Forward Region: Simulation and Performance Studies

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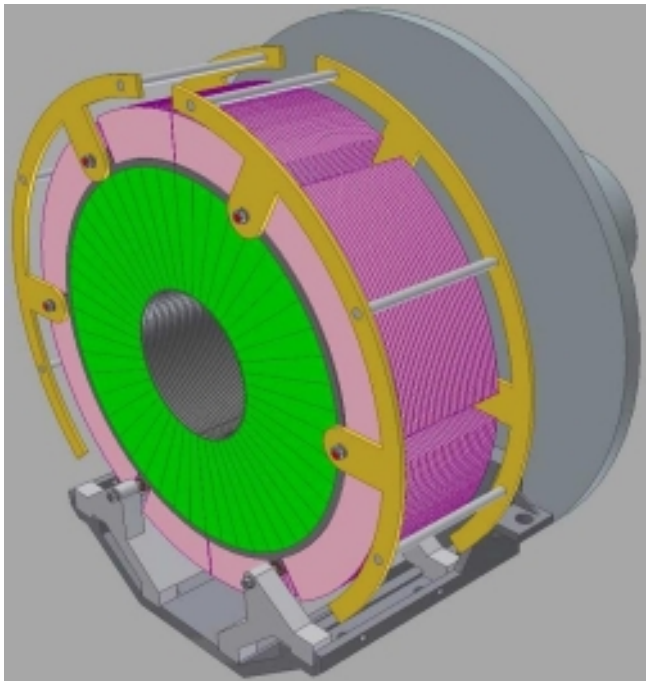
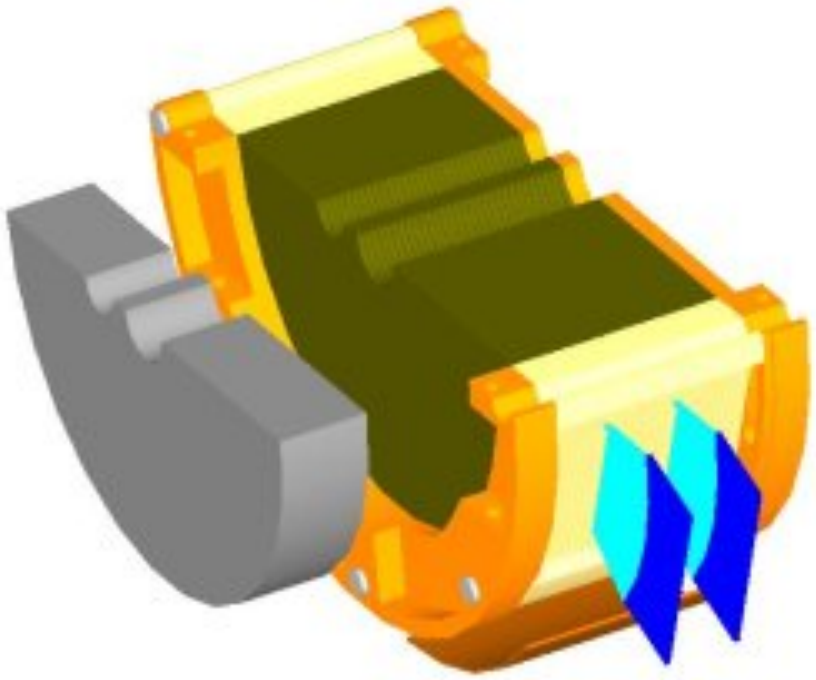
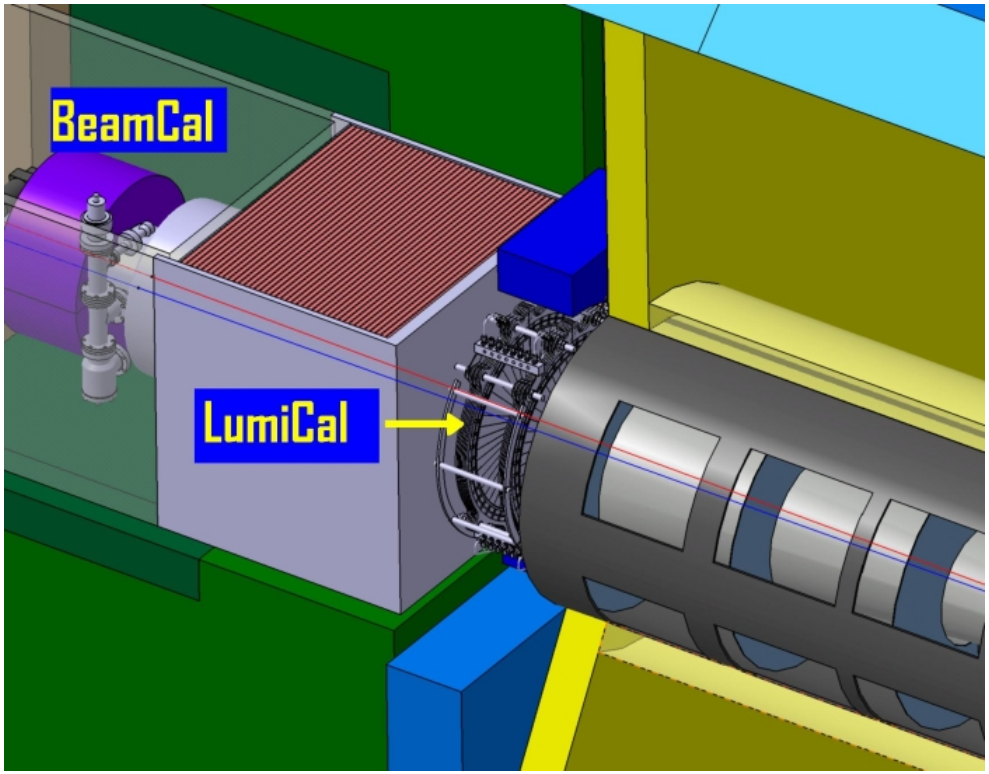




