

Status of the Geant4 Physics Validation with the ATLAS HEC Testbeam

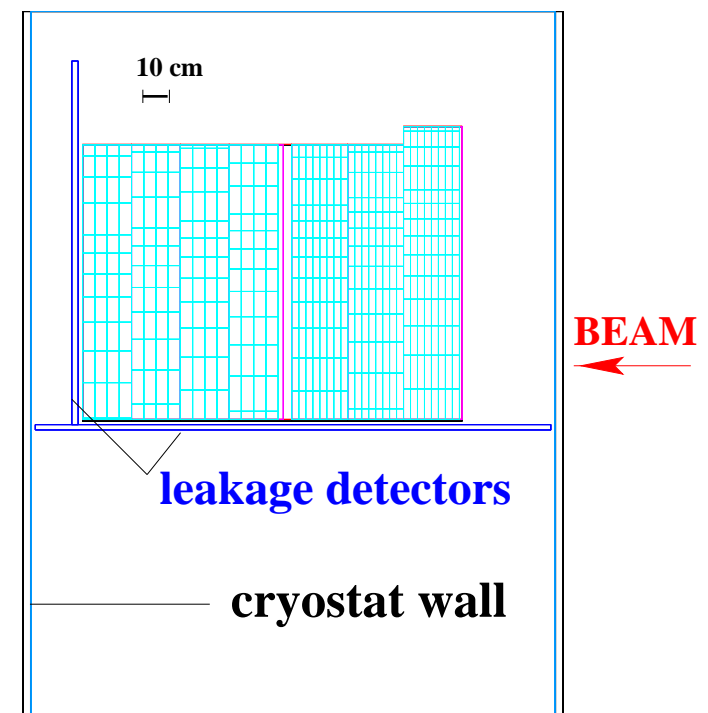
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- HEC stand-alone beam tests: experimental data and simulations
- Electron results
- Pion results
- Conclusions and plans



HEC Stand-Alone Testbeam

- Experimental results:
 - B. Dowler *et al.*, NIM A482 (2002) 94.
 - Additional analysis of 2001 data
- Geometrical description of testbeam elements (**very close** in Geant4 and Geant3 codes)
 - beam line elements (MWPCs, scintillator counters)
 - cryostat (with LAr excluder)
 - calorimeter modules
 - * sensitive LAr
 - * sensitive copper plates
 - “virtual” leakage detectors



- Geant4

- Version 5.0p01
- Hadronic physics lists for calorimetry
<http://cmsdoc.cern.ch/~hpw/GHAD/HomePage/>
 - * LHEP
 - * QGSP
 - * QGSC
 - * FTFP
- Different range cuts

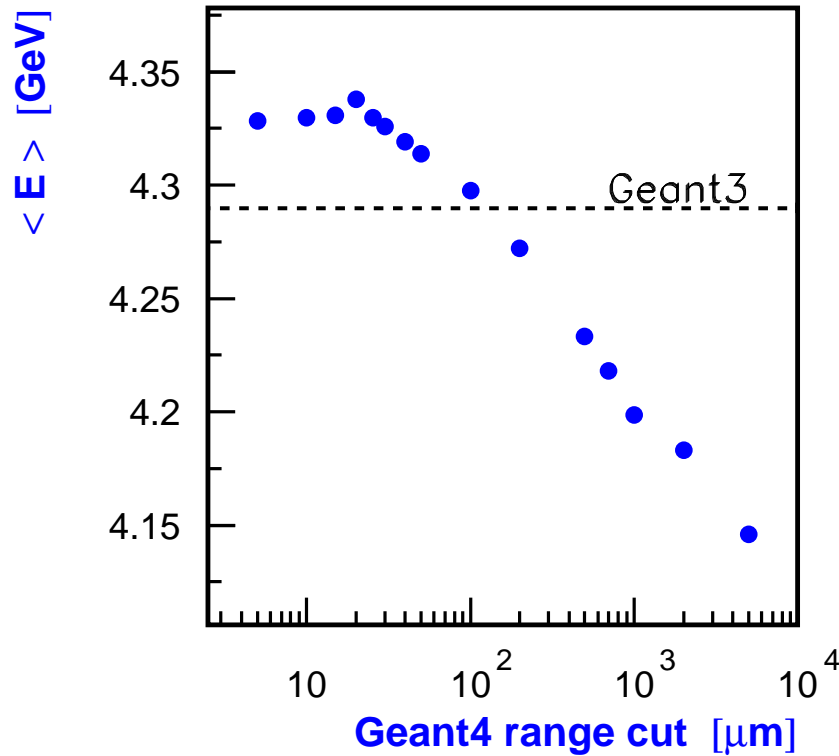
- Geant3

- Version 3.21
- G-CALOR (hadronic shower code)
- 100 keV transport cuts and 1 MeV process cuts

