

# Si/W ECAL Testbeam at DESY 2006

Working Report

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## Outline

- ▶ **General - Reminder**
- ▶ **Chamber/Tdc mapping**
- ▶ **Studies on response uniformity**
- ▶ **Work in progress - Scope of interest**
- ▶ **Summary**

# ECAL testbeam at DESY, May 2006

## ▶ - Si/W prototype

: 24 layers (10 at 1.4mm W + 10 at 2.8mm + 4 at 4.2mm) equipped with  
18 × 12 matrix of active Si cells, **cellsize: 1 × 1 cm<sup>2</sup>**,  
total: **5184 channels**

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

: testbeam with electrons

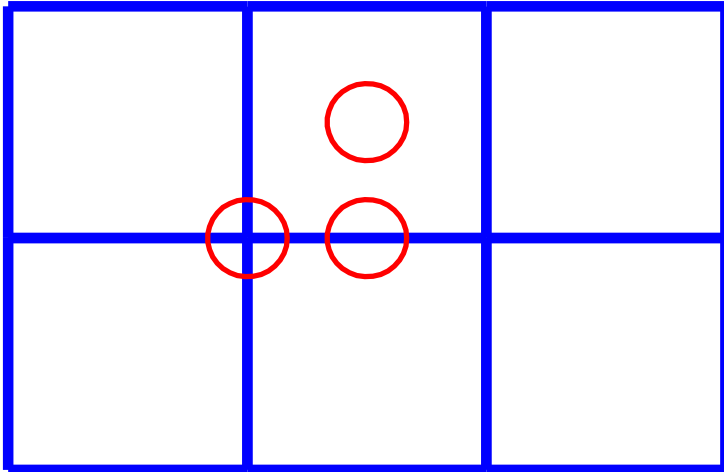
: position scan (center - edge - corner of wafers)

energy scan (1, 1.5, 2, 3, 4, 5, 6 GeV)

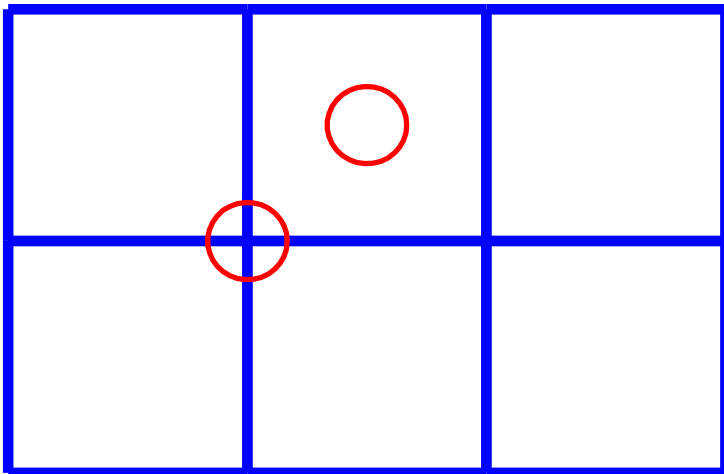
angle scan (0°, 10°, 20°, 30°, 45°)

: **total: ~ 8 Mevents**

# Testbeam at DESY with electrons



- ECAL at  $0^\circ$   
three position points
- energy scan (1, 1.5, 2, 3, 4, 5, 6 GeV)
- 100k events per sample



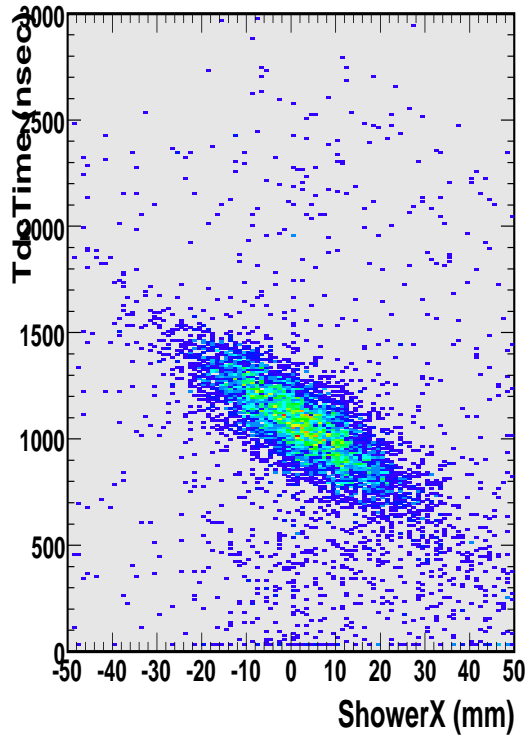
- angle scan ( $10^\circ$ ,  $20^\circ$ ,  $30^\circ$ ,  $45^\circ$ )  
two position points
- energy scan (1, 1.5, 2, 3, 4, 5, 6 GeV)
- 100k events per sample

# TdcMap of ECAL Testbeam DESY2006

- ▶ .
  - : confusion with what was written at the logbook, "checks" on site etc
  
- ▶ .
  - : correlate shower barycenter at ECAL and tdc time and try to extract the correct mapping, parity, position etc. of each chamber channel, do checksums of channels with alternating parity
  
- ▶ . **work in progress**
  - : extract position shifts among chamber centers
    - method 1: 3point fitting and extrapolation/interpolation to the 4th chamber or
    - method 2: 4point fitting at once
  - then if there is no shift, distribution of residuals should be centered at zero
  
