Updates on the performance of the BeamCal

Aura Rosca

15th November 2010

Cluster reconstruction algorithm in BeamCal

(Developed by Olga N. and Wolfgang L.)

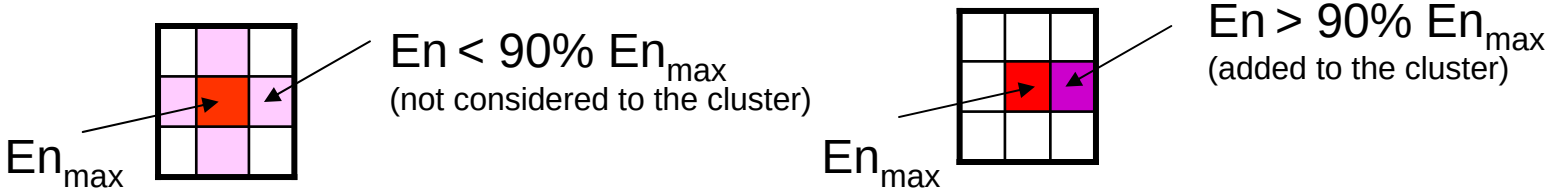
- **Calculate average and rms of the energy deposition of the background in each pad of the BeamCal, from 10 BX;**

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

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

- **Search for a cluster generated by a high energy electron:**

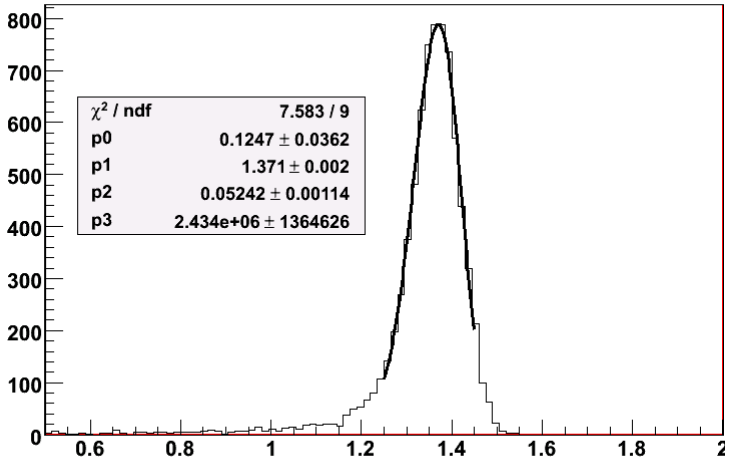
  - identify towers after the 5-th layer as chains of 10 consecutive fired pads;
  - search for the tower with maximum deposited energy;
  - add neighbor towers, in a 3×3 matrix, with an energy larger than 90% of the energy of the central tower;



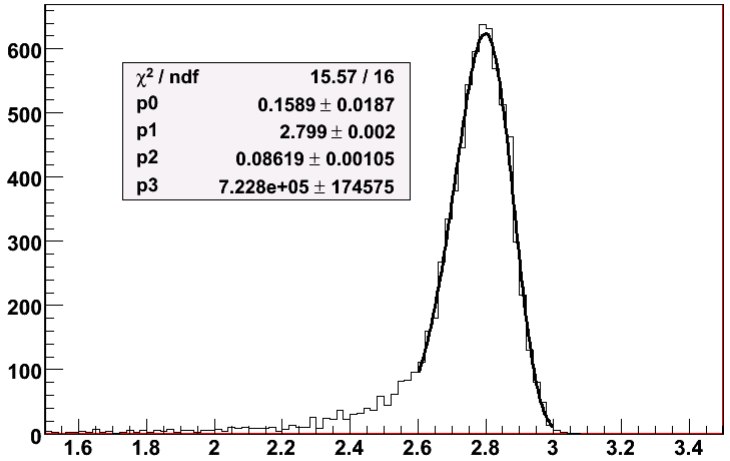
- exclude all towers that correspond to the found cluster and repeat searching

