Guard ring studies for SiW Ecal of ILD

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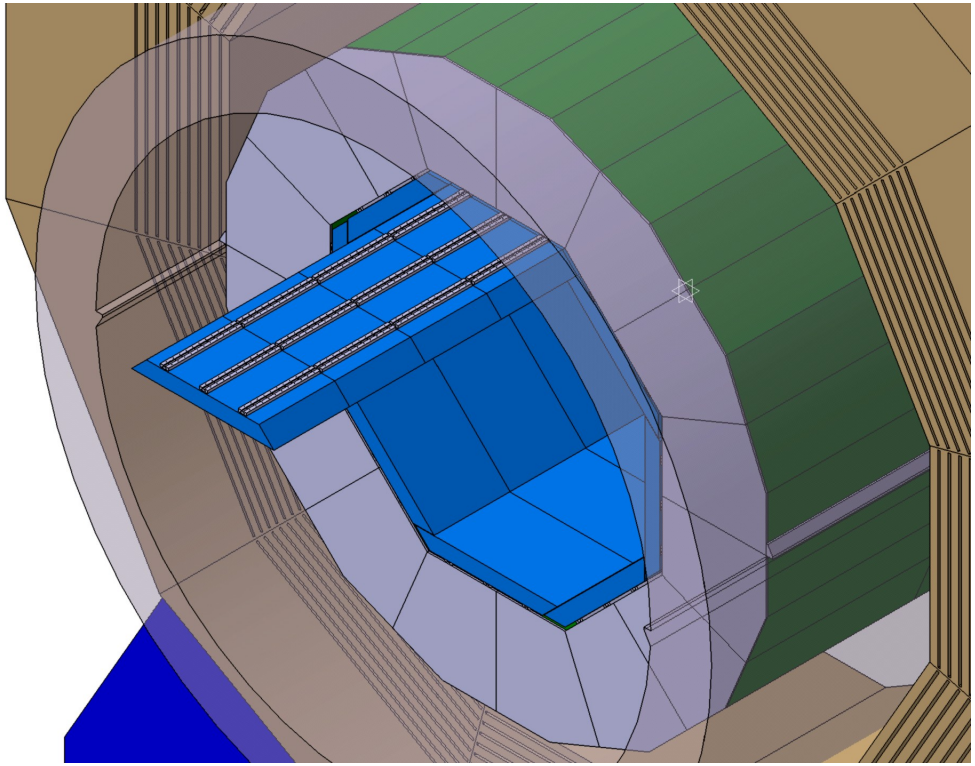
SiW Ecal - Basics

The SiW Ecal in the ILD Detector



Basic Requirements

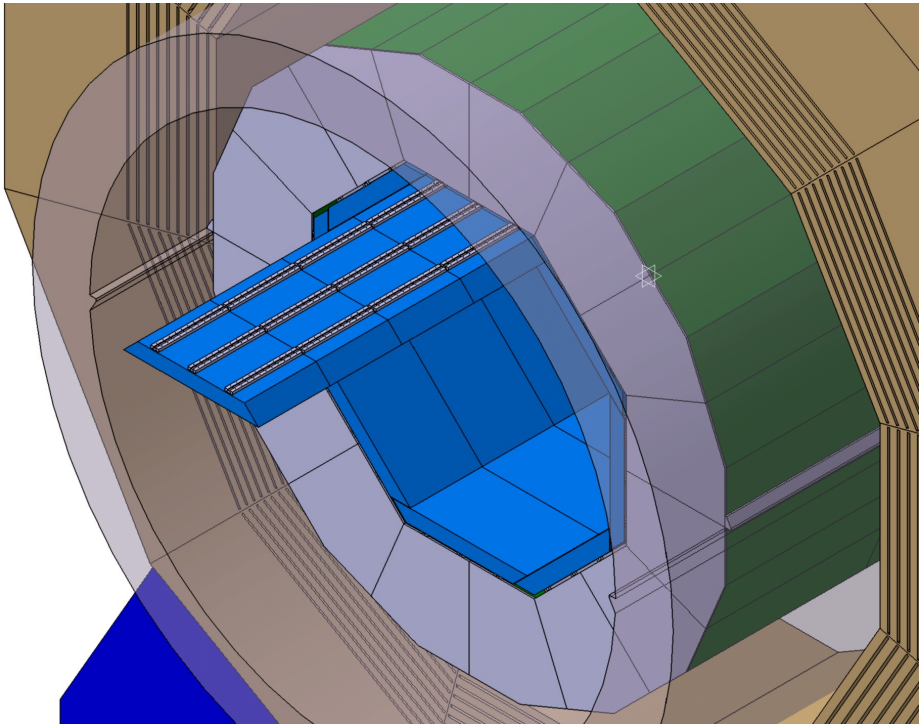
- Extreme high granularity
- Compact and hermetic

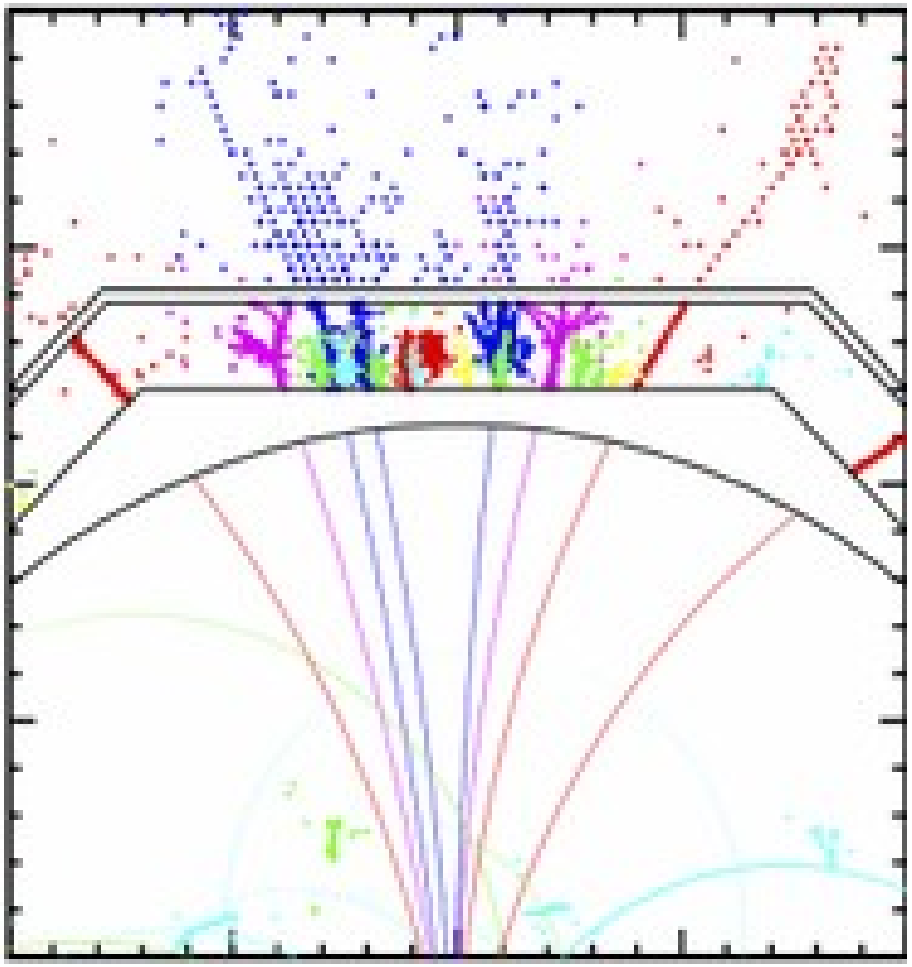
Basic Choices

- Tungsten as absorber material
  - X_0=3.5mm, R_M=9mm, λ_I=96mm
  - Narrow showers
  - Assures compact design
- Silicon as active material
  - Support compact design
  - Allows for pixelisation
  - Large signal/noise ratio