- ▶ .
  - : see also Michele's talk for drift velocity/tracking studies

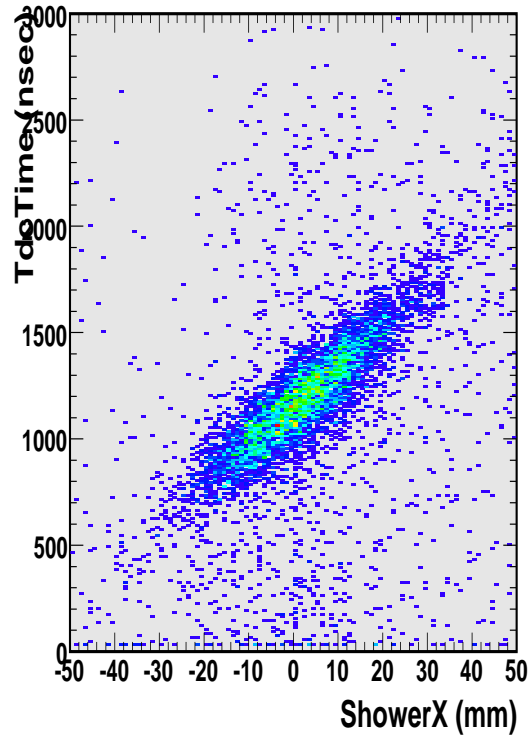
# TdcTime vs ShowerX

TdcTime[9] vs ShowerX

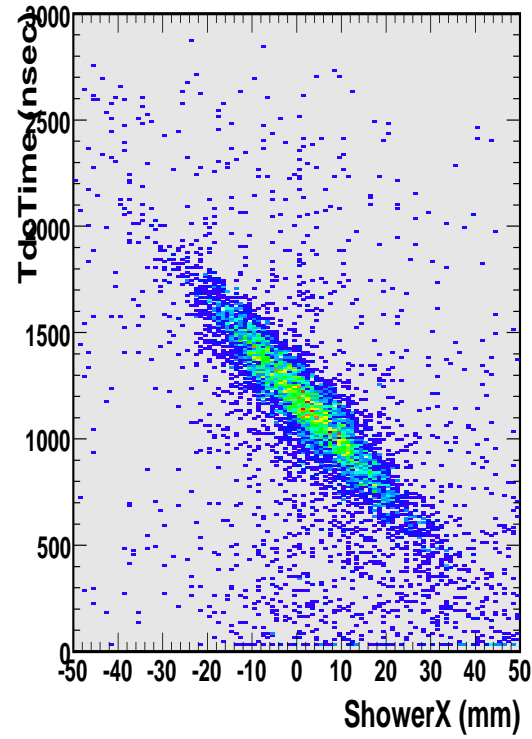


closer to beamgun

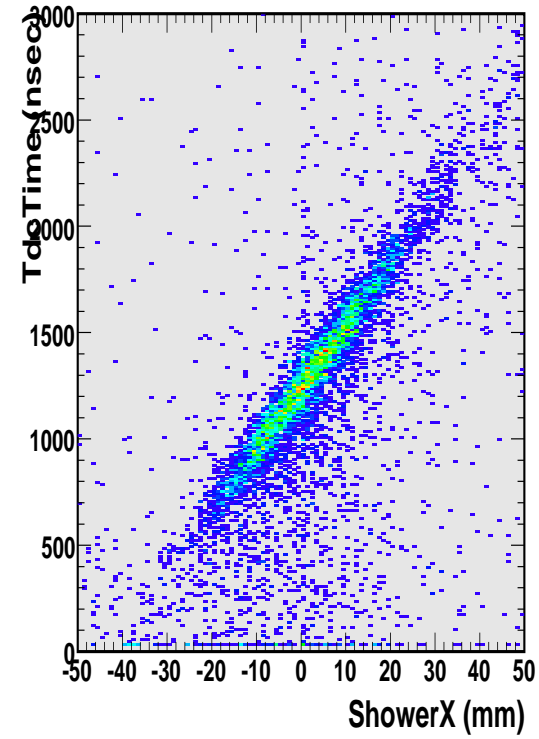
TdcTime[7] vs ShowerX



TdcTime[5] vs ShowerX



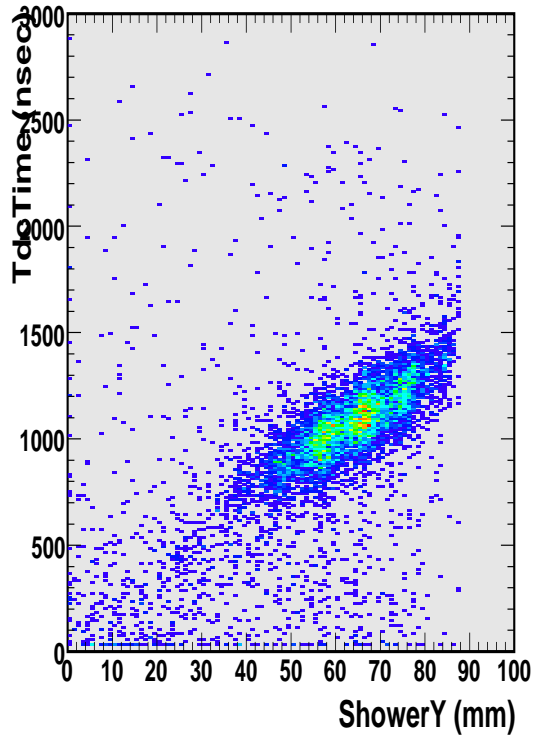
TdcTime[3] vs ShowerX



closer to ecal

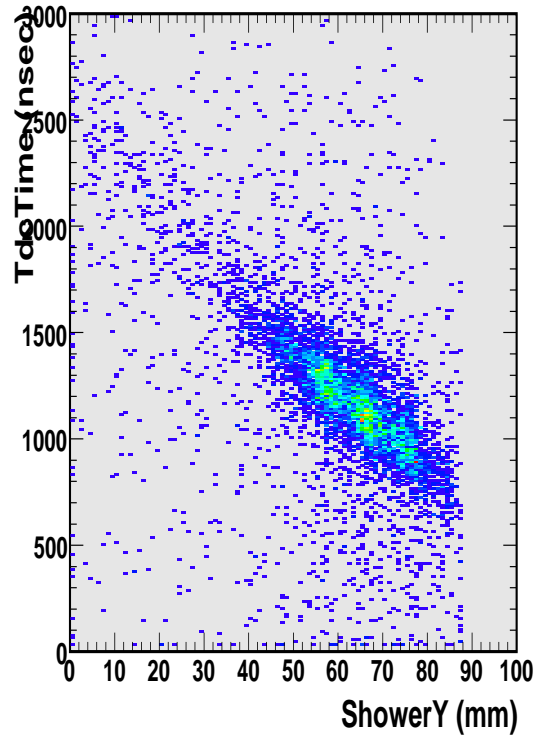
# TdcTime vs ShowerY

TdcTime[10] vs ShowerY

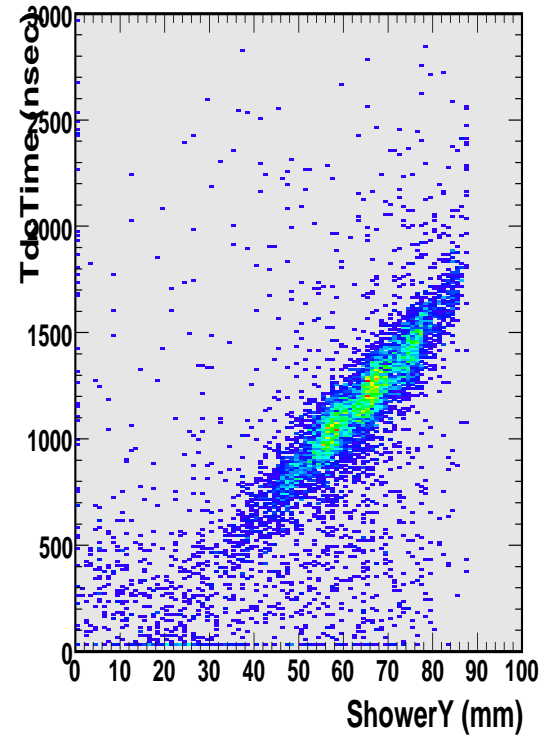


closer to beamgun

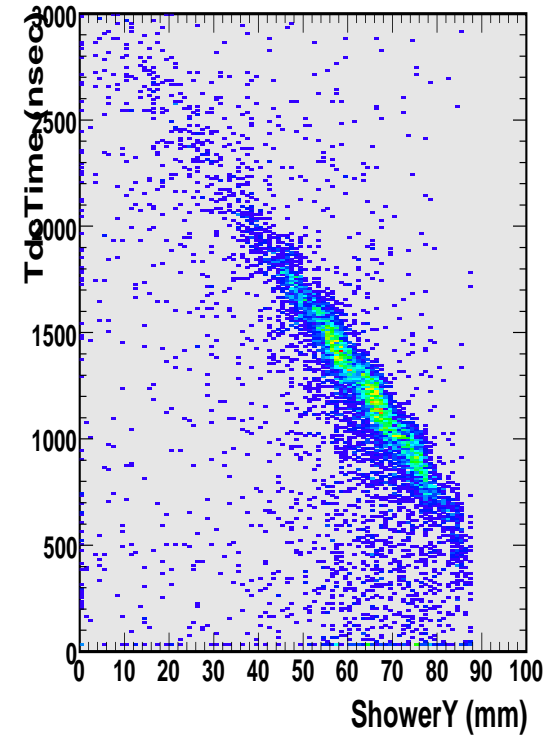
