

Geant4 release 5.1 summary

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Release contents

- Introduction of *region* as concept for defining *production cuts*
 - First introduced in *beta* release of February
 - Modified strategy for handling cuts by physics processes
 - Reviewed initialization mechanism of physics tables
 - Backward-compatibility with previous release and defined migration path for future releases
- Bug fixes

Brief introduction to cuts & regions - 1

- Cut = production threshold
 - Distance below which no secondary particles are produced (internally converted to energy for each used material)
 - NOT tracking cut
- Geant4 was originally designed to allow a *unique* cut in range
 - **Unique cut in range for each particle**
 - The default is the same cut for all particles
 - **Allows consistency of simulated physics**
 - Guaranties that a volume with high cuts (I.e. with poor physics quality) will not "pollute" the simulation of a neighboring volume with low cuts
- Requirements from ATLAS, BABAR, CMS, LHCb, ... to allow several cuts
 - Globally or per particle

Brief introduction to cuts & regions - 2

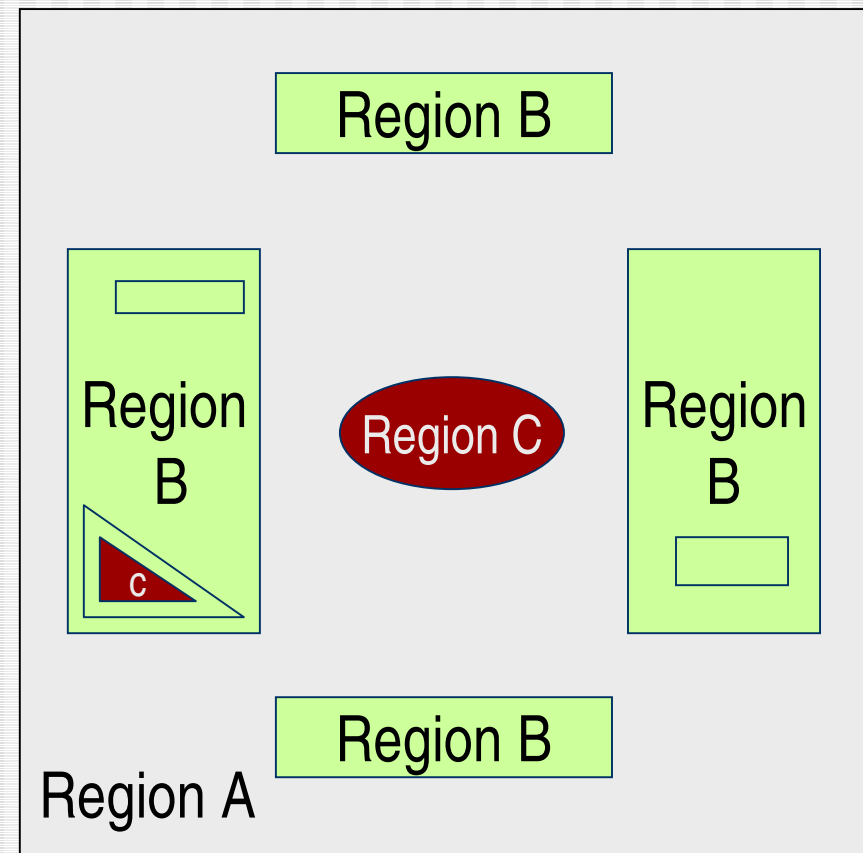
- Motivations for having several cuts
 - A unique cut may be source of run-time performance penalties
 - Detector's parts with lower cuts fix the cut for the whole simulation
 - A cut can be far too low than necessary in some detector's parts
 - A cut is typically required at the level of a detector subsystem