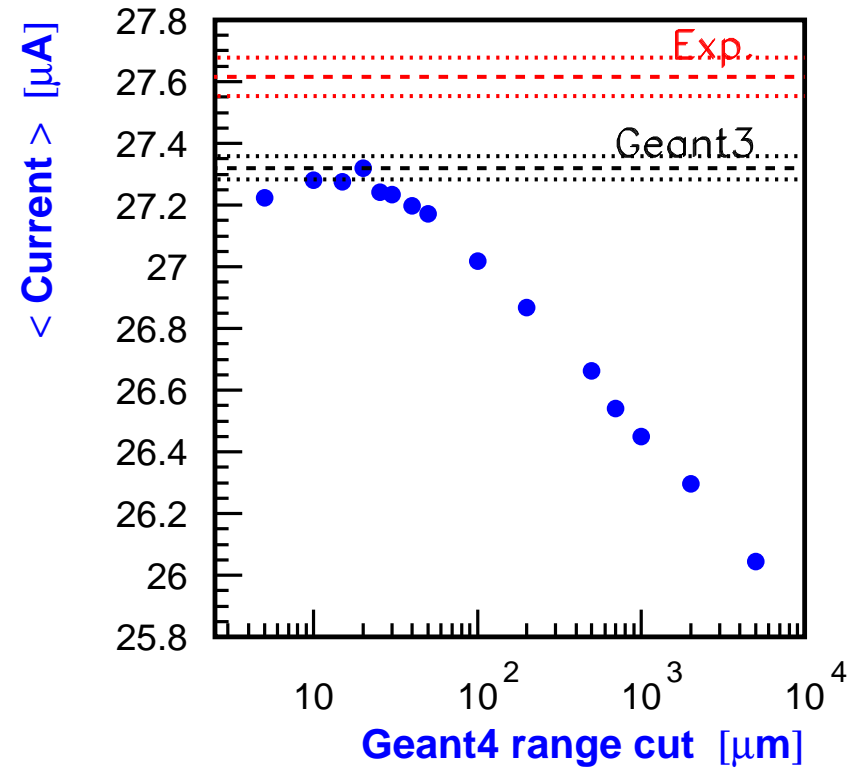


Electron Results

- 100 GeV electrons: scan over range cut



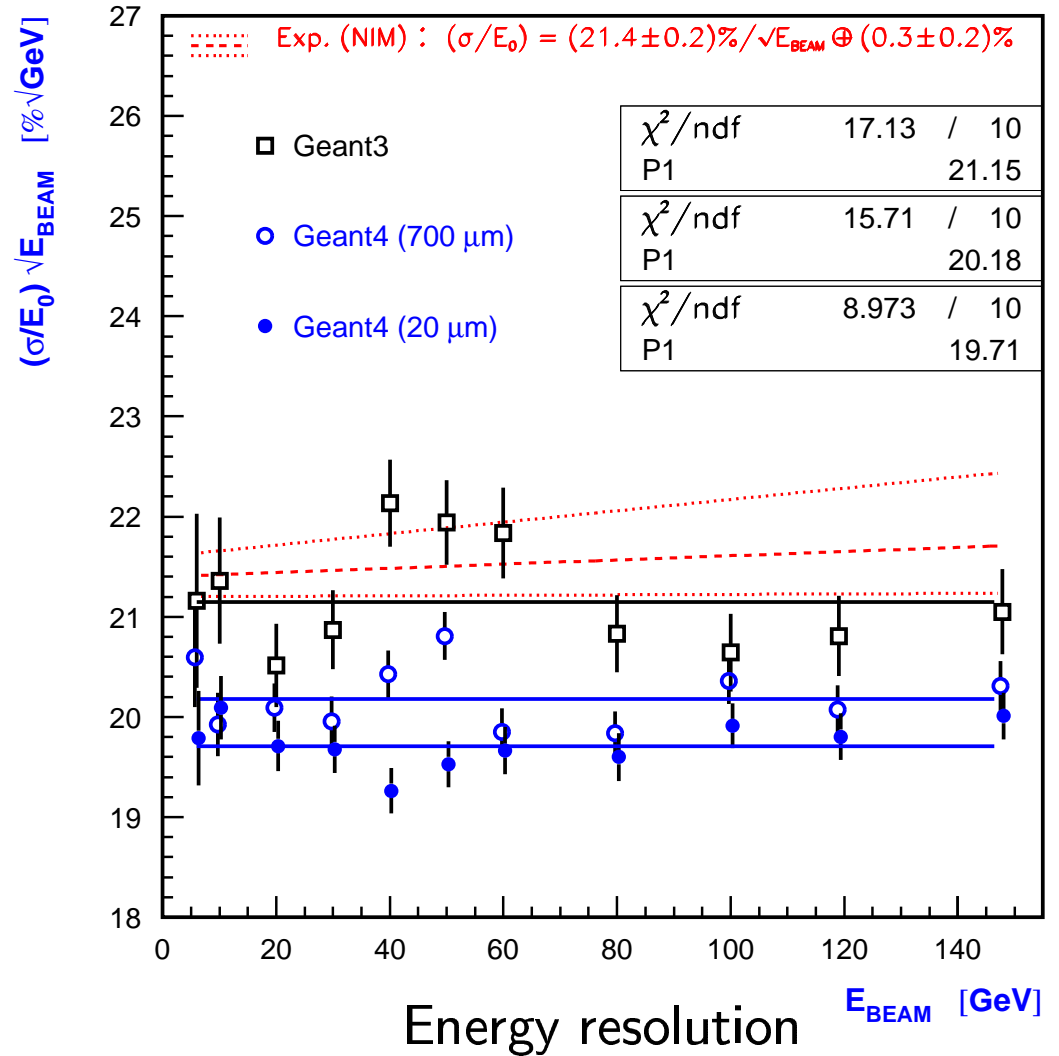
Signal in the first two layers



Signal in the most loaded channel
(visible energy $\times 7.135 \mu\text{A}/\text{GeV}$)



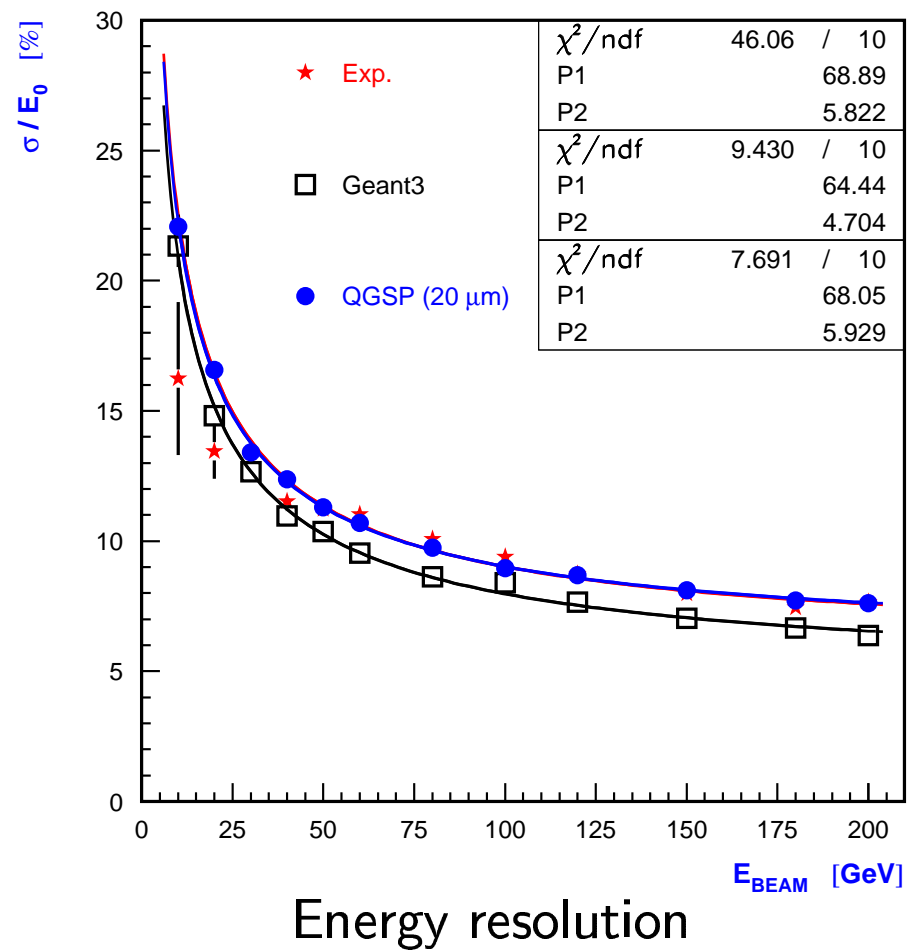
- Energy scan with electrons:
 - 6-147.8 GeV
 - 6 cell tower
- Geant4: 20 and 700 μm range cut



