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Combined Testbeam of EMEC/HEC/FCal: Some Results

HEC meeting at MPI
14-th of October, 2008

Reconstruction and Analysis

Reconstruction at RZG

- ATHENA release 12.0.6
- Standard set of packages and tools
- Energy scans with electrons and charged pions at the standard impact point D
- Cone algorithm
- Electromagnetic scale

Analysis at MPI

- Single runs and combined runs with the same beam energy
- Reconstructed energy distributions: Gaussian fit in the certain interval $\rightarrow$ E_0 and σ
- Energy response E_0/E_{BEAM} and resolution σ/E_0, three term parametrisation:

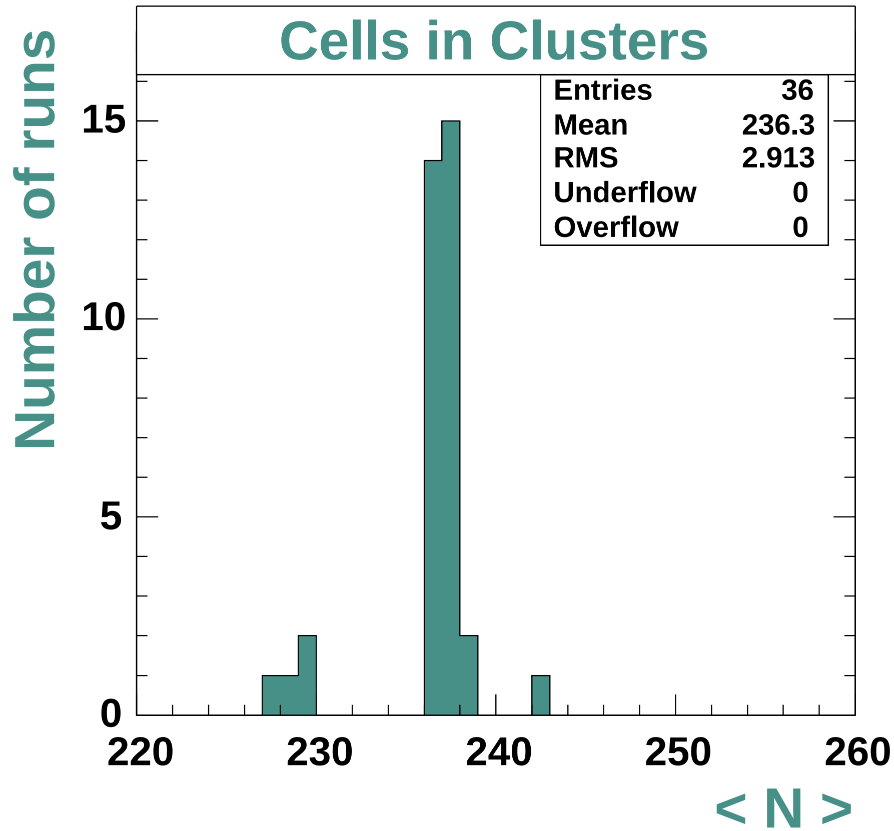
$$A/\sqrt{E_{BEAM}} \oplus B \oplus C/E_{BEAM}$$

- Noise in clusters
- Resolution after noise subtraction, two term parametrisation:

