

# CALICE-ECAL testbeam topics

G.Mavromanolakis, University of Cambridge



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## Outline

- ▶ **Testbeam results** \*
  - : position resolution, tracking performance
  - : response map, inhomogeneity
  - : transverse containment, Moliere radius

\* see [www.hep.phy.cam.ac.uk/~gmavroma/calice/documents/d051012\\_talk\\_desy.pdf](http://www.hep.phy.cam.ac.uk/~gmavroma/calice/documents/d051012_talk_desy.pdf)

- ▶ **Discussion topics**
  - : user instructions : shift schedule
  - : run planning : testbeam duration
  - : monitoring : data storage
  - : drift chambers : after the testbeam

# 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)

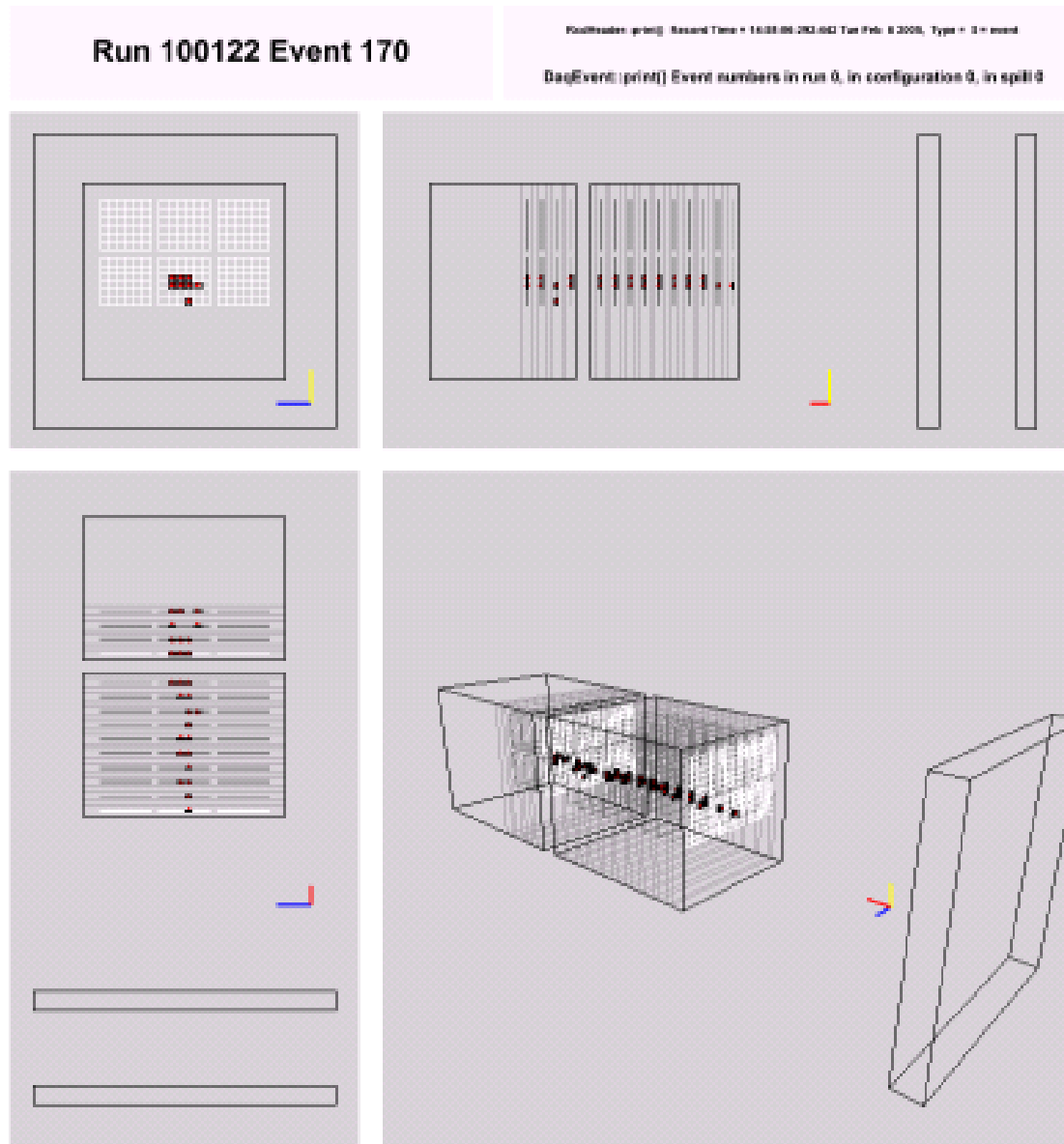
- ▶ . **next round in xx/2006 with more layers-channels**

# Testbeam Summary

week	events ( $e^-$ triggers)	time(sec)	average(Hz)	beam (timeON/time)	daq peak(Hz)
1 (Mon 050207 to Sat 050212)	5554662	425 $10^3$	13.07 Hz	~ 65%	~ 20 Hz
2 (Tue 050215 to Fri 050218)	4133217	290 $10^3$	14.25 Hz	~ 48%	~ 30 Hz
3 (Mon 050221 to Thu 050224)	5703056	255 $10^3$	22.36 Hz	~ 64%	~ 35 Hz

