BeamCal electron reconstruction

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24th November 2010

Cluster reconstruction algorithm in BeamCal

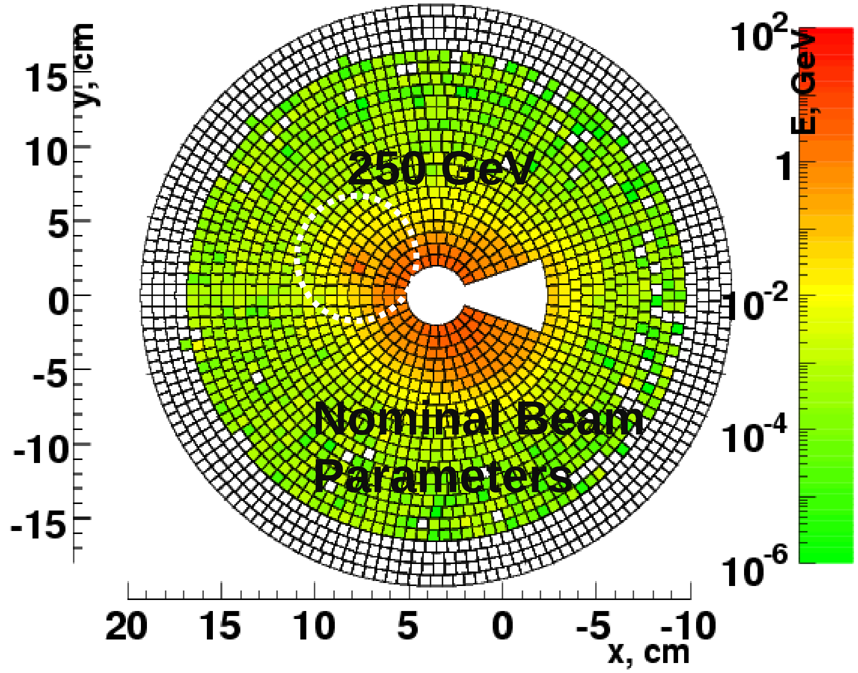
(Developed by Olga N. and Wolfgang L.)

1. Background subtraction procedure

- **Calculate average and rms of the energy deposition of the background in each pad of the BeamCal, from 10 BX;**

- **Superimpose 1 BX background + 1 high energy electron;**

- **Subtract the value of the background average from the superposition;**



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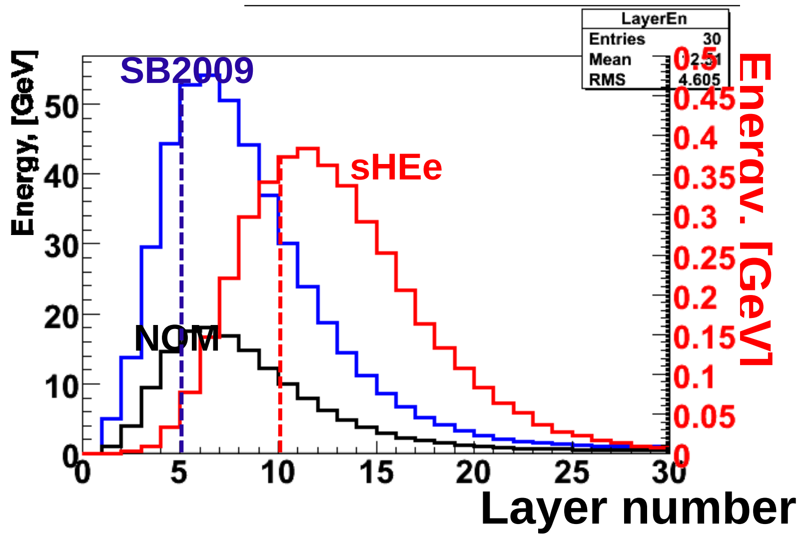
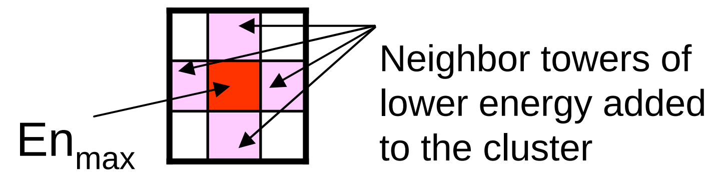
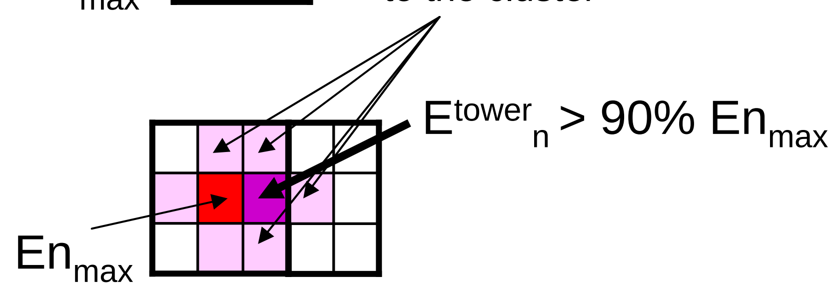
2. Cluster search