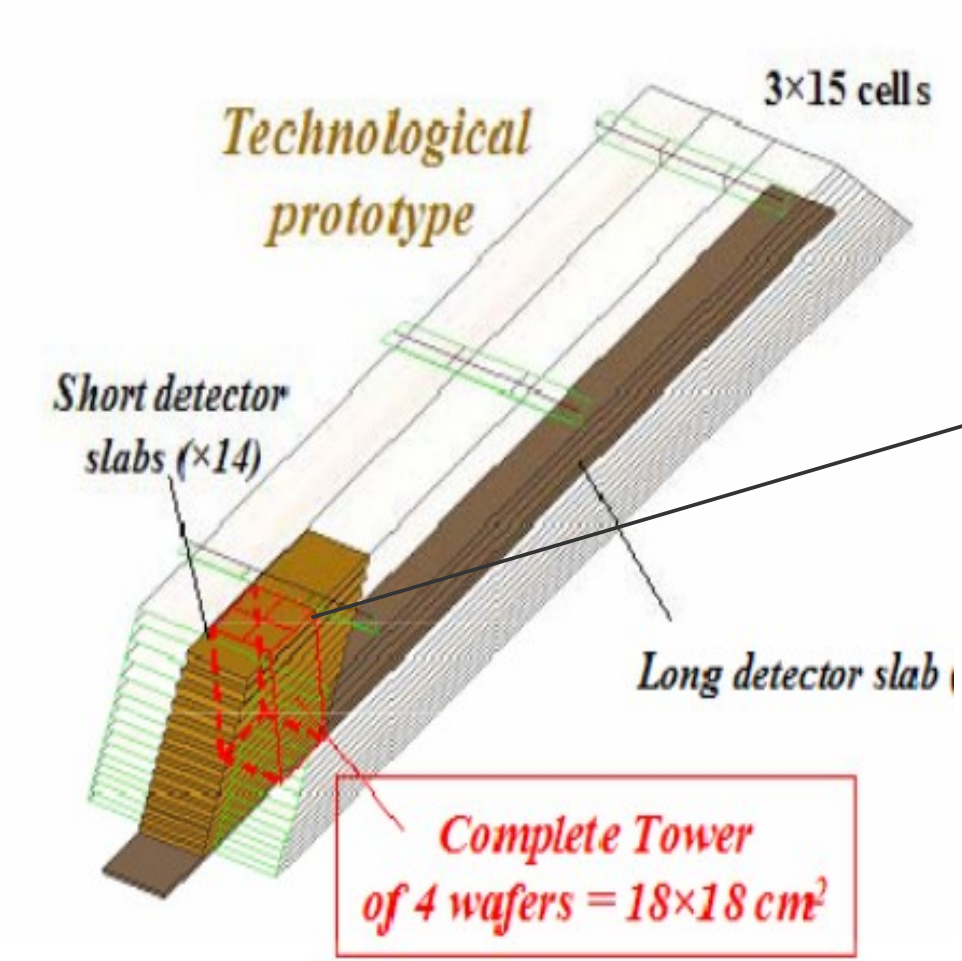
SiW Ecal designed as Particle Flow Calorimeter

