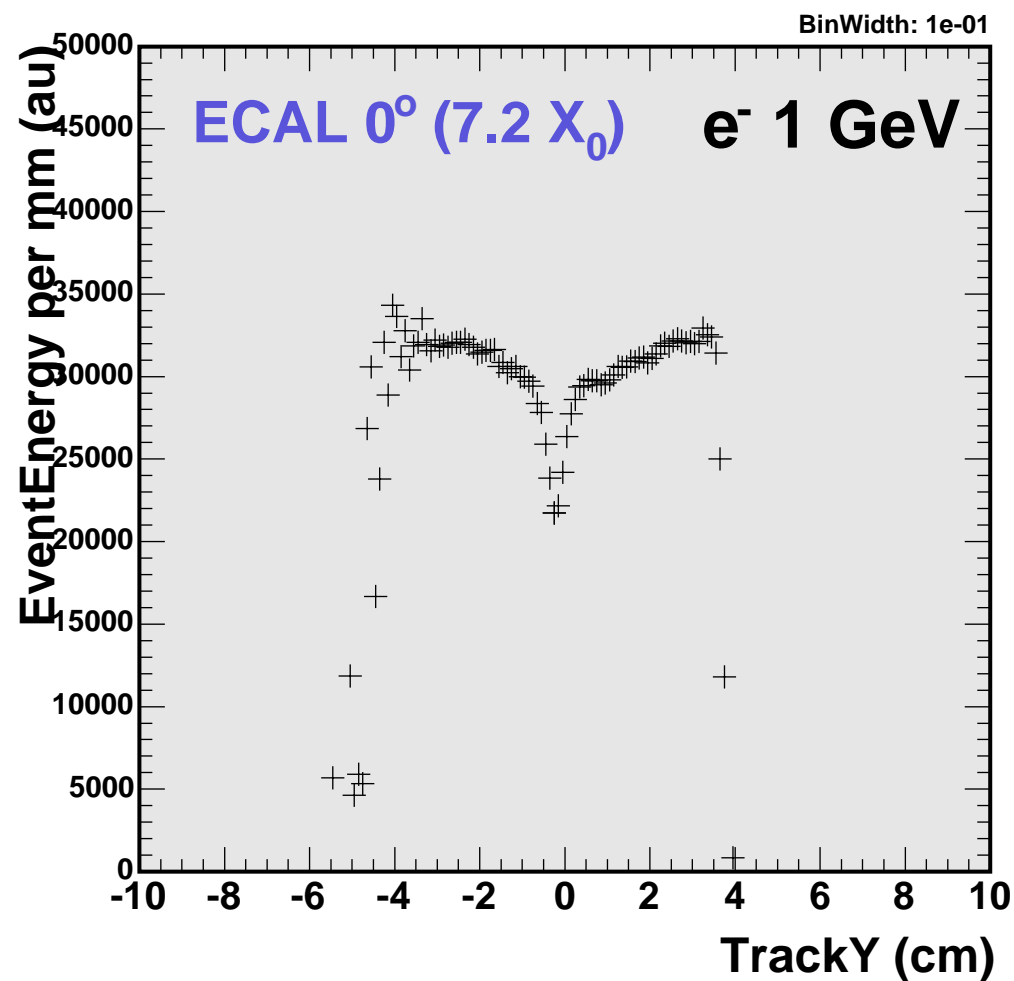
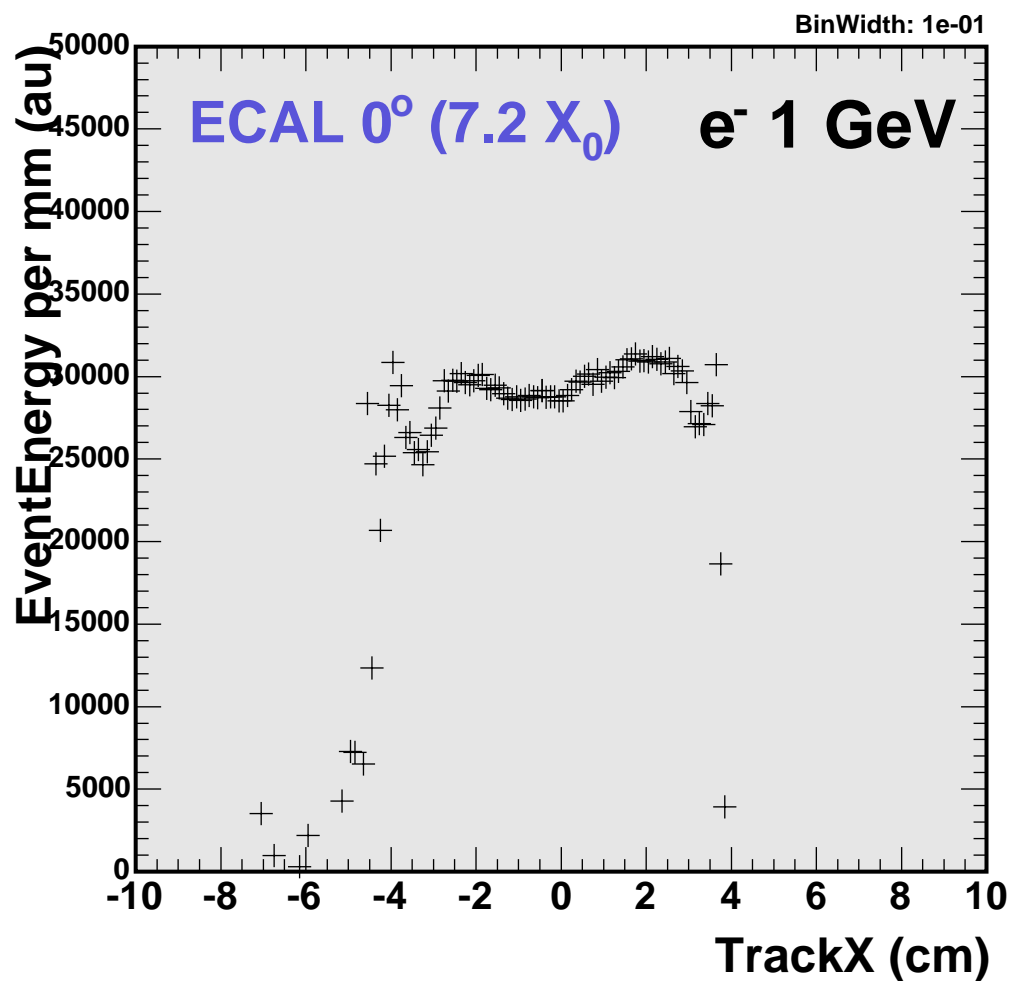
# Wafer border