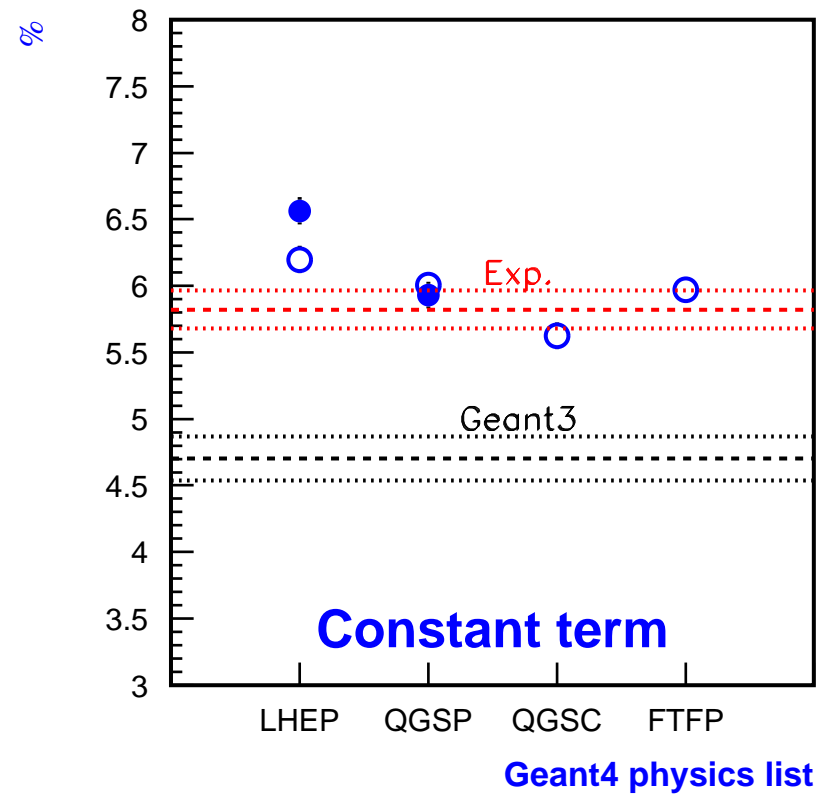
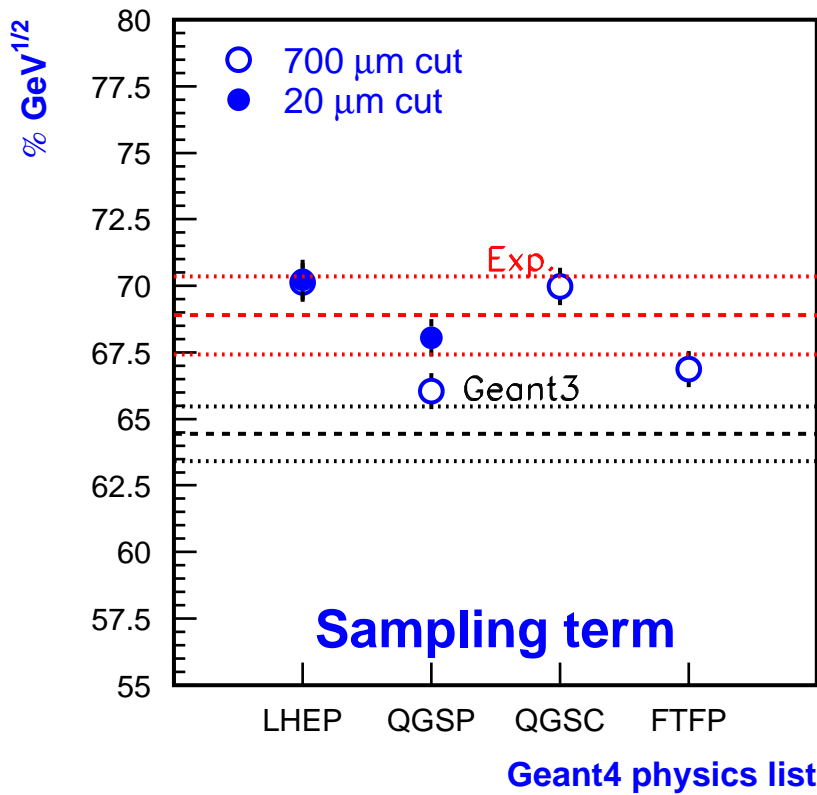
Pion Results