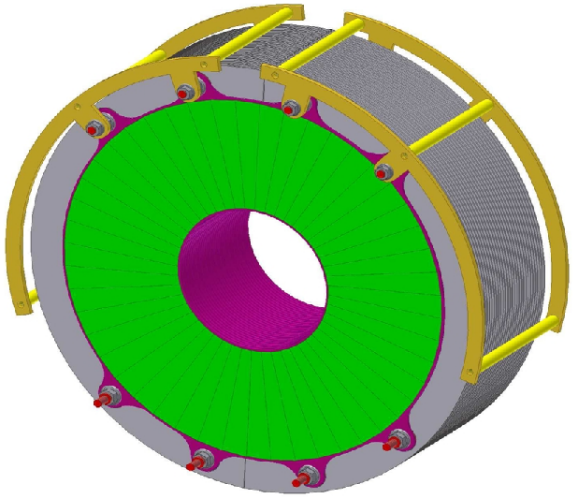
Introduction

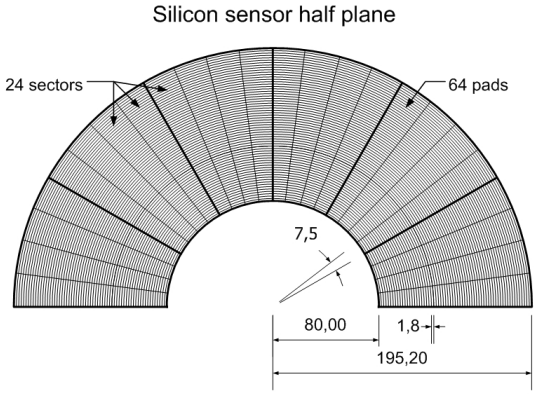
- LumiCal goals:
  - High precision in $\Delta L/L$
    - Bhabha scattering
    - 10^{-3} ($\sqrt{s}$ = 500 GeV)
    - 10^{-4} (GIGA-Z)
- BeamCal goals:
  - Fast luminosity estimation (using beamstrahlung)
  - Assist beam tuning
  - Assure good hermiticity



LumiCal Geometry

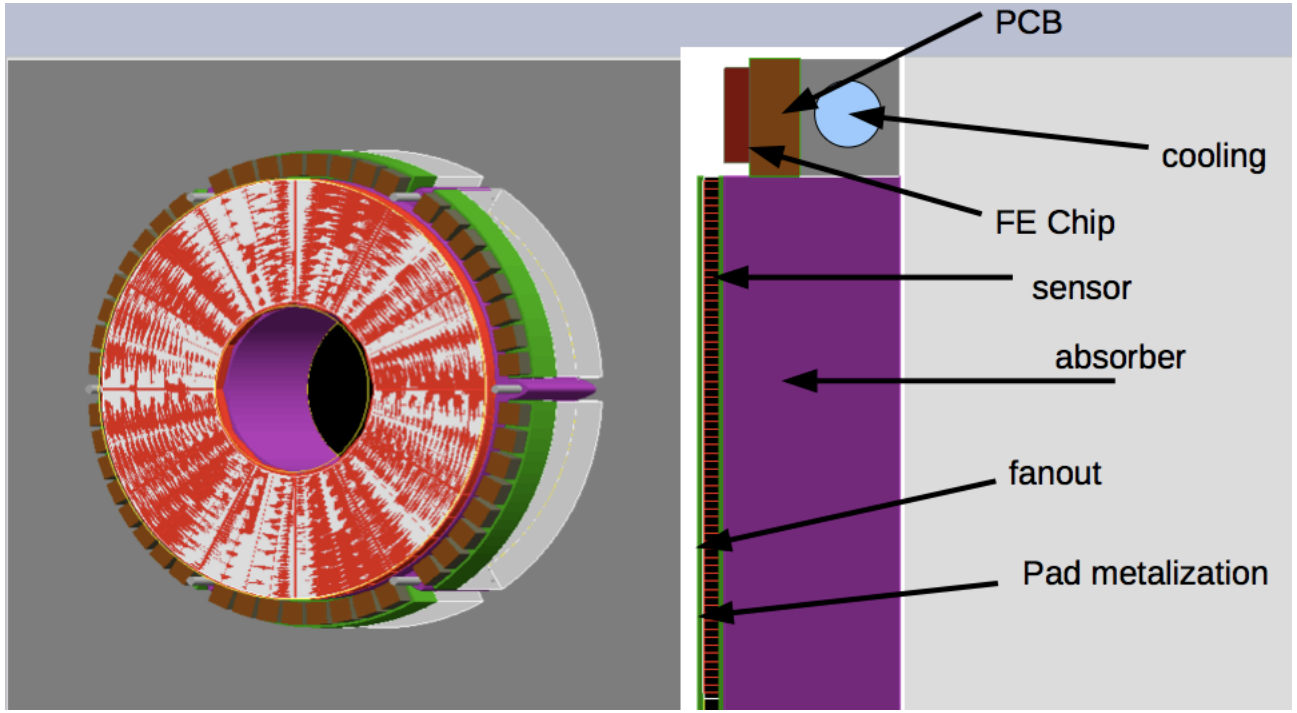
- Mechanical design for LumiCal exists; high level of realism.
- LumiCal structure:
  - Type — Si-W
  - # layers — 30
  - Absorber Δz — $1X_0$
  - Si Δz — 300 μm
  - Layer offset — 3.75^o
  - Inner radius — 80 mm
  - Outer radius — 195.2 mm
  - Distance from IP — 2.5 m



