Geometry & Persistency
Recent & ongoing developments

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for the Geant4 Geometry & Persistency Working Groups

Contents

- Development and fixes in the last year
  - Introduced in release 10.4 and patches
- Features expected in Geant4 10.5
  - Currently under development and scheduled for inclusion in the next release

Geometry

Solids

- Added new construct, *G4MultiUnion* as native type, implementing a multiple-union of several volumes, displaced/rotated and same material

10.4

- New revised algorithms for basic shapes (box, trap, trd, para,…)
  - Providing more compact implementation and CPU speedup

10.4

- Improved VecGeom library

10.4

  - External library VecGeom v00.05.01
    - https://gitlab.cern.ch/VecGeom/VecGeom/tree/v00.05.01

(*) See VecGeom status slides in Parallel 4B

  - Deprecated & replaced USolids old interfaces and wrapping system
  - Available shapes for replacement:
    - Box, Trapezoid (Trap), Simple Trapezoid (Trd), Orb, Sphere (+ sphere section), Tube (+ cylindrical section) , Cone (+ conical section), Generic Trapezoid (Arb8), Polycone (PCon), Polyhedron (PGon), Parallelepiped (Para), Paraboloid, Torus (+ torus section)
- Implemented specialized constructs for trap and extruded-solid
  - Trd-like structure and convex/non-convex right prism

10.4

- Improved construction of *G4DisplacedSolid* to combine transformations for nested displaced types

10.4.p02

More on Solids

Expected in release 10.5

- New enabled VecGeom wrappers for *G4ExtrudedSolid*, *G4TessellatedSolid, G4Hype* and *G4Tet*
- Improved new version of the VecGeom library

(*) See VecGeom status slides in Parallel 4B

  - Removed USolids module and deprecated interfaces
  - Improved implementation for Generic Trapezoid, Extruded & Tessellated Solid
  - Factory for specialization of shapes

Volumes, Navigation

- Implemented proper destruction of geometry objects in MT-mode — 10.4
  - Extended splitter classes and corrected destructors in field & manager classes
- Fix for momentum value in G4PathFinder::SetChargeMomentumMass() — 10.4.p01
  - Magnitude square was passed instead of magnitude… Problem report #2037
- Fix in G4Navigator::GetLocalExitNormal() for normal calculated at the endpoint of current step, on a 'candidate' next volume — 10.4.p02
  - Adds missing transformation to the frame of the current volume. Problem report #2054 — 10.5-β
- Replaced use of Inverse() from G4AffineTransform with new dedicated methods
  - Avoid creation of temporaries in G4RegularNavigation, G4Navigator and G4ReplicaNavigation

(*) See also E.Tcherniaev slides in Parallel 4B

- Reviewed geometry workspace classes — 10.4-ref07
  - Make use of generic templated pool class

Magnetic Field

- New stepper, *G4DormandPrince457*, now set as the default stepper for magnetic fields, providing highe accuracy than *G4ClassicalRK4*, the old default — 10.4
- Modified behaviour of *SetDetector()* in *G4FieldManager* to pass the Field to the Equation, as for natural user expectation. Introduced *G4VIntegrationDriver* base class for any driver algorithm — 10.4
- Fixed caching of momentum, field location & value in *G4NystromRK4* stepper — 10.4
  - Problem reported by ALICE
- Correction in G4MagneticField to no longer inherit from G4ElectroMagneticField — 10.5-β
  - It is no longer possible to use the equation of motion for a pure magnetic field for the case of a mixed electromagnetic field
- Introduced Bulirsch-Stoer method of integration, an alternative to Runge-Kutta based on the mid-point method — 10.5-β
- Separate driver derived from G4VIntegrationDriver and implemented using specialisation of G4IntegrationDriver template class — 10.5-β
- Change in G4FieldManager::CreateChordFinder() to cope better with case where field argument is null — 10.5-β

More on field & transportation…

Expected in release 10.5

- Fix in *G4PropagatorInField* for case of finishing integration in last iteration. Improved reporting of looping particle — 10.5-β
- New default values for thresholds related to the killing of looping particles in *G4Transportation* & *G4CoupledTransportation* — 10.5-β
  (*) See J.Apostolakis slides in Parallel 4B
  - **Important_Energy**: particles with MORE energy are killed ONLY after multiple steps marked as 'looping'; 1.0 MeV
  - **Warning_Energy**: particles with LESS energy are killed SILENTLY; 1.0 KeV
  - **Intermediate value**: particles between these energies are killed after one 'looping step' with warning
- Improved reporting of the issue of dropped particles (above 'warning threshold') — 10.5-β
  - Now providing the type of particle, position, momentum, material density and step length in addition to the energy
  - Added recommendations for users along with the warning
  - Problem report #2063
- Adoption of interpolation in intersection calculation in magnetic field propagation

Persistency

GDML module

- Fixed schema for replicas along angular axis — 10.4
- Added possibility to specify material properties tables for optical surfaces; added general optical surface properties block to GDML schema (GDML 3.1.5) — 10.4
- Added ability to export limited number of levels in the geometry hierarchy, by specifying this through the *G4GDMLParser::SetMaxExportLevel(G4int)* method — 10.4
- Added commands to *G4GDMLMessenger* for enable/disable stripping of names for reading and for appending or not pointers to names for writing — 10.4
- Handle all possible variants for *G4TwistedTubs*, included asymmetric ones. Fixed export of shape to correctly export end-inner/outer radii — 10.4
  - Extended schema for coping with all possible parameters for G4TwistedTubs (GDML 3.1.6)
- Enabled import/export of *G4MultiUnion* as a native type — 10.4
- Clear auxiliary map information in G4GDMLReadStructure::Clear() — 10.5-β
  - Problem report #2064

More from
geometry & transportation workplan

- Implementation of a prototype navigator based on VecGeom
  - Applicable to placed/static geometries only
  - First attempt based on 'smart' cloning of navigation histories
  - Evaluation of performance

(*) See S.Wenzel slides in Parallel 4B

- Separate safety computation and state from navigator
  - Implement strategy for a light-weight base navigator class not holding navigation state
- Profiling and optimization of multiple navigation
  - Revise design and implementation of multiple navigation and coupled-transportation
- Prototype of specialized transportation processes for neutral and charged particles

(*) See M.Asai slides in Parallel 3B

Thanks !

Tue 28/08 Parallel 4B

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16:00	**Updates on solids modelling in VecGeom**	*Gabriele Cosmo*	16:00 - 16:20
	Latest developments in navigation with VecGeom	*Sandro Christian Wenzel*	16:20 - 16:40
	Investigations in the ATLAS geometry	*Evgueni Tcherniaev*	16:40 - 17:00
17:00	**Updated field thresholds for looping particles**	*John Apostolakis*	17:00 - 17:20
	Review of open issues and discussion		17:20 - 17:30