- Energy scan with negative pions:
 - 10-200 GeV
 - fixed cluster

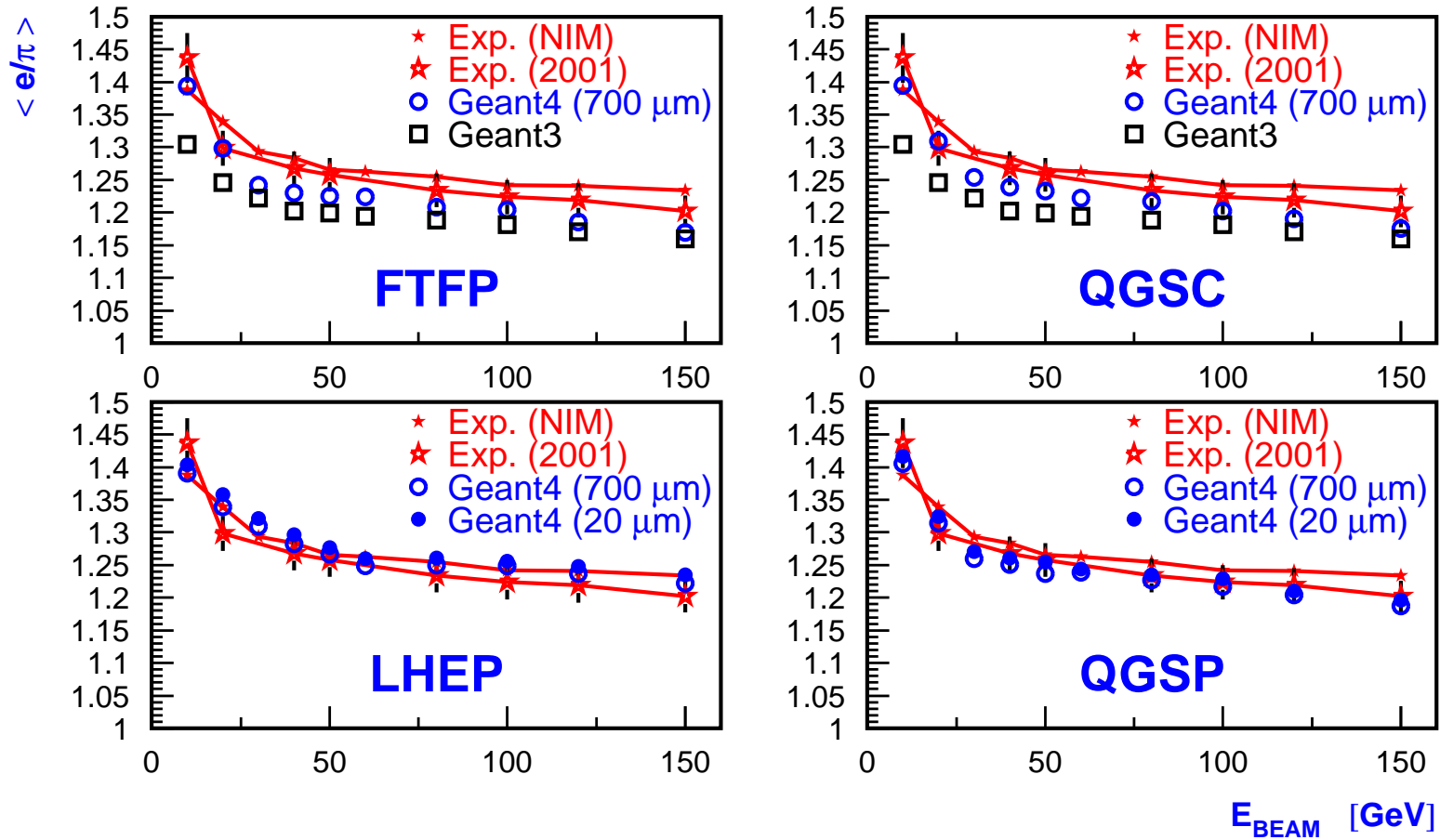
- Geant4:
 - 20 μm range cut (LHEP and QGSP)
 - 700 μm range cut (all lists)