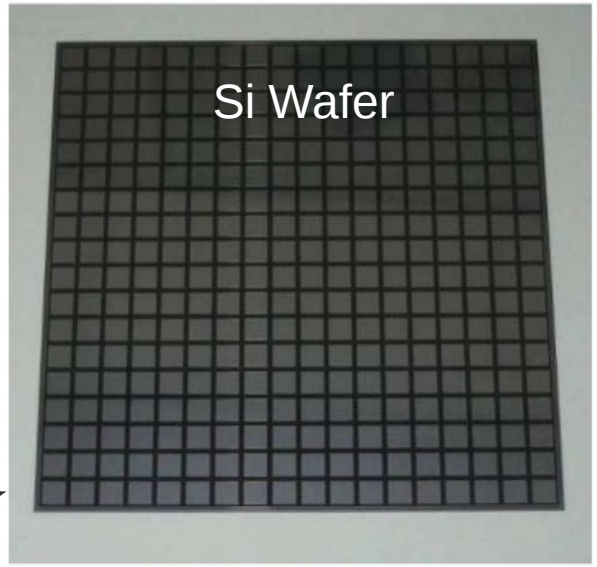
ILD-ECAL



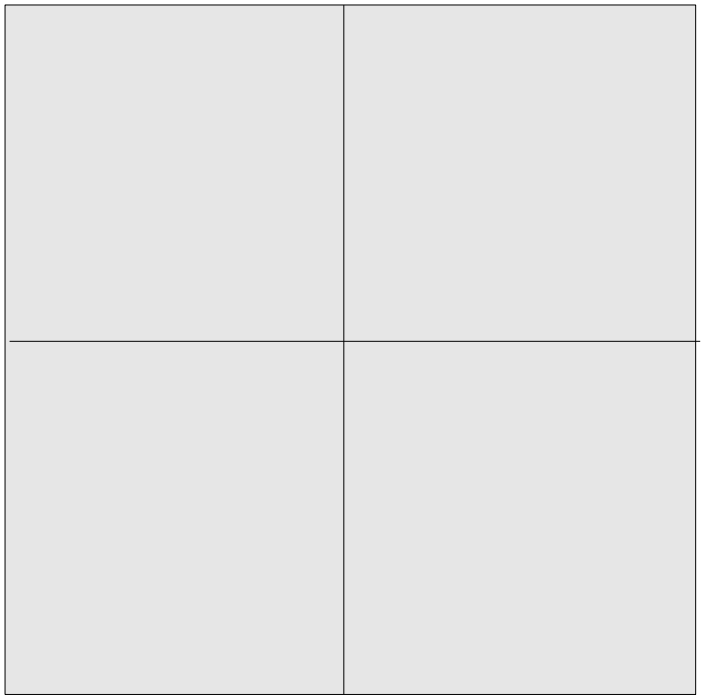


Technological Prototype and Silicon Wafer



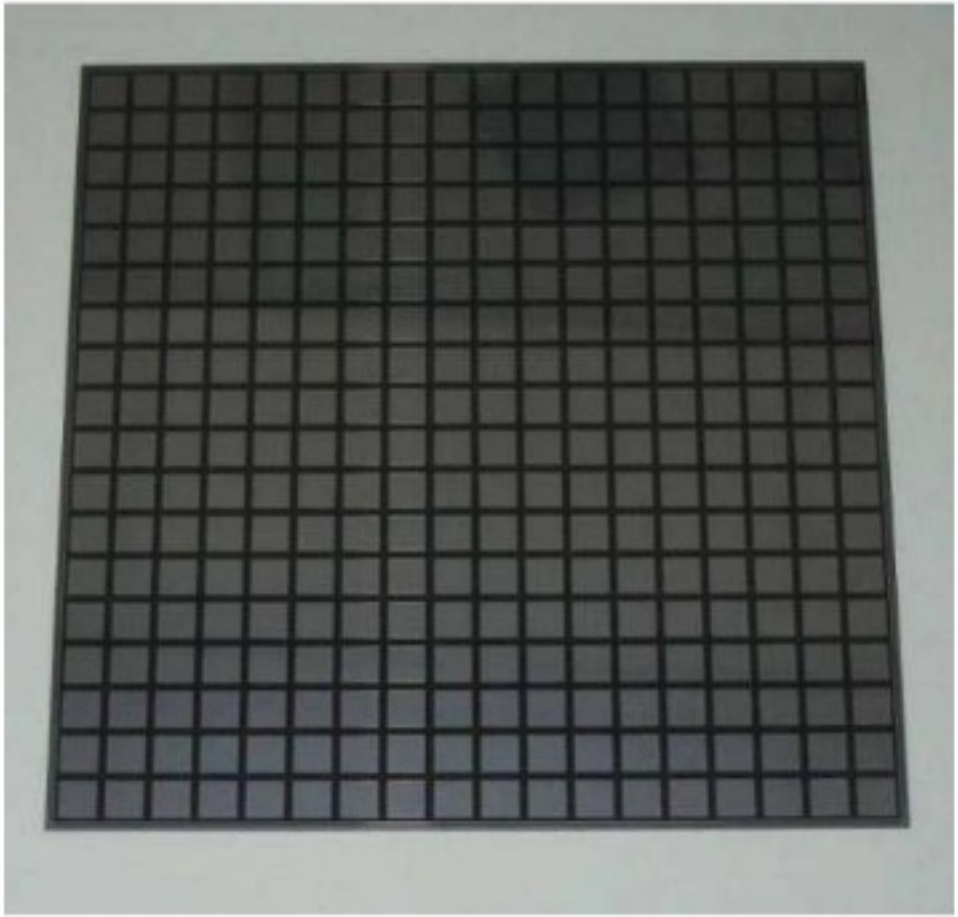


4 wafers on one ASU

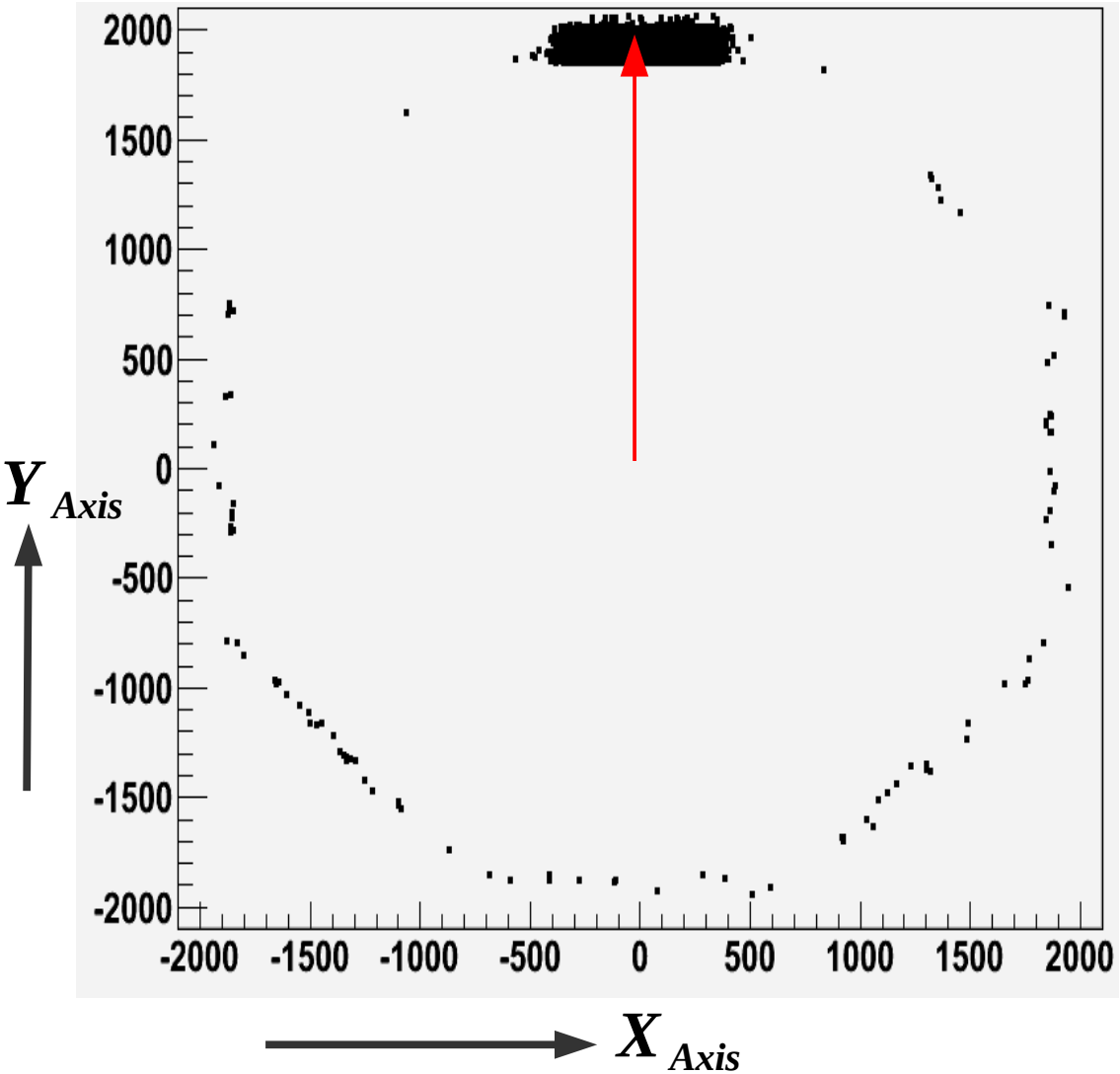


Some details on silicon wafers

- The wafer is surrounded by a guard ring to control the leakage currents.
- Studies conducted 18X18 Cells Wafer (Standard Mokka Implementation).
- Cell size 5mm X 5 mm.
- The typical/**default** guard Ring size is **1 mm.**
- Purpose of the study is to optimize the guard ring size. (Important aspect of wafer design, see Remi's talk)

