The LuminCal Energy Resolution dependence on the angular layer alignment

Itamar Levy

Tel Aviv University



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LumiCal Performance requirements

- 1. Required precision is: $\frac{\Delta L}{L} < 10^{-3}$, GigaZ (hadronic Z decays) 10^9 / year $\frac{\Delta L}{L} \sim 10^{-3}$, $e^+ e^- \rightarrow W^+ W^ 10^6$ / year $\frac{\Delta L}{L} \sim 10^{-3}$, $e^+ e^- \rightarrow q^+ q^ 10^6$ / year
- 2. Measure luminosity by counting the number of Bhabha events (N_B) in a well defined angular and energetic range:



Topology of Bhabha scattering

• Bhabha scattering with $\sqrt{s} = 500 \text{ GeV} - \text{Distributions of the}$ generated properties of the electron/positron



LumiCal Design parameters (SLcal03)

1. Placement:

- 2500 mm from the IP
- Inner Radius 77 mm
- Outer Radius 196 mm

2. Segmentation:

- 48 azimuthal & 64 radial divisions:
- Azimuthal Cell Size 131 mrad
- Radial Cell Size ~ 0.8 mrad



3. Layers:

- Number of layers 30
- Tungsten Thickness 3.5 mm
- Silicon Thickness 0.32 mm
- Elec. Space 0.1 mm
- Support Thickness 0.4 mm



Tile gaps

Every layer built from 12 identical tiles.

Each of them cover 30° of the whole ring.

Between any two tiles there is a "dead area" of 2.5mm called the tile gap.



Energyu resolution of LumiCal

 Energy resolution for the previous LumiCal model in MOKKA where there were there were no tile gaps.



The complete empirical formula look like:



The default solution (SLcal03 driver in ILD_fwp01 7 MOKKA detector model)





Alternative solutions

•Setup 1 – hand fan.

•Setup 2 – without rotation (all holes aligned).

•Setup 3 – Mixed hand fan.

•Setup 4 –angular gap bigger then 1 Moliere radius (RM)





 $\Delta \Phi$ refers to the angular distance between hole in any two consecutive layers.

Fest simulation

- we generate a random events ($\theta \& \Phi$) in a flat distribution.
- how mach area is lost



From a 1 RM circle in all 30 lavers?



Full simulation

- 1. In Mokka (07-02) using SLcal03, we simulate 50K uniformly distributed (in $\theta \& \Phi$) events of 250 GeV electrons in LumiCal, for each setup.
- 2. We check that the result for the default set up is similar to previous results (FCAL Report Oct 2009).



Full simulation – another look

When looking on all the tile in one layer one can see the symmetry in the Φ direction of 30°.in each section we have ~1° of tile gap and the rest is the sensitive sensor.



Full simulation – another look

The leakage in the energy histogram causing a higher energy resolution factor



Full simulation

default setup in a comparison to setup 2 (white out rotating)





Full simulation



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EngyHistArray

1107

2.567

0.03508

Entries

Mean

RMS

Summary