- **Identify towers after the 5-th layer as chains of 10 consecutive fired pads;**
- **Search for the tower with maximum deposited energy;**
- **Add neighbor towers, in a 3×3 matrix around the tower with the highest energy;**
- **If such a neighbor tower has an energy larger than 90% of the energy of the central tower, add this tower neighbors as well;**

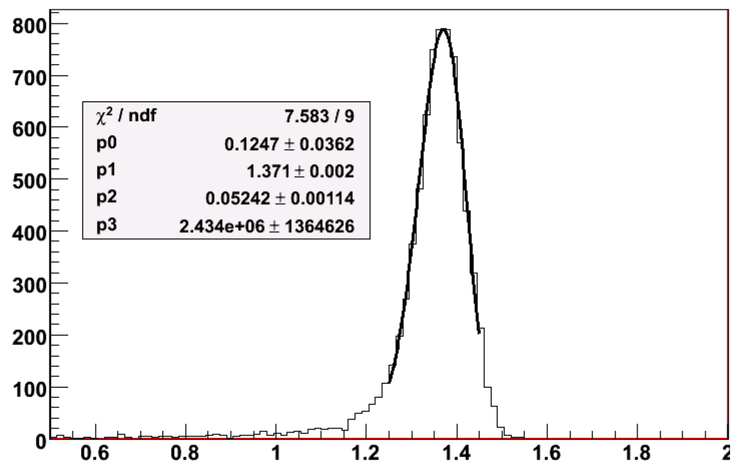




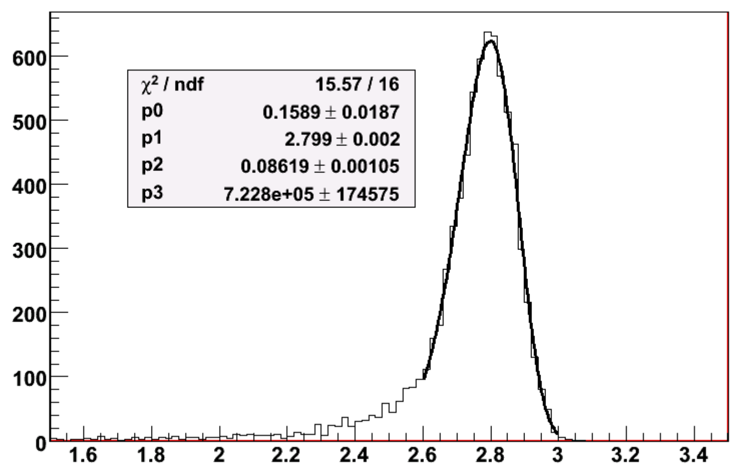


Calibration curve

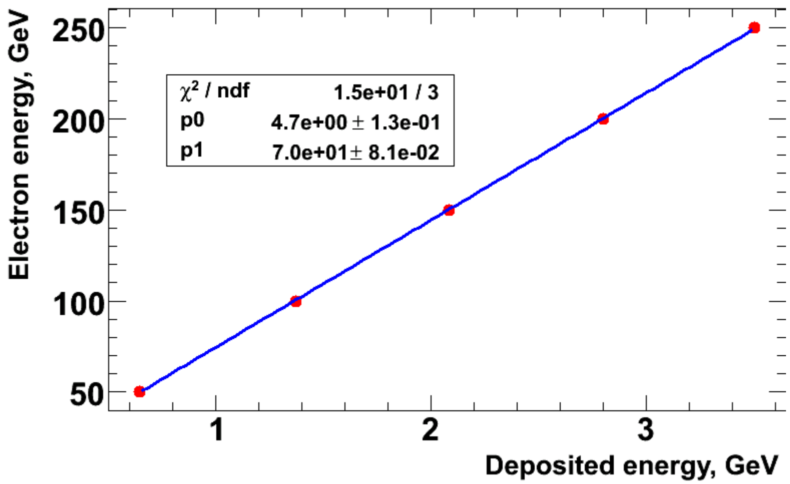
Energy deposition from 100 GeV electron showers