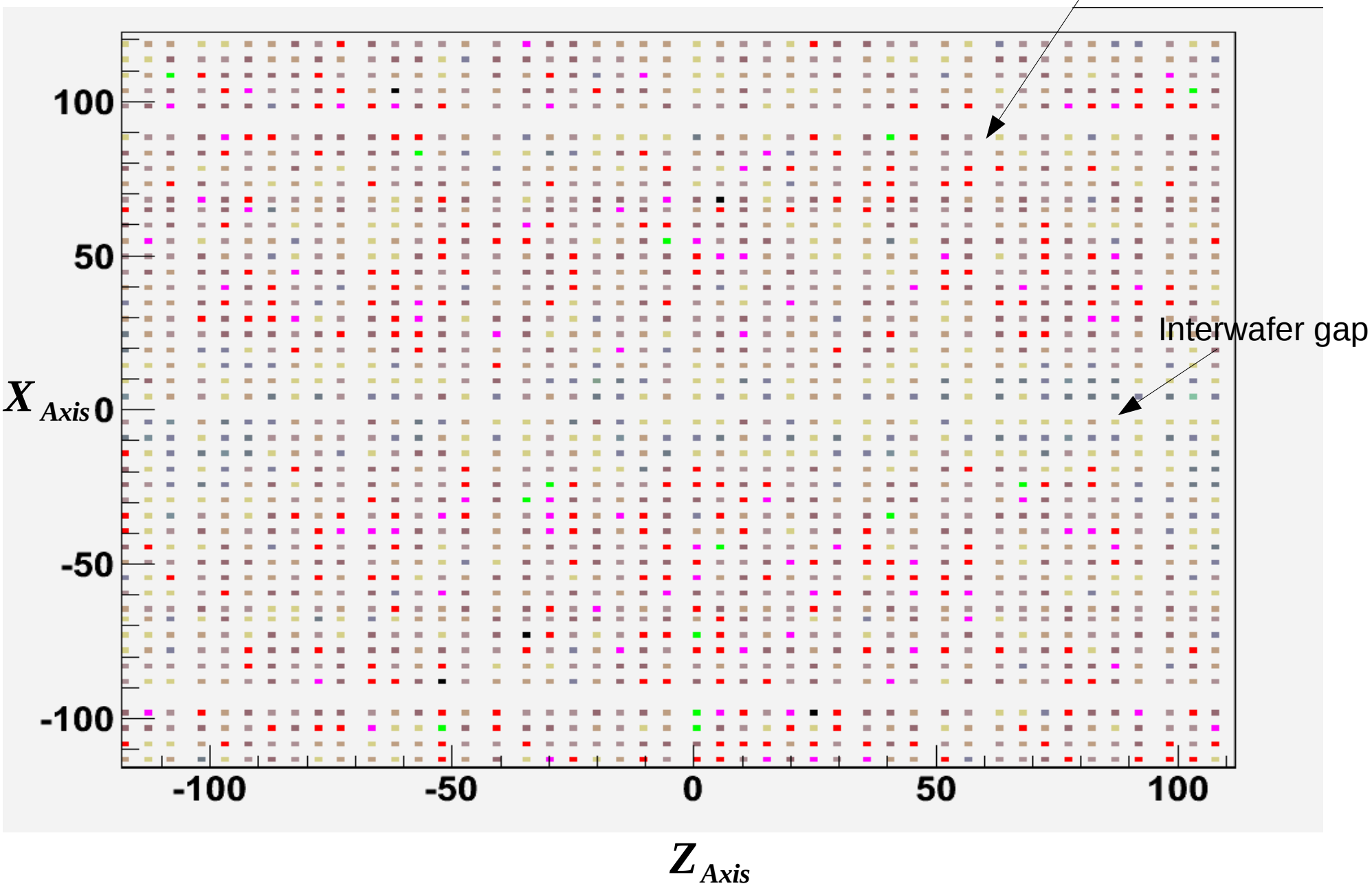


Systematic studies with photons

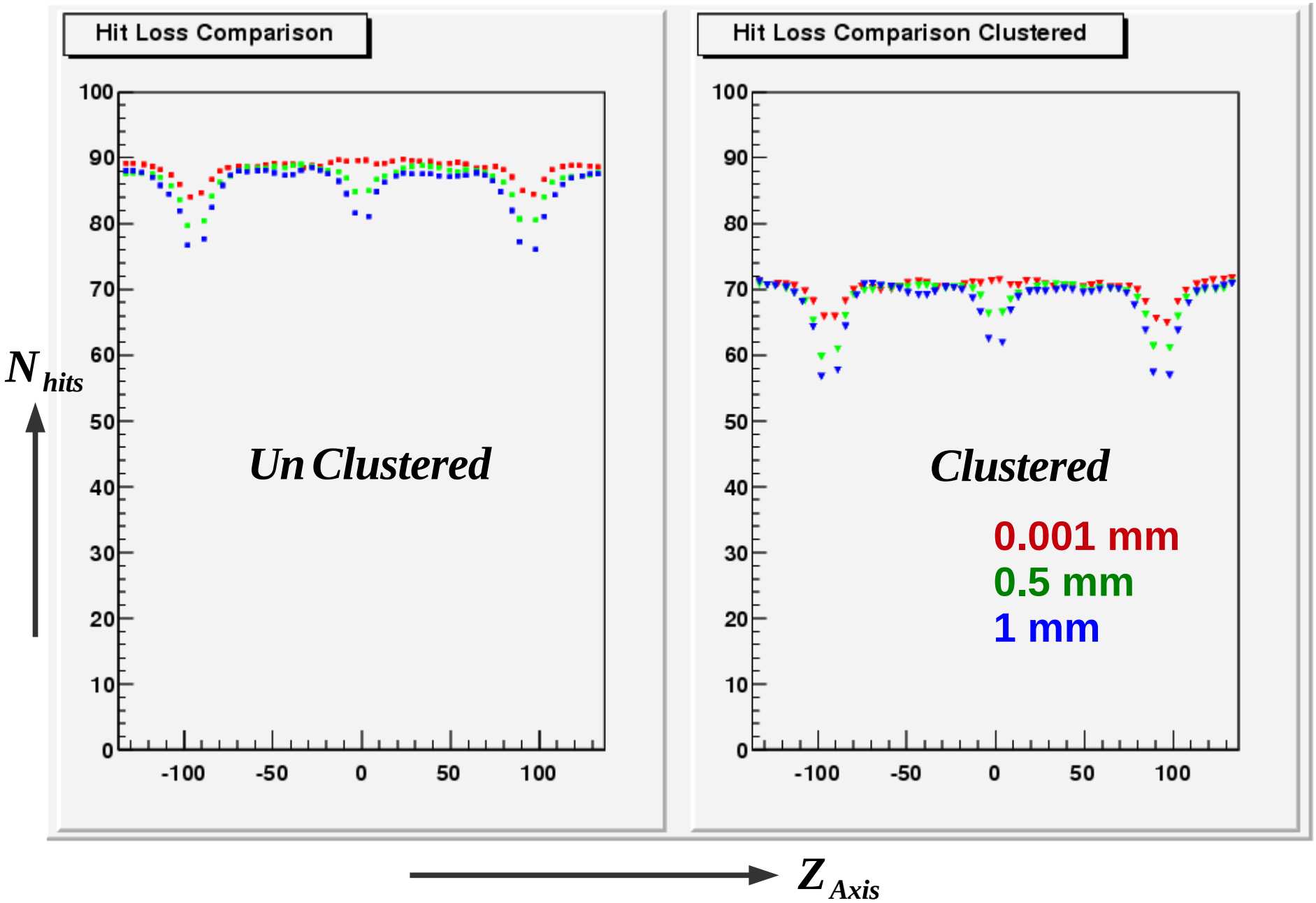


- The Studies are performed with Single Photons Events at 2 GeV .
- For the single Photon events we test three different sizes to see the effects, 0.001mm (~0) ,0.5 mm and 1 mm.
- The study concentrates on the effects induced by varying the Guard Ring size.
- A Theta and Phi smearing of initially 10 Degree and later on of 4 Degree was applied to zoom into a particular region.

