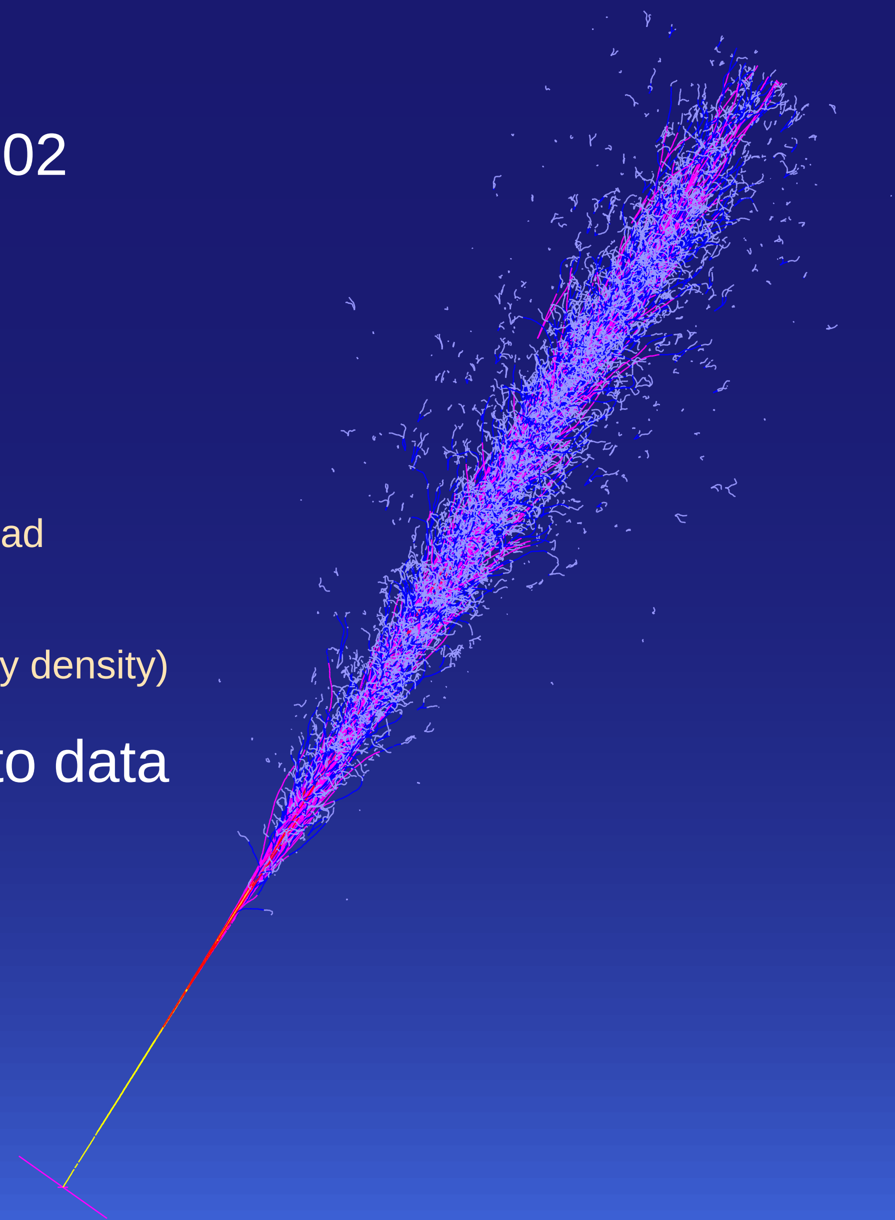
Status of Cell Weighting with Calibration Hits

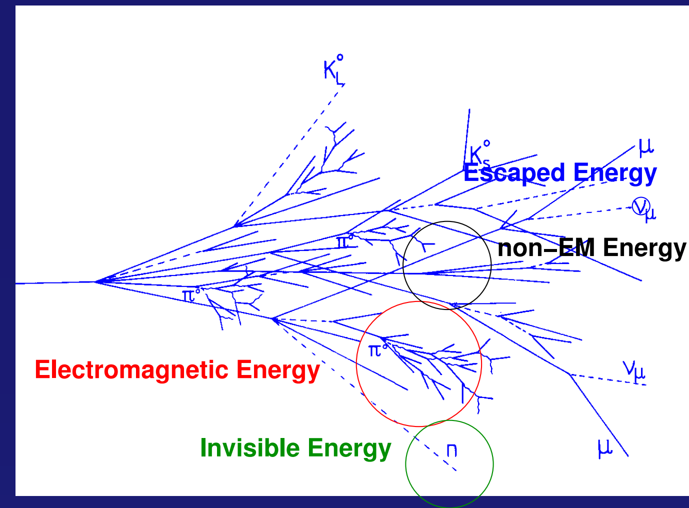
MPI HEC group meeting — Sven Menke, Pavel Stavina MPI München — 8. Nov 2004, MPI