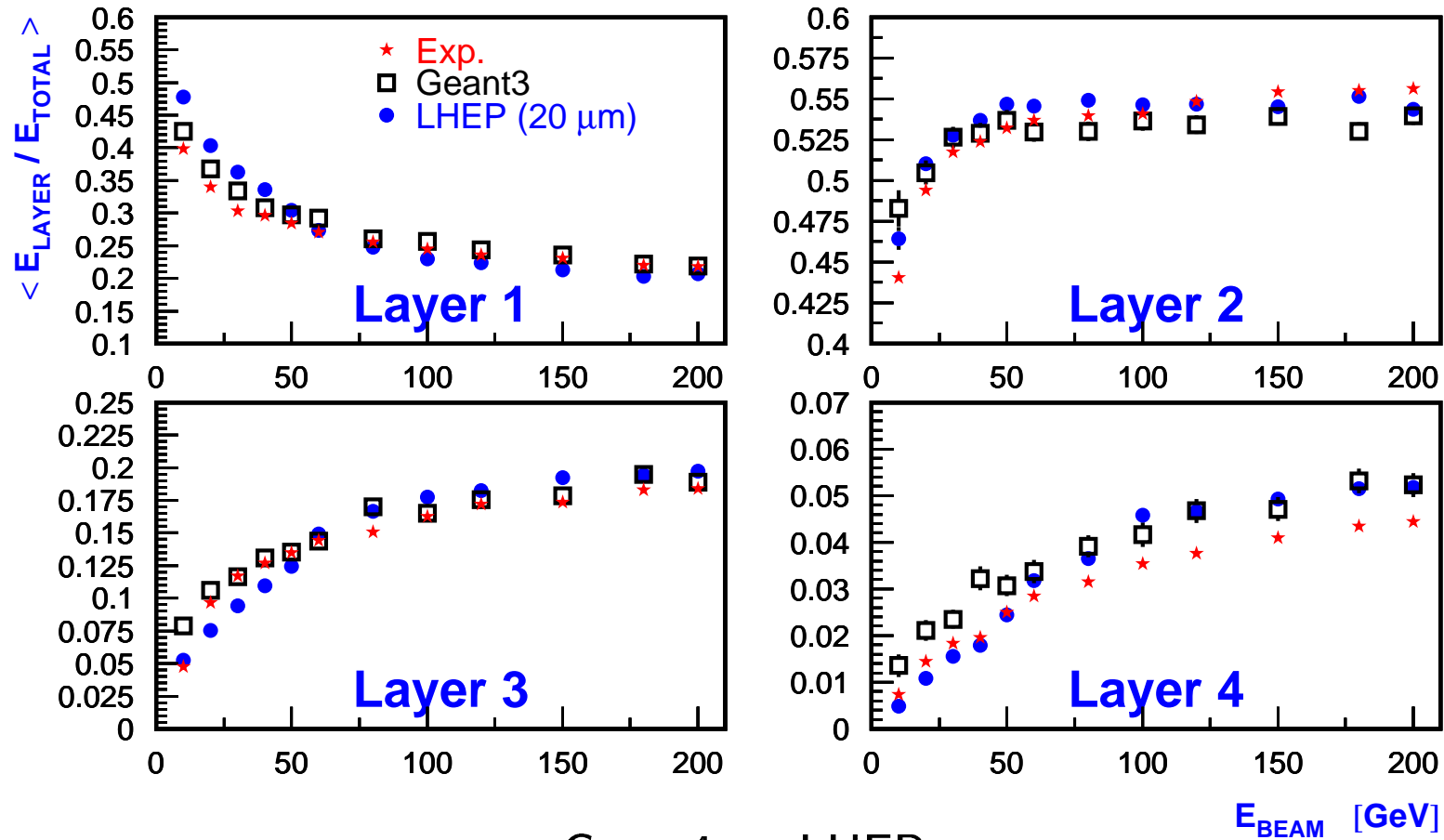
Terms of pion energy resolution



Ratio e/π



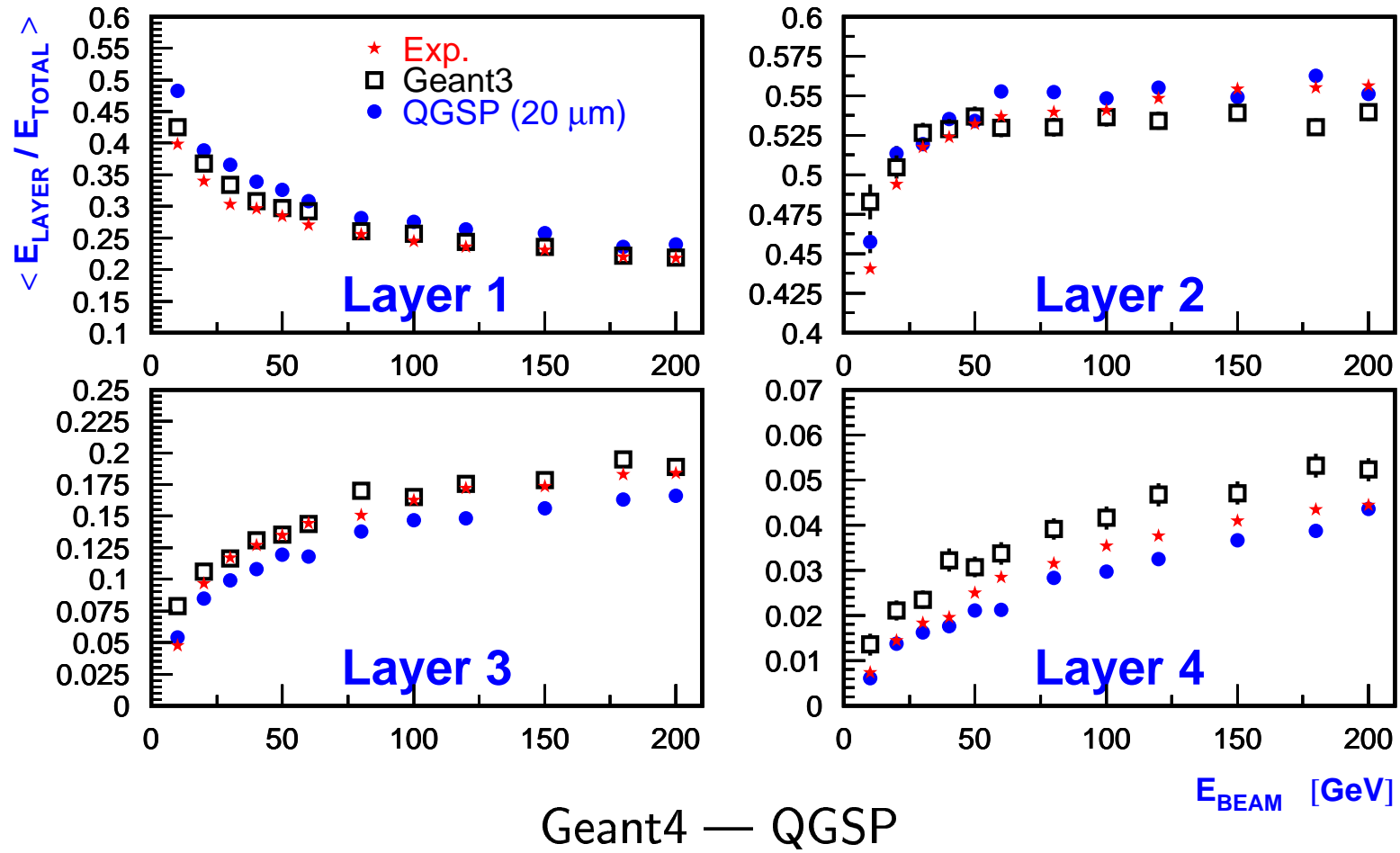
Fraction of energy in HEC layers



