

Geant4 North American Medical Users Organization - G4NAMU

SLAC - Redwood Room
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Recent Developments in Geant4
of Interest to Medical Users

<http://geant4.slac.stanford.edu/g4namu/>

Geant4 Release 4.8.0

- Released December 2005
- Patch 4.8.0p1 released 10 February 2006
- Recent Developments:
 - Changes to Multiple Scattering
 - You No Longer have to Write your own Scoring Classes
 - GRAPE Volume Renderer

Changes to Multiple Scattering

- Electromagnetic standard package major changes have been introduced concerning the Multiple Scattering process.
- To improve the behavior of low energy particles (electrons in particular, but affecting also hadrons), Multiple Scattering now limits the step size for the particles.
- A model of the correlation between lateral displacement and final direction has been implemented (see the Physics Reference Manual for further information).

Step Limitation

- Multiple Scattering now limits the step size for the particles.
 - Previously only limited after a boundary
- $\text{Step} = \text{fr} \cdot \text{Max}(\text{range}, \text{lambda})$
 - New default $\text{fr} = 0.02$ (instead of 0.2)
 - Strong constraint only for low energy particles
- Ensure that a track always does few steps in any volume
 - more than 1

Final State

- A model of the correlation between lateral displacement and final direction has been implemented.
- Correlate final direction with lateral displacement
 - $u.d = f(\lambda)$ taken from Lewis theory

Changes to Multiple Scattering

- Most physical observables are now more stable when varying production cuts (i.e. less "cut dependent").
- There is a corresponding cost, a CPU-time penalty, when utilizing the same value of the production thresholds. This penalty can be significant, depending on the user's setup and the cut values.
- For many use cases the increased stability will allow the choice of higher production thresholds, recovering computing performance while maintaining physics performance.
- Backward compatibility: to restore old behavior you can use either of these two methods:
 - `mults -> MscStepLimitation (false)`
 - or use the old code, still available in the release as `G4MultipleScattering71`

You no longer have to write your own scoring classes

- Introduced new base classes G4VPrimitiveScorer and G4VSDFilter, G4THitsMap template class, G4MultiFunctionalDetector class and several concrete scorer and filter classes.
- These enhancements make it much easier to write scoring applications, in particular for medical and space applications such as dose or energy-deposition scoring.
- See section 4.4.5 G4MultiFunctionalDetector and G4VPrimitiveScorer of the Users Guide for Application Developers
 - <http://geant4.web.cern.ch/geant4/G4UsersDocuments/UsersGuides/ForApplica>
- The hands-on examples in this week's four day tutorial will make extensive use of these new scorers.

GRAPE Volume Renderer

- This year, the Geant4 collaboration will be working on issues of how to visualize volume data, such as DICOM data
- In today's talk by Takashi Sasaki about Geant4 medical activities in Japan, you will hear about a new rendering solution for these purposes, GRAPE