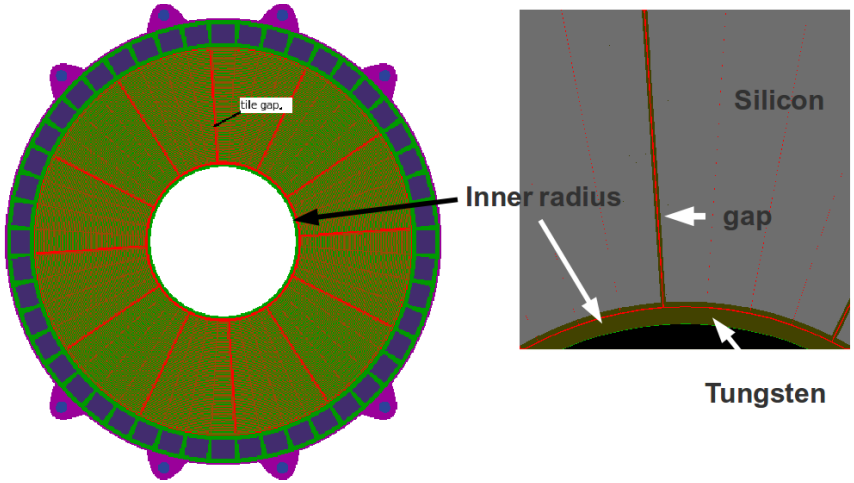


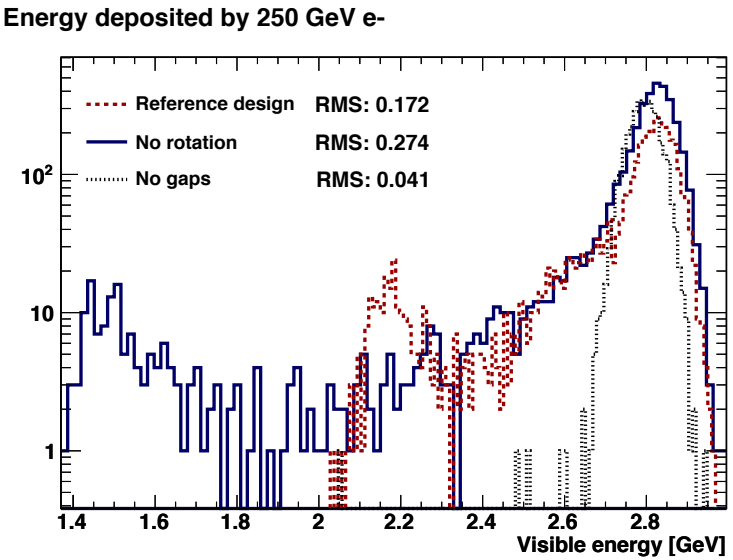
LumiCal Geometry

- Realistic software model in agreement with the mechanical design
- Sensitive detector very detailed:
  - tile gaps, pad metalization, support structure, cooling, electronics.



