



Summary of recent patch release & 2018 work plan - EM physics part

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GEANT4
A SIMULATION TOOLKIT

Patch release 10.4p01 (1/2)

- Re-enable user-defined material properties in G4MaterialPropertiesTable and G4MaterialPropertiesIndex. Addressing problem report #2030 from LHCb.
- G4PairProductionRelModel (problem #2017):
 - fixed misuse of G4Pow (A13(..) should be used instead of Z13(..))
 - added initialisation of an element cache before sampling of final state
- G4EmParametersMessenger:
 - use G4Exception for warnings instead of G4cout
 - review G4State for UI commands and signal the RunManager about modification of physics if a command is issued in Idle state.
 - fixed printout format and
 - added lock and protection in commands defining physics per region

Patch release 10.4p01 (2/2)

- Technical fixes:
 - G4EmParameters, G4VEmProcess, G4VEnergyLossProcess: define the same default values for few internal members
 - moved few static and virtual methods from inline to source.
 - fixed self consistency of headers in few classes
- G4VXTRenergyLoss: extended XTR angle limit up to 250/gamma, on ATLAS request
- G4DNAMolecularMaterial: allow GetDensityTableFor() and GetNumMolPerVolTableFor() methods to be accepted at G4State_Init rather than G4State_Idle
- It is recommended to switch to 10.4p01 for users of EM physics, especially, for HEP applications

Plans of EM Standard Group for 2018

1 – June 2018 (10.5beta)

2 – December 2018 (10.5)

* - developments which will be done if manpower will be identified

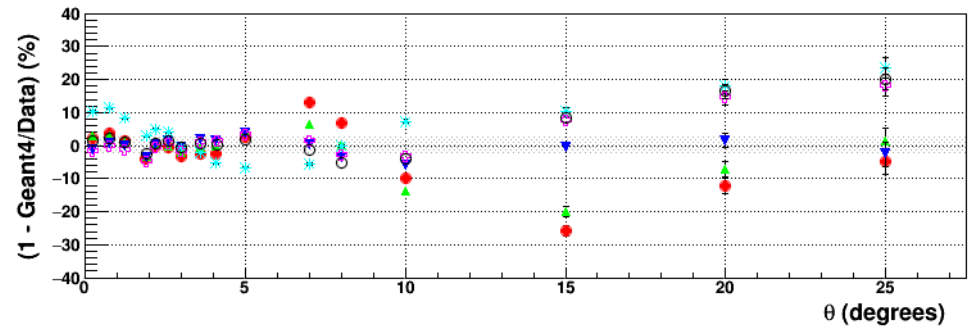
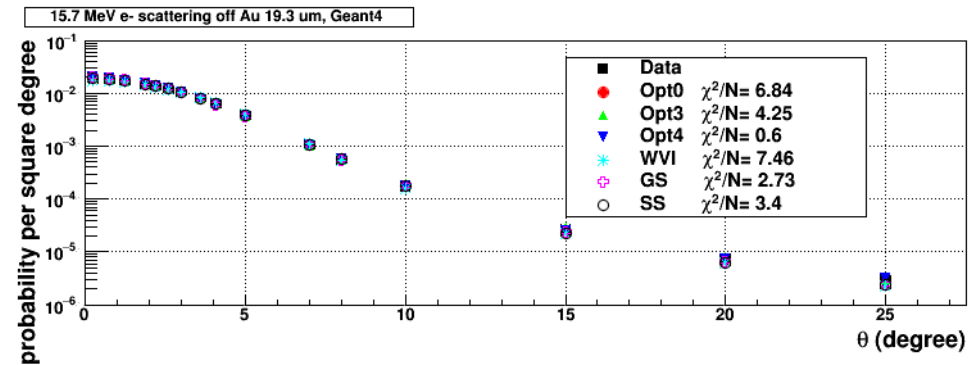
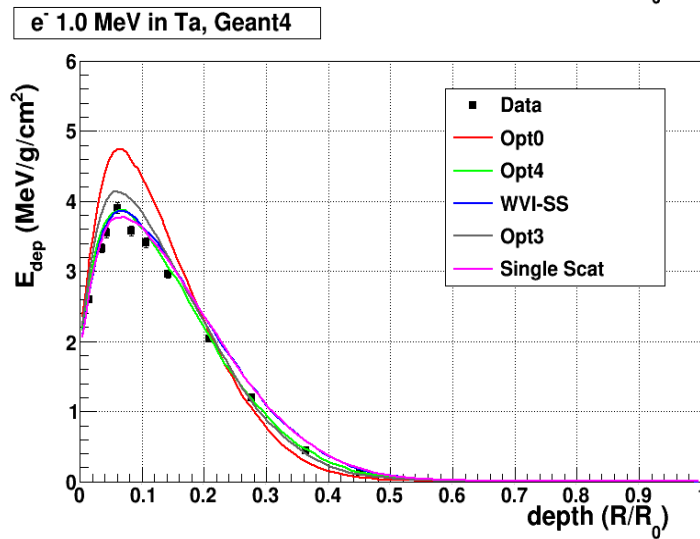
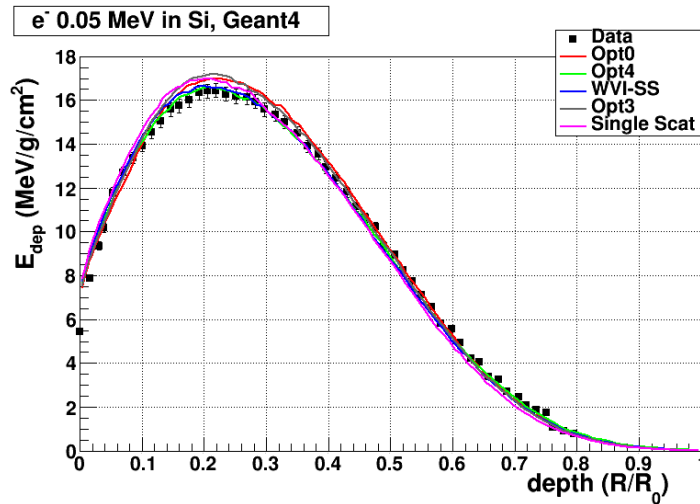
1) Infrastructure and general support for EM physics