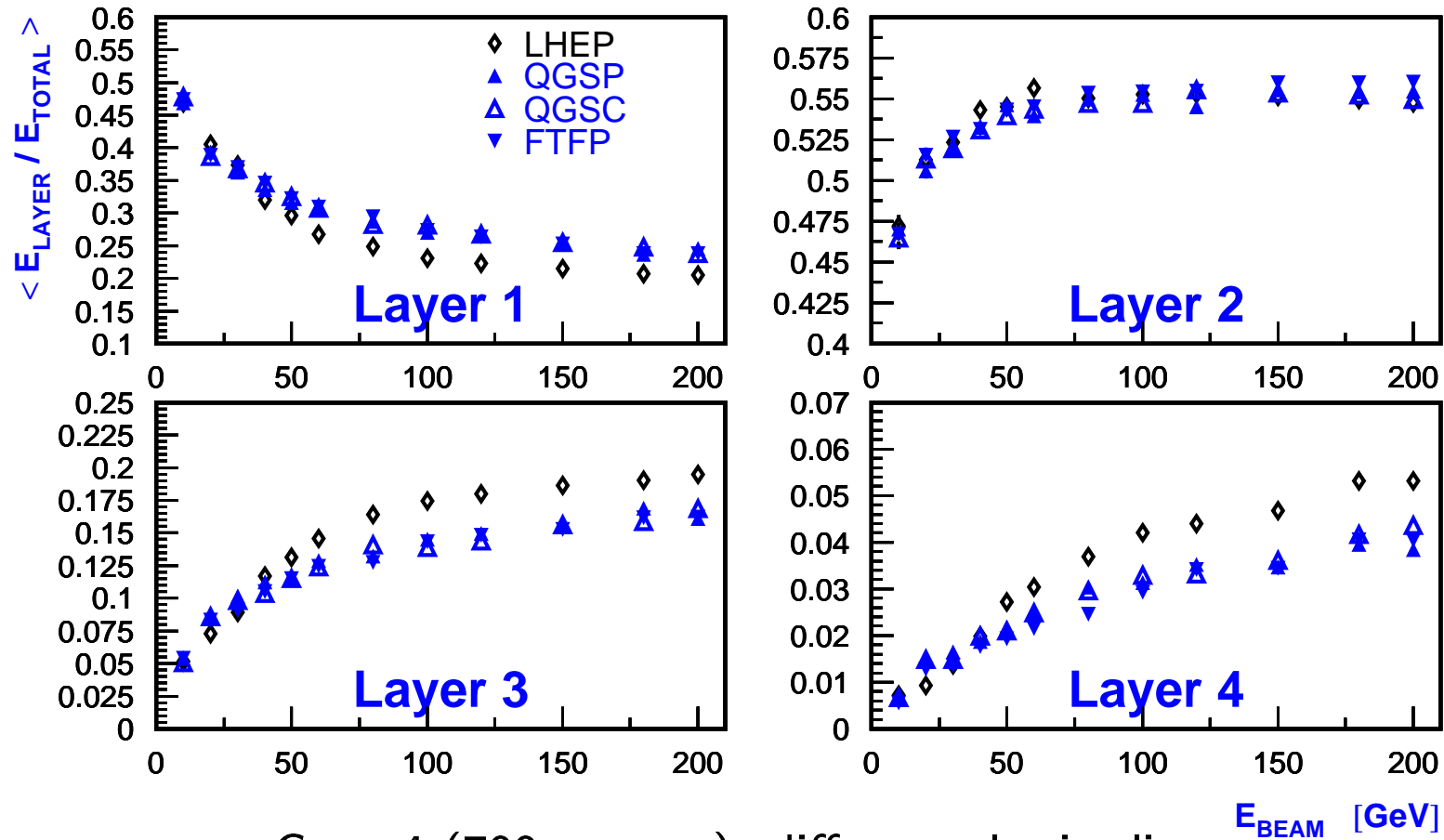
Geant4 — LHEP



Fraction of energy in HEC layers



Fraction of energy in HEC layers