Implementation of Gaps



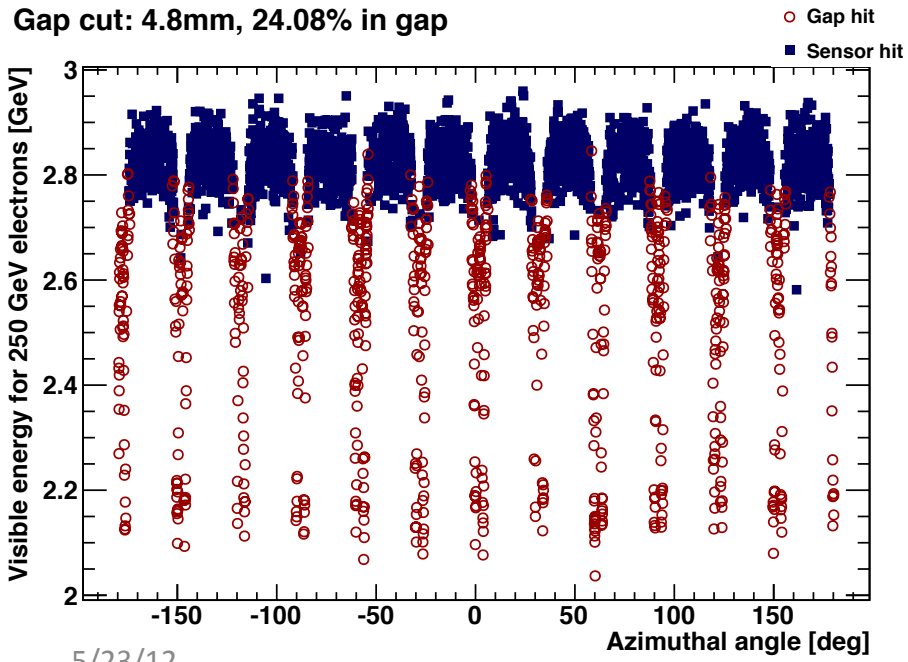


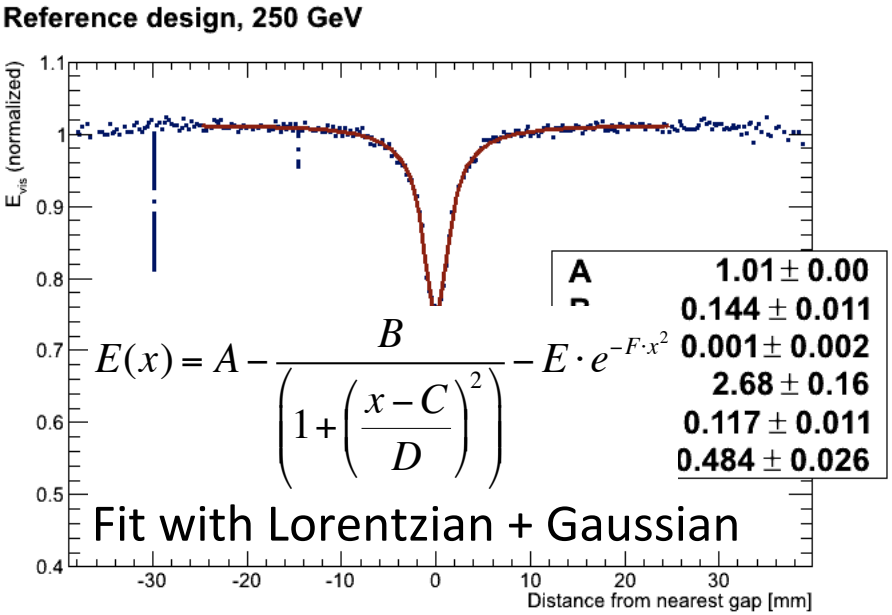
- Gaps between sensors implemented in the geometry.
- Strong gap effects, need to be simulated and corrected.
  - reject energy depositions on the tile gap
  - fit the energy depositions in gaps

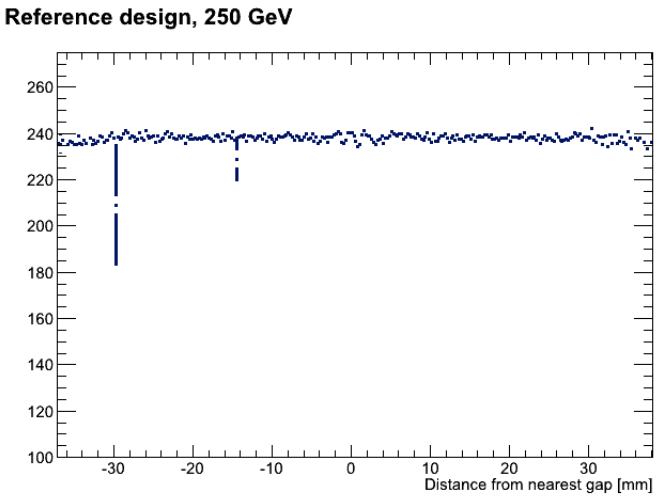
LumiCal Performance

- Detailed studies with single electrons, documented in: J. Aguilar et al.,Physics Procedia 00 (2012) 1-8

Energy deposition from 250 GeV e⁻
(in the gaps shown in red)