- perform regular execution and regression analysis using existing testing suites (1/2)
- adding unit tests for regular tests (1)
- adding new test for pair production model (1)
- full migration of the EM testing suite to CVMFS, EOS, and ROOT6 (1)
- addition of CMS HGCAL simplified test-beam into testing suite (2)
- evaluation on existing models and R&D on possible new for search of particles beyond the Standard Model, extend dmparticle extended example (1/2)
- address ATLAS tilecal problem (1/2) (*)
- study on effect of high energy muon scattering due to high energy radiative processes (2) (*)

2) Further development of the processes of multiple and single scattering

- further tuning and optimisation of options for the Goudsmit-Saunderson model for HEP applications (1)
- further tuning of lateral displacement in the Urban model (1)
- improve backscattering in the Urban model (2)
- introduce Mott corrections to WentzelVI and SS models (2)
- evaluate WentzelVI model performance with 2nd order corrections enabled (2) (*)
- study on of the displacement beyond boundary algorithm (1/2) (*)

For 10.4p01 Improved Opt4 EM Physics



The goal is to improve Opt0 EM physics without degradation of CPU performance

3) Further update of ionization processes

- review model for sampling fluctuations of e^+e^- , look for the alternative model (1/2)
- further tuning of the Urban model of fluctuations (2)
- alternative ion ionisation models for moderate energies (1)

4) Bremsstrahlung and gamma models

- review and improvement of Seltzer-Berger model performance (1)
- introduce bremsstrahlung on atomic electrons at high and moderate energies with triplet production (2)
- introduce 5D model of gamma conversion with polarisation effects and triplet production (1)
- extend validation of the gamma conversion models including cross sections and final states (2)
- introduce direction splitting for bremsstrahlung (2)
- improve muon production cross section by gamma at threshold (1)

5) Extended model of positron annihilation

- incorporation of the three gamma annihilation (1)
- improve muon production cross section at threshold (1)
- addition of tau pair production by positrons (2)
- extend energy limit for positron annihilation to hadrons (2) (*)

6) Optical photon and X-ray physics

- extended transition radiation model (1)
- improve Synchrotron radiation angular distribution (2)
- review and update interface to G4MaterialProperties to be thread safe and fast (1)
- propagate new interfaces to all optical processes (2)
- addition of extra test for new interfaces (2)
- addition of X-ray boundary processes (2) (*)

Plans of EM Low-Energy Group for 2018

1 – June 2018 (10.5beta)

2 – December 2018 (10.5)

* - developments which will be done if manpower will be identified

1) Livermore and related models

- upgrade of Livermore electron ionisation (2)
- pair production
 - new model for polarized pair production in nuclear field (2)
 - improvement of pair production in the electron field (*)
- evaluate possibility to use EPICS-2017 data-base (1/2)
- extension of shell ionisation cross sections for the de-excitation module (2)
 - In collaboration with ANSTO, Australia
- finalize migration and testing of polarized gamma models to same software design as non-polarized Livermore models (*)

2) Penelope and Monash U. models

- Penelope
 - continue testing and validation of Penelope models (2)
- Monash
 - complete the recalculation of atomic electron momentum PDFs and Compton profiles for elements $Z = 1 - 100$ for the Monash models (2)
 - development and implementation of a new low energy photoelectric absorption model (2)

3) Geant4-DNA and MicroElec models

- Geant4-DNA physics
 - new and/or alternative cross section models for liquid water and other biological materials (2)
 - in collaboration with Ioannina U. and Toulouse U.
- Geant4-DNA chemistry
 - testing and validation of chemistry (2)
 - new chemistry models compatible with geometries (*)
- Geant4-DNA examples
 - deliver review of Geant4-DNA physics examples (*)
 - new related DNA examples for the modelling of early biological damage to DNA (2, *)
- MicroElec
 - extension to new materials (*)

4) Validation of Low-Energy physics

- Finalize validation of photon cross sections (2)
- Finalize validation of electron backscattering (2)
- validation of proton scattering (2)
- Continue G4MSBG effort in collaboration with Standard EM