- Calibration Hits for CTB 2002 (Pavol Strizenec)
  - MC status
  - reconstruction status
- Cell Weights
  - what to include (LAr, Absorber, Dead material?)
  - choice of x-Axis (function of energy density)
- Application of the weights to data and MC
- Conclusions/Outlook

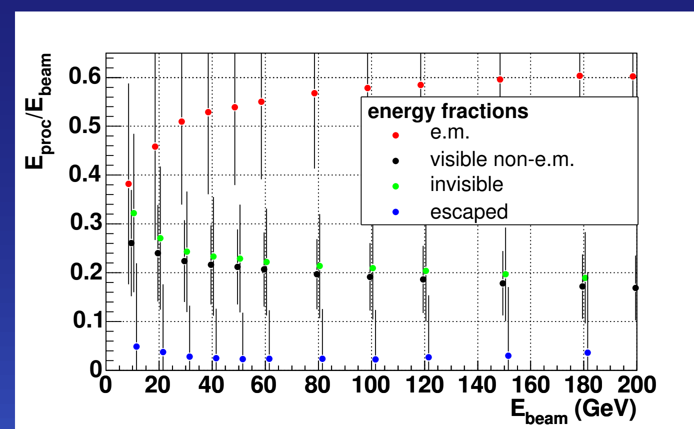


Status of Calibration Hits for CTB02

- A hadronic shower consists of
  - EM energy (e.g. $\pi^0 \rightarrow \gamma\gamma$) $O(50\,\%)$
  - visible non-EM energy (e.g. dE/dx from $\pi^{\pm}, \mu^{\pm}$, etc.) $O(25\,\%)$
  - invisible energy (e.g. breakup of nuclei and nuclear excitation) $O(25\,\%)$
  - escaped energy (e.g. ν) $O(2\,\%)$



- each fraction is energy dependent and subject to large fluctuations
- Data to the right is taken from Pavol's simulated files
  - contains "calibration hits" in the 4 energy categories for
    - active material
    - absorber material
    - dead material
  - QGSP and LHEP physics lists
  - π^- and e^- from 10 GeV to 200 GeV at 3 points with 2000 (1000) events per π^- (e^-) energy, physics list and point
  - Cu in front of HEC I and HEC II and absorber areas outside electrode boundaries are counted as dead material



- Reconstruction with added noise like for real data is done

Cell Weighting with MC

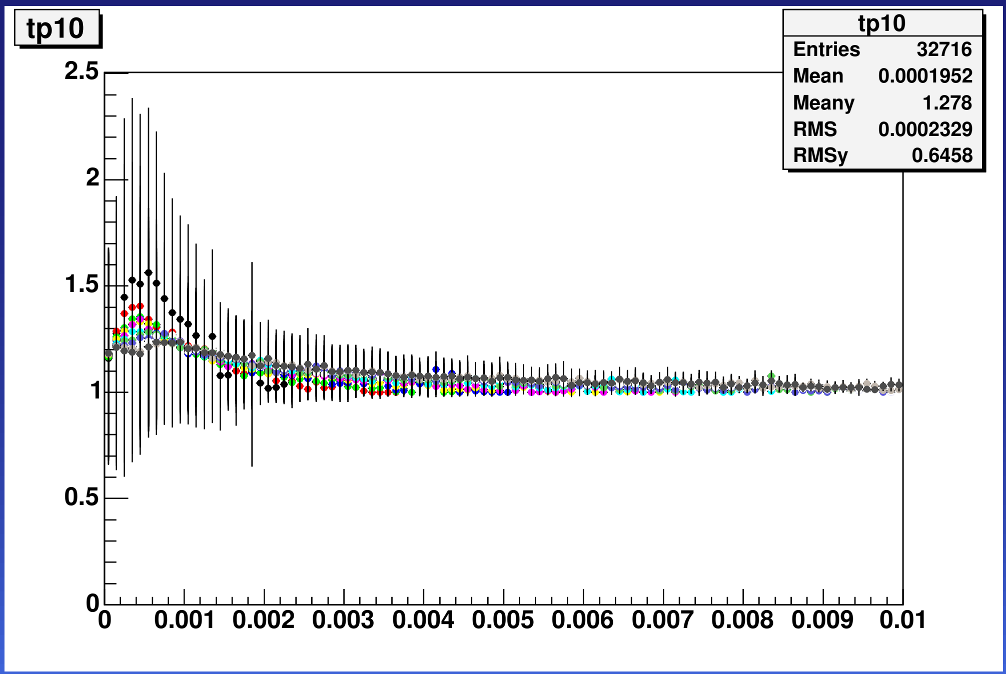
$$E'_{\text{cell}} = w\,E_{\text{cell}}$$