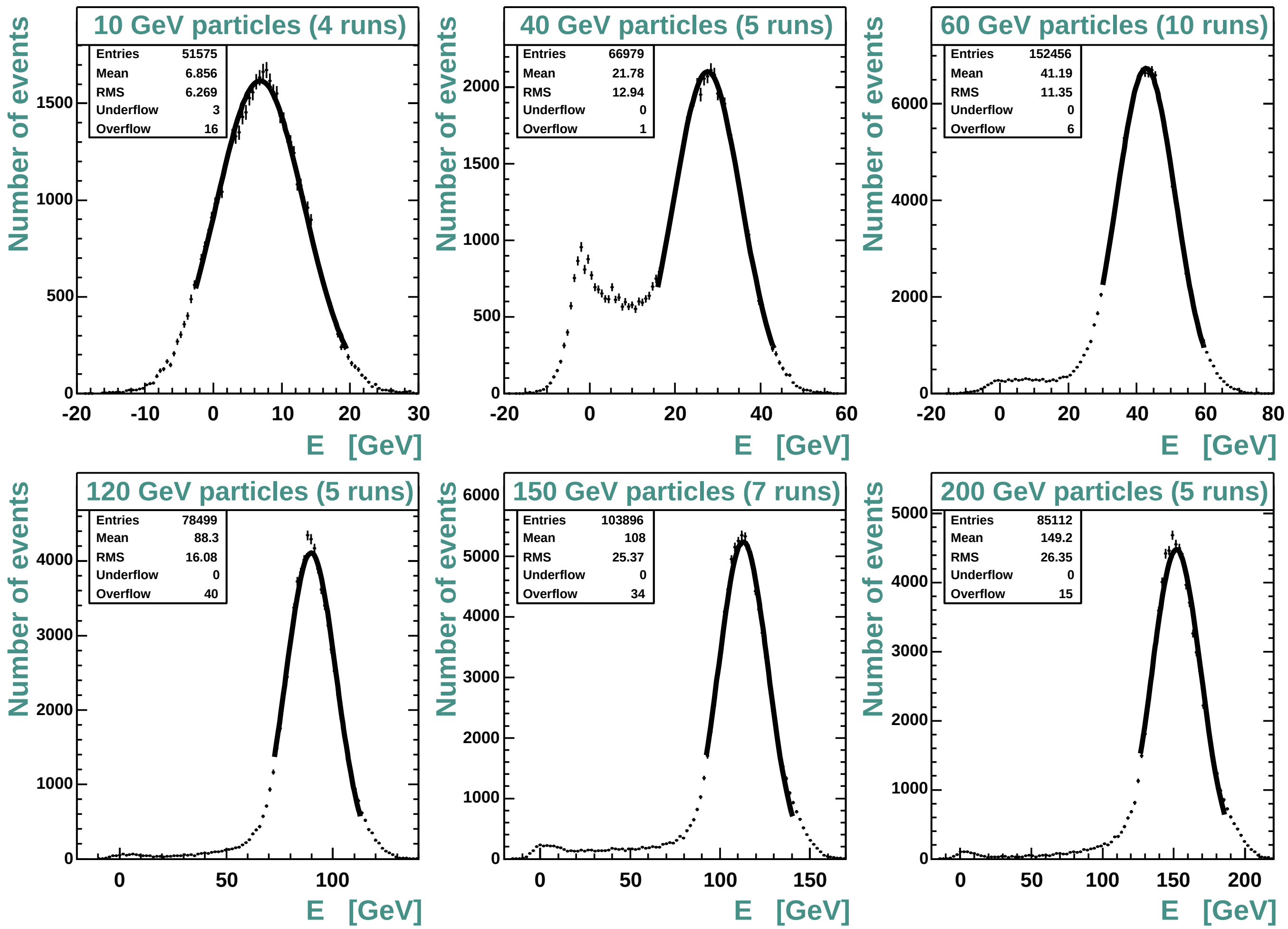
$$A/\sqrt{E_{BEAM}} \oplus B$$

Charged Pion Results

- Six beam energies: from 10 to 200 GeV
- 36 runs
- Cone radius $R = 0.5$



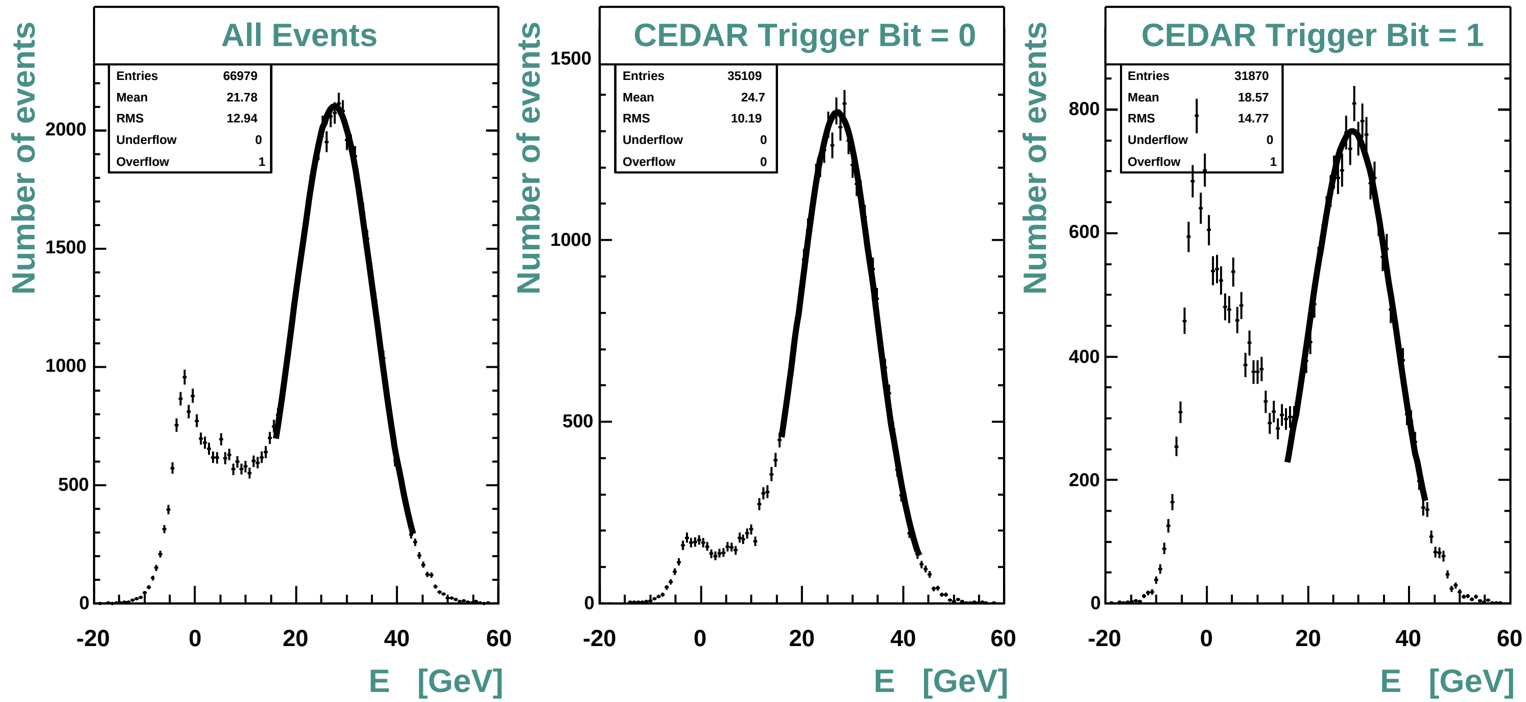
Energy distributions



