GEANT4 10.7 highlights

kernel modules

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for the Geant4 Collaboration

Outline

- Features and fixes introduced in release 10.7
  - Kernel modules
  - EM Physics (see talk by V.Ivantchenko)
  - Hadronic physics (see talk by A.Ribon)

➢ *Detailed release notes:*

- **http://cern.ch/geant4-data/ReleaseNotes/ReleaseNotes4.10.7.html**

➢ *List of planned features for 2020:*

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

Geometry

Geometrical primitives

- Updated VecGeom library, VecGeom v1.1.8
  - Selection for enabling use made at configuration
    - https://gitlab.cern.ch/VecGeom/VecGeom/tree/v01.01.08
  - Improved configuration settings
  - Enhanced navigation system with optional indexing
  - GPU adaptation of navigation for ray-tracing
  - Bug fixes
- Improved speed for overlaps detection
  - Either through UI commands or at geometry construction
  - Improved algorithms for generation of random points on surface and computation of surface area and cubic volume on specific solids

Geometry

Navigation, Field, Volumes, Transportation

- New templated field classes for equation of motion and selected steppers
  - Avoid virtual call for field and equation
  - Expected to provide a direct speedup
- Enhanced reporting from field drivers & debugging logs
  - New dedicated class G4DriverReporter
  - New *check-mode* for G4PropagatorInField and G4VIntersectionLocator
  - Adoption of new whiteboard for logging/debugging
- Further C++11 revision of geometry code
- Code optimization to G4Transportation class

Materials, Analysis & Digits/Hits

- Materials:
  - Added new methods for adding elements to a material definition:
    - AddElementsByNumberOfAtoms(...) and AddElementByMassFraction(...)
  - Added new properties for scintillation allowing 3-time constants and a second wavelength shifter in the same material
- Analysis:
  - Major upgrade to include support for multiple files and multiple output types in the same run
  - Enabled handling of automatic min/max axes values in case of log scale
- Digits/Hits:
  - New G4VPrimitivePlotter allowing the user to extend a primitive scorer
  - New ability to create a "probe" scoring mesh with layered mass geometries

Run, Global, Biasing

- Run:
  - New tasking system (Beta version) as option
    - Dedicated run manager (G4TaskRunManager) and factory (G4RunManagerFactory), enabling use of tasks for the event loop
    - Based on PTL (Parallel Tasking Library) package, with internal thread-pool and task-queue
    - Fully compatible with Intel/TBB, which can be selected at configuration
- Global:
  - Added possibility to enable backtracing for debugging purpose
  - New profiling settings for TiMemory, allowing for per-{run,event,track,step} profiling, to enable at configuration
- Paramaterisations:
  - New general facilities based on GFlash to facilitate multiple hit (energy & position) creation from fast simulation models

Visualization/Interfaces & Data sets

- Visualization & Interfaces:
  - First alpha-version of a Qt3D visualization driver, based on native Qt rendering
  - Added support for Open Inventor Qt visualisation driver (OIQt); enabled use of OIQt viewer within Qt UI
- Data sets:
  - New versions:
    - **G4EMLOW-7.13, G4RadioactiveDecay-5.6**
    - **G4PhotonEvaporation-5.7, G4ENSDFSTATE-2.3**
    - **G4PARTICLEXS-3.1, G4RealSurface-2.2**

Configuration & Externals

- Cmake:
  - Minimum CMake version 3.8 enforced
  - CMake version 3.12 required for enabling C++20
  - Enabled support of G4Py module activation through GEANT4_USE_PYTHON flag
  - Simplified CMake builds to enable future modularisation of Geant4 libraries
- CLHEP - Version 2.4.4.0 required
  - Updated to 2019 SI units/constants:
    - e_SI (electron charge), h_Planck (Planck constant)
    - Avogadro (Avogadro constant), k_Boltzmann (Boltzmann constant)

Examples

- New extended examples
  - Hadr09 - showing how to use Geant4 as a generator for simulating inelastic hadron-nuclear interactions
  - Par03 - demonstrating how to create multiple energy deposits from the fast simulation model
  - Saxs - implementing a Small Angle X-ray Scattering (SAXS) experiment; illustrating the usage of molecular interference (MI) of Rayleigh (coherent) scattering of photons in matter
  - Chem6 - DNA example providing scoring of the radiochemical yield G as a function of time and LET
- New advanced examples
  - FastAerosol - showing how to efficiently simulate particle transport through aerosols containing billions of randomly-positioned droplets, using an ordinary workstation
  - Gorad (Geant4 Open-sourced Radiation Analysis and Design) - a turn-key application for radiation analysis and spacecraft design
  - HGCal_testbeam - based on a Geant4 standalone application for the CMS High Granularity Calorimeter (HGCal) studies, to demonstrate a test beam setup used in HEP experiments, and as a base for the validation studies and comparison with experimental data
  - ICRP110_HumanPhantoms - modelling the ICRP110 reference computational human phantoms and calculating the dose in individual voxels and entire organs. The human male phantom is created from a whole-body clinical CT image

Platforms for 10.7

- Linux, gcc-4.9.3 to 10.2, 64 bits
- MacOS 10.15 Catalina, Apple Clang 12.0 (XCode 12.x), 64 bits
- Windows 10, Visual C++ 14.28 (Visual Studio 2019)
- Also tested (sequential/MT):
  - Linux CentOS7, icc-19, clang-8/9/10
  - Linux Ubuntu 18/20, gcc-7.5/9.3
  - MacOS 10.14 Mojave Apple Clang-10/11
  - MacOS 11.1 Big Sur, Apple Clang-12 (Intel chips only)

Thanks!