Geant4 9.6p03 and 10.0patch01 physics highlights

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Outline

- Fixes common to 9.6p03 and 10.0p01
- Fixes for 9.6p03
  - Corresponding improvements are already part of 10.0
- Fixes for 10.0p01
- There are number of technical fixes which will not be discussed because not affect physics
  - Fixes of compilation at specific platforms
  - Fixes for static analysis warning
  - Fixes in printouts
- Fixes marked in red definetly affect performance and robustness of user applications

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Fixes common to 9.6p03 and 10.0p01

- G4Decay fix
  - Seen in ATLAS and CMS production
- For Livermore, Penelope, Option3,4 EM physics constructors the default RangeFactor is set to 0.01 instead of 0.04
  - Important for medical, space, and other application for more accurate low-energy electron transport
- G4NuclearStopping : do not reset dynamic charge because the G4ionIonisation is responsible for ion dynamic charge
  - This fix transport of partially charged ion beam in dense media and electromagnetic field
- For EM processes interaction length is reset if corresponding model is activated or de-activated
  - Is essential for DNA physics simulation when for high energy standard models are used and for low-energy DNA model are applied
- Bug #1371- fixed minor memory leak in G4ExcitationHandler
- Bug #1536 – fixed infinite loop in mu- capture at rest when pre-compound model is used
  - Return back 9.5 algorithm

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Fixes for 9.6p03 (1/2)

- Increased lowest limit for multiple scattering from 1 eV to 10 eV to exclude semi-infinite loops for low-energy electrons
  - Seen in HEP calorimeter simulation
- UrbanMscModel95, 96 – fixed randomisation of the 1st step after the boundary
  - Important for backscattering simulation
- In Livermore, Penelope, Option3,4 physics constructors G4UrbanMscModel96 is used instead of 95 model
  - More accurate and stable for medical, space, and other users for low-energy applications
- Fixed crashes for G4PenelopeOscillatorManager for specific materials
- Fixed bug #1471
  - numerical exception at initialisation of muon bremsstrahlung and e+e- pair production

Fixes for 9.6p03 (2/2)

- Optimisation of G4ElectronuclearCrossSection and G4PhotoNuclearCrossSection classes
  - Only saving CPU, no effect for physics
- Fixed rare non-reproducibility in Bertini
- Fixed bug #1557
  - Make singleton G4CascadeParameters canonically
- G4NeutronRadCapture: fixed memory leak and set correct time for secondary particles
  - QBBC and FTFP_BERT_TRV Physics Lists
- G4LundStringFragmentation: fixed two mistakes in index manipulation of the BaryonWeight
- G4VParticipants, G4PomeronCrossSection – remove incorrect inline statements responsible for run time errors at some platforms

Fixes for 10.0p01 (1/3)

- G4EmCalculator – extend control on validity of parameters of public methods
  - added G4Exception if material-cuts couple is not found out, when range or CSDA range tables are not found out
- Added G4Log, G4Exp, G4Pow is some places where std methods were still used
  - CPU performance improvement
- G4Universal Fluctuations – fix numerical problem happens at extreme small cuts
- Penelope models – allow for (Auto-lock-protected) creation on-the-fly extra G4PhysicsVectors
  - Needed for unit tests and for G4EmCalculator
- Bug #1569: for stable particles life time age of universe is used instead of DBL_MAX
  - To avoid numerical problems
- For G4OptWLS process use make WLSTimeGeneratorProfile and UseTimeProfile statis
  - Essential for MT

Fixes for 10.0p01 (2/3)

- G4CrossSectionDataStore::SampleZandA – remove extra if statement ; G4BGGNucleaonInelasticXS – removed internal cross section threshold
    - Fixing crash observed in QBBC
- G4BinaryLightIonCascade – fixed minor memory leak and fixed kinematics for "fusion"
    - This removes G4Fragment warning "negative excitation energy" and rare 4-momentum dis-balance on MeV level
- G4Fragment uses G4Allocator
    - About 30% reduction of memory churn for FullCMS benchmark
- Bug 1543 fix reading of compressed files for thermal HP scattering data
- G4RadioactiveDecay – fixed memory leak at destruction

Fixes for 10.0p01 (3/3)

- In Livermore, Penelope, Option3,4 physics constructors G4UrbanMscModel is used for pions, kaons, protons, anti-protons instead of WentzelVI
  - to have more accurate ranges
- In Option0, 1, 2 standard physics constructors added CoulombScattering process for large angle single scattering for pion, kaons, muons, protons, anti-protons as it is done for muons
  - To have more smooth transition between EM and hadronic scattering
- OpticalPhysics constructor fixed initialisation of physics in for MT mode
- Ion physics constructor with INCL++ - upper limit for deuteron, triton, He3, and alpha is set to correct values
- LBE Phyics List – neutron capture upper limit is set to 20 MeV

Stability of calorimeter results