TdcTime[8] vs ShowerY



TdcTime[6] vs ShowerY

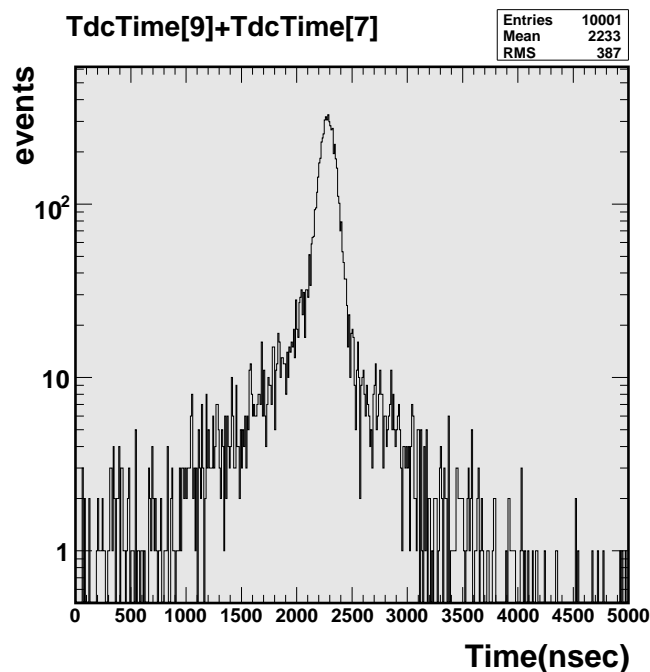


TdcTime[4] vs ShowerY

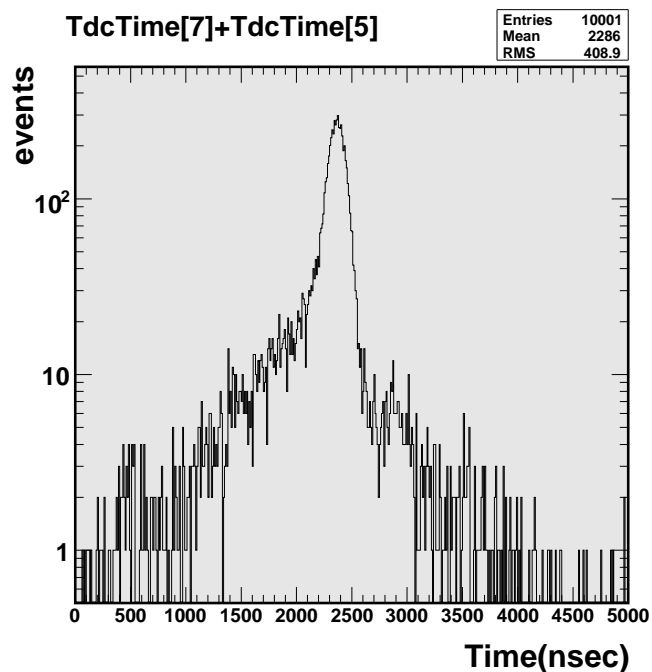


closer to ecal

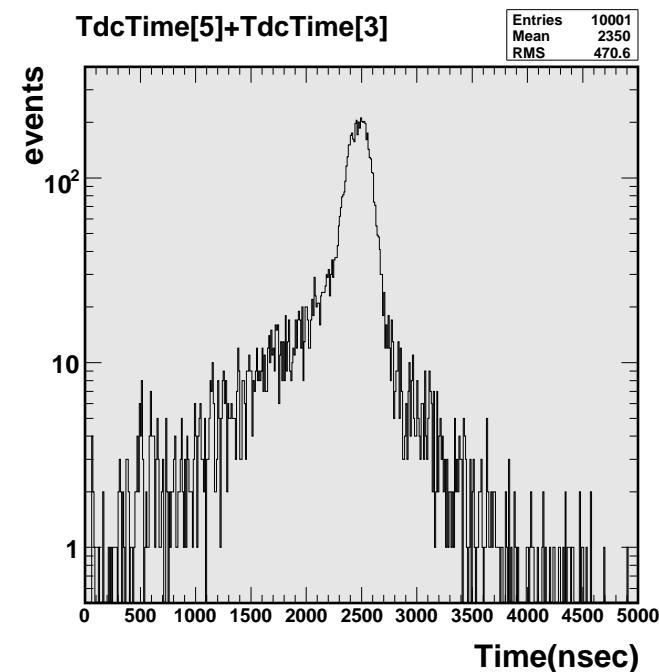
# Checksums for channels along X



9+7

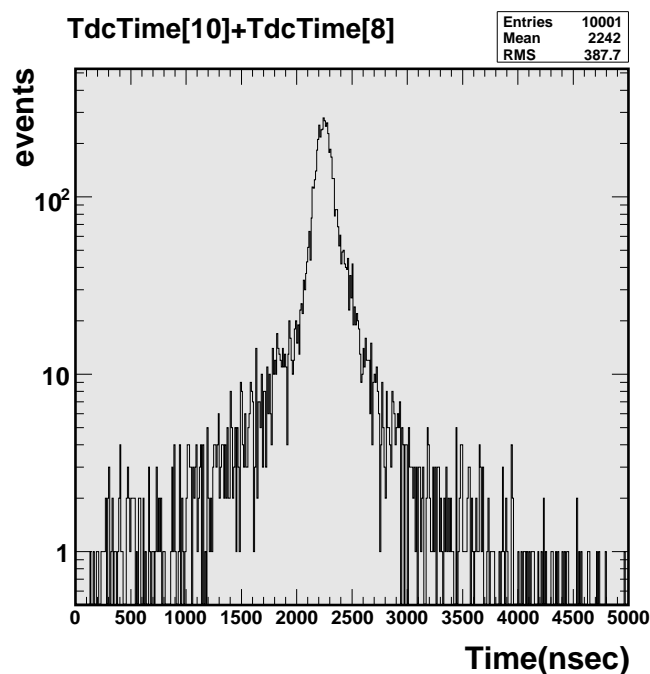


7+5

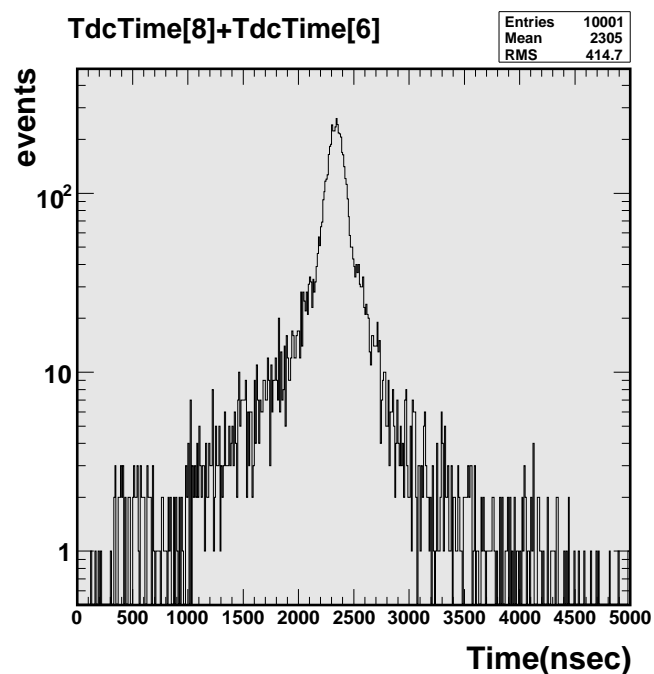


5+3

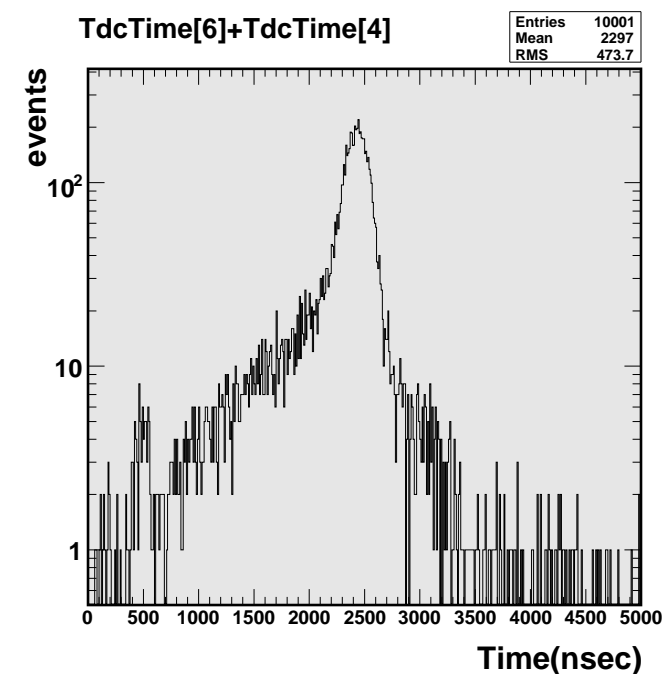
# Checksums for channels along X



**10+8**



**8+6**



**6+4**



# Conventions

- ▶ . : righthanded coordinate system with beam coming from **-Z**

so

+X is left  
-X is right  
+Y is up  
-Y is down

- ▶ . : define **parity=+1** when drift velocity and unit vector point to the same direction

$$TrackX_i = centerX_i + parityX_i \cdot (length/2 - timeX_i \cdot u_{drift})$$

$$TrackY_i = centerY_i + parityY_i \cdot (length/2 - timeY_i \cdot u_{drift})$$

$i$  denotes position order along Z

# TdcMap DESY2006

TdcChannel [0...15]	Chamber Name	Position [0...3]	Direction 0=X,1=Y	Parity,Wire +1=up or left, -1=down or right
9	X4	0	0	+1, left
10	Y4	0	1	-1, down
7	X3	1	0	-1, right
8	Y3	1	1	+1, up
5	X1	2	0	+1, left
6	Y1	2	1	-1, down
3	X2	3	0	-1, right
4	Y2	3	1	+1, up

