

# GEANT4 10.5 highlights

*kernel modules*

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# Outline

- Features and fixes introduced in release 10.5
  - 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/ReleaseNotes4.10.5.html>

➤ *List of planned features for 2018:*

- [http://cern.ch/geant4/support/planned\\_features](http://cern.ch/geant4/support/planned_features)

# Geometry

## *Geometrical primitives*

- Updated VecGeom library, VecGeom v01.01.00
  - Selection for enabling use made at configuration
    - <https://gitlab.cern.ch/VecGeom/VecGeom/tree/v01.01.00>
  - Removed old USolids module and interfaces; cleaned up setup
  - Introduced factory for specialized instantiation of shapes
    - Revision of most shapes with update of internal API
  - New tessellated section helper used in complex faceted solids
  - Addition of multi-union and Tetrahedron
  - Available shapes for replacement:
    - Box, Trapezoid (Trap), Simple Trapezoid (Trd), Parallelepiped (Para), Orb, Sphere (+ sphere section), Tube (+ cylindrical section) , Cut Tube, Cone (+ conical section), Generic Trapezoid (Arb8), Polycone (PCon), Polyhedron (PGon), Parallelepiped (Para), Paraboloid, Hyperboloid, Torus (+ torus section), Tetrahedron (Tet), Tessellated Solid, Extruded Solid
- Reimplemented EstimateSurfaceArea() for approximate calculation of the surface area of a solid
  - New more performant algorithm, providing more accurate estimation

# Geometry

## *Transportation, Field*

- Treatment of looping particles in transportation has been reviewed:
  - Only stable particles are killed if they 'loop', i.e. take more than the maximum (default 1000) integration steps in one physics step; unstable particles are now propagated indefinitely
    - 100 MeV (warning energy): below this, tracks are killed silently
    - 250 MeV (important energy): above this, tracks are given multiple chances (10 physics steps)
  - Settings are fully under user control
    - New methods in G4PhysicsListHelper allow the user to select a set of low/high values of 'looper' energy thresholds
  - Enhanced diagnostics for looping particles
- Correction in G4MagneticField to no longer inherit from G4ElectroMagneticField
- Introduced Bulirsch-Stoer integration algorithm, an alternative to Runge-Kutta based on the mid-point method
- New G4InterpolationDriver field driver class using Runge-Kutta method with interpolation property to integrate EoM with error control
- Updated field steppers to make use of cached field values

# Analysis & Digits/Hits

- Analysis:
  - Switched default Root n-tuple merge mode to row-wise in analysis tools; added function in G4RootAnalysisManager allowing to override the defaults
  - Added "Boolean reset" argument in G4AnalysisManager::CloseFile() function, allowing to close a file without resetting data
- Digits/Hits:
  - New class G4StatAnalysis, a lightweight statistics class to calculate mean, FOM, relative error, standard deviation, variance and other quantities.
    - Provides a quick way for accumulating statistics for scoring
  - New class G4THitsVector, a generic hits container compatible with G4THitsMap, that enables the underlying storage container to utilize a sequential container instead of a map (saving memory)
  - New interface class, G4VScoreNtupleWriter, allowing for automated storing of scorers hits with Geant4 analysis tools

# Global, Run, Examples

- Global:
  - Replaced POSIX threading with C++11 threading, enabling multi-threading on Windows for use with either static or DLL libraries
- Run:
  - Added track/step/volume information in G4ExceptionHandler when an exception happens while event is being processed
- Examples:
  - New examples (in extended/analysis) demonstrating saving of scorers hits in form of n-tuples in a Root file using Geant4 analysis tools
  - New example in extended/parallel/MPI demonstrating merging n-tuples via MPI
  - Extended example (in extended/field/field01) to demonstrate use of G4PhysicsListHelper's Use[Low|High]LooperThresholds() methods and to demonstrate fine grained control of G4[Coupled]Transportation parameters for (killing) looping tracks
  - New G4DNA examples (in extended/medical/dna)
  - New example (in extended/optical) for investigation of optical properties and parameters

# Visualization & Data sets

- Visualization:
  - Implemented simple algorithm to allow coloring of detector elements based on materials density
  - RayTracer now visualizes layered-mass-geometry volumes defined in parallel worlds
  - Added ability to dump/report about overlaps through vis UI commands (will be soon extended with ability to visualize overlapping volumes)
- Data sets:
  - New versions: `G4EMLOW-7.7`, `G4SAIDDATA-2.0`, `G4PARTICLEXS-1.0`, `G4RadioactiveDecay-5.3`, `G4PhotonEvaporation-5.3`, `G4INCL-1.0`
  - Deprecated and no longer necessary `G4NEUTRONXS` data set

# Configuration & Externals

- Cmake:
  - Added c++17 to C++ standards; requiring CMake v3.8 or higher to enable it
  - Added “auto” dummy TLS model to configuration, for which selection of TLS model is left to compiler default
  - Added configuration support for MT on Windows
- CLHEP:
  - Version 2.4.1.0 required
- Zlib:
  - Updated to version 1.2.11



# Platforms for 10.5

- Linux, gcc-4.8.5, 4.9.X, 5.4.X, 6.3.X, 7.3.X, 8.2.X 64 bits
- MacOSX 10.14, llvm/clang-6.0.1 (XCode 10.x), 64 bits
- Windows 10, Visual C++ 14.11 (Visual Studio 2017)
- Also tested (sequential/MT):
  - Linux SLC6/CentOS7, icc-19, clang-3.9/5.0
  - Linux Ubuntu 16, gcc-5.4
  - MacOSX 10.11/10.12/10.13, clang-3.8/4.0/5.0
  - Windows 10, VC++14.0 (Visual Studio 2015)

# Thanks!