- ▶ in total 12 days at 15.5 Hz
- ▶ equivalent to 8 days at 23 Hz

# "Tracking Calorimetry"

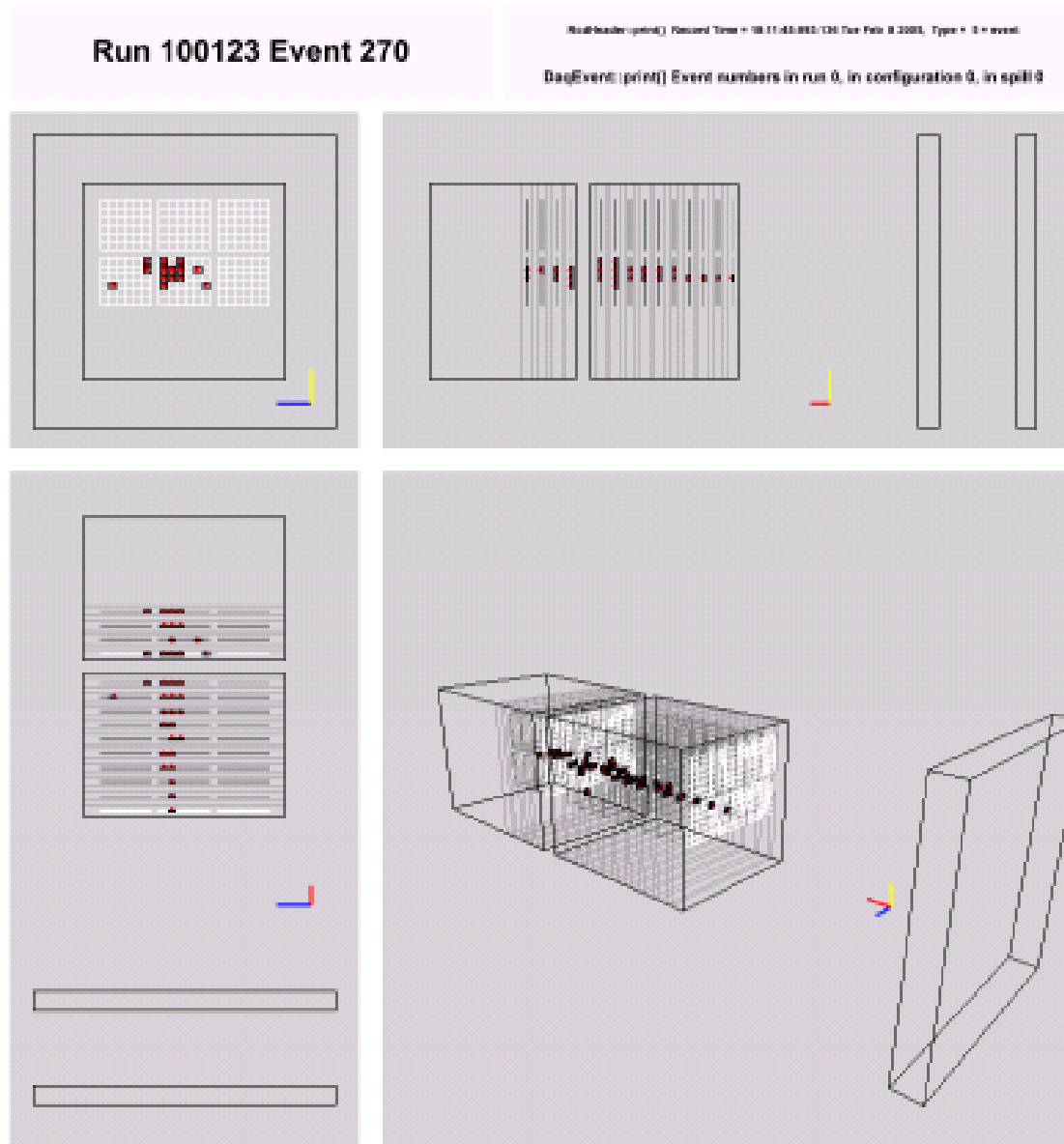


(not to scale)

$e^-$  1 GeV

cell threshold = 0.5 mip

# "Tracking Calorimetry"

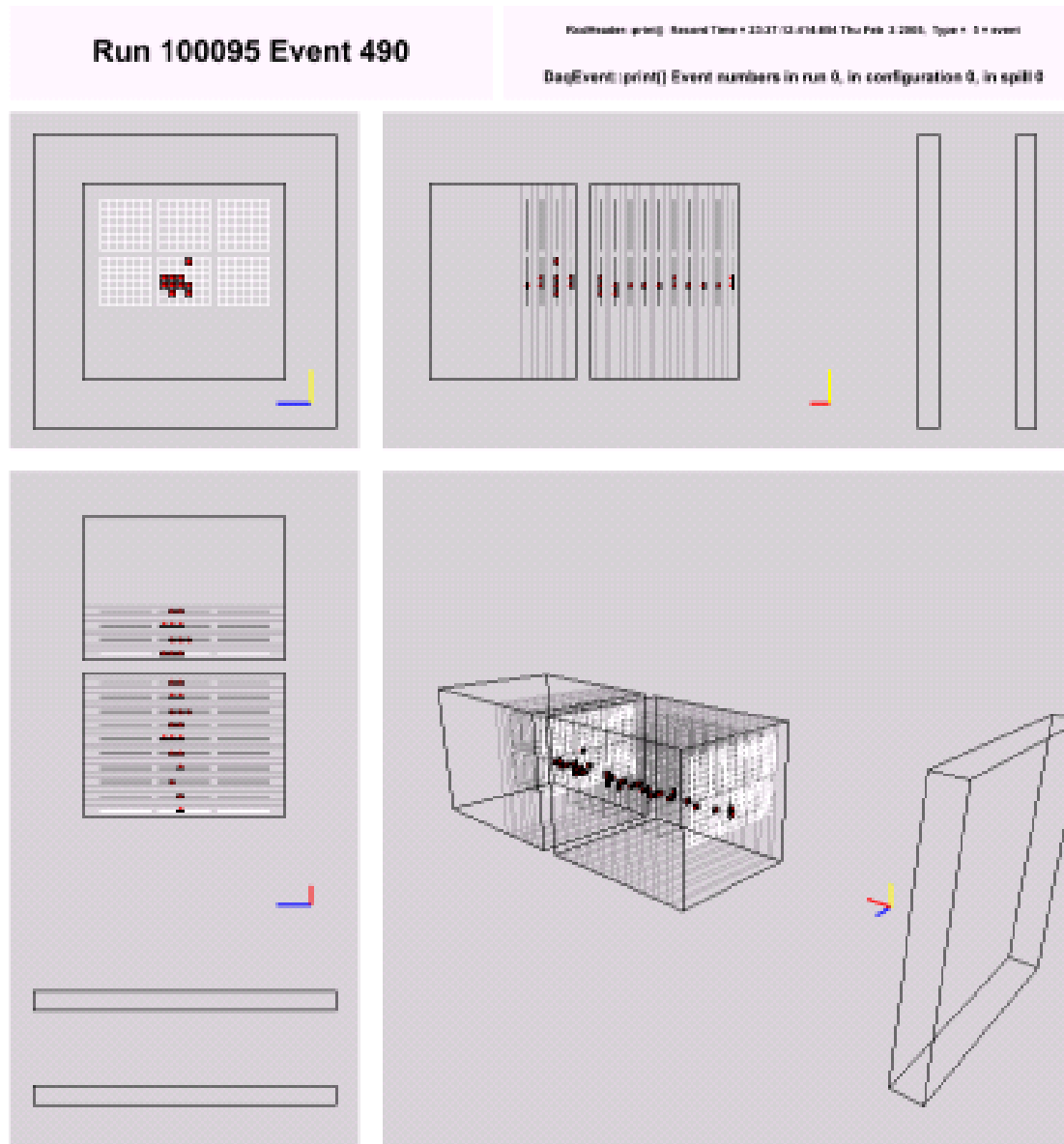


(not to scale)