# Si/W ECAL Testbeam at DESY 2006

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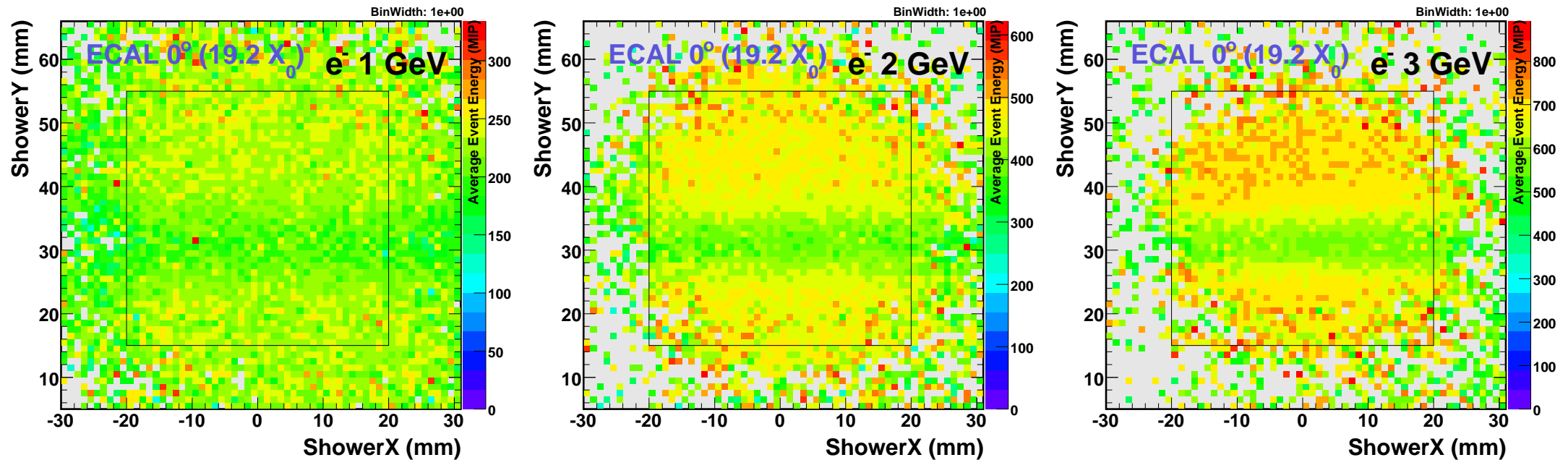
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## Outline

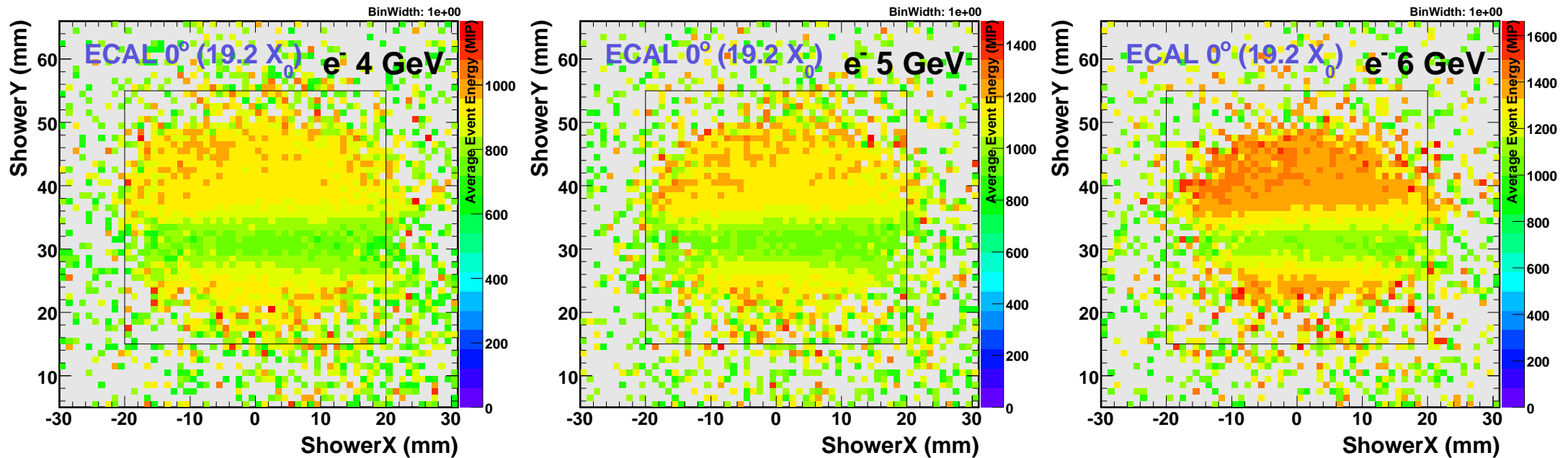
- ▶ General - Reminder
- ▶ Chamber/Tdc mapping
- ▶ **Studies on response uniformity**
- ▶ **Work in progress - Scope of interest**
- ▶ Summary

