

GEANT4 11.2 highlights

kernel modules

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for the [Geant4 Collaboration](#)



Outline

- Features and fixes introduced in release 11.2
 - Kernel modules
 - EM Physics (see talk by V.Ivantchenko)
 - Hadronic physics (see talk by A.Ribon)

➤ *Detailed release & patches notes:*

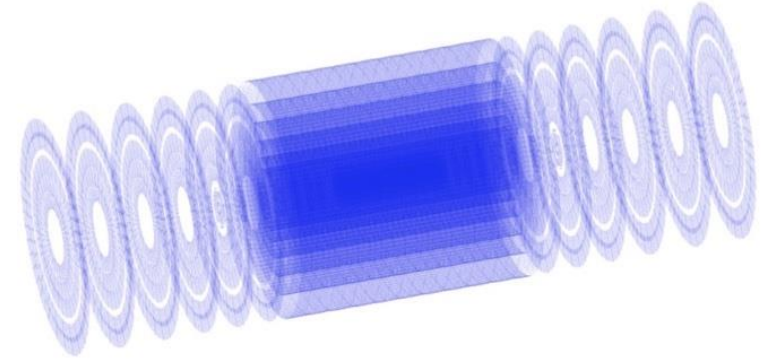
- <https://cern.ch/geant4-data/ReleaseNotes/ReleaseNotes.11.2.html>

➤ *List of planned features for 2023:*

- <https://cern.ch/geant4/planned-features-2023>

Geometry

VecGeom



- Updated VecGeom library, VecGeom v1.2.7
 - Selection for enabling use made at configuration
 - <https://gitlab.cern.ch/VecGeom/VecGeom/tree/v01.02.07>
 - Improvements and extensions to the GDML parser
 - Extensions to the BVH navigator interface
 - Fixes in geometry synchronization on GPU
 - Bug fixes to shapes (Trapezoid, Polyhedron, SimpleExtruded)
- New 2.0.0 release candidate, VecGeom v2.0.0-rc2
 - <https://gitlab.cern.ch/VecGeom/VecGeom/-/tree/v2.0.0-rc2>
 - Simplified code; removed unused interfaces and backends (vector API, unused specialisations)
 - Targeting final release v2.0.0 with portable code across devices
- Surface Model geometry development
 - Conversion of solids to framed surfaces – currently most available shapes supported

Geometry

Navigation, Volumes, Magnetic Field

- Removed inheritance level for G4TouchableHistory, simplifying touchables handling
 - G4VTouchable is now a simple typedef of G4TouchableHistory, therefore forward declarations of G4VTouchable in the code will have to be promoted to concrete inclusion of the related header file
- New Quantum State Simulation (QSS) integration method
 - First implementation of an alternative method of integration offering built-in interpolation capability and enabling faster finding of the intersection of the trajectory with surfaces
- New G4VNavigation common navigation interface class
 - Streamlined code in navigation classes to use the new common interface
- New G4SafetyCalculator class, auxiliary to G4Navigator
 - Used in G4Navigator in ComputeSafety() to avoid saving/restoring state

Materials, Analysis & Persistency

- Materials:
 - New G4ElementDataRegistry class, a management class for shared data
 - In G4NistMaterialBuilder, updated mean ionisation potential of carbon and graphite and defined state as `kStateLiquid` for several liquids including G4WATER. Addressing problem report [#2568](#)
- Analysis:
 - New G4AnalysisManager functions for deleting selected histograms, profiles and n-tuples, with related UI commands
 - Functions `GetNof[Hn|Pn|Ntuple]s()` can be called with a new, optional, Boolean argument `onlyIfExists`
 - New UI commands for creating n-tuple
- Persistency/GDML:
 - Added possibility to set alternative grammar for schema validation while reading a GDML file
 - The build of the persistency library, G4Persistency, has been split into components G4mctruth, G4geomtext and (optional) G4gdml libraries

Run, Particles, Parameterisations, Global

- Run:
 - Added handling (registration and merging) of sub-events in G4Run and G4RunManager.
 - First step towards support of sub-event level parallelism
- Particles:
 - Updated particle properties to PDG-2023
 - Scanned all mesons and baryons, including their resonances
 - Updated mass and decay width (lifetime) for particles with relative error above 1% against PDG-2023
- Parameterisations:
 - New submodule **channeling**, implementing fast-simulation channeling model in oriented crystals with Baier Katkov method for the calculation of radiation probability, radiation point and parameters of photon production as well as spectrum accumulation
- Global:
 - Added **G4debug** output stream for logging messages at lower priority than **G4cout**

