Energy Density Cluster Weighting

- Hadronic showers are separated into many clusters, especially in the EMEC where there is high granularity
- Because we are using a non-compensating calorimeter with an e/h > 1, the hadronic component of a shower has a lower response than the electromagnetic component
- High energy density clusters can be associated to an electromagnetic weight, while low energy density clusters can be associated to a higher weight
- Energy density dependent cluster weighting allows for partial software compensation, which improves the calorimeter performance

Methodology

- To determine the best weights for different energy densities, we use Minuit to minimize a chi-square

$$\chi^2 = \sum_{\text{all events}} \frac{(E_{beam} - E_{leak} - E_{reco}(C_{1E}, C_{3E}, C_{1H}, C_{3H}))^2}{(\sigma_{leak}^2 + \sigma_{reco}^2)}$$

- Here E_{reco} is found using

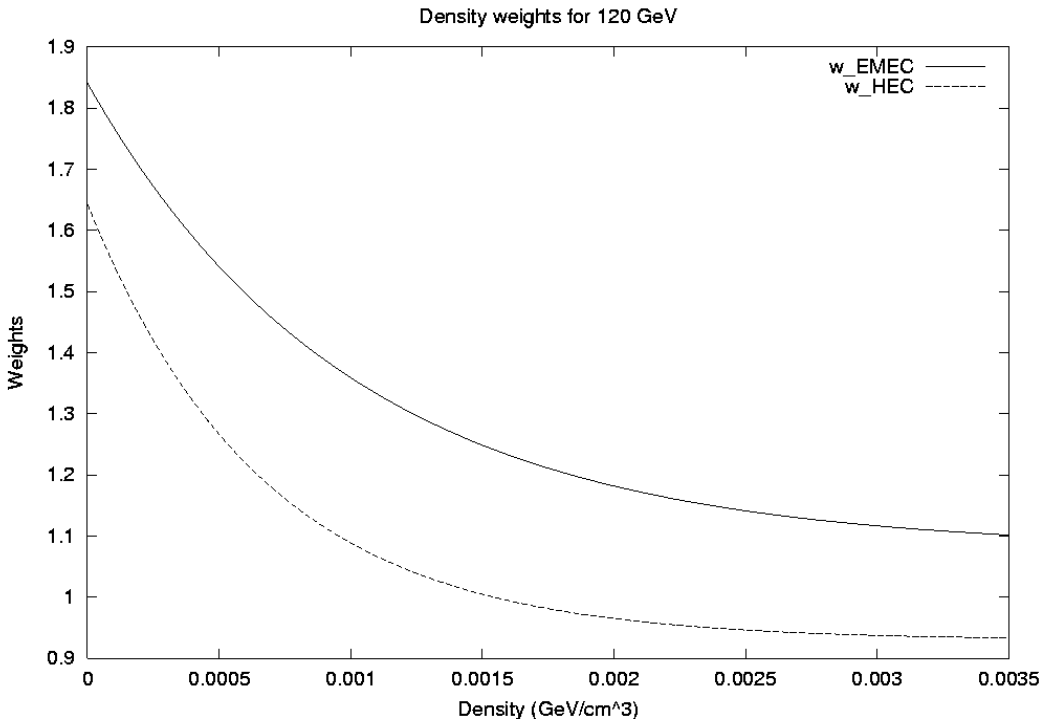
$$E_{reco} = \sum_{clusters} w_E \cdot E_{EMEC} + \sum_{clusters} w_H \cdot E_{HEC}$$

