Status of Validation of GEANT4 Version 8.0 with ATLAS HEC Testbeam Data

A. Kiryunin (MPI Munich)

- Beam tests of serial modules of the ATLAS hadronic end-cap calorimeter (HEC)
- New round of GEANT4 simulations: version 8.0 + patch-01
- Simulated/analysed samples:
 - scan over the GEANT4 range cut with electrons
 - electron energy scans (to be analysed)
 - charged pion energy scans (to be analysed)



Simulation packages

• GEANT4

Version	5.2p02	6.2p02 ¹⁾	7.0p01	8.0p01
Physics lists	LHEP 3.6 QGSP 2.7	LHEP 3.7 QGSP 2.8	LHEP 3.7 QGSP 2.8	LHEP 4.0 QGSP 3.0
Packaging				
library	PACK 2.3	PACK 2.4	PACK 2.4	PACK 5.0
Date	October 2003	October 2004	February 2005	February 2006

• GEANT3

- Version 3.21
- G-CALOR (hadronic shower code)
- 100 keV transport cuts and 1 MeV process cuts
- HEC geometry: the same in GEANT4 and very similar in GEANT3
- ¹⁾ A.E. Kiryunin et al., NIM A560 (2006) 278-290





- 100 GeV electrons
- GEANT4 range cut: 5 μ m 5 mm
- LHEP
- 5000 events per cut
- Variables:
 - visible energy in LAr gaps E_{LAr}
 - energy deposited in copper plates E_{Cu}
 - their sum E_{SUM}
 - sampling fraction $S = \langle E_{LAr} \rangle / \langle E_{Cu} \rangle$











Comparison with experiment: Signal in one cell

[hA]

< Current >

29

28

28.5

27.5

27

26.5

25.5

26

25

6.2

5.2

10

GEANT3

- Cell with the maximal average signal
- Experiment (averaging over 11 runs): mean±RMS
- Visible energy \Rightarrow Current
- Conversion factor

 (from detailed modeling of the HEC electronic chain):
 7.135 μA/GeV

with an uncertainty of $\pm 1~\%$



3



2

Comparison with experiment: Energy resolution





Time of simulations

- Batch farm at MPI
- 2 processor computers
- 1533 MHz









Some conclusions

New round of GEANT4 based simulations with version **8.0p01** was carried out for the HEC stand-alone testbeam. Analysis of the range cut scan for electrons is done. Comparison with experimental results and results of previous simulations (GEANT4 versions **7.0p01**, **6.2p02** and **5.2p02**, GEANT3) is fulfilled.

- Certain changes are observed in the new version:
 - broader plateau of the visible energy in LAr as a function of the range cut (starting, at least, at 5 μ m)
 - increase of the visible energy (2-4 %)
 - decrease of the total deposited energy (0.5 %)
 - increase of the simulation time by factor ~ 2 (w.r.t. version 7.0)
- Analysis of energy scans with electrons and charged pions is going on

