

GEANT4: Release 8.2 Update

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for the **Geant4 Collaboration**

Outline

- Relevant developments since release 8.1
- Highlights of developments & fixes in
 - Kernel
 - Physics Lists
 - Physics Processes
- Not all fixes introduced are treated here

Notes:

⌘ For more information see <http://cern.ch/geant4/>

⌘ full details in release notes at

<http://cern.ch/geant4/support/download.shtml>

Geometry & Transportation

- Introduced ability to handle navigation on multiple geometries
 - Can be optionally activated by registering a *parallel world*
 - New **G4PathFinder** class
 - Determines the correct path taking into account response from multiple navigators attached to user-defined parallel geometries
 - Revised version of the transportation
 - First β release
- Introduced ability for solids to compute their surface area
- Reviewed algorithm for finding intersection point in propagation in field
 - Enhanced detection of the intersection point

Particles, event & run management

- Updated particle definitions
 - To match PDG-2006
 - Mass, width and encoding
 - Introduced PDG encoding for nuclei
- First implementation of **flat_sampling** (biasing) for multiple sources in GPS
- Introduced new classes for definition of parallel geometry
 - **G4VUserParallelWorld** - abstract base class for the generation of the user's parallel world
 - Added mechanism for detecting presence of parallel world registered
- **G4Run** object is now kept until the beginning of the next run
 - Access to a valid **G4Run** pointer during the **Idle** state after the run
 - Events can be kept un-deleted, stored in **G4Run**, until deletion of the run

Hits, Parameterisations & Transportation

■ *Digitization & Hits*

- New class **G4PSCellCharge**
 - Primitive scorer class for scoring cell charge
 - Cell charge is defined as the sum of deposited charge in the cell

■ *Scoring*

- New module with classes for handling scoring and geometrical biasing in parallel geometries using multiple navigation

■ *Parameterisations*

- New classes to handle multiple navigation in parallel geometries

■ *Transportation*

- New classes **G4NeutronKiller** and **G4NeutronKillerMessenger**
 - Allow for easy disabling simulation of unwanted neutrons
 - Useful to improve CPU performance

Physics Lists

- Moved physics lists into source tree
 - Removed external tree. Simplified directory and library structure
 - Only two granular libraries now existing
- Added deprecation warning for physics lists now obsolete
 - LHEP: `_HP`, `_BIC`, `BIC_HP`, `_PRECO`, `QGSP_HP`
- Added neutron tracking cut to QGSP and FTF lists without `_HP` extension
- New lists of development
 - QGSC_EMV, QGSC_EFLOW, QGSP_BIC_HP and QGSP_QEL (i.e. QGSP with CHIPS elastic)
- Added possibility to use Glauber-Gribov cross-sections in QBBC list

EM Physics

- Multiple-scattering process
 - Modified the algorithm for step limitation
 - Modified minimum step limit
 - Introduced optional possibility to reduce steps before boundary crossing
 - The step restriction is weaker for particles with higher energy, helping in having smaller material dependence
 - Modified angular distribution
 - New class **G4hMultipleScattering**
 - With step limitation only near geometry boundaries
 - Meant to be used for hadrons/ions
- Added deprecation warning to all processes '52' and '71' types
- New classes implementing ionisation for a classical magnetic monopole
- New **polarisation** library for simulation of circular polarized beams of e⁺- and gamma
 - e⁺e⁻ annihilation, bremsstrahlung, compton scattering, ionisation and e⁺e⁻ pair production

Hadronic Physics

- *Cross sections*
 - Changed scaling of interpolated pion cross sections from $Z^{(2/3)}$ to $A^{(3/4)}$
 - Will slightly increase interpolated cross section values
- *High Precision Neutrons*
 - New data set G4NDL-3.10, containing cross sections and models below 4eV
 - Based on thermal neutron scattering files from ENDF/B-VI, Release2
 - New cross section data files added from JENDL database
 - Will allow extended validity of HP neutrons up to 3 GeV in future releases
- *Elastic scattering*
 - New CHIPS **G4QElastic** process
 - Uses improved fits to cross section data and correct kinematics
 - Currently to be used with proton and neutron projectiles only
 - Extended coherent elastic scattering down to 0.4 GeV
 - Data tables are computed on-flight, **G4ELASTICDATA** data set is no longer used
- *Radioactive decay*
 - Added capability of handling decay emission of proton or neutron
 - New updated data set: RadioactiveDecay 3.1
- *Stopping*
 - Reviewed kinematics in mu-stopping
 - Improved kinematics in muon decay sampling

User Interactivity

■ Visualization

- Enhanced trajectory-modeling abilities and new commands
- Expanded trajectory and hit filtering abilities
- Added trajectory time-slicing
- New commands to control “event keeping” facilities in the kernel
- Added ability for visualization of parallel geometries
- Added ability to create movies with OpenGL
 - Animated display of events during time

■ Environments

- Enhanced existing Python module for steering Geant4 applications
 - Added MacOSX support
 - Provided more examples

More ...

■ *Data sets*

- New data set for high precision neutron processes **G4NDL 3.10**
- New data set for low-energy EM processes **G4EMLOW 4.1**
- New data set for radioactive-decay processes
Radioactivedecay 3.1

■ *Examples*

- New extended examples:
 - **eventgenerator/mctruth** - handling of MC truth information through HepMC
 - **polarisation/Pol01** - polarised EM processes
- Several improvements and fixes ...

Configuration & supported platforms / 8.2

- Suggested CLHEP version:
 - CLHEP 2.0.3.1 (or 1.9.3.1)
- Enhancements to Configure script
- Full support for DLLs on Windows
 - Also for physics-lists
- OS / compilers verified
 - SLC3 with gcc 3.2.3 (IA32)
 - Being deprecated !
 - SLC4 with gcc 3.4.6 (IA32 & AMD64) and gcc 4.1.1
 - MacOS 10.4 with gcc 4.0.1
 - SunOS 5.8 with CC 5.5
 - Win/XP with VC++7.1/8.0