Fit interval: $[E_0 - 1.5\sigma; E_0 + 2.0\sigma]$

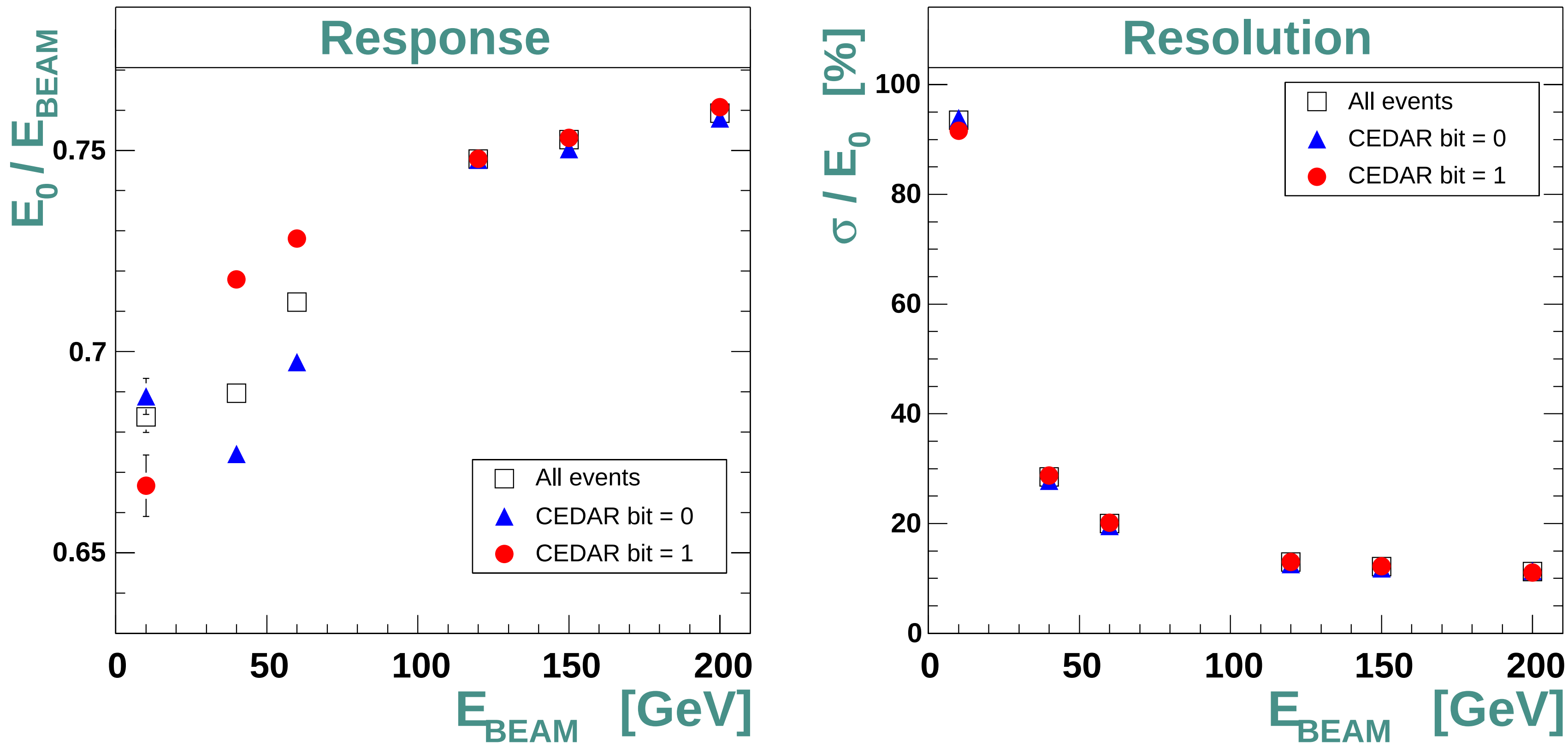
Positively charged hadrons

- 40 and 60 GeV beams
- Trigger bit "CEDAR 6 of 8 segments":
  0 — protons
  1 — charged pions



