Patch release 10.6-p01 and 2020 work plan: EM physics part

V. Ivanchenko, CERN & Tomsk State University, Russia

for the Geant4 Collaboration

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EM Physics Updates for Geant4 10.6p01

- For the process of e+e- pair production by muon an option is added allowing to retrieve precomputed PDF from the data files
  - /process/em/MuDataFromFile true
  - There is equivalent C++ interface
  - Should significantly reduce initialization before the run
- G4BetheHeitler5DModel – fixed rare numerical problem
- G4EmModelActivator – fix problem #2106
  - Correct configuration of e+e- multiple scattering
- New data set 10.6 G4EMLOW7.9.1

2020 workplan for the EM physics

- "1" - feature will be available in the June beta-release
- "2" – will be available in December release

Developments for code speed-up

- implementation of an alternative, specialized transport for e+- and gamma for HEP applications (1/2)
- consolidate the "general gamma process" and extend it for e+- (1/2)
- speed-up of the Urban msc model keeping physics performance (1)
- review of Geant4 classes related to transport (1)
- reduce CPU for initialisation in the MT mode (1)

Infrastructure and general support for EM physics

- perform regular execution and regression analysis using existing testing suites (1/2)
- extend geant-val by full set of tests from the EM testing suite (1/2)
- introduction of detailed test of stepping for EM calorimeters triggered by ATLAS (1)
- review adjoint model sub-library (1)
- addition of CMS HGCAL test-beam into testing suite (1)

Further development of the processes of multiple and single scattering

- further tuning and optimisation of options for the Goudsmit-Saunderson model for HEP applications (2)
- new single scattering model for e+- based on ELSEPA (numerical Dirac-Fock PWA) (2)
- improve back-scattering algorithm for the Urban model (1)

Further update of ionisation models

- review model for sampling fluctuations of e+-, evaluate alternative models (1/2)
- evaluate usage of ICRU90 stopping power data as the default (1/2)
- evaluate ion ionisation models for moderate and high energies (1)
- evaluate new ion energy fluctuations model (2)
- implement Taborda approximation to electron stopping below 30 keV (2)
- development of ionisation model for gold based on dielectric theory (1/2)

Gamma models

- introduce linear gamma polarization options into all gamma models (2)
- introduce EPICS 2017 cross sections to all gamma models as an alternative option (1/2)
- review and update all Livermore gamma models (1/2)
- complete the recalculation of atomic electron momentum PDFs and Compton profiles for all elements (2)
- introduce quantum entanglement for the gamma transport (1)

Extended model of positron annihilation

- addition of more accurate two-gamma annihilation using atomic electron momentum PDFs (1/2)
- evaluation of the model of the three-gamma annihilation (1/2)
- addition of tau pair production by positrons (2)

Atomic de-excitation module

- further development of ANSTO PIXE data library and evaluate Auger emission yields (1/2)
- implementation of a data base for ionisation cross sections of K-, L-, and M- shells by heavy ion collisions (2)

Medical physics applications and radiobiology

- regular running and evaluation of medical physics benchmarks (1/2)
- complete report on Geant4 medical physics benchmarks (1)
- simulation studies on RBE, LET, G-values, and DNA damage (1/2)
- addition of a new example with more realistic human phantoms for radiation protection and medical purposes (2)

Optical photon and X-ray physics

- extended modelling of scintillation and WLS (1)
- perform tests of Synchrotron radiation in complex magnets (1/2)
- support of the transition radiation model for ATLAS and ALICE (2)
- integration of the Opticks package in the new extended example (2)

DNA physics

- implement CPA100 models for DNA related materials (2)
- increase upper limit for DNA proton physics from 100 to 300 MeV (2)
- increase upper limit for DNA e- physics Option4 from 10 keV up to 1 MeV (2)

DNA chemistry

- improve existing examples and add chem6 (1)
- implement IRT chemistry transport (1/2)