Update on analysis of beam-test results

comparison v2 and v3 geometries

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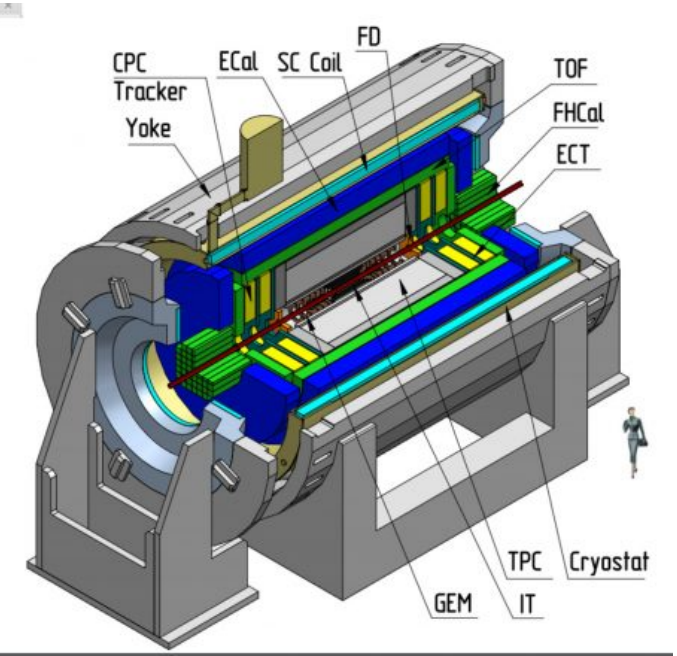
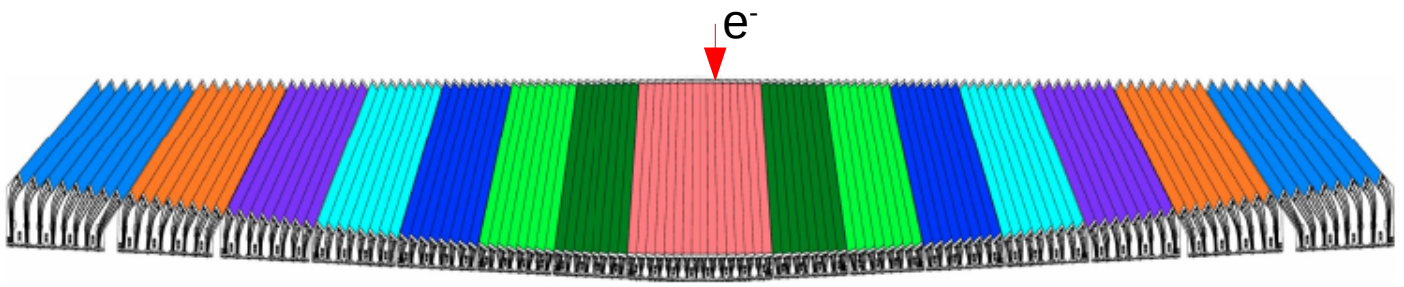
Data analyzed

- **Data**
  - Kindly provided by Viacheslav Kulikov
  - Electron beam 293 MeV
  - Prototype 6*8 towers
  - 14000 events

