GEANT4 9.6.p01 highlights

kernel modules

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Outline

- Major features and fixes introduced in release 9.6 and the patch release 9.6.p01
  - Kernel
  - Physics (see talk by V.Ivantchenko)

➢ *Detailed release notes for 9.6:*

- **http://geant4.cern.ch/support/ReleaseNotes4.9.6.html**

➢ *Release notes for patch-01:*

- **http://cern.ch/geant4/support/Patch4.9.6-1.txt**

Event reproducibility

- Full event reproducibility now provided in simulations with most physics lists
  - Allowing to restart a simulation from an intermediate event and obtain exactly the same results in different runs
- Event reproducibility valid for the majority of the physics lists, including FTFP_BERT, QGSP_BERT and QGSP_FTFP_BERT
  - Strict event reproducibility achieved in all physics models, with two exceptions: CHIPS stopping and neutron HP

Integration with frameworks

- G4RunManager offers new, more granular public methods
  - Enables external frameworks with own event loop to execute each individual event
  - No longer need to copy the context of G4RunManager base class methods

Performance

- Small speedup of simulation (compared to Geant4 9.5.p02)
  - EM showers (2-3%) in calorimeters
  - EM initialisation faster by roughly a factor 2.
- Optimized implementation for *G4StackTrack* and *G4StackedTrack*
  - Measured speedup of ~35% in simple test programs
- Optimized tuning of *G4SmartTrackStack*, now enabled by default
  - Measured speedup of 4-5% total execution time in complex setups
- Revised implementation of G4TessellatedSolid
  - CPU boost and reduced memory footprint for large number of facets
  - Better scaling of CPU time with increased complexity
  - Part of the work going on within the AIDA EU project

Check of conservation laws

- Hadronic processes checks for energy non-conservation
  - If violation of energy conservation found, re-sampling the interaction
- Failure of E/p conservation is signaled only if both checks, absolute and relative, fail. A violation is signaled only if it is both:
  a) larger in absolute value than the E threshold, and
  b) a larger fraction of the incoming E than the threshold fraction

EM: Memory and initialisation CPU

- EM builders use the same instance of a process for a particle/antiparticle pair
  - Bremsstrahlung and e+/e- pair production
    - mu+ and mu- share one instance of each process
    - Pi+ and pi- share a different instance of each one
    - K+ and K- too, and
    - proton and antiproton also
- Reduces memory used for physics tables and initialisation time

Materials & Track

- G4Element constructs an isotope-vector for all elements
  - if user does not create isotopes, a vector of isotopes with natural abundances is created automatically using NIST data
    - The sum of isotope abundances is normalized to unity
  - No longer needed to define natural composition of isotopes in the user code
- Fixes
  - bug in **`G4ParticleChange::AddSecondary()`**, where the local time of the parent was incorrectly used

Physics Lists

- New factory class implementing automatic registration of physics-lists
  - Instrumented EM and hadronic constructors
- New FTFP_BERT_HP physics list
  - Combining HP data-driven treatment for neutrons
- Removed direct dependency on CHIPS model from all physics lists, except QGSC* and CHIPS*
- Updated physics lists combinations and options

Configuration & global…

- Cmake
  - Complete rewrite of data installation with support for custom install location
  - Added support for Clang detection and possibility to specify C++ standard

- Global
  - Fixed cases of variable shadowing and Coverity defects
  - Added deprecation warnings for classes/methods planned for removal in next major release
  - In future (release 10) `G4SystemOfUnits.hh` will **not** be anymore implicitly included through globals.hh
    - Any class that need it will need to include it explicitly or directly include the CLHEP headers
    - In toolkit already include headers for system of units and physical constants explicitly

Fixes in 9.6 patch 1

- Bug fixes included:
  - #1334, #1359, #1380, #1386, #1402, #1403, #1404, #1406, #1418, #1420, #1421, #1424
- Non-physics corrections:
  - Fixed process which interfered with deflection in field (#1403)
  - Fix for tessellated solid on 32-bits platform
  - NIST material: revision of stainless steel definition
- Important fixes in EM
  - see next talk by V.Ivantchenko

Supported platforms for 9.6 series

- Linux SLC5, gcc-4.1.2, 4.3.X, 64 bits
- MacOSX 10.7, 10.8, gcc-4.2.1, 64 bits
- Windows 7, Visual C++ 10.0 (Visual Studio 2010)

- Also tested:
  - Linux SLC5/SLC6, gcc-4.6/4.7, icc-13
  - Linux Ubuntu 11/12, gcc-4.6
  - Windows 7, VC++-9.0
  - AIX 5.3, 6.1 with xlC 10.1

Thanks!