Calibration curve

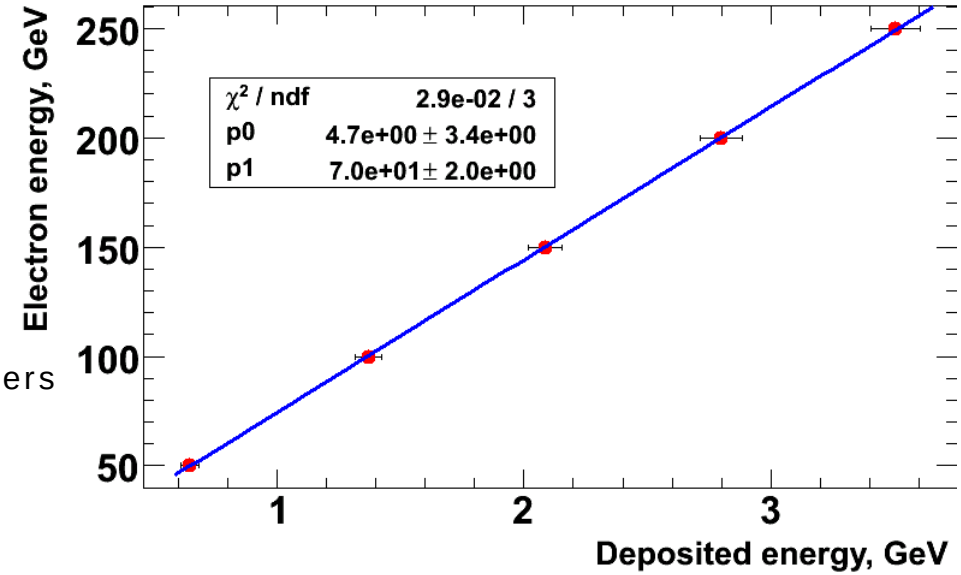
Energy deposition from 100 GeV electron showers