where w is

$$w = C_1 \cdot \exp(-C_2 \cdot E/V) + C_3$$

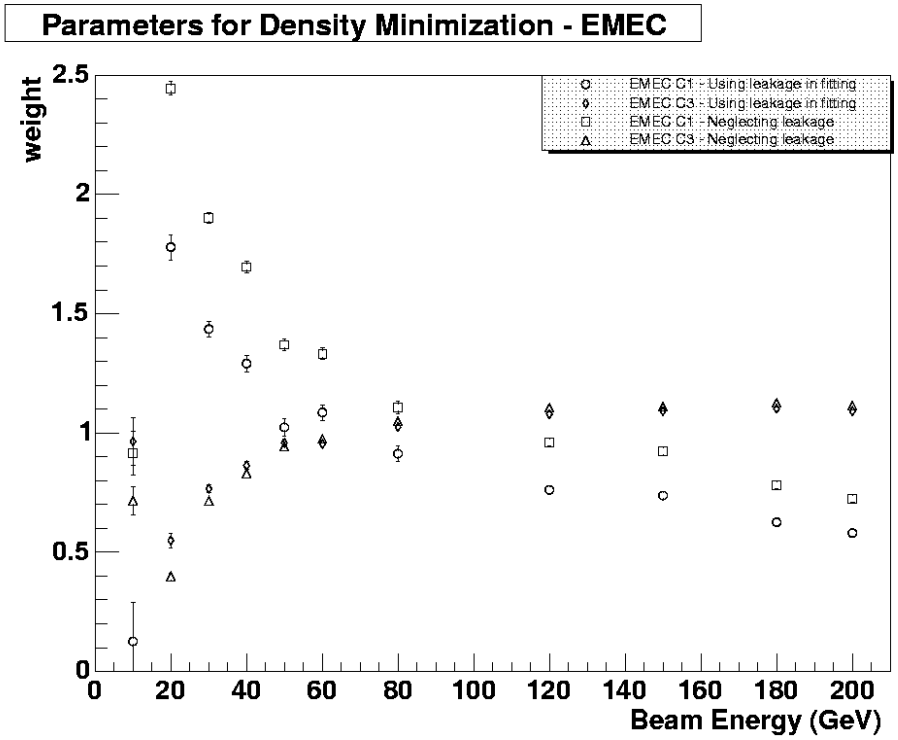
$C_{2E} = 1000$ cm^3/GeV, $C_{2H} = 1500$ cm^3/GeV

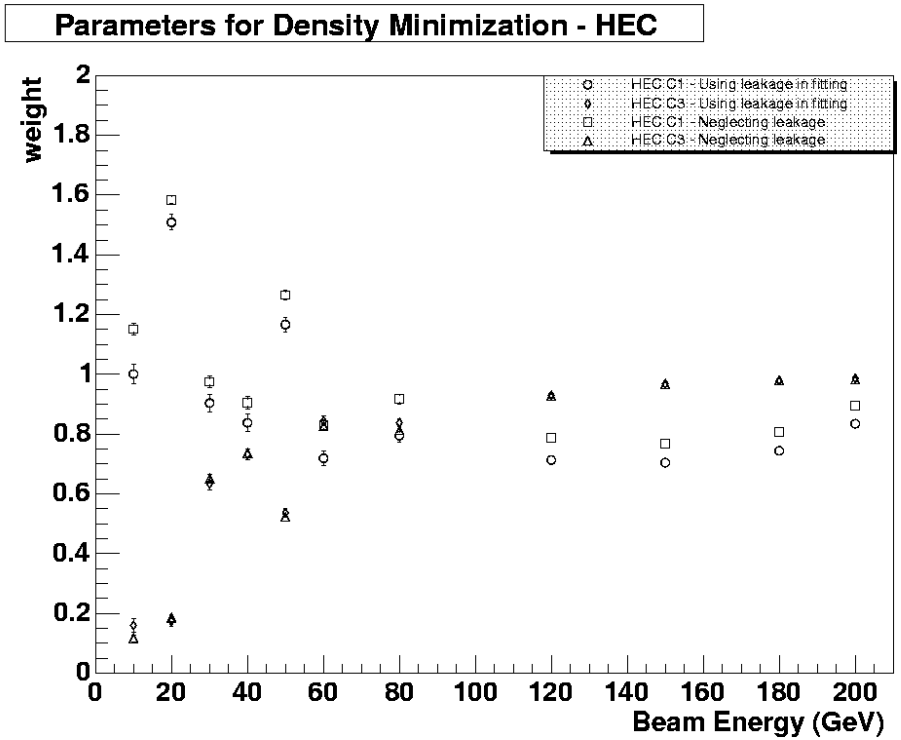
Weights



- Weights for HEC and EMEC clusters for different energy densities
- This example is from the 120 GeV π^- run (run 13149)