$e^-$  2 GeV

cell threshold = 0.5 mip

# "Tracking Calorimetry"

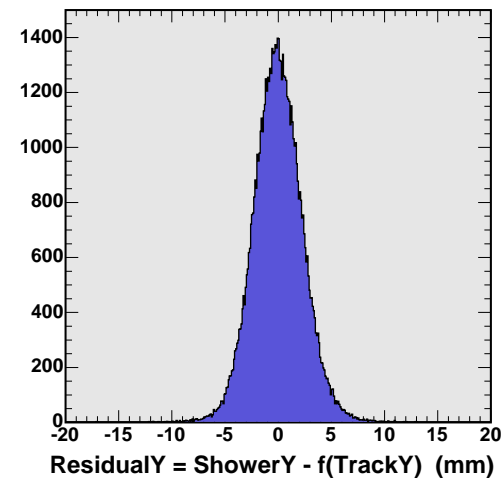
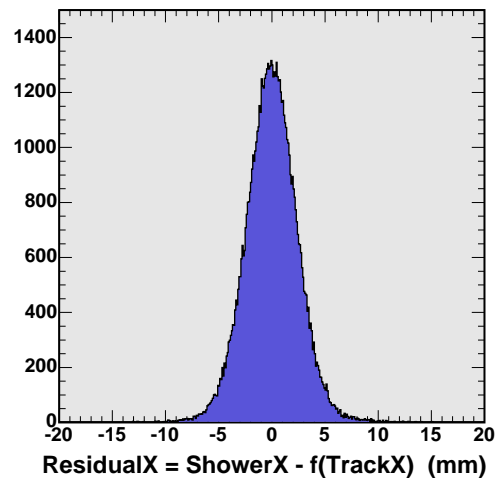
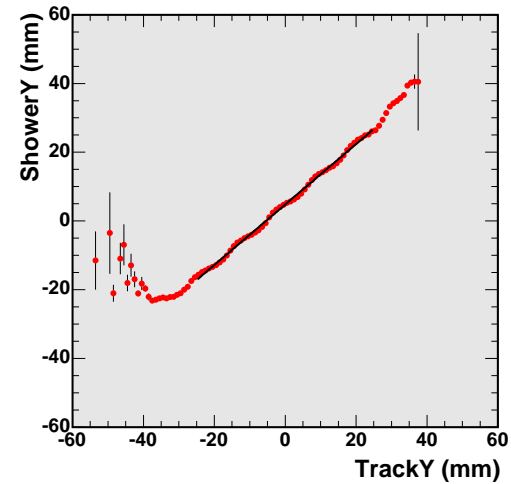
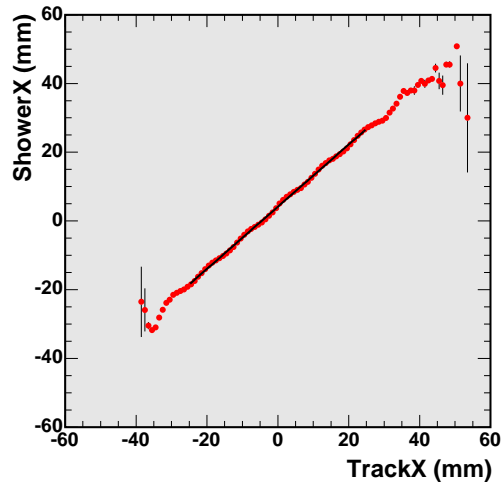


(not to scale)

$e^-$  3 GeV

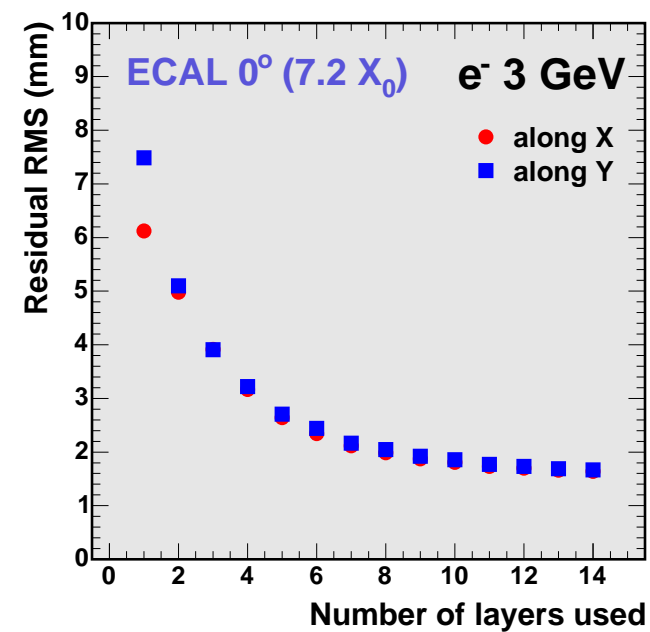
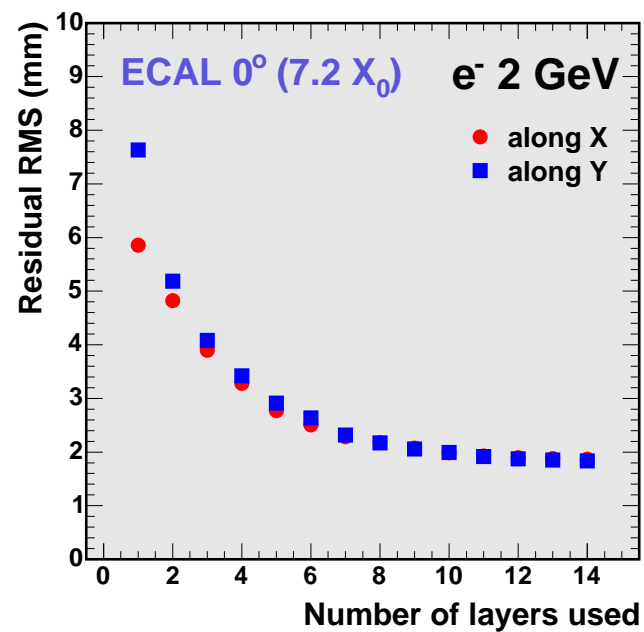
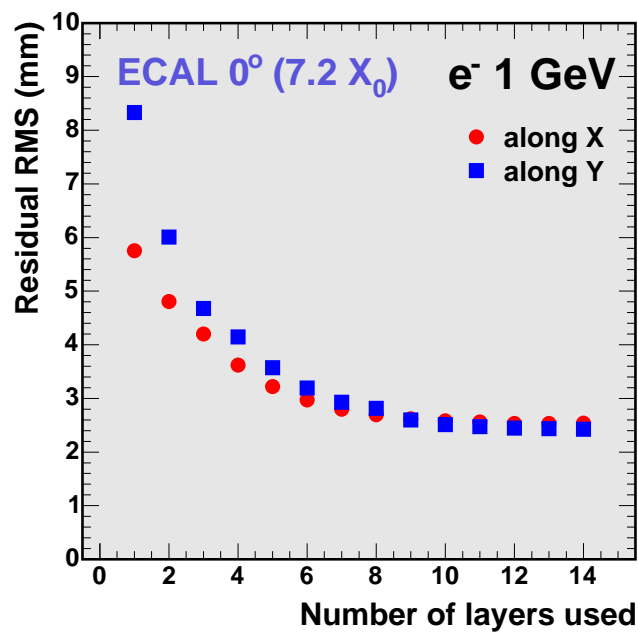
cell threshold = 0.5 mip