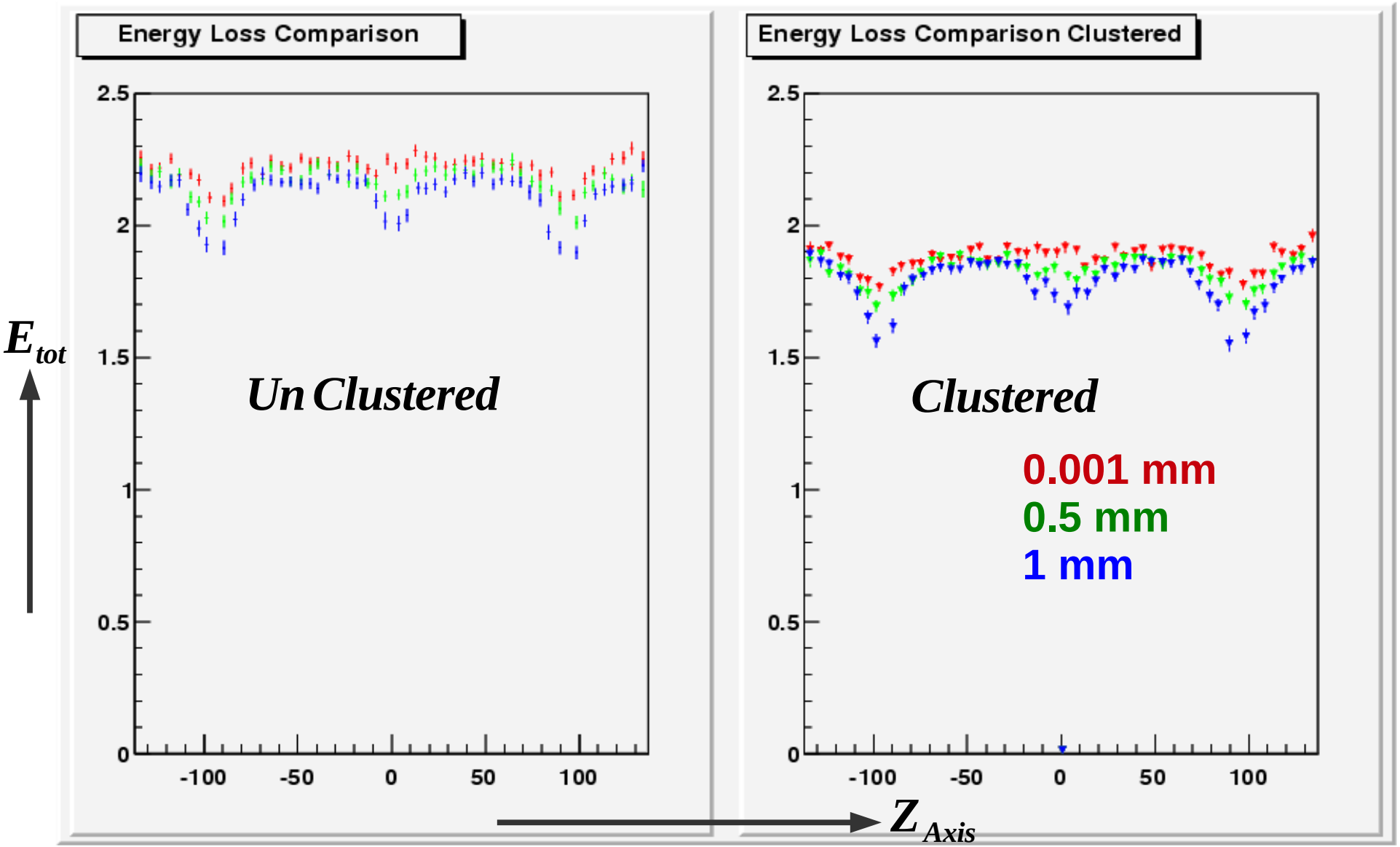
The Wafer Map



Hit Loss due to Guard Ring



Energy Loss due to Guard Ring



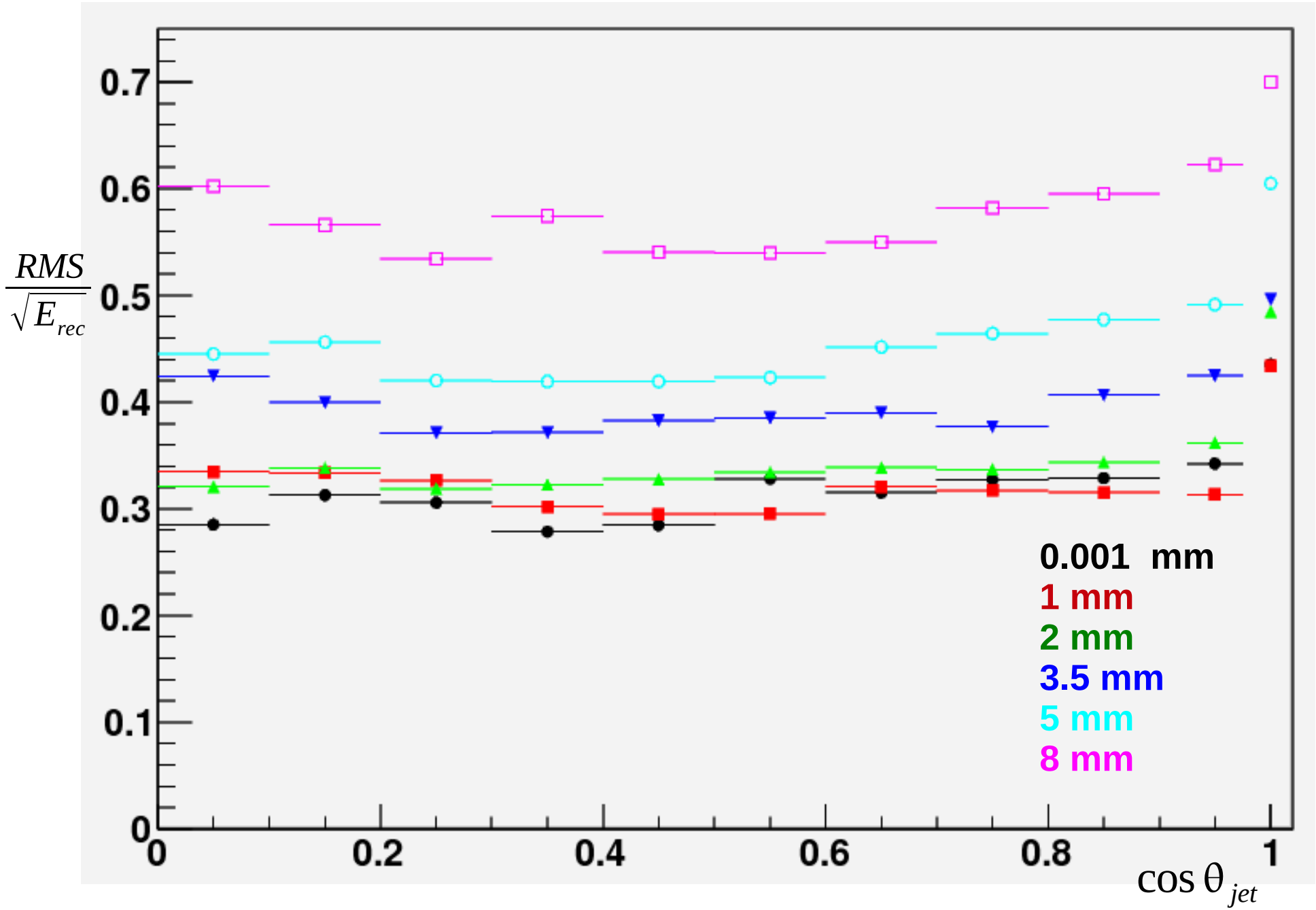
Physics Channels

- Two Important channels.
- Six GR sizes in rang 0-8 mm.
- 1 mm standard, for redundancy.
- Mokka 06-07 and ILCSoft 01-10.
- Full detector simulation.

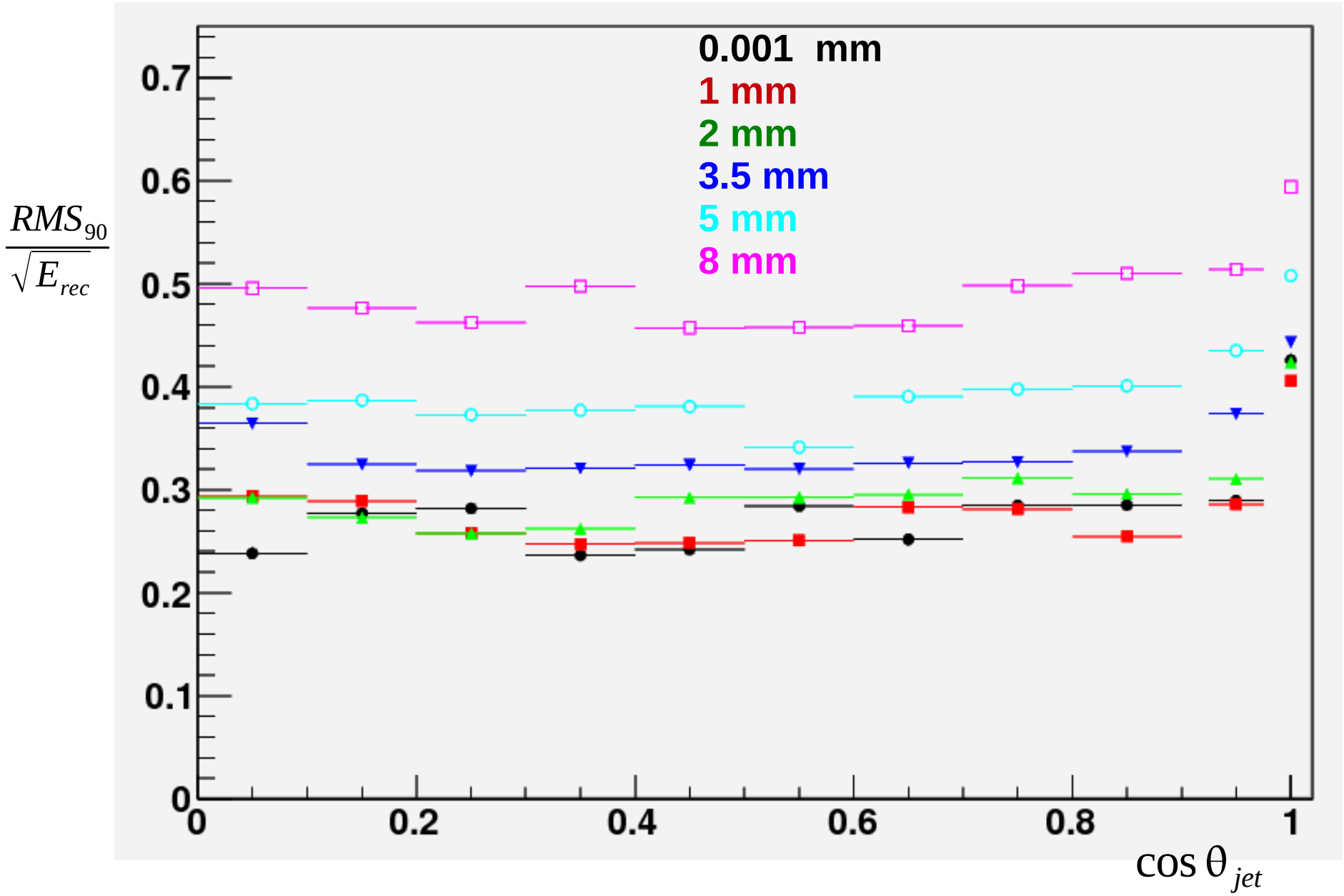
Z->uds (Hadronic Z decay at 91GeV)