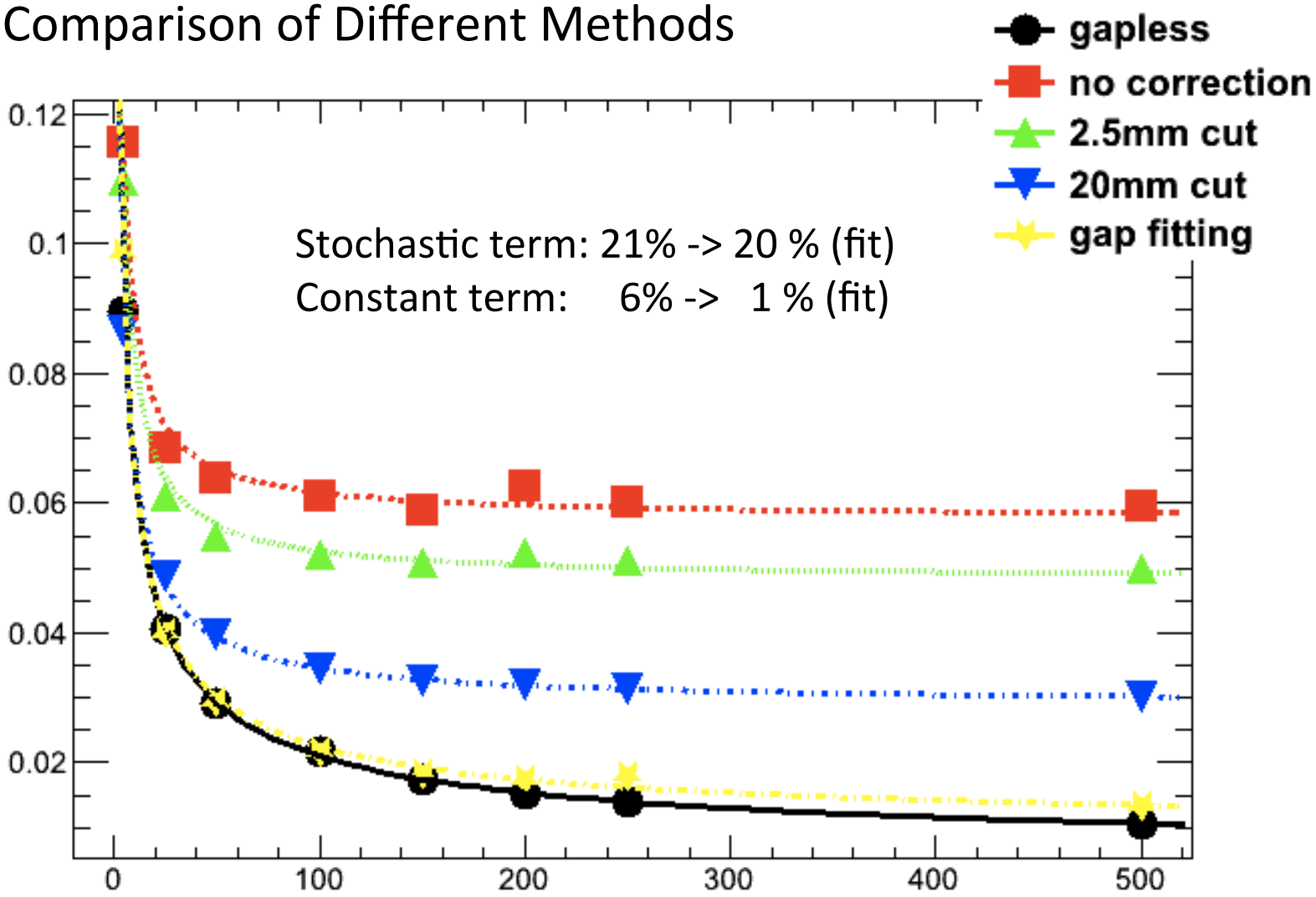






Energy Resolution

Comparison of Different Methods



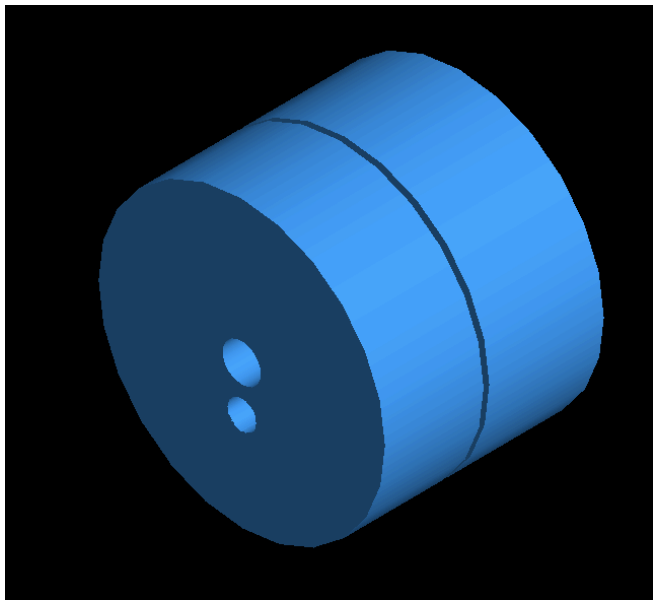
BeamCal Geometry

- Realistic simulation exists in Mokka.
- Model derived from the mechanical design.
- BeamCal geometry described in:

Mokka/source/Geometry/Tesla/src/BeamCal01.cc

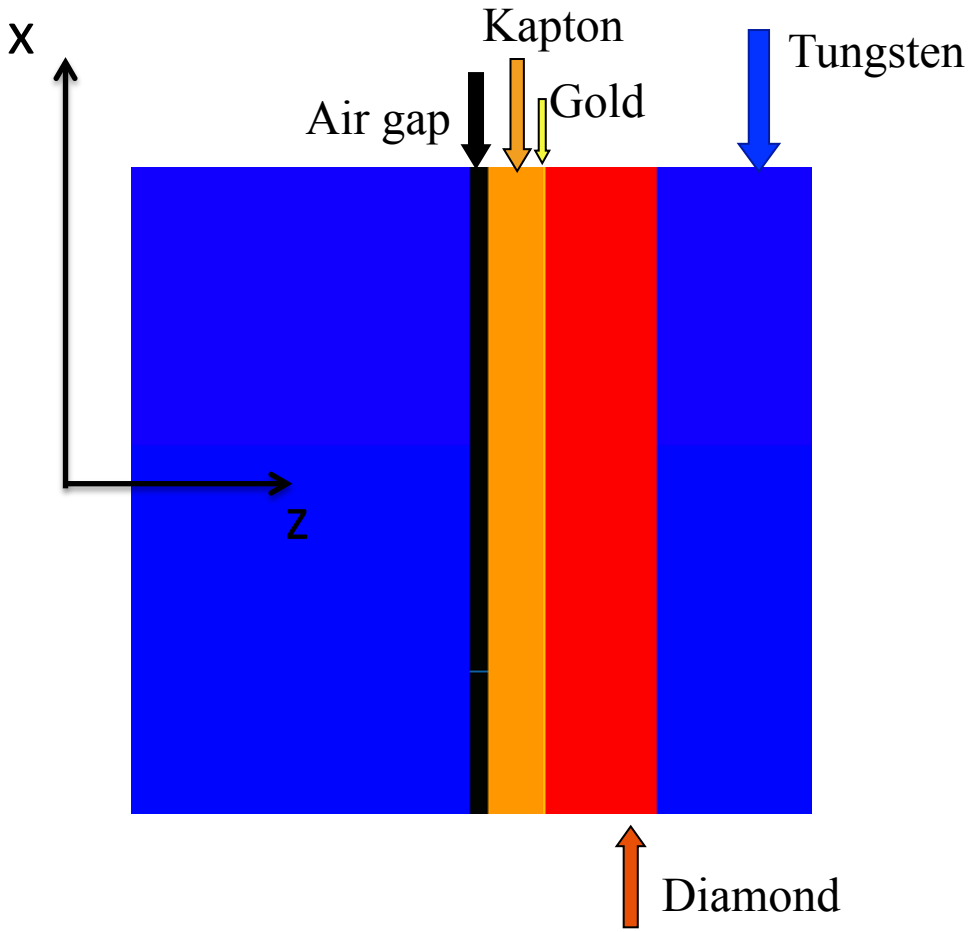
  - Cylindrical geometry
  - Graphite shield, 100 mm thick
  - 30 W layers, 3.5 mm thick
  - 30 diamond sensitive layers
  - Cells ~8 x 8 mm^2

  - Two holes for passing the tubes, beamcal centered around the outgoing pipe.



