GEANT4 9.3 and patches

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Outline

- Major fixes and features included in release 9.3
  - Geometry & GDML
  - Materials, Particles & Generic processes
  - Physics
  - Visualization, UI
  - Configuration & Kernel
- Quick overview on future patch 9.3.p01

  - If also available in 9.2.p03: ★
    - Release notes for 9.3 in:
      - http://geant4.cern.ch/support/ReleaseNotes4.9.3.html
    - Detailed notes for 9.2.p03 in:
      - http://geant4.cern.ch/support/Patch4.9.2-3.txt
  - List of 2010 planned developments:
    - http://geant4.cern.ch/support/planned_features.shtml

Features in release 9.3

Geometry

- Revised implementation for curved surface solids with **`Phi`** sections: **`G4Tubs`**, **`G4Cons`**, **`G4Sphere`**
  - As part of code review 2009 for solids
- Fixes to solids: ★
  - **`G4Cons`** (stuck tracks reported by CMS), **`G4Torus`** (problem report #1086) and **`G4Ellipsoid`** (problem report #1076)
- Implemented generic divisions along **`Z`** for phedra and pcones
- Fix in CheckOverlaps() for parameterised volumes (#1078) ★
- Improved interoperability of multiple navigators/geometries ★
  - Parallel navigation and activation of magnetic field, etc…
- Improved handling of small steps at boundaries in field ★
- Improved memory management for navigation touchables ★
- Extension of **`G4Region`** to hold local magnetic fields

Persistency

- GDML
  - Implemented virtual layer to allow customisation of the writer for user-extended schemas
  - Implemented ability to write surface properties associated to volumes and material properties
  - Implemented ability to handle 'assembly' structures in reader
  - Corrected handling of 'quantity' tag
  - General code cleanup

Global, Materials & Particles

- Reviewed implementation of physics vectors
  - Providing CPU improvement at initialisation
  - Further improvement to Spline interpolation
- Implemented migration of **`ICRU-73`** stopping power classes for materials to the **`G4VIonDEDXTable`** interface
  - Access methods of physics vectors have changed (vectors can also be identified via atomic number of material if material is pure)
  - Classes now deliver mass stopping powers instead of stopping powers per unit length
  - Removed dependency on **`ICRU-73`** material densities
  - New utility class **`G4ExtDEDXTable`** to handle external electronic stopping power tables for ions
- Added method **`GetNuclearMass(A,Z)`** in **`G4NuclearProperty`**
  - made obsolete class **`G4NucleiPropertiesTable`** (will be removed)

Generic Processes & Parameterisations

- Integration of Reverse Monte Carlo for EM particles (e+/e-/γ)
  - Prototype of reverse EM tracking for protons
- Improved implementation of **`G4VRangeToEnergyConverter`** ★
  - Faster initialisation by a factor 2 to 3
- New method **`ResetConverters()`**
  - Reduces memory waste after initialisation in **`G4ProductionCutTable`**
- Reviewed ionisation potentials
- Reviewed density effect parameterisations

Electromagnetic physics - 1

- Standard EM models
  - Frozen version of default multiple-scattering model (**`G4UrbanMscModel`**) from release 9.2
    - New tuning of multiple-scattering (development class **`G4UrbanMscModel2`**) for central part and tail of the angular distribution
    - Added relativistic factor to Rutherford cross section and various developments for Coulomb scattering classes and **`G4WentzelVIModel`**
  - Simplified initialization of models and code cleanup
  - Modification in width correction in **`G4UniversalFluctuation`**, fixed step dependency for the correction on energy deposition

Electromagnetic physics - 2

- Standard EM models
  - New Goudsmit-Saunderson multiple scattering model for electrons & positrons (e^-/e^+)
  - Fixed algorithm for selection of model by its energy range in **`G4EmModelManager`** to better treat energy-region overlap with low-energy models
  - Fixed problem in retrieving physics tables from file ★
  - Gamma conversion with LPM effect
  - Addition of muon multiple-scattering model in Physics Lists
  - Physics lists with combinations of standard and low-energy models
  - Introduction of cut in range for recoil

Electromagnetic physics - 3

- Optical processes
  - Inclusion of Mie scattering as a new optical photon physics process
  - Extension to the unified surface model to have both specular and diffuse components for the transmitted photons
  - New capability of simulating surface reflections with Look-Up-Tables (LUT), containing measured optical reflectance for a variety of surface treatments
    - Requires new data set RealSurface-1.0
  - New extended/optical example to exhibit transmission properties of optical fibers with circular and elliptical cross section

Electromagnetic physics - 4

- Low-energy EM
  - Complete migration to 'standard-EM' design: added Bremsstrahlung physics according to Penelope and Livermore models; added **`G4LivermoreIonisationModel`**, first implementation of low-energy ionisation (**`G4LowEnergyIonisation`**) in the common design
  - New DNA processes migrated to the new design; new G4EMLOW-6.9 data set; made obsolete old cross-sections and final-state classes
  - Added **`G4RayleighScattering`** process to describe Rayleigh scattering and removed obsolete classes
  - Added new scaling algorithm, to obtain heavy ion stopping powers for ions not covered by **`ICRU-73`** report
  - Better performance from improved **`G4LogLogInterpolation`** class
  - Implementation of polarized photoelectric, gamma conversion and triple conversion models (`gamma -> e+ e- e-`) ?