- ILC will have multijet final states.
- Jets contain photons coming from π°.
- ~60% hadrons start showering in ECAL.
- ECAL resolution utmost important for precise reconstruction of Jets.

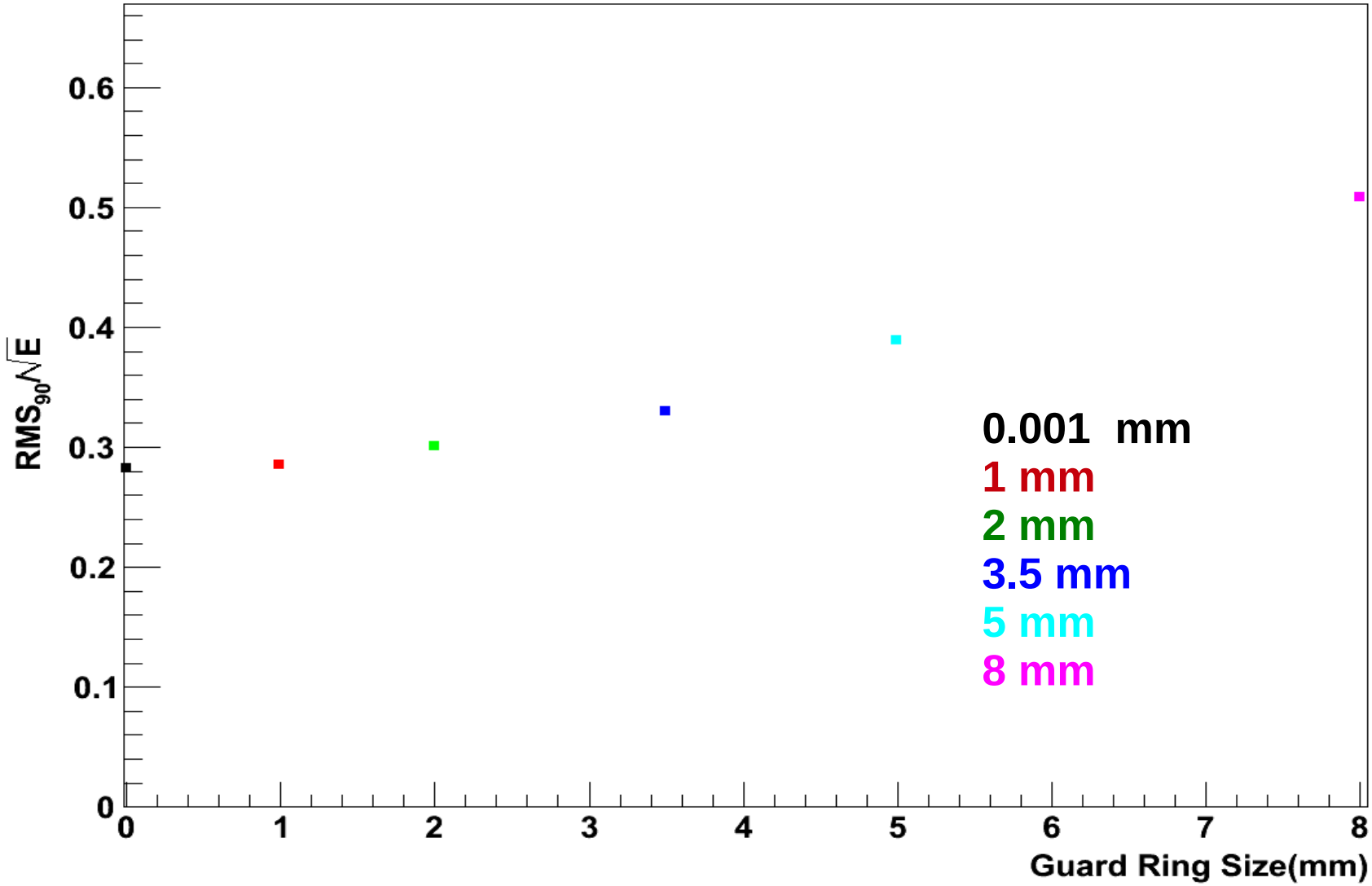
Comparison of RMS for different sizes



Comparison of RMS90 for different sizes



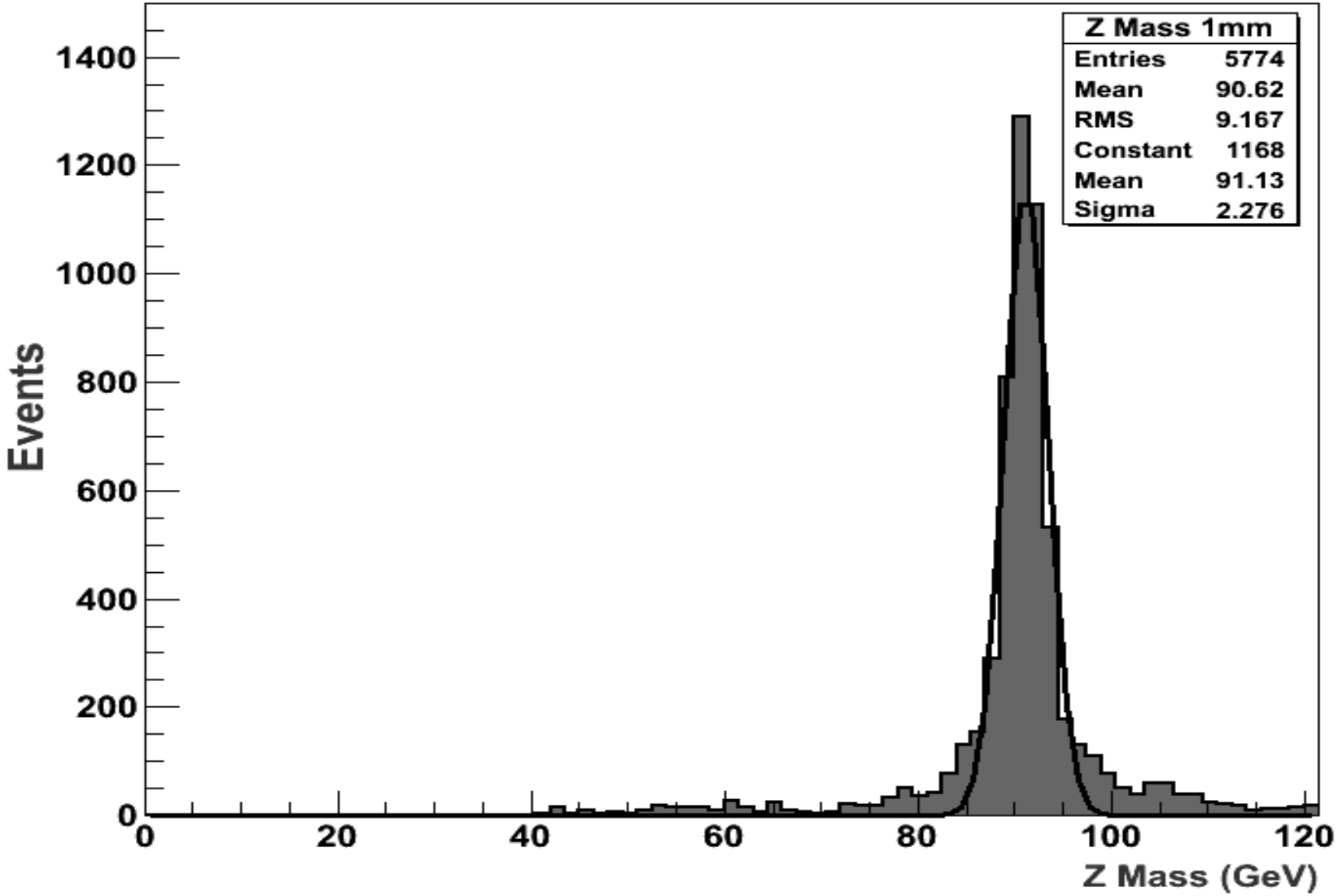
Jet Energy Resolution vs Guard Ring Size