Layer Structure

Current implementation of the detector layers:



	Unit	14 mrad	
Graphite shield thickness	mm	100	
Absorber layer	mm	3.5	$1X_0$
Sensor layer	mm	0.3	
Readout plane/air gap	mm	0.2	
Total X_0		30	

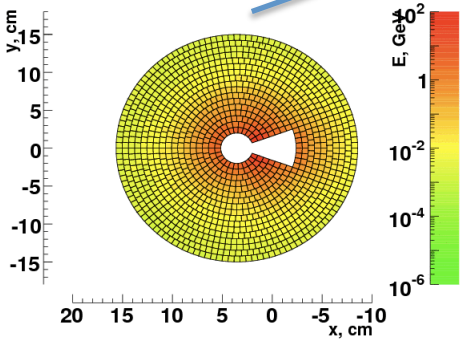
BeamCal Reconstruction

- Clustering/Reconstruction is done in

MarlinReco/Clustering/BCalReco/src/Reconstruction.cc , BCalReco.cc

- Part of the standard reconstruction chain for the DBD.
- Operates in the presence of beam background
- BCalReco.cc is a Marlin processor that calls the reconstruction code, after a simulation of the effect of backgrounds.
  - Needs the background depositions in all cells, as an external file: bg_aver_LDC_3.5T_14mrad_AntiDID_NominalBeamParam.root
  - Must be renewed for each set of beam parameters