# Response map - edge of wafer



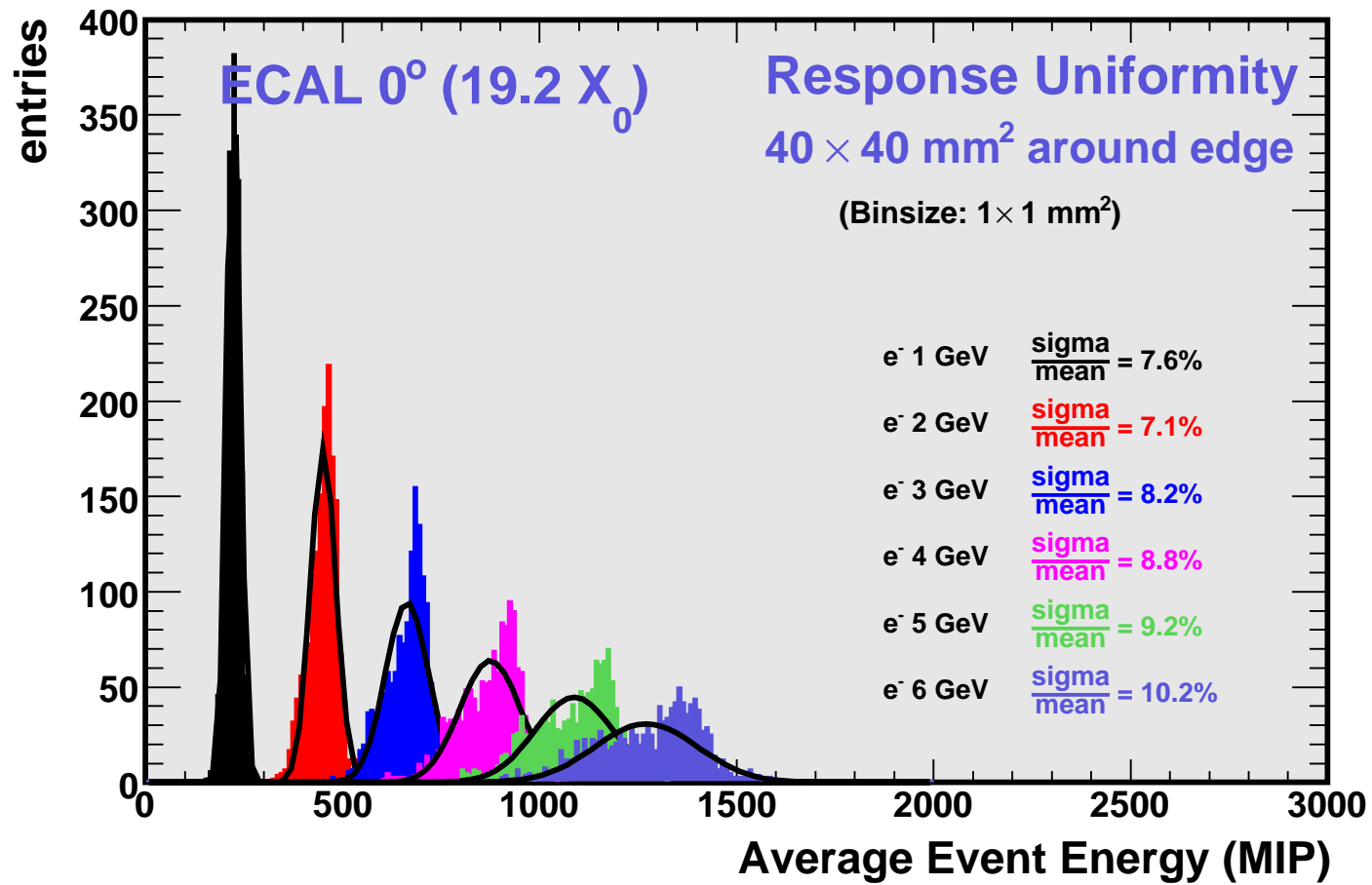
- ▶ average ECAL response vs shower barycenter
- ▶ square is  $40 \times 40 \text{ mm}^2$  area around edge of wafer, binsize is  $1 \times 1 \text{ mm}^2$

# Response map - edge of wafer



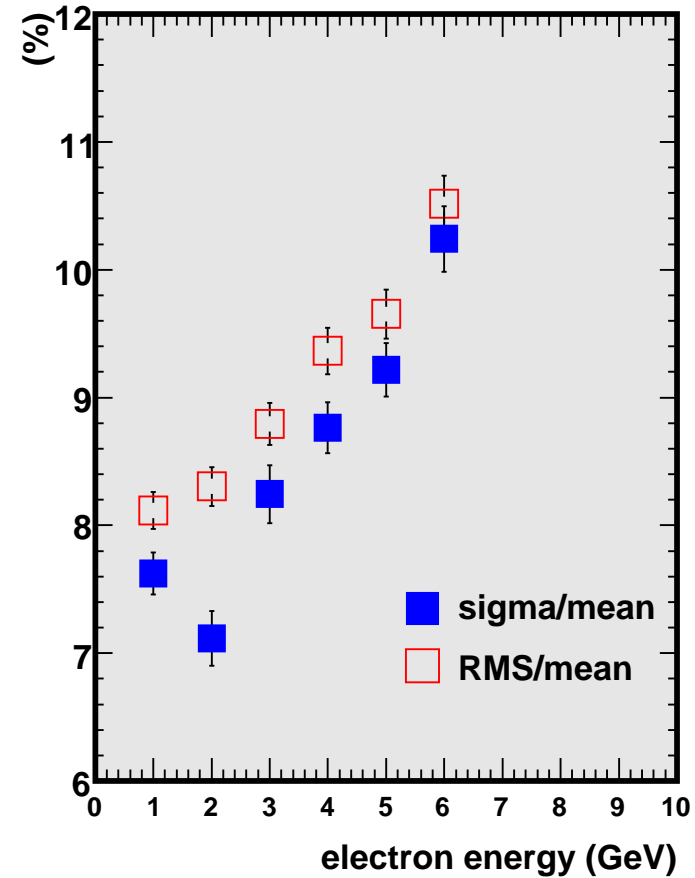
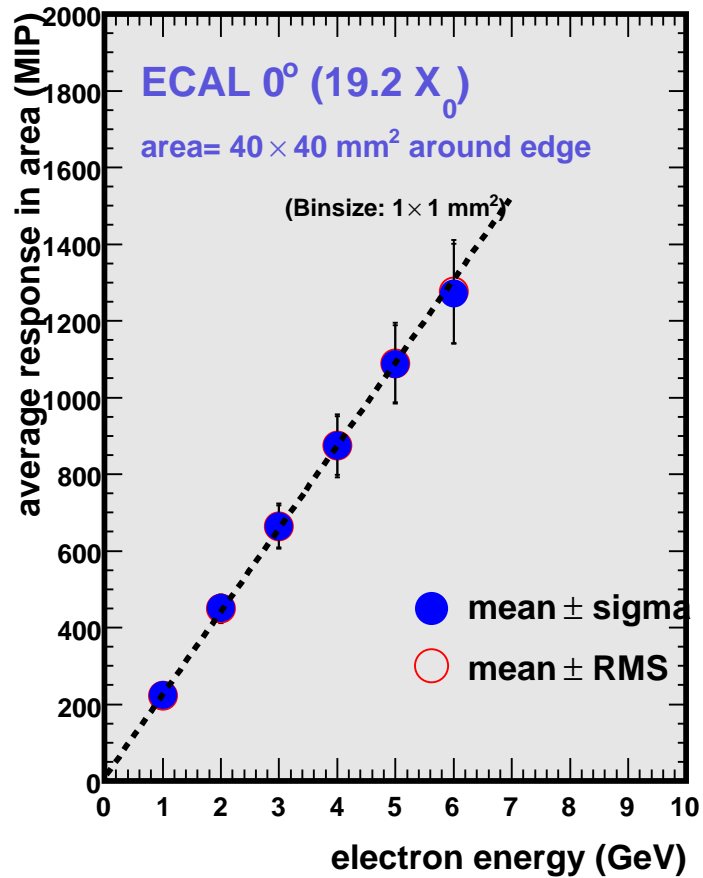
- ▶ average ECAL response vs shower barycenter
- ▶ square is  $40 \times 40 \text{ mm}^2$  area around edge of wafer, binsize is  $1 \times 1 \text{ mm}^2$