# Tracking - Residuals



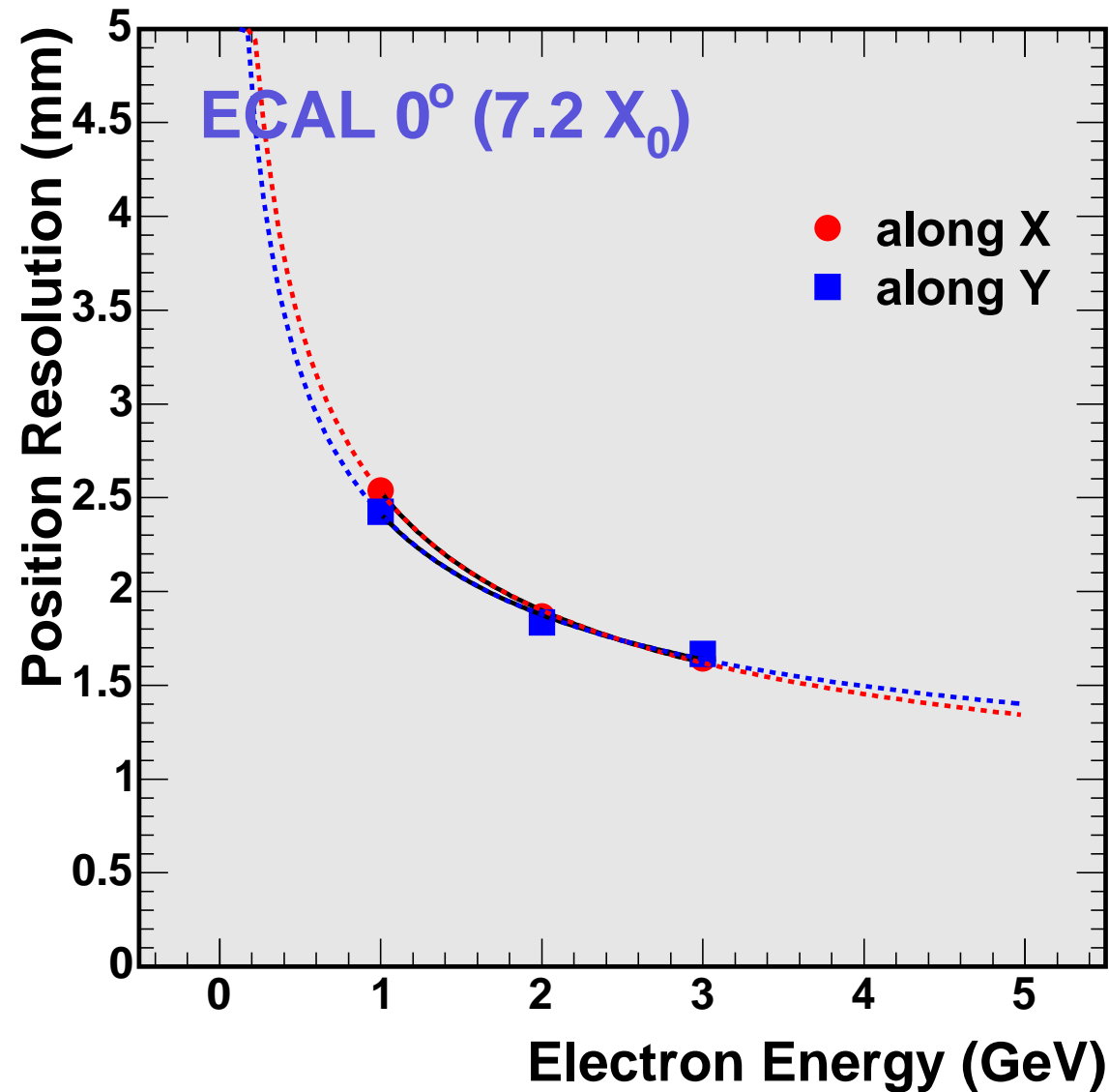
- ▷ ShowerX,Y from barycenter in ecal
- ▷ TrackX,Y from 4 drift chambers

# Position resolution



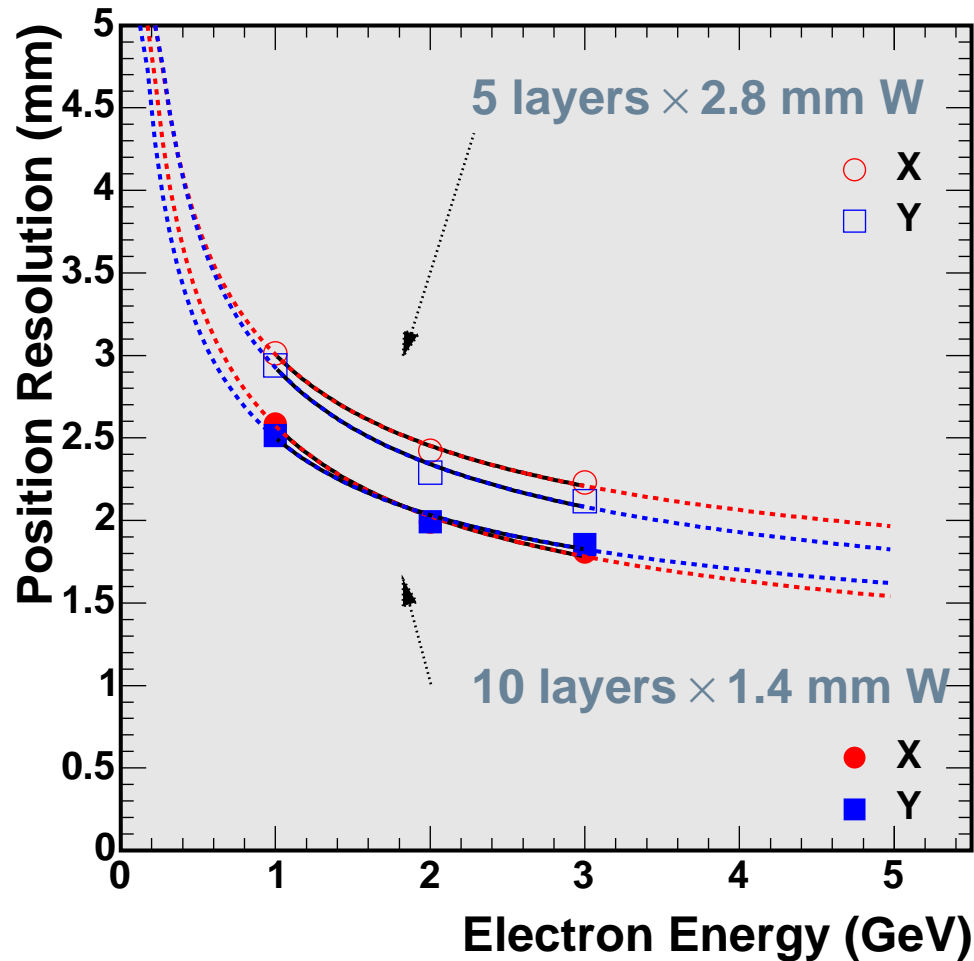
▷ Residual RMS as a function of the number of ecal layers used