Overview of Reconstruction Algorithm



Read Background Map

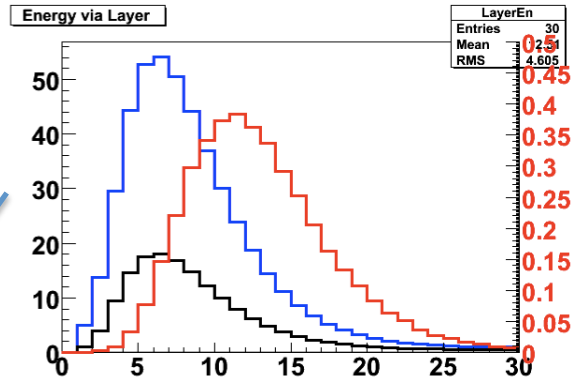
Smear Energy

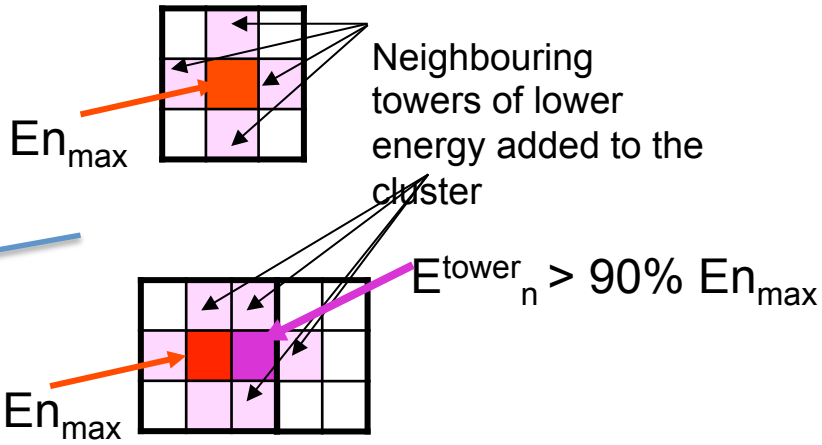
Select Pads with $E_{pad} > 1\ \sigma$

Build Towers

Build Clusters

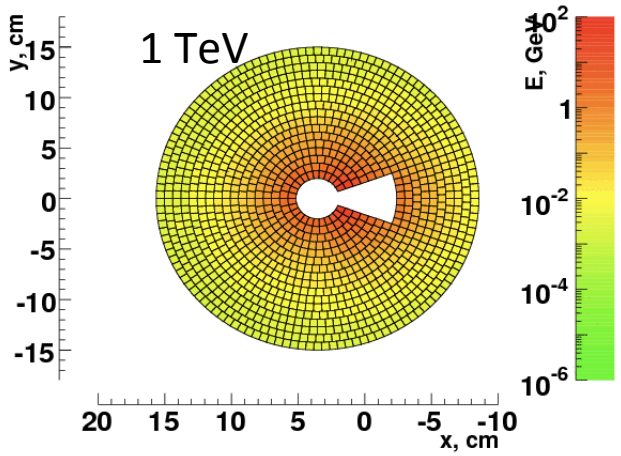
Accept Cluster
Calculate E, x,y,z

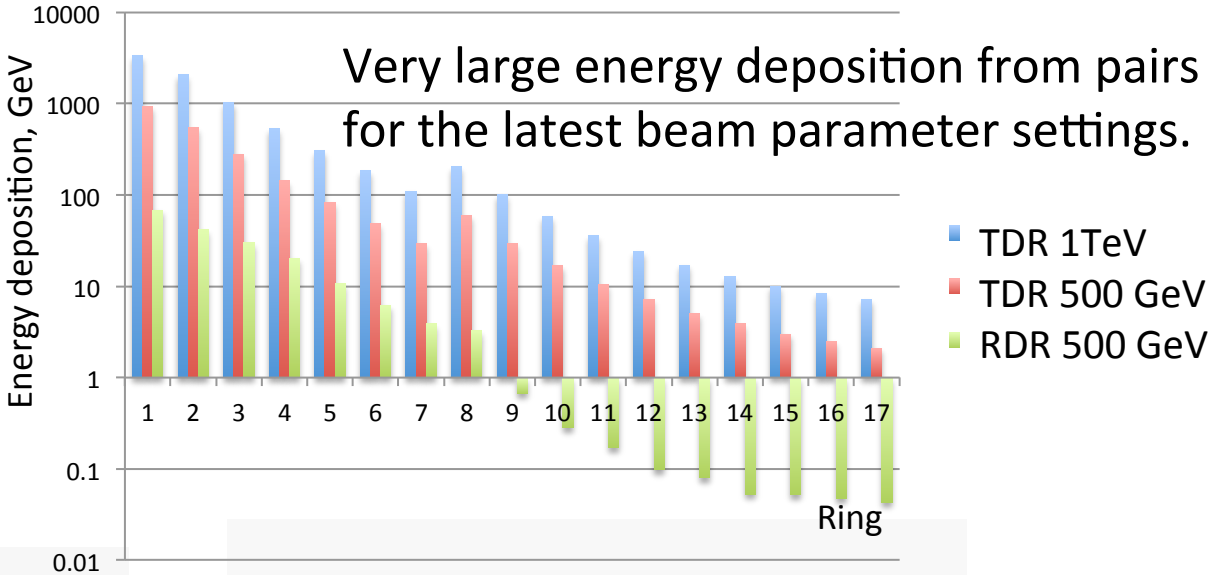


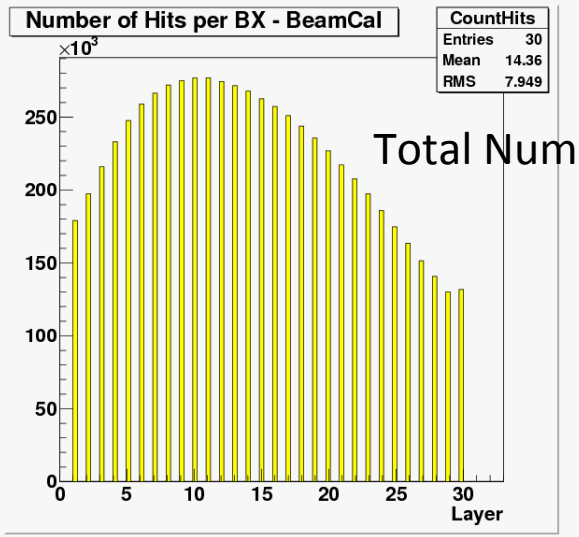


Pair Background in BeamCal

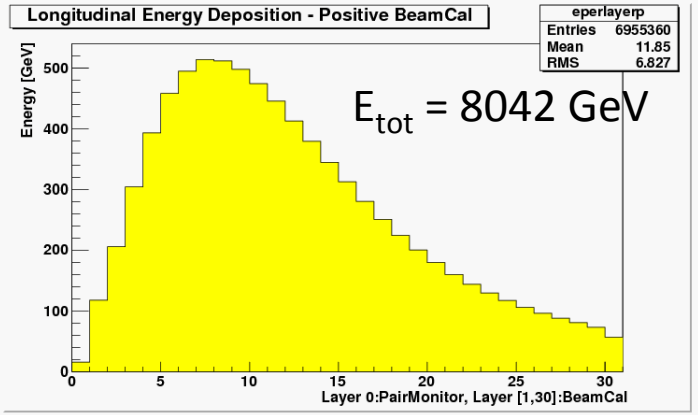
Radial Energy Distributions



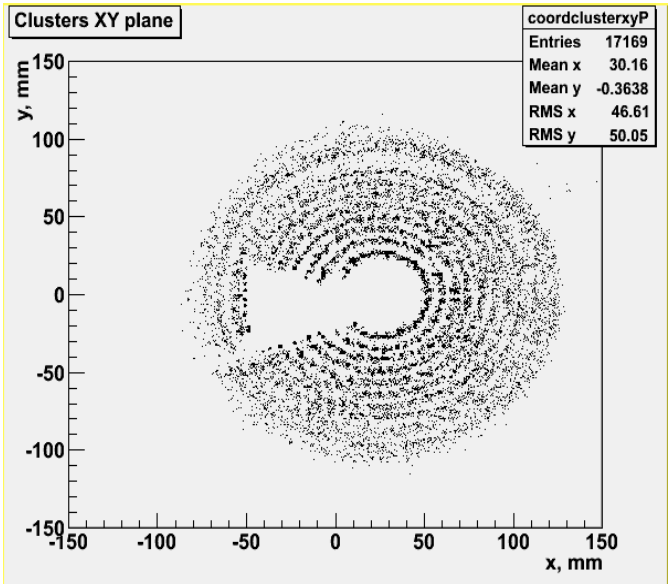


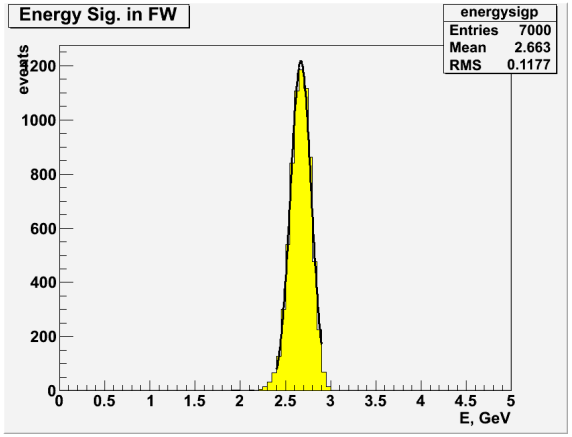


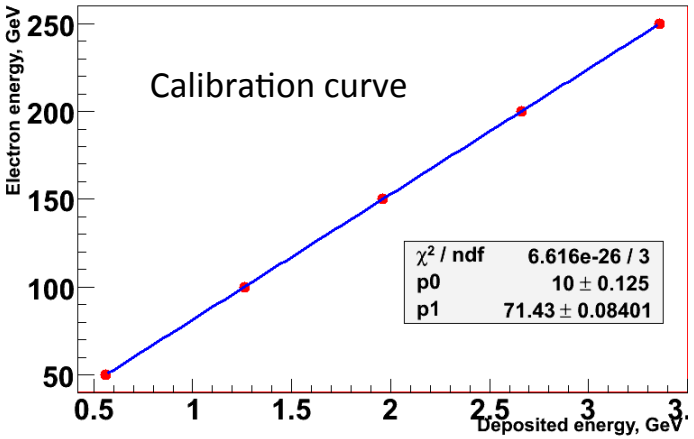
Longitudinal Energy Distribution