Visualization/Interfaces

- Enabled first-level support for Qt6
 - In order to allow support of Qt6, OGL is temporarily diverted to TSG by default. If VTK is requested, due to compatibility issues, all other drivers that use OpenGL are not registered automatically
- First version of the TSG_[QT,X11,XT,WINDOWS]_ZB sub drivers
 - Allowing for interactive 3D rendering bypassing native graphics systems
 - TSGQt driver temporarily enabled by default with OGL driver choice, to allow support of Qt6
- Updated and extended Vtk visualization driver with new features and fixes
- First implementation of a no-frills GUI-side scene tree in the Qt GUI
- Implemented a more flexible way of choosing a graphics system for visualisation, preserving the existing behaviour in all aspects
- Implemented *generic cutaways* in visualization
 - Clips, sections and cutaways will now be available to **all** viewers
- In G4UIQt, implemented right-click pop-up menu for touchables in new scene tree

Data sets

- New data set versions:
 - **G4EMLOW-8.5**, **G4ABLA-3.3**, **G4INCL-1.2**
- In order to use **ParticleHP** for charged particles (protons, deuterons, tritons, He3 and alphas), an optional data set is required, and can be optionally downloaded in addition:
 - **G4TENDL-1.4**

Configuration & Externals

- Configuration/General
 - Added support for declaring headers of a source code module private
 - Headers declared private are not installed. Partial refactoring of modules
 - Applied `clang-tidy` rules and `clang-format` in several modules of the toolkit
 - Removed deprecated GNUmake scripts for libraries build
- Cmake:
 - Fixed minimum supported version for Qt5; requiring Qt5 \geq 5.9
 - Bump minimum VecGeom version to v1.2.6
 - CMake 3.16 is the minimum version required to build Geant4
- CLHEP - Version 2.4.7.1
 - Optimised MixMax engine performance and class structure. Fixes to resolve reproducibility issues
 - Fixed compilation warnings when using C++20 Standard
- ZLIB
 - Updated to 1.2.13, retaining prior Geant4 patches

Extended & Advanced examples

- New **Geant4-FLUKA** interface and two extended hadronic examples
 - Providing access to FLUKA-Cern hadron-nucleus inelastic physics
- New extended example **radiobiology**
 - Realized for dosimetric and radiobiological applications of proton and ion beams
- New extended **Vtk** specific example demonstrating new features only available in the VTK viewer
- New Geant4-DNA extended example **UHDR** showing how to activate the mesoscopic model in chemistry
 - It allows to simulate chemical reactions longtime (beyond 1 us) of post-irradiation
- New Geant4-DNA extended example **dnadamage2**
 - Providing scoring of plasmid DNA strand breaks using the IRT method
- New advanced example **xray_TESdetector** of the application of Geant4 in a space environment
 - Representing an x-ray detector derived from the X-IFU, the X-ray spectrometer designed and developed by the European Space Agency (ESA) for use on the ATHENA telescope
- New advanced example **xray_SiliconPoreOptics**, an application of Geant4 in space environment
 - The geometry represents a single reflective pore used to simulate on a smaller scale the effect of the millions of pores forming the mirror of the ATHENA Silicon Pore Optics (SPO)
- New advanced example **dsbandrepair**
 - Geant4-DNA application for evaluating the early radiation-induced DNA damage

Platforms for 11.2

- Linux Alma9/RedHat Linux Enterprise 9
 - gcc-11.3.1 to 13.2, 64 bits (Intel or AMD)
- macOS 14 Sonoma
 - Apple Clang-15 (XCode 15.x), 64 bits (Intel or Apple Silicon)
- Windows 10
 - Visual C++ 14.36 (Visual Studio 2022)
- ❖ Also tested (sequential/MT):
 - Linux CentOS7, icx-2023, clang-14/16/17
 - Linux Ubuntu 20/22, gcc-9.4/11.4
 - macOS 13 Ventura, Apple Clang-15
 - macOS 12 Monterey, Apple Clang-14

Thanks!