# Response Uniformity



(energy and fiducial volume cuts applied)

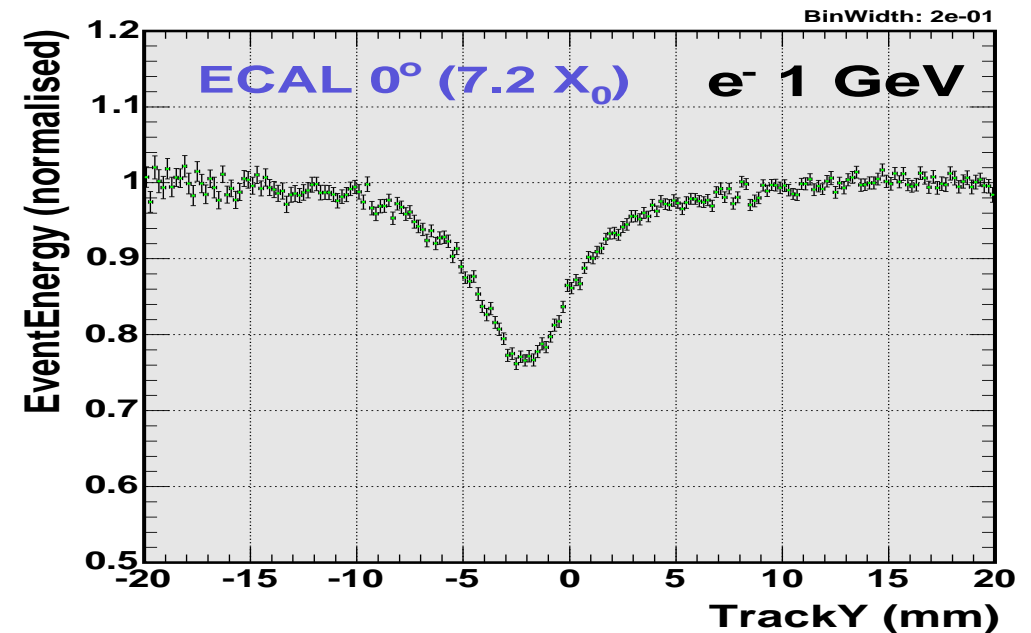
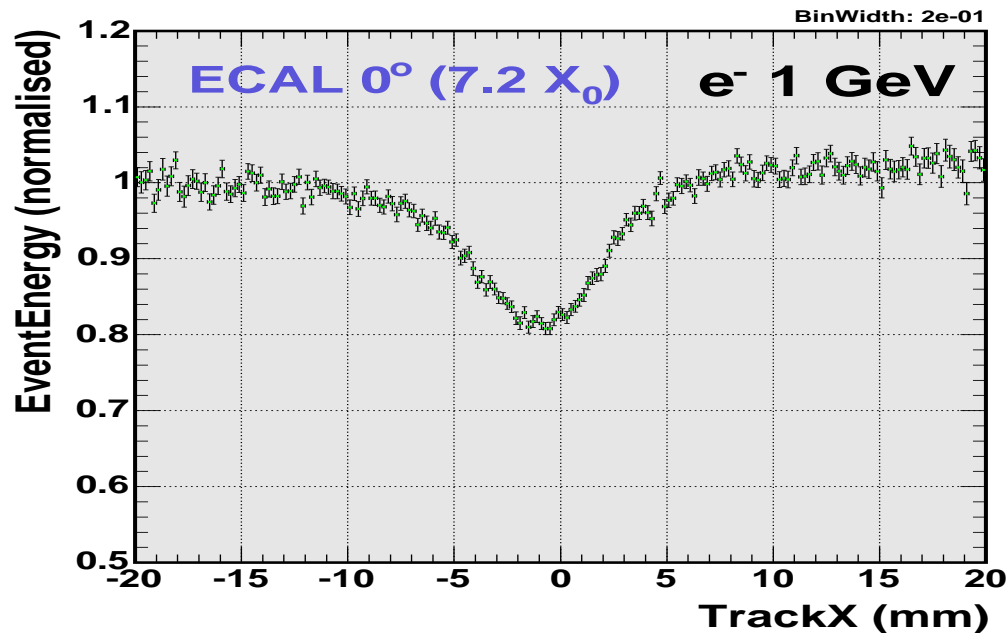
# Response Uniformity



(energy and fiducial volume cuts applied)

# Correction Schemes

## Position scan along wafer borders (DESY2005)



- ▷ alternate layers staggered along X (by 2.5 mm)
- ▷ dip is shallower and wider

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

- ▷ Try to correct for response degradation due to gap around wafers
- ▷ Apply various correction/weighting schemes and study improvement



# Correction Schemes

wafer

C1	B1	B1	B1	B1	C1
A1					A1
A1					A1
A1					A1
A1					A1
C1	B1	B1	B1	B1	C1

3 correction regions

wafer

C1	B1	B1	B1	B1	C1
A1	C2	B2	B2	C2	A1
A1	A2			A2	A1
A1	A2			A2	A1
A1	C2	B2	B2	C2	A1
C1	B1	B1	B1	B1	C1

6 correction regions

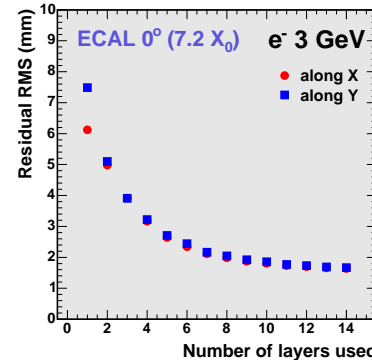
... etc ...