Brief introduction to cuts & regions - 3

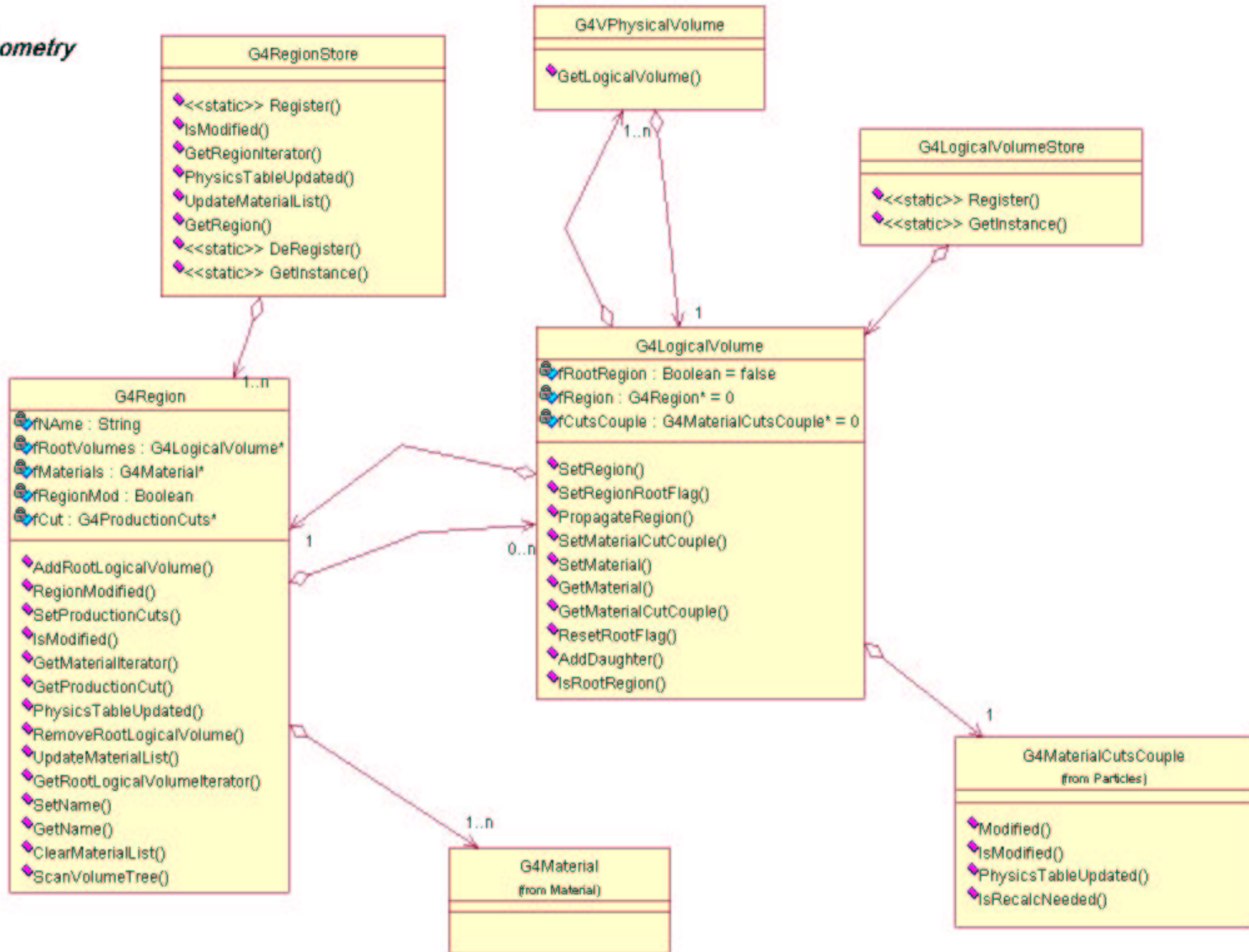
- Introduce the concept of *G4Region*
 - Large geometrical area, typically the root logical volume of a subsystem
 - Can also be a group of root logical volumes (e.g. barrel + end-caps of the calorimeter)
 - A cut in range *G4ProductionCut* is associated to a region. A default one is defined
 - Eventually, a range cut per particle is allowed
 - One or more root logical volumes can be added to a region

Brief introduction to cuts & regions - 4

- A region can have several root volumes
- The world is in a predefined *default* region