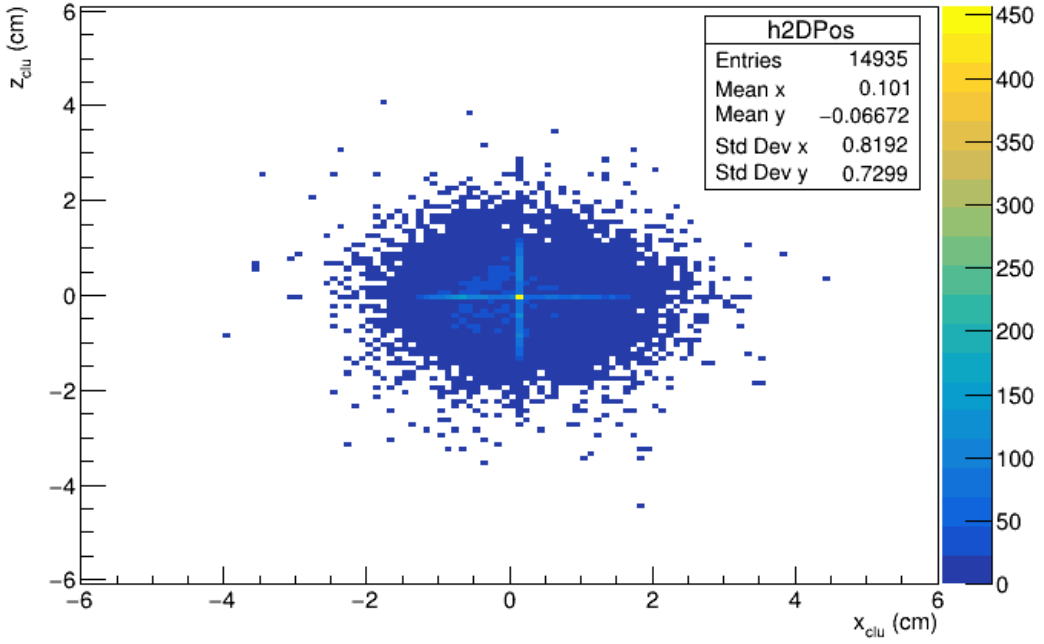


- **MC**
  - Single electron simulation
  - pt 290 MeV,
  - direction η=0, ϕ=270°
  - vertex just in front of center of EMCal tower (7.5, -168., 7.5) → (9., -168., 13.) cm
  - Magnetic field off
  - 10000 events