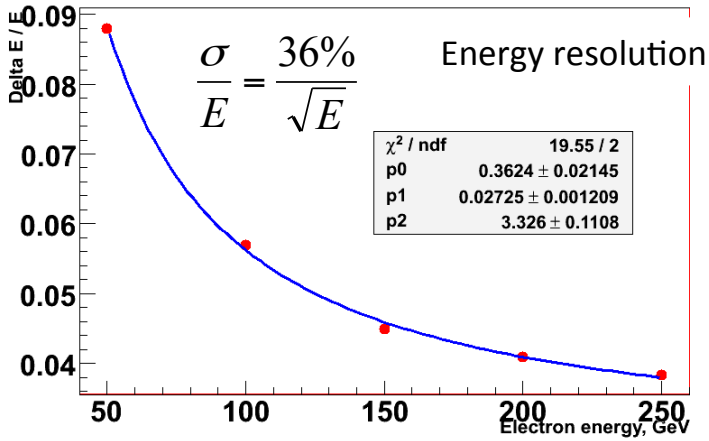


BeamCal Performance



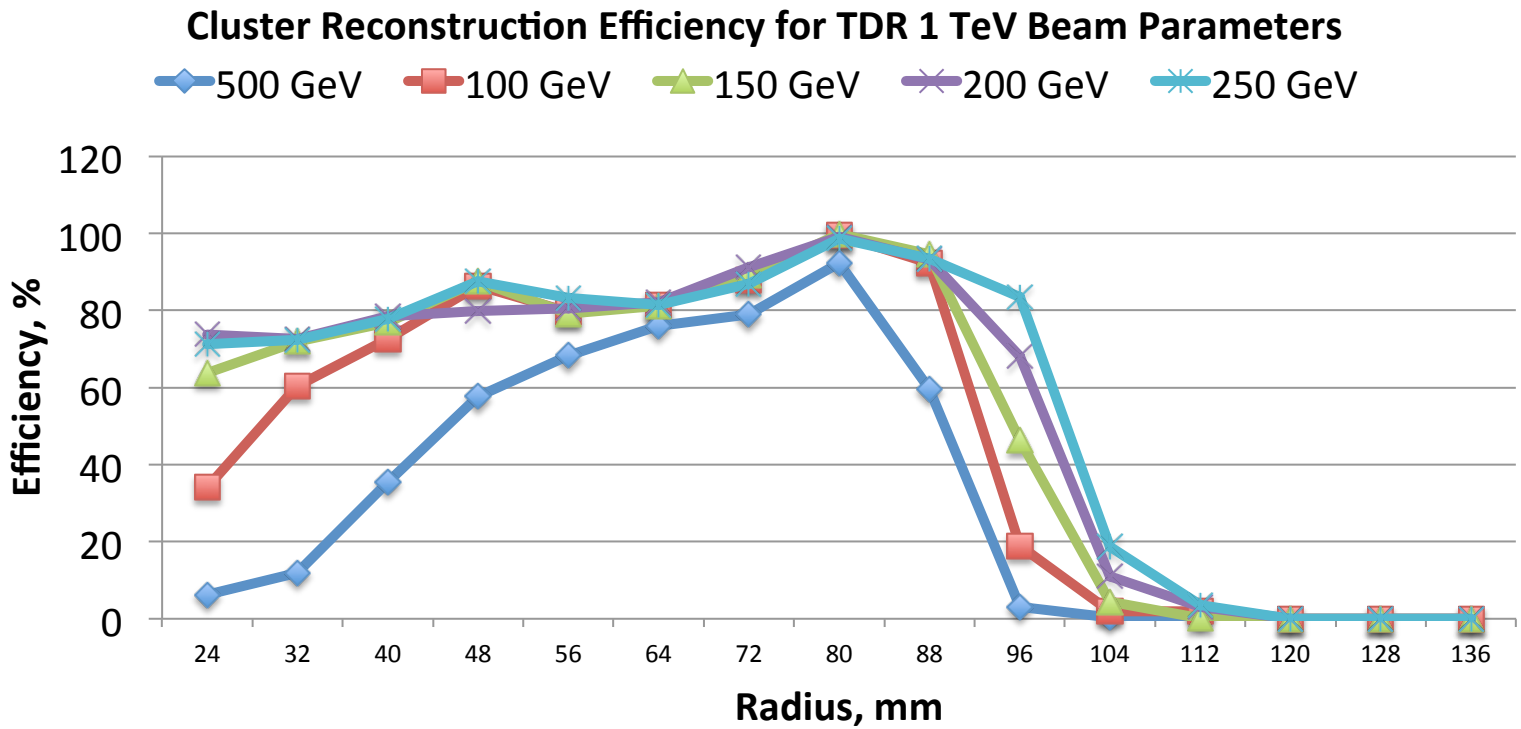






Reconstruction Efficiency

Single electrons, with energies 50 GeV, 100 GeV, 150 GeV, 200 GeV and 250 GeV, $\phi \in [0, 2\pi]$, $\theta \in [0.0067, 0.038]$ rad



Summary

- Realistic Mokka simulation models, in agreement with mechanical design.
- Tested and debugged Mokka drivers, ready for DBD production.
- Reconstruction code is part of the standard reconstruction chain.
- Tile gap effect in LumiCal understood and corrected for.
- Very large incoherent pair backgrounds for 1TeV TDR beam parameters, its impact needs to be better understood.