Energy deposition from 200 GeV electron showers



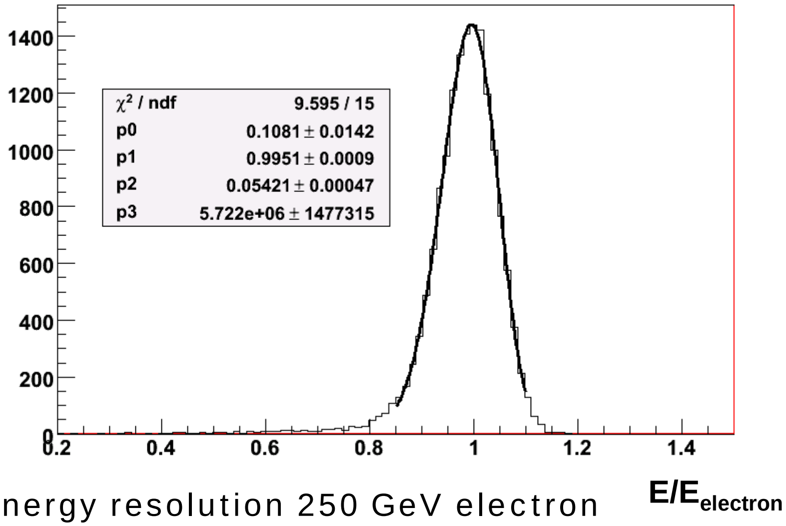
Calibration curve



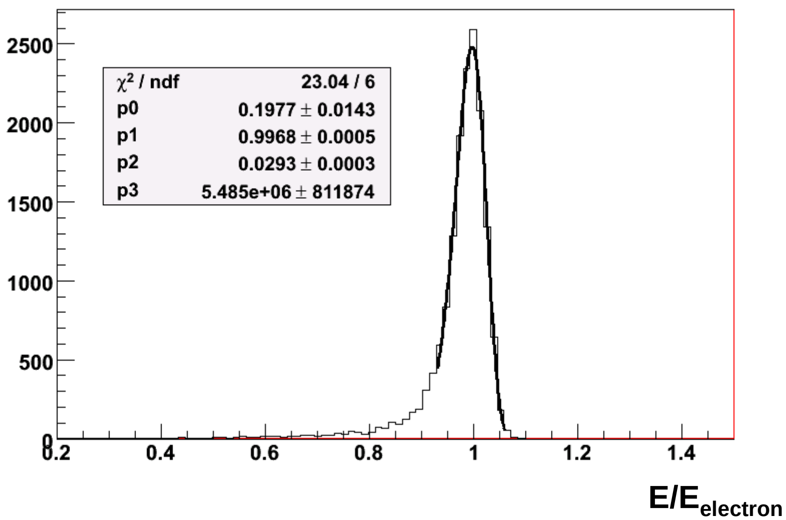
$$E = (70 * En_{dep} + 4.7)\ \text{GeV}$$

