

GEANT4 10.6.p01 & 2020 planned developments *kernel modules*

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Outline

- Fixes introduced in release 10.6.p01
 - Kernel modules
 - Physics (see talks by V.Ivantchenko & A.Ribon)
- Overview of planned developments for 2020
 - Kernel modules
 - Physics (see talks by V.Ivantchenko & A.Ribon)
- *Detailed patch release notes:*
 - <http://cern.ch/geant4-data/ReleaseNotes/Patch4.10.6-1.txt>
- *List of planned features for 2020:*
 - http://cern.ch/geant4/support/planned_features

Bugzilla problem reports addressed

10.6.p01:

- [#2106](#) – Potential problems with assigning EM physics options to G4Regions
- [#2164](#) – Memory usage for /grdm/sourceTimeProfile
- [#2193](#) – bug in G4DecayTableMessenger
- [#2196](#) – bad_alloc in G4RegularNavigation
- [#2199](#) – Mistake in beta-plus decay spectrum shape due to wrong sign in Fermi correction
- [#2206](#) – Stuck track in G4Ellipsoid
- [#2209](#) – G4Tet does not support parameterization (from 10.6)
- [#2215](#) – INVENTOR_INCLUDE_DIR not being properly added to CXX_INCLUDES for building
- [#2216](#) – TrackLength scorer does not work with optional Boolean flags
- [#2217](#) – Error in building G4 with MultiThreading on Windows with Qt5 enabled
- [#2220](#) – inelasticXS of Gheisha is using elasticXS from 10.5 to 10.6
- [#2221](#) – With 'set -u' set, the launch script fails

10.6.p01 - Geometry

Geometrical primitives & navigation/field

- Avoid potential cases of looping in G4RegularNavigation by enabling pushing mechanism with increasing step size
 - Problem report [#2196](#)
- Re-established parameterisation mechanism for G4Tet and G4UTet which was removed by mistake
 - Problem report [#2209](#)
- Revision of G4Tet, fixing issues detected in unit tests and speedup
 - Implemented SetVertices(), direct modifier for vertices
- Revision of G4Ellipsoid, fixing issues of stuck tracks (30-70% speed-up)
 - Problem report [#2206](#)
- Added protection in G4VFacet header for double definition of global symbols from Windows Kits code
- Switched off verbosity by default in field driver classes

10.6.p01 – Particles, Digits/Hits, UI

- Particles:
 - Fixed broken if-block in G4DecayTableMessenger
 - Problem report [#2193](#)
- Digits/Hits:
 - In G4ScoreQuantityMessenger, changed SetDefaultUnit() in trackLength scorer to SetDefaultValue() to support various unit category
 - Problem report [#2216](#)
- UI:
 - Fixed obsolete URLs in Qt UI splash screen

10.6.p01 – More ...

- Configuration:
 - Applied patch to allow compilation on Windows using Clang
 - Fixed installation warnings on Windows
 - Fix to prevent errors when a shell is in "set -u" mode
 - Problem report [#2221](#)
 - Updated to data-set G4EMLOW-7.9.1
- Global:
 - Fixed symbol exporting problem in G4coutDestination on Windows - Problem report [#2217](#)
- Data Sets: G4EMLOW-7.9.1
 - Added a new directory mupair for double differential probability of e+e- pairs produced by muons or hadrons

2020 Planned Developments

Kernel

✓ In progress...

✓ Achieved already

Releases

- 2020 release of Geant4
 - Patches for previous releases as needed
- Consolidated releases of VecGeom
 - Further optimizations
 - Enhancements to navigators (CPU/GPU)
 - Documentation

Infrastructure

- Evaluation/possible adoption of GitLab CI
- Enhancements to Geant4 GitLab workflow
 - Integration with Geant4Py build ✓
 - Adaptation to new features in future versions of GitLab
- Modularization of Geant4 Libraries ✓
 - Global/granular/optional
- Enhancements to build system
 - Allow build/install of VecGeom and other core dependencies
 - Switch to C++17 as minimum requirement
- Optimization of Data Libraries
 - Simplify data library configuration/location
 - Provide C++ API for accessing/parsing data libraries
 - Optimize file access patterns and formats to minimize number of small files opened
- Migration of web site to Drupal-8 ✓
 - As also part of workplan for SFT sites
- Extend use of workspaces and task-based parallelism in Geant4 ✓

