

Feedback from LHCb

29th G4 Technical Forum
Issues from Experiments and Users
16th November 2010

- Current productions are done with **G4 9.2p04**
- plan is to maintain current PL settings for 2010 (see next slides):
EMOpt1 and **LHEP**
- move to G4 9.4 in 2011 (validation tests will start in December)

Now focus on few hot-topics for LHCb:

- material interaction cross-sections
- MCS description
- Energy calibration in calorimeter
- remaining issues...

Summer 2010: extensive work of validation to cross-check the interaction cross sections simulated inside Geant4 for p, K, pi using different targets (Al, Be, Si) with those available in COMPAS database performed

- studies on how the interaction cross sections and hadronic multiplicities vary using different hadronic PLs:
 - LHEP
 - QGSP_BERT
 - FTFP_BERT
- results did not give sufficient motivations to move from LHEP to a different hadronic PL, i.e. for current production LHEP is kept.
- nevertheless needed an hadronic physics builder with well modeled Kaon interactions...

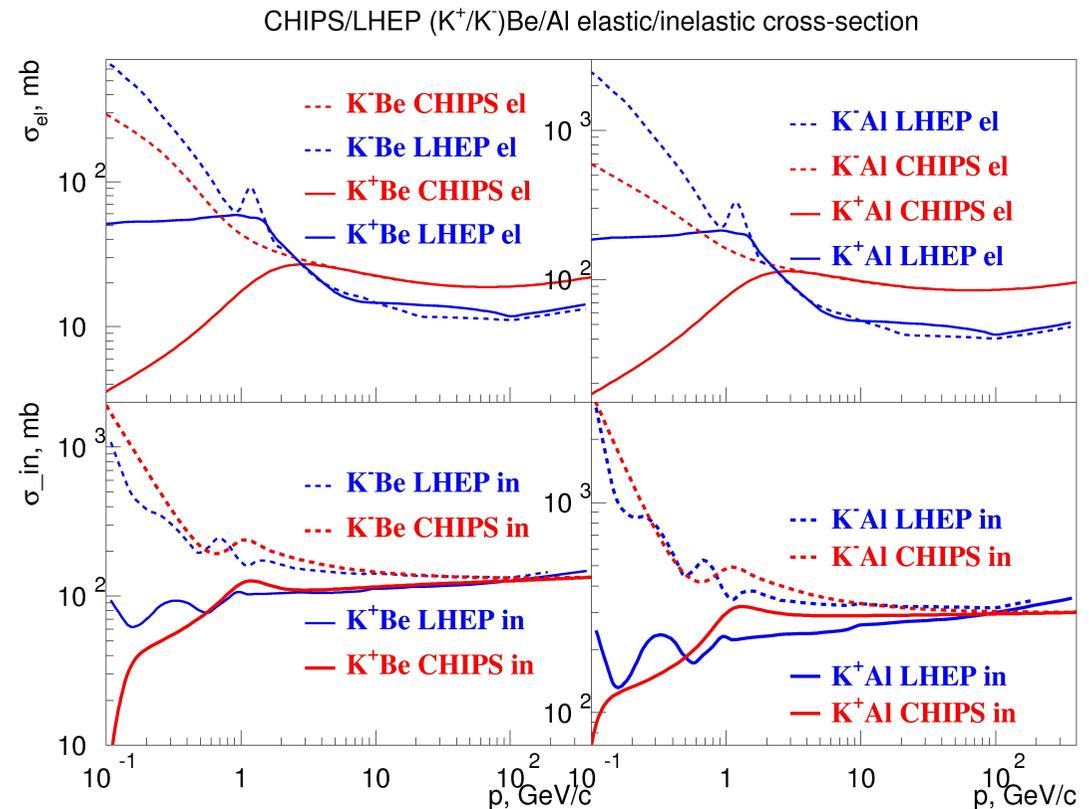
material interaction cross sections



Improved PL QGSP_BERT_CHIPS

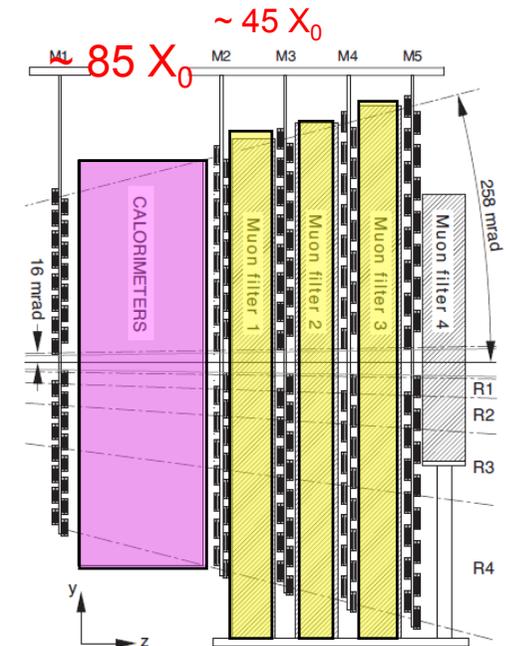
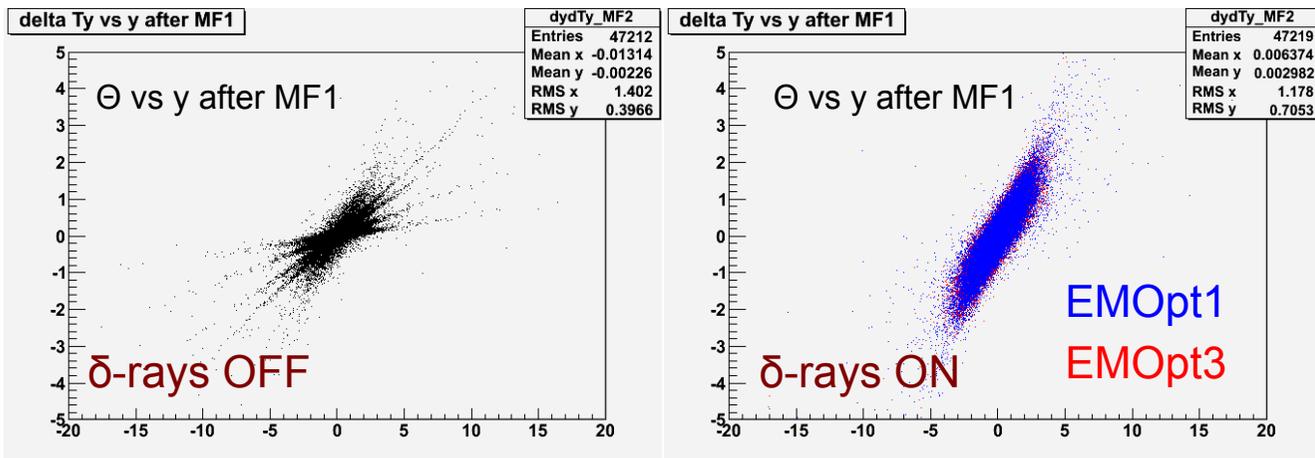
- improved cross sections for Kaons
- improved inelastic models and cross sections for anti-nucleons and hyperons (CHIPS)

needs to be validated in G4 9.4
(feedbacks by January 2011)



Multiple coulomb scattering

- the MCS in G4 is not correctly simulated in case of dense material and large step sizes, MUON Filters in LHCb are a perfect example
- correlation between displacement and angular deviation not maintained.
- step size not constrained by other factors
- activating δ -rays simulation forces Geant to increase the number of steps -> better description of multiple scattering (side effect)