# Position scan - edge of wafer

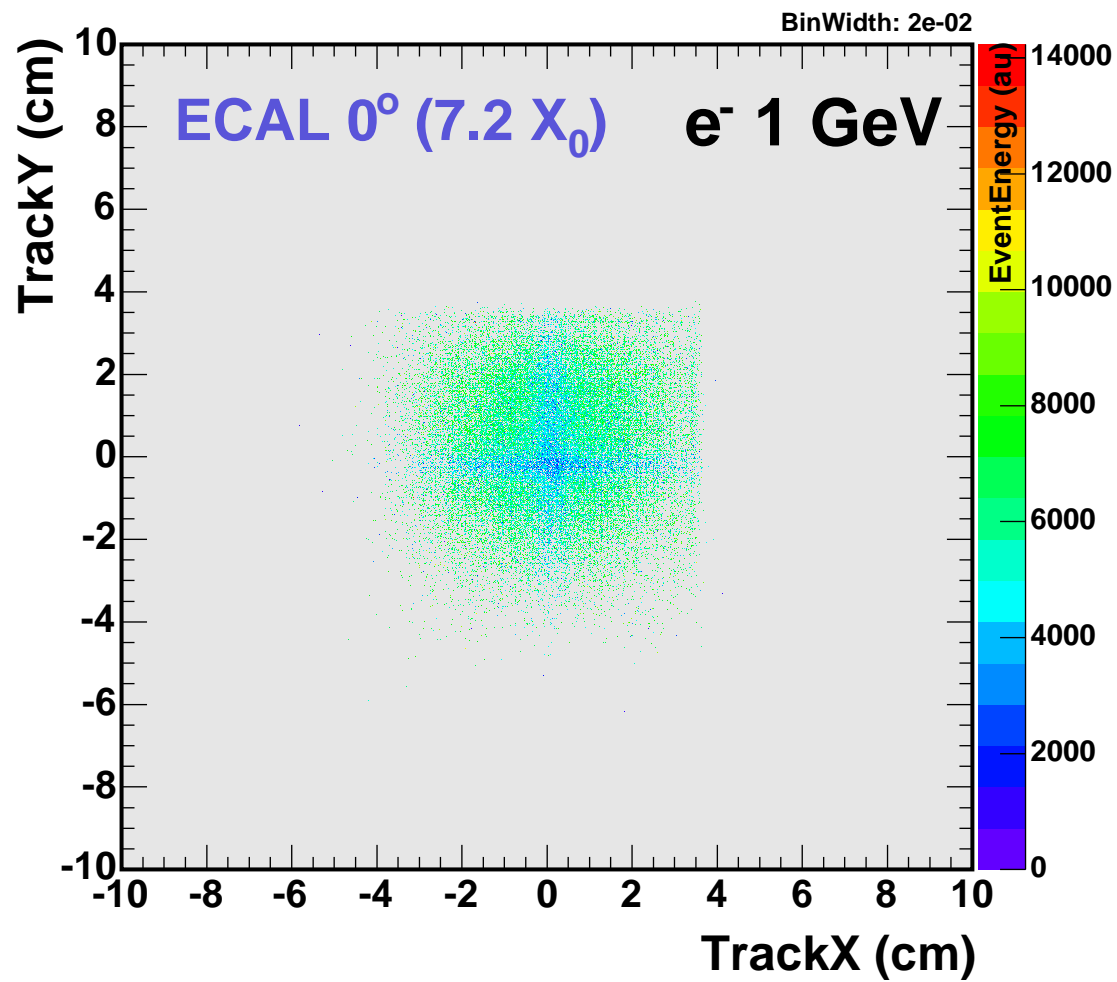
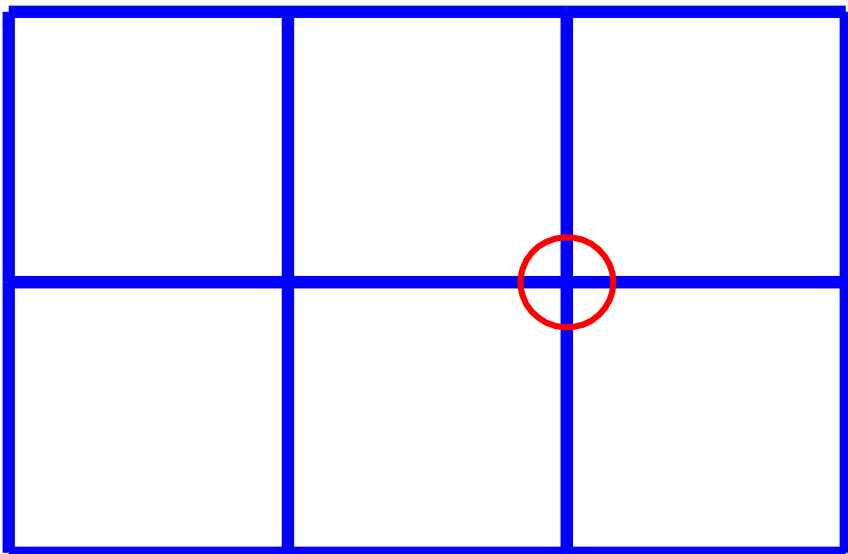