# Position resolution



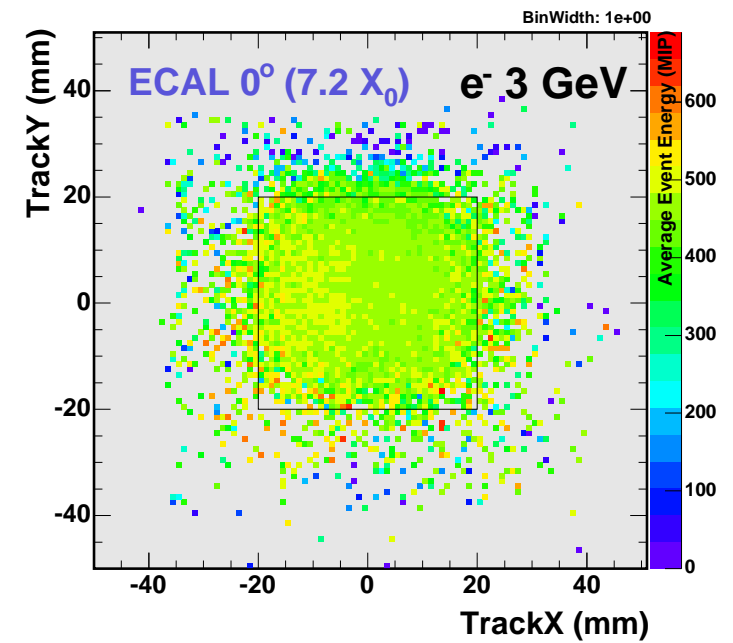
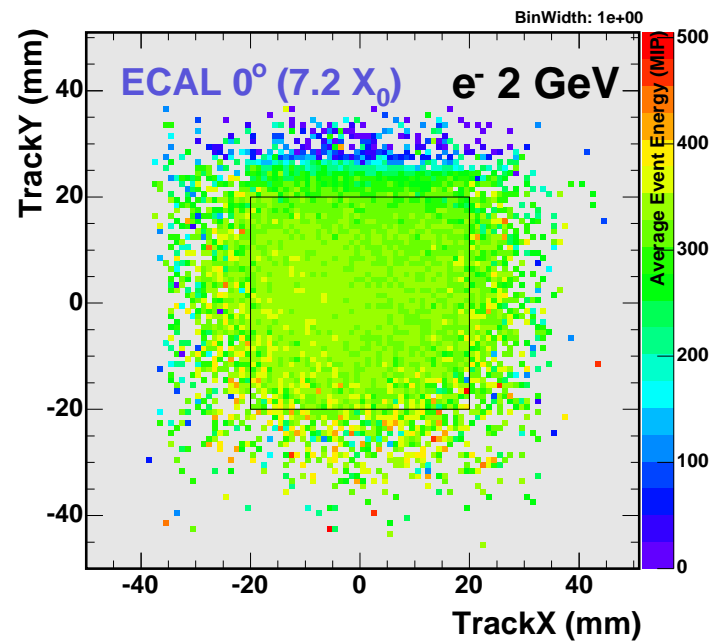
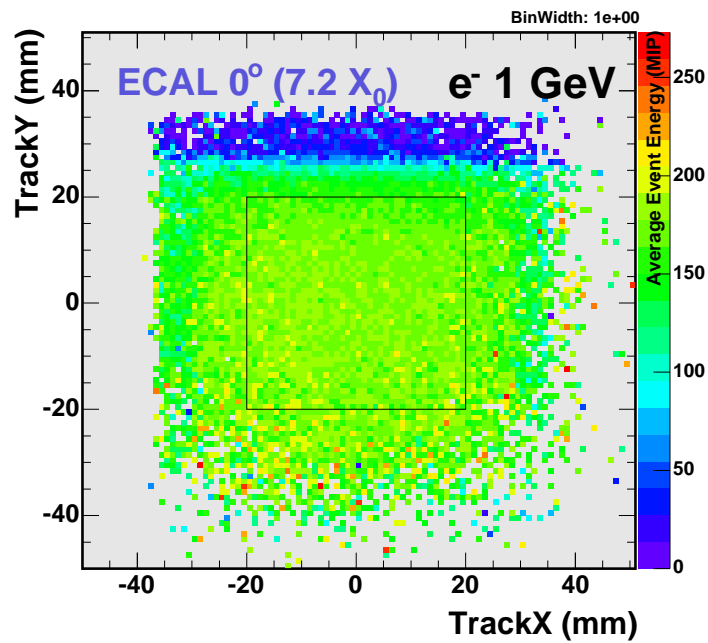
▷ highly granular ECAL → excellent position resolution