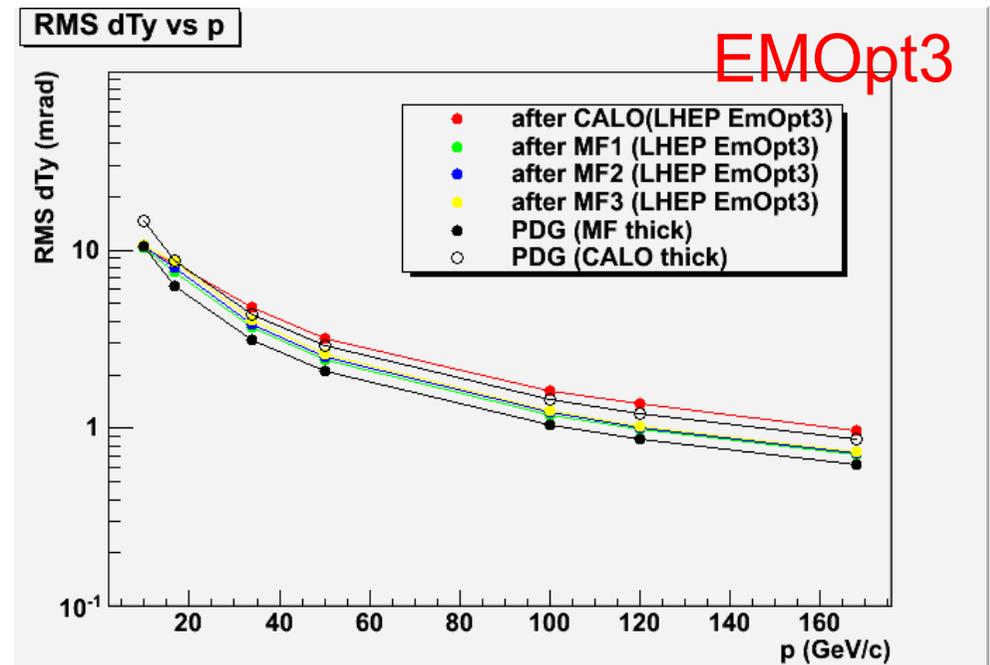
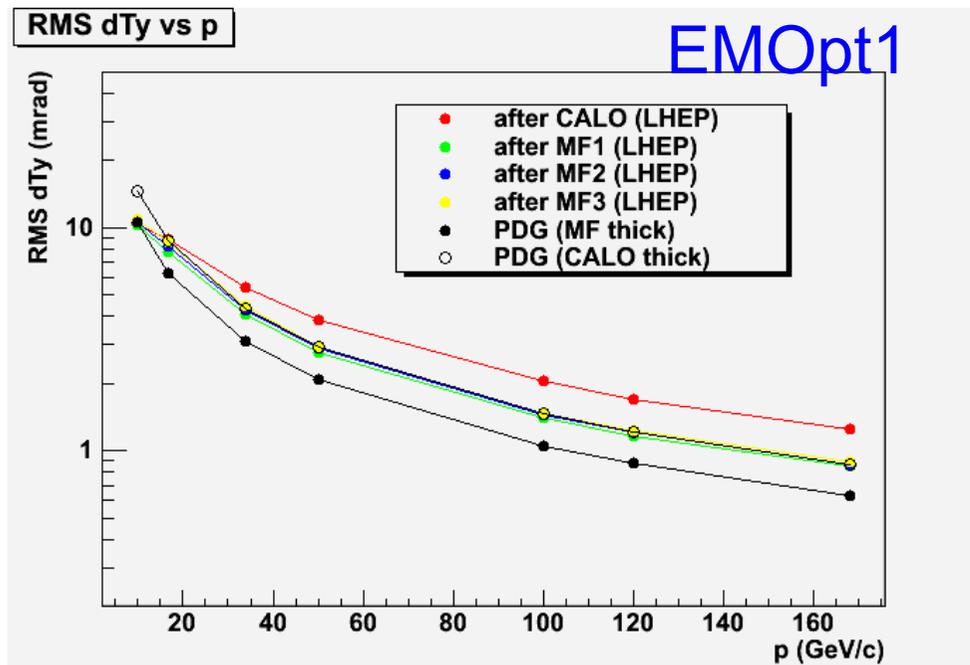


Multiple coulomb scattering



- EmOpt3 seems to show better agreement with PDG for both RMS distributions but...
- CPU time:
 - Muon PGUNs 1k EMOpt3 (batch farm) +27% wrt EmOpt1
 - Pion PGUNs 1k EMOpt3 (batch farm) +60% wrt EmOpt1
 - MinBias 1k EMOpt3 (dedicated slc5 machine) +97% wrt EmOpt1