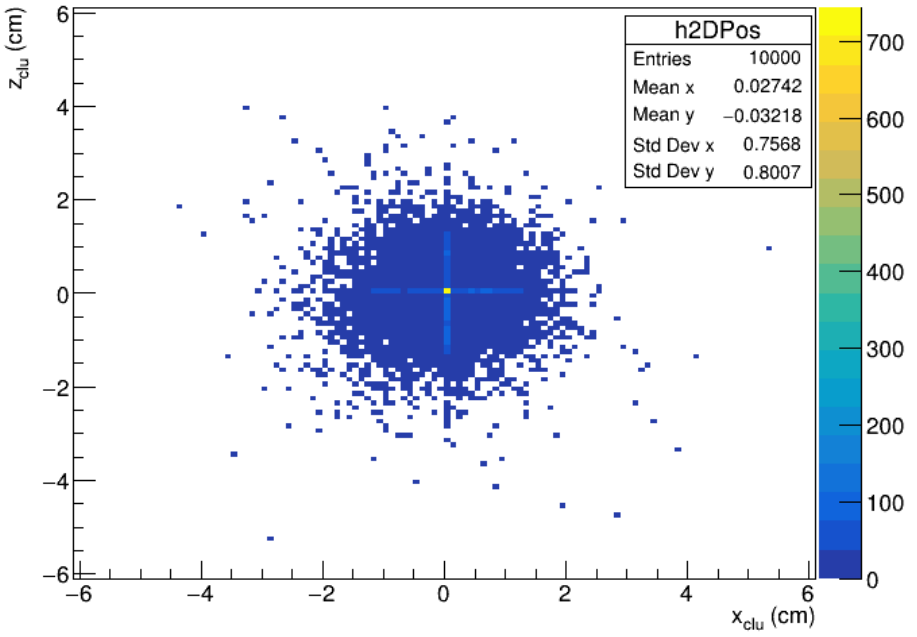


Choice of incidence position

Beam-test, position resolution



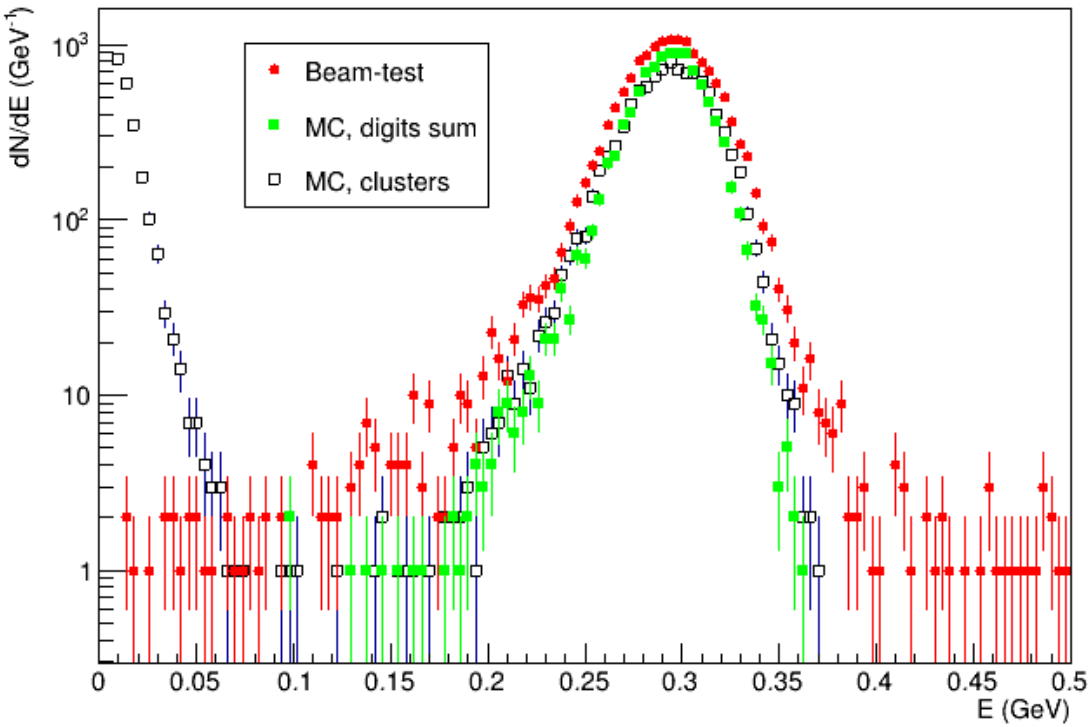
MC simulations, geometry v3



Cross appears when cluster multiplicity is low and corresponds to the center of tower.

Choose incident position to have same distribution: electron primary vertex: (9.5, -168., 13.0)

Comparison of energy resolution



Beam-test: sum of energies of all towers in event with E_i>100 ADC(1.43 MeV)

σ=22.6 MeV*

MC, digits sum: sum of all energy depositions in event above threshold (1.4 MeV)

σ=18.1 MeV**

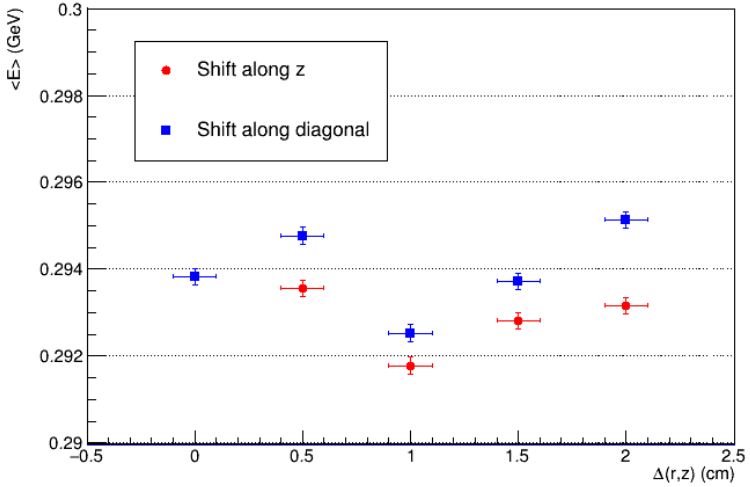
MC, clusters: standard clusterization applied. E_{min}=1.5 MeV, E_{seed}=10 MeV, Digits with common edges added to cluster, common vertex not sufficient.