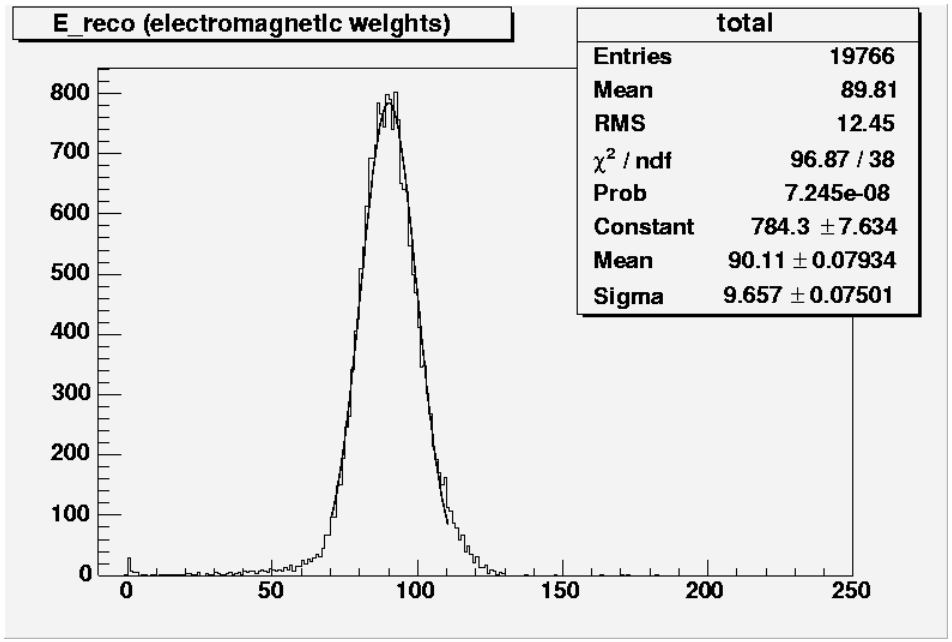
Parameters

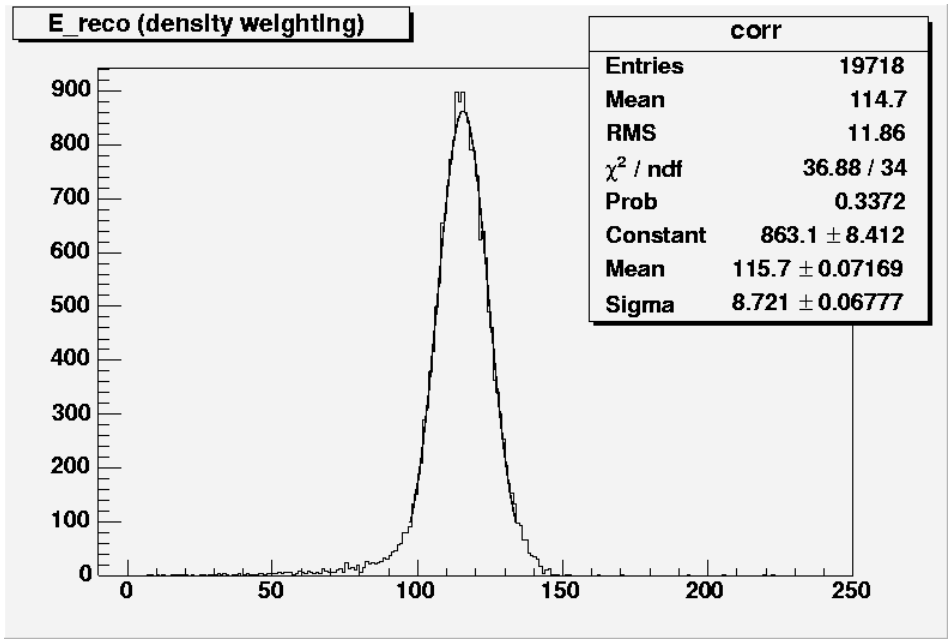




Results are similar to NIM paper

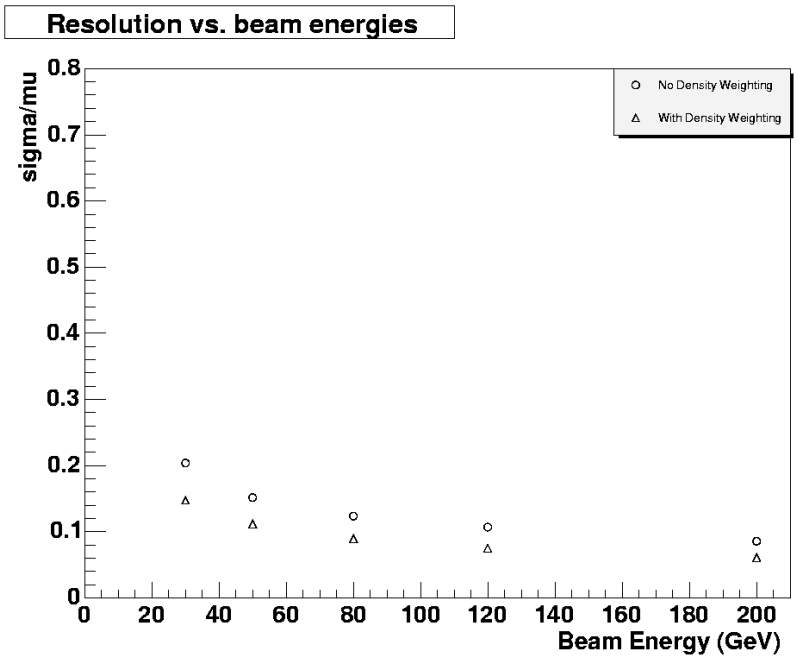
Energy Reconstruction

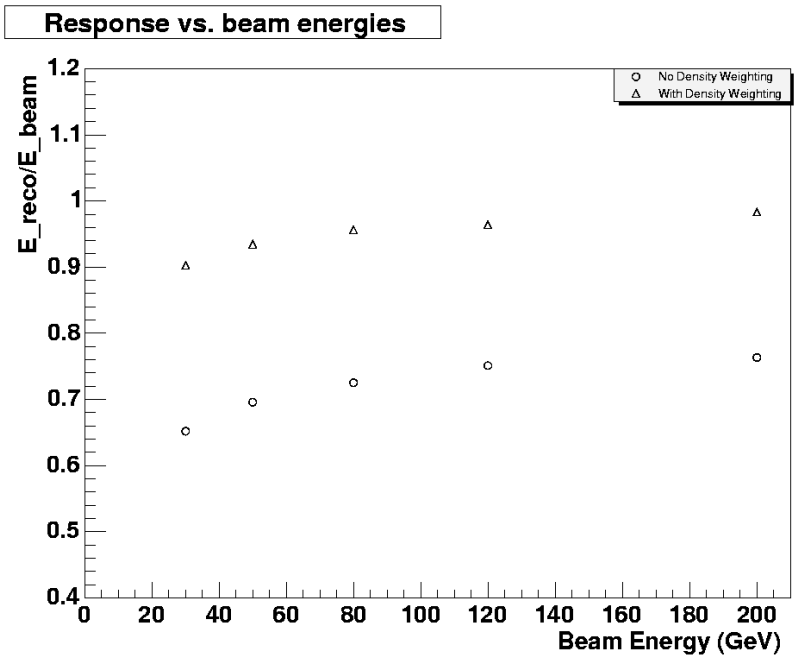