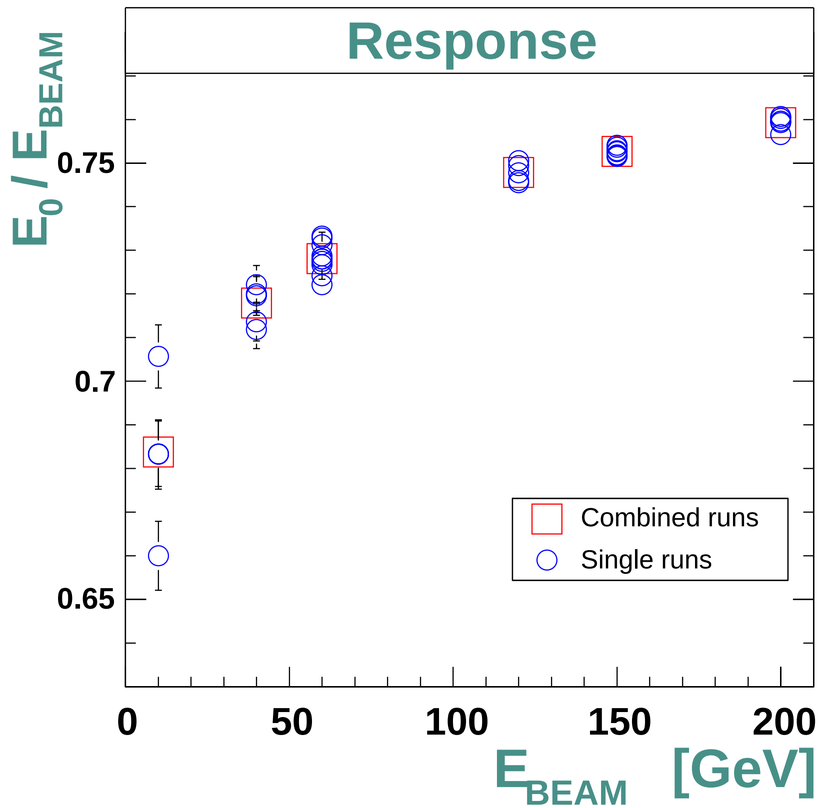
40 GeV particles

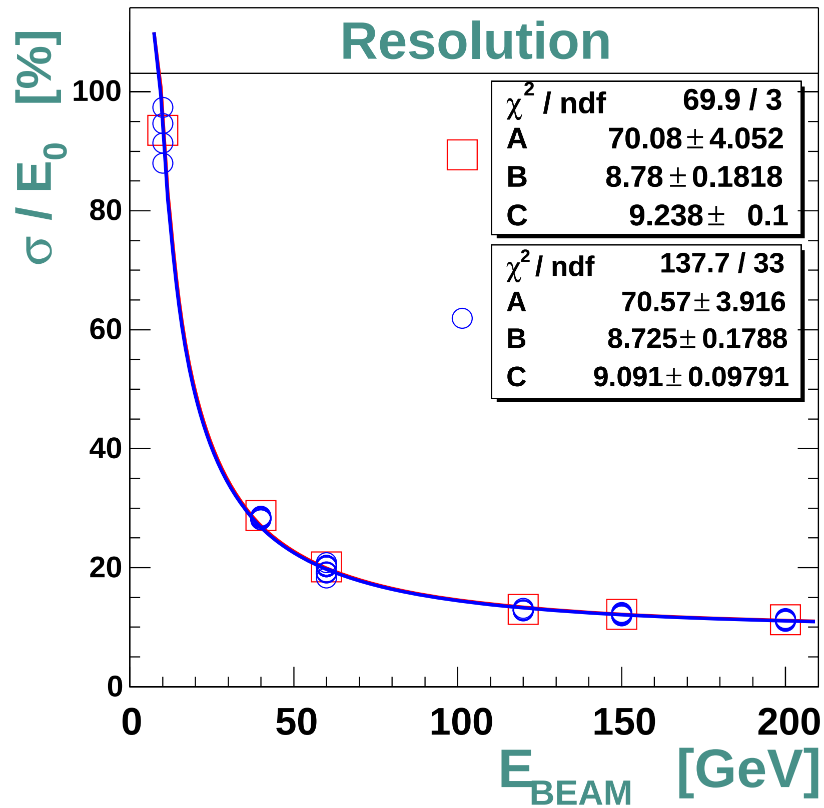
Response and Resolution: Different CEDAR triggers



- Smooth behaviour of the response for pion triggers
- No dependence on the trigger for the energy resolution σ/E_0

Response and Resolution: Combined runs and Single runs





Noise in Clusters

Database noise

- noise in an event $= \sqrt{\Sigma\sigma_i^2}$
- σ_i — noise RMS from database for cell i (for the corresponding gain)
- sum over cluster cells in a physics event
- resulting noise in a run $=$ average over all physics events

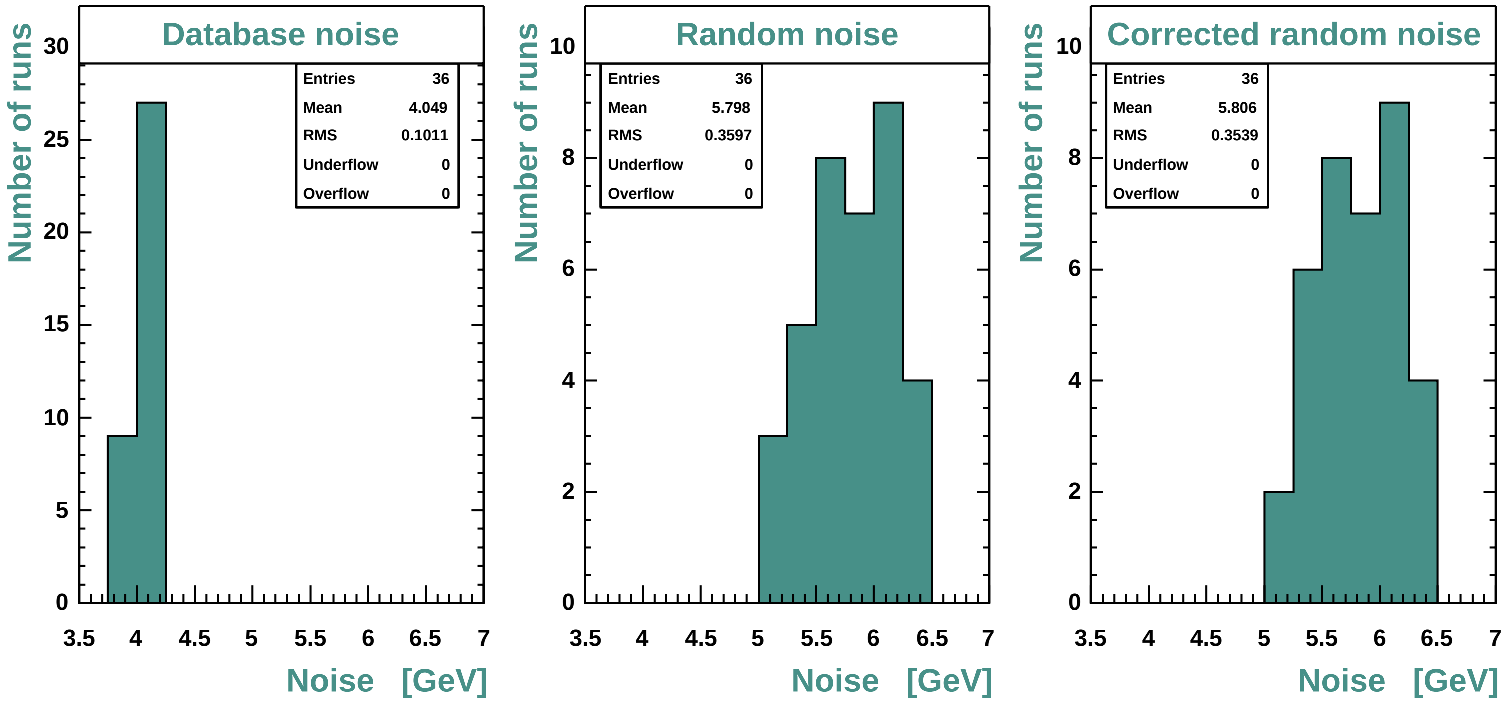
Random noise

- noise in an event $= \Sigma S_i$
- S_i — signal in cell i in a random event (for the default gain)
- sum over cluster cells as in a physics event
- resulting noise in a run $= \sigma$ of a Gaussian fit to the obtained distribution (loops over random events)