Hadronic physics

- Models
  - Reviewed **CHIPS** model extended to all energies, particles and targets
    - Fix in **G4QElasticCrossSection** for memory corruption in release 9.2 ★
  - Model precise sampling and 'on-the-fly' table preparation for **coherent_elastic** module
  - Major improvements to FTF (Fritiof) model (pi absorption, Reggeon cascade, ...)
  - Complete improvements to pre-compound model
  - Allow carbon-ion projectiles in INCL model
- Physics lists
  - New development physics-lists
    - **QGSP_FTFP_BERT** (replaces LEP with FTFP for nucleon & pion projectiles)
    - **CHIPS** physics list (completely replaces LEP, also for hyperons)
  - New physics-lists with special EM options (EMV, EMX, EMY)
  - Completed and validated INCL/ABLA physics list
  - Declared obsolete old unused configurations
- General cleanup of the hadronic code and speed-up study
- Better memory handling in final deletion of processes and models ★
- Review of physics models to identify and fix cases of event irreproducibility

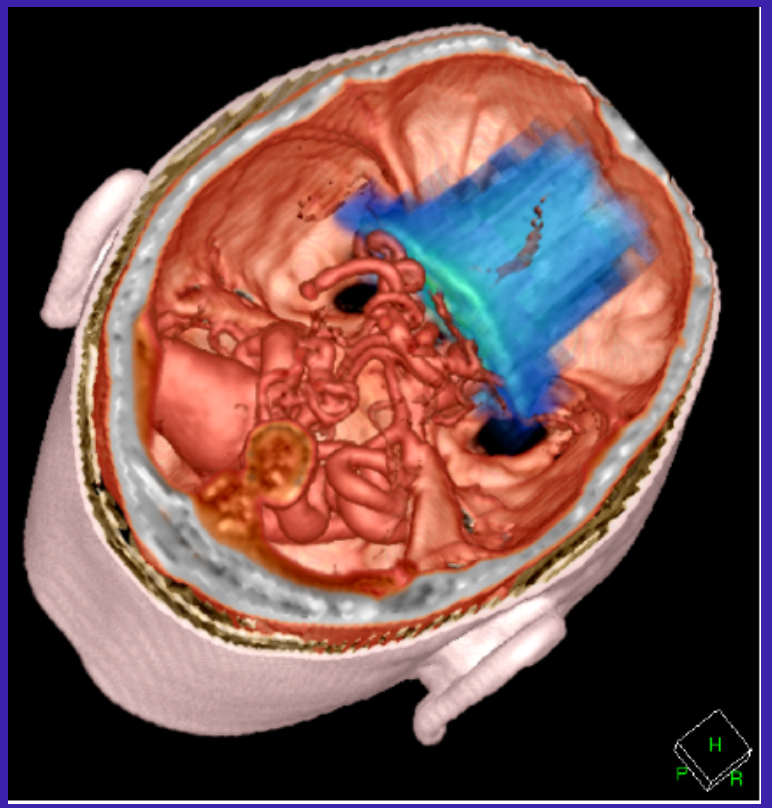
Visualization

- Improved control over location and size of all GL windows
- Ability to make high resolution PostScript output
  - Via **`gl2ps`** option
- Addition of initial Kinetic Energy to trajectory attributes
- Addition of "remaining energy" attribute to rich trajectory points
- Considerably improved visualization of Boolean volumes
- New UI commands:
  - **`/vis/scene/add/title, date, logo2D, text2D`**

gMocren

Great tool available for volume visualization

- From JST/CREST project
- Able to visualize:
  - Volume data
    (including overlay of more than one set)
  - Trajectories
  - Geometry
- Driver now integrated in Geant4
  - Based on a commercial package but offered freely to all Geant4 users
  - http://geant4.kek.jp/gMocren



9.3: more …

- Scoring
  - Corrected counting of flux and current passing through curved surfaces
- Interfaces/UI
  - New class **`G4UIExecutive`** for automatic instantiation of user interactive sessions, as done for visualization drivers
  - Enhancements to **`G4VBasicShell`** for better command completion in command line
  - Developments in Qt driver
- Error Propagation
  - Inclusion of pi+, pi- and proton in physics list
  - Added possibility to account for error deflation for 'smoothing'
- Configure script
  - Improved handling of Qt external dependencies
- First prototype thread-safe/multi-core kernel (alternative code tree)
  - To be released in 2010 based on release 9.3 series
- New and updated examples (advanced & extended)

- List of planned developments for the current year now available:
  - http://geant4.cern.ch/support/planned_features.shtml

Upcoming: 9.3.p01 - 1

- Planned for distribution shortly after Easter holidays
- Fixes being included and currently under testing:
  - Fixed initialization problem in optical processes
    - Addressing problem report #1094
  - Fixes in standard-EM:
    - for cases of negative cross-sections
    - for ion processes
  - Fix in GDML for dumping material property vectors
    - Addressing problem report #1104
  - Improvements in use of math functions (phedra and pcons solids, cross-sections), strings (user-track-info, transportation in field)
    - CMS performance task-force contribution

Upcoming: 9.3.p01 - 2

- More fixes being included, currently under testing:
  - Fixes in hadronic processes:
    - Corrected tuning for CHIPS model and fixed initialization neutron elastic cross-sections
    - Fix to address crash in high-energy model for k0 inelastic
  - Fixes in EM low-energy DNA processes for electron correction and charge exchange
  - Correction in **`G4Physics[Log/Ln/Linear]Vector`** to resolve precision problems leading to crashes on Windows
  - Minor fixes in **`G4RichTrajectory`** classes
  - Updated physics-lists in examples to use particle-bases multiple-scattering processes

Platforms supported for 9.3

- Linux SL(C)5, gcc-4.1.2, gcc-4.3.X, 32/64 bits
- Linux SL(C)4, gcc-3.4.6, 32/64 bits
- MacOsX 10.5/10.6, gcc-4.0.1/gcc-4.2.1, 32/64 bits
- Windows/XP and CygWin Tools
  - Compiler Visual C++ 9.0 (Visual Studio 2008)

- Also tested: gcc-4.4.X, icc-11.X

Thanks!