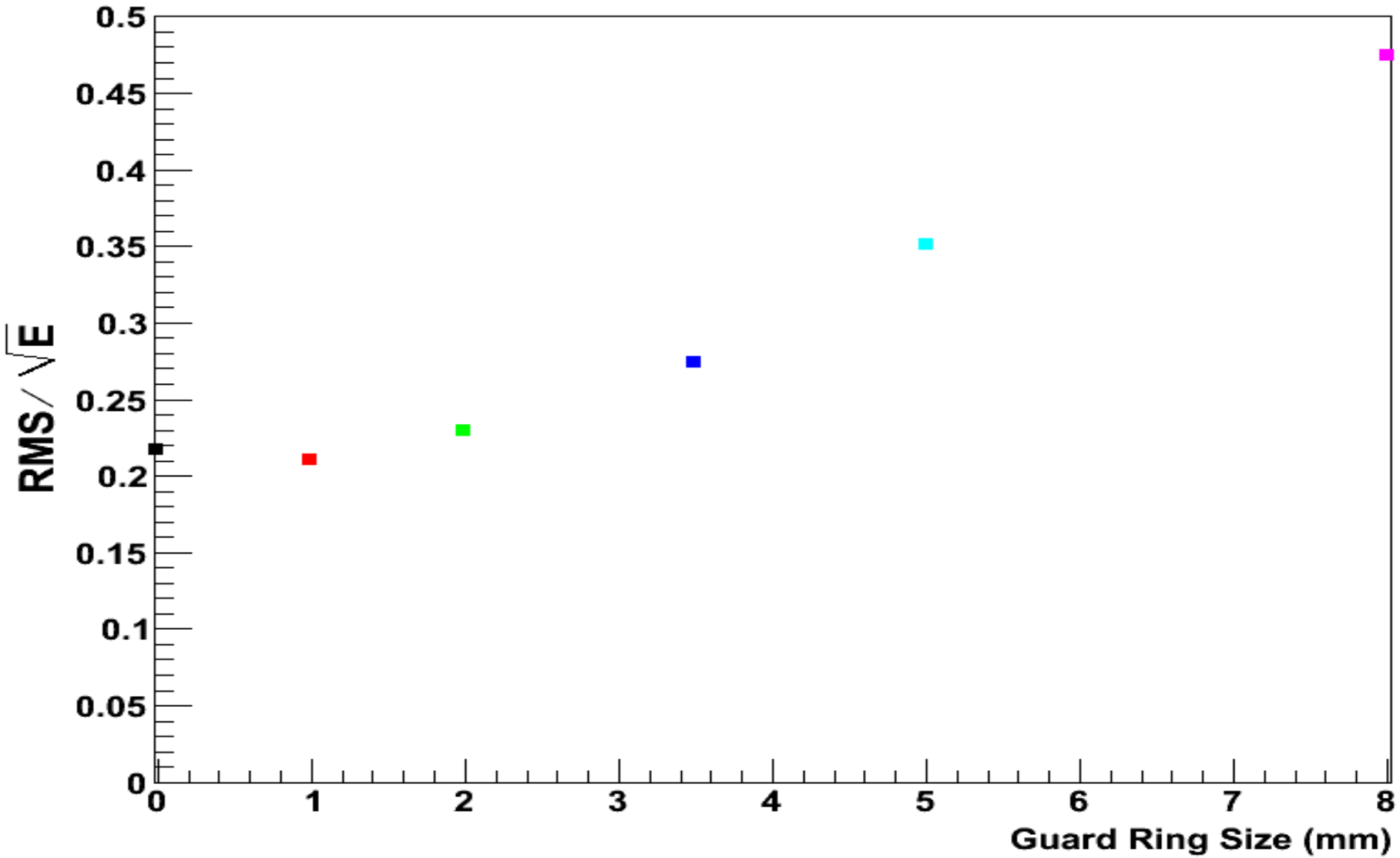
Z->ee Channel (Leptonic Z decay)

- Precisions on Z Mass.
- Calibration of detector.
- Leptons are reconstructed in ECAL.
- Bremsstrahlung photons recovery.
- Higgs via Z recoil Mass.

Z Mass reconstruction.