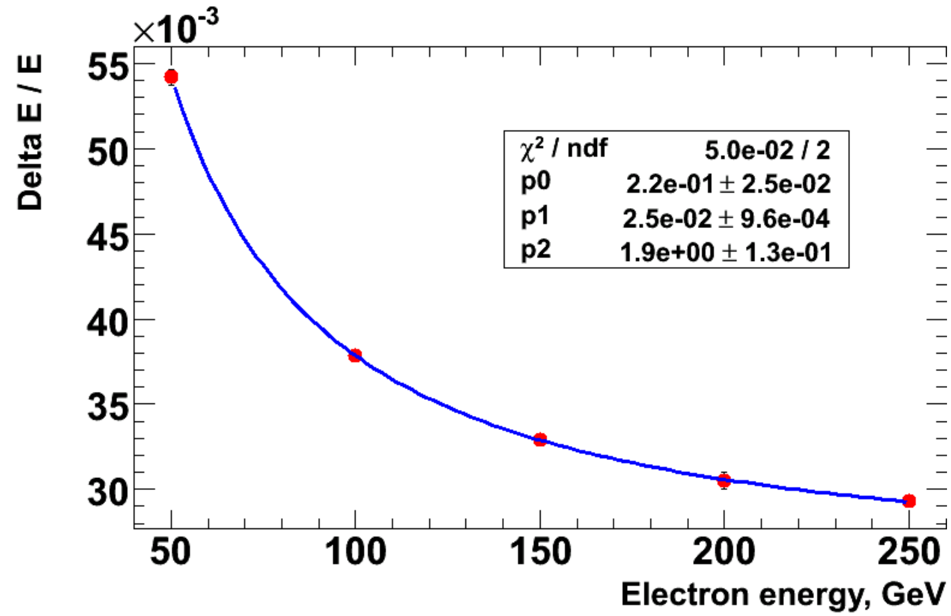
Energy resolution

- Energy resolution 50 GeV electron



- Energy resolution 250 GeV electron





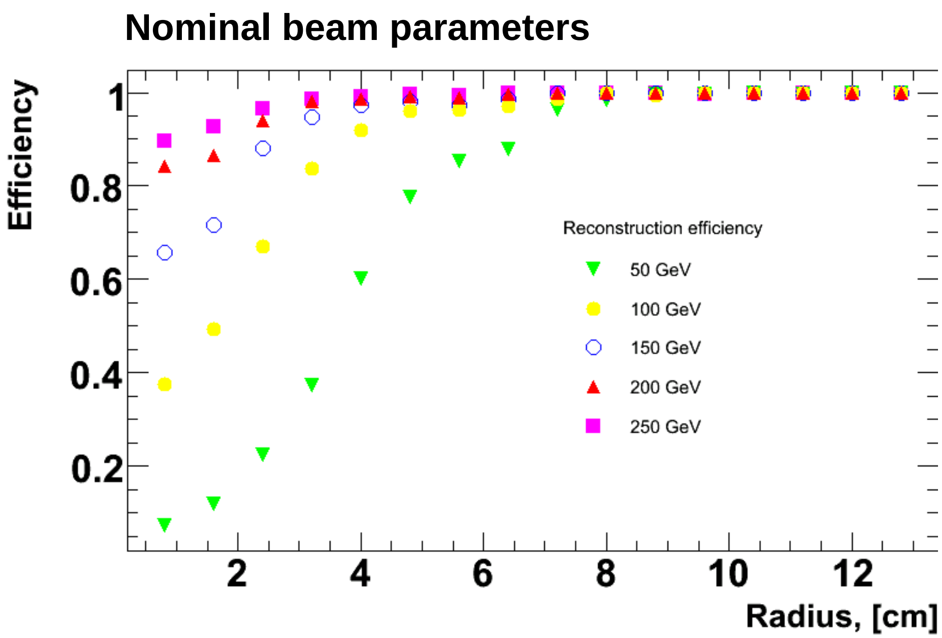
$$\sigma(E)/E = \sigma_1 / E^{1/2} \oplus \sigma_2 \oplus \sigma_3 / E$$

$$\sigma_1 = (22.0 \pm 2.50)\%$$

$$\sigma_2 = (2.5 \pm 0.1)\%$$

$$\sigma_3 = 2$$

Reconstruction efficiency



New parameterization of the efficiency as a function of electron energy and background energy deposition, valid for nominal beam parameters:

$p0 = f_1(Energy) = 7.534199e\text{-}02 + 7.452120e\text{-}04 * Energy - 2.001878e\text{-}06 * Energy * Energy$

$p1 = f_2(Energy) = 8.149966e\text{-}02 + 9.193878e\text{-}04 * Energy - 2.437620e\text{-}06 * Energy * Energy$

$p2 = f_3(Energy) = -1.259418e\text{-}01 + 9.974422e\text{+}03 / (Energy * Energy)$

$efficiency = f(Energy, EnDensity_{Bkgd}) = p0 + 1/(1+p1*\exp(p2*EnDensity_{Bkgd}))$

Implementation in Marlin

- Parameterization is used together with a background map of energy density deposition of the background in the BeamCal pads, in the form of a root file;
- It is of interest for physics studies that need to estimate the probability to detect a high energy electron at a position in BeamCal with a given local energy density;
- The efficiency for each particle can be accessed via the method getGoodnessOfPID() of the class ReconstructedParticle from the Marlin package;
- Parametrization should substitute the old one in the existing processor BCalTagEfficiency;
- Open point: who performs the implementation in the official released?

Summary

- Clustering algorithm in BeamCal is based mainly on finding neighbor towers of 10 consecutive pads after a background subtraction procedure is applied;
- Energy resolution in BeamCal is: $\sigma_1 = (22.0 \pm 2.50)\%$;
- New parameterization exists of the electron reconstruction efficiency in BeamCal, for nominal beam parameters.