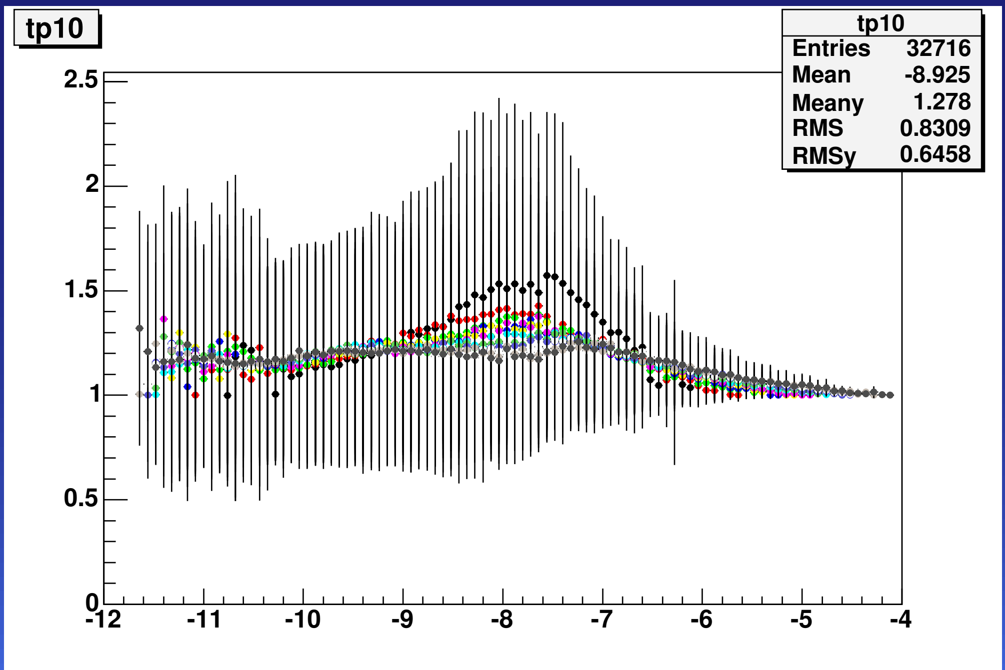
$$w = \left(E^{\text{em}}_{\text{cell}} + E^{\text{non-em vis}}_{\text{cell}} + E^{\text{non-em invis}}_{\text{cell}} + E^{\text{escaped}}_{\text{cell}}\right) / \left(E^{\text{em}}_{\text{cell}} + E^{\text{non-em vis}}_{\text{cell}}\right)$$

- start again with “3D”-clustering and splitting to define cluster-level quantities the weights might depend on
  - energy and energy density
  - cluster shape
  - distance of the cell from shower axis, . . .
- for test beam data use sum of “2D”-clusters “3D”-cluster
- take cluster energy on EM scale as start value
- interpolate weights from MC according to cluster energy
- apply cell weights and re-calculate cluster energy
- iterate