Corrected random noise

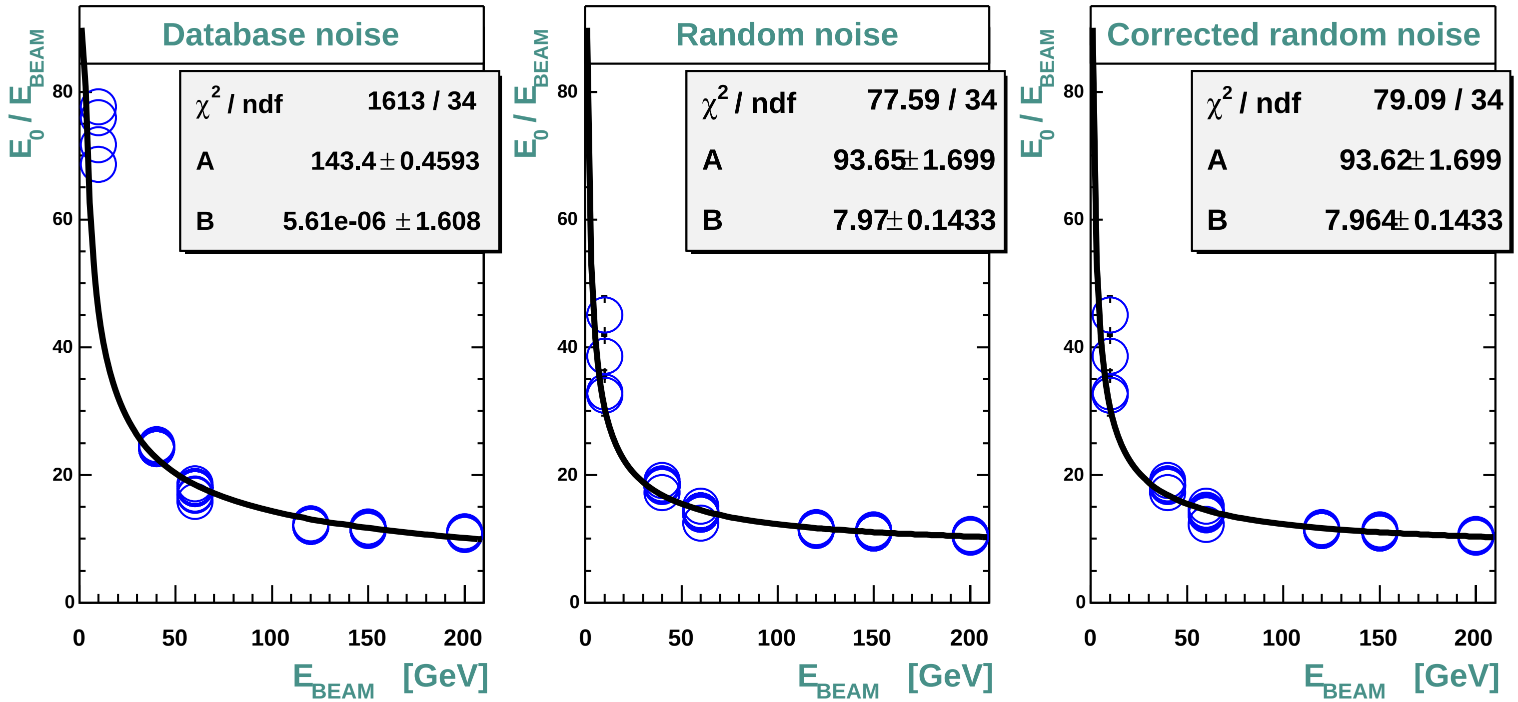
- noise in an event $= \Sigma S_i C_i$
- C_i — correction factor = ratio between noise RMS for the medium and noise RMS for the high gain (from database)
- sum over cluster cells as in a physics event
- resulting noise in a run $= \sigma$ of a Gaussian fit to the obtained distribution (loops over random events)
- gain corrections affect only EMEC cells

Noise in pion clusters



- Random noise and corrected random noise are very close
- Database noise is significantly smaller than random noise

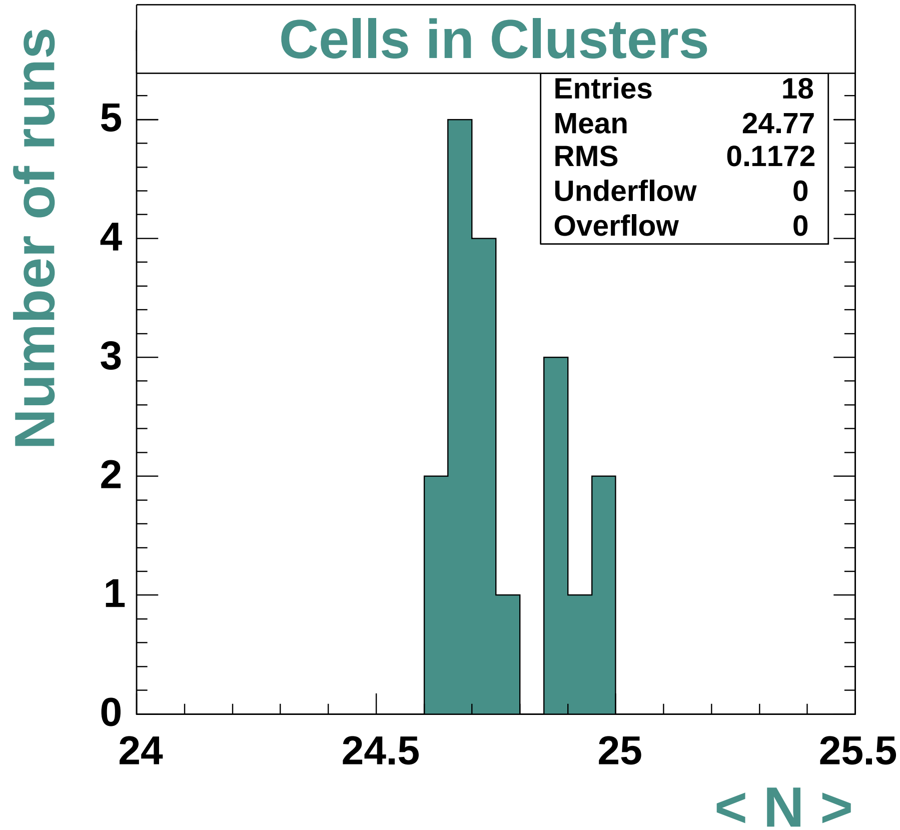
Energy resolution after Noise subtraction