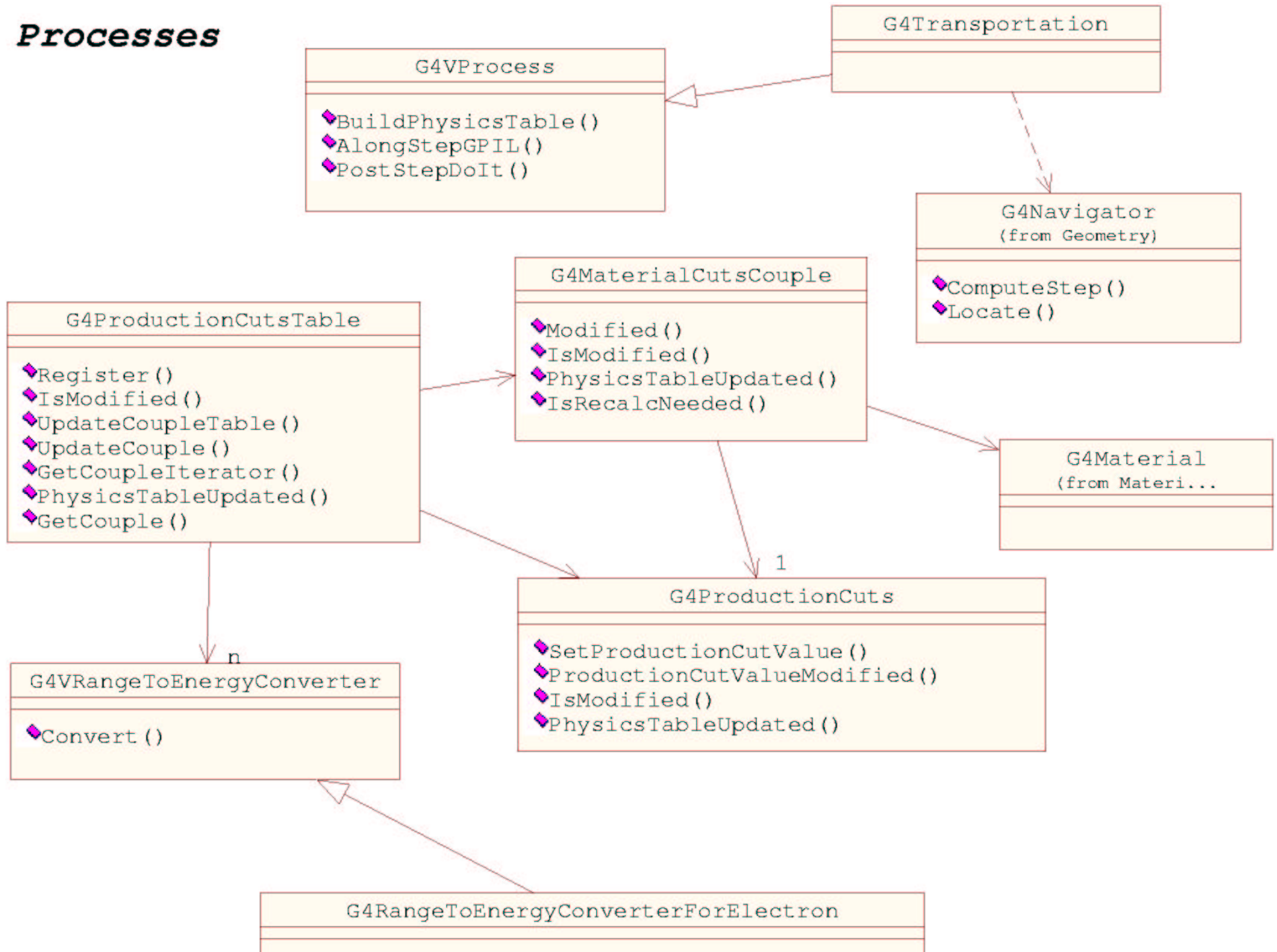
Geometry



Physics processes & cuts

- Only processes dealing with cuts are affected
- Main issue is to know which cross-section table to use in the current volume at tracking time
- In the old scheme, for a given process, there was a one-to-one relation between a material and a cross-section table:
 - This was used to retrieve the physics table using:
 - « *index of material* » == « *index of physics table* »
- Now, since the same material may appear in several regions above relation is replaced by:
 - « *index of {material, region} couple* » == « *index of physics table* »

Processes



Some features and known limitations

- *G4Region* implemented for use in cuts
 - But *could be of more general usage in future*
- Above mechanism requires a ***partition*** of the logical volumes
 - *A same logical volume cannot belong to two different regions*
 - Understood as being a (very) weak limitation in practice
- The propagation of the region's attributes is triggered at initialization time and whenever a change to the detector-description setup is applied
- *G4ProductionCut* defines a set of cuts for all particles
 - The same cut value appears for, say e-, in two different cut objects and same materials appear in the related regions
 - the *relevant cross-section table entries will be calculated twice*
 - *Cross-section tables will be built only for used materials*

More features ...

- The calculation of the cross-section tables takes place after the *BeamOn* command is issued.
 - The initialization of the run-manager is noticeably faster
 - On the other hand, more time is required to get the first event loop starting
- Production thresholds are now adopted only for *gammas*, *electrons* and *positrons*
 - Other particles do not use the concept of production threshold

Items for migration of the user code to release 5.1 - 1

- User applications having user-defined production cuts will work with no required transition to the new interface, as long as regions are not used
- The new interface for setting production cuts will be required for using the 'cuts-by-region' feature (see the guides)
- The old interface for setting/controlling production cuts (methods and UI commands) will be made obsolete in the next public release and later-on removed
- The file format of storing physics tables has been changed. Thus all the stored physics tables must be rebuilt

Items for migration of the user code to release 5.1 - 2

- Advanced applications making use of a subclassed run-manager will have to migrate to the new initialization scheme and interface defined in *G4RunManager*
 - Similarly for user-defined physics processes
- Particularly, users must be aware of the change in the sequence of building the physics tables
 - *G4RunManager::BuildPhysicsTable()* must be invoked from *G4RunManager::RunInitialization()*
 - *G4VUserPhysicsList::SetCuts()* does not trigger the construction of the physics tables, it simply sets the production thresholds (cuts)

What next ?

- Release 5.2, end of June
 - *Consolidation* release
 - Performance optimisation
 - Some minor developments
 - Bug fixes, code cleanup
- Release 6.0, December
 - New features
 - See:
http://cern.ch/geant4/source/planned_features.html