Energy deposition from 200 GeV electron showers



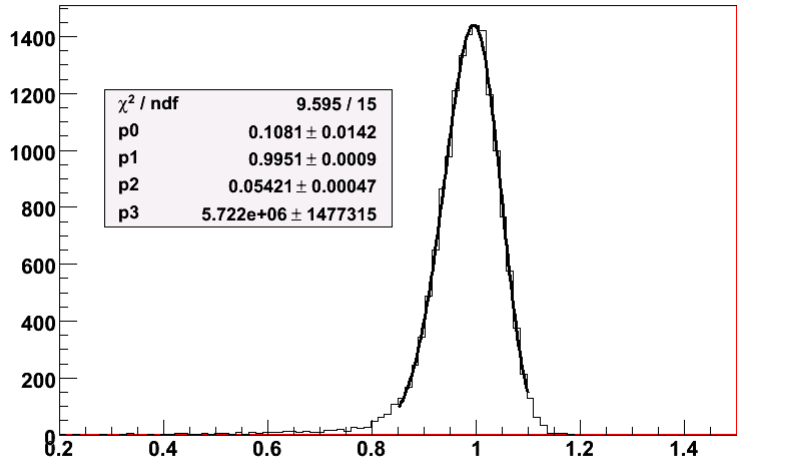
Calibration curve



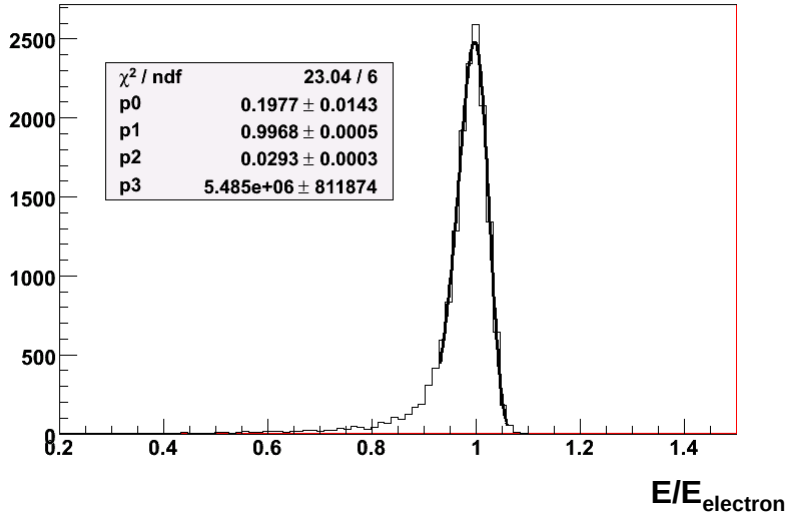
$E = (70*En_{dep}+4.7)$ GeV

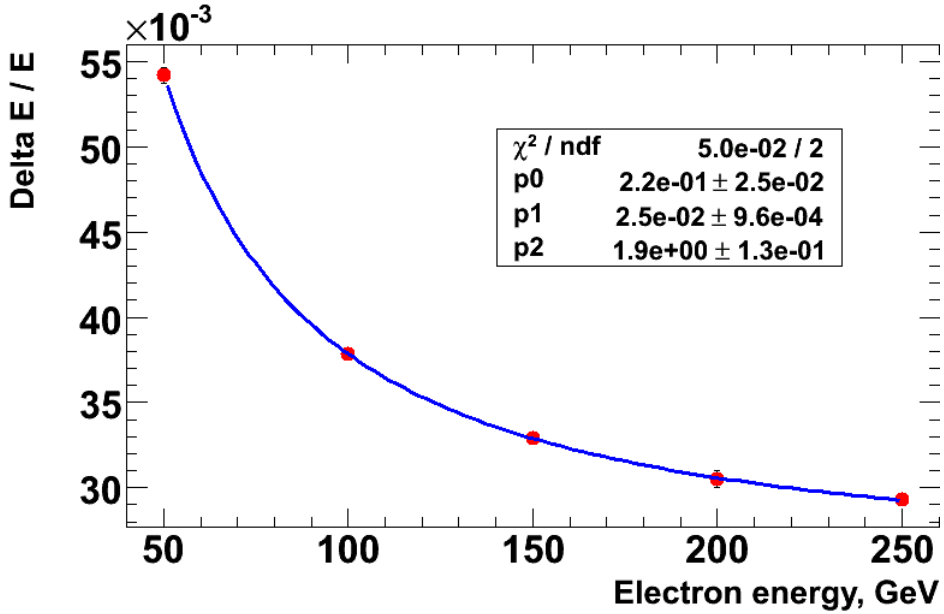
Energy resolution

Energy resolution 50 GeV electron



Energy resolution 250 GeV electron





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

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

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

$$\sigma_3 = 2$$

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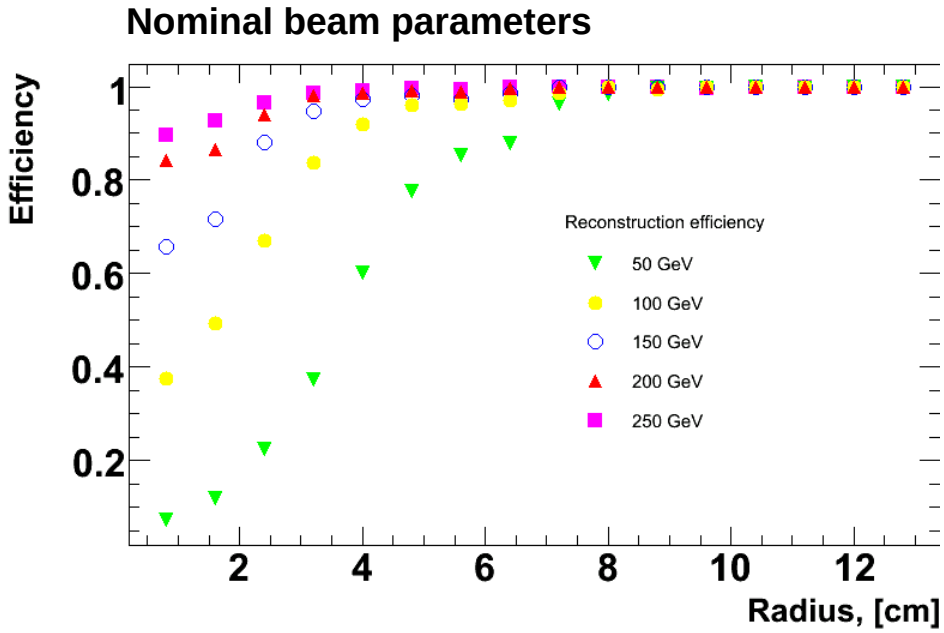
Reconstruction efficiency



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

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

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

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

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

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;
- 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?
- Eventually more details from Mikael B. who is using it currently.

Summary

- Clustering algorithm in BeamCal is based mainly on finding the central tower 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.