Study of SiW-ECAL performance with reduced number of layers at reduced radius

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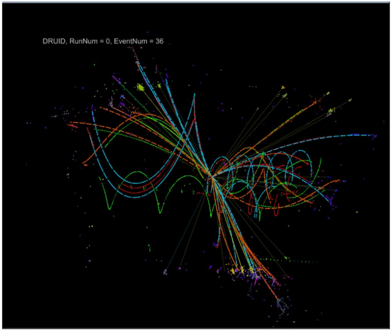


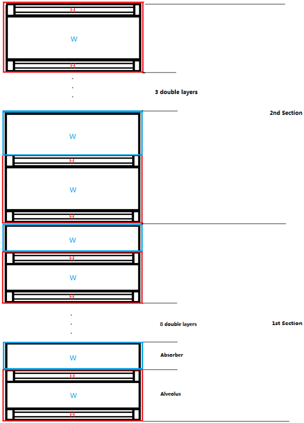
Geometry

- Model: ILD_o2_v05(SEcal04, SDHcal)
- Radius: 1450mm (baseline design: 1843mm)
- Barrel half length: 1848mm
- Si thickness: 500μm
- Variables: Number of layers

number of Si layers	W layers (1st section)	Thickness (mm)	W layers (2nd section)	Thickness (mm)
20	13	3.15	6	6.3
26	17	2.4	8	4.8
30	20	2.1	9	4.2

Geometry

How ECAL Barrel is built in Mokka



ECAL prototype built with Mokka

Calibration procedures

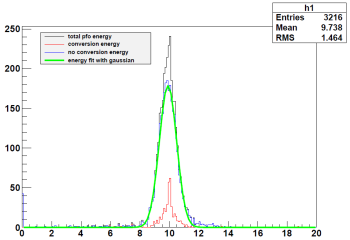
- Absorber correction factor (10000 γ at 10 GeV)
- (Mip): effect is very small
- Angular correction (100000 γ at 10 GeV and 50000 K_L^0 at 5 GeV)
- Pandora parameter optimisation (10000 Z$\rightarrow$uds events at 91GeV, 200GeV, 360 GeV, 500 GeV)

Absorber correction factor

Check using 10000 γ at energy 10 GeV

$c_{new} = c_{old} \times \frac{E_{mean}}{10GeV}$

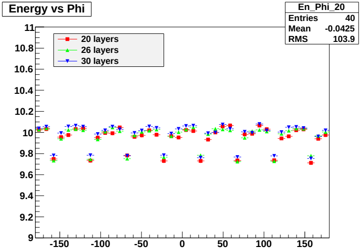
ECAL setup	Coef. (1st section)	Coef. (2nd section)
30 layers (default)	42.8	85.6
26 layers	49.6	99.2
20 layers	60.2	120.4



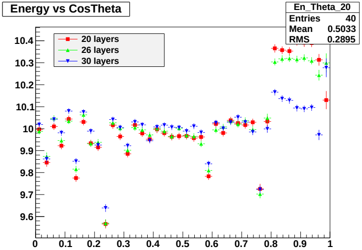
sum of hit energies 10GeV, the reconstructed energy of all events(black) is a summation of a gaussian and a peak, the energy for the events without conversion (blue) is fitted with a gaussian (green), and energy for conversion events (red) is shown to be a peak

Angular corrections

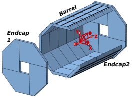
Dependence of energy on angles: the gaps between modules, the gaps between staves, etc.



(a) energy depending on ϕ



(b) energy depending on $|\cos\theta|$



The energies after this correction have been corrected to be at simulated energy (10GeV).