# Position resolution - undersampling

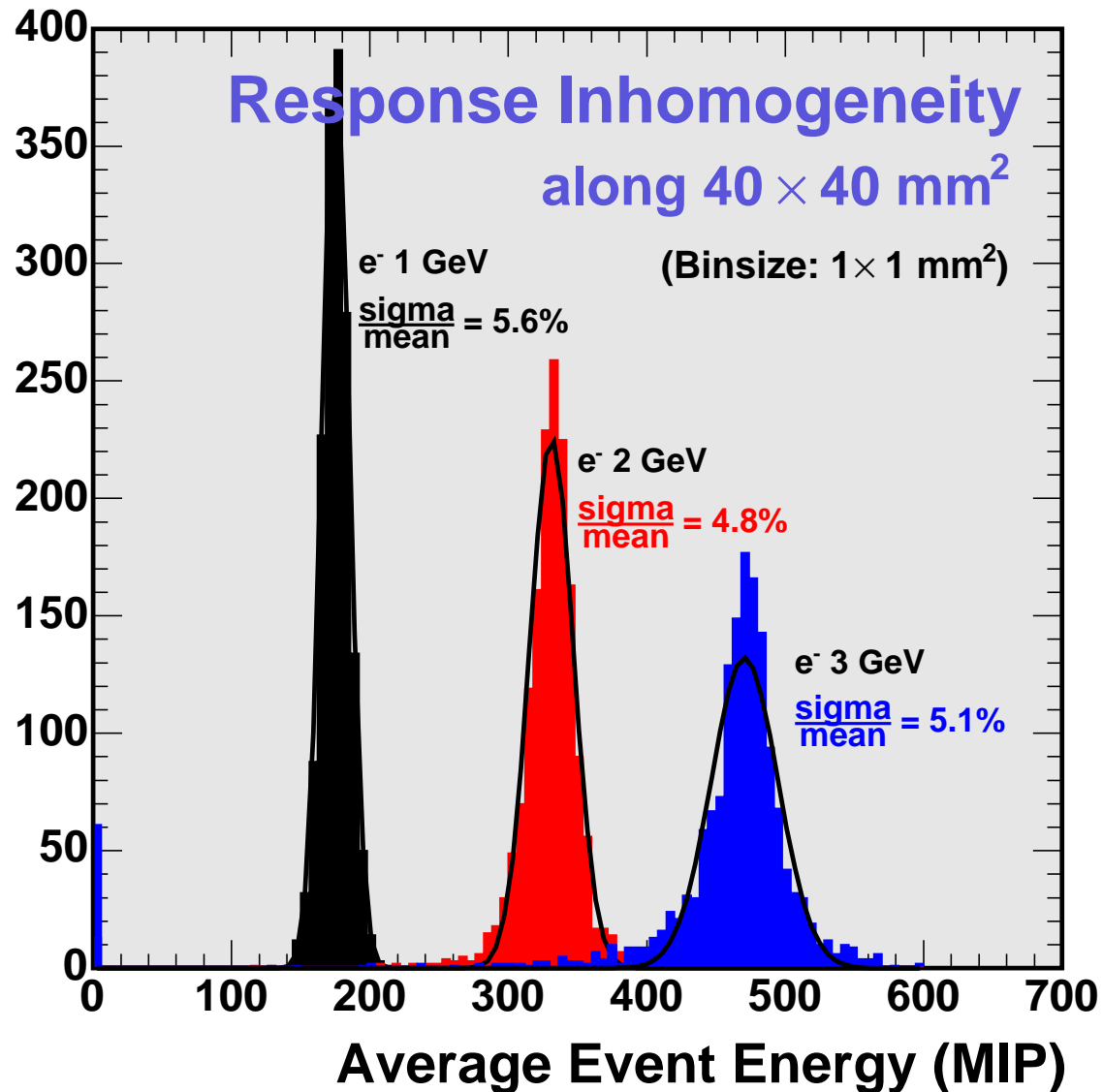


- do tracking by using only hits from every 2nd layer
- to investigate the tracking performance of an ecal with 5 layers × 2.8 mm W (instead of 10 layers × 1.4 mm W)
- expect position resolution to degrade by factor  $\frac{\sigma_5}{\sigma_{10}} \approx \frac{\sqrt{10}}{\sqrt{5}}$