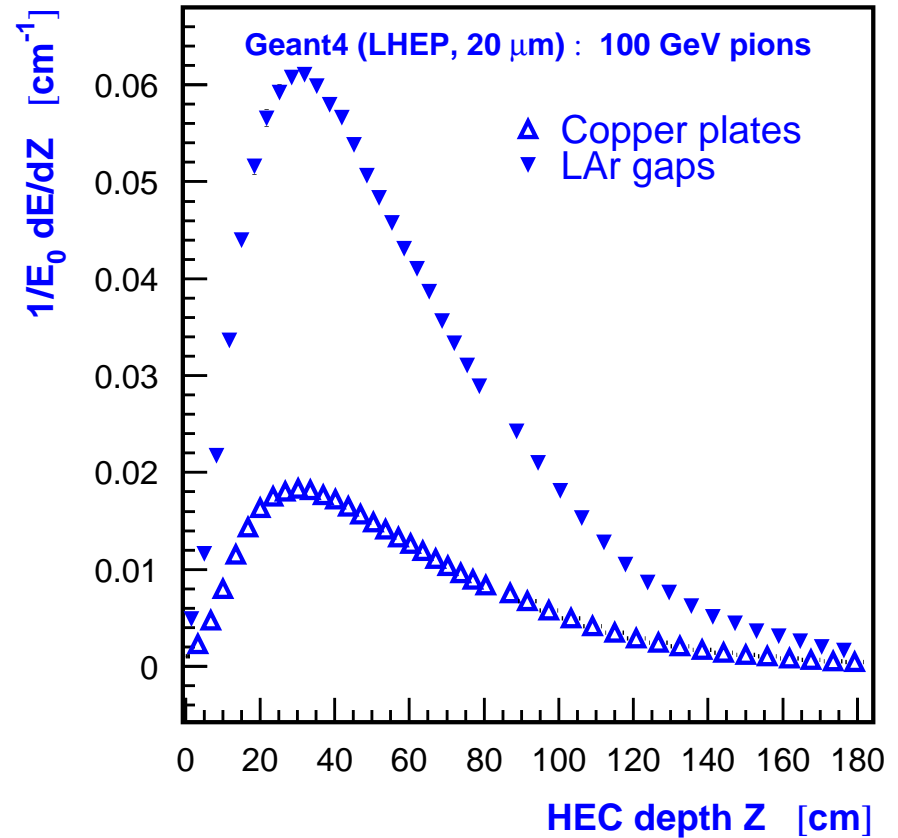


Geant4 (700 μm cut): different physics lists

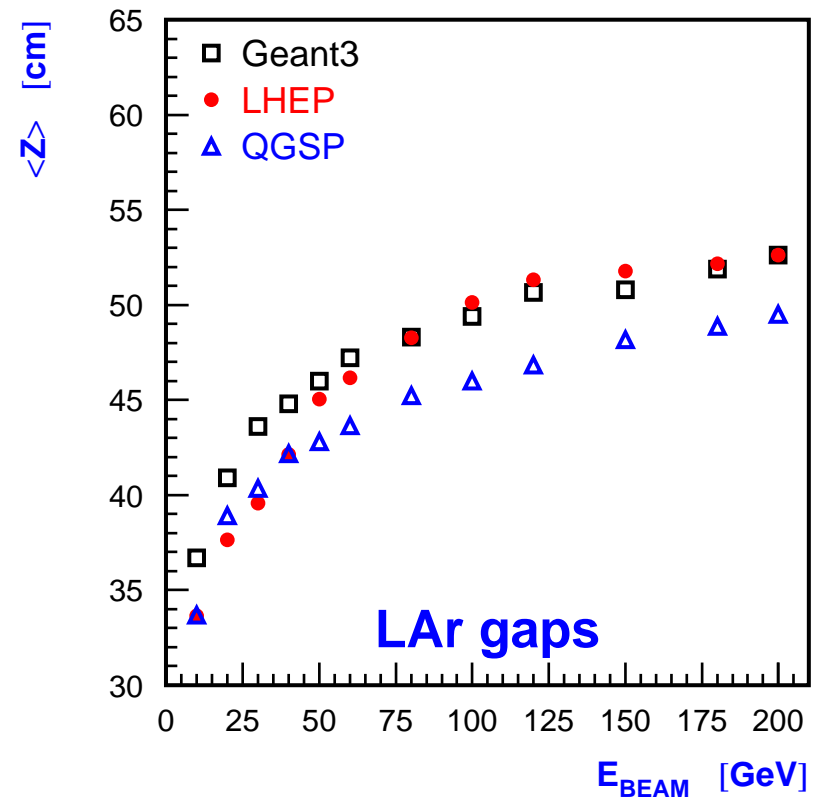
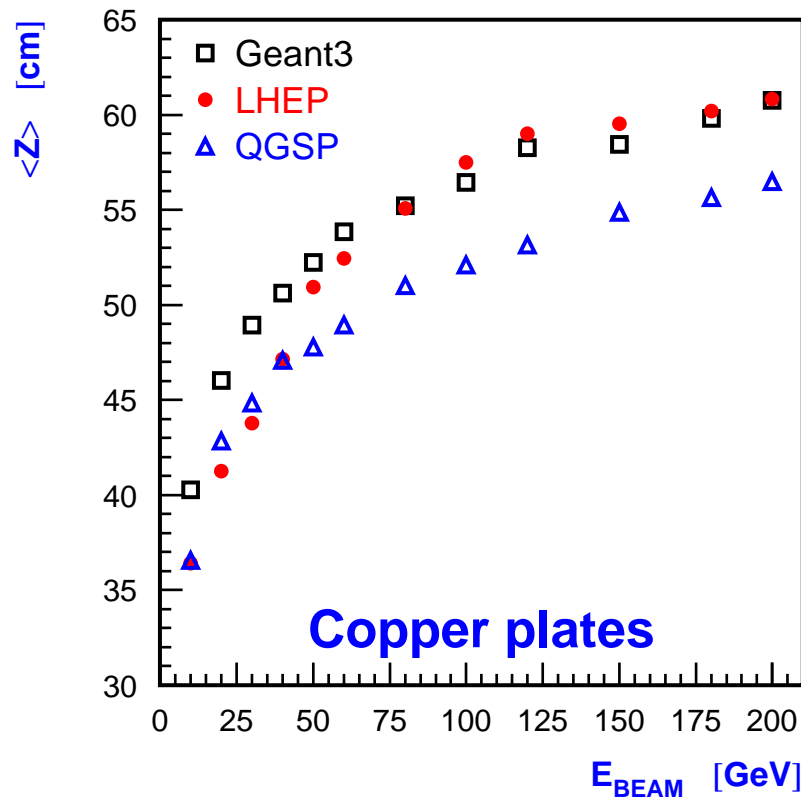