- RMS of projected angular deviation vs momentum



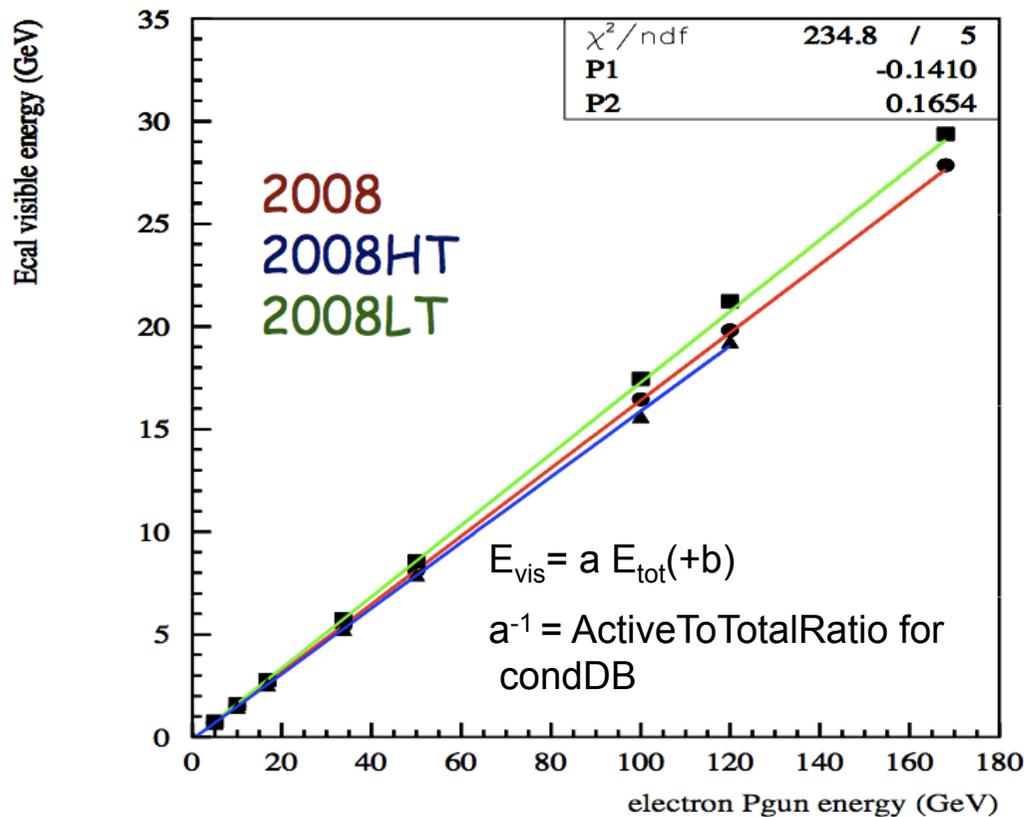
Multiple coulomb scattering



- **MCS** is still a **hot topic** for the simulation
- It does not involve only MUON (ST is reporting problems in thin Si)
- **problem identified** as: whenever the step size in G4 is comparable with the foreseen displacement -> displacement is set to 0 for safety reasons (particle could fall outside volume boundaries)
- **improved treatment of MCS** (fixing of step size without zeroing the displacement) exist in **G4 9.4 EMOpt3** (**only for e⁻ though**)
- G4 experts (V.I.) to **set up a customized EM PL** with correct treatment of **MCS for all particles**
- CPU problem could be avoided activating the high-precision MCS only in certain volumes/regions (e.g. trackers)

Calorimeter calibration

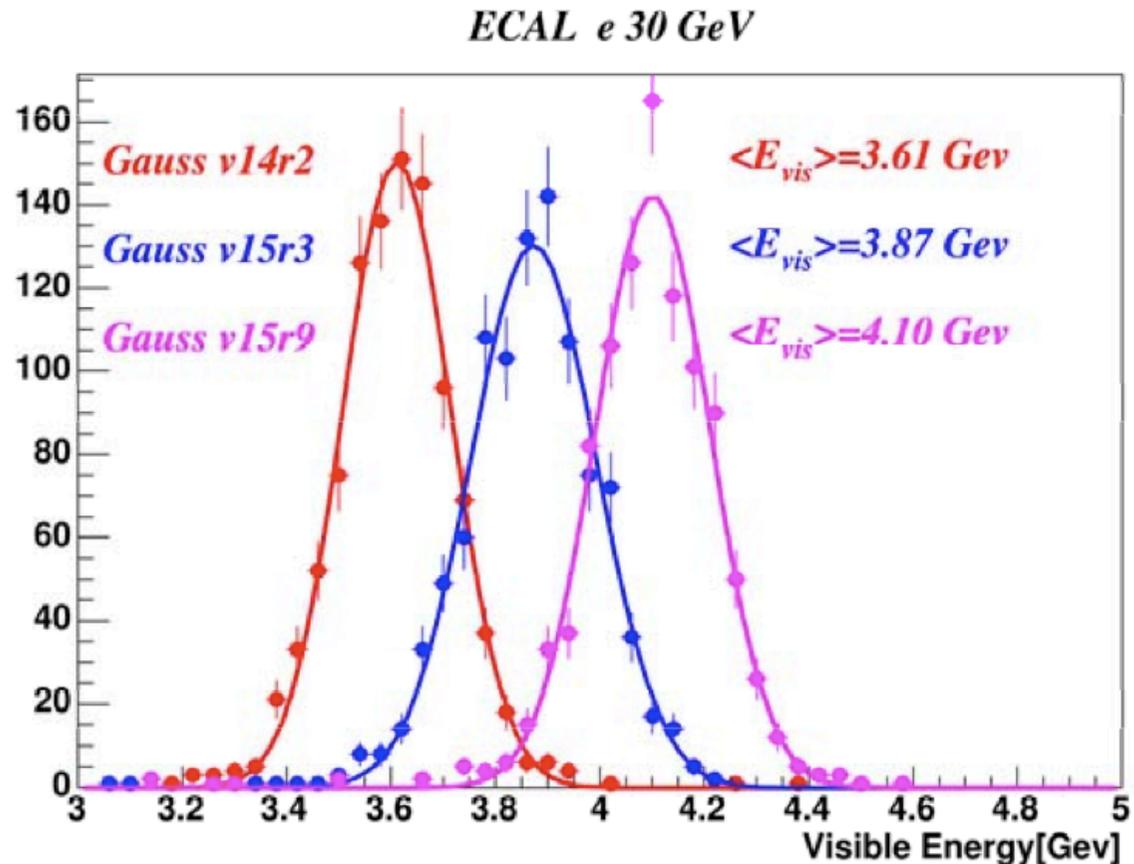
- CALO parameters need to be tuned for simulation/digitization with recent G4
- ECAL and HCAL ActiveToTotalRatio (needed in digitization phase to convert MC tot Energy deposit into ADC): $ADC = (ActiveToTotalRatio * visible Energy) / Gain$



