Geant4 10.4.p01
& 2018 planned developments

kernel modules

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Outline

- Fixes introduced in release 10.4.p01
  - Kernel modules
  - Physics (see talks by V.Ivantchenko & A.Ribon)
- Overview of planned developments for 2018
  - Kernel modules
  - Physics (see talks by V.Ivantchenko & A.Ribon)

➢ *Detailed patch release notes:*

- http://cern.ch/geant4/support/Patch4.10.4-1.txt

➢ *All planned features for 2018:*

- http://cern.ch/geant4/support/planned_features

Bugzilla problem reports addressed

10.4.p01:

#1942 - No check of validity of G4LEVELGAMMADATA and G4RADIOACTIVEDATA

#1945 - Event biasing creates a data race leading to erratic behavior in MT mode

#2016 - G4ExtrudedSolid bad access fault in G4.10.4.0 (array index problem)

#2017 - Problem of energy spectrum in relativistic gamma conversion model

#2030 - Cannot add user defined property into material property table

#2037 - Passing momentum^2 instead of momentum to equations of motion

10.4.p01 - Geometry

Geometrical primitives & navigation

- Fix for momentum value in G4PathFinder::SetChargeMomentumMass(); where magnitude square was passed instead of magnitude
  - Problem report #2037
- Added missing initialisation of two data-members in copy-constructor and assignment operator of G4ExtrudedSolid
  - Problem report #2016
- Correction in G4UPara wrapper in ComputeDimensions() to add explicit cast for the solid type to parameterise

10.4.p01 – Materials & Run

- Materials:
  - Re-enable user-defined material properties in G4MaterialPropertiesTable and G4MaterialPropertiesIndex
    - Addressing problem report #2030

- Run:
  - G4RunManagerKernel: application state is set to **`G4State_Init`** while application is in RunInitialization()

10.4.p01 – UI commands

- Commands now forbidden for **`G4State_GeomClosed`** or **`G4State_EventProc`** application states:
  - /process/activate
  - /process/inactivate
  - /particle/process/activate
  - /particle/process/inactivate
- UI commands return an error message if a command is refused due to incorrect parameter(s)
- Added deprecation warning for command: /gun/ionL
- G4UIcommand, G4UImanager: added mechanism for carrying back error message from the messenger if a command is rejected
- G4UIQt: fix to remove parameters from popup in Qt interface when autocompleting command line

10.4.p01 - More …

- Biasing:
  - G4ImportanceConfigurator: introduced protection in instantiation of the biasing process against a thread-race in MT
    - Addressing old problem report #1945
- General:
  - Fixed self-consistency in headers (missing #include) wherever necessary
- Configuration:
  - Allow enabling of c++17 standard builds, for experimental testing. Will require a minimum CMake version 3.8 to work; availability not checked

2018 Planned Developments

Kernel

Releases

- 2018 release of Geant4
  - Patches for previous releases as needed
- Consolidated releases of VecGeom
  - Further optimization and new shapes
  - Documentation
- Full support for C++17

Infrastructure

- Migration of Geant4 Development repository from SVN to Git
  - Convert SVN repository to Git format using svn2git
  - Implement GitLab infrastructure for Feature Branch + Merge Request workflow
  - Migrate Jenkins/CDash Continuous-Nightly-Release testing to GitLab
  - Adaptation of release procedure (GitLab/GitHub)
  - Provide documentation for Geant4 developers on using the new workflow
- Modularization of Geant4 Libraries
  - Global/granular/optional
- Optimization of Data Libraries
  - Simplify data library configuration/location using layered lookup via self-location, single environment variable, UI commands/C++ API
  - Provide C++ API for accessing/parsing data libraries
  - Optimize file access patterns and formats to minimize number of small files opened
- Adoption of C++11 threading models and workspaces
  - Will allow MT support on Windows platform

Geometry & Transportation

- VecGeom shapes
  - Implementation of missing shapes/constructs: multi-union, generic-polycone, tetrahedron, half-spaces, etc..
  - Further optimizations and vectorization of algorithms
  - Factory for optimal volume definition
- Implementation of a prototype navigator based on VecGeom
- Separate safety computation and state from navigator
  - Implement strategy for a light-weight base navigator class not holding navigation state
- Profiling and optimization of multiple navigation
  - Revise design and implementation of multiple navigation and coupled-transportation
- Prototype of specialized transportation processes for neutral and charged particles
- Adoption of interpolation in intersection calculation in magnetic field propagation

Materials & Biasing

- Redesign of the materials property table
- Enrich event biasing options
  - leading particle biasing, DXTRAN-like biasing, implicit capture
- Extend generic biasing scheme for at rest case
- Prototype implementation of biasing techniques:
  - biasing of charged particles (with cross-section changing over the step)
  - occurrence biasing (continuous density change inside a same volume)
  - material/isotope biasing; Woodcock tracking
- Implementation of new elastic differential cross-section class to be used in DXTRAN biasing option
- Improve usability enriching physics list constructor of fast simulation
- Revision and C++11 adoption for GFlash model

Analysis

- Merging of ntuples with Root format in MPI mode
- Merging of HDF5 output format in MT mode

Particles & Track

- Redesign unified way of tracking ions, muonic atoms, radicals and electrons/holes/phonons
- Review of production thresholds

Run & Detector Response

- Multi-threading:
  - Implement hooks for sub-event level parallelism
  - Finalize new design of threads, allowing threads to join/leave workers pool
  - Migration from POSIX threads to **`std::thread`**
  - Porting of material scanner to MT
  - Workspace and memory cleanup in MT
  - Support of MT on Windows platforms
- Implementation of a phase-space file to GPS

User and Category Interfaces

- Improvements to ZeroMQ interface / Jupyter frontend (backend for UI-command distribution using ZeroMQ message-queue service)
- Improvements to logic of UI manager and for detection of UI command failures when a command is not executed
- Updates to the Wt driver

Visualisation

- OpenGL drivers:
  - Improvementa to toolbar in OpenGL Qt
  - Adapt to newer OpenGL versions, exploit new functionalities and replace deprecated calls
- Other drivers:
  - New driver for export to format readable by Paraview
  - Updates to gMocrenFile and gMocren to support visualization attributes and other information
  - New driver G4DAE exporter for export in Collada format
  - Updates to OpenInventor
  - Development of visualization solutions for iOS and Android devices
  - New PDF3D driver
  - Change from flat format to hierarchical format in VRML
- Support for visualisation of Boolean shapes
- New tool to support high resolution transparent visualization with ability to rotate and zoom
- Automatic addition of visualization attributes from GDML imported geometries
- Support of user-drawn primitives in multi-threaded mode
- Integrated visualization of field lines

Novice & Extended Examples

- Review of examples macros and tests
- New example illustrating generic biasing for "DXTRAN" MCNP-like option and implicit capture
- Extended biasing examples: fix overlap among B02, B03 and GB03 examples
- Updating selected examples with usage of G4Accumulable
- Porting of Geant4e and related example to multi-threading
- Extension to the DICOM reader to support RT Dose format
- Switch to use new default random number generator MixMax
- Complete application of coding guidelines
- Continue code review

Advanced Examples

- Migration of medical_linac to use parallel geometry
- Hadrontherapy example:
  - Development of alternative approaches for LET calculation
  - Revision of analysis, geometry and validation scripts
- Introduction of some C++11 specific features/utilities
- Code review and coding guidelines

Thanks!