Cell Weighting with MC ► Choice of Variables

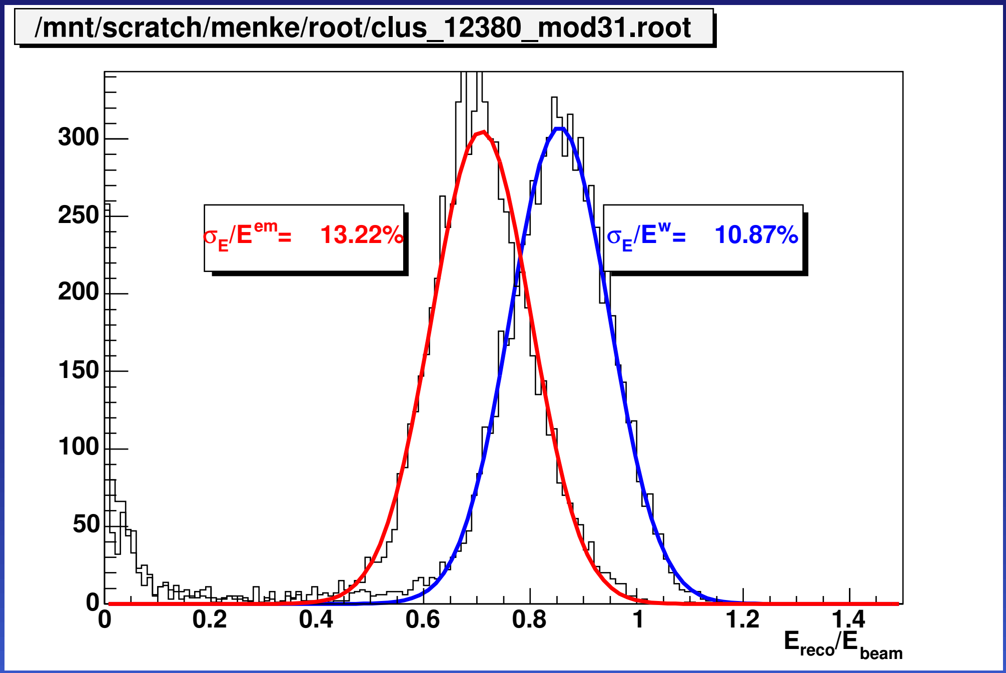
- include absorber in weight ratio
  - no dependency on sampling ratio
  - corrects for invisible energy only
  - electron weights are at 1
- Pavel tried many choices for the x-axis
  - function of $E_{\text{cell}}^{\text{with noise}}/V_{\text{cell}}$ for every layer
  - scaled by $1/E_{\text{beam}}$ or $1/\ln E_{\text{beam}}$ for better interpolation
  - modified by (optional) non-linear terms