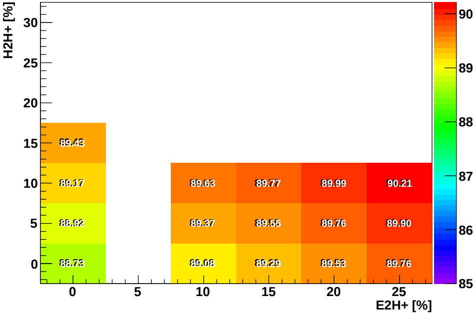
Calibration Parameter Scan

Di-jet energy: 91 GeV, 200 GeV, 360 GeV, 500 GeV

Weights to:

- energy deposit in HCAL which belongs to hadronic shower (H2H)
- energy deposit in ECAL which belongs to hadronic shower (E2H)

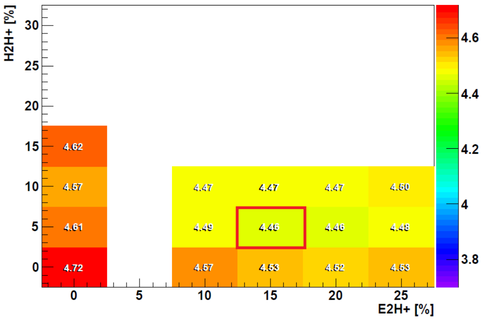
Ensures that energy mean value is close to generated energy



Parameter Scan

Calibration Parameter Scan

- Provides the optimum for JER (Single JER expressed in terms of RMS90)
- $\frac{rms_{90}(E_j)}{E_j} = \frac{rms_{90}(E_{jj})}{E_{jj}} \cdot \sqrt{2}$
- RMS90: the RMS in the smallest range of reconstructed energy which contains 90% of the events.

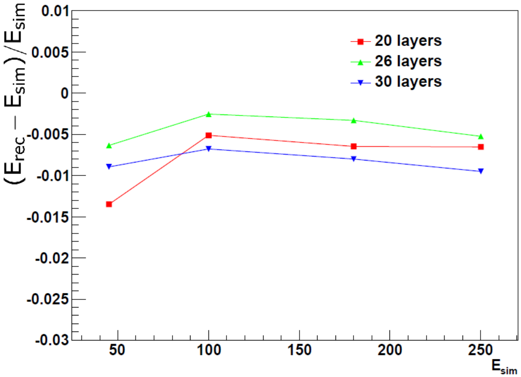


Parameter Scan

Same scan done for other energies and other models.

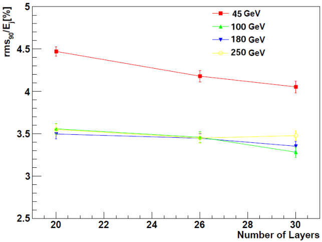
Linearity

The difference between reconstructed energy and generated energy: $< 2\%$

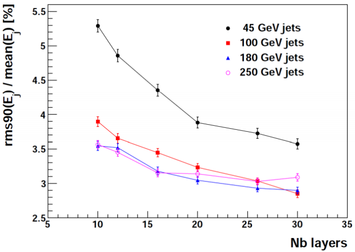


Check linearity of reconstructed energy, error bars is at the order of less than 1 %

Jet Energy Resolution



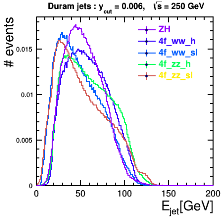
JER comparison for different jets energy (A cut $|\cos(\theta_{jet})| < 0.7$ is applied to avoid the Barrel/Endcap overlap area) in function of layer numbers
R= $1450mm$



JER comparison for different jets energy in function of layer numbers (from the presentation of Trong Hieu TRAN at LCWS12 workshop)
R= $1843mm$

Conclusion

- Performance SiW-ECAL for different number of layers studied
- Calibration was performed for every ECAL setups with different number of layers



- Resolution increases 6% for 45 GeV (the most probable jet energy for ZH events) jets by decreasing the number of Si layers from 30 to 20 and less than 5% for higher energy di-jets(R=1450mm in all cases)
  - To be extended for 70 GeV jets (thanks to John Marshall for the files)

- Comparison

Optimisation option	JER degradation
1843mm → 1450mm	10%
30 Layers → 20 Layers	1450mm 6% 1843mm 9%

- Study with only PandoraPFA: Garlic, Arbor...
- Other parameters: Si wafer size, number of towers...