# Position scan - edge of wafer

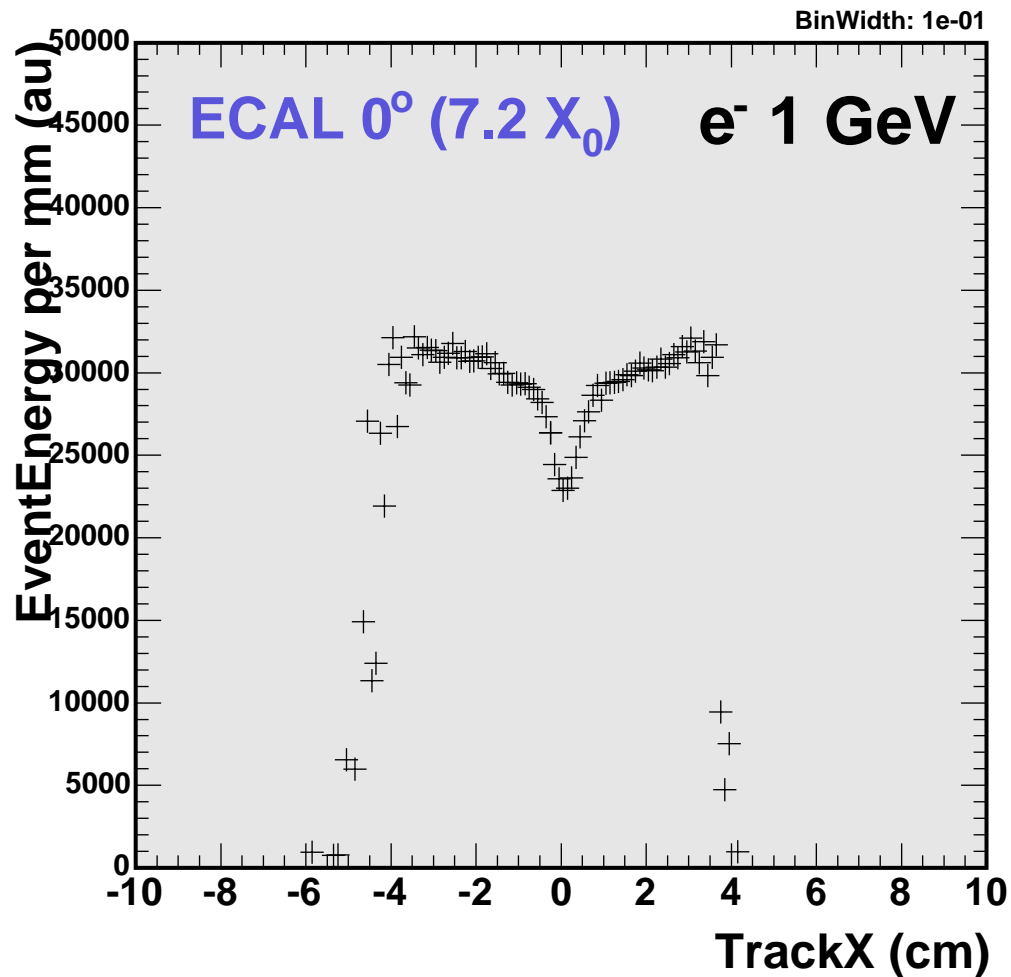


▷ PRELIMINARY

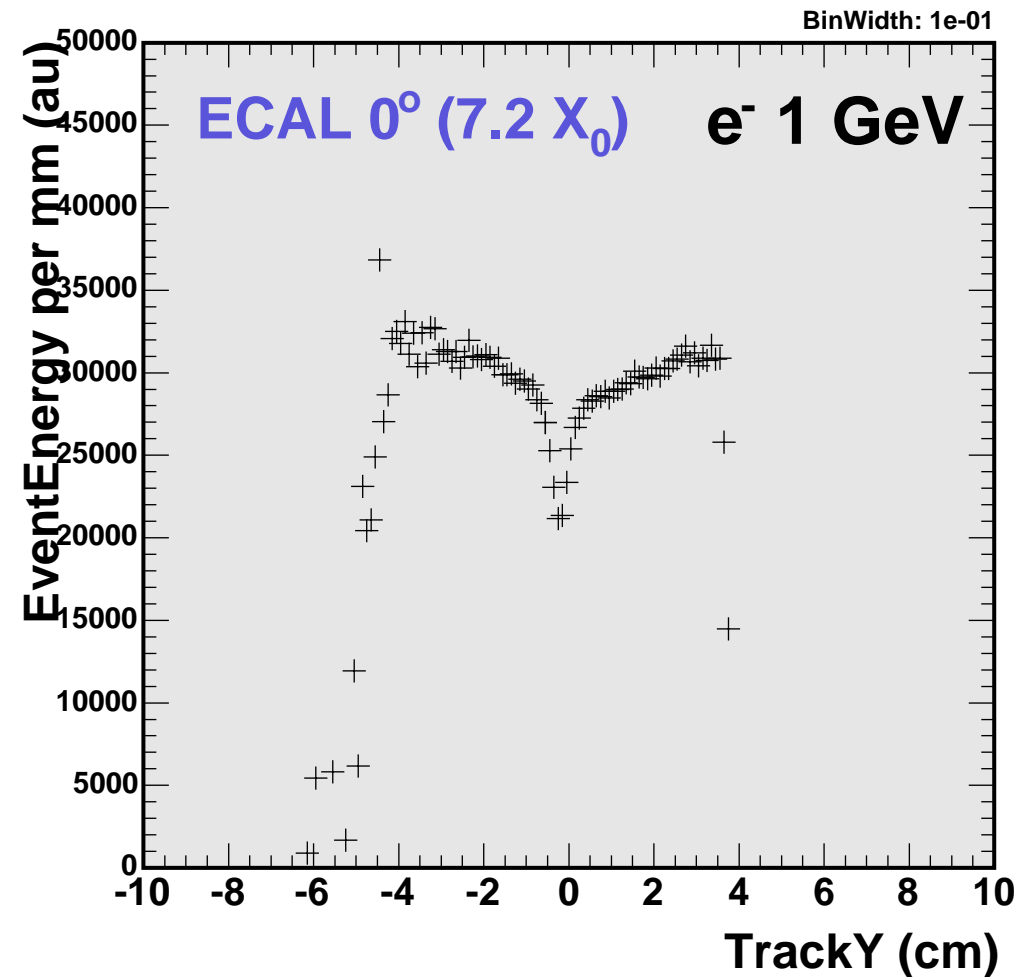
# Position scan - corner of wafer



# Position scan - corner of wafer



- ▷ alternate layers staggered along X
- ▷ dip is shallower and wider



- ▷ layers not staggered along Y
- ▷ dip is deeper and narrower

▷ PRELIMINARY



# Summary

- ▶ **first "1/3" of CALICE Si/W ECAL prototype**
  - : 3024 channels of  $1 \times 1 \text{ cm}^2$ ,  $7.2 X_0$
  - : first testbeam at DESY with  $e^-$  (Jan/Feb05), very smooth, a lot of data collected
- ▶ **analysis has just started**
  - : do systematic studies and understand the detector before the next round
- ▶ **next testbeam planned for Jun05**
  - : with more layers-channels