- The resolution greatly improves due to software compensation

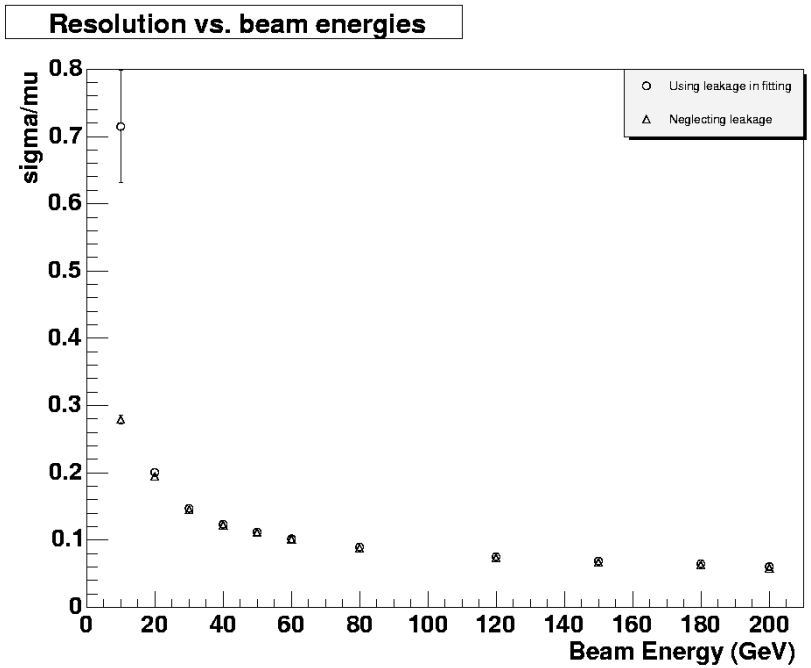
Resolution and Response

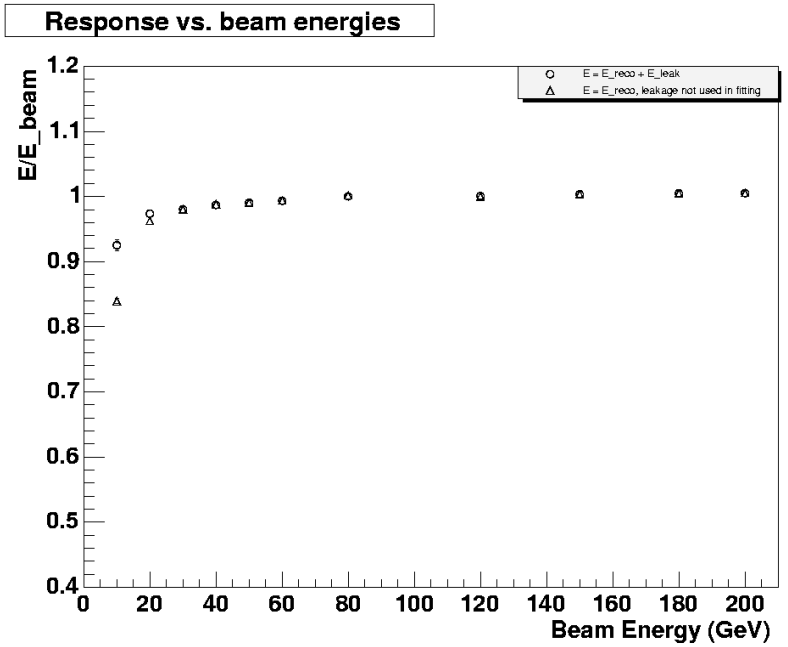




- These results show the large improvement in resolution when using energy density weighting as compared with electromagnetic weights

Resolution and Response





These plots show the difference in results when leakage is or is not taken in account in the χ^2