Longitudinal profiles

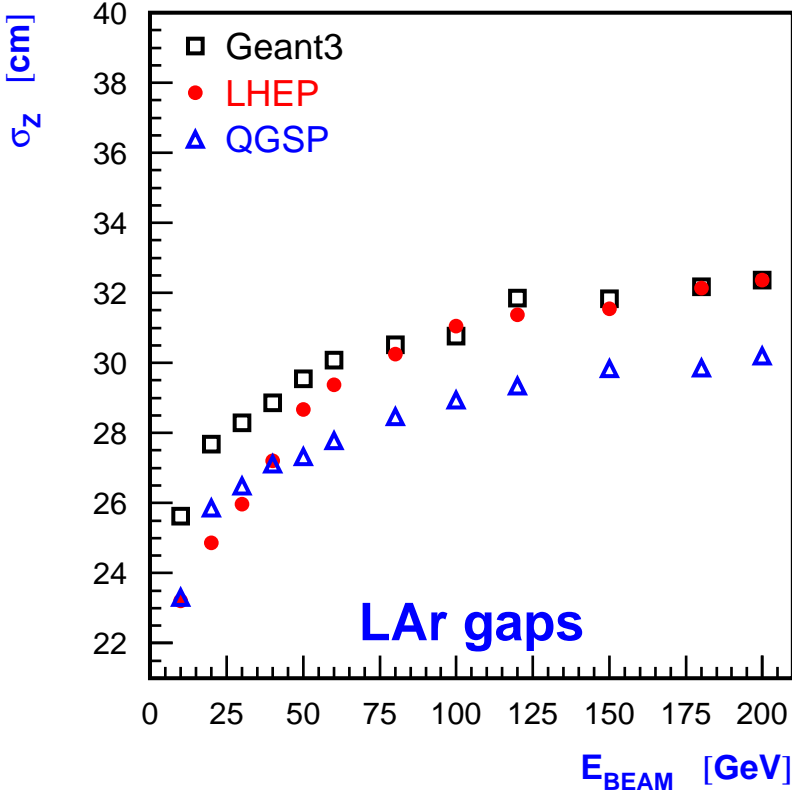
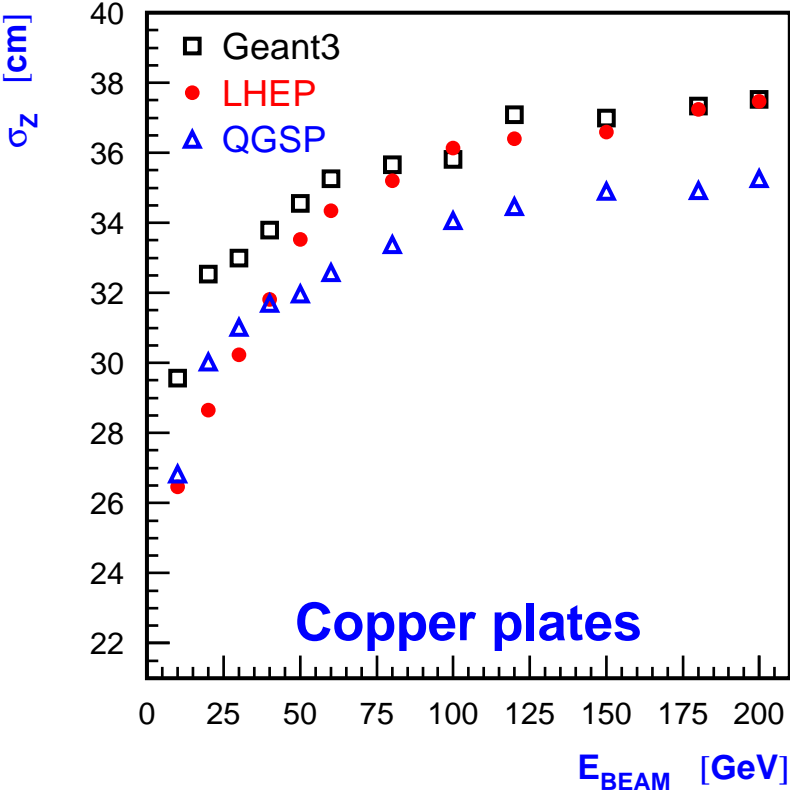
- Special simulations from the front face of the calorimeter (“no beam”)
- Geant4: LHEP and QGSP (20 μm range cut)
- HEC longitudinal structure:
 - 42 copper plates (25 and 50 mm thick)
 - 40 gaps of LAr (8.5 mm thick)



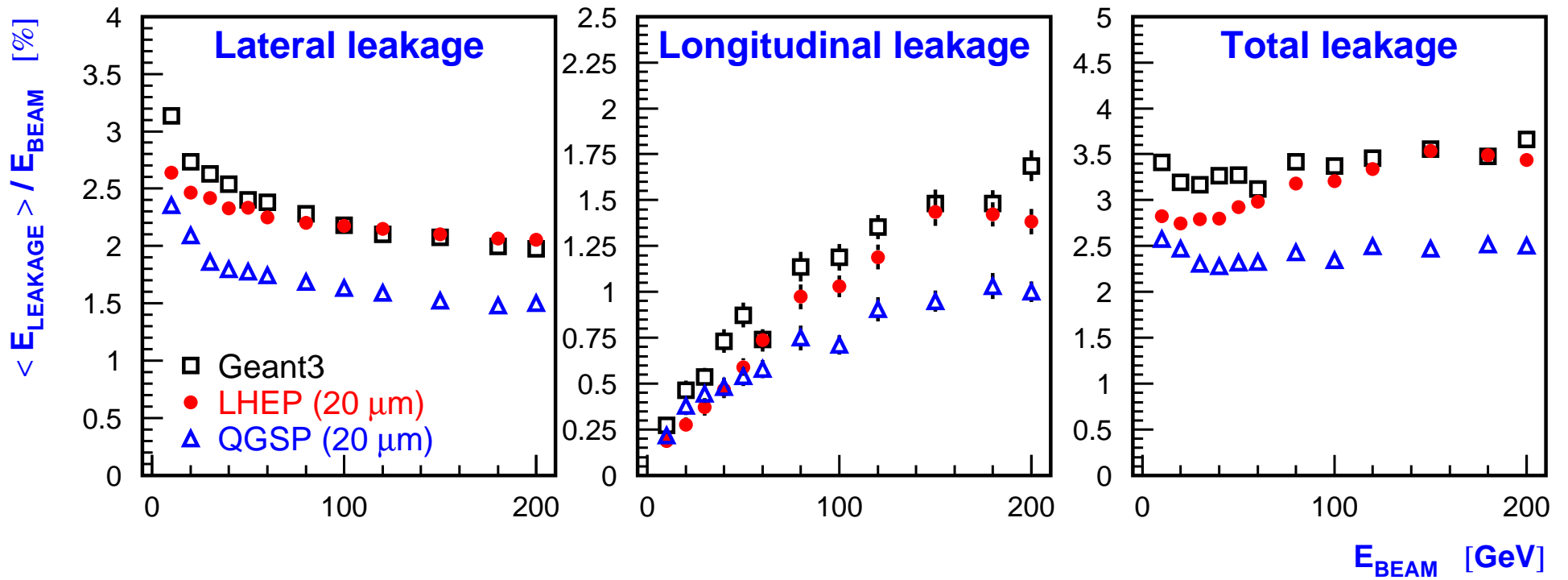
Average longitudinal position of a shower



Longitudinal spread of a shower



Energy leakage



Conclusions and Plans

- Conclusions

- New round of Geant4 based simulations with version 5.0p01 was carried out for the HEC testbeam
- Electron results are very similar to the previous ones (obtained with version 4.1)
- Further improvement (w.r.t. Geant4 version 4.1) is observed for charged pion simulations
- QGSP and LHEP physics lists describe rather well:
 - * the energy resolution for pions
 - * the e/π -ratio
- There are still some problems in the description of longitudinal development of hadronic showers



- Plans

- Fulfill some simulations with version 5.2
- Prepare a note on Geant4 physics validation with the HEC testbeam
- Continue work on simulations for combined beam tests of EMEC and HEC