Geometry & Transportation

- VecGeom
 - Enhancements to navigators, neighbor volume detection
 - Gilbert-Johnson-Keerthi Algorithm for Convex Shapes – *proposed summer project*
- Interface with navigator based on VecGeom in Geant4 ✓
- Separate safety computation and state from navigator
 - Implement strategy for a light-weight base navigator class not holding navigation state
- Revision of transportation processes ✓
 - Specialized transportation processes for neutral and charged particles
- Review accuracy of boundary crossing in field
 - ALICE and CMS requirement
- Equation of motion and steppers templated on type of field

Materials & Biasing

- Materials
 - Addition of new materials to the list of UV transparent for very low-energy photoelectric-effect
 - Addition/update of interfaces allowing use of NIST parameters for custom element/materials
 - Completion of ambient dose equivalent $H^*(10)$ topics for radiotherapy and radio-protection
- Geometry Biasing & Importance
 - Comparison between generic and importance biasing
 - Investigation on rare crashes in geometry-based importance biasing
 - Implementation of an extension for multiple particle type biasing
- Differential cross-sections
 - Implementation of new elastic differential cross-section class to be used in DXTRAN biasing option ✓
 - Adoption of the new elastic differential cross-section class in hadron elastic
- Generic Biasing
 - Enrich event biasing options: DXTRAN-like biasing, implicit capture, occurrence biasing of charged particles with cross-section changing over the step ✓
 - Extend generic biasing scheme for at rest case ✓
 - Implementation of a statistical test suite to verify correctness of biased wrt analog simulation
 - Prototype: occurrence biasing (continuous density change inside a same volume); material/isotope biasing; Woodcock tracking
 - Investigation on effects in propagating tiny weights for large cross-section change (neutrino interactions)

Fast Simulation & Analysis

- Fast Simulation
 - Finalise revision of GFlash model
 - Modernisation of EM shower parametrisation, including automated tuning procedures
 - Investigation on possibility of facilitators for machine learning inference
- Analysis
 - Integration of g4tools/plotting in vis and UI system
 - Addition of flexibility in resetting/deleting histograms
 - Review support for writing the same histogram/profile in a file several times (object versions)
 - Handling of more files by analysis manager
 - Separation of the n-tuple management from the histogram and profiles management

Tracking, Run & Detector Response

- Tracking:
 - Redesign and implementation of G4ForceConditions
- Multi-threading:
 - Finalise tasking-based mechanism (allow threads to join/leave workers pool) ✓
 - Prototype for sub-event level parallelism
- Enhancements to command-based scorer and creation a new example to demonstrate its new features
- Revision of production thresholds ✓
- Implementation of a phase-space file interface to GPS

User and Category Interfaces

- Revision of the UI command broadcasting mechanism from master to worker threads along with the task-based parallelism
- Migration to Python3 as default Python interface (drop of Python2)
- Integration of G4Py module to CMake build ✓

Visualisation

- OpenGL/Qt drivers:
 - OGLFile to produce image files in batch jobs where no graphics card is present
 - Improvements to toolbar in OpenGL Qt
 - Adapt to newer OpenGL versions, new functionalities and replace deprecated calls
 - Investigate a way to switch from OpenGL to other technology
 - Apple/Metal: alternative way to render without OpenGL on MacOS
 - Native Qt driver (Qt3D)
- Other drivers:
 - Remove code of obsolete Wt driver
 - OpenInventor: continue development of G4OpenInventorQtExtendedViewer
 - iOS and Android Devices: develop visualization solutions
- Integrate g4tools/plotting in Geant4 UI system
- Implementation of a native Qt driver
- Updates to gMocrenFile and gMocren
 - Support visualization attributes and other information

Novice & Extended Examples

- Improvements to existing DNA examples
 - Addition of new chem6 (scoring radiochemical yield G) ✓
- New example illustrating generic biasing
 - "DXTRAN" MCNP-like option and implicit capture
- Extended biasing examples ✓
 - Fix overlap among B02, B03 and GB03 examples
- Update of 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
- Inclusion of new cross-sections for gas materials in the "icsd" Geant4-DNA example
- Review of examples macros and tests ✓
- Complete application of coding guidelines ✓
- Integration of the Opticks package in a new extended example

Advanced Examples

- Code review and coding guidelines ✓
- Development of alternative approaches for LET calculation in hadrontherapy ✓
- New example modelling dust cloud ✓
- Release of GORAD (Geant4 Open-source Radiation Analysis and Design)
- New example for nanomedicine (gold nanoparticles in X-ray radiotherapy)
- New example for import in Geant4 simulations of IAEA Phase Space Files
- Improvement of GammaRayTel example to deal with polarised processes

Thanks!