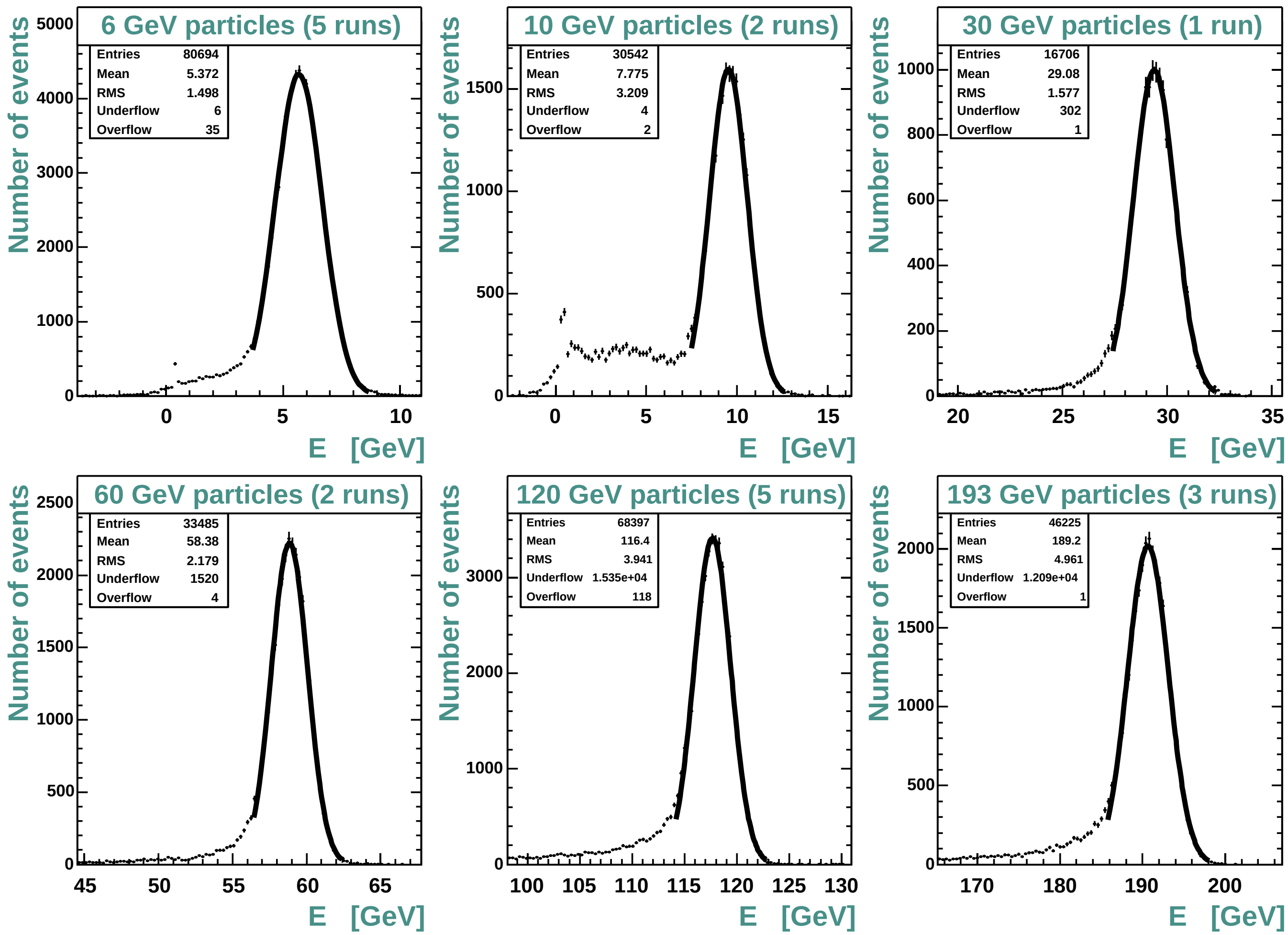
Energy dependence of the resolution is much better described by the two-term formula after random noise subtraction than after database noise subtraction