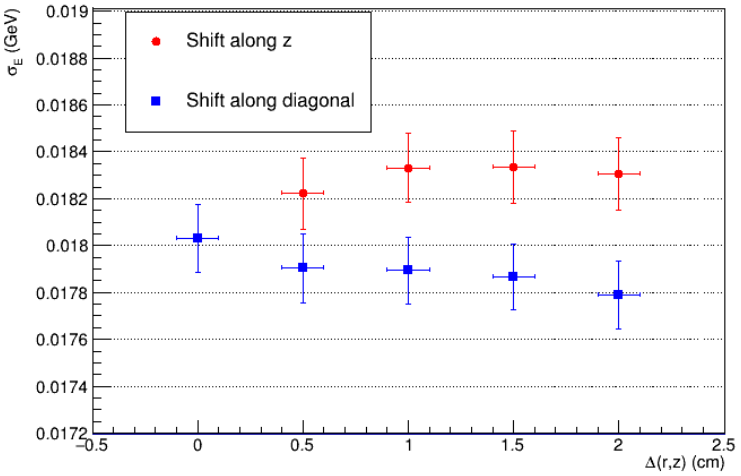
σ=21.1 MeV

*Fit with Gaus in range 0.22-0.35
**MC calibration fixed to reproduce mean

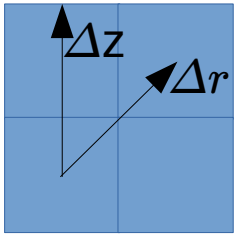
Some electronic noise/digitization/... should be added to MC.
To check energy dependence of resolution, BT at several energies is necessary.

Energy resolution: dependence on hit position





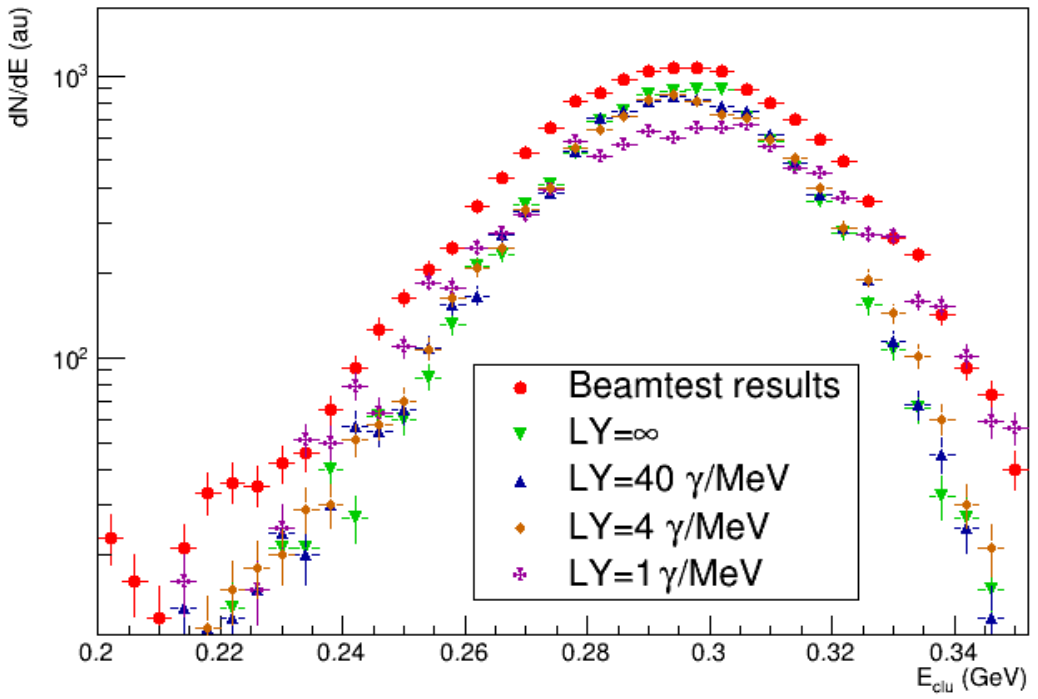
Test mean energy and resolution vs. beam incidence position.