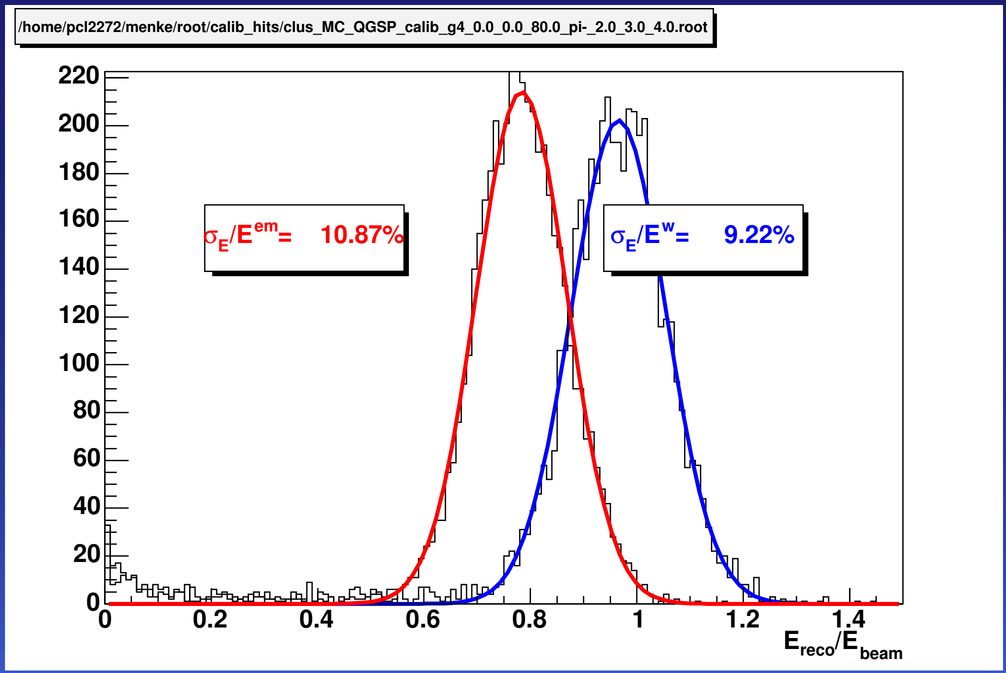




Application of the Weihgts to Data and MC

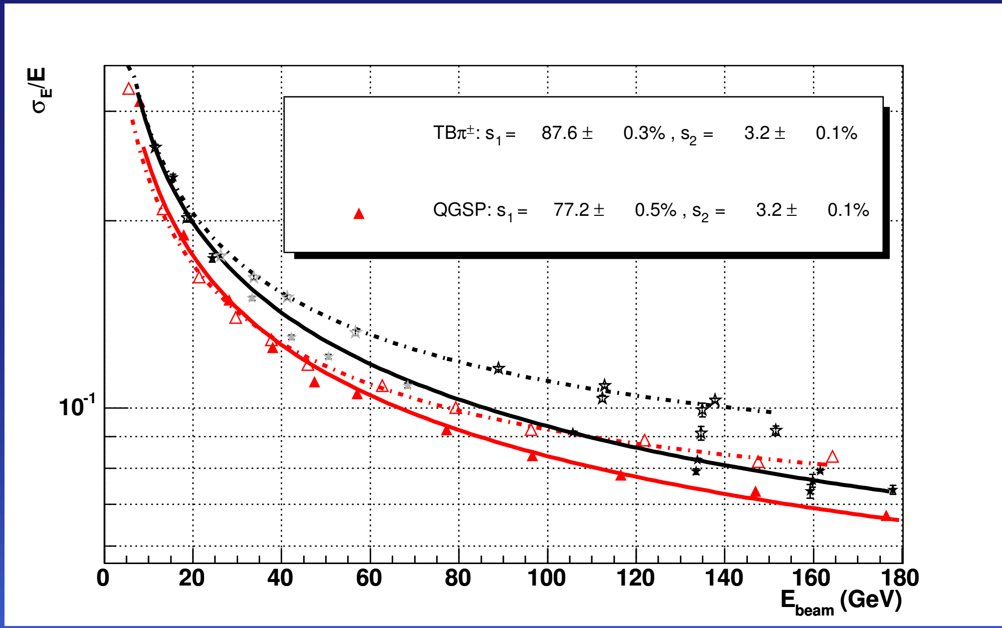
- the following plots are for $x = E_{\mathrm{cell}}^{\mathrm{with\ noise}}/V_{\mathrm{cell}} \times 1/\log E_{\mathrm{clus}}$
- examples show (normalized) cluster energies for 80 GeV π^- before and after the weighting itration
  - in red before the iteration (em)
  - in blue after the iteration (w)
  - usually 2 iterations are enough

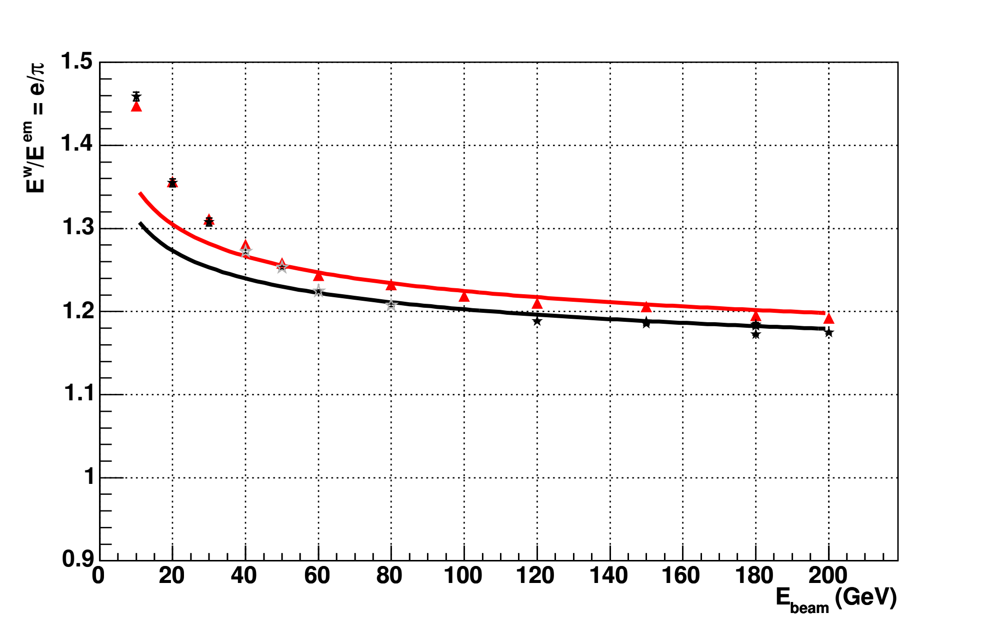




Application of the Weihgts to Data and MC ► Resolution

- first shot gives
  - data: $\sigma_E/E = 87.6\,\%/\sqrt{E\ (\mathrm{GeV})} \oplus 3.2\,\%$
  - MC: $\sigma_E/E = 77.2\,\%/\sqrt{E\ (\mathrm{GeV})} \oplus 3.2\,\%$
  - both including noise
- need to check linearity
- need to check electrons





Conclusions

- Calibration Hits seem to work
  - simulation
  - reconstruction
  - weight definition
  - application to MC and data
- First look at resolution gives similar result to cluster weights in NIM paper
  - and for those we did not iterate, but took the beam energy as input!
- Hope to get more results for High Tatra