- ▷ Apply various correction schemes and study improvement on ECAL response uniformity, resolution etc

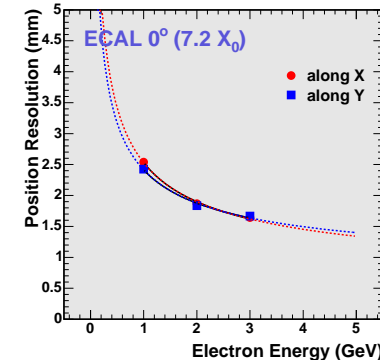
# Work in progress/Scope of interest

## Position resolution

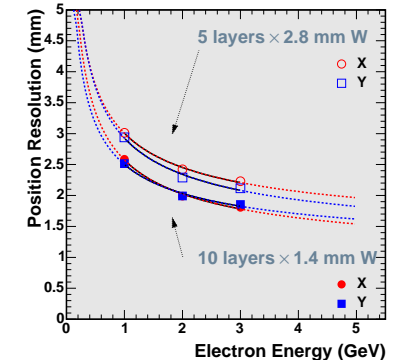
- : data from DESY 2006 testbeam with more layers and up to 6 GeV energy
- : repeat/extend studies



vs layers



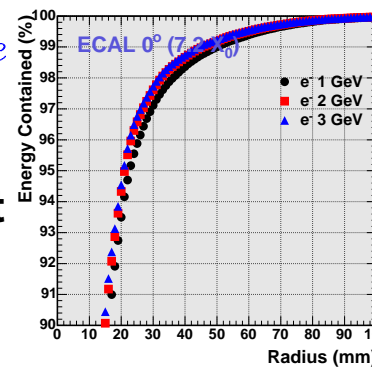
vs energy



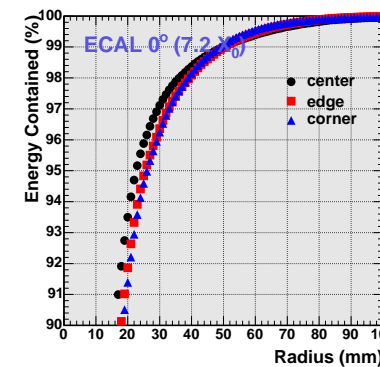
vs sampling

## Transverse containment, $R_{Moliere}$

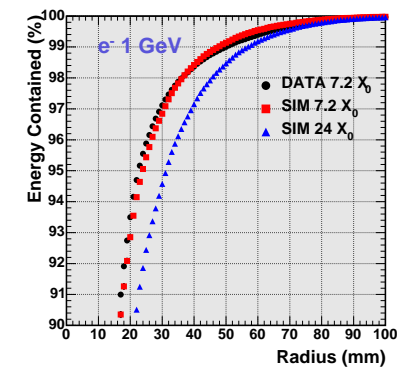
- : extract effective Moliere radius, study variation vs energy, impact point
- : compare data with simulation



vs energy



vs position



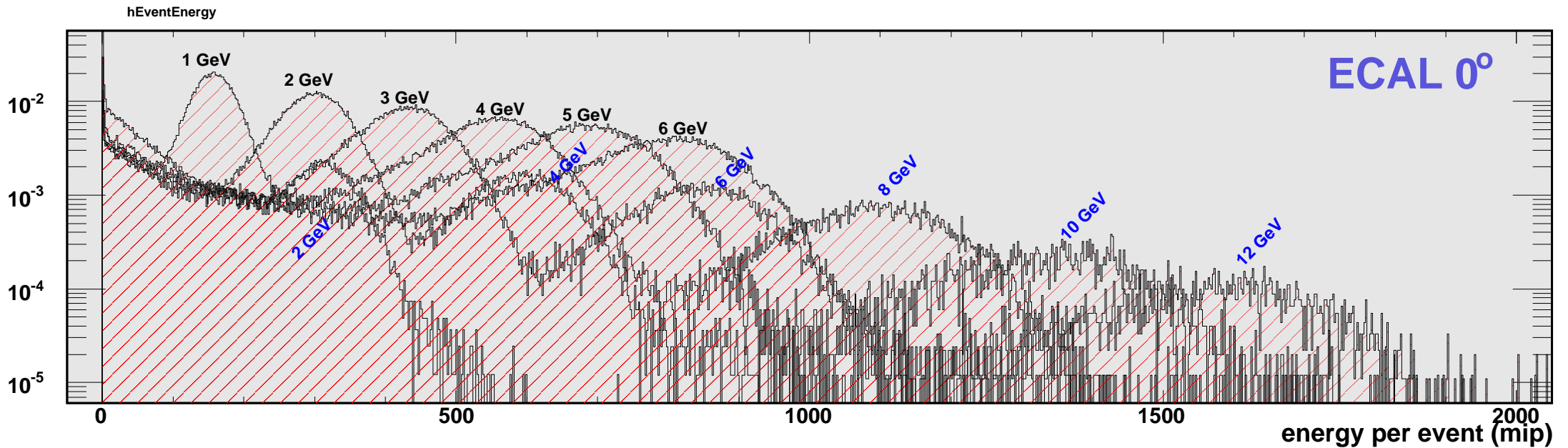
data - sim

# Summary - Outlook

- ▶ **Chamber/Tdc mapping**
  - : situation resolved
  - : **todo:** extract position shifts among chamber centers
  
- ▶ **Ecal response uniformity**
  - : report on preliminary studies based on shower barycenter
  - : refine and repeat studies with impact point determined by tracking
  - : apply correction schemes and study performance improvement
  
- ▶ **transverse containment, position resolution**
  - : first results soon

# "Longterm" plans - Clustering

ECAL Testbeam DESY 2006



**REMINDER**



- ▶ a lot of events with 2 incident particles observed
- ▶ useful for clustering and double-particle separation/resolution studies
- ▶ (low priority at the moment, but very interesting subject)