Electron Results

- Six beam energies: from 6 to 193 GeV
- 18 runs
- Cone radius $R = 0.2$



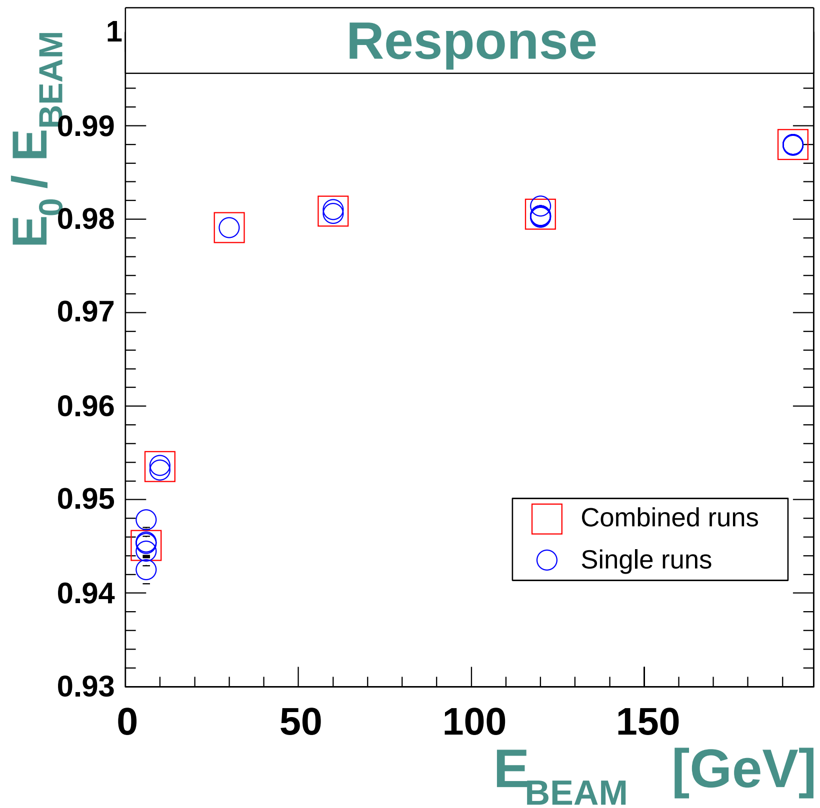
Energy distributions

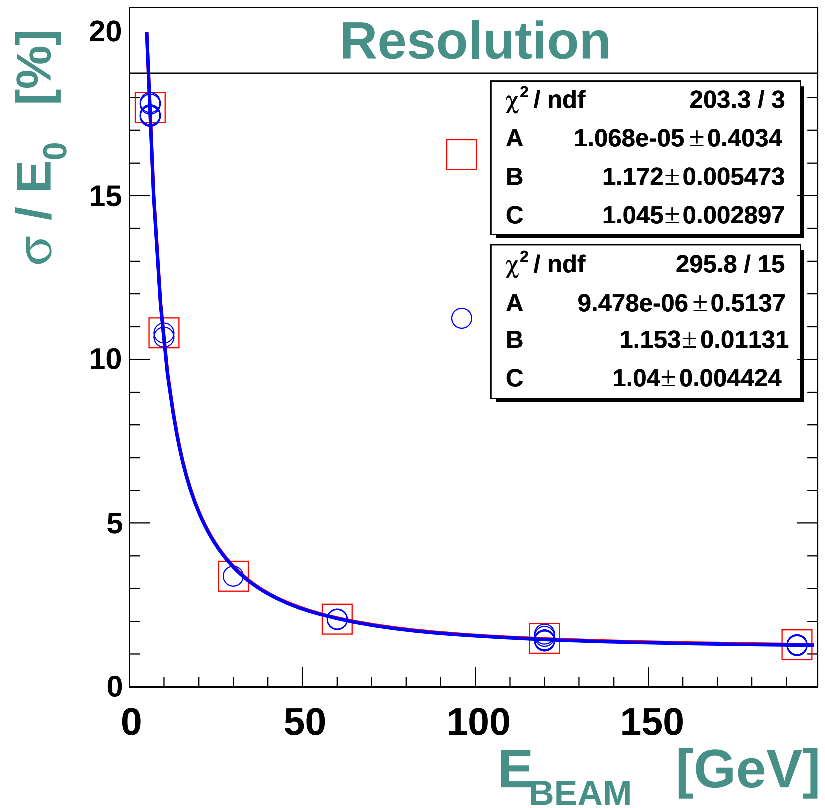


Fit interval: $[E_0 - 2\sigma; E_0 + 3\sigma]$

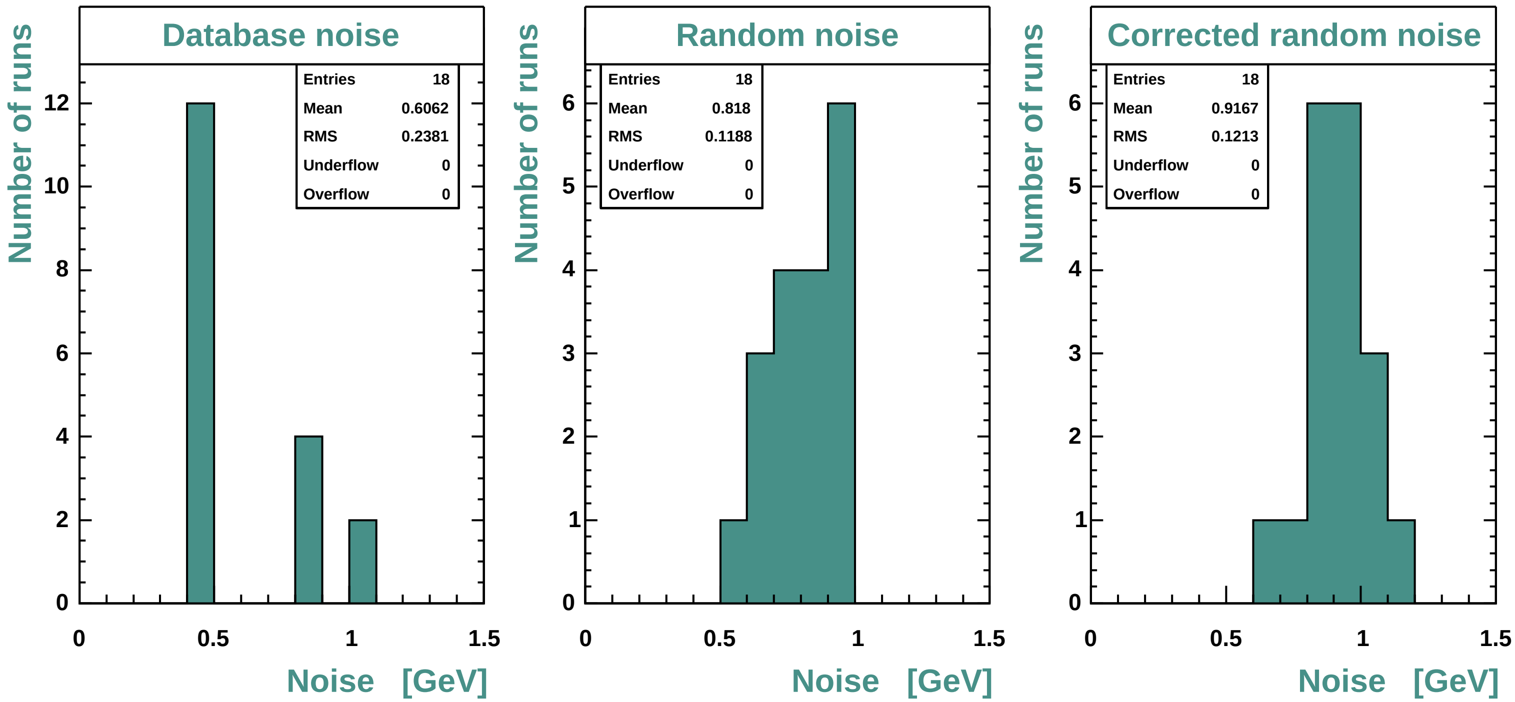
Electrons

Response and Resolution: Combined runs and Single runs



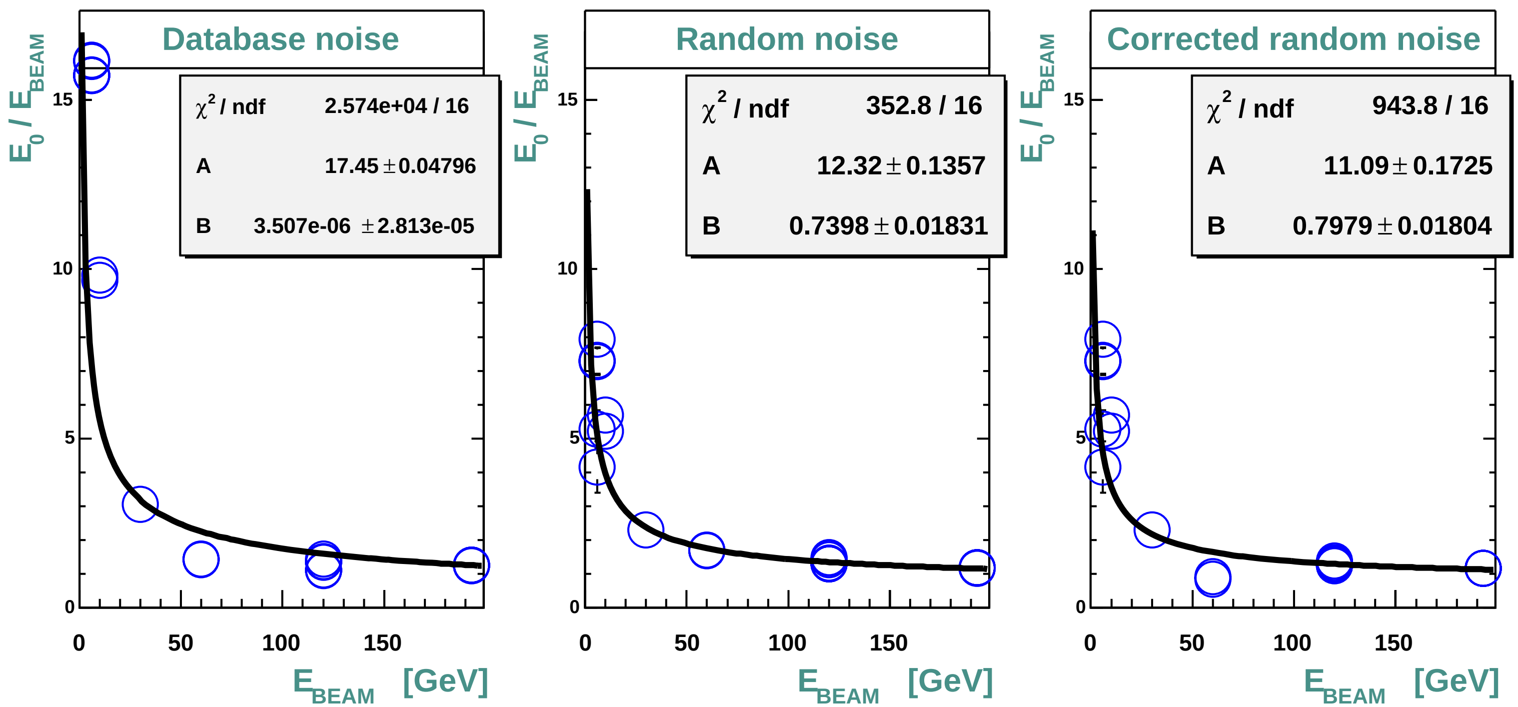


Noise in electron clusters



- Medium gain noise brings problems in database noise
- Corrected random noise is larger than random noise

Energy resolution after Noise subtraction



- Energy dependence of the resolution is best described by the two-term formula after random noise subtraction
- Subtraction of database noise and corrected random noise leads to poor description of the energy resolution

Some Conclusions and Plans

- Analysis of testbeam data raises some questions:
  - quality of database noise in general and medium gain noise in particular
  - reconstruction of 40 GeV charged pions
  - energy resolution for 10 GeV electrons after noise subtraction
- Next steps:
  - switch to ATHENA release 14.2.21
  - use topological cluster reconstruction and local hadron calibration