# Response map - center of wafer

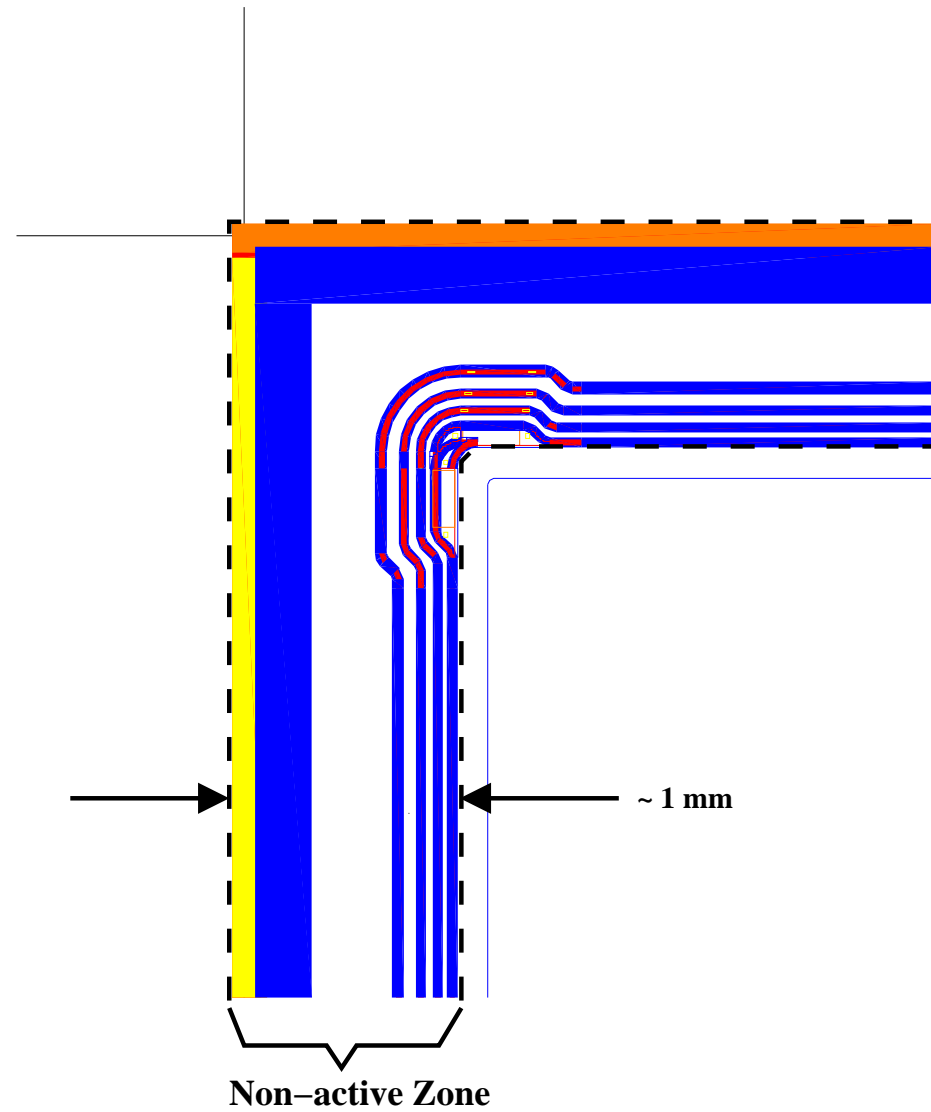


# Response Inhomogeneity



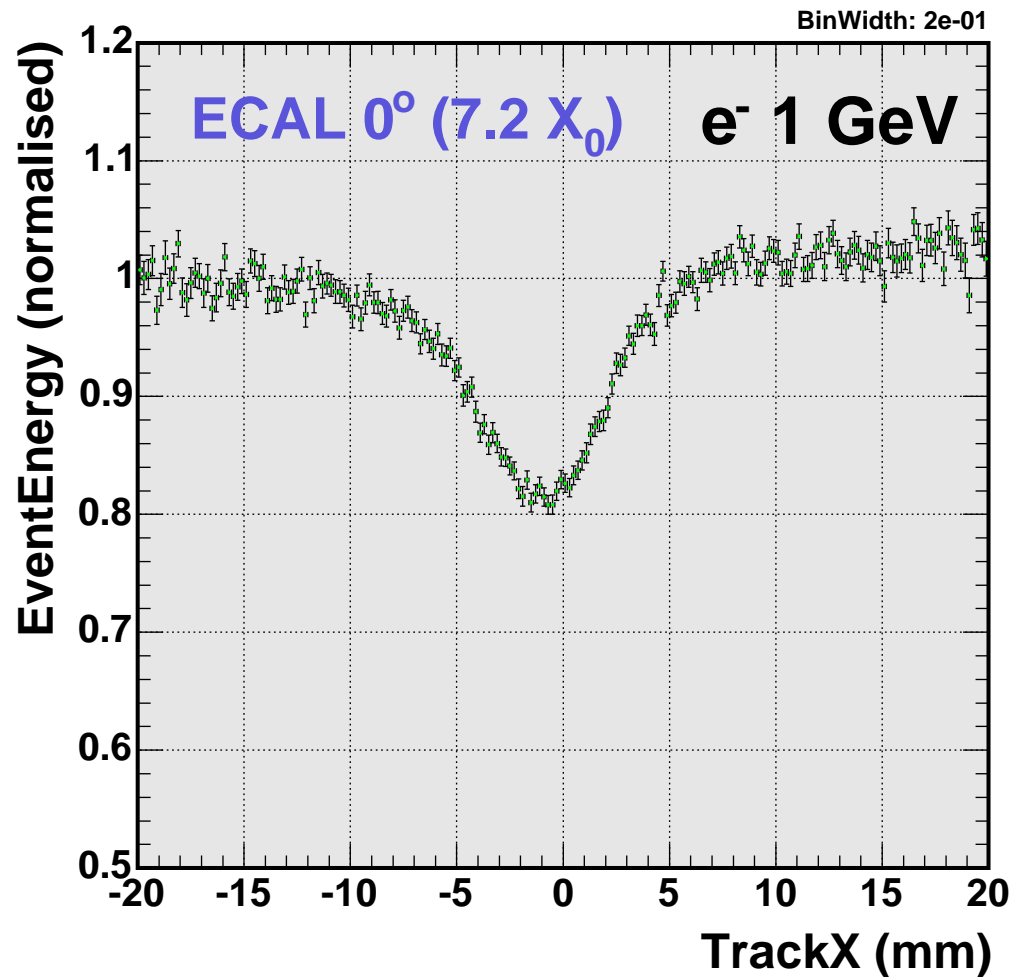
- ▷ response variation around the center of wafer

# Wafer border

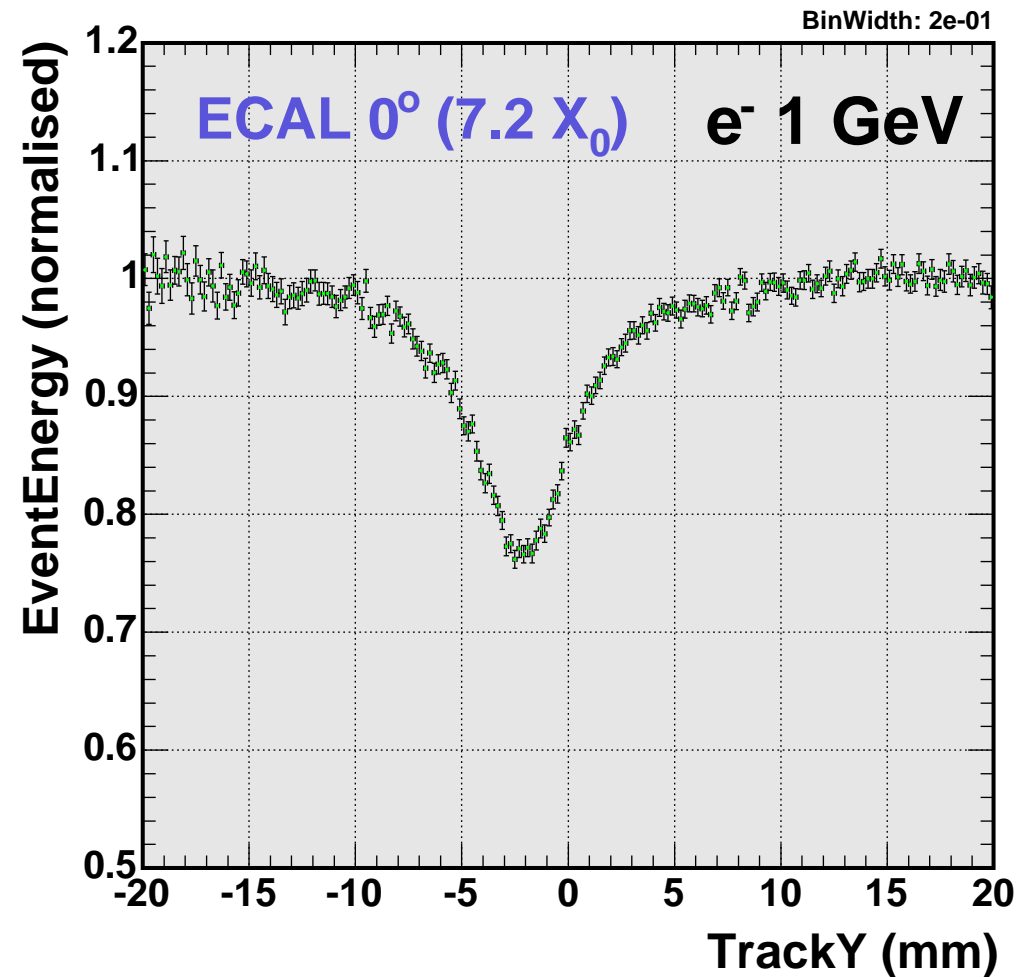


▷ (C.LoBianco, LC-DET-2004-007)