Calorimeter calibration

- sensitive variations of $\langle E_{vis} \rangle$ with Gauss versions was observed in the past ($\sim 10\%$)
- dedicated set of PGUN production required with various energy (from 100MeV to 168 GeV) with no material in front of CALO produced with recent Gauss -> will allow more detailed analysis to verify new tuning parameters

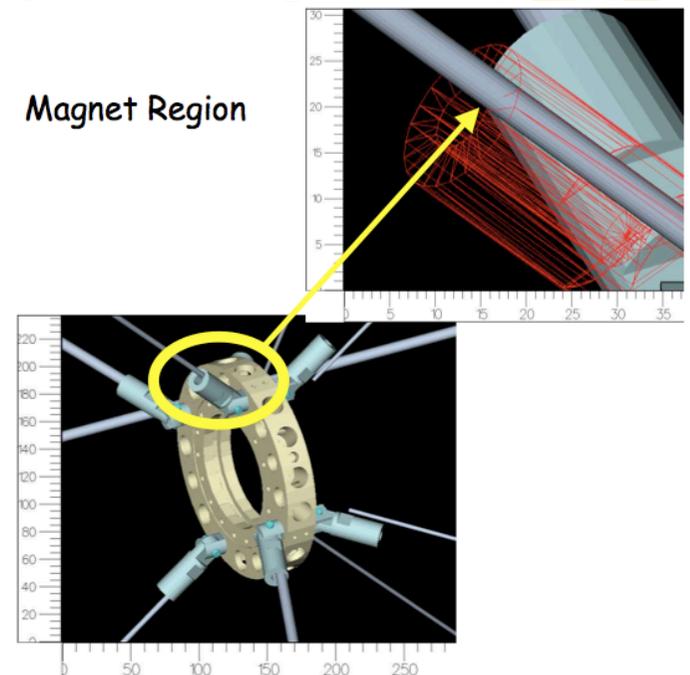
- Hot off the press:
9.2 energy scale $\sim 15\%$ (ECAL),
 $\sim 30\%$ (HCAL) difference with respect to 9.1
(similar to what was in 7.1)
- delta rays on/off only few % difference in energy scale



future plans



- Low Energy Background simulation for MUON
 - not applied so far for 2010 simulation: bunches very far away
 - LHC foresees 150 ns bunch spacing and neutron component can be very slow
 - last parametrization done for 14 TeV collision
 - need to switch on the cavern description and use dedicated PL (QGSP_BERT_HP) with HP extension to be recommissioned
- Geometry description
 - extensive work of validation of implemented geometry done by subdetectors (for silicon trackers, all the rechecks done against tech drawing & overlaps fixing)
 - the same in progress in few other places (e.g. adding connection to cables in beam pipe supports)



Open issue



- jobs hanging running Gauss on 64-bit (slc4 and scl5)
 - jobs stuck while consuming CPU. Does not seem a ping-pong effect.
 - not always on the same point, although same zone and going to universe
 - not always the same particle type
 - memory corruption suspected.