Energy Resolution vs Guard Ring Size



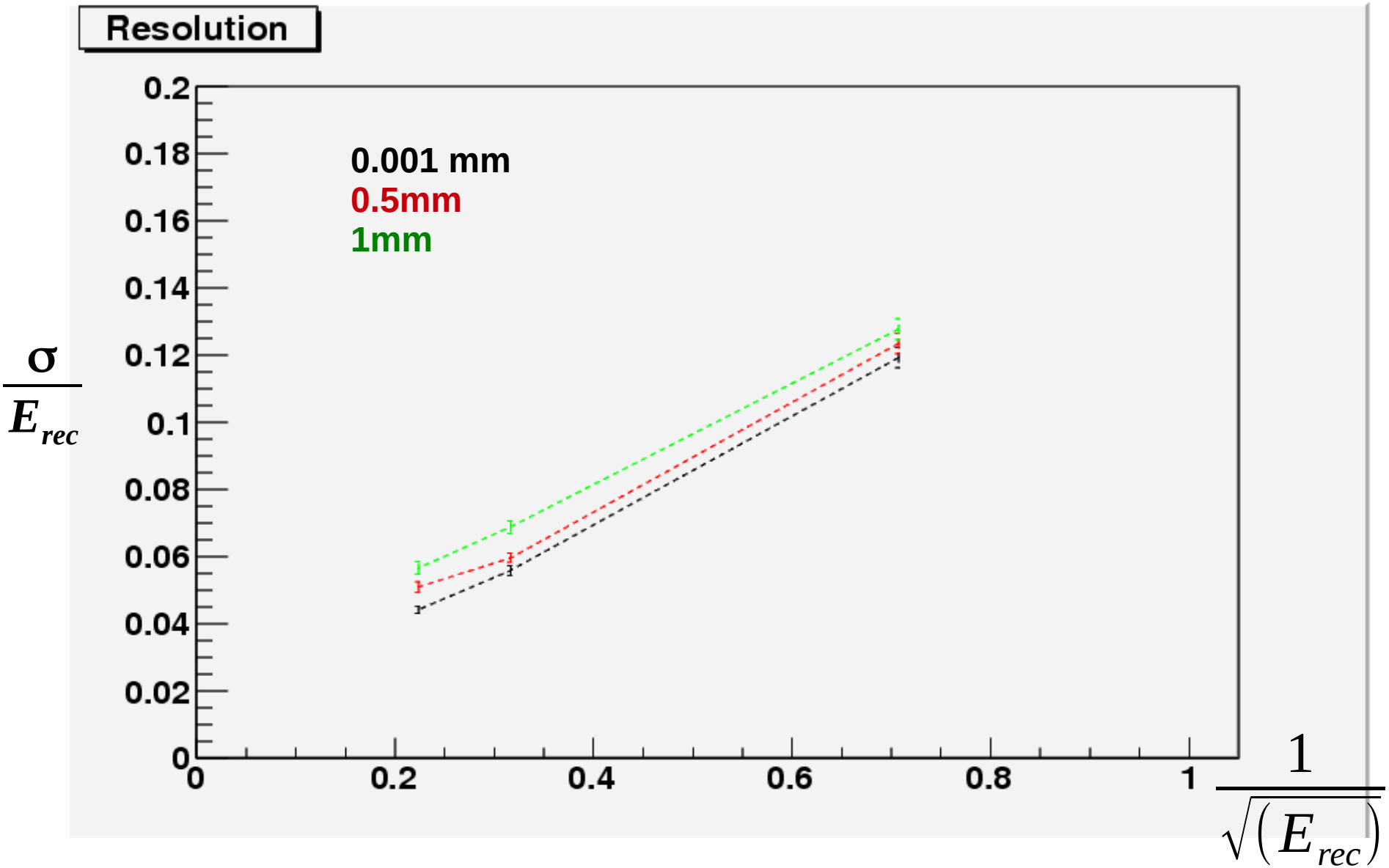
Conclusions

- Study on Guard ring sizes for single photon events and two standard physics channels at the ILC
- Using standard ILC reconstruction tools it looks as if guard rings of up to 2mm size does not effect the ECAL performance

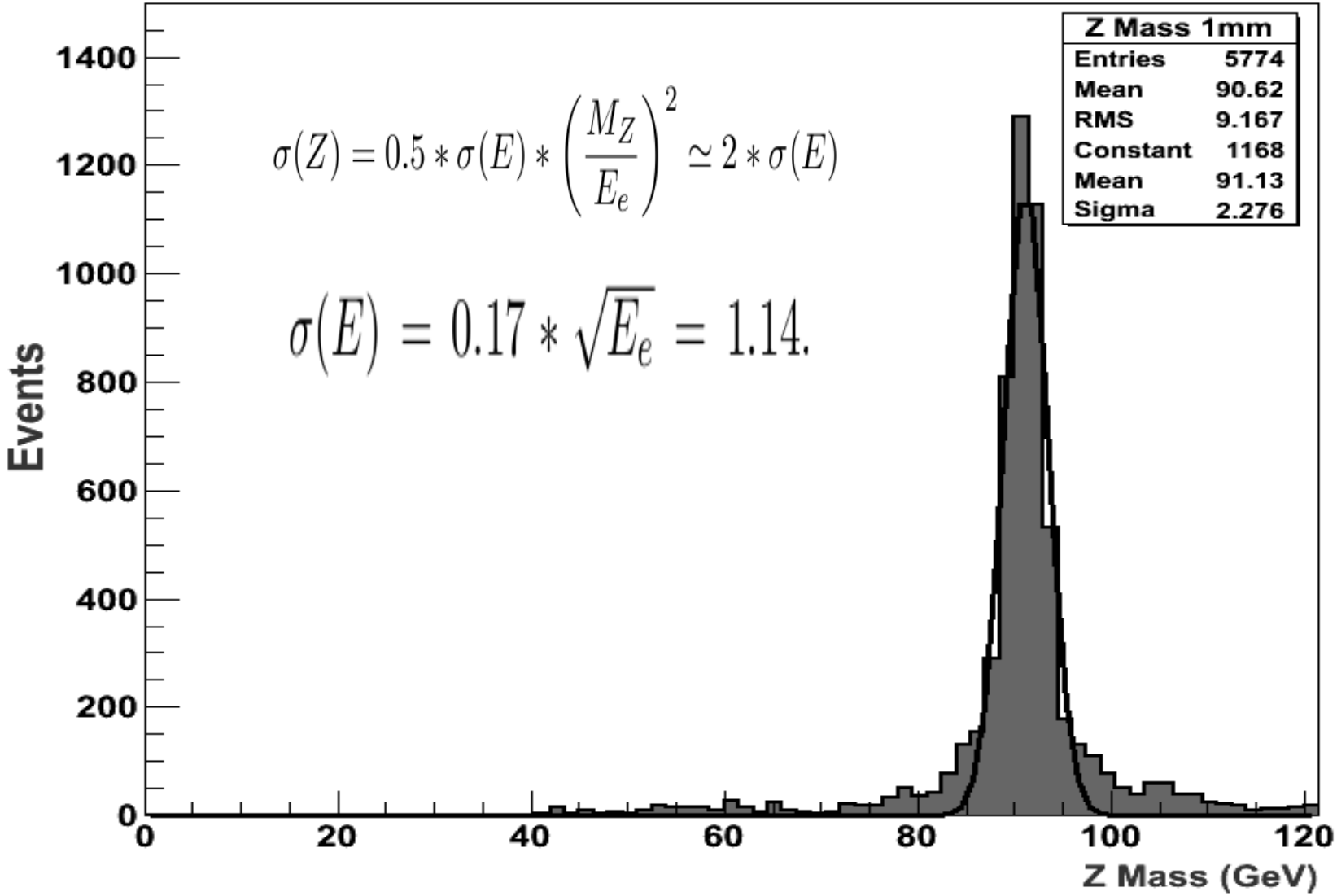
=> Flexibility of guard ring design

- The study has it's importance when defining the layout of the silicon wafers (e.g. when discussing with manufacturers)

Effect on Resolution of ECAL

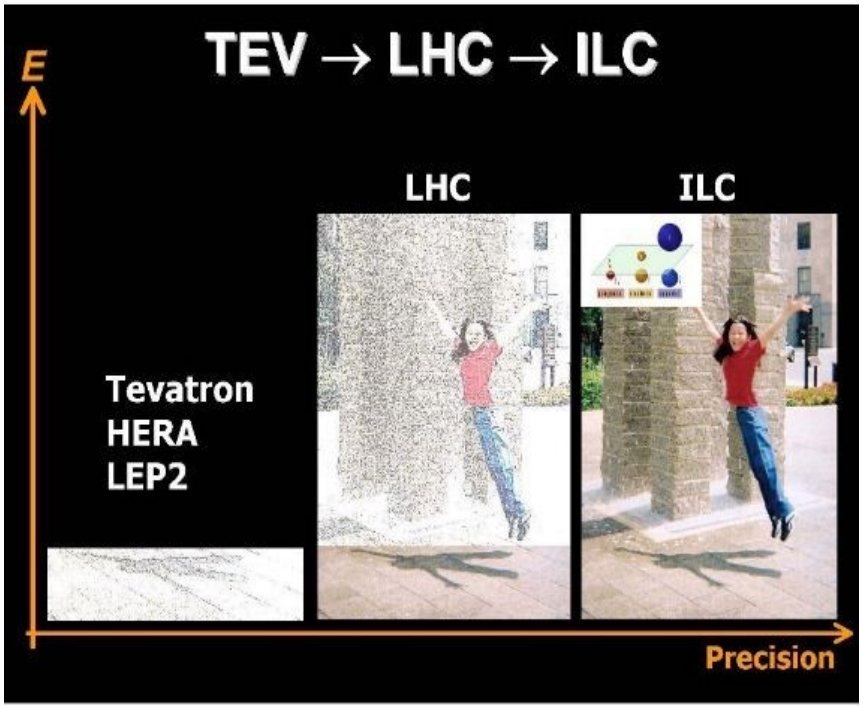


Z Mass reconstruction.



ILC - ILD

- International Linear Collider
- e- e+ Collisions
- 500 GeV to 1 TeV.
- Precision.
- ILD (International Large Detector) is one of the two proposed detectors at ILC.



ilc international linear collider