# Position scan along wafer borders

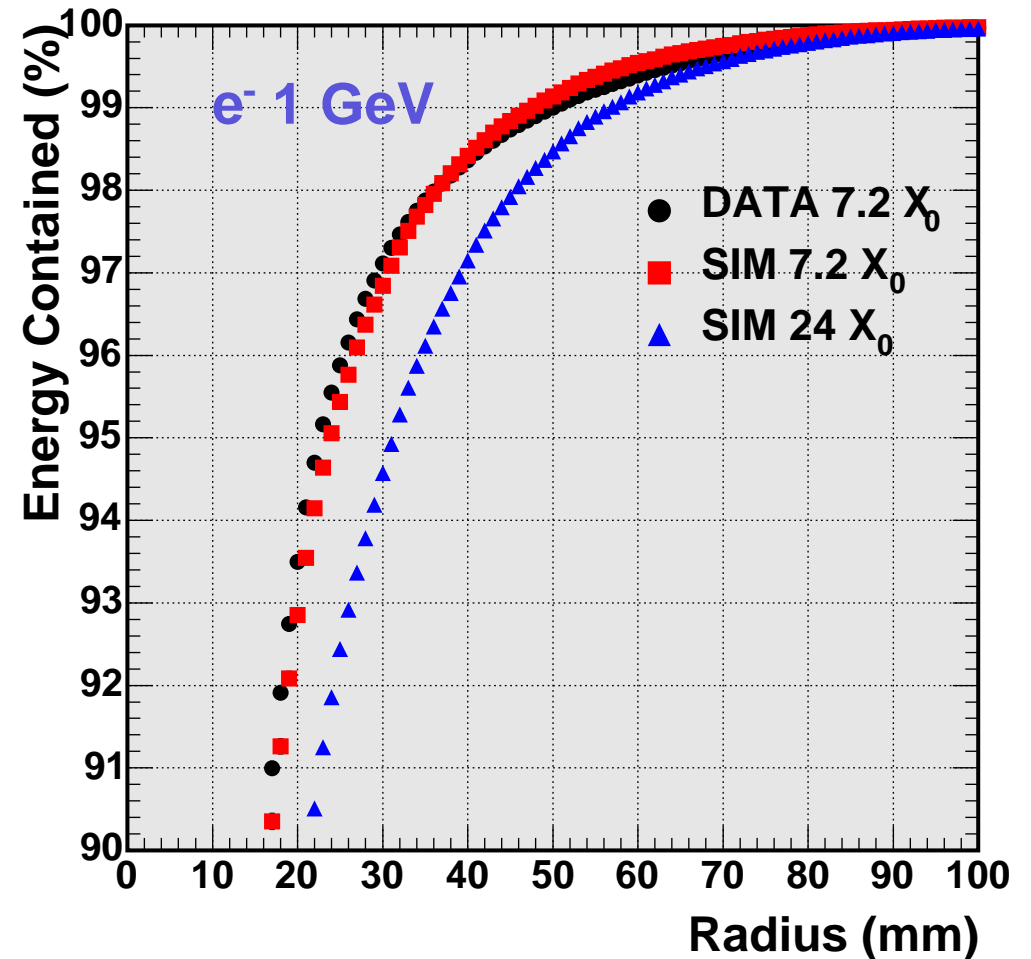
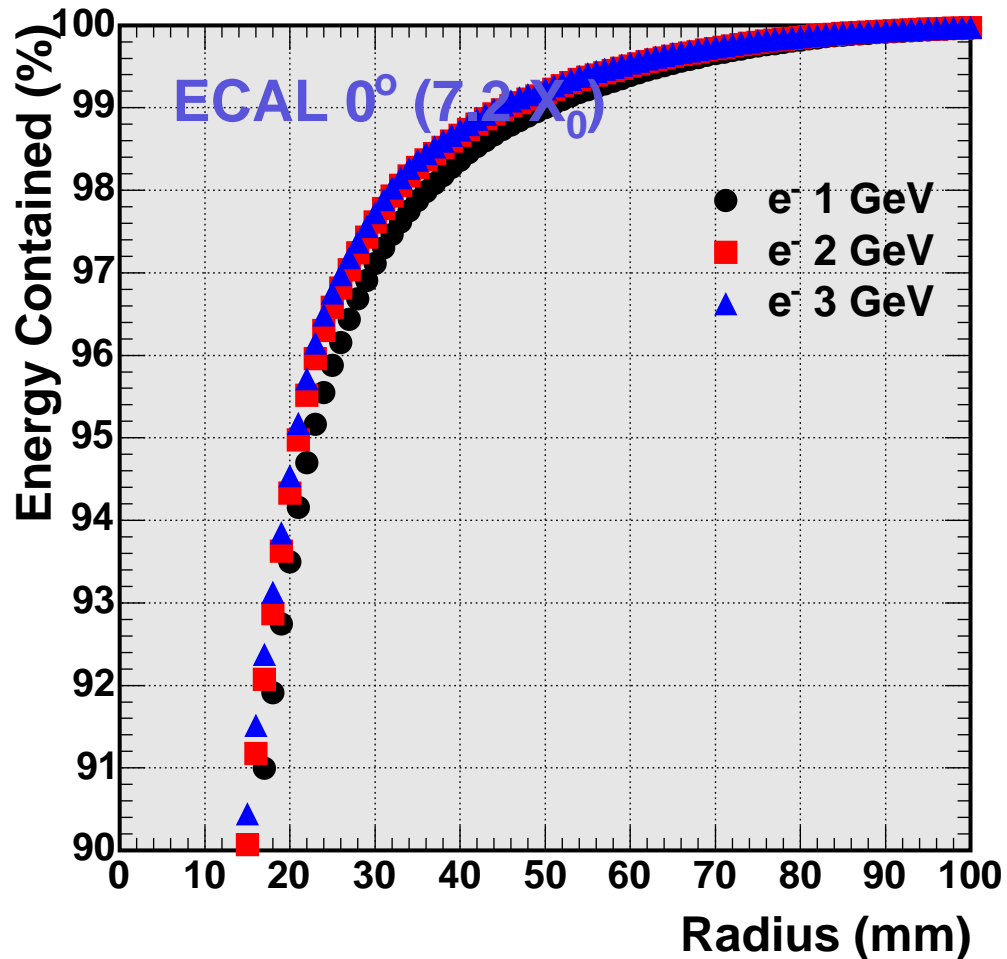


- ▷ alternate layers staggered along X (by 2.5 mm)
- ▷ dip is shallower and wider



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

# Transverse containment (Moliere radius)



▷ e.g. 1 GeV  $e^-$  shower "contained" at

- : 90% within radius 16 mm
- : 95%                    23 mm
- : 99%                    50 mm

▷ data-simulation comparison

▷ results expected for the 24  $X_0$  prototype

REMINDER: for an infinitely long and wide calorimeter  
 shower contained at 90% within radius  $\sim 1 R_M$   
 95%                     $\sim 2 R_M$   
 ( for solid W,  $R_M \simeq 10$  mm ) 99%                     $\sim 3.5 R_M$

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# Topics for discussion

- ▶ . user instructions
- ▶ . run planning
- ▶ . monitoring
- ▶ . drift chambers
- ▶ . shift schedule
- ▶ . testbeam duration
- ▶ . data storage, backup
- ▶ . after the testbeam

- ▶ **user instructions (hardware)**
  - : leaflet with basic instructions on how to run the system
  - : update and refine (trouble shooting, key contacts etc.)
  
- ▶ **user instructions (software)**
  - : a complete mess, almost a "no-go" area for non experts
  - : bundle packages, howto's, key instructions in one "box" with proper support and proper maintenance
  
- ▶ **run planning**
  - : priority list
  - : basic schedule (when everything goes reasonably fine)  
AND  
thin/fat versions (when everything goes terribly bad/well)

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▶ **monitoring**

: we had NO proper monitoring

: need additional pc's for data processing/histogramming,  
webcasting key plots/parameters

▶ **drift chambers**

: flammable gas

: 24hr gas flushing before turn on

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▶ **shift schedule**

: IT WAS A BIG PROBLEM !

: may improve with shorter testbeam time

AND

better planning (e.g. at least 1 month in advance)

▶ **testbeam duration**

: it lasted 18 days = 3 days flushing gas + 3 days off + 12 days data taking

: "one go" equivalent of 13 days (1 day flushing gas + 12 days data taking)

: if possible, keep duration short to focus limited manpower

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▶ **data storage, backup**

: during data-taking we had a rsync relay from DESY to ICL to LLR

: use local mass storage system (dcache at DESY, castor at CERN)

: note finally will be 4 versions of data :

- : "raw"
- : "raw-converted"
- : "reconstructed"
- : "simulation"

▶ **after the testbeam**

: a lot of effort put on having a successful testbeam run

: AND THEN  
complete silence/lack of interest on analysis of the data !  
WHY ?