Zero: incidence into the center of tower, then moving along z axis and along diagonal.

Very minor dependence of mean energy (non-linearity) ~0.5%
Small dependence of resolution ~2%.

Energy resolution: varying light yield



Beam-test: sum of energies of all towers in event with E_i>100 ADC(1.43 MeV)

σ=22.6 MeV

MC, no simulation of light collection:

σ=18.1 MeV

MC, simulation of light collection, 40 photons/MeV:

σ=18.7 MeV

MC, LY on, 4 photons/MeV:

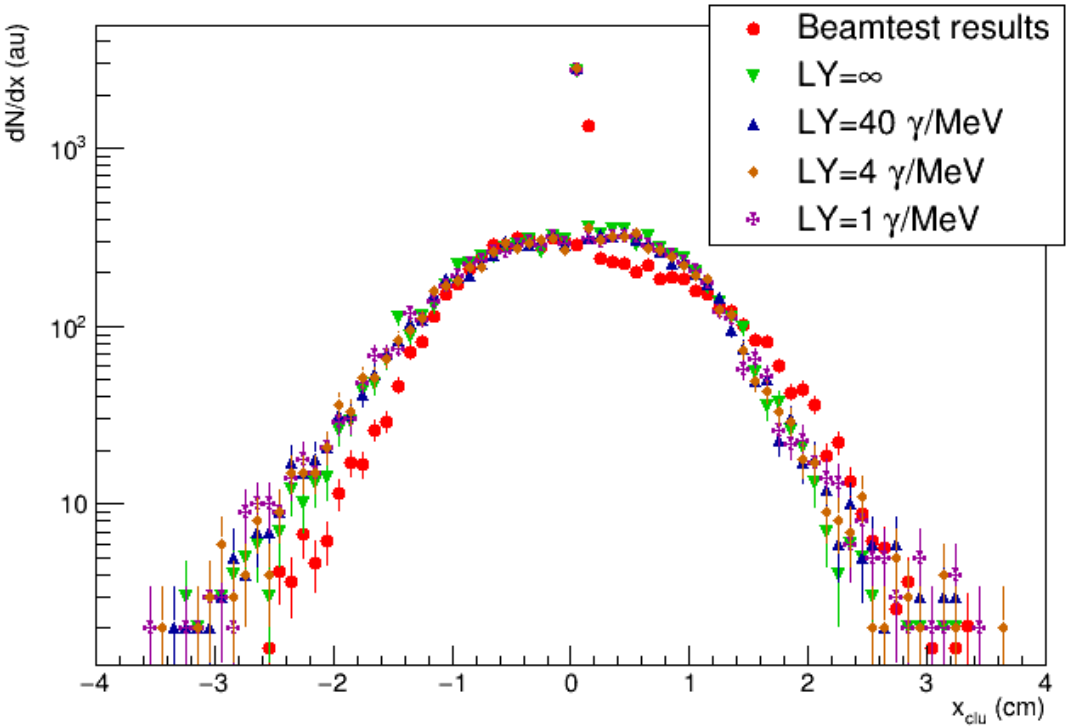
σ=19.5 MeV

MC, LY on, 1 photon/MeV:

σ=24.4 MeV

Position resolution

$$x = \frac{\sum x_i w_i}{\sum w_i} \qquad w_i = Max(0, 3 + \log(E_i / E_{tot}))$$



Beam-test: use all towers in event with E_i>100 ADC(1.43 MeV)

MC, digits sum: use all energy depositions in event above threshold (1.4 MeV)

Position resolutions are close, but shape in beam-test is different and asymmetric.

Conclusions

- Moving electron vertex in MC from the edge of EMC improved energy resolution
- Now energy resolution in MC without LY simulation and electronic noise is smaller than in beamtest
- Agreement can be reached both by adjusting LY and noise simulation, need another energy to fix
- Position resolution is similar, but because